NEVADA STATE WATER PLAN

SUMMARY

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Nevada Division of Water Planning
Department of Conservation and Natural Resources

Nevada Division of Water Planning

Nevada State Water Plan

Executive Summary
Findings and Recommendations

Introduction

The *Nevada State Water Plan* is designed to guide the development, management and use of the state's water resources. It assesses the quantity and quality of our water resources, identifies constraints and opportunities which affect water resource decision making, and seeks to coordinate future actions to ensure that Nevadans obtain the greatest benefit from their water resources in the years to come. The first state water plan, *Water for Nevada*, was developed in the late 1960s and early 1970s. It identified a variety of issues and contained recommendations for improved water management, many which have now been implemented. Administration and management of the state's water resources has continued to evolve much to the benefit of the state's residents and the resources themselves.

Much has changed in the 25 years since that first plan was completed. Nevada's population has tripled, there is increased competition for our limited water resources, and new state and federal regulations have been enacted which impact local and state water management. An updated plan is needed to establish a comprehensive process for addressing our evolving water needs and addressing the challenges generated by growth in this, the driest of states.

Development of the *State Water Plan* is mandated by Nevada Revised Statute (NRS) 540. The *State Water Plan* was developed by the Nevada Division of Water Planning (NDWP) with the assistance of the 15-member Advisory Board for Water Resources Planning and Development (Board), the Department of Conservation and Natural Resources (DCNR) Steering Committee, local, state and federal agencies, and the public. This Executive Summary summarizes some key components of the *State Water Plan.* While the *Plan* contains a wealth of information, the following summary focuses only on water demand projections, and issues and recommendations.

Future Water Needs

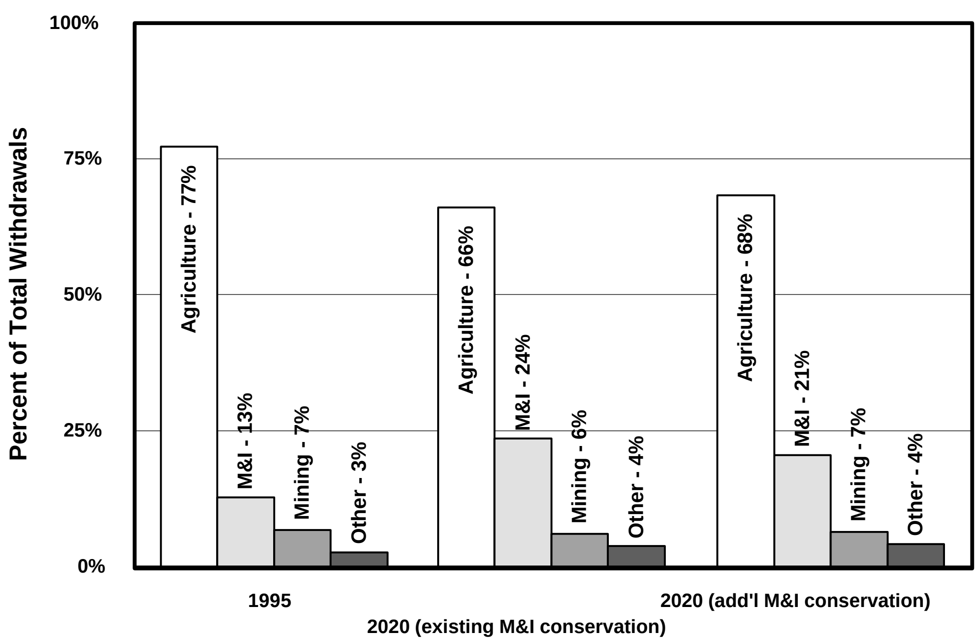
Total statewide water withdrawals are forecasted to increase about 9 percent from 4,041,000 acre-feet (af) in 1995 to 4,391,000 af in 2020, assuming current levels of conservation. Approximately one-half of these withdrawals are consumptively used. This projected increase in water use is directly attributable to Nevada's increasing population and related increases in economic endeavors. Figure ES-1 summarizes forecasted population, irrigated acres, and water withdrawals for the major use categories: agriculture, municipal and industrial (M&I), mining, and other self-supplied users (commercial, industrial, thermoelectric, domestic).

Fig. ES-1. Summary of Key Water Use Statistics

	1995	2020	Percent Increase or Decrease
Population	1,579,000	3,047,000	93%
Served by Public Supply Systems	1,488,000	2,907,000	95%
Self-Supplied	91,000	140,000	53%
Total Employment (workers)	784,000	1,512,000	93%
Irrigated Acres	715,000	666,000	-7%

	1995	2020 (existing M&I conservation)	2020 (add'l M&I conservation)
Water Withdrawals (acre-feet)			
Agriculture	3,120,000	2,902,000	2,902,000
Public Supply (M&I)	525,000	1,034,000	884,000
Mining	274,000	278,000	278,000
Other	122,000	177,000	177,000
Total	4,041,000	4,391,000	4,241,000

Distribution of Water Withdrawals by Category



The anticipated rise in total statewide water withdrawals primarily reflects expected increases in public supply for M&I water usage to meet the needs of a growing urban population, with expanding commercial and industrial activities. Nevada's population is projected to reach about 3,047,000 by the year 2020, with about 95 percent of these residents served by public water systems. It is expected that Nevada's population will become increasingly concentrated in its primary urban areas of Las Vegas (Clark County), Reno/Sparks (Washoe County) and Carson City, with varied spillover effects on neighboring counties.

M&I withdrawals currently account for about 13 percent of the water used in Nevada. Annual M&I water use is projected to increase from 525,000 af in 1995 to 1,034,000 af in 2020 (24 percent of total water withdrawals) based upon existing water use patterns and conservation measures (Figure ES-1). However, the implementation of additional conservation measures will result in M&I water withdrawals lower than the 1,034,000 af predicted. Planning groups for Southern Nevada and Washoe County have estimated that their planned additional conservation measures will result in an annual savings of about 150,000 af by the year 2020 (a 15 percent reduction in predicted withdrawals). The achievement of additional conservation is an integral part of Southern Nevada's water supply plan for the future.

About 77 percent of water withdrawals are for agricultural use. Forecasts suggest that agricultural water use could experience a 7 percent decline through 2020, with irrigated acreage possibly decreasing from about 715,000 to 666,000 acres. The historic data indicate that in some counties, irrigated acres will remain about the same, while in other counties, encroaching urbanization and the transfer of agricultural water rights to other uses will lead to reductions in irrigated acreage. Nonetheless, agriculture will continue to account for a majority of the statewide use during the next 20 years. It must be noted that statewide agricultural water use is highly variable, depending upon weather conditions and water supplies, and can vary more than 25 percent from a wet year to a dry year as a result of changing water availability.

Almost 6 to 7 percent of statewide water withdrawals occur in the mining industry. It is anticipated that mining water withdrawals will remain relatively constant at around 275,000 afy for the next 20 years. In 1995, a majority of the mining withdrawals were associated with mine dewatering with about 185,000 acre-feet per year either discharged to surface water systems, reinjected into aquifers or used by other sectors such as irrigation. This trend is expected to continue.

Self-supplied uses for commercial, industrial, thermoelectric, and domestic purposes are projected to increase from about 122,000 acre-feet in 1995 to 177,000 acre-feet in 2020. During the planning horizon, these self-supplied uses are expected to account for 3 to 4 percent of the total statewide water withdrawals.

Interest in obtaining the necessary water supplies for wildlife and environmental needs is increasing. Additionally, the popularity of water-based outdoor recreation continues to grow. It is anticipated that these trends will continue, resulting in increased water supply demands for wildlife, environmental and recreational purposes.

Future Water Supplies

Currently, surface water supplies are virtually fully appropriated. The increase in total statewide demand, particularly M&I water use, is expected to be met via better demand management (conservation), use of alternative sources (reused water, reclaimed water and greywater), purchases, leases or other transfers from existing water users, and by new groundwater appropriations. Much of the state's unappropriated groundwater is located in basins at a distance from urban centers. Thus, increasing attention will be placed on interbasin and intercounty transfers, and implementation of underutilized water management tools such as water marketing and water banking. Water for instream flow purposes, wildlife protection, environmental purposes and recreation will likely be generated by increased conservation and the acquisition of existing water rights.

Issues and Recommendations

The *Nevada State Water Plan* presents a number of important water-related issue papers and related recommendations for future water policy development and planning. The issues presented in the *Plan* were selected after an extensive public scoping process, and were then prioritized by members of the Board, administrators within DCNR, NDWP staff and inputs from the general public. Fourteen issue discussions and recommendations were then cooperatively developed. The list of issues discussed in the *State Water Plan* is by no means exhaustive, but does represent a spectrum of the significant issues affecting Nevada's water future. Future updates of the *Water Plan* will evaluate the state's progress in addressing these issues, as well as identify and address additional issues.

The *Plan*'s 14 issues were divided into five categories: water supply and allocation, water quality, resource conservation and recreational uses, flood management, and water planning and management. Of the 14 issues, two deserve special mention. Data acquisition and management represents one of the greatest challenge facing water planners and managers in the state. The State must improve its capability to collect and analyze data about its water resources and about water usage statewide. Development of the 1999 *State Water Plan* was hampered by the inaccessibility of data and concern about the reliability of the existing data. This issue affects water planning at all levels of government. The quality of future state water plans will be impaired if the State does not address the issue of data acquisition and management in the near future.

The transfer of water between basins and between counties is a significant issue statewide. Currently, Nevada has more than 15 interbasin or intercounty water transfers, and water transfers represent a significant opportunity to meet future water needs. However, water managers need to carefully identify the potential benefits and impacts water transfers may on areas of origin and areas receiving the water. Information about water transfers must continue to be made available to the public, and the State must continue to evaluate transfer proposals to ensure that such transfers are in the public interest.

Following are summaries of the recommendations presented in the *State Water Plan.*

Water Supply and Allocation

Water Conservation. Recommendations include establishment of a state Office of Water Conservation, changes to existing conservation plan requirements, formalizing a credit for conservation program, providing assistance to agricultural users and state agencies in implementing conservation measures, establishment of a fund for water conservation demonstration projects, metering of public supply water deliveries, greater use of effluent and greywater, and initiation of a water measurement pilot program.

Integrated Water Management. Recommendations include continuation of monitoring to refine perennial yield estimates, increased development of recharge/recovery projects, increased use of a variety of water sources, and assurance that users of multiple water sources do not exceed their combined water use allocation.

Interbasin and Intercounty Transfers. Recommendations include recognition of the net value water transfers can have as long as potential impacts are addressed and public involvement is encouraged; and ensuring that water transfers are justified, environmentally sound, consistent with regional plans and do not unduly limit growth in the area of origin. Other recommendations encourage the development of mitigation plans, the provision of water planning assistance to local governments to help them respond to water transfer proposals and conducting additional research on water banking and water marketing.

Water Use Measurement and Estimation. Recommendations include development and funding of a comprehensive water use measurement and estimation program.

Domestic Wells. Recommendations include the State Engineer continuing to notify counties of potential water resource impacts due to multiple parceling activities and of appropriate water right dedication requirements; establishment of domestic well inventories; distribution of education materials to existing and potential domestic well owners; and funding support for the installation or expansion of regional water supply and/or wastewater treatment in areas where domestic well water quality has been impaired.

Water Quality

Nonpoint Source Pollution. Recommendations include the continuation of the nonpoint source program consisting of regulatory and voluntary measures.

Comprehensive Ground Water Protection and Management. Recommendations include continued support for the development and implementation of the Comprehensive State Ground Water Protection Program; development of a comprehensive groundwater monitoring network; the Division of Environmental Protection's continued evaluation of MTBE and other gasoline additives, and activities necessary to control nitrate contamination; and funding support for the installation or expansion of regional water supply systems in areas where septic tank pollution has become an issue.

Resource Conservation and Recreational Uses

Maintenance of Recreational Values. Recommendations include continued evaluation of the state's water-based recreation resources and application of this information to recreation planning and management efforts; stronger consideration of the impacts to recreation resources resulting from proposed water-related projects, such as dams and reservoirs; continuation of water right acquisitions from willing sellers for recreational purposes; enhanced funding for the development of recreation facilities; increased research on alternative ways to meet water-based recreation needs; and increased management of watersheds to protect and enhance recreation values, among other considerations.

Water for Wildlife and Environmental Purposes. Recommendations include the development of a comprehensive and integrated management plan for prioritizing and coordinating maintenance of instream flows; adoption of a policy encouraging the purchase, lease or donation of water rights for wildlife and environmental purposes, and creation of a trust fund for acquisitions; establishment of incentive programs for the restoration of impaired aquatic and riparian resources; and the convening of a statewide working group of experts to identify alternative ways to obtain water supplies for wildlife and environmental purposes.

Flood Management

Flood Management in Nevada. Recommendations include amendment of NRS to include floodplain management as an official duty of the Division of Water Planning; development of a task force to develop a predictive model for alluvial fan flooding; development of a plan for reviewing, updating and maintaining flood maps; improved coordination with all involved agencies to improve floodplain management; creation of a flood mitigation fund; continued development of a state flood management plan; and revision of the state's model floodplain ordinance.

Water Planning and Management

Watershed Planning and Management. Recommendations include development of a Department of Conservation and Natural Resources strategy for participation in watershed planning efforts; support of watershed planning at the local level; continued development and implementation of basin plans for Nevada's hydrographic regions; funding for watershed planning groups; and participation in the review of watershed management plans.

Water Resources Data Management. Recommendations include support of agencies and local governments in the development of electronic databases and improved access to data; creation of a state GIS task force; development of a detailed water resources data inventory; development of information describing available data; development of a comprehensive water use measurement and estimation program; establishment of a groundwater quality and level monitoring network for priority basins; continued support for cooperative agreements with the U.S.Geological Survey for the funding of the stream gaging station network; and continued support of research projects such as efforts to update perennial yield estimates for priority basins.

Water Planning Assistance to Local Governments. Recommendations include enhancement of state water planning assistance to local governments through financial and/or technical means; improved water use measurement and estimation; improved data management, coordination and sharing; and enhanced watershed management and planning.

Water Education. Recommendations include expanding funding for the state's water education program; creation of a water education coordinator position in the Division of Water Planning; increased evaluation of water education programs at all levels; and increased coordination of statewide (public and private) water education activities.

Nevada State Water Plan
SUMMARY

Section 1
Purpose, Guidelines and the Water Planning Process

Introduction and Purpose

Nevada is the driest state in the nation and one of the fastest growing. Water is Nevada's most precious resource, and more than any other resource, water will determine Nevada's future. The success of our economic endeavors, the sustainability of our rural communities and the protection of our environment are all dependent on the wise management of the states's water resources. Thus, comprehensive, coordinated and continuing water management planning is vital to our state's economic future and quality of life.

Development of the state water plan is required by the Nevada Revised Statutes (NRS 540.101.) In statute, the Legislature also declares that "it is the policy of the State of Nevada to continue to recognize the critical nature of the state's limited water resources" and acknowledges the increasing demands placed on these resources by growth. Further, the Nevada Legislature "recognizes the important role of water resource planning and that such planning must be based on identifying current and future needs for water" (NRS 540.011). Legislative review and consideration of the state water plan will provide additional legislative policy guidance to ongoing planning efforts.

The *Nevada State Water Plan* is designed to help guide the development, management and use of the state's water resources. The plan assesses the quantity and quality of Nevada's water resources, and identifies constraints and opportunities which affect water resource decision making. The plan looks at historical and current water use, and projects demands out to the year 2020. The most current and accepted hydrologic and socioeconomic data sets available are used to develop the plan's forecasts.

Along with providing data about water supplies and water use, the state water plan identifies pressing water management issues and recommends policy directions and actions designed to assist water managers throughout the state and all levels of government. Thus, the plan establishes a common base of knowledge and understanding which is critical if Nevadans are to reach consensus on future water management issues.

The state water plan is designed to be a policy and planning guide, not a water supply plan. Many of the decisions regarding how to meet a particular water supply objective are best determined and implemented at the local level. And in fact, many local governments have taken a close look at their own water supply needs and are now charting a course to meet those needs. Thus, while the plan summarizes local and regional water planning efforts, it focuses on a broad array of water planning issues which affect water planning, management and allocation of water resources statewide.

The key to development of the state water plan has been the establishment of a dynamic, flexible water planning process. Ongoing review and update of the plan is essential to ensure that we, as a state, successfully evaluate emerging issues and prepare ourselves to meet future challenges.

The state water plan's recommendations are addressed to a wide variety of agencies, organizations and decision makers. Thus, implementation of the plan's recommendations, subject to changing needs, will require a cooperative and coordinated effort. Prior to implementation, each of the plan's recommendations must be prioritized and evaluated for technical feasibility, and the costs and benefits of each must be identified and weighed. Implementation of the plan should assist local organizations and agencies with their own water planning, as well as help guide water management decisions at the state level. The plan's ultimate effectiveness will be judged by the extent to which it's recommendations are incorporated into other state, local and federal planning efforts and agency actions.

Public input is vital to any planning process. The state's water planning process provides Nevada's residents with a unique opportunity to help decide how the state's water resources should be managed. The state water plan has been significantly enhanced by the willingness of Nevada's residents to participate in it's development, and to share their thoughts, ideas and perspectives. At its heart, the state water plan is a valuable expression of public interest.

Statutory Authority

In 1995, the Nevada State Legislature amended Nevada Revised Statute (NRS) 540.101 and directed the Division of Water Planning to develop a state water plan. Following the 1997 legislative session, the Legislature sent the Division of Water Planning a "Letter of Intent" requesting the state water plan be submitted to the Legislature by February 15, 1999. The Division requested a 6-week time extension for plan submittal, to April 1, 1999, to allow sufficient time to complete public review of the final draft.

The authority for the preparation of the State Water Plan is found in NRS 540.101 which states in part:

1. The Division [of Water Planning] shall develop a plan for the use of water resources in the state.

2. The Division shall coordinate with local governments in developing the plan pursuant to section 1. Upon request of the Division, each local government shall cooperate with and assist the Division in the development of the plan.

3. The water plan developed pursuant to subsection 1 must include provisions designed to protect the identified needs for water for current and future development in the rural areas of the state, giving consideration to relevant factors, including but not limited to, the economy of the affected areas and the quality of life in the affected areas.

4. The Division shall submit to the Legislature for its review and consideration:
   (a) The plan developed pursuant to subsection 1; and

(b) The recommendations regarding the plan provided to the Division by the advisory board on water resources planning and development pursuant to NRS 540.111.
The Division must obtain the approval of the Legislature before the plan is implemented.

Guidelines for the State Water Plan

The *Nevada State Water Plan* was developed in accordance with the legislative declaration of policy found in Nevada Revised Statutes (NRS) 540.011, and based on a series of "guiding principles" generated by the Advisory Board on Water Resources Planning and Development (Advisory Board). (See subsection below, *Participants in the Planning Process*, for a discussion of those involved in developing the state water plan.) The Advisory Board then assisted with developing the goals for the state water planning process and strategies for developing the state water plan.

Legislative Policy

NRS 540.011 establishes the basic legislative policy which has guided development of the state water plan:

NRS 540.011 Legislative declaration:

1. The legislature determines that it is the policy of the State of Nevada to continue to recognize the critical nature of the state's limited water resources. It is acknowledged that many of the state's surface water resources are committed to existing uses, under existing water rights, and that in many areas of the state the available groundwater supplies have been appropriated for current uses. It is the policy of the State of Nevada to recognize and provide for the protection of these existing water rights. It is also the policy of the state to encourage efficient and nonwasteful use of these limited supplies.

2. The legislature further recognizes the relationship between the critical nature of the state's limited water resources and the increasing demands placed on these resources as the population of the state continues to grow.

3. The legislature further recognizes the relationship between the quantity of water and the quality of water, and the necessity to consider both factors simultaneously when planning the uses of water.

4. The legislature further recognizes the important role of water resource planning and that such planning must be based upon identifying current and future needs for water. The legislature determines that the purpose of the state's water resource planning is to assist the state, its local governments and its citizens in developing effective plans for the use of water.

The legislative declaration of policy establishes the importance of protecting existing water rights, supporting water conservation, acknowledging the relationship between water supply and growth, and the role water planning plays in this, the driest state. It further establishes that water planning must focus on current and future water needs and that all levels of government must be involved in water planning.

Guiding Principles for the State Water Plan

At their January 6, 1994 meeting, the Advisory Board developed a set of 23 “guiding principles” to philosophically guide development of the State Water Plan. Some of the guiding principles reflect state law or state policy. Others reflect important water planning considerations identified during development of the state water. Later, in 1997, the Advisory Board condensed the guiding principles to these 11:

1. All water within the state, whether above or below ground, belongs to the public and its use is subject to a system of water rights administered by the State Engineer, and by state and federal court decrees and regulations.
2. Public education and public input is vital to statewide water resources planning.
3. The State Water Plan should integrate water supply, water quality, water use, and environmental issues, and should be used to guide decisions which affect water resources in the state.
4. The State Water Plan by design should be “growth neutral.” It should neither encourage nor restrict growth, and present no positions regarding the type, location or rate of growth.
5. Water right owners are entitled to buy, sell or trade their water rights to others under free market conditions. However, changes in the point of diversion, or place or manner of use must be approved prior to the change in accordance with the state water law, and state and federal court decrees and regulations.
6. The water resource needs of future generations of Nevadans should be protected by balancing economic goals with social, aesthetic, cultural and ecological values.
7. All water resource projects should be technically, environmentally and economically sound, and consistent with state law.
8. The State Water Plan should help integrate and coordinate the water planning and management activities of local, state and federal agencies.
9. The relationship between groundwater and surface water must be recognized in the State Water Plan.
10. Water conservation is an important component in the planning and management of the State’s Water Resources.
11. Watershed planning efforts should be encouraged and should include representatives of all agencies, municipalities, political subdivisions, water users and any others with an interest in the planning and management of a watershed.

Planning Goals

Following development of the guiding principles, the Advisory Board and the Department of Conservation and Natural Resources (DCNR) Steering Committee developed a number of goals and strategies for the planning process and the state water plan. As the plan evolved, so too did the goals and strategies. In general terms, the goal of the state water planning process is to make water planning and water decision making in Nevada *better*: more efficient, more effective and more inclusive. Following are results we hope to achieve through the water planning process and development of the state water plan:

1. **Water Supply:** Enough water of sufficient quality for future generations
2. **Water Rights:** Protection of existing water rights
3. **Economic Efficiency:** The preferential use of water for greatest economic gain to the state
4. **Conservation:** More conservation and less waste of water
5. **Water Quality:** Protection and enhancement of water quality
6. **Rural Water Supplies:** Protection of water supplies for current and future development in rural areas
7. **Environmental Quality :** Protection and enhancement of the environment
8. **Efficiency:** Agency actions which are coordinated and integrated to save money and time, reduce duplication in projects or services, address gaps in resource protection, and result in better decisions
9. **Decision making:** Less litigation and more cooperative decision making to resolve water resource issues
10. **Effectiveness:** More informed water resource decision making, with a greater awareness of aesthetic, cultural and ecological values
11. **Sound Science:** Water resource projects which are technically, environmentally and economically sound
12. **Public Involvement:** A better educated citizenry and more public participation in water resource decision making
13. **Quality of Life:** A higher quality of life for all Nevadans

Each update of the state water plan should bring us closer to reaching these goals. It is important to note that some of the goals may conflict, or appear to conflict, with one another. For example, economic efficiency may appear to be in direct conflict with environmental protection. However, there is growing recognition that environmental protection is actually an essential component of economic development. Economic and environmental *sustainability* is the emerging goal of many communities. Clearly, for a state that is now ranked in the top three in the country as a vacation destination, environmental quality goes hand-in-hand with economic efficiency. It is one of the roles of the water planning process to seek a balance among competing goals so that the plan's overall goal of better water management is achieved. Public involvement in the water planning process has been the key to achieving a balance which reflects the evolving interests and will of the citizenry.

Plan Components

The primary elements to be included in the State Water Plan were derived from NRS 540.051, Duties of the Division of Water Planning and NRS 540.101, Development, contents and implementation of the [state water] plan. Statutory plan components include: (1) providing arid regions with information, alternatives and recommendations including courses of planning and actions for acquiring additional water or for conserving water, (2) investigation of new sources of water such as desalinization, importation, and conservation, (3) consideration of issues of water quantity and quality simultaneously, (4) development of forecasts of future supply and demand, (5) inclusion of provisions designed to protect the need for water for current and future development in the rural areas of the state, considering the economy and quality of life in the affected areas, and (6) the development of recommendations to the Legislature to improve state water policy. Additional plan components were added as a result of input from the Division's Advisory Board, Department of Conservation and Natural Resources staff and the public.

The Planning Process

The 1999 *Nevada State Water Plan* was developed over a period of 4 ½ years (between late 1994 and January 1999) with the involvement of thousands of Nevada citizens. The Division of Water Planning has taken the lead, assisted by the Advisory Board on Water Resources Planning and Development, staff from the various agencies of the Department of Conservation and Natural Resources, and input from state, local and federal agencies and the public.

The steps in the water planning process were as follows:

- solicit public input to determine the scope of the plan and the issues to be addressed
- develop and update basic hydrologic and socioeconomic data sets
- analyze the water resources institutional framework
- forecast the state's population and anticipated economic trends over the next 20 years
- forecast future water needs over the next 20 years
- inventory water supplies presently available
- inventory resources already committed (permits, vested rights, etc.)
- research additional possible sources of supply
- identify alternate scenarios to meet the water needs of the state
- identify issues that affect water use, allocation and management
- develop and evaluate policy and programmatic recommendations to address the issues
- solicit public input throughout plan development to gauge the relevancy of the issues and the appropriateness of recommendations
- present comprehensive plan with recommendations to the state legislature for review and approval

Once the state Legislature approves the Plan, the Division of Water Planning will communicate plan recommendations to agencies or individuals who are in the best position to further evaluate and implement them. In some cases, the Division will establish new working groups or task forces to help determine the best approach to plan implementation. It is anticipated that the Water Planning Advisory Board will continue to advise the Division and assist in plan implementation. The Division will be responsible for tracking the progress of plan implementation and evaluating the effectiveness of plan recommendations. Subsequent updates of the Plan will include an evaluation of the state's progress in implementing the *Plan's* recommendations.

Participants in the Planning Process

Many individuals, organizations and agencies participated in development of the State Water Plan. Plan participants and their roles in plan development are briefly described below.

The Public. Extensive public involvement has been key to development of the State Water Plan. The public's opinions, thoughts, and recommendations have been solicited during every phase of the planning process. In 1992, prior to initiation of the 1999 State Water Plan, more than 800 Nevadans participated in a series of Water Policy Forums sponsored by the Nevada Cooperative Extension, the Nevada Humanities Committee and others. The results of these forums were tabulated in a report titled *Nevada's Water Future: Making Tough Choices*. This report, representing a diversity of views, was useful in the early stages of plan development and in generating options to address water issues.

In 1994 and 1995, more than 600 citizens participated in 20 public workshops sponsored by the Division of Water Planning. The purpose of these workshops was to educate the public on Nevada water law and the water planning process, and to get an early sense of the public's perception of key issues such as interbasin transfers. These scoping sessions were useful to the Division in establishing the breadth and scope of the plan.

Governor's Office. The Governor and his staff have provided executive sponsorship during plan development. Starting with the 1990 biennial report, the Governor addressed the need for development of a new state water plan as one of the most critical issues facing the state. In discussing the need for natural resource planning, the report states:

> "Tantamount among these plans is the development of a statewide water management plan, especially as related to intercounty and interbasin transfers, projection of water needs, the outline of conservation methods, development of drought contingency plans and information on regulations to conserve water usage." (page 5, *Perspectives: A Biennial Report of Nevada State Agencies – 1990*)

Subsequent biennial reports have continued to underscore the need for a state water plan and to reiterate the Governor's commitment to statewide water planning.

Division of Water Planning. Between 1993 and 1997, the Division of Water Planning compiled socioeconomic and hydrologic databases and wrote more than 25 publications (see Table 1–1) to serve as a basis for the water plan. Key documents produced during that period included the *Nevada Water Words Dictionary*, the *DRAFT State Water Policy*, reports on water usage by sector, three detailed water basin *Chronologies*, and the *County Graph and Data Books* and *Socioeconomic Overviews*.

In 1994, the Division completed the early public scoping meetings which served to help prioritize the state water plan elements. The Division went on to develop drafts of the *State Water Plan*, and then finalized the draft to be presented to the Legislature. Almost all Division staff were involved in this work effort, from plan conceptualization to final editing. The Division also provided staff support to the Advisory Board on Water Resources Planning and Development, conducted public outreach efforts and organized technical work group and steering committee meetings.

Technical Working Group. In 1994, a 20- member interagency working group composed of state and federal agencies met over an 11- month period to frame the issues, generate ideas and develop options. The perspectives of this working group were drafted into issue papers which formed the basis of the policy recommendations contained in the *DRAFT State Water Policy*, produced in March 1995.

DCNR Steering Committee. In 1995, staff from Divisions within the Department of Conservation and Natural Resources formed a high-level departmental oversight committee to support development of the State Water Plan. This group, which included the Director and Assistant Director of the Department and staff from the Divisions of State Lands, Environmental Protection, Wildlife, Water Resources and Water Planning, and the Natural Heritage Program, provided insight into the laws, regulations and issues within their jurisdictions, recommended approaches to the planning and obtaining public input, evaluated existing state water policies and recommended changes. This steering committee was essential in setting the tone, pace and direction of the plan. Altogether, the DCNR steering committee members committed over 1700 hours to plan development.

Advisory Board on Water Resources Planning and Development. To advise the Division in matters relating to planning and development of water resources, NRS 540.111 establishes the Advisory Board on Water Resources Planning and Development (Advisory Board.) In 1995, the Legislature passed SB 101, which among other things, enlarged the Advisory Board from 13 to 15 members, and changed its composition. The Board for Financing Water Projects, formally ex-officio members of the Advisory Board, was separated to form a stand alone board, and new Advisory Board positions were opened up for representatives of mining, ranching, agriculture, conservation and the general public. The number of Washoe County representatives was also increased.

As a follow-up to the enactment of SB 101, in 1996 the Governor appointed a new set of Advisory Board members (see p viii for the list of members), only 4 of whom had served on the previous Advisory Board. The current composition of the Advisory Board on Water Resources Planning and Development is as follows:

- ❑ **Six** members representing the governing bodies of the county with the largest population in the state [Clark County] and the cities in that county;
- ❑ **One** member representing the largest water utility in the county with the largest population in the state [the Las Vegas Valley Water District];
- ❑ **Two** members representing the county with the second largest population in the state [Washoe County] and the cities in that county;
- ❑ **One** member representing the largest water utility in the county with the second largest population in the state [Sierra Pacific Power Company];
- ❑ **One** member representing the general public; and
- ❑ **Four** members, each representing a different one of the following interests:

  (1) Farming;
  (2) Mining;
  (3) Ranching; and
  (4) Wildlife.

The Governor is to make the Advisory Board appointments so that at least seven members are residents of Clark County, three members are residents of Washoe County and at least three members are residents of counties which have a population less than 100,000. Altogether, the Advisory Boards held more than 25, one-to-two day meetings to participate in development of the state water plan. The Advisory Board meetings were always publicly advertised and open to public comment, and occasionally the Advisory Board held special workshops to solicit public comment in a more formal setting.

Pursuant to NRS 540.111, one of the Advisory Board's roles is to make recommendations to the Division concerning their level of concurrence with the content, findings and recommendations of the *State Water Plan*. The Division is to then submit the Advisory Board's recommendations to the Legislature with the *Plan*. The time and effort contributed by the Water Planning Advisory Board has been invaluable in bringing the Plan to fruition.

Department of Conservation and Natural Resources Advisory Board. The Department of Conservation and Natural Resources maintains its own Advisory Board. The seven Board members each represent one of the following interests: (1) general public, (2) state park users, (3) agricultural industry, (4) mining industry, (5) outdoor recreationists, (6) forestry/fire control, and (7) conservation. This DCNR Advisory Board has frequently reviewed *Nevada State Water Plan* drafts and provided advice and counsel as to the plan's content and the planning process.

Interest Groups. Many interest groups have been active in the development of the *State Water Plan*. Groups such as the Nevada Farm Bureau, Nevada Cattlemen's Association, Northern Nevada Conservation Forum, Southern Nevada Homebuilders Association, and the League of Women Voters have sponsored workshops on the plan and/or commented formally on plan work products.

Local Governments. Local government input has been critical to the planning process. The Division Administrator or staff met personally with 16 of the 17 County Commissions, and the Southern Nevada Water Authority in Clark County, to update them on plan progress, request review of key work products, and request their participation in meetings of the Water Planning Advisory Board. Nearly all county commissions sent representatives to participate in Advisory Board meetings and to provide input on local water issues.

State Legislature. The Nevada State Legislature plays a significant role in the water planning process. The Legislature initiated the water planning program and has set time frames for plan completion. The Legislature has also provided guidance for plan development via its declaration of legislative intent at the start of NRS 540, the water planning statute. Legislative committees have requested periodic briefings on plan progress, and individual Legislators have shown a special interest by participating in scoping sessions and public workshops, submitting comments on the plan or by requesting additional information. When it is finalized, the *Nevada State Water Plan* will be presented to the 1999 Legislature for their review and consideration as required by NRS 540.101.4.

Federal Agencies. Federal agencies have been involved in plan development. Federal agency staffs made presentations to the Advisory Board on regional water issues, served on technical working groups, assisted in development of some issue papers, and commented on plan drafts. Federal agencies such as the U.S. Geological Survey, Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service and Natural Resources Conservation Service made significant contributions.

Plan Formulation and Review

Division of Water Planning staff researched and produced data compilations and publications as a preliminary step in developing the state water plan. As publications were finalized and sections of the *State Water Plan* were developed, they were reviewed by the DCNR Steering Committee, the Water Planning Advisory Board and the DCNR Advisory Board. Public comment was always solicited at meetings of both Advisory Boards. Once portions of the plan were in agreed upon draft form, the drafts were sent out for public review and comment. Typically, workshops were held to explain plan sections and to elicit comment from the public.

From this intensive review, public involvement and consensus building process, the *State Water Plan* has taken shape. The plan that has emerged is directed toward the development, adoption and implementation of a variety of programs, projects and policies designed to better utilize, conserve and protect the state's most valuable natural resource. However, the planning process not only resulted in the 1999 *State Water Plan*, but also in a strong consensus regarding the need to keep the water planning process alive, funded and connected to the state's water resource decision making processes and programs.

Public Comments on the Water Plan Drafts

An interim draft of the state water plan was released during the summer of 1998. This draft included many of the background and introductory plan sections, along with the basic data which formed the foundation of the plan. The goal of this early review period was to reach consensus on the data used to develop the plan, before moving on to addressing the more complex issues and recommendations in later plan sections. Six public workshops were held during this time. The Division also made presentations to 15 of the 17 county commissions, the Southern Nevada Water Authority in Clark County and the Carson City Board of Supervisors to update them on the plan, solicit their continuing assistance in plan development and receive their preliminary thoughts and comments.

The final public review draft of the state water plan was released at the end of January 1999 and the review period extended to March 8, 1999. Over 1000 copies of the draft state water plan were distributed for public review and comment . Drafts of the plan were also made available through the Division of Water Planning's website. During this time, seven public workshops were held to review the plan's recommendations and solicit public input. Additional presentations were made before various legislative committees, interested organizations and state advisory boards, working groups and commissions. Altogether, over 50 public workshops were held and presentations made on the plan throughout the 4 ½ year planning cycle.

The Division received 39 written comments on the final public review draft of the water plan and many additional comments at public workshops. At the end of the final comment period, all of the comments received were entered into a database. The use of a database enabled the Division to more closely evaluate and analyze the comments, and to ensure that all comments on a topic were evaluated together and addressed appropriately and consistently.

Comments were provided by agricultural and rural interests, wildlife and environmental interests and agencies. Relatively few comments were received from urban interests. Of the 39 letters received 10 were from special interest groups, 8 from individuals and one from a business (mining). The other 21 letters were from local (9), federal (8) and state (1) agencies, irrigation districts (2) and tribes(1). Comments were directed most frequently to the issues and recommendations contained in the issue papers, to the data used in the plan and in some cases, to the findings (particularly the projected decrease in agricultural water use.) While some comments focused on edits or data corrections, a large number provided policy, philosophical or analytical perspectives, especially regarding growth, interbasin transfers and the importance of water planning to the state. Many comments recognized the significant work effort that went into developing the 1999 water plan and found it to be a valuable resource.

Issues given the greatest attention by commenters, both pro and con, included:

- conservation and credit for conservation
- water resources data collection, management and distribution
- integrated water management
- water measurement and estimation
- interbasin and intercounty transfers
- instream flows and water for wildlife and the environment
- local vs. state water planning

A number of the comments addressed the planning principles utilized in the plan or the plan's goals. The commenters generally noted the difficulty in developing a plan based on very general, and sometimes conflicting, goals. The water plan's goals and guiding principles were the subject of much discussion and debate early in the planning process by the Advisory Board, and were reconsidered at various points during development of the plan. Therefore, while the comments on these areas were acknowledged, the plan's goals and guiding principles were not revised.

Frequently, comments conflicted with one another. For example, some comments questioned the need for a water plan and supported the status quo. These commenters believe that the current system is working and a state water plan is not necessary. Others applauded the water plan as a critical step in proactively planning and managing the state's water resources. Another example related to the use of data in the plan. Some groups wanted the plan to include the most current data available, even if that meant that data sets weren't comparable between counties. Others wanted data sets standardized to a particular year, even if that meant that older "vintage" data was used in lieu of the latest available data. Some felt that since some of the data sets have weaknesses, no conclusions should be drawn in the plan, while others were comfortable with use of the best available data to forecast future water use.

Environmental organizations wanted to see more emphasis on managing growth and implementation of water conservation technologies, while others felt the plan should stay away from growth issues altogether and that conservation was a good idea but should not be mandated. (The plan is designed to be growth neutral, but does make strong recommendations to enhance water conservation in the state.)

Some comments expressed philosophical opposition to interbasin transfers, going so far as to suggest that they be banned altogether, while others felt that water transfers represented THE solution to the state's water supply problems. Some comments suggested that the water plan should express a vision of the future on a variety of topics including concepts such as sustainability, watershed planning and biodiversity. (The plan does discuss watershed planning in depth and recommend its greater usage, but only addresses issues of biodiversity or sustainability in the context of other issues.)

Concern was expressed about the role of the plan, and whether it is to be considered a mandate. However, the plan is clearly designed to be an education, planning and policy tool which makes recommendations to enhance future water management. In and of itself, the plan is not a new law, nor does it change existing water rights or reallocate water rights in any way. Projections of future water use are simply projections based on existing trends, and do not assume sweeping changes in our economy. It is anticipated that the market for water rights will drive any transfers of water rights.

A number of agricultural groups felt the plan should highlight the importance of agriculture to the state and its value in enhancing wildlife habitat, open space and rural quality of life. However, the plan does not advocate the value of any one water use or economic endeavor over another.

Comments expressed concern about the lack of water rights for maintenance of instream flows, the habitat of endangered and threatened species and the environment in general. They felt the state should assume a more active role in purchasing water rights for environmental water uses and in protecting habitats. On the other hand, a number of rural counties considered the plan's recommendations for purchase of water rights as "alarming", and a threat to their tax base. They suggested assisting irrigators in maintaining minimum pools on their own land by, for example, purchasing hay for them in dry years to prevent a reduction in stream flows at critical times.

Domestic wells were mentioned by quite a few commenters. Concerns were expressed about definition and protection of the legal rights of domestic well owners (who are not required by law to have a water right until their use exceeds 1800 gallons per day). Other comments included the view that domestic wells should be a local issue only, not a state issue, and a request for state funding support if domestic wells are required to hook up to regional water systems by the state.

A number of commenters concurred with the plan's recommendations to enhance water education, support watershed planning, develop better data, measure water use more accurately, do better flood planning and management, provide greater water planning assistance to local governments and ensure that the public remains closely involved in both state and regional water planning.

All comments were carefully reviewed and incorporated into the plan wherever possible. It is noteworthy that many of the issues raised by commenters had been discussed at length by both the Steering Committee and the Advisory Board during plan development. Thus, while these comments did not highlight new issues, they did validate the planning and public input process that was utilized. Some commenters did raise issues which were not specifically addressed in the plan. Recommendations for subjects to be addressed, or more thoroughly addressed, in future plans are listed below. It is the intent of the Division of Water Planning to include these issues in future plan updates:

- mine dewatering

- integrated management of surface and ground water
- conflict resolution
- better identification of environmental water needs
- more thorough discussion of various types of water storage
- dam safety
- better assessment of perennial yield and restoration of over utilized aquifers

Comments received on the final public review draft of the *Nevada State Water Plan* and the comment database are available for review at the Division of Water Planning's office in Carson City.

Previous Water Planning Efforts

The state water planning program began in the 1960's. In 1967 the Nevada Legislature directed the Division of Water Resources within the Department of Conservation and Natural Resources to determine Nevada's future water needs and available water resources. The Legislative Commission was directed to study future statewide water needs and it appointed a special Legislative Subcommittee to undertake the study. The State Engineer and the Subcommittee jointly recommended the establishment of a separate section within the Division of Water Resources to carry out the necessary planning studies, and specific legislation to establish the statutory authority to implement the program.

The 1969 Legislature authorized development of a comprehensive water resource plan for Nevada through an amendment to NRS 532, and made an appropriation to the Division of Water Resources to develop a planning section. The 1973 Legislature required the State Engineer to complete the water resource plan and submit it to the 1975 legislative session. The first state water plan, *Water for Nevada*, was completed and published by November 1974. The state water planning program was active until the early 1980's, although with a dwindling staff. In 1982 the program was all but eliminated due to severe funding shortages.

The water planning program was re-instituted in 1989 through the efforts of Assembly Speaker Joe Dini and like-minded legislators who were increasingly concerned about Nevada's rapidly growing population and the lack of a current plan to identify additional water resources to satisfy demands. There was also concern regarding the lack of flood, conservation and drought planning. Thus, the present day Water Planning Division was created under NRS 540 and a small staff was hired by 1991. Since 1991, the Division of Water Planning has produced over 30 publications in support of the *State Water Plan* (as well as numerous publication updates and revisions); initiated a water education program and Internet home page; obtained grant funding to coordinate water planning activities in the Walker River Basin; assisted local governments in their water planning efforts; awarded over $20 million in grants to small water systems; and sponsored numerous water resource conferences and workshops. In 1997 the Division received state and federal appropriations to initiate a flood planning and grant program.

The 1999 *Nevada State Water Plan* completes the latest cycle of statewide water planning. Following approval of the plan, the Division will turn its attention to developing a handbook for regional water planning and begin developing specific water management plans for the various hydrographic regions in Nevada.

Summary of Earlier Water Planning Reports and Recommendations

The first state water plan, *Water for Nevada*, was completed and published in November 1974. It consisted of a series of 16 planning documents which estimated water use, inventoried the water resources of the state, provided maps, developed forecasts for future water needs for mining, agriculture, fish and wildlife, recreation, power production and municipal use, evaluated the use of input-output economic models to analyze future water scenarios and described the water administration process in Nevada.

Many issues were identified in the 1974 State Water Plan, and a number of actions were recommended. In most cases, the plan suggested a cautious "wait and see" approach. Key plan recommendations included: (1) enacting legislation to bring geothermal resources under the purview of state water law, (2) placing time limits on subdivision approvals, (3) actively protecting state sovereignty in water allocation decisions on federal lands, (4) establishing state level floodplain zoning, (5) analyzing the state's responsibilities for maintaining stream channels in navigable waterways, (6) continuing the data collection and water planning activities, (7) developing a new program for funding water system infrastructure improvements and water resource projects (8) protecting critical habitat and rare and endangered species when making water resource decisions and (9) where necessary, acquiring water rights for wildlife protection. Many of these recommendations were ultimately implemented in one form or another. A more detailed summary of the 1974 state water plan recommendations is provided in Volume 2 (Part 1, Section 2) of the *Nevada State Water Plan*, along with a status report on implementation of the recommendations and new developments in the last 25 years.

The *Water for Nevada* series was followed by a second series of 6 water planning reports — *Alternative Plans for Water Resource Use*. The objectives of these planning documents were environmental quality, economic efficiency and area development. The planning was focused on those regions which were having difficulty in meeting their water needs or which were expected to run out of water in the near future. Alternative plans were developed for the Walker, Humboldt, Carson-Truckee, Colorado and Snake River Basins and the Central Region of Nevada. Each report examined a series of alternate economic development scenarios for a region and projected those future scenarios which might occur *without* a plan in place.

All of the alternative plans identified water resource issues which remain issues today, 25 years later. For example, the Walker River Basin Report noted that Walker Lake was declining by 60,000 acre-feet per year, flooding was occurring throughout the basin and there were unmet water needs for agriculture and recreation. The Truckee-Carson River Basin Report noted the decline of Pyramid Lake, municipal, agricultural and industrial water shortages, lack of adequate water for wildlife areas, and flooding. These issues are perhaps even more pressing now. At this time, both lakes have declined further, municipal and industrial water shortages are more common and the New Year's Day Flood of 1997 has moved flooding to the top of many people's agendas.

A final *Special Summary Report* concluded the water planning series. It noted that virtually all of Nevada's surface water resources had been committed; that in a rare year some overflow might be available, but that in most cases storage facilities were inadequate to capture the runoff for later use. It noted that significant groundwater supplies had already been developed, and that some areas held good potential for further development. However, we had already reached the point in some basins, such as the Las Vegas Groundwater Basin and Diamond Valley, where no additional appropriations could be allowed. It was also apparent that obtaining water supplies from outside the state's boundaries was likely to be problematic, as it still is today.

The *Special Summary Report* noted that Nevada's residents viewed the lack of readily available water as a mixed blessing. While the lack of water restricted economic development in many areas of the state, it also meant that Nevada would be preserved in a fairly natural state with a relatively small population, thus enhancing the resident's "quality of life." In general, it was concluded from reaction and comment at the water planning forums, that most people of the state wanted the water resources developed and used, but not "over used." With this in mind, the state water plan conclusions and recommendations sought a middle ground.

One of the last publications produced through the early water planning program was titled *Water For Southern Nevada*. This report presented a comprehensive analysis of southern Nevada's water resources, and provided an analysis of alternatives for future water supply needs. Water supply plans were presented which describe a preferred alternative for water supply needs as well as an implementation program for water resources management.

Organization of the Nevada State Water Plan

The 1999 *Nevada State Water Plan* is being produced in six volumes:

- A *Summary* presents highlights of the State Water Plan's findings, with an emphasis on recommended legislative water policy and program initiatives.

- The main body of the *State Water Plan* includes an inventory, assessment and issue analysis of water resources in Nevada. It establishes the regulatory, historical and institutional framework affecting water planning and management within the state, provides the socioeconomic context within which water decisions are made, projects population and economic trends affecting water use, forecasts future water needs, identifies current water issues and presents recommendations to address those issues. The main body of the *State Water Plan* is divided into 3 parts as follows:

  Part 1 – Water Resources Background and Assessment
  Part 2 – Water Use and Forecasts
  Part 3 – Water Planning and Management Issues

- A *Technical Data Appendix* which contains the detailed planning data and forecasts of the State's counties, cities and hydrographic basins (also available upon request in an electronic format).

Index to Summary, Part 1:

Nevada State Water Plan
SUMMARY

Section 2
Institutional Framework for Water Planning and Management

Introduction

This section presents an overview of the institutional framework affecting water planning and management within the State. All entities involved with water planning, allocation, management and development issues must navigate their way through portions of this institutional framework in their decision-making process.

Statutory, Regulatory and Legal Considerations

This subsection provides a general summary of the major state and federal statutory, regulatory and legal constraints impacting water planning and management. Water quantity allocation and management; interstate water resource management; water quality protection and management; resource protection; flood protection and drought planning; and conservation are all important constraints to consider for a successful water plan.

Water Quantity Allocation and Management

Nevada Water Law. All waters within the boundaries of Nevada, whether above or beneath the ground surface, belong to the public and are managed on their behalf by the State. The State Engineer is responsible for the administration of Nevada Water Law, which ensures that these waters are managed so that sufficient quantities are available to preserve our quality of life and to protect existing water rights. Entities within the State can apply for the right to use that water. Like many of the western states, Nevada water law is founded on the doctrine of prior appropriation - "first in time, first in right." Under this doctrine, the first user of water from a watercourse acquires a priority right to the water and to the extent of its use under that right.

Nevada water law is set forth in Nevada Revised Statutes (NRS), Chapters 533 and 534. In addition, there are numerous court decisions which have further defined Nevada law. It is the State Engineer who determines the limit and extent of the rights of claimants to water, the use to which water may be put, the quantity of water that is reasonably required for beneficial use, and where water may be used.

As part of the duties of the office, the State Engineer reviews applications for new water rights appropriations. In approving or rejecting an application to appropriate water, the State Engineer follows statutory criteria:

- Is there unappropriated water in the proposed source?
- Will the proposed use impair existing rights?
- Will the proposed use prove detrimental to the public interest?
- Is the project feasible and not filed for speculative purposes?

All water rights are considered real property and can be bought, sold, traded and leased. The place of use and type of use can be changed with the State Engineer's approval. The attributes of appropriative water rights in Nevada are: 1) beneficial use is the measure and limit of the right to the use of the water; 2) rights are stated in terms of definite quantity, manner of use, and period of use; and 3) a water right can possibly be lost by abandonment or forfeiture.

Decrees. Most surface waters in Nevada are managed in accordance with civil, state or federal decrees. There are over 100 decrees governing water allocation and management in Nevada.

Tribal Water Rights. When the United States reserved land from the public domain for uses such as Native American reservations, it also implicitly reserved sufficient water to satisfy the primary purposes for which the reservation was created. This federal reserved water rights doctrine was established by the U.S. Supreme Court in 1908 in *Winters v. United States.* Federally reserved Native American water rights differ from state-issued rights in a number of ways. For instance, the Winters Doctrine asserts that federal reserved rights cannot be lost by failure to put the associated water to beneficial use. In Nevada, there are more than 20 Native American reservations and colonies.

Interstate Water Resource Management

Colorado River. In addition to Nevada, the states of California, Arizona, Wyoming, Colorado, New Mexico, and Utah, and the Republic of Mexico, all use water from the Colorado River. In 1922, these seven states entered into an interstate compact which includes a provision for the equitable division and apportionment of the waters of the Colorado River system. The U.S. Supreme Court Decree in *Arizona v. California*, 1964, established several additional dimensions to the apportionment of Colorado River water, including apportionments to the lower basin states of Nevada, California and Arizona. It was ruled that of the first 7.5 million acre-feet of mainstem water consumed in the lower basin, California was entitled to a consumptive use of 4.4 million acre-feet/year; Arizona to 2.8 million acre-feet/year; and Nevada to 0.3 million acre-feet/year.

California-Nevada Interstate Compact. The need for apportioning the water of the Truckee, Carson and Walker rivers between Nevada and California has been considered over the years. After years of negotiations, the state legislatures of California (in 1970) and Nevada (in 1971) passed legislation adopting the California-Nevada Interstate Compact. However, the U.S. Congress never ratified the Compact. Interstate allocations of the Truckee and Carson rivers were addressed in the Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990.

Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990. The latest effort to resolve long-standing disputes over water and water rights on the Truckee River has been the enactment of congressional settlement legislation for the Truckee and Carson Rivers. This legislation, known as the Truckee-Carson-Pyramid Lake Water Rights Settlement Act (or "Negotiated Settlement"), was approved by the 101st Congress on November 16, 1990. The main authorizations and directives included in the legislation are: an interstate allocation between Nevada and California is made of the waters of the Truckee and Carson Rivers, and Lake Tahoe; a new operating agreement is to be negotiated for the Truckee River; the Newlands Projects is reauthorized to serve additional purposes, including recreation, fish and wildlife, and as a municipal water supply for the Fallon area; a recovery program is to be developed for the endangered Pyramid Lake cui-ui fish and threatened Lahontan cutthroat trout, with a water right acquisitions program authorized; and a water rights purchase program is authorized for the Lahontan Valley wetlands.

Water Quality Protection and Management

Clean Water Act (CWA). The Water Quality Act is a 1987 amendment to the Clean Water Act of 1977, which amended the Federal Water Pollution Control Act of 1972, and is the primary legislative vehicle for federal water pollution control programs. The Water Quality Act is often referred to as the Clean Water Act (CWA). This Act was established to "restore and maintain the chemical, physical, and biological integrity of the nation's waters" and set goals to eliminate discharges of pollutants into navigable water, protect fish and wildlife, and prohibit the discharge of toxic pollutants in quantities that could adversely affect the environment.

The State Environmental Commission (SEC), established by State law, has adopted regulations which define State programs to carry out the provisions of Nevada's Water Pollution Control Laws. These laws, contained in Chapter 445A of the Nevada Revised Statutes (NRS), establish the authority to implement portions of the CWA and the Safe Drinking Water Act in addition to several non-federal water pollution control programs. In addition to adopting regulations, the SEC establishes fee schedules for permits, advises, consults and cooperates with other governmental agencies regarding water pollution matters, establishes qualifications for sewage treatment plan operators, and holds hearing regarding the actions of the Nevada Division of Environmental Protection (NDEP). The Nevada Division of Environmental Protection (NDEP) has been delegated the authority to implement aspects of the CWA in Nevada.

Other Programs (NDEP). In addition to the federal CWA and Safe Drinking Water Act programs delegated to NDEP, numerous state programs exist to protect, control and restore the quality of the waters of the State. Apart from the National Pollution Discharge Elimination System (NPDES) permits issued under the CWA, NDEP issues Water Pollution Control Permits with a zero-discharge performance standard for certain mining facilities, and State Ground Water Permits for infiltration basins, land application of treated effluent, large septic systems and industrial facilities. In addition to these permitting processes, NDEP reviews subdivision plans to ensure that wastewater is disposed of adequately. Also, NDEP regulates highly hazardous substances under the chemical accident prevention program. Remediation of polluted soil and/or groundwater falls under the State Corrective Actions Program which includes authorities under two federal acts: the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Safe Drinking Water Act. In 1974, the U.S. Congress enacted the Safe Drinking Water Act (SDWA) to enhance the safety of public drinking water in the United States through the establishment and enforcement of national drinking water standards. Congress gave the EPA the responsibility for implementation and enforcement of the SDWA. In 1978, the U.S. Environmental Protection Agency (EPA) granted primary enforcement authority (primacy) for the SDWA in Nevada to the State of Nevada (Division of Health). In 1996, additional amendments were enacted and a state revolving loan fund was authorized.

The State Health Division is responsible for implementing the program in 15 of Nevada's 17 counties. The Health Division has interlocal agreements with Clark County Health District and Washoe County District Health Department to implement various activities related to the SDWA and State Board of Health requirements in those counties.

The SDWA applies to all public drinking water systems which provide piped water for human consumption to at least 15 service connections, or regularly serve an average of at least 25 individuals daily for at least 60 days out of the year. There are currently about 700 public water systems in Nevada that are regulated under the SDWA.

Resource Protection

Endangered Species Act. The federal Endangered Species Act provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The U.S. Fish and Wildlife maintains a list of endangered and threatened species. Species include birds, insects, fish, reptiles, mammals, crustaceans, flowers, grasses, and trees, all of which are dependent upon water. The law prohibits any action, administrative or real, that results in a "taking" of a listed species, or adversely affects habitat.

In Nevada, there are 28 endangered taxa (species/subspecies) (2 are plants) and 14 threatened taxa (7 are plants). Rankings by the Nevada Natural Heritage Program place Nevada in the top ten states having the most globally imperilled species of plants and vertebrates.

State of Nevada Programs and Authority. The State of Nevada Natural Heritage Program researches, collects, and analyzes information on the existence, locations, numbers, condition, biology, and habitats of hundreds of sensitive plant and animal species throughout Nevada. These are species that could qualify for listing as a threatened or endangered in the future under current management and land-use situations. The Program continually prioritizes conservation needs throughout the State, and its easily-accessible computer database, maps, and paper files serve as a cost-effective "early warning system" designed to help prevent costly future species listings.

Nevada Revised Statute 503.589 grants the Division of Wildlife administrator the authority to enter into agreements with other entities for the conservation, protection, restoration and propagation of species of native fish, wildlife and other fauna which are threatened with extinction. Nevada Revised Statute 527.300 grants the state forester firewarden the authority to enter into agreements with other entities for the conservation, protection, restoration and propagation of species of native flora which are threatened with extinction.

National Environmental Policy Act. The National Environmental Policy Act (NEPA) directs federal agencies to prepare an environmental impact statement (EIS) for all major federal actions which may have a significant effect on the human environment. NEPA states that it is the goal of the federal government to use all practicable means, consistent with other considerations of national policy, to protect and enhance the quality of the environment. NEPA requires all federal agencies to consider the environmental impacts of their proposed actions during the planning and decision-making processes.

Wild and Scenic Rivers Acts (Federal and California). In 1968, Congress passed the National Wild and Scenic Rivers Act to preserve in their free-flowing condition rivers which possess "outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values." No rivers within Nevada have been designated under this federal act. In 1972, the California Legislature passed the State Wild and Scenic Rivers Act. Portions of the West Walker River and East Fork of the Carson River upstream of Nevada have been designated under the California Act. The California Act prohibits construction of any dam, reservoir, diversion or other water impoundments on a designated river.

The current U.S. Forest Service's Humboldt and Toiyabe Land and Resource Management Plan has identified other river segments that are suitable for inclusion in the Wild and Scenic Rivers system, including segments in Jarbidge River; Little Humboldt River, North Fork; Marys River; Carson River, East Fork; East Walker River; and West Walker River.

Flood Protection and Drought Planning

Flood Control Act. The Flood Control Act authorizes the U.S. Army Corps of Engineers to perform several flood-related tasks, including the construction of small flood control projects; addressing floods and floodplain issues; snagging and clearing for flood control in channels; and emergency streambank and shoreline erosion protection for public facilities and services.

National Flood Insurance Act. The National Flood Insurance Program (NFIP) was established in 1968 by the National Flood Insurance Act. The intent of this act is to encourage communities to mitigate future flood damage by adopting and enforcing strict floodplain management ordinances in accordance with federal regulations. The Act made federally subsidized flood insurance availible in communities which participate in the NFIP. In Nevada, 15 counties and 13 incorporated cities voluntarily participate in the NFIP. The Federal Emergency Management Agency (FEMA) administers the program, providing flood insurance studies and mapping for participating communities. The flood insurance studies are used for development of the Flood Insurance Rate Maps (FIRMs) that are adopted and incorporated by reference into the Flood Hazard Reduction Ordinances administered by each community. In Nevada, the Division of Water Planning has responsibility for oversight and implementation of the NFIP.

Emergency Watershed Protection. The Emergency Watershed Protection program (EWP) is administered by the Natural Resource Conservation Service (NRCS). The program provides technical and financial assistance to restore small watersheds damaged by flooding.

State Floodplain Management. Following the flooding experienced in northern Nevada in 1997, the Division of Water Planning was designated as the lead agency for floodplain management at the State level. The Division's floodplain management duties include implementation of the Community Assistance Program (CAP) and Flood Mitigation Assistance program (FMA), sponsered by FEMA. Under CAP, the Division provides technical assistance and training as needed to help communities achieve and maintain compliance with NFIP requirements. FMA grants are for mitigation projects aimed at reducing repetitive insurance losses and future damage.

The Channel Clearance program is managed by the Nevada Division of Water Resources. The program provides funding for channel clearance maintenance, restoration, surveying and monumenting. During the 1997 State Legislative Session, Senate Bill 218 was passed, establishing a state fund of $4 million to help communities recover from damages sustained in the event of a disaster. The fund is administered by the Legislative Counsel Bureau.

Local Floodplain Management. Regulations for the development of local flood control districts are described in the Nevada Revised Statutes (NRS) 543. The Clark County Regional Flood Control District was formed under this statute in 1985. The Clark County Regional Flood Control District is a proactive regional entity with the mission of protecting life and property from flood impacts through implementation of flood control infrastructure.

State Drought Plan and the Drought Review and Reporting Committee. During the first year of the 1987-94 drought, Governor Bryan formed the Drought Review and Reporting Committee (DRRC) to monitor drought severity and recommend actions. By 1991, the Division of Water Planning, with assistance from the Governor's DRRC and the Advisory Board for Water Resource Planning and Development, developed the State Drought Plan. The Drought Plan defines drought stages (warning, severe, emergency), and establishes the roles of the DRRC, drought task forces and other agencies during the various drought stages.

Conservation

Service Connection Metering. A majority of the public water system withdrawals (in terms of volume) are metered, however not all deliveries to each service connection are metered. For example, only about 25 percent of residences in Reno/Sparks have water meters. Water meters were initially prohibited in the cities of Reno and Sparks by a 1919 statute (NRS 704.230). Since that time, gradual changes have occurred which: 1) require meters on all businesses (1977) and on all new homes built after 1988; and 2) allow meters on residences upon owner request and under certain conditions tied to the Negotiated Settlement (1990).

Low Flow Plumbing Standards. The Nevada Legislature passed Assembly Bill 359 in 1991 thereby imposing certain minimum standards for plumbing fixtures (toilets, showers, faucets and urinals) in new construction and expansions in residential, industrial, commercial and public buildings. Each county and city was required to include these requirements in its building code or to adopt these requirements by ordinance, and to prohibit by ordinance the sale and installation of any plumbing fixture which does not meet the minimum standards.

Conservation Plans. In 1991, the Nevada Legislature passed Senate Bill 360 requiring all water purveyors (that supply water for municipal, industrial or domestic purposes) to adopt conservation plans before July 1, 1992. Public water purveyors were to submit their plans to the Division of Water Planning for review and approval before adoption (NRS 540.121 through 540.151). Private utilities were to submit their plans to the Public Service Commission (NRS 704.662 through 704.6624). However, Senate Bill 360 did not require periodic plan updates or progress reports.

U.S. Bureau of Reclamation Conservation Plans. On October 12, 1982, the Reclamation Reform Act (RRA) was signed into law. One of the provisions of the RRA requires each district, that has entered into a repayment contract or water service contract, to develop a water conservation plan. The plan is to contain definite goals, appropriate water conservation measures, and a time schedule for meeting the water conservation objectives. This provision of the RRA impacts districts such as the Truckee Carson Irrigation District and Pershing County Water Conservation District. Through their Field Services Program, Reclamation's intent is to encourage the consideration and incorporation of prudent and responsible water conservation measures in district operations.

Local and State Water Planning and Management

Many local and state entities have statutory authorities related to water use, management, protection and development. Some of the authorities are summarized in Tables 2-1 and 2-2.

Table 2-1. Local Organization Statutory Authority

Category	Agency	Program	Authority (NRS)
Water Supply	Cities	Water Facilities	266.285
	Counties	Water Facilities	244.366
	General Improvement Districts	Water Facilities	318.144
	Irrigation Districts	Irrigation	539.010 - 539.783
	Water Conservancy Districts	Water Supply	541.010 - 541.420
Water Quality	Cities	Sewer Facilities	266.285
	Counties	Sewer Facilities	244.366
	General Improvement Districts	Sewer Facilities	318.140
Environmental Uses	Conservation Districts	Conservation of Natural Resources	548.010 - 548.550
Flood Management	Flood Control Districts	Flood Control	543.170 - 543.830
	Water Conservancy Districts	Flood Control and Drainage	541.010 - 541.420
Water Planning and Management	Cities	Master Plan	278.150 - 278.230
	Counties	Regional Plan	278.0272 - 278.029
		Master Plan	278.150 - 278.230

Table 2-2. State Agency Statutory Authority

Category	Agency	Program	Authority (NRS)
Water Supply and Allocation	State Engineer's Office (Division of Water Resources)	Water Right Adjudication and Appropriation	533
		Groundwater Regulation	534
	Division of Water Planning	Small Community Grant Program	349.980 - 349.987
		Conservation Plans	540.121 - 540.151
	Public Utilities Commission	Regulation of Public Utilities	704.001 - 704.960
		Utility Environmental Protection Act (UEPA)	704.001 - 704.960
		Conservation Plans	704.662 - 704.6624
Water Quality	Division of Environmental Protection	Water Pollution Control Clean Water Act State Groundwater Permit Safe Drinking Water Act Mining Reclamation	445A.300 - 445.730 519A.010 - 519A.280
	Division of Agriculture	Control of Pesticides	586.010 - 586.520
	Bureau of Health Protection Services, Health Division	Safe Drinking Water Act	445A.800 - 445A.955
		Control of Septic Systems	444.650
Environmental and Recreational Uses	Division of Wildlife	Boating Safety	488, 501.243
		Wildlife Management and Propagation	504.140 - 504.490
		Protection of Threatened Species	503.584
	Natural Heritage Program	Threatened and Endangered Species Database	527.260 - 527.300
	Division of Parks	Park Facilities	407.011 - 407.250
	Division of Forestry	Protection and Preservation of Timbered Lands, Trees and Flora	527.010 - 527.330
		Forest Practice and Reforestation	528.010 - 528.120
Flood Management	Division of Water Planning	National Flood Insurance Program (Community Assistance, Flood Mitigation Assistance)	540
	Division of Water Resources	Dam Safety	535.005 - 535.110
		Channel Clearance	532.220 - 532.230
	Division of Emergency Management	Hazard Mitigation Grant	414
	Division of Forestry	Forest/Vegetative Cover for Flood Prevention	472.043
	Department of Conservation and Natural Resources	Flood Control Loans	543.090 - 543.140
Water Planning and Management	Division of Water Planning	State Water Plan	540.101
		Planning Assistance	540.011 - 540.151

Regional Plans

According to Nevada Revised Statutes 540.101(2), the Division of Water Planning is to coordinate with local governments (political subdivisions) in developing the *State Water Plan,* and upon the request of the Division, each local government shall cooperate with and assist the Division in the development of the Plan. Following is a summary of selected regional planning efforts that are underway. These planning efforts will provide valuable information for the *State Water Plan.*

Southern Nevada Water Authority Water Resource Plan

The Southern Nevada Water Authority (SNWA) was created in 1991 through a cooperative agreement among the seven regional water and wastewater agencies, including Big Bend Water District (Laughlin); City of Boulder City; Clark County Sanitation District; City of Henderson; City of Las Vegas; Las Vegas Valley Water District; and City of North Las Vegas. The purposes of SNWA are to seek new water resources for Southern Nevada, to manage existing and future water resources, to construct and manage regional water facilities, and to promote responsible conservation. The SNWA Water Resource Plan was completed January 1996, and amended February 1997.

Washoe County Comprehensive Regional Water Management Plan

In 1995, the Nevada State Legislature approved legislation which created the Regional Water Planning Commission and provided the basis and direction for the Commission and the 1995-2015 Washoe County Comprehensive Regional Water Management Plan. This legislation required that the Commission develop "...a comprehensive plan for the region covering the supply of municipal and industrial water, quality of water, sanitary sewerage, treatment of sewerage, drainage of storm waters and control of floods." The Plan was completed and approved by the 1997 State Legislature.

Clark County Regional Flood Control District Flood Control Master Plan

In response to major floods in 1983 and 1984, the Clark County Regional Flood Control District (CCRFCD) was established in 1985 to develop a regional flood control program for the Las Vegas Valley and surrounding environs. As part of the CCRFCD mandate, a comprehensive, regional Master Plan was prepared and adopted in 1986. The principal objective of the Master Plan is to provide for the long-term improvement in public safety and property damage protection from flooding events by guiding the siting, design, and installation of flood control facilities. Periodic Master Plan updates are required by law to account for changes in land use, the construction of new facilities, and for improved hydrologic and hydraulic data.

Water Quality Management Plans (Section 208 of the Clean Water Act)

Section 208 of the federal Clean Water Act was promulgated for the purpose of encouraging and facilitating the development and implementation of areawide waste treatment management plans. Section 208 plans have been developed for all areas of Nevada.

City/County Master Plans

Nevada Revised Statutes 278.150 requires each city and county to prepare and adopt a comprehensive, long-term general plan for the physical development of the city, county or region. The master plan may address a variety of matters, such as conservation, land use, population, public services and facilities, recreation, and solid waste disposal.

Water Resources Data Collection and Research

A majority of the available water resources data in Nevada is collected by a variety of state and federal entities, such as U.S. Geological Survey (USGS), Desert Research Institute (DRI), Natural Resources Conservation Service, Nevada Division of Environmental Protection, Nevada Division of Water Resources, Nevada Health Division, and the Nevada State Health Laboratory. The main types of water resources data include: streamflow data and forecasts, lake and reservoir water levels, groundwater levels,water usage, water right information, water quality data, treatment plant discharges, snowpack amounts, precipitation, and temperature. Much of the research related to Nevada's water resources is performed by USGS, DRI and University of Nevada Reno (Department of Environmental and Natural Resource Sciences; Applied Economics and Statistics).

Funding Opportunities

A variety of state and federal funding sources exist for the planning, management, protection and development of our water resources as shown in Table 2-3. These funding programs are described in more detail in Part 1, Section 1 of the *State Water Plan*.

Table 2-3. Selected Funding Programs

Agency	Program
State Agencies	
Division of Water Planning	Grants for Capital Improvements to Community Water Systems
Division of Environmental Protection	Clean Water Act Section 319 Nonpoint Source Implementation Grant Program
	Clean Water Act State Revolving Loan Fund
Division of Water Resources	Channel Clearance Program
Commission on Economic Development	Community Development Block Grant Program
Department of Business and Industry	Water Projects Financing Program
Division of Health, Bureau of Health Protection Services	Safe Drinking Water Act State Revolving Loan Fund
Legislative Counsel Bureau	Disaster Relief Fund
Federal Agencies	
Department of Agriculture, Rural Development	Rural Utilities Service Program
Environmental Protection Agency	Clean Water Act Section 104 (b)(3) Wetland Protection Development Grants
Natural Resources Conservation Service; Fish and Wildlife Service	Wetlands Reserve Program
Natural Resources Conservation Service	Environmental Quality Incentive Programs
Federal Emergency Management Agency	Flood Mitigation Assistance Grants

Nevada State Water Plan
SUMMARY

Section 3
Water Resources and Use Assessment

Introduction

An understanding of the state's water resources and its usage is a necessary component to the planning and management process. This section provides an overview of the physical characteristics of Nevada's water resources and historic water use for the last 25 years.

Water Resources Background

The following discussion provides an overview of Nevada's surface water and groundwater resources.

Topography

The topography of Nevada and the surrounding areas makes for a unique and diversified climate. Nearly all of Nevada is in the Basin and Range Province of the Intermountain Plateaus, a rugged elevated area between the Rocky Mountains and the Pacific mountain system. The topography of the Basin and Range province is characterized by isolated, long and narrow, roughly north-south trending, parallel mountain ranges and broad, intervening valleys. Internal drainage is a significant feature of the hydrology of much of Nevada with about 84 percent of the drainage flowing to low areas in enclosed basins rather than to the sea.

The topography and related geology of the State has resulted in complex surface and ground water systems, complicating the management of these resources. In the 1960s, the Nevada State Engineer's Office and the U.S. Geological Survey (USGS) recognized the need for a systematic identification of the valleys or hydrographic areas, and developed a hydrographic area map. The current hydrographic area map delineates 256 hydrographic areas within 14 major hydrographic regions and basins (Figure 3-1, Table 3-1). Of the 14 hydrographic regions and basins, only the Snake River Basin and the Colorado River Basin drain to the sea.

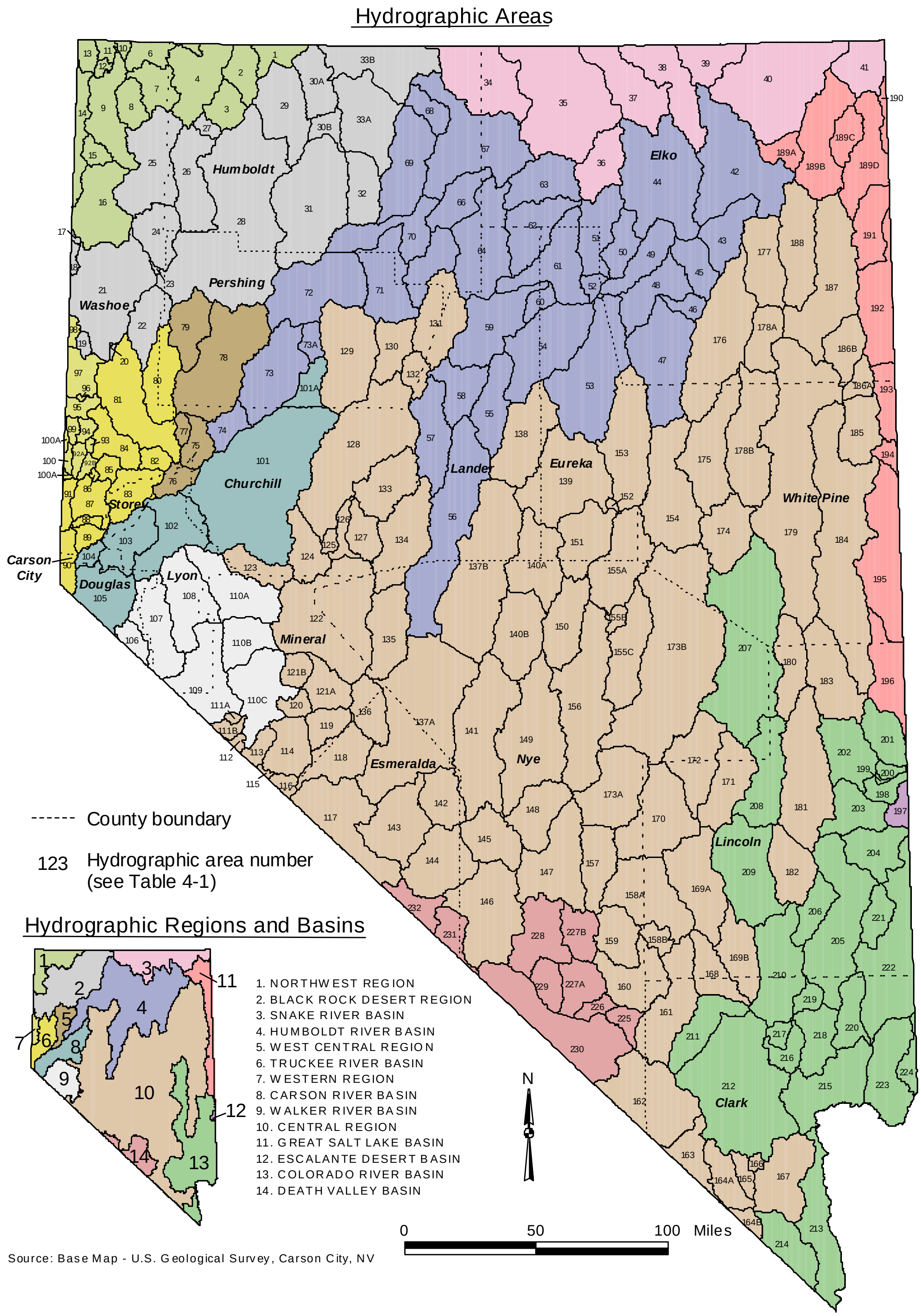


Figure 3-1. Hydrographic Regions and Basins

Table 3-1. List of Hydrographic Areas

1. NORTHWEST REGION
1. Pueblo Valley
2. Continental Lake Valley
3. Gridley Lake Valley
4. Virgin Valley
5. Sage Hen Valley
6. Guano Valley
7. Swan Lake Valley
8. Massacre Lake Valley
9. Long Valley
10. Macy Flat
11. Coleman Valley
12. Mosquito Valley
13. Warner Valley
14. Surprise Valley
15. Boulder Valley
16. Duck Lake Valley

2. BLACK ROCK DESERT REGION
17. Pilgrim Flat
18. Painter Flat
19. Dry Valley
20. Sano Valley
21. Smoke Creek Desert
22. San Emidio Desert
23. Granite Basin
24. Hualapai Flat
25. High Rock Lake Valley
26. Mud Meadow
27. Summit Lake Valley
28. Black Rock Desert
29. Pine Forest Valley
30. Kings River Valley
    (A) Rio King Subarea
    (B) Sod House Subarea
31. Desert Valley
32. Silver State Valley
33. Quinn River Valley
    (A) Orovada Subarea
    (B) McDermitt Subarea

3. SNAKE RIVER BASIN
34. Little Owyhee River Area
35. South Fork Owyhee River Area
36. Independence Valley
37. Owyhee River Area
38. Bruneau River Area
39. Jarbidge River Area
40. Salmon Falls Creek Area
41. Goose Creek Area

4. HUMBOLDT RIVER BASIN
42. Marys River Area
43. Starr Valley Area
44. North Fork Area
45. Lamoille Valley
46. South Fork Area
47. Huntington Valley
48. Dixie Creek - Tenmile Creek Area
49. Elko Segment
50. Susie Creek Area
51. Maggie Creek Area
52. Marys Creek Area
53. Pine Valley
54. Crescent Valley
55. Carico Lake Valley
56. Upper Reese River Valley
57. Antelope Valley
58. Middle Reese River Valley
59. Lower Reese River Valley
60. Whirlwind Valley
61. Boulder Flat
62. Rock Creek Valley
63. Willow Creek Valley
64. Clovers Area
65. Pumpernickel Valley
66. Kelly Creek Area
67. Little Humboldt Valley
68. Hardscrabble Area
69. Paradise Valley
70. Winnemucca Segment
71. Grass Valley
72. Imlay Area
73. Lovelock Valley
    (A) Oreana Subarea
74. White Plains

5. WEST CENTRAL REGION
75. Bradys Hot Springs Area
76. Fernley Area
77. Fireball Valley
78. Granite Springs Valley
79. Kumiva Valley

6. TRUCKEE RIVER BASIN
80. Winnemucca Lake Valley
81. Pyramid Lake Valley
82. Dodge Flat
83. Tracy Segment
84. Warm Springs Valley
85. Spanish Springs Valley
86. Sun Valley
87. Truckee Meadows
88. Pleasant Valley
89. Washoe Valley
90. Lake Tahoe Basin
91. Truckee Canyon Segment

7. WESTERN REGION
92. Lemmon Valley
    (A) Western Part
    (B) Eastern Part
93. Antelope Valley
94. Bedell Flat
95. Dry Valley
96. Newcomb Lake Valley
97. Honey Lake Valley
98. Skedaddle Creek Valley
99. Red Rock Valley
100. Cold Spring Valley
    (A) Long Valley

8. CARSON RIVER BASIN
101. Carson Desert
    (A) Packard Valley
102. Churchill Valley
103. Dayton Valley
104. Eagle Valley
105. Carson Valley

9. WALKER RIVER BASIN
106. Antelope Valley
107. Smith Valley
108. Mason Valley
109. East Walker Area
110. Walker Lake Valley
    (A) Schurz Subarea
    (B) Lake Subarea
    (C) Whisky Flat - Hawthorne Subarea

10. CENTRAL REGION
111. Alkali Valley (Mineral)
    (A) Northern Part
    (B) Southern Part
112. Mono Valley
113. Huntoon Valley
114. Teels Marsh Valley
115. Adobe Valley
116. Queen Valley
117. Fish Lake Valley
118. Columbus Salt Marsh Valley
119. Rhodes Salt Marsh Valley
120. Garfield Flat
121. Soda Spring Valley
    (A) Eastern Part
    (B) Western Part
122. Gabbs Valley
123. Rawhide Flats
124. Fairview Valley
125. Stingaree Valley
126. Cowkick Valley
127. Eastgate Valley Area
128. Dixie Valley
129. Buena Vista Valley
130. Pleasant Valley
131. Buffalo Valley
132. Jersey Valley
133. Edwards Creek Valley
134. Smith Creek Valley
135. Ione Valley
136. Monte Cristo Valley
137. Big Smoky Valley
    (A) Tonopah Flat
    (B) Northern Part
138. Grass Valley
139. Kobeh Valley
140. Monitor Valley
    (A) Northern Part
    (B) Southern Part
141. Ralston Valley
142. Alkali Spring Valley (Esmeralda)
143. Clayton Valley
144. Lida Valley
145. Stonewall Flat
146. Sarcobatus Flat
147. Gold Flat
148. Cactus Flat
149. Stone Cabin Flat
150. Little Fish Lake Valley
151. Antelope Valley (Eureka & Nye)
152. Stevens Basin
153. Diamond Valley
154. Newark Valley
155. Little Smoky Valley
    (A) Northern Part
    (B) Central Part
    (C) Southern Part
156. Hot Creek Valley
157. Kawich Valley
158. Emigrant Valley
    (A) Groom Lake Valley
    (B) Papoose Lake Valley
159. Yucca Flat
160. Frenchman Flat
161. Indian Springs Valley
162. Pahrump Valley
163. Mesquite Valley (Sandy Valley)
164. Ivanpah Valley
    (A) Northern Part
    (B) Southern Part
165. Jean Lake Valley
166. Hidden Valley (South)
167. Eldorado Valley
168. Three Lakes Valley (Northern Part)
169. Tikapoo Valley (Tickaboo Valley)
    (A) Northern Part
    (B) Southern Part
170. Penoyer Valley (Sand Spring Valley)
171. Coal Valley
172. Garden Valley
173. Railroad Valley
    (A) Southern Part
    (B) Northern Part
174. Jakes Valley
175. Long Valley
176. Ruby Valley
177. Clover Valley
178. Butte Valley
    (A) Northern Part (Round Valley)
    (B) Southern Part
179. Steptoe Valley
180. Cave Valley
181. Dry Lake Valley
182. Delamar Valley
183. Lake Valley
184. Spring Valley
185. Tippett Valley
186. Antelope Valley (White Pine & Elko)
    (A) Southern Part
    (B) Northern Part
187. Goshute Valley
188. Independence Valley (Pequop Valley)

11. GREAT SALT LAKE BASIN
189. Thousand Springs Valley
    (A) Herrill Siding - Brush Creek Area
    (B) Toano - Rock Spring Area
    (C) Montello - Crittenden Creek Area (Montello Valley)
190. Grouse Creek Valley
191. Pilot Creek Valley
192. Great Salt Lake Desert
193. Deep Creek Valley
194. Pleasant Valley
195. Snake Valley
196. Hamlin Valley

12. ESCALANTE DESERT
197. Escalante Desert

13. COLORADO RIVER BASIN
198. Dry Valley
199. Rose Valley
200. Eagle Valley
201. Spring Valley
202. Patterson Valley
203. Panaca Valley
204. Clover Valley
205. Lower Meadow Valley Wash
206. Kane Springs Valley
207. White River Valley
208. Pahroc Valley
209. Pahranagat Valley
210. Coyote Spring Valley
211. Three Lakes Valley (Southern Part)
212. Las Vegas Valley
213. Colorado Valley
214. Piute Valley
215. Black Mountains Area
216. Garnet Valley (Dry Lake Valley)
217. Hidden Valley (North)
218. California Wash
219. Muddy River Springs Area (Upper Moapa Valley)
220. Lower Moapa Valley
221. Tule Desert
222. Virgin River Valley
223. Gold Butte Area
224. Greasewood Basin

14. DEATH VALLEY BASIN
225. Mercury Valley
226. Rock Valley
227. Fortymile Canyon
    (A) Jackass Flats
    (B) Buckboard Mesa
228. Oasis Valley
229. Crater Flat
230. Amargosa Desert
231. Grapevine Canyon
232. Oriental Wash

Climate

Nevada is truly a land of great climatic differences. The climate of Nevada is characterized as semi-arid to arid. Temperatures can fall below -40°F in the northeast, and rise over 120°F in the south. Precipitation can range from only three to four inches in Southern Nevada to over 40 inches (and over 300 inches of snowfall) in the Carson Range portion of the Sierra Nevada Mountains. With total precipitation averaging approximately nine inches per year, Nevada is the most arid state in the nation.

Surface Water

Surface water is a limited and precious resource in Nevada providing about 70 percent of the total water supply used in the state. Spring and summer snowmelt supplies most of the streamflow in Nevada. However, isolated summer convective storms probably cause a majority of the streamflow in southern Nevada's low altitude basins.

Major Rivers, Lakes and Reservoirs. Nevada can claim very few large rivers and streams compared to other states. With the exception of the Colorado River, Nevada's perennial rivers are small by nationwide standards. The rivers in the Snake River and Colorado River basin regions flow to the oceans, with the remaining stream systems discharging into terminal sinks and lakes. The major river systems in Nevada are the Colorado, Walker, Carson, Truckee, and Humboldt (Figure 3-2). Table 3-2 summarizes the main lakes and reservoirs within these river systems and in Nevada.

Streamflow Characteristics. Most of the streamflow in Nevada is the result of runoff from melting snow. Runoff patterns in Nevada vary seasonally and geographically, and are mainly determined by precipitation patterns (location and timing) and other climate patterns, such as temperature. Other factors such as surface geology, vegetation, land use affect the amount of runoff entering the rivers and streams. Streamflows are further affected by human-induced influences such as diversions and reservoir operations.

Table 3-3 summarizes some basic streamflow characteristics for selected USGS gaging stations throughout Nevada. As shown, average annual flows vary widely from river to river. Within a given river system, flows fluctuate year to year in response to changes in precipitation amounts. Monthly and annual flows for the Humboldt River are shown on Figures 3-3 and 3-4.

Water Yields and Committed Resources. The estimated average annual yield from Nevada's surface water systems is approximately 3.2 million acre-feet per year (Table 3-4). Generally, Nevada's surface water sources, such as lakes, streams and springs, have been fully appropriated and used for many years. In some instances, water may be available from these sources during high water years, however storage facilities would be required to capture the surplus flows for later use.

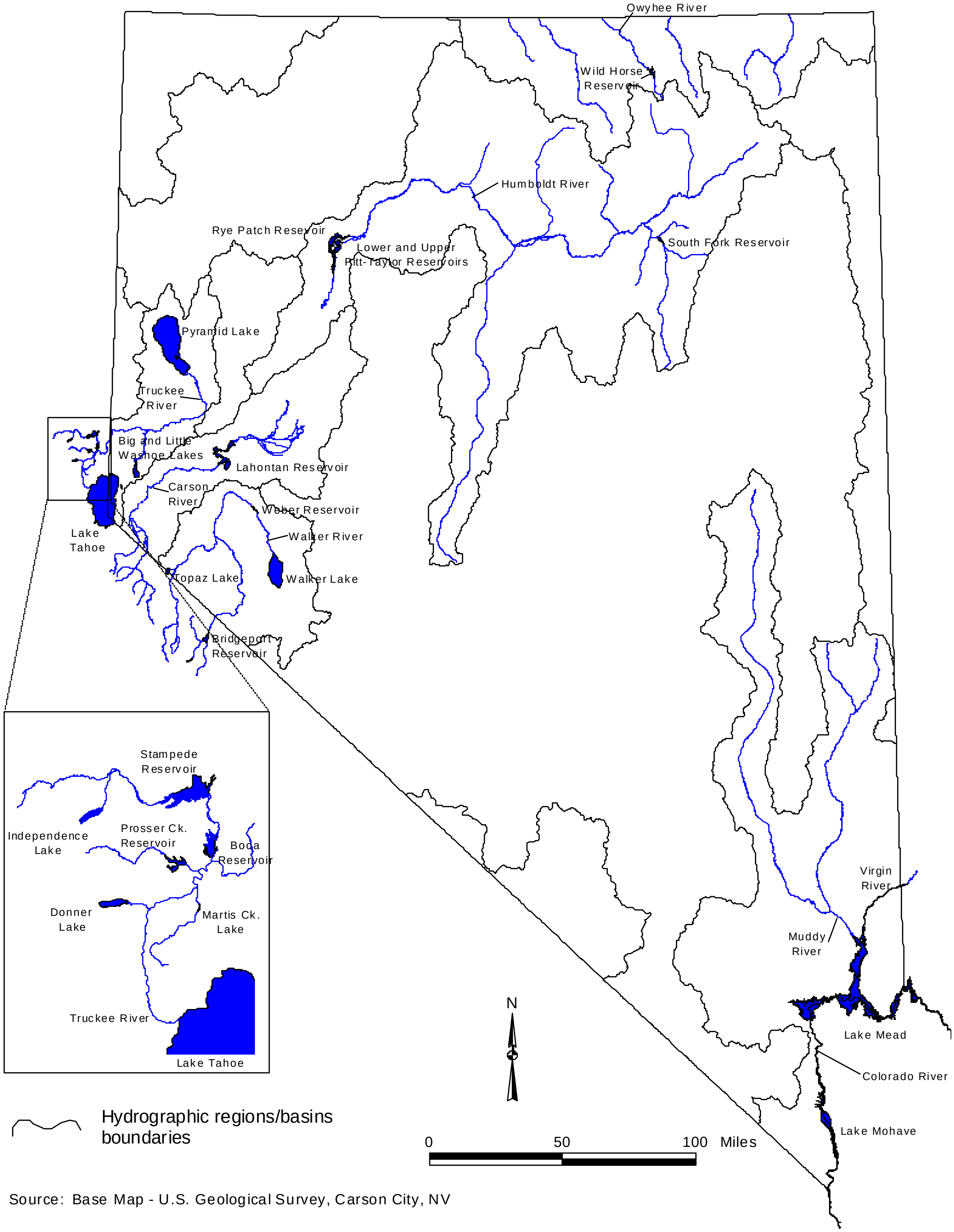


Figure 3-2. Major Rivers, Lakes and Reservoirs

Table 3-2. Major Lakes and Reservoirs of Nevada and Portions of California

Hydrographic Region	Lake/Reservoir	Surface Area, acres	Active Storage Capacity, acre-feet	Total Storage Capacity, acre-feet
Carson River	Lahontan Reservoir	14,600	317,000	317,000
Colorado River	Lake Mead	158,000	26,200,000	29,700,000
	Lake Mohave	28,000	1,810,000	1,820,000
Humboldt River	Pitt-Taylor Reservoir, Lower	2,570	22,200	22,200
	Pitt-Taylor Reservoir, Upper	2,070	24,200	24,200
	Rye Patch Reservoir	12,400	194,300	194,300
	South Fork Reservoir	1,650	41,000	41,000
Snake River	Wild Horse Reservoir	2,830	73,500	73,500
Truckee River	Big and Little Washoe Lakes	5,800	14,000	38,000
	Boca Reservoir	980	40,870	41,110
	Donner Lake	800	9,500	Not reported
	Independence Lake	700	17,500	Not reported
	Lake Tahoe	124,000	744,600	125,000,000
	Martis Creek Lake	770	20,400	21,200
	Prosser Creek Reservoir	750	28,640	29,840
	Pyramid Lake[1]	111,400 (as of 9/30/96)	not applicable	21,760,000 (as of 9/30/96)
	Stampede Reservoir	3,440	221,860	226,500
Walker River	Bridgeport Reservoir	2,914	40,500	40,500
	Topaz Lake	2,410	61,000	126,000
	Walker Lake[1]	33,500 (as of 9/30/96)	not applicable	2,153,000 (as of 9/30/96)
	Weber Reservoir	950	13,000	13,000

[1]Pyramid and Walker lakes are natural terminal lakes with no outlet.

Table 3-3. Summary of Streamflow Data for Selected Gaging Stations

Hydrographic Region	Gaging Station Name (Number)	Period of Record	Annual Streamflow Statistics, acre-feet		
			Average Annual	Lowest Annual	Highest Annual
Carson River	East Fork Carson River near Gardnerville, NV (10309000)	1890-1997	278,800	66,300	655,200
	West Fork Carson River at Woodfords, CA (10310000)	1901-97	81,000	18,900	210, 000
	Carson River near Carson City, NV (10311000)	1940-97	298,700	42,400	826,800
	Carson River near Ft. Churchill, NV (10312000)	1911-97	272,900	26,300	804,400
Colorado River	Virgin River at Littlefield, AZ (09415000)	1930-97	175,600	72,400	504,600
	Muddy River near Glendale, NV (09419000)	1913-97	30,600	23,500	35,900
	Colorado River below Hoover Dam, AZ-NV (09421500)	1935-97	10,050,000	5,556,000	22,150,000
Humboldt River	Humboldt River at Palisade, NV (10322500)	1903-97	288,800	25,200	1,336,000
	Humboldt River near Imlay, NV (10333000)	1935-97	201,000	18,800	1,460,000
Snake River	Owyhee River above China Diversion Dam near Owyhee, NV (13176000)	1939-84	107,600	33,500	230,800
Truckee River	Truckee River at Farad, CA (10346000)	1909-97	554,500	133,200	1,769,000
	Truckee River at Reno, NV (10348000)	1907-96	492,500	76,700	1,701,000
	Truckee River below Derby Dam near Wadsworth, NV (10351600)	1918-97	289,100	4,500	1,759,000
Walker River	East Walker River near Bridgeport, CA (10293000)	1922-97	105,800	27,100	320,700
	West Walker near Coleville, CA (10296500)	1903-97	202,100	53,900	484,300
	Walker River near Wabuska, NV (10301500)	1902-97	123,300	9,300	602,300

Note: Some years of data may be missing within each period of record.
Source: U.S. Geological Survey

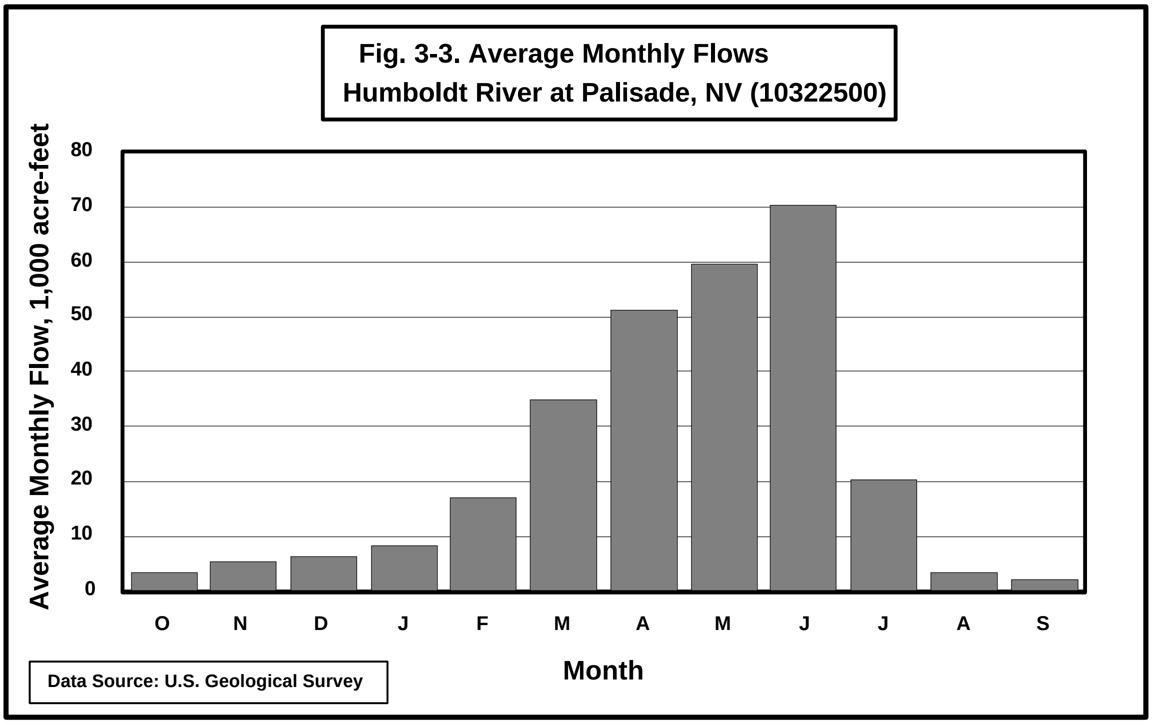


Fig. 3-3. Average Monthly Flows
Humboldt River at Palisade, NV (10322500)
Average Monthly Flow, 1,000 acre-feet
80
70
60
50
40
30
20
10
0
O
N
D
J
F
M
A
M
J
J
A
S
Month
Data Source: U.S. Geological Survey

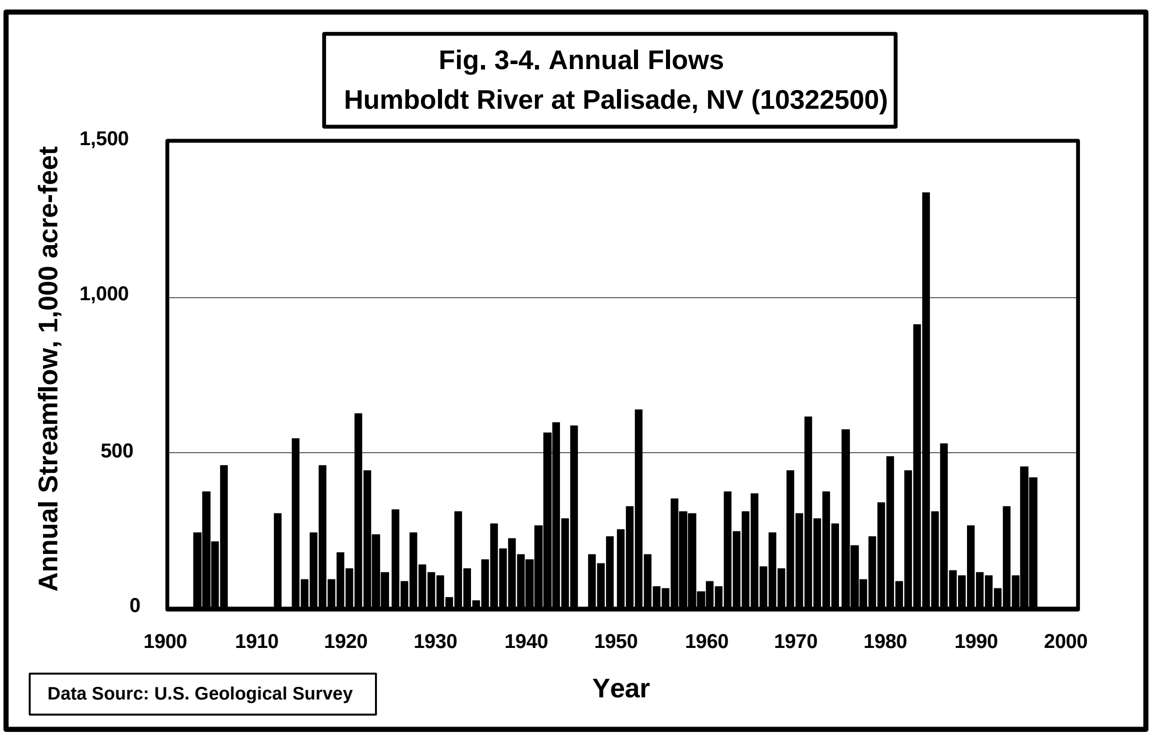


Fig. 3-4. Annual Flows
Humboldt River at Palisade, NV (10322500)
Annual Streamflow, 1,000 acre-feet
1,500
1,000
500
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
Year
Data Sourc: U.S. Geological Survey

Table 3-4. Summary of Surface Water Runoff and Flows (excluding Colorado River)

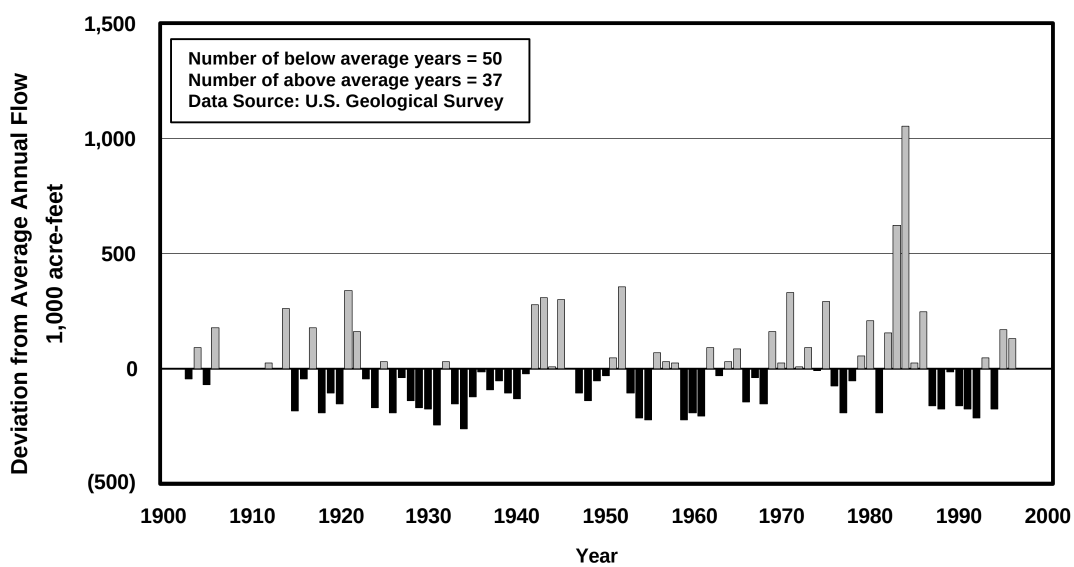
Description	Acre-feet per year
Average Annual Surface Runoff	
From Watersheds within Nevada	1,900,000
Inflow from Other States	1,300,000
Total	3,200,000
Average Annual Surface Outflow to Other States	700,000

Source: "Water for Nevada, Report No. 3", State Engineer's Office, 1971

<u>Droughts and Floods.</u> Nevada is a land of extremes, with droughts and floods common in our highly variable climate. Years of average streamflows are rarely experienced. Periods of high flows followed by low flows are more the norm in Nevada.

Drought periods (consecutive years with streamflows much less than average) are frequent in Nevada. In many cases, Nevada's river systems experience more "below average water years" than "above average water years" (Figure 3-5).

Fig. 3-5. Annual Deviations from Average Annual Flows
Humboldt River at Palisade (10322500)

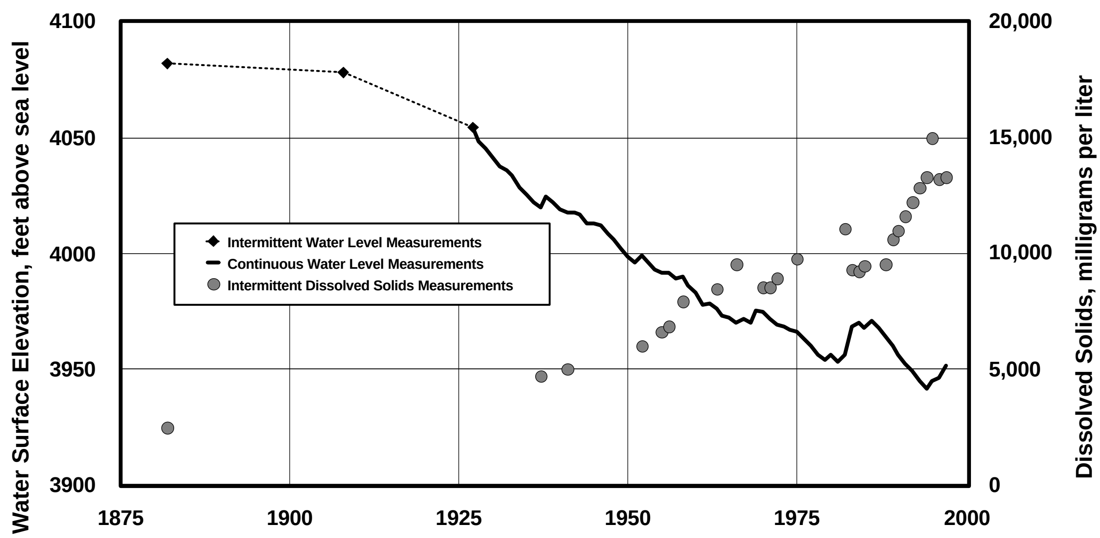


Even though Nevada is the driest state with an average annual precipitation of nine inches, floods are common and have occurred in all parts of the state. The effects of floods in Nevada have increased steadily as population and development have increased since the mid-1900s. Development has encroached upon natural floodplains, including alluvial fans, and thereby increased flood damage risks.

On the Truckee, Carson, and Walker rivers in west-central Nevada, the most severe floods have resulted from winter rains on snow in the Sierra Nevada Mountains. In the large drainages in southern Nevada, and small drainages and alluvial fans throughout Nevada, flash floods resulting from intense rainfall over relatively small areas are the most common.

Water Quality. Nevada's surface water quality is regulated by the Nevada Division of Environmental Protection (NDEP) and the State Environmental Commission (SEC). The quality of surface water in Nevada varies greatly from location to location and from month to month with changes in flows. In planning, both water quantity and quality need to be considered concurrently as both are interrelated. In general, constituent concentrations vary with changes in streamflow. Similarly, lake water quality has deteriorated with lowering water levels in the State's terminal lakes, such as Walker Lake (see Figure 3-6).

Fig. 3-6. Water Surface Elevations and Dissolved Solids Concentrations - Walker Lake



Data Source: U.S. Geological Survey

Groundwater

Groundwater in Nevada is an important water supply source. The surface water resources in our state have been virtually fully appropriated and future development must rely on either ground-water sources or the reallocation of surface water supplies. Groundwater provides about 40 percent of the total water supply used in Nevada and in some areas provides the entire supply. The extent to which groundwater is used may vary considerably from year to year. In many areas, groundwater is pumped to supplement surface water sources. As a result, groundwater usage in these areas increases during periods of low streamflow and decreases during high runoff periods.

Principal Ground-water Aquifers. Principal ground-water aquifers in Nevada are basin-fill aquifers, carbonate-rock aquifers, volcanic-rock aquifers, and volcanic- and sedimentary-rock aquifers. The basin-fill aquifers, composed primarily of alluvial, colluvial and lacustrine deposits, are the major aquifers in the State. Virtually all major ground-water development has been in the basin-fill aquifers with the withdrawals from the upper 500 feet of these aquifers. In eastern and southern Nevada, thick sequences of carbonate rock underlie many of the alluvial basins forming a complex regional aquifer system or systems that are largely undeveloped and not yet fully understood. The carbonate-rock aquifer supplies water to numerous springs which are used for irrigation. Volcanic-rock aquifers extend over hundreds of square miles but only one volcanic-rock aquifer in the Carson Desert (Churchill County) of west-central Nevada has been developed as a municipal water supply.

Perennial Yield and Committed Resources. Perennial yield is the amount of usable water from a ground-water aquifer which can be economically withdrawn and consumed each year for an indefinite period of time without depleting the source. Estimates of perennial yield are necessary to provide the State Engineer with a guideline by which to limit groundwater allocations (committed resources). Over the years, the USGS has developed a series of perennial yield estimates.

Under the authority granted in Nevada Revised Statutes 534, the State Engineer issues groundwater rights. The term “committed resource” represents the total volume of the permitted, certificated and vested groundwater rights which are recognized by the State Engineer and generally can be withdrawn from a basin or area in any given year. When reviewing groundwater right applications, the State Engineer considers the individual and regional perennial yield estimates, system yield estimates, and the committed resources amounts among other things in making his determination.

To assist in the tracking of the committed groundwater resources, NDWR maintains a computer database of state-issued water rights. Based upon this database, the total committed groundwater resource amount in Nevada equals about 3 million acre-feet per year (as of March/April 1998). The term “committed” refers to those water rights that are either permitted or certificated. Table 3-5 summarizes the committed resources by hydrographic region and by type of use. Committed resource values presented in the *State Water Plan* are time sensitive and subject to change from future actions on pending applications and other procedures. It must be noted that the 3 million acre-feet figure is calculated from NDWR database output and represents the estimated amount of the groundwater resources committed (permitted or certificated) to a particular beneficial use. The database is still under development and all committed resource numbers presented in the *State Water*

Table 3-5. Approximate Perennial Yield and Committed Groundwater Resources (as of March/April 1998) by Use and Hydrographic Region

Hydrographic Region	Combined Perennial Yield, acre-feet per year	Committed Groundwater Resources by Category, acre-feet per year (as of March/April 1998)					
		Irrigation & Stock	Municipal & Quasi-municipal	Mining & Milling[1]	Commercial & Industrial	Other[2]	Total
1. Northwest Region	55,500	28,625	6	132	5	64	28,832
2. Black Rock Desert Region	178,825	215,658[3]	608	58,952[4]	920[5]	1,687[5]	277,825
3. Snake River Basin	62,100	8,091	1,145	7,813	4,877	511	22,437
4. Humboldt River Basin	463,900	492,307[3,6]	53,737	141,576	63,637[5]	91,055[7]	842,312
5. West Central Region	8,200	1,678	8,743	58	28,249[5]	1,289	40,017
6. Truckee River Region	76,425	34,989[3]	83,902[8]	5,172	68,030[5]	19,014	211,107
7. Western Region	17,850	18,662	5,174	5,174	518	508	25,328
8. Carson River Basin	70,255	95,926[3]	62,438	4,068	12,979[5]	13,196[5]	188,607
9. Walker River Basin	57,300	205,354[3]	14,949	8,657	12,383[9]	6,019	247,362
10. Central Region	798,460	573,277	50,978	96,765	37,141[5]	9,775[5]	767,936
11. Great Salt Lake Basin	63,150	28,155	3,506	1,305	732	13	33,711
12. Escalante Desert Basin	1,000	2	0	0	0	0	2
13. Colorado River Basin	219,800	78,057[3]	101,362[10]	11,171	35,895	19,165[11]	245,650
14. Death Valley Basin	24,550	22,325	2,154	6,086	638	333	31,536
TOTAL	2,097,315	1,803,106	388,702	342,221	266,004	162,629	2,962,662

General notes:

A. Data on committed resources were obtained from the Nevada Division of Water Resources water rights database and represent estimated resources committed as of March/April 1998.

B. The committed resources values include permitted and certificated amounts only.

C. These numbers are preliminary and intended to be used for planning purposes only. Totals may include water rights that have not been adjusted for supplemental relationships with other groundwater rights. Also, totals do not include any adjustment for supplemental relationships with surface water rights. Values are subject to change due to pending water right applications, and possible cancellations and forfeitures.

Other notes:

1 Mining is considered a temporary use by the State Engineer's Office and upon cessation of mining, many permits will expire. The "Mining & Milling" category includes only those rights associated with the consumptive use needs of the mines. Permits associated with dewatering operations are included in the "Other" category.

2 "Other" includes following uses: domestic, environmental, power generation, recreation, storage, wildlife, other/decreed. Includes environmental permits issued for environmental cleanup projects. These environmental permits are temporary and expire upon cessation of cleanup activities.

3 Portions of rights are supplemental to surface water and are used only when surface water is not available.

4 Majority of rights held for a mine operation that is no longer pumping.

5 Portion of rights include geothermal pumpage for power generation, with majority of geothermal water reinjected into geothermal reservoir.

6 Portion of rights not exercised as mine pit dewatering discharge is being used as a substituted water source. See Footnote 7.

7 Includes rights associated with mine pit dewatering. Portion of withdrawals are used as a water source for irrigation. See Footnote 6.

8 Actual annual pumpage limited to lower value by State Engineer restrictions.

9 Portion of rights include geothermal pumpage for power generation, with some of geothermal water not reinjected.

10 Includes permits that will be revoked when water right holders provided water from another source (Colorado River).

11 Includes environmental permits issued for environmental cleanup projects. These environmental permits are temporary and expire upon cessation of cleanup activities. Also includes permits granted for pumping of shallow poor quality groundwater in the Las Vegas area as needed to alleviate potential hazards resulting from rising groundwater levels caused by secondary recharge.

Plan are approximate. Actual groundwater withdrawal and consumption amounts are far less than the committed resource value of 3 million acre-feet from the NDWR database. In 1995, approximately 1.6 million acre-feet of groundwater was withdrawn with about 0.7 million acre-feet consumed. There are a number of reasons for these differences:

- Some groundwater rights are *supplemental* to surface water rights and are only exercised during low surface water flow periods;
- In some basins, the NDWR database may be double counting a smaller portion of groundwater rights that are *supplemental* to other groundwater rights;
- Some groundwater rights may not be exercised to their fullest extent every year;
- Some groundwater rights are not currently being exercised as a water supply is being provided from another replacement source; and
- The State Engineer has placed administrative limits on pumping in some areas.

The committed resource figures derived from the NDWR database may not reflect long-term groundwater commitments for the following reasons:

- Mining is considered a temporary use by the State Engineer's Office. With some mines, existing water right permits will expire once the mining operations have ceased;
- Environmental permits issued for environmental cleanup projects are included in the committed resource figures in Table 3-5. The cleanup projects are considered temporary, and once a cleanup operation is complete the associated water rights expire; and
- The NDWR database includes committed resource amounts associated with revocable groundwater permits issued in the Las Vegas area. These rights will be revoked when the water right holders are provided water from another source, such as the Colorado River.

Designated Groundwater Basins. As the demand for groundwater has increased over the years, the State Engineer has had to increase administrative efforts in some of the groundwater basins. The State Engineer may designate a groundwater basin which is being depleted or is in need of additional administration. Basins are designated through orders issued by the State Engineer. By "designating" a basin, the State Engineer is granted additional authority in the administration of the groundwater resources within the designated basin.

Figure 3-7 displays the designation status for the 256 groundwater basins in Nevada. This map is a useful tool to generally determine where the greatest impediments to groundwater development may exist. However, the associated State Engineer's orders and rulings need to be examined for a complete understanding of the management issues and water availability within a basin. The designation status of basins as defined by the State Engineer's orders have been divided into four general categories as shown in Table 3-6.

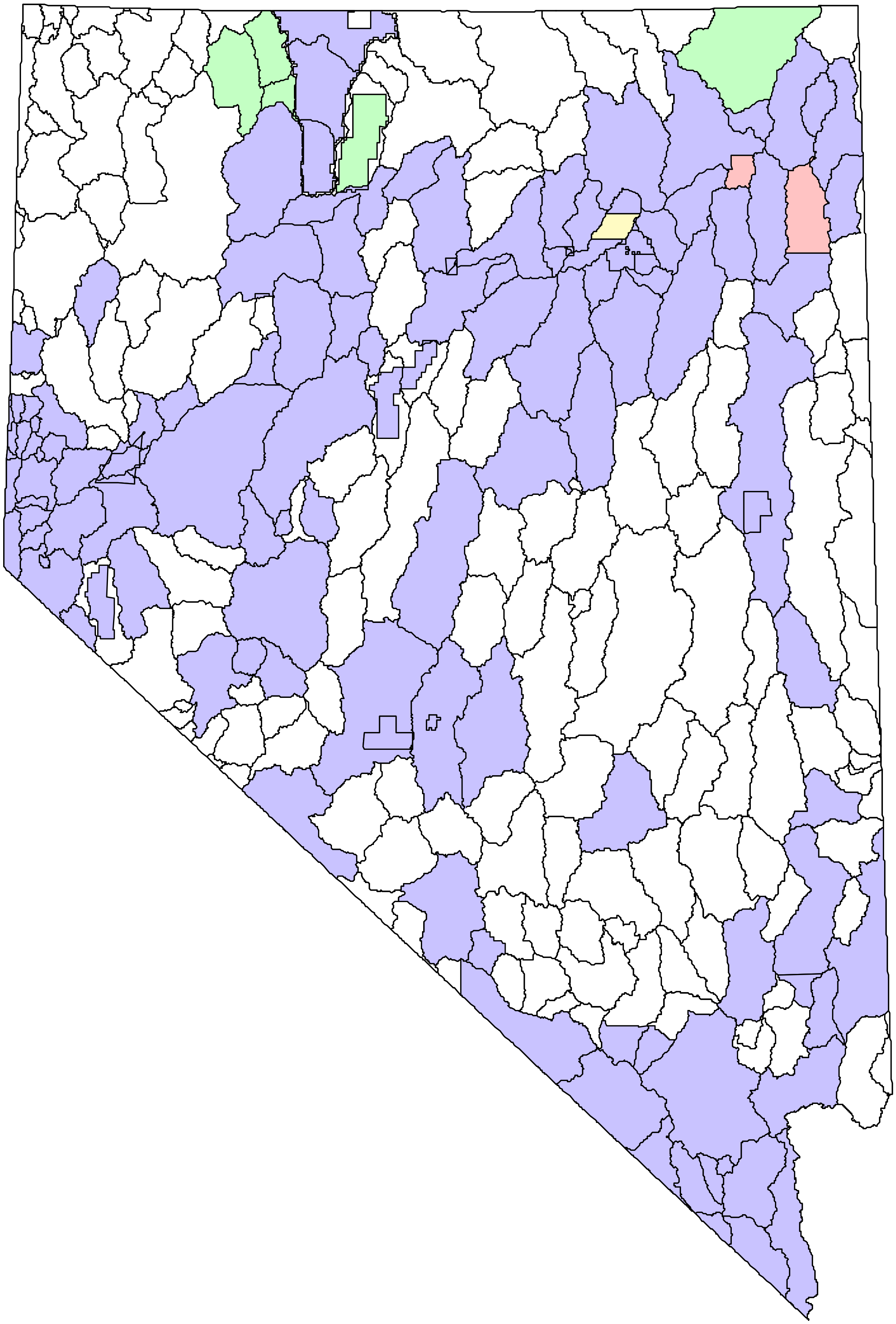


Table 3-6. Designated Groundwater Basin Categories

Designation Status	General Description of Associated State Engineer's Orders
Designated	State Engineer's order(s) do not define any administrative controls.
Designated - Irrigation Denied	State Engineer's order(s) state that irrigation is <u>not</u> a preferred use in these basins and applications for new irrigation appropriations will be denied.
Designated - Preferred Uses	State Engineer's order(s) list certain types of uses as preferred in these basins, and quantity restrictions may be placed on these preferred uses.
Designated - Preferred Uses; Irrigation Denied	State Engineer's order(s) list certain types of uses as preferred in these basins. Quantity restrictions may be placed on these preferred uses. State Engineer's order(s) also state that irrigation is <u>not</u> a preferred use in these basins and applications for new irrigation appropriations will be denied. Other uses may also be listed as denied.

Whether or not a basin is designated dictates the procedures to be followed in obtaining a groundwater permit. In undesignated basins, a person can drill a well in these basins prior to filing an application for a groundwater permit. In designated basins, a groundwater permit must be obtained prior to drilling a well. Domestic wells are exempt from the permitting process, however, drillers are required to notify the State Engineer of their intent to drill a domestic well and submit a well log following completion.

<u>Groundwater Levels.</u> Groundwater levels fluctuate seasonally and annually in response to changes in pumpage and the climate. In some areas, groundwater levels during the late 1980s and early 1990s tended to decline due to heavier than average reliance upon groundwater during the drought of that period, but have been recovering with the return to normal and above-normal precipitation.

<u>Groundwater Quality.</u> The water quality in most aquifers in Nevada is suitable or marginally suitable for most uses, with constituent concentrations not exceeding State and national drinking water standards. However, there are parts of some aquifers with constituent concentrations exceeding these standards. It is important to realize that these excessive concentrations of certain constituents in groundwater may result from natural processes and/or human activities.

The quality of groundwater in the unconsolidated deposits in the Basin and Range alluvial aquifers varies from basin to basin. Dissolved-solids concentrations range from less than 500 parts per million (ppm) to more than 10,000 ppm in some areas. By comparison, ocean water has dissolved-solids concentrations of about 35,000 ppm. Locally, saline water is present near thermal springs and in areas where the basin-fill aquifers include large amounts of soluble salts. In discharge or sink areas such as the Carson and Humboldt sinks, the dissolved-solid concentrations can make the water economically unuseable. Although highly mineralized water is common in aquifers beneath playas, a deeper freshwater flow system may be present in some areas.

Historic and Current Water Use

Comprehensive water use information is critical to the success of all water planning and management functions. The following discussion provides an overview of historic and current water use estimates and discusses observed trends in Nevada's water use.

Estimating Water Use

It has been estimated that 50 to 75 percent of the total water withdrawn from groundwater and surface water sources in Nevada is actually measured, with only a portion of these data reported to any state planning agencies. Therefore in order to develop comprehensive statewide water use figures, it is necessary to generate estimates for many of the values. The most significant water use estimation program in Nevada is implemented by the U.S. Geological Survey (USGS) as part of the USGS National Water Use Information Program.

The USGS has the only program in Nevada responsible for estimating statewide water use on a routine and comprehensive basis. Staff in the USGS's National Water Use Information Program compile and disseminate water use information on local, state and national levels. In developing their estimates, the USGS staff work in cooperation with local, state, and federal agencies.

Since 1950, the USGS has estimated statewide water use at 5-year intervals and published these estimates in a national summary report. It must be stressed that the Nevada water use figures developed by USGS staff are <u>estimates</u> and that the water use values developed are based upon a mixture of measured and estimated water use. To the extent possible, the USGS compiles water use data collected by other agencies, water purveyors, and irrigation districts. Upon review of the USGS estimates, the Division of Water Planning identified some inconsistencies in the data. However, it is difficult to make adjustments to these data because the USGS does not produce a separate state water report documenting data sources and assumptions. Nevertheless, modifications were made by the Nevada Division of Water Planning (NDWP) as feasible to address a portion of these inconsistencies. Clearly a more comprehensive water measurement and/or estimation program is needed to improve water use quantification.

Current Water Use and Past Trends

This section presents statewide water use estimates for the period 1970-1995 at 5-year intervals (Tables 3-7 through 3-10). These estimates are divided into 8 categories of water use:

- public supply
- domestic
- commercial
- industrial
- thermoelectric
- mining
- irrigation
- livestock

Public Supply Water Use. *Public supply* refers to water withdrawn by public and private water suppliers and delivered for a variety of uses such as domestic, commercial, industrial, thermoelectric, and public uses such as park landscape irrigation. Public supply use is also referred to as Municipal and Industrial (M&I) water use. "Public supply systems" are defined as those which provide water to at least 25 people or 15 connections.

As expected, public supply water use has increased as Nevada's population has grown. Public supply withdrawals have increased from approximately 151,000 acre-feet to 525,000 acre-feet from 1970 to 1995. For the same period, the population served by public supply systems increased from about 441,000 to about 1,488,000. From 1970 to 1990, public supply water use rates in Nevada increased from 306 to 334 gallons per capita per day (gpcd). Successful conservation programs during the 1990s have lowered statewide M&I water use down to 315 gpcd by 1995. A majority of this decrease was due to aggressive conservation in the Las Vegas area. For example, M&I use within the Las Vegas Valley Water District decreased from 358 gpcd in 1989 to 320 gpcd in 1997.

Domestic Water Use. *Domestic use* refers to water used for household purposes and includes both indoor and outdoor uses, such as drinking, food preparation, bathing, clothes and dish washing, and lawn and garden watering. Domestic water needs are met by either public supply systems or self-supplied systems (domestic wells, individual pumps, cisterns, etc.).

Domestic water use has increased over the years in response to the growing population. From 1970 to 1995, domestic water use increased from about 117,000 acre-feet to about 361,000 acre-feet. Nevada's population increased from about 488,700 to 1,579,150 during the same period, with the percentage of people served by public supply systems increasing from about 90% to 94% of the total population.

Commercial Water Use. *Commercial use* includes water for casinos, motels, restaurants, office buildings, campgrounds, other commercial facilities, and civilian and military institutions. Commercial water needs are met by either public supply systems (community water systems) or self-supplied systems (non-community systems).

Commercial water use has increased from about 67,000 acre-feet to about 153,000 acre-feet during the period 1985 to 1995. Commercial water use trends cannot be established for previous years. Prior to 1985, the USGS had not provided water use estimates for commercial purposes as a separate category but rather commercial usage was aggregated under other uses.

Industrial Water Use. *Industrial use* includes water for manufacturing and construction. Industrial water needs are met by either public supply systems or self-supplied systems. Total industrial water use changed little during the period 1985 to 1995, ranging from about 14,000 to 19,000 acre-feet per year. Industrial water use trends cannot be established for previous years. Prior to 1985, the USGS did not separate out water use estimates for industrial purposes, rather industrial usage was aggregated with other uses.

Thermoelectric Water Use. *Thermoelectric use* includes water used in the production of electric power generation from fossil fuel and geothermal sources. Nevada has 22 thermoelectric powerplants of which 7 are fossil fueled and 15 are geothermal. Total thermoelectric water use has more than doubled from 1985 to 1995 increasing from about 29,000 acre-feet to 65,000 acre-feet. Over the 10 year period, public supply systems provided a minor portion of the total thermoelectric water used. Usage trends cannot be presented for previous years. Prior to 1985, the USGS did not compile water use estimates for all thermoelectric purposes as a separate category.

Mining Water Use. *Mining use* refers to water used in the extraction, milling, and processing of naturally occurring minerals (including petroleum), and other activities that are part of mining, such as dust control. Minerals mined in Nevada can be divided into two categories, metals and industrial minerals. Metals mined in Nevada include gold, silver, lead, zinc, molybdenum and copper. Mined industrial minerals include aggregate, barite, cement, clay, gypsum, lime, diatomite, lithium carbonate and silica. Water use varies widely from operation to operation and is dependent upon the mineral being recovered and the recovery process employed.

Mining water withdrawals have changed significantly, increasing from about 27,000 acre-feet in 1985 to about 274,000 acre-feet in 1995. A majority of this increase is attributable to an increase in mining activities within the Humboldt River basin. Mining water use trends cannot be established for previous years. Prior to 1985, the USGS did not compile water use estimates for mining as a separate category.

Irrigation Water Use. *Irrigation use* refers to water withdrawn and applied to lands to grow crops and pasture as well as water used to irrigate golf courses and parks. Under this category, water for irrigation is self-supplied or supplied by irrigation companies or districts. Landscape watering included in the other categories, such as public supply, domestic, and commercial, is not included in the *irrigation use* category.

The main field crops grown in Nevada include alfalfa and other hay, alfalfa seed, winter and spring wheat, potatoes, garlic and onions. These crops account for about 70% of the total irrigated acreage. In addition to harvested field crops, about 30% of the irrigated acreage in Nevada is pasture.

USGS estimates (with 1995 Division of Water Planning modifications) show that irrigated acreage and water use decreased during the period 1970 to 1995. Withdrawals have decreased from about 3.4 million acre-feet in 1970 to about 3.1 million acre-feet in 1995. Due to the uncertainty with the data, it is unknown if this decrease is indicative of any statewide trend or is merely an artifact of the estimation process.

Livestock Water Use. *Livestock use* refers to water used for stock watering, feed lots, dairy operations, and other on-farm needs. Cattle are the major livestock raised in Nevada with most grazed on open range. Other livestock include sheep, horses and hogs. USGS estimates for 1970-95 shows wide fluctuations in statewide livestock water use. The variations in the data may be the result of inconsistent estimation techniques from year to year. As a result, these data may not be suitable as a basis for evaluating past water use trends. The *Nevada Agricultural Statistics* reports are an alternative data source for examining livestock trends includes. According to the *Nevada*

Agricultural Statistics, during the 1970 to 1995 period there was a general decline in the number of head of cattle, sheep and hogs from about 850,000 to about 600,000.

Water Use Summary. Statewide water use for the period 1970 to 1995 is summarized in Tables 3-7 through 3-10. Over the last 20 years, statewide water withdrawals in Nevada have been about 4 million acre-feet per year, with a little under 2 million acre-feet consumptively used. In 1995, about 60 percent of the withdrawals were from surface water sources (Tables 3-8 and 3-10). Irrigation has historically been the largest water use in Nevada varying from about 80 percent to 90 percent of the total statewide water withdrawals and consumptive use. Variations in irrigation water use are primarily the result of Nevada's variable weather and streamflow conditions. Irrigation accounted for about 77 percent of the state withdrawals in 1995 (Figure 3-8).

The total statewide water use has changed little since 1970 but with some significant changes within certain use sectors. The most significant changes have occurred with "Public Supply" and "Mining" water uses. Public supply water use has more than tripled since 1970 in response to Nevada's ever increasing population. Mining water use has experienced a significant increase since 1985 mostly as a result of increased mining activity in the Humboldt River basin.

Fig. 3-8. 1995 Statewide Water Withdrawals by Public Supply and Self-Supplied Uses

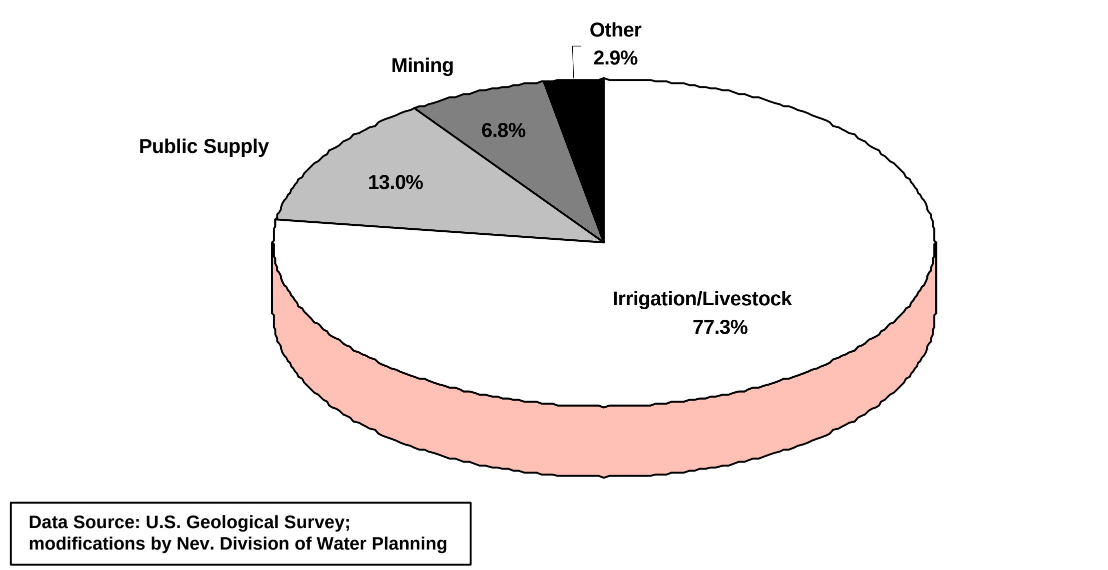


Table 3-7. Summary of Estimated Statewide Water Use (1970-95) Grouped by Public Supply and Self-Supplied Uses (in acre-feet)

Water Use Category		1970	1975	1980	1985	1990	1995
Public Supply							
Domestic	Withdrawals	106,400	134,400	168,000	211,900	266,900	342,600
	Consumptive Use	43,000	49,000	65,000	107,100	133,400	171,000
Commercial [1]	Withdrawals				60,300	100,200	129,700
	Consumptive Use				12,100	18,400	23,300
Industrial [1]	Withdrawals	44,800	58,300	93,000	7,100	2,900	2,500
	Consumptive Use	8,500	9,200	12,300	1,400	600	500
Thermoelectric [1]	Withdrawals				2,700	900	1,600
	Consumptive Use				2,700	900	1,600
Public Uses and Losses [1]	Withdrawals	Included in "Public Supply - Domestic" Category			40,100	60,400	48,500
	Consumptive Use				0	0	0
Total Public Supply	Withdrawals	151,200	192,700	261,000	322,100	431,300	524,900
	Consumptive Use	51,500	58,200	77,300	123,400	153,300	196,400
Self-Supplied							
Domestic	Withdrawals	10,200	13,400	16,500	19,700	16,700	18,100
	Consumptive Use	5,100	6,700	8,300	10,100	8,400	9,000
Commercial [1]	Withdrawals				8,300	25,400	23,500
	Consumptive Use				1,700	3,600	3,200
Industrial [1]	Withdrawals				11,400	11,400	16,800
	Consumptive Use	150,000	260,000	270,000	2,100	2,200	5,000
Thermoelectric [1]	Withdrawals	55,000	80,000	95,000	26,300	74,000	63,800
	Consumptive Use				23,700	49,300	39,400
Mining [1]	Withdrawals				27,300	120,100	274,400
	Consumptive Use				22,500	67,900	89,200
Irrigation	Withdrawals	3,400,000	3,500,000	3,500,000	3,750,000	3,160,700	3,113,600
	Consumptive Use	1,600,000	1,700,000	1,700,000	1,934,000	1,633,800	1,612,100
Livestock	Withdrawals	4,900	13,400	13,400	29,100	6,300	6,300
	Consumptive Use	2,400	9,900	10,000	7,400	2,300	2,300
Total							
	Withdrawals	3,716,300	3,979,500	4,060,900	4,194,100	3,846,000	4,041,400
	Consumptive Use	1,714,000	1,854,800	1,890,600	2,124,800	1,920,800	1,956,600

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning

Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.

[1] Individual estimates were not available for 1970-80

Table 3-8. Estimated 1995 Statewide Groundwater and Surface Water Withdrawals for Public Supply and Self-Supplied Uses (in acre-feet)

Category	Source	Amount
Public Supply		
Total Public Supply	Groundwater	132,000
	Surface water	392,900
	Total	524,900
Self-Supplied		
Domestic	Groundwater	17,800
	Surface water	300
	Total	18,100
Commercial	Groundwater	7,900
	Surface water	15,600
	Total	23,500
Industrial	Groundwater	8,300
	Surface water	8,400
	Total	16,700
Thermoelectric	Groundwater	40,700
	Surface water	23,200
	Total	63,900
Mining	Groundwater	270,500
	Surface water	3,900
	Total	274,400
Irrigation	Groundwater	1,138,200
	Surface water	1,975,400
	Total	3,113,600
Livestock	Groundwater	1,100
	Surface water	5,200
	Total	6,300
Total		
Statewide Total	Groundwater	1,616,500
	Surface water	2,424,900
	Total	4,041,400

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning

Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.

Table 3-9. Summary of Estimated Statewide Water Use (1970-95) Grouped by Type of Use (in acre-feet)

<table>
<tr><th colspan="2">Water Use Category</th><th>1970</th><th>1975</th><th>1980</th><th>1985</th><th>1990</th><th>1995</th></tr>
<tr><td rowspan="2">Domestic</td><td>Withdrawals</td><td>116,600</td><td>147,800</td><td>184,500</td><td>231,600</td><td>283,600</td><td>360,700</td></tr>
<tr><td>Consumptive Use</td><td>48,100</td><td>55,700</td><td>73,300</td><td>117,200</td><td>141,800</td><td>180,000</td></tr>
<tr><td rowspan="2">Commercial [1]</td><td>Withdrawals</td><td rowspan="8">194,800
63,500</td><td rowspan="8">318,300
89,200</td><td rowspan="8">363,000
107,300</td><td>68,600</td><td>125,600</td><td>153,200</td></tr>
<tr><td>Consumptive Use</td><td>13,800</td><td>22,000</td><td>26,500</td></tr>
<tr><td rowspan="2">Industrial [1]</td><td>Withdrawals</td><td>18,400</td><td>14,400</td><td>19,200</td></tr>
<tr><td>Consumptive Use</td><td>3,600</td><td>2,800</td><td>5,500</td></tr>
<tr><td rowspan="2">Thermoelectric [1]</td><td>Withdrawals</td><td>29,000</td><td>74,900</td><td>65,400</td></tr>
<tr><td>Consumptive Use</td><td>26,400</td><td>50,200</td><td>41,100</td></tr>
<tr><td rowspan="2">Mining [1]</td><td>Withdrawals</td><td>27,300</td><td>120,100</td><td>274,400</td></tr>
<tr><td>Consumptive Use</td><td>22,500</td><td>67,900</td><td>89,200</td></tr>
<tr><td rowspan="2">Irrigation</td><td>Withdrawals</td><td>3,400,000</td><td>3,500,000</td><td>3,500,000</td><td>3,750,000</td><td>3,160,700</td><td>3,113,600</td></tr>
<tr><td>Consumptive Use</td><td>1,600,000</td><td>1,700,000</td><td>1,700,000</td><td>1,934,000</td><td>1,633,800</td><td>1,612,100</td></tr>
<tr><td rowspan="2">Livestock</td><td>Withdrawals</td><td>4,900</td><td>13,400</td><td>13,400</td><td>29,100</td><td>6,300</td><td>6,300</td></tr>
<tr><td>Consumptive Use</td><td>2,400</td><td>9,900</td><td>10,000</td><td>7,400</td><td>2,300</td><td>2,300</td></tr>
<tr><td rowspan="2">Public Supply - Public Uses and Losses</td><td>Withdrawals</td><td colspan="3" rowspan="2">Included in "Domestic" Category</td><td>40,100</td><td>60,400</td><td>48,500</td></tr>
<tr><td>Consumptive Use</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td rowspan="2">Total</td><td>Withdrawals</td><td>3,716,300</td><td>3,979,500</td><td>4,060,900</td><td>4,194,100</td><td>3,846,000</td><td>4,041,400</td></tr>
<tr><td>Consumptive Use</td><td>1,714,000</td><td>1,854,800</td><td>1,890,600</td><td>2,124,800</td><td>1,920,800</td><td>1,956,600</td></tr>
</table>

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning
Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.
[1] Individual estimates were not available for 1970-80.

Table 3-10. Estimated 1995 Statewide Groundwater and Surface Water Withdrawals for Use Types

Category	Source	Amount
Domestic (self-supplied & public supplied)	Groundwater	104,100
	Surface water	256,700
	Total	360,800
Commercial (self-supplied & public supplied)	Groundwater	40,600
	Surface water	112,600
	Total	153,200
Industrial (self-supplied & public supplied)	Groundwater	8,900
	Surface water	10,300
	Total	19,200
Thermoelectric (self-supplied & public supplied)	Groundwater	41,100
	Surface water	24,400
	Total	65,500
Mining	Groundwater	270,500
	Surface water	3,900
	Total	274,400
Irrigation	Groundwater	1,138,200
	Surface water	1,975,400
	Total	3,113,600
Livestock	Groundwater	1,100
	Surface water	5,200
	Total	6,300
Public Supply - Public Uses and Losses	Groundwater	12,200
	Surface water	36,300
	Total	48,500
Total	Groundwater	1,616,700
	Surface water	2,424,800
	Total	4,041,500

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning
Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.

Nevada State Water Plan
SUMMARY

Section 4
Socioeconomic Assessment and Forecasts

Introduction

This section of the Summary of the *Nevada State Water Plan* presents population and economic trends and forecasts for the Nevada economy to develop a basis for statewide water demand projections. The socioeconomic forecasts, particularly as they relate to population and employment, are used to predict state and county future water needs over a planning horizon extending through the year 2020. Population forecasts for each county and the total state are contained in Appendix 2 of the Appendices of the water plan. Appendix 3 of the Appendices presents state and county employment forecasts, which are derived from population forecasts through estimated employment-to-population ratios. Forecasts for irrigated acreage, which drive the irrigation and livestock water withdrawals, are presented in Appendix 4 of the Appendices.

Population Trends and Forecasts

Over the planning horizon, the rate of growth in Nevada's population is expected to slow, but the state's population is expected to continue to become increasingly concentrated in the primary urban areas of Las Vegas (Clark County), Reno/Sparks (Washoe County) and Carson City. The growth in population in these three principal geographic areas will have varied spillover effects on neighboring counties, such as Nye County for Clark County (Las Vegas) and Churchill, Douglas, Lyon, and Storey counties for Washoe County (Reno) and Carson City. Population forecasts incorporated into this water plan for Clark and Washoe counties were provided by the Clark County Department of Comprehensive Planning and the Washoe County Department of Community Development, respectively. The population forecasts for Washoe County were modified slightly by the Nevada Division of Water Planning (NDWP) to better smooth the intervening period forecasts, matching Washoe County's population forecast for the year 2020. Other county population forecasts developed by the NDWP were based on an extension and general moderation of recent historical growth trends. Also incorporated in the state and county population forecasts are estimates of commercial and industrial development and employment forecasts based on inputs provided by the Nevada Department of Employment, Training and Rehabilitation (DETR).

Table 4–1. Nevada Population Analysis, presents historical populations and population shares (in terms of county percent shares of the total state's population) for Nevada and its seventeen counties for selected years from 1950 to 1997. This table shows that in 1997, Nevada's total resident population was estimated to be 1,779,850 persons, up 1,618,705 persons since 1950.

Table 4–1. Nevada Population Analysis — 1950–1997

Shares Based on Percent of Total State Population (Persons/Percent of Total State)

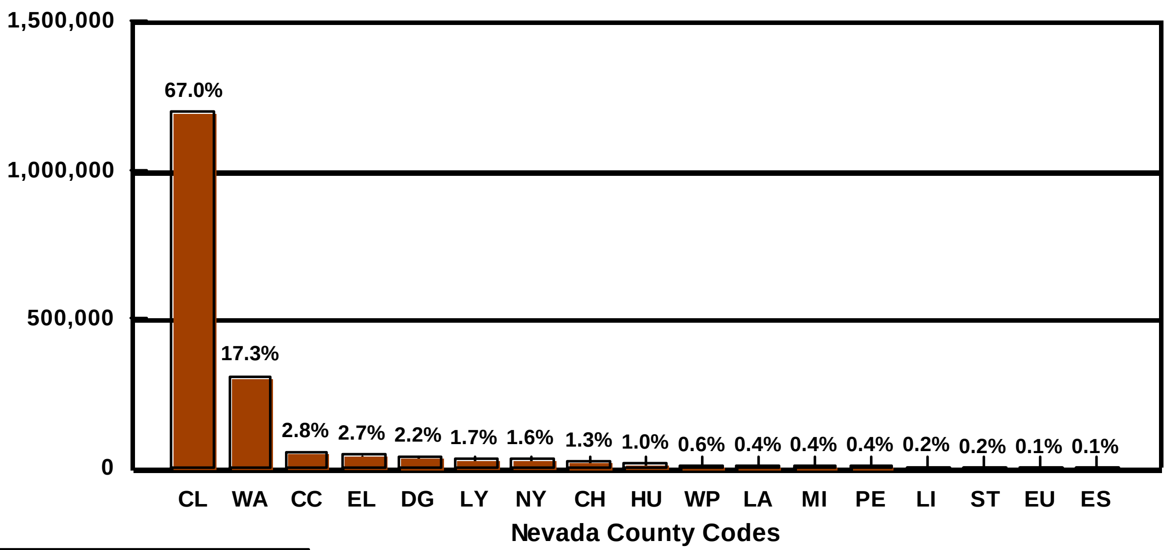
State/County	1950	1960	1970	1980	1990	1997
NEVADA	**161,145**	**287,660**	**494,990**	**800,508**	**1,236,130**	**1,779,850**
Carson City	4,198	8,020	16,054	32,022	40,950	50,410
Statewide Share	2.61%	2.79%	3.24%	4.00%	3.31%	2.83%
Churchill County	6,188	8,505	10,650	13,917	18,100	23,860
Statewide Share	3.84%	2.96%	2.15%	1.74%	1.46%	1.34%
Clark County	48,811	128,734	277,230	463,087	770,280	1,192,200
Statewide Share	30.29%	44.75%	56.01%	57.85%	62.31%	66.98%
Douglas County	2,023	3,575	7,067	19,421	28,070	39,590
Statewide Share	1.26%	1.24%	1.43%	2.43%	2.27%	2.22%
Elko County	11,703	12,051	13,946	17,269	33,770	47,710
Statewide Share	7.26%	4.19%	2.82%	2.16%	2.73%	2.68%
Esmeralda County	611	634	623	777	1,350	1,460
Statewide Share	0.38%	0.22%	0.13%	0.10%	0.11%	0.08%
Eureka County	897	775	938	1,198	1,550	1,660
Statewide Share	0.56%	0.27%	0.19%	0.15%	0.13%	0.09%
Humboldt County	4,870	5,723	6,380	9,449	13,020	17,520
Statewide Share	3.02%	1.99%	1.29%	1.18%	1.05%	0.98%
Lander County	1,860	1,580	2,653	4,076	6,340	7,030
Statewide Share	1.15%	0.55%	0.54%	0.51%	0.51%	0.39%
Lincoln County	3,850	2,378	2,526	3,732	3,810	4,110
Statewide Share	2.39%	0.83%	0.51%	0.47%	0.31%	0.23%
Lyon County	3,703	6,245	8,437	13,594	20,590	30,370
Statewide Share	2.30%	2.17%	1.70%	1.70%	1.67%	1.71%
Mineral County	5,588	6,329	6,961	6,217	6,470	6,860
Statewide Share	3.47%	2.20%	1.41%	0.78%	0.52%	0.39%
Nye County	3,101	4,642	5,459	9,048	18,190	27,610
Statewide Share	1.92%	1.61%	1.10%	1.13%	1.47%	1.55%
Pershing County	3,122	3,178	2,656	3,408	4,550	6,600
Statewide Share	1.94%	1.10%	0.54%	0.43%	0.37%	0.37%
Storey County	657	571	696	1,503	2,560	3,520
Statewide Share	0.41%	0.20%	0.14%	0.19%	0.21%	0.20%
Washoe County	50,484	84,988	122,574	193,623	257,120	308,700
Statewide Share	31.33%	29.54%	24.76%	24.19%	20.80%	17.34%
White Pine County	9,479	9,732	10,140	8,167	9,410	10,640
Statewide Share	5.88%	3.38%	2.05%	1.02%	0.76%	0.60%

Source Data: Nevada State Demographer.

Clark County's total resident population was estimated at 1,192,200 persons in 1997 and accounted for 67.0 percent of the state's total population. This represented an increase of 36.7 percentage points in Clark County's share of the state's total population since 1950. Washoe County's population was estimated at 308,700 persons in 1997, accounting for 17.3 percent of Nevada's total population, a decline of 14.0 percentage points in its share of statewide population since 1950. Carson City's 1997 population of 50,410 persons comprised 2.8 percent of the state's total population, an increase of just over 0.2 percentage point in its population share since 1950. Together, these three Nevada urban areas accounted for 87.2 percent of the state's total population in 1997. Elko County, representing the other principal population center in Nevada, had an estimated 1997 population of 47,710 persons, accounting for 2.7 percent of the state's population and representing a decline of 4.6 percent points in state population share since 1950.

Fig. 4-1. Nevada Population Shares by County

Population Estimates and Shares as of July 1, 1997 (Persons/Percent)



Source: Nevada State Demographer.

With the exception of Carson City and Clark and Douglas counties, every county in Nevada, while growing in terms of its total resident population, has actually declined in terms of its share of statewide population between 1950 and 1997. Douglas County's population trends have been strongly influenced by the county's increasing status as a "bedroom" community for neighboring Carson City, and thus Carson City and Douglas County tend to act as an integrated economic unit. These two counties have shown a slight increase in their joint population share from 3.9 percent of statewide population in 1950 to 5.1 percent in 1997. Unique population trends exist for other Nevada counties as well. For example, rapid population growth in Elko County has been due in large part to the mining industry. Between 1950 and 1970, Elko County's population grew by only 2,243 persons. However, over the next 27 years its population increased by nearly 30,000 persons.

Much of this growth was due to mining, both in Elko County and neighboring Eureka County. Lyon County represents another county where growth in neighboring Carson City, primarily, has affected its population growth. Similarly, recent rapid growth in Nye County has been primarily centered in the southern part of the county at Pahrump, which has been strongly influenced by rapid growth in nearby Las Vegas.

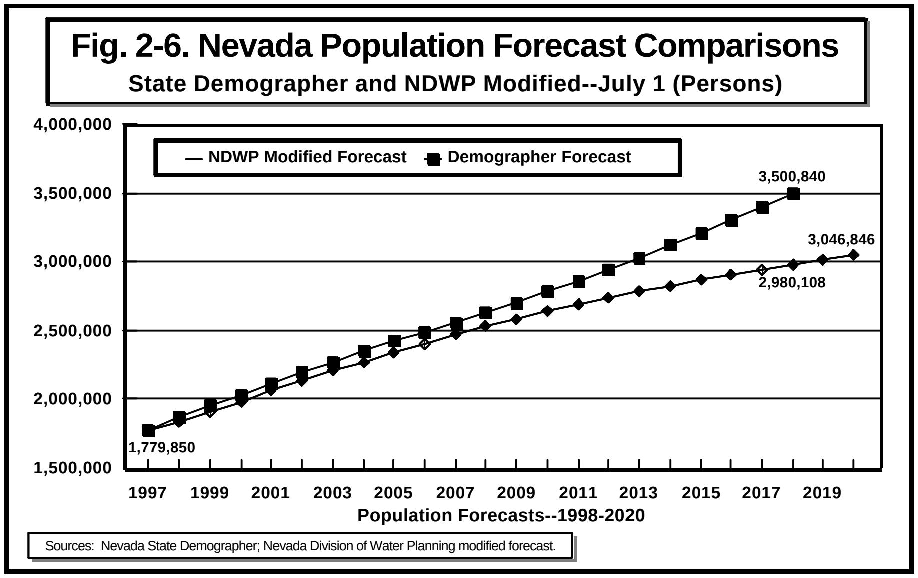


Fig. 2-6. Nevada Population Forecast Comparisons
State Demographer and NDWP Modified--July 1 (Persons)

Two separate population forecasts are presented in the state water plan. Every year the Nevada State Demographer estimates the current population and, following this estimation process, produces a twenty-year population forecast for all counties and the total state. All state agencies are required by the Governor's Executive Order to utilize the population forecasts of the State Demographer in their budgeting and planning activities. Under an agreement with the state's population contracting agency, the Nevada Department of Taxation, the NDWP has developed an alternate set of county and state population forecasts based on inputs received from the individual counties, inputs from the Nevada Department of Employment, Training and Rehabilitation (DETR), and from the NDWP's own best forecast scenarios. These alternate forecasts are used as a basis for projecting municipal and industrial, domestic and commercial and industrial water uses.

Overall, the NDWP's statewide population forecast predicts a more moderate population growth than that of the State Demographer. The reason for this is that Nevada's total population is largely influenced by the trends in Clark County, which currently accounts for over two-thirds of the state's total population. Based on infrastructure requirements and current

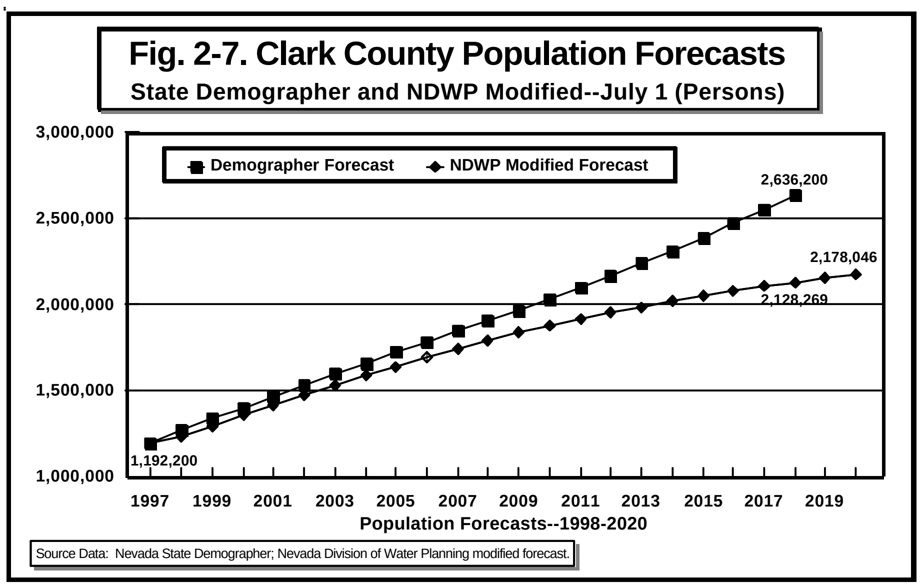


Fig. 2-7. Clark County Population Forecasts
State Demographer and NDWP Modified--July 1 (Persons)

resource limitations, local planners in Clark County expect slower growth over the plan's forecast horizon than does the State Demographer. The State Water Plan incorporates both sets of population forecasts, as shown in Table 4–2. Nevada Population Forecast Comparisons to present an anticipated "range of expected growth." However, only the NDWP's forecasts are incorporated into the water plan's future water withdrawal projections. A complete set of population forecasts and related graphical analysis for each county is presented in Appendix 2 of the Appendices. This appendix also contains a comparative analysis of population forecasts for all individual counties.

Table 4–2. Nevada Population Forecast Comparisons

Nevada State Demographer and Nevada Division of Water Planning (NDWP)

Nevada Forecasts by Source	2000	2005	2010	2015	2018	2020
State Demographer						
Resident Population (persons)	2,034,020	2,421,020	2,783,700	3,313,260	3,500,840	n.a.
Nevada Division of Water Planning						
Resident Population (persons)	1,986,257	2,341,374	2,640,306	2,868,979	2,980,108	3,046,846
Difference (persons)	47,763	79,646	143,394	343,281	520,732	–
Percent Difference	2.4%	3.3%	5.2%	10.7%	14.9%	–

Note: The population forecasts of the State Demographer currently extend only through the year 2018. The "Difference" row in the table represents the difference between the forecasts of the State Demographer and NDWP. NDWP population forecasts for Clark and Washoe counties are based on population forecast inputs from those counties.
Source Data: Nevada State Demographer; Nevada Division of Water Planning (NDWP).

The Nevada State Demographer has forecast a total resident population for Nevada for the year 2018 of 3,500,840 persons, primarily based on a continuation of the more recent virtual exponential growth in Las Vegas (Clark County). The State Demographer's forecast represents an overall increase in statewide population of 1,720,990 persons between 1997 and 2018, a near doubling of Nevada's population over the next 20 years. The State Demographer's forecast scenario results in an average annual rate of growth of statewide population of 3.3 percent per year for the overall forecast period of 1998 to 2018, with a sub-period average annual rate of growth of 3.6 percent between 1998 and 2008 and 2.9 percent between 2008 and 2018. The State

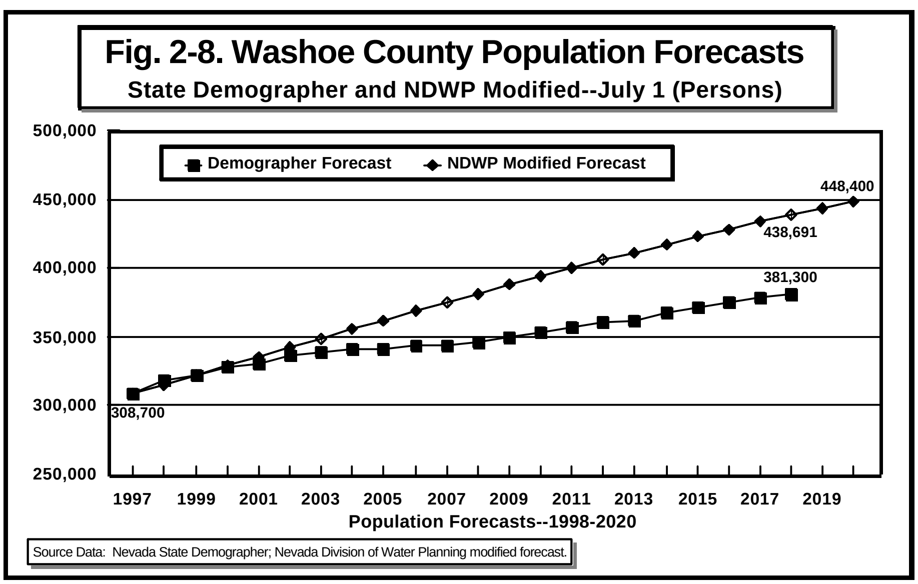


Fig. 2-8. Washoe County Population Forecasts
State Demographer and NDWP Modified--July 1 (Persons)

Demographer's forecasted population for the year 2018 is approximately 15 percent higher than that of the NDWP.

The NDWP forecast scenario, based primarily on the expectation of slower population growth in Clark County, assumes a 2.5 percent overall annual rate of population growth for Nevada between the years 1998 and 2018, with sub-period average annual rates of 3.2 percent per year for 1998 through 2008 and 1.6 percent per year for 2008 through 2018. Based on this "range" of population forecasts developed independently by the State Demographer and the NDWP, Nevada is projected to grow at a rate of between 2.5–3.3 percent per year through 2018 at which time the population is expected to be between 3.0 and 3.5 million persons. Table 4–3. Nevada Population Forecast Summary, 1997–2020, presents a summary of the population forecasts made by the NDWP for those Nevada counties expected to equal or exceed a total resident population of 50,000 persons by the year 2020. Complete population estimates, forecasts and analysis for all Nevada's counties may be found in the Appendices, Appendix 2.

Table 4–3. NDWP Nevada Population Forecast Summary

Population Forecasts and Shares for Larger Nevada Counties — 1997–2020

(For counties expected to exceed 50,000 persons by the year 2020)

State/County	1997	2000	2005	2010	2015	2020
Nevada						
Resident Population (persons)	**1,779,850**	**1,986,257**	**2,341,374**	**2,640,306**	**2,868,979**	**3,046,846**
Carson City						
Resident Population (persons)	50,410	54,445	60,703	66,041	70,099	72,587
Percent of Total State	2.83%	2.74%	2.59%	2.50%	2.44%	2.38%
Clark County (Las Vegas)						
Resident Population (persons)	1,192,200	1,355,368	1,640,444	1,874,431	2,046,229	2,178,046
Percent of Total State	66.98%	68.24%	70.06%	70.99%	71.32%	71.49%
Douglas County						
Resident Population (persons)	39,590	42,834	48,180	53,272	57,900	61,854
Percent of Total State	2.22%	2.16%	2.06%	2.02%	2.02%	2.03%
Elko County						
Resident Population (persons)	47,710	51,665	57,857	63,224	67,408	70,113
Percent of Total State	2.68%	2.60%	2.47%	2.39%	2.35%	2.30%
Lyon County						
Resident Population (persons)	30,370	33,721	39,377	44,878	49,914	54,170
Percent of Total State	1.71%	1.70%	1.68%	1.70%	1.74%	1.78%
Washoe County (Reno)						
Resident Population (persons)	308,700	329,021	362,260	393,884	422,917	448,400
Percent of Total State	17.34%	16.56%	15.47%	14.92%	14.74%	14.72%

Note: Counties included are only those that are forecast to equal or exceed a resident population of 50,000 persons by the end of the forecast period (2020).
Source Data: Nevada State Demographer (1997 estimate); Nevada Division of Water Planning (2000–2020 forecasts).

Economic Trends and Forecasts

In the following analysis, principal sectors of the Nevada economy are reviewed in terms of recent trends and their probable effects on Nevada's and individual counties' future growth patterns. These primary economic sectors include gaming, which is the principal driving economic force in both Clark and Washoe counties, mining, which impacts a number of more rural counties including Elko, Eureka, Lander, Humboldt, Pershing and Nye, and agriculture, which affects a number of counties including principally Elko, Humboldt, Pershing, Douglas, Churchill and Lyon.

Gaming. Casino gaming and tourism in Nevada represents the primary "driving" economic force most affecting the state's overall population trends. While growth in tourism visitation and gaming win (revenues) has slowed over the last several years in the state's principal northern Nevada casino gaming markets of Reno-Sparks (Washoe County) and South Lake Tahoe (Douglas County), this trend has been more than off-set by high rates of growth in the southern Nevada gaming market of Las Vegas (Clark County), and specifically by trends within the Las Vegas Strip gaming sub-market. The introduction of the mega-resort complex among the Las Vegas Strip gaming properties beginning in late 1989 established a trend of rapid casino and support industry employment growth, population expansion, and gaming win growth that characterized this market throughout the 1990's. The mega-resort casino complex, with individual property employment frequently exceeding 5,000-6,000 workers (Mirage Resorts' Bellagio Resort opened in October 1998 with over 9,300 employees), had significant impacts on population growth, support service businesses, infrastructure requirements, and particularly water demands. Further, new resort complexes opening in this market through 1999 and into 2000 will extend these trends into the next century.

In contrast to the relatively strong growth expected to continue in the near term for Clark County, the Washoe County and Carson City areas, and in fact much of northern Nevada, are beginning to see significantly slower growth due to more intense competition in the gaming and tourism industry. Based on the growth in legalized gaming in other jurisdictions, especially the rise of Indian gambling on reservation lands, particularly in California and the Pacific Northwest, it is reasonable to expect a continued slowdown in the growth of gaming and tourism throughout Nevada from approximately the year 2005 onward.

The November 1998 passage of "Proposition 5", which legalized certain slot devices in Indian reservation casinos in California, is destined to have profound impacts on gaming in that state. While a constitutional challenge to this proposition has already been filed, the California voters appear to have changed their attitude towards some form of legalized casino gaming in the state and further moves in this direction may be reasonably expected. Furthermore, in January 1999, the governor of California withdrew the state's participation in any constitutional challenge to Proposition 5 and expressed the state's desire to begin negotiations on Indian gaming compacts.

While many of Nevada's tourism and gaming attractions, both man-made and natural, continue to be unrivaled in competitive markets, studies have shown that proximity has an important influence over player patronage. As a result, Nevada's casino gaming industry will have to work especially hard to compete effectively with developing gaming markets located closer to population centers throughout the U.S. The anticipated slowing in the growth in Nevada's gaming industry, however, is not expected to be uniform and will be greater in those gaming markets which do not offer features of a distinctive nature to lure consumers from more proximate gaming venues.

Mining. While gaming and tourism have had significant impacts on growth in Clark and Washoe counties, mining has had major influences on many of the rural counties' population and employment growth, demographic trends, and economic development. Since 1989, gold mining in Nevada has made a major contribution to a number of rural counties' economic growth, most especially Elko, Eureka, Humboldt, Lander, Nye, and Pershing counties. However, more recently this industry has come under growing economic and financial stress. Beginning in late 1997 and extending into 1998, due primarily to European monetary reform and Asian economic and financial problems, gold prices realized by Nevada mines have slipped dramatically. The average price of gold fell from $387.87 per (troy) ounce in 1996 to $331.29 per ounce in 1997, and by mid-1998 the price received by Nevada's mining interests was well below $300 per ounce. By late 1998, gold's price had rebounded somewhat to "around" $300 an ounce. Some of this price decline has, for the time being, been mitigated through the mining industry's use of "forward" contracts wherein the mining companies have locked in to committed prices for future gold sales.

Over the plan's forecast period, international economic and financial conditions are expected to continue to affect the nature and structure of mining operations in Nevada, thereby influencing the demographic and economic growth prospects of the rural, mining-dependent Nevada counties. Over the long-term, however, conditions within the mining industry are expected to stabilize at a price of $280–$350 per ounce for gold, which has become incorporated into the levels of forecast production for the industry and particularly the amount of economically recoverable reserves.

Agriculture. Agriculture represents one of Nevada's oldest and most lasting economic activities. Since the first settlements were established in the 1850's, agriculture in Nevada has continued to survive and even prosper. Today, agriculture remains a fundamental socioeconomic underpinning for a number of rural Nevada counties and, no doubt, will remain an integral part of these counties' economies irrespective of trends in other economic sectors. While on the whole agriculture may appear to have only a slight impact on Nevada's overall economic trends, the importance of agriculture for a number of rural counties cannot be overstated.

In viewing the individual county agricultural-related figures (which are presented in the Appendices, Appendix 4), particularly with respect to the amount of irrigated acreage, wide fluctuations appear typical in the estimated levels of irrigated acreage. Such fluctuations tend to indicate both highly volatile irrigation and crop production cycles based on variations in water availability and basic problems in reporting and gathering accurate data on this industry sector.

The volatility in historical measures of this industry, particularly with respect to irrigated acreage, makes forecasting irrigation and livestock water use especially difficult. However, there does appear to be a trend towards no increase in agricultural lands being brought under cultivation. In fact, some counties, Carson City, Churchill, Douglas, and Washoe in particular, it appears that encroaching urbanization and the transfer of water rights from irrigation to M&I uses is causing the level of irrigated lands to decline. Given new and growing demands for limited water resources in the state, particularly for municipal and industrial use, wildlife protection and fishery restoration, instream flows and recreation, the future amount of irrigated acreage is uncertain.

Figure 4–5. Nevada Estimated and Forecasted Irrigated Acreage, shows both estimates of historical irrigated acreage since 1945 and the Division of Water Planning's forecasts for Nevada's total irrigated acreage through the year 2020 based on individual county forecasts which are aggregated to the statewide total. Detailed forecasts for all counties and the total state appear in the Appendices, Appendix 4. Forecasts were based on the approximation of a non-linear "best fit" line which tracked

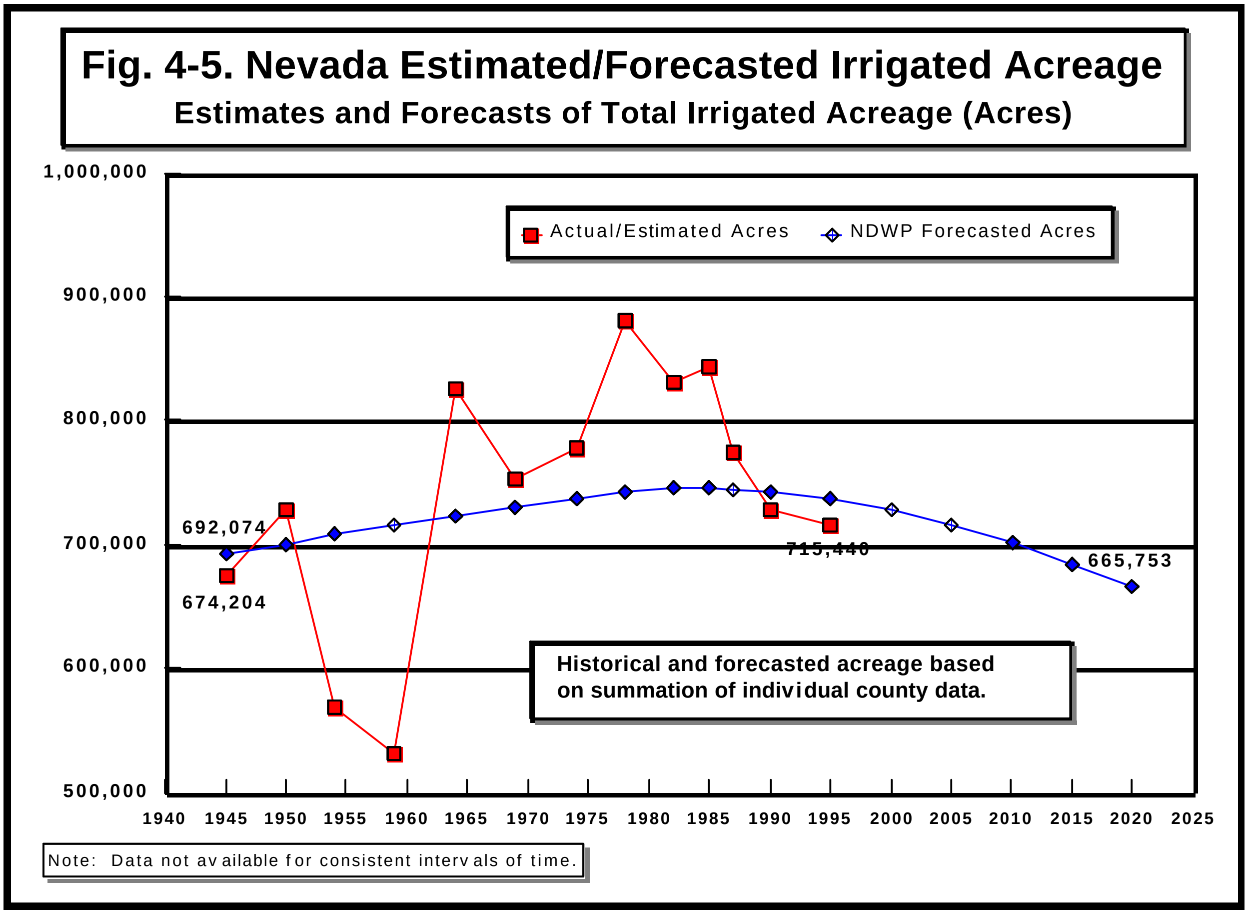


Fig. 4-5. Nevada Estimated/Forecasted Irrigated Acreage
Estimates and Forecasts of Total Irrigated Acreage (Acres)

individual county historical trends and then was extrapolated (extended) out to the year 2020 based upon estimates of agricultural trends and other factors such urban encroachment.

Employment Trends and Forecasts

Employment trends and forecasts constitute an important underpinning to understanding and forecasting water withdrawals by Nevada's businesses and industry. Employment-to-population ratios, which measure the ratio of total employment to total resident population, are crucial in forecasting future employment levels from a county's resident population. This analysis, and related statistical tests of confidence which gauge the suitability of this methodology, are presented in the Appendices for each county and aggregated for the total state (Appendix 3). Forecasts of county total employment, when combined with estimated historical commercial and industrial water use factors (gallons per worker per day), are used to forecast each county's commercial and industrial water withdrawals and, through aggregation, these same water withdrawals for the total state.

Omitting the effects of national economic recessions, Nevada's ratio of its total covered employment (i.e., employment covered under state and federal unemployment insurance programs) to its total resident population has tended to be relatively stable over time. For the period of 1980-1997, Nevada's overall employment-to-population ratio has averaged 48.2 percent. Omitting recessionary periods (i.e., 1980-82 and 1990-91), the statewide average employment-to-population ratio has tended to be closer to 50 percent. Nevada's relatively high employment-to-population ratio is typical of an economy that is being driven primarily by commercial (casino) expansion and related strong employment growth. Also evident from an analysis of these trends is that Nevada's employment-to-population ratio has shown marked sensitivity to national business cycle fluctuations, notably the national recessionary periods of 1980-82 and 1990-91. While this point needs to be recognized, forecasts of future recessions are not explicitly incorporated in the forecasts of future employment.

Table 4–4. Nevada Population and Employment Forecasts, shows historical and forecasted population, employment and employment-to-population ratios for Nevada for selected years from 1997 through 2020. A more extensive presentation of this information for the total state and all Nevada counties for all years from 1980 through 2020 can be found in the Appendices, Appendix 3. The information and forecasts in this appendix were based on historical levels and omit possible effects of future national and local recessions.

Table 4–4. Nevada Population and Employment Forecasts

Population/Employment Estimates — 1997, NDWP Forecasts — 2000–2020

(Annual Averages — Persons and Workers)

NEVADA	1997	2000	2005	2010	2015	2020	1997-2020 Change	1997-2020 Percent Change*
Population	1,779,850	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846	1,266,996	71.2%
Employment	888,574	987,950	1,162,764	1,310,176	1,423,256	1,511,617	623,043	70.1%
Employment-to-Population Ratio	49.9%	49.9%	49.8%	49.7%	49.7%	49.7%	–	-0.20%

Note: Changes to the employment-to-population ratios over time are measured in percentage points. The Nevada figure is based on the aggregation of individual county estimates (1997) and forecasts (2000–2020) and was not forecasted independently.

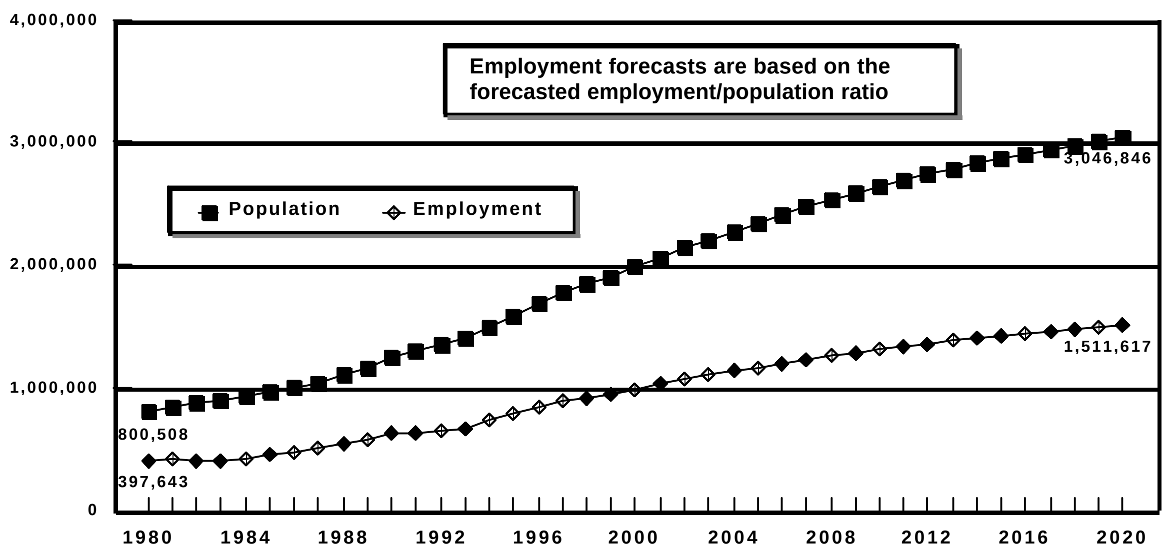
Source Data: Population estimates (1997) – Nevada State Demographer; Employment estimates (1997) – Department of Employment, Training and Rehabilitation (DETR); Population and employment forecasts (2000–2020) – Nevada Division of Water Planning (NDWP). Population forecasts incorporated into the Nevada total for Clark County are from forecasts adopted by the Clark County Department of Comprehensive Planning; Population forecasts for Washoe County are from the Washoe County Department of Community Development.

Fig. 4–6. Nevada Population and Employment Forecasts, shows the relationship between the state and county population forecasts and the employment forecasts derived through the estimates and forecasts of individual county employment-to-population ratios. The Nevada figures presented in Table 4–4 and Fig. 4–6 represent the aggregation of those county forecasts.

Index to Summary, Section 4:

Fig. 4-6. Nevada Population and Employment Forecasts

Total Population (Persons) and Total Covered Employment (Workers)



Source Data: Nevada State Demographer; DETR; Forecasts-NDWP.

Nevada State Water Plan
SUMMARY

Section 5
Water Use Assessment and Forecasts

Introduction

This section of the Summary of the *Nevada State Water Plan* is intended to summarize the Nevada Division of Water Planning's water withdrawals forecasts by public supply and type of use categories and provide and overview of the methodology by which these forecasts were made. For detailed definitions of these source and use categories and a more extensive explanation of the water use forecast methodology including all equations used, see Part 2, Water Use and Forecasts, Section 5, Technical Supplement.

Forecasted Categories of Water Use

The water plan includes forecasts for fourteen categories of water withdrawals which comprise either unique forecasted water use categories, i.e., irrigation water withdrawals, or an aggregation of forecasted categories, i.e., total mining water withdrawals derived from processing water withdrawals and dewatering. Forecasts were made by the public supplied uses, i.e., municipal and industrial (M&I) withdrawals, and by the use of the water, e.g., domestic (residential) withdrawals. The following represents a listing of the water source or use categories presented in this plan:

Water Withdrawals by Public Supply Providers:
- Total Municipal and Industrial (M&I) Water Withdrawals

Water Withdrawals by Type of Water Use:
- Total Water Withdrawals
  - Total Domestic (Residential) Water Withdrawals
    - Domestic Public Supply Withdrawals
    - Domestic Self-Supplied Withdrawals
  - Commercial and Industrial Water Withdrawals
  - Thermoelectric Water Withdrawals
  - M&I Public Use and Losses
  - Total Mining Water Withdrawals
    - Mine Processing (Consumptive) Withdrawals
    - Mine Dewatering (Non-Consumptive) Withdrawals
  - Total Agricultural Water Withdrawals
    - Irrigation Withdrawals
    - Livestock (including Fisheries and Hatcheries) Withdrawals

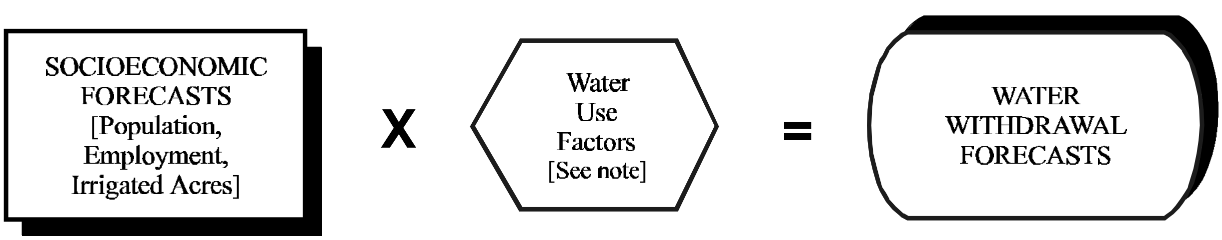
The Forecast Methodology

The forecast methodology developed for the water plan employs a relatively unique and innovative method of linking the forecasts of key socioeconomic variables, i.e., population, employment and irrigated acreage, to specific forecasts of water withdrawals through unique water use coefficients or factors. This process is depicted in its simplest form in Flow Chart 1. Basic Forecasting Methodology. Specifically, forecasts of population and employment (which were derived from the population forecasts), and irrigated acreage provide the means to develop the majority of water withdrawal forecasts for Nevada. The water use factors, which are measured from historical use patterns in terms of gallons per person or per worker per day for M&I, domestic, and commercial and industrial water uses, or in acre-feet per acre per year for irrigation water withdrawals, provide the means to more precisely link changes in the socioeconomic conditions with the resultant changes in water use. Only thermoelectric and mining water use forecasts required a different forecast methodology as explained below.

[*Note:* The terms "water withdrawal" and "water use" are used interchangeably in this forecast analysis. While assumed to have the same meaning in this presentation, the term "water withdrawal" represents the total amount of water withdrawn for a specific use category without reference to the amount of return flow. Thus, it does not measure consumptive use, which is water that is not returned to a source or able to be used again.]

<u>Municipal and Industrial (M&I).</u> Forecasts for M&I water withdrawals were based on forecasts

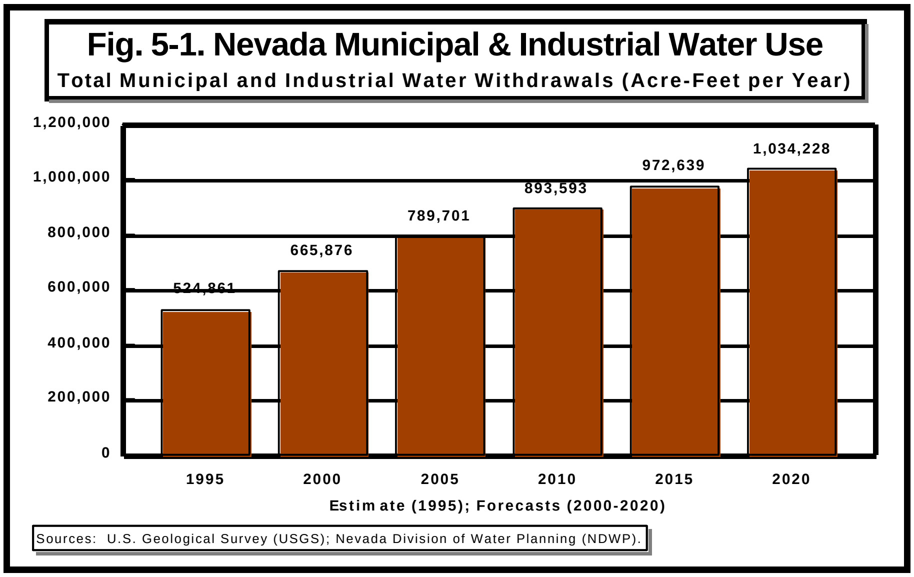
Flow Chart 1. Basic Forecast Methodology
Socioeconomic Forecasts to Water Withdrawal Forecasts



Note: Water Use Factors Measured in Gallons per Capita per Day, Gallons per Employee per Day, or Acre-Feet per Acre per Year

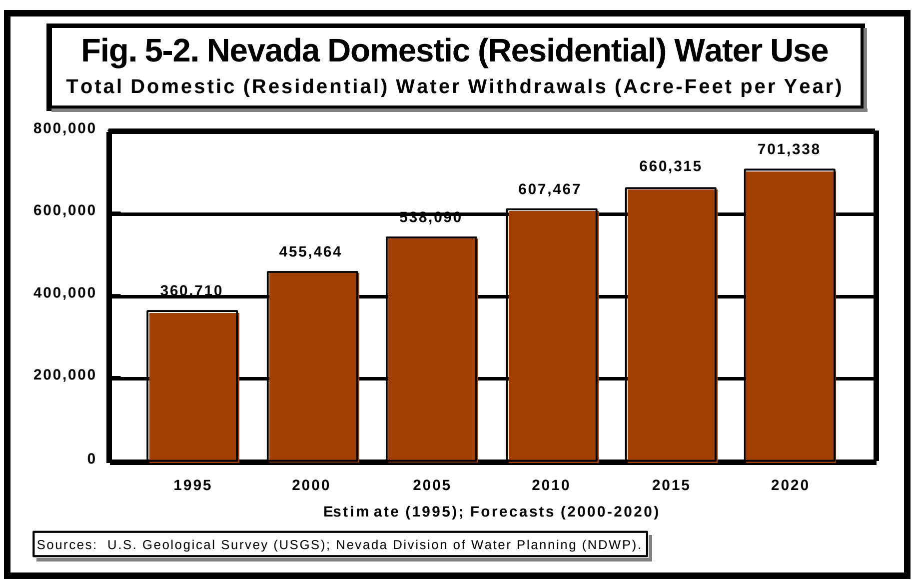
Nevada Division of Water Planning/Socioeconomic Analysis and Planning

of the population being supplied water by public supply water systems. These forecasts were based on forecasts of total resident population. The estimates of the population on public supply water systems were made at the county level and were derived from 1995 water use characteristics and forecasts of the proportion of the population on public supply water systems. The population on public supply water systems, times a county-unique M&I water use factor in gallons per capita (person) per day (GPCD), provided the forecasts for total M&I water withdrawals. Both M&I water withdrawals and domestic water withdrawals were additionally affected by the assumption of a changing proportion of the population being on public supply water systems. These forecasts were made for each county based on historical patterns.



Domestic (Residential). Total domestic or residential water withdrawals were estimated from the total resident population times a county-unique domestic water use factor measured in gallons per capita per day (GPCD). As with M&I water withdrawals, domestic water use forecasts were affected by the assumption of a changing proportion of each county's population being on public supply water systems. In effect, total domestic water withdrawal forecasts under this assumption were based on the aggregation of (1) public supply domestic withdrawal forecasts and (2) self-supplied domestic water withdrawal forecasts using specific water use factors for each use type and a varying proportion of the population on public and self-supplied water systems.

Commercial and Industrial. Commercial and industrial water withdrawals were based on the forecasted level of employment, which was estimated for each county from that county's population forecast and a county-unique employment-to-population ratio. The commercial and industrial water use forecast was then derived from the employment forecast multiplied by a commercial water use factor measured in gallons per employee per day (GPED). Since mining water use was forecast separately using a different methodology, county-specific forecasts



of the number of mining workers were subtracted from the forecasts of total county employment. Also, the historical commercial and industrial water use factor was calculated omitting mining workers and mining water use.

Public Use and Losses. Water withdrawals for public use and losses was assumed to be a constant percentage of each counties' M&I water withdrawal amount. Therefore, forecasts of this water use were based on forecasts of M&I water withdrawals, with the county-unique percentage factors remaining constant throughout the forecasts period.

Irrigation and Livestock. Irrigation water withdrawal forecasts were made using forecasts of county irrigated acreage multiplied by an irrigated acreage water requirement factor in acre-feet per acre per year. Livestock water withdrawal forecasts were based upon a constant ratio (percentage) of livestock water withdrawals to irrigation water withdrawals. Total agricultural water withdrawal forecasts represented the sum of irrigation water withdrawals and livestock water withdrawals.

Thermoelectric. Thermoelectric (including geothermal) water withdrawal forecasts did not lend themselves to the use of the water use factor method described above. In addition, power production across the state is generally not dependent upon the socioeconomic conditions in any one county due to the power plant's widespread distribution system. Consequently, these forecasts were based primarily on general population trends and increasing demands for electrical power in the diverse markets served by these power production plants, particularly from extensive mining operations in some of the rural counties.

Mining. Mining water withdrawal forecasts (including both consumptive and non-consumptive withdrawals, such as mine dewatering), also presented a unique forecasting environment and did not lend itself to the use of water use factors based on mineral production, mining employment, or other socioeconomic factors. These forecasts were therefore based principally on the projected state of Nevada's gold industry, and specifically on the market price of gold, the grade of available ore bodies which influences the type of processing required and the amount of water used in processing, the level of economically-recoverable gold reserves, the nature of production (underground mining versus open-pit mining), and the continued need for mining dewatering in relation to future mining operations.

Summary of Water Withdrawals by Use Category

Table 5–1. Nevada Water Withdrawal Forecast Summary, presents historical estimates (1995) and forecasts (2000–2020) of water withdrawals by major water use categories along with each categories' percentage share of total statewide water withdrawals. Water for domestic, commercial and industrial and thermoelectric use categories include water from both public and self-supplied sources. Public use and losses are assumed to be from public supply water sources only. It should be noted that these water withdrawal forecasts are based on the most current available data on water use and assume current levels of water conservation. Therefore, these forecasts do not explicitly incorporate the use of new technologies or changes in policy and pricing actions, or changes in conservation practices which would alter the water use rates used to develop these forecasts.

The water use forecasts presented in Table 5–1 show that Nevada's total water withdrawals for all sectors and use categories is expected to increase by 8.6 percent from 1995's estimated 4,041,385 acre-feet of total water withdrawals to approximately 4,391,000 acre-feet of annual water withdrawals by the year 2020, an increase of nearly 350,000 acre-feet. The state's total municipal and industrial water withdrawals, which as a source of water are presented separately in Table 5–2, are expected to grow by nearly 509,400 acre-feet from 524,861 acre-feet in 1995 to approximately 1,034,200 acre-feet by 2020, an increase of 97.0 percent. This trend is expected to increase M&I's share of the state's total water withdrawals from 13.0 percent in 1995 to 23.6 percent by the year 2020. However, on a statewide basis, it is expected that much of the increased demand in water resources for M&I, domestic, and commercial and industrial needs will be offset by declines in agricultural water withdrawals, especially from reduced irrigation water requirements.

Table 5–1. Nevada Water Withdrawal Forecast Summary

Estimated (1995) and Forecasted (2000–2020) Water Use by Use Type

Acre Feet per Year and Percent of Statewide Total Water Withdrawals

Total Nevada	1995	2000	2005	2010	2015	2020
Domestic (Residential) Withdrawals[1]	360,710	455,464	538,090	607,467	660,315	701,338
Percent of Total Withdrawals	8.9%	10.7%	12.4%	13.8%	15.0%	16.0%
Commercial & Industrial Withdrawals[2]	172,407	220,355	261,880	296,905	323,811	344,919
Percent of Total Withdrawals	4.3%	5.2%	6.0%	6.8%	7.4%	7.8%
Public Use and Losses[3]	48,472	61,195	72,313	81,707	88,930	94,582
Percent of Total Withdrawals	1.2%	1.4%	1.7%	1.9%	2.0%	2.2%
Thermoelectric Withdrawals[4]	65,449	67,085	68,427	69,522	70,412	71,223
Percent of Total Withdrawals	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
Total Mining Use[5]	274,434	278,996	282,708	284,965	283,764	277,566
Percent of Total Withdrawals	6.8%	6.6%	6.5%	6.5%	6.4%	6.3%
Total Agriculture Withdrawals[6]	3,119,914	3,167,378	3,115,872	3,052,038	2,976,780	2,901,522
Percent of Total Withdrawals	77.2%	74.5%	71.8%	69.5%	67.6%	66.1%
Total Water Withdrawals (Use)	**4,041,385**	**4,250,474**	**4,339,289**	**4,392,604**	**4,404,012**	**4,391,150**

Notes: "Water Withdrawal" and "Water Use" are equivalent terms, but are not the same as consumptive use; they do not account for return flows. Figures for total Nevada are based on an aggregation of individual county water withdrawal estimates and forecasts.

[1] Total domestic withdrawals include the total residential use, both indoors and outdoors (i.e., residential landscaping).

[2] Commercial and Industrial water withdrawals include both public supply and self-supplied withdrawals.

[3] Public use and losses are forecast as a fixed percent of total municipal and industrial (M&I) water use based on historical trends.

[4] Thermoelectric withdrawals include water used for geothermal power plants and cooling water for conventional power plants.

[5] Total mining withdrawals include both consumptive and non-consumptive uses (i.e., processing and mining dewatering).

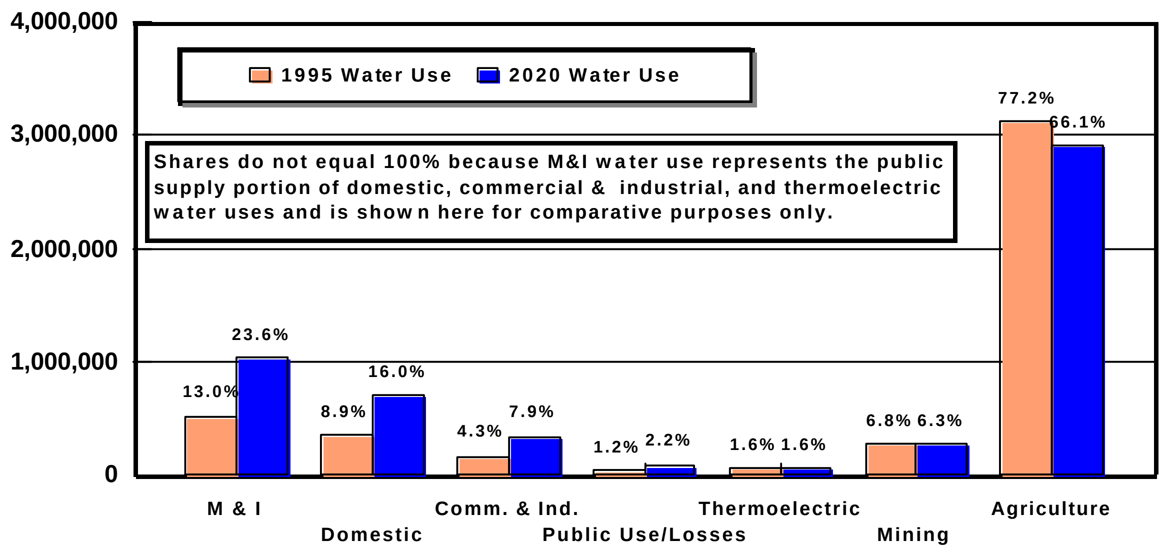
[6] Total agriculture withdrawals include both irrigation water withdrawals and livestock water use.

Source Data: Nevada State Demographer; Nevada Department of Employment, Training and Rehabilitation (DETR); U.S. Geological Survey (USGS); and Nevada Division of Water Planning (NDWP); Irrigated acreage and 1995 irrigation water withdrawals based on USGS estimates modified by NDWP; Forecasts through 2020 based on 1995 water usage rates and NDWP forecasts of population, employment, general business and economic conditions and estimated irrigated acreage.

Total domestic (residential) water withdrawals are expected to increase by over 340,000 acre-feet, or 94 percent over the forecast horizon, from an estimated 360,710 acre-feet of water withdrawals in 1995 to a forecasted 701,000 acre-feet by the year 2020. This will raise the share of domestic water withdrawals from 8.9 percent of total water withdrawals in 1995 to 16.0 percent by 2020. Within total domestic, public supply domestic water withdrawals are expected to increase by 331,000 acre-feet, or nearly 97 percent, from an estimated 342,605 acre-feet in 1995 to a forecasted 674,000 acre-feet by 2020. Self-supplied domestic water withdrawals are forecasted to increase by 9,700 acre-feet, or 53 percent, from an estimated 18,105 acre-feet in 1995 to nearly 28,000 acre-feet by 2020. Commercial and industrial water withdrawals are expected to increase by 172,500 acre-feet, or 100 percent by 2020, from an estimated 172,407 acre-feet in 1995 to a forecasted 345,000 acre-feet of water withdrawals by the year 2020. This will increase commercial and industrial water withdrawals' share of statewide total withdrawals from 4.3 percent in 1995 to 7.9 percent by 2020. Statewide total public use and losses, which are forecasted here as a constant percent of total municipal and industrial (M&I) withdrawals, are projected to increase by 95 percent from 48,472

Fig. 5-3. Nevada Water Withdrawals by Category

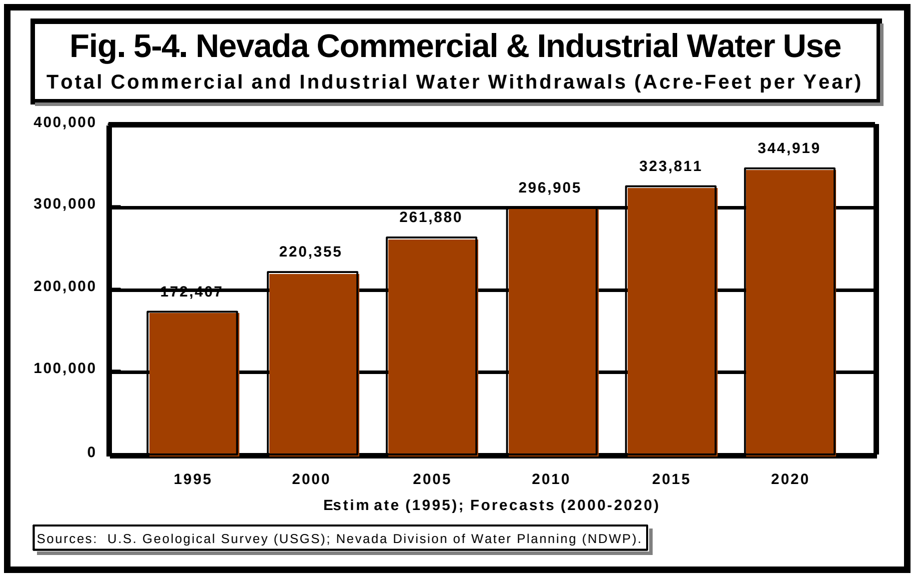
1995 / 2020 Water Withdrawal Comparisons (Percent of Total Use)



Source Data: USGS (1995 Estimates); NDWP (2020 Forecasts).

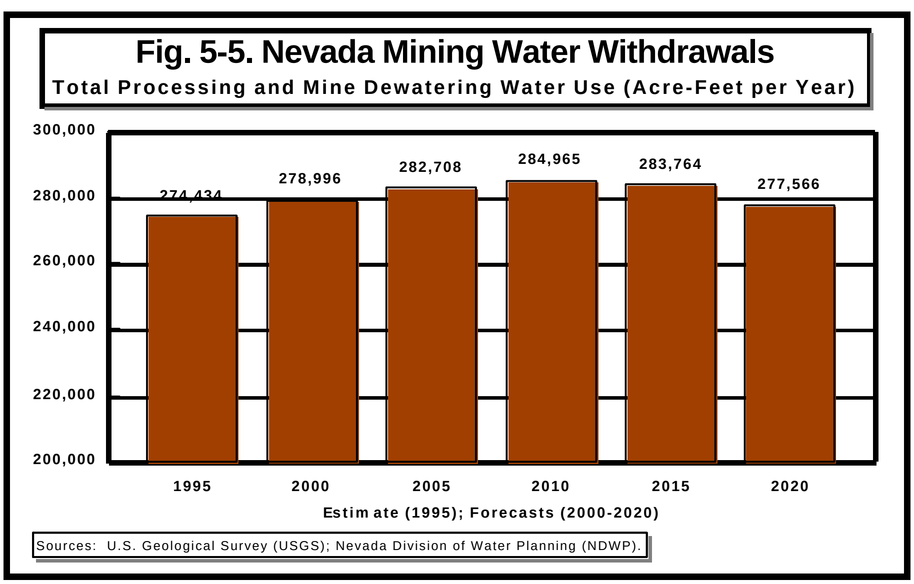
acre-feet in 1995 to 94,600 acre-feet by the year 2020. This will increase this category's share of total water use from 1.2 percent in 1995 to 2.2 percent by 2020. Thermoelectric water withdrawals are predicted to increase modestly throughout the forecast period based on rising population, continued mining activity, and other electrical energy demands. Total thermoelectric water withdrawals are expected to increase by 5,800 acre-feet, or 8.8 percent between 1995 and 2020 from 65,449 acre-feet to 71,200 acre-feet. As a share of statewide total water withdrawals, thermoelectric is expected to remain constant at 1.6 percent.

Total mining water withdrawals are expected to peak around the year 2010 at nearly 285,000 acre-feet, an increase of 10,500 acre-feet, or 3.8 percent from 1995's estimated mining water withdrawals.



As more of Nevada gold mining goes underground, total mining water withdrawals are expected to decline slightly to approximately 277,600 acre-feet by 2020, a decrease of 7,400 acre-feet, or 2.6 percent from water withdrawals forecasted for 2010. Most of this decline occurs in mine dewatering as mining operations and mine processing water withdrawals are expected to decline only modestly after the year 2010. Mining water withdrawals are projected to show a slight decline in both the amount and share of water withdrawn between 1995 and 2020 from 6.8 percent of statewide total water withdrawals in 1995 to 6.3 percent by 2020.

The most dramatic declines in water use patterns in the state are expected in agriculture and specifically in irrigation water withdrawals. Based on patterns in forecasted total irrigated acreage determined from individual county forecasts, total agricultural water withdrawals, including both irrigation and livestock water withdrawals, are forecasted to peak around the year 2000 at approximately at 3.167 million acre-feet and then decline by some 266,000 acre-feet, or 8.4 percent, to 2.902 million acre-feet by the year 2020. This decline is based solely on forecasted trends in irrigated acreage. Annual water use for irrigation is expected to decline by 218,179 acre-feet, or 7.0 percent, from an estimated 3,113,585 acre-feet in 1995 to a forecasted 2,895,000 acre-feet by 2020.



Agriculture's share of statewide total water withdrawals is expected to decline from an estimated 77.2 percent in 1995 to 66.1 percent by the year 2020. This decline assumes that levels of irrigated acreage will remain relatively stable or show modest declines in Nevada's rural counties. It also assumes the continued conversion of irrigated farmlands into urban lands and residential tracts and commercial businesses in the state's more urbanized counties.

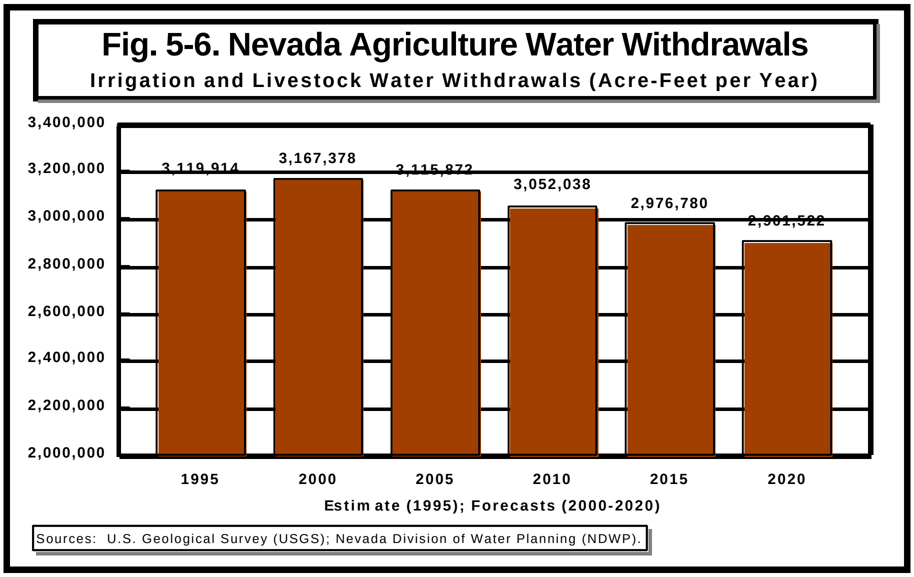


Table 5–2. Municipal & Industrial (M&I) Water Withdrawals, presents estimated (1995) and forecasted (2000 to 2020) municipal and industrial (M&I) water withdrawals for Nevada. M&I water use consists of withdrawals from public supply water systems for domestic, commercial and industrial and thermoelectric uses. Table 5–2 also presents the population growth assumptions, the estimated population on public supply water systems, and the statewide average water use factors derived from the development of the statewide forecasts for M&I water use. All figures contained within this table represent the aggregation of trends and forecasts contained for Nevada's individual counties. The table also presents an estimate of consumptive use based on 1995 consumptive use patterns.

The socioeconomic forecast calls for a near doubling in Nevada's resident population from 1995 to the year 2020. Nevada's estimated 1995 total population of 1,579,150 persons is expected to increase by 1,467,700 persons, or 92.9 percent, to an expected 3,046,846 persons by the year 2020. In addition, based on individual county population forecasts and related socioeconomic trends, the proportion of Nevada's population on public supply water systems is expected to increase from 94.2 percent of the state's total resident population in 1995 to 95.4 percent of the state's total population by the year 2020. Based on higher usage rates typical of public supply system water users, and an increasingly larger proportion of the population coming onto public supply water systems, the statewide average M&I water use factor is expected to increase from 315.0 gallons per capita per day (GPCD) in 1995 to 317.6 GPCD by the year 2020. As a result of these changes, statewide M&I water withdrawals are expected to increase from 524,861 acre-feet in 1995 to 1,034,200 acre-feet by 2020, an increase of 509,400 acre-feet or 97.0 percent. [Note: These forecasts for M&I water withdrawals do not take into account future water conservation efforts.]

Table 5–2. Municipal & Industrial (M&I) Water Withdrawals

Estimates and Forecasts of Total Public Supply Water Withdrawals

(Water withdrawals in acre-feet per year; Use factors in gallons per person per day)

Total Nevada	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	1,579,150	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846
Percent Population on Public Supply[2]	94.2%	94.6%	94.8%	95.0%	95.2%	95.4%
Population on Public Supply[3]	1,487,636	1,878,477	2,221,592	2,510,991	2,733,001	2,906,882
Population Self Supplied	91,514	107,780	119,783	129,315	135,978	139,964
Municipal & Industrial (M&I) Factor[4]	315.0	316.5	317.3	317.7	317.7	317.6
Municipal & Industrial Withdrawals[5]	**524,861**	**665,876**	**789,701**	**893,593**	**972,639**	**1,034,228**
Percent of Total Water Withdrawals	13.0%	15.7%	18.2%	20.3%	22.1%	23.6%
M&I Consumptive Use[6]	196,444	249,223	295,568	334,452	364,037	387,089
Public Use and Losses[7]	**48,472**	**61,195**	**72,313**	**81,707**	**88,930**	**94,582**
As a Percent of Total M&I Use[7]	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%
Percent of Total Water Withdrawals	1.2%	1.4%	1.7%	1.9%	2.0%	2.2%

Notes: One acre-foot equals approximately 325,851 gallons. Water withdrawals and water use are equivalent terms, but are not the same as consumptive use as they do not account for return flows. Total Nevada figures represent an aggregation of individual county estimates and forecasts. As aggregated into the total Nevada figures, population forecasts for Clark County are based on population forecasts adopted by the Clark County Department of Comprehensive Planning; population forecasts for Washoe County are based on population forecasts adopted by the Washoe County Department of Community Development.

[1] 1995's population estimate was developed by the Nevada State Demographer; population forecasts for the years 2000–2020 were developed by the Nevada Division of Water Planning (NDWP) along with individual county inputs.

[2] The percent of population on public supply water systems for 1995 was based on estimated made by the U.S. Geological Survey (USGS); changes to this percent over the plan's forecast horizon were estimated by NDWP.

[3] The total Nevada figure was based on aggregation of individual county estimates and forecasts.

[4] M&I water use factor was based on an aggregation of individual county trends and varies with both the proportion of the population on public supply water systems and individual county water use characteristics.

[5] Total M&I water use includes all public supplied water for domestic, commercial, industrial and thermoelectric uses; includes the effects of a variable population on public supply water systems.

[6] M&I consumptive water use was estimated from a fixed 37.4 percent of total M&I estimated and forecasted water withdrawals. The consumptive use factors are presented for all water use categories in Fig. 5–7, Nevada Consumptive Water Use Analysis.

[7] Forecasts for public use and losses were based on a fixed percent of total M&I water withdrawals for each county. The Nevada figure was based on the aggregation of the county totals and while shown here as a fixed 9.2 percent of M&I withdrawals, this figure actually varies slightly over the forecast horizon based on individual county growth patterns, but does not show here due to rounding.

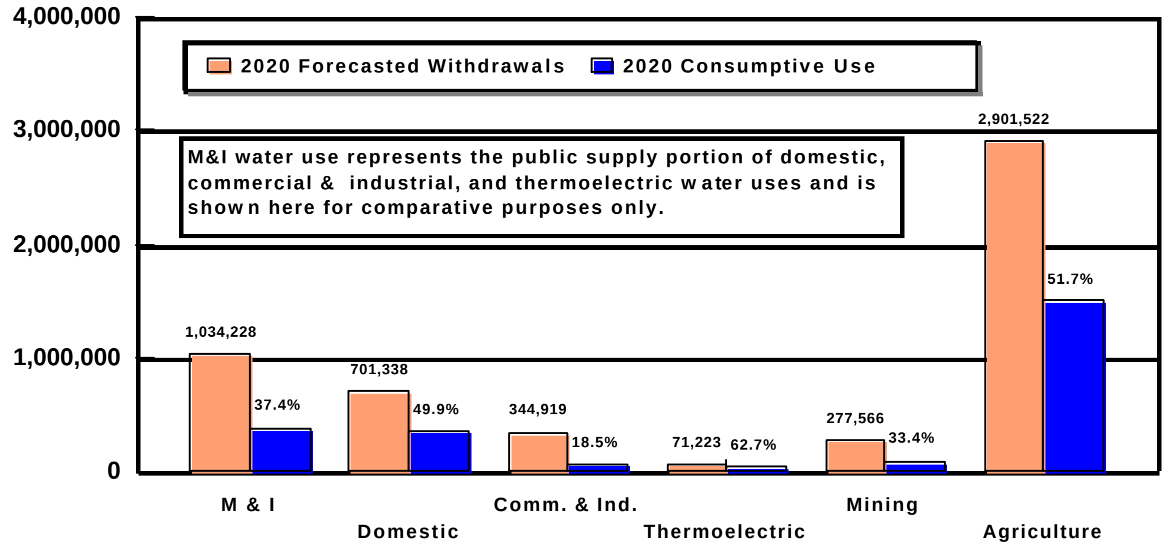
Source Data: Nevada State Demographer; U.S. Geological Survey (USGS); Nevada Division of Water Planning (NDWP).

Consumptive Use Forecasts

Fig. 5–7. Nevada Consumptive Water Use Analysis, presents estimates of consumptive water use by principal source and use category based on total water withdrawals for these same categories. The data presented in this graph are based on historical relationships between water withdrawals and respective consumptive use patterns. The statewide total consumptive use figure, representing the summation of all categories of water withdrawals, is expected to decrease from 48.4 percent of total water withdrawals in 1995 to 46.8 percent by 2020 as water use patterns change across the various water use categories primarily from agriculture (with a consumptive use estimated at 51.7 percent including both irrigation and livestock consumptive uses) to municipal and industrial which has an average consumptive use estimated at 37.4 percent, thereby providing nearly a 63 percent return flow from total M&I water withdrawals.

Fig. 5-7. Nevada Consumptive Water Use Analysis

2020 Withdrawal/Consumptive Use Comparisons (Acre-Feet and Percent)



Percentages show consumptive use as a percent of total withdrawals.

Index to Summary, Section 5:

Nevada State Water Plan
SUMMARY

Section 6
Meeting Our Future Water Supply Needs

Introduction

The future presents Nevada with many water resource challenges as a result of an ever increasing population, and competition over our limited water resources. Every effort should be made to ensure that all Nevadans have adequate and safe water supplies while protecting the quantity and quality of our water resources for current and future uses. This section provides a summary of future water demands, alternatives for meeting those needs, and water supply options identified in regional water plans.

Future Demands

As presented in the Summary, Section 5 of the *State Water Plan*, total statewide annual water withdrawals during the period 1995 to 2020 are forecasted to increase about 350,000 acre-feet (af) from 4,041,000 to 4,391,000 acre-feet per year (afy), assuming current levels of conservation. Correspondingly, annual consumptive use will increase about 96,000 af from 1,957,000 to 2,053,000 afy. This projected increase in water use is directly attributable to increasing population and related increases in economic endeavors, resulting in rising public supply (M&I), domestic, commercial, industrial and thermoelectric water usage.

The anticipated increase in total statewide water withdrawals is primarily the result of increasing public supply (M&I) water usage. Annual M&I water use is projected to increase by 509,000 af from 525,000 to 1,034,000 afy, almost doubling from 1995 to 2020. A majority of this increase in demand will be met with surface water supplies. Approximately 91 percent of this increase can be attributed to anticipated growth in Clark and Washoe counties. One of Nevada's water resource challenges will be meeting the water needs of the nearly 3 million people expected to reside in the state by 2020.

The M&I water use projections presented in the *State Water Plan* are based upon existing water use patterns and conservation measures and do not include the effects of future conservation efforts. The implementation of additional M&I conservation measures will result in lower M&I water withdrawals (in 2020) than the 1,034,000 afy predicted in the water plan. Planning groups for Southern Nevada and Washoe County have estimated that their proposed additional conservation measures will result in annual M&I withdrawals about 150,000 af less than would occur without these additional measures. The achievement of additional conservation is an integral part of Southern Nevada's water supply plan for the future.

Based upon the economic forecasts in Part 2 of the *State Water Plan*, agricultural water use could experience a 7 percent decline through 2020. Nonetheless, agriculture will continue to account for a majority of the statewide use during the next 20 years. It must be noted that statewide agricultural water use is highly variable depending upon weather conditions and water supplies, and can vary more than 25 percent from a wet year to a dry year as a result of changing water availability. While the projections in the *State Water Plan* suggest that agricultural water use will decrease in the future, planning and management efforts need to consider providing more reliable water supplies for irrigation during drought periods.

Almost 6 to 7 percent of statewide water withdrawals occur in the mining industry. It is anticipated that mining water withdrawals will remain relatively constant at around 275,000 afy with a slight increase over the next 10 years followed by a slight decline after 2010. A majority of the withdrawals are associated with mine dewatering, and about 185,000 acre-feet per year of these withdrawals are either discharged to surface water systems, reinjected into aquifers or used by other sectors such as irrigation. The impacts of these future mine dewatering activities will continue to be monitored and evaluated.

Water Availability

Approximately 60 percent of the water withdrawn in Nevada comes from surface water sources. Available surface water supplies are highly dependent upon weather conditions with variable monthly and annual flows. With such wide fluctuations, it is difficult to provide adequate and consistent water supplies to users on the system. Utilization of above ground and below ground storage capabilities are one strategy for smoothing out some of the flow fluctuations, thereby guaranteeing more reliable supplies. Generally, Nevada's surface water sources have been fully appropriated and utilized for many years. Expanded usage of our surface water resources can only occur to a restricted extent. With limited "excess" surface water available, those looking to surface supplies to meet future demands will need to examine a variety of options such as water right acquisitions and transfers, storage and improved management.

Groundwater supplies provide about 40 percent of our water needs. In some areas of Nevada, groundwater sources are used as a supplemental source during times of limited surface water flows. Currently, about 60 percent of Nevada's groundwater basins have varying amounts of water available for additional appropriations. However, most of these groundwater resources exist in areas distant from the anticipated water demand growth areas. Development of these sources becomes an expensive endeavor.

Options for Meeting Future Needs

Meeting our future water needs will require implementation of a combination of strategies. Possible strategies have been divided into two categories: demand management and supply development. Through demand management, water purveyors make wiser use of the available water thereby lessening the need for new source development. Supply development strategies include a variety of methods for increasing supplies and improving supply reliability.

Increasing demands and competition for our limited resources oblige water managers and suppliers to implement both demand management and supply development strategies. However, each option needs to be evaluated on a case-by-case basis for suitability, cost effectiveness and public acceptance.

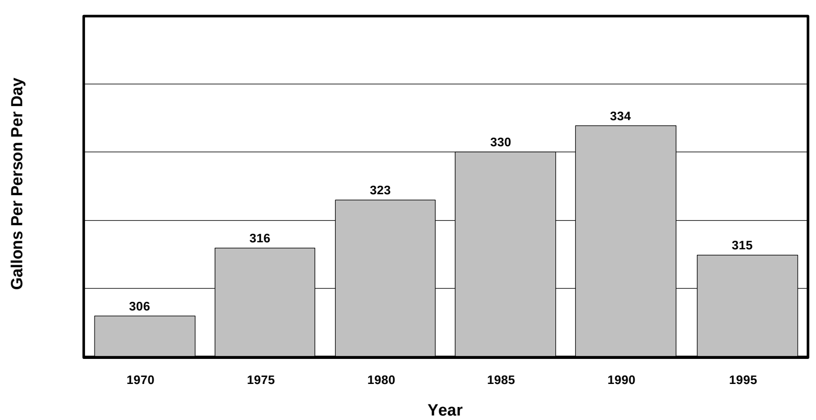
Demand Management Strategies

The time is past when water supply needs can be met simply by developing more water withdrawal, storage and delivery systems. Demand management must also be part of any long-range water supply plan. By reducing demands, new supply developments can be delayed with potential savings to the users. Demands can be managed through conservation measures and alternate strategies such as effluent reuse, greywater use and dual water systems.

Conservation. Conservation is recognized by most water suppliers and users as a cost-effective approach for extending water supplies, improving supply reliability during times of shortages, and deferring the need for new supply development. Numerous case studies have shown that a good conservation program can reduce demands significantly.

A comprehensive municipal water conservation program typically includes features such as: water system audits and leak detection, a public information and awareness program, utilization of increasing block billing, new ordinances, installation of low flow fixtures, landscape demonstration projects, use of drought tolerant plants and implementation of a xeriscape program, and installation of meters. From 1970 to 1990, Municipal & Industrial (M&I) water use rates in Nevada were on the rise (Figure 6-1). Successful conservation programs during the 1990s have lowered statewide M&I water use from 334 gallons per person per day (gpcd) in 1990 to 315 gpcd in 1995.

Fig. 6-1. M&I Per Capita Water Use in Nevada



Data Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning

Agricultural conservation programs typically include: laser leveling of fields, lining of ditches, use of soil and plant moisture monitoring devices, conversion to overhead or drip irrigation methods, and selection of low water use crops. Nevada's agricultural community has been implementing many of these conservation measures throughout the State, particularly in the Walker River and Carson River basins and the Lovelock area (Humboldt River basin).

Alternate Strategies for Reducing Potable Water Demands. Conservation reduces potable water demands by decreasing the overall water needs of the users. Other options to achieve potable water demand reductions involve the utilization of lower quality water in lieu of treated potable water, such as effluent reuse, greywater reuse and dual distribution systems.

One way to reduce demands for potable water and thus extend the higher quality supplies is through the use of treated wastewater effluent as a replacement source in Nevada. Current uses for reclaimed water include: urban landscaping such as golf courses, parks, road medians, cemeteries, etc.; agricultural irrigation; industrial uses such as cooling water and process water; wetlands applications; and construction water. Effluent reuse is increasing in Nevada with a majority of the treated wastewater being reused in Clark, Douglas, Elko, Lyon and Washoe counties and Carson City.

Another potential method for reducing potable water demands is to irrigate trees and shrubs with greywater - water that has already been used for bathing or clothes washing. Greywater can account for more than one-half of all residential indoor water use. Because greywater systems require dual piping, surge tanks and distribution piping, they can be expensive to install and may be more suitable for new construction rather than retrofit situations. Greywater is reused to a limited extent in Nevada.

The use of dual water systems is another method for reducing potable water demands. With this strategy, lower quality water (nonpotable) is used for outdoor landscape irrigation and is delivered to users via a second pipeline system separate from the potable water distribution network. As with some of the other demand management strategies, the use of dual water system may be more cost effective for new construction and limited retrofit situations.

Supply Development Strategies

Supply development strategies include alternative methods for increasing supplies and improving supply reliability, such as use of uncommitted supplies, acquisition and transfer of existing water rights, improved management of both groundwater and surface water supplies, utilization of lower quality (saline) water, and increasing natural supplies. The strategies presented in the following discussion may not be appropriate in all situations and must be examined on a case-by-case basis.

Use of Existing Committed and Uncommitted Supplies. With this strategy, water suppliers further utilize supplies under their existing water rights and/or obtain new appropriations for previously unallocated water. In general, future new allocations will be limited to groundwater as most of the surface water resources have been fully appropriated. For some areas of Nevada, this strategy may be an expensive proposition as most of the unappropriated groundwater resources exist in areas distant from the growing metropolitan areas.

Water Transfers. One tool for increasing available supplies to meet future demands is water transfers. Under this option, water rights are purchased or leased from one user for use by another. As most groundwater and surface water sources are fully appropriated, opportunities for new appropriations are typically limited to basins distant from the growing metropolitan areas. In some cases, water transfers from existing uses may be more cost effective than developing distant sources.

Groundwater Recharge and Recovery. Artificially recharging aquifers is a water resource management option available to some areas as a means of securing more reliable water supplies during periods of low surface water flows. This strategy involves recharging groundwater aquifers with available surface water for later use. Underground water storage has a number of advantages over surface reservoirs. In general, surface reservoirs may have higher construction costs and more difficult environmental permitting requirements, and higher water losses (due to evaporation). Nevada state water law provides criteria for the establishment of groundwater recharge/recovery programs.

Conjunctive use. Conjunctive use is the coordinated management of both surface water and ground water supplies. Under an active form of conjunctive use, surface water is used when available, excess surface water (if available) is stored in groundwater aquifers, and groundwater and stored surface water is then pumped to meet demands over and above those met with the surface water supplies. Benefits of conjunctive use include improved management of resources, more reliable supplies, emergency and drought relief capacity, and summer peaking options.

Desalination. Desalination is a process that removes dissolved minerals (including but not limited to salt) from seawater, saline water, or treated wastewater. Desalination for Southern Nevada has been suggested in the form of an exchange with California, i.e. Las Vegas would pay for desalination facilities in California in exchange for the use by Southern Nevada of a portion of California's Colorado River apportionment. However, high desalting costs continue to keep this option as a lower priority.

Cloud Seeding. Cloud seeding is a weather modification technique involving the injection of a substance into a cloud for the purpose of increasing precipitation amounts, thereby increasing snowpack amounts and associated streamflows. Cloud seeding first began in Nevada in the Lake Tahoe basin in the 1960s. Currently, cloud seeding activities exist in the drainage basins of Lake Tahoe, Truckee River, Carson River, Walker River, upper Humboldt River, South Fork of the Owyhee River, and Reese River. The Desert Research Institute has designed and operated the Nevada state cloud seeding program since its inception. Estimates of augmented water from seeding have varied from 35,000 to 60,000 acre-feet over each of the last ten years.

Meeting Future Municipal and Industrial (M&I) Water Needs

As already discussed, statewide M&I water use could increase from 525,000 to 1,034,000 acre-feet per year by the year 2020 if current water use patterns continue. Approximately 91 percent of this increase can be attributable to anticipated growth in Clark and Washoe counties. According to planning documents for Clark and Washoe counties, the increase in their M&I demands will be met primarily with expanded utilization of surface water supplies. Projections show that a number of other counties are also expected to experience significant M&I water use growth from 1995 to 2020: Nye (113 percent), Lyon (105 percent), Churchill (89 percent), Pershing (76 percent), Douglas (74 percent), Elko (64 percent), Storey (57 percent), Carson City (56 percent), and Humboldt (55 percent).

Many of these counties or regional entities have developed or are actively developing plans to deal with these increasing water needs. The most common solutions being considered in these plans are: conservation; expanded use of current supplies; acquisition and transfer of existing rights; reclaimed water use; groundwater recharge/recovery; and conjunctive use. Upon reviewing water supply planning efforts for Southern Nevada, and Washoe and Douglas counties, a number of observations can be made and some lessons can be learned:

- Water purveyors are utilizing demand management as a means for delaying or reducing the need for additional supplies. Conservation has become commonplace and additional conservation measures are planned for the future. For example, the achievement of additional conservation is an integral part of Southern Nevada Water Authority's water supply plan for the future.

- Effluent reuse has increased in recent years and these plans indicate that this trend will continue during the planning horizon.

- In general, these plans call for a variety of strategies and sources for meeting future demands. By not putting all their eggs in one basket, water purveyors will be able to provide reliable and safe drinking water supplies.

- Conjunctive use and recharge/recovery program are recognized as useful tools for managing both groundwater and surface water sources. The implementation of conjunctive use and recharge/recovery programs will expand in the future.

- Municipal and Industrial water supply planning is being done on a regional basis. All persons within a region can benefit when planning includes all users and interest groups, and considers both water quantity and quality within a region.

- Creative water supply solutions are being developed. With our limited water resources and growing demands, it has become necessary to look for creative solutions, such as Southern Nevada Water Authority's Arizona Banking Demonstration Project.

- The positive value of regional, consolidated M&I water systems is being acknowledged. Improved water management and “economies of scale” can be realized through water system consolidation.

- Currently, there is little reliance upon greywater and dual water systems, and desalination treatment due to the higher costs of these options. These plans suggest that this trend will probably continue.

One or all of the options presented in the Southern Nevada Water Authority, Washoe County and Douglas County plans may have possible application for M&I water system throughout Nevada. Other water purveyors and planners stand to gain valuable insight into their own water supply problems and solutions by studying other water plans.

Meeting Future Agricultural Water Needs

According to U.S. Geological Survey estimates, annual irrigation withdrawals have varied from 3.1 to 3.4 million acre-feet over the last 25 years. Irrigation withdrawals in 1995 were estimated at about 3.1 million acre-feet, with about 63 percent diverted from surface water sources. Historically, irrigated acreage and associated water usage has varied greatly from year to year in response to our fluctuating precipitation and surface water supplies. With highly variable streamflows in Nevada, those agricultural operations utilizing surface water are faced with unreliable supplies during low flow periods. As a result, many of these irrigators have developed groundwater supplies to supplement surface water sources. However, pumping groundwater is generally expensive and may not be cost effective in some cases.

Based upon past use trends, NDWP projects that statewide agricultural water withdrawals could experience a 7 percent decline through 2020. In part, encroaching urbanization and the transfer of agricultural water rights to other uses such as municipal and natural resource needs will drive future agricultural water use reductions.

While the projections in the water plan suggest that the agricultural water supply will be generally adequate to meet future usage, that should not preclude water managers, planners and users from evaluating other water supply and management issues and options such as:

- methods to improve water supply reliability for agricultural users dependent upon fluctuating surface water sources;

- implementation of water conservation methods; and

- increased utilization of treated wastewater effluent.

Meeting Future Mining Water Needs

Mining water withdrawals are anticipated to remain relatively constant at about 275,000 afy with a slight increase up to the year 2010 followed by a slight decline. Beginning in the early 1990s, a majority of the mining withdrawals have been associated with mine dewatering. These withdrawals have been significantly higher than the mines' consumptive use needs, thereby requiring the mining operations to develop alternative disposal methods for the excess water. A majority of this "excess" water has been either discharged to surface water systems, reinjected into aquifers or used by other sectors such as irrigation. It is anticipated that this trend will continue with pit dewatering activities generating water volumes in excess of mine processing and consumptive needs.

The forecasted future mining withdrawals are estimates only and are highly dependent upon the price of gold. Actual water use may also be affected by shifts from open pit mining to underground mining. However, some degree of mine dewatering is expected to continue regardless of the type of production activity.

Meeting Future Domestic Water Needs

Statewide domestic water withdrawals are forecasted to increase from about 361,000 afy to about 701,000 afy by 2020 in response to a growing population. Public supply systems are the primary providers of water for domestic uses. As of 1995, the domestic water needs for about 94.2 percent of Nevada's population were met by public water systems. This percentage is projected to increase to 95.4 percent by 2020. Nevertheless, the number of persons on domestic wells is still expected to increase from 92,000 to 140,000 over the next 20 years.

Meeting Future Commercial, Industrial and Thermoelectric Water Needs

In 1995, commercial, industrial and thermoelectric sectors withdrew about 238,000 af of water accounting for about 6 percent of total statewide withdrawals. Public supply systems met a majority (about 85 percent) of the total commercial needs in Nevada. In the industrial and thermoelectric sectors, self-supplied systems provided most (95 percent) of the water needs.

By the year 2020, commercial, industrial and thermoelectric withdrawals are projected to increase to about 416,000 afy. It is anticipated that public supply systems will continue to satisfy a majority of future commercial water needs, while self-supplied systems will be utilized to meet most future industrial and thermoelectric demands.

Meeting Future Wildlife and Environmental Water Needs

Interest in obtaining the necessary water supplies to meet wildlife and environmental water needs is increasing. However, quantifying these water needs is a challenge. In the broadest sense, all water (with the possible exception of deep groundwater) may provide benefits to wildlife and the environment. For example, all surface water, whether in rivers, ponds, lakes or reservoirs supports a variety of flora and fauna, while also supporting other needs such as public system and irrigation uses. Additionally, shallow groundwater supports riparian vegetation and phreatophytes which provide habitat. Also, habitat may be created as a result of other activities such as irrigation. Wildlife and environmental water needs become difficult to quantify when examined in this broad manner.

The securing of water supplies for wildlife and environmental purposes is still a relatively new resource management concept. In recent years, governmental agencies and conservation organizations in Nevada have used a variety of mechanisms to obtain water for fishes, wildlife, special status species, wetlands and water quality improvement. Water has been obtained by purchasing and transferring water rights to a designated water body or portion thereof, filing for new appropriative water rights and entering into formal and informal agreements for reuse of water from agricultural irrigation systems, wastewater treatment plants, mine dewatering operations and an electric generating station. The water obtained for wildlife and environmental needs is generally used to augment stream flow, reservoir and lake levels, spring pools, wetlands and riparian areas.

Water rights have been acquired for the Lower Truckee River, Meadow Valley Wash (Condor Canyon), Upper Blue Lake (Humboldt County), Bruneau River, Carson Lake and Pasture and for a number of other aquatic and wetland resources on various federal wildlife refuges and state wildlife management areas. Many water acquisition projects have been cooperative interagency actions to meet requirements of state and federal legislation, such as the Truckee-Carson-Pyramid Lake Water Rights Settlement Act (Public Law 101-618) Endangered Species Act, Section 404 of the Clean Water Act (wetland protections), the Migratory Bird Treaty Act and the National Environmental Policy Act.

Currently, efforts to assess and provide water supply needs are commonly retrospective, having been concentrated where ecosystem components already are deteriorating. Providing for future wildlife and environmental water supplies requires implementation of an ongoing, structured assessment process to determine where additional water supplies for wildlife and environmental needs are not being met as evidenced by deterioration in essential resource conditions. Laws and regulations have been instituted which require assessment and management actions to minimize the risk that municipal and industrial water supplies will not meet demand. A similar policy approach is needed for wildlife and environmental resources.

Meeting Future Recreation Water Needs

The popularity of water based outdoor recreation continues to grow. The number of people fishing, wildlife watching, boating, and swimming in Nevada's waters has never be higher, significantly adding to the state and local economies. In fact, tourism officials now commonly advertise the other side of Nevada, its expansive landscape and comparatively unique and rare water resources in the desert. Government agencies responsible for maintaining recreation resource values have acquired water for recreation purposes, primarily at reservoirs in the state. However, as recent experience has shown parks managers and visitors, droughts can dramatically impact water supplies at reservoirs, resulting in significant loss of available recreation resource area. Sometimes the seniority of acquired water rights does not ensure water availability during drier seasons.

As with wildlife and environmental water needs, quantification of recreational water needs may be difficult. In some instances, water for recreation is provided as the result of other water use activities. For example, reservoirs created for irrigation or municipal water supplies also provide recreation opportunities as a secondary or additional benefit. Anticipating future water needs for recreation will require implementation of a comprehensive and integrated assessment process. In fact, recreation resource needs are often intertwined with those of wildlife and the environment. Therefore, it would be practical to combine recreation and natural resource water needs assessments.

Nevada State Water Plan
SUMMARY

Section 7
Issues and Recommendations

Introduction

The following issue papers represent a summarization of those issues contained in Part 3, Water Planning and Management Issues of the *Nevada State Water Plan*. All recommendations have been retained from the original issue papers. The numbers and titles used below are the same as those used in Part 3.

1 — WATER SUPPLY AND ALLOCATION

Water Conservation

Ensuring an adequate water supply for any use is no longer only a matter of developing new sources. Conservation has become an essential part of the water supply equation. Over the last 10 years conservation has been shown to be a cost effective way to reduce demands and to extend a given water supply. Conservation measures can be pursued by all water users regardless of the type of water system, i.e. municipal, irrigation, private home, commercial or industrial, etc. Water use measurement is a key component to any conservation program. Meters and other measurement devices are needed to evaluate program effectiveness.

At this time, the State has no comprehensive program for promoting and encouraging conservation, or for assisting water use entities in developing water conservation strategies. However, in recent years the State has instituted some statutes and regulations encouraging conservation. For example in 1991, the Nevada State Legislature enacted a law requiring that each "supplier of water" for municipal, industrial or domestic purposes adopt a water conservation plan based on the climate and the living conditions in its service area by July 1, 1992. Also, the Nevada Legislature passed Assembly Bill 359 in 1991 thereby imposing certain minimum standards for plumbing fixtures (toilets, showers, faucets and urinals) in new construction and expansions in residential, industrial, commercial and public buildings. In 1992, the U.S. Congress passed the National Energy and Policy Conservation Act which set nationwide minimum flow standards for plumbing fixtures.

Issues

1. At this time, the State has no comprehensive program for promoting and encouraging conservation throughout Nevada and for assisting water users in developing water conservation strategies.
2. Currently, state law requires municipal water suppliers to submit conservation plans, but provides

little incentive for compliance. Also, there are no requirements that these plans be periodically updated or reviewed for effectiveness. Water users other than public suppliers are not required to submit conservation plans.

3. The current law of "use it or lose it" does not encourage conservation. However, existing statutes prohibit the waste of water, and provide the basis for a "credit for conservation" program.
4. State law provides few requirements and no specific incentives to conserve.
5. There have been attempts to appeal the federal minimum flow standards for plumbing fixtures. Repealing the federal standards could adversely affect Nevada's conservation efforts.

Recommendations

The following recommendations are offered as measures for improving conservation efforts in Nevada. In developing these recommendations, it was assumed that conservation would remain primarily a voluntary activity for water suppliers and users, with the State providing assistance and incentives. It is not the intent of these recommendations to advocate conservation purely for the sake of conservation. Conservation should be recognized as one of many water resource management tools that should be considered when it makes sense in terms of economics and overall resource management.

1. The State should add staff to the Division of Water Planning to provide technical, educational and financial assistance with water conservation. Duties of this staff could include:
   - review water conservation plans and provide technical assistance;
   - distribute grants;
   - prepare conservation plans for state facilities;
   - prepare and/or evaluate water audits for state facilities;
   - assemble a repository of water conservation information for distribution;
   - develop conservation education materials and provide educational seminars; and
   - compile a list of recommended best management practices for use in Nevada.
2. All municipal water suppliers are now required to implement conservation plans. It is recommended that the following steps be taken to improve this program:
   1. require municipal water systems over a certain population threshold to periodically update their conservation plans, and establish ongoing reporting requirements;
   - require municipal water systems over a certain population threshold to adopt, implement and update their water conservation plans prior to receiving any state grants or loans or State Revolving Funds (Safe Drinking Water Act);
   - require municipal water systems over a certain population threshold to adopt, implement and update their water conservation plans prior to the State Engineer's approval of a water right application or transfer request; and
   - add staff to assist municipal water systems with developing their conservation plans and encourage compliance with conservation plan requirements.
3. On a trial basis, the State should require additional groups of water users (such as irrigators, and self-supplied commercial and industrial users) above a certain water use threshold to prepare water conservation plans. A cooperative agreement with other agencies could be set up to assist in developing and reviewing the plans.
4. The Department of Conservation and Natural Resources should develop a more formal "credit for conservation" program in order to encourage more conservation throughout Nevada. This

program would be voluntary. Water use measurement and enforcement would be essential for such a program to be successful.

5. The State, in cooperation with Cooperative Extension and Natural Resources Conservation Service, should assist agricultural users in implementing conservation measures through the following mechanisms: develop an irrigation management information system with weather stations in selected basins to provide real time evapotranspiration data for irrigation scheduling; establish mobile laboratories to visit farmers to help them evaluate their water management efficiency; and establish an irrigation training and research center.
6. If state government is to promote conservation throughout Nevada, it must lead by example and assist the various state agencies in becoming more efficient. The State Legislature and the Governor should promote statewide water conservation by:
    1. incorporating water conservation policy goals into all appropriate activities and programs of state government
    2. directing agencies responsible for constructing, leasing or maintaining state facilities and property to use water conserving plumbing fixture and devices, water efficient landscape practices and other programs to maximize water conservation
    3. providing appropriate funding to affected state agencies to retrofit existing state facilities with water conserving devices.
7. The State should establish a fund to help pay for water conservation projects to demonstrate the benefits of water efficiency measures and provide an incentive for conservation/
8. The State should encourage public supply systems to meter water deliveries. Refer to the "Water Use and Estimation" issue discussion for additional information on water use measurement in Nevada.
9. The State should encourage effluent reuse and greywater use where feasible.
10. The State should initiate a water measurement program for all water users to install water measurement devices, or implement water use estimation techniques (based upon power use, etc.) for certain users over a threshold use amount and for certain basins. Funding support would be a necessary component. Refer to the "Water Use and Estimation" issue discussion for additional information on water use measurement in Nevada.
11. The State should continue to support existing state and federal minimum flow standards for plumbing fixtures.

Integrated Water Management

Groundwater and surface water supplies in Nevada are finite resources, only replenished by the nine inches of average annual precipitation. The State's rapidly expanding population is putting increased pressures on the available water supplies, thus increasing the need for integrated water management.

Surface water is used to meet approximately 60 percent of the water needs in Nevada, with groundwater making up the other 40 percent. Surface water in the State is fully appropriated, thus future development will rely heavily on groundwater resources. In many communities groundwater currently provides 100 percent of the water supply for municipal uses. In years of low surface water supply, groundwater is pumped to supplement surface water sources.

Water quality typically varies throughout the state, dependant upon the aquifer material, location relative to thermal areas, and point and non-point sources of pollution. Concentrations of naturally occurring contaminates such as TDS, metals, fluoride and sulfates vary but typically do not exceed State and Federal drinking water standards in the majority of aquifers used for drinking water supply.

Integrated water management in Nevada consists of three components:

- ***Conjunctive Use* —** The goal of conjunctive use of water systems is to maximize the use of surface water supplies when they are available, and minimize the use of groundwater to conserve the total resource.
- ***Water Storage* —** Storage of surplus surface water in aquifers underground or in above ground reservoirs enhances groundwater supply and can be withdrawn when available supplies are not adequate to meet demand.
- ***Water Reuse* —** Use of previously used water or treated waste water for commercial, industrial and irrigation uses is becoming more common in Nevada. Treated effluent is currently used for irrigation at many golf courses, while commercial uses include using previously used water for cooling tower make-up water at power generating station.

Issues

1. Effective management of the total water supply in the state depends on a clear understanding of the interaction of the water resources.
2. Groundwater and surface water are managed as two separate sources in Nevada. Water allocation and management decisions need to incorporate state-of-the-art knowledge regarding the relationship between groundwater and surface water.
3. Underground storage is a viable alternative to surface water storage, eliminating evaporative losses which can be significant in Nevada. However, few communities are actively exploring the potential for underground storage.

Recommendations

1. The State should continue groundwater and surface water monitoring to refine the estimates of perennial yield of hydrographic basins, and provide an improved estimate of water availability in the state.
2. The State should support funding and development of an enhanced groundwater level and quality monitoring network to better quantify groundwater availability and use throughout the state and especially in areas of rapid growth.
3. The State should fund integrated water resource studies to assess the effects of groundwater pumping on surface water flows on critical streams and springs where impacts have been identified.
4. The State should encourage development of aquifer recharge/recovery projects where feasible throughout the state, and evaluate surface water storage options where underground storage is not feasible.
5. The State should encourage installation of dual piping in new developments to facilitate use of treated water for irrigation and other uses which are not required to meet drinking water standards.
6. The State should encourage the preferential use of reclaimed water, surface water, and stored water.

7. The State should ensure that water users who use a combination of surface water, groundwater, or alternative water sources (reclaimed water, grey water, etc.) do not use more than the total amount of water necessary to meet their needs efficiently within the limit of their water right.

Interbasin and Intercounty Transfers

Water transfers involve withdrawing either groundwater or surface water from one basin or county for beneficial use in another. Water transfers have been around for a long time and are an integral part of the settlement of Nevada . There are over 20 interbasin transfers occurring in the state today. Growing urban areas are looking to appropriate available water rights and transfer them to the place of need or purchase existing water rights and change them to municipal use, frequently in a different basin or county. Water right transfers are also being viewed as an important way to augment instream flows.

State water allocation law does not contain special criteria for evaluating interbasin or intercounty transfers. As long as unappropriated water is available, existing water rights are not impacted, and the transfer does not threaten to prove detrimental to the public interest, the State Engineer may approve the transfer. However, other sections of state law contain special requirements for water transfers, including public noticing and the establishment of a water transfer tax and mitigation plans.

Water transfers have contributed to economic development, growth and prosperity in Nevada, but there are also costs associated with such transfers. A water transfer can enable a receiving area to meet current or projected water needs, or lead to economic development or expansion. An area-of-origin can benefit from a water transfer if the area has excess water resources not otherwise needed to meet future growth or resource conservation needs. Water transfer concerns center on whether a water transfer has the potential to impact the rights of existing water users, reduce instream flows, decrease flows to wetlands or lakes downstream of the point of diversion, or decrease recharge to aquifers. Social, economic and fiscal concerns center on potential losses of taxable income, social stability or the ability to economically develop in the future. Other concerns include the impacts that population growth may bring.

Interest in water marketing, and associated water transfers, is increasing as the demand and price for water rights increases. The 1994 Nevada Legislative Committee to Study the Use, Allocation and Management of Water recommended that the water plan include general criteria for the approval of interbasin water transfer applications. The 1995 Nevada State Legislature amended the water planning statute to require that the state water plan include provisions to protect water supplies in rural areas for future development and quality of life benefits.

Issues

1. Water transfers can impact third parties. It is sometimes difficult to determine who the affected parties are and to inform them about proposed water transfers.
2. Concerns have been expressed about water transfers and their potential impacts. Regional water planning enables local officials to be prepared when water transfers are proposed for their area, and to better capitalize on any benefits and mitigate any impacts water transfers may bring.

3. Water transfers may have relatively larger impacts on rural counties. Rural counties must carefully evaluate the potential social, fiscal and economic impacts of water right transfers.
4. Nevada has many threatened and endangered species and unique ecosystems, and has lost much of its wetland environments. Protection of water quality and recreation opportunities depend in large part on water availability. Because the water needs for these beneficial uses of water have not been adequately quantified and few water rights have been obtained to support them in the past, a thorough evaluation of the potential environmental impacts must precede any large scale water transfer.
5. Water markets are developing in various ways in different parts of Nevada. There are few, if any, mechanisms to bring buyers into contact with sellers or to bring order and rationality to the process. Therefore, transaction costs are high and water rights may not be appropriately valued.

Recommendations

The following recommendations were significantly influenced by recommendations made by Nevada county commissioners and the public at more than 25 public meetings and workshops on the state water plan held in 1998. The recommendations were also influenced by the recommendations found in the 1994 *Study of the Use, Allocation and Management of Water* prepared by the Legislative Commission of the Legislative Council Bureau, State of Nevada, and in *Water Transfers in the West – Efficiency, Equity and the Environment*, 1992, prepared by the National Research Council. The recommendations below are designed to balance the positive and negative impacts interbasin and intercounty transfers may have.

1. All levels of government should recognize the potential net value of water transfers as a way to respond to changing demands for water, and encourage voluntary transfers, as long as the public interest is protected. Efforts should continue to make information available to the public concerning water transfer proposals and to provide affected interests with an opportunity to participate in any proceedings.
2. In applying the public interest test (under NRS 533.370(3)) to an interbasin or intercounty water right appropriation or change request, the State Engineer should continue to consider whether:
   - the applicant for the water transfer has justified the need to import the water and demonstrated that an effective conservation plan has been adopted for the region in need and is being effectively implemented;
   - the transfer plan conforms to or conflicts with the substance of any adopted water plans for either the area-of-origin or the area to receive the water;
   - the project is environmentally sound; and
   - the project is an appropriate long-term solution which will not unduly limit future development and growth in the area-of-origin.
3. When in the public interest, the State Engineer should continue to place conditions on water right permits to mitigate impacts of interbasin or intercounty water transfers.
4. The State should continue to provide, and accelerate where funding allows, water planning assistance to local governments to help develop regional water plans and to identify future water needs. Regional water planning will enable local governments to better plan for their economic development and protect their natural resources, and prepare them to respond to proposals to transfer water into, or out of, their areas.
5. The Division of Water Planning, with the assistance of others, should conduct additional research on the opportunities and costs associated with water banking and water marketing in Nevada, and

develop additional recommendations to improve future water transfers.

Water Use Measurement and Estimation

One of the major obstacles to improved comprehensive water planning and management is the State's lack of an overall water use and estimation program. Approximately 65 to 75 percent of the total water withdrawn from groundwater and surface water sources in Nevada is either measured with detailed diversion records maintained by various entities or estimated by the State annually in detailed pumpage and crop inventories. Only a portion of these data are maintained in an electronic database. Much of the available water use data are collected for regulatory purposes (compliance with permits, decrees, etc.) and may lack the detail needed to fully characterize water usage for planning purposes. The lack of readily available and comprehensive water use data impedes local and state planning and management efforts, including the State Water Plan. Managing and planning water resources without accurate water use information is comparable to managing a checking account without tracking the outgoing checks.

Issues

The State of Nevada lacks a comprehensive water use and estimation program. At this time, the U.S. Geological Survey (USGS) is the only agency that estimates statewide water use for Nevada. The USGS program for Nevada had been cooperatively funded by the Nevada Division of Water Resources (State Engineer's Office) until funding was cut in 1991. Since that time, the USGS has continued the program with other limited funds and the State has had little involvement in the process.

Recommendations

The following is offered as a method for improving water use measurement and estimation, and ultimately future water planning and management efforts, in Nevada:

The State should develop and fund a comprehensive water use measurement and estimation program. Some elements of this program could include the following:

- Enter water use data and estimations currently being compiled by the State Engineer into electronic databases, and link these data with the water right permits database;
- Acquire more detailed public supply, commercial, industrial and thermoelectric usage data through one of the following mechanisms:
  a. request that municipal water systems provide additional details of water usage data currently submitted to State Engineer's Office (for compliance with water right permit conditions) such as population served, number of connections, consumptive use estimates and breakdowns by domestic, commercial, industrial, thermoelectric deliveries, etc.;

  OR

  b. require all of the following water users to submit detailed water use information (measured or estimated) if not currently submitted:
     - public supply systems;
     - self-supplied commercial/industrial/thermoelectric users with usage over a threshold value to be determined; and

    - mining operations with water usage over a threshold value to be determined.

  Information should include the following as applicable:
    - number of persons served;
    - monthly/annual withdrawals by source;
    - monthly/annual deliveries by category (domestic, commercial, industrial);
    - estimated consumptive use;
    - anticipated future needs
- Expand existing program for estimating irrigated acreage and associated water use;
- Encourage public supply systems to meter all water deliveries;
- Initiate a water measurement program for all water users to install water measurement devices, or implement water use estimation techniques (based upon power use, etc.) for certain users over a threshold use amount and for certain basins. Funding support would be a necessary component; and
- Provide State funding for the Division of Water Planning to match the USGS cooperative water use estimation program so that all of the water use information could be compiled in a comprehensive and integrated manner.

Domestic Wells

In Nevada, domestic wells serve approximately 6 percent of the population and withdrawal about 18,000 acre-feet per year (less than 0.5 percent of total state water use). Domestic well usage is projected to increase to about 28,000 acre-feet per year by the year 2020. Though current and projected domestic well usage accounts for a small portion of the State's total water use, some domestic well issues require consideration in the planning process.

Issues
1. For developments created through parceling, the counties have the sole responsibility for determining whether or not water rights need to be dedicated. Some counties have passed ordinances which set forth water right dedication requirements. When deemed appropriate, the State Engineer notifies county commissions of the need for water rights dedication requirements for designated basins, and encourages them to pass appropriate ordinances.
2. Under the existing system, domestic well information may be limited in some basins.
3. Domestic well owners may have limited protection from declines in water levels. Further, domestic wells may not be drilled deep enough to provide protection from drought or interference from other groundwater users.
4. The quality of domestic water supplies have been impaired by septic tank discharges and other contaminants in some areas in Nevada. Limited funding is available to mitigate these situations.

Recommendations
1. The State Engineer should continue, as necessary, to notify counties of the potential impacts on water resources due to multiple parceling activities, and recommend the implementation of water rights dedication requirements for designated basins.
2. The State Engineer, in cooperation with local governments, should establish complete domestic

well inventories (location and number).

3. The Department of Conservation and Natural Resources should distribute educational material to existing and prospective domestic well owners regarding factors to consider when having a new well drilled or purchasing an existing well.
4. The State should support the installation or expansion of regional water supply and/or wastewater treatment systems in areas where the quality of domestic wells supplies have been impaired. The Legislature should consider modifying the AB198 Grants to Small Water Systems program or establishing a new program to provide funding for these new installations or expansions.

2 — WATER QUALITY

Nonpoint Source Pollution

The leading cause of water quality impairment is nonpoint source (NPS) pollution. Assessments indicate all major rivers in Nevada are impacted. Urban, agricultural and grazing lands are major source areas. Flow regulation and wetland and riparian area losses are factors also. NPS pollution occurs wherever water flowing across the land or underground picks up nutrients, salts, metals, organic material, soil, or chemicals and delivers the accumulated pollutants to streams, lakes, wetlands or ground water aquifers in amounts greater than natural background levels. The excess pollutants may result in nutrient enrichment, undesirable algae growth, higher total dissolved solids, turbidity, lower dissolved oxygen, pH changes, higher temperatures and increases in pathogenic microorganisms. These conditions negatively affect water supplies by fouling water systems and increasing treatment requirements and operation and maintenance costs. Aquatic ecosystems may also be impacted by nonpoint sources.

The Nevada Division of Environmental Protection (NDEP) administers regulatory and voluntary NPS programs. Pollution control regulations and permit programs have been implemented for septic systems, storm water systems and soil grading activities. Regulation of large animal feed lots is pending. Other actions include public education, support for local Best Management Practices (BMPs), water quality monitoring and source assessments, and interagency cooperation. Potential management options include a NPS pollution credit trading program and participation in the federal Clean Water Action Plan (CWAP). The CWAP offers incentives to states undertaking an interagency watershed management process to control NPS.

Nevada's NPS management approach relies on local and federal agency cooperation. Local agency measures entail master planning to protect sensitive lands, ordinances encouraging cluster development and open space retention, wider setbacks along water courses, impervious surface limits, and ordinances requiring BMPs. Several federal agencies are involved. The Environmental Protection Agency administers Clean Water Act section 319 which promotes state NPS planning. Federal land managers address NPS pollution with land use planning and permits. The U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service protect and manage wetlands. The Natural Resources Conservation Service provides NPS project funding and technical assistance to agricultural and suburban communities through incentive programs. The USGS maintains a monitoring program for water quality, sediment quality, and aquatic biota, and conducts water quality investigations and publishes related reports.

Issues

1. The 1998 Nevada Water Quality Assessment (305b) Report by the NDEP indicates that water quality does not meet some or all of the beneficial use standards on 775 miles of the 1,639 river miles assessed. NPS generally contributes the most to the impairment.
2. Cost is an obstacle to the implementation and acceptance of BMPs. Monitoring the effectiveness and costs of BMPs is essential to identifying least cost options. The Tahoe Bond Act of 1996 is the only state funding source for NPS projects.
3. The pollution control potential of wetlands and riparian areas has diminished. Regulations enhance agency efforts to halt wetland losses, but support for restoration is limited.
4. Expanding urban boundaries put pressure on wetlands, floodplains, and forest and range lands which adds to NPS pollution problems. Correcting NPS pollution after the fact is difficult and costly.

Recommendation

The management of nonpoint source pollution is an important water supply planning objective. To meet that objective, the following recommendation is offered.

1. The Nevada Division of Environmental Protection, in cooperation with other state agencies, should continue its nonpoint source program consisting of regulatory and voluntary measures, and coordination with federal, state, and local agencies, and the general public.

Comprehensive Ground Water Protection and Management

Aridity, complex hydrogeology, rapid population growth and diversifying public interests are factors driving a need for comprehensive ground water protection and management. Ground water provides about 40 percent of domestic, commercial, industrial, mining and agricultural water use. It also is a supply source for riparian, aquatic and certain upland ecosystems and recreational resources. Some aquifers are showing signs of water quality deterioration and increased use. Many different land uses release nitrates, pesticides, petro-chemicals and other pollutants. A pervasive contaminant from natural and human processes is dissolved solids (salinity). Naturally occurring contaminants also include metals, arsenic, boron, sulfates and radon.

Plans to increase ground water use often must address migration or contaminant concentration issues. The Nevada Division of Environmental Protection (NDEP) administers the Comprehensive State Ground Water Protection Program (CSGWPP). The program emphasizes interagency collaboration to meet objectives that complement existing regulations, address pollution control and remediation priorities, promote pollution prevention (e.g., wellhead protection program), and enhance public education. Mandatory and voluntary provisions of federal and state statutes, such as the Safe Drinking Water Act and Nevada Pesticides Act, are core elements of the CSGWPP.

The Nevada Division of Water Resources (NDWR) allocates, adjudicates, and manages ground water. Statutes emphasize protection of appropriative water rights and non-wasteful, beneficial use. The State Engineer may administer pumping limits or preferred uses where average annual recharge does not satisfy all water rights. Aquifers are recharged by natural, incidental or artificial mechanisms. Natural replenishment occurs slowly in Nevada's arid climate. Recharge areas are limited, so protective measures are an important land use planning consideration. Incidental recharge augments shallow ground water, but in the process may result in lower quality water in the aquifer. Artificial recharge projects have been permitted by the NDWR and NDEP for storage and recovery, control of water table declines, land subsidence management and quality improvement.

Shallow ground water may influence the quantity and quality of surface water available to flora and fauna. Ecological studies of some springs have found unique, long-lived aquatic species, a number of which are vulnerable or have become extinct due to ground water changes. Acquiring a better understanding and monitoring interactions between ground water and surface water, and ecosystem resiliency is a concern of the Nevada Division of Wildlife, the Nevada Natural Heritage Program and other agencies.

Water quality protections and appropriation of ground water rights by federal or local agencies is subject to Nevada water law. Federal and local agencies protect and manage ground water individually and cooperatively through the CSGWPP. Local governments may adopt ordinances, modify land use plans, and take other actions to protect ground water. Wellhead protection program work is ongoing in many communities, although some have encountered obstacles due to limited resources, data, and expertise. The U.S. Environmental Protection Agency created the CSGWPP framework in 1992 to encourage state action. The U.S. Geological Survey (USGS) conducts investigations and monitors levels and quality in some basins. The U.S. Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service and National Park Service address state ground water objectives in natural and recreational resource management plans and permits.

Issues

1. Water quality and quantity data is collected and stored by different agencies using varying formats. This creates access and use difficulties. Agencies acknowledge that improved data management is essential, but a comprehensive effort has been difficult to muster.
2. Water management decisions increasingly require monitoring data on ambient ground water conditions, trends, and interactions. A statewide monitoring network was proposed in 1978 by USGS and NDEP. Availability of agency resources has been an obstacle.
3. Ground water use has grown. A greater understanding of technical, scientific, economic and legal aspects of recharge/recovery options and recharge zone protections is needed.
4. Pollution from nonpoint sources may cause ground water quality impairment. Use of BMPs and other preventative measures can minimize impacts and contain higher, future mitigation and remediation costs. BMP implementation costs can be an obstacle to their acceptability.
5. High densities of septic systems and stock animals have been associated with ground water nitrate enrichment, often in developments approved through a review process known as "parceling." Evaluation of water quality impacts usually is not required in this process.
6. Some evidence suggests lowering of shallow water tables can impact the ecological integrity and health of riparian and aquatic resources. Inadequate scientific understanding may lead to unanticipated natural resource degradation and losses.
7. Chemical and physical properties make MTBE a threat to drinking water supplies. Utilities with wells near fueling facilities are concerned about present and future contamination risks.

Recommendations

1. The Department of Conservation and Natural Resources (Department) should continue to fully support the development and implementation by NDEP of the Comprehensive State Ground Water Protection Program (CSGWPP).
2. The Department should support the development of and funding for a more extensive, sophisticated and comprehensive ground water monitoring network as necessary to ensure that statutory water supply protection requirements and ground water management objectives are being met, including local recharge zone protection. The monitoring network should be a coordinated effort among state agencies, as well as cooperating federal and local agencies.
3. The NDEP should continue to evaluate MTBE and other gasoline additives with respect to the positive and negative impacts to both air quality and water quality, and the overall desirability of the use of such additives in Nevada.
4. The NDEP should continue to evaluate activities necessary to control sources of nitrate contamination, such as septic system discharges, which affect ground water.
5. The NDWP should research the possibility of modifying the AB 198 Grant Program or establishing a new program to fund the creation of new or expansion of existing public water systems where septic tank pollution of the ground water has become an issue.

3 — RESOURCE CONSERVATION AND RECREATION USES

Maintenance of Recreational Values

Water recreation in Nevada is growing. Nevada Division of State Parks (NDSP) reported about 3.2 million people visited state parks in 1997, a 22 percent increase over 1987. About 70 percent of the visits were to parks with water amenities. Estimated 1996 expenditures for fishing, hunting and wildlife watching were $211.1, $94.9, and $262.8 million, respectively. About 150,000 people fish in Nevada each year, according to Nevada Division of Wildlife (NDOW). Their registration data shows boating has grown 75 percent over the past decade. Recreation preferences are also changing. The number of registered personal water craft (e.g., jet skis) rose from 1,326 to 13,451 in the past decade, and wildlife watching activity is trending upward. The number of recreational water bodies with amenities are comparatively rare, so state parks are important to urban and rural communities. Thus, providing adequate supplies of suitable water for recreation resources is vital.

Recreation value has both intrinsic resource and economic components. Fish and wildlife habitat condition, water quality, number of fish caught, hunting prospects, biological diversity, aesthetics, and solitude are examples of intrinsic values. The intrinsic value people place on recreational experiences is difficult to measure precisely, yet it is an important consideration in managing natural resources for recreation. Estimations of intrinsic resource and economic values concentrate on monetary measures, such as the average dollar amount people spend traveling to and using parks (a proxy for “valuing” the enjoyment recreationists place on certain resources). A common economic measure is total expenditures for recreational goods and services.

State agencies have varied responsibilities for maintaining water recreation values. NDOW administers laws to protect, manage and conserve game, non-game and sensitive fishes, migratory waterfowl and other fauna. NDSP has taken a lead role in past statewide recreation planning. The Nevada Board of Wildlife Commissioners and NDOW recently completed a a strategic planning policy analysis for wetlands at state Wildlife Management Areas (WMAs) from which updated management plans will be developed. Strategic concerns identified by these agencies include: (1) competition among multiple users of public lands and land use changes to private land have resulted in impairment and loss of wetlands and riparian areas; (2) water management is the most important issue at most WMAs; (3) water resources are vital components of Nevada's recreational base and should be protected to maintain quantity, quality and accessibility; and (4) existing levels of outdoor recreation funding are inadequate to meet recreation needs. Efforts to address these issues are ongoing.

NDOW acquires strategic conservation easements, access agreements for private land with wildlife values (e.g., agricultural fields), and water rights. The State Engineer has approved state and federal water appropriation and water right transfer applications for recreation and wildlife uses, and works with NDOW to identify applications for uses that may impact recreation resources. Since 1987, $28 million has been spent to buy and improve state parks, some coming from the 1990 Question 5 Bond Initiative. Purchases include three ranches along the Carson River below Fort Churchill, construction of the South Fork Reservoir boat facilities and campground, Little Washoe Lake and development of day use facilities, and sewer and water systems upgrades in several parks. In addition, the Nevada Division of State Lands has acquired 8,000 acre feet of water rights for the Lahontan Valley wetlands on behalf of NDOW.

Recreation has become a major management emphasis on the 62 million acres in Nevada managed by the U.S. Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, Bureau of Indian Affairs, and National Park Service. Federal land managers have become more recreation-focused in their land and resource planning. State and federal agencies manage recreation values of these resources cooperatively.

Issues

1. Satisfying growing expectations for a range of water recreation choices, settings and amenities while protecting resource values presents significant management challenges.
2. Public interest in water supplies for recreation purposes has grown. Surface waters are fully appropriated, so innovative approaches to water allocation for recreation may be needed.
3. Urban areas are expanding up to public land boundaries, resulting in loss of access. More interagency cooperation with local planners could avoid or mitigate access issues.
4. The cost of agency operations per recreation user has increased while federal funding has fallen. Awards from the federal Land and Water Conservation Fund dropped from $3.2 million in 1979 to zero in 1995. New recreation funding strategies are needed.
5. Competition between recreation and other beneficial users for water access is growing. Recreation values should be considered in agency review of water project proposals.
6. The type and intensity of recreation uses may detrimentally affect unique, sensitive or outstanding waters. More monitoring of uses and resource values may be desirable.
7. Most water recreation occurs on public land managed by federal and state agencies. Greater

interagency coordination may enhance recreation planning and management.

Recommendations

The *1992 State Comprehensive Outdoor Recreation Plan* (*SCORP*) contains discussion of specific issues, policy recommendations and suggested actions that pertain to the broader issue of maintenance of recreation values. Recreation issues applicable to the state water plan are found in Chapter IV of the 1992 *SCORP*, Issues and Actions for the Next Five Years. In 1997 NDSP produced the State Park System Plan which describes operations and resources within the park system and its future. Another source of guidance on recreation values is the policies and plans developed by the Nevada Board of Wildlife Commissioners and the NDOW presented in the *Wetland Conservation Plan Applicable to Nine State Wildlife Management Areas* (1998). This plan focuses on wetland protection at WMAs, but recommendations may have applicability to wetlands statewide.

1. The Department of Conservation and Natural Resources (Department) should continue to periodically evaluate the state's water-based recreation resources, assess public demand for this type of recreation, and apply this information to state recreation planning and management efforts to improve customer satisfaction while protecting natural resources.
2. The Department should encourage public agencies to consider impacts to recreation resources and their values relative to existing and potential recreation uses, whenever modification to existing or new public water-related projects, such as dams, weirs and reservoirs, are proposed.
3. The Department should continue to seek opportunities to acquire water rights from willing sellers for recreational purposes, including enhancements for fish habitat, wildlife habitat, flat water recreation and river-based recreation, where consistent with an agency's management plans.
4. The Department should continue to seek new and additional sources of funding to enhance opportunities and maintain resources for recreation.
5. The Department should research the feasibility of alternative mechanisms the state could use to meet public water-based recreation needs, such as purchasing land adjacent to state-owned water bodies, and obtaining development rights, conservation easements, and land use agreements.
6. The Department should encourage and support the efforts of state, federal and local agencies in managing watersheds for protection and enhancement of a full complement of recreation values, in addition to the other natural resource conservation considerations.

Water for Wildlife and Environmental Purposes

Nevada water law has recognized instream beneficial uses for many years. "Minimum" instream flow is a supply planning criterion describing the least amount of water to meet instream beneficial uses, such as habitat for aquatic flora and fauna; water quality; and recreation. A concern is whether instream flows in Nevada are adequate to sustain the quantity and quality of natural resources.

Diverting water for human use is essential, yet the public also places a high value on its natural resources. The number of extinct, threatened, endangered or sensitive fishes may indicate a deficiency in water available to some aquatic ecosystems. Of 98 native fishes in Nevada, 11 are extinct or extirpated, 23 are threatened or endangered and 43 percent are sensitive (December 1998).

Other sensitive species include amphibians, mammals, insects, gastropods and birds. The vulnerability of so many species reflects the need for instream flow protection in some areas. Inadequate supplies of suitable water for sensitive species may exacerbate their vulnerability, and may result in added regulations and costs. By considering the integrated relationships of instream flow to species vulnerability, water quality, and recreation in water allocation decisions, such outcomes may be avoided.

Methods to assess water supply requirements for biota, recreation, aesthetics, and channel maintenance have been developed and used in Nevada. Equivalent methods exist to estimate minimum water supplies for other aquatic resources and for channel maintenance purposes (e.g., revegetation, flood flow capacity). Most upper basin stream segments are free-flowing, so efforts to assess instream flow needs may focus on select portions of water bodies during low flow periods. Agencies and conservation organizations have conducted instream flow assessments on a number of water bodies. However, instream flow assessment has not yet become a commonly used tool.

Divisions within the Department of Conservation and Natural Resources have administrative authority for state laws addressing water use and allocation, water quality, and fish and wildlife, and thus have a preeminent role managing water for resource conservation. The Nevada Division of Wildlife evaluates the potential instream flow impacts on fisheries due to proposed water use projects, and has bought water rights for reservoirs, wetlands, and streams. The Nevada Division of Water Resources has approved several applications from governmental agencies to appropriate new water or convert existing water rights to instream flow purposes. Federal agencies implementing environmental and resource management statutes on public lands and waters are important cooperators in instream flow protection, as are local and tribal agencies. Policies promoting measures to increase water supplies for resource conservation may need to include incentives or compensation to water right holders. Examples of current instream flow protection efforts in Nevada include:

- U.S. Fish and Wildlife Service (FWS) and Nevada Division of State Lands are implementing a plan to acquire water for 25,000 acres for Lahontan Valley Wetlands.
- Washoe County and the cities of Reno and Sparks have begun to purchase and transfer water rights to mitigate periodic water quality impairment on segments of the Truckee River.
- The Nature Conservancy, USFWS and Federal Water Master have worked out modified river operations to aid cottonwood regeneration on the lower Truckee River.
- U.S. Bureau of Land Management has studied Walker Lake inflow rates required to raise the water level and quality for at-risk native trout and habitat for waterfowl.

Issues

1. A large share of Nevada's biological diversity is associated with comparatively rare aquatic and riparian ecosystems. Difficulties stabilizing and reversing statewide trends in resource losses signals a need for greater conservation efforts.
2. The historic and potential future losses of sensitive aquatic, riparian and wetland species indicates that additional emphasis on proactive water supply planning and management for resource conservation is a matter of urgency.
3. Wildlife Commission policies direct NDOW to secure water to maintain adequate instream flow, minimum pools, wetlands, springs and seeps for wildlife and their habitats. Difficulties acquiring water rights may be encountered due to funding or staffing levels.

4. Obtaining instream flow rights may be a cost effective and durable approach to achieving many resource conservation objectives simultaneously. Appropriate incentives may stimulate implementation of measures that make water available for resource conservation.
5. Most surface water withdrawals are for agricultural uses. Acquiring water for instream flow would likely involve the agricultural industry and communities and impact their viability. An incentive program with technical assistance may facilitate a willing agricultural water user to undertake measures that make water available for resource conservation while minimizing or avoiding impacts on existing uses.
6. Management of threatened or endangered species has proven to be complex, controversial, and costly for the private and public sector. Proactive planning and actions could enhance the survival of sensitive species, thus avoiding difficult and expensive recovery strategies.
7. Assessments often focus on "minimum" instream flow for a particular resource objective rather than an "optimum," multi-objective approach. Comprehensive, integrated assessments should lead to greater ecosystem integrity and longer term survival of sensitive species.

Recommendations

To enhance the ongoing efforts of the state to enhance water supplies for resource conservation purposes and to encourage and facilitate public support, the following recommendations are offered.

1. The Department should seek legislative support for:
   - development of a comprehensive and integrated management plan for the purpose of prioritizing and coordinating interagency and interdisciplinary assessments of critical water needs for wildlife and environmental purposes;
   - adoption of a policy that actively encourages the purchase, lease or donation of existing water and storage rights for transfer to instream rights or to maintain lake or wetland areas;
   - establishment of a Water Rights Trust Fund to fund acquisition efforts; and
   - incentive programs for the restoration of impaired aquatic and riparian resources (e.g., "conservation for credits," see recommendations in the Conservation issue paper, Part 3, Section 1A).
2. The Department should convene a statewide working group of experts to identify alternative mechanisms for obtaining water supplies for resource conservation and examine the existing legal, institutional, and economic aspects of identified alternatives. In addition, the working group should develop guidelines and criteria to be used by the Department in planning and evaluating water resource projects, including dam construction, significant water transfers, and modifications to reservoir storage and operation plans.

4 — FLOOD MANAGEMENT

Flood Management in Nevada

All areas of Nevada are subject to flooding, either from rivers and streams or from flash floods emerging from canyon mouths at high velocities. As more land is built upon in the watersheds and alluvial fans, the severity of flooding and cost of flood recovery is increasing. Floodplain management consists of planning and implementing programs designed to alleviate the impact of flooding on people and communities. A key component of effective floodplain management is implementation of the National Flood Insurance Program (NFIP) at the local level. In 1998, 15 of 17 counties and numerous communities participate in the NFIP. Participation allows property owners to obtain federally subsidized flood insurance. In participating communities, the Federal Emergency Management Agency (FEMA) performs Flood Insurance Studies, and provides Flood Insurance Rate Maps (FIRMs). The FIRMs show the areas of the community subject to flooding.

Floodplain management can be achieved through both structural and non-structural measures. Structural controls include levees, detention basins, and dikes. Non-structural approaches include:

- Development of regional flood management plans;
- Mapping and study of historic flood prone areas;
- Acquisition and removal/relocation of repetitively flooded structures;
- Floodproofing;
- Flood forecasting and warning systems;
- Providing education and information to the local communities.

Issues

1. Consistent state-level assistance in implementing and enforcing floodplain management has not been available to the counties and communities in the state for several years. Lack of state assistance, combined with turnover in personnel and lack of training have made it difficult for some communities to comply with NFIP regulations.
2. Alluvial fan or flash flooding is unpredictable, and results in high velocity flows with great erosive capability. Alluvial fan flooding risks are typically either over- or under predicted due to disagreement on effective model for predicting flood flows and mapping alluvial fan flood zones among engineering and planning professionals.
3. Many of the FIRMs used for planning and permitting development are over five years old, and don't reflect current existing conditions. Rapid growth in areas of outdated flood maps may result in construction of structures in harm's way.
4. Coordination between state agencies and between state and local agencies was often inadequate in the past. Increased coordination is clearly an essential element in improving flood program effectiveness.
5. Floodplain management and mitigation must be considered an essential, on-going element in local and regional planning. In a presidentially declared disaster, FEMA sets aside a portion of the total reimbursed damages to fund mitigation work. The State has a Disaster Relief Fund, but funds for preventive mitigation are not currently available.
6. The state's model ordinance contains the minimum NFIP requirements for obtaining flood insurance which are general standards applicable nationwide. The model ordinance needs to be updated and enhanced to reflect the unique flooding conditions present in Nevada.

Recommendations

To further enhance floodplain management in Nevada, the following recommendations are proposed.

1. The State Legislature should amend NRS 540 which describes the duties of the Nevada Division of Water Planning, to include floodplain management. Formal recognition of the role assigned to the Division by the 1997 Legislature would enhance the Division's ability to administer the CAP and FMA programs.
2. The Nevada Division of Water Planning should coordinate participation of local, state, and

federal agencies to develop a procedure for quantifying alluvial fan flooding that is acceptable to engineering and planning professionals involved in floodplain management, as recommended by the Western Governors' Association**.** The Division should coordinate with the Nevada Bureau of Mines and Geology (NBMG) to incorporate fluvial geologic information into mapping flood-prone areas in the state.

3. The Nevada Division of Water Planning should develop a plan for reviewing, updating, and maintaining flood maps and research the potential for the state to participate in FEMA's proposed map modernization program as a Cooperating Technical Community in conjunction with the NBMG. Several communities in the state already have the capability to develop and maintain their flood maps digitally. This capability combined with the rapid growth in the state would make Nevada a good candidate for the map modernization program.
4. The Nevada Division of Water Planning should take a leadership role in improving coordination with all involved agencies (Nevada Division of Water Resources, Department of Transportation, Division of Emergency Management, Clark County Regional Flood Control District, regional water management districts, local community development agencies, community and county building departments, public works departments, etc.) to accomplish the following flood management objectives:
    a. Encourage complete statewide participation in the NFIP;
    b. Encourage participation in the Community Rating System;
    c. Encourage relocation of flood prone structures and restoration of natural floodplain functions;
    d. Encourage local communities to take advantage of the FIRM revision process; and
    e. Emphasize education on floodplain management strategies and flood-loss reduction.
5. The State should create a state-funded Flood Mitigation Fund separate from the Disaster Relief Fund (SB 218), as recommended by the Western Governors' Association. In a presidentially declared disaster, FEMA typically sets aside 15 percent of the total FEMA-reimbursed damages to be spent specifically on flood mitigation. Similarly, 15 percent of the state's $4 million Disaster Relief Fund ($600,000) should be set aside for preventive flood loss strategies.
6. The Nevada Division of Water Planning should continue development of a detailed statewide Flood Management Plan which addresses the unique flooding conditions experienced in Nevada. The plan will provide a guideline for communities to use in implementing their flood ordinances. A Flood Management Plan would be particularly helpful to the communities outside of the major urban centers.
7. The Nevada Division of Water Planning should revise the state's Model Ordinance (minimum standards) to include "lessons learned" from the 1997 flood event in northern Nevada and flash flooding events throughout the state, such as higher reference floor elevations for development in flood hazard areas, and more appropriate development and construction standards in known but unmapped alluvial fan areas. Further, the state should develop a set of recommended standards. At a minimum, local governments should adopt the revised Model Floodplain Ordinance and should be encouraged to adopt the recommended standards.
8. All communities should develop flood mitigation plans which identify flood hazards and flooding risks, and evaluate options for flood mitigation. High priority should be placed on relocation of flood-prone development, restoration of natural beneficial floodplain functions and the use of zoning and conservation easements to direct growth away from floodplains.

5 — WATER PLANNING AND MANAGEMENT

Watershed Planning and Management

As the state rapidly grows, so too does the intensity and diversity of land use activities which places greater demand on the finite land and scarce water resources. To keep pace, over the past 20 years state agencies have implemented regulatory and voluntary programs to achieve significant reductions in point and non-point sources of pollution; prevent contamination from hazardous waste sites; more efficiently allocate and manage water resources; and provide assistance, information and funding to local organizations for management of watershed resources. Increasing agency support for a watershed approach stems from a recognition that water resource problems involve a multitude of land use activities that are dispersed and cross political boundaries, and that impacts on the environment can be cumulative and persistent.

A watershed is an area within a hydrographic or river basin consisting of interconnected water sources and drainages, bounded by topographic highs or water divides. In a planning context, it is an area with boundaries set by stakeholders having interests in the water resources of a watershed.

At its best, a watershed management plan is *comprehensive* in terms of basin geography, political units, and water resources; *inclusive*, created by all stakeholders and attentive to their environmental, social, regulatory and economic goals; and *integrated*, taking stock of relationships between the quantity and quality of water and other natural resources and environmental criteria. The basic steps in watershed planning include stakeholder participation and expression of interests, problem identification, strategy development and evaluation, action and monitoring plan development, and periodic progress assessments and plan reevaluation.

Advantages to implementing a watershed management approach include:

1. A watershed is a logical geographic unit for water resource planning, permitting, reporting, and problem solving.
2. Management decisions are improved as agencies collaborate more on problem resolution.
3. Data collection resources are pooled, so data is more comprehensive, integrated and available.
4. Resources are better directed to priority issues or those portions of the basin where the greatest problems exist.
5. Funding and human resources can be better leveraged. Volunteers can be involved.
6. Program efficiencies are enhanced by coordinating workloads. For example, monitoring can be done by participants closest to the sites and reporting requirements can be consolidated.
7. Public participation is encouraged and public support for management actions is enhanced.
8. A wider array of experts and citizens is involved in an integrated problem-solving process. A diversity of disciplines involved leads to expanded management choices.
9. The prospects of more stringent regulatory standards or programs may be averted.

A foundation for watershed planning is rooted in state water laws. In the 1960's, the Nevada State Engineer's Office and the U.S. Geological Survey recognized the need for a systematic identification of the hydrographic areas in Nevada in order to effectively study, develop, allocate and manage the state's surface and ground water resources. The first hydrographic map was developed in 1968, and with minor revisions, continues to provide the basis for water planning, management and administration today. In the mid 1970's, the Nevada Division of Environmental Protection (NDWP) developed water quality management plans for the hydrographic basins under Clean Water Act (CWA), section 303. In the late 1970's and early 1980's, designated local agencies developed comprehensive wastewater management plans under CWA section 208 in Clark County, the Truckee River Basin, the Lake Tahoe Basin and the Carson River Basin using the basic principals for watershed planning.

The Department of Conservation and Natural Resources (Department) plays a leadership role in determining the extent to which watershed planning and management is instituted. Recently the Department coordinated various Divisions' involvement in watershed based actions include the Tahoe Presidential Forum and Truckee River Negotiated Settlement. Under the State Division of Conservation Districts' guidance and support, local Conservation Districts have facilitated plans and projects to conserve, protect, and enhance natural resources on a watershed basis. Examples of watershed planning include wellhead protection programs, the Truckee River Strategy Group, the Lake Mead Water Quality Forum and the Truckee River Water Quality Agreement. Another is the Nevada Ground Water Protection Task Force, a voluntary coordinating group of state, local and federal agencies which has begun efforts to define hydrographic basins with critical ground water quality concerns.

Most streams originate and ground water recharge occurs within upper and middle portions of watersheds managed by the U.S. Forest Service and U.S. Bureau of Land Management. In the past 30 years, several resource and land use laws have been enacted directing these and other federal agencies (e.g., Natural Resources Conservation Service) to make watershed management a high priority. The aim is to protect watershed values, such as riparian, wetland, and aquatic ecosystems, floodplains, water quality, water yield, soil stability, and agricultural lands. Since most water supply sources originate on watersheds managed by federal agencies, their participation in watershed planning and management is essential.

Issues

1. The watershed planning approach is already being implemented by various groups in Nevada. In order to apply these resources more effectively and efficiently, the Department of Conservation and Natural Resources is striving to improve coordination across divisions in a more integrated framework. It is anticipated that all agencies in DCNR could be involved in implementing certain recommendations listed below, as well as other agencies such as the Divisions of Health, Emergency Management, Agriculture and Minerals.
2. The application of a watershed planning approach to water resource problem solving is growing. Federal agencies and the Western Governors Association through the Western States Water Council promote and support it. Many local and regional planning efforts have been or will be initiated at a watershed level.
3. In principle, the watershed planning approach has applicability at the hydrographic basin level. Comprehensive and integrated water resource management can be accomplished by examining water resource linkages throughout a basin. The Department is well positioned to facilitate coordination across jurisdictions, land and resource management units, economic interests, and resource values. An integrated water basin plan provides a mechanism for focusing efforts,

disseminating viewpoints, summarizing actions, and articulating a set of goals and strategies with a timetable.

4. Department agencies and the Bureau of Health Protection Services are involved in federally co-funded grant and loan programs for watershed planning-related activities under the Clean Water and Safe Drinking Water Acts. In October 1997 the Clinton Administration announced the Clean Water Action Plan, which may provide federal funding to state, federal and local agencies implementing unified watershed assessments and restoration strategies. Other federal funding has been provided via direct Congressional appropriations. State agencies have supported watershed efforts through re-prioritization within programs, but few general fund appropriations have been made by the legislature to date to support these efforts. State funding could be used to train staff, and improve data gathering and dissemination, or as incentive grants to encourage local governments to participate in watershed planning.
5. Monitoring and assessment should be integral parts of all watershed management plans and can be used to determine:
   - whether planned restoration efforts have been implemented in the manner intended;
   - the effectiveness of implemented actions in achieving desired results;
   - the validity of the assumptions upon which management strategies were designed;
   - adjustments to restoration efforts that are needed due to changing conditions; and
   - the cost effectiveness of actions taken.

Recommendations

To further enhance watershed management and planning in Nevada, the following recommendations are offered:

1. The Department of Conservation and Natural Resources (Department) should develop an inter-division watershed planning and management strategy in order to more effectively play an active, participatory role in watershed planning when a water resource assessment indicates there is a need for this strategy or when a water planning group requests Department support.
2. The Department should support watershed planning at the local level.
3. The Department should continue to work together with local, regional and federal agencies and non-governmental organizations to develop and implement integrated water basin plans for Nevada's hydrographic regions.
4. The Department should support watershed planning groups with additional funding to assist in the development of integrated, broad-based and comprehensive watershed plans.
5. The Department should assist in the review of watershed management plans, evaluate whether goals or objectives are being achieved, strategic actions implemented and results monitored, and cooperatively recommend changes where monitoring results indicate a need for improvements.

Water Resources Data Management

Accurate and comprehensive water resource data are critical to planners and decision-makers at all levels of government, researchers, developers and the business community. Now more than ever, the increasing need to manage our precious natural resources is driving the need for more detailed water and natural resources data for many areas of the state.

At this time, state and federal agencies, counties, municipalities, universities and industries collect and maintain extensive water resource data. However, some of these data are not readily available to others, datasets may be missing information which decrease their usefulness to other agencies, or access is time consuming or cumbersome. As a result, planning and management efforts, such as development of the *State Water Plan*, become difficult. Many agencies are starting to address the data issue by providing data directories and data downloading capabilities through their Internet web sites. It is anticipated that the Internet will be the most significant tool for improving data sharing capabilities in the future.

Improved data development, collection, management, coordination and sharing offer direct and indirect benefits to all Nevadans. For example, decision-makers, planners, regulators and the public can become better informed which may lead to improved decisions, future *State Water Plan* releases can be improved, and the State's ability to assist local planning efforts can be enhanced (See "Water Planning Assistance to Local Governments" discussion in the *Summary* and Part 3 of the *State Water Plan*). Also, improved data access and sharing between agencies can result in reduced duplication of efforts, thereby saving tax dollars.

Issues

1. The State lacks a comprehensive plan to coordinate development and dissemination of temporal, textual and spatial (GIS) information.
2. Data accessibility needs to be enhanced. Some datasets are stored on paper or electronic spreadsheets which reduce their usefulness. Other datasets are managed using database systems but access may be restricted.
3. Without a comprehensive data inventory, potential users have difficulties identifying, locating and obtaining needed data.
4. Metadata (data about the data) are lacking in some instances, making it difficult for potential users to determine the appropriateness of the data for their particular purpose.
5. Data gaps exist in some areas due to the lack of a statewide groundwater quality and level monitoring network and a comprehensive statewide water use estimation program.
6. The lack of a comprehensive water use estimation program may impede state and local water planning efforts.
7. The maintenance of a viable stream gaging program is an integral part of managing our water resources.
8. Ongoing research of Nevada's water resources is needed for improved water management and planning. Current perennial yield estimates may be inaccurate for some basins and could be updated using newer technologies and methodologies.

Recommendations

The following recommendations are provided as possible means for improving water resources data management in Nevada:

1. The State should encourage and support agencies and local governments in the development of electronic databases for data currently stored on paper copies and in electronic spreadsheet files, and for future data collected. Data stored in spreadsheet files are more useful than data on paper, however the spreadsheet format does not lend itself to the types of manipulations possible with databases.

2. The State should create a new GIS task force of local, state and federal interests to evaluate in detail GIS issues and management needs. Their main task should be the development of a strategic plan which would address data coordination, collection and sharing needs, staffing and funding considerations, and provide recommendations to address these issues.
3. The State should support federal agencies, such as U.S. Geological Survey (USGS) and U.S. Environmental Protection Agency, in their efforts to provide Internet access to data. For instance, the Department of Conservation and Natural Resources should cooperate with the USGS to provide public access to USGS water quality data.
4. The Division of Water Planning should develop and maintain a detailed inventory of water resource datasets with Internet access to the inventory and access information. State agencies should develop and provide Internet sites for data sharing to the extent possible.
5. The State should support efforts by all groups to provide GIS data information via Nevada's connection to the National Geospatial Data Clearinghouse.
6. The State should encourage the development of metadata (information about the dataset) so that potential users can more easily determine the appropriateness of the data for their particular purpose.
7. The Department of Conservation and Natural Resources should develop and implement a groundwater quality and level monitoring network for priority basins. In some basins, water level information collected more frequently than once a year would be useful.
8. The State should improve water use measurement and estimation efforts through the program defined in the "Water Use Measurement and Estimation" issue discussion.
9. The Department of Conservation and Natural Resources should continue to support the cooperative agreements with the USGS for the funding of the stream gaging station network. Future efforts to discontinue existing gaging stations must be closely scrutinized.
10. The Department of Conservation and Natural Resources should continue to support further research projects as necessary, and should support efforts to update perennial yield estimates for priority basins.

Water Planning Assistance to Local Governments

Water planning by local governments is becoming more common and more necessary in response to increasing population, increasing competition for water, and natural resource concerns. Local governments are also realizing the need to plan the future of their land and water resources in a more comprehensive manner, involving all stakeholders in the process. Without a comprehensive water planning process, decisions may be made without full consideration of potential impacts to the watershed, the water resources, and other future needs and projects. Local water plans are not only useful to guide decisions related to internal proposals, but they can also guide responses to the activities of others such as water rights transfers, proposed housing or industrial developments, federal environmental impact statements and environmental assessments, and state and federal planning efforts.

Comprehensive water planning can be time consuming and costly to local governments. Many local governments have limited personnel and funding resources for water planning. The State currently has some programs to provide local water planning assistance but more could be done to facilitate local water planning efforts. State water planning assistance to local governments can occur in many forms. Examples of assistance include information and data sharing, financial support of local water planning efforts, review of local water planning documents, technical assistance, participation in local water planning efforts

Issues

1. Many smaller governmental entities have limited personnel and funding resources for the development of local water plans; participation in planning efforts by others, such as U.S. Bureau of Land Management and U.S. Forest Service, that may affect their region; and review and comment on federal environmental impact statements and environmental assessments for proposed projects in their area.
2. Because of limited funding and staffing at the State level, NDWP and other agencies are limited in their ability to provide a higher level of assistance to local water planning efforts.
3. Other issue discussions in the *State Water Plan* present related issues:
    - “Water Use Measurement and Estimation”: The lack of comprehensive detailed water use information for some regions may impede local planning efforts.
    - “Water Resource Data Development, Collection and Management”: Data availability and access limitations may hinder local planning.
    - “Watershed Planning and Management”: The State could further enhance watershed management and planning through additional measures.

Recommendations

The following recommendations are offered as mechanisms for improving the State’s support of local water planning activities:

1. The State should enhance local water planning assistance efforts through financial support and/or additional technical support from Division of Water Planning staff and other agencies.
2. The State should improve water use measurement and estimation efforts through the program defined in the “Water Use Measurement and Estimation” issue discussion.
3. The State should improve data management, coordination and sharing through the measures defined in the “Water Resources Data Development, Collection and Management” issue discussion.
4. The State should further enhance watershed management and planning in Nevada through the recommendation offered in the “Watershed Planning and Management” issue discussion.

Water Education

It is important that Nevada’s residents understand the fundamental science of water, how water is managed in the state, and the issues affecting water management. It is especially important that Nevada’s children learn about water so that they develop an appreciation for the unique role water plays in the development of our state and become informed citizens who can think critically and evaluate information intelligently throughout their lives. Water education must become a priority.

The state of Nevada has had a water education program in the Nevada Division of Water Planning since 1991. It includes components focusing on both children and adults, and incorporates a variety of methods and teaching aids. Project WET (Water Education for Teachers) is a science and math education enhancement program focused on grades K-12. The program provides teachers with a foundation in the science of water and current information on water resource issues affecting Nevada, with the goal of generating teacher interest, enthusiasm and ability to teach about water. Approximately 700 of 12,000 K-12 teachers have taken the 15-hour, 1-credit Project WET course. Nevada Project WET has no dedicated staff and has been dependent on grant funding. Over the last 7 years, the Division has raised close to $175,000 in grants, with a state contribution of about $15,000. In 1997, the state increased its financial support to $20,000 per year.

Other grant funded water education programs in the Division include: (1) *Nevada Riverwatch*, a student water quality monitoring program; (2) the *Water Education Calendar*, a publication of children's art work and water facts in a calendar format for distribution to elementary school classes; and (3) adult education including training seminars, conferences, events and specialty publications. Staff from other Divisions in the Department of Conservation and Natural Resources support water education as well, with seminars, conferences, grants and speaker's bureaus.

Issues

1. **Grant Funding – Administrative and Fiscal Support.** The Division of Water Planning's water education program has no staff and is dependent on grant funding. Grants require a large amount of administrative and fiscal support, both in applying for grants and tracking and accounting after a grant is awarded. State staff is necessary to coordinate and manage the water education programs, grants and contracts.
2. **Grant Funding – Match Requirements.** The limited availability of state dollars has limited the state's ability to qualify for grants because the Division cannot meet grant match requirements.
3. **Grant Funding – Start-Up.** Many federal grants are designed to provide startup funds, not long-term, continued funding. Federal granting agencies expect the state to pick-up support for the programs once they are up and rolling.
4. **Assessing the Value of Water Education**. According to a study recently published by the American Water Works Association, the cost of water education programs is quite low, ranging from 5 to 57 cents per household per year, especially as compared to the benefits provided. There is agreement that agencies must continue to look for ways to evaluate the effectiveness of their education programs, but that the long-term efficacy of such programs is probably not quantifiable.
5. **Coordination.** There are a number of groups working on water education goals throughout the state. Coordination of these groups could lead to greater effectiveness of the individual programs and increased funding opportunities.

Recommendations

1. The State should continue and enhance funding for the state water education program.
2. The State should create and fund a Water Education Coordinator position in the Division of Water Planning.
3. All organizations should continue to develop and implement methods to evaluate the effectiveness of their water education programs.
4. The Division of Water Planning should develop a water education coordination group to support water education programs, develop funding options, leverage dollars, share information, and

coordinate activities. Participants could include the University of Nevada – Cooperative Extension, public and private water utilities, the Nevada Rural Water Association, the U.S. Bureau of Reclamation, and the Nevada Department of Education and Divisions of Environmental Protection, Wildlife and Water Resources.

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Nevada Division of Water Planning

Nevada State Water Plan
SUMMARY

Section 8
Glossary of Terminology

[Source: Nevada Division of Water Planning's *Water Words Dictionary*. Words presented in italics and the referenced appendices may be found in the Dictionary. Words and definitions included in this glossary which explain or summarize elements of existing water law are not intended to change that law in any way.]

Acre-Foot (AF) — A unit commonly used for measuring the volume of water; equal to the quantity of water required to cover one acre (43,560 square feet or 4,047 square meters) to a depth of 1 foot (0.30 meter) and equal to 43,560 cubic feet (1,234 cubic meters), or 325,851 gallons.

Agricultural Water Use (Withdrawals) — Includes water used for irrigation and non-irrigation purposes. Irrigation water use includes the artificial application of water on lands to promote the growth of crops and pasture, or to maintain vegetative growth in recreational lands, parks, and golf courses. Non-irrigation water use includes water used for livestock, which includes water for stock watering, feedlots, and dairy operations, and fish farming and other farm needs.

(Prior) Appropriation Doctrine — The system for allocating water to private individuals used in the western United States under which (1) the right to water was acquired by diverting water and applying it to a beneficial use and (2) a right to water acquired earlier in time is superior to a similar right acquired later in time. The doctrine of *Prior Appropriation* was in common use throughout the arid west as early settlers and miners began to develop the land. The prior appropriation doctrine is based on the concept of *"First in Time, First in Right."* The first person to take a quantity of water and put it to *Beneficial Use* has a higher priority of right than a subsequent user. Under drought conditions, higher priority users are satisfied before junior users receive water. Appropriative rights can be lost through nonuse; they can also be sold or transferred apart from the land. Contrast with *Riparian Water Rights*.

Aquifer — (1) A geologic formation, a group of formations, or a part of a formation that is water bearing. (2) A geological formation or structure that stores or transmits water, or both, such as to wells and springs. (3) An underground layer of porous rock, sand, or gravel containing large amounts of water. Use of the term is usually restricted to those water-bearing structures capable of yielding water in sufficient quantity to constitute a usable supply.

Basin — (1) (Hydrology) A geographic area drained by a single major stream; consists of a drainage system comprised of streams and often natural or man-made lakes. Also referred to as *Drainage Basin*, *Watershed*, or *Hydrographic Region*. (2) (Irrigation) A level plot or field, surrounded by dikes, which may be flood irrigated. (3) (Erosion Control) A catchment constructed to contain and slow runoff to permit the settling and collection of soil materials transported by overland and rill runoff flows. (4) A naturally or artificially enclosed harbor for small craft, such as a yacht basin.

Beneficial Use (of Water) — (1) A use of water resulting in appreciable gain or benefit to the user, consistent with state law, which varies from one state to another. Most states recognize the following uses as beneficial:

[1] domestic and municipal uses;
[2] industrial uses;
[3] irrigation;
[4] mining;
[5] hydroelectric power;
[6] navigation;

[7] recreation;
[8] stock raising;
[9] public parks;
[10] wildlife and game preserves.

(2) The cardinal principle of the *(Prior) Appropriation Doctrine*. A use of water that is, in general, productive of public benefit, and which promotes the peace, health, safety and welfare of the people of the State. A certificated water right is obtained by putting water to a beneficial use. The right may be lost if beneficial use is discontinued. A beneficial use of water is a use which is of benefit to the appropriator and to society as well. The term encompasses considerations of social and economic value and efficiency of use. In the past, most reasonably efficient uses of water for economic purposes have been considered beneficial. Usually, challenges have only been raised to wasteful use or use for some non-economic purpose, such as preserving instream values. Recent statutes in some states have expressly made the use of water for recreation, fish and wildlife purposes, or preservation of the environment a beneficial use. Also see *Appropriative Water Rights*.

Best Management Practices (BMP) — Water conservation measures that generally meet one of two criteria: (1) Constitutes an established and generally accepted practice that provides for the more efficient use of existing water supplies or contributes towards the conservation of water; or (2) Practices which provide sufficient data to clearly indicate their value, are technically and economically reasonable, are environmentally and socially acceptable, are reasonably capable of being implemented by water purveyors and users, and for which significant conservation or conservation-related benefits can be achieved.

Biodiversity — Refers to the variety and variability of life, including the complex relationships among microorganisms, insects, animals, and plants that decompose waste, cycle nutrients, and create the air that we breathe. Diversity can be defined as the number of different items and their relative frequencies. For biological diversity, these items are organized at many levels, ranging from complete *Ecosystems* to the biochemical structures that are the molecular basis of heredity.

Clean Water Act (CWA) [Public Law 92–500] — More formally referred to as the *Federal Water Pollution Control Act*, the Clean Water Act constitutes the basic federal water pollution control statute for the United States. Originally based on the *Water Quality Act* of 1965 which began setting water quality standards. The 1966 amendments to this act increased federal government funding for sewage treatment plants. Additional 1972 amendments established a goal of zero toxic discharges and “fishable” and “swimmable” surface waters. Enforceable provisions of the CWA include technology-based effluent standards for point sources of pollution, a state-run control program for nonpoint pollution sources, a construction grants program to build or upgrade municipal sewage treatment plants, a regulatory system for spills of oil and other hazardous wastes, and a *Wetlands* preservation program (Section 404).

Clean Water Act (CWA), Section 319 — A federal grant program added by Congress to the CWA in 1987 and managed by the *U.S. Environmental Protection Agency (EPA)*, Section 319 is specifically designed to develop and implement state *Nonpoint Source (NPS) Pollution* management programs, and to maximize the focus of such programs on a watershed or waterbasin basis with each state. Today, all 50 states and U.S. territories receive Section 319 grand funds and are encouraged to use the funding to conduct nonpoint source assessments and revise and strengthen their nonpoint source management programs. Before a grant is provided under Section 319, states are required to: (1) complete a Nonpoint Source (NPS) Assessment Report identifying state waters that require nonpoint source control and their pollution sources; and (2) develop Nonpoint Source Management Programs that outline four-year strategies to address these identified sources.

Commercial Water Use (Withdrawals) — Water for motels, hotels, restaurants, office buildings, and other commercial facilities and institutions, both civilian and military. The water may be obtained from a public supply or may be self supplied. The terms “water use” and “water withdrawals” are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also see *Industrial Water Use (Withdrawals), Public Water Supply System* and *Self-Supplied Water*.

Conjunctive (Water) Use — (1) The operation of a groundwater basin in combination with a surface water storage and conveyance system. Water is stored in the groundwater basin for later use by intentionally recharging the basin during years of above-average water supply. (2) The combined use of surface and groundwater systems and sources to optimize resource use and prevent or minimize adverse effects of using a single source; the joining together of two sources of water, such as groundwater and surface water, to serve a particular use. (3) The integrated use and management of hydrologically connected groundwater and surface water.

Consumptive (Water) Use — (1) A use which lessens the amount of water available for another use (e.g., water that is used for development and growth of plant tissue or consumed by humans or animals). (2) A use of water that renders it no longer available because it has been evaporated, transpired by plants, incorporated into products or corps, consumed by people or livestock, or otherwise removed from water supplies. (3) The portion of water withdrawn from a surface or groundwater source that is consumed for a particular use (e.g., irrigation, domestic needs, and industry), and does not return to its original source or another body of water. The terms *Consumptive Use* and *Nonconsumptive Use* are traditionally associated with water rights and water use studies, but they are not completely definitive. No typical consumptive use is 100 percent efficient; there is always some return flow associated with such use either in the form of a return to surface flows or as a ground water recharge. Nor are typically nonconsumptive uses of water entirely nonconsumptive. There are evaporation losses, for instance, associated with maintaining a reservoir at a specified elevation to support fish, recreation, or hydropower, and there are conveyance losses associated with maintaining a minimum streamflow in a river, diversion canal, or irrigation ditch.

Cubic Feet Per Second (CFS) — A unit expressing rate of discharge, typically used in measuring streamflow. One cubic foot per second is equal to the discharge of a stream having a cross section of 1 square foot and flowing at an average velocity of 1 foot per second. It also equals a rate of approximately 7.48 gallons per second, 448.83 gallons per minute. 1.9835 acre-feet per day, or 723.97 acre-feet per year.

Cubic Feet Per Second Day (CFS-Day) — The volume of water represented by a flow of one cubic foot per second for 24 hours. It equals 86,400 cubic feet, 1.983471 acre-feet, or 646,317 gallons.

Designated Groundwater Basin [Nevada] — In the interest of public welfare, the Nevada State Engineer, *Division of Water Resources*, *Department of Conservation and Natural Resources*, is authorized by statute (Nevada Revised Statute 534.120) and directed to designate a ground water basin and declare *Preferred Uses* within such designated basin. The State Engineer has additional authority in the administration of the water resources within a designated ground water basin. [A listing of Nevada's Hydrographic Regions, and designated Areas and Sub-Areas is presented in the NDWP's *Water Words Dictionary* in Appendix A–1 (hydrographic regions, areas and sub-areas), Appendix A–2 (listed sequentially by area number) Appendix A–3 (listed alphabetically by area name), and Appendix A–4 (listed alphabetically by principal Nevada county(ies) in which located).]

Dewater, and Dewatering — (1) To remove water from a waste produce or streambed, for example. (2) The extraction of a portion of the water present in sludge or slurry, producing a dewatered product which is easier to handle. (3) (Mining) The removal of ground water in conjunction with mining operations, particularly open-pit mining when the excavation has penetrated below the ground-water table. Such operations may include extensive ground-water removal and, if extensive enough and if not re-injected into the groundwater, these discharges may alter surface water (stream) flows and lead to the creation of lakes and wetland areas.

Domestic Water Use (Withdrawals) — Water used normally for residential purposes, including household use, personal hygiene, drinking, washing clothes and dishes, flushing toilets, watering of domestic animals, and outside uses such as car washing, swimming pools, and for lawns, gardens, trees and shrubs. The water may be obtained from a public supply or may be self supplied. The terms "water use" and "water withdrawals" are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also referred to as *Residential Water Use*. Also see *Public Water Supply System* and *Self-Supplied Water*.

Domestic Well — A water well used solely for domestic, i.e., residential or household purposes to include both indoor and outdoor water uses. Such wells are generally not required to be permitted; however, they may have restrictions in terms of daily pumping amounts, for example, 1,800 gallons per day.

Drought — There is no universally accepted quantitative definition of drought. Generally, the term is applied to periods of less than average or normal precipitation over a certain period of time sufficiently prolonged to cause a serious hydrological imbalance resulting in biological losses (impact flora and fauna ecosystems) and/or economic losses (affecting man). In a less precise sense, it can also signify nature's failure to fulfill the water wants and needs of man.

Duty (of Water) — (1) The total volume of water per year that may be diverted under a vested water right. (2) The total volume of irrigation water required for irrigation in order to mature a particular type of crop. In stating the duty, the crop, and usually the location of the land in question, as well as the type of soil, should be specified. It also includes consumptive use, evaporation and seepage from on-farm ditches and canals, and the water that is eventually returned to streams by percolation and surface runoff. Also see *Alpine Decree [Nevada]*, *Orr Ditch Decree [Nevada]*, *Bench Lands [Nevada]*, and *Bottom Lands [Nevada]* for additional information and examples of specific water duties.

Ecosystem — A community of animals, plants, and bacteria, and its interrelated physical and chemical environment. An ecosystem can be as small as a rotting log or a puddle of water, but current management efforts typically focus on larger landscape units, such as a mountain range, a river basin, or a watershed. Also see *Biodiversity*.

Ecosystem Management — (Environmental) An approach to managing the nation's lands and natural resources which recognizes that plant and animal communities are interdependent and interact with their physical environment (i.e., soil, water, and air) to form distinct ecological units called *Ecosystems*. The fact that these ecosystems span jurisdictional and political boundaries necessitates a more comprehensive and unified approach to managing them. Implementing the initial stage of a government-wide approach to ecosystem management typically requires clarifying the policy goals and undertaking certain practical steps to apply the principles being considered to include:
- [1] Delineating the ecosystem;
- [2] Understanding the system(s) ecologies;
- [3] Making management choices;
- [4] Unifying disparate data and information needs and sources; and
- [5] Adapting management on the basis of new information.

Efficient Water Management Practices (EWMP)–Agricultural Water Use — The agricultural water use equivalent of *Best Management Practices (BMP)* as applied to urban water use, efficient water management practices cover the spectrum of methods to improve both the efficiency and conservation of agricultural water use by (1) enhancing irrigation management services, measurement, and accounting; (2) improving the physical system of irrigation delivery, distribution, and drainage; and (3) promoting the modification of and adjustments to the institutional system of water use by agricultural interests to include information and educational programs.

Endangered Species — Any plant or animal species threatened with extinction by man-made or natural changes throughout all or a significant area of its range; identified by the Secretary of the Interior as "endangered", in accordance with the 1973 *Endangered Species Act (ESA)*, below. [See Appendix D–1, Nevada's Endangered and Threatened Species.]

Endangered Species Act (ESA) — An act passed by Congress in 1973 intended to protect species and subspecies of plants and animals that are of "aesthetic, ecological, educational, historical, recreational and scientific value." It may also protect the listed species' "critical habitat", the geographic area occupied by, or essential to, the protected species. The *U.S. Fish and Wildlife Service (USFWS)* and the *National Marine Fisheries Service (NMFS)* share authority to list endangered species, determine critical habitat and develop recovery plans for listed species. Currently, approximately 830 animals and 270 plants are listed as endangered or threatened nationwide at Title 50, Part 17, sections 11 and 12 of the Code of Federal Regulations. Further, under a settlement with environmental groups, USFWS has agreed to propose listing another 400 species over the next few years. The 1973 Endangered Species Act superseded and strengthened the *Endangered Species Preservation Act* of 1966 and the *Endangered Species Conservation Act* of 1969. The 1973 provisions required that the act be re-authorized by Congress every five years.

Evapotranspiration (ET) — (1) The quantity of water transpired (given off), retained in plant tissues, and evaporated from plant tissues and surrounding soil surfaces. (2) The sum of *Evaporation* and *Transpiration* from a unit land area. (3) The combined processes by which water is transferred from the earth surface to the atmosphere; evaporation of liquid or solid water plus transpiration from plants. Evapotranspiration occurs through evaporation of water from the surface, evaporation from the capillary fringe of the groundwater table, and the transpiration of groundwater by plants (*Phreatophytes*) whose roots tap the capillary fringe of the groundwater table. The sum of evaporation plus transpiration.

"First in Time, First in Right" — A phrase indicating that older water rights have priority over more recent rights if there is not enough water to satisfy all rights. See *(Prior) Appropriation Doctrine* and *Appropriative Water Rights*.

Flood, or Flood Waters — (1) An overflow of water onto lands that are used or usable by man and not normally covered by water. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river, stream, lake, or ocean. (2) As defined, in part, in the *Standard Flood Insurance Policy (SFIP)*: "A general and temporary condition of partial or complete inundation of normally dry land areas from overflow of inland or tidal waters or from the unusual and rapid accumulation or runoff of surface waters from any source."

Flood, 100-Year — A 100-year flood does not refer to a flood that occurs once every 100 years, but rather to a flood level with a 1 percent or greater chance of being equaled or exceeded in any given year. Areas below the 100 year flood level are termed special flood hazard areas. Areas between the 100-year and the 500-year flood boundaries are termed *Moderate Flood Hazard Areas*. The remaining areas are above the 500-year flood level and are termed *Minimal Flood Hazard Areas*.

Forecast (Forecasting) — (Statistics) A forecast is a quantitative estimate (or set of estimates) about the likelihood of future events based on past and current information. This "past and current information" is specifically embodied in the structure of the econometric model used to generate the forecasts. By extrapolating the model out beyond the period over which it was estimated, we can use the information contained in it to make forecasts about future events. It is useful to distinguish between two types of forecasting, *ex post* and *ex ante*. In an *ex post* forecasts all values of dependent and independent variables are known with certainty and therefore provides a means of evaluating a forecasting model. Specifically, in an *ex post* forecast, a model will be estimated using observations excluding those in the *ex post* period, and then comparisons of the forecasts will be made to these actual values. An *ex ante* forecast predicts values of the dependent variable beyond the estimation period using values for the explanatory variables which may or may not be known with certainty.

Forecast Horizon — (Statistics) The number of time periods to be forecasted; also, the time period in the future to which forecasts are to be made.

Gage, or Gauge — (1) An instrument used to measure magnitude or position; gages may be used to measure the elevation of a water surface, the velocity of flowing water, the pressure of water, the amount of intensity of precipitation, the depth of snowfall, etc. (2) The act or operation of registering or measuring magnitude or position. (3) The operation, including both field and office work, of measuring the discharge of a stream of water in a waterway.

Gallons per Capita (Person) per Day (GPCD) — An expression of the average rate of domestic and commercial water demand, usually computed for public water supply systems. Depending on the size of the system, the climate, whether the system is metered, the cost of water, and other factors, *Public Water Supply Systems (PWSS)* in the United States experience a demand rate of approximately 60 to 150 gallons per capita per day. Also see *Gallons per Employee per Day (GED)* for information on the application of this concept to commercial water use by *Standard Industrial Classification (SIC) Code*. [See Appendix C–4, Gallons Per Capita Per Day (GPCD), Water Used for Public Water Supplies by State.]

Gallons per Employee (Worker) per Day (GED, or GPED) — A measure or coefficient expressing an area's commercial water use per worker (employee), typically for distinct industry sectors. It is based on an analytical technique for measuring and forecasting commercial water use in a service area based upon the unique, seasonal, business-related water use by specific industrial sectors. GED commercial water-use coefficients are typically developed based upon Standard Industrial Classifications (SIC) codes for which comparable commercial water use and employment data are available. For forecasting more frequently than annually, GED coefficients will incorporate seasonal patterns (monthly or quarterly) as well. By deriving forecasts of trends in industry sector employment and combining them with appropriate, industry-specific GED coefficients, relatively accurate forecasts of the corresponding commercial water use may be obtained.

Great Basin [Nevada] — An area covering most of Nevada and much of western Utah and portions of southern Oregon and southeastern California consisting primarily of arid, high elevation, desert valleys, sinks (playas), dry lake beds, and salt flats. The Great Basin is characterized by the fact that all surface waters drain *inward* to terminal lakes or sinks. Principal excluded regions within Nevada include the extreme north-central portion of the state whose waters drain northward into the Snake River Basin, thence to the Columbia River and finally to the Pacific Ocean, and the south-eastern portion of Nevada whose surface waters drain into the Colorado River Basin, thence to the Gulf of California (Mexico) and the Pacific Ocean.

Greywater (Graywater) — Wastewater from clothes washing machines, showers, bathtubs, hand washing, lavatories and sinks that are not used for disposal of chemicals or chemical-biological ingredients. Less commonly spelled *Graywater*.

Ground Water, also Groundwater — (1) Generally, all subsurface water as distinct from *Surface Water*; specifically, the part that is in the saturated zone of a defined aquifer. (2) Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper level of the saturate zone is called the Water Table. (3) Water stored underground in rock crevices and in the pores of geologic materials that make up the earth's crust. Ground water lies under the surface in the ground's *Zone of Saturation*, and is also referred to as *Phreatic Water*.

Hydrographic Area [Nevada] — The 232 subdivisions (256 *Hydrographic Areas* and *Hydrographic Sub-Areas*) of the 14 Nevada *Hydrographic Regions* as defined by the State Engineer's Office, Department of Conservation and Natural Resources, Division of Water Resources. Primarily these are sub-drainage systems within the 14 major drainage basins. Hydrographic Areas (valleys) may be further subdivided into Hydrographic Sub-Areas based on unique hydrologic characteristics (e.g., differences in surface flows) within a given valley or area. [A listing of Nevada's Hydrographic Regions, Areas and Sub-Areas is presented in Appendix A–1 (hydrographic regions, areas and sub-areas), Appendix A–2 (listed sequentially by area number) Appendix A–3 (listed alphabetically by area name), and Appendix A–4 (listed alphabetically by principal Nevada county(ies) in which located).]

Hydrographic Region [Nevada] — Nevada has been divided into 14 hydrographic regions or basins, which are now used by the Nevada Division of Water Resources, Department of Conservation and Natural Resources, and the U.S. Geological Survey (USGS) to compile information pertaining to water resources and water use. These regions are also further subdivided into 232 *Hydrographic Areas* (256 Hydrographic Areas and Sub-Areas, combined) for more detailed study. See *Basins [Nevada]*, for a complete listing and description of Nevada's 14 Hydrographic Regions.

Industrial Water Use (Withdrawals) — Industrial water use includes water used for processing activities, washing, and cooling. Major water-using manufacturing industries include food processing, textile and apparel products, lumber, furniture and wood products, paper production, printing and publishing, chemicals, petroleum, rubber products, stone, clay, glass and concrete products, primary and fabricated metal industries, industrial and commercial equipment and electrical, electronic and measuring equipment and transportation equipment. The terms "water use" and "water withdrawals" are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also see *Commercial Water Use (Withdrawals)*.

Instream Flow or Instream Use — (1) The amount of water remaining in a stream, without diversions, that is required to satisfy a particular aquatic environment or water use. (2) Nonconsumptive water requirements which do not reduce the water supply; water flows for uses within a defined stream channel. Examples of instream flows include:

- [1] ***Aesthetics*** — Water required for maintaining flowing steams, lakes, and bodies of water for visual enjoyment;
- [2] ***Fish and Wildlife*** — Water required for fish and wildlife;
- [3] ***Navigation*** — Water required to maintain minimum flow for waterborne commerce;
- [4] ***Quality Dilution*** — Water required for diluting salt and pollution loading to acceptable concentrations; and
- [5] ***Recreation*** — Water required for outdoor water recreation such as fishing, boating, water skiing, and swimming.

Interbasin Transfer (of Water) — A transfer of water rights and/or a diversion of water (either groundwater or surface water) from one *Drainage* or *Hydrographic Basin* to another, typically from the basin of origin to a different hydrologic basis. Also referred to as *Water Exports* and/or *Water Imports*.

Interstate Allocation [Nevada and California] — An agreement between the states of Nevada and California over the use of the waters of Lake Tahoe and the Truckee, Carson, and Walker rivers which was ratified by California (1970) and Nevada (1971), but was never ratified by Congress. Despite this, both states have enacted legislation to enforce to the allocation of the Truckee, Carson, and Walker rivers between these two states. Subsequently, in 1990 many of the compact's provisions dealing with the waters of Lake Tahoe and the Truckee and Carson rivers became formalized under *Public Law 101–618* (the *Negotiated Settlement*).

Interstate Water Compact — (1) Broadly, an agreement between two or more states regarding competing demands for a water resource which are beyond the legal authority of one state alone to solve. (2) States administer water rights within their own political boundaries; however, the process becomes more complicated when it involves an interstate body of water (*Interstate Water*). Under these conditions there are three possible ways to achieve an interstate allocation of water: (1) A suit for equitable apportionment brought by the states in the U.S. Supreme

Court; (2) a Congressional act; and (3) an interstate compact. An interstate compact is an agreement negotiated between states, adopted by their state legislatures, and then approved by Congress. Once an allocation of interstate water is determined by such a means, the individual states may then issue water rights to its share of the water through their normal administrative process. Interstate compacts have been traditionally used in making water allocations in the western states. Also see *Interstate Allocation [Nevada and California]*.

Intrabasin Transfer (of Water) — Transfers of water within the same water basin or hydrographic area.

Irrigation Water Use (Withdrawals) — Artificial application of water on lands to assist in the growing of crops and pastures or to maintain vegetative growth on recreational lands, such as parks and golf courses. The terms "water use" and "water withdrawals" are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also see *Irrigation Return Flow*.

Junior (Water) Rights — A junior water rights holder is one who holds rights that are temporarily more recent than senior rights holders. All water rights are defined in relation to other users, and a water rights holder only acquires the right to use a specific quantity of water under specified conditions. Therefore, when limited water is available, junior rights are not met until all senior rights have been satisfied. See *Prior Appropriation Doctrine*.

Land Subsidence — (1) The sinking or settling of land to a lower level in response to various natural and man-caused factors. (1) With respect to ground water, subsidence most frequently results from overdrafts of the underlying water table or aquifer and its inability to fully recharge, a process termed *Aquifer Compaction*. Also see *Subsidence*.

Livestock Water Use — Water use for stock watering, feed lots, dairy operations, fish farming, and other on-farm needs. Livestock as used here includes cattle, sheep, goats, hogs, and poultry. Also included are such animal specialties as horses, rabbits, bees, pets, fur-bearing animals in captivity, and fish in captivity. Also see *Rural Water Use*.

Methyl Tertiary Butyl Ether (MTBE) — A oxygenate and gasoline additive used to improve the efficiency of combustion engines in order to enhance air quality and meet air pollution standards. MTBE is a product of petroleum refining that has been added to gasoline nationwide since the late 1970's as an octane booster. Following federal actions in the early 1990's, refiners began adding more MTBE to clean up the air. Current federal law requires some minimum amount of an oxygenate in gasoline sold in areas that do not meet air quality standards. The *U.S. Environmental Protection Agency (EPA)* considers MTBE a possible human carcinogen. In addition to being a suspected carcinogen, MTBE also pollutes waters, particularly by personal watercraft using two-stroke marine engines. More recently, leaking gasoline storage tanks containing MTBE have been found to cause contamination of nearby municipal water wells forcing their closure. MTBE has been found to mix and move more easily in water than many other fuel components, thereby making it harder to control, particularly once it has entered surface or ground waters.

Municipal and Industrial (M & I) Water Withdrawals (Use) — Water supplied for municipal and industrial uses provided through a municipal distribution system for rural domestic use, stock water, steam electric powerplants, and water used in industry and commerce.

National Environmental Policy Act (NEPA) — A 1970 Act of Congress that requires all federal agencies to incorporate environmental considerations into their decision-making processes. The act requires an *Environmental Impact Statement (EIS)* for any "major federal action significantly affecting the quality of the human environment."

National Flood Insurance Program (NFIP) — A federal program enabling property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is based on an agreement between local communities and the federal government that if a community will implement and enforce measures to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHA), then the federal government will make flood insurance available to protect against flood losses that do occur. The NFIP was established by Congress through the passage of the National Flood Insurance Act of 1968. Features of the program were modified and extended with the 1973 passage of the Flood Disaster Protection Act, and other legislative measures. The NFIP is administered by the Federal Insurance Administration (FIA), which is a component part of the *Federal Emergency Management Agency*

(FEMA).

Navigable Waters [Nevada] — In Nevada bodies of water are navigable if they are used, or are susceptible of being used, in their ordinary condition as highways for commerce, over which trade and travel are or may be conducted in the customary modes of trade and travel on water. In Nevada, this test of navigability (*State of Nevada v. Julius Bunkowski, et al.*, 1972) held that the Carson River was navigable, and therefore the State of Nevada owned its bed, as logs were floated down the river from about 1860 to 1895 (the commerce requirement).

Non-Point Source (NPS) Pollution — (1) Pollution discharged over a wide land area, not from one specific location. (2) Water pollution caused by diffuse sources with no discernible distinct point of source, often referred to as runoff or polluted runoff from agriculture, urban areas, mining, construction sites and other sites. These are forms of diffuse pollution caused by sediment, nutrients, organic and toxic substances originating from land use activities, which are carried to lakes and streams by surface runoff.

Perennial Yield (Ground Water) — The amount of usable water of a ground water reservoir that can be withdrawn and consumed economically each year for an indefinite period of time. It cannot exceed the sum of the *Natural Recharge*, the *Artificial* (or *Induced*) *Recharge*, and the *Incidental Recharge* without causing depletion of the groundwater reservoir. Also referred to as *Safe Yield*.

Perfected Water Right — (1) A completed or fully executed water right. A water right is said to have been perfected when all terms and conditions associated with it have been fully accomplished, e.g., the diversion has been effected and the water applied to beneficial use. (2) A water right to which the owner has applied for and obtained a permit, has complied with the conditions of the permit, and has obtained a license or certification of appropriation. (3) A water right which indicates that the uses anticipated by an applicant, and made under permit, were made for *Beneficial Use*. Usually it is irrevocable unless voluntarily canceled or forfeited due to several consecutive years of nonuse. Also referred to as a *Certified Water Right*. Also see *Appropriation Doctrine*.

Permit — (1) (Water Right) A written document which grants authority to take unused water and put it to *Beneficial Use*. If all requirements of the permit are satisfied, then the permit for water appropriation can mature into a license or *Perfected Water Right*. (2) (Discharge) A legally binding document issued by a state or federal permit agency to the owner or manager of a point source discharge. The permit document contains a schedule of compliance requiring the permit holder to achieve a specified standard or limitation (by constructing treatment facilities or modifying plant processes) by a specified date. Permit documents typically specify monitoring and reporting requirements to be conducted by the applicant as well as the maximum time period over which the permit is valid. Also see *Application, Water Right*.

Permit, Water [Nevada] — The written permission from the state engineer to appropriate public waters for a beneficial use from a surface or underground source, at a specific point of diversion, under limited circumstances. If all requirements of the permit are satisfied, then the permit for water appropriation can mature into a license or *Perfected Water Right*. Also see *Permitted Water Right [Nevada]*, and *Application, Water Right*.

Planning — A comprehensive study of present trends and of probable future developments, together with recommendations of policies to be pursued. Planning embraces such subjects as population growth and distribution; social forces; availability of land, water, minerals, and other natural resources; technological progress; and probable future revenues, expenditures, and financial policies. Planning must be responsive to rapidly changing conditions.

Planning Horizon — The overall time period considered in the planning process that spans all activities covered in or associated with the analysis or plan and all future conditions and effects or proposed actions which would influence the planning decisions.

Point Source (PS) Pollution — (1) Pollution originating from any discrete source. (2) Pollutants discharged from any distinct, identifiable point or source, including pipes, ditches, channels, sewers, tunnels, wells, containers of various types, concentrated animal-feeding operations, or floating craft. Also referred to as *Point Source of Pollution*. Also see *Non-Point Source (NPS) Pollution*.

Preferred Use [Nevada] — In the interest of public welfare, the state engineer is authorized and directed to designate preferred uses of water within the respective areas so designated by him and from which the ground water is being depleted. In acting on applications to appropriate ground water, the State Engineer may designate preferred uses in different categories: domestic, municipal, quasi-municipal, industrial, irrigation, mining and stock-watering uses and any uses for which a county, city, town, public water district or public water company furnishes the water.

Prescribed Water Rights — (1) Water rights to which legal title is acquired by long possession and use without protest of other parties. (2) Water use rights gained by trespass or unauthorized taking that ripen into a title; on a par with rights to land gained through adverse possession. To perfect the right, the use of water must be adverse, hostile, open and continuous for five continuous years against the recognized water rights holder. Contrast with *Appropriative Water Rights*, *Riparian Water Rights*, and *Littoral Water Rights*.

Prior Appropriation Doctrine — (1) A concept in water law under which a right to a given quantity of water is determined by determining the earliest *Priority Date*. (2) The system for allocating water to private individuals used in most of the western United States. The doctrine of *Prior Appropriation* was in common use throughout the arid west as early settlers and miners began to develop the land. The prior appropriation doctrine is based on the concept of *"First in Time, First in Right"*. The first person to take a quantity of water and put it to *Beneficial Use* has a higher priority of right than a subsequent user. Under drought conditions, higher priority users are satisfied before junior users receive water. Appropriative rights can be lost through nonuse; they can also be sold or transferred apart from the land.

Priority — The concept that the person first using water has a better right to it than those commencing their use later. An appropriator is usually assigned a "priority date". However, the date is not significant in and of itself, but only in relation to the dates assigned other water users from the same source of water. Priority is only important when the quantity of available water is insufficient to meet the needs of all those having a right to use water. See *(Prior) Appropriation Doctrine* and *Appropriative Water Rights*.

Project WET (Water Education for Teachers) [Nevada] — A statewide supplementary, interdisciplinary water education program with components for the education community (K–12) and the general public. The goal of *Nevada Project WET* is to facilitate and promote the awareness, appreciation, knowledge, and stewardship of Nevada's water resources through the development and dissemination of classroom ready teaching aides, teacher training, learning materials, and demonstration models as well as the maintenance of a resource bureau. The program is designed to provide useful, unbiased information in a straight-forward, neutral fashion addressing a wide variety of water-related topics.

Public Interest, or Public Welfare — An interest or benefit accruing to society generally, rather than to any individuals or groups of individuals in the society. In many states, a permit to appropriate water must be denied if the appropriation would be contrary to the public interest or public welfare. These terms are sometimes vague and state engineers or others administering the water permit systems generally have viewed narrowly the authority granted under such provisions. In some cases they have restricted their consideration to matters of economic efficiency or the effects of the proposed appropriation on existing or future use for the water and have not considered such things as the environmental effects. However, recent developments, such as state environmental policy acts or legislation addressing specific public interest criteria, have placed new emphasis on this issue. Also see *Public Trust Doctrine*.

Public Scoping — The process of soliciting public comments on the issues to be examined in environmental documents such as an *Environmental Impact Statement (EIS)* or water planning documents. The process can be carried out by public meetings, soliciting written comments, or both. The identification of issues, alternatives, impacts, mitigation and/or monitoring all may be addressed during the scoping process.

Public Supply Water — (1) Water withdrawn for all users by public and private water suppliers and delivered to users that do not supply their own water. (2) Water withdrawn by and delivered to a public water system regardless of the use made of the water. Includes water supplied both by large municipal systems and by smaller quasi-municipal or privately-owned water companies. Water suppliers provide water for a variety of uses, such as *Domestic Water Use* (also referred to as *Residential Water Use*), *Commercial Water Use*, *Industrial Water Use*, *Thermoelectric Power Water Use* (domestic and cooling purposes), and *Public Water Use*.

Public Trust Doctrine — (1) A vaguely defined judicial doctrine under which the state holds its navigable waters and underlying beds in trust for the public and is required or authorized to protect the public interest in such waters. All water rights issued by the state are subject to the overriding interest of the public and the exercise of the public trust by state administrative agencies. (2) Based in Roman Law, the Public Trust Doctrine holds that certain resources belong to all the people and are therefore held in trust by the state for future generations. Since the 1970s, court rulings have expanded the concept of public trust to protect not only the traditional uses of navigation, commerce, and fishing, but also ecological preservation, open space maintenance, and scenic and wildlife habitat preservation. In a 1983 landmark ruling by the California Supreme Court (*National Audubon Society v. Superior Court of Alpine County*), the court held that water right licenses held by the City of Los Angeles and its Department of Water and Power to divert water from streams tributary to Mono Lake remain subject to ongoing State of California supervision under the public trust doctrine and could be curtailed or revoked, if necessary, to protect the public trust. The court held that public trust uses must be considered and balanced when the rights to divert water away from *Navigable* bodies of water are to be considered. Therefore, in issuing or reconsidering any rights to appropriate or divert water, the state must balance public trust needs with the needs for other beneficial uses of water. Also see *Equal Footing Doctrine (U.S. Constitution)* and *Public Interest, or Public Welfare*.

Public Water Use — Water supplied from a *Public Water Supply System (PWSS)* and used for such purposes as fire fighting, street washing, and municipal parks, golf courses, and swimming pools. Public water use also includes system water losses (water lost to leakage) and brine water discharged from desalination facilities. Also referred to as *Utility Water Use*.

Reasonable Use — A rule with regard to percolating or riparian water restricting the landowner to a reasonable use of his own rights and property in view of and qualified by the similar rights of others, and the condition that such use not injure others in the enjoyment of their rights.

Reasonable Use Theory — A *Riparian Owner* may make reasonable use of his water for either natural or artificial wants. However, he may not so use his rights so as to affect the quantity of quality of water available to a lower riparian owner.

Reservation Doctrine, Reserved Rights Doctrine, and Winters Doctrine (or Winters Rights) — The legal rule which states that when the United States reserves public lands for a particular purpose it also reserves sufficient water to accomplish that purpose. Those who initiate water rights after the date of the reservation are subject to the reserved right. The doctrine was first announced by the United States Supreme Court in the case of *Winters v. United States*, 207 U.S. 564 (1908), involving a dispute between an Indian reservation and a rancher. For many years it was thought that the doctrine only applied to Indian reservations, but in recent years it has been extended to other types of federal reservations, such as national parks and forests. Also see *Winters Rights (Decision)* and *Practicably Irrigable Acreage (PIA)*.

Reserved Water Rights (Federal) — (1) A category of federal water rights, created by federal law and recognized by judicial decision. These rights are created when the federal government withdraws land from the public domain to establish a federal reservation such as a national park, forest, or Indian reservation. By this action, the government is held to have reserved water rights sufficient for the primary purpose for which the land was withdrawn. (2) This class of water rights is a judicial creation derived from *Winters v. United States* (207 U.S. 564, 1907) and subsequent federal case law, which collectively hold that when the federal government withdraws land from general use and reserves it for a specific purpose, the federal government by implication reserves the minimum amount of water unappropriated at the time the land was withdrawn or reserved to accomplish the primary purpose of the reservation. Federal reserved water rights may be claimed when Congress has by statute withdrawn lands from the public domain for a particular federal purpose or where the President has withdrawn lands from the public domain for a particular federal purpose pursuant to congressional authorization. The right to such water is not lost by nonuse, and its priority date is the date the land was set aside. Also see *Winters Rights (Decision)*, *Reservation Doctrine, Reserved Rights Doctrine, and Winters Doctrine (or Winters Rights)*, and *Water Law [Federal]*.

Residential Water Use — Water used normally for residential purposes, including household use, personal hygiene, and drinking, watering of domestic animals, and outside uses such as car washing, swimming pools, and for lawns, gardens, trees and shrubs. The water may be obtained from a public supply or may be self supplied. Also referred to as *Domestic Water Use*. Also see *Public Water Supply System* and *Self-Supplied Water*.

Riparian — Pertaining to the banks of a river, stream, waterway, or other, typically, flowing body of water as well as to plant and animal communities along such bodies of water.

Riparian Areas (Habitat) — (1) Land areas directly influenced by a body of water. Usually such areas have visible vegetation or physical characteristics showing this water influence. Stream sides, lake borders, and marshes are typical riparian areas. Generally refers to such areas along flowing bodies of water.

Riparian Doctrine — The system for allocating water used in England and the eastern United States, in which owners of lands along the banks of a stream or water body have the right to *Reasonable Use* of the waters and a *Correlative Right* protecting against unreasonable use by others that substantially diminishes the quantity or quality of water. The right is appurtenant to the land and does not depend on prior use. Under this doctrine, ownership of land along a stream or river (i.e., riparian lands) is an absolute prerequisite to a right to use water from that body of water and each such landowner has an equal right to withdraw "reasonable" amounts of water (whether or not he is presently using it or not) so long as downstream landowners are not unreasonably damaged. Contrast with *Prior Appropriation Doctrine*.

Riverine — (1) Relating to, formed by, or resembling a river including tributaries, streams, brooks, etc. (2) Pertaining to or formed by a river; situated or living along the banks of a river, for example, a "riverine ore deposit." Also see *Riparian*.

Safe Drinking Water Act [SDWA] (Public Law 93–523) — An amendment to the *Public Health Service Act* which established primary and secondary quality standards for drinking water. The SDWA was passed in 1976 to protect public health by establishing uniform drinking water standards for the nation. In 1986 SDWA Amendments were passed that mandated the *U.S. Environmental Protection Agency (EPA)* to establish standards for 83 drinking water contaminants by 1992 and identify an additional 25 contaminants for regulation every 3 years thereafter.

Senior Rights — A senior rights holder is one who holds rights that are older (more senior) than those of junior rights holders. All water rights are defined in relation to other users, and a water rights holder only acquires the right to use a specific quantity of water under specified conditions. Thus, when limited water is available, senior rights are satisfied first in the order of their *Priority Date*.

Snowpack Telemetry (SNOTEL) — A remote, automated measurement system operated and maintained by the *Natural Resources Conservation Service (NRCS)* in the western United States to assess snowpack accumulation and potential streamflows. The concept is based upon the relationship between the water content in the snowpack and spring runoff under certain assumptions. Forecasts of runoff are made through the coordination of hydrologists with the NRCS and the *National Weather Service (NWS)*. A typical SNOTEL site consists of: (1) a precipitation measurement tube which measures the actual level of precipitation in inches of equivalent water; (2) a snow "pillow" which measures the weight of the snowpack and therefore its water content, and (3) the measurement and transmitting equipment which send the data to NRCS collection offices.

Socioeconomics — The study of the economic, demographic, and social interactions of humans.

Stream — A general term for a body of flowing water; natural water course containing water at least part of the year.

Subsidence — (1) The sinking of the land surface due to a number of factors, of which groundwater extraction is one. (2) A sinking of a large area of the earth's crust. Typically this may result from the over-pumping of a basin's water table and the inability of the soils to re-absorb water from natural or artificial injection. Also frequently results from overdrafts of the aquifer and its inability to fully recharge, a process termed *Aquifer Compaction*. Also see *Land Subsidence*.

Surface Water — (1) An open body of water such as a stream, lake, or reservoir. (2) Water that remains on the earth's surface; all waters whose surface is naturally exposed to the atmosphere, for example, rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc., and all springs, wells, or other collectors directly influenced by surface water. (3) A source of drinking water that originates in rivers, lakes and run-off from melting snow. It is either drawn directly from a river or captured behind dams and stored in reservoirs. Also see *Ground Water Under the Direct Influence (UDI) of Surface Water*.

Thermoelectric (Power) Water Use — Water used in the process of the generation of *Thermoelectric Power*. The water may be obtained from a *Public Water Supply System* or may be self supplied. Also see *Self-Supplied Water*.

Total Dissolved Solids (TDS) — (Water Quality) A measure of the amount of material dissolved in water (mostly inorganic salts). Typically aggregates of carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, etc. of calcium, magnesium, manganese, sodium, potassium, and other cations which form salts. The inorganic salts are measured by filtering a water sample to remove any suspended particulate material, evaporating the water, and weighing the solids that remain. An important use of the measure involves the examination of the quality of drinking water. Water that has a high content of inorganic material frequently has taste problems and/or water hardness problems. The common and synonymously used term for TDS is "salt". Usually expressed in milligrams per liter.

Transfer (Water Right) — (1) The process of transferring a water right from one person to another. (2) A passing or conveyance of title to a water right; a permanent assignment as opposed to a temporary lease or disposal of water. Most states require that some formal notice or filing be made with an appropriate state agency so that the transaction is officially recorded and the new owner is recorded as the owner of the water right.

Turbidity — A measure of the reduced transparency of water due to suspended material which carries water quality implications. The term "turbid" is applied to waters containing suspended matter that interferes with the passage of light through the water or in which visual depth is restricted. The turbidity may be caused by a wide variety of suspended materials, such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, plankton and other microscopic organisms and similar substances.

Usufructuary (Water) Right — (1) A right to use rather than own the property of another, such as the state's water. (2) A water right holder's authority to divert and use a certain amount of water. See *Usufruct*.

Vested Water Right — (1) The water right to use either surface or ground water acquired through more or less continual beneficial use prior to the enactment of water law pertaining to the source of the water. These claims become final through *Adjudication*. (2) A fully executed or finalized appropriative right to use the waters of a state for a beneficial purpose. Also see *Certificated Water Right* and *Perfected Water Right*.

Water Administration (and Management) — A broad term referring to the collective role of defined state agencies to implement state and federal water laws, commonly through the development and implementation of appropriate statutes and regulations. This role can include oversight, approval, and enforcement responsibilities.

Water Banking — A water conservation and use optimization system whereby water is reallocated for current use or stored for later use. Water banking may be a means of handling surplus water resources and may involve aquifer recharge or similar means of storage. Typically, under such arrangements, an agency is created with the authority to purchase, sell, hold, and transfer water and water rights in addition to serving as a negotiator between buyers and sellers. Generally, participants in water banking arrangements will have their water rights protected from cancellation (non-beneficial use) for a specific period so long as their water is "deposited" in the water bank. Also see *Water Marketing*.

Water Conservation — The physical control, protection, management, and use of water resources in such a way as to maintain crop, grazing, and forest lands, vegetative cover, wildlife, and wildlife habitat for maximum sustained benefits to people, agriculture, industry, commerce, and other segments of the national economy. The extent to which these actions actually create a savings in water supply depends on how they affect new water use and depletion.

Water Duty [Nevada] — The *Alpine Decree* and *Orr Ditch Decree* provide the basis for virtually all irrigation water duties relating to water diversions from the Truckee, Carson, and Walker rivers in Northern Nevada. These decrees provide for an annual maximum irrigation duty of 4.5 acre-feet per acre for water-righted *Bench Lands* and 3.5 acre-feet per acre for water-righted *Bottom Lands* delivered to farm headgates. These duties are based on the *Crop Water Requirement* on the irrigation of alfalfa, as it is the most prominent crop and the highest water-using crop grown in the *Newlands (Irrigation) Project* in west-central Nevada. However, neither decree identifies lands as to bottom or bench lands.

Water Importation — The act or process whereby water is brought into an area or region which would not naturally receive such waters. Typically, it refers to the artificial transport of water through aqueducts, canals, or pipelines from one water basin, drainage area, county or *Hydrographic Area* to another, thereby affecting the natural surface and groundwater drainage and flow patterns in both the water exporting and importing areas.

Water Management — (1) (General) Application of practices to obtain added benefits from precipitation, water, or water flow in any of a number of areas, such as irrigation, drainage, wildlife and recreation, water supply, watershed management, and water storage in soil for crop production. Includes *Irrigation Water Management* and *Watershed Management*. (2) (Irrigation Water Management) The use and management of irrigation water where the quantity of water used for each irrigation is determined by the water-holding capacity of the soil and the need for the crop, and where the water is applied at a rate and in such a manner that the crop can use it efficiently and significant erosion does not occur. (3) (Watershed Management) The analysis, protection, development, operation, or maintenance of the land, vegetation, and water resources of a drainage basin for the conservation of all its resources for the benefit of its residents. Watershed management for water production is concerned with the quality, quantity, and timing of the water which is produced. Also see *Basin Management*.

Water Plan — A document of issues, policies, strategies and action plans intended to effectively and economically execute a *Water Planning* process.

Water Planning — Water planning is an analytical planning process developed and continually modified to address the physical, economic, and sociological dimensions of water use. As a planning process it must assess and quantify the available supply of water resources and the future demands anticipated to be levied upon those resources. Based upon this continuous supply and demand evaluation, water planning must also give direction for moving water supplies to points of use while encouraging users to be good and effective stewards of available water resources.

The water planning process requires constant re-evaluation and updating to address changing social, political, economic, and environmental parameters. While the ultimate objective of such efforts is typically the development of a comprehensive, publicly-supported *Water Plan*, it is also critical to develop and maintain a comprehensive and viable water planning process that covers various aspects of water resource development, transport, water treatment, allocation among various competing uses, conservation, waste-water treatment, re-use, and disposal.

Water Resource Plan — A planning document or process which assesses both sources and uses of water and develops strategies for their most effective and efficient use according to public needs and criteria. Also see *Water Plan*.

Water Right — (1) The legal right to use a specific quantity of water, on a specific time schedule, at a specific place, and for a specific purpose. (2) A legally-protected right, granted by law, to take possession of water occurring in a water supply and to put it to *Beneficial Use*. (3) A legal right to divert state waters for a beneficial purpose.

Water-Righted Acreage — The land base for which there are water rights.

Water Rights — (1) The legal rights to the use of water. (2) A grant, permit, decree, appropriation, or claim to the use of water for beneficial purposes, and subject to other rights of earlier date or use, called *Priority* or *Prior Appropriation*. They consist of *Riparian Water Rights*, *Appropriative Water Rights*, *Prescribed Water Rights*, and *Reserved Water Rights*. Also see *Water Law*, *Water Law [California]*, *Water Law (Federal)*, and *Water Law [Nevada]*.

Watermaster — Often an employee of a court hired to administer a court decree. Also may be an employee of a water department who distributes available water supplies at the request of water rights holders and collects hydrographic data. Also refers to a position within an irrigation project that is responsible for the internal distribution of project water.

Watershed — (1) An area that, because of topographic slope, contributes water to a specified surface water drainage system, such as a stream or river. (2) All lands enclosed by a continuous hydrologic drainage divide and lying upslope from a specified point on a stream; a region or area bounded peripherally by a water parting and draining ultimately to a particular water course or body of water. Also referred to as *Water Basin* or *Drainage Basin*. (3) A ridge of relatively high land dividing two areas that are drained by different river systems. Also referred to as *Water Parting*.

Watershed Management — The analysis, protection, development, operation or maintenance of the land, vegetation and water resources of a drainage basin for the conservation of all its resources for the benefit of its residents. Watershed management for water production is concerned with the quality and timing of the water which is produced. Also referred to as *Water Management* and *Basin Management*.

Watershed Planning — The formulation of a plan, based on the concept of a *Watershed*, a *Water Basin*, a *Hydrologic Region*, or a *Hydrologic Study Area (HSA)*, with the intent to assess climatological conditions, inventory existing ground and surface water resources, determine current water uses, project future socioeconomic and environmental demands for those resources, and explore feasible water-balancing options, so as to maximize the benefits to the inhabitants of a study area while simultaneously preserving and protecting the region's wildlife, habitat, and environmental conditions.

Wellhead Protection (Program) — Programs intended to protect and preserve the quality of ground water used as a source of drinking water. A typical wellhead protection program will have a number of critical elements to include: (1) delineating the roles and responsibilities of state agencies, local governments, and water purveyors; (2) delineation of wellhead protection areas; (3) contaminant source inventories; (4) management options; (5) siting of new wells; (6) contingency and emergency planning; and (7) public participation. Typically, steps taken to protect and preserve the quality of a well are far less costly than actions necessary to restore a contaminated well.

Wetlands [Nevada] — (State Wildlife Management Areas) Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency or duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands typically include swamps, marshes, bogs, playas, springs, seeps, and similar areas. Wetlands are land transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water.

Winters Doctrine — The doctrine of (federal) reservation rights. See *Winters Rights (Decision)*.

Winters Rights (Decision) — The U.S. Supreme Court precedent decision (*Winters v. United States*, 207 U.S. 564 [1908]) in which the Court prohibited any uses by non-Indians that interfered with the Indian tribes' use of their reserved water. In *Winters*, the Court held that when reservations were established, Indian tribes and the Unites States implicitly reserved, along with the land, sufficient water to fulfill the purposes of the reservations. The ruling rests on the principle that Indian tribes retain all rights not explicitly relinquished. These federal reserved water rights are commonly known as *Winters Rights* as based on the *Winters Doctrine.* The court recognized these rights as having a priority date coinciding with the date the reservation was established, thus providing a means to integrate federally reserved rights with *Appropriative Water Rights* recognized under state law. Since reserved rights are not created by state law, *Winters Rights* retain their validity and seniority regardless of whether tribes have put the water to *Beneficial Use.* On-going conflicts concerning this ruling tend to involve non-Indian water users appropriating water under state law, water that previously may have been reserved for Indian tribes, though never quantified by courts or fully used on reservations.

Water Use — The amount of water needed or used for a variety of purposes including drinking, irrigation, processing of goods, power generation, and other uses. The amount of water used may not equal the amount of water withdrawn due to water transfers or the recirculation or recycling of the same water. For example, a power plant may use the same water a multiple of times but withdraw a significantly different amount. Also see *Water Use, Types*, below.

Xeriscape™ — Landscaping with native and naturalized plant species that are adapted to survive in areas of low precipitation. [*Trademark Note:* The term "Xeriscape" is a trademark of the National Xeriscape Council, Inc., and accordingly must always be capitalized, must always be used the first time with a "™" symbol, and can only be used as an adjective, e.g., Xeriscape landscaping, a Xeriscape garden, etc.]

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Section 9
Abbreviations and Acronyms

[The following terms have been extracted from the Nevada Division of Water Planning's *Water Words Dictionary* and may appear within the *Nevada State Water Plan*. Definitions of these words and a more extensive listing of water-related acronyms may be found in the *Water Words Dictionary*. With respect to notation and presentation, where two acronyms have different meanings, generally the more frequently used one will be listed first.]

AF	Acre-Feet (or Acre-Foot)
AFY	Acre-Feet per Year
AMD	Acid Mine Drainage
ASC	Atmospheric Sciences Center (DRI)
ASCE	American Society of Civil Engineers
ASOS	Automated Surface Observing Systems (NWS/NOAA)
AWWA	American Water Works Association
BAC	Biological Activated Carbon [Process]
BAT	Best Available Technology [Economically Achievable]
BFE	Base Flood Elevation (FEMA)
BIA	Bureau of Indian Affairs (USDI)
BLM	Bureau of Land Management (USDI)
BMP	Best Management Practice [Urban Water Use]
BOD	Biochemical Oxygen Demand/Biological Oxygen Demand
BPI	Bureau of Plant Industry [Evaporation Pan] (USDA)
BSC	Biological Sciences Center (DRI)
CAA	Clean Air Act (EPA)
CAPA	Critical Aquifer Protection Area (SDWA)
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (EPA)
CERES	California Environmental Resources Evaluation System
CFCs	Chlorofluorocarbons
CF	Cubic Feet (or Foot)
CFS	Cubic Feet per Second
CLOMR	Conditional Letter of Map Revision (FEMA)
COI	Cone of Influence
COD	Cone of Depression
CORPS	U.S. Army Corps of Engineers (also USACE)
CWA	Clean Water Act (EPA)
DCNR	Department of Conservation and Natural Resources (State of Nevada)
DEP	Division of Environmental Protection (DCNR)
DO	Dissolved Oxygen
DOF	Division of Forestry (DCNR)

DOW	Division of Wildlife (DCNR)
DDT	Dichlorodiphenyltrichloroethane
DRI	Desert Research Institute (University of Nevada System, State of Nevada)
DWR	Division of Water Resources (DCNR)
DWR	Department of Water Resources (The Resources Agency, State of California)
DWP	Division of Water Planning (DCNR)
EA	Environmental Assessment (NEPA)
EA	Endangerment Assessment (EPA)
EDF	Environmental Defense Fund
EEEC	Energy and Environmental Engineering Center (DRI)
EIS	Environmental Impact Statement (NEPA)
EPA	[U.S.] Environmental Protection Agency
ESA	Endangered Species Act (USFWS)
ESWTR	Enhanced Surface Water Treatment Rule (EPA)
ET	Evapotranspiration
ETAW	Evapotranspiration of Applied Water
EWMP	Efficient Water Management Practice [Agricultural Water Use]
FBFM	Flood Boundary Floodway Map
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHBM	Floodway Hazard Boundary Map (FEMA)
FIRM	Flood Insurance Rate Map (FEMA)
FIS	Flood Insurance Study (FEMA)
FONSI	Finding of No Significant Impact (NEPA)
FS	Feasibility Study (EPA)
FTE	Full Time Equivalent (Employment)
GAC	Granular Activated Carbon
GD	Geologic Division (USGS)
GFD	Gallons per Square Foot [of membrane] per Day
GID	General Improvement District
GIS	Geographic Information System
GPC	Gallons per Capita (Person)
GPCD	Gallons per Capita per Day
GPD	Gallons per Day
GPED	Gallons per Employee per Day
HSA	Hydrologic Study Area (DWR, State of California)
I.E.	Irrigation Efficiency
IOWE	International Office for Water Education (Utah State University)
IRP	Integrated Resource Planning
JTU	Jackson Turbidity Unit
KGAL	Kilogallons (thousand gallons)
LOMA	Letter of Map Amendment (FEMA)
LOMR	Letter of Map Revision (FEMA)
LVEA	Lahontan Valley Environmental Alliance

MAF Million Acre-Feet
M&I Municipal and Industrial
MBAS Methylene Blue Active Substance
MEQ/L Milliequivalents per Liter
MGD Million Gallons per Day
MG/L Milligrams per Liter
MIS Management Indicator Species
MSL Mean Sea Level
MTBE Methyl Tertiary Butyl Ether

NASQAN National Stream Quality Accounting Network (USGS)
NDEPS National Pollutant Discharge Elimination System (EPA)
NDOW Nevada Division of Wildlife (DCNR)
NDSP Nevada Division of State Parks (DCNR)
NDWP Nevada Division of Water Planning (DCNR)
NEPA National Environmental Policy Act
NESDIS National Environmental Satellite, Data and Information Service (NOAA)
NEXRAD Doppler Radar Data System (NWS/NOAA)
NFIP National Flood Insurance Program (FEMA)
NFS National Forest Service (USDA)
NGVD National Geodetic Vertical Datum
NHP Natural Heritage Program (DCNR)
NIDS NEXRAD Information Dissemination Service (NWS/NOAA)
NMD National Mapping Division (USGS)
NMFS National Marine Fisheries Service (NOAA)
NOAA National Oceanic and Atmospheric Administration (U.S. Department of Commerce)
NPDES National Pollutant Discharge Elimination System (EPA)
NPDWR National Primary Drinking Water Regulations (SDWA/EPA)
NPL National Priorities List [“Superfund” List] (EPA)
NPS Non-Point Source [Pollution]
NPS National Park Service (USDI)
NRCS Natural Resources Conservation Service (USDA)
NRP National Research Program [Centers] (WRD/USGS)
NTU Nephelometric Turbidity Unit
NWIC National Water Information Clearinghouse (USGS)
NWPA Newlands [Irrigation Project] Water Protective Association
NWR National Wildlife Refuge [System] (USFWS)
NWS National Weather Service (NOAA)

OCAP Operating Criteria and Procedures (TCID/USBR)
OFA Other Federal Agencies [Program] (WRD/USGS)
OSM Office of Surface Mining Reclamation and Enforcement (Bureau of Mines/USDI)

PAHs Polycyclic Aromatic Hydrocarbons, or Polararomatic Hydrocarbons
PAMs Polyacrylamides
PCBs Polychlorinated Biphenyls
PCE Perchloroethylene
pH Hydrogen Ion Concentration [Potential of Hydrogen]
PIA Practicably Irrigable Acreage
P.L. Public Law
PMF Probable Maximum Flood (FEMA)
PPB Parts per Billion

PPM	Parts per Million
PPT	Parts per Thousand
PS	Point Source [Pollution]
PSA	Primary Settlement Agreement
QSC	Quaternary Sciences Center (DRI)
RCRA	Resource Conservation and Recovery Act (EPA)
RMP	Resource Management Plan (BLM)
S.A.	Seasonally Adjusted
SCS	Soil Conservation Service (now NRCS)
SDWA	Safe Drinking Water Act (EPA)
SFHA	Special Flood Hazard Area (FEMA)
SFIP	Standard Flood Insurance Policy (FEMA)
SIC	Standard Industrial Classification [Code]
SNOTEL	Snowpack Telemetry (NRCS)
SPF	Standard Project Flood (FEMA)
SWE	Snow Water Equivalent
SWRCB	State Water Resources Control Board (DWR/State of California)
SWTR	Surface Water Treatment Rule (SDWA)
TCID	Truckee–Carson Irrigation District [Nevada]
TDS	Total Dissolved Solids
THMs	Trihalomethanes
TNC	The Nature Conservancy
TROA	Truckee River Operating Agreement [California and Nevada]
TSCA	Toxic Substances Control Act (EPA)
TSS	Total Suspended Solids
TTHMs	Total Trihalomethanes
UDI	[Ground Water] Under the Direct Influence [of Surface Water]
USACE	U.S. Army Corps of Engineers (also Corps)
USBR	U.S. Bureau of Reclamation (USDI)
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USFS	U.S. Forest Service (USDA)
USFWS	U.S. Fish and Wildlife Service (USDI)
USGS	U.S. Geological Survey (USDI)
USRS	U.S. Reclamation Service (USBR)
VOCs	Volatile Organic Chemicals
WAVE	Water Alliances for Voluntary Efficiency (EPA)
WCWCD	Washoe County Water Conservation District (Nevada)
WET	Water Education for Teachers
WHPA	Wellhead Protection Area
WMA	Wildlife Management Area (NDOW/State of Nevada)
WRC	Water Resources Center (DRI)
WRD	Water Resources Division (USGS)

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Section 10
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Nevada State Water Plan
SUMMARY

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NEVADA STATE WATER PLAN

PART 1 – BACKGROUND AND RESOURCE ASSESSMENT

March 1999

Nevada Division of Water Planning
Department of Conservation and Natural Resources

Nevada State Water Plan
PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 1
Purpose, Guidelines and the Water Planning Process

Introduction and Purpose

Nevada is the driest state in the nation and one of the fastest growing. Water is Nevada's most precious resource, and more than any other resource, water will determine Nevada's future. The success of our economic endeavors, the sustainability of our rural communities and the protection of our environment are all dependent on the wise management of the states's water resources. Thus, comprehensive, coordinated and continuing water management planning is vital to our state's economic future and quality of life.

Development of the state water plan is required by the Nevada Revised Statutes (NRS 540.101.) In statute, the Legislature also declares that "it is the policy of the State of Nevada to continue to recognize the critical nature of the state's limited water resources" and acknowledges the increasing demands placed on these resources by growth. Further, the Nevada Legislature "recognizes the important role of water resource planning and that such planning must be based on identifying current and future needs for water" (NRS 540.011). Legislative review and consideration of the state water plan will provide additional legislative policy guidance to ongoing planning efforts.

The *Nevada State Water Plan* is designed to help guide the development, management and use of the state's water resources. The plan assesses the quantity and quality of Nevada's water resources, and identifies constraints and opportunities which affect water resource decision making. The plan looks at historical and current water use, and projects demands out to the year 2020. The most current and accepted hydrologic and socioeconomic data sets available are used to develop the plan's forecasts.

Along with providing data about water supplies and water use, the state water plan identifies pressing water management issues and recommends policy directions and actions designed to assist water managers throughout the state and all levels of government. Thus, the plan establishes a common base of knowledge and understanding which is critical if Nevadans are to reach consensus on future water management issues.

The state water plan is designed to be a policy and planning guide, not a water supply plan. Many of the decisions regarding how to meet a particular water supply objective are best determined and implemented at the local level. And in fact, many local governments have taken a close look at their own water supply needs and are now charting a course to meet those needs. Thus, while the plan summarizes local and regional water planning efforts, it focuses on a broad array of water planning issues which affect water planning, management and allocation of water resources statewide.

The key to development of the state water plan has been the establishment of a dynamic, flexible water planning process. Ongoing review and update of the plan is essential to ensure that we, as a state, successfully evaluate emerging issues and prepare ourselves to meet future challenges.

The state water plan's recommendations are addressed to a wide variety of agencies, organizations and decision makers. Thus, implementation of the plan's recommendations, subject to changing needs, will require a cooperative and coordinated effort. Prior to implementation, each of the plan's recommendations must be prioritized and evaluated for technical feasibility, and the costs and benefits of each must be identified and weighed. Implementation of the plan should assist local organizations and agencies with their own water planning, as well as help guide water management decisions at the state level. The plan's ultimate effectiveness will be judged by the extent to which it's recommendations are incorporated into other state, local and federal planning efforts and agency actions.

Public input is vital to any planning process. The state's water planning process provides Nevada's residents with a unique opportunity to help decide how the state's water resources should be managed. The state water plan has been significantly enhanced by the willingness of Nevada's residents to participate in its development, and to share their thoughts, ideas and perspectives.
At its heart, the state water plan is a valuable expression of public interest.

Statutory Authority

In 1995, the Nevada State Legislature amended Nevada Revised Statute (NRS) 540.101 and directed the Division of Water Planning to develop a state water plan. Following the 1997 legislative session, the Legislature sent the Division of Water Planning a "Letter of Intent" requesting the state water plan be submitted to the Legislature by February 15, 1999. That date was extended to April 1, 1999 to allow sufficient time to complete public review of the final draft.

The authority for the preparation of the State Water Plan is found in NRS 540.101 which states in part:

1. The Division [of Water Planning] shall develop a plan for the use of water resources in the state.

2. The Division shall coordinate with local governments in developing the plan pursuant to section 1. Upon request of the Division, each local government shall cooperate with and assist the Division in the development of the plan.

3. The water plan developed pursuant to subsection 1 must include provisions designed to protect the identified needs for water for current and future development in the rural areas of the state, giving consideration to relevant factors, including but not limited to, the economy of the affected areas and the quality of life in the affected areas.

4. The Division shall submit to the Legislature for its review and consideration:
   (a) The plan developed pursuant to subsection 1; and

(b) The recommendations regarding the plan provided to the Division by the advisory board on water resources planning and development pursuant to NRS 540.111.
The Division must obtain the approval of the Legislature before the plan is implemented.

The legislative declaration of policy establishes the importance of protecting existing water rights, supporting water conservation, the relationship between water supply and growth, and the role water planning plays in this, the driest state. It further establishes that water planning must focus on current and future water needs and that all levels of government must be involved in water planning.

Guidelines for the State Water Plan

The *Nevada State Water Plan* was developed in accordance with the legislative declaration of policy found in Nevada Revised Statutes (NRS) 540.011, and based on a series of "guiding principles" generated by the Advisory Board on Water Resources Planning and Development (Advisory Board). (See subsection below, *Participants in the Planning Process,* for a discussion of those involved in developing the state water plan.) The Advisory Board then assisted with developing the goals for the state water planning process and strategies for developing the state water plan.

Legislative Policy

NRS 540.011 establishes the basic legislative policy which has guided development of the state water plan:

NRS 540.011 Legislative declaration:

1. The legislature determines that it is the policy of the State of Nevada to continue to recognize the critical nature of the state's limited water resources. It is acknowledged that many of the state's surface water resources are committed to existing uses, under existing water rights, and that in many areas of the state the available groundwater supplies have been appropriated for current uses. It is the policy of the State of Nevada to recognize and provide for the protection of these existing water rights. It is also the policy of the state to encourage efficient and nonwasteful use of these limited supplies.

2. The legislature further recognizes the relationship between the critical nature of the state's limited water resources and the increasing demands placed on these resources as the population of the state continues to grow.

3. The legislature further recognizes the relationship between the quantity of water and the quality of water, and the necessity to consider both factors simultaneously when planning the uses of water.

4. The legislature further recognizes the important role of water resource planning and that such planning must be based upon identifying current and future needs for water. The legislature determines that the purpose of the state's water resource planning is to assist the state, its local governments and its citizens in developing effective plans for the use of water.

The legislative declaration of policy establishes the importance of protecting existing water rights, supporting water conservation, acknowledging the relationship between water supply and growth, and the role water planning plays in this, the driest state. It further establishes that water planning must focus on current and future water needs and that all levels of government must be involved in water planning.

Guiding Principles for the State Water Plan

At their January 6, 1994 meeting, the Advisory Board developed a set of 23 "guiding principles" to philosophically guide development of the State Water Plan. Some of the guiding principles reflect state law or state policy. Others reflect important water planning considerations identified during development of the state water. Later, in 1997, the Advisory Board condensed the guiding principles to these 11:

1. All water within the state, whether above or below ground, belongs to the public and its use is subject to a system of water rights administered by the State Engineer, and by state and federal court decrees and regulations.
2. Public education and public input is vital to statewide water resources planning.
3. The State Water Plan should integrate water supply, water quality, water use, and environmental issues, and should be used to guide decisions which affect water resources in the state.
4. The State Water Plan by design should be "growth neutral." It should neither encourage nor restrict growth, and present no positions regarding the type, location or rate of growth.
5. Water right owners are entitled to buy, sell or trade their water rights to others under free market conditions. However, changes in the point of diversion, or place or manner of use must be approved prior to the change in accordance with the state water law, and state and federal court decrees and regulations.
6. The water resource needs of future generations of Nevadans should be protected by balancing economic goals with social, aesthetic, cultural and ecological values.
7. All water resource projects should be technically, environmentally and economically sound, and consistent with state law.
8. The State Water Plan should help integrate and coordinate the water planning and management activities of local, state and federal agencies.
9. The relationship between groundwater and surface water must be recognized in the State Water Plan.
10. Water conservation is an important component in the planning and management of the State's Water Resources.
11. Watershed planning efforts should be encouraged and should include representatives of all agencies, municipalities, political subdivisions, water users and any others with an interest in the planning and management of a watershed.

Planning Goals

Following development of the guiding principles, the Advisory Board and the Department of

Conservation and Natural Resources (DCNR) Steering Committee developed a number of goals and strategies for the planning process and the state water plan. As the plan evolved, so too did the goals and strategies. In general terms, the goal of the state water planning process is to make water planning and water decision making in Nevada *better*: more efficient, more effective and more inclusive. Following are results we hope to achieve through the water planning process and development of the state water plan:

1. **Water Supply:** Enough water of sufficient quality for future generations
2. **Water Rights:** Protection of existing water rights
3. **Economic Efficiency:** The preferential use of water for greatest economic gain to the state
4. **Conservation:** More conservation and less waste of water
5. **Water Quality:** Protection and enhancement of water quality
6. **Rural Water Supplies:** Protection of water supplies for current and future development in rural areas
7. **Environmental Quality :** Protection and enhancement of the environment
8. **Efficiency:** Agency actions which are coordinated and integrated to save money and time, reduce duplication in projects or services, address gaps in resource protection, and result in better decisions
9. **Decision making:** Less litigation and more cooperative decision making to resolve water resource issues
10. **Effectiveness:** More informed water resource decision making, with a greater awareness of aesthetic, cultural and ecological values
11. **Sound Science:** Water resource projects which are technically, environmentally and economically sound
12. **Public Involvement:** A better educated citizenry and more public participation in water resource decision making
13. **Quality of Life:** A higher quality of life for all Nevadans

Each update of the state water plan should bring us closer to reaching these goals. It is important to note that some of the goals may conflict, or appear to conflict, with one another. For example, economic efficiency may appear to be in direct conflict with environmental protection. However, there is growing recognition that environmental protection is actually an essential component of economic development. Economic and environmental *sustainability* is the emerging goal of many communities. Clearly, for a state that is now ranked in the top three in the country as a vacation destination, environmental quality goes hand-in-hand with economic efficiency. It is one of the roles of the water planning process to seek a balance among competing goals so that the plan's overall goal of better water management is achieved. Public involvement in the water planning process has been the key to achieving a balance which reflects the evolving interests and will of the citizenry. **Plan Components**

The primary elements to be included in the State Water Plan were derived from NRS 540.051, Duties of the Division of Water Planning and NRS 540.101, Development, contents and implementation of the [state water] plan. Statutory plan components include: (1) providing arid regions with information, alternatives and recommendations including courses of planning and actions for acquiring additional water or for conserving water, (2) investigation of new sources of water such as desalinization, importation, and conservation, (3) consideration of issues of water quantity and quality simultaneously, (4) development of forecasts of future supply and demand, (5) inclusion of provisions designed to protect the need for water for current and future development in the rural areas of the state, considering the economy and quality of life in the affected areas, and (6) the development of recommendations to the Legislature to improve state water policy. Additional plan components were added as a result of input from the Division's Advisory Board, Department of Conservation and Natural Resources staff and the public.

Major State Statutory Policies Affecting the Water Planning Process

Following is a summary of the major legislative policies, declarations and other statements in the Nevada Revised Statutes (NRS) that affect water planning and management in Nevada. Each NRS citation has been assigned to only one of the main categories, although the statute may address issues within two or more categories.

Water Supply and Allocation

533.024 "The legislature declares that it is the policy of this state:

14. To encourage and promote the use of effluent, where that use is not contrary to the public health, safety and welfare, and where that use does not interfere with federal obligations to deliver water of the Colorado River."
15. In a county whose population is less than 400,000 to recognize the importance of domestic wells as appurtenances to private homes, to create a protectible interest in such wells and to protect their supply of water from unreasonable adverse effects caused by municipal, quasi-municipal or industrial uses."

533.025 "The water of all sources of water supply within the boundaries of the state whether above or beneath the surface of the ground, belong to the public."

534.020 (1) "All underground waters within the boundaries of the state belong to the public, and, subject to all existing rights to the use thereof, are subject to appropriation for beneficial use only under the laws of this state relating to the appropriation and use of water and not otherwise."

540.011 (1) "...It is acknowledged that many of the state's surface water resources are committed to existing uses, under existing water rights, and that in many areas of the state the available ground water supplies have been appropriated for current uses. It is the policy of the State of Nevada to recognize and provide for the protection of these existing rights..."

541.030 (2)(a) "It is therefore declared to be the policy of the State of Nevada:

(a) To control, make use of and apply to beneficial use unappropriated waters in this state to a direct and supplemental use of such waters for domestic, manufacturing, irrigation, power and other beneficial uses."

Water Quality

445.132 "1. The legislature finds that pollution of water in this state:

(a) Adversely affects public health and welfare:

(b) Is harmful to wildlife, fish and other aquatic life; and
(c) Impairs domestic, agricultural, industrial, recreational and other beneficial uses of water.
2. The legislature declares that it is the policy of this state and the purpose of NRS 445.131 to 445.354, inclusive:
(a) To maintain the quality of the waters of the state consistent with the public health and enjoyments, the propagation and protection of terrestrial and aquatic life, the operation of existing industries, the pursuit of agriculture, and the economic development of the state; and
(b) To encourage and promote the use of methods of waste collection and pollution control for all significant sources of water pollution (including point and diffuse sources)."

Environmental and Recreational Uses

501.100 "1. Wildlife in this state not domesticated and in its natural habitat is part of the natural resources belonging to the people of the State of Nevada.
2. The preservation, protection, management and restoration of wildlife within the state contribute immeasurable to the aesthetic, recreational and economic aspects of these natural resources."

527.260 (1)(b) "The legislature finds that:
(b) The people of the State of Nevada have an obligation to conserve and protect the various species of flora which are threatened with extinction."

Water Use Efficiency

534.020 (2) "It is the intention of the legislature, by this chapter to prevent the waste of underground waters and pollution and contamination thereof ..."

540.011 (1) "...It is also the policy of the state to encourage efficient and nonwasteful use of these limited supplies."

Water Planning and Management

540.011 "1. The legislature determines that it is the policy of the State of Nevada to continue to recognize the critical nature of the state's limited water resources...
2. The legislature further recognizes the relationship between the critical nature of the state's limited water resources and the increasing demands placed on these resources as the population of the state continues to grow.
3. The legislature further recognizes the relationship between the quantity of water and the quality of water, and the necessity to consider both factors simultaneously when planning the uses of water.
4. The legislature further recognizes the important role of water resource planning and that such planning must be based upon identifying current and future needs for water. The legislature determines that the purpose of the state's water resource planning is to assist the state, it local governments and its citizens in developing effective plans for the use of water."

541.030 (2)(b) "It is therefore declared to be the policy of the State of Nevada:
(b) To cooperate with the United States and agencies thereof under the federal reclamation laws or other federal laws now or hereafter enacted and to construct and finance works within or without the State of Nevada as herein defined and to operate and maintain the same."

543.020 "It is hereby declared to be the policy of the State of Nevada to cooperate with the United States and its departments and agencies, and with the counties, cities and public districts of the state, in preventing loss of life and property, disruption of commerce; interruption of transportation and communication and waste of water resulting from floods, and in furthering the conservation, development, utilization and disposal of water."

548.095 "It is hereby declared, as a matter of legislative determination:

1. That the renewable natural resources of the State of Nevada are basic assets.
2. That they are being affected by the ever-increasing demands of farm and ranch operations and by changes in land use from agricultural to nonagricultural uses, such as, but not limited to, residential and commercial developments, highways and airports.
3. That conservation, protection, and controlled development of these renewable natural resources are necessary at such rate and such levels of quality as will meet the needs of the people of this state."

548.100 "It is hereby declared, as a matter of legislative determination, that the consequences of failing to plan for and accomplish the conservation and controlled development of the renewable resources of the State of Nevada are to handicap economic development and cause degeneration of environmental conditions important to future generations."

548.110 "It is hereby declared to be the policy of the legislature to recognize the ever-increasing demands on the renewable natural resources of the state and the need to conserve, protect and develop such resources at such levels of quality as will meet the needs of the people of the state."

The Planning Process

The 1999 *Nevada State Water Plan* was developed over a period of 4-1/2 years (between late 1994 and January 1999) with the involvement of thousands of Nevada citizens. The Division of Water Planning has taken the lead, assisted by the Advisory Board on Water Resources Planning and Development, staff from the various agencies of the Department of Conservation and Natural Resources, and input from state, local and federal agencies and the public.

The steps in the water planning process were as follows:

- ❐ solicit public input to determine the scope of the plan and the issues to be addressed
- ❐ develop and update basic hydrologic and socioeconomic data sets
- ❐ analyze the water resources institutional framework
- ❐ forecast the state's population and anticipated economic trends over the next 20 years
- ❐ forecast future water needs over the next 20 years
- ❐ inventory water supplies presently available
- ❐ inventory resources already committed (permits, vested rights, etc.)
- ❐ research additional possible sources of supply
- ❐ identify alternate scenarios to meet the water needs of the state
- ❐ identify issues that affect water use, allocation and management
- ❐ develop and evaluate policy and programmatic recommendations to address the issues
- ❐ solicit public input throughout plan development to gauge the relevancy of the issues and the appropriateness of recommendations
- ❐ present comprehensive plan with recommendations to the state legislature for review and approval

Once the state Legislature approves the Plan, the Division of Water Planning will communicate plan recommendations to agencies or individuals who are in the best position to further evaluate and implement them. In some cases, the Division will establish new working groups or task forces to help determine the best approach to plan implementation. It is anticipated that the Water Planning Advisory Board will continue to advise the Division and assist in plan implementation. The Division will be responsible for tracking the progress of plan implementation and evaluating the effectiveness of plan recommendations. Subsequent updates of the Plan will include an evaluation of the state's progress in implementing the Plan's recommendations.

Participants in the Planning Process

Many individuals, organizations and agencies participated in development of the State Water Plan. Plan participants and their roles in plan development are briefly described below.

The Public. Extensive public involvement has been key to development of the State Water Plan. The public's opinions, thoughts, and recommendations have been solicited during every phase of the planning process. In 1992, prior to initiation of the 1999 State Water Plan, more than 800 Nevadans participated in a series of Water Policy Forums sponsored by the Nevada Cooperative Extension, the Nevada Humanities Committee and others. The results of these forums were tabulated in a report titled *Nevada's Water Future: Making Tough Choices*. This report, representing a diversity of views, was useful in the early stages of plan development and in generating options to address water issues.

In 1994 and 1995, more than 600 citizens participated in 20 public workshops sponsored by the Division of Water Planning. The purpose of these workshops was to educate the public on Nevada water law and the water planning process, and to get an early sense of the public's perception of key issues such as interbasin transfers. These scoping sessions were useful to the Division in establishing the breadth and scope of the plan.

Governor's Office. The Governor and his staff have provided executive sponsorship during plan development. Starting with the 1990 biennial report, the Governor addressed the need for development of a new state water plan as one of the most critical issues facing the state. In discussing the need for natural resource planning, the report states:

> Tantamount among these plans is the development of a statewide water management plan, especially as related to intercounty and interbasin transfers, projection of water needs, the outline of conservation methods, development of drought contingency plans and information on regulations to conserve water usage. (p. 5, *Perspectives: A Biennial Report of Nevada State Agencies - 1990*)

Subsequent biennial reports have continued to underscore the need for a state water plan and to reiterate the Governor's commitment to statewide water planning.

Division of Water Planning. Between 1993 and 1997, the Division of Water Planning compiled socioeconomic and hydrologic databases and wrote more than 25 publications (see Table 1–1) to serve as a basis for the water plan. Key documents produced during that period included the *Nevada Water Words Dictionary*, the *DRAFT State Water Policy*, reports on water usage by sector, three detailed water basin *Chronologies*, and the *County Graph and Data Books* and *Socioeconomic Overviews*.

In 1994, the Division completed the early public scoping meetings which served to help prioritize the state water plan elements. The Division went on to develop drafts of the *State Water Plan*, and then finalized the draft to be presented to the Legislature. Almost all Division staff were involved in this work effort, from plan conceptualization to final editing. The Division also provided staff support to the Advisory Board on Water Resources Planning and Development, conducted public outreach efforts and organized technical work group and steering committee meetings.

Technical Working Group. In 1994, a 20- member interagency working group composed of state and federal agencies met over an 11- month period to frame the issues, generate ideas and develop options. The perspectives of this working group were drafted into issue papers which formed the basis of the policy recommendations contained in the *DRAFT State Water Policy*, produced in March 1995.

DCNR Steering Committee. In 1995, staff from Divisions within the Department of Conservation and Natural Resources formed a high-level departmental oversight committee to support development of the State Water Plan. This group, which included the Director and Assistant Director of the Department and staff from the Divisions of State Lands, Environmental Protection, Wildlife, Water Resources and Water Planning, and the Natural Heritage Program, provided insight into the laws, regulations and issues within their jurisdictions, recommended approaches to the planning and obtaining public input, evaluated existing state water policies and recommended changes. This steering committee was essential in setting the tone, pace and direction of the plan. Altogether, the DCNR steering committee members committed over 1700 hours to plan development.

Advisory Board on Water Resources Planning and Development. To advise the Division in matters relating to planning and development of water resources, NRS 540.111 establishes the Advisory Board on Water Resources Planning and Development (Advisory Board.) In 1995, the Legislature passed SB 101, which among other things, enlarged the Advisory Board from 13 to 15 members, and changed its composition. The Board for Financing Water Projects, formally ex-officio members of the Advisory Board, was separated to form a stand alone board, and new Advisory Board positions were opened up for representatives of mining, ranching, agriculture, conservation and the general public. The number of Washoe County representatives was also increased.

As a follow-up to the enactment of SB 101, in 1996 the Governor appointed a new set of Advisory Board members (see p viii for the list of members), only 4 of whom had served on the previous Advisory Board. The current composition of the Advisory Board on Water Resources Planning and Development is as follows:

- ❑ **Six** members representing the governing bodies of the county with the largest population in the state [Clark County] and the cities in that county;
- ❑ **One** member representing the largest water utility in the county with the largest population in the state [the Las Vegas Valley Water District];
- ❑ **Two** members representing the county with the second largest population in the state [Washoe County] and the cities in that county;
- ❑ **One** member representing the largest water utility in the county with the second largest population in the state [Sierra Pacific Power Company];

- ❑ **One** member representing the general public; and
  Four members, each representing a different one of the following interests:
  (1) Farming;
  (2) Mining;
  (3) Ranching; and
  (4) Wildlife.

The Governor is to make the Advisory Board appointments so that at least seven members are residents of Clark County, three members are residents of Washoe County and at least three members are residents of counties which have a population less than 100,000. Altogether, the Advisory Boards held more than 25, one-to-two day meetings to participate in development of the state water plan. The Advisory Board meetings were always publicly advertised and open to public comment, and occasionally the Advisory Board held special workshops to solicit public comment in a more formal setting.

Pursuant to NRS 540.111, one of the Advisory Board's roles is to make recommendations to the Division concerning their level of concurrence with the content, findings and recommendations of the *State Water Plan*. The Division is to then submit the Advisory Board's recommendations to the Legislature with the *Plan*. The time and effort contributed by the Water Planning Advisory Board has been invaluable in bringing the Plan to fruition.

Department of Conservation and Natural Resources Advisory Board. The Department of Conservation and Natural Resources maintains its own Advisory Board. The seven DCNR Advisory Board members each represent one of the following interests: (1) general public, (2) state park users, (3) agricultural industry, (4) mining industry, (5) outdoor recreationists, (6) forestry/fire control, and (7) conservation. This Advisory Board has frequently reviewed *State Water Plan* drafts and provided advice and counsel as to the plan's content and the planning process.

Interest Groups. Many interest groups have been active in the development of the *State Water Plan*. Groups such as the Nevada Farm Bureau, Nevada Cattlemen's Association, Northern Nevada Conservation Forum, Southern Nevada Homebuilders Association, and the League of Women Voters have sponsored workshops on the plan and/or commented formally on plan work products.

Local Governments. Local government input has been critical to the planning process. The Division Administrator or staff met personally with 16 of the 17 County Commissions, and the Southern Nevada Water Authority in Clark County, to update them on plan progress, request review of key work products, and request their participation in meetings of the Water Planning Advisory Board. Nearly all county commissions sent representatives to participate in Advisory Board meetings and to provide input on local water issues.

State Legislature. The Nevada State Legislature plays a significant role in the water planning process. The Legislature initiated the water planning program and has set time frames for plan completion. The Legislature has also provided guidance for plan development via its declaration of legislative intent at the start of NRS 540, the water planning statute. Legislative committees have requested periodic briefings on plan progress, and individual Legislators have shown a special interest by participating in scoping sessions and public workshops, submitting comments on the plan or by requesting additional information. When it is finalized, the *Nevada State Water Plan* will be presented to the 1999 Legislature for their review and consideration as required by NRS 540.101.4.

Federal Agencies. Federal agencies have been involved in plan development. Federal agency staffs made presentations to the Advisory Board on regional water issues, served on technical working groups, assisted in development of some issue papers, and commented on plan drafts. Federal agencies such as the U.S. Geological Survey, Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service and Natural Resources Conservation Service made significant contributions.

Plan Formulation and Review

Division of Water Planning staff researched and produced data compilations and publications as a preliminary step in developing the state water plan. As publications were finalized and sections of the *State Water Plan* were developed, they were reviewed by the DCNR Steering Committee, the Water Planning Advisory Board and the DCNR Advisory Board. Public comment was always solicited at meetings of both Advisory Boards. Once portions of the plan were in agreed upon draft form, the drafts were sent out for public review and comment. Typically, workshops were held to explain plan sections and to elicit comment from the public.

From this intensive review, public involvement and consensus building process, the *State Water Plan* has taken shape. The plan that has emerged is directed toward the development, adoption and implementation of a variety of programs, projects and policies designed to better utilize, conserve and protect the state's most valuable natural resource. However, the planning process not only resulted in the 1999 *State Water Plan*, but also in a strong consensus regarding the need to keep the water planning process alive, funded and connected to the state's water resource decision making processes and programs.

Public Comments on the Water Plan Drafts

An interim draft of the state water plan was released during the summer of 1998. This draft included many of the background and introductory plan sections, along with the basic data which formed the foundation of the plan. The goal of this early review period was to reach consensus on the data used to develop the plan, before moving on to addressing the more complex issues and recommendations in later plan sections. Six public workshops were held during this time. The Division also made presentations to 15 of the 17 county commissions, the Southern Nevada Water Authority in Clark County and the Carson City Board of Supervisors to update them on the plan, solicit their continuing assistance in plan development and receive their preliminary thoughts and comments.

The final public review draft of the state water plan was released at the end of January 1999 and the review period extended to March 8, 1999. Over 1000 copies of the draft state water plan were distributed for public review and comment . Drafts of the plan were also made available through the Division of Water Planning's website. During this time, seven public workshops were held to review the plan's recommendations and solicit public input. Additional presentations were made before various legislative committees, interested organizations and state advisory boards, working groups and commissions. Altogether, over 50 public workshops were held and presentations made on the plan throughout the 4 ½ year planning cycle.

The Division received 39 written comments on the final public review draft of the water plan and many additional comments at public workshops. At the end of the final comment period, all of the comments received were entered into a database. The use of a database enabled the Division to more closely evaluate and analyze the comments, and to ensure that all comments on a topic were evaluated together and addressed appropriately and consistently.

Comments were provided by agricultural and rural interests, wildlife and environmental interests and agencies. Relatively few comments were received from urban interests. Of the 39 letters received 10 were from special interest groups, 8 from individuals and one from a business (mining). The other 21 letters were from local (9), federal (8) and state (1) agencies, irrigation districts (2) and tribes(1). Comments were directed most frequently to the issues and recommendations contained in the issue papers, to the data used in the plan and in some cases, to the findings (particularly the projected decrease in agricultural water use.) While some comments focused on edits or data corrections, a large number provided policy, philosophical or analytical perspectives, especially regarding growth, interbasin transfers and the importance of water planning to the state. Many comments recognized the significant work effort that went into developing the 1999 water plan and found it to be a valuable resource.

Issues given the greatest attention by commenters, both pro and con, included:

- conservation and credit for conservation
- water resources data collection, management and distribution
- integrated water management
- water measurement and estimation
- interbasin and intercounty transfers
- instream flows and water for wildlife and the environment
- local vs. state water planning

A number of the comments addressed the planning principles utilized in the plan or the plan's goals. The commenters generally noted the difficulty in developing a plan based on very general, and sometimes conflicting, goals. The water plan's goals and guiding principles were the subject of much discussion and debate early in the planning process by the Advisory Board, and were reconsidered at various points during development of the plan. Therefore, while the comments on these areas were acknowledged, the plan's goals and guiding principles were not revised.

Frequently, comments conflicted with one another. For example, some comments questioned the need for a water plan and supported the status quo. These commenters believe that the current system is working and a state water plan is not necessary. Others applauded the water plan as a critical step in proactively planning and managing the state's water resources. Another example related to the use of data in the plan. Some groups wanted the plan to include the most current data available, even if that meant that data sets weren't comparable between counties. Others wanted data sets standardized to a particular year, even if that meant that older "vintage" data was used in lieu of the latest available data. Some felt that since some of the data sets have weaknesses, no conclusions should be drawn in the plan, while others were comfortable with use of the best available data to forecast future water use.

Environmental organizations wanted to see more emphasis on managing growth and implementation of water conservation technologies, while others felt the plan should stay away from growth issues altogether and that conservation was a good idea but should not be mandated. (The plan is designed to be growth neutral, but does make strong recommendations to enhance water conservation in the state.)

Some comments expressed philosophical opposition to interbasin transfers, going so far as to suggest that they be banned altogether, while others felt that water transfers represented THE solution to the state's water supply problems. Some comments suggested that the water plan should express a vision of the future on a variety of topics including concepts such as sustainability, watershed planning and biodiversity. (The plan does discuss watershed planning in depth and recommend its greater usage, but only addresses issues of biodiversity or sustainability in the context of other issues.)

Concern was expressed about the role of the plan, and whether it is to be considered a mandate. However, the plan is clearly designed to be an education, planning and policy tool which makes recommendations to enhance future water management. In and of itself, the plan is not a new law, nor does it change existing water rights or reallocate water rights in any way. Projections of future water use are simply projections based on existing trends, and do not assume sweeping changes in our economy. It is anticipated that the market for water rights will drive any transfers of water rights.

A number of agricultural groups felt the plan should highlight the importance of agriculture to the state and its value in enhancing wildlife habitat, open space and rural quality of life. However, the plan does not advocate the value of any one water use or economic endeavor over another.

Comments expressed concern about the lack of water rights for maintenance of instream flows, the habitat of endangered and threatened species and the environment in general. They felt the state should assume a more active role in purchasing water rights for environmental water uses and in protecting habitats. On the other hand, a number of rural counties considered the plan's recommendations for purchase of water rights as "alarming", and a threat to their tax base. They suggested assisting irrigators in maintaining minimum pools on their own land by, for example, purchasing hay for them in dry years to prevent a reduction in stream flows at critical times.

Domestic wells were mentioned by quite a few commenters. Concerns were expressed about definition and protection of the legal rights of domestic well owners (who are not required by law to have a water right until their use exceeds 1800 gallons per day). Other comments included the view that domestic wells should be a local issue only, not a state issue, and a request for state funding support if domestic wells are required to hook up to regional water systems by the state.

A number of commenters concurred with the plan's recommendations to enhance water education, support watershed planning, develop better data, measure water use more accurately, do better flood planning and management, provide greater water planning assistance to local governments and ensure that the public remains closely involved in both state and regional water planning.

All comments were carefully reviewed and incorporated into the plan wherever possible. It is noteworthy that many of the issues raised by commenters had been discussed at length by both the Steering Committee and the Advisory Board during plan development. Thus, while these comments did not highlight new issues, they did validate the planning and public input process that was utilized. Some commenters did raise issues which were not specifically addressed in the plan. Recommendations for subjects to be addressed, or more thoroughly addressed, in future plans are listed below. It is the intent of the Division of Water Planning to include these issues in future plan updates:

- mine dewatering
- integrated management of surface and ground water
- conflict resolution
- better identification of environmental water needs
- more thorough discussion of various types of water storage
- dam safety
- better assessment of perennial yield and restoration of over utilized aquifers

Comments received on the final public review draft of the *Nevada State Water Plan*, as well as the comment database, are available for review at the Division of Water Planning's office in Carson City.

Previous Water Planning Efforts

The state water planning program began in the 1960's. In 1967 the Nevada Legislature directed the Division of Water Resources within the Department of Conservation and Natural Resources to determine Nevada's future water needs and available water resources. The Legislative Commission was directed to study future statewide water needs and it appointed a special Legislative Subcommittee to undertake the study. The State Engineer and the Subcommittee jointly recommended the establishment of a separate section within the Division of Water Resources to carry out the necessary planning studies, and specific legislation to establish the statutory authority to implement the program.

The 1969 Legislature authorized development of a comprehensive water resource plan for Nevada through an amendment to NRS 532, and made an appropriation to the Division of Water Resources to develop a planning section. The 1973 Legislature required the State Engineer to complete the water resource plan and submit it to the 1975 legislative session. The first state water plan, *Water for Nevada,* was completed and published by November 1974. The state water planning program was active until the early 1980's, although with a dwindling staff. In 1982 the program was all but eliminated due to severe funding shortages.

The water planning program was re-instituted in 1989 through the efforts of Assembly Speaker Joe Dini and like-minded legislators who were increasingly concerned about Nevada's rapidly growing population and the lack of a current plan to identify additional water resources to satisfy demands. There was also concern regarding the lack of flood, conservation and drought planning. Thus, the present day Water Planning Division was created under NRS 540 and a small staff was hired by 1991.

Since 1991, the Division of Water Planning has produced over 30 publications in support of the *State Water Plan* (as well as numerous publication updates and revisions); initiated a water education program and Internet home page; obtained grant funding to coordinate water planning activities in the Walker River Basin; assisted local governments in their water planning efforts; awarded over $20 million in grants to small water systems; and sponsored numerous water resource conferences and workshops. In 1997 the Division received state and federal appropriations to initiate a flood planning and grant program.

The 1999 *Nevada State Water Plan* completes the latest cycle of statewide water planning. Following approval of the plan, the Division will turn its attention to developing a handbook for regional water planning and begin developing specific water management plans for the various hydrographic regions in Nevada.

Organization of the Nevada State Water Plan

The 1999 *Nevada State Water Plan* is being produced in six volumes:

- ❒ A *Summary* presents highlights of the State Water Plan's findings, with an emphasis on recommended legislative water policy and program initiatives.

- ❒ The main body of the *State Water Plan* includes an inventory, assessment and issue analysis of water resources in Nevada. It establishes the regulatory, historical and institutional framework affecting water planning and management within the state, provides the socioeconomic context within which water decisions are made, projects population and economic trends affecting water use, forecasts future water needs, identifies current water issues and presents recommendations to address those issues. The main body of the *State Water Plan* is divided into 3 parts as follows:

  Part 1 – Water Resources Background and Assessment
  Part 2 – Water Use and Forecasts
  Part 3 – Water Planning and Management Issues

- ❒ Two *Technical Data Appendices* which contain the detailed planning data and forecasts of the State's counties, cities and hydrographic basins (also available upon request in an electronic format).

Index to Part 1, Section 1:

Nevada State Water Plan
PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 2
Summary of 1974 State Water Plan

Introduction

The first state water plan, *Water for Nevada*, was completed and published by November 1974. It consisted of a series of 16 planning documents which estimated water use, inventoried the water resources of the state, provided maps, developed forecasts for future water needs for mining, agriculture, fish and wildlife, recreation, power production and municipal use, evaluated the use of input-output economic models to analyze future water scenarios and described the water administration process in Nevada.

The *Water for Nevada* series was followed by a second series of 6 water planning reports - *Alternative Plans for Water Resource Use*. The objectives of these planning documents were environmental quality, economic efficiency and area development. The purpose of the plans was to unite these objectives for better resource management. The planning was focused on those regions which were having difficulty in meeting their water needs or which were expected to run out of water in the near future. Alternative plans were developed for the Walker, Humboldt, Carson-Truckee, Colorado and Snake River Basins and the Central Region of Nevada. Each report examined a series of alternate economic development scenarios for a region and projected those future scenarios which might occur without a plan in place.

All of the alternative plans identified water resource issues which remain issues today, 25 years later. For example, the 1974 Water Plan noted that Walker Lake was declining by 60,000 acre-feet per year, flooding was occurring throughout the basin and there were unmet water needs for agriculture and recreation. The Truckee-Carson River Basin Report noted the decline of Pyramid Lake, municipal, agricultural and industrial water shortages, lack of adequate water for wildlife areas, and flooding. These issues remain and are perhaps even more pressing today. At this time, both lakes have declined further, municipal and industrial water shortages are more common, efforts to obtain water for wildlife and recreation are currently underway and the New Year's Day Flood of 1997 has moved flooding to the top of many people's agendas.

A final *Special Summary Report* concluded the water planning series. It noted that virtually all of Nevada's surface water resources had been committed; that in a rare year some overflow might be available, but that in most cases storage facilities were inadequate to capture the runoff for later use. It noted that significant groundwater supplies had already been developed, and that some areas held good potential for further development. However, we had already reached the point in some basins, such as the Las Vegas Groundwater Basin and Diamond Valley, where no additional appropriations could be allowed. It was also apparent that obtaining water supplies from outside the state's boundaries was likely to be problematic, as it still is today.

The *Special Summary Report* noted that Nevada's residents viewed the lack of readily available water as a mixed blessing. While the lack of water restricted economic development in many areas of the state, it also meant that Nevada would be preserved in a fairly natural state with a relatively small population, thus enhancing the resident's "quality of life." In general, it was concluded from reaction and comment at the water planning forums, that most people of the state wanted the water resources developed and used, but not "over used." With this in mind, the state water plan conclusions and recommendations sought a middle ground.

Many issues were identified in the 1974 State Water Plan, and a number of actions were recommended. In most cases, the plan suggested a cautious "wait and see" approach. Key Plan recommendations included: 1) enacting legislation to bring geothermal resources under the purview of state water law, 2) placing time limits on subdivision approvals, 3) establishing state funding for water system infrastructure and flood management, 4) actively protecting state sovereignty in water allocation decisions on federal lands, 5) establishing state level floodplain zoning, 6) analyzing the state's responsibilities for maintaining stream channels in navigable waterways, 7) continuing the data collection and water planning activities, 8) protecting critical habitat and rare and endangered species when making water resource decisions and 9) where necessary, acquiring water rights for wildlife protection. Many of these recommendations were ultimately implemented in one form or another. The following sections summarize the conclusions and recommendations presented in the 1974 State Water Plan and the status of each today. Of note, the conclusions and recommendations presented herein are directly excerpted from the 1974 *Special Summary Report*.

General Conclusions and Recommendations of the 1974 State Water Plan

Water Law and Administrative Procedures

1974 Recommendations. "The theory inherent in the state water law involving the appropriation doctrine commonly referred to as 'first in time - first in right' and the concept that beneficial use is the measure of a right to the use of water have proven to be effective and in the State's interest. The law itself provides for changes in use as desire or demand dictate and thereby makes the law adaptable to varying conditions. Past legislative actions have provided necessary amendments all of which have been carefully evaluated for not only immediate but long term effects and ramifications. No basic changes in the theory or philosophy of the state water law are recommended. However, it should be continually scrutinized for necessary modification of specific provisions."

Status. The theory and philosophy of state water law has remained the same, however the State continues to carefully evaluate the water law and make some amendments in response to changing conditions. In fact, there have been some modifications to the state water law since 1974. One of the major statutory changes allows the State Engineer to approve temporary changes in place of diversion, manner of use or place of use of an existing water right (NRS 533.345). Another statutory change allows the State Engineer to issue environmental permits which are temporary permits to appropriate water for the avoidance of pollution or contamination of a water source (NRS 533.437). NRS 534.250, added to the statutes in 1987, defined permitting requirements for recharge/recovery projects. In 1993, NRS 534.350 was added which allows a public water system in certain basins to receive water right credits for the addition of new customers previously served by domestic wells.

Funding of Water Resource Projects

1974 Recommendations. "It has been suggested that a fund be established to provide State participation in funding water resource development or flood control projects. Legislative consideration of funding in the past has been on a project by project basis...Establishment of a separate construction or development fund is not recommended. Individual projects should continue to be considered by the legislature for partial or total funding or financial support."

Current Status. In 1987, the Legislature established a $200 million loan program for financing water projects (NRS 349.935 through 349.961). Through this program, loans can be issued for financing any project for the management, control, delivery, use or distribution of water. Only two loans have been issued under this program. In recent years, this program has had no activity.

In 1991, the Legislature established the AB 198 Grant Program administered by the Division of Water Planning which provides financial assistance to water purveyors. Grant funds can be used to partially finance capital improvements made necessary by State health regulations and the federal Safe Drinking Water Act. The Board for Financing Water Projects can award up to $40 million in grants. Thus far, over $20 million in grant funds have been awarded for 20 projects throughout Nevada. This program remains active today.

The federal Safe Drinking Water Act (SDWA) Amendments of 1996 authorized a Drinking Water State Revolving Fund for the purpose of loaning funds to public water systems for infrastructure improvements required to achieve or maintain compliance with SDWA requirements and to protect public health objectives of the Act. In Nevada, this program is currently being developed with the Bureau of Health Protection Services acting as the lead agency.

Local Options and Discretion

1974 Recommendations. "...The concept of state administration of the water resource through application of the provisions of the water law is generally not only accepted, but endorsed with an enthusiasm for continuance...It is recommended that State authority over water resource administration be retained. Where and when possible, local options and discretion should be recognized in such matters as internal management, construction of projects affecting local interest, and financing of such projects."

Current Status. The State has retained authority over water resource administration, however the need for local entities to be proactive in regional water resource planning is being recognized. In recent years, a number of local and watershed planning efforts have been undertaken. To ensure that counties are aware of water right application potentially affecting their region, statutory changes were made requiring the State Engineer to notify county commissioners of water right applications in their county for use in another county (NRS 533.363).

Mining or Depletion of Ground Water

1974 Recommendations. "Withdrawal of groundwater is limited to that naturally recharged to the groundwater basin. The only exception is covered under the provisions of NRS 534.120, which allows issuance of temporary permits to appropriate groundwater which can be limited as to time and which may revoked if and when water can be furnished by entity. This provision has been applied only in Las Vegas Valley where the alternate source of the Colorado River is available. Concepts have been advanced whereby groundwater in storage would be depleted over a given period of time...It is recommended that caution be exercised in any legislative changes to expand authorization for depletion of ground water in storage. Any authorization, in addition to that presently existing, should be on an area-by-area or case-by-case basis and should not be applicable statewide."

Current Status. It is the policy of the State of Nevada to appropriate groundwater up to the perennial yield. In some instances, some minor applications may be approved in a fully appropriated basin if the proposed use is a preferred use and is in the public interest. Mining is considered a temporary use, and in some basins, mining withdrawals have been allowed to exceed perennial yield with the excess water being put to beneficial use where feasible.

Transbasin Diversions

1974 Recommendations. "There is presently no specific statutory reference to transbasin diversions. This has not created any problems and existing or proposed transbasin diversions can be considered, evaluated, and regulated under existing statutory provisions regarding availability of supplies and effects on existing water rights. It is recommended that no legislative amendments be initiated on this subject."

Current Status. A number of actions have been taken since 1974. The discussion on "Interbasin and Intercounty Transfers" in Part 3 of the *State Water Plan* provides an overview of these actions and additional recommendations.

Preferred Uses

1974 Recommendations. "The only existing provision for consideration of preferred use in the appropriation of water is NRS 534.120, which relates to new appropriations of groundwater in basins being depleted. The effectiveness of the time-priority system rather than type of use-priority, coupled with provisions for changing the manner of use of water supplies as need and desire arise, lead to the conclusion that no changes are required as regards preferred uses."

Current Status. Since 1974, no legislative changes have been made regarding preferred uses. In designated basins, the State Engineer has continued to define preferred uses for specific regions as needed. In response to the influx of Desert Land Entry requests, the 1981 State Legislature adopted NRS 533.357 which establishes priorities for various categories of irrigation water use.

Reservation of Water Quantities

1974 Recommendations. "The idea of reserving quantities of water and essentially setting them aside from appropriation for use for some specific purpose at some time in the future has been advanced. This has been specifically considered regarding future supplies for Municipal and Industrial purposes. It has been proven to be in the State and private interest to allow appropriation of available water for any beneficial use to which it can be applied at the time it can be applied. Again, as demands or requirements change, so can the manner of use of water be changed. It is recommended that this concept of reserving water be rejected."

Current Status. Beginning prior to 1974, the State Engineer has issued orders which designate areas for preferred uses and denial of other uses. Through these orders, the State Engineer has essentially reserved an area for particular types of use. Regarding municipal water appropriations, changes to NRS 533.380 have given municipalities more flexibility in obtaining time extensions regarding the placing of water appropriations to beneficial use.

Termed Approvals of Water Appropriations

1974 Recommendations. "Water rights, when perfected, are a right in perpetuity, subject to forfeiture and abandonment. There is perhaps some authority for issuing water rights for a specific term, or time period, if it is demonstrated that the capability for beneficial use is limited to that time. There is some interest in the western states in expanding the authority for issuing termed water rights. It is not clear how this might be applied in Nevada water administration at this time. It is recommended that the concept of issuing termed water rights be further explored before any definitive action is taken."

Current Status. In 1991, NRS 533.371 was added which allows the State Engineer to issue permits that are effective for a limited time period for a temporary use.

Water Supplies and Rights for Temporary Construction Uses

1974 Recommendations. "Generally, water supplies for temporary construction, such as highway projects, are available from existing sources and agreements can be reached for water use under some existing water right. However, time is required to obtain a water right, and this can affect obtaining water, particularly in designated groundwater basins. Limited problems created do not warrant the issuance of any type of 'special permit.' It is recommended that the State Highway Department consider this matter in bid notices and other material furnished potential bidders or contractors."

Current Status. Language has been added to NRS 534.050 which allows the State Engineer to waive permit application requirements for the temporary use of water in highway construction, and other uses.

Wells for Domestic Use

1974 Recommendations. "Current statutory provisions do not apply in the matter of obtaining permits for underground water from a well for domestic purpose where the draught does not exceed 1800 gallons per day. A ‘permit system’ for individual domestic wells has been considered; but it is estimated that use from such wells is about one percent of the total water use in the state. The merits and benefits to be derived do not, at this time, warrant the time, staff, and financing that would be required to administer a domestic well permit system. This is a matter that warrants continuing consideration in the future.”

Current Status. The merits and benefits of a domestic well permitting system still do not warrant the time, staff and financing required. Several bills have been introduced in the Legislature attempting to create such a system, but have not been successful. For additional information, refer to the discussion on “Domestic Wells” in Part 3 of the *State Water Plan*.

Taxes on Well Production

1974 Recommendations. “In a previous session of the legislature, a bill was introduced to provide a tax on water produced from wells. There was a serious objection from all areas of the State and the bill did not pass from committee. It has since been proposed that such a tax be considered, not on a statewide basis, but in particular areas. Specifically there is interest by some local residents in taxing production from wells in Las Vegas Valley. The thought is that this would equalize the cost of well water with that served by the public utilities. It is recommended that any consideration of taxes on well production be limited to that under temporary permits which are subject to revocation within the Las Vegas Artesian Basin. It is also recommended that even this be approached only after thorough evaluation of legal ramifications and equity.”

Current Status. With passage of Assembly Bill 436 in 1997, a program for the management of the groundwater in the Las Vegas Valley basin was created. As part of this program groundwater users are assessed an annual pumpage fee to fund the Las Vegas groundwater management program.

Geothermal Resources

1974 Recommendations. “Nevada’s geothermal resources are administered by the state engineer pursuant to the attorney general’s opinion of August 12, 1965...The implementation of the federal geothermal leasing act makes no provision for compliance with existing State water law, or for protection of existing water rights on private or public lands. Designated critical ground water basins within the State require particular regulation by the state engineer. Unregulated exploratory drilling for geothermal resources in these designated basins and other basins could adversely affect existing rights, in that the federal geothermal leasing act makes no provisions for exploration activity on private or corporate lands. It is recommended that legislation be enacted to specifically provide that geothermal resources are subject to administration under the water law and to provide for establishment of rules and regulations for such control and administration.”

Current Status. NRS 534A describing geothermal resource administration was added to the statutes in 1975 with subsequent changes. Under NRS 534A, a permit is needed from the State Engineer if any of the geothermal water is consumptively used, not including reasonable system losses. Nonconsumptive geothermal permitting is administered by the Division of Minerals.

Water Supplies for Proposed Subdivisions

1974 Recommendations. "Legislation was enacted in 1971 (NRS 116 and 117) giving the State Engineer the responsibility to confirm water supplies for proposed subdivisions. This was amended in 1973 to provide that the State Engineer was to prepare and provide a review of water quantity. Authority for final approval rests with the health division of the Department of Human Resources. It is appropriate and necessary that the State Engineer be responsible for water quantity determinations in accordance with the provisions of the water law. Such provisions require that due diligence be exercised in any development of water to satisfy any proposed use. Subdivision approval does not include similar requirements. It is recommended that consideration be given to time limits on subdivision approvals [by counties]. That is, subdivisions would be approved [by counties] for development within a given period, at the conclusion of which the undeveloped portion would be subject to reconsideration. An alternative to this approach would be a requirement that water supply and sewer or disposal service be available at each lot prior to sale."

Current Status. NRS 278.360 has since been modified which places time limits on tentative subdivision map approvals. NRS 278.377, added in 1977 with subsequent revisions, requires approval of subdivision maps by the State Engineer with regard to water quantity. A 1978 Attorney General's opinion found that this statute grants the State Engineer has the authority to disapprove tentative subdivision maps on the basis of water quantity. Also, NRS 278.462 was added which authorizes the State Engineer to make recommendations on water quantity for parcels when requested by the county or other governing body.

State vs. Federal Jurisdiction

1974 Recommendations. "There [have] long existed questions about state and federal jurisdiction over water supplies on federally controlled lands. There have been numerous court decisions on this subject, however there remain many uncertainties which can only be resolved through federal legislation. Such legislation has been introduced in Congress in the past and will likely be introduced in the future. It is recommended that officials and citizens of the State closely scrutinize any such legislation and offer support or resistance in an effort to protect what should properly be the individual State role in administration of the resource."

Current Status. The State continues to protect its primacy in water resources administration.

Flood Control

1974 Recommendations. "...There are extensive flood insurance programs presently available through federal agencies, and State assistance is available to local authorities for securing information about such programs. It is recommended that flood plain zoning ordinances or regulations be formulated and enforced by local government agencies. If this is not effective, flood plain zoning should be considered at the State level."

Current Status. There have been a number of improvements to state floodplain management since issuance of the 1974 State Water Plan. For details on these changes, refer to the discussion on

"Flood Management in Nevada" in Part 3 of the *State Water Plan.*

Navigability Effects

1974 Recommendations. "There have recently been judicial determinations and legal opinions concerning navigability of some of the streams in Nevada. This has raised questions regarding State responsibilities and possible liabilities in maintaining stream channels and related issues. For example, if the course of a navigable stream is altered, either through natural processes or by design, what is the ownership status of the vacated area and resources, such as gravel aggregate within these areas. It is recommended that proper authority analyze possible ramifications, not only for the protection of the State, but so that the public may be better informed."

Current Status. NRS 532.220 established a program to aid local governments in the clearance, maintenance, restoration, surveying and monumenting of navigable rivers. In 1980, the Attorney General issued an opinion stating that cities, counties and public districts (including irrigation districts and flood control districts) and the United States have the authority to maintain or improve the channel of a navigable river to assure its flow capacity or to avoid flood damage to adjoining property. However, no state or federal statutes require these entities to undertake such projects.

Environmental Considerations

1974 Recommendations. "There has been an increasing public awareness and understanding regarding environmentally related concerns with respect to water and other natural resources within the State. Efforts to continue and extend this public awareness through dissemination of information and through the academic system should be encouraged. Specific project or resource planning should include a consideration of environmental impacts, not only on the immediate area, but on a regional basis. Watershed management programs should include such factors as sediment retention, vegetation manipulation and management, livestock and wildlife carrying capacities, and other factors to enhance environmental quality within water availability. Critical habitat and rare and endangered species should be considered and, if necessary for their protection, appropriate water rights should be acquired. In most instances, water quality and quantity questions and issues must be jointly considered. Compatibility of administrative procedures and regulations must be retained."

Current Status. A number of actions have been taken since 1974. NRS 533.437 was added thereby allowing the issuance of temporary permits to appropriate water needed to avoid pollution of contamination of a water source. NRS 533.367 was added which states that "[b]efore a person may obtain a right to the use of water from a spring or water which has seeped to the surface of the ground, he must ensure that wildlife which customarily uses the water will continue to have access to it." Since 1974, Nevada Supreme Court findings have led to a broader legal interpretation of beneficial use regarding wildlife needs. In 1988, *Nevada v. Morros* concluded that providing water to wildlife is a beneficial use of water.

There are numerous examples of water rights being acquired for resource conservation purposes. The Park and Wildlife Bond Act of 1990 (Question 5) authorized the expenditure of $47.2 million which has been used to purchase land with special resource values. In addition, $5 million was designated for water rights acquisitions.

The Director of the Department of Conservation and Natural Resources and the Divisions of Water Resources, Environmental Protection, and Wildlife are jointly considering water quantity, water quality and wildlife impacts when reviewing mining withdrawal applications. The Division of Water Planning has been directed to consider both water quantity and quality in its planning.

For additional information, refer to the discussions on "Nonpoint Source Pollution", "Comprehensive Groundwater Protection and Management", "Watershed Planning and Management", and "Wildlife and Environmental Water Uses and Needs" in Part 3 of the *State Water Plan*.

Continuing Planning Efforts

1974 Recommendations. "The planning effort does not end here. In the 1969 report to the Legislative Commission and in testimony before the Legislative Committees, it was emphasized that water planning would be a continuing requirement. The State role and responsibility of review and evaluation of proposals by other agencies continues. Also, there is a need to provide assistance in other planning efforts, such as land planning, and water quality planning. Participation in federal, regional, and interstate investigation and negotiations is necessary to assure adequate consideration of the State of Nevada's interest and position in water transfer or related matters. Data and information used in water resource decisions requires continuing attention to assure that it is current. It is recommended that staff and funding for the Water Planning Section in the Division of Water Resources be continued at the current rate for the next biennium and that requirements be reevaluated periodically thereafter."

Current Status. The state water planning program was active until the early 1980's, although with a dwindling staff. In 1982, the program was eliminated due to severe funding shortages. The water planning program was re-instituted by the 1989 State Legislature, with staff hired during 1990. Since that time, the Division of Water Planning has undertaken a number of efforts. For example, the Division has produced over 50 publications including the *State Water Plan*, continues to provide assistance to local planning efforts, compiles and distributes needed information, and administers a drinking water system grant program and a floodplain management program.

Regional Conclusions and Recommendations of the 1974 State Water Plan

Walker River Basin

1974 Recommendations. “There is not sufficient water in the Walker River system to satisfy present and projected requirements upstream and yet maintain Walker Lake as a viable fishery as it presently exists. Water levels will continue to decline and salinity will continue to increase.

Water rights confirmed both by Decree from the Federal District Court and in appropriations through State procedures must be recognized in administering water supplies of the system.

It has been suggested that extensive studies such as State-Federal Task Forces be created to further evaluate water uses and practices within the Walker River Basin. Many of the findings of the Pyramid Lake Task Force can be applied, at least in concept, to the Walker River system. It is doubtful that another Task Force effort would yield significant new data or information.

Means of maintaining the Walker Lake fishery by introducing new species that can adjust to increased salinity should be explored. Also, replacement of fishery pressures to upstream reservoirs should be considered.

The only apparent means of maintaining the existing level of Walker Lake would be to acquire existing water rights upstream for transfer to Walker Lake. No recommendation is made for a legislative determination in this matter.

It is recommended that the allocation of water set forth in the California-Nevada Interstate Water Compact be recognized and preserved.”

Current Status. Since the completion of the 1974 State Water Plan, Walker Lake water levels have continued to decline and salinity has increased.

Walker River Decree rights and state appropriative rights continue to be recognized in administering the water supplies.

The University of Nevada Reno and the Desert Research Institute have been studying the feasibility of a water bank as a mechanism for the voluntary leasing or transferring of water rights from one user to another. The Walker River Basin Advisory Committee is studying strategies for improving water conservation in the basin. Both of these studies are funded primarily with federal monies. The U.S. Army Corps of Engineers is now planning to develop various ecosystem restoration studies and projects in the basin, and is seeking local sponsorship. The Division of Water Planning created the Walker River Basin Technical Network to increase coordination among the various groups studying the basin, and improve information sharing and distribution. Using federal funds, the Division hired a part-time watershed planner to oversee the Network and begin development of a watershed plan.

A number of efforts addressing the Walker Lake situation have been undertaken in recent years. For instance, the Division of Wildlife is now acclimating hatchery fish to high salinity water prior to their release into Walker Lake. This has greatly decreased fish mortality following planting. Over 20 studies by 10 separate agencies are currently underway or pending.

In 1983, the Division of Wildlife perfected a water right (certificate was issued) for the Walker River flood waters flowing into Walker Lake. This right is one of the most junior on the system with a priority date of September 17, 1970. A number of studies are underway which examine feasible water augmentation solutions for Walker Lake.

The California-Nevada Interstate Compact remains unratified by U.S. Congress. The Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990 (Public Law 101-618) addressed interstate allocations of the Truckee and Carson rivers, and Lake Tahoe, but not interstate allocations of the Walker River.

Carson-Truckee River Basins

1974 Recommendations. "...The State should continue to pursue and support Congressional approval of the California-Nevada Interstate Compact concerning waters of Lake Tahoe and the Truckee, Carson and Walker River Basins as ratified by the State of Nevada and California. Pending Congressional approval, the allocations of water and other provisions should be recognized and followed as State policy.

The Pyramid Lake Task Force Recommendations (both the so-called 'Government' recommendations and 'Sierra Club' recommendations) should be pressed for implementation in the areas found practical and feasible.

(Note: A summary of the main recommendations presented by these groups include:

- strict enforcement of existing decrees
- continue following suggested rules and regulations for operation of the Truckee and Carson rivers, including Lahontan Reservoir
- a variety of improvements to Truckee-Carson Irrigation District facilities to improve efficiencies while wildlife, waterfowl and recreation areas are kept viable
- initiate a cooperative pilot program to demonstrate the effects of a sprinkler system
- expedite design and construction of Marble Bluff Dam and Fishway)

The State should provide necessary funding for advancing and defending the State's position in litigation.

A firm decision should be made regarding development of water supplies within the 'Marlette-Hobart' system and intended uses of these supplies.

A reevaluation of Watasheamu Dam and Reservoir for possible recreation use and Municipal and

Industrial use in Carson Valley and Carson City should be requested of the Bureau of Reclamation.

Several alternatives for additional water supplies to serve Carson City have been identified and presented. Local interests should be encouraged to proceed with necessary legal, engineering and funding proposals for augmentation. The alternative will be a limitation on future growth and development."

Current Status. The California-Nevada Interstate Compact remains unratified by U.S. Congress. The Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990 (Public Law 101-618) addressed interstate allocations of the Truckee and Carson rivers, and Lake Tahoe, but not interstate allocations of the Walker River.

Many of the recommendations of the Pyramid Lake Task Force were addressed in Public Law 101-618 including efficiency studies, and the purchase of water rights for wildlife. Other recommendations were addressed in OCAP (Operating Criteria and Procedures) such as storage levels, operational improvements, etc. Also, the Pyramid Lake Paiute Tribe has secured a right to the unappropriated water in the Truckee River in accordance with Nevada water law.

For about 25 years, the Department of Conservation and Natural Resources has had a fund for financing litigation in the Truckee, Carson and Walker rivers.

Since 1974, the State acquired the Marlette-Hobart system and operates it today to serve Silver City, Gold Hill, Virginia City and Carson City.

With California designating the East Fork of the Carson River as a wild and scenic river, the Watasheamu Dam and Reservoir project (which would inundate a portion of the river in California) was prohibited. Subsequent to this action, the Carson Water Subconservancy District funded a study examining the feasibility of a smaller dam and reservoir (Bodie Dam) which would not inundate lands in California. Bodie Dam was not found to be cost effective. The Subconservancy continues to examine alternative supply and management options.

Since 1974, Carson City has proceeded with the necessary steps for supply augmentation and has secured adequate water supplies for their planning horizon.

Humboldt River Basin

1974 Recommendations. "Occasionally, there are surplus waters in the Humboldt river system...Portions of this water could be salvaged for beneficial conservation and recreation uses upstream. Additionally, there is need for stabilizing flows, reducing flood damages and providing sediment detention by providing upstream storage.

The proposed Humboldt River Storage Project includes...[a number of storage reservoirs]. The 1973 Legislature passed a Resolution supporting the Humboldt Project, contingent upon a favorable environmental and fish and wildlife impact assessment and other beneficial aspects. A sum was also appropriated for an analysis of the impacts. The results will be furnished in separate reports, and specific recommendations will depend upon these results.

However, it can be recommended that in any event, existing water rights be protected and in no way jeopardized.

Also, water rights for the Humboldt-Toulon Wildlife area are being considered and will be considered further.”

Current Status. In 1974, an environmental investigation of proposed Humboldt River Storage Project plus the proposed Rock Creek dam was completed. Of the proposed projects, only the South Fork Dam and Reservoir has been constructed at a smaller scale than originally envisioned. South Fork Reservoir is operated solely for recreation purposes.

Existing water rights continue to be protected.

Water rights have been acquired for the Humboldt-Toulon Wildlife area.

Central Region

1974 Recommendations. “This area encompasses the large portion of Central Nevada where there are no large stream systems or surface water sources...[Local people] were concerned about being ‘lumped’ in such a large area. Some Pahrump Valley residents felt that population projections were low.

Consideration should be given to a Compact concerning water of the Pahrump Valley Ground Water Basin between Nevada and California.

It is recommended that growth trends be carefully monitored to assess the potential water requirements.

This region also holds potential for the area development concept, but this should not be imposed on the local people without their opportunity to be heard.”

Current Status. No action has been taken on a compact between Nevada and California regarding Pahrump Valley groundwater. In 1991, NRS 532.175 was added to the statutes thereby authorizing the State Engineer to enter into agreements with neighboring states concerning the cooperative management of shared groundwater basins. Currently, no such agreement exists for Pahrump Valley.

Some of the counties within the Central Region are developing water plans that examine growth trends and assess their future water needs.

Colorado River Basin

1974 Recommendations. “Presently available sources of water for the Las Vegas Valley including groundwater, Colorado River supplies, and return flows from use of these sources are projected to be adequate until sometime between 1990 and 2000. There may be a period of time before 1980 (prior to implementation of the second stage of the Southern Nevada Water Supply Project) when shortages could be expected. These times and dates will depend on growth of the area and resulting increases in water requirements.

Recommendations for this area are: The second stage of the Southern Nevada Water Supply Project should be expedited and completed at the earliest possible time.

Local water service entities should continue and, in fact, increase their efforts to maximize use of the Colorado River supplies and thus reduce withdrawals from the ground water basin.

Population growth and resulting increases in water requirements should be monitored closely.

The alternatives presented in the special Water Planning Report, 'Water Supply for the Future in Southern Nevada' [1971] should be considered in establishing goals and procedures for possible means of meeting future water requirements. This responsibility should be assumed by Clark County with necessary assistance provided by the State.

(Note: The basic alternatives presented in the above-referenced report included:

- water from sources within Nevada - Pahrump Valley, Amargosa Desert, Railroad Valley, Pahranagat Valley, Virgin River Valley
- water from sources outside Nevada - Snake River basin, Columbia River basin, desalination of Pacific Ocean water in exchange for additional Colorado River water
- conservation to reduce demands
- population redistribution - providing economic incentives to future growth to occur outside of the Las Vegas metropolitan in other areas of excess water
- limiting population growth)

Return flow should be carefully administered and managed for optimum use.

The State and local roles in matters such as Colorado River salinity and water quality controls should continue to be vigorously pursued.

The State representation should continue active participation in efforts such as the Committee of '14' and the Colorado River Salinity Forum to assure that Nevada's interests in the Colorado River are protected.

Discussions should be initiated with representatives of Utah and Arizona directed to formulating a Compact to allocate the waters of the Virgin River."

Current Status. Construction of the second stage of the Southern Nevada Water Supply Project started in 1977 and was completed by 1983. Rapid growth has continued in the Las Vegas Valley and in 1993 the first phase of a multiyear capital improvement plan to supply the needed water was initiated. Phase I was completed in 1997 and Phase II will be completed in 1999.

In 1991, the Southern Nevada Water Authority (SNWA) was created through a cooperative agreement among the seven regional water and wastewater agencies in Clark County. The purposes of SNWA are to seek new water resources for Southern Nevada, to manage existing and future water resources, to construct and manage regional water facilities, and to promote responsible conservation. In 1994, SNWA began an integrated resource planning process to aid in the selection of appropriate combinations of resources, facilities and conservation program to meet future demands in Southern Nevada. The SNWA Water Resource Plan was completed January 1996 and amended February 1997. SNWA continues to monitor population and water use growth, and examine alternatives which optimize all supplies, including the Colorado River, other surface water, groundwater, and reclaimed water.

Some of the alternatives presented in "Water Supply for the Future in Southern Nevada" are being implemented, fully or partially, or are still being considered as potential future solutions:

- Conservation measures are successfully reducing water demands in the Las Vegas Valley. The implementation of additional conservation measures is an integral part of SNWA's Water Resource Plan for the future.

- The SNWA Water Resource Plan includes the Cooperative Water Project (CWP) as a potential future water supply alternative to meet demands beyond the year 2025. The CWP involves the collection and transmission of groundwater from sixteen hydrologic basins in Clark, Lincoln, Nye and White Pine counties.

Return flows to the Colorado River from Las Vegas Valley are calculated by a methodology developed by the U.S. Bureau of Reclamation in consultation with the Colorado River Commission, and was approved by the lower Colorado River basin states in 1984.

The Nevada Division of Environmental Protection established the Lake Mead Water Quality Coordination Forum with the objective to protect public health and preserve the water quality of the Las Vegas Valley Wash and Bay and Lake Mead. The Forum coordinates the many efforts of the interested parties and stakeholders regarding the water quality concerns.

The State continues to be active in the Colorado River Basin Salinity Control Forum and support those projects beneficial to Nevada.

The State Engineer has initiated discussions with Utah and Arizona representatives regarding the allocation of Virgin River water. Also, the State Engineer has issued a water right permit to Southern Nevada Water Authority for an average of 190,000 acre-feet per year from the Virgin River.

Snake River Basin

1974 Recommendations. "The Nevada Legislature previously ratified a Columbia River Compact which includes the water supplies within this region. The Compact was not ratified by some other participating states and is therefore not effective. There has been a renewed interest throughout the Northwestern states in pursuing Compact negotiations.

It is recommended that Nevada representatives actively participate in such negotiations to protect our share of this resource.

The State is currently a party in a suit involving development and use of groundwater in Nevada and the possible effects on surface streams in Nevada which flow into Idaho. It is recommended that the State's position in this suit be aggressively pursued and defended."

Current Status. The Columbia River Compact remains unratified by some states, however the Compact Commission is still in existence. The suit referred to the 1974 Recommendations (Bellbrand) has been settled. The surface waters in the Salmon Falls Creek and Goose Creek areas were adjudicated. The remainder of the tributaries are presently being adjudicated.

1974 State Water Plan Conclusions and Recommendations on Projected Water Requirements

Municipal and Industrial

1974 Recommendations. "In most communities and cities throughout the State, there will be sufficient water available in the immediate area to meet projected municipal and industrial requirements, through the planning period or until 2020. In some cases, water quality problems may develop and treatment will be necessary. Also, in many instances, it may be necessary to acquire existing water rights and change the manner of use.

It is recommended that water service entities in the various cities and communities assess their water supply and treatment needs and immediately initiate programs to assure a sufficient water supply for their anticipated needs. Necessary data and assistance is available from State Water Planning information."

Current Status. The larger municipal water suppliers have been actively planning for future water supply and treatment needs, and developing capital improvement programs. The Division of Water Planning continues to provide data and assistance to water service entities and others. Through the AB 198 grant program, the Division of Water Planning has provided funding assistance to the smaller communities for infrastructure improvements.

Electric Energy Generation

1974 Recommendations. "More electric energy facilities will be required in the future to supply Nevada's demand, and possibly to supply a portion of demand in the remaining ten Western States.

Private, state, and federal studies should continue for conventional fossil fueled plants, as well as nuclear plants, geothermal plants, and pumped storage facilities. New dams and reservoirs should be analyzed to see if electric power generation would be feasible. Utilities should consider purchasing existing water rights to provide the additional necessary water supplies required for steam-electric generation of electric energy.

Caution should be exercised not to overcommit water supplies for generation of power to be exported. If export is necessary for a period of time, a ‘recapture’ condition should be imposed to assure that demands and requirements within Nevada can be met.”

Current Status. In 1981, NRS 533.372 was added to the statutes authorizing the State Engineer to approve or disapprove any water right application for the purpose of generating energy to be exported out of Nevada.

Mining

1974 Recommendations. “Mining has been an industry in Nevada for over 100 years and is expected to continue to be economically vital. Many of the mining processes require large amounts of water, some of which result in a degradation of water quality.

Discharge water should be adequately treated before returning to the stream or river system or to a ground water basin.

In water-short areas, or where the projected mining water demands exceed the available supply, plans to augment present supplies should be initiated. These might include interbasin transfers, purchasing existing water rights, and possibly reusing discharge waters.”

Current Status. Mining water use has changed significantly since the release of the 1974 State Water Plan. Since that time, withdrawals have increased over 10 times due primarily to increased pit dewatering activities. Of the estimated 274,000 acre-feet withdrawn in 1995 at mines, only about 32 percent was consumptively used by mine operations. The remaining volume was reinjected, infiltrated, evaporated, discharged to surface water bodies, or reused for irrigation purposes. Disposal of these excess waters has been regulated by the Division of Environmental Protection to ensure that the waters are adequately treated prior to discharge. While some mines are utilizing excess pit water, other mines have had to rely on interbasin transfers or the purchase of water rights for their needed supplies.

Recreation

1974 Recommendations. “There is a general need for more water-based recreation in Nevada... In construction of new reservoirs, consideration should be given to minimum flows and maintenance of minimum pools. Diversions should be screened and fish ladders built at new and existing dams. As the demand increases for water-based recreation, new areas should be developed and new facilities should be established at existing lakes and reservoirs.

Requirements for minimum pools and minimum flows should not be imposed on existing facilities or projects unless water rights are acquired for these purposes, either through new appropriation or acquisition of existing rights."

Current Status. NRS 535.020 requires that new dams or the alteration of existing dams have fishways installed over or around dams, and for the protection and preservation of fish in streams obstructed by dams. In 1986, the South Fork Reservoir near Elko was constructed solely for recreational purposes. The operation of this reservoir provides for minimum downstream flows. There are numerous examples of water rights being acquired for recreation, environmental and wildlife purposes as presented in the "Environmental Considerations" discussion in this section of the *State Water Plan*. For additional information, refer to the discussion on "Maintaining Recreational Values" in Part 3 of the *State Water Plan.*

Agriculture

1974 Recommendations. "Potential agricultural development is severely limited in many areas of the State because of inadequate water supplies. It has been necessary to deny issuance of permits to appropriate water for agricultural use in some areas. Existing agriculture is inhibited also in some cases by variations of flows, sedimentation, salinity, floods, and outmoded structures and facilities.

Consideration should be given by ranchers, farmers, irrigation districts and water companies to improved efficiencies, regulatory storage facilities, management and operation practices and to other conservation measures.

The state should continue to enforce water right conditions for maximum utilization of the limited supplies."

Current Status. Nevada's agricultural community has been implementing a variety of conservation measures throughout the State, particularly in the Walker and Carson River basins and the Lovelock area (Humboldt River basin). For more information, refer to the discussion on "Water Conservation" in Part 3 of the *State Water Plan.*

Fish and Wildlife

1974 Recommendations. "As the development and use of water in the State has increased, in some cases, natural sources of water have been restricted or become completely inaccessible to wildlife. Other factors affecting wildlife watering include the continued physical presence of domestic livestock or human activity at or near water sources.

One possible solution would be for the Fish and Game Department to acquire water rights for wildlife purposes at the various natural water sources. This procedure would be time consuming and expensive.

An alternative would be legislation to provide that in new appropriations of water, that the applicant allow a sufficient quantity of water to remain at the source for wildlife needs. This requirement should not be imposed on existing facilities and should not impair or adversely affect existing water rights.

Current Status. A number of actions have been taken to provide water supplies for fish and wildlife. For more information, refer to the discussions on “Environmental Considerations” and “Recreation” presented earlier in this section of the *State Water Plan*.

Nevada State Water Plan
PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 3
The Institutional Framework for Water Planning and Management

Introduction

This section presents an overview of the institutional framework affecting water planning and management within the State. All entities involved with water planning, allocation, management and development issues must navigate their way through portions of this institutional framework in their decision-making process.

Statutory, Regulatory and Legal Considerations

This subsection provides a general summary of the major state and federal statutory, regulatory and legal constraints impacting water planning and management. Water quantity allocation and management; interstate water resource management; water quality protection and management; resource protection; flood protection and drought planning; and conservation are all important constraints to consider for a successful water plan.

Water Quantity Allocation and Management

Nevada Water Law. All waters within the boundaries of Nevada, whether above or beneath the ground surface, belong to the public and are managed on their behalf by the State. The State Engineer is responsible for the administration of Nevada Water Law, which ensures that these waters are managed so that sufficient quantities are available to preserve our quality of life and to protect existing water rights. Entities within the State can apply for the right to use that water. Like many of the western states, Nevada water law is founded on the doctrine of prior appropriation - "first in time, first in right." Under this doctrine, the first user of water from a watercourse acquires a priority right to the water and to the extent of its use under that right.

Nevada water law is set forth in Nevada Revised Statutes (NRS), Chapters 533 and 534. In addition, there are numerous court decisions which have further defined Nevada law. It is the State Engineer who determines the limit and extent of the rights of claimants to water, the use to which water may be put, the quantity of water that is reasonably required for beneficial use, and where water may be used.

As part of the duties of the office, the State Engineer reviews applications for new water rights appropriations. In approving or rejecting an application to appropriate water, the State Engineer follows statutory criteria:

- Is there unappropriated water in the proposed source?
- Will the proposed use impair existing rights?
- Will the proposed use prove detrimental to the public interest?
- Is the project feasible and not filed for speculative purposes?

All water rights are considered real property and can be bought, sold, traded and leased. The place of use and type of use can be changed with the State Engineer's approval. The attributes of appropriative water rights in Nevada are: 1) beneficial use is the measure and limit of the right to the use of the water; 2) rights are stated in terms of definite quantity, manner of use, and period of use; and 3) a water right can possibly be lost by abandonment or forfeiture.

The State Engineer has primary responsibility for the distribution of all surface water in Nevada except on civil decreed streams systems unless so granted by the civil court; and except on federally decreed stream systems. Stream systems which have been adjudicated are distributed in accordance with the associated decree by water commissioners. The water commissioners are recommended by the State Engineer and confirmed by the state district court. In areas where an irrigation district has been formed, the water is distributed by irrigation district personnel.

Decrees. Most surface waters in Nevada are managed in accordance with civil, state or federal decrees. There are over 100 decrees governing water allocation and management in Nevada. Following is a brief summary of the major decrees affecting water allocation and management in specified basins:

- **Alpine Decree (federal).** The waters of the Carson River are distributed in accordance with the Alpine Decree issued in *United States v. Alpine Land and Reservoir Co., et al.* by the federal district court on October 28, 1980. Although the Alpine Decree encompasses water rights in both Nevada and California, it is not an interstate allocation as neither state was a party to the decree.

- **Bartlett Decree, Edwards Decree (state).** The waters of the Humboldt River are distributed in accordance with the Bartlett Decree issued by state district court in 1931 and the Edwards Decree issued by state district court in 1935. The Edwards Decree corrected errors and omissions in the Bartlett Decree.

- **Orr Ditch Decree (federal).** The waters of the Truckee River and its tributaries are distributed in accordance with the Orr Ditch Decree issued in *United States v. Orr Ditch Water Company, et al.* by federal district court on September 8, 1944. No rights to the use of Truckee River water in California were included in this decree. The Orr Ditch Decree also incorporated the provisions of the earlier Truckee River Agreement. In 1935, the United States, Truckee-Carson Irrigation District, Sierra Pacific Power Company, and the Washoe County Water Conservation District entered into the Truckee River Agreement which set out the operational rules of the river system.

- **Walker River Decree (federal).** The waters of the Walker River and its tributaries are distributed in accordance with the federal decree issued in *United States v. Walker River Irrigation District, et al.* by federal district court on April 14, 1936 and amended on April 24, 1940. Although the Walker River Decree encompasses water rights in both Nevada and California, it is not an interstate allocation as neither state was a party to the decree.

Tribal Water Rights. When the United States reserved land from the public domain for uses such as Native American reservations, it also implicitly reserved sufficient water to satisfy the purposes for which the reservation was created. This federal reserved water rights doctrine was established by the U.S. Supreme Court in 1908 in *Winters v. United States.* Federally reserved Indian water rights differ from state-issued rights in a number of ways. For instance, the Winters Doctrine asserts that federal reserved rights cannot be lost by failure to put the associated water to beneficial use.

In Nevada, the more than 20 Native American reservations and colonies occupy approximately 1.6% of the land area (about 1 million acres). About 90% of these reserved lands are within five reservations: 1) Pyramid Lake Indian Reservation (southern Washoe County); 2) Walker River Indian Reservation (predominately northern Mineral County); 3) Duck Valley Indian Reservation (northern Elko County); 4) Goshute Indian Reservation (northeastern White Pine County); and 5) Moapa River Indian Reservation (northern Clark County).

Interstate Water Resource Management

Colorado River. In addition to Nevada, the states of California, Arizona, Wyoming, Colorado, New Mexico, and Utah, and the Republic of Mexico, all use water from the Colorado River. In 1922, these seven states entered into an interstate compact which includes a provision for the equitable division and apportionment of the waters of the Colorado River system. The Boulder Canyon Act of 1928 provided, among other things, for the construction of works to protect and develop the Colorado River Basin by the U.S. Bureau of Reclamation. The U.S. Supreme Court Decree in *Arizona v. California*, 1964, established several additional dimensions to the apportionment of Colorado River water, including apportionments to the lower basin states of Nevada, California and Arizona. It was ruled that of the first 7.5 million acre-feet of mainstem water consumed in the lower basin, California was entitled to a consumptive use of 4.4 million acre-feet/year; Arizona to 2.8 million acre-feet/year; and Nevada to 0.3 million acre-feet/year. In 1968, the Colorado River Basin Project Act authorized the Central Arizona Project and it provided for allocations to the lower basin states in years of insufficient mainstream water to satisfy the specified consumptive use of 7.5 million acre-feet per year.

The Nevada State Legislature recognized the value of this resource in 1935 when it created the Nevada Colorado River Commission to serve as the State's watchdog over the Colorado River. Among its other statutory responsibilities, the commission is required to "receive, protect and safeguard and hold in trust for the State of Nevada" all the water and associated water rights in the Colorado River to which the State is entitled under federal law, interstate compacts and treaties. The Commission is also responsible in various ways for the distribution of this water, and thus is authorized to contract for the use of the water.

California-Nevada Interstate Compact. The need for apportioning the water of the Truckee, Carson and Walker rivers between Nevada and California has been considered over the years. After years of negotiations, the state legislatures of California (in 1970) and Nevada (in 1971) passed legislation adopting the California-Nevada Interstate Compact. However, the U.S. Congress never ratified the Compact. Interstate allocations of the Truckee and Carson rivers were addressed in the Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990.

Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990. The latest effort to resolve long-standing disputes over water and water rights on the Truckee River has been the enactment of congressional settlement legislation for the Truckee and Carson Rivers. This legislation, known as the Truckee-Carson-Pyramid Lake Water Rights Settlement Act (or "Negotiated Settlement"), was approved by the 101st Congress on November 16, 1990. The main authorizations and directives included in the legislation are:

- an interstate allocation between Nevada and California is made of the waters of the Truckee and Carson Rivers, and Lake Tahoe;
- a new operating agreement is to be negotiated for the Truckee River;
- the Newlands Projects is reauthorized to serve additional purposes, including recreation, fish and wildlife, and as a municipal water supply for the Fallon area;
- a recovery program is to be developed for the endangered Pyramid Lake cui-ui fish and threatened Lahontan cutthroat trout, with a water right acquisitions program authorized; and
- a water rights purchase program is authorized for the Lahontan Valley wetlands.

Many of the Negotiated Settlement's provisions, including the interstate apportionment, will not become effective until a number of conditions are met, including dismissal of certain lawsuits and the negotiation of an operating agreement for the Truckee River among the United States, Nevada, California, the Pyramid Lake Paiute Indian Tribe, the Sierra Pacific Power Company, and other parties. The involved parties hope to complete the operating agreement negotiations by 1999.

Water Quality Protection and Management

Clean Water Act (CWA). The Water Quality Act is a 1987 amendment to the Clean Water Act of 1977, which amended the Federal Water Pollution Control Act of 1972, and is the primary legislative vehicle for federal water pollution control programs. The Water Quality Act is often referred to as the Clean Water Act (CWA). This Act was established to "restore and maintain the chemical, physical, and biological integrity of the nation's waters" and set goals to eliminate discharges of pollutants into navigable water, protect fish and wildlife, and prohibit the discharge of toxic pollutants in quantities that could adversely affect the environment.

The State Environmental Commission (SEC), established by State law, has adopted regulations which define State programs to carry out the provisions of Nevada's Water Pollution Control Laws. These laws, contained in Chapter 445A of the Nevada Revised Statutes (NRS), establish the authority to implement portions of the CWA and the Safe Drinking Water Act in addition to several non-federal water pollution control programs. In addition to adopting regulations, the SEC establishes fee schedules for permits, advises, consults and cooperates with other governmental agencies regarding water pollution matters, establishes qualifications for sewage treatment plant operators, and holds hearings regarding the actions of the Nevada Division of Environmental Protection (NDEP). The powers and duties of the SEC are listed primarily in NRS 445A.425, and also in NRS 445A.135, 445A.160, 445A.180, 445A.428, 445A.430, 445A.605, and 445A.610.

NDEP has been delegated the authority to implement aspects of the CWA in Nevada. Following is a summary of major sections of the CWA and their application to water quality management in Nevada.

- **Section 106(e) - Water Quality Monitoring.** With assistance from federal grants, NDEP operates a surface water quality monitoring network with water quality parameters monitored at about 100 sites throughout the State. In addition, NDEP has access to water quality data collected by other agencies. Data collected under these monitoring programs are used to establish water quality standards, assess compliance with water quality standards, conduct trend analyses, validate water quality models, set discharge limitations, conduct nonpoint source assessments, compile the Section 303(d) List, develop Section 208 Plan amendments, and develop the Section 305(b) Report.

- **Section 208 - Water Quality Management Plans.** Section 208 of the CWA was promulgated for the purpose of encouraging and facilitating the development and implementation of areawide wastewater treatment management plans. If an area(s) within the State is identified as having substantial water quality control problems as a result of urban-industrial concentrations or other factors, the Governor of the State may designate the boundaries of each such area and appoint a single representative organization, including elected officials from local governments or their designees, capable and responsible for developing effective areawide water treatment management plans. Absent action by the Governor, NDEP is the responsible agency for developing 208 Plans. Following are the five areas for which 208 plans have been developed and the agencies responsible for plan development:

  Carson River Basin - NDEP
  Clark County - Clark County Board of County Commissioners
  Lake Tahoe Basin - Tahoe Regional Planning Agency
  Washoe County - Truckee Meadows Regional Planning Agency
  Remainder of the State (non-designated area) - NDEP

  Section 208 Plans are used in the review of permit and funding applications. Proposed activities which are inconsistent with the 208 Plan cannot go forward until a plan amendment is approved.

- **Section 303 - Water Quality Standards.** Federal requirements for water quality standards and antidegradation are contained in Section 303 of the CWA. State requirements are contained in NRS 445A.520 and NRS 445A.425 states the powers and duties of the SEC, including the adoption of water quality standards. Water quality standards define water quality goals of a waterbody by designated uses and by setting criteria necessary to protect the uses. Antidegradation requirements are contained in NRS 445A.565 which requires that waters of higher quality be protected. Water quality standards serve as the regulatory basis for establishing water quality based treatment controls. In Nevada, the SEC is required to establish water quality standards at a level to protect and ensure a continuation of the designated beneficial use or uses within a stream or other waterbody (NRS 445A.425).

- **Section 303(d) List.** Section 303(d) of the CWA requires states to identify waters that do not or are not expected to meet applicable water quality standards with existing controls alone. This Section 303(d) List, developed by the NDEP provides a comprehensive inventory of waterbodies impaired by all sources of pollution, including point sources, nonpoint sources, or a combination of both. This inventory is the basis for targeting waterbodies for watershed solutions.

  Once these waters are identified, the State is required to develop total maximum daily loads (TMDLs) for these waters. A TMDL quantifies allowable pollutant loads that a given water body can assimilate to the level needed to meet the water quality standards. TMDLs are then used to set effluent limits for permitted discharges.

- **Section 305(b) - Water Quality Assessment.** Section 305(b) of the CWA requires states to produce biennial "Water Quality Assessments" that assess progress in achieving the objectives of the CWA. NDEP is responsible for producing Nevada's 305(b) Reports.

- **Section 314 - Clean Lakes.** Pursuant to Section 314 of the CWA, the Clean Lakes Program was established in 1972 to define the causes and extent of water pollution problems in the lakes of each State and for developing and implementing effective techniques to restore them. Through the Clean Lakes Program, NDEP State has received Federal funding for numerous studies and implementation projects. Federal funding is no longer available under Section 314.

- **Section 319 - Nonpoint Source Pollution.** Section 319 of the CWA authorizes the Nonpoint Source Pollution Management Program and provides funding to states to implement nonpoint source program. Nevada began the Nonpoint Source (NPS) Management Program in 1987 using Federal funds. The primary goal of the program is to identify, control and abate the impacts of NPS pollution on the quality of the State's surface and ground waters. The State's current approach in controlling nonpoint sources is to seek voluntary compliance through regulatory and non-regulatory programs including technical and financial assistance, training, technology transfer, demonstration projects and education.

- **Section 401 Certification Program.** Under provisions of the CWA, any applicant for a Federal license or permit (e.g. 404 permit) to conduct any activity that may result in a discharge to navigable waters must provide the Federal agency with a Section 401 certification. The 401 certification, made by the state in which the discharge originates, declares that the discharge will comply with applicable provisions of the CWA, including water quality standards. Section 401 provides states with two distinct powers: 1) the power indirectly to deny Federal permits or licenses by withholding certification; and 2) the power to impose conditions upon Federal permits by placing limitations on certification.

  In Nevada, NDEP has the responsibility to review and comment on proposed projects under the 401 Certification Program. NDEP may grant, waive or deny certification for a federally permitted activity that may result in a discharge to the waters of the state or adversely impact downstream water quality. If the applicant can demonstrate that the proposed project will not impact existing water quality nor cause a violation of a water quality standard, or water quality improvements are expected, 401 certification is given. If the project is expected to negatively impact water quality, NDEP will require conditions in the permit to offset project impacts or deny certification.

- **Section 402 - National Pollutant Discharge Elimination System.** Section 402 of the CWA established a permit system known as the National Pollutant Discharge Elimination System (NPDES) to regulate point sources of discharges (wastewater treatment plants, etc.) into surface waters of the United States. In 1987, Section 402 was amended to require the regulation of stormwater runoff under the NPDES. The U.S. Environmental Protection Agency (EPA) has delegated this program to NDEP. NPDES permits cannot be issued if the proposed discharge is inconsistent with the 208 Water Quality Management Plan for the area (NRS 445A.490).

- **Section 404 - Dredge and Fill Permits.** Section 404 regulates the discharge of dredged and fill materials into navigable rivers, and protects wetlands from encroachment. None of these regulated activities may occur unless a permit is obtained from the U.S. Army Corps of Engineers. Generally, the project proponent must agree to mitigate or have plans to mitigate environmental impacts caused by the project before a permit is issued.

  Under amendments in the CWA, the State is responsible for certifying a Section 404 project proposal's compliance with applicable water quality standards. NDEP has the responsibility to review and comment on proposed projects under the 401 Certification Program and has the right to deny certification of a 404 permit which would prevent the Corps of Engineers from using the permit.

- **Section 603 - State Revolving Fund Program.** Section 603 of the CWA provides for the establishment of State Revolving Fund (SRF) programs. Through the SRF, NDEP provides loans at or below market rates and other forms of financial assistance to municipalities and other entities to assist in financing the construction of waste water treatment works or projects to control nonpoint sources of water pollution. Only those facilities addressed in the Section 208 Plan are eligible for funding under this program.

<u>Other State Programs (NDEP).</u> In addition to the federal CWA and Safe Drinking Water Act programs delegated to NDEP, numerous state programs exist to protect, control and restore the quality of the waters of the State. Apart from the NPDES permits issued under the CWA, NDEP issues Water Pollution Control Permits with a zero-discharge performance standard for certain mining facilities, and State Ground Water Permits for infiltration basins, land application of treated effluent, large septic systems and industrial facilities. In addition to these permitting processes, NDEP reviews subdivision plans to ensure that wastewater is disposed of adequately. Also, NDEP regulates highly hazardous substances under the chemical accident prevention program. Remediation of polluted soil and/or groundwater falls under the State Corrective Actions Program which includes authorities under two federal acts: the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Other Federal Programs (NDEP). Management of solid waste, hazardous waste and underground storage tanks are covered by the Resource Conservation and Recovery Act (RCRA) programs delegated to NDEP. Nevada also has a program under the Comprehensive Environmental Response Compensation, and Liability Act (CERCLA) to perform spill reporting and tracking, assessments, investigations and remedial activities as necessary.

Safe Drinking Water Act. In 1974, the U.S. Congress enacted the Safe Drinking Water Act (SDWA) to enhance the safety of public drinking water in the United States through the establishment and enforcement of national drinking water standards. Congress gave the EPA the responsibility for implementation and enforcement of the SDWA. In 1978, EPA granted primary enforcement authority (primacy) for the SDWA in Nevada to the State of Nevada (Division of Health). The State Health Division is responsible for implementing the program in 15 of Nevada's 17 counties. The Health Division has interlocal agreements with Clark County Health District and Washoe County District Health Department to implement various activities related to the SDWA and State Board of Health requirements in those counties.

The SDWA applies to all public drinking water systems which provide piped water for human consumption to at least 15 service connections, or regularly serve an average of at least 25 individuals daily for at least 60 days out of the year. There are currently about 700 public water systems in Nevada that are regulated under the SDWA.

In 1996, additional amendments were enacted and a state revolving loan fund was authorized. The amendments included a "right to know" provision which will require water authorities to disclose chemicals and bacteria found in drinking water and required EPA to establish more stringent standards against cryptosporidium and other drinking water contaminants that pose significant health risks. The new law goes beyond a regulatory approach to add the concept of prevention. The law seeks to prevent problems by increasing public water systems' capacity to provide safe drinking water, and by protecting the source waters. EPA is currently developing additional rules which will address radon, uranium and arsenic concentrations, disinfection byproducts, groundwater disinfection, and enhancement of the Surface Water Treatment Rule. Following are descriptions of the main highlights of the current SDWA.

- **Public Water Supply Supervision Program.** Primary enforcement authority of the SDWA is the responsibility of the Nevada Health Division. Through the State Public Water Supply Supervision Programs (PWSS), the Nevada Health Division enforces the drinking water quality standards of the water provided by the 700 public water systems in the State. The Health Division has interlocal agreements with Clark County Health District and Washoe County District Health Department to implement various activities related to the SDWA and State Board of Health requirements.

- **Underground Injection Control Program.** Authorized under the Safe Drinking Water Act, the Underground Injection Control (UIC) Program is delegated to the State. NRS 445 provides the authority which allows the NDEP, Bureau of Water Pollution Control, through the SEC, to regulate the UIC Program and issue permits. The purpose of the UIC permit is to regulate underground injection and to prevent pollution of groundwater and protect the environment. A UIC permit must be obtained prior to drilling an injection well or injecting fluid into a well.

- **Wellhead Protection Program.** The 1986 Amendments to the SDWA established a new Wellhead Protection Program (WHPP) to protect groundwater supplies for public water supply systems, and mandated that each state develop a WHPP. The authority to implement Nevada's WHPP was delegated to NDEP by the Governor during the same year. At a minimum, each State's WHPP must: 1) specify roles and duties of state and local entities, and public water suppliers, with respect to the development and implementation of WHPPs; 2) delineate the wellhead protection area (WHPA) for each well; 3) identify sources of contamination within each WHPA; 4) develop management options to protect the water supply within the WHPA from such contaminants; 5) develop contingency plans in the event of contamination; 6) site new wells as needed to maximize yield and minimize potential contamination; and 7) ensure public participation.

  In 1994, Nevada's WHPP was approved by EPA and has been successfully implementing wellhead protection at the local level. Presently there are seventeen Nevada communities developing or implementing WHPPs with the assistance of NDEP, and interest has been expressed by several more communities. The voluntary nature of Nevada's WHPP coupled with both financial and technical assistance from the State and EPA have been the keys to its success.

- **Comprehensive State Ground Water Protection Program.** EPA initiated the Comprehensive State Ground Water Protection Program (CSGWPP) guidance to provide states with a framework for developing comprehensive, integrated groundwater protection programs. EPA is encouraging states to develop and implement CSGWPPs that meet the needs of the state. CSGWPPs are voluntary and encourage groundwater resource management through a cooperative, multi-agency approach.

  While the State of Nevada has the primary role in protecting and managing its groundwater resources, the CSGWPP process provides the opportunity to review, evaluate, and revise groundwater protection efforts so as to improve their effectiveness. The goal of a Fully-Integrated CSGWPP is to ensure that groundwater protection and management efforts are consistent and coordinated across all federal, State and local programs. The Nevada Division of Environmental Protection is the lead agency for the CSGWPP development and received EPA endorsement of its core CSGWPP in November 1997.

- **Drinking Water State Revolving Fund.** The SDWA Amendments of 1996 authorized a Drinking Water State Revolving Fund (DWSRF) to assist public water systems to finance the costs of infrastructure needed to achieve or maintain compliance with SDWA requirements and to protect public health objectives of the Act. The administrator of EPA is authorized to award capitalization grants to States, which in turn can provide low cost loans and other types of assistance to eligible systems (community and non-profit non-community water systems). To be eligible to receive capitalization grants, a state must establish a drinking water treatment revolving loan fund.

Under this program, Nevada will receive an annual allotment from the federal government, but must contribute an amount equal to 20 percent of the total federal contribution. The DWSRF funds can then be loaned to public water systems to facilitate compliance with national primary drinking water regulations and further the health protection objectives of the SDWA. Disadvantaged systems may receive loan subsidies, including forgiveness of the principal. Portions of the DWSRF funds may also be used for fund administration, small system technical assistance, Public Water Supply Supervision activities, state capacity development strategies, operator certification programs, and source water protection programs. The Bureau of Health Protection Services is the lead agency for the DWSRF.

- **Capacity Development.** Under the 1996 SDWA Amendments, states are given until October 1, 1999 to obtain the authority to ensure that new community water systems and non-transient non-community water systems have the technical, financial, and managerial capacity to meet National Primary Drinking Water Regulations. A state will receive only 80 percent of its Drinking Water State Revolving Fund allotment unless the state has such authority. As part of this program, states are required to prepare and submit to EPA a list of community water systems and non-transient, non-community water systems that have a history of significant noncompliance and the reasons for their noncompliance. States are also required to establish strategies for assisting systems in developing and maintaining technical, financial and management capacity. Periodic reports on the efficacy of their development strategies and water system capacity improvements are required.

- **Vulnerability Assessment Program.** The SDWA regulations set forth monitoring requirements (e.g. sampling frequency, etc.) for various potential contaminants. The costs associated with some of the related laboratory analyses can place a significant financial burden on water systems. Sensitive to these potential high costs, the SDWA allows states some flexibility in establishing water chemistry monitoring requirements. In response, the Nevada State Health Division, Bureau of Health Protection Services, has voluntarily developed a monitoring waiver program. Certain water quality monitoring requirements may be waived for a given water system if the vulnerability assessment shows the system to be at low risk to contamination.

  The waiver program focuses on performing vulnerability assessments including an evaluation of the source water site, an evaluation of the components of the water system, previous monitoring results, prior historical/environmental/land usage in the source water area, contaminant persistence and transport potential, hydrogeology of the area, well construction, known well abandonment history and a review of the initial water quality monitoring results.

  As a direct result of the vulnerability assessment program, water systems throughout Nevada have saved about $3.5 million to date in monitoring costs. It is anticipated that a total of $5.5 million to $6 million could be saved if vulnerability assessments are performed for all water sources.

- **Source Water Assessment Program.** Reauthorization of the SDWA in 1996 added new requirements for States to develop and implement a Source Water Assessment Program (SWAP). The purpose of a SWAP is to identify existing sources of drinking water and determine what potential contamination problems may arise that need to be addressed. In part, the final SWAP is to address: delineations of land area contributing to public water systems' sources (Source Water Protection Areas - SWPA); inventory of known and significant contaminants within the SWPAs; analysis of source susceptibility to contamination; and plans for protection of source waters. The Bureau of Health Protection Services is responsible for development and implementation of SWAP.

Insecticide, Fungicide, and Rodenticide Act (Pesticide Management Plan). The Nevada Division of Agriculture (DOA) has primacy to administer the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) in the State. With regard to pesticides, the primary responsibility is to regulate the registration, use, storage, sale, and disposal of unwanted, canceled and suspended pesticides in Nevada. The DOA has been involved in groundwater protection activities since 1988 as a direct result of a nationwide EPA study which discovered that at least 46 different pesticides had contaminated groundwater in 26 states. In most cases, sources of contamination were traced to legal, prescribed use of the particular pesticide. However, some contamination was attributed to direct sources such as pesticide mixing and loading, accidents, and improper well design.

Although the EPA study did not detect pesticide contamination in Nevada, the DOA decided to take a pro-active approach to this problem and designed a program that would prevent further degradation of groundwater quality. Based on the experience of other states and EPA, DOA has developed a program to address this issue. The program began with the development of a Generic State Management Plan that contains a description of essential elements designed to accomplish the goal of designing a protective program that would prevent further degradation of groundwater quality. This has lead to the development of Pesticide Management Plans (PMPs). These PMPs as well as the Generic State Management Plan contain many elements. The major elements discussed in the plans will include: 1) protective and preventative actions; 2) monitoring; 3) resources available; 4) other state and federal agencies' roles and responsibilities; and the DOA's legal authority to administer the groundwater protection program. The Generic State Management Plan has been developed which addresses most of these elements. A regulatory framework will be part of the PMPs, which may require setback restrictions, restricted use classification, time of year restrictions, and outright cancellation of pesticides where the water resources may be vulnerable to groundwater contamination.

Resource Protection

Endangered Species Act. The federal Endangered Species Act provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The U.S. Fish and Wildlife maintains a list of endangered and threatened species. Species include birds, insects, fish, reptiles, mammals, crustaceans, flowers, grasses, and trees, all of which are dependent upon water. The law prohibits any action, administrative or real, that results in a "taking" of a listed species, or adversely affects habitat.

In Nevada, there are 28 endangered taxa (species/subspecies) (2 are plants) and 14 threatened taxa (7 are plants). Approximately another 250 taxa are considered as potential candidates for listing. More information is needed before these taxa can be removed from the candidate list or moved to the threatened/endangered list. Nevada leads the nation and North America in having the most fishes listed as endangered, threatened, or of special concern (43 taxa according to the American Fisheries Society). Rankings by the Nevada Natural Heritage Program place Nevada in the top ten states having the most globally imperilled species of plants and vertebrates.

Nevada Natural Heritage Program. The State of Nevada Natural Heritage Program researches, collects, and analyzes information on the existence, locations, numbers, condition, biology, and habitats of hundreds of sensitive plant and animal species throughout Nevada. These are species that could qualify for listing as a threatened or endangered in the future under current management and land-use situations. The Program continually prioritizes conservation needs throughout the State, and its easily-accessible computer database, maps, and paper files serve as a cost-effective "early warning system" designed to help prevent costly future species listings.

Wildlife Commission Statutory Authority. NRS 503.589 grants the Division of Wildlife administrator the authority to enter into agreements with other entities for the conservation, protection, restoration and propagation of species of native fish, wildlife and other fauna which are threatened with extinction.

Division of Forestry Statutory Authority. NRS 527.300 grants the state forester firewarden the authority to enter into agreements with other entities for the conservation, protection, restoration and propagation of species of native flora which are threatened with extinction.

National Environmental Policy Act. The National Environmental Policy Act (NEPA) directs federal agencies to prepare an environmental impact statement (EIS) for all major federal actions which may have a significant effect on the human environment. NEPA states that it is the goal of the federal government to use all practicable means, consistent with other considerations of national policy, to protect and enhance the quality of the environment. NEPA requires all federal agencies to consider the environmental impacts of their proposed actions during the planning and decision-making processes.

Wild and Scenic Rivers Acts (Federal and California). In 1968, Congress passed the National Wild and Scenic Rivers Act to preserve in their free-flowing condition rivers which possess "outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values." No rivers within Nevada have been designated under this federal act. In 1972, the California Legislature passed the State Wild and Scenic Rivers Act. Portions of the West Walker River and East Fork of the Carson River upstream of Nevada have been designated under the California Act. The California Act prohibits construction of any dam, reservoir, diversion or other water impoundments on a designated river.

The current U.S. Forest Service's Humboldt and Toiyabe Land and Resource Management Plan has identified other river segments that are suitable for inclusion in the Wild and Scenic Rivers system. These river segments are:

- Jarbidge River - from Idaho-Nevada border to source;
- Little Humboldt River, North Fork - from reservoir at Little Humboldt River confluence to

source;
- Marys River - from west boundary of Section 13, T42N, R59E to source;
- Carson River, East Fork - from last diversion dam approximately one mile above Lahontan Fish Hatchery to source;
- East Walker River - from Bridgeport Reservoir to bridge crossing near Flying M Ranch headquarters; and
- West Walker River - from source at Tower Lake to confluence with Rock Creek.

Flood Protection and Drought Planning

Flood Control Act. The Flood Control Act authorizes the U.S. Army Corps of Engineers to perform several flood-related tasks**.** Section 205 of the Act authorizes the construction of small flood control projects; Section 206 authorizes the Corps Flood Plain Management Services Program to deal with floods and floodplain issues; Section 208 provides for snagging and clearing for flood control in channels; and Section 14 authorizes emergency streambank and shoreline erosion protection for public facilities and services. Activities performed under the Flood Plain Management Services program include technical assistance, planning guidance, pamphlets and supporting studies.
National Flood Insurance Act. The National Flood Insurance Program (NFIP) was established in 1968 by the National Flood Insurance Act. The intent of this act is to encourage communities to mitigate future flood damage by adopting and enforcing strict floodplain management ordinances in accordance with federal regulations. The Act made federally subsidized flood insurance availible in communities which participate in the NFIP. In Nevada, 15 counties and 13 incorporated cities voluntarily participate in the NFIP. The Federal Emergency Management Agency (FEMA) administers the program, providing flood insurance studies and mapping for participating communities. The flood insurance studies are used for development of the Flood Insurance Rate Maps (FIRMs) that are adopted and incorporated by reference into the Flood Hazard Reduction Ordinances administered by each community. In Nevada, the Division of Water Planning (NDWP) has responsibility for oversight and implementation of the NFIP.

Emergency Watershed Protection. The Emergency Watershed Protection program (EWP) is administered by the Natural Resource Conservation Service (NRCS). The program provides technical and financial assistance to restore small watersheds damaged by flooding. The type of assistance provided by the program includes clearing debris from clogged water sheds, restoring vegetation and stabilizing river banks. In addition, NRCS is authorized under the 1996 Farm Bill, to offer a floodplain easement option to agricultural landowners. This option allows land which has been damaged by flooding to be permenantly restored to natural floodplain hydrology.

State Floodplain Management. Following the flooding experienced in northern Nevada in 1997, NDWP was designated as the lead agency for floodplain management at the State level. The Division's floodplain management duties include implementation of the Community Assistance Program (CAP) and Flood Mitigation Assistance program (FMA), sponsered by FEMA. Under CAP, NDWP provides technical assistance and training as needed to help communities achieve and maintain compliance with NFIP requirements. FMA grants are for mitigation projects aimed at reducing repetitive insurance losses and future damage.

- **Hazard Mitigation Program.** The Nevada Division of Emergency Management is responsible for implementing a comprehensive hazard mitigation program which includes flooding mitigation. The State Hazard Mitigation Officer manages the Hazard Mitigation Grant Program (HMGP), sponsored by FEMA.

- **Statewide All-Hazard Mitigation Committee.** This committee was established in 1998 to help coordinate mitigation activities and funding needs associated with all hazards including flooding. The 21 members come from a wide array of public and private organizations.

- **Channel Clearance Program.** The Channel Clearance program is managed by the Nevada Division of Water Resources (NDWR). The program provides funding for channel clearance maintenance, restoration, surveying and monumenting. Local communities, including counties, cities, irrigation districts, and flood control districts can apply for matching funds to maintain channels of navigable rivers within their jurisdictional boundaries.

- **Disaster Relief Bill.** During the 1997 State Legislative Session, Senate Bill 218 was passed, establishing a state fund of $4 million to help communities recover from damages sustained in the event of a disaster. The fund is administered by the Legislative Counsel Bureau.

Local Floodplain Management. Regulations for the development of local flood control districts are described in NRS 543. The Clark County Regional Flood Control District was formed under this statute in 1985. The Clark County Regional Flood Control District is a proactive regional entity with the mission of protecting life and property from flood impacts through implementation of flood control infrastructure. Flood control projects are funded by a one quarter of one percent sales tax. The District has also implemented a comprehensive floodplain management program which includes flood hazard mitigation, community outreach, and mapping.

State Drought Plan and the Drought Review and Reporting Committee. During the first year of the 1987-94 drought, Governor Bryan formed the Drought Review and Reporting Committee (DRRC) to monitor drought severity and recommend actions. By 1991, NDWP, with assistance from the Governor's DRRC and the Advisory Board for Water Resource Planning and Development, developed the State Drought Plan. The State Drought Plan defines the State's response in the event of a drought. More specifically, the Drought Plan defines drought stages (warning, severe, emergency), and establishes the roles of the DRRC, drought task forces and other agencies during the various drought stages.

Conservation

Service Connection Metering. A majority of the public water system withdrawals (in terms of volume) are metered, however not all deliveries to each service connection are metered. For example, only about 25 percent of residences in Reno/Sparks have water meters. Water meters were initially prohibited in the cities of Reno and Sparks by a 1919 statute (NRS 704.230). Since that time, gradual changes have occurred which: 1) require meters on all businesses (1977) and on all new homes built after 1988; and 2) allow meters on residences upon owner request and under certain conditions tied to the Negotiated Settlement (1990).

Low Flow Plumbing Standards. The Nevada Legislature passed Assembly Bill 359 in 1991 thereby imposing certain minimum standards for plumbing fixtures (toilets, showers, faucets and urinals) in new construction and expansions in residential, industrial, commercial and public buildings. Each county and city was required to include these requirements in its building code or to adopt these requirements by ordinance, and to prohibit by ordinance the sale and installation of any plumbing fixture which does not meet the minimum standards.

Conservation Plans. In 1991, the Nevada Legislature passed Senate Bill 360 requiring all water purveyors (that supply water for municipal, industrial or domestic purposes) to adopt conservation plans before July 1, 1992. These plans were to include provisions relating to:

- Public education to increase public awareness for the need to conserve water;
- Specific conservation measures suitable for the service area;
- Water management, including leak detection, effluent reuse;
- Contingency plan for drought;
- Implementation schedule; and
- Measures to evaluate plan effectiveness.

Public water purveyors were to submit their plans to NDWP for review and approval before adoption (NRS 540.121 through 540.151). Private utilities were to submit their plans to the Public Service Commission (NRS 704.662 through 704.6624). However, Senate Bill 360 did not require periodic plan updates or progress reports.

U.S. Bureau of Reclamation Conservation Plans. On October 12, 1982, the Reclamation Reform Act (RRA) was signed into law. One of the provisions of the RRA requires each district, that has entered into a repayment contract or water service contract, to develop a water conservation plan. The plan is to contain definite goals, appropriate water conservation measures, and a time schedule for meeting the water conservation objectives. This provision of the RRA impacts districts such as the Truckee Carson Irrigation District and Pershing County Water Conservation District. Through their Field Services Program, Reclamation's intent is to encourage the consideration and incorporation of prudent and responsible water conservation measures in district operations. This is to be achieved by:

- Providing technical and financial assistance to districts and entities developing and implementing water conservation plans;
- Establishing collaborative efforts with districts and other entities to improve the management of water and to assist in meeting their water conservation goals;
- Encouraging joint efforts toward the coordinated planning, preparation and implementation of water conservation plans by districts with mutual or complementary needs;
- Ensuring that Reclamation assistance programs support and complement State water conservation efforts;
- Providing districts with education materials to assist with water plan development and implementation; and

- Providing water management and conservation planning workshops and training opportunities for districts and other entities.

Local and State Water Planning and Management

Many local and state entities have statutory authorities related to water use, management, protection and development. Some of the authorities are summarized in the following tables.

Table 3-1. Local Organization Statutory Authority

Category	Agency	Program	Authority (NRS)
Water Supply	Cities	Water Facilities	266.285
	Counties	Water Facilities	244.366
	General Improvement Districts	Water Facilities	318.144
	Irrigation Districts	Irrigation	539.010 - 539.783
	Water Conservancy Districts	Water Supply	541.010 - 541.420
Water Quality	Cities	Sewer Facilities	266.285
	Counties	Sewer Facilities	244.366
	General Improvement Districts	Sewer Facilities	318.140
Environmental Uses	Conservation Districts	Conservation of Natural Resources	548.010 - 548.550
Flood Management	Flood Control Districts	Flood Control	543.170 - 543.830
	Water Conservancy Districts	Flood Control and Drainage	541.010 - 541.420
Water Planning and Management	Cities	Master Plan	278.150 - 278.230
	Counties	Regional Plan	278.0272 - 278.029
		Master Plan	278.150 - 278.230

Table 3-2. State Agency Statutory Authority

Category	Agency	Program	Authority (NRS)
Water Supply and Allocation	State Engineer's Office (Division of Water Resources)	Water Right Adjudication and Appropriation	533
		Groundwater Regulation	534
	Division of Water Planning	Small Community Grant Program	349.980 - 349.987
		Conservation Plans	540.121 - 540.151
	Public Utilities Commission	Regulation of Public Utilities	704.001 - 704.960
		Utility Environmental Protection Act (UEPA)	704.001 - 704.960
		Conservation Plans	704.662 - 704.6624
Water Quality	Division of Environmental Protection	Water Pollution Control Clean Water Act State Groundwater Permit Safe Drinking Water Act Mining Reclamation	 445A.300 - 445A.730 519A.010 - 519A.280
	Division of Agriculture	Control of Pesticides	586.010 - 586.520
	Bureau of Health Protection Services, Health Division	Safe Drinking Water Act	445A.800 - 445A.955
		Control of Septic Systems	444.650
Environmental and Recreational Uses	Division of Wildlife	Boating Safety	488, 501.243
		Wildlife Management and Propagation	504.140 - 504.490
		Protection of Threatened Species	503.584
	Natural Heritage Program	Threatened and Endangered Species Database	527.260 - 527.300
	Division of Parks	Park Facilities	407.011 - 407.250
	Division of Forestry	Protection and Preservation of Timbered Lands, Trees and Flora	527.010 - 527.330
		Forest Practice and Reforestation	528.010 - 528.120
Flood Management	Division of Water Planning	National Flood Insurance Program (Community Assistance, Flood Mitigation Assistance)	540
	Division of Water Resources	Dam Safety	535.005 - 535.110
		Channel Clearance	532.220 - 532.230
	Division of Emergency Management	Hazard Mitigation Grant	414
	Division of Forestry	Forest/Vegetative Cover for Flood Prevention	472.043
	Department of Conservation and Natural Resources	Flood Control Loans	543.090 - 543.140
Water Planning and Management	Division of Water Planning	State Water Plan	540.101
		Planning Assistance	540.011 - 540.151

Regional Plans

According to NRS 540.101(2), NDWP is to coordinate with local governments (political subdivisions) in developing the *State Water Plan*, and upon the request of the Division, each local government shall cooperate with and assist the Division in the development of the Plan. Following is a summary of selected regional planning efforts that are underway. These planning efforts will provide valuable information for the *State Water Plan*.

Southern Nevada Water Authority Water Resource Plan

The Southern Nevada Water Authority (SNWA) was created in 1991 through a cooperative agreement among the following seven regional water and wastewater agencies:

- Big Bend Water District (Laughlin);
- City of Boulder City;
- Clark County Sanitation District;
- City of Henderson;
- City of Las Vegas;
- Las Vegas Valley Water District; and
- City of North Las Vegas.

The purposes of SNWA are to seek new water resources for Southern Nevada, to manage existing and future water resources, to construct and manage regional water facilities, and to promote responsible conservation. The SNWA Water Resource Plan was completed January 1996, and amended February 1997.

Washoe County Comprehensive Regional Water Management Plan

In 1995, the Nevada State Legislature approved legislation which created the Regional Water Planning Commission and provided the basis and direction for the Commission and the 1995-2015 Washoe County Comprehensive Regional Water Management Plan. This legislation required that the Commission develop "...a comprehensive plan for the region covering the supply of municipal and industrial water, quality of water, sanitary sewerage, treatment of sewerage, drainage of storm waters and control of floods." The Plan was completed and approved by the 1997 State Legislature.

Clark County Regional Flood Control District Flood Control Master Plan

In response to major floods in 1983 and 1984, the Clark County Regional Flood Control District (CCRFCD) was established in 1985 to develop a regional flood control program for the Las Vegas Valley and surrounding environs. As part of the CCRFCD mandate, a comprehensive, regional Master Plan was prepared and adopted in 1986. The principal objective of the Master Plan is to provide for the long-term improvement in public safety and property damage protection from flooding events by guiding the siting, design, and installation of flood control facilities. Periodic Master Plan updates are required by law to account for changes in land use, the construction of new facilities, and for improved hydrologic and hydraulic data.

Water Quality Management Plans (Section 208 of the Clean Water Act)

Section 208 of the federal Clean Water Act was promulgated for the purpose of encouraging and facilitating the development and implementation of areawide waste treatment management plans. Following are the five areas for which 208 plans have been developed and the agencies responsible for plan development:

Carson River Basin - NDEP
Clark County - Board of County Commissioners
Lake Tahoe Basin - Tahoe Regional Planning Agency
Washoe County - Truckee Meadows Regional Planning Agency
Remainder of the State (non-designated area) - NDEP

City/County Master Plans

Nevada Revised Statutes 278.150 requires each city and county to prepare and adopt a comprehensive, long-term general plan for the physical development of the city, county or region. The master plan may address a variety of matters, such as:

- Conservation;

  This element of the plan may address a variety of topics including development and utilization of natural resources, including water, underground water, water supply, forests, soils, rivers and other waters, harbors, fisheries, wildlife, minerals and other natural resources. The reclamation of land and waters, flood control, prevention and control of the pollution of streams and other waters may also be included

- Land use;
- Population;
- Public services and facilities;
- Recreation; and
- Solid waste disposal.

Water Resources Data Collection and Research

The following section provides a brief discussion of the main entities collecting water resources data and performing water resources research in Nevada.

U.S. Geological Survey - Water Resources Division

The mission of the Water Resources Division (WRD) of the U.S. Geological Survey (USGS) is to provide the hydrologic information and understanding needed to manage the Nation's water resources to benefit the people of the United States. To accomplish this mission, WRD in cooperation with federal, state and local agencies, uses a variety of investigative and interpretive techniques to collect and transfer hydrologic information to interested parties. Programs sponsored by WRD in Nevada include:

- Data collection to aid in evaluating the quantity, quality, distribution, and use of water resources in Nevada. WRD routinely collects water discharge data for gaging stations on streams, canals and drains; peak flow data at miscellaneous sites and springs; water elevation and contents for lakes and reservoirs; water levels in wells; and water quality for stream, canal and drain sites, and wells.
- Analytical and interpretive water-resources appraisals to describe the occurrence, quality, and availability of surface and ground water in Nevada.
- Basic and problem-oriented research in hydraulics, hydrology, and related fields of science and engineering
- Scientific and technical assistance in hydrology to other federal, state and local agencies
- Development and maintenance of national computer databases and associated Geographic Information System (GIS) databases for hydrologic data - streamflow, water quality and biology, groundwater characteristics and water use.
- Public distribution of water resources data and results of water resources investigations through reports, maps, computerized information services, and other forms of release

The USGS cooperates with more than 40 local, State, and Federal agencies and Indian Tribes in Nevada. Partnerships with local and State agencies typically are financed on a matching-funds basis.

Desert Research Institute

A nonprofit, statewide division of the University and Community College System of Nevada, Desert Research Institute (DRI) pursues a full-time program of basic and applied environmental research on a local, national, and international scale. The five centers within DRI research such divers areas as: the natural and human factors influencing the availability and quality of water resources, issues and concerns common to arid and developing regions worldwide, improving society's fundamental knowledge and understanding of hydrologic systems, and encouraging more effective and efficient management of water resources (Water Resources Center); improving the fundamental understanding of the nature of the Earth's dynamic surface from approximately 2 million years ago to the present day, and applying this knowledge toward enhancing effective management of the environment and cultural resources (Quaternary Sciences Center); understanding atmospheric chemistry, climate dynamics, large-scale dynamic meteorology, mesoscale dynamic meteorology, and physical meteorology, and developing instrumentation and techniques for atmospheric measurements (Atmospheric Sciences Center); researching how natural and agricultural ecosystems function and respond to natural and human impacts on the environment, especially air quality, and the technology that can be applied to mitigate these impacts (Energy and Environmental Engineering Center). Additionally, the Western Regional Climate Center, within the Atmospheric Sciences Center, is one of six regional centers funded by the National Oceanic and Atmospheric Administration. The Climate Center provides data and products tailored to the needs of federal agencies, regional organizations, state and local entities, and the private sector.

University of Nevada Reno (UNR)

Within UNR's College of Agriculture, two departments perform a variety of research projects pertaining to Nevada's water resources. The Department of Environmental and Natural Resource Sciences provides interdisciplinary research in physical, biological and ecological sciences. The Department of Applied Economic and Statistics with the College of Agriculture provides research which emphasizes the application of economic principles and statistical analysis to issues involving growth, infrastructure, agriculture, natural resources and the environment.

Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) within U.S. Department of Agriculture works in three primary areas: soil and water conservation; resource inventories; and rural community development. Under one NRCS program, staff perform snow surveys and develop water supply forecasts. The purpose of the program is to provide western states and Alaska with information on future water supplies. NRCS field staff collect and analyze data on depth and water equivalent of the snowpack at more than 1,200 mountain sites and estimate annual water availability, spring runoff, and summer streamflows. Individuals, organizations, and state and Federal agencies use these forecasts for decisions relating to agricultural production, fish and wildlife management, municipal and industrial water supply, urban development, flood control, recreation power generation, and water quality management. The National Weather Service includes the forecasts in their river forecasting function.

Nevada Division of Environmental Protection

NDEP operates a surface water quality monitoring network. Under this program, water quality parameters are monitored by NDEP at about 100 sites throughout Nevada. A variety of other data are compiled under other NDEP programs. NDEP's UIC (Underground Injection Control) program requires groundwater quality characterization data in the permit application. The Solid Waste program, hazardous waste facilities oversight, mining-related permitting and state groundwater permitting programs all require some amount of groundwater monitoring in the absence of any contaminant release. Facilities such as wastewater treatment plants and industrial operations with permitted discharges to surface water are required to monitor effluent quality and to submit discharge monitoring reports to NDEP.

Nevada Division of Water Resources

NDWR maintains an electronic database of water rights within the State, including information on place of use, point of diversion, allowable diversion rates and volumes, and other ancillary data. NDWR also collects well log data and pumpage data, and develops crop and pumpage inventories.

Nevada Health Division and State Health Laboratory

As required by state and federal drinking water regulations, public supply systems routinely submit water samples to laboratories for analysis. The laboratory results are then sent as paper copies to the Nevada Health Division which has primary enforcement authority for drinking water regulations. Depending upon the public supply system, analyses are performed by either the State Health Laboratory or by private laboratories. The State Health Laboratory maintains analytical results in an electronic database.

Funding Opportunities

A variety of state and federal funding sources exist for the planning, management, protection and development of our water resources. The following discussion provides a brief introduction to the main funding programs available in Nevada.

State Agencies

Grants for Capital Improvements to Community Water Systems (Nevada Division of Water Planning). The Assembly Bill (AB) 198 Grant program provides assistance to water purveyors in partially funding capital improvements made necessary by the State health regulations and the federal Safe Drinking Water Act. Preference is given to water systems serving less than 6,000 people. Grants are limited to publicly owned water systems. Eligible projects include pipe and tank replacements, looping lines, improvement of springs, and drilling of new wells. Expansion of existing systems to meet growth needs is not eligible.

Clean Water Act Section 319 Nonpoint Source Implementation Grant Program (Nevada Division of Environmental Protection, Nonpoint Source Program). These grants are made available through federal funds passed through NDEP's Nonpoint Source Program, and are awarded annually on a competitive basis. Eligible activities include: best management practices which reduce, eliminate and/or prevent nonpoint source pollution; technology transfer, innovative methods or practices, ground water protection, pollution prevention, technical assistance and public education. This program is a matching grant program where at least 50 percent of the project cost is a local expense.

Community Development Block Grant Program (Nevada Commission on Economic Development). Under this program, grants are awarded for community infrastructure studies and construction. Eligible projects include construction of new wells and water distribution lines.

Water Projects Financing Program (Nevada Department of Business and Industry). Through this programs, loans are issued for financing any project for the management, control, delivery, use or distribution of water. To be eligible, any proposed project must satisfy one or more of the following: resolve or abate an emergency situation; provide for the best utilization of surface and ground waters; promote reclamation; provide storage; facilitate offstream storage; accomplish aquifer recharge; acquire site for a reservoir; generate benefits from the rehabilitation or modernization of existing facilities; and obtain significant economic, environmental and water conservation benefits.

State Petroleum Fund (Nevada Division of Environmental Protection, UST/LUST/Claims

Branch). The Nevada Petroleum Fund can reimburse underground and above-ground storage tank owners for a substantial percentage of costs incurred in clean-up activities. Home heating oil tanks are automatically enrolled in the Fund and are eligible for funding.

State Revolving Fund (Clean Water Act) (Nevada Division of Environmental Protection, Bureau of Water Pollution Control). The Nevada State Revolving Fund provides loans at or below market rate and other forms of financial assistance to municipalities and other entities to assist in financing the construction of waste water treatment works or projects to control nonpoint sources of water pollution.

Drinking Water State Revolving Fund (Safe Drinking Water Act) (Nevada Division of Health, Bureau of Health Protection Services). The SDWA Amendments of 1996 authorized a Drinking Water State Revolving Fund (DWSRF) to assist public water systems to finance the costs of infrastructure needed to achieve or maintain compliance with SDWA requirements and to protect public health objectives of the Act.

Channel Clearance Program (Nevada Division of Water Resources). This program provides funding for channel clearance maintenance, restoration, surveying and monumenting. Local communities, including counties, cities, irrigation districts, and flood control districts can apply for matching funds to maintain channels of navigable rivers within their jurisdictional boundaries.

Disaster Relief Fund (Legislative Counsel Bureau). In 1997, the Legislature established a state fund of $4 million to help communities recover from damages sustained in the event of a disaster.

Federal Agencies

Rural Utilities Service Program (U.S. Dept. Of Agriculture, Rural Development). This program provides a variety of funding opportunities for rural areas and towns with populations under 10,000. Rural Development offers loans for the development of water and waste disposal systems (including solid waste disposal and storm drainage). Also, Rural Development offers grants for:

- development of water and waste disposal systems;
- technical assistance and training on a wide range of issues related to water delivery and waste disposal;
- technical assistance and training for improved solid waste management; and
- emergency improvements to drinking water systems.

Clean Water Act Section 104 (b)(3) Wetland Protection Development Grants (U.S. Environmental Protection Agency). This grant program was designed to assist state, tribal and local governments in developing wetlands protection programs. Grants are provided to state agencies for priority wetlands planning activities such as wetland watershed protection approach demonstration projects; state wetlands conservation plan development, refinement or implementation; state/tribal section 404 assumption assistance; streamlining state/tribal regulatory programs; and assessing and monitoring the ecological integrity of wetlands.

Wetlands Reserve Program (Natural Resources Conservation Service & U.S. Fish & Wildlife Service). The Wetlands Reserve Program is a conservation easement and habitat restoration program that focuses primarily on wetlands in agricultural production. The purposes of the program are: to restore the hydrology and vegetation of converted wetlands (wetlands brought into agricultural production prior to December 23, 1985) or wetlands formed under natural conditions; to protect the functions and values of wetlands for wildlife habitat; and to improve water quality, floodwater retention, and ground water recharge capacity of wetlands. The program offers cash payment to landowners for placing permanent conservation easements on their wetland property, as well as cost-share assistance for restoration work.

Environmental Quality Incentives Program (Natural Resources Conservation Service, USDA). The 1996 Federal Agricultural Improvement and Reform Act of 1996 (1996 Farm Bill) created the Environmental Quality Incentives Program (EQIP) to combine the functions of most existing U.S. Department of Agriculture conservation cost-share programs. Its purpose is to provide flexible technical, financial and educational assistance to farmers and ranchers to address a broad range of conservation issues. EQIP provides cost-share assistance for up to 75 percent depending on the conservation practices used.

Flood Mitigation Assistance Grants (Federal Emergency Management Agency and Nevada Division of Water Planning). The Federal Emergency Management Agency provides grants to communities for mitigation projects aimed at reducing repetitive insurance losses and future damage. The Nevada Division of Water Planning is the point of contact for this grant program.

Nevada State Water Plan
PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 4
Water Resources Background

Introduction

An understanding of the state's water resources is a necessary component to the planning and management process. It is the intent of this section to provide the reader with an overview of Nevada's surface water and groundwater resources.

Topography

The topography of Nevada and the surrounding areas makes for a unique and diversified climate. Nearly all of Nevada is in the Basin and Range Province of the Intermountain Plateaus, a rugged elevated area between the Rocky Mountains and the Pacific mountain system. The topography of the Basin and Range province is characterized by isolated, long and narrow, roughly north-south trending, parallel mountain ranges and broad, intervening valleys as shown in Figure 4-1.

Internal drainage is a significant feature of the hydrology of much of Nevada. About 84 percent of the State is within the Great Basin in which drainage is to low areas in enclosed basins rather than to the sea.

Hydrographic Areas

The topography and related geology of the State has resulted in complex surface and ground water systems, complicating the management of these resources. In the 1960s, the Nevada State Engineer's Office and the U.S. Geological Survey (USGS) recognized the need for a systematic identification of the valleys or hydrographic areas throughout Nevada. Such a system was needed in the study, research, development, management and administration of the water resources, both ground-water and surface water. A hydrographic areas map was subsequently developed in 1968 by the USGS and the State Engineer's Office. This was the first known effort to identify completely and systematically the hydrographic regions and areas of the Nevada. While the 1968 map has undergone some minor revisions, it continues to provide the basis for water planning, management and administration. The current hydrographic area map delineates 256 hydrographic areas within 14 major hydrographic regions and basins (Figure 4-2, Table 4-1). Of the 14 hydrographic regions and basins, only the Snake River Basin and the Colorado River Basin drain to the sea.

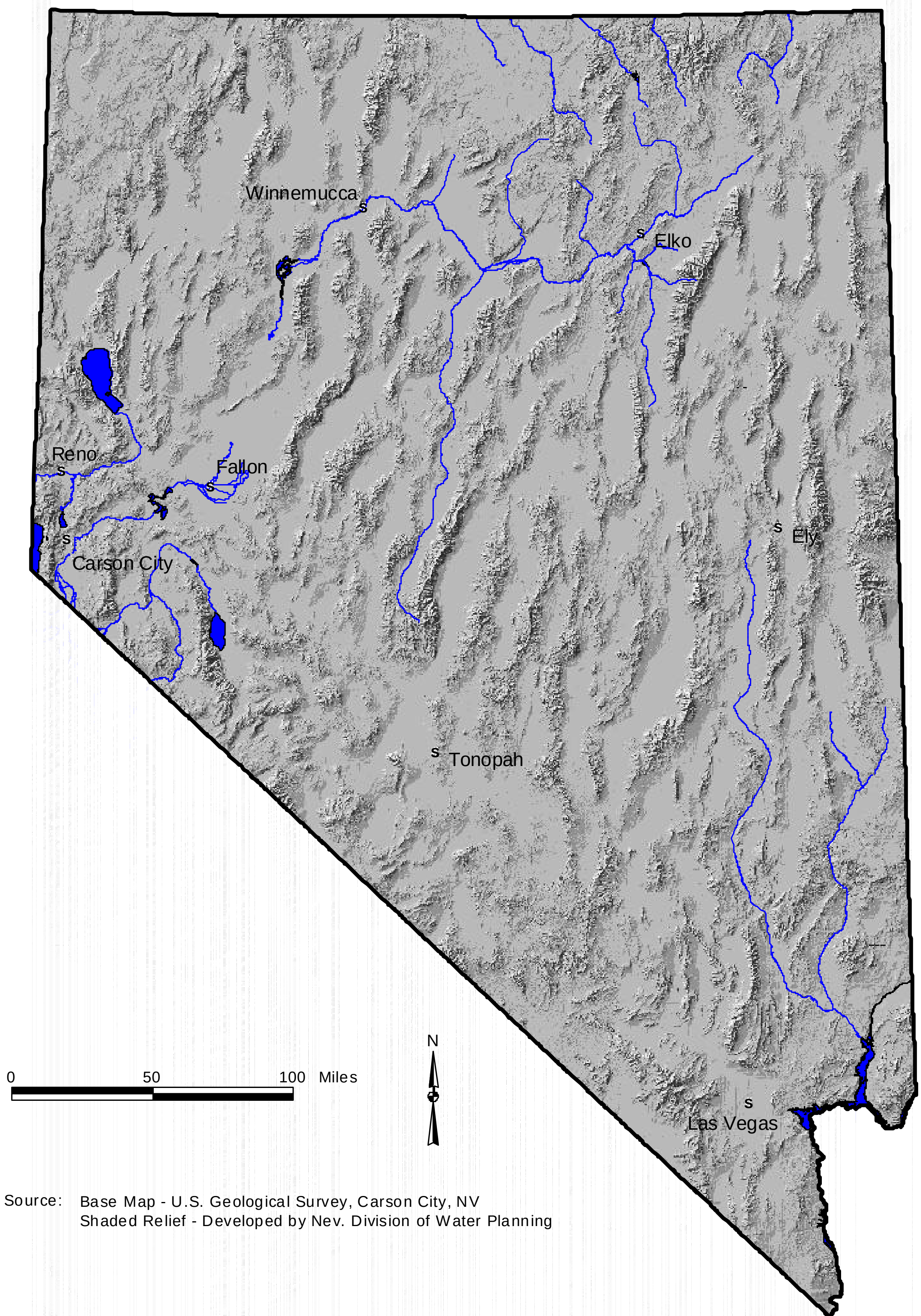


Figure 4-1. Shaded Relief Map of Nevada

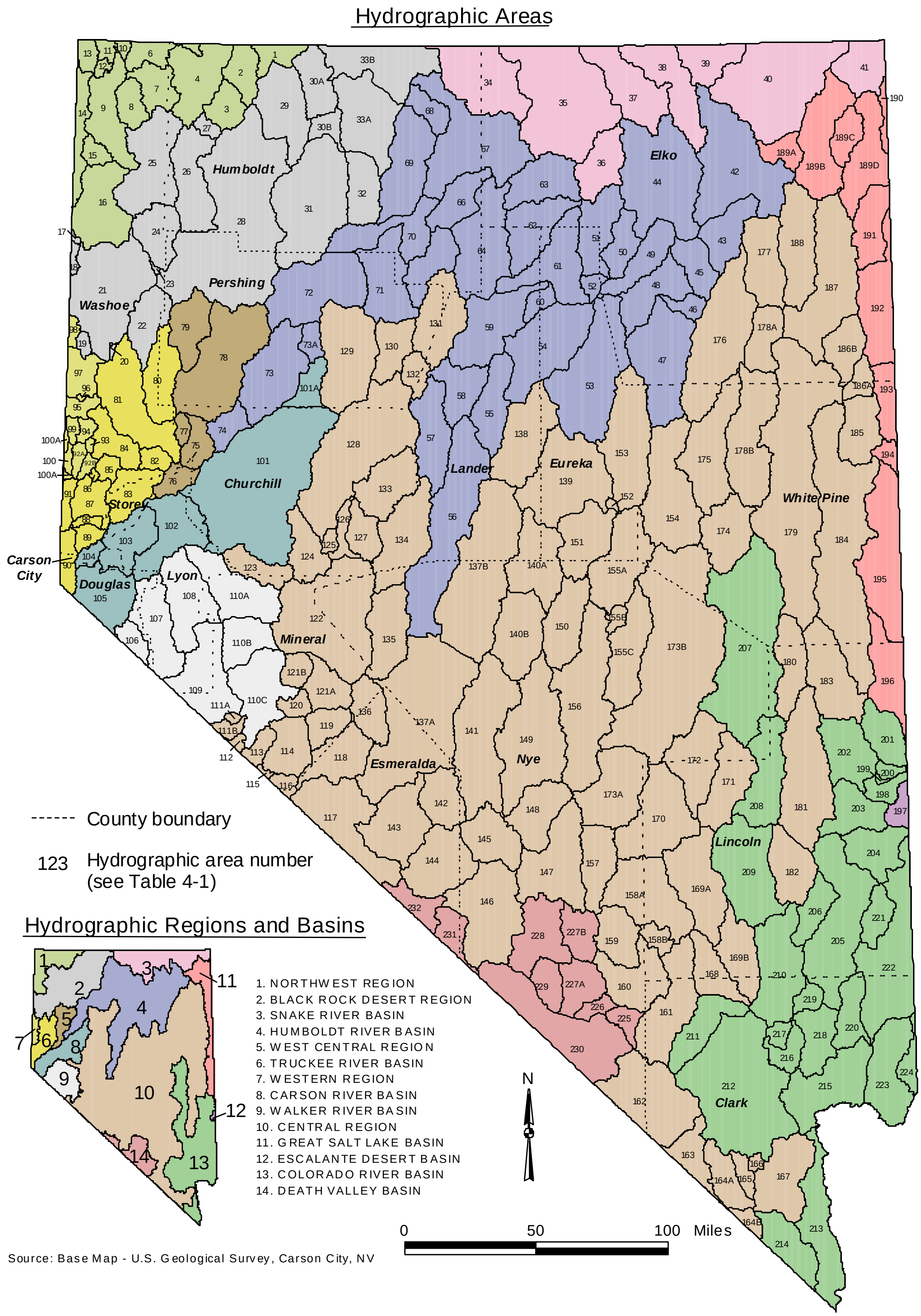


Figure 4-2. Hydrographic Regions and Basins

Table 4-1. List of Hydrographic Areas

1. NORTHWEST REGION
1. Pueblo Valley
2. Continental Lake Valley
3. Gridley Lake Valley
4. Virgin Valley
5. Sage Hen Valley
6. Guano Valley
7. Swan Lake Valley
8. Massacre Lake Valley
9. Long Valley
10. Macy Flat
11. Coleman Valley
12. Mosquito Valley
13. Warner Valley
14. Surprise Valley
15. Boulder Valley
16. Duck Lake Valley

2. BLACK ROCK DESERT REGION
17. Pilgrim Flat
18. Painter Flat
19. Dry Valley
20. Sano Valley
21. Smoke Creek Desert
22. San Emidio Desert
23. Granite Basin
24. Hualapai Flat
25. High Rock Lake Valley
26. Mud Meadow
27. Summit Lake Valley
28. Black Rock Desert
29. Pine Forest Valley
30. Kings River Valley
 (A) Rio King Subarea
 (B) Sod House Subarea
31. Desert Valley
32. Silver State Valley
33. Quinn River Valley
 (A) Orovada Subarea
 (B) McDermitt Subarea

3. SNAKE RIVER BASIN
34. Little Owyhee River Area
35. South Fork Owyhee River Area
36. Independence Valley
37. Owyhee River Area
38. Bruneau River Area
39. Jarbidge River Area
40. Salmon Falls Creek Area
41. Goose Creek Area

4. HUMBOLDT RIVER BASIN
42. Marys River Area
43. Starr Valley Area
44. North Fork Area
45. Lamoille Valley
46. South Fork Area
47. Huntington Valley
48. Dixie Creek - Tenmile Creek Area
49. Elko Segment
50. Susie Creek Area
51. Maggie Creek Area
52. Marys Creek Area
53. Pine Valley
54. Crescent Valley
55. Carico Lake Valley
56. Upper Reese River Valley
57. Antelope Valley
58. Middle Reese River Valley
59. Lower Reese River Valley
60. Whirlwind Valley
61. Boulder Flat
62. Rock Creek Valley
63. Willow Creek Valley
64. Clovers Area
65. Pumpernickel Valley
66. Kelly Creek Area
67. Little Humboldt Valley
68. Hardscrabble Area
69. Paradise Valley
70. Winnemucca Segment
71. Grass Valley
72. Imlay Area
73. Lovelock Valley
 (A) Oreana Subarea
74. White Plains

5. WEST CENTRAL REGION
75. Bradys Hot Springs Area
76. Fernley Area
77. Fireball Valley
78. Granite Springs Valley
79. Kumiva Valley

6. TRUCKEE RIVER BASIN
80. Winnemucca Lake Valley
81. Pyramid Lake Valley
82. Dodge Flat
83. Tracy Segment
84. Warm Springs Valley
85. Spanish Springs Valley
86. Sun Valley
87. Truckee Meadows
88. Pleasant Valley
89. Washoe Valley
90. Lake Tahoe Basin
91. Truckee Canyon Segment

7. WESTERN REGION
92. Lemmon Valley
 (A) Western Part
 (B) Eastern Part
93. Antelope Valley
94. Bedell Flat
95. Dry Valley
96. Newcomb Lake Valley
97. Honey Lake Valley
98. Skedaddle Creek Valley
99. Red Rock Valley
100. Cold Spring Valley
 (A) Long Valley

8. CARSON RIVER BASIN
101. Carson Desert
 (A) Packard Valley
102. Churchill Valley
103. Dayton Valley
104. Eagle Valley
105. Carson Valley

9. WALKER RIVER BASIN
106. Antelope Valley
107. Smith Valley
108. Mason Valley
109. East Walker Area
110. Walker Lake Valley
 (A) Schurz Subarea
 (B) Lake Subarea
 (C) Whisky Flat - Hawthorne Subarea

10. CENTRAL REGION
111. Alkali Valley (Mineral)
 (A) Northern Part
 (B) Southern Part
112. Mono Valley
113. Huntoon Valley
114. Teels Marsh Valley
115. Adobe Valley
116. Queen Valley
117. Fish Lake Valley
118. Columbus Salt Marsh Valley
119. Rhodes Salt Marsh Valley
120. Garfield Flat
121. Soda Spring Valley
 (A) Eastern Part
 (B) Western Part
122. Gabbs Valley
123. Rawhide Flats
124. Fairview Valley
125. Stingaree Valley
126. Cowkick Valley
127. Eastgate Valley Area
128. Dixie Valley
129. Buena Vista Valley
130. Pleasant Valley
131. Buffalo Valley
132. Jersey Valley
133. Edwards Creek Valley
134. Smith Creek Valley
135. Ione Valley
136. Monte Cristo Valley
137. Big Smoky Valley
 (A) Tonopah Flat
 (B) Northern Part
138. Grass Valley
139. Kobeh Valley
140. Monitor Valley
 (A) Northern Part
 (B) Southern Part
141. Ralston Valley
142. Alkali Spring Valley (Esmeralda)
143. Clayton Valley
144. Lida Valley
145. Stonewall Flat
146. Sarcobatus Flat
147. Gold Flat
148. Cactus Flat
149. Stone Cabin Flat
150. Little Fish Lake Valley
151. Antelope Valley (Eureka & Nye)
152. Stevens Basin
153. Diamond Valley
154. Newark Valley
155. Little Smoky Valley
 (A) Northern Part
 (B) Central Part
 (C) Southern Part
156. Hot Creek Valley
157. Kawich Valley
158. Emigrant Valley
 (A) Groom Lake Valley
 (B) Papoose Lake Valley
159. Yucca Flat
160. Frenchman Flat
161. Indian Springs Valley
162. Pahrump Valley
163. Mesquite Valley (Sandy Valley)
164. Ivanpah Valley
 (A) Northern Part
 (B) Southern Part
165. Jean Lake Valley
166. Hidden Valley (South)
167. Eldorado Valley
168. Three Lakes Valley (Northern Part)
169. Tikapoo Valley (Tickaboo Valley)
 (A) Northern Part
 (B) Southern Part
170. Penoyer Valley (Sand Spring Valley)
171. Coal Valley
172. Garden Valley
173. Railroad Valley
 (A) Southern Part
 (B) Northern Part
174. Jakes Valley
175. Long Valley
176. Ruby Valley
177. Clover Valley
178. Butte Valley
 (A) Northern Part (Round Valley)
 (B) Southern Part
179. Steptoe Valley
180. Cave Valley
181. Dry Lake Valley
182. Delamar Valley
183. Lake Valley
184. Spring Valley
185. Tippett Valley
186. Antelope Valley (White Pine & Elko)
 (A) Southern Part
 (B) Northern Part
187. Goshute Valley
188. Independence Valley (Pequop Valley)

11. GREAT SALT LAKE BASIN
189. Thousand Springs Valley
 (A) Herrill Siding - Brush Creek Area
 (B) Toano - Rock Spring Area
 (C) Montello - Crittenden Creek Area (Montello Valley)
190. Grouse Creek Valley
191. Pilot Creek Valley
192. Great Salt Lake Desert
193. Deep Creek Valley
194. Pleasant Valley
195. Snake Valley
196. Hamlin Valley

12. ESCALANTE DESERT
197. Escalante Desert

13. COLORADO RIVER BASIN
198. Dry Valley
199. Rose Valley
200. Eagle Valley
201. Spring Valley
202. Patterson Valley
203. Panaca Valley
204. Clover Valley
205. Lower Meadow Valley Wash
206. Kane Springs Valley
207. White River Valley
208. Pahroc Valley
209. Pahranagat Valley
210. Coyote Spring Valley
211. Three Lakes Valley (Southern Part)
212. Las Vegas Valley
213. Colorado Valley
214. Piute Valley
215. Black Mountains Area
216. Garnet Valley (Dry Lake Valley)
217. Hidden Valley (North)
218. California Wash
219. Muddy River Springs Area (Upper Moapa Valley)
220. Lower Moapa Valley
221. Tule Desert
222. Virgin River Valley
223. Gold Butte Area
224. Greasewood Basin

14. DEATH VALLEY BASIN
225. Mercury Valley
226. Rock Valley
227. Fortymile Canyon
 (A) Jackass Flats
 (B) Buckboard Mesa
228. Oasis Valley
229. Crater Flat
230. Amargosa Desert
231. Grapevine Canyon
232. Oriental Wash

Climate

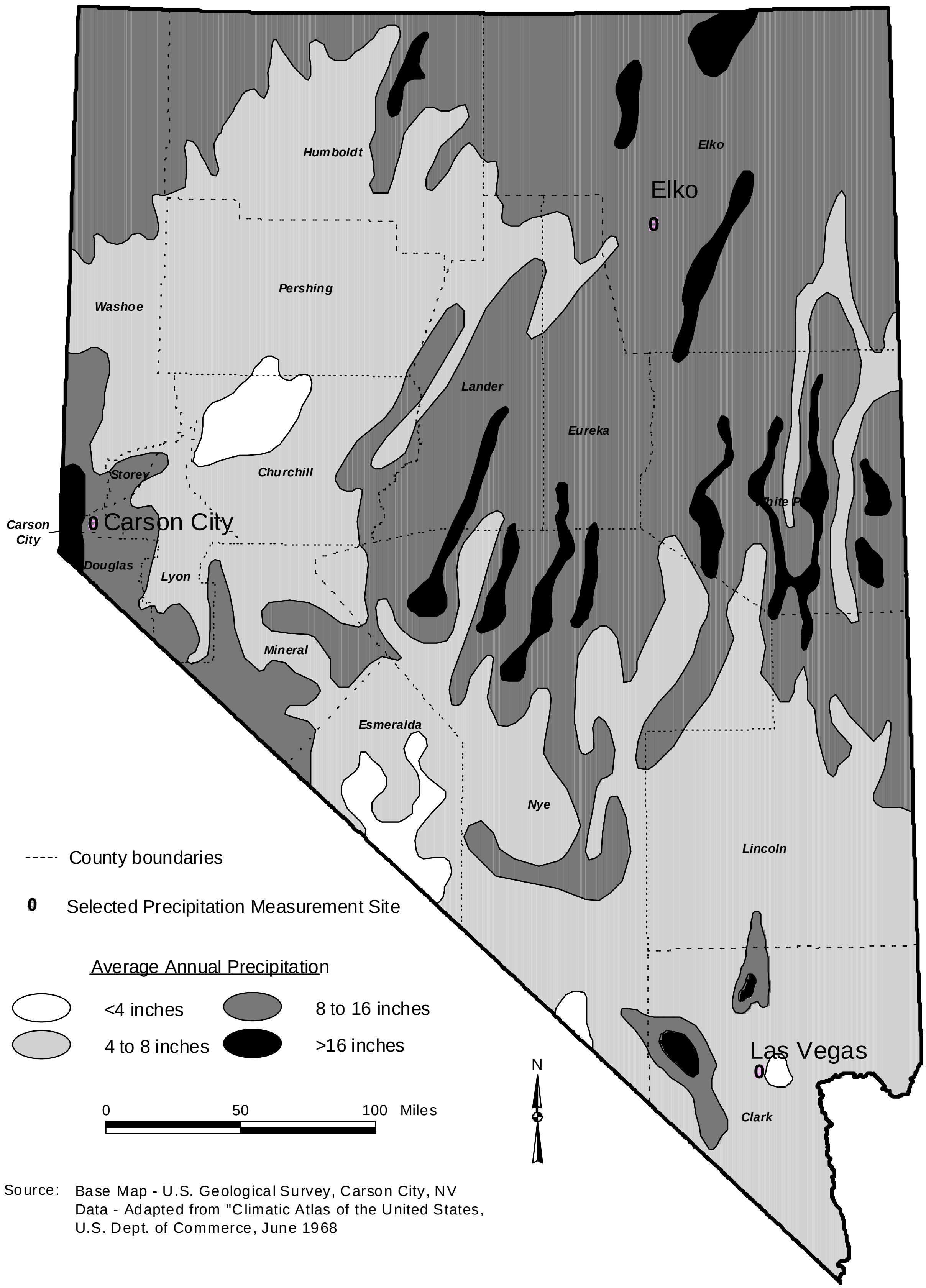
The climate of Nevada is characterized as semi-arid to arid with precipitation and climate varying widely throughout the State. With temperatures that fall below -40°F in the northeast, and rise over 120°F in the south, and precipitation that ranges from only three to four inches in Southern Nevada to over 40 inches (and over 300 inches of snowfall) in the Carson Range portion of the Sierra Nevada Mountains, Nevada is truly a land of constrasts. Three basic geographical characteristics are responsible for Nevada's unusual and diverse climate:

Latitude: Nevada spans approximately seven degrees of latitude, or about 500 miles, from the north boundary to the southern tip of the State. As a result, average temperatures are 15° to 20°F cooler in the north than the south.

Elevation: The Basin and Range Province, with its wide elevation fluctuations from the valley floors to the mountain tops, is another factor responsible for our diverse climate. Elevations vary from under 1,000 feet to over 13,000 feet above sea level, with the higher elevations generally experiencing lower temperatures and more precipitation.

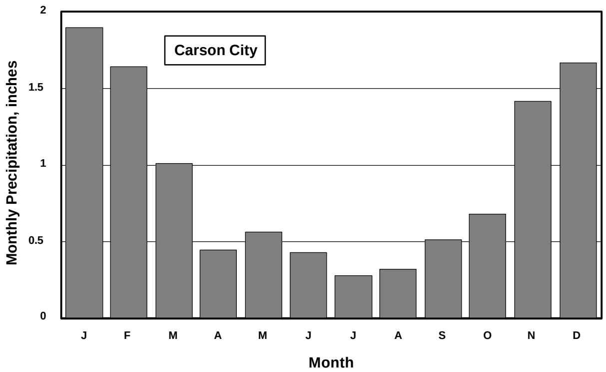
Continentality: Continentality is the most important factor affecting Nevada's climate. The continental effect results from the continuous barrier of the Pacific mountain system to the west. Moisture laden winds traveling east from the Pacific Ocean are forced to rise, cool and drop precipitation as the Pacific mountain system is encountered. The resulting winds entering Nevada are much drier and provide reduced precipitation. This rainshadow effect is the primary reason for Nevada's dry climate.

Figure 4-3 shows the spatial variability of precipitation in Nevada. With total precipitation averaging approximately nine inches per year, Nevada is the most arid state in the nation. Monthly and annual fluctuations in precipitation can be significant. Figure 4-4 displays monthly and annual precipitation variations for three selected precipitation measurement sites in Nevada. Of the total annual precipitation falling in Nevada, approximately 10 percent results in stream runoff and groundwater recharge (*Water for Nevada, Nevada's Water Resources - Report No. 3,* State Engineer's Office, October 1971). The remaining 90 percent is lost through evaporation and transpiration. Like precipitation, evaporation is also widely variable. Average lake surface evaporation rates range from less than 36 inches per year in the west to over 80 inches per year in the south (Figure 4-5).

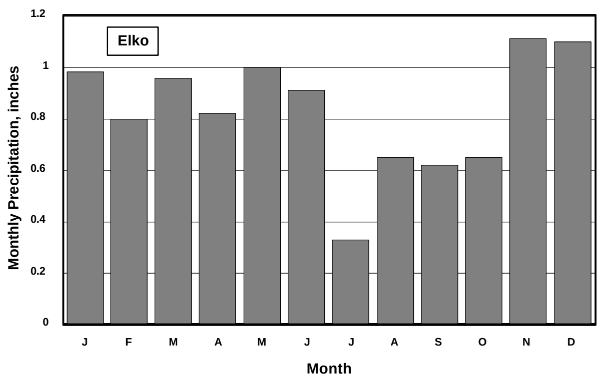


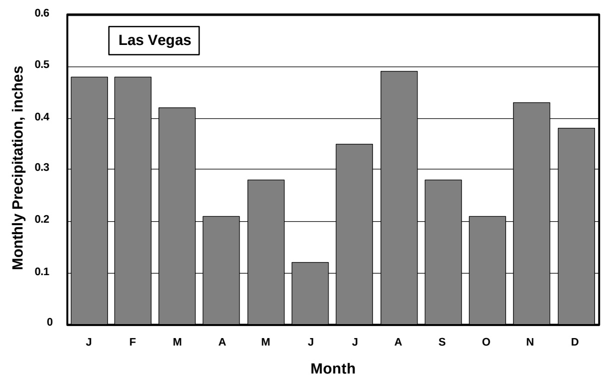
Source: Base Map - U.S. Geological Survey, Carson City, NV
Data - Adapted from "Climatic Atlas of the United States,
U.S. Dept. of Commerce, June 1968

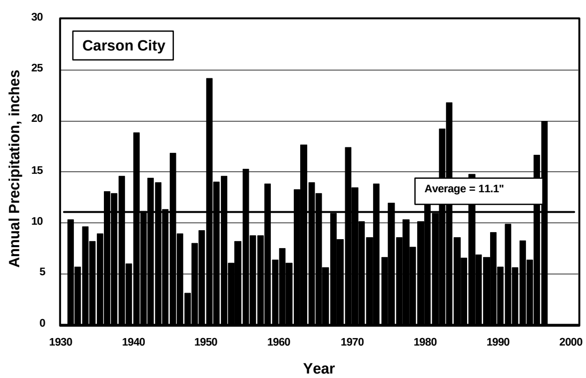
Figure 4-3. Average Annual Precipitation



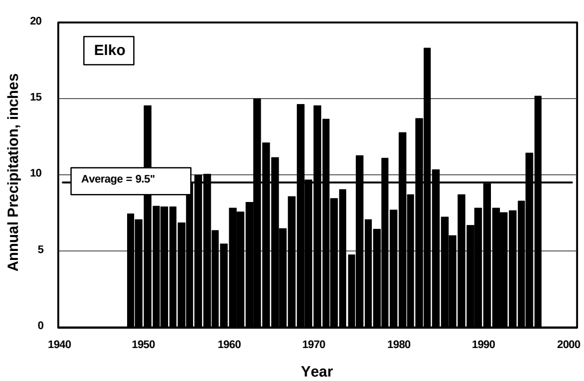
Monthly Variations: Precipitation in Nevada varies from month to month with most moisture falling in the winter. During the warmer and drier summer periods, the precipitation that does occur is the result of convective summer thunderstorms which can produce brief, but intense rainfall.







Annual Variations: The average of annual precipitation is commonly used as an indicator of the amount of precipitation that could be expected in a given year. However, annual variations in precipitation are significant and "average" years are rarely experienced.



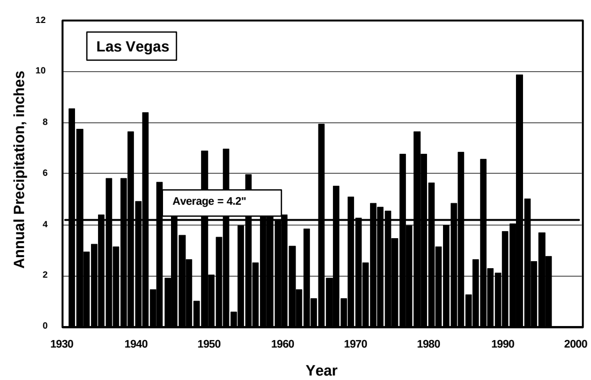
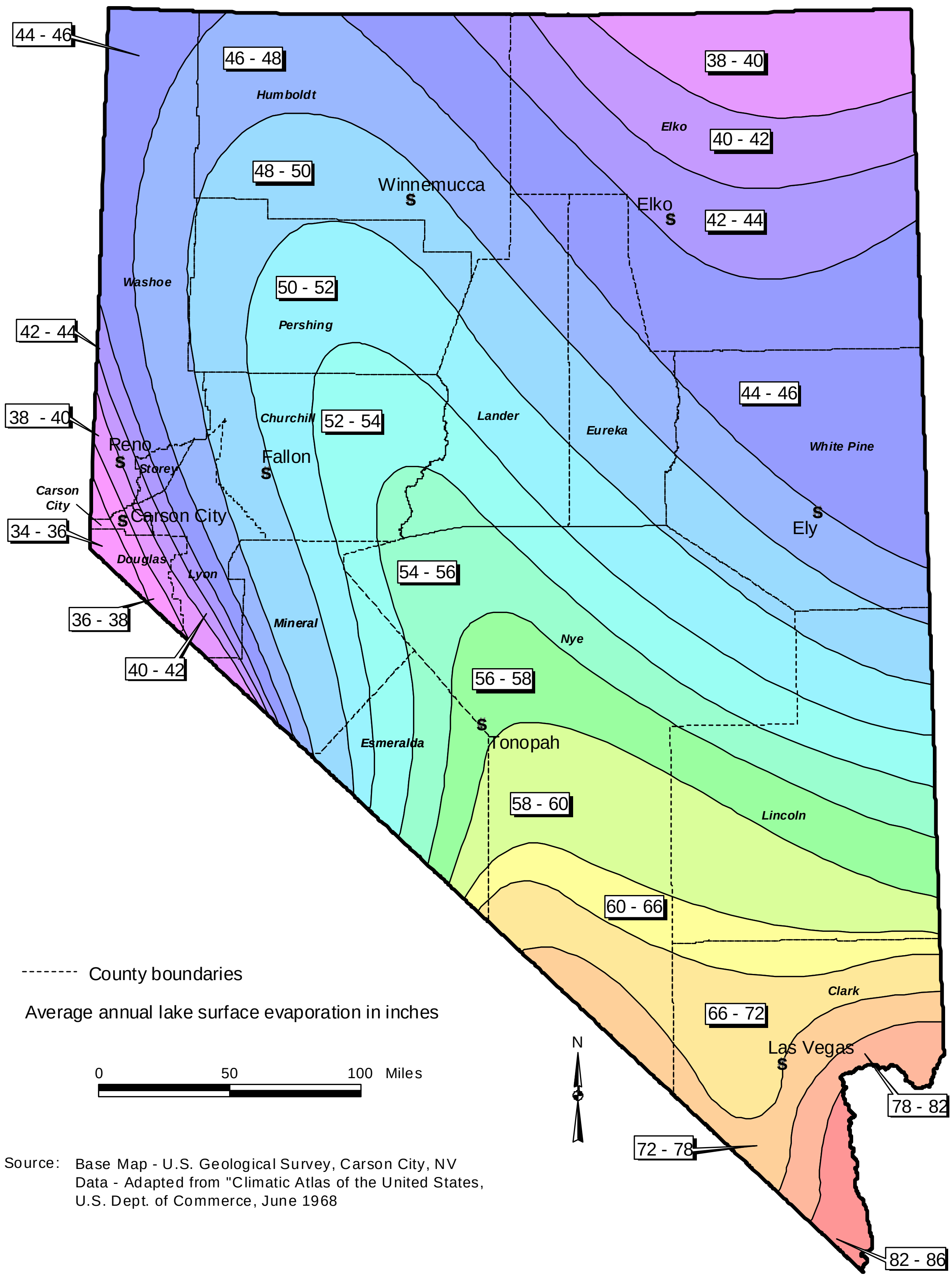


Fig. 4-4. Precipitation Variability for 3 Selected Sites



Source: Base Map - U.S. Geological Survey, Carson City, NV
Data - Adapted from "Climatic Atlas of the United States, U.S. Dept. of Commerce, June 1968

Figure 4-5. Average Annual Lake Surface Evaporation

Surface Water

Surface water is a limited and precious resource in Nevada providing about 70 percent of the total water supply used in the state. Spring and summer snowmelt supplies most of the streamflow in Nevada. However, isolated summer convective storms probably cause a majority of the streamflow in southern Nevada's low altitude basins.

Throughout the State, surface water flows can vary widely from year to year and from month to month, with maximum discharges generally in May and June as a result of snowmelt in the mountains. With the exception of the Humboldt Basin, most of the surface waters in Nevada's rivers are the result of snowmelt occurring in other states such as California, Wyoming, Colorado, and Utah.

Flows in the upper reaches of the larger rivers (Carson, Humboldt, Truckee, Walker) typically increase as one moves downstream. The larger rivers typically follow the flow pattern of a gaining stream in the well-watered mountain reaches and a losing stream in the lower-altitude reaches. Reductions in flow occur due to irrigation, public use, infiltration, and evapotranspiration.

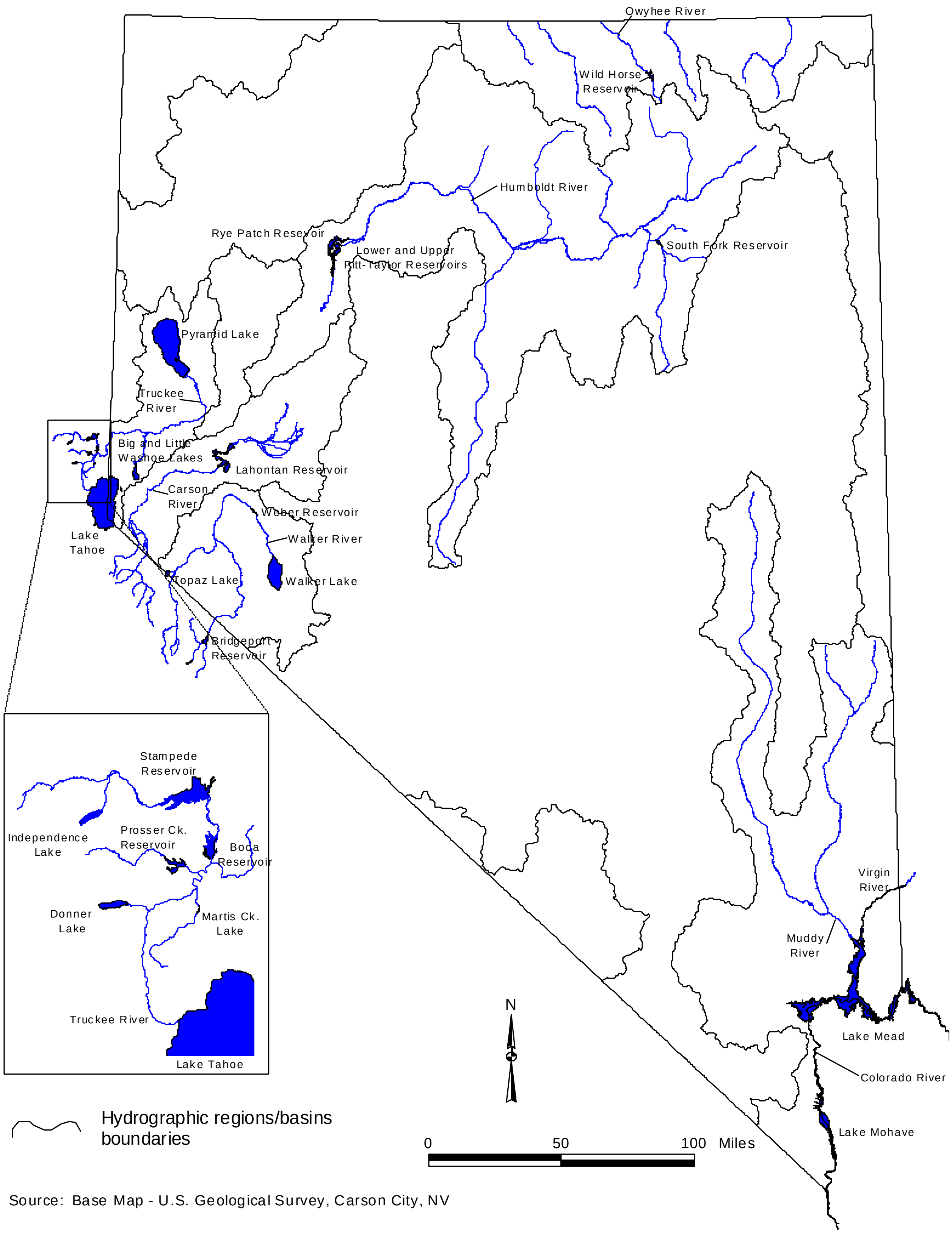
Major Rivers, Lakes and Reservoirs

Nevada can claim very few large rivers and streams compared to other states. With the exception of the Colorado River, Nevada's perennial rivers are small by nationwide standards. Rivers in the Snake River Basin and Colorado River Basin regions flow into the ocean, with the remaining streams systems discharging into terminal sinks and lakes with no outflow to the sea. The major river systems in Nevada are the Colorado, Walker, Carson, Truckee, and Humboldt (Figure 4-6). Table 4-2 summarizes the main lakes and reservoirs within these river systems and in Nevada.

The **Carson River** flows from the eastern slopes of the Sierra Nevada in California and terminates in the Carson Sink. Waters of the Carson River are used predominately for agriculture from Carson Valley down to the Fallon area. Only a few regulating storage reservoirs exist in the basin, with Lahontan Reservoir being the largest. Lahontan Reservoir is used to store water from the Carson River, and water diverted from the Truckee River by Derby Dam and conveyed to Lahontan Reservoir via the Truckee Canal. Water released from Lahontan Reservoir is used predominately for agriculture, and wildlife purposes.

The **Colorado River** is the largest river in Nevada, flowing through Wyoming, Colorado, Utah, New Mexico, Arizona, California and Nevada. Along its 1,400 mile course to the Gulf of Mexico, the Colorado River Basin drains an area of about 240,000 square miles or about one-twelfth the area of the contiguous United States. The Colorado River and tributaries in Nevada provide a majority of the drinking water supply to the Las Vegas area, hydroelectric power and recreation opportunities at Lake Mead and Lake Mohave, and water for agricultural purposes.

Figure 4-6 Major rivers, lakes, reservoirs



Source: Base Map - U.S. Geological Survey, Carson City, NV

Figure 4-6. Major Rivers, Lakes and Reservoirs

Table 4-2. Major Lakes and Reservoirs of Nevada and Portions of California

Hydrographic Region	Lake/Reservoir	Surface Area, acres	Active Storage Capacity, acre-feet	Total Storage Capacity, acre-feet
Carson River	Lahontan Reservoir	14,600	317,000	317,000
Colorado River	Lake Mead	158,000	26,200,000	29,700,000
	Lake Mohave	28,000	1,810,000	1,820,000
Humboldt River	Pitt-Taylor Reservoir, Lower	2,570	22,200	22,200
	Pitt-Taylor Reservoir, Upper	2,070	24,200	24,200
	Rye Patch Reservoir	12,400	194,300	194,300
	South Fork Reservoir	1,650	41,000	41,000
Snake River	Wild Horse Reservoir	2,830	73,500	73,500
Truckee River	Big and Little Washoe Lakes	5,800	14,000	38,000
	Boca Reservoir	980	40,870	41,110
	Donner Lake	800	9,500	Not reported
	Independence Lake	700	17,500	Not reported
	Lake Tahoe	124,000	744,600	125,000,000
	Martis Creek Lake	770	20,400	21,200
	Prosser Creek Reservoir	750	28,640	29,840
	Pyramid Lake[1]	111,400 (as of 9/30/96)	not applicable	21,760,000 (as of 9/30/96)
	Stampede Reservoir	3,440	221,860	226,500
Walker River	Bridgeport Reservoir	2,914	40,500	40,500
	Topaz Lake	2,410	61,000	126,000
	Walker Lake[1]	33,500 (as of 9/30/96)	not applicable	2,153,000 (as of 9/30/96)
	Weber Reservoir	950	13,000	13,000

[1]Pyramid and Walker lakes are natural terminal lakes with no outlet.

The **Humboldt River** is the longest river contained wholly within the State. The Humboldt River originates in the Ruby, East Humboldt, Independence and Jarbidge Mountains and flows westward to terminate in the Humboldt Sink. A majority of the Humboldt River system water is used for agriculture. There are only a few flow regulating reservoirs in the basin, the largest (Rye Patch Reservoir) being near the end of the system. As a result, late season irrigation water shortages are commonplace throughout much of the area above Rye Patch Reservoir.

The **Truckee River** originates at the northern end of Lake Tahoe in California and terminates at Pyramid Lake. Along its course, water is utilized to meet a variety of needs, such as municipal and industrial, agriculture, hydroelectric power, and wildlife. A portion of the Truckee River flow is diverted at Derby Dam and is conveyed via the Truckee Canal to Lahontan Reservoir in the Carson River Basin. With numerous upstream reservoirs, mostly in California, the Truckee River is one of the most regulated river systems in Nevada.

The **Walker River**, with its headwaters in California, flows into Nevada and terminates at Walker Lake. Most of the flow of the Walker River system originates in California and is used predominately for agricultural purposes in Nevada and California. The two largest reservoirs on the system (Topaz Lake located in Nevada and California, Bridgeport Reservoir located wholly in California) are owned and operated by the Walker River Irrigation District and are predominately used to supply irrigation water to district members.

Streamflow Forecasts and Data Collection

The collection and analysis of snowpack and streamflow data are essential for proper management and planning of our surface water resources. A better understanding of each basin's surface water system is made possible through snow depth and streamflow measurements.

Snowpack Measurments and Streamflow Forecasts. Natural Resources Conservation Service (NRCS) operates a series of snow depth measurement stations through the western United States, including Nevada. Utilizing the data collected at these stations, NRCS and National Weather Service hydrologists develop streamflow and water supply forecasts for the major surface water systems. These forecasts are used to guide water management and emergency management decisions.

Gaging Stations. The USGS is the principal Federal agency which collects surface water data in Nevada. The USGS began collecting streamflow data in 1889 with the establishment of a gaging station on the Truckee River near the Nevada-California state line. During the next six years, additional gaging stations were established in the Humboldt, Carson, Walker and Truckee basins. As of 1996, the USGS surface water quantity monitoring network consists of water discharge measurements for 170 gaging stations on streams, canals and drains, 99 peak flow stations and miscellaneous sites, and five springs; and water levels and contents for 22 lakes and reservoirs. The general objective of the stream-gaging program is to provide information on, or to develop estimates of, flow characteristics at any point on any stream.

Other entities collect streamflow data for regional purposes. For example, the Clark County Regional Flood Control District operates a network of meteorologic and water depth monitoring stations as part of the District's Flood Threat Recognition Program..

Streamflow Characteristics. Most of the streamflow in Nevada is the result of runoff from melting snow. Runoff patterns in Nevada vary greatly both seasonally and geographically, and are mainly determined by precipitation patterns (location and timing) and other climate patterns, such as temperature. Other factors such as surface geology, vegetation, and land use affect the amount of runoff entering the rivers and streams. Streamflows are further affected by human-induced influences such as diversions and reservoir operations.

Table 4-3 summarizes some basic streamflow characteristics for selected USGS gaging stations throughout Nevada (see Figure 4-7 for station locations). As shown, average annual flows vary widely from river to river. Within a given river system, flows fluctuate year to year in response to changes in precipitation amounts. Some of these annual variations can be dramatic. For instance, at the "Walker River near Wabuska, NV" gaging station, the highest flows for a year exceeded the lowest annual flows by over 50 times. Figure 4-8 depict monthly and annual streamflow variations for the Colorado, Humboldt and Truckee rivers.

Water Yields and Committed Resources

The estimated average annual yield from Nevada's surface water systems is approximately 3.2 million acre-feet per year (Table 4-4). Generally, Nevada's surface water sources, such as lakes, streams and springs, have been fully appropriated and used for many years. In some instances, water may be available from these sources during high water years, however storage facilities would be required to capture the surplus flows for later use.

Most priority rights for surface water in Nevada were established in the 1800s. Rights to use water for irrigation date back to the 1850s in streams draining the Sierra Nevada Mountains and to the 1870s and 1880s in the Humboldt River Basin.

Droughts and Floods

Nevada is a land of extremes, with droughts and floods common in our highly variable climate. Years of average streamflows are rarely experienced. Periods of high flows followed by low flows are more the norm in Nevada.

Droughts. Years of below average flows in rivers are not uncommon and many water users are prepared to cope with one year of low streamflows by resorting to supplemental sources such as reservoirs and groundwater. For most of Nevada's water users, who depend mostly upon surface water, problems can begin to occur when below average flows are experienced for two or more consecutive years. Over time, reservoir and groundwater levels tend to decline due to increased uses and these supplemental sources may become depleted. Droughts can also create quality problems for both surface water and groundwater sources. The decreased flows experienced during a drought tend to result in diminished quality for the remaining water.

Table 4-3. Summary of Streamflow Data for Selected Gaging Stations

Hydrographic Region	Gaging Station Name (Number)	Period of Record	Annual Streamflow Statistics, acre-feet		
			Average Annual	Lowest Annual	Highest Annual
Carson River	East Fork Carson River near Gardnerville, NV (10309000)	1890-1997	278,800	66,300	655,200
	West Fork Carson River at Woodfords, CA (10310000)	1901-97	81,000	18,900	210, 000
	Carson River near Carson City, NV (10311000)	1940-97	298,700	42,400	826,800
	Carson River near Ft. Churchill, NV (10312000)	1911-97	272,900	26,300	804,400
Colorado River	Virgin River at Littlefield, AZ (09415000)	1930-97	175,600	72,400	504,600
	Muddy River near Glendale, NV (09419000)	1913-97	30,600	23,500	35,900
	Colorado River below Hoover Dam, AZ-NV (09421500)	1935-97	10,050,000	5,556,000	22,150,000
Humboldt River	Humboldt River at Palisade, NV (10322500)	1903-97	288,800	25,200	1,336,000
	Humboldt River near Imlay, NV (10333000)	1935-97	201,000	18,800	1,460,000
Snake River	Owyhee River above China Diversion Dam near Owyhee, NV (13176000)	1939-84	107,600	33,500	230,800
Truckee River	Truckee River at Farad, CA (10346000)	1909-97	554,500	133,200	1,769,000
	Truckee River at Reno, NV (10348000)	1907-96	492,500	76,700	1,701,000
	Truckee River below Derby Dam near Wadsworth, NV (10351600)	1918-97	289,100	4,500	1,759,000
Walker River	East Walker River near Bridgeport, CA (10293000)	1922-97	105,800	27,100	320,700
	West Walker near Coleville, CA (10296500)	1903-97	202,100	53,900	484,300
	Walker River near Wabuska, NV (10301500)	1902-97	123,300	9,300	602,300

Note: Some years of data may be missing within each period of record.
Source: U.S. Geological Survey

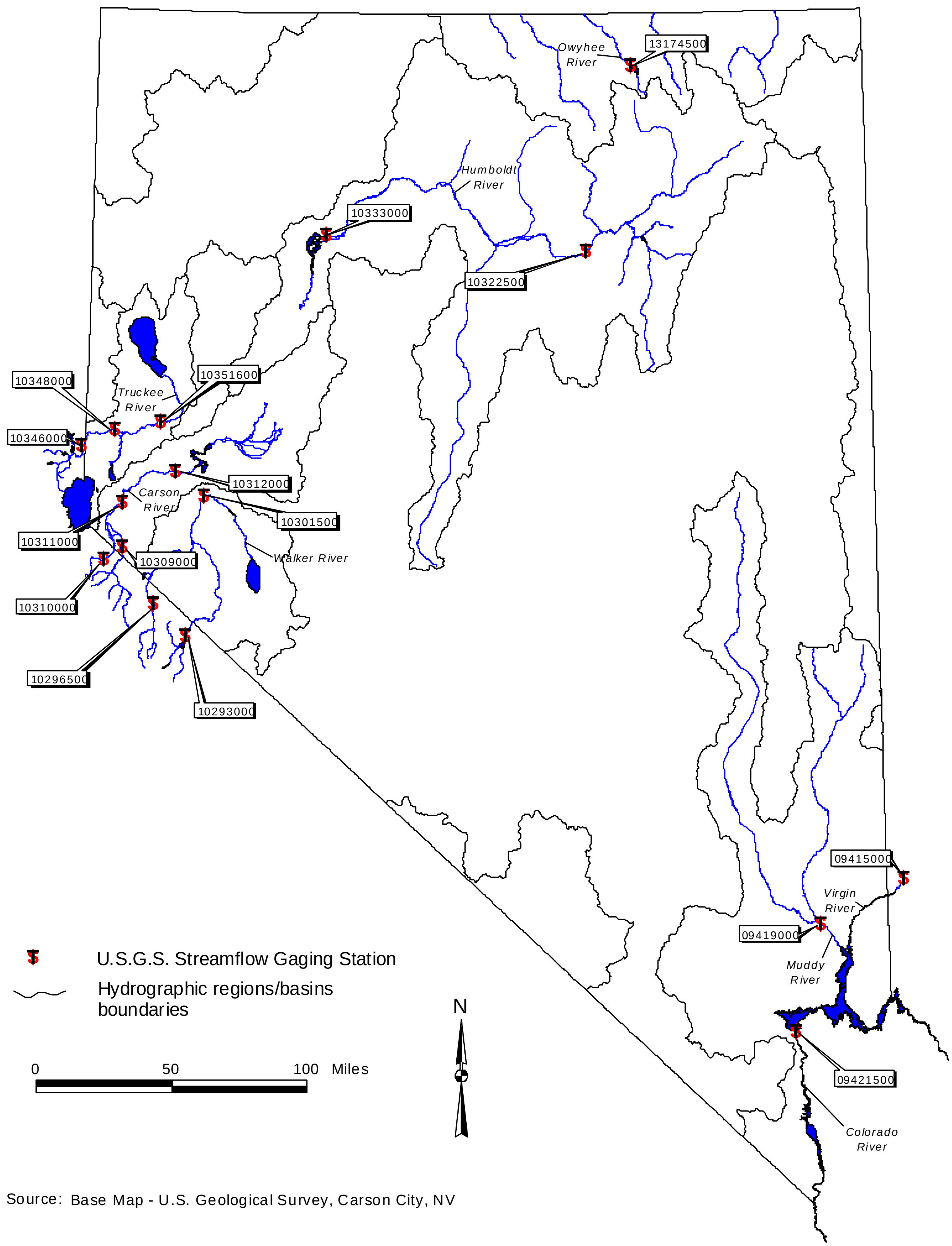
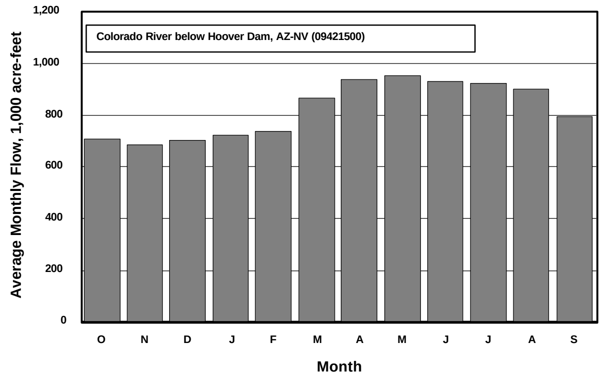
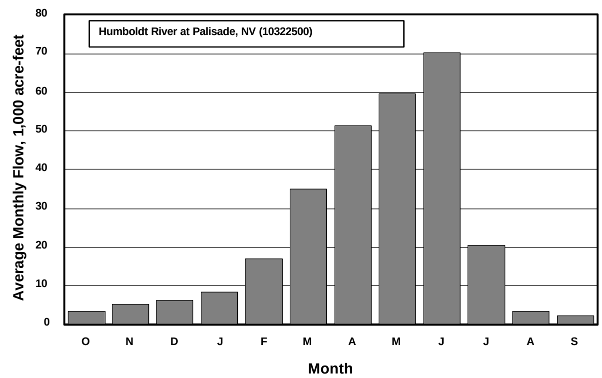
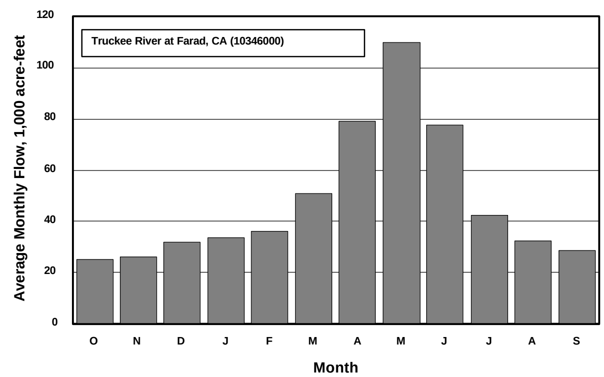


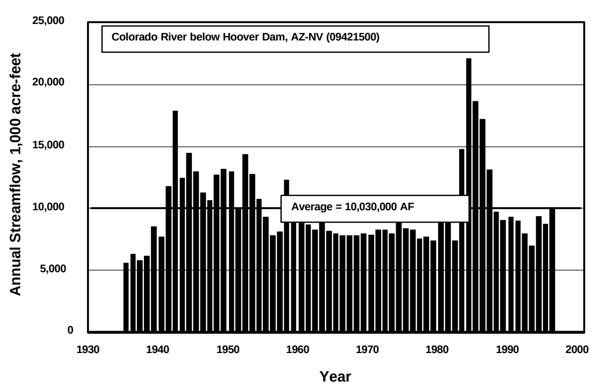
Figure 4-7. Selected USGS Streamflow Gaging Stations



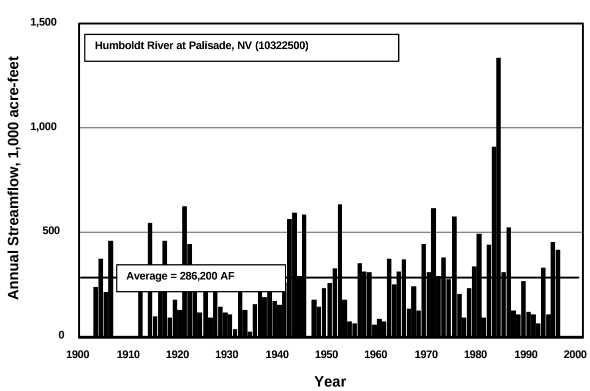
Monthly Variations: Streamflows in Nevada vary from month to month with most flow occurring from March through June as a result of snowmelt. Colorado River flows fluctuate much less from one month to the next due to the regulating effect of reservoirs on the system.







Annual Variations: Streamflows vary from year to year in response to annual variations in precipitation amounts upstream of the gaging stations



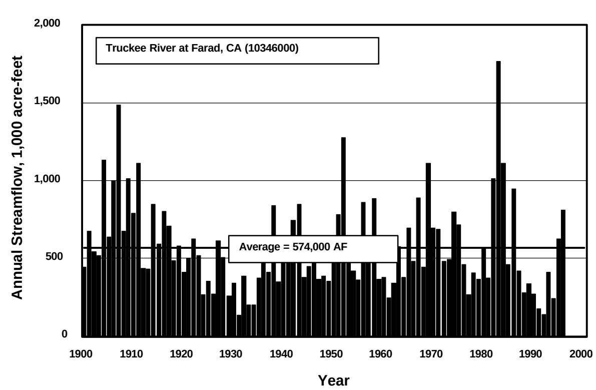


Fig. 4-8. Streamflow Variability for 3 Selected Sites

Table 4-4.

Summary of Surface Water Runoff and Flows (excluding Colorado River)

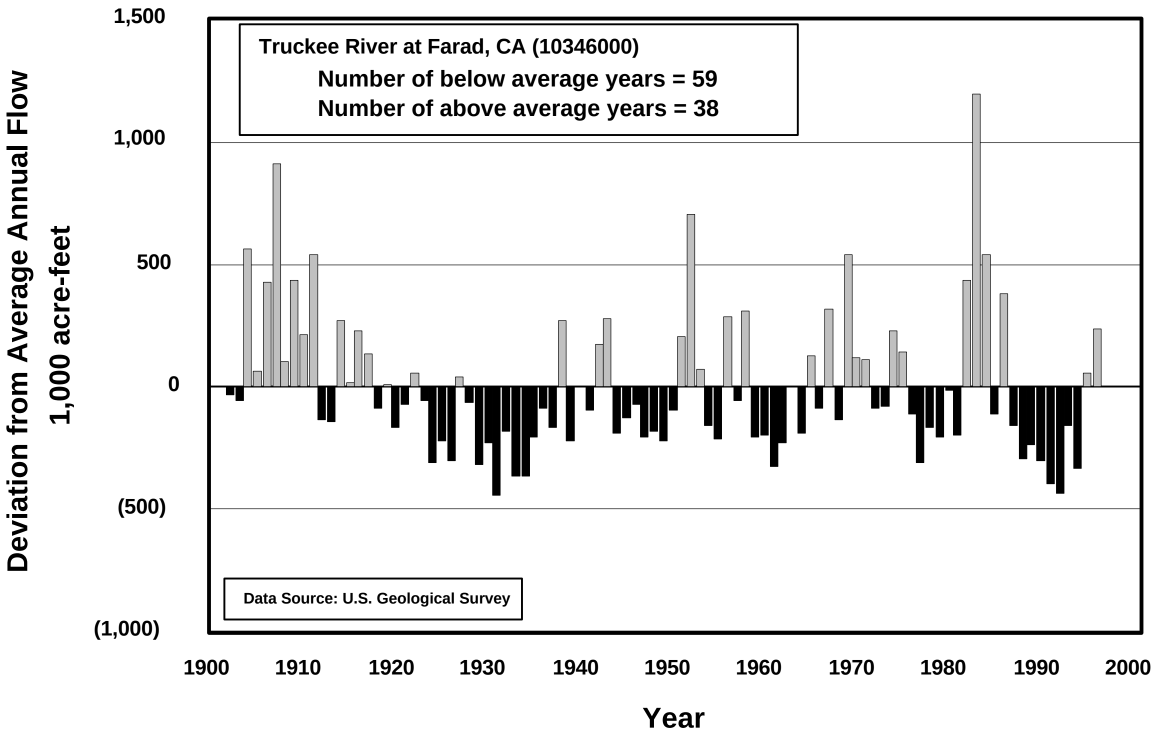
Description	Acre-feet per year
Average Annual Surface Runoff	
From Watersheds within Nevada	1,900,000
Inflow from Other States	1,300,000
Total	3,200,000
Average Annual Surface Outflow to Other States	700,000

Source: "Water for Nevada, Report No. 3", State Engineer's Office, 1971

Drought periods (consecutive years with streamflows much less than average) are frequent in Nevada. In many cases, Nevada's river systems experience more "below average water years" than "above average water years" (Figure 4-9). The most significant documented droughts of the 20th century were during 1928-37, 1953-55, 1959-62, 1976-77 and 1987-94, with the 1928-37 period possibly the most severe and longest of this century in northern Nevada.

Floods. Even though Nevada is the driest state with an average annual precipitation of nine inches, floods are common and have occurred in all parts of the state. The effects of floods in Nevada have increased steadily as population and development have increase since the mid-1900s. Development has encroached upon natural floodplains, including alluvial fans, and thereby increasing flood damage risks.

On the Truckee, Carson, and Walker rivers in west-central Nevada, the most severe floods have resulted from winter rains on snow in the Sierra Nevada Mountains. In the large drainages in southern Nevada, and small drainages and alluvial fans throughout Nevada, flash floods resulting from intense rainfall over relatively small areas are the most common. Flooding from these intense rainstorms is typically sudden and life threatening. Flooding along the Humboldt, Truckee, Carson, and Walker rivers in northern Nevada is generally not as sudden and more time is available to prepare for the flooding. However, these floods are usually longer with longer periods of flood inundation. Table 4-5 summarizes the major flood events that have occurred this century in Nevada.



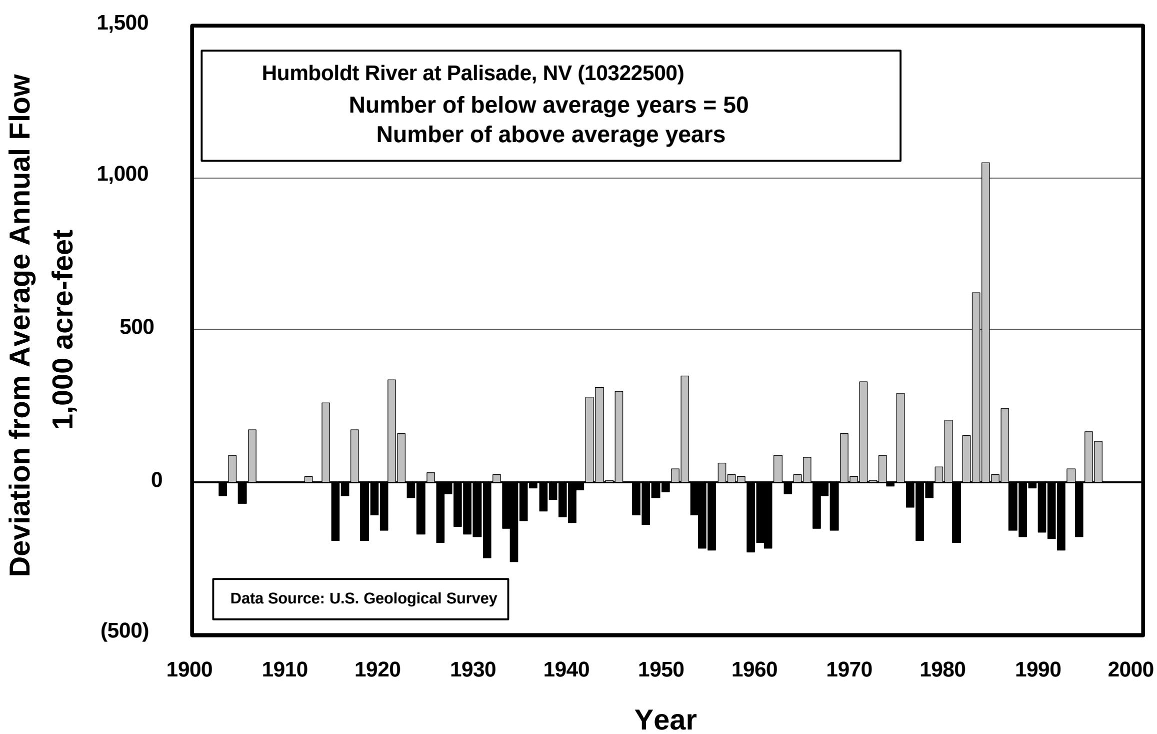


Fig. 4-9. Examples of Annual Deviations from Average Annual Flows

Table 4-5. Summary of Major Floods in Nevada, 1907-97

Date	Area Affected	Recurrence Interval (years)	Remarks
Mar. 1907	Sierra Nevada drainages	Unknown	May rank with 1950 and 1955 floods in Carson Valley and along Truckee River
Feb. 1910	Upper Humboldt River basin	>100	Similar to hydrologic conditions during Feb. 1962 flood.
Nov.-Dec. 1950	Sierra Nevada drainages	50	Not as severe as Dec. 1955 flood in Carson River drainage.
Dec. 1955	Sierra Nevada drainages	40 to 100	Most severe flood from upper Carson River drainage downstream to Carson City
Feb. 1962	Humboldt River drainage	>50 in upper Humboldt	Rapid thawing and light rain on snowpack
Feb. 1963	Sierra Nevada drainages	50	Severe in Carson and Truckee River drainages
Dec. 1964	Sierra Nevada drainages	20	
Sept. 14, 1974	Eldorado Canyon (dry tributary to the Colorado River, 50 miles southeast of Las Vegas)	>100	9 lives lost
July 1975	Las Vegas Valley	Unknown	2 lives lost
Aug. 1981	Moapa Valley and vicinity	Unknown	Severe damage to agriculture and highways.
Mar.-June 1983	Statewide except south	<10 to 50	Greatest snowmelt floods known (except in Humboldt River basin - see Apr.-June 1984).
July 1983	Las Vegas Valley, Muddy River	Unknown	
Apr.-June 1984	Centered in Humboldt River drainage	>100 along middle and lower Humboldt River	Greatest snowmelt floods known in Humboldt River basin.
July-Sept. 1984	Las Vegas Valley	Unknown	5 lives lost
Feb. 1986	Sierra Nevada drainages	10 to 50	Greatest discharge in main rivers since 1963
Jan. 1997	Sierra Nevada drainages	50 to >100	Heavy rainfall on snowpack

Source: National Water Summary 1988-89 - Floods and Droughts: Nevada, U.S. Geological Survey, Carson City, Nevada.; January 1997 Flooding in Northern Nevada - Was This a "100-Year Flood"?, U.S.G.S. Fact Sheet FS-077-97, U.S. Geological Survey, Carson City, Nevada, May 1997.

Water Quality

Nevada's surface water quality is regulated by the Nevada Division of Environmental Protection (NDEP) and the State Environmental Commission (SEC). The quality of surface water in Nevada varies greatly from location to location and from month to month with changes in flows. Tables 4-6 and 4-7 shows average total dissolved solids concentrations at a number of surface water monitoring sites throughout Nevada. In planning, both water quantity and quality need to be considered concurrently as both are interrelated. In general, constituent concentrations vary with changes in streamflow. Similarly, lake water quality is impacted by water levels in the State's terminal lakes. Figure 4-10 shows how total dissolved solids concentrations have increased in Walker and Pyramid lakes as the volume of water has decreased

Table 4-6. Comparison of Streamflow and Dissolved-Solids Concentrations at Selected USGS Water-Quality Sites

U.S.G.S. Water Quality Station	Mean Concentration of Dissolved Solids, milligrams per liter	Mean Discharge, cubic feet per second
Virgin River at Littlefield, AZ (09415000)	1,990	243
Colorado River below Hoover Dam, AZ-NV (09521500)	697	13,840
Steptoe Creek near Ely, NV (10244950)	180	7.0
South Twin River near Round Mountain, NV (10249300)	86	6.6
Carson River near Carson City, NV (10311000)	199	405
Humboldt River near Carlin, NV (10321000)	301	375

Source: Water Resources Data, Nevada, Water Year 1996, U.S. Geological Survey Water Data Report NV-96-1

Table 4-7. Comparison of Streamflow and Dissolved-Solids Concentrations at Selected NDEP Water-Quality Sites

NDEP Water Quality Station	Mean Concentration of Dissolved Solids, milligrams per liter	Mean Discharge, cubic feet per second
Truckee River at Tracy, NV	160	780
Walker River at Snyder Lane	200	180

Source: Nevada Division of Environmental Protection files, U.S. Geological Survey data, and Nevada Division of Water Planning files

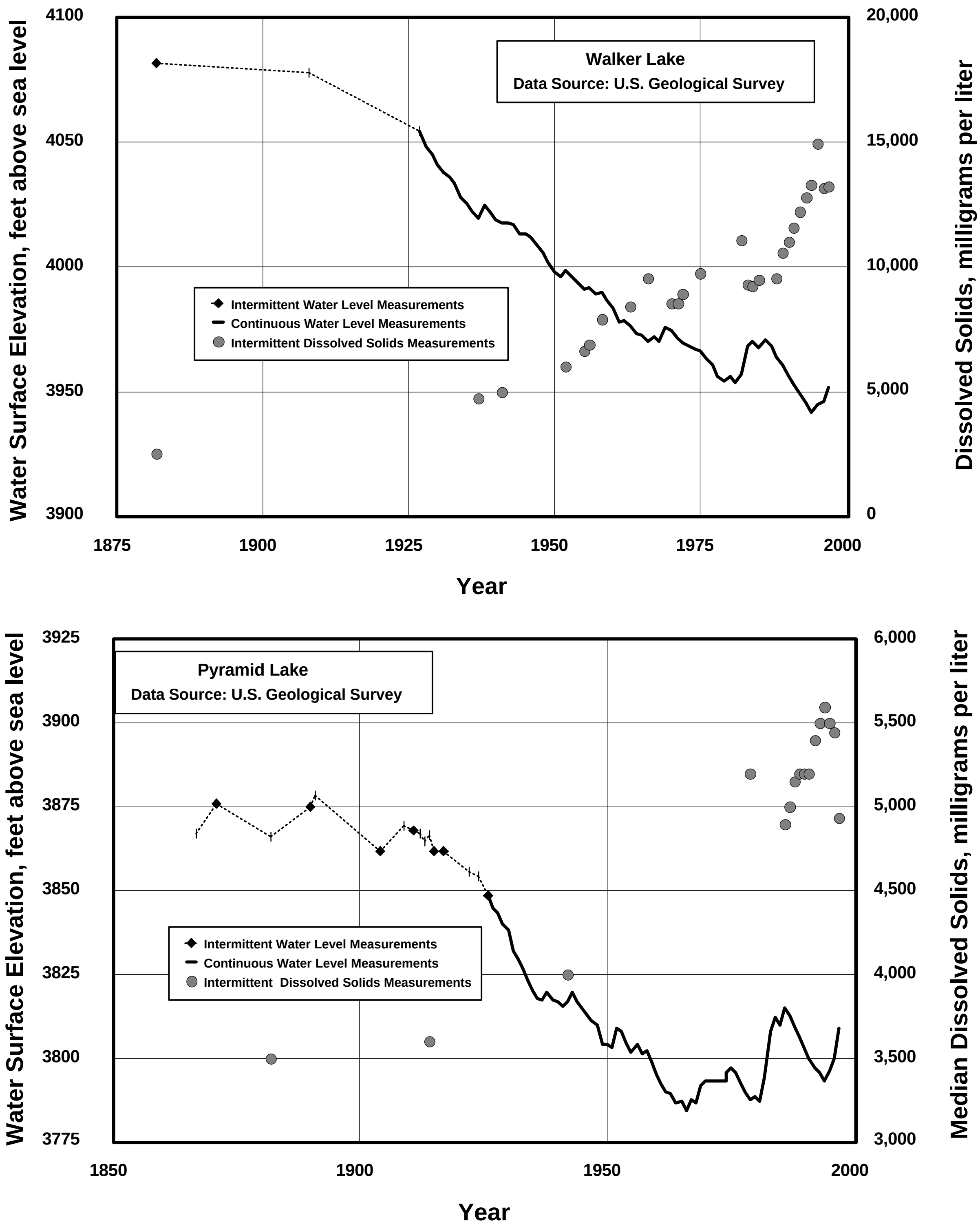


Fig. 4-10. Water Surface Elevations and Dissolved Solids Concentrations at Walker and Pyramid Lakes

The impacts on water quality from the municipal and industrial discharges have been greatly reduced over the last few years, with most point source polluters eliminated from direct discharges or stringently controlled. Nonpoint source pollution due mainly to agriculture, urban runoff and hydrologic modifications impacts various waters of Nevada. Water quality parameters of concern include nutrients, suspended solids, turbidity and bacteria which are being targeted in the State's Nonpoint Source Program administered by NDEP. Water quality has been improving due to the removal of point sources and the implementation of more stringent standards. The Nonpoint Source Program helps to further improve water quality by promoting public awareness, improved grazing and irrigation practices, erosion control measures and the implementation of best management practices.

Surface Water Quality Management and Data Collection. Nevada's surface water quality is regulated by NDEP and the SEC. Certain aspects of the Federal Clean Water Act are implemented by NDEP for programs within Nevada. With assistance from federal grants, NDEP operates a surface water quality monitoring program of water bodies in Nevada, regularly monitoring over 100 sampling points in the 14 hydrographic regions. Section 303(d) of the Clean Water Act requires the State to develop a list of water bodies that need additional measures beyond existing controls to achieve or maintain water quality standards. The Section 303(d) list, developed by NDEP, provides a comprehensive inventory of water bodies impaired by all pollution sources, including point sources and nonpoint sources. This inventory is the basis for targeting water bodies for watershed-based solutions. Nevada's first priority in targeting water bodies is impairment of the beneficial use standards. In general, a water body is included on the 303(d) list if the beneficial use standards were exceeded more than 25% of the time. The current 303(d) list is available from NDEP upon request. For a more complete description of NDEP water quality programs, refer to Part 1, Section 3 of the *State Water Plan*.

As of 1996, the USGS collected water quality data for 96 stream, canal, spring and drain sites throughout Nevada as part of their systematic data-collection program. In addition to routine monitoring, USGS is also conducting the National Water Quality Assessment Program (NAWQA) in Nevada and throughout the United States in response to the lack of long-term, consistent information on water quality nationwide. NAWQA Program goals are to describe the status and trends in the quality of the Nation's water resources and to provide scientific understanding of the major factors which affect surface and ground water quality. The Nevada NAWQA Project began in 1991 and includes the Las Vegas Valley area and the Carson and the Truckee River Basins. Project scientists are using multi-disciplinary approaches to compare and contrast the effects of urban and agricultural activities on water quality.

Groundwater

Groundwater in Nevada is an important water supply source. The surface water resources in our state have been virtually fully appropriated and future development must rely on either ground-water sources or the reallocation of surface water supplies. Groundwater provides about 40 percent of the total water supply used in Nevada and in some areas provides the entire supply. The extent to which groundwater is used may vary considerably from year to year. In many areas, groundwater is pumped to supplement surface water sources. As a result, groundwater usage in these areas increases during periods of low streamflow and decreases during high runoff periods.

Proper planning and management of our ground-water resources cannot occur without knowledge about aquifer location, perennial yield, recharge, storage volume, committed resources (water righted amounts), actual water usage, water levels, water quality, and projected trends. The following sections provide available background information on Nevada's groundwater resources.

Principal Ground-water Aquifers

Principal ground-water aquifers in Nevada are basin-fill aquifers, carbonate-rock aquifers, volcanic-rock aquifers, and volcanic- and sedimentary-rock aquifers (Figure 4-11). The basin-fill aquifers, composed primarily of alluvial, colluvial and lacustrine deposits, are the major aquifers in the State. Virtually all major ground-water development has been in the basin-fill aquifers with the withdrawals from the upper 500 feet of these aquifers. In eastern and southern Nevada, thick sequences of carbonate rock underlie many of the alluvial basins forming a complex regional aquifer system or systems that are largely undeveloped and not yet fully understood. The carbonate-rock aquifer supplies water to numerous springs which are used for irrigation. Volcanic-rock aquifers extend over hundreds of square miles but only one volcanic-rock aquifer in the Carson Desert (Churchill County) of west-central Nevada has been developed as a municipal water supply.

Within the Basin and Range Province, aquifers are generally not continuous, or regional, because of the complex faulting in the region. Of the aquifer types discussed above, any or all may be in, or underlie, a particular basin and constitute separate sources of water. However in some instance, interconnection between the aquifers may exist.

Groundwater and Surface Water Interaction

Groundwater and surface water cannot be viewed as independent and separate sources in water management decisions. In some areas, groundwater may discharge into streams and contribute significantly to surface water flows. Groundwater usage may lessen surface flows in these instances. Conversely, surface water infiltrates into the groundwater systems through natural causes and/or human activities (such as irrigation). As a result, changes in surface water flows and usage may impact groundwater levels.

Figure 4-11 Aquifers

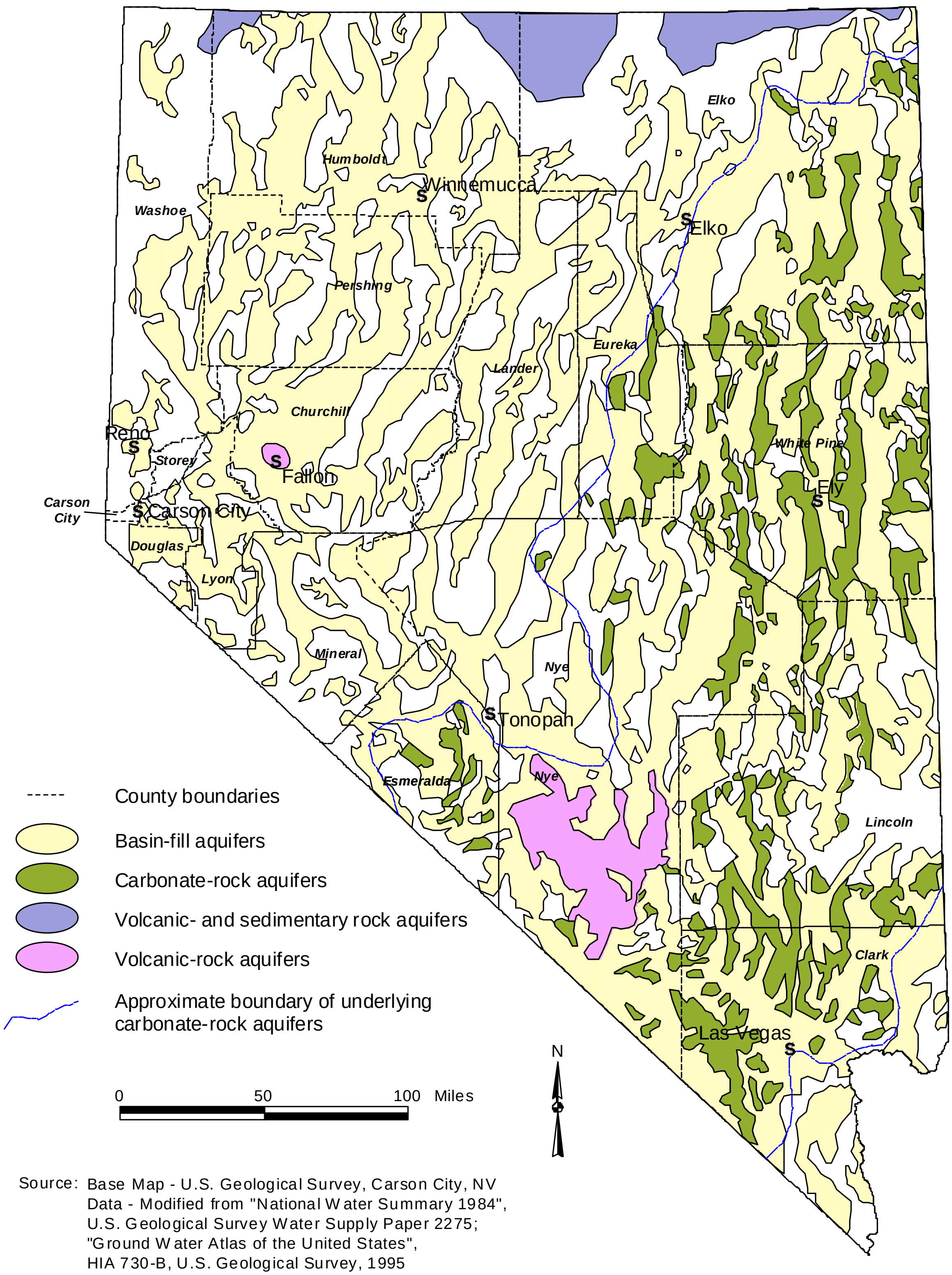


Figure 4-11. Approximate Boundaries of Major Aquifers in Nevada

Perennial Yield and Committed Resources

Perennial yield is the amount of usable water from a ground-water aquifer which can be economically withdrawn and consumed each year for an indefinite period of time without depleting the source. Estimates of perennial yield are necessary to provide the State Engineer with a guideline by which to limit groundwater allocations (committed resources).

Recognizing the need for more detailed groundwater information, such as perennial yield estimates, the State Engineer and the U.S. Geological Survey (USGS) began a cooperative groundwater study program in 1945 with funding from the State Legislature. A number of water resource bulletins have been produced from this program. However, the most statewide comprehensive groundwater study efforts did not begin until the State Legislature in 1960 authorized a series of ground-water reconnaissance studies be performed under the cooperative supervision of the Nevada Division of Water Resources (NDWR) and the USGS. This program, which extended until 1974, resulted in 60 reconnaissance reports covering the hydrology of 219 hydrographic areas. Based upon these reports, the water resources bulletins, and other more recent studies, estimates of perennial yield have been developed for the 256 hydrographic areas. The total combined perennial yield of the basin-fill aquifers statewide is approximately 2.1 million acre-feet per year. The perennial yield figures currently available are estimates only and provide guidelines for water planning and management. In developing these estimates, the USGS utilized the Maxey-Eakin method which was developed between 1947 and 1951. While some of the perennial yield estimates have been updated with more current methodologies, many of the yield estimates in use today were developed over 25 years ago.

In basins with significant groundwater discharge to streams, the USGS developed system yield estimates in addition to the groundwater perennial yield estimates. System yield is the amount of usable groundwater and surface water that can be economically withdrawn and consumed each year for an indefinite period of time without depleting the source. For these basins, the perennial yield estimates may include groundwater discharges to surface streams. Development of these groundwater aquifers could potentially reduce surface flows and impact downstream surface water users.

Under the authority granted in Nevada Revised Statutes 534, the State Engineer issues groundwater rights. The term “committed resource” represents the total volume of the permitted, certificated and vested groundwater rights which are recognized by the State Engineer and generally can be withdrawn from a basin or area in any given year. When reviewing groundwater right applications, the State Engineer considers the individual and regional perennial yield estimates, system yield estimates, and the committed resources amounts among other things in making determinations.

To assist in the tracking of the committed groundwater resources, NDWR maintains a computer database of state-issued water rights. Based upon this database, the total committed groundwater resource amount in Nevada equals about 3 million acre-feet per year (as of March/April 1998). The term "committed" refers to those water rights that are either permitted or certificated. Table 4-8 and Figure 4-12 summarizes the committed resources by hydrographic region and by type of use. Committed resource values presented in the *State Water Plan* are time sensitive and subject to change from future actions on pending applications and other procedures. It must be noted that the 3 million acre-feet figure is calculated from NDWR database output and represents the estimated amount of the groundwater resources committed (permitted or certificated) to a particular beneficial use. The database is still under development and all committed resource numbers presented in the *State Water Plan* are approximate. Actual groundwater withdrawal and consumption amounts are far less than the committed resource value of 3 million acre-feet. In 1995, approximately 1.6 million acre-feet of groundwater was withdrawn with about 0.7 million acre-feet consumed. There are a number of reasons for these differences:

- Some groundwater rights are *supplemental* to surface water rights. Supplemental groundwater is generally pumped only as needed to augment low surface water supplies. As a result, supplemental groundwater rights are not usually exercised to their fullest extent every year.

- Some groundwater rights are *supplemental* to other groundwater rights with one well pumped to augment the supply from another well. When this supplemental relationship exists between rights, the State Engineer assigns a combined annual pumpage duty for both wells which is less than the sum of each well's individual duty. The NDWR database does not automatically account for these supplemental situations. NDWR staff must first make adjustments to the database numbers to avoid double counting of these supplemental commitments. These adjustments have been made to the database for about 35% of basins. In the other basins, committed resources values as taken from the NDWR may be overestimated due to double counting of the supplemental water rights.

- Some groundwater rights may not be exercised to their fullest extent every year. For example, municipalities are allowed to hold water rights in reserve as needed for future growth.

- Some groundwater rights are not currently being exercised as a water supply is being provided from another source. For example, groundwater being pumped as part of the mine dewatering operations at Barrick's Post/Betze-Meikle Mine is utilized for irrigation in Boulder Flat Valley (Humboldt River Basin). Both the irrigation and mine dewatering are separately permitted with their permitted pumpage amounts included in Table 4-8. However under this situation, the irrigation operation is using the pit water rather than pumping the irrigation wells and exercising their groundwater rights. The NDWR database is not capable of adjusting for this type of substitution, and database printouts obtained for the *State Water Plan* include both the irrigation rights and the dewatering rights in the committed resource values.

Table 4-8. Approximate Perennial Yield and Committed Groundwater Resources (as of March/April 1998) by Use and Hydrographic Region

Hydrographic Region	Combined Perennial Yield, acre-feet per year	Committed Groundwater Resources by Category, acre-feet per year (as of March/April 1998)					
		Irrigation & Stock	Municipal & Quasi-municipal	Mining & Milling[1]	Commercial & Industrial	Other[2]	Total
1. Northwest Region	55,500	28,625	6	132	5	64	28,832
2. Black Rock Desert Region	178,825	215,658[3]	608	58,952[4]	920[5]	1,687[5]	277,825
3. Snake River Basin	62,100	8,091	1,145	7,813	4,877	511	22,437
4. Humboldt River Basin	463,900	492,307[3,6]	53,737	141,576	63,637[5]	91,055[7]	842,312
5. West Central Region	8,200	1,678	8,743	58	28,249[5]	1,289	40,017
6. Truckee River Region	76,425	34,989[3]	83,902[8]	5,172	68,030[5]	19,014	211,107
7. Western Region	17,850	18,662	5,174	5,174	518	508	25,328
8. Carson River Basin	70,255	95,926[3]	62,438	4,068	12,979[5]	13,196[5]	188,607
9. Walker River Basin	57,300	205,354[3]	14,949	8,657	12,383[9]	6,019	247,362
10. Central Region	798,460	573,277	50,978	96,765	37,141[5]	9,775[5]	767,936
11. Great Salt Lake Basin	63,150	28,155	3,506	1,305	732	13	33,711
12. Escalante Desert Basin	1,000	2	0	0	0	0	2
13. Colorado River Basin	219,800	78,057[3]	101,362[10]	11,171	35,895	19,165[11]	245,650
14. Death Valley Basin	24,550	22,325	2,154	6,086	638	333	31,536
TOTAL	2,097,315	1,803,106	388,702	342,221	266,004	162,629	2,962,662

General notes:

A. Data on committed resources were obtained from the Nevada Division of Water Resources water rights database and represent estimated resources committed as of March/April 1998.

B. The committed resources values include permitted and certificated amounts only.

C. These numbers are preliminary and intended to be used for planning purposes only. Totals may include water rights that have not been adjusted for supplemental relationships with other groundwater rights. Also, totals do not include any adjustment for supplemental relationships with surface water rights. Values are subject to change due to pending water right applications, and possible cancellations and forfeitures.

Other notes:

1 Mining is considered a temporary use by the State Engineer's Office and upon cessation of mining, many permits will expire. The "Mining & Milling" category includes only those rights associated with the consumptive use needs of the mines. Permits associated with dewatering operations are included in the "Other" category.

2 "Other" includes following uses: domestic, environmental, power generation, recreation, storage, wildlife, other/decreed. Includes environmental permits issued for environmental cleanup projects. These environmental permits are temporary and expire upon cessation of cleanup activities.

3 Portions of rights are supplemental to surface water and are used only when surface water is not available.

4 Majority of rights held for a mine operation that is no longer pumping.

5 Portion of rights include geothermal pumpage for power generation, with majority of geothermal water reinjected into geothermal reservoir.

6 Portion of rights not exercised as mine pit dewatering discharge is being used as a substituted water source. See Footnote 7.

7 Includes rights associated with mine pit dewatering. Portion of withdrawals are used as a water source for irrigation. See Footnote 6.

8 Actual annual pumpage limited to lower value by State Engineer restrictions.

9 Portion of rights include geothermal pumpage for power generation, with some of geothermal water not reinjected.

10 Includes permits that will be revoked when water right holders provided water from another source (Colorado River).

11 Includes environmental permits issued for environmental cleanup projects. These environmental permits are temporary and expire upon cessation of cleanup activities. Also includes permits granted for pumping of shallow poor quality groundwater in the Las Vegas area as needed to alleviate potential hazards resulting from rising groundwater levels caused by secondary recharge.

Figure 4-12. Estimated Committed Groundwater Resources by Type of Use and Hydrographic Region.

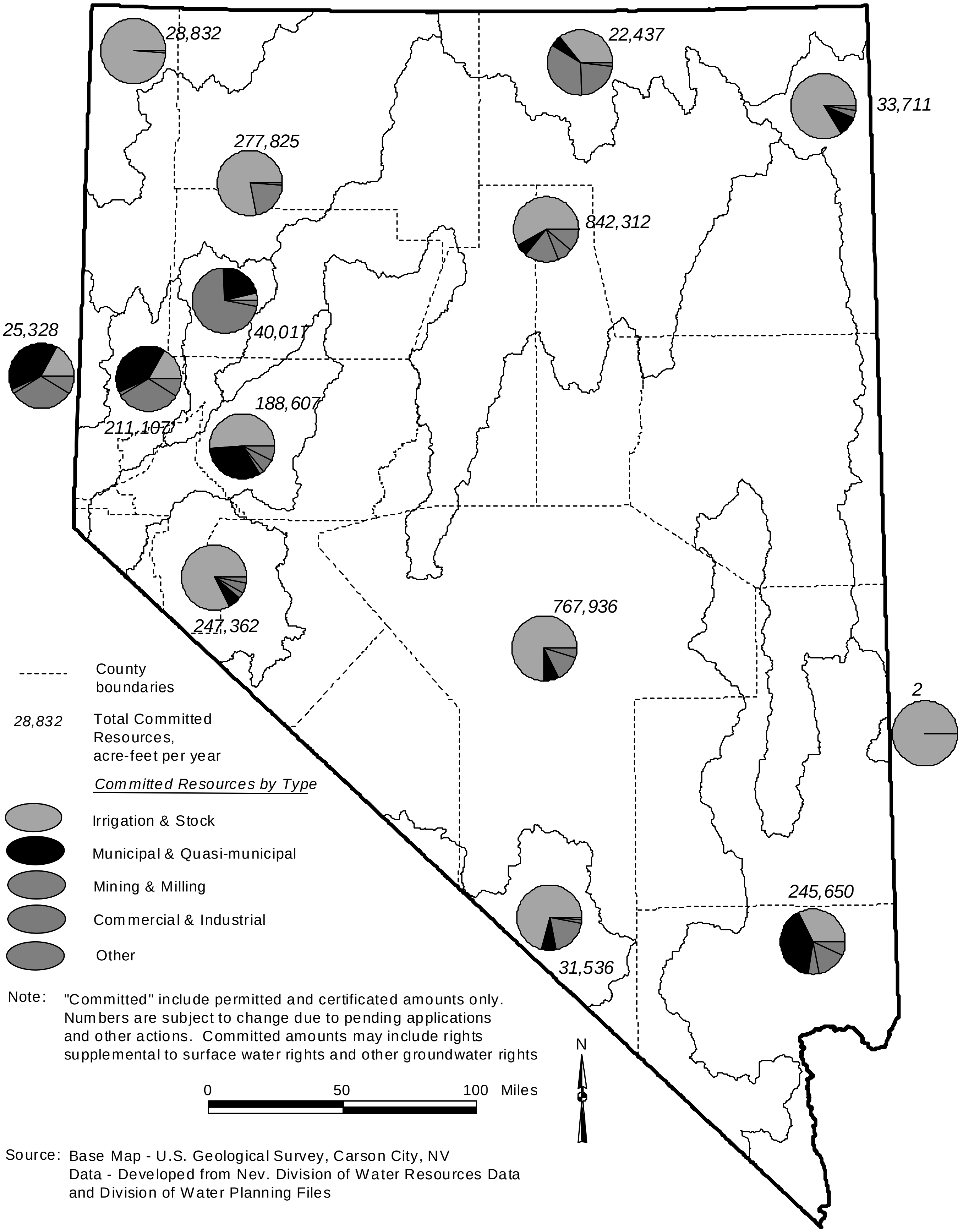


Figure 4-12. Approximate Committed Groundwater Resources (as of March/April 1998) by Hydrographic Region and Use

- The State Engineer has placed administrative limits on pumping in some areas. For example, the State Engineer has limited pumpage by Sierra Pacific Power Company from the Truckee Meadows Basin to an amount less than Sierra's water right duty. The NDWR database is not capable of reflecting this pumpage limit in any calculation of committed resource amounts. Any committed resource values taken from the NDWR database reflect only the permitted/certificated pumpage amounts, not any pumpage limits.

The committed resource figures derived from the NDWR database may not reflect long-term groundwater commitments for the following reasons:

- Mining is considered a temporary use by the State Engineer's Office. With some mines, existing water right permits will expire once the mining operations have ceased.

- Environmental permits issued for environmental cleanup projects are included in the committed resource figures in Table 4-7. The cleanup projects are considered temporary, and once a cleanup operation is complete the associated water rights expire.

- The NDWR database includes committed resource amounts associated with revocable groundwater permits issued in the Las Vegas area. These rights will be revoked when the water right holders are provided water from another source, such as the Colorado River.

Management of Groundwater Rights Information

The total committed groundwater resource values presented in Table 4-8 and Figure 4-12 were derived directly from the NDWR database as of March and April 1998. At that time (March/April 1998), approximately 85 percent of all state-issued water rights in Nevada had been entered into this database. However, the groundwater rights for 88 of the 256 basins have been completely entered into the database and adjusted for supplemental rights (Figure 4-13). As a result, the committed resource figures from the NDWR database for these 88 basins are more accurate than for the other 168 basins, and the committed resource totals derived from the NDWR database maybe slightly lower than the actual amount. Committed resource values for the 168 basins should be considered preliminary estimates. Also, the committed resource values in some basins change daily. Current estimates should be obtained from the Nevada Division of Water Resources.

Groundwater Availability

As the demand for groundwater has increased over the years, the State Engineer has had to increase administrative efforts in some of the groundwater basins. The State Engineer may designate a groundwater basin which is being depleted or is in need of additional administration. Basins are designated through orders issued by the State Engineer. By "designating" a basin, the State Engineer is granted additional authority in the administration of the groundwater resources within the designated basin. For example, the State Engineer may issue orders which define preferred uses, deny certain water uses, or curtail pumpage. Preferred uses may include domestic, municipal, quasi-municipal, industrial, irrigation, mining and stock-watering uses or any other beneficial use. Each basin is managed as a separate unit with the State Engineer issuing orders and rulings as needed for

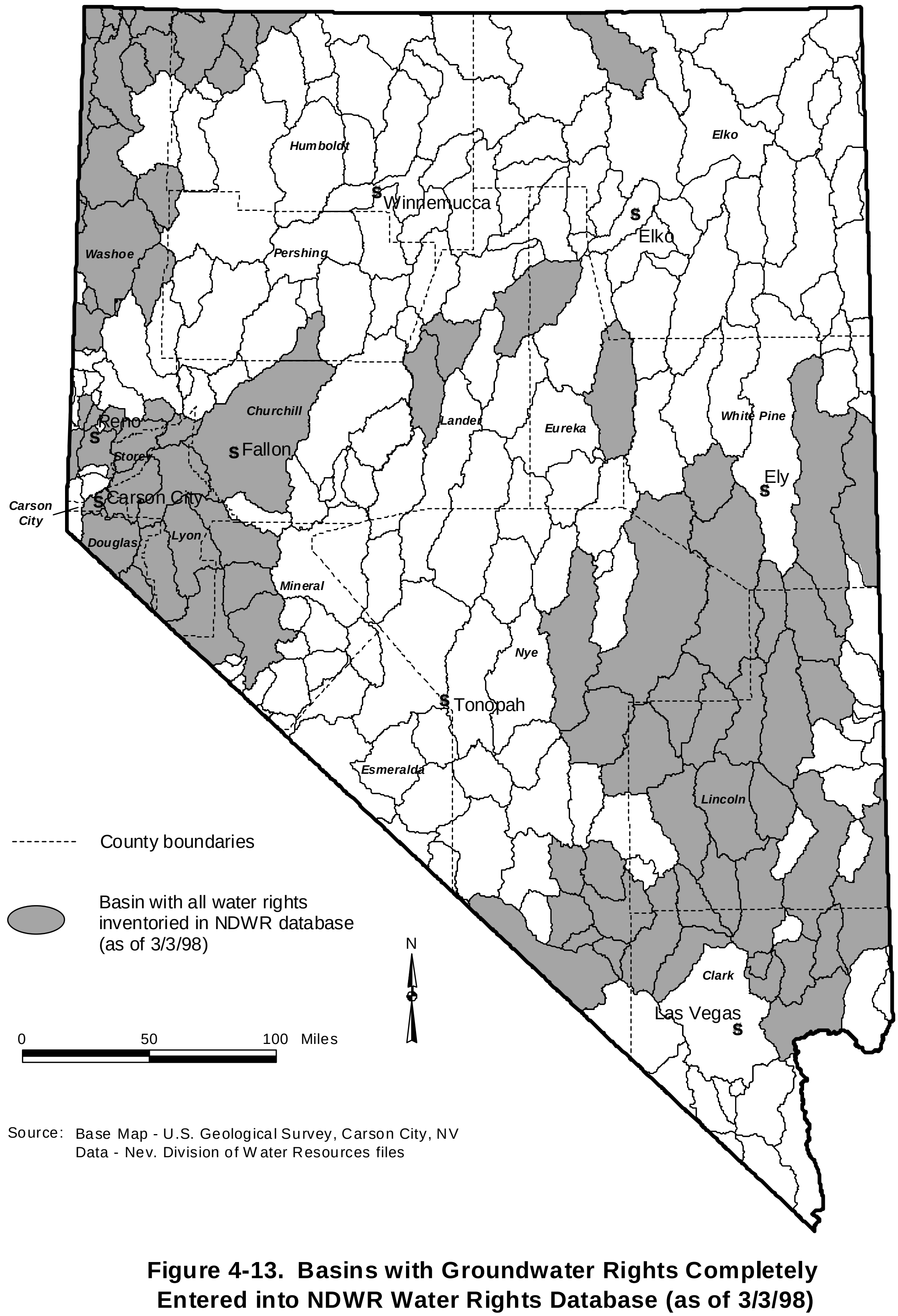


Figure 4-13. Basins with Groundwater Rights Completely Entered into NDWR Water Rights Database (as of 3/3/98)

the management of the groundwater resources. Figure 4-14 displays the designation status for the 256 groundwater basins in Nevada. This map is a useful tool to generally determine where the greatest impediments to groundwater development may exist. However, the associated State Engineer's orders and rulings need to be examined for a complete understanding of the management issues and water availability within a basin. The designation status of basins as defined by the State Engineer's orders have been divided into four general categories as shown in Table 4-9.

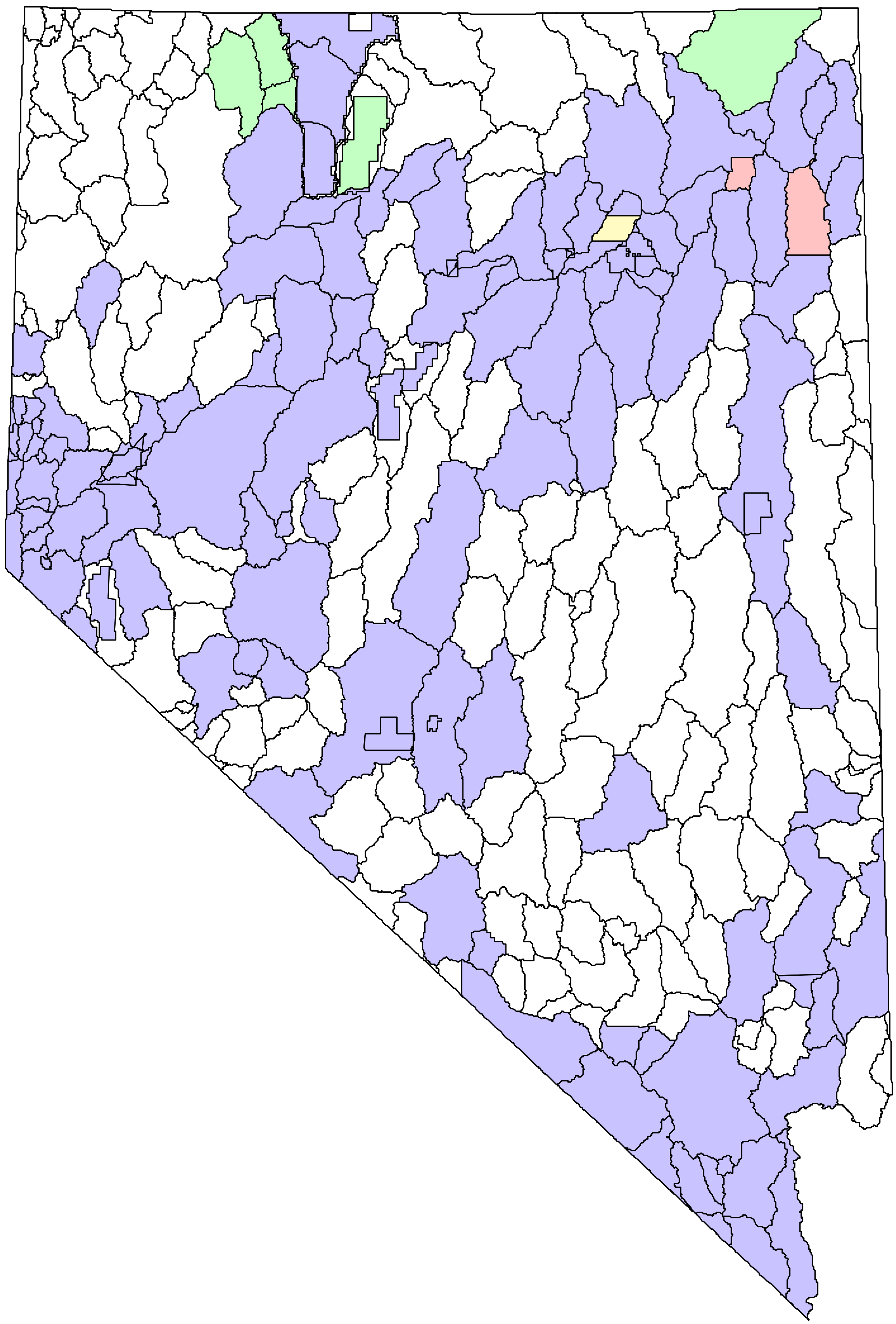
Table 4-9. Designated Groundwater Basin Categories

Designation Status	General Description of Associated State Engineer's Orders
Designated	State Engineer's order(s) do not define any administrative controls.
Designated - Irrigation Denied	State Engineer's order(s) state that irrigation is not a preferred use in these basins and applications for new irrigation appropriations will be denied.
Designated - Preferred Uses	State Engineer's order(s) list certain types of uses as preferred in these basins, and quantity restrictions may be placed on these preferred uses.
Designated - Preferred Uses; Irrigation Denied	State Engineer's order(s) list certain types of uses as preferred in these basins. Quantity restrictions may be placed on these preferred uses. State Engineer's order(s) also state that irrigation is not a preferred use in these basins and applications for new irrigation appropriations will be denied. Other uses may also be listed as denied.

Whether or not a basin is designated dictates the procedures to be followed in obtaining a groundwater permit. In undesignated basins, a person can drill a well in these basins prior to filing an application for a groundwater permit. In designated basins, a groundwater permit must be obtained prior to drilling a well. Domestic wells are exempt from the permitting process, however, drillers are required to notify the State Engineer of their intent to drill a domestic well and submit a well log following completion.

In general for basins with preferred uses defined, applications for preferred uses are considered by the State Engineer prior to applications for non-preferred uses. However, the State Engineer has the authority to deny applications for non-preferred uses even though the designation orders do not explicitly prohibit these uses. Regardless of the basin designation status, the State Engineer has the authority to deny a water application if: 1) there is not unappropriated water; 2) the proposed use will impair existing rights; 3) the proposed use will be detrimental to the public interest; and 4) the project is not feasible and is filed for speculative purposes.

Figure 4-15 presents a general picture of the uncommitted groundwater resources in Nevada. "Uncommitted groundwater resources" are assumed equal to perennial yield estimates less permitted and certificated water right amounts as extracted from the NDWR water rights database as shown on Table 4-7. Approximately 60% of the 256 basins have committed resource volumes below the perennial yield estimates. The following qualifiers apply to the data upon which this map is based:



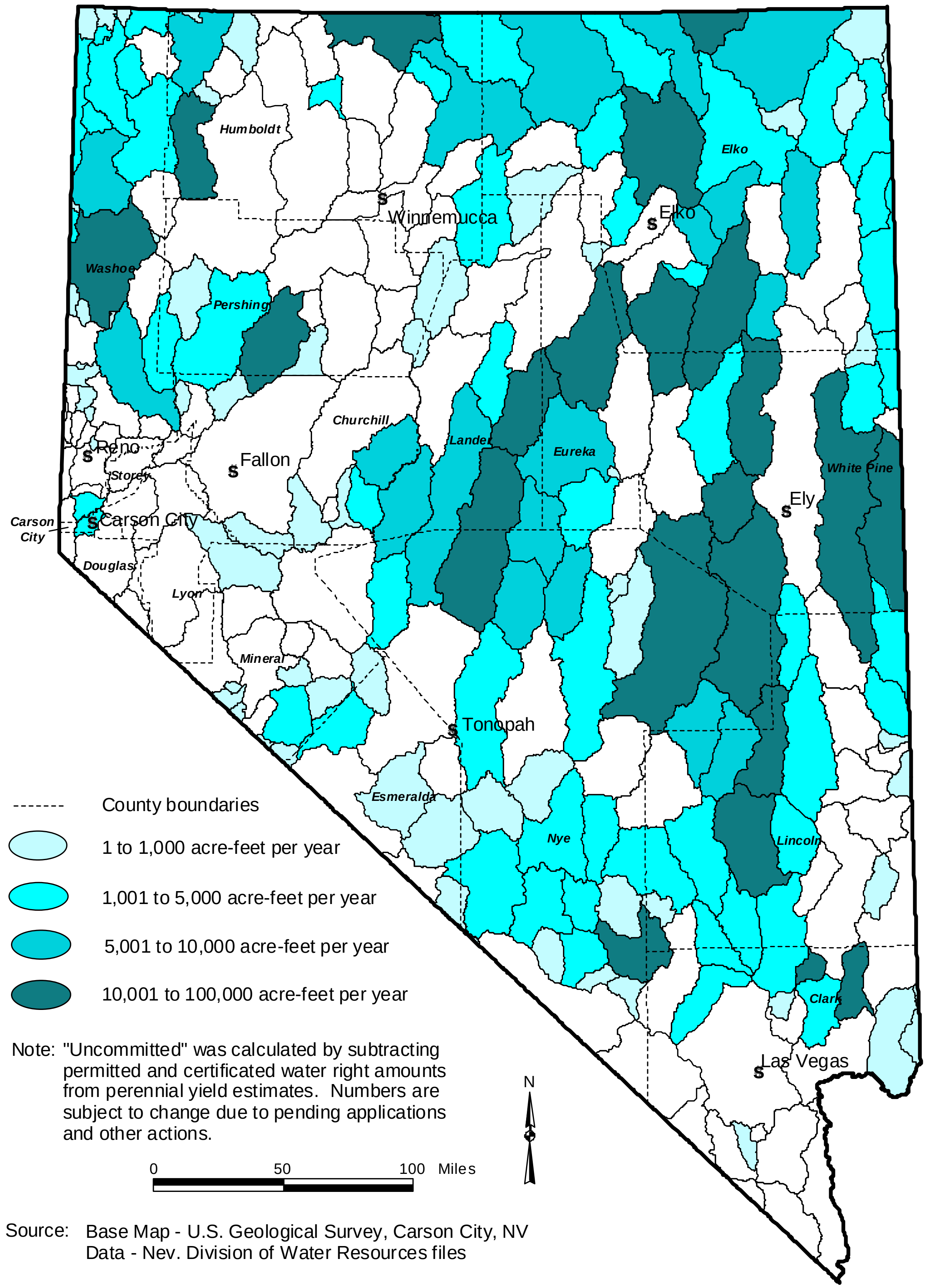


Figure 4-15. Approximate Uncommitted Groundwater Resources (as of March/April 1998)

- The perennial yield figures are estimates only and are subject to change following future studies.

- In some basins, groundwater aquifers discharge to streams thereby providing a portion of the supply for downstream surface water users. In these basins, development of the entire perennial yield amount could potentially impact surface water uses.

- The committed resource numbers upon which this map is based are subject to change on a daily basis as a result of new actions, such as approval of pending applications or forfeitures. About 1/3 of the groundwater basins have pending applications. The most current information can be obtained from NDWR.

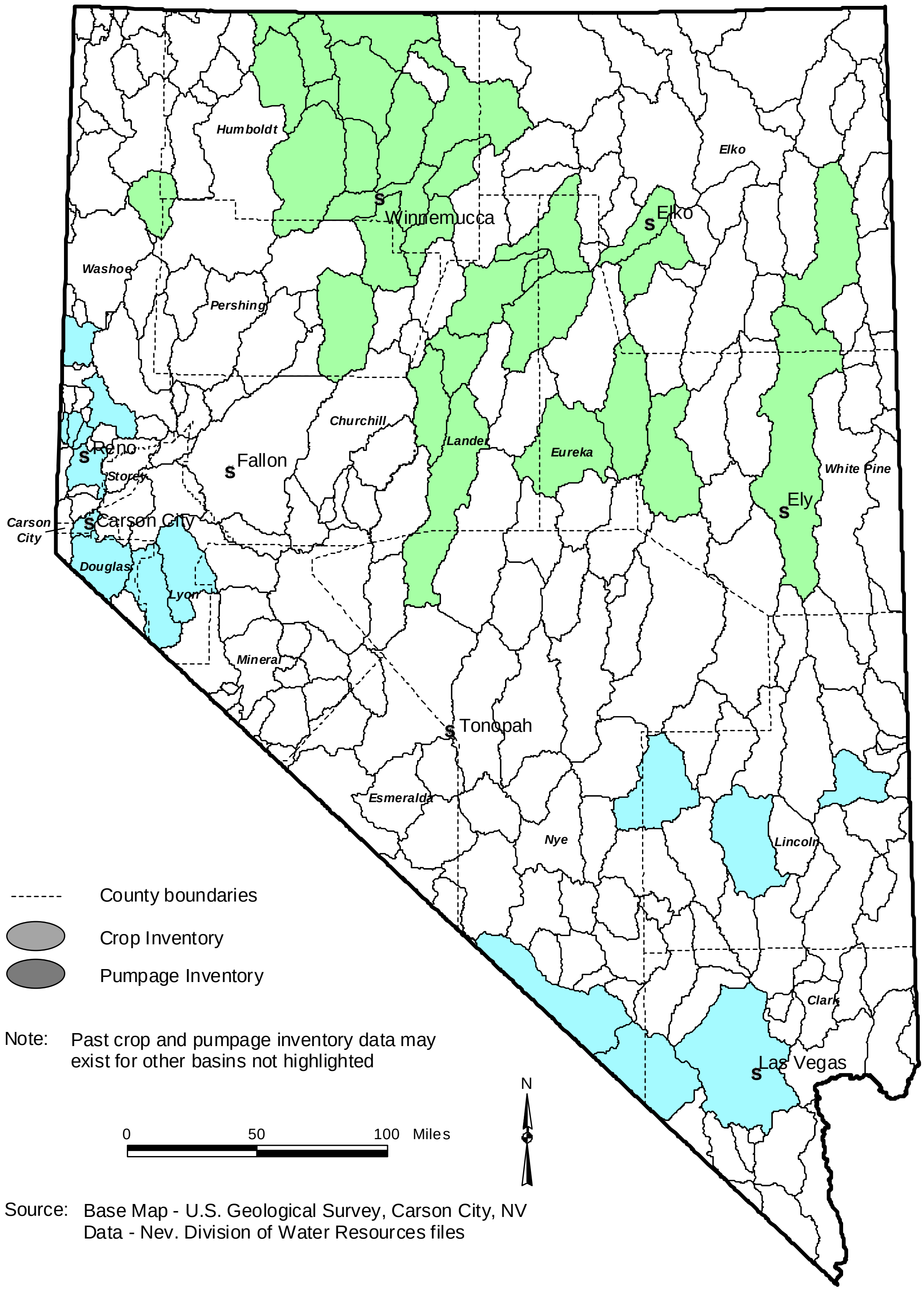
Groundwater Data Collection

NDWR and USGS collect a majority of the groundwater usage and level data in Nevada as described in the following discussion.

Pumpage and Crop Inventories. As part of their groundwater management duties, NDWR performs annual estimates of pumpage or "pumpage inventories" for some of the groundwater basins. Generally, these pumpage inventories are based upon a mixture of both actual measurements and estimates. In other basins, NDWR performs crop inventories in which irrigated crop acreages and associated water use are estimated. Figure 4-16 shows the basin locations for these inventories and their status. Some pumpage data are submitted to NDWR by the permit holders as a requirement of water right permit conditions, however these data do not represent all of the groundwater use within these basins. Figure 4-17 shows the basin for which groundwater pumpage data are submitted to NDWR as required by water right conditions.

Groundwater Level Data. The USGS and NDWR are the primary agencies collecting groundwater level data on a statewide basis. In the report entitled "Water Resources Data, Nevada, Water Year 1996" which is part of an annual series, the USGS presents water level data for 145 primary observation wells (measured monthly or more frequently) and 1041 secondary observation wells (measured one to four times per year) within 98 hydrographic basins. These water level data are maintained in electronic databases. Some of the groundwater level data presented in USGS's annual report have been collected by other agencies and then compiled by the USGS. NDWR currently collects groundwater level data in 73 basins. Figure 4-18 shows the basins where the USGS and NDWR collect groundwater level data. Most of the NDWR data is collected once a year, typically in the spring. Only a portion of the NDWR data are maintained in the USGS database with the remaining data stored in paper files.

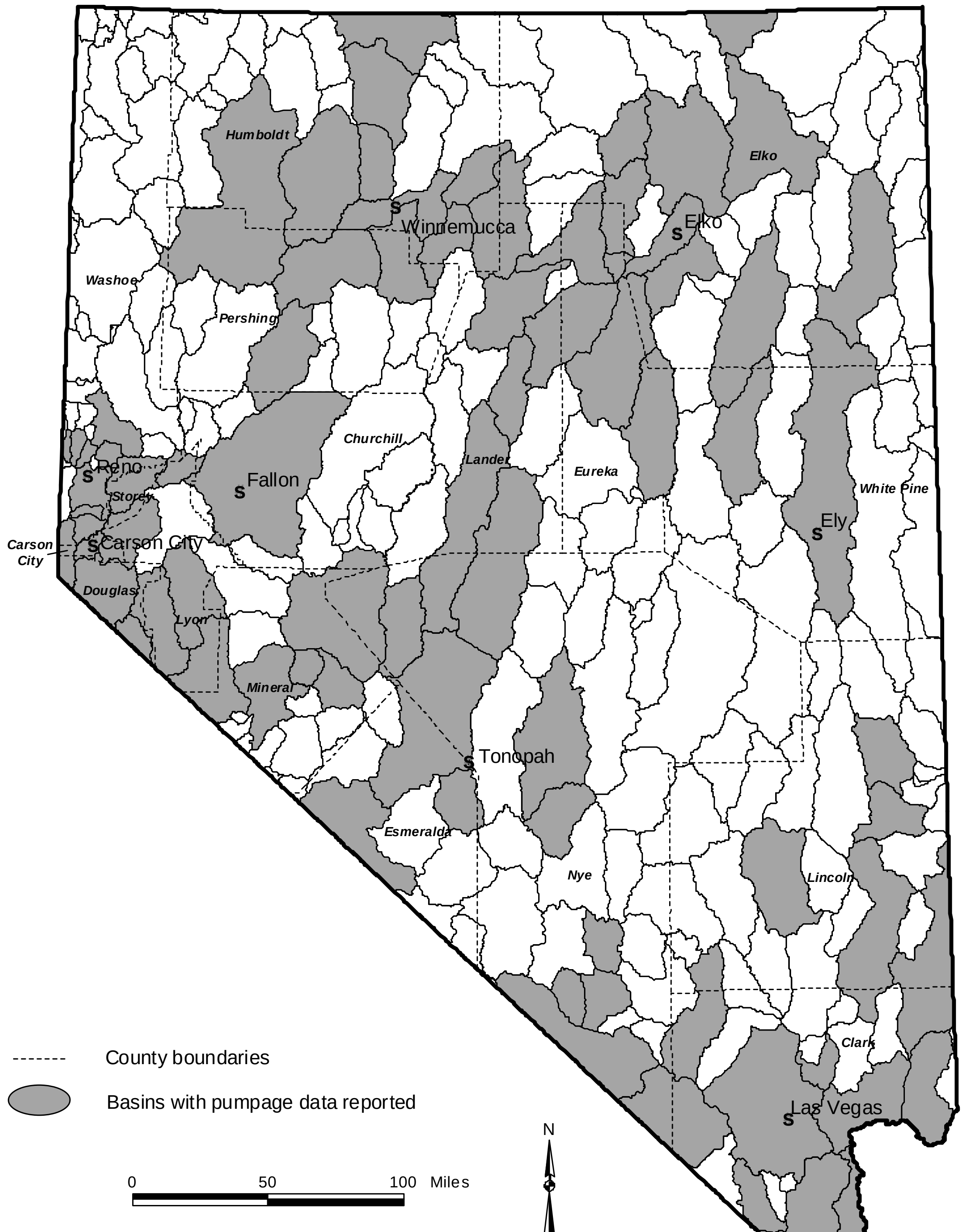
Groundwater levels fluctuate seasonally and annually in response to changes in pumpage and the climate. Figure 4-19 shows long-term groundwater levels for six selected wells throughout Nevada. In some areas, groundwater levels during the late 1980s and early 1990s tended to decline due to heavier than average reliance upon groundwater during the drought of that period, but have been recovering with the return to normal and above-normal precipitation.



Note: Past crop and pumpage inventory data may exist for other basins not highlighted

Source: Base Map - U.S. Geological Survey, Carson City, NV
Data - Nev. Division of Water Resources files

Figure 4-16. Current Crop and Pumpage Inventory Activities by Nevada Division of Water Resources



Source: Base Map - U.S. Geological Survey, Carson City, NV
Data - Nev. Division of Water Resources files

Figure 4-17. Basins with Groundwater Pumpage Data Collected by Nevada Division of Water Resources as Required by Water Rights Conditions

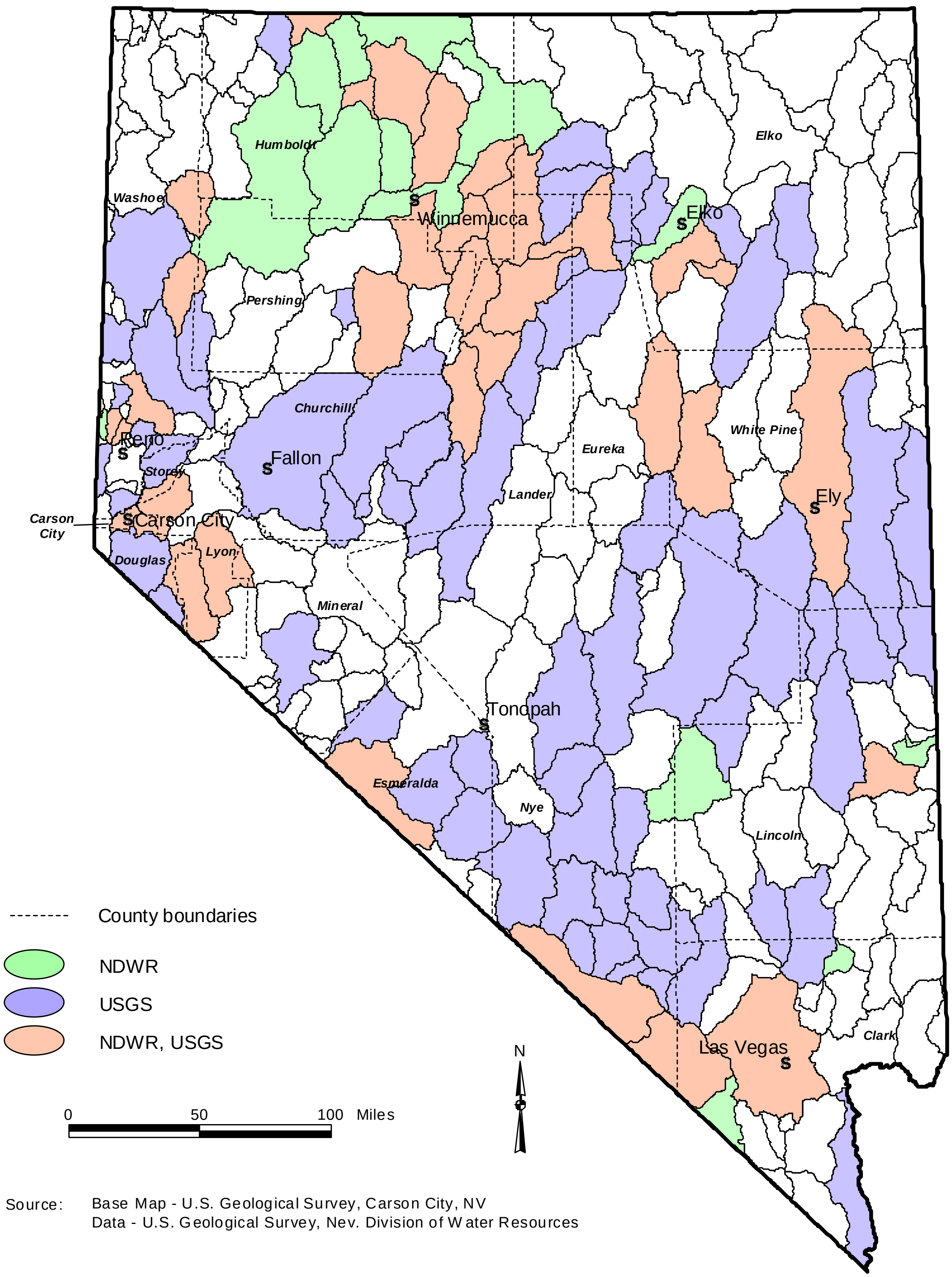


Figure 4-18. Current Groundwater Level Collection Activities by U.S. Geological Survey and Nevada Division of Water Resources

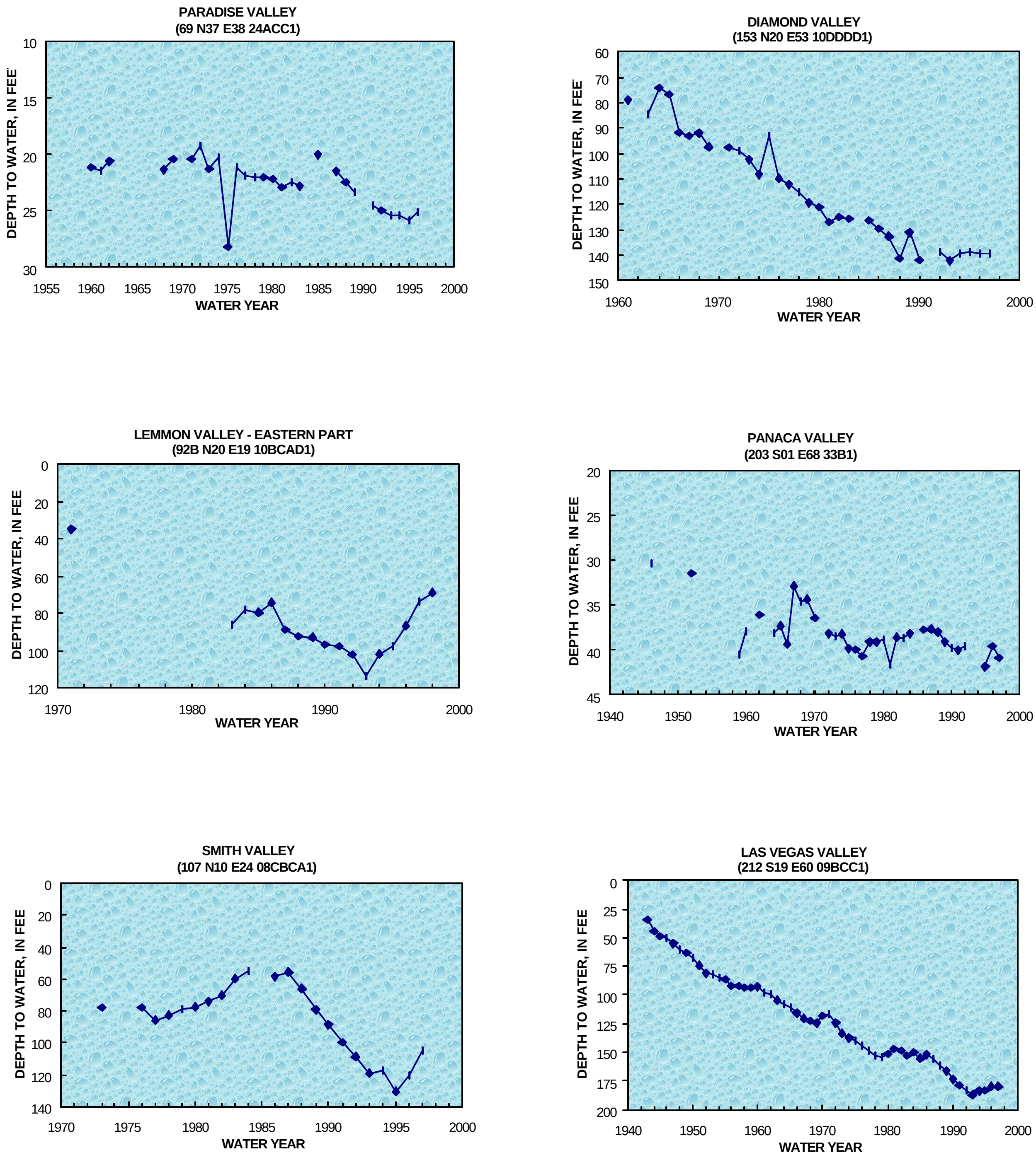
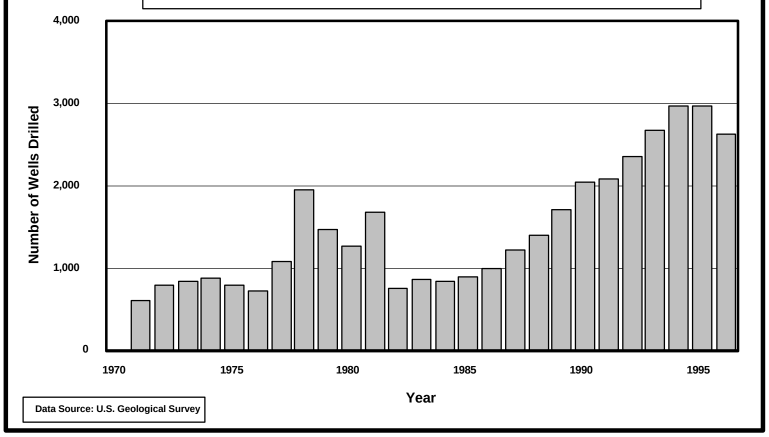


Fig. 4-19. Long-term Water Levels in 6 Selected Wells

As shown on Figure 4-19, significant groundwater level declines have occurred in Diamond Valley. In response, the State Engineer has designated the basin and has taken actions to reduce total pumpage in the basin. Las Vegas Valley has also experienced significant groundwater level declines (Figure 4-19) due to overpumpage. Another result of overpumping groundwater is the reduction of artesian pressures in the aquifer, which leads to the compaction of aquifer materials and to land surface subsidence. Subsidence in the Las Vegas Valley has been monitored since 1935. Since that time, the land surface has subsided over five feet in many areas of the valley. A number of actions have been taken to address the basin overdraft and subsidence problems. Starting in 1987, the Las Vegas Valley Water District began an artificial recharge program to temporarily store Colorado River water in the principal aquifer during times of lower water use. The State Engineer has designated the basin and has taken actions to reduce pumpage in the basin. In 1997 the Nevada State Legislature created a Las Vegas Valley Groundwater Management Program for the oversight, protection and stabilization of the basin's groundwater supply.

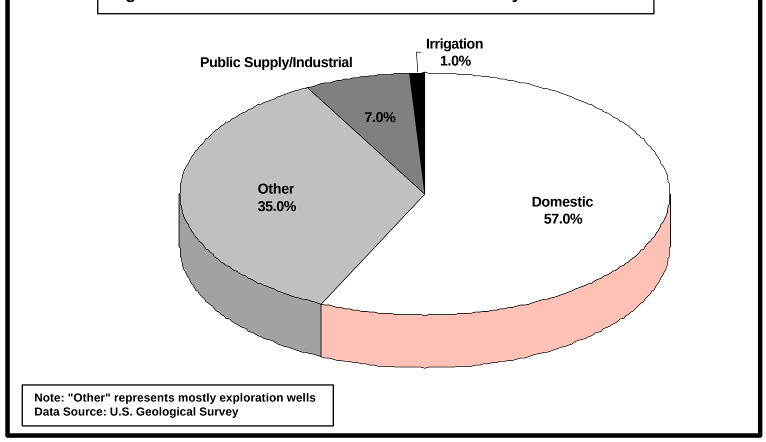
<u>Well Logs.</u> Since the 1940s, well logs have been submitted to the State Engineer's Office. These well logs include a variety of information such as: well location, drilling method, proposed use, well depth, and depth to water. Examination of these logs indicates that groundwater development in Nevada has continued to expand over the years. Figure 4-20 displays the increase experienced in the number of wells drilled annually from 1971 to 1996. In 1996, there were approximately 2,632 new wells drilled in Nevada. Of this total, about 1,500 wells were for domestic uses and about 900 were exploration wells (Figure 4-21). In 1996 the well drilling was concentrated in the north-central, northwestern, and southern parts of the State.

Fig. 4-20. Number of New Wells Drilled from 1971-96



In 1994, NDWR and USGS cooperatively developed a computer database for managing the well log information. Currently, the database contains information on approximately 50,000 wells in Nevada. The database does not contain any detailed information on the subsurface geology.

Fig. 4-21. Distribution of Wells Drilled in 1996 by Use



Groundwater Quality

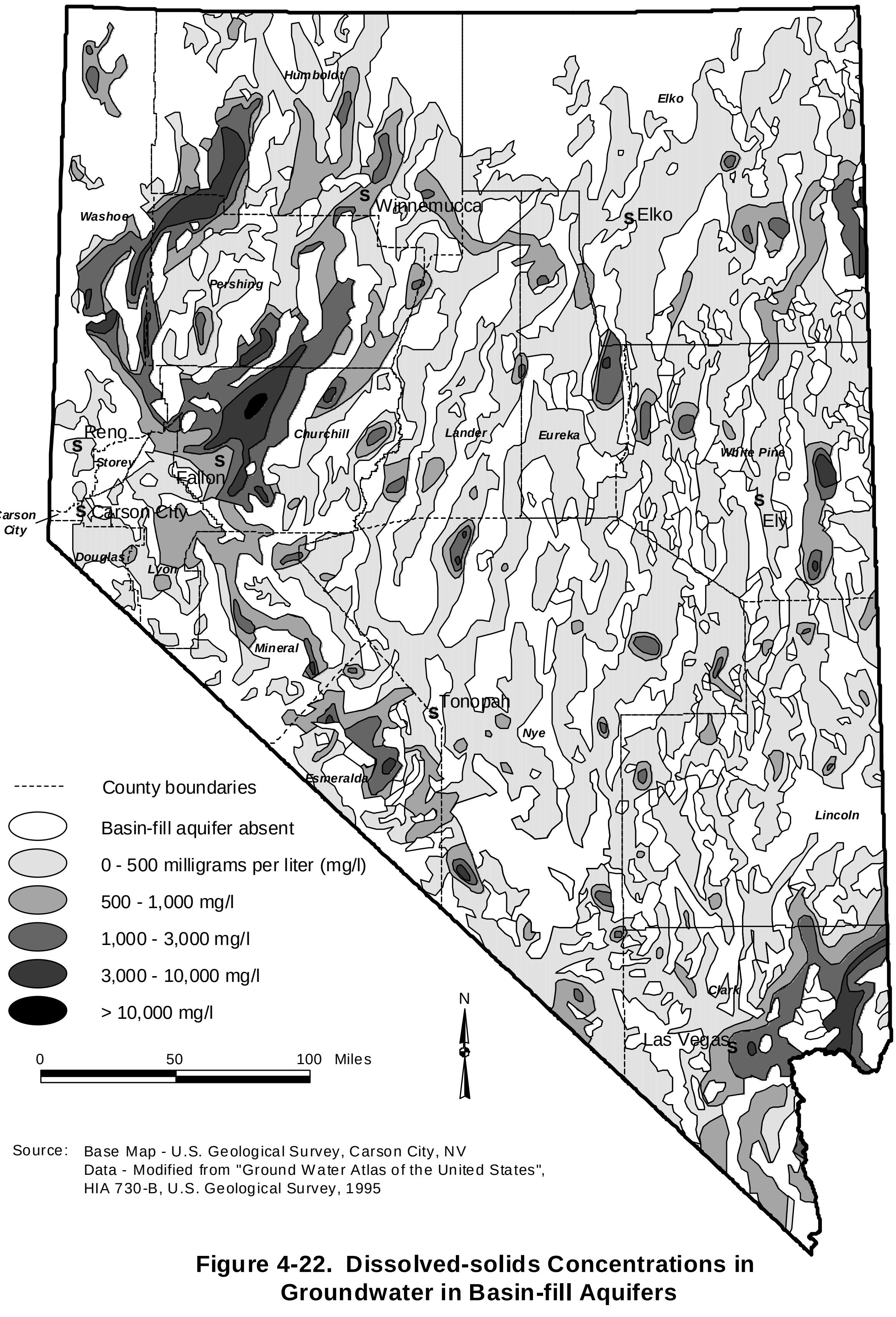
The quality of water from most aquifers in Nevada is suitable or marginally suitable for most uses. Most aquifers contain water with a majority of the constituent concentrations not exceeding State and national drinking water standards. However, there are parts of some aquifers with constituent concentrations exceeding these standards. It is important to realize that these excessive concentrations of certain constituents in groundwater may result from both natural processes and/or human activities.

The quality of groundwater in the unconsolidated deposits in the Basin and Range alluvial aquifers varies from basin to basin. Dissolved-solids concentrations range from less than 500 parts per millions (ppm) to more than 10,000 ppm in some areas (Figure 4-22). By comparison, ocean water has dissolved-solids concentrations of about 35,000 ppm. Locally, saline water is present near thermal springs and in areas where the basin-fill aquifers include large amounts of soluble salts. In discharge or sink areas such as the Carson and Humboldt sinks, the dissolved-solid concentrations can make the water economically unuseable. Although highly mineralized water is common in aquifers beneath playas, a deeper freshwater flow system may be present in some areas.

Groundwater Quality Management and Data Collection. Groundwater quality is regulated by NDEP and the SEC. Certain aspects of the Federal Clean Water Act and the Safe Drinking Water Act are implemented by NDEP within Nevada. Groundwater quality is monitored by NDEP, and other State and Federal agencies. However, there is no ambient groundwater quality monitoring network in Nevada as there is with the surface water resources. Most of the available groundwater quality data are the result of special studies in specific areas, monitoring required by State permitting programs and by drinking water regulations. For instance, NDEP may require groundwater monitoring for groundwater discharge permits issued for industrial plants, land applications of treated sewage effluent, and geothermal injection wells. Groundwater monitoring also may be required in response to suspected contamination, such as mining sites or leaking fuel tanks.

Other NDEP activities include the development of the Comprehensive State Ground Water Protection Program (CSGWPP) and the Wellhead Protection Program (WHPP). NDEP initiated the CSGWPP to protect groundwater resources throughout Nevada and has received EPA endorsement on the program. The WHPP is intended to protect existing and future municipal groundwater resources. For a more complete description of NDEP water quality programs, refer to Part 1, Section 3 of the *State Water Plan*.

All community water systems are required to monitor water quality under the Federal Safe Drinking Water Act and State law for both groundwater and surface water systems. The State Health Division, Bureau of Health Protection Services, uses these data to check for compliance with the drinking water standards.



Source: Base Map - U.S. Geological Survey, Carson City, NV
Data - Modified from "Ground Water Atlas of the United States", HIA 730-B, U.S. Geological Survey, 1995

Figure 4-22. Dissolved-solids Concentrations in Groundwater in Basin-fill Aquifers

Another significant source of groundwater quality data is the USGS. The USGS undertakes a wide range of special studies in specific basins which results in the collection and compilation of groundwater quality data. As of 1996, the USGS is collecting water quality data for 111 wells within 11 of the 256 hydrographic basins. As stated above, most groundwater monitoring is short-term and site specific in response to a particular problem. This lack of continuous, long-term groundwater quality data makes any trend assessments a difficult proposition. In response to the lack of long-term, consistent information on water quality nationwide, the USGS developed the National Water-quality Assessment (NAWQA) Program. NAWQA Program goals are to describe the status and trends in the quality of the Nation’s water resources and to provide scientific understanding of the major factors that affect surface and ground water quality. The Nevada NAWQA Project began in 1991 and includes the Las Vegas Valley area and the Carson and the Truckee River Basins. Project scientists are using multi-disciplinary approaches to compare and contrast the effects of urban and agricultural activities on water quality.

Nevada State Water Plan
PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 5
Socioeconomic Background

Introduction

This section of the *Nevada State Water Plan* provides an overview of demographic and economic characteristics and trends within the State of Nevada. Nevada's seventeen counties have shown considerable variation in their population s growth rates and other economic conditions. To facilitate a better understanding of these county-specific conditions and trends, individual county socioeconomic overviews have been compiled as stand-alone publications in support of the state water plan.

Nevada's present and future water needs can only be determined in concert with a thorough understanding of the trends in the state's population growth and economic prospects. This overview of Nevada's socioeconomic characteristics is intended to provide the baseline information upon which future water demands can be determined. By analyzing and combining economic conditions and water usage patterns with forecasts of future socioeconomic trends, a more accurate picture of Nevada's future water use needs can be derived.

Early Settlement Patterns, Economic Pursuits and Population Trends

Nevada's earliest European settlements served the needs of the first emigrant wagon trains traveling to Oregon and California. In the 1850's, in the northern part of the state, water diversions for irrigation originated along the Humboldt, Carson, Truckee and Walker rivers to facilitate increased agriculture production, making this the state's first and longest lasting industry. In the southern part of the state, the city of Las Vegas and the valley in which it lies were named for the lush meadows supported by natural artesian springs. The first organized water diversion and irrigation efforts in the state was recorded in the Las Vegas Valley, where early Mormon colonists began diverting the flow of Las Vegas Creek for agricultural purposes.

Later, in the 1860's, the early discoveries of Nevada's vast mineral wealth, particularly with the Comstock Lode (Storey County), Aurora (Mineral County) and Bodie (California), led to an expansion of agriculture and ranching endeavors in Smith and Mason valleys (Lyon County). Carson Valley (Douglas County) and Stillwater (Churchill County) also became important agricultural centers for the early influx of miners. A virtual explosion in population took place in Nevada's various mining districts. Water, and particularly its availability and use, soon influenced Nevada's growth patterns. Early in Nevada's development, water-rights conflicts arose among the mines and ore-processing mills, the loggers and lumbermen, and the state's agricultural interests.

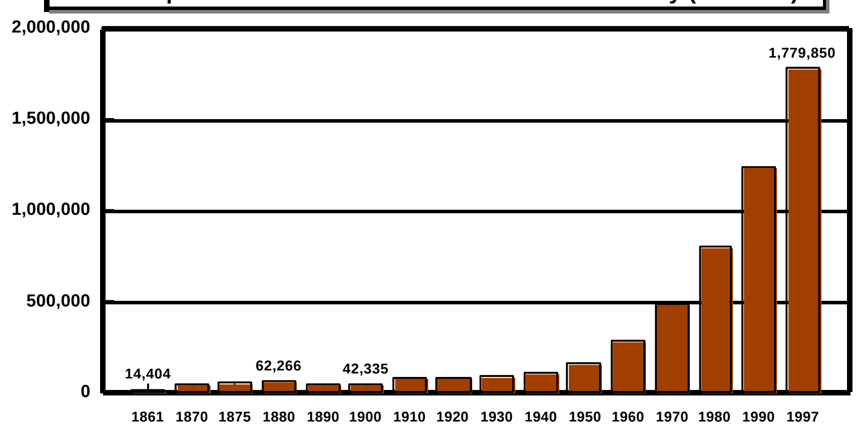
On November 25, 1861, the Nevada Territory was separated from the Utah Territory and the first Nevada Territorial Legislature met in Carson City and carved nine counties out of the newly created territory — Churchill, Douglas, Esmeralda, Humboldt, Lyon, Ormsby (later Carson City), Storey, Washoe and Lake counties. Just over a year later Lake County, which comprised the northern portion of present-day Washoe County, was renamed Roop County, and finally, in 1883, it became incorporated into Washoe County. At its inception, Esmeralda County comprised virtually four-fifths of the area of the new Territory of Nevada, with the remaining eight counties clustered in the northwestern portion of the state. Eventually, Esmeralda County was whittled down, ultimately resulting in the creation of an additional eight counties for Nevada.

While Nevada was still a territory, both Lander County (1862) and Nye County (1864) were created out of Esmeralda County. After statehood was obtained on October 31, 1864, Lincoln County, named after the President who supported Nevada's entry into the Union, was formed in 1866 out of Nye County. Then, in 1869, Elko and White Pine counties were created out of Lander County, as was Eureka County in 1873. Later, in 1908, Clark County was formed out of the southern portion of Lincoln County, Mineral County was formed in 1911 out of Esmeralda County, and finally, rounding out Nevada's present 17 counties, Pershing County was formed in 1919 out of the southern portion of Humboldt County. (See the Nevada and county map on the inside of the front cover.)

Based on a special territorial census conducted in 1861, Nevada's population was recorded at 14,404 persons, with the greatest portion, or 4,581 persons, residing in and around Virginia City (Storey County). By the 1870 census, Nevada's population had risen dramatically to 42,491 persons, of which 11,359 inhabitants, or 27 percent of the state's total, were located in Virginia City and its environs, and 7,189 persons, or another 17 percent of the state's total population, were located in and around Ely in White Pine County. These constituted the two principal mining centers in the state at that time. Meanwhile, Reno's (Washoe County's) population of only 3,224 persons comprised less than eight percent of the state's total population, while Las Vegas (Clark County) was still part of Lincoln County (1870 population of 2,985) and would not come into its own until 1908.

Fig. 5-1. Nevada Historical Populations

State Populations from Formation of Nevada Territory (Persons)



Sources: Nevada Historical Society; Nevada State Demographer.

By 1875 the state's population had grown to 52,630 persons and that of Virginia City, mirroring the fortunes of the Comstock Lode silver mining boom, had peaked at 19,528 residents, comprising over 37 percent of the state's total population.

By 1877, however, the era of the Comstock mines was beginning to wane. While mining efforts in this area continued at a far reduced scale for another 20 years, the last of the great bonanzas, uncovered in 1875, steadily and gradually played out after 1880. By the time of the 1880 census, the state's population had risen to 62,266 persons, although with the decline of the Comstock, Virginia City's population, at 16,155 persons, had begun its inevitable decline.

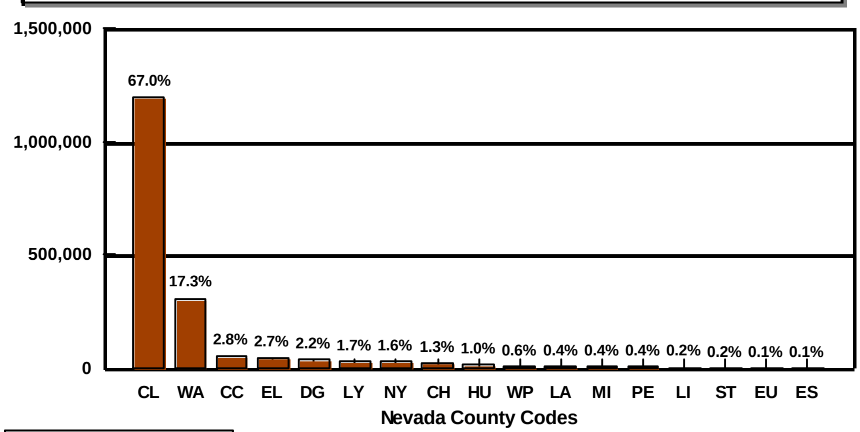
By the turn of the century, the collapse of the mining industry produced the state's Great Depression of 1880–1900, reducing Nevada's population to 42,335 persons in 1890, down nearly 20,000 persons and 32 percent from that recorded in 1880 (see Figure 5–1). The temporary demise of Nevada's mining industry led to profound population contractions throughout the state with almost 16,000 persons abandoning the Comstock mining area alone. As a result, by 1900 only 3,673 persons remained in Virginia City to work the mine tailings and eke out an existence as best they could. This exodus from the Comstock continued virtually unabated and by 1930 less than 700 persons remained in the town that had, quite literally, secured a place for Nevada in the Union.

Nevada's 1900 census of population showed that Reno, located along the Truckee River, had become the dominant socioeconomic center of the state, a distinction it would not relinquish until late in 1950 to Las Vegas. Reno's 9,141 residents recorded in the 1900 census accounted for almost 22 percent of Nevada's total population. The other two large communities were Winnemucca, located along the Humboldt River and the path of the Central Pacific Railroad, which accounted for 4,463 of the state's population, and Elko, with 5,688 residents. Together, these three large agriculture-based economies — Reno, Winnemucca, and Elko — strategically located along both river systems and rail routes, accounted for over 45 percent of Nevada's 42,335 total residents in 1900. Interestingly, some 30 years before this time, the two major mining areas of the state — Virginia City and Ely — had comprised an identical 45 percent of the state's total population. By 1890, however, their share of Nevada's total resident population had fallen to only 13 percent, and would eventually fall to less than one percent by 1997. It was not the last time that mining in Nevada so abruptly altered the socioeconomic patterns and fortunes of a region.

New mineral discoveries and massive infusions of capital and labor brought Nevada back to its feet and effectively ended the state's 1880–1900 Great Depression. On May 19, 1900, an erstwhile miner named Jim Butler discovered a promising outcrop of ore in the desert of southwestern Nevada. Initial assays revealed over 640 ounces of silver and $200 of gold per ton. The rush

Fig. 5-2. Nevada Population Shares by County

Population Estimates and Shares as of July 1, 1997 (Persons/Percent)



Source: Nevada State Demographer.

was on to the Goldfield Mining District and the cycle of prosperity, so reminiscent of the Comstock era, provided an unexpected boon to the state. During the 1900 census, Goldfield's (Esmeralda County) population was recorded at only 1,972 persons. Within five years, this isolated mining community had swelled to between 25,000 and 30,000 persons and was by far the largest community in Nevada. Nearly just as quickly, however, the Goldfield mining boom began its inevitable downward spiral. Goldfield's population fell to 9,369 persons by 1910 and then to only 2,410 persons by the time of the 1920 census, fewer than had been recorded during the 1880 population census of Esmeralda County. Such extreme variations in population would come to characterize early mining in Nevada. Thirty miles to the north of Goldfield, the town of Tonopah (Nye County) also boomed from local gold discoveries, with its population exploding from just 1,140 persons in 1900 to 7,513 persons by 1910.

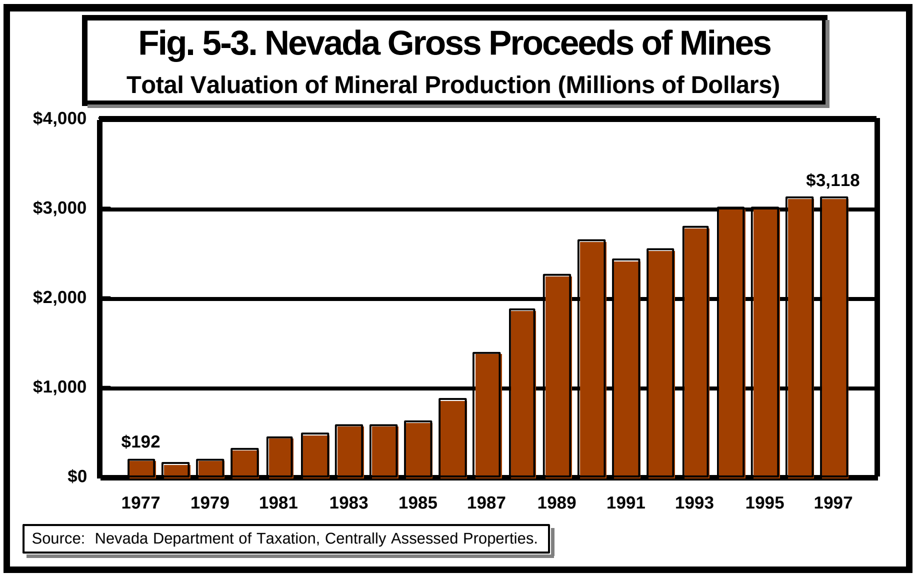
As further evidence of Nevada's extensive mineral wealth, promising gold deposits were discovered north of Carlin in Eureka and Elko counties in 1907. However, many decades would pass before precious metal prices and advancements in mining extraction and milling technology allowed for the extensive development and cost-effective mining of this vast, but relatively low-grade region of ore, later to be called the "Carlin Trend".

The Development of Modern Nevada

After the last of the great gold rushes in central Nevada, events began to take place that were destined to dramatically shape Nevada's future and lay the foundations for solid economic growth and prosperity. After an absence of 21 years, gambling again became legal in the State of Nevada on March 19, 1931. At that time, probably few could foresee the far-reaching impacts that the legalization of gaming would have on the state's future socioeconomic development, the fiscal structure of the state, water-use patterns and consumption rates, and the economic prosperity of its citizens. While showing modest growth through the Great Depression era and World War II, after the war the industry began to expand rapidly based largely on improved transportation infrastructure and a more mobile and affluent population.

The development of Nevada's gaming industry since WWII has been complemented by a diversification into other business endeavors as well, most notably warehousing, transportation, manufacturing and distribution. Early railway development was enhanced by Nevada's strategic location and access to the large urban markets of California, Oregon, and Washington, and public warehousing gained a natural foothold in Nevada. Legislative support for these industry pursuits came in the form of a 1949 law granting tax-exempt status to stored personal property awaiting interstate or international transshipment. In 1969, the "Freeport Law" was enhanced further by including "manufacturing" in the list of freeport-allowable processes and interpreting "processing" to include the feeding, watering, and slaughter of livestock. This law has proven to be instrumental in the continued growth and diversification of Nevada's economy.

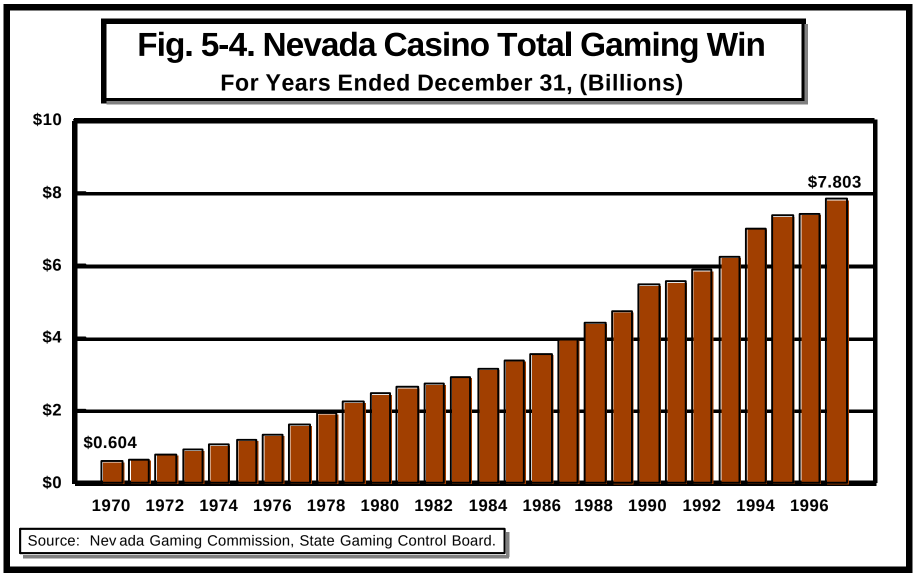
Based upon Nevada's growing emphasis on gaming, tourism, warehousing and manufacturing, by 1960 nearly 75 percent of Nevada's population of 285,278 inhabitants lived in either Las Vegas with 127,016 persons (45 percent of the total population), or Reno with 84,743 persons (30 percent of the total population). By the 1970 census, Nevada's population stood at 488,738 persons, of which 56 percent resided in Las Vegas and 25 percent were located in Reno. These two metropolitan areas now accounted for almost 81 percent of Nevada's total population.



By the late 1970's and early 1980's, the combination of national inflation, recession, and economic uncertainty had significantly elevated the price of gold and fostered a new resurgence in Nevada mining activities. Although gold had first been discovered along the "Carlin Trend" in 1907, it took the combination of high prices and advanced technology in the extraction and milling processes to promote the extensive development of these new mining operations. Today, the Carlin Trend constitutes Nevada's richest gold deposit and covers a vast area of north-central Nevada, running in approximately a northwesterly direction from Carlin, in Elko County, through the northeast corner of Eureka County, and back into Elko County (see Figure 5–3).

Major expansions in the state's gaming and tourism industry continued through the 1970's, 1980's and especially in the 1990's, when a new paradigm of Nevada casino, the mega-resort hotel and entertainment complex, became evident along the Las Vegas Strip. These full-featured casino, resort, and entertainment complexes firmly established the Las Vegas market as the premier destination resort location in the world, enticing over 30 million visitors in 1997 to the many-varied features (see Figure 5–4). After the severe national recession of 1980-82, which had noticeable effects on the state's gaming industry, the state's political leaders reinforced Nevada's commitment to economic diversification through the creation of a Commission of Economic Development and financial support of regional economic development authorities. With the state's economy and fiscal sources of revenues critically dependent on the health of the casino gaming industry, the state's diversification efforts ably served to present "the other side of Nevada."

During the late 1990's, effective marketing of the state's tourism and gaming attractions, combined with the continued promotion of diversified business interests, made Nevada the fastest growing state in the nation. By 1997, Nevada's resident population was estimated to have reached nearly 1.8 million persons, a considerable expansion from the 14,404 persons recorded in the first special territorial census taken in 1861. This overall growth equated to an average increase of nearly 13,000 persons per year over each of these 136 years. Furthermore, since 1950, Nevada's population has increased by an average of approximately 34,500 persons per year during the last 47 years. Of the total 1997 estimated population of 1,779,850 persons, 1,192,200 persons, or 67.0 percent, were estimated to be living in Las Vegas, and 308,7000 persons, or 17.3 percent, were living in Reno. Together, these two areas now account for over 80 percent of Nevada's total population. Adding the other principal urban areas of Carson City (50,410 residents) and City of Elko (19,670 residents), produces an urban population concentration in Nevada of over 88 percent (see Figure 5–2).

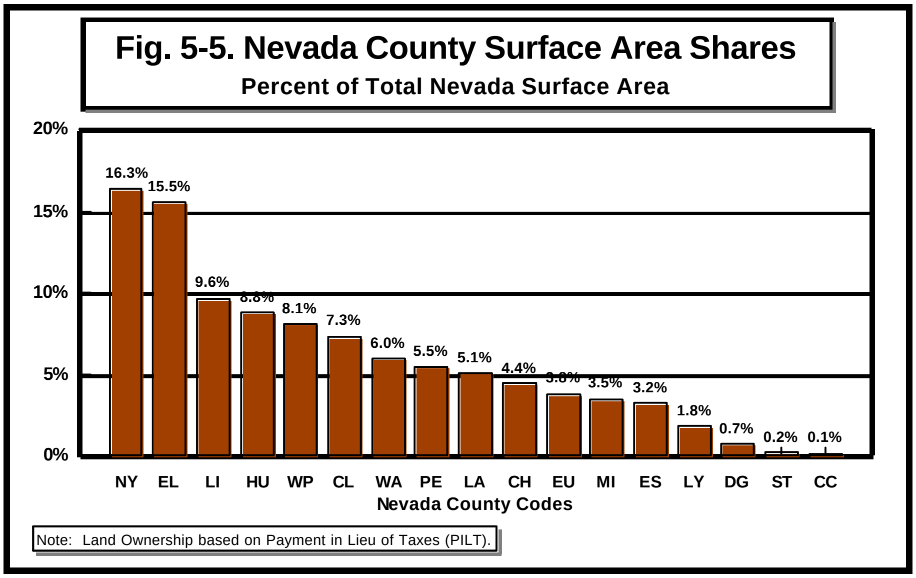


But growth in Nevada and in particular the high rate of growth, has put severe strains on the state's resource requirements, particularly water. The state's infrastructure needs, social service requirements, police and fire protection, environmental conditions, and overall quality of life have also been affected. While some of the problems related to this rapid growth may be overcome or mitigated with judicious and timely legislation and more effective planning, others may become long-term situations that Nevada's residents in these rapidly growing areas will just have to accept. Despite the issues that growth raises, many believe that growth, appropriately planned and managed, must continue if the state, and its fundamental economic sectors, are to remain competitive and viable.

Geography, Land Ownership, and County Relationships to Hydrographic Regions

Nevada is situated in the western United States and is bordered by the State of California to the west and south; the states of Oregon and Idaho to the north, and the states of Utah and Arizona to the east. The Colorado River serves as Nevada's southeastern border with part of Arizona.

Nevada is divided into sixteen counties and one incorporated city, Carson City, the state's capital and the former Ormsby County. Nevada has a total surface area of 110,540 square miles and is the seventh largest state in the nation. Figure 5–5 shows county shares of Nevada's total area. From this graph we may see that just two counties — Nye and Elko — account for nearly one-third of Nevada's total area. The relationship between county populations and areas can be seen in Figure 5–9, which shows the population densities in persons per square mile using 1997 population figures. Nevada's overall topography is characterized by basins and ranges consisting of isolated mountain ranges with intervening long and relatively narrow valleys. Most of Nevada, totaling approximately 93,000 square miles, lies within what is called the Great Basin, in which all surface waters drain inward to terminal lakes, sinks, or playas. The highest point in the state is Boundary Peak (13,140 feet above mean sea level, or MSL), located in the Sierra Nevada Mountains in Esmeralda County and along the border with California. The lowest elevation in the state is 490 feet (MSL) and is located in the southernmost tip of the state along the Colorado River.



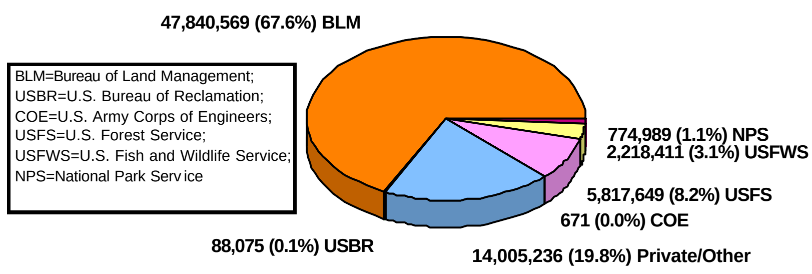
Nevada is the driest state in the nation in terms of its average annual rainfall. While the state is characterized by a number of high mountain ranges, much of the precipitation driven by the jet stream and coming off the Pacific Coast is blocked by the rain shadow effect of the Sierra Nevada Mountains which lies along Nevada's western border. Other precipitation entering the state typically comes in from the north and east, affecting the Ruby, Jarbidge, Independence, and East Humboldt mountains in Elko County in northeastern Nevada, and from wet tropical storm systems driven up from the south into Clark County and the Las Vegas area. The seasonal nature of the state's precipitation, combined with its highly uneven nature, has required the extensive use of dams, reservoirs, lakes and diversion structures to trap the from the mountains in the spring and supply water for irrigation during the growing season and livestock and municipal purposes throughout the year. Groundwater pumping has also proven an increasingly important source of water, particularly for domestic purposes.

Of Nevada's 70,745,600 acres of surface area, 56,740,364 acres, or over 87 percent of the state's total area are managed and controlled by the federal government. Of these federally-managed public lands, approximately 47,840,569 acres are managed by the U.S. Bureau of Land Management (BLM); 5,817,649 acres are managed by the U.S. Forest Service (USFS); 2,218,411 acres are managed by the U.S. Fish and Wildlife Service (USFWS); 774,989 acres are managed by the National Park Service (NPS); 88,075 acres are managed by the U.S. Bureau of Reclamation (USBR); and 671 acres in Lincoln County are controlled by the U.S. Army Corps of Engineers (COE). Another 1,114,521 acres of the state lie within Indian Reservations and are held in trust by the Bureau of Indian Affairs (BIA). The state owns 264,166 acres. Relative to other states in the nation, Nevada has the highest percentage of federally-managed public lands. Figure 5–6 presents the areas and shares of the state's total area that is owned or managed by various entities. This graph is based on the "Payment in Lieu of Tax System (PILT)" and includes only those lands specifically withdrawn for public use for which the federal government pays taxes to the state.

The U.S. Geological Survey (USGS) and the Nevada Division of Water Resources (DWR), Department of Conservation and Natural Resources, have divided the State of Nevada into discrete hydrologic units for water planning and surface and groundwater management purposes. These have been identified as 232 hydrographic areas (256 hydrographic areas and sub-areas, combined) within 14 major hydrographic regions or basins. These fourteen hydrographic regions (basins) and their 256 hydrographic areas and sub-areas, and their relationship to Nevada's seventeen counties are presented below and in the map which follows.

Fig. 5-6. State of Nevada Land Ownership

1997 County Ownership Shares (Acres/Percent Total State)



Note: Land Ownership based on Payment in Lieu of Taxes (PILT).

[1] ***Northwest Region*** — Covers 3,052 square miles (7,905 square kilometers or 1,953,280 acres) of northern Washoe and Humboldt counties and encompasses 16 hydrographic areas; extends into the State of California to the west and the State of Oregon to the north;

[2] ***Black Rock Desert Region*** — Covers 8,632 square miles (22,357 square kilometers or 5,524,480 acres) of parts of Washoe, Humboldt, and Pershing counties and includes 17 hydrographic areas, two of which are divided into separate hydrographic sub-areas; extends into the State of California to the west and the State of Oregon to the north;

[3] ***Snake River Basin*** — Covers 5,230 square miles (13,546 square kilometers or 3,347,200 acres) in parts of Elko and Humboldt counties and includes eight hydrographic areas; extends into the states of Oregon and Idaho to the north and the State of Utah to the east;

[4] ***Humboldt River Basin*** — Covers 16,843 square miles (43,623 square kilometers or 10,779,520 acres) in parts of eight counties — Elko, White Pine, Eureka, Humboldt, Lander, Nye, Pershing, and Churchill — and the largest river (Humboldt River) wholly contained within Nevada. This basin contains 34 hydrographic areas and one hydrographic sub-area and is one of only two that are wholly contained within the State of Nevada. It originates in the Ruby, Jarbidge, Independence, and East Humboldt Mountain ranges (Elko County) and terminates in the Humboldt Lake and Sink (Pershing and Churchill counties). During particularly wet years, the Humboldt Sink may drain into the Carson Sink by means of the Humboldt Slough;

[5] ***West Central Region*** — Covers 1,656 square miles (4,289 square kilometers or 1,059,840 acres) and includes parts of Pershing, Lyon, and Churchill counties and comprises five hydrographic areas. This basin is one of only two waterbasins that are wholly contained within the State of Nevada;

[6] ***Truckee River Basin*** — Encompasses 2,300 square miles (5,957 square kilometers or 1,472,000 acres) containing parts of Washoe, Pershing, Churchill, Lyon, Douglas,

Carson City, and Storey counties comprising 12 hydrographic areas; originates in the Sierra Nevada Mountains, the State of California and the Lake Tahoe Basin and terminates in Pyramid Lake (Washoe County);

[7] ***Western Region*** — Covers 602 square miles (1,559 square kilometers or 385,280 acres) and is contained only in Washoe County in Nevada; contains nine hydrographic areas, one of which is divided into two sub-areas and another into one hydrographic sub-area; extends to the west into the State of California;

[8] ***Carson River Basin*** — Covers 3,519 square miles (9,114 square kilometers or 2,252,160 acres) and includes parts of six counties—Douglas, Carson City, Lyon, Storey, Churchill, and Pershing; contains five hydrographic areas and one sub-area; has its origin to the west in the Sierra Nevada Mountains and the State of California and its terminus in the Carson Sink and Desert (Churchill and Pershing counties);

[9] ***Walker River Basin*** — Covers 3,046 square miles (7,889 square kilometers or 1,949,440 acres) of Mineral, Lyon, and Douglas counties (and a very small portion of Churchill County) and includes five hydrographic areas, one of which has been divided into three hydrographic sub-areas; has its origin to the west in the Sierra Nevada Mountains and the State of California and its terminus in Walker Lake (Mineral County);

[10] ***Central Region*** — By far the largest hydrographic region in Nevada covering 46,783 square miles (121,167 square kilometers or 29,941,120 acres) in thirteen Nevada counties—Nye, Elko, White Pine, Lincoln, Clark, Humboldt, Pershing, Churchill, Lander, Eureka, Lyon, Mineral, and Esmeralda. This region includes 78 hydrographic areas, ten of which are divided into two sub-areas and one into three sub-areas; extends to the south and west into the State of California;

[11] ***Great Salt Lake Basin*** — Covers 3,807 square miles (9,860 square kilometers or 2,436,480 acres) of the easternmost portions of Elko, White Pine, and Lincoln counties; includes eight hydrographic areas, one of which is divided into four hydrographic sub-areas; extends to the east into the State of Utah;

[12] ***Escalante Desert Basin*** — Covers a large area in Utah but only a very small part of it is in Lincoln County, Nevada—106 square miles (275 square kilometers or 67,480 acres). It is made up of only one hydrographic area; extends to the east into the State of Utah;

[13] ***Colorado River Basin*** — Covers 12,376 square miles (32,054 square kilometers or 7,920,640 acres) including parts of Clark, Lincoln, Nye, and White Pine counties and is divided into 27 hydrographic areas; extends to the south into California, borders the Colorado River to the south and east, and extends into the states of Arizona and Utah to the east;

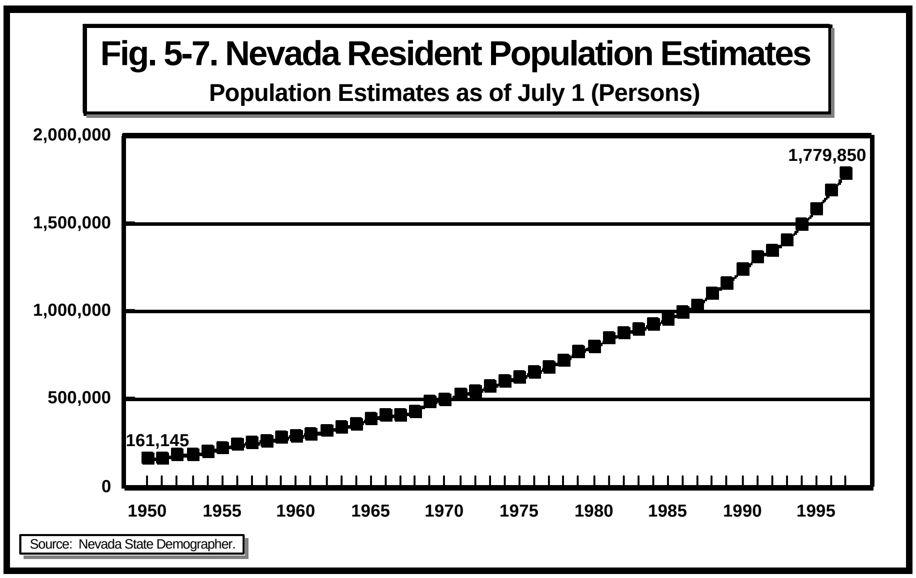
[14] ***Death Valley Basin*** — Covers 2,593 square miles (6,716 square kilometers or 1,659,520 acres) of Nye and Esmeralda counties including eight hydrographic areas, one of which has been divided into two hydrographic sub-areas; also extends into the State of California to the south and west.

The figure, Nevada Hydrographic Regions/Basins and County Boundaries, shows the relationship between Nevada's political borders, i.e., counties, and its water basins. This information, and the relationship between the political (county) designations and the watershed boundaries becomes important as water planning shifts from a county basis, as largely presented in this water plan, to a more watershed-oriented basis.

[Placement of Figure 1.5 – 1. Nevada Hydrographic Regions/Basins and County Boundaries]

Socioeconomic Characteristics

Population. Nevada's resident population was estimated at 1,779,850 persons on July 1, 1997, representing a population increase of 5.7 percent over the prior year and corresponding to an increase of 95,280 persons. During the years of 1990 through 1997, Nevada's population growth averaged 5.2 percent per year. By decade, Nevada's population has grown at an annual average rate as follows: 1950's — 6.0 percent per year; 1960's — 5.6 percent per year; 1970's — 4.9 percent per year; and during the 1980's — 4.4 percent per year (see Table 5–1). During the entire 1950–1997 time period, Nevada's population growth has averaged a rate of growth of 5.4 percent per year. Figure 5–7 presents the trend in the state's population estimates for 1950 through 1997. This graphs shows the more recent rapid rise in population since 1990, which corresponded to trends in Las Vegas (Clark County) and the completion of the first mega-resort casino properties — The Mirage and Excalibur.



Nevada's total population has grown by 72.0 percent over the most recent ten-period of 1987–1997. Over this same 10-year period, the fastest growing counties in terms of population have been Elko (96.3 percent), Clark (93.3 percent), and Nye County (81.6 percent). The slowest growing counties with respect to resident population since 1987 include Eureka (11.4 percent), Mineral (9.4 percent), Lincoln (8.4 percent) and Esmeralda County (down 5.2 percent). Other counties' 10-year population growth rates, ranked by rate of growth, include Lyon (65.6 percent), Storey (65.3 percent), Pershing (60.6 percent), Douglas (57.9 percent), Lander (52.8 percent), Humboldt (52.5 percent), Churchill (42.8 percent), Carson City (36.3 percent), White Pine (33.0 percent), and Washoe County (29.5 percent). Figure 5–8 shows annual population growth rates for 1950 through 1997.

Table 5–1. Nevada Population Estimates — 1950–1997, shows total state and individual county decennial population estimates for the years 1950 through 1990, the latest population estimate for 1997, and annual average rates of growth for each decennial estimation period and for the period of 1990 through 1997. Population growth rates declined for the three decades after the 1950's when growth averaged nearly 6.0 percent per year. However, by the 1990's, with rapid growth in the state's basic industry of gaming and tourism and the construction of mega-resort casino complexes in Las Vegas (Clark County), population growth accelerated to nearly 5.4 percent per year, a trend that is likely to carry into the early 21st century as new mega-resort complexes continue to be constructed into the year 2000 (see Figure 5–8).

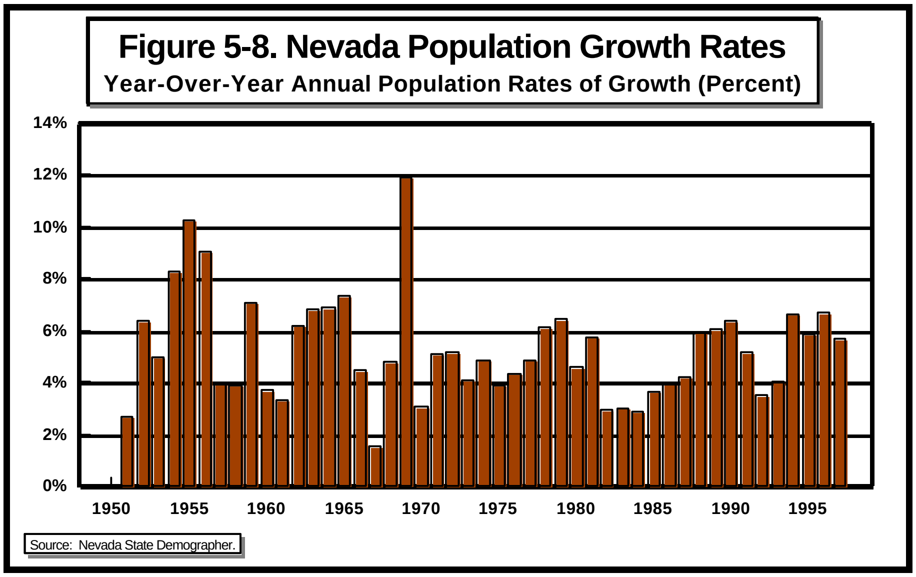
Table 5–1. Nevada Population Estimates — 1950–1997

Population Estimates by County and Period Annual Average Growth (Persons)

State/County	1950	1960	1970	1980	1990	1997
NEVADA	**161,145**	**287,660**	**494,990**	**800,508**	**1,236,130**	**1,779,850**
Annual Average Growth	—	5.97%	5.58%	4.92%	4.44%	5.35%
Carson City	4,198	8,020	16,054	32,022	40,950	50,410
Annual Average Growth	—	6.69%	7.19%	7.15%	2.49%	3.01%
Churchill County	6,188	8,505	10,650	13,917	18,100	23,860
Annual Average Growth	—	3.23%	2.27%	2.71%	2.66%	4.03%
Clark County	48,811	128,734	277,230	463,087	770,280	1,192,200
Annual Average Growth	—	10.18%	7.97%	5.26%	5.22%	6.44%
Douglas County	2,023	3,575	7,067	19,421	28,070	39,590
Annual Average Growth	—	5.86%	7.05%	10.64%	3.75%	5.04%
Elko County	11,703	12,051	13,946	17,269	33,770	47,710
Annual Average Growth	—	0.29%	1.47%	2.16%	6.94%	5.06%
Esmeralda County	611	634	623	777	1,350	1,460
Annual Average Growth	—	0.37%	-0.17%	2.23%	5.68%	1.13%
Eureka County	897	775	938	1,198	1,550	1,660
Annual Average Growth	—	-1.45%	1.93%	2.48%	2.61%	0.98%
Humboldt County	4,870	5,723	6,380	9,449	13,020	17,520
Annual Average Growth	—	1.63%	1.09%	4.01%	3.26%	4.33%
Lander County	1,860	1,580	2,653	4,076	6,340	7,030
Annual Average Growth	—	-1.62%	5.32%	4.39%	4.52%	1.49%
Lincoln County	3,850	2,378	2,526	3,732	3,810	4,110
Annual Average Growth	—	-4.70%	0.61%	3.98%	0.21%	1.09%
Lyon County	3,703	6,245	8,437	13,594	20,590	30,370
Annual Average Growth	—	5.37%	3.05%	4.89%	4.24%	5.71%
Mineral County	5,588	6,329	6,961	6,217	6,470	6,860
Annual Average Growth	—	1.25%	0.96%	-1.12%	0.40%	0.84%
Nye County	3,101	4,642	5,459	9,048	18,190	27,610
Annual Average Growth	—	4.12%	1.63%	5.18%	7.23%	6.14%
Pershing County	3,122	3,178	2,656	3,408	4,550	6,600
Annual Average Growth	—	0.18%	-1.78%	2.52%	2.93%	5.46%
Storey County	657	571	696	1,503	2,560	3,520
Annual Average Growth	—	-1.39%	2.00%	8.00%	5.47%	4.65%
Washoe County	50,484	84,988	122,574	193,623	257,120	308,700
Annual Average Growth	—	5.35%	3.73%	4.68%	2.88%	2.65%
White Pine County	9,479	9,732	10,140	8,167	9,410	10,640
Annual Average Growth	—	0.26%	0.41%	-2.14%	1.43%	1.77%

Note: Annual Average Growth Rates are measured from the preceding decennial population estimate.
Source Data: Nevada State Demographer.

Nevada shows extreme variation in its population density among its seventeen counties. Based on



1997 populations, Nevada's average population density across all counties was approximately 16.1 persons per square mile. By county, Nevada's most populous counties in 1997 were Carson City (329 persons per square mile), Clark County (147 persons per square mile), Douglas County (53 persons per square mile), and Washoe County (47 persons per square mile). At the opposite extreme, Nevada's least populous counties were Esmeralda, Eureka, and Lincoln, all with a population density of approximately 0.4 person per square mile.

Labor Force and Employment. Table 5–2. Nevada Labor Force and Employment Information, presents populations, labor force information, total employment and unemployment for the years 1970 through 1997. The labor force and employment information in Table 5–2 is based on Nevada's resident population and shows only those workers residing within the state. The labor force to population ratios provide information on Nevada's labor force participation rate, an important measure in assessing that portion of the total population either employed or actively seeking employment. Figure 5–10 presents trends in Nevada' labor force and employment over the period of 1970 through 1997 while Figure 5–11 shows the level and percent (of the labor force) of the state's unemployment for these same years.

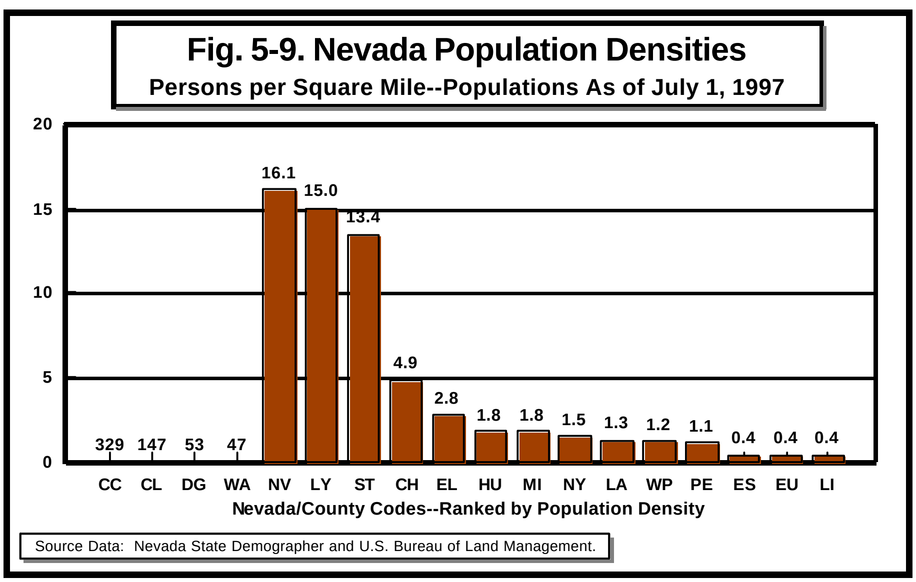


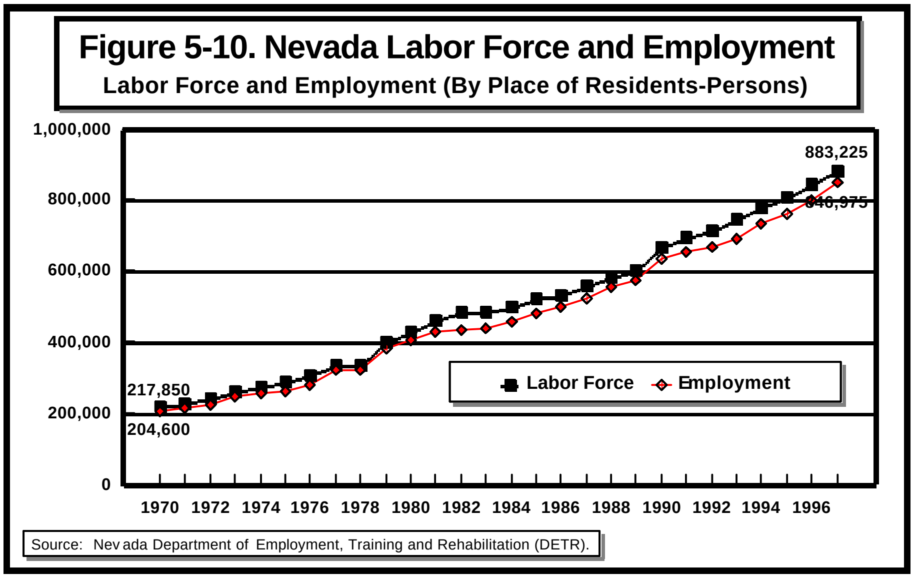
Table 5–2. Nevada Labor Force and Employment Information

1970–1997 Populations, Labor Force, Employment and Unemployment

Year	Population (Persons)	Total Labor Force (Persons)	Labor Force to Population Ratio	Total Employment (Persons)	Persons Unemployed	Unemploy. Rate (S.A.)
1970	494,990	217,850	44.0%	204,600	13,250	5.9%
1971	520,000	227,950	43.8%	211,900	16,050	7.0%
1972	546,800	241,300	44.1%	224,075	17,225	7.0%
1973	569,200	260,175	45.7%	244,125	16,050	6.1%
1974	596,700	276,125	46.3%	253,900	22,225	7.8%
1975	620,000	288,300	46.5%	260,325	27,975	9.7%
1976	646,800	304,875	47.1%	277,750	27,125	8.9%
1977	678,100	333,875	49.2%	318,725	15,150	4.5%
1978	719,300	336,875	46.8%	321,775	15,100	4.4%
1979	765,300	400,000	52.3%	379,800	20,200	5.0%
1980	800,508	429,975	53.7%	402,575	27,400	6.3%
1981	846,220	463,025	54.7%	429,875	33,150	7.1%
1982	870,970	483,000	55.5%	433,975	49,025	10.2%
1983	897,160	486,000	54.2%	437,225	48,775	9.9%
1984	922,580	500,000	54.2%	457,775	42,225	7.8%
1985	955,810	521,000	54.5%	478,450	42,550	8.1%
1986	993,220	532,025	53.6%	500,000	32,025	6.0%
1987	1,035,040	557,025	53.8%	521,475	35,550	6.3%
1988	1,096,130	583,975	53.3%	554,000	29,975	5.1%
1989	1,162,340	602,000	51.8%	571,875	30,125	5.0%
1990	1,236,130	667,000	54.0%	633,125	33,875	5.0%
1991	1,299,360	693,000	53.3%	654,850	38,150	5.5%
1992	1,345,035	715,000	53.2%	667,400	47,600	6.6%
1993	1,398,840	745,975	53.3%	691,300	54,675	7.2%
1994	1,491,490	777,525	52.1%	729,700	47,825	6.1%
1995	1,579,150	804,350	50.9%	760,950	43,400	5.4%
1996	1,684,570	844,050	50.1%	798,400	45,650	5.4%
1997	1,779,850	883,225	49.6%	846,975	36,250	4.4%

Notes: Population estimates are as of July 1st; labor force and employment are measures of the number of persons by place of residence and are based on census relationships.
Source Data: Nevada State Demographer; Nevada Department of Employment, Training and Rehabilitation (DETR), Research and Analysis Bureau.

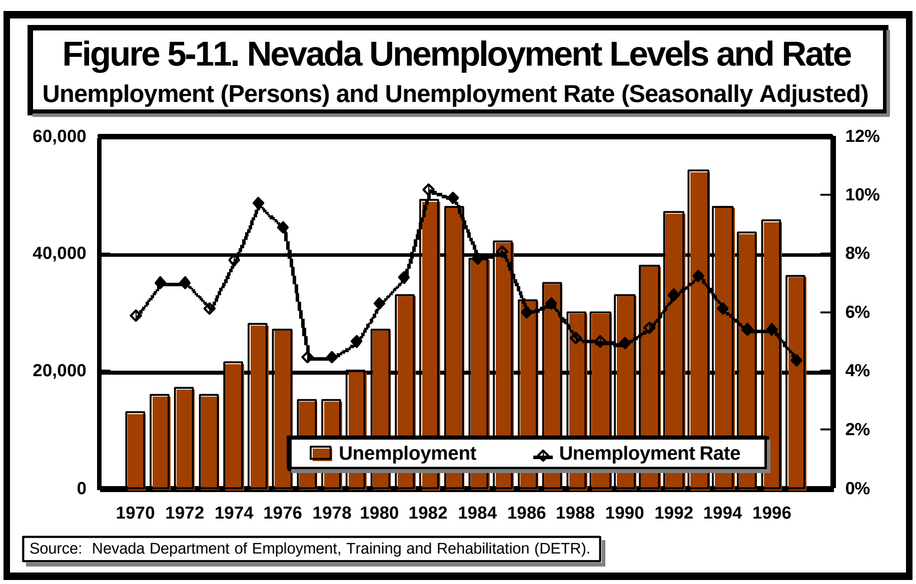
Covered Employment and Payrolls. Table 5-3. Nevada Covered Employment and Payrolls — 1997, presents Nevada's employment characteristics based on Nevada's 1997 total covered employment (i.e., workers covered under state and federal unemployment insurance programs). This table shows that of Nevada's 888,574 workers (excluding agriculture) in 1997, the 371,753 workers in the state's service industry accounted for the greatest portion of total employment at 41.8 percent. Nevada's 216,491 gaming industry jobs alone accounted for 24.4 percent of the state's total jobs in 1997. The state's service industries also accounted for the greatest percentage of total state payrolls at 38.9 percent, with gaming alone accounting for 20.4 percent of Nevada's 1997 payrolls. (See Figure 5–12 for trends in Nevada's total covered employment for 1980 through 1997.)



The highest average annual salary in Nevada in 1997 was in the mining industry which, at $49,905 per worker per year, was 74.1 percent greater than the state's average all-industry annual salary of $28,671 per worker. The lowest average annual salary was in the state's wholesale and retail trade industries, which, at $21,704 per worker per year, was only 75.7 percent of Nevada's overall average annual wage. Based on U.S. Department of Commerce, Bureau of Economic Analysis (BEA) full and part-time job classifications, the combined classification of agriculture, forestry, and fishing-related employment was estimated to comprise only approximately 1.4 percent of all jobs within Nevada in 1996 as compared to 2.1 percent of all jobs in 1970.

Table 5-3. Nevada Covered Employment and Payrolls — 1997

Covered Employment, Payrolls, and Average Annual Salaries



Industry Category	Employment (Persons)	Percent of Total Employment	Payrolls (Millions of Dollars)	Percent of Total Payrolls	Annual Average Salaries (Dollars)	Salary as a Percent of the County Average
TOTAL STATE	**888,574**	**n.a.**	**$25,476.73**	**n.a.**	**$28,671**	**100.0%**
Mining	14,663	1.7%	731.75	2.9%	49,905	174.1%
Construction	81,953	9.2%	2,907.04	11.4%	35,472	123.7%
Total Manufacturing	40,604	4.6%	1,342.50	5.3%	33,063	115.3%
Trans., Public Utilities	44,877	5.1%	1,459.20	5.7%	32,516	113.4%
Total Trade	180,425	20.3%	3,915.94	15.4%	21,704	75.7%
Finance, Insurance and Real Estate	40,338	4.5%	1,371.24	5.4%	33,994	118.6%
Service Industries	371,753	41.8%	9,906.98	38.9%	26,649	92.9%
Gaming-Related	216,491	24.4%	5,202.57	20.4%	24,031	83.8%
Total Government	104,255	11.7%	3,638.94	14.3%	34,904	121.7%
Federal Government	13,519	1.5%	572.76	2.2%	42,367	147.8%
State Government	24,974	2.8%	838.29	3.3%	33,566	117.1%
Local Government	65,762	7.4%	2,227.89	8.7%	33,878	118.2%

Note: Includes employees covered under state and federal unemployment insurance programs. Agricultural employment is not part of this employment series.
Source Data: Nevada Department of Employment, Training and Rehabilitation (DETR), Research and Analysis Bureau.

Of Nevada's principal industry sectors, the state's service industry dominates labor market and employment trends. With nearly 42 percent of all jobs in various service industries, primarily gaming related, medical and health care, and business and personal services, this industry tends to both drive and

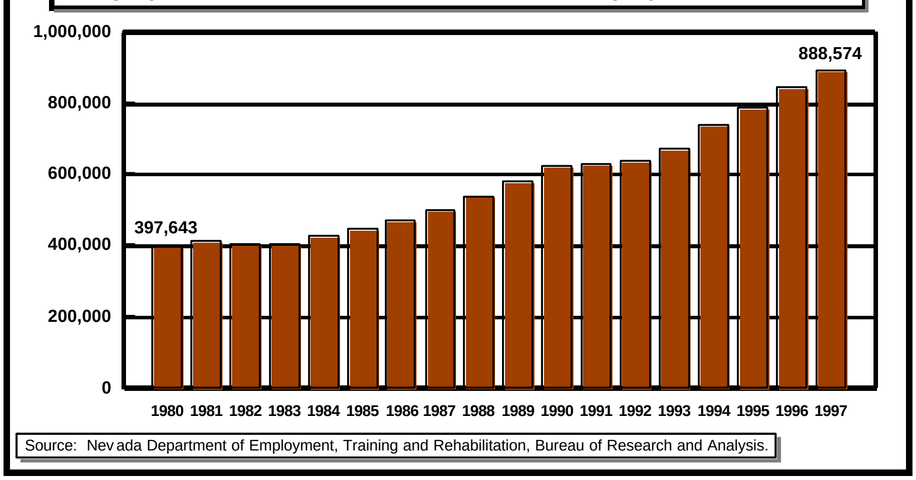
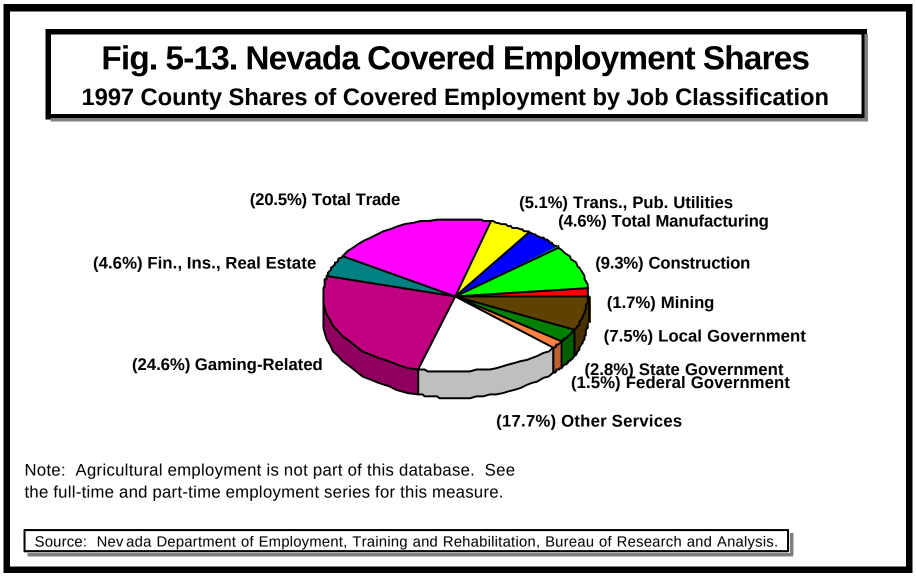


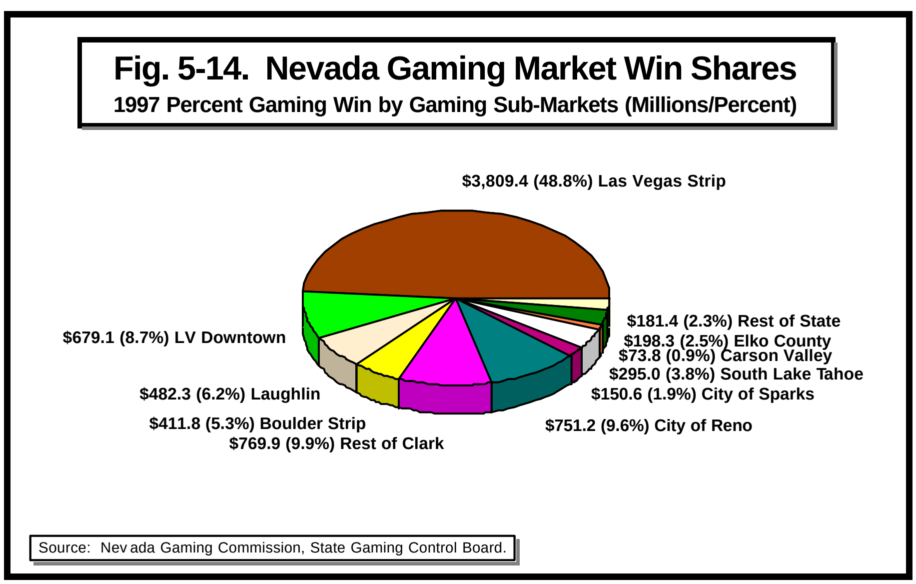
Fig. 5-12. Nevada Total Covered Employment
Employees Covered Under State/Federal Unemployment Insurance

respond to employment trends in many other sectors, particularly trade, transportation and communication, finance and real estate, and state and local government sectors. Furthermore, with the services sector, one quarter of all jobs in Nevada are employed directly in gaming and related industry sectors of amusement and recreation.



Casino Gaming. The Nevada casino gaming industry represents a fundamental underpinning of the state's economy both in terms of economic output and in terms of its fiscal effects on state and local government revenues. In addition, gaming also represents the state's major "export" industry, bringing new capital (i.e., money) into the state in terms of tourism expenditures for Nevada's gaming and tourism-related products and services. Nevada's total casino gaming win, that is, the casinos' "take" after payment of all winnings to players, was $7.803 billion in 1997 and has grown at an average annual rate of approximately 9.5 percent since 1970.

Table 5–4. Nevada Casino Gaming Win — 1970–1997, shows gaming win trends for Nevada and its principal gaming markets and sub-markets. The Nevada casino gaming industry is characterized by a number of principal gaming markets, typically delineated by county or city boundaries. Figure 5–14 presents Nevada's principal gaming markets and sub-markets and their 1997 levels of total gaming win and shares of statewide total gaming win. On a principal gaming market basis, Clark County accounted for 78.9 percent of Nevada's total gaming win in 1997, Washoe County accounted for 12.7 percent of statewide total gaming win, and the South Lake Tahoe portion of Douglas County accounted for 3.8 percent of 1997's total gaming win. Other



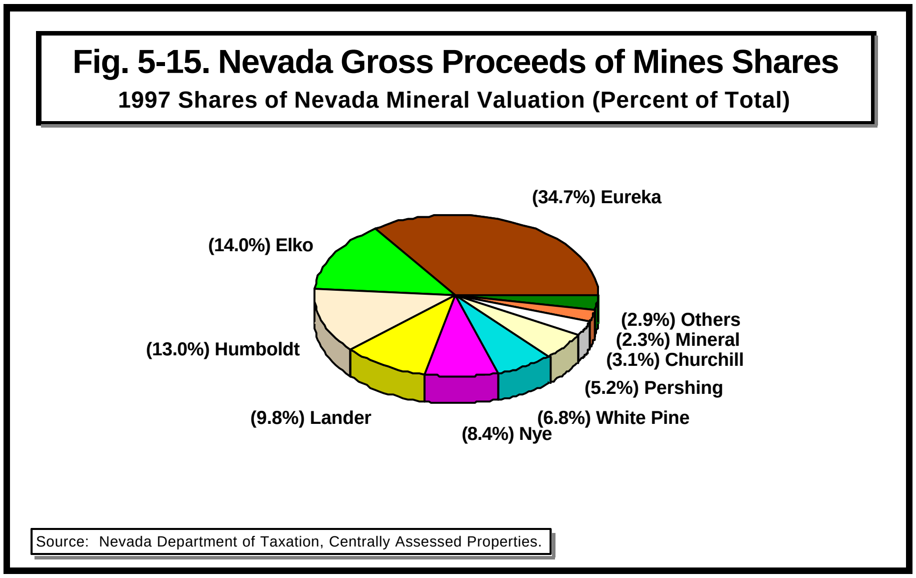
principal gaming markets in Nevada included Elko County, which accounted for 2.5 percent of the state's total gaming win in 1997, and Carson Valley, which includes Carson City and that portion of Douglas County outside the South Lake Tahoe area and accounted for slightly less than 1.0 percent of the state's total gaming win in 1997.

Table 5–4. Nevada Casino Gaming Win — 1970–1997

Total Casino Gaming Win† by Principal Gaming Market (Millions of Dollars)

Principal Gaming Market or Sub-Market	1970	1980	1990	1997	1990-97 Change in Gaming Win and Share	1990-97 Percent Change in Gaming Win
TOTAL STATE	**604.35**	**2,478.45**	**5,480.25**	**7,802.70**	**2,322.45**	**42.38%**
Clark County[1]	394.24	1,697.41	4,103.39	6,152.42	2,049.03	49.94%
Percent of Total	65.23%	68.49%	74.88%	78.85%	3.97%	
Las Vegas Strip	290.90	1,231.98	2,604.98	3,809.40	1,204.41	46.23%
Percent of Total	48.13%	49.71%	47.53%	48.82%	1.29%	
Las Vegas Downtown	91.50	348.63	676.91	679.05	2.15	0.32%
Percent of Total	15.14%	14.07%	12.35%	8.70%	-3.65%	
Laughlin	n.a.	n.a.	398.64	482.26	83.62	20.98%
Percent of Total			7.27%	6.18%	-1.09%	
Boulder Strip	n.a.	n.a.	142.14	411.79	269.64	189.70%
Percent of Total			2.59%	5.28%	2.68%	
Rest of Clark County[2]	11.84	116.80	280.72	769.93	489.21	174.27%
Percent of Total	1.96%	4.71%	5.12%	9.87%	4.75%	
Washoe County[3]	119.52	462.28	814.14	995.23	181.09	22.24%
Percent of Total	19.78%	18.65%	14.86%	12.75%	-2.10%	
City of Reno	91.72	362.12	628.02	751.21	123.19	19.62%
Percent of Total	15.18%	14.61%	11.46%	9.63%	-1.83%	
City of Sparks	n.a.	n.a.	104.04	150.64	46.61	44.80%
Percent of Total			1.90%	1.93%	0.03%	
South Lake Tahoe[4]	72.21	221.09	339.16	294.97	(44.19)	-13.03%
Percent of Total	11.95%	8.92%	6.19%	3.78%	-2.41%	
Carson Valley[5]	3.88	34.63	57.26	73.75	16.49	28.80%
Percent of Total	0.64%	1.40%	1.04%	0.95%	-0.10%	
Elko County	7.48	37.87	111.67	198.31	86.64	77.58%
Percent of Total	1.24%	1.53%	2.04%	2.54%	0.50%	
City of Wendover	n.a.	n.a.	53.39	99.83	46.44	86.99%
Percent of Total			0.97%	1.28%	0.31%	

Notes: Casino gaming win is equal to the "house hold," or the amount retained by the casino after all payouts as winnings to customers. "Percent of Total" measures each gaming market's share of Nevada's total gaming win. Principal gaming markets are presented in bold face type; gaming "sub-markets" appear in regular type. The Clark County (Las Vegas) casino gaming market consists of a number of sub-markets, the most important being the Las Vegas Strip. Others sub-markets include Las Vegas Downtown, Laughlin, Boulder Strip and the "Rest of Clark County," consisting of off-Strip properties and casinos in North Las Vegas. Carson Valley casinos include those in Carson City and Douglas County, excluding the South Lake Tahoe properties. n.a. = Gaming win data not available for these time periods.



Source Data: Nevada Gaming Commission, State Gaming Control Board.

Nevada's gaming markets are further subdivided into distinct gaming areas or sub-markets, typically based on a city or defined geographic area basis. These principal sub-markets include the Las Vegas Strip (comprising 48.8 percent of Nevada's total gaming win in 1997), Las Vegas Downtown (comprising 8.7 percent of the state's total gaming win), Laughlin (comprising 6.2 percent of statewide gaming win), Boulder Strip (comprising 5.3 percent of statewide gaming win), the city of Reno (comprising 9.6 percent of total gaming win), the city of Sparks (comprising 1.9 percent of total gaming win), and the city of Wendover in Elko County (comprising 1.3 percent of statewide total gaming win).

Mining. Table 5–5. Nevada Mining Industry Analysis — 1985–1997, presents information and trends with respect to the total valuation of minerals produced, the number of mining workers, and the productivity of mining workers for Nevada's counties principally involved in mining activities. With the exception of White Pine County, which produces gold, silver and copper, the principal output of these counties' mines is gold, with silver being a by-product. The rapid and relatively recent growth in gold mining in Nevada is clearly reflected by the trends between 1985 and 1990 (see Figure 5–3). Since that time, production has typically shown more modest gains and in some cases actually shown retrenchment in total production (e.g., Eureka and Humboldt counties).

Since the state became a territory in 1861, mining has and continues to play a crucial role in terms of the socioeconomic characteristics and trends of Nevada's more rural counties. Today, Nevada represents the largest gold producer in the United States with $2.671 billion in total gold production in 1997. The total value of all mining activity in the state in 1997 came to $3.118 billion, up slightly over 1996's total mineral production of $3.110 billion. Five Nevada counties — Eureka County (accounting for 34.7 percent of total mineral production in 1997), Elko County (14.0 percent of total production), Humboldt County (13.0 percent of total production), Lander County (9.8 percent of total production), and Nye County (8.4 percent of total production) — accounted for 79.9 percent of the state's 1997 total proceeds of mines (see Figure 5–15 for shares of mining proceeds for Nevada's major producing counties).

Table 5–5. Nevada Mining Industry Analysis — 1985–1997

Gross Mineral Proceeds, Workers, Productivity of Nevada's Principal Mining Counties
(Proceeds in Millions of Dollars; Productivity in Dollars per Worker per Year)

Mining County	1985	1990	1995	1997	1990-97 Volume Change	1990-97 Percent Change
NEVADA						
Gross Mining Proceeds[1]	$623.63	$2,635.47	$2,991.62	$3,118.09	$482.61	18.31%
Number Mining Workers	6,081	14,321	13,187	14,663	342	2.39%
Mining Worker Productivity[3]	$102,554	$184,029	$226,862	$212,650	$28,621	15.55%
Elko County						
Gross Mining Proceeds	$102.35	$238.43	$183.47	$436.31	$197.88	82.99%
Number Mining Workers	774	1,289	1,295	1,427	138	10.71%
Mining Worker Productivity	$132,235	$184,970	$141,674	$305,751	$120,780	65.30%
Eureka County						
Gross Mining Proceeds	$114.88	$789.73	$1,412.68	$1,081.39	$291.66	36.93%
Number Mining Workers	636	3,599	3,927	4,270	671	18.64%
Mining Worker Productivity	$180,633	$219,432	$359,735	$253,254	$33,822	15.41%
Humboldt County						
Gross Mining Proceeds	$31.94	$356.96	$441.82	$405.24	$48.28	13.52%
Number Mining Workers	393	1,527	2,305	2,451	924	60.51%
Mining Worker Productivity	$81,272	$233,768	$191,681	$165,338	($68,431)	-29.27%
Lander County						
Gross Mining Proceeds	$96.22	$276.03	$279.94	$304.58	$28.55	10.34%
Number Mining Workers	845	1,360	1,082	1,290	(70)	-5.15%
Mining Worker Productivity	$113,869	$202,961	$258,726	$236,110	$33,149	16.33%
Nye County						
Gross Mining Proceeds	$140.04	$500.41	$229.55	$260.90	($239.52)	-47.86%
Number Mining Workers	884	1,949	1,296	1,363	(586)	-30.07%
Mining Worker Productivity	$158,420	$256,754	$177,120	$191,413	($65,341)	-25.45%
Pershing County						
Gross Mining Proceeds	$16.12	$96.90	$111.60	$163.04	$66.15	68.27%
Number Mining Workers	195	683	682	861	178	26.06%
Mining Worker Productivity	82,688	141,869	163,639	189,367	47,498	33.48%
White Pine County						
Gross Mining Proceeds	$22.16	$98.04	$60.87	$210.65	$112.61	114.86%
Number Mining Workers	412	886	615	767	(119)	-13.43%
Mining Worker Productivity	$53,783	$110,653	$98,980	$274,636	$163,982	148.19%

[1] Gross mining proceeds measures the market valuation of mineral sales made by the Nevada mining industry.
[2] Mining worker productivity measures the total state or county gross mining proceeds divided by the respective mining employment; measured in dollars per mining worker per year.
Source Data: Nevada Department of Taxation, Centrally Assessed Properties, Division of Assessment Standards.

In 1997 Nevada mines employed 14,663 workers, accounting for 1.7 percent of the state's total employment. The Nevada mining industry paid $731.75 million in total payrolls, accounting for 2.9 percent of the state's total payrolls. Mining jobs averaged $49,905 in annual wages per worker, 74.1 percent greater than the state's all-industry average payroll of $28,671 per worker. On average, the mining worker in Nevada produced $212,650 in gross proceeds in 1997, effectively covering the average mining wage by 4.26 times. In Eureka County's gold mines, the average worker produced

$253,254 in gross proceeds in 1997, covering the average mining wage in that county by 4.80 times. Figures of mining productivity provide good measures of the viability of future mining operations with higher productivity measures also providing higher returns to producers (see Figure 5–16 for relative levels of mining worker productivity measures). While mining's impact to the major population centers is slight, a number of rural counties are critically dependent on the health of this industry sector and it will continue to be a primary driving force for those counties' socioeconomic conditions and trends.

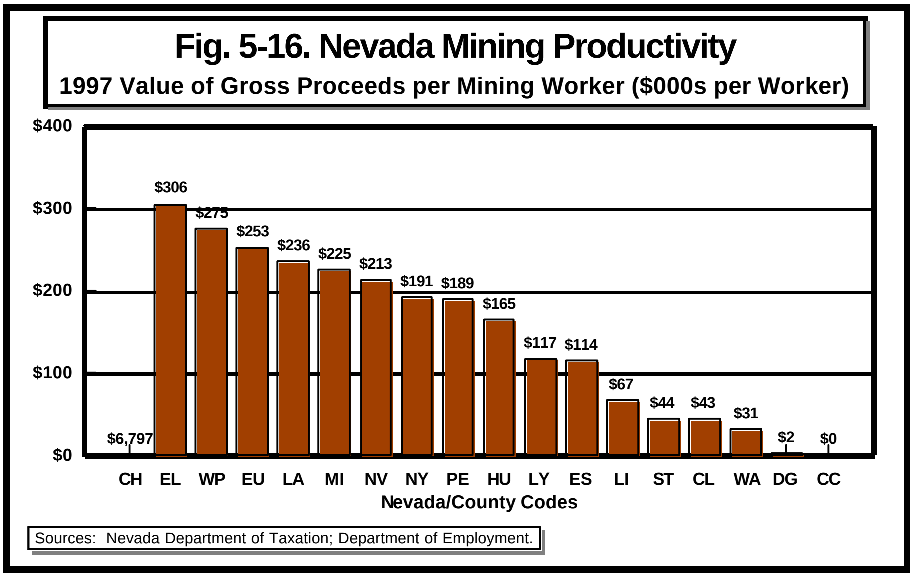


Fig. 5-16. Nevada Mining Productivity
1997 Value of Gross Proceeds per Mining Worker ($000s per Worker)

<u>Agriculture.</u> Agriculture represents one of Nevada's oldest and longest-lasting economic activities. While mining may have been responsible for the early influx of emigrants through and into Nevada between 1850-1880, as well as bringing the State of Nevada into the Union in 1864, it was agriculture that remained after the original Comstock Lode's demise in the 1870's and 1880's. It was also agriculture that persevered during Nevada's depression of 1880-1900 when the state lost nearly one-third of its population. Agriculture in Nevada continued to survive and even prosper when later mining efforts in the state went through boom and bust cycles during the early 1990's. Today, agriculture remains a fundamental socioeconomic underpinning for a number of rural Nevada counties and, no doubt, will remain an integral part of these counties' economies irrespective of current or future mining trends. Figure 5–17 shows the county shares of the state's total irrigated acreage, which was estimated at 715,439 acres in 1995.

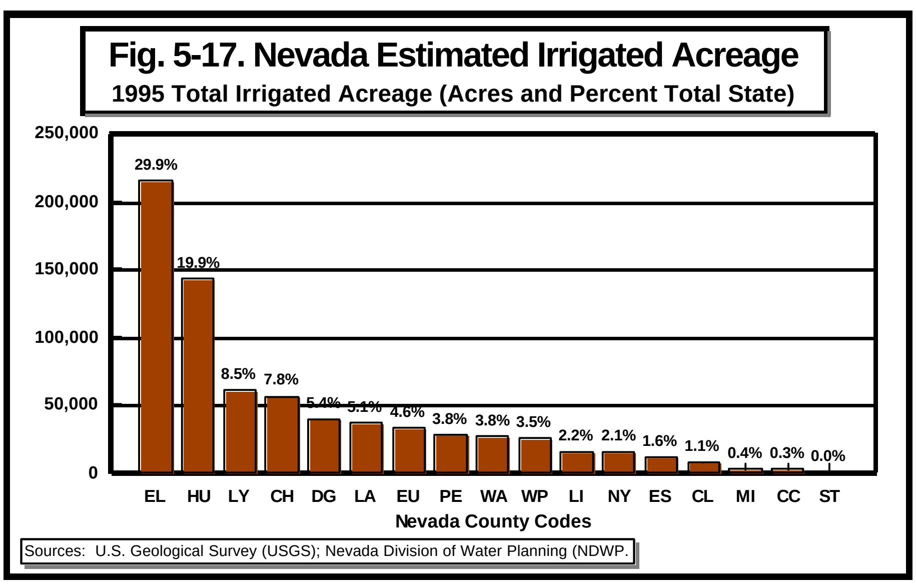


Fig. 5-17. Nevada Estimated Irrigated Acreage
1995 Total Irrigated Acreage (Acres and Percent Total State)

Table 5–6. Nevada Agricultural Statistics — 1974–1995, shows key agriculture statistics for all Nevada's counties. It appears that agriculture, in terms of total irrigated acreage, peaked in the state during the late 1970's or early 1980's. There has also been a more recent trend towards a strong statewide decline in on-farm workers and stronger growth to employment in related agricultural areas, primarily agricultural service workers, most typically representing the landscaping and lawn care service industries in the more urbanized areas of the state. On a statewide basis, workers involved in farm activities declined from 4,570 workers in 1974 to 3,962 workers by 1995 while workers in agricultural-related activities increased from 1,325 workers in 1974 to 9,180 workers by 1995.

Table 5–6. Nevada Agricultural Statistics — 1974–1995

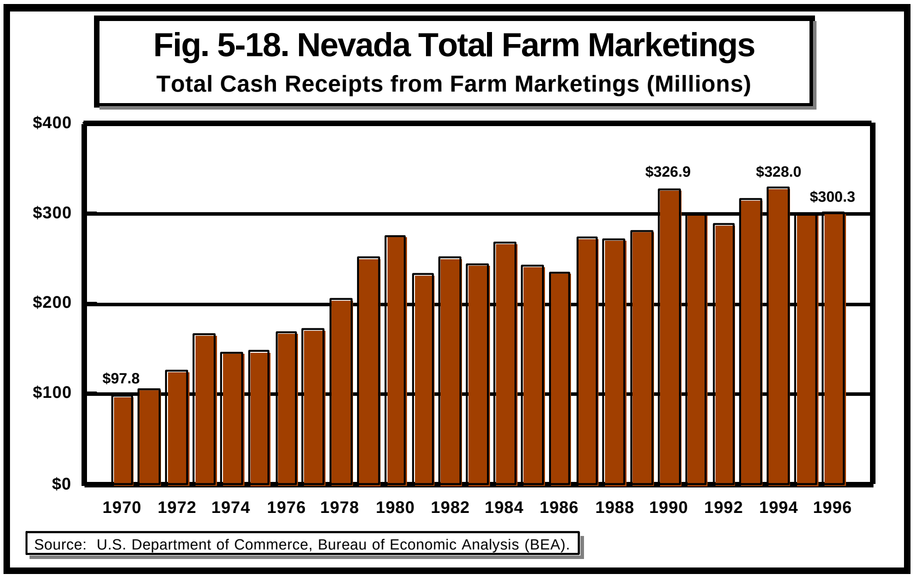
Irrigated Acreage, Farm Marketings and Farm-Related Employment

NEVADA	1974	1978	1982	1987	1990	1995
Irrigated Acres	777,510	881,151	829,761	773,588	728,350	715,439
Farm Marketings ($000s)	$145,458	$204,047	$250,610	$271,904	$326,889	$298,085
Farm Workers	4,570	5,639	5,140	5,628	5,260	3,962
Agric. Services Workers	1,325	2,089	2,723	4,405	6,227	9,180

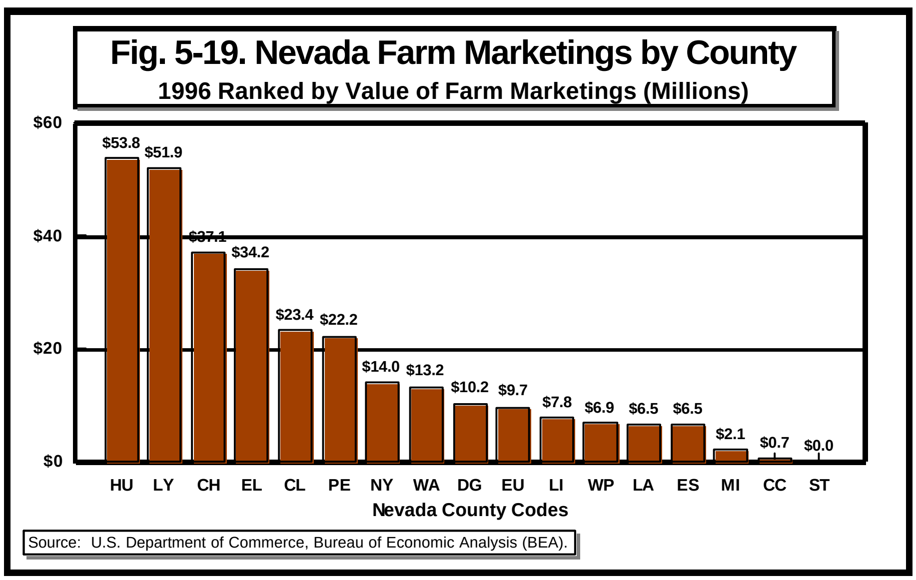
Source Data: Irrigated acreage figures for 1974, 1978, 1982 and 1987 are from the Bureau of the Census, Agriculture Division; irrigated acreage figures for 1990 are estimates from the U.S. Geological Survey (USGS); irrigated acreage for 1995 are derived from estimates made by the Nevada Division of Water Planning (NDWP). Farm marketings, number of farm and agricultural service workers are from U.S. Department of Commerce, Bureau of Economic Analysis (BEA), Regional Economic Information Service (REIS). Agricultural Services Workers include workers in agricultural services, which is primarily landscaping and lawn care, as well as jobs in the forestry and fisheries areas.

With rising prices for agricultural produce, it appears that the value of Nevada's farm marketings peaked in the early 1990's, considerably later than the peak in reported acreage under irrigation (see Table 5–6 and Figure 5–18). Figure 5–19 shows the value of farm marketings ranked by county. In comparing these figures with the ranking of county irrigated acreage in Figure 5–17, we may see that while Elko County accounted for nearly 30 percent of the state's total irrigated acreage in 1996, it accounts for $34.2 million, or 11.4 percent, of the state's total farm marketings. On the other hand, Lyon County, which accounted for only 8.5 percent of statewide irrigated acreage in 1996, made up $51.9 million, or 17.3 percent of total farm marketings. The differences between shares of irrigated acreage and shares of farm marketings are best explained by the nature of the crops, with lower producing counties emphasizing forage crops like alfalfa, and other counties producing higher-valued crops (potatoes, onions, garlic, etc.).

In viewing the individual county figures, which are presented in Appendix 4 of the Appendices, particularly with respect to the amount of irrigated acreage, there also appears wide fluctuations in these levels of irrigated acreage indicating either highly volatile irrigation and crop production cycles based on water available for irrigation or, also very likely, fundamental problems in reporting and gathering accurate data on this industry sector.



The volatility in historical measures of this industry, particularly with respect to irrigated acreage, related water usage rates and livestock figures, makes forecasting irrigation and livestock water use especially difficult. However, there does appear to be a trend towards no new agricultural lands being brought under cultivation and in some counties, e.g., Carson City, Churchill, Douglas, and Washoe in particular, it appears that encroaching urbanization and the transfer of water rights to other uses, i.e., municipal and industrial, is causing the level of irrigated lands to actually decline. Given new and growing demands for limited water resources in the state, particularly for municipal use, wildlife protection and fishery restoration, instream flows and recreation, the future of agriculture in Nevada becomes especially uncertain.



Index to Part 1, Section 5:

Nevada State Water Plan
PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 6
Glossary of Terminology

[Source: Nevada Division of Water Planning's *Water Words Dictionary*. Words presented in italics and the referenced appendices may be found in that source. Words and definitions included in this glossary which explain or summarize elements of existing water law are not intended to change that law in any way.]

(Prior) Appropriation Doctrine — The system for allocating water to private individuals used in the western United States under which (1) the right to water was acquired by diverting water and applying it to a beneficial use and (2) a right to water acquired earlier in time is superior to a similar right acquired later in time. In most states water rights are not now acquired by diverting water and applying it to a beneficial use. Such a system is referred to as the constitutional method of appropriation. Water rights are acquired by application, permit, and license, which may not require diversion and application to a beneficial use. Superiority of right is based on earliest in time and has no reference to whether two rights are for a similar use. The doctrine of *Prior Appropriation* was in common use throughout the arid west as early settlers and miners began to develop the land. The prior appropriation doctrine is based on the concept of *"First in Time, First in Right."* The first person to take a quantity of water and put it to *Beneficial Use* has a higher priority of right than a subsequent user. Under drought conditions, higher priority users are satisfied before junior users receive water. Appropriative rights can be lost through nonuse; they can also be sold or transferred apart from the land. Contrast with *Riparian Water Rights*.

Appropriative Water Right [Nevada] — Nevada's water law is based on statutes enacted in 1903 and 1905 and are founded on the principal of *Prior Appropriation*. Unlike some other states, Nevada has a statewide system for the administration of both ground water and surface water. Appropriative water rights are based on the concept of applying water to *Beneficial Use* and *"First in Time, First in Right."* Appropriative water rights can be lost through nonuse and they may be sold or transferred apart from the land. Due in large part to the relative scarcity of water in Nevada and numerous competing uses, Nevada has had a thriving market for water transfers for a number of years. A person in Nevada who desires to place water to beneficial use must file an application with the State Engineer to initiate the process of acquiring an appropriative water right. Also see *Riparian Water Rights*, *Prescribed Water Rights*, and *Reserved Water Rights (Federal)*.

Beneficial Use (of Water) — (1) The amount of water necessary when reasonable intelligence and diligence are used for a stated purpose. (2) A use of water resulting in appreciable gain or benefit to the user, consistent with state law, which varies from one state to another. Most states recognize the following uses as beneficial:

[1] domestic and municipal uses;
[2] industrial uses;
[3] irrigation;
[4] mining;
[5] hydroelectric power;
[6] navigation;
[7] recreation;
[8] stock raising;
[9] public parks;
[10] wildlife and game preserves.

(2) The cardinal principle of the *(Prior) Appropriation Doctrine*. A use of water that is, in general, productive of public benefit, and which promotes the peace, health, safety and welfare of the people of the State. A certificated

water right is obtained by putting water to a beneficial use. The right may be lost if beneficial use is discontinued. A beneficial use of water is a use which is of benefit to the appropriator and to society as well. The term encompasses considerations of social and economic value and efficiency of use. In the past, most reasonably efficient uses of water for economic purposes have been considered beneficial. Usually, challenges have only been raised to wasteful use or use for some non-economic purpose, such as preserving instream values. Recent statutes in some states have expressly made the use of water for recreation, fish and wildlife purposes, or preservation of the environment a beneficial use. Also see *Appropriative Water Rights*.

Biodiversity — Refers to the variety and variability of life, including the complex relationships among microorganisms, insects, animals, and plants that decompose waste, cycle nutrients, and create the air that we breathe. Diversity can be defined as the number of different items and their relative frequencies. For biological diversity, these items are organized at many levels, ranging from complete *Ecosystems* to the biochemical structures that are the molecular basis of heredity.

Clean Water Act (CWA) [Public Law 92–500] — More formally referred to as the *Federal Water Pollution Control Act*, the Clean Water Act constitutes the basic federal water pollution control statute for the United States. Originally based on the *Water Quality Act* of 1965 which began setting water quality standards. The 1966 amendments to this act increased federal government funding for sewage treatment plants. Additional 1972 amendments established a goal of zero toxic discharges and “fishable” and “swimmable” surface waters. Enforceable provisions of the CWA include technology-based effluent standards for point sources of pollution, a state-run control program for nonpoint pollution sources, a construction grants program to build or upgrade municipal sewage treatment plants, a regulatory system for spills of oil and other hazardous wastes, and a *Wetlands* preservation program (Section 404).

Clean Water Act (CWA), Section 319 — A federal grant program added by Congress to the CWA in 1987 and managed by the *U.S. Environmental Protection Agency (EPA),* Section 319 is specifically designed to develop and implement state *Nonpoint Source (NPS) Pollution* management programs, and to maximize the focus of such programs on a watershed or waterbasin basis with each state. Today, all 50 states and U.S. territories receive Section 319 grand funds and are encouraged to use the funding to conduct nonpoint source assessments and revise and strengthen their nonpoint source management programs. Before a grant is provided under Section 319, states are required to: (1) complete a Nonpoint Source (NPS) Assessment Report identifying state waters that require nonpoint source control and their pollution sources; and (2) develop Nonpoint Source Management Programs that outline four-year strategies to address these identified sources.

Clean Water Standards (EPA) — Generally refers to any enforceable limitation, control, condition, prohibition, standard, or other requirement which is promulgated pursuant to the *Federal Water Pollution Control Act (Clean Water Act) [Public Law 92–500]* or contained in a permit issued to a discharger by the *U.S. Environmental Protection Agency (EPA)* or by a state under an approved program, as authorized by Section 402 of the Clean Water Act, or by local governments to ensure compliance with pretreatment regulations as required by Section 307 of the Clean Water Act.

Designated Groundwater Basin [Nevada] — In the interest of public welfare, the Nevada State Engineer, *Division of Water Resources*, *Department of Conservation and Natural Resources*, is authorized by statute (Nevada Revised Statute 534.120) and directed to designate a ground water basin and declare *Preferred Uses* within such designated basin. The State Engineer has additional authority in the administration of the water resources within a designated ground water basin. [A listing of Nevada’s Hydrographic Regions, and designated Areas and Sub-Areas is presented in the NDWP’s *Water Words Dictionary* in Appendix A–1 (hydrographic regions, areas and sub-areas), Appendix A–2 (listed sequentially by area number) Appendix A–3 (listed alphabetically by area name), and Appendix A–4 (listed alphabetically by principal Nevada county(ies) in which located).]

Drought — There is no universally accepted quantitative definition of drought. Generally, the term is applied to periods of less than average or normal precipitation over a certain period of time sufficiently prolonged to cause a serious hydrological imbalance resulting in biological losses (impact flora and fauna ecosystems) and/or economic losses (affecting man). In a less precise sense, it can also signify nature’s failure to fulfill the water wants and needs of man.

Ecosystem — A community of animals, plants, and bacteria, and its interrelated physical and chemical environment.

An ecosystem can be as small as a rotting log or a puddle of water, but current management efforts typically focus on larger landscape units, such as a mountain range, a river basin, or a watershed. Also see *Biodiversity*.

Ecosystem Management — (Environmental) An approach to managing the nation's lands and natural resources which recognizes that plant and animal communities are interdependent and interact with their physical environment (i.e., soil, water, and air) to form distinct ecological units called *Ecosystems*. The fact that these ecosystems span jurisdictional and political boundaries necessitates a more comprehensive and unified approach to managing them. Implementing the initial stage of a government-wide approach to ecosystem management typically requires clarifying the policy goals and undertaking certain practical steps to apply the principles being considered to include:

- [1] Delineating the ecosystem;
- [2] Understanding the system(s) ecologies;
- [3] Making management choices;
- [4] Unifying disparate data and information needs and sources; and
- [5] Adapting management on the basis of new information.

Endangered Species — Any plant or animal species threatened with extinction by man-made or natural changes throughout all or a significant area of its range; identified by the Secretary of the Interior as "endangered", in accordance with the 1973 *Endangered Species Act (ESA)*, below. [See Appendix D–1, Nevada's Endangered and Threatened Species.]

Endangered Species Act (ESA) — An act passed by Congress in 1973 intended to protect species and subspecies of plants and animals that are of "aesthetic, ecological, educational, historical, recreational and scientific value." It may also protect the listed species' "critical habitat", the geographic area occupied by, or essential to, the protected species. The *U.S. Fish and Wildlife Service (USFWS)* and the *National Marine Fisheries Service (NMFS)* share authority to list endangered species, determine critical habitat and develop recovery plans for listed species. Currently, approximately 830 animals and 270 plants are listed as endangered or threatened nationwide at Title 50, Part 17, sections 11 and 12 of the Code of Federal Regulations. Further, under a settlement with environmental groups, USFWS has agreed to propose listing another 400 species over the next few years. The 1973 Endangered Species Act superseded and strengthened the *Endangered Species Preservation Act* of 1966 and the *Endangered Species Conservation Act* of 1969. The 1973 provisions required that the act be re-authorized by Congress every five years.

"First in Time, First in Right" — A phrase indicating that older water rights have priority over more recent rights if there is not enough water to satisfy all rights. See *(Prior) Appropriation Doctrine* and *Appropriative Water Rights*.

Gage, or Gauge — (1) An instrument used to measure magnitude or position; gages may be used to measure the elevation of a water surface, the velocity of flowing water, the pressure of water, the amount of intensity of precipitation, the depth of snowfall, etc. (2) The act or operation of registering or measuring magnitude or position. (3) The operation, including both field and office work, of measuring the discharge of a stream of water in a waterway.

Great Basin [Nevada] — An area covering most of Nevada and much of western Utah and portions of southern Oregon and southeastern California consisting primarily of arid, high elevation, desert valleys, sinks (playas), dry lake beds, and salt flats. The Great Basin is characterized by the fact that all surface waters drain *inward* to terminal lakes or sinks. Principal excluded regions within Nevada include the extreme north-central portion of the state whose waters drain northward into the Snake River Basin, thence to the Columbia River and finally to the Pacific Ocean, and the south-eastern portion of Nevada whose surface waters drain into the Colorado River Basin, thence to the Gulf of California (Mexico) and the Pacific Ocean. Within this area referred to as the Great Basin, major river drainage areas include:

- [1] ***Truckee River***, whose source is Lake Tahoe (Basin) and whose terminus is Pyramid Lake in western Nevada;
- [2] ***Carson River***, whose west and east forks originate along the eastern slopes of the Sierra Nevada Mountains and whose terminus is the Carson Sink (Playa) in west-central Nevada;
- [3] ***Walker River***, whose west and east fork tributaries also originate along the eastern slopes of the Sierra Nevada Mountains and whose terminus is Walker Lake in western Nevada; and

[4] ***Humboldt River***, the only major river wholly contained in Nevada, whose principal source is the Ruby Mountains in eastern Nevada and whose terminus is the Carson Sink (Playa) in west-central Nevada.

Pyramid Lake and Walker Lake in western Nevada represent the remnants of the ancient *Lake Lahontan*, an *Ice Age* lake that covered a considerable portion of northwestern Nevada during the Pluvial Period of some 75,000–10,000 years ago. The Great Salt Lake in western Utah, the last major remnant of the ancient Ice Age Lake Bonneville, which covered a large portion of what is now the Utah portion of the Great Basin, is also contained within this area and acts as the terminus for surface water drainage from the western slopes of the Wasatch Range in north-central Utah.

Ground Water, also Groundwater — (1) Generally, all subsurface water as distinct from *Surface Water*; specifically, the part that is in the saturated zone of a defined aquifer. (2) Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper level of the saturate zone is called the Water Table. (3) Water stored underground in rock crevices and in the pores of geologic materials that make up the earth's crust. Ground water lies under the surface in the ground's *Zone of Saturation*, and is also referred to as *Phreatic Water*.

Integrated (Water) Resource Planning (IRP) — A comprehensive, interdisciplinary approach to water resource planning that encompasses water resource assessment, demand considerations, analysis of alternatives, risk management, resource diversity, environmental considerations, least-cost analysis, multidimensional modeling, and participatory decision making and public input, among other factors. Integrated Resource Planning begins with specific policy objectives that are applied to extensive lists of options for water supply sources, distribution systems, or other operational requirements. The options are then narrowed after evaluating demand requirements, environmental impacts, conservation options, costs, risks, and other aspects of a project. IRP involves a dynamic process of assessing demand and supply conditions and creatively integrating alternatives and new technologies. While the concepts of IRP are relatively new to the process of water planning, it has been used extensively in the energy industry. As a planning process it helps decision makers select the best mix of water resources, facilities, and conservation measures to meet water demands. In addition to traditional planning techniques, IRP also

[1] Includes extensive public involvement;
[2] Considers both supply-side (resources and facilities) and demand-side (conservation) alternatives as ways of meeting demands;
[3] Considers goals and objectives in addition to dollar costs (e.g., environmental concerns, public acceptability, etc.);
[4] Considers uncertainty in demand forecasts, regulations, etc.; and
[5] Considers the effect of water rates on water demands.

Interbasin Transfer (of Water) — A transfer of water rights and/or a diversion of water (either groundwater or surface water) from one *Drainage* or *Hydrographic Basin* to another, typically from the basin of origin to a different hydrologic basis. Also referred to as *Water Exports* and/or *Water Imports*.

Interstate Allocation [Nevada and California] — An agreement between the states of Nevada and California over the use of the waters of Lake Tahoe and the Truckee, Carson, and Walker rivers which was ratified by California (1970) and Nevada (1971), but was never ratified by Congress. Despite this, both states have enacted legislation to enforce to the allocation of the Truckee, Carson, and Walker rivers between these two states. Subsequently, in 1990 many of the compact's provisions dealing with the waters of Lake Tahoe and the Truckee and Carson rivers became formalized under *Public Law 101–618* (the *Negotiated Settlement*).

Interstate Water Compact — (1) Broadly, an agreement between two or more states regarding competing demands for a water resource which are beyond the legal authority of one state alone to solve. (2) States administer water rights within their own political boundaries; however, the process becomes more complicated when involving an interstate body of water (*Interstate Water*). Under these conditions there are three possible ways to achieve an interstate allocation of water: (1) A suit for equitable apportionment brought by the states in the U.S. Supreme Court; (2) a Congressional act; and (3) an interstate compact. An interstate compact is an agreement negotiated between states, adopted by their state legislatures, and then approved by Congress. Once an allocation of interstate water is determined by such a means, the individual states may then issue water rights to its share of the water through their normal administrative process. Interstate compacts have been traditionally used in making water allocations in the western states. Also see *Interstate Allocation [Nevada and California]*.

Interstate Waters — According to law, interstate waters are defined as: (1) rivers, lakes and other waters that flow across or form a part of state or international boundaries; (2) waters of the Great Lakes; and (3) coastal waters whose scope has been defined to include ocean waters seaward to the territorial limits and waters along the coastline (including inland steams) influenced by the tide.

Intrabasin Transfer (of Water) — Transfers of water within the same water basin or hydrographic area.

Junior (Water) Rights — A junior water rights holder is one who holds rights that are temporarily more recent than senior rights holders. All water rights are defined in relation to other users, and a water rights holder only acquires the right to use a specific quantity of water under specified conditions. Therefore, when limited water is available, junior rights are not met until all senior rights have been satisfied. See *Prior Appropriation Doctrine*.

National Economic Development — One of the two main objectives of planning for water and related land resources by governmental agencies whose activities involve planning and development of water resources. Such activities are reflected in the increase in the nation's productive output, an output which is partly reflected in a national product and income accounting framework to measure the continuing flow of goods and services into direct consumption or investment.

National Environmental Policy Act (NEPA) — A 1970 Act of Congress that requires all federal agencies to incorporate environmental considerations into their decision-making processes. The act requires an *Environmental Impact Statement (EIS)* for any "major federal action significantly affecting the quality of the human environment."

National Flood Insurance Program (NFIP) — A federal program enabling property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is based on an agreement between local communities and the federal government that if a community will implement and enforce measures to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHA), then the federal government will make flood insurance available to protect against flood losses that do occur. The NFIP was established by Congress through the passage of the National Flood Insurance Act of 1968. Features of the program were modified and extended with the 1973 passage of the Flood Disaster Protection Act, and other legislative measures. The NFIP is administered by the Federal Insurance Administration (FIA), which is a component part of the *Federal Emergency Management Agency (FEMA)*.

Navigable Waters [Nevada] — In Nevada bodies of water are navigable if they are used, or are susceptible of being used, in their ordinary condition as highways for commerce, over which trade and travel are or may be conducted in the customary modes of trade and travel on water. In Nevada, this test of navigability (*State of Nevada v. Julius Bunkowski, et al.*, 1972) held that the Carson River was navigable, and therefore the State of Nevada owned its bed, as logs were floated down the river from about 1860 to 1895 (the commerce requirement).

Perennial Yield (Ground Water) — The amount of usable water of a ground water reservoir that can be withdrawn and consumed economically each year for an indefinite period of time. It cannot exceed the sum of the *Natural Recharge*, the *Artificial* (or *Induced*) *Recharge*, and the *Incidental Recharge* without causing depletion of the groundwater reservoir. Also referred to as *Safe Yield*.

Perfected Water Right — (1) A completed or fully executed water right. A water right is said to have been perfected when all terms and conditions associated with it have been fully accomplished, e.g., the diversion has been effected and the water applied to beneficial use. (2) A water right to which the owner has applied for and obtained a permit, has complied with the conditions of the permit, and has obtained a license or certification of appropriation. (3) A water right which indicates that the uses anticipated by an applicant, and made under permit, were made for *Beneficial Use*. Usually it is irrevocable unless voluntarily canceled or forfeited due to several consecutive years of nonuse. Also referred to as a *Certified Water Right*. Also see *Appropriation Doctrine*.

Permit — (1) (Water Right) A written document which grants authority to take unused water and put it to *Beneficial Use*. If all requirements of the permit are satisfied, then the permit for water appropriation can mature into a license or *Perfected Water Right*. (2) (Discharge) A legally binding document issued by a state or federal permit agency to the owner or manager of a point source discharge. The permit document contains a schedule of compliance requiring the permit holder to achieve a specified standard or limitation (by constructing treatment facilities or modifying plant processes) by a specified date. Permit documents typically specify monitoring and reporting requirements to be conducted by the applicant as well as the maximum time period over which the permit is valid. Also see *Application, Water Right*.

Permit, Water [Nevada] — The written permission from the state engineer to appropriate public waters for a beneficial use from a surface or underground source, at a specific point of diversion, under limited circumstances. If all requirements of the permit are satisfied, then the permit for water appropriation can mature into a license or *Perfected Water Right*. Also see *Permitted Water Right [Nevada]*, and *Application, Water Right*.

Planning — A comprehensive study of present trends and of probable future developments, together with recommendations of policies to be pursued. Planning embraces such subjects as population growth and distribution; social forces; availability of land, water, minerals, and other natural resources; technological progress; and probable future revenues, expenditures, and financial policies. Planning must be responsive to rapidly changing conditions.

Planning Horizon — The overall time period considered in the planning process that spans all activities covered in or associated with the analysis or plan and all future conditions and effects or proposed actions which would influence the planning decisions.

Policy — (Water Planning) A statement of governmental intent against which individual actions and decisions are evaluated. The wording of policies conveys the level of commitment to action, for example, policies which use the word "shall" are mandatory directives, while those using the word "should" are statements of direction to be followed unless there are compelling reasons to do otherwise.

Preferred Use — A use given some sort of preference not given other uses. Preference can take many forms, depending on state law. One type of use, such as domestic use, may be preferred over others when there are competing applications to appropriate the same water. Persons having water rights for preferred use may be entitled to take water before those having rights for other uses, regardless of their relative priorities. A person needing water for a preferred use may be authorized to condemn (i.e., to buy in a forced judicial sale) water being used for non-preferred purposes. Also see *Designated Ground Water Basin* and *Designated Ground Water Basin [Nevada]*.

Preferred Use [Nevada] — In the interest of public welfare, the state engineer is authorized and directed to designate preferred uses of water within the respective areas so designated by him and from which the ground water is being depleted. In acting on applications to appropriate ground water, he may designate such preferred uses in different categories with respect to the particular areas involved within the following limits: domestic, municipal, quasi-municipal, industrial, irrigation, mining and stock-watering uses and any uses for which a county, city, town, public water district or public water company furnishes the water.

Prescribed Water Rights — (1) Water rights to which legal title is acquired by long possession and use without protest of other parties. (2) Water use rights gained by trespass or unauthorized taking that ripen into a title; on a par with rights to land gained through adverse possession. To perfect the right, the use of water must be adverse, hostile, open and continuous for five continuous years against the recognized water rights holder. Contrast with *Appropriative Water Rights*, *Riparian Water Rights*, and *Littoral Water Rights*.

Prior Appropriation Doctrine — (1) A concept in water law under which a right to a given quantity of water is determined by such a procedure as having the earliest *Priority Date*. (2) The system for allocating water to private individuals used in most of the western United States. The doctrine of *Prior Appropriation* was in common use throughout the arid west as early settlers and miners began to develop the land. The prior appropriation doctrine is based on the concept of *"First in Time, First in Right"*. The first person to take a quantity of water and put it to *Beneficial Use* has a higher priority of right than a subsequent user. Under drought conditions, higher priority users are satisfied before junior users receive water. Appropriative rights can be lost through nonuse; they can also be sold or transferred apart from the land. Contrasts with *Riparian Doctrine* and *Riparian Water Rights*. Also see *Littoral Water Rights* and *Prescribed Water Rights*.

Priority — The concept that the person first using water has a better right to it than those commencing their use later. An appropriator is usually assigned a "priority date". However, the date is not significant in and of itself, but only in relation to the dates assigned other water users from the same source of water. Priority is only important when the quantity of available water is insufficient to meet the needs of all those having a right to use water. See *(Prior) Appropriation Doctrine* and *Appropriative Water Rights*.

Priority Date — The date of establishment of a water right; the officially recognized date associated with a water right. The rights established by application have the application date as the date of priority. Relative to other water rights, the priority date may make a water right senior (predating other rights) or junior (subordinate to other rights). See *(Prior) Appropriation Doctrine* and *Appropriative Water Rights*.

Public Interest, or Public Welfare — An interest or benefit accruing to society generally, rather than to any individuals or groups of individuals in the society. In many states, a permit to appropriate water must be denied if the appropriation would be contrary to the public interest or public welfare. These terms are sometimes vague and state engineers or others administering the water permit systems generally have viewed narrowly the authority granted under such provisions. In some cases they have restricted their consideration to matters of economic efficiency or the effects of the proposed appropriation on existing or future use for the water and have not considered such things as the environmental effects. However, recent developments, such as state environmental policy acts or legislation addressing specific public interest criteria, have placed new emphasis on this issue. Also see *Public Trust Doctrine*.

Public Scoping — The process of soliciting public comments on the issues to be examined in environmental documents such as an *Environmental Impact Statement (EIS)* or water planning documents. The process can be carried out by public meetings, soliciting written comments, or both. The identification of issues, alternatives, impacts, mitigation and/or monitoring all may be addressed during the scoping process.

Public Trust Doctrine — (1) A vaguely defined judicial doctrine under which the state holds its navigable waters and underlying beds in trust for the public and is required or authorized to protect the public interest in such waters. All water rights issued by the state are subject to the overriding interest of the public and the exercise of the public trust by state administrative agencies. (2) Based in Roman Law, the Public Trust Doctrine holds that certain resources belong to all the people and are therefore held in trust by the state for future generations. Since the 1970s, court rulings have expanded the concept of public trust to protect not only the traditional uses of navigation, commerce, and fishing, but also ecological preservation, open space maintenance, and scenic and wildlife habitat preservation. In a 1983 landmark ruling by the California Supreme Court (*National Audubon Society v. Superior Court of Alpine County*), the court held that water right licenses held by the City of Los Angeles and its Department of Water and Power to divert water from streams tributary to Mono Lake remain subject to ongoing State of California supervision under the public trust doctrine and could be curtailed or revoked, if necessary, to protect the public trust. The court held that public trust uses must be considered and balanced when the rights to divert water away from *Navigable* bodies of water are to be considered. Therefore, in issuing or reconsidering any rights to appropriate or divert water, the state must balance public trust needs with the needs for other beneficial uses of water. Also see *Equal Footing Doctrine (U.S. Constitution)* and *Public Interest, or Public Welfare*.

Reasonable Use — A rule with regard to percolating or riparian water restricting the landowner to a reasonable use of his own rights and property in view of and qualified by the similar rights of others, and the condition that such use not injure others in the enjoyment of their rights.

Reasonable Use Theory — A *Riparian Owner* may make reasonable use of his water for either natural or artificial wants. However, he may not so use his rights so as to affect the quantity of quality of water available to a lower riparian owner.

Reservation Doctrine, Reserved Rights Doctrine, and Winters Doctrine (or Winters Rights) — The legal rule which states that when the United States reserves public lands for a particular purpose it also reserves sufficient water to accomplish that purpose. Those who initiate water rights after the date of the reservation are subject to the reserved right. The doctrine was first announced by the United States Supreme Court in the case of *Winters v. United States*, 207 U.S. 564 (1908), involving a dispute between an Indian reservation and a rancher. For many years it was thought that the doctrine only applied to Indian reservations, but in recent years it has been extended to other types of federal reservations, such as national parks and forests. Also see *Winters Rights (Decision)* and *Practicably Irrigable Acreage (PIA)*.

Reserved Water Rights (Federal) — (1) A category of federal water rights, created by federal law and recognized by judicial decision. These rights are created when the federal government withdraws land from the public domain to establish a federal reservation such as a national park, forest, or Indian reservation. By this action, the government is held to have reserved water rights sufficient for the primary purpose for which the land was withdrawn. (2) This class of water rights is a judicial creation derived from *Winters v. United States* (207 U.S. 564, 1907) and subsequent federal case law, which collectively hold that when the federal government withdraws land from general use and reserves it for a specific purpose, the federal government by implication reserves the minimum amount of water unappropriated at the time the land was withdrawn or reserved to accomplish the primary purpose of the reservation. Federal reserved water rights may be claimed when Congress has by statute withdrawn lands from the public domain for a particular federal purpose or where the President has withdrawn lands from the public domain for a particular federal purpose pursuant to congressional authorization. The right to such water is not lost by nonuse, and its priority date is the date the land was set aside. Also see *Winters Rights (Decision), Reservation Doctrine, Reserved Rights Doctrine, and Winters Doctrine (or Winters Rights)*, and *Water Law [Federal]*.

Riparian Doctrine — The system for allocating water used in England and the eastern United States, in which owners of lands along the banks of a stream or water body have the right to *Reasonable Use* of the waters and a *Correlative Right* protecting against unreasonable use by others that substantially diminishes the quantity or quality of water. The right is appurtenant to the land and does not depend on prior use. Under this doctrine, ownership of land along a stream or river (i.e., riparian lands) is an absolute prerequisite to a right to use water from that body of water and each such landowner has an equal right to withdraw "reasonable" amounts of water (whether or not he is presently using it or not) so long as downstream landowners are not unreasonably damaged. Contrast with *Prior Appropriation Doctrine*.

Safe Drinking Water Act [SDWA] (Public Law 93–523) — An amendment to the *Public Health Service Act* which established primary and secondary quality standards for drinking water. The SDWA was passed in 1976 to protect public health by establishing uniform drinking water standards for the nation. In 1986 SDWA Amendments were passed that mandated the *U.S. Environmental Protection Agency (EPA)* to establish standards for 83 drinking water contaminants by 1992 and identify an additional 25 contaminants for regulation every 3 years thereafter. See *Drinking Water Standards*, *Drinking Water Standards [Nevada]*, *Primary Drinking Water Standards*, and *Secondary Drinking Water Standards*. [Also see Appendix B–3, Nevada Drinking Water Standards of the *Water Words Dictionary*.]

Senior Rights — A senior rights holder is one who holds rights that are older (more senior) than those of junior rights holders. All water rights are defined in relation to other users, and a water rights holder only acquires the right to use a specific quantity of water under specified conditions. Thus, when limited water is available, senior rights are satisfied first in the order of their *Priority Date*.

Snowpack Telemetry (SNOTEL) — A remote, automated measurement system operated and maintained by the *Natural Resources Conservation Service (NRCS)* in the western United States to assess snowpack accumulation and potential streamflows. The concept is based upon the relationship between the water content in the snowpack and spring runoff under certain assumptions. Forecasts of runoff are made through the coordination of hydrologists with the NRCS and the *National Weather Service (NWS)*. A typical SNOTEL site consists of: (1) a precipitation measurement tube which measures the actual level of precipitation in inches of equivalent water; (2) a snow "pillow" which measures the weight of the snowpack and therefore its water content, and (3) the measurement and transmitting equipment which send the data to NRCS collection offices.

Socioeconomics — The study of the economic, demographic, and social interactions of humans.

Stream — A general term for a body of flowing water; natural water course containing water at least part of the year. In *Hydrology*, the term is generally applied to the water flowing in a natural channel as distinct from a canal. More generally, as in the term *Stream Gaging*, it is applied to the water flowing in any channel, natural or artificial. Some classifications of streams include, *in relation to time*:

[1] ***Ephemeral Streams*** — Streams which flow only in direct response to precipitation and whose channel is at all times above the water table.

[2] ***Intermittent or Seasonal Streams*** — Streams which flow only at certain times of the year when it receives water from springs, rainfall, or from surface sources such as melting snow.

[3] ***Perennial Streams*** — Streams which flow continuously.

And, *in relation to ground water*:

[4] ***Gaining Streams*** — Streams or a reach of a stream that receive water from the zone of saturation. Also referred to as an *Effluent Stream*.

[5] ***Insulated Streams*** — Streams or a reach of a stream that neither contribute water to the zone of saturation nor receive water from it. Such streams are separated from the zones of saturation by an impermeable bed.

[6] ***Losing Streams*** — Streams or a reach of a stream that contribute water to the zone of saturation. Also referred to as an *Influent Stream*.

[7] ***Perched Streams*** — Perched streams are either losing streams or insulated streams that are separated from the underlying ground water by a zone of aeration.

Surface Water — (1) An open body of water such as a stream, lake, or reservoir. (2) Water that remains on the earth's surface; all waters whose surface is naturally exposed to the atmosphere, for example, rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc., and all springs, wells, or other collectors directly influenced by surface water. (3) A source of drinking water that originates in rivers, lakes and run-off from melting snow. It is either drawn directly from a river or captured behind dams and stored in reservoirs. Also see *Ground Water Under the Direct Influence (UDI) of Surface Water*.

Transfer (Water Right) — (1) The process of transferring a water right from one person to another. (2) A passing or conveyance of title to a water right; a permanent assignment as opposed to a temporary lease or disposal of water. Most states require that some formal notice or filing be made with an appropriate state agency so that the transaction is officially recorded and the new owner is recorded as the owner of the water right.

Truckee–Carson–Pyramid Lake Water Rights Settlement Act of 1990 — See *Negotiated Settlement*.

Underground Injection Control (UIC) — A program required in each state by a provision of the *Safe Drinking Water Act (SDWA)* for the regulation of *Injection Wells*, including a permit system. An applicant must demonstrate that the well has no reasonable chance of adversely affecting the quality of an underground source of drinking water before a permit is issued.

Usufruct, also Usufructuary — (Legal–Civil Law) The right of enjoying a thing, the property of which is vested in another, and to draw from the same all the profit, utility, and advantage which it may produce, provided it be without altering the substance of the thing. For example, in Nevada, the state's water belongs to the people, but is permitted, through the water rights permitting process, to be used beneficially by other individuals or entities.

Usufructuary (Water) Right — (1) A right to use rather than own the property of another, such as the state's water. (2) A water right holder's authority to divert and use a certain amount of water. See *Usufruct*.

Vested Water Right — (1) The water right to use either surface or ground water acquired through more or less continual beneficial use prior to the enactment of water law pertaining to the source of the water. These claims become final through *Adjudication*. (2) A fully executed or finalized appropriative right to use the waters of a state for a beneficial purpose. Also see *Certificated Water Right* and *Perfected Water Right*.

Water Administration (and Management) — A broad term referring to the collective role of defined state agencies to implement state and federal water laws, commonly through the development and implementation of appropriate statutes and regulations. This role can include oversight, approval, and enforcement responsibilities.

Water Duty [Nevada] — The *Alpine Decree* and *Orr Ditch Decree* provide the basis for virtually all irrigation water duties relating to water diversions from the Truckee, Carson, and Walker rivers in Northern Nevada. These decrees provide for an annual maximum irrigation duty of 4.5 acre-feet per acre for water-righted *Bench Lands* and 3.5 acre-feet per acre for water-righted *Bottom Lands* delivered to farm headgates. These duties are based on the *Crop Water Requirement* on the irrigation of alfalfa, as it is the most prominent crop and the highest water-using crop grown in the *Newlands (Irrigation) Project* in west-central Nevada. However, neither decree identifies lands as to bottom or bench. This has created considerable controversy, particularly within the Newlands Project, which constitutes a principal water user of both Carson River waters and Truckee River (diverted) waters. Also see *Alpine Decree [California and Nevada]*, *Orr Ditch Decree [Nevada and California]*, *Bench Lands [Nevada]*, and *Bottom Lands [Nevada]*.

Water Law — A law that has been instigated to control the right to the use of water. See *(Prior) Appropriation Doctrine* and *Riparian Doctrine*.

Water Law [Federal] — Except when provided by federal law, e.g., *Federal Reserved (Water) Rights*, federal water rights must satisfy the administration and permitting process of the state in which the federal project is located. An important 1978 U.S. Supreme Court case (*California v. United States*) held that unless state law conflicted with clear Congressional directives, the federal government must obtain water rights under state law for reclamation purposes. Under the federal reserved rights concept, the federal government reserves sufficient water rights when it withdraws land from the public domain to establish a federal reservation such as a national park or Indian reservation. Also see *Reservation Doctrine, Reserved Rights Doctrine, and Winters Doctrine* and *Winters Rights (Decision)*.

Water Law [Nevada] — Nevada's water law is based on the *Prior Appropriation Doctrine*. Furthermore, unlike some other states, Nevada has a statewide system for the administration of both ground water and surface water. *Appropriative Water Rights* are based on the concept of applying water to *Beneficial Use* and *"First in Time, First in Right"*. Appropriative water rights can be lost through nonuse and they may be sold or transferred apart from the land. Due in large part to the relative scarcity of water in Nevada and numerous competing uses, Nevada has had a thriving market for water transfers for a number of years. Water rights in Nevada are administered by the State Engineer. Also see *Application, Water Right*, *Riparian Doctrine*, *Riparian Water Rights*, *Littoral Water Rights*, *Prescribed Water Rights*, and *Reserved Water Rights*.

Water Management — (1) (General) Application of practices to obtain added benefits from precipitation, water, or water flow in any of a number of areas, such as irrigation, drainage, wildlife and recreation, water supply, watershed management, and water storage in soil for crop production. Includes *Irrigation Water Management* and *Watershed Management*. (2) (Irrigation Water Management) The use and management of irrigation water where the quantity of water used for each irrigation is determined by the water-holding capacity of the soil and the need for the crop, and where the water is applied at a rate and in such a manner that the crop can use it efficiently and significant erosion does not occur. (3) (Watershed Management) The analysis, protection, development, operation, or maintenance of the land, vegetation, and water resources of a drainage basin for the conservation of all its resources for the benefit of its residents. Watershed management for water production is concerned with the quality, quantity, and timing of the water which is produced. Also see *Basin Management*.

Water Plan — A document of issues, policies, strategies and action plans intended to effectively and economically execute a *Water Planning* process. Also see *Water Policy*.

Water Planning — Water planning is an analytical planning process developed and continually modified to address the physical, economic, and sociological dimensions of water use. As a planning process it must assess and quantify the available supply of water resources and the future demands anticipated to be levied upon those resources. Based upon this continuous supply and demand evaluation, water planning must also give direction for moving water supplies to points of use while encouraging users to be good and effective stewards of available water resources. The water planning process requires constant re-evaluation and updating to address changing social, political, economic, and environmental parameters. While the ultimate objective of such efforts is typically the development of a comprehensive, publicly-supported *Water Plan*, it is also critical to develop and maintain a comprehensive and viable water planning process that covers various aspects of water resource development, transport, water treatment, allocation among various competing uses, conservation, waste-water treatment, re-use, and disposal. Also see *Water Policy*.

Water Resource Plan — A planning document or process which assesses both sources and uses of water and develops strategies for their most effective and efficient use according to public needs and criteria. Also see *Water Plan*, *Water Planning*, and *Water Policy*.

Water Right — (1) The legal right to use a specific quantity of water, on a specific time schedule, at a specific place, and for a specific purpose. (2) A legally-protected right, granted by law, to take possession of water occurring in a water supply and to put it to *Beneficial Use*. (3) A legal right to divert state waters for a beneficial purpose.

Water-Righted Acreage — The land base for which there are water rights.

Water Rights — (1) The legal rights to the use of water. (2) A grant, permit, decree, appropriation, or claim to the use of water for beneficial purposes, and subject to other rights of earlier date or use, called *Priority* or *Prior Appropriation*. They consist of *Riparian Water Rights*, *Appropriative Water Rights*, *Prescribed Water Rights*, and *Reserved Water Rights*. Also see *Water Law, Water Law [California]*, *Water Law (Federal)*, and *Water Law [Nevada]*.

Water Rights, Correlative Doctrine — When a source of water does not provide enough for all users, the water is reapportioned proportionately on the basis of prior water rights held by each user.

Water Use — The amount of water needed or used for a variety of purposes including drinking, irrigation, processing of goods, power generation, and other uses. The amount of water used may not equal the amount of water withdrawn due to water transfers or the recirculation or recycling of the same water. For example, a power plant may use the same water a multiple of times but withdraw a significantly different amount. Also see *Water Use, Types,* below.

Water Use Practices — Direct, indirect, consumptive, and nonconsumptive uses of water. These include domestic practices (e.g., washing, bathing, cooking, drinking), navigation, wildlife habitat management, irrigation practices, recreation activities, industrial uses, and hydroelectric power generation.

Water Use, Types — The use of water may be classified by specific types according to distinctive uses, such as the following:

[1] Commercial Water Use
[2] Domestic Water Use
[3] Hydroelectric Power Water Use

[4] Irrigation Water Use
[5] Livestock Water Use
[6] Mining Water Use
[7] Navigational Water Use
[8] Other Water Use
[9] Public Water Use (same as *Utility Water Use*)
[10] Residential Water Use (same as *Domestic Water Use*)
[11] Rural Water Use
[12] Thermoelectric Power Water Use

Watermaster — Often an employee of a court hired to administer a court decree. Also may be an employee of a water department who distributes available water supplies at the request of water rights holders and collects hydrographic data. Also refers to a position within an irrigation project that is responsible for the internal distribution of project water.

Watershed — (1) An area that, because of topographic slope, contributes water to a specified surface water drainage system, such as a stream or river. (2) All lands enclosed by a continuous hydrologic drainage divide and lying upslope from a specified point on a stream; a region or area bounded peripherally by a water parting and draining ultimately to a particular water course or body of water. Also referred to as *Water Basin* or *Drainage Basin*. (3) A ridge of relatively high land dividing two areas that are drained by different river systems. Also referred to as *Water Parting*.

Watershed Management — The analysis, protection, development, operation or maintenance of the land, vegetation and water resources of a drainage basin for the conservation of all its resources for the benefit of its residents. Watershed management for water production is concerned with the quality and timing of the water which is produced. Also referred to as *Water Management* and *Basin Management*.

Watershed Planning — The formulation of a plan, based on the concept of a *Watershed*, a *Water Basin*, a *Hydrologic Region*, or a *Hydrologic Study Area (HSA)*, with the intent to assess climatological conditions, inventory existing ground and surface water resources, determine current water uses, project future socioeconomic and environmental demands for those resources, and explore feasible water-balancing options, so as to maximize the benefits to the inhabitants of a study area while simultaneously preserving and protecting the region's wildlife, habitat, and environmental conditions.

Wellhead Protection (Program) — Programs intended to protect and preserve the quality of ground water used as a source of drinking water. A typical wellhead protection program will have a number of critical elements to include: (1) delineating the roles and responsibilities of state agencies, local governments, and water purveyors; (2) delineation of wellhead protection areas; (3) contaminant source inventories; (4) management options; (5) siting of new wells; (6) contingency and emergency planning; and (7) public participation. Typically, steps taken to protect and preserve the quality of a well are far less costly than actions necessary to restore a contaminated well.

Wetlands [Nevada] — (State Wildlife Management Areas) Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency or duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands typically include swamps, marshes, bogs, playas, springs, seeps, and similar areas. Wetlands are land transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water.

Winters Doctrine — The doctrine of (federal) reservation rights. See *Winters Rights (Decision)*.

Winters Rights (Decision) — The U.S. Supreme Court precedent decision (*Winters v. United States*, 207 U.S. 564 [1908]) in which the Court prohibited any uses by non-Indians that interfered with the Indian tribes' use of their reserved water. In *Winters*, the Court held that when reservations were established, Indian tribes and the Unites States implicitly reserved, along with the land, sufficient water to fulfill the purposes of the reservations. The ruling rests on the principle that Indian tribes retain all rights not explicitly relinquished. These federal reserved water rights are commonly known as *Winters Rights* as based on the *Winters Doctrine*. The court recognized these rights as having a priority date coinciding with the date the reservation was established, thus providing a means to integrate federally reserved rights with *Appropriative Water Rights* recognized under state law. Since reserved rights are not created by state law, *Winters Rights* retain their validity and seniority regardless of whether tribes have put the water to *Beneficial Use*. On-going conflicts concerning this ruling tend to involve non-Indian water users appropriating water under state law, water that previously may have been reserved for Indian tribes, though never quantified by courts or fully used on reservations. Also see *Reservation Doctrine, Reserved Rights Doctrine,* *and Winters Doctrine*, *Practicably Irrigable Acreage (PIA)*, *(Prior) Appropriation Doctrine*, and *Water Law [Federal]*.

Yield, Firm — The maximum annual supply of a given water development that is expected to be available on demand, with the understanding that lower yields will occur in accordance with a predetermined schedule or probability. Sometimes referred to as *Dependable Yield*.

Yield, Perennial — The amount of usable water of a ground-water reservoir that can be economically withdrawn and consumed each year for an indefinite period of time. It cannot exceed the sum of the *Natural Recharge*, the *Artificial* (or *Induced*) *Recharge*, and the *Incidental Recharge* without causing depletion of the groundwater reservoir. Also referred to as *Safe Yield*.

Yield, Safe — With reference to either a surface- or ground-water supply, the rate of diversion or extraction for *Consumptive Use* which can be maintained indefinitely, within the limits of economic feasibility, under specified conditions of water-supply development. Also see *Perennial Yield*.

Nevada State Water Plan
PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 7
Glossary on Selected Federal, State, and Local Agencies and Organizations

[Source: Nevada Division of Water Planning's *Water Words Dictionary*. Words presented in italics and the referenced appendices may be found in that source.]

(United States) Army Corps of Engineers (Corps or COE) — Originally formed in 1775 during the Revolutionary War by General George Washington as the engineering and construction arm of the Continental Army. Initially, the Corps of Engineers built fortifications and coastal batteries to strengthen the country's defenses and went on to found the Military Academy at West Point, help open the West, and to develop the nation's water resources. In its military role, the COE plans, designs, and supervises the construction of facilities to insure the combat readiness of the U.S. Army and Air Forces. In its civilian role, the COE has planned and executed national programs for navigation and commerce, flood control, water supply, hydroelectric power generation, recreation, conservation, and preservation of the environment. In a very general sense, the U.S. Army Corps of Engineers has a primary responsibility for water projects which protect property from potential flood damage, whereas the (U.S. Department of the Interior) *Bureau of Reclamation (USBR)* is responsible for primarily western water projects with respect to developing water sources for agriculture and commerce. In reality, however, quite often these federal agencies' project goals overlap with USBR's dams and reservoirs providing important flood protection and the COE's water projects — dams, locks, and canals — providing important water transportation linkages and benefits to commerce. The following are the COE's primary missions and objectives. [See Appendix E–2 of the *Water Words Dictionary* for a more complete description of the U.S. Army Corps of Engineers' organizational structure and primary missions and objectives.]

[1] ***Navigation Improvements***—to assist in the development, safety, and conduct of waterborne commerce;

[2] ***Flood Control***—to prevent or reduce flood damages and disruptions by accommodating flood flows in problem areas;

[3] ***Hurricane and Storm Damage Reduction***—preventing or reducing tidal and storm-related damage by building protective structures, such as dams or barriers, in estuaries; by raising the heights of dunes and natural beaches; and by building groins, dikes, seawalls or breakwaters;

[4] ***Coastal and Shoreline Erosion***—protect against ocean and lake shoreline erosion by providing seawalls, groins or other structures that reduce waves' destructive effects; by filling an nourishing beaches and dunes to replace and maintain lost areas; and by planting vegetation that will hold and stabilize erodible materials; by preventing streambank erosion through the use of gabions, riprap and vegetative plantings;

[5] ***Water Supply***—at the request of local interests, include water supply storage in new projects, and modify existing projects for new or additional water supply storage, and in limited emergency circumstances, provide emergency supplies of clean water to a locality confronted by a source of contaminated water likely to cause a substantial threat to public health;

[6] ***Hydroelectric Power***—facilities for hydroelectric power are recognized as primarily the responsibility of non-federal interests; however, the Corps may include hydroelectric power development in multipurpose projects when it complements the major objectives of flood control or navigation;

[7] ***Outdoor Recreation***—facilitate the development of outdoor recreation facilities at Corps projects thereby providing a variety of opportunities for picnicking, camping, swimming, boating, hunting, fishing, hiking, and other pursuits;

[8] ***Environment***—per various federal requirements (*Fish and Wildlife Coordination Act*, *Endangered Species Act*, *National Historic Preservation Act*), a recognition that Corps projects must include not only facilities

to mitigate unavoidable environmental damages, but also considerations of environmental restoration through opportunities created by the projects;

[9] ***Water Quality Control***—per *Federal Water Pollution Control Act* (*Clean Water Act*) requirements, the Corps is required to consider including water storage for regulation of stream flow and quality improvements in is reservoir and lake projects;

[10] ***Aquatic Plant Control***—per the *River and Harbor Act*, the Corps is authorized to conduct research and control or eradicate undesirable aquatic plants through research and application on the use of chemicals, mechanical harvesters, and natural enemies (insects, pathogens, and fish).

(United States) Bureau of Indian Affairs (BIA) — An agency of the U.S. Department of the Interior which has the primary responsibility for exercising the federal government's trust relationship with Indian tribes. The BIA was first established in 1824 in the War Department, then transferred to the Department of the Interior in 1849. The BIA has prime responsibility to provide services to Indian tribes and plays a central role in the settlement process of Indian water rights disputes. The BIA exercises prime trust responsibility in providing federal government protection for Indian resources and federal assistance in resource development and management. Quite often this responsibility complicates the Department of the Interior's other broad responsibilities to manage the use of lands and natural resources on public lands through its *Bureau of Land Management (BLM)* land use programs, its *Bureau of Reclamation (USBR)* water-related projects, and its *U.S. Fish and Wildlife Service (USFWS)* wildlife and habitat restoration programs, which may frequently come in conflict with the Bureau of Indian Affairs Indian water rights issues. [For example, in *Nevada v. United States* (463 U.S. 129{1983}), the United States Supreme Court held that the United States [Department of the Interior] could adequately represent more than one interest simultaneously, and so it is not subject to the same standards as a private trustee. In this case, the Court found that claims made by the United States on behalf of the Pyramid Lake Paiute Indian Tribe to protect fisheries should have been asserted in prior litigation. Nevertheless, the Court found the failure to do so was not a breach of its trust obligations to the tribe, even though the United States also had protected the competing interests of non-Indian irrigators.] Also see *Negotiated Settlement* and *Truckee River Operating Agreement (TROA).*

(United States) Bureau of Land Management (BLM) — An agency of the U.S. Department of the Interior responsible for the stewardship of the nation's public lands. The Bureau of Land Management is committed to the sustained management, protection, and improvement of these lands in a manner consistent with the needs of the American people. The BLM's management philosophy is based on the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. The resources under the BLM's oversight include recreation, rangelands, timber, minerals, watersheds, fish and wildlife, wilderness, air, and scenic, scientific and cultural values. The BLM oversees the largest natural resource base in the federal government. This base includes 270 million acres of public lands ranging from old growth forests in the Pacific Northwest to sun drenched desert ecosystems in the Southwest to Arctic tundra in Alaska. The BLM also supervises mineral leasing and operations on an additional 300 million acres of federal mineral estate that underlie other surface ownerships. BLM managed public lands provide habitat for thousands of wildlife and plant species, including some 220 federally-listed threatened and endangered species and 1,200 species considered candidates for listing. The BLM manages over 169,000 miles of fish bearing streams and more than 50 million acres of forested lands. In addition, the BLM is caretaker of an estimated 4 million cultural properties, including 400 listed in the *National Register of Historic Places*. The BLM also manages more than 1.6 million acres of designated wilderness and 22.8 million acres of wilderness study areas. More than 46,500 wild horses and burros roam BLM land in the West. The BLM permits and manages various uses of the public lands, including grazing, mining, recreation, and timber operations. These activities traditionally have been managed on an individual basis. However, more recently the BLM's management efforts have shifted to a more comprehensive ecosystem basis of managing such lands to insure sustained benefits for future generations of Americans. The Bureau of Land Management has its headquarters office in Washington, D.C. There are an additional eleven state offices for managing resources in the western states of Alaska, Arizona, California, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, and Wyoming. BLM resources for the Eastern United States are managed out of Springfield, Virginia. The BLM also supports a National Interagency Fire Center (NIFC) in Boise, Idaho as well as a public information service center (SC) in Denver, Colorado and a centralized employee training center in Phoenix, Arizona. In Nevada alone, the BLM manages some 48 million acres of public lands or approximately 67 percent of all lands in Nevada.

(United States) Bureau of Reclamation (USBR) — An agency of the U.S. Department of the Interior responsible for many of the dam, reservoir, and irrigation projects in the Western United States. The USBR reclamation program was authorized by the Reclamation Act of 1902 which was initially intended to reclaim the arid and semiarid lands of the Western United States by conserving and supplying irrigation water to make them productive. Since that beginning, the USBR's mission has expanded considerably to include multipurpose water development by providing water for irrigation, hydroelectric power, water for homes, businesses and factories, outdoor recreation, flood control, fish and wildlife enhancement, improved water quality, river regulation and control, and other related uses of water. Currently the USBR administers some 322 storage dams, 14,490 miles of canals, 174 pumping plants, and 50 hydroelectric plants. USBR water irrigates 146,000 farms in the West, provides part or all the water needs on nearly 10 million acres, yielding enough food for 33 million people, and also provides 620 billion gallons of water a year of municipal and industrial use in western towns and cities. In terms of its original intent and broad governing guidelines, the U.S. Bureau of Reclamation is primarily responsible for water projects with respect to developing water sources for agriculture and commerce, while the *U.S. Army Corps of Engineers (COE)* has had primary responsibility for water projects which protect property from potential flood damage. In reality, however, quite often these federal agencies' project goals overlap with USBR's dams and reservoirs providing important flood protection and the COE's water projects—dams, locks, and canals—providing important water transportation linkages and benefits to commerce.

Colorado River Commission [Nevada] — An agency of the State of Nevada consisting of seven members, to include four members appointed by the Governor and three members from the *Southern Nevada Water Authority* Board of Directors. The Colorado River Commission has broad statutory authority to establish policies for the management of Nevada's allocation of power and water resources from the Colorado River and for the development of designated land in Southern Nevada.

Department of Conservation And Natural Resources [Nevada] — The mission of the Department is to conserve, protect, manage, and enhance the Nevada's natural resources in order to provide the highest quality of life for Nevada's citizens and visitors. The Department consists of nine divisions and/or agencies which include:

[1] ***Division of Conservation Districts*** — Regulates the activities of the state's locally elected conservation districts which work for the conservation and proper development of the state's renewable natural resources by providing services to individual landowners and coordination with other public and private agencies.

[2] ***Division of Environmental Protection (DEP)*** — Responsible for the administration and enforcement of all environmental statutes and regulations; issues permits, monitors for air and water pollution and inspects solid and hazardous waste management. The Division consists of the *Bureau of Air Quality*, the *Bureau of Water Pollution Control*, *Bureau of Mining Regulation and Reclamation*, *Bureau of Water Quality Planning*, *Bureau of Corrective Actions*, *Bureau of Waste Management*, and the *Bureau of Federal Facilities*. The *State Environmental Commission* is also part of the Division and is responsible for adopting necessary environmental rules, regulations and plans authorized by statute. [See Appendix E–4 for a more complete description of DEP's functional responsibilities.]

[3] ***Division of Forestry*** — Manages and coordinates all forestry, nursery, endangered plant species and watershed resource activities on certain public and private lands; responsible for protecting structural and natural resources through fire protection, prevention and suppression. The Division also conducts the Forestry Conservation Camps Program which coordinates and supervises the outside work performed by inmates residing in Department of Prison conservation camps.

[4] ***Division of State Lands*** — Acquires, holds, and disposes of all state lands and interests in lands; provides technical land-use planning assistance, training, and information to local units of government or other agencies; develops policies and plans for the use of lands under federal management and represents the state in its dealings with the federal land management agencies.

[5] ***Division of State Parks*** **—** Plans, develops, and maintains a system of parks and recreational areas for the use and enjoyment of residents and visitors. The Division also preserves areas of scenic, historic, and scientific significance in Nevada.

[6] ***Division of Water Planning*** — Provides technical, financial and economic assistance to government agencies and individual citizens concerning regional and local water supplies; develops and implements a statewide water resource management plan and policy initiatives on a watershed basis; conducts hydrologic, climatologic, and socioeconomic data collection, research, modeling, forecasting and data analysis; develops and implements water resource public information and education programs; provides technical and financial assistance and outreach programs to assist local governments, watershed planning groups, and other agencies with respect to water resource matters; and develops and implements a statewide water conservation program.

[7] ***Division of Water Resources*** — Responsible for protecting the health and safety of Nevada citizens through the appropriation of public waters. Other responsibilities include the adjudication of claims of vested water rights; distribution of water in accordance with court decrees; review of water availability for new major construction and housing projects; review of the construction and operation of dams; appropriation of geothermal resources; licensing of well drillers and water right surveyors; review of flood control projects; maintenance of water resource data and records; and providing technical assistance to government boards, offices, and agencies.

[8] ***Division of Wildlife* —** Preserves, protects, manages and restores wildlife and its habitat within the state for aesthetic, scientific, recreational and economic benefits; tasked with promoting safety for persons and property in the operation of equipment and boating vessels

[9] ***Natural Heritage Program* —** Serves as a centralized repository containing detailed information on sensitive (threatened and endangered) species of animals, plants, and communities; provides information on biology, habitats, locations, population and conservation status, and management needs.

(United States) Department of the Interior (USDI) — Originally established by Congress in 1849 as the executive department of the United States government, the USDI's function has changed from that of performing housekeeping duties for the federal government to its present role as custodian of the nation's natural resources. As the nation's principal conservation agency, the USDI has the responsibility of protecting and conserving the country's land, water, minerals, fish, and wildlife; of promoting the wise use of all these natural resources; of maintaining national parks and recreation areas; and of preserving historic places. It also provides for the welfare of American Indian reservation communities and of inhabitants of island territories under U.S. administration. As of 1988 the USDI managed more than 220 million hectares (550 million acres, or 850,000 square miles) of federal resource lands; about 340 units of the national park system; 70 fish hatcheries, and 442 *National Wildlife Refuges (NWF)*; and numerous reclamation dams that provide water, electricity, and recreation. The USDI also constructs irrigation works, enforces mine safety laws, makes geological surveys and prepares maps, conducts mineral research, and administers wild and scenic rivers as well as national and regional trails. The USDI is currently in charge of the *Bureau of Indian Affairs (BIA)*, the *U.S. Fish and Wildlife Service (USFWS)*, the *National Park Service (NPS)*, and the *U.S. Geological Survey (USGS)*. It also oversees the Bureau of Mines, which is responsible for ensuring that the nation has adequate mineral supplies and for overseeing and evaluating all aspects of minerals research; the *U.S. Bureau of Land Management (BLM)*, which manages public lands and their resources; the *U.S. Bureau of Reclamation (USBR)*, which assists local governments in reclaiming arid lands in western states and provides programs for hydro-electric power generation, flood control, and river regulation; the Minerals Management Service, which deals with leasable minerals on the Outer Continental Shelf and ensures efficient recovery of mineral resources; and the Office of Surface Mining Reclamation and Enforcement, which helps to protect the environment from adverse effects of mining operations. Other agencies under the USDI's jurisdiction include the Office of Small and Disadvantaged Business Utilization and the Office of Territorial and International Affairs.

Department of Water Resources (DWR) [California] — The California state agency within *The Resources Agency* that is responsible for long-term water planning, operation of the *State Water Project*, and state water conservation programs. The basic goal of the DWR is to ensure that California's needs for water supplies, water-related recreation, fish and wildlife, hydroelectric power, prevention of damage and loss of life from floods and dam failure, and water-related environmental enhancements are met; and to ensure that the manner in which these needs are fulfilled is consistent with public desires and attitudes concerning environmental and social considerations. The *California Water Commission*, also within The Resources Agency, serves as a policy advisory body to the Director of the DWR on matters within the department's jurisdiction and coordinates state and local views on federal appropriations for water projects in California. The commission also conducts public hearings and investigations statewide for the department and provides an open forum for interested citizens to voice on water development issues. The *California State Water Resources Control Board (SWRCB)*, located within the California Environmental Protection Agency, is assigned the responsibility to protect water quality and allocate water rights.

Desert Research Institute (DRI) [Nevada] — The Desert Research Institute was created in 1959 by an act of the Nevada Legislature as a unit of the University of Nevada. When the University of Nevada System was formed in 1968, DRI became an autonomous, nonprofit division of this system. Since that time DRI has grown to be one of the world's largest multi-disciplinary environmental research organizations focusing on arid lands. The DRI operates from statewide facilities in Las Vegas, Reno, Stead, Laughlin, and Boulder City. The DRI's activities are directed from five research centers representing the ***Geosphere*** (Quaternary Sciences Center), ***Hydrosphere*** (Water Resources Center), ***Biosphere*** (Biological Sciences Center), and ***Atmosphere*** (Atmospheric Sciences Center and Energy and Environmental Engineering Center). Multi-disciplinary teams drawn from these centers are assembled to address basic and applied research problems on a project-by-project basis. Listed below are the DRI's five research centers and their primary mission statement. [See Appendix E–3 of the *Water Words Dictionary* for a more complete listing of the DRI's major laboratories operated and the principal skills and activities supported.]

[1] ***Atmospheric Sciences Center (ASC)*** — The ASC is a nationally recognized leader in the field of atmospheric sciences. The ASC's mission is to improve the fundamental understanding of the earth's atmosphere, particularly as it relates to the weather and to the climate of arid regions. The ASC is the home of the strongest atmospheric modification research program in the United States.

[2] ***Biological Sciences Center (BSC)*** — The BSC focuses on plant and soil biology from an ecological perspective. The BSC's mission is to improve the fundamental understanding of the earth's biosphere, thereby providing the knowledge needed to effectively manage biological resources important to the future use and habitation of the earth.

[3] ***Energy and Environmental Engineering Center (EEEC)*** — The EEEC largely conducts air resources research. The EEEC's mission is to conduct high-quality research to understand current and future human impacts on the environment, especially air quality, an the technology that can be applied to mitigate these impacts.

[4] ***Quaternary Sciences Center (QSC)*** **—** The QSC is one of approximately 15 Quaternary research programs worldwide. The QSC's mission is to improve the fundamental understanding of past climates and associated environmental responses and human adaptations to climate change during the Quaternary Period (covering the last 1.8 million years).

[5] ***Water Resources Center (WRC)*** — The WRC is the largest water research group focused on arid lands in the United States. The WRC's mission to improve the fundamental understanding and knowledge of hydrologic systems, with special emphasis on arid lands, for more effective management of hydrologic resources.

(State) Division of Health [Nevada] — An agency within the Department of Human Resources, State of Nevada, whose primary water-related mandate (Nevada Revised Statutes 445.361) is "to provide water which is safe for drinking and other domestic purposes and thereby promote the public health and welfare." The Division serves as the primacy agency for the *Public Water System Supervision Program (PWSSP)* as authorized under the federal *Safe Drinking Water Act (SDWA) [Public Law 93–523]* and its amendments. The Division implements State Board of Health regulations which address drinking water monitoring and quality, public water system construction, and public water system operator certification. To accomplish its tasks, the Division consists of a number of Boards and Bureaus, to include:

[1] ***State Board of Health*** — Advises the Health Division Administrator on matters relating to public health and welfare.

[2] ***State Health Officer*** — Primary state adviser on matters pertaining to medical health; oversees the activities of the Bureau of Laboratory Services, Bureau of Community Health Services, Bureau of

Family Health Services, Bureau of Disease Control and Intervention Services, and the Bureau of Health Planning.

[3] ***Bureau of Health Protection Services*** — Provides for safe drinking water, health engineering, sanitation (food, dairy, drugs and cosmetics), and radiological health matters.

[4] ***Bureau of Laboratory Services*** — Microbiology lab, chemistry lab, research and testing on community water systems.

[5] ***Bureau of Community Health Services*** — Family planning, community health nursing, and clinic services.

[6] ***Bureau of Family Health Services*** — Genetics, special children's clinic, children's dental services, newborn screening, and health promotion and education.

[7] ***Bureau of Health Planning*** — State health plan, primary care development center, state center for health statistics, tobacco control initiative.

[8] ***Bureau of Disease Control and Intervention Services*** — Programs dealing with surveillance, immunization, TB control.

[9] ***Bureau of Licensure and Certification*** — Programs dealing with health facilities, laboratory personnel certification, emergency medical services and trauma.

[10] ***Bureau of Administrative Services*** — Fiscal management, personnel, affirmative action, legal services, vital records, and cancer registry.

(United States) Environmental Protection Agency (EPA) — The U.S. Environmental Protection Agency (EPA) is responsible for implementing the federal laws designed to protect the environment. EPA endeavors to accomplish it mission systematically by proper integration of a variety of research, monitoring, standard-setting, and enforcement activities. As a complement to its other activities, EPA coordinates and supports research and anti-pollution activities of state and local governments, private and public groups, individuals, and educational institutions. EPA also monitors the operations of other Federal agencies with respect to their impact on the environment. EPA was created through Reorganization Plan #3 of 1970, which was devised to consolidate the federal government's environmental regulatory activities into a single agency. The plan was sent by the President to Congress on July 9, 1970, and the agency began operation on December 2, 1970. EPA was formed by bringing together 15 components from 5 executive departments and independent agencies. Air pollution control, solid waste management, radiation control, and the drinking water program were transferred from the Department of Health, Education, and Welfare (now the Department of Health and Human Services). The federal water pollution control program was taken from the Department of the Interior, as was part of a pesticide research program. From the Department of Agriculture, EPA acquired authority to register pesticides and to regulate their use, and from the Food and Drug Administration, EPA inherited the responsibility to set tolerance levels of pesticides in food. EPA was assigned some responsibility from the Atomic Energy Commission, and absorbed the duties of the Federal Radiation Council. The enactment of major new environmental laws and important amendments to older laws in the 1970s and 1980s greatly expanded EPA's responsibilities. The agency now administers ten comprehensive environmental protection laws:

[1] Clean Air Act (CAA)
[2] Clean Water Act (CWA)
[3] Safe Drinking Water Act (SDWA)
[4] Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or "Superfund")
[5] Resource Conservation and Recovery Act (RCRA)
[6] Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
[7] Toxic Substances Control Act (TSCA)
[8] Marine Protection, Research, and Sanctuaries Act (MPRSA)
[9] Uranium Mill Tailings Radiation Control Act (UMTRCA)
[10] Pollution Prevention Act

The primary mandates for the water-related programs administered through the EPA Water Management Division are the *Federal Water Pollution Control Act (Public Law 92–500)*, as amended, commonly referred to as the *Clean Water Act (CWA)*, and the *Safe Drinking Water Act (SDWA — Public Law 93–523)*. The CWA addresses the discharge of pollutants from point and nonpoint sources into waters of the United States (as defined). The goal of the SDWA is to protect public health over lifetime exposure to drinking water by ensuring that the source water as well as the system storage distribution and service lines are free and protected from contamination. EPA water-related programs establish national and regional objectives, promote delegation of programs to states (primacy), and support that delegation in a manner that ensures achievement of required objectives. Also see *Science Advisory Board (SAB)*. The following constitute the principal offices of the EPA. [See Appendix E–1 of the *Water Words Dictionary* for a more complete description of the organizational structure of the U.S. Environmental Protection Agency and a description of each office's functions.]

[1] Office of the Administrator (OA)
[2] Office of Administration and Resources Management (OARM)
[3] Office of Enforcement (OE)
[4] Office of General Counsel (OGC)
[5] Office of Policy, Planning, and Evaluation (OPPE)
[6] Office of International Activities (OIA)
[7] Office of Inspector General (OIG)
[8] Office of Water (OW)
[9] Office of Solid Waste and Emergency Response (OSWER)
[10] Office of Air and Radiation (OAR)
[11] Office of Prevention, Pesticides and Toxic Substances (OPPTS)
[12] Office of Research and Development (ORD)

Federal Emergency Management Agency (FEMA) — An independent agency of the federal government founded in 1979 and reporting to the President of the United States and headquartered in Washington D.C. FEMA's mission is to reduce loss of life and property and protect our nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery. Primary support functions of FEMA include; (1) advising on building codes and flood plain management; (2) teaching people how to get through a disaster; (3) helping equip local and state emergency preparedness; (4) coordinating the federal response to a disaster; (5) making disaster assistance available to states, communities, businesses and individuals; (6) training emergency managers; (7) supporting the nation's fire service; and (8) administering the national flood and crime insurance programs (*National Flood Insurance Program*). FEMA's operating directorates consist of: (1) Mitigation Directorate; (2) Information Technology Directorate; (3) Federal Insurance Administration (Program); (4) Operations Support Directorate; (5) Preparedness Directorate; (6) Response and Recovery Directorate; (7) United States Fire Administration; and (8) ten Regional Offices. FEMA's ten regions, Federal Regional Centers, and states included in each region are:

[1] Region I (Boston, Massachusetts) — Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont;
[2] Region II (New York, N.Y., Caribbean Division – San Juan, Puerto Rico) — New York, New Jersey, the Commonwealth of Puerto Rico and the Territory of the U.S. Virgin Islands;
[3] Region III (Philadelphia, Pennsylvania) — District of Columbia, Delaware, Maryland, Pennsylvania, Virginia, West Virginia;
[4] Region IV (Atlanta, Georgia) — Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee;
[5] Region V (Chicago, Illinois) — Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin;
[6] Region VI (Denton, Texas) — Arkansas, Louisiana, New Mexico, Oklahoma and Texas;
[7] Region VII (Kansas City, Missouri) — Iowa, Kansas, Missouri, Nebraska;
[8] Region VIII (Denver, Colorado) — Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming;
[9] Region IX (San Francisco, California) — Arizona, California, Hawaii and Nevada; and the Territory of American Samoa, the Territory of Guam, the Commonwealth of the Northern Mariana Islands, the Republic of the Marshall Islands, the Federated States of Micronesia, and the Republic of Palau;
[10] Region X (Bothell, Washington) — Alaska, Idaho, Oregon and Washington.

(United States) Fish and Wildlife Service (USFWS) — Part of the U.S. Department of the Interior, the early beginnings of the Fish and Wildlife Service go back to 1871 when the federal government established the Commissioner of Fisheries. In 1896, the Division of Biological Survey was established within the Department of Agriculture. In 1939, these functions were transferred to the Department of the Interior. Then in 1940, these functions were formally consolidated and redesignated as the Fish and Wildlife Service. Further reorganization came in 1956 when the Fish and Wildlife Act created the Bureau of Sport Fisheries and Wildlife. An amendment to this act in 1974 designated the Bureau as the U.S. Fish and Wildlife Service. Today the USFWS consists of a headquarters in Washington, D.C., eight regional offices, and over 700 field units and installations. Included are more than 470 National Wildlife Refuges, comprising more than 90 million acres, 57 fish and wildlife research laboratories and field units, 43 cooperative research units at universities across the country, nearly 135 national fish hatcheries and fishery assistance stations, and a nationwide network of law enforcement agents and biologists. The functions of the USFWS primarily includes the following:

[1] Acquires, protects and manages unique ecosystems necessary to sustain fish and wildlife, such as migratory birds and endangered species;

[2] As specified in the *Endangered Species Act (ESA)* (1973), as amended, and in conjunction with the *National Marine Fisheries Service (NMFS)*, determines critical habitat and develops recovery plans for protected endangered and threatened species of plants and animals;

[3] Operates fish hatcheries to support research, develop new techniques and fulfill the public demand for recreational fishing;

[4] Operates wildlife refuges to provide, restore, and manage a national network of lands and waters sufficient in size, diversity and location to meet society's needs for areas where the widest possible spectrum of benefits associated with wildlife and wildlands is enhanced and made available;

[5] Conducts fundamental research on fish, wildlife and their habitats to provide better management and produce healthier and more vigorous animals; also protects fish and wildlife from dislocation or destruction of their habitats;

[6] Renders financial and professional assistance to states, through federal aid programs, for the enhancement and restoration of fish and wildlife resources;

[7] Establishes and enforces regulations for the protection of migratory birds, marine mammals, fish and other non-endangered wildlife from illegal taking, transportation or sale within the United States or from foreign countries; and

[8] Communicates information essential for public awareness and understanding of the importance of fish and wildlife resources, and changes reflecting environmental degradation that ultimately will affect the welfare of human beings.

Also see *National Wildlife Refuge System*, *Endangered Species Act (ESA)*, *Endangered Species*, *Threaten Species*, and *National Oceanic and Atmospheric Administration (NOAA)*.

(United States) Forest Service (USFS) — The largest and most diverse agency of the U.S. Department of Agriculture, the Forest Service provides leadership in the management, protection, and use of the nation's forests and rangelands, which comprise almost two-thirds of the nation's federally owned lands. The creation of the Forest Service go back to 1891 when the President was authorized to establish Forest Reserves from forest and range lands in the *Public Domain*. In 1905 the responsibilities for the management and protection of these Forest Reserves was transferred from the Department of the Interior to the Department of Agriculture and the Forest Service was formally established. The Forest Reserves were then renamed National Forests. Today the Forest Services manages 156 National Forests, 19 National Grasslands, and 16 Land Utilization Projects that make up the National Forest System located in 44 states, Puerto Rico, and the Virgin Islands. Much of the nation's fresh water supply flows from National Forest System lands and insuring adequate yields of high quality water and continuing soil productivity are primary aims of the Forest Service's watershed management programs. The Forest Service manages more than 14 percent of the nation's 1.2 billion acres of forest range. This National Forest System (NFS) rangeland is managed to conserve the land and its vegetation while providing food for both domestic livestock and wildlife. The Forest Service manages fish and wildlife habitat on the National Forests and National Grasslands in cooperation with the individual states' fish and game departments. Of the 191 million acres of National Forests, 86.5 million acres are classified as commercial forests, available for, and capable of, producing crops of industrial wood. National Forest timber reserves are managed on a sustained-yield basis to produce a continuous supply of wood products to meet the nation's economic demands while maintaining the productive capacity of these lands. In 1924 the Forest Service pioneered the establishment of wilderness areas on National Forest lands. National Forest lands are a major source of mineral and energy supplies with regulatory and management responsibilities for mineral activities shared with the Department of the Interior, Bureau of Mines. The Forest Service, with one of the world's largest wildland firefighting forces, provides direct fire protection and control for National Forest System lands as well as cooperative fire control on several million additional acres. The Forest Service is responsible for the forest management aspects of the Watershed Protection and Flood Prevention Program administered by the *Natural Resources Conservation Service (NRCS)*. The Forest Service also participates in the forestry aspects of the River Basin Program, which guides and coordinates water and related land resource planning among several federal departments. The Forest Service operates an extensive forestry research program consisting of eight Forest and Range Experiment Stations, a Forest Products Laboratory, and 75 research labs located throughout the U.S., Puerto Rico, and the Pacific Trust Territories. The Forest Service is organized into nine (9) regions as listed below (regional headquarters are in parentheses):

[1] ***Eastern Region*** (Milwaukee, Wisconsin) — Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, West Virginia, Ohio, Indiana, Michigan, Illinois, Missouri, Iowa, Wisconsin, Minnesota;
[2] ***Southern Region*** (Atlanta, Georgia) — Virginia, North Carolina, South Carolina, Kentucky, Tennessee, Georgia, Florida, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas;
[3] ***Rocky Mountain Region*** (Denver, Colorado) — South Dakota, Nebraska, Kansas, Wyoming, Colorado;
[4] ***Northern Region*** (Missoula, Montana) — North Dakota, Montana, Idaho (northern part only), South Dakota (northwest corner only), Wyoming (northwest corner only);
[5] ***Intermountain Region*** (Ogden, Utah) — Nevada, Utah, Idaho (except northern portion), Wyoming (western portion only);
[6] ***Southwest Region*** (Albuquerque, New Mexico) — Arizona, New Mexico;
[7] ***Pacific Northwest Region*** (Portland, Oregon) — Washington, Oregon;
[8] ***Pacific Southwest Region*** (San Francisco, California) — California, Hawaii;
[9] ***Alaska Region*** (Juneau, Alaska) — Alaska.

(United States) Geological Survey (USGS) — An agency of the U.S. Department of Interior responsible for providing extensive earth-science studies of the Nation's land, water, and mineral resources. The USGS was established by an act of Congress on March 3, 1879, to provide a permanent federal agency to conduct the systematic and scientific "classification of the public lands, and examination of the geological structure, mineral resources, and products of national domain." An integral part of that original mission is to publish and distribute the earth-science information needed to understand, plan the use of, and manage the nation's energy, land, mineral, and water resources. Since 1879, the research and fact-finding role of the USGS has grown and been modified to meet the changing needs of the nation it serves. As part of that evolution, the USGS has become the map-making agency for the federal government, the primary source of data on surface- and ground-water resources of the nation, and the employer of the largest number of professional earth scientists. The USGS is organized into three operational Divisions: the National Mapping Division (NMD), charged with development and application of mapping and *Geographic Information System (GIS)* technology; the Geologic Division (GD), which conducts geologic mapping and research; and the Water Resources Division (WRD). The mission of the Water Resources Division of the USGS is to provide the hydrologic information and understanding needed to manage the nation's water resources to benefit its residents. Typical water resource programs sponsored by the WRD include:

[1] Data collection to aid in evaluating the quantity, quality, distribution, and use of the nation's water resources;
[2] Analytical and interpretive water-resources appraisals to describe the occurrence, quality, and availability of surface and ground water throughout the nation;
[3] Basic and problem-oriented research in hydraulics, hydrology, and related fields of science and engineering;
[4] Scientific and technical assistance in hydrology to other federal, state, and local agencies;
[5] Development and maintenance of national computer data bases and associated Geographic Information Systems (GIS) of hydrologic data — streamflow, water quality and biology, groundwater characteristics, and water use; and
[6] Public distribution of water-resources data and results of water-resources investigations through reports, maps, computerized information services, and other forms of release.

Programs of the Water Resources Division are funded under three types of arrangements:

[1] *Federal Program* — funding is appropriated directly to USGS by the U.S. Congress for projects of national interest;

[2] *Cooperative Program* — funding is shared by USGS and interested state and local agencies; and

[3] *Other Federal Agencies (OFA) Program* — funding is supplied by federal agencies requesting technical assistance from the USGS.

The Water Resources Division's headquarters is at the USGS National Center in Reston, Virginia. Regional offices are maintained in Reston; Atlanta, Georgia; Denver, Colorado; and Menlo Park, California. With the exception of the National Research Program (NRP) centers at Reston, Denver, and Menlo Park, most of the WRD program is distributed to 51 USGS District Offices organized by state boundaries.

National Oceanic and Atmospheric Administration (NOAA) — An agency of the U.S. Department of Commerce, the National Oceanic and Atmospheric Administration was formed in 1970, but its origins may actually be traced as far back as 1807 when President Thomas Jefferson ordered a survey of the new nation's coastline. Today, NOAA has translated the United States' geographic, atmospheric, oceanic, and meteorological informational needs into an organization concentrating in the following principal areas:

[1] ***Research and Analysis*** — NOAA researchers and scientists in the areas of oceanography, meteorology, biology, and physics explore the sea and air for new clues aimed at understanding or reversing environmental damage such as ozone depletion, the greenhouse effect, and possible global warming;

[2] ***Satellite Imaging and Mapping*** — NOAA's satellites provide essential information for accurate weather forecasts, monitor winter snowpack conditions across the country, and gauge the health of coastal estuaries;

[3] ***Data Compilation and Dissemination*** — The results of NOAA's data collection, satellite mapping, and research and analysis affords vast stores of information in NOAA's global data centers available for climate, oceanographic and geophysical reports vital to the public and industry;

[4] ***Forecasting and Weather Warning*** — Through the National Weather Service (NWS), NOAA provides extensive information and warnings when severe weather threatens life and property.

The National Oceanic and Atmospheric Administration consists of a number of separate agencies to effect these research, analysis, monitoring, informational, and forecasting requirements.

[1] ***National Weather Service (NWS)*** — The National Weather Service operates a vast network of automated weather stations around the nation equipped with sophisticated doppler radar systems on the ground as well as sophisticated satellites providing detailed imaging which provide meteorologists and citizens early warnings of severe weather conditions. In cooperation with the Federal Aviation Administration (FAA), the NWS is proceeding with establishing some 1,000 fully automated weather data collection sites, termed *Automated Surface Observing Systems (ASOS)*.

[2] ***National Ocean Service (NOS)*** — The National Ocean Service charts and surveys America's coastal waterways, providing safe passage for commerce and recreation interests. The NOS also plays a major role in managing America's coastlines and NOAA's *Coastal Zone Management Program* strives to protect wetlands, water quality, beaches, wildlife, and other important resources and uses of our coasts. As part of the NOS, NOAA's *National Marine Sanctuaries*, the nation's underwater national parks, provide unique undersea preserves to protect important coastal resources. The NOS monitors the health of the coast and probes how our use of the nation's nearshore waters affects the environment.

[3] ***National Environmental Satellite, Data and Information Service (NESDIS)*** — The NESDIS operates the world's largest environmental data storage and distribution facility providing extensive and highly detailed data on weather, the oceans and geophysics. The NESDIS is also responsible for NOAA's polar orbiting and geostationary satellites which provide important information on the oceans and atmosphere. Other NESDIS satellites collect images of cloud and storm patterns which are then relayed to NOAA's National Weather Service and are extensively used by the nation's meteorologists for local weather reporting and forecasting.

[4] ***National Marine Fisheries Service (NMFS)*** — The NMFS serves as steward for America's living marine resources, conducting research necessary to manage these valuable resources and enforces

fishery regulations, maintains the wholesomeness of U.S. seafood products, and protects coastal fishery habitats and nurseries. The NMFS manages the 32 federal fishery resource plans, covering more than 230 species, and plays a key role in protecting coastal habitats, marine mammals and endangered and threatened species per the *Endangered Species Act (ESA)*.

[5] ***Office of Oceanic and Atmospheric Research*** — NOAA's scientists conduct leading edge research on weather, climate, air quality, the oceans and the Great Lakes through a network of environmental laboratories and monitoring stations as well as through university researchers supported by NOAA through the *National Sea Grant College Program* and the *National Undersea Research Program*.

[6] ***NOAA Corps*** — NOAA also operates the nation's smallest uniformed service consisting of some 400 officers commanding NOAA's fleet of hurricane hunter aircraft and environmental research ships providing in a variety of scientific and research operations.

National Weather Service (NWS) — An agency of the (U.S. Department of Commerce) *National Oceanic and Atmospheric Administration (NOAA)*, the primary mission of the National Weather Service is to protect life and property and enhance the nation's economy by providing warnings and forecasts of hazardous weather, including thunderstorms, flooding, hurricanes, tornadoes, winter weather, and tsunamis. The primary customer of the NWS is the private weather industry whose meteorologists receive data and information directly from the NWS and incorporate it into local news reports. The NWS also operates its own radio network; the *NOAA Weather Radio* is the sole government radio system providing direct warnings of hazardous weather conditions and natural disasters to private citizens through a network of 390 transmitters across the nation. The NWS provides short and long-range forecasts, severe weather warnings, and atmospheric data continually to private weather vendors for a fee using a telephone data transmittal system called *Family of Services*. NWS Doppler radar data is provided through the NWS *NEXRAD Information Dissemination Service (NIDS)* and is available from commercial weather vendors under an agreement with the NWS. The *NOAA Weather Wire Service* is the primary NWS telecommunications network for NWS forecasts, warnings, and other products to the mass media (TV, radio, newspaper) and emergency management agencies. It consists of a satellite communications system operated under contract by GTE/Contel. In a joint effort with the Federal Aviation Administration (FAA), some 250 NWS manual data collection field offices will be replaced with approximately 1,000 automated data collections sites, termed *Automated Surface Observing Systems (ASOS)*, thereby greatly enhancing both the timeliness and frequency of the NWS weather reporting capabilities.

(United States) Natural Resources Conservation Service (NRCS) — Formerly known as the *Soil Conservation Service (SCS)*, an agency of the U.S. Department of Agriculture, the Natural Resources Conservation Service (NRCS) had its beginnings with a 1929 emergency act of Congress in response to the famous Dust Bowl when land practices, primarily in the Midwest Farm Belt, caused extensive soil erosion and threatened the food production of the United States. Initially, ten experiment stations were established to work with Land Grant Universities to study soil erosion and ways to prevent it. As a result of these initial efforts, the Soil Erosion Service was established in 1933 to show American farmers new ways of preventing and recovering from soil erosion. In 1935 Congress changed the Soil Erosion Service into the Soil Conservation Service and made it a permanent agency of the U.S. Department of Agriculture. In 1994 the name was change to Natural Resources Conservation Service to denote a broader role of responsibility in natural resource conservation. Presently, the NRCS works in three primary areas: (1) soil and water conservation; (2) resource inventories; and (3) rural community development. These activities are covered under a number of direct NRCS programs, involving only NRCS resources, and NRCS assisted programs, involving the NRCS and at least one other government agency.

Direct NRCS Programs:

[1] Technical Assistance
[2] Great Plains Conservation Program
[3] Watershed Protection, Long-Term Contracts (Public Law 566)
[4] USDA Compliance Plans

NRCS Assisted Programs:

[1] Agriculture Conservation Program
[2] Water Bank Program
[3] Colorado River Salinity Control Program

[4] Conservation Reserve Program
[5] Water Quality Incentive Program
[6] Emergency Conservation Program
[7] Wetlands Reserve Program

Newlands (Irrigation) Project [Nevada] — One of the first Department of the Interior, *U.S. Bureau of Reclamation (USBR)* (U.S. Reclamation Service at that time) irrigation projects completed in the United States. The project was authorized originally as the *Truckee–Carson Irrigation Project* on March 14, 1903 by the Secretary of the Interior and was renamed the Newlands Project in 1919 in honor of Nevada Senator Francis G. Newlands, who originally sponsored the 1902 Reclamation Act. Derby Dam, located on the lower Truckee River, was completed in June 1905 to divert waters from the Truckee River Basin to the Carson River. In August 1906 the Truckee Canal was completed between the Truckee and Carson rivers. Waters began flowing through this canal in 1906 while 1907 proved to be the first full year of irrigation. Lahontan Reservoir was completed in 1915 on the Carson River to receive Truckee River waters through the Truckee Canal and provided a more stable supply of water for irrigation needs to a defined service area in the Town of Fernley and the lower Carson River Basin near the City of Fallon, Churchill County, in western Nevada. The project originally (1902) called for the possible irrigation of up to 450,000 acres; however, this figure was continually reduced, finally to approximately 73,000 acres when it was found, after much legal controversy, that the full use of the waters of Lake Tahoe would not be available. Soon after the project was authorized, this figure of irrigable acreage was reduced to 210,000 acres in 1904, to 172,000 acres in 1910, and to 97,400 acres in 1925, of which 73,301 acres were determined to be irrigable in 1926. The project's service area currently consists of approximately 73,800 acres of land that are entitled to receive irrigation water, of which only approximately 58,000–60,000 acres are actually irrigated. Water for these lands is supplied from the Truckee and Carson rivers. Water from the Truckee River is diverted to the Carson River Basin at Derby Dam via the 32.5–mile long Truckee Canal. Since its completion, the Newlands Project has been embroiled in controversy resulting from intense competition for the limited water from these two rivers. Controversy has centered on the actual number of acres with legal water rights, the classification of irrigation lands as *Bench Land* or *Bottom Land* (which determines the applicable water duty — 4.5 AF/year or 3.5 AF/year, respectively), the maximum allowable water duty, the efficiency of project operations, and the volume of water diverted from the Truckee River's terminus, Pyramid Lake. In 1967, *Operating Criteria and Procedures (OCAP)* were first instituted in order to maximize the use of Carson River flows to satisfy project requirements and to minimize water diversions from the Truckee River at Derby Dam. Even so, controversy continued and in 1973, the Federal District Court in Washington, D.C. ordered the implementation of a new OCAP for this project. Amid continued controversy, in 1985 the Bureau of Reclamation published an *Environmental Assessment (EA)* which examined an alternative OCAP. Based on comments to this 1985 EA, the Bureau of Reclamation made the decision to initiate an *Environmental Impact Statement (EIS)*. A final OCAP was approved in 1988. *Public Law 101–618*, enacted on November 16, 1990, (also referred to as the *Negotiated Settlement*), requires the current OCAP to remain in effect at least through December 31, 1997, and is intended to allow all principal parties to develop a new *Truckee River Operating Agreement (TROA)*. A major issue has been to secure an adequate water supply (both as to quantity and quality) to preserve Pyramid Lake and protect its environmentally sensitive fish species, the endangered cui-ui (*Chasmistes cujus*) and the threatened Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*).

(The) Resources Agency [California] — The mission of the California Resources Agency is to oversee the state's activities relating to the conservation, management, and enhancement of California's natural and cultural resources; including land, wildlife, water, and minerals. The administrative head of The Resources Agency, the Secretary for Resources, is a member of the Governor's Cabinet, serves as the Governor's representative on the Agency's boards and commissions, and oversees administration of the *California Environmental Quality Act (CEQA)*. The California Resources Agency is comprised of the following entities:

- California Coastal Commission
- Department of Boating and Waterways
- Department of Conservation
- California Conservation Corps
- Department of Fish and Game

- Department of Forestry and Fire Protection
- Department of Parks and Recreation
- Department of Water Resources
- California Energy Commission
- California State Lands Commission
- San Francisco Bay Conservation and Development Commission
- California Tahoe Conservancy
- Colorado River Board of California
- Coachella Valley Conservancy
- Santa Monica Mountains Conservancy
- State Coastal Conservancy
- State Reclamation Board

Other special programs administered by The Resources Agency include:

- CERES, the California Environmental Resources Evaluation System
- California Biodiversity Council
- California Rivers Assessment
- CAL–FED Bay–Delta Program
- Natural Community Conservation Program
- California Ocean Resources Management Program

Southern Nevada Water Authority (SNWA) [Nevada] — An agency created in 1991 through a cooperative agreement among the seven regional water and wastewater agencies in southern Nevada. The purpose of the SNWA was to address water resource management and water conservation on a regional basis through *Integrated Resource Planning (IRP)* techniques and, through such efforts, plan, manage, and develop additional supplies of water for southern Nevada. The seven regional agencies comprising the SNWA include:

[1] Big Bend Water District (Laughlin)
[2] City of Boulder City
[3] City of Henderson
[4] City of Las Vegas
[5] City of North Las Vegas (serving portions of unincorporated Clark County and the City of Las Vegas)
[6] Clark County Sanitation District
[7] Las Vegas Valley Water District (LVVWD, serving the City of Las Vegas and portions of unincorporated Clark County)

Potable water in the Las Vegas region is provided by five different water purveyors: Big Bend Water District, Boulder City, City of Henderson, Las Vegas Valley Water District (LVVWD), and the City of North Las Vegas. Wastewater service is provided by four different agencies: Boulder City, City of Henderson, the City of Las Vegas and Clark County Sanitation District. Also see *Southern Nevada Water System (SNWS)*.

Southern Nevada Water System (SNWS) [Nevada] — On October 22, 1965, President Lyndon B. Johnson signed legislation authorizing construction of the Alfred Merrit Smith Water Treatment Facility and the Robert B. Griffith Water Project. These two projects form the Southern Nevada Water System, which supplies municipal and industrial water to the Las Vegas Valley Water District, Nellis Air Force Base and the cities of Boulder City, Henderson, and North Las Vegas. The Southern Nevada Water System refers to the system of treatment and transmission facilities that diverts raw Colorado River water from Lake Mead, and delivers potable water to three major retail water purveyors in the Las Vegas Valley, as well as Nellis Air Force Base and Boulder City. The treatment facility, located on the shores of Lake Mead, is known as the Alfred Merritt Smith Water Treatment Facility (AMSWTF). The transmission facilities, which divert water from Lake Mead to the treatment plant and then deliver treated water to Boulder City through the River Mountains tunnel and throughout the Las Vegas Valley, are referred to as the Robert B. Griffith Water Project. Treatment facilities were constructed in two stages by the State of Nevada acting through its Colorado River Commission. Transmission facilities were also constructed in two stages by the federal government through the U.S. Bureau of Reclamation. The state and federal facilities work together to form the Southern Nevada Water System which, as of January 1, 1996, is controlled by the *Southern Nevada Water Authority (SNWA)*. SNWA in turn employs the Las Vegas Valley Water

District (LVVWD) as its operating agent. The principal facilities of the SNWS are detailed below:

Treatment Facilities – Treatment facilities currently have the capacity to treat 600 million gallons per day (MGD). Until completion of the SNWS Phase II Improvements in 1999, delivery capability is 480 MGD. During 1997 the treatment plant produced an average of 314.8 MGD. The maximum day production was 469.5 MGD. The treatment process involves disinfection, aeration, flocculation, filtration and post-treatment. Disinfection is accomplished primarily by the application of chlorine; however, new facilities will employ ozonation for disinfection as well. Aeration is done primarily to improve aesthetic qualities of the water. Flocculation is a chemical process that causes minute particles in the water to coagulate into larger particles that can be filtered out. Filtration is provided by 26 filters, each with 2800 square feet of surface area; the filter media is composed of anthracite coal, silica sand, and aggregate. Filter performance is monitored and, when it declines below acceptable limits, the filter is backwashed. All backwash water is reclaimed and recycled to the head of the facility; no backwash water is returned to Lake Mead. Sludge captured in the backwash process is dried and disposed of in a landfill. Post-treatment is the addition of a small amount of chemicals to retard corrosion, and additional chlorine if necessary, to prevent bacteriological regrowth in the distribution systems. Water quality is assured by testing samples taken from over 260 different locations throughout the system. Samples are tested for chemical, microbiological, and other contaminants. Lake Mead has proven to be a very high quality water source which, along with effective design and operation of the treatment facilities, allows SNWS to provide water that exceeds all applicable standards to the over one million people in the Las Vegas Valley.

Transmission Facilities – Transmission facilities begin with the 13-foot diameter intake tunnel, which diverts Lake Mead water from 150 feet below its surface and conveys it through Saddle Island to Pumping Plant #1. The pumping plant lifts the water up to the raw water aqueduct, which conveys it to the AMSWTF. Treated water is lifted 708 feet to the River Mountains Tunnel, where it flows 4 miles by gravity to the Las Vegas Valley. After emerging from the tunnel, water is diverted to various points throughout the valley, where it is handed off to the facilities of retail purveyors at 17 rate-of-flow control stations. Pumping plants are used to move the water uphill, and rate-of-flow control stations are used to regulate and measure the flow into customers' storage facilities. Water from the AMSWTF is also conveyed to Boulder City by five pumping plants and eight miles of pipelines. Once it enters the system, treated water is never exposed to open air until the consumer uses it. SNWS consumes approximately 10 percent of the power generated by Nevada Power Company, making it the largest single customer.

Major Components of the Transmission Facilities – (1) Intake Tunnel: 1400 feet long, 13 feet in diameter; (2) 6 miles of raw and treated water aqueducts, 10 feet in diameter, and associated surge tanks; (3) River Mountains Tunnel: 4 miles long, 12 feet in diameter; (4) 14 major pumping plants and associated electrical equipment; (5) 18 major lateral systems totaling over 80 miles of pipeline as large as 12 feet in diameter; (6) 17 rate-of-flow control stations and associated regulating tanks.

State Water Resources Control Board (SWRCB) [California] — The water rights and water permitting agency of the State of California. The SWRCB consists of five members (to include a Chairman and Vice Chairman) whose responsibility it is to "protect water quality and allocate water rights" within the State of California. To assist in these functions, the SWRCB is served by a staff to include an Executive Director, a Chief Deputy and nine (9) Regional Board Executive Officers serving the regions of:

[1] North Coast Region;
[2] San Francisco Bay Region;
[3] Central Coast Region;
[4] Los Angeles Region;
[5] Central Valley Region;
[6] Lahontan Region;
[7] Colorado River Basin Region;
[8] Santa Ana Region; and
[9] San Diego Region.

Tahoe Regional Planning Agency (TRPA) [California and Nevada] — A bi-state regulatory agency created in July 1968 as part of a provisional California–Nevada Interstate Compact developed by the joint California–Nevada

Interstate Compact Commission which was formed in 1995. The TRPA was the first bi-state regional environmental planning agency in the United States. The TRPA was intended to oversee land-use planning and environmental issues within the Lake Tahoe Basin and is dedicated to preserving the beauty of the region. Today, the TRPA leads the cooperative effort within the basin to preserve, restore, and enhance the unique natural and human environment of the region and is a leading partner in a comprehensive program which monitors water quality, air quality, and other threshold standard indicators. The TRPA's Environmental Thresholds Carrying Capacities (ETCC) programs are designed to address the following thresholds:

- Water Quality
- Air Quality
- Soil Conservation
- Vegetation
- Fisheries
- Wildlife
- Scenic Resources/Community Design
- Recreation
- Noise

The structure of the TRPA consists of a 15-member Governing Board which sets TRPA policy, oversees administration of the agency, approves all amendments to the Lake Tahoe Basin Regional Plan and reviews major project applications. The Governing Board is advised by a 19-member Advisory Planning Commission made up of area planning and natural resource management professionals, and lay persons. The Executive Director directs approximately 50 staff members in the following principal functional areas: (1) Environmental Education; (2) Environmental Improvement Program (EIP) Facilitation; (3) Environmental Compliance Division; (4) Project Review Division; and (5) Long Range Planning Division. Representation on the TRPA's Governing Board is as follows:

[1] Governor of California Appointee (California);
[2] Governor of California Appointee (California);
[3] California Assembly Speaker Appointee (California);
[4] California Senate Rules Committee Appointee (California);
[5] El Dorado County Appointee (California);
[6] Placer County Appointee (California);
[7] City of South Lake Tahoe Appointee (California);
[8] Governor of Nevada Appointee (Nevada);
[9] Nevada Government Appointee (Nevada);
[10] Nevada Department of Conservation & Natural Resources Appointee (Nevada);
[11] Washoe County Appointee (Nevada);
[12] Douglas County Appointee (Nevada);
[13] Carson City Appointee (Nevada);
[14] Nevada at-Large Appointee (Nevada);
[15] Presidential Appointee (United States)

In late 1995 the TRPA created the Shorezone Partnership Committee of 20 organizations and entities to lessen the problems among those interested in the future development of Lake Tahoe. Those represented included: California and Nevada state lands; California and Nevada state parks, California Department of Fish and Game, California Tahoe Conservancy, Lahontan Regional Water Quality Control Board; League to Save Lake Tahoe; Nevada Division of Wildlife; Tahoe Lakefront Owners Association; TRPA; Tahoe Research Group; Tahoe–Sierra Preservation Council; U.S. Army Corps of Engineers; U.S. Forest Service; commercial property owners; Lake Tahoe marinas; Lake Tahoe tour-boat operators; other private property owners; and Lake Tahoe Basin recreation concessionaires.

Truckee–Carson Irrigation District (TCID) [Nevada] — The agent of the U.S. Department of the Interior *Bureau of Reclamation (USBR)* which serves the interests of the water-righted agricultural water users in the *Newlands (Irrigation) Project*, located in Churchill County, Nevada. The Newlands Project, originally named the Truckee–Carson Irrigation Project, was America's first federal reclamation project completed under the Reclamation Act of 1902. The Truckee–Carson Irrigation District has operated the Newlands Project since 1926 and is responsible for dispersing some 320,000 acre-feet of water from the Carson and Truckee rivers during normal water years. TCID is responsible for the operation of the Lake Tahoe Dam at the outlet to Lake Tahoe at Tahoe City in Placer County, California, Derby Dam on the lower Truckee River in Washoe County, Nevada, Lahontan Dam on the lower Carson River in Churchill County, Nevada, and, some six miles below Lahontan Dam, the Carson Diversion Dam which distributes the releases from Lahontan Reservoir into the project's principal "T" (T–Line) and "V" (V–Line) primary distribution canals. Within the Newlands Projects, there are 102 miles of main canals, 312 miles of irrigation laterals, an extensive system of private ditches, 345 miles of drainage ditches, and numerous diversion dams and regulating reservoirs. TCID offices are located in Fallon, Nevada (Churchill County), and its operations are managed by a Project Manager, a board of seven members, and approximately 50 full-time employees. In 1978 the USBR canceled the contract under which TCID had operated the project since 1926. The cancellation was in response to a refusal of the farmer-dominated organization to follow federal water conservation guidelines, or *Operating Criteria and Procedures (OCAP)*. TCID has been operating under a temporary contract since 1984.

Walker River Irrigation District (WRID) [Nevada] — The litigation of *Pacific Live Stock Company v. Antelope Valley Land and Cattle Company* and the issuance of *Decree 731* caused a number of farmers in Smith and Mason valleys to band together in April 1919 and form the Walker River Irrigation District (WRID). WRID included all irrigated areas in Nevada on the East Walker River, the West Walker River, and the main Walker River, except those areas within the Walker River Indian Reservation. WRID moved to obtain the financing and rights to both Bridgeport and Topaz reservoir sites, sites which had earlier been selected and surveyed by the U.S. Reclamation Service (USRS, currently the U.S. Bureau of Reclamation, USBR). The water rights for Topaz Reservoir were obtained from the liquidation of the Antelope Valley Land and Cattle Company. Although WRID was established as a Nevada agency serving lands entirely within Nevada, its reservoirs would be located either entirely in California (Bridgeport Reservoir) or partially in California and Nevada (Topaz Reservoir). Funding for dam and reservoir construction and operation was obtained privately with water recipients obligated to pay off the debt. Initial funding was held down as WRID assumed no responsibility for the construction or maintenance of irrigation canals, ditches, or laterals.

Water Alliances For Voluntary Efficiency (WAVE) — A water conservation program conceived by the *U.S. Environmental Protection Agency (EPA)* in December 1992 and designed to help increase water efficiency in U.S. lodging facilities. The program encourages participating hotels to install water efficient technologies for bathroom fixtures, dish washing and laundry facilities, cooling towers, and landscaping. The program's goal is to reduce water use and associated energy consumption, help inform hotel guests and employees about the importance of water conservation, and help hotels realize a monetary savings for their efforts. Program components consist of technical assistance, research material availability, computer software programs to survey water use and evaluate options, and public recognition of participation.

Nevada State Water Plan
PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 8
Glossary on Selected Water-Related Decrees, Agreements and Operating Criteria

[Source: Nevada Division of Water Planning's *Water Words Dictionary*. Words presented in italics and the referenced appendices may be found in that source. Words and definitions included in this glossary which explain or summarize elements of existing water law are not intended to change that law in any way.]

Alpine Decree [California and Nevada] — The Federal Court adjudication of the relative water rights on the Carson River which is the primary regulatory control of Carson River operations today. The decree is administered in the field by a *Watermaster* appointed by the federal district court. The decree, initiated by the U.S. Department of the Interior on May 1, 1925 through *United States of America v. Alpine Land and Reservoir Company, et al.*, Civ. No. D-183 BRT, to adjudicate water rights along the Carson River. The decree was finally entered 55 years later on October 28, 1980, making it the longest lawsuit undertaken by the federal government against private parties over water rights. The decree established the respective water rights (to surface water only) of the parties to the original lawsuit, both in California and Nevada to Carson River water. The decree did not make an interstate allocation of the Carson River between California and Nevada; it only quantified individual water rights. Neither state was a party to the decree. In addition to Carson River surface water rights, it also established the rights to reservoir storage in the high alpine reservoirs and confirmed the historical practice of operating the river on rotation, so that irrigators with more junior priorities could be served as long as possible. These upper alpine reservoirs were permitted to fill out of priority order, in accordance with historical practice. The decree also specifically recognized *Riparian Water Rights* in California (as distinguished from the quantified *Appropriative Water Rights* used in Nevada). For purposes of water distribution, the Carson River and its east and west forks, were divided into eight (8) segments and when the river went into regulation (i.e., there was not enough water in the Upper Carson River to serve the most junior priority) each segment of the river was to be administered autonomously. Duties of water were set forth for various locations according to *Bench Land* and *Bottom Land* designations. For lands in the *Newlands Irrigation Project* (i.e., below Lahontan Dam) in Churchill County near Fallon, the Alpine decree provided for an annual net consumptive use of surface water for irrigation of 2.99 acre-feet per acre and a maximum water duty of 4.5 acre-feet per acre for water-righted bench lands and 3.5 acre-feet per acre for water-righted bottom lands *delivered to the land*. For lands above the Newlands Project (i.e., above Lahontan Reservoir), the net consumptive water use was set at 2.5 acre-feet per acre with water duties of 4.5 acre-feet per acre *diverted to the canal* for bottom lands, 6.0 acre-feet per acre diverted to the canal for the alluvial fan lands and 9.0 acre-feet per acre diverted to the canal for the bench lands. This annual net consumptive use, or *Crop Water Requirement*, was based on the water duty of alfalfa as it is a dominant and the highest water-using crop grown in Nevada. While the Alpine Decree established water duties for bench and bottom lands throughout the Carson River Basin, it made no identification of those lands. The decree also granted landowners on the Newlands Project an *Appurtenant Water Right* for the patented lands, effectively transferring water rights to these land holders individually.

Bartlett Decree [Nevada] — The Bartlett Decree was issued on January 2, 1931 by Judge George A. Bartlett and adjudicated water rights along the Humboldt River and its tributaries. In addition to adjudicating the river system's water rights, this decree also recognized that the surface waters within the Humboldt River system were already fully appropriated, leaving no surplus water for irrigation during an average, or normal water year. Another important finding of the Bartlett Decree recognized the differences in growing seasons between the Humboldt River's upper basin and its lower basin and therefore divided the river system into two districts, District

No. 1 below Palisade (USGS gaging station 10322500) and District No. 2 above Palisade. The Bartlett Decree also recognized the seasonal and ephemeral nature of many streams within the Humboldt River Basin through the concept of "flash streams" and the special need to accommodate water appropriators along such stream systems. These water courses were defined as streams "that have a sudden or flash flow or flush flow for a comparatively brief period of time, while such stream is draining the particular basin or source of supply fed by melting snows…These flash streams in varying degrees are typical of the necessity of cumulating the flow during the flush for the particular rights to be served. Where lands are entitled to irrigation from such flash streams, they must be served at the times when the water is available." The Bartlett Decree established three classes of lands with different irrigation requirements (water duties) and irrigation periods (both with respect to the number of days of allowable irrigation and the specific periods of irrigation). These irrigable land classes included: (1) Harvest crop lands (Class A) – all lands devoted to cultivated crops, including irrigated native or other grass lands which normally receive sufficient water to produce a crop which will justify cutting for hay, although it may sometimes be pastured and not cut; (2) Meadow pasture lands (Class B) – all grass lands free from brush which receive sufficient water to produce what may be classed as good pasture, but not sufficient to warrant cutting for hay; and (3) Diversified pasture lands (Class C) – all lands from which the brush has not been cleared but which are artificially irrigated to some extent for the production of grasses for pasturage. Further, the irrigation periods within the Humboldt River system varied by both the class of the land and whether it was in District No. 1 (below Palisade) or District No. 2 (above Palisade). Due to extensive review and corrections of the written findings by Judge Bartlett, the final Bartlett Decree would not be entered until October 20, 1931. The Bartlett Decree was subsequently modified by the *Edwards Decree*. With respect to adjudication of the Humboldt River, also see *Carville Decree*.

California–Nevada Interstate Compact [California and Nevada] — After thirteen years of negotiations between the two states (begun in 1955), the joint California–Nevada Interstate Compact Commission approved a provisional Interstate Compact in July 1968 for the division of the waters of Lake Tahoe, and the Truckee, Carson, and Walker rivers. This provisional compact, with some modification, was eventually ratified by both states (California in September 1970 and Nevada in March 1971). The compact created the Tahoe Regional Planning Agency (TRPA) to oversee land-use planning and environmental issues within the Lake Tahoe Basin. However, the compact was never ratified by Congress which would have made it law. A major issue of contention was a phrase in the compact which stated that the use of waters by the federal government, its agencies, instrumentalities, or wards was to be against the use by the state in which it is made. This limitation, combined with new court interpretations of the federal *reserved water rights* (*Winters Doctrine*), waters required for Pyramid Lake fish species under the *Endangered Species Act (ESA)*, and *public trust doctrine* issues combined to derail Congressional approval. Even so, both states chose to implement its terms under individual state legislation. With respect to the Lake Tahoe Basin, the compact provided for a maximum annual gross diversion from all sources of 34,000 acre-feet, of which California was allocated 23,000 acre-feet per year and Nevada 11,000 acre-feet per year.

Carville Decree [Nevada] — The Carville Decree was issued on January 24, 1935 by Judge E.P. Carville and adjudicated water rights for the Little Humboldt River. As with the 1931 *Bartlett Decree* (and the 1935 *Edwards Decree* modifying the Bartlette Decree), the Carville Decree determined water rights for three classes of lands: (1) Class A – harvest crops; (2) Class B – meadow pasture; and (3) Class C – diversified pasture. In general, the decree provided for a flow of 1.0 cfs per 100 acres of decreed land, or at rates proportional to this. When water was available, Class A water rights are for the delivery of water at this rate of flow for a period of 180 days from March 15 to September 15, or a total water diversion during the season of 3.6 acre-feet per acre. Class B rights are for 90 days from March 15 to June 13, for a total of 1.8 acre-feet per acre. Class C rights are for 45 days from March 15 to April 28, for a total of 0.9 acre-feet per acre. With respect to adjudication of the Humboldt River, also see *Bartlett Decree* and *Edwards Decree*.

Colorado River Compact — An agreement entered into on November 24, 1922 and ratified by the legislatures of the seven states within the Colorado River Basin — Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming — agreeing to the general allocation of the waters of the Colorado River. The compact divided the Colorado River Basin into an *Upper Basin* and a *Lower Basin*, with the division point established at Lees Ferry, a point in the mainstream of the Colorado River approximately 30 river miles south of the Utah-Arizona boundary. The Upper Basin was defined to include those parts of the states of Arizona, Colorado, New Mexico, Utah, and

Wyoming within and from which waters naturally drain into the Colorado River system above Lees Ferry, and all parts of these states that are not part of the river's drainage system but may benefit from water diverted from the system above Lees Ferry. The Lower Basin was defined to include those parts of the states of Arizona, California, Nevada, New Mexico, and Utah within and from which waters naturally drain into the Colorado River system below Lees Ferry, and all parts of these states that are not part of the river's drainage system but may benefit from water diverted from the system below Lees Ferry. The compact did not apportion water to any state; however, it did apportion to each upper and lower basin the exclusive, beneficial consumptive use of 7,500,000 acre-feet of water per year from the Colorado River system in perpetuity. Further, the compact gave to the Lower Basin the right to increase its annual beneficial consumptive use of such water by 1,000,000 acre-feet. This compact cleared the way for federal legislation for the construction of Hoover Dam. Subsequently, the Upper Basin states entered into the *Upper Colorado River Basin Compact* on October 11, 1948 which provided Arizona to use 50,000 acre-feet of water per year from the upper Colorado River system and apportioned the remaining water to the Upper Basin states according to the following percentages: Colorado, 51.75 percent; New Mexico, 11.25 percent; Utah, 23 percent; and Wyoming, 14 percent. The Lower Basin states could not come to an agreement on apportionment on their own, and in October 1962, the U.S. Supreme Court ruled that of the first 7,500,000 acre-feet of mainstream water in the Lower Basin, California is entitled to 4,400,000 acre-feet (58.67 percent), Arizona to 2,800,000 acre-feet (37.33 percent), and Nevada to 300,000 acre-feet (4.00 percent).

Decree 731 (Interim Walker River Decree) [Nevada] — In response to the suit filed in 1902 (*Miller et Lux v. Rickey*), subsequently renamed to the *Pacific Livestock Company v. Antelope Valley Land and Cattle Company*, water rights adjudication in the Federal District Court for Nevada resulted in the issuance of Decree 731 on March 24, 1919. [During the Nevada gold mining boom of the early 1900's, Thomas B. Rickey was actively involved in both mining and banking as well as ranching. So much so, in fact, that he suffered failure in the panic of 1907 and his ranching properties were sold to the Antelope Valley Land and Cattle Company. Also, the agricultural holdings of Muller and Lux were taken over by the Pacific Livestock Company.] The Decree addressed the amount of water to which each party was entitled, the source of the water, the area to which it was to be applied, and the priority date for each use. The Decree also encompassed many, but not all, of the other water users on the river, particularly the water rights of the smaller agricultural water users as well as the irrigation rights of the Walker River Indian Reservation. Five separate water rights for the reservation were quantified with priority dates ranging from 1868 to 1886 (the reservation was established on November 29, 1859) and the government was permitted to purchase additional rights from the proposed Topaz Reservoir to supply the reservation. [These five water rights included: (1) 1868 priority date – 4.70 cfs, 385.95 acres irrigated; (2) 1872 priority date – 3.55 cfs, 295.80 acres irrigated; (3) 1875 priority date – 6.15 cfs, 512.80 acres irrigated; (4) 1883 priority date – 7.50 cfs, 625.20 acres irrigated; and (5) 1886 priority date – 1.03 cfs, 85.80 acres irrigated.] In effect, the Decree addressed essentially only direct diversions from the river and its tributaries. Except for some general provisions pertaining to the Antelope Valley Land and Cattle Company's storage rights, particularly those relating to the prospective development of Alkali Lake (Topaz) Reservoir, no other storage rights were quantified. As an interim measure, Decree 731 did assign priorities and amounts of water for irrigating specified lands of the parties and allowed incidental domestic and stock-watering uses to be served under the irrigation rights.

Decree C–125 (Final Walker River Decree) [Nevada] — In adjudication of the 1924 filing of *United States v. Walker River Irrigation District, et al.*, Decree C–125 for waters of the Walker River was issued on April 14, 1936 by the Federal District Court for Nevada. In addition to recognizing the water rights defined in Decree 731 (March 24, 1919) as to priority date, amount and place of use, and defined other storage and diversion rights, the Walker River Indian Reservation's attempt to acquire a right to divert 150 cfs for the irrigation of reservation lands was rejected. While Decree C–125 adjudicated most of the irrigation rights of the Walker River system, the court did not define domestic rights, irrigation uses on natural forest land, some private riparian lands, and any storage rights for Weber Reservoir, which had recently been constructed on the Walker River Indian Reservation. Also, no rights were included for Walker Lake itself. A federal *Watermaster* would be responsible for its enforcement. The District Court refused the Tribe's claim (for right to a rate of flow of 150 cfs), stating that even if an implied tribal water right was included with reservation lands, the white pioneers were in "an inexpugnable position" and the "court was not about to take fifty years of beneficial farming use away from these settlers for the sake of supplying the tribe with guaranteed water." In June 1939 Decree C–125 was modified on appeal to the U.S. Circuit Court of Appeals, Ninth Circuit (104 Fed 2d 334 [1939]). The Walker River Indian Reservation was granted a right to divert 26.25 cfs (they had asked for 150 cfs) for 180 days (amounting to 9,450 acre-feet from natural flows) to be measured at the Parker Gage (currently the Wabuska gage) at the north (outlet) end of Mason Valley approximately where the reservation boundary begins. This diversion period is in contrast to upstream users who have an irrigation season of up to 245 days as reaffirmed in the "Rules and Regulations for the Walker River System" under Decree C–125. All defendants agreed to the stipulation which granted the Walker River Indian Reservation a November 29, 1859 priority date for its water rights for the irrigation of 2,100 acres of reservation land. The original priority dates established in Decree 731 in 1919 had assigned priority dates (5) ranging from 1868 to 1886. [These five water rights included: (1) 1868 priority date – 4.70 cfs, 385.95 acres irrigated; (2) 1872 priority date – 3.55 cfs, 295.80 acres irrigated; (3) 1875 priority date – 6.15 cfs, 512.80 acres irrigated; (4) 1883 priority date – 7.50 cfs, 625.20 acres irrigated; and (5) 1886 priority date – 1.03 cfs, 85.80 acres irrigated.

Edwards Decree [Nevada] — The Edwards Decree was issued on October 8, 1935 and represented a modification of adjudicated water rights for the Humboldt River based on the October 20, 1931 *Bartlett Decree*. Due to subsequent protests to the issuance of the Bartlett Decree, on December 16, 1931, the first of a number of rulings for the modification, correction and amendment of the Bartlett Decree was made by Judge H.W. Edwards. This was followed by additional changes and amendments entered on April 27, 1933, February 8, 1934, June 8, 1934, October 1, 1934, November 19, 1934, February 11, 1935, and finally on March 11, 1935. Collectively, this compilation of modifications and changes to the 1931 Bartlett Decree became known as the Edwards Decree. One particular change of some importance removed the Bartlett Decree's language pertaining to the formal division of the Humboldt River system into a District No. 1 below Palisade and a District No. 2 above Palisade. In its place, the Edwards Decree merely established specific irrigation seasons and reaffirmed the three classes of land for specific water rights, the water duty for each land class, and the period over which water was to be received by these lands. As most of the corrected water-rights contained within the Edwards Decree applied to lands above Palisade (i.e., the upper Humboldt River Basin), the Edwards Decree was applied to and used for distribution of the Humboldt River system's waters above Palisade, while the Bartlett Decree continued to apply to and be used in the distribution of water below Palisade. In general, the Edwards Decree provided for a flow of 1.23 cfs per 100 acres of decreed land or at proportional rates. Three land classes were established (the same as for the Bartlett Decree) with different dates of use and number of days of allowed irrigation. Each sub-basin within the overall Humboldt River Basin had its unique amount of decreed land and decreed water within the three land classes (A, B and C). Diverted water for irrigation purposes was to be measured where the main ditch enters or becomes adjacent to the land to be irrigated. With respect to adjudication of the Humboldt River, also see *Carville Decree*.

Floriston Rates [California and Nevada] — Currently represents the primary operational criteria of the Truckee River between its source (Lake Tahoe) and its terminus (Pyramid Lake). The rates originated in a 1915 decree (*Truckee River General Electric Decree*) in which the *U.S. Bureau of Reclamation (USBR)* gained an easement to operate the Lake Tahoe outlet dam in return for providing year-round flow rates for run-of-the-river users — hydropower and a pulp and paper mill. Along with the *Orr Ditch Decree* (1944) and the *Truckee River Agreement* (1935), which has been incorporated into the Orr Ditch Decree, these requirements govern the Truckee River flows. The Floriston rates essentially constitute a minimum instream flow in the river, as long as water is physically available in Lake Tahoe and Boca Reservoir to support the rates. Water may only be stored in Lake Tahoe and Boca Reservoir when rates are being met. The precise definition contained in the Truckee River Agreement is as follows:

[1] **Floriston Rates** means the rate of flow in the Truckee River at the head of the diversion penstock at Floriston, California (to be measured at the Iceland gage, but currently measured at the Farad gage) consisting of an average flow of 500 cubic feet of water per second each day during the period commencing March 1 and ending September 30 of any year, and an average flow of 400 cubic feet per second each day during the period commencing October 1 and ending the last day of the next following February of any year.

[2] **Reduced Floriston Rates** means rates of flow in the Truckee River, measured at the Iceland gage (currently the Farad gage), effective and in force during the period commencing November 1 and ending the next following March 31 of each year, determined as follows:

(a) 350 cubic feet per second whenever the elevation of the water surface of Lake Tahoe is below 6226.0 feet above sea level and not below 6225.25 feet above sea level; and

(b) 300 cubic feet per second whenever the water surface elevation of Lake Tahoe is below 6225.25 feet above sea level.

Also see *Truckee River Agreement [Nevada and California]*.

(Truckee River) General Electric Decree [California] — Represented the resolution, through a 1915 federal court consent decree, of a lengthy series of conflicts, litigation, and negotiations between the U.S. Bureau of Reclamation (USBR, then the U.S. Reclamation Service, USRS) and the Truckee River General Electric Company (predecessor to the present-day Sierra Pacific Power Company), which, in 1902, through a complicated series of real estate transactions had obtained title to the Lake Tahoe Dam, surrounding lands, and the hydropower plants on the Truckee River. The Bureau of Reclamation was in desperate need of Lake Tahoe water for its Newlands Project, then nearing completion near Fallon in Churchill County. This decree granted the Bureau of Reclamation an easement to operate the Lake Tahoe Dam and to use surrounding property owned by the power company. On its part, the Bureau of Reclamation was required to provide certain year-round flow rates (the *Floriston Rates*), measured at a stream gage near the state line, to support hydropower generation. These rates, in fact, dated back to a 1908 river flow agreement among the Truckee River General Electric Company, the Floriston Land and Power Company, and the Floriston Pulp and Paper Company and required that "...there shall be maintained a flow of water in the said Truckee River at Floriston [California] of not less than 500 cubic feet per second from the First day of March to the 30th day of September inclusive, in each year, and of not less than 400 cubic feet per second from the 1st day of October to the last day of February, inclusive, in each year." While this decree did dictate how the Lake Tahoe Dam would be operated, it did little to solve the concerns of residents of the lake and lessen California's concerns over the apportionment of Lake Tahoe waters.

OCAP (Operating Criteria and Procedures) [Nevada] — Operating criteria originally instituted in 1967 for water diversions and irrigation of the *Newlands (Irrigation) Project [Nevada]* in the Carson River Basin and designed to maximize use of Carson River flows to satisfy project requirements and minimize diversions from the Truckee River. Current OCAP requirements for this project were set in 1988 and according to *Public Law 101–618* (the *Negotiated Settlement*) are to remain in effect at least through December 31, 1997 at which time a new *Truckee River Operating Agreement (TROA) [Nevada and California]* will be implemented.

Orr Ditch Decree [Nevada and California] — A tabulation or adjudication of Nevada (only) water rights for the Truckee River and its tributaries regulated through a series of reservoirs and irrigation canals, administered by the U.S. District Court Federal Water Master in Reno, Nevada. In combination with the *Truckee River Agreement [Nevada and California]* and the *Floriston Rates [California and Nevada]*, the Orr Ditch Decree currently represents the basis for operation of the Truckee River between its source (Lake Tahoe) and its terminus (Pyramid Lake). The Orr Ditch Decree (1944) incorporates the provisions of the Truckee River Agreement (1935), which provides for operation of storage facilities, especially Lake Tahoe, to satisfy Truckee River water rights. The Floriston rates constitute the chief operation objective on the Truckee River today and originated as a turn-of-the-century flow requirement for run-of-the-river users — hydropower and a pulp and paper mill. While the Orr Ditch Decree establishes water rights for entities within Nevada using the Truckee River's waters, the Truckee River Agreement, as part of that Decree, determines the operational mechanisms to satisfy those rights. Also see *Truckee River General Electric Decree [California]*.

Preliminary Settlement Agreement (PSA) [Nevada] — An agreement reached between the Pyramid Lake Paiute Tribe of Indians and Sierra Pacific Power Company (SPPCo) on May 23, 1989. The PSA provides SPPCo the ability to store its water rights in federally operated reservoirs along the Truckee River in California at times when it is not needed for municipal and industrial (M&I) water supply in the Reno–Sparks Metropolitan Area. In exchange, excess water in storage is used for fishery purposes when drought conditions are not in effect. Also, SPPCo forgoes its right to single-use hydroelectric flows in the Truckee River under the *Orr Ditch Decree [Nevada and California]*, thereby enabling the United States and the Tribe to store water for fishery benefit at certain times of the year. The PSA is incorporated into *Public Law 101–618* (the *Negotiated Settlement*) by reference.

Public Law 101–618 (PL 101–618) [Nevada and California] — Omnibus legislation passed by the 101st Congress at the end of its 1990 session intended to settle a number of outstanding disputes concerning the Truckee and

Carson Rivers. The legislation authorized an ambitious environmental restoration program to benefit the *Lahontan Valley Wetland System [Nevada]* and Pyramid Lake and the lower Truckee River. It also established a framework for resolving separate by closely-related water-resource conflicts involving the Pyramid Lake Paiute and Fallon Paiute–Shoshone Tribes, the cities of Reno and Sparks (Nevada), the states of Nevada and California, and (pending the resolution of several as-yet unsatisfied controversies) the *Newlands (Irrigation) Project [Nevada]*. The legislation contains two primary titles: *TITLE I — The Fallon Paiute–Shoshone Indian Tribal Settlement Act*; and *TITLE II — The Truckee–Carson–Pyramid Lake Water Rights Settlement Act*. Collectively, the legislation can be referred to as the *Negotiated Settlement*. The seven (7) main elements covered by the legislation include:

[1] ***Promote the Enhancement and Recovery of Endangered and Threatened Fish Species*** — A recovery program is to be developed for the Pyramid Lake endangered fish species cui-ui (*Chasmistes cujus*) and the threatened fish species Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) in compliance with the *Endangered Species Act (ESA)* and the Truckee–Carson–Pyramid Lake Water Rights Settlement Act. Water rights acquisitions are authorized for this purpose.

[2] ***Protect Wetlands from Further Degradation*** — A water rights purchase program is authorized for *Lahontan Valley Wetlands*, with the intent of sustaining an average of 25,000 acres of wetlands (*Stillwater National Wildlife Refuge*: 14,000 acres; Carson Lake and Pasture: 10,200 acres; and Fallon Reservation and Indian Lakes: 800 acres) to both prevent further degradation and improve the habitat of the fish and wildlife which depend on those wetlands. The *U.S. Fish and Wildlife Service (USFWS)* has estimated that this will require up to 125,000 acre-feet (AF) of water per year.

[3] ***Encourage the Development of Solutions for Demands on Truckee River Waters*** — An operating agreement is to be negotiated for the Truckee River — *The Truckee River Operating Agreement (TROA)* — covering procedures for using storage capacity in upstream reservoirs in California consistent with recovery objectives for listed Pyramid Lake fishes. This includes the implementation of the terms and conditions of the *Primary Settlement Agreement (PSA)* between SPPCo and the Pyramid Lake Paiute Tribe.

[4] ***Improve Management and Efficiency of the Newlands Project*** — The Secretary of the Interior is authorized to operate and maintain the *Newlands Project* to serve additional purposes, including recreation, improved water quality flowing to the wetlands, improved fish and wildlife habitat, and municipal water supply for Lyon and Churchill counties. A project efficiency study is required. The 1973 Gesell Decision is recognized and the 1988 *Operating Criteria and Procedures (OCAP)* is to remain in effect at least through 1997.

[5] ***Fallon Paiute–Shoshone Water Issues Settlement*** — Establishment of a settlement fund for the Fallon Paiute–Shoshone Tribe totaling $43 million. The Tribe is authorized to purchase land and water rights to consolidate tribal holdings within the reservation. Specific litigation filed by the Tribe is to be dismissed.

[6] ***Pyramid Lake Paiute Tribe Issues Settlement*** — A tribal economic development fund of $40 million was established for the Pyramid Lake Paiute Indian Tribe to provide for the settlement of water, fish, and other issues. Another fund of $25 million was established for the Pyramid Lake fishery.

[7] ***Interstate Water Apportionment Settlement*** — Facilitate an interstate allocation of the waters of the Truckee River, Carson River, and Lake Tahoe between the states of California and Nevada.

Also see *Truckee River Agreement [Nevada and California]*.

Sierra Valley Decree [California–Nevada] — Adjudication (1958) allowing the Sierra Valley Water Company to divert a portion of the Little Truckee River in California into Webber Creek for irrigation purposes in the Sierra Valley in the Feather River Basin. The maximum allowable diversion is 60 cubic feet per second (cfs), averaging approximately 5,700 acre-feet (AF) per year (although as a supplemental water source, diversions typically vary between 1,500 AF and 10,000 AF per year). Waters may be diverted only between March 15th and September 30th of each year. The *Priority Date* of this water right was set at 1870.

Tahoe–Prosser Exchange Agreement (California-Nevada) — Also referred to as the "Agreement for Water Exchange Operations of Lake Tahoe and Prosser Creek Reservoir," this agreement was finalized in June 1959 and designated certain waters in Prosser Reservoir in the Truckee River Basin as "Tahoe Exchange Water." By this agreement, when waters were to be released from Lake Tahoe for a minimum instream flow (50 cfs winter; 70 cfs summer) and when such releases from Lake Tahoe were not necessary for *Floriston Rates* due to normal flows elsewhere in the river, then an equal amount of water (exchange water) could be stored in Prosser Reservoir and used for releases at other times. Also see *Truckee River Agreement [Nevada and California]*.

Tri-Partite Agreement [Lahontan Valley, Nevada] — The 50-year agreement among Truckee-Carson Irrigation District (TCID), Nevada State Board of Fish and Game Commissioners (currently the Nevada Board of Wildlife Commissioners as part of the Nevada Division of Wildlife, NDOW), and U.S. Fish and Wildlife Service (USFWS) regarding the establishment, development, operation, and maintenance of *Stillwater National Wildlife Management Area*, dated November 26, 1948. In 1960 the management of this area was changed to a two-party agreement between USFWS and NDOW.

Truckee River Agreement [Nevada and California] — The Truckee River Agreement (1935) represents the current basis for the operation of the Truckee River, including its tributaries and diversions, between its source (Lake Tahoe) and its terminus (Pyramid Lake). Parties to this agreement include the *Truckee–Carson Irrigation District (TCID)*, serving the irrigation rights of agricultural water users of the *Newlands (Irrigation) Project [Nevada]* in Churchill County, Nevada, Sierra Pacific Power Company (SPPCo), serving primarily the municipal and industrial water needs of the cities of Reno and Sparks, Nevada, and the Washoe County Water Conservation District (WCWCD), serving the agricultural water users in the Truckee Meadows. Operation of upstream reservoirs is under the supervision of the Federal Water Master, who administers court-imposed requirements under the *Orr Ditch Decree [Nevada and California]* to supply water to achieve *Floriston Rates [California]* (mandated river flow rates) at the California–Nevada border. The 1944 Orr Ditch Decree, which incorporates the Truckee River Agreement, affirmed numerous individual water rights (both municipal and industrial and agricultural), including Truckee River diversion rights earlier than 1939. The Truckee River Agreement provides for operation of storage facilities, especially Lake Tahoe, to satisfy these rights and required the building of Boca Dam and Reservoir. The agreement further contains language intended to settle the disputes over pumping Lake Tahoe by:

[1] Establishing the natural conditions in the bed and banks of Lake Tahoe and of the Truckee River near Tahoe City, Placer County, California, and prohibiting any alteration of such natural conditions without the approval of the Attorney General of the State of California, and, in fact, allowing parties to the agreement the right to restore these areas to their natural condition, as necessary;

[2] Prohibiting the creation of any other outlet of Lake Tahoe in addition to the present and natural outlet at the head of the Truckee River;

[3] Prohibiting the removal of water from Lake Tahoe for irrigation or power uses by any means other than gravity except upon the declaration of the U.S. Secretary of the Interior; and

[4] Prohibiting the removal of water from Lake Tahoe for sanitary or domestic uses by any means other than gravity, except upon the condition that the Departments of Health of the States of Nevada and California, or other officers exercising similar authority, shall first have made and filed with the Attorney General of the State of Nevada and the Attorney General of the State of California certificates showing that a necessity for such pumping of Lake Tahoe exists.

The prescribed Floriston rates constitute the chief operational objective on the Truckee River today and originated as a turn-of-the-century flow requirement for run-of-the-river users — hydropower and a pulp and paper mill. Stored water in Lake Tahoe and Boca Reservoir is used to “make rates,” as specified in the Truckee River Agreement, when the river’s natural flow alone does not suffice. The following is a listing of the dams and reservoirs that are operated along the Truckee River and their ownership, uses, and operational criteria. Not all these reservoirs are operated as part of the Truckee River Agreement.

[1] ***Lake Tahoe*** — The first dam at Lake Tahoe’s exit into the Truckee River, located at Tahoe City in Placer County, California, was constructed in the early 1870s and the existing Lake Tahoe Dam was constructed in 1913. The Lake Tahoe drainage area covers approximately 506 square miles. Water is stored only in the top 6.1 feet, from an elevation of 6,223.0 feet (the lake’s assumed natural rim above mean sea level — MSL) to an elevation of 6,229.1 feet (MSL). Total storage capacity equals approximately 744,600 acre-feet and is used to supplement Floriston rates in conjunction with natural runoff of other tributaries and Boca Dam releases. The Lake Tahoe Dam is owned by the USBR and operated under agreement by the TCID for the Newlands Project in Churchill County, Nevada. Lake Tahoe storage capacity is not considered part of the U.S. Army Corps of Engineers (COE) flood control system. Lake Tahoe waters may be exchanged for water from Prosser Creek Reservoir (the

Tahoe–Prosser Exchange Agreement) in order to maintain a live stream below the Lake Tahoe Dam without adversely affecting Nevada water users' storage. Whenever possible, Lake Tahoe releases are to maintain a minimum instream flow of 50–70 cubic feet per second (cfs) downstream from the dam (varies with season).

[2] ***Donner Lake*** — The first dam on Donner Lake was built in 1877, while the current dam was constructed in the 1930s. Donner Lake drains an area of only approximately 14 square miles. Water in Donner Lake is privately owned by Sierra Pacific Power Company (SPPCo) of Reno, Nevada and TCID and is not required to be used to meet Floriston rates. The dam is jointly owned and operated by SPPCo and TCID. Lake storage levels range between 5,924 feet MSL and 5,935.8 feet MSL (providing for 9,500 acre-feet of storage capacity). The SPPCo portion of the stored water is used to supplement Reno–Sparks municipal and industrial water use; the TCID portion is used to supplement Newlands Project irrigation water requirements. After the lake fills, lake inflows are passed through to supplement Floriston rates. Lake storage is not part of COE flood control system. The State of California requires a minimum flow of 2–3 cfs downstream from the dam for maintaining fish habitat.

[3] ***Independence Lake*** — The original Independence Lake dam was constructed in 1879 and created a storage capacity of 3,000 acre-feet. After SPPCo acquired ownership of the lake and dam in 1937, the dam was enlarged in 1939 to its present size with a total storage capacity of 17,500 acre-feet. Independence Lake drains an area of only eight square miles. Like Donner Lake water, this water is privately owned and not required to be used to meet Floriston rates; the stored waters are owned by SPPCo and supplement the SPPCo water supply for the Reno–Sparks municipal and industrial water use during droughts. The lake's first storage priority is for 3,000 acre-feet of (original) storage; an additional 14,500 acre-feet of storage is permitted after Boca Reservoir is full and the Floriston rates and Truckee River diversion rights (Orr Ditch Decree) are satisfied. The State of California requires a minimum flow of 2 cfs downstream from the dam for maintaining fish habitat.

[4] ***Martis Creek Reservoir*** — The Martis Creek Dam was constructed by the COE in 1971 and was intended to store waters from a 40 square mile drainage area to include not only Martis Creek, by the East, West, and Central Martis Creeks as well. In accordance with COE requirements, this reservoir, with a total storage capacity of 20,400 acre-feet, serves only flood control purposes. While legislation allows for other uses, only temporary storage is currently permitted due to an unsafe, leaking dam. Except during flood storage, reservoir outflows equal inflows.

[5] ***Prosser Creek Reservoir*** — The Prosser Creek Reservoir was constructed by the USBR in 1962 to store waters from a 50 square mile drainage area beginning 11 miles to the west at Warren Lake. The reservoir, with a total capacity of 29,800 acre-feet, is owned and operated by the USBR for three purposes: (a) as part of the COE Truckee River flood control program; (b) the storage of water under the terms of the Tahoe–Prosser Exchange Agreement (which provides that a portion of this water, when available, may be used to meet Floriston rates in lieu of making such releases from Lake Tahoe); and (c) to meet the spawning flow needs of Pyramid Lake's endangered cui-ui fish species and its threatened Lahontan cutthroat trout, or for other federal purposes. The State of California generally requires a minimum flow of natural flow or 5 cfs, whichever is less, downstream from the dam for maintaining fish habitat.

[6] ***Stampede Reservoir*** — The dam and reservoir, constructed by the USBR in 1970, drains an area of some 136 square miles and has a total capacity of 226,000 acre-feet. Water must be used primarily for spawning flows for the endangered cui-ui fish species and the threatened Lahontan cutthroat trout of Pyramid Lake. Storage space is also part of COE flood control plan. Stampede Reservoir water may be stored only after: (1) Floriston rates and Truckee River diversion rights have been satisfied; (2) Boca Reservoir is full; and (3) Independence Lake is full. Due to its relatively junior water rights, this reservoir seldom fills and therefore has been targeted as a prime storage location for Reno–Sparks municipal water as part of the Negotiated Settlement (Public Law 101–618) and the implementation of a new Truckee River Operating Agreement (TROA). The State of California requires a minimum flow of 30 cfs downstream from the dam for maintaining fish habitat (although this agreement has expired, the rates of flow have been maintained).

[7] ***Boca Reservoir*** — The original Boca dam was built around 1868 for ice harvesting. The present, much larger dam, was constructed in 1937 and created a reservoir with a total capacity of 40,800 acre-

feet and a drainage area, to include the entire Little Truckee River Basin (including both Independence Lake and Stampede Reservoir) of some 172 square miles. Title to stored water is held by the USBR and operated by the Washoe County Water Conservation District (WCWCD). The reservoir's water is used in conjunction with Lake Tahoe water to maintain Floriston rates and to provide part of the required COE flood control capacity. Up to 25,000 acre-feet of water may be stored in Boca Reservoir only after Floriston rates are satisfied and Independence Lake's first storage priority of 3,000 acre-feet is satisfied. The balance may not be filled unless the Newlands Project diversion right at Derby Dam (on the lower Truckee River) has been satisfied. SPPCo stores a small portion (800 acre-feet) of its privately owned stored water (POSW) rights here. There are no minimum downstream flow requirement associated with Boca Reservoir.

[8] ***Derby Dam/Truckee Canal/Lahontan Reservoir*** — Although Lahontan Reservoir is not a storage facility of the Truckee River Basin, it does store Truckee River waters diverted at Derby Dam on the lower Truckee River. Derby Dam, which is located approximately 11 miles upstream from Wadsworth, Nevada, is the regulating device by which Truckee River waters are diverted into the Truckee Canal for use within the Truckee Division of the Newlands Project and for storage in Lahontan Reservoir in the Carson River Basin for use within the Carson Division of the Newlands Project. The dam, originally named the Truckee River Diversion Dam, was completed by the USBR in June 1905, whereas the Truckee Canal was not completed through to the Carson River until August 1906. Lahontan Reservoir was not completed until 1915, at which time the Truckee Canal's outlet was re-routed slightly upstream so as to enter Lahontan Reservoir instead of flowing directly into the Carson River below the dam. Diversions and releases are conducted in accordance with the Truckee River Agreement, the Orr Ditch Decree, and Newlands Project OCAPs, which allow for a maximum diversion of up to 1,500 cfs (Orr Ditch Decree right, although current canal capacity is only 900 cfs) from: (a) remainder of Floriston rates and return flows from upstream diversions; (b) right to Truckee River tributary water; and (c) any water bypassed or released to obtain space to store flood waters in reservoirs if water right holder did not identify a use for the release. Under the more recent project OCAPs, the quantity of water which may be diverted from the Truckee River at Derby Dam varies with the determination of irrigation entitlement each year (water-righted acreage to be irrigated and the appropriate water duty for bench and bottom lands) and the predicted runoff from the Carson River and water in storage in Lahontan Reservoir.

Also see *Operational Criteria and Procedures (OCAP) [Nevada]*, *Public Law 101–618 [Nevada and California]*, and *Truckee River Operating Agreement (TROA) [Nevada and California]*.

Truckee River General Electric Decree [California] — Represented the resolution, through a 1915 federal court consent decree, of a lengthy series of conflicts, litigation, and negotiations between the *U.S. Bureau of Reclamation (USBR)* and the Truckee River General Electric Company (predecessor to the present-day Sierra Pacific Power Company), which, in 1902, through a complicated series of real estate transactions had obtained title to the Lake Tahoe Dam, surrounding lands, and the hydropower plants on the Truckee River. The USBR was in desperate need of Lake Tahoe water for its Newlands Project, then nearing completion near Fallon in Churchill County. This decree granted the USBR an easement to operate the Lake Tahoe Dam and to use surrounding property owned by the power company. On its part, the USBR was required to provide certain year-round flow rates (the *Floriston Rates*), measured at a stream gage near the state line, to support hydropower generation. These rates, in fact, dated back to a 1908 river flow agreement among the Truckee River General Electric Company, the Floriston Land and Power Company, and the Floriston Pulp and Paper Company and required that "...there shall be maintained a flow of water in the said Truckee River at Floriston [California] of not less than 500 cubic feet per second from the First day of March to the 30th day of September inclusive, in each year, and of not less than 400 cubic feet per second from the 1st day of October to the last day of February, inclusive, in each year." While this decree did dictate how the Lake Tahoe Dam would be operated, it did little to solve the concerns of residents of the lake and lessen California's concerns over the apportionment of Lake Tahoe waters.

Truckee River Operating Agreement (TROA) [Nevada and California] — The Truckee River Operating Agreement is incorporated in Section 205 of *Public Law 101–618* (the *Negotiated Settlement*) and requires that the U.S. Secretary of the Interior negotiate an operating agreement for the Truckee River with the States of Nevada and California, and other parties. The intent of the TROA is to supplant the current *Truckee River Agreement* and provide for the comprehensive management of the Truckee River waters in California and Nevada, as well as to provide important long-term drought protection for the Reno–Sparks (Nevada) Metropolitan Area. The primary purpose of the TROA is to improve management of Truckee River reservoirs located in California by expanding existing operations for the benefit of municipal and industrial water use, increase drought storage, aid in the recovery of endangered and threatened fish species, and, in general, improve fish and wildlife habitat within the Truckee River Basin. This would be accomplished by "networking" reservoir releases and storage (i.e., unify reservoir operations for a common objective and into a single schedule) in a manner that would not infringe on existing water storage, release, and use rights or flood control requirements. The TROA would also allow for the exchange, transfer, and release of waters from the upstream reservoirs to improve the likelihood of maintaining instream flows for fish and wildlife. The TROA is intended to provided a number of substantive benefits to users of Truckee River waters. These benefits may be listed in four fundamental areas:

[1] ***Reservoir Management*** — Improve river flow and river management by improving flexibility, coordinate reservoir storage and release, allow transfers and exchanges among various reservoirs to reduce spills, provide for recreational pools, etc., create a water credit system, promote more efficient use of existing water supplies, allow for the storage of "other waters", centralize Truckee River water management, improve water accounting (budgeting) and forecasting, eliminate releases solely for power generation, permit storage of water savings from conservation in the Reno–Sparks Metropolitan Area, and provide for greater water marketing among private water rights holders;

[2] ***Fish and Wildlife*** — Enhance spawning potential of the Pyramid Lake endangered cui-ui (*Chasmistes cujus*) and threatened Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) fish species through improved overall river operations, commitment of specified waters, increased water availability, and mitigation of significant adverse environmental impacts;

[3] ***Municipal and Industrial Use*** — Provide additional M&I drought relief storage for the Reno–Sparks Metropolitan Area through an M&I Water Credit System;

[4] ***Conservation*** — Promote water conservation in the Reno–Sparks Metropolitan Area through water metering and various conservation programs.

Nevada State Water Plan
PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 9
Abbreviations and Acronyms

[The following terms have been extracted from the Nevada Division of Water Planning's *Water Words Dictionary* and may appear within the *Nevada State Water Plan*. Definitions of these words and a more extensive listing of water-related acronyms may be found in the *Water Words Dictionary*. With respect to notation and presentation, where two acronyms have different meanings, generally the more frequently used one will be listed first.]

AF	Acre-Feet (or Acre-Foot)
AFY	Acre-Feet per Year
ASC	Atmospheric Sciences Center (DRI)
ASCE	American Society of Civil Engineers
ASOS	Automated Surface Observing Systems (NWS/NOAA)
AWWA	American Water Works Association
BAC	Biological Activated Carbon [Process]
BADT	Best Available Demonstrated Technology
BAT	Best Available Technology [Economically Achievable]
BCF	Bioconcentration Factor
BCP	Bioconcentration Potential
BCT	Best [Conventional] Control Technology
BFE	Base Flood Elevation (FEMA)
BIA	Bureau of Indian Affairs (USDI)
BLM	Bureau of Land Management (USDI)
BMP	Best Management Practice [Urban Water Use]
BOD	Biochemical Oxygen Demand/Biological Oxygen Demand
BPI	Bureau of Plant Industry [Evaporation Pan] (USDA)
BPT	Best Practicable Control Technology
BSC	Biological Sciences Center (DRI)
CAA	Clean Air Act (EPA)
CAPA	Critical Aquifer Protection Area (SDWA)
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (EPA)
CERES	California Environmental Resources Evaluation System
CFCs	Chlorofluorocarbons
CF	Cubic Feet (or Foot)
CFS	Cubic Feet per Second
CIR	Consumptive Irrigation Requirement/Crop Irrigation Requirement
CLOMR	Conditional Letter of Map Revision (FEMA)
COI	Cone of Influence
COD	Chemical Oxygen Demand
COD	Cone of Depression
CORPS	U.S. Army Corps of Engineers (also USACE)
CSS	Combined Sewer System

CWA	Clean Water Act (EPA)
DBPs	Disinfection By-Products
DCNR	Department of Conservation and Natural Resources (State of Nevada)
D/DBP	Disinfectant and Disinfection By-Product Rule (EPA)
DEP	Division of Environmental Protection (DCNR)
DNAPLs	Denser (than water) Non-Aqueous-Phase Liquids
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DOF	Division of Forestry (DCNR)
DOW	Division of Wildlife (DCNR)
DDT	Dichlorodiphenyltrichloroethane
DRI	Desert Research Institute (University of Nevada System, State of Nevada)
DWR	Division of Water Resources (DCNR)
DWR	Department of Water Resources (The Resources Agency, State of California)
DWP	Division of Water Planning (DCNR)
EA	Environmental Assessment (NEPA)
EA	Endangerment Assessment (EPA)
EDF	Environmental Defense Fund
EEEC	Energy and Environmental Engineering Center (DRI)
EIS	Environmental Impact Statement (NEPA)
EPA	[U.S.] Environmental Protection Agency
ESA	Endangered Species Act (USFWS)
ESWTR	Enhanced Surface Water Treatment Rule (EPA)
ET	Evapotranspiration
ETAW	Evapotranspiration of Applied Water
EWMP	Efficient Water Management Practice [Agricultural Water Use]
FBFM	Flood Boundary Floodway Map (FEMA)
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHBM	Floodway Hazard Boundary Map (FEMA)
FIRM	Flood Insurance Rate Map (FEMA)
FIS	Flood Insurance Study (FEMA)
FONSI	Finding of No Significant Impact (NEPA)
FS	Feasibility Study (EPA)
FTE	Full Time Equivalent (Employment)
GAC	Granular Activated Carbon
GACT	Granular Activated Carbon Treatment
GD	Geologic Division (USGS)
GFD	Gallons per Square Foot [of membrane] per Day
GID	General Improvement District
GIS	Geographic Information System
GPC	Gallons per Capita (Person)
GPCD	Gallons per Capita per Day
GPD	Gallons per Day
GPED	Gallons per Employee per Day
HCP	Habitat Conservation Plan (EPA)
HSA	Hydrologic Study Area (DWR, State of California)

ICR Information Collection Rule (EPA)
I.E. Irrigation Efficiency
IOWE International Office for Water Education (Utah State University)
IRP Integrated Resource Planning

JTU Jackson Turbidity Unit

KGAL Kilogallons (thousand gallons)
KGRA Known Geothermal Resource Area

LOMA Letter of Map Amendment (FEMA)
LOMR Letter of Map Revision (FEMA)
LR Leaching Requirement
LTAR Long Term Acceptance Rate [of Soils]
LVEA Lahontan Valley Environmental Alliance

MAF Million Acre-Feet
M&I Municipal and Industrial
MBAS Methylene Blue Active Substance
MCL Maximum Contaminant Level (EPA)
MCLG Maximum Contaminant Level Goal (EPA)
MEQ/L Milliequivalents per Liter
MGD Million Gallons per Day
MG/L Milligrams per Liter
MIS Management Indicator Species
MSL Mean Sea Level
MTBE Methyl Tertiary Butyl Ether

NAPLs Non-Aqueous-Phase Liquids
NASQAN National Stream Quality Accounting Network (USGS)
NDEPS National Pollutant Discharge Elimination System (EPA)
NDOW Nevada Division of Wildlife (DCNR)
NDSP Nevada Division of State Parks (DCNR)
NDWP Nevada Division of Water Planning (DCNR)
NEPA National Environmental Policy Act
NESDIS National Environmental Satellite, Data and Information Service (NOAA)
NEXRAD Doppler Radar Data System (NWS/NOAA)
NFIP National Flood Insurance Program (FEMA)
NFS National Forest Service (USDA)
NGVD National Geodetic Vertical Datum
NHP Natural Heritage Program (DCNR)
NIDS NEXRAD Information Dissemination Service (NWS/NOAA)
NIFC National Interagency Fire Center (BLM)
NIPDWR National Interim Primary Drinking Water Regulations
NMD National Mapping Division (USGS)
NMFS National Marine Fisheries Service (NOAA)
NOAA National Oceanic and Atmospheric Administration (U.S. Department of Commerce)
NO_x Oxides of Nitrogen
NPDES National Pollutant Discharge Elimination System (EPA)
NPDWR National Primary Drinking Water Regulations (SDWA/EPA)
NPL National Priorities List [“Superfund” List] (EPA)

NPS	Non-Point Source [Pollution]
NPS	National Park Service (USDI)
NRCS	Natural Resources Conservation Service (USDA)
NRDC	Natural Resources Defense Council (private environmental organization)
NRP	National Research Program [Centers] (WRD/USGS)
NSDWR	National Secondary Drinking Water Regulations
NTU	Nephelometric Turbidity Unit
NVS	Non-Volatile Solids
NVSS	Non-Volatile Suspended Solids
NWIC	National Water Information Clearinghouse (USGS)
NWPA	Newlands [Irrigation Project] Water Protective Association
NWR	National Wildlife Refuge [System] (USFWS)
NWS	National Weather Service (NOAA)
OCAP	Operating Criteria and Procedures (TCID/USBR)
OFA	Other Federal Agencies [Program] (WRD/USGS)
OSM	Office of Surface Mining Reclamation and Enforcement (Bureau of Mines/USDI)
PAHs	Polycyclic Aromatic Hydrocarbons, or Polararomatic Hydrocarbons
PAMs	Polyacrylamides
PCBs	Polychlorinated Biphenyls
PCE	Perchloroethylene
PDC	Project Dependable Capacity
pH	Hydrogen Ion Concentration [Potential of Hydrogen]
PIA	Practicably Irrigable Acreage
P.L.	Public Law
PLSS	Public Land Survey System
PMF	Probable Maximum Flood (FEMA)
PNAs	Polynuclear Aromatic Hydrocarbons
PPB	Parts per Billion
PPM	Parts per Million
PPT	Parts per Thousand
PS	Point Source [Pollution]
PSA	Primary Settlement Agreement
PWS	Public Water System/Public Water Supply
PWSS	Public Water Supply System
QPF	Quantitative Precipitation Forecast
QSC	Quaternary Sciences Center (DRI)
RCRA	Resource Conservation and Recovery Act (EPA)
RI	Remedial Investigation (EPA)
RI/FS	Remedial Investigation/Feasibility Study (EPA)
RMCL	Recommended Maximum Containment Level
RMP	Resource Management Plan (BLM)
S.A.	Seasonally Adjusted
SAB	Science Advisory Board (EPA)
SAE	Seasonal Application Efficiency
SCS	Soil Conservation Service (now NRCS)
SDWA	Safe Drinking Water Act (EPA)
SFHA	Special Flood Hazard Area (FEMA)

SFIP Standard Flood Insurance Policy (FEMA)
SIC Standard Industrial Classification [Code]
SMCL Secondary Maximum Contaminant Level (EPA)
SNOTEL Snowpack Telemetry (NRCS)
SPCCP Spill Prevention Control and Countermeasures Plan (CWA)
SPF Standard Project Flood (FEMA)
SWAP Source Water Protection Program (EPA)
SWCS Soil and Water Conservation Society
SWE Snow Water Equivalent
SWPP Source Water Protection Program (EPA)
SWRCB State Water Resources Control Board (DWR/State of California)
SWTR Surface Water Treatment Rule (SDWA)

TC Total Carbon
TCID Truckee–Carson Irrigation District [Nevada]
TDS Total Dissolved Solids
THMs Trihalomethanes
TMDL Total Maximum Daily Load (EPA)
TNC The Nature Conservancy
TROA Truckee River Operating Agreement [California and Nevada]
TS Total Solids
TSCA Toxic Substances Control Act (EPA)
TSS Total Suspended Solids
TTHMs Total Trihalomethanes

UDI [Ground Water] Under the Direct Influence [of Surface Water]
UIC Underground Injection Control
USACE U.S. Army Corps of Engineers (also Corps)
USBR U.S. Bureau of Reclamation (USDI)
USDA U.S. Department of Agriculture
USDI U.S. Department of the Interior
USDW Underground Source of Drinking Water
USFS U.S. Forest Service (USDA)
USFWS U.S. Fish and Wildlife Service (USDI)
USGS U.S. Geological Survey (USDI)
USRS U.S. Reclamation Service (USBR)
UV Ultraviolet Radiation

VOC Volatile Organic Carbon
VOCs Volatile Organic Chemicals

WAVE Water Alliances for Voluntary Efficiency (EPA)
WCWCD Washoe County Water Conservation District (Nevada)
WET Water Education for Teachers
WHPA Wellhead Protection Area
WMA Wildlife Management Area (NDOW/State of Nevada)
WPA Watershed Protection Approach (EPA)
WRC Water Resources Center (DRI)
WRD Water Resources Division (USGS)

ZOC Zone of Contribution
ZOI Zone of Influence

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Section 10
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Section 11
Indexes to Part 1

[Note: Index entries are presented separately for each section.]

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Section 2 – Summary of the 1974 Water Plan:

Section 3 – The Institutional Framework for Water Planning and Management:

Section 4 – Water Resources Background:

Section 5 – Socioeconomic Background:

NEVADA STATE WATER PLAN

PART 2 – WATER USE AND FORECASTS

March 1999

Nevada Division of Water Planning
Department of Conservation and Natural Resources

Nevada State Water Plan
PART 2 — WATER USE AND FORECASTS

Section 1
Historic and Current Water Use

Introduction

Comprehensive water use information is critical to the success of all water planning and management functions. This section of the *State Water Plan* provides an overview of historic and current water use estimates and discusses observed trends in Nevada's water use.

Estimating Water Use

Approximately 65 to 75 percent of the total water withdrawn annually from groundwater and surface water sources in Nevada is either measured with detailed diversion records maintained by various entities or estimated by the State annually in detailed pumpage and crop inventories. According to the State Engineer's Office, water use data submitted to the Office and calculated by staff in the pumpage and crop inventories accounts for about 90 percent of the total groundwater usage. The balance of the groundwater and surface water usage must be estimated. The most significant water use estimation program in Nevada is implemented by the U.S. Geological Survey (USGS) as part of the USGS National Water Use Information Program.

USGS National Water Use Information Program

The USGS has the only program in Nevada responsible for estimating statewide water use on a routine and comprehensive basis. Staff in the USGS's National Water Use Information Program compile and disseminate water use information on local, state and national levels. In developing their estimates, the USGS staff work in cooperation with local, state, and federal agencies.

Since 1950, the USGS has estimated statewide water use at 5-year intervals and published these estimates in a national summary report. USGS water use estimates for Nevada and other states are included in the national summary report, but a separate detailed Nevada water use report with individual county breakdowns is not published. The national summary report includes water use information for each of the 50 states, plus the District of Columbia, Puerto Rico and the Virgin Islands, and for each of the 21 major water resources regions in the United States. The USGS water use estimates for Nevada have been maintained in an electronic database since 1985.

It is important to note that the Nevada water use figures developed by USGS staff are estimates and that the water use values developed are based upon a mixture of *measured* and *estimated* water use. To the extent possible, the USGS compiles water use data collected by other agencies. Much of the information is obtained from the State Engineer's Office (Nevada Division of Water Resources). As discussed in Part 1, Section 4 of the *State Water Plan,* the State Engineer's Office develops crop and pumpage inventories for about 40% of the basins. Pumpage data from about 30% of the 256 hydrographic areas are submitted by water right holders to the State Engineer's Office as a requirement of permit conditions. However, the pumpage data that are submitted may not represent all water usage within a particular basin. The USGS obtains additional information through personal communcations with various irrigation districts, federal water masters, water purveyors and from any recent USGS studies for a particular region. Federal law does not allow the USGS to mail out surveys to collect additional data.

Much of the water use data presented in this section has been developed by the USGS as part of the National Water Use Information Program. Upon review of the USGS estimates, the Division of Water Planning identified some inconsistencies in the data. However, it is difficult to make adjustments to these data because the USGS does not produce a separate Nevada water use report documenting data sources and assumptions. Nevertheless, as feasible, modifications were made to the USGS estimates by the Nevada Division of Water Planning (NDWP) to address a portion of these inconsistencies. Clearly, a more comprehensive water measurement and/or estimation program is needed to improve water use quantification. Both the original source data obtained from the USGS and the NDWP modifications are presented in the appendix. The "Water Use Measurement and Estimation" issue discussion in Part 3 of the *State Water Plan* provides additional information on available data and needs.

Current Water Use and Past Trends

This section presents statewide water use estimates for the period 1970-1995 at 5-year intervals. These estimates are divided into 8 categories of water use:

- public supply
- domestic
- commercial
- industrial
- thermoelectric
- mining
- irrigation
- livestock

For the public supply category (municipal water systems), this section provides estimated withdrawals by source and deliveries to domestic, commercial, industrial, and thermoelectric power users. The other categories represent both public supplied and self-supplied uses. Self-supplied withdrawals by source, deliveries from public suppliers (where applicable), and consumptive use estimates are given for these categories. Detailed county estimates are presented in the appendices.

Public Supply Water Use

Public supply refers to water withdrawn by public and private water suppliers and delivered for a variety of uses such as domestic, commercial, industrial, thermoelectric, and public uses such as park landscape irrigation. Public supply use is also referred to as Municipal and Industrial (M&I) water use. "Public supply systems" are defined as those which provide water to at least 25 people or 15 connections.

Background on Data Sources. Water use information submitted to the State Engineer for water right permit compliance was the primary source of data utilized by the USGS in their public supply water use estimations. Currently, about 20% of the approximately 300 public supply systems in Nevada are required to submit water withdrawal information to the State Engineer's Office for permit compliance. These systems include over 95% of the total population served by public supply systems. However, the data submitted to the State Engineer do not include details needed to develop a comprehensive picture of public supply water use. Such details include:

- number of persons served by the system;
- deliveries by categories, i.e. domestic, commercial, industrial, thermoelectric;
- consumptive use amounts; and
- estimation of public uses and losses.

In developing their water use figures, the USGS relied on other data sources or estimations for these types of information. Upon review of the USGS estimates, the Division of Water Planning identified some inconsistencies in the data and modified the estimates as appropriate. Both the original USGS estimates and the Division of Water Planning modifications are presented in the appendix.

1995 Public Supply Water Use. More than 90 percent of Nevada's population is currently served by about 300 public supply systems. The percentage of the population that is served by public supply systems varies from county to county (Table 1-1). According to the U.S. Census Bureau, about 92.5% of Nevada's population were served by public supply systems in 1990 with the remaining 7.5% served by domestic wells or other individual water systems. For 1995, the USGS estimated that about 94.2% of the population was supplied by public supply systems.

Table 1-1. Percentage of Population on Public Supply Systems

County	1970	1980	1990
Carson City	86.1	92.2	92.9
Churchill	42.0	48.4	49.1
Clark	94.8	97.1	97.5
Douglas	78.5	81.6	77.1
Elko	80.0	85.2	84.8
Esmeralda	54.2	65.8	68.1
Eureka	60.4	67.3	58.1
Humboldt	71.6	72.0	63.9
Lander	81.5	82.4	77.6
Lincoln	83.7	85.2	77.1
Lyon	58.0	61.4	64.4
Mineral	87.5	90.6	92.5
Nye	72.4	59.0	51.3
Pershing	89.8	72.2	76.7
Storey	99.4	70.9	57.7
Washoe	91.9	93.1	92.5
White Pine	89.8	84.8	75.8
Average	90.7	92.4	92.5

Table 1-2 provides a summary of public supply water use estimates for 1995 (see appendix for more detailed water information). Public supply systems withdrew approximately 525,000 acre-feet (af) in 1995, which is about 13% of the total statewide water withdrawals. Approximately 37% (196,000 af) of the withdrawals were consumptively used by the various users.

While only about 10% of the public supply systems utilize surface water, over 70% of the people on public supply systems receive surface water as some portion of their drinking water supply. As of 1995, about 75% of public supply system withdrawals were surface water. Most of the surface water use is in the Las Vegas area (Colorado River) and the Reno-Sparks and Lake Tahoe areas (Lake Tahoe/Truckee River system).

Table 1-2. Estimated Public Supply Water Use for 1995

Category	Value
Population	
Population served	1,487,640
Percentage of total population	94.2%
Withdrawals (acre-feet)	
Groundwater	131,958
Surface Water	392,903
Total	524,861
Deliveries & public uses/losses (acre-feet)	
Domestic	342,605
Commercial	129,707
Industrial	2,454
Thermoelectric	1,624
Total deliveries	476,388
Public uses and losses	48,473
Total deliveries and public uses and losses	524,861
Consumptive use (acre-feet)	196,444
Water use per person (gallons per person per day)	
Withdrawals per person	315
Domestic deliveries per person	206

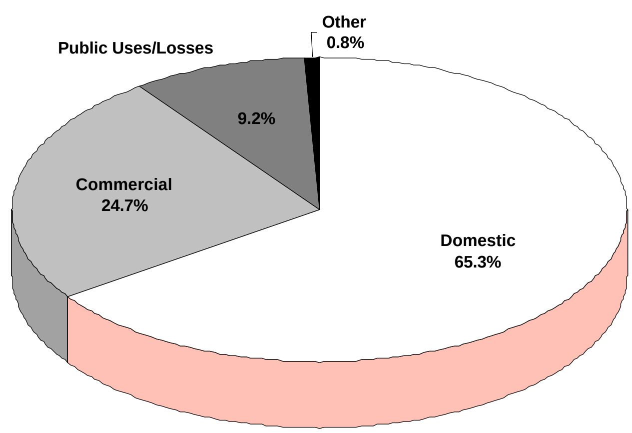
Note: Data are estimates only and subject to revision.

Source: U.S. Geological Survey with modifications by Nevada Division of Water Planning

In 1995, public supply systems delivered approximately 65% (343,000 af) to domestic users, 25% (130,000 af) to commercial users, and 1% (4,000 af) to industrial and thermoelectric users. The remaining 9% (48,000 af) was estimated for public uses (firefighting, street washing, etc.) and losses from the distribution system (Figure 1-1).

Often public supply water use is presented in terms of gallons per person (capita) per day (gpcd). In 1995, Nevada's public supply systems withdrew an average of about 315 gallons each day for each person on these systems. This factor includes all water used for all purposes such as domestic, commercial, industrial, and thermoelectric, and also includes public uses and system losses. Domestic deliveries accounted for about 65% of all water used within the public supply systems, resulting in a residential use factor of 206 gpcd (Table 1-2). Per capita water use tends to vary from county to county and region to region. Nevada's average per capita water use is greatly impacted by Clark County usage rates. Public supply water use in Clark County accounts for over 70% of all public supply usage in Nevada.

Fig. 1-1. 1995 Public Supply Water Uses by Category

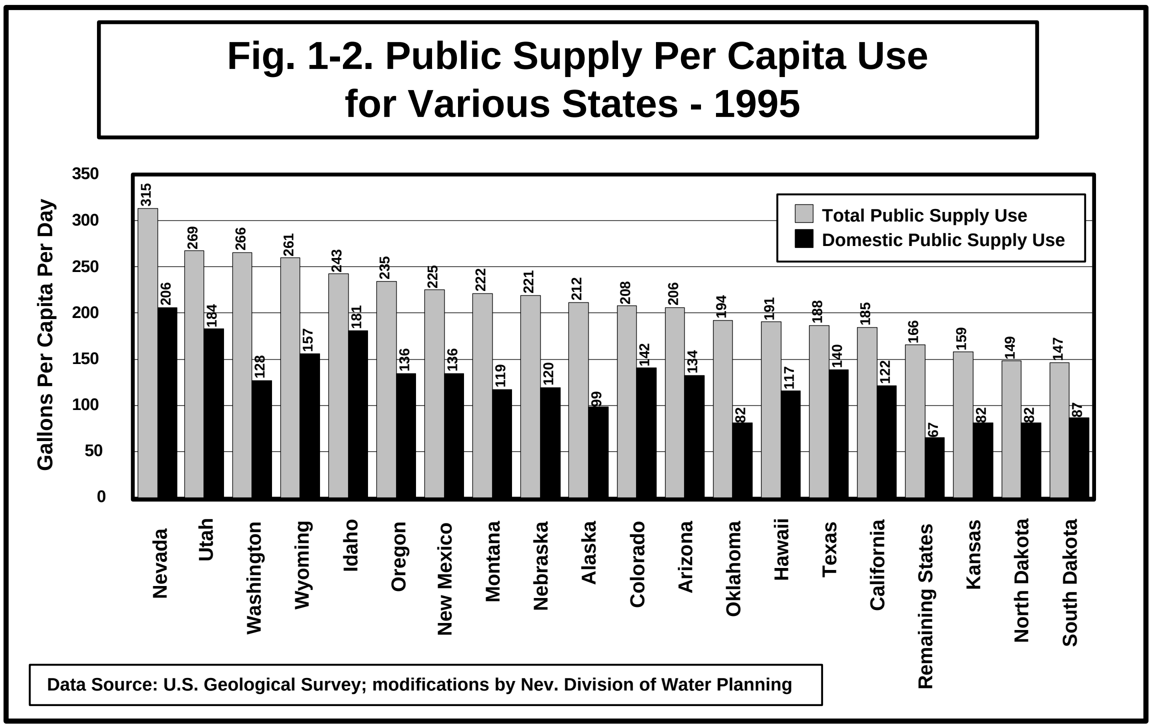


Data Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning

Per capita public supply water use varies from state to state with higher per person water use in the western United States compared to the eastern states. According to USGS estimates for the period 1970-90, Nevada has typically had one of the highest per capita water use rates in the country. Figure 1-2 presents 1995 per capita water use for each of the western states and the remaining states as a whole. In 1995, Nevada had the highest per capita water use (315 gpcd) for all public supply uses and the highest per capita use (206 gpcd) for domestic public supply uses.

There are a few possible explanations for Nevada's high per capita water use. For instance, about 1/3 of the water withdrawn by Nevada public supply systems is used for landscape watering. As Nevada is the driest state in the U.S., more landscape watering is generally required than in other states thereby increasing our increasing our per capita water usage. Another possible explanation is that the public withdrawal amounts estimated by USGS include water used by hotels and casinos, and other tourism-dependent operations. However only the resident population is included in the per capita estimates. The large number of visitors to Nevada result in higher public supply water use and per capita rates.

Public Supply Water Use Trends. As expected, public supply water use has increased as Nevada's population has grown. Public supply withdrawals have increased from approximately



151,000 acre-feet to 525,000 acre-feet from 1970 to 1995 (Table 1-3, Figure 1-3). For the same period, the population served by public supply systems increased from about 441,000 to about 1,488,000. From 1970 to 1990, public supply water use rates in Nevada increased from 306 to 334 gallons per capita per day (gpcd). Successful conservation programs during the 1990s have lowered statewide M&I water use down to 315 gpcd by 1995. A majority of this decrease was due to aggressive conservation in the Las Vegas area. For example, M&I use within the Las Vegas Valley Water District decreased from 358 gpcd in 1989 to 320 gpcd in 1997. Detailed county water use data for 1985-95 are included in the appendices.

Table 1-3. Estimated Public Supply Withdrawals and Consumptive Use, 1970-95

Category	1970	1975	1980	1985	1990	1995
Withdrawals (acre-feet)	151,219	192,664	260,993	322,143	431,322	524,861
Consumptive Use (acre-feet)	51,526	58,247	77,290	123,358	153,321	196,444

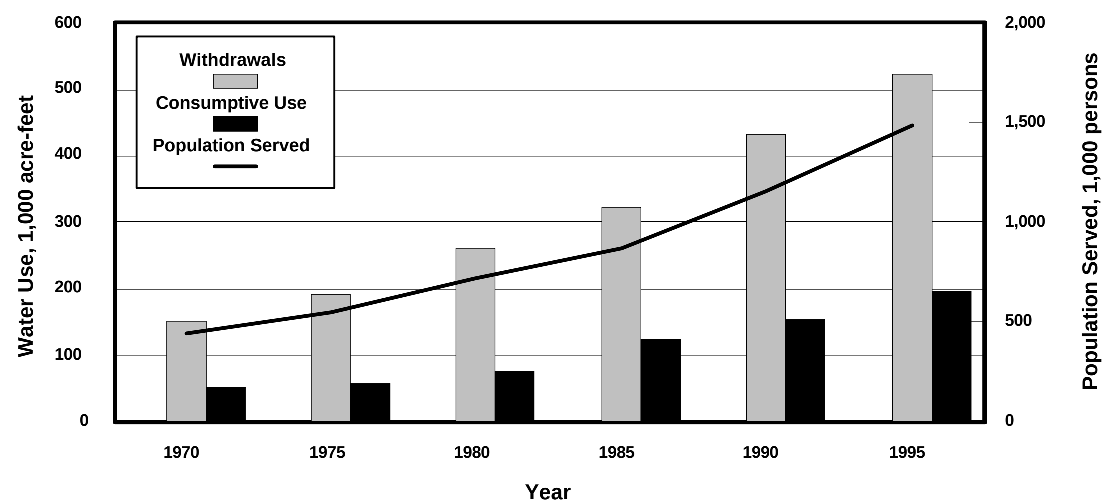
Population Served	441,000	545,000	721,000	871,140	1,152,770	1,487,640
% of State Population	90.2%	90.1%	90.1%	91.1%	93.3%	94.2%
Withdrawals Per Person (gpcd)	306	316	323	330	334	315

gpcd = gallons per capita (person) per day
Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning
Note: Data are estimates only and subject to revision

Domestic Water Use

Domestic use refers to water used for household purposes and includes both indoor and outdoor uses, such as drinking, food preparation, bathing, clothes and dish washing, and lawn and garden watering. Domestic water needs are met by either public supply systems or self-supplied systems

Fig. 1-3. Public Supply Water Use and Population Served, 1970-95



Data Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning

(domestic wells, individual pumps, cisterns, etc.).

<u>Background on Data Sources.</u> As described earlier, the major public supply systems submit water withdrawal information to the State Engineer's Office. However, these data are not divided into categories such as domestic, commercial, industrial, and thermoelectric, nor do they include information on the number of persons served. Fortunately, the larger water systems produce planning documents that provide these types of details. The USGS relies primarily on these planning documents and other available reports to analyze the domestic use portion of the total public supply use. For those smaller public supply systems lacking detailed water use reports, the USGS estimates the domestic use portion based upon factors developed for larger systems in the same region. Populations served by public supply systems are estimated based upon the available water planning documents.

Measurements of self-supplied domestic use are limited and, thus estimation is required for most values. As part of the National Water Use Information Program, the USGS estimates self-supplied domestic use by assuming a water use rate of approximately 120 gallons per person per day. A higher value is deemed to be more appropriate. For the *State Water Plan*, self-supplied domestic use for each county is assumed at 90 percent of county public-supplied domestic use. By multiplying these per person water use rates and the number of persons on private domestic systems, total self-supplied domestic water usages are estimated. The number of person on private domestic systems are estimated by subtracting the population served by public systems from total county populations.

1995 Domestic Water Use. Table 1-4 presents a summary of domestic water use estimates for 1995 as developed by the USGS and modified by the Division of Water Planning (see the appendices for more detailed estimates). In 1995, domestic use withdrawals were approximately 361,000 acre-feet with 50% (180,000 acre-feet) of this amount consumed. Domestic water withdrawals accounts for about 9% of the 1995 state total water withdrawals.

In 1995, the domestic water needs of 94.2% of Nevada's population (1,488,000) were met with public supply systems. Self-supplied systems provided domestic water for the other 5.8% (92,000). Over 96% (343,000 acre-feet) of the water needed for domestic purposes was delivered by public supply systems. Domestic self-supplied systems withdrew about 18,000 acre-feet in 1995, with groundwater being the primary source.

Table 1-4. Estimated Domestic Water Use for 1995

	Self-Supplied Domestic	Public-Supplied Domestic	All Domestic Combined
Population served	91,510	1,487,640	1,579,150
% of total population	5.8%	94.2%	100.0%
Withdrawals or deliveries, acre-feet			
Groundwater	17,783	86,303 *	104,086*
Surface water	321	256,302 *	256,623*
Total	18,105	342,605	360,710
Consumptive Use, acre-feet	9,022	171,015	180,037
Water use per person (gallons per person per day)	177	206	204

* Estimated by Nevada Division of Water Planning

Source: U.S. Geological Survey with modifications by Nevada Division of Water Planning

Note: Data are estimates only and subject to revision.

Domestic Water Use Trends. Domestic water use has increased over the years in response to the growing population. From 1970 to 1995, domestic water use increased from about 117,000 acre-feet to about 361,000 acre-feet (Table 1-5, Figure 1-4). Nevada's population increased from about 489,000 to about 1,579,000 during the same period, with the percentage of people served by public supply systems increasing from about 90% to 94% of the total population. Refer to the appendices for detailed county water use data for 1985-95.

Table 1-5. Estimated Domestic Withdrawals and Consumptive Use, 1970-95

Category	1970	1975	1980	1985	1990	1995
Self-Supplied Domestic						
Withdrawals, acre-feet	10,200	13,400	16,500	19,673	16,668	18,105
Consumptive Use, acre-feet	5,100	6,700	8,250	10,092	8,385	9,022
Population Served	47,700 *	60,000 *	79,500 *	84,670	83,360	91,510
% of Total Population	9.8%	9.9%	9.9%	8.9%	6.7%	5.8%
Withdrawals Per Person, gpcd	190 *	200 *	185 *	207	179	177
Public-Supplied Domestic						
Deliveries, acre-feet	106,400 **	134,400 **	168,000 **	211,896	266,906	342,605
Consumptive Use, acre-feet	43,000 *	49,000 *	65,000 *	107,129	133,442	171,015
Population Served	441,000	545,000	721,000	871,140	1,152,770	1,487,640
% of Total Population	90.2%	90.1%	90.1%	91.1%	93.3%	94.2%
Withdrawals Per Person, gpcd	215	220	208	217	207	206
All Domestic Combined						
Withdrawals/deliveries, acre-feet	116,600 **	147,800 **	184,500 **	231,569	283,574	360,710
Consumptive Use, acre-feet	48,100 *	55,700 *	73,250 *	117,221	141,827	180,037
Population Served	488,700 *	605,000 *	800,500 *	955,810	1,236,130	1,579,150
Withdrawals Per Person, gpcd	213 *	218 *	206 *	216	205	204

* Data not available from USGS. Estimated by NDWP.

** Includes public uses & losses.

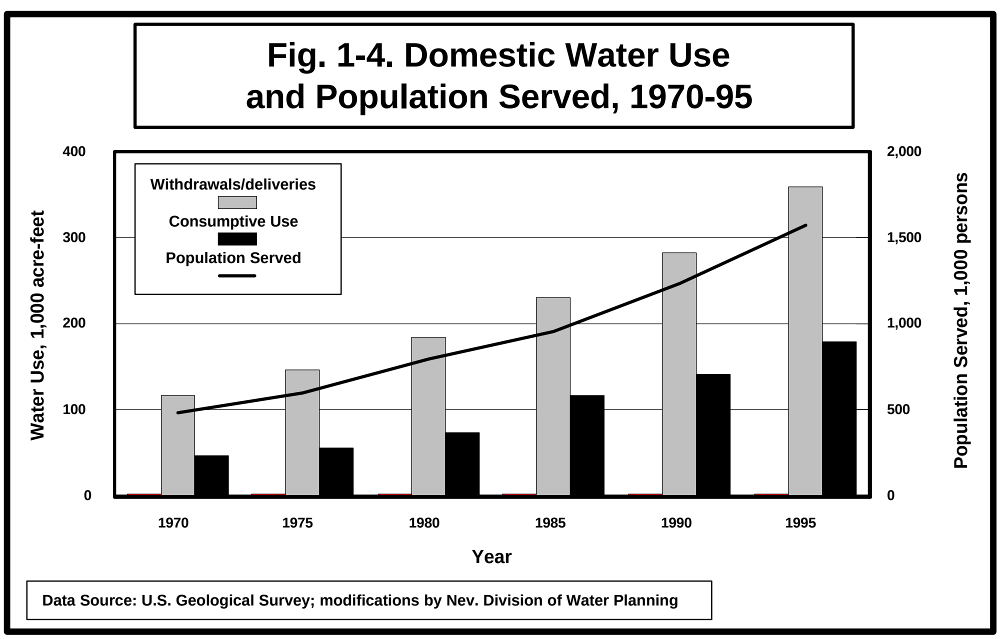
gpcd = gallons per capita (person) per day

Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning

Note: Data are estimates only and subject to revision.

Commercial Water Use

Commercial use includes water for casinos, motels, restaurants, office buildings, campgrounds, other commercial facilities, and civilian and military institutions. Commercial water needs are met by



either public supply systems (community water systems) or self-supplied systems (non-community systems).

Background on Data Sources. In quantifying a portion of the public-supplied commercial water use, the USGS has relied upon reports produced by the larger public supply systems. For those smaller systems lacking detailed water use reports, the USGS estimated public-supplied commercial water use with factors developed for the larger public supply systems and other factors (such as water use per employee estimates).

There are about 400 self-supplied water systems in Nevada which provide water for casinos, motels, campgrounds and other commercial facilities. In general, the USGS applies various use factors to estimate water use by these systems thereby quantifying self-supplied commercial usage. The USGS also uses available water use information collected by the State Enginer's Office. None of the USGS estimates were modified by the Nevada Division of Water Planning.

1995 Commercial Water Use. Table 1-6 provides a summary of 1995 commercial water use estimates as developed by the USGS (see appendix for more detailed estimates). In 1995, about 153,000 acre-feet was used for commercial purposes, with about 17% (26,000 acre-feet) of these withdrawals being consumed. Commercial water use accounts for 4% of the state total. About 85% (130,000 acre-feet) of the water needed for commercial operations in 1995 was delivered by public supply systems. The remaining 15% (23,000 acre-feet) was provided by self-supplied systems. Surface water was the principal source for self-supplied water furnishing about 66% (16,000 acre-feet) of the self-supplied withdrawals.

Table 1-6. Estimated Commercial Water Use for 1995

	Self-Supplied Commercial	Public-Supplied Commercial	All Commercial Combined
Withdrawals or deliveries, acre-feet			
Groundwater	7,919	32,674 *	40,593 *
Surface water	15,559	97,033 *	112,592 *
Total	23,477	129,707	153,184
Consumptive Use, acre-feet	3,193	23,268	26,461

* Estimated by the Nevada Division of Water Planning

Source: U.S. Geological Survey

Note: Data are estimates only and subject to revision.

Commercial Water Use Trends. Commercial water use has increased from about 69,000 acre-feet to about 153,000 acre-feet during the period 1985 to 1995 (Table 1-7). Commercial water use trends cannot be established for previous years. Prior to 1985, the USGS had not provided water use estimates for commercial purposes as a separate category but rather commercial usage was aggregated under other uses. Refer to the appendices for detailed county water use data for 1985-95.

Table 1-7. Estimated Commercial Withdrawals and Consumptive Use, 1985-95

Category	1985	1990	1995
Self-Supplied Commercial			
Withdrawals (acre-feet)	8,287	25,426	23,477
Consumptive Use (acre-feet)	1,669	3,583	3,193
Public-Supplied Commercial			
Deliveries (acre-feet)	60,340	100,218	129,707
Consumptive Use (acre-feet)	12,096	18,401	23,268
All Commercial Combined			
Withdrawals/deliveries (acre-feet)	68,627	125,644	153,184
Consumptive Use (acre-feet)	13,765	21,984	26,461

Source: U.S. Geological Survey
Note: Data are estimates only and subject to revision.

Industrial Water Use

Industrial use includes water for manufacturing and construction. Industrial water needs are met by either public supply systems or self-supplied systems.

Background on Data Sources. To estimate industrial water usage, the USGS utilizes data obtained from water-supply companies, and Nevada Division of Water Resources pumpage records. However, these data generally cover only a portion of the industrial water use. Also, few public supply systems record industrial and commercial use as two separate categories. Due to the lack of data, the USGS estimates much of the industrial usage in Nevada. None of the USGS estimates were modified by the Nevada Division of Water Planning.

1995 Industrial Water Use. Industrial water use estimates for 1995 are shown in Table 1-8 (see the appendices for more detailed estimates). In 1995, approximately 19,000 acre-feet were used for industrial purposes with about 29% (5,000 acre-feet) being consumed. Industrial water withdrawals account for 0.5% of the state total. About 87% (17,000 acre-feet) of the water used for industrial purposes was furnished by self-supplied systems, with the other 13% provided by public supply systems. The self-supplied systems withdrew almost equal amounts of surface water and groundwater during 1995.

Table 1-8. Estimated Industrial Water Use for 1995

	Self-Supplied Industrial	Public-Supplied Industrial	All Industrial Combined
Withdrawals or deliveries, acre-feet			
Groundwater	8,322	618 *	8,940 *
Surface water	8,446	1,836 *	10,282 *
Total	16,768	2,454	19,222
Consumptive Use, acre-feet	4,952	537	5,489

* Estimated by the Nevada Division of Water Planning

Source: U.S. Geological Survey

Note: Data are estimates only and subject to revision.

Industrial Water Use Trends. Total industrial water use changed little during the period 1985 to 1995 (Table 1-9). Industrial water use trends cannot be established for previous years. Prior to 1985, the USGS did not separate out water use estimates for industrial purposes, rather industrial usage was aggregated with other uses. Refer to the appendices for detailed county water use data for 1985-95.

Table 1-9. Estimated Industrial Withdrawals and Consumptive Use, 1985-95

Category	1985	1990	1995
Self-Supplied Industrial			
Withdrawals (acre-feet)	11,369	11,437	16,768
Consumptive Use (acre-feet)	2,139	2,228	4,952
Public-Supplied Industrial			
Deliveries (acre-feet)	7,057	2,946	2,454
Consumptive Use (acre-feet)	1,411	582	537
All Industrial Combined			
Withdrawals/deliveries (acre-feet)	18,426	14,383	19,222
Consumptive Use (acre-feet)	3,550	2,810	5,489

Source: U.S. Geological Survey
Note: Data are estimates only and subject to revision.

Thermoelectric Water Use

Thermoelectric use includes water used in the production of electric power generation from fossil fuel and geothermal sources. Nevada has 22 thermoelectric powerplants, seven of which are fossil fueled and 15 are geothermal.

Background on Data Sources. Thermoelectric water use data, as compiled by the USGS, were obtained directly from the power plants, State Engineer's records and/or estimated. No modifications were performed by the Nevada Division of Water Planning.

1995 Thermoelectric Water Use. Thermoelectric water use estimates for 1995 are shown in

Table 1-10 (see the appendices for detailed county estimates). In 1995 approximately 65,000 acre-feet were used for thermoelectric power generation with about 63% (41,000 acre-feet) being consumed. Thermoelectric water withdrawals accounts for 2% of the state total. The USGS estimated that Nevada's thermoelectric plants generated about 19 billion kilowatt-hours in 1995.

Table 1-10. Estimated Thermoelectric Water Use for 1995

	Self-Supplied Thermoelectric	Public-Supplied Thermoelectric	All Thermoelectric Combined
Withdrawals or deliveries, acre-feet			
Groundwater	40,650	409 *	41,059 *
Surface water	23,176	1,215 *	24,391 *
Total	63,825	1,624	65,449
Consumptive Use, acre-feet	39,429	1,624	41,053

* Estimated by the Nevada Division of Water Planning
Source: U.S. Geological Survey
Note: Data are estimates only and subject to revision.

Over 97% (about 64,000 acre-feet) of the water needed for thermoelectric operations in 1995 was furnished by self-supplied systems. The remaining 2,000 acre-feet was provided by public supply water systems. Groundwater was the primary source for self-supplied water furnishing about 64% (41,000 acre-feet) of the self-supplied withdrawals.

Thermoelectric Water Use Trends. Total thermoelectric water withdrawals have more than doubled from 1985 to 1995 increasing from about 29,000 acre-feet to 65,000 acre-feet (Table 1-11). Over the 10 year period, public supply systems provided a minor portion of the total thermoelectric water used. Usage trends cannot be presented for previous years. Prior to 1985, the USGS did not compile water use estimates for all thermoelectric purposes as a separate category.

Table 1-11. Estimated Thermoelectric Withdrawals and Consumptive Use, 1985-95

Category	1985	1990	1995
Self-Supplied Thermoelectric			
Withdrawals (acre-feet)	26,278	74,019	63,825
Consumptive Use (acre-feet)	23,668	49,298	39,429
Public-Supplied Thermoelectric			
Deliveries (acre-feet)	2,722	896	1,624
Consumptive Use (acre-feet)	2,744	896	1,624
All Thermoelectric Combined			
Withdrawals/deliveries (acre-feet)	29,022	74,915	65,449
Consumptive Use (acre-feet)	26,390	50,194	41,053

Source: U.S. Geological Survey
Note: Data are estimates only and subject to revision.

Mining Water Use

Mining use refers to water used in the extraction, milling, and processing of naturally occurring minerals (including petroleum), and other activities that are part of mining, such as dust control. Minerals mined in Nevada can be divided into two categories: metals and industrial minerals. Metals mined in Nevada include gold, silver, lead, zinc, molybdenum and copper. Mined industrial minerals include aggregate, barite, clay, gypsum, lime, diatomite, lithium carbonate, magnesite and silica. Water use varies widely from operation to operation and is dependent upon the mineral being recovered and the recovery process employed.

Background on Data Sources. In developing mining water use estimates for Nevada, the USGS relies upon pumpage data available from the Nevada Division of Water Resources and prepares estimates where data gaps exist. Prior to 1985, the USGS did not have a separate estimate for mining water use.

Many mines operate dewatering systems to maintain dry conditions as ore and other materials are removed. Under the USGS National Water Use Information Program, any water removed for mine dewatering that is not consumptively used in the mine operations is not included in the withdrawal figures. However in Nevada, mine dewatering represents a significant share of total water withdrawals and may impact the amount of water available for other uses. Therefore, mine dewatering needs to be considered in any planning effort. For this reason, the Division of Water Planning modified the USGS water use estimates to include all dewatering withdrawals. Utilizing the State Engineer's pumpage records for 1990 and 1995, the Division calculated the nonconsumptive use portion of the withdrawals. The mine dewatering figures include water that is reinjected into the groundwater, utilized for another use such as irrigation, or discharged. The nonconsumptive use dewatering values were added to the USGS consumptive use figures to arrive at total mining water withdrawals. Adjustments were not made to the USGS estimates for 1985 as no pumpage data are available from the State Engineer's Office for that year.

1995 Mining Water Use. Mining water use estimates for 1995 are shown on Table 1-12 (see the appendices for more detailed estimates). Of the estimated 274,000 acre-feet per year withdrawn in 1995, approximately 89,000 acre-feet per year (about 32%) was consumptively used by mining operations. The remaining 68% (185,000) was reinjected, infiltrated, evaporated, discharged to surface water bodies, or used for irrigation purposes. In some areas, mine dewatering discharges are being used for irrigation as a substitute for pumped water from irrigation wells. In these instances, the irrigation operation is temporarily using the mine dewatering discharge rather than pumping its own permitted groundwater wells.

Mine water withdrawals accounted for about 7% of the total state water withdrawals. A majority of statewide mine water withdrawals occur in the Humboldt River basin. In 1995, mine water withdrawals in the Humboldt River basin accounted for about 70% of the state total mine water withdrawals.

Table 1-12. Estimated Mining Water Use for 1995

Use Category	Use, acre-feet
Withdrawals	
Groundwater	270,524
Surface water	3,909
Total	274,433
Consumptive Use	89,163
Nonconsumptive Use	185,270

Source: U.S. Geological Survey with modifications by Nev. Division of Water Planning

Note: Data are estimates only and subject to revision.

Mining Water Use Trends. Mining water use has changed significantly since 1985. According to Table 1-13, total mining withdrawals have increased by a factor of 10 from 1985 to 1995 with consumptive uses increasing by a factor of 4. A majority of this increase is attributable to an increase in mining activities within the Humboldt River basin. Mining water use trends cannot be established for previous years. Prior to 1985, the USGS did not compile water use estimates for mining as a separate category. Refer to the appendix for detailed county water use data for 1985-95.

Table 1-13. Estimated Mining Withdrawals and Consumptive Use, 1985-95

Category	1985	1990	1995
Withdrawals (acre-feet)	27,309	120,124	274,433
Consumptive Use (acre-feet)	22,469	67,858	89,163
Nonconsumptive Use (acre-feet)	4,840	52,266	185,270

Source: U.S. Geological Survey: modifications by Nevada Division of Water Planning
Note: Data are estimates only and subject to revision.

Irrigation Water Use

Irrigation use, as classified by the USGS for the National Water Use Information Program, refers to water withdrawn and applied to lands to grow crops and pasture as well as self-supplied water used to irrigate golf courses and parks. Under this category, water for irrigation is self-supplied or supplied by irrigation companies or districts. The amount of self-supplied water used for golf course and park irrigation is minor compared to the agricultural irrigation use and could not be presented as a separate category due to data limitations. Landscape watering from a public supply water system is not included in the *irrigation use* category, but rather in the public supply category. The main field crops grown in Nevada include alfalfa and other hay, alfalfa seed, winter and spring wheat, potatoes, garlic and onions. These crops account for about 70% of the total irrigated acreage. In addition to harvested field crops, about 30% of the irrigated acreage in Nevada is pasture.

Background on Data Sources. Although irrigation is the largest use of water in Nevada, only limited irrigation measurements are available. The measured data that do exist must be obtained from a variety of sources which sometimes contain conflicting information.

For those areas of Nevada lacking measured water use data, the USGS typically estimates irrigation water use as follows:

- compile estimates of irrigated land by crop type and irrigation method (flood, sprinkler);

- develop consumptive use factors (acre-feet used per acre) and irrigation efficiency coefficients (ranging from 0.0 [least efficient] to 1.0 [most efficient]); and

- develop consumptive use and withdrawal estimates by applying the above factors to the irrigated acreage values.

The USGS staff has used a variety of data sources to develop irrigation water use estimates. Irrigated acreage estimates were generally derived from Nevada Division of Water Resources crop and pumpage inventories, data obtained from irrigation districts, other USGS project reports, some satellite imagery, the *Census of Agriculture* developed by the U.S. Census Bureau every 4 to 5 years, (however periods do not necessarily coincide with the USGS estimates), and the *Nevada Agricultural Statistics* published annually by the Nevada Agricultural Statistics Service (reports harvested crops only which accounts for about 70% of irrigated land). Consumptive use rates for different areas of the State and various crops were obtained from the U.S. Natural Resources Conservation Service; and irrigation efficiency factors were developed from available information and literature. The following general equations were utilized by the USGS to estimate consumptive use and withdrawals:

consumptive use (acre-feet) = irrigated acreage (acres) x consumptive use factor (acre-feet/acre)

withdrawals (acre-feet) = consumptive use (acre-feet) / irrigation efficiency coefficient

With the exception of the 1995 data, the USGS irrigation water use estimates for the previous years were utilized for the *State Water Plan*. The original 1995 data showed a significant drop in irrigated acreage and water use from 1985/90 to 1995 which was not consistent with data presented in the *Nevada Agricultural Statistics* reports. Therefore, the Division of Water Planning modified the 1995 estimates for inclusion in the *Plan*.

According to the USGS, the 1995 acreage estimates were based upon the 1992 U.S. Agriculture Census which indicated a sharp decline in irrigated land as a result of the drought. Also, the consumptive use factors utilized for the 1995 estimates were generally lower than those used for the previous 1985/90 estimates. For the *State Water Plan*, the Division of Water Planning developed new 1995 irrigated acreage estimates based upon *Nevada Agricultural Statistics* data. As the *Nevada Agricultural Statistics* reports only harvested hay acreages by county (which accounts for only about 70% of the total irrigated acreage), these data were adjusted as needed to include all irrigated lands. Consumptive use and withdrawal amounts were then developed by utilizing use consumptive use factors and efficiency coefficients more consistent with the 1985 and 1990 estimates. A detailed explanation of this methodology is presented in the appendix.

Irrigation water use in Nevada can be extremely variable from year to year in response to water availability. During periods of drought, irrigated acreage and water use typically decline or groundwater use may increase to augment reduced surface supplies. It must be emphasized that the USGS water use estimates are developed only every 5 years and as such these estimates do not accurately reflect the annual variations in irrigation water use.

1995 Irrigation Water Use. Table 1-14 provides a summary of 1995 irrigation water use estimates (see appendix for more detailed estimates). In 1995 about 3.1 million acre-feet were withdrawn for irrigation purposes, of which about 1.6 million acre-feet were consumed. Irrigation water withdrawals accounted for 77% of the 1995 total state withdrawals.

Table 1-14. Estimated Irrigation Water Use for 1995

Category	Value
Withdrawals, acre-feet	
Groundwater	1,138,184
Surface water	1,975,401
Total	3,113,585
Consumptive use, acre-feet	1,612,079
Irrigated Land, acres	
Sprinkler	175,284
Flood	540,156
Total	715,440

Source: U.S. Geological Survey with modifications by Nevada Division of Water Planning
Note: Data are estimates only and subject to revision.

It is estimated that about 63% of the total water withdrawn in 1995 was diverted from surface water sources with the remaining 37% produced from groundwater sources. Flood irrigation was used for about 75% of the approximate 715,000 acres irrigated, with sprinklers used for the other 25%. The average amount of water withdrawn for irrigation was about 4.4 acre-feet per irrigated acre (which includes conveyance losses). Consumptive use averages about 1/2 that amount, or 2.3 acre-feet per irrigated acre.

Irrigation Water Use Trends. USGS estimates (with 1995 Division of Water Planning modifications) show that irrigated acreage and water use decreased during the period 1970 to 1995 (Table 1-15, Figure 1-5). Due to the uncertainty with the data, it is unknown if this decrease is indicative of any statewide trend or is merely an artifact of the estimation process.

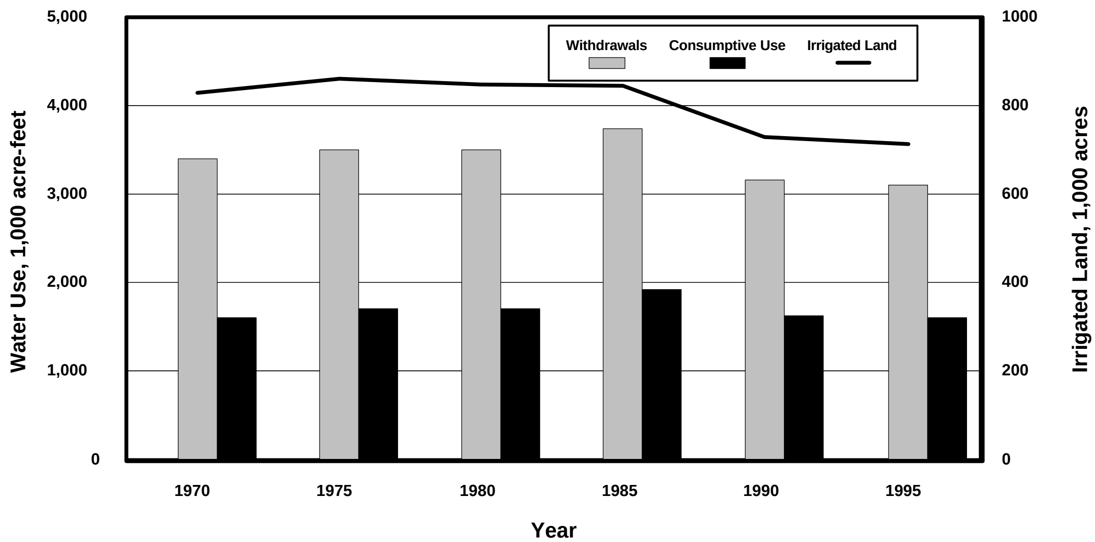
Table 1-15. Estimated Irrigation Withdrawals and Consumptive Use, 1970-95

Category	1970	1975	1980	1985	1990	1995
Withdrawals (acre-feet)	3,400,000	3,500,000	3,500,000	3,750,000	3,161,000	3,114,000
Consumptive Use (acre-feet)	1,600,000	1,700,000	1,700,000	1,934,000	1,634,000	1,613,000
Irrigated Land (acres)	830,000	860,000	850,000	844,000	729,000	715,000

Source: U.S. Geological Survey; 1995 USGS estimates modified by Nevada Division of Water Planning
Note: Data are estimates only and subject to revision.

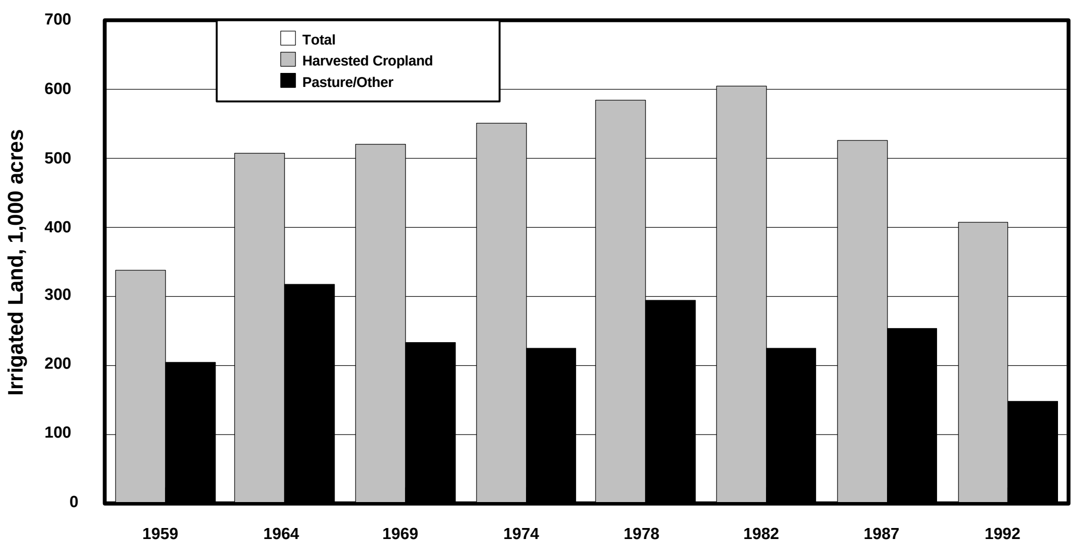
Other data sources for the amount of historically irrigated lands include the U.S. Census and the *Nevada Agricultural Statistics*. U.S. Census data show that irrigated acreage fluctuated during the period 1959 to 1992 (Figure 1-6) varying from lows of about 550,000 acres in 1959 and 1992 (both dry years) to a high of 881,000 acres in 1978. Data published in *Nevada Agricultural Statistics* reports indicates that the amount of harvested cropland has fluctuated widely during the 1960 to
1995 period (Figure 1-7). The amount of harvested cropland peaked at just over 600,000 acres during the early 1980s. According to the U.S. Census data, harvested cropland accounts for about 70% of the total irrigated land in Nevada.

Fig. 1-5. Irrigation Water Use and Irrigated Land, 1970-95

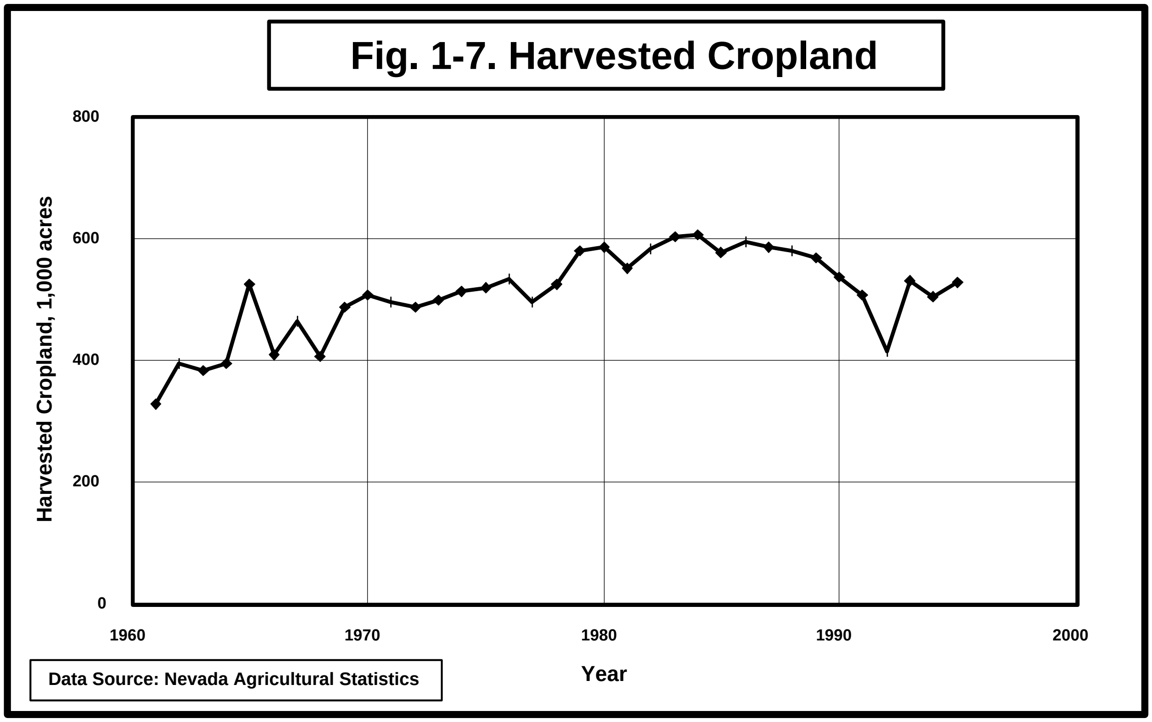


Data Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning

Fig. 1-6. Irrigated Land



Data Source: U.S. Census Bureau



Livestock Water Use

Livestock use refers to water used for stock watering, feed lots, dairy operations, and other on-farm needs. Cattle are the major livestock raised in Nevada with most grazed on open range. Other livestock include sheep, horses and hogs.

Background on Data Sources. Several sources are used by the USGS in deriving livestock water use estimates. Livestock population estimates are compiled from a number of agencies such as the Nevada Department of Agriculture, U.S. Bureau of Census, and U.S. Bureau of Land Management. Assumed water use rates per animal are applied to the population counts to estimate water use. None of the USGS estimates were modified by the Division of Water Planning.

Table 1-16. Estimated Livestock Water Use for 1995

Category	Value
Withdrawals, acre-feet	
Groundwater	1,119
Surface water	5,210
Total	6,329
Consumptive Use, acre-feet	2,319

Source: U.S. Geological Survey
Note: Data are estimates only and subject to revision

1995 Livestock Water Use. Table 1-16 provides a summary of 1995 livestock water use estimates (see appendix for more detailed estimates). In 1995 about 6,000 acre-feet was withdrawn for livestock purposes, of which about 2,000 acre-feet was consumed. About 80% of the total water withdrawn in 1995 was diverted from surface water sources. Livestock water withdrawals accounted for about 0.2% of the 1995 total state use.

Livestock Water Use Trends. USGS estimates for 1970-95 shows wide fluctuations in statewide livestock water use (Table 1-17). The variations in the data may be the result of inconsistent estimation techniques from year to year. As a result, these data may not be suitable as a basis for evaluating past water use trends. The *Nevada Agricultural Statistics* reports are an alternative data source for examining livestock trends. According to the *Nevada Agricultural Statistics,* during the 1970 to 1995 period there was a general decline in the number of head of cattle, sheep and hogs from about 850,000 to about 600,000 (Figure 1-8).

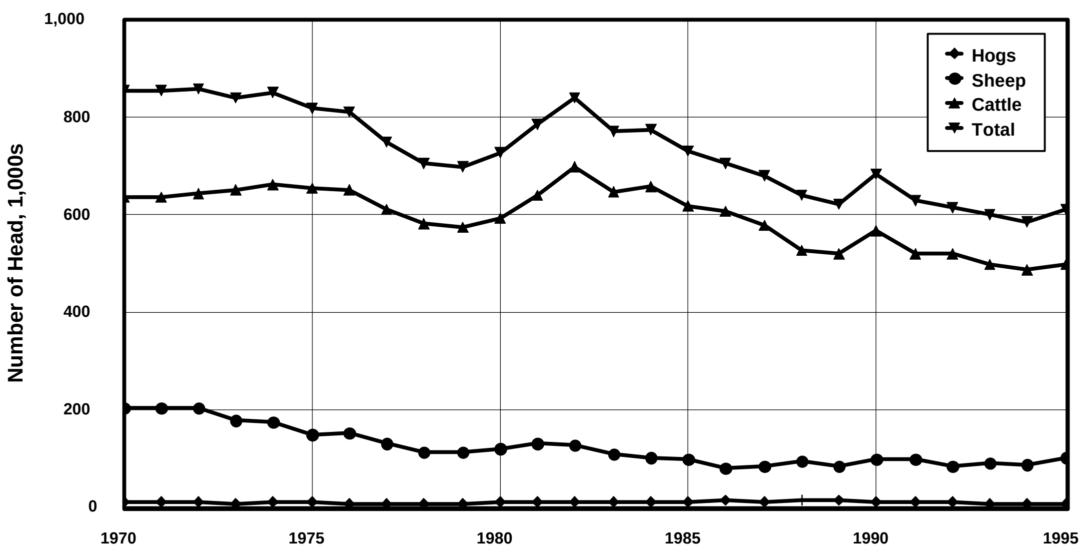
Table 1-17. Estimated Livestock Withdrawals and Consumptive Use, 1970-95

Category	1970	1975	1980	1985	1990	1995
Withdrawals (acre-feet)	4,900	13,400	13,400	29,100	6,300	6,300
Consumptive Use (acre-feet)	2,400	9,900	10,000	7,400	2,300	2,300

Source: U.S. Geological Survey

Note: Data are estimates only and subject to revision

Fig. 1-8. Livestock Inventory, 1970-95



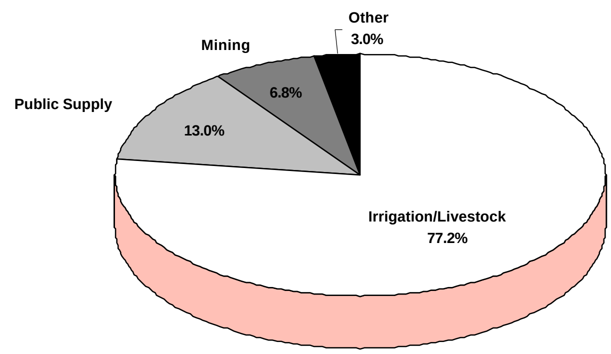
Data Source: Nevada Agricultural Statistics

Water Use Summary

Statewide water use for the period 1970 to 1995 is summarized in two different forms in the following tables and figures. Tables 1-18 and 1-19, and Figure 1-9 presents water use divided into two major categories - public supply uses and self-supplied uses. Table 1-20 and 1-21, and Figure 1-10 provides a water use breakdown by type of use regardless of water supplier.

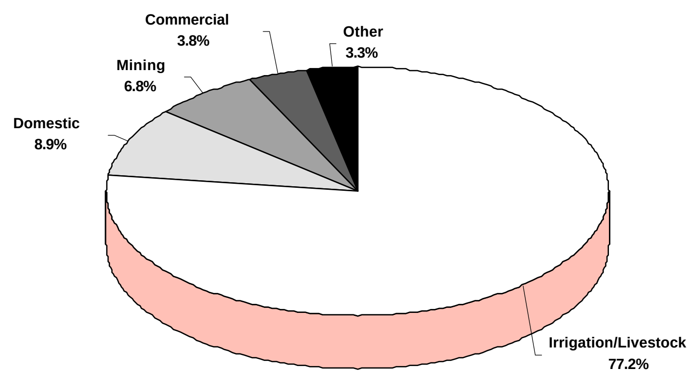
Over the last 20 years, statewide water withdrawals in Nevada have been about 4 million acre-feet per year, with a little under 2 million acre-feet consumptively used. In 1995, about 60 percent of the withdrawals were from surface water sources. Irrigation has historically been the largest water use in Nevada varying from about 80 percent to 90 percent of the total statewide water withdrawals and consumptive use. In 1995, irrigation use accounted for about 77 percent of the total state withdrawals. Variations in irrigation water use are primarily the result of Nevada's variable weather and streamflow conditions.

Fig. 1-9. 1995 Statewide Water Withdrawals by Public Supply and Self-Supplied Uses



Data Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning

Fig. 1-10. 1995 Statewide Water Withdrawals by Type of Use



Data Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning

Overall, the total statewide water use has changed little since 1970, however, there have been some significant changes within certain use sectors. The most significant changes have occurred with "Public Supply" and "Mining" water uses. Public supply water use has more than tripled since 1970 in response to Nevada's ever increasing population. Mining water use has experienced a significant increase since 1985 mostly as a result of increased mining activity in the Humboldt River basin.

Table 1-18. Summary of Estimated Statewide Water Use (1970-95) Grouped by Public Supply and Self-Supplied Uses (in acre-feet)

Water Use Category		1970	1975	1980	1985	1990	1995
Public Supply							
Domestic	Withdrawals	106,400	134,400	168,000	211,900	266,900	342,600
	Consumptive Use	43,000	49,000	65,000	107,100	133,400	171,000
Commercial [1]	Withdrawals				60,300	100,200	129,700
	Consumptive Use				12,100	18,400	23,300
Industrial [1]	Withdrawals	44,800	58,300	93,000	7,100	2,900	2,500
	Consumptive Use	8,500	9,200	12,300	1,400	600	500
Thermoelectric [1]	Withdrawals				2,700	900	1,600
	Consumptive Use				2,700	900	1,600
Public Uses and Losses [1]	Withdrawals	Included in "Public Supply - Domestic" Category			40,100	60,400	48,500
	Consumptive Use				0	0	0
Total Public Supply	Withdrawals	151,200	192,700	261,000	322,100	431,300	524,900
	Consumptive Use	51,500	58,200	77,300	123,400	153,300	196,400
Self-Supplied							
Domestic	Withdrawals	10,200	13,400	16,500	19,700	16,700	18,100
	Consumptive Use	5,100	6,700	8,300	10,100	8,400	9,000
Commercial [1]	Withdrawals				8,300	25,400	23,500
	Consumptive Use				1,700	3,600	3,200
Industrial [1]	Withdrawals				11,400	11,400	16,800
	Consumptive Use	150,000	260,000	270,000	2,100	2,200	5,000
Thermoelectric [1]	Withdrawals	55,000	80,000	95,000	26,300	74,000	63,800
	Consumptive Use				23,700	49,300	39,400
Mining [1]	Withdrawals				27,300	120,100	274,400
	Consumptive Use				22,500	67,900	89,200
Irrigation	Withdrawals	3,400,000	3,500,000	3,500,000	3,750,000	3,160,700	3,113,600
	Consumptive Use	1,600,000	1,700,000	1,700,000	1,934,000	1,633,800	1,612,100
Livestock	Withdrawals	4,900	13,400	13,400	29,100	6,300	6,300
	Consumptive Use	2,400	9,900	10,000	7,400	2,300	2,300
Total							
	Withdrawals	3,716,300	3,979,500	4,060,900	4,194,100	3,846,000	4,041,400
	Consumptive Use	1,714,000	1,854,800	1,890,600	2,124,800	1,920,800	1,956,600

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning

Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.

[1] Individual estimates were not available for 1970-80

Table 1-19. Estimated 1995 Statewide Groundwater and Surface Water Withdrawals for Public Supply and Self-Supplied Uses (in acre-feet)

Category	Source	Amount
Public Supply		
Total Public Supply	Groundwater	132,000
	Surface water	392,900
	Total	524,900
Self-Supplied		
Domestic	Groundwater	17,800
	Surface water	300
	Total	18,100
Commercial	Groundwater	7,900
	Surface water	15,600
	Total	23,500
Industrial	Groundwater	8,300
	Surface water	8,400
	Total	16,700
Thermoelectric	Groundwater	40,700
	Surface water	23,200
	Total	63,900
Mining	Groundwater	270,500
	Surface water	3,900
	Total	274,400
Irrigation	Groundwater	1,138,200
	Surface water	1,975,400
	Total	3,113,600
Livestock	Groundwater	1,100
	Surface water	5,200
	Total	6,300
Total		
Statewide Total	Groundwater	1,616,500
	Surface water	2,424,900
	Total	4,041,400

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning

Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.

Table 1-20. Summary of Estimated Statewide Water Use (1970-95) Grouped by Type of Use (in acre-feet)

<table>
<tr><th colspan="2">Water Use Category</th><th>1970</th><th>1975</th><th>1980</th><th>1985</th><th>1990</th><th>1995</th></tr>
<tr><td rowspan="2">Domestic (self-supplied & public supplied)</td><td>Withdrawals</td><td>116,600</td><td>147,800</td><td>184,500</td><td>231,600</td><td>283,600</td><td>360,700</td></tr>
<tr><td>Consumptive Use</td><td>48,100</td><td>55,700</td><td>73,300</td><td>117,200</td><td>141,800</td><td>180,000</td></tr>
<tr><td rowspan="2">Commercial [1] (self-supplied & public supplied)</td><td>Withdrawals</td><td rowspan="8">194,800
63,500</td><td rowspan="8">318,300
89,200</td><td rowspan="8">363,000
107,300</td><td>68,600</td><td>125,600</td><td>153,200</td></tr>
<tr><td>Consumptive Use</td><td>13,800</td><td>22,000</td><td>26,500</td></tr>
<tr><td rowspan="2">Industrial [1] (self-supplied & public supplied)</td><td>Withdrawals</td><td>18,400</td><td>14,400</td><td>19,200</td></tr>
<tr><td>Consumptive Use</td><td>3,600</td><td>2,800</td><td>5,500</td></tr>
<tr><td rowspan="2">Thermoelectric [1] (self-supplied & public supplied)</td><td>Withdrawals</td><td>29,000</td><td>74,900</td><td>65,400</td></tr>
<tr><td>Consumptive Use</td><td>26,400</td><td>50,200</td><td>41,100</td></tr>
<tr><td rowspan="2">Mining [1]</td><td>Withdrawals</td><td>27,300</td><td>120,100</td><td>274,400</td></tr>
<tr><td>Consumptive Use</td><td>22,500</td><td>67,900</td><td>89,200</td></tr>
<tr><td rowspan="2">Irrigation</td><td>Withdrawals</td><td>3,400,000</td><td>3,500,000</td><td>3,500,000</td><td>3,750,000</td><td>3,160,700</td><td>3,113,600</td></tr>
<tr><td>Consumptive Use</td><td>1,600,000</td><td>1,700,000</td><td>1,700,000</td><td>1,934,000</td><td>1,633,800</td><td>1,612,100</td></tr>
<tr><td rowspan="2">Livestock</td><td>Withdrawals</td><td>4,900</td><td>13,400</td><td>13,400</td><td>29,100</td><td>6,300</td><td>6,300</td></tr>
<tr><td>Consumptive Use</td><td>2,400</td><td>9,900</td><td>10,000</td><td>7,400</td><td>2,300</td><td>2,300</td></tr>
<tr><td rowspan="2">Public Supply - Public Uses and Losses</td><td>Withdrawals</td><td colspan="3" rowspan="2">Included in "Domestic" Category</td><td>40,100</td><td>60,400</td><td>48,500</td></tr>
<tr><td>Consumptive Use</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td rowspan="2">Total</td><td>Withdrawals</td><td>3,716,300</td><td>3,979,500</td><td>4,060,900</td><td>4,194,100</td><td>3,846,000</td><td>4,041,400</td></tr>
<tr><td>Consumptive Use</td><td>1,714,000</td><td>1,854,800</td><td>1,890,600</td><td>2,124,800</td><td>1,920,800</td><td>1,956,600</td></tr>
</table>

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning
Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.
[1] Individual estimates were not available for 1970-80.

Table 1-21. Estimated 1995 Statewide Groundwater and Surface Water Withdrawals for Use Types

Category	Source	Amount
Domestic (self-supplied & public supplied)	Groundwater	104,100
	Surface water	256,700
	Total	360,800
Commercial (self-supplied & public supplied)	Groundwater	40,600
	Surface water	112,600
	Total	153,200
Industrial (self-supplied & public supplied)	Groundwater	8,900
	Surface water	10,300
	Total	19,200
Thermoelectric (self-supplied & public supplied)	Groundwater	41,100
	Surface water	24,400
	Total	65,500
Mining	Groundwater	270,500
	Surface water	3,900
	Total	274,400
Irrigation	Groundwater	1,138,200
	Surface water	1,975,400
	Total	3,113,600
Livestock	Groundwater	1,100
	Surface water	5,200
	Total	6,300
Public Supply - Public Uses and Losses	Groundwater	12,200
	Surface water	36,300
	Total	48,500
Total	Groundwater	1,616,700
	Surface water	2,424,800
	Total	4,041,500

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning
Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.

Index - Part 2, Section 1 - Water Use

Nevada State Water Plan
PART 2 — WATER USE AND FORECASTS

Section 2
Socioeconomic Assessment and Forecasts

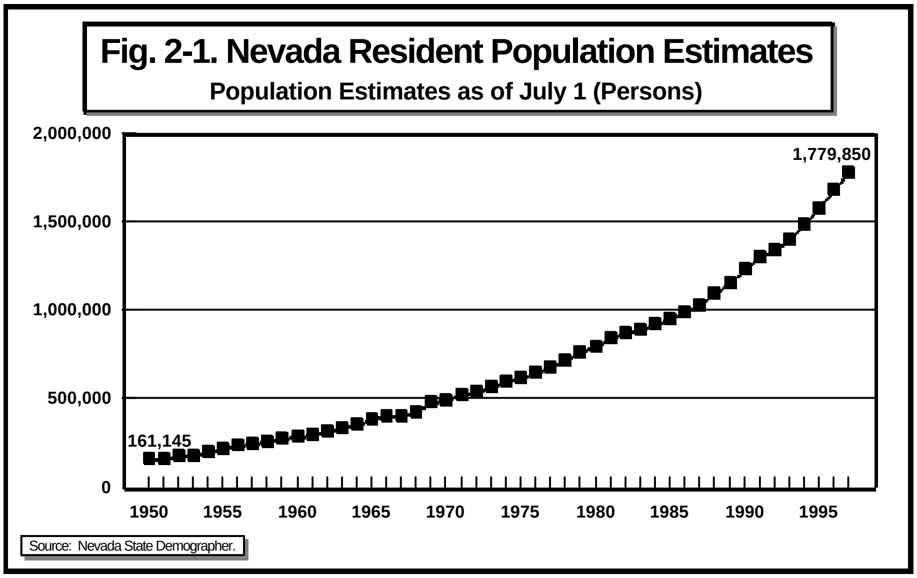
Introduction

This section of the *Nevada State Water Plan* presents population, demographic and economic conditions and trends for the Nevada economy and provides individual county and statewide population and socioeconomic forecasts. In Part 2, Section 3 of the water plan, these demographic forecasts, particularly as they related to population and employment, are used to predict future water needs over a planning horizon extending through the year 2020. More specifically, population forecasts and their relationship to total employment comprise the foundation of the forecasts for municipal and industrial (M&I), domestic (residential), and commercial and industrial water withdrawals as well as M&I public use and losses.

Population forecasts for each Nevada county and the total state are contained in Appendix 2 of the Appendices of the water plan. Appendix 3 of the Appendices presents the employment forecasts, which are derived from population forecasts, and also contains specific water use coefficients in either gallons per person or per worker per day to forecast each county's M&I, domestic (residential) and commercial and industrial water use. County forecasts for these measures are aggregated for the statewide total. Tables showing individual county population, employment and water withdrawal estimates and projects are contained in this appendix. Other categories of water withdrawals, namely thermoelectric (including geothermal), mining (including both consumptive and non-consumptive uses, such as mine dewatering), irrigation and livestock (total agriculture), are forecast using methods unique to each of these sectors as explained in Part 2, Section 3, Water Use Assessment and Forecasts.

Population and Demographic Trends

Nevada's population is expected to continue to become increasingly concentrated in its primary urban areas of Las Vegas (Clark County), Reno-Sparks (Washoe County) and Carson City. This increasing level of urbanization will have varied spillover effects on neighboring counties, e.g., Nye County for Clark County, and Churchill, Douglas, Lyon, and Storey counties for Washoe County and Carson City. Population forecasts incorporated into this plan for Clark and Washoe counties were provided by the Clark County Department of Comprehensive Planning and the Washoe County Department of Community Development, respectively. The population forecasts for Washoe County were slightly modified by the Nevada Division of Water Planning (NDWP) to smooth the intervening period forecasts, matching Washoe County's population forecast for the year 2020. Other county



population forecasts were developed by the NDWP in conjunction with county inputs and were based on an extension and moderation of recent historical growth trends and the incorporation of estimated industrial development and employment forecasts based on inputs provided by the Nevada Department of Employment, Training and Rehabilitation (DETR).

Fig. 2–1. Nevada Population Estimates, and Fig. 2–2. Nevada Population Growth Rates show annual population trends from 1950 through 1997. From Fig. 2–1, one can see the more recent acceleration of growth occurring since 1990 with the arrival of the first mega-resort casino in the Las Vegas gaming market. Table 2–1. Nevada Population Share Analysis — 1950–1997, presents historical and forecasted populations and population shares (in terms of county shares of the state's total population) for Nevada and its seventeen counties at ten-year intervals from 1950 to 1997. This table shows that in 1997, Clark County's total resident population was estimated at 1,192,200 persons and accounted for nearly 67.0 percent of the state's total population. This represented an increase of 36.7 percentage points in Clark County's share of the state's total population since 1950.

Also from Table 2–1, Washoe County's population was estimated at 308,700 persons in 1997, accounting for 17.3 percent of Nevada's total population, a decline of 14.0 percentage points in its share of statewide population since 1950. Carson City's population of 50,410 persons in 1997 comprised 2.8 percent of the state's total population, an increase of just over 0.2 percentage point in its population share since 1950. Together, these three Nevada urban areas accounted for 87.2 percent of the state's total population in 1997. Elko County, representing the other principal population center in Nevada, had an estimated population of 47,710 persons in 1997, accounting for 2.7 percent of the state's population and representing a decline of 4.6 percent points in state population share since 1950.

Table 2–1 also shows that the combined population share of the state's principal urban areas of Clark County, Washoe County and Carson City increased from 64.2 percent in 1950 to 87.2 percent of the state's total population in 1997. This represents an increase of 23.0 percentage points in these area's share of statewide total population from 1950 to 1997. The gain in population share from 1950 to 1997 was due entirely to the rapid growth in Clark County as Carson City showed virtually no change in its population share over the 1950-1997 time period and Washoe County actually lost 14.0 percentage points in its share of the state's total population from 1950 to 1997.

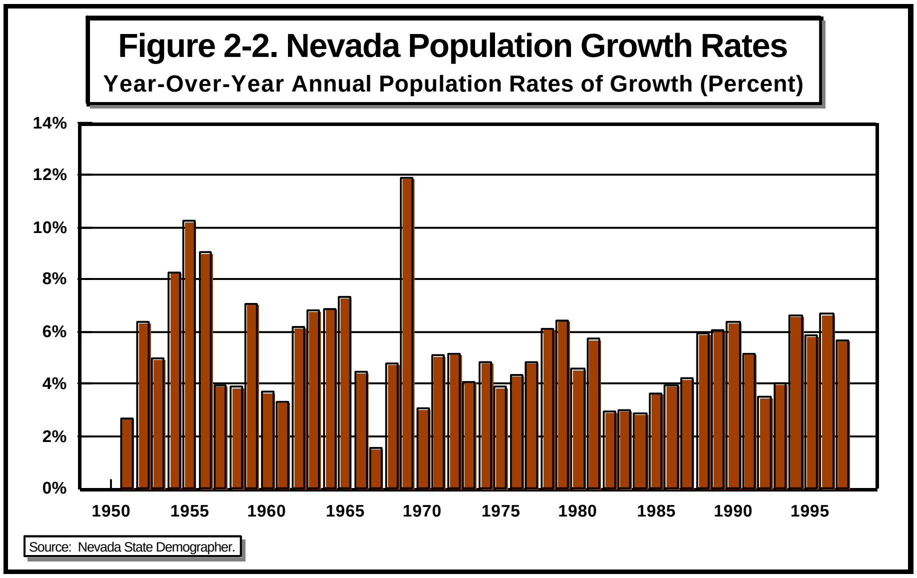
Table 2–1. Nevada Population Share Analysis — 1950–1997

Shares Based on Percent of Total State Population (Persons/Percent of Total State)

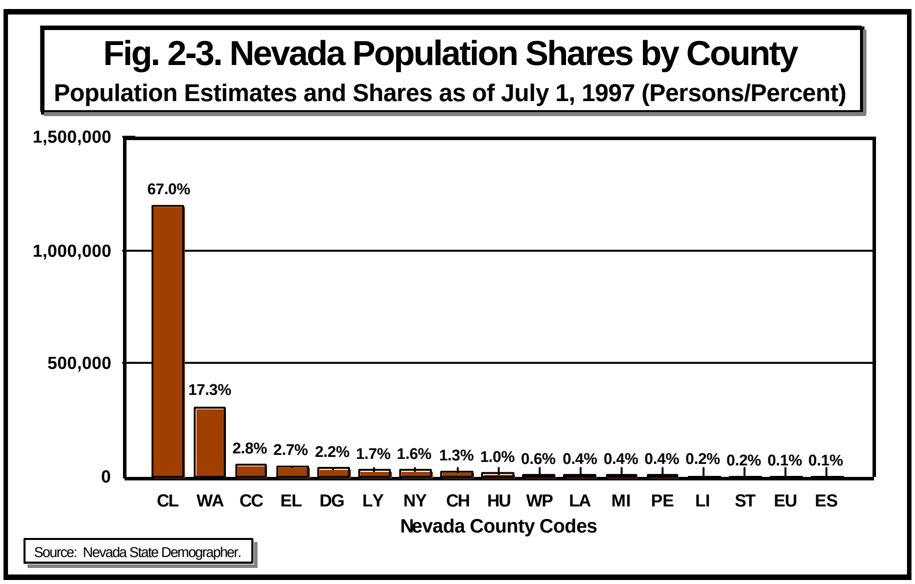
State/County	1950	1960	1970	1980	1990	1997
NEVADA	**161,145**	**287,660**	**494,990**	**800,508**	**1,236,130**	**1,779,850**
Carson City	4,198	8,020	16,054	32,022	40,950	50,410
Statewide Share	2.61%	2.79%	3.24%	4.00%	3.31%	2.83%
Churchill County	6,188	8,505	10,650	13,917	18,100	23,860
Statewide Share	3.84%	2.96%	2.15%	1.74%	1.46%	1.34%
Clark County	48,811	128,734	277,230	463,087	770,280	1,192,200
Statewide Share	30.29%	44.75%	56.01%	57.85%	62.31%	66.98%
Douglas County	2,023	3,575	7,067	19,421	28,070	39,590
Statewide Share	1.26%	1.24%	1.43%	2.43%	2.27%	2.22%
Elko County	11,703	12,051	13,946	17,269	33,770	47,710
Statewide Share	7.26%	4.19%	2.82%	2.16%	2.73%	2.68%
Esmeralda County	611	634	623	777	1,350	1,460
Statewide Share	0.38%	0.22%	0.13%	0.10%	0.11%	0.08%
Eureka County	897	775	938	1,198	1,550	1,660
Statewide Share	0.56%	0.27%	0.19%	0.15%	0.13%	0.09%
Humboldt County	4,870	5,723	6,380	9,449	13,020	17,520
Statewide Share	3.02%	1.99%	1.29%	1.18%	1.05%	0.98%
Lander County	1,860	1,580	2,653	4,076	6,340	7,030
Statewide Share	1.15%	0.55%	0.54%	0.51%	0.51%	0.39%
Lincoln County	3,850	2,378	2,526	3,732	3,810	4,110
Statewide Share	2.39%	0.83%	0.51%	0.47%	0.31%	0.23%
Lyon County	3,703	6,245	8,437	13,594	20,590	30,370
Statewide Share	2.30%	2.17%	1.70%	1.70%	1.67%	1.71%
Mineral County	5,588	6,329	6,961	6,217	6,470	6,860
Statewide Share	3.47%	2.20%	1.41%	0.78%	0.52%	0.39%
Nye County	3,101	4,642	5,459	9,048	18,190	27,610
Statewide Share	1.92%	1.61%	1.10%	1.13%	1.47%	1.55%
Pershing County	3,122	3,178	2,656	3,408	4,550	6,600
Statewide Share	1.94%	1.10%	0.54%	0.43%	0.37%	0.37%
Storey County	657	571	696	1,503	2,560	3,520
Statewide Share	0.41%	0.20%	0.14%	0.19%	0.21%	0.20%
Washoe County	50,484	84,988	122,574	193,623	257,120	308,700
Statewide Share	31.33%	29.54%	24.76%	24.19%	20.80%	17.34%
White Pine County	9,479	9,732	10,140	8,167	9,410	10,640
Statewide Share	5.88%	3.38%	2.05%	1.02%	0.76%	0.60%

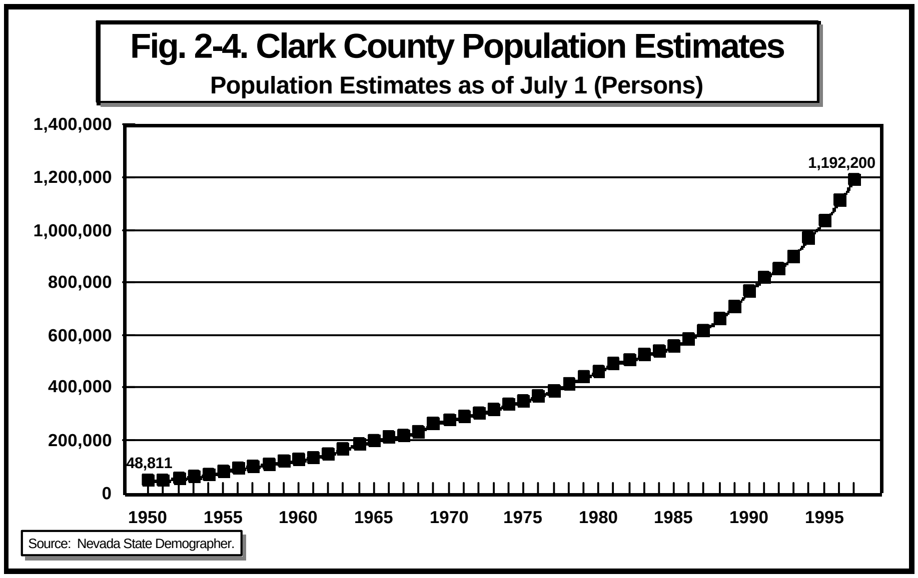
Note: County population shares are based on a percentage of the statewide total population.
Source Data: Nevada State Demographer.

The population share trends presented in Table 2–1 indicate that while virtually every rural county in Nevada (i.e., all counties excluding Clark, Washoe and Carson City), has grown in its total resident population, they have declined in terms of their shares of statewide population between 1950 and 1997. The only exception to this has been Douglas County, where population trends have been strongly influenced by the county's increasing status as a "bedroom" community for neighboring Carson City. Unique population trends exist for other Nevada counties as well. For example, rapid population growth in Elko County has been due in large part to trends in the mining industry, especially since the late 1980's. Between 1950 and 1970, Elko County's population grew by only 2,243 persons. However, over the next 27 years its population grew by nearly 30,000 persons. Much of this growth was due to mining, both in Elko County and neighboring Eureka County. Lyon County represents another county where growth in neighboring Carson City, primarily, has affected its population growth. Similarly, recent rapid growth in Nye County has been primarily centered in the southern part of the county at Pahrump, which has been influenced by rapid growth in nearby Las Vegas.



Gaming and Tourism. Casino gaming and tourism in Nevada represent the primary "driving" economic force most affecting the state's overall population trends. While growth in tourism and gaming win (revenues) has more recently slowed in the state's principal northern Nevada casino gaming markets of Reno-Sparks (Washoe County) and South Lake Tahoe (Douglas County), this trend has been more than off-set by high rates of growth in the southern Nevada gaming market of Las Vegas (Clark County), and specifically by trends within the Las Vegas Strip gaming sub-market, which alone accounts for nearly 50 percent of the state's total gaming win. The introduction of the mega-resort complex to the Las Vegas Strip gaming market beginning in late 1989 established a trend of rapid employment growth, population expansion,

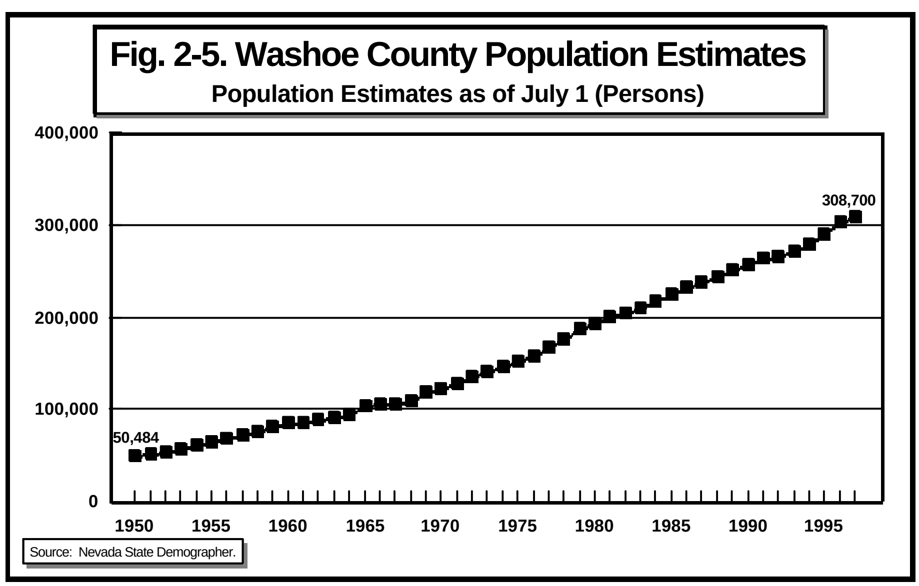




and gaming win growth that has characterized this market throughout the 1990's. The mega-resort casino complex, with employment requirements for each new facility frequently exceeding 5,000-6,000 workers (the Bellagio, which opened in late 1998, employs over 9,000 workers), has produced significant impacts on population growth, the expansion of support service businesses, infrastructure requirements, and water demands. Furthermore, new resort complexes opening in this gaming market through 1999 and into 2000 will extend these growth trends into the next century.

Mining. While gaming and tourism have had significant impacts on growth in Clark and Washoe counties, mining has had major influences on many of the rural counties' population and employment growth, demographic trends, and economic development. Since 1989, gold mining in Nevada has made a major contribution to a number of rural counties' economic growth, most especially Elko, Eureka, Humboldt, Lander, Nye, and Pershing counties.

More recently, however, this industry has come under growing economic stress. Beginning in late 1997 and extending into 1999, due primarily to European monetary reform(the creation of the European Monetary Union, or EMU) and Asian economic and financial problems, gold prices realized by Nevada mines have slipped dramatically. The average price of gold fell from $387.87 per (troy) ounce in 1996 to $331.29 per ounce in 1997, and by mid-1998 the price received by Nevada's mining interests was well below $300 per ounce. By late 1998, gold's price had rebounded somewhat to "around" $300 an ounce. Some of this price decline has, for the time



being, been mitigated through the mining industry's use of "forward" contracts wherein the mining companies have locked in to committed prices for future gold sales.

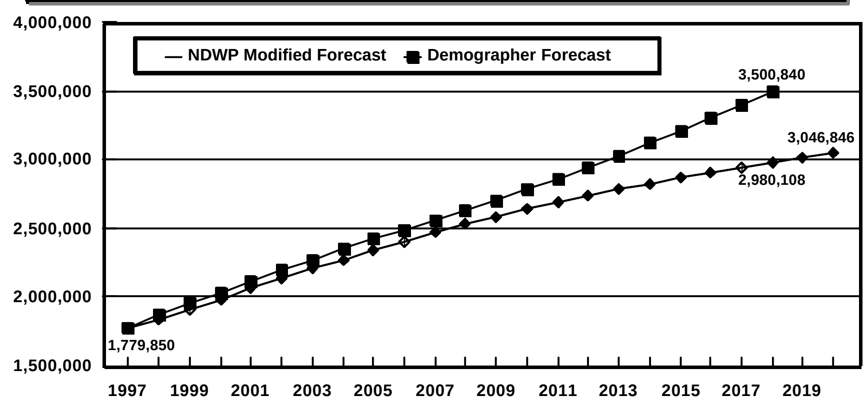
Over the plan's forecast period, international economic and financial conditions are expected to continue to affect the nature and structure of mining operations in Nevada, and, in the process, the demographic and economic growth prospects of the rural, mining-dependent Nevada counties. Long-term conditions within the mining industry are expected to stabilize gold's price at approximately \$280–\$350 per ounce, which has become incorporated into the levels of forecast production for the industry and particularly the amount of economically recoverable reserves.

Nevada Population Analysis and Forecasts

Two separate population forecasts are presented in the water plan. Every year the Nevada State Demographer estimates the current population and, following this, produces a twenty-year population forecast for all counties and the total state. All state agencies are required by the Governor's Executive Order to utilize the population forecasts of the State Demographer in their budgeting and planning activities. Per agreement with the state's population contracting agency, the Nevada Department of Taxation, the NDWP has developed an alternate set of county and state population forecasts based on inputs received from the individual counties, inputs from the Nevada Department of Employment, Training and Rehabilitation (DETR), and from the NDWP's own best estimates.

Overall, the NDWP's statewide population forecast predicts a more moderate population growth than that of the State Demographer. The reason for this is that Nevada's total population is largely influenced by the trends in Clark County's population, which in 1997 accounted for nearly 67 percent of the state's resident population. Based on infrastructure requirements and current resource limitations, local planners in Clark County expect slower growth over the plan's forecast horizon than does the Nevada State Demographer. The water plan incorporates both sets of population forecasts, as shown in Table 2–2. Nevada Population Forecast Comparisons, to present an anticipated "range of expected growth." However, only the NDWP's forecasts are incorporated into the water plan's future water withdrawal projections. The complete set of population forecasts and related graphical analysis for each county is presented in Appendix 2 of the Appendices. This

Fig. 2-6. Nevada Population Forecast Comparisons
State Demographer and NDWP Modified--July 1 (Persons)



Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.

appendix also contains the comparative analysis of the two sets of forecasts for all individual counties.

The Nevada State Demographer has forecast a population for Nevada for the year 2018 of 3,500,840 persons, primarily based on the continued virtual exponential growth in Clark County. This forecast represents an overall increase in statewide population of 1,720,990 persons between 1997 and 2018, a near doubling of Nevada's population over the next 20 years. The State Demographer's forecast scenario results in an average annual rate of growth of statewide population of 3.3 percent per year for the overall forecast period of 1998 to 2018, with a sub-period average annual rate of growth of 3.6 percent between 1998 and 2008 slowing to 2.9 percent between 2008 and 2018. The State Demographer's forecasted population for 2018 is approximately 15 percent higher than that of the NDWP.

Table 2–2. Nevada Population Forecast Comparisons

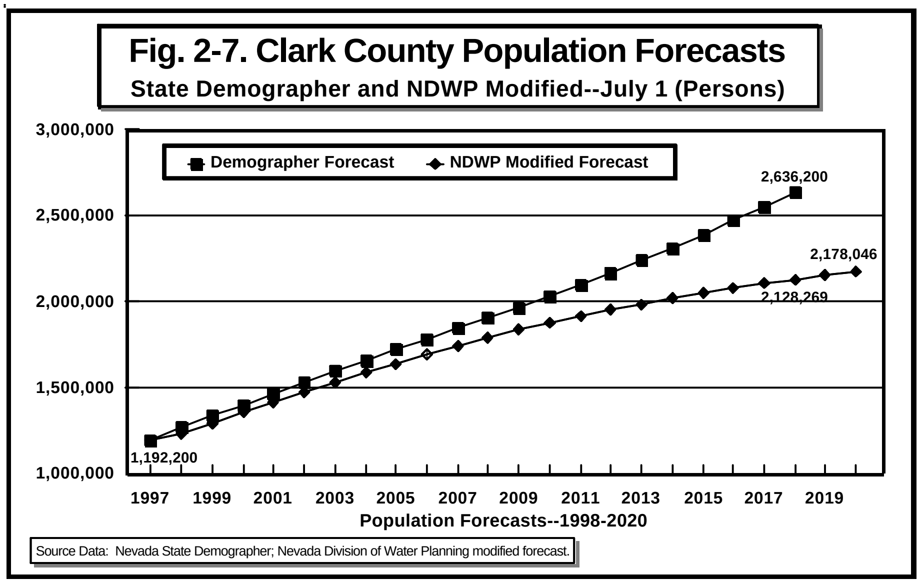
Nevada State Demographer and Nevada Division of Water Planning (NDWP)

Nevada Forecasts by Source	2000	2005	2010	2015	2018	2020
State Demographer						
Resident Population (persons)	2,034,020	2,421,020	2,783,700	3,313,260	3,500,840	n.a.
Nevada Division of Water Planning						
Resident Population (persons)	1,986,257	2,341,374	2,640,306	2,868,979	2,980,108	3,046,846
Difference (persons)	47,763	79,646	143,394	343,281	520,732	–
Percent Difference	2.4%	3.3%	5.2%	10.7%	14.9%	–

Note: The population forecasts of the State Demographer currently extend only through the year 2018. The difference amount represents the difference between the forecasts of the State Demographer and NDWP. NDWP population forecasts for Clark and Washoe counties are based on population forecast inputs from those counties.
Source Data: Nevada State Demographer; Nevada Division of Water Planning (NDWP).

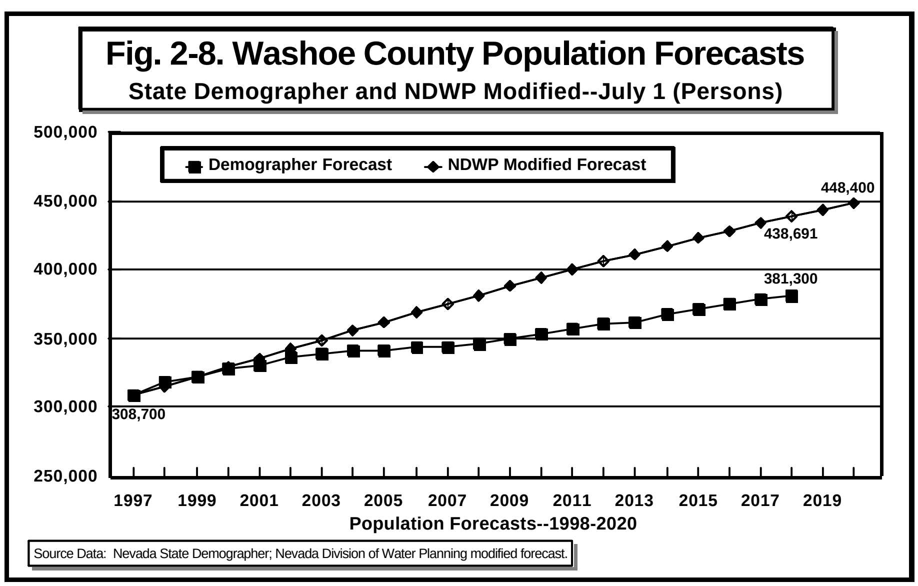
The NDWP forecast scenario, based primarily on slower population growth in Clark County, assumes a more modest 2.5 percent overall annual rate of population growth for Nevada between the years 1998 and 2018, with sub-period average annual rates of 3.2 percent per year for 1998 to 2008 falling to an average annual rate of growth of 1.6 percent for the years 2008 through 2018.

Based on the "range" of population forecasts developed independently by the State Demographer and the NDWP, Nevada is projected to grow at a rate of between 2.5–3.3 percent per year through 2018. Growth rates are expected to average between 3.2–3.6 percent per year between 1998 and 2008 and then moderate to between 1.6–2.9 percent per year between 2008 and 2018. This overall rate of



growth represents an increase in Nevada's total population of between 1,200,258 persons (NDWP) and 1,720,990 persons (State Demographer) between 1997 and 2018, resulting in a total forecasted population range of 2,980,108–3,500,840 persons by July 1, 2018. In the near term, the increase in the state's population will continue to be fueled in large part by strong growth in the Las Vegas economy, particularly from its casino gaming and tourism industry. The gaming sector, at least for the next several years, will continue to see new major resort-casino construction, continuing to make southern Nevada the premier destination resort location in the world.

By contrast, the Washoe County and Carson City areas, and in fact much of northern Nevada, are beginning to see slower growth due to more intense competition in the gaming and tourism industry. Based on the growth in legalized gaming in other jurisdictions, and particularly the rise of Indian gambling on reservation lands, especially in California and the Pacific Northwest, it is reasonable to expect a continued slowdown in the growth of gaming and tourism throughout Nevada from approximately the year 2005 onward. The November 1998 passage of "Proposition 5", which legalized slot devices in Indian reservation casinos in California, is destined to have profound impacts on gaming in that state.



While at least two constitutional challenges to Proposition 5 have been filed, California voters appear to have changed their attitude towards legalized casino gaming within their state and further moves in this direction may be reasonably expected. Also, in early January 1999, California's Governor and Attorney General withdrew their support for any challenge to Proposition 5.

While many of Nevada's tourism and gaming attractions, both man-made and natural, continue to be unrivaled with respect to featured offerings in competitive markets, studies have shown that proximity has an important influence over player patronage. As a result, Nevada's casino gaming industry will have to work hard to compete with developing gaming markets located closer to population centers throughout the U.S. The anticipated slowing in the growth in Nevada's gaming industry, however, is not expected to be uniform and will be stronger in those markets which do not offer features of a distinctive nature to lure consumers from more proximate gaming opportunities.

Table 2–3. Nevada Population Forecast Summary, 1995–2020, presents a summary of the population forecasts for those larger Nevada counties expected to equal or exceed a total resident population of 50,000 persons by the year 2020. Complete population forecasts and analysis for all Nevada's counties may be found in Appendix 2 of the Appendices. These population forecasts and county shares of total state population are based on the modified forecasts made by the NDWP and specifically incorporate the population forecasts provided by the Clark County Department of Comprehensive Planning and the Washoe County Department of Community Development.

Table 2–3. NDWP Nevada Population Forecast Summary

Population Forecasts and Shares for Larger Nevada Counties — 1997–2020

(For counties expected to exceed 50,000 persons by the year 2020)

State/County	1997	2000	2005	2010	2015	2020
Nevada						
Resident Population (persons)	**1,779,850**	**1,986,257**	**2,341,374**	**2,640,306**	**2,868,979**	**3,046,846**
Carson City						
Resident Population (persons)	50,410	54,445	60,703	66,041	70,099	72,587
Percent of Total State	2.83%	2.74%	2.59%	2.50%	2.44%	2.38%
Clark County (Las Vegas)						
Resident Population (persons)	1,192,200	1,355,368	1,640,444	1,874,431	2,046,229	2,178,046
Percent of Total State	66.98%	68.24%	70.06%	70.99%	71.32%	71.49%
Douglas County						
Resident Population (persons)	39,590	42,834	48,180	53,272	57,900	61,854
Percent of Total State	2.22%	2.16%	2.06%	2.02%	2.02%	2.03%
Elko County						
Resident Population (persons)	47,710	51,665	57,857	63,224	67,408	70,113
Percent of Total State	2.68%	2.60%	2.47%	2.39%	2.35%	2.30%
Lyon County						
Resident Population (persons)	30,370	33,721	39,377	44,878	49,914	54,170
Percent of Total State	1.71%	1.70%	1.68%	1.70%	1.74%	1.78%
Washoe County (Reno)						
Resident Population (persons)	308,700	329,021	362,260	393,884	422,917	448,400
Percent of Total State	17.34%	16.56%	15.47%	14.92%	14.74%	14.72%

Note: Counties included are only those that are forecast to equal or exceed a resident population of 50,000 persons by the end of

the forecast horizon (2020).
Source Data: Nevada State Demographer (1997 estimate); Nevada Division of Water Planning (2000–2020 forecasts).

Nevada's Employment Composition and Industry Trends

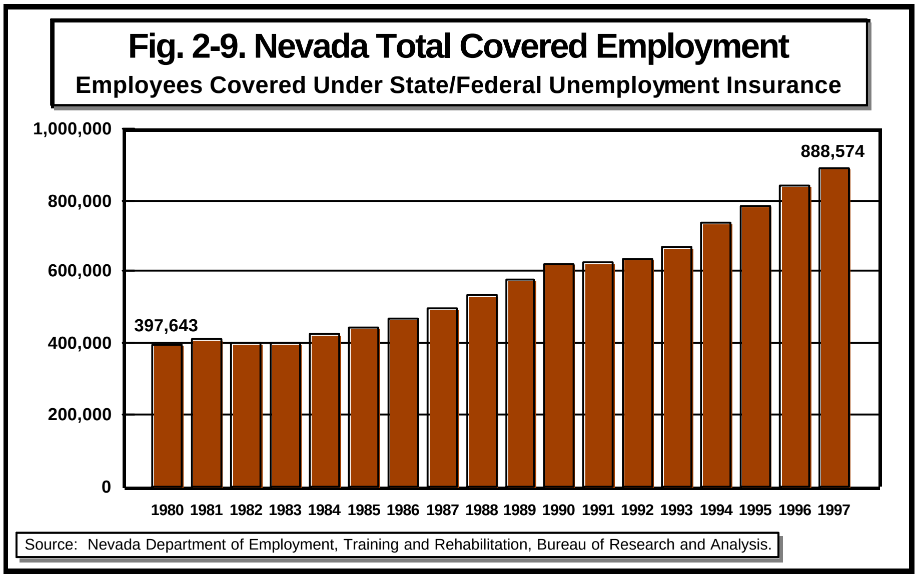


Table 2–4. Nevada Covered Employment — 1980–1997, shows trends in Nevada's total "covered employment" (a definition of employment which includes those employees covered under state and federal unemployment insurance programs) as well as trends in the shares of total employment by principal industry sector. Employment trends and industry composition are important considerations in forecasting commercial and industrial water withdrawals as each industry sector tends to use water at different rates in terms of gallons per employee per day. To forecast commercial and industrial water withdrawals for the water plan, an average commercial and industrial "water use coefficient" for all industry sectors is used in conjunction with forecasted total employment. It is therefore important to assess anticipated changes in future employment composition by specific industry sectors to insure that no dramatic changes are expected which might significantly alter the average usage factor and thereby jeopardize the reasonableness and usefulness of this forecast methodology.

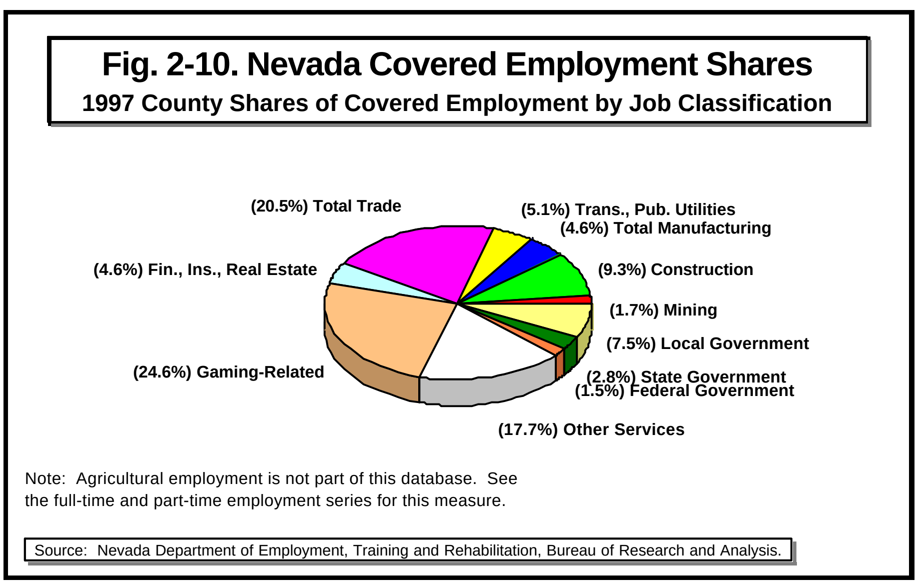


Fig. 2–9. Nevada Total Covered Employment shows the trend in statewide total employment from 1980 to 1997. This graph shows the slowdown in employment growth in Nevada during the national recessionary periods of 1980-82 and 1990-91, clearly indicating Nevada's linkages to national business cycles. The state's covered employment data,

compiled by the Nevada Department of Employment, Training and Rehabilitation (DETR), represents the most accurate and detailed measure of commercial and industrial employment in the State of Nevada.

Table 2–4. Nevada Covered Employment Trends — 1980–1997

Trends in Covered Employment and Shares by Principal Industry Sector (Workers)

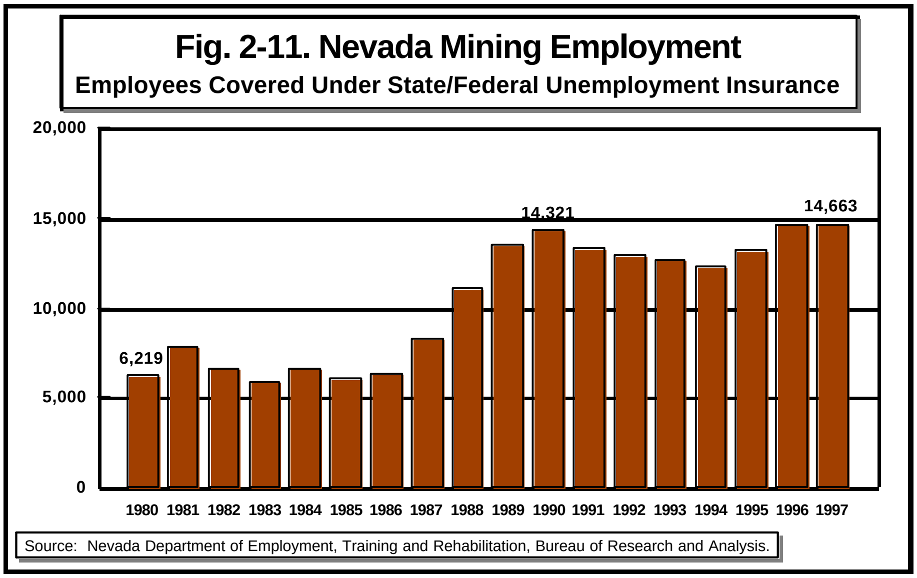
Industry Category	1980	1985	1990	1997	1980-97 Change in Workers	1980-97 Percent Change
Total State	**397,643**	**443,527**	**619,638**	**888,574**	**490,931**	**123.5%**
Mining Percent of Total	6,219 1.56%	6,081 1.37%	14,321 2.31%	14,663 1.65%	8,444	135.8%
Construction Percent of Total	26,434 6.65%	24,121 5.44%	46,903 7.57%	81,953 9.22%	55,519	210.0%
Total Manufacturing Percent of Total	19,200 4.83%	21,958 4.95%	26,245 4.24%	40,604 4.57%	21,404	111.5%
Trans., Public Utilities Percent of Total	22,403 5.63%	23,908 5.39%	31,445 5.07%	44,877 5.05%	22,474	100.3%
Total Trade Percent of Total	80,330 20.20%	90,874 20.49%	124,260 20.05%	180,425 20.31%	100,095	124.6%
Fin., Ins., Real Estate Percent of Total	17,777 4.47%	21,287 4.80%	28,245 4.56%	40,338 4.54%	22,561	126.9%
Service Industries Percent of Total	165,516 41.62%	192,289 43.35%	267,067 43.10%	371,753 41.84%	206,237	124.6%
Gaming-Related Percent of Total	114,950 28.91%	125,483 28.29%	165,384 26.69%	216,491 24.36%	101,541	88.3%
Total Government Percent of Total	56,830 14.29%	59,788 13.48%	75,962 12.26%	104,254 11.73%	47,424	83.4%
Federal Government Percent of Total	10,369 2.61%	10,462 2.36%	12,341 1.99%	13,519 1.52%	3,150	30.4%
State & Local Gov't Percent of Total	46,462 11.68%	49,325 11.12%	63,621 10.27%	90,736 10.21%	44,274	95.3%
State Government Percent of Total†	15,300 32.93%	15,621 31.67%	19,354 30.42%	24,974 27.52%	9,674	63.2%
Local Government Percent of Total†	31,162 67.07%	33,704 68.33%	44,267 69.58%	65,762 72.48%	34,600	111.0%

Notes: Includes employment covered under state and federal unemployment insurance programs. State and local government employment shares for the years 1980, 1985, and 1990 are estimated based on trends of 1993 through 1997. Agriculture and related employment categories (i.e., agricultural services, forestry and fisheries) are not part of this database).

† Percent of total for state government and local government are based on a percent of total state and local government only.

Source Data: Nevada Department of Employment, Training and Rehabilitation (DETR), Research and Analysis Bureau.

Fig. 2–10. Nevada Covered Employment Shares, shows the distribution of total covered employment across Nevada's principal industry sectors for 1997. However, this database does not include workers in the sectors of farming, agricultural services, forestry or fisheries. Therefore, employment



in these sectors was analyzed using another employment measure, termed "full and part-time employment," which is compiled by the U.S. Department of Commerce, Bureau of Economic Analysis (BEA). Fig. 2–15. Nevada Full/Part-Time Employment Shares, presents this alternative employment measure and, while not as recent as the covered employment data, it does incorporate agricultural and related employment for the State of Nevada. Fig 2–15 shows a wide range in employment shares for 1996 in various sectors from a high of 42.7 percent in total services to 1.5 percent in farming and related agricultural service industry jobs.

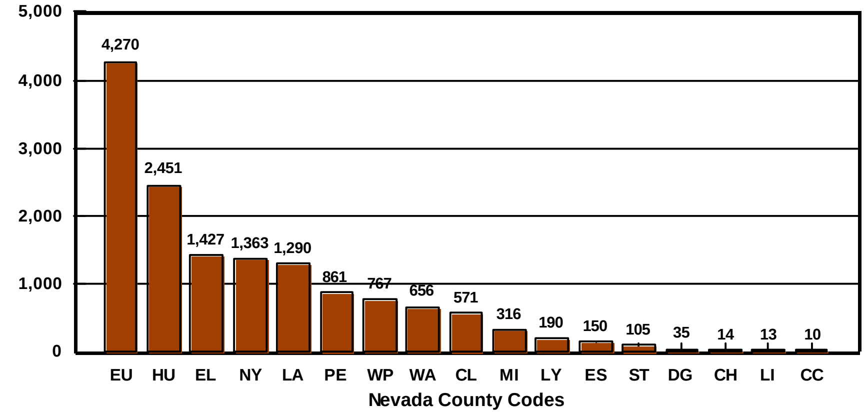
Table 2–4 shows that since 1980, covered employment in Nevada's construction industry has shown the most rapid growth, which is not surprising in a rapidly growing state like Nevada. This construction industry growth has been driven by construction needed for commercial development (primarily major casino complexes in the Las Vegas economy) as well as growth in associated retail trade businesses, residential housing units and various infrastructure requirements such as airport facilities, roads and highways, public utilities, schools, etc. Since 1989, statewide construction jobs in support of Nevada's mining industry also contributed to these totals. In the following section each principal industry sector is analyzed in terms of its historical trends and future prospects for growth.

Employment Analysis by Industry Sector

Construction. In addition to its rapid growth, construction employment has proven to be the most volatile employment sector in the state. Nevada's construction employment declined by 25.0 percent, or 6,594 workers from 1980 to 1983, reflecting the 1980-82 national recessionary period. Then, reflecting the 1990-91 national recession, Nevada's construction employment declined again by 16.4 percent or 7,690 workers between 1990 and 1993. The construction industry increased its share of statewide total covered employment from 6.6 percent in 1980 to 9.2 percent by 1997. Continued strong, albeit more moderate, growth trends in this sector are expected into the next century, with some slowdown occurring in the later part of the plan's forecasting horizon (1998-2020).

Mining. Mining jobs in Nevada rose by 8,444 workers, an increase of nearly 136 percent between 1980 and 1997 (see Fig. 2–11). More recent trends have indicated a marked slowdown in this industry sector due to price pressures on Nevada's primary mineral, gold, and resultant cost restraints on mining operators. Due to the take-off of Nevada's gold mining industry in the late 1980's, this

Fig. 2-12. Nevada Mining Jobs by County
1997 County Mining Covered Employment (Workers)

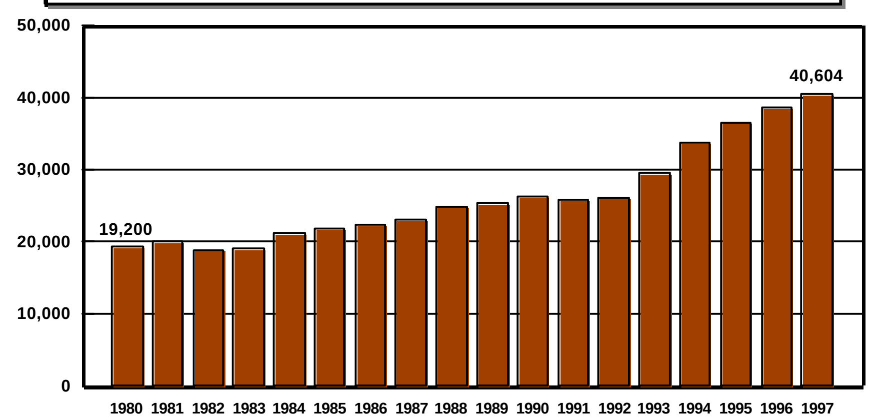


Source: Nevada Department of Employment, Training, and Rehabilitation.

industry's share of statewide total covered employment rose from 1.6 percent in 1980 to 2.3 percent by 1990. By 1997, due to significant declines in the price of gold, Nevada's mining industry's share of total covered employment slipped back to 1.6 percent, the same share of statewide total employment it held in 1980. Over the near term, mining employment in Nevada is expected to decline, eventually falling and then remaining at about 12,000-13,000 workers over most of the water plan's forecast period. Impacts on the mining industry due to price swings and continued uncertainty in world gold markets will affect both employment and population growth in Nevada's rural and mining-dependent counties. Fig. 2–12 shows the number of 1997 mining jobs ranked by county.

Manufacturing. Manufacturing has shown relatively good growth in terms of employment. Between 1980 and 1997, employment in this industry sector has risen by 21,404 workers, or 111.5 percent (see Fig. 2–13). As a primary industry targeted for the state's economic diversification efforts, continued growth in the state's manufacturing sector is expected. Although manufacturing's share of statewide total covered employment has actually declined slightly from 1980 (4.8 percent to 4.6 percent), its relative stability in terms of employment share is counter to national trends in which manufacturing employment slid significantly from over 20 percent of total employment in the early 1960's to only 14 percent in the 1990's.

Fig. 2-13. Nevada Manufacturing Employment
Employees Covered Under State/Federal Unemployment Insurance



Source: Nevada Department of Employment, Training and Rehabilitation, Bureau of Research and Analysis.

Transportation and Public Utilities. Nevada's transportation and public utility jobs, as well as jobs in finance, insurance and real estate, represent two industry sectors in which only modest gains to employment are anticipated over the forecast horizon. These industries are being particularly impacted by mergers (finance and especially banking) and deregulation (public utilities, particularly electrical power, gas and water), with the net effect of only modest increases expected to employment over the forecast horizon. Since 1980, transportation and public utility jobs have grown by 100.3 percent, or 22,474 workers. This industry's share of statewide total covered employment has fallen, however, from 5.6 percent in 1980 to 5.0 percent by 1997.

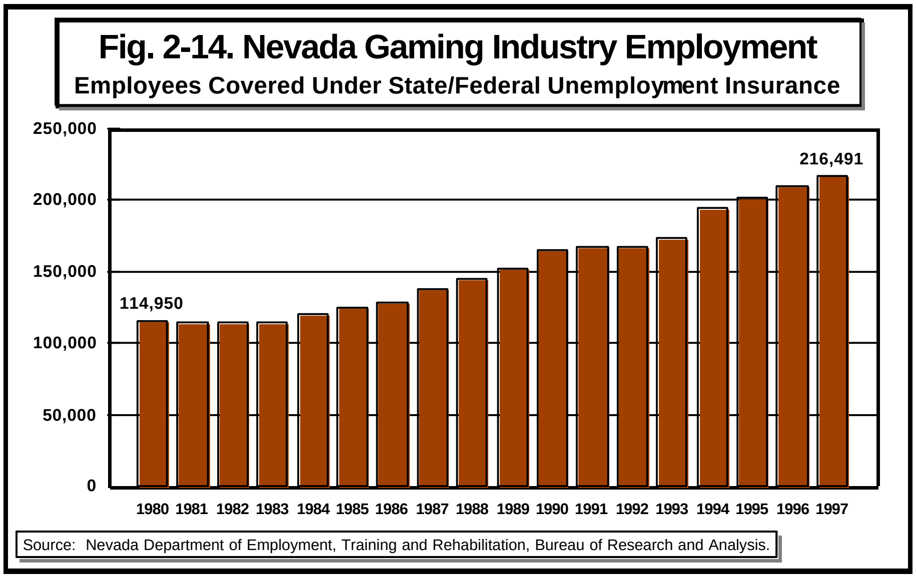
Recent trends in the mandated deregulation of the electrical power industry are destined to result in mergers and, initially, reduced levels of employment. However, there also has been a tendency for these newly deregulated businesses to expand into new businesses more or less related to their primary business of power generation or distribution. Consequently, later in the forecast horizon, more rapid employment growth in the public utility sector may be expected.

Finance, Insurance and Real Estate (F.I.R.E.). Finance-related jobs in Nevada have shown an increase of 126.9 percent since 1980, representing an addition of 22,561 workers to total state employment. Much of this increased employment has come in the real estate area, whereas employment trends in the state's financial institutions, and banking in particular, have been and will continue to be adversely impacted by out-of-state ownership and continued mergers and acquisitions. Financial-related employment in the state showed virtually the same share of total jobs in 1997 as it did in 1980, 4.5 percent.

Wholesale and Retail Trade. Total wholesale and retail trade employment growth from 1980 to 1997 has shown gains slightly above those of the state average (124.6 percent versus 133.5 percent). From 1980 to 1997, employment in this industry sector has grown by 124.6 percent, representing an addition of 100,095 workers since 1980. The majority of this growth has occurred in the state's retail trade businesses and has been closely linked to growth in Nevada's tourism and gaming industries, as well as the rapid growth in resident population. This industry's share of statewide total employment has changed only slightly since 1980, rising from 20.2 percent to 20.3 percent of statewide employment by 1997. More modest increases in the state's gaming and tourism industry sectors are destined to also moderate future growth rates in total trade employment.

Total Services. Employment in all of Nevada's service industries (i.e., gaming-related, medical and health care services, personal services, business services, etc.), which represents the dominant industry sector in the state, has advanced by 124.6 percent since 1980, resulting in an addition of 206,237 new workers. Particularly strong employment growth has been shown in business services and medical and health care services industry sectors. Due primarily to more modest gains in gaming-related employment, which accounted for over 58 percent of total service industry employment in 1997, jobs in total services have only increased slightly since 1980, rising from a 41.6 percent share of statewide total employment to 41.8 percent by 1997.

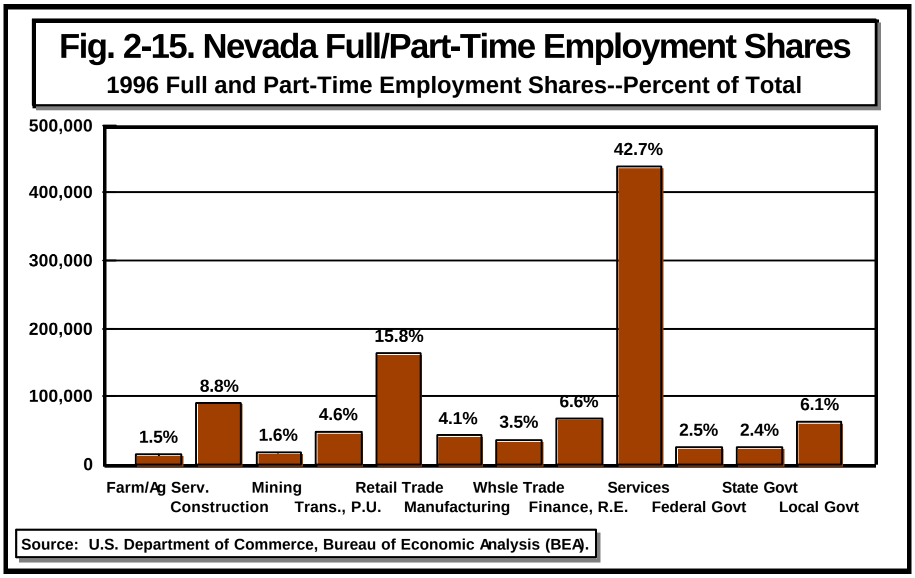
Services – Gaming and Tourism. Relative to other principal industry sectors, gaming-related employment in Nevada has shown more modest employment growth since 1980 (see Fig. 2–14). This trend primarily reflects the effects of a more competitive gaming industry, both interstate and intra-state, and a maturing Nevada economy in which gaming continues to represent the dominant basic industry, but one of diminishing importance as support industries expand their employment levels. Gaming's share of statewide total employment has fallen from 28.9 percent in 1980 to 24.4 percent by 1997 as Nevada's support industries have, in effect, played "catch-up" to the lead that the gaming and tourism industry showed beginning in the early 1980's. Gaming, however, will continue as the primary industry sector, although its dominance is destined to slowly decline as the market for tourists becomes increasingly saturated and Nevada finds itself competing with the growing number of legalized gaming locations throughout the U.S. and the world.



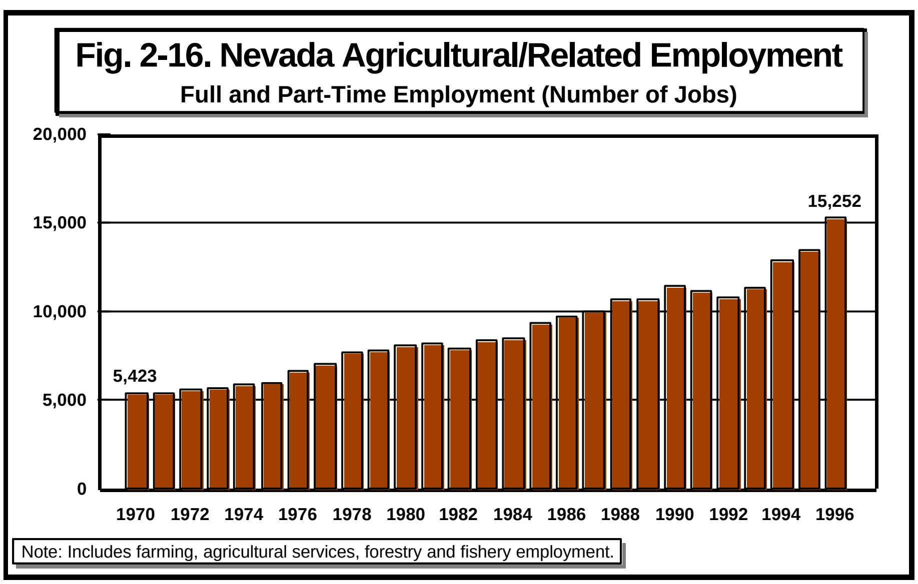
Government. Statewide total government employment (federal, state, and local governments) has reflected the effects of rapid population growth and the need to provide public services by local (county and city) governments. As a result, the greatest growth in the overall government sector has occurred at the local government level, where employment has risen 111.0 percent since 1980, reflecting a statewide increase of 34,600 jobs. Local government's share of total government employment has risen from approximately 67 percent in 1980 to over 72 percent by 1997. State government has also been influenced by population demands, but not to the extent shown by Nevada's local governmental entities. Total state government employment rose from 15,300 workers in 1980 to nearly 25,000 workers by 1997, an increase of 63.2 percent or 9,674 workers. By comparison, total employment in Nevada has risen by nearly twice this amount, or nearly 124 percent since 1980.

Characteristically, federal government employment has risen more in response to program requirements and federal budgetary restrictions than local population effects. On this basis, Nevada's federal government employment rose by only 30.4 percent since 1980, representing an increase of 3,150 workers over 17 years. Over the planning horizon covered by the State Water Plan, federal government employment growth is expected to remain relatively stable and state government employment to slow from prior periods. Local government employment will also moderate somewhat as statewide overall economic activity begins to slow and state and local government budgets become more strained.

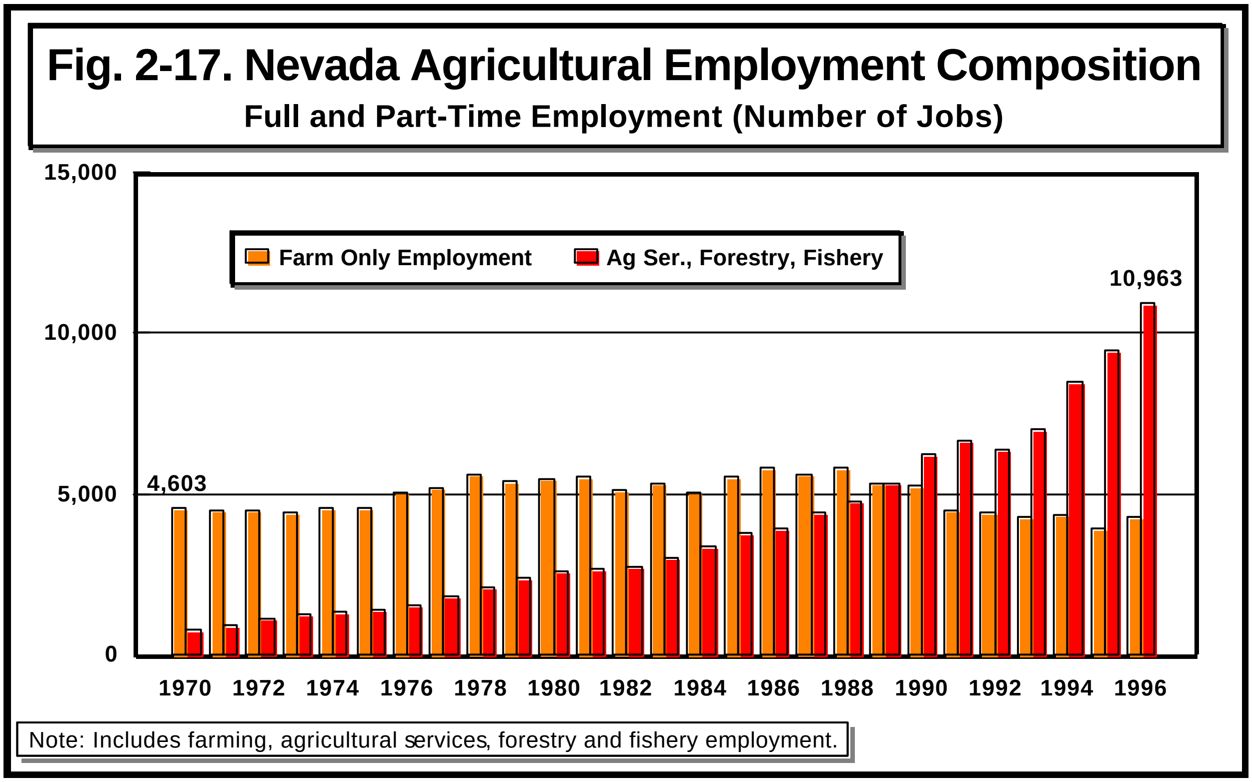
Agriculture and Related Industries. Using BEA's full time and part-time employment data, Nevada's agriculture (farming) industry accounted for only 1.5 percent of Nevada's total employment in 1996 and has shown virtually no growth since 1970. On the other hand, employment in agricultural services, forestry and fisheries has expanded more dramatically. While it appears that total agricultural-related employment has increased since 1970 (see Fig. 2-16. Nevada Agricultural/Related Employment), on-farm jobs have actually declined slightly from 1970 to 1996. Fig. 2-17. Nevada Agricultural Employment Composition shows that agricultural service and related jobs have grown from 820 workers in 1970 to 10,963 workers in 1996. The majority of these jobs are in lawn services and landscaping and are primarily located in the more urban areas of the state. For example, of this total amount, 9,432 agricultural and related service jobs, or 86.0 percent, were located in either Carson City, Clark or Washoe counties. Employment growth in the farm sector is expected to continue to decline moderately while the agricultural and related employment sectors are expected to continue to show strong growth along with population and commercial and industrial expansion.



While some changes are expected in the overall composition and share of industry sectors within individual counties and for the total state, it is not expected that these changes in job mix will be significant enough to preclude the use of an average commercial and industry water use factor (i.e., gallons per worker per day) to estimate future commercial and industrial water use patterns based on total employment trends. Both state and county economic and employment data sets and the related water use coefficients will be updated as new



information becomes available.



Nevada's Casino Gaming Industry

Casino gaming represents Nevada's primary industry sector in terms of persons employed, payrolls, "exports" (of gaming-related products and services) and impacts on other industry sectors both in terms of employment and productive output. Table 2–5. Nevada Casino Gaming Win — 1970–1997 presents basic revenue trends in Nevada's gaming industry for its principal gaming markets (Clark, Washoe and Elko counties, South Lake Tahoe, and Carson Valley in Table 2–5) and the various gaming sub-markets within these principal gaming markets. The gaming win measures the dollar volume of casino patrons' wagered amounts that are retained by the casino after all payouts as winnings. This amount is also referred to as the "house hold". As a primary revenue source, the gaming win represents the most fundamental measure of the economic and financial health of this industry and the effects of tourists' patronage of Nevada casinos.

Table 2–5 shows the effects that increasing intra-state competition has had on Nevada's various casino gaming markets. Rapid casino expansion, primarily in the Las Vegas (Clark County) gaming sub-markets of the Las Vegas Strip and the Boulder Strip, has adversely affected gaming revenue trends of other sub-markets within Clark County, i.e., the Las Vegas Downtown and Laughlin casinos. Laughlin's revenue growth has also been adversely affected by Indian casinos around Phoenix, Arizona, a principal "feeder" market for this gaming location. Even so, the Clark County gaming market has shown impressive gaming win growth and now accounts for nearly 80 percent of the state's total gaming win (see Fig. 2–18).

Table 2–5. Nevada Casino Gaming Win — 1970–1997

Total Casino Gaming Win† by Principal Gaming Market (Millions of Dollars)

Principal Gaming Market or Sub-Market	1970	1980	1990	1997	1990-97 Change in Gaming Win and Share	1990-97 Percent Change in Gaming Win
TOTAL STATE	**$604.35**	**$2,478.45**	**$5,480.25**	**$7,802.70**	**$2,322.45**	**42.38%**
Clark County[1]	$394.24	$1,697.41	$4,103.39	$6,152.42	$2,049.03	49.94%
Percent of Total	65.23%	68.49%	74.88%	78.85%	3.97%	
Las Vegas Strip	$290.90	$1,231.98	$2,604.98	$3,809.40	$1,204.41	46.23%
Percent of Total	48.13%	49.71%	47.53%	48.82%	1.29%	
Las Vegas Downtown	$91.50	$348.63	$676.91	$679.05	$2.15	0.32%
Percent of Total	15.14%	14.07%	12.35%	8.70%	-3.65%	
Laughlin	n.a.	n.a.	$398.64	$482.26	$83.62	20.98%
Percent of Total			7.27%	6.18%	-1.09%	
Boulder Strip	n.a.	n.a.	$142.14	$411.79	$269.64	189.70%
Percent of Total			2.59%	5.28%	2.68%	
Rest of Clark County[2]	$11.84	$116.80	$280.72	$769.93	$489.21	174.27%
Percent of Total	1.96%	4.71%	5.12%	9.87%	4.75%	
Washoe County[3]	$119.52	$462.28	$814.14	$995.23	$181.09	22.24%
Percent of Total	19.78%	18.65%	14.86%	12.75%	-2.10%	
City of Reno	$91.72	$362.12	$628.02	$751.21	$123.19	19.62%
Percent of Total	15.18%	14.61%	11.46%	9.63%	-1.83%	
City of Sparks	n.a.	n.a.	$104.04	$150.64	$46.61	44.80%
Percent of Total			1.90%	1.93%	0.03%	
South Lake Tahoe[4]	$72.21	$221.09	$339.16	$294.97	($44.19)	-13.03%
Percent of Total	11.95%	8.92%	6.19%	3.78%	-2.41%	
Carson Valley[5]	$3.88	$34.63	$57.26	$73.75	$16.49	28.80%
Percent of Total	0.64%	1.40%	1.04%	0.95%	-0.10%	
Elko County	$7.48	$37.87	$111.67	$198.31	$86.64	77.58%
Percent of Total	1.24%	1.53%	2.04%	2.54%	0.50%	
City of Wendover	n.a.	n.a.	$53.39	$99.83	$46.44	86.99%
Percent of Total			0.97%	1.28%	0.31%	

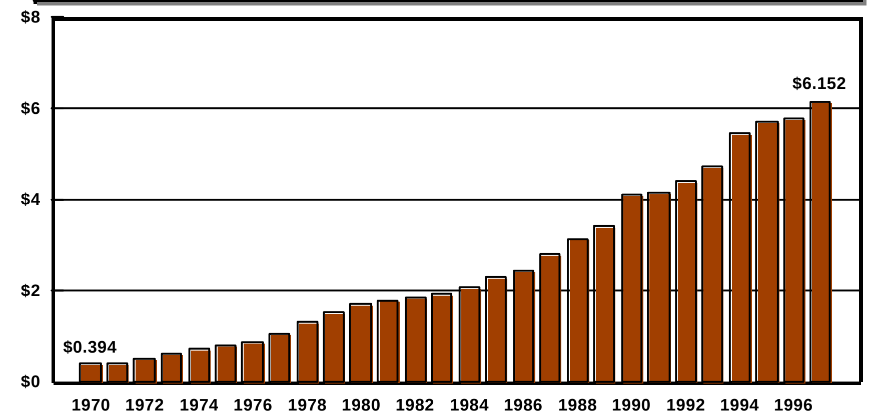
Notes: "Percent of Total" measures each gaming market's share of Nevada's total gaming win. Average annual growth rates (Ave. Ann.) are the average annual rate of growth between 1990 and 1997. Principal gaming markets are presented in bold face type; gaming "sub-markets" appear in regular type. Carson Valley casinos include those in Carson City and Douglas County, excluding the South Lake Tahoe properties.

† Casino gaming win is equal to the "house hold," or the amount retained by the casino after all payouts as winnings to customers. n.a. = Gaming win data not available for these time periods.

Source Data: Nevada Gaming Commission, State Gaming Control Board.

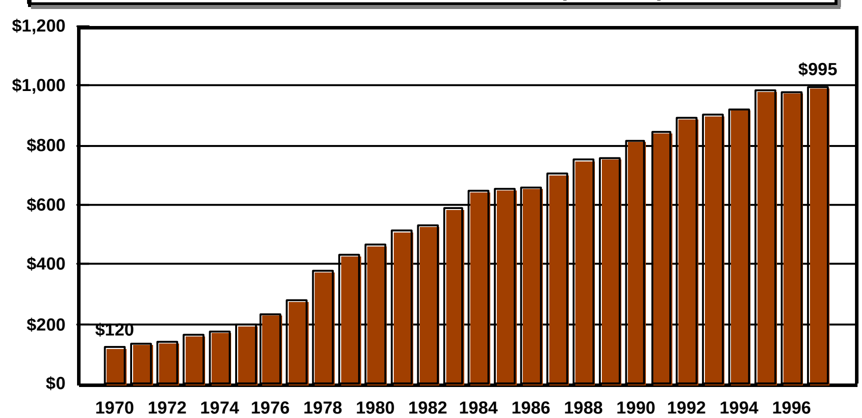
The expansion of mega-resort casino complexes along and just off the Las Vegas Strip has also had an adverse impact on the northern Nevada gaming markets of Washoe County (Reno-Sparks) and South Lake Tahoe (Douglas County) as can be seen by a marked slowing of growth in these markets in the 1990's (see Fig. 2–19). These trends, combined with near-term openings of major casino resort complexes along the Las Vegas Strip (Bellagio, Mandalay Bay, Venetian, Paris, etc.) in late 1998 and into 1999 portend a continuation of intensifying competition for a limited supply of tourists and casino patrons. Consequently, based on both interstate and intra-state competition, the forecast for this industry is for more modest overall growth over the entire forecast horizon and even slower growth in those gaming markets which do not make sufficient investments to maintain a competitive advantage in this industry. Due to the relatively greater importance of gaming to the Las Vegas economy, this assessment constitutes the primary reason for lower rates of growth in forecasts for both employment and population in southern Nevada.

Fig. 2-18. Clark County (Las Vegas) Total Gaming Win
For Years Ended December 31, (Billions)



Source: Nevada Gaming Commission, State Gaming Control Board.

Fig. 2-19. Washoe County (Reno) Total Gaming Win
For Years Ended December 31, (Millions)



Source: Nevada Gaming Commission, State Gaming Control Board.

Nevada's Mining Industry

Table 2–6. Nevada Mineral, Petroleum, Geothermal Production, shows the relative concentration of Nevada's mineral industry in gold and silver production, especially gold. This is particularly true with respect to mining's effects on employment in a number of rural counties. Also shown in this table are the relatively wide price fluctuations which have typified the market behavior of these precious metals. In 1997, gold prices had averaged $331 for Nevada's mining operations and by early 1998 they had moved below $300 per ounce, creating severe pressures on the state's gold producers. Based on both economic fundamentals and financial market conditions, it is expected that some recovery to the price of gold will be experienced over the forecast horizon, but it is doubtful that prices will recover to levels shown in the early 1990's. Consequently, mining employment in Nevada is expected to decline slightly over the next 20 years as producers attempt to cut costs, especially salaries, and improve operating efficiencies. (See Fig. 2–20 for trends in the gross proceeds of Nevada's mines from 1977 through 1997, and Fig. 2–21 for county shares of 1997's gross proceeds of mines.)

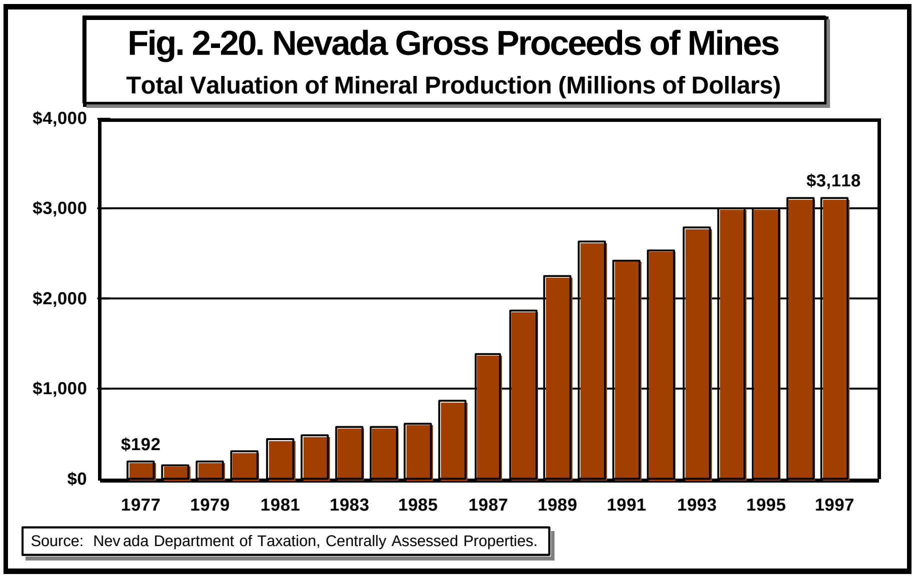
Table 2–6. Nevada Mineral, Petroleum, Geothermal Production

Statewide Production of Principal Minerals for Years 1978–1997 (Units of Production)

Mineral	1978	1980	1985	1990	1995	1997
Barite (thousands of short tons)	1,788	2,268	590	405	514	586
Copper (thousand lbs)	20,543	—	—	11,067	13,000	148,600
Geothermal Power (thousands of mega-water hours)	—	—	—	884	1,360	1,348
Gold (troy ounces)	**260,895**	**250,618**	**1,276,114**	**5,813,000**	**6,764,000**	**7,828,000**
Mercury (76-pound flasks)	24,163	3,300	16,530	—	—	—
Petroleum (thousands of 42-gallon barrels)	1,269	893	3,060	4,012	1,342	1,000
Sand and Gravel (thousands of short tons)	10,040	7,000	9,979	26,000	28,000	28,000
Silver (troy ounces)	**804,000**	**167,000**	**4,947,000**	**21,529,000**	**24,602,000**	**24,645,000**
Gold–Average Price per Ounce (dollars)	$193.55	$613.28	$317.66	$380.02	$384.09	$324.99
Silver–Average Price per Ounce (dollars)	$5.40	$21.54	$6.14	$5.00	$5.19	$4.62

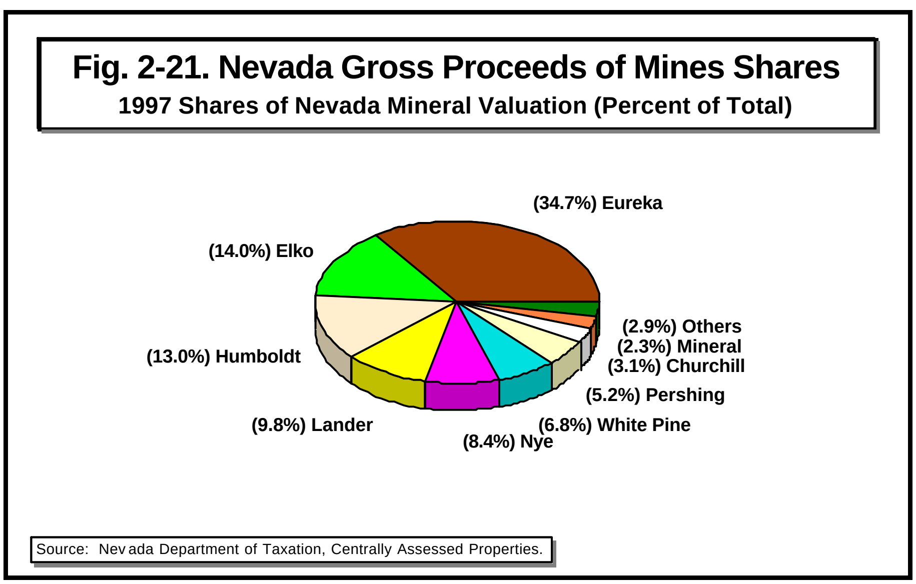
Note: In 1997, gold and silver comprised nearly 86 percent of total mineral valuation in Nevada.
Source Data: Nevada Bureau of Mines and Geology, *The Nevada Mineral Industry*, various issues.

Table 2–6 shows the historical relative market prices received for Nevada's precious metals. This information shows that market prices for both gold and silver have varied greatly over the entire period of presentation, and most especially during times of economic uncertainty and inflation, i.e., the 1980-82 recessionary period. This high price variability reflects the more historic use of these precious metals, and particularly gold, as a "store of value" and inflation hedge. From these trends, which show the price of gold varying from a low of $194 per ounce in 1978 to a high of $613 per ounce in 1980 (an inflationary and recessionary year), and the price of silver ranging between $5.00 and $21.54 per ounce, it becomes more obvious why Nevada's production of these minerals has shown such extreme variation over recent years. In fact, gold production in Nevada has been relatively stable during the more recent period of economic stability during the 1990's when gold's price has remained within a relatively narrow range well above $300 per ounce.



The declining price of gold has resulted in significant declines in mining-dependent taxable sales (a major source of county tax revenues) as mining companies have curtailed major investment projects and reduced local spending. To offset declining market prices and revenues, Nevada's gold mines have been able to reduce their weighted average cash production costs from an average of $229 per ounce in 1996 to $214 per ounce in 1997. Much of this cost constraint has come from the unique relationship between the market price of gold and production costs. As market prices decline, gold producers quickly switch to higher grade deposits (higher concentrations of gold per ton of earth removed), thereby automatically lowering production costs. More recently, mines have been able to effect this change very rapidly, thereby virtually "locking in" production costs to market prices.

Based on continuing international financial changes (European monetary reform and the backing levels in gold of the European Monetary Union) and economic turmoil (Asia), some further moderation to the price of gold is expected in 1998 and into 1999. Mining and construction-related employment have begun to reflect the impacts of these gold price declines and production cost restraints. Even though Nevada currently remains one of the most efficient (i.e., least-cost) gold producers in the world (e.g., in 1997 South Africa showed an average production cost of $301 per ounce and Australia showed $261 per ounce), the extent of the worldwide decline in the price of gold has nonetheless forced severe cost-cutting measures and altered the



Nevada gold industry's development and production efforts, shifting emphasis to higher grade ore bodies and more productive underground gold mining versus surface (open pit) mining. Uncertainty about the price of gold is destined to affect future employment and population growth in the rural Nevada counties

So long as gold has been priced at a "premium" based on its extensive use as an effective hedge against inflation and economic uncertainty, and not priced solely on its intrinsic (i.e., industrial or commercial usage) value, such price fluctuations will likely continue. More recent trends, however, show gold's diminished role as an inflation hedge as well as a less important role as a monetary reserve held by central banks in support of national currencies. In particular, the formation of the European Monetary Union, with its requirement for significantly lower holdings of gold reserves, has resulted in large bullion sales, consequently depressing gold prices below $300 per ounce in early 1998. Once these transitory effects have settled down, however, some recovery to gold's longer-term price is expected, although it is uncertain as to the extent of that recovery. Forecasts for Nevada's mining industry will depend primarily on the market price of gold, as this price "drives" economically-recoverable reserves upon which industry production and exploration depend. Forecast assumptions incorporated into this plan for mineral production and mining water withdrawals are based on an industry-accepted long-term price of gold at $280–$350 per ounce.

The resurgence of copper mining in Nevada, principally in White Pine County, is also a recent trend as reflected in Table 2–6. As with precious metals, falling copper prices have affected this industry and it is not certain if recent cost-cutting efforts will insure the long-term survivability of copper mining in Nevada. The fluctuating world-wide prices of both industrial and precious minerals has characterized Nevada's mining industry since the late 1800's and makes forecasting this industry (e.g., production, employment, water withdrawals, etc.) especially difficult in the face of numerous economic, financial, political and environmental related influences and uncertainties.

Nevada's Agricultural Industry

Agriculture represents one of Nevada's oldest and most lasting economic activities. Since the first settlements were established in the 1850's, agriculture in Nevada has continued to survive and even prosper. Today, agriculture remains a fundamental socioeconomic underpinning for a number of rural Nevada counties and, no doubt, will remain an integral part of these counties' economies irrespective of current or future mining trends. While on the whole agriculture may appear to have relatively little impact on Nevada's overall economic trends, the importance of agriculture for a number of rural counties cannot be overstated. See Fig. 2–22 for trends in Nevada's total farm marketings since 1970 and Fig. 2–23 for 1996 shares of total farm marketings by county.

Table 2–7. Nevada Agricultural Statistics — 1974–1995, summarizes key agriculture statistics for Nevada in terms of irrigated acreage, total farm marketings (monies received from farm marketing sales), farm worker employment and employment in agricultural services, forestry and fisheries. From the information in this table, it appears that agriculture, in terms of total irrigated acreage, peaked in the state during the late 1970's or early 1980's. (Precise determination is difficult and some important agricultural data, for example irrigated acreage, is only obtained by the Census Bureau every four or five years.) Based on rising agricultural prices, farm marketings, however, continued to increase through at least 1990 despite fewer acres being irrigated. Livestock and related sales constituted over 70 percent of total farm marketings from 1974 through at least 1987, falling to 60 percent by 1995.

Table 2–7. Nevada Agricultural Statistics — 1974–1995

Irrigated Acreage, Farm Marketings and Farm-Related Employment

NEVADA	1974	1978	1982	1987	1990	1995
Irrigated Acres	777,510	881,151	829,761	773,588	728,350	715,439
Farm Marketings ($000s)	$145,458	$204,047	$250,610	$271,904	$326,889	$298,085
Livestock and Products	$115,979	$154,820	$181,373	$203,774	$211,486	$179,589
Percent of Marketings	79.7%	75.9%	72.4%	74.9%	64.7%	60.2%
Total Crops	$29,479	$49,227	$69,237	$68,130	$115,403	$118,496
Percent of Marketings	20.3%	24.1%	27.6%	25.1%	35.3%	39.8%
Total Agric. Employment	5,895	7,728	7,863	10,033	11,487	13,142
Farm Workers	4,570	5,639	5,140	5,628	5,260	3,962
Percent Total Employment	77.5%	73.0%	65.4%	56.1%	45.8%	30.2%
Agric. Services Workers	1,325	2,089	2,723	4,405	6,227	9,180
Percent Total Employment	22.5%	27.0%	34.6%	43.9%	54.2%	69.8%

Source Data: Irrigated acreage figures for 1974, 1978, 1982 and 1987 are from the U.S. Bureau of the Census, Agriculture Division; irrigated acreage figures for 1990 are estimates from the USGS data; irrigated acreage for 1995 are derived from estimates made by the NDWP. Farm marketings, number of farm and agricultural service workers are from U.S. Department of Commerce, Bureau of Economic Analysis (BEA). Agricultural Services Workers include workers in agricultural services, which is primarily landscaping and lawn care occupations, as well as jobs in the forestry and fisheries employment areas.

There has also been a more recent trend towards a strong statewide decline in on-farm workers and a growing importance of employment in related agricultural-related fields, primarily consisting of agricultural service workers, most typically representing the landscaping and lawn care service industries. From Table 2–7, workers involved in on-farm activities declined from 4,570 workers in 1974, comprising 77.5 percent of total agriculture and related employment, to 3,962 workers, or 30.2 percent of employment, by 1995. Meanwhile, workers in agricultural-related activities increased from 1,325 workers in 1974 (22.5 percent of employment in these fields) to 9,180 workers by 1995 (nearly 70 percent of total agricultural-related employment). In viewing the individual county agricultural-related figures (which are presented in Appendix 4 of the Appendices), particularly with respect to the amount of irrigated acreage, there appears wide fluctuations in estimated levels of irrigated acreage. Such fluctuations tend to indicate either highly volatile irrigation and crop production cycles or, more than likely, fundamental problems in reporting and gathering accurate data on this industry sector.

The volatility in historical measures of this industry, particularly with respect to irrigated acreage, related water usage rates and livestock figures, makes forecasting irrigation and livestock water use especially difficult. However, there does appear to be a trend towards no increase in agricultural lands being brought under cultivation and in some counties, e.g., Carson City, Churchill, Douglas, and Washoe in particular, it appears that encroaching urbanization and the transfer of water rights to other uses, i.e., municipal and industrial, is causing the level of irrigated lands to actually decline. Given new and growing demands for limited water resources in the state, particularly for municipal use, wildlife protection and fishery restoration, instream flows and recreation, the future of agriculture in Nevada is somewhat uncertain.

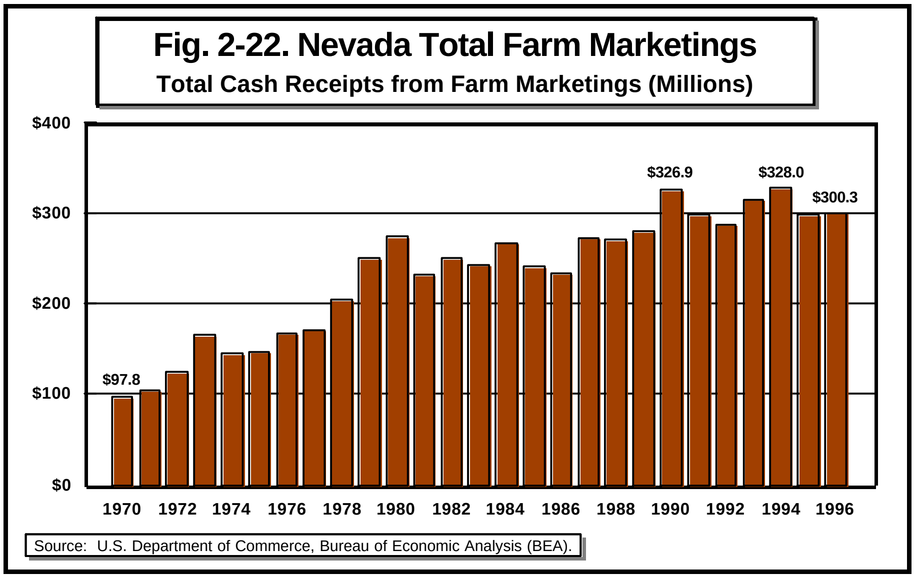


Fig. 2-22. Nevada Total Farm Marketings
Total Cash Receipts from Farm Marketings (Millions)

Table 2–8. Nevada Forecasted Irrigated Acreage presents the Nevada Division of Water Planning's forecasts for total irrigated acreage Nevada and the state's principal agricultural counties. Nevada's total irrigated acreage figures are based on individual county forecasts which were then aggregated to produce the statewide total. Forecasts of irrigated acreage are expected to show declines in all counties, with accelerated declines in the more urbanized counties, i.e., Washoe County in Table 2–8.

Table 2–8. Nevada Forecasted Irrigated Acreage
Selected Counties – Estimated (1995) and Forecasted (2000–2020) Irrigated Acreage (Acres)

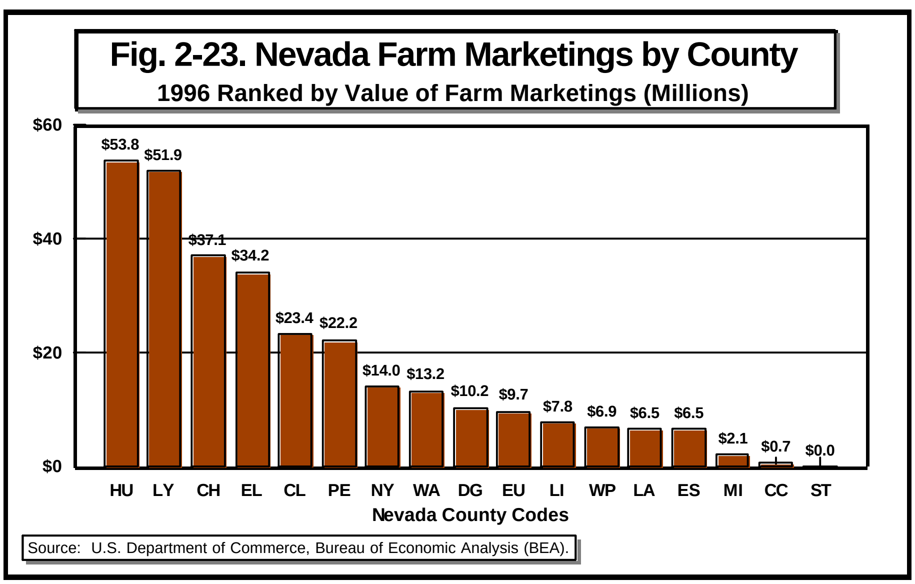


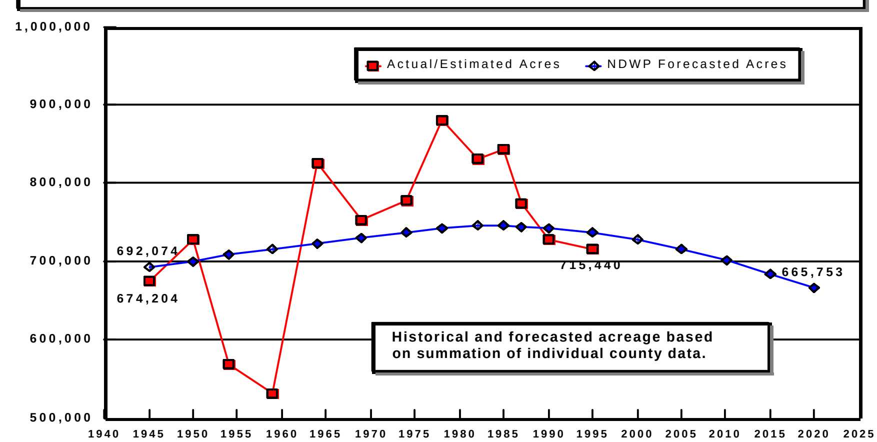
Fig. 2-23. Nevada Farm Marketings by County
1996 Ranked by Value of Farm Marketings (Millions)

Nevada/Selected Counties	1995	2000	2005	2010	2015	2020
Nevada Total Irrigated Acreage	**715,440**	**727,500**	**715,563**	**700,742**	**683,247**	**665,753**
Churchill County Irrigated Acreage	56,094	54,523	54,130	53,685	53,191	52,696
Douglas County Irrigated Acreage	38,640	37,877	37,266	36,554	35,746	34,937
Elko County Irrigated Acreage	213,903	214,007	211,077	207,396	203,001	198,606
Humboldt County Irrigated Acreage	142,558	144,936	141,487	136,988	131,536	126,084
Lyon County Irrigated Acreage	60,975	61,317	60,643	59,884	59,045	58,207
Pershing County Irrigated Acreage	27,368	29,079	28,441	27,688	26,831	25,974
Washoe County Irrigated Acreage	27,048	25,716	24,671	23,483	22,176	20,869

Notes: The selected counties presented above accounted for nearly 80 percent of Nevada's total estimated irrigated acreage in 1995. Nevada totals are based on an aggregation of individual county estimates and forecasts of total irrigated acreage. Estimates of irrigated acreage for 1995 are based on U.S. Geological Survey (USGS) estimates, modified by the Nevada Division of Water Planning (NDWP) with modifications based on other source information (U.S. Department of Agriculture, Nevada Agricultural Statistics Service, and U.S. Department of Commerce, Bureau of Economic Analysis). County forecasts of irrigated acreage for 2000–2020 were based on NDWP forecasts derived from a non-linear "best fit" line for each county's 1945–1995 data and then extrapolated out to the year 2000.
Source Data: 1995 irrigated acreage – USGS and NDWP; irrigated acreage forecasts – NDWP.

Fig. 2-24. Nevada Irrigated Acreage, shows both estimates of historical irrigated acreage since 1945 and the Division of Water Planning's forecasts for Nevada's total irrigated acreage through the year 20202 based on individual county forecasts which are aggregated to the statewide total. Detailed forecasts for all counties and the total state appear in Appendix 4 of the Appendices. Forecasts were based on the approximation of a non-linear "best fit" line which tracked historical trends and then was extrapolated (extended) out to the year 2020 based upon estimates of agricultural trends and other factors, for example urban encroachment.

Fig. 2-24. Nevada Estimated/Forecasted Irrigated Acreage
Estimates and Forecasts of Total Irrigated Acreage (Acres)



Note: Data not available for consistent intervals of time.

Nevada's Population and Employment Forecasts

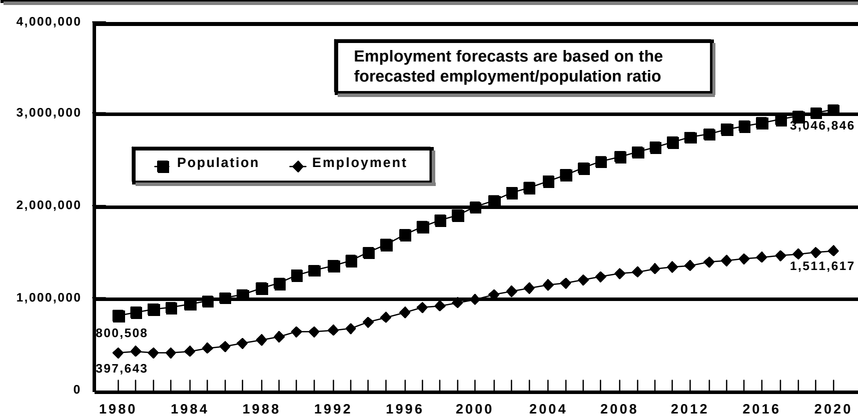
Forecasted employment-to-population ratios for each county are crucial in forecasting employment levels from the respective county's population forecasts. This analysis and related statistical tests are presented in Appendix 3 of the Appendices for each county and aggregated for the total state. The resultant forecasts of county total employment, combined with estimated historical and commercial and industrial water use factors (gallons per worker per day), are then used to forecast each county's commercial and industrial water withdrawals and, through aggregation, commercial and industrial water withdrawals for the total state.

Omitting the effects of national economic recessions, Nevada's ratio of its total covered employment to its resident population have tended to be relatively stable over time. For the period of 1980-1997, Nevada's ratio of its employment to population has averaged 48.2 percent. The average employment-to-population ratio, omitting recessionary periods, has tended to be closer to 50 percent. Nevada's relatively high employment-to-population ratio is typical of an economy that is being driven primarily by commercial expansion and related strong employment growth. Also evident from an analysis of these trends is that Nevada's employment-to-population ratio has shown marked sensitivity to national business cycle fluctuations, notably the U.S. recessionary periods of 1980-82 and 1990-91. While this point needs to be recognized, future recessions do not constitute any part of the forecasts for water withdrawals.

Another factor which would tend to affect the employment-to-population ratio is that as an economy "matures" and employment growth moderates relative to population growth, the trend towards household formation and a larger retired population component begins to affect this relationship, typically lowering the employment-to-population ratio over time. Changes in this relationship may also be influenced by changes in certain demographic factors, for example, changing birth rates (fertility rates) which would tend to alter the relationship between population growth and employment growth. Also, a change in the status of an area, for example, its appeal as a major retirement community, would tend to change the ratio of an area's employment to population over time.

Fig. 2-25. Nevada Population and Employment Forecasts

Total Population (Persons) and Total Covered Employment (Workers)



Source Data: Nevada State Demographer; DETR; Forecasts-NDWP.

Table 2–9. Nevada Population and Employment Forecasts shows historical and forecasted population, employment and employment-to-population ratios for Nevada for selected years from 1997 through 2020. Unlike the forecast output tables which begin with the last estimated year of water withdrawal measures, i.e., 1995, this table uses 1997 to show the last year of population and employment estimates and hence the last actual measure of the employment-to-population ratio. A more extensive presentation of this information for the total state and all counties for all years from 1980 through 2020 can be found in Appendix 3 of the Appendices. The information and forecasts in this appendix were based on historical levels and omit possible effects of future national and local recessions. Inputs on demographic trends and industrial development were also provided by the Nevada Department of Employment, Training and Rehabilitation (DETR).

Table 2–9. Nevada Population and Employment Forecasts

Population/Employment Estimates — 1997, NDWP Forecasts — 2000–2020
(Annual Averages — Persons and Workers)

NEVADA	1997	2000	2005	2010	2015	2020	1997-2020 Change	1997-2020 Percent Change*
Population	1,779,850	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846	1,266,996	71.2%
Employment	888,574	987,950	1,162,764	1,310,176	1,423,256	1,511,617	623,043	70.1%
Employment-to-Population Ratio	49.9%	49.9%	49.8%	49.7%	49.7%	49.7%	–	-0.20%

Note: Changes in the employment-to-population ratios are measured in percentage points. The Nevada employment-to-population figure is based on the aggregation of individual county estimates (1997) and forecasts (2000–2020).
Source Data: Population estimates (1997) – Nevada State Demographer; employment estimates (1997) – Nevada Department of Employment, Training and Rehabilitation (DETR); population and employment forecasts (2000–2020) – Nevada Division of Water Planning (NDWP). Population forecasts for Clark County were provided by the Clark County Department of Comprehensive Planning; population forecasts for Washoe County were derived from forecasts adopted by the Washoe County Department of Community Development.

Fig. 2-25. Nevada Population and Employment Forecasts presents forecasts of Nevada's population and employment through the planning horizon. Population forecasts are more fully presented in the Appendix 2 of the Appendices while the employment forecasts are presented in Appendix 3 of the Appendices and are derived from the forecasts of employment-to-population ratios developed for each county. The total state figures are obtained from an aggregation of the individual county estimates and forecasts.

Index to Part 2, Section 2:

Nevada State Water Plan
PART 2 — WATER USE AND FORECASTS

Section 3
Water Withdrawal Forecasts

Introduction

This section of the *Nevada State Water Plan* presents the water withdrawal forecasts for the state. In addition, this section also presents the methodology used in forecasting water withdrawals by various source and use categories. Fourteen separate categories of water withdrawals were forecast for the water plan as shown below. For definitions of these source and use categories, see Section 5, Technical Supplement – Water Use Coefficient and Related Factor Development and Application.

Forecasted Categories of Water Use

The water plan includes forecasts for fourteen categories of water withdrawals which comprise either unique forecasted water use categories, i.e., irrigation water withdrawals, or an aggregation of forecasted categories, i.e., total mining water withdrawals derived from forecasts of mining processing water withdrawals and mine dewatering. Forecasts were made by the source of water, i.e., municipal and industrial (M&I) water withdrawals, or by the use of water, e.g., domestic (residential) withdrawals. The following represents a listing of the public supply and water use categories presented in this plan:

- **By Public Supply:**
  - Total Municipal and Industrial (M&I) Water Withdrawals
- **By Water Use Type:**
  - Total Water Withdrawals
    - Total Domestic (Residential) Water Withdrawals
      - Domestic Public Supply Withdrawals
      - Domestic Self-Supplied Withdrawals
    - Commercial and Industrial Water Withdrawals
    - Thermoelectric Water Withdrawals
    - M&I Public Use and Losses
    - Total Mining Water Withdrawals
      - Mine Processing (Consumptive) Withdrawals
      - Mine Dewatering (Non-Consumptive) Withdrawals
    - Total Agricultural Water Withdrawals
      - Irrigation Withdrawals
      - Livestock (including Fisheries and Hatcheries) Withdrawals

In addition to forecasts of water withdrawals for these categories, estimates are also presented of consumptive water use by specific use category. The material in this section is supported by Section 5, which, in addition to providing a more detailed explanation of the methodology of the forecasts, also presents graphs of the county-specific water use coefficients and other factors used in the development of the water withdrawal. In addition, a number of appendices to the water plan lend themselves to providing greater detail for the water use forecasts and underlying socioeconomic forecasts. Specifically, Appendix 1 of the Appendices provides historical water use data for the years 1985, 1990, and 1995; Appendix 2 of the Appendices develops the population forecasts; Appendix 3 develops the employment forecasts from the population forecasts and provides detailed county forecasts for all source and use categories forecasted using these socioeconomic variables. Appendix 4 of the Appendices develops the county and state forecasts of irrigated acreage; and Appendix 5 of the Appendices presents a summary of all forecasts for the state and all counties.

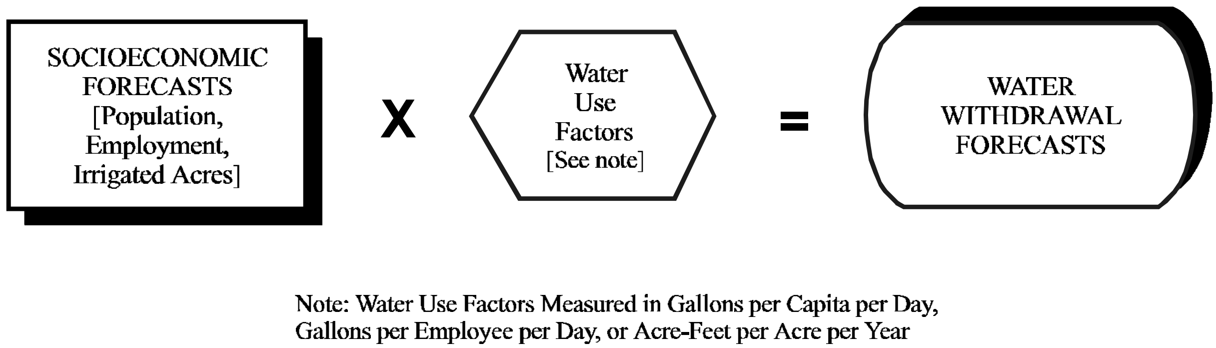
The Nevada Division of Water Planning's (NDWP's) water use forecast methodology is intended to link the socioeconomic growth rate assumptions and forecasts developed in Part 2, Section 2, Nevada Socioeconomic Forecasts, for population, employment and agricultural irrigated acreage, with individual county and statewide forecasts for water withdrawals through the use of estimated "water use" factors. The water use factors were calculated from historical water withdrawal amounts divided by populations, employment, or irrigated acreage. This process of linking the socioeconomic forecasts with water withdrawal forecasts is more extensively explained in the following section, "The Forecast Methodology." [Note: For a detailed explanation of the development of the water use factors, or coefficients, and their application to specific water withdrawal forecasts, see Part 2, Section 5.] The forecast methodology represents an integrated forecasting technique which only requires forecasts of population and agricultural irrigated acreage in order to produce most of the state's water withdrawal forecasts by water use category. It should be noted that all water withdrawal forecasts presented in this section are made at the county level and then aggregated to produce the forecasts for the State of Nevada.

The Forecast Methodology

The forecast methodology developed for the water plan uses a forecast of key socioeconomic variables multiplied by a water use factor or coefficient to produce a water withdrawal forecast. This process is depicted in its simplest form in Flow Chart 1. Basic Forecasting Methodology. Specifically, forecasts of population, employment (which itself is derived from the population forecast), and irrigated acreage provide the means to develop a number of water withdrawal forecasts by water use category, including withdrawals for domestic (both public and self-supplied), municipal and industrial (M&I), public use and losses, commercial and industrial, irrigation and livestock water withdrawals. The only forecasted categories which use a different methodology are thermoelectric and mining water uses.

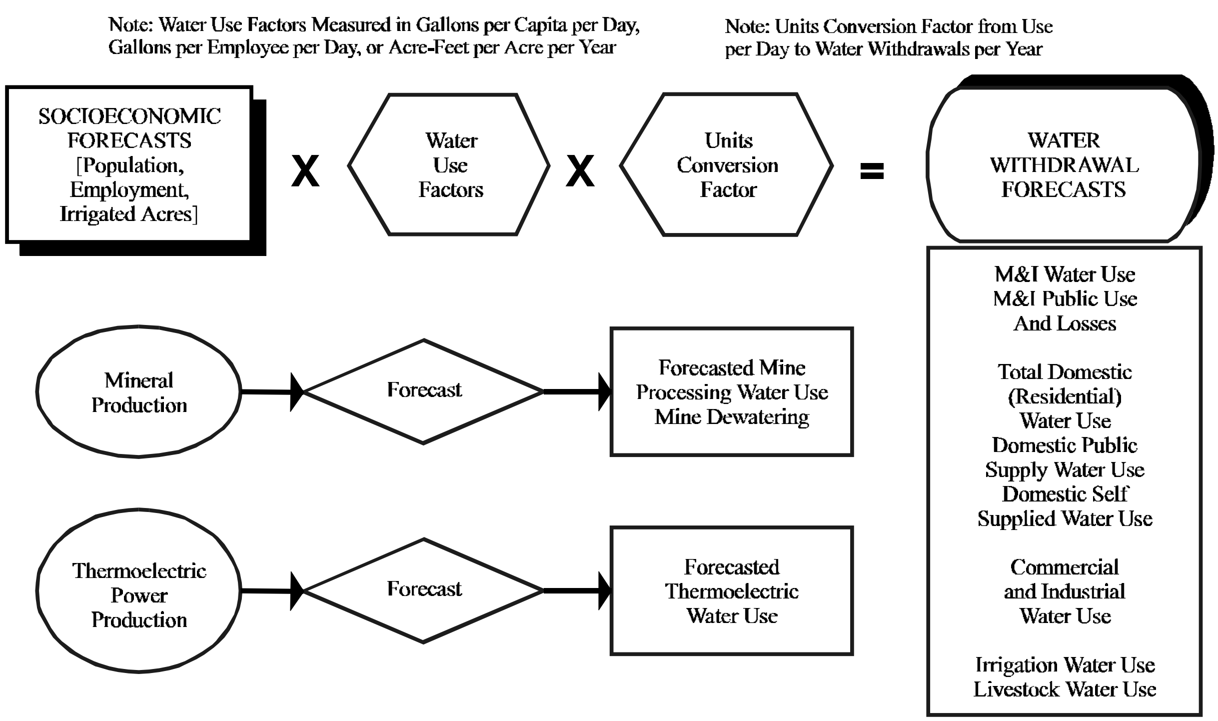
Flow Chart 2. Forecast Methodology by Use Category, expands the basic concept of Flow Chart 1 to show how the various water withdrawal forecasts by source or use category are determined. Flow Chart 2 introduces a "Units Conversion Factor" factor which merely converts the water use coefficients, measured in either gallons per capita or per employee per day, to a total water withdrawal figure in acre-feet per year. Flow Chart 2 depicts how the fundamental socioeconomic forecasts (population, employment and irrigated acreage) are used to develop specific forecasts of water withdrawal by category. This chart also shows how mining water uses (both consumptive and

Flow Chart 1. Basic Forecast Methodology
Socioeconomic Forecasts to Water Withdrawal Forecasts



Nevada Division of Water Planning/Socioeconomic Analysis and Planning

Flow Chart 2. Forecast Methodology by Use Category
Socioeconomic Forecasts to Water Withdrawal Forecasts



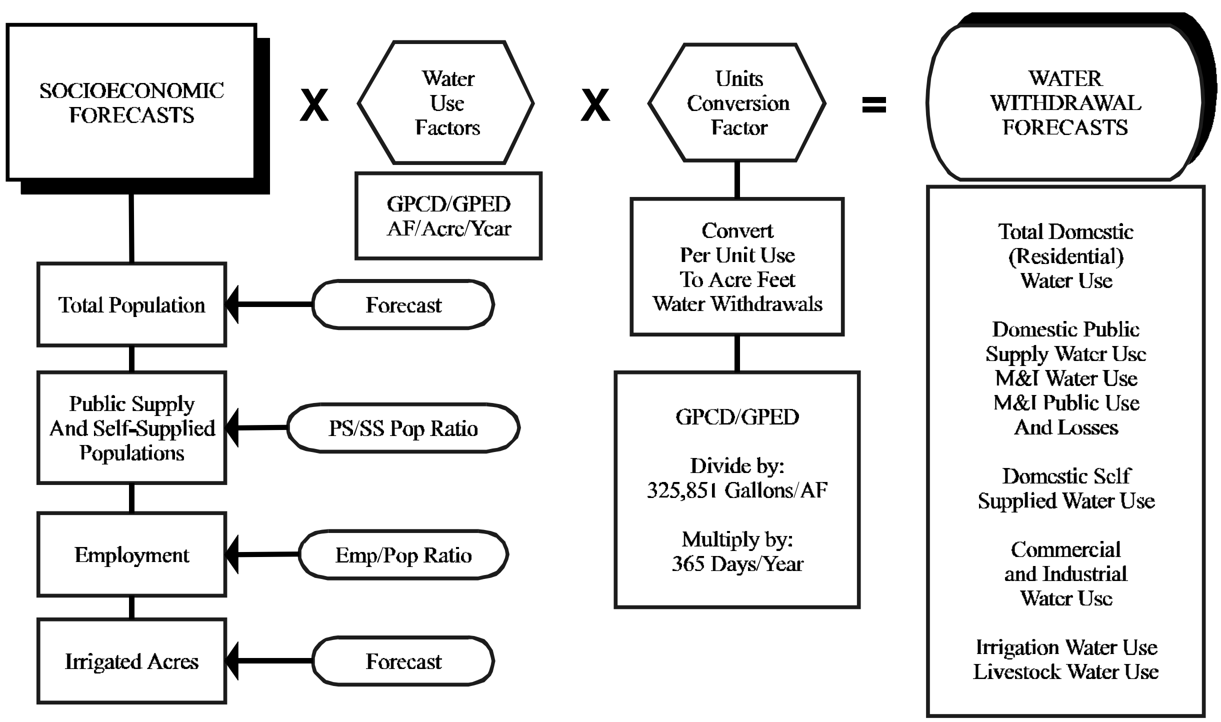
Nevada Division of Water Planning/Socioeconomic Analysis and Planning

non-consumptive) are forecast from estimates of mining activity and production levels. Also shown is the methodology for thermoelectric water withdrawal forecasts, which are estimated from general forecasts of future production levels based on such factors as population growth and regional mining activity.

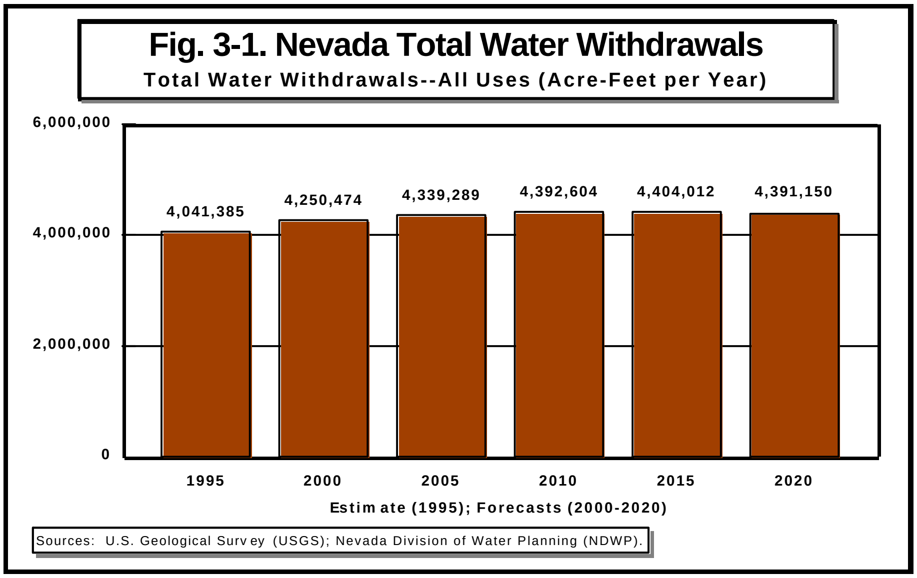
Flow Chart 3. Socioeconomic and Water Withdrawal Forecasts, shows in greater detail the interaction of the socioeconomic forecasts (population, employment and irrigated acreage), the water use factors, other forecasts assumptions (factors) and the units conversion factors, to produce the water withdrawal forecasts for the M&I, domestic, commercial and industrial and agriculture use categories. Of special note is that forecasts for all water withdrawal categories are made at the county level and then aggregated county-by-county to produce the statewide totals for all categories of water use. By this aggregation process, however, the water use coefficients reflected for the total state vary over time depending on individual county trends. This is based on the fact that the statewide water use coefficients represent, in effect, weighted averages of individual county use coefficients and therefore will vary depending on individual county trends.

Flow Chart 3 shows that the forecast of total population, multiplied by a total domestic water use factor in gallons per capita (per persons) per day (GPCD) and then multiplied by a units conversion factor, provides a forecast of total domestic (residential) water withdrawals. Similarly, the forecast of total population, multiplied by a public supply/self-supplied population factor (“PS/SS Pop Ratio”

Flow Chart 3. Socioeconomic and Water Withdrawal Forecasts
Socioeconomic Forecasts, Forecast Factors, Conversion Factors and Forecasted Water Withdrawals by Category



Nevada Division of Water Planning/Socioeconomic Analysis and Planning

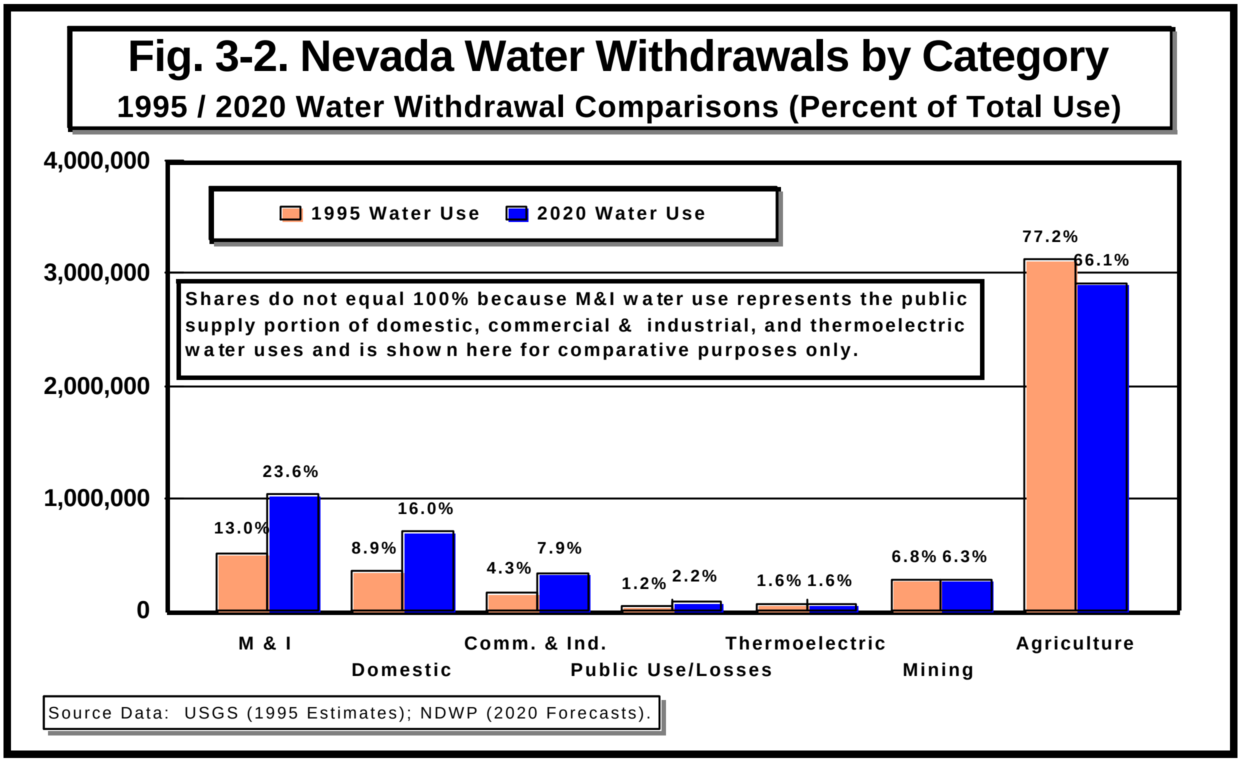


in Flow Chart 3) provides both a public supply population and a self-supplied population from which (using appropriate water use factors) domestic public supply and domestic self-supplied water withdrawal forecasts are made. The total municipal and industrial water withdrawals are projected using the estimates of the population on public supply water systems multiplied by a M&I water use factor. The M&I public use and losses are estimated (at approximately 10 percent of total M&I water withdrawals for the total state) based on historical public use and losses.

Commercial and industrial water withdrawals are based on the forecasted level of employment, which is estimated from the population forecast. Water withdrawals are then estimated using an employment-to-population ratio multiplied by a commercial water use factor. This water use factor is calculated from historical use patterns in gallons per employee per day (GPED) to yield total commercial and industrial water withdrawals. Since mining water use is forecasted using a different methodology, mining workers are subtracted from the forecasts of total employment.

Irrigation water withdrawal forecasts are made using forecasts of county irrigated acreage multiplied by an irrigated acreage water requirement factor in acre-feet per acre per year. Livestock water withdrawal forecasts are made based upon a factor (ratio) of livestock water withdrawals to irrigation water withdrawals. Total agricultural water withdrawal forecasts represent the sum of irrigation water withdrawals and livestock water withdrawals. [*Note:* The terms “water withdrawal” and “water use” are used interchangeably in this forecast analysis. While assumed to have the same meaning in this presentation, the term water withdrawal represents the total amount of water withdrawn for a specific use category without reference to the amount of return flow. Thus, it does not measure consumptive use, which represents water which is not returned to a source or able to be used again. Table 3–8 presents estimates and forecasts of both total water withdrawals and the estimated consumptive use.]

Thermoelectric (including geothermal) water withdrawal forecasts did not lend themselves to the use of the water use factor method described above. In addition, power production across the state is generally not dependent upon the socioeconomic conditions in any one county. Consequently, these forecasts were based primarily on general population trends and increasing demands for electrical power, particularly from mining operations in some of the rural counties. Mining water withdrawal



forecasts (including both consumptive and non-consumptive withdrawals, such as mine dewatering), also presented a unique forecasting environment where employment is not directly related to water used in mineral production. These forecasts were therefore based principally on the projected state of Nevada's gold industry, and specifically on the market price of gold, the grade of available ore bodies which influences the type of processing required and the amount of water used in processing, the level of economically-recoverable reserves, the nature of production (underground mining versus open-pit mining), and the continued need for mining dewatering in relation to future mining operations. As with all of the forecasts, the forecasted future mining water withdrawals are estimates only and actual future water use will be highly dependent on the price of gold.

Summary of Water Withdrawals by Use Category

Table 3–1. Nevada Water Withdrawal Forecast Summary, presents historical estimates (1995) and forecasts (2000–2020) of water withdrawals by major use category along with each categories' percentage share of total statewide water withdrawals. This table represents a condensed version of Table 3–7. Nevada Estimated and Forecasted Water Withdrawals, which appears later in this section with the addition of the forecasted percentage share changes by water use category. See Fig. 3–1 for estimated and forecast water withdrawals for 1995 through 2020 and Fig. 3–2 for changes in the shares of water withdrawals between the years 1995 and 2020. In Table 3–1, the water withdrawals for domestic, commercial and industrial and thermoelectric use categories include water from both public and self-supplied sources. Public use and losses are assumed to be from public supply water sources only. It should be noted that these water withdrawal forecasts are based on the most current available level of water use and the state of water conservation. Therefore, these forecasts do not explicitly incorporate the introduction of new technology and changes in policy and pricing actions which may tend to change the water use rates used to develop these forecasts.

Table 3–1. Nevada Water Withdrawal Forecast Summary

Estimated (1995) and Forecasted (2000–2020) Water Use by Use Type

Acre Feet per Year and Percent of Statewide Total Water Withdrawals

Total Nevada	1995	2000	2005	2010	2015	2020
Domestic (Residential) Withdrawals[1]	360,710	455,464	538,090	607,467	660,315	701,338
Percent of Total Withdrawals	8.9%	10.7%	12.4%	13.8%	15.0%	16.0%
Commercial & Industrial Withdrawals[2]	172,407	220,355	261,880	296,905	323,811	344,919
Percent of Total Withdrawals	4.3%	5.2%	6.0%	6.8%	7.4%	7.%
Public Use and Losses[3]	48,472	61,195	72,313	81,707	88,930	94,582
Percent of Total Withdrawals	1.2%	1.4%	1.7%	1.9%	2.0%	2.2%
Thermoelectric Withdrawals[4]	65,449	67,085	68,427	69,522	70,412	71,223
Percent of Total Withdrawals	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
Total Mining Use[5]	274,434	278,996	282,708	284,965	283,764	277,566
Percent of Total Withdrawals	6.8%	6.6%	6.5%	6.5%	6.4%	6.3%
Total Agriculture Withdrawals[6]	3,119,914	3,167,378	3,115,872	3,052,038	2,976,780	2,901,522
Percent of Total Withdrawals	77.2%	74.5%	71.8%	69.5%	67.6%	66.1%
Total Water Withdrawals (Use)	**4,041,385**	**4,250,474**	**4,339,289**	**4,392,604**	**4,404,012**	**4,391,150**

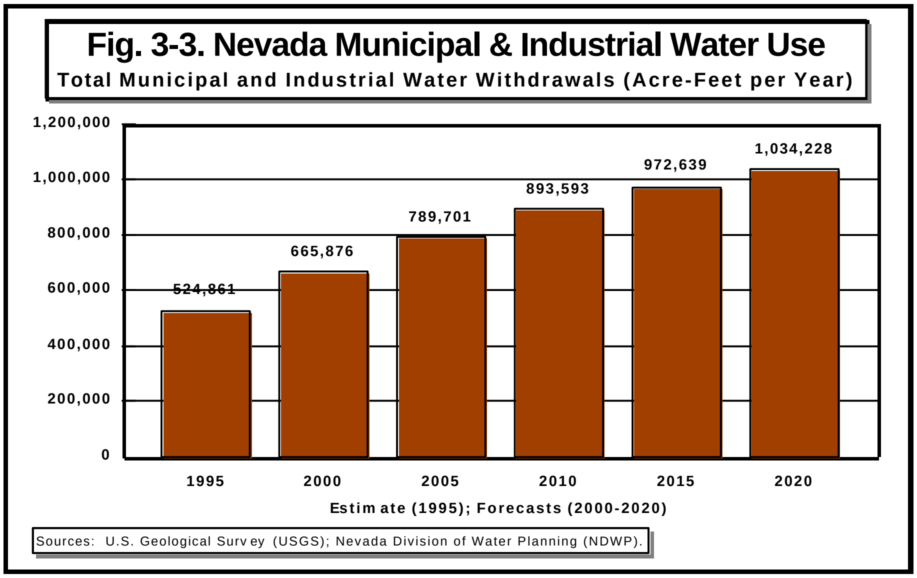
Notes: "Water Withdrawal" and "Water Use" are equivalent terms, but are not the same as consumptive use; they do not account for return flows. Figures for total State of Nevada are based on an aggregation of individual county water withdrawal estimates and forecasts. Water withdrawal forecasts are based on the existing levels of conservation.

[1] Total Domestic Withdrawals includes the total residential use, both indoors and outdoors (i.e., residential landscaping).
[2] Includes both public and self-supplied withdrawals.
[3] Public Use and Losses is forecasted as a percent of total M&I water use based on historical trends.
[4] Thermoelectric Withdrawals includes water used for geothermal power plants and cooling water for conventional plants.
[5] Total Mining Withdrawals includes both consumptive and non-consumptive uses (i.e., mining dewatering).
[6] Total Agriculture Withdrawals include both irrigation and livestock water use.

Source Data: Nevada State Demographer; Nevada Department of Employment, Training and Rehabilitation (DETR); U.S. Geological Survey (USGS); and Nevada Division of Water Planning (NDWP); Irrigated acreage and 1995 irrigation water withdrawals based on USGS estimates modified by NDWP; Forecasts through 2020 based on 1995 water usage rates and NDWP forecasts of population, employment, general business conditions and estimated irrigated acreage.

Table 3–1 shows that domestic water withdrawals are expected to increase their share of statewide total water withdrawals from 8.9 percent to 16.0 percent, rising from an estimated 360,710 acre-feet in 1995 to a forecasted 701,338 acre-feet by 2020. Commercial and industrial water withdrawals are expected to rise from 4.3 percent of statewide total withdrawals in 1995 to 7.9 percent from an estimated 172,407 acre-feet in 1995 to 344,919 acre-feet by the year 2020. Public use and losses, which are forecasted by this methodology as a constant percent of total municipal and industrial withdrawals, increases from 1.2 percent of total water withdrawals in 1995 to 2.2 percent by 2020.

Thermoelectric water withdrawals, which are based primarily on continued growth in population and industry in the state, are expected to remain essentially constant at 1.6 percent of statewide total



water withdrawals. Mining water withdrawals are projected to show a slight decline in both the amount of water withdrawn between 1995 and 2020 and the share of statewide water withdrawals from 6.8 percent in 1995 to 6.4 percent by 2020. The most dramatic declines in shares of water withdrawals are expected in agriculture and specifically, irrigation water withdrawals. Agriculture's share of statewide total water withdrawals is expected to decline from an estimated 77.2 percent in 1995 to 66.4 percent in 2020. This decline is based on an assumption of relatively stable to modest declines in the levels of irrigated acreage in Nevada's rural counties and the continued conversion of irrigated farmlands into urban lands and residential tracts in more urbanized counties. Fig 3-2 shows the various changes in water withdrawal shares by specific water use over the forecast horizon of 1995 to 2020.

Municipal & Industrial Water Withdrawal Forecasts

Table 3–2. Municipal & Industrial (M&I) Water Withdrawal Estimates and Forecasts, presents the statewide 1995 estimated and 2000 to 2020 forecasted municipal and industrial (M&I) water withdrawals for Nevada. M&I water use consists of withdrawals from public supply water systems for domestic, commercial and industrial and thermoelectric uses. In effect, it represents total withdrawals from public supply water systems, excluding public use and losses, which are presented separately. Table 3–2 presents the population growth assumptions and water use factors used in developing the statewide forecasts for M&I water use. The table also presents an estimate of consumptive use. These figures were developed by aggregating the individual county forecasts as presented in Appendix 3 of the Appendices. The key components to this forecast methodology are: (1) estimates and forecasts of the resident population (see Appendix 2 of the Appendices); (2) estimates and forecasts of the resident population on public supply water systems (see Appendix 3 of the Appendices); and (3) estimates of the municipal and industrial water use factor (in gallons per person per day). All water withdrawal factors used in these forecasts for each individual county are presented in Appendix 3 of the Appendices. See Fig. 3–3 for estimates and forecasts of M&I water withdrawals for the years 1995 through 2020.

Municipal and industrial water withdrawal forecasts are based on the resident population utilizing a public supply water system multiplied by a water use factor which is determined from historical conditions and trends. The water use factor for M&I water use for 1995 was based on the trends for that year and therefore represents the level of M&I water use conservation at that time. Further, throughout the forecast, the M&I water use factor is not fixed, but rather varies over time as the proportion of the resident population on public supply water systems changes (see Table 3–2, line "Percent Population on Public Supply"). Table 3–2 shows the variation in the M&I water use factor over time ("Municipal & Industrial Use Factor"), that is, from 315.0 gallons per person per day in 1995 to 317.6 gallons per person per day by 2020, reflecting the assumption that an increasing proportion of Nevada's total population will be provided water by a public supply water system.

Table 3–2. Municipal & Industrial (M&I) Water Withdrawals

Estimates and Forecasts of Total Public Supply Water Withdrawals

(Water withdrawals in acre-feet per year; Use factors in gallons per person per day)

Total Nevada	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	1,579,150	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846
Percent Population on Public Supply[2]	94.2%	94.6%	94.8%	95.0%	95.2%	95.4%
Population on Public Supply[3]	1,487,636	1,878,477	2,221,592	2,510,991	2,733,001	2,906,882
Population Self Supplied	91,514	107,780	119,783	129,315	135,978	139,964
Municipal & Industrial (M&I) Factor[4]	315.0	316.5	317.3	317.7	317.7	317.6
Municipal & Industrial Withdrawals[4]	**524,861**	**665,876**	**789,701**	**893,593**	**972,639**	**1,034,228**
Percent of Total Water Withdrawals	13.0%	15.7%	18.2%	20.3%	22.1%	23.6%
M&I Consumptive Use[5]	196,444	249,223	295,568	334,452	364,037	387,089
Public Use and Losses[6]	**48,472**	**61,195**	**72,313**	**81,707**	**88,930**	**94,582**
As a Percent of Total M&I Use[6]	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%
Percent of Total Water Withdrawals	1.2%	1.4%	1.7%	1.9%	2.0%	2.2%

Notes: One acre-foot equals approximately 325,851 gallons. Water withdrawals and water use are equivalent terms, but are not the same as consumptive use as they do not account for return flows. Nevada figures represent an aggregation of individual county estimates and forecasts. As aggregated into the total Nevada figures, population forecasts for Clark County are based on population forecasts adopted by the Clark County Department of Comprehensive Planning; Population forecasts for Washoe County are based on population forecasts adopted by the Washoe County Department of Community Development. Water withdrawal forecasts are based on the existing levels of conservation.

[1] 1995 population estimate developed by the Nevada State Demographer; population forecasts for 2000–2020 were developed by the Nevada Division of Water Planning (NDWP).

[2] Percent of population on public supply water systems for 1995 is based on USGS estimates; changes to this percent over the forecast horizon are estimated by NDWP.

[3] Total Nevada figure based on aggregation of individual county totals.

[4] Total M&I water use includes all public supplied water for domestic, commercial, industrial and thermoelectric uses; includes effects of a variable population on public supply water systems.

[5] M&I consumptive water use estimated from a fixed 37.4 percent of total M&I estimated and forecasted water withdrawals. The consumptive use factors are presented for all water use categories in Table 3.8.

[6] Public Use and Losses based on a fixed percent of total M&I water withdrawals for each county. The Nevada figure is based on the aggregation of the county totals and while shown here as a fixed 9.2 percent of M&I withdrawals, this figure actually varies slightly over the forecast horizon based on individual county growth patterns.

Source Data: Nevada State Demographer; U.S. Geological Survey (USGS); Nevada Division of Water Planning (NDWP).

The public supply domestic water use factor was assumed to be higher than the usage rate for self supplied domestic water users. As a result, as the proportion of the population receiving its waters from public supply water systems increases the water usage rate will tend to raise as well. This approach also assumes that other principal M&I uses, i.e., commercial and industrial, have constant usage rates in gallons per worker per day. Based on both increasing population and commercial development, water use forecasts call for total M&I water withdrawals to increase from an estimated 524,861 acre-feet in 1995 to 1,034,228 acre-feet by the year 2020, a total increase of over 97 percent. This corresponds to an average annual increase of 2.8 percent per year over the state water plan's forecast horizon.

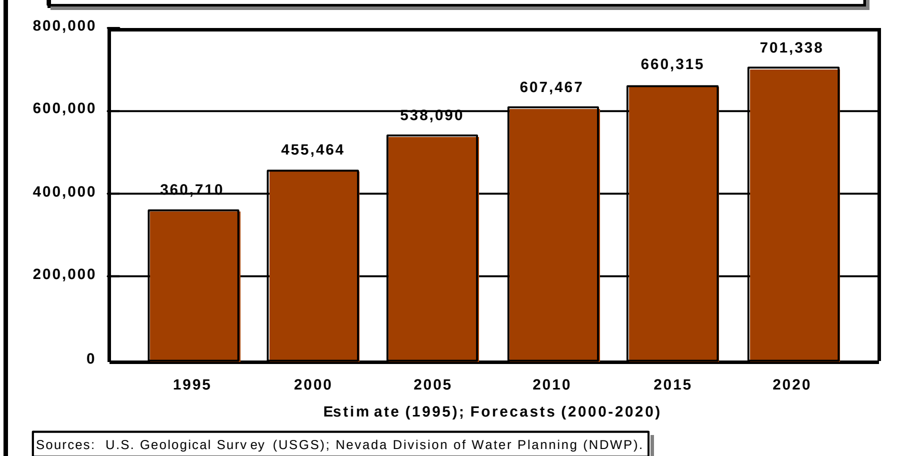
Domestic (Residential) Water Withdrawal Forecasts

Domestic water withdrawal forecasts were based on both population and usage rates as determined from historical trends. Table 3–3. Domestic Water Withdrawal Forecasts, presents domestic (residential) water withdrawal forecasts for both domestic public supply and self-supplied water withdrawals. The key components to the domestic water forecast methodology are: (1) estimates and forecasts of the total resident populations (see Appendix 2 of the Appendices); (2) estimates and forecasts of the resident population on public supply water systems (see Appendix 3 of the Appendices); (3) estimates and forecasts of the population on self-supplied water systems; and (4) estimates of specific water use factors for total domestic water use (using the entire population), public supplied domestic water use (using public supply population only), and self-supplied domestic water use (using only the self-supplied population).

The forecasts for domestic water withdrawals presented in Table 3–3 and in Fig. 3–4 assume that a varying proportion of the total population is on public supply water systems. Varying the percent of the population on public water systems over time is believed to represent a more realistic estimate of future water use conditions. This assumption is also supported by historic trends, which have more typically shown such variations. These changes to the proportion of the population on public supply systems were estimated individually for each county based on NDWP estimates of future growth characteristics. All forecast changes are presented in Appendix 3 of the Appendices.

Based on the forecasts presented in Table 3–3, total domestic water withdrawals are forecasted to rise from an estimated 360,710 acre-feet in 1995 to an estimated 701,338 acre-feet by the year 2020. This represents a total increase of 94 percent and an average annual increase of 2.7 percent per year. It is also estimated that the

Fig. 3-4. Nevada Domestic (Residential) Water Use



percent of the population on public supply water systems would increase over this forecast period. This results in the total domestic water use factor rising slightly over time (from 203.9 gallons per person per day in 1995 to 205.5 gallons per person per day by 2020).

Table 3–3. Domestic (Residential) Water Withdrawal Forecasts

Based on Variable Percent of Population on Public Supply Water Systems

(Water withdrawals in acre-feet per year; Use factors in gallons per person per day)

Total Nevada	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	1,579,150	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846
Percent Population on Public Supply[2]	94.2%	94.6%	94.8%	95.0%	95.2%	95.4%
Population on Public Supply[3]	1,487,636	1,878,477	2,221,592	2,510,991	2,733,001	2,906,882
Population being Self Supplied	91,514	107,780	119,783	129,315	135,978	139,964
Variable Domestic Use Factor[4]	203.9	204.7	205.2	205.4	205.5	205.5
Public Supply Use Factor	205.6	206.3	206.7	206.8	206.9	206.9
Self-Supplied Use Factor	176.6	177.3	177.5	177.5	177.4	177.2
Total Domestic Water Withdrawals[4]	**360,710**	**455,464**	**538,090**	**607,467**	**660,315**	**701,338**
Percent of Total Water Withdrawals	8.9%	10.7%	12.4%	13.8%	15.0%	16.0%
Public Supply Domestic Water Use	**342,605**	**434,063**	**514,277**	**581,756**	**633,300**	**673,563**
Self-Supplied Domestic Water Use	**18,105**	**21,401**	**23,813**	**25,711**	**27,016**	**27,775**
Total Domestic Consumptive Use[5]	180,037	227,331	268,571	303,198	329,575	350,051

Notes: One acre-foot equals approximately 325,851 gallons. Water withdrawals and water use are equivalent terms, but are not the same as consumptive use as they do not account for return flows. Nevada figures represent an aggregation of individual county estimates and forecasts. As aggregated into the total Nevada figures, population forecasts for Clark County are based on population forecasts adopted by the Clark County Department of Comprehensive Planning; Population forecasts for Washoe County are based on population forecasts adopted by the Washoe County Department of Community Development. Water withdrawal forecasts are based on the existing levels of conservation.

[1] 1995 population estimate developed by the Nevada State Demographer; population forecasts for 2000–2020 were developed by the NDWP in conjunction with Clark and Washoe counties.

[2] Percent of population on public supply water systems for 1995 is based on USGS estimates; changes to this percent over the forecast horizon are estimated by NDWP.

[3] Total Nevada figure based on aggregation of individual county totals.

[4] Variable Total Domestic Use Factor represents change in population on public supply water systems for each county and was developed from the aggregation of individual county forecasts.

[5] Domestic consumptive water use based on a fixed 49.9 percent of total domestic estimated and forecasted water withdrawals. The consumptive use factors are presented for all water use categories in Table 3–8.

Source Data: Nevada State Demographer; Department of Employment, Training and Rehabilitation (DETR); U.S. Geological Survey (USGS); and Nevada Division of Water Planning (NDWP).

Domestic water withdrawals for public supply water users are expected to increase from 342,605 acre-feet per year in 1995 to 673,563 acre-feet by 2020, an overall increase of 97 percent or 2.7 percent per year. Water withdrawals made by self-supplied domestic water users are expected to increase from 18,105 acre-feet in 1995 to 27,775 acre-feet by 2020, an overall increase of 53 percent or 1.7 percent per year.

Commercial and Industrial Water Withdrawal Forecasts

Commercial and industrial water use forecasts are presented in Table 3–4. Commercial and Industrial Water Withdrawal Forecasts. These forecasts are based on the forecasted number of employees multiplied by a water use factor measured in gallons per worker per day for each county and then aggregated to a statewide total. However, the employment figures used for each county were adjusted to remove mining workers, as water use by these workers (and the mining industry) are presented separately.

Table 3–4. Commercial and Industrial Water Withdrawal Forecasts

Based on Total Employment less the Estimated and Forecasted Number of Mining Workers (Water withdrawal in acre-feet per year; Use factor in gallons per employee per day)

Total Nevada	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	1,579,150	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846
Employment-Population Ratio	49.7%	49.7%	49.7%	49.6%	49.6%	49.6%
Total Employment (workers)	784,486	987,950	1,162,764	1,310,176	1,423,256	1,511,617
Employment less Mining Workers	771,299	973,251	1,148,331	1,295,999	1,409,685	1,499,030
Commercial/Industrial Use Factor[2]	199.6	202.1	203.6	204.5	205.1	205.4
Commercial/Industrial Withdrawals[2]	**172,407**	**220,355**	**261,880**	**296,905**	**323,811**	**344,919**
Percent of Total Water Withdrawals	4.3%	5.2%	6.0%	6.8%	7.4%	7.9%
Comm./Industrial Consumptive Use[3]	31,950	40,836	48,531	55,022	60,008	63,920

Notes: One acre-foot equals approximately 325,851 gallons. Water use and water withdrawals are equivalent terms, but are not the same as consumptive use as they do not account for return flows. As aggregated into the total Nevada figures, population forecasts for Clark County are based on population forecasts adopted by the Clark County Department of Comprehensive Planning; Population forecasts for Washoe County are based on population forecasts adopted by the Department of Community Development. Water withdrawal forecasts are based on the existing levels of conservation.

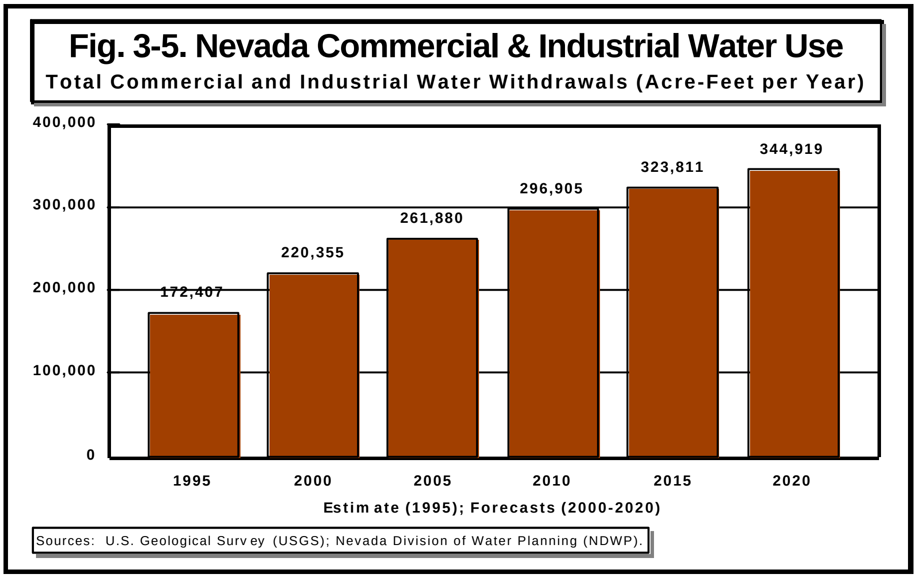
[1] 1995 population estimate developed by the Nevada State Demographer; population forecasts for 2000–2020 developed by the Nevada Division of Water Planning (NDWP) in conjunction with Clark and Washoe counties.

[2] Excludes water used in mining operations and by mining workers; mining water use is calculated separately.

[3] Commercial and Industrial consumptive water use is based on fixed 18.5 percent of commercial and industrial estimated and forecasted water withdrawals. The consumptive use factors are presented for all water use categories in Table 3.8.

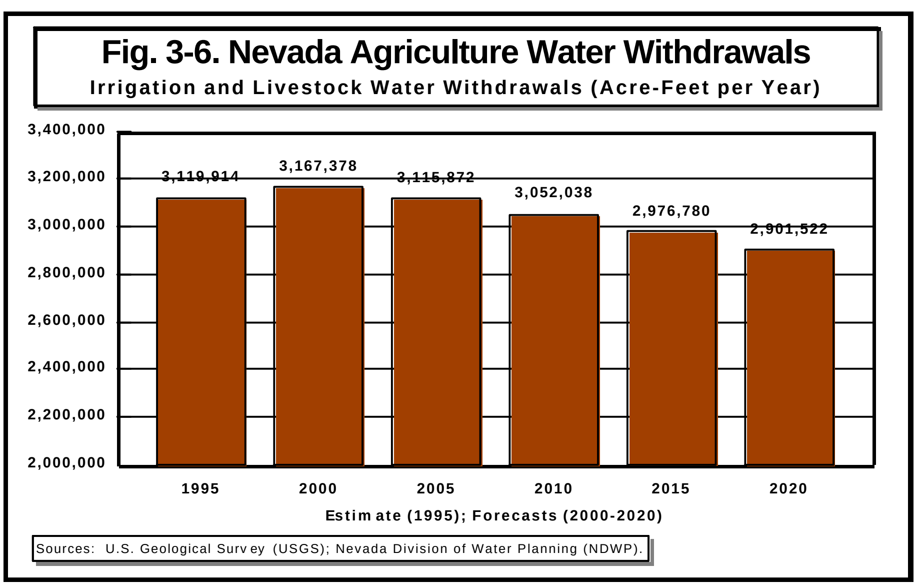
Source Data: Nevada State Demographer; Department of Employment, Training and Rehabilitation (DETR); U.S. Geological Survey (USGS); and Nevada Division of Water Planning (NDWP).

The employment forecasts for each county were determined from historical trends in that county's employment-to-population ratio. Individual county information showing population forecasts, forecasts of each county's employment-to-population ratio, total employment and mining employment forecasts are presented in Appendix 3 of the Appendices. Based on these individual county forecasts, statewide total commercial and industrial water use is expected to increase from an estimated 172,407 acre-feet in 1995 to 338,881 acre-feet by 2020 (see Fig. 3–5), corresponding to an overall increase of 96.6 percent and an average annual increase of 2.7 percent per year.



Agricultural Water Withdrawal Forecasts

Agricultural water withdrawal forecasts for Nevada were developed using forecasts of county irrigated acreage multiplied by a county-unique irrigated acreage water use factor, measured in acre-feet per acre per year. The forecasts for irrigated acreage were presented in Part 2, Section 2, Socioeconomic Assessment and Forecasts and are also presented for each county in Appendix 4 of the Appendices. The forecasts of irrigated acreage were made for each county using a non-linear "curve-fitting" estimation process and extrapolation out to the year 2020. The water use factor represents an average water requirement derived from 1995 data which is unique to each county and which is assumed to be applicable to all irrigated lands in that county. The individual irrigation water use factors were not varied over the forecast period. Using a constant irrigation factor is reasonable given that each irrigator's water use permit or certificate specifies a fixed application quantity or rate. It also implies that there will be no significant changes in the nature of the crops being grown or the number of croppings per year. Forecasted figures of



irrigated acreage were multiplied by the county-unique irrigated acreage water use factor.

Livestock water withdrawals were estimated from forecasted irrigation water withdrawals based on the historical trends of the ratio of livestock water use to total irrigation water use. Table 3–5. Nevada Agricultural Water Withdrawal Forecasts, presents forecasts of Nevada's irrigated acreage, irrigation water withdrawals, the irrigated acreage water use factor, livestock water withdrawals, livestock/irrigation water use factor, and total agricultural water withdrawals (irrigation and livestock combined) for 5-year intervals between 1995 through 2020. These figures represent an aggregation of individual county forecasts which are presented in Appendix 4 of the Appendices along with a statewide average irrigation water requirement.

Table 3–5. Nevada Agricultural Water Withdrawal Forecasts

Irrigated Acreage (Acres), Water Requirement (Acre-Feet per Acre per Year), and Irrigation and Livestock Water Use (Acre-Feet) — 1995–2020 (Acres and Acre-Feet per Year)

Total Nevada	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Total Irrigated Acreage	715,439	727,500	715,563	700,742	683,247	665,753
Irrigation Water Withdrawals	**3,113,585**	**3,160,754**	**3,109,348**	**3,045,636**	**2,970,521**	**2,895,406**
Percent of Agricultural Withdrawals	99.8%	99.8%	99.8%	99.8%	99.8%	99.8%
Irrigation Water Requirement	4.4	4.3	4.3	4.3	4.3	4.3
Irrigation Consumptive Use†	1,612,079	1,636,501	1,609,885	1,576,898	1,538,007	1,499,115
Livestock Water Withdrawals	**6,329**	**6,624**	**6,524**	**6,402**	**6,259**	**6,116**
Percent of Agricultural Withdrawals	0.20%	0.21%	0.21%	0.21%	0.21%	0.21%
As a Percent of Irrigation Use	0.203%	0.210%	0.210%	0.210%	0.211%	0.211%
Livestock Consumptive Use†	2,319	2,427	2,390	2,346	2,293	2,241
Total Agricultural Water Use	**3,119,914**	**3,167,378**	**3,115,872**	**3,052,038**	**2,976,780**	**2,901,522**
Percent of Total Water Withdrawals	77.2%	74.5%	72.0%	70.0%	67.9%	66.4%
Agricultural Consumptive Use	1,614,398	1,638,928	1,612,275	1,579,244	1,540,300	1,501,356

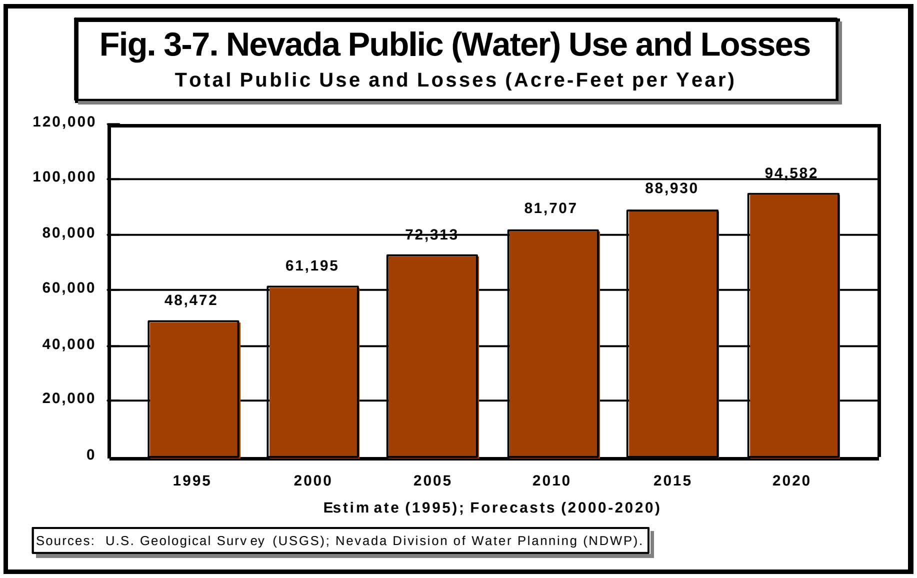
Notes: One acre-foot equals approximately 325,851 gallons. Water use and water withdrawals are equivalent terms, but are not the same as consumptive use as they do not account for return flows. 1995 irrigation figures based on U.S. Geological Survey (USGS) estimates, modified by the Nevada Division of Water Planning (NDWP). Forecasts through 2020 are based on 1995 usage rates and relationships and NDWP forecasted irrigated acreage amounts. Livestock water use as a percent of irrigation water use based on 1990 USGS studies. Nevada totals based on aggregation of individual county estimates and forecasts. Water withdrawal forecasts are based on the existing levels of conservation.

† Consumptive uses for both irrigation and livestock are estimated from a fixed percent of respective water withdrawals.

Source Data: 1995 irrigated acreage – USGS and NDWP; Irrigated acreage forecasts – NDWP; Irrigation water use factor (water duty) – USGS and NDWP; Livestock water use rates – USGS and NDWP.

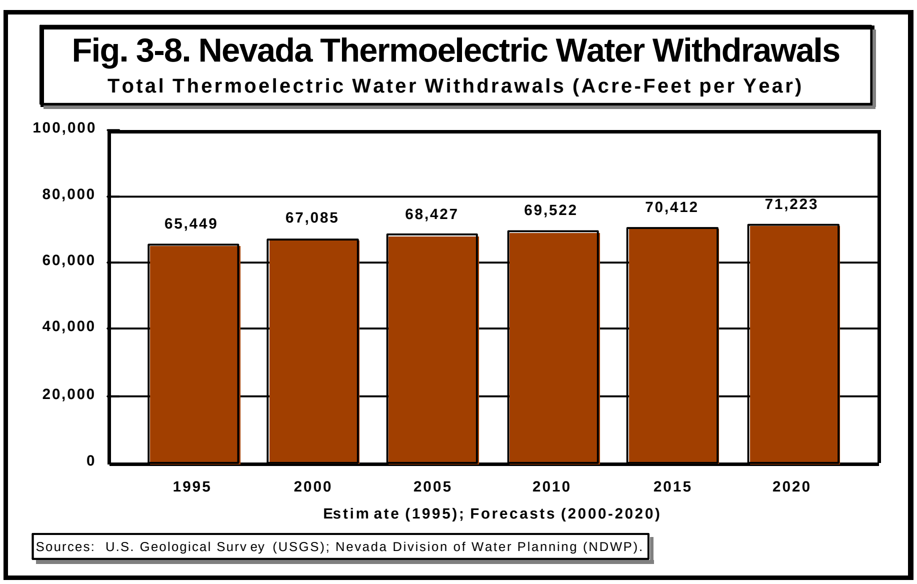
Table 3–5 shows that Nevada's total irrigated acreage is forecast to increase slightly from an estimated 715,440 acres in 1995 to 727,500 acres by the year 2000. Subsequently, irrigated acreage is forecast to decline through the year 2020 to 665,753 acres, representing a total period decline of 6.9 percent, or an average annual decline of 0.3 percent per year.

Based on an average water use coefficient of 4.3–4.4 acre-feet per acre per year (based on an aggregation of the individual county irrigation water use requirements), statewide total irrigation water withdrawals are expected to go from an estimated 3,113,585 acre-feet in 1995 to 2,895,406 acre-feet by the year 2020, representing a total decline of 7.0 percent and an average annual decline of 0.3 percent per year. Livestock water withdrawals are expected to decline from 6,313 acre-feet in 1995 to 6,116 acre-feet in the year 2020. Thus, total agricultural water withdrawals are expected to decline from 3,119,914 acre-feet in 1995 to 2,901,522 acre-feet by the year 2020, representing a total decline in this sector's water use of 218,392 acre-feet or 7.0 percent over the next 20 years.



Public Use and Losses

Forecasts of public use and losses (see Fig. 3–7) were developed using the assumption that this water use category constituted essentially a fixed percent of total municipal and industrial (M&I) forecasted water withdrawals and are presented in Table 3–2 along with the M&I water withdrawal forecasts. The statewide total for this water use category was based on an aggregation of individual county estimates and forecasts. The percentage figures for each individual county's public use and loss water use ratio to total M&I water withdrawals were based on 1995 relationships.

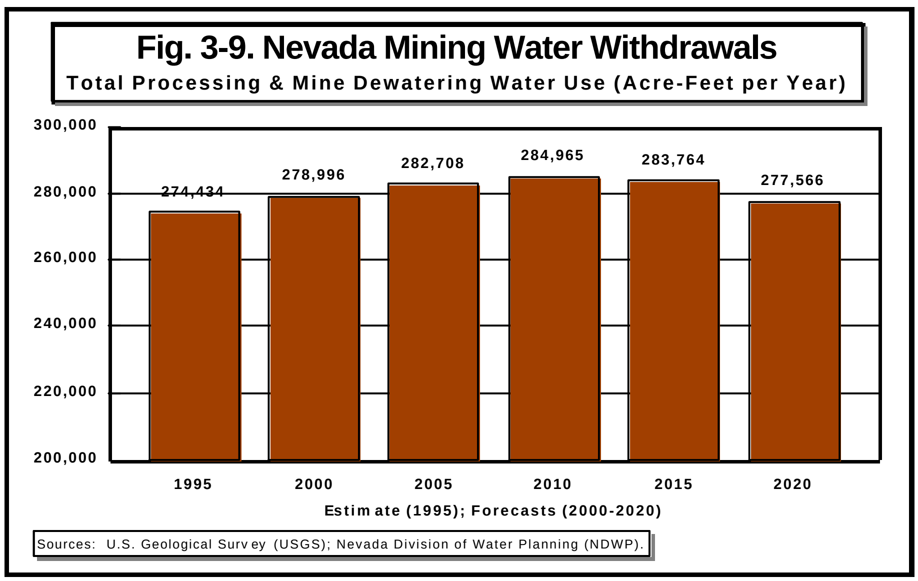


Thermoelectric Water Withdrawals

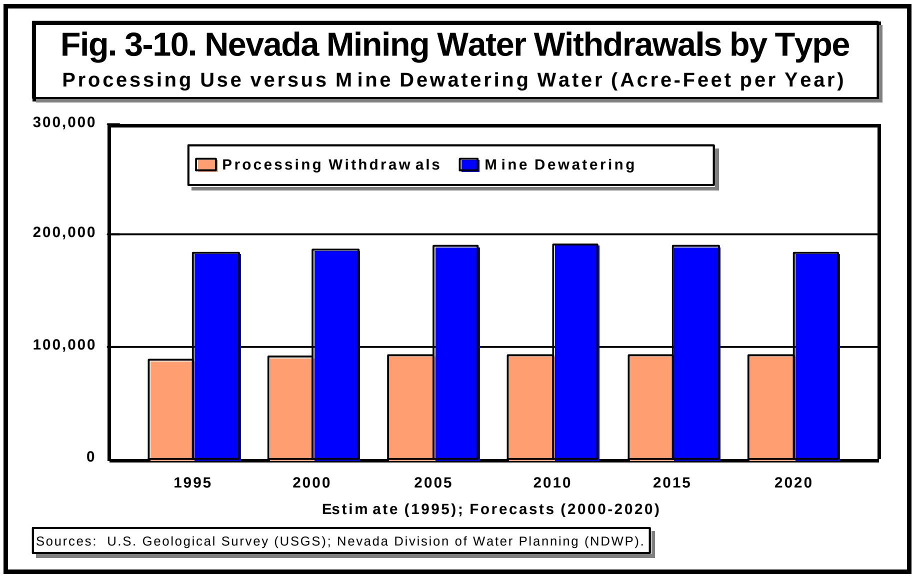
Forecasts for the statewide total thermoelectric water withdrawals (see Fig. 3–8) were based on an aggregation of individual county estimates and forecasts. County forecasts were made based on historical trends in this water withdrawal category and general forecasts of populations and commercial and industrial activities, particularly including anticipated future mining production served by these electrical power systems.

Mining Water Withdrawal Assumptions and Forecasts

Water withdrawal forecasts for Nevada's mining industry are based on the expected trends in the state's gold mining industry, which constitutes the majority of this economic sector's production, employment and water withdrawals. Water withdrawal estimates for the mining industry for 1995 showed a total of 274,434 acre-feet of water withdrawals, of which mine dewatering activities, mostly in support of open-pit gold mining, accounted for over two-thirds. In addition, gold mining processing operations, consisting primarily of washing, scrubbing and leaching, accounted for a significant portion of the mines' processing (consumptive) water withdrawals. Based on conditions and assumptions presented below, the forecasts for mining water withdrawals are presented in Table 3–6. Nevada Forecasted Mining Water Withdrawals. Fig. 3–9 shows total forecasted mining withdrawals, to include both consumptive (processing) use and non-consumptive (mining dewatering) withdrawals.



With respect to the state of the gold mining industry, several key factors and critical assumptions come into play. First, future gold mining activity in Nevada, and thus future water use, are critically dependent on the price of gold which determines the level of economically-recoverable gold reserves. As gold's market price declines, irrespective of the use of futures contracts to "lock in" on an economically viable price, available reserves which are economically feasible for recovery also decline. Conversely, as the price of gold increases, more marginal ore bodies now become economically attractive based on production costs of recovery. Also, the gold industry has become far more



resilient in its ability to adjust its cost structure to current gold prices. Therefore, falling prices do not necessarily spell an end to gold mining, as the industry rapidly adjusts to the mining of available higher grade ore, thereby lowering the mines' overall cost structure. Consequently, while exploration and future investment may wane with falling gold prices, reasonable production levels are likely to be maintained.

In 1997, Nevada's gold mining industry produced over 7 million ounces of gold at an average market price of around $330 per ounce. At an estimated "recovery" price of between $280 and $350 per (troy) ounce, which is the long-term market price anticipated by the industry for gold once the economic and financial fundamentals become better stabilized, there currently exists estimated recoverable reserves in Nevada of just over 95 million ounces. This indicates an estimated economic life of this industry of 12–15 years at current production levels. However, historically, estimated recoverable reserves have been periodically bolstered by new discoveries as existing ore bodies and proven reserves near depletion. Therefore, as an over-riding assumption in mining water use forecasts, it is assumed that with continued exploration some level of economically profitable gold mining in Nevada will continue throughout the forecast horizon.

Table 3–6. Nevada Forecasted Mining Water Withdrawals

Estimated (1995) and Forecasted (2000–2020) Water Use (Acre-Feet/Year)

Total Nevada	1995	2000	2005	2010	2015	2020
Total Mining Water Withdrawals[1]	**274,434**	**278,996**	**282,708**	**284,965**	**283,764**	**277,566**
Percent of Total Water Withdrawals	6.8%	6.6%	6.5%	6.5%	6.4%	6.3%
Mine Processing (consumptive use)	**89,164**	**90,947**	**92,402**	**93,289**	**93,469**	**92,751**
Percent of Total Mining Water Use	32.5%	32.6%	32.7%	32.7%	32.9%	33.4%
Mine Dewatering (non-consumptive)	**185,270**	**188,049**	**190,306**	**191,676**	**190,296**	**184,815**
Percent of Total Mining Water Use	67.5%	67.4%	67.3%	67.3%	67.1%	66.6%

Notes: "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows. Water withdrawal forecasts are based on the existing levels of conservation.
[1] Total Mining Use includes both consumptive (processing) and non-consumptive uses (i.e., mining dewatering).
Source Data: U.S. Geological Survey (USGS); and Nevada Division of Water Planning (NDWP); Forecasts through 2020 based on 1995 mining processing and dewatering usage rates and NDWP assumptions of mineral (gold) prices, economically-recoverable

reserves, type of production activities and general market conditions.

Other important mining issues are the nature of production and how changes in production techniques will modify both consumptive water use and mining dewatering. Whether the industry follows current production trends towards more underground mining of higher-grade ore, or continues its present emphasis on open-pit mining of lower-grade ore is, to a degree, dependent on gold's market price and will affect the amount of water use. Currently, the industry does not expect a significant alteration in dewatering levels even if more mining operations move below ground; dewatering of adjacent or nearby open pits is usually sufficient to also dewater mine shafts in the near vicinity of the pit. In addition, there is a general belief within the industry that underground mining may not necessitate the same level of either processing water use (due to higher grade ores and difference processing needs), or require mining dewatering as in the past. However, some degree of mine dewatering is expected to continue irrespective of the type of production activity. Based on these assumptions, in general agreement with mining association production estimates, forecasts for both mine productive water use and mining dewatering are anticipated to grow only slightly over the near-term and then begin to decline moderately after the year 2010 (see Fig. 3–10).

Total Water Use Forecasts

Table 3–7. Nevada Estimated and Forecasted Water Use by Sector, presents the entire set of water withdrawal forecasts by category for Nevada. The table shows water withdrawal estimates for 1995 and forecasts at five-year intervals out to 2020. These forecasts for the total state are based on the aggregation of county figures as presented in Appendix 5 of the Appendices. All forecasts are based on existing conservation measures and do not account for significant changes in water use patterns. From these projections, statewide total water withdrawals are expected to begin to level off between 2010 and 2015 and then begin to decline. While M&I, domestic and commercial and industrial water withdrawals are expected to continue to grow based on increasing population, employment, commercial and industrial expansion, the sectors of irrigation and mine dewatering are expected to show a decline in water withdrawals.

Based on these projections, Nevada's total water withdrawals for all sectors and categories is expected to increase from 1995's estimated 4,041,385 acre-feet of total water withdrawals to approximately 4,391,000 acre-feet of annual water withdrawals by the year 2020, an increase of nearly 350,000 acre-feet, or 8.6 percent. The state's total municipal and industrial water withdrawals are expected to grow by 509,000 acre-feet from 524,861 acre-feet in 1995 to approximately 1,034,000 acre-feet by 2020, an increase of 97 percent. However, it is expected that much of this increase will be offset by decreased agricultural water withdrawals, especially irrigation water withdrawals. Annual water use for irrigation is expected to decline by 218,179 acre-feet, or 7.0 percent, from an estimated 3,113,585 acre-feet in 1995 to a forecasted 2,895,000 acre-feet by 2020.

Total domestic (residential) water withdrawals are expected to increase by over 340,000 acre-feet, or 94 percent by 2020, from an estimated 360,710 acre-feet of water withdrawals in 1995 to a forecasted 701,000 acre-feet by the year 2020. Domestic public supply water withdrawals are expected to increase by 331,000 acre-feet, or nearly 97 percent, from an estimated 342,605 acre-feet in 1995 to a forecasted 674,000 acre-feet by 2020. Self-supplied domestic water withdrawals are forecasted to increase by 9,700 acre-feet, or 53 percent from an estimated 18,105 acre-feet in 1995 to nearly 28,000 acre-feet by 2020. Commercial and industrial water withdrawals are expected to increase by 172,500 acre-feet, or 100 percent by 2020, from an estimated 172,407 acre-feet in 1995 to a forecasted 345,000 acre-feet of water withdrawals by the year 2020.

Table 3–7. Nevada Estimated and Forecasted Water Withdrawals

Estimated (1995) and Forecasted (2000–2020) Water Use by Use Type (Acre-Feet/Year)

Total Nevada	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Total Domestic (Residential) Use[1]	360,710	455,464	538,090	607,467	660,315	701,338
Domestic–Public Supplied[2]	342,605	434,063	514,277	581,756	633,300	673,563
Domestic–Self Supplied	18,105	21,401	23,813	25,711	27,016	27,775
Commercial and Industrial Use	172,407	220,355	261,880	296,905	323,811	344,919
Public Use and Losses[3]	48,472	61,195	72,313	81,707	88,930	94,582
Thermoelectric Use[4]	65,449	67,085	68,427	69,522	70,412	71,223
Total Mining Use[5]	274,434	278,996	282,708	284,965	283,764	277,566
Mine Processing (consumptive)	89,164	90,947	92,402	93,289	93,469	92,751
Mine Dewatering (non-consumptive)	185,270	188,049	190,306	191,676	190,296	184,815
Total Agriculture Withdrawals[6]	3,119,914	3,167,378	3,115,872	3,052,038	2,976,780	2,901,522
Irrigation Water Withdrawals	3,113,585	3,160,754	3,109,348	3,045,636	2,970,521	2,895,406
Livestock Water Use	6,329	6,624	6,524	6,402	6,259	6,116
Total Water Withdrawals (Use)	**4,041,385**	**4,250,474**	**4,339,289**	**4,392,604**	**4,404,012**	**4,391,150**

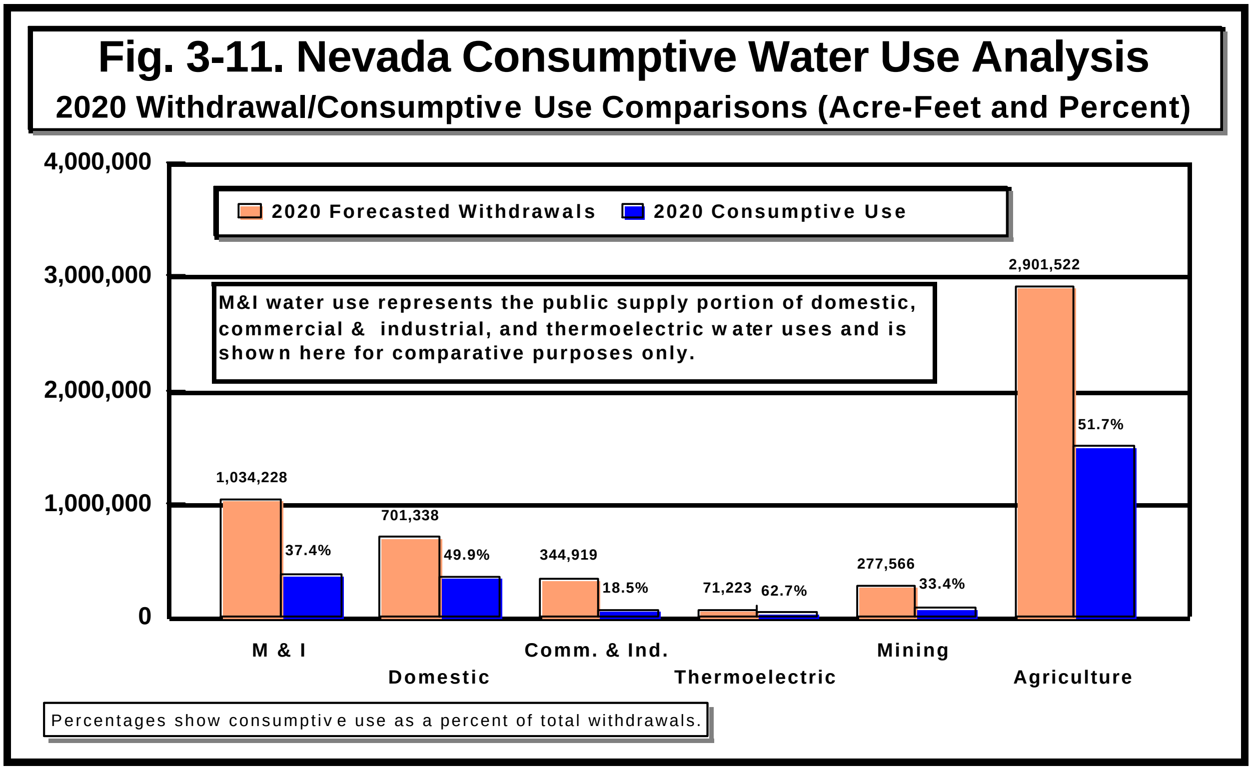
Notes: One acre-foot equals approximately 325,851 gallons. Water withdrawals and water use are equivalent terms, but are not the same as consumptive use as they do not account for return flows. Water withdrawal forecasts are based on the existing levels of conservation.

[1] Total Domestic Withdrawals equals the total residential use, both indoors and outdoors (i.e., residential landscaping).
[2] Domestic Public Supplied Water Withdrawals is residential use of water supplied by public supply water systems.
[3] Public Use and Losses are estimated at a fixed percent of total M&I based on historical trends.
[4] Thermoelectric Withdrawals includes water used for geothermal power plants and cooling water for conventional plants.
[5] Total Mining Withdrawals includes both consumptive and non-consumptive uses (i.e., mining dewatering).
[6] Total Agriculture Withdrawals includes both irrigation and livestock water withdrawals.

Source Data: Nevada State Demographer; Nevada Department of Employment, Training and Rehabilitation (DETR); U.S. Geological Survey (USGS); and Nevada Division of Water Planning (NDWP).

Based on patterns in forecasted total irrigated acreage determined from individual county forecasts, total agricultural water withdrawals, including both irrigation and livestock water withdrawals, are forecasted to peak around the year 2000 at approximately at 3.167 million acre-feet and then decline by some 266,000 acre-feet, or 8.4 percent, to 2.902 million acre-feet by the year 2020. This decline is based solely on forecasted trends in irrigated acreage. Total mining water withdrawals are expected to peak around the year 2010 at nearly 285,000 acre-feet, an increase of 10,500 acre-feet, or 3.8 percent from 1995's estimated mining water withdrawals.

As more of Nevada gold mining goes underground, total mining water withdrawals are expected to decline to approximately 277,600 acre-feet by 2020, a decline of 7,400 acre-feet, or 2.6 percent from water withdrawals forecasted for 2010. Most of this decline occurs in mine dewatering as mining operations and mine processing water withdrawals are expected to decline only modestly after the year 2010. Thermoelectric water withdrawals continue to increase throughout the forecast period based on rising population, continued mining activity, and other electrical energy demands. Total thermoelectric water withdrawals are expected to increase by 5,800 acre-feet, or 8.8 percent between



1995 and 2020.

Consumptive Use Forecasts

Table 3–8. Nevada Consumptive Use Forecast Summary presents estimates of consumptive water use by principal use category based on total water withdrawals for these same categories. The forecasts in this table were based on historical relationships between water withdrawals and respective consumptive use patterns. The total consumptive use figure, representing the summation of all categories, is expected to decrease from 48.4 percent of total water withdrawals to 46.8 percent as water use patterns change across the various water use categories primarily from agriculture (with a consumptive use estimated at 51.7 percent including both irrigation and livestock consumptive uses) to municipal and industrial which has an average consumptive use estimated at 37.4 percent, i.e., a 63 percent return flow. Fig. 3–11 shows the statewide total forecasted water withdrawals by use category for the year 2020 and that portion of each water withdrawal which is expected to be consumptively used.

Table 3–8. Nevada Consumptive Use Forecast Summary

Estimated (1995) and Forecasted (2000–2020) Consumptive Use by Use Type (Acre-Feet/Year)

Total Nevada	1995	2000	2005	2010	2015	2020
Domestic (Residential) Withdrawals[1]	360,710	455,464	538,090	607,467	660,315	701,338
Total Consumptive Use	180,037	227,331	268,571	303,198	329,575	350,051
Percent Consumptive Use	49.9%	49.9%	49.9%	49.9%	49.9%	49.9%
Commercial & Industrial Withdrawals	172,407	220,355	261,880	296,905	323,811	344,919
Total Consumptive Use	31,950	40,836	48,531	55,022	60,008	63,920
Percent Consumptive Use	18.5%	18.5%	18.5%	18.5%	18.5%	18.5%
Thermoelectric Withdrawals[2]	65,449	67,085	68,427	69,522	70,412	71,223
Total Consumptive Use	41,053	42,079	42,921	43,608	44,166	44,675
Percent Consumptive Use	62.7%	62.7%	62.7%	62.7%	62.7%	62.7%
Total Mining Use[3]	274,434	278,996	282,708	284,965	283,764	277,566
Total Consumptive Use	89,164	90,947	92,402	93,289	93,469	92,751
Percent Consumptive Use	32.5%	32.6%	32.7%	32.7%	32.9%	33.4%
Total Agriculture Withdrawals[4]	3,119,914	3,167,378	3,115,872	3,052,038	2,976,780	2,901,522
Total Consumptive Use	1,614,398	1,638,928	1,612,275	1,579,244	1,540,300	1,501,356
Percent Consumptive Use	51.7%	51.7%	51.7%	51.7%	51.7%	51.7%
Irrigation Water Withdrawals	3,113,585	3,160,754	3,109,348	3,045,636	2,970,521	2,895,406
Irrigation Consumptive Use	1,612,079	1,636,501	1,609,885	1,576,898	1,538,007	1,499,115
Percent Consumptive Use	51.8%	51.8%	51.8%	51.8%	51.8%	51.8%
Livestock Water Withdrawals	6,329	6,624	6,524	6,402	6,259	6,116
Livestock Consumptive Use	2,319	2,427	2,390	2,346	2,293	2,241
Percent Consumptive Use	36.6%	36.6%	36.6%	36.6%	36.6%	36.6%
Total Water Withdrawals (Use)	**4,041,385**	**4,250,474**	**4,339,289**	**4,392,604**	**4,404,012**	**4,391,150**
Total Consumptive Use	1,956,602	2,040,121	2,064,701	2,074,361	2,067,518	2,052,752
Percent Consumptive Use	48.4%	48.0%	47.6%	47.2%	46.9%	46.7%

Notes: "Water Withdrawal" and "Water Use" are equivalent terms, but are not the same as consumptive use; do not account for return flows. Estimates of consumptive use are based on estimates provided by the U.S. Geological Survey (USGS). Figures for the total State of Nevada are based on an aggregation of individual county estimates and forecasts of water withdrawals and consumptive use. Water withdrawal forecasts are based on the existing levels of conservation.

[1] Total Domestic Use equals the total residential use, both indoors and outdoors (i.e., residential landscaping).

[2] Thermoelectric Use includes water used for geothermal power plants and cooling water for conventional plants.

[3] Total Mining Use includes both consumptive and non consumptive uses (i.e., mining dewatering).

[4] Total Agriculture Withdrawals includes both irrigation and livestock water use.

Source Data: Nevada State Demographer; Nevada Department of Employment, Training and Rehabilitation (DETR); U.S. Geological Survey (USGS); and Nevada Division of Water Planning (NDWP).

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Nevada State Water Plan
PART 2 — WATER USE AND FORECASTS

Section 4
Meeting Our Future Water Supply Needs

Introduction

The future presents Nevada with many water resource challenges as a result of an ever increasing population, and competition over our limited water resources. Every effort should be made to ensure that all Nevadans have adequate and safe water supplies while protecting the quantity and quality of our water resources for current and future uses. This section of the *State Water Plan* is intended as an overview of future water demands, alternatives for meeting those needs, and water supply options identified in regional water plans.

Future Demands

As presented in Part 2, Section 3 of the *State Water Plan*, total statewide annual water withdrawals during the period 1995 to 2020 are forecasted to increase about 350,000 acre-feet (af) from 4,041,000 to 4,391,000 acre-feet per year (afy), assuming current levels of conservation. Correspondingly, annual consumptive use will increase about 96,000 af from 1,957,000 to 2,053,000 afy. This projected increase in water use is directly attributable to increasing population and related increases in economic endeavors, resulting in rising public supply (M&I), domestic, commercial, industrial and thermoelectric water usage.

The anticipated increase in total statewide water withdrawals is primarily the result of increasing public supply (M&I) water usage. Annual M&I water use is projected to increase by 509,000 af from 525,000 to 1,034,000 afy, almost doubling from 1995 to 2020. A majority of this increase in demand will be met with surface water supplies. Approximately 91 percent of this increase can be attributed to anticipated growth in Clark and Washoe counties. It is expected that M&I usage will account for almost one-quarter of the total statewide usage by 2020. One of Nevada's water resource challenges will be meeting the water needs of the nearly 3 million people expected to reside in the state by 2020.

The M&I water use projections presented in Part 2 of the *State Water Plan* are based upon existing water use patterns and conservation measures and do not include the effects of future conservation efforts. The implementation of additional M&I conservation measures will result in lower M&I water withdrawals (in 2020) than the 1,034,000 afy predicted in the water plan. Planning groups for Southern Nevada and Washoe County have estimated that their proposed additional conservation measures will result in annual M&I withdrawals about 150,000 af less than would occur without these additional measures. The achievement of additional conservation is an integral part of Southern Nevada's water supply plan for the future.

Based upon the economic forecasts in Part 2 of the *State Water Plan*, agricultural water use could experience a 7 percent decline through 2020. Nonetheless, agriculture will continue to account for a majority of the statewide use during the next 20 years. It must be noted that statewide agricultural water use is highly variable depending upon weather conditions and water supplies, and can vary more than 25 percent from a wet year to a dry year as a result of changing water availability. While the projections in the *State Water Plan* suggest that agricultural water use will decrease in the future, planning and management efforts need to consider providing more reliable water supplies for irrigation during drought periods.

Almost 6 to 7 percent of statewide water withdrawals occur in the mining industry. It is anticipated that mining water withdrawals will remain relatively constant at around 275,000 afy with a slight increase over the next 10 years followed by a slight decline after 2010. A majority of the withdrawals are associated with mine dewatering, and about 185,000 acre-feet per year of these withdrawals are either discharged to surface water systems, reinjected into aquifers or used by other sectors such as irrigation. The impacts of these future mine dewatering activities will continue to be monitored and evaluated.

Water Availability

Approximately 60 percent of the water withdrawn in Nevada comes from surface water sources. Most of Nevada's surface water is the result of runoff from melting snow, with peak flows generally occurring in May and June. Available surface water supplies are highly dependent upon weather conditions with variable monthly and annual flows. For example, the Humboldt River at Palisade (midway down the river) has experienced flows of 1,336,000 acre-feet during one year and only 25,000 acre-feet during another year. With such wide fluctuations, it is difficult to provide adequate and consistent water supplies to users on the system. Utilization of above ground and below ground storage capabilities are one strategy for smoothing out some of the flow fluctuations, thereby guaranteeing more reliable supplies.

Generally, Nevada's surface water sources have been fully appropriated and utilized for many years. Expanded usage of our surface water resources can only occur to a restricted extent. With limited "excess" surface water available, those looking to surface supplies to meet future demands will need to examine a variety of options such as water right acquisitions and transfers, storage and improved management.

Groundwater supplies provide about 40 percent of our water needs. In some areas, groundwater is used as a sole source. In other areas, groundwater is used as a supplemental source during times of limited surface water flows. Currently, about 60 percent of Nevada's groundwater basins have varying amounts of water available for additional appropriations for agriculture, urban and other uses. However, most of these groundwater resources exist in areas distant from the anticipated water demand growth areas. Development of these sources can become an expensive endeavor if interbasin transfers are involved.

Options for Meeting Future Water Needs

Meeting our future water needs will require implementation of a combination of strategies. Possible strategies have been divided into two categories: demand management and supply development. Through demand management, water purveyors make wiser use of the available water thereby lessening the need for new source development. Supply development strategies include a variety of methods for increasing supplies and improving supply reliability.

Increasing demands and competition for our limited resources oblige water managers and suppliers to implement both demand management and supply development strategies. However, each option needs to be evaluated on a case-by-case basis for suitability, cost effectiveness and public acceptance.

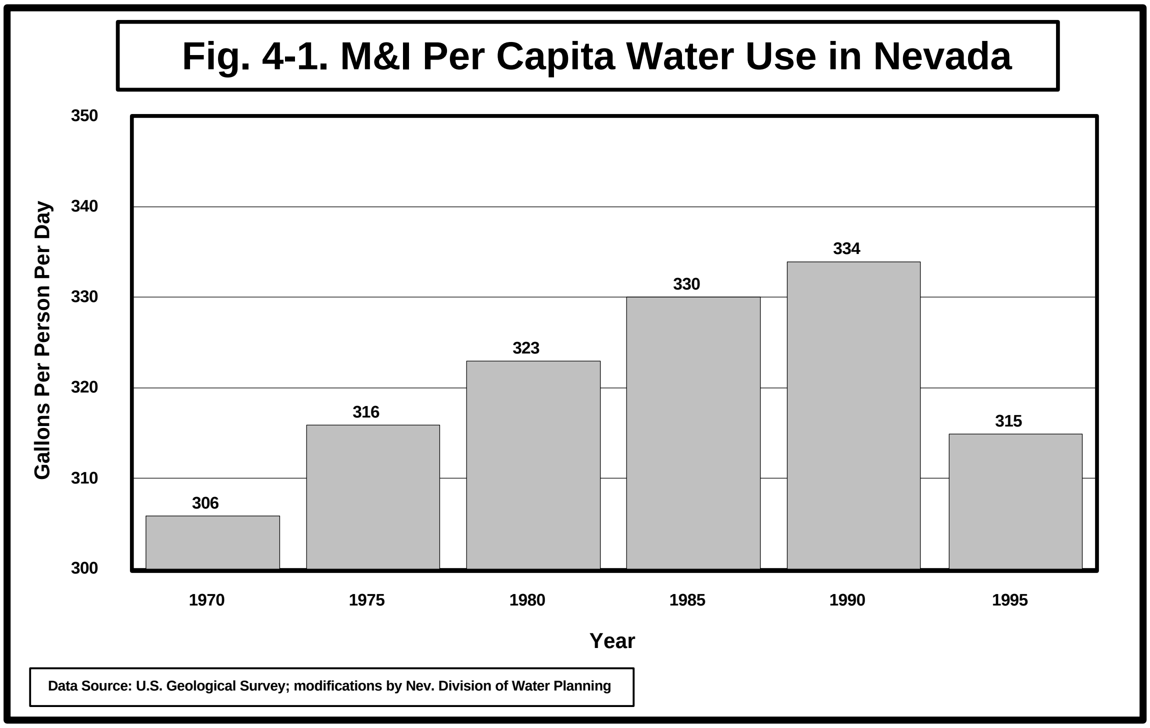
Demand Management Strategies

The time is past when water supply needs can be met simply by developing more water withdrawal, storage and delivery systems. Demand management must also be part of any long-range water supply plan. By reducing demands, new supply developments can be delayed with potential savings to the users. Demands can be managed through conservation measures and alternate strategies such as effluent reuse, greywater use and dual water systems.

Conservation. Conservation is recognized by most water suppliers and users as a cost-effective approach for extending water supplies, improving supply reliability during times of shortages, and deferring the need for new supply development. Numerous case studies have shown that a good conservation program can reduce demands significantly.

A comprehensive municipal water conservation program typically includes features such as: water system audits and leak detection, a public information and awareness program, utilization of increasing block billing, new ordinances, installation of low flow fixtures, landscape demonstration projects, use of drought tolerant plants and implementation of a xeriscape program, and installation of meters.

From 1970 to 1990, Municipal & Industrial (M&I) water use rates in Nevada were on the rise (Figure 4-1). Successful conservation programs during the 1990s have lowered statewide M&I water use from 334 gallons per person per day (gpcd) in 1990 to 315 gpcd in 1995. In the Las Vegas area, the critical impact of conservation to the region's water planning efforts has been recognized by the Southern Nevada Water Authority and participating water purveyors. The local governments and water suppliers have implemented a variety of conservation measures, such as: banning the creation of artificial lakes, adopting water waste ordinances, restricting lawn watering, establishing increasing block rates for billing purposes, establishing an active public education and outreach



program, and pursuing the use of lower quality water in lieu of potable supplies where feasible. As a result of these conservation efforts, Municipal & Industrial (M&I) water use in the Las Vegas Valley Water District has decreased from 358 gpcd (gallons per capita per day) in 1989 to 320 gpcd in 1997. Residential use has decreased from 213 gpcd to 197 gpcd during the same period.

Agricultural conservation programs typically include: laser leveling of fields, lining of ditches, use of soil and plant moisture monitoring devices, conversion to overhead or drip irrigation methods, and selection of low water use crops. Nevada's agricultural community has been implementing many of these conservation measures throughout the State, particularly in the Walker River and Carson River basins and the Lovelock area (Humboldt River basin).

For additional information on conservation, refer to Part 3 of the *State Water Plan.*

Alternate Strategies for Reducing Potable Water Demands. Conservation reduces potable water demands by decreasing the overall water needs of the users. Other options to achieve potable water demand reductions involve the utilization of lower quality water in lieu of treated potable water. The main options in this category include: effluent reuse, greywater reuse and dual distribution systems. These alternate strategies may not reduce overall water usage, but rather shift some of the demand from one water source (potable) to another (nonpotable). These approaches may not be appropriate in all situations and must be examined on a case-by-case basis.

- **Effluent reuse.** One way to reduce demands for potable water and thus extend the higher quality supplies is through the use of treated wastewater effluent as a replacement source in Nevada.

Current uses for reclaimed water include: urban landscaping such as golf courses, parks, road medians, cemeteries, etc.; agricultural irrigation; industrial uses such as cooling water and process water; wetlands applications; and construction water.

Effluent reuse is not only a tool for managing and reducing potable water demands, but also a tool for managing treated wastewater. Increasingly stringent wastewater discharge requirements have induced some municipalities and industries to seek alternative methods to dispose of treated wastewater effluent. Effluent reuse decreases potable water demands only if it is used as a replacement source.

Effluent reuse is increasing in Nevada. In Clark County, approximately 11,000 acre-feet of treated wastewater was reused for landscape and golf course irrigation, and power plant purposes during 1997. The Southern Nevada Water Authority has projected wastewater reuse to reach approximately 25,000 acre-feet per year by the year 2000. Approximately 4,000 acre-feet of the wastewater generated in Washoe County (about 2,000 acre-feet from Lake Tahoe basin for reuse in Douglas County, about 2,000 acre-feet from Truckee Meadows area) was reused during 1997 for landscape, golf course and agricultural irrigation, and environmental uses, such as wetlands. According to the "1995-2015 Washoe County Comprehensive Regional Water Management Plan," effluent reuse is expected to increase as treated wastewater is substituted for fresh water used for irrigation. The City of Carson City reuses all of its treated wastewater (approximately 6,000 acre-feet in 1997) for landscape and agricultural irrigation, and will continue to do so as the community population and the associated wastewater volumes increase. Also, all wastewater generated (about 4,000 acre-feet in 1997) in Nevada's portion of the Lake Tahoe basin is exported for reuse in Douglas County.

Treated wastewater is also used in other counties, primarily Elko, and Lyon. Generally, effluent reuse has served both as a replacement for potable water and as an alternative disposal method.

- **Greywater Use.** Another potential method for reducing potable water demands is to irrigate trees and shrubs with greywater - water that has already been used for bathing or clothes washing. Greywater can account for more than one-half of all residential indoor water use. However, some household water, such as wastewater from toilets, kitchen sinks, dishwashers, or laundry water from soiled diapers, is not suitable for reuse because it may contain bacterial contaminants, grease or residues of detergents that are harmful to plants. Because greywater systems require dual piping, surge tanks and distribution piping, they can be expensive to install and may be more suitable for new construction rather than retrofit situations.

  In the early 1990s, California developed standards for household use of greywater for irrigation. The standards set specifications for plumbing design and equipment to ensure that greywater is safe for intended uses. The California Urban Water Conservation Council considers greywater use to be a potential Best Management Practice (BMP), but has taken no action to elevate it to a mandatory BMP. At this time, greywater is reused to a limited extent in Nevada.

- **Dual Water Systems.** The use of dual water systems is another method for reducing potable water demands. With this strategy, lower quality water (nonpotable) is used for outdoor landscape irrigation and is delivered to users via a second pipeline system separate from the potable water distribution network.

  Approximately one-third of our treated drinking water is used for landscape irrigation. Utilizing untreated water for landscape purposes has the potential to significantly decrease potable water needs. Dual water systems allow public water systems to extend their high quality water sources and reduce water treatment costs. However the requirement for an additional distribution system can cause dual water systems to be cost prohibitive. As with some of the other demand management strategies, the use of dual water systems may be more cost effective for new construction and limited retrofit situations.

  Dual water systems are common along the Wasatch Front in Utah. Most communities in that area utilize dual systems to pipe untreated water for landscape water purposes.

Supply Development Strategies

Supply development strategies include alternative methods for increasing supplies and improving supply reliability, such as use of uncommitted supplies, acquisition and transfer of existing water rights, improved management of both groundwater and surface water supplies, utilization of lower quality (saline) water, and increasing natural supplies. The strategies presented in the following discussion may not be appropriate in all situations and must be examined on a case-by-case basis.

Use of Existing Committed and Uncommitted Supplies. With this strategy, water suppliers further utilize supplies under their existing water rights and/or obtain new appropriations for previously unallocated water. In general, future new allocations will be limited to groundwater as most of the surface water resources have been fully appropriated. For some areas of Nevada, this strategy may be an expensive proposition as most of the unappropriated groundwater resources exist in areas distant from the growing metropolitan areas.

Water Transfers. One tool for increasing available supplies to meet future demands is water transfers. Under this option, water rights are purchased or leased from one user for use by another. As most groundwater and surface water sources are fully appropriated, opportunities for new appropriations are typically limited to basins distant from the growing metropolitan areas. In some cases, water transfers from existing uses may be more cost effective than developing distant sources.

Additional information on transfers is provided in the "Interbasin Transfer" discussion in Part 3 of the *State Water Plan*.

Groundwater Recharge and Recovery. Artificially recharging aquifers is a water resource management option available to some areas as a means of securing more reliable water supplies during periods of low surface water flows. This strategy involves recharging groundwater aquifers with available surface water for later use. In effect, it makes use of an underground reservoir to store water in much the same way that surface water reservoirs are used. The stored water is then removed when needed to augment other supplies. It must be noted that groundwater recharge/recovery is only feasible in certain areas as dictated in part by aquifer conditions.

Underground water storage has a number of advantages over surface reservoirs. In general, surface reservoirs may have higher construction costs and more difficult environmental permitting requirements, and higher water losses (due to evaporation). Nevada state water law provides criteria for the establishment of groundwater recharge/recovery programs.

Additional information on groundwater recharge and recovery is provided in the "Integrated Groundwater and Surface Water Management" discussion in Part 3 of the *State Water Plan*.

Conjunctive use. Conjunctive use is the coordinated management of both surface water and ground water supplies. Under an active form of conjunctive use, surface water is used when available, excess surface water (if available) is stored in groundwater aquifers, and groundwater and stored surface water is then pumped to meet demands over and above those met with the surface water supplies. (Note: With the groundwater recharge/recovery strategy, only the stored surface water is removed to augment existing surface water supplies.) A passive form of conjunctive use is to simply rely on surface water in wet years and use groundwater in dry years with no institutional groundwater recharge program. Benefits of conjunctive use include improved management of resources, more reliable supplies, emergency and drought relief capacity, and summer peaking options.

Additional information on conjunctive use is provided in the "Integrated Groundwater and Surface Water Management" discussion in Part 3 of the *State Water Plan*.

Desalination. Desalination is a process that removes dissolved minerals (including but not limited to salt) from seawater, saline water, or treated wastewater. A number of technologies have been developed for desalination, examples being reverse osmosis (RO) and distillation. Of the more than 7,500 desalination plants in operation worldwide, 60 percent are located in the Middle East. In contrast, 12 percent of the world's desalination capacity is in the Americas, with most of the plants located in the Caribbean and Florida. According to the California Water Plan, California has more than 150 desalting plants (combined capacity of 66,000 acre-feet per year) providing freshwater for municipal, industrial, power, and other uses. In California, the main applications, in order of treatment capacities, are groundwater recovery, wastewater desalination and seawater desalting.

The desalination of saline waters is proven technology but has little application in Nevada. While Nevada does have areas of high salinity groundwater, the cost of developing other freshwater supply options has been more cost effective. Desalination may become more cost effective in the future as available freshwater sources become fully utilized and/or more expensive to develop. As long as cheaper freshwater sources are available, future use of desalination plants in Nevada will be limited.

Desalination for Southern Nevada has been suggested in the form of an exchange with California, i.e. Las Vegas would pay for desalination facilities in California in exchange for the use by Southern Nevada of a portion of California's Colorado River apportionment. However, high desalting costs continue to keep this option as a lower priority.

Cloud Seeding. Cloud seeding is a weather modification technique involving the injection of a substance into a cloud for the purpose of increasing precipitation amounts, thereby increasing snowpack amounts and associated streamflows. In northern Nevada where the primary water source is snowmelt from the Sierra Nevada and other mountain ranges, the appropriate cloud seeding option is one which augments the winter snowpack over these mountain ranges.

Operational cloud seeding over mountain ranges in the western United States has been conducted for over 40 years. Currently, most of the watersheds on the western slopes of the Sierra Nevada have wintertime cloud seeding projects associated with them, with sponsorship primarily by farming organizations and power companies. The value of water to these groups has made cloud seeding a viable alternative for additional water for many years. Cloud seeding first began in Nevada in the Lake Tahoe basin in the 1960s. Currently, cloud seeding activities exist in the drainage basins of Lake Tahoe, Truckee River, Carson River, Walker River, upper Humboldt River, South Fork of the Owyhee River, and Reese River. The Desert Research Institute has designed and operated the Nevada state cloud seeding program since its inception. Estimates of augmented water from seeding have varied from 35,000 to 60,000 acre-feet over each of the last ten years.

Meeting Future Municipal and Industrial (M&I) Water Needs

As already discussed, statewide M&I water use could increase from 525,000 to 1,034,000 acre-feet per year by the year 2020 if current water use patterns continue. Approximately 91 percent of this increase can be attributable to anticipated growth in Clark and Washoe counties. According to planning documents for Clark and Washoe counties, the increase in their M&I demands will be met primarily with expanded utilization of surface water supplies. Projections show that a number of other counties are also expected to experience significant M&I water use growth from 1995 to 2020: Nye (113 percent), Lyon (105 percent), Churchill (89 percent), Pershing (76 percent), Douglas (74 percent), Elko (64 percent), Storey (57 percent), Carson City (56 percent), and Humboldt (55 percent).

Many of these counties have developed or are actively developing plans to deal with these increasing water needs. The most common solutions being considered in these plans are: conservation; expanded use of current supplies; acquisition and transfer of existing rights; reclaimed water use; groundwater recharge/recovery; and conjunctive use. Following is a discussion of some regional water planning efforts that have been undertaken around the State. This is not intended to be an exhaustive presentation of all water supply planning activities in Nevada, but rather an overview of some of the major M&I supply challenges facing different regions and associated potential solutions. Each region has its own unique set of challenges and solutions must be evaluated on a case-by-case basis.

Southern Nevada Water Authority

The Southern Nevada Water Authority (SNWA) was created in 1991 through a cooperative agreement among the seven regional water and wastewater agencies in Clark County. SNWA membership includes:

- Big Bend Water District (Laughlin)
- City of Boulder City
- Clark County Sanitation District
- City of Henderson
- City of Las Vegas
- Las Vegas Valley Water District
- City of North Las Vegas

It should be noted that water use by entities within the Authority accounts for a majority of the Municipal & Industrial (M&I) use in Clark County. The purposes of SNWA are to seek new water resources for Southern Nevada, to manage existing and future water resources, to construct and manage regional water facilities, and to promote responsible conservation. In 1994, the Authority began an integrated resource planning process to aid in the selection of appropriate combinations of resources, facilities and conservation programs to meet future water demands in Southern Nevada. The SNWA Water Resource Plan was completed January 1996 and amended February 1997.

Water Use Forecasts. M&I water withdrawals in Clark County have been forecasted by the Division of Water Planning to increase from about 380,000 acre-feet in 1995 to 784,000 acre-feet in 2020 (Table 4-1). This value corresponds favorably with SNWA's Year 2020 forecasts ("With Existing Conservation" Scenario) for Authority water purveyors. Conservation measures are being successfully implemented by SNWA purveyors. For example, Las Vegas Valley Water District has reduced their total M&I usage from 358 gallons per capita per day (gpcd) in 1989 to 320 gpcd in 1997, a decline of about 11 percent. Domestic usage decreased from 213 gpcd to 197 gpcd during that same period.

The achievement of additional conservation is an integral part of SNWA's Water Resource Plan and needed to meet demands to the Year 2025. Based upon planned additional conservation in the future, SNWA estimated M&I water withdrawals to be approximately 642,000 acre-feet in the Year 2020 and 714,700 acre-feet in 2030 (Table 4-1). The SNWA Water Resource Plan presents options for meeting these demands.

Table 4-1. Comparison of M&I Water Withdrawal Projections for Southern Nevada

Agency	Scenario	Applicable Region	1995 (acre-feet)	2020 (acre-feet)	2030 (acre-feet)
USGS	Estimated historic use	Clark County	380,000	not applicable	not applicable
NDWP	Based upon 1995 water use and conservation patterns	Clark County	See USGS data	784,000	not applicable
SNWA (per SNWA Water Resource Plan)	Based upon existing conservation measures	SNWA water purveyors (Note: Includes about 96% of Clark County's M&I usage; includes both potable and nonpotable water usage)	364,400	777,500	865,400
	With planned additional conservation greater than 1995 patterns			642,000	714,700

Data Sources: U.S. Geological Survey, SNWA Water Resource Plan (1997), Nev. Division of Water Planning

Supply Options. According to the SNWA Water Resource Plan, water demands can be met from now until approximately 2007 by fully utilizing the Authority's existing long-term water supplies, unused Nevada (non-SNWA) Colorado River water, the Las Vegas Valley aquifer, and continuing conservation efforts. The existing long-term water supplies include:

- reclaimed water;
- current groundwater rights;
- pre-1992 Colorado River water rights;
- Colorado River water acquired from Southern California Edison and Basic Management Inc.; and
- SNWA's 1992 contract with the Secretary of the Interior for additional Colorado River water.

To meet increased water demands from 2007 until 2025, the Authority intends to utilize Colorado River surpluses (if available), the Southern Nevada Groundwater Bank, the Arizona Banking Demonstration Project, and the future Arizona groundwater bank (if necessary). The Authority also intends to exercise the 1992 contractual rights it has with the Secretary of the Interior (right similar to those relied upon by California). These rights provide for an annual distribution by the Secretary of the Interior of unused apportionments and surplus flows within the lower Colorado River. Banked water, unused apportionments and surplus flows are all critical resources for the Authority. Since unused apportionments and surplus flows are uncertain, however, the Authority will continue to aggressively pursue other future resources.

Under the Southern Nevada Groundwater Bank, the Las Vegas Valley Water District is recharging available Colorado River water into the regional groundwater system for later use. Under the Arizona Banking Demonstration Project, the Authority paid the Central Arizona Water Conservation District to store a portion of Arizona's Colorado River apportionment in Arizona aquifers for use by Nevada. Under certain conditions, Nevada will be able to divert additional Colorado River water in exchange for the water stored in the Arizona aquifers.

To meet water demands beyond 2025, future resource possibilities for SNWA include: utilization of surface water from the Virgin and/or Muddy rivers, Colorado River water banked in the Southern Nevada Groundwater Bank or the Arizona Groundwater Bank, managed surpluses of Colorado River water, Colorado River transfers and marketing, or construction of the Cooperative Water Project to import groundwater from sixteen hydrologic basins in southern and eastern Nevada via a pipeline network.

Washoe County

In 1995, the Nevada State Legislature approved legislation which created the Washoe County Regional Water Planning Commission and provided the basis and direction for the Commission and the 1995-2015 Washoe County Comprehensive Regional Water Management Plan. This legislation required that the Commission develop "...a comprehensive plan for the region covering the supply of municipal and industrial [public supply] water, quality of water, sanitary sewerage, treatment of sewerage, drainage of storm waters and control of floods." The plan was completed and approved by the 1997 State Legislature. All areas of Washoe County are included in the plan except for the Tahoe Basin, the Pyramid Lake Paiute Reservation, and generally the area north of Pyramid Lake. Water use by the public water systems within the Washoe County Plan area accounts for a majority of the potable water use in Washoe County.

Water Use Forecasts. The Washoe County Plan includes potable water withdrawal projections up to the year 2015 and discusses options for meeting these future needs. Because of uncertainty in future water use patterns, the Washoe County Plan provides a range of potential water use figures.

The Division of Water Planning projected Washoe County public supply withdrawals at 115,800 acre-feet per year for the year 2015 and 123,000 acre-feet for 2020 (Table 4-2). These forecasts were developed using factors representative of 1995 water use patterns and conservation efforts. NDWP's 2015 forecast of 115,800 acre-feet per year is just slightly higher than Washoe County's forecast of 111,500 (with 1996 typical conservation). One reason for the difference is that the NDWP projections include Lake Tahoe, Pyramid Lake Paiute Reservation, and northern Washoe County public supply water usage.

At the direction of the Washoe County Regional Water Planning Commission, the Washoe County Plan identifies the scenario "with Negotiated Settlement" (94,000 acre-feet in the year 2015) as the most probable potable water demand projection. The Washoe County Plan also provides non-potable water demand forecasts. According to the Plan, "[T]he outlook [for non-potable water usage] is for a broad decline in freshwater use to irrigate large public areas (e.g. parks, golf courses) and remaining agricultural lands."

Table 4-2. Comparison of M&I Water Withdrawal Projections for Washoe County

Agency	Scenario	Applicable Region	1995 (acre-feet)	2015 (acre-feet)	2020 (acre-feet)
USGS	Estimated historic use	Washoe County	79,400	not applicable	not applicable
NDWP	Based upon 1995 water use and conservation patterns	Washoe County	See USGS data	115,800	123,000
Washoe County (per Washoe County Water Plan)	With 1996 typical conservation	Washoe County excluding Lake Tahoe basin, Pyramid Lake Paiute Reservation, and northern regions (Note: includes about 95% of Washoe County's M&I usage)	83,300[1]	111,500[1]	not available
	With Negotiated Settlement conservation and metering			94,000[1]	
	With aggressive conservation			86,600[1]	

[1]Values include water withdrawals for domestic wells, however the Washoe County Plan does not provide a detailed breakdown to represent estimated domestic well usage. According to NDWP estimates, 1995 domestic water use was approximately 5,000 acre-feet.

Data Sources: U.S. Geological Survey, 1995-2015 Washoe County Comprehensive Regional Water Management Plan (1997), Nev. Division of Water Planning

Supply Options. Current primary water sources for public supply systems within the Washoe County Plan study area include Truckee River water (about 75 percent) and/or groundwater (about 25 percent). Both of these sources are utilized to meet potable water needs in the Central Truckee Meadows and some outlying areas. For most of the basins outside the Central Truckee Meadows, groundwater is the primary water resource. Conjunctive use of Truckee River water and groundwater is implemented to optimize the yield of the region's water resources, thus reducing the risk that some outlying basins in Washoe County will experience groundwater overdrafts in the near future. Of the current potable water withdrawal of approximately 83,000 acre-feet/year, about 60,000 to 70,000 acre-feet is diverted from the Truckee River with the remainder withdrawn from groundwater sources. The primary water purveyor in Washoe County is Sierra Pacific Power Company (SPPCo) which has produced it own plan entitled "1995-2015 Water Resource Plan." Since issuance of its plan, SPPCo has entered into a service territory agreement with Washoe County making its Truckee River water supplies available regionwide through wholesale agreements. The Washoe County Regional Water Plan recommends that the SPPCo plan serve as the basis for water resource planning in the Central Truckee Meadows and adjoining systems which are interconnected to SPPCo.

The Washoe County Water Plan is based upon the assumption that the Negotiated Settlement (Public Law 101-618) will be fully implemented. The Negotiated Settlement not only provides sufficient water resources for the next 50 years or more, it also secures the community's existing Truckee River supply. The Settlement quiets bi-state claims to Truckee River water, resolves many years of litigation, provides environmental and Tribal benefits, and more than triples available drought storage. Upon full implementation, the Negotiated Settlement will provide a water supply from the Truckee River of 119,000 acre-feet/year (current usage is 60,000 to 70,000 acre-feet/year), sufficient to meet regional water needs well past the Year 2020. Incremental yield of the Negotiated Settlement has been estimated at 39,000 acre-feet per year which reflects the conversion of 42,900 acre-feet of

Truckee River irrigation rights to municipal uses.

Since the Negotiated Settlement is not yet in effect, SPPCo has studied and evaluated alternate resource options. In the event the Settlement is not completed, subsequent Washoe County Plan revisions will need to include alternate water supplies, including regional conjunctive use of resources, artificial recharge and contract(s) for storage in Federal reservoirs.

The Washoe County Water Plan also identifies water supply alternatives for meeting future M&I needs in the valleys north of the Central Truckee Meadows area. These options include: delivery of Truckee River water, and importation of surface water and groundwater from neighboring hydrographic basins.

Douglas County

In 1994, the "Carson Valley Comprehensive Water Plan" was prepared to provide a comprehensive review of municipal water resource supply and provisions of water service to the various communities within the Carson Valley. The plan elements and recommendations were updated and included in the Douglas County Master Plan adopted in 1996. This element of the Water Plan addresses the water needs of those public supply systems in the Carson Valley and Topaz Lake regions of the county. There are a number of public supply systems in the Lake Tahoe basin portion of Douglas County which are not included in the master plan element. Subsequent to the adoption of the 1996 Master Plan, Douglas County has developed updated water use projections for Carson Valley (Douglas County only).

Water Use Forecasts. NDWP has forecasted Douglas County M&I water withdrawals at approximately 18,000 acre-feet for the year 2015 and 19,200 acre-feet for 2020 (Table 4-3). Utilizing higher population estimates, the County has projected annual M&I use (excluding Lake Tahoe basin and the Topaz Lake area) at about 19,500 acre-feet by 2017.

Supply Options. The water element of the Douglas County Master Plan recommends that the future M&I demands (Year 2015) be met by consolidating some of the water systems and further utilizing existing M&I water rights. There are approximately 14 public water supply systems in the Carson Valley and Topaz Lake regions of Douglas County. When considered as a whole, these public supply systems possess sufficient cumulative M&I groundwater rights to meet future M&I water system demands beyond the year 2015. However some of the public supply systems have excess rights, while others have insufficient rights to meet these future demands. The Douglas Master Plan water and wastewater element recommends the physical interconnection of a number of these systems to benefit the systems with inadequate water rights and to improve overall water supply reliability.

Table 4-3. Comparison of M&I Water Withdrawal Projections for Douglas County

Agency	Scenario	Applicable Region	1995 (acre-feet)	2015 (acre-feet)	2020 (acre-feet)
USGS	Estimated historic use	Douglas County	11,100	not applicable	not applicable
NDWP	Based upon 1995 water use and conservation patterns	Douglas County	See USGS data	18,000	19,200
Douglas County Master Plan	With 1996 typical conservation	Douglas County - excluding Lake Tahoe basin and Topaz Lake area (Note: includes about 75% of Douglas County's M&I usage)	9,531 (1996)	19,500 (2017)	not applicable
	With 10% conservation			17,531 (2017)	

Data Sources: U.S. Geological Survey, Douglas County Master Plan (1996), correspondence from Douglas County, Nev. Division of Water Planning

Summary

The previous discussion presented a brief summary of current M&I water supply planning efforts undertaken by SNWA, Washoe County, and Douglas County. Each planning effort has identified strategies that may be useful for other planning efforts.

Upon reviewing these regional plans, a number of observations can be made and some lessons can be learned:

- Water purveyors are utilizing demand management as a means for delaying or reducing the need for additional supplies. Conservation has become commonplace and additional conservation measures are planned for the future. For example, the achievement of additional conservation is an integral part of Southern Nevada Water Authority's water supply plan for the future.

- Effluent reuse has increased in recent years and these plans indicate that this trend will continue during the planning horizon.

- In general, these plans call for a variety of strategies and sources for meeting future demands. By not putting all their eggs in one basket, water purveyors will be able to provide reliable and safe drinking water supplies.

- Conjunctive use and recharge/recovery program are recognized as useful tools for managing both groundwater and surface water sources. The implementation of conjunctive use and recharge/recovery programs will expand in the future.

- Municipal and Industrial water supply planning is being done on a regional basis. All persons within a region can benefit when planning includes all users and interest groups, and considers both water quantity and quality within a region.

- Creative water supply solutions are being developed. With our limited water resources and growing demands, it has become necessary to look for creative solutions, such as SNWA's Arizona Banking Demonstration Project.

- The positive value of regional, consolidated M&I water systems is being acknowledged. Improved water management and "economies of scale" can be realized through water system consolidation.

- Currently, there is little reliance upon greywater and dual water systems, and desalination treatment due to the higher costs of these options. These plans suggest that this trend will probably continue.

One or all of the options presented in the SNWA, Washoe County and Douglas County plans may have possible application for M&I water systems throughout Nevada. Other water purveyors and planners stand to gain valuable insight into their own water supply problems and solutions by studying other water plans.

Meeting Future Agricultural Water Needs

According to U.S. Geological Survey estimates, annual irrigation withdrawals have varied from 3.1 to 3.4 million acre-feet over the last 25 years. Irrigation withdrawals in 1995 were estimated at about 3.1 million acre-feet, with about 63 percent diverted from surface water sources. Historically, irrigated acreage and associated water usage has varied greatly from year to year in response to our fluctuating precipitation and surface water supplies. With highly variable streamflows in Nevada, those agricultural operations utilizing surface water are faced with unreliable supplies during low flow periods. As a result, many of these irrigators have developed groundwater supplies to supplement surface water sources. However, pumping groundwater is generally expensive and may not be cost effective in some cases.

Based upon past use trends, NDWP projects that statewide agricultural water withdrawals could experience a 7 percent decline through 2020. In part, encroaching urbanization and the transfer of agricultural water rights to other uses such as municipal and natural resource needs will drive future agricultural water use reductions.

While the projections in the water plan suggest that the agricultural water supply will be generally adequate to meet future usage, that should not preclude water managers, planners and users from evaluating other water supply and management issues and options such as:

- methods to improve water supply reliability for agricultural users dependent upon fluctuating surface water sources, including storage:
- implementation of water conservation methods;
- increased utilization of treated wastewater effluent; and
- development of available groundwater resources.

Meeting Future Mining Water Needs

Mining water withdrawals are anticipated to remain relatively constant at about 275,000 afy with a slight increase up to the year 2010 followed by a slight decline. Beginning in the early 1990s, a majority of the mining withdrawals have been associated with mine dewatering. These withdrawals have been significantly higher than the mines' consumptive use needs, thereby requiring the mining operations to develop alternative disposal methods for the excess water. A majority of this "excess" water has been either discharged to surface water systems, reinjected into aquifers or used by other sectors such as irrigation. It is anticipated that this trend will continue with pit dewatering activities generating water volumes in excess of mine processing and consumptive needs.

The forecasted future mining withdrawals are estimates only and are highly dependent upon the price of gold. Actual water use may also be affected by shifts from open pit mining to underground mining. However, some degree of mine dewatering is expected to continue regardless of the type of production activity.

Meeting Future Domestic Water Needs

Statewide domestic water withdrawals are forecasted to increase from about 361,000 afy to about 701,000 afy by 2020 in response to a growing population. Public supply systems are the primary providers of water for domestic uses. As of 1995, the domestic water needs for about 94.2 percent of Nevada's population were met by public water systems. This percentage is projected to increase to 95.4 percent by 2020. Nevertheless, the number of persons on domestic wells is still expected to increase from 92,000 to 140,000 over the next 20 years.

Meeting Future Commercial, Industrial and Thermoelectric Water Needs

In 1995, commercial, industrial and thermoelectric sectors withdrew about 238,000 af of water accounting for about 6 percent of total statewide withdrawals. Public supply systems met a majority (about 85 percent) of the total commercial needs in Nevada. In the industrial and thermoelectric sectors, self-supplied systems provided most (95 percent) of the water needs (Table 4-3).

Table 4-3. 1995 Commercial, Industrial and Thermoelectric Water Use

Sector	Self-Supplied Withdrawals (acre-feet per year)	Public Supplied Deliveries (acre-feet per year)	Total Water Use (acre-feet per year)
Commercial	23,500 [15% of total commercial]	129,700 [85% of total commercial]	153,200
Industrial	16,800 [87% of total industrial]	2,500 [13% of total industrial]	19,300
Thermoelectric	63,800 [98% of total thermoelectric]	1,600 [2% of total thermoelectric]	65,400
Total	104,100 [44% ot total commercial, industrial, thermoelectric]	133,800 [56% of total commercial, industrial, thermoelectric]	237,900

Source: U.S. Geological Survey

By the year 2020, commercial, industrial and thermoelectric withdrawals are projected to increase to about 416,000 afy. It is anticipated that public supply systems will continue to satisfy a majority of future commercial water needs, while self-supplied systems will be utilized to meet most future industrial and thermoelectric demands.

Meeting Future Wildlife and Environmental Water Needs

Interest in obtaining the necessary water supplies to meet wildlife and environmental water needs is increasing. However, quantifying these water needs is a challenge. In the broadest sense, all water (with the possible exception of deep groundwater) may provide benefits to wildlife and the environment. For example, all surface water whether in rivers, ponds, lakes or reservoirs supports a variety of flora and fauna, while also supporting other needs such as public system and irrigation uses. Additionally, shallow groundwater supports riparian vegetation and phreatophytes which provide habitat. Also, habitat may be created as a result of other activities such as irrigation. Wildlife and environmental water needs become difficult to quantify when examined in this broad manner.

The securing of water supplies for wildlife and environmental purposes is still a relatively new resource management concept. In recent years, governmental agencies and conservation organizations in Nevada have used a variety of mechanisms to obtain water for fishes, wildlife, special status species, wetlands and water quality improvement. Water has been obtained by purchasing and transferring water rights to a designated water body or portion thereof, filing for new appropriative water rights and entering into formal and informal agreements for reuse of water from agricultural irrigation systems, wastewater treatment plants, mine dewatering operations and an electric generating station. The water obtained for wildlife and environmental needs is generally used to augment stream flow, reservoir and lake levels, spring pools, wetlands and riparian areas.

Water rights have been acquired for the Lower Truckee River, Meadow Valley Wash (Condor Canyon), Upper Blue Lake (Humboldt County), Bruneau River, Carson Lake and Pasture and for a number of other aquatic and wetland resources on various federal wildlife refuges and state wildlife management areas. Many water acquisition projects have been cooperative interagency actions to meet requirements of state and federal legislation, such as the Truckee-Carson-Pyramid Lake Water Rights Settlement Act (Public Law 101-618) Endangered Species Act, Section 404 of the Clean Water Act (wetland protections), the Migratory Bird Treaty Act and the National Environmental Policy Act.

Currently, efforts to assess and provide water supply needs are commonly retrospective, having been concentrated where ecosystem components already are deteriorating. Providing for future wildlife and environmental water supplies requires implementation of an ongoing, structured assessment process to determine where additional water supplies for wildlife and environmental needs are not being met as evidenced by deterioration in essential resource conditions. Laws and regulations have been instituted which require assessment and management actions to minimize the risk that municipal and industrial water supplies will not meet demand. A similar policy approach is needed for wildlife and environmental resources.

Meeting Future Recreation Water Needs

The popularity of water based outdoor recreation continues to grow. The number of people fishing, wildlife watching, boating, and swimming in Nevada's waters has never be higher, significantly adding to the state and local economies. In fact, tourism officials now commonly advertise the other side of Nevada, its expansive landscape and comparatively unique and rare water resources in the desert. Government agencies responsible for maintaining recreation resource values have acquired water for recreation purposes, primarily at reservoirs in the state. However, as recent experience has shown parks managers and visitors, droughts can dramatically impact water supplies at reservoirs, resulting in significant loss of available recreation resource area. Sometimes the seniority of acquired water rights does not ensure water availability during drier seasons.

As with wildlife and environmental water needs, quantification of recreational water needs may be difficult. In some instances, water for recreation is provided as the result of other water use activities. For example, reservoirs created for irrigation or municipal water supplies also provide recreation opportunities as a secondary or additional benefit. Anticipating future water needs for recreation will require implementation of a comprehensive and integrated assessment process. In fact, recreation resource needs are often intertwined with those of wildlife and the environment. Therefore, it would be practical to combine recreation and natural resource water needs assessments.

Index - Part 2, Section 4 - Meeting Future Water Needs

Nevada State Water Plan
PART 2 —WATER USE AND FORECASTS

Section 5
Technical Supplement
Water Use Coefficient and Related Forecast Factor Development and Application

Introduction

This technical supplement to the water withdrawal (use) forecasts presented in Section 3, Part 2 of the *Nevada State Water Plan* provides more detailed information as to the methodology behind the forecasts. Specifically, this section provides (1) a description of the water withdrawal categories analyzed and forecasted in this water plan and (2) the process by which specific water use coefficients and related forecast factors were estimated and the methodology used in the forecast development process. Graphs are also provided which present county-specific water use coefficients and other, related forecasts factors. The water use coefficients or factors, presented in gallons per person per day for municipal and industrial (M&I) water use and domestic water use, gallons per worker per day for commercial and industrial water use, or acre-feet per acre per year for irrigation water use, allow for the direct incorporation of socioeconomic forecasts (population, employment, irrigated acreage) into the water planning and forecasting process. This methodology provides the means by which forecasts of water withdrawals for certain economic sectors can be determined directly from changes in related socioeconomic factors.

Water Withdrawal (Use) Forecast Categories (Sectors)

The following water withdrawal categories were analyzed and forecast in this plan.

Total Water Withdrawals — Includes water withdrawals from both public and self-supplied sources for the categories of domestic, commercial and industrial, thermoelectric, public use and losses, mining and agricultural water uses.

Domestic (Residential) Water Withdrawals — Water withdrawn normally for residential purposes, including household use, personal hygiene, drinking, washing clothes and dishes, flushing toilets, watering of domestic animals, and outside uses such as car washing, swimming pools, and for lawns, gardens, trees and shrubs. The water may be obtained from a public supply water system or may be may be self supplied. The State Water Plan presents forecasts for total domestic, public supply domestic and self-supplied domestic water withdrawals.

Commercial and Industrial Water Withdrawals — Water withdrawals for motels, hotels, restaurants, office buildings, and other commercial facilities and institutions, both civilian and military. The water may be obtained from a public supply or may be self supplied. As used in this plan, commercial and industrial water withdrawal forecasts include all water withdrawals by businesses and industry, excluding thermoelectric and mining.

Public Use and Losses — Water supplied from a public water supply system (PWSS) and used for such purposes as fire fighting, street washing, and municipal parks, golf courses, and swimming pools. Also includes system water losses (water lost to leakage). Also referred to as public water use or utility water use.

Thermoelectric Water Withdrawals — Water withdrawals used for thermoelectric power generation and for cooling purposes in electric power plants. The water may be obtained from a public water supply system or may be self supplied. Only total thermoelectric water withdrawals are forecast within this water plan.

Mining Water Withdrawals — Consists of water withdrawals for mining processing functions (presumed to be consumptive uses) and for mine dewatering purposes (assumed to be a non-consumptive use). In actuality, all processing uses are not necessarily consumptive in nature and, similarly, all mine dewatering is not necessarily non-consumptive. For purposes of this water plan, forecasts are presented for total mining water withdrawals as well as those withdrawals for mine processing use and mine dewatering.

Total Agricultural Water Withdrawals — All water withdrawals for agricultural purposes consisting of water withdrawals for both irrigation applications (crops and irrigated pasture lands) and livestock watering purposes. Forecasts are presented for total agricultural water withdrawals and its component parts of irrigation water withdrawals and livestock (to include fishery, i.e., hatchery) water withdrawals.

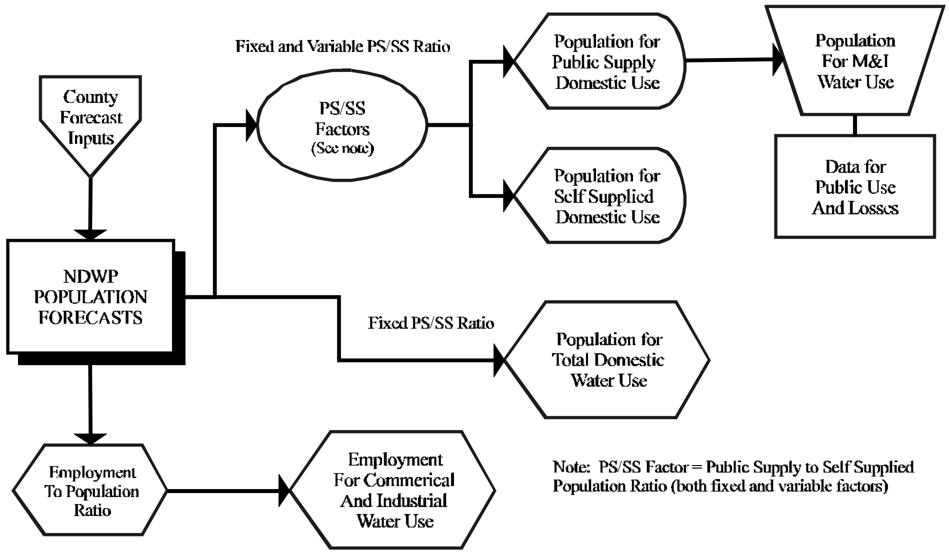
Municipal and Industrial (M&I) Water Withdrawals — All water withdrawals supplied by public supply water systems. For the purposes of this planning and forecasting effort, these withdrawals are assumed to consist of water withdrawals for domestic (residential), commercial, industrial and thermoelectric purposes. Unlike the water "use" categories listed above which comprise total water withdrawals, M&I water withdrawals are not so much a water use as it is a measure of the withdrawals from a water "source".

Water Use Coefficient Development and Application in the Water Withdrawal Forecasts

The presentation on water use coefficients (or water use factors) and related factor terms and their application to forecasting water withdrawals for the State of Nevada and its counties is presented in the following sections. These sections pertain specifically to the development of specific and county-unique water use coefficients and their use in forecasting municipal and industrial (M&I) water withdrawals, domestic (residential) water withdrawals (both public supply and self supplied withdrawals), commercial and industrial water withdrawals and total agricultural water withdrawals (consisting of both irrigation and livestock water withdrawals). [*Note:* The terms "water withdrawal" and "water use" are used interchangeably in this presentation. While assumed to have the same in meaning, the term water withdrawal is a more descriptive term as it is intended to represent the total water withdrawn for a specific use category and makes no inference as to degree of consumptive use and return flows from that particular use.]

Flow Chart 1. Population Forecasts and Water Withdrawals shows the basic relationship between the county population forecasts and various water withdrawals by sector. Water withdrawals may be considered as by the source of water, i.e., M&I water from public supply water systems, or by use, i.e., domestic, commercial, industrial, thermoelectric, etc. Population forecasts constitute a crucial part of the forecasts for municipal and industrial (M&I) water withdrawals, public use and losses (from M&I water withdrawals), domestic water withdrawals (both public supply and self supplied), and commercial and industrial water withdrawals (from employment which was based on employment-to-population ratios). The remaining flow charts in this technical supplement reflect the method by which water withdrawal forecasts were determined and are described in greater detail by the equations which follow.

Flow Chart 1. Population and Water Withdrawal Forecasts



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Municipal and Industrial (M&I) Water Withdrawals

The technique to develop M&I water withdrawals is presented in Flow Chart 2. Municipal & Industrial (M&I) Water Withdrawals and the equations which follow. The forecasts for (M&I) Public Use and Losses were based on a county-specific fixed relationship (factor) between the M&I water withdrawal forecast and historical use patterns and then aggregated for the total state. These factors averaged between 9 and 10 percent on a statewide based and are presented for each county in Appendix 3 of the Appendices.

This section on M&I water withdrawals is presented in two parts. Part (A) describes the development of M&I water withdrawals forecasts based on a fixed proportion of the total resident population remaining on public supply water systems whereas Part (B) incorporates a specific variation in this proportion which is unique to each county and uses, as a starting value, the proportion figures for each county for the year 1995. The basic assumption under Part (B) was that there will exist a change in the proportion of the population on public supply water systems, which tends to agree with historical experience. The specific M&I water withdrawal forecasts incorporated in the water plan use the assumption of a variable proportion of the population on public supply water systems.

<u>M&I Fixed Water Withdrawals.</u> (Assumption: A fixed proportion of the population remains on public supply water systems resulting in the use of a fixed total M&I water use coefficient). This population assumption is shown in Equation [1]:

$$[\text{Population on Public Supply Water Systems}]_{\text{Fixed Proportion}}$$
$$= [\text{Total Resident Population Forecast}] \times [\text{Constant PS/SS Percentage Factor}] \qquad [1]$$

The term [Total Resident Population Forecast] in Equation [1] represent the county population forecasts based on NDWP's population growth assumptions (see Appendix 2 of the Appendices for each county's forecasts and aggregated forecasts for the total state). Also in Equation [1], the term

$$[\text{Constant PS/SS Percentage Factor}] \qquad [2]$$

represents a constant proportion (PS/SS = public supply population to self supplied population) of the resident population for 1995 assumed to remain on public supply water systems (and therefore a constant proportion continues to be self supplied). These county-unique fixed proportions are presented in the summary table of water use coefficients and related forecasting factors in Appendix 3 of the Appendices. From this information, total M&I water withdrawals, measured in acre-feet per year and based on a fixed proportion of the population on public supply water systems was determined from

$$[\text{Total M\&I Water Withdrawals}]_{\text{Fixed}} = [\text{Population on Public Supply}]_{\text{Fixed Proportion}} \times [\text{M\&I Water Use Factor}]_{\text{Fixed}} \qquad [3]$$

where the M&I water use coefficient (factor) was determined from 1995 historical data by

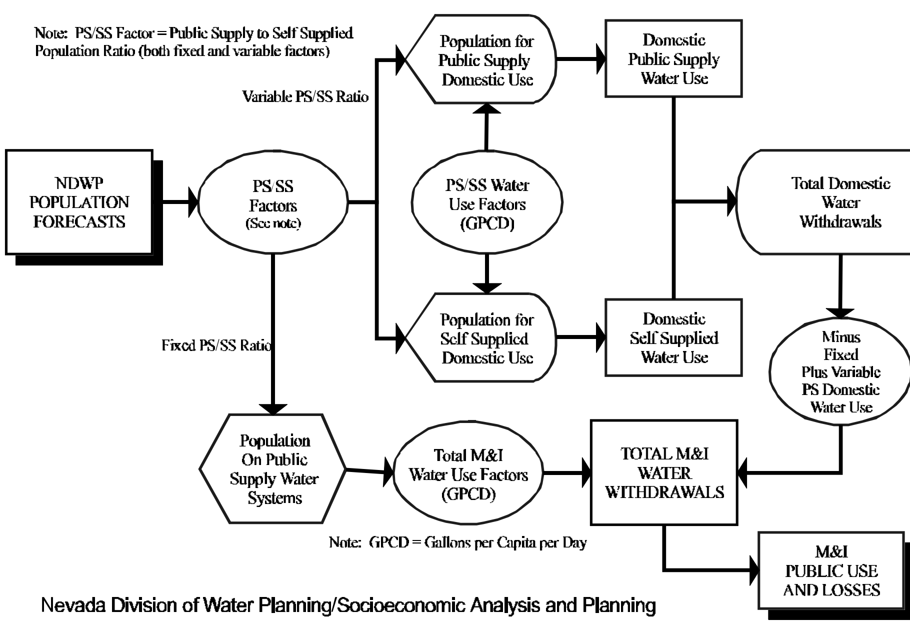
$$[\text{M\&I Water Use Factor}]_{\text{Fixed}} = [\text{M\&I Water Use}]_{1995} / [\text{Population on Public Supply}]_{1995} \qquad [4]$$

and is measured in gallons per capita (per person) per day (GPCD).

M&I Variable Water Withdrawals. (Assumption: A variable proportion of the population was on public supply water systems resulting in a variable total M&I water use coefficient; variation in total M&I water use coefficient was based on the difference in total domestic water use based on a varying percent of the population on public supply water systems and the differences in the water use coefficients for domestic public supply usage and domestic self supplied usage). Conceptually, total M&I water withdrawals based on the assumption of a varying proportion of the population on public supply water systems could be calculated using a relationship similar to that presented in Equation [3] above, or,

$$[\text{Total M\&I Water Withdrawals}]_{\text{Variable}} = [\text{Population on Public Supply}]_{\text{Variable Proportion}} \times [\text{M\&I Water Use Factor}]_{\text{Variable}} \qquad [5]$$

Flow Chart 2. Municipal & Industrial (M&I) Water Withdrawals



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where the population on public supply water systems in Equation [5] was determined from Equation [6] presented below:

$$[\text{Population on Public Supply}]_{\text{Variable Proportion}} = [\text{Total Resident Population Forecast}] \times [\text{Variable PS/SS Percentage Factor}] \quad [6]$$

In Equation [6], the term [Variable PS/SS Percentage Factor] represents a variable proportional term unique for each county based on the historical (1995) proportion of the population on public supply water systems and forecasts of changes in this proportion through the year 2020. This information for each county is presented in Appendix 3 of the Appendices. However, the water use coefficient term, [M&I Water Use Factor]$_{\text{Variable}}$, presented in Equation [5] is unknown in this situation as it will vary by population proportions (public and self supplied) and specific water use coefficients for these types of uses. Furthermore, it cannot be readily calculated and will therefore have to be calculated indirectly.

The change in total M&I water withdrawals based on the forecast assumption of a varying proportion of the population on public supply water systems, however, can be determined from the change in total domestic water withdrawals based on changes in the proportion of the population on public supply water systems. Therefore, the following equation will be used in lieu of Equation [5] to calculate the total M&I water withdrawals based on variations in the population on public supply water systems:

$$[\text{Total M\&I Water Withdrawals}]_{\text{Variable}} = [\text{Total M\&I Water Withdrawals}]_{\text{Fixed}} - [\text{Public Supply Domestic Water Withdrawals}]_{\text{Fixed}} + [\text{Public Supply Domestic Water Withdrawals}]_{\text{Variable}} \quad [7]$$

In Equation [7] the term [Total M&I Water Withdrawals]$_{\text{Fixed}}$ was calcuated in Equation [3], above, and both the terms [Public Supply Domestic Water Withdrawals]$_{\text{Fixed}}$ and [Public Supply Domestic Water Withdrawals]$_{\text{Variable}}$ can be determined directly from population forecasts, estimated proportions of the population on public supply water systems, and appropriate domestic public and self supplied water use coefficients. These calculations and equations are presented in the next section on forecasting domestic water withdrawals.

The term [Public Supply Domestic Water Withdrawals]$_{\text{Variable}}$ in Equation [7], unlike the term [Public Supply Domestic Water Withdrawals]$_{\text{Fixed}}$, will therefore incorporate the effects of a varying proportion of the population on public supply water systems. Inherent in this methodology is that the water use factors for other components of M&I water use, i.e., commercial and industrial, will not change over time. From Equation [7], the variable M&I water use coefficient term, [M&I Water Use Factor]$_{\text{Variable}}$, measured in gallons per capita (person) per day (GPCD), can then be determined from Equation [8]:

$$[\text{M\&I Water Use Factor}]_{\text{Variable}} = [\text{Total M\&I Water Withdrawals}]_{\text{Variable}} / [\text{Population on Public Supply}]_{\text{Variable Proportion}} \quad [8]$$

As the calculation of this M&I water use coefficient (factor) in Equation [8] is made "after the fact," that is, after the (variable population) total M&I water withdrawals have already been calculated, the coefficient itself serves no useful function in the forecast development and only shows the resultant variation in the M&I water use coefficient based on the assumption of a varying proportion of the population being served by public supply water systems. Also, since the coefficient incorporates specific assumptions about population forecasts and forecasts of the proportion of that population on public supply water systems, its usefulness in future forecasts and planning is restricted to retaining these exact assumptions.

The final water use forecast described in this section deals with public use and losses. As shown in Flow Chart 2, forecasts of this type of water withdrawal are based directly on the level of M&I water withdrawals. The relationship between each county's historical public use and losses and its total M&I water withdrawals resulted in a county-specific public use and loss factor as presented in Appendix 3 of the Appendices. These factors were then used to forecast public use and losses as follows:

$$\text{[Public Use and Losses]} = \text{[Total M\&I Water Withdrawals]}_{\text{Variable}} \times \text{[Public Use and Losses Factor]}_{\text{Fixed}} \qquad [9]$$

from which the fixed term [Public Use and Losses Factor]$_{\text{Fixed}}$ in Equation [9] is based on historical 1995 data as calculated from

$$\text{Public Use and Losses Factor]}_{\text{Fixed}} = \text{[Public Use and Losses]}_{1995} / \text{[Total M\&I Water Withdrawals]}_{1995} \qquad [10]$$

No changes in these factor terms for all counties were made over the forecast horizon.

Total Domestic (Residential), Public Supply Domestic, and Self-Supplied Domestic Water Withdrawals

The technique to develop the domestic water withdrawal forecasts are presented in Flow Chart 3. Total Domestic (Residential) Water Withdrawals. This flow chart, and the equations below, describe the method used to develop water use forecasts on both a fixed and variable basis, that is, (1) the assumption that a fixed proportion of the population remains on public supply systems (Part A) and (2) that this proportion varies over the forecast horizon (Part B). This distinction becomes important as it is the variable Total Domestic Water Withdrawal forecasts that are incorporated in this plan and are also used for the development of the Total M&I Water Withdrawal forecasts presented in the previous section.

Total Domestic, Public Supply and Self-Supplied Fixed Water Withdrawals. (Assumption: A fixed proportion of the resident population remains on public supply water systems resulting in a fixed total domestic water use coefficient). Total domestic water withdrawals, in acre-feet per year, can be calculated from the relationship in Equation [11]:

$$\text{[Total Domestic Water Withdrawals]}_{\text{Fixed}} = \text{[Total Resident Population Forecast]} \times \text{[Total Domestic Water Use Factor]}_{\text{Fixed}} \qquad [11]$$

where the water use factor, in gallons per capita (person) per day (GPCD), was determined from historical information on water withdrawals and populations such that

$$\text{[Total Domestic Water Use Factor]}_{\text{Fixed}}$$

$$= [\text{Total Domestic Water Use}]_{1995} \; / \; [\text{Total Resident Population}]_{1995} \qquad [12]$$

Similarly, for the domestic public supply water withdrawals, in acre-feet per year, we can use

$$[\text{Domestic Public Supply Water Withdrawals}]_{\text{Fixed}}$$
$$= [\text{Resident Population}]_{\text{Public Supply–Fixed}} \times [\text{Domestic Public Supply Use Factor}]_{\text{Fixed}} \qquad [13]$$

where the domestic public supply water use factor, measured in gallons per capita (person) per day (GPCD), was calculated using historical relationships such that

$$[\text{Domestic Public Supply Water Use Factor}]_{\text{Fixed}}$$
$$= [\text{Domestic Public Supply Water Use}]_{1995} \; / \; [\text{Population on Public Supply}]_{1995} \qquad [14]$$

Likewise, for the domestic self-supplied water withdrawals, also measured in acre-feet per year, we can use

$$[\text{Domestic Self-Supplied Water Withdrawals}]_{\text{Fixed}}$$
$$= [\text{Resident Population}]_{\text{Self Supplied–Fixed}} \times [\text{Domestic Self-Supplied Use Factor}]_{\text{Fixed}} \qquad [15]$$

where the domestic self-supplied water use factor, measured in gallons per capita (person) per day (GPCD), was calculated using historical data such that

$$[\text{Domestic Self-Supplied Water Use Factor}]_{\text{Fixed}}$$
$$= [\text{Domestic Self-Supplied Water Use}]_{1995} \; / \; [\text{Population being Self Supplied}]_{1995} \qquad [16]$$

Total Domestic, Public Supply and Self-Supplied Variable Water Withdrawals. (Assumption: A variable proportion of the population is on public supply water systems resulting in a variable total domestic water use coefficient; variation in the total domestic water use coefficient is based on the differences in the domestic public supply usage rate and the domestic self supplied usage rate). Here, the total domestic water withdrawals cannot be calculated directly due to the variations that will occur in the total domestic water use factor from the changing proportion of the population on public supply water systems. Therefore, total domestic water withdrawals are calculated from its separate components, as shown in Equation [17] below:

$$[\text{Total Domestic Water Withdrawals}]_{\text{Variable}} = [\text{Domestic Public Supply Water Withdrawals}]_{\text{Variable}}$$
$$+ [\text{Domestic Self-Supplied Water Withdrawals}]_{\text{Variable}} \qquad [17]$$

where domestic public supply water withdrawals, measured in acre-feet per year and assuming a variable proportion of population on public supply water systems, can be calculated from Equation [18] below:

$$[\text{Domestic Public Supply Water Withdrawals}]_{\text{Variable}}$$
$$= [\text{Population on Public Supply}]_{\text{Variable Proportion}} \times [\text{Domestic Public Supply Use Factor}]_{\text{Fixed}} \qquad [18]$$

Similarly, the domestic self supplied water withdrawals in acre-feet per year can be calculated from

$$[\text{Domestic Self-Supplied Water Withdrawals}]_{\text{Variable}}$$

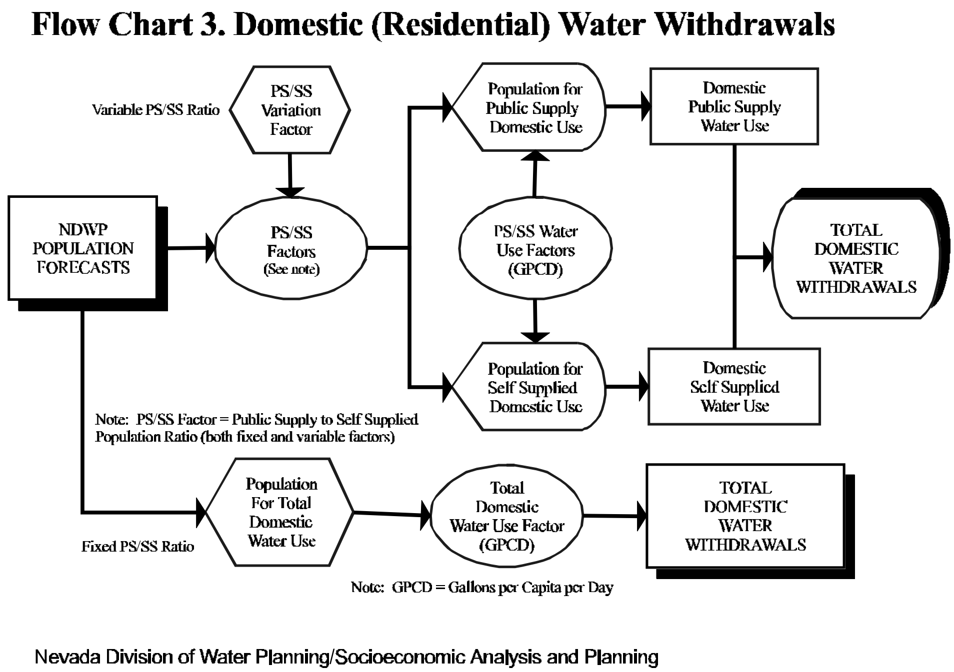
$$= [\text{Population being Self Supplied}]_{\text{Variable Proportion}} \times [\text{Domestic Self-Supplied Use Factor}]_{\text{Fixed}} \quad [19]$$

In order to determine the proportion of the resident population being self supplied, we can use the relationship shown in Equation [6] for the determination of the variations in the population on public supply water systems (and therefore the population being self supplied). Based on this relationship, we have the relationship shown in Equation [20]:

$$[\text{Population on Public Supply}]_{\text{Variable Proportion}} = [\text{Total Resident Population Forecast}] \times [\text{Variable PS/SS Percentage Factor}] \quad [20]$$

with the requirement that

$$[\text{Total Resident Population Forecast}] = [\text{Population on Public Supply}]_{\text{Variable Proportion}} + [\text{Population being Self Supplied}]_{\text{Variable Proportion}} \quad [21]$$



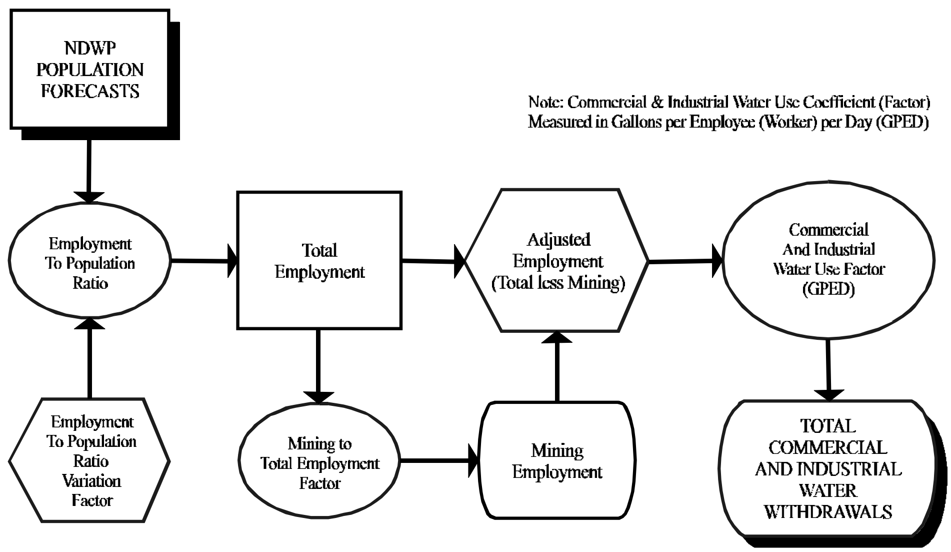
Calculations of total domestic, public supply domestic and self supplied domestic water withdrawal forecasts, along with all assumptions, water use factors and population proportions on public supply water systems, are presented in Appendix 3 of the Appendices for all counties and aggregated for the total state.

Commercial and Industrial Water Withdrawals

The water withdrawal forecasts for commercial and industrial water use are presented in Flow Chart 4. Commercial and Industrial Water Withdrawals and presented in more detail in the equations below. Flow Chart 4 shows that this forecast methodology incorporates three forecast factors. First, total employment was estimated for each county based on a unique forecast of that county's employment-to-population ratio. This ratio was based on the county's 1997 figure and assumed to vary over the forecast horizon. The ratio variation rate constituted the second forecast factor. The third forecast factor was the county-specific commercial and industrial water use coefficient, in gallons per employee (per worker) per day (GPED), and was based on each individual county's commercial structure and historical water use patterns. This coefficient was kept constant over the forecast horizon as its value was based more on the nature of production and the state of technology.

Total commercial and industrial water withdrawals were therefore forecast using forecasts of a socioeconomic measure (i.e., employment) and a water use factor. The water use factor, in gallons per employee per day, represented an average water usage rate for all employment classifications. While it is known that various industry sectors use water at different rates (i.e., at varying gallons per employee per day, or GPED's) based on unique processing and business conditions, so long as the overall composition of employment and production does not show significant changes over the forecast horizon, this fixed commercial water use coefficient represents a reasonable assumption of average water use rate for all industry sectors.

Flow Chart 4. Commercial & Industrial Water Withdrawals



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One important alteration in this methodology was the exclusion of mining employment from the total employment figures and from the determination of the commercial and industrial water use coefficient calculation. This was necessary as mining water withdrawals were determined from direct forecasts of mining output. Using this methodology, total commercial and industrial water withdrawals, measured in acre-feet per year, were calculated from Equation [22]:

$$[\text{Commercial \& Industrial Water Withdrawals}] = [\text{Total Employment}]_{\text{Adjusted}} \times [\text{Commercial \& Industrial Use Factor}]_{\text{Fixed}} \quad [22]$$

where the adjusted total employment term in Equation [22] was derived from

$$[\text{Total Employment}]_{\text{Adjusted}} = [\text{Total Employment}] - [\text{Mining Employment}] \quad [23]$$

Equation [23] reflects the removal of the forecasted mining employment from the forecasts of each county's total employment. These forecasts of total employment and mining employment are presented In Appendix 3 of the Appendices for each county and the total state, with the statewide total being an aggregation of the individual counties. The commercial and industrial water use coefficient, measured in gallons per worker per day, was calculated from historical data on water use and employment using the following equation:

$$[\text{Commercial \& Industrial Use Factor}]_{\text{Fixed}}$$

$$= [\text{Commercial \& Industrial Water Use}]_{1995} \,/\, [\text{Total Employment} - \text{Mining Employment}]_{1995} \qquad [24]$$

As can be seen from Equation [24], above, the development of the commercial and industrial water use factor also incorporated the removal of mining employment. Total employment for each county was determined uniquely from historical relationships between the total employment and the total resident population and presented in the form of a county-unique employment-to-population ratio.

Historical employment-to-population ratios for 1997 for Nevada and all counties are presented in Fig. 5–9. Employment to Population Ratios. These ratio, which varied uniquely for each county over the forecast horizon, were then used to forecast each county's total employment (and the total state from an aggregation of the county forecasts) as shown in the following equation:

$$[\text{Total Employment}] = [\text{Total Resident Population Forecast}] \times [\text{Employment-to-Population Ratio}]_{\text{Variable}} \qquad [25]$$

where forecasts of the term $[\text{Employment-to-Population Ratio}]_{\text{Variable}}$ in Equation [25] were estimated uniquely for each county based on forecasts of future industrial development and related employment trends versus population forecasts. Each county's mining employment (aggregated to a statewide total) was also determined uniquely based on current mining conditions and trends and forecasts of future mining activity. These forecasts of mining employment are presented in detail for each county in Appendix 3 of the Appendices and were based on the following calculation:

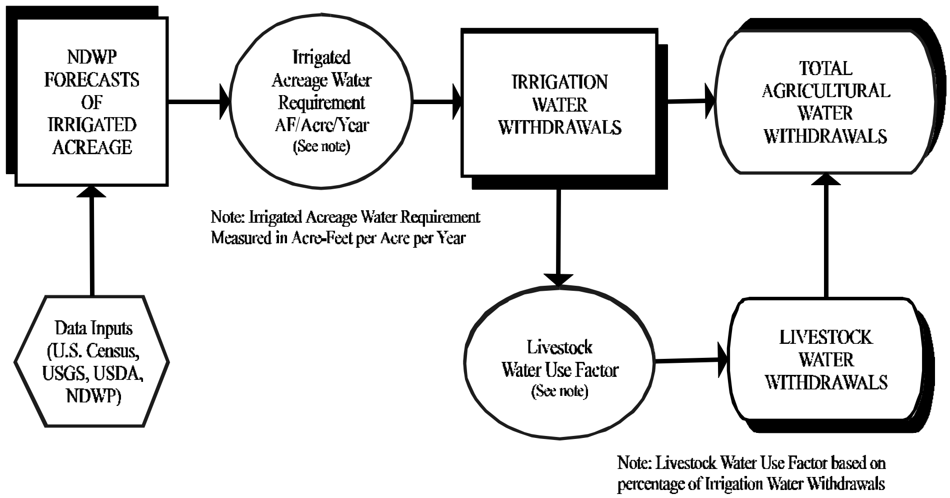
$$[\text{Mining Employment}] = [\text{Total Employment}] \times [\text{Mining Employment Factor}]_{\text{Variable}} \qquad [26]$$

where $[\text{Mining Employment Factor}]_{\text{Variable}}$ represented the assumption of a variable percent of mining employment to total county employment.

Agricultural Water Withdrawals

The methodology for total agricultural, irrigation and livestock water withdrawals is presented in Flow Chart 5. Total Agricultural, Irrigation and Livestock Water Withdrawals and is presented greater detail in the equations below. Agricultural water withdrawals were driven from forecasts of (1) irrigated acreage, (2) county-unique irrigated acreage water use requirements, and (3) county-specific relationships of irrigation water withdrawals and livestock water withdrawals. This assumption of a consistent link (i.e., fixed factor) between livestock water needs and irrigation water withdrawals represented a simplifying assumption and precluded the need to make county-specific livestock forecasts independently of forecasts of irrigated acreage and pasture lands, which itself may be subject to errors and inconsistencies. All historical trends, irrigation and livestock forecast assumptions, and forecasts for both irrigation and livestock water withdrawals are presented in Appendix 4 of the Appendices for each county and aggregated for the statewide total.

Flow Chart 5. Total Agriculture, Irrigation and Livestock Water Withdrawals



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The basic calculation for forecasting each county's total agricultural water withdrawals, measured in acre-feet per year, was based on the relationship shown in Equation [27]:

[Total Agricultural Water Withdrawals]
= [Irrigation Water Withdrawals] + [Livestock Water Withdrawals] [27]

where forecasted irrigation water withdrawals in Equation [27] are based on forecasts of total irrigated acreage (including irrigated pasture lands) times a fixed irrigated acreage water use requirement, measured in acre-feet per acre per year, such that

[Irrigation Water Withdrawals]
= [Irrigated Acreage] x [Irrigated Acreage Water Use Requirement]$_{\text{Fixed}}$ [28]

Livestock water withdrawals in Equation [27] are based on the level of irrigation water withdrawals times a "livestock water use factor" which is based on historical conditions, or

$$[\text{Livestock Water Withdrawals}] = [\text{Irrigation Water Use}] \times [\text{Livestock Water Use Factor}]_{\text{Fixed}} \qquad [29]$$

Forecasts of each county's irrigated acreage were based on historical trends and a "best fit" non-linear line (curve fit) of these trends extrapolated out to the year 2020. Graphs and tables of historical data and forecasts for each county's irrigated acreage are presented in detail in Appendix 4 of the Appendices. The irrigated acreage water use requirement coefficient term was determined from historical water use patterns by the equation

$$[\text{Irrigated Acreage Water Use Requirement}]_{\text{Fixed}} = [\text{Irrigation Water Withdrawals}]_{1995} / [\text{Total Irrigated Acreage}]_{1995} \qquad [30]$$

The livestock water withdrawals were assumed to be based on the level of irrigation water withdrawals and a fixed factor term, $[\text{Livestock Water Use Factor}]_{\text{Fixed}}$, in Equation [29] representing the historical relationships between livestock water withdrawals and irrigation water withdrawals, such that

$$[\text{Livestock Water Use Factor}]_{\text{Fixed}} = [\text{Livestock Water Withdrawals}]_{1995} / [\text{Irrigation Water Withdrawals}]_{1995} \qquad [31]$$

Both the irrigated acreage water use requirement (as shown in Fig. 5-11. Irrigated Acreage Water Requirement) and the livestock use coefficient (as shown in Fig. 5-12. Livestock to Irrigation Water Withdrawals), while unique to each county, are assumed to be fixed over the forecast horizon. State of Nevada totals for both irrigation water withdrawals and livestock water withdrawals were based on the aggregation of individual county forecasts of these measures.

Graphs: Water Use Coefficients and Related Forecast Factors

The graphs on the following pages present the county-specific water use coefficients and related forecasts factors used in the forecast model equations just described.

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Nevada State Water Plan
PART 2 — WATER USE AND FORECASTS

Section 6
Glossary of Terminology

[Source: Nevada Division of Water Planning's *Water Words Dictionary*. Words presented in italics and the referenced appendices may be found in the Dictionary. Words and definitions included in this glossary which explain or summarize elements of existing water law are not intended to change that law in any way.]

Acre-Feet (AF) — A unit commonly used for measuring the volume of water. See *Acre-Foot*.

Acre-Foot (AF) — A unit commonly used for measuring the volume of water; equal to the quantity of water required to cover one acre (43,560 square feet or 4,047 square meters) to a depth of 1 foot (0.30 meter) and equal to 43,560 cubic feet (1,234 cubic meters), or 325,851 gallons.

Agricultural Use — The use of any tract of land for the production of animal or vegetable life; uses include, but are not limited to, the pasturing, grazing, and watering of livestock and the cropping, cultivation, and harvesting of plants.

Agricultural Water Use (Withdrawals) — Includes water used for irrigation and non-irrigation purposes. Irrigation water use includes the artificial application of water on lands to promote the growth of crops and pasture, or to maintain vegetative growth in recreational lands, parks, and golf courses. Non-irrigation water use includes water used for livestock, which includes water for stock watering, feedlots, and dairy operations, and fish farming and other farm needs.

Average Water Year — A term denoting the average annual hydrologic conditions based upon an extended or existing period of record. Because precipitation, runoff, and other hydrologic variables vary from year to year, planners typically project future scenarios based on hydrologic conditions that generally include average, wet (high-water), and drought (low-water) years.

Basin — (1) (Hydrology) A geographic area drained by a single major stream; consists of a drainage system comprised of streams and often natural or man-made lakes. Also referred to as *Drainage Basin*, *Watershed*, or *Hydrographic Region*. (2) (Irrigation) A level plot or field, surrounded by dikes, which may be flood irrigated. (3) (Erosion Control) A catchment constructed to contain and slow runoff to permit the settling and collection of soil materials transported by overland and rill runoff flows. (4) A naturally or artificially enclosed harbor for small craft, such as a yacht basin.

Blackwater — Water that contains animal, human, or food wastes; wastewater from toilet, latrine, and agua privy flushing and sinks used for food preparation or disposal of chemical or chemical-biological ingredients. Compare to *Greywater*.

CFS (Cubic Foot per Second) — A unit of discharge for measurement of flowing liquid equal to a flow of one cubic foot per second past a given section. A rate of flow equivalent to 448.83 gallons per minute. Also called *Second-Foot*.

CFS-Day — The volume of water represented by a flow of 1 cubic foot per second for 24 hours. It equals 86,400 cubic feet, 1.983471 acre-feet, or 646,317 gallons.

Cloud Seeding — A *Weather Modification* technique involving the injection of a substance into a cloud for the purpose of influencing the cloud's subsequent development. Ordinarily, this refers to the injection of a nucleating agent, which creates a nucleus around which precipitation will form. In common practice, cloud seeding involves the aerial release of silver iodide particles into convective clouds to create thunderstorms.

Commercial Water Use (Withdrawals) — Water for motels, hotels, restaurants, office buildings, and other commercial facilities and institutions, both civilian and military. The water may be obtained from a public supply or may be self supplied. The terms “water use” and “water withdrawals” are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also see *Industrial Water Use (Withdrawals)*, *Public Water Supply System* and *Self-Supplied Water*.

Community Water System — A public water system with 15 or more connections and serving 25 or more year-round residents and thus is subject to the *U.S. Environmental Protection Agency (EPA)* regulations enforcing the *Safe Drinking Water Act (SDWA)*.

Conjunctive Management — The integrated management and use of two or more water resources, such as a (groundwater) aquifer and a surface water body.

Conjunctive (Water) Use — (1) The combined use of surface and groundwater systems and sources to optimize resource use and prevent or minimize adverse effects of using a single source; the joining together of two sources of water, such as groundwater and surface water, to serve a particular use. (2) The integrated use and management of hydrologically connected groundwater and surface water.

Conservation — (1) Increasing the efficiency of energy use, water use, production, or distribution. (2) The careful and organized management and use of natural resource, for example, the controlled use and systematic protection of natural resources, such as forests, soil, and water systems in accordance with principles that assure their optimum long-term economic and social benefits. Also, preservation of such resources from loss, damage, or neglect.

Consumption, Domestic — The quantity or quantity per capita (person) of water consumed in a municipality or district for domestic uses during a given period, usually one day. Domestic consumption is generally considered to include all uses included in “municipal use of water,” in addition to the quantity of water wasted, lost, or otherwise unaccounted for. Also see *Consumption, Municipal*; *Municipal Use of Water*.

Consumption, Industrial — The quantity of water consumed in a municipality or district for mechanical, trade, and manufacturing uses during a given period, usually one day.

Consumption, Municipal — The quantity of water consumed through use in developed urban areas. Also see *Consumption, Domestic*; *Consumptive Use*.

Consumptive (Water) Use — (1) A use which lessens the amount of water available for another use (e.g., water that is used for development and growth of plant tissue or consumed by humans or animals). (2) A use of water that renders it no longer available because it has been evaporated, transpired by plants, incorporated into products or corps, consumed by people or livestock, or otherwise removed from water supplies. (3) The portion of water withdrawn from a surface or groundwater source that is consumed for a particular use (e.g., irrigation, domestic needs, and industry), and does not return to its original source or another body of water. No typical use is 100 percent efficient; there is always some return flow associated with a use either in the form of a return to surface flows or as a ground water recharge. Nor are typically nonconsumptive uses of water entirely nonconsumptive. There are evaporation losses, for instance, associated with maintaining a reservoir at a specified elevation to support fish, recreation, or hydropower, and there are conveyance losses associated with maintaining a minimum streamflow in a river, diversion canal, or irrigation ditch.

Consumptive Water Use, Irrigation — The quantity of water that is absorbed by the crop and transpired or used directly in the building of plant tissue, together with that evaporated from the cropped area. Does not include runoff or deep percolation in support of the *Crop Leaching Requirement*.

Crop Irrigation Requirement — The amount of irrigation water in acre-feet per acre required by the crop; it is the difference between *Crop Consumptive Use*, or *Crop Requirement*, and the effective precipitation for plant growth. To this amount the following items, as applicable, are added: (1) irrigation applied prior to crop growth; (2) water required for leaching; (3) miscellaneous requirements of germination, frost protection, plant cooling, etc.; and (4) the decrease in soil moisture should be subtracted.

Cropland — Land currently tilled, including cropland harvested, land on which crops have failed, summer fallowed land, idle cropland, cropland planted in cover crops or soil improvement crops not harvested or pastured, rotation pasture, and cropland being prepared for crops, or newly seeded cropland. Cropland also includes land planted in vegetables and fruits, including those grown on farms for home use. All cultivated (tame) hay is included as cropland. Wild hay is excluded from cropland and included in pasture and range.

Cross-Sectional Analysis — (Statistics) Observations or characteristics of a variable analyzed without respect to variations due to time. Cross-sectional econometric models provide information on the behavior of a variable due to external factors. Contrast with *Time-Series Analysis*.

Cubic Feet Per Second (CFS) — A unit expressing rate of discharge, typically used in measuring streamflow. One cubic foot per second is equal to the discharge of a stream having a cross section of 1 square foot and flowing at an average velocity of 1 foot per second. It also equals a rate of approximately 7.48 gallons per second, 448.83 gallons per minute. 1.9835 acre-feet per day, or 723.97 acre-feet per year.

Cubic Feet Per Second Day (CFS-Day) — The volume of water represented by a flow of one cubic foot per second for 24 hours. It equals 86,400 cubic feet, 1.983471 acre-feet, or 646,317 gallons.

Demand Management Alternatives — Water management programs that reduce the demand for water, such as water conservation, drought rationing, rate incentive programs, public awareness and education, drought landscaping, etc.

Dependable Supply — That water which can be expected to be available at a time and place with the quality demanded; sometimes the amount of water available is at a stated percentage of time.

Dependable Yield — The maximum annual supply of a given water development that is expected to be available on demand, with the understanding that lower yields will occur in accordance with a predetermined schedule or probability. More frequently referred to as *Firm Yield*.

Desalination, or Desalinization — (1) To remove salts and other chemicals, as from sea water or soil, for example. Usually used with respect to the salt contained in water. (2) Specific treatment processes to demineralize sea water or brackish (saline) water for reuse. Also referred to as *Desalting*.

Designated Groundwater Basin — A basin where permitted ground water rights approach or exceed the estimated average annual recharge and the water resources are being depleted or require additional administration. Under such conditions, a state's water officials will so designate a groundwater basin and, in the interest of public welfare, declare *Preferred Uses* (e.g., municipal and industrial, domestic, agriculture, etc.). Also referred to as *Administered Groundwater Basin*.

Designated Groundwater Basin [Nevada] — In the interest of public welfare, the Nevada State Engineer, *Division of Water Resources*, *Department of Conservation and Natural Resources*, is authorized by statute (Nevada Revised Statute 534.120) and directed to designate a ground water basin and declare *Preferred Uses* within such designated basin. The State Engineer has additional authority in the administration of the water resources within a designated ground water basin.

Dewater, and Dewatering — (1) To remove water from a waste produce or streambed, for example. (2) The extraction of a portion of the water present in sludge or slurry, producing a dewatered product which is easier to handle. (3) (Mining) The removal of ground water in conjunction with mining operations, particularly open-pit mining when the excavation has penetrated below the ground-water table. Such operations may include extensive ground-water removal and, if extensive enough and if not re-injected into the groundwater, these discharges may alter surface water (stream) flows and lead to the creation of lakes and wetland areas. As such water removals only last so long as the mine is in operation, eventually surface water impacts, if present, will be eliminated, consequently jeopardizing surface water uses, such as irrigation, livestock, wildlife, or riparian habitat that may have become dependent upon the continuation of these temporary flows. Also, when the mine dewatering operations cease, the remaining open pit will eventually begin to fill up with ground water, resulting in significantly increased evaporation from ground water reservoirs.

Domestic Water — Water supplied to individual dwellings and other land uses which is suitable for drinking.

Domestic Water Use (Withdrawals) — Water used normally for residential purposes, including household use, personal hygiene, drinking, washing clothes and dishes, flushing toilets, watering of domestic animals, and outside uses such as car washing, swimming pools, and for lawns, gardens, trees and shrubs. The water may be obtained from a public supply or may be self supplied. The terms "water use" and "water withdrawals" are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also referred to as *Residential Water Use*. Also see *Public Water Supply System* and *Self-Supplied Water*.

Evapotranspiration (ET) — (1) The quantity of water transpired (given off), retained in plant tissues, and evaporated from plant tissues and surrounding soil surfaces. (2) The sum of *Evaporation* and *Transpiration* from a unit land area. (3) The combined processes by which water is transferred from the earth surface to the atmosphere; evaporation of liquid or solid water plus transpiration from plants. Evapotranspiration occurs through evaporation of water from the surface, evaporation from the capillary fringe of the groundwater table, and the transpiration of groundwater by plants (*Phreatophytes*) whose roots tap the capillary fringe of the groundwater table. The sum of evaporation plus transpiration.

Forecast (Forecasting) — (Statistics) A forecast is a quantitative estimate (or set of estimates) about the likelihood of future events based on past and current information. This "past and current information" is specifically embodied in the structure of the econometric model used to generate the forecasts. By extrapolating the model out beyond the period over which it was estimated, we can use the information contained in it to make forecasts about future events. It is useful to distinguish between two types of forecasting, *ex post* and *ex ante*. In an *ex post* forecasts all values of dependent and independent variables are known with certainty and therefore provides a means of evaluating a forecasting model. Specifically, in an *ex post* forecast, a model will be estimated using observations excluding those in the *ex post* period, and then comparisons of the forecasts will be made to these actual values. An *ex ante* forecast predicts values of the dependent variable beyond the estimation period using values for the explanatory variables which may or may not be known with certainty.

Forecast Horizon — (Statistics) The number of time periods to be forecasted; also, the time period in the future to which forecasts are to be made.

Gallon [U.S.] — A unit of capacity, containing four quarts, used in the United States primarily for liquid measure. One U.S. gallon contains 231 cubic inches, 0.133 cubic feet, or 3.7853 liters. It takes approximately 325,851 gallons to make up 1 acre-foot (AF). [*Historical Note:* The U.S. gallon is the same as the old English *wine gallon* which was originally intended in England to be equivalent to a cylinder of seven inches in diameter and six inches in height.]

Gallons per Capita (GPC) — A term used relative to water use per person per specified time, usually a day.

Gallons per Capita (Person) per Day (GPCD) — An expression of the average rate of domestic and commercial water demand, usually computed for public water supply systems. Depending on the size of the system, the climate, whether the system is metered, the cost of water, and other factors, *Public Water Supply Systems (PWSS)* in the United States experience a demand rate of approximately 60 to 150 gallons per capita per day. Also see *Gallons per Employee per Day (GED)* for information on the application of this concept to commercial water use by *Standard Industrial Classification (SIC) Code*. [See Appendix C–4, Gallons Per Capita Per Day (GPCD), Water Used for Public Water Supplies by State.]

Gallons per Employee (Worker) per Day (GED, or GPED) — A measure or coefficient expressing an area's commercial water use per worker (employee), typically for distinct industry sectors. It is based on an analytical technique for measuring and forecasting commercial water use in a service area based upon the unique, seasonal, business-related water use by specific industrial sectors. GED commercial water-use coefficients are typically developed based upon Standard Industrial Classifications (SIC) codes for which comparable commercial water use and employment data are available. For forecasting more frequently than annually, GED coefficients will incorporate seasonal patterns (monthly or quarterly) as well. By deriving forecasts of trends in industry sector employment and combining them with appropriate, industry-specific GED coefficients, relatively accurate forecasts of the corresponding commercial water use may be obtained.

Gallons per Minute — A unit expressing rate of discharge, used in measuring well capacity. Typically used for rates of flow less than a few cubic feet per second (cfs).

GPCD — Gallons per capita (per person) per day — a measure of water use in municipalities. [See Appendix C–4, Gallons Per Capita Per Day (GPCD), Water Used for Public Water Supplies by State.]

GPD — Gallons per day, a measure of the rate of flow or the rate of water withdrawal from a well. Typically used when the rate of flow in cubic feet per second (cfs) is too low to be useful.

Greywater (Graywater) — Wastewater from clothes washing machines, showers, bathtubs, hand washing, lavatories and sinks that are not used for disposal of chemicals or chemical-biological ingredients.

Hydrographic Area [Nevada] — The 232 subdivisions (256 *Hydrographic Areas* and *Hydrographic Sub-Areas*) of the 14 Nevada *Hydrographic Regions* as defined by the State Engineer's Office, Department of Conservation and Natural Resources, Division of Water Resources. Primarily these are sub-drainage systems within the 14 major drainage basins. Hydrographic Areas (valleys) may be further subdivided into Hydrographic Sub-Areas based on unique hydrologic characteristics (e.g., differences in surface flows) within a given valley or area. [A listing of Nevada's Hydrographic Regions, Areas and Sub-Areas is presented in Appendix A–1 (hydrographic regions, areas and sub-areas), Appendix A–2 (listed sequentially by area number) Appendix A–3 (listed alphabetically by area name), and Appendix A–4 (listed alphabetically by principal Nevada county(ies) in which located).]

Hydrographic Region [Nevada] — Nevada has been divided into 14 hydrographic regions or basins, which are now used by the Nevada Division of Water Resources, Department of Conservation and Natural Resources, and the U.S. Geological Survey (USGS) to compile information pertaining to water resources and water use. These regions are also further subdivided into 232 *Hydrographic Areas* (256 Hydrographic Areas and Sub-Areas, combined) for more detailed study. See *Basins [Nevada]*, for a complete listing and description of Nevada's 14 Hydrographic Regions.

Impound — To accumulate and store water as in a reservoir.

Indirect Water Uses — Uses of water that are not immediately apparent to the consumer. For example, a person indirectly uses water when driving a car because water was used in the production process of steel and other automotive components.

Industrial, Self-supplied Water — Water withdrawn from privately developed sources and delivered through water systems established entirely or primarily for commercial and industrial use. Includes water used by mining, manufacturing, military establishments, educational and penal institutions, golf courses, hotels, motels, restaurants, casinos and other small businesses.

Industrial Water Use (Withdrawals) — Industrial water use includes water used for processing activities, washing, and cooling. Major water-using manufacturing industries include food processing, textile and apparel products, lumber, furniture and wood products, paper production, printing and publishing, chemicals, petroleum, rubber products, stone, clay, glass and concrete products, primary and fabricated metal industries, industrial and commercial equipment and electrical, electronic and measuring equipment and transportation equipment. The terms "water use" and "water withdrawals" are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also see *Commercial Water Use (Withdrawals)*.

Injection Well — Refers to a well constructed for the purpose of injection treated wastewater directly into the ground. Wastewater is generally forced (pumped) into the well for dispersal or storage into a designated aquifer. Injection wells are generally drilled into nonpotable aquifers, unused aquifers, or below freshwater levels.

Irrigate — (1) To supply (dry land) with water by means of ditches, pipes, or streams; to water artificially. (2) To wash out (a body cavity or wound) with water or a medicated fluid. (3) To make fertile or vital as if by watering.

Irrigation — (1) The controlled application of water for agricultural purposes through man-made systems to supply water requirements not satisfied by rainfall. (2) The application of water to soil for crop production or for turf, shrubbery, or wildlife food and habitat.

Irrigation Water Use (Withdrawals) — Artificial application of water on lands to assist in the growing of crops and pastures or to maintain vegetative growth on recreational lands, such as parks and golf courses. The terms "water use" and "water withdrawals" are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also see *Irrigation Return Flow*.

Livestock Water Use — Water use for stock watering, feed lots, dairy operations, fish farming, and other on-farm needs. Livestock as used here includes cattle, sheep, goats, hogs, and poultry. Also included are such animal specialties as horses, rabbits, bees, pets, fur-bearing animals in captivity, and fish in captivity. Also see *Rural Water Use*.

M&I (Municipal and Industrial) Water Withdrawals (Use) — Water supplied for municipal and industrial uses provided through a municipal distribution system.

Mining Water Use — Water use for the extraction of minerals occurring naturally including solids, such as coal and ores; liquids, such as crude petroleum; and gases, such as natural gas. Also includes uses associated with quarrying, well operations (*Dewatering*), milling (crushing, screening, washing, flotation, and so forth), and other preparations customarily done at the mine site or as part of a mining activity, such as dust control, maintenance, and wetland restoration. Generally, most of the water used at a mining operation is self-supplied. Also see *Self-Supplied Water*.

Model — (Statistics) A simulation, by descriptive, conceptual, statistical, or other means, of a process or thing that is difficult or impossible to observe directly, as in an *Economic Consumption Model* or a *River Flow Model*.

Modeling (Forecasting and Simulation Analysis) — The application of a mathematical process or simulation framework, for example a mathematical or *Econometric Model*, to describe various phenomenon and analyze the effects of changes in independent (i.e., explanatory) variables on dependent variables.

Municipal and Industrial (M & I) Water Withdrawals (Use) — Water supplied for municipal and industrial uses provided through a municipal distribution system for rural domestic use, stock water, steam electric powerplants, and water used in industry and commerce.

Municipal Water System — A water system which has at least five service connections or which regularly serves 25 individuals for 60 days. See *Public Water System (PWS).*

Non-Community Water System (NCWS) — A public water system that is not a community water system, e.g., the water supply at a camp site or national park.

Non-Consumptive Water Use — Non-consumptive water use includes a water use that is not consumed, for example, water withdrawn for purposes such as hydropower generation. This also includes uses such as boating or fishing where the water is still available for other uses at the same site. No typical consumptive use is 100 percent efficient; there is always some return flow associated with such use either in the form of a return to surface flows or as a ground water recharge. Nor are typically non-consumptive uses of water entirely non-consumptive. There are evaporation losses, for instance, associated with maintaining a reservoir at a specified elevation to support fish, recreation, or hydro-power, and there are conveyance losses associated with maintaining a minimum streamflow in a river, canal, or ditch.

Non-Transient Non-Community Water System — (1) A public water system that regularly serves at least 25 of the same non-resident persons per day for more than six months per year. (2) A public water system that is not a community water system and that regularly serves at least 25 of the same people over six months per year. Common types of such water systems are those serving schools, daycare centers, factories, restaurants, nursing homes, and hospitals.

Open-Pit Mining — The process of removing mineral deposits that are found close enough to the surface so that the construction of tunnels (underground mining) is not necessary. The soil and strata that cover the deposit are removed to gain access to the mineral deposit.

Population — (Statistics) The total number of potential observations in a specific category, for example, the human population of a particular city, or the number of animals of a particular species within a defined area. Typically, measurements of the behavior and characteristics of the population are not possible and therefore a *Sample* is selected which, if an *Unbiased Sample,* will, even in its limited numbers, be representative of the characteristics of the total population.

Population Density — (1) The number per unit area of individuals of any given species at a given time. (2) (Water Planning) The number of people in a given area. The number may be obtained by multiplying the number of dwelling units per unit area (e.g., square mile, square kilometer, acre, etc.) by the number of residents per dwelling unit.

Potable Water — Water that is drinkable. Specifically, freshwater that generally meets the standards in quality as established in the U.S. Environmental Protection Agency (EPA) *Drinking Water Standards* for drinking water throughout the United States. Potable water is considered safe for human consumption and is often referred to as *Drinking Water*. Freshwater that exceeds established chloride and dissolved solids limits is often referred to as slightly saline, brackish, or nonpotable water and is either diluted with fresher water or treated through a desalination process to meet potable-water standards for public supply.

Price Elasticity (of Water) — Defined as the ratio of the percent change in the quantity demanded of water (or any other economic good) and the percent change in price, or

$$n_{water} = \text{Percent Change in } Q_{water} \,/\, \text{Percent Change in } P_{water}$$

An elastic demand results when the ratio of n_{water} is greater than unity (>1), implying that a given change in price will result in a greater (percentage) change in the quantity demanded. Under such conditions of “elastic demand” for water, consumers tend to be responsive to changes in the price for water. Conversely, an inelastic demand results when the ratio of n_{water} is less than unity (<1), implying that a given change in price will result in a smaller (percentage) change in the quantity demanded. Under such conditions of “inelastic demand,” consumers are relatively unresponsive to changes in the price for water. Along any given (downward sloping) demand curve, the elasticity will vary from inelastic, to unity, to elastic as the price rises further.

Public Supply Water — (1) Water withdrawn for all users by public and private water suppliers and delivered to users that do not supply their own water. (2) Water withdrawn by and delivered to a public water system regardless of the use made of the water. Includes water supplied both by large municipal systems and by smaller quasi-municipal or privately-owned water companies. Water suppliers provide water for a variety of uses, such as *Domestic Water Use* (also referred to as *Residential Water Use*), *Commercial Water Use*, *Industrial Water Use*, *Thermoelectric Power Water Use* (domestic and cooling purposes), and *Public Water Use*.

Public Utility — A private business organization, subject to government regulation, that provides an essential commodity or service, such as water, electricity, transportation, or communications, to the public.

Public Water Use — Water supplied from a *Public Water Supply System (PWSS)* and used for such purposes as fire fighting, street washing, and municipal parks, golf courses, and swimming pools. Public water use also includes system water losses (water lost to leakage) and brine water discharged from desalination facilities. Also referred to as *Utility Water Use*.

Reclaimed Water — Waste water that becomes suitable for a specific beneficial use as a result of treatment or brackish water demineralized for use. General types of reclaimed waste water include:

[1] ***Primary Effluent*** — reclaimed water that only has had sewage solids removed and is typically used only for surface irrigation of tree, fodder, and fiber crops;

[2] ***Secondary Effluent*** — reclaimed water that has had sewage solids removed and has been oxidized and disinfected and is used to irrigate golf courses and cemeteries and provide water for pasture and food crops; and

[3] ***Tertiary Recycled Water*** — water produced by conventional sewage treatment followed by more advanced procedures including filtration and disinfection, providing it with the broadest range of uses.

Residential Water Use — Water used normally for residential purposes, including household use, personal hygiene, and drinking, watering of domestic animals, and outside uses such as car washing, swimming pools, and for lawns, gardens, trees and shrubs. The water may be obtained from a public supply or may be self supplied. Also referred to as *Domestic Water Use*. Also see *Public Water Supply System* and *Self-Supplied Water*.

Resident Population — The number of persons who live within a state or other political subdivision (county, city, etc.) who consider it their permanent place of residence. College students, military personnel, and inmates of penal institutions are counted as permanent residents. According to this definition, tourist and seasonal or part-time residents are considered nonresident population.

Return Flow — (1) The amount of water that reaches a ground or surface water source after release from the point of use and thus becomes available for further use. (2) That part of a diverted flow which is not consumptively used and returns to its original source or another body of water. (3) (Irrigation) Drainage water from irrigated farmlands that re-enters the water system to be used further downstream. Such waters may contain dissolved salts or other materials that have been leached out of the upper layers of the soil.

Reuse (of Water) — (1) Water that is discharged by one user and is used by other users. (2) Repeated use of the same water by subsequent users in sequential systems. Sometimes, it also means water discharged by one unit and used by other units in the same plant. Also referred to as *Recycled Water*.

Reuse Systems — Refers to the deliberate application of reclaimed water for a beneficial purpose. Reuse may encompass landscape irrigation (such as golf courses, cemeteries, highway medians, parks, playgrounds, school yards, nurseries, and residential properties), agricultural irrigation (such as food and fruit crops, wholesale nurseries, sod farms and pasture grass), aesthetic uses, ground-water recharge, environmental enhancement of surface water and wetland restoration, fire protection, and other useful purposes.

Reverse Osmosis — (1) (Desalination) Refers to the process of removing salts from water using a membrane. With reverse osmosis, the product water passes through a fine membrane that the salts are unable to pass through, while the salt waste (brine) is removed and disposed. This process differs from electrodialysis, where the salts are extracted from the feedwater by using a membrane with an electrical current to separate the ions. The positive ions go through one membrane, while the negative ions flow through a different membrane, leaving the end product of freshwater. (2) (Water Quality) An advanced method of water or wastewater treatment that relies on a *Semi-permeable Membrane* to separate waters from pollutants. An external force is used to reverse the normal osmotic process resulting in the solvent moving from a solution of higher concentration to one of lower concentration.

Self-Supplied Water — Water withdrawn from a surface or ground-water source directly by a user rather than being obtained from a *Public Water Supply System (PWSS)*.

Self-Supplied Water (Industrial) — Water for industrial use, supplied from sources other than municipal distribution systems.

Sigmoid Growth — (Data Analysis) A growth rate trend characterized by an elongated S–shaped, or sigmoid curve. Typical of population growth rate trends which begin rapidly at an exponential rate but slow as limiting factors are encountered until a limit is approached asymptotically.

Significant (Statistical) — A term applied to differences, correlations, cause-and-effect relationships, etc., to indicate that they are probably not due to chance alone. Significant ordinarily indicates a probability of not less than 95 percent, while highly significant indicates a probability of not less than 99 percent.

Thermoelectric Power — Electrical power generated using fossil-fuel (coal, oil, or natural gas), geothermal, or nuclear energy.

Thermoelectric (Power) Water Use — Water used in the process of the generation of *Thermoelectric Power*. The water may be obtained from a *Public Water Supply System* or may be self supplied. Also see *Self-Supplied Water*.

Time-Series Analysis — (Statistics) Techniques that attempt to predict the future by using historical data rather than by building cause-and-effect models. Typically, such techniques are most appropriate when the historical data is relatively well behaved and when forecasts, primarily, are sought and not precise cause-and-effect relationships. Contrast with *Cross-Sectional Analysis*.

Variable — (Statistics) A series of comparable observations or characteristics of a phenomenon taken as a single set of data; a listing of specific characteristics of a population or a number of observations taken over a specific period of time which may reasonably be expected to vary from observation to observation.

Water Conservation — The physical control, protection, management, and use of water resources in such a way as to obtain maximum sustained benefits while reducing water use. Water conservation results in a reduction in applied water due to more efficient water use such as through the implementation of *Best Management Practices (BMP) — Urban Water Use*, or *Efficient Water Management Practices (EWMP) — Agricultural Water Use*.

Water Demand — The water requirements for a particular purpose, such as irrigation, power production, municipal supply, plant transpiration, or storage.

Water Supply System — Includes the works and auxiliaries for collection, treatment, storage, and distribution of the water from the sources of supply to the free-flowing outlet of the ultimate consumer. Also see *Public Water System (PWS).*

Water Use — The amount of water used for a variety of purposes including drinking, irrigation, processing of goods, power generation, and other uses. The amount of water used is typically less than the amount of water withdrawn for a particular use due to water transfers, the recirculation or recycling of the same water, return flows, etc. For example, a power plant may use the same water multiple times, but withdraw a significantly different amount. Also see *Water Use, Types*, below.

Water Use, Types — The use of water may be classified by specific types according to distinctive uses, such as the following:

[1] Commercial Water Use
[2] Domestic Water Use
[3] Hydroelectric Power Water Use
[4] Irrigation Water Use
[5] Livestock Water Use
[6] Mining Water Use
[7] Navigational Water Use
[8] Other Water Use
[9] Public Water Use (same as *Utility Water Use*)
[10] Residential Water Use (same as *Domestic Water Use*)
[11] Rural Water Use
[12] Thermoelectric Power Water Use

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Section 7
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Section 8
Indexes to Part 2

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NEVADA STATE WATER PLAN

PART 3 – WATER PLANNING AND MANAGEMENT ISSUES

March 1999

Nevada Division of Water Planning
Department of Conservation and Natural Resources

A. Water Conservation

Introduction

Ensuring an adequate water supply for any use is no longer only a matter of developing new sources. Conservation has become an essential part of the water supply equation. Over the last 10 years conservation has been shown to be a cost effective way to extend a given water supply. This issue discussion describes available conservation measures, current conservation activities in Nevada and in other states, and recommendations for addressing future needs. It is not the intent of this discussion to advocate conservation purely for the sake of conservation. Conservation should be recognized as one of many water resource management tools that should be considered when it makes sense in terms of economics and overall resource management.

Background

Numerous case studies have shown that a good conservation program can reduce demand significantly. Conservation measures can be pursued by all water users regardless of the type of water system, i.e. municipal, irrigation, private home, commercial or industrial, etc. Following is a description of conservation measures available for municipal, agricultural and other water users.

Municipal Conservation

Conservation is becoming an important tool to help public water systems manage water demands and infrastructure needs, especially in fast growing areas. The main incentive for municipal systems to implement conservation measures is economics. For instance, conservation can defer the need for investment in expanded water supplies and costly infrastructure such as water treatment systems. Less water used within a municipal water system means less wastewater that must be treated at the wastewater treatment plant, potentially saving some additional treatment and infrastructure costs. On the other hand, conservation may impact treatment process due to higher waste concentrations in the wastewater, and result in less water available for reuse of reclaimed water, less return flows back into stream systems, and less recharge of shallow aquifers, thereby potentially affecting other water users. Consideration needs to be given to all of these factors when developing a conservation program.

A comprehensive municipal water conservation program typically includes features such as: water system audits and leak detection, a public information and awareness program, utilization of increasing block billing, new ordinances, installation of low flow fixtures, landscape demonstration projects, use of drought tolerant plants, implementation of a xeriscape program, and installation of meters to help establish a baseline to evaluate the water conservation program and to provide a basis for billing. Many of these features can also be part of a conservation program for a private home, or commercial or industrial water system, depending on the specifics of each system. In addition, commercial and industrial systems may take advantage of other measures aimed at improving water use efficiency as related to heating, cooling, sanitary, kitchen and processing needs.

Agricultural Conservation

Agricultural support agencies such as the U.S. Natural Resources Conservation Service can frequently assist irrigators in analyzing their water management program and selecting the best management practices to implement. The Natural Resources Conservation Service offers financial, technical, and educational assistance to implement conservation practices. Using this help, farmers and ranchers can apply practices that reduce soil erosion, improve water quality, and enhance wetlands, grazing lands and wildlife habitat. Agricultural conservation measures typically include: laser leveling of fields, lining of ditches, use of soil moisture monitoring devices, conversion from flood to overhead or drip irrigation methods, selection of low water use crops, reusing water on-site and an analysis of water management practices on site.

Conservation can provide a number of financial benefits. With conservation, water users can stretch available supplies during drier periods; reduce groundwater pumping and power costs; and under a "credit for conservation" program, conservation can allow for the expansion of irrigated land, leasing or sale of saved water to another user or for instream flow purposes.

Conservation for Other Water Uses

Opportunities for water conservation in industrial and commercial facilities include capturing steam condensate in boilers and HVAC (heating, ventilating and air conditioning) systems for reuse, eliminating single-pass cooling in cooling tower operations, using closed-loop systems for water-cooled equipment, and installing low-flow plumbing fixtures.

Conservation in Nevada

At this time, the State has no comprehensive program for promoting and encouraging conservation, or for assisting water use entities in developing water conservation strategies. However, in recent years the State has instituted some statutes and regulations encouraging conservation. Following is a discussion of existing conservation efforts within Nevada and some of the challenges being faced.

Water Law and Conservation

State water law is based on the principle of beneficial use. A water user must show that the permitted water is being beneficially used in order to perfect the right through the issuance of a water right certificate. Water rights can be lost through forfeiture or abandonment[1]. Certificated groundwater rights come under Nevada's forfeiture statute. In most instances, the groundwater must be used at least once in every consecutive five year period in order to preserve the water right. If not, it may be lost through statutory forfeiture. Pre-statutory (pre-1913) rights to surface water are exempt from forfeiture, but may be subject to abandonment if clear and convincing evidence showing intent to abandon is presented. By statute any water right lost through forfeiture or abandonment returns to the public waters of the state and may be subject to re-appropriation by others. The water law regarding abandonment and forfeiture is subject to change due to evolving case law.

Cities, towns and municipalities are generally granted latitude in the speed with which they must show beneficial use. Municipalities and water companies are allowed to hold water rights in the permit stage for future growth, but eventually must put the water to beneficial use in order to perfect the right.

The beneficial use rule ("use it or lose it") as it applies to perfected (certificated) water rights does not encourage conservation. Water users do not have an incentive to reduce water use as they must show continuous beneficial use in order to preserve their right to use the water in the future. However, other aspects of the water law support conservation (See discussion on "Credit for Conservation"). Also, a number of sections in NRS 533 and 534 do prohibit the wasting of water.

Credit for Conservation

Water users have expressed a desire to obtain credit for water they save through conservation. With this credit, the water user could be allowed to use the saved water on additional lands or for additional homes, lease or sell the saved water, or dedicate the saved water to instream flows. The State Engineer has explained that this option is already available under existing water law. In fact, the State Engineer has approved applications allowing the use of existing water rights for expanded uses, as long as the expanded uses do not increase the total consumptive use, does not impact other water right holders, are not located in a fully-appropriated basin, and actual water savings can be demonstrated over time. Data shows that few water users have taken advantage of this option or even know it exists. It appears that either few are aware of the "credit for conservation" permitting process, the process is too cumbersome, water use data is not available to show actual savings, or the permitting process is not viewed as sufficiently beneficial to provide an incentive to conserve.

Conservation Plans

In 1991, the Nevada State Legislature enacted a law requiring that each "supplier of water" for municipal, industrial or domestic purposes adopt a water conservation plan based on the climate and the living conditions in its service area by July 1, 1992. For publicly owned utilities, NRS 540.121

[1] In the case of *In re Waters of Manse Spring,* 60 Nev. 280 (1940), the Court clarified the meaning of abandonment and forfeiture by stating "While, upon the one hand, abandonment is the relinquishment of the right by the owner with the intent to forsake and desert it, forfeiture, upon the other hand, is the involuntary or forced loss of the right, caused by the failure of the appropriator or owner to do or perform some act required by the statute...The element of intent, therefore, so necessary in the case of an abandonment, is not a necessary element in the case of forfeiture."

through 540.151 was added to specify the contents of the plans and the process and timeframes to be followed. NRS 704.662 through 704.6624 was added to establish conservation plan requirements for those utilities regulated by the Public Service Commission (now the Public Utilities Commission). Water users located within Bureau of Reclamation projects (such as the Newlands Project, Southern Nevada Water Authority) are required to submit conservation plans to the Bureau. Issues relating to the conservation plan statutes include:

- Thus far, only about 100 out of 700 public water systems have approved conservation plans. However, those systems that do have approved plans serve about 95 percent of the total population served by public water systems. Under the Division of Water Planning's *Small Community Water System Grant Program*, approved conservation plans are required prior to the granting of any funds.

- There are no assurances that plans are actually being implemented or are effective as no ongoing reporting is required.

- There are no statutory requirements that plans be updated periodically to meet changing needs or new technological developments.

- The state has not funded the water conservation plan program. There are no specific staff to help water systems develop water conservation plans, to review the plans once they are submitted to the Division or to follow up with the water systems to ensure the plans are being implemented.

- Only municipal water systems are required to submit conservation plans to the State. These users account for only about 13 percent of the total water withdrawn in Nevada.

Low Flow Plumbing Standards

The Nevada Legislature passed Assembly Bill 359 in 1991 thereby imposing certain minimum standards for plumbing fixtures (toilets, showers, faucets and urinals) in new construction and expansions in residential, industrial, commercial and public buildings. Each county and city was required to include these requirements in its building code or to adopt these requirements by ordinance, and to prohibit by ordinance the sale and installation of any plumbing fixture which does not meet the minimum standards.

In 1992, the U.S. Congress passed the National Energy and Policy Conservation Act which set nationwide minimum flow standards for plumbing fixtures. Legislation was introduced in 1997 to repeal the uniform national plumbing efficiency standards established in the Act. National standards, in addition to state standards, are appropriate and necessary because:

- otherwise plumbing manufacturers would be faced with the production of dozens of different product line to meet the varying standards for each state; and
- it supports Nevada's plumbing standards by controlling the flow of non-complying products into Nevada.

Water Measurement

Water use measurement is a key component to any conservation program. Meters and other measurement devices can be used as a tool to evaluate program effectiveness in terms of water use changes. In addition, meters can provide a basis for billing when used with a rate structure designed to promote conservation and discourage waste. Water use measurements are also needed for water users wishing to participate in a "credit for conservation" program.

A majority of the public water system withdrawals (in terms of volume) are metered, however not all deliveries to each service connection are metered. For example, only about 25 percent of residences in Reno/Sparks have water meters. Water meters were initially prohibited in the cities of Reno and Sparks by a 1919 statute (NRS 704.230). Since that time, gradual changes have occurred which: 1) require meters on all businesses (1977) and on all new homes built after 1988; and 2) allow meters on residences upon owner request and under certain conditions tied to the Negotiated Settlement (1990).

Water Reuse

The reuse of treated wastewater effluent is becoming more common in Nevada. The U.S. Geological Survey estimated that in 1995 about 26,000 acre-feet of treated effluent was reused statewide. Current uses for treated effluent include landscape irrigation; agricultural irrigation; industrial uses such as cooling water and process water; supplies for wetlands; and construction water. By using treated effluent as a replacement source, more potable water is available for other uses with more stringent water quality requirements.

U.S. Bureau of Reclamation Conservation Plans

The Reclamation Reform Act of 1982 requires each district, that has entered into a repayment contract or water service contract, to develop a water conservation plan. The plan is to contain definite goals, appropriate water conservation measures, and a time schedule for meeting the water conservation objectives. Districts, such as the Truckee-Carson Irrigation District and Pershing County Water Conservation District, are impacted by this requirement.

Summary

Even though the State has no comprehensive program for promoting and encouraging conservation, many municipal water systems have taken the initiative to develop their own conservation programs and are reducing water use. For example, the rate of Municipal & Industrial (M&I) water use has declined in recent years primarily due to conservation efforts. Successful conservation programs during the 1990s lowered statewide M&I water use from 334 gallons per person per day (gpcd) in 1990 to 314 gpcd in 1995. Southern Nevada water purveyors have implemented a variety of conservation measures, such as: banning the creation of artificial lakes, adopting water waste ordinances, restricting lawn watering, establishing increasing block rates for billing purposes, establishing an active public education and outreach program, and pursuing the use of lower quality water in lieu of potable supplies where feasible. As a result of these conservation efforts, Municipal & Industrial (M&I) water use in the Las Vegas Valley Water District has decreased from 358 gpcd (gallons per capita per day) in 1989 to 320 gpcd in 1997. Residential use in the District has decreased from 213 gpcd to 197 gpcd during the same period.

Nevada's agricultural community has also been implementing a variety of conservation measures throughout the State, particularly in the Walker River and Carson River basins, and the Lovelock area (Humboldt River basin). Through measures such as laser leveling of fields, sprinkler systems and reusing return flows, agricultural water users are improving their water use efficiency. As already discussed, irrigation conservation is motivated in part by economic incentives. However for some irrigation operations, conservation may not be economically justified if the irrigator's costs exceed the irrigator's expected benefits.

Conservation in Other States

Many other states recognize conservation as an important mechanism for extending water supplies, reducing and delaying infrastructure needs, controlling supply overdrafts, providing additional water for other uses, and reducing return flows affecting water quality. Throughout the United States a variety of approaches for promoting conservation have been undertaken. Following is a brief description of conservation activities in a few other western states.

Arizona

The Arizona Groundwater Management Code establishes the legal framework for conserving water in Arizona's most populous management areas. To help achieve its goals, selected active management areas are required to implement management plans which, among other things, establish conservation requirements for municipal, agricultural and industrial water users.

As required by the Groundwater Management Code, municipal water providers in certain management areas are assigned a water use rate target (in gallons per person per day). Water use audits are regularly performed and if a target is not met, the Arizona Department of Water Resources sends out a notice of non-compliance and attempts to negotiate a settlement for the overusage of water. In general, agricultural and industrial water users are also required to meet conservation requirements as set forth in the management plans.

California

California's Urban Water Management Planning Act of 1983 required all municipal water users with more than 3,000 connections to submit a water conservation plan, and update the plan every 5 years. Another key urban conservation effort has been the development of accepted measures for achieving conservation, otherwise known as "Best Management Practices (BMPs)" Urban water agencies, environmental groups and State agencies have identified 16 BMPs. Approximately two-thirds of California's urban water suppliers signed a 1991 memorandum of understanding (MOU) by which they agreed to implement the 16 BMPs, although implementation of the BMPs is spotty.

Legislation enacted in 1990 (AB 3616) resulted in development of another MOU by which signatory irrigation districts and water agencies commited to adopt a number of mandatory and voluntary "Efficient Water Management Practices" analogous to the BMPs designed for urban water suppliers. As with the urban suppliers' MOU, the agricultural MOU is not universally endorsed, and agricultural interests have questioned the practices aimed at enhancing planning and water measurement.

California has established a number of programs in support of agricultural conservation efforts. For example, they have established an Irrigation Management Information System to assist agricultural water users with irrigation scheduling. As part of this system, irrigators can access a number of computerized weather stations for climatological data and evapotranspiration. California has also established: 1) mobile labs to visit farmers and help them evaluate their water management efficiency; and 2) an irrigation training and research center, supported partially by training course fees.

Oregon

In 1990, the Oregon Water Resources Commission and Department adopted a statewide policy on Conservation and Efficient Water Use. The policy identifies a wide range of strategies for encouraging conservation, including public information, incentives and regulation to enforce the statutory prohibition against waste. The policy also calls for the preparation of water management and conservation plans by major agricultural and municipal water suppliers. Later, the Commission adopted rules by which municipal water suppliers are required by permit conditions to complete conservation plans. In addition, irrigation districts are required under the law to prepare conservation plans prior to using certain water right transfer processes.

In 1987, Oregon began a program which allows a water user who conserves water to use a portion of the conserved water on additional lands, lease or sell the water, or dedicate the water to instream use. Initially, the program was not utilized because of the complexity of the application review process and water users' concerns about the potential effects on their water rights. Since that time, the program has been restructured and is now being utilized by water users.

Issues

The primary issues relating to conservation in Nevada are as follows:

1. At this time, the State has no comprehensive program for promoting and encouraging conservation throughout Nevada and for assisting water users in developing water conservation strategies.
2. Currently, state law requires municipal water suppliers to submit conservation plans, but provides little incentive for compliance. Also, there are no requirements that these plans be periodically updated or reviewed for effectiveness. Water users other than public suppliers are not required to submit conservation plans.

3. The current law of "use it or lose it" does not encourage conservation. However, existing statutes prohibit the waste of water, and provide the basis for a "credit for conservation" program.

4. State law provides few requirements and no specific incentives to conserve.

5. There have been attempts to appeal the federal minimum flow standards for plumbing fixtures. Repealing the federal standards could adversely affect Nevada's conservation efforts.

Recommendations

The following recommendations are offered as measures for improving conservation efforts in Nevada. In developing these recommendations, it was assumed that conservation would remain primarily a voluntary activity for water suppliers and users, with the State providing assistance and incentives. It is not the intent of these recommendations to advocate conservation purely for the sake of conservation. Conservation should be recognized as one of many water resource management tools that should be considered when it makes sense in terms of economics and overall resource management.

1. The State should add staff to the Division of Water Planning to provide technical, educational and financial assistance with water conservation. Duties of this staff could include:

    a. review water conservation plans and provide technical assistance;
    b. distribute grants;
    c. prepare conservation plans for state facilities;
    d. prepare and/or evaluate water audits for state facilities;
    e. assemble a repository of water conservation information for distribution;
    f. develop conservation education materials and provide educational seminars; and
    g. compile a list of recommended best management practices for use in Nevada.

2. All municipal water suppliers are now required to implement conservation plans. It is recommended that the following steps be taken to improve this program:

    a. require municipal water systems over a certain population threshold to periodically update their conservation plans, and establish ongoing reporting requirements;
    b. require municipal water systems over a certain population threshold to adopt, implement and update their water conservation plans prior to receiving any state grants or loans or State Revolving Funds (Safe Drinking Water Act);
    c. require municipal water systems over a certain population threshold to adopt, implement and update their water conservation plans prior to the State Engineer's approval of a water right application or transfer request; and
    d. add staff to assist municipal water systems with developing their conservation plans and encourage compliance with conservation plan requirements.

3. On a trial basis, the State should require additional groups of water users (such as irrigators, and self-supplied commercial and industrial users) above a certain water use threshold to prepare water conservation plans. A cooperative agreement with other agencies could be set up to assist in developing and reviewing the plans.

4. The Department of Conservation and Natural Resources should develop a more formal "credit for conservation" program in order to encourage more conservation throughout Nevada. This program would be voluntary. Water use measurement and enforcement would be essential for such a program to be successful.

5. The State, in cooperation with Cooperative Extension and Natural Resources Conservation Service, should assist agricultural users in implementing conservation measures through the following mechanisms: develop an irrigation management information system with weather stations in selected basins to provide real time evapotranspiration data for irrigation scheduling; establish mobile laboratories to visit farmers to help them evaluate their water management efficiency; and establish an irrigation training and research center.

6. If state government is to promote conservation throughout Nevada, it must lead by example and assist the various state agencies in becoming more efficient. The State Legislature and the Governor should promote statewide water conservation by:

    a. incorporating water conservation policy goals into all appropriate activities and programs of state government
    b. directing agencies responsible for constructing, leasing or maintaining state facilities and property to use water conserving plumbing fixture and devices, water efficient landscape practices and other programs to maximize water conservation
    c. providing appropriate funding to affected state agencies to retrofit existing state facilities with water conserving devices.

7. The State should establish a fund to help pay for water conservation projects to demonstrate the benefits of water efficiency measures and provide an incentive for conservation/

8. The State should encourage public supply systems to meter water deliveries. Refer to the "Water Use and Estimation" issue discussion for additional information on water use measurement in Nevada.

9. The State should encourage effluent reuse and greywater use where feasible.

10. The State should initiate a water measurement program for all water users to install water measurement devices, or implement water use estimation techniques (based upon power use, etc.) for certain users over a threshold use amount and for certain basins. Funding support would be a necessary component. Refer to the "Water Use and Estimation" issue discussion for additional information on water use measurement in Nevada.

11. The State should continue to support existing state and federal minimum flow standards for plumbing fixtures.

Index - Part 3, Section 1 - Conservation

B. Integrated Water Management

Introduction

Groundwater and surface water supplies in Nevada are finite resources. As the driest state in the nation, with an average precipitation of nine inches annually, Nevada's water supplies must be managed to maximize their effectiveness. As in many western states, Nevada's water supplies are typically not present at the locations where and when they are most needed. Further, variations between high water years and low water years can be dramatic. As an example, in northern Nevada along the Humboldt River, water supplies may vary from 25 percent of average (1994) to 250 percent of average (1995) from one water year to the next. The hydrologic systems throughout the state are complex and highly varied. The State's rapidly expanding population is putting increased pressures on available water supplies, thus increasing the need for integrated groundwater and surface water management.

Water Supply

Surface water provides approximately 60 percent of the total water used in the state. Snowmelt contributes to most of the stream flow, especially in the northern half of the state. Stream discharge is typically greatest during the months of May and June as a result of snow melt in the mountains. October low flow measurements range from 0.01 percent to 1 percent of June peak flow. Summer convective storms create much of the stream flow in southern Nevada. Flows are typically greatest near the headwaters, declining in low-altitude reaches due to irrigation, public use, infiltration and evapotranspiration. Surface waters in Nevada are virtually fully appropriated, thus, future development will rely heavily on groundwater resources.

Groundwater provides approximately 40 percent of the water used throughout the state. In many communities, groundwater provides 100 percent of the water used for municipal supply. In years of low surface water supply, groundwater may be pumped to supplement surface water sources. Groundwater usage typically increases in years with less rainfall, and declines when surface water supplies are adequate. Most groundwater supplies in the state have been developed from relatively shallow aquifers, less than 500 feet below ground surface.

Water Quality

Groundwater and surface water quality regulations are administered by the Nevada Division of Environmental Protection (NDEP) and adopted by the State Environmental Commission. In general, surface water quality varies over time and between reaches as one moves downstream, dependent on the amount of water in the stream. The water quality constituents of greatest concern in surface water are total dissolved solids (TDS), temperature, pH, nutrients and dissolved oxygen. Concentrations of chemical constituents are typically greatest during periods of low flow. In contrast, concentrations of suspended solids are generally greatest during high flows. Stormwater runoff can impact surface water quality, contributing pesticides, petroleum products, and organic chemicals to surface water supplies.

Impacts from geothermal groundwater and surface water are found in areas throughout the state. Typically, the water quality constituents of thermal waters include temperature, TDS and metals such as arsenic and boron, and high concentrations of chloride, sulfate, and fluoride. Geothermal water is generally not suitable for most consumptive uses.

Groundwater quality typically varies throughout the State, dependant upon the composition of the aquifer material and sources and types of pollution. Concentrations of naturally occurring contaminates such as TDS, metals, fluoride, and sulfates vary, but typically do not exceed State and Federal drinking water standards in the majority of aquifers used.

Integrated Management

Conjunctive Use

The State of Nevada encourages conjunctive management of groundwater and surface water resources, to improve the reliability, economics and yield of available water supplies. The goal of conjunctive use of water systems in Nevada is to maximize the total yield of water. One approach is to maximize the use of surface water supplies when they are available and only rely on groundwater when surface water is not available. For example, the Carson City Utility Division has permits from the State Engineer authorizing them to increase groundwater withdrawals up to an imposed maximum (based on the conditions of the permit) during times of low surface water availability, with the understanding that surface water will be used to the maximum extent feasible. Another goal of integrated water management is to encourage the use of higher quality water sources for uses such as public drinking water supply. Lower quality sources can then be used for agricultural and landscape irrigation, mining, and other commercial and industrial uses which do not require potable water.

The availability of water from the three major rivers in northern Nevada (Truckee, Carson, and Walker) is dependent in large part on what flows across the state line from California. The amount of groundwater available to augment these supplies is small by comparison to the surface water flows. However, in times of drought, groundwater is an important component of an overall water management strategy to meet water demand.

Water Storage

One component of an integrated water management program is storage of surplus surface water in underground aquifers or in above ground reservoirs. The stored water enhances groundwater supplies, which can then be withdrawn when available surface water supplies are inadequate to meet demand. Surface reservoirs are relatively straightforward in their construction, but may not be financially, environmentally, or administratively feasible. Evaporation losses from surface reservoirs are also a factor. In northern Nevada, evaporation rates range from 3 to 5 feet per year, while in southern Nevada evaporative losses can exceed 8 feet per year. Underground storage is legally and administratively complex, however, underground storage is typically less costly than above ground storage and evaporation losses are non-existent. The Nevada Division of Water Resources (NDWR) administers the statute governing development of aquifer recharge/recovery systems in the State. One component of the statute is a requirement to establish a "storage account", which defines the amount of water which can be recovered after recharge.

Water Reuse

The use of previously used water or treated waste water effluent for commercial, industrial, and irrigation uses is becoming more common in Nevada. Treated effluent is currently used for irrigation at many golf courses in both northern and southern Nevada. Treated effluent is also used for cooling tower make-up water at the Nevada Power Company power generating station at Sunrise Mountain in southern Nevada. Sierra Pacific Power Company's power generating station at Valmy uses water generated from mine dewatering at Lone Tree for cooling tower make-up water. This kind of water reuse helps to minimize withdrawals of potable water and thus maximize the amount of potable water available for the drinking water supply.

Groundwater / Surface Water Connection

The degree of connection between groundwater and surface water and the impacts due to water use can vary and so too, any impacts due to water withdrawals. Thus, water resources must be evaluated on a case-by-case basis to assess the best management practices for each specific use. In Nevada's basin and range province, the mountain ranges are typically fractured, allowing recharge to deep aquifers to occur. In contrast, in many locations, the valley floors are composed of fine lake sediments which inhibit groundwater recharge, as demonstrated by the presence of playa lakes. In most locations throughout the state, shallow groundwater aquifers have some connection with surface water systems.

If there is a connection between shallow groundwater and surface waters, water withdrawals may affect both water supplies and water quality. Monitoring and proper management of groundwater pumping can avoid or minimize any potential depletion of surface water resources which depend on groundwater inflows. Well drilling regulations which require a 100 foot deep sanitary seal in wells located within one-quarter mile of a stream, canal, or other water body are designed to prevent impacts due to pumping. How land is used may also affect groundwater and surface water quality. Fuel storage, land surface disturbance, urbanization and wastewater disposal all have the potential to impact both surface and groundwater supplies.

In some locations, applied irrigation using surface water is the primary component of shallow groundwater recharge. In these areas, water levels in shallow aquifer systems will vary depending on surface water supply and applied irrigation. Typically, the deeper aquifers are confined by fine-grained lake bed sediments and may be under artesian pressure, thus water levels will remain relatively constant over time, regardless of withdrawals from the shallow aquifer unless the shallow aquifer is significantly over-pumped.

State Agency Roles

Several state agencies have a role in integrated water management. The Nevada Division of Water Resources (NDWR) is responsible for issuing permits for groundwater and surface water use in the State. The Nevada Division of Environmental Protection (NDEP) is responsible for protecting surface and ground water quality. The Nevada Division of Water Planning is responsible for developing effective plans for water resource management in the state.

Nevada Division of Water Resources

The Nevada Division of Water Resources (NDWR) is responsible for allocating, adjudicating, and managing surface and groundwater rights in the State through the office of the State Engineer. Authorization for groundwater use is dependant upon the availability of unappropriated water and protection of existing water rights. Groundwater and surface water use requires a permit which identifies the point of use, timing, and manner of beneficial use. The State Engineer encourages the practice of conjunctive use for both public water supply systems and irrigation systems in the State. When the State Engineer issues permits for supplemental water rights, the total volume of water (duty) that can be used from any and all sources is established in the permit conditions. The State Engineer is responsible for ensuring that groundwater withdrawals do not exceed the perennial yield for each basin, in part to avoid impacts on surface water resources. NDWR also issues permits for aquifer recharge/recovery projects and conjunctive use projects.

Nevada Division of Environmental Protection

Groundwater and surface water quality are regulated by the NDEP and the State Environmental Commission. The NDEP updated the State of Nevada Comprehensive State Ground Water Protection Program (CSGWPP) in March 1998. This program addresses water quality impacts from sources such as agricultural chemicals, mining, underground storage tanks, underground injection wells, landfills and hazardous waste disposal. The NDEP's approach emphasizes pollution prevention. The Division's regulations require preventive measures, such as leak containment, discharge permitting, and storm water management.

Nevada Division of Water Planning

The Division of Water Planning (NDWP) is charged with development and implementation of a plan for use of groundwater and surface water resources within the state (the State Water Plan). NDWP provides the State, counties, and local communities with information, alternatives and recommendations for regional water planning and action for acquisition or conservation of existing resources. NDWP is responsible for investigation of new sources of water, including importation and conservation. The Nevada legislature has recognized the critical nature of the State's limited water resources and the demands placed on that resource by an increasing population, in the Divisions's statute (NRS 540). The legislature also recognizes the relationship between quality and quantity of water in NRS 540, including among the duties of the Division a stipulation that water quality and water quantity issues be considered simultaneously in planning efforts.

Nevada Division of Wildlife

The Nevada Division of Wildlife (NDOW) is responsible for protection and management of wildlife and its habitat in the state. NDOW has specific water management concerns at the Wildlife Management Areas (WMAs) throughout the state. Water for fish and wildlife has been recognized as a beneficial use in Nevada since 1982, and NDOW is authorized to acquire land and water rights for preservation and restoration of wildlife and its habitat. However, water supplies vary, depending on the seniority of water rights owned by NDOW, and drought periods can severely impact wildlife habitat. Integrated groundwater and surface water management is a key component in maintaining water supplies for fish and wildlife habitat throughout the State and minimizing drought impacts.

Issues

1. If we are to increase our water supply development opportunities in Nevada, we must increase our understanding of the water resource as a whole. Effective management of the surface and groundwater supplies depends on a clear understanding of the nature and interaction of the water resources.

2. Surface water and groundwater are managed as two separate sources in Nevada. The appropriation and adjudication of surface water and groundwater are covered in NRS 533, and additional groundwater management tools are included in NRS 534. Each application for a water right permit can include only one source of water, even if the intended use requires water from more than one source, or a supplemental source (NRS 533.330). Water allocation and management decisions need to incorporate state-of-the-art knowledge regarding the relationship between groundwater and surface water.

3. Groundwater withdrawals in excess of perennial yield from near surface aquifers may impact the surface water base flow by drawing water down below the reach of a nearby stream. Over pumping groundwater can impact not only stream flows, but over time, may cause ground subsidence as well. Ground subsidence of up to five feet has occurred in Las Vegas Valley.

4. Underground storage is a viable alternative to the use of surface water reservoirs. Underground storage also virtually eliminates evaporative losses, which can range from 3 to 8 feet annually in Nevada. However, where the valley fill is fully saturated or where the alluvium consists of fine-grained silts and clays, surface water storage may be the only alternative to dampen variations between times of plentiful water and drought. Few communities are actively exploring the potential for underground storage of water, and fewer still are actively storing water underground.

Recommendations

To address the issues identified above, the following recommendations are made:

1. The State should continue groundwater and surface water monitoring to refine the estimates of perennial yield of hydrographic basins, and provide an improved estimate of water availability in the state.

2. The State should support funding and development of an enhanced groundwater level and quality monitoring network to better quantify groundwater availability and use throughout the state and especially in areas of rapid growth.

3. The State should fund integrated water resource studies to assess the effects of groundwater pumping on surface water flows on critical streams and springs where impacts have been identified.

4. The State should encourage development of aquifer recharge/recovery projects where feasible throughout the state, and evaluate surface water storage options where underground storage is not feasible.

5. The State should encourage installation of dual piping in new developments to facilitate use of treated water for irrigation and other uses which are not required to meet drinking water standards.

6. The State should encourage the preferential use of reclaimed water, surface water, and stored water.

7. The State should ensure that water users who use a combination of surface water, groundwater, or alternative water sources (reclaimed water, grey water, etc.) do not use more than the total amount of water necessary to meet their needs efficiently within the limit of their water right.

Index to Water Supply and Allocation

C. Interbasin and Intercounty Transfers

The Need for Water Transfers

Nevada is the driest state and one of the fastest growing, and is currently ranked as the most urbanized state in the nation. Overall, water demand in the state is expected to increase by about 9 percent by the year 2020, resulting in an increase in demand for new water appropriations of about 350,000 acre-feet. Most of Nevada's surface water systems are fully appropriated and nearly half of the groundwater basins have been *designated* as in need of additional administration by the State Engineer; in most cases this means that they are fully appropriated as well. There are few rivers flowing to the sea which might be tapped for future water needs.

Because of the limited options available, interbasin and intercounty transfers are likely to become more important in meeting future water needs than in the past. Growing urban areas are looking to appropriate new water rights or purchase existing water rights and transfer them to new places of use, frequently in a different basin or county. Water right transfers are also being viewed as an important way to augment instream flows and to meet environmental needs for water.

Water transfers involve withdrawing either groundwater or surface water from one basin or county for beneficial use in another. The term *water transfers* can apply to either an existing water right or a new appropriation. *Intercounty* transfers involve the movement of water from one county to another for use. *Interbasin* transfers involve the movement of water from a *basin-of-origin* to a *receiving basin* for use. The term *basin-of-origin* refers to the place from which the water is diverted; the term *receiving basin* refers to the place where the water is used. In the following discussion, the term *basin* can refer to either a groundwater basin or a surface water basin. A water transfer can be either an intercounty transfer or an interbasin transfer, or both.

Of all the topics in the *Nevda State Water Plan*, that of interbasin and intercounty transfers requires the greatest care in balancing the goals of the water plan, as set forth in Part 1. In summary these include:

- Water supply sufficiency
- Protection of existing water rights
- Preferential use of water for greatest economic gain to the state
- Greater conservation
- Protection of water quality
- Protection of water supplies for rural areas
- Environmental protection
- Sound processes for decision-making, including efficiency, cooperation, more information, sound science and public involvement

Water transfers provide an opportunity to resolve a variety of water management issues. A receiving area (basin or county) can benefit from a water transfer if the new water supply allows the receiving area to meet current or projected water needs, or leads to economic development or expansion. An area of origin (county or basin) can benefit from a water transfer if the area has excess water resources not otherwise needed to meet future growth or resource conservation needs and some form of mitigation is offered to offset any impacts expected to the area (i.e., through the collection of a water transfer tax and/or implementation of a mitigation plan). Examples from California, Idaho, Colorado and even Nevada are discussed in the book *Water Transfers in the West.* Each of the case studies provides examples where water transfers are being used to solve a spectrum of problems, including water supply, power generation, wetlands restoration, instream flows or water quality improvements. Each case study also highlights potential impacts that have been or need to be addressed.

Historical Context

Water transfers have been around for a long time. Prior appropriation law has never limited the use of water to the watershed or ground water basin in which it originated. In Nevada, water transfers are an integral part of the water arena, and interwoven with the history of the settlement of the state. Without water transfers, Virginia City and Tonopah would not exist, many mining claims would never have been developed, farming in Fallon would be a fraction of what it is today, and Las Vegas would be a town not a destination city.

There are over 20 interbasin transfers occurring in Nevada today. Tables 1 and 2 show some examples of these interbasin transfers. The examples are divided by whether the source of the water is groundwater or surface water.

Water transfers in Nevada have contributed to economic development, growth and prosperity. But there are also costs associated with such transfers. In one case, the transfer of water for agricultural development has had an impact on lake levels downstream of the diversion point. Under the Truckee River Decree, mandated by Federal Court, water is transferred from the Truckee River Basin via the Truckee Canal to the Carson River Basin. Although this water transfer resulted in economic development in the Fernley and Fallon areas in Lyon and Churchill counties, it also resulted in declines of water levels in Pyramid Lake, the terminus of the Truckee River. Because of the potential for physical, social, fiscal and economic impacts, water transfers must be carefully evaluated prior to approval and closely monitored after implementation.

Table 1. Examples of Current Interbasin Diversions

Groundwater Source		
Basin-of-Origin	**Receiving Basin**	**Type of Use**
Washoe Valley	Eagle Valley	Carson City municipal supply
Goshute Valley	Great Salt Lake Desert	Wendover municipal supply
Pilot Creek Valley	Great Salt Lake Desert	Wendover municipal supply
Long Valley	Cold Springs Valley	municipal supply
Ralston Valley	Big Smokey Valley	Tonopah municipal Supply
Carson Valley	Eagle Valley	Carson City municipal supply
Dayton Valley	Eagle Valley	Carson City municipal supply
L. Meadow Valley Wash	Muddy River Springs Area	Reid Gardner Power Plant
Oreana Sub-area	Lovelock Valley	Lovelock Municipal Supply
Surface Water Source		
Source / Basin-of-Origin	**Receiving Basin**	**Type of Use**
Lake Tahoe Basin	Eagle Valley	Carson City municipal supply
Lake Tahoe Basin	Dayton Valley	Virginia City municipal supply
Truckee River (Tracy Segment)	Carson River (Churchill Valley via Truckee Canal)	Truckee-Carson Irrigation District irrigation
Newark Valley (spring)	Diamond Valley	Eureka municipal supply
Lake Tahoe Basin (treated effluent)	Carson Valley	irrigation
Truckee River (Truckee Meadows)	Lemmon Valley	SPPCo municipal supply
Carson River (Dayton Valley)	Eagle Valley	Carson City municipal supply
Colorado River (Black Mountain area)	Las Vegas Valley	Las Vegas area municipal supply
Truckee River (Truckee Meadows)	Spanish Springs Valley (via Orr Ditch)	irrigation
Truckee River (Truckee Meadows)	Sun Valley	SPPCo for municipal supply

Table 2. Examples of Interbasin Transfers of a Previously Existing Water Right

Original Point of Diversion	New Point of Diversion	Original Place of Use	New Place of Use	Type of Use
Carson River (Carson Valley)	Carson River (Dayton Valley)	Carson Valley	Eagle Valley	Carson City municipal supply
Humboldt River (Battle Mountain)	Rye Patch Reservoir (storage)	Battle Mountain	Lovelock area	irrigation

Laws and Legislative Actions Regarding Interbasin and Intercounty Transfers

Water Allocation. Nevada Revised Statutes 533 and 534 provide basic criteria for evaluating all water appropriations or changes of water rights, including interbasin and intercounty transfers. As long as unappropriated water is available, existing water rights are not impacted, and the transfer does not threaten to prove detrimental to the public interest, the State Engineer may approve the transfer. The State Engineer has issued a number of orders and rulings which address the public interest issue.

Water Rights. A water right owner has the right to use the water pursuant to the terms of the certificated water right, but any changes in the place of use, manner of use or point of withdrawal must be approved by the State Engineer prior to the change. The ability to buy and sell water rights is the basis for "water marketing" described below.

Public Noticing. The State Engineer's office publishes a notice of an application for a new appropriation or change of water rights in the newspaper of general circulation in the county where the water is to be appropriated and used, once a week for four consecutive weeks (NRS 533.360). In the case of intercounty transfers, NRS 533.363 requires the State Engineer to also notify county commissioners, in both the county of origin and the county of use, of a pending application for appropriation or change, with some minor exceptions. The applicant must send a copy of the application to each of the counties. Each county commission must then hold a public workshop on the proposed intercounty transfer, and send their non-binding recommendations on the proposal to the State Engineer.

Water Transfer Tax. In 1991, the Nevada Legislature amended NRS 534 to allow a $6 per acre-foot tax on water transfers where water is to be withdrawn in one county and used in another county or state (NRS 533.438). The monies collected are to be placed in a trust fund, the use of which is restricted to economic development, health care and education.

Mitigation Plans. If a county declines to impose the water use transfer tax, the applicant and the governing body of the county-of-origin may execute a plan to mitigate the adverse economic effects caused by the transfer of the water (NRS 533.4385). The mitigation plan may include a reservation of designated water rights to the county-of-origin and compensation for the economic impacts of the transfer, among other things. The plan must be submitted to the State Engineer who then has the authority to amend the plan if it violates a specific statute or is deemed unworkable.

1994 Legislative Study. The 1994 Interim Legislative Committee heard testimony on the issue of interbasin transfers. In their report, *Study of the Use, Allocation and Management of Water*, the committee recommended that the state water plan include general criteria for the approval of water transfer applications and related determinations that pertain to the movement of water from one basin to another[1]. Further, they recommended that the general criteria should include evidence that:

1. the project is fair and equitable to the area-of-origin;
2. the project is environmentally sound; and
3. the project is an appropriate long-term solution which will not unduly limit future development and growth of the area-of-origin.

1995 Legislature. In 1995, the Legislature amended the water planning statute to require that "The [state] water plan ... include provisions designed to protect the identified needs for water for current and future development in rural areas of the state, giving consideration to relevant factors, including but not limited to, the economy ... and the quality of life in the affected areas" (NRS 540.101.3). In partial fulfillment of this statute, recommendations regarding interbasin transfers are listed at the end of this issue paper.

1997 Legislature. During the 1997 legislative session, the Legislature considered a bill (S.B. 454) to set specific criteria to ensure that interbasin transfers do not cause undue economic or environmental harm to rural counties. The bill was proposed jointly by three counties, Nye, Lincoln and White Pine. Rather than adopt the bill at that time, the Legislature referred the issue to the Legislative Committee on Public Lands for further fact finding during the interim period between legislative sessions. The committee held a number of work sessions to hear testimony on the issue and proposed a bill draft for consideration by the 1999 Legislature.

Issues

Water transfers can have both benefits and impacts. The degree to which a water transfer benefits or impacts a region, and the locations in which those benefits or impacts are experienced, varies widely. Some benefits and impacts are more commonly associated with interbasin transfers; others are more likely to be observed with an intercounty transfer. Some have a larger effect on an area of origin; others are felt more keenly in a receiving area. Impacts to the water resource itself or the environment are more likely with interbasin transfers than with intercounty transfers. Economic,

[1] *Study of the Use, Allocation and Management of Water* . Bulletin No - 95-4. Legislative Commission of the Legislative Counsel Bureau, State of Nevada. p. vii.

social or fiscal impacts are more commonly associated with intercounty transfers. Economic benefits are more likely to accrue to a receiving area than to a basin or county-of-origin, although areas of origin can certainly receive economic benefits, especially if a previously unused or unneeded water resource will now be put to beneficial use.

Potential Impacts

Basin-of-origin concerns center on whether a groundwater or surface water transfer has the potential to impact the rights of existing water users, reduce instream flows, decrease flows to wetlands or lakes downstream of the point of diversion, or decrease recharge to aquifers. *County-of-origin* concerns center on potential losses of tax income, social stability or the ability to economically develop the region in the future. In a *receiving basin,* natural resource concerns include the possible introduction of poorer quality waters into the receiving basin, or the generation of air and water pollution associated with growth that is likely to occur if a new water source becomes available to a previously water short region. *Receiving county* concerns focus on managing the potential societal and quality of life impacts and new infrastructure demands associated with the new growth which may be induced by the availability of new water supplies.

Views of the Public

Concerns about the economic and environmental effects of interbasin and intercounty transfers increased in the late 1980’s when large scale applications were filed for water transfers from rural areas to urban centers in both northern and southern Nevada.[2] In 1992, the Nevada Cooperative Extension, the Nevada Humanities Committee and a number of other organizations co-sponsored a series of water issue forums. More than 800 Nevadans participated in workshops held throughout the state. The workshops were designed both to educate residents about state water laws and policies and to elicit their thoughts and recommendations on current water issues.

The results of the water forums are summarized in a report entitled *Nevada’s Water Future: Making Tough Choices*.[3] According to the report, some residents view water as they would any commodity - free to be bought and sold, moved and transferred — a resource to be put to work to meet the economic and social needs of the state. They believe that the market is the most desirable mechanism for ensuring that water is transferred to uses where its economic value is greatest. And clearly, the very existence of many of our communities and their prosperity can be traced directly to the movement of water across basin and county lines.

[2] *Study of the Use, Allocation and Management of Water*, p. 24.

[3] Henderson, Ford, Cobourn. *Nevada’s Water Future: Making Tough Choices* - *A Report on Nevada Water Forums, 1992-1993*, May 1993.

Others believe we should live within our means, that growth should be sustained only by locally available resources. These residents believe that transferring or "exporting" water out of basins is ecologically non-supportable. They express concerns that wetlands and springs in the basin-of-origin will dry up, playas will turn permanently to dust and the potential for growth in the basin-of-origin will be reduced.

The findings of 1992 water forums were mirrored in workshops held by the Division of Water Planning during development of the State Water Plan, both in the Winter of 1994/1995 and in 1998. Intercounty and interbasin transfers topped the list of all issues requested for discussion in the water plan, both in terms of amount of time spent in discussion and the fervor expressed.

People in rural counties were generally concerned about the potential impacts of both intercounty and interbasin transfers. In some cases, this concern went deep enough to cause individuals or their county commissions to call for an outright ban on such transfers even when the county itself was the beneficiary of an ongoing interbasin transfer. Some residents in urban counties viewed interbasin transfers as precursors to additional growth which they viewed negatively. In response to public concerns, urban community leaders and water managers have stated that they do not want their region to benefit at the expense of other areas, and have expressed a commitment to provide appropriate mitigation.

Water Marketing

Water marketing - or the change of water rights from existing uses to new uses at market value - has the potential to increase water use efficiency, certainly an important consideration in a state as dry as Nevada. According to the National Research Council [4]:

> "Markets respond to price signals to move resources from lower- to higher-valued uses. Markets respect existing property entitlements, and thus water right holders set the pace of transition and receive compensation when water is transferred. Reliance on water marketing, rather than government subsidy and regulation, reflects a general societal belief that markets are a more effective way to allocate scarce resources to meet the twin goals of efficiency and equity ... However, there is a need for caution....Transfers must be carefully evaluated because, as with any policy option, there are benefits and costs to their use. And significant costs - some concrete and others quite difficult to measure - can come at the expense of third parties."

Interest in water marketing, and associated interbasin and intercounty water transfers, is increasing due to a number of factors. First and foremost, the demand for water is growing, especially in the municipal and industrial sectors. Farmers and ranchers currently withdraw about 77 percent of the

[4] *Water Transfers in the West; Efficiency, Equity and the Environment,* prepared by the Committee on Western Water Management, Water Science and Technology Board and Commission on Engineering and Technical Systems, with the Assistance of the Board on Agriculture, National Research Council. 1992, p.3.

water in Nevada. Part 2 of the State Water Plan explains that municipal and industrial (M & I) water demand is expected to double over the next 20 years, while agricultural water use is expected to decline by about 7 percent over the same period.

Third Party Interests

The greatest concern over water marketing, especially interbasin and intercounty water marketing, is that potential third party impacts must be addressed if transfers are to be equitable and efficient. Third parties include everyone who is not a buyer or seller in a water transfer negotiation. Third party interests include those who hold other water rights that may be at risk due to a transfer, as well as those representing economic, wildlife, environmental and social interests that may be affected by the transfer.

Nevada has laws which are designed to ensure that pending water allocation actions are publicly noticed. Further, county commissions are specifically notified of proposed intercounty transfers. Third parties who are not water right holders have been recognized and allowed to participate in water right proceedings. In fact, the State Engineer has issued two rulings where the legitimacy of third parties to participate in administrative hearings was specifically acknowledged.

Rural Communities and Counties

Water transfers out of a county can have economic, fiscal, environmental and social impacts on rural communities. In the short term, per capita costs for system maintenance and operation in irrigation districts can increase. This possibility is addressed in NRS 533.370.1 (b), which requires the State Engineer to review any application within an irrigation district to ensure that it does not affect the costs of water for other irrigators or lessen the district's efficiency. In the long run, future development opportunities which might have brought increased tax revenues may be lost. This is partially addressed by NRS 533.438 which allows a county to assess a transfer tax or to require a mitigation plan.

If water rights are removed from the land it may result in the value of the land itself being removed from the tax rolls or taxed at a lower rate. County tax rates may then have to be increased placing a heavier load on existing tax payers, or alternatively, services cut. At the same time, the county's bonding capacity and legal debt limit, which are based on the county's net valuation may be decreased. Population is the basis for distribution of state sales tax revenues. If an area loses population because of decreased economic opportunities, sales tax revenues will decline as well, making it harder for the county to provide services for the remaining residents. Counties with only a small percentage of private land, i.e. most of the rural counties in Nevada, are particularly hard hit by the fiscal impacts of retiring irrigated lands.
Water transfers may affect a community's social structure and long term viability[5]. Production from remaining farms or ranches may be insufficient to support other local businesses. If a community

[5] *Water Transfers in the West*, p 45.

becomes less populous and prosperous, the social infrastructure such as churches, civic groups and political organizations may decline just when the community may need them most to deal with the new economic changes. A community's sense of independence, self- determination and "quality of life" may all be impacted. Increased air pollution may occur if lands are not adequately vegetated prior to a transfer. Surficial aquifers which may have been incidentally recharged from leaky irrigation canals may fall if the water that kept them full is transferred out of the basin, creating problems meeting domestic needs.

Despite these effects, water transfers that appear negative from a rural perspective may be viewed positively from an urban perspective. It is important to acknowledge that a dynamic, evolving economy is dependent on shifting resources as needs change. If Nevada's economy continues developing, and if the national and global demands for food produced in Nevada do not match production capability, then some dis-investment in irrigated agriculture is likely to occur.

Wildlife, Instream Flows, Recreation and Water Quality

Nevada's ecosystems include wetlands and riparian areas and associated fish, wildlife and vegetation. Transfers of surface or ground water, especially out of a basin, can have significant impacts on these water systems and their flora and fauna. Due to its basin and range nature, aridity, and active development, Nevada has many threatened and endangered species, especially fish species. In some cases, land and water development in Nevada has led to the reduction in size of wetland areas, stream flow and lakes at the end of closed river basins. On the other hand, agricultural return flows, flood irrigation of pastures, leakage along drainage ditches and canals, mine dewatering have actually created some new wetland areas.

Healthy ecosystems need dependable water supplies. In Nevada, recreational and environmental uses are considered *beneficial uses* in the state's water allocation law. Water rights may be appropriated or obtained by any legal water right owner to maintain instream flows or in-situ (in place) supplies. Since, for the most part, rivers and tributaries in Nevada are already fully appropriated, water for fish and wildlife enhancement must typically be acquired from existing water right holders.

Instream flows are not only critical to preserving fish and wildlife habitat in arid regions, but they are critical to water-dependent recreation. Tourism, which relies on both gaming and recreation, is an important segment in Nevada's economy. As the state seeks to promote itself, recreation is becoming increasingly important to the mix.

Instream flows for recreation generate dollars both directly and indirectly, and they provide water quality benefits as well. Both stream levels and flow rates influence dissolved oxygen levels, turbidity, nutrients and other water quality parameters. When evaluating a water transfer proposal it is sometimes difficult to adequately address the wide range of economic, environmental and intrinsic values that instream and in-situ (in place) uses of water provide, but it is important to do so if the public interest is to be effectively addressed and any potential impacts of water transfers appropriately mitigated.

Issues

While water transfers have the potential to bring large benefits to the state, the impacts and costs of such transfers must be identified, evaluated and mitigated. Following are the main issues which must be addressed:

1. Water transfers can impact third parties. It is sometimes difficult to determine who the affected parties are and to inform them about proposed water transfers.

2. Concerns have been expressed about water transfers and their potential impacts. Regional water planning enables local officials to be prepared when water transfers are proposed for their area, and to better capitalize on any benefits and mitigate any impacts water transfers may bring.

3. Water transfers may have relatively larger impacts on rural counties. Rural counties must carefully evaluate the potential social, fiscal and economic impacts of water right transfers.

4. Nevada has many threatened and endangered species and unique ecosystems, and has lost wetlands and aquatic environments in a number of areas. Protection of water quality and recreation opportunities depend in large part on water availability. Because the water needs for these beneficial uses of water have not been adequately quantified and few water rights have been obtained to support them in the past, a thorough evaluation of the potential environmental impacts should precede any large scale water transfer.

5. Water markets are developing in a variety of ways in different parts of Nevada. There are few, if any, mechanisms to bring buyers into contact with sellers or to bring order and rationality to the process. Therefore, transaction costs are high and water rights may not be appropriately valued.

Recommendations

The following recommendations were significantly influenced by recommendations made by Nevada county commissioners and the public at more than 25 public meetings and workshops on the state water plan held in 1998. The recommendations were also influenced by the recommendations found in the 1994 *Study of the Use, Allocation and Management of Water* prepared by the Legislative Commission of the Legislative Council Bureau, State of Nevada, and in *Water Transfers in the West – Efficiency, Equity and the Environment*, 1992, prepared by the National Research Council. The recommendations below are designed to balance the positive and negative impacts interbasin and intercounty transfers may have.

1. All levels of government should recognize the potential net value of water transfers as a way to respond to changing demands for water, and encourage voluntary transfers, as long as the public

interest is protected. Efforts should continue to make information available to the public concerning water transfer proposals and to provide affected interests with an opportunity to participate in any proceedings.

2. In applying the public interest test (under NRS 533.370(3)) to an interbasin or intercounty water right appropriation or change request, the State Engineer should continue to consider whether:

   1. the applicant for the water transfer has justified the need to import the water and demonstrated that an effective conservation plan has been adopted for the region in need and is being effectively implemented;
   - the transfer plan conforms to or conflicts with the substance of any adopted water plans for either the area-of-origin or the area to receive the water;
   - the project is environmentally sound; and
   - the project is an appropriate long-term solution which will not unduly limit future development and growth in the area-of-origin.

3. When in the public interest, the State Engineer should continue to place conditions on water right permits to mitigate impacts of interbasin or intercounty water transfers.

4. The State should continue to provide, and accelerate where funding allows, water planning assistance to local governments to help develop regional water plans and to identify future water needs. Regional water planning will enable local governments to better plan for their economic development and protect their natural resources, and prepare them to respond to proposals to transfer water into, or out of, their areas.

5. The Division of Water Planning, with the assistance of others, should conduct additional research on the opportunities and costs associated with water banking and water marketing in Nevada, and develop additional recommendations to improve future water transfers.

Index to Interbasin Transfer Issue Paper:

D. Water Use Measurement and Estimation

Introduction

It has been estimated that 65 to 75 percent of the total water withdrawn annually from groundwater and surface water sources in Nevada is either measured with detailed diversion records, or estimated annually in detailed pumpage and crop inventories. Only a portion of these data are maintained in an electronic database. Much of the available water use data are collected for regulatory purposes (compliance with permits, decrees, etc.) and may lack the detail needed to fully characterize water usage for planning purposes.

Water use information (whether measured or estimated) is critical for effective water planning and management at both the local and state levels. Managing and planning water resources without accurate water use information is comparable to managing a checking account without tracking the outgoing checks. In general, most of the groundwater basins in Nevada are managed as individual water sources. The State has tended to focus its water use measurement and estimation efforts as needed to implement the prior appropriation system. As a result, most of the data are compiled for those basins with declining water tables, increasing competition for the available resources, or usages with potential impacts to others. The lack of readily available and comprehensive water use information has complicated the *State Water Plan* development process.

Water use measurement is a key component to any conservation program. Meters and other measurement devices can be used as a tool in evaluating program effectiveness in terms of water usage changes. In addition, meters can provide a basis for billing with a rate structure such that customers pay for what is used and waste is discouraged.

Additional information on water use and measurement is presented in Part 2, Section 1, “Historic and Current Water Use”, of the *State Water Plan*.

Water Metering in Nevada

Upon issuance of a permit, the State Engineer has always required some type of measuring device be placed near the point of diversion and that records of these measurements be kept; however the type of measuring device used was at the discretion of the permittee. These use records are the basis for establishing the beneficial use amount, except in the case of irrigation use. The beneficial use amount for irrigation is based on various items such as total irrigated acreage, crop type, geographic location, and length of growing season. In the early 1970s, requirements changed for permits issued for an underground source and totalizing meters were required on most wells. However, not all permittees were required to submit this information to the State Engineer. Beginning in the mid-1980s, all permits issued for an underground source required a totalizing meter except for some irrigation permits. In critical groundwater basins, totalizing meters were required for all irrigation permits. Today all new permits for major groundwater uses of all types have conditions requiring the installation of totalizing meters on wells and the submittal of pumpage records to the State Engineer.

In the Truckee, Carson and Walker rivers, agricultural surface water diversions are measured with the data recorded and maintained by federal water masters and irrigation districts. On the Humboldt River system, flow measuring devices are installed and used to ensure compliance with the applicable decrees. Historically no detailed diversion records are kept for the Humboldt River system with surface water diversions monitored by the State Engineer's Office.

A majority of the public water system withdrawals (in terms of volume) are metered, however, service connections may or may not be metered (about 15 percent of the service connections in Nevada are unmetered). For example, only about 25 percent of residences in Reno/Sparks have water meters. Water meters were initially prohibited in the cities of Reno and Sparks by the 1913 State Legislature. Since that time, gradual changes have occurred which require meters on all businesses (1977), require meters on all new homes built after 1988, allow meters on residences upon owner request, and allow retrofit of meters on residences under certain conditions tied to the Negotiated Settlement (1990).

Comprehensive Water Use Estimation in Nevada

Since 1950, the U.S. Geological Survey (USGS) has estimated statewide water use at 5-year intervals and published these estimates as part of a national program. USGS water use estimates for Nevada and other states are included in the national summary report, but a detailed Nevada water use report with individual county breakdowns is not published by USGS (although this information is compiled). In developing these estimates, the USGS obtains available water use data and related information from a variety of entities such as the Nevada Division of Water Resources, U.S. Bureau of Reclamation, U.S. Census Bureau, U.S. Department of Agriculture, irrigation districts, federal water masters, water purveyors and other USGS studies. Since much of the water use in Nevada is not measured, the USGS has to rely upon estimation techniques for filling in data gaps and developing comprehensive county and state total water use values.

The water use estimation program in Nevada had been cooperatively funded by the Nevada Division of Water Resources (State Engineer's Office) until funding was cut in 1991. Since that time, the USGS has continued the program with other limited funds and the State has had little involvement in the process. The Division of Water Planning has requested funds to resume this program on a small scale in the current budget cycle (FY 2000 and 2001). Since the entire *State Water Plan* is predicated on water use data, resumption of the program is viewed by many as vital to the integrity of the water planning program and development of future water plan updates.

Water Use Data Currently Compiled by the State

The Nevada Division of Water Resources (NDWR) compiles a majority of the detailed water use data and estimates available within the State. Groundwater use estimates are developed for selected basins and compiled in pumpage and crop inventories. NDWR also collects other pumpage data which are submitted to satisfy water right permit requirements. According to the State Engineer's Office, these data account for about 90 percent of all groundwater use in Nevada. While these sources account for most of the statewide groundwater usage, the data are generally not maintained in an electronic database for easier access and analysis for statewide planning purposes.

Pumpage and Crop Inventories

NDWR annually compiles pumpage and crop inventories for selected basins. NDWR estimates the total groundwater pumpage for about 16 of the 256 hydrographic areas. Generally these groundwater pumpage inventories are based upon a mixture of both actual measurements and estimates. The groundwater pumpage amounts estimated in these inventories accounts for over 95 percent of the total groundwater used by municipal water systems in Nevada. As part of the crop inventories, NDWR estimates irrigated crop acreage and associated water withdrawals for about 30 of the 256 hydrographic areas.

Miscellaneous Pumpage Data

In about 80 of the 256 hydrographic areas, some water right holders are required by permit conditions to submit surface water and groundwater pumpage data to NDWR. These data are specific to a particular users such as public supply systems, mining and other self-supplied users, and may not account for all water uses within a hydrographic area.

Public Water Supply Systems. About 20 percent of the approximately 300 systems in Nevada submit water withdrawal information to NDWR. These systems serve about 95 percent of the total population and account for about 95 percent of statewide public system withdrawals. However, data may not include all surface water withdrawals by these systems, and details such as population served, consumptive use estimates and breakdowns by domestic, commercial, industrial, and thermoelectric deliveries are not requested by the State.

Other Data. NDWR collects groundwater withdrawal information for approximately 50 mining operations in Nevada. The mining operations continuously measure water withdrawals, mining consumptive uses, irrigation uses of excess mine withdrawals, reinjection volumes, and water discharges to surface streams. It is estimated that these data account for over 95 percent of the statewide mining groundwater usage. Miscellaneous commercial and industrial operations also submit groundwater withdrawal information to NDWR.

Water Use Estimation in Other States

Utah

The Utah Water Use Program is a cooperative effort between the State of Utah and the U.S. Geological Survey. As required by Utah Administrative Code R309-102-8, all community water systems are required to complete annual water use forms furnished by the state. The state also collects data from self-supplied industrial users with questionnaires mailed to these users. In 1985, the State of Utah started delineating irrigated acreages on 7.5 minute topographic map sheets, in lieu of outdated U.S. Natural Resources Conservation Service estimates. Utah updates about one-tenth of these maps every year. Irrigated water usage is then estimated from these data.

California

The Department of Water Resources has surveyed retail water agencies and analyzed their water production data for more than 35 years. This information is used in updating the California State Water Plan. In addition, the Department has been performing land use surveys since the 1950s to quantify acreage of irrigated land and corresponding crop types, and currently maps irrigated acreage in six to seven counties per year. Water use estimates are derived from water use requirements and the irrigated acreage amounts.

Other States

Many other states have water use reporting and estimation programs. Wyoming has a cooperative water use program with the USGS and mails out survey forms similar to those used by Utah. In Indiana, all entities with water use greater than 100,000 gallons per day are required to report their water use annually to the state. This requirement came about in response to declining water tables and competition for available water.

Issues

One of the major obstacles to improved comprehensive water planning and management is the State's lack of an overall water use and estimation program. The resulting lack of readily available water use data complicated development of the *State Water Plan* and has hindered other efforts. At this time, the U.S. Geological Survey (USGS) is the only agency that estimates statewide water use for Nevada. The USGS program for Nevada had been cooperatively funded by the Nevada Division of Water Resources (State Engineer's Office) until funding was cut in 1991. Since that time, the USGS has continued the program with other limited funds and the State has had little involvement in the process.

Recommendations

The following recommendations are offered as a method for improving water use measurement and estimation, and ultimately future water planning and management efforts, in Nevada:

1. The State should develop and fund a comprehensive water use measurement and estimation program. Some elements of this program could include the following:

   A. Enter water use data and estimations currently being compiled by the State Engineer into electronic databases, and link this data with water right permits database;

   B. Acquire more detailed public supply, commercial, industrial and thermoelectric usage data through one of the following mechanisms:

      a. request that municipal water systems provide additional details of water usage for data currently submitted to State Engineer's Office (for compliance with water right permit conditions) such as population served, number of connections, consumptive use estimates and breakdowns by domestic, commercial, industrial, thermoelectric deliveries, etc.;

      OR

      b. require all of the following water users to submit detailed water use information (measured or estimated) if not currently submitted:
         - public supply systems;
         - self-supplied commercial/industrial/thermoelectric users with usage over a threshold value to be determined; and
         - mining operations with water usage over a threshold value to be determined.

      Information should include the following as applicable:
         - number of persons served;
         - monthly/annual withdrawals by source;
         - monthly/annual deliveries by category (domestic, commercial, industrial);
         - estimated consumptive use;
         - anticipated future needs

   C. Expand existing program for estimating irrigated acreage and associated water use;

   D. Encourage public supply systems to meter all water deliveries; and

   E. Initiate a water measurement program for all water users to install water measurement devices, or implement water use estimation techniques (based upon power use, etc.) for certain users over a threshold use amount and for certain basins. Funding support would be a necessary component.

   F. Provide state funding for the Division of Water Planning to match the USGS cooperative water use estimation program so that all of the water use information could be compiled in a comprehensive and integrated manner.

Index - Part 3, Section 1D - Water Use Measurement

E. Domestic Wells

Introduction

In Nevada, domestic wells serve approximately 6 percent of the population and withdraw about 18,000 acre-feet per year (less than 0.5 percent of total state water use). Though domestic wells account for a small portion of the State's total water use, some domestic well issues require consideration in the planning process. The purpose of this discussion is to present the main issues associated with domestic wells in Nevada and to provide recommendations addressing these concerns.

Domestic Wells and the Water Law

As in most states, domestic wells are exempt from water right permitting under state law. This exemption applies to domestic wells with uses less than 1,800 gallons per day, which includes most domestic wells (NRS 534.180 (1)). Although domestic wells owners do not need to file water right applications with the State Engineer, drillers are required to file drilling logs with the State Engineer within 30 days after the drilling of any well, including domestic wells (NRS 534.170 (2), added in 1981)). In 1981, the State Engineer was given the authority to the registration of all wells drilled for domestic purposes within any groundwater basin or portion of a basin (NRS 534.180 (2)). For domestic wells drilled in these declared areas, well drillers are required to submit information required by the State Engineer within 10 days after well completion, and a registry of these domestic wells is maintained by the State Engineer.

Domestic Well Owner Protection

Because no permits are required for domestic wells, well owners' legal rights as existing users have been subject to conflicting statutory interpretations. Domestic well owners have the right to protest any water right application. In fact, NRS 533.360 (3) requires that applicants for a proposed groundwater use for municipal, quasi-municipal or industrial purposes with an expected withdrawal rate of 0.5 cubic feet per second (cfs) or more, in all counties except Clark County, notify all domestic well owners within 2,500 feet of the proposed well. To circumvent this requirement, some water right applicants have filed numerous applications for withdrawals, each less than 0.5 cfs, but which total together more than 0.5 cfs. In addition to these protective measures, the State Engineer has recognized that domestic well owners have the right to file complaints if they believe they are being impacted by existing permitted water uses. However, state law does allow for a reasonable lowering of the static water level at the appropriator's point of diversion (NRS 534.110 (4)).

While domestic well owners may have some recourse through the State Engineer if impacted by other junior priority water users, all well owners may have little protection from natural declines in the groundwater level due to drought. The well owner's level of protection depends in part on the depth of his or her domestic well. State drilling regulations indirectly place depth requirements on any wells through seal requirements, but do not explicitly require a minimum penetration into the aquifer. It becomes the responsibility of the well owner to be aware of potential problems with the private water supply and plan appropriately.

Parceling

For land which is to be developed as a "subdivision" with domestic wells, the State Engineer has the authority to require that water rights sufficient to meet the domestic needs be dedicated for the development. However, the State Engineer has no review authority for land divided under the "parceling map" statutes (NRS 278)[1]. Some developers have circumvented the subdivision approval requirements by parceling their property multiple times. In these instances, the State Engineer has not had an opportunity to ensure that adequate water supplies are available for the new development and that other water users are not impacted by the new development. This situation has complicated the State's ability to provide comprehensive water resource management, particularly in designated basins, and ensure that existing users are protected.

Many counties have addressed this problem by requiring water rights dedications for parcel developments under certain circumstances. When deemed appropriate, the State Engineer notifies county commissions of the need for water rights dedication requirements for designated basins, and encourages them to pass appropriate ordinances. Also NRS 278.462 authorizes the county or other governing body to request the State Engineer's recommendation on water quantity needs for parcel developments.

Groundwater Management and Planning

Complete domestic well inventories do not exist for some areas of the state. As discussed in the "Water Resources Data Development, Collection and Management" issue in Part 3 of the *State Water Plan*, the State Engineer's Office maintains a database of well logs submitted since the 1940s. However at this time, the database does not account for those wells drilled in Northern Nevada prior to 1984. All wells drilled in Southern Nevada are included in the database.

Without adequate information for quantifying the number of domestic wells in some areas, it may become difficult to estimate total and domestic well water use and total committed groundwater resources in a basin. As a result, comprehensive groundwater management and planning becomes more difficult. The State Engineer needs to consider all water uses and commitments when reviewing an application for a water right or when considering the implementation of additional administrative measures for a basin. Thus, the lack of data regarding domestic well use impacts the State Engineer's

[1]According to NRS 278.320(1), a subdivision is generally defined as "...any land, vacant or improved, which is divided or proposed to be divided into five or more lots, parcels, sites, units or plots, for the purpose of any transfer, development or any proposed transfer or development..." The State Engineer has the authority to require water rights for subdivisions.. A developer can circumvent the State Engineer's review process by dividing the property into four or fewer lots (parceling).

decision process and may lead to an inadvertent over allocation of a basin's groundwater. Effective planning requires accurate knowledge of existing water use as well. Under the existing system, this information is frequently not available.

Domestic Wells and Water Quality

Most single family dwellings using domestic wells also use individual septic tanks for wastewater disposal. State regulations and policies provide spacing requirements between domestic wells and septic tanks, and septic tank concentrations. However, the quality of domestic water supplies have been impaired by septic tank discharges and other contaminants in some areas in Nevada. While the State has funding programs to assist public water systems in complying with state and federal drinking water quality standards, limited funding assistance is available for domestic well owners.

Issues

Following is a summary of the main issues related to domestic wells in Nevada:

1. For developments created through parceling, the counties have the sole responsibility for determining whether or not water rights need to be dedicated. Some counties have passed ordinances which set forth water right dedication requirements. When deemed appropriate, the State Engineer notifies county commissions of the need for water rights dedication requirements for designated basins, and encourages them to pass appropriate ordinances.

2. Under the existing system, domestic well information may be limited in some basins.

3. Domestic well owners may have limited protection from declines in water levels. Further, domestic wells may not be drilled deep enough to provide protection from drought or interference from other groundwater users.

4. The quality of domestic well water supplies have been impaired by septic tank discharges and other contaminants in some areas. Limited funding assistance is available to mitigate these situations.

Recommendations

The following recommendations are offered to address the domestic wells issues in Nevada:

1. The State Engineer should continue, as necessary, to notify counties of the potential impacts on water resources due to multiple parceling activities, and recommend the implementation of water rights dedication requirements for designated basins.
2. The State Engineer, in cooperation with local governments, should establish complete domestic well inventories (location and number).

3. The Department of Conservation and Natural Resources should distribute educational material to existing and prospective domestic well owners regarding factors to consider when having a new well drilled or purchasing an existing well.

4. The State should support the installation or expansion of regional water supply and/or wastewater treatment systems in areas where the quality of domestic wells supplies have been impaired. The Legislature should consider modifying the AB198 Grants to Small Water Systems program or establishing a new program to provide funding for these new installations or expansions.

Index - Part 3, Section 1E - Domestic Wells

A. Nonpoint Source Pollution

Background

Clean water is essential to all life. Yet every-day activities impair water quality and thus reduce the availability of good water supplies. Throughout the U.S. and Nevada water resource experts and agencies are finding that the leading cause of water quality impairment is nonpoint source (NPS) pollution. Pollution from nonpoint, or diffuse, sources is more difficult to control than pollution from point sources, which are discharges through pipes or channels from a distinct source. Almost any activity can increase runoff and add to NPS pollution. Commonly identified sources activities and facilities such as mining, construction, grading, roads and trails, septic systems, underground storage tanks, modified water courses, feed lots, grazing and timber harvesting are commonly identified sources. These widespread activities can stir up, produce and release pollutants which are then picked up by runoff from melting snow, rain fall, or irrigation and deposited downstream in pulses.

NPS pollution occurs wherever water flowing across the land or underground picks up nutrients, salts, metals, organic material, soil, or chemicals and delivers the accumulated pollutants to streams, lakes, wetlands or ground water aquifers in amounts greater than natural background levels. The excess pollutants may result in impacts such as nutrient enrichment, undesirable algae growth, higher total dissolved solids, turbidity, lower dissolved oxygen, pH changes, higher temperatures and increases in pathogenic microorganisms. These conditions negatively affect water supplies by fouling water systems and increasing treatment requirements and operation and maintenance costs. Aquatic ecosystems may also be impacted by diffuse sources. For example, in the U.S. Fish and Wildlife Service (USFWS) recovery plans nonpoint sources are identified as an important cause of degraded fish habitat for endangered cui ui populations in the lower Truckee River system and for Lahontan cutthroat trout populations in the Truckee, Humboldt, Carson, and Walker River systems.[1] Accelerated eutrophication of lakes (e.g., Lake Tahoe) is also a concern.[2]

The presence of wetlands and water availability are important factors determining the degree of NPS impact to water quality. One of the reasons wetlands and riparian zones are valued and protected by regulation is their treatment capacity, which is the ability to detain, trap, convert and assimilate sediment, nutrients, and organic wastes. The actual relationship between stream flow and water quality is complex, but in general where river flows are lowered by drought and/or upstream diversions and nonpoint pollution is present, the negative water quality impacts can be amplified.

An innovative approach to improving water quality with increased stream flow is the Water Quality Settlement Agreement for the Truckee River. State, local, tribal and federal agencies cooperatively

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[1] *Cui-ui Recovery Plan*. U.S. Fish and Wildlife Service. 1978. *Lahontan Cutthroat Trout Recovery Plan*. U.S. Fish and Wildlife Service. 1995.

[2] Eutrophication is the aging process of a lake. Over long time spans lakes receive sediment, nutrients, and organic material. As these materials accumulate the lake slowly undergoes ecosystem changes as it fills-in.

developed a plan in 1996 to increase flows and dilute point and nonpoint source pollutant concentrations, primarily in the Lower Truckee River. Federal and local governments have agreed to share the cost of acquiring water and reservoir storage rights in the upper Truckee River system. The acquired water is intended to increase stream flow during periods when low water levels are likely to contribute to poor water quality conditions.

The dry climate, infrequency of rainfall events, and diversions from streams often are significant factors influencing the degree of nonpoint pollution impacts on water resources. For example, Steamboat Creek, a tributary of the Truckee River, collects urban and agricultural drainage. Below the creek's confluence with the Truckee River, water quality conditions deteriorate in late summer because river flows are lower, so the nonpoint source pollutant load from Steamboat Creek has a larger influence on river water quality. In the case of a large storm water runoff event that occurs after a long dry spell, larger quantities of NPS pollutants from urban development and suburban ranches can be mobilized and thus cause not only a short term water quality impact but also contribute to longer term levels of lower water quality as more solids become deposited in the creek and river channels. Circumstances vary on each river, so intensive field investigations are helpful in explaining site specific cause and effect relationships between nonpoint sources and hydrologic conditions that contribute to NPS pollutant discharges and water quality impairment. [3]

Preventing and controlling NPS pollution is accomplished primarily by implementing Best Management Practices (BMPs).[4] BMPs work on the principles that materials belonging on the land should be kept there, and that decreasing the distance runoff travels from the source minimizes control costs. Some general categories of BMPs applicable to many source activities are soil conservation, revegetation of disturbed areas, erosion and storm water controls, fertilizer management planning, integrated pest management, wetland protection and enhancement, and storm water treatment cells. Land use planning practices such as open space master plan designations, zoning controls, and subdivision development ordinances also have been used to ameliorate nonpoint source pollution potential of land development.

State agency water quality assessments, more fully described below, have found that urban areas, irrigation, grazing, and flow regulation practices are the largest nonpoint pollutant contributors.[5]

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[3] The Washoe/Storey Conservation District, Washoe County and NDEP, are working on watershed planning activities that address NPS pollution in Steamboat Creek. A related study by a University of Nevada graduate student investigates the role of land uses, pathways, and seasonality of nutrient loading into the creek.

[4] Best Management Practices for water quality improvements are defined as "those methods, measures or practices designed to prevent or reduce water pollution, including, but not limited to structural and nonstructural controls, and including both operation and maintenance procedures." BMPs should be "the most effective, practical means of preventing or reducing the amount of water pollution from nonpoint sources to a level compatible with water quality goals". *Nevada Water Quality Assessment 305(b) Report*. Nevada Division of Environmental Protection. 1998. *State of Nevada Non-Designated Area Water Quality Management Plan, Handbook of Best Management Practices*. State Conservation Commission, et. al. Not dated.

[5] Flow regulation practices includes hydromodification, which involves re-shaping a channel or drainage to carry higher volumes of water or constructing bank protective measures, and stream diversions or reservoir storage. Changes in flow patterns can cause undesirable channel adjustments that lead to impaired water quality.

Statewide, the most common NPS pollutants of concern include suspended solids, total dissolved solids (salinity and chlorides), total phosphates, nitrogen species, turbidity, and thermal energy. In some waters, arsenic, boron, selenium, lead, and iron levels are elevated. These elements are associated with geothermal sources, and become concentrated in closed basins by high evaporation rates. Runoff and subsurface flow from irrigated agricultural land may increase the amount of these contaminants. A special concern is mercury in the Carson River from historic mining and milling operations. Rapid population growth, changing land uses, urbanization, and changing public expectations regarding water quality add to the complexity of managing NPS pollution. Given the prevalence of these factors in Nevada, it is not surprising that all major rivers are impacted to some degree by NPS pollution.

Much is being done cooperatively by state, local and federal agencies and land owners to manage nonpoint source pollution through education, encouraging and funding implementation of pollution prevention and BMP retrofit projects, installation of control technologies, monitoring and assessment of nonpoint sources, improving our understanding of the cause and effect relationships between water quality impairment and pollutant sources, and researching and implementing new, more effective strategies is an ongoing effort of all agencies within the Department of Conservation and Natural Resources (Department).

State Agency Involvement with Nonpoint Sources

To address the role of nonpoint source pollution in water quality impairment, new and enhanced policies and measures were included in section 319 of the 1987 Clean Water Act Amendments (CWA). A key provision in section 319 is the requirement for states to develop, adopt and implement NPS management plans and undertake periodic water quality assessments. Nevada's policy, to identify, control, and abate NPS pollution through a combination of regulatory requirements and voluntary control and prevention measures, is consistent with section 319. In addition, NPS problem assessments and control plans in Nevada are developed through the CWA section 208 area wide Water Quality Improvement Planning process.

The NPS management activities of agencies within the Department are discussed next, followed by a general description of local and federal agency involvement in NPS pollution management.

Nevada Division of Environmental Protection

The Nevada Division of Environmental Protection (NDEP) developed Nevada's initial Nonpoint Source Pollution Management Program and Nonpoint Pollution Assessment Report in 1989. Since then the state has instituted regulatory and voluntary programs to control and abate the impacts of NPS pollution through public awareness, cooperation with other agencies and land owners, and application of Best Management Practices (BMPs). Pollution control regulations and permit programs have been implemented for discharges from septic systems, municipal storm water systems and construction or land clearing activities on projects covering five acres or more.

The NDEP emphasizes the use of Best Management Practices (BMPs), technology transfer through demonstration projects, and supporting NPS management activities by local agencies and organizations with CWA section 319 pass-through grants and technical assistance. With the assistance of NDEP and other state agencies, many NPS projects have been completed or are on-going in all major river basins. Examples of projects funded by NDEP grants include wetland and riparian zone restoration, channel erosion controls, waste load assessments, urban BMPs, grazing management practices, and water education.

The Clean Water Action Plan (CWAP), a federal initiative launched in February 1998, provides incentives to states undertaking a multi-agency process of identifying and prioritizing watersheds in need of additional NPS management actions, referred to as a Unified Watershed Assessment. NDEP and the Natural Resource Conservation Service began the process in June 1998 with a statewide watershed assessment involving interested governmental agencies and non-governmental organizations. The assessment considered water quality and related natural resource goals, then set priorities on the area's ability to meet those goals. The 303(d) listed waters (see discussion below) were a major consideration in setting priorities for Nevada's Unified Water Assessment element of the CWAP. Restoration strategies are being developed for high priority watersheds which will then be implemented by watershed stakeholders.

Innovative water quality management practices include the use of Clean Water Act State Revolving Fund monies for the purchase of Truckee River water rights to maintain minimum stream flow and improve water quality. Additionally, the Division is considering implementing a program for NPS pollution credit trading. Conceptually, NPS pollutant loads would be quantified and then removed, generating a credit which then could be applied at a discounted rate to a point source discharge. Another innovative approach that is being evaluated is the use of biological indicators as a means to further assess water quality. NDEP is cooperating with EPA on the development of a rapid biological assessment protocol that could be modified to work on streams in Nevada.

NDEP, in cooperation with the U.S. Geological Survey (USGS), monitors various waters throughout the state. The data is used to produce the biennial *Nevada Water Quality Assessment 305(b) Report* and *Nevada's 303(d) List*. The *305(b) Report* provides an inventory of major river segments, lakes and wetlands where monitoring shows impairment of beneficial uses by both point sources and nonpoint sources. Source activities and causative agents of pollution are also identified. The *303(d) List* identifies water bodies that need additional controls to achieve or maintain water quality standards, including establishing total maximum daily loads (TMDLs), and is the basis for targeting water bodies for watershed-based solutions. The TMDL process provides an organized framework to develop these solutions. TMDLs have been set by the NDEP on segments of the Truckee, Carson, Walker, and Humboldt Rivers, and the Las Vegas Wash.

The Section 208 Water Quality Management Plan (WQMP) provides a framework within which state, regional and local agencies cooperatively prioritize the management of pollution sources, including NPS. Washoe, and Clark, and the Tahoe Regional Planning Agency (TRPA) have each developed Section 208 WQMP for their respective jurisdictions. NDEP has developed a Section 208 plan for the non-designated areas of the state (including the Walker and Humboldt river basins) plus another designated area, the Carson River Basin. Of this group, TRPA is unique in their use of a mandatory, tiered approach to implementing BMPs on private land in the Lake Tahoe Basin.

Nevada Division of Conservation Districts (NDCD)

In its overall approach to conservation planning, the NDCD works to prevent and control NPS pollution with programs that build community awareness and provide technical assistance to rural and urban landowners. Areas of focus include resource planning to prevent soil erosion, protection and restoration of riparian areas and wetlands, and implementation of BMPs. The Division networks with other state, federal and local agencies in providing technical and education assistance to the public, land owners, and resource managers. The division has 27 locally led conservation districts. The districts participate in resource planning for cooperative NPS control projects, obtain the voluntary services of natural resource professionals, seek grants from state and federal funding sources, and assist local governments with NPS water quality planning projects and programs. In 1994, the NDCD and NDEP together produced the state *Best Management Practices Handbook*.

Other State Agencies

The Nevada Division of Forestry consults with landowners on plant community management techniques that emphasize erosion control. The division also operates the Forest Stewardship program through which funding and technical expertise is supplied for projects that control NPS.

The Nevada Division of Wildlife (NDOW) manages extensive wetlands on Wildlife Management Areas, evaluates fish and wildlife habitat conditions, and supports actions to alleviate NPS pollution that impact the functioning of aquatic ecosystems. In cooperation with the Nevada Divisions of State Lands and Water Resources, NDOW also seeks to obtain additional wetland areas and water supplies for fish and wildlife habitat improvement.

The Nevada Division of Agriculture (NDOA) regulates the use of pesticides and monitors for contamination. With the U.S. Environmental Protection Agency (EPA), NDOA is finalizing a management plan to protect Nevada's ground water resources from pesticide contamination.

Bi-State Agency — Tahoe Regional Planning Agency

The Tahoe Regional Planning Agency (TRPA) administers and enforces land use ordinances in the Lake Tahoe Basin that are intended to reduce NPS pollution, among other things. BMPs are required by TRPA for all construction and other land use activity on private land in the Lake Tahoe Basin. The Nevada Division of State Lands (NDSL) administers the Tahoe Basin Act of 1996, a bond program which provides $20 million to implement storm water quality improvement, erosion control and stream and wetland restoration projects in the basin.

Local Agencies Involvement with Nonpoint Sources

Nevada's nonpoint source control program places an emphasis on local management and enforcement. Local governments have a variety of tools available to accomplish this, including: 1) identifying environmentally sensitive lands during the Master Land Use Planning process; 2) adopting development ordinances with design criteria intended to minimize soil disturbance and erosion, retain wetlands and riparian zones, and preserve natural drainages and stream channels; 3) acquiring open space to achieve environmental objectives; and 4) adoption of ordinances requiring application of BMPs. Cities and counties also collaborate with conservation districts and the University of Nevada Cooperative Extension offices to enhance public education efforts on pollution prevention and to review development plans for NPS concerns.

The two largest metropolitan areas located in Washoe and Clark Counties hold permits from NDEP for discharges from their municipal stormwater systems. Under these permits, agencies within the metropolitan areas agree to monitor water quality, apply BMPs, correct illegal discharges to storm drains, and work to alleviate significant NPS discharges to storm drainage system segments within their jurisdiction.

Federal Agency Involvement with Nonpoint Sources

The U.S. Environmental Protection Agency (EPA) administers the Clean Water Act (CWA), including section 319, which encourages states to establish plans for assessing and reducing NPS pollution "to the maximum extent practicable." States meeting minimum requirements regarding assessment and management of NPS qualify for grant funding and technical assistance from the EPA.

NPS control is a key objective for federal land and water resource management agencies . The U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM) address NPS pollution through land use decisions, permits issued for grazing, timber harvest, mining and other resource extraction activities, and the application of Best Management Practices. The U.S. Army Corps of Engineers (COE) plays an important role in NPS management under CWA section 404 and other regulatory programs regarding dredging and filling of wetlands and certain waterways. Restoration of previously modified river channels and protection of wetlands are major objectives of the COE. The U.S. Fish and Wildlife Service (USFWS) coordinates with other agencies to protect wetlands on public lands and manages wetlands on national wildlife refuges. The USFS, BLM, COE and Natural Resource Conservation Service, have entered into Memorandums of Understanding with NDEP that lay out state, local and federal agency responsibilities in management and abatement of NPS pollution and wetland protection on public lands.

The Natural Resource Conservation Service (NRCS) administers programs that address NPS concerns in agricultural and suburban areas through partnerships with other agencies, such as the NDCD. The Emergency Watershed Protection, Environmental Quality Incentive Program (EQIP), and Wildlife Habitat Incentive Programs (WHIP) are examples of funding programs that help land owners pay for BMPs and NPS demonstration projects. Projects include fencing riparian areas, tailwater treatment in wetlands, and channel bank stabilization using bioengineering techniques.[6] Within a watershed framework, the NRCS periodically assesses natural resources to identify NPS problem areas and coordinates with NDEP to prioritize improvement projects.

Collection and analysis of water quality data is an essential part of the state NPS management

[6] Bioengineering techniques refers to the use of vegetation to stabilize eroding stream channels. For example, willow branches which are capable of producing new plants in moist soils, are bundled and secured in shallow trenches along sloughing embankments.

program. The USGS conducts water quality investigations and maintains permanent water quality sampling stations throughout Nevada. In addition to monitoring physical and chemical water quality constituents, sediment and biological sampling and analysis is performed.

Issues

1. The 1998 305(b) Nevada Water Quality Assessment Report indicates that ambient water quality is either partially not supporting or fully not supporting (i.e., does not meet some or all of the beneficial use standards) for 775 perennial river miles. Of the 14,988 miles of perennial rivers in Nevada, 1,639 were assessed in 1997. NPS pollution is a significant contributor to impairment of assessed waters. However, more comprehensive and watershed specific data may be necessary to track and correlate nonpoint source water quality consequences associated with hydrologic conditions (i.e., storm events, stream diversions, drought) and source areas. For example, more stream flow gauge data would be helpful in estimating nonpoint source loading during storm events and dry periods. This would result in greater cost, but these could be offset by performing field investigations in cooperation with other agencies and organizations. Furthermore, the possibility of producing more effective and lasting water quality solutions is greater.

2. Cost can be an obstacle to installing and maintaining BMPs. Federal grants are available through NDEP and NRCS (e.g., CWA section 319, EQIP, WHIP), money from which supports BMP projects on private land. The matching funds for these projects typically come from local agencies, organizations, and landowners. With the exception of the Tahoe Bond Act of 1996, currently there is no state source of funding for NPS projects.

3. Numerous studies have shown that wetlands act as relatively inexpensive NPS pollutant treatment systems, in addition to providing other natural resource benefits. The 1998 305(b) Report includes estimates that meadow wetlands historically may have covered about 246,000 acres in Nevada, and that 136,650 acres currently remain. Riparian wetland losses are uncertain. The NDEP, NDOW, community park planning departments, comprehensive planning departments, TRPA, COE and USFWS have stopped the decline of these sensitive areas. Projects encroaching upon wetlands are often required to mitigate losses in excess of the wetland acreage impaired. The cooperative approach to wetland protection between federal, state and local agencies needs to continue in order to prevent further losses and for wetland protection efforts to remain cost effective.
4. As the urban boundaries of communities in Nevada expand, development pressure on environmentally sensitive lands, such as hillslopes, wetlands, floodplains, and forested areas is likely to increase. Development of these areas can increase the potential for NPS pollution. Correcting NPS pollution problems after the fact is difficult and costly. Some local land use planning agencies in Nevada and elsewhere are addressing potential NPS impacts by incorporating water quality concerns into development policies and design standards. Examples include master planning to retain open space or protect environmentally sensitive areas, revising zoning ordinances to encourage cluster development, enlarging setbacks along drainage ways and flowing streams, limiting the amount of impervious surface, and incorporating a wide variety of BMPs into the design of roads and developments.

Recommendations

The management of nonpoint source pollution is an important water supply planning objective. To meet that objective, the following recommendation is offered.

1. The Division of Environmental Protection, in cooperation with other state agencies, should continue its nonpoint source program consisting of regulatory and voluntary measures, and coordination with federal, state, and local agencies, and the general public.

Index for Part 3, Section 2A:

B. Comprehensive Groundwater Protection and Management

Background

Ground water is a vital and finite resource. In Nevada, aridity, complex hydrogeology, rapid population growth and diversifying public interests are factors substantiating the need for comprehensive ground water protection and management. The increasing importance of this water resource is indicated by statewide ground water supply data. Forty percent of the combined water use for domestic, commercial, industrial, mining and agricultural purposes is now withdrawn from ground water aquifers. All public supply water use in 11 of Nevada's 17 counties was met in 1995 with ground water withdrawals.[1] In 1997, a total of 1930 wells were drilled for domestic (1748), industrial/public-supply (145) and irrigation (37).

A number of factors suggest that dependence on ground water will increase. Surface waters in the state are essentially fully appropriated. Furthermore, ground water resources are considered to be more drought resistant than surface supplies, thus more reliable. At present, ground water supplies generally require less treatment for removal of pollutants than surface water, due in part to the pollutant filtering effect of soils and aquifer materials. (Pending changes to federal drinking water quality standards may result in new water treatment requirements.) Also, where ground water occurs near and at the surface in an integrated system of springs and seeps, it forms an important resource for upland and aquatic ecosystems, thereby contributing to the number and value of outdoor recreation opportunities, the protection of biological diversity, a higher quality of life statewide.

Most ground water basins in Nevada contain aquifers with water of adequate quality and quantity for one or more beneficial uses.[2] However, some aquifers are showing the effects of increased demand and water quality deterioration. People commonly associate ground water pollution with drinking water concerns, but agricultural, industrial and resource conservation uses may also be affected. Ground water pollution comes from many sources, both human induced and natural, potentially limiting the types of uses and further development of aquifers. Thus, the importance of taking a comprehensive approach to ground water pollution protection and management has been well established.

Allocation of ground water resources is managed by the state engineer in the Nevada Division of Water Resources (NDWR) in conformance with the Nevada Revised Statutes (NRS) Chapter 534. The statutes are intended to provide for the protection of existing water rights and to encourage

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[1] *Draft State Water Plan*, Section 2. Public water supply refers to residential, commercial, and industrial water use by customers supplied by a public water supply system.

[2] The major exception may be basins where underground nuclear weapons testing has occurred. Matters related to accessibility and quality of ground water in these areas is beyond the scope of this paper.

efficient and non-wasteful use of the state's limited supplies. A fundamental principle is that additional allocation or appropriation of ground water will be restricted if the state engineer determines that additional wells would cause undue interference with existing wells or prove detrimental to the public interest. Where it appears that the average annual replenishment to the ground water supply may not be adequate for the needs of all permitted water right holders, the state engineer must investigate basins or portions thereof and may restrict withdrawals if recharge is found to be inadequate, or take other appropriate administrative measures (NRS 534.110).

Nevada's policy is to protect all ground water against deterioration in quality, in order to maintain supplies that are suitable for beneficial uses. In general, the approach to ground water quality has been centered on controlling specific sources of pollution. All ground water in Nevada is considered to be a potential source of drinking water. Therefore the federal Safe Drinking Water Quality Act standards (i.e., U.S. Environmental Protection Agency established Maximum Contaminant Levels) as adopted by the Nevada State Environmental Commission are applied when evaluating the potential impacts of different pollutant sources and setting remediation, or clean up, actions levels.

The Nevada Division of Environmental Protection (NDEP), in cooperation with other agencies, has developed and is now implementing a Comprehensive State Ground Water Protection Program (CSGWPP) to complement the existing water quality regulations. Program elements include assessment of ground water quality conditions, prioritization of pollution control and remediation needs, and implementation of pollution prevention and control strategies such as the Wellhead Protection Program. A primary objective of the program is to coordinate development of program elements between state, federal and local agencies, thereby taking advantage of complementary roles, responsibilities and resources to enhance the effectiveness and efficiency of ground water quality protection statewide.

Ground Water Quality

Contamination has occurred in many areas of the state, both in rural and urban settings. Sources found to cause ground water pollution include drainage from crop lands and urban lawns and golf courses treated with pesticides and fertilizers, livestock feed lots, clustered septic systems, underground chemical and fuel storage tanks, mining sites, federal facilities, oil wells and pipelines, and solid and hazardous waste disposal sites. Pollutant releases and ground water contamination from such sources are minimized through administration of regulations that require implementation of preventative measures and monitoring. Public education and awareness raising programs are elements of the cooperative strategy. Some pollution events are obvious, such as chemical or fuel spills, and can be cleaned up quickly enough to avoid aquifer contamination. However, there continues to be concern with less obvious pollutant releases which gradually become water quality problems. The presence of man-made contaminants such as pesticides, industrial solvents, and gasoline components in shallow monitoring and drinking water wells in urban areas are examples. Another example is the occurrence of high nitrate and/or pathogenic bacteria levels in some suburban and rural domestic wells. This problem often occurs in locations where the density of septic systems and residential livestock holdings are high and where the ability of soil and microorganisms to assimilate and dilute the percolating effluent is relatively low.

Much deterioration of ground water occurs through natural processes, such as leaching of mineral from rock formations, soil and playas. Salts are the most pervasive naturally occurring pollutant. Salt concentrations generally are measured as total dissolved solids (TDS).[3] Geothermal systems and volcanic rocks impart iron, manganese, fluoride, arsenic, boron and sulfates. Radon is another contaminant of concern that is commonly associated with granitic rock types. In some basins with natural contaminants, decisions to increase pumpage rates or locate new wells must take into consideration potential for migration of contaminants. Some persistent forms of natural contaminants (e.g., TDS, metals) may become more of a problem as an aquifer is depleted. Several municipal and industrial water suppliers in Nevada have had to change supply resources or implement other measures to mitigate naturally occurring high levels of TDS, iron, manganese, arsenic or nitrates.

Ground Water Recharge

Aquifers may be recharged by natural, incidental or artificial mechanisms. Natural replenishment occurs slowly in Nevada, so protecting or enhancing aquifer recharge areas and processes should be an important element of land use planning in the state. On average, only 3 to 7% of the state's annual average precipitation (9 inches, the lowest of all states) is available for ground water recharge because of high evaporation and transpiration rates, periodic droughts, and land use factors. The quantity of ground water recharge is influenced by changes in hydrologic conditions of contributing source areas and by climate. Changes of land use in a watershed that interfere with infiltration and percolation of rainfall, snowmelt and streamflow (e.g., impervious areas, road cuts, and gully erosion) can diminish both the amount of percolating water and the water quality benefits from dilution of salts.

Ground water quality and quantity can be related to recharge rates and locations. Incidental recharge by different land uses (i.e., wastewater or stormwater impoundments, urban, agricultural and golf course irrigation, septic systems) is an important ground water protection consideration because saturated conditions are created that more readily conduct pollutants into an aquifer. Both urban and agricultural areas have experienced recharge benefits and pollution impacts due to incidental recharge. In contrast, artificial recharge is accomplished under controlled conditions through the use of injection wells and infiltration basins. Artificial recharge projects proceed under permits issued by the NDWR and NDEP that require careful study and monitoring to ensure that ground water quality and permeability of aquifer formations are not significantly affected. In fact, artificial recharge can be implemented to improve overall water quality by blending with higher quality water. The NDWR has issued permits for 5 artificial recharge projects. Project sites are in Eagle Valley (Carson City), Las Vegas Valley, the Truckee Meadows (Washoe County) and in Golden and Lemmon Valleys, north of Reno. The Las Vegas Valley aquifer storage and recovery program, started in 1988, has resulted in over 150,000 acre feet of Colorado River water being injected during the winter to help meet demand in the future. Subsidence control and ground water level stabilization may be additional

[3] Total Dissolved Solids is a measure of mostly inorganic salts (e.g., sodium and chloride) dissolved in water. High TDS is often associated with taste, water hardness, and salinity problems.

benefits.

The Ground Water/Surface Water Connection

Interconnections between shallow ground water and surface water systems (i.e., integrated water systems) may exist to varying degrees in some basins. The influence of ground water discharges on the amount of water available to streams, springs and wetlands is basin specific, dictated largely by the occurrence of subsurface flow paths through aquifer formations and climate conditions. Springs in the mountains and on valley floors provide important watering opportunities for many animals and habitat for diverse assemblages of fish, wildlife and plant species. A water table in decline due to pumping can diminish surface water resources that are dependent on ground water discharge, and in turn impact biological resources and water quality. For example, dewatering of mines in the Humboldt River Basin has the potential, both during and after mining, to interfere with ground water flow and quality, thereby altering the availability and suitability of surface water for natural resources. (These cause and effect relationships are being studied jointly by mining companies and federal and state agencies.)

Studies of the ecology of springs found throughout Nevada have identified many unique, long-lived species of fish, snails, and water insects which are threatened, endangered or have been extirpated. In some circumstances, ground water pumpage and water level decline has been linked to lost or impaired habitat. This suggests more research is needed to better understand the integrated relationships between ground water use, aquifer/surface water response, and natural resource resiliency.

State Agency Involvement with Ground Water Management

State agencies have the lead role in establishing a comprehensive approach to ground water protection and management. Authority lies in various federal and state statutes, regulations, and policies. More detailed information can be found in the *State of Nevada Comprehensive State Ground Water Protection Program Profile* (CSGWPP) report and the *State of Nevada Comprehensive State Ground Water Protection Program Self Assessment* report, both of which were updated by NDEP in March 1998. The NDWR has the primary authority to allocate, adjudicate, and manage underground water resources. Regulations for ground water quality protection are implemented by NDEP, the Bureau of Health Protection Services (BHPS) in the Nevada State Health Division, and the Nevada Division of Agriculture (NDOA). The Nevada Division of Water Planning (NDWP) cooperates with these agencies to forecast water supply needs and to recommend alternative management plans to meet them. Federal, local and regional agencies participate extensively in ground water protection also.

<u>Nevada Division of Water Resources</u>

Ground water use is managed by the State Engineer in NDWR according to Nevada water law (Chapters 533 and 534, NRS). Well construction and ground water use permits are issued by the State Engineer's office. Authorization for a new ground water use is contingent upon the availability of unappropriated water, the protection of existing water rights, and consideration of factors that may prove detrimental to the public interest. Ground water use is also subject to a permit that conditions the location, timing and manner of beneficial use. However, a water right permit is not required for a domestic well.[4] The State Engineer will only appropriate as much water in a basin as can safely be expected to recharge on average over the long run.

An important set of regulations administered by NDWR are those pertaining to well construction and abandonment measures that address concerns over direct aquifer contamination from the surface or aquifer to aquifer contamination. Construction codes require measures that prevent movement of pollutant through the wells, including surface seals and plugging of abandoned wells. Well drillers are licensed by NDWR, and they must adhere to the code or face license revocation. Drillers are also required to file well logs with NDWR.

Other ground water management duties include estimation of annual pumpage and collection of various types of data where required by the water right permit, including ground water use, withdrawal, and water level data.

<u>Nevada Division of Environmental Protection</u>

The state's integrated approach to ground water quality protection is described in the CSGWPP, mentioned above. This report lists and describes regulatory and cooperative programs aimed at preventing, mitigating and remediating ground water contamination. The NDEP is now in the process of implementing elements of the CSGWPP to complement the existing pollution control programs. The core elements of the comprehensive program are existing pollution control programs that address potential water quality impacts from pesticide use, mining, underground storage tanks, underground injection control, landfills, and hazardous waste disposal. Bureaus within NDEP involved in these programs include Water Pollution Control, Mining Regulation and Reclamation, Corrective Actions, Federal Facilities, Waste Management, and Water Quality Planning. The Nevada Division of Agriculture's (NDOA) pesticide regulation and monitoring responsibilities is also in the process of being integrated into the comprehensive state program.

An emphasis on prevention is an important aspect of NDEP's comprehensive approach to ground water protection. Water pollution control regulations mandate that preventative measures be designed into facilities that are potential pollution sources, such as impermeable leak containment structures for chemical and fuel storage tanks. Solutions to controlling diffuse source pollution from urban, industrial and agricultural areas include voluntary and mandatory use of Best Management Practices (BMPs), public education, and land use regulations (e.g., ground water protection district

[4] The exemption for domestic well owners applies if the use is for a single family dwelling and where the use does not exceed a daily maximum of 1800 gallons (about 2 acre feet per year) (NRS 534.180). Metering of domestic ground water use generally is not required.

overlay zoning).

The NDEP is committed to developing a comprehensive ground water assessment, under which a process will be established for identifying “critical basins”. Criteria will include the impact of potential contaminant sources, inherent sensitivity of ground water, and the degree of local dependence on water. The assessments may be used to set priorities for basins needing additional attention in terms of coordination between programs and targeting pollution prevention efforts.

A major component of the CSGWPP is the Wellhead Protection Program (WHPP).[5] Wellhead protection involves integrated water resource planning and preventative actions intended to reduce the risk that the quality of current and future drinking ground water supplies will be contaminated from known or potential causes. Wellhead protection programs already have been started in twenty Nevada communities. Developing a WHPP requires coordinated effort by cooperating agencies and organizations to delineate wellhead protection areas, inventory potential and existing contamination sources, select and implement contaminant management strategies, develop plans for locating new wells, and develop a contingency plan. Public participation and education is an important part of wellhead protection.

Bureau of Health Protection Services, Nevada State Health Division

The Bureau of Health Protection Services (BHPS) supervises compliance of public drinking water supply systems with federal Safe Drinking Water Act (SDWA) requirements and permits domestic septic systems. SDWA Vulnerability Assessments of ground water sources supplying public water systems are done by BHPS to determine the risk of contamination and evaluate the need for periodic contaminant monitoring. A more comprehensive approach being implemented under provisions of the 1996 SDWA Amendments is the Source Water Assessment Program (SWAP). The SWAP will build upon Vulnerability Assessments with added provisions to evaluate surface water supply resources and conduct risk analysis. The source water assessment process is being integrated into wellhead protection programs in some municipalities. As SWAPs are completed, BHPS, NDEP and other cooperating agencies will encourage the development of Source Water Protection Plans. The BHPS also collects and monitors water quality data submitted by the public water supply systems.

[5] State of Nevada Wellhead Protection Area Delineation Recommendations. Nevada Division of Environmental Protection. August 1995.

Nevada Division of Agriculture

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and the Nevada Pesticides Act is administered by the NDOA. The division has authority to regulate pesticide use, and may impose a local or statewide ban on the use of specific pesticides. NDOA has drafted the Nevada State Ground Water Protection Pesticide Management Plan, and is coordinating with EPA and the USGS in the plan's implementation. Ground water monitoring in agricultural areas that have been targeted as vulnerable to pesticide contamination is done on a rotating basis around the state. Other agricultural areas are monitored randomly. Public education on safe pesticide and fertilizer use is provided by NDOA, as well as the University of Nevada Cooperative Extension and Conservation Districts.

Other State Agencies

The Nevada Division of Wildlife (NDOW) and the Nevada Division of State Parks (NDSP) hold ground water rights for various wildlife and recreation purposes, including drinking water, irrigation, wetlands, and fish rearing stations. If NDOW or NDSP has reason to believe an application to appropriate ground water will be detrimental to recreational or natural resources under their jurisdiction, the agency may object through the statutory protest process administered by the State Engineer. State water law protects springs and seeps on which wildlife customarily subsist (NRS 533.367). The Nevada Natural Heritage Program can play an important ground water management role by providing information on threatened, endangered and other sensitive aquatic species that inhabit unique shallow ground water-fed surface waters found throughout the state, and then help to develop recovery and habitat conservation plans.

Non-Governmental Organizations

The Nevada Rural Water Association (NRWA) provides ground water protection assistance to rural public and private water systems. The organization helps with the design and implementation of wellhead protection programs, satisfying Safe Drinking Water Act requirements, technical assistance, and public education.

Local and Regional Agency Involvement with Ground Water Management

Local governmental agencies and organizations are active in ground water resource protection. Local governments have the authority to pass ordinances and make land use decisions to protect ground water. An important element of master land use planning should be the evaluation and consideration of the accessibility and suitability of ground water supplies to meet future development. Several counties have environmental health departments that review land use and development proposals for potential ground water impacts, monitor ground water conditions, and implement public education programs. Twenty communities are developing or implementing wellhead protection programs, although some are encountering difficulties in implementing the programs due to limited resources, data, and expertise. Many local agencies and utility districts are advancing ground water protection public awareness and education, with programs implemented individually or in partnerships with different organizations such as the Ground Water Protection Task Force, University of Nevada Cooperative Extension, and local Conservation Districts.

In Clark County, the Advisory Committee for Groundwater Management and the Southern Nevada Water Authority (SNWA) will be seeking 1999 legislative approval to enhance and expand the Las Vegas Valley Groundwater Management Program.[6] Program elements include the construction of dedicated recharge facilities, the permanent storage of up to 5,000 acre-feet per year, public education and a comprehensive well inventory, among other activities. To meet increased water demands from 2007 until 2025, the SNWA intends to utilize Colorado River surpluses (if available), the Southern Nevada Groundwater Bank, the Arizona Banking Demonstration Project and the future Arizona ground water bank (if necessary). Under the Southern Nevada Groundwater Bank, the Las Vegas Valley Water District is recharging available Colorado River water into the regional ground water system for later use. Under the Arizona Banking Demonstration Project, the Authority paid the Central Arizona Water Conservation District to store a portion of Arizona's Colorado River apportionment in Arizona aquifers for use by Nevada. Under certain conditions, Nevada will be able to divert additional Colorado River water in exchange for the water stored in the Arizona aquifers.

Regional and local comprehensive ground water management plans are under development in other counties as well. Ground water management is a major component of the 1995-2015 Washoe County Comprehensive Regional Water Management Plan. Ground water quality and supply elements address, among other matters, industrial and nonpoint source pollution remediation and prevention, aquifer accessibility and suitability, maintenance of minimum ground water level and need for recharge, conjunctive use options, and other matters. The Carson Water Subconservancy District (Douglas, Carson City and Lyon Counties) is developing a water supply management plan which will include analysis of the benefits and costs of ground water banking (recharge) and conjunctive surface/ground water use alternatives. Nye County has undertaken a comprehensive ground water management planning effort, partly to address the potential reoccurrence of overdrafting of a ground water basin in the southern part of the county (Pahrump Valley). Other counties in developmental stages of ground water resource management planning include White Pine and Lincoln counties.

A good example of a collaborative local ground water protection organization is Nevada GOLD, or Guard Our Local Drinking water, sponsored by the University of Nevada, Reno Cooperative Extension with the Retired Senior Volunteer Program (RSVP) in Fallon and Churchill County. Volunteers use several channels to inform the public about potential pollution sources and the effect on ground water such as presentations at schools and information booths at community events. The group visits residences with private wells and septic systems to educate homeowners and to survey potential contaminant sources, such as fertilizer and pesticide use, keeping livestock, fuel storage tanks, abandoned wells, and maintenance of wells and septic systems**.**

Federal Agency Involvement with Ground Water Management

[6] *Las Vegas Valley Groundwater Management Program, Report to the Nevada Legislature*. Advisory Committee for Groundwater Management and the Southern Nevada Water Authority. December 31, 1998.

Recognizing the need for greater ground water protection, yet realizing that many state environmental statutes already addressed the matter, the U.S. Environmental Protection Agency (EPA) established the comprehensive state ground water protection program framework in 1992. Conformance with the EPA framework includes three steps: (1) developing a state profile of programs protecting ground water; (2) instituting a task force, or round table, of interested and affected organizations; and (3) performing a self-assessment of existing programs relative to protection goals. The Nevada Ground Water Protection Task Force serves the round table function through interagency coordination and public outreach. The EPA endorsed Nevada's CSGWPP in 1997.

The U.S. Geological Survey (USGS) performs many ground water basin investigations throughout Nevada, adding greatly to the understanding of the behavior of underground water systems and aquifer formations under different levels of use. Major areas of research include land subsidence, urban and agricultural drainage quality, pit mining impacts, and characterization of regional ground water systems. Monitoring of ground water levels and quality is another important activity; however, it is commonly associated with specific, localized projects or programs, and is not part of a statewide comprehensive ground water monitoring network capable of defining trends in quality or quantity.

The U.S. Bureau of Land Management (BLM), U.S. Forest Service (USFS), and U.S. Fish and Wildlife Service (USFWS) also have ground water protection interests and responsibilities. Recreational use of geothermal hot springs is popular, and these unique resources are managed to protect specially designated plant and animal species. Springs and wells are important watering supplies for wildlife and stock animals. Through land use planning and permitting, and watershed management activities, federal agencies work to avoid or mitigate potential impacts to ground water quality and recharge potential. Federal land management agencies also participate in USGS field studies involving ground water impacts on federal land.

Comprehensive Ground Water Protection Issues in Nevada

1. Substantial amounts of data on ground water quality and quantity are collected by local, state and federal agencies. Unfortunately, most data sources are scattered among the various agencies making data access for external agencies a cumbersome and time consuming process. Some agency-collected data exist in paper files and reports and are not entered into electronic database for more efficient access. State and federal agencies have recognized the need for improved data management and availability and are beginning to develop solutions. Additional funding is needed to make significant progress. The *Water Resource Data Management* issue paper (Part 3, *Nevada State Water Plan*) addresses this issue in greater detail.

2. The need for a statewide ground water level and quality monitoring network has been recognized for some time. In 1978, the USGS, with NDEP, produced a report titled *Ground-Water Quality in Nevada – A Proposed Monitoring Program* that outlined a program for systematically monitoring ground water conditions in Nevada and defined procedures for prioritizing basins for monitoring. A fundamental purpose for monitoring is to acquire data necessary for protection of existing rights and planning to accommodate increasing use of the state's limited supplies.

More information about ambient conditions and trends in water availability and suitability, and a better understanding of interactions between quality and quantity and between surface and ground water systems is needed. Extensive data are being collected in some areas, but these data collection efforts are typically driven by regulatory requirements or research projects; thus, insufficient data may exist for other areas, adding to the difficulty in current and future ground water supply planning and management efforts.

3. More reliance on ground water supplies to meet increasing demand creates a need for study of ground water supply management options. Obstacles to proposals for new dams and surface water reservoirs include high construction cost, potential environmental impacts, dwindling public funding and public opposition. There are few projects in Nevada which provide a basis for gauging the financial, socioeconomic and environmental benefits and costs of artificial aquifer recharge and recovery as a reasonable water supply alternative. In anticipation of increased ground water use, there is a need for more information about the technical, scientific, economic and legal feasibility of ground water recharge and recovery options. Additionally, research is needed to better identify important recharge zones and ascertain the potential impact of land disturbance and impermeable coverage over them.

4. Pollutants from such sources as irrigated agricultural land, golf courses, and lawns, from urban and industrial storm water impoundments and from septic systems, may cause significant ground water quality impairment. Nutrients, pesticides, salts and other pollutants can be transported through the subsurface not only to shallow wells and to deeper aquifers, but also to surface waters, contributing to nonpoint source pollution of streams. Consistent implementation of Best Management Practices (BMPs), public education programs are essential and wellhead protection programs are important ground water quality management strategies. Agencies and others recognize that higher mitigation and remediation costs can be controlled with ground water pollution prevention activities, however implementation costs may be an obstacle for some.

5. Relatively high densities of septic systems and stock animals in suburban areas have been associated with nitrate enrichment of ground water. This situation can occur where residential development proceeds incrementally over many years and the potential for cumulative water quality impacts are not recognized or studied. Domestic and municipal wells may be located in areas of impaired water quality. When larger developments are proposed, the NDEP and BHPS review project plans for potential water quality impacts and health risks. If necessary, agencies can require additional or enhanced protective measures. Remediation or mitigation measures required after water quality deterioration has occurred are often costly and controversial.

6. Relatively little is known about the cumulative effects of long term or seasonal lowering of water tables on stream or spring discharges, and whether upland and water dependent ecosystems are adversely impacted. More research is needed to gain a better understanding of seasonal and longer term ground water table changes and how fish and wildlife and their habitats, range and forest lands, and wetlands are affected by water level changes.

7. Municipal ground water supplies in California (e.g., South Lake Tahoe) have been contaminated

by methyl tert-*butyl* ether (MTBE), forcing the closure of many wells, and raising awareness and concern over MTBE use in Nevada. MTBE is mixed with gasoline to control pollutant emissions from vehicles. It was used in Clark and Washoe Counties in the past. Chemical and physical properties make MTBE a serious threat to drinking water supplies. A number of MTBE formulated gasoline fuel leaks have been discovered and are being remediated. In the absence of a federal safe drinking water standard, NDEP is developing an interim policy setting an MTBE clean-up level. Public water supply utilities with wells in the vicinity of gas stations are concerned over the present and future risk of contamination.

Recommendations

To further enhance comprehensive ground water protection and management, the following recommendations are offered.

1. The Department of Conservation and Natural Resources (Department) should continue to fully support the development and implementation by NDEP of the Comprehensive State Ground Water Protection Program (CSGWPP).

2. The Department should support the development of and funding for a more extensive, sophisticated and comprehensive ground water monitoring network as necessary to ensure that statutory water supply protection requirements and ground water management objectives are being met, including local recharge zone protection. The monitoring network should be a coordinated effort among state agencies, as well as cooperating federal and local agencies.

3. The NDEP should continue to evaluate MTBE and other gasoline additives with respect to the positive and negative impacts to both air quality and water quality, and the overall desirability of the use of such additives in Nevada.

4. The NDEP should continue to evaluate activities necessary to control sources of nitrate contamination, such as septic system discharges, which affect ground water.

5. The NDWP should research the possibility of modifying the AB 198 Grant Program or establishing a new program to fund the creation of new or expansion of existing public water systems where septic tank pollution of the ground water has become an issue.

Index for Part 3, Section 2B.

A. Maintenance of Recreational Values

Background

Recreational use of public waters and lands is on the rise in the U.S. Federal and state visitor and expenditure data suggests that outdoor recreation in Nevada is growing as well. The U.S. National Park Service (NPS) reported 9,926,532 visits to National Parks in Nevada during 1995. The U.S. Forest Service (USFS) recorded 21,423,000 recreation visits to national forest lands during 1996. Nevada Division of State Parks (NDSP) reported about 3.2 million people visited its 24 state parks in 1997, compared to 2.5 million visitors at 22 state parks in 1987. In a 1996 nationwide study of freshwater sport fishing, the American Sportfishing Association estimated angler expenditures to be $211 million, overall economic impact of $335.7 million, and related salaries and wages to be $92 million. According to 1996 recreation expenditure data collected by the U.S. Fish and Wildlife Service (USFWS), fishing, hunting and wildlife watching activities generated about $211.1, $94.9, and $262.8 million, respectively. Boating registration has grown nearly 75% over the past ten years, according to the Nevada Division of Wildlife (NDOW). The forms of recreation are also changing. NDOW reports the number of registered personal water craft (e.g., jet skis) has grown in the past decade from 1,326 to 13,451. NDOW has also noted a groundswell in wildlife watching activities.

Water-based recreation is an integral part of meeting the recreation needs of Nevada’s residents and visitors. About 70% (2,277,440) of the visits to Nevada State Parks in 1997 occurred at state parks with water resources available for recreation. Fishing, boating, skiing, swimming, camping and picnicking are popular activities at lakes and reservoirs. Nevada’s larger streams offer many of the same activities plus white-water boating (i.e., rafting, kayaking, and canoeing). Of Nevada’s 24 state parks, 14 incorporate water as a key component of the recreation resource. Nevada’s State Wildlife Management Areas (WMA) contain natural and artificial wetlands that provide hunting, fishing, hiking, camping and bird and wildlife watching opportunities.

Some recreation resources in the state have international importance such as the Lahontan Valley Wetlands which support large populations of waterfowl migrating along the Pacific Flyway, and the Lake Tahoe Basin, with water clear enough to be the centerpiece of a multi-billion dollar tourism industry. Hydrologic, vegetative and open space conditions on some agricultural lands support recreational resources directly and indirectly with unique wildlife and aesthetic values. Providing adequate amounts of suitable water for Nevada’s recreation resources is integral to the linkage between regional, state and local natural resource values and their economies. Thus, maintaining recreation values is an important consideration in water supply planning.

What are “Recreation Values”?

Water resources (i.e., streams, lakes, springs, riparian systems, wetlands, etc.) possess intrinsic characteristics that people value for passive and active recreation activities. The condition of fish and wildlife habitat and water quality, number of fish caught, upland game hunting prospects, biological diversity and aesthetics, wilderness, solitude and spiritual regeneration all play a part in determining the public's recreation "values". The inherent values which users place on outdoor recreational experiences are difficult to measure. However, resource managers require "recreation values" information as inputs to develop plans that will provide the recreational opportunities for the state's growing population without sacrificing the quality and integrity of the natural resources and aquatic systems used and developed.

Recreation value can be measured in monetary terms in at least three ways: (1) the value users place on enjoyment of their recreation experiences measured by the amount people are willing to spend to get to and use various sites; (2) the net economic income a type of recreation generates - the revenues generated directly and indirectly by recreation activity, less the costs of providing and managing the recreation resources and facilities; and (3) an analysis of revenues (including taxes) generated by expenditures on recreational goods and services.

Additionally, the availability of water recreation resources is an amenity that can enhance a community's attractiveness to new businesses. In some communities, quality of life indicators have been adopted that recognize the linkage between economic development, community well being and outdoor recreation values.

State Agency Involvement with Recreation Values

The Nevada Divisions of Wildlife and State Parks have primary management responsibility for recreation resources and facilities at many water bodies in the state, but all divisions play an important role in maintaining recreation values. To varying degrees, the management of developed and natural features of state lands used for recreation is shared, according to each agency's area of expertise. For example, NDSP cooperates with NDOW to meet campground needs on wildlife management areas and NDOW cooperates with NDSP on fishery management matters at state parks. Key responsibilities and work efforts related to water-based recreation uses and values are summarized by state division below.

Nevada Division of State Parks

The Statewide Comprehensive Outdoor Recreation Plan (SCORP), prepared by NDSP, is intended "to carefully examine the collective influence of the many recreation providers, analyze the recreational issues important to both providers and recreationists, and provide a policy plan to improve and maintain Nevada's recreation base...[and] provide a tool for recreation leadership and action in Nevada for the next five years." Two of the foremost concerns identified by the participants in the 1992 SCORP planning process were: (1) "Water resources are vital components of Nevada's recreational base and should be protected to maintain sufficient quantity, quality and adequate accessibility, where appropriate; and (2) Existing levels of outdoor recreation funding are inadequate to meet the recreation needs of Nevada." [1] In recent years, steps have been taken to address both of these issues.

[1] *1992 State Comprehensive Outdoor Recreation Plan*. Nevada Division of State Parks. October 1992.

A comprehensive State Park System Plan was completed in 1997 which contains individual master development plans for each park unit. Almost $28 million has been spent since 1987 acquiring and improving state parks. Some of this funding came from the 1990 Parks and Wildlife Bond Initiative. A few of the many actions include acquisition of three major ranches along the Carson River between Fort Churchill and Lahontan Reservoir creating an innovative water trail, construction of the South Fork Reservoir boat launch facilities and campground, acquisition of Little Washoe Lake and development of basic day use facilities, and upgrading sewer and water systems in several parks.

Nevada Division of Wildlife

The protection, preservation, management, restoration and use of wildlife populations in Nevada is the primary responsibility of NDOW. Agency planning, operations and funding for wildlife population and habitat management are linked to the public's wants and needs for boating, hunting, fishing and wildlife watching opportunities. Protection and management of wildlife habitat and acquiring legal access to it for recreation purposes is a priority objective that is implemented cooperatively with other state and federal agencies, and private parties (e.g., owners of crop land with wildlife habitat). Acquiring access, conservation easements and water rights from willing parties to enhance fishery and other wildlife values of open water and wetland resources is one strategy being pursued. These actions will progressively meet the growing public demand for boating, fishing, and wildlife watching resources.

Another strategic action is the development of 150 water sources in areas where water is a limiting factor for wildlife. Over 1000 wildlife guzzlers have been installed, and NDOW has plans for more.[2] In addition, NDOW manages wildlife and habitat on approximately 120,000 acres at 11 State Wildlife Management Areas (WMAs). Wetlands are important features of most of the WMAs.

The Division's responsibilities for management and protection of fisheries, boating, and migratory and resident bird habitat are three major areas of statewide recreational resource management directly related to water resources. Approximately 150,000 people fish in Nevada each year, accounting for an estimated expenditure of over $211 Million, according to a Division study in 1996. Special protections for rare and jeopardized fishes, production of fishes at hatcheries and rearing stations, regulation of anglers, and access are elements of the fisheries program. Use of personal water craft is increasing also, presenting new challenges to maintenance of water recreation values. Boating activity is concentrated on lakes and reservoirs, although white-water boating on streams is growing. Six major areas of NDOW's boating safety program are administration and enforcement of regulations, education, registration and titling, navigational aids and public access.

Competition among multiple users of public lands and land use changes to private lands have resulted in impairment and loss of wetlands and riparian areas inhabited by waterfowl. The Division cooperates with several agencies and organizations in management of migratory game birds under provisions of the federal Migratory Bird Treaty Act. The Division's overall direction is to manage and protect all aquatic habitats for both game and non-game species.

[2] *Comprehensive Strategic Plan*. Nevada Division of Wildlife. 1997.

The Wetland Conservation Plan Applicable to Nine State of Nevada Wildlife Management Areas was completed in 1998. The preliminary assessment of wildlife resource values and functions at the WMAs (Volumes II and III of the above mentioned report) resulted in identification of several policy and management issues, of which the foremost was water management. Specific areas of concern mentioned are: (1) water has not always been managed efficiently in all areas of the State; (2) water availability depends on adequacy and seniority of water rights owned by NDOW; and (3) cyclical, prolonged drought periods exacerbate shortfalls in water needed to sustain wetlands at the WMAs. The Board of Wildlife Commissioners will review and may revise relevant policies as a result of this planning effort.[3]

Nevada Division of Water Resources

The State Engineer recognizes recreation and wildlife as legitimate beneficial uses for which water rights may be held (to establish and maintain wetlands, fisheries and watering sources at springs and seeps for wildlife use). Under statutory criteria the State Engineer must consider the public interest in his decision making process. The State Engineer has approved water rights for recreation purposes such as: (1) wetlands and open waters at many of the WMAs; (2) instream flows for Mahogany Creek and Condor Canyon (Meadow Valley Wash); (3) numerous spring developments for wildlife; and (4) minimum pool elevations at several reservoirs (Illipah, Lahontan, Knott Creek, Lake Tahoe, Lake Mead, and Topaz Lake). Ongoing actions to secure more water for recreation include applications received for many streams in the Jarbidge and Bruneau River drainages and negotiations involving Onion Reservoir.

Nevada Division of Environmental Protection

The Nevada Division of Environmental Protection (NDEP), with the State Environmental Commission, sets water quality standards protective of designated beneficial uses that include recreation, (i.e., contact and non-contact recreation activities, sustaining populations of aquatic organisms, and wildlife propagation). Water quality of major river systems, lakes and reservoirs is monitored to determine whether ambient conditions meet the site and use specific water quality standards. NDEP is also involved in water quality investigations to determine whether recreation activities, among others, may be impacting water quality. An example is study of the potential water quality impacts resulting from motorized recreational activities on Lake Tahoe. The division also cooperates with other agencies where changing water quality conditions may place the recreating public's health at risk.

Nevada Division of Forestry

The Division of Forestry (NDF) protects recreation values with watershed management activities, such as: (1) managing wildland fires; (2) operating a seed bank and nursery that provides native and adapted plants for rehabilitation projects; (3) managing conservation honor camp inmate crews to

[3] *Wildlife Resource Values of Wetlands. Task II. Wildlife Resource Values of Wetlands at the State of Nevada Wildlife Management Areas.* Prepared for Nevada Division of Wildlife by Huffman and Associates, Inc. July 1998.

rehabilitate recreation lands; and, (4) assisting public and private land owners to manage forest resources for watershed protection, wildlife habitat and recreation. Since 1990 NDF has written Forest Stewardship plans for over 121,377 acres of private land leading to projects such as bank stabilization on the Muddy River and timber stand improvement in the Lake Tahoe Basin.

Federal Agency Involvement with Recreation Values

More than 62 million acres are managed by federal agencies in Nevada. Recreation has become a major management emphasis for the federal agencies which include the U.S. Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, Bureau of Indian Affairs, and the National Park Service. They manage developed recreational resources throughout Nevada. Most of the prominent natural and man-made lakes and reservoirs with developed recreation resources are located on public lands. State and federal agencies cooperatively manage fish and wildlife populations, water quality, lands leased by the state for recreation facilities, and other recreation resources.

The majority of public lands in Nevada are open for dispersed recreational activities such as day hiking, horseback riding, vehicle touring, camping, backpacking, canoeing and kayaking, fishing, and hunting. Dispersed activities on public lands may have cumulative water resource impacts where large numbers of recreationists visit popular streams, springs, wetlands and lakes, such as those near urban areas. Federal agencies generally recognize the potential water quality impacts from recreation as important watershed management considerations, especially in those watersheds that are sources for public water supplies.

Federal land managers have become more recreation-focused in their forest plans and land use plan revisions in response to public demand nationwide. The creation of wildlife management areas and refuges and national recreation areas, and efforts to acquire water rights for wildlife habitat are indicators of this changing focus, as is the National Recreation Lakes Study Commission. The commission was created in the Omnibus Parks and Public Land Management Act of 1996 (P.L. 104-333). The purpose of the commission's study is to "review the current and anticipated demand for recreational opportunities at federally-managed manmade lakes and reservoirs" and "to develop alternatives for enhanced recreational use of such facilities."

Issues

1. Maintenance of recreation values is an issue considered in the state water plan because recreation is an important beneficial use of the state's water resources. Recreationists today expect an diverse range of recreation choices in a variety of settings. Maintenance of recreation values depends upon a balance between developing facilities to accommodate a diversity of recreation types while protecting the quality and quantity of aquatic systems and natural resources from overuse for present and future generations.

2. With increased recreation, there is growing public interest in enhancing and maintaining stream

flows, reservoir and lake levels, good water quality conditions, high quality riparian zones and wetlands for fish and wildlife habitat, and public access to waters and adjacent land. However, major rivers in Nevada are fully allocated and during droughts recreation resources are negatively impacted. During the prolonged drought of the late 1980's through early 90's, many boating access points at lakes and reservoirs were unusable; fish and wildlife habitat deteriorated and populations declined; perennially flowing segments of major rivers went dry; water quality declined; and overall water-based recreational opportunities were fewer. It is likely that more innovative water allocation approaches will be needed to sustain water-based recreation values in the face of growing recreation demand, fully allocated rivers, and recurring droughts.

3. Nevada's urban areas are expanding. In some areas, development of private land abutting public land results in loss of access to recreational waters. Increased cooperation between federal, state, and local land use planning agencies could avoid or mitigate access issues.

4. While the public's demand for water-based recreation has grown, the cost of agency operations per user has increased and federal funding for recreation has dwindled (e.g., Federal Land and Water Conservation Fund awards to Nevada fell from $3.2 million in 1979 to zero in 1995). Funding is inadequate to maintain existing water based recreation sites and amenities. New funding strategies are warranted.

5. Conflicts occur between recreationists and other water resource users using the same water body for different purposes. For example, new diversion dams or weirs that extend the full width of river channels can impact navigability, limit fish passage and create safety hazards. Agencies reviewing project proposals to modify existing or construct new structures, as well as other land use activities in water bodies and shore zones, have become increasingly cognizant of the need to take changing recreation needs and values into consideration.

6. The type and intensity of recreation activities affects waters with unique or sensitive resource values, such as habitat of protected animal and plant species, archeological and historical features, and waters with unique or outstanding resource values. An example is the effect that increasing personal water craft use has on water quality. Recreation has been managed by state and federal agencies to avoid or minimize those effects, however increasing recreational activity could present the need for more monitoring to ensure unique or sensitive resources are adequately protected.

7. Most of Nevada's outdoor recreation occurs on and around waters managed by state and federal agencies. Finding opportunities to increase coordination between agencies could enhance recreation resource planning and management. Collection of recreation data (e.g., visitor days, forms of recreation, and recreation values) is one example where agency cooperation could be mutually beneficial in terms of sharing and reducing cost, improving data consistency and reliability, and assisting in making better informed recreation resource management decisions.

Recommendations

The *1992 State Comprehensive Outdoor Recreation Plan* (*SCORP*) contains discussion of specific issues, policy recommendations and suggested actions that pertain to the broader issue of maintenance of recreation values.[4] Recreation issues applicable to the state water plan are found in Chapter IV of the 1992 *SCORP*, Issues and Actions for the Next Five Years. In 1997 NDSP produced the State Park System Plan which describes operations and resources within the park system and its future. Another source of guidance on recreation values is the policies and plans developed by the Nevada Board of Wildlife Commissioners and the NDOW presented in the *Wetland Conservation Plan Applicable to Nine State Wildlife Management Areas* (1998). This plan focuses on wetland protection at WMAs, but recommendations may have applicability to wetlands statewide.

1. The Department of Conservation and Natural Resources (Department) should continue to periodically evaluate the state's water-based recreation resources, assess public demand for this type of recreation, and apply this information to state recreation planning and management efforts to improve customer satisfaction while protecting natural resources.

2. The Department should encourage public agencies to consider impacts to recreation resources and their values relative to existing and potential recreation uses, whenever modification to existing or new public water-related projects, such as dams, weirs and reservoirs, are proposed.

3. The Department should continue to seek opportunities to acquire water rights from willing sellers for recreational purposes, including enhancements for fish habitat, wildlife habitat, flat water recreation and river-based recreation, where consistent with an agency's management plans.

4. The Department should continue to seek new and additional sources of funding to enhance opportunities and maintain resources for recreation.

5. The Department should research the feasibility of alternative mechanisms the state could use to meet public water-based recreation needs, such as purchasing land adjacent to state-owned water bodies, and obtaining development rights, conservation easements, and land use agreements.

6. The Department should encourage and support the efforts of state, federal and local agencies to manage watersheds for protection and enhancement of a full complement of recreation values, in addition to the other natural resource conservation considerations.

Index for Part 3, Section 3A

[4] The update of the State Comprehensive Outdoor Recreation Plan by the NDSP is ongoing. It should be completed late in 1999.

B. Water for Wildlife and Environmental Purposes

Background

As competition for the state's limited water intensifies, concern is growing that water supplies for wildlife and environmental purposes, or the minimum instream flow to conserve such resources, have not been fully considered in policy making and planning frameworks. Thus, maintaining minimum instream flows has become an important water use management issue in Nevada.

Instream flow is typically defined as water which is not diverted from a channel and used consumptively, but rather remains in a water course to maintain other non-consumptive beneficial uses. Herein, the term *instream flow* encompasses the broad range of non-consumptive uses also identified as water for wildlife and environmental purposes and resource conservation. A common water planning criteria is *minimum* instream flow. This is defined as the smallest amount of flow (measured in cubic feet per second) necessary to maintain one or more beneficial uses specified for a stream or segment. The term *instream flow* is further described in the broad context of water supply planning to conserve and enhance streams, riparian zones, wetlands, springs and lake and the biological resources they support.

Instream beneficial uses in Nevada include habitat for aquatic invertebrates, fishes, birds and other wildlife, maintenance of water quality, and recreation. Maintaining the productivity, diversity, and resiliency of Nevada's biological resources depends on adequate and reliable stream flow. Minimum streamflow for natural resource conservation is the focus of this issue paper. For more information about water supply planning for recreation, see the issue paper titled *Maintenance of Recreation Values* in Part 3 of the *Nevada State Water Plan*.

Surface water in Nevada is often fully appropriated. Yet, relatively few water rights are held for resource conservation, since most appropriated water is permitted for consumptive beneficial uses that require offstream diversions.[1] Since early in the state's development, people have had to divert streamflow for such essential purposes as agriculture, mining, domestic, municipal and industrial supply uses. While acknowledging the necessity of continuing to divert water for human use, society has begun to place increasing value on environmental protection and natural resource conservation.

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[1] Agricultural, municipal and industrial consumptive uses generate return flows which vary in quantity and quality. Return flow is the portion of water diverted for use that is not consumed and is returned to the source. Unconsumed water which is returned to the original source is available for the next offstream or instream use. Streamflow which is reused many times without intervening treatment can increase pollutant concentrations, negatively affecting biological productivity of crop and pasture lands as well as aquatic and riparian ecosystems. Ameliorating impacts such as elevated salinity, biochemical oxygen demand, and temperature often requires the application of more water to flush or dilute pollutants concentrated in the soil or water column.

One hundred years ago, impacts on fish populations, riparian vegetation and lake ecosystems as a result of diversions were unanticipated or not viewed as a concern. In the last 25 years, expectations for the protection of rivers and streams have changed gradually. The Clean Water Act (CWA), Endangered Species Act (ESA), National Environmental Policy Act (NEPA) and Wild and Scenic Rivers Act (WSRA) were all passed in the last 30 years in growing recognition of the economic and social benefits to conserving natural resources. These laws are persuasive testimony to continuing public concern for the environment. Water resource allocation and management decisions now include consideration of vulnerable species, water quality, environmental values and recreation demand generated by the state's growing urban population and tourism-oriented industry. Nevada's laws permitting instream flow rights for wildlife and environmental (and recreation) purposes are responsive to this perspective.

Nevada's Unique Water Resources

Nevada's landscape encompasses unique water dependent ecosystems that provide economically and socially important benefits, including fishing, hunting, wildlife watching, scientific research and solitude. The state has terminal desert lakes and expansive wetlands which are crucial to waterfowl migrations. Rare, relict fish and mollusk species still subsist in ancient springs. Native fish populations have stood the test of the Great Basin's climatic and hydrologic extremes. Riparian plant communities host diverse assemblages of mammals, amphibians and birds, and also moderate stream temperatures, trap sediment, and impart resiliency and predictability to channel behavior in times of flood. Water available to these resources must be adequate in frequency, duration and amount in order to maintain their natural restorative and regenerative functions. Critical self regulating mechanisms include the ability to convert, dilute and flush accumulated pollutants; redistribute sediment to retain floodway capacity; rejuvenate coarse and fine grained patches of habitat essential for the diverse life cycle needs of aquatic organisms; disperse seeds from riparian and wetland plants and thereafter keep soil moist for their germination and survival.

The number of native fishes that have become extinct or listed as threatened, endangered or sensitive by federal and state agencies is an indicator of the adequacy of water supplies available for aquatic ecosystems. Of Nevada's 104 native fish species and subspecies, 11 are now extinct (i.e., no longer existing) or extirpated (i.e., no longer existing in portions of its native range) and 23 are listed as threatened or endangered under the Endangered Species Act (ESA). Approximately 56 percent are designated as sensitive.[2] Other water dependent species at risk include 7 amphibians, 3 mammals, 67 gastropods which inhabit springs and/or creeks, and a number of water insects. Twenty-eight (28) bird species that depend upon functioning aquatic or riparian ecosystems at some point in their life cycle are also at risk.[3] The statewide distribution of mapped occurrences of sensitive species is shown on Figure 3-1 on page 3B-5. The sensitive status of so many species is an indicator of the need for instream flow assessment and protection in some areas.

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[2] *Sensitive* is a term used by the Nevada Natural Heritage Program that is applied to species that are tracked. Such species are either declining, exists in isolated populations, or requires special management to survive. Of the 70 native, extant fishes that are not listed, 39 are designated as sensitive.

[3] Personal communication, Nevada Natural Heritage Program staff, December 1998.

Other indicators that water supplies may be insufficient for wildlife and environmental purposes include extensive loss of riparian forest and wetland systems; long term declining water levels in Pyramid Lake and Walker Lake; periodic drying of river channel segments; and impaired water quality of some lakes and segments of the state's major rivers.[4] Managing stream flow to protect sensitive species alleviates stresses from other detrimental forces, forestalling more stringent regulations, and thereby reducing administrative burdens on private enterprise and public agencies. Thus, water resource managers are increasing their efforts to augment water supplies for instream beneficial uses and to enhance the integrity of water dependent ecosystems.

Factors other than stream flow depletion by offstream diversions may have an impact upon aquatic and riparian life and habitats. For example, some dams prevent fish passage or alter sedimentation processes in ways that impair the quality of aquatic habitat for fish and wildlife propagation. Nonnative fish species prey on a range of aquatic organisms and may be more aggressive, out-competing native fishes for spawning habitat and food supply. Overdrafting shallow aquifers may affect stream and spring flow, a growing concern as more ground water supplies are developed. Flow regimes may be impacted by land use activities and developments that do not adequately mitigate their effects on hydrologic processes, thereby diminishing a watershed's ability to capture and slowly release runoff and recharge aquifers. Encroaching development, nonpoint source pollution, invasion of exotic plants, degraded watershed and channel conditions, and natural variation are other possible causes for aquatic ecosystem impacts. These site specific factors should be evaluated when determining how best to achieve aquatic and riparian resource conservation objectives.

Assessing Water Needs for Wildlife and Environmental Purposes

Determining minimum instream flow requirements is an important consideration in protecting Nevada's comparatively rare aquatic and riparian ecosystems (and associated recreation opportunities). Minimum instream flow requirements fluctuate seasonally and vary by stream segment depending on characteristics such as channel dimensions and shape, amounts of shallow ground water flowing into or out of a channel reach, water or moisture requirements of present (and absent) aquatic and riparian animal and plant species, and the rate of pollutant inputs from both natural and human sources compared to the natural capacity of biogeochemical processes (e.g., nutrient and carbon cycles) to regulate pollution levels.

In Nevada, most upper basin stream segments are free-flowing. Proceeding downstream through the middle and lower valleys of Nevada's river basins, stream flow increasingly becomes regulated

[4] The estimated long term loss of wetland acreage statewide is 52 percent. In western Nevada, wetland losses are about 85%. An evaluation of threats to wetlands by the Nevada Divisions of Wildlife and State Parks in 1987 ranked diversions and lack of water rights as the most serious threat. (in *Wetland Conservation Plan Applicable to Nine State of Nevada Wildlife Management Areas*, Huffman and Associates, Inc., July 1998.) Lower Truckee River riparian shrub and forest communities historically covered about 7,700 acres, and is estimated today to be 1,020 acres according to recent US Army Corps of Engineers reports. US Fish and Wildlife Service vegetation mapping in 1993 indicated only about 85 acres of cottonwood forest coverage remains below Derby Dam (in *Truckee River Operating Agreement, Draft EIS/EIR, Biological Resources Appendix*. US Department of the Interior. February 1998.)

by the operation of reservoir and diversion dams. Flow fluctuations are important to help (re)establish riparian vegetation, maintain water quality, remove sediment from the floodway, and otherwise maintain the efficiency of a stream channel. Diversions may have a dampening effect on flows, moderating the natural highs and lows. The combination of natural losses and offstream diversions significantly reduces streamflow through the summer and autumn months. Typically, October low flow measurements are in the range of 1.0% to 0.1%, or less, of June peak flow measurements in the middle and lower stream reaches. Natural losses are due to higher evaporation and transpiration rates and seepage away from the channel. Evaporation and transpiration losses may be exacerbated along over-widened and unshaded stream segments, or where exotic phreatophytes (e.g., tamarisk) are dominant. By late autumn and early winter, stream discharge rates typically rebound to approximate base flow levels.

There are no standards for setting a baseline or formula for establishing minimum instream flows. However, various methods to assess minimum flow or minimum pool requirements for biota, recreation, aesthetics, and channel maintenance have been developed. Equivalent methods to estimate minimum water supply needs for other water bodies and wetlands have been developed and have been used occasionally in Nevada. Most often, instream flow assessments in Nevada have been conducted in response to applications for new water rights or changes in the point of diversion for existing water rights, and projects that require environmental assessments in accordance with provisions of the NEPA or the ESA.

Water Rights for Wildlife and Environmental Purposes

Protecting instream flow will depend on acquiring water rights, and converting them from existing uses to instream uses according to state water law. Nevada's legislature adopted a system of allocating water rights based on the principles of prior appropriation and beneficial use in 1905. Because surface water demand sometimes exceeded normal streamflow, the courts had to settle, or adjudicate, competing water claims on large and small stream systems. Court decrees were formulated for each major river, specifying the water right holder, the extent of the water right (i.e., quantity, location, and manner of use), allocation priorities, and river system-specific procedures for water transfers.

In recent years, more consideration has been given to obtaining water rights for instream purposes because of advancements in science and changes to the state water law. As scientists have refined their knowledge of aquatic and riparian ecology and as agencies have increased resource monitoring, awareness has grown regarding the impacts of diminished streamflow and lowered ground water levels. During this period, the Supreme Court of Nevada handed down decisions that have led to a broader legal interpretation of beneficial use, and have better defined public interest criteria that has been applied by the State Engineer when making decisions about appropriative water rights.

In 1988 the Court ruled that the State Engineer acted within the legislated authority of the office in granting a water right to the U.S. Bureau of Land Management (BLM) to maintain a minimum pool of water, an *in situ* use (i.e., in place, non-diversionary and nonconsumptive), for recreation, wildlife, fisheries and stockwater purposes in Upper Blue Lake, Humboldt County (Nevada v. Morros, 766 P.2d 263 (Nev. 1988)). Nevada water law allows the holding of water rights for instream uses for the benefit of biological resources and recreation. Additionally, where instream water rights for environmental uses have been permitted, applications for new water rights or the transfer of existing water rights may be denied if the proposed use "threatens to prove detrimental" to the instream water rights.

Examples of Instream Flow Management Actions

Over the past ten years a number of agencies and conservation organizations have assessed water supply needs and pursued water right purchases for wildlife and environmental purposes. Some of these activities are briefly described below.

1. To satisfy Truckee-Carson-Pyramid Lake Water Rights Settlement Act (Public Law 101-618) provisions, wetland water requirements were estimated by the US Fish and Wildlife Service (FWS) for the Stillwater National Wildlife Refuge, Stillwater Wildlife Management Area, Carson Lake and Pasture and Fallon Paiute-Shoshone Indian Reservation wetlands. The FWS, in cooperation with the U.S. Department of Interior (DOI) and Nevada Division of State Lands (NDSL), is responsible for purchasing from willing sellers sufficient water to sustain 25,000 acres of prime wetlands in Lahontan Valley.

2. To implement the Truckee River Water Quality Agreement, cooperating agencies have modeled water quality improvement as a function of stream flow and used the information to estimate water supply needs for flow augmentation during periods of lower water quality. Washoe County and the cities of Reno and Sparks, have begun to purchase water rights and apply for their transfer.

3. Also on the Truckee River, the FWS, using a plan developed by The Nature Conservancy, has obtained the Federal Water Master's agreement to modify reservoir releases when surplus water is available to meet requirements for riparian forest regeneration along the lower river.

4. The BLM has estimated Walker Lake inflow requirements for the restoration of lake level and water quality in support of the vulnerable cutthroat trout population and migratory waterfowl habitat.

5. The Nevada Division of Wildlife (NDOW) has assessed minimum instream flows to determine the potential impact to fish habitat from water development projects proposed for the Truckee River and Lamoille Creek. The agency also has taken advantage of opportunities to obtain water rights and formal and informal agreements for return flow water from irrigation systems, a power plant, and a municipal water treatment plant to maintain reservoir pool elevations and wetlands on state wildlife management areas (WMA).

Since a water right is recognized as property, any public policy measures to increase water supplies for resource conservation purposes may require compensation. In Nevada, both federal and state funds have been allocated to purchase water rights from willing sellers. Alternative approaches are being implemented in other western states. Colorado allows tax benefits for water right donations to the Colorado Water Conservation Board. In New Mexico, the Middle Rio Grande Conservancy District recently opened a water bank, which will lease surplus water to other users.[5]

Conservation organizations in several states have acquired water rights for instream flow protection. They have identified important considerations when evaluating the benefits of acquiring water rights for instream flow enhancement, which include: (1) whether transfer of the water rights to instream use can meet transfer requirements of state law; (2) the seniority of the water right relative to others; (3) the suitability of the source water for the instream purpose(s); (4) the availability of reservoir storage rights, if required; and (5) the price for a water right, which varies in a competitive market according to such factors as location, type of use and priority date.

State Agency Involvement in Instream Flow Management

Divisions within the Department of Conservation and Natural Resources have primary authority to administer laws and regulations pertaining to water use and allocation, water quality, and fish and wildlife populations in Nevada. Thus, these agencies have the largest role in water supply management for resource conservation. Federal agencies with land use management and federal law administration responsibilities make important contributions to instream flow protection as well. Local and tribal agencies have also become involved with instream flow management.

Nevada Division of Wildlife

The Nevada Board of Wildlife Commissioners has adopted explicit policies and regulations to achieve adequate instream flows, minimum reservoir pools, and water for wetlands, springs and seeps for the benefit of fish, aquatic ecosystems and wildlife. NDOW supports the acquisition of water rights from willing sellers as opportunities arise. Nine state wildlife management areas (WMAs) managed by NDOW contain wetland acreage and reservoirs for which surface and ground water rights have been obtained. Water rights at some WMAs depend on surplus flow or irrigation tail water, presenting management constraints and resource quality concerns, especially during dry periods.[6]

NDOW also has responsibilities and programs for protection and propagation of native fish populations and sensitive species. NDOW reviews water appropriation applications submitted to the State Engineer to evaluate potential for impacts to wildlife and habitat. If the proposed water use would threaten, drastically modify, or severely curtail protected or sensitive wildlife populations or their habitats, the Division Administrator may file a written protest against granting the

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[5] *Saving Our Streams Through Water Markets. A Practical Guide*. Clay J. Landry. Political Economy Research Center. 1998.

[6] *Wildlife Resource Values of Wetlands. Task II. Wildlife Resource Values of Wetlands at the State of Nevada Wildlife Management Areas.* Huffman and Associates, Inc. July 1998.

application. Assessments of the adequacy of minimum instream flow have been performed to provide the grounds for protest. Instream flow and aquatic ecosystem values have been successfully protected through protest filings against water right transfers on the Truckee River west of Reno and Lamoille Creek near Elko.

NDOW has the ability to partially compensate for impacts of water supply deficiencies on fish and wildlife. For example, in coordination with federal agencies, NDOW has programs to rear game and sensitive fish species (e.g., Lahontan cutthroat trout, razorback sucker) at hatcheries and reservoirs for stocking programs associated with recreational fishing and sensitive species recovery plans. However, game fishes are not stocked in some areas to avoid potential impacts on populations of sensitive native aquatic species.

Periodically NDOW performs stream surveys on major rivers and tributaries to evaluate habitat conditions for wildlife and fishes, and fishery management plans are prepared for major rivers, reservoirs and lakes. This activity presents opportunities to assess instream flow requirements.

Nevada Natural Heritage Program

The Nevada Natural Heritage Program (NNHP) collects and disseminates information on the occurrence, distribution, and population status of all threatened, endangered and sensitive flora and fauna in order to identify trends that could result in their becoming either more or less vulnerable. Areas of the state which sustain critical concentrations of sensitive species are identified and ranked relative to protection urgency and management needs. This information is published periodically, most recently in the report titled *Scorecard - June 1998: Highest Priority Conservation Sites*. NNHP staff cooperate with other agencies, conservation organizations and developers to create habitat conservation plans and recovery plans for at-risk species. Each year the Program answers hundreds of requests for location, biology and conservation information and technical advice from planners, developers, agencies, scientists, conservationists and the general public.

Approximately 43 percent of Nevada's native fishes are designated sensitive. In addition, a number of sensitive amphibians, gastropods, insects, mammals, birds and plants have been identified. Ongoing research into the ecology of springs continues to unveil rare and unique aquatic species. Progress in mapping the past and current distribution of waterfowl, shorebirds and water resource-affiliated passerine birds (i.e., perching birds and songbirds) indicates that the loss of aquatic and wetland habitat is associated with a reduction in the abundance of bird species. Distributing information on the status of the vulnerability of species and cooperating in conservation planning is a crucial aspect of proactive management. By so doing, potential or actual impacts of land use activities on sensitive species may be moderated sufficiently to preclude the need for listing the species under the Endangered Species Act.

Nevada Division of Water Resources

Nevada water law (NRS Chapters 533, 534) and Court decisions authorize the State Engineer to approve water right applications for various instream beneficial uses, which may include wildlife, establishment of wetlands and fisheries, and recreation. Approval for a new water right or transfer of an existing water right is contingent upon the State Engineer's determination that certain criteria can be satisfied. The review criteria are: 1) the requested water is available, 2) the use will not conflict with existing water rights, and 3) the use does not threaten to prove detrimental to the public interest. Public interest is a discretionary matter for the State Engineer. Instream flow is not an explicit public interest criteria against which an application to appropriate water must be considered, however protection exists within the law. Where instream water rights for resource conservation purposes have been permitted, the State Engineer must evaluate whether a proposed new use or change in use threatens to prove detrimental to the instream water right. Further, spring flows which support wildlife populations must be protected (NRS 533.367).

New water rights and transfers of existing water rights have been granted for resource conservation and recreation purposes at a number of sites. In addition to those examples mentioned previously, other sites are Meadow Valley Wash (Condor Canyon), Upper Blue Lake (Pine Forest Range, Humboldt County), Mahogany Creek (Humboldt County), Bruneau River, Franklin Lake and South Fork of the Humboldt River.

Nevada Division of State Lands

The Nevada Division of State Lands (NDSL) acquires land and water rights on behalf of other state agencies, such as NDOW. The voters elected in 1990 to fund land and water rights acquisitions for parks and wildlife through a state bond. The Park and Wildlife Bond Act of 1990 (Question 5) authorized the expenditure of $47.2 million which has been used to purchase land with special resource values, including three ranches along the lower Carson River connecting Fort Churchill State Historic Park with Lahontan State Recreation Area. In addition, $5 million was designated for water rights, enabling NDSL so far to purchase about 8,000 acre feet of water for the Lahontan Valley Wetlands. Efforts to purchase additional land and water rights continue as a portion of the bond fund remains available.

As owner of the beds and banks of navigable water ways (i.e., Truckee, Carson, Colorado and Virgin rivers, Lake Tahoe and Washoe and Walker lakes), NDSL has authority to issue permits for activities and structures below the ordinary high water line, including construction of diversion dams. Through coordination with other agencies, permits may be conditioned to mitigate instream flow concerns, such as fish passage, habitat restoration and channel protection.

Nevada Division of Environmental Protection

The State Environmental Commission (SEC) is responsible for adopting surface water quality standards to protect beneficial uses. While abnormally high or low instream flow can adversely affect water quality and the attainment of a beneficial use, the Division of Environmental Protection (NDEP) and SEC have no authority under the Nevada Revised Statutes (NRS) to regulate water quantity (NRS 445A.725). Accordingly, water pollution control regulations do not consider water quality standards violated during periods of abnormal flow (NAC 445A.121.8). However, a recent U.S. Supreme Court ruling has granted limited instream flow authority under section 401 of the Clean Water Act. Although NDEP has been delegated 401 certification authority, the agency clearly is bound by state statute. As stated previously, the Divisions of Water Resources, Wildlife and State Lands address instream flow with a variety of management techniques.

Federal Agency Involvement with Instream Flow Management

Since Nevada has primacy for administration of water laws, federal agencies must submit an application to the NDWR and receive the State Engineer's approval for the appropriation or transfer of a water right for instream wildlife and environmental use. Federal agencies may seek to acquire instream flow water rights in order to carry out provisions of the Endangered Species Act, Clean Water Act, Migratory Bird Treaty Act, or the Wild and Scenic Rivers Act. As mentioned before, the BLM, FWS, and DOI have been involved in purchases and transfers of water rights in several states under the auspices of these federal laws. Special designations under the Wild and Scenic Rivers Act have not been authorized by Congress in Nevada.[7]

The U.S. National Park Service (NPS) and U.S. Fish and Wildlife Service (FWS) have the ability, in limited circumstances, to protect instream flows through assertion of federal reserved water rights and implementation of federal environmental laws. Federal reserved water rights are implied rights, based on the primary purposes for which the federal land was reserved by Congress, and limited to the minimum quantity of water needed to accomplish the purposes for which the reservation was created. The priority date of reserved water rights coincides with the date Congress authorized creation of the reservation. Indian tribes and federal agencies have asserted reserved water rights for instream flows and minimum pools within Indian reservations, national parks and monuments, and wilderness areas. The U.S. Supreme Court decision requiring reduction in permitted agricultural ground water pumping to maintain the Devils Hole spring pool (an enclave of Death Valley National Monument) for the benefit of an endangered species of pupfish is one instance in Nevada where federal reserved water rights have been claimed successfully for minimum pool protection.

Federal courts in one case have decided that under some circumstances water should be reserved to meet resource protection requirements of federal laws. The U.S. Supreme Court ruled in favor of a proposal to release water from Stampede Reservoir for fish habitat flows for the threatened Lahontan cutthroat trout and endangered cui-ui inhabiting waters within the Pyramid Lake Paiute Indian Reservation and lower Truckee River.

The U.S. Bureau of Land Management (BLM) in Nevada is working on specific programs that may have the effect of preventing future riparian wildlife habitat loss and benefitting instream flow on rivers in western Nevada. One is the Rural Lands Initiative, in which a land owner can voluntarily

[7] In California, segments of the East Fork of the Carson River, and West Walker, each have been designated a "California Wild and Scenic River." The segments terminate at the state border. Similar to the federal counterpart, the California Wild and Scenic Rivers Act requires that certain rivers possessing extraordinary scenic, recreational, fishery, or wildlife values be preserved in their free-flowing state.

sell an agricultural conservation easement to the BLM. The conservation easement is legal assurance that use of productive agricultural land will continue to be cultivated, thereby avoiding the loss of wildlife, riparian, ground water or surface water resource values that often comes with subdivision and development. This program does not involve a water right acquisition. Another BLM program is "Water for Walker Lake". Its purpose is to acquire water rights from willing sellers and transfer the water use downstream to Walker Lake. Water is needed to raise lake levels sufficiently to improve the aquatic and riparian ecosystems for the diminished Lahontan cutthroat trout population and migratory bird habitat.

The BLM and U.S. Forest Service issue permits for grazing, timber harvest, mining and water development on federal lands. These permits may be conditioned to mitigate hydrologic impacts, such as diminished stream flow or reduced shallow ground water recharge. Riparian zone restoration is an important management objective in many areas. Watershed conditions are assessed periodically where permitted land use activities occur. If conditions warrant, measures to improve vegetative cover, soil and stream channel stability, and riparian and wetland plant community structure may be implemented by the permittee or the agency. Such rehabilitative efforts can augment instream flow by enhancing the ability of watersheds to detain snowmelt and storm runoff.

Local Agency and Tribal Involvement with Instream Flow Management

Local agencies have had some involvement with minimum instream flow protection and applying for water rights for resource conservation uses. Actions taken by Washoe County and the cities of Reno and Sparks and the Pyramid Lake Paiute Tribe provide examples of local governments directly assessing minimum instream flow requirements and obtaining water rights to meet water resource objectives. In accordance with the Truckee River Water Quality Agreement, the county, cities, and the DOI, will acquire reservoir storage and water rights for the purpose of improving water quality in the lower Truckee River. A total of $24 million will be spent jointly.

The Pyramid Lake Paiute Tribe obtained federal court consent to be granted water and storage rights on the Truckee River system for the protection of the Lahontan cutthroat trout and the cui-ui. Water stored in Stampede Reservoir is used solely for the benefit of the Pyramid Lake fishery.

Issues

1. A large share of Nevada's biological diversity is found in association with the state's comparatively rare aquatic and riparian ecosystems. An evaluation of threats to wetlands by the Nevada Divisions of Wildlife and State Parks in 1987 ranked diversions and lack of water rights as the most serious threat. A large number of fishes and other fauna dependent on aquatic and wetland ecosystems are designated sensitive, threatened, or endangered. A large percentage of the threatened, endangered and sensitive fish species and other aquatic organisms inhabit desert spring pools. Over 50 percent of the wetlands statewide, and over 80 percent of those in western Nevada, have been lost. Approximately 87 percent of the riparian area along the Truckee River and 50 percent of the wetlands along segments of the Humboldt River and Rock Creek also have

been lost.[8] The loss in riparian area along other large streams has not been quantified. Difficulty in stabilizing and reversing statewide trends in aquatic and riparian wetland resource losses signals a need for more conservation efforts.

2. The historic and potential future losses of the state's aquatic, riparian and wetland ecosystems, and the large number of water dependent species at risk indicates that additional emphasis on proactive planning and management of water supplies for natural resource conservation is a matter of urgency for the state. Although divisions in the Department have individual roles in protecting water supplies for natural resources, a more definitive, comprehensive and integrated state policy and appropriate authority may be needed to improve the effectiveness and efficiency of conservation actions. Current, key policy mechanisms include: a) the legal authority of the State Engineer to permit the appropriation of instream (non-diversionary) water rights for fish, wildlife and recreation in accordance with state statutes and Court decisions; b) the state funded water rights acquisition program for wetlands; and c) policies adopted by the Nevada Wildlife Commission that encourage NDOW to acquire water for wildlife and their habitats and to protest surface and ground water right applications that would threaten, drastically modify or severely curtail wildlife and its habitat.[9]

3. The Nevada Board of Wildlife Commissioners has adopted policies that directs the Division of Wildlife to secure water from willing sellers in order to maintain adequate instream flows, minimum reservoir pools, and existing wetlands, springs and seeps for the preservation, maintenance and enhancement of wildlife and their habitats. However, difficulties in acquiring water rights may be encountered because levels of funding or staffing are insufficient. In some instances, other participants in a water market can move more quickly to purchase water rights. Thus, the agency is hampered in its ability to purchase or lease more suitable or senior water rights. Increased cooperation with land and water conservancies is a strategy that could be implemented to overcome some of the mentioned obstacles to water rights procurement.

4. Obtaining instream flow rights may prove to be a cost effective and durable approach to achieve multiple aquatic and biological resource conservation objectives, including sensitive species protection, water quality requirements and increased recreation opportunities. There is a need for incentives to increase water supplies for resource conservation purposes may raise private and public support for this activity. Measures which could enhance instream flows include water conservation, noxious phreatophyte control, or watershed improvements. To encourage such actions, an administrative mechanism may be needed to officially permit, verify and establish a "credit" for the amount of "new" or "additional" water made available for instream flows. For example, an individual might may have an interest in paying for the implementation of conservation measures to augment streamflow for fish habitat if there was certainty that a valued, transferrable credit would be created. This approach could encourage natural resource improvements which may exceed the benefits of simply increasing water supplies. For more information about credit for conservation, see the *Conservation* issue paper (Part 3, Section 1A

[8] Wildlife and Wildlife Habitats Associated with the Humboldt River and Its Tributaries. Biological Bulletin No. 10. Nevada Department of Wildlife. 1989.

[9] Nevada Wildlife Commission Policies, Numbers 60 and 61, as amended December 2, 1995.

of the Nevada State Water Plan).

5. Most current surface water withdrawals are for agricultural purposes. Thus, acquiring additional water supplies for instream flow would likely involve the agricultural industry and rural communities. Agriculture is important to the economy and culture of many counties. Acquisition of water rights for instream flow protection could impact the viability of farming and ranching beyond the property lines of individual parcels. The continuity of the channel network and distribution of operation and maintenance costs within irrigation districts are some potential effects that may have to be addressed. Some irrigated crop fields and pastures support wildlife, which is another important consideration. A public program with market incentives and technical assistance may be needed to facilitate the willing agricultural water user to manage water more conservatively, lease water rights for instream uses, or undertake other measures to augment water supplies for water quality improvement, fisheries protection and other objectives.

6. Management of species that are threatened or endangered has proven to be complex, controversial, and costly for private enterprise and resource managers. Nevada is among the top 5 states in the nation for both the diversity and vulnerability of its biological resources. A large percentage of vulnerable species rely on functioning aquatic and riparian ecosystems for survival. Proactive planning and actions now could improve the distribution of species, and thus avoid the imposition of federal mandates and implementation of more difficult and more expensive recovery strategies later.

7. Use of the *minimum* criterion as a water supply planning objective may narrow the focus of conservation efforts to the water resource conditions needed for a particular resource or attribute (i.e., habitat for a fish species, or a recreation activity). Another criterion used in some instream flow management assessments is the *optimum* water supply, which expands the focus of study to the integrity of an ecosystem. Determining the optimum quantity of water needed entails conducting a more comprehensive and integrated assessment, but may increase the likelihood that the resource will become self-regulating, thereby reducing future management needs.

Recommendations

To enhance the ongoing efforts of the state to enhance water supplies for resource conservation purposes and to encourage and facilitate public support, the following recommendations are offered.

1. The Department should seek legislative support for:

   - development of a comprehensive and integrated management plan for the purpose of prioritizing and coordinating interagency and interdisciplinary assessments of critical water needs for wildlife and environmental purposes;
   - adoption of a policy that actively encourages the purchase, lease or donation of existing water and storage rights for transfer to instream rights or to maintain lake or wetland areas;
   - establishment of a Water Rights Trust Fund to fund acquisition efforts; and
   - incentive programs for the restoration of impaired aquatic and riparian resources (e.g.,

"conservation for credits," see recommendations in the Conservation issue paper, Part 3, Section 1A).

2. The Department should convene a statewide working group of experts to identify alternative mechanisms for obtaining water supplies for resource conservation and examine the existing legal, institutional, and economic aspects of identified alternatives. In addition, the working group should develop guidelines and criteria to be used by the Department in planning and evaluating water resource projects, including dam construction, significant water transfers, and modifications to reservoir storage and operation plans.

Index for Part 3, Section B.

A. Flood Management in Nevada

Introduction

Flooding has been a concern for Nevada communities since the first settlers moved to the territory in the mid-1800's. Fourteen significant flood events have occurred on the Truckee River alone since the 1860's. Numerous flash floods take place throughout the state annually. The costs of recovery from flood events is rising. Prior to the January 1997 flood event in northern Nevada, damages due to flooding on the Truckee and Carson Rivers totaled more than $31.5 million.[1] The damage caused by flooding in northern Nevada during the January 1997 event topped out at over $600 million if indirect damages such as lost revenue, wages, and sales taxes are included.[2]

Flood hazards in Nevada are typically underestimated due to the arid climate, few perennial streams, and low precipitation. Lack of data and a sparse stream-gaging network also contribute to underestimation of flood hazards. Two types of flooding occur in Nevada: riverine flooding and alluvial fan flooding. Riverine flooding occurs when water levels in rivers and streams rise and discharge volumes increase over a period of hours or days. Flood waters overtop the stream banks and inundate nearby low lying areas. In Nevada, riverine flooding typically occurs during the winter or spring runoff periods.

Alluvial fans are found throughout Nevada. An alluvial fan is a fan-shaped deposit of material created where a stream flows out onto the valley floor. Alluvial fans are the cumulative result of successive flood events over hundreds to thousands of years. Alluvial fan flooding is potentially more dangerous than riverine flooding because it is less predictable and the threat is not apparent, therefore it is not often considered during land development. Additionally, the influence of minor grading, roads, and structures can greatly impact and exaggerate damage from alluvial fan flooding. This type of flooding can occur with little warning. Alluvial fan flooding occurs when flood waters emerge from canyon mouths and travel downstream at very high velocities carrying an enormous load of sediment and debris. The hazards associated with alluvial fan flooding are compounded by the potential for migration of flood waters across the width of the fan. Alluvial fan flooding impacts are especially severe on fans which are developed without mitigation measures installed.

Flash flooding on streams emerging from steep canyons in the mountains are another significant flood hazard in Nevada. Flash floods are very unpredictable, and can cause flooding at a distance from the precipitation source. Because flash floods are typically caused by high intensity-short duration convective storm events in the mountains, they occur with little warning, and can be very destructive in terms of erosion and sediment deposition.

Nevada's rapid population growth is contributing to flood impacts. As more land is developed in

[1] Flooding Issue Paper, prepared by U.S. Army Corps of Engineers, date unknown.

[2] The 1997 New Year's Floods in Western Nevada, Nevada Bureau of Mines and Geology, 1998.

river basins and on alluvial fans, the severity of flooding and cost of flood recovery is increasing. As development moves from flat prime real estate to the broad alluvial fans throughout the state, a greater percentage of the population is exposed to flood hazards. The impacts of flooding to the people, communities, and infrastructure throughout the state point to a need for floodplain management.

What is Floodplain Management?

Floodplain management consists of planning and implementing programs designed to alleviate the impact of flooding on people and communities. It includes activities such as instituting land use policies and regulations for development in flood prone areas, and restoring and preserving natural resources and functions of floodplains and contributing watersheds. A key component of floodplain management is implementation of the National Flood Insurance Program (NFIP) at the local level.

The U.S. Congress established the National Flood Insurance Program in 1968 with the passage of the National Flood Insurance Act. The purpose of the act is to encourage local communities to mitigate future flood damage by adopting and enforcing minimum floodplain management ordinances, thus making the community eligible for federally-subsidized flood insurance. In Nevada, 15 counties and 13 communities currently participate in this program. Participation in the program allows property owners in the communities to purchase federally subsidized flood insurance. The program provides Flood Insurance Studies (FIS) and Flood Insurance Rate Maps (FIRMs) prepared by the Federal Emergency Management Agency (FEMA) to participating communities. A FIRM designates Special Flood Hazard Areas (SFHAs) within a community which are subject to flooding that has a one-percent chance of being equaled or exceeded in any given year. This flood is also referred to as the ‘100-year’ flood.

Floodplain management consists of both structural and nonstructural measures for mitigating flood impacts. Structural approaches include measures which reduce the amount of flood water in a stream or contain flood water in a channel so that it does not inundate nearby areas. Such measures may include detention facilities, levees or dikes. Structural measures built with public money have been used historically to manage flood impacts with varying degrees of success. Structural flood controls may require the use of valuable land and natural resources.

A structural approach to flood control in existing urban areas can provide a cost-effective benefit to the public. In southern Nevada, the Clark County Regional Flood Control District uses structural controls very effectively to manage flash flooding impacts in developing areas. Washoe County is currently implementing a Regional Flood Control Master Plan which also incorporates structural flood control, along with other measures.

Nonstructural approaches to floodplain management have been gaining adherents as our recognition of the limitations of flood control has increased. The most cost-effective approach to flood hazard protection can be achieved using land use planning and sound floodplain management regulations in flood prone areas. Nonstructural approaches to floodplain management include:

1. Development of regional master plans for flood management;
2. Mapping and study of historic flood prone areas;
3. Implementation of floodplain regulations, including zoning ordinances, subdivision regulations, and building codes which guide development in floodplains and flood prone areas;
4. Implementation of a development review process at the local or regional level;
5. Acquisition and removal, or relocation of structures which experience repetitive losses;
6. Flood proofing existing structures by elevating a building's structure or the infrastructure;
7. Flood forecasting and warning systems;
8. Disaster preparedness plans;
9. Rehabilitation of disturbed watersheds, wetlands, and riparian zones;
10. Designation of green belts; and
11. Providing education and information to the local communities.

Flood Management in Nevada

Although floodplain management most effectively occurs at the local or regional level, the state plays an important role. The State's primary functions include coordination between federal and local agencies, education and information dissemination, and management of grant funds passed through from the federal government or the state to the local communities.

State Agency Involvement in Flood Management

Division of Water Planning

In 1997, as a direct result of the flooding in northern Nevada, the FEMA-sponsored Community Assistance Program (CAP) was transferred to the Division of Water Planning from the Division of Emergency Management at DEM's request. The objective of CAP is to provide technical assistance for flood mitigation activities and coordinate floodplain management in communities participating in the NFIP. The Division provides floodplain ordinance review, supports local agencies in development of building codes and enforcement capabilities, provides information and education on flooding issues, conducts floodplain management workshops for local officials, performs community visits to assess compliance with NFIP regulations, and prepares and distributes manuals, newsletters and flyers promoting flood hazard awareness.

In 1997, the Governor's Office named the Nevada Division of Water Planning as the point-of-contact for FEMA's new Flood Mitigation Assistance (FMA) program. The FMA provides grant funds for planning and project activities related to elevation or relocation of structures which experience repetitive losses. The Division is responsible for providing technical assistance to interested communities in preparing FMA grant applications and flood plans, and coordinating FMA funded projects.

Division of Emergency Management

The Nevada Division of Emergency Management (DEM) is responsible for implementing a comprehensive mitigation program which includes flooding mitigation. The State Hazard Mitigation Officer manages the FEMA-sponsored Hazard Mitigation Grant Program (HMGP), which can be used to purchase flood prone privately owned structures and flood easements subsequent to flood events. DEM and the Nevada Division of Water Planning are cosponsoring the state-wide All Hazard Mitigation Advisory Committee to evaluate hazard mitigation needs and funding sources for mitigation projects.

Division of Water Resources

The Division of Water Resources (DWR) manages a program for channel clearance, maintenance, restoration, surveying, and monumenting, established under NRS 532.220. Under the channel clearance program, local entities, including counties, cities, irrigation districts, and flood control districts can apply for matching grant funds to maintain channels of navigable rivers within their boundaries. In addition, the DWR is responsible for the state dam inspection and safety program, established under NRS 535.030. Communities throughout the state can take credit for the State's dam safety program through the NFIP's Community Rating System, resulting in lower flood insurance rates in the participating communities.

Disaster Relief Bill

During the 1997 legislative session, Senate Bill 218 was passed which established a state fund of $4 million to help communities recover from damages sustained in the event of a disaster. The fund is administered by the Legislative Counsel Bureau, and has been used to provide financial relief following river and flash flooding events in communities throughout the state.

Local Agency Involvement in Flood Management

Provisions for formation of flood control districts are described in the Nevada Revised Statutes, NRS 543. The Clark County Regional Flood Control District was formed under this statute in 1985. It is the only such district in the state. The District is comprised of the unincorporated county and the five incorporated cities within the county. The District was created to manage flooding hazards through land use controls, and to fund and coordinate construction and maintenance of flood control structures. Flood control projects are funded by a one-quarter of one percent sales tax. The District has also implemented a comprehensive floodplain management program that includes flood hazard mitigation and mapping.

Local communities and counties are responsible for developing and implementing ordinances for management of areas in their communities which are prone to flooding. Adoption of the minimum standards for floodplain management identified in the Code of Federal Regulations (CFR) Title 44, section 60.3, is the primary requirement for participation in the NFIP. The minimum NFIP requirements are floodplain management standards which are generally applicable nationwide, but which do not take into account unique regional and local conditions. Washoe and Clark counties have adopted ordinances which go above the minimum NFIP standard. Counties and communities which do more than the minimum required by the NFIP are eligible for participation in the Community Rating System (CRS), which provides credits in the form of reduced insurance costs for property owners holding flood insurance.

Project Impact is FEMA's program for developing disaster resistant communities. This program was initiated in 1998, with the city of Sparks named as the first Project Impact Community in Nevada. Project Impact was developed to help communities take responsibility for mitigating the impact of disasters of all types.

Federal Involvement in Floodplain Management

Several federal agencies have programs which support floodplain management at the state level by providing funding and technical assistance, and facilitating coordination with local communities.

FEMA provides technical assistance on floodplain management issues and oversees the NFIP. In addition, FEMA offers flood mitigation programs and technical assistance in updating the State Hazard Mitigation Plan, and funds mitigation projects through grants such as the Hazard Mitigation Grant Program and the Flood Mitigation Assistance Program.

The U.S. Army Corps of Engineers (Corps) offers both emergency and long-term services for pre- and post-disaster mitigation and response. They perform general investigation studies for flood control, and provide floodplain management planning services, in addition to their role in design and construction of flood retention structures (see Part 1, Section 3 of the State Water Plan). The Corps has recently proposed a new Flood Hazard Mitigation and Riverine Restoration program, titled Challenge 21, intended to focus on nonstructural solutions to restore river channels that were modified for flood control.

The Natural Resources Conservation Service (NRCS) provides services related to measuring and reducing flood hazards and emergency response following a flood event. They conduct floodplain management studies in which ecological resources are cataloged and opportunities for restoring and preserving floodplains are identified. Under the Emergency Watershed Protection program, NRCS provides technical and financial assistance when a natural disaster causes damage in a watershed. Emergency response actions are related to assessing damages and identifying actions.

Regional Involvement in Flood Management

Western Governors' Association

The Western Governors' Association (WGA), adopted a policy resolution on Flood Mitigation and Recovery Issues in December 1997. The Task Force organized by WGA concluded that flood planning and floodplain management are essential elements in reducing flood risk. The task force developed *An Action Plan for Reducing Flood Risk in the West*. The action plan developed by the task force contains 21 recommendations for improving floodplain management and coordination and communication of flood issues. Several of WGA's recommendations are used as a basis for the recommendations presented at the end of this discussion.

Issues

1. Communities participating in the NFIP outside of the major urban centers have not had access to consistent state-level assistance in implementing and managing their floodplain management ordinances. In some cases, this lack of state assistance, combined with turnover in personnel at the community and county level, and resultant lack of training have made it difficult for local communities to comply with NFIP regulations.

2. Alluvial fan or flash flooding is a critical issue for two reasons: a) flash flooding is less predictable than riverine flooding and results in high velocity flows with great erosive capability, and there is a high potential for channel migration to previously unidentified areas; and b) the risk of alluvial fan flooding is either over- or under- predicted due to disagreement on effective models for predicting flows and mapping alluvial fan flood zones among engineering and planning professionals.

3. The Flood Insurance Rate Maps (FIRMs), used by the local administrators outside of major urban centers for planning and permitting development, are well over five years old, and areas which are currently being developed were never mapped in detail in the original studies. Use of regression equations that are based on generalized hydraulic geometry and that to not incorporate site specific geologic and soil type data have resulted in underestimating the extent and depth of flooding. Rapid growth in areas with outdated flood zone maps can result in the construction of homes and businesses in harm's way.

4. In the past, coordination between state agencies, and between state and local agencies, was often inadequate. This resulted in gaps in services and missed opportunities for grant funding. When the 1997 state legislature re-assigned the flood management program to Division of Water Planning and enhanced funding, it created the opportunity for improved coordination and will result in better implementation of flood mitigation efforts and reduced costs of flood recovery. Increased coordination is clearly an essential element in improving flood program effectiveness at all levels.

5. Floodplain management must be considered an essential on-going element in local and regional

planning, not something that takes place after a flooding event. In a presidentially declared disaster, FEMA sets aside a portion of the total reimbursed damages to fund mitigation work. The State has a Disaster Relief Fund, but funds for preventive mitigation are not currently available.

6. To avoid recurrence of losses experienced in the 1997 flood event in northern Nevada, the 1997 state legislature requested development of a Flood Management Plan for the state.

7. The State's Model Floodplain Ordinance contains the *minimum* national The minimum NFIP requirements are floodplain management standards which do not take Nevada's unique regional conditions into consideration. Conditions which make Nevada NFIP requirements that communities and counties must implement to obtain flood insurance. unique are rapid growth in areas with outdated flood maps, alluvial fan flooding and flash flooding. The State Model Ordinance was developed in 1994, prior to the 1997 flood event in northern Nevada, and needs to be updated to include lessons learned from that event. Further, to adequately prevent flood impacts and keep damages and costs of recovery to a minimum, the state also needs to develop a set of recommended standards over and above the minimum standards established in the model ordinance to reflect Nevada's unique flood management concerns.

8. In Northern Nevada, communities located along rivers are incurring increasing costs due to flooding. Growth and development in floodplains exacerbated flood losses. Further, it is clear that existing structural controls are not effective in preventing damages. Studies throughout the west show the benefits of incorporating non-structural measures such as preservation and restoration of floodplain areas, through zoning and conservation easements, and relocating structures out of floodplain areas.

Recommendations

To further enhance floodplain management in Nevada, the following recommendations are proposed.

1. The State Legislature should amend NRS 540 which describes the duties of the Nevada Division of Water Planning, to include floodplain management. Formal recognition of the role assigned to the Division by the 1997 Legislature would enhance the Division's ability to administer the CAP and FMA programs.

2. The Nevada Division of Water Planning should coordinate participation of local, state, and federal agencies to develop a procedure for quantifying alluvial fan flooding that is acceptable to engineering and planning professionals involved in floodplain management, as recommended by the Western Governors' Association**.** The Division should coordinate with the Nevada Bureau of Mines and Geology (NBMG) to incorporate fluvial geologic information into mapping flood-prone areas in the state.

3. The Nevada Division of Water Planning should develop a plan for reviewing, updating, and maintaining flood maps and research the potential for the state to participate in FEMA's proposed

map modernization program as a Cooperating Technical Community in conjunction with the NBMG. Several communities in the state already have the capability to develop and maintain their flood maps digitally. This capability combined with the rapid growth in the state would make Nevada a good candidate for the map modernization program.

4. The Nevada Division of Water Planning should take a leadership role in improving coordination with all involved agencies (Nevada Division of Water Resources, Department of Transportation, Division of Emergency Management, Clark County Regional Flood Control District, regional water management districts, local community development agencies, community and county building departments, public works departments, etc.) to accomplish the following flood management objectives:

    a. Encourage complete statewide participation in the NFIP;
    b. Encourage participation in the Community Rating System;
    c. Encourage relocation of flood prone structures and restoration of natural floodplain functions;
    d. Encourage local communities to take advantage of the FIRM revision process; and
    e. Emphasize education on floodplain management strategies and flood-loss reduction.

5. The State should create a state-funded Flood Mitigation Fund separate from the Disaster Relief Fund (SB 218), as recommended by the Western Governors' Association. In a presidentially declared disaster, FEMA typically sets aside 15 percent of the total FEMA-reimbursed damages to be spent specifically on flood mitigation. Similarly, 15 percent of the state's $4 million Disaster Relief Fund ($600,000) should be set aside for preventive flood loss strategies.

6. The Nevada Division of Water Planning should continue development of a detailed statewide Flood Management Plan which addresses the unique flooding conditions experienced in Nevada. The plan will provide a guideline for communities to use in implementing their flood ordinances. A Flood Management Plan would be particularly helpful to the communities outside of the major urban centers.

7. The Nevada Division of Water Planning should revise the state's Model Ordinance (minimum standards) to include "lessons learned" from the 1997 flood event in northern Nevada and flash flooding events throughout the state, such as higher reference floor elevations for development in flood hazard areas, and more appropriate development and construction standards in known but unmapped alluvial fan areas. Further, the state should develop a set of recommended standards. At a minimum, local governments should adopt the revised Model Floodplain Ordinance and should be encouraged to adopt the recommended standards.

8. All communities should develop flood mitigation plans which identify flood hazards and flooding risks, and evaluate options for flood mitigation. High priority should be placed on relocation of flood-prone development, restoration of natural beneficial floodplain functions and the use of zoning and conservation easements to direct growth away from floodplains.

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Special Flood Hazard Areas (4A – 2)
U.S. Army Corps of Engineers (4A – 5)
Western Governors' Association (4A – 6)
'100-year' flood. (4A – 2)

A. Watershed Planning and Management

Background

What is a watershed? Generally, a watershed is described as an area within a hydrographic or river basin which consists of interconnected water sources and drainages, bounded by topographic highs or water divides. For watershed planning and management purposes, a watershed is an area with specified boundaries set by a group of stakeholders who have interests in the water resources within the watershed.[1]

Watershed planning and management is described as a process for integrating water resource, natural resource, and land use considerations into a collaborative problem solving network, supported by interested parties within a designated watershed. Resources of concern may include all or parts of riparian, wetland, spring and stream ecosystems, as well as specific watershed values, including fish and wildlife habitat, flood plain storage, water quality, water yield and recharge, soil stability, and productivity of agricultural lands. Typically, effective watershed planning and management efforts have certain basic characteristics. These are:

- *comprehensive* - in terms of basin geography, political units, and water resources;
- *inclusive* - created by all stakeholders and attentive to their environmental, social, regulatory and economic goals; and,
- *integrated* - taking stock of relationships between the quantity and quality of water, ground and surface water interaction, as well as interactions of other natural resources and environmental conditions.

Taking a comprehensive, inclusive, and integrated approach to water resource planning, allocation and management is intended to produce a strategic action plan to better protect water quantity, water quality and related resources for current and future needs. Greater cooperation leads to widespread support for agreed upon management objectives and action plans, and reduced reliance on new regulatory requirements and litigation.[2] Solutions are more practical and acceptable, and thus, more effective and lasting.

The basic steps in watershed planning include:

1. Identify stakeholders and facilitators to assist with problem definition and administration;
2. Listen to and develop an understanding of interests being expressed;
3. Develop a number of strategies to meet the concerns expressed by the interests;

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[1] Stakeholders could include individuals, organizations, and agencies working, residing, recreating, or regulating in the watershed.

[2] Watershed planning is not an alternative to satisfying applicable regulatory requirements. It can be complementary, but it cannot be a substitute.

4. Evaluate the strategies as to scientific validity, cost, practicality, environmental impacts;
5. Develop an action plan to implement the strategies;
6. Define ways to monitor outcomes and evaluate success; and,
7. Periodically review the interests, goals and plan itself, and make adjustments.

Need for A Watershed Approach

The need for the state's support for the watershed approach stems from a recognition that water resource problems arise from a wide range of activities throughout a watershed, these activities are dispersed and cross political boundaries, and impacts on the environment are cumulative and are potentially long term and difficult to reverse.

Advantages to implementing a watershed management approach include:

1. A watershed is a logical geographic unit for water resource planning, permitting, reporting, and problem solving.
2. Management decisions are improved because agencies collaborate more on problem resolution.
3. Data collection resources are pooled, so databases are more comprehensive and more types of related data are available.
4. Resources are better directed to priority issues or those portions of the basin where the greatest problems exist.
5. Funding and human resources can be better leveraged. Volunteers can be involved.
6. Program efficiencies are enhanced by coordinating workloads. For example, monitoring can be done by participants closest to the sites and reporting requirements can be consolidated.
7. Public participation is encouraged and public understanding and support for management options enhanced.
8. A wider array of experts and citizens is involved in an integrated problem-solving process. A diversity of disciplines involved leads to expanded management choices.
9. The prospects of more stringent regulatory standards or programs may be averted with good planning and plan implementation.

State Agency Involvement With Watershed Planning and Management

As the state's economy and population grows, so too does the intensity and diversity of land use activities, placing greater demand on the state's finite land and scarce water resources. To keep pace, over the past 20 years Nevada state agencies have administered regulatory and voluntary programs which have achieved significant reductions in both point and non-point sources of pollution; prevented contamination from hazardous waste sites; more efficiently allocated and managed water resources; and provided assistance, information and funding to local organizations for the management of watershed resources.

Watershed planning is well rooted in Nevada's water allocation process (Nevada Revised Statutes 533 and 534) and in the protection of water quality. In the 1960's, the Nevada State Engineer's

Office and the U.S. Geological Survey recognized the need for a systematic identification of the hydrographic areas throughout Nevada. Such a system was needed to more effectively study, develop, allocate and manage the state's water resources, both groundwater and surface water, to meet current and future demand. The first hydrographic map was developed in 1968, and while it has undergone some minor revisions, it continues to provide the basis for water planning, management and administration today. Watershed-oriented planning and management programs and projects implemented by state and federal agencies are described below.

Department of Conservation and Natural Resources

The mission of the Department of Conservation and Natural Resources (Department) is to conserve, protect, manage, and enhance the State's natural resources in order to provide the highest quality of life for Nevada's citizens and visitors. Administrative, technical, budgetary and supervisory support is provided to coordinate management goals and activities involving all of the Divisions within the Department. The Department plays a leadership role in determining the extent to which watershed planning and management is instituted. Recent notable instances where the Department coordinated various Division's involvement in major water resource management issues set within a watershed context include the Tahoe Presidential Forum and the Truckee River Negotiated Settlement.

Division of Environmental Protection

In the mid 1970's, the Division of Environmental Protection (NDEP) developed water quality management plans for the hydrographic basins under section 303 of the Clean Water Act (CWA). In the late 1970's and early 1980's, the designated local agencies developed comprehensive wastewater management plans under section 208 of the CWA for Clark County, Truckee River Basin, Lake Tahoe Basin and the Carson River Basin. For the remainder of the state, the Division developed a CWA 208 plan utilizing as a minimum the basic steps for watershed planning.

Currently, under the Comprehensive State Groundwater Protection Program, mandatory and voluntary groundwater protection programs are administered by NDEP. The Nevada Ground Water Protection Task Force is a voluntary coordinating group composed of state, local and federal agencies which promote public awareness of ground water protection issues and of alternative protection options. This group is defining hydrographic basins which have critical ground water quality concerns.

The Bureau of Water Quality Planning administers the Nonpoint Source Management Program through which voluntary watershed management demonstration projects are funded under the Clean Water Act, Section 319. Active watershed planning and demonstration projects are underway at Steamboat Creek; Muddy River; Mason Valley; and the Upper, Middle, and Lower portions of the Carson River. A notable example of a comprehensive, inclusive and integrated plan is the Upper Carson River Watershed Management Plan. The Plan draft was completed in 1996 and contains strategic recommendations which are being implemented.

Other examples of watershed planning include the State and local Wellhead Protection Programs, the Truckee River Strategy Group, the Lake Mead Water Quality Forum and the Truckee River Water

Quality Agreement. The Division also supports water quality planning efforts regarding Emergency Response Planning on the Truckee River.

Divisions of State Lands and Conservation Districts

With the guidance and support of the Nevada Division of Conservation Districts, local Conservation Districts have adopted goals and facilitated projects to conserve, protect, and manage development of Nevada's natural resources on a watershed basis. These activities often occur jointly with federal agencies such as the Natural Resource Conservation Service and federal land management agencies. Administration of the Tahoe Bond Act funding program for water quality improvements by watershed is an example of these coordinated activities. Another is the Steamboat Creek Restoration Project, which is lead by the Washoe-Storey Conservation District.

Division of Water Planning

The State Water Plan is being developed on a hydrographic basin basis, with a consideration of many water resource issues, and with a great deal of public involvement. The goal is to analyze issues in a comprehensive, integrated fashion and to develop realistic recommendations which address the viewpoints of many stakeholders.

Walker River Basin Technical Network is an effort to bring together a wide variety of stakeholders in a hydrographic basin to share information, coordinate activities, leverage dollars, avoid duplication of effort, and ultimately, to develop a watershed plan for the basin addressing water supply, water quality, habitat, recreation, and economic issues.

Division of Water Resources

Under the Cooperative Program with the U.S. Geological Survey, the Division of Water Resources (NDWR) funds and supports data collection and report development on surface and ground water conditions. In addition, the NDWR has participated in site specific studies for watershed scale projects, such as the Humboldt River Basin Study, Fallon Basalt Aquifer Recharge Study, Las Vegas Valley Subsidence Study, Beaver Dam Wash Study, Spanish Springs Study and Honey Lake Valley Study.

Federal Agency Involvement in Watershed Planning and Management [3]

About 87 percent of the land in Nevada is managed by federal agencies. Most streams originate on and much of the ground water recharge occurs on upper and mid-level elevations of watersheds managed by the U.S. Forest Service and U.S. Bureau of Land Management. During the past 30 years, several laws have been enacted that direct federal agencies to make watershed protection a high priority in their management plans. These and other laws aim to protect riparian areas, wetlands, and stream ecosystems on federal lands, as well as protection of other watershed values, including fish and wildlife habitat, flood plains, water quality, water yield, soil stability, and productive agricultural lands. Since much of Nevada's water supply falls on portions of watersheds managed by federal agencies, their involvement in watershed planning and management is essential.

The Natural Resource Conservation Service (NRCS) is a federal agency involved in community level watershed planning and management activities. Their primary function is to provide natural resource planning and management assistance to farmers, ranchers and forest landowners. The NRCS also supports joint public/private watershed improvement projects with technical assistance and funding through a number of cost-share programs intended to improve water quality, soil stability, forest resources, flood plains, noxious weed management and wildlife habitat.

The U.S. Environmental Protection Agency (EPA) has championed the Watershed Protection Approach (WPA) for many years. The WPA strategy is based on the concept that many water quality and ecosystem problems are best solved at the watershed level, rather than the individual waterbody or discharger level. The WPA is grounded in the Clean Water Act and Safe Drinking Water Act, which contain provisions that promote aspects of watershed planning and management activities. Nevada's Wellhead Protection and Source Water Protection Programs, Area-wide Water Quality Management Plans, Comprehensive Ground Water Protection Program, and Nonpoint Source Pollution Program are examples of joint state, federal and local agency implementation of these programs.

The most recent federal initiative regarding the watershed approach is the President's *Clean Water Action Plan* (CWAP). Lead federal agencies are the EPA and NRCS; however, the CWAP provides incentives for state agency leadership in: (1) undertaking public/private cooperative efforts within a watershed framework; (2) conducting "unified watershed assessments" where impaired waters exist; (3) applying federal resources and technical expertise to state and local watershed restoration and protection; and, (4) making federal agencies' data and information about watershed conditions more available to the public. In response to the CWAP, NDEP and Natural Resources Conservation Service (NRCS) have developed a unified watershed assessment involving affected state, local and federal agencies, and interested organizations. Other key federal agencies could include the U.S. Forest, Service, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation and the Bureau of Indian Affairs.

[3] The involvement of federal agencies in watershed planning and management is discussed extensively in the Report of the Western Water Policy Review Advisory Commission, *Water in the West: Challenge for the Next Century*, June 1998.

Issues

1. The watershed planning approach is already being implemented by various groups in Nevada, and appears to be an effective approach to integrating water and land resource issue. The Department is striving to improve coordination across divisions in a more integrated framework. It is anticipated that all agencies in the Department could be involved in implementing certain recommendations listed below, as well as agencies within other departments, such as the Divisions of Health, Emergency Management, Agriculture and Minerals. To implement Recommendation 1, the Department will review state policies, laws and regulations, staff workloads and skills, current coordination among agencies, mechanisms for future coordination, and the availability of watershed planning funds.

2. The application of a watershed planning approach to water resource problem solving is growing. Federal agencies and the Western Governors Association through the Western States Water Council promote and support it. Many local and regional planning efforts have been or will be initiated at a watershed level. To the extent practicable, Department staff should assist in meeting expressed needs of local watershed planning groups, whether the need is for data and information, or assistance in facilitating the planning process, mediating between local and federal concerns, developing watershed management plans, or implementing an action plan.

3. In principle, the watershed planning approach has applicability at the hydrographic basin level. Comprehensive and integrated water resource management can be accomplished by examining water resource linkages throughout a basin. The Department is well positioned to facilitate coordination across jurisdictions, land and resource management units, economic interests, and resource values. An integrated water basin plan provides a mechanism for focusing efforts, disseminating viewpoints, summarizing actions, and articulating a set of goals and strategies with a timetable.

   Recommendation 3 below, speaks to the next major step envisioned for State Water Plan development. It is a concept that has been informally discussed with the Advisory Board before. It is introduced here because instituting an integrated water basin planning approach: 1) is functionally similar to a watershed planning approach, and 2) should be complementary and consistent to watershed management plans in a basin where a plan has been developed and implemented.

4. Department agencies and the Bureau of Health Protection Services are involved in federally co-funded grant and loan programs for watershed planning-related activities under the Clean Water and Safe Drinking Water Acts. Currently, a key program is the Clean Water Action Plan (CWAP). Under the CWAP, federal funding is being provided to support joint state, federal and local agencies implementation of an Unified Watershed Assessment and coordinated restoration strategies. Other federal funding has been provided via direct Congressional appropriations. State agencies have supported watershed efforts through re-prioritization within programs, but few general fund appropriations have been made by the legislature to date to support these efforts. State funding could be used to train staff, and improve data gathering and dissemination, or as incentive grants to encourage local governments to participate in watershed planning.

5. Monitoring and assessment should be integral parts of all watershed management plans. Monitoring provides a vital feedback loop and can be used to determine:
   - whether planned restoration efforts have been implemented in the manner intended;
   - the effectiveness of implemented actions in achieving desired results;
   - the validity of the assumptions upon which management strategies were designed;
   - adjustments to restoration efforts that are needed due to changing conditions; and
   - the cost effectiveness of actions taken.

Recommendations

To further enhance watershed management and planning in Nevada, the following recommendations are offered:

1. The Department of Conservation and Natural Resources (Department) should develop an inter-division watershed planning and management strategy in order to more effectively play an active, participatory role in watershed planning when a water resource assessment indicates there is a need for this strategy or when a water planning group requests Department support.

2. The Department should support watershed planning at the local level.

3. The Department should continue to work together with local, regional and federal agencies and non-governmental organizations to develop and implement integrated water basin plans for Nevada's hydrographic regions.

4. The Department should support watershed planning groups with additional funding to assist in the development of integrated, broad-based and comprehensive watershed plans.

5. The Department should assist in the review of watershed management plans, evaluate whether goals or objectives are being achieved, strategic actions implemented and results monitored, and cooperatively recommend changes where monitoring results indicate a need for improvements.

Index to Part 3, Section 5A.

watershed values (5A–1)

B. Water Resources Data Development, Collection and Management

Introduction

Accurate and comprehensive water resource data are critical to planners and decisionmakers at all levels of government, researchers, developers and the business community. Now more than ever, the increasing need to manage our precious natural resources is driving the need for more detailed water and natural resources data for many areas of the state. This issue discussion describes some of the current data development, collection and management efforts in Nevada, current and future challenges facing data managers and users, and recommendations for meeting these challenges.

Background

At this time, state and federal agencies, counties, municipalities, universities and industries collect and maintain extensive water resource data. However, some of these data are not readily available to others, datasets may be missing information which decrease their usefulness to other agencies, or access is time consuming or cumbersome. As a result, planning and management efforts, such as development of the *State Water Plan*, become difficult. Many agencies are starting to address the data issue by providing data directories and data downloading capabilities through their Internet websites. It is anticipated that the Internet will be the most significant tool for improving data sharing capabilities in the future.

Improved data development, collection, management, coordination and sharing offer direct and indirect benefits to all Nevadans. For example, decisionmakers, planners, regulators and the public can become better informed which may lead to improved decisions, future *State Water Plan* releases can be improved, and the State's ability to assist local planning efforts can be enhanced (See "Water Planning Assistance to Local Governments" discussion in Part 3 of the *State Water Plan*). Also, improved data access and sharing between agencies can result in reduced duplication of efforts, thereby saving tax dollars.

For purposes of this discussion, data are divided into three types: temporal, textual and spatial data. Temporal data are those data related to a particular point in time or period of time. Examples include streamflows, groundwater levels, and precipitation data. Textual data consists of text-based information such as directories, library bibliographies and inventories. Spatial data are those data related to space which can be shown on a map, and are commonly maintained by Geographic Information Systems (GIS). GIS is a computer system for assembling, storing, manipulating, and displaying spatial data which includes information on the physical locations (geographic coordinates) of features and information about those features. GIS was once viewed as an expensive toy, but is now considered an indispensable planning and management tool.

Metadata, or information about the data in a dataset, is a critical component of information management. With metadata, the characteristics of a dataset are documented so that potential users can determine the appropriateness of the data for their particular purpose. Metadata can include a variety of information such as the agency responsible for the data; measurement, collection and laboratory methodologies; and data accuracy.

Major Water Resource Data Collection, Management and Distribution Programs

Brief descriptions of some of the major water resource data collection, management and distribution efforts currently underway follow. Separate discussions are provided for temporal, textual and spatial data.

Temporal Data

Temporal data are those data related to a particular point in time or period of time. Examples of temporal data include streamflows, groundwater levels and precipitation data. Following are examples of some major temporal datasets as maintained by various agencies.

Nevada Division of Water Resources. The Nevada Division of Water Resources (NDWR) collects, compiles and maintains and a variety of data including water rights information, well logs, groundwater levels, and water use information.

- **Water Rights Database.** NDWR maintains an electronic database of water rights within the State. Of the more than 73,000 records, over 60,000 have been entered into the database. The database includes information on place of beneficial use, point of diversion, allowable diversion rates and volumes, and other ancillary data. Direct access to the database is limited to internal users, however others can obtain database query reports upon request.

- **Well Logs Database.** Since the 1940s, well logs have been submitted to the NDWR. These well logs include a variety of information such as: well location, drilling method, proposed use, well depth, and depth to water. In 1994, NDWR and USGS cooperatively developed a computer database for managing the well log information. Direct access to the database is limited to internal users, however, others can obtain database query reports upon request. Currently, the database contains information on approximately 50,000 wells in Nevada. The computer database does not contain any detailed information on the subsurface geology. However, this information can be obtained from paper copies of the well logs. The database does not account for all existing wells logs. While all wells in southern Nevada are recorded in the database, only those well drilled since 1984 are accounted for in the database.

- **Groundwater Levels.** NDWR collects groundwater level data in about 73 basins. Much of this information is collected once a year, typically in the spring. Only a portion of the NDWR level data are stored in an electronic database maintained by USGS. The remaining data are stored in paper files.
- **Water Use Data.** NDWR compiles and develops a variety of water use data. According to the

State Engineer's Office, water use data submitted to the Office and calculated by staff in the pumpage and crop inventories accounts for about 90 percent of the total groundwater usage. These data are utilized by the U.S. Geological Survey in their development of statewide water use estimates.

NDWR estimates the total groundwater pumpage within about 16 of the 256 hydrographic areas. Generally these groundwater pumpage inventories are based upon a mixture of both actual measurements and estimates. These data are maintained in electronic spreadsheet files.

NDWR estimates irrigated crop acreages and associated water withdrawals within about 30 of the 256 hydrographic areas. These data are currently stored on paper.

Surface water and groundwater pumpage data are submitted to NDWR by some water right holders as a requirement of water right permit conditions within about 80 of the 256 hydrographic areas. These data are specific to particular users and may not account for all water uses within a hydrographic area. A majority of the uses reported are for public supply systems, mining operations and miscellaneous commercial and industrial operations. These data are maintained in electronic spreadsheet files. NDWR is researching the possibility of entry of these data into an electronic database with links to the water rights database.

Nevada Division of Environmental Protection. Nevada Division of Environmental Protection (NDEP) conducts surface water quality monitoring of major water bodies. Water quality parameters are monitored by NDEP at about 100 sites throughout Nevada. These data are stored in EPA's STORET database (see later discussion on STORET).

A variety of other data are compiled under NDEP programs. NDEP's Underground Injection Control (IUC) program requires groundwater quality characterization data in the permit application. The Solid Waste program, Resource Conservation and Recovery Act (RCRA) hazardous waste facilities oversight, mining-related permitting and state groundwater permitting programs all require some amount of groundwater monitoring in the absence of any contaminant release. Facilities such as wastewater treatment plants and industrial operations with permitted discharges to the surface water are required to monitor effluent quality and to submit discharge monitoring reports to NDEP. Currently, most of these data are stored on paper in files. NDEP's Bureau of Water Quality Planning has initiated efforts to encourage all NDEP programs to automate current data collection and management activities.

Nevada Division of Water Planning. The Division of Water Planning maintains a variety of socioeconomic databases and has taken steps to improve water resource data distribution.

- **Socioeconomic Databases.** The Nevada Division of Water Planning maintains over 20 socioeconomic databases containing information such as population, employment by sector, agricultural production and mining production. These data are obtained from a variety of sources and are available on diskette from the Division in spreadsheet format.
- **Data Access.** Recognizing the need for centralized access to water resources data and information, the Nevada Division of Water Planning has developed an Internet homepage which

provides links to websites for other agencies and data sources such as streamflow, precipitation and snowpack conditions.

Health Division and State Health Laboratory. As required by state and federal drinking water regulations, public supply systems routinely submit water samples to laboratories for analysis. The laboratory results are then sent as paper copies to the Nevada Health Division which has primary enforcement authority for drinking water regulations. Depending upon the public supply system, analyses are performed by either the State Health Laboratory or by private laboratories. The State Health Laboratory maintains analysis results in an electronic database, but these data are not readily available to other agencies. However, others can obtain database query reports upon request.

Currently, the Nevada Health Division is planning for the implementation of a comprehensive electronic data management system. Under this proposed system, data generated by the laboratories will be electronically transferred to the planned Health Division system. This program is being funded with federal monies and may take a number of years to implement.

U.S. Environmental Protection Agency. STORET (STOrage and RETrieval) is a computerized information system residing on U.S. Environmental Protection Agency's (EPA) computer at Research Triangle Park, North Carolina. STORET contains information for over 800,000 sampling sites throughout the United States, and consists of several software programs which allow users to store and retrieve water quality data, and analyze these data. Currently, STORET data are downloadable by selected users. EPA is in the process of making STORET data available via the Internet.

As discussed above, the Nevada Division of Environmental Protection (NDEP) operates a surface water quality monitoring network of about 100 sites throughout Nevada. NDEP utilizes STORET for the maintenance of these data.

U.S. Geological Survey. The USGS Water Resources Division routinely collects water discharge data for gaging stations on streams, canals and drains; peak-flow data at miscellaneous sites and springs; water elevation and contents for lakes and reservoirs; water levels in wells; and water quality for stream, canal and drain sites and wells. These data are maintained in a number of electronic databases and published in an annual data report. Only the streamflow data are available to the public via the Internet. Other data such as groundwater levels and water quality information can be obtained in electronic format only upon request. USGS is currently working on an application for Internet access to statewide groundwater level information. There are no current plans to provide Internet access to their groundwater and surface water quality data.

Other Agencies. A number of agencies provide climatological (precipitation, temperature, snowpack conditions) data via the Internet such as the U.S. Natural Resources Conservation Service, National Weather Service, National Climate Data Center and Western Regional Climate Center.

Textual Data

Textual data consists of text-based information such as directories, library bibliographies and inventories. Following are examples of some major textual datasets as maintained by various agencies.

Nevada Division of Water Planning. The Division is in the process of developing a directory of professionals working in the water resources field and will provide information on occupation, areas of specialty and access. The directory will be produced in a database format and be available over the Internet.

The Division maintains a library of over 4,000 water resources related documents. The documents are indexed by major hydrographic region and subject area. The library includes water planning documents from many other states as well as many state, federal and local agency reports and publications. A detailed document listing is maintained within an electronic database. The Division is in the process of providing Internet access to the library document listing.

Biological Resources and Research Center (BRRC). BRRC's Effort Gap program is a database of biological research efforts in the Great Basin. The program's goal is to provide an easily accessible information center to agencies, organizations, and individuals involved in biological research. The database is accessible via the Internet and contains a variety of information such as contacts, project descriptions and directories of available data.

Spatial Data

Spatial data are those data related to space which can be shown on a map, and which are commonly maintained within a Geographic Information System (GIS). Following is a discussion of some past and ongoing GIS development and coordination efforts.

GIS data development. Many agencies and organizations in Nevada are developing GIS data files which are of use in water resource planning and management. Such agencies include:

- Department of Conservation and Natural Resources
- Division of Water Resources
- Division of Environmental Protection
- Division of Wildlife
- Division of State Lands
- Division of State Parks
- Natural Heritage Program
- Division of Water Planning
- Legislative Counsel Bureau
- Department of Transportation
- University of Nevada System
- Tahoe Regional Planning Agency
- Desert Research Institute
- U.S. Geological Survey
- U.S. Forest Service
- U.S. Bureau of Land Management
- U.S. Bureau of Reclamation
- U.S. Natural Resources Conservation Service
- Nevada Bureau of Mines and Geology

Few of these agencies provide Internet access to their GIS files or directories. No comprehensive list of all available GIS files held by these agencies exists at this time.

GIS Data Coordination and Distribution Efforts. Following is a discussion of some recent GIS data coordination and distribution efforts.

- **State GIS Task Force.** In 1995, the Department of Information Technology (DoIT), then the Department of Information Services, created a GIS task force in concurrence with the Department's strategic plan. The overall objectives of the task force were to:

  - document GIS hardware and software requirements;
  - develop standards for hardware and software;
  - set direction for future GIS users;
  - establish a standard data format for GIS data for the state;
  - provide recommendations to enable GIS information transfer among all agencies within the state who demonstrate a need;
  - establish a clearinghouse for GIS data; and
  - establish guidelines and recommendations for GIS training and education.

  The GIS Task Force consisted of about 50 representatives from state, local and federal agencies with meetings facilitated by DoIT staff. DoIT staff produced a draft report of conclusions and recommendations, but the report and its recommendations have not been finalized. One of the draft recommendations calls for the creation of a Geographic Information Board to take a leadership role in the coordination of state GIS functions.

- **Department of Conservation and Natural Resources GIS Committee.** The Department of Conservation and Natural Resources has formed a committee to coordinate departmental GIS issues.

- **Federal Geographic Data Committee.** The Federal Geographic Data Committee, established by Executive Order in 1994, was charged with three major activities:

  - establishment of a National Geospatial Data Clearinghouse;
  - development of standards for data documentation, collection, and exchange making data sharing easier; and
  - development of procedures and partnerships to decrease duplication of efforts in data development, and fill in areas where data gaps exist.

  The National Geospatial Data Clearinghouse is accessible via the Internet and provides access to a network of spatial data directories and libraries as maintained by a variety of participating agencies. The Clearinghouse does not maintain any data but merely provides the means to locate and obtain the data maintained by others. At this time, approximately 25 states are participating in the National Geospatial Data Clearinghouse program. The State of Nevada is in the process of developing a link to the Clearinghouse.
- **Nevada Bureau of Mines and Geology/State Mapping Advisory Committee.** The Nevada Bureau of Mines and Geology (NBMG), on behalf of the State Mapping Advisory Committee (SMAC), received a grant from the Federal Geographic Data Committee (FGDC) in 1997 to support a study of how we use and share our digital geographic data in Nevada. NBMG mailed out surveys to GIS users throughout Nevada. These surveys indicated that most GIS users are not satisfied with existing coordination activities and that more formal coordination and data accessibility efforts are necessary. As a start to addressing this issue, NBMG in cooperation with

SMAC established an Internet website as a rudimentary geographic information clearinghouse. The NBMG website does not directly provide any GIS file listings or file access capabilities, but rather provides links to the homepages of agencies which maintain GIS and related data. Although a number of these agencies maintain GIS systems, data listings and access information may or may not be available from their homepages.

SMAC/NBMG recently obtained additional funding from the Federal Geographic Data Committee to establish a link to the National Geospatial Data Clearinghouse. Funding will be used to purchase the necessary computer hardware and to develop the Internet links to geospatial data providers in Nevada. As described below, the National Geospatial Data Clearinghouse does not maintain any data but merely provides information on where and how users may access data, information about the data (metadata) and links to data source Internet sites. The Clearinghouse link will be online mid-1999 and ready to receive metadata from agencies. Geospatial data providers in Nevada will need to submit metadata to the clearinghouse administrator in order for this clearinghouse to be an effective distribution tool.

- **National Performance Review (NPR) Project.** The NPR project is a cooperative effort between the U.S. Forest Service, University of Nevada-Reno, and the Nevada Division of Water Planning. One goal of this project is to provide access to information relevant to watershed planning and risk assessment in the upper Carson, Truckee and Walker watersheds. The project participants are compiling GIS information (physical, biological and cultural) for these watersheds, and plan to provide others access to the information via the Internet to the extent possible including basic viewing and downloading capabilities.

- **Biological Resources Research Center (BRRC).** The BRRC homepage provides a listing of GIS files maintained by BRRC. None of the data are accessible via the Internet, however GIS files can be requested from BRRC.

Data Gaps and Research Needs

While the management and dissemination of existing data is critical for effective decisionmaking, there is also the need to collect additional data and perform further research. In the following discussion, key data and research needs are presented.

Groundwater Quality and Water Levels

The USGS and NDEP operate a network for monitoring surface water quality and flows. No such statewide network for monitoring groundwater quality and water levels exists in Nevada. Much of the available groundwater data are the result of special studies in specific areas, and monitoring required by State permitting programs and drinking water regulations. The USGS and NDWR are the primary agencies collecting groundwater level data on a statewide basis. Much of this information is collected once a year, typically in the spring.

A fundamental purpose for monitoring is to acquire data necessary for the protection of existing rights and planning to accommodate increased water usage. In some basins, the lack of continuous, long-term groundwater quality and level data makes it difficult to assess trends and manage the resource for current and future needs.

The need for a statewide groundwater level and quality monitoring network has been recognized for some time. In 1978, the USGS with NDEP produced a report titled "Ground-Water Quality in Nevada - A Proposed Monitoring Program" that outlined a program for systematically monitoring groundwater conditions in Nevada and defined procedures for prioritizing basins for monitoring.

Streamflow Gaging

The U.S. Geological Survey (USGS) is the principal Federal agency which collects surface water data in Nevada. The USGS began collecting streamflow data in 1889 with the establishment of a gaging station on the Truckee River near the Nevada-California State line. During the next six years, additional gaging stations were established in the Humboldt, Carson, Walker and Truckee basins. As of 1997, the USGS surface water quantity monitoring network consists of water discharge measurements for 173 gaging stations on streams, canals and drains, 170 peak flow stations and miscellaneous sites, and six springs; and water levels and contents for 21 lakes and reservoirs. The general objective of the stream-gaging program is to provide information on, or to develop estimates of, flow characteristics at any point on any stream. The USGS and various entities in Nevada have had cooperative agreements for implementation of the gaging program. Assistance from these other entities has come in the form of funding and/or services. This program would not be viable without these cooperative agreements.

Other entities collect streamflow data for regional purposes. For example, the Clark County Regional Flood Control District operates a network of meteorologic and water depth monitoring stations as part of the District's Flood Threat Recognition Program.

Streamflow records can be used for a number of purposes, such as:

- managing water supplies for various uses and minimum flow needs;
- administering compacts and decrees;
- operating and designing multipurpose storage facilities;
- characterizing water quality conditions, including sediment and chemical constituent loads;
- setting permit requirements for treated wastewater discharge;

- forecasting and managing floods;
- delineating and managing floodplains;
- designing highway bridges and culverts; and
- performing scientific studies for water quantity and quality planning and management purposes.

Most of the USGS gaging stations have one primary purpose and can have several secondary purposes. In some instances, gaging station data are used for day-to-day operations. However the resulting data can also be useful for long-term studies in the future. All existing and potential uses of the data need to be considered prior to discontinuing the operation of any gaging station. The maintenance of a viable stream gaging program is an integral part of managing our natural resources. Future efforts to discontinue existing gaging stations must be closely scrutinized. We must not lose sight of the long-term value of a comprehensive stream gaging network.

Water Use

Approximately 65 to 75 percent of the total water withdrawn annually from groundwater and surface water sources in Nevada is either measured with detailed diversion records maintained by various entities, or estimated by the State annually in detailed pumpage and crop inventories. Only a portion of these data are maintained in an electronic database and reported to any state planning agencies. Much of the available water use data are collected for regulatory purposes (compliance with permits, decrees, etc.) and may lack the detail needed to fully characterize water usage for planning purposes. Water use information (whether measured or estimated) is critical for effective water planning and management both at the state and local levels. Additional information on water use and measurement is presented in Part 3, Section 1, "Water Use Measurement and Estimation."

Water Resources Research

Ongoing research concerning Nevada's water resources which utilizes new technologies and methodologies provides valuable information for improved water management and planning. Improved understanding of our water resources leads to enhancements in planning and management.

One particular research need is the updating of groundwater perennial yield estimates. A majority of the groundwater perennial yield estimates currently available were developed by the U.S. Geological Survey during the 1960's and 1970's as part of a reconnaissance investigation series. The resulting perennial yield estimates form the basis for the management of the groundwater quantity in Nevada. However, these reconnaissance investigations were never intended to provide definitive groundwater budgets for hydrographic areas in Nevada. Instead, these studies were intended to serve as guides for more comprehensive investigations when new data became available and more advanced methodologies were developed. Since the time of the original perennial yield estimates, developments in new methods and technology for estimating water resource availability and groundwater recharge and discharge have been significant. These new methodologies are considered to be more accurate and could result in higher perennial yield values than previously estimated. For instance, the U.S. Geological Survey has applied new procedures to 16 basins in east-central Nevada and now estimate perennial yield amounts at more than twice the previously recognized values for 14 of these basins.

Updated estimates of groundwater availability, recharge and discharge, will better facilitate economic development, protection of scarce water resources and optimal resource allocation.

Data Management in Other States

Many states have recognized the need for improved data management and distribution, and have taken steps towards meeting these demands. Responses to data management needs vary from state to state, but the Internet has become the primary instrument by which users can research available data in their state. Depending upon the state, users can view and/or search data directories, view associated metadata and in some cases can download both temporal and/or spatial datasets. About 25 states are participating in National Geospatial Data Clearinghouse efforts. Nevada is in the process of developing an Internet link to the Clearinghouse which will present GIS metadata.

Some states have coordinated statewide efforts for improving data distribution. For example, a number of states have created geographic information boards to develop their GIS management strategies and policies, and oversee data sharing activities. Board members typically represent a number of different state agencies. In other states, individual agencies have taken the lead on developing their own data distribution program. Some states have a state GIS coordinator who facilitates and coordinates the activities of an informal GIS task force. All states bordering Nevada have some form of GIS coordinating board whether formal or informal. Following are some examples of data management activities in other states.

Wyoming

In support of their state water plan development, the State of Wyoming recently completed a detailed inventory of temporal and spatial water data available in the state. The statewide data inventory is accessible via the Internet and allows water resource professionals and the general public to access primary data descriptions under specific themes in Wyoming river basins. Information on procedures for obtaining the data is also provided.

Idaho

In Idaho, the Department of Water Resources manages the Idaho Geographic Information Center in accordance with policies set by the Geographic Information Advisory Committee. Through the Center's Internet homepage, users can download spatial data generated by a variety of agencies, but maintained in a central location by the state.

Utah

The Utah Division of Water Rights is the office of record for water rights in the State of Utah, and all records are available for public review. Through the Division of Water Rights' Internet homepage, users can access a variety of information and data including water rights information.

Florida

In 1996, the Florida State Legislature created the Florida Geographic Information Board (FGIB) to facilitate the identification, coordination, collection, and sharing of geographic information throughout the state. The board develops solutions, policies, and standards to increase the value and usefulness of geographic information. In addition, FGIB maintains a data directory on the Internet from which interested parties can obtain metadata on available GIS files and information on obtaining electronic copies.

Issues

Good water resource management decisions require reliable and accessible water resource information and data. While agencies in Nevada have made important strides in gathering, compiling and sharing water resources information, more needs to be done to provide a common and accurate core of information to enable timely and wise decisions. Future State Water Plan releases would be significantly enhanced with improvements in data management and availability. Following are the main issues that need to be addressed:

1. The State lacks a comprehensive plan to coordinate development and dissemination of temporal, textual and spatial (GIS) information.

2. Data accessibility needs to increase. Some datasets are stored on paper or electronic spreadsheets which reduces their usefulness. Other datasets are managed using database systems, but access may be restricted.

3. Without a comprehensive data inventory, potential users have difficulties in identifying, locating and obtaining needed data.

4. Metadata (data about the data) are lacking in some instances, making it difficult for potential users to determine the appropriateness of the data for their particular purpose.

5. Data gaps exist in some areas due to the lack of a statewide groundwater quality and level monitoring network, and a comprehensive statewide water use estimation program.

6. The lack of a comprehensive water use estimation program may impede state and local water planning efforts.

7. A viable stream gaging program is an integral part of managing our water resources, yet funding

and maintaining the stream gages remains problematic.

8. Ongoing research on Nevada's water resources is needed for improved water management and planning. Current perennial yield estimates may be inaccurate for some basins and could be updated using newer technologies and methodologies.

Recommendations

The following recommendations are provided as possible means for improving water resources data management in Nevada:

1. The State should encourage and support agencies and local governments in the development of electronic databases for data currently stored on paper copies and in electronic spreadsheet files, and for future data collected. Data stored in spreadsheet files are more useful than data on paper, however the spreadsheet format does not lend itself to the types of manipulations possible with databases.

2. The State should create a new GIS task force of local, state and federal interests to evaluate in detail GIS issues and management needs. Their main task should be the development of a strategic plan which would address data coordination, collection and sharing needs, staffing and funding considerations, and provide recommendations to address these issues.

3. The State should support federal agencies, such as U.S. Geological Survey (USGS) and U.S. Environmental Protection Agency, in their efforts to provide Internet access to data. For instance, the Department of Conservation and Natural Resources should cooperate with the USGS to provide public access to USGS water quality data.

4. The Division of Water Planning should develop and maintain a detailed inventory of water resource datasets with Internet access to the inventory and access information. State agencies should develop and provide Internet sites for data sharing to the extent possible.

5. The State should support efforts by all groups to provide GIS data information via Nevada's connection to the National Geospatial Data Clearinghouse.

6. The State should encourage the development of metadata (information about the dataset) so that potential users can more easily determine the appropriateness of the data for their particular purpose.

7. The Department of Conservation and Natural Resources should develop and implement a groundwater quality and level monitoring network for priority basins. In some basins, water level information collected more frequently than once a year would be useful.

8. The State should improve water use measurement and estimation efforts through the program defined in the "Water Use Measurement and Estimation" issue discussion.

9. The Department of Conservation and Natural Resources should continue to support the cooperative agreements with the USGS for the funding of the stream gaging station network. Future efforts to discontinue existing gaging stations must be closely scrutinized.

10. The Department of Conservation and Natural Resources should continue to support further research projects as necessary, and should support efforts to update perennial yield estimates for priority basins.

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C. Water Planning Assistance to Local Governments

Introduction

Water planning by local governments is becoming more common and more necessary in response to increasing population, increasing competition for water, and natural resource concerns. Local governments are also realizing the need to plan the future of their land and water resources in a more comprehensive manner, involving all stakeholders in the process.

Comprehensive water planning can be time consuming and costly to local governments. The State currently has some programs to provide local water planning assistance but more could be done to facilitate local water planning efforts. This issue paper describes the need for local water planning, ways in which the State currently provides planning assistance, and recommendations for improving the State's assistance to local planning entities.

The Need for Local Water Planning

As with the state government, local entities also need water plans as tools to guide future decisions affecting their regions. Without a comprehensive water planning process, decisions may be made without full consideration of potential impacts to the watershed, the water resources, and other future needs and projects. Water purveyors, sanitation districts, towns and cities, counties, irrigation districts, water conservancy districts, and general improvement districts can all benefit by implementing water planning programs. Depending upon an entity's authority, a variety of planning efforts may be desirable. For example, water plans can be developed to address drought response and emergency water supplies needs, future water and wastewater infrastructure needs, future water supply needs and options, conservation programs, flood control, land use and comprehensive watershed needs.

Local water plans are not only useful to guide decisions related to internal proposals, but they can also guide responses to the activities of others such as water rights transfers, proposed housing or industrial developments, federal environmental impact statements and environmental assessments, and state and federal planning efforts. Local water plans may be useful for identifying areas of potential conflict with other groups within the jurisdiction of the planning agency and suggest appropriate actions.

A local or regional water plan can go far in helping to address water quantity and quality issues, coordinating individual actions and developing unique information to help assess potential impacts of proposed actions. Local water planning can also create an atmosphere of cooperation between the various participants. If the planning is done in a comprehensive manner, it brings the community and stakeholders together to plan for their future. Cooperatively developed water plans can address the needs of all stakeholders and ensure that one program, for example water supply, does not succeed to the detriment of other community and state goals such as habitat protection or water quality protection. However, planning does require time and money to develop real solutions for the long term, not just quick fixes.

There are a number of local water and watershed planning efforts currently underway in Nevada. Southern Nevada Water Authority and Washoe County have successfully developed water resource plans which are frequently updated. Elko, Eureka, Lincoln, Nye and White Pine counties are developing water plans, but with limited staffing and funding support. In addition, the Carson River Subconservancy District is developing a regional water plan for the Carson Basin. A number of research and water planning efforts are underway in the Walker River basin (which encompasses parts of Mineral, Lyon and Douglas counties) aimed at developing technical information and tools to guide water resource decisions within the basin. Utilizing a one-time federal appropriation, the Nevada Division of Water Planning has recently hired a part-time watershed planner to facilitate the coordination of the various efforts in the Walker basin. During the mid-1990s, the Humboldt River Basin Water Authority was formed, with membership from Humboldt, Lander, Eureka, Elko and Pershing counties. The Authority has defined a number of roles and responsibilities for itself, including review and comment on activities which may impact the water resources within the Humboldt River Basin, and facilitation of the development and maintenance of data and information regarding the use and management of Humboldt River Basin water resources.

Water Planning Assistance

Many local governments have limited personnel and funding resources for water planning. As a result, local governments sometimes have difficulties with: effectively developing regional water plans and updating existing plans; planning for growth; adequately addressing environmental concerns; participating in planning efforts by others, such as Bureau of Land Management, U.S. Forest Service, that may affect local regions; and reviewing and commenting on federal environmental impact statements and environmental assessments for proposed projects in their area.

State water planning assistance to local governments can occur in many forms:

- Information and data sharing

  The State can assist local water planning by developing, providing or increasing access to water-related data, such as water use estimates, available and committed water resources, water quality characteristics, groundwater levels, and streamflow rates.

- Financial support of local water planning efforts

  The State can provide funding to support local water planning efforts. Funding could be used for the local water planning groups to hire staff and/or consultants to develop the necessary plans.

- Review of local water planning documents

  By reviewing planning documents and providing input, the State can be involved in improving local planning products and reports, and the local decisionmaking process.

- Technical assistance

  The State can provide technical assistance through a variety of activities such as: information and data sharing, data analysis, document review, document preparation, and map development.

- Participation in local water planning efforts

  The State can be an active participant in local water planning activities by having staff attend planning group meetings, facilitate planning meetings, and/or serve on local planning boards. Such involvement represents a high level of commitment to the local process and requires that the State obligate staff and associated funding as needed for the long term.

Current Water Planning Assistance Efforts

A number of state agencies provide local water planning assistance in some form, either directly or indirectly through the methods discussed above. Following are some examples of state assistance to local water planning efforts. This list is by no means intended to be a complete discussion of all water planning assistance currently occurring within Nevada.

Nevada Division of Water Planning

The Nevada State Legislature recognizes the need for local water planning assistance and the role of the Division of Water Planning (NDWP) in providing this assistance. As stated in the Nevada Revised Statutes pertinent to NDWP, "The legislature determines that the purpose of the state's water resource planning is to assist the state, its local government and its citizens in developing effective plans for the use of water" (NRS 540.011(4)). It is further stated that NDWP shall "Provide political subdivisions and private enterprises in arid regions with information, alternatives and recommendations bearing upon regional shortages of water including feasible selections or courses of planning and action for acquiring additional water or for conserving water now available, or both" (NRS 540.051).

NDWP has undertaken a number of activities in an attempt to satisfy these legislative directives. In fact, most of NDWP's activities provide some form of assistance to local interests:

- NDWP has generated numerous documents covering a variety of water-related topics and has compiled many socioeconomic databases, which are made available to local planning groups. In addition, the Division maintains an extensive library of 4,000 water-related documents which serves as an aid to other planning and research entities. NDWP handles numerous requests for these publications and database. These documents and data have been a valuable resource for both the Division and other entities throughout Nevada and the United States. To improve data and information access and distribution, NDWP has developed an Internet homepage to help interested agencies and the public obtain desired information; and for providing links to other agency's Internet sites.

- As the lead agency for floodplain management at the state level, NDWP's duties include implementation of the Flood Mitigation Assistance Grants (FMA) program and the Community Assistance Program (CAP). FMA grants to local governments are for mitigation projects aimed at reducing repetitive insurance losses and future damage. Through this program, communities can also obtain technical and financial assistance for the development and updating of Flood Mitigation Plans. The Community Assistance Program focuses on assisting communities to plan for flooding events and prevent damages by locating buildings outside the floodplain or away from alluvial fans. Staff develop and update the state model flood ordinance and assist communities in developing and implementing their own ordinances and building codes. Staff also provide training to local officials on the latest FEMA regulations and flood management technologies.

- NDWP staff regularly provide assistance to local watershed planning groups, local governments and planning groups, and private citizens. This assistance has included activities such as providing technical reviews of documents; compiling and providing data, information and reports; cosponsoring conferences and technical training sessions; facilitating the development of additional data; and participating in local planning meetings. For example, NDWP is a non-voting member of the Washoe County Regional Water Planning Commission, and has participated in local planning efforts in the Walker, Carson, Truckee and Humboldt River basins. Further, at the request of White Pine County, the Division provided input on their draft water plan outline and has provided technical data in support of their plan. NDWP also handles many telephone, written and electronic mail requests for data, information, and technical advice.

- The Division administers the AB198 Grants to Small Water Systems program. Under this program, the Board for Financing Water Projects can award a total of $40 million dollars in grants to assist small water systems to provide better, higher quality water and become more self sufficient. Division staff review grant requests for capital improvements and work with communities to develop water system designs and financial approaches to best serve their customers. To date, 19 communities have received a total of over $19 million dollars to fund new wells and pumps, replace aging and leaking tanks and pipes, loop lines, rehabilitate springs, and install new treatment systems.

- The *State Water Plan* is intended to serve as a planning tool for local governments. The Plan provides information on existing laws and regulations, water resources, socioeconomic characteristics, and issue discussions and recommendations which will be useful to local planning groups.

While NDWP has provided local assistance in a variety of forms, the Division has been limited in its ability to provide a higher level of support. In some instances, the Division is not able to fully participate in local planning activities due to limited funding and staffing.

Nevada Division of Environmental Protection (NDEP)

208 Water Quality Management Plans. Section 208 of the federal Clean Water Act defines the need for the development and implementation of areawide wastewater treatment management plans. Following are the five areas for which 208 plans have been developed and the agencies responsible for plan development:

Planning Area	Responsible Agency
Carson River Basin	Nevada Division of Environmental Protection
Clark County	Clark County Board of County Commissioners
Lake Tahoe Basin	Tahoe Regional Planning Agency
Washoe County	Truckee Meadows Regional Planning Agency
Remainder of the State	Nevada Division of Environmental Protection

As indicated by this list, NDEP provides assistance to local entities through the development of 208 plans for a majority of the State's geographic area.

Wellhead Protection Program. Wellhead protection involves integrated resource planning and preventative actions intended to reduce the risk of contamination of the drinking groundwater supplies. In part, developing a Wellhead Protection Program (WHPP) has resulted in coordinated efforts by cooperating agencies and organizations to delineate wellhead protection areas, inventory potential and existing contamination sources, select and implement strategies for minimizing contamination potential, develop plans for locating new wells, and develop a contingency plan. NDEP provides technical and financial assistance when available to communities developing WHPPs.

Nonpoint Source Management Program. Section 319 of the federal Clean Water Act establishes the Nonpoint Source Management Program which is administered by NDEP. Under this program, NDEP provides technical and financial assistance for implementation of nonpoint source pollution control projects.

Nevada Division of State Lands. Nevada Revised Statutes 278.150 requires each city and county to prepare and adopt a comprehensive, long-term general plan for the physical development of the city, county or region. The master plan may address a variety of matters, such as water conservation, land use, population, public services and facilities, recreation and solid waste disposal. Upon request, Division of State Lands staff may provide technical assistance to the local entities during the plan development. Assistance has consisted of data sharing, document review and comment, and actual plan preparation and public meeting facilitation.

The Division of State Lands is working in cooperation with appropriate federal and state agencies and local governments to develop plans or statements of policy concerning the acquisition and use of lands under federal management. The plans or statements of policy are developed to provide local input to federal land planning actions and require the approval of the governing board of the affected county.

Issues

Following is a summary of the main issues related to water planning assistance to local governments:

1. Many smaller governmental entities have limited personnel and funding resources for the development of local water plans; participation in planning efforts by others, such as Bureau of Land Management and U.S. Forest Service, that may affect their region; and review and comment on federal environmental impact statements and environmental assessments for proposed projects in their area.

2. Because of limited funding and staffing at the State level, NDWP and other agencies are limited in their ability to provide a higher level of assistance to local water planning efforts.

3. Other issue discussions in the *State Water Plan* present related issues:

   - "Water Use Measurement and Estimation": The lack of comprehensive detailed water use information for some regions may impede local planning efforts.

   - "Water Resource Data Management": Data availability and access limitations may hinder local planning.

   - "Watershed Planning and Management": The State could further enhance watershed management and planning through additional measures.

Recommendations

The following recommendations are offered as mechanisms for improving the State's support of local water planning activities:

1. The State should enhance local water planning assistance efforts through financial support and/or additional technical support from Division of Water Planning staff and other agencies.

2. The State should improve water use measurement and estimation efforts through the program defined in the "Water Use Measurement and Estimation" issue discussion.

3. The State should improve data management, coordination and sharing through the measures defined in the "Water Resources Data Development, Collection and Management" issue discussion.

4. The State should further enhance watershed management and planning in Nevada through the recommendation offered in the “Watershed Planning and Management” issue discussion.

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D. Water Education

Introduction

As the driest state in the nation and one of the fastest growing, it is important that Nevada's residents understand the fundamental science of water, how water is managed in the state, and the issues affecting water management. An educated populace is clearly a key to future management of water resources, and therefore, water education must become a priority.

Benefits of Water Education

The overall goal of water education is to develop more knowledgeable citizens who can participate in public discussion and debate about water issues. Information improves people's ability to examine and evaluate information presented — and the information that is not presented. With a basic understanding of water, residents can respond intelligently to issues such as the need to develop water supplies or wastewater treatment facilities, the benefits and costs of conservation, the dangers associated with leaking contaminants, the risks posed by poor water quality, the benefits and costs of river restoration or flood control. With education, people can form their own opinions based on data and information, and rely less on emotion or rhetoric.

It is especially important that Nevada's children learn about water so that they develop an appreciation for the unique role water plays in the development of our state and become informed citizens who can think critically and evaluate information intelligently throughout their lives. Water as a topic has natural links to science, math, social studies, and language and is an excellent unifying curricular theme. Water attracts kids and learning about it can be interesting and fun, encouraging both a greater appreciation of the environment and a greater interest in selecting science and math oriented careers.

Background

The state of Nevada has had a water education program in the Nevada Division of Water Planning since 1991. The program has components focusing on both children and adults, and incorporates a variety of methods, tools and approaches to increase learning about water. The state water plan itself is an important educational tool.

Project WET

Project WET (Water Education for Teachers) is a science and math education enhancement program focused on grades K-12. It is an interdisciplinary program intended to supplement a school's existing curriculum. The mission of National Project WET is to increase awareness, appreciation, knowledge and stewardship of water resources. Project WET offers Nevada's teachers classroom-ready teaching aids such as activity guides, lesson plans, groundwater and watershed models, computer simulations, publications and a network of specialists to call upon, so that incorporating water education into the classroom is easy for teachers and interesting for children.

National Project WET began in the 1980's at the University of North Dakota. The program's founder, Dennis Nelson, eventually moved to the University of Montana where the program is headquartered today. Forty states in the country have Project WET programs. In Nevada, the Division of Water Planning has sponsored the program with help from a variety of partners including the University of Nevada – Cooperative Extension and the U.S. Bureau of Reclamation. The Division of Water Planning operates the program under a cooperative agreement with National Project WET. National WET continues to establish guiding principles and standards for the program, develop new educational materials, sponsor national meetings for Project WET coordinators in all the participating states and assist with fund raising.

There are over 12,000 K-12 teachers in Nevada. Of these, approximately 700 have taken the 15-hour, 1-credit Project WET course. The course is accredited through the University of Nevada in both Reno and Las Vegas, Sierra Nevada College, Western Nevada Community College in Carson City and Fallon, and Brigham Young University in Salt Lake City. It is available for both graduate and undergraduate credit and for teacher in-service credit. Evaluations for the program have been outstanding. The only issues have concerned the large amount of information to be mastered, the desire to have more frequent classes in all areas of Nevada and the desire to obtain advanced training.

Nevada Project WET has no staff and has been dependent on grant funding. Over the last 7 years, the Division has raised close to $175,000 to support the program, with a state contribution during this period of approximately $15,000. In the last legislative session, the Legislature added $20,000 per year to the Division of Water Planning's budget to help support the program. The state dollars are being used to fund two water education contractors, one of whom is responsible for managing, tracking and applying for more grants (among other duties), while the other coordinates and instructs the Project WET classes throughout Nevada. Yet another contractor is supported by federal grant funds to coordinate and teach Project WET classes in southern Nevada.

Funding and staffing for Nevada Project WET has been provided by the Eisenhower Foundation, the U.S. Bureau of Reclamation, the U.S. Environmental Protection Agency, National Project WET, the Nevada Division of Environmental Protection's Section 319 Grant Program, the Southern Nevada Water Authority and the University of Nevada – Cooperative Extension.

Nevada Riverwatch

In 1996 and 1997, the Division of Water Planning was awarded several federal grants to start a student water quality monitoring program. The goals of *Nevada Riverwatch* are to help students develop skills in: (1) science (through sample collection, field and laboratory analysis, recordation, observation and comparison); (2) math, statistics, and time series using computers (through analysis of the data); (3) writing (by keeping records and writing an end of the year report); and (4) public speaking (by presenting data at conferences.) The funds were used to hire a contractor to design and implement the program, and to purchase extensive field and classroom equipment to test local waters in northern Nevada. It is expected that the program will be expanded throughout Nevada if the pilot program is successful.

The Division developed Memorandums of Understanding (MOUs) with junior high and high schools in Washoe and Lyon Counties and Carson City. Each school had to agree to have the students take pre- and post- tests to evaluate the knowledge they gained during the project, help co-sponsor an end-of-the-year conference where students from all three schools would present their testing results, and make a three-year commitment to the program. Testing sites along the Truckee and Carson Rivers were selected and the Division arranged to have staff from cooperating agencies instruct the students and teachers in proper sampling and analysis techniques.

At this time the MOUs with the schools have been developed and all of the field and classroom equipment has been purchased. The first sampling period was to begin in winter of 1997, but was delayed a year because of flooding on the rivers, and then by restoration and clean-up work at the sample sites. The Division's contractor was laid off for a while due to fiscal issues arising from the grant funding. The Division is now about to rehire the contractor and continue the program. Funding sources for Nevada Riverwatch have included grants from the Nevada Division of Environmental Protection's Section 319 program and the U.S. Geological Survey (USGS) Educational Partnership program.

Nevada Water Education Calendar

For 7 years the Division of Water Planning has produced a Water Education Calendar for use in all 2nd through 6th grade classrooms in Nevada. Each year, the Division sponsors a poster contest using a different water theme. Children in grades 3 through 6 submit posters for judging. Thirteen of the posters are published in the water education calendar along with water facts and figures. To offset the costs of producing and printing the calendar, the Division solicits donations. The calendar includes a write-up on each major sponsor. A number of agencies in the Department of Conservation and Natural Resources help to co-sponsor the calendar including the Divisions of Water Resources and Environmental Protection. Other sponsors include the Bureau of Reclamation, Washoe and Clark Counties, mining companies, engineering companies, and private individuals.

Adult Education

The Division of Water Planning is also active in the adult water education arena. Throughout the year the Division co-sponsors seminars, conferences and events to help agency staff, professionals and the general public learn more about water. Examples from 1998 include two widely attended flood conferences about the Carson and Walker Rivers, the annual Nevada Water Resource Association Conference, a full day seminar on water banking, the Champions of the Truckee River Day, and Clean-up the Carson River Day. Frequent presentations on water topics and issues are made to service clubs, professional associations, and elected and advisory boards.

Staff from the Divisions of Water Resources (DWR) and Environmental Protection (DEP) provide similar educational support. In 1998, the DWR sponsored a number of full-day seminars on water rights and was actively involved in the NWRA conference, and the DEP gave many presentations to groups, especially on the subject of groundwater protection.

Issues

1. **<u>Grant Funding – Administrative and Fiscal Support.</u>** Grants often require a large amount of administrative and fiscal support. Efforts must be devoted to researching grant opportunities and developing and writing grant proposals. Such proposals require a great deal of preliminary work to develop partnerships, prepare budgets, identify appropriate state match opportunities and generate letters of support. Once a grant is obtained, detailed administrative and fiscal data must be maintained and quarterly reports must be prepared. Tracking and accounting activities are usually significant. The time spent in grant administration could be more effectively spent in providing hands-on water education activities in the classroom or in the field.

   The addition of funds for Project WET contractors has allowed some of the administrative work to be assigned to contractors. However, many administrative activities are not appropriately assigned to contractors. State staff is necessary to coordinate and manage the water education programs, grants and contracts.

2. **<u>Grant Funding – Match Requirements.</u>** Many federal grants require a state match. The limited amount of state dollars available has limited the state's ability to qualify for a number of grants in terms of meeting the match requirements.

3. **<u>Grant Funding - Start-Up.</u>** Many federal grants are designed to provide startup funds, not long-term, continued funding. Oftentimes the Division has been able to tap a funding source only two to three times. The federal granting agencies expect the state to pick-up support for the programs once they are up and rolling.

4. **<u>Assessing the Value of Water Education.</u>** The American Water Works Association recently published a study on the importance of water education at all levels.[1] They found a broad range of programs across the country. According to the research, the cost of these programs is quite low, ranging from 5 to 57 cents per household per year, with an average of only 24 cents per household per year. There was widespread agreement about the long term value of such programs and the fact that youth education programs provide an excellent opportunity for outreach. There is also agreement that agencies must continue to look for ways to evaluate the effectiveness of their education programs, but that the long-term efficacy of such programs is probably not quantifiable

5. **<u>Coordination.</u>** There are a number of groups working on water education goals throughout the state. Coordination of these groups could lead to greater effectiveness of the individual programs and increased funding opportunities.

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[1] Mirvis and Clark, *Assessing the value of youth education*, in Journal of the American Water Works Association, Volume 90, Issue 1, January 1998.

Recommendations

1. The State should continue and enhance funding for the state water education program.

2. The State should create and fund a Water Education Coordinator position in the Division of Water Planning.

3. All organizations should continue to develop and implement methods to evaluate the effectiveness of their water education programs.

4. The Division of Water Planning should develop a water education coordination group to support water education programs, develop funding options, leverage dollars, share information, and coordinate activities. Participants could include the University of Nevada – Cooperative Extension, public and private water utilities, the Nevada Rural Water Association, the U.S. Bureau of Reclamation, and the Nevada Department of Education and Divisions of Environmental Protection, Wildlife and Water Resources.

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Nevada State Water Plan
PART 3 — WATER MANAGEMENT ISSUES

Section 6
Glossary of Terminology

[Source: Nevada Division of Water Planning's *Water Words Dictionary*. Words presented in italics and the referenced appendices may be found in the Dictionary. Words and definitions included in this glossary which explain or summarize elements of existing water law are not intended to change that law in any way.]

Abandoned Well — A well which is no longer used or a well removed from service; a well whose use has been permanently discontinued or which is in a state of such disrepair that it cannot be used for its intended purpose. Generally, abandoned wells will be filled with concrete or cement grout to protect underground water from waste and contamination.

Acid Mine Drainage — Acidic water that flows into streams from abandoned mines or piles of mining waste or tailings. Iron sulfide oxidation products include sulfuric acid, the presence of which has reduced or eliminated aquatic life in many streams in mining regions. Also see *Open-Pit Mining* and *Yellowboy*. Also referred to as *Acid Mine Waste*.

Alluvial Fan Flooding — Flooding occurring on the surface of an *Alluvial Fan* or similar landform which originates at the apex and is characterized by high-velocity flows: active processes of erosion, sediment transport, deposition, and unpredictable flow paths.

Annual Flood — The highest peak discharge of a stream in a *Water Year*.

Annual Low-Flow — The lowest flow occurring each year, usually the lowest average flow for periods of perhaps 3, 7, 15, 30, 60, 120, or 180 consecutive days.

Aquifer — (1) A geologic formation, a group of formations, or a part of a formation that is water bearing. (2) A geological formation or structure that stores or transmits water, or both, such as to wells and springs. (3) An underground layer of porous rock, sand, or gravel containing large amounts of water. Use of the term is usually restricted to those water-bearing structures capable of yielding water in sufficient quantity to constitute a usable supply.

Base Flood (100-Year Flood) — The flood having a 1 percent average probability of being equaled or exceeded in a given year at a designated location. It may occur in any year or even in successive years if the hydrologic conditions are conducive for flooding. Also see *Hundred-Year Flood*, *X-Year Flood*, and *X-Year Flood, Y-Duration Rain*.

Base Flood Elevation — The height in relation to mean sea level (MSL) expected to be reached by the waters of the base flood at specific points in the floodplain of *Riverine* areas.

Basin Management (of Water) — Also referred to as *Water or Watershed Management*, it is the analysis, protection, development, operation, or maintenance of the land, vegetation, and water resources of a drainage basin for the conservation of all its resources for the benefit of man. Basin management for water production is concerned with the quality, quantity, and timing of the water which is produced.

Beneficial Use (of Water) — (1) The amount of water necessary when reasonable intelligence and diligence are used for a stated purpose. (2) A use of water resulting in appreciable gain or benefit to the user, consistent with state law, which varies from one state to another. Most states recognize the following uses as beneficial:

[1] domestic and municipal uses;
[2] industrial uses;
[3] irrigation;
[4] mining;
[5] hydroelectric power;

[6] navigation;
[7] recreation;
[8] stock raising;
[9] public parks;
[10] wildlife and game preserves.

(3) The cardinal principle of the *(Prior) Appropriation Doctrine*. A use of water that is, in general, productive of public benefit, and which promotes the peace, health, safety and welfare of the people of the State. A certificated water right is obtained by putting water to a beneficial use. The right may be lost if beneficial use is discontinued. A beneficial use of water is a use which is of benefit to the appropriator and to society as well. The term encompasses considerations of social and economic value and efficiency of use. In the past, most reasonably efficient uses of water for economic purposes have been considered beneficial. Usually, challenges have only been raised to wasteful use or use for some non-consumptive purpose, such as preserving instream values. Recent statutes in some states have expressly made the use of water for recreation, fish and wildlife purposes, or preservation of the environment a beneficial use. Also see *Appropriative Water Rights*.

Best Management Practices (BMP) — Accepted methods for controlling *Non-Point Source (NPS) Pollution* as defined by the 1977 *Clean Water Act (CWA)*; may include one or more conservation practices. Also refers to water conservation techniques of proven value. See, for example, *Best Management Practices (BMP) — Urban Water Use*.

Best Management Practices (BMP)–Urban Water Use — Water conservation measures that generally meet one of two criteria: (1) Constitutes an established and generally accepted practice among water purveyors that provides for the more efficient use of existing water supplies or contributes towards the conservation of water; or (2) Practices which provide sufficient data to clearly indicate their value, are technically and economically reasonable, are environmentally and socially acceptable, are reasonably capable of being implemented by water purveyors and users, and for which significant conservation or conservation-related benefits can be achieved.

Biodiversity — Refers to the variety and variability of life, including the complex relationships among microorganisms, insects, animals, and plants that decompose waste, cycle nutrients, and create the air that we breathe. Diversity can be defined as the number of different items and their relative frequencies. For biological diversity, these items are organized at many levels, ranging from complete *Ecosystems* to the biochemical structures that are the molecular basis of heredity. Thus, the term encompasses different ecosystems, species, and genes. It is generally accepted that human survival is dependent upon the conservation and preservation of a diversity of life forms. Typically five levels of biodiversity are recognized:

[1] ***Genes*** — Genetic diversity encompasses the variety of genetically coded characteristics of plant and animal populations;
[2] ***Populations*** — Groups of individuals of a species that interbreed or interact socially in an area;
[3] ***Species*** — The level at which most organisms are recognizable as distinct from all others;
[4] ***Natural Communities*** — Groups of species that typically occur in recognizable units, such as redwood forests, coastal sage scrub, or oak woodlands. A natural community includes all the vegetation and animal life, and their interactions within that community; and
[5] ***Ecosystems*** — A collection of natural communities. An ecosystem can be as small as a rotting log or a puddle of water, but current management efforts typically focus on larger landscape units, such as a mountain range, a river basin, or a watershed.

Biological Oxygen Demand (BOD) — A measure of the amount of oxygen removed from aquatic environments by aerobic micro-organisms for their metabolic requirements. Measurement of BOD is used to determine the level of organic pollution of a stream or lake. The greater the BOD, the greater the degree of water pollution. Also referred to as *Biochemical Oxygen Demand (BOD)*.

Blackwater — Water that contains animal, human, or food wastes; wastewater from toilet, latrine, and agua privy flushing and sinks used for food preparation or disposal of chemical or chemical-biological ingredients. Compare to *Greywater*.

Candidate Species — Plant or animal species designated by the Department of the Interior, *U.S. Fish and Wildlife Service (USFWS)* as candidates for potential future listing as an *Endangered Species* or *Threatened Species* pursuant to the *Endangered Species Act (ESA)* of 1973; plant or animal species that are candidates for designation as endangered (in danger of becoming extinct) or threatened (likely to become endangered).

Clean Water Act (CWA) [Public Law 92–500] — More formally referred to as the *Federal Water Pollution Control Act*, the Clean Water Act constitutes the basic federal water pollution control statute for the United States. Originally based on the *Water Quality Act* of 1965 which began setting water quality standards. The 1966 amendments to this act increased federal government funding for sewage treatment plants. Additional 1972 amendments established a goal of zero toxic discharges and "fishable" and "swimmable" surface waters. Enforceable provisions of the CWA include technology-based effluent standards for point sources of pollution, a state-run control program for nonpoint pollution sources, a construction grants program to build or upgrade municipal sewage treatment plants, a regulatory system for spills of oil and other hazardous wastes, and a *Wetlands* preservation program (Section 404).

Community Assistance Program (CAP) — A grant program for state programs funded by the *Federal Emergency Management Agency (FEMA)* with the objective of providing technical assistance for flood mitigation activities and coordinating floodplain management activities in counties and communities participating in the *National Flood Insurance Program (NFIP)*.

Conjunctive (Water) Use — (1) The operation of a groundwater basin in combination with a surface water storage and conveyance system. Water is stored in the groundwater basin for later use by intentionally recharging the basin during years of above-average water supply. (2) The combined use of surface and groundwater systems and sources to optimize resource use and prevent or minimize adverse effects of using a single source; the joining together of two sources of water, such as groundwater and surface water, to serve a particular use. (3) The integrated use and management of hydrologically connected groundwater and surface water.

Conservation District — A public organization crated under state-enabling law as a special purpose district to develop and carry out a program of soil, water, and related resource conservation, use, and development within its boundaries. In the United States, such districts are usually a subdivision of state government with a local governing body and are frequently called a soil conservation district or a soil and water conservation district.

Conservation Easement — An agreement negotiated on privately owned lands to preserve open space or protect certain natural resources.

Coordinated Resource Management and Planning — A planning process used by the U.S. Department of the Interior, *Bureau of Land Management (BLM)* that includes public users, interest groups, agencies and affected individuals in the decision-making process before on-the-ground implementation of an activity plan.

Data — In its strictest sense, data may be defined only as the raw numbers (or descriptions, in the case of qualitative data), either in *Time-Series* format (data covering observations over specific periods of time), *Cross-Sectional* format (spatial numeric data consisting of a number of observations taken at a specific point in time or about a specific event or phenomenon), or a combination of these two. Information, on the other hand, deals more specifically with the manipulation, re-organization, analysis, graphing, charting, and presentation of data for specific management and decision-making purposes. Also see *Information Management*.

Data Base — A well-defined collection of data, usually of the same general type, which can be accessed by a computer and may readily be used for further analysis, presentation, and forecasting.

Data Management — The act, process, or means by which data is managed. This may include the compilation, storage, safe-guarding, listing, organization, extraction, retrieval, manipulation, and dissemination of data.

Designated Groundwater Basin — A basin where permitted ground water rights approach or exceed the estimated average annual recharge and the water resources are being depleted or require additional administration. Under such conditions, a state's water officials will designate a groundwater basin and, in the interest of public welfare, declare *Preferred Uses* (e.g., municipal and industrial, domestic, agriculture, etc.). Also referred to as *Administered Groundwater Basin*.

Designated Groundwater Basin [Nevada] — In the interest of public welfare, the Nevada State Engineer, *Division of Water Resources*, *Department of Conservation and Natural Resources*, is authorized by statute (Nevada Revised Statute 534.120) and directed to designate a ground water basin and declare *Preferred Uses* within such designated basin. The State Engineer has additional authority in the administration of the water resources within a designated ground water basin. [A listing of Nevada's Hydrographic Regions, and designated Areas and Sub-Areas is presented in Appendix A–1 (hydrographic regions, areas and sub-areas), Appendix A–2 (listed sequentially by area number) Appendix A–3 (listed alphabetically by area name), and Appendix A–4 (listed alphabetically by principal Nevada county(ies) in which located).]

Dewater, and Dewatering — (1) To remove water from an aquifer or streambed. (2) The extraction of a portion of the water present in sludge or slurry, producing a dewatered product which is easier to handle. (3) (Mining) The removal of ground water in conjunction with mining operations, particularly open-pit mining when the excavation has penetrated below the ground-water table. Such operations may include extensive ground-water removal and, if extensive enough and if not re-injected into the groundwater, these discharges may alter surface water (stream) flows and lead to the creation of lakes and wetland areas.

Disaster Relief Bill (SB 218) [Nevada] — A State of Nevada fund established to help communities recover from damages sustained in a disaster.

Dissolved Oxygen (DO) — (1) Concentration of oxygen dissolved in water. (2) The amount of free (not chemically combined) oxygen dissolved in water, wastewater, or other liquid, usually expressed in milligrams per liter, parts per million, or percent of saturation. Adequate concentrations of dissolved oxygen are necessary for the life of fish and other aquatic organisms and the prevention of offensive odors. Dissolved oxygen levels are considered the most important and commonly employed measurement of water quality and an indicator of a water body's ability to support desirable aquatic life. The ideal dissolved oxygen level for fish is between 7 and 9 milligrams per liter (mg/l); most fish cannot survive at levels below 3 mg/l of dissolved oxygen. Secondary and advanced wastewater treatment techniques are generally designed to ensure adequate dissolved oxygen in waste-receiving waters.

Domestic Well — A water well used solely for domestic, i.e., residential or household purposes to include both indoor and outdoor water uses. Such wells are generally not required to be permitted; however, they may have restrictions in terms of daily pumping amounts, for example, 1,800 gallons per day.

Drinking Water Standards [Nevada] — The primary objective of Nevada's drinking water standards is to assure safe water for human consumption. To this end, the *Nevada Department of Human Resources*, *Health Division — Consumer Health Protection* has established statewide primary and secondary drinking water standards at least as rigorous as those required by the *U.S. Environmental Protection Agency (EPA)*. *Primary Drinking Water Standards* limit contaminants (constituents) which may affect consumer health. *Secondary Drinking Water Standards* were developed to deal with the aesthetic qualities of drinking water. [Appendix B–3, Nevada Drinking Water Standards, presents a listing of Nevada's current primary and secondary drinking water quality standards.]

Drought — There is no universally accepted quantitative definition of drought. Generally, the term is applied to periods of less than average or normal precipitation over a certain period of time sufficiently prolonged to cause a serious hydrological imbalance resulting in biological losses (impact flora and fauna ecosystems) and/or economic losses (affecting man). In a less precise sense, it can also signify nature's failure to fulfill the water wants and needs of man.

Ecology — The study of the inter-relationships of living things to one another and to the environment.

Ecosystem — A community of animals, plants, and bacteria, and its interrelated physical and chemical environment. An ecosystem can be as small as a rotting log or a puddle of water, but current management efforts typically focus on larger landscape units, such as a mountain range, a river basin, or a watershed. Also see *Biodiversity*.

Ecosystem Management — An approach to managing the nation's lands and natural resources which recognizes that plant and animal communities are interdependent and interact with their physical environment (i.e., soil, water, and air) to form distinct ecological units called *Ecosystems*. The fact that these ecosystems span jurisdictional and political boundaries necessitates a more comprehensive and unified approach to managing them. Implementing the initial stage of a government-wide approach to ecosystem management typically requires clarifying the policy goals and undertaking certain practical steps to apply the principles being considered to include:

- [1] Delineating the ecosystem;
- [2] Understanding the system(s) ecologies;
- [3] Making management choices;
- [4] Unifying disparate data and information needs and sources; and
- [5] Adapting management on the basis of new information.

Endangered Species — Any plant or animal species threatened with extinction by man-made or natural changes throughout all or a significant area of its range; identified by the Secretary of the Interior as "endangered", in accordance with the 1973 *Endangered Species Act (ESA)*, below. [See Appendix D–1, Nevada's Endangered and Threatened Species.]

Flood, or Flood Waters — (1) An overflow of water onto lands that are used or usable by man and not normally covered by water. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river, stream, lake, or ocean. (2) As defined, in part, in the *Standard Flood Insurance Policy (SFIP)*: "A general and temporary condition of partial or complete inundation of normally dry land areas from overflow of inland or tidal waters or from the unusual and rapid accumulation or runoff of surface waters from any source."

Flood Control Districts — A district organized to manage flooding hazards through land use controls and construction and maintenance of flood control structures.

Flood, 100-Year — A 100-year flood does not refer to a flood that occurs once every 100 years, but rather to a flood level with a 1 percent or greater chance of being equaled or exceeded in any given year. Areas below the 100 year flood level are termed special flood hazard areas. Areas between the 100-year and the 500-year flood boundaries are termed *Moderate Flood Hazard Areas*. The remaining areas are above the 500-year flood level and are termed *Minimal Flood Hazard Areas*.

Flood Hazard Zones (Defined) — Zones on the *Flood Insurance Rate Map (FIRM)* in which the risk premium insurance rates have been established by a *Flood Insurance Study (FIS)*.

Flood Insurance — A means of spreading the cost of flood losses. It enables property owners in communities participating in the *National Flood Insurance Program (NFIP)* to purchase insurance against loss resulting from floods.

Flood Insurance Rate Map (FIRM) — Official map on which the *Federal Emergency Management Agency (FEMA)* has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

Flood Insurance Study (FIS) — A document containing the results of an examination, evaluation, and determination of flood hazards and, if appropriate, corresponding water surface elevations, mudslides and erosion hazards.

Flood Mitigation Assistance Program (FMA) — A grant program funded by the *Federal Emergency Management Agency (FEMA)* with the objective of providing funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes and other structures insurable under the *National Flood Insurance Program (NFIP)*.

Floodplain, also Flood Plain — (1) A strip of relatively smooth land bordering a stream, built of sediment carried by the stream and dropped in the slack water beyond the influence of the swiftest current. It is called a *Living Flood Plain* if it is overflowed in times of high water but a *Fossil Flood Plain* if it is beyond the reach of the highest flood. (2) The lowland that borders a stream or river, usually dry but subject to flooding. (3) That land outside of a stream channel described by the perimeter of the *Maximum Probable Flood*. Also referred to as a *Flood-Prone Area*.

Floodplain Management — Comprehensive flood damage prevention programs which require the integration of all alternative measures (structural and nonstructural) in investigation of flood problems and planning for wise use of the floodplain. Includes corrective and preventive measures for reducing flood damage and preserving and enhancing, where possible, natural resources in the floodplain, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations and ordinances.

Floodplain Management Regulations — Any federal, state, or local government regulations and zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as a grading permit and erosion control requirement) and other applications of regulatory power which control development in flood-prone areas specifically for the purpose of preventing and reducing flood loss and damage.

Floodplain Management Measures — Refers to an overall community program of corrective and preventive measures for reducing future flood damage. The measures take a variety of forms and generally include zoning, subdivision, or building requirements and special-purpose floodplain ordinances. Also see *National Flood Insurance Program (NFIP)* and *Federal Emergency Management Agency (FEMA)*.

Gap Analysis — A method for determining spatial relationships between areas of high biological diversity and the boundaries of *National Parks, National Wildlife Refuges (NWR)*, and other preserves. The primary goal of Gap Analysis is to prevent additional species from being listed as threatened or endangered. Analyses are made and displayed using a *Geographic Information System (GIS)*. Estimates of diversity are often derived from known or hypothesized relationships between mapped plant communities and animal populations. In addition to the *National Biological Survey*, which serves as the primary coordinating agency, there are over 200 collaborating organizations involved in performing Gap Analysis on a state-by-state basis, including businesses, universities, and state, local, and federal government entities. [The term *Gap* originated from an initial *Biodiversity* study in Hawaii which showed that for certain sensitive animal species there existed a physical (geographic) gap between the species and its habitat and wildlife preserves (national parks, forests, wildlife protection areas, etc.), indicating potential limitations of species and habitat protection.]

Geothermal — Terrestrial heat, usually associated with water as around hot springs.

Greywater (Graywater) — Waste water from a household or small commercial establishment which specifically excludes water from a toilet, kitchen sink, dishwasher, or water used for washing diapers.

Groundwater, also Ground Water — (1) Generally, all subsurface water as distinct from *Surface Water*; specifically, the part that is in the saturated zone of a defined aquifer. (2) Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper level of the saturate zone is called the Water Table. (3) Water stored underground in rock crevices and in the pores of geologic materials that make up the earth's crust. Ground water lies under the surface in the ground's *Zone of Saturation*, and is also referred to as *Phreatic Water*.

Import (Water) — Water piped or channeled into an area.

Injection — Generally refers to a system of artificially introducing surface water into the ground water system as a means of storage or recharge. Most typically, this includes the use of *Recharge Wells* which work directly opposite of pumping wells to inject surface water into underlying formations. Depending on the water-bearing formation, these methods may have limited usefulness and are generally better used for pumping water into deep, confined aquifers. (Water Quality) Refers to a system of subsurface disposal of brine effluent into an acceptable formation. Also see *Induced Recharge*.

Instream Flow or Instream Use — (1) The amount of water remaining in a stream, without diversions, that is required to satisfy a particular aquatic environment or water use. (2) Nonconsumptive water requirements which do not reduce the water supply; water flows for uses within a defined stream channel. Examples of instream flows include:

[1] ***Aesthetics*** — Water required for maintaining flowing steams, lakes, and bodies of water for visual enjoyment;

[2] ***Fish and Wildlife*** — Water required for fish and wildlife;

[3] ***Navigation*** — Water required to maintain minimum flow for waterborne commerce;

[4] ***Quality Dilution*** — Water required for diluting salt and pollution loading to acceptable concentrations; and

[5] ***Recreation*** — Water required for outdoor water recreation such as fishing, boating, water skiing, and swimming.

Instream Flow Requirement — The flow required in a stream to maintain desired instream benefits such as navigation, water quality, fish propagation, and recreation.

Integrated (Water) Resource Planning (IRP) — A comprehensive, interdisciplinary approach to water resource planning that encompasses water resource assessment, demand considerations, analysis of alternatives, risk management, resource diversity, environmental considerations, least-cost analysis, multidimensional modeling, and participatory decision making and public input, among other factors. Integrated Resource Planning begins with specific policy objectives that are applied to extensive lists of options for water supply sources, distribution systems, or other operational requirements. The options are then narrowed after evaluating demand requirements, environmental impacts, conservation options, costs, risks, and other aspects of a project. IRP involves a dynamic process of assessing demand and supply conditions and creatively integrating alternatives and new technologies. While the concepts of IRP are relatively new to the process of water planning, it has been used extensively in the energy industry. As a planning process it helps decision makers select the best mix of water resources, facilities, and conservation measures to meet water demands.

Interbasin Transfer (of Water) — A transfer of water rights and/or a diversion of water (either groundwater or surface water) from one *Drainage* or *Hydrographic Basin* to another, typically from the basin of origin to a different hydrologic basis. Also referred to as *Water Exports* and/or *Water Imports*.

Intermittent Stream — A stream that carries water only part of the time, generally in response to periods of heavy runoff either from snowmelt or storms; a stream or part of a stream that flows only in direct response to precipitation. It receives little or no water from springs or other sources. It is dry for a large part of the year, generally more than three months. Flow generally occurs for several weeks or months in response to seasonal precipitation, due to groundwater discharge, in contrast to the *Ephemeral Stream* that flows but a few hours or days following a single storm. Also referred to as *Seasonal Streams*. Also see *Stream*.

Interstate Waters — According to federal and state laws, interstate waters are defined as: (1) rivers, lakes and other waters that flow across or form a part of state or international boundaries; (2) waters of the Great Lakes; and (3) coastal waters whose scope has been defined to include ocean waters seaward to the territorial limits and waters along the coastline (including inland steams) influenced by the tide.

Land Subsidence — (1) The sinking or settling of land to a lower level in response to various natural and man-caused factors. (1) With respect to ground water, subsidence most frequently results from overdrafts of the underlying water table or aquifer and its inability to fully recharge, a process termed *Aquifer Compaction*. Also see *Subsidence*.

Land Use Planning — The process of inventorying and assessing the status, potentials, and limitations of a particular geographic area and its resources, interacting with the populations associated and/or concerned with the area to determine their needs, wants, and aspirations for the future.

Methyl Tertiary Butyl Ether (MTBE) — A oxygenate and gasoline additive used to improve the efficiency of combustion engines in order to enhance air quality and meet air pollution standards. MTBE is a product of petroleum refining that has been added to gasoline nationwide since the late 1970's as an octane booster. Following federal actions in the early 1990's, refiners began adding more MTBE to clean up the air. Current federal law requires some minimum amount of an oxygenate in gasoline sold in areas that do not meet air quality standards. The *U.S. Environmental Protection Agency (EPA)* considers MTBE a possible human carcinogen. In addition to being a suspected carcinogen, MTBE also pollutes waters, particularly by personal watercraft using two-stroke marine engines. More recently, leaking gasoline storage tanks containing MTBE have been found to cause contamination of nearby municipal water wells forcing their closure. MTBE has been found to mix and move more easily in water than many other fuel components, thereby making it harder to control, particularly once it has entered surface or ground waters.

Minimum Instream Flow — The specific amount of water required to support aquatic life, to minimize pollution, or for recreation. It is subject to the priority system and does not affect water rights established prior to its institution.

Mitigation — (1) (Environmental, General) Actions designed to lessen or reduce adverse impacts; frequently used in the context of environmental assessment. (2) (NEPA) Action taken to avoid, reduce the severity of, or eliminate an adverse impact. Mitigation can include one or more of the following:

- [1] avoiding impacts;
- [2] minimizing impacts by limiting the degree or magnitude of an action;
- [3] rectifying impacts by restoring, rehabilitating, or repairing the affected environment;
- [4] reducing or eliminating impacts over time; and
- [5] compensating for the impact by replacing or providing substitute resources or environments to offset the loss.

Monitoring Well — (1) A well used to obtain water quality samples or measure groundwater levels. (2) (Water Quality) A well drilled in close proximity to a waste storage or disposal facility, or hazardous waste management facility or *Superfund Site* to check the integrity of the facility or to keep track of leakage of materials into the adjacent groundwater.

Native Species — A species that is a part of an area's original fauna or flora.

Natural Resource — A material source of wealth, such as timber, fresh water, or a mineral deposit, that occurs in a natural state and has economic and/or value. Natural resources are considered *Nonrenewable* when they do not naturally replenish themselves within the limits of human time or *Renewable* when they are more or less continuously replenished in the course of natural events within the limits of human time.

Non-Point Source (NPS) Pollution — (1) Pollution discharged over a wide land area, not from one specific location. (2) Water pollution caused by diffuse sources with no discernible distinct point of source, often referred to as runoff or polluted runoff from agriculture, urban areas, mining, construction sites and other sites. These are forms of diffuse pollution caused by sediment, nutrients, organic and toxic substances originating from land use activities, which are carried to lakes and streams by surface runoff.

Nonstructural Measures — Measures for managing, utilizing, or controlling water and related lands without structural development to achieve the desired objective. Such measures include best management practices, flood plain zoning, flood warning systems, education and legal restraints, and preservation, as well as the more common land management measures.

One Hundred-Year Flood — Having the same meaning as *Base Flood*, *1 percent Flood*, or *Hundred-Year Flood*. Also see *X–Year Flood*, and *X–Year Flood, Y–Duration Rain*.

Overdraft — (1) A condition that occurs in a ground water basin when pumping exceeds recharge over an extended period of time. (2) That quantity of water pumped in excess of the safe yield; the act of overdrawing a water supply or aquifer in amounts greater than replenishment. Also, the sustained extraction of ground water from an aquifer at a rate greater than the recharge rate of the aquifer, resulting in a drop in the level of the water table. Also see *Ground Water Overdraft* and *Ground Water Mining*.

Perennial Yield (Ground Water) — The amount of usable water of a ground water reservoir that can be withdrawn and consumed economically each year for an indefinite period of time. It cannot exceed the sum of the *Natural Recharge*, the *Artificial* (or *Induced*) *Recharge*, and the *Incidental Recharge* without causing depletion of the groundwater reservoir. Also referred to as *Safe Yield*.

pH (Hydrogen Ion Concentration) — (1) A convenient method of expressing the acidity or basicity of a solution in terms of the logarithm of the reciprocal (or negative logarithm) of the hydrogen ion concentration. The pH scale runs from 0 to 14; a pH value of 7.0 indicates a neutral solution. Values above 7.0 pH indicate basicity (basic solutions); those below 7.0 pH indicate acidity (acidic solutions). Natural waters usually have a pH between 6.5 and 8.5.

Point Source (PS) Pollution — (1) Pollution originating from any discrete source. (2) Pollutants discharged from any distinct, identifiable point or source, including pipes, ditches, channels, sewers, tunnels, wells, containers of various types, concentrated animal-feeding operations, or floating craft. Also referred to as *Point Source of Pollution*. Also see *Non-Point Source (NPS) Pollution*.

Pollution — (1) Any alteration in the character or quality of the environment which renders it unfit or less suited for certain uses. With respect to water, the alteration of the physical, chemical, or biological properties by the introduction of any substance that adversely affects any beneficial use. (2) Adverse and unreasonable impairment of the beneficial uses of water even though no actual health hazard is involved. Under the Clean Water Act (CWA), for example, the term is defined as the manmade or man-induced alteration of the physical, biological, chemical, and radiological integrity of water.

Prior Appropriation Doctrine — (1) A concept in water law under which a right to a given quantity of water is determined by such a procedure as having the earliest *Priority Date*. (2) The system for allocating water to private individuals used in most of the western United States. The doctrine of *Prior Appropriation* was in common use throughout the arid west as early settlers and miners began to develop the land. The prior appropriation doctrine is based on the concept of *"First in Time, First in Right"*. The first person to take a quantity of water and put it to *Beneficial Use* has a higher priority of right than a subsequent user. Under drought conditions, higher priority users are satisfied before junior users receive water. Appropriative rights can be lost through nonuse; they can also be sold or transferred apart from the land. Contrasts with *Riparian Doctrine* and *Riparian Water Rights*. Also see *Littoral Water Rights* and *Prescribed Water Rights*.

Project WET (Water Education for Teachers) [Nevada] — A statewide supplementary, interdisciplinary water education program with components for the education community (K–12) and the general public. The goal of *Nevada Project WET* is to facilitate and promote the awareness, appreciation, knowledge, and stewardship of Nevada's water resources through the development and dissemination of classroom ready teaching aides, teacher training, learning materials, and demonstration models as well as the maintenance of a resource bureau. The program is designed to provide useful, unbiased information in a straight-forward, neutral fashion addressing a wide variety of water-related topics. National Project WET at Montana State University coordinates the individual state WET programs. The *Nevada Division of Water Planning* (*Department of Conservation and Natural Resources*), is the official sponsor of the Project WET program in the State of Nevada. Other water education programs include the International Office for Water Education (IOWE), established at Utah State University in 1983 to promote water/science education, the *U.S. Geological Survey (USGS)* National Water Information Clearinghouse (NWIC), which was established to serve as a focus for the dissemination of water resource information to all levels of government, academia, the private sector, the cooperative extension, and the general public.

Recharge (Hydrologic) — (1) The process by which water is added to the *Zone of Saturation*. (2) The introduction of surface or ground water to groundwater storage such as an aquifer. Recharge or replenishment of groundwater supplies consists of three (3) types:

[1] ***Natural Recharge*** which consists of precipitation or other natural surface flows making their way into groundwater supplies;

[2] ***Artificial or Induced Recharge*** which includes actions by man specifically designed to increase supplies in a groundwater reservoirs through various methods such as water spreading (flooding), ditches, and pumping techniques; and

[3] ***Incidental Recharge*** which consists of actions, such as irrigation and water diversion, which add to groundwater supplies but are intended for other purposes.

Recharge may also refer to the amount of water so added.

Recharge Area (Groundwater) — The area in which water reaches the *Zone of Saturation* by surface infiltration. Infiltration moves downward into the deeper parts of an aquifer in a recharge area. Also referred to as a *Recharge Zone*.

Recharge, Artificial — The designed (as opposed to the natural or incidental) replenishment of ground water storage from surface water supplies. There exist five (5) common techniques to effect artificial recharge of a groundwater basin:

[1] ***Water Spreading*** consisting of the basin method, stream-channel method, ditch method, and flooding method, all of which tend to divert surface water supplies to effect underground infiltration;

[2] ***Recharge Pits*** designed to take advantage of permeable soil or rock formations;

[3] ***Recharge Wells*** which work directly opposite of pumping wells although have limited scope and are better used for deep, confined aquifers;

[4] ***Induced Recharge*** which results from pumping wells near surface supplies thereby inducing higher discharge towards the well; and

[5] ***Wastewater Disposal*** which includes the use of secondary treatment wastewater in combination with spreading techniques, recharge pits, and recharge wells to reintroduce the water to deep aquifers thereby both increasing the available groundwater supply and also further improving the quality of the wastewater.

Also referred to as *Induced Recharge*. Also see *Natural Recharge*, *Incidental Recharge*, *Injection,* and *Perennial Yield*.

Recharge Basin — A surface facility, often a large pond, used to increase the infiltration of surface water into a ground water basin.

Recharge Well — Used in conjunction with artificial or induced ground water recharge techniques, the recharge well works directly opposite of pumping wells to induce surface water into the ground water system. Based on the nature of the soil and rock being recharged, the use of recharge wells typically have limited scope and are better employed for recharging deep, confined aquifers. Also see *Injection*.

Reclaimed Waste Water — Waste water that becomes suitable for a specific beneficial use as a result of treatment or brackish water demineralized for use. General types of reclaimed waste water include:

[1] ***Primary Effluent* —** reclaimed water that only has had sewage solids removed and is typically used only for surface irrigation of tree, fodder, and fiber crops;

[2] ***Secondary Effluent* —** reclaimed water that has had sewage solids removed and has been oxidized and disinfected and is used to irrigate golf courses and cemeteries and provide water for pasture and food crops; and

[3] ***Tertiary Recycled Water* —** water produced by conventional sewage treatment followed by more advanced procedures including filtration and disinfection, providing it with the broadest range of uses.

Also see *Waste Water Reclamation* and *"Repurified Water."*

Reclaimed Water — Refers to water that has received at least *Secondary Wastewater Treatment* and is reused after flowing out of a wastewater treatment facility.

Recreation Resource — Land and water areas and their natural attributes, with or without man-made facilities, that provide opportunities for outdoor recreation.

Restoration — The act or process of bringing something back to a previous condition or position. For example, the establishment of natural land contours and vegetative cover following extensive degradation of the environment caused by activities such as *Surface Mining*. Under this condition, the term is used interchangeably with *Reclamation*.

Reuse (of Water) — (1) Water that is discharged by one user and is used by other users. (2) Repeated use of the same water by subsequent users in sequential systems. Sometimes, it also means water discharged by one unit and used by other units in the same plant. Also referred to as *Recycled Water*.

Reverse Osmosis — (1) (Desalination) Refers to the process of removing salts from water using a membrane. With reverse osmosis, the product water passes through a fine membrane that the salts are unable to pass through, while the salt waste (brine) is removed and disposed. This process differs from electrodialysis, where the salts are extracted from the feedwater by using a membrane with an electrical current to separate the ions. The positive ions go through one membrane, while the negative ions flow through a different membrane, leaving the end product of freshwater. (2) (Water Quality) An advanced method of water or wastewater treatment that relies on a *Semi-permeable Membrane* to separate waters from pollutants. An external force is used to reverse the normal osmotic process resulting in the solvent moving from a solution of higher concentration to one of lower concentration.

Riparian — Pertaining to the banks of a river, stream, waterway, or other, typically, flowing body of water as well as to plant and animal communities along such bodies of water.

Riparian Areas (Habitat) — (1) Land areas directly influenced by a body of water. Usually such areas have visible vegetation or physical characteristics showing this water influence. Stream sides, lake borders, and marshes are typical riparian areas. Generally refers to such areas along flowing bodies of water.

Riparian Doctrine — The system for allocating water used in England and the eastern United States, in which owners of lands along the banks of a stream or water body have the right to *Reasonable Use* of the waters and a *Correlative Right* protecting against unreasonable use by others that substantially diminishes the quantity or quality of water. The right is appurtenant to the land and does not depend on prior use. Under this doctrine, ownership of land along a stream or river (i.e., riparian lands) is an absolute prerequisite to a right to use water from that body of water and each such landowner has an equal right to withdraw “reasonable” amounts of water (whether or not he is presently using it or not) so long as downstream landowners are not unreasonably damaged. Contrast with *Prior Appropriation Doctrine*.

Riverine — (1) Relating to, formed by, or resembling a river including tributaries, streams, brooks, etc. (2) Pertaining to or formed by a river; situated or living along the banks of a river, for example, a “riverine ore deposit.” Also see *Riparian*.

Safe Yield — (1) The rate at which water can be withdrawn from supply, source, or an aquifer over a period of years without causing eventual depletion or contamination of the supply. (2) A rate of extraction that does not deplete the basin over time. (3) (Groundwater) The amount of water that can be withdrawn from an aquifer without producing an undesired effect. (4) (Surface Water) The amount of water than can be withdrawn or released from a reservoir on an ongoing basis with an acceptably small risk of supply interruption (i.e., reducing the reservoir storage to zero.) More commonly referred to a *Perennial Yield* and *Sustained Yield*. Generally consists of the rate of *Natural Recharge*, *Artificial* (or *Induced*) *Recharge*, and *Incidental Recharge*.

Salinity — (1) The concentration of dissolved salts in water or soil water. (2) The relative concentration of salts, usually sodium chloride, in a given water sample. It is usually expressed in terms of the number of parts per thousand (‰) or parts per million (ppm) of chloride (Cl). Although the measurement takes into account all of the dissolved salts, sodium chloride (NaCl) normally constitutes the primary salt being measured. As a reference, the salinity of seawater is approximately 35‰. See *Salts* for comparative salt concentrations in water. Also see *Total Dissolved Solids*.

Sanitary Seal (Water Well) — The neat cement seal at the top of a water well intended to prevent well contamination from surface water or shallow ground water flows containing potential contaminants.

Sensitive Species — Those plant or animal species susceptible or vulnerable to activity impacts or habitat alterations. Species not yet officially listed but undergoing status review for listing on the *U.S. Fish and Wildlife Service’s (USFWS)* official threatened and endangered list; species whose populations are small and widely dispersed or restricted to a few localities; and species whose numbers are declining so rapidly that official listing may be necessary. Also see *Endangered Species Act (ESA)*, *Endangered Species* and *Threatened Species*.

Subsidence — (1) The sinking of the land surface due to a number of factors, of which groundwater extraction is one. (2) A sinking of a large area of the earth’s crust. Typically this may result from the over-pumping of a basin’s water table and the inability of the soils to re-absorb water from natural or artificial injection. Also frequently results from overdrafts of the aquifer and its inability to fully recharge, a process termed *Aquifer Compaction*. Also see *Land Subsidence*.

Total Dissolved Solids (TDS) — (Water Quality) A measure of the amount of material dissolved in water (mostly inorganic salts). Typically aggregates of carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, etc. of calcium, magnesium, manganese, sodium, potassium, and other cations which form salts. The inorganic salts are measured by filtering a water sample to remove any suspended particulate material, evaporating the water, and weighing the solids that remain. An important use of the measure involves the examination of the quality of drinking water. Water that has a high content of inorganic material frequently has taste problems and/or water hardness problems. The common and synonymously used term for TDS is "salt". Usually expressed in milligrams per liter. Also see *Hard Water* and *Salinity*.

Treated (Wastewater) Effluent — Water that has received primary, secondary, or advanced treatment to reduce its pollution or health hazards and is subsequently released from a wastewater facility after treatment.

Trihalomethanes (THMs) — (1) Any of several synthetic organic compounds formed when chlorine combines with organic materials in water during the disinfection process. The most common THM is chloroform.

Turbidity — A measure of the reduced transparency of water due to suspended material which carries water quality implications. The term "turbid" is applied to waters containing suspended matter that interferes with the passage of light through the water or in which visual depth is restricted. The turbidity may be caused by a wide variety of suspended materials, such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, plankton and other microscopic organisms and similar substances. Turbidity in water has public health implications due to the possibilities of pathogenic bacteria encased in the particles and thus escaping disinfection processes. Turbidity interferes with water treatment (filtration), and affects aquatic life. Excessive amounts of turbidity also make water aesthetically objectionable. The degree of the turbidity of water is measured by a *Turbidimeter*.

Water Bank — A mechanism for holding water for eventual use. A water bank may include the use of surface water reservoirs, underground storage facilities (e.g., groundwater recharge), or a combination of these mechanisms.

Water Banking — A water conservation and use optimization system whereby water is reallocated for current use or stored for later use. Water banking may be a means of handling surplus water resources and may involve aquifer recharge or similar means of storage. Typically, under such arrangements, an agency is created with the authority to purchase, sell, hold, and transfer water and water rights in addition to serving as a negotiator between buyers and sellers. In its broadest sense, all water rights would be covered under such water banking arrangements to include surface water, groundwater, treated wastewater effluent, and irrigation tailwater. Generally, participants in water banking arrangements will have their water rights protected from cancellation (non-beneficial use) for a specific period so long as their water is "deposited" in the water bank. Also see *Water Marketing*.

Water-Based Recreation — Those activities which require water for participation such as boating, swimming, sailing and canoeing.

Water Importation — The act or process whereby water is brought into an area or region which would not naturally receive such waters. Typically, it refers to the artificial transport of water through aqueducts, canals, or pipelines from one water basin, drainage area, county or *Hydrographic Area* to another, thereby affecting the natural surface and groundwater drainage and flow patterns in both the water exporting and importing areas.

Water Management — (1) (General) Application of practices to obtain added benefits from precipitation, water, or water flow in any of a number of areas, such as irrigation, drainage, wildlife and recreation, water supply, watershed management, and water storage in soil for crop production. Includes *Irrigation Water Management* and *Watershed Management*. (2) (Irrigation Water Management) The use and management of irrigation water where the quantity of water used for each irrigation is determined by the water-holding capacity of the soil and the need for the crop, and where the water is applied at a rate and in such a manner that the crop can use it efficiently and significant erosion does not occur. (3) (Watershed Management) The analysis, protection, development, operation, or maintenance of the land, vegetation, and water resources of a drainage basin for the conservation of all its resources for the benefit of its residents. Watershed management for water production is concerned with the quality, quantity, and timing of the water which is produced. Also see *Basin Management*.

Water Marketing — A concept of water transfer and use borne out of increased demand by urban populations for water whereby a holder of water rights is allowed to sell or lease those rights in an open market to the highest bidder. As an example, in the United States one acre-foot of water typically yields only about $400 on a farm versus $400,000 in manufacturing (National Geographic Special Edition, *WATER: The Power, Promise, and Turmoil of North America's Fresh Water*, November 1993). Such water marketing arrangements, however, can only succeed where necessary water transport and delivery systems exist between supply points and demand points. There are a variety of transactions that are considered marketing transactions, including intrastate transfers, interstate transfers, interbasin transfers, conserved water, and short-term and long-term leasing arrangements, etc. Also see *Water Banking*.

Water Pollution — Generally, the presence in water of enough harmful or objectionable material to damage the water's quality. More specifically, pollution shall be construed to mean contamination of any waters such as will create or is likely to create a nuisance or to render such waters harmful, detrimental or injurious to public health, safety or welfare, or to domestic, municipal, commercial, industrial, agricultural, recreational, or other legitimate uses, or to livestock, wild animals, birds, fish or other aquatic life, including but not limited to such contamination by alteration of the physical, chemical or biological properties of such waters, or change in temperature, taste, color or order thereof, or the discharge of any liquid, gaseous, radioactive, solid or other substances into such waters. More simply, it refers to quality levels resulting from man's activities that interfere with or prevent water use or uses.

Water Quality Management — Planning for the protection of a water's quality for various *Beneficial Uses*, for the provision of adequate wastewater collection, treatment, and disposal for municipalities and industries, and for activities that might create water quality problems, and regulating and enforcing programs to accomplish the planning goals and laws and regulations dealing with water pollution control.

Water Quality Standards — (1) A plan for water quality management containing four major elements: water use; criteria to protect uses; implementation plans, and enforcement plans. An anti-degradation statement is sometimes prepared to protect existing high quality water sources. (2) State-adopted and *U.S. Environmental Protection Agency (EPA)* approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.

Watershed Protection Approach (WPA) — A type of pollution management program supported by the *U.S. Environmental Protection Agency (EPA)* as being the most effective mechanism for achieving clean water and healthy, sustainable ecosystems throughout the United States. The WPA is a "placed-based" strategy that integrates water quality management activities within hydrologically defined drainage basins or watersheds as opposed to using conventional, politically-defined boundaries. The WPA allows stakeholders to tailor corrective actions to local concerns within the coordinated framework of a state, Tribal, and national water program. In addition, an emphasis on public participation provides the opportunity to incorporate environmental justice issues into watershed management. Six basic objectives form the general foundations of EPA's watershed protection process:

- [1] identifying critical watersheds with EPA and state participation;
- [2] clearly defining the problems, general causes, and specific sources of risks and impairments to the watershed;
- [3] developing potential pollution prevention and control strategies;
- [4] implementing point and nonpoint source controls;
- [5] developing scientifically valid and practical indicators for gauging and reducing the risks in the watershed; and
- [6] developing ecological criteria that states may use in formulating future watershed protection standards.

Water Use — The amount of water needed or used for a variety of purposes including drinking, irrigation, processing of goods, power generation, and other uses. The amount of water used may not equal the amount of water withdrawn due to water transfers or the recirculation or recycling of the same water. For example, a power plant may use the same water a multiple of times but withdraw a significantly different amount. Also see *Water Use, Types*, below.

Water Use Practices — Direct, indirect, consumptive, and nonconsumptive uses of water. These include domestic practices (e.g., washing, bathing, cooking, drinking), navigation, wildlife habitat management, irrigation practices, recreation activities, industrial uses, and hydroelectric power generation.

Water Use, Types — The use of water may be classified by specific types according to distinctive uses, such as the following:

- [1] Commercial Water Use
- [2] Domestic Water Use
- [3] Hydroelectric Power Water Use
- [4] Irrigation Water Use

[5] Livestock Water Use
[6] Mining Water Use
[7] Navigational Water Use
[8] Other Water Use
[9] Public Water Use (same as *Utility Water Use*)
[10] Residential Water Use (same as *Domestic Water Use*)
[11] Rural Water Use
[12] Thermoelectric Power Water Use

Wellhead Protection (Program) — Programs intended to protect and preserve the quality of ground water used as a source of drinking water. A typical wellhead protection program will have a number of critical elements to include: (1) delineating the roles and responsibilities of state agencies, local governments, and water purveyors; (2) delineation of wellhead protection areas; (3) contaminant source inventories; (4) management options; (5) siting of new wells; (6) contingency and emergency planning; and (7) public participation. Typically, steps taken to protect and preserve the quality of a well are far less costly than actions necessary to restore a contaminated well.

Wetlands, also Wetland — Wetlands are those areas where water saturation is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the surrounding environment. The identification of wetlands and associated habitats is regulated by complex federal legislation. The *U.S. Environmental Protection Agency (EPA)*, the *U.S. Army Corps of Engineers (COE)*, the (U.S. Department of Agriculture) *Natural Resources Conservation Service (NRCS)* (formerly the *Soil Conservation Service — SCS*), and the (Department of the Interior) *U.S. Fish and Wildlife Service (USFWS)*, have developed definitions of wetlands in response to their regulatory responsibilities. The single feature that all wetlands have in common is a soil or substrate that is saturated with water during at least a part of the growing season. These saturated conditions control the types of plants and animals that live in these areas. Other common names for wetlands are *Sloughs*, *Ponds*, *Swamps*, *Bogs*, and *Marshes*. Basically, all definitions of wetlands require that one or more attributes be met:

[1] ***Wetland Hydrology* —** At some point of time in the growing season the substrate is periodically or permanently saturated with or covered by water;
[2] ***Hydrophytic Vegetation*** — At least periodically, the land supports predominantly water-loving plants such as cattails, rushes, or sedges;
[3] ***Hydric Soils*** — The area contains undrained, wet soil which is anaerobic, or lacks oxygen in the upper levels.

Wildlife Management Areas (WMAs) [Nevada] — Nevada's Wildlife Management Areas (WMAs) are lands and waters which have been acquired to effectuate a coordinated and balanced program resulting in the maximum revival of fish and wildlife and in the maximum recreational advantages to the people of the State of Nevada. Lands in Nevada set aside as WMAs currently total almost 275,000 acres (429 square miles). State WMAs are subject to supervision by the Nevada Board of Wildlife Commissioners.

Xeriscape™ — Landscaping with native and naturalized plant species that are adapted to survive in areas of low precipitation. [*Trademark Note:* The term "Xeriscape" is a trademark of the National Xeriscape Council, Inc., and accordingly must always be capitalized, must always be used the first time with a "™" symbol, and can only be used as an adjective, e.g., Xeriscape landscaping, a Xeriscape garden, etc.]

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Section 7
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Nevada State Water Plan
PART 3 — WATER PLANNING AND MANAGEMENT ISSUES

Section 8
Indexes to Part 3

[Note: Index entries are presented separately for each issue paper.]

Section 1 – Water Supply and Allocation:

A. Conservation

B. Integrated Water Management

C. Interbasin and Intercounty Transfers

D. Water Use Measurement and Estimation

E. Domestic Wells

Section 2 – Water Quality:

A. Nonpoint Source Pollution

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Section 3 – Resource Conservation and Recreational Uses:

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B. Water for Wildlife and Environmental Purposes

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B. Water Resources Data Management

C. Water Planning Assistance to Local Governments

D. Water Education

NEVADA STATE WATER PLAN

APPENDICES

March 1999

Nevada Division of Water Planning
Department of Conservation and Natural Resources

Notes to the Reader

The *Nevada State Water Plan* is published in five volumes including a summary, three parts of background information, forecasts and water-related issues, and supporting appendices. The following is a listing of all volumes of the plan and a brief summary of each volume's contents:

SUMMARY

Executive Summary, purpose and governing directive, water plan organization and contents, brief summary of water planning and management issues, with all of the recommendations, a glossary of terminology and a glossary of abbreviations and acronyms

PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Introduction, guidelines for the State Water Plan, the institutional framework for water planning and management in Nevada, water resources background, socioeconomic background, glossary of terminology (for Part 1), glossary on selected agencies and organizations, glossary on selected water-related decrees, agreements and operating criteria, and abbreviations and acronyms

PART 2 — WATER USE AND FORECASTS

Historic and current water use, socioeconomic assessment and forecasts, water use assessment and forecasts, meeting our future water supply needs, and a glossary of terminology (for Part 2)

PART 3 — WATER PLANNING AND MANAGEMENT ISSUES

Issue papers in the areas of water supply and allocation, water quality, resource conservation and recreational uses, flood management, and water planning and management, and a glossary of terminology (for Part 3)

APPENDICES

Appendix 1 – Water use data, analysis and the development of water use factors for the years 1985, 1990, 1995; **Appendix 2** –Population estimates, forecasts and analysis; **Appendix 3** – Population and employment forecasts for municipal and industrial (M&I), domestic (residential) and commercial and industrial water withdrawals; **Appendix 4** – Forecasts of Nevada and county irrigated acreage; **Appendix 5** – Water withdrawal forecast summaries; **Appendix 6** – Nevada and county socioeconomic overviews (incorporated by reference)

Should you have any questions or comments concerning this water plan, or wish additional information in regards to the data used in this publication, please contact us at the address below. The *Nevada State Water Plan* is also available on the Internet at the web site address listed below.

NEVADA DIVISION OF WATER PLANNING
Department of Conservation and Natural Resources
1550 East College Parkway, Suite 142
Carson City, Nevada 89706–7921
Telephone: (775) 687-3600 x21
FAX: (775) 687-1288
Internet Home Page: **http://www.state.nv.us/cnr/ndwp/home.htm**
Internet E-mail: ndwpinfo@govmail.state.nv.us

Kenny C. Guinn, Governor
STATE OF NEVADA

NEVADA STATE WATER PLAN

APPENDICES

MARCH 1999

Peter G. Morros, P.E., Director
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

Naomi S. Duerr, P.G., State Water Planner
NEVADA DIVISION OF WATER PLANNING

Nevada Division of Water Planning

Nevada State Water Plan
APPENDICES

Contents

Introduction

The ***Appendices*** of the *Nevada State Water Plan* contains technical and detailed information that constitutes the basis of socioeconomic and water use analysis and may prove useful in better understanding the development of both the socioeconomic and water withdrawal forecasts. While the text of the water plan deals primarily with statewide water use and socioeconomic data, the appendices contain all the detailed county data, analysis and forecasts from which the statewide figures were derived. All forecasts for Nevada's future water use and socioeconomic trends were prepared on a county basis and then aggregated up to the state level. No unique statewide forecasts were prepared.

Appendix 1, State and County Water Use Data, 1985, 1990, 1995, contains all the source data used in deriving water use and other forecasts for the state water plan. The water use coefficients and related forecast factors for each county and the total state are summarized at the beginning of Appendix 3.

Appendix 2, State and County Population Estimates, Forecasts and Analysis, presents population estimates, population shares and growth rate analysis for the years 1950 through 1997 and population forecasts out to the year 2020 for all the counties and the total state. The population forecasts in this section constitute the underpinning of the water use forecasts developed in the plan.

Appendix 3, State and County Population and Employment Forecasts, presents the employment forecasts derived from the population forecasts, as well as a number of water use forecasts.

Appendix 4, State and County Forecasts of Irrigated Acreage, contains historical and forecasted irrigated acreage for each county and the total state. These irrigated acreage forecasts are then used in developing the forecasts for irrigation and livestock water withdrawals.

Appendix 5, State and County Water Withdrawal Forecast Summaries, presents summary tables of all the forecasted water use categories for each county and the total state.

Appendix 6, State and County Socioeconomic Overviews, is not included here but is incorporated by reference. It includes individual socioeconomic overviews for the 17 Nevada counties and the total state. Each 55-page document (80 pages for the Nevada Socioeconomic Overview) provides a broad assessment of each county's historic, geographic, hydrologic, water use and socioeconomic trends and conditions, and constitutes an integral part of the forecasts incorporated into the state water plan.

State Agencies and Agency Representatives Involved in the Nevada State Water Plan

STATE OF NEVADA

Kenny C. Guinn	Governor

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

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Glenn H. Clemmer, Program Manager	Nevada Natural Heritage Program

OFFICE OF THE ATTORNEY GENERAL

Ronda L. Moore	Deputy Attorney General

This plan was prepared by

DIVISION OF WATER PLANNING

Naomi S. Duerr, P.G.	Administrator and State Water Planner

Planning and Analysis Section

Randy A. Pahl, P.E.	Hydrologist/Engineer
Gary A. Horton	Water Planning Economist
Edward P. Skudlarek	Natural Resource Planner
Saxon E. Sharpe, Ph.D.	Watershed Planner

Floodplain Management Section

Jeanne M. Ruefer, P.G.	Program Officer

Management Support

Audra Blackwell	Management Assistant
Lori Barnum	Program Assistant

Assistance in the development and review of water plan materials was provided by the following Department of Conservation and Natural Resources staff:

<u>Division of Environmental Protection</u>

Tom Porta	Water Quality Planning Bureau Chief
James Smitherman	Supervisor, Non-point Source Branch
Laura Helsel	Environmental Scientist

<u>Division of State Lands</u>

Mike DelGrosso	Land Use Planner

<u>Natural Heritage Program</u>

Kim Goodwin	Data Manager
Carrie Carreno	Program Biologist

<u>Division of State Parks</u>

Wayne Perock	Administrator

<u>Division of Water Resources</u>

Hugh Ricci	Deputy State Engineer
Christine Thiel	Deputy State Engineer
Kelvin Hickenbottom	Staff Engineer
Kim Groenewold	Special Studies Coordinator

<u>Division of Wildlife</u>

Robert McQuivey	Habitat Bureau Chief
Gene Weller	Fisheries Bureau Chief
Doug Hunt	Staff Biologist
Laura Richards	Staff Biologist

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(Nevada Revised Statute 540.111)

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Ed Schmidt, Director, Washoe County Department of Water Resources

One Member Representing the Largest Water Utility in the County with the Second Largest Population in the State:

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Alternates:

Alan Glaser, Alternate for Jack Boyd (Ranching)
L. Steve Koon, Alternate for Phillip Henry (Largest County)
Donald A. Mahin, Alternate for Ed Schmidt (Second Largest County)

Nevada State Water Plan

Appendix 1 – Nevada Water Use Data and Analysis – 1985, 1990, 1995

A. WATER ANALYSIS AND FORECASTS FACTOR DEVELOPMENT TABLES:

B. WATER WITHDRAWAL DATA TABLES:

Appendix 1A

WATER ANALYSIS AND FORECAST FACTOR DEVELOPMENT TABLES

[1] Nevada Water Use Summary 1995

Water Withdrawals by Principal Category of Use (Acre-Feet per Year) Rev. 11/23/98

County and County Codes		Total Water Withdrawals All Uses	Total Domestic Water Withdrawals	Total Commercial Water Withdrawals	Total Industrial Water Withdrawals	Total Thermo-Electric Water Withdrawals	Total Mining Water Withdrawals	Livestock Water Withdrawals	Irrigation Water Withdrawals
Carson City..........	CC	20,932	7,096	1,221	1,053	0	0	11	10,710
Churchill..............	CH	286,300	3,457	1,120	302	22,963	179	672	256,553
Clark.....................	CL	468,353	246,709	111,993	9,073	25,337	2,386	280	40,292
Douglas................	DG	203,956	10,513	2,991	302	0	0	258	189,544
Elko......................	EL	936,593	11,595	7,942	0	0	5,354	1,703	908,645
Esmeralda.............	ES	62,809	297	45	0	0	12,613	123	49,687
Eureka..................	EU	244,422	425	67	0	4,637	114,243	157	124,859
Humboldt.............	HU	686,585	4,454	851	560	3,226	76,640	627	599,845
Lander..................	LA	198,983	1,353	146	0	0	35,598	336	161,382
Lincoln.................	LI	67,516	1,355	364	0	0	0	123	65,537
Lyon......................	LY	325,076	4,171	3,965	4,929	1,400	2,565	448	306,926
Mineral.................	MI	19,714	1,153	280	0	0	2,520	34	15,682
Nye.......................	NY	76,615	5,785	784	0	0	7,695	739	60,233
Pershing...............	PE	121,216	1,342	414	0	0	2,106	258	116,962
Storey...................	ST	3,532	340	67	0	1,826	258	0	1,008
Washoe................	WA	218,983	57,382	20,689	3,002	6,060	717	291	121,533
White Pine............	WP	99,803	3,283	246	0	0	11,560	269	84,187
NEVADA............	**NV**	**4,041,387**	**360,710**	**153,186**	**19,222**	**65,450**	**274,434**	**6,329**	**3,113,585**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Water Withdrawals All Uses" includes all withdrawals both public supplied and self-supplied. Also includes public use and losses presented in Table 2 and mining consumptive and non-comsumptive use as broken out in Table 9.

(3) Total Domestic, Commercial, Industrial, and Thermoelectric water withdrawals includes both public supplied and self-supplied water use; Total Mining Water Withdrawals includes both consumtpive use (i.e., processing) and non-consumptive use (i.e., mine dewatering).

(4) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); U.S. Department of Agriculture (USDA), Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

[2] Nevada Public Supplied Water Use 1995

Public Supplied Water Withdrawals by Principal Use (Acre-Feet per Year)

Rev. 11/23/98

County and County Codes		Population Served by Public Supplied Water (Persons)	Total Public Supplied Water	Domestic Public Supplied Water	Commercial Public Supplied Water	Industrial Public Supplied Water	Thermo-Electric Public Supplied Water	Public Use and Losses	Public Supplied Water Use Per Person (Gallons/Day)
Carson City	CC	42,182	9,342	6,463	1,210	829	0	840	197.7
Churchill	CH	12,922	3,573	2,151	336	34	0	1,053	246.9
Clark	CL	1,014,867	379,921	242,109	102,684	1,221	1,624	32,283	334.2
Douglas	DG	32,323	11,078	9,566	1,165	0	0	347	306.0
Elko	EL	40,151	14,920	10,888	2,677	0	0	1,355	331.7
Esmeralda	ES	1,133	302	213	45	0	0	45	238.3
Eureka	EU	1,177	426	325	67	0	0	34	322.9
Humboldt	HU	10,752	4,201	3,047	773	0	0	381	348.8
Lander	LA	5,176	1,423	1,109	146	0	0	168	245.4
Lincoln	LI	3,211	1,550	1,082	330	0	0	138	430.9
Lyon	LY	24,350	5,746	3,853	1,165	56	0	672	210.7
Mineral	MI	5,291	1,255	930	280	0	0	45	211.7
Nye	NY	15,730	6,127	4,077	672	0	0	1,378	347.7
Pershing	PE	4,539	1,736	1,199	403	0	0	134	341.5
Storey	ST	2,028	325	224	67	0	0	34	143.0
Washoe	WA	262,809	79,385	52,322	17,441	314	0	9,308	269.7
White Pine	WP	8,995	3,551	3,047	246	0	0	258	352.4
NEVADA	**NV**	**1,487,636**	**524,861**	**342,605**	**129,707**	**2,453**	**1,624**	**48,472**	**315.0**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) Populations are for those state or county residents served by public water systems only.

(3) "Total Public Supplied Water" includes water supplied by public water supply purveyors, including public use and estimates of system losses. Also referred to as "Municipal and Industrial" or "M&I" water use.

(4) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); Nevada Division of Water Planning (NDWP).

[3] Nevada Self-Supplied and Other Water Uses 1995

Self Supplied, Mining, Livestock, Irrigation Water Use (Acre-Feet per Year)

Rev. 11/23/98

County and County Codes		Total Water Withdrawals All Uses	Total Public Supplied Water	Domestic Self Supplied Water	Commercial Self Supplied Water	Industrial Self Supplied Water	Thermo-Electric Self Supplied Water	Mining Water Withdrawals Consumptive Use Only	Livestock and Irrigation Water Withdrawals
Carson City..........	CC	20,932	9,342	633	11	224	0	0	10,721
Churchill...............	CH	286,300	3,573	1,306	784	269	22,963	179	257,225
Clark.....................	CL	468,353	379,921	4,600	9,308	7,852	23,713	2,386	40,572
Douglas................	DG	203,956	11,078	947	1,826	302	0	0	189,802
Elko......................	EL	936,593	14,920	707	5,265	0	0	5,354	910,347
Esmeralda.............	ES	62,809	302	84	0	0	0	12,613	49,810
Eureka..................	EU	244,422	426	100	0	0	4,637	19,222	125,016
Humboldt.............	HU	686,585	4,201	1,407	78	560	3,226	15,077	600,472
Lander..................	LA	198,983	1,423	244	0	0	0	7,550	161,718
Lincoln.................	LI	67,516	1,550	273	34	0	0	0	65,660
Lyon.....................	LY	325,076	5,746	318	2,800	4,873	1,400	2,565	307,374
Mineral.................	MI	19,714	1,255	223	0	0	0	2,520	15,716
Nye......................	NY	76,615	6,127	1,708	112	0	0	7,057	60,973
Pershing...............	PE	121,216	1,736	143	11	0	0	2,106	117,220
Storey....................	ST	3,532	325	116	0	0	1,826	258	1,008
Washoe.................	WA	218,983	79,385	5,060	3,248	2,688	6,060	717	121,824
White Pine...........	WP	99,803	3,551	236	0	0	0	11,560	84,456
NEVADA............	**NV**	**4,041,387**	**524,861**	**18,105**	**23,478**	**16,769**	**63,826**	**89,164**	**3,119,914**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Public Supplied Water" includes domestic, commercial, industrial, and thermoelectric water supplied by public water supply purveyors.

(3) "Total Self-Supplied Water" is water from private wells or other private water systems serving a limited use and/or a limited number of customers.

(4) Mining water withdrawals excludes non-consumptive uses, i.e., mine dewatering.

(5) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

[4] Nevada Domestic, M&I, and Total Water Use per Capita 1995

Domestic Public and Self Supplied, M&I, Adjusted M&I, Total Use (Gallons/Day)

Rev. 11/23/98

County and County Codes		Total Nevada and County Resident Populations (Persons)	Population Served by Public Supplied Water (Persons)	Percent of Population Served by Public Supply Water Systems	Domestic Public Supplied Water Use per Person (Gallons/Day)	Domestic Self Supplied Water Use per Person (Gallons/Day)	Municipal and Industrial (M&I--Public Supplied) Water Use per Person (Gallons/Day)	Public and (Partial) Self Supplied Water Use per Person (Gallons/Day)
Carson City............	CC	46,770	42,182	90.2%	136.8	123.2	197.7	216.1
Churchill................	CH	21,640	12,922	59.7%	148.6	133.7	246.9	409.8
Clark......................	CL	1,036,290	1,014,867	97.9%	213.0	191.7	334.2	353.3
Douglas..................	DG	35,880	32,323	90.1%	264.2	237.7	306.0	390.9
Elko........................	EL	43,050	40,151	93.3%	242.1	217.7	331.7	464.5
Esmeralda...............	ES	1,630	1,133	69.5%	167.7	150.9	238.3	304.5
Eureka....................	EU	1,580	1,177	74.5%	246.4	221.5	322.9	398.7
Humboldt...............	HU	16,270	10,752	66.1%	253.0	227.6	348.8	518.6
Lander....................	LA	6,440	5,176	80.4%	191.3	172.3	245.4	287.4
Lincoln...................	LI	4,110	3,211	78.1%	300.8	271.1	430.9	516.2
Lyon.......................	LY	26,580	24,350	91.6%	141.3	127.3	210.7	503.7
Mineral..................	MI	6,700	5,291	79.0%	156.9	141.3	211.7	249.3
Nye.........................	NY	23,050	15,730	68.2%	231.4	208.3	347.7	451.0
Pershing.................	PE	5,140	4,539	88.3%	235.7	212.4	341.5	371.8
Storey.....................	ST	3,200	2,028	63.4%	98.6	88.4	143.0	194.1
Washoe...................	WA	291,050	262,809	90.3%	177.7	160.0	269.7	307.0
White Pine..............	WP	9,770	8,995	92.1%	302.4	271.9	352.4	375.8
NEVADA...............	**NV**	**1,579,150**	**1,487,636**	**94.2%**	**205.6**	**176.6**	**315.0**	**350.0**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Domestic Public Supplied Water Use per Person (Gallons/Day)" equals public supplied water use divided by population served by public supply systems.

(3) "Domestic Self Supplied Water Use per Person (Gallons/Day)" equals self supplied water use divided by persons served by self supplied systems.

(4) "Municipal and Industrial Water Use per Person (Gallons/Day)" is based on public supplied water and population served by public supply water systems.

(5) "Public and (Partial) Self Supplied Water Use per Person (Gallons/Day)" is based on both public supplied water (i.e., M&I water use) and self supplied water for domestic, commercial and industrial use only, divided by the total population. Excludes self supplied thermoelectric water use and all mining water use.

Sources: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada State Demographer.

[5] Nevada Domestic and Commercial & Industrial Water Uses 1995

Domestic, Commercial & Industrial Water Use (Acre-Feet/Year and Gallons/Day) Rev. 11/23/98

County and County Codes		Total Domestic Water Withdrawals	Domestic Consumptive Water Use	Domestic Consumptive Use as Percent of Withdrawals	Total Domestic Water Use per Person (Gallons/Day)	Total Commercial and Industrial Water Withdrawals	Commercial and Industrial Consumptive Water Use	Commercial Consumptive Use as Percent of Withdrawals	Commercial and Industrial Water Use per Worker (Gallons/Day)
Carson City...........	CC	7,096	3,553	50.1%	135.5	2,274	313	13.8%	77.4
Churchill...............	CH	3,457	1,739	50.3%	142.6	1,423	325	22.8%	182.3
Clark......................	CL	246,709	123,152	49.9%	212.5	121,066	23,198	19.2%	215.2
Douglas.................	DG	10,513	5,268	50.1%	261.6	3,293	370	11.2%	152.5
Elko.......................	EL	11,595	5,786	49.9%	240.4	7,942	560	7.1%	386.0
Esmeralda.............	ES	297	153	51.5%	162.6	45	11	25.0%	124.2
Eureka..................	EU	425	206	48.5%	240.0	67	11	16.7%	13.2
Humboldt..............	HU	4,454	2,215	49.7%	244.4	1,411	325	23.0%	162.2
Lander..................	LA	1,353	691	51.1%	187.6	146	34	23.1%	52.7
Lincoln.................	LI	1,355	671	49.5%	294.3	364	94	25.9%	211.5
Lyon.....................	LY	4,171	2,087	50.0%	140.1	8,894	1,680	18.9%	1,126.1
Mineral.................	MI	1,153	582	50.5%	153.6	280	56	20.0%	98.2
Nye.......................	NY	5,785	2,745	47.4%	224.1	784	358	45.7%	82.4
Pershing................	PE	1,342	688	51.3%	233.0	414	56	13.5%	196.2
Storey....................	ST	340	170	50.0%	94.9	67	11	16.7%	82.9
Washoe.................	WA	57,382	28,703	50.0%	176.0	23,691	4,492	19.0%	129.6
White Pine............	WP	3,283	1,628	49.6%	300.0	246	56	22.7%	52.0
NEVADA.............	**NV**	**360,710**	**180,037**	**49.9%**	**203.9**	**172,407**	**31,951**	**18.5%**	**196.2**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.
(2) "Total Domestic Water Withdrawals" and "Total Commercial Water Withdrawals" include both public supplied and self supplied water.
(3) "Total Domestic Water Use per Person (Gallons/Day)" equals "Total Domestic Water Withdrawals" divided by resident population; measured in gallons per day.
(4) "Commercial and Industrial Water Use per Worker (Gallons/Day)" equals "Total Commercial and Industiral Water Withdrawals" divided by covered employment; measured in gallons per worker per day.
(5) One acre-foot is equivalent to 325,851 gallons.
Source: U.S. Geological Survey (USGS).

[6] Nevada Livestock and Irrigation Water Uses 1995

Livestock and Irrigation Water Use Analysis (Acre-Feet per Year)

Rev. 11/23/98

County and County Codes		Livestock Water Withdrawals	Livestock Consumptive Water Use	Livestock Consumptive Use as Percent of Withdrawals	Total Irrigation Water Withdrawals	Irrigation Consumptive Use	Irrigation Consumptive Use as Percent of Irrigation Withdrawals	Total Livestock and Irrigation Water Withdrawals	Total Livestock and Irrigation Water Use as Percent of Total Withdrawals
Carson City..........	CC	11	0	0.0%	10,710	4,932	46.0%	10,721	51.2%
Churchill..............	CH	672	258	38.3%	256,553	117,890	46.0%	257,225	89.8%
Clark....................	CL	280	202	72.0%	40,292	28,771	71.4%	40,572	8.7%
Douglas................	DG	258	134	52.2%	189,544	85,565	45.1%	189,802	93.1%
Elko......................	EL	1,703	672	39.5%	908,645	464,897	51.2%	910,347	97.2%
Esmeralda............	ES	123	67	54.5%	49,687	31,204	62.8%	49,810	79.3%
Eureka..................	EU	157	67	42.9%	124,859	72,903	58.4%	125,016	51.1%
Humboldt.............	HU	627	224	35.7%	599,845	313,687	52.3%	600,472	87.5%
Lander..................	LA	336	123	36.7%	161,382	85,694	53.1%	161,718	81.3%
Lincoln.................	LI	123	34	27.3%	65,537	42,980	65.6%	65,660	97.3%
Lyon.....................	LY	448	146	32.5%	306,926	141,005	45.9%	307,374	94.6%
Mineral.................	MI	34	34	100.0%	15,682	7,253	46.3%	15,716	79.7%
Nye.......................	NY	739	67	9.1%	60,233	39,383	65.4%	60,973	79.6%
Pershing...............	PE	258	78	30.4%	116,962	62,405	53.4%	117,220	96.7%
Storey...................	ST	0	0	--	1,008	560	55.6%	1,008	28.5%
Washoe.................	WA	291	123	42.3%	121,533	60,241	49.6%	121,824	55.6%
White Pine............	WP	269	90	33.3%	84,187	52,709	62.6%	84,456	84.6%
NEVADA............	**NV**	**6,329**	**2,319**	**36.6%**	**3,113,585**	**1,612,080**	**51.8%**	**3,119,914**	**77.2%**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

[7] Nevada Irrigation Water Use Analysis 1995

Irrigation Water Withdrawals, Consumptive Use, Conveyance Losses, and Water Duty
(Acre-Feet per Year and Acre-Feet per Acre per Year)

Rev. 11/23/98

County and County Codes		Total Irrigation Water Withdrawals	Irrigation Consumptive Use	Irrigation Consumptive Use as Percent of Irrigation Withdrawals	Irrigation Conveyance Losses	Conveyance Losses as Percent of Irrigation Withdrawals	Total Irrigated Acreage (Acres)	Irrigation Water Withdrawal Rate (Acre-Feet per Acre per Year)	Irrigation Conveyance Losses (Acre-Feet per Acre per Year)
Carson City..........	CC	10,710	4,932	46.0%	3,165	29.6%	2,431	4.4	1.3
Churchill..............	CH	256,553	117,890	46.0%	74,602	29.1%	56,094	4.6	1.3
Clark.....................	CL	40,292	28,771	71.4%	2,218	5.5%	7,755	5.2	0.3
Douglas.................	DG	189,544	85,565	45.1%	56,246	29.7%	38,640	4.9	1.5
Elko.......................	EL	908,645	464,897	51.2%	196,391	21.6%	213,903	4.2	0.9
Esmeralda............	ES	49,687	31,204	62.8%	5,121	10.3%	11,286	4.4	0.5
Eureka..................	EU	124,859	72,903	58.4%	17,743	14.2%	32,780	3.8	0.5
Humboldt.............	HU	599,845	313,687	52.3%	117,620	19.6%	142,558	4.2	0.8
Lander..................	LA	161,382	85,694	53.1%	30,600	19.0%	36,192	4.5	0.8
Lincoln.................	LI	65,537	42,980	65.6%	4,320	6.6%	15,629	4.2	0.3
Lyon......................	LY	306,926	141,005	45.9%	91,713	29.9%	60,975	5.0	1.5
Mineral.................	MI	15,682	7,253	46.3%	4,565	29.1%	2,900	5.4	1.6
Nye.......................	NY	60,233	39,383	65.4%	6,064	10.1%	14,742	4.1	0.4
Pershing...............	PE	116,962	62,405	53.4%	21,823	18.7%	27,368	4.3	0.8
Storey....................	ST	1,008	560	55.6%	336	33.3%	300	3.4	1.1
Washoe.................	WA	121,533	60,241	49.6%	30,909	25.4%	27,048	4.5	1.1
White Pine...........	WP	84,187	52,709	62.6%	8,979	10.7%	24,839	3.4	0.4
NEVADA............	**NV**	**3,113,585**	**1,612,080**	**51.8%**	**672,415**	**21.6%**	**715,439**	**4.4**	**0.9**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Irrigation Water Withdrawal Rate (Acre-Feet per Acre per Year)" calculated by dividing "Total Irrigation Water Withdrawals" by "Total Irrigated Acreage."

(3) "Irrigation Conveyance Losses (Acre-Feet per Acre per Year)" is calculated by dividing "Irrigation Conveyance Losses" by "Total Irrigated Acreage."

(4) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

[8] Nevada Irrigation and Farm Marketings Analysis 1995

Irrigated Acreage, Irrigation Water Withdrawals, and Value of Farm Marketings

(Acres, Acre-Feet per Year, Acre-Feet per Acre per Year, and Dollars) Rev. 11/23/98

County and County Codes		Estimated Total Irrigated Acreage (Acres)	Percent of Total State	Irrigation and Livestock Water Withdrawals (AF/Year)	Percent of Total State	Livestock and Irrigation Water Use (Acre-Feet per Acre per Year)	Value of Total Farm Marketings ($000s)	Value of Farm Marketings per Acre-Foot (Dollars)	Value of Farm Marketings per Irrigated Acre (Dollars)
Carson City...........	CC	2,431	0.34%	10,721	0.34%	4.4	$669	$62	$275
Churchill..............	CH	56,094	7.84%	257,225	8.24%	4.6	33,791	131	602
Clark....................	CL	7,755	1.08%	40,572	1.30%	5.2	20,072	495	2,588
Douglas................	DG	38,640	5.40%	189,802	6.08%	4.9	10,725	57	278
Elko......................	EL	213,903	29.90%	910,347	29.18%	4.3	40,527	45	189
Esmeralda.............	ES	11,286	1.58%	49,810	1.60%	4.4	6,590	132	584
Eureka..................	EU	32,780	4.58%	125,016	4.01%	3.8	9,832	79	300
Humboldt.............	HU	142,558	19.93%	600,472	19.25%	4.2	50,499	84	354
Lander..................	LA	36,192	5.06%	161,718	5.18%	4.5	7,008	43	194
Lincoln.................	LI	15,629	2.18%	65,660	2.10%	4.2	8,219	125	526
Lyon.....................	LY	60,975	8.52%	307,374	9.85%	5.0	47,565	155	780
Mineral.................	MI	2,900	0.41%	15,716	0.50%	5.4	2,476	158	854
Nye.......................	NY	14,742	2.06%	60,973	1.95%	4.1	13,081	215	887
Pershing...............	PE	27,368	3.83%	117,220	3.76%	4.3	25,246	215	922
Storey...................	ST	300	0.04%	1,008	0.03%	3.4	0	0	0
Washoe.................	WA	27,048	3.78%	121,824	3.90%	4.5	13,763	113	509
White Pine............	WP	24,839	3.47%	84,456	2.71%	3.4	8,022	95	323
NEVADA............	**NV**	**715,439**	**100.00%**	**3,119,914**	**100.00%**	**4.4**	**$298,085**	**$96**	**$417**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Livestock and Irrigation Water Use (Acre-Feet per Acre per Year)" calculated by dividing the "Irrigation and Livestock Water Withdrawals" by the "Estimated irrigated Acreage."

(3) "Value of Farm Marketings per Acre-Foot and per Irrigated Acre (Dollars)" calculated by dividing the "Value of Total Farm Marketings" by either "Irrigation and Livestock Water Withdrawals" or by "Estimated Total Irrigated Acreage."

Sources: USGS; USDA Nevada Agricultural Statistics Service; U.S. Department of Commerce, Bureau of Economic Analysis (BEA); Nevada Division of Water Planning (NDWP).

[9] Commercial, Industrial, Thermoelectric and Mining Water Uses 1995

Commercial, Industrial, Thermoelectric, and Mining Water Use Analysis
(Acre-Feet per Year and Gallons per Worker per Day)

Rev. 11/23/98

County and County Codes		Total Nevada and County Covered Employment	Total Commercial and Industrial Water Withdrawals	Total Thermo-Electric Water Withdrawals	Mining Water Withdrawals for Consumptive Use Only	Mining Water Withdrawals Non Consumptive Use	Commercial and Industrial Public Supplied Water Use per Worker (Gallons/Day)	Total Commercial and Industrial Water Use per Worker (Gallons/Day)	Commercial and Industrial Water Use per Worker-excl. Mining Emp. (Gallons/Day)
Carson City..........	CC	26,218	2,274	0	0	0	69.4	77.4	77.5
Churchill..............	CH	6,967	1,423	22,963	179	0	47.4	182.3	183.0
Clark....................	CL	502,180	121,066	25,337	2,386	0	184.7	215.2	215.4
Douglas................	DG	19,277	3,293	0	0	0	54.0	152.5	152.7
Elko......................	EL	18,370	7,942	0	5,354	0	130.1	386.0	415.2
Esmeralda.............	ES	322	45	0	12,613	0	124.2	124.2	239.5
Eureka..................	EU	4,554	67	4,637	19,222	95,021	13.2	13.2	95.7
Humboldt.............	HU	7,770	1,411	3,226	15,077	61,563	88.8	162.2	230.6
Lander..................	LA	2,465	146	0	7,550	28,048	52.7	52.7	94.0
Lincoln.................	LI	1,535	364	0	0	0	191.9	211.5	213.6
Lyon.....................	LY	7,051	8,894	1,400	2,565	0	154.6	1,126.1	1,155.9
Mineral.................	MI	2,545	280	0	2,520	0	98.2	98.2	116.3
Nye.......................	NY	8,496	784	0	7,057	638	70.6	82.4	97.2
Pershing................	PE	1,886	414	0	2,106	0	190.9	196.2	307.3
Storey...................	ST	724	67	1,826	258	0	82.9	82.9	93.3
Washoe.................	WA	163,151	23,691	6,060	717	0	97.1	129.6	130.1
White Pine............	WP	4,230	246	0	11,560	0	52.0	52.0	60.9
NEVADA.............	**NV**	**784,486**	**172,407**	**65,450**	**89,164**	**185,270**	**150.4**	**196.2**	**199.6**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Nevada and County Covered Employment" includes workers covered under state and federal unemployment insurance programs.

(3) Commercial, Industrial, Thermoelectric, and Mining water withdrawals include both public supplied and self-supplied water. Mining excludes dewatering.

(4) "Per Worker" usage rates are calculated by dividing the appropriate water use (commercial public supplied only, total commercial, i.e., both public and self-supplied wate use or total commercial and total industrial water use only) by the number of total covered employees.

Sources: U.S. Geological Survey (USGS); Nevada Department of Employment, Training and Rehabilitation (DETR).

[10] Nevada Water Usage Rate Analysis 1995

Population and Employment Water Usage Rate Summary and Analysis

(Acre-Feet per Year, Except per Capita and per Worker Usage Rates)

Rev. 11/23/98

County and County Codes		Total Nevada and County Resident Populations (Persons)	Total Water Withdrawals Excluding Mine Dewatering	Percent of Total Water Withdrawals	Total Domestic Water Withdrawals per Person (Gallons/Day)	Domestic Public Supplied Water Use per Person (Gallons/Day)	Municipal and Industrial (M&I--Public Supplied) Water Use per Person (Gallons/Day)	Commercial and Industrial Water Use per Worker-excl. Mining Emp. (Gallons/Day)	Mining Water Withdrawals per Mining Worker (Gallons/Day)
Carson City............	CC	46,770	20,932	0.54%	135.5	136.8	197.7	77.5	0
Churchill................	CH	21,640	286,300	7.42%	142.6	148.6	246.9	183.0	6,154
Clark......................	CL	1,036,290	468,353	12.15%	212.5	213.0	334.2	215.4	4,755
Douglas..................	DG	35,880	203,956	5.29%	261.6	264.2	306.0	152.7	0
Elko........................	EL	43,050	936,593	24.29%	240.4	242.1	331.7	415.2	3,691
Esmeralda...............	ES	1,630	62,809	1.63%	162.6	167.7	238.3	239.5	72,646
Eureka....................	EU	1,580	149,401	3.87%	240.0	246.4	322.9	95.7	4,370
Humboldt................	HU	16,270	625,022	16.21%	244.4	253.0	348.8	230.6	5,840
Lander....................	LA	6,440	170,935	4.43%	187.6	191.3	245.4	94.0	6,229
Lincoln....................	LI	4,110	67,516	1.75%	294.3	300.8	430.9	213.6	0
Lyon........................	LY	26,580	325,076	8.43%	140.1	141.3	210.7	1,155.9	12,582
Mineral...................	MI	6,700	19,714	0.51%	153.6	156.9	211.7	116.3	5,682
Nye.........................	NY	23,050	75,977	1.97%	224.1	231.4	347.7	97.2	4,861
Pershing..................	PE	5,140	121,216	3.14%	233.0	235.7	341.5	307.3	2,757
Storey.....................	ST	3,200	3,532	0.09%	94.9	98.6	143.0	93.3	2,840
Washoe...................	WA	291,050	218,983	5.68%	176.0	177.7	269.7	130.1	1,044
White Pine..............	WP	9,770	99,803	2.59%	300.0	302.4	352.4	60.9	16,781
NEVADA...............	**NV**	**1,579,150**	**3,856,117**	**100.00%**	**203.9**	**205.6**	**315.0**	**199.6**	**6,036**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Water Withdrawals" excludes mine dewatering, i.e., mining non-consumptive water use.

(3) "Total Domestic Withdrawals per Person (Gallons/Day)" includes public supplied water and self-supplied water divided by the resident population.

(4) "Municipal and Industrial Water Use per Person (Gallons/Day)" includes public supplied domestic, commercial, industrial and thermoelectric withdrawals.

(5) "Mining Water Withdrawals per Mining Worker" based on consumptive use only and does not include mine dewatering (i.e., non-consumptive use).

(6) "Commercial and Industrial Water Use per Worker" equals commercial and industrial (public and self supplied) withdrawals divided by total covered employment.

Sources: USGS; USDA Nevada Agricultural Statistics Service; Nevada State Demographer; Department of Employment, Training and Rehabilitation (DETR).

[11] Nevada Household Water Usage Rate Analysis 1995

Water Withdrawals for Population and Occupied Housing Units
(Acre-Feet per Year, Except per Household and per Capita Usage Rates) Rev. 11/23/98

County and County Codes		Total Nevada and County Resident Populations (Persons)	Total Nevada and County Covered Employment	Households (Occupied Housing Units)	Average Number of Persons per Occupied Housing Unit	Average Number of Workers per Occupied Housing Unit	Total Domestic Water Withdrawals	Total Domestic Water Use per Household (Gallons/Day)	Total Domestic Water Withdrawals per Person (Gallons/Day)
Carson City	CC	46,770	26,218	18,154	2.6	1.4	7,096	349.0	135.5
Churchill	CH	21,640	6,967	7,970	2.7	0.9	3,457	387.2	142.6
Clark	CL	1,036,290	502,180	386,147	2.7	1.3	246,709	570.4	212.5
Douglas	DG	35,880	19,277	13,512	2.7	1.4	10,513	694.6	261.6
Elko	EL	43,050	18,370	15,013	2.9	1.2	11,595	689.5	240.4
Esmeralda	ES	1,630	322	710	2.3	0.5	297	373.3	162.6
Eureka	EU	1,580	4,554	629	2.5	7.2	425	603.0	240.0
Humboldt	HU	16,270	7,770	5,671	2.9	1.4	4,454	701.2	244.4
Lander	LA	6,440	2,465	2,247	2.9	1.1	1,353	537.6	187.6
Lincoln	LI	4,110	1,535	1,429	2.9	1.1	1,355	846.3	294.3
Lyon	LY	26,580	7,051	9,914	2.7	0.7	4,171	375.6	140.1
Mineral	MI	6,700	2,545	2,619	2.6	1.0	1,153	392.9	153.6
Nye	NY	23,050	8,496	8,444	2.7	1.0	5,785	611.6	224.1
Pershing	PE	5,140	1,886	1,823	2.8	1.0	1,342	656.9	233.0
Storey	ST	3,200	724	1,258	2.5	0.6	340	241.4	94.9
Washoe	WA	291,050	163,151	115,793	2.5	1.4	57,382	442.4	176.0
White Pine	WP	9,770	4,230	3,422	2.9	1.2	3,283	856.4	300.0
NEVADA	**NV**	**1,579,150**	**784,486**	**594,755**	**2.7**	**1.3**	**360,710**	**541.4**	**203.9**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Nevada and County Covered Employment" includes workers covered under state and federal unemployment insurance programs.

(3) Households equivalent to occupied housing units; not the same as total housing units.

(4) "Total Domestic Water Withdrawals" includes both public supplied and self supplied water for residential (household) uses.

Sources: U.S. Geological Survey (USGS); Nevada State Demographer; U.S. Bureau of the Census; Nevada Department of Employment.

[12] Nevada Water Use by Category Share Analysis 1995

Shares of Total Water Withdrawals by Principal Use Category (Percent) Rev. 11/23/98

County and County Codes		Total Domestic Water Withdrawals	Total Commercial Water Withdrawals	Total Industrial Water Withdrawals	Total Thermo-Electric Water Withdrawals	Total Mining Water Withdrawals	Livestock Water Withdrawals	Irrigation Water Withdrawals	Public Use and Losses
Carson City............	CC	33.90%	5.83%	5.03%	0.00%	0.00%	0.05%	51.17%	4.01%
Churchill................	CH	1.21%	0.39%	0.11%	8.02%	0.06%	0.23%	89.61%	0.37%
Clark......................	CL	52.68%	23.91%	1.94%	5.41%	0.51%	0.06%	8.60%	6.89%
Douglas..................	DG	5.15%	1.47%	0.15%	0.00%	0.00%	0.13%	92.93%	0.17%
Elko........................	EL	1.24%	0.85%	0.00%	0.00%	0.57%	0.18%	97.02%	0.14%
Esmeralda...............	ES	0.47%	0.07%	0.00%	0.00%	20.08%	0.20%	79.11%	0.07%
Eureka....................	EU	0.17%	0.03%	0.00%	1.90%	46.74%	0.06%	51.08%	0.01%
Humboldt...............	HU	0.65%	0.12%	0.08%	0.47%	11.16%	0.09%	87.37%	0.06%
Lander....................	LA	0.68%	0.07%	0.00%	0.00%	17.89%	0.17%	81.10%	0.08%
Lincoln...................	LI	2.01%	0.54%	0.00%	0.00%	0.00%	0.18%	97.07%	0.20%
Lyon.......................	LY	1.28%	1.22%	1.52%	0.43%	0.79%	0.14%	94.42%	0.21%
Mineral...................	MI	5.85%	1.42%	0.00%	0.00%	12.78%	0.17%	79.55%	0.23%
Nye.........................	NY	7.55%	1.02%	0.00%	0.00%	10.04%	0.96%	78.62%	1.80%
Pershing.................	PE	1.11%	0.34%	0.00%	0.00%	1.74%	0.21%	96.49%	0.11%
Storey.....................	ST	9.63%	1.90%	0.00%	51.69%	7.29%	0.00%	28.54%	0.95%
Washoe...................	WA	26.20%	9.45%	1.37%	2.77%	0.33%	0.13%	55.50%	4.25%
White Pine..............	WP	3.29%	0.25%	0.00%	0.00%	11.58%	0.27%	84.35%	0.26%
NEVADA...............	**NV**	**8.93%**	**3.79%**	**0.48%**	**1.62%**	**6.79%**	**0.16%**	**77.04%**	**1.20%**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) Shares by use category are measured as percent of "Total Water Withdrawals All Uses," presented on Table 1, which includes all water withdrawals both public supplied and self supplied. Total withdrawals also includes "Public Use and Losses" presented on Table 2 and all mining withdrawals in Table 9.

(3) Total domestic, commercial, industrial, and thermoelectric water withdrawals include both public supplied and self-supplied; Total mining water use includes both consumptive use (processing) and non-consumptive use (mine dewatering).

Source Data: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

[1] Nevada Water Use Summary 1990

Water Withdrawals by Principal Category of Use (Acre-Feet per Year)

Rev. 11/23/98

County and County Codes		Total Water Withdrawals All Uses	Total Domestic Water Withdrawals	Total Commercial Water Withdrawals	Total Industrial Water Withdrawals	Total Thermo-Electric Water Withdrawals	Total Mining Water Withdrawals	Livestock Water Withdrawals	Irrigation Water Withdrawals
Carson City..........	CC	13,405	7,244	1,243	1,064	0	0	11	2,812
Churchill..............	CH	308,886	2,908	818	291	22,952	179	672	280,819
Clark....................	CL	389,762	180,274	84,402	10,854	27,286	2,823	280	36,629
Douglas................	DG	214,117	7,530	2,151	302	0	123	258	203,081
Elko......................	EL	917,535	9,941	7,953	0	0	5,130	1,703	892,696
Esmeralda.............	ES	50,842	211	56	0	0	15,660	123	34,780
Eureka..................	EU	205,233	427	78	0	4,637	29,639	157	170,261
Humboldt.............	HU	603,180	3,255	538	0	5,153	25,842	627	567,463
Lander..................	LA	159,853	951	246	0	0	19,109	336	139,121
Lincoln.................	LI	67,434	1,368	381	0	0	0	123	65,416
Lyon.....................	LY	335,668	3,513	1,221	90	5,556	4,268	448	320,136
Mineral.................	MI	35,402	913	1,199	0	0	1,646	34	31,364
Nye.......................	NY	63,033	2,870	1,904	22	0	7,561	739	49,510
Pershing...............	PE	125,556	1,277	358	0	0	1,646	258	121,871
Storey...................	ST	3,937	273	56	0	3,282	292	0	0
Washoe................	WA	252,110	57,597	19,771	1,759	6,049	2,274	291	155,475
White Pine............	WP	100,082	3,022	3,271	0	0	3,932	269	89,275
NEVADA............	**NV**	**3,846,035**	**283,576**	**125,644**	**14,383**	**74,915**	**120,125**	**6,329**	**3,160,709**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Water Withdrawals All Uses" includes all withdrawals both public supplied and self-supplied. Also includes public use and losses presented in Table 2 and mining consumptive and non-comsumptive use as broken out in Table 9.

(3) Total Domestic, Commercial, Industrial, and Thermoelectric water withdrawals includes both public supplied and self-supplied water use; Total Mining Water Withdrawals includes both consumtpive use (i.e., processing) and non-consumptive use (i.e., mine dewatering).

(4) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); U.S. Department of Agriculture (USDA), Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

[2] Nevada Public Supplied Water Use 1990

Public Supplied Water Withdrawals by Principal Use (Acre-Feet per Year)

Rev. 11/23/98

County and County Codes		Population Served by Public Supplied Water (Persons)	Total Public Supplied Water	Domestic Public Supplied Water	Commercial Public Supplied Water	Industrial Public Supplied Water	Thermo-Electric Public Supplied Water	Public Use and Losses	Public Supplied Water Use Per Person (Gallons/Day)
Carson City	CC	36,930	9,700	6,598	1,232	840	0	1,031	234.5
Churchill	CH	9,353	2,621	1,579	773	22	0	246	250.2
Clark	CL	754,365	299,615	176,915	72,607	1,983	896	47,214	354.6
Douglas	DG	19,905	8,211	5,500	2,039	0	0	672	368.3
Elko	EL	28,915	11,269	8,636	2,520	0	0	112	347.9
Esmeralda	ES	826	190	134	45	0	0	11	205.8
Eureka	EU	980	381	280	67	0	0	34	346.9
Humboldt	HU	9,268	3,192	2,386	504	0	0	302	307.5
Lander	LA	4,651	1,053	717	246	0	0	90	202.1
Lincoln	LI	3,225	1,669	1,176	347	0	0	146	462.0
Lyon	LY	16,894	4,201	2,935	829	0	0	437	222.0
Mineral	MI	5,901	2,263	840	1,176	0	0	246	342.3
Nye	NY	11,704	3,506	1,915	1,165	0	0	426	267.4
Pershing	PE	3,722	1,557	1,064	347	0	0	146	373.5
Storey	ST	1,619	258	179	45	0	0	34	142.1
Washoe	WA	236,130	78,399	53,330	16,074	101	0	8,894	296.4
White Pine	WP	8,384	3,237	2,722	202	0	0	314	344.7
NEVADA	**NV**	**1,152,772**	**431,322**	**266,906**	**100,218**	**2,946**	**896**	**60,355**	**334.0**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) Populations are for those state or county residents served by public water systems only.

(3) "Total Public Supplied Water" includes water supplied by public water supply purveyors, including public use and estimates of system losses. Also referred to as "Municipal and Industrial" or "M&I" water use.

(4) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); Nevada Division of Water Planning (NDWP).

[3] Nevada Self-Supplied and Other Water Uses 1990

Self Supplied, Mining, Livestock, Irrigation Water Use (Acre-Feet per Year)

Rev. 11/23/98

County and County Codes		Total Water Withdrawals All Uses	Total Public Supplied Water	Domestic Self Supplied Water	Commercial Self Supplied Water	Industrial Self Supplied Water	Thermo-Electric Self Supplied Water	Mining Water Withdrawals Consumptive Use Only	Livestock and Irrigation Water Withdrawals
Carson City..........	CC	13,405	9,700	646	11	224	0	0	2,823
Churchill..............	CH	308,886	2,621	1,329	45	269	22,952	179	281,491
Clark....................	CL	389,762	299,615	3,359	11,795	8,872	26,390	1,983	36,909
Douglas................	DG	214,117	8,211	2,030	112	302	0	123	203,339
Elko......................	EL	917,535	11,269	1,305	5,433	0	0	4,682	894,399
Esmeralda............	ES	50,842	190	77	11	0	0	12,837	34,903
Eureka..................	EU	205,233	381	147	11	0	4,637	16,332	170,418
Humboldt.............	HU	603,180	3,192	869	34	0	5,153	5,668	568,090
Lander..................	LA	159,853	1,053	234	0	0	0	7,975	139,457
Lincoln.................	LI	67,434	1,669	192	34	0	0	0	65,539
Lyon.....................	LY	335,668	4,201	578	392	90	5,556	2,565	320,584
Mineral.................	MI	35,402	2,263	73	22	0	0	1,624	31,398
Nye.......................	NY	63,033	3,506	955	739	22	0	7,505	50,249
Pershing...............	PE	125,556	1,557	213	11	0	0	1,579	122,129
Storey...................	ST	3,937	258	94	11	0	3,282	258	0
Washoe.................	WA	252,110	78,399	4,267	3,696	1,658	6,049	717	155,766
White Pine............	WP	100,082	3,237	300	3,069	0	0	3,831	89,544
NEVADA............	**NV**	**3,846,035**	**431,322**	**16,668**	**25,426**	**11,437**	**74,019**	**67,858**	**3,167,038**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Public Supplied Water" includes domestic, commercial, industrial, and thermoelectric water supplied by public water supply purveyors.

(3) "Total Self-Supplied Water" is water from private wells or other private water systems serving a limited use and/or a limited number of customers.

(4) Mining water withdrawals excludes non-consumptive uses, i.e., mine dewatering.

(5) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

[4] Nevada Domestic, M&I, and Total Water Use per Capita 1990

Domestic Public and Self Supplied, M&I, Adjusted M&I, Total Use (Gallons/Day) Rev. 11/23/98

County and County Codes		Total Nevada and County Resident Populations (Persons)	Population Served by Public Supplied Water (Persons)	Percent of Population Served by Public Supply Water Systems	Domestic Public Supplied Water Use per Person (Gallons/Day)	Domestic Self Supplied Water Use per Person (Gallons/Day)	Municipal and Industrial (M&I--Public Supplied) Water Use per Person (Gallons/Day)	Public and (Partial) Self Supplied Water Use per Person (Gallons/Day)
Carson City............	CC	40,950	36,930	90.2%	159.5	143.5	234.5	255.8
Churchill................	CH	18,100	9,353	51.7%	150.8	135.6	250.2	407.0
Clark.......................	CL	770,280	754,365	97.9%	209.4	188.4	354.6	383.0
Douglas..................	DG	28,070	19,905	70.9%	246.7	222.0	368.3	477.9
Elko........................	EL	33,770	28,915	85.6%	266.6	240.0	347.9	555.9
Esmeralda...............	ES	1,350	826	61.2%	145.3	131.2	205.8	301.1
Eureka....................	EU	1,550	980	63.2%	255.1	230.2	346.9	491.1
Humboldt................	HU	13,020	9,268	71.2%	229.8	206.8	307.5	394.5
Lander....................	LA	6,340	4,651	73.4%	137.6	123.7	202.1	247.0
Lincoln...................	LI	3,810	3,225	84.6%	325.6	293.0	462.0	524.5
Lyon.......................	LY	20,590	16,894	82.0%	155.1	139.6	222.0	278.0
Mineral...................	MI	6,470	5,901	91.2%	127.1	114.5	342.3	356.7
Nye.........................	NY	18,190	11,704	64.3%	146.1	131.4	267.4	398.4
Pershing.................	PE	4,550	3,722	81.8%	255.2	229.7	373.5	427.2
Storey.....................	ST	2,560	1,619	63.2%	98.8	89.2	142.1	200.1
Washoe...................	WA	257,120	236,130	91.8%	201.6	181.5	296.4	332.8
White Pine..............	WP	9,410	8,384	89.1%	289.8	261.0	344.7	703.5
NEVADA...............	**NV**	**1,236,130**	**1,152,772**	**93.3%**	**206.7**	**178.5**	**334.0**	**375.5**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Domestic Public Supplied Water Use per Person (Gallons/Day)" equals public supplied water use divided by population served by public supply systems.

(3) "Domestic Self Supplied Water Use per Person (Gallons/Day)" equals self supplied water use divided by persons served by self supplied systems.

(4) "Municipal and Industrial Water Use per Person (Gallons/Day)" is based on public supplied water and population served by public supply water systems.

(5) "Public and (Partial) Self Supplied Water Use per Person (Gallons/Day)" is based on both public supplied water (i.e., M&I water use) and self supplied water for domestic, commercial and industrial use only, divided by the total population. Excludes self supplied thermoelectric water use and all mining water use.

Sources: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada State Demographer.

[5] Nevada Domestic and Commercial & Industrial Water Uses 1990

Domestic, Commercial & Industrial Water Use (Acre-Feet/Year and Gallons/Day)

Rev. 11/23/98

County and County Codes		Total Domestic Water Withdrawals	Domestic Consumptive Water Use	Domestic Consumptive Use as Percent of Withdrawals	Total Domestic Water Use per Person (Gallons/Day)	Total Commercial and Industrial Water Withdrawals	Commercial and Industrial Consumptive Water Use	Commercial Consumptive Use as Percent of Withdrawals	Commercial and Industrial Water Use per Worker (Gallons/Day)
Carson City	CC	7,244	3,616	49.9%	157.9	2,308	459	19.9%	95.7
Churchill	CH	2,908	1,448	49.8%	143.5	1,109	224	20.2%	169.1
Clark	CL	180,274	90,137	50.0%	208.9	95,256	18,190	19.1%	227.2
Douglas	DG	7,530	3,760	49.9%	239.5	2,453	481	19.6%	119.8
Elko	EL	9,941	4,966	50.0%	262.8	7,953	582	7.3%	461.8
Esmeralda	ES	211	106	50.1%	139.8	56	11	20.0%	136.2
Eureka	EU	427	231	54.1%	246.0	78	11	14.3%	17.4
Humboldt	HU	3,255	1,621	49.8%	223.2	538	112	20.8%	78.4
Lander	LA	951	475	50.0%	133.9	246	45	18.2%	83.8
Lincoln	LI	1,368	705	51.5%	320.6	381	78	20.6%	186.1
Lyon	LY	3,513	1,749	49.8%	152.3	1,311	201	15.4%	221.3
Mineral	MI	913	468	51.3%	126.0	1,199	246	20.6%	415.9
Nye	NY	2,870	1,430	49.8%	140.9	1,927	381	19.8%	153.3
Pershing	PE	1,277	656	51.4%	250.6	358	67	18.8%	181.8
Storey	ST	273	141	51.6%	95.3	56	11	20.0%	67.8
Washoe	WA	57,597	28,813	50.0%	200.0	21,529	3,628	16.9%	134.7
White Pine	WP	3,022	1,505	49.8%	286.7	3,271	67	2.1%	745.1
NEVADA	**NV**	**283,574**	**141,827**	**50.0%**	**204.8**	**140,027**	**24,794**	**17.7%**	**201.7**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Domestic Water Withdrawals" and "Total Commercial Water Withdrawals" include both public supplied and self supplied water.

(3) "Total Domestic Water Use per Person (Gallons/Day)" equals "Total Domestic Water Withdrawals" divided by resident population; measured in gallons per day.

(4) "Commercial and Industrial Water Use per Worker (Gallons/Day)" equals "Total Commercial and Industiral Water Withdrawals" divided by covered employment; measured in gallons per worker per day.

(5) One acre-foot is equivalent to 325,851 gallons.

Source: U.S. Geological Survey (USGS).

[6] Nevada Livestock and Irrigation Water Uses 1990

Livestock and Irrigation Water Use Analysis (Acre-Feet per Year)

Rev. 11/23/98

County and County Codes		Livestock Water Withdrawals	Livestock Consumptive Water Use	Livestock Consumptive Use as Percent of Withdrawals	Total Irrigation Water Withdrawals	Irrigation Consumptive Use	Irrigation Consumptive Use as Percent of Irrigation Withdrawals	Total Livestock and Irrigation Water Withdrawals	Total Livestock and Irrigation Water Use as Percent of Total Withdrawals
Carson City..........	CC	11	0	0.0%	2,812	1,512	53.8%	2,823	21.1%
Churchill..............	CH	672	258	38.3%	280,819	129,040	46.0%	281,491	91.1%
Clark....................	CL	280	202	72.0%	36,629	26,155	71.4%	36,909	9.5%
Douglas................	DG	258	134	52.2%	203,081	92,748	45.7%	203,339	95.0%
Elko......................	EL	1,703	672	39.5%	892,696	456,737	51.2%	894,399	97.5%
Esmeralda............	ES	123	67	54.5%	34,780	21,843	62.8%	34,903	68.7%
Eureka..................	EU	157	67	42.9%	170,261	99,412	58.4%	170,418	83.0%
Humboldt.............	HU	627	224	35.7%	567,463	297,677	52.5%	568,090	94.2%
Lander..................	LA	336	123	36.7%	139,121	73,873	53.1%	139,457	87.2%
Lincoln.................	LI	123	34	27.3%	65,416	42,901	65.6%	65,539	97.2%
Lyon.....................	LY	448	146	32.5%	320,136	147,074	45.9%	320,584	95.5%
Mineral................	MI	34	34	100.0%	31,364	14,506	46.3%	31,398	88.7%
Nye.......................	NY	739	67	9.1%	49,510	32,372	65.4%	50,249	79.7%
Pershing...............	PE	258	78	30.4%	121,871	65,024	53.4%	122,129	97.3%
Storey..................	ST	0	0	--	0	0	--	0	0.0%
Washoe.................	WA	291	123	42.3%	155,475	77,066	49.6%	155,766	61.8%
White Pine............	WP	269	90	33.3%	89,275	55,895	62.6%	89,544	89.5%
NEVADA............	**NV**	**6,329**	**2,319**	**36.6%**	**3,160,709**	**1,633,835**	**51.7%**	**3,167,038**	**82.3%**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

[7] Nevada Irrigation Water Use Analysis

1990

Irrigation Water Withdrawals, Consumptive Use, Conveyance Losses, and Water Duty

(Acre-Feet per Year and Acre-Feet per Acre per Year)

Rev. 11/23/98

County and County Codes		Total Irrigation Water Withdrawals	Irrigation Consumptive Use	Irrigation Consumptive Use as Percent of Irrigation Withdrawals	Irrigation Conveyance Losses	Conveyance Losses as Percent of Irrigation Withdrawals	Total Irrigated Acreage (Acres)	Irrigation Water Withdrawal Rate (Acre-Feet per Acre per Year)	Irrigation Conveyance Losses (Acre-Feet per Acre per Year)
Carson City..........	CC	2,812	1,512	53.8%	1,008	35.9%	900	3.1	1.1
Churchill..............	CH	280,819	129,040	46.0%	81,658	29.1%	61,400	4.6	1.3
Clark.....................	CL	36,629	26,155	71.4%	2,016	5.5%	7,050	5.2	0.3
Douglas................	DG	203,081	92,748	45.7%	60,264	29.7%	41,400	4.9	1.5
Elko......................	EL	892,696	456,737	51.2%	192,944	21.6%	210,150	4.2	0.9
Esmeralda.............	ES	34,780	21,843	62.8%	3,584	10.3%	7,900	4.4	0.5
Eureka..................	EU	170,261	99,412	58.4%	24,195	14.2%	44,700	3.8	0.5
Humboldt.............	HU	567,463	297,677	52.5%	111,174	19.6%	134,750	4.2	0.8
Lander..................	LA	139,121	73,873	53.1%	26,379	19.0%	31,200	4.5	0.8
Lincoln.................	LI	65,416	42,901	65.6%	4,313	6.6%	15,600	4.2	0.3
Lyon.....................	LY	320,136	147,074	45.9%	95,660	29.9%	63,600	5.0	1.5
Mineral.................	MI	31,364	14,506	46.3%	9,129	29.1%	5,800	5.4	1.6
Nye.......................	NY	49,510	32,372	65.4%	4,985	10.1%	12,200	4.1	0.4
Pershing...............	PE	121,871	65,024	53.4%	22,739	18.7%	31,100	3.9	0.7
Storey....................	ST	0	0	--	0	--	0	--	--
Washoe.................	WA	155,475	77,066	49.6%	39,541	25.4%	34,600	4.5	1.1
White Pine............	WP	89,275	55,895	62.6%	9,552	10.7%	26,300	3.4	0.4
NEVADA............	**NV**	**3,160,709**	**1,633,835**	**51.7%**	**689,143**	**21.8%**	**728,650**	**4.3**	**0.9**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Irrigation Water Withdrawal Rate (Acre-Feet per Acre per Year)" calculated by dividing "Total Irrigation Water Withdrawals" by "Total Irrigated Acreage."

(3) "Irrigation Conveyance Losses (Acre-Feet per Acre per Year)" is calculated by dividing "Irrigation Conveyance Losses" by "Total Irrigated Acreage."

(4) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

[8] Nevada Irrigation and Farm Marketings Analysis 1990

Irrigated Acreage, Irrigation Water Withdrawals, and Value of Farm Marketings

(Acres, Acre-Feet per Year, Acre-Feet per Acre per Year, and Dollars) Rev. 11/23/98

County and County Codes		Estimated Total Irrigated Acreage (Acres)	Percent of Total State	Irrigation and Livestock Water Withdrawals (AF/Year)	Percent of Total State	Livestock and Irrigation Water Use (Acre-Feet per Acre per Year)	Value of Total Farm Marketings ($000s)	Value of Farm Marketings per Acre-Foot (Dollars)	Value of Farm Marketings per Irrigated Acre (Dollars)
Carson City...........	CC	900	0.12%	2,823	0.09%	3.1	$918	$325	$1,020
Churchill..............	CH	61,400	8.43%	281,491	8.89%	4.6	38,348	136	625
Clark.....................	CL	7,050	0.97%	36,909	1.17%	5.2	18,618	504	2,641
Douglas.................	DG	41,400	5.68%	203,339	6.42%	4.9	11,324	56	274
Elko......................	EL	210,150	28.84%	894,399	28.24%	4.3	53,071	59	253
Esmeralda.............	ES	7,900	1.08%	34,903	1.10%	4.4	6,163	177	780
Eureka..................	EU	44,700	6.13%	170,418	5.38%	3.8	11,254	66	252
Humboldt.............	HU	134,750	18.49%	568,090	17.94%	4.2	55,565	98	412
Lander..................	LA	31,200	4.28%	139,457	4.40%	4.5	9,563	69	307
Lincoln.................	LI	15,600	2.14%	65,539	2.07%	4.2	7,096	108	455
Lyon.....................	LY	63,600	8.73%	320,584	10.12%	5.0	50,832	159	799
Mineral.................	MI	5,800	0.80%	31,398	0.99%	5.4	2,228	71	384
Nye.......................	NY	12,200	1.67%	50,249	1.59%	4.1	11,342	226	930
Pershing...............	PE	31,100	4.27%	122,129	3.86%	3.9	27,871	228	896
Storey....................	ST	0	0.00%	0	0.00%	ERR	0	ERR	ERR
Washoe.................	WA	34,600	4.75%	155,766	4.92%	4.5	13,887	89	401
White Pine............	WP	26,300	3.61%	89,544	2.83%	3.4	8,808	98	335
NEVADA.............	**NV**	**728,650**	**100.00%**	**3,167,038**	**100.00%**	**4.3**	**$326,888**	**$103**	**$449**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Livestock and Irrigation Water Use (Acre-Feet per Acre per Year)" calculated by dividing the "Irrigation and Livestock Water Withdrawals" by the "Estimated irrigated Acreage."

(3) "Value of Farm Marketings per Acre-Foot and per Irrigated Acre (Dollars)" calculated by dividing the "Value of Total Farm Marketings" by either "Irrigation and Livestock Water Withdrawals" or by "Estimated Total Irrigated Acreage."

Sources: USGS; USDA Nevada Agricultural Statistics Service; U.S. Department of Commerce, Bureau of Economic Analysis (BEA); Nevada Division of Water Planning (NDWP).

[9] Commercial, Industrial, Thermoelectric and Mining Water Uses 1990

Commercial, Industrial, Thermoelectric, and Mining Water Use Analysis

(Acre-Feet per Year and Gallons per Worker per Day)

Rev. 11/23/98

County and County Codes		Total Nevada and County Covered Employment	Total Commercial and Industrial Water Withdrawals	Total Thermo-Electric Water Withdrawals	Mining Water Withdrawals for Consumptive Use Only	Mining Water Withdrawals Non Consumptive Use	Commercial and Industrial Public Supplied Water Use per Worker (Gallons/Day)	Total Commercial and Industrial Water Use per Worker (Gallons/Day)	Commercial and Industrial Water Use per Worker-excl. Mining Emp. (Gallons/Day)
Carson City..........	CC	21,520	2,308	0	0	0	86.0	95.7	95.9
Churchill...............	CH	5,853	1,109	22,952	179	0	121.3	169.1	170.7
Clark.....................	CL	374,231	95,256	27,286	1,983	840	177.9	227.2	227.4
Douglas................	DG	18,275	2,453	0	123	0	99.6	119.8	119.9
Elko......................	EL	15,376	7,953	0	4,682	448	146.3	461.8	504.0
Esmeralda.............	ES	367	56	0	12,837	2,823	109.0	136.2	218.3
Eureka..................	EU	4,026	78	4,637	16,332	13,307	14.9	17.4	163.9
Humboldt.............	HU	6,123	538	5,153	5,668	20,174	73.5	78.4	104.4
Lander..................	LA	2,626	246	0	7,975	11,134	83.8	83.8	173.8
Lincoln.................	LI	1,827	381	0	0	0	169.7	186.1	188.9
Lyon.....................	LY	5,288	1,311	5,556	2,565	1,703	139.9	221.3	228.4
Mineral.................	MI	2,573	1,199	0	1,624	22	408.1	415.9	543.2
Nye.......................	NY	11,220	1,927	0	7,505	56	92.7	153.3	185.5
Pershing................	PE	1,760	358	0	1,579	67	176.1	181.8	297.1
Storey...................	ST	737	56	3,282	258	34	54.3	67.8	86.5
Washoe.................	WA	142,671	21,529	6,049	717	1,557	101.2	134.7	136.2
White Pine............	WP	3,919	3,271	0	3,831	101	45.9	745.1	962.7
NEVADA............	**NV**	**619,639**	**140,027**	**74,915**	**67,858**	**52,266**	**148.6**	**201.7**	**206.5**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Nevada and County Covered Employment" includes workers covered under state and federal unemployment insurance programs.

(3) Commercial, Industrial, Thermoelectric, and Mining water withdrawals include both public supplied and self-supplied water. Mining excludes dewatering.

(4) "Per Worker" usage rates are calculated by dividing the appropriate water use (commercial public supplied only, total commercial, i.e., both public and self-supplied wate use or total commercial and total industrial water use only) by the number of total covered employees.

Sources: U.S. Geological Survey (USGS); Nevada Department of Employment, Training and Rehabilitation (DETR).

[10] Nevada Water Usage Rate Analysis 1990

Population and Employment Water Usage Rate Summary and Analysis
(Acre-Feet per Year, Except per Capita and per Worker Usage Rates)

Rev. 11/23/98

County and County Codes		Total Nevada and County Resident Populations (Persons)	Total Water Withdrawals Excluding Mine Dewatering	Percent of Total Water Withdrawals	Total Domestic Water Withdrawals per Person (Gallons/Day)	Domestic Public Supplied Water Use per Person (Gallons/Day)	Municipal and Industrial (M&I--Public Supplied) Water Use per Person (Gallons/Day)	Commercial and Industrial Water Use per Worker-excl. Mining Emp. (Gallons/Day)	Mining Water Withdrawals per Mining Worker (Gallons/Day)
Carson City............	CC	40,950	13,405	0.35%	157.9	159.5	234.5	95.9	0
Churchill................	CH	18,100	308,886	8.14%	143.5	150.8	250.2	170.7	2,963
Clark......................	CL	770,280	388,922	10.25%	208.9	209.4	354.6	227.4	6,969
Douglas.................	DG	28,070	214,117	5.64%	239.5	246.7	368.3	119.9	7,857
Elko.......................	EL	33,770	917,087	24.17%	262.8	266.6	347.9	504.0	3,243
Esmeralda..............	ES	1,350	48,019	1.27%	139.8	145.3	205.8	218.3	83,044
Eureka...................	EU	1,550	191,926	5.06%	246.0	255.1	346.9	163.9	4,051
Humboldt...............	HU	13,020	583,006	15.37%	223.2	229.8	307.5	104.4	3,314
Lander...................	LA	6,340	148,719	3.92%	133.9	137.6	202.1	173.8	5,235
Lincoln..................	LI	3,810	67,434	1.78%	320.6	325.6	462.0	188.9	0
Lyon......................	LY	20,590	333,965	8.80%	152.3	155.1	222.0	228.4	13,879
Mineral..................	MI	6,470	35,380	0.93%	126.0	127.1	342.3	543.2	2,405
Nye........................	NY	18,190	62,977	1.66%	140.9	146.1	267.4	185.5	3,438
Pershing.................	PE	4,550	125,489	3.31%	250.6	255.2	373.5	297.1	2,064
Storey....................	ST	2,560	3,903	0.10%	95.3	98.8	142.1	86.5	1,447
Washoe..................	WA	257,120	250,553	6.60%	200.0	201.6	296.4	136.2	423
White Pine.............	WP	9,410	99,981	2.64%	286.7	289.8	344.7	962.7	3,860
NEVADA...............	**NV**	**1,236,130**	**3,793,769**	**100.00%**	**204.8**	**206.7**	**334.0**	**206.5**	**4,230**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Water Withdrawals" excludes mine dewatering, i.e., mining non-consumptive water use.

(3) "Total Domestic Withdrawals per Person (Gallons/Day)" includes public supplied water and self-supplied water divided by the resident population.

(4) "Municipal and Industrial Water Use per Person (Gallons/Day)" includes public supplied domestic, commercial, industrial and thermoelectric withdrawals.

(5) "Mining Water Withdrawals per Mining Worker" based on consumptive use only and does not include mine dewatering (i.e., non-consumptive use).

(6) "Commercial and Industrial Water Use per Worker" equals commercial and industrial (public and self supplied) withdrawals divided by total covered employment.

Sources: USGS; USDA Nevada Agricultural Statistics Service; Nevada State Demographer; Department of Employment, Training and Rehabilitation (DETR).

[11] Nevada Household Water Usage Rate Analysis 1990

Water Withdrawals for Population and Occupied Housing Units
(Acre-Feet per Year, Except per Household and per Capita Usage Rates)

Rev. 11/23/98

County and County Codes		Total Nevada and County Resident Populations (Persons)	Total Nevada and County Covered Employment	Households (Occupied Housing Units)	Average Number of Persons per Occupied Housing Unit	Average Number of Workers per Occupied Housing Unit	Total Domestic Water Withdrawals	Total Domestic Water Use per Household (Gallons/Day)	Total Domestic Water Withdrawals per Person (Gallons/Day)
Carson City.........	CC	40,950	21,520	15,895	2.6	1.4	7,244	406.8	157.9
Churchill.............	CH	18,100	5,853	6,666	2.7	0.9	2,908	389.5	143.5
Clark..................	CL	770,280	374,231	287,025	2.7	1.3	180,274	560.7	208.9
Douglas..............	DG	28,070	18,275	10,571	2.7	1.7	7,530	635.9	239.5
Elko....................	EL	33,770	15,376	11,777	2.9	1.3	9,941	753.6	262.8
Esmeralda...........	ES	1,350	367	588	2.3	0.6	211	321.0	139.8
Eureka................	EU	1,550	4,026	617	2.5	6.5	427	617.9	246.0
Humboldt...........	HU	13,020	6,123	4,538	2.9	1.3	3,255	640.3	223.2
Lander................	LA	6,340	2,626	2,212	2.9	1.2	951	383.8	133.9
Lincoln...............	LI	3,810	1,827	1,325	2.9	1.4	1,368	921.8	320.6
Lyon...................	LY	20,590	5,288	7,680	2.7	0.7	3,513	408.3	152.3
Mineral...............	MI	6,470	2,573	2,529	2.6	1.0	913	322.3	126.0
Nye.....................	NY	18,190	11,220	6,664	2.7	1.7	2,870	384.5	140.9
Pershing.............	PE	4,550	1,760	1,614	2.8	1.1	1,277	706.4	250.6
Storey.................	ST	2,560	737	1,006	2.5	0.7	273	242.5	95.3
Washoe..............	WA	257,120	142,671	102,294	2.5	1.4	57,597	502.7	200.0
White Pine.........	WP	9,410	3,919	3,296	2.9	1.2	3,022	818.5	286.7
NEVADA..........	**NV**	**1,236,130**	**619,639**	**466,297**	**2.7**	**1.3**	**283,574**	**542.9**	**204.8**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Nevada and County Covered Employment" includes workers covered under state and federal unemployment insurance programs.

(3) Households equivalent to occupied housing units; not the same as total housing units.

(4) "Total Domestic Water Withdrawals" includes both public supplied and self supplied water for residential (household) uses.

Sources: U.S. Geological Survey (USGS); Nevada State Demographer; U.S. Bureau of the Census; Nevada Department of Employment.

[12] Nevada Water Use by Category Share Analysis 1990

Shares of Total Water Withdrawals by Principal Use Category (Percent)

Rev. 11/23/98

County and County Codes		Total Domestic Water Withdrawals	Total Commercial Water Withdrawals	Total Industrial Water Withdrawals	Total Thermo-Electric Water Withdrawals	Total Mining Water Withdrawals	Livestock Water Withdrawals	Irrigation Water Withdrawals	Public Use and Losses
Carson City.............	CC	54.04%	9.28%	7.94%	0.00%	0.00%	0.08%	20.97%	7.69%
Churchill.................	CH	0.94%	0.26%	0.09%	7.43%	0.06%	0.22%	90.91%	0.08%
Clark.......................	CL	46.25%	21.65%	2.78%	7.00%	0.72%	0.07%	9.40%	12.11%
Douglas..................	DG	3.52%	1.00%	0.14%	0.00%	0.06%	0.12%	94.85%	0.31%
Elko........................	EL	1.08%	0.87%	0.00%	0.00%	0.56%	0.19%	97.29%	0.01%
Esmeralda...............	ES	0.42%	0.11%	0.00%	0.00%	30.80%	0.24%	68.41%	0.02%
Eureka....................	EU	0.21%	0.04%	0.00%	2.26%	14.44%	0.08%	82.96%	0.02%
Humboldt................	HU	0.54%	0.09%	0.00%	0.85%	4.28%	0.10%	94.08%	0.05%
Lander....................	LA	0.59%	0.15%	0.00%	0.00%	11.95%	0.21%	87.03%	0.06%
Lincoln..................	LI	2.03%	0.56%	0.00%	0.00%	0.00%	0.18%	97.01%	0.22%
Lyon.......................	LY	1.05%	0.36%	0.03%	1.66%	1.27%	0.13%	95.37%	0.13%
Mineral..................	MI	2.58%	3.39%	0.00%	0.00%	4.65%	0.09%	88.59%	0.70%
Nye.........................	NY	4.55%	3.02%	0.04%	0.00%	12.00%	1.17%	78.55%	0.68%
Pershing.................	PE	1.02%	0.29%	0.00%	0.00%	1.31%	0.21%	97.06%	0.12%
Storey.....................	ST	6.94%	1.42%	0.00%	83.37%	7.41%	0.00%	0.00%	0.85%
Washoe...................	WA	22.85%	7.84%	0.70%	2.40%	0.90%	0.12%	61.67%	3.53%
White Pine..............	WP	3.02%	3.27%	0.00%	0.00%	3.93%	0.27%	89.20%	0.31%
NEVADA...............	**NV**	**7.37%**	**3.27%**	**0.37%**	**1.95%**	**3.12%**	**0.16%**	**82.18%**	**1.57%**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) Shares by use category are measured as percent of "Total Water Withdrawals All Uses," presented on Table 1, which includes all water withdrawals both public supplied and self supplied. Total withdrawals also includes "Public Use and Losses" presented on Table 2 and all mining withdrawals in Table 9.

(3) Total domestic, commercial, industrial, and thermoelectric water withdrawals include both public supplied and self-supplied; Total mining water use includes both consumptive use (processing) and non-consumptive use (mine dewatering).

Source Data: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

[1] Nevada Water Use Summary

1985

Water Withdrawals by Principal Category of Use (Acre-Feet per Year)

Rev. 11/23/98

County and County Codes		Total Water Withdrawals All Uses	Total Domestic Water Withdrawals	Total Commercial Water Withdrawals	Total Industrial Water Withdrawals	Total Thermo-Electric Water Withdrawals	Total Mining Water Withdrawals	Livestock Water Withdrawals	Irrigation Water Withdrawals
Carson City..........	CC	13,316	7,110	1,098	952	0	0	67	3,260
Churchill..............	CH	359,501	3,520	370	302	45	269	1,288	353,494
Clark....................	CL	299,429	136,371	49,151	10,865	19,064	1,411	4,985	48,536
Douglas................	DG	242,044	7,610	650	224	0	381	717	231,947
Elko.....................	EL	1,058,581	7,575	1,949	0	0	2,733	8,681	1,035,928
Esmeralda............	ES	40,880	230	22	0	0	4,850	235	35,542
Eureka..................	EU	186,484	305	22	0	0	3,349	605	182,191
Humboldt.............	HU	659,715	2,417	123	224	6,071	1,915	1,367	647,519
Lander..................	LA	164,719	909	123	90	0	4,055	560	158,892
Lincoln.................	LI	73,273	934	78	0	0	202	392	71,566
Lyon.....................	LY	399,490	5,301	325	123	3,248	717	1,378	388,073
Mineral.................	MI	42,348	1,117	291	0	0	605	90	40,123
Nye......................	NY	88,938	2,990	358	370	0	4,940	538	79,597
Pershing...............	PE	197,429	766	235	0	0	280	538	195,420
Storey...................	ST	1,087	202	67	0	594	168	0	0
Washoe................	WA	259,635	51,445	13,487	5,276	0	336	4,055	178,685
White Pine...........	WP	107,243	2,767	280	0	0	1,098	3,562	99,222
NEVADA...........	**NV**	**4,194,112**	**231,570**	**68,627**	**18,426**	**29,022**	**27,309**	**29,058**	**3,749,955**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Water Withdrawals All Uses" includes all withdrawals both public supplied and self-supplied. Also includes public use and losses presented in Table 2 and mining consumptive and non-comsumptive use as broken out in Table 9.

(3) Total Domestic, Commercial, Industrial, and Thermoelectric water withdrawals includes both public supplied and self-supplied water use; Total Mining Water Withdrawals includes both consumtpive use (i.e., processing) and non-consumptive use (i.e., mine dewatering).

(4) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); U.S. Department of Agriculture (USDA), Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

[2] Nevada Public Supplied Water Use 1985

Public Supplied Water Withdrawals by Principal Use (Acre-Feet per Year)

Rev. 11/23/98

County and County Codes		Population Served by Public Supplied Water (Persons)	Total Public Supplied Water	Domestic Public Supplied Water	Commercial Public Supplied Water	Industrial Public Supplied Water	Thermo-Electric Public Supplied Water	Public Use and Losses	Public Supplied Water Use Per Person (Gallons/Day)
Carson City	CC	33,928	9,376	6,799	1,075	672	0	829	246.7
Churchill	CH	8,025	2,532	1,960	325	34	0	213	281.6
Clark	CL	542,467	208,055	132,031	42,397	1,837	2,744	29,045	342.4
Douglas	DG	14,613	6,105	5,018	515	56	0	515	373.0
Elko	EL	19,298	9,857	6,631	1,512	0	0	1,714	456.0
Esmeralda	ES	937	157	146	11	0	0	0	149.4
Eureka	EU	538	157	134	11	0	0	11	260.2
Humboldt	HU	6,019	1,591	1,355	78	78	0	78	235.9
Lander	LA	3,305	986	683	123	90	0	90	266.3
Lincoln	LI	3,312	975	829	45	0	0	101	262.7
Lyon	LY	8,611	3,607	2,912	269	101	0	325	373.9
Mineral	MI	5,657	1,423	1,031	269	0	0	123	224.5
Nye	NY	7,643	2,363	1,647	224	347	0	146	276.0
Pershing	PE	2,768	1,008	594	224	0	0	190	325.1
Storey	ST	1,403	269	157	56	0	0	56	171.1
Washoe	WA	206,167	70,770	47,617	12,960	3,842	0	6,351	306.4
White Pine	WP	6,445	2,912	2,352	246	0	0	314	403.4
NEVADA	**NV**	**871,136**	**322,143**	**211,896**	**60,340**	**7,057**	**2,744**	**40,101**	**330.1**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) Populations are for those state or county residents served by public water systems only.

(3) "Total Public Supplied Water" includes water supplied by public water supply purveyors, including public use and estimates of system losses. Also referred to as "Municipal and Industrial" or "M&I" water use.

(4) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); Nevada Division of Water Planning (NDWP).

[3] Nevada Self-Supplied and Other Water Uses 1985

Self Supplied, Mining, Livestock, Irrigation Water Use (Acre-Feet per Year)

Rev. 11/23/98

County and County Codes		Total Water Withdrawals All Uses	Total Public Supplied Water	Domestic Self Supplied Water	Commercial Self Supplied Water	Industrial Self Supplied Water	Thermo-Electric Self Supplied Water	Mining Water Withdrawals Consumptive Use Only	Livestock and Irrigation Water Withdrawals
Carson City	CC	13,316	9,376	311	22	280	0	0	3,327
Churchill	CH	359,501	2,532	1,560	45	269	45	269	354,782
Clark	CL	299,429	208,055	4,340	6,754	9,028	16,320	1,411	53,521
Douglas	DG	242,044	6,105	2,592	134	168	0	381	232,664
Elko	EL	1,058,581	9,857	944	437	0	0	2,733	1,044,609
Esmeralda	ES	40,880	157	84	11	0	0	4,850	35,778
Eureka	EU	186,484	157	171	11	0	0	3,349	182,796
Humboldt	HU	659,715	1,591	1,062	45	146	6,071	1,915	648,886
Lander	LA	164,719	986	226	0	0	0	4,055	159,452
Lincoln	LI	73,273	975	105	34	0	0	202	71,958
Lyon	LY	399,490	3,607	2,389	56	22	3,248	717	389,451
Mineral	MI	42,348	1,423	86	22	0	0	605	40,213
Nye	NY	88,938	2,363	1,343	134	22	0	4,940	80,135
Pershing	PE	197,429	1,008	172	11	0	0	280	195,958
Storey	ST	1,087	269	45	11	0	594	168	0
Washoe	WA	259,635	70,770	3,828	526	1,434	0	336	182,740
White Pine	WP	107,243	2,912	415	34	0	0	1,098	102,784
NEVADA	**NV**	**4,194,112**	**322,143**	**19,673**	**8,287**	**11,369**	**26,278**	**27,309**	**3,779,013**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.
(2) "Total Public Supplied Water" includes domestic, commercial, industrial, and thermoelectric water supplied by public water supply purveyors.
(3) "Total Self-Supplied Water" is water from private wells or other private water systems serving a limited use and/or a limited number of customers.
(4) Mining water withdrawals excludes non-consumptive uses, i.e., mine dewatering.
(5) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

[4] Nevada Domestic, M&I, and Total Water Use per Capita 1985

Domestic Public and Self Supplied, M&I, Adjusted M&I, Total Use (Gallons/Day) Rev. 11/23/98

County and County Codes		Total Nevada and County Resident Populations (Persons)	Population Served by Public Supplied Water (Persons)	Percent of Population Served by Public Supply Water Systems	Domestic Public Supplied Water Use per Person (Gallons/Day)	Domestic Self Supplied Water Use per Person (Gallons/Day)	Municipal and Industrial (M&I--Public Supplied) Water Use per Person (Gallons/Day)	Public and (Partial) Self Supplied Water Use per Person (Gallons/Day)
Carson City............	CC	35,650	33,928	95.2%	178.9	161.2	246.7	262.8
Churchill................	CH	15,120	8,025	53.1%	218.1	196.3	281.6	490.1
Clark......................	CL	562,280	542,467	96.5%	217.3	195.6	342.4	375.5
Douglas..................	DG	23,000	14,613	63.5%	306.6	275.9	373.0	549.8
Elko........................	EL	22,350	19,298	86.3%	306.8	276.1	456.0	519.9
Esmeralda...............	ES	1,540	937	60.8%	138.7	124.4	149.4	240.1
Eureka....................	EU	1,300	538	41.4%	223.0	200.3	260.2	562.6
Humboldt................	HU	11,260	6,019	53.5%	201.0	180.9	235.9	421.7
Lander....................	LA	4,520	3,305	73.1%	184.6	166.1	266.3	327.3
Lincoln....................	LI	3,780	3,312	87.6%	223.4	200.3	262.7	300.0
Lyon.......................	LY	16,460	8,611	52.3%	301.9	271.7	373.9	629.8
Mineral...................	MI	6,180	5,657	91.5%	162.6	146.8	224.5	241.6
Nye.........................	NY	14,570	7,643	52.5%	192.3	173.1	276.0	451.2
Pershing..................	PE	3,660	2,768	75.6%	191.5	172.1	325.1	384.2
Storey.....................	ST	1,850	1,403	75.8%	99.8	89.9	171.1	206.8
Washoe...................	WA	224,580	206,167	91.8%	206.2	185.6	306.4	331.5
White Pine..............	WP	7,710	6,445	83.6%	325.8	292.9	403.4	465.6
NEVADA...............	**NV**	**955,810**	**871,136**	**91.1%**	**217.2**	**207.4**	**330.1**	**370.4**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Domestic Public Supplied Water Use per Person (Gallons/Day)" equals public supplied water use divided by population served by public supply systems.

(3) "Domestic Self Supplied Water Use per Person (Gallons/Day)" equals self supplied water use divided by persons served by self supplied systems.

(4) "Municipal and Industrial Water Use per Person (Gallons/Day)" is based on public supplied water and population served by public supply water systems.

(5) "Public and (Partial) Self Supplied Water Use per Person (Gallons/Day)" is based on both public supplied water (i.e., M&I water use) and self supplied water for domestic, commercial and industrial use only, divided by the total population. Excludes self supplied thermoelectric water use and all mining water use.

Sources: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada State Demographer.

[5] Nevada Domestic and Commercial & Industrial Water Uses 1985

Domestic, Commercial & Industrial Water Use (Acre-Feet/Year and Gallons/Day)

Rev. 11/23/98

County and County Codes		Total Domestic Water Withdrawals	Domestic Consumptive Water Use	Domestic Consumptive Use as Percent of Withdrawals	Total Domestic Water Use per Person (Gallons/Day)	Total Commercial and Industrial Water Withdrawals	Commercial and Industrial Consumptive Water Use	Commercial Consumptive Use as Percent of Withdrawals	Commercial and Industrial Water Use per Worker (Gallons/Day)
Carson City...........	CC	7,110	3,661	51.5%	178.1	2,050	414	20.2%	105.1
Churchill...............	CH	3,520	1,654	47.0%	207.8	672	145	21.6%	141.3
Clark.....................	CL	136,371	68,678	50.4%	216.5	60,016	11,828	19.7%	218.8
Douglas.................	DG	7,610	3,970	52.2%	295.4	874	191	21.8%	45.4
Elko......................	EL	7,575	3,842	50.7%	302.6	1,949	392	20.1%	165.0
Esmeralda.............	ES	230	115	50.1%	133.1	22	0	0.0%	46.4
Eureka..................	EU	305	164	53.7%	209.7	22	0	0.0%	19.8
Humboldt..............	HU	2,417	1,349	55.8%	191.7	347	55	16.0%	76.6
Lander..................	LA	909	467	51.4%	179.6	213	22	10.5%	112.4
Lincoln.................	LI	934	475	50.9%	220.6	78	22	28.6%	41.3
Lyon.....................	LY	5,301	2,814	53.1%	287.5	448	112	25.0%	114.3
Mineral.................	MI	1,117	565	50.6%	161.3	291	56	19.2%	111.3
Nye.......................	NY	2,990	1,579	52.8%	183.2	728	202	27.7%	66.4
Pershing................	PE	766	400	52.2%	186.8	235	45	19.0%	196.4
Storey....................	ST	202	113	56.0%	97.4	67	11	16.7%	103.4
Washoe..................	WA	51,445	25,967	50.5%	204.5	18,763	3,764	20.1%	140.3
White Pine............	WP	2,767	1,408	50.9%	320.4	280	56	20.0%	92.2
NEVADA.............	**NV**	**231,569**	**117,221**	**50.6%**	**216.3**	**87,053**	**17,315**	**19.9%**	**175.2**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Domestic Water Withdrawals" and "Total Commercial Water Withdrawals" include both public supplied and self supplied water.

(3) "Total Domestic Water Use per Person (Gallons/Day)" equals "Total Domestic Water Withdrawals" divided by resident population; measured in gallons per day.

(4) "Commercial and Industrial Water Use per Worker (Gallons/Day)" equals "Total Commercial and Industiral Water Withdrawals" divided by covered employment; measured in gallons per worker per day.

(5) One acre-foot is equivalent to 325,851 gallons.

Source: U.S. Geological Survey (USGS).

[6] Nevada Livestock and Irrigation Water Uses 1985

Livestock and Irrigation Water Use Analysis (Acre-Feet per Year)

Rev. 11/23/98

County and County Codes		Livestock Water Withdrawals	Livestock Consumptive Water Use	Livestock Consumptive Use as Percent of Withdrawals	Total Irrigation Water Withdrawals	Irrigation Consumptive Use	Irrigation Consumptive Use as Percent of Irrigation Withdrawals	Total Livestock and Irrigation Water Withdrawals	Total Livestock and Irrigation Water Use as Percent of Total Withdrawals
Carson City..........	CC	67	34	50.0%	3,260	1,501	46.0%	3,327	25.0%
Churchill..............	CH	1,288	706	54.8%	353,494	163,182	46.2%	354,782	98.7%
Clark....................	CL	4,985	683	13.7%	48,536	34,635	71.4%	53,521	17.9%
Douglas................	DG	717	213	29.7%	231,947	105,909	45.7%	232,664	96.1%
Elko......................	EL	8,681	2,173	25.0%	1,035,928	529,692	51.1%	1,044,609	98.7%
Esmeralda............	ES	235	213	90.5%	35,542	22,302	62.7%	35,778	87.5%
Eureka..................	EU	605	336	55.6%	182,191	106,268	58.3%	182,796	98.0%
Humboldt.............	HU	1,367	638	46.7%	647,519	338,618	52.3%	648,886	98.4%
Lander..................	LA	560	280	50.0%	158,892	84,201	53.0%	159,452	96.8%
Lincoln.................	LI	392	235	60.0%	71,566	46,811	65.4%	71,958	98.2%
Lyon.....................	LY	1,378	403	29.3%	388,073	176,881	45.6%	389,451	97.5%
Mineral.................	MI	90	90	100.0%	40,123	18,550	46.2%	40,213	95.0%
Nye.......................	NY	538	314	58.3%	79,597	51,090	64.2%	80,135	90.1%
Pershing...............	PE	538	224	41.7%	195,420	103,983	53.2%	195,958	99.3%
Storey....................	ST	0	0	--	0	0	--	0	0.0%
Washoe.................	WA	4,055	437	10.8%	178,685	88,435	49.5%	182,740	70.4%
White Pine............	WP	3,562	426	11.9%	99,222	61,989	62.5%	102,784	95.8%
NEVADA............	**NV**	**29,058**	**7,405**	**25.5%**	**3,749,955**	**1,934,047**	**51.6%**	**3,779,013**	**90.1%**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

[7] Nevada Irrigation Water Use Analysis 1985

Irrigation Water Withdrawals, Consumptive Use, Conveyance Losses, and Water Duty

(Acre-Feet per Year and Acre-Feet per Acre per Year)

Rev. 11/23/98

County and County Codes		Total Irrigation Water Withdrawals	Irrigation Consumptive Use	Irrigation Consumptive Use as Percent of Irrigation Withdrawals	Irrigation Conveyance Losses	Conveyance Losses as Percent of Irrigation Withdrawals	Total Irrigated Acreage (Acres)	Irrigation Water Withdrawal Rate (Acre-Feet per Acre per Year)	Irrigation Conveyance Losses (Acre-Feet per Acre per Year)
Carson City..........	CC	3,260	1,501	46.0%	963	29.6%	740	4.4	1.3
Churchill..............	CH	353,494	163,182	46.2%	103,355	29.2%	64,080	5.5	1.6
Clark....................	CL	48,536	34,635	71.4%	2,711	5.6%	9,340	5.2	0.3
Douglas................	DG	231,947	105,909	45.7%	69,303	29.9%	47,620	4.9	1.5
Elko......................	EL	1,035,928	529,692	51.1%	224,039	21.6%	243,960	4.2	0.9
Esmeralda............	ES	35,542	22,302	62.7%	3,685	10.4%	8,340	4.3	0.4
Eureka..................	EU	182,191	106,268	58.3%	25,987	14.3%	48,040	3.8	0.5
Humboldt.............	HU	647,519	338,618	52.3%	126,968	19.6%	153,890	4.2	0.8
Lander..................	LA	158,892	84,201	53.0%	30,165	19.0%	35,640	4.5	0.8
Lincoln.................	LI	71,566	46,811	65.4%	4,738	6.6%	17,090	4.2	0.3
Lyon.....................	LY	388,073	176,881	45.6%	116,091	29.9%	76,920	5.0	1.5
Mineral.................	MI	40,123	18,550	46.2%	11,750	29.3%	7,440	5.4	1.6
Nye.......................	NY	79,597	51,090	64.2%	7,975	10.0%	19,350	4.1	0.4
Pershing...............	PE	195,420	103,983	53.2%	36,718	18.8%	42,220	4.6	0.9
Storey..................	ST	0	0	--	0	--	0	--	--
Washoe.................	WA	178,685	88,435	49.5%	45,410	25.4%	39,770	4.5	1.1
White Pine............	WP	99,222	61,989	62.5%	10,585	10.7%	29,320	3.4	0.4
NEVADA............	**NV**	**3,749,955**	**1,934,047**	**51.6%**	**820,443**	**21.9%**	**843,760**	**4.4**	**1.0**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Irrigation Water Withdrawal Rate (Acre-Feet per Acre per Year)" calculated by dividing "Total Irrigation Water Withdrawals" by "Total Irrigated Acreage."

(3) "Irrigation Conveyance Losses (Acre-Feet per Acre per Year)" is calculated by dividing "Irrigation Conveyance Losses" by "Total Irrigated Acreage."

(4) One acre-foot is equivalent to 325,851 gallons.

Sources: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

[8] Nevada Irrigation and Farm Marketings Analysis 1985

Irrigated Acreage, Irrigation Water Withdrawals, and Value of Farm Marketings

(Acres, Acre-Feet per Year, Acre-Feet per Acre per Year, and Dollars)

Rev. 11/23/98

County and County Codes		Estimated Total Irrigated Acreage (Acres)	Percent of Total State	Irrigation and Livestock Water Withdrawals (AF/Year)	Percent of Total State	Livestock and Irrigation Water Use (Acre-Feet per Acre per Year)	Value of Total Farm Marketings ($000s)	Value of Farm Marketings per Acre-Foot (Dollars)	Value of Farm Marketings per Irrigated Acre (Dollars)
Carson City..........	CC	740	0.09%	3,327	0.09%	4.5	$739	$222	$999
Churchill..............	CH	64,080	7.59%	354,782	9.39%	5.5	33,971	96	530
Clark....................	CL	9,340	1.11%	53,521	1.42%	5.7	15,333	286	1,642
Douglas................	DG	47,620	5.64%	232,664	6.16%	4.9	9,012	39	189
Elko......................	EL	243,960	28.91%	1,044,609	27.64%	4.3	33,379	32	137
Esmeralda............	ES	8,340	0.99%	35,778	0.95%	4.3	4,620	129	554
Eureka..................	EU	48,040	5.69%	182,796	4.84%	3.8	11,370	62	237
Humboldt.............	HU	153,890	18.24%	648,886	17.17%	4.2	35,161	54	228
Lander..................	LA	35,640	4.22%	159,452	4.22%	4.5	5,756	36	162
Lincoln.................	LI	17,090	2.03%	71,958	1.90%	4.2	4,112	57	241
Lyon.....................	LY	76,920	9.12%	389,451	10.31%	5.1	40,796	105	530
Mineral.................	MI	7,440	0.88%	40,213	1.06%	5.4	955	24	128
Nye.......................	NY	19,350	2.29%	80,135	2.12%	4.1	5,464	68	282
Pershing...............	PE	42,220	5.00%	195,958	5.19%	4.6	22,084	113	523
Storey...................	ST	0	0.00%	0	0.00%	0	0	0	0
Washoe.................	WA	39,770	4.71%	182,740	4.84%	4.6	9,849	54	248
White Pine............	WP	29,320	3.47%	102,784	2.72%	3.5	8,358	81	285
NEVADA............	**NV**	**843,760**	**100.00%**	**3,779,013**	**100.00%**	**4.5**	**$240,959**	**$64**	**$286**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Livestock and Irrigation Water Use (Acre-Feet per Acre per Year)" calculated by dividing the "Irrigation and Livestock Water Withdrawals" by the "Estimated irrigated Acreage."

(3) "Value of Farm Marketings per Acre-Foot and per Irrigated Acre (Dollars)" calculated by dividing the "Value of Total Farm Marketings" by either "Irrigation and Livestock Water Withdrawals" or by "Estimated Total Irrigated Acreage."

Sources: USGS; USDA Nevada Agricultural Statistics Service; U.S. Department of Commerce, Bureau of Economic Analysis (BEA); Nevada Division of Water Planning (NDWP).

[9] Commercial, Industrial, Thermoelectric and Mining Water Uses 1985

Commercial, Industrial, Thermoelectric, and Mining Water Use Analysis
(Acre-Feet per Year and Gallons per Worker per Day)

Rev. 11/23/98

County and County Codes		Total Nevada and County Covered Employment	Total Commercial and Industrial Water Withdrawals	Total Thermo-Electric Water Withdrawals	Mining Water Withdrawals for Consumptive Use Only	Mining Water Withdrawals Non Consumptive Use	Commercial and Industrial Public Supplied Water Use per Worker (Gallons/Day)	Total Commercial and Industrial Water Use per Worker (Gallons/Day)	Commercial and Industrial Water Use per Worker-excl. Mining Emp. (Gallons/Day)
Carson City..........	CC	17,408	2,050	0	0	0	89.6	105.1	105.4
Churchill..............	CH	4,246	672	45	269	0	75.4	141.3	142.8
Clark.....................	CL	244,869	60,016	19,064	1,411	0	161.3	218.8	219.0
Douglas................	DG	17,185	874	0	381	0	29.7	45.4	45.6
Elko......................	EL	10,546	1,949	0	2,733	0	128.0	165.0	178.1
Esmeralda............	ES	431	22	0	4,850	0	23.2	46.4	101.5
Eureka..................	EU	1,010	22	0	3,349	0	9.9	19.8	53.5
Humboldt.............	HU	4,046	347	6,071	1,915	0	34.6	76.6	84.9
Lander..................	LA	1,691	213	0	4,055	0	112.4	112.4	224.6
Lincoln.................	LI	1,693	78	0	202	0	23.6	41.3	42.5
Lyon.....................	LY	3,499	448	3,248	717	0	94.3	114.3	118.8
Mineral.................	MI	2,335	291	0	605	0	102.8	111.3	126.8
Nye.......................	NY	9,783	728	0	4,940	0	52.1	66.4	73.0
Pershing................	PE	1,069	235	0	280	0	187.1	196.4	240.3
Storey...................	ST	580	67	594	168	0	86.2	103.4	132.2
Washoe.................	WA	119,421	18,763	0	336	0	125.6	140.3	141.1
White Pine...........	WP	2,712	280	0	1,098	0	81.1	92.2	108.7
NEVADA............	**NV**	**443,527**	**87,053**	**29,022**	**27,309**	**0**	**135.7**	**175.2**	**177.7**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Nevada and County Covered Employment" includes workers covered under state and federal unemployment insurance programs.

(3) Commercial, Industrial, Thermoelectric, and Mining water withdrawals include both public supplied and self-supplied water. Mining excludes dewatering.

(4) "Per Worker" usage rates are calculated by dividing the appropriate water use (commercial public supplied only, total commercial, i.e., both public and self-supplied wate use or total commercial and total industrial water use only) by the number of total covered employees.

Sources: U.S. Geological Survey (USGS); Nevada Department of Employment, Training and Rehabilitation (DETR).

[10] Nevada Water Usage Rate Analysis 1985

Population and Employment Water Usage Rate Summary and Analysis

(Acre-Feet per Year, Except per Capita and per Worker Usage Rates)

Rev. 11/23/98

County and County Codes		Total Nevada and County Resident Populations (Persons)	Total Water Withdrawals Excluding Mine Dewatering	Percent of Total Water Withdrawals	Total Domestic Water Withdrawals per Person (Gallons/Day)	Domestic Public Supplied Water Use per Person (Gallons/Day)	Municipal and Industrial (M&I-- Public Supplied) Water Use per Person (Gallons/Day)	Commercial and Industrial Water Use per Worker-excl. Mining Emp. (Gallons/Day)	Mining Water Withdrawals per Mining Worker (Gallons/Day)
Carson City.............	CC	35,650	13,316	0.32%	178.1	178.9	246.7	105.4	0
Churchill.................	CH	15,120	359,501	8.57%	207.8	218.1	281.6	142.8	5,581
Clark.......................	CL	562,280	299,429	7.14%	216.5	217.3	342.4	219.0	5,101
Douglas..................	DG	23,000	242,044	5.77%	295.4	306.6	373.0	45.6	4,857
Elko........................	EL	22,350	1,058,581	25.24%	302.6	306.8	456.0	178.1	3,152
Esmeralda...............	ES	1,540	40,880	0.97%	133.1	138.7	149.4	101.5	18,504
Eureka....................	EU	1,300	186,484	4.45%	209.7	223.0	260.2	53.5	4,701
Humboldt................	HU	11,260	659,715	15.73%	191.7	201.0	235.9	84.9	4,351
Lander....................	LA	4,520	164,719	3.93%	179.6	184.6	266.3	224.6	4,284
Lincoln...................	LI	3,780	73,273	1.75%	220.6	223.4	262.7	42.5	3,830
Lyon.......................	LY	16,460	399,490	9.53%	287.5	301.9	373.9	118.8	4,886
Mineral...................	MI	6,180	42,348	1.01%	161.3	162.6	224.5	126.8	1,901
Nye.........................	NY	14,570	88,938	2.12%	183.2	192.3	276.0	73.0	4,989
Pershing..................	PE	3,660	197,429	4.71%	186.8	191.5	325.1	240.3	1,282
Storey.....................	ST	1,850	1,087	0.03%	97.4	99.8	171.1	132.2	1,190
Washoe...................	WA	224,580	259,635	6.19%	204.5	206.2	306.4	141.1	427
White Pine..............	WP	7,710	107,243	2.56%	320.4	325.8	403.4	108.7	2,379
NEVADA...............	**NV**	**955,810**	**4,194,112**	**100.00%**	**216.3**	**217.2**	**330.1**	**177.7**	**4,009**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.
(2) "Total Water Withdrawals" excludes mine dewatering, i.e., mining non-consumptive water use.
(3) "Total Domestic Withdrawals per Person (Gallons/Day)" includes public supplied water and self-supplied water divided by the resident population.
(4) "Municipal and Industrial Water Use per Person (Gallons/Day)" includes public supplied domestic, commercial, industrial and thermoelectric withdrawals.
(5) "Mining Water Withdrawals per Mining Worker" based on consumptive use only and does not include mine dewatering (i.e., non-consumptive use).
(6) "Commercial and Industrial Water Use per Worker" equals commercial and industrial (public and self supplied) withdrawals divided by total covered employment.
Sources: USGS; USDA Nevada Agricultural Statistics Service; Nevada State Demographer; Department of Employment, Training and Rehabilitation (DETR).

[11] Nevada Household Water Usage Rate Analysis 1985

Water Withdrawals for Population and Occupied Housing Units

(Acre-Feet per Year, Except per Household and per Capita Usage Rates) Rev. 11/23/98

County and County Codes		Total Nevada and County Resident Populations (Persons)	Total Nevada and County Covered Employment	Households (Occupied Housing Units)	Average Number of Persons per Occupied Housing Unit	Average Number of Workers per Occupied Housing Unit	Total Domestic Water Withdrawals	Total Domestic Water Use per Household (Gallons/Day)	Total Domestic Water Withdrawals per Person (Gallons/Day)
Carson City.........	CC	35,650	17,408	13,838	2.6	1.3	7,110	458.7	178.1
Churchill............	CH	15,120	4,246	5,569	2.7	0.8	3,520	564.4	207.8
Clark..................	CL	562,280	244,869	209,519	2.7	1.2	136,371	581.1	216.5
Douglas..............	DG	23,000	17,185	8,662	2.7	2.0	7,610	784.4	295.4
Elko....................	EL	22,350	10,546	7,794	2.9	1.4	7,575	867.6	302.6
Esmeralda...........	ES	1,540	431	671	2.3	0.6	230	305.6	133.1
Eureka................	EU	1,300	1,010	517	2.5	2.0	305	526.9	209.7
Humboldt...........	HU	11,260	4,046	3,925	2.9	1.0	2,417	549.9	191.7
Lander................	LA	4,520	1,691	1,577	2.9	1.1	909	514.7	179.6
Lincoln...............	LI	3,780	1,693	1,315	2.9	1.3	934	634.2	220.6
Lyon..................	LY	16,460	3,499	6,140	2.7	0.6	5,301	770.9	287.5
Mineral...............	MI	6,180	2,335	2,416	2.6	1.0	1,117	412.6	161.3
Nye....................	NY	14,570	9,783	5,338	2.7	1.8	2,990	500.0	183.2
Pershing.............	PE	3,660	1,069	1,298	2.8	0.8	766	526.5	186.8
Storey.................	ST	1,850	580	727	2.5	0.8	202	247.8	97.4
Washoe..............	WA	224,580	119,421	89,348	2.5	1.3	51,445	514.0	204.5
White Pine..........	WP	7,710	2,712	2,701	2.9	1.0	2,767	914.8	320.4
NEVADA..........	**NV**	**955,810**	**443,527**	**360,554**	**2.7**	**1.2**	**231,569**	**573.4**	**216.3**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) "Total Nevada and County Covered Employment" includes workers covered under state and federal unemployment insurance programs.

(3) Households equivalent to occupied housing units; not the same as total housing units.

(4) "Total Domestic Water Withdrawals" includes both public supplied and self supplied water for residential (household) uses.

Sources: U.S. Geological Survey (USGS); Nevada State Demographer; U.S. Bureau of the Census; Nevada Department of Employment.

[12] Nevada Water Use by Category Share Analysis 1985

Shares of Total Water Withdrawals by Principal Use Category (Percent)

Rev. 11/23/98

County and County Codes		Total Domestic Water Withdrawals	Total Commercial Water Withdrawals	Total Industrial Water Withdrawals	Total Thermo-Electric Water Withdrawals	Total Mining Water Withdrawals	Livestock Water Withdrawals	Irrigation Water Withdrawals	Public Use and Losses
Carson City............	CC	53.40%	8.24%	7.15%	0.00%	0.00%	0.50%	24.48%	6.22%
Churchill................	CH	0.98%	0.10%	0.08%	0.01%	0.07%	0.36%	98.33%	0.06%
Clark......................	CL	45.54%	16.41%	3.63%	6.37%	0.47%	1.66%	16.21%	9.70%
Douglas..................	DG	3.14%	0.27%	0.09%	0.00%	0.16%	0.30%	95.83%	0.21%
Elko........................	EL	0.72%	0.18%	0.00%	0.00%	0.26%	0.82%	97.86%	0.16%
Esmeralda...............	ES	0.56%	0.05%	0.00%	0.00%	11.86%	0.58%	86.94%	0.00%
Eureka....................	EU	0.16%	0.01%	0.00%	0.00%	1.80%	0.32%	97.70%	0.01%
Humboldt................	HU	0.37%	0.02%	0.03%	0.92%	0.29%	0.21%	98.15%	0.01%
Lander....................	LA	0.55%	0.07%	0.05%	0.00%	2.46%	0.34%	96.46%	0.05%
Lincoln...................	LI	1.27%	0.11%	0.00%	0.00%	0.28%	0.54%	97.67%	0.14%
Lyon.......................	LY	1.33%	0.08%	0.03%	0.81%	0.18%	0.34%	97.14%	0.08%
Mineral...................	MI	2.64%	0.69%	0.00%	0.00%	1.43%	0.21%	94.74%	0.29%
Nye.........................	NY	3.36%	0.40%	0.42%	0.00%	5.55%	0.60%	89.50%	0.16%
Pershing.................	PE	0.39%	0.12%	0.00%	0.00%	0.14%	0.27%	98.98%	0.10%
Storey.....................	ST	18.57%	6.18%	0.00%	54.63%	15.46%	0.00%	0.00%	5.15%
Washoe...................	WA	19.81%	5.19%	2.03%	0.00%	0.13%	1.56%	68.82%	2.45%
White Pine..............	WP	2.58%	0.26%	0.00%	0.00%	1.02%	3.32%	92.52%	0.29%
NEVADA...............	**NV**	**5.52%**	**1.64%**	**0.44%**	**0.69%**	**0.65%**	**0.69%**	**89.41%**	**0.96%**

Table Notes:

(1) "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

(2) Shares by use category are measured as percent of "Total Water Withdrawals All Uses," presented on Table 1, which includes all water withdrawals both public supplied and self supplied. Total withdrawals also includes "Public Use and Losses" presented on Table 2 and all mining withdrawals in Table 9.

(3) Total domestic, commercial, industrial, and thermoelectric water withdrawals include both public supplied and self-supplied; Total mining water use includes both consumptive use (processing) and non-consumptive use (mine dewatering).

Source Data: U.S. Geological Survey (USGS); USDA Nevada Agricultural Statistics Service; Nevada Division of Water Planning (NDWP).

Appendix 1B

WATER WITHDRAWAL DATA TABLES

Table 1 – Public Supply Water Use

Table 2 – Commercial Water Use

Table 3 – Domestic Water Use

Table 4 – Industrial Water Use

Table 5 – Thermoelectric Power Water Use

Table 6 – Mining Water Use

Table 7 – Livestock Water Use

Table 8 – Irrigation Water Use

Table 9 – Hydroelectric Power Water Use

Table 10 – Water Use by Category–1

Table 11 – Water Use by Category–2

Table 12 – Water Use by Source

Public Supply Water Use - NDWP

1995

COUNTY	POPULATION SERVED, IN THOUSANDS	WITHDRAWALS, AFY			DELIVERIES, AFY					PUBLIC USE AND LOSSES, AFY	DOMESTIC DELIVERIES PER CAPITA USE, GPCD	TOTAL WITHDRAWALS PER CAPITA USE, GPCD	CONSUMP-TIVE USE Use, AFY
		GROUND WATER	SURFACE WATER	TOTAL	DOMESTIC	COMMERCIAL	INDUSTRIAL	THERMO ELECTRIC	TOTAL				
Carson City	42.18	6,172	3,170	9,342	6,463	1,210	829	0	8,502	840	137	198	3,528
Churchill	12.92	3,573	0	3,573	2,151	336	34	0	2,520	1,053	149	247	1,165
Clark	1,014.87	51,157	328,764	379,921	242,109	102,684	1,221	1,624	347,638	32,283	213	334	141,652
Douglas	32.32	10,406	672	11,078	9,566	1,165	0	0	10,731	347	264	306	4,895
Elko	40.15	14,920	0	14,920	10,888	2,677	0	0	13,565	1,355	242	332	5,623
Esmeralda	1.13	302	0	302	213	45	0	0	258	45	168	238	123
Eureka	1.18	426	0	426	325	67	0	0	392	34	247	323	168
Humboldt	10.75	4,201	0	4,201	3,047	773	0	0	3,820	381	253	349	1,669
Lander	5.18	1,423	0	1,423	1,109	146	0	0	1,255	168	191	245	594
Lincoln	3.21	1,550	0	1,550	1,082	330	0	0	1,412	138	301	431	624
Lyon	24.35	5,746	0	5,746	3,853	1,165	56	0	5,074	672	141	211	2,005
Mineral	5.29	1,255	0	1,255	930	280	0	0	1,210	45	157	212	526
Nye	15.73	6,127	0	6,127	4,077	672	0	0	4,749	1,378	231	348	2,229
Pershing	4.54	1,736	0	1,736	1,199	403	0	0	1,602	134	236	341	661
Storey	2.03	34	291	325	224	67	0	0	291	34	99	143	123
Washoe	262.81	19,726	59,659	79,385	52,322	17,441	314	0	70,076	9,308	178	270	29,280
White Pine	8.99	3,204	347	3,551	3,047	246	0	0	3,293	258	302	352	1,579
TOTAL	1,487.64	131,958	392,903	524,861	342,605	129,707	2,454	1,624	476,388	48,473	206	315	196,444

Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning

Commercial Water Use - NDWP

COUNTY	SELF-SUPPLIED WITHDRAWALS, AFY			SELF-SUPPLIED CONSUMP-TIVE USE, AFY	PUBLIC SUPPLY COMMERCIAL DELIVERIES, AFY	PUBLIC SUPPLY COMMERCIAL CONSUMP-TIVE USE, AFY	SELF-SUPPLIED + PUBLIC SUPPLY COMMERCIAL	
	BY SOURCE		TOTAL				WITHDRAWALS + DELIVERIES, AFY	CONSUMPTIVE USE, AFY
	GROUND WATER	SURFACE WATER						
1995								
Carson City	11	0	11	0	1,210	224	1,221	224
Churchill	784	0	784	157	336	67	1,120	224
Clark	919	8,390	9,308	1,703	102,684	18,818	111,992	20,521
Douglas	1,826	0	1,826	168	1,165	112	2,991	280
Elko	224	5,041	5,265	370	2,677	190	7,942	560
Esmeralda	0	0	0	0	45	11	45	11
Eureka	0	0	0	0	67	11	67	11
Humboldt	78	0	78	11	773	146	851	157
Lander	0	0	0	0	146	34	146	34
Lincoln	34	0	34	11	330	83	364	94
Lyon	2,800	0	2,800	157	1,165	67	3,965	224
Mineral	0	0	0	0	280	56	280	56
Nye	112	0	112	56	672	302	784	358
Pershing	11	0	11	0	403	56	414	56
Storey	0	0	0	0	67	11	67	11
Washoe	1,120	2,128	3,248	560	17,441	3,024	20,689	3,584
White Pine	0	0	0	0	246	56	246	56
TOTAL	7,919	15,559	23,477	3,193	129,707	23,268	153,184	26,461

Domestic Water Use - NDWP

COUNTY	SELF-SUPPLIED DOMESTIC						PUBLIC SUPPLY DOMESTIC				SELF-SUPPLIED + PUBLIC SUPPLY DOMESTIC		
	POPULATION SERVED, IN THOUSANDS	WITHDRAWALS, AFY			PER CAPITA USE, GPCD	CONSUMP-TIVE USE, AFY	POPULATION SERVED, IN THOUSANDS	DELIVERIES, AFY	PER CAPITA USE, GPCD	CONSUMP-TIVE USE, AFY	WITHDRAWALS + DELIVERIES, AFY	CONSUMPTIVE USE, AFY	PER CAPITA TOTAL, GPCD
		GROUND WATER	SURFACE WATER	TOTAL									
1995													
Carson City	4.59	633	0	633	123	316	42.18	6,463	137	3,237	7,096	3,553	135
Churchill	8.72	1,294	12	1,306	134	652	12.92	2,151	149	1,087	3,457	1,739	143
Clark	21.42	4,580	18	4,600	192	2,300	1,014.87	242,109	213	120,852	246,709	123,152	213
Douglas	3.56	902	45	947	238	485	32.32	9,566	264	4,783	10,513	5,268	262
Elko	2.90	687	20	707	218	353	40.15	10,888	242	5,433	11,595	5,786	240
Esmeralda	0.50	84	0	84	151	41	1.13	213	168	112	297	153	163
Eureka	0.40	100	0	100	222	49	1.18	325	247	157	425	206	240
Humboldt	5.52	1,386	21	1,407	228	692	10.75	3,047	253	1,523	4,454	2,215	244
Lander	1.26	244	0	244	172	131	5.18	1,109	191	560	1,353	691	188
Lincoln	0.90	258	15	273	271	130	3.21	1,082	301	541	1,355	671	294
Lyon	2.23	306	12	318	127	160	24.35	3,853	141	1,927	4,171	2,087	140
Mineral	1.41	209	14	223	141	112	5.29	930	157	470	1,153	582	154
Nye	7.32	1,635	73	1,708	208	818	15.73	4,077	231	1,927	5,785	2,745	224
Pershing	0.60	123	20	143	212	83	4.54	1,199	236	605	1,342	688	233
Storey	1.17	116	0	116	88	58	2.03	224	99	112	340	170	95
Washoe	28.24	5,016	45	5,060	160	2,537	262.81	52,322	178	26,166	57,382	28,703	176
White Pine	0.78	210	26	236	272	105	8.99	3,047	302	1,523	3,283	1,628	300
Total	91.51	17,783	321	18,105	177	9,022	1,487.64	342,605	206	171,015	360,710	180,037	204

Industrial Water Use - NDWP

COUNTY	SELF-SUPPLIED INDUSTRIAL				PUBLIC SUPPLY INDUSTRIAL		SELF-SUPPLIED + PUBLIC SUPPLY INDUSTRIAL	
	WITHDRAWALS, AFY			CONSUMPTIVE USE, AFY	DELIVERIES, AFY	CONSUMPTIVE USE, AFY	WITHDRAWALS + DELIVERIES, AFY	CONSUMPTIVE USE, AFY
	GROUNDWATER	SURFACE WATER	TOTAL					
1995								
Carson City	224	0	224	22	829	67	1,053	89
Churchill	269	0	269	90	34	11	303	101
Clark	1,680	6,172	7,852	2,319	1,221	358	9,073	2,677
Douglas	302	0	302	90	0	0	302	90
Elko	0	0	0	0	0	0	0	0
Esmeralda	0	0	0	0	0	0	0	0
Eureka	0	0	0	0	0	0	0	0
Humboldt	560	0	560	168	0	0	560	168
Lander	0	0	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0	0	0
Lyon	4,873	0	4,873	1,445	56	11	4,929	1,456
Mineral	0	0	0	0	0	0	0	0
Nye	0	0	0	0	0	0	0	0
Pershing	0	0	0	0	0	0	0	0
Storey	0	0	0	0	0	0	0	0
Washoe	414	2,274	2,688	818	314	90	3,002	908
White Pine	0	0	0	0	0	0	0	0
Total	8,322	8,446	16,768	4,952	2,454	537	19,222	5,489

Thermoelectric Power Water Use - NDWP

COUNTY	SELF-SUPPLIED THERMOELECTRIC					PUBLIC SUPPLY THERMOELECTRIC			SELF-SUPPLIED + PUBLIC SUPPLY THERMOELECTRIC		
	WITHDRAWALS, AFY			CONSUMP-TIVE USE, AFY	POWER GENERATED, MILLION KWH	DELIVERIES, AFY	CONSUMP-TIVE USE, AFY	POWER GENERATED, MILLION KWH	WITHDRAWALS + DELIVERIES, AFY	CONSUMPTIVE USE, AFY	POWER GENERATED, MILLION KWH
	GROUNDWATER	SURFACE WATER	TOTAL								
1995											
Carson City	0	0	0	0	0.00	0	0	0	0	0	0.00
Churchill	22,963	0	22,963	8,233	614.79	0	0	0	22,963	8,233	614.79
Clark	4,145	19,569	23,713	23,713	12,987.36	1,624	1,624	890	25,337	25,337	13,876.90
Douglas	0	0	0	0	0.00	0	0	0	0	0	0.00
Elko	0	0	0	0	0.00	0	0	0	0	0	0.00
Esmeralda	0	0	0	0	0.00	0	0	0	0	0	0.00
Eureka	4,637	0	4,637	997	115.05	0	0	0	4,637	997	115.05
Humboldt	1,131	2,095	3,226	3,226	1,868.06	0	0	0	3,226	3,226	1,868.06
Lander	0	0	0	0	0.00	0	0	0	0	0	0.00
Lincoln	0	0	0	0	0.00	0	0	0	0	0	0.00
Lyon	1,400	0	1,400	1,400	1,314.49	0	0	0	1,400	1,400	1,314.49
Mineral	0	0	0	0	0.00	0	0	0	0	0	0.00
Nye	0	0	0	0	0.00	0	0	0	0	0	0.00
Pershing	0	0	0	0	0.00	0	0	0	0	0	0.00
Storey	314	1,512	1,826	1,826	1,016.70	0	0	0	1,826	1,826	1,016.70
Washoe	6,060	0	6,060	34	121.72	0	0	0	6,060	34	121.72
White Pine	0	0	0	0	0.00	0	0	0	0	0	0.00
Total	40,650	23,176	63,825	39,429	18,038.17	1,624	1,624	890	65,449	41,053	18,927.71

Mining Water Use - NDWP

COUNTY	CONSUMPTIVE USE WITHDRAWALS, AFY				NONCONSUMPTIVE USE WITHDRAWALS, AFY	TOTAL GW WITHDRAWALS, AFY	TOTAL WITHDRAWALS, AFY
	GROUNDWATER WITHDRAWALS, AFY	SURFACE WATER WITHDRAWALS, AFY	TOTAL WITHDRAWALS, AFY	CONSUMPTIVE USE, AFY			
1995							
Carson City	0	0	0	0	0	0	0
Churchill	179	0	179	179	0	179	179
Clark	1,143	1,243	2,386	2,375	0	1,143	2,386
Douglas	0	0	0	0	0	0	0
Elko	5,175	179	5,354	5,354	0	5,175	5,354
Esmeralda	12,613	0	12,613	12,613	0	12,613	12,613
Eureka	19,210	11	19,222	19,222	95,021	114,231	114,243
Humboldt	15,077	0	15,077	15,077	61,563	76,640	76,640
Lander	7,460	90	7,550	7,550	28,048	35,508	35,598
Lincoln	0	0	0	0	0	0	0
Lyon	314	2,251	2,565	2,565	0	314	2,565
Mineral	2,520	0	2,520	2,520	0	2,520	2,520
Nye	7,057	0	7,057	7,057	638	7,695	7,695
Pershing	2,106	0	2,106	2,106	0	2,106	2,106
Storey	224	34	258	258	0	224	258
Washoe	717	0	717	717	0	717	717
White Pine	11,459	101	11,560	11,560	0	11,459	11,560
TOTAL	85,254	3,909	89,164	89,153	185,270	270,524	274,434

Livestock Water Use - NDWP

COUNTY	WITHDRAWALS, AFY			CONSUMPTIVE USE, AFY
	GROUNDWATER	SURFACE WATER	TOTAL	
1995				
Carson City	0	11	11	0
Churchill	168	504	672	258
Clark	112	168	280	202
Douglas	22	236	258	134
Elko	302	1,401	1,703	672
Esmeralda	67	56	123	67
Eureka	22	135	157	67
Humboldt	101	526	627	224
Lander	67	269	336	123
Lincoln	22	101	123	34
Lyon	34	414	448	146
Mineral	34	0	34	34
Nye	45	694	739	67
Pershing	22	236	258	78
Storey	0	0	0	0
Washoe	67	224	291	123
White Pine	34	235	269	90
TOTAL	1,119	5,210	6,329	2,319

Irrigation Water Use - NDWP

COUNTY	WITHDRAWALS, AFY			CONSUMPTIVE USE, AFY	CONVEYANCE LOSS, AFY	IRRIGATED LAND, 1000 ACRES			RECLAIMED WASTEWATER, AFY
	GROUNDWATER	SURFACE WATER	TOTAL			SPRINKLER	SURFACE	TOTAL	
1995									
Carson City	0	10,710	10,710	4,932	3,165	0.24	2.19	2.43	4,817
Churchill	25,636	230,917	256,553	117,890	74,602	9.43	46.66	56.09	11
Clark	31,408	8,884	40,292	28,771	2,218	5.68	2.07	7.75	8,558
Douglas	20,891	168,653	189,544	85,565	56,246	0.32	38.32	38.64	5,903
Elko	102,906	805,739	908,645	464,897	196,391	24.43	189.47	213.90	5,130
Esmeralda	42,098	7,589	49,687	31,204	5,121	5.09	6.20	11.29	0
Eureka	101,257	23,602	124,859	72,903	17,743	26.15	6.28	32.78	0
Humboldt	462,769	137,076	599,845	313,687	117,620	65.10	77.46	142.56	0
Lander	106,739	54,643	161,382	85,694	30,600	9.75	26.44	36.19	0
Lincoln	42,024	23,513	65,537	42,980	4,320	2.49	13.14	15.63	0
Lyon	45,489	261,437	306,926	141,005	91,713	3.58	57.39	60.98	0
Mineral	3,920	11,762	15,682	7,253	4,565	0.39	2.51	2.90	0
Nye	48,013	12,220	60,233	39,383	6,064	5.96	8.78	14.74	0
Pershing	36,909	80,053	116,962	62,405	21,823	7.83	19.54	27.37	0
Storey	0	1,008	1,008	560	336	0.00	0.30	0.30	0
Washoe	26,377	95,156	121,533	60,241	30,909	2.59	24.46	27.05	1,456
White Pine	41,748	42,439	84,187	52,709	8,979	6.24	18.60	24.84	448
TOTAL	1,138,184	1,975,401	3,113,585	1,612,079	672,415	175.28	539.81	715.44	26,323

Hydroelectric Power Water Use - NDWP

COUNTY	INSTREAM WATER USE, AFY	POWER GENERATED, MILLION KWH
1995		
Carson City	0	0.00
Churchill	53,195	2.61
Clark	5,635,099	6,270.91
Douglas	0	0.00
Elko	0	0.00
Esmeralda	0	0.00
Eureka	0	0.00
Humboldt	0	0.00
Lander	0	0.00
Lincoln	0	0.00
Lyon	0	0.00
Mineral	0	0.00
Nye	0	0.00
Pershing	0	0.00
Storey	0	0.00
Washoe	1,117,116	42.55
White Pine	0	0.00
TOTAL	6,805,410	6316.07

Water Use by Category (1) - NDWP

COUNTY	WITHDRAWALS, AFY								
	PUBLIC SUPPLY	SELF-SUPPLIED COMMERCIAL	SELF-SUPPLIED DOMESTIC	SELF-SUPPLIED INDUSTRIAL	SELF-SUPPLIED THERMO ELECTRIC	MINING	LIVESTOCK	IRRIGATION	TOTAL
1995									
Carson City	9,342	11	633	224	0	0	11	10,710	20,931
Churchill	3,573	784	1,306	269	22,963	179	672	256,553	286,299
Clark	379,921	9,308	4,600	7,852	23,713	2,386	280	40,292	468,352
Douglas	11,078	1,826	947	302	0	0	258	189,544	203,955
Elko	14,920	5,265	707	0	0	5,354	1,703	908,645	936,594
Esmeralda	302	0	84	0	0	12,613	123	49,687	62,809
Eureka	426	0	100	0	4,637	114,243	157	124,859	244,422
Humboldt	4,201	78	1,407	560	3,226	76,640	627	599,845	686,584
Lander	1,423	0	244	0	0	35,598	336	161,382	198,983
Lincoln	1,550	34	273	0	0	0	123	65,537	67,517
Lyon	5,746	2,800	318	4,873	1,400	2,565	448	306,926	325,076
Mineral	1,255	0	223	0	0	2,520	34	15,682	19,714
Nye	6,127	112	1,708	0	0	7,695	739	60,233	76,614
Pershing	1,736	11	143	0	0	2,106	258	116,962	121,216
Storey	325	0	116	0	1,826	258	0	1,008	3,533
Washoe	79,385	3,248	5,060	2,688	6,060	717	291	121,533	218,982
White Pine	3,551	0	236	0	0	11,560	269	84,187	99,803
TOTAL	524,861	23,477	18,105	16,768	63,825	274,434	6,329	3,113,585	4,041,384

Water Use by Category (2) - NDWP

COUNTY	WITHDRAWALS, AFY								
	PUBLIC SUPPLY - PUBLIC USE AND LOSSES	COMMERCIAL	DOMESTIC	INDUSTRIAL	THERMO ELECTRIC	MINING	LIVESTOCK	IRRIGATION	TOTAL
1995									
Carson City	840	1,221	7,096	1,053	0	0	11	11	20,931
Churchill	1,053	1,120	3,457	303	22,963	179	672	672	286,300
Clark	32,283	111,992	246,709	9,073	25,337	2,386	280	280	468,352
Douglas	347	2,991	10,513	302	0	0	258	258	203,955
Elko	1,355	7,942	11,595	0	0	5,354	1,703	1,703	936,594
Esmeralda	45	45	297	0	0	12,613	123	123	62,810
Eureka	34	67	425	0	4,637	114,243	157	157	244,422
Humboldt	381	851	4,454	560	3,226	76,640	627	627	686,584
Lander	168	146	1,353	0	0	35,598	336	336	198,983
Lincoln	138	364	1,355	0	0	0	123	123	67,517
Lyon	672	3,965	4,171	4,929	1,400	2,565	448	448	325,076
Mineral	45	280	1,153	0	0	2,520	34	34	19,714
Nye	1,378	784	5,785	0	0	7,695	739	739	76,614
Pershing	134	414	1,342	0	0	2,106	258	258	121,216
Storey	34	67	340	0	1,826	258	0	0	3,533
Washoe	9,308	20,689	57,382	3,002	6,060	717	291	291	218,982
White Pine	258	246	3,283	0	0	11,560	269	269	99,803
TOTAL	48,473	153,184	360,710	19,222	65,449	274,434	6,329	3,113,585	4,041,386

Water Use by Source - NDWP

COUNTY	WITHDRAWALS, AFY			CONSUMPTIVE USE, AFY
	GROUND WATER	SURFACE WATER	TOTAL	
1995				
Carson City	7,040	13,891	20,931	8,798
Churchill	54,866	231,433	286,299	128,624
Clark	95,144	373,208	468,352	203,035
Douglas	34,349	169,606	203,955	91,337
Elko	124,214	812,380	936,594	477,269
Esmeralda	55,164	7,645	62,809	44,048
Eureka	220,673	23,748	244,422	93,406
Humboldt	546,866	139,718	686,584	334,754
Lander	143,981	55,002	198,983	94,092
Lincoln	43,888	23,629	67,517	43,779
Lyon	60,962	264,114	325,076	148,883
Mineral	7,938	11,776	19,714	10,445
Nye	63,627	12,987	76,614	49,610
Pershing	40,907	80,309	121,216	65,333
Storey	688	2,845	3,533	2,825
Washoe	59,497	159,486	218,982	94,310
White Pine	56,655	43,148	99,803	66,043
TOTAL	1,616,459	2,424,925	4,041,384	1,956,591

Public Supply Water Use - NDWP

COUNTY	POPULATION SERVED, IN THOUSANDS	WITHDRAWALS, AFY			DELIVERIES, AFY					PUBLIC USE AND LOSSES, AFY	DOMESTIC DELIVERIES PER CAPITA USE, GPCD	TOTAL WITHDRAWALS PER CAPITA USE, GPCD	CONSUMP-TIVE USE Use, AFY
		GROUND WATER	SURFACE WATER	TOTAL	DOMESTIC	COMMERCIAL	INDUSTRIAL	THERMO ELECTRIC	TOTAL				
1990													
Carson City	36.93	6,609	3,092	9,700	6,598	1,232	840	0	8,670	1,031	160	234	3,707
Churchill	9.35	2,621	0	2,621	1,579	773	22	0	2,375	246	151	250	941
Clark	754.37	45,153	254,462	299,615	176,915	72,607	1,983	896	252,401	47,214	209	355	103,556
Douglas	19.91	5,085	3,125	8,211	5,500	2,039	0	0	7,539	672	247	368	3,147
Elko	28.91	11,269	0	11,269	8,636	2,520	0	0	11,157	112	267	348	4,492
Esmeralda	0.83	190	0	190	134	45	0	0	179	11	145	205	78
Eureka	0.98	381	0	381	280	67	0	0	347	34	255	347	157
Humboldt	9.27	3,192	0	3,192	2,386	504	0	0	2,890	302	230	307	1,288
Lander	4.65	1,053	0	1,053	717	246	0	0	963	90	138	202	403
Lincoln	3.23	1,669	0	1,669	1,176	347	0	0	1,523	146	326	462	661
Lyon	16.89	4,201	0	4,201	2,935	829	0	0	3,764	437	155	222	1,590
Mineral	5.90	493	1,770	2,263	840	1,176	0	0	2,016	246	127	342	672
Nye	11.70	3,506	0	3,506	1,915	1,165	0	0	3,080	426	146	267	1,187
Pershing	3.72	1,557	0	1,557	1,064	347	0	0	1,411	146	255	373	605
Storey	1.62	34	224	258	179	45	0	0	224	34	99	142	101
Washoe	236.13	26,682	51,717	78,399	53,330	16,074	101	0	69,505	8,894	202	296	29,381
White Pine	8.38	2,890	347	3,237	2,722	202	0	0	2,924	314	290	345	1,355
TOTAL	1,152.77	116,585	314,737	431,322	266,906	100,218	2,946	896	370,968	60,355	207	334	153,321

Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning

Commercial Water Use - NDWP

COUNTY	SELF-SUPPLIED WITHDRAWALS, AFY			SELF-SUPPLIED CONSUMP-TIVE USE, AFY	PUBLIC SUPPLY COMMERCIAL DELIVERIES, AFY	PUBLIC SUPPLY COMMERCIAL CONSUMP-TIVE USE, AFY	SELF-SUPPLIED + PUBLIC SUPPLY COMMERCIAL	
	BY SOURCE		TOTAL					
	GROUND WATER	SURFACE WATER					WITHDRAWALS + DELIVERIES, AFY	CONSUMPTIVE USE, AFY
1990								
Carson City	11	0	11	0	1,232	246	1,243	246
Churchill	45	0	45	11	773	157	818	168
Clark	4,738	7,057	11,795	2,240	72,607	13,811	84,402	16,051
Douglas	101	11	112	22	2,039	403	2,151	425
Elko	392	5,041	5,433	403	2,520	179	7,953	582
Esmeralda	11	0	11	0	45	11	56	11
Eureka	11	0	11	0	67	11	78	11
Humboldt	34	0	34	11	504	101	538	112
Lander	0	0	0	0	246	45	246	45
Lincoln	34	0	34	11	347	67	381	78
Lyon	56	336	392	56	829	123	1,221	179
Mineral	22	0	22	0	1,176	246	1,198	246
Nye	739	0	739	146	1,165	235	1,904	381
Pershing	11	0	11	0	347	67	358	67
Storey	11	0	11	0	45	11	56	11
Washoe	1,568	2,128	3,696	616	16,074	2,688	19,770	3,304
White Pine	157	2,912	3,069	67	202	0	3,271	67
TOTAL	7,941	17,485	25,426	3,583	100,218	18,401	125,644	21,984

Domestic Water Use - NDWP

COUNTY	SELF-SUPPLIED DOMESTIC						PUBLIC SUPPLY DOMESTIC				SELF-SUPPLIED + PUBLIC SUPPLY DOMESTIC		
	POPULATION SERVED, IN THOUSANDS	WITHDRAWALS, AFY			PER CAPITA USE, GPCD	CONSUMP-TIVE USE, AFY	POPULATION SERVED, IN THOUSANDS	DELIVERIES, AFY	PER CAPITA USE, GPCD	CONSUMP-TIVE USE, AFY	WITHDRAWALS + DELIVERIES, AFY	CONSUMPTIVE USE, AFY	PER CAPITA TOTAL, GPCD
		GROUND WATER	SURFACE WATER	TOTAL									
1990													
Carson City	4.02	646	0	646	143	323	36.93	6,598	160	3,293	7,244	3,616	158
Churchill	8.75	1,316	13	1,329	136	664	9.35	1,579	151	784	2,908	1,448	143
Clark	15.91	3,341	18	3,359	188	1,680	754.37	176,915	209	88,457	180,274	90,137	209
Douglas	8.16	1,988	42	2,030	222	1,016	19.91	5,500	247	2,744	7,530	3,760	239
Elko	4.86	1,281	22	1,305	240	653	28.91	8,636	267	4,313	9,941	4,966	263
Esmeralda	0.52	77	0	77	131	39	0.83	134	145	67	211	106	140
Eureka	0.57	147	0	147	230	85	0.98	280	255	146	427	231	246
Humboldt	3.75	850	19	869	207	434	9.27	2,386	230	1,187	3,255	1,621	223
Lander	1.69	234	0	234	124	117	4.65	717	138	358	951	475	134
Lincoln	0.58	165	27	192	293	111	3.23	1,176	326	594	1,368	705	321
Lyon	3.70	564	13	578	140	282	16.89	2,935	155	1,467	3,513	1,749	152
Mineral	0.57	63	10	73	115	42	5.90	840	127	426	913	468	126
Nye	6.49	906	50	955	131	478	11.70	1,915	146	952	2,870	1,430	141
Pershing	0.83	190	23	213	230	118	3.72	1,064	255	538	1,277	656	251
Storey	0.94	94	0	94	89	51	1.62	179	99	90	273	141	95
Washoe	20.99	4,217	52	4,267	181	2,142	236.13	53,330	202	26,671	57,597	28,813	200
White Pine	1.03	275	25	300	261	150	8.38	2,722	290	1,355	3,022	1,505	287
Total	83.36	16,354	314	16,668	179	8,385	1,152.77	266,906	207	133,442	283,574	141,827	205

Industrial Water Use - NDWP

COUNTY	SELF-SUPPLIED INDUSTRIAL WITHDRAWALS, AFY GROUNDWATER	SELF-SUPPLIED INDUSTRIAL WITHDRAWALS, AFY SURFACE WATER	SELF-SUPPLIED INDUSTRIAL WITHDRAWALS, AFY TOTAL	SELF-SUPPLIED INDUSTRIAL CONSUMPTIVE USE, AFY	PUBLIC SUPPLY INDUSTRIAL DELIVERIES, AFY	PUBLIC SUPPLY INDUSTRIAL CONSUMPTIVE USE, AFY	SELF-SUPPLIED + PUBLIC SUPPLY INDUSTRIAL WITHDRAWALS + DELIVERIES, AFY	SELF-SUPPLIED + PUBLIC SUPPLY INDUSTRIAL CONSUMPTIVE USE, AFY
1990								
Carson City	224	0	224	45	840	168	1,064	213
Churchill	269	0	269	56	22	0	291	56
Clark	8,311	560	8,872	1,747	1,983	392	10,855	2,139
Douglas	302	0	302	56	0	0	302	56
Elko	0	0	0	0	0	0	0	0
Esmeralda	0	0	0	0	0	0	0	0
Eureka	0	0	0	0	0	0	0	0
Humboldt	0	0	0	0	0	0	0	0
Lander	0	0	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0	0	0
Lyon	90	0	90	22	0	0	90	22
Mineral	0	0	0	0	0	0	0	0
Nye	22	0	22	0	0	0	22	0
Pershing	0	0	0	0	0	0	0	0
Storey	0	0	0	0	0	0	0	0
Washoe	1,344	314	1,658	302	101	22	1,759	324
White Pine	0	0	0	0	0	0	0	0
Total	10,562	874	11,437	2,228	2,946	582	14,383	2,810

Thermoelectric Power Water Use - NDWP

COUNTY	SELF-SUPPLIED THERMOELECTRIC					PUBLIC SUPPLY THERMOELECTRIC			SELF-SUPPLIED + PUBLIC SUPPLY THERMOELECTRIC		
	WITHDRAWALS, AFY			CONSUMP-TIVE USE, AFY	POWER GENERATED, MILLION KWH	DELIVERIES, AFY	CONSUMP-TIVE USE, AFY	POWER GENERATED, MILLION KWH	WITHDRAWALS + DELIVERIES, AFY	CONSUMPTIVE USE, AFY	POWER GENERATED, MILLION KWH
	GROUNDWATER	SURFACE WATER	TOTAL								
1990											
Carson City	0	0	0	0	0.00	0	0	0	0	0	0.00
Churchill	22,952	0	22,952	8,233	614.79	0	0	0	22,952	8,233	614.79
Clark	4,940	21,451	26,390	26,390	13,876.78	896	896	471	27,286	27,286	14,347.78
Douglas	0	0	0	0	0.00	0	0	0	0	0	0.00
Elko	0	0	0	0	0.00	0	0	0	0	0	0.00
Esmeralda	0	0	0	0	0.00	0	0	0	0	0	0.00
Eureka	4,637	0	4,637	997	115.05	0	0	0	4,637	997	115.05
Humboldt	5,153	0	5,153	5,153	2,986.00	0	0	0	5,153	5,153	2,986.00
Lander	0	0	0	0	0.00	0	0	0	0	0	0.00
Lincoln	0	0	0	0	0.00	0	0	0	0	0	0.00
Lyon	5,556	0	5,556	5,209	1,098.23	0	0	0	5,556	5,209	1,098.23
Mineral	0	0	0	0	0.00	0	0	0	0	0	0.00
Nye	0	0	0	0	0.00	0	0	0	0	0	0.00
Pershing	0	0	0	0	0.00	0	0	0	0	0	0.00
Storey	56	3,226	3,282	3,282	715.69	0	0	0	3,282	3,282	715.69
Washoe	6,049	0	6,049	34	121.72	0	0	0	6,049	34	121.72
White Pine	0	0	0	0	0.00	0	0	0	0	0	0.00
Total	49,343	24,677	74,019	49,298	19,528.26	896	896	471	74,915	50,194	19,999.26

Mining Water Use - NDWP

COUNTY	CONSUMPTIVE USE WITHDRAWALS, AFY				NONCONSUMPTIVE USE WITHDRAWALS, AFY	TOTAL GW WITHDRAWALS, AFY	TOTAL WITHDRAWALS, AFY
	GROUNDWATER WITHDRAWALS, AFY	SURFACE WATER WITHDRAWALS, AFY	TOTAL WITHDRAWALS, AFY	CONSUMPTIVE USE, AFY			
1990							
Carson City	0	0	0	0	0	0	0
Churchill	179	0	179	179	0	179	179
Clark	739	1,243	1,983	1,983	840	1,579	2,823
Douglas	123	0	123	123	0	123	123
Elko	4,503	179	4,682	4,682	448	4,951	5,130
Esmeralda	12,837	0	12,837	12,837	2,823	15,660	15,660
Eureka	16,320	11	16,332	16,332	13,307	29,627	29,639
Humboldt	5,668	0	5,668	5,668	20,174	25,842	25,842
Lander	7,886	90	7,975	7,975	11,134	19,020	19,109
Lincoln	0	0	0	0	0	0	0
Lyon	314	2,251	2,565	2,565	1,703	2,017	4,268
Mineral	1,624	0	1,624	1,624	22	1,646	1,646
Nye	7,505	0	7,505	7,505	56	7,561	7,561
Pershing	1,579	0	1,579	1,579	67	1,646	1,646
Storey	224	34	258	258	34	258	292
Washoe	717	0	717	717	1,557	2,274	2,274
White Pine	3,730	101	3,831	3,831	101	3,831	3,932
TOTAL	63,948	3,909	67,858	67,858	52,266	116,214	120,124

Livestock Water Use - NDWP

COUNTY	WITHDRAWALS, AFY			CONSUMPTIVE USE, AFY
	GROUNDWATER	SURFACE WATER	TOTAL	
1990				
Carson City	0	11	11	0
Churchill	168	504	672	258
Clark	112	168	280	202
Douglas	22	235	258	134
Elko	302	1,400	1,703	672
Esmeralda	67	56	123	67
Eureka	22	134	157	67
Humboldt	101	526	627	224
Lander	67	269	336	123
Lincoln	22	101	123	34
Lyon	34	414	448	146
Mineral	34	0	34	34
Nye	45	694	739	67
Pershing	22	235	258	78
Storey	0	0	0	0
Washoe	67	224	291	123
White Pine	34	235	269	90
TOTAL	1,119	5,206	6,329	2,319

Irrigation Water Use - NDWP

COUNTY	WITHDRAWALS, AFY			CONSUMPTIVE USE, AFY	CONVEYANCE LOSS, AFY	IRRIGATED LAND, 1000 ACRES			RECLAIMED WASTEWATER, AFY
	GROUNDWATER	SURFACE WATER	TOTAL			SPRINKLER	SURFACE	TOTAL	
1990									
Carson City	11	2,800	2,812	1,512	1,008	0.10	0.80	0.90	2,711
Churchill	22,403	258,416	280,819	129,040	81,658	9.50	51.90	61.40	11
Clark	16,802	19,826	36,629	26,155	2,016	3.55	3.50	7.05	3,181
Douglas	10,641	192,440	203,081	92,748	60,264	3.20	38.20	41.40	4,682
Elko	61,608	831,088	892,696	456,737	192,944	33.75	176.40	210.15	1,109
Esmeralda	29,684	5,097	34,780	21,843	3,584	1.30	6.60	7.90	0
Eureka	123,215	47,046	170,261	99,412	24,195	8.70	36.00	44.70	0
Humboldt	291,236	276,227	567,463	297,677	111,174	45.00	89.75	134.75	0
Lander	66,088	73,033	139,121	73,873	26,379	9.50	21.70	31.20	0
Lincoln	44,806	20,611	65,416	42,901	4,313	2.50	13.10	15.60	0
Lyon	100,813	219,323	320,136	147,074	95,660	9.40	54.20	63.60	358
Mineral	6,721	24,643	31,364	14,506	9,129	0.90	4.90	5.80	0
Nye	42,005	7,505	49,510	32,372	4,985	3.00	9.20	12.20	78
Pershing	61,944	59,927	121,871	65,024	22,739	9.10	22.00	31.10	0
Storey	0	0	0	0	0	0.00	0.00	0.00	0
Washoe	44,806	110,670	155,475	77,066	39,541	10.20	24.40	34.60	11
White Pine	52,647	36,629	89,275	55,895	560	5.10	21.20	26.30	0
TOTAL	975,430	2,185,281	3,160,709	1,633,835	680,149	154.80	573.85	728.65	12,141

Hydroelectric Power Water Use - NDWP

COUNTY	INSTREAM WATER USE, AFY	POWER GENERATED, MILLION KWH
1990		
Carson City	0	0.00
Churchill	135,940	6.67
Clark	3,434,528	1,597.26
Douglas	0	0.00
Elko	0	0.00
Esmeralda	0	0.00
Eureka	0	0.00
Humboldt	0	0.00
Lander	0	0.00
Lincoln	0	0.00
Lyon	0	0.00
Mineral	0	0.00
Nye	0	0.00
Pershing	0	0.00
Storey	0	0.00
Washoe	340,825	12.98
White Pine	0	0.00
TOTAL	3,911,293	1616.91

Water Use by Category (1) - NDWP

COUNTY	WITHDRAWALS, AFY								
	PUBLIC SUPPLY	SELF-SUPPLIED COMMERCIAL	SELF-SUPPLIED DOMESTIC	SELF-SUPPLIED INDUSTRIAL	SELF-SUPPLIED THERMO ELECTRIC	MINING	LIVESTOCK	IRRIGATION	TOTAL

1990

Carson City	9,700	11	646	224	0	0	11	2,812	13,404
Churchill	2,621	45	1,329	269	22,952	179	672	280,819	308,886
Clark	299,615	11,795	3,359	8,872	26,390	2,823	280	36,629	389,763
Douglas	8,211	112	2,030	302	0	123	258	203,081	214,117
Elko	11,269	5,433	1,305	0	0	5,130	1,703	892,696	917,536
Esmeralda	190	11	77	0	0	15,660	123	34,780	50,841
Eureka	381	11	147	0	4,637	29,639	157	170,261	205,233
Humboldt	3,192	34	869	0	5,153	25,842	627	567,463	603,180
Lander	1,053	0	234	0	0	19,109	336	139,121	159,853
Lincoln	1,669	34	192	0	0	0	123	65,416	67,434
Lyon	4,201	392	578	90	5,556	4,268	448	320,136	335,669
Mineral	2,263	22	73	0	0	1,646	34	31,364	35,402
Nye	3,506	739	955	22	0	7,561	739	49,510	63,032
Pershing	1,557	11	213	0	0	1,646	258	121,871	125,556
Storey	258	11	94	0	3,282	292	0	0	3,937
Washoe	78,399	3,696	4,267	1,658	6,049	2,274	291	155,475	252,109
White Pine	3,237	3,069	300	0	0	3,932	269	89,275	100,082
TOTAL	431,322	25,426	16,668	11,437	74,019	120,124	6,329	3,160,709	3,846,034

Water Use by Category (2) - NDWP

COUNTY	WITHDRAWALS, AFY								
	PUBLIC SUPPLY - PUBLIC USE AND LOSSES	COMMERCIAL	DOMESTIC	INDUSTRIAL	THERMO ELECTRIC	MINING	LIVESTOCK	IRRIGATION	TOTAL
1990									
Carson City	1,031	1,243	7,244	1,064	0	0	11	11	13,405
Churchill	246	818	2,908	291	22,952	179	672	672	308,885
Clark	47,214	84,402	180,274	10,855	27,286	2,823	280	280	389,763
Douglas	672	2,151	7,530	302	0	123	258	258	214,117
Elko	112	7,953	9,941	0	0	5,130	1,703	1,703	917,535
Esmeralda	11	56	211	0	0	15,660	123	123	50,841
Eureka	34	78	427	0	4,637	29,639	157	157	205,233
Humboldt	302	538	3,255	0	5,153	25,842	627	627	603,180
Lander	90	246	951	0	0	19,109	336	336	159,853
Lincoln	146	381	1,368	0	0	0	123	123	67,434
Lyon	437	1,221	3,513	90	5,556	4,268	448	448	335,669
Mineral	246	1,198	913	0	0	1,646	34	34	35,401
Nye	426	1,904	2,870	22	0	7,561	739	739	63,032
Pershing	146	358	1,277	0	0	1,646	258	258	125,556
Storey	34	56	273	0	3,282	292	0	0	3,937
Washoe	8,894	19,770	57,597	1,759	6,049	2,274	291	291	252,109
White Pine	314	3,271	3,022	0	0	3,932	269	269	100,083
TOTAL	60,355	125,644	283,574	14,383	74,915	120,124	6,329	3,160,709	3,846,033

Water Use by Source - NDWP

COUNTY	WITHDRAWALS, AFY			CONSUMPTIVE USE, AFY
	GROUND WATER	SURFACE WATER	TOTAL	
1990				
Carson City	7,501	5,903	13,404	5,587
Churchill	49,953	258,933	308,886	139,382
Clark	84,976	304,785	389,763	163,953
Douglas	18,262	195,853	214,117	97,246
Elko	79,803	837,730	917,536	467,639
Esmeralda	45,689	5,153	50,841	34,864
Eureka	158,040	47,191	205,233	117,050
Humboldt	326,408	276,772	603,180	310,455
Lander	86,462	73,392	159,853	82,491
Lincoln	46,696	20,739	67,434	43,718
Lyon	113,331	222,337	335,669	156,944
Mineral	8,979	26,423	35,402	16,878
Nye	54,784	8,249	63,032	41,755
Pershing	65,370	60,185	125,556	67,404
Storey	453	3,484	3,937	3,692
Washoe	87,007	165,105	252,109	110,381
White Pine	59,834	40,249	100,082	61,388
TOTAL	1,293,548	2,552,483	3,846,034	1,920,827

Public Supply Water Use - NDWP

COUNTY	POPULATION SERVED, IN THOUSANDS	WITHDRAWALS, AFY			DELIVERIES, AFY					PUBLIC USE AND LOSSES, AFY	DOMESTIC DELIVERIES PER CAPITA USE, GPCD	TOTAL WITHDRAWALS PER CAPITA USE, GPCD	CONSUMP-TIVE USE Use, AFY
		GROUND WATER	SURFACE WATER	TOTAL	DOMESTIC	COMMERCIAL	INDUSTRIAL	THERMO ELECTRIC	TOTAL				
1985													
Carson City	33.93	6,698	2,677	9,376	6,799	1,075	672	0	8,547	829	179	247	3,864
Churchill	8.03	2,520	11	2,532	1,960	325	34	0	2,319	213	218	282	997
Clark	542.47	52,344	155,711	208,055	132,031	42,397	1,837	2,744	179,010	29,045	217	342	78,029
Douglas	14.61	3,954	2,151	6,105	5,018	515	56	0	5,589	515	307	373	2,744
Elko	19.30	9,779	78	9,857	6,631	1,512	0	0	8,143	1,714	307	456	3,662
Esmeralda	0.94	157	0	157	146	11	0	0	157	0	139	150	78
Eureka	0.54	157	0	157	134	11	0	0	146	11	222	261	78
Humboldt	6.02	1,591	0	1,591	1,355	78	78	0	1,512	78	201	236	772
Lander	3.31	952	34	986	683	123	90	0	896	90	184	266	369
Lincoln	3.31	975	0	975	829	45	0	0	874	101	223	263	425
Lyon	8.61	3,607	0	3,607	2,912	269	101	0	3,282	325	302	374	1,636
Mineral	5.66	997	426	1,423	1,031	269	0	0	1,299	123	163	225	571
Nye	7.64	2,363	0	2,363	1,647	224	347	0	2,218	146	192	276	1,031
Pershing	2.77	952	56	1,008	594	224	0	0	818	190	192	325	359
Storey	1.40	45	224	269	157	56	0	0	213	56	100	171	101
Washoe	206.17	15,872	54,898	70,770	47,617	12,960	3,842	0	64,419	6,351	206	306	27,410
White Pine	6.45	2,554	358	2,912	2,352	246	0	0	2,599	314	326	403	1,232
TOTAL	871.14	105,517	216,624	322,143	211,896	60,340	7,057	2,744	282,041	40,101	217	330	123,358

Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning

Commercial Water Use - NDWP

COUNTY	SELF-SUPPLIED WITHDRAWALS, AFY			SELF-SUPPLIED CONSUMP-TIVE USE, AFY	PUBLIC SUPPLY COMMERCIAL DELIVERIES, AFY	PUBLIC SUPPLY COMMERCIAL CONSUMP-TIVE USE, AFY	SELF-SUPPLIED + PUBLIC SUPPLY COMMERCIAL	
	BY SOURCE		TOTAL					
	GROUND WATER	SURFACE WATER					WITHDRAWALS + DELIVERIES, AFY	CONSUMPTIVE USE, AFY
1985								
Carson City	22	0	22	0	1,075	224	1,097	224
Churchill	45	0	45	11	325	67	370	78
Clark	6,362	392	6,754	1,355	42,397	8,479	49,151	9,834
Douglas	123	11	134	34	515	112	649	146
Elko	437	0	437	90	1,512	302	1,949	392
Esmeralda	11	0	11	0	11	0	22	0
Eureka	11	0	11	0	11	0	22	0
Humboldt	45	0	45	11	78	11	123	22
Lander	0	0	0	0	123	22	123	22
Lincoln	34	0	34	11	45	11	79	22
Lyon	56	0	56	11	269	56	325	67
Mineral	22	0	22	0	269	56	291	56
Nye	134	0	134	34	224	45	358	79
Pershing	11	0	11	0	224	45	235	45
Storey	11	0	11	0	56	11	67	11
Washoe	526	0	526	101	12,960	2,610	13,486	2,711
White Pine	34	0	34	11	246	45	280	56
TOTAL	7,884	403	8,287	1,669	60,340	12,096	68,627	13,765

Domestic Water Use - NDWP

COUNTY	SELF-SUPPLIED DOMESTIC						PUBLIC SUPPLY DOMESTIC				SELF-SUPPLIED + PUBLIC SUPPLY DOMESTIC		
	POPULATION SERVED, IN THOUSANDS	WITHDRAWALS, AFY			PER CAPITA USE, GPCD	CONSUMP-TIVE USE, AFY	POPULATION SERVED, IN THOUSANDS	DELIVERIES, AFY	PER CAPITA USE, GPCD	CONSUMP-TIVE USE, AFY	WITHDRAWALS + DELIVERIES, AFY	CONSUMPTIVE USE, AFY	PER CAPITA TOTAL, GPCD
		GROUND WATER	SURFACE WATER	TOTAL									
1985													
Carson City	1.72	311	0	311	161	155	33.93	6,799	179	3,506	7,110	3,661	178
Churchill	7.09	1,545	15	1,560	196	735	8.03	1,960	218	919	3,520	1,654	208
Clark	19.81	4,201	139	4,340	196	2,186	542.47	132,031	217	66,492	136,371	68,678	217
Douglas	8.39	2,504	88	2,592	276	1,349	14.61	5,018	307	2,621	7,610	3,970	295
Elko	3.05	811	131	944	276	482	19.30	6,631	307	3,360	7,575	3,842	303
Esmeralda	0.60	84	0	84	124	37	0.94	146	139	78	230	115	133
Eureka	0.76	157	14	171	200	86	0.54	134	222	78	305	164	209
Humboldt	5.24	1,007	55	1,062	181	599	6.02	1,355	201	750	2,417	1,349	192
Lander	1.22	159	67	226	166	120	3.31	683	184	347	909	467	180
Lincoln	0.47	75	30	105	200	61	3.31	829	223	414	934	475	221
Lyon	7.85	2,325	64	2,389	272	1,268	8.61	2,912	302	1,546	5,301	2,814	288
Mineral	0.52	74	12	86	147	50	5.66	1,031	163	515	1,117	565	161
Nye	6.93	1,234	109	1,343	173	705	7.64	1,647	192	874	2,990	1,579	183
Pershing	0.89	130	44	172	172	86	2.77	594	192	314	766	400	187
Storey	0.45	45	0	45	90	23	1.40	157	100	90	202	113	97
Washoe	18.41	3,727	101	3,828	186	1,929	206.17	47,617	206	24,038	51,445	25,967	205
White Pine	1.26	343	74	415	293	221	6.45	2,352	326	1,187	2,767	1,408	320
Total	84.67	18,732	943	19,673	207	10,092	871.14	211,896	217	107,129	231,569	117,221	216

Industrial Water Use - NDWP

COUNTY	SELF-SUPPLIED INDUSTRIAL WITHDRAWALS, AFY			SELF-SUPPLIED INDUSTRIAL	PUBLIC SUPPLY INDUSTRIAL		SELF-SUPPLIED + PUBLIC SUPPLY INDUSTRIAL	
	GROUNDWATER	SURFACE WATER	TOTAL	CONSUMPTIVE USE, AFY	DELIVERIES, AFY	CONSUMPTIVE USE, AFY	WITHDRAWALS + DELIVERIES, AFY	CONSUMPTIVE USE, AFY
1985								
Carson City	224	56	280	56	672	134	952	190
Churchill	269	0	269	56	34	11	303	67
Clark	717	8,311	9,028	1,658	1,837	336	10,865	1,994
Douglas	168	0	168	34	56	11	224	45
Elko	0	0	0	0	0	0	0	0
Esmeralda	0	0	0	0	0	0	0	0
Eureka	0	0	0	0	0	0	0	0
Humboldt	90	56	146	22	78	11	224	33
Lander	0	0	0	0	90	0	90	0
Lincoln	0	0	0	0	0	0	0	0
Lyon	22	0	22	11	101	34	123	45
Mineral	0	0	0	0	0	0	0	0
Nye	22	0	22	11	347	112	369	123
Pershing	0	0	0	0	0	0	0	0
Storey	0	0	0	0	0	0	0	0
Washoe	1,120	314	1,434	291	3,842	762	5,276	1,053
White Pine	0	0	0	0	0	0	0	0
Total	2,632	8,737	11,369	2,139	7,057	1,411	18,426	3,550

Thermoelectric Power Water Use - NDWP

COUNTY	SELF-SUPPLIED THERMOELECTRIC					PUBLIC SUPPLY THERMOELECTRIC			SELF-SUPPLIED + PUBLIC SUPPLY THERMOELECTRIC		
	WITHDRAWALS, AFY			CONSUMP-TIVE USE, AFY	POWER GENERATED, MILLION KWH	DELIVERIES, AFY	CONSUMP-TIVE USE, AFY	POWER GENERATED, MILLION KWH	WITHDRAWALS + DELIVERIES, AFY	CONSUMPTIVE USE, AFY	POWER GENERATED, MILLION KWH
	GROUNDWATER	SURFACE WATER	TOTAL								
1985											
Carson City	0	0	0	0	0.00	0	0	0	0	0	0.00
Churchill	45	0	45	0	0.30	0	0	0	45	0	0.30
Clark	8,345	7,975	16,320	16,208	7,923.00	2,744	2,722	1,333	19,064	18,930	9,255.53
Douglas	0	0	0	0	0.00	0	0	0	0	0	0.00
Elko	0	0	0	0	0.00	0	0	0	0	0	0.00
Esmeralda	0	0	0	0	0.00	0	0	0	0	0	0.00
Eureka	0	0	0	0	0.00	0	0	0	0	0	0.00
Humboldt	6,071	0	6,071	4,861	2,880.73	0	0	0	6,071	4,861	2,880.73
Lander	0	0	0	0	0.00	0	0	0	0	0	0.00
Lincoln	0	0	0	0	0.00	0	0	0	0	0	0.00
Lyon	3,248	0	3,248	2,005	210.75	0	0	0	3,248	2,005	210.75
Mineral	0	0	0	0	0.00	0	0	0	0	0	0.00
Nye	0	0	0	0	0.00	0	0	0	0	0	0.00
Pershing	0	0	0	0	0.00	0	0	0	0	0	0.00
Storey	134	459	594	594	59.36	0	0	0	594	594	59.36
Washoe	0	0	0	0	0.00	0	0	0	0	0	0.00
White Pine	0	0	0	0	0.00	0	0	0	0	0	0.00
Total	17,843	8,434	26,278	23,668	11,074.14	2,744	2,722	1,333	29,022	26,390	12,406.67

Mining Water Use - NDWP

COUNTY	CONSUMPTIVE USE WITHDRAWALS, AFY				NONCONSUMPTIVE USE WITHDRAWALS, AFY	TOTAL GW WITHDRAWALS, AFY	TOTAL WITHDRAWALS, AFY
	GROUNDWATER WITHDRAWALS, AFY	SURFACE WATER WITHDRAWALS, AFY	TOTAL WITHDRAWALS, AFY	CONSUMPTIVE USE, AFY			
1985							
Carson City	0	0	0	0	0	0	0
Churchill	202	67	269	213	0	202	269
Clark	1,266	146	1,411	807	0	1,266	1,411
Douglas	381	0	381	190	0	381	381
Elko	2,509	224	2,733	2,520	0	2,509	2,733
Esmeralda	4,794	56	4,850	2,554	0	4,794	4,850
Eureka	3,170	179	3,349	3,136	0	3,170	3,349
Humboldt	1,904	11	1,915	1,859	0	1,904	1,915
Lander	3,842	213	4,055	3,898	0	3,842	4,055
Lincoln	202	0	202	190	0	202	202
Lyon	706	11	717	594	0	706	717
Mineral	594	11	605	504	0	594	605
Nye	3,002	1,938	4,940	4,649	0	3,002	4,940
Pershing	269	11	280	246	0	269	280
Storey	168	0	168	134	0	168	168
Washoe	314	22	336	202	0	314	336
White Pine	930	168	1,098	773	0	930	1,098
TOTAL	24,253	3,057	27,309	22,469	0	24,253	27,309

Livestock Water Use - NDWP

COUNTY	WITHDRAWALS, AFY			CONSUMPTIVE USE, AFY
	GROUNDWATER	SURFACE WATER	TOTAL	
1985				
Carson City	22	45	67	34
Churchill	504	784	1,288	706
Clark	672	4,313	4,985	683
Douglas	269	448	717	213
Elko	1,411	7,270	8,681	2,173
Esmeralda	235	0	235	213
Eureka	269	336	605	336
Humboldt	437	930	1,367	638
Lander	213	347	560	280
Lincoln	190	202	392	235
Lyon	202	1,176	1,378	403
Mineral	90	0	90	90
Nye	246	291	538	314
Pershing	112	426	538	224
Storey	0	0	0	0
Washoe	1,389	2,666	4,055	437
White Pine	336	3,226	3,562	426
TOTAL	6,597	22,460	29,058	7,405

Irrigation Water Use - NDWP

COUNTY	WITHDRAWALS, AFY			CONSUMPTIVE USE, AFY	CONVEYANCE LOSS, AFY	IRRIGATED LAND, 1000 ACRES			RECLAIMED WASTEWATER, AFY
	GROUNDWATER	SURFACE WATER	TOTAL			SPRINKLER	SURFACE	TOTAL	
1985									
Carson City	34	3,226	3,260	1,501	963	0.09	0.65	0.74	1,725
Churchill	12,445	341,049	353,494	163,182	103,355	9.93	54.15	64.08	314
Clark	13,050	35,486	48,536	34,635	2,711	3.57	5.77	9.34	5,074
Douglas	10,541	221,407	231,947	105,909	69,303	3.68	43.94	47.62	3,237
Elko	58,158	977,770	1,035,928	529,692	224,039	33.84	210.12	243.96	1,445
Esmeralda	28,295	7,247	35,542	22,302	3,685	1.33	7.01	8.34	0
Eureka	115,027	67,164	182,191	106,268	25,987	8.69	39.35	48.04	0
Humboldt	279,262	368,257	647,519	338,618	126,968	45.39	108.50	153.89	168
Lander	54,629	104,263	158,892	84,201	30,165	9.52	26.12	35.64	0
Lincoln	42,061	29,504	71,566	46,811	4,738	2.48	14.61	17.09	0
Lyon	74,736	313,337	388,073	176,881	116,091	9.40	67.52	76.92	258
Mineral	4,895	35,228	40,123	18,550	11,750	0.95	6.49	7.44	0
Nye	40,045	39,552	79,597	51,090	7,975	2.99	16.36	19.35	0
Pershing	21,395	174,025	195,420	103,983	36,718	9.16	33.06	42.22	134
Storey	0	0	0	0	0	0.00	0.00	0.00	0
Washoe	38,152	140,533	178,685	88,435	45,410	10.25	29.52	39.77	67
White Pine	46,878	52,344	99,222	61,989	10,585	5.16	24.16	29.32	0
TOTAL	839,603	2,910,392	3,749,995	1,934,047	820,443	156.43	687.33	843.76	12,422

Hydroelectric Power Water Use - NDWP

COUNTY	INSTREAM WATER USE, AFY	POWER GENERATED, MILLION KWH
1985		
Carson City	0	0.00
Churchill	233,583	10.59
Clark	9,257,621	4,308.66
Douglas	0	0.00
Elko	8,928	0.43
Emeralda	1,042	0.05
Eureka	0	0.00
Humboldt	0	0.00
Lander	0	0.00
Lincoln	0	0.00
Ly on	0	0.00
Mineral	0	0.00
Ny e	0	0.00
Pershing	0	0.00
Storey	0	0.00
Washoe	473,864	32.82
White Pine	0	0.00
TOTAL	9,975,038	4352.55

Water Use by Category (1) - NDWP

COUNTY	WITHDRAWALS, AFY								
	PUBLIC SUPPLY	SELF-SUPPLIED COMMERCIAL	SELF-SUPPLIED DOMESTIC	SELF-SUPPLIED INDUSTRIAL	SELF-SUPPLIED THERMO ELECTRIC	MINING	LIVESTOCK	IRRIGATION	TOTAL
1985									
Carson City	9,376	22	311	280	0	0	67	3,260	13,316
Churchill	2,532	45	1,560	269	45	269	1,288	353,494	359,502
Clark	208,055	6,754	4,340	9,028	16,320	1,411	4,985	48,536	299,429
Douglas	6,105	134	2,592	168	0	381	717	231,947	242,044
Elko	9,857	437	944	0	0	2,733	8,681	1,035,928	1,058,580
Esmeralda	157	11	84	0	0	4,850	235	35,542	40,879
Eureka	157	11	171	0	0	3,349	605	182,191	186,484
Humboldt	1,591	45	1,062	146	6,071	1,915	1,367	647,519	659,716
Lander	986	0	226	0	0	4,055	560	158,892	164,719
Lincoln	975	34	105	0	0	202	392	71,566	73,274
Lyon	3,607	56	2,389	22	3,248	717	1,378	388,073	399,490
Mineral	1,423	22	86	0	0	605	90	40,123	42,349
Nye	2,363	134	1,343	22	0	4,940	538	79,597	88,937
Pershing	1,008	11	172	0	0	280	538	195,420	197,429
Storey	269	11	45	0	594	168	0	0	1,087
Washoe	70,770	526	3,828	1,434	0	336	4,055	178,685	259,634
White Pine	2,912	34	415	0	0	1,098	3,562	99,222	107,243
TOTAL	322,143	8,287	19,673	11,369	26,278	27,309	29,058	3,749,995	4,194,112

Water Use by Category (2) - NDWP

COUNTY	WITHDRAWALS, AFY								
	PUBLIC SUPPLY - PUBLIC USE AND LOSSES	COMMERCIAL	DOMESTIC	INDUSTRIAL	THERMO ELECTRIC	MINING	LIVESTOCK	IRRIGATION	TOTAL
1985									
Carson City	829	1,097	7,110	952	0	0	67	67	13,315
Churchill	213	370	3,520	303	45	269	1,288	1,288	359,502
Clark	29,045	49,151	136,371	10,865	19,064	1,411	4,985	4,985	299,428
Douglas	515	649	7,610	224	0	381	717	717	242,043
Elko	1,714	1,949	7,575	0	0	2,733	8,681	8,681	1,058,580
Esmeralda	0	22	230	0	0	4,850	235	235	40,879
Eureka	11	22	305	0	0	3,349	605	605	186,483
Humboldt	78	123	2,417	224	6,071	1,915	1,367	1,367	659,714
Lander	90	123	909	90	0	4,055	560	560	164,719
Lincoln	101	79	934	0	0	202	392	392	73,274
Lyon	325	325	5,301	123	3,248	717	1,378	1,378	399,490
Mineral	123	291	1,117	0	0	605	90	90	42,349
Nye	146	358	2,990	369	0	4,940	538	538	88,938
Pershing	190	235	766	0	0	280	538	538	197,429
Storey	56	67	202	0	594	168	0	0	1,087
Washoe	6,351	13,486	51,445	5,276	0	336	4,055	4,055	259,634
White Pine	314	280	2,767	0	0	1,098	3,562	3,562	107,243
TOTAL	40,101	68,627	231,569	18,426	29,022	27,309	29,058	3,749,995	4,194,107

Water Use by Source - NDWP

1985

COUNTY	WITHDRAWALS, AFY			CONSUMPTIVE USE, AFY
	GROUND WATER	SURFACE WATER	TOTAL	
Carson City	7,311	6,004	13,316	5,610
Churchill	17,575	341,926	359,502	165,900
Clark	86,957	212,473	299,429	135,561
Douglas	17,940	224,105	242,044	110,473
Elko	73,105	985,473	1,058,580	538,619
Esmeralda	33,576	7,303	40,879	25,184
Eureka	118,791	67,693	186,484	109,904
Humboldt	290,407	369,309	659,716	347,380
Lander	59,795	104,924	164,719	88,868
Lincoln	43,537	29,736	73,274	47,733
Lyon	84,902	314,588	399,490	182,809
Mineral	6,672	35,677	42,349	19,765
Nye	47,046	41,890	88,937	57,834
Pershing	22,869	174,562	197,429	104,898
Storey	403	683	1,087	852
Washoe	61,100	198,534	259,634	118,805
White Pine	51,075	56,170	107,243	64,652
TOTAL	1,023,061	3,171,050	4,194,112	2,124,847

Nevada State Water Plan

Appendix 2 – Population Estimates, Forecasts and Comparative Analysis

TABLES:

GRAPHS:

Foreword
to
Nevada Population Forecasts

Appendix 2 presents a series of population estimates and forecasts used in the *Nevada State Water Plan*. The Nevada Division of Water Planning, like other State agencies, is bound by Executive Order (August 15, 1989) to use the population estimates and forecasts developed by the Nevada State Demographer. However, in some cases, significant discontinuities exist between the State's official state and county population forecasts and those forecasts developed by some local governments and other agencies. Because these discontinuities have important ramifications on projected water use trends, the Division, in agreement with the State's contracting agency for population forecasts, the Nevada Department of Taxation, has utilized the latest forecasts provided by both the Clark County Department of Comprehensive Planning and the Washoe County Department of Community Development. The Division also developed the population forecasts for the remaining counties.

Population forecasts for the total state were not forecast independently, but instead, represent an aggregation of individual county population forecasts. While both sets of population forecasts are presented in this appendix for comparative analysis purposes and to provide a range of population projections, it was the forecasts developed by or adopted by the Division that constituted the forecasts used in the water plan's forecasts of water withdrawals.

Nevada Population Forecast Summary

Population Estimates--1950-1997, NDWP Modified Forecasts--1998-2020 [see below]

Year	Nevada	Carson City	Churchill County	Clark County	Douglas County	Elko County	Esmeralda County	Eureka County	Humboldt County
1950	161,145	4,198	6,188	48,811	2,023	11,703	611	897	4,870
1951	165,400	4,300	6,300	50,900	2,000	11,900	600	900	5,000
1952	175,900	4,500	6,300	57,500	2,600	12,200	600	800	5,100
1953	184,600	4,500	6,400	61,700	2,500	12,000	600	900	5,100
1954	199,800	4,600	6,500	71,300	2,700	12,400	500	900	5,100
1955	220,200	4,800	6,900	82,900	3,100	12,900	600	900	5,200
1956	240,100	4,900	7,100	96,400	3,200	13,200	600	1,000	5,400
1957	249,500	5,200	7,100	101,800	3,300	13,400	500	1,000	5,300
1958	259,200	6,200	7,200	107,400	3,300	13,500	500	900	5,300
1959	277,500	7,100	7,500	119,300	3,500	13,600	600	700	5,400
1960	287,660	8,020	8,505	128,734	3,575	12,051	634	775	5,723
1961	297,185	7,846	8,716	135,605	3,951	12,211	696	809	5,783
1962	315,599	8,220	8,640	150,922	3,969	12,187	594	825	5,806
1963	336,990	8,910	8,608	169,855	4,044	12,168	495	830	5,876
1964	360,114	9,767	8,744	189,389	4,144	12,217	382	811	5,836
1965	386,466	11,278	8,984	201,984	5,195	12,841	531	946	6,178
1966	403,696	12,361	9,367	212,623	5,503	13,299	525	940	6,363
1967	409,843	12,834	9,568	218,928	5,604	13,131	544	782	6,380
1968	429,273	13,525	9,516	233,899	5,826	13,076	546	852	6,303
1969	480,306	15,144	10,382	267,720	6,749	14,056	561	914	6,356
1970	494,990	16,054	10,650	277,230	7,067	13,946	623	938	6,380
1971	520,000	18,400	11,200	293,000	7,800	13,900	600	900	6,400
1972	546,800	20,000	11,600	307,400	8,800	15,100	600	900	6,600
1973	569,200	22,200	11,900	319,400	10,100	15,500	700	1,000	6,800
1974	596,700	23,800	11,900	336,900	11,100	15,700	700	1,100	7,000
1975	620,000	25,500	12,000	351,300	12,100	15,600	700	1,100	7,400
1976	646,800	26,100	12,000	369,500	13,100	15,800	700	1,100	7,400
1977	678,100	27,300	12,100	390,000	14,300	15,500	700	1,100	7,600
1978	719,300	30,000	12,800	412,900	16,100	15,800	700	900	7,900
1979	765,300	31,800	13,600	441,400	18,400	16,100	800	1,000	8,600
1980	800,508	32,022	13,917	463,087	19,421	17,269	777	1,198	9,449
1981	846,220	33,290	14,390	491,620	20,410	18,650	1,190	1,220	10,380
1982	870,970	34,070	14,480	507,510	20,880	19,530	1,320	1,220	10,920
1983	897,160	34,610	14,610	525,050	21,310	20,450	1,480	1,230	10,960
1984	922,580	34,950	14,810	539,030	21,990	21,420	1,680	1,260	11,190
1985	955,810	35,650	15,120	562,280	23,000	22,350	1,540	1,300	11,260
1986	993,220	36,340	15,400	587,760	24,030	23,320	1,540	1,330	11,220
1987	1,035,040	36,990	16,710	616,650	25,070	24,300	1,540	1,490	11,490
1988	1,096,130	38,280	17,790	661,690	25,900	27,010	1,440	1,510	12,050
1989	1,162,340	39,970	17,990	708,750	26,930	31,830	1,360	1,530	12,580
1990	1,236,130	40,950	18,100	770,280	28,070	33,770	1,350	1,550	13,020
1991	1,299,360	41,130	18,330	820,840	28,810	35,950	1,390	1,560	13,500
1992	1,345,035	42,140	19,210	856,350	29,470	37,420	1,410	1,580	14,000
1993	1,398,840	43,460	19,850	898,020	30,390	39,340	1,320	1,650	14,510
1994	1,491,490	44,580	20,570	971,680	34,600	41,260	1,380	1,550	15,670
1995	1,579,150	46,770	21,640	1,036,290	35,880	43,050	1,630	1,580	16,270
1996	1,684,570	48,860	22,580	1,115,940	37,480	45,630	1,490	1,650	16,460
1997	1,779,850	50,410	23,860	1,192,200	39,590	47,710	1,460	1,660	17,520
1998	1,835,458	51,771	24,579	1,233,347	40,671	49,041	1,467	1,700	17,985
1999	1,905,312	53,117	25,300	1,288,781	41,753	50,360	1,474	1,739	18,444

Year	Nevada	Carson City	Churchill County	Clark County	Douglas County	Elko County	Esmeralda County	Eureka County	Humboldt County
2000	1,986,257	54,445	26,019	1,355,368	42,834	51,665	1,480	1,777	18,897
2001	2,062,293	55,752	26,737	1,417,132	43,913	52,951	1,486	1,815	19,343
2002	2,135,420	57,034	27,453	1,476,095	44,989	54,217	1,492	1,851	19,781
2003	2,205,757	58,289	28,164	1,532,400	46,060	55,458	1,498	1,886	20,209
2004	2,274,255	59,513	28,869	1,587,021	47,124	56,673	1,503	1,920	20,627
2005	2,341,374	60,703	29,568	1,640,444	48,180	57,857	1,509	1,953	21,034
2006	2,407,472	61,856	30,258	1,693,049	49,225	59,009	1,513	1,984	21,427
2007	2,470,245	62,970	30,939	1,742,557	50,259	60,124	1,518	2,014	21,808
2008	2,529,804	64,040	31,609	1,789,103	51,279	61,200	1,522	2,042	22,174
2009	2,586,448	65,065	32,266	1,833,010	52,284	62,234	1,526	2,068	22,524
2010	2,640,306	66,041	32,910	1,874,431	53,272	63,224	1,530	2,093	22,858
2011	2,691,357	66,966	33,539	1,913,368	54,242	64,166	1,533	2,116	23,174
2012	2,739,653	67,836	34,151	1,949,898	55,191	65,058	1,536	2,137	23,473
2013	2,785,141	68,650	34,745	1,983,988	56,118	65,897	1,539	2,157	23,752
2014	2,828,168	69,405	35,320	2,016,010	57,022	66,681	1,541	2,174	24,012
2015	2,868,979	70,099	35,875	2,046,229	57,900	67,408	1,544	2,189	24,251
2016	2,907,639	70,730	36,407	2,074,731	58,751	68,075	1,545	2,202	24,468
2017	2,944,651	71,296	36,917	2,102,041	59,574	68,681	1,547	2,213	24,664
2018	2,980,108	71,795	37,402	2,128,269	60,366	69,224	1,548	2,222	24,837
2019	3,014,119	72,226	37,862	2,153,544	61,127	69,701	1,549	2,229	24,987
2020	3,046,846	72,587	38,296	2,178,046	61,854	70,113	1,550	2,233	25,114

Sources: Population estimates. Nevada State Demographer; Population Forecasts, Nevada Division of Water Planning (NDWP). Population forecasts for Clark County based on forecasts adopted by the Clark County Department of Comprehensive Planning; Population forecasts for Washoe County have been modified from the consensus forecast adopted by the Washoe County Department of Community Development.

Nevada Population Forecast Summary

Population Estimates--1950-1997, NDWP Modified Forecasts--1998-2020 [see below]

Year	Lander County	Lincoln County	Lyon County	Mineral County	Nye County	Pershing County	Storey County	Washoe County	White Pine County
1950	1,860	3,850	3,703	5,588	3,101	3,122	657	50,484	9,479
1951	1,900	3,900	3,800	5,700	3,100	3,200	600	51,600	9,700
1952	1,900	3,900	3,900	6,200	2,800	3,300	600	54,000	9,700
1953	1,800	3,900	3,700	7,100	2,800	3,400	600	58,100	9,500
1954	1,800	3,800	4,100	8,000	2,700	3,500	600	60,500	10,800
1955	1,800	3,900	4,400	9,000	2,600	3,700	700	65,200	11,600
1956	1,800	3,800	4,600	10,200	2,500	3,800	600	68,900	12,100
1957	1,800	3,800	4,600	9,100	2,600	3,900	600	73,000	12,500
1958	1,800	3,700	4,600	8,900	3,100	3,900	600	76,000	12,300
1959	1,700	3,800	4,700	7,900	3,700	3,800	600	81,300	12,300
1960	1,580	2,378	6,245	6,329	4,642	3,178	571	84,988	9,732
1961	1,635	2,164	6,655	6,327	5,716	3,092	582	85,969	9,428
1962	1,665	2,140	6,578	6,032	6,628	3,061	615	88,648	9,069
1963	1,686	2,113	6,663	5,728	6,047	2,848	597	91,705	8,817
1964	1,822	2,038	6,823	5,500	5,575	2,716	551	95,289	8,510
1965	2,032	2,162	7,146	5,710	5,453	2,822	663	103,420	9,121
1966	2,211	2,398	7,445	6,072	5,348	2,876	688	106,356	9,321
1967	2,583	2,316	7,584	6,441	5,165	2,693	679	105,541	9,070
1968	2,451	2,334	7,747	6,694	5,376	2,644	634	108,776	9,074
1969	2,615	2,454	7,934	7,111	5,699	2,656	696	119,192	10,067
1970	2,653	2,526	8,437	6,961	5,459	2,656	696	122,574	10,140
1971	2,600	2,400	9,300	6,600	4,900	2,600	700	128,600	10,100
1972	2,700	2,300	9,700	6,900	5,000	2,700	800	135,400	10,300
1973	2,700	2,400	10,100	7,000	5,000	2,600	900	141,000	9,900
1974	2,800	2,500	10,200	7,000	5,200	2,600	900	147,400	9,900
1975	3,000	2,800	10,400	6,800	5,500	2,800	900	152,200	9,900
1976	3,200	2,900	10,500	6,500	5,800	2,900	1,000	158,700	9,600
1977	3,300	3,000	10,800	6,100	5,900	3,000	1,000	167,800	8,600
1978	3,500	3,400	11,300	5,900	7,400	3,100	1,100	177,600	8,900
1979	3,600	3,600	12,400	6,100	8,200	3,100	1,300	187,200	8,100
1980	4,076	3,732	13,594	6,217	9,048	3,408	1,503	193,623	8,167
1981	5,010	3,760	14,160	6,230	11,000	3,610	1,590	201,680	8,030
1982	5,000	3,770	14,600	6,220	13,040	3,720	1,690	205,130	7,870
1983	4,720	3,760	15,080	6,200	13,480	3,710	1,730	210,990	7,790
1984	4,590	3,770	15,680	6,180	14,570	3,650	1,780	218,320	7,710
1985	4,520	3,780	16,460	6,180	14,570	3,660	1,850	224,580	7,710
1986	4,510	3,780	17,160	6,200	14,680	3,830	1,960	232,270	7,890
1987	4,600	3,790	18,340	6,270	15,200	4,110	2,130	238,360	8,000
1988	5,480	3,800	19,220	6,400	15,760	4,380	2,140	244,890	8,390
1989	6,270	3,800	20,150	6,460	17,540	4,470	2,480	251,580	8,650
1990	6,340	3,810	20,590	6,470	18,190	4,550	2,560	257,120	9,410
1991	6,370	3,870	21,430	6,460	19,110	4,700	2,720	263,710	9,480
1992	6,380	4,080	22,410	6,560	20,080	4,800	2,820	266,755	9,570
1993	6,430	4,130	23,750	6,510	20,550	4,690	2,850	271,850	9,540
1994	6,410	4,320	25,360	6,410	20,720	4,790	3,100	279,820	9,270
1995	6,440	4,110	26,580	6,700	23,050	5,140	3,200	291,050	9,770
1996	6,710	4,020	28,480	6,810	25,240	6,260	3,320	303,240	10,400
1997	7,030	4,110	30,370	6,860	27,610	6,600	3,520	308,700	10,640
1998	7,097	4,130	31,479	6,893	28,680	6,759	3,605	315,488	10,766
1999	7,163	4,149	32,596	6,924	29,755	6,915	3,690	322,264	10,889

Year	Lander County	Lincoln County	Lyon County	Mineral County	Nye County	Pershing County	Storey County	Washoe County	White Pine County
2000	7,226	4,167	33,721	6,955	30,834	7,068	3,773	329,021	11,007
2001	7,287	4,184	34,850	6,984	31,913	7,218	3,855	335,752	11,120
2002	7,345	4,201	35,983	7,011	32,990	7,364	3,936	342,448	11,229
2003	7,401	4,217	37,116	7,037	34,062	7,506	4,016	349,104	11,334
2004	7,454	4,232	38,248	7,062	35,127	7,644	4,094	355,710	11,433
2005	7,505	4,247	39,377	7,086	36,181	7,777	4,170	362,260	11,527
2006	7,553	4,260	40,499	7,108	37,221	7,905	4,244	368,745	11,616
2007	7,598	4,273	41,613	7,128	38,244	8,027	4,316	375,158	11,700
2008	7,640	4,285	42,715	7,148	39,248	8,144	4,386	381,490	11,778
2009	7,680	4,296	43,805	7,165	40,230	8,255	4,454	387,735	11,850
2010	7,717	4,307	44,878	7,182	41,185	8,359	4,519	393,884	11,917
2011	7,751	4,316	45,932	7,196	42,112	8,457	4,581	399,929	11,978
2012	7,782	4,325	46,966	7,210	43,007	8,548	4,640	405,863	12,033
2013	7,810	4,332	47,976	7,221	43,867	8,632	4,697	411,677	12,082
2014	7,835	4,339	48,959	7,232	44,689	8,708	4,751	417,364	12,125
2015	7,857	4,345	49,914	7,241	45,471	8,777	4,801	422,917	12,162
2016	7,876	4,351	50,837	7,248	46,210	8,838	4,848	428,327	12,193
2017	7,892	4,355	51,727	7,254	46,903	8,891	4,892	433,588	12,217
2018	7,904	4,358	52,580	7,258	47,548	8,936	4,932	438,691	12,235
2019	7,914	4,361	53,395	7,261	48,143	8,973	4,968	443,631	12,247
2020	7,920	4,363	54,170	7,262	48,684	9,001	5,001	448,400	12,253

Sources: Population estimates, Nevada State Demographer; Population Forecasts, Nevada Division of Water Planning (NDWP). Population forecasts for Clark County based on forecasts adopted by the Clark County Department of Comprehensive Planning; Population forecasts for Washoe County have been modified from the consensus forecast adopted by the Washoe County Department of Community Development.

Nevada Population Share Analysis Summary

Population Shares Based on Population Estimates and Forecasts [see below]

Year	Nevada	Carson City	Churchill County	Clark County	Douglas County	Elko County	Esmeralda County	Eureka County	Humboldt County
1950	100.00%	2.61%	3.84%	30.29%	1.26%	7.26%	0.38%	0.56%	3.02%
1951	100.00%	2.60%	3.81%	30.77%	1.21%	7.19%	0.36%	0.54%	3.02%
1952	100.00%	2.56%	3.58%	32.69%	1.48%	6.94%	0.34%	0.45%	2.90%
1953	100.00%	2.44%	3.47%	33.42%	1.35%	6.50%	0.33%	0.49%	2.76%
1954	100.00%	2.30%	3.25%	35.69%	1.35%	6.21%	0.25%	0.45%	2.55%
1955	100.00%	2.18%	3.13%	37.65%	1.41%	5.86%	0.27%	0.41%	2.36%
1956	100.00%	2.04%	2.96%	40.15%	1.33%	5.50%	0.25%	0.42%	2.25%
1957	100.00%	2.08%	2.85%	40.80%	1.32%	5.37%	0.20%	0.40%	2.12%
1958	100.00%	2.39%	2.78%	41.44%	1.27%	5.21%	0.19%	0.35%	2.04%
1959	100.00%	2.56%	2.70%	42.99%	1.26%	4.90%	0.22%	0.25%	1.95%
1960	100.00%	2.79%	2.96%	44.75%	1.24%	4.19%	0.22%	0.27%	1.99%
1961	100.00%	2.64%	2.93%	45.63%	1.33%	4.11%	0.23%	0.27%	1.95%
1962	100.00%	2.60%	2.74%	47.82%	1.26%	3.86%	0.19%	0.26%	1.84%
1963	100.00%	2.64%	2.55%	50.40%	1.20%	3.61%	0.15%	0.25%	1.74%
1964	100.00%	2.71%	2.43%	52.59%	1.15%	3.39%	0.11%	0.23%	1.62%
1965	100.00%	2.92%	2.32%	52.26%	1.34%	3.32%	0.14%	0.24%	1.60%
1966	100.00%	3.06%	2.32%	52.67%	1.36%	3.29%	0.13%	0.23%	1.58%
1967	100.00%	3.13%	2.33%	53.42%	1.37%	3.20%	0.13%	0.19%	1.56%
1968	100.00%	3.15%	2.22%	54.49%	1.36%	3.05%	0.13%	0.20%	1.47%
1969	100.00%	3.15%	2.16%	55.74%	1.41%	2.93%	0.12%	0.19%	1.32%
1970	100.00%	3.24%	2.15%	56.01%	1.43%	2.82%	0.13%	0.19%	1.29%
1971	100.00%	3.54%	2.15%	56.35%	1.50%	2.67%	0.12%	0.17%	1.23%
1972	100.00%	3.66%	2.12%	56.22%	1.61%	2.76%	0.11%	0.16%	1.21%
1973	100.00%	3.90%	2.09%	56.11%	1.77%	2.72%	0.12%	0.18%	1.19%
1974	100.00%	3.99%	1.99%	56.46%	1.86%	2.63%	0.12%	0.18%	1.17%
1975	100.00%	4.11%	1.94%	56.66%	1.95%	2.52%	0.11%	0.18%	1.19%
1976	100.00%	4.04%	1.86%	57.13%	2.03%	2.44%	0.11%	0.17%	1.14%
1977	100.00%	4.03%	1.78%	57.51%	2.11%	2.29%	0.10%	0.16%	1.12%
1978	100.00%	4.17%	1.78%	57.40%	2.24%	2.20%	0.10%	0.13%	1.10%
1979	100.00%	4.16%	1.78%	57.68%	2.40%	2.10%	0.10%	0.13%	1.12%
1980	100.00%	4.00%	1.74%	57.85%	2.43%	2.16%	0.10%	0.15%	1.18%
1981	100.00%	3.93%	1.70%	58.10%	2.41%	2.20%	0.14%	0.14%	1.23%
1982	100.00%	3.91%	1.66%	58.27%	2.40%	2.24%	0.15%	0.14%	1.25%
1983	100.00%	3.86%	1.63%	58.52%	2.38%	2.28%	0.16%	0.14%	1.22%
1984	100.00%	3.79%	1.61%	58.43%	2.38%	2.32%	0.18%	0.14%	1.21%
1985	100.00%	3.73%	1.58%	58.83%	2.41%	2.34%	0.16%	0.14%	1.18%
1986	100.00%	3.66%	1.55%	59.18%	2.42%	2.35%	0.16%	0.13%	1.13%
1987	100.00%	3.57%	1.61%	59.58%	2.42%	2.35%	0.15%	0.14%	1.11%
1988	100.00%	3.49%	1.62%	60.37%	2.36%	2.46%	0.13%	0.14%	1.10%
1989	100.00%	3.44%	1.55%	60.98%	2.32%	2.74%	0.12%	0.13%	1.08%
1990	100.00%	3.31%	1.46%	62.31%	2.27%	2.73%	0.11%	0.13%	1.05%
1991	100.00%	3.17%	1.41%	63.17%	2.22%	2.77%	0.11%	0.12%	1.04%
1992	100.00%	3.13%	1.43%	63.67%	2.19%	2.78%	0.10%	0.12%	1.04%
1993	100.00%	3.11%	1.42%	64.20%	2.17%	2.81%	0.09%	0.12%	1.04%
1994	100.00%	2.99%	1.38%	65.15%	2.32%	2.77%	0.09%	0.10%	1.05%
1995	100.00%	2.96%	1.37%	65.62%	2.27%	2.73%	0.10%	0.10%	1.03%
1996	100.00%	2.90%	1.34%	66.24%	2.22%	2.71%	0.09%	0.10%	0.98%
1997	100.00%	2.83%	1.34%	66.98%	2.22%	2.68%	0.08%	0.09%	0.98%
1998	100.00%	2.82%	1.34%	67.20%	2.22%	2.67%	0.08%	0.09%	0.98%
1999	100.00%	2.79%	1.33%	67.64%	2.19%	2.64%	0.08%	0.09%	0.97%

Year	Nevada	Carson City	Churchill County	Clark County	Douglas County	Elko County	Esmeralda County	Eureka County	Humboldt County
2000	100.00%	2.74%	1.31%	68.24%	2.16%	2.60%	0.07%	0.09%	0.95%
2001	100.00%	2.70%	1.30%	68.72%	2.13%	2.57%	0.07%	0.09%	0.94%
2002	100.00%	2.67%	1.29%	69.12%	2.11%	2.54%	0.07%	0.09%	0.93%
2003	100.00%	2.64%	1.28%	69.47%	2.09%	2.51%	0.07%	0.09%	0.92%
2004	100.00%	2.62%	1.27%	69.78%	2.07%	2.49%	0.07%	0.08%	0.91%
2005	100.00%	2.59%	1.26%	70.06%	2.06%	2.47%	0.06%	0.08%	0.90%
2006	100.00%	2.57%	1.26%	70.32%	2.04%	2.45%	0.06%	0.08%	0.89%
2007	100.00%	2.55%	1.25%	70.54%	2.03%	2.43%	0.06%	0.08%	0.88%
2008	100.00%	2.53%	1.25%	70.72%	2.03%	2.42%	0.06%	0.08%	0.88%
2009	100.00%	2.52%	1.25%	70.87%	2.02%	2.41%	0.06%	0.08%	0.87%
2010	100.00%	2.50%	1.25%	70.99%	2.02%	2.39%	0.06%	0.08%	0.87%
2011	100.00%	2.49%	1.25%	71.09%	2.02%	2.38%	0.06%	0.08%	0.86%
2012	100.00%	2.48%	1.25%	71.17%	2.01%	2.37%	0.06%	0.08%	0.86%
2013	100.00%	2.46%	1.25%	71.23%	2.01%	2.37%	0.06%	0.08%	0.85%
2014	100.00%	2.45%	1.25%	71.28%	2.02%	2.36%	0.05%	0.08%	0.85%
2015	100.00%	2.44%	1.25%	71.32%	2.02%	2.35%	0.05%	0.08%	0.85%
2016	100.00%	2.43%	1.25%	71.35%	2.02%	2.34%	0.05%	0.08%	0.84%
2017	100.00%	2.42%	1.25%	71.39%	2.02%	2.33%	0.05%	0.08%	0.84%
2018	100.00%	2.41%	1.26%	71.42%	2.03%	2.32%	0.05%	0.07%	0.83%
2019	100.00%	2.40%	1.26%	71.45%	2.03%	2.31%	0.05%	0.07%	0.83%
2020	100.00%	2.38%	1.26%	71.49%	2.03%	2.30%	0.05%	0.07%	0.82%

Sources: Population estimates, Nevada State Demographer; Population Forecasts, Nevada Division of Water Planning (NDWP). Population forecasts for Clark County based on forecasts adopted by the Clark County Department of Comprehensive Planning; Population forecasts for Washoe County have been modified from the consensus forecast adopted by the Washoe County Department of Community Development.

Nevada Population Share Analysis Summary

Population Shares Based on Population Estimates and Forecasts [see below]

Year	Lander County	Lincoln County	Lyon County	Mineral County	Nye County	Pershing County	Storey County	Washoe County	White Pine County
1950	1.15%	2.39%	2.30%	3.47%	1.92%	1.94%	0.41%	31.33%	5.88%
1951	1.15%	2.36%	2.30%	3.45%	1.87%	1.93%	0.36%	31.20%	5.86%
1952	1.08%	2.22%	2.22%	3.52%	1.59%	1.88%	0.34%	30.70%	5.51%
1953	0.98%	2.11%	2.00%	3.85%	1.52%	1.84%	0.33%	31.47%	5.15%
1954	0.90%	1.90%	2.05%	4.00%	1.35%	1.75%	0.30%	30.28%	5.41%
1955	0.82%	1.77%	2.00%	4.09%	1.18%	1.68%	0.32%	29.61%	5.27%
1956	0.75%	1.58%	1.92%	4.25%	1.04%	1.58%	0.25%	28.70%	5.04%
1957	0.72%	1.52%	1.84%	3.65%	1.04%	1.56%	0.24%	29.26%	5.01%
1958	0.69%	1.43%	1.77%	3.43%	1.20%	1.50%	0.23%	29.32%	4.75%
1959	0.61%	1.37%	1.69%	2.85%	1.33%	1.37%	0.22%	29.30%	4.43%
1960	0.55%	0.83%	2.17%	2.20%	1.61%	1.10%	0.20%	29.54%	3.38%
1961	0.55%	0.73%	2.24%	2.13%	1.92%	1.04%	0.20%	28.93%	3.17%
1962	0.53%	0.68%	2.08%	1.91%	2.10%	0.97%	0.19%	28.09%	2.87%
1963	0.50%	0.63%	1.98%	1.70%	1.79%	0.85%	0.18%	27.21%	2.62%
1964	0.51%	0.57%	1.89%	1.53%	1.55%	0.75%	0.15%	26.46%	2.36%
1965	0.53%	0.56%	1.85%	1.48%	1.41%	0.73%	0.17%	26.76%	2.36%
1966	0.55%	0.59%	1.84%	1.50%	1.32%	0.71%	0.17%	26.35%	2.31%
1967	0.63%	0.57%	1.85%	1.57%	1.26%	0.66%	0.17%	25.75%	2.21%
1968	0.57%	0.54%	1.80%	1.56%	1.25%	0.62%	0.15%	25.34%	2.11%
1969	0.54%	0.51%	1.65%	1.48%	1.19%	0.55%	0.14%	24.82%	2.10%
1970	0.54%	0.51%	1.70%	1.41%	1.10%	0.54%	0.14%	24.76%	2.05%
1971	0.50%	0.46%	1.79%	1.27%	0.94%	0.50%	0.13%	24.73%	1.94%
1972	0.49%	0.42%	1.77%	1.26%	0.91%	0.49%	0.15%	24.76%	1.88%
1973	0.47%	0.42%	1.77%	1.23%	0.88%	0.46%	0.16%	24.77%	1.74%
1974	0.47%	0.42%	1.71%	1.17%	0.87%	0.44%	0.15%	24.70%	1.66%
1975	0.48%	0.45%	1.68%	1.10%	0.89%	0.45%	0.15%	24.55%	1.60%
1976	0.49%	0.45%	1.62%	1.00%	0.90%	0.45%	0.15%	24.54%	1.48%
1977	0.49%	0.44%	1.59%	0.90%	0.87%	0.44%	0.15%	24.75%	1.27%
1978	0.49%	0.47%	1.57%	0.82%	1.03%	0.43%	0.15%	24.69%	1.24%
1979	0.47%	0.47%	1.62%	0.80%	1.07%	0.41%	0.17%	24.46%	1.06%
1980	0.51%	0.47%	1.70%	0.78%	1.13%	0.43%	0.19%	24.19%	1.02%
1981	0.59%	0.44%	1.67%	0.74%	1.30%	0.43%	0.19%	23.83%	0.95%
1982	0.57%	0.43%	1.68%	0.71%	1.50%	0.43%	0.19%	23.55%	0.90%
1983	0.53%	0.42%	1.68%	0.69%	1.50%	0.41%	0.19%	23.52%	0.87%
1984	0.50%	0.41%	1.70%	0.67%	1.58%	0.40%	0.19%	23.66%	0.84%
1985	0.47%	0.40%	1.72%	0.65%	1.52%	0.38%	0.19%	23.50%	0.81%
1986	0.45%	0.38%	1.73%	0.62%	1.48%	0.39%	0.20%	23.39%	0.79%
1987	0.44%	0.37%	1.77%	0.61%	1.47%	0.40%	0.21%	23.03%	0.77%
1988	0.50%	0.35%	1.75%	0.58%	1.44%	0.40%	0.20%	22.34%	0.77%
1989	0.54%	0.33%	1.73%	0.56%	1.51%	0.38%	0.21%	21.64%	0.74%
1990	0.51%	0.31%	1.67%	0.52%	1.47%	0.37%	0.21%	20.80%	0.76%
1991	0.49%	0.30%	1.65%	0.50%	1.47%	0.36%	0.21%	20.30%	0.73%
1992	0.47%	0.30%	1.67%	0.49%	1.49%	0.36%	0.21%	19.83%	0.71%
1993	0.46%	0.30%	1.70%	0.47%	1.47%	0.34%	0.20%	19.43%	0.68%
1994	0.43%	0.29%	1.70%	0.43%	1.39%	0.32%	0.21%	18.76%	0.62%
1995	0.41%	0.26%	1.68%	0.42%	1.46%	0.33%	0.20%	18.43%	0.62%
1996	0.40%	0.24%	1.69%	0.40%	1.50%	0.37%	0.20%	18.00%	0.62%
1997	0.39%	0.23%	1.71%	0.39%	1.55%	0.37%	0.20%	17.34%	0.60%
1998	0.39%	0.22%	1.72%	0.38%	1.56%	0.37%	0.20%	17.19%	0.59%
1999	0.38%	0.22%	1.71%	0.36%	1.56%	0.36%	0.19%	16.91%	0.57%

Year	Lander County	Lincoln County	Lyon County	Mineral County	Nye County	Pershing County	Storey County	Washoe County	White Pine County
2000	0.36%	0.21%	1.70%	0.35%	1.55%	0.36%	0.19%	16.56%	0.55%
2001	0.35%	0.20%	1.69%	0.34%	1.55%	0.35%	0.19%	16.28%	0.54%
2002	0.34%	0.20%	1.69%	0.33%	1.54%	0.34%	0.18%	16.04%	0.53%
2003	0.34%	0.19%	1.68%	0.32%	1.54%	0.34%	0.18%	15.83%	0.51%
2004	0.33%	0.19%	1.68%	0.31%	1.54%	0.34%	0.18%	15.64%	0.50%
2005	0.32%	0.18%	1.68%	0.30%	1.55%	0.33%	0.18%	15.47%	0.49%
2006	0.31%	0.18%	1.68%	0.30%	1.55%	0.33%	0.18%	15.32%	0.48%
2007	0.31%	0.17%	1.68%	0.29%	1.55%	0.32%	0.17%	15.19%	0.47%
2008	0.30%	0.17%	1.69%	0.28%	1.55%	0.32%	0.17%	15.08%	0.47%
2009	0.30%	0.17%	1.69%	0.28%	1.56%	0.32%	0.17%	14.99%	0.46%
2010	0.29%	0.16%	1.70%	0.27%	1.56%	0.32%	0.17%	14.92%	0.45%
2011	0.29%	0.16%	1.71%	0.27%	1.56%	0.31%	0.17%	14.86%	0.45%
2012	0.28%	0.16%	1.71%	0.26%	1.57%	0.31%	0.17%	14.81%	0.44%
2013	0.28%	0.16%	1.72%	0.26%	1.58%	0.31%	0.17%	14.78%	0.43%
2014	0.28%	0.15%	1.73%	0.26%	1.58%	0.31%	0.17%	14.76%	0.43%
2015	0.27%	0.15%	1.74%	0.25%	1.58%	0.31%	0.17%	14.74%	0.42%
2016	0.27%	0.15%	1.75%	0.25%	1.59%	0.30%	0.17%	14.73%	0.42%
2017	0.27%	0.15%	1.76%	0.25%	1.59%	0.30%	0.17%	14.72%	0.41%
2018	0.27%	0.15%	1.76%	0.24%	1.60%	0.30%	0.17%	14.72%	0.41%
2019	0.26%	0.14%	1.77%	0.24%	1.60%	0.30%	0.16%	14.72%	0.41%
2020	0.26%	0.14%	1.78%	0.24%	1.60%	0.30%	0.16%	14.72%	0.40%

Sources: Population estimates, Nevada State Demographer; Population Forecasts, Nevada Division of Water Planning (NDWP). Population forecasts for Clark County based on forecasts adopted by the Clark County Department of Comprehensive Planning; Population forecasts for Washoe County have been modified from the consensus forecast adopted by the Washoe County Department of Community Development.

Nevada Population Growth Estimates and Forecasts

Population Estimates--1950-1997, NDWP Population Forecasts--2020

Annual Average Growth Are Rates of Growth for Decennial Periods (Persons and percent)

State/County	1950 Population Estimate	1960 Population Estimate	1970 Population Estimate	1980 Population Estimate	1990 Population Estimate	1997 Population Estimate	2020 NDWP Population Forecast	1997-2020 Population and Percent Change
NEVADA	**161,145**	**287,660**	**494,990**	**800,508**	**1,236,130**	**1,779,850**	**3,046,846**	**1,266,996**
Annual Average Growth	--	5.97%	5.58%	4.92%	4.44%	5.35%	2.59%	71.2%
Carson City	4,198	8,020	16,054	32,022	40,950	50,410	72,587	22,177
Annual Average Growth	--	6.69%	7.19%	7.15%	2.49%	3.01%	1.75%	44.0%
Churchill County	6,188	8,505	10,650	13,917	18,100	23,860	38,296	14,436
Annual Average Growth	--	3.23%	2.27%	2.71%	2.66%	4.03%	2.28%	60.5%
Clark County	48,811	128,734	277,230	463,087	770,280	1,192,200	2,178,046	985,846
Annual Average Growth	--	10.18%	7.97%	5.26%	5.22%	6.44%	2.91%	82.7%
Douglas County	2,023	3,575	7,067	19,421	28,070	39,590	61,854	22,264
Annual Average Growth	--	5.86%	7.05%	10.64%	3.75%	5.04%	2.15%	56.2%
Elko County	11,703	12,051	13,946	17,269	33,770	47,710	70,113	22,403
Annual Average Growth	--	0.29%	1.47%	2.16%	6.94%	5.06%	1.85%	47.0%
Esmeralda County	611	634	623	777	1,350	1,460	1,550	90
Annual Average Growth	--	0.37%	-0.17%	2.23%	5.68%	1.13%	0.28%	6.2%
Eureka County	897	775	938	1,198	1,550	1,660	2,233	573
Annual Average Growth	--	-1.45%	1.93%	2.48%	2.61%	0.98%	1.42%	34.5%
Humboldt County	4,870	5,723	6,380	9,449	13,020	17,520	25,114	7,594
Annual Average Growth	--	1.63%	1.09%	4.01%	3.26%	4.33%	1.73%	43.3%
Lander County	1,860	1,580	2,653	4,076	6,340	7,030	7,920	890
Annual Average Growth	--	-1.62%	5.32%	4.39%	4.52%	1.49%	0.57%	12.7%
Lincoln County	3,850	2,378	2,526	3,732	3,810	4,110	4,363	253
Annual Average Growth	--	-4.70%	0.61%	3.98%	0.21%	1.09%	0.28%	6.2%
Lyon County	3,703	6,245	8,437	13,594	20,590	30,370	54,170	23,800
Annual Average Growth	--	5.37%	3.05%	4.89%	4.24%	5.71%	2.79%	78.4%
Mineral County	5,588	6,329	6,961	6,217	6,470	6,860	7,262	402
Annual Average Growth	--	1.25%	0.96%	-1.12%	0.40%	0.84%	0.27%	5.9%
Nye County	3,101	4,642	5,459	9,048	18,190	27,610	48,684	21,074
Annual Average Growth	--	4.12%	1.63%	5.18%	7.23%	6.14%	2.74%	76.3%
Pershing County	3,122	3,178	2,656	3,408	4,550	6,600	9,001	2,401
Annual Average Growth	--	0.18%	-1.78%	2.52%	2.93%	5.46%	1.49%	36.4%
Storey County	657	571	696	1,503	2,560	3,520	5,001	1,481
Annual Average Growth	--	-1.39%	2.00%	8.00%	5.47%	4.65%	1.69%	42.1%
Washoe County	50,484	84,988	122,574	193,623	257,120	308,700	448,400	139,700
Annual Average Growth	--	5.35%	3.73%	4.68%	2.88%	2.65%	1.79%	45.3%
White Pine County	9,479	9,732	10,140	8,167	9,410	10,640	12,253	1,613
Annual Average Growth	--	0.26%	0.41%	-2.14%	1.43%	1.77%	0.67%	15.2%

Note: Annual average growth rates are annual averages measured from the preceding decennial population estimate.

Data Sources: Population estimates--Nevada State Demographer; population forecasts--Nevada Division of Water Planning (NDWP). Forecasts for Clark County are based on population forecasts adopted by the Clark County Department of Comprehensive Planning; Forecasts for Washoe County are based on population forecasts adopted by the Washoe County Department of Community Development.

Nevada Population Share Estimates and Forecasts

Population Estimates--1950-1997, NDWP Population Forecasts--2020

Population Estimates and Shares of Total State Population (Persons and percent of total)

State/County	1950 Population Estimate	1960 Population Estimate	1970 Population Estimate	1980 Population Estimate	1990 Population Estimate	1997 Population Estimate	2020 NDWP Population Forecast	1997-2020 Population and Share Change
NEVADA	**161,145**	**287,660**	**494,990**	**800,508**	**1,236,130**	**1,779,850**	**3,046,846**	**1,266,996**
Carson City	4,198	8,020	16,054	32,022	40,950	50,410	72,587	22,177
Percent Total State	2.61%	2.79%	3.24%	4.00%	3.31%	2.83%	2.38%	-0.45%
Churchill County	6,188	8,505	10,650	13,917	18,100	23,860	38,296	14,436
Percent Total State	3.84%	2.96%	2.15%	1.74%	1.46%	1.34%	1.26%	-0.08%
Clark County	48,811	128,734	277,230	463,087	770,280	1,192,200	2,178,046	985,846
Percent Total State	30.29%	44.75%	56.01%	57.85%	62.31%	66.98%	71.49%	4.50%
Douglas County	2,023	3,575	7,067	19,421	28,070	39,590	61,854	22,264
Percent Total State	1.26%	1.24%	1.43%	2.43%	2.27%	2.22%	2.03%	-0.19%
Elko County	11,703	12,051	13,946	17,269	33,770	47,710	70,113	22,403
Percent Total State	7.26%	4.19%	2.82%	2.16%	2.73%	2.68%	2.30%	-0.38%
Esmeralda County	611	634	623	777	1,350	1,460	1,550	90
Percent Total State	0.38%	0.22%	0.13%	0.10%	0.11%	0.08%	0.05%	-0.03%
Eureka County	897	775	938	1,198	1,550	1,660	2,233	573
Percent Total State	0.56%	0.27%	0.19%	0.15%	0.13%	0.09%	0.07%	-0.02%
Humboldt County	4,870	5,723	6,380	9,449	13,020	17,520	25,114	7,594
Percent Total State	3.02%	1.99%	1.29%	1.18%	1.05%	0.98%	0.82%	-0.16%
Lander County	1,860	1,580	2,653	4,076	6,340	7,030	7,920	890
Percent Total State	1.15%	0.55%	0.54%	0.51%	0.51%	0.39%	0.26%	-0.14%
Lincoln County	3,850	2,378	2,526	3,732	3,810	4,110	4,363	253
Percent Total State	2.39%	0.83%	0.51%	0.47%	0.31%	0.23%	0.14%	-0.09%
Lyon County	3,703	6,245	8,437	13,594	20,590	30,370	54,170	23,800
Percent Total State	2.30%	2.17%	1.70%	1.70%	1.67%	1.71%	1.78%	0.07%
Mineral County	5,588	6,329	6,961	6,217	6,470	6,860	7,262	402
Percent Total State	3.47%	2.20%	1.41%	0.78%	0.52%	0.39%	0.24%	-0.15%
Nye County	3,101	4,642	5,459	9,048	18,190	27,610	48,684	21,074
Percent Total State	1.92%	1.61%	1.10%	1.13%	1.47%	1.55%	1.60%	0.05%
Pershing County	3,122	3,178	2,656	3,408	4,550	6,600	9,001	2,401
Percent Total State	1.94%	1.10%	0.54%	0.43%	0.37%	0.37%	0.30%	-0.08%
Storey County	657	571	696	1,503	2,560	3,520	5,001	1,481
Percent Total State	0.41%	0.20%	0.14%	0.19%	0.21%	0.20%	0.16%	-0.03%
Washoe County	50,484	84,988	122,574	193,623	257,120	308,700	448,400	139,700
Percent Total State	31.33%	29.54%	24.76%	24.19%	20.80%	17.34%	14.72%	-2.63%
White Pine County	9,479	9,732	10,140	8,167	9,410	10,640	12,253	1,613
Percent Total State	5.88%	3.38%	2.05%	1.02%	0.76%	0.60%	0.40%	-0.20%

Note: Percents of Total State measure each county's share of the state's total population.

Data Sources: Population estimates--Nevada State Demographer; population forecasts--Nevada Division of Water Planning (NDWP). Forecasts for Clark County are based on population forecasts adopted by the Clark County Department of Comprehensive Planning; Forecasts for Washoe County are based on population forecasts adopted by the Washoe County Department of Community Development.

Nevada Population Estimates and Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Forecasted Population Difference (Persons)	Percent Difference
1950	161,145	--	--	161,145	--	--	--	--
1951	165,400	4,255	2.64%	165,400	4,255	2.64%	--	--
1952	175,900	10,500	6.35%	175,900	10,500	6.35%	--	--
1953	184,600	8,700	4.95%	184,600	8,700	4.95%	--	--
1954	199,800	15,200	8.23%	199,800	15,200	8.23%	--	--
1955	220,200	20,400	10.21%	220,200	20,400	10.21%	--	--
1956	240,100	19,900	9.04%	240,100	19,900	9.04%	--	--
1957	249,500	9,400	3.92%	249,500	9,400	3.92%	--	--
1958	259,200	9,700	3.89%	259,200	9,700	3.89%	--	--
1959	277,500	18,300	7.06%	277,500	18,300	7.06%	--	--
1960	287,660	10,160	3.66%	287,660	10,160	3.66%	--	--
1961	297,185	9,525	3.31%	297,185	9,525	3.31%	--	--
1962	315,599	18,414	6.20%	315,599	18,414	6.20%	--	--
1963	336,990	21,391	6.78%	336,990	21,391	6.78%	--	--
1964	360,114	23,124	6.86%	360,114	23,124	6.86%	--	--
1965	386,466	26,352	7.32%	386,466	26,352	7.32%	--	--
1966	403,696	17,230	4.46%	403,696	17,230	4.46%	--	--
1967	409,843	6,147	1.52%	409,843	6,147	1.52%	--	--
1968	429,273	19,430	4.74%	429,273	19,430	4.74%	--	--
1969	480,306	51,033	11.89%	480,306	51,033	11.89%	--	--
1970	494,990	14,684	3.06%	494,990	14,684	3.06%	--	--
1971	520,000	25,010	5.05%	520,000	25,010	5.05%	--	--
1972	546,800	26,800	5.15%	546,800	26,800	5.15%	--	--
1973	569,200	22,400	4.10%	569,200	22,400	4.10%	--	--
1974	596,700	27,500	4.83%	596,700	27,500	4.83%	--	--
1975	620,000	23,300	3.90%	620,000	23,300	3.90%	--	--
1976	646,800	26,800	4.32%	646,800	26,800	4.32%	--	--
1977	678,100	31,300	4.84%	678,100	31,300	4.84%	--	--
1978	719,300	41,200	6.08%	719,300	41,200	6.08%	--	--
1979	765,300	46,000	6.40%	765,300	46,000	6.40%	--	--
1980	800,508	35,208	4.60%	800,508	35,208	4.60%	--	--
1981	846,220	45,712	5.71%	846,220	45,712	5.71%	--	--
1982	870,970	24,750	2.92%	870,970	24,750	2.92%	--	--
1983	897,160	26,190	3.01%	897,160	26,190	3.01%	--	--
1984	922,580	25,420	2.83%	922,580	25,420	2.83%	--	--
1985	955,810	33,230	3.60%	955,810	33,230	3.60%	--	--
1986	993,220	37,410	3.91%	993,220	37,410	3.91%	--	--
1987	1,035,040	41,820	4.21%	1,035,040	41,820	4.21%	--	--
1988	1,096,130	61,090	5.90%	1,096,130	61,090	5.90%	--	--
1989	1,162,340	66,210	6.04%	1,162,340	66,210	6.04%	--	--
1990	1,236,130	73,790	6.35%	1,236,130	73,790	6.35%	--	--
1991	1,299,360	63,230	5.12%	1,299,360	63,230	5.12%	--	--
1992	1,345,035	45,675	3.52%	1,345,035	45,675	3.52%	--	--
1993	1,398,840	53,805	4.00%	1,398,840	53,805	4.00%	--	--
1994	1,491,490	92,650	6.62%	1,491,490	92,650	6.62%	--	--
1995	1,579,150	87,660	5.88%	1,579,150	87,660	5.88%	--	--
1996	1,684,570	105,420	6.68%	1,684,570	105,420	6.68%	--	--
1997	1,779,850	95,280	5.66%	1,779,850	95,280	5.66%	--	--
1998	1,874,760	94,910	5.33%	1,835,458	55,608	3.12%	39,302	2.10%
1999	1,961,660	86,900	4.64%	1,905,312	69,854	3.81%	56,348	2.87%

Nevada Population Estimates and Forecasts

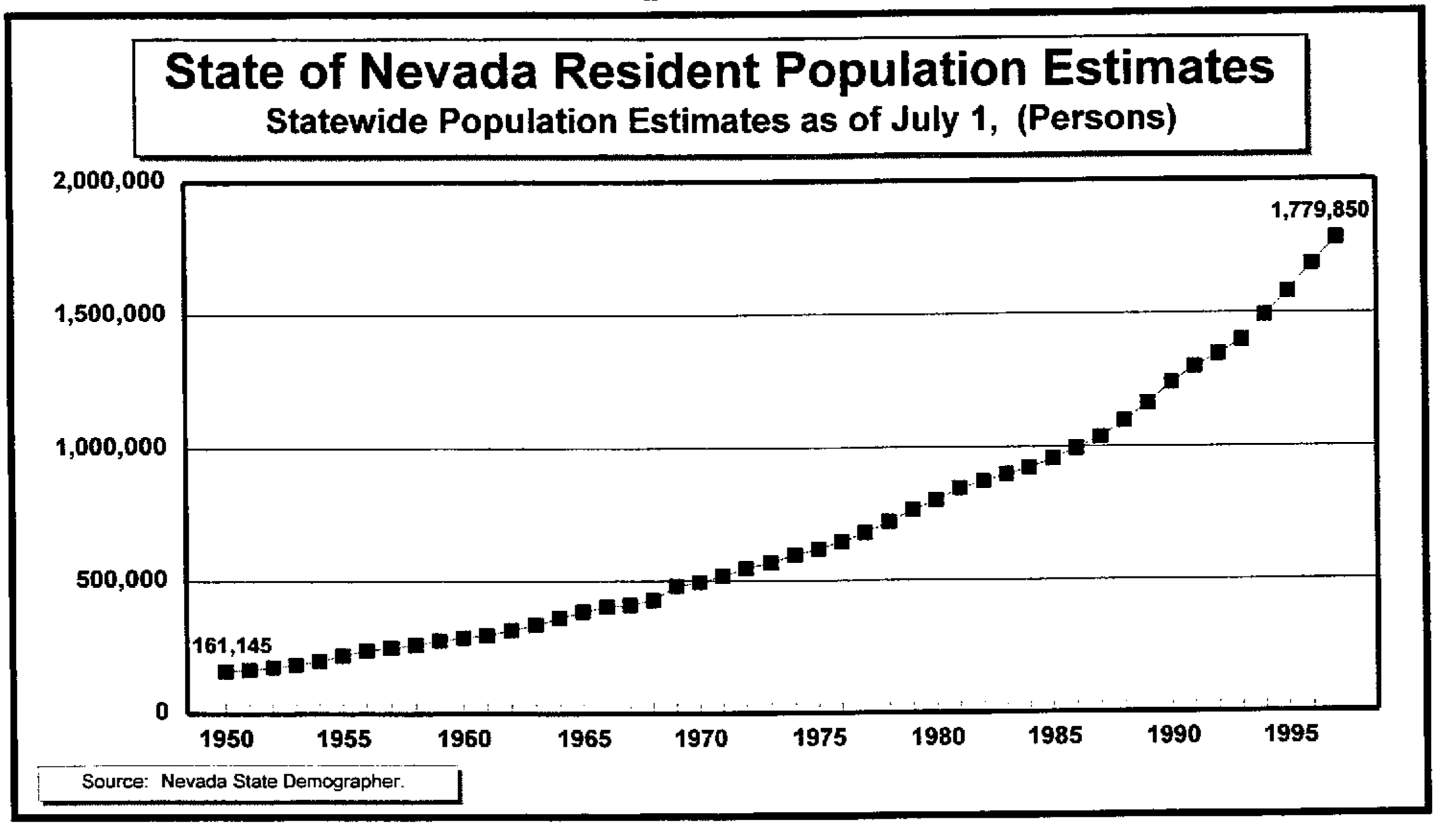
Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

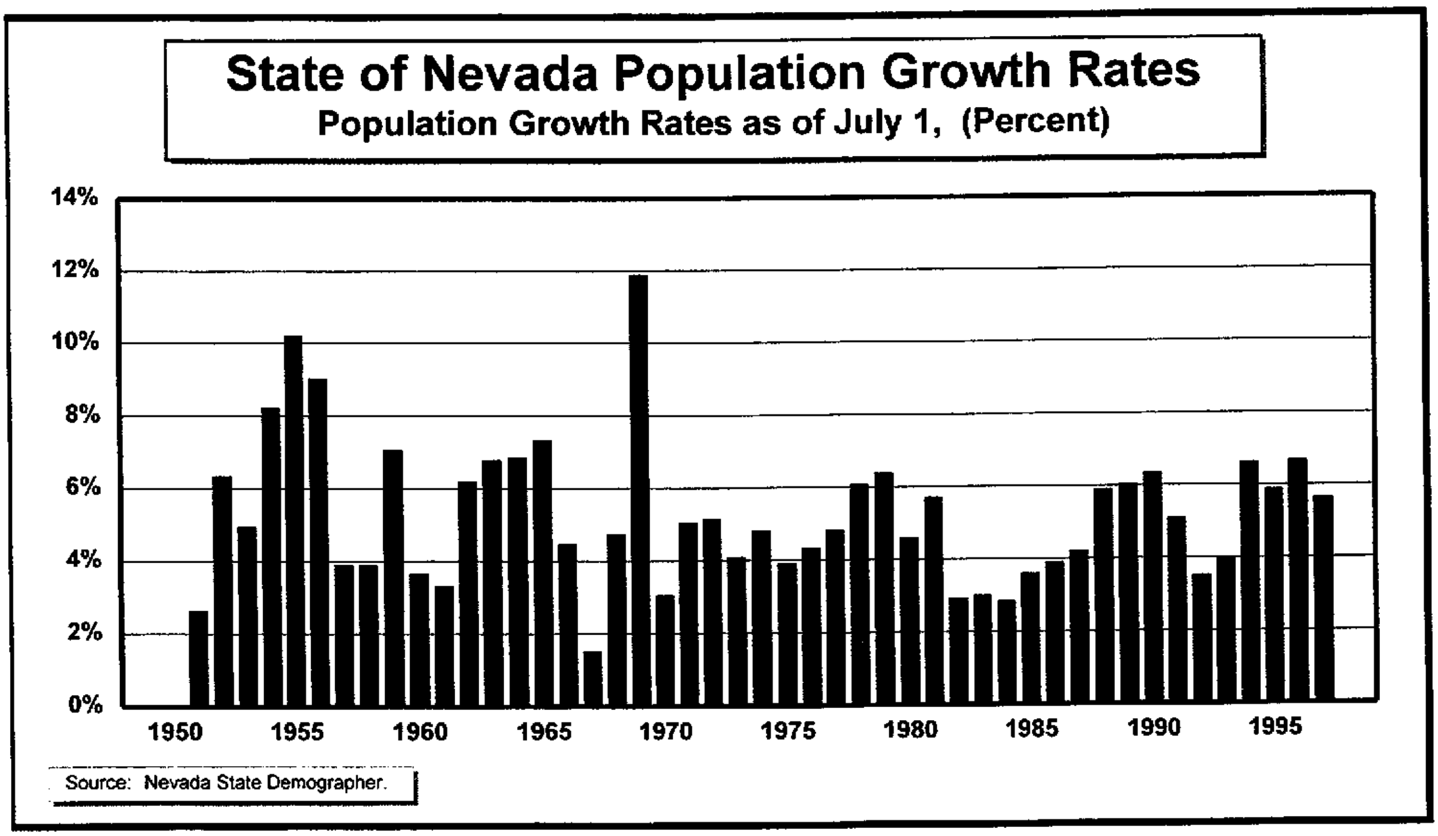
Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Forecasted Population Difference (Persons)	Percent Difference
2000	2,034,020	72,360	3.69%	1,986,257	80,945	4.25%	47,763	2.35%
2001	2,119,360	85,340	4.20%	2,062,293	76,036	3.83%	57,067	2.69%
2002	2,199,160	79,800	3.77%	2,135,420	73,127	3.55%	63,740	2.90%
2003	2,275,470	76,310	3.47%	2,205,757	70,337	3.29%	69,713	3.06%
2004	2,348,960	73,490	3.23%	2,274,255	68,497	3.11%	74,705	3.18%
2005	2,421,020	72,060	3.07%	2,341,374	67,120	2.95%	79,646	3.29%
2006	2,487,940	66,920	2.76%	2,407,472	66,098	2.82%	80,468	3.23%
2007	2,557,440	69,500	2.79%	2,470,245	62,773	2.61%	87,195	3.41%
2008	2,629,850	72,410	2.83%	2,529,804	59,559	2.41%	100,046	3.80%
2009	2,705,290	75,440	2.87%	2,586,448	56,644	2.24%	118,842	4.39%
2010	2,783,700	78,410	2.90%	2,640,306	53,858	2.08%	143,394	5.15%
2011	2,863,820	80,120	2.88%	2,691,357	51,051	1.93%	172,463	6.02%
2012	2,946,840	83,020	2.90%	2,739,653	48,297	1.79%	207,187	7.03%
2013	3,032,660	85,820	2.91%	2,785,141	45,487	1.66%	247,519	8.16%
2014	3,121,160	88,500	2.92%	2,828,168	43,027	1.54%	292,992	9.39%
2015	3,212,260	91,100	2.92%	2,868,979	40,811	1.44%	343,281	10.69%
2016	3,307,220	94,960	2.96%	2,907,639	38,659	1.35%	399,581	12.08%
2017	3,403,390	96,170	2.91%	2,944,651	37,013	1.27%	458,739	13.48%
2018	3,500,840	97,450	2.86%	2,980,108	35,456	1.20%	520,732	14.87%
2019	--	--	--	3,014,119	34,011	1.14%	--	--
2020	--	--	--	3,046,846	32,728	1.09%	--	--

Growth Rate Analysis:	1950-1997	5.24%		
Average Annual Rates	1950-1960	5.97%		
of Change by Specific	1960-1970	5.58%		
Time Period (percent)	1970-1980	4.92%		
	1980-1990	4.44%		
	1990-1997	5.35%		
Forecast Periods:	**1998-2018**	**3.27%**	**2.48%**	**NDWP Modified Forecast**
	1998-2008	**3.61%**	**3.25%**	
	2008-2018	**2.90%**	**1.65%**	

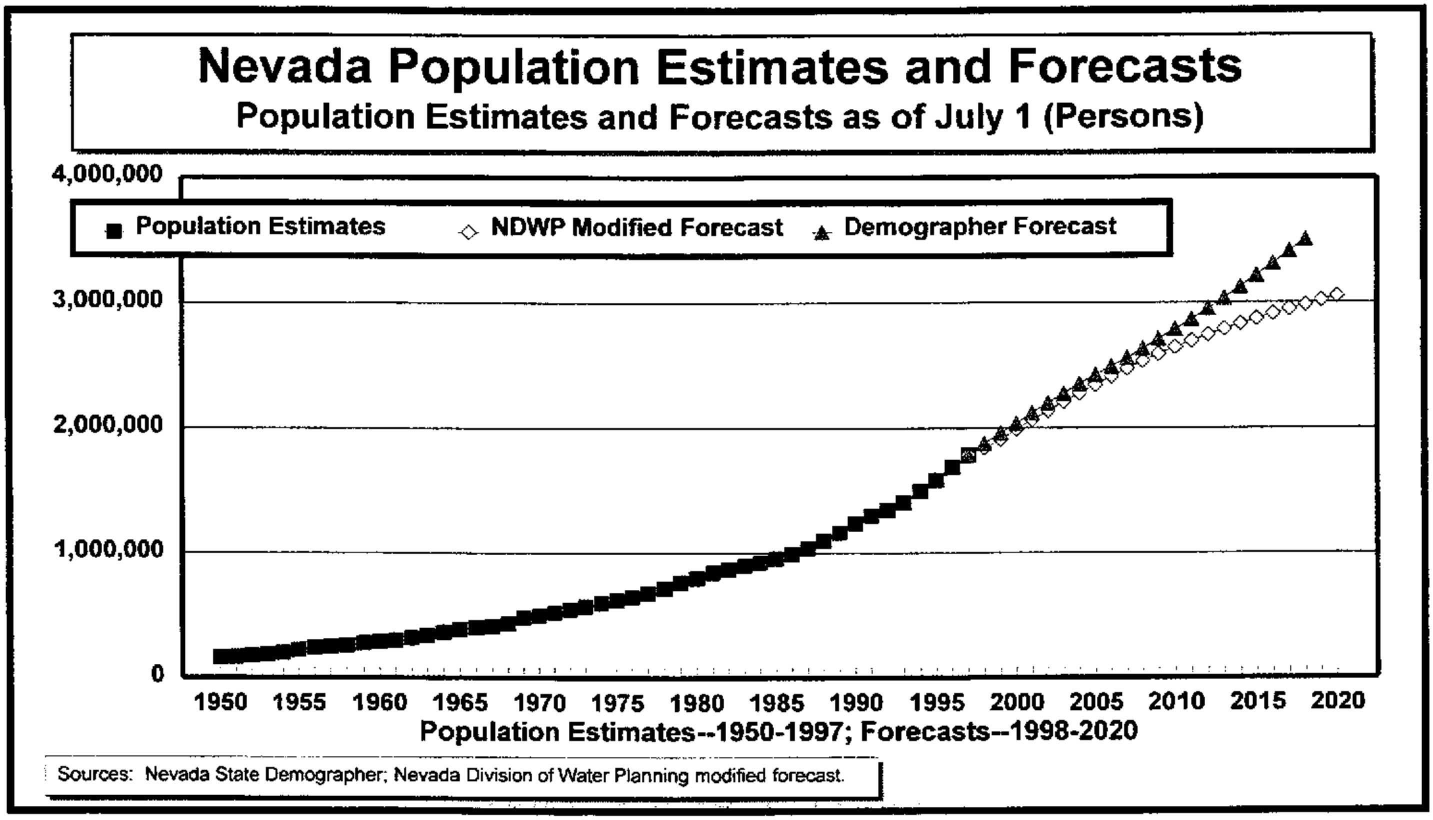
Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

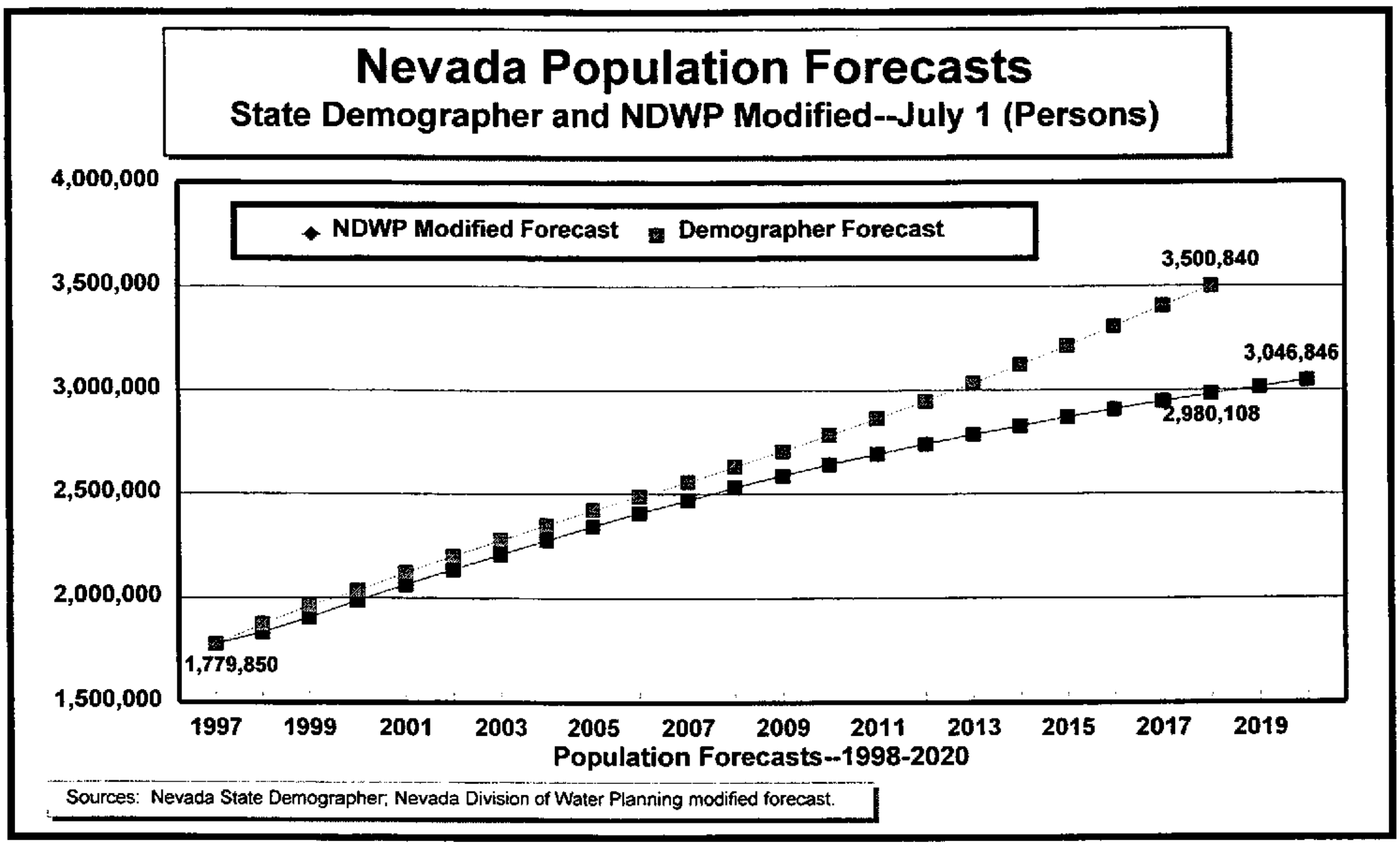
Nevada Population Analysis



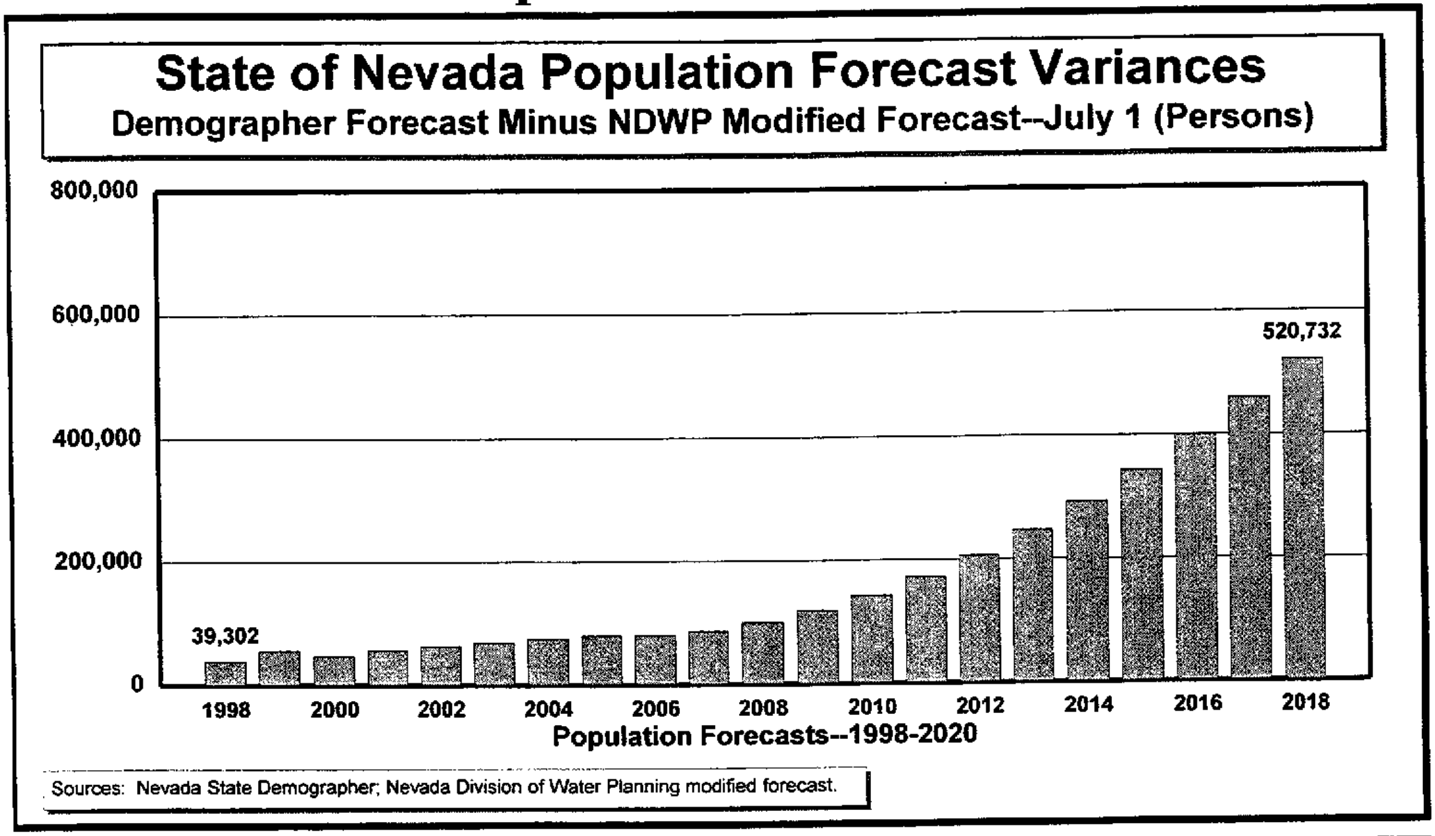


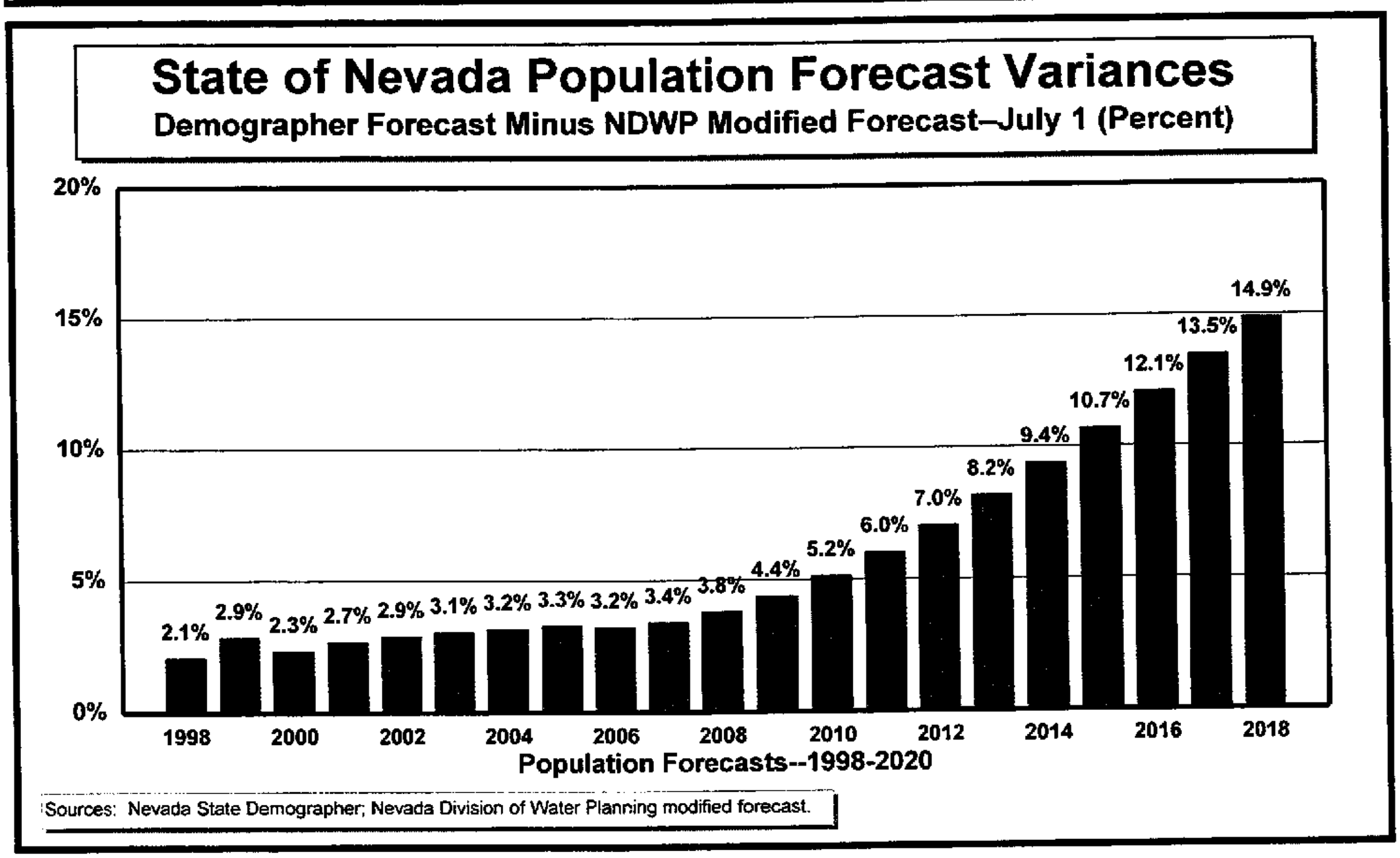
Nevada Population Forecast Analysis





Nevada Population Forecast Variances





Carson City Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	4,198	--	--	2.61%	4,198	--	--	2.61%
1951	4,300	102	2.43%	2.60%	4,300	102	2.43%	2.60%
1952	4,500	200	4.65%	2.56%	4,500	200	4.65%	2.56%
1953	4,500	0	0.00%	2.44%	4,500	0	0.00%	2.44%
1954	4,600	100	2.22%	2.30%	4,600	100	2.22%	2.30%
1955	4,800	200	4.35%	2.18%	4,800	200	4.35%	2.18%
1956	4,900	100	2.08%	2.04%	4,900	100	2.08%	2.04%
1957	5,200	300	6.12%	2.08%	5,200	300	6.12%	2.08%
1958	6,200	1,000	19.23%	2.39%	6,200	1,000	19.23%	2.39%
1959	7,100	900	14.52%	2.56%	7,100	900	14.52%	2.56%
1960	8,020	920	12.96%	2.79%	8,020	920	12.96%	2.79%
1961	7,846	(174)	-2.17%	2.64%	7,846	(174)	-2.17%	2.64%
1962	8,220	374	4.77%	2.60%	8,220	374	4.77%	2.60%
1963	8,910	690	8.39%	2.64%	8,910	690	8.39%	2.64%
1964	9,767	857	9.62%	2.71%	9,767	857	9.62%	2.71%
1965	11,278	1,511	15.47%	2.92%	11,278	1,511	15.47%	2.92%
1966	12,361	1,083	9.60%	3.06%	12,361	1,083	9.60%	3.06%
1967	12,834	473	3.83%	3.13%	12,834	473	3.83%	3.13%
1968	13,525	691	5.38%	3.15%	13,525	691	5.38%	3.15%
1969	15,144	1,619	11.97%	3.15%	15,144	1,619	11.97%	3.15%
1970	16,054	910	6.01%	3.24%	16,054	910	6.01%	3.24%
1971	18,400	2,346	14.61%	3.54%	18,400	2,346	14.61%	3.54%
1972	20,000	1,600	8.70%	3.66%	20,000	1,600	8.70%	3.66%
1973	22,200	2,200	11.00%	3.90%	22,200	2,200	11.00%	3.90%
1974	23,800	1,600	7.21%	3.99%	23,800	1,600	7.21%	3.99%
1975	25,500	1,700	7.14%	4.11%	25,500	1,700	7.14%	4.11%
1976	26,100	600	2.35%	4.04%	26,100	600	2.35%	4.04%
1977	27,300	1,200	4.60%	4.03%	27,300	1,200	4.60%	4.03%
1978	30,000	2,700	9.89%	4.17%	30,000	2,700	9.89%	4.17%
1979	31,800	1,800	6.00%	4.16%	31,800	1,800	6.00%	4.16%
1980	32,022	222	0.70%	4.00%	32,022	222	0.70%	4.00%
1981	33,290	1,268	3.96%	3.93%	33,290	1,268	3.96%	3.93%
1982	34,070	780	2.34%	3.91%	34,070	780	2.34%	3.91%
1983	34,610	540	1.58%	3.86%	34,610	540	1.58%	3.86%
1984	34,950	340	0.98%	3.79%	34,950	340	0.98%	3.79%
1985	35,650	700	2.00%	3.73%	35,650	700	2.00%	3.73%
1986	36,340	690	1.94%	3.66%	36,340	690	1.94%	3.66%
1987	36,990	650	1.79%	3.57%	36,990	650	1.79%	3.57%
1988	38,280	1,290	3.49%	3.49%	38,280	1,290	3.49%	3.49%
1989	39,970	1,690	4.41%	3.44%	39,970	1,690	4.41%	3.44%
1990	40,950	980	2.45%	3.31%	40,950	980	2.45%	3.31%
1991	41,130	180	0.44%	3.17%	41,130	180	0.44%	3.17%
1992	42,140	1,010	2.46%	3.13%	42,140	1,010	2.46%	3.13%
1993	43,460	1,320	3.13%	3.11%	43,460	1,320	3.13%	3.11%
1994	44,580	1,120	2.58%	2.99%	44,580	1,120	2.58%	2.99%
1995	46,770	2,190	4.91%	2.96%	46,770	2,190	4.91%	2.96%
1996	48,860	2,090	4.47%	2.90%	48,860	2,090	4.47%	2.90%
1997	50,410	1,550	3.17%	2.83%	50,410	1,550	3.17%	2.83%
1998	50,970	560	1.11%	2.72%	51,771	1,361	2.70%	2.82%
1999	51,950	980	1.92%	2.65%	53,117	1,346	2.60%	2.79%

Carson City Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

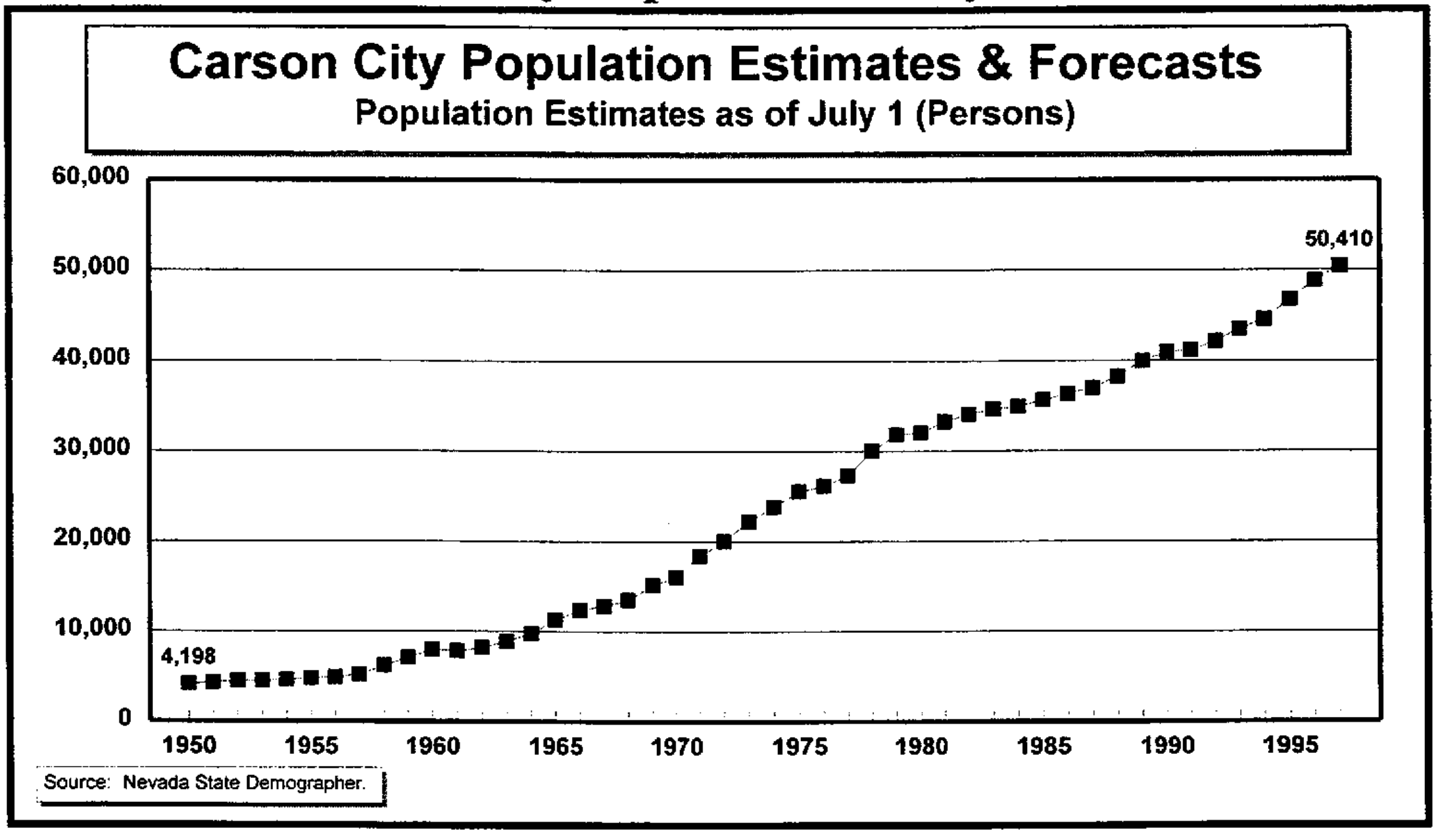
Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	53,250	1,300	2.50%	2.62%	54,445	1,328	2.50%	2.74%
2001	53,690	440	0.83%	2.53%	55,752	1,307	2.40%	2.70%
2002	53,920	230	0.43%	2.45%	57,034	1,282	2.30%	2.67%
2003	54,160	240	0.45%	2.38%	58,289	1,255	2.20%	2.64%
2004	54,610	450	0.83%	2.32%	59,513	1,224	2.10%	2.62%
2005	54,350	(260)	-0.48%	2.24%	60,703	1,190	2.00%	2.59%
2006	54,480	130	0.24%	2.19%	61,856	1,153	1.90%	2.57%
2007	54,610	130	0.24%	2.14%	62,970	1,113	1.80%	2.55%
2008	54,970	360	0.66%	2.09%	64,040	1,070	1.70%	2.53%
2009	55,330	360	0.65%	2.05%	65,065	1,025	1.60%	2.52%
2010	55,920	590	1.07%	2.01%	66,041	976	1.50%	2.50%
2011	56,800	880	1.57%	1.98%	66,966	925	1.40%	2.49%
2012	57,510	710	1.25%	1.95%	67,836	871	1.30%	2.48%
2013	58,240	730	1.27%	1.92%	68,650	814	1.20%	2.46%
2014	58,880	640	1.10%	1.89%	69,405	755	1.10%	2.45%
2015	59,590	710	1.21%	1.86%	70,099	694	1.00%	2.44%
2016	60,140	550	0.92%	1.82%	70,730	631	0.90%	2.43%
2017	60,650	510	0.85%	1.78%	71,296	566	0.80%	2.42%
2018	61,190	540	0.89%	1.75%	71,795	499	0.70%	2.41%
2019	--	--	--	--	72,226	431	0.60%	2.40%
2020	--	--	--	--	72,587	361	0.50%	2.38%

Growth Rate Analysis:	1950-1997	5.43%
Average Annual Rates	1950-1960	6.69%
of Change by Specific	1960-1970	7.19%
Time Period (percent)	1970-1980	7.15%
	1980-1990	2.49%
	1990-1997	3.01%

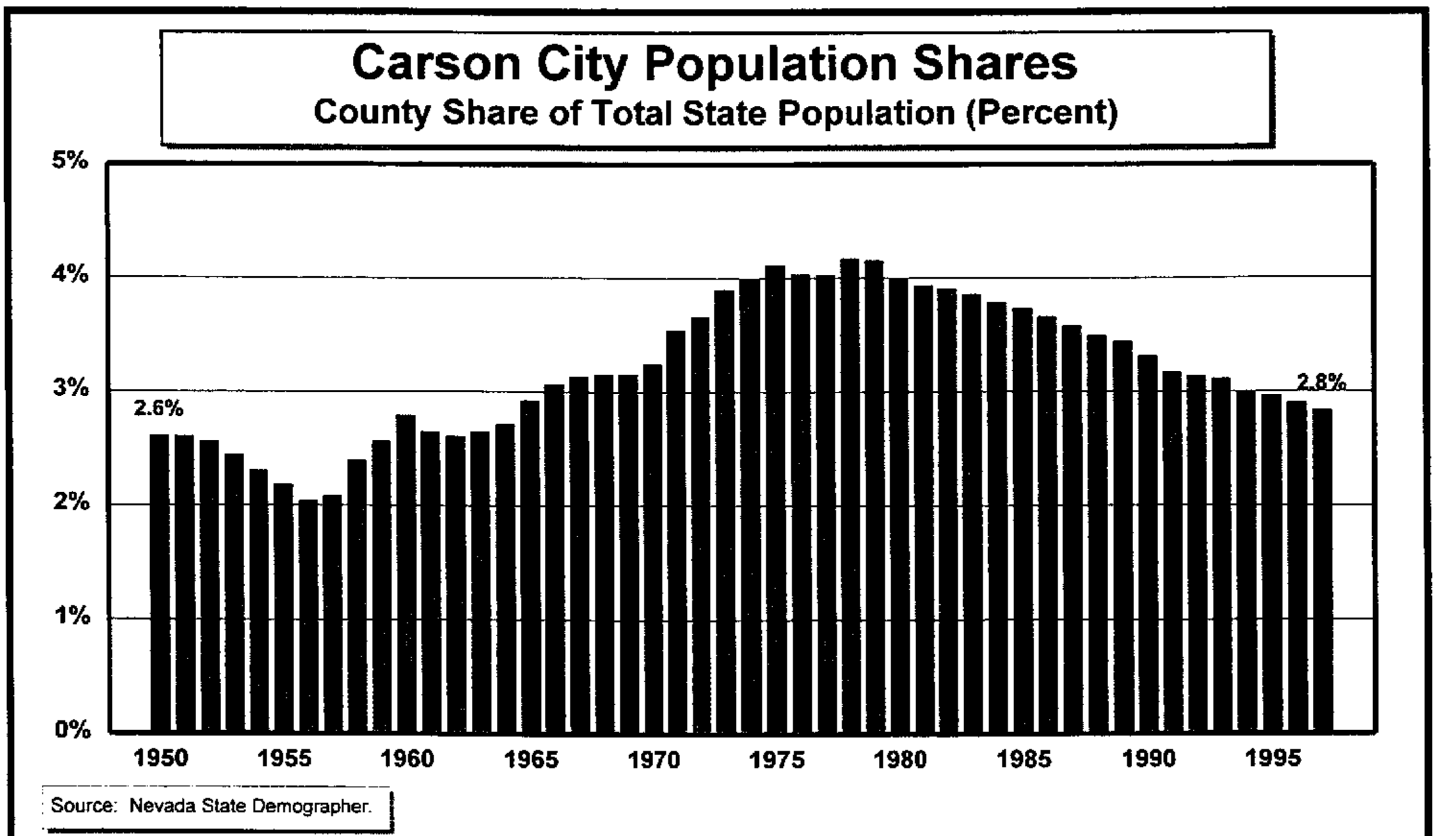
Forecast Periods:	**1998-2018**	**0.93%**	**State Demographer**	**1.70%**	**NDWP Modified Forecast**
	1998-2008	**0.79%**		**2.20%**	
	2008-2018	**1.04%**		**1.20%**	

Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

County Population Analysis

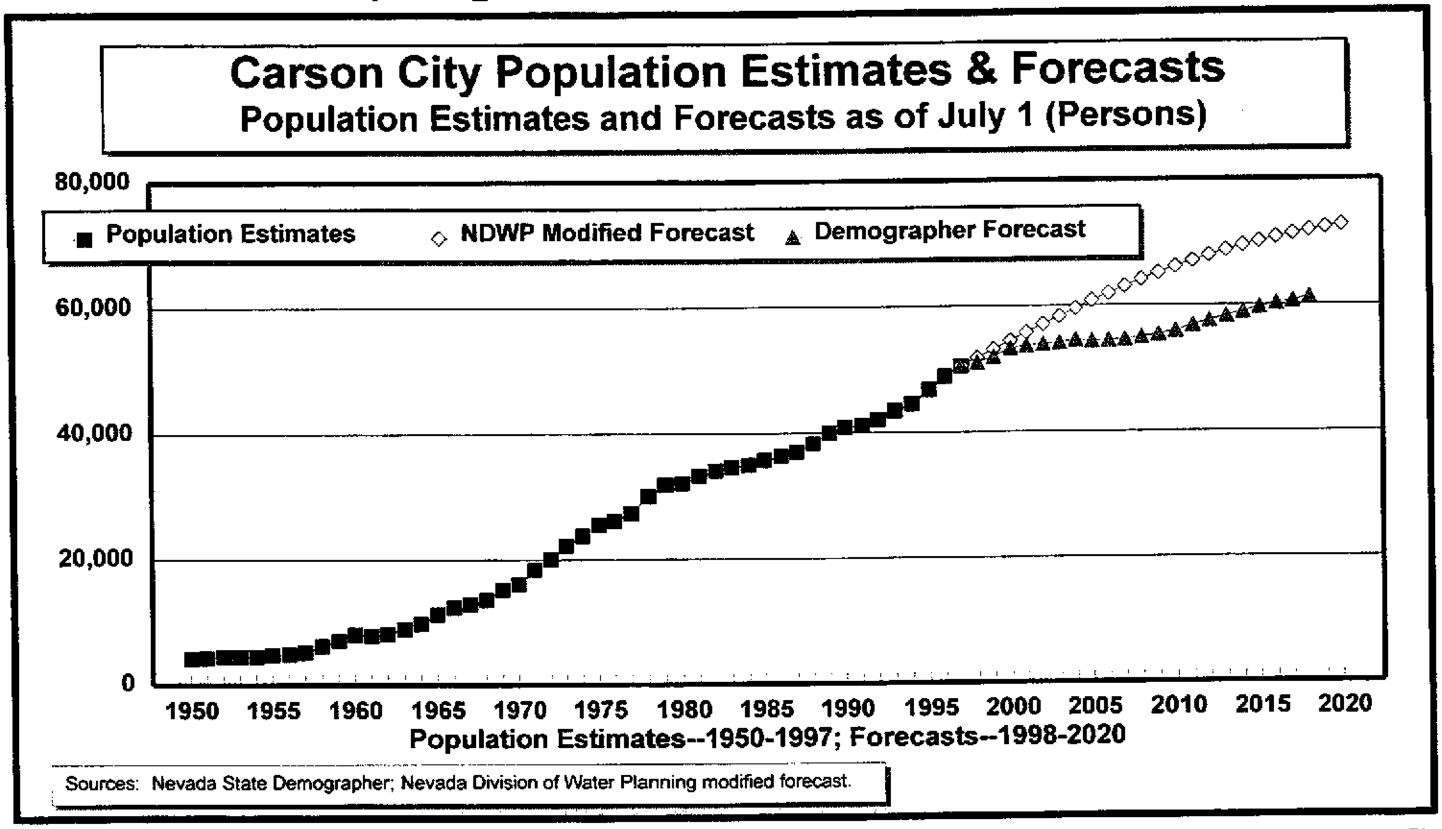


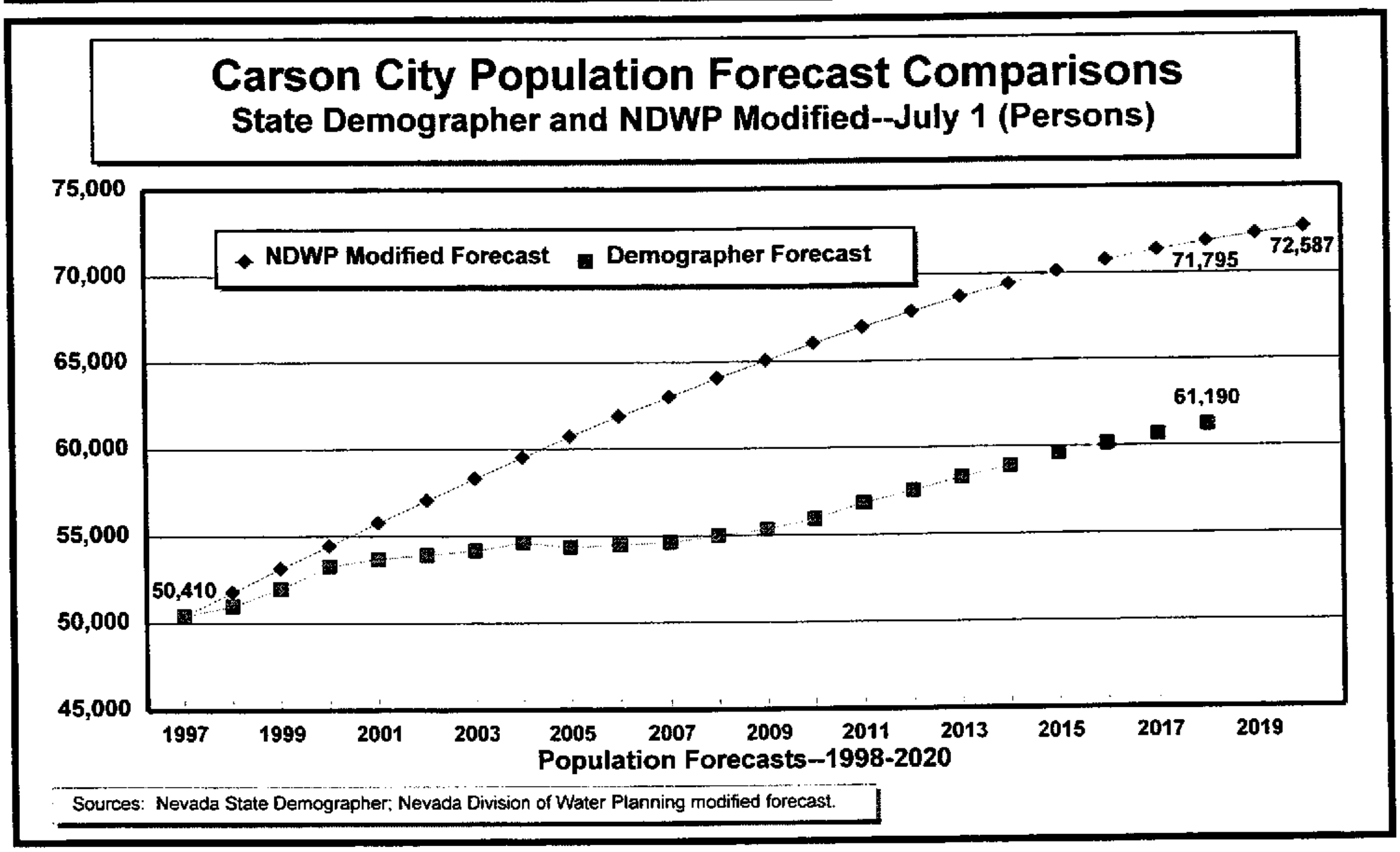
Source: Nevada State Demographer.



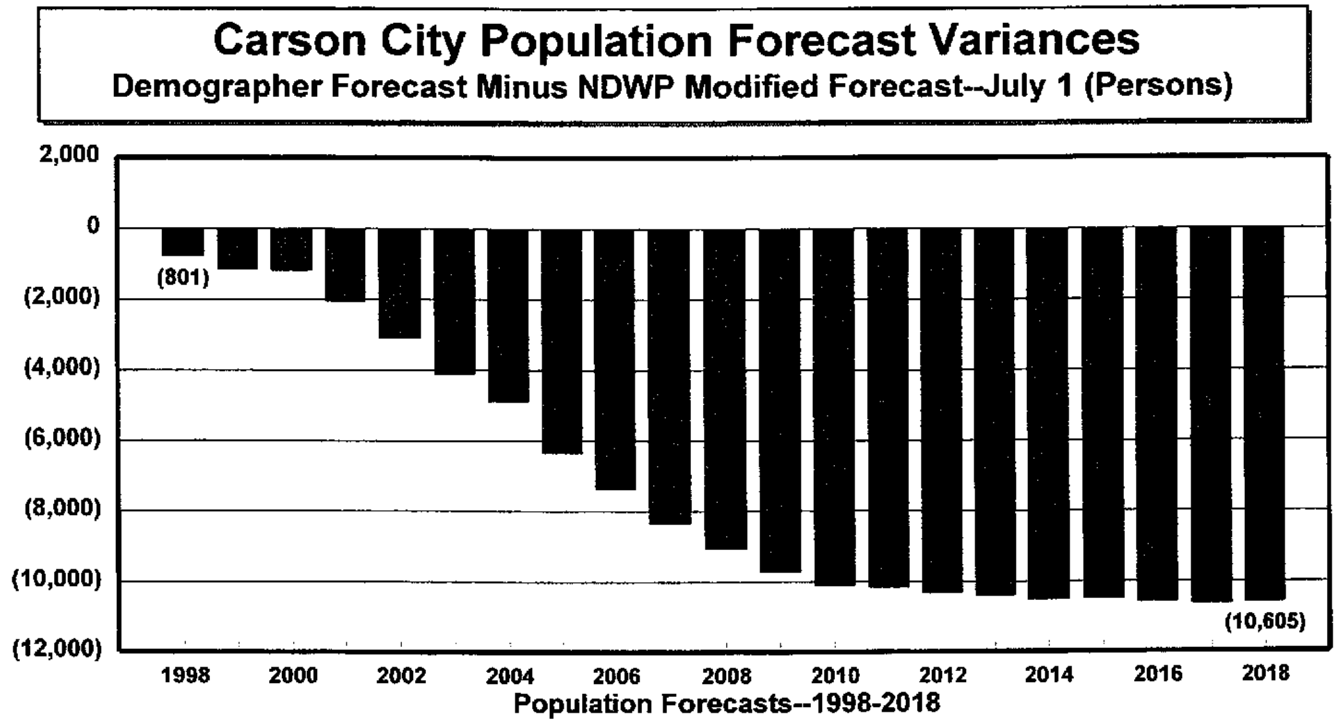
Source: Nevada State Demographer.

County Population Analysis and Forecasts

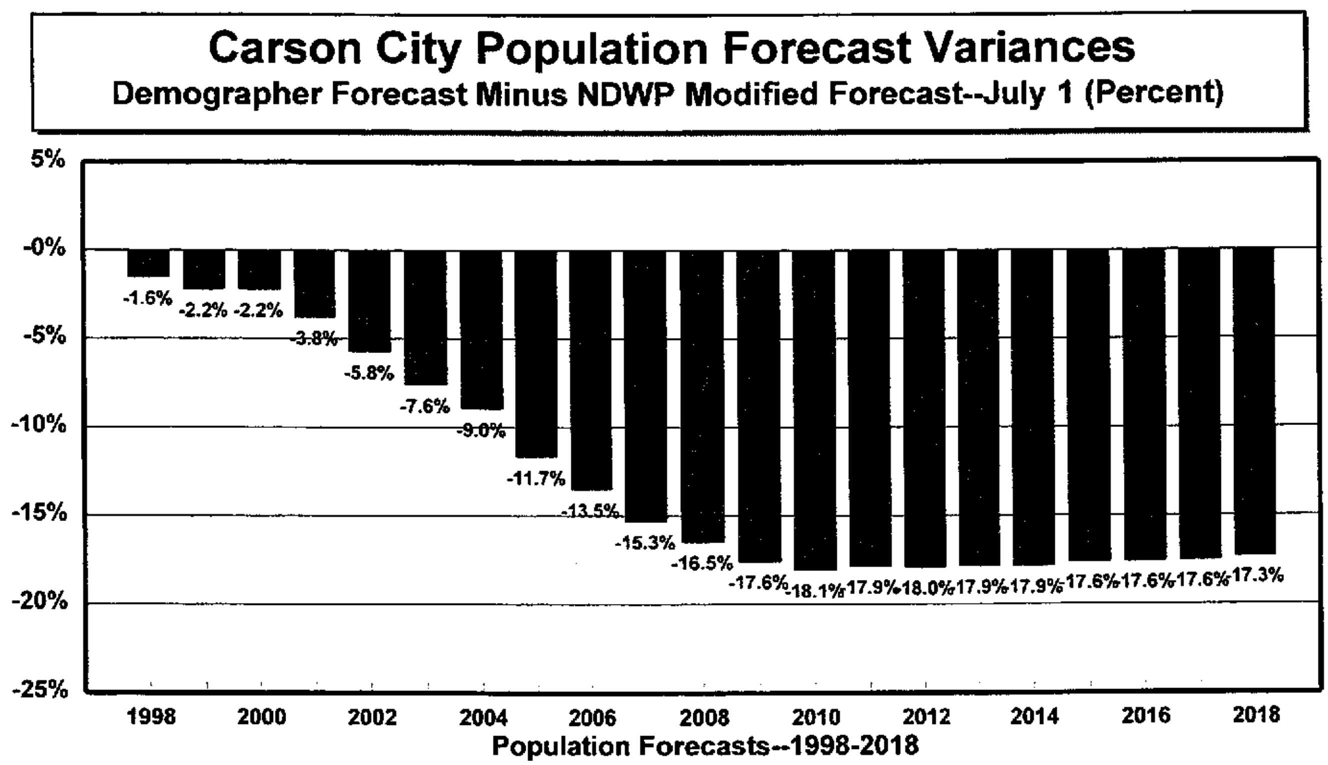




County Population Forecast Variances



Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.



Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.

Churchill County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	6,188	--	--	3.84%	6,188	--	--	3.84%
1951	6,300	112	1.81%	3.81%	6,300	112	1.81%	3.81%
1952	6,300	0	0.00%	3.58%	6,300	0	0.00%	3.58%
1953	6,400	100	1.59%	3.47%	6,400	100	1.59%	3.47%
1954	6,500	100	1.56%	3.25%	6,500	100	1.56%	3.25%
1955	6,900	400	6.15%	3.13%	6,900	400	6.15%	3.13%
1956	7,100	200	2.90%	2.96%	7,100	200	2.90%	2.96%
1957	7,100	0	0.00%	2.85%	7,100	0	0.00%	2.85%
1958	7,200	100	1.41%	2.78%	7,200	100	1.41%	2.78%
1959	7,500	300	4.17%	2.70%	7,500	300	4.17%	2.70%
1960	8,505	1,005	13.40%	2.96%	8,505	1,005	13.40%	2.96%
1961	8,716	211	2.48%	2.93%	8,716	211	2.48%	2.93%
1962	8,640	(76)	-0.87%	2.74%	8,640	(76)	-0.87%	2.74%
1963	8,608	(32)	-0.37%	2.55%	8,608	(32)	-0.37%	2.55%
1964	8,744	136	1.58%	2.43%	8,744	136	1.58%	2.43%
1965	8,984	240	2.74%	2.32%	8,984	240	2.74%	2.32%
1966	9,367	383	4.26%	2.32%	9,367	383	4.26%	2.32%
1967	9,568	201	2.15%	2.33%	9,568	201	2.15%	2.33%
1968	9,516	(52)	-0.54%	2.22%	9,516	(52)	-0.54%	2.22%
1969	10,382	866	9.10%	2.16%	10,382	866	9.10%	2.16%
1970	10,650	268	2.58%	2.15%	10,650	268	2.58%	2.15%
1971	11,200	550	5.16%	2.15%	11,200	550	5.16%	2.15%
1972	11,600	400	3.57%	2.12%	11,600	400	3.57%	2.12%
1973	11,900	300	2.59%	2.09%	11,900	300	2.59%	2.09%
1974	11,900	0	0.00%	1.99%	11,900	0	0.00%	1.99%
1975	12,000	100	0.84%	1.94%	12,000	100	0.84%	1.94%
1976	12,000	0	0.00%	1.86%	12,000	0	0.00%	1.86%
1977	12,100	100	0.83%	1.78%	12,100	100	0.83%	1.78%
1978	12,800	700	5.79%	1.78%	12,800	700	5.79%	1.78%
1979	13,600	800	6.25%	1.78%	13,600	800	6.25%	1.78%
1980	13,917	317	2.33%	1.74%	13,917	317	2.33%	1.74%
1981	14,390	473	3.40%	1.70%	14,390	473	3.40%	1.70%
1982	14,480	90	0.63%	1.66%	14,480	90	0.63%	1.66%
1983	14,610	130	0.90%	1.63%	14,610	130	0.90%	1.63%
1984	14,810	200	1.37%	1.61%	14,810	200	1.37%	1.61%
1985	15,120	310	2.09%	1.58%	15,120	310	2.09%	1.58%
1986	15,400	280	1.85%	1.55%	15,400	280	1.85%	1.55%
1987	16,710	1,310	8.51%	1.61%	16,710	1,310	8.51%	1.61%
1988	17,790	1,080	6.46%	1.62%	17,790	1,080	6.46%	1.62%
1989	17,990	200	1.12%	1.55%	17,990	200	1.12%	1.55%
1990	18,100	110	0.61%	1.46%	18,100	110	0.61%	1.46%
1991	18,330	230	1.27%	1.41%	18,330	230	1.27%	1.41%
1992	19,210	880	4.80%	1.43%	19,210	880	4.80%	1.43%
1993	19,850	640	3.33%	1.42%	19,850	640	3.33%	1.42%
1994	20,570	720	3.63%	1.38%	20,570	720	3.63%	1.38%
1995	21,640	1,070	5.20%	1.37%	21,640	1,070	5.20%	1.37%
1996	22,580	940	4.34%	1.34%	22,580	940	4.34%	1.34%
1997	23,860	1,280	5.67%	1.34%	23,860	1,280	5.67%	1.34%
1998	25,020	1,160	4.86%	1.33%	24,579	719	3.02%	1.34%
1999	26,030	1,010	4.04%	1.33%	25,300	720	2.93%	1.33%

Churchill County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

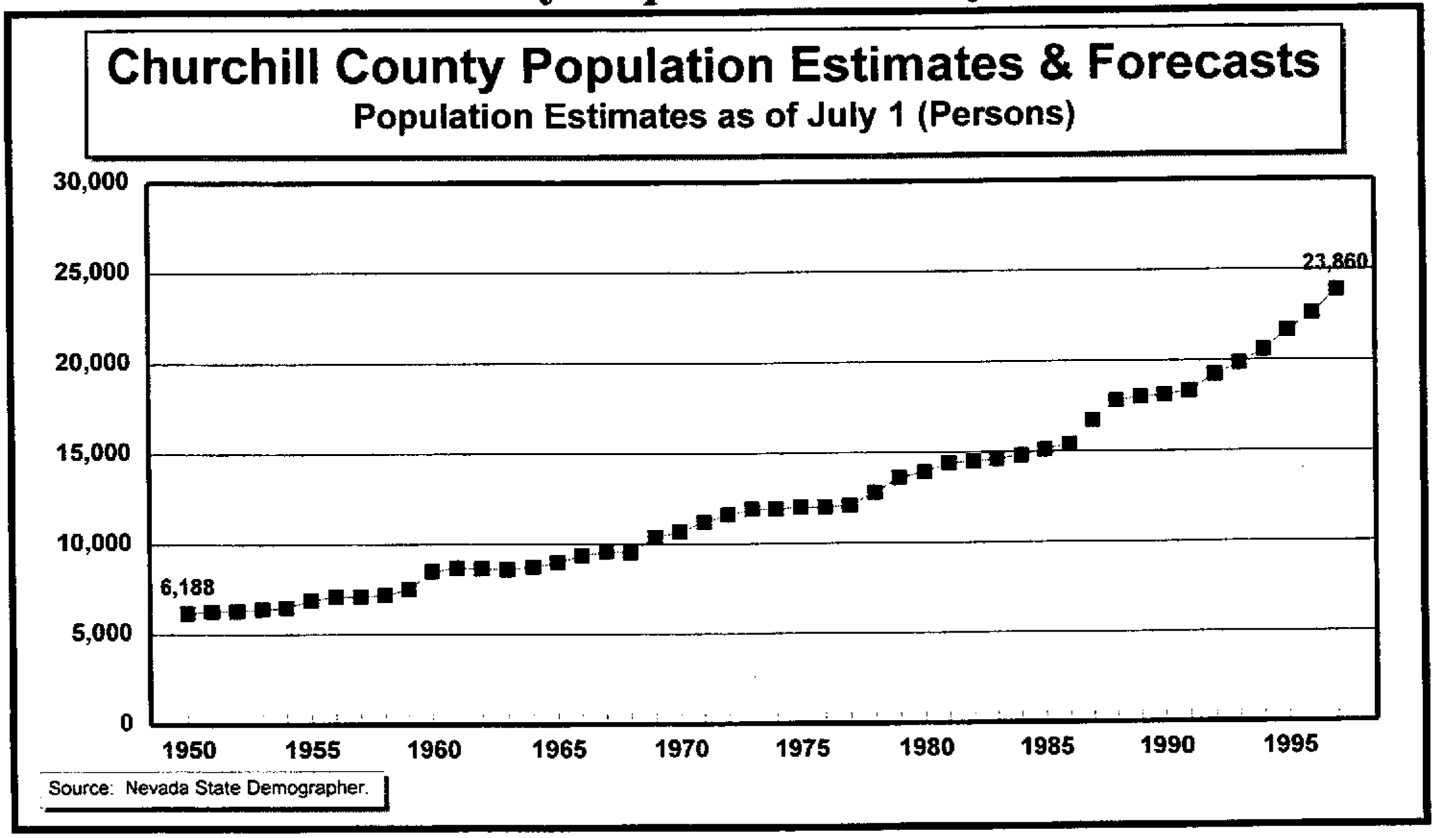
Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	27,010	980	3.76%	1.33%	26,019	720	2.85%	1.31%
2001	27,780	770	2.85%	1.31%	26,737	718	2.76%	1.30%
2002	28,620	840	3.02%	1.30%	27,453	715	2.68%	1.29%
2003	29,130	510	1.78%	1.28%	28,164	711	2.59%	1.28%
2004	29,910	780	2.68%	1.27%	28,869	706	2.51%	1.27%
2005	30,470	560	1.87%	1.26%	29,568	699	2.42%	1.26%
2006	31,240	770	2.53%	1.26%	30,258	690	2.34%	1.26%
2007	31,830	590	1.89%	1.24%	30,939	681	2.25%	1.25%
2008	32,660	830	2.61%	1.24%	31,609	670	2.17%	1.25%
2009	33,680	1,020	3.12%	1.24%	32,266	657	2.08%	1.25%
2010	34,720	1,040	3.09%	1.25%	32,910	644	2.00%	1.25%
2011	35,770	1,050	3.02%	1.25%	33,539	629	1.91%	1.25%
2012	36,850	1,080	3.02%	1.25%	34,151	612	1.83%	1.25%
2013	37,970	1,120	3.04%	1.25%	34,745	594	1.74%	1.25%
2014	39,050	1,080	2.84%	1.25%	35,320	575	1.65%	1.25%
2015	40,170	1,120	2.87%	1.25%	35,875	555	1.57%	1.25%
2016	41,320	1,150	2.86%	1.25%	36,407	533	1.49%	1.25%
2017	42,470	1,150	2.78%	1.25%	36,917	510	1.40%	1.25%
2018	43,620	1,150	2.71%	1.25%	37,402	485	1.32%	1.26%
2019	--	--	--	--	37,862	460	1.23%	1.26%
2020	--	--	--	--	38,296	434	1.15%	1.26%

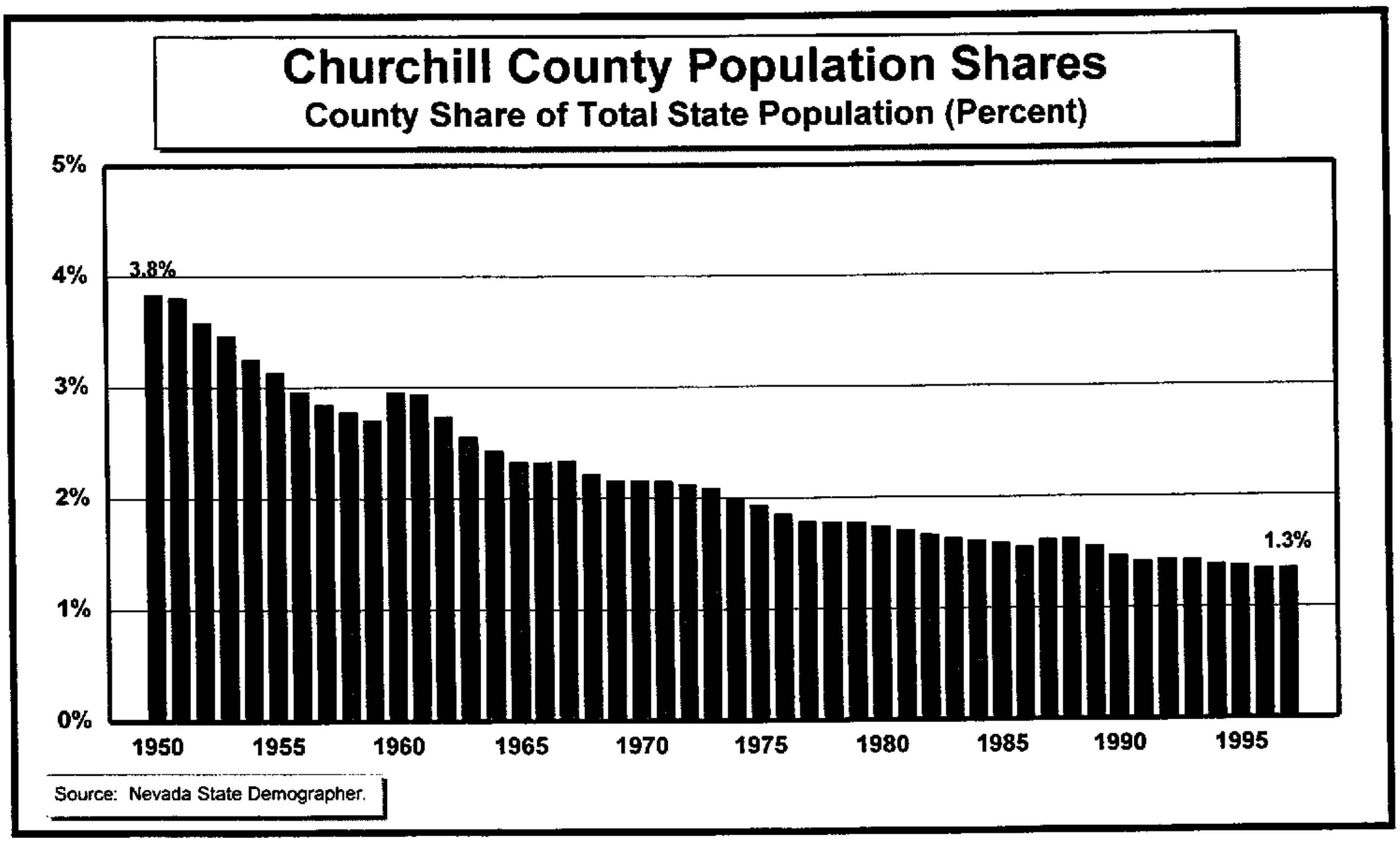
Growth Rate Analysis:	1950-1997	2.91%
Average Annual Rates	1950-1960	3.23%
of Change by Specific	1960-1970	2.27%
Time Period (percent)	1970-1980	2.71%
	1980-1990	2.66%
	1990-1997	4.03%

Forecast Periods:	**1998-2018**	**2.91%**	**State Demographer**	**2.16%**	**NDWP Modified Forecast**
	1998-2008	**2.90%**		**2.59%**	
	2008-2018	**2.91%**		**1.74%**	

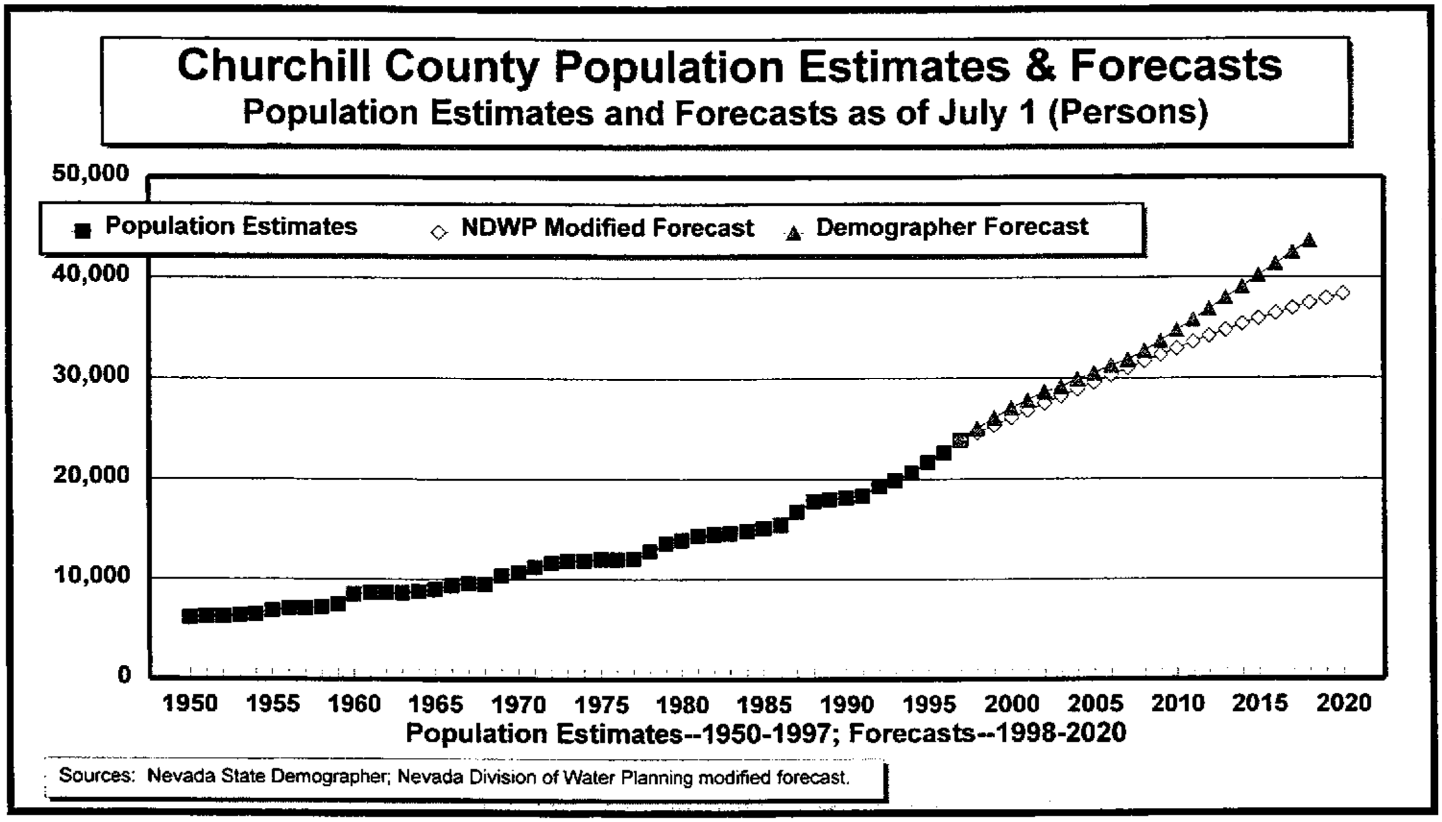
Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

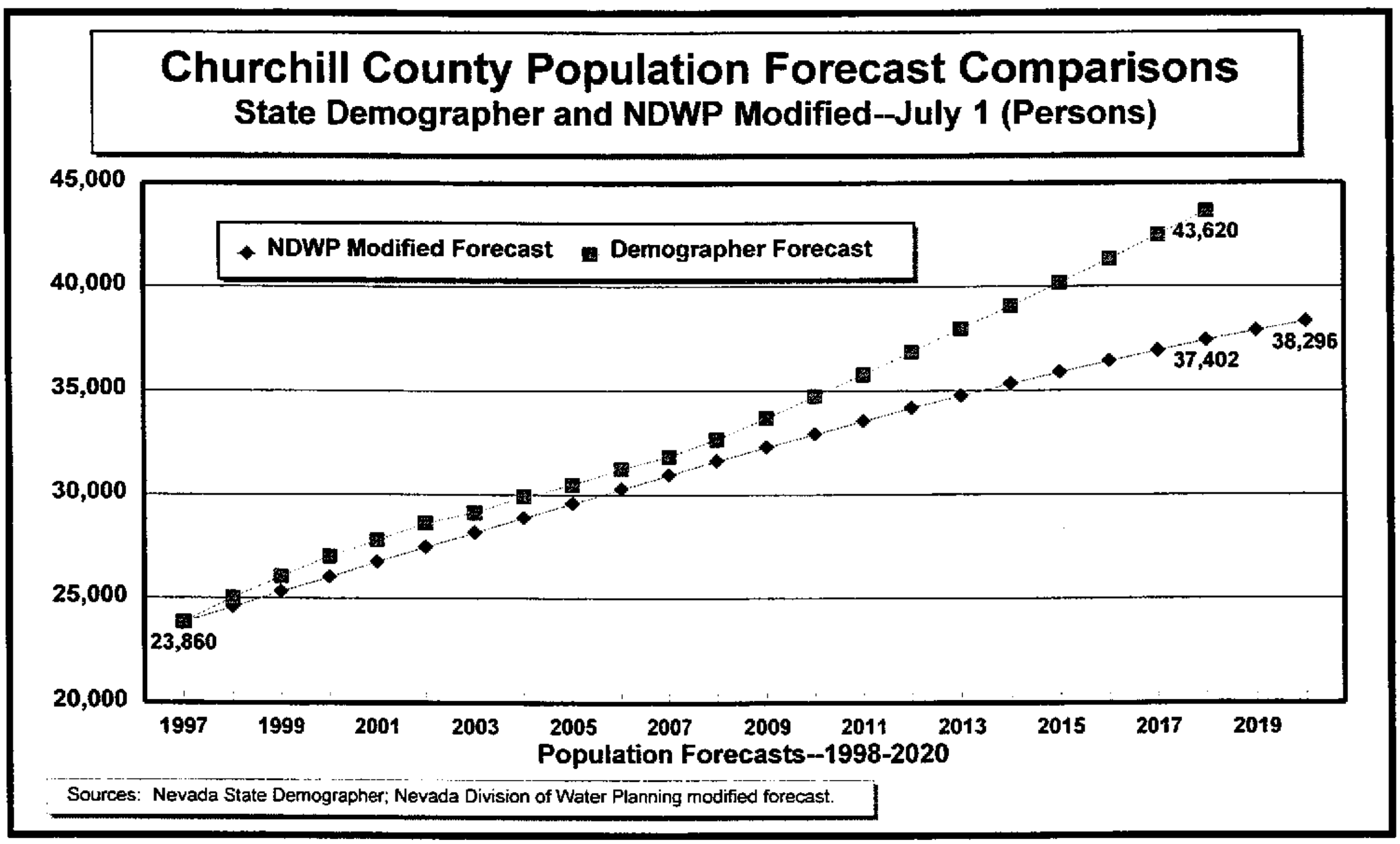
County Population Analysis





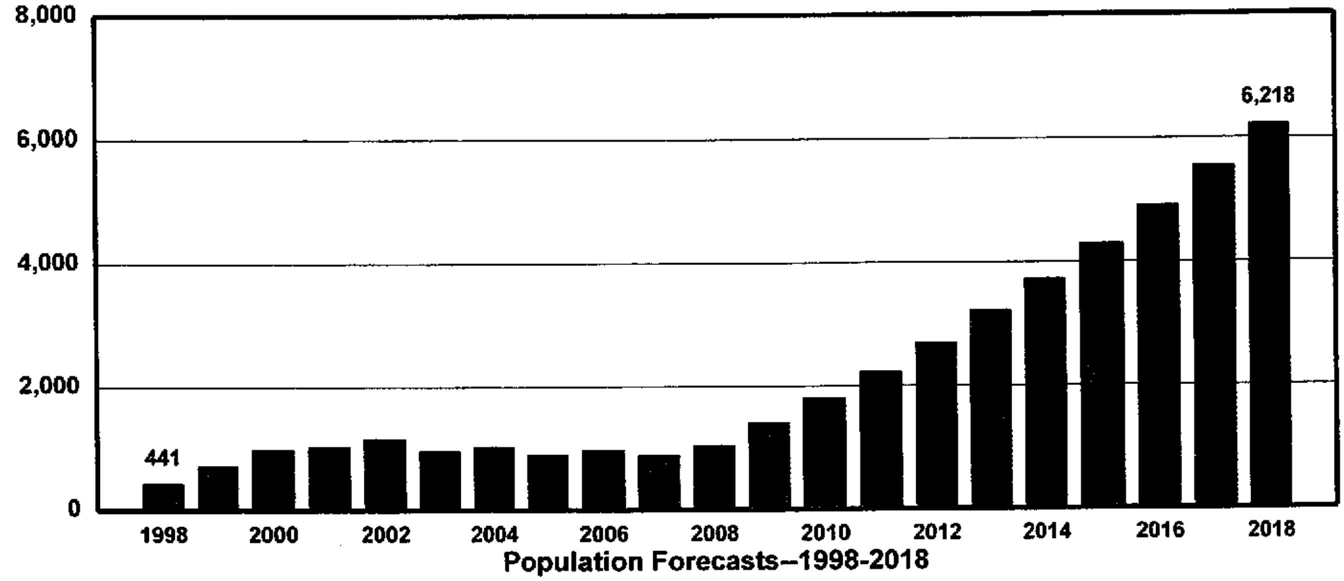
County Population Analysis and Forecasts





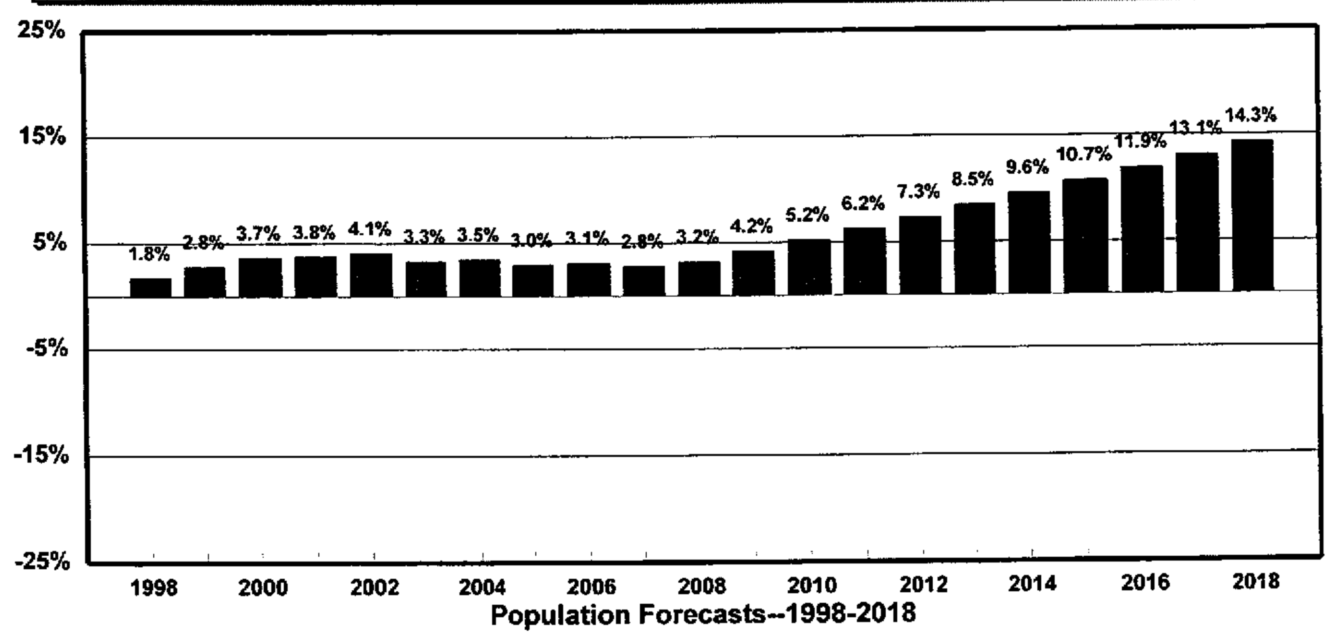
County Population Forecast Variances

Churchill County Population Forecast Variances
Demographer Forecast Minus NDWP Modified Forecast--July 1 (Persons)



Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.

Churchill County Population Forecast Variances
Demographer Forecast Minus NDWP Modified Forecast--July 1 (Percent)



Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.

Clark County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	48,811	--	--	30.29%	48,811	--	--	30.29%
1951	50,900	2,089	4.28%	30.77%	50,900	2,089	4.28%	30.77%
1952	57,500	6,600	12.97%	32.69%	57,500	6,600	12.97%	32.69%
1953	61,700	4,200	7.30%	33.42%	61,700	4,200	7.30%	33.42%
1954	71,300	9,600	15.56%	35.69%	71,300	9,600	15.56%	35.69%
1955	82,900	11,600	16.27%	37.65%	82,900	11,600	16.27%	37.65%
1956	96,400	13,500	16.28%	40.15%	96,400	13,500	16.28%	40.15%
1957	101,800	5,400	5.60%	40.80%	101,800	5,400	5.60%	40.80%
1958	107,400	5,600	5.50%	41.44%	107,400	5,600	5.50%	41.44%
1959	119,300	11,900	11.08%	42.99%	119,300	11,900	11.08%	42.99%
1960	128,734	9,434	7.91%	44.75%	128,734	9,434	7.91%	44.75%
1961	135,605	6,871	5.34%	45.63%	135,605	6,871	5.34%	45.63%
1962	150,922	15,317	11.30%	47.82%	150,922	15,317	11.30%	47.82%
1963	169,855	18,933	12.54%	50.40%	169,855	18,933	12.54%	50.40%
1964	189,389	19,534	11.50%	52.59%	189,389	19,534	11.50%	52.59%
1965	201,984	12,595	6.65%	52.26%	201,984	12,595	6.65%	52.26%
1966	212,623	10,639	5.27%	52.67%	212,623	10,639	5.27%	52.67%
1967	218,928	6,305	2.97%	53.42%	218,928	6,305	2.97%	53.42%
1968	233,899	14,971	6.84%	54.49%	233,899	14,971	6.84%	54.49%
1969	267,720	33,821	14.46%	55.74%	267,720	33,821	14.46%	55.74%
1970	277,230	9,510	3.55%	56.01%	277,230	9,510	3.55%	56.01%
1971	293,000	15,770	5.69%	56.35%	293,000	15,770	5.69%	56.35%
1972	307,400	14,400	4.91%	56.22%	307,400	14,400	4.91%	56.22%
1973	319,400	12,000	3.90%	56.11%	319,400	12,000	3.90%	56.11%
1974	336,900	17,500	5.48%	56.46%	336,900	17,500	5.48%	56.46%
1975	351,300	14,400	4.27%	56.66%	351,300	14,400	4.27%	56.66%
1976	369,500	18,200	5.18%	57.13%	369,500	18,200	5.18%	57.13%
1977	390,000	20,500	5.55%	57.51%	390,000	20,500	5.55%	57.51%
1978	412,900	22,900	5.87%	57.40%	412,900	22,900	5.87%	57.40%
1979	441,400	28,500	6.90%	57.68%	441,400	28,500	6.90%	57.68%
1980	463,087	21,687	4.91%	57.85%	463,087	21,687	4.91%	57.85%
1981	491,620	28,533	6.16%	58.10%	491,620	28,533	6.16%	58.10%
1982	507,510	15,890	3.23%	58.27%	507,510	15,890	3.23%	58.27%
1983	525,050	17,540	3.46%	58.52%	525,050	17,540	3.46%	58.52%
1984	539,030	13,980	2.66%	58.43%	539,030	13,980	2.66%	58.43%
1985	562,280	23,250	4.31%	58.83%	562,280	23,250	4.31%	58.83%
1986	587,760	25,480	4.53%	59.18%	587,760	25,480	4.53%	59.18%
1987	616,650	28,890	4.92%	59.58%	616,650	28,890	4.92%	59.58%
1988	661,690	45,040	7.30%	60.37%	661,690	45,040	7.30%	60.37%
1989	708,750	47,060	7.11%	60.98%	708,750	47,060	7.11%	60.98%
1990	770,280	61,530	8.68%	62.31%	770,280	61,530	8.68%	62.31%
1991	820,840	50,560	6.56%	63.17%	820,840	50,560	6.56%	63.17%
1992	856,350	35,510	4.33%	63.67%	856,350	35,510	4.33%	63.67%
1993	898,020	41,670	4.87%	64.20%	898,020	41,670	4.87%	64.20%
1994	971,680	73,660	8.20%	65.15%	971,680	73,660	8.20%	65.15%
1995	1,036,290	64,610	6.65%	65.62%	1,036,290	64,610	6.65%	65.62%
1996	1,115,940	79,650	7.69%	66.24%	1,115,940	79,650	7.69%	66.24%
1997	1,192,200	76,260	6.83%	66.98%	1,192,200	76,260	6.83%	66.98%
1998	1,265,590	73,390	6.16%	67.51%	1,233,347	41,147	3.45%	67.20%
1999	1,337,400	71,810	5.67%	68.18%	1,288,781	55,434	4.49%	67.64%

Clark County Population Estimates & Forecasts

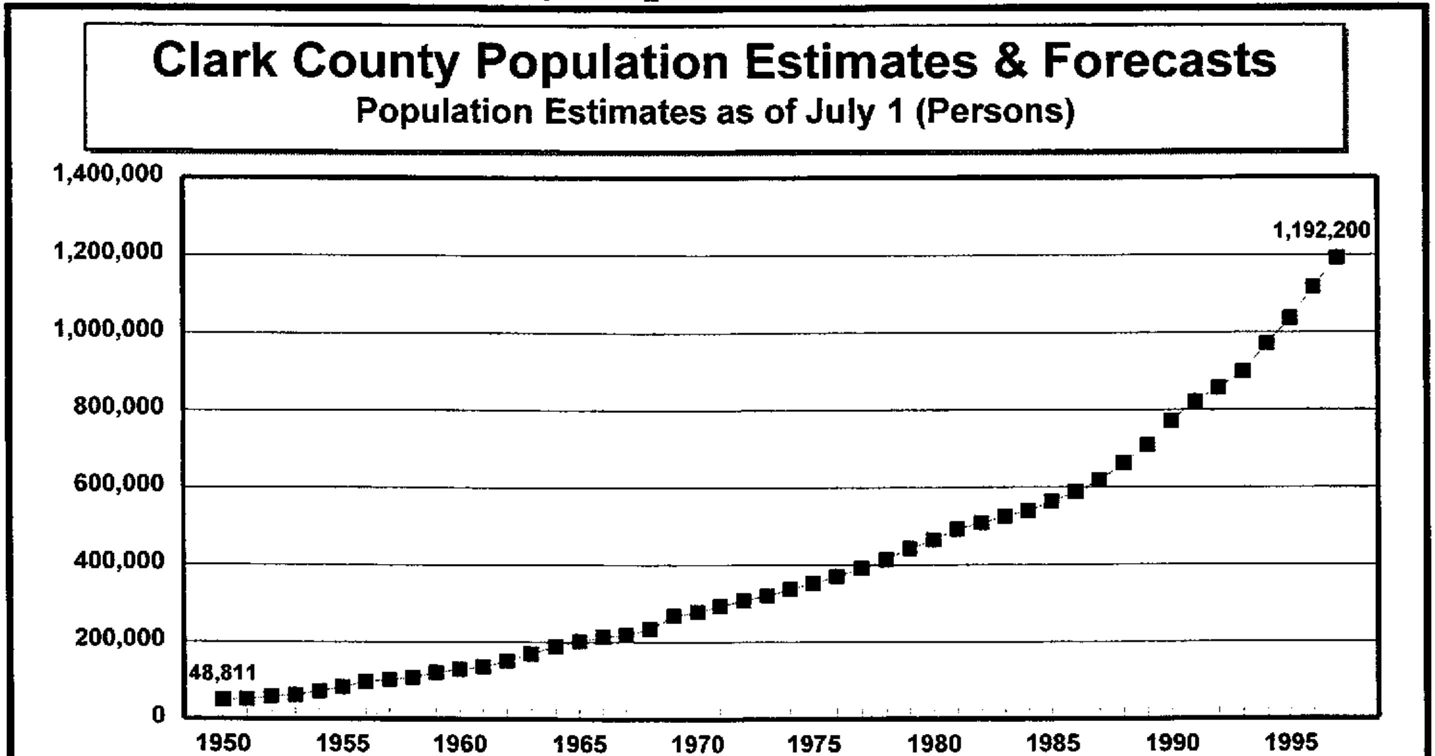
Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	1,393,760	56,360	4.21%	68.52%	1,355,368	66,587	5.17%	68.24%
2001	1,466,090	72,330	5.19%	69.18%	1,417,132	61,764	4.56%	68.72%
2002	1,529,680	63,590	4.34%	69.56%	1,476,095	58,963	4.16%	69.12%
2003	1,596,360	66,680	4.36%	70.16%	1,532,400	56,305	3.81%	69.47%
2004	1,656,840	60,480	3.79%	70.54%	1,587,021	54,621	3.56%	69.78%
2005	1,722,630	65,790	3.97%	71.15%	1,640,444	53,423	3.37%	70.06%
2006	1,779,720	57,090	3.31%	71.53%	1,693,049	52,605	3.21%	70.32%
2007	1,843,920	64,200	3.61%	72.10%	1,742,557	49,508	2.92%	70.54%
2008	1,905,050	61,130	3.32%	72.44%	1,789,103	46,546	2.67%	70.72%
2009	1,966,930	61,880	3.25%	72.71%	1,833,010	43,907	2.45%	70.87%
2010	2,031,500	64,570	3.28%	72.98%	1,874,431	41,421	2.26%	70.99%
2011	2,097,710	66,210	3.26%	73.25%	1,913,368	38,937	2.08%	71.09%
2012	2,166,830	69,120	3.30%	73.53%	1,949,898	36,530	1.91%	71.17%
2013	2,239,910	73,080	3.37%	73.86%	1,983,988	34,090	1.75%	71.23%
2014	2,312,410	72,500	3.24%	74.09%	2,016,010	32,022	1.61%	71.28%
2015	2,389,340	76,930	3.33%	74.38%	2,046,229	30,219	1.50%	71.32%
2016	2,470,010	80,670	3.38%	74.69%	2,074,731	28,502	1.39%	71.35%
2017	2,552,270	82,260	3.33%	74.99%	2,102,041	27,310	1.32%	71.39%
2018	2,636,200	83,930	3.29%	75.30%	2,128,269	26,228	1.25%	71.42%
2019	--	--	--	--	2,153,544	25,275	1.19%	71.45%
2020	--	--	--	--	2,178,046	24,502	1.14%	71.49%

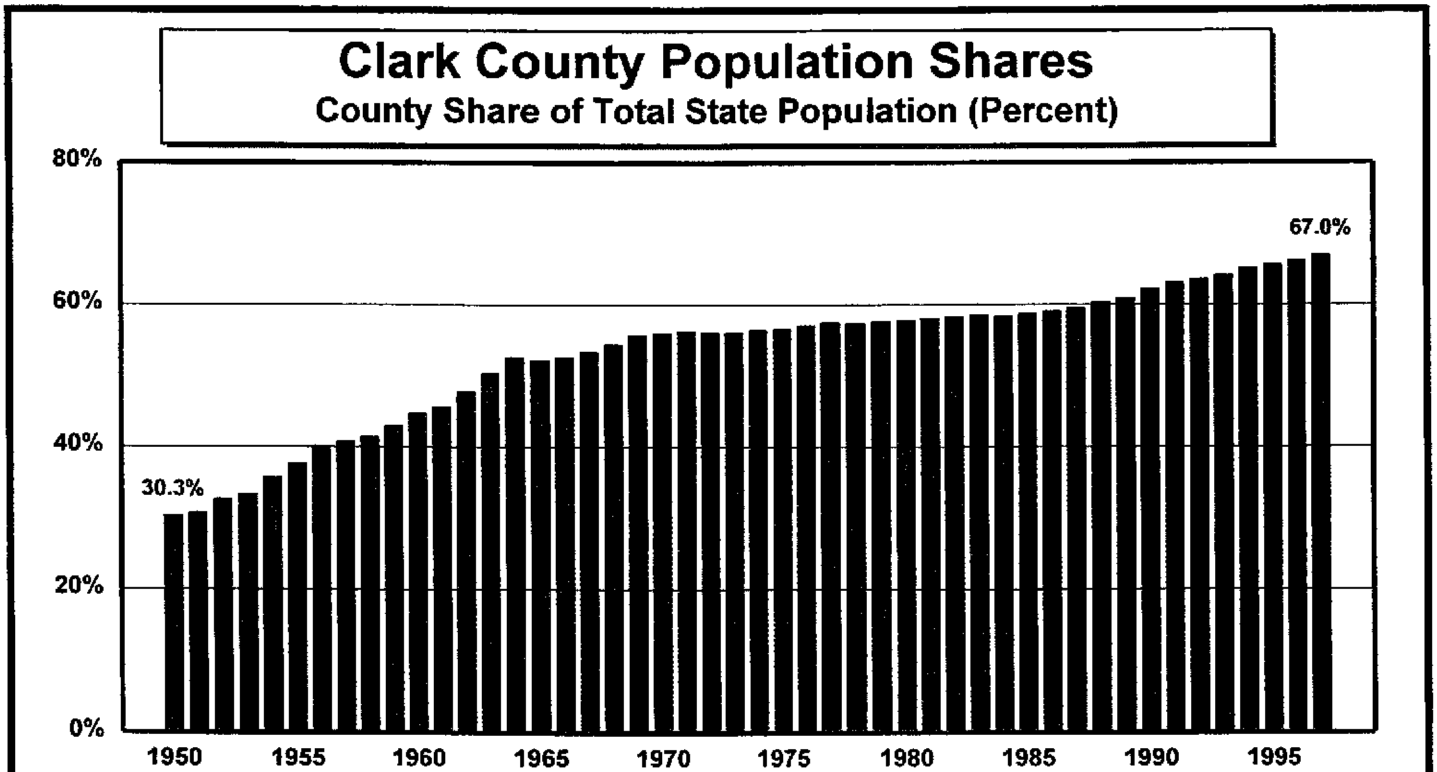
Growth Rate Analysis:	1950-1997	7.04%			
Average Annual Rates	1950-1960	10.18%			
of Change by Specific	1960-1970	7.97%			
Time Period (percent)	1970-1980	5.26%			
	1980-1990	5.22%			
	1990-1997	6.44%			
Forecast Periods:	**1998-2018**	**3.85%**	**State Demographer**	**2.80%**	**NDWP Modified Forecast**
	1998-2008	**4.35%**		**3.76%**	
	2008-2018	**3.30%**		**1.83%**	

Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

County Population Analysis

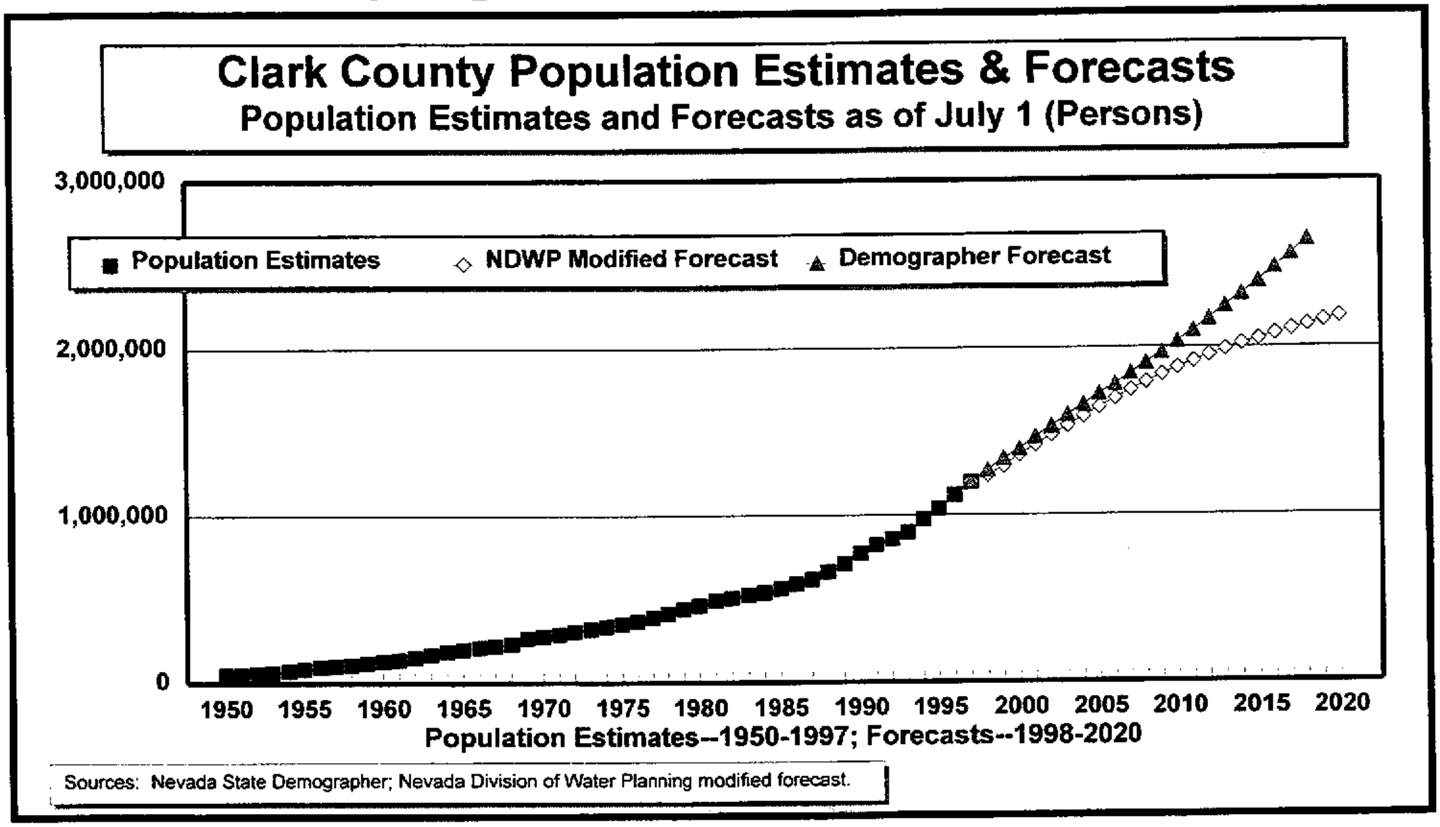


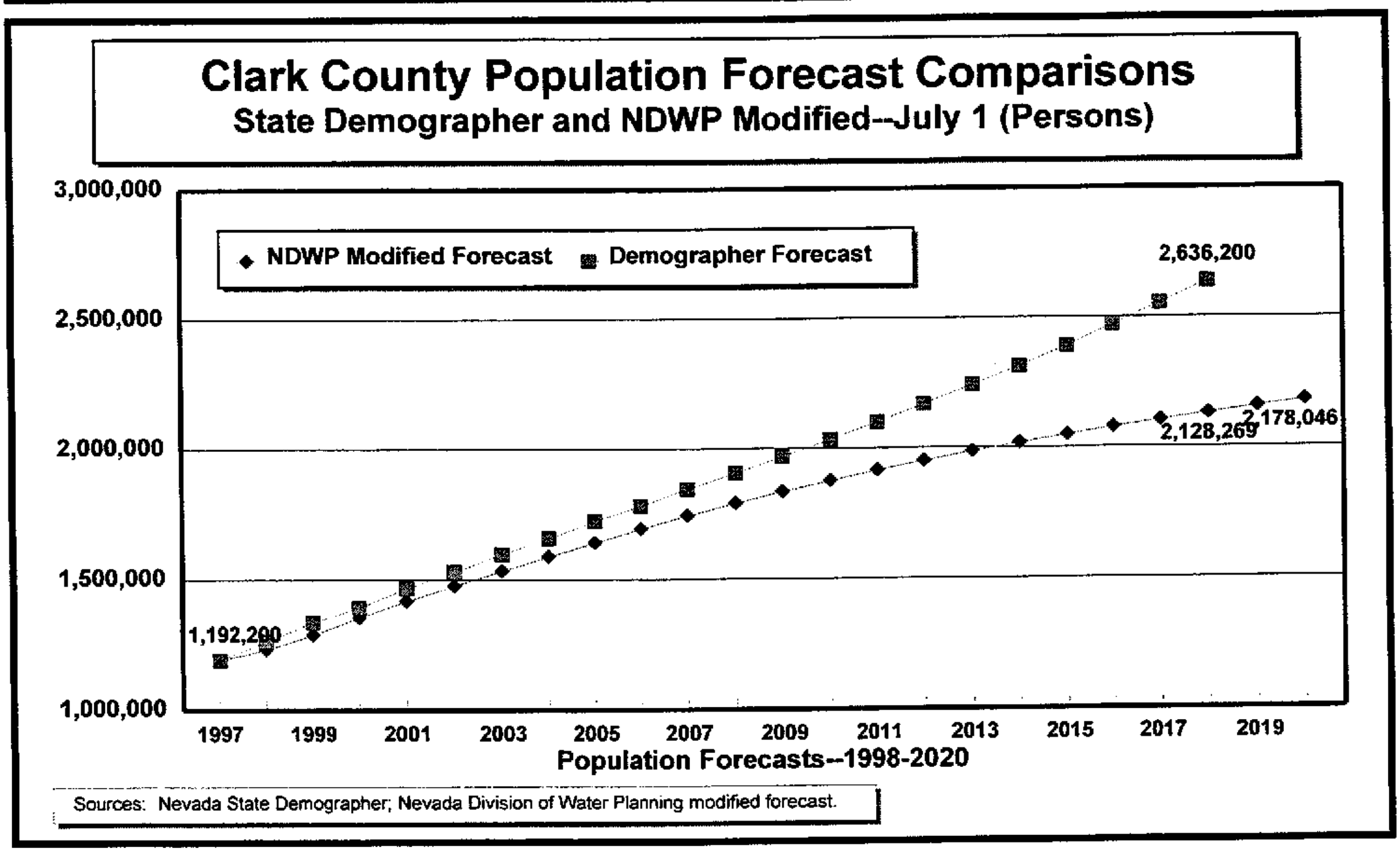
Source: Nevada State Demographer.



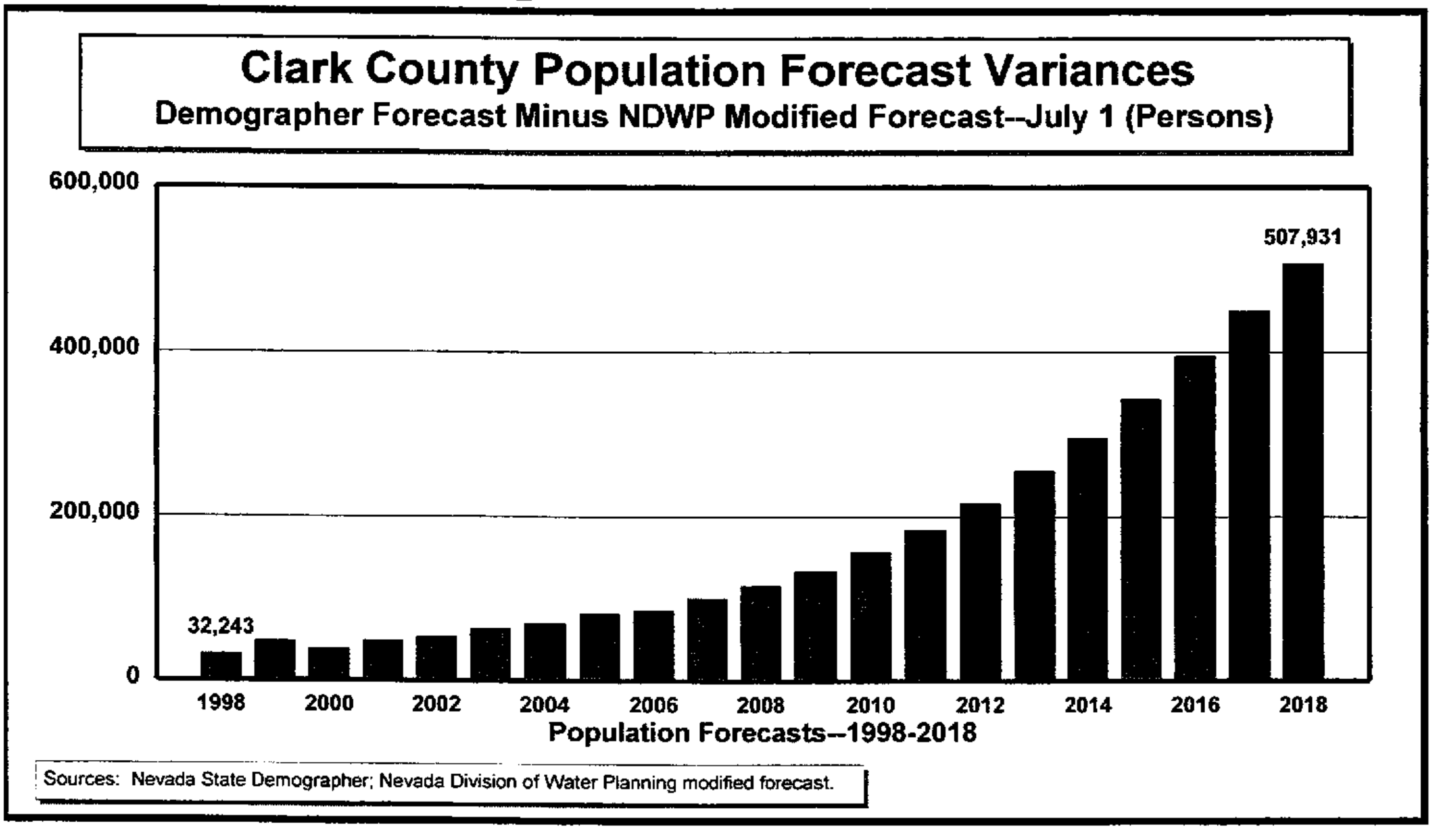
Source: Nevada State Demographer.

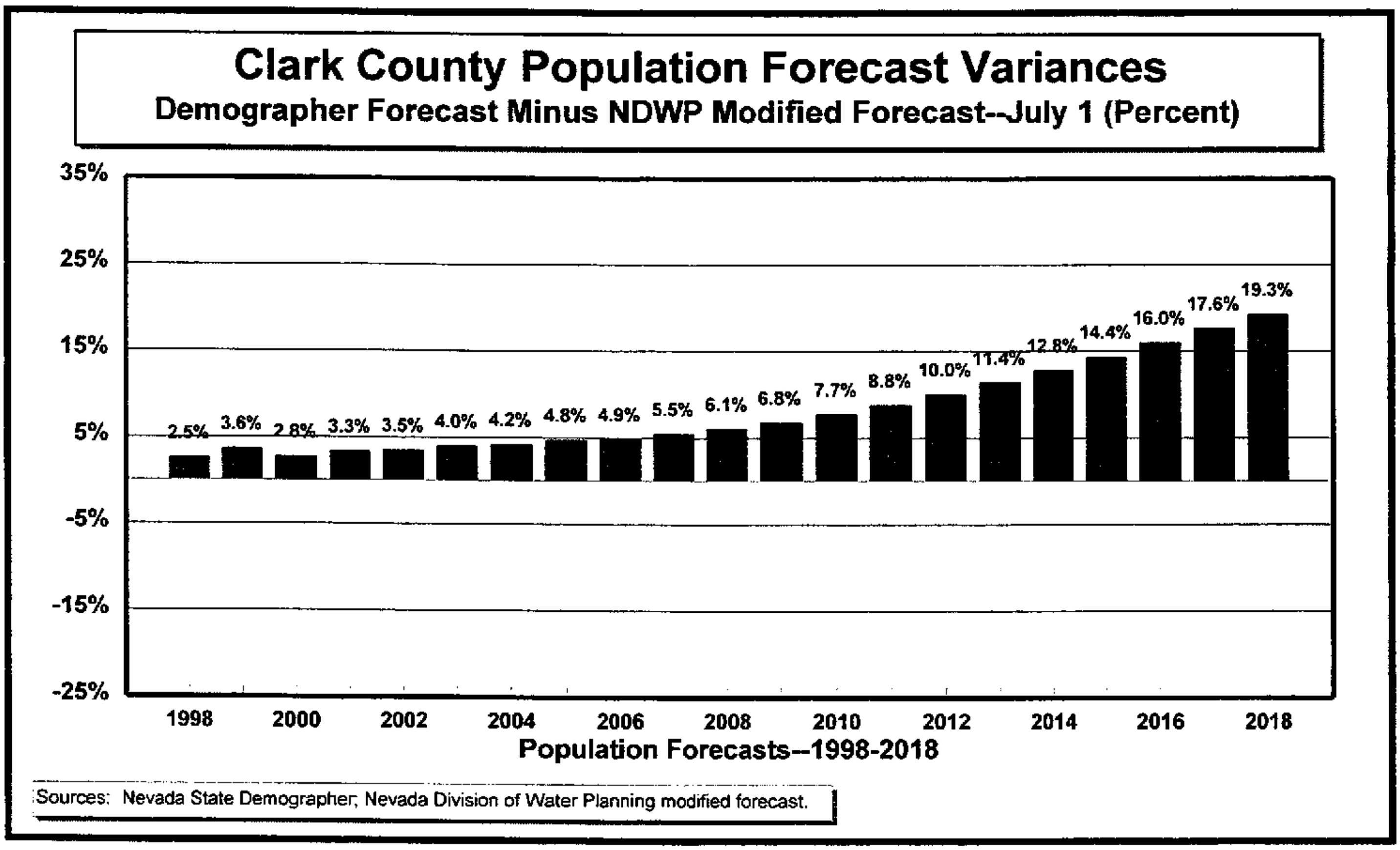
County Population Analysis and Forecasts





County Population Forecast Variances





Douglas County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	2,023	--	--	1.26%	2,023	--	--	1.26%
1951	2,000	(23)	-1.14%	1.21%	2,000	(23)	-1.14%	1.21%
1952	2,600	600	30.00%	1.48%	2,600	600	30.00%	1.48%
1953	2,500	(100)	-3.85%	1.35%	2,500	(100)	-3.85%	1.35%
1954	2,700	200	8.00%	1.35%	2,700	200	8.00%	1.35%
1955	3,100	400	14.81%	1.41%	3,100	400	14.81%	1.41%
1956	3,200	100	3.23%	1.33%	3,200	100	3.23%	1.33%
1957	3,300	100	3.13%	1.32%	3,300	100	3.13%	1.32%
1958	3,300	0	0.00%	1.27%	3,300	0	0.00%	1.27%
1959	3,500	200	6.06%	1.26%	3,500	200	6.06%	1.26%
1960	3,575	75	2.14%	1.24%	3,575	75	2.14%	1.24%
1961	3,951	376	10.52%	1.33%	3,951	376	10.52%	1.33%
1962	3,969	18	0.46%	1.26%	3,969	18	0.46%	1.26%
1963	4,044	75	1.89%	1.20%	4,044	75	1.89%	1.20%
1964	4,144	100	2.47%	1.15%	4,144	100	2.47%	1.15%
1965	5,195	1,051	25.36%	1.34%	5,195	1,051	25.36%	1.34%
1966	5,503	308	5.93%	1.36%	5,503	308	5.93%	1.36%
1967	5,604	101	1.84%	1.37%	5,604	101	1.84%	1.37%
1968	5,826	222	3.96%	1.36%	5,826	222	3.96%	1.36%
1969	6,749	923	15.84%	1.41%	6,749	923	15.84%	1.41%
1970	7,067	318	4.71%	1.43%	7,067	318	4.71%	1.43%
1971	7,800	733	10.37%	1.50%	7,800	733	10.37%	1.50%
1972	8,800	1,000	12.82%	1.61%	8,800	1,000	12.82%	1.61%
1973	10,100	1,300	14.77%	1.77%	10,100	1,300	14.77%	1.77%
1974	11,100	1,000	9.90%	1.86%	11,100	1,000	9.90%	1.86%
1975	12,100	1,000	9.01%	1.95%	12,100	1,000	9.01%	1.95%
1976	13,100	1,000	8.26%	2.03%	13,100	1,000	8.26%	2.03%
1977	14,300	1,200	9.16%	2.11%	14,300	1,200	9.16%	2.11%
1978	16,100	1,800	12.59%	2.24%	16,100	1,800	12.59%	2.24%
1979	18,400	2,300	14.29%	2.40%	18,400	2,300	14.29%	2.40%
1980	19,421	1,021	5.55%	2.43%	19,421	1,021	5.55%	2.43%
1981	20,410	989	5.09%	2.41%	20,410	989	5.09%	2.41%
1982	20,880	470	2.30%	2.40%	20,880	470	2.30%	2.40%
1983	21,310	430	2.06%	2.38%	21,310	430	2.06%	2.38%
1984	21,990	680	3.19%	2.38%	21,990	680	3.19%	2.38%
1985	23,000	1,010	4.59%	2.41%	23,000	1,010	4.59%	2.41%
1986	24,030	1,030	4.48%	2.42%	24,030	1,030	4.48%	2.42%
1987	25,070	1,040	4.33%	2.42%	25,070	1,040	4.33%	2.42%
1988	25,900	830	3.31%	2.36%	25,900	830	3.31%	2.36%
1989	26,930	1,030	3.98%	2.32%	26,930	1,030	3.98%	2.32%
1990	28,070	1,140	4.23%	2.27%	28,070	1,140	4.23%	2.27%
1991	28,810	740	2.64%	2.22%	28,810	740	2.64%	2.22%
1992	29,470	660	2.29%	2.19%	29,470	660	2.29%	2.19%
1993	30,390	920	3.12%	2.17%	30,390	920	3.12%	2.17%
1994	34,600	4,210	13.85%	2.32%	34,600	4,210	13.85%	2.32%
1995	35,880	1,280	3.70%	2.27%	35,880	1,280	3.70%	2.27%
1996	37,480	1,600	4.46%	2.22%	37,480	1,600	4.46%	2.22%
1997	39,590	2,110	5.63%	2.22%	39,590	2,110	5.63%	2.22%
1998	41,360	1,770	4.47%	2.21%	40,671	1,081	2.73%	2.22%
1999	42,810	1,450	3.51%	2.18%	41,753	1,082	2.66%	2.19%

Douglas County Population Estimates & Forecasts

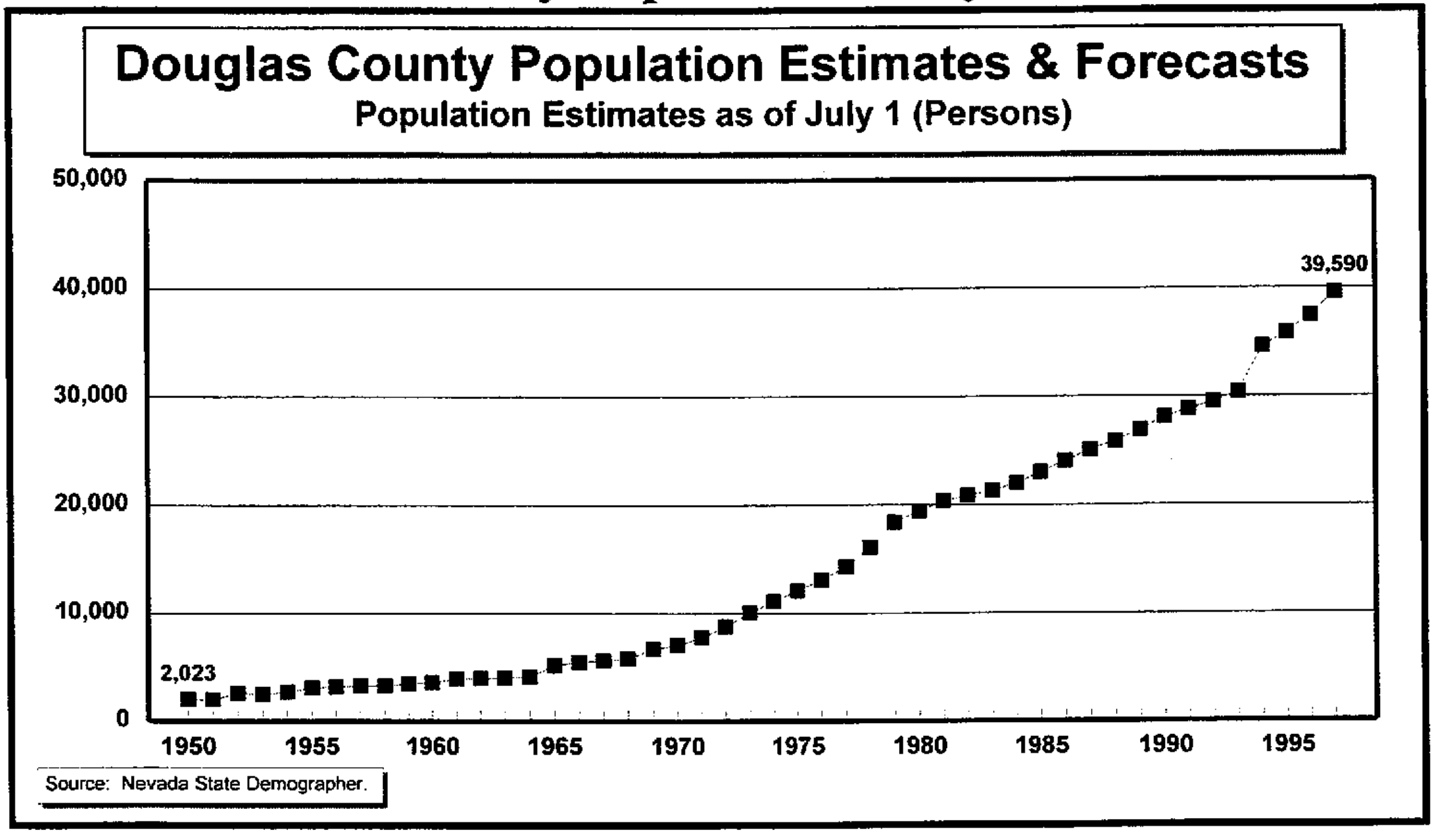
Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

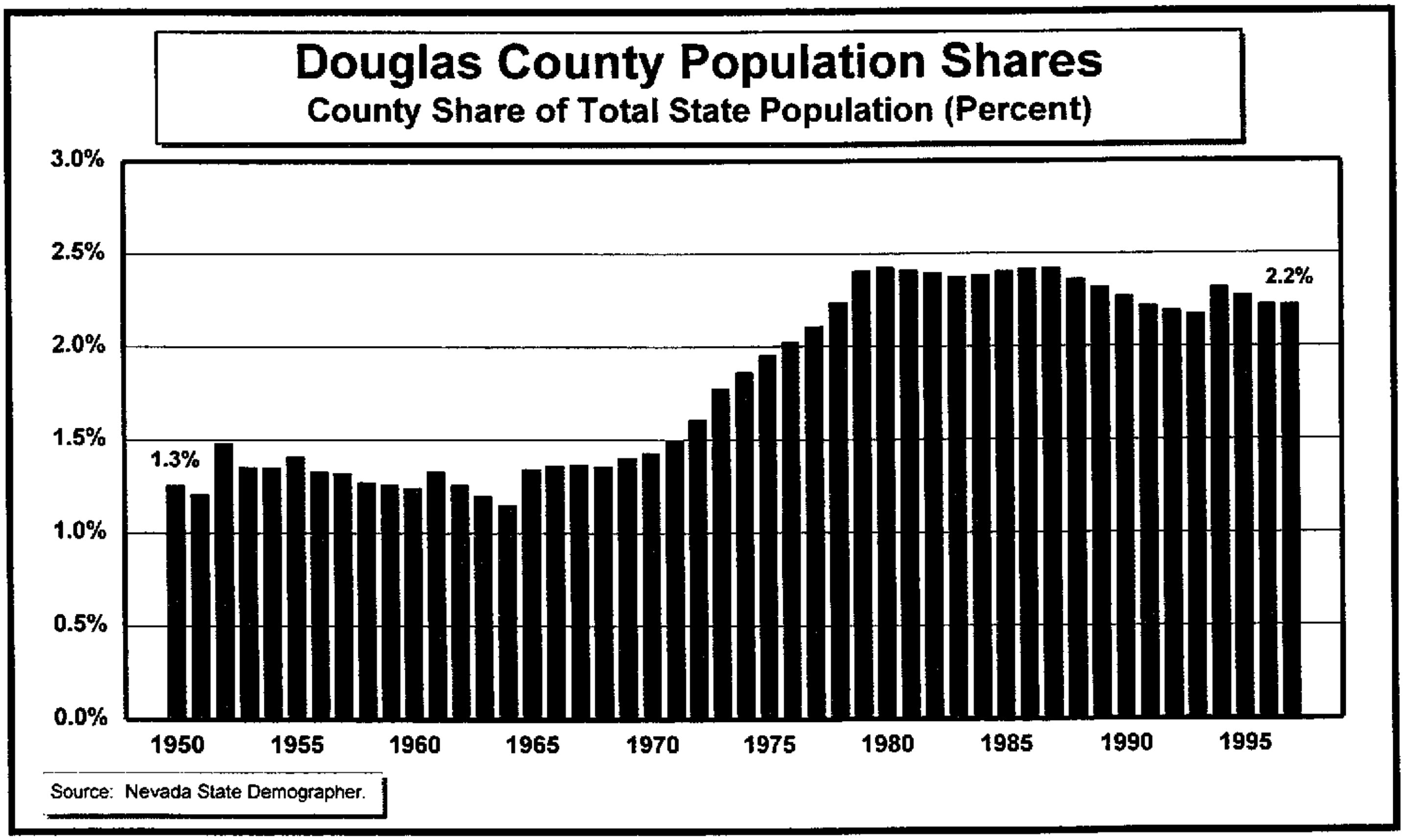
Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	44,290	1,480	3.46%	2.18%	42,834	1,081	2.59%	2.16%
2001	45,710	1,420	3.21%	2.16%	43,913	1,079	2.52%	2.13%
2002	47,510	1,800	3.94%	2.16%	44,989	1,076	2.45%	2.11%
2003	48,790	1,280	2.69%	2.14%	46,060	1,071	2.38%	2.09%
2004	50,400	1,610	3.30%	2.15%	47,124	1,064	2.31%	2.07%
2005	51,520	1,120	2.22%	2.13%	48,180	1,056	2.24%	2.06%
2006	52,890	1,370	2.66%	2.13%	49,225	1,045	2.17%	2.04%
2007	53,880	990	1.87%	2.11%	50,259	1,034	2.10%	2.03%
2008	55,290	1,410	2.62%	2.10%	51,279	1,020	2.03%	2.03%
2009	56,980	1,690	3.06%	2.11%	52,284	1,005	1.96%	2.02%
2010	58,690	1,710	3.00%	2.11%	53,272	988	1.89%	2.02%
2011	60,380	1,690	2.88%	2.11%	54,242	970	1.82%	2.02%
2012	62,100	1,720	2.85%	2.11%	55,191	949	1.75%	2.01%
2013	63,860	1,760	2.83%	2.11%	56,118	927	1.68%	2.01%
2014	65,530	1,670	2.62%	2.10%	57,022	904	1.61%	2.02%
2015	67,250	1,720	2.62%	2.09%	57,900	878	1.54%	2.02%
2016	68,990	1,740	2.59%	2.09%	58,751	851	1.47%	2.02%
2017	70,680	1,690	2.45%	2.08%	59,574	823	1.40%	2.02%
2018	72,320	1,640	2.32%	2.07%	60,366	792	1.33%	2.03%
2019	--	--	--	--	61,127	761	1.26%	2.03%
2020	--	--	--	--	61,854	727	1.19%	2.03%

Growth Rate Analysis:	1950-1997	6.53%			
Average Annual Rates	1950-1960	5.86%			
of Change by Specific	1960-1970	7.05%			
Time Period (percent)	1970-1980	10.64%			
	1980-1990	3.75%			
	1990-1997	5.04%			
Forecast Periods:	**1998-2018**	**2.91%**	**State Demographer**	**2.03%**	**NDWP Modified Forecast**
	1998-2008	**3.08%**		**2.38%**	
	2008-2018	**2.71%**		**1.68%**	

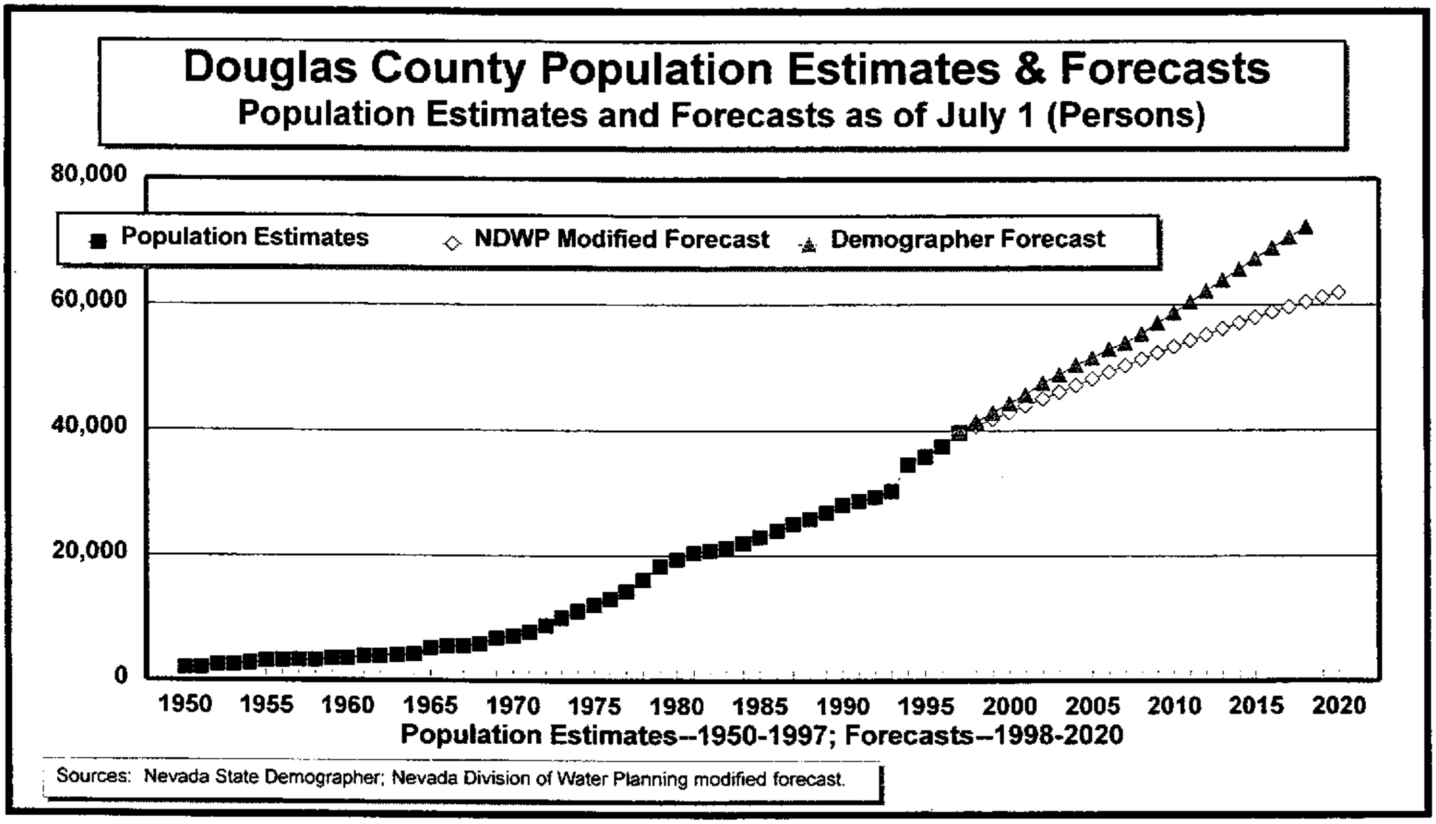
Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

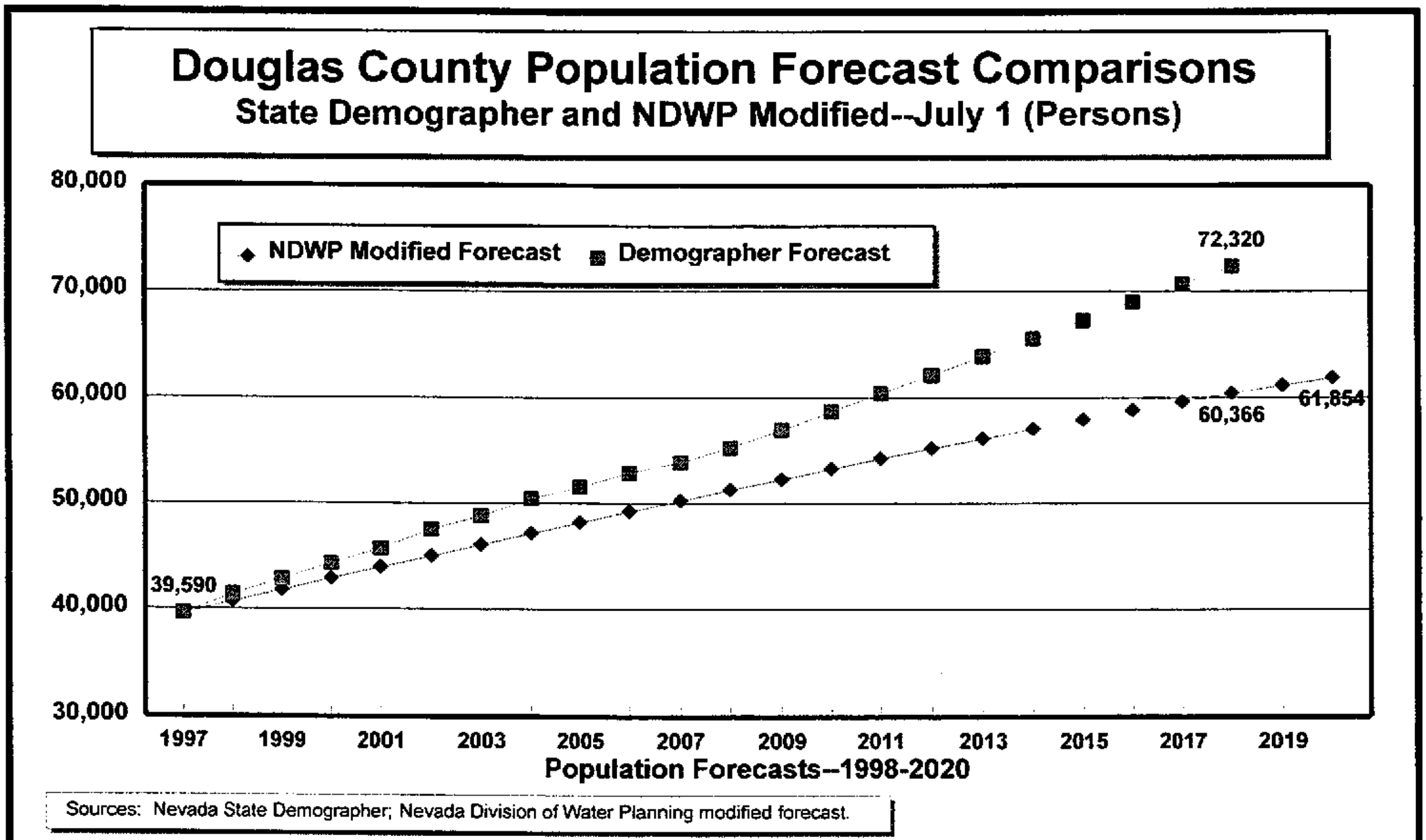
County Population Analysis



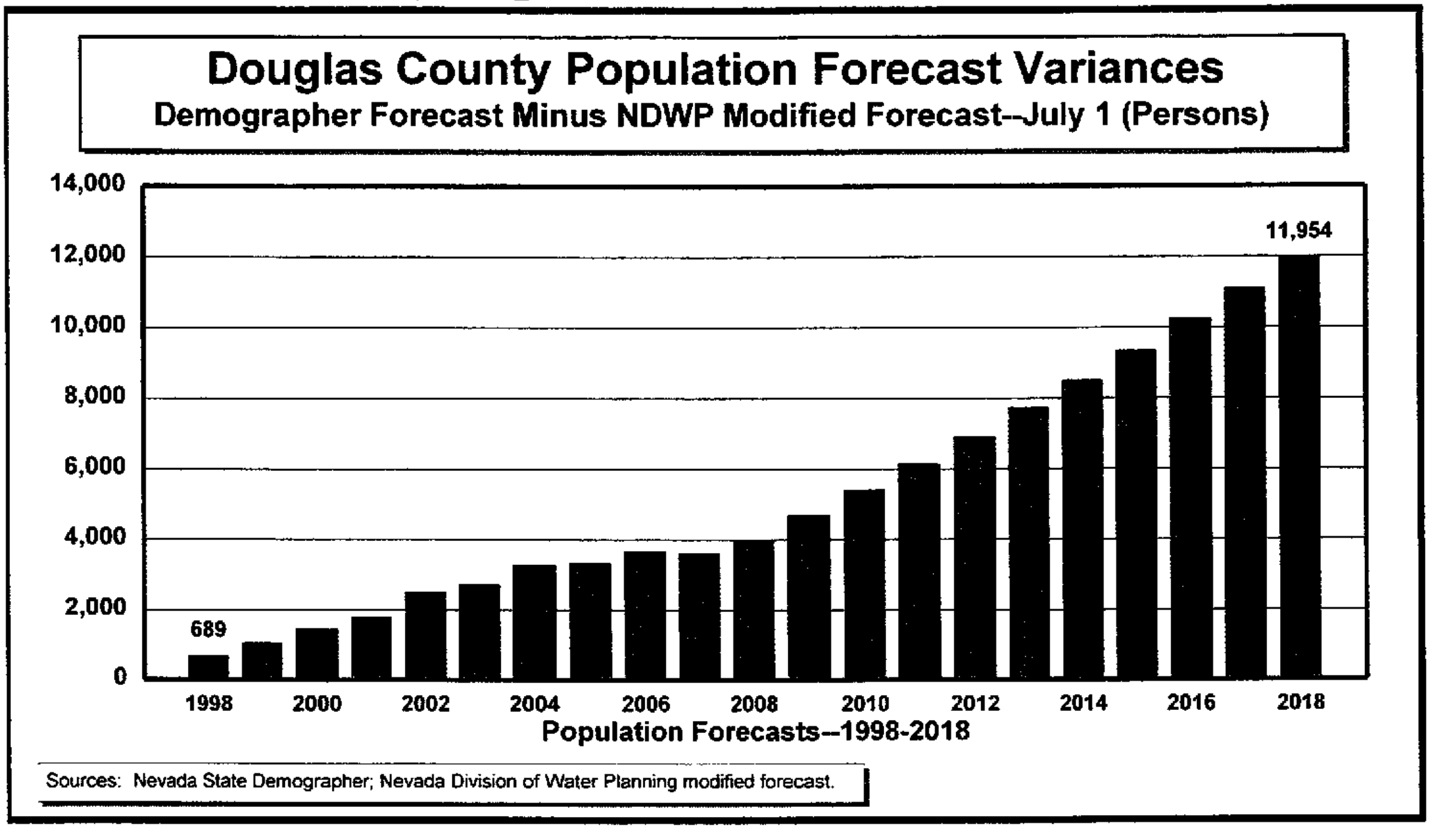


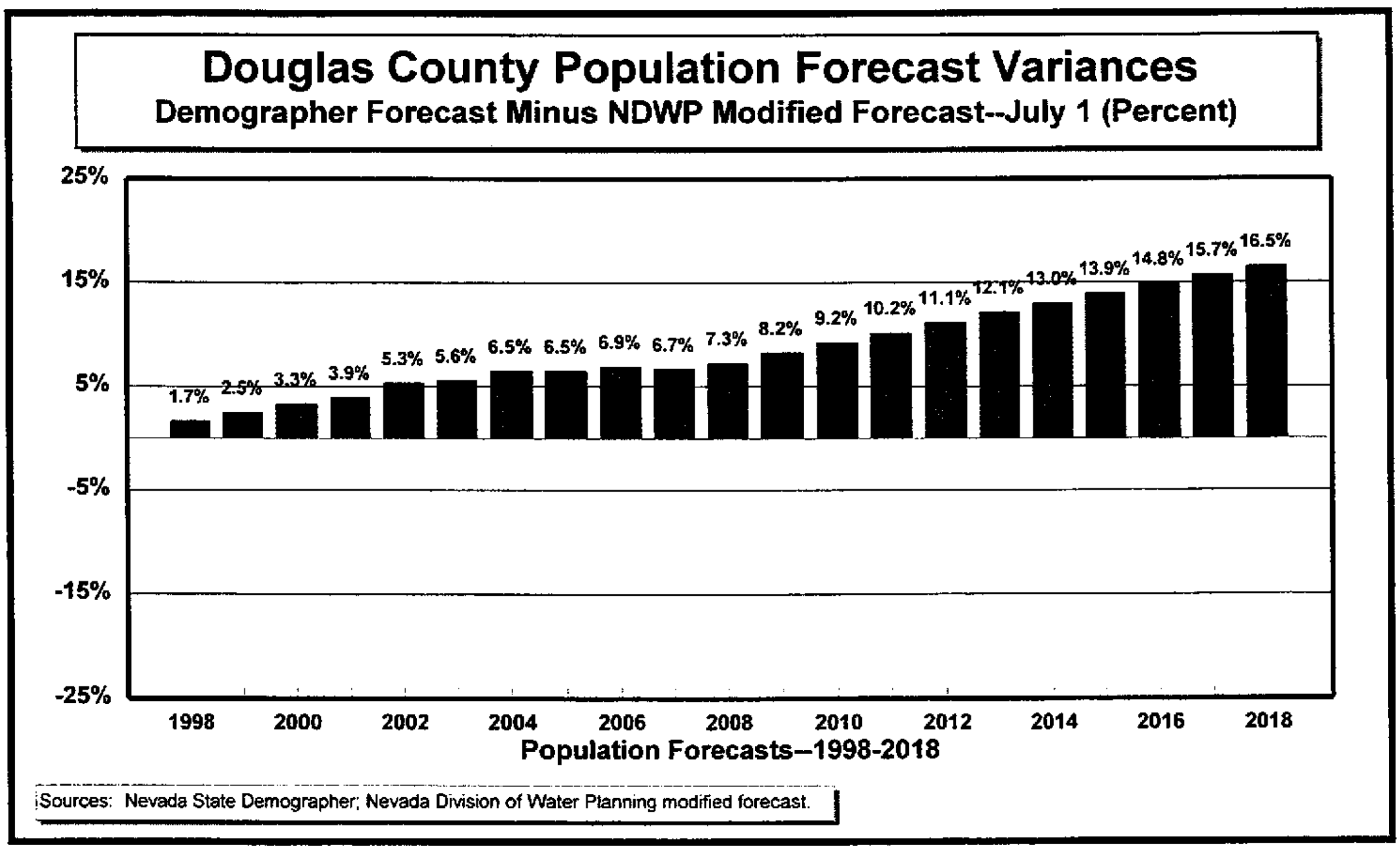
County Population Analysis and Forecasts





County Population Forecast Variances





Elko County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	11,703	--	--	7.26%	11,703	--	--	7.26%
1951	11,900	197	1.68%	7.19%	11,900	197	1.68%	7.19%
1952	12,200	300	2.52%	6.94%	12,200	300	2.52%	6.94%
1953	12,000	(200)	-1.64%	6.50%	12,000	(200)	-1.64%	6.50%
1954	12,400	400	3.33%	6.21%	12,400	400	3.33%	6.21%
1955	12,900	500	4.03%	5.86%	12,900	500	4.03%	5.86%
1956	13,200	300	2.33%	5.50%	13,200	300	2.33%	5.50%
1957	13,400	200	1.52%	5.37%	13,400	200	1.52%	5.37%
1958	13,500	100	0.75%	5.21%	13,500	100	0.75%	5.21%
1959	13,600	100	0.74%	4.90%	13,600	100	0.74%	4.90%
1960	12,051	(1,549)	-11.39%	4.19%	12,051	(1,549)	-11.39%	4.19%
1961	12,211	160	1.33%	4.11%	12,211	160	1.33%	4.11%
1962	12,187	(24)	-0.20%	3.86%	12,187	(24)	-0.20%	3.86%
1963	12,168	(19)	-0.16%	3.61%	12,168	(19)	-0.16%	3.61%
1964	12,217	49	0.40%	3.39%	12,217	49	0.40%	3.39%
1965	12,841	624	5.11%	3.32%	12,841	624	5.11%	3.32%
1966	13,299	458	3.57%	3.29%	13,299	458	3.57%	3.29%
1967	13,131	(168)	-1.26%	3.20%	13,131	(168)	-1.26%	3.20%
1968	13,076	(55)	-0.42%	3.05%	13,076	(55)	-0.42%	3.05%
1969	14,056	980	7.49%	2.93%	14,056	980	7.49%	2.93%
1970	13,946	(110)	-0.78%	2.82%	13,946	(110)	-0.78%	2.82%
1971	13,900	(46)	-0.33%	2.67%	13,900	(46)	-0.33%	2.67%
1972	15,100	1,200	8.63%	2.76%	15,100	1,200	8.63%	2.76%
1973	15,500	400	2.65%	2.72%	15,500	400	2.65%	2.72%
1974	15,700	200	1.29%	2.63%	15,700	200	1.29%	2.63%
1975	15,600	(100)	-0.64%	2.52%	15,600	(100)	-0.64%	2.52%
1976	15,800	200	1.28%	2.44%	15,800	200	1.28%	2.44%
1977	15,500	(300)	-1.90%	2.29%	15,500	(300)	-1.90%	2.29%
1978	15,800	300	1.94%	2.20%	15,800	300	1.94%	2.20%
1979	16,100	300	1.90%	2.10%	16,100	300	1.90%	2.10%
1980	17,269	1,169	7.26%	2.16%	17,269	1,169	7.26%	2.16%
1981	18,650	1,381	8.00%	2.20%	18,650	1,381	8.00%	2.20%
1982	19,530	880	4.72%	2.24%	19,530	880	4.72%	2.24%
1983	20,450	920	4.71%	2.28%	20,450	920	4.71%	2.28%
1984	21,420	970	4.74%	2.32%	21,420	970	4.74%	2.32%
1985	22,350	930	4.34%	2.34%	22,350	930	4.34%	2.34%
1986	23,320	970	4.34%	2.35%	23,320	970	4.34%	2.35%
1987	24,300	980	4.20%	2.35%	24,300	980	4.20%	2.35%
1988	27,010	2,710	11.15%	2.46%	27,010	2,710	11.15%	2.46%
1989	31,830	4,820	17.85%	2.74%	31,830	4,820	17.85%	2.74%
1990	33,770	1,940	6.09%	2.73%	33,770	1,940	6.09%	2.73%
1991	35,950	2,180	6.46%	2.77%	35,950	2,180	6.46%	2.77%
1992	37,420	1,470	4.09%	2.78%	37,420	1,470	4.09%	2.78%
1993	39,340	1,920	5.13%	2.81%	39,340	1,920	5.13%	2.81%
1994	41,260	1,920	4.88%	2.77%	41,260	1,920	4.88%	2.77%
1995	43,050	1,790	4.34%	2.73%	43,050	1,790	4.34%	2.73%
1996	45,630	2,580	5.99%	2.71%	45,630	2,580	5.99%	2.71%
1997	47,710	2,080	4.56%	2.68%	47,710	2,080	4.56%	2.68%
1998	50,250	2,540	5.32%	2.68%	49,041	1,331	2.79%	2.67%
1999	51,540	1,290	2.57%	2.63%	50,360	1,319	2.69%	2.64%

Elko County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

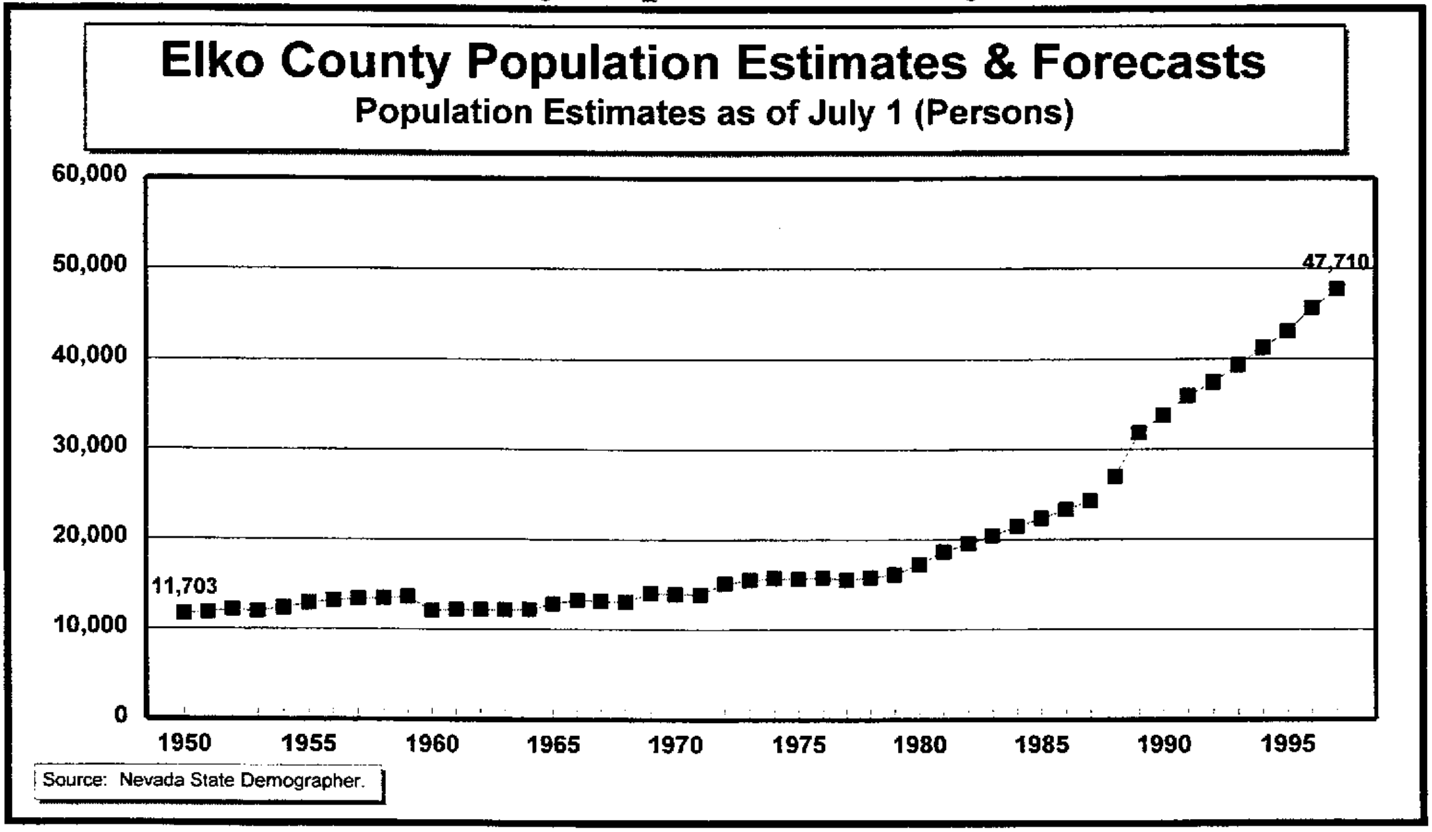
Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	53,230	1,690	3.28%	2.62%	51,665	1,304	2.59%	2.60%
2001	55,070	1,840	3.46%	2.60%	52,951	1,286	2.49%	2.57%
2002	57,480	2,410	4.38%	2.61%	54,217	1,266	2.39%	2.54%
2003	59,090	1,610	2.80%	2.60%	55,458	1,242	2.29%	2.51%
2004	60,840	1,750	2.96%	2.59%	56,673	1,215	2.19%	2.49%
2005	61,810	970	1.59%	2.55%	57,857	1,184	2.09%	2.47%
2006	63,060	1,250	2.02%	2.53%	59,009	1,151	1.99%	2.45%
2007	63,970	910	1.44%	2.50%	60,124	1,115	1.89%	2.43%
2008	65,450	1,480	2.31%	2.49%	61,200	1,076	1.79%	2.42%
2009	67,240	1,790	2.73%	2.49%	62,234	1,034	1.69%	2.41%
2010	68,940	1,700	2.53%	2.48%	63,224	990	1.59%	2.39%
2011	70,520	1,580	2.29%	2.46%	64,166	942	1.49%	2.38%
2012	72,090	1,570	2.23%	2.45%	65,058	892	1.39%	2.37%
2013	73,750	1,660	2.30%	2.43%	65,897	839	1.29%	2.37%
2014	75,340	1,590	2.16%	2.41%	66,681	784	1.19%	2.36%
2015	77,010	1,670	2.22%	2.40%	67,408	727	1.09%	2.35%
2016	78,660	1,650	2.14%	2.38%	68,075	667	0.99%	2.34%
2017	80,220	1,560	1.98%	2.36%	68,681	606	0.89%	2.33%
2018	81,710	1,490	1.86%	2.33%	69,224	543	0.79%	2.32%
2019	--	--	--	--	69,701	478	0.69%	2.31%
2020	--	--	--	--	70,113	411	0.59%	2.30%

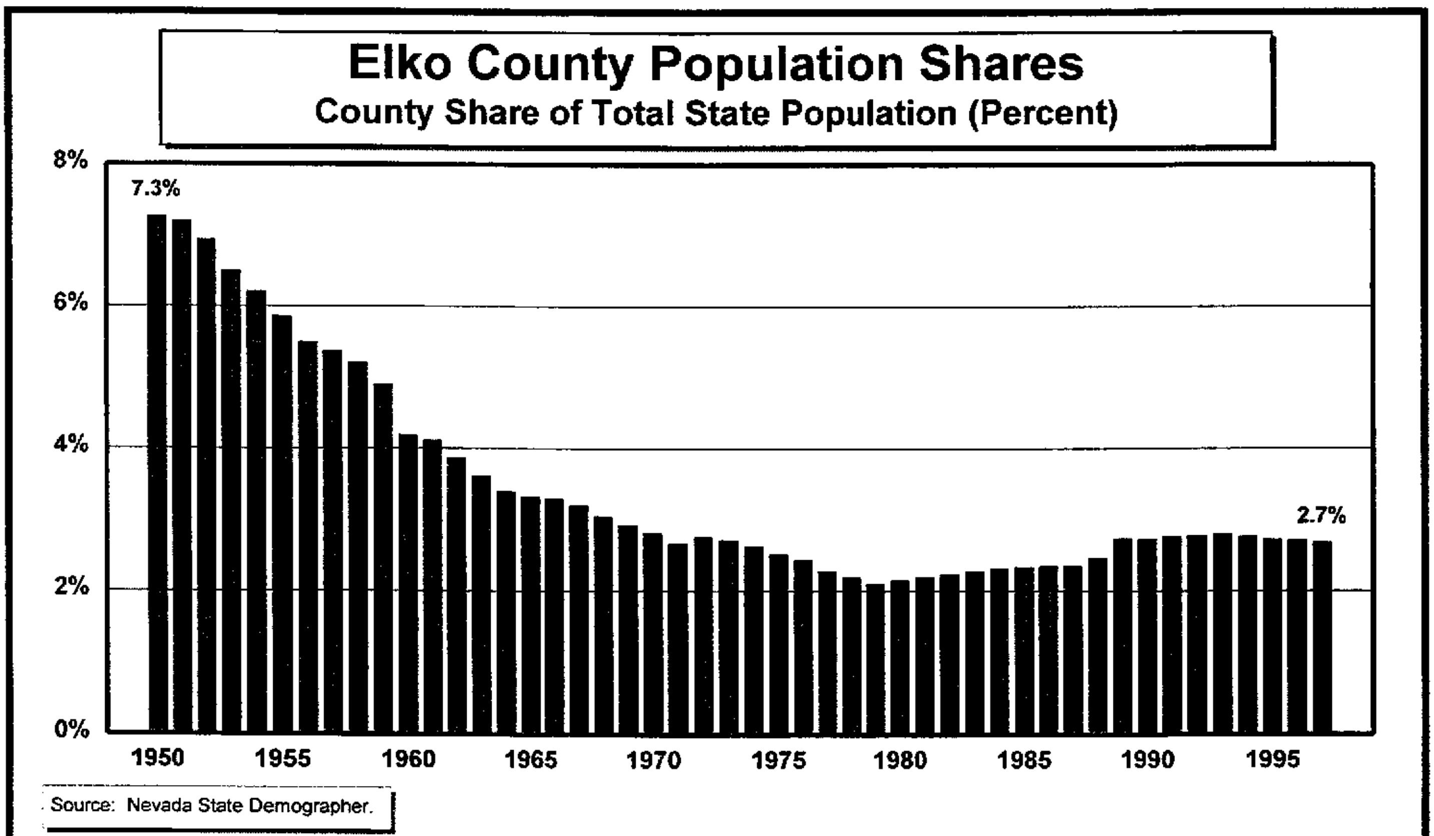
Growth Rate Analysis:	1950-1997	3.04%
Average Annual Rates	1950-1960	0.29%
of Change by Specific	1960-1970	1.47%
Time Period (percent)	1970-1980	2.16%
	1980-1990	6.94%
	1990-1997	5.06%

Forecast Periods:	**1998-2018**	**2.60%**	**State Demographer**	**1.79%**	**NDWP Modified Forecast**
	1998-2008	**2.92%**		**2.29%**	
	2008-2018	**2.25%**		**1.29%**	

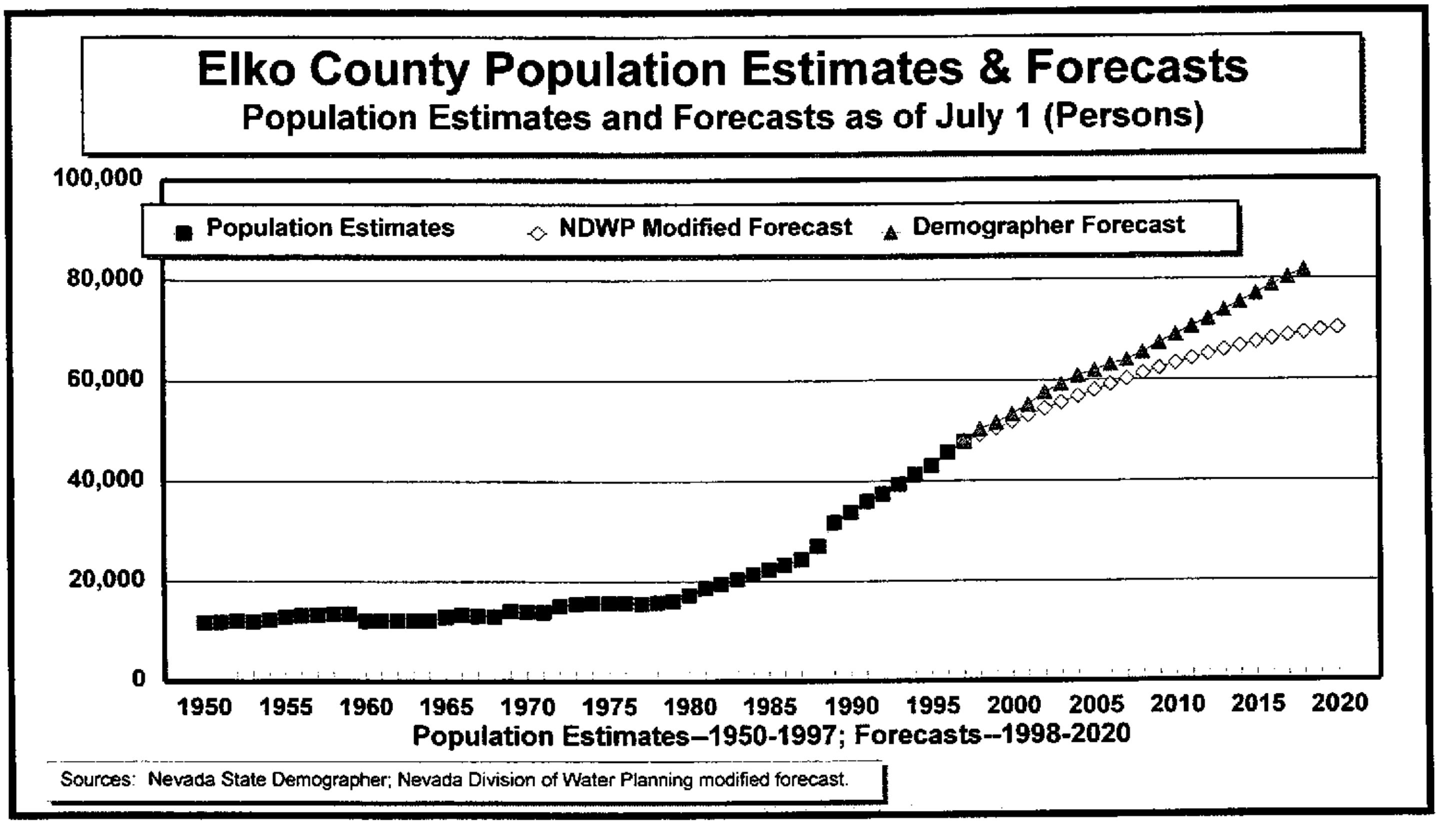
Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

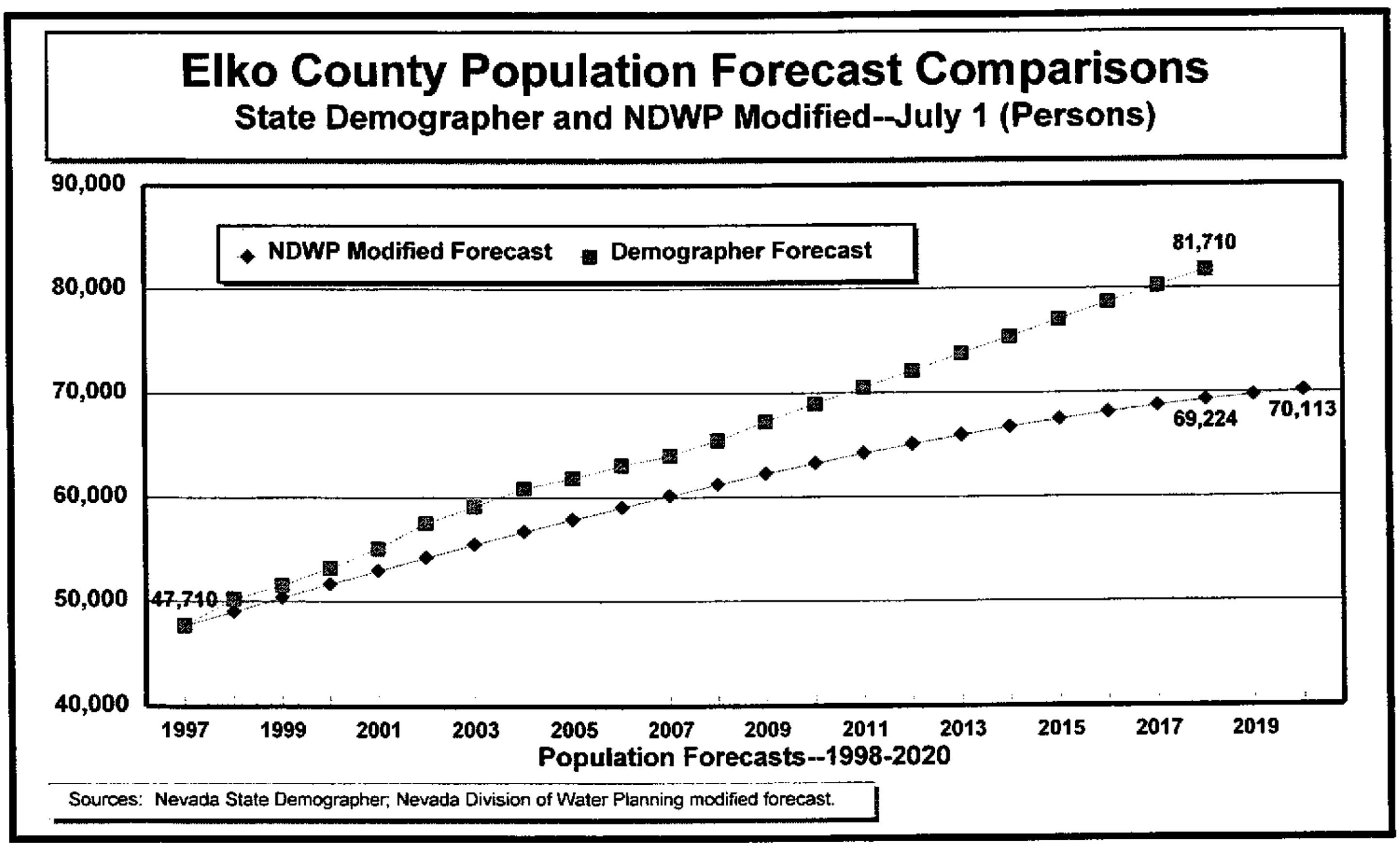
County Population Analysis



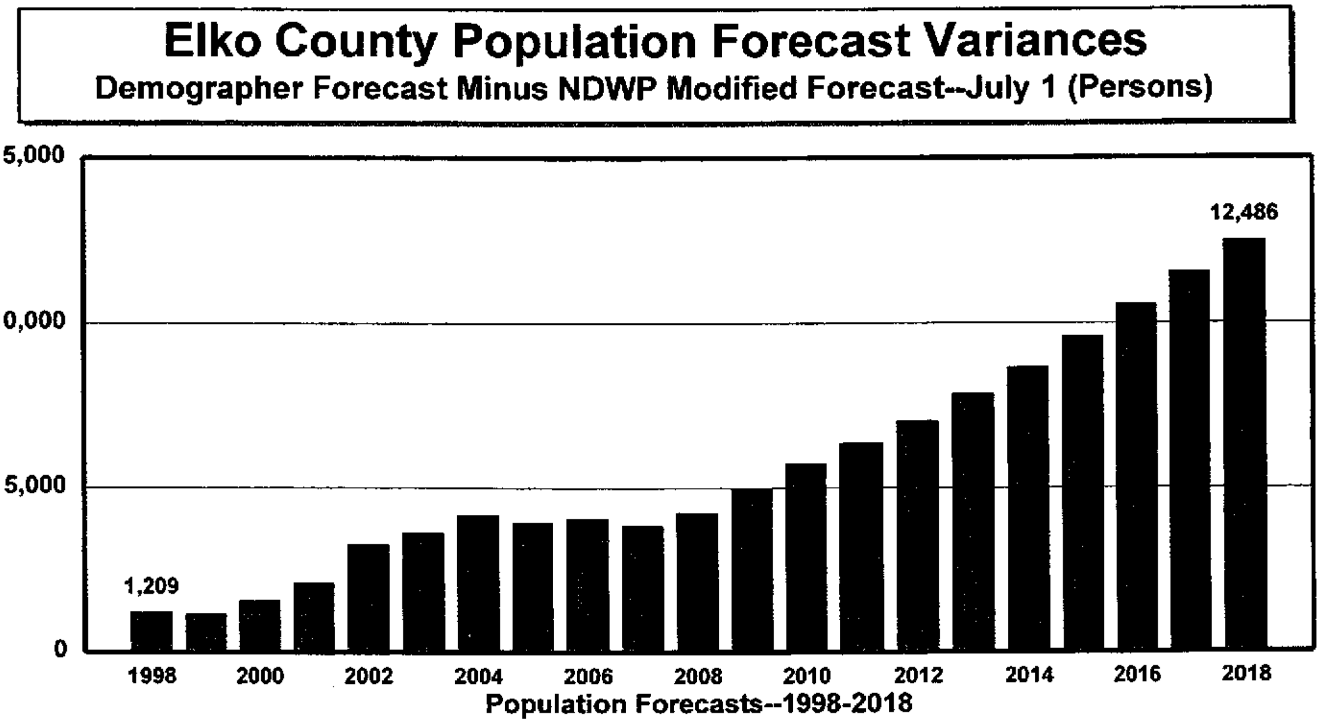


County Population Analysis and Forecasts

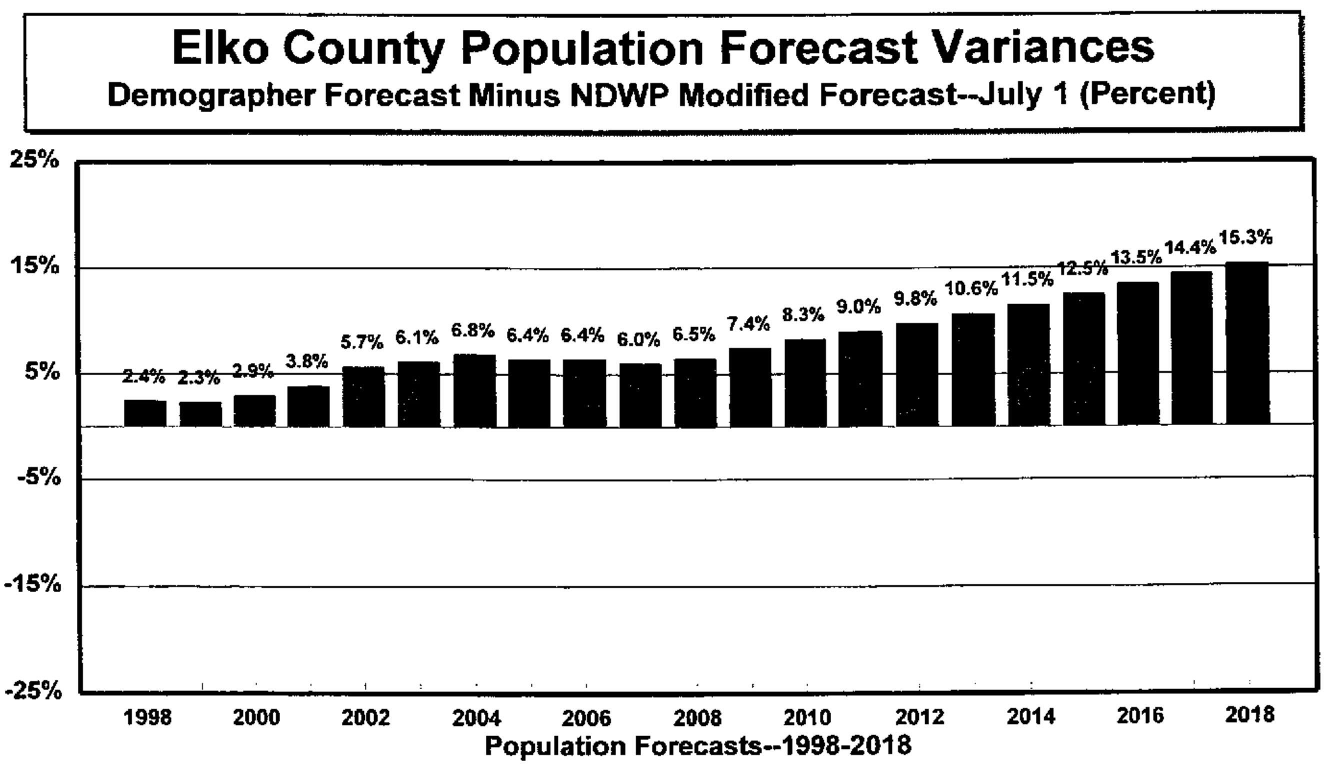




County Population Forecast Variances



Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.



Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.

Esmeralda County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	611	--	--	0.38%	611	--	--	0.38%
1951	600	(11)	-1.80%	0.36%	600	(11)	-1.80%	0.36%
1952	600	0	0.00%	0.34%	600	0	0.00%	0.34%
1953	600	0	0.00%	0.33%	600	0	0.00%	0.33%
1954	500	(100)	-16.67%	0.25%	500	(100)	-16.67%	0.25%
1955	600	100	20.00%	0.27%	600	100	20.00%	0.27%
1956	600	0	0.00%	0.25%	600	0	0.00%	0.25%
1957	500	(100)	-16.67%	0.20%	500	(100)	-16.67%	0.20%
1958	500	0	0.00%	0.19%	500	0	0.00%	0.19%
1959	600	100	20.00%	0.22%	600	100	20.00%	0.22%
1960	634	34	5.67%	0.22%	634	34	5.67%	0.22%
1961	696	62	9.78%	0.23%	696	62	9.78%	0.23%
1962	594	(102)	-14.66%	0.19%	594	(102)	-14.66%	0.19%
1963	495	(99)	-16.67%	0.15%	495	(99)	-16.67%	0.15%
1964	382	(113)	-22.83%	0.11%	382	(113)	-22.83%	0.11%
1965	531	149	39.01%	0.14%	531	149	39.01%	0.14%
1966	525	(6)	-1.13%	0.13%	525	(6)	-1.13%	0.13%
1967	544	19	3.62%	0.13%	544	19	3.62%	0.13%
1968	546	2	0.37%	0.13%	546	2	0.37%	0.13%
1969	561	15	2.75%	0.12%	561	15	2.75%	0.12%
1970	623	62	11.05%	0.13%	623	62	11.05%	0.13%
1971	600	(23)	-3.69%	0.12%	600	(23)	-3.69%	0.12%
1972	600	0	0.00%	0.11%	600	0	0.00%	0.11%
1973	700	100	16.67%	0.12%	700	100	16.67%	0.12%
1974	700	0	0.00%	0.12%	700	0	0.00%	0.12%
1975	700	0	0.00%	0.11%	700	0	0.00%	0.11%
1976	700	0	0.00%	0.11%	700	0	0.00%	0.11%
1977	700	0	0.00%	0.10%	700	0	0.00%	0.10%
1978	700	0	0.00%	0.10%	700	0	0.00%	0.10%
1979	800	100	14.29%	0.10%	800	100	14.29%	0.10%
1980	777	(23)	-2.88%	0.10%	777	(23)	-2.88%	0.10%
1981	1,190	413	53.15%	0.14%	1,190	413	53.15%	0.14%
1982	1,320	130	10.92%	0.15%	1,320	130	10.92%	0.15%
1983	1,480	160	12.12%	0.16%	1,480	160	12.12%	0.16%
1984	1,680	200	13.51%	0.18%	1,680	200	13.51%	0.18%
1985	1,540	(140)	-8.33%	0.16%	1,540	(140)	-8.33%	0.16%
1986	1,540	0	0.00%	0.16%	1,540	0	0.00%	0.16%
1987	1,540	0	0.00%	0.15%	1,540	0	0.00%	0.15%
1988	1,440	(100)	-6.49%	0.13%	1,440	(100)	-6.49%	0.13%
1989	1,360	(80)	-5.56%	0.12%	1,360	(80)	-5.56%	0.12%
1990	1,350	(10)	-0.74%	0.11%	1,350	(10)	-0.74%	0.11%
1991	1,390	40	2.96%	0.11%	1,390	40	2.96%	0.11%
1992	1,410	20	1.44%	0.10%	1,410	20	1.44%	0.10%
1993	1,320	(90)	-6.38%	0.09%	1,320	(90)	-6.38%	0.09%
1994	1,380	60	4.55%	0.09%	1,380	60	4.55%	0.09%
1995	1,630	250	18.12%	0.10%	1,630	250	18.12%	0.10%
1996	1,490	(140)	-8.59%	0.09%	1,490	(140)	-8.59%	0.09%
1997	1,460	(30)	-2.01%	0.08%	1,460	(30)	-2.01%	0.08%
1998	1,200	(260)	-17.81%	0.06%	1,467	7	0.48%	0.08%
1999	1,290	90	7.50%	0.07%	1,474	7	0.46%	0.08%

Esmeralda County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

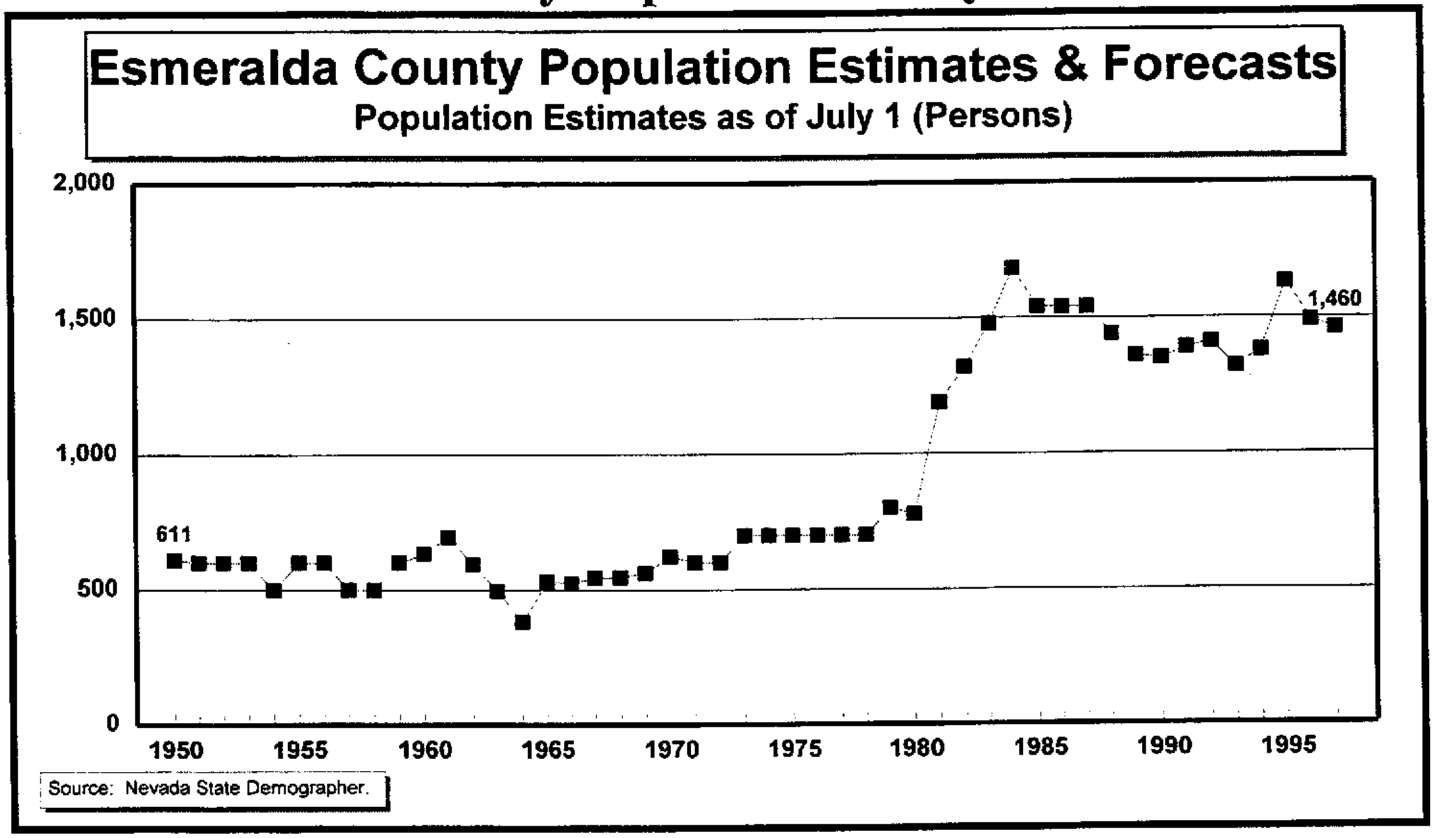
Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	1,390	100	7.75%	0.07%	1,480	6	0.44%	0.07%
2001	1,600	210	15.11%	0.08%	1,486	6	0.42%	0.07%
2002	1,570	(30)	-1.88%	0.07%	1,492	6	0.40%	0.07%
2003	1,530	(40)	-2.55%	0.07%	1,498	6	0.38%	0.07%
2004	1,470	(60)	-3.92%	0.06%	1,503	5	0.36%	0.07%
2005	1,540	70	4.76%	0.06%	1,509	5	0.34%	0.06%
2006	1,580	40	2.60%	0.06%	1,513	5	0.32%	0.06%
2007	1,610	30	1.90%	0.06%	1,518	5	0.30%	0.06%
2008	1,550	(60)	-3.73%	0.06%	1,522	4	0.28%	0.06%
2009	1,550	0	0.00%	0.06%	1,526	4	0.26%	0.06%
2010	1,540	(10)	-0.65%	0.06%	1,530	4	0.24%	0.06%
2011	1,600	60	3.90%	0.06%	1,533	3	0.22%	0.06%
2012	1,600	0	0.00%	0.05%	1,536	3	0.20%	0.06%
2013	1,620	20	1.25%	0.05%	1,539	3	0.18%	0.06%
2014	1,590	(30)	-1.85%	0.05%	1,541	2	0.16%	0.05%
2015	1,610	20	1.26%	0.05%	1,544	2	0.14%	0.05%
2016	1,620	10	0.62%	0.05%	1,545	2	0.12%	0.05%
2017	1,650	30	1.85%	0.05%	1,547	2	0.10%	0.05%
2018	1,640	(10)	-0.61%	0.05%	1,548	1	0.08%	0.05%
2019	--	--	--	--	1,549	1	0.06%	0.05%
2020	--	--	--	--	1,550	1	0.04%	0.05%

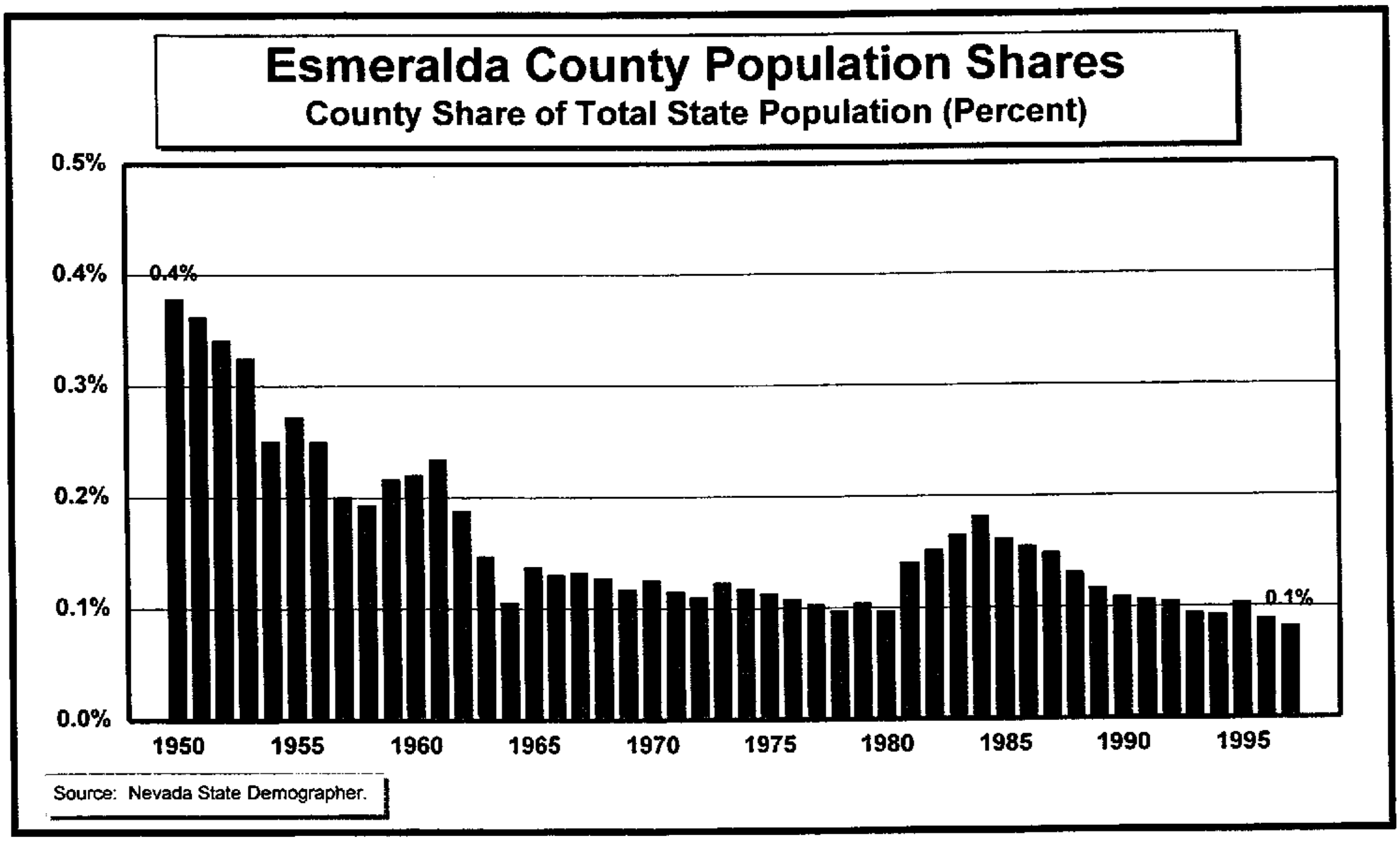
Growth Rate Analysis:	1950-1997	1.87%
Average Annual Rates	1950-1960	0.37%
of Change by Specific	1960-1970	-0.17%
Time Period (percent)	1970-1980	2.23%
	1980-1990	5.68%
	1990-1997	1.13%

Forecast Periods:	**1998-2018**	**0.56%**	**State Demographer**	**0.28%**	**NDWP Modified Forecast**
	1998-2008	**0.55%**		**0.38%**	
	2008-2018	**0.17%**		**0.18%**	

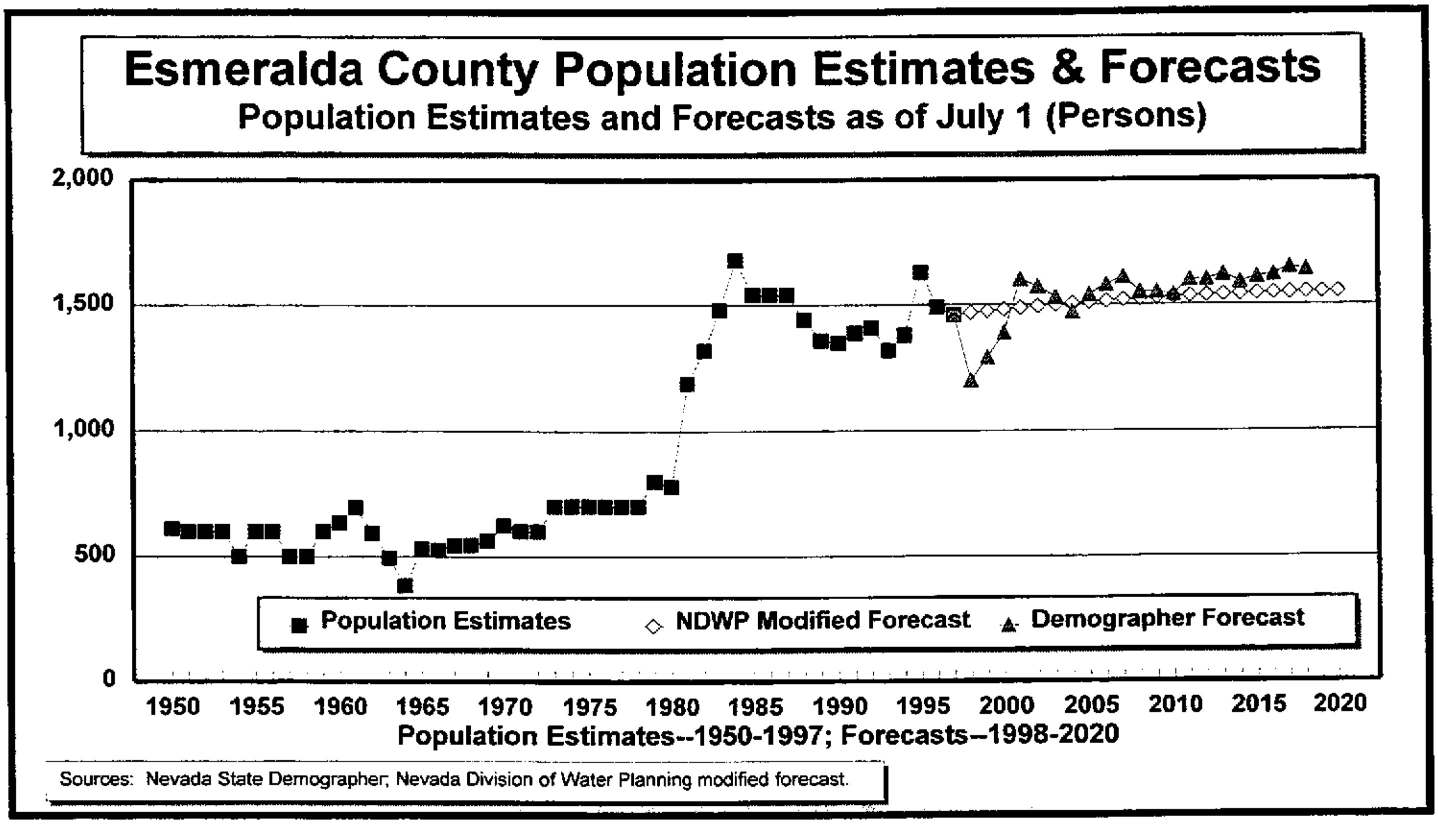
Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

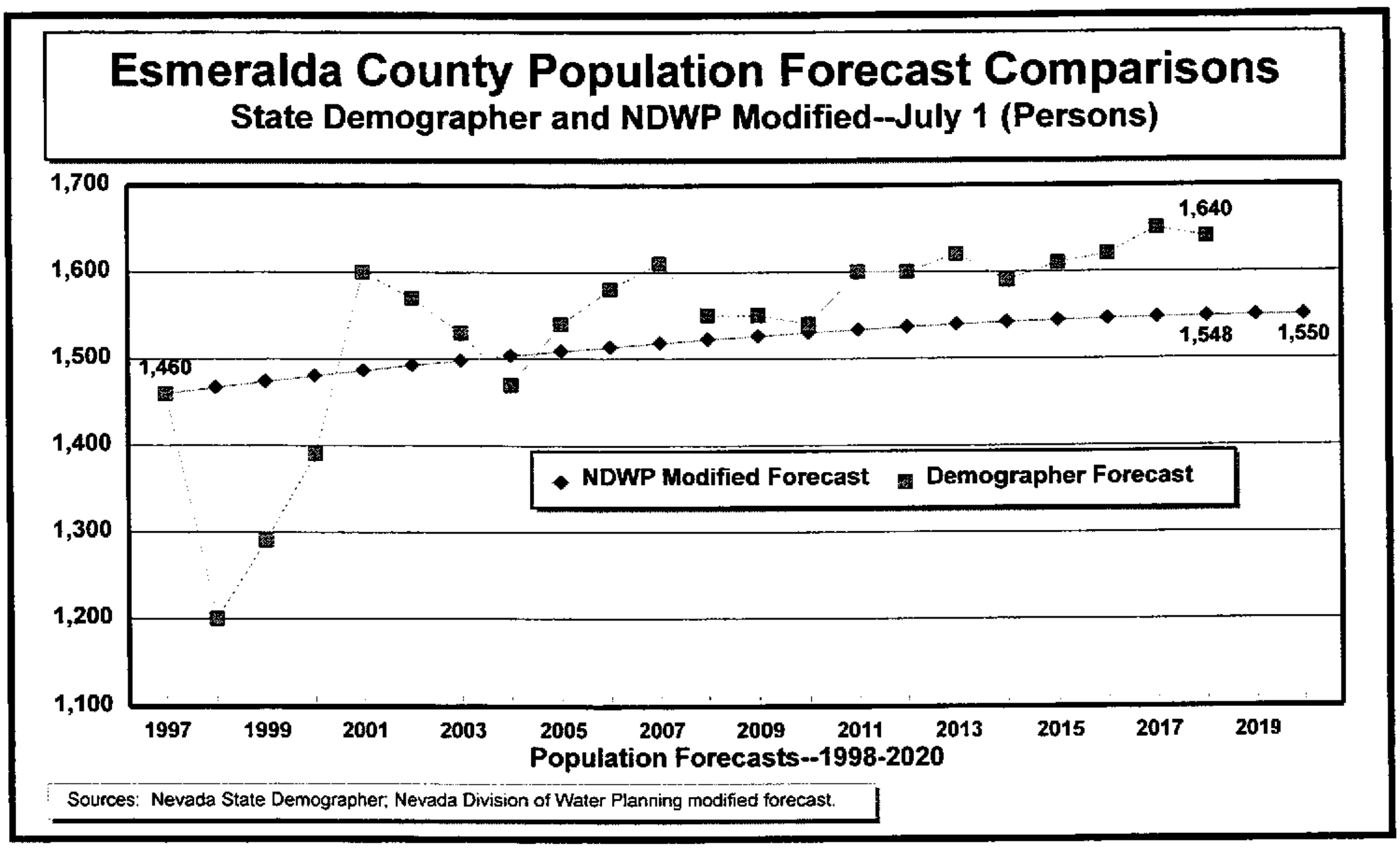
County Population Analysis



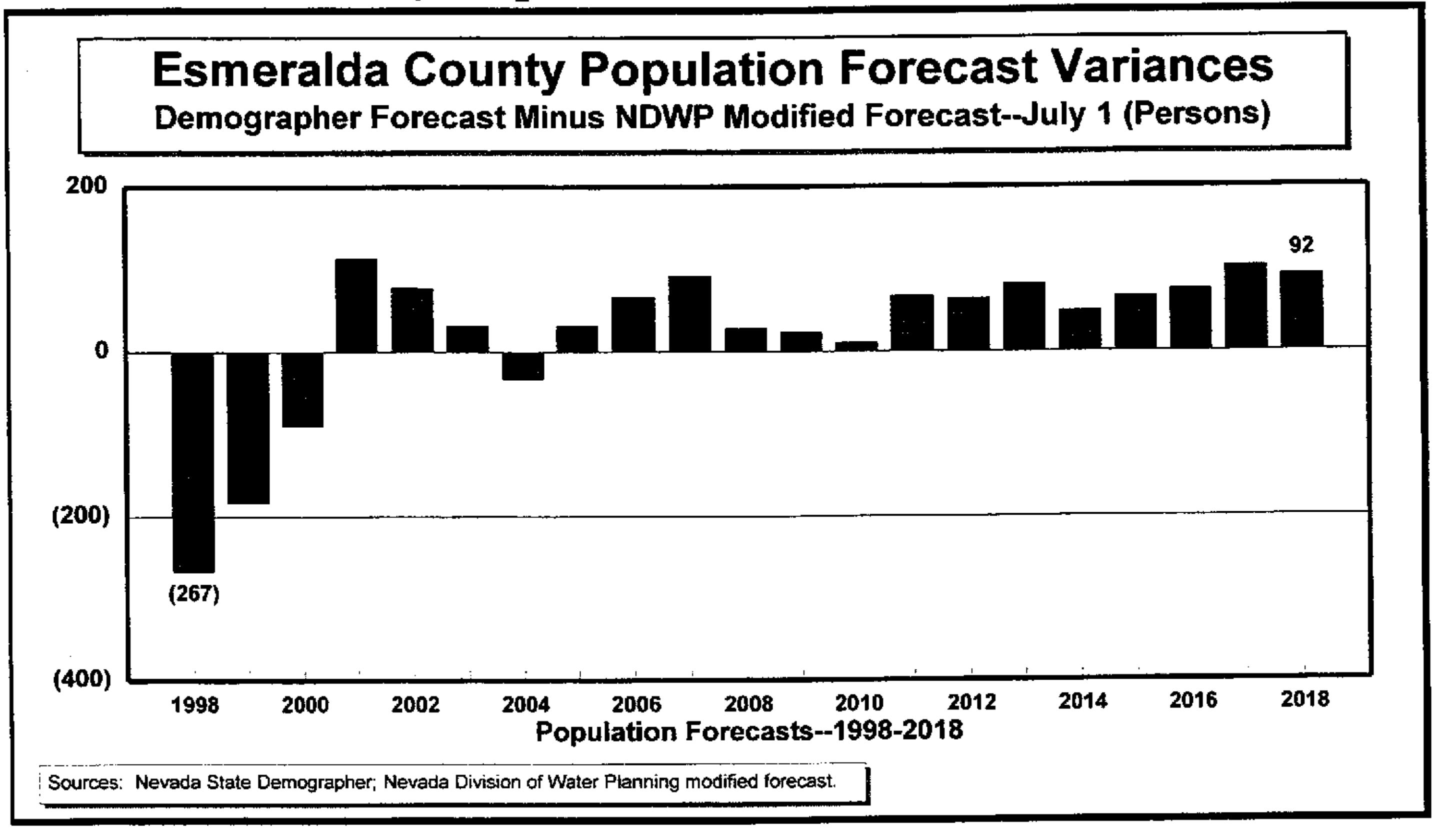


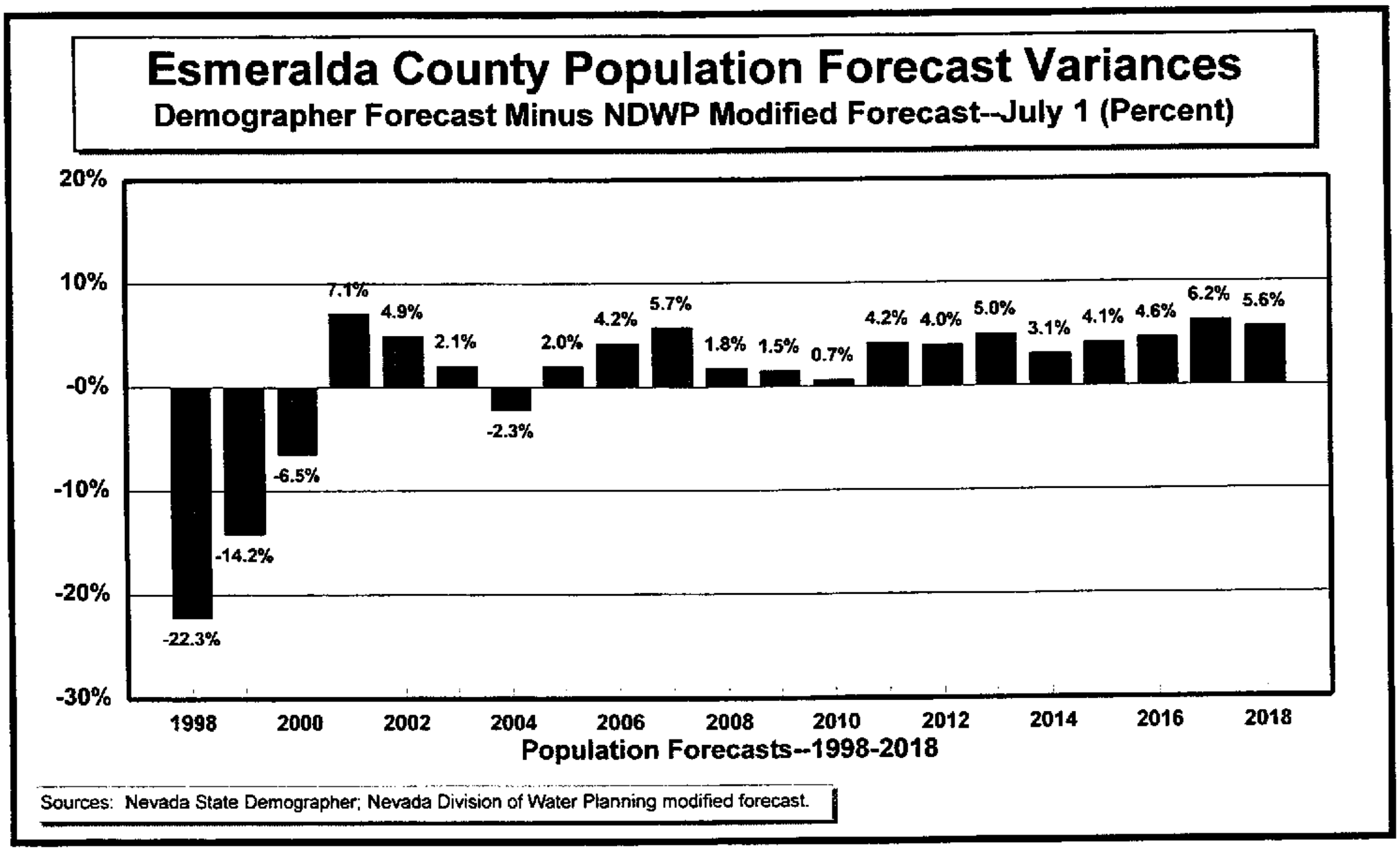
County Population Analysis and Forecasts





County Population Forecast Variances





Eureka County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	897	--	--	0.56%	897	--	--	0.56%
1951	900	3	0.33%	0.54%	900	3	0.33%	0.54%
1952	800	(100)	-11.11%	0.45%	800	(100)	-11.11%	0.45%
1953	900	100	12.50%	0.49%	900	100	12.50%	0.49%
1954	900	0	0.00%	0.45%	900	0	0.00%	0.45%
1955	900	0	0.00%	0.41%	900	0	0.00%	0.41%
1956	1,000	100	11.11%	0.42%	1,000	100	11.11%	0.42%
1957	1,000	0	0.00%	0.40%	1,000	0	0.00%	0.40%
1958	900	(100)	-10.00%	0.35%	900	(100)	-10.00%	0.35%
1959	700	(200)	-22.22%	0.25%	700	(200)	-22.22%	0.25%
1960	775	75	10.71%	0.27%	775	75	10.71%	0.27%
1961	809	34	4.39%	0.27%	809	34	4.39%	0.27%
1962	825	16	1.98%	0.26%	825	16	1.98%	0.26%
1963	830	5	0.61%	0.25%	830	5	0.61%	0.25%
1964	811	(19)	-2.29%	0.23%	811	(19)	-2.29%	0.23%
1965	946	135	16.65%	0.24%	946	135	16.65%	0.24%
1966	940	(6)	-0.63%	0.23%	940	(6)	-0.63%	0.23%
1967	782	(158)	-16.81%	0.19%	782	(158)	-16.81%	0.19%
1968	852	70	8.95%	0.20%	852	70	8.95%	0.20%
1969	914	62	7.28%	0.19%	914	62	7.28%	0.19%
1970	938	24	2.63%	0.19%	938	24	2.63%	0.19%
1971	900	(38)	-4.05%	0.17%	900	(38)	-4.05%	0.17%
1972	900	0	0.00%	0.16%	900	0	0.00%	0.16%
1973	1,000	100	11.11%	0.18%	1,000	100	11.11%	0.18%
1974	1,100	100	10.00%	0.18%	1,100	100	10.00%	0.18%
1975	1,100	0	0.00%	0.18%	1,100	0	0.00%	0.18%
1976	1,100	0	0.00%	0.17%	1,100	0	0.00%	0.17%
1977	1,100	0	0.00%	0.16%	1,100	0	0.00%	0.16%
1978	900	(200)	-18.18%	0.13%	900	(200)	-18.18%	0.13%
1979	1,000	100	11.11%	0.13%	1,000	100	11.11%	0.13%
1980	1,198	198	19.80%	0.15%	1,198	198	19.80%	0.15%
1981	1,220	22	1.84%	0.14%	1,220	22	1.84%	0.14%
1982	1,220	0	0.00%	0.14%	1,220	0	0.00%	0.14%
1983	1,230	10	0.82%	0.14%	1,230	10	0.82%	0.14%
1984	1,260	30	2.44%	0.14%	1,260	30	2.44%	0.14%
1985	1,300	40	3.17%	0.14%	1,300	40	3.17%	0.14%
1986	1,330	30	2.31%	0.13%	1,330	30	2.31%	0.13%
1987	1,490	160	12.03%	0.14%	1,490	160	12.03%	0.14%
1988	1,510	20	1.34%	0.14%	1,510	20	1.34%	0.14%
1989	1,530	20	1.32%	0.13%	1,530	20	1.32%	0.13%
1990	1,550	20	1.31%	0.13%	1,550	20	1.31%	0.13%
1991	1,560	10	0.65%	0.12%	1,560	10	0.65%	0.12%
1992	1,580	20	1.28%	0.12%	1,580	20	1.28%	0.12%
1993	1,650	70	4.43%	0.12%	1,650	70	4.43%	0.12%
1994	1,550	(100)	-6.06%	0.10%	1,550	(100)	-6.06%	0.10%
1995	1,580	30	1.94%	0.10%	1,580	30	1.94%	0.10%
1996	1,650	70	4.43%	0.10%	1,650	70	4.43%	0.10%
1997	1,660	10	0.61%	0.09%	1,660	10	0.61%	0.09%
1998	1,960	300	18.07%	0.10%	1,700	40	2.40%	0.09%
1999	2,120	160	8.16%	0.11%	1,739	39	2.30%	0.09%

Eureka County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	2,100	(20)	-0.94%	0.10%	1,777	38	2.20%	0.09%
2001	2,120	20	0.95%	0.10%	1,815	37	2.10%	0.09%
2002	2,140	20	0.94%	0.10%	1,851	36	2.00%	0.09%
2003	2,150	10	0.47%	0.09%	1,886	35	1.90%	0.09%
2004	2,190	40	1.86%	0.09%	1,920	34	1.80%	0.08%
2005	2,180	(10)	-0.46%	0.09%	1,953	33	1.70%	0.08%
2006	2,220	40	1.83%	0.09%	1,984	31	1.60%	0.08%
2007	2,250	30	1.35%	0.09%	2,014	30	1.50%	0.08%
2008	2,280	30	1.33%	0.09%	2,042	28	1.40%	0.08%
2009	2,330	50	2.19%	0.09%	2,068	27	1.30%	0.08%
2010	2,400	70	3.00%	0.09%	2,093	25	1.20%	0.08%
2011	2,480	80	3.33%	0.09%	2,116	23	1.10%	0.08%
2012	2,540	60	2.42%	0.09%	2,137	21	1.00%	0.08%
2013	2,590	50	1.97%	0.09%	2,157	19	0.90%	0.08%
2014	2,640	50	1.93%	0.08%	2,174	17	0.80%	0.08%
2015	2,690	50	1.89%	0.08%	2,189	15	0.70%	0.08%
2016	2,740	50	1.86%	0.08%	2,202	13	0.60%	0.08%
2017	2,780	40	1.46%	0.08%	2,213	11	0.50%	0.08%
2018	2,830	50	1.80%	0.08%	2,222	9	0.40%	0.07%
2019	--	--	--	--	2,229	7	0.30%	0.07%
2020	--	--	--	--	2,233	4	0.20%	0.07%

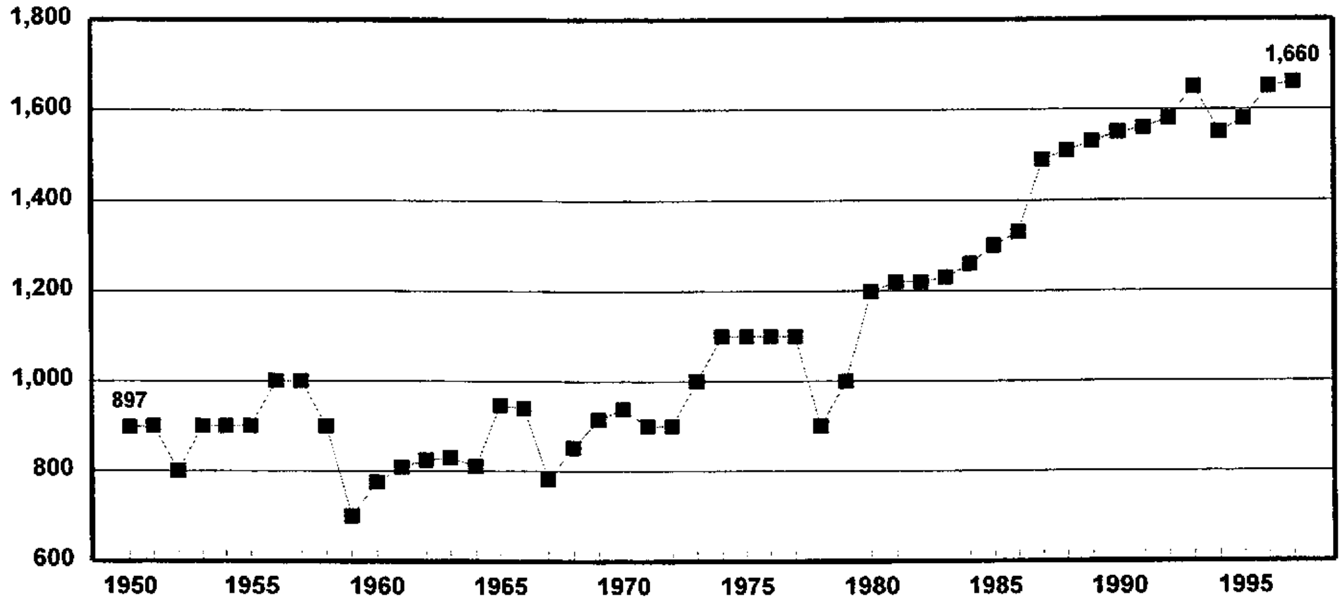
Growth Rate Analysis:	1950-1997	1.32%		
Average Annual Rates	1950-1960	-1.45%		
of Change by Specific	1960-1970	1.93%		
Time Period (percent)	1970-1980	2.48%		
	1980-1990	2.61%		
	1990-1997	0.98%		
Forecast Periods:	**1998-2018**	**2.57%**	**State Demographer**	**1.40%** **NDWP Modified Forecast**
	1998-2008	**2.93%**		**1.90%**
	2008-2018	**2.11%**		**0.90%**

Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

County Population Analysis

Eureka County Population Estimates & Forecasts

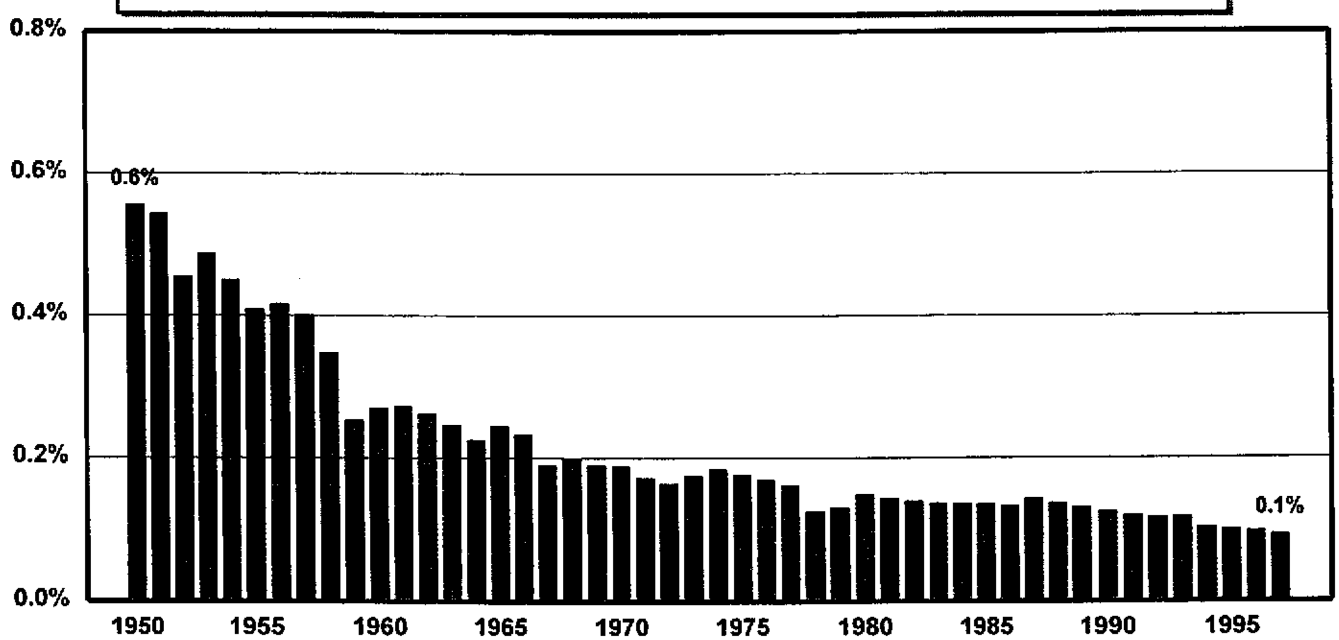
Population Estimates as of July 1 (Persons)



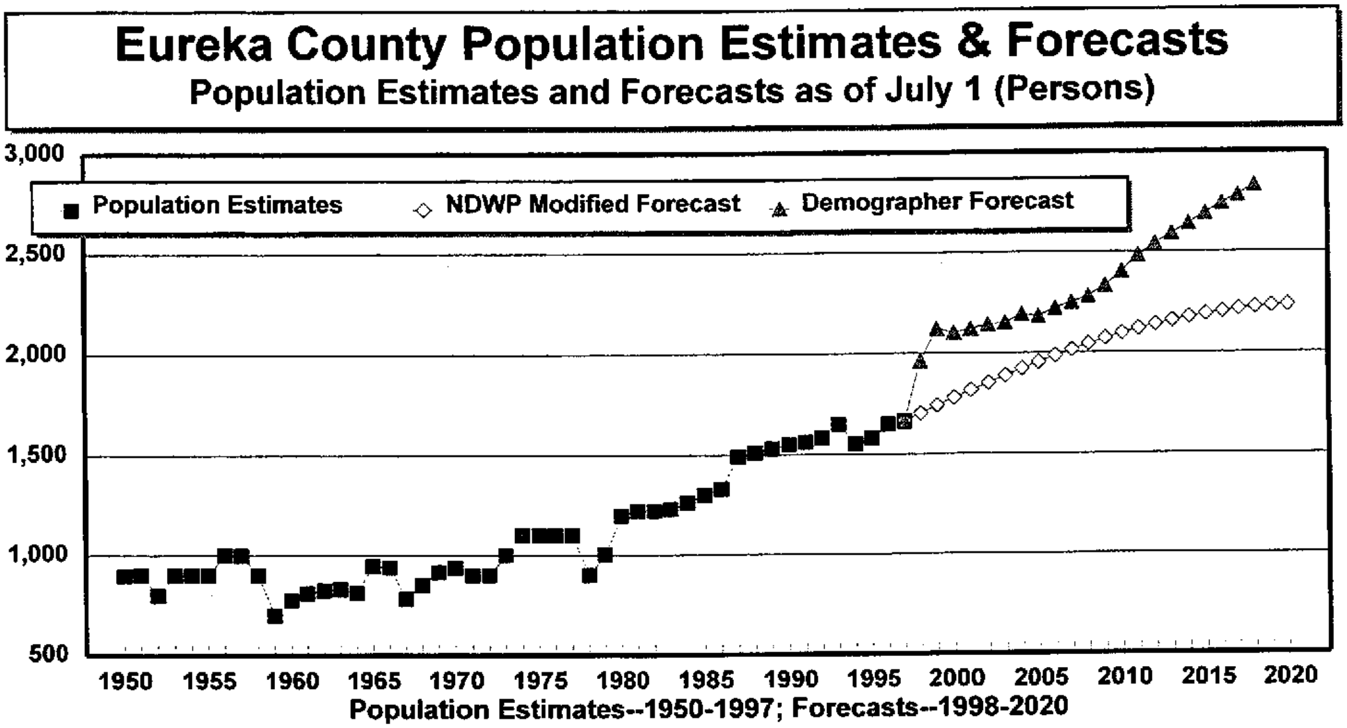
Source: Nevada State Demographer.

Eureka County Population Shares

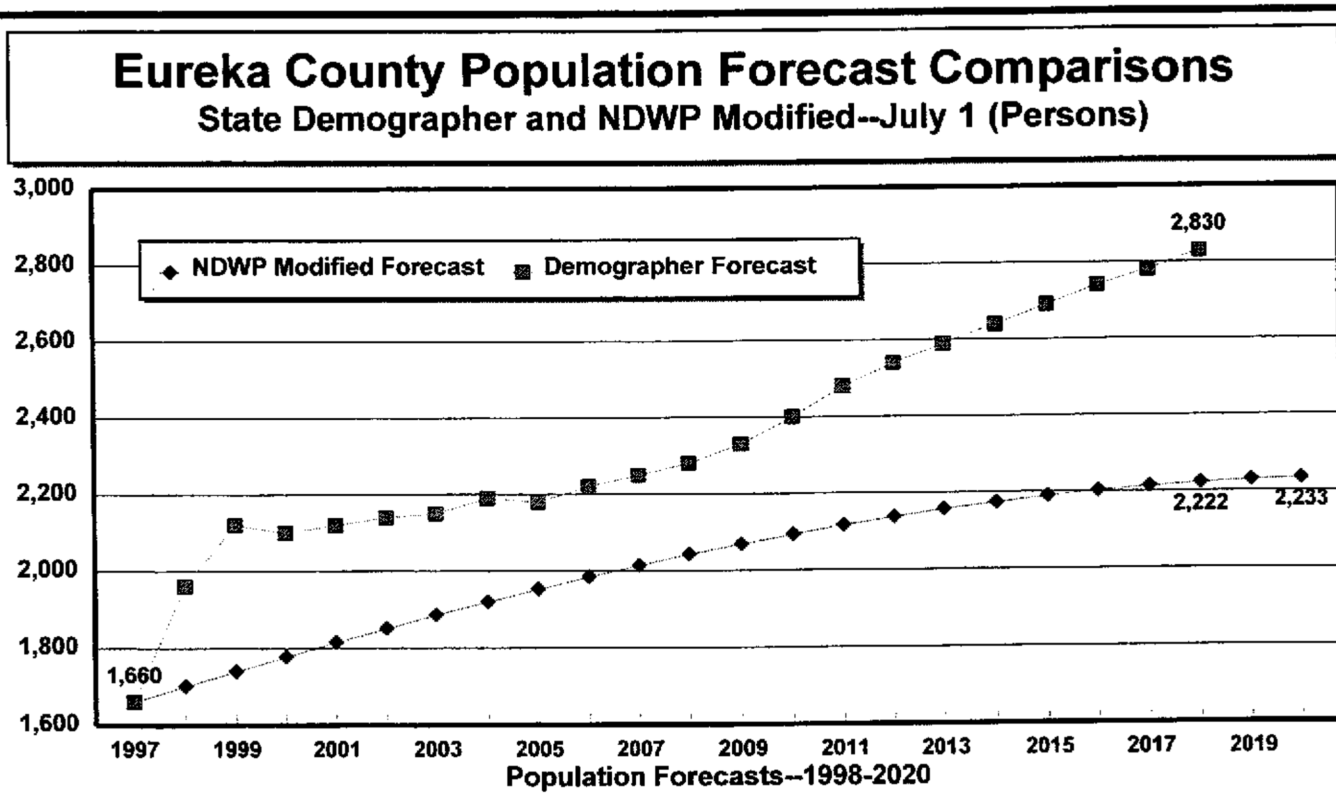
County Share of Total State Population (Percent)



Source: Nevada State Demographer.

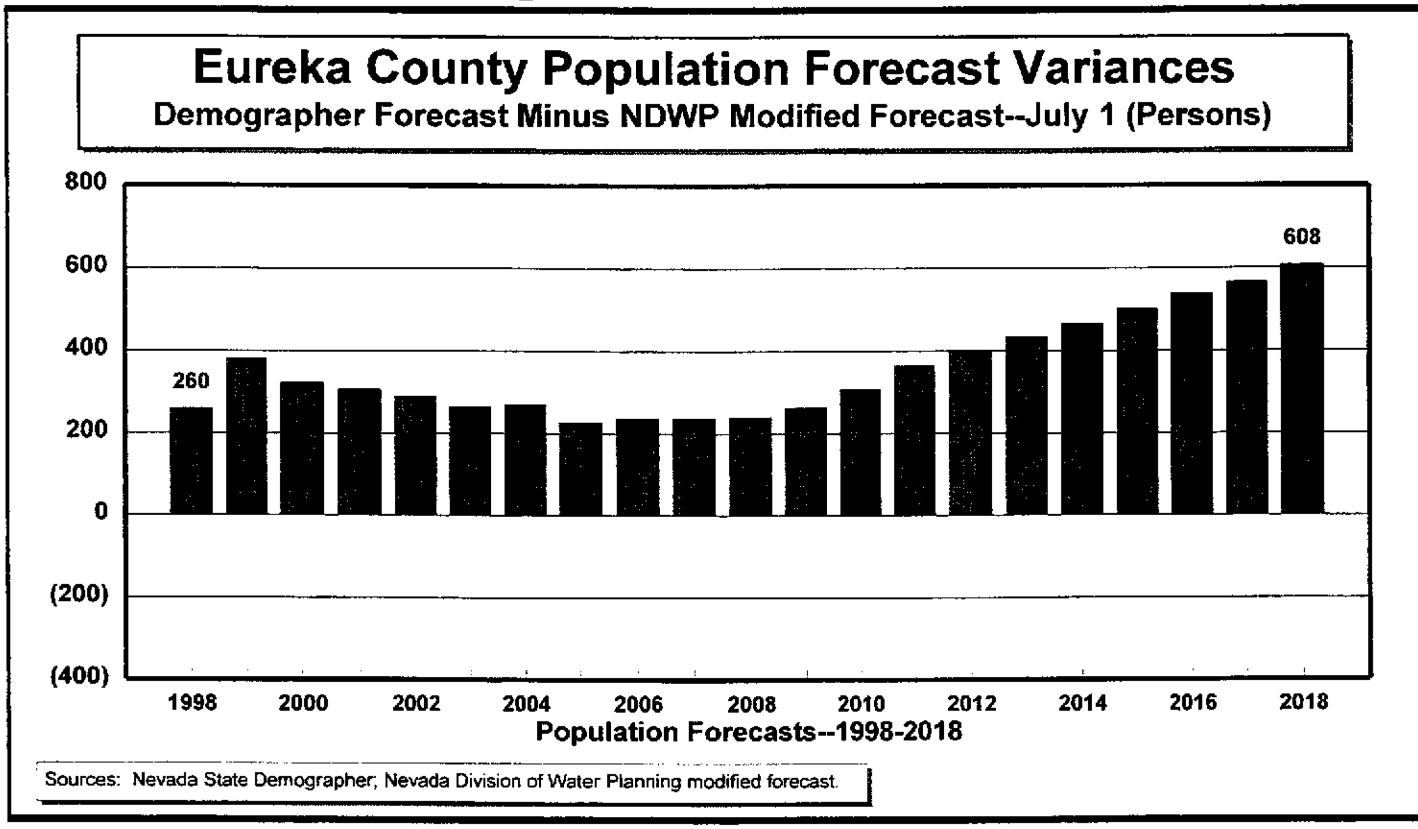


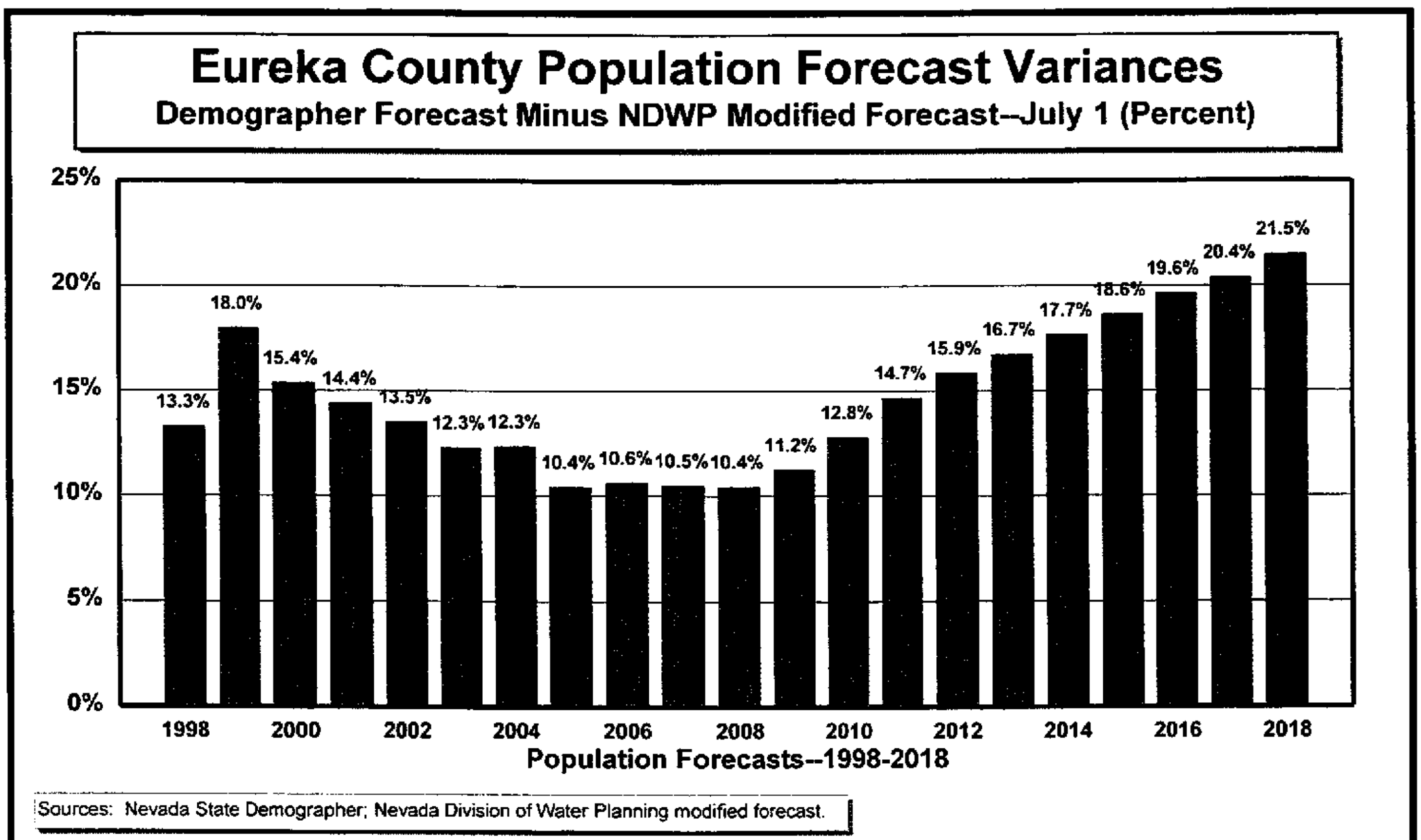
Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.



Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.

County Population Forecast Variances





Humboldt County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	4,870	--	--	3.02%	4,870	--	--	3.02%
1951	5,000	130	2.67%	3.02%	5,000	130	2.67%	3.02%
1952	5,100	100	2.00%	2.90%	5,100	100	2.00%	2.90%
1953	5,100	0	0.00%	2.76%	5,100	0	0.00%	2.76%
1954	5,100	0	0.00%	2.55%	5,100	0	0.00%	2.55%
1955	5,200	100	1.96%	2.36%	5,200	100	1.96%	2.36%
1956	5,400	200	3.85%	2.25%	5,400	200	3.85%	2.25%
1957	5,300	(100)	-1.85%	2.12%	5,300	(100)	-1.85%	2.12%
1958	5,300	0	0.00%	2.04%	5,300	0	0.00%	2.04%
1959	5,400	100	1.89%	1.95%	5,400	100	1.89%	1.95%
1960	5,723	323	5.98%	1.99%	5,723	323	5.98%	1.99%
1961	5,783	60	1.05%	1.95%	5,783	60	1.05%	1.95%
1962	5,806	23	0.40%	1.84%	5,806	23	0.40%	1.84%
1963	5,876	70	1.21%	1.74%	5,876	70	1.21%	1.74%
1964	5,836	(40)	-0.68%	1.62%	5,836	(40)	-0.68%	1.62%
1965	6,178	342	5.86%	1.60%	6,178	342	5.86%	1.60%
1966	6,363	185	2.99%	1.58%	6,363	185	2.99%	1.58%
1967	6,380	17	0.27%	1.56%	6,380	17	0.27%	1.56%
1968	6,303	(77)	-1.21%	1.47%	6,303	(77)	-1.21%	1.47%
1969	6,356	53	0.84%	1.32%	6,356	53	0.84%	1.32%
1970	6,380	24	0.38%	1.29%	6,380	24	0.38%	1.29%
1971	6,400	20	0.31%	1.23%	6,400	20	0.31%	1.23%
1972	6,600	200	3.13%	1.21%	6,600	200	3.13%	1.21%
1973	6,800	200	3.03%	1.19%	6,800	200	3.03%	1.19%
1974	7,000	200	2.94%	1.17%	7,000	200	2.94%	1.17%
1975	7,400	400	5.71%	1.19%	7,400	400	5.71%	1.19%
1976	7,400	0	0.00%	1.14%	7,400	0	0.00%	1.14%
1977	7,600	200	2.70%	1.12%	7,600	200	2.70%	1.12%
1978	7,900	300	3.95%	1.10%	7,900	300	3.95%	1.10%
1979	8,600	700	8.86%	1.12%	8,600	700	8.86%	1.12%
1980	9,449	849	9.87%	1.18%	9,449	849	9.87%	1.18%
1981	10,380	931	9.85%	1.23%	10,380	931	9.85%	1.23%
1982	10,920	540	5.20%	1.25%	10,920	540	5.20%	1.25%
1983	10,960	40	0.37%	1.22%	10,960	40	0.37%	1.22%
1984	11,190	230	2.10%	1.21%	11,190	230	2.10%	1.21%
1985	11,260	70	0.63%	1.18%	11,260	70	0.63%	1.18%
1986	11,220	(40)	-0.36%	1.13%	11,220	(40)	-0.36%	1.13%
1987	11,490	270	2.41%	1.11%	11,490	270	2.41%	1.11%
1988	12,050	560	4.87%	1.10%	12,050	560	4.87%	1.10%
1989	12,580	530	4.40%	1.08%	12,580	530	4.40%	1.08%
1990	13,020	440	3.50%	1.05%	13,020	440	3.50%	1.05%
1991	13,500	480	3.69%	1.04%	13,500	480	3.69%	1.04%
1992	14,000	500	3.70%	1.04%	14,000	500	3.70%	1.04%
1993	14,510	510	3.64%	1.04%	14,510	510	3.64%	1.04%
1994	15,670	1,160	7.99%	1.05%	15,670	1,160	7.99%	1.05%
1995	16,270	600	3.83%	1.03%	16,270	600	3.83%	1.03%
1996	16,460	190	1.17%	0.98%	16,460	190	1.17%	0.98%
1997	17,520	1,060	6.44%	0.98%	17,520	1,060	6.44%	0.98%
1998	18,190	670	3.82%	0.97%	17,985	465	2.65%	0.98%
1999	18,810	620	3.41%	0.96%	18,444	460	2.55%	0.97%

Humboldt County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

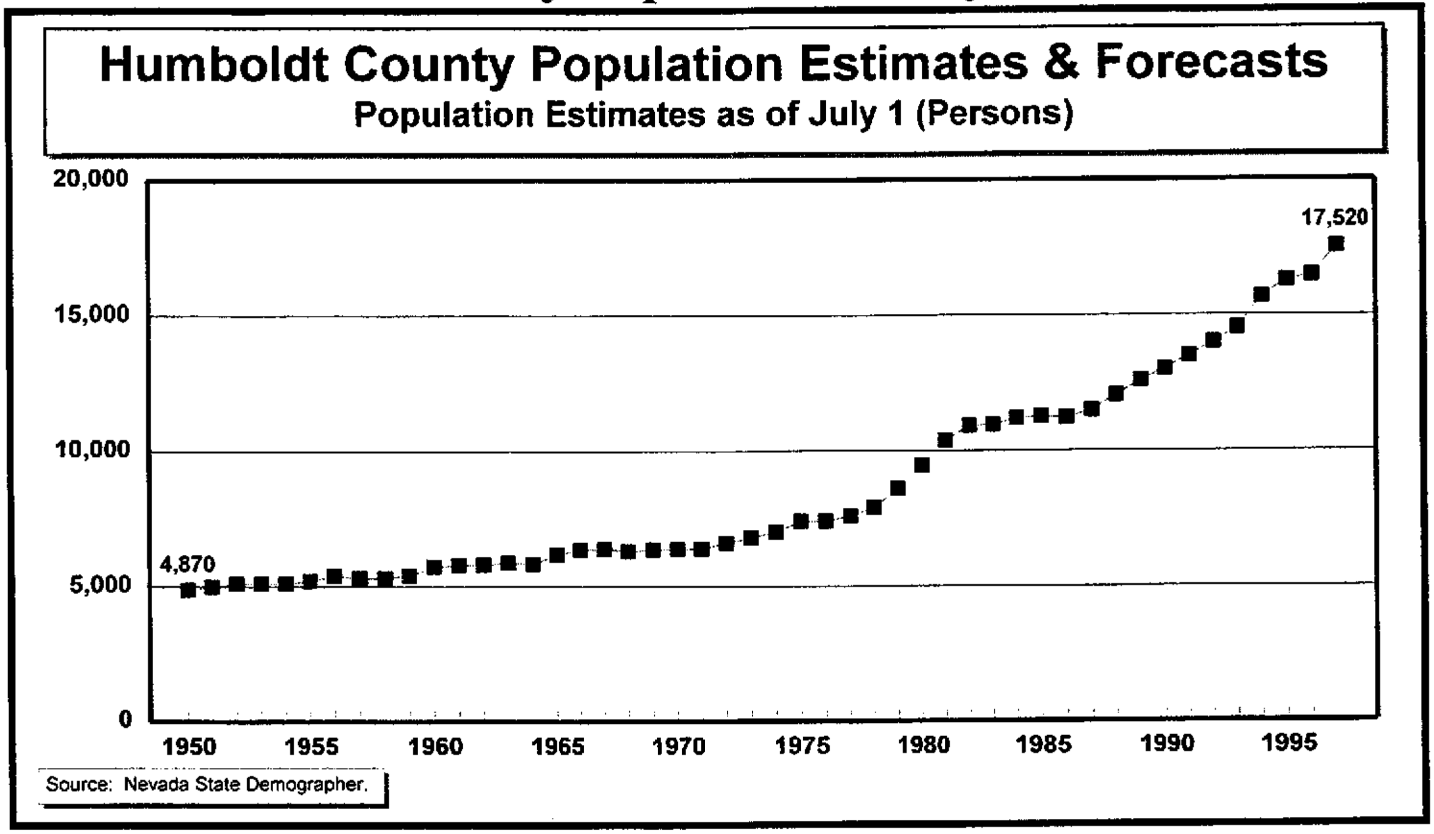
Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	19,320	510	2.71%	0.95%	18,897	453	2.46%	0.95%
2001	19,680	360	1.86%	0.93%	19,343	446	2.36%	0.94%
2002	20,130	450	2.29%	0.92%	19,781	438	2.26%	0.93%
2003	20,320	190	0.94%	0.89%	20,209	428	2.17%	0.92%
2004	20,650	330	1.62%	0.88%	20,627	418	2.07%	0.91%
2005	20,790	140	0.68%	0.86%	21,034	406	1.97%	0.90%
2006	21,040	250	1.20%	0.85%	21,427	394	1.87%	0.89%
2007	21,160	120	0.57%	0.83%	21,808	380	1.78%	0.88%
2008	21,460	300	1.42%	0.82%	22,174	366	1.68%	0.88%
2009	21,880	420	1.96%	0.81%	22,524	350	1.58%	0.87%
2010	22,310	430	1.97%	0.80%	22,858	334	1.48%	0.87%
2011	22,730	420	1.88%	0.79%	23,174	317	1.39%	0.86%
2012	23,160	430	1.89%	0.79%	23,473	298	1.29%	0.86%
2013	23,590	430	1.86%	0.78%	23,752	279	1.19%	0.85%
2014	23,970	380	1.61%	0.77%	24,012	259	1.09%	0.85%
2015	24,350	380	1.59%	0.76%	24,251	239	1.00%	0.85%
2016	24,730	380	1.56%	0.75%	24,468	218	0.90%	0.84%
2017	25,090	360	1.46%	0.74%	24,664	196	0.80%	0.84%
2018	25,430	340	1.36%	0.73%	24,837	173	0.70%	0.83%
2019	--	--	--	--	24,987	150	0.61%	0.83%
2020	--	--	--	--	25,114	127	0.51%	0.82%

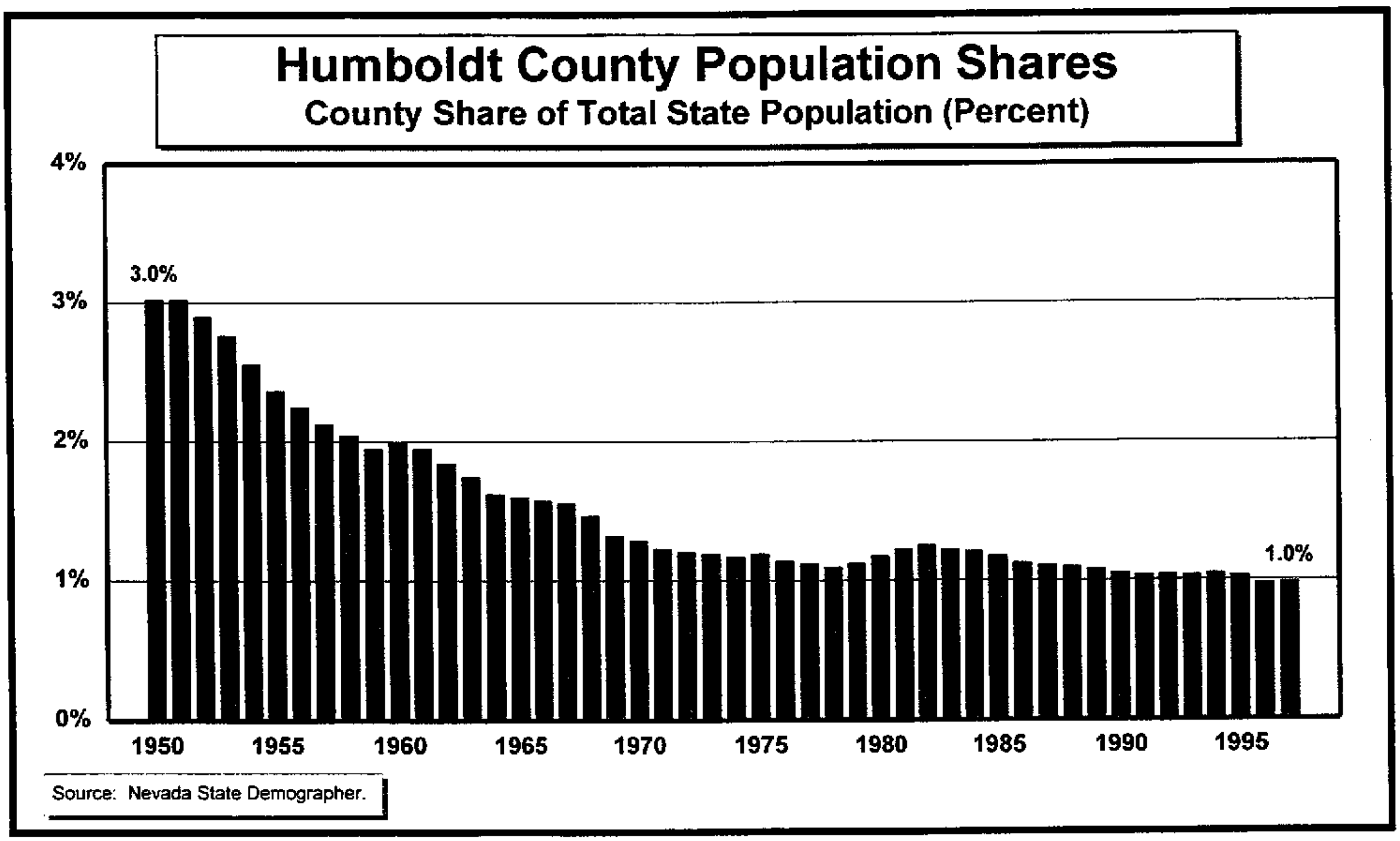
Growth Rate Analysis:	1950-1997	2.76%
Average Annual Rates	1950-1960	1.63%
of Change by Specific	1960-1970	1.09%
Time Period (percent)	1970-1980	4.01%
	1980-1990	3.26%
	1990-1997	4.33%

Forecast Periods:	**1998-2018**	**1.79%**	**State Demographer**	**1.68%**	**NDWP Modified Forecast**
	1998-2008	**1.86%**		**2.16%**	
	2008-2018	**1.69%**		**1.19%**	

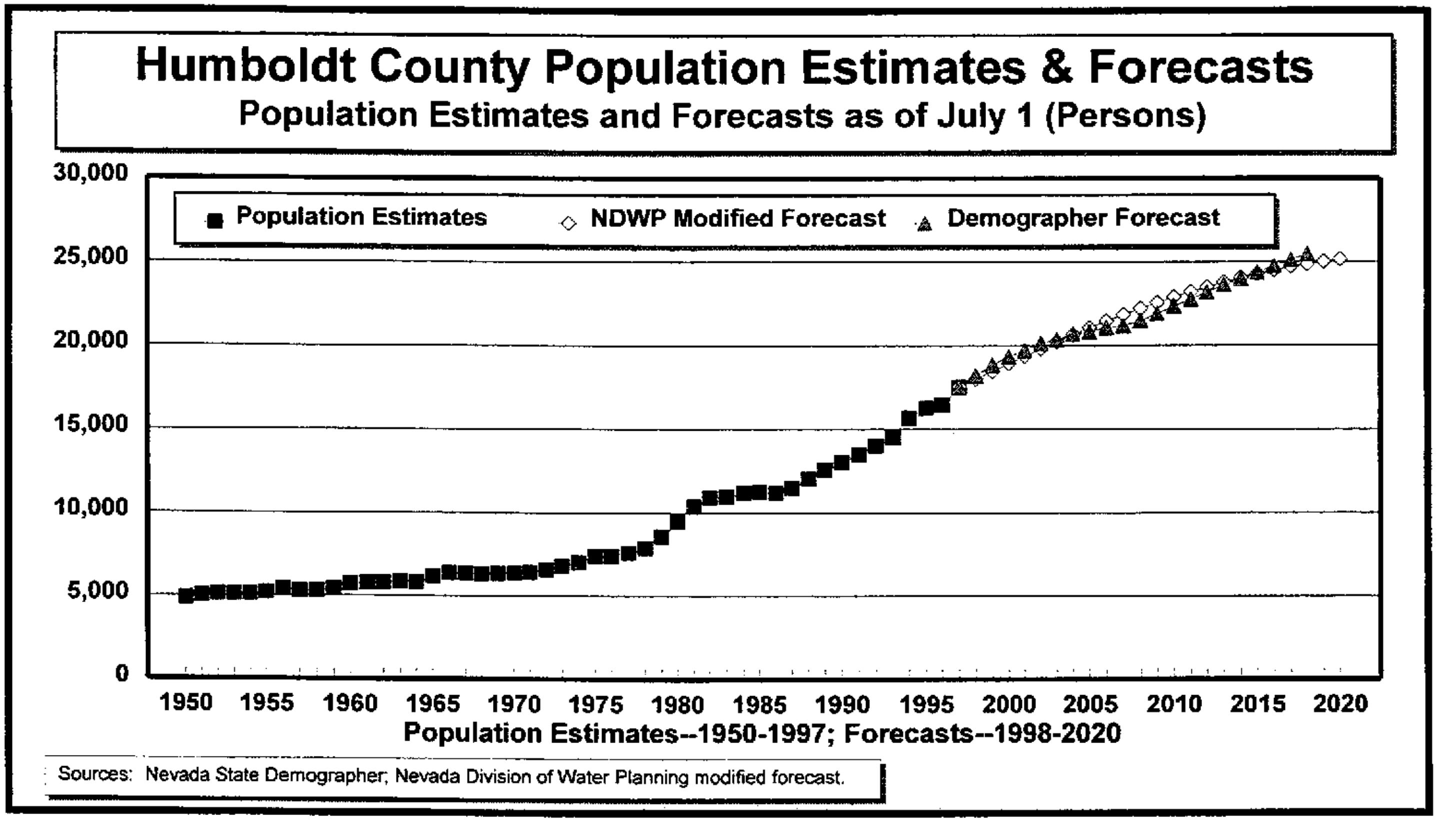
Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

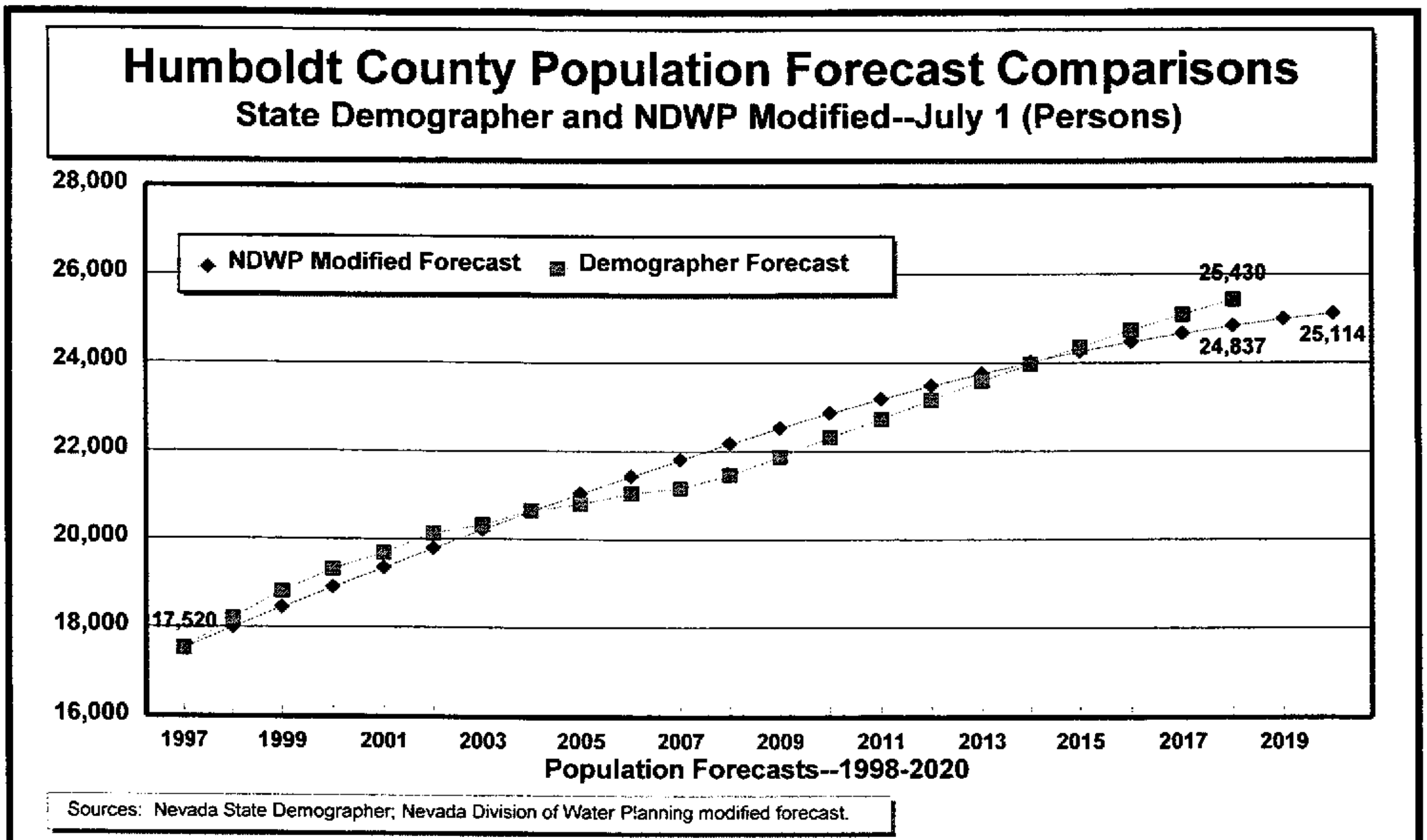
County Population Analysis



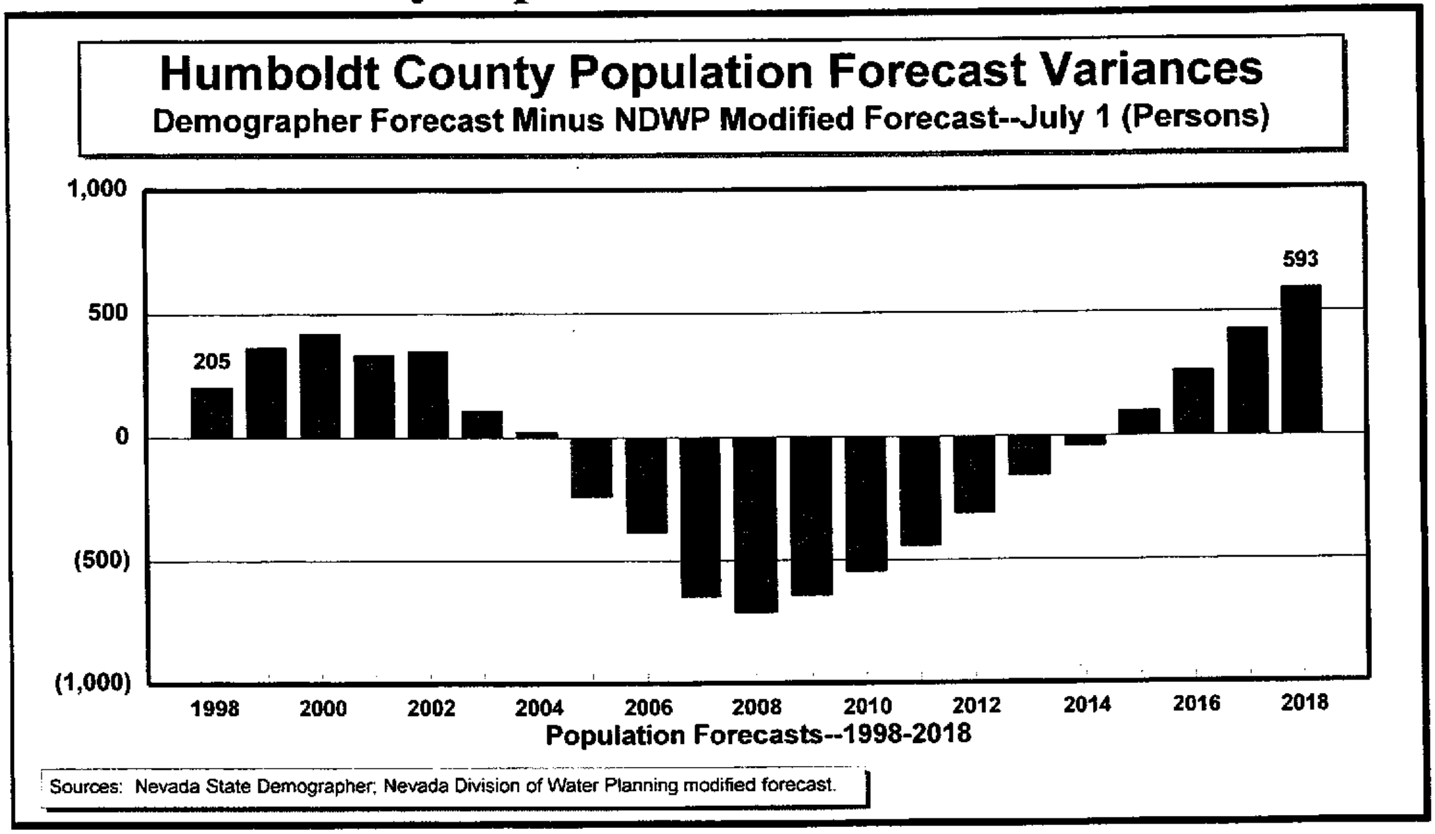


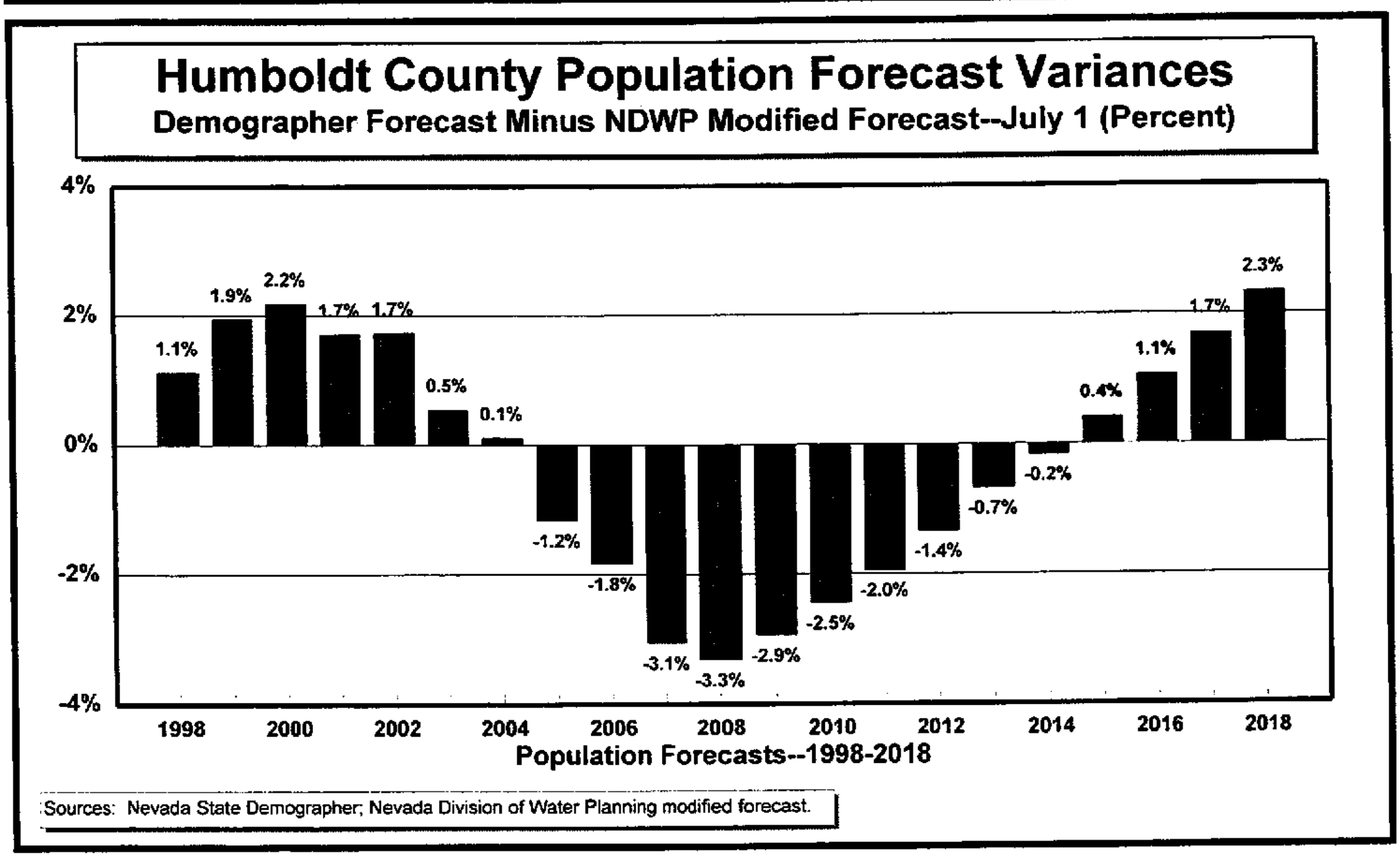
County Population Analysis and Forecasts





County Population Forecast Variances





Lander County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	1,860	--	--	1.15%	1,860	--	--	1.15%
1951	1,900	40	2.15%	1.15%	1,900	40	2.15%	1.15%
1952	1,900	0	0.00%	1.08%	1,900	0	0.00%	1.08%
1953	1,800	(100)	-5.26%	0.98%	1,800	(100)	-5.26%	0.98%
1954	1,800	0	0.00%	0.90%	1,800	0	0.00%	0.90%
1955	1,800	0	0.00%	0.82%	1,800	0	0.00%	0.82%
1956	1,800	0	0.00%	0.75%	1,800	0	0.00%	0.75%
1957	1,800	0	0.00%	0.72%	1,800	0	0.00%	0.72%
1958	1,800	0	0.00%	0.69%	1,800	0	0.00%	0.69%
1959	1,700	(100)	-5.56%	0.61%	1,700	(100)	-5.56%	0.61%
1960	1,580	(120)	-7.06%	0.55%	1,580	(120)	-7.06%	0.55%
1961	1,635	55	3.48%	0.55%	1,635	55	3.48%	0.55%
1962	1,665	30	1.83%	0.53%	1,665	30	1.83%	0.53%
1963	1,686	21	1.26%	0.50%	1,686	21	1.26%	0.50%
1964	1,822	136	8.07%	0.51%	1,822	136	8.07%	0.51%
1965	2,032	210	11.53%	0.53%	2,032	210	11.53%	0.53%
1966	2,211	179	8.81%	0.55%	2,211	179	8.81%	0.55%
1967	2,583	372	16.82%	0.63%	2,583	372	16.82%	0.63%
1968	2,451	(132)	-5.11%	0.57%	2,451	(132)	-5.11%	0.57%
1969	2,615	164	6.69%	0.54%	2,615	164	6.69%	0.54%
1970	2,653	38	1.45%	0.54%	2,653	38	1.45%	0.54%
1971	2,600	(53)	-2.00%	0.50%	2,600	(53)	-2.00%	0.50%
1972	2,700	100	3.85%	0.49%	2,700	100	3.85%	0.49%
1973	2,700	0	0.00%	0.47%	2,700	0	0.00%	0.47%
1974	2,800	100	3.70%	0.47%	2,800	100	3.70%	0.47%
1975	3,000	200	7.14%	0.48%	3,000	200	7.14%	0.48%
1976	3,200	200	6.67%	0.49%	3,200	200	6.67%	0.49%
1977	3,300	100	3.13%	0.49%	3,300	100	3.13%	0.49%
1978	3,500	200	6.06%	0.49%	3,500	200	6.06%	0.49%
1979	3,600	100	2.86%	0.47%	3,600	100	2.86%	0.47%
1980	4,076	476	13.22%	0.51%	4,076	476	13.22%	0.51%
1981	5,010	934	22.91%	0.59%	5,010	934	22.91%	0.59%
1982	5,000	(10)	-0.20%	0.57%	5,000	(10)	-0.20%	0.57%
1983	4,720	(280)	-5.60%	0.53%	4,720	(280)	-5.60%	0.53%
1984	4,590	(130)	-2.75%	0.50%	4,590	(130)	-2.75%	0.50%
1985	4,520	(70)	-1.53%	0.47%	4,520	(70)	-1.53%	0.47%
1986	4,510	(10)	-0.22%	0.45%	4,510	(10)	-0.22%	0.45%
1987	4,600	90	2.00%	0.44%	4,600	90	2.00%	0.44%
1988	5,480	880	19.13%	0.50%	5,480	880	19.13%	0.50%
1989	6,270	790	14.42%	0.54%	6,270	790	14.42%	0.54%
1990	6,340	70	1.12%	0.51%	6,340	70	1.12%	0.51%
1991	6,370	30	0.47%	0.49%	6,370	30	0.47%	0.49%
1992	6,380	10	0.16%	0.47%	6,380	10	0.16%	0.47%
1993	6,430	50	0.78%	0.46%	6,430	50	0.78%	0.46%
1994	6,410	(20)	-0.31%	0.43%	6,410	(20)	-0.31%	0.43%
1995	6,440	30	0.47%	0.41%	6,440	30	0.47%	0.41%
1996	6,710	270	4.19%	0.40%	6,710	270	4.19%	0.40%
1997	7,030	320	4.77%	0.39%	7,030	320	4.77%	0.39%
1998	7,340	310	4.41%	0.39%	7,097	67	0.96%	0.39%
1999	7,560	220	3.00%	0.39%	7,163	65	0.92%	0.38%

Lander County Population Estimates & Forecasts

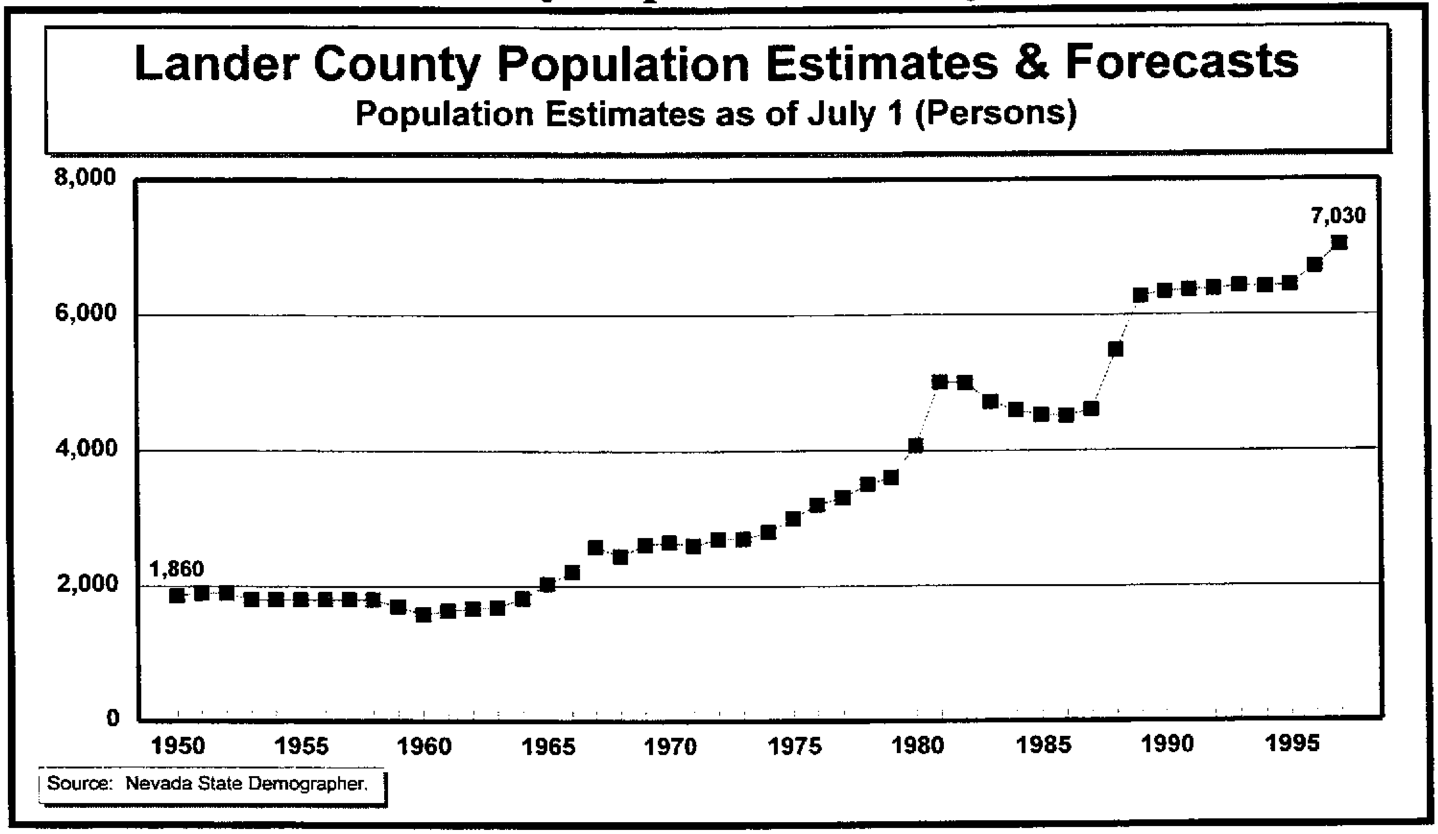
Population Estimates (1950-1997) and Forecasts (1998-2020)—July 1st (Persons)

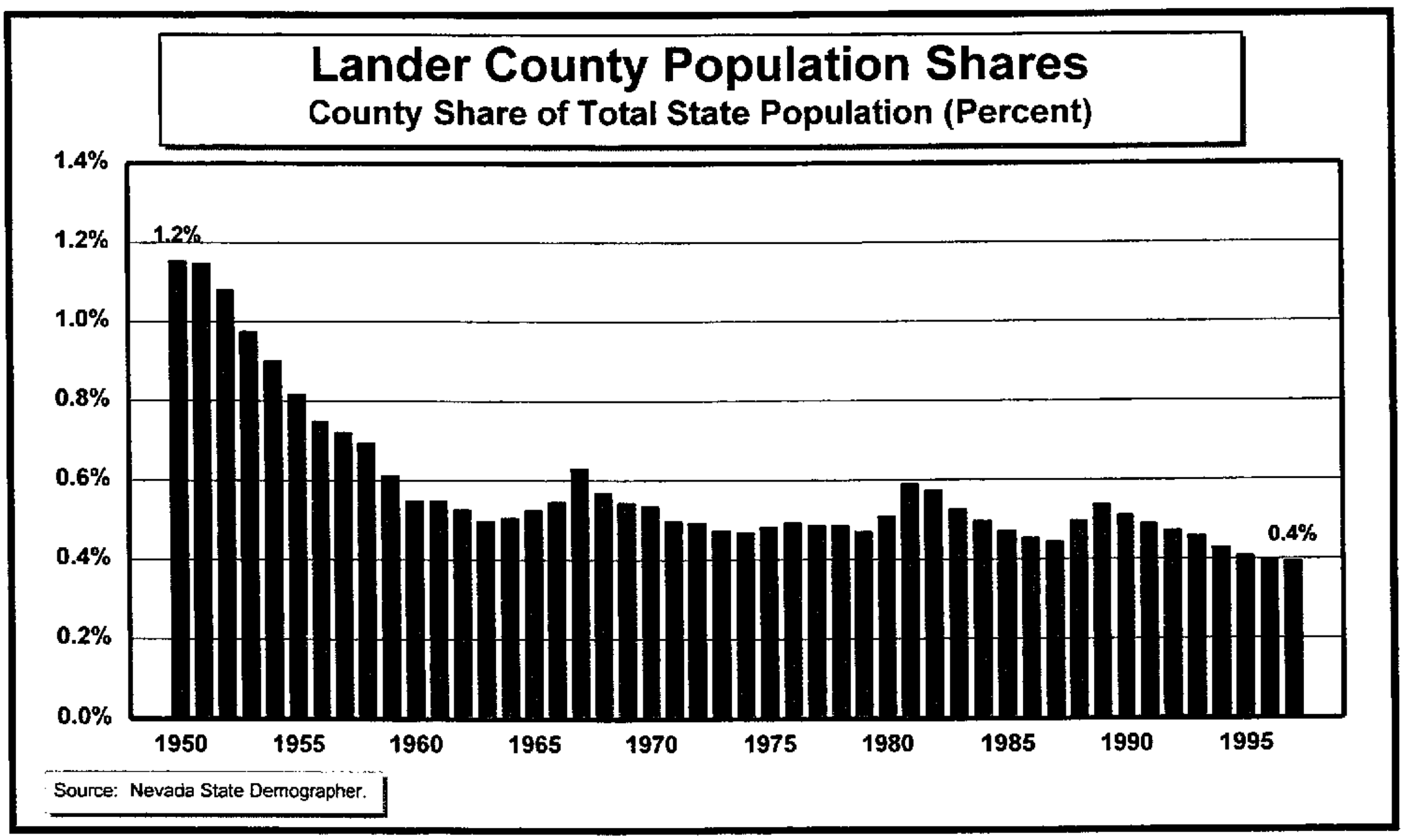
Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	7,710	150	1.98%	0.38%	7,226	63	0.88%	0.36%
2001	7,770	60	0.78%	0.37%	7,287	61	0.84%	0.35%
2002	7,860	90	1.16%	0.36%	7,345	58	0.80%	0.34%
2003	7,860	0	0.00%	0.35%	7,401	56	0.76%	0.34%
2004	7,940	80	1.02%	0.34%	7,454	53	0.72%	0.33%
2005	7,980	40	0.50%	0.33%	7,505	51	0.68%	0.32%
2006	8,070	90	1.13%	0.32%	7,553	48	0.64%	0.31%
2007	8,110	40	0.50%	0.32%	7,598	45	0.60%	0.31%
2008	8,200	90	1.11%	0.31%	7,640	43	0.56%	0.30%
2009	8,310	110	1.34%	0.31%	7,680	40	0.52%	0.30%
2010	8,400	90	1.08%	0.30%	7,717	37	0.48%	0.29%
2011	8,490	90	1.07%	0.30%	7,751	34	0.44%	0.29%
2012	8,580	90	1.06%	0.29%	7,782	31	0.40%	0.28%
2013	8,670	90	1.05%	0.29%	7,810	28	0.36%	0.28%
2014	8,770	100	1.15%	0.28%	7,835	25	0.32%	0.28%
2015	8,870	100	1.14%	0.28%	7,857	22	0.28%	0.27%
2016	8,980	110	1.24%	0.27%	7,876	19	0.24%	0.27%
2017	9,080	100	1.11%	0.27%	7,892	16	0.20%	0.27%
2018	9,170	90	0.99%	0.26%	7,904	13	0.16%	0.27%
2019	--	--	--	--	7,914	9	0.12%	0.26%
2020	--	--	--	--	7,920	6	0.08%	0.26%

Growth Rate Analysis:	1950-1997	2.87%			
Average Annual Rates	1950-1960	-1.62%			
of Change by Specific	1960-1970	5.32%			
Time Period (percent)	1970-1980	4.39%			
	1980-1990	4.52%			
	1990-1997	1.49%			
Forecast Periods:	**1998-2018**	**1.27%**	**State Demographer**	**0.56%**	**NDWP Modified Forecast**
	1998-2008	**1.41%**		**0.76%**	
	2008-2018	**1.12%**		**0.36%**	

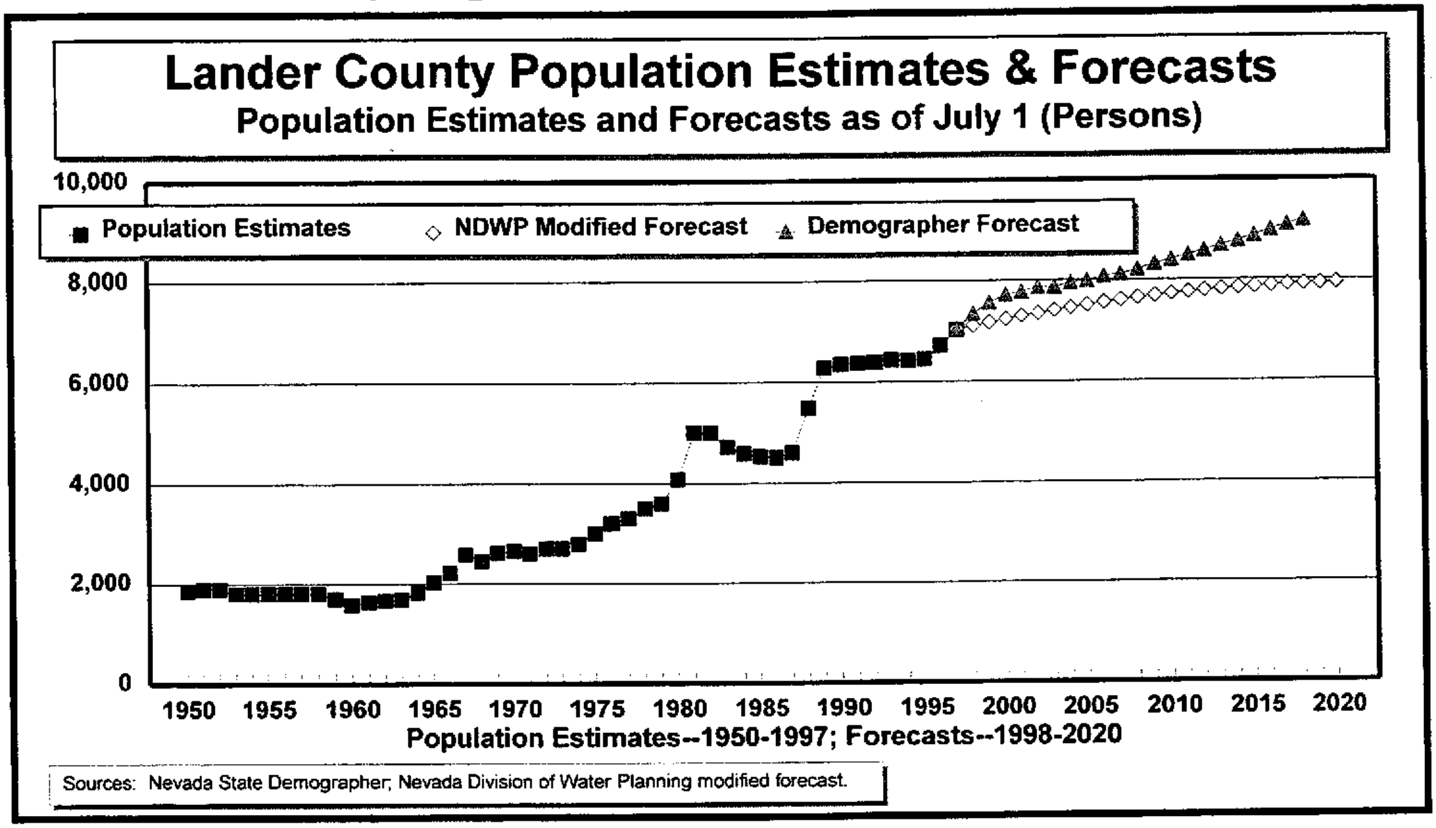
Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

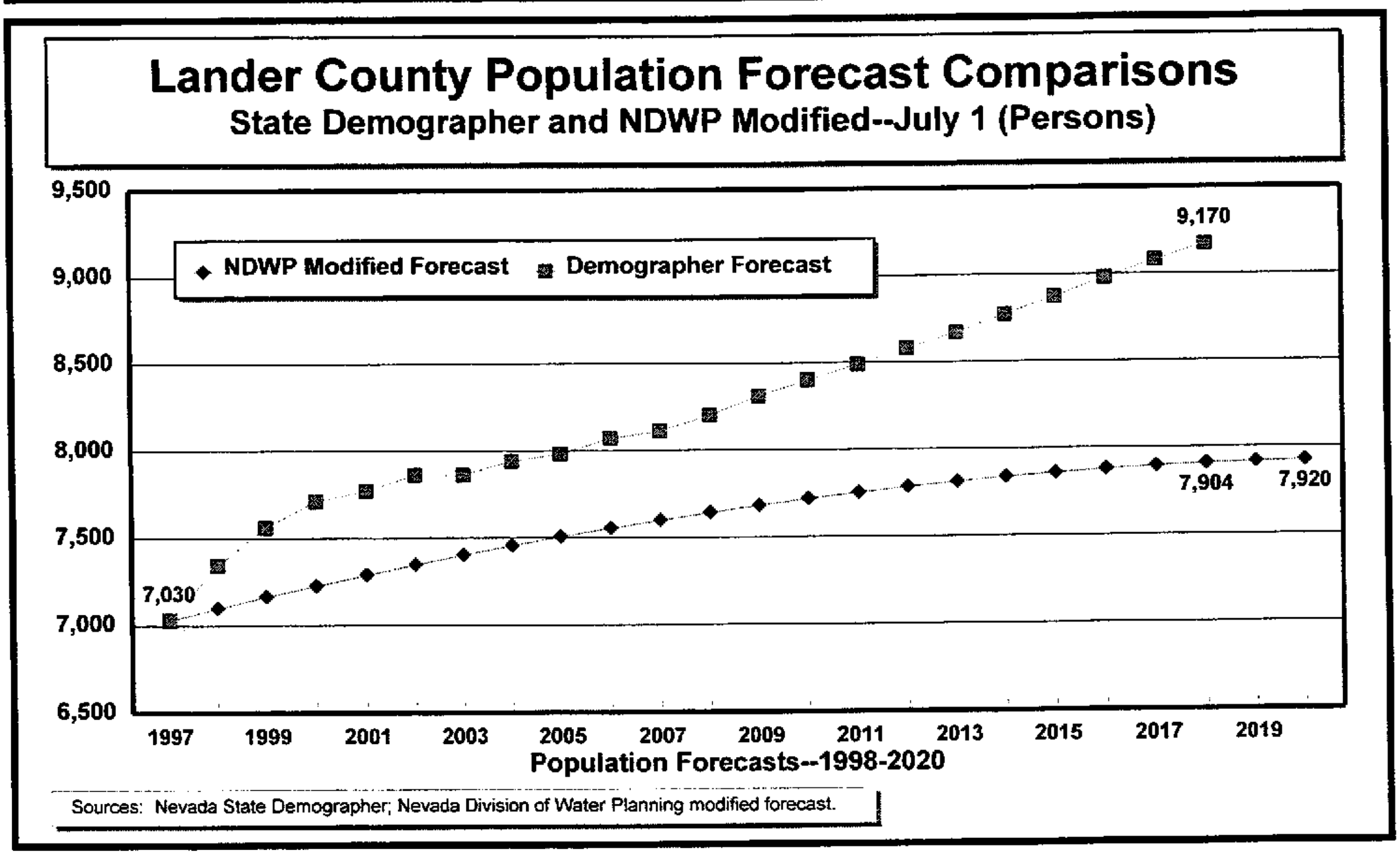
County Population Analysis



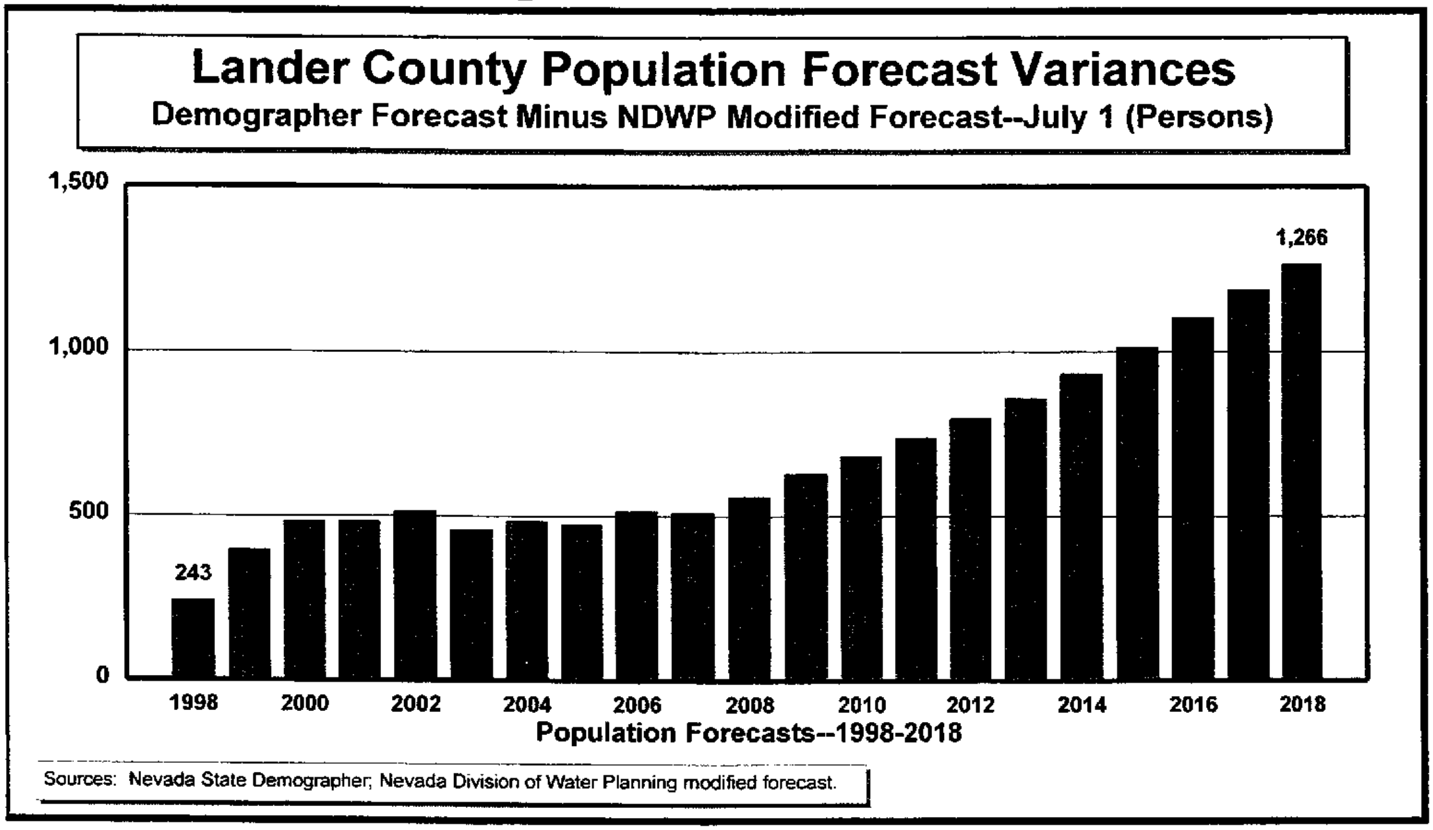


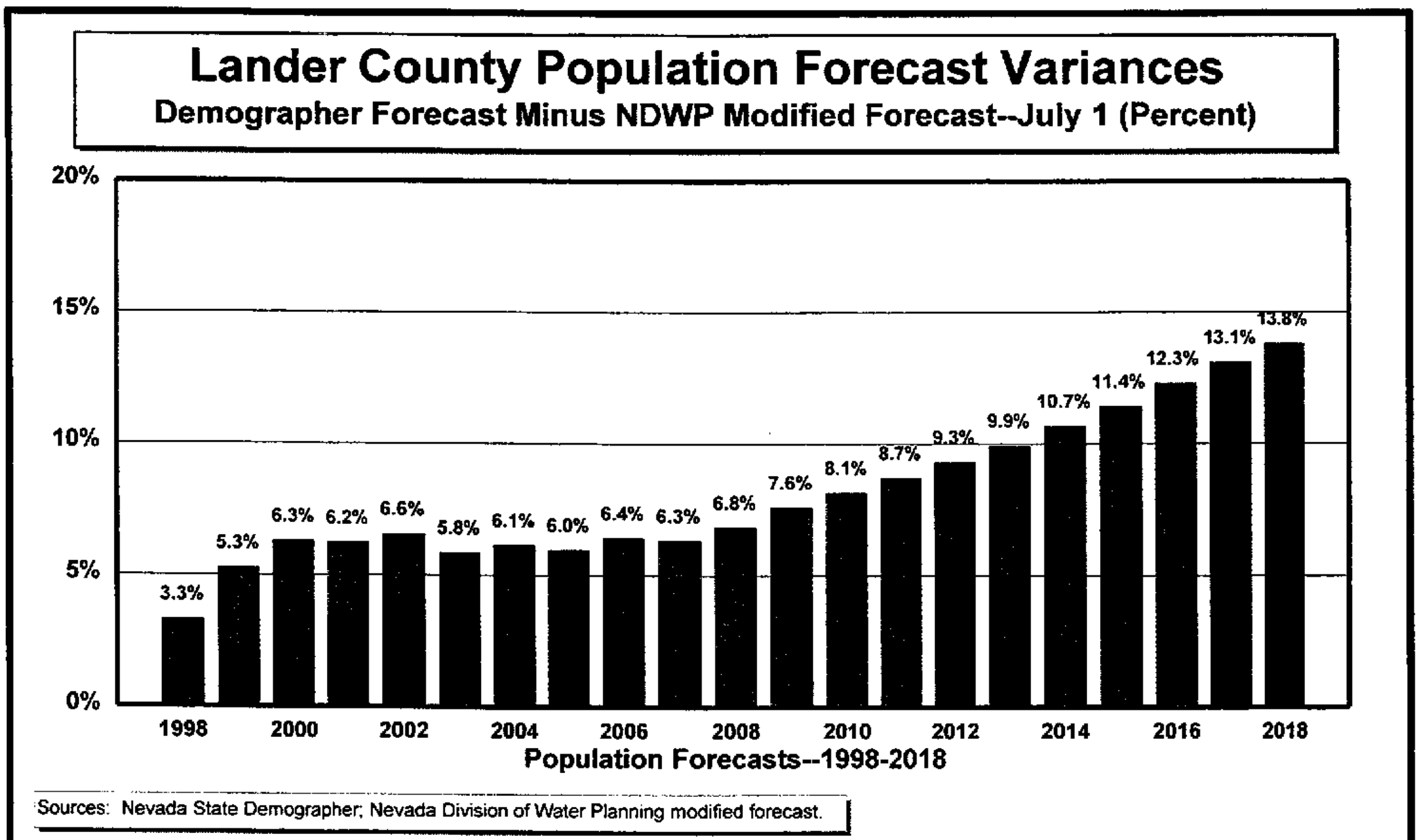
County Population Analysis and Forecasts





County Population Forecast Variances





Lincoln County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	3,850	--	--	2.39%	3,850	--	--	2.39%
1951	3,900	50	1.30%	2.36%	3,900	50	1.30%	2.36%
1952	3,900	0	0.00%	2.22%	3,900	0	0.00%	2.22%
1953	3,900	0	0.00%	2.11%	3,900	0	0.00%	2.11%
1954	3,800	(100)	-2.56%	1.90%	3,800	(100)	-2.56%	1.90%
1955	3,900	100	2.63%	1.77%	3,900	100	2.63%	1.77%
1956	3,800	(100)	-2.56%	1.58%	3,800	(100)	-2.56%	1.58%
1957	3,800	0	0.00%	1.52%	3,800	0	0.00%	1.52%
1958	3,700	(100)	-2.63%	1.43%	3,700	(100)	-2.63%	1.43%
1959	3,800	100	2.70%	1.37%	3,800	100	2.70%	1.37%
1960	2,378	(1,422)	-37.42%	0.83%	2,378	(1,422)	-37.42%	0.83%
1961	2,164	(214)	-9.00%	0.73%	2,164	(214)	-9.00%	0.73%
1962	2,140	(24)	-1.11%	0.68%	2,140	(24)	-1.11%	0.68%
1963	2,113	(27)	-1.26%	0.63%	2,113	(27)	-1.26%	0.63%
1964	2,038	(75)	-3.55%	0.57%	2,038	(75)	-3.55%	0.57%
1965	2,162	124	6.08%	0.56%	2,162	124	6.08%	0.56%
1966	2,398	236	10.92%	0.59%	2,398	236	10.92%	0.59%
1967	2,316	(82)	-3.42%	0.57%	2,316	(82)	-3.42%	0.57%
1968	2,334	18	0.78%	0.54%	2,334	18	0.78%	0.54%
1969	2,454	120	5.14%	0.51%	2,454	120	5.14%	0.51%
1970	2,526	72	2.93%	0.51%	2,526	72	2.93%	0.51%
1971	2,400	(126)	-4.99%	0.46%	2,400	(126)	-4.99%	0.46%
1972	2,300	(100)	-4.17%	0.42%	2,300	(100)	-4.17%	0.42%
1973	2,400	100	4.35%	0.42%	2,400	100	4.35%	0.42%
1974	2,500	100	4.17%	0.42%	2,500	100	4.17%	0.42%
1975	2,800	300	12.00%	0.45%	2,800	300	12.00%	0.45%
1976	2,900	100	3.57%	0.45%	2,900	100	3.57%	0.45%
1977	3,000	100	3.45%	0.44%	3,000	100	3.45%	0.44%
1978	3,400	400	13.33%	0.47%	3,400	400	13.33%	0.47%
1979	3,600	200	5.88%	0.47%	3,600	200	5.88%	0.47%
1980	3,732	132	3.67%	0.47%	3,732	132	3.67%	0.47%
1981	3,760	28	0.75%	0.44%	3,760	28	0.75%	0.44%
1982	3,770	10	0.27%	0.43%	3,770	10	0.27%	0.43%
1983	3,760	(10)	-0.27%	0.42%	3,760	(10)	-0.27%	0.42%
1984	3,770	10	0.27%	0.41%	3,770	10	0.27%	0.41%
1985	3,780	10	0.27%	0.40%	3,780	10	0.27%	0.40%
1986	3,780	0	0.00%	0.38%	3,780	0	0.00%	0.38%
1987	3,790	10	0.26%	0.37%	3,790	10	0.26%	0.37%
1988	3,800	10	0.26%	0.35%	3,800	10	0.26%	0.35%
1989	3,800	0	0.00%	0.33%	3,800	0	0.00%	0.33%
1990	3,810	10	0.26%	0.31%	3,810	10	0.26%	0.31%
1991	3,870	60	1.57%	0.30%	3,870	60	1.57%	0.30%
1992	4,080	210	5.43%	0.30%	4,080	210	5.43%	0.30%
1993	4,130	50	1.23%	0.30%	4,130	50	1.23%	0.30%
1994	4,320	190	4.60%	0.29%	4,320	190	4.60%	0.29%
1995	4,110	(210)	-4.86%	0.26%	4,110	(210)	-4.86%	0.26%
1996	4,020	(90)	-2.19%	0.24%	4,020	(90)	-2.19%	0.24%
1997	4,110	90	2.24%	0.23%	4,110	90	2.24%	0.23%
1998	4,210	100	2.43%	0.22%	4,130	20	0.48%	0.22%
1999	4,280	70	1.66%	0.22%	4,149	19	0.46%	0.22%

Lincoln County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

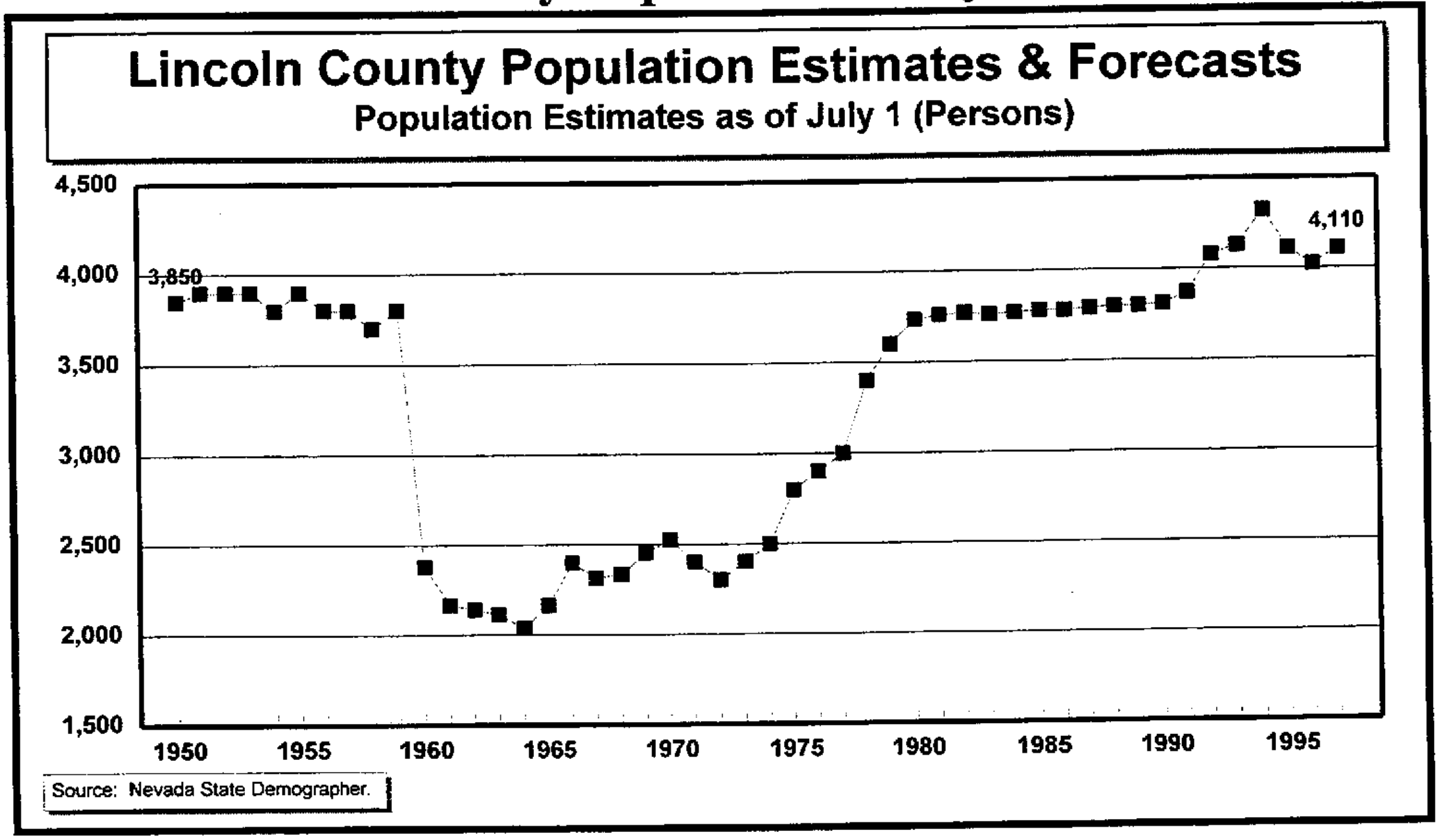
Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	4,410	130	3.04%	0.22%	4,167	18	0.44%	0.21%
2001	4,470	60	1.36%	0.21%	4,184	18	0.42%	0.20%
2002	4,490	20	0.45%	0.20%	4,201	17	0.40%	0.20%
2003	4,450	(40)	-0.89%	0.20%	4,217	16	0.38%	0.19%
2004	4,440	(10)	-0.22%	0.19%	4,232	15	0.36%	0.19%
2005	4,400	(40)	-0.90%	0.18%	4,247	14	0.34%	0.18%
2006	4,390	(10)	-0.23%	0.18%	4,260	14	0.32%	0.18%
2007	4,360	(30)	-0.68%	0.17%	4,273	13	0.30%	0.17%
2008	4,380	20	0.46%	0.17%	4,285	12	0.28%	0.17%
2009	4,400	20	0.46%	0.16%	4,296	11	0.26%	0.17%
2010	4,430	30	0.68%	0.16%	4,307	10	0.24%	0.16%
2011	4,440	10	0.23%	0.16%	4,316	9	0.22%	0.16%
2012	4,460	20	0.45%	0.15%	4,325	9	0.20%	0.16%
2013	4,480	20	0.45%	0.15%	4,332	8	0.18%	0.16%
2014	4,490	10	0.22%	0.14%	4,339	7	0.16%	0.15%
2015	4,510	20	0.45%	0.14%	4,345	6	0.14%	0.15%
2016	4,540	30	0.67%	0.14%	4,351	5	0.12%	0.15%
2017	4,560	20	0.44%	0.13%	4,355	4	0.10%	0.15%
2018	4,580	20	0.44%	0.13%	4,358	3	0.08%	0.15%
2019	--	--	--	--	4,361	3	0.06%	0.14%
2020	--	--	--	--	4,363	2	0.04%	0.14%

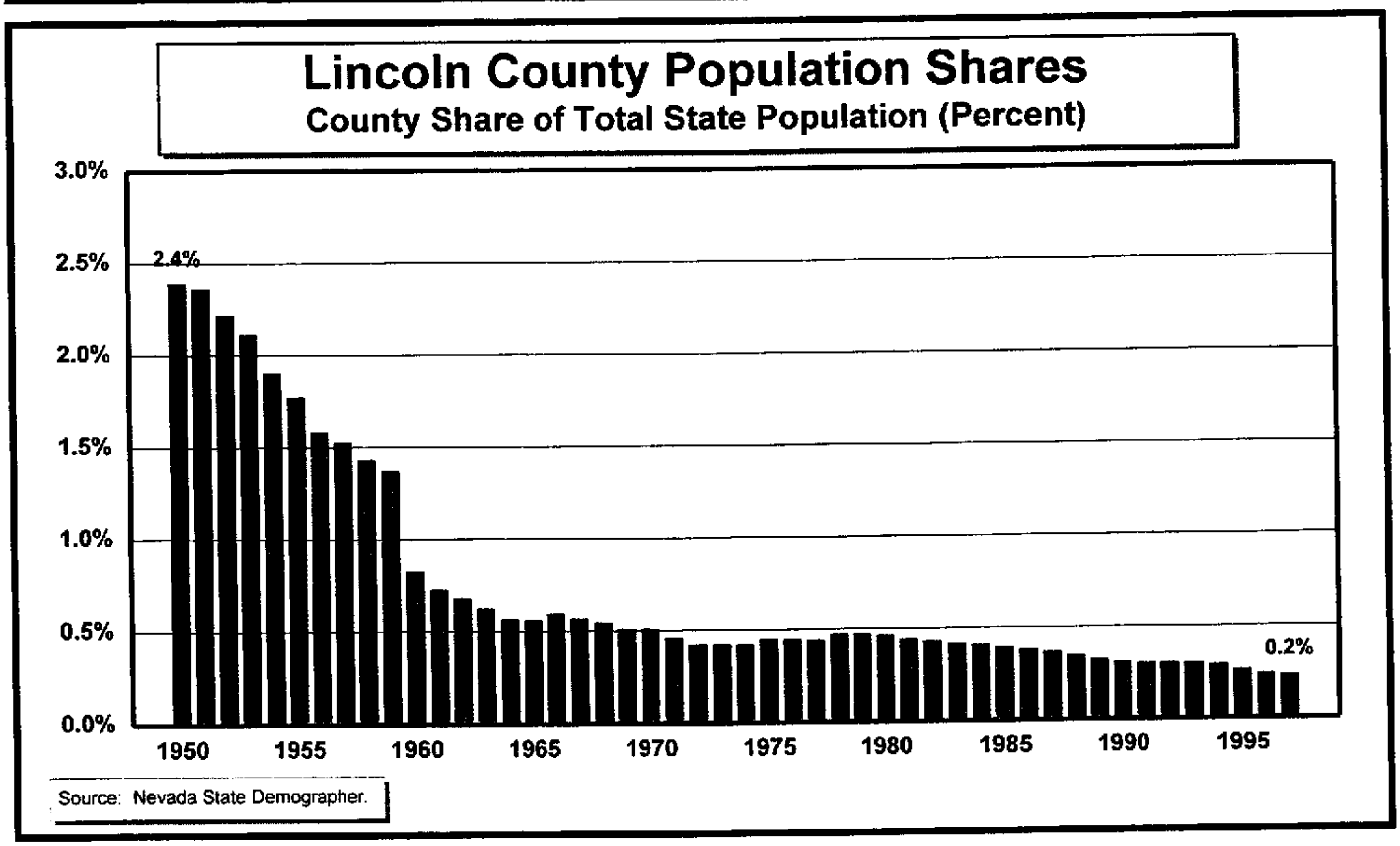
Growth Rate Analysis:	1950-1997	0.14%
Average Annual Rates	1950-1960	-4.70%
of Change by Specific	1960-1970	0.61%
Time Period (percent)	1970-1980	3.98%
	1980-1990	0.21%
	1990-1997	1.09%

Forecast Periods:	**1998-2018**	**0.52%**	**State Demographer**	**0.28%**	**NDWP Modified Forecast**
	1998-2008	**0.58%**		**0.38%**	
	2008-2018	**0.45%**		**0.18%**	

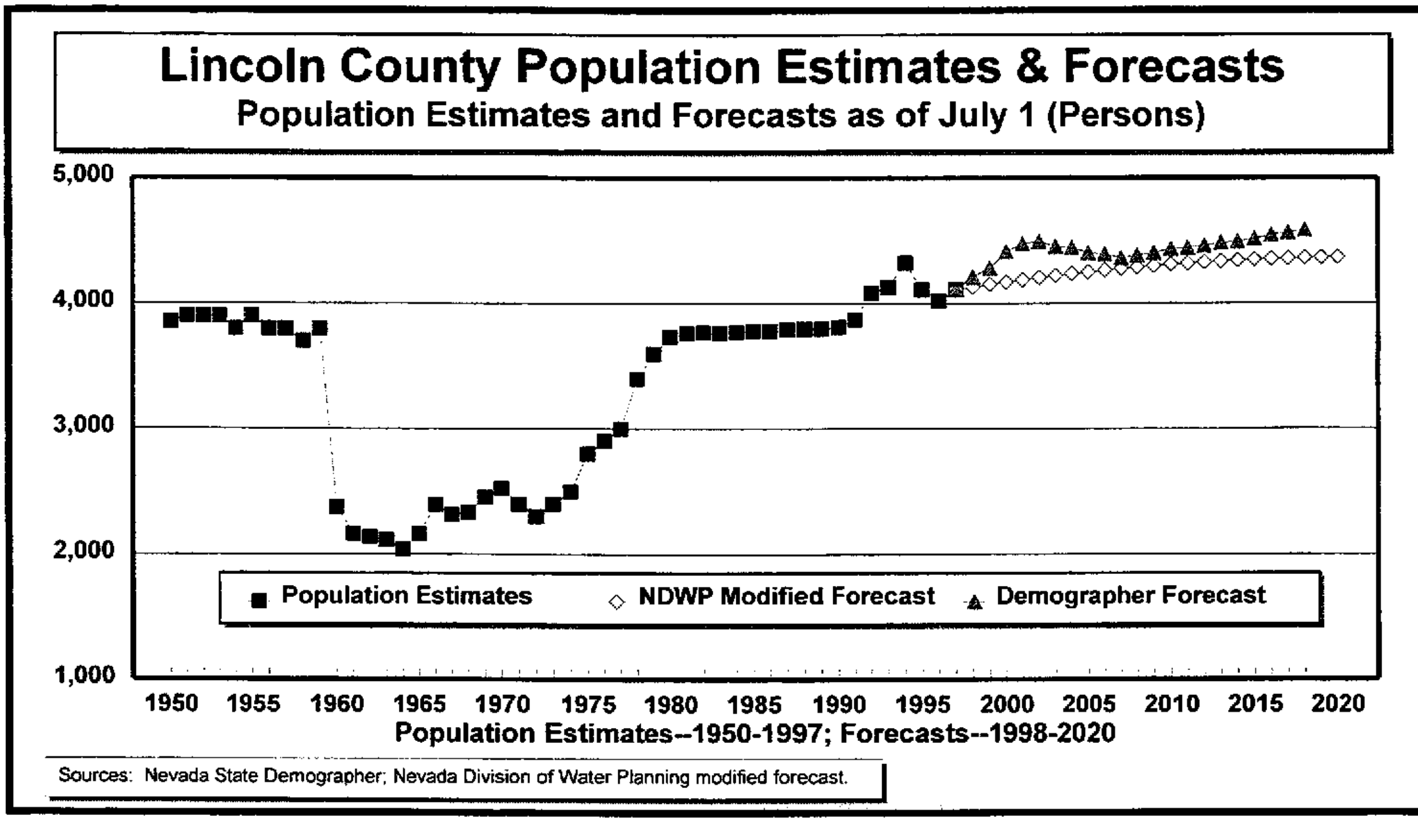
Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

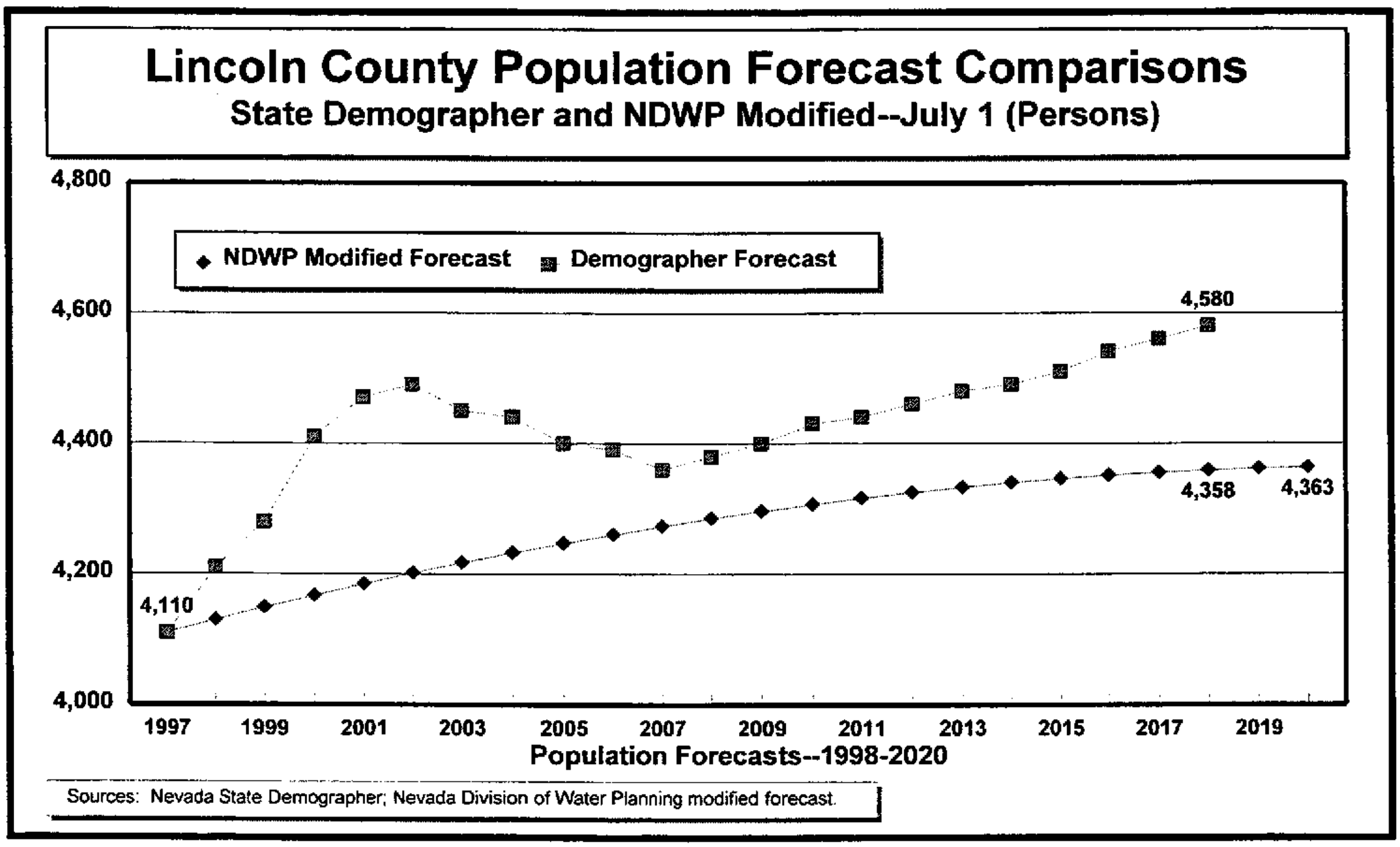
County Population Analysis



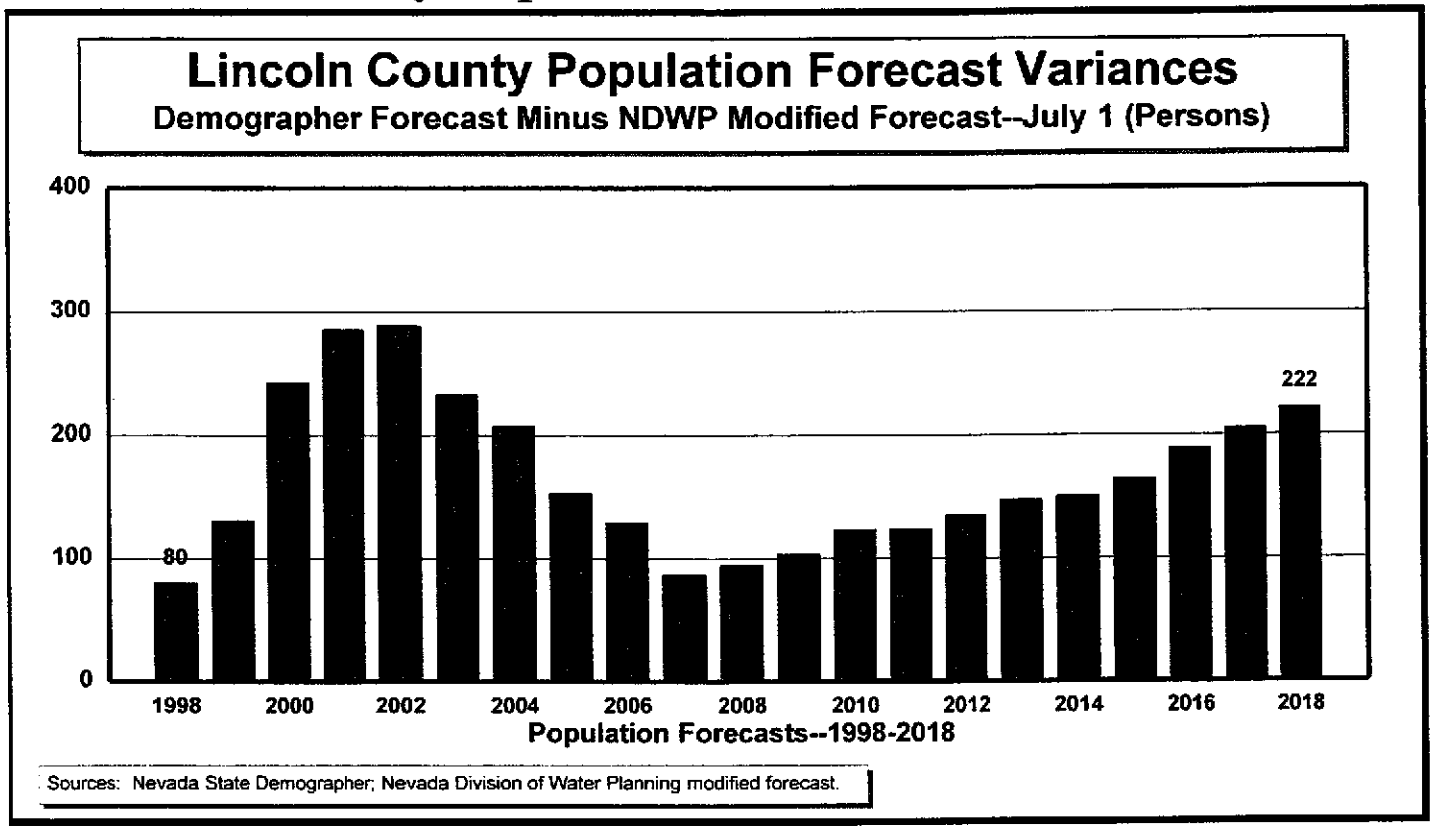


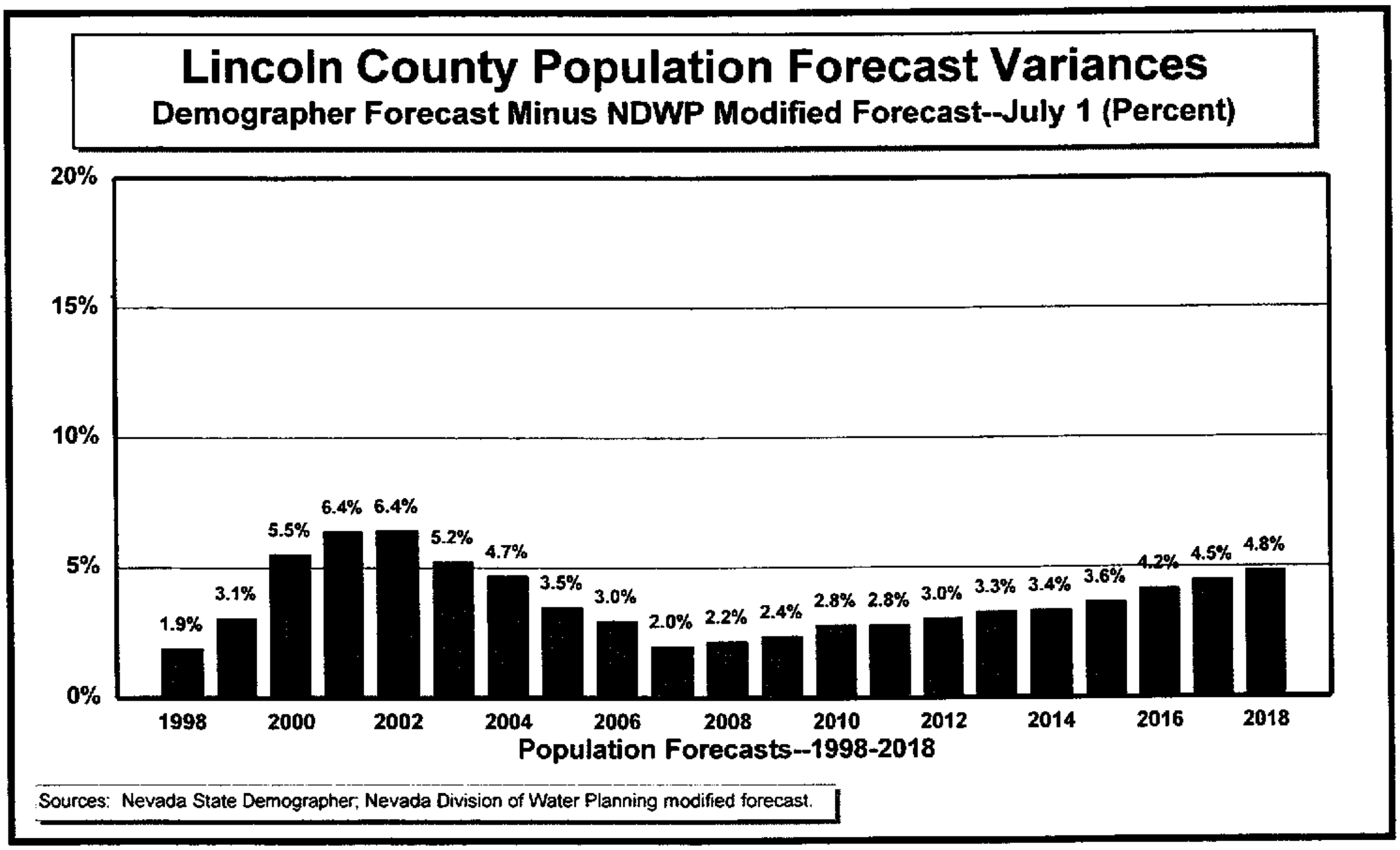
County Population Analysis and Forecasts





County Population Forecast Variances





Lyon County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	3,703	--	--	2.30%	3,703	--	--	2.30%
1951	3,800	97	2.62%	2.30%	3,800	97	2.62%	2.30%
1952	3,900	100	2.63%	2.22%	3,900	100	2.63%	2.22%
1953	3,700	(200)	-5.13%	2.00%	3,700	(200)	-5.13%	2.00%
1954	4,100	400	10.81%	2.05%	4,100	400	10.81%	2.05%
1955	4,400	300	7.32%	2.00%	4,400	300	7.32%	2.00%
1956	4,600	200	4.55%	1.92%	4,600	200	4.55%	1.92%
1957	4,600	0	0.00%	1.84%	4,600	0	0.00%	1.84%
1958	4,600	0	0.00%	1.77%	4,600	0	0.00%	1.77%
1959	4,700	100	2.17%	1.69%	4,700	100	2.17%	1.69%
1960	6,245	1,545	32.87%	2.17%	6,245	1,545	32.87%	2.17%
1961	6,655	410	6.57%	2.24%	6,655	410	6.57%	2.24%
1962	6,578	(77)	-1.16%	2.08%	6,578	(77)	-1.16%	2.08%
1963	6,663	85	1.29%	1.98%	6,663	85	1.29%	1.98%
1964	6,823	160	2.40%	1.89%	6,823	160	2.40%	1.89%
1965	7,146	323	4.73%	1.85%	7,146	323	4.73%	1.85%
1966	7,445	299	4.18%	1.84%	7,445	299	4.18%	1.84%
1967	7,584	139	1.87%	1.85%	7,584	139	1.87%	1.85%
1968	7,747	163	2.15%	1.80%	7,747	163	2.15%	1.80%
1969	7,934	187	2.41%	1.65%	7,934	187	2.41%	1.65%
1970	8,437	503	6.34%	1.70%	8,437	503	6.34%	1.70%
1971	9,300	863	10.23%	1.79%	9,300	863	10.23%	1.79%
1972	9,700	400	4.30%	1.77%	9,700	400	4.30%	1.77%
1973	10,100	400	4.12%	1.77%	10,100	400	4.12%	1.77%
1974	10,200	100	0.99%	1.71%	10,200	100	0.99%	1.71%
1975	10,400	200	1.96%	1.68%	10,400	200	1.96%	1.68%
1976	10,500	100	0.96%	1.62%	10,500	100	0.96%	1.62%
1977	10,800	300	2.86%	1.59%	10,800	300	2.86%	1.59%
1978	11,300	500	4.63%	1.57%	11,300	500	4.63%	1.57%
1979	12,400	1,100	9.73%	1.62%	12,400	1,100	9.73%	1.62%
1980	13,594	1,194	9.63%	1.70%	13,594	1,194	9.63%	1.70%
1981	14,160	566	4.16%	1.67%	14,160	566	4.16%	1.67%
1982	14,600	440	3.11%	1.68%	14,600	440	3.11%	1.68%
1983	15,080	480	3.29%	1.68%	15,080	480	3.29%	1.68%
1984	15,680	600	3.98%	1.70%	15,680	600	3.98%	1.70%
1985	16,460	780	4.97%	1.72%	16,460	780	4.97%	1.72%
1986	17,160	700	4.25%	1.73%	17,160	700	4.25%	1.73%
1987	18,340	1,180	6.88%	1.77%	18,340	1,180	6.88%	1.77%
1988	19,220	880	4.80%	1.75%	19,220	880	4.80%	1.75%
1989	20,150	930	4.84%	1.73%	20,150	930	4.84%	1.73%
1990	20,590	440	2.18%	1.67%	20,590	440	2.18%	1.67%
1991	21,430	840	4.08%	1.65%	21,430	840	4.08%	1.65%
1992	22,410	980	4.57%	1.67%	22,410	980	4.57%	1.67%
1993	23,750	1,340	5.98%	1.70%	23,750	1,340	5.98%	1.70%
1994	25,360	1,610	6.78%	1.70%	25,360	1,610	6.78%	1.70%
1995	26,580	1,220	4.81%	1.68%	26,580	1,220	4.81%	1.68%
1996	28,480	1,900	7.15%	1.69%	28,480	1,900	7.15%	1.69%
1997	30,370	1,890	6.64%	1.71%	30,370	1,890	6.64%	1.71%
1998	32,180	1,810	5.96%	1.72%	31,479	1,109	3.65%	1.72%
1999	33,900	1,720	5.34%	1.73%	32,596	1,117	3.55%	1.71%

Lyon County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

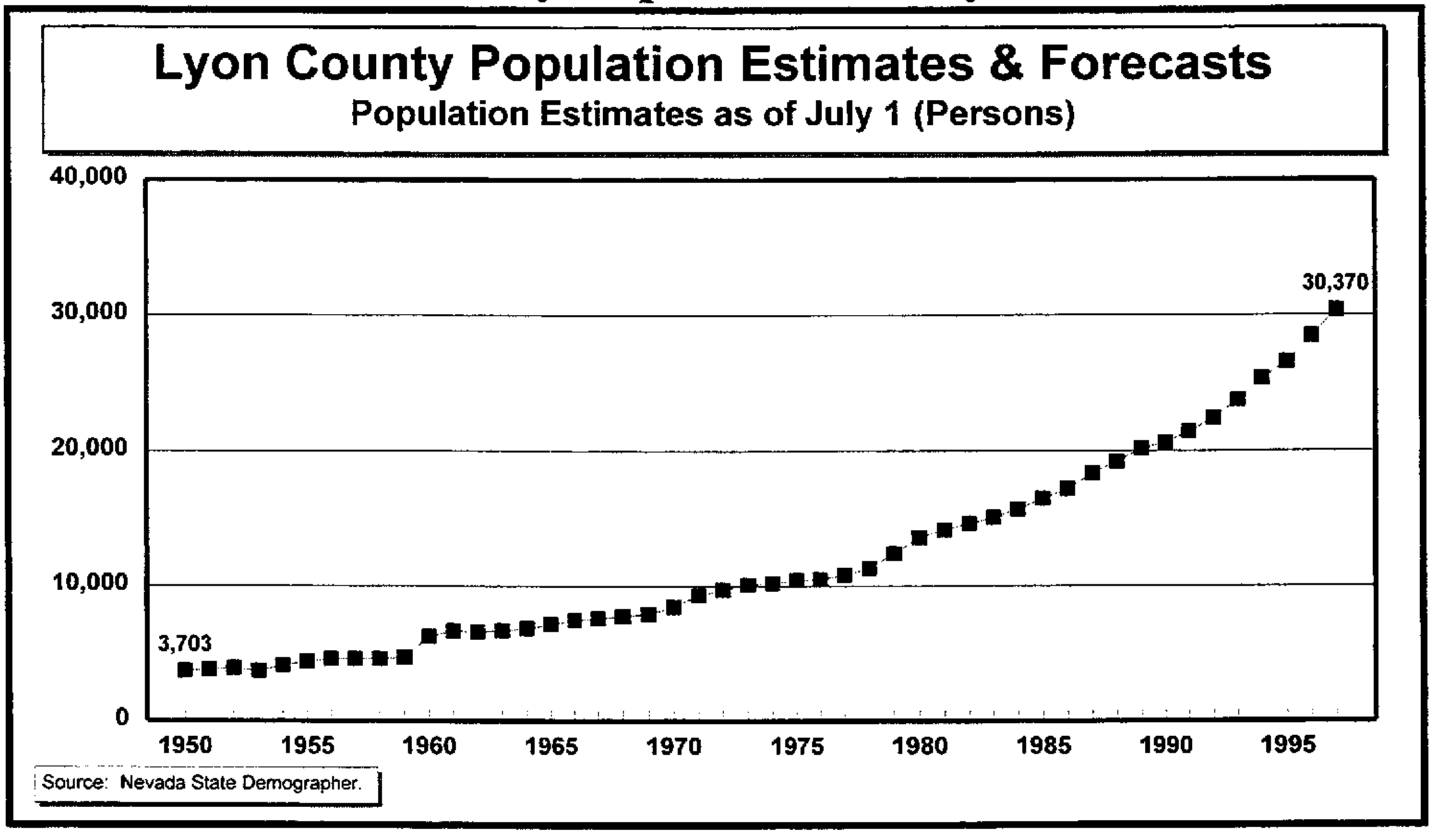
Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	35,700	1,800	5.31%	1.76%	33,721	1,125	3.45%	1.70%
2001	37,400	1,700	4.76%	1.76%	34,850	1,130	3.35%	1.69%
2002	39,410	2,010	5.37%	1.79%	35,983	1,133	3.25%	1.69%
2003	41,040	1,630	4.14%	1.80%	37,116	1,133	3.15%	1.68%
2004	43,060	2,020	4.92%	1.83%	38,248	1,132	3.05%	1.68%
2005	44,740	1,680	3.90%	1.85%	39,377	1,128	2.95%	1.68%
2006	46,710	1,970	4.40%	1.88%	40,499	1,122	2.85%	1.68%
2007	48,380	1,670	3.58%	1.89%	41,613	1,114	2.75%	1.68%
2008	50,470	2,090	4.32%	1.92%	42,715	1,103	2.65%	1.69%
2009	52,870	2,400	4.76%	1.95%	43,805	1,089	2.55%	1.69%
2010	55,370	2,500	4.73%	1.99%	44,878	1,073	2.45%	1.70%
2011	57,950	2,580	4.66%	2.02%	45,932	1,055	2.35%	1.71%
2012	60,630	2,680	4.62%	2.06%	46,966	1,033	2.25%	1.71%
2013	63,450	2,820	4.65%	2.09%	47,976	1,010	2.15%	1.72%
2014	66,270	2,820	4.44%	2.12%	48,959	984	2.05%	1.73%
2015	69,230	2,960	4.47%	2.16%	49,914	955	1.95%	1.74%
2016	72,300	3,070	4.43%	2.19%	50,837	923	1.85%	1.75%
2017	75,440	3,140	4.34%	2.22%	51,727	890	1.75%	1.76%
2018	78,620	3,180	4.22%	2.25%	52,580	853	1.65%	1.76%
2019	--	--	--	--	53,395	815	1.55%	1.77%
2020	--	--	--	--	54,170	774	1.45%	1.78%

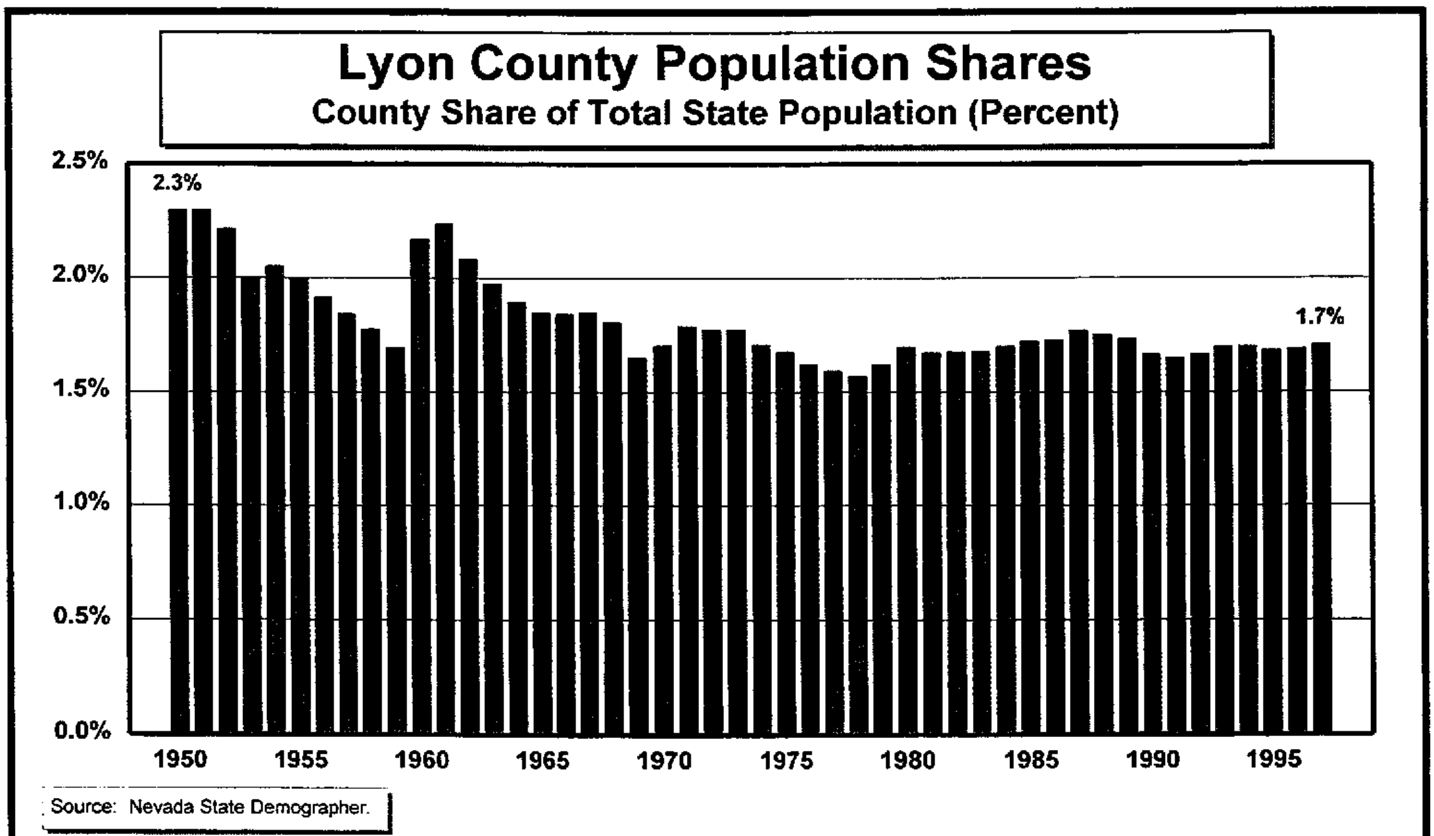
Growth Rate Analysis: Average Annual Rates of Change by Specific Time Period (percent)	Period	Rate
	1950-1997	4.58%
	1950-1960	5.37%
	1960-1970	3.05%
	1970-1980	4.89%
	1980-1990	4.24%
	1990-1997	5.71%

Forecast Periods:	Period	Rate		Rate	
	1998-2018	**4.63%**	**State Demographer**	**2.65%**	**NDWP Modified Forecast**
	1998-2008	**4.73%**		**3.15%**	
	2008-2018	**4.51%**		**2.15%**	

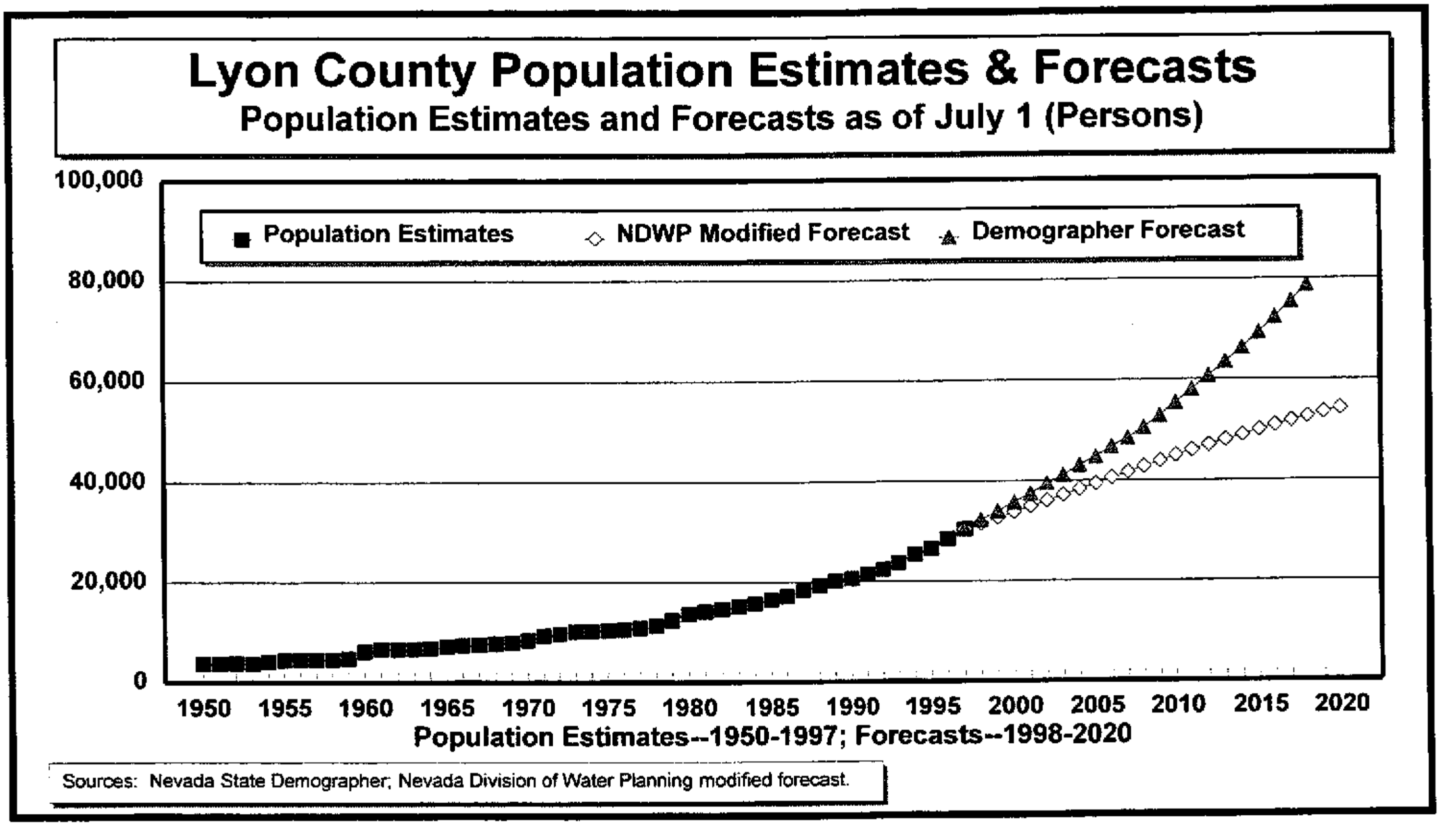
Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

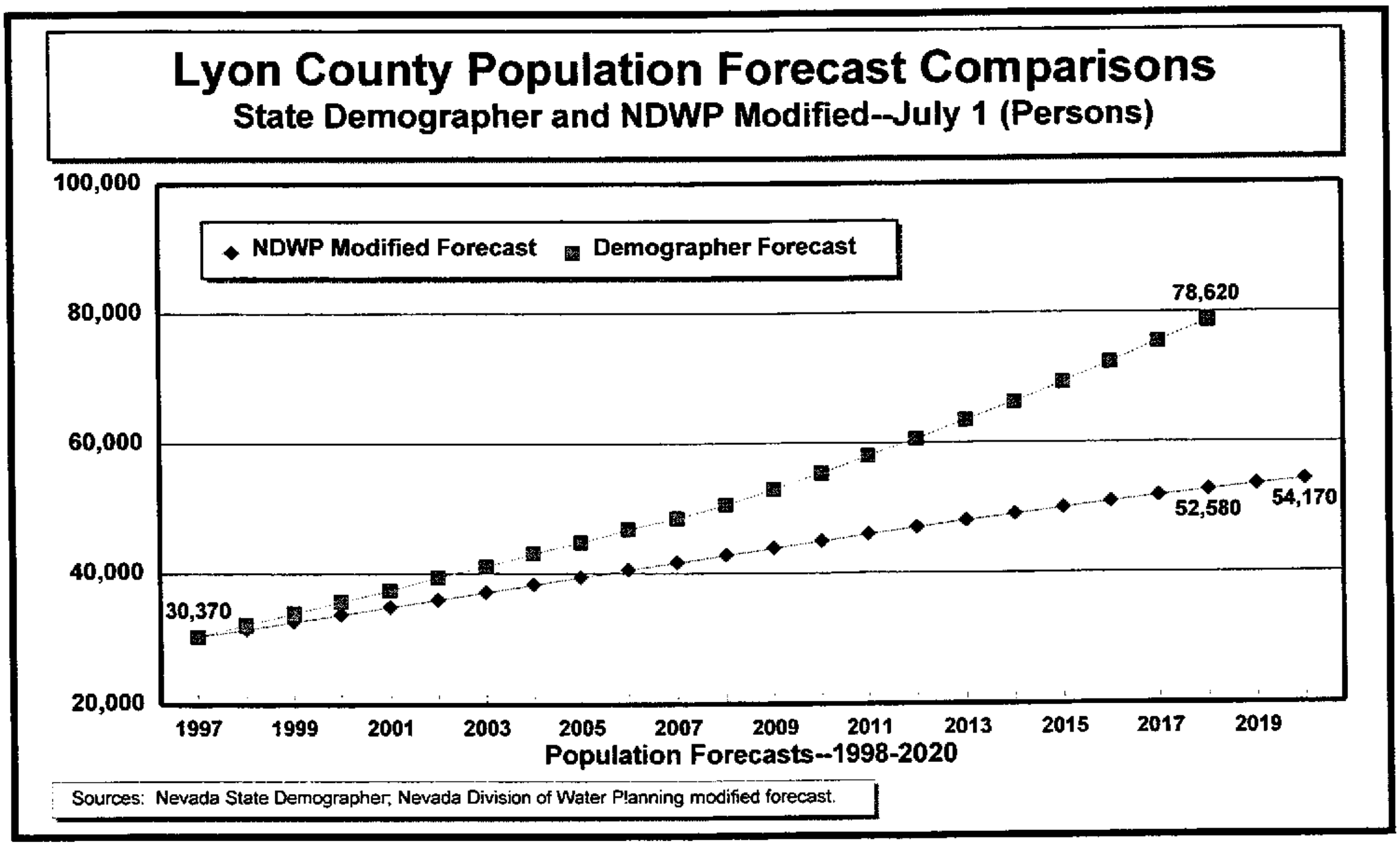
County Population Analysis



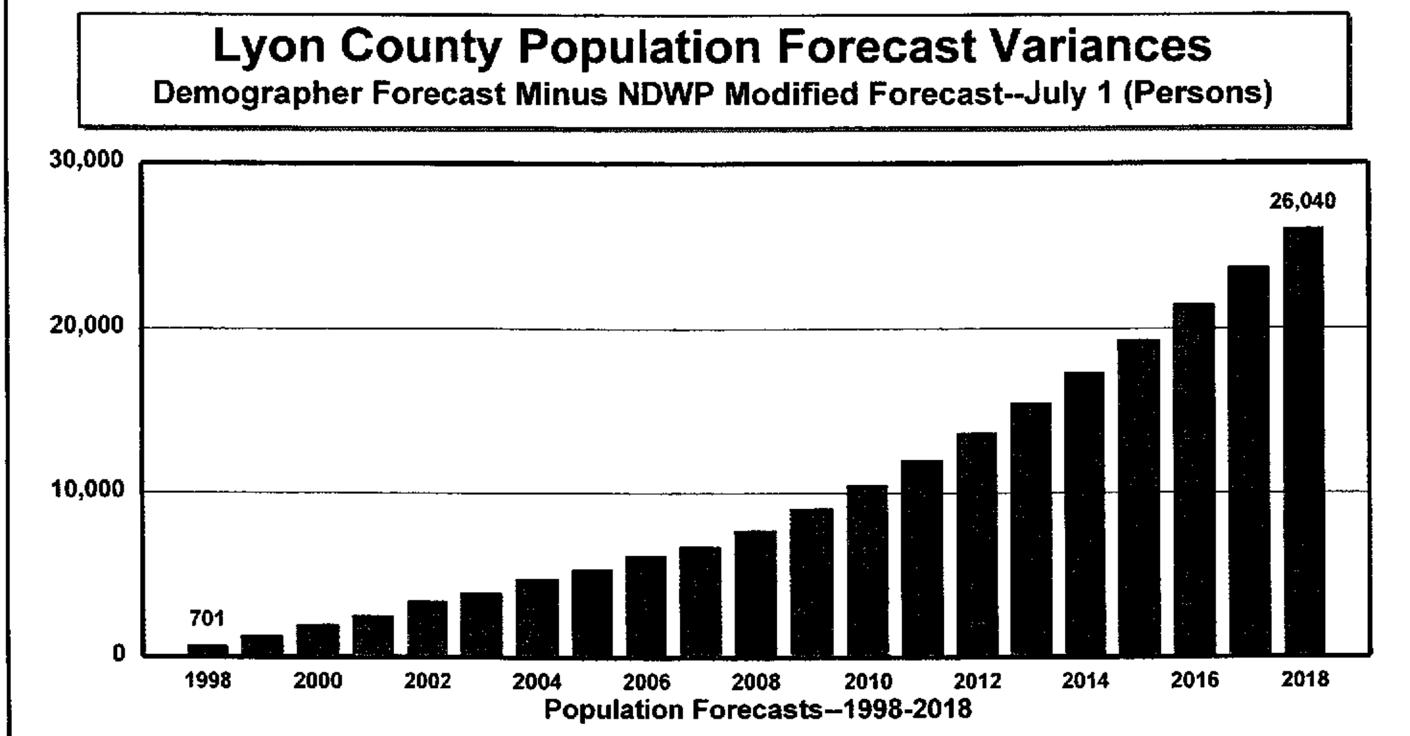


County Population Analysis and Forecasts

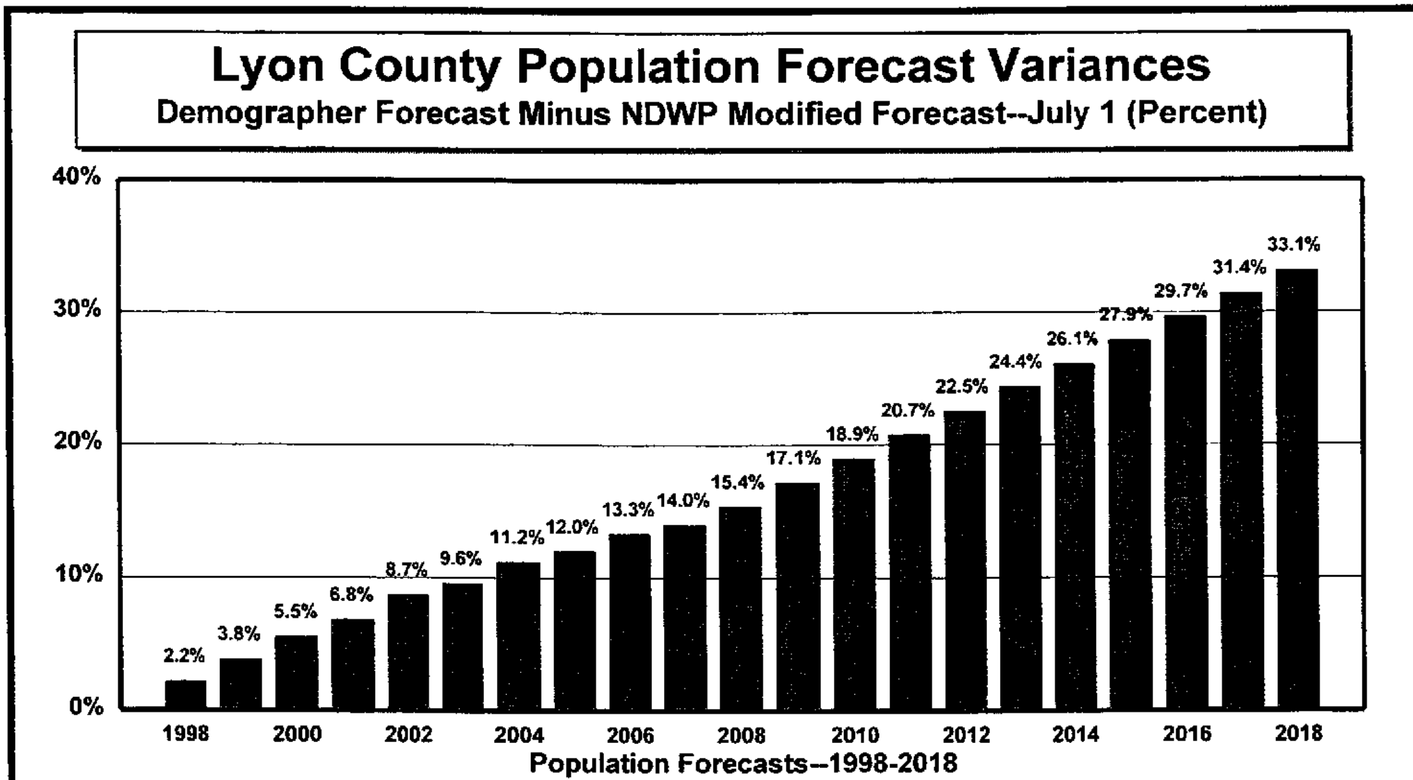




County Population Forecast Variances



Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.



Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.

Mineral County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	5,588	--	--	3.47%	5,588	--	--	3.47%
1951	5,700	112	2.00%	3.45%	5,700	112	2.00%	3.45%
1952	6,200	500	8.77%	3.52%	6,200	500	8.77%	3.52%
1953	7,100	900	14.52%	3.85%	7,100	900	14.52%	3.85%
1954	8,000	900	12.68%	4.00%	8,000	900	12.68%	4.00%
1955	9,000	1,000	12.50%	4.09%	9,000	1,000	12.50%	4.09%
1956	10,200	1,200	13.33%	4.25%	10,200	1,200	13.33%	4.25%
1957	9,100	(1,100)	-10.78%	3.65%	9,100	(1,100)	-10.78%	3.65%
1958	8,900	(200)	-2.20%	3.43%	8,900	(200)	-2.20%	3.43%
1959	7,900	(1,000)	-11.24%	2.85%	7,900	(1,000)	-11.24%	2.85%
1960	6,329	(1,571)	-19.89%	2.20%	6,329	(1,571)	-19.89%	2.20%
1961	6,327	(2)	-0.03%	2.13%	6,327	(2)	-0.03%	2.13%
1962	6,032	(295)	-4.66%	1.91%	6,032	(295)	-4.66%	1.91%
1963	5,728	(304)	-5.04%	1.70%	5,728	(304)	-5.04%	1.70%
1964	5,500	(228)	-3.98%	1.53%	5,500	(228)	-3.98%	1.53%
1965	5,710	210	3.82%	1.48%	5,710	210	3.82%	1.48%
1966	6,072	362	6.34%	1.50%	6,072	362	6.34%	1.50%
1967	6,441	369	6.08%	1.57%	6,441	369	6.08%	1.57%
1968	6,694	253	3.93%	1.56%	6,694	253	3.93%	1.56%
1969	7,111	417	6.23%	1.48%	7,111	417	6.23%	1.48%
1970	6,961	(150)	-2.11%	1.41%	6,961	(150)	-2.11%	1.41%
1971	6,600	(361)	-5.19%	1.27%	6,600	(361)	-5.19%	1.27%
1972	6,900	300	4.55%	1.26%	6,900	300	4.55%	1.26%
1973	7,000	100	1.45%	1.23%	7,000	100	1.45%	1.23%
1974	7,000	0	0.00%	1.17%	7,000	0	0.00%	1.17%
1975	6,800	(200)	-2.86%	1.10%	6,800	(200)	-2.86%	1.10%
1976	6,500	(300)	-4.41%	1.00%	6,500	(300)	-4.41%	1.00%
1977	6,100	(400)	-6.15%	0.90%	6,100	(400)	-6.15%	0.90%
1978	5,900	(200)	-3.28%	0.82%	5,900	(200)	-3.28%	0.82%
1979	6,100	200	3.39%	0.80%	6,100	200	3.39%	0.80%
1980	6,217	117	1.92%	0.78%	6,217	117	1.92%	0.78%
1981	6,230	13	0.21%	0.74%	6,230	13	0.21%	0.74%
1982	6,220	(10)	-0.16%	0.71%	6,220	(10)	-0.16%	0.71%
1983	6,200	(20)	-0.32%	0.69%	6,200	(20)	-0.32%	0.69%
1984	6,180	(20)	-0.32%	0.67%	6,180	(20)	-0.32%	0.67%
1985	6,180	0	0.00%	0.65%	6,180	0	0.00%	0.65%
1986	6,200	20	0.32%	0.62%	6,200	20	0.32%	0.62%
1987	6,270	70	1.13%	0.61%	6,270	70	1.13%	0.61%
1988	6,400	130	2.07%	0.58%	6,400	130	2.07%	0.58%
1989	6,460	60	0.94%	0.56%	6,460	60	0.94%	0.56%
1990	6,470	10	0.15%	0.52%	6,470	10	0.15%	0.52%
1991	6,460	(10)	-0.15%	0.50%	6,460	(10)	-0.15%	0.50%
1992	6,560	100	1.55%	0.49%	6,560	100	1.55%	0.49%
1993	6,510	(50)	-0.76%	0.47%	6,510	(50)	-0.76%	0.47%
1994	6,410	(100)	-1.54%	0.43%	6,410	(100)	-1.54%	0.43%
1995	6,700	290	4.52%	0.42%	6,700	290	4.52%	0.42%
1996	6,810	110	1.64%	0.40%	6,810	110	1.64%	0.40%
1997	6,860	50	0.73%	0.39%	6,860	50	0.73%	0.39%
1998	6,740	(120)	-1.75%	0.36%	6,893	33	0.48%	0.38%
1999	6,600	(140)	-2.08%	0.34%	6,924	32	0.46%	0.36%

Mineral County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

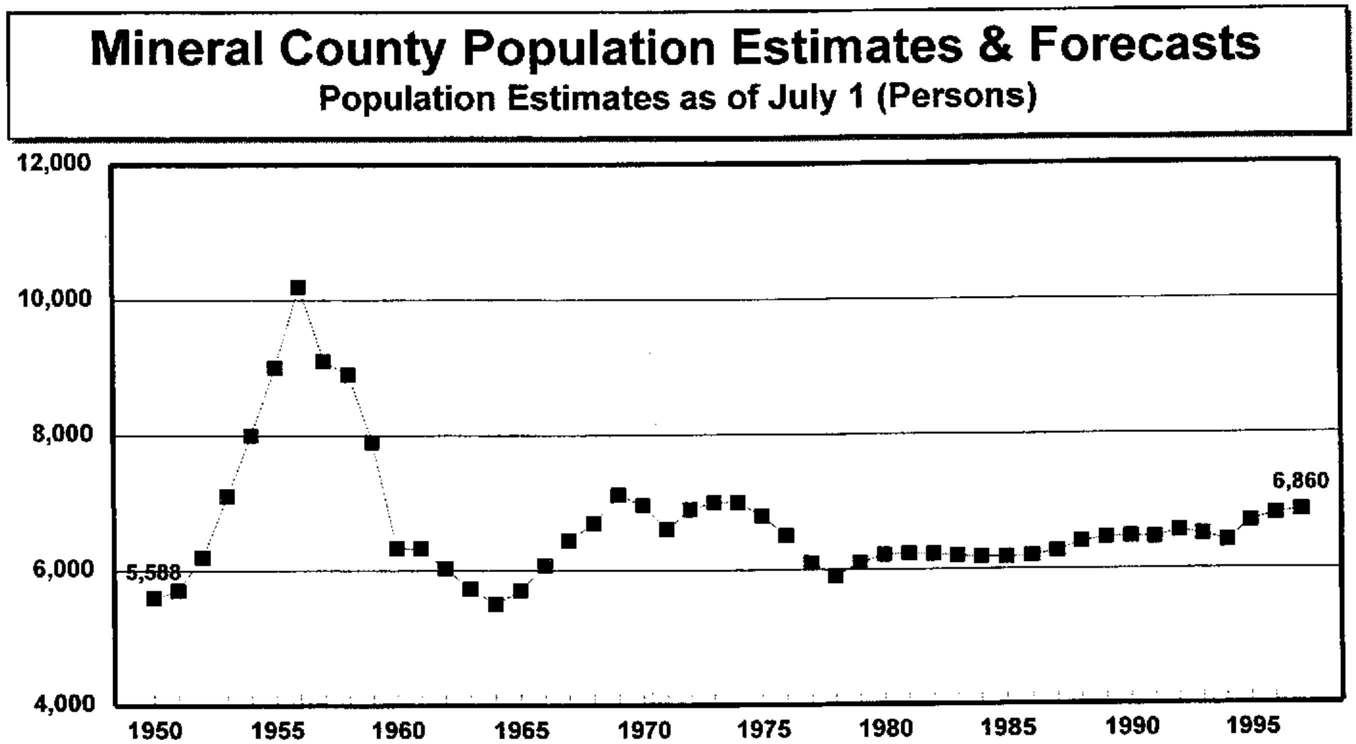
Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	6,560	(40)	-0.61%	0.32%	6,955	30	0.44%	0.35%
2001	6,570	10	0.15%	0.31%	6,984	29	0.42%	0.34%
2002	6,630	60	0.91%	0.30%	7,011	28	0.39%	0.33%
2003	6,570	(60)	-0.90%	0.29%	7,037	26	0.37%	0.32%
2004	6,530	(40)	-0.61%	0.28%	7,062	25	0.35%	0.31%
2005	6,420	(110)	-1.68%	0.27%	7,086	23	0.33%	0.30%
2006	6,370	(50)	-0.78%	0.26%	7,108	22	0.31%	0.30%
2007	6,290	(80)	-1.26%	0.25%	7,128	21	0.29%	0.29%
2008	6,250	(40)	-0.64%	0.24%	7,148	19	0.27%	0.28%
2009	6,240	(10)	-0.16%	0.23%	7,165	18	0.25%	0.28%
2010	6,220	(20)	-0.32%	0.22%	7,182	16	0.23%	0.27%
2011	6,200	(20)	-0.32%	0.22%	7,196	15	0.21%	0.27%
2012	6,180	(20)	-0.32%	0.21%	7,210	13	0.18%	0.26%
2013	6,170	(10)	-0.16%	0.20%	7,221	12	0.16%	0.26%
2014	6,150	(20)	-0.32%	0.20%	7,232	10	0.14%	0.26%
2015	6,140	(10)	-0.16%	0.19%	7,241	9	0.12%	0.25%
2016	6,120	(20)	-0.33%	0.19%	7,248	7	0.10%	0.25%
2017	6,110	(10)	-0.16%	0.18%	7,254	6	0.08%	0.25%
2018	6,090	(20)	-0.33%	0.17%	7,258	4	0.06%	0.24%
2019	--	--	--	--	7,261	3	0.04%	0.24%
2020	--	--	--	--	7,262	1	0.02%	0.24%

Growth Rate Analysis:	1950-1997	0.44%
Average Annual Rates	1950-1960	1.25%
of Change by Specific	1960-1970	0.96%
Time Period (percent)	1970-1980	-1.12%
	1980-1990	0.40%
	1990-1997	0.84%

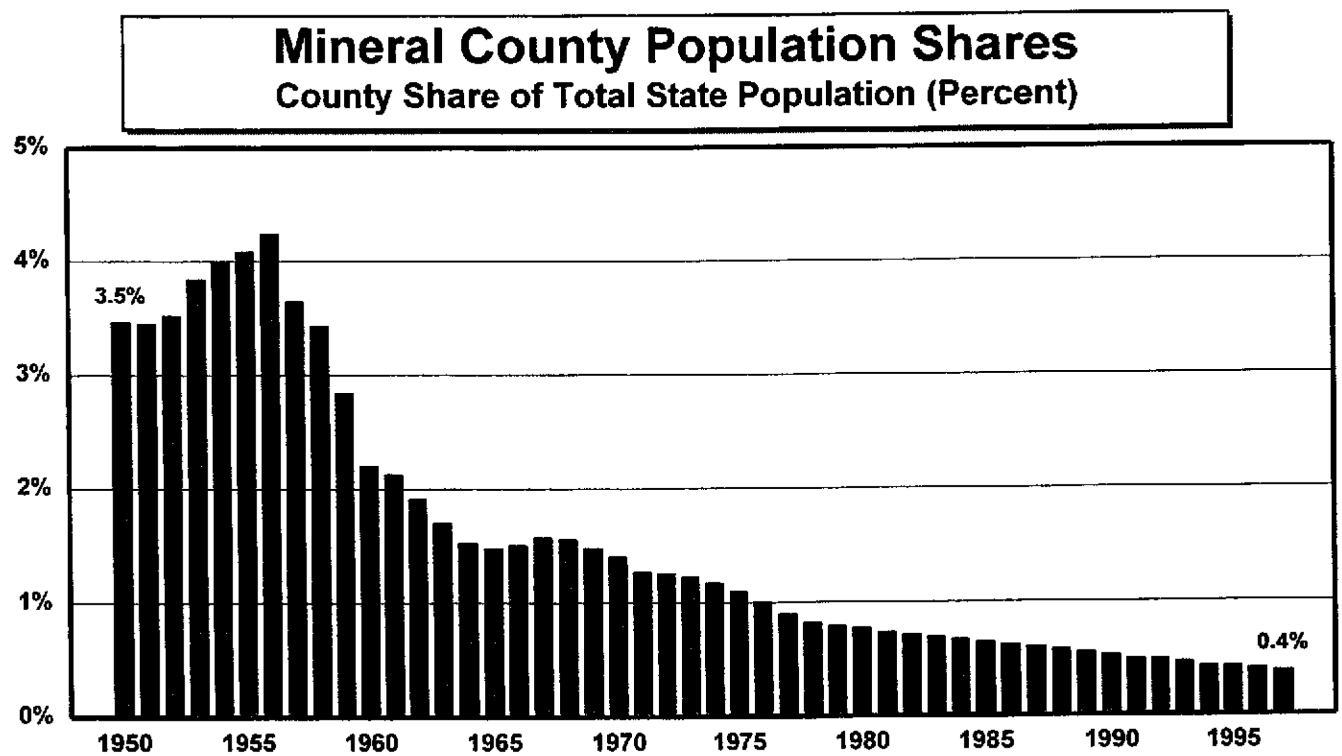
Forecast Periods:	**1998-2018**	**-0.57%**	**State Demographer**	**0.27%**	**NDWP Modified Forecast**
	1998-2008	**-0.84%**		**0.37%**	
	2008-2018	**-0.29%**		**0.16%**	

Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

County Population Analysis

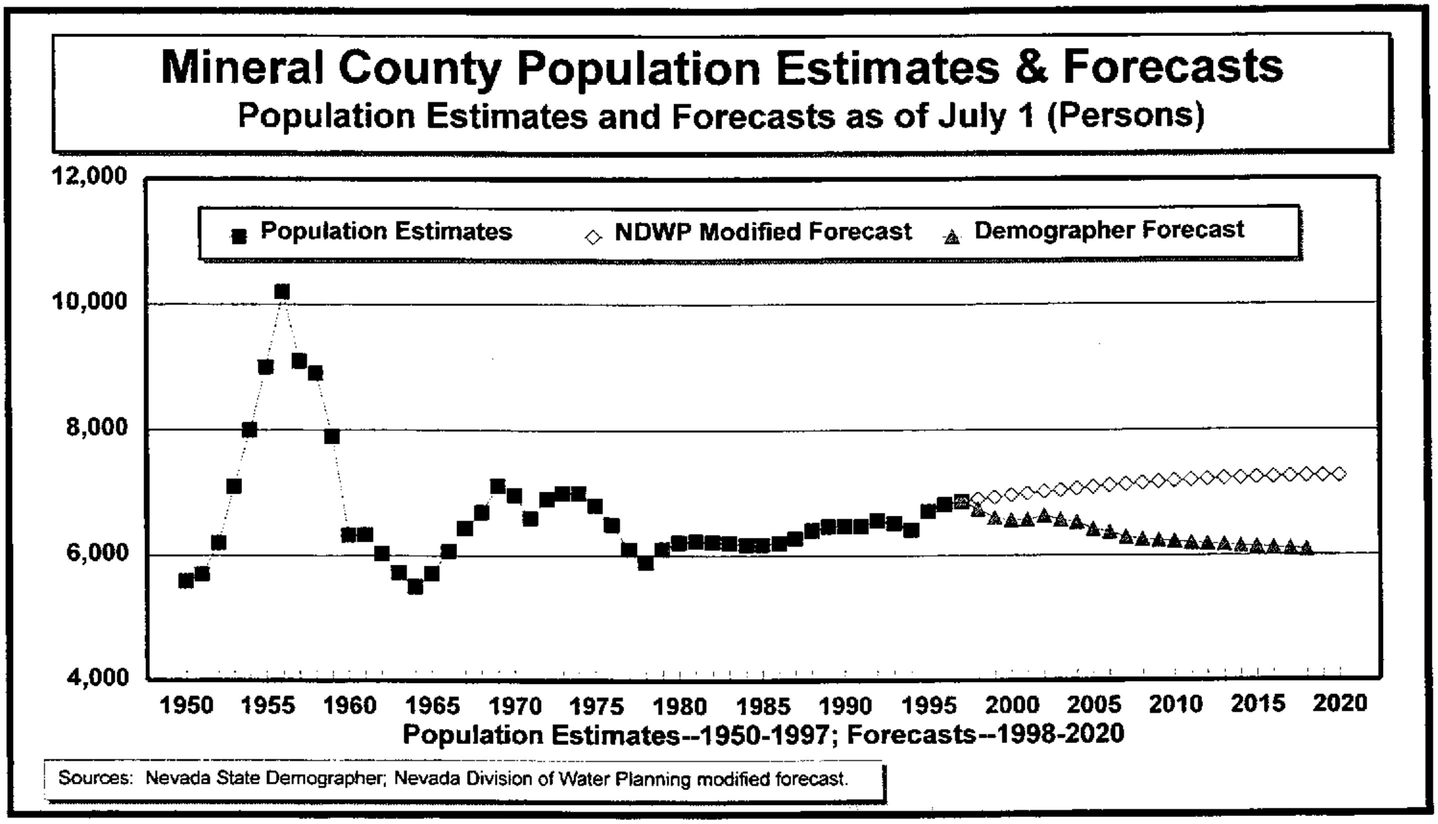


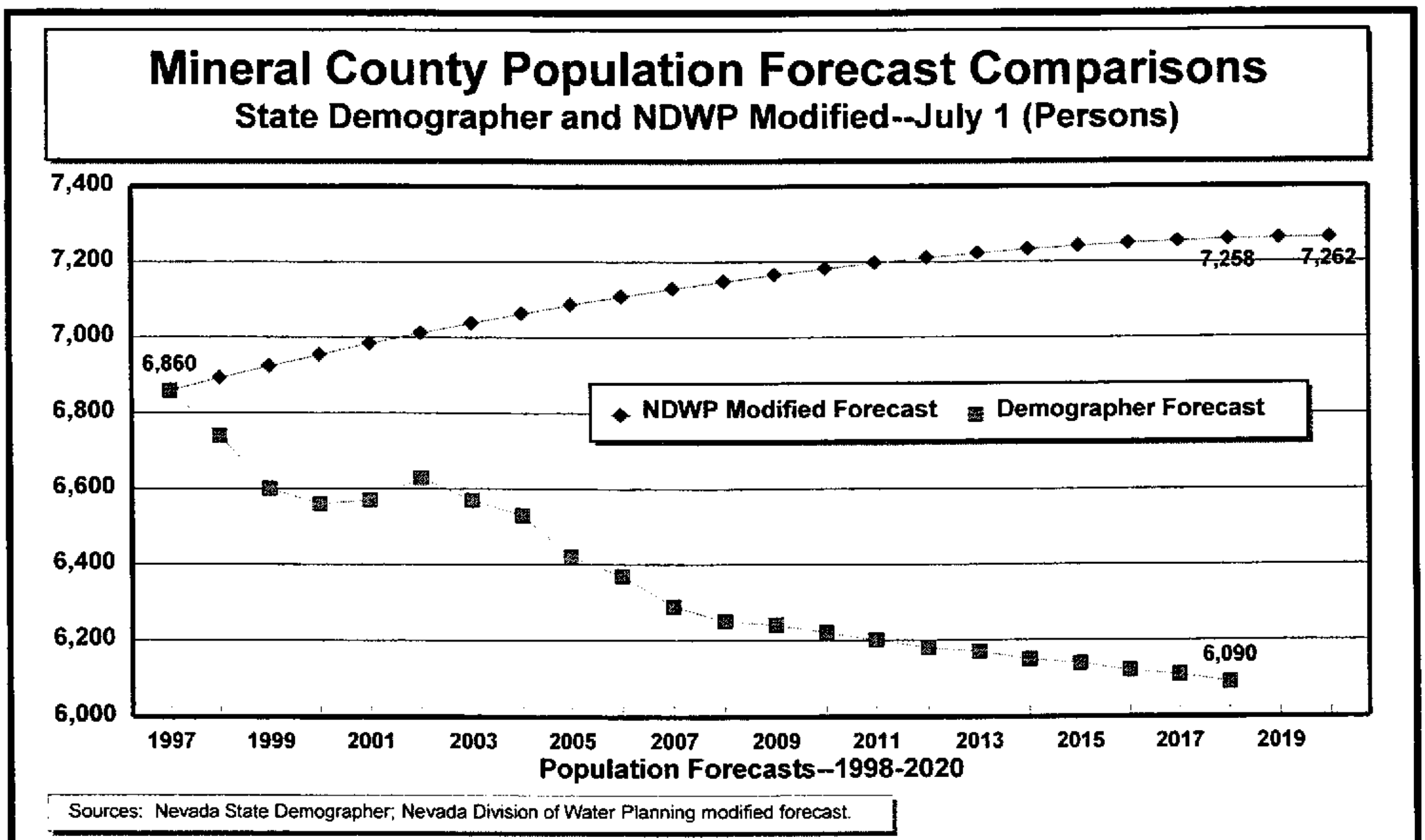
Source: Nevada State Demographer.



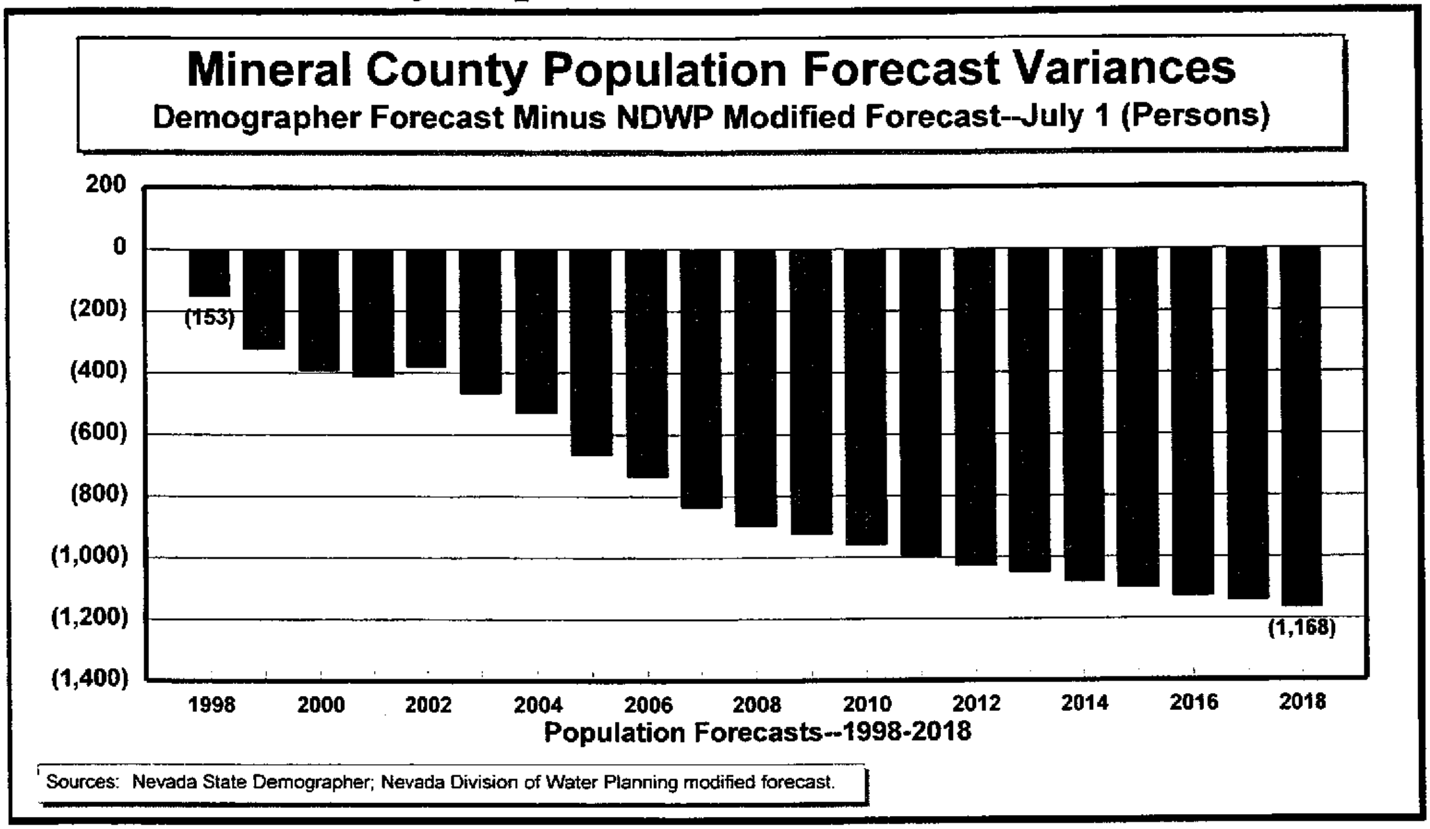
Source: Nevada State Demographer.

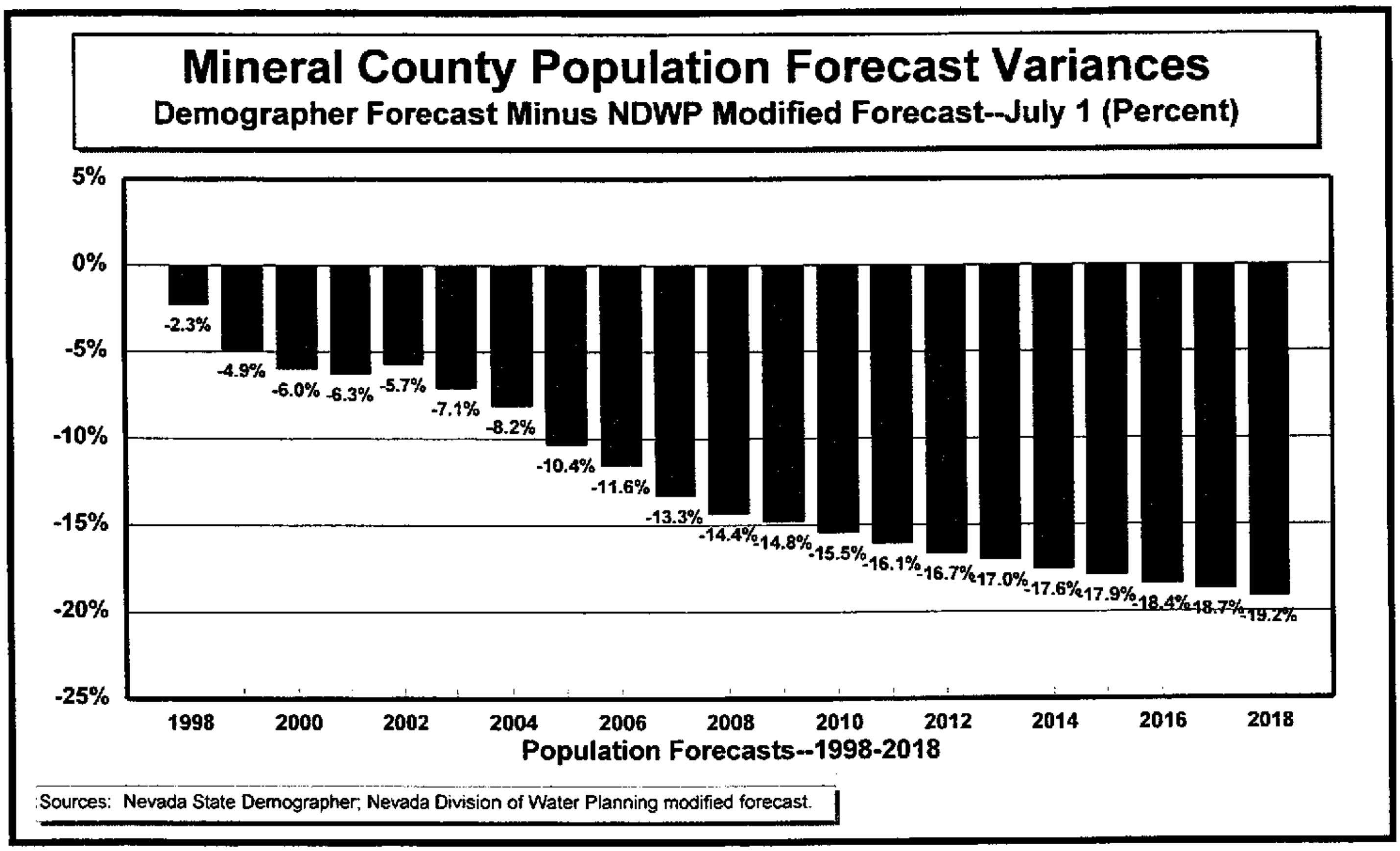
County Population Analysis and Forecasts





County Population Forecast Variances





Nye County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	3,101	--	--	1.92%	3,101	--	--	1.92%
1951	3,100	(1)	-0.03%	1.87%	3,100	(1)	-0.03%	1.87%
1952	2,800	(300)	-9.68%	1.59%	2,800	(300)	-9.68%	1.59%
1953	2,800	0	0.00%	1.52%	2,800	0	0.00%	1.52%
1954	2,700	(100)	-3.57%	1.35%	2,700	(100)	-3.57%	1.35%
1955	2,600	(100)	-3.70%	1.18%	2,600	(100)	-3.70%	1.18%
1956	2,500	(100)	-3.85%	1.04%	2,500	(100)	-3.85%	1.04%
1957	2,600	100	4.00%	1.04%	2,600	100	4.00%	1.04%
1958	3,100	500	19.23%	1.20%	3,100	500	19.23%	1.20%
1959	3,700	600	19.35%	1.33%	3,700	600	19.35%	1.33%
1960	4,642	942	25.46%	1.61%	4,642	942	25.46%	1.61%
1961	5,716	1,074	23.14%	1.92%	5,716	1,074	23.14%	1.92%
1962	6,628	912	15.96%	2.10%	6,628	912	15.96%	2.10%
1963	6,047	(581)	-8.77%	1.79%	6,047	(581)	-8.77%	1.79%
1964	5,575	(472)	-7.81%	1.55%	5,575	(472)	-7.81%	1.55%
1965	5,453	(122)	-2.19%	1.41%	5,453	(122)	-2.19%	1.41%
1966	5,348	(105)	-1.93%	1.32%	5,348	(105)	-1.93%	1.32%
1967	5,165	(183)	-3.42%	1.26%	5,165	(183)	-3.42%	1.26%
1968	5,376	211	4.09%	1.25%	5,376	211	4.09%	1.25%
1969	5,699	323	6.01%	1.19%	5,699	323	6.01%	1.19%
1970	5,459	(240)	-4.21%	1.10%	5,459	(240)	-4.21%	1.10%
1971	4,900	(559)	-10.24%	0.94%	4,900	(559)	-10.24%	0.94%
1972	5,000	100	2.04%	0.91%	5,000	100	2.04%	0.91%
1973	5,000	0	0.00%	0.88%	5,000	0	0.00%	0.88%
1974	5,200	200	4.00%	0.87%	5,200	200	4.00%	0.87%
1975	5,500	300	5.77%	0.89%	5,500	300	5.77%	0.89%
1976	5,800	300	5.45%	0.90%	5,800	300	5.45%	0.90%
1977	5,900	100	1.72%	0.87%	5,900	100	1.72%	0.87%
1978	7,400	1,500	25.42%	1.03%	7,400	1,500	25.42%	1.03%
1979	8,200	800	10.81%	1.07%	8,200	800	10.81%	1.07%
1980	9,048	848	10.34%	1.13%	9,048	848	10.34%	1.13%
1981	11,000	1,952	21.57%	1.30%	11,000	1,952	21.57%	1.30%
1982	13,040	2,040	18.55%	1.50%	13,040	2,040	18.55%	1.50%
1983	13,480	440	3.37%	1.50%	13,480	440	3.37%	1.50%
1984	14,570	1,090	8.09%	1.58%	14,570	1,090	8.09%	1.58%
1985	14,570	0	0.00%	1.52%	14,570	0	0.00%	1.52%
1986	14,680	110	0.75%	1.48%	14,680	110	0.75%	1.48%
1987	15,200	520	3.54%	1.47%	15,200	520	3.54%	1.47%
1988	15,760	560	3.68%	1.44%	15,760	560	3.68%	1.44%
1989	17,540	1,780	11.29%	1.51%	17,540	1,780	11.29%	1.51%
1990	18,190	650	3.71%	1.47%	18,190	650	3.71%	1.47%
1991	19,110	920	5.06%	1.47%	19,110	920	5.06%	1.47%
1992	20,080	970	5.08%	1.49%	20,080	970	5.08%	1.49%
1993	20,550	470	2.34%	1.47%	20,550	470	2.34%	1.47%
1994	20,720	170	0.83%	1.39%	20,720	170	0.83%	1.39%
1995	23,050	2,330	11.25%	1.46%	23,050	2,330	11.25%	1.46%
1996	25,240	2,190	9.50%	1.50%	25,240	2,190	9.50%	1.50%
1997	27,610	2,370	9.39%	1.55%	27,610	2,370	9.39%	1.55%
1998	30,410	2,800	10.14%	1.62%	28,680	1,070	3.88%	1.56%
1999	32,710	2,300	7.56%	1.67%	29,755	1,075	3.75%	1.56%

Nye County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	35,050	2,340	7.15%	1.72%	30,834	1,079	3.63%	1.55%
2001	37,340	2,290	6.53%	1.76%	31,913	1,079	3.50%	1.55%
2002	39,880	2,540	6.80%	1.81%	32,990	1,077	3.37%	1.54%
2003	41,890	2,010	5.04%	1.84%	34,062	1,072	3.25%	1.54%
2004	44,080	2,190	5.23%	1.88%	35,127	1,064	3.13%	1.54%
2005	45,750	1,670	3.79%	1.89%	36,181	1,054	3.00%	1.55%
2006	47,510	1,760	3.85%	1.91%	37,221	1,040	2.88%	1.55%
2007	48,820	1,310	2.76%	1.91%	38,244	1,024	2.75%	1.55%
2008	50,380	1,560	3.20%	1.92%	39,248	1,004	2.63%	1.55%
2009	52,080	1,700	3.37%	1.93%	40,230	981	2.50%	1.56%
2010	53,720	1,640	3.15%	1.93%	41,185	955	2.37%	1.56%
2011	55,280	1,560	2.90%	1.93%	42,112	927	2.25%	1.56%
2012	56,820	1,540	2.79%	1.93%	43,007	895	2.12%	1.57%
2013	58,360	1,540	2.71%	1.92%	43,867	860	2.00%	1.58%
2014	59,810	1,450	2.48%	1.92%	44,689	823	1.87%	1.58%
2015	61,290	1,480	2.47%	1.91%	45,471	782	1.75%	1.58%
2016	62,800	1,510	2.46%	1.90%	46,210	739	1.62%	1.59%
2017	64,290	1,490	2.37%	1.89%	46,903	693	1.50%	1.59%
2018	65,750	1,460	2.27%	1.88%	47,548	645	1.37%	1.60%
2019	--	--	--	--	48,143	594	1.25%	1.60%
2020	--	--	--	--	48,684	542	1.12%	1.60%

Growth Rate Analysis:	1950-1997	4.76%
Average Annual Rates	1950-1960	4.12%
of Change by Specific	1960-1970	1.63%
Time Period (percent)	1970-1980	5.18%
	1980-1990	7.23%
	1990-1997	6.14%

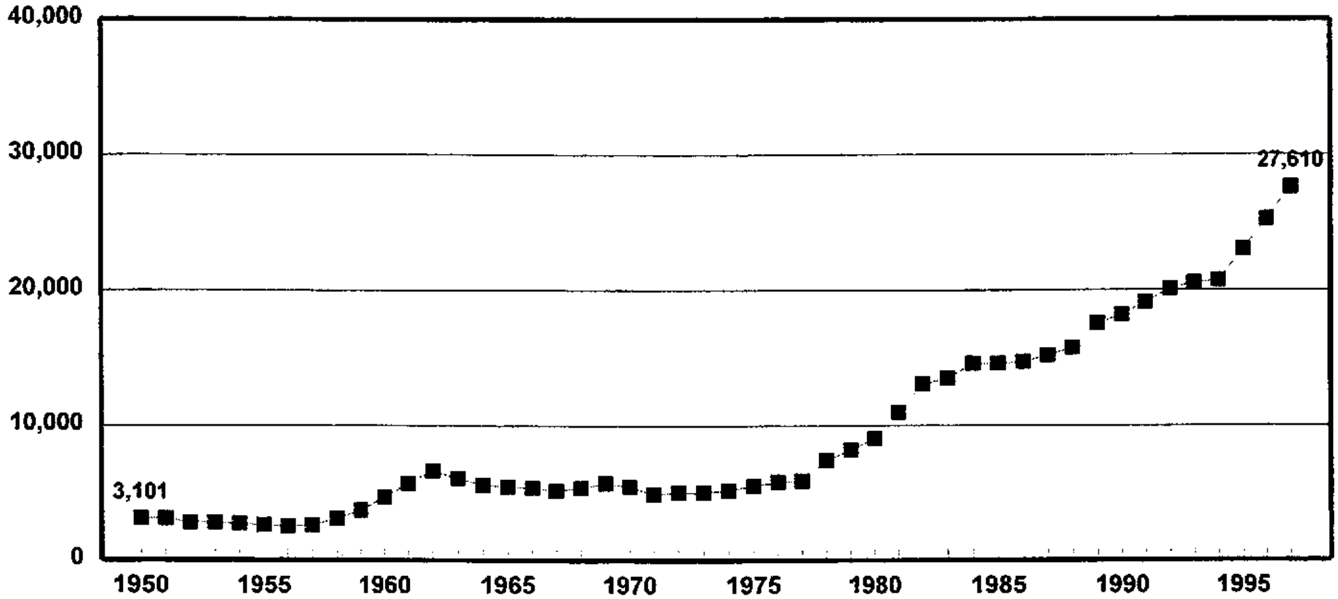
Forecast Periods:	**1998-2018**	**4.22%**	**State Demographer**	**2.62%**	**NDWP Modified Forecast**
	1998-2008	**5.62%**		**3.25%**	
	2008-2018	**2.74%**		**2.00%**	

Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

County Population Analysis

Nye County Population Estimates & Forecasts

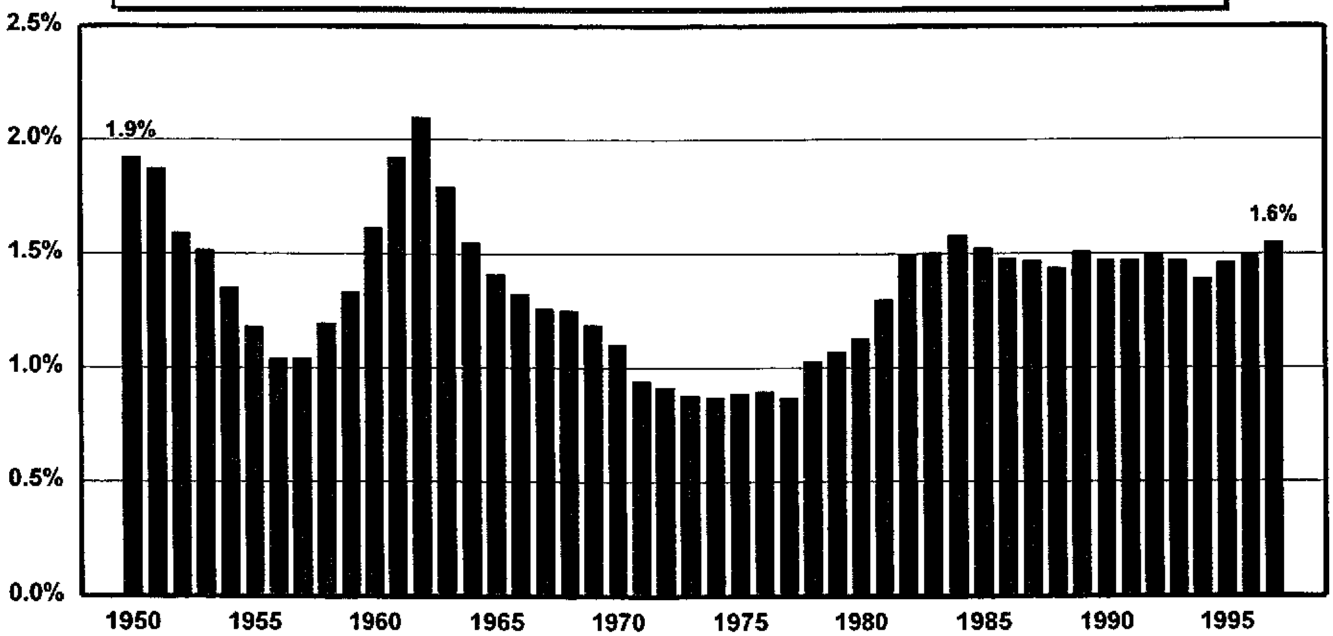
Population Estimates as of July 1 (Persons)



Source: Nevada State Demographer.

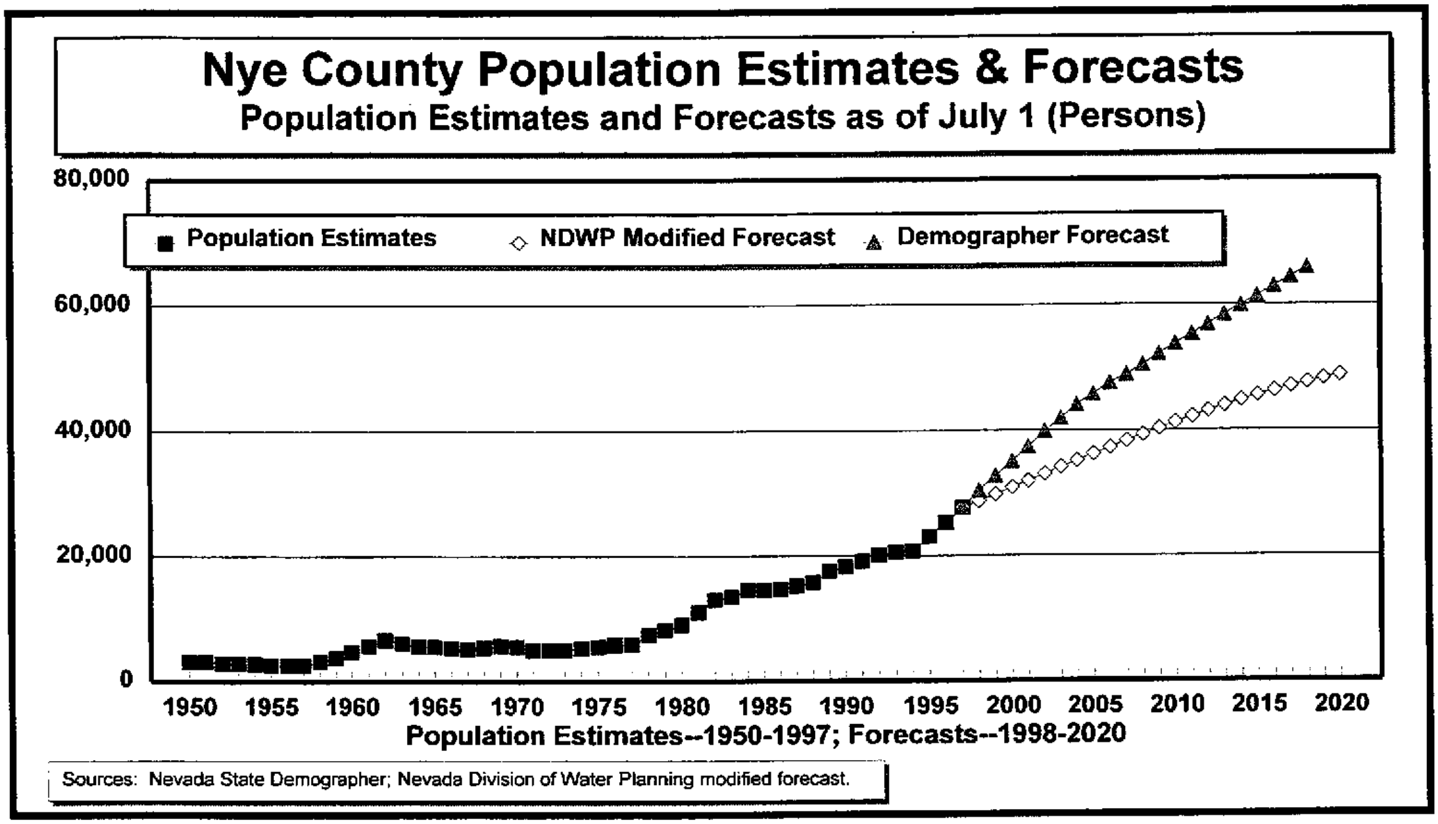
Nye County Population Shares

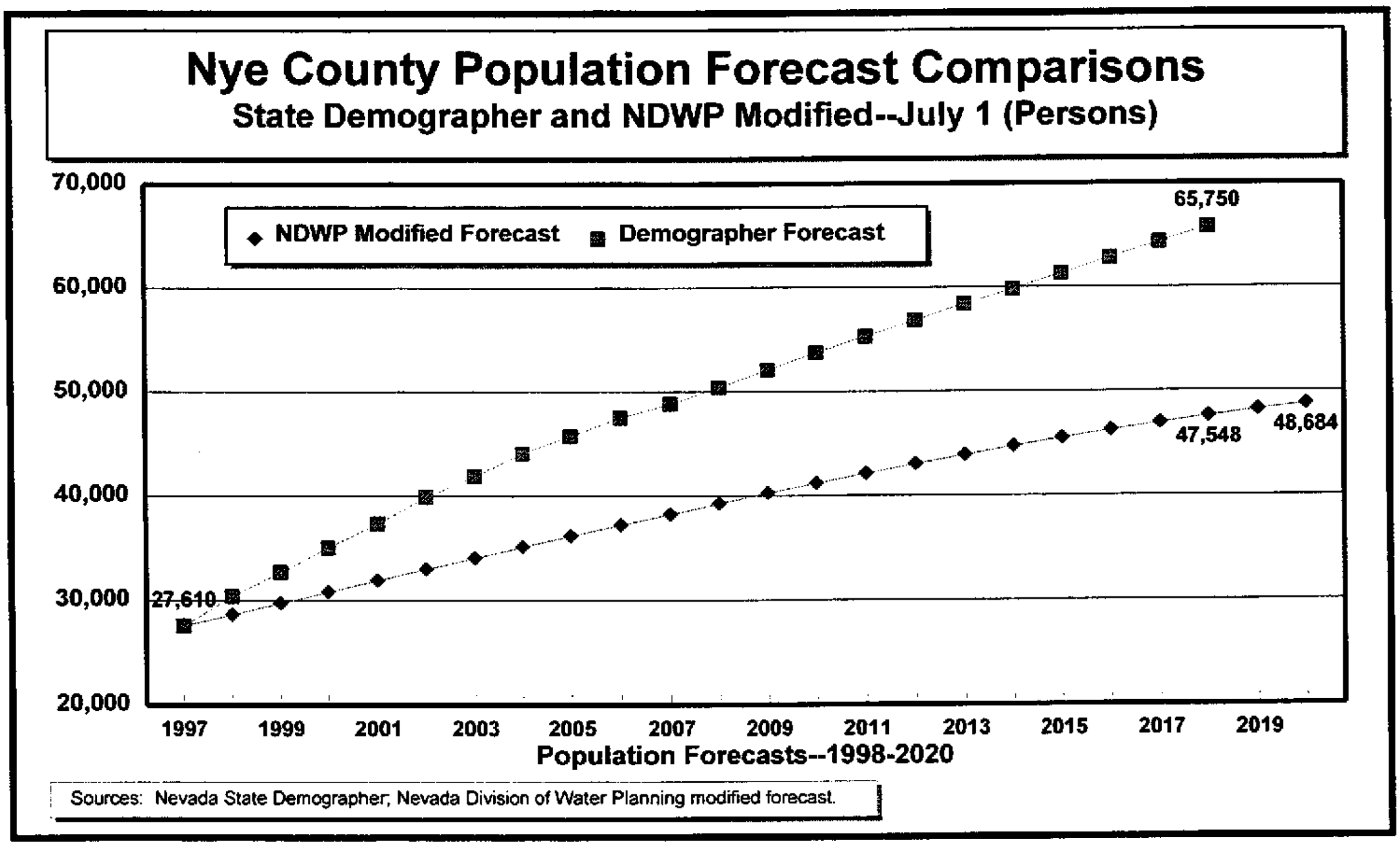
County Share of Total State Population (Percent)



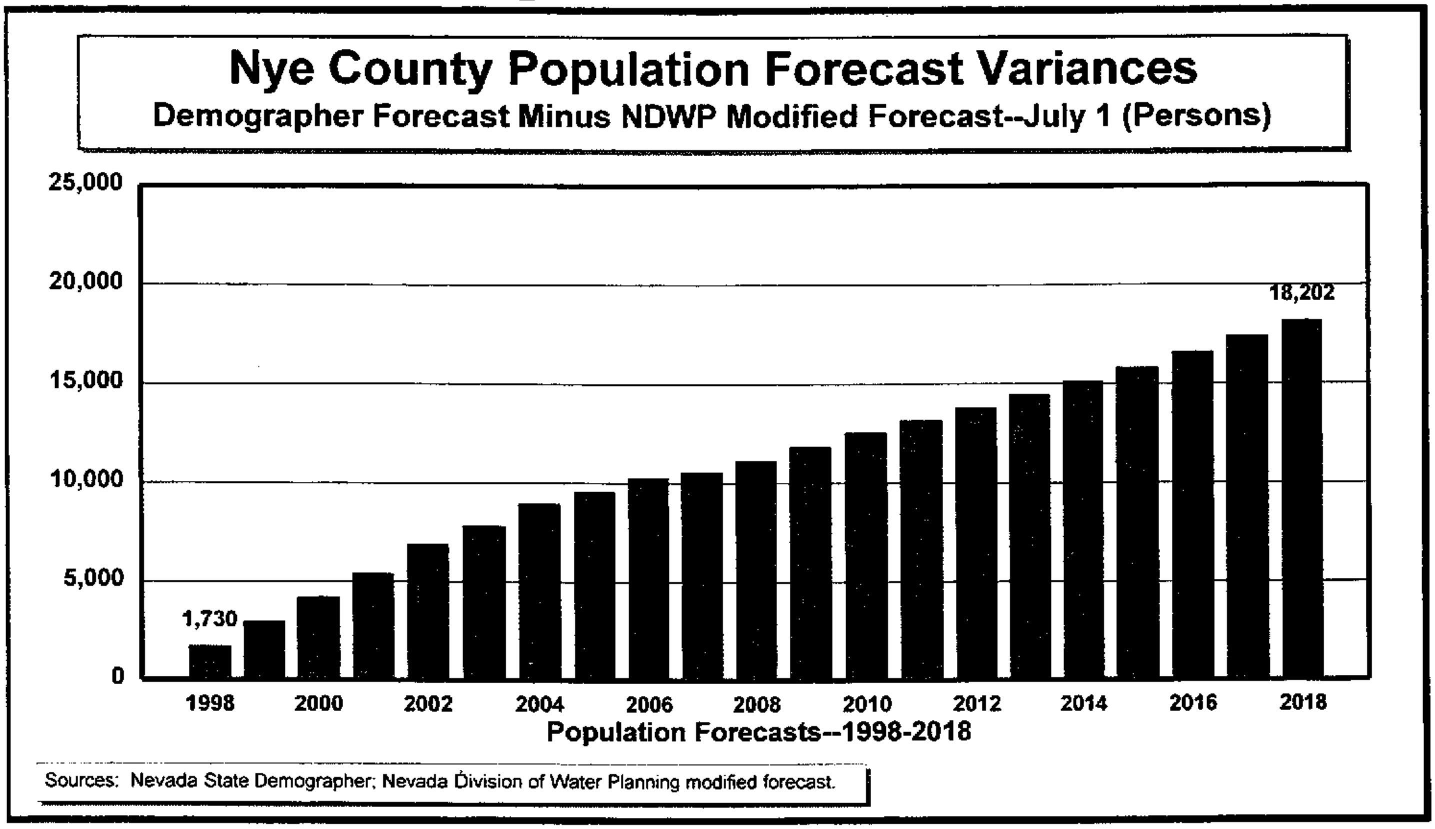
Source: Nevada State Demographer.

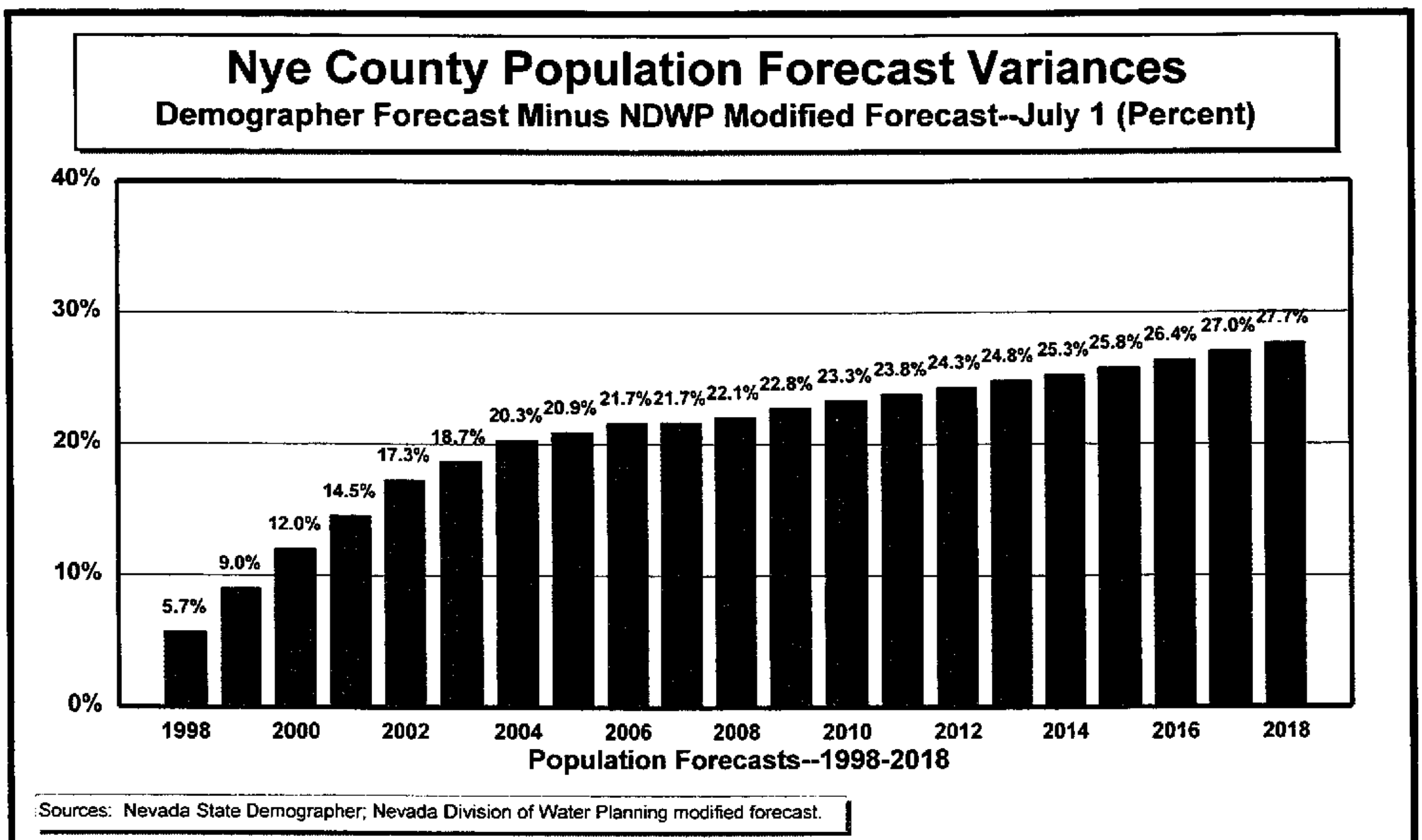
County Population Analysis and Forecasts





County Population Forecast Variances





Pershing County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	3,122	--	--	1.94%	3,122	--	--	1.94%
1951	3,200	78	2.50%	1.93%	3,200	78	2.50%	1.93%
1952	3,300	100	3.13%	1.88%	3,300	100	3.13%	1.88%
1953	3,400	100	3.03%	1.84%	3,400	100	3.03%	1.84%
1954	3,500	100	2.94%	1.75%	3,500	100	2.94%	1.75%
1955	3,700	200	5.71%	1.68%	3,700	200	5.71%	1.68%
1956	3,800	100	2.70%	1.58%	3,800	100	2.70%	1.58%
1957	3,900	100	2.63%	1.56%	3,900	100	2.63%	1.56%
1958	3,900	0	0.00%	1.50%	3,900	0	0.00%	1.50%
1959	3,800	(100)	-2.56%	1.37%	3,800	(100)	-2.56%	1.37%
1960	3,178	(622)	-16.37%	1.10%	3,178	(622)	-16.37%	1.10%
1961	3,092	(86)	-2.71%	1.04%	3,092	(86)	-2.71%	1.04%
1962	3,061	(31)	-1.00%	0.97%	3,061	(31)	-1.00%	0.97%
1963	2,848	(213)	-6.96%	0.85%	2,848	(213)	-6.96%	0.85%
1964	2,716	(132)	-4.63%	0.75%	2,716	(132)	-4.63%	0.75%
1965	2,822	106	3.90%	0.73%	2,822	106	3.90%	0.73%
1966	2,876	54	1.91%	0.71%	2,876	54	1.91%	0.71%
1967	2,693	(183)	-6.36%	0.66%	2,693	(183)	-6.36%	0.66%
1968	2,644	(49)	-1.82%	0.62%	2,644	(49)	-1.82%	0.62%
1969	2,656	12	0.45%	0.55%	2,656	12	0.45%	0.55%
1970	2,656	0	0.00%	0.54%	2,656	0	0.00%	0.54%
1971	2,600	(56)	-2.11%	0.50%	2,600	(56)	-2.11%	0.50%
1972	2,700	100	3.85%	0.49%	2,700	100	3.85%	0.49%
1973	2,600	(100)	-3.70%	0.46%	2,600	(100)	-3.70%	0.46%
1974	2,600	0	0.00%	0.44%	2,600	0	0.00%	0.44%
1975	2,800	200	7.69%	0.45%	2,800	200	7.69%	0.45%
1976	2,900	100	3.57%	0.45%	2,900	100	3.57%	0.45%
1977	3,000	100	3.45%	0.44%	3,000	100	3.45%	0.44%
1978	3,100	100	3.33%	0.43%	3,100	100	3.33%	0.43%
1979	3,100	0	0.00%	0.41%	3,100	0	0.00%	0.41%
1980	3,408	308	9.94%	0.43%	3,408	308	9.94%	0.43%
1981	3,610	202	5.93%	0.43%	3,610	202	5.93%	0.43%
1982	3,720	110	3.05%	0.43%	3,720	110	3.05%	0.43%
1983	3,710	(10)	-0.27%	0.41%	3,710	(10)	-0.27%	0.41%
1984	3,650	(60)	-1.62%	0.40%	3,650	(60)	-1.62%	0.40%
1985	3,660	10	0.27%	0.38%	3,660	10	0.27%	0.38%
1986	3,830	170	4.64%	0.39%	3,830	170	4.64%	0.39%
1987	4,110	280	7.31%	0.40%	4,110	280	7.31%	0.40%
1988	4,380	270	6.57%	0.40%	4,380	270	6.57%	0.40%
1989	4,470	90	2.05%	0.38%	4,470	90	2.05%	0.38%
1990	4,550	80	1.79%	0.37%	4,550	80	1.79%	0.37%
1991	4,700	150	3.30%	0.36%	4,700	150	3.30%	0.36%
1992	4,800	100	2.13%	0.36%	4,800	100	2.13%	0.36%
1993	4,690	(110)	-2.29%	0.34%	4,690	(110)	-2.29%	0.34%
1994	4,790	100	2.13%	0.32%	4,790	100	2.13%	0.32%
1995	5,140	350	7.31%	0.33%	5,140	350	7.31%	0.33%
1996	6,260	1,120	21.79%	0.37%	6,260	1,120	21.79%	0.37%
1997	6,600	340	5.43%	0.37%	6,600	340	5.43%	0.37%
1998	6,880	280	4.24%	0.37%	6,759	159	2.41%	0.37%
1999	7,130	250	3.63%	0.36%	6,915	156	2.31%	0.36%

Pershing County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	7,410	280	3.93%	0.36%	7,068	153	2.21%	0.36%
2001	7,650	240	3.24%	0.36%	7,218	150	2.12%	0.35%
2002	7,940	290	3.79%	0.36%	7,364	146	2.02%	0.34%
2003	8,140	200	2.52%	0.36%	7,506	142	1.93%	0.34%
2004	8,400	260	3.19%	0.36%	7,644	138	1.84%	0.34%
2005	8,570	170	2.02%	0.35%	7,777	133	1.74%	0.33%
2006	8,790	220	2.57%	0.35%	7,905	128	1.64%	0.33%
2007	8,950	160	1.82%	0.35%	8,027	123	1.55%	0.32%
2008	9,170	220	2.46%	0.35%	8,144	117	1.45%	0.32%
2009	9,440	270	2.94%	0.35%	8,255	111	1.36%	0.32%
2010	9,710	270	2.86%	0.35%	8,359	104	1.27%	0.32%
2011	9,980	270	2.78%	0.35%	8,457	98	1.17%	0.31%
2012	10,250	270	2.71%	0.35%	8,548	91	1.08%	0.31%
2013	10,530	280	2.73%	0.35%	8,632	84	0.98%	0.31%
2014	10,800	270	2.56%	0.35%	8,708	76	0.88%	0.31%
2015	11,080	280	2.59%	0.34%	8,777	69	0.79%	0.31%
2016	11,360	280	2.53%	0.34%	8,838	61	0.69%	0.30%
2017	11,640	280	2.46%	0.34%	8,891	53	0.60%	0.30%
2018	11,910	270	2.32%	0.34%	8,936	45	0.50%	0.30%
2019	--	--	--	--	8,973	37	0.41%	0.30%
2020	--	--	--	--	9,001	28	0.32%	0.30%

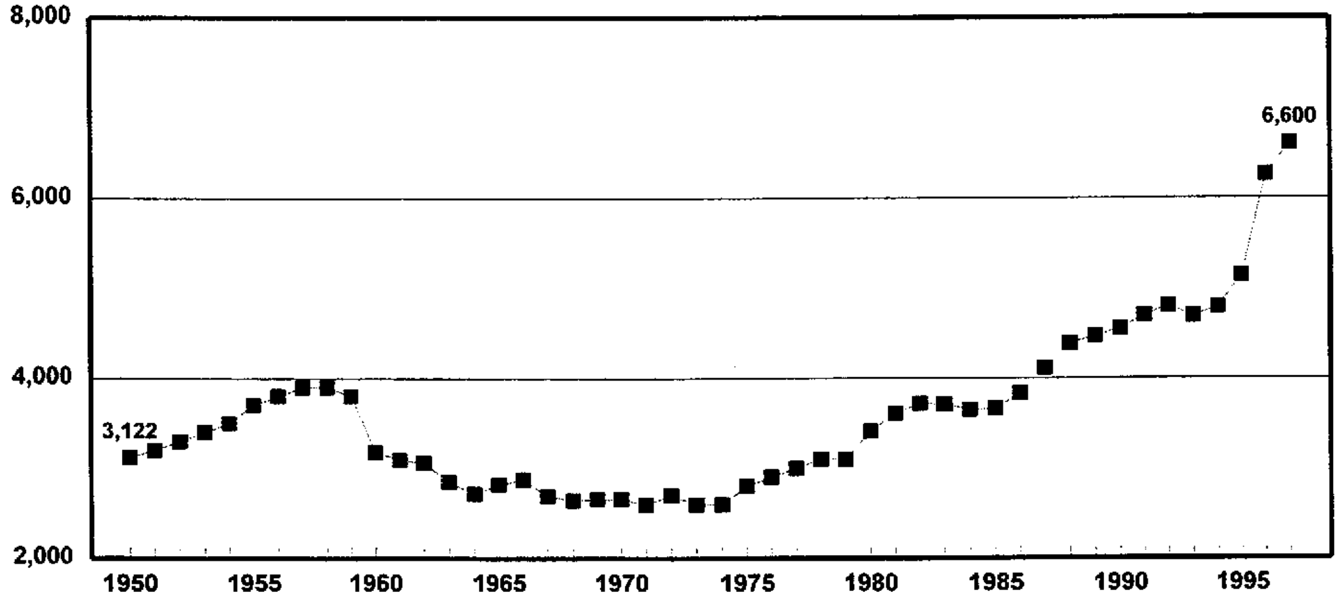
Growth Rate Analysis:	1950-1997	1.61%
Average Annual Rates	1950-1960	0.18%
of Change by Specific	1960-1970	-1.78%
Time Period (percent)	1970-1980	2.52%
	1980-1990	2.93%
	1990-1997	5.46%

Forecast Periods:	**1998-2018**	**2.85%**	**State Demographer**	**1.45%**	**NDWP Modified Forecast**
	1998-2008	**3.03%**		**1.93%**	
	2008-2018	**2.63%**		**0.98%**	

Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

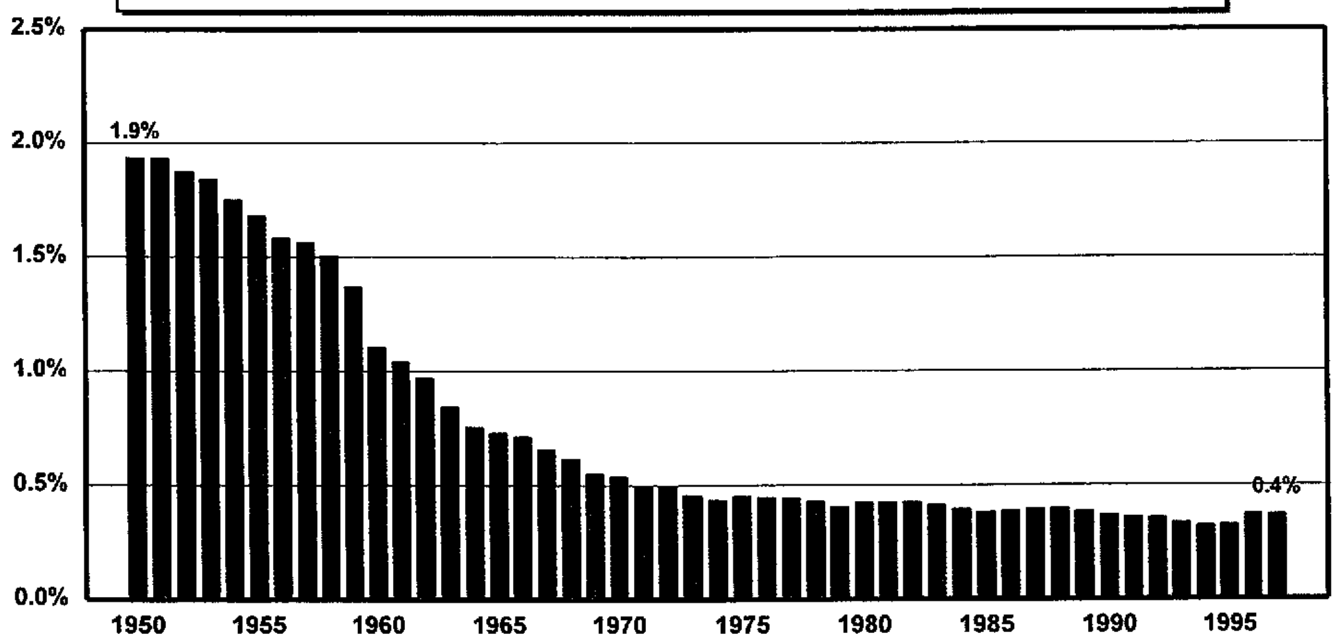
County Population Analysis

Pershing County Population Estimates & Forecasts
Population Estimates as of July 1 (Persons)



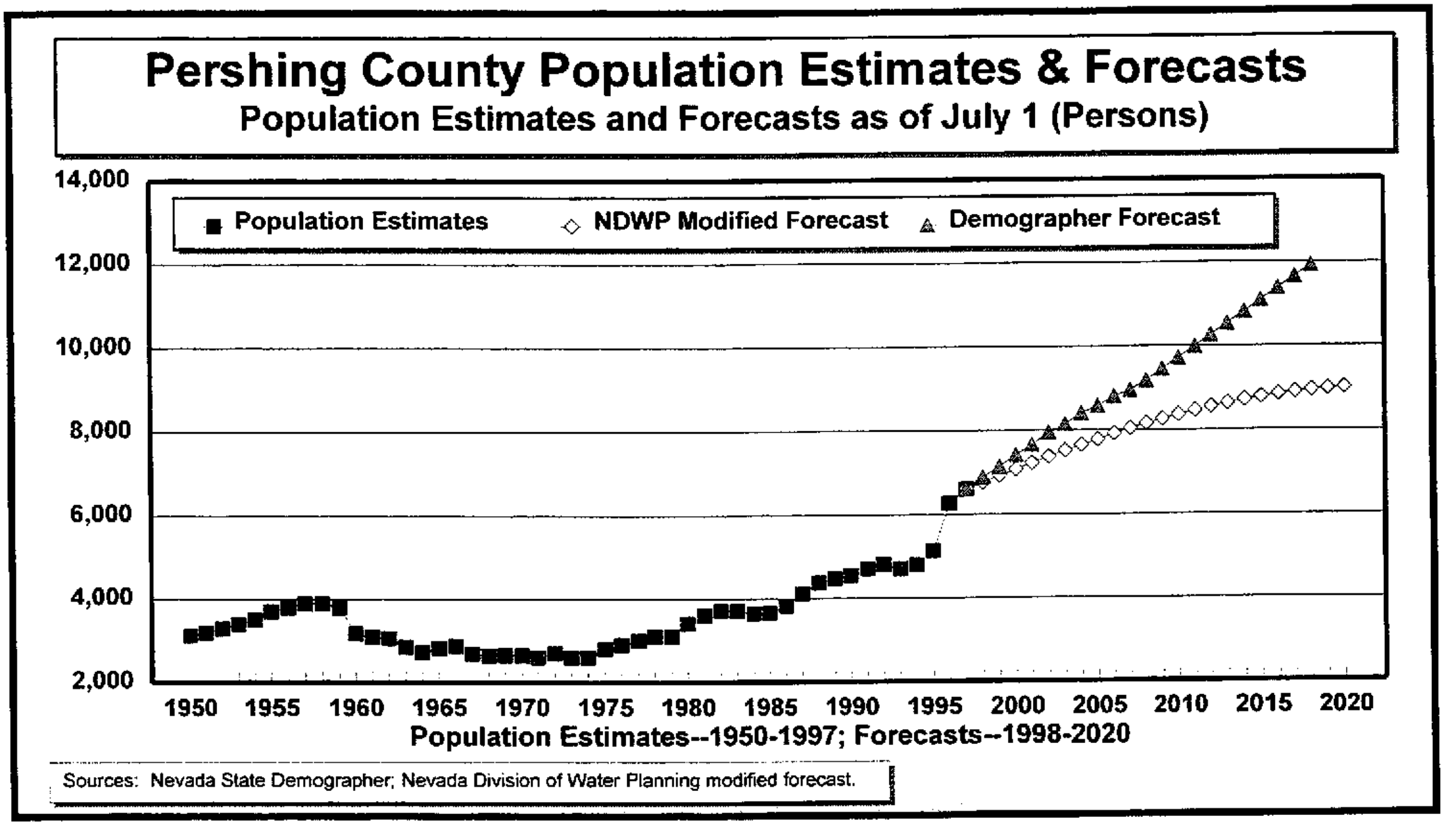
Source: Nevada State Demographer.

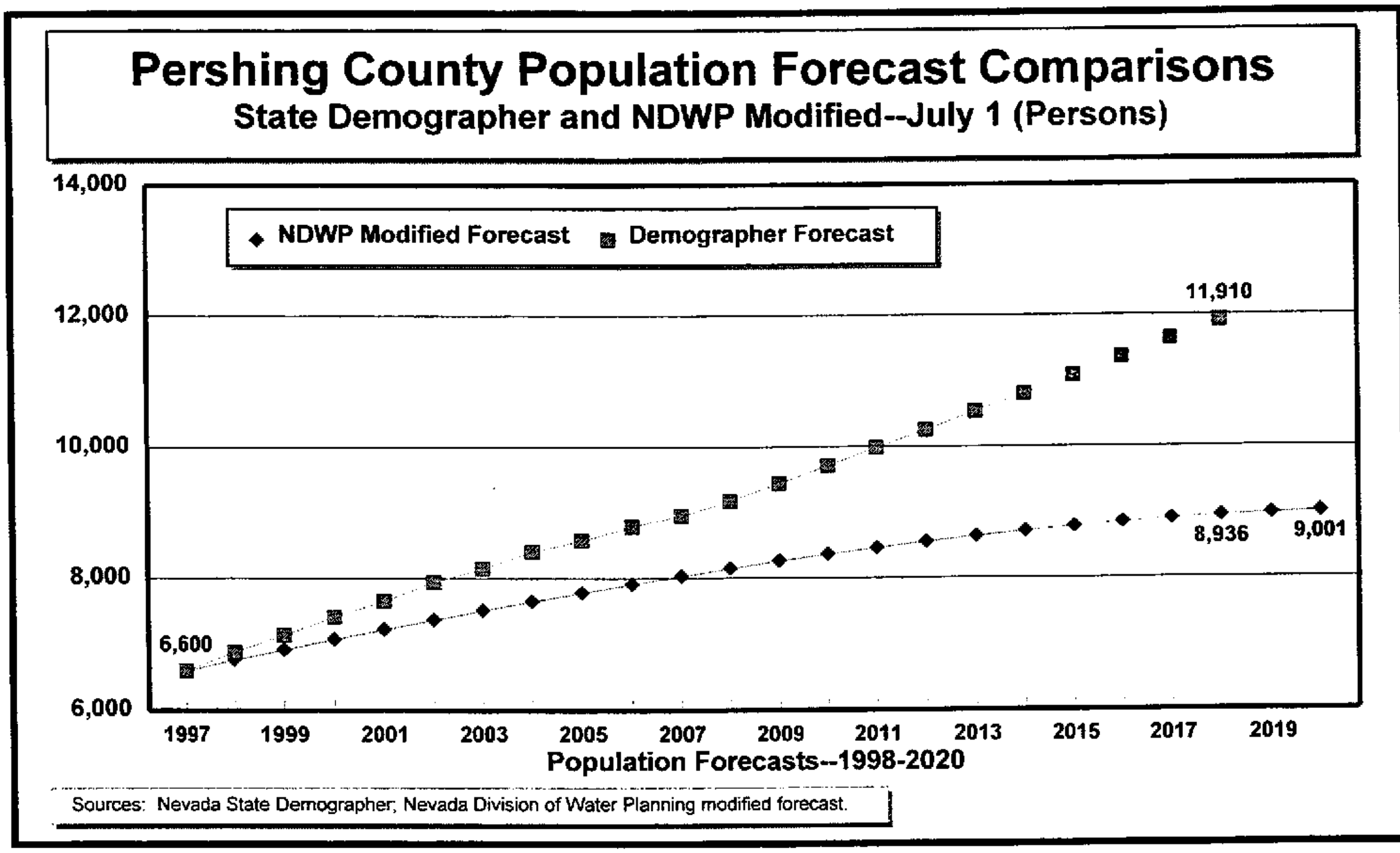
Pershing County Population Shares
County Share of Total State Population (Percent)



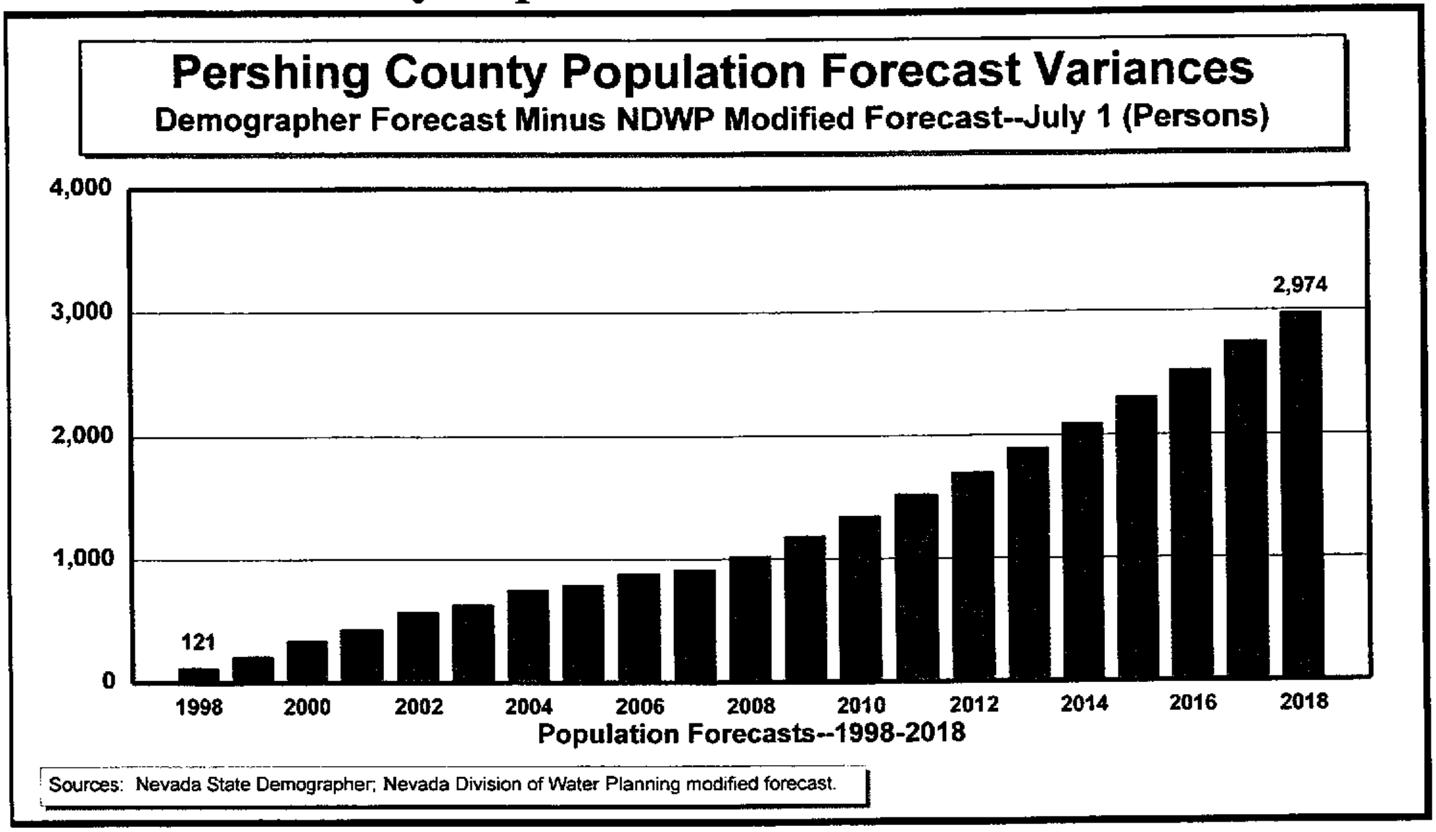
Source: Nevada State Demographer.

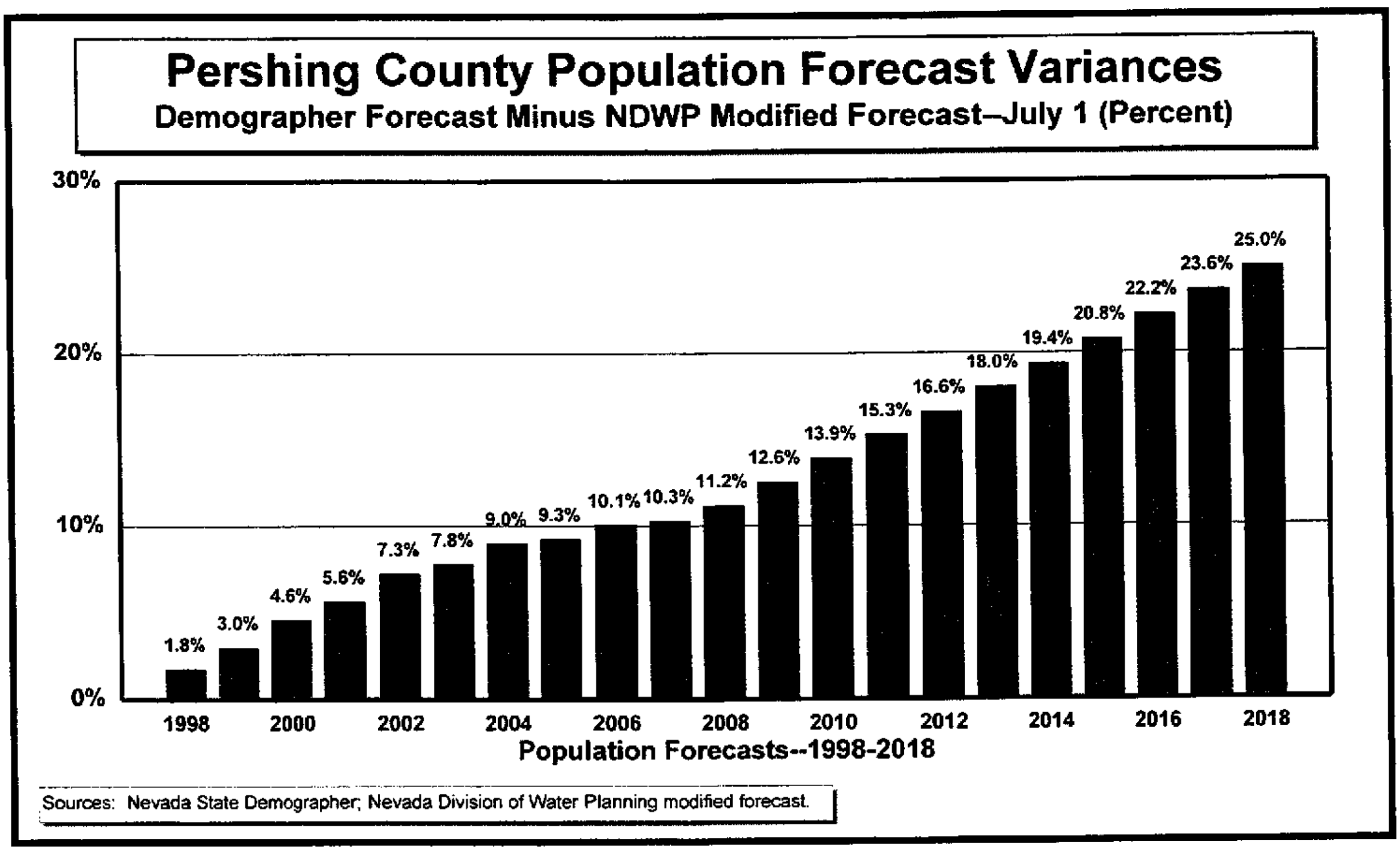
County Population Analysis and Forecasts





County Population Forecast Variances





Storey County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	657	--	--	0.41%	657	--	--	0.41%
1951	600	(57)	-8.68%	0.36%	600	(57)	-8.68%	0.36%
1952	600	0	0.00%	0.34%	600	0	0.00%	0.34%
1953	600	0	0.00%	0.33%	600	0	0.00%	0.33%
1954	600	0	0.00%	0.30%	600	0	0.00%	0.30%
1955	700	100	16.67%	0.32%	700	100	16.67%	0.32%
1956	600	(100)	-14.29%	0.25%	600	(100)	-14.29%	0.25%
1957	600	0	0.00%	0.24%	600	0	0.00%	0.24%
1958	600	0	0.00%	0.23%	600	0	0.00%	0.23%
1959	600	0	0.00%	0.22%	600	0	0.00%	0.22%
1960	571	(29)	-4.83%	0.20%	571	(29)	-4.83%	0.20%
1961	582	11	1.93%	0.20%	582	11	1.93%	0.20%
1962	615	33	5.67%	0.19%	615	33	5.67%	0.19%
1963	597	(18)	-2.93%	0.18%	597	(18)	-2.93%	0.18%
1964	551	(46)	-7.71%	0.15%	551	(46)	-7.71%	0.15%
1965	663	112	20.33%	0.17%	663	112	20.33%	0.17%
1966	688	25	3.77%	0.17%	688	25	3.77%	0.17%
1967	679	(9)	-1.31%	0.17%	679	(9)	-1.31%	0.17%
1968	634	(45)	-6.63%	0.15%	634	(45)	-6.63%	0.15%
1969	696	62	9.78%	0.14%	696	62	9.78%	0.14%
1970	696	0	0.00%	0.14%	696	0	0.00%	0.14%
1971	700	4	0.57%	0.13%	700	4	0.57%	0.13%
1972	800	100	14.29%	0.15%	800	100	14.29%	0.15%
1973	900	100	12.50%	0.16%	900	100	12.50%	0.16%
1974	900	0	0.00%	0.15%	900	0	0.00%	0.15%
1975	900	0	0.00%	0.15%	900	0	0.00%	0.15%
1976	1,000	100	11.11%	0.15%	1,000	100	11.11%	0.15%
1977	1,000	0	0.00%	0.15%	1,000	0	0.00%	0.15%
1978	1,100	100	10.00%	0.15%	1,100	100	10.00%	0.15%
1979	1,300	200	18.18%	0.17%	1,300	200	18.18%	0.17%
1980	1,503	203	15.62%	0.19%	1,503	203	15.62%	0.19%
1981	1,590	87	5.79%	0.19%	1,590	87	5.79%	0.19%
1982	1,690	100	6.29%	0.19%	1,690	100	6.29%	0.19%
1983	1,730	40	2.37%	0.19%	1,730	40	2.37%	0.19%
1984	1,780	50	2.89%	0.19%	1,780	50	2.89%	0.19%
1985	1,850	70	3.93%	0.19%	1,850	70	3.93%	0.19%
1986	1,960	110	5.95%	0.20%	1,960	110	5.95%	0.20%
1987	2,130	170	8.67%	0.21%	2,130	170	8.67%	0.21%
1988	2,140	10	0.47%	0.20%	2,140	10	0.47%	0.20%
1989	2,480	340	15.89%	0.21%	2,480	340	15.89%	0.21%
1990	2,560	80	3.23%	0.21%	2,560	80	3.23%	0.21%
1991	2,720	160	6.25%	0.21%	2,720	160	6.25%	0.21%
1992	2,820	100	3.68%	0.21%	2,820	100	3.68%	0.21%
1993	2,850	30	1.06%	0.20%	2,850	30	1.06%	0.20%
1994	3,100	250	8.77%	0.21%	3,100	250	8.77%	0.21%
1995	3,200	100	3.23%	0.20%	3,200	100	3.23%	0.20%
1996	3,320	120	3.75%	0.20%	3,320	120	3.75%	0.20%
1997	3,520	200	6.02%	0.20%	3,520	200	6.02%	0.20%
1998	3,650	130	3.69%	0.19%	3,605	85	2.42%	0.20%
1999	3,790	140	3.84%	0.19%	3,690	84	2.34%	0.19%

Storey County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

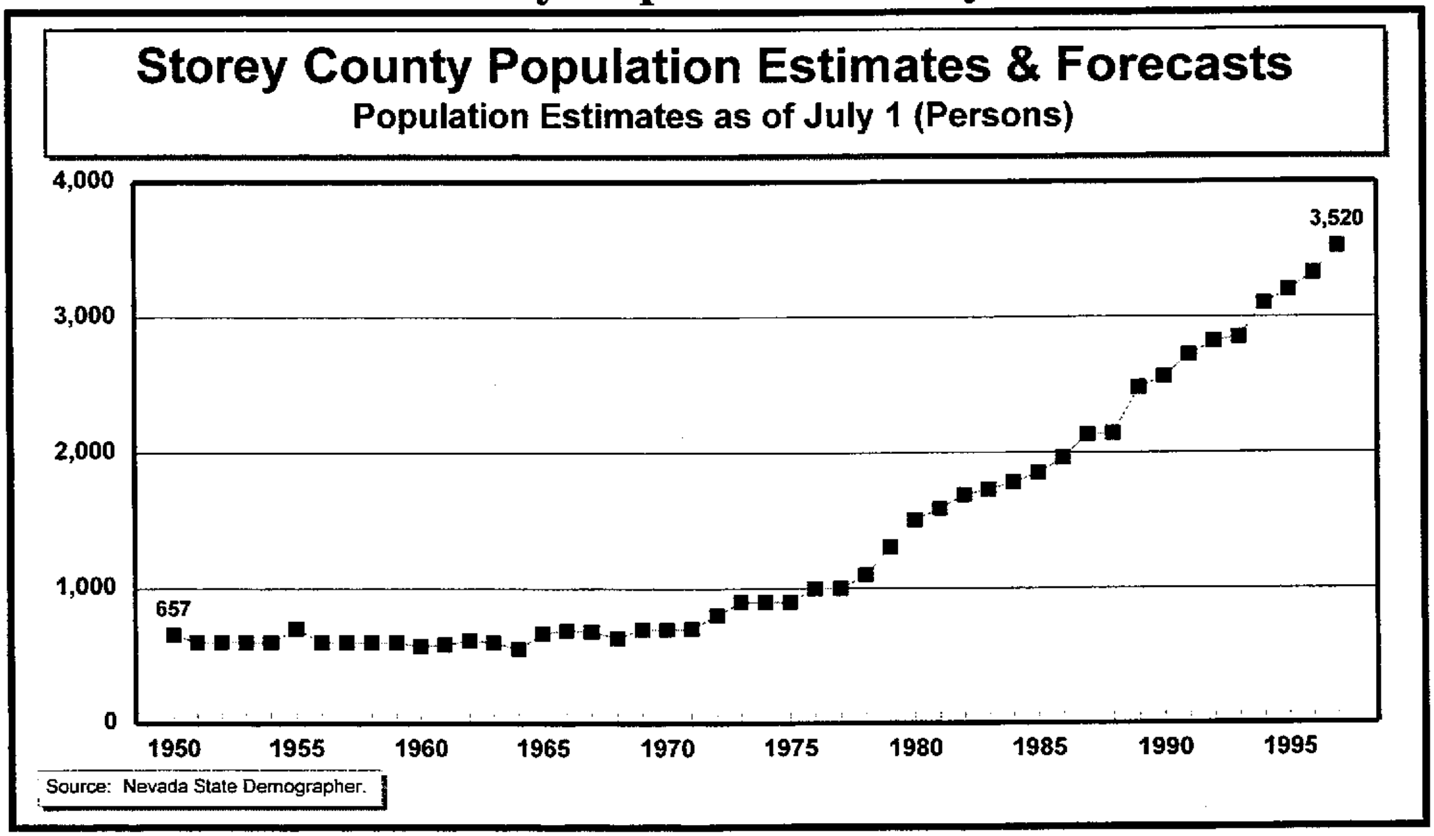
Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	3,850	60	1.58%	0.19%	3,773	83	2.26%	0.19%
2001	3,880	30	0.78%	0.18%	3,855	82	2.18%	0.19%
2002	3,990	110	2.84%	0.18%	3,936	81	2.10%	0.18%
2003	4,000	10	0.25%	0.18%	4,016	80	2.02%	0.18%
2004	4,100	100	2.50%	0.17%	4,094	78	1.94%	0.18%
2005	4,160	60	1.46%	0.17%	4,170	76	1.86%	0.18%
2006	4,220	60	1.44%	0.17%	4,244	74	1.78%	0.18%
2007	4,260	40	0.95%	0.17%	4,316	72	1.70%	0.17%
2008	4,320	60	1.41%	0.16%	4,386	70	1.62%	0.17%
2009	4,390	70	1.62%	0.16%	4,454	68	1.54%	0.17%
2010	4,460	70	1.59%	0.16%	4,519	65	1.46%	0.17%
2011	4,520	60	1.35%	0.16%	4,581	62	1.38%	0.17%
2012	4,600	80	1.77%	0.16%	4,640	60	1.30%	0.17%
2013	4,680	80	1.74%	0.15%	4,697	57	1.22%	0.17%
2014	4,750	70	1.50%	0.15%	4,751	54	1.14%	0.17%
2015	4,840	90	1.89%	0.15%	4,801	50	1.06%	0.17%
2016	4,910	70	1.45%	0.15%	4,848	47	0.98%	0.17%
2017	4,990	80	1.63%	0.15%	4,892	44	0.90%	0.17%
2018	5,050	60	1.20%	0.14%	4,932	40	0.82%	0.17%
2019	--	--	--	--	4,968	36	0.74%	0.16%
2020	--	--	--	--	5,001	33	0.66%	0.16%

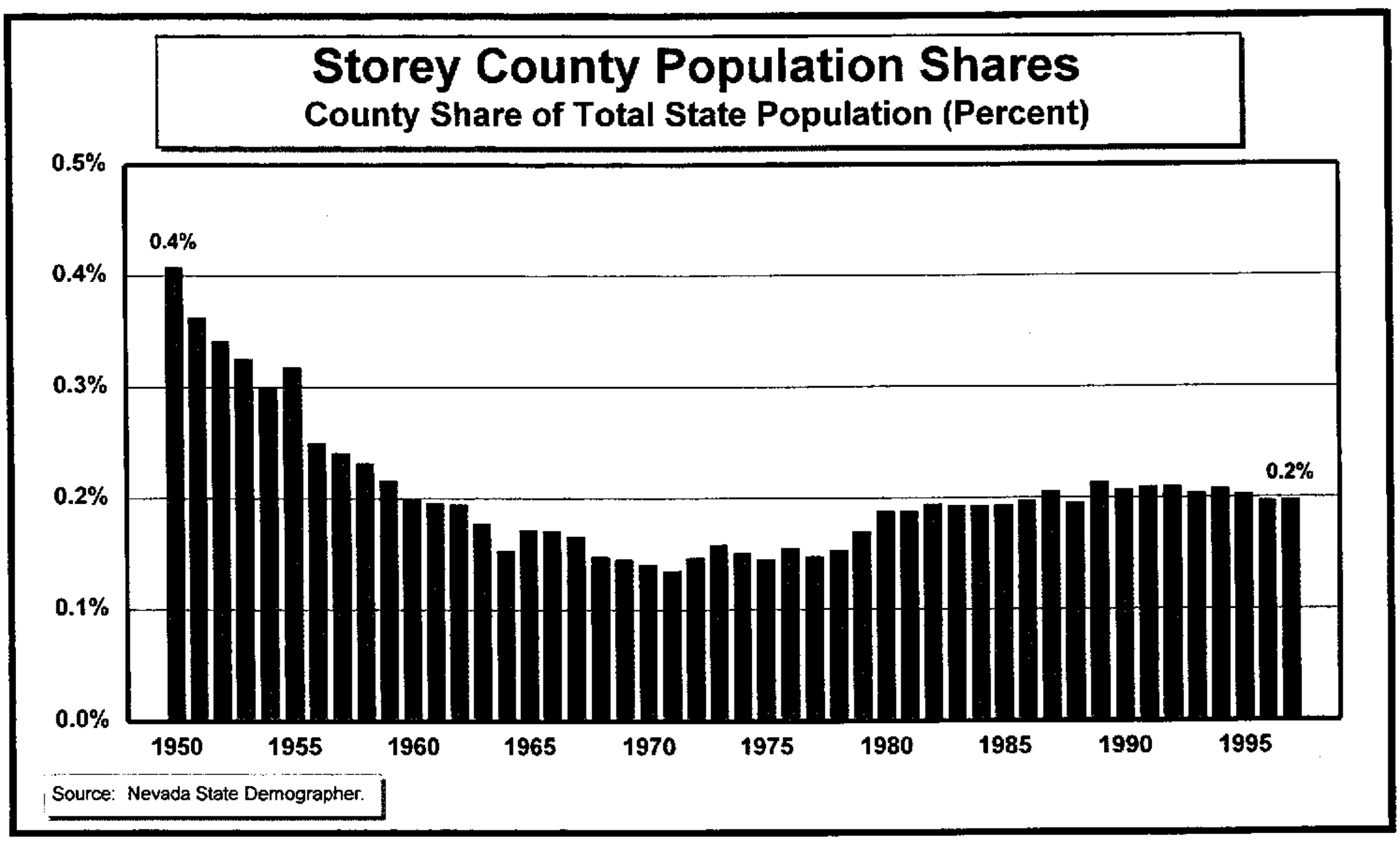
Growth Rate Analysis:	1950-1997	3.64%
Average Annual Rates	1950-1960	-1.39%
of Change by Specific	1960-1970	2.00%
Time Period (percent)	1970-1980	8.00%
	1980-1990	5.47%
	1990-1997	4.65%

Forecast Periods:	**1998-2018**	**1.73%**	**State Demographer**	**1.62%**	**NDWP Modified Forecast**
	1998-2008	**1.88%**		**2.02%**	
	2008-2018	**1.56%**		**1.22%**	

Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

County Population Analysis

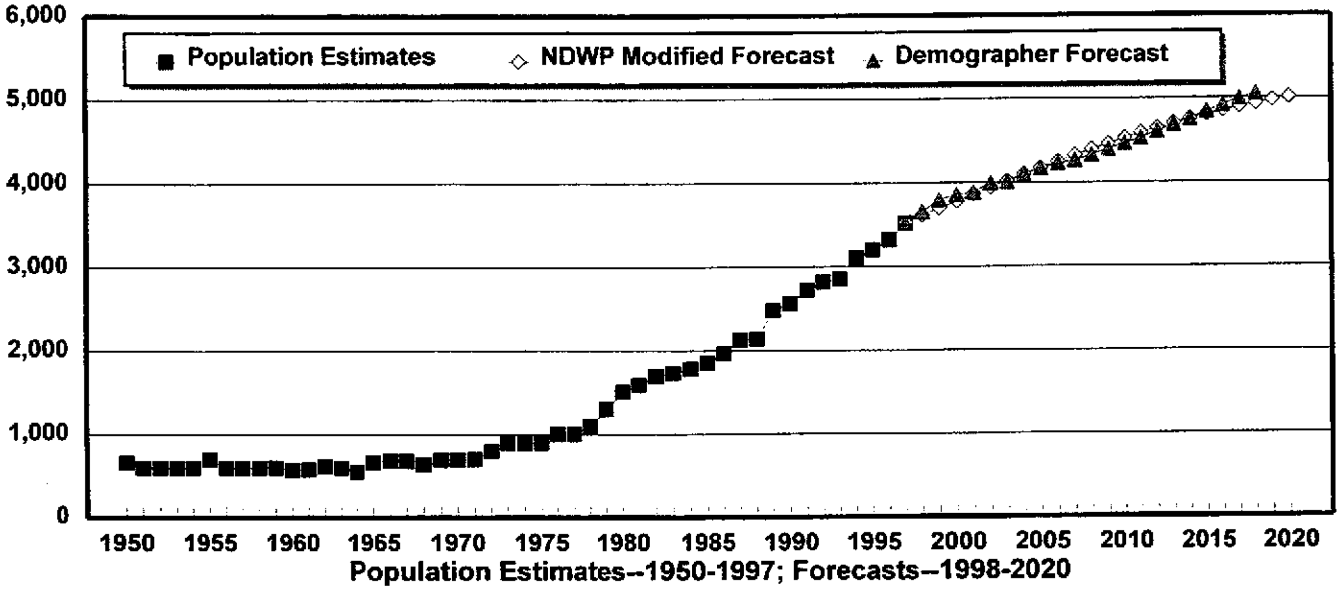




County Population Analysis and Forecasts

Storey County Population Estimates & Forecasts

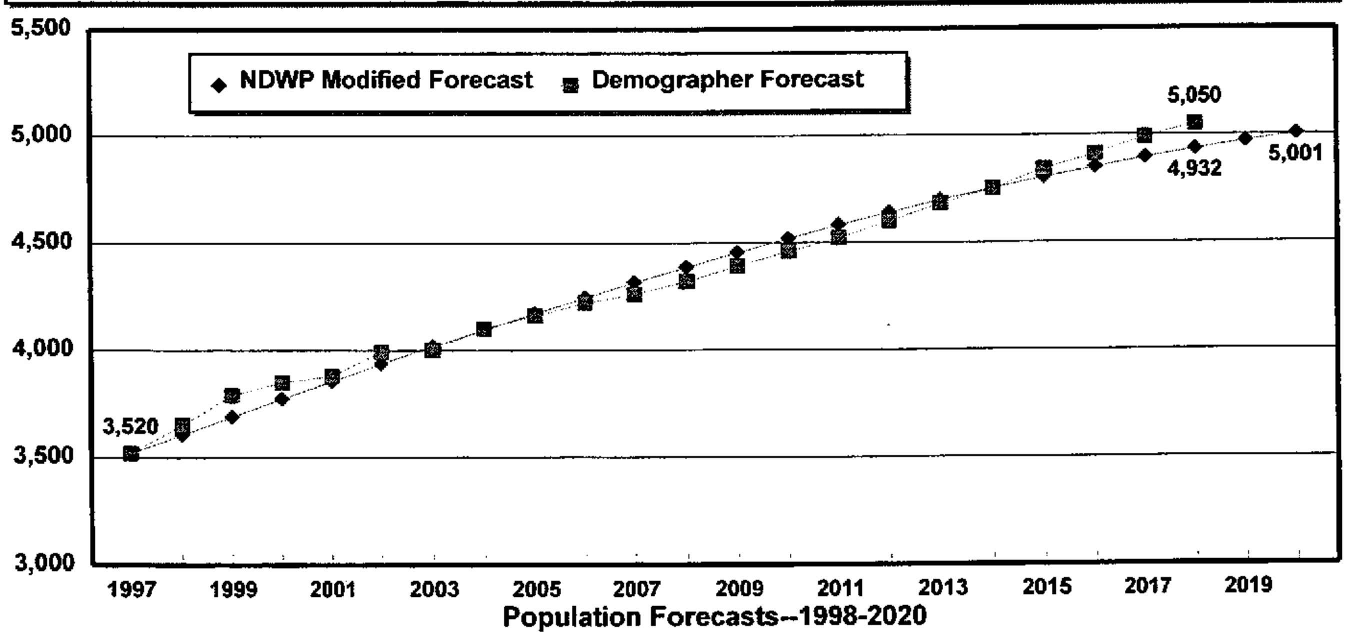
Population Estimates and Forecasts as of July 1 (Persons)



Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.

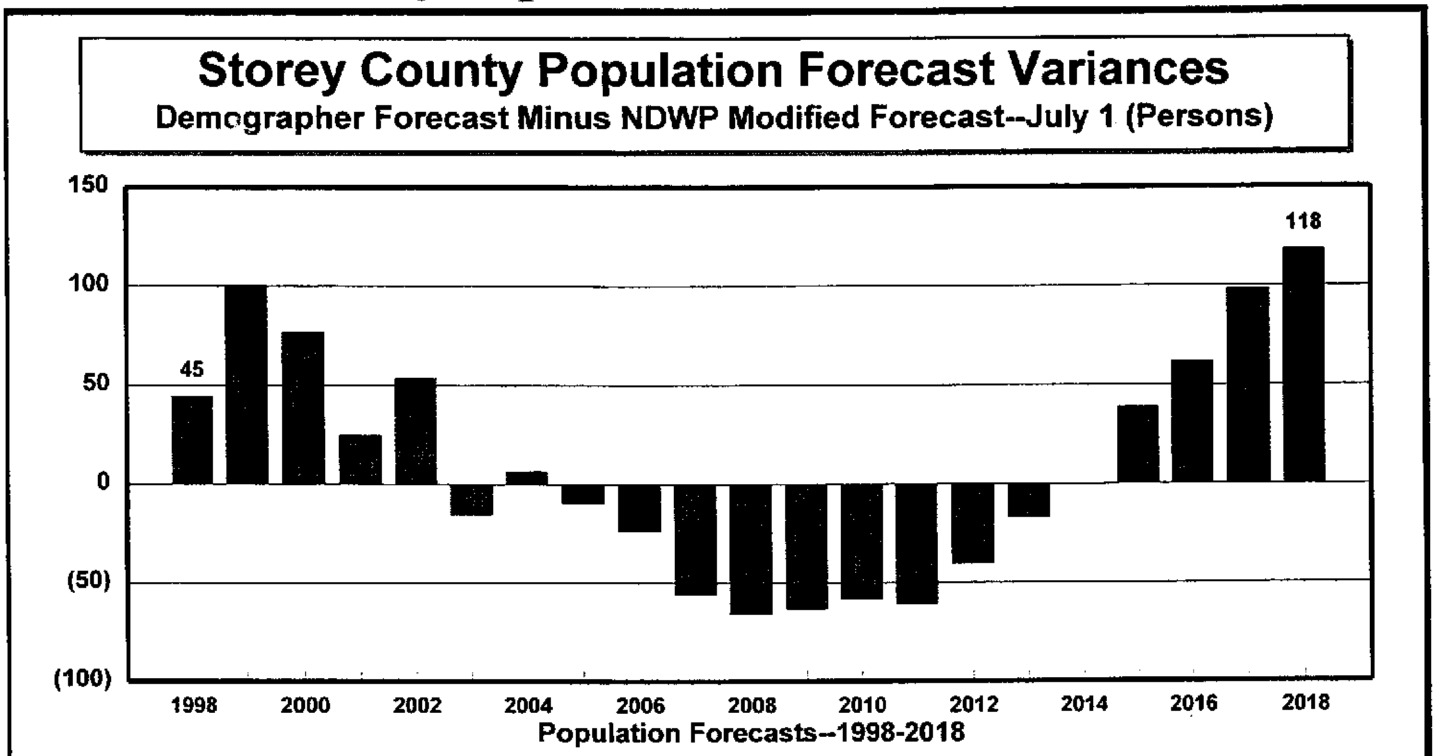
Storey County Population Forecast Comparisons

State Demographer and NDWP Modified--July 1 (Persons)

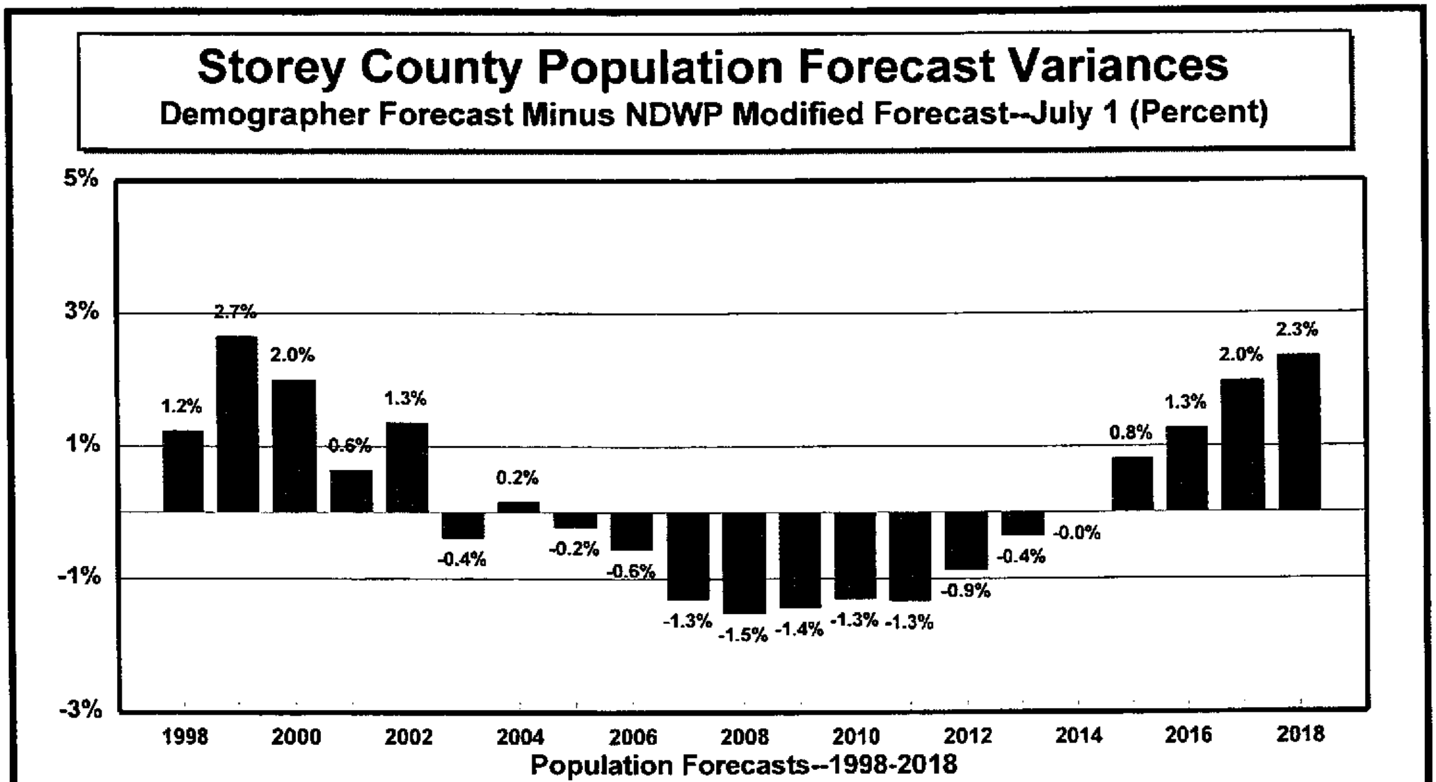


Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.

County Population Forecast Variances



Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.



Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.

Washoe County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	50,484	--	--	31.33%	50,484	--	--	31.33%
1951	51,600	1,116	2.21%	31.20%	51,600	1,116	2.21%	31.20%
1952	54,000	2,400	4.65%	30.70%	54,000	2,400	4.65%	30.70%
1953	58,100	4,100	7.59%	31.47%	58,100	4,100	7.59%	31.47%
1954	60,500	2,400	4.13%	30.28%	60,500	2,400	4.13%	30.28%
1955	65,200	4,700	7.77%	29.61%	65,200	4,700	7.77%	29.61%
1956	68,900	3,700	5.67%	28.70%	68,900	3,700	5.67%	28.70%
1957	73,000	4,100	5.95%	29.26%	73,000	4,100	5.95%	29.26%
1958	76,000	3,000	4.11%	29.32%	76,000	3,000	4.11%	29.32%
1959	81,300	5,300	6.97%	29.30%	81,300	5,300	6.97%	29.30%
1960	84,988	3,688	4.54%	29.54%	84,988	3,688	4.54%	29.54%
1961	85,969	981	1.15%	28.93%	85,969	981	1.15%	28.93%
1962	88,648	2,679	3.12%	28.09%	88,648	2,679	3.12%	28.09%
1963	91,705	3,057	3.45%	27.21%	91,705	3,057	3.45%	27.21%
1964	95,289	3,584	3.91%	26.46%	95,289	3,584	3.91%	26.46%
1965	103,420	8,131	8.53%	26.76%	103,420	8,131	8.53%	26.76%
1966	106,356	2,936	2.84%	26.35%	106,356	2,936	2.84%	26.35%
1967	105,541	(815)	-0.77%	25.75%	105,541	(815)	-0.77%	25.75%
1968	108,776	3,235	3.07%	25.34%	108,776	3,235	3.07%	25.34%
1969	119,192	10,416	9.58%	24.82%	119,192	10,416	9.58%	24.82%
1970	122,574	3,382	2.84%	24.76%	122,574	3,382	2.84%	24.76%
1971	128,600	6,026	4.92%	24.73%	128,600	6,026	4.92%	24.73%
1972	135,400	6,800	5.29%	24.76%	135,400	6,800	5.29%	24.76%
1973	141,000	5,600	4.14%	24.77%	141,000	5,600	4.14%	24.77%
1974	147,400	6,400	4.54%	24.70%	147,400	6,400	4.54%	24.70%
1975	152,200	4,800	3.26%	24.55%	152,200	4,800	3.26%	24.55%
1976	158,700	6,500	4.27%	24.54%	158,700	6,500	4.27%	24.54%
1977	167,800	9,100	5.73%	24.75%	167,800	9,100	5.73%	24.75%
1978	177,600	9,800	5.84%	24.69%	177,600	9,800	5.84%	24.69%
1979	187,200	9,600	5.41%	24.46%	187,200	9,600	5.41%	24.46%
1980	193,623	6,423	3.43%	24.19%	193,623	6,423	3.43%	24.19%
1981	201,680	8,057	4.16%	23.83%	201,680	8,057	4.16%	23.83%
1982	205,130	3,450	1.71%	23.55%	205,130	3,450	1.71%	23.55%
1983	210,990	5,860	2.86%	23.52%	210,990	5,860	2.86%	23.52%
1984	218,320	7,330	3.47%	23.66%	218,320	7,330	3.47%	23.66%
1985	224,580	6,260	2.87%	23.50%	224,580	6,260	2.87%	23.50%
1986	232,270	7,690	3.42%	23.39%	232,270	7,690	3.42%	23.39%
1987	238,360	6,090	2.62%	23.03%	238,360	6,090	2.62%	23.03%
1988	244,890	6,530	2.74%	22.34%	244,890	6,530	2.74%	22.34%
1989	251,580	6,690	2.73%	21.64%	251,580	6,690	2.73%	21.64%
1990	257,120	5,540	2.20%	20.80%	257,120	5,540	2.20%	20.80%
1991	263,710	6,590	2.56%	20.30%	263,710	6,590	2.56%	20.30%
1992	266,755	3,045	1.15%	19.83%	266,755	3,045	1.15%	19.83%
1993	271,850	5,095	1.91%	19.43%	271,850	5,095	1.91%	19.43%
1994	279,820	7,970	2.93%	18.76%	279,820	7,970	2.93%	18.76%
1995	291,050	11,230	4.01%	18.43%	291,050	11,230	4.01%	18.43%
1996	303,240	12,190	4.19%	18.00%	303,240	12,190	4.19%	18.00%
1997	308,700	5,460	1.80%	17.34%	308,700	5,460	1.80%	17.34%
1998	318,050	9,350	3.03%	16.96%	315,488	6,788	2.20%	17.19%
1999	322,810	4,760	1.50%	16.46%	322,264	6,776	2.15%	16.91%

Washoe County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

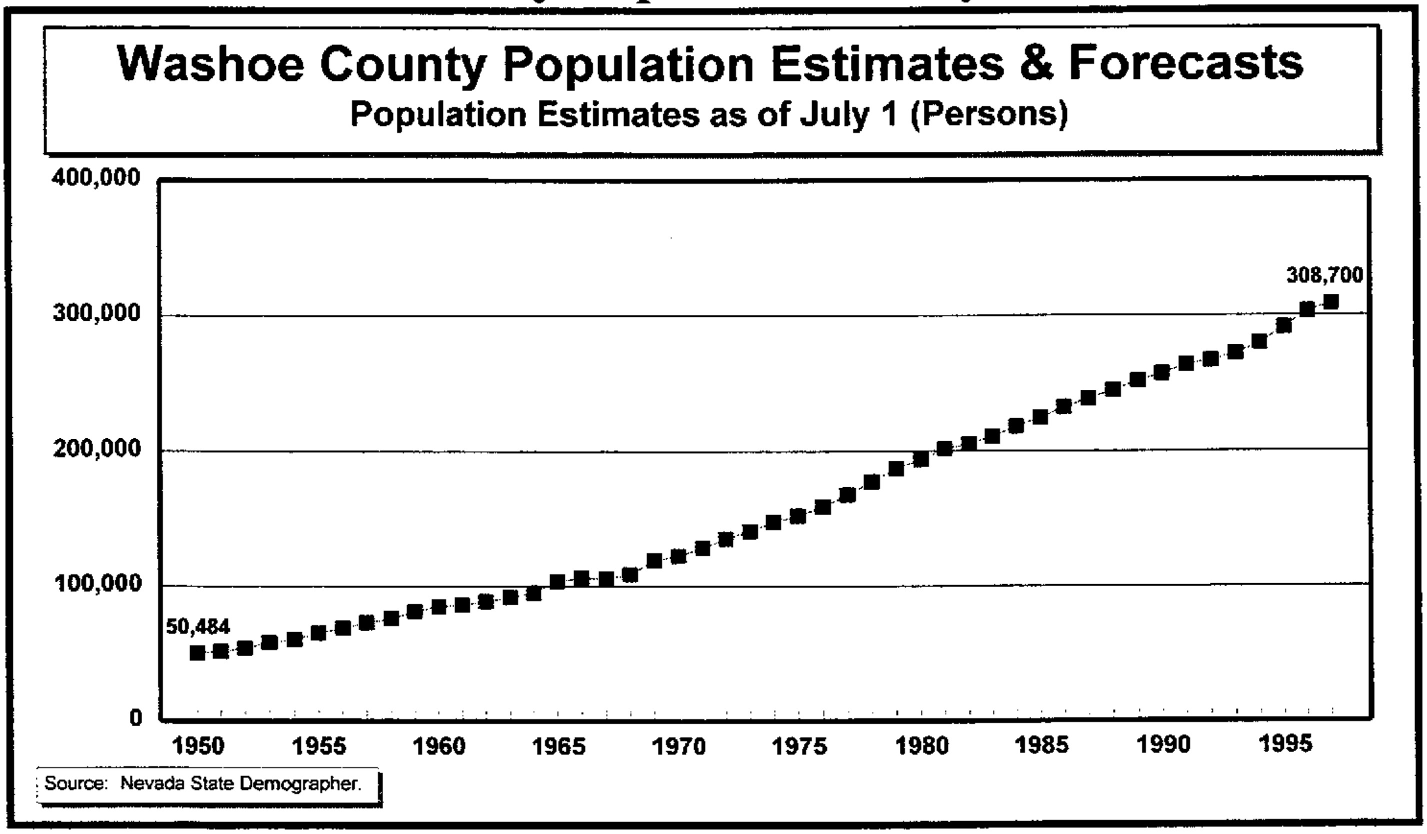
Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	327,830	5,020	1.56%	16.12%	329,021	6,757	2.10%	16.56%
2001	331,240	3,410	1.04%	15.63%	335,752	6,731	2.05%	16.28%
2002	336,430	5,190	1.57%	15.30%	342,448	6,697	1.99%	16.04%
2003	338,460	2,030	0.60%	14.87%	349,104	6,655	1.94%	15.83%
2004	341,830	3,370	1.00%	14.55%	355,710	6,606	1.89%	15.64%
2005	342,000	170	0.05%	14.13%	362,260	6,550	1.84%	15.47%
2006	343,850	1,850	0.54%	13.82%	368,745	6,485	1.79%	15.32%
2007	343,240	(610)	-0.18%	13.42%	375,158	6,413	1.74%	15.19%
2008	346,070	2,830	0.82%	13.16%	381,490	6,333	1.69%	15.08%
2009	349,590	3,520	1.02%	12.92%	387,735	6,245	1.64%	14.99%
2010	353,170	3,580	1.02%	12.69%	393,884	6,149	1.59%	14.92%
2011	356,620	3,450	0.98%	12.45%	399,929	6,045	1.53%	14.86%
2012	360,130	3,510	0.98%	12.22%	405,863	5,934	1.48%	14.81%
2013	362,120	1,990	0.55%	11.94%	411,677	5,814	1.43%	14.78%
2014	367,890	5,770	1.59%	11.79%	417,364	5,687	1.38%	14.76%
2015	371,320	3,430	0.93%	11.56%	422,917	5,553	1.33%	14.74%
2016	374,870	3,550	0.96%	11.33%	428,327	5,410	1.28%	14.73%
2017	378,190	3,320	0.89%	11.11%	433,588	5,261	1.23%	14.72%
2018	381,300	3,110	0.82%	10.89%	438,691	5,104	1.18%	14.72%
2019	--	--	--	--	443,631	4,940	1.13%	14.72%
2020	--	--	--	--	448,400	4,769	1.07%	14.72%

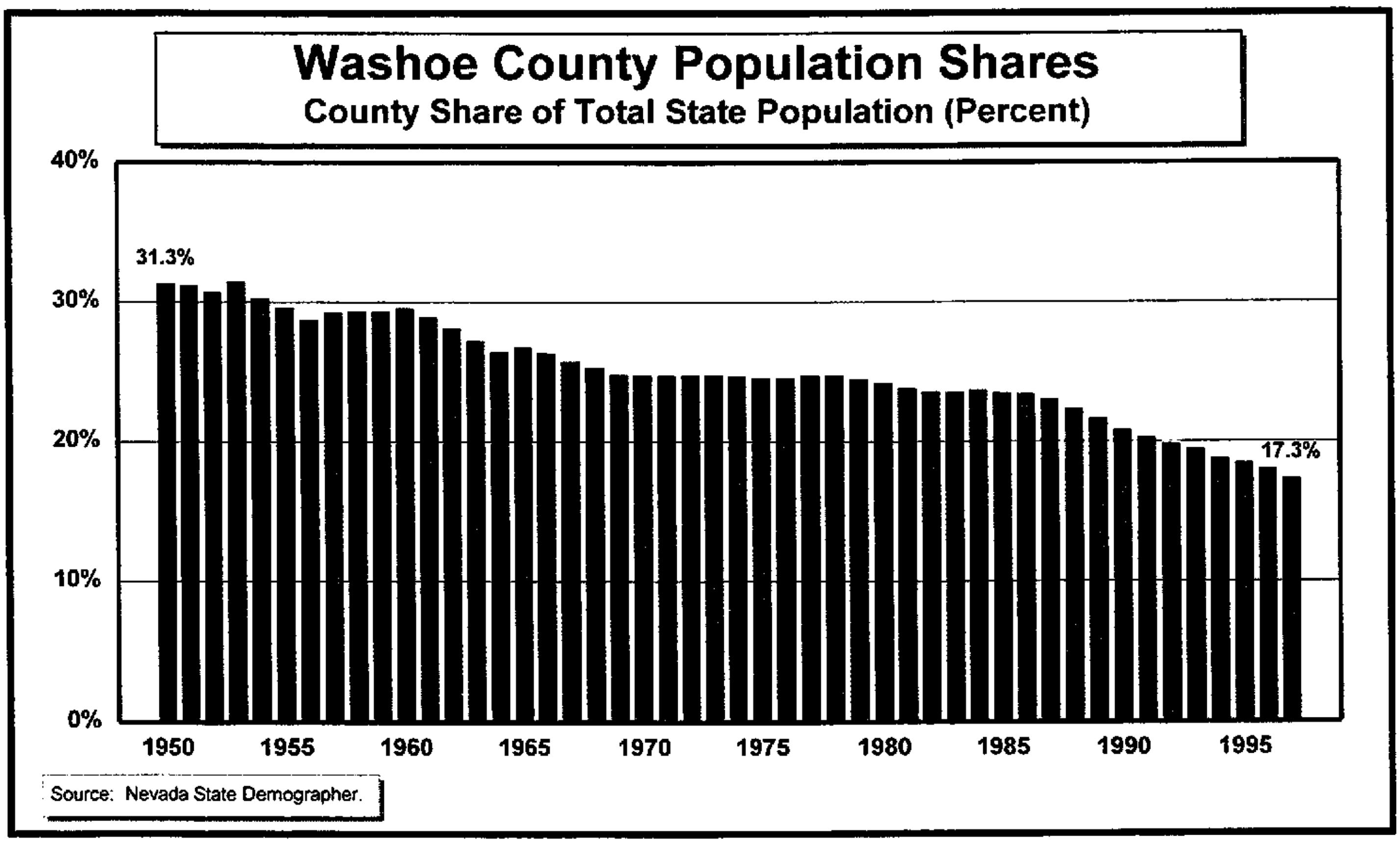
Growth Rate Analysis:	1950-1997	3.93%
Average Annual Rates	1950-1960	5.35%
of Change by Specific	1960-1970	3.73%
Time Period (percent)	1970-1980	4.68%
	1980-1990	2.88%
	1990-1997	2.65%

Forecast Periods:	**1998-2018**	**1.01%**	**State Demographer**	**1.69%**	**NDWP Modified Forecast**
	1998-2008	**1.04%**		**1.94%**	
	2008-2018	**0.96%**		**1.43%**	

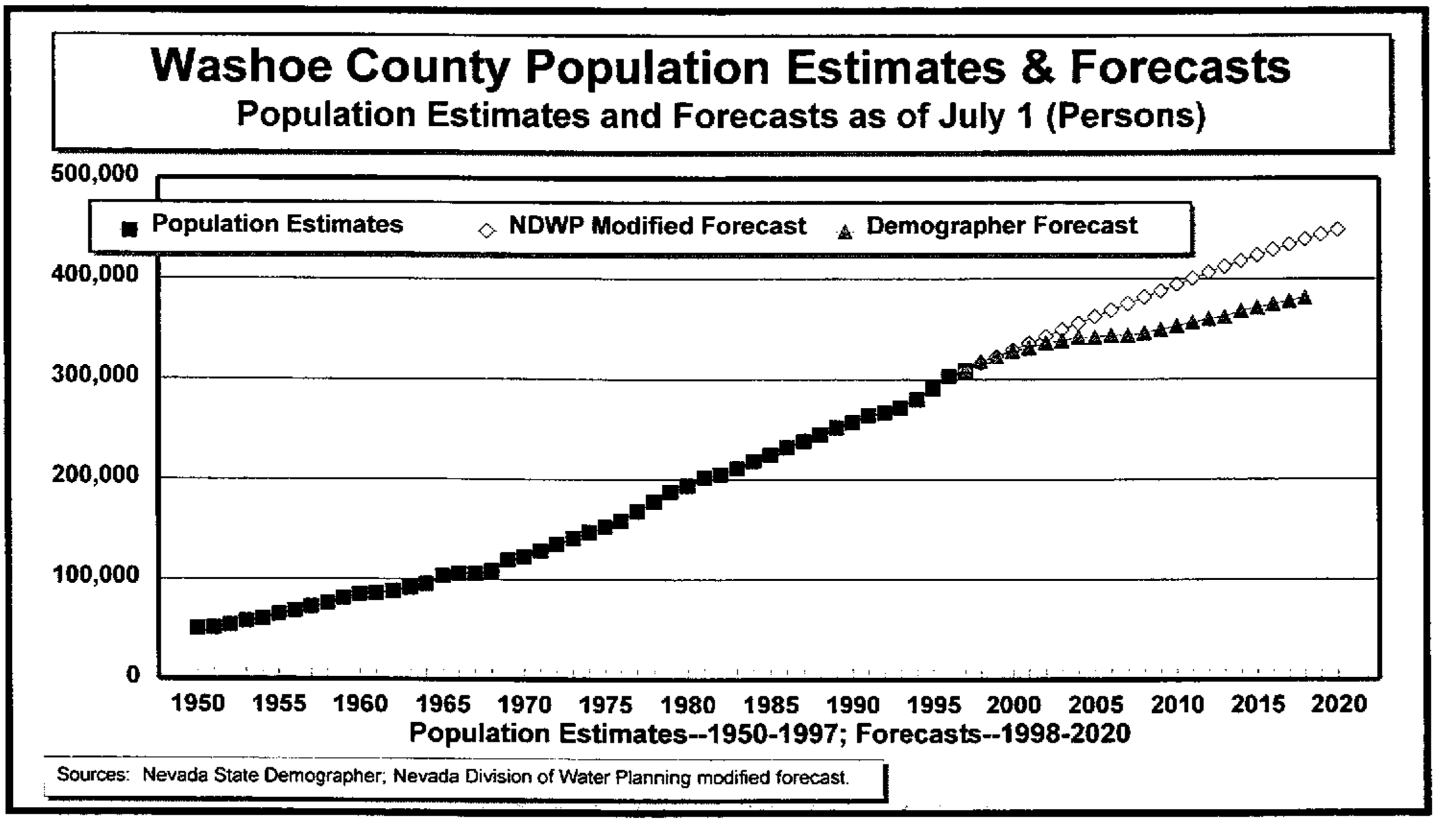
Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

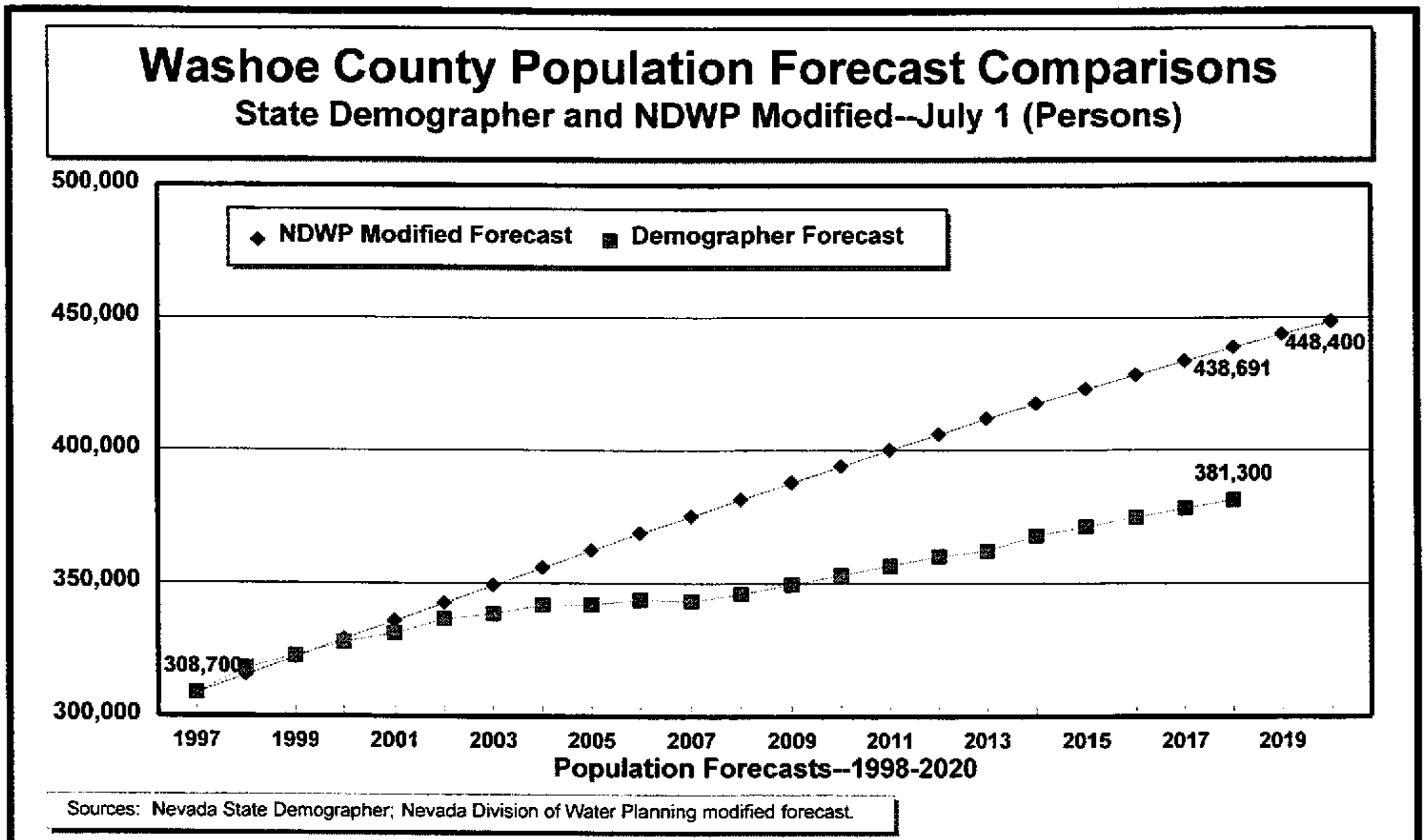
County Population Analysis



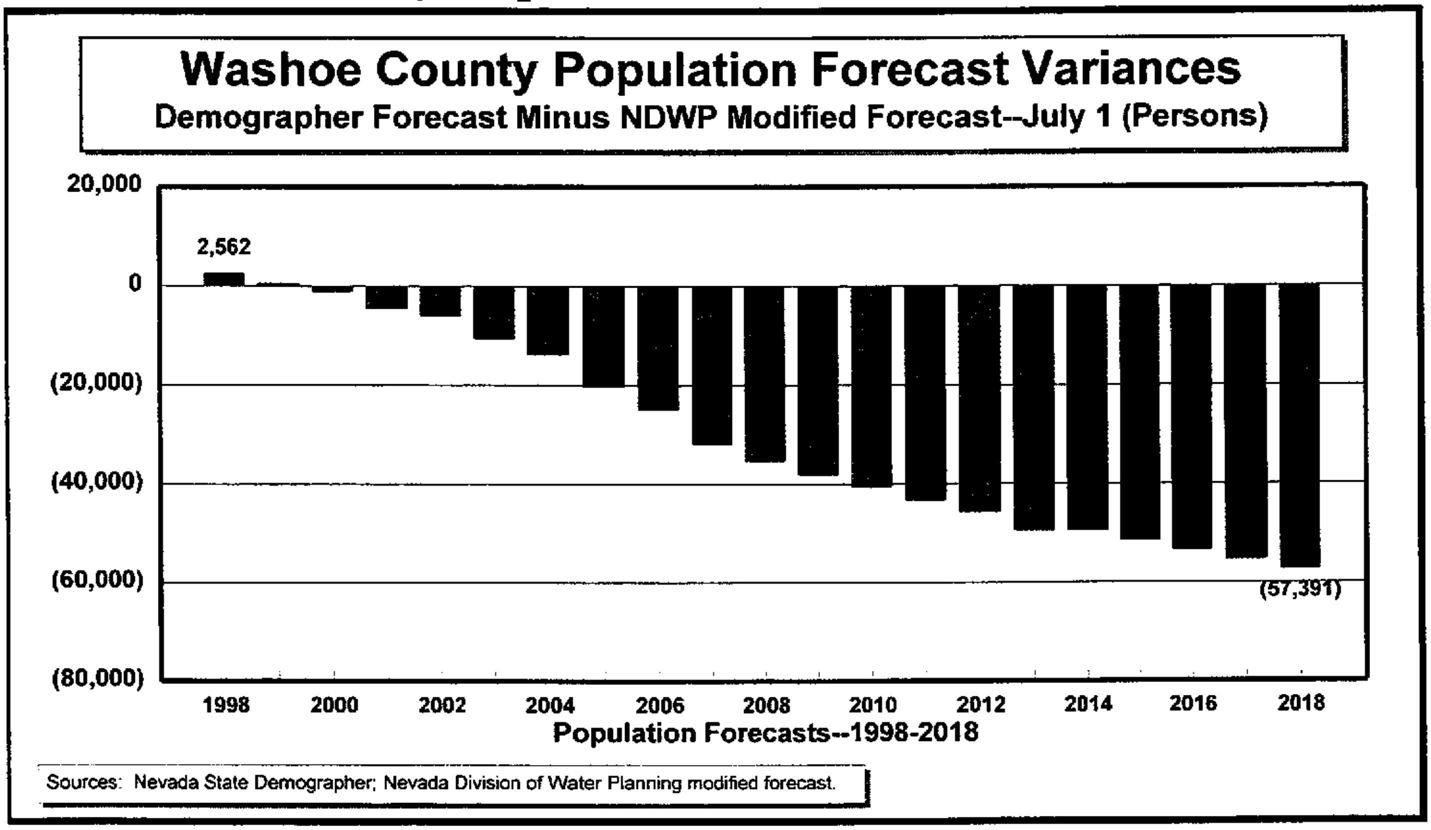


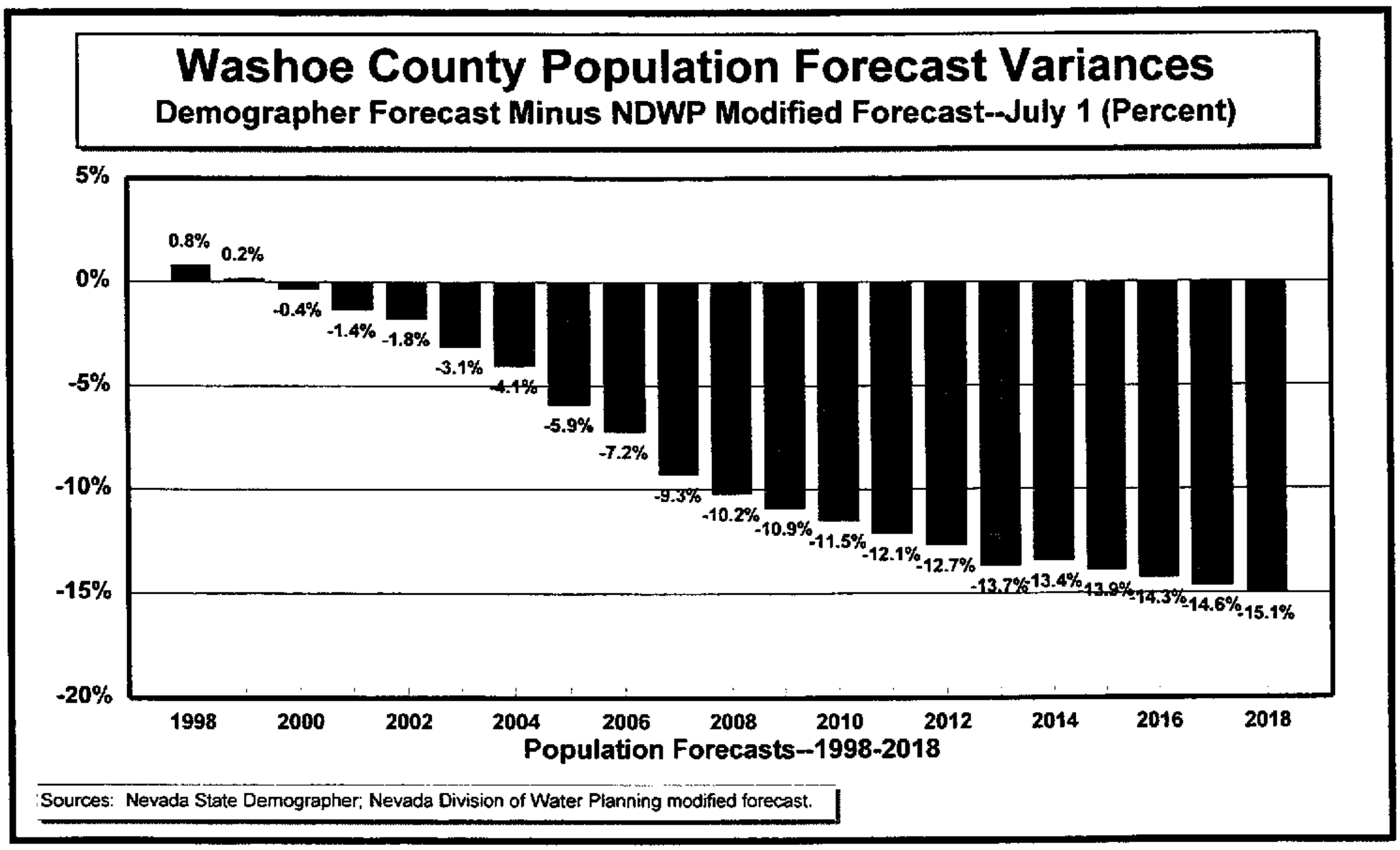
County Population Analysis and Forecasts





County Population Forecast Variances





White Pine County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

Year	Demographer Estimates and Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Year-Year Change in Population (Persons)	Year-Year Percent Change	Share of Total State Population
1950	9,479	--	--	5.88%	9,479	--	--	5.88%
1951	9,700	221	2.33%	5.86%	9,700	221	2.33%	5.86%
1952	9,700	0	0.00%	5.51%	9,700	0	0.00%	5.51%
1953	9,500	(200)	-2.06%	5.15%	9,500	(200)	-2.06%	5.15%
1954	10,800	1,300	13.68%	5.41%	10,800	1,300	13.68%	5.41%
1955	11,600	800	7.41%	5.27%	11,600	800	7.41%	5.27%
1956	12,100	500	4.31%	5.04%	12,100	500	4.31%	5.04%
1957	12,500	400	3.31%	5.01%	12,500	400	3.31%	5.01%
1958	12,300	(200)	-1.60%	4.75%	12,300	(200)	-1.60%	4.75%
1959	12,300	0	0.00%	4.43%	12,300	0	0.00%	4.43%
1960	9,732	(2,568)	-20.88%	3.38%	9,732	(2,568)	-20.88%	3.38%
1961	9,428	(304)	-3.12%	3.17%	9,428	(304)	-3.12%	3.17%
1962	9,069	(359)	-3.81%	2.87%	9,069	(359)	-3.81%	2.87%
1963	8,817	(252)	-2.78%	2.62%	8,817	(252)	-2.78%	2.62%
1964	8,510	(307)	-3.48%	2.36%	8,510	(307)	-3.48%	2.36%
1965	9,121	611	7.18%	2.36%	9,121	611	7.18%	2.36%
1966	9,321	200	2.19%	2.31%	9,321	200	2.19%	2.31%
1967	9,070	(251)	-2.69%	2.21%	9,070	(251)	-2.69%	2.21%
1968	9,074	4	0.04%	2.11%	9,074	4	0.04%	2.11%
1969	10,067	993	10.94%	2.10%	10,067	993	10.94%	2.10%
1970	10,140	73	0.73%	2.05%	10,140	73	0.73%	2.05%
1971	10,100	(40)	-0.39%	1.94%	10,100	(40)	-0.39%	1.94%
1972	10,300	200	1.98%	1.88%	10,300	200	1.98%	1.88%
1973	9,900	(400)	-3.88%	1.74%	9,900	(400)	-3.88%	1.74%
1974	9,900	0	0.00%	1.66%	9,900	0	0.00%	1.66%
1975	9,900	0	0.00%	1.60%	9,900	0	0.00%	1.60%
1976	9,600	(300)	-3.03%	1.48%	9,600	(300)	-3.03%	1.48%
1977	8,600	(1,000)	-10.42%	1.27%	8,600	(1,000)	-10.42%	1.27%
1978	8,900	300	3.49%	1.24%	8,900	300	3.49%	1.24%
1979	8,100	(800)	-8.99%	1.06%	8,100	(800)	-8.99%	1.06%
1980	8,167	67	0.83%	1.02%	8,167	67	0.83%	1.02%
1981	8,030	(137)	-1.68%	0.95%	8,030	(137)	-1.68%	0.95%
1982	7,870	(160)	-1.99%	0.90%	7,870	(160)	-1.99%	0.90%
1983	7,790	(80)	-1.02%	0.87%	7,790	(80)	-1.02%	0.87%
1984	7,710	(80)	-1.03%	0.84%	7,710	(80)	-1.03%	0.84%
1985	7,710	0	0.00%	0.81%	7,710	0	0.00%	0.81%
1986	7,890	180	2.33%	0.79%	7,890	180	2.33%	0.79%
1987	8,000	110	1.39%	0.77%	8,000	110	1.39%	0.77%
1988	8,390	390	4.88%	0.77%	8,390	390	4.88%	0.77%
1989	8,650	260	3.10%	0.74%	8,650	260	3.10%	0.74%
1990	9,410	760	8.79%	0.76%	9,410	760	8.79%	0.76%
1991	9,480	70	0.74%	0.73%	9,480	70	0.74%	0.73%
1992	9,570	90	0.95%	0.71%	9,570	90	0.95%	0.71%
1993	9,540	(30)	-0.31%	0.68%	9,540	(30)	-0.31%	0.68%
1994	9,270	(270)	-2.83%	0.62%	9,270	(270)	-2.83%	0.62%
1995	9,770	500	5.39%	0.62%	9,770	500	5.39%	0.62%
1996	10,400	630	6.45%	0.62%	10,400	630	6.45%	0.62%
1997	10,640	240	2.31%	0.60%	10,640	240	2.31%	0.60%
1998	10,760	120	1.13%	0.57%	10,766	126	1.19%	0.59%
1999	10,930	170	1.58%	0.56%	10,889	122	1.14%	0.57%

White Pine County Population Estimates & Forecasts

Population Estimates (1950-1997) and Forecasts (1998-2020)--July 1st (Persons)

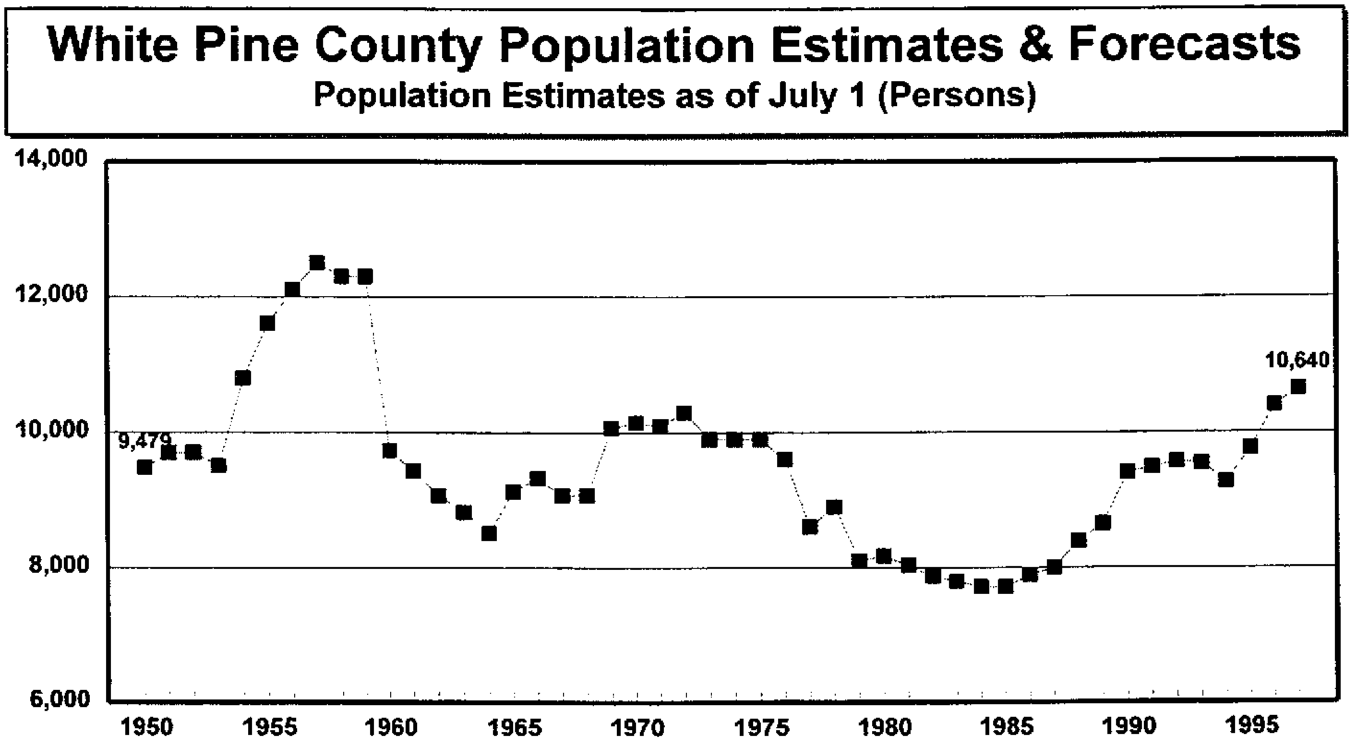
Year	Demographer Estimates and Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population	Estimates and NDWP Modified Forecasts	Change in Population (Persons)	Percent Change	Share of Total State Population
2000	11,150	220	2.01%	0.55%	11,007	118	1.08%	0.55%
2001	11,300	150	1.35%	0.53%	11,120	114	1.03%	0.54%
2002	11,480	180	1.59%	0.52%	11,229	109	0.98%	0.53%
2003	11,530	50	0.44%	0.51%	11,334	104	0.93%	0.51%
2004	11,670	140	1.21%	0.50%	11,433	99	0.88%	0.50%
2005	11,710	40	0.34%	0.48%	11,527	94	0.82%	0.49%
2006	11,800	90	0.77%	0.47%	11,616	89	0.77%	0.48%
2007	11,800	0	0.00%	0.46%	11,700	84	0.72%	0.47%
2008	11,900	100	0.85%	0.45%	11,778	78	0.67%	0.47%
2009	12,050	150	1.26%	0.45%	11,850	73	0.62%	0.46%
2010	12,200	150	1.24%	0.44%	11,917	67	0.56%	0.45%
2011	12,350	150	1.23%	0.43%	11,978	61	0.51%	0.45%
2012	12,510	160	1.30%	0.42%	12,033	55	0.46%	0.44%
2013	12,670	160	1.28%	0.42%	12,082	49	0.41%	0.43%
2014	12,820	150	1.18%	0.41%	12,125	43	0.36%	0.43%
2015	12,970	150	1.17%	0.40%	12,162	37	0.30%	0.42%
2016	13,130	160	1.23%	0.40%	12,193	31	0.25%	0.42%
2017	13,280	150	1.14%	0.39%	12,217	24	0.20%	0.41%
2018	13,430	150	1.13%	0.38%	12,235	18	0.15%	0.41%
2019	--	--	--	--	12,247	12	0.10%	0.41%
2020	--	--	--	--	12,253	5	0.04%	0.40%

Growth Rate Analysis:	1950-1997	0.25%
Average Annual Rates	1950-1960	0.26%
of Change by Specific	1960-1970	0.41%
Time Period (percent)	1970-1980	-2.14%
	1980-1990	1.43%
	1990-1997	1.77%

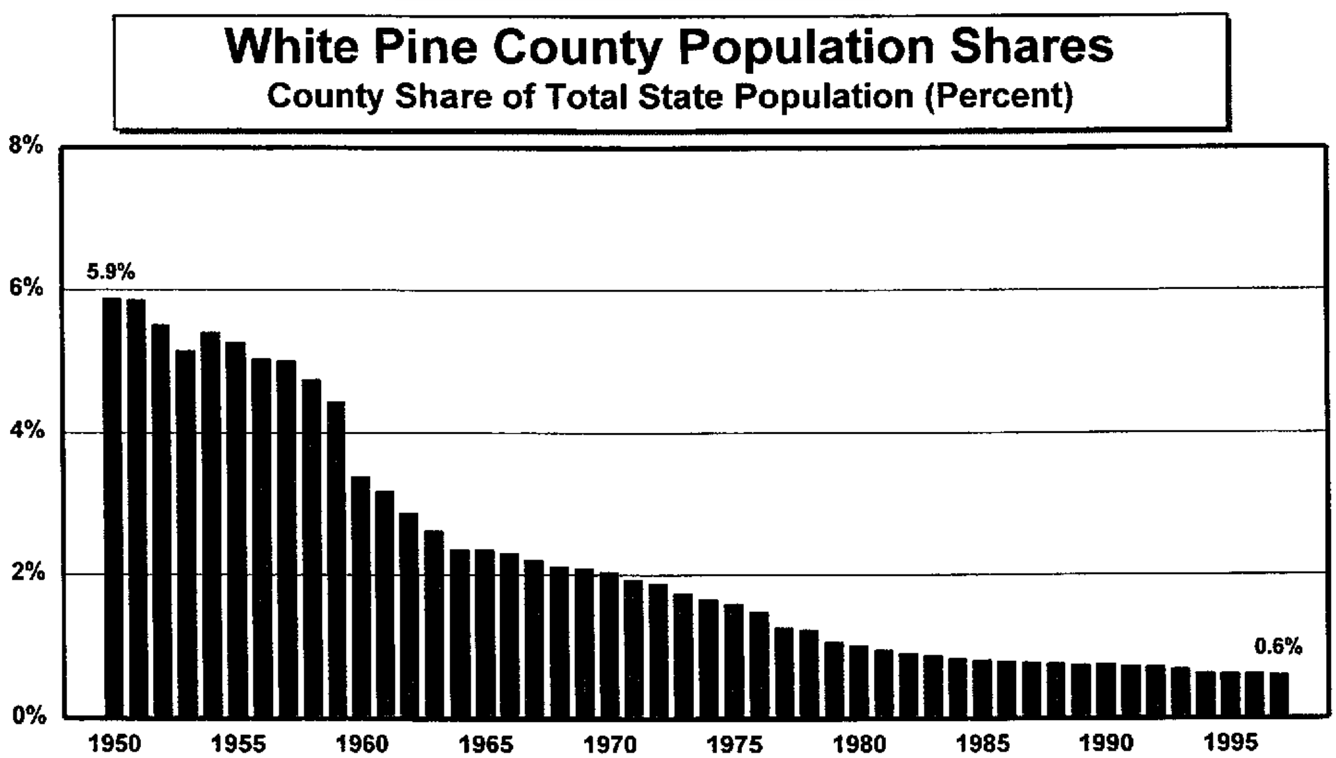
Forecast Periods:	**1998-2018**	**1.12%**	**State Demographer**	**0.67%**	**NDWP Modified Forecast**
	1998-2008	**1.02%**		**0.93%**	
	2008-2018	**1.18%**		**0.41%**	

Sources: Nevada Office of the State Demographer (forecasts effective April 13, 1998); Nevada Division of Water Planning (Clark County population forecasts based on Clark County Department of Comprehensive Planning forecasts; Washoe County population forecasts based on forecasts provided by the Washoe County Department of Community Development).

County Population Analysis

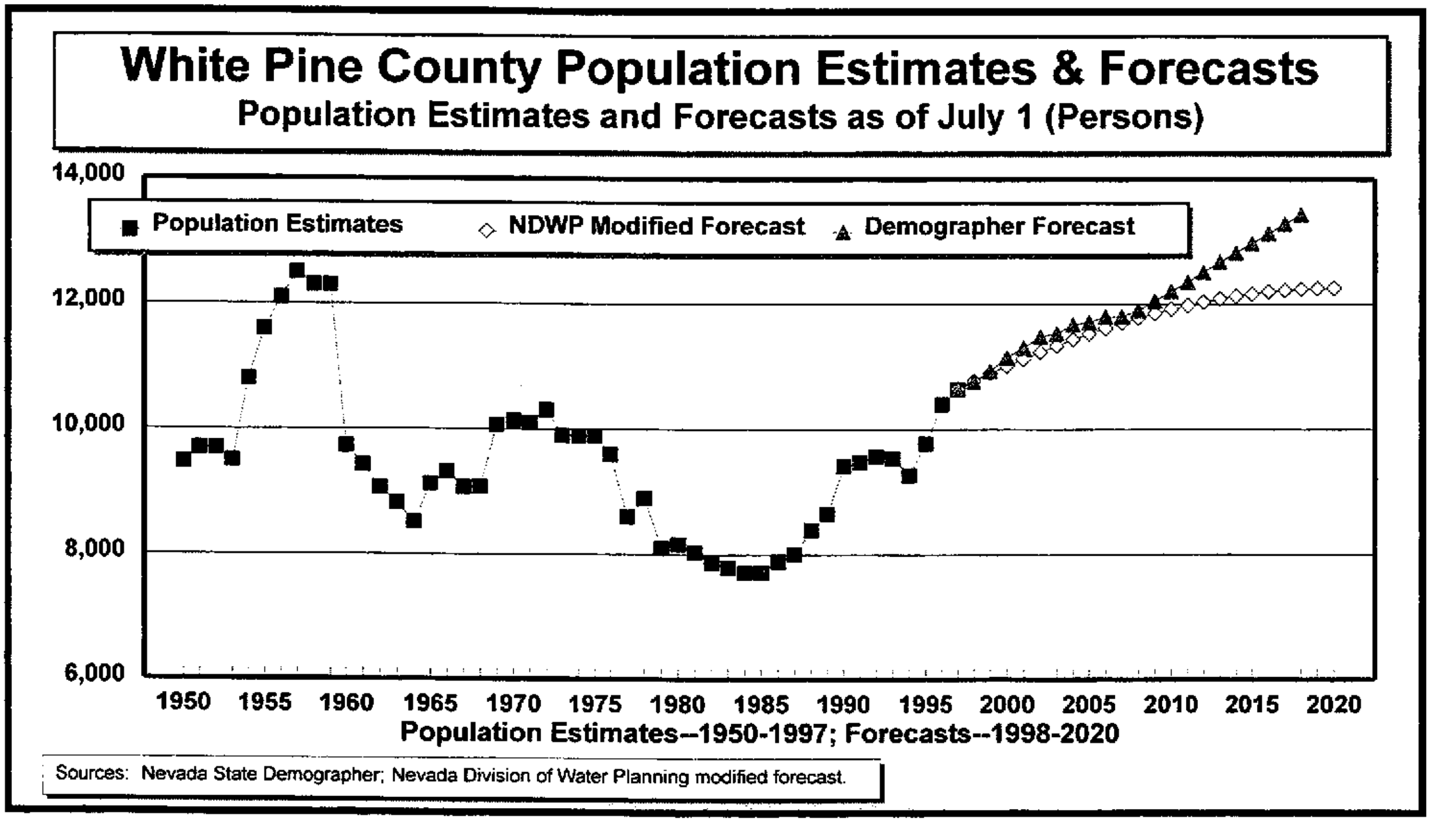


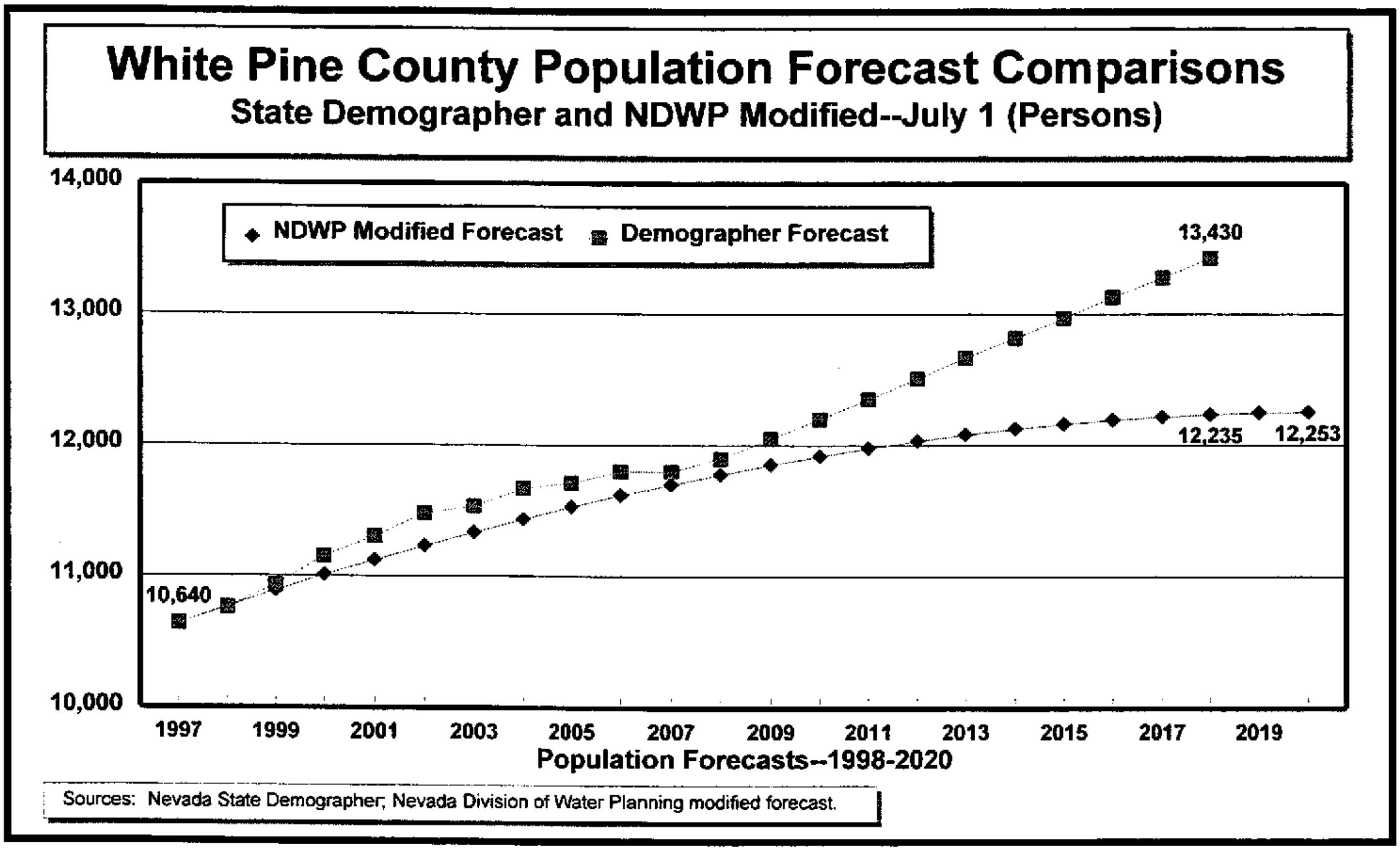
Source: Nevada State Demographer.



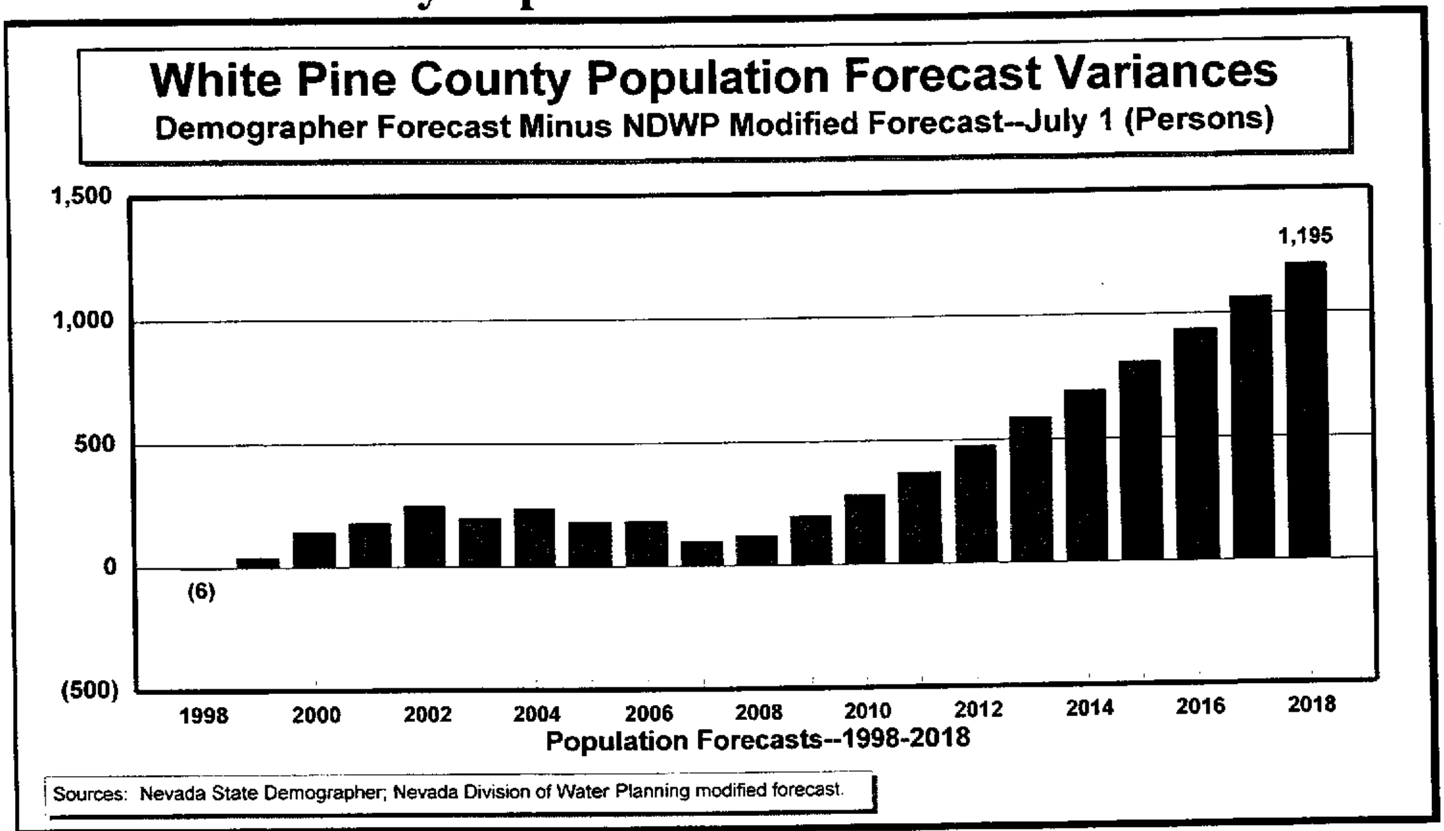
Source: Nevada State Demographer.

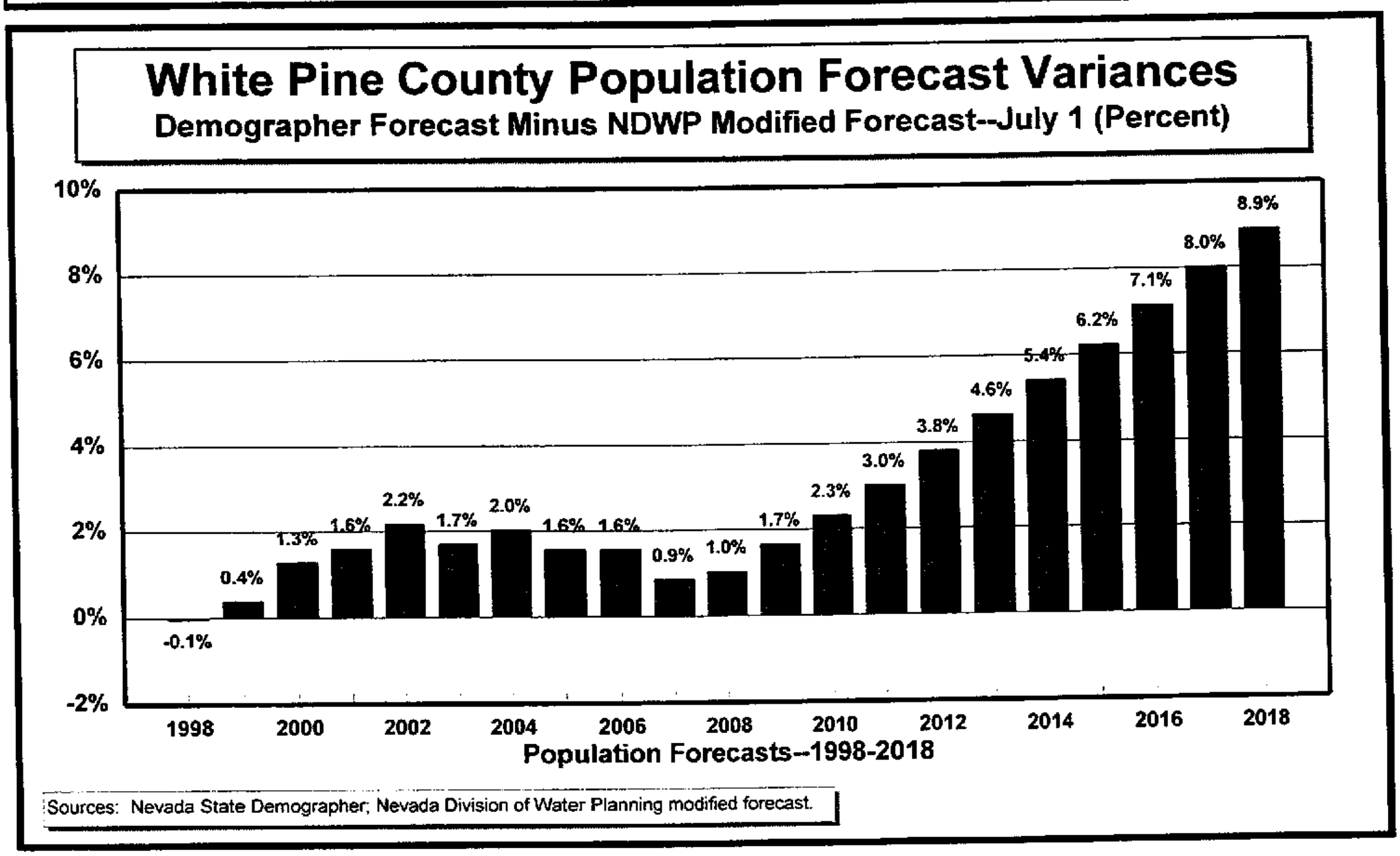
County Population Analysis and Forecasts





County Population Forecast Variances





Nevada State Water Plan

Appendix 3 – Population and Employment Forecasts and Municipal and Industrial (M&I), Public Use and Losses, Domestic (Residential) and Commercial and Industrial Water Use Analysis and Forecasts

TABLES:

GRAPHS:

Nevada Water Coefficient and Forecast Factor Summary

Water Use Factors, Public/Self Supplied Population Percents, Other Use Rates

(Gallons per person per day; gallons per worker per day) Revised: 11/23/98

County	Municipal and Industrial (M&I-Public Supplied) Water Use per Person (Gallons/Day)	Total Domestic Water Withdrawals per Person (Gallons/Day)	Domestic Public Supplied Water Use per Person (Gallons/Day)	Domestic Self Supplied Water Use per Person (Gallons/Day)	Percent of Resident Population on Public Supply Water Systems	Commercial and Industrial Water Use per Worker-excl. Mining (Gallons/Day)	Public Use and Losses as a Percent of Total Public Supply Water (M&I)
Carson City..	197.7	135.5	136.8	123.2	90.19%	77.5	8.99%
Churchill......	246.9	142.6	148.6	133.7	59.71%	183.0	29.47%
Clark............	334.2	212.5	213.0	191.7	97.93%	215.4	8.50%
Douglas.......	306.0	261.6	264.2	237.7	90.09%	152.7	3.13%
Elko.............	331.7	240.4	242.1	217.7	93.27%	415.2	9.08%
Esmeralda....	238.3	162.6	167.7	150.9	69.51%	239.5	14.81%
Eureka.........	322.9	240.0	246.4	221.5	74.49%	95.7	7.89%
Humboldt.....	348.8	244.4	253.0	227.6	66.08%	230.6	9.07%
Lander.........	245.4	187.6	191.3	172.3	80.37%	94.0	11.81%
Lincoln........	430.9	294.3	300.8	271.1	78.13%	213.6	8.90%
Lyon............	210.7	140.1	141.3	127.3	91.61%	1,155.9	11.70%
Mineral........	211.7	153.6	156.9	141.3	78.97%	116.3	3.57%
Nye.............	347.7	224.1	231.4	208.3	68.24%	97.2	22.49%
Pershing.......	341.5	233.0	235.7	212.4	88.31%	307.3	7.74%
Storey..........	143.0	94.9	98.6	88.4	63.38%	93.3	10.34%
Washoe........	269.7	176.0	177.7	160.0	90.30%	130.1	11.73%
White Pine...	352.4	300.0	302.4	271.9	92.07%	60.9	7.26%
NEVADA....	**315.0**	**203.9**	**205.6**	**176.6**	**94.20%**	**199.6**	**9.24%**

Sources: U.S. Geological Survey (USGS); Nevadad Division of Water Planning (NDWP).

Nevada M&I, Domestic, Commercial and Industrial Water Use Forecasts

Variable and Constant Percent of Population on Public Supply Water Systems Revised:
(Water Use in Acre-Feet per Year; Water Use Factors in Gallons per Person or per Worker per Day) 12/3/98

NEVADA	1995	2000	2005	2010	2015	2020
Resident Population (persons)[1]	1,579,150	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846
Percent Population on Public Supply[2]	94.20%	94.57%	94.88%	95.10%	95.26%	95.41%
Population on Public Supply[3]	1,487,636	1,878,477	2,221,592	2,510,991	2,733,001	2,906,882
Population being Self Supplied	91,514	107,780	119,783	129,315	135,978	139,964
Municipal & Industrial (M&I) Factor[4]	315.0	316.5	317.3	317.7	317.7	317.6
Total Municipal & Industrial Use	524,861	665,876	789,701	893,593	972,639	1,034,228
Public Use and Losses[5]	48,472	61,195	72,313	81,707	88,930	94,582
As a Percent of Total M&I Water Use	9.24%	9.23%	9.21%	9.21%	9.20%	9.19%
Variable Domestic Use Factor[6]	203.9	204.7	205.2	205.4	205.5	205.5
Public Supply Use Factor	205.6	206.3	206.7	206.8	206.9	206.9
Self Supply Use Factor	176.6	177.3	177.5	177.5	177.4	177.2
Total Domestic Water Use	360,710	455,464	538,090	607,467	660,315	701,338
Public Supply Water Use	342,605	434,063	514,277	581,756	633,300	673,563
Self Supply Water Use	18,105	21,401	23,813	25,711	27,016	27,775
Fixed Total Domestic Use Factor[7]	203.9	203.9	203.9	203.9	203.9	203.9
Total Domestic Water Use[7]	360,710	455,407	537,955	607,238	659,983	700,897
Public Supply Water Use	342,605	433,492	512,927	579,467	629,977	669,147
Self Supply Water Use	18,105	21,915	25,028	27,771	30,006	31,749
Total Employment (workers)	784,486	987,950	1,162,764	1,310,176	1,423,256	1,511,617
Employment less Mining Workers	771,299	973,251	1,148,331	1,295,999	1,409,685	1,499,030
Commercial/Industrial Use Factor[8]	199.6	199.6	199.6	199.6	199.6	199.6
Commercial/Industrial Water Use[8]	172,407	220,355	261,880	296,905	323,811	344,919
Carson City	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	46,770	54,445	60,703	66,041	70,099	72,587
Percent Population on Public Supply[2]	90.19%	90.30%	90.42%	90.53%	90.64%	90.76%
Population on Public Supply[3]	42,182	49,166	54,885	59,786	63,540	65,877
Population being Self Supplied	4,588	5,279	5,818	6,255	6,560	6,710
Municipal & Industrial (M&I) Factor[4]	197.7	197.6	197.6	197.5	197.4	197.3
Total Municipal & Industrial Use	9,342	10,885	12,146	13,226	14,051	14,562
Public Use and Losses[5]	840	878	906	930	955	979
As a Percent of Total M&I Water Use	8.99%	8.99%	8.99%	8.99%	8.99%	8.99%
Variable Domestic Use Factor[6]	135.5	135.5	135.5	135.5	135.5	135.5
Public Supply Use Factor	136.8	136.8	136.8	136.8	136.8	136.8
Self Supply Use Factor	123.2	123.2	123.2	123.2	123.2	123.2
Total Domestic Water Use	7,096	8,262	9,212	10,024	10,641	11,020
Public Supply Water Use	6,463	7,533	8,410	9,161	9,736	10,094
Self Supply Water Use	633	728	803	863	905	926
Fixed Total Domestic Use Factor[7]	135.5	135.5	135.5	135.5	135.5	135.5
Total Domestic Water Use[7]	7,096	8,261	9,210	10,020	10,636	11,013
Public Supply Water Use	6,463	7,524	8,389	9,126	9,687	10,031
Self Supply Water Use	633	737	822	894	949	982
Total Employment (workers)	26,218	29,988	33,325	36,136	38,230	39,457
Employment less Mining Workers	26,206	29,978	33,314	36,124	38,217	39,443
Commercial/Industrial Use Factor[8]	77.5	77.5	77.5	77.5	77.5	77.5
Commercial/Industrial Water Use[8]	2,274	2,601	2,891	3,134	3,316	3,423

Nevada M&I, Domestic, Commercial and Industrial Water Use Forecasts

Variable and Constant Percent of Population on Public Supply Water Systems Revised:
(Water Use in Acre-Feet per Year; Water Use Factors in Gallons per Person or per Worker per Day) **12/3/98**

Churchill County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	21,640	26,019	29,568	32,910	35,875	38,296
Percent Population on Public Supply[2]	59.71%	60.46%	61.22%	61.99%	62.77%	63.56%
Population on Public Supply[3]	12,922	15,732	18,102	20,402	22,519	24,341
Population being Self Supplied	8,718	10,287	11,465	12,508	13,356	13,955
Municipal & Industrial (M&I) Factor[4]	246.9	245.6	244.4	243.3	242.1	240.9
Total Municipal & Industrial Use	3,573	4,329	4,957	5,559	6,106	6,569
Public Use and Losses[5]	1,053	1,276	1,461	1,638	1,799	1,936
As a Percent of Total M&I Water Use	29.47%	29.47%	29.47%	29.47%	29.47%	29.47%
Variable Domestic Use Factor[6]	142.6	142.7	142.8	142.9	143.1	143.2
Public Supply Use Factor	148.6	148.6	148.6	148.6	148.6	148.6
Self Supply Use Factor	133.7	133.7	133.7	133.7	133.7	133.7
Total Domestic Water Use	3,457	4,159	4,730	5,269	5,749	6,142
Public Supply Water Use	2,151	2,618	3,013	3,396	3,748	4,051
Self Supply Water Use	1,306	1,541	1,718	1,874	2,001	2,091
Fixed Total Domestic Use Factor[7]	142.6	142.6	142.6	142.6	142.6	142.6
Total Domestic Water Use[7]	3,457	4,156	4,723	5,257	5,730	6,117
Public Supply Water Use	2,151	2,586	2,939	3,271	3,565	3,806
Self Supply Water Use	1,306	1,570	1,784	1,986	2,165	2,311
Total Employment (workers)	6,967	8,389	9,652	10,878	12,007	12,979
Employment less Mining Workers	6,941	8,373	9,635	10,860	11,989	12,961
Commercial/Industrial Use Factor[8]	183.0	183.0	183.0	183.0	183.0	183.0
Commercial/Industrial Water Use[8]	1,423	1,716	1,975	2,226	2,457	2,656

Clark County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	1,036,290	1,355,368	1,640,444	1,874,431	2,046,229	2,178,046
Percent Population on Public Supply[2]	97.93%	98.06%	98.18%	98.30%	98.42%	98.55%
Population on Public Supply[3]	1,014,867	1,329,009	1,610,552	1,842,577	2,013,971	2,146,391
Population being Self Supplied	21,423	26,359	29,892	31,854	32,258	31,655
Municipal & Industrial (M&I) Factor[4]	334.2	334.1	333.9	333.7	333.6	333.4
Total Municipal & Industrial Use	379,921	497,297	602,373	688,843	752,578	801,698
Public Use and Losses[5]	32,283	42,256	51,185	58,532	63,948	68,122
As a Percent of Total M&I Water Use	8.50%	8.50%	8.50%	8.50%	8.50%	8.50%
Variable Domestic Use Factor[6]	212.5	212.6	212.6	212.6	212.6	212.7
Public Supply Use Factor	213.0	213.0	213.0	213.0	213.0	213.0
Self Supply Use Factor	191.7	191.7	191.7	191.7	191.7	191.7
Total Domestic Water Use	246,709	322,712	390,636	446,410	487,385	518,845
Public Supply Water Use	242,109	317,052	384,217	439,570	480,458	512,048
Self Supply Water Use	4,600	5,660	6,418	6,840	6,926	6,797
Fixed Total Domestic Use Factor[7]	212.5	212.5	212.5	212.5	212.5	212.5
Total Domestic Water Use[7]	246,709	322,672	390,540	446,245	487,145	518,527
Public Supply Water Use	242,109	316,656	383,258	437,925	478,062	508,859
Self Supply Water Use	4,600	6,016	7,282	8,320	9,083	9,668
Total Employment (workers)	[illegible]	666,400	807,602	924,054	1,010,008	1,076,417

Nevada M&I, Domestic, Commercial and Industrial Water Use Forecasts

Variable and Constant Percent of Population on Public Supply Water Systems Revised:
(Water Use in Acre-Feet per Year; Water Use Factors in Gallons per Person or per Worker per Day) 12/3/98

Douglas County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	35,880	42,834	48,180	53,272	57,900	61,854
Percent Population on Public Supply[2]	90.09%	90.20%	90.31%	90.42%	90.54%	90.65%
Population on Public Supply[3]	32,323	38,636	43,512	48,171	52,421	56,071
Population being Self Supplied	3,557	4,198	4,668	5,101	5,479	5,783
Municipal & Industrial (M&I) Factor[4]	306.0	305.9	305.9	305.8	305.8	305.7
Total Municipal & Industrial Use	11,078	13,240	14,908	16,502	17,955	19,201
Public Use and Losses[5]	347	415	467	517	563	602
As a Percent of Total M&I Water Use	3.13%	3.13%	3.13%	3.13%	3.13%	3.13%
Variable Domestic Use Factor[6]	261.6	261.6	261.6	261.7	261.7	261.7
Public Supply Use Factor	264.2	264.2	264.2	264.2	264.2	264.2
Self Supply Use Factor	237.7	237.7	237.7	237.7	237.7	237.7
Total Domestic Water Use	10,513	12,552	14,120	15,615	16,973	18,134
Public Supply Water Use	9,566	11,434	12,877	14,256	15,514	16,594
Self Supply Water Use	947	1,118	1,243	1,358	1,459	1,540
Fixed Total Domestic Use Factor[7]	261.6	261.6	261.6	261.6	261.6	261.6
Total Domestic Water Use[7]	10,513	12,551	14,117	15,609	16,965	18,124
Public Supply Water Use	9,566	11,420	12,845	14,203	15,437	16,491
Self Supply Water Use	947	1,131	1,272	1,406	1,528	1,633
Total Employment (workers)	19,277	21,123	23,670	26,074	28,233	30,048
Employment less Mining Workers	19,258	21,087	23,633	26,037	28,197	30,015
Commercial/Industrial Use Factor[8]	152.7	152.7	152.7	152.7	152.7	152.7
Commercial/Industrial Water Use[8]	3,293	3,606	4,041	4,453	4,822	5,133
Elko County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	43,050	51,665	57,857	63,224	67,408	70,113
Percent Population on Public Supply[2]	93.27%	93.38%	93.50%	93.62%	93.73%	93.85%
Population on Public Supply[3]	40,151	48,246	54,096	59,188	63,184	65,801
Population being Self Supplied	2,899	3,419	3,761	4,036	4,224	4,311
Municipal & Industrial (M&I) Factor[4]	331.7	331.6	331.5	331.4	331.3	331.2
Total Municipal & Industrial Use	14,920	17,922	20,088	21,972	23,447	24,410
Public Use and Losses[5]	1,355	1,628	1,824	1,995	2,129	2,217
As a Percent of Total M&I Water Use	9.08%	9.08%	9.08%	9.08%	9.08%	9.08%
Variable Domestic Use Factor[6]	240.4	240.5	240.5	240.5	240.6	240.6
Public Supply Use Factor	242.1	242.1	242.1	242.1	242.1	242.1
Self Supply Use Factor	217.7	217.7	217.7	217.7	217.7	217.7
Total Domestic Water Use	11,595	13,917	15,587	17,034	18,164	18,895
Public Supply Water Use	10,888	13,083	14,669	16,050	17,134	17,843
Self Supply Water Use	707	834	917	984	1,030	1,051
Fixed Total Domestic Use Factor[7]	240.4	240.4	240.4	240.4	240.4	240.4
Total Domestic Water Use[7]	11,595	13,915	15,583	17,028	18,155	18,884
Public Supply Water Use	10,888	13,067	14,633	15,990	17,048	17,732
Self Supply Water Use	707	848	950	1,038	1,107	1,151
Total Employment (workers)	18,370	21,871	24,523	26,832	28,643	29,830
Employment less Mining Workers	17,075	20,456	23,182	25,498	27,305	28,511
Commercial/Industrial Use Factor[8]	415.2	415.2	415.2	415.2	415.2	415.2
Commercial/Industrial Water Use[8]	7,942	9,514	10,782	11,859	12,700	13,261

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Variable and Constant Percent of Population on Public Supply Water Systems Revised: 12/3/98

(Water Use in Acre-Feet per Year; Water Use Factors in Gallons per Person or per Worker per Day)

Esmeralda County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	1,630	1,480	1,509	1,530	1,544	1,550
Percent Population on Public Supply[2]	69.51%	69.60%	69.68%	69.77%	69.86%	69.94%
Population on Public Supply[3]	1,133	1,030	1,051	1,067	1,078	1,084
Population being Self Supplied	497	450	457	462	465	466
Municipal & Industrial (M&I) Factor[4]	238.3	238.2	238.1	238.0	238.0	237.9
Total Municipal & Industrial Use	302	275	280	285	287	289
Public Use and Losses[5]	45	41	42	42	43	43
As a Percent of Total M&I Water Use	14.81%	14.81%	14.81%	14.81%	14.81%	14.81%
Variable Domestic Use Factor[6]	162.6	162.6	162.6	162.6	162.6	162.6
Public Supply Use Factor	167.7	167.7	167.7	167.7	167.7	167.7
Self Supply Use Factor	150.9	150.9	150.9	150.9	150.9	150.9
Total Domestic Water Use	297	270	275	279	281	282
Public Supply Water Use	213	194	197	200	203	204
Self Supply Water Use	84	76	77	78	79	79
Fixed Total Domestic Use Factor[7]	162.6	162.6	162.6	162.6	162.6	162.6
Total Domestic Water Use[7]	297	270	275	279	281	282
Public Supply Water Use	213	193	197	200	202	202
Self Supply Water Use	84	76	78	79	80	80
Total Employment (workers)	322	331	336	340	342	342
Employment less Mining Workers	168	180	185	188	191	193
Commercial/Industrial Use Factor[8]	239.5	239.5	239.5	239.5	239.5	239.5
Commercial/Industrial Water Use[8]	45	48	50	51	51	52

Eureka County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	1,580	1,777	1,953	2,093	2,189	2,233
Percent Population on Public Supply[2]	74.49%	74.59%	74.68%	74.77%	74.87%	74.96%
Population on Public Supply[3]	1,177	1,326	1,458	1,565	1,639	1,674
Population being Self Supplied	403	452	494	528	550	559
Municipal & Industrial (M&I) Factor[4]	322.9	322.8	322.7	322.6	322.5	322.4
Total Municipal & Industrial Use	426	479	527	566	592	604
Public Use and Losses[5]	34	38	42	45	47	48
As a Percent of Total M&I Water Use	7.89%	7.89%	7.89%	7.89%	7.89%	7.89%
Variable Domestic Use Factor[6]	240.0	240.1	240.1	240.1	240.1	240.2
Public Supply Use Factor	246.4	246.4	246.4	246.4	246.4	246.4
Self Supply Use Factor	221.5	221.5	221.5	221.5	221.5	221.5
Total Domestic Water Use	425	478	525	563	589	601
Public Supply Water Use	325	366	402	432	452	462
Self Supply Water Use	100	112	123	131	137	139
Fixed Total Domestic Use Factor[7]	240.0	240.0	240.0	240.0	240.0	240.0
Total Domestic Water Use[7]	425	478	525	563	589	600
Public Supply Water Use	325	365	401	430	450	459
Self Supply Water Use	100	112	124	132	139	141
Total Employment (workers)	4,554	5,189	5,687	6,081	6,343	6,455
Employment less Mining Workers	627	1,013	1,736	2,161	2,571	2,939
Commercial/Industrial Use Factor[8]	95.7	95.7	95.7	95.7	95.7	95.7
Commercial/Industrial Water Use[8]	67	109	186	232	276	315

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Variable and Constant Percent of Population on Public Supply Water Systems Revised:

(Water Use in Acre-Feet per Year; Water Use Factors in Gallons per Person or per Worker per Day) **12/3/98**

Humboldt County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	16,270	18,897	21,034	22,858	24,251	25,114
Percent Population on Public Supply[2]	66.08%	66.17%	66.25%	66.33%	66.42%	66.50%
Population on Public Supply[3]	10,752	12,504	13,935	15,162	16,106	16,701
Population being Self Supplied	5,518	6,394	7,099	7,696	8,144	8,414
Municipal & Industrial (M&I) Factor[4]	348.8	348.7	348.5	348.4	348.3	348.2
Total Municipal & Industrial Use	4,201	4,883	5,440	5,917	6,284	6,513
Public Use and Losses[5]	381	443	493	537	570	591
As a Percent of Total M&I Water Use	9.07%	9.07%	9.07%	9.07%	9.07%	9.07%
Variable Domestic Use Factor[6]	244.4	244.4	244.4	244.4	244.5	244.5
Public Supply Use Factor	253.0	253.0	253.0	253.0	253.0	253.0
Self Supply Use Factor	227.6	227.6	227.6	227.6	227.6	227.6
Total Domestic Water Use	4,454	5,174	5,759	6,259	6,641	6,878
Public Supply Water Use	3,047	3,543	3,949	4,297	4,564	4,733
Self Supply Water Use	1,407	1,630	1,810	1,962	2,077	2,145
Fixed Total Domestic Use Factor[7]	244.4	244.4	244.4	244.4	244.4	244.4
Total Domestic Water Use[7]	4,454	5,173	5,758	6,257	6,638	6,875
Public Supply Water Use	3,047	3,539	3,939	4,280	4,541	4,703
Self Supply Water Use	1,407	1,634	1,819	1,977	2,097	2,172
Total Employment (workers)	7,770	9,233	10,290	11,196	11,894	12,333
Employment less Mining Workers	5,464	6,796	7,959	9,080	10,091	10,926
Commercial/Industrial Use Factor[8]	230.6	230.6	230.6	230.6	230.6	230.6
Commercial/Industrial Water Use[8]	1,411	1,755	2,055	2,345	2,606	2,822
Lander County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	6,440	7,226	7,505	7,717	7,857	7,920
Percent Population on Public Supply[2]	80.37%	80.47%	80.57%	80.67%	80.78%	80.88%
Population on Public Supply[3]	5,176	5,815	6,047	6,226	6,347	6,405
Population being Self Supplied	1,264	1,411	1,458	1,491	1,510	1,515
Municipal & Industrial (M&I) Factor[4]	245.4	245.3	245.2	245.2	245.1	245.0
Total Municipal & Industrial Use	1,423	1,598	1,661	1,710	1,742	1,758
Public Use and Losses[5]	168	189	196	202	206	208
As a Percent of Total M&I Water Use	11.81%	11.81%	11.81%	11.81%	11.81%	11.81%
Variable Domestic Use Factor[6]	187.6	187.6	187.6	187.6	187.6	187.6
Public Supply Use Factor	191.3	191.3	191.3	191.3	191.3	191.3
Self Supply Use Factor	172.3	172.3	172.3	172.3	172.3	172.3
Total Domestic Water Use	1,353	1,518	1,577	1,622	1,651	1,665
Public Supply Water Use	1,109	1,246	1,296	1,334	1,360	1,372
Self Supply Water Use	244	272	281	288	292	292
Fixed Total Domestic Use Factor[7]	187.6	187.6	187.6	187.6	187.6	187.6
Total Domestic Water Use[7]	1,353	1,518	1,577	1,621	1,651	1,664
Public Supply Water Use	1,109	1,244	1,292	1,329	1,353	1,364
Self Supply Water Use	244	274	284	292	298	300
Total Employment (workers)	2,465	2,780	2,882	2,957	3,005	3,023
Employment less Mining Workers	1,383	1,479	1,573	1,656	1,725	1,778
Commercial/Industrial Use Factor[8]	94.0	94.0	94.0	94.0	94.0	94.0
Commercial/Industrial Water Use[8]	146	156	166	174	182	187

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(Water Use in Acre-Feet per Year; Water Use Factors in Gallons per Person or per Worker per Day)

Lincoln County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	4,110	4,167	4,247	4,307	4,345	4,363
Percent Population on Public Supply[2]	78.13%	78.22%	78.32%	78.42%	78.52%	78.62%
Population on Public Supply[3]	3,211	3,260	3,326	3,377	3,412	3,430
Population being Self Supplied	899	907	921	929	933	933
Municipal & Industrial (M&I) Factor[4]	430.9	430.8	430.6	430.5	430.3	430.1
Total Municipal & Industrial Use	1,550	1,573	1,604	1,628	1,645	1,653
Public Use and Losses[5]	138	140	143	145	146	147
As a Percent of Total M&I Water Use	8.90%	8.90%	8.90%	8.90%	8.90%	8.90%
Variable Domestic Use Factor[6]	294.3	294.4	294.4	294.4	294.4	294.5
Public Supply Use Factor	300.8	300.8	300.8	300.8	300.8	300.8
Self Supply Use Factor	271.1	271.1	271.1	271.1	271.1	271.1
Total Domestic Water Use	1,355	1,374	1,400	1,420	1,433	1,439
Public Supply Water Use	1,082	1,098	1,121	1,138	1,150	1,156
Self Supply Water Use	273	276	280	282	283	283
Fixed Total Domestic Use Factor[7]	294.3	294.3	294.3	294.3	294.3	294.3
Total Domestic Water Use[7]	1,355	1,374	1,400	1,420	1,433	1,438
Public Supply Water Use	1,082	1,097	1,118	1,134	1,144	1,149
Self Supply Water Use	273	277	282	286	289	290
Total Employment (workers)	1,535	1,472	1,482	1,484	1,479	1,466
Employment less Mining Workers	1,521	1,460	1,470	1,473	1,469	1,457
Commercial/Industrial Use Factor[8]	213.6	213.6	213.6	213.6	213.6	213.6
Commercial/Industrial Water Use[8]	364	349	352	352	351	349

Lyon County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	26,580	33,721	39,377	44,878	49,914	54,170
Percent Population on Public Supply[2]	91.61%	91.72%	91.84%	91.95%	92.07%	92.18%
Population on Public Supply[3]	24,350	30,930	36,163	41,267	45,955	49,936
Population being Self Supplied	2,230	2,790	3,213	3,611	3,958	4,234
Municipal & Industrial (M&I) Factor[4]	210.7	210.6	210.5	210.4	210.3	210.2
Total Municipal & Industrial Use	5,746	7,296	8,527	9,727	10,827	11,760
Public Use and Losses[5]	672	853	997	1,138	1,266	1,375
As a Percent of Total M&I Water Use	11.70%	11.70%	11.70%	11.70%	11.70%	11.70%
Variable Domestic Use Factor[6]	140.1	140.1	140.1	140.2	140.2	140.2
Public Supply Use Factor	141.3	141.3	141.3	141.3	141.3	141.3
Self Supply Use Factor	127.3	127.3	127.3	127.3	127.3	127.3
Total Domestic Water Use	4,171	5,293	6,181	7,045	7,837	8,506
Public Supply Water Use	3,853	4,895	5,723	6,530	7,272	7,902
Self Supply Water Use	318	398	458	515	564	604
Fixed Total Domestic Use Factor[7]	140.1	140.1	140.1	140.1	140.1	140.1
Total Domestic Water Use[7]	4,171	5,292	6,180	7,043	7,833	8,501
Public Supply Water Use	3,853	4,888	5,708	6,506	7,236	7,853
Self Supply Water Use	318	403	471	537	597	648
Total Employment (workers)	7,051	8,509	9,949	11,353	12,643	13,738
Employment less Mining Workers	6,869	8,308	9,734	11,130	12,420	13,524
Commercial/Industrial Use Factor[8]	1,155.9	1,155.9	1,155.9	1,155.9	1,155.9	1,155.9
Commercial/Industrial Water Use[8]	8,894	10,758	12,604	14,412	16,082	17,510

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(Water Use in Acre-Feet per Year; Water Use Factors in Gallons per Person or per Worker per Day)

Mineral County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	6,700	6,955	7,086	7,182	7,241	7,262
Percent Population on Public Supply[2]	78.97%	79.07%	79.17%	79.27%	79.37%	79.47%
Population on Public Supply[3]	5,291	5,499	5,610	5,693	5,747	5,771
Population being Self Supplied	1,409	1,456	1,476	1,489	1,494	1,491
Municipal & Industrial (M&I) Factor[4]	211.7	211.6	211.5	211.5	211.4	211.3
Total Municipal & Industrial Use	1,255	1,303	1,329	1,348	1,361	1,366
Public Use and Losses[5]	45	47	47	48	49	49
As a Percent of Total M&I Water Use	3.57%	3.57%	3.57%	3.57%	3.57%	3.57%
Variable Domestic Use Factor[6]	153.6	153.6	153.6	153.6	153.7	153.7
Public Supply Use Factor	156.9	156.9	156.9	156.9	156.9	156.9
Self Supply Use Factor	141.3	141.3	141.3	141.3	141.3	141.3
Total Domestic Water Use	1,153	1,197	1,219	1,236	1,246	1,250
Public Supply Water Use	930	966	986	1,000	1,010	1,014
Self Supply Water Use	223	230	234	236	236	236
Fixed Total Domestic Use Factor[7]	153.6	153.6	153.6	153.6	153.6	153.6
Total Domestic Water Use[7]	1,153	1,197	1,219	1,236	1,246	1,249
Public Supply Water Use	930	965	983	997	1,005	1,008
Self Supply Water Use	223	231	236	239	241	242
Total Employment (workers)	2,545	2,353	2,338	2,311	2,272	2,222
Employment less Mining Workers	2,150	2,041	2,034	2,016	1,988	1,950
Commercial/Industrial Use Factor[8]	116.3	116.3	116.3	116.3	116.3	116.3
Commercial/Industrial Water Use[8]	280	266	265	263	259	254

Nye County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	23,050	30,834	36,181	41,185	45,471	48,684
Percent Population on Public Supply[2]	68.24%	68.33%	68.41%	68.50%	68.58%	68.67%
Population on Public Supply[3]	15,730	21,068	24,753	28,211	31,186	33,432
Population being Self Supplied	7,320	9,766	11,428	12,974	14,285	15,252
Municipal & Industrial (M&I) Factor[4]	347.7	347.6	347.5	347.3	347.2	347.0
Total Municipal & Industrial Use	6,127	8,203	9,634	10,975	12,128	12,995
Public Use and Losses[5]	1,378	1,845	2,166	2,468	2,727	2,922
As a Percent of Total M&I Water Use	22.49%	22.49%	22.49%	22.49%	22.49%	22.49%
Variable Domestic Use Factor[6]	224.1	224.1	224.1	224.1	224.1	224.2
Public Supply Use Factor	231.4	231.4	231.4	231.4	231.4	231.4
Self Supply Use Factor	208.3	208.3	208.3	208.3	208.3	208.3
Total Domestic Water Use	5,785	7,740	9,083	10,340	11,417	12,225
Public Supply Water Use	4,077	5,461	6,416	7,313	8,084	8,666
Self Supply Water Use	1,708	2,279	2,667	3,027	3,333	3,559
Fixed Total Domestic Use Factor[7]	224.1	224.1	224.1	224.1	224.1	224.1
Total Domestic Water Use[7]	5,785	7,739	9,081	10,337	11,413	12,219
Public Supply Water Use	4,077	5,454	6,400	7,285	8,043	8,612
Self Supply Water Use	1,708	2,285	2,681	3,052	3,369	3,607
Total Employment (workers)	8,496	9,636	11,265	12,775	14,051	14,988
Employment less Mining Workers	7,201	8,204	9,760	11,260	12,596	13,660
Commercial/Industrial Use Factor[8]	97.2	97.2	97.2	97.2	97.2	97.2
Commercial/Industrial Water Use[8]	784	893	1,063	1,226	1,372	1,488

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(Water Use in Acre-Feet per Year; Water Use Factors in Gallons per Person or per Worker per Day)

Pershing County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	5,140	7,068	7,777	8,359	8,777	9,001
Percent Population on Public Supply[2]	88.31%	88.42%	88.53%	88.64%	88.75%	88.86%
Population on Public Supply[3]	4,539	6,249	6,885	7,410	7,790	7,998
Population being Self Supplied	601	819	892	950	987	1,003
Municipal & Industrial (M&I) Factor[4]	341.5	341.4	341.2	341.1	341.0	340.8
Total Municipal & Industrial Use	1,736	2,390	2,631	2,831	2,975	3,054
Public Use and Losses[5]	134	185	204	219	230	236
As a Percent of Total M&I Water Use	7.74%	7.74%	7.74%	7.74%	7.74%	7.74%
Variable Domestic Use Factor[6]	233.0	233.0	233.1	233.1	233.1	233.1
Public Supply Use Factor	235.7	235.7	235.7	235.7	235.7	235.7
Self Supply Use Factor	212.4	212.4	212.4	212.4	212.4	212.4
Total Domestic Water Use	1,342	1,845	2,030	2,183	2,292	2,351
Public Supply Water Use	1,199	1,650	1,818	1,957	2,057	2,112
Self Supply Water Use	143	195	212	226	235	239
Fixed Total Domestic Use Factor[7]	233.0	233.0	233.0	233.0	233.0	233.0
Total Domestic Water Use[7]	1,342	1,845	2,030	2,182	2,291	2,349
Public Supply Water Use	1,199	1,648	1,813	1,949	2,047	2,099
Self Supply Water Use	143	197	216	233	244	250
Total Employment (workers)	1,886	2,434	2,671	2,864	3,000	3,068
Employment less Mining Workers	1,204	1,542	1,746	1,930	2,081	2,190
Commercial/Industrial Use Factor[8]	307.3	307.3	307.3	307.3	307.3	307.3
Commercial/Industrial Water Use[8]	414	531	601	664	716	754

Storey County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	3,200	3,773	4,170	4,519	4,801	5,001
Percent Population on Public Supply[2]	63.38%	63.45%	63.53%	63.61%	63.69%	63.77%
Population on Public Supply[3]	2,028	2,394	2,649	2,874	3,058	3,189
Population being Self Supplied	1,172	1,379	1,521	1,644	1,743	1,812
Municipal & Industrial (M&I) Factor[4]	143.0	142.9	142.9	142.8	142.8	142.7
Total Municipal & Industrial Use	325	383	424	460	489	510
Public Use and Losses[5]	34	40	44	48	51	53
As a Percent of Total M&I Water Use	10.34%	10.34%	10.34%	10.34%	10.34%	10.34%
Variable Domestic Use Factor[6]	94.9	94.9	94.9	94.9	94.9	94.9
Public Supply Use Factor	98.6	98.6	98.6	98.6	98.6	98.6
Self Supply Use Factor	88.4	88.4	88.4	88.4	88.4	88.4
Total Domestic Water Use	340	401	443	480	510	532
Public Supply Water Use	224	264	293	318	338	352
Self Supply Water Use	116	136	150	163	173	179
Fixed Total Domestic Use Factor[7]	94.9	94.9	94.9	94.9	94.9	94.9
Total Domestic Water Use[7]	340	401	443	480	510	531
Public Supply Water Use	224	264	292	316	336	350
Self Supply Water Use	116	137	151	164	174	181
Total Employment (workers)	724	1,044	1,169	1,282	1,380	1,455
Employment less Mining Workers	643	934	1,051	1,160	1,255	1,331
Commercial/Industrial Use Factor[8]	93.3	93.3	93.3	93.3	93.3	93.3
Commercial/Industrial Water Use[8]	67	98	110	121	131	139

Nevada M&I, Domestic, Commercial and Industrial Water Use Forecasts

Variable and Constant Percent of Population on Public Supply Water Systems Revised:

(Water Use in Acre-Feet per Year; Water Use Factors in Gallons per Person or per Worker per Day) 12/3/98

Washoe County	1995	2000	2005	2010	2015	2020
Resident Population (persons)[1]	291,050	329,021	362,260	393,884	422,917	448,400
Percent Population on Public Supply[2]	90.30%	90.41%	90.52%	90.64%	90.75%	90.86%
Population on Public Supply[3]	262,809	297,467	327,928	357,001	383,794	407,429
Population being Self Supplied	28,241	31,554	34,332	36,883	39,122	40,971
Municipal & Industrial (M&I) Factor[4]	269.7	269.6	269.4	269.3	269.2	269.1
Total Municipal & Industrial Use	79,385	89,816	98,971	107,699	115,733	122,808
Public Use and Losses[5]	9,308	10,532	11,605	12,629	13,571	14,400
As a Percent of Total M&I Water Use	11.73%	11.73%	11.73%	11.73%	11.73%	11.73%
Variable Domestic Use Factor[6]	176.0	176.0	176.0	176.1	176.1	176.1
Public Supply Use Factor	177.7	177.7	177.7	177.7	177.7	177.7
Self Supply Use Factor	160.0	160.0	160.0	160.0	160.0	160.0
Total Domestic Water Use	57,382	64,876	71,438	77,683	83,419	88,455
Public Supply Water Use	52,322	59,222	65,287	71,075	76,409	81,114
Self Supply Water Use	5,060	5,654	6,151	6,608	7,010	7,341
Fixed Total Domestic Use Factor[7]	176.0	176.0	176.0	176.0	176.0	176.0
Total Domestic Water Use[7]	57,382	64,868	71,422	77,657	83,380	88,405
Public Supply Water Use	52,322	59,148	65,124	70,809	76,028	80,609
Self Supply Water Use	5,060	5,720	6,298	6,848	7,353	7,796
Total Employment (workers)	163,151	186,234	204,792	222,391	238,485	252,539
Employment less Mining Workers	162,537	185,580	204,155	221,788	237,934	252,057
Commercial/Industrial Use Factor[8]	130.1	130.1	130.1	130.1	130.1	130.1
Commercial/Industrial Water Use[8]	23,691	27,050	29,757	32,327	34,681	36,739
White Pine County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Resident Population (persons)[1]	9,770	11,007	11,527	11,917	12,162	12,253
Percent Population on Public Supply[2]	92.07%	92.18%	92.30%	92.41%	92.53%	92.64%
Population on Public Supply[3]	8,995	10,146	10,639	11,013	11,254	11,351
Population being Self Supplied	775	860	888	904	909	901
Municipal & Industrial (M&I) Factor[4]	352.4	352.4	352.3	352.2	352.2	352.1
Total Municipal & Industrial Use	3,551	4,005	4,198	4,345	4,439	4,477
Public Use and Losses[5]	258	291	305	315	322	325
As a Percent of Total M&I Water Use	7.26%	7.26%	7.26%	7.26%	7.26%	7.26%
Variable Domestic Use Factor[6]	300.0	300.0	300.0	300.1	300.1	300.1
Public Supply Use Factor	302.4	302.4	302.4	302.4	302.4	302.4
Self Supply Use Factor	271.9	271.9	271.9	271.9	271.9	271.9
Total Domestic Water Use	3,283	3,699	3,874	4,006	4,089	4,119
Public Supply Water Use	3,047	3,437	3,604	3,730	3,812	3,845
Self Supply Water Use	236	262	270	275	277	274
Fixed Total Domestic Use Factor[7]	300.0	300.0	300.0	300.0	300.0	300.0
Total Domestic Water Use[7]	3,283	3,698	3,873	4,004	4,087	4,117
Public Supply Water Use	3,047	3,432	3,595	3,716	3,793	3,821
Self Supply Water Use	236	266	278	288	294	296
Total Employment (workers)	4,230	4,065	4,241	4,368	4,441	4,457
Employment less Mining Workers	3,616	3,285	3,449	3,574	3,643	3,662
Commercial/Industrial Use Factor[8]	60.9	60.9	60.9	60.9	60.9	60.9
Commercial/Industrial Water Use[8]	246	224	235	244	248	250

Note: One acre-feet equals approximately 325,851 gallons.

[1] Population estimates: Nevada State Demographer; population forecasts: Nevada Division of Water Planning (NDWP).

[2] Percent of population on public supply water systems for 1995 based on USGS estimates; changes to this percent over the forecast horizon based on estimates by NDWP. Total Nevada figure based on aggregation of individual counties.

Nevada M&I, Domestic, Commercial and Industrial Water Use Forecasts

Variable and Constant Percent of Population on Public Supply Water Systems Revised:

(Water Use in Acre-Feet per Year; Water Use Factors in Gallons per Person or per Worker per Day) 12/3/98

[3] Total Nevada figure based on aggregation of individual county totals.

[4] Total Municipal & Industrial water use includes all public supplied water for domestic, commercial, industrial and thermoelectric uses; include effects of a variable population on public supply water systems.

[5] Public Use and Losses based of county specific percentage of total M&I water withdrawals; Nevada figure is weighted average of counties.

[6] Variable Total Domestic Use Factor based on weighted average of changes in population on public-supplied water.

[7] Fixed Total Domestic Use Factor based on 1995 estimate; population on public supply remains constant over forecast horizon.

[8] Excludes water used in mining operations and by mining workers.

Sources: Population estimates--Nevada State Demographer; Employment estimates--Department of Employment, Training and Rehabilitation (DETR); Population and employment forecasts--Nevada Division of Water Planning (NDWP). Population forecasts for Clark County: Department of Comprehensive Planning; Population forecasts for Washoe County: Department of Community Development.

State of Nevada Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	800,508	397,643	49.67%	6,149	1.55%	182,853	87,510	266,065
1981	846,220	408,656	48.29%	7,834	1.92%	193,294	89,596	281,258
1982	870,970	397,952	45.69%	6,615	1.66%	198,948	87,475	289,485
1983	897,160	400,236	44.61%	5,838	1.46%	204,930	88,160	298,189
1984	922,580	423,469	45.90%	6,550	1.55%	210,736	93,194	306,638
1985	955,810	443,527	46.40%	6,060	1.37%	218,327	97,787	317,683
1986	993,220	465,867	46.90%	6,292	1.35%	226,872	102,729	330,117
1987	1,035,040	498,072	48.12%	8,139	1.63%	236,425	109,514	344,017
1988	1,096,130	535,771	48.88%	10,976	2.05%	250,379	117,307	364,321
1989	1,162,340	579,690	49.87%	13,462	2.32%	265,503	126,568	386,327
1990	1,236,130	619,638	50.13%	14,237	2.30%	282,358	135,325	410,853
1991	1,299,360	626,261	48.20%	13,337	2.13%	296,801	137,007	431,869
1992	1,345,035	637,108	47.37%	12,894	2.02%	307,234	139,530	447,050
1993	1,398,840	670,342	47.92%	12,568	1.87%	319,524	147,032	464,933
1994	1,491,490	737,502	49.45%	12,212	1.66%	340,687	162,124	495,727
1995	1,579,150	784,486	49.68%	13,187	1.68%	360,711	172,407	524,863
1996	1,684,570	840,798	49.91%	14,559	1.73%	385,162	185,525	559,901
1997	1,779,850	888,574	49.92%	14,664	1.65%	407,487	196,354	591,569
1998	1,835,458	913,784	49.79%	14,690	1.61%	420,318	202,781	610,052
1999	1,905,312	948,137	49.76%	14,703	1.55%	436,542	210,905	633,269
2000	1,986,257	987,950	49.74%	14,700	1.49%	455,407	220,355	660,173
2001	2,062,293	1,025,360	49.72%	14,673	1.43%	473,105	229,234	685,445
2002	2,135,420	1,061,348	49.70%	14,623	1.38%	490,112	237,779	709,751
2003	2,205,757	1,095,973	49.69%	14,551	1.33%	506,457	246,005	733,128
2004	2,274,255	1,129,703	49.67%	14,457	1.28%	522,368	254,024	755,895
2005	2,341,374	1,162,764	49.66%	14,433	1.24%	537,955	261,880	778,204
2006	2,407,472	1,195,333	49.65%	14,379	1.20%	553,303	269,614	800,173
2007	2,470,245	1,226,276	49.64%	14,379	1.17%	567,864	276,964	821,036
2008	2,529,804	1,255,646	49.63%	14,324	1.14%	581,666	283,943	840,832
2009	2,586,448	1,283,592	49.63%	14,259	1.11%	594,780	290,584	859,659
2010	2,640,306	1,310,176	49.62%	14,177	1.08%	607,238	296,905	877,560
2011	2,691,357	1,335,388	49.62%	14,076	1.05%	619,035	302,903	894,527
2012	2,739,653	1,359,255	49.61%	13,975	1.03%	630,184	308,578	910,580
2013	2,785,141	1,381,749	49.61%	13,857	1.00%	640,674	313,928	925,698
2014	2,828,168	1,403,042	49.61%	13,722	0.98%	650,587	318,997	939,999
2015	2,868,979	1,423,256	49.61%	13,571	0.95%	659,983	323,811	953,564
2016	2,907,639	1,442,421	49.61%	13,404	0.93%	668,877	328,380	966,413
2017	2,944,651	1,460,788	49.61%	13,221	0.91%	677,390	332,763	978,715
2018	2,980,108	1,478,402	49.61%	13,024	0.88%	685,545	336,971	990,500
2019	3,014,119	1,495,318	49.61%	12,812	0.86%	693,367	341,016	1,001,804
2020	3,046,846	1,511,617	49.61%	12,587	0.83%	700,897	344,919	1,012,681
Actual Period Average (1980-1997).......			48.16%	1.65%	Standard Deviation (1980-1997)			
Forecast Period Average (1998-2020)....			49.65%	49.74%	Latest/Most Stable Period (1994-1997)			

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person......................	315.0	203.9	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.3528	0.2284	Acre-feet per person per year
Commercial & Industrial Water Use per Worker................	199.6	Gallons per worker per day (excludes mining)	
[Commercial & Industrial Water Use Coefficient]	0.2235	Acre-feet per worker per year (excludes mining)	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

State of Nevada Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	754,117	173,675	9,178	--	--	--	--	--
1981	797,180	183,592	9,702	--	--	--	--	--
1982	820,496	188,962	9,986	--	--	--	--	--
1983	845,168	194,644	10,286	--	--	--	--	--
1984	869,115	200,159	10,577	--	--	--	--	--
1985	900,419	207,368	10,958	--	--	--	--	--
1986	935,661	215,485	11,387	--	--	--	--	--
1987	975,058	224,558	11,867	--	--	--	--	--
1988	1,032,608	237,812	12,567	--	--	--	--	--
1989	1,094,981	252,176	13,326	--	--	--	--	--
1990	1,164,494	268,185	14,172	--	--	--	--	--
1991	1,224,060	281,903	14,897	--	--	--	--	--
1992	1,267,088	291,813	15,421	--	--	--	--	--
1993	1,317,775	303,486	16,038	--	--	--	--	--
1994	1,405,056	323,587	17,100	--	--	--	--	--
1995	1,487,636	342,605	18,106	1,487,636	94.20%	342,605	18,105	524,861
1996	1,586,947	366,065	19,097	1,588,562	94.30%	366,161	19,010	561,145
1997	1,676,705	387,437	20,050	1,679,706	94.37%	387,641	19,866	594,240
1998	1,729,090	399,704	20,614	1,732,992	94.42%	400,021	20,329	613,267
1999	1,794,897	415,302	21,241	1,800,276	94.49%	415,740	20,846	637,530
2000	1,871,150	433,492	21,915	1,878,477	94.57%	434,063	21,401	665,876
2001	1,942,780	450,539	22,566	1,951,914	94.65%	451,251	21,925	692,438
2002	2,011,670	466,910	23,202	2,022,547	94.71%	467,771	22,427	717,952
2003	2,077,931	482,636	23,822	2,090,495	94.77%	483,653	22,906	742,463
2004	2,142,458	497,938	24,430	2,156,692	94.83%	499,118	23,368	766,322
2005	2,205,688	512,927	25,028	2,221,592	94.88%	514,277	23,813	789,701
2006	2,267,956	527,686	25,617	2,285,547	94.94%	529,214	24,241	812,732
2007	2,327,091	541,679	26,185	2,346,298	94.98%	543,390	24,645	834,573
2008	2,383,198	554,932	26,734	2,403,953	95.03%	556,832	25,024	855,266
2009	2,436,560	567,518	27,262	2,458,809	95.07%	569,610	25,379	874,923
2010	2,487,297	579,467	27,771	2,510,991	95.10%	581,756	25,711	893,593
2011	2,535,389	590,775	28,260	2,560,481	95.14%	593,265	26,018	911,270
2012	2,580,887	601,457	28,728	2,607,332	95.17%	604,151	26,303	927,976
2013	2,623,738	611,500	29,174	2,651,489	95.20%	614,401	26,563	943,692
2014	2,664,272	620,988	29,600	2,693,299	95.23%	624,098	26,801	958,549
2015	2,702,718	629,977	30,006	2,733,001	95.26%	633,300	27,016	972,639
2016	2,739,137	638,486	30,391	2,770,660	95.29%	642,022	27,209	985,986
2017	2,774,004	646,632	30,759	2,806,774	95.32%	650,385	27,381	998,779
2018	2,807,406	654,437	31,107	2,841,434	95.35%	658,409	27,533	1,011,052
2019	2,839,446	661,930	31,437	2,874,750	95.38%	666,123	27,664	1,022,848
2020	2,870,277	669,147	31,749	2,906,882	95.41%	673,563	27,775	1,034,228

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied).....................	315.0	205.6	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.3528	0.2303	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	176.6	Gallons per person per day--self supply	
[Self-Supplied Water Use Coefficient]	0.1978	Acre-feet per person per year	
1995 Estimated Population on Public Supply.......................	94.20%	Percent of total resident population	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

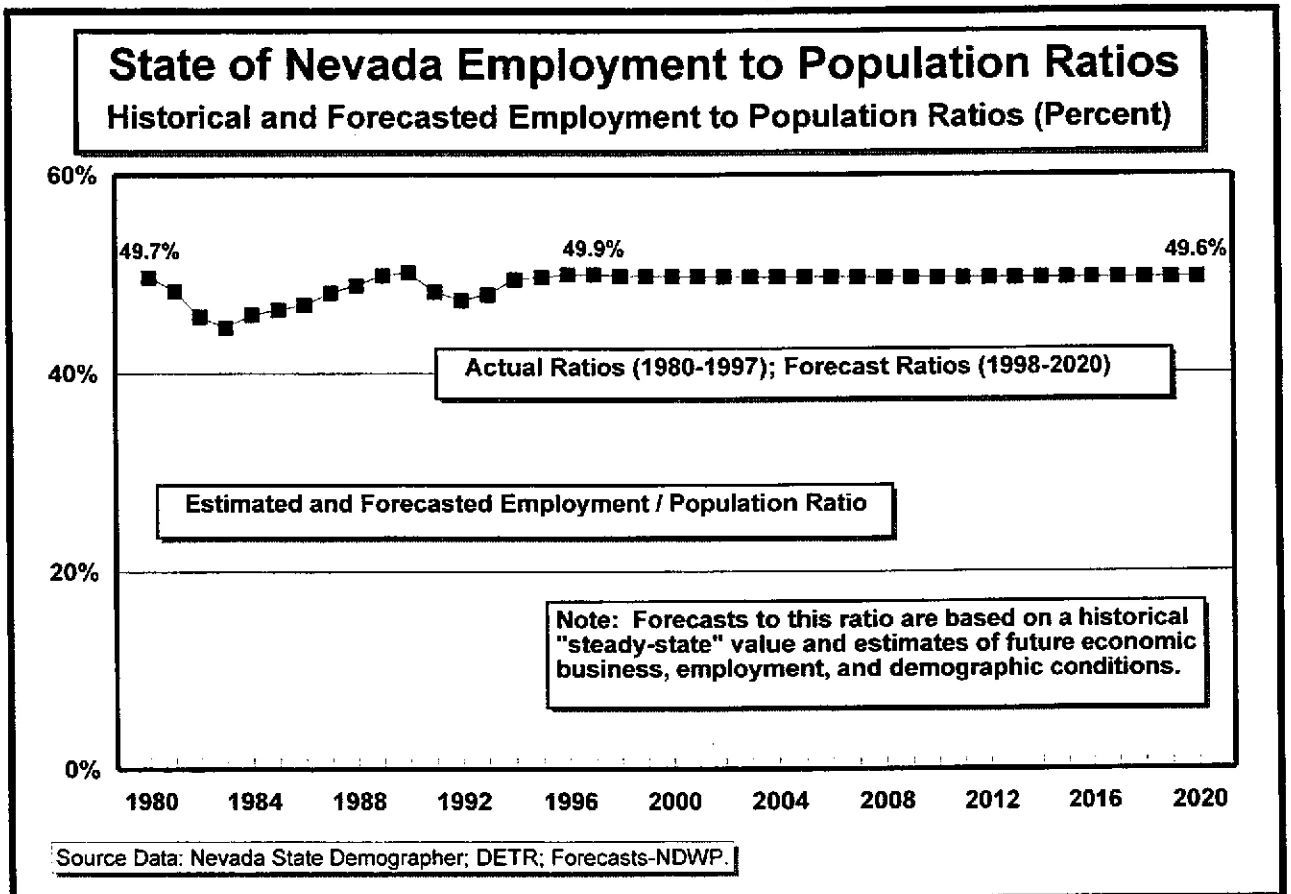
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

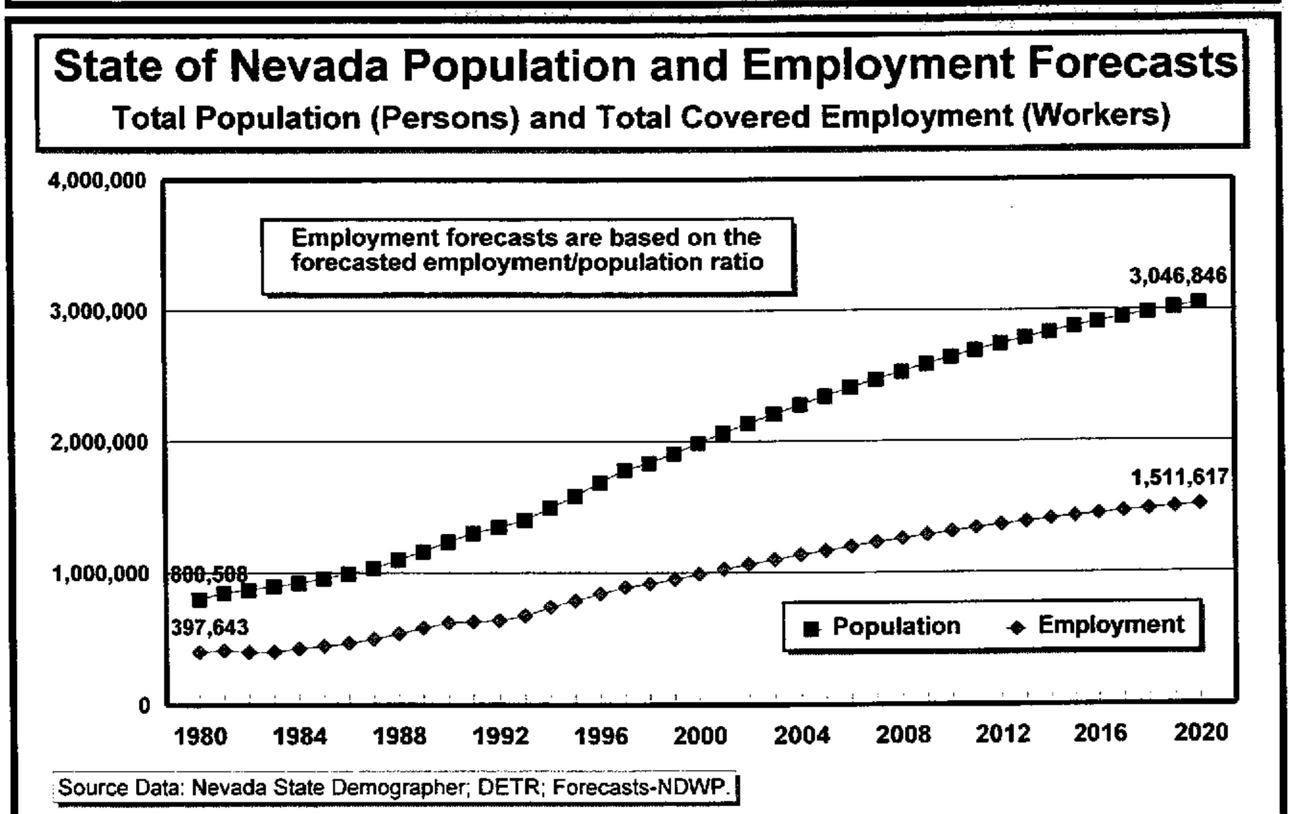
[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

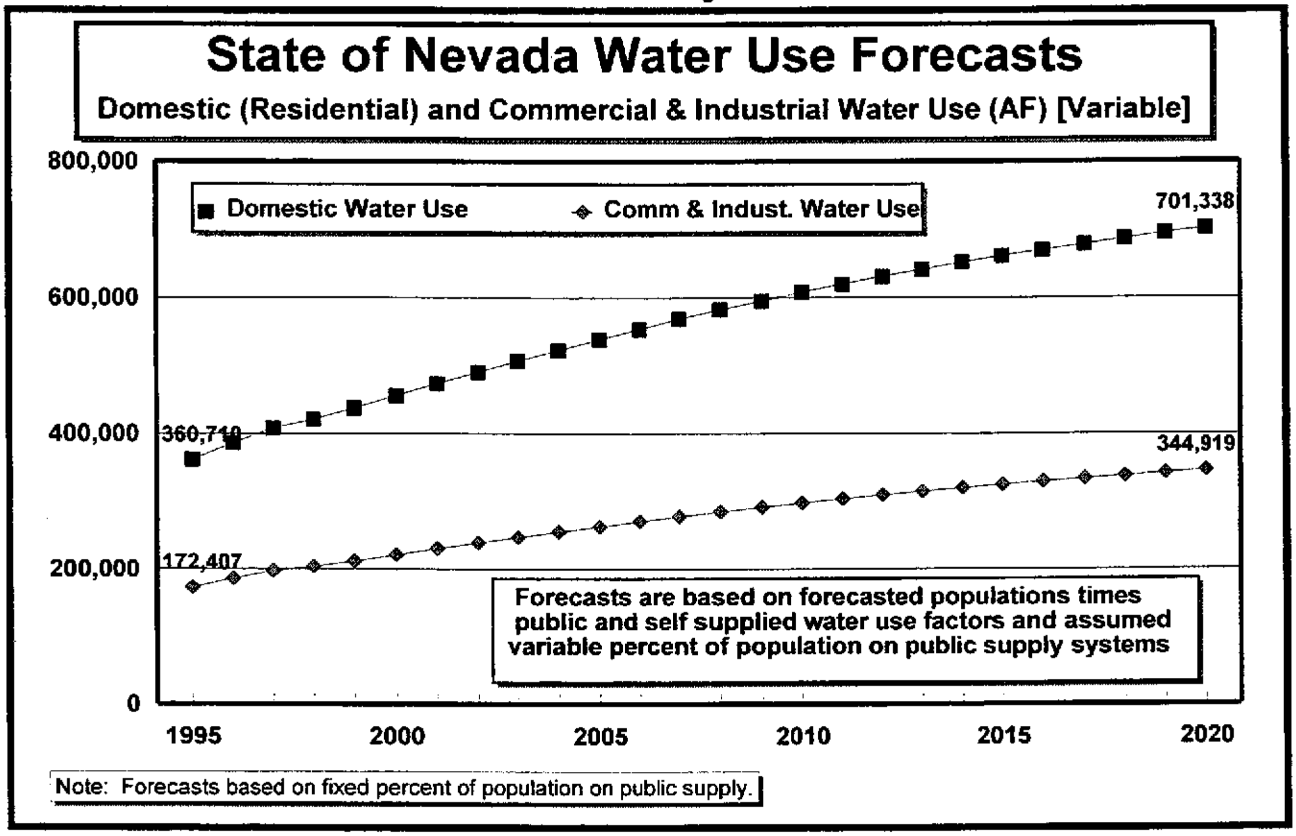
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

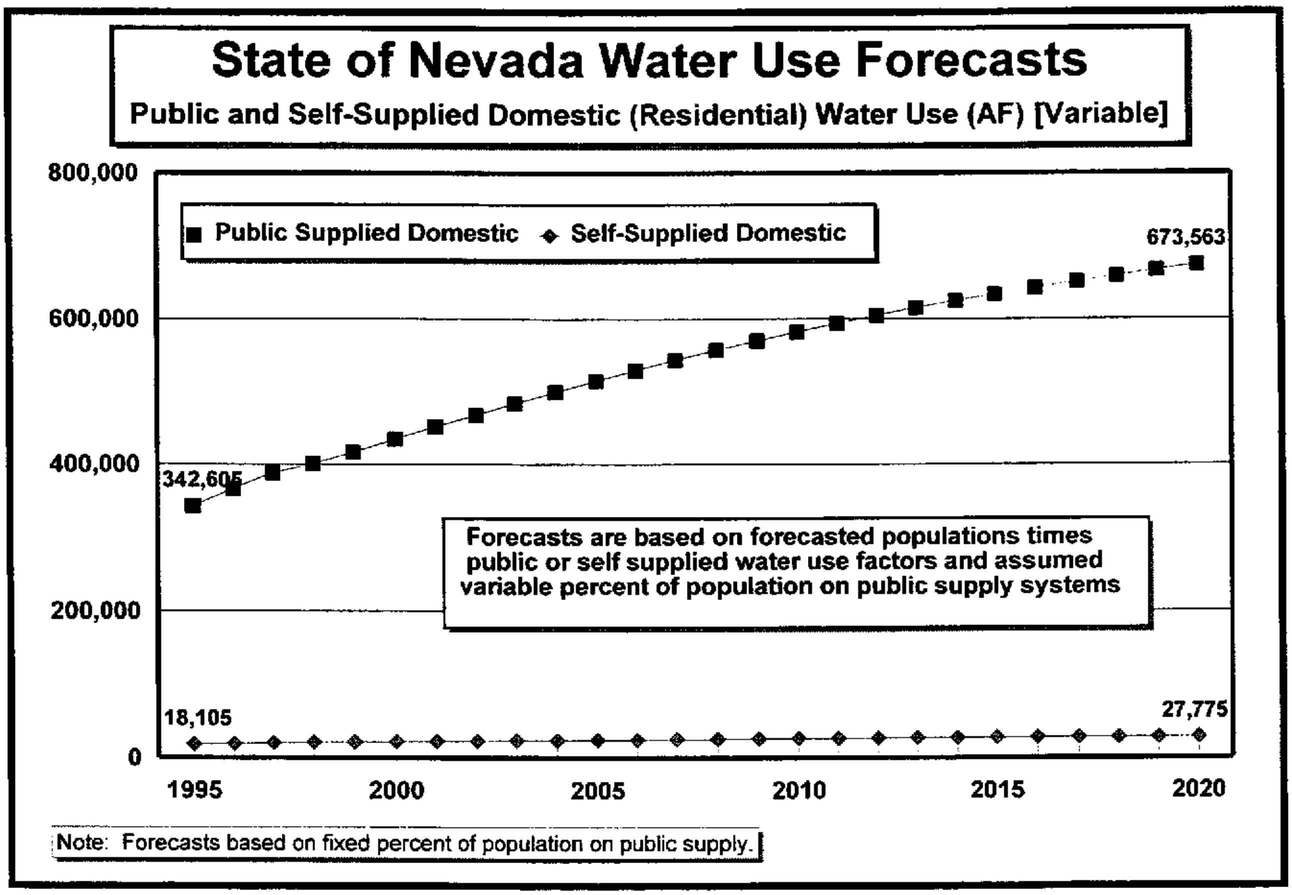
Nevada Socioeconomic Analysis and Forecasts





Nevada Water Use Analysis and Forecasts-1





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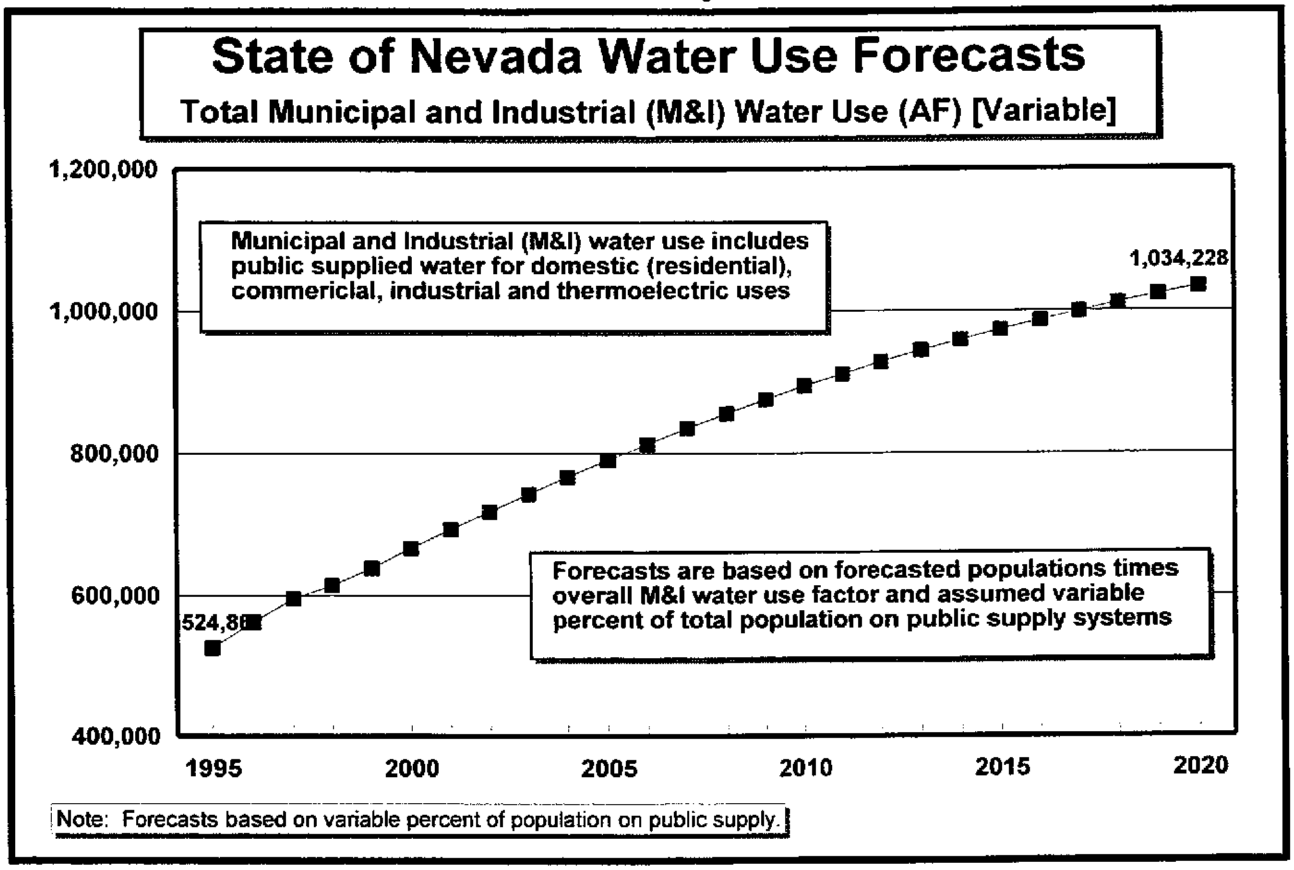
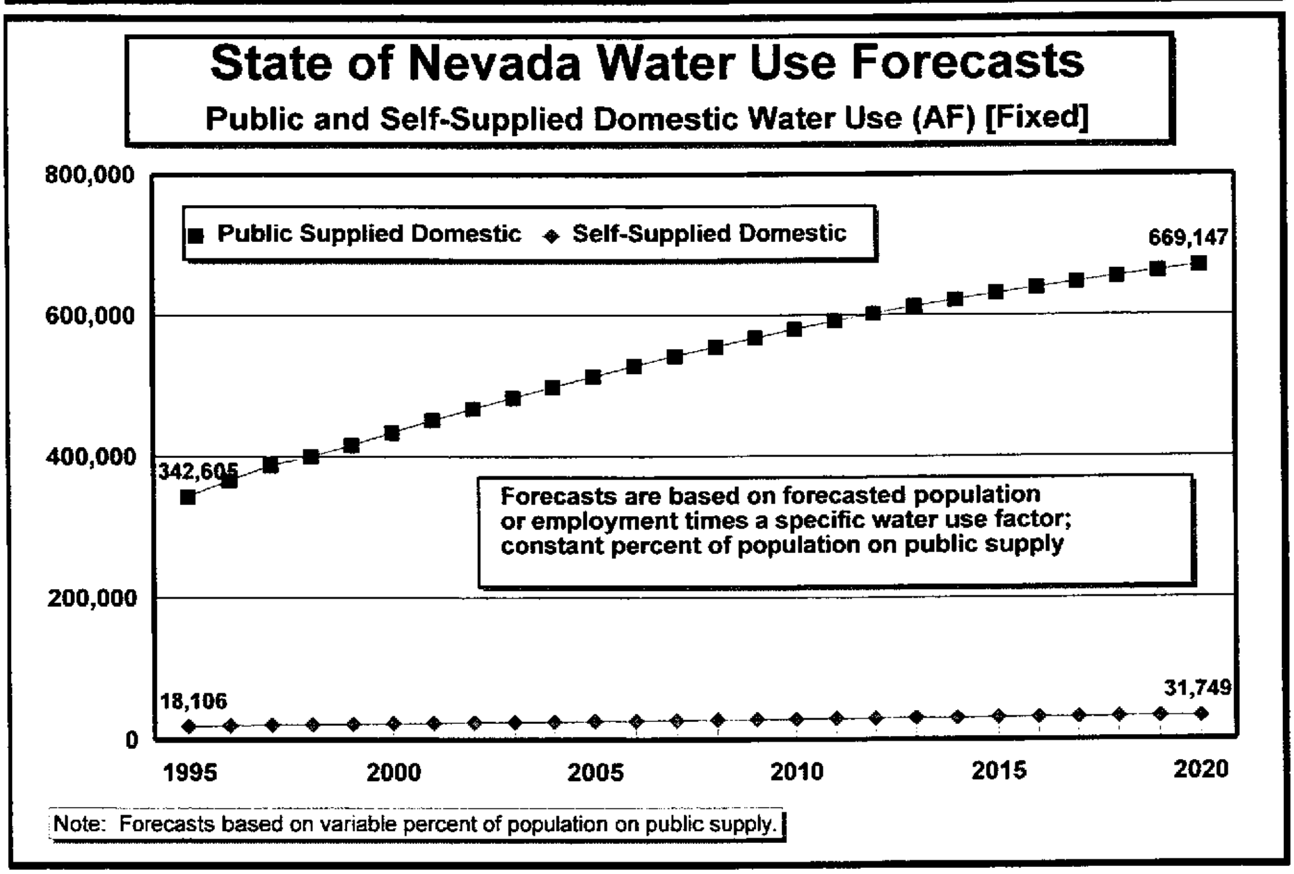




Carson City Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	32,022	15,507	48.43%	26	0.17%	4,859	1,343	6,396
1981	33,290	15,795	47.45%	95	0.60%	5,051	1,362	6,650
1982	34,070	15,203	44.62%	66	0.43%	5,169	1,313	6,805
1983	34,610	15,496	44.77%	54	0.35%	5,251	1,340	6,913
1984	34,950	16,422	46.99%	48	0.29%	5,303	1,421	6,981
1985	35,650	17,408	48.83%	39	0.22%	5,409	1,507	7,121
1986	36,340	18,084	49.76%	37	0.21%	5,514	1,566	7,259
1987	36,990	19,037	51.47%	22	0.11%	5,612	1,650	7,389
1988	38,280	20,148	52.63%	28	0.14%	5,808	1,746	7,646
1989	39,970	20,815	52.08%	31	0.15%	6,065	1,803	7,984
1990	40,950	21,520	52.55%	47	0.22%	6,213	1,863	8,180
1991	41,130	21,573	52.45%	57	0.26%	6,241	1,867	8,216
1992	42,140	21,483	50.98%	27	0.13%	6,394	1,862	8,417
1993	43,460	22,403	51.55%	29	0.13%	6,594	1,941	8,681
1994	44,580	24,170	54.22%	7	0.03%	6,764	2,097	8,905
1995	46,770	26,218	56.06%	12	0.04%	7,096	2,274	9,342
1996	48,860	27,017	55.30%	11	0.04%	7,413	2,343	9,760
1997	50,410	27,821	55.19%	10	0.04%	7,649	2,413	10,069
1998	51,771	28,553	55.15%	10	0.04%	7,855	2,477	10,341
1999	53,117	29,276	55.12%	10	0.04%	8,059	2,539	10,610
2000	54,445	29,988	55.08%	11	0.04%	8,261	2,601	10,875
2001	55,752	30,688	55.04%	11	0.04%	8,459	2,662	11,136
2002	57,034	31,373	55.01%	11	0.04%	8,654	2,721	11,392
2003	58,289	32,042	54.97%	11	0.04%	8,844	2,779	11,643
2004	59,513	32,693	54.93%	12	0.04%	9,030	2,836	11,887
2005	60,703	33,325	54.90%	12	0.04%	9,210	2,891	12,125
2006	61,856	33,936	54.86%	12	0.04%	9,385	2,944	12,356
2007	62,970	34,524	54.83%	12	0.03%	9,554	2,995	12,578
2008	64,040	35,088	54.79%	12	0.03%	9,717	3,044	12,792
2009	65,065	35,626	54.75%	12	0.03%	9,872	3,090	12,996
2010	66,041	36,136	54.72%	13	0.03%	10,020	3,134	13,191
2011	66,966	36,618	54.68%	13	0.03%	10,160	3,176	13,376
2012	67,836	37,069	54.65%	13	0.03%	10,293	3,215	13,550
2013	68,650	37,490	54.61%	13	0.03%	10,416	3,252	13,713
2014	69,405	37,877	54.57%	13	0.03%	10,531	3,285	13,863
2015	70,099	38,230	54.54%	13	0.03%	10,636	3,316	14,002
2016	70,730	38,549	54.50%	13	0.03%	10,732	3,344	14,128
2017	71,296	38,832	54.47%	13	0.03%	10,818	3,368	14,241
2018	71,795	39,078	54.43%	13	0.03%	10,893	3,390	14,341
2019	72,226	39,286	54.39%	13	0.03%	10,959	3,408	14,427
2020	72,587	39,457	54.36%	13	0.03%	11,013	3,423	14,499

Actual Period Average (1980-1997).......	50.85%	3.35%	Standard Deviation (1980-1997)
Forecast Period Average (1998-2020)....	54.75%	55.19%	Latest/Most Stable Period (1994-1997)

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person........................	197.7	135.5	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.2215	0.1517	Acre-feet per person per year
Commercial & Industrial Water Use per Worker..............	77.5		Gallons per worker per day (excludes mining)
[Commercial & Industrial Water Use Coefficient]	0.0868		Acre-feet per worker per year (excludes mining)

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Carson City Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	28,881	4,425	433	--	--	--	--	--
1981	30,024	4,600	451	--	--	--	--	--
1982	30,728	4,708	461	--	--	--	--	--
1983	31,215	4,783	468	--	--	--	--	--
1984	31,522	4,830	473	--	--	--	--	--
1985	32,153	4,927	482	--	--	--	--	--
1986	32,775	5,022	492	--	--	--	--	--
1987	33,361	5,112	501	--	--	--	--	--
1988	34,525	5,290	518	--	--	--	--	--
1989	36,049	5,524	541	--	--	--	--	--
1990	36,933	5,659	554	--	--	--	--	--
1991	37,095	5,684	557	--	--	--	--	--
1992	38,006	5,823	570	--	--	--	--	--
1993	39,197	6,006	588	--	--	--	--	--
1994	40,207	6,161	603	--	--	--	--	--
1995	42,182	6,463	633	42,182	90.19%	6,463	633	9,342
1996	44,067	6,752	661	44,078	90.21%	6,754	660	9,761
1997	45,465	6,966	682	45,488	90.24%	6,970	679	10,073
1998	46,692	7,154	701	46,728	90.26%	7,160	696	10,346
1999	47,906	7,340	719	47,954	90.28%	7,348	712	10,617
2000	49,104	7,524	737	49,166	90.30%	7,533	728	10,885
2001	50,283	7,704	755	50,358	90.33%	7,716	744	11,148
2002	51,439	7,882	772	51,529	90.35%	7,896	759	11,406
2003	52,571	8,055	789	52,676	90.37%	8,071	774	11,659
2004	53,675	8,224	805	53,796	90.39%	8,243	789	11,906
2005	54,748	8,389	822	54,885	90.42%	8,410	803	12,146
2006	55,789	8,548	837	55,942	90.44%	8,572	816	12,379
2007	56,793	8,702	852	56,963	90.46%	8,728	829	12,604
2008	57,758	8,850	867	57,946	90.48%	8,879	841	12,821
2009	58,682	8,992	881	58,888	90.51%	9,023	852	13,028
2010	59,563	9,126	894	59,786	90.53%	9,161	863	13,226
2011	60,396	9,254	906	60,638	90.55%	9,291	873	13,413
2012	61,182	9,374	918	61,442	90.57%	9,414	882	13,590
2013	61,916	9,487	929	62,195	90.60%	9,530	891	13,755
2014	62,597	9,591	939	62,895	90.62%	9,637	898	13,909
2015	63,223	9,687	949	63,540	90.64%	9,736	905	14,051
2016	63,792	9,774	957	64,128	90.66%	9,826	911	14,179
2017	64,302	9,853	965	64,657	90.69%	9,907	916	14,295
2018	64,752	9,922	972	65,126	90.71%	9,979	920	14,398
2019	65,141	9,981	978	65,533	90.73%	10,041	923	14,487
2020	65,466	10,031	982	65,877	90.76%	10,094	926	14,562

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied)...................	197.7	136.8	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.2215	0.1532	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	123.2		Gallons per person per day--self supply
[Self-Supplied Water Use Coefficient]	0.1380		Acre-feet per person per year
1995 Estimated Resident Population on Public Supply........	90.19%		Percent of total resident population

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

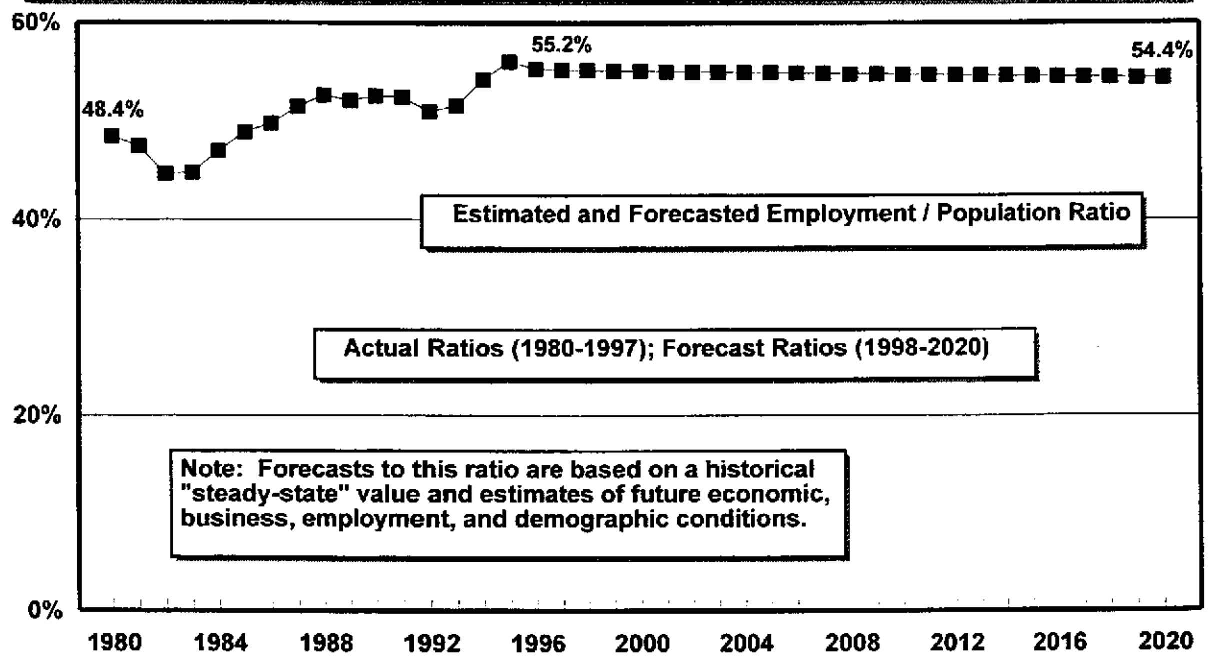
[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Carson City Employment-to-Population Ratios

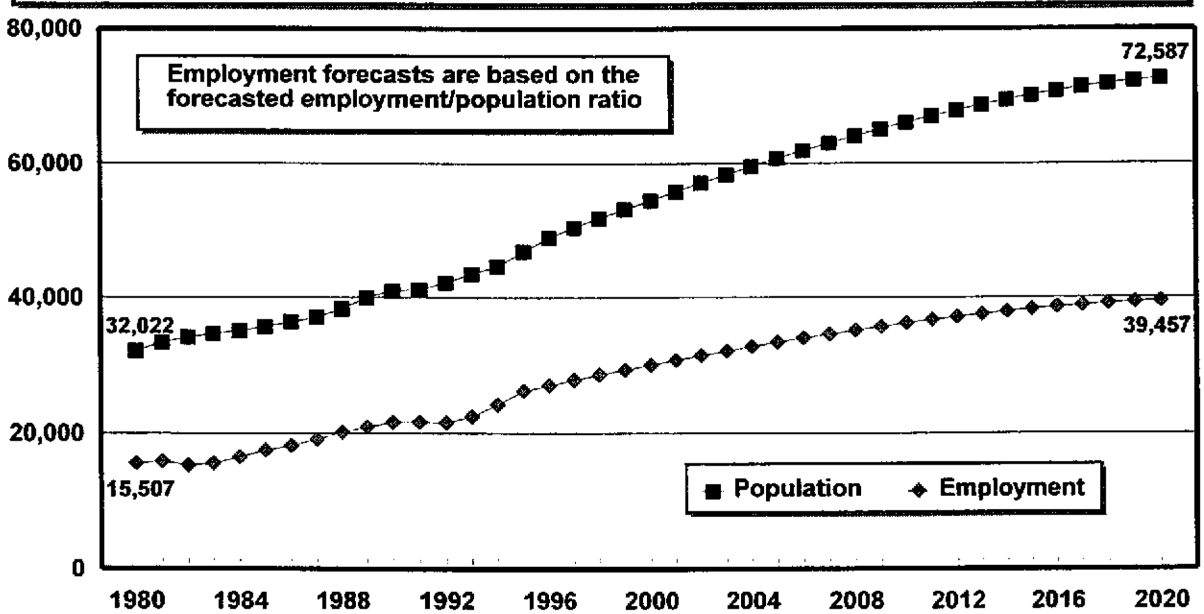
Ratio of Total Covered Employment to Total Population (Percent)



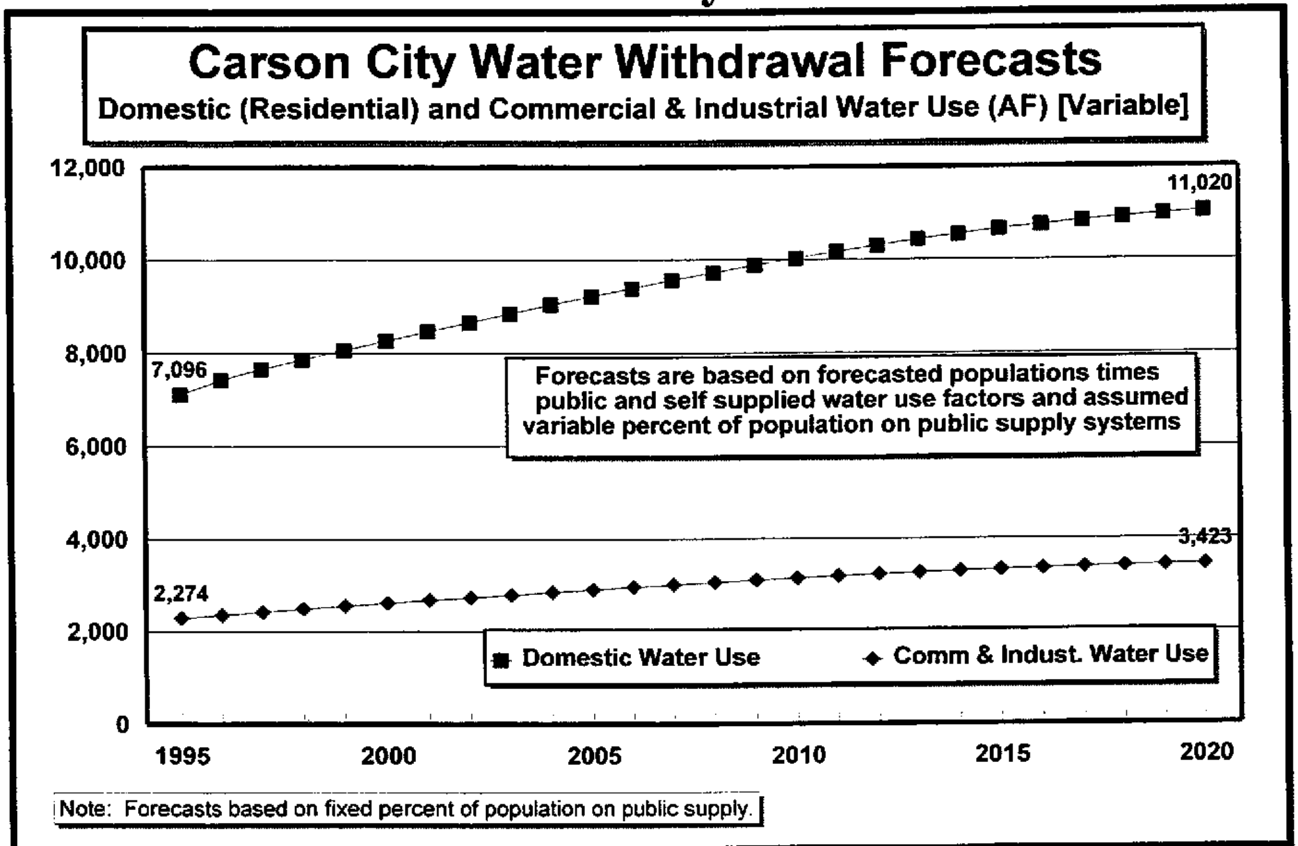
Source Data: Nevada State Demographer; DETR.

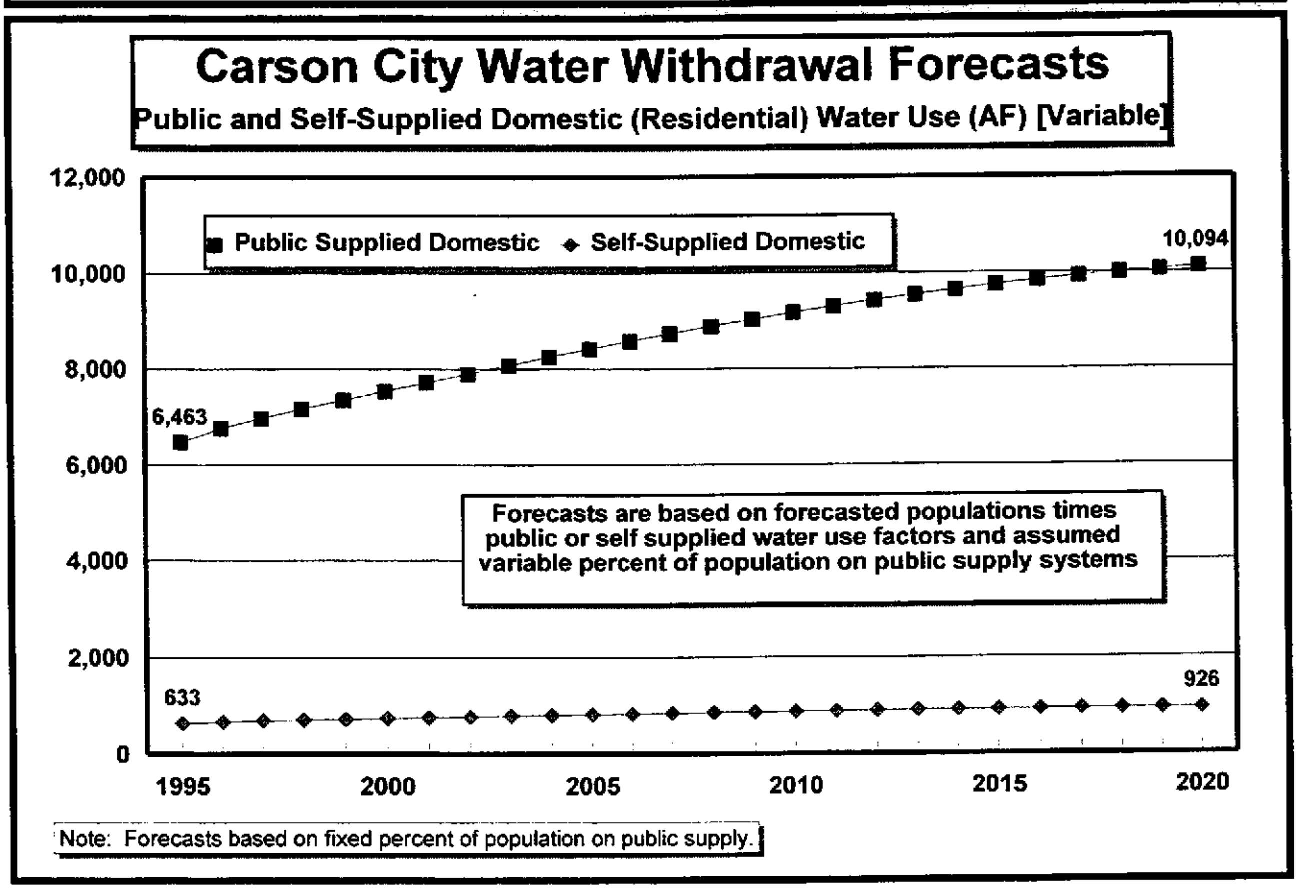
Carson City Population & Employment Forecasts

Total Population (Persons) and Total Covered Employment (Workers)

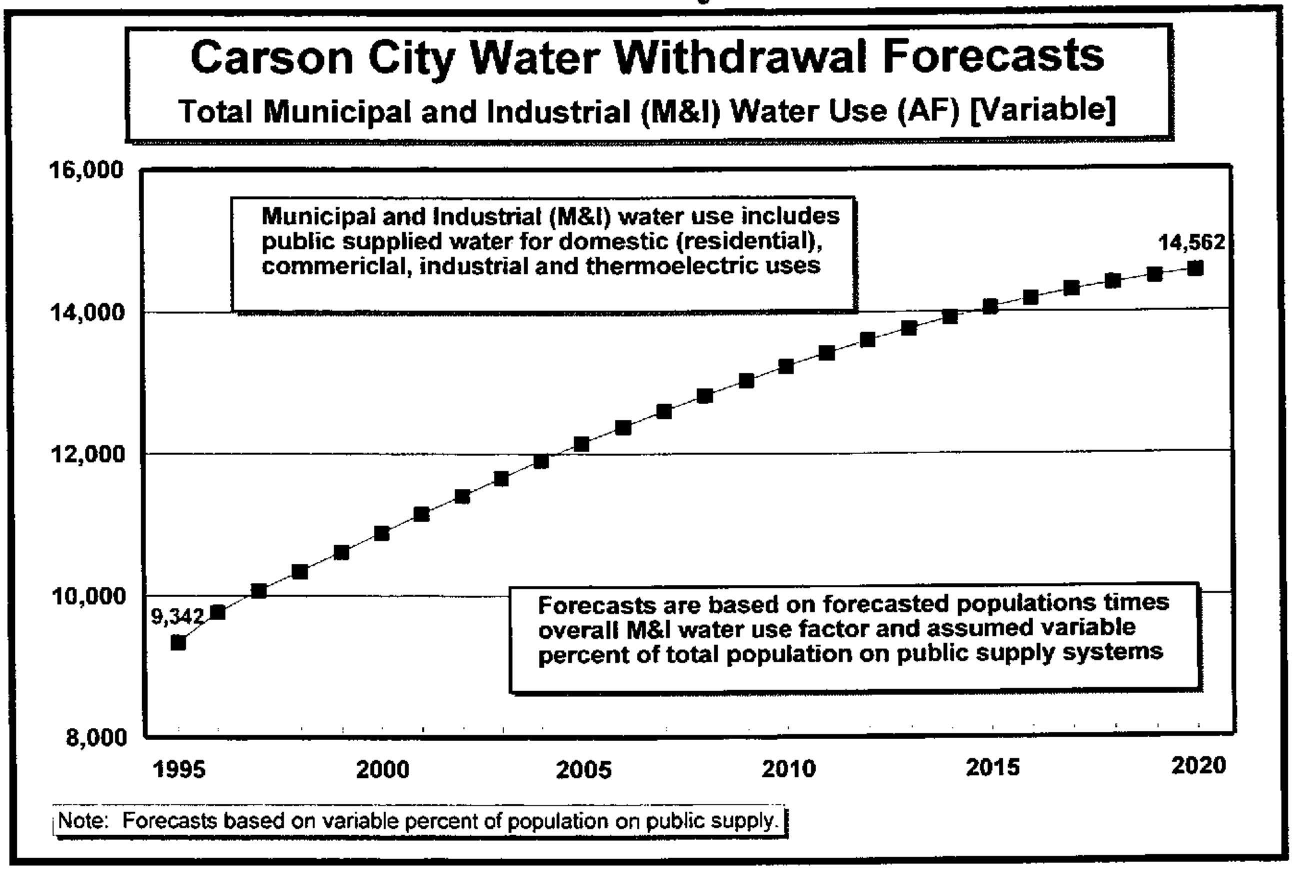


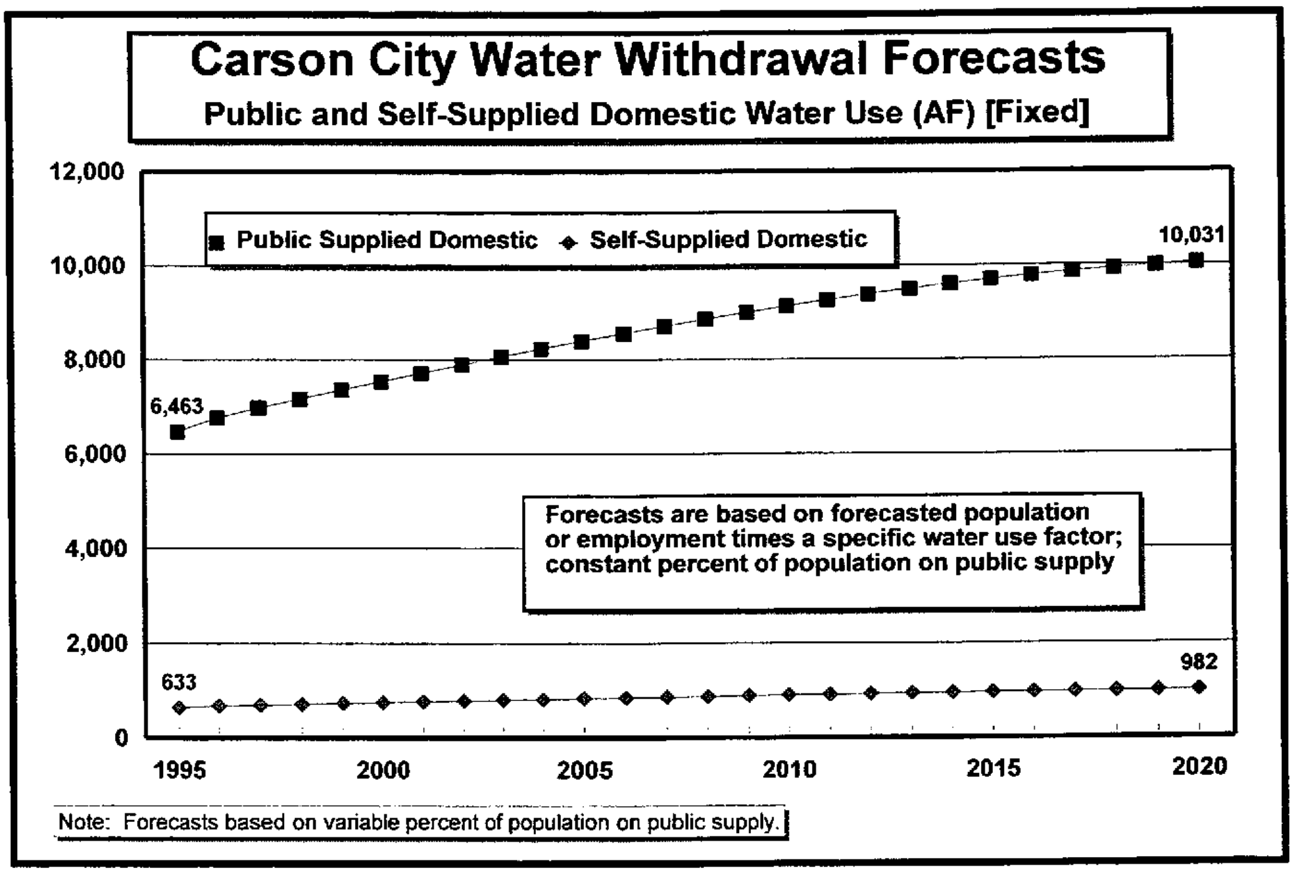
Source Data: Nevada State Demographer; DETR.


Carson City Water Withdrawal Forecasts
Domestic (Residential) and Commercial & Industrial Water Use (AF) [Variable]
12,000
10,000
8,000
6,000
4,000
2,000
0
1995
2000
2005
2010
2015
2020
7,096
11,020
2,274
3,423
Forecasts are based on forecasted populations times public and self supplied water use factors and assumed variable percent of population on public supply systems
Domestic Water Use
Comm & Indust. Water Use
Note: Forecasts based on fixed percent of population on public supply.


Carson City Water Withdrawal Forecasts
Public and Self-Supplied Domestic (Residential) Water Use (AF) [Variable]
12,000
10,000
8,000
6,000
4,000
2,000
0
1995
2000
2005
2010
2015
2020
Public Supplied Domestic
Self-Supplied Domestic
10,094
6,463
633
926
Forecasts are based on forecasted populations times public or self supplied water use factors and assumed variable percent of population on public supply systems
Note: Forecasts based on fixed percent of population on public supply.

Nevada Water Use Analysis and Forecasts-2





Churchill County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	13,917	3,556	25.55%	93	2.62%	2,223	710	2,298
1981	14,390	3,616	25.13%	117	3.24%	2,299	717	2,376
1982	14,480	3,609	24.92%	44	1.21%	2,313	731	2,391
1983	14,610	3,647	24.96%	29	0.81%	2,334	742	2,412
1984	14,810	3,898	26.32%	42	1.08%	2,366	790	2,445
1985	15,120	4,246	28.08%	43	1.01%	2,415	861	2,497
1986	15,400	4,454	28.92%	32	0.71%	2,460	906	2,543
1987	16,710	5,094	30.49%	29	0.57%	2,669	1,038	2,759
1988	17,790	5,610	31.53%	30	0.54%	2,842	1,144	2,938
1989	17,990	5,714	31.76%	42	0.74%	2,874	1,162	2,971
1990	18,100	5,823	32.17%	25	0.43%	2,891	1,188	2,989
1991	18,330	5,837	31.85%	13	0.23%	2,928	1,194	3,027
1992	19,210	6,006	31.27%	11	0.18%	3,069	1,229	3,172
1993	19,850	6,258	31.52%	22	0.36%	3,171	1,278	3,278
1994	20,570	6,753	32.83%	28	0.41%	3,286	1,378	3,397
1995	21,640	6,967	32.20%	26	0.38%	3,457	1,423	3,573
1996	22,580	7,579	33.56%	34	0.45%	3,607	1,546	3,729
1997	23,860	7,635	32.00%	14	0.18%	3,811	1,562	3,940
1998	24,579	7,885	32.08%	14	0.18%	3,926	1,613	4,059
1999	25,300	8,136	32.16%	15	0.18%	4,041	1,664	4,178
2000	26,019	8,389	32.24%	15	0.18%	4,156	1,716	4,296
2001	26,737	8,642	32.32%	16	0.18%	4,271	1,768	4,415
2002	27,453	8,895	32.40%	16	0.18%	4,385	1,820	4,533
2003	28,164	9,148	32.48%	17	0.18%	4,499	1,872	4,651
2004	28,869	9,401	32.56%	17	0.18%	4,611	1,923	4,767
2005	29,568	9,652	32.64%	18	0.18%	4,723	1,975	4,882
2006	30,258	9,902	32.73%	18	0.18%	4,833	2,026	4,996
2007	30,939	10,151	32.81%	18	0.18%	4,942	2,077	5,109
2008	31,609	10,396	32.89%	18	0.17%	5,049	2,127	5,219
2009	32,266	10,639	32.97%	18	0.17%	5,154	2,177	5,328
2010	32,910	10,878	33.05%	18	0.17%	5,257	2,226	5,434
2011	33,539	11,114	33.14%	18	0.16%	5,357	2,274	5,538
2012	34,151	11,345	33.22%	18	0.16%	5,455	2,322	5,639
2013	34,745	11,571	33.30%	18	0.16%	5,550	2,368	5,737
2014	35,320	11,792	33.39%	18	0.15%	5,642	2,413	5,832
2015	35,875	12,007	33.47%	18	0.15%	5,730	2,457	5,924
2016	36,407	12,216	33.55%	18	0.15%	5,816	2,500	6,012
2017	36,917	12,418	33.64%	18	0.14%	5,897	2,541	6,096
2018	37,402	12,613	33.72%	18	0.14%	5,975	2,581	6,176
2019	37,862	12,800	33.81%	18	0.14%	6,048	2,620	6,252
2020	38,296	12,979	33.89%	18	0.14%	6,117	2,656	6,324
Actual Period Average (1980-1997)......			29.73%	2.97%	Standard Deviation (1980-1997)			
Forecast Period Average (1998-2020)....			32.98%	32.65%	Latest/Most Stable Period (1994-1997)			

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person....................	**246.9**	**142.6**	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.2765	0.1597	Acre-feet per person per year
Commercial & Industrial Water Use per Worker..............	**183.0**	Gallons per worker per day (excludes mining)	
[Commercial & Industrial Water Use Coefficient]	0.2050	Acre-feet per worker per year (excludes mining)	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Churchill County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	8,310	1,383	840	--	--	--	--	--
1981	8,593	1,430	868	--	--	--	--	--
1982	8,647	1,439	874	--	--	--	--	--
1983	8,724	1,452	882	--	--	--	--	--
1984	8,844	1,472	894	--	--	--	--	--
1985	9,029	1,503	913	--	--	--	--	--
1986	9,196	1,531	929	--	--	--	--	--
1987	9,978	1,661	1,008	--	--	--	--	--
1988	10,623	1,768	1,074	--	--	--	--	--
1989	10,742	1,788	1,086	--	--	--	--	--
1990	10,808	1,799	1,092	--	--	--	--	--
1991	10,945	1,822	1,106	--	--	--	--	--
1992	11,471	1,909	1,159	--	--	--	--	--
1993	11,853	1,973	1,198	--	--	--	--	--
1994	12,283	2,044	1,241	--	--	--	--	--
1995	12,922	2,151	1,306	12,922	59.71%	2,151	1,306	3,573
1996	13,483	2,244	1,363	13,517	59.86%	2,250	1,358	3,734
1997	14,248	2,371	1,440	14,319	60.01%	2,383	1,429	3,952
1998	14,677	2,443	1,483	14,788	60.16%	2,461	1,467	4,077
1999	15,107	2,514	1,527	15,259	60.31%	2,540	1,504	4,203
2000	15,537	2,586	1,570	15,732	60.46%	2,618	1,541	4,329
2001	15,966	2,657	1,614	16,207	60.61%	2,697	1,578	4,455
2002	16,393	2,728	1,657	16,682	60.77%	2,776	1,614	4,581
2003	16,818	2,799	1,700	17,157	60.92%	2,856	1,649	4,707
2004	17,239	2,869	1,742	17,631	61.07%	2,934	1,684	4,832
2005	17,656	2,939	1,784	18,102	61.22%	3,013	1,718	4,957
2006	18,068	3,007	1,826	18,571	61.38%	3,091	1,751	5,080
2007	18,475	3,075	1,867	19,037	61.53%	3,168	1,783	5,202
2008	18,875	3,141	1,908	19,497	61.68%	3,245	1,814	5,323
2009	19,267	3,207	1,947	19,953	61.84%	3,321	1,845	5,442
2010	19,652	3,271	1,986	20,402	61.99%	3,396	1,874	5,559
2011	20,027	3,333	2,024	20,843	62.15%	3,469	1,902	5,674
2012	20,393	3,394	2,061	21,277	62.30%	3,541	1,929	5,786
2013	20,747	3,453	2,097	21,701	62.46%	3,612	1,954	5,896
2014	21,091	3,510	2,132	22,115	62.61%	3,681	1,978	6,003
2015	21,422	3,565	2,165	22,519	62.77%	3,748	2,001	6,106
2016	21,740	3,618	2,197	22,910	62.93%	3,813	2,022	6,207
2017	22,044	3,669	2,228	23,289	63.09%	3,876	2,042	6,303
2018	22,334	3,717	2,257	23,654	63.24%	3,937	2,060	6,396
2019	22,609	3,763	2,285	24,005	63.40%	3,995	2,076	6,484
2020	22,868	3,806	2,311	24,341	63.56%	4,051	2,091	6,569

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied)....................	**246.9**	**148.6**	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.2765	0.1664	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	**133.7**	Gallons per person per day--self supply	
[Self-Supplied Water Use Coefficient]	0.1498	Acre-feet per person per year	
1995 Estimated Resident Population on Public Supply........	**59.71%**	Percent of total resident population	

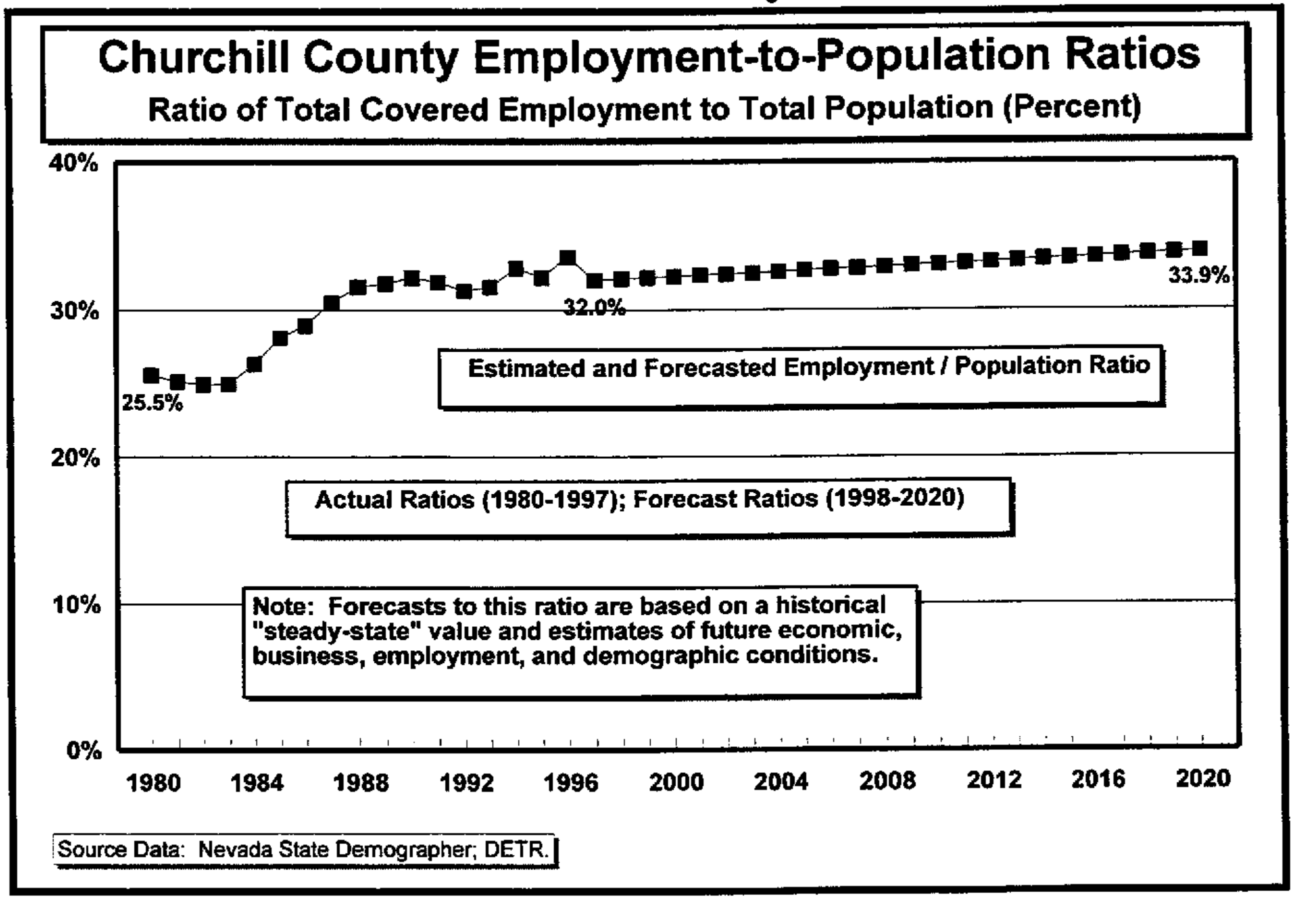
Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

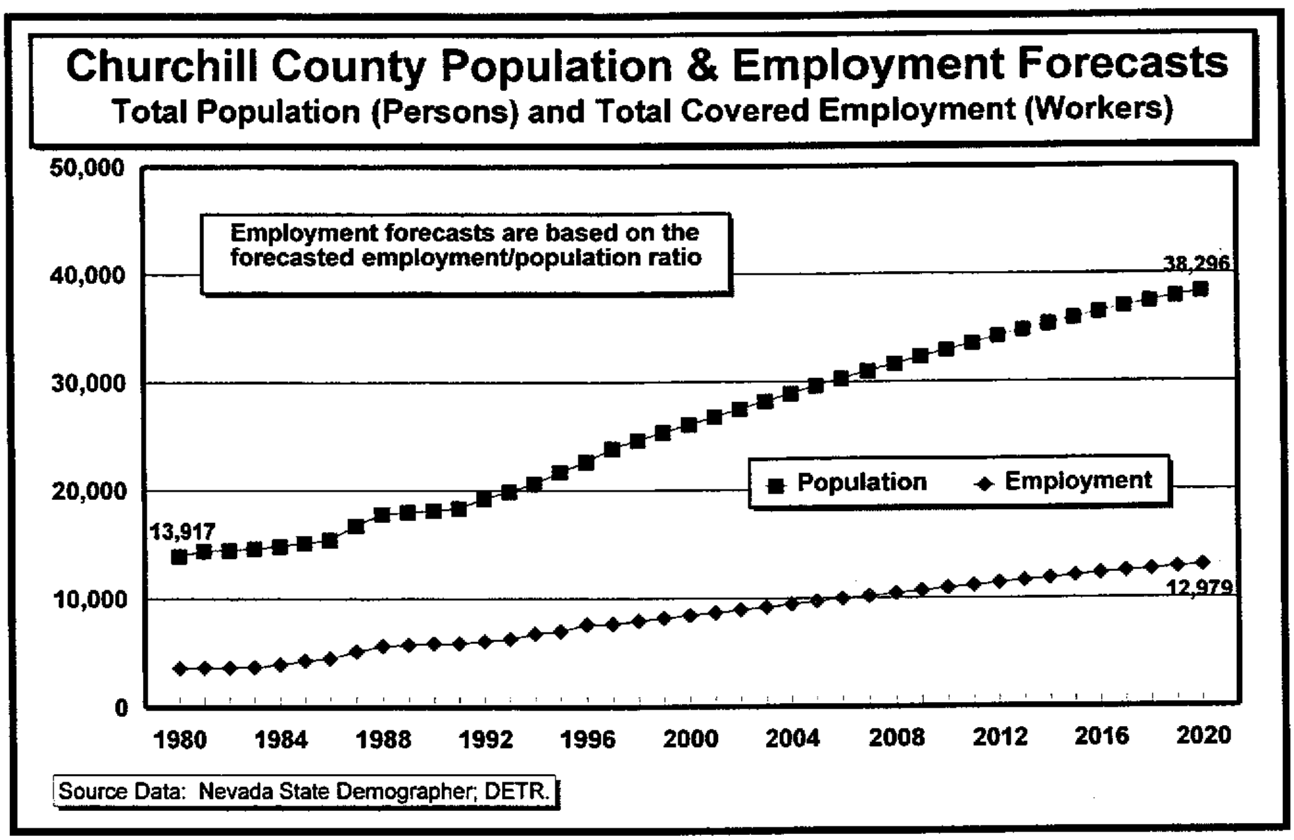
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

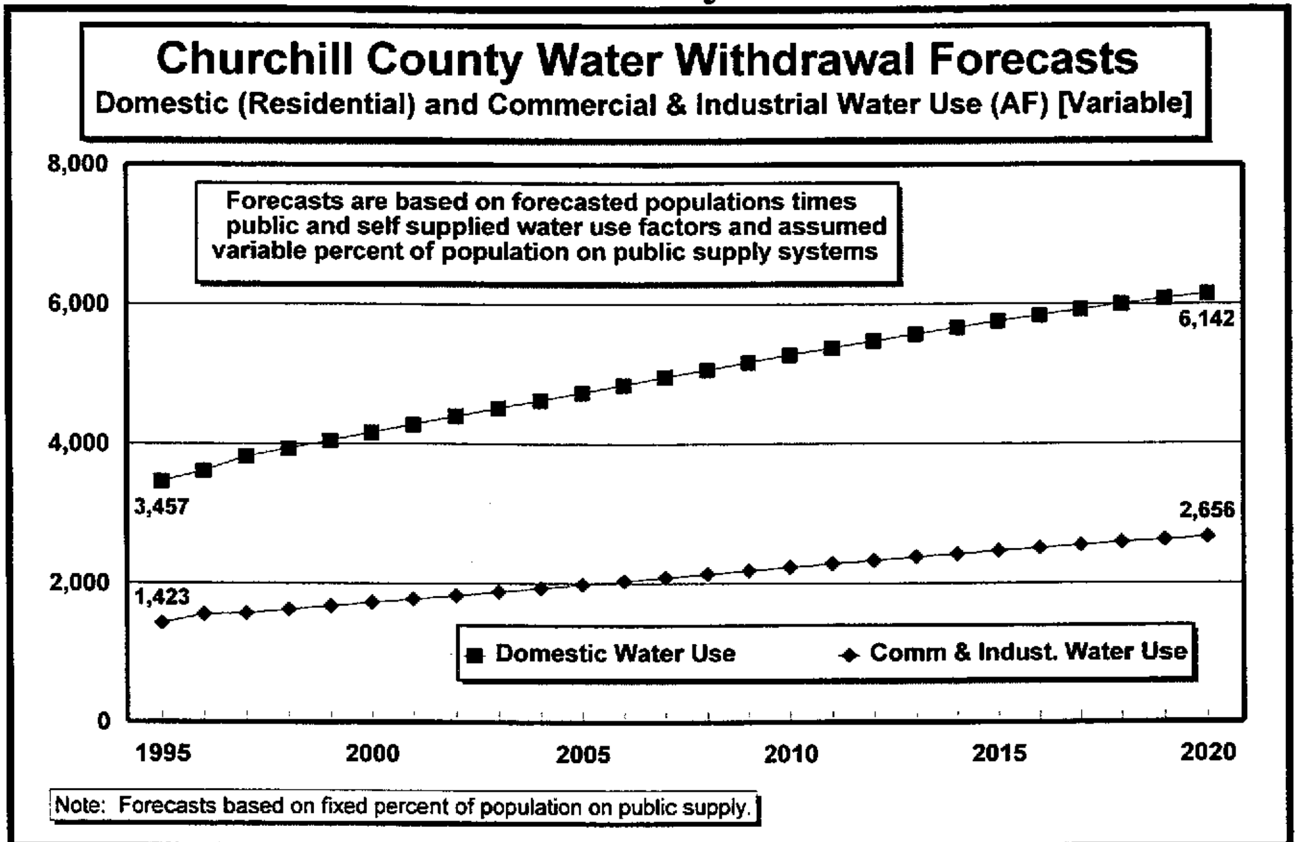
[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

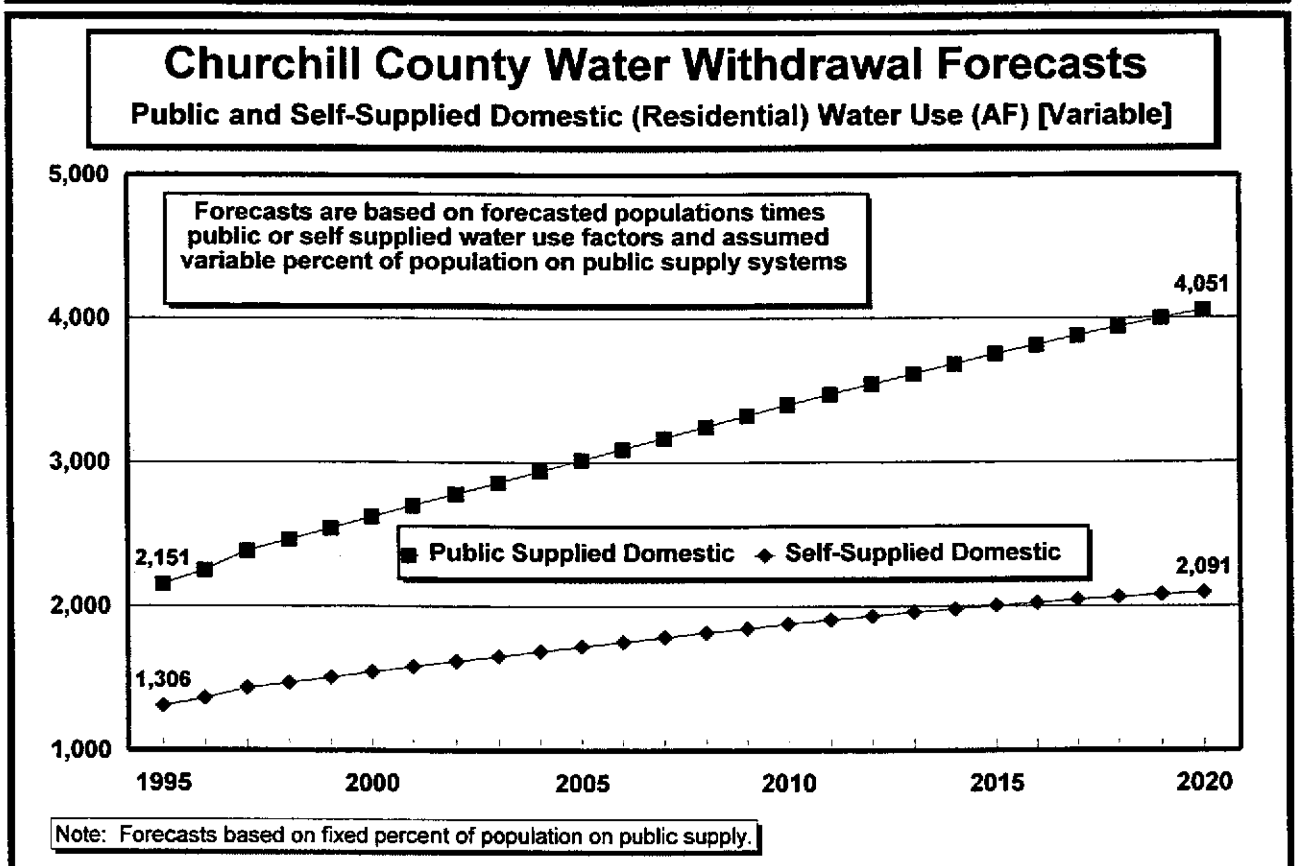
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.


Churchill County Employment-to-Population Ratios
Ratio of Total Covered Employment to Total Population (Percent)
40%
30%
20%
10%
0%
25.5%
32.0%
33.9%
Estimated and Forecasted Employment / Population Ratio
Actual Ratios (1980-1997); Forecast Ratios (1998-2020)
Note: Forecasts to this ratio are based on a historical "steady-state" value and estimates of future economic, business, employment, and demographic conditions.
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Source Data: Nevada State Demographer; DETR.

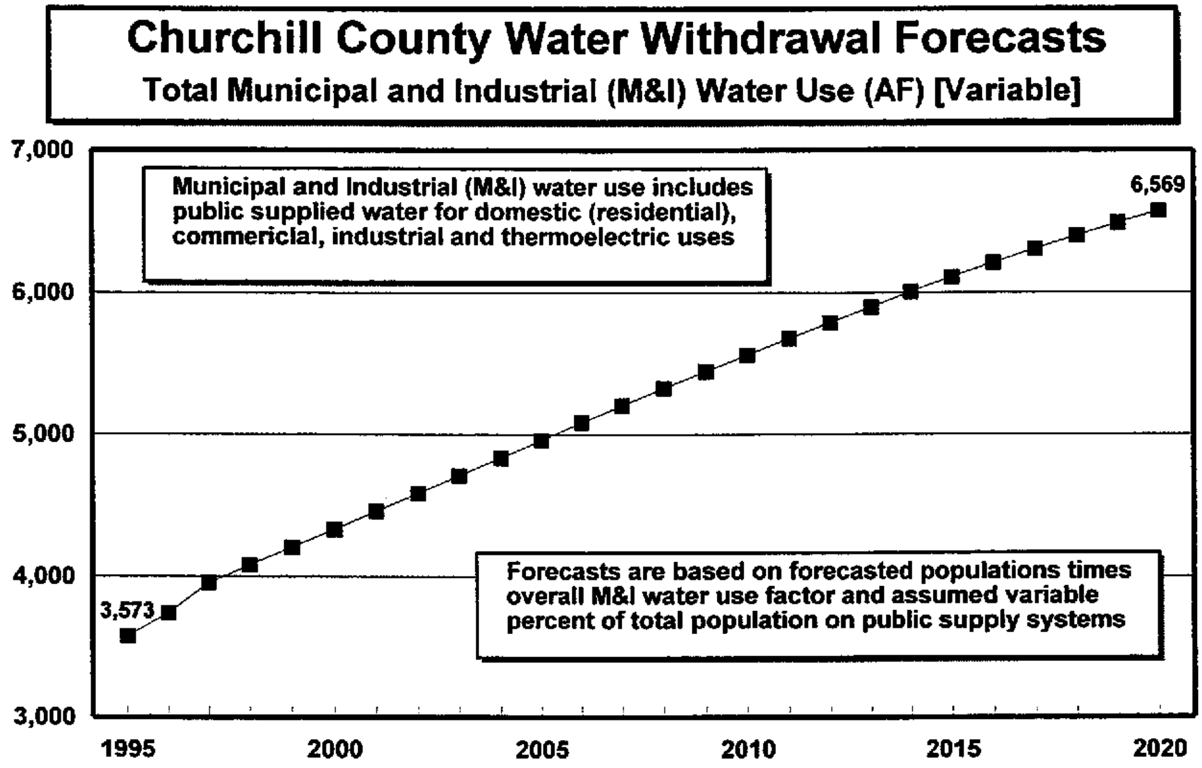

Churchill County Population & Employment Forecasts
Total Population (Persons) and Total Covered Employment (Workers)
50,000
40,000
30,000
20,000
10,000
0
Employment forecasts are based on the forecasted employment/population ratio
38,296
13,917
Population
Employment
12,979
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Source Data: Nevada State Demographer; DETR.

Nevada Water Use Analysis and Forecasts-1

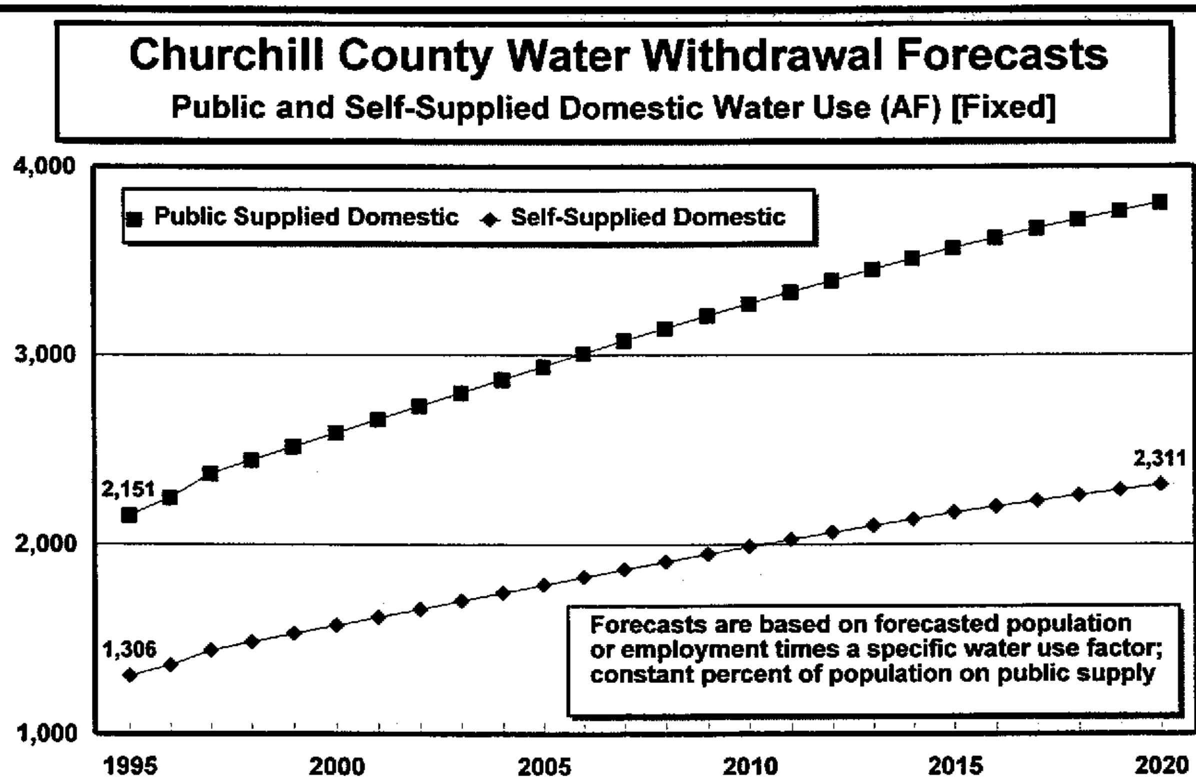




Nevada Water Use Analysis and Forecasts-2



Note: Forecasts based on variable percent of population on public supply.



Note: Forecasts based on variable percent of population on public supply.

Clark County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	463,087	216,188	46.68%	471	0.22%	110,247	52,052	169,776
1981	491,620	222,938	45.35%	504	0.23%	117,040	53,673	180,237
1982	507,510	217,018	42.76%	410	0.19%	120,823	52,267	186,062
1983	525,050	219,719	41.85%	292	0.13%	124,999	52,947	192,493
1984	539,030	231,684	42.98%	291	0.13%	128,327	55,834	197,618
1985	562,280	244,869	43.55%	247	0.10%	133,862	59,026	206,142
1986	587,760	260,739	44.36%	279	0.11%	139,928	62,848	215,483
1987	616,650	283,291	45.94%	284	0.10%	146,806	68,289	226,075
1988	661,690	306,215	46.28%	199	0.06%	157,529	73,841	242,587
1989	708,750	339,256	47.87%	266	0.08%	168,732	81,797	259,840
1990	770,280	374,231	48.58%	254	0.07%	183,381	90,239	282,398
1991	820,840	382,103	46.55%	232	0.06%	195,418	92,144	300,935
1992	856,350	390,065	45.55%	302	0.08%	203,872	94,048	313,953
1993	898,020	415,550	46.27%	405	0.10%	213,792	100,173	329,230
1994	971,680	467,143	48.08%	387	0.08%	231,328	112,627	356,235
1995	1,036,290	502,180	48.46%	448	0.09%	246,710	121,066	379,922
1996	1,115,940	548,282	49.13%	542	0.10%	265,672	132,168	409,123
1997	1,192,200	585,822	49.14%	571	0.10%	283,827	141,219	437,082
1998	1,233,347	606,192	49.15%	573	0.09%	293,623	146,134	452,167
1999	1,288,781	633,597	49.16%	580	0.09%	306,821	152,745	472,490
2000	1,355,368	666,499	49.17%	590	0.09%	322,673	160,682	496,902
2001	1,417,132	697,045	49.19%	596	0.09%	337,377	168,051	519,546
2002	1,476,095	726,229	49.20%	599	0.08%	351,414	175,092	541,163
2003	1,532,400	754,119	49.21%	599	0.08%	364,819	181,822	561,805
2004	1,587,021	781,194	49.22%	597	0.08%	377,823	188,355	581,830
2005	1,640,444	807,693	49.24%	601	0.07%	390,541	194,748	601,416
2006	1,693,049	833,802	49.25%	604	0.07%	403,065	201,048	620,702
2007	1,742,557	858,399	49.26%	605	0.07%	414,851	206,983	638,852
2008	1,789,103	881,548	49.27%	604	0.07%	425,932	212,569	655,917
2009	1,833,010	903,408	49.29%	610	0.07%	436,385	217,842	672,014
2010	1,874,431	924,054	49.30%	614	0.07%	446,246	222,823	687,200
2011	1,913,368	943,485	49.31%	618	0.07%	455,516	227,510	701,475
2012	1,949,898	961,738	49.32%	620	0.06%	464,213	231,914	714,867
2013	1,983,988	978,797	49.33%	621	0.06%	472,329	236,030	727,365
2014	2,016,010	994,843	49.35%	621	0.06%	479,952	239,902	739,105
2015	2,046,229	1,010,008	49.36%	621	0.06%	487,146	243,562	750,184
2016	2,074,731	1,024,333	49.37%	619	0.06%	493,932	247,018	760,633
2017	2,102,041	1,038,076	49.38%	617	0.06%	500,434	250,335	770,646
2018	2,128,269	1,051,291	49.40%	615	0.06%	506,678	253,524	780,261
2019	2,153,544	1,064,042	49.41%	612	0.06%	512,695	256,602	789,527
2020	2,178,046	1,076,417	49.42%	608	0.06%	518,528	259,589	798,510

Actual Period Average (1980-1997).......	46.08%	2.20%	Standard Deviation (1980-1997)
Forecast Period Average (1998-2020)....	49.29%	48.70%	Latest/Most Stable Period (1994-1997)
Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person.....................	**334.2**	**212.5**	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.3744	0.2381	Acre-feet per person per year
Commercial & Industrial Water Use per Worker..............	**215.4**	Gallons per worker per day (excludes mining)	
[Commercial & Industrial Water Use Coefficient]	0.2413	Acre-feet per worker per year (excludes mining)	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Clark County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	453,514	108,192	2,056	--	--	--	--	--
1981	481,457	114,858	2,182	--	--	--	--	--
1982	497,018	118,570	2,253	--	--	--	--	--
1983	514,196	122,668	2,331	--	--	--	--	--
1984	527,887	125,934	2,393	--	--	--	--	--
1985	550,656	131,366	2,496	--	--	--	--	--
1986	575,609	137,319	2,609	--	--	--	--	--
1987	603,902	144,069	2,737	--	--	--	--	--
1988	648,011	154,592	2,937	--	--	--	--	--
1989	694,098	165,586	3,146	--	--	--	--	--
1990	754,356	179,962	3,419	--	--	--	--	--
1991	803,871	191,774	3,644	--	--	--	--	--
1992	838,647	200,070	3,801	--	--	--	--	--
1993	879,455	209,806	3,986	--	--	--	--	--
1994	951,593	227,015	4,313	--	--	--	--	--
1995	1,014,867	242,110	4,600	1,014,867	97.93%	242,110	4,600	379,922
1996	1,092,870	260,719	4,954	1,093,144	97.96%	260,784	4,895	409,189
1997	1,167,554	278,535	5,292	1,168,138	97.98%	278,675	5,167	437,221
1998	1,207,850	288,149	5,475	1,208,756	98.01%	288,365	5,280	452,383
1999	1,262,138	301,100	5,721	1,263,401	98.03%	301,401	5,450	472,791
2000	1,327,349	316,657	6,016	1,329,009	98.06%	317,053	5,660	497,298
2001	1,387,836	331,087	6,291	1,389,919	98.08%	331,583	5,843	520,043
2002	1,445,580	344,862	6,552	1,448,112	98.10%	345,466	6,009	541,767
2003	1,500,721	358,017	6,802	1,503,725	98.13%	358,733	6,157	562,522
2004	1,554,213	370,778	7,045	1,557,713	98.15%	371,613	6,293	582,665
2005	1,606,531	383,259	7,282	1,610,552	98.18%	384,218	6,418	602,375
2006	1,658,049	395,549	7,515	1,662,614	98.20%	396,639	6,535	621,791
2007	1,706,533	407,116	7,735	1,711,660	98.23%	408,339	6,634	640,075
2008	1,752,117	417,991	7,942	1,757,820	98.25%	419,351	6,717	657,277
2009	1,795,117	428,249	8,137	1,801,410	98.28%	429,750	6,785	673,515
2010	1,835,681	437,926	8,320	1,842,577	98.30%	439,571	6,840	688,845
2011	1,873,813	447,023	8,493	1,881,323	98.33%	448,814	6,881	703,266
2012	1,909,588	455,557	8,655	1,917,720	98.35%	457,497	6,909	716,807
2013	1,942,973	463,522	8,807	1,951,735	98.37%	465,612	6,925	729,456
2014	1,974,333	471,003	8,949	1,983,733	98.40%	473,246	6,931	741,347
2015	2,003,928	478,063	9,083	2,013,971	98.42%	480,459	6,926	752,580
2016	2,031,841	484,722	9,210	2,042,534	98.45%	487,273	6,913	763,184
2017	2,058,586	491,103	9,331	2,069,938	98.47%	493,811	6,893	773,354
2018	2,084,272	497,230	9,447	2,096,289	98.50%	500,097	6,867	783,128
2019	2,109,024	503,136	9,559	2,121,715	98.52%	506,163	6,834	792,555
2020	2,133,020	508,860	9,668	2,146,391	98.55%	512,050	6,797	801,700

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied).....................	334.2	213.0	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.3744	0.2386	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	191.7	Gallons per person per day--self supply	
[Self-Supplied Water Use Coefficient]	0.2147	Acre-feet per person per year	
1995 Estimated Resident Population on Public Supply........	97.93%	Percent of total resident population	

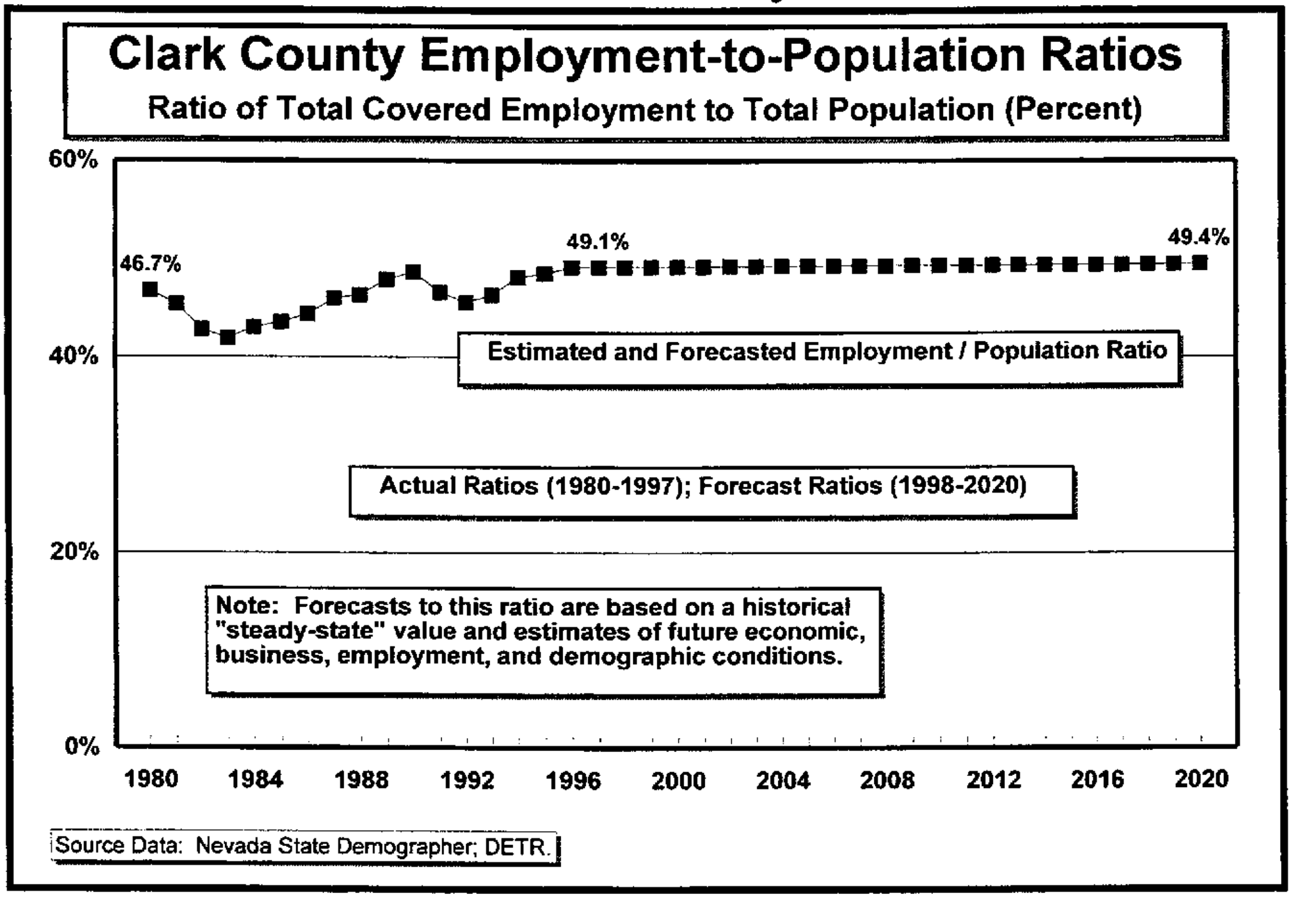
Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

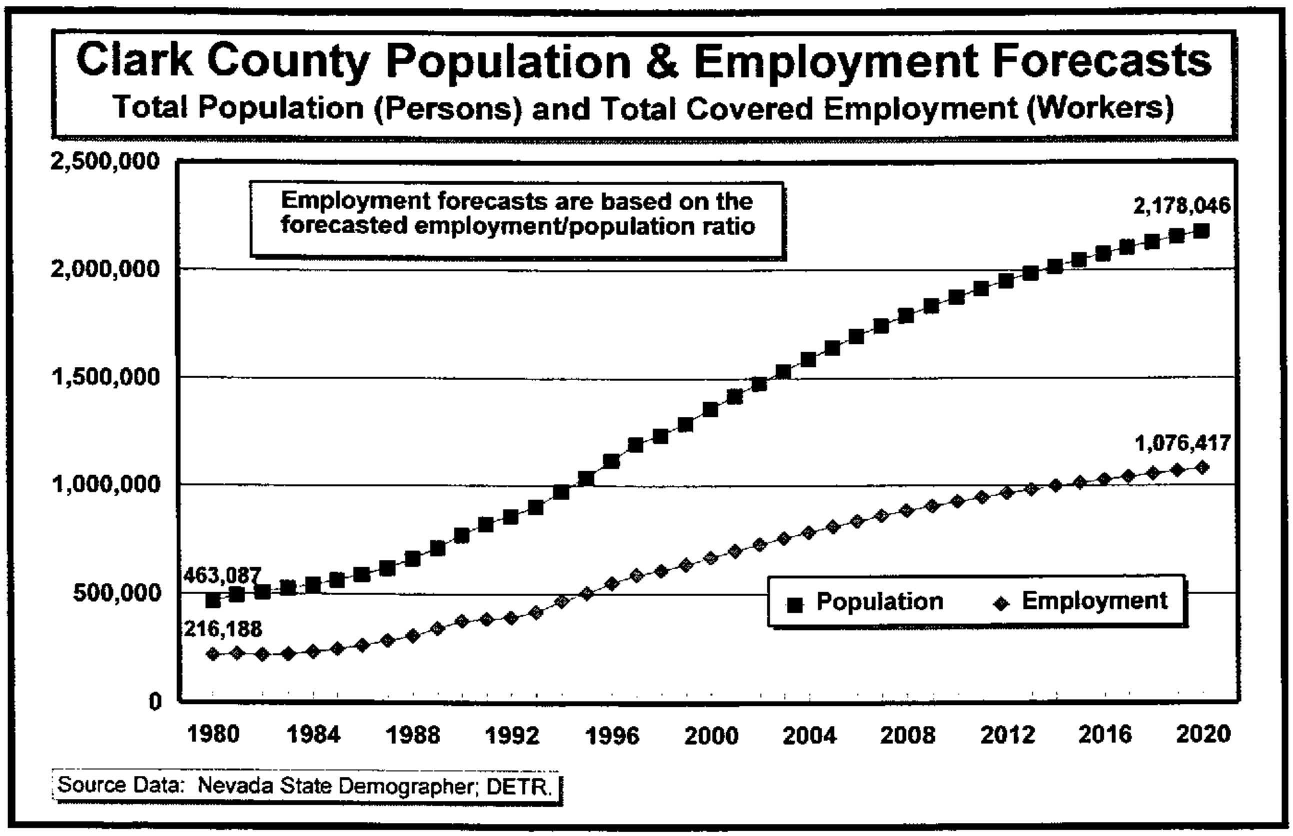
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

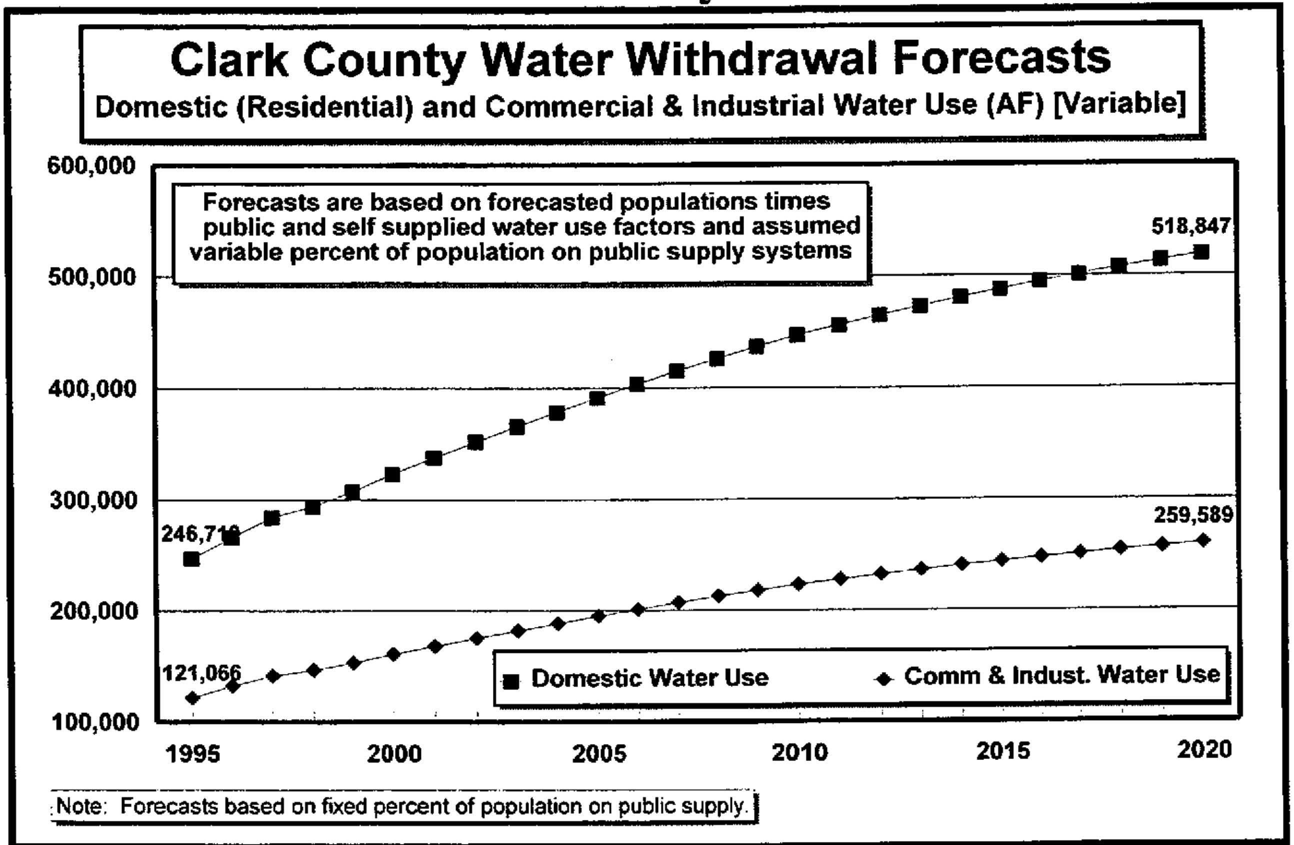
[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

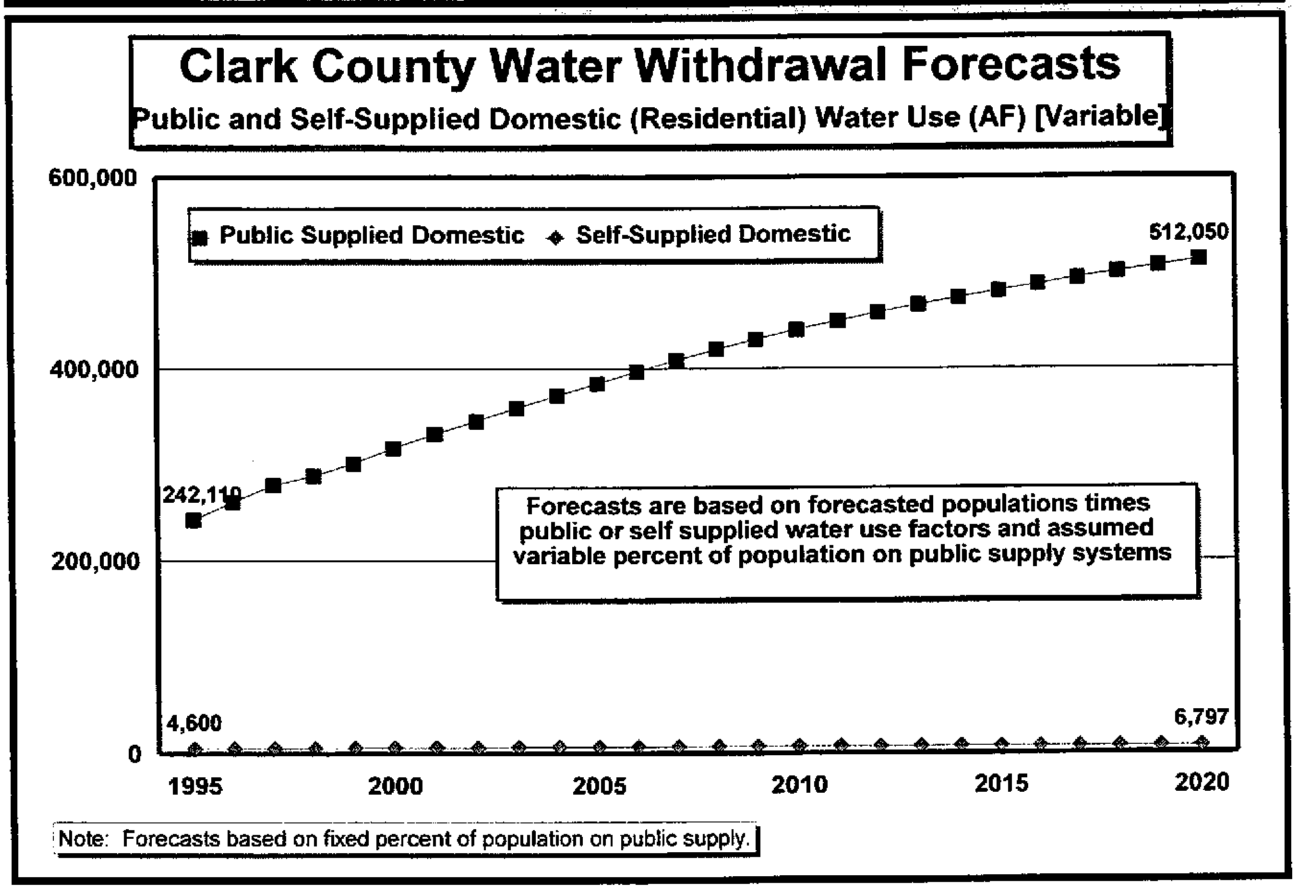
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.


Clark County Employment-to-Population Ratios
Ratio of Total Covered Employment to Total Population (Percent)
60%
40%
20%
0%
46.7%
49.1%
49.4%
Estimated and Forecasted Employment / Population Ratio
Actual Ratios (1980-1997); Forecast Ratios (1998-2020)
Note: Forecasts to this ratio are based on a historical "steady-state" value and estimates of future economic, business, employment, and demographic conditions.
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Source Data: Nevada State Demographer; DETR.

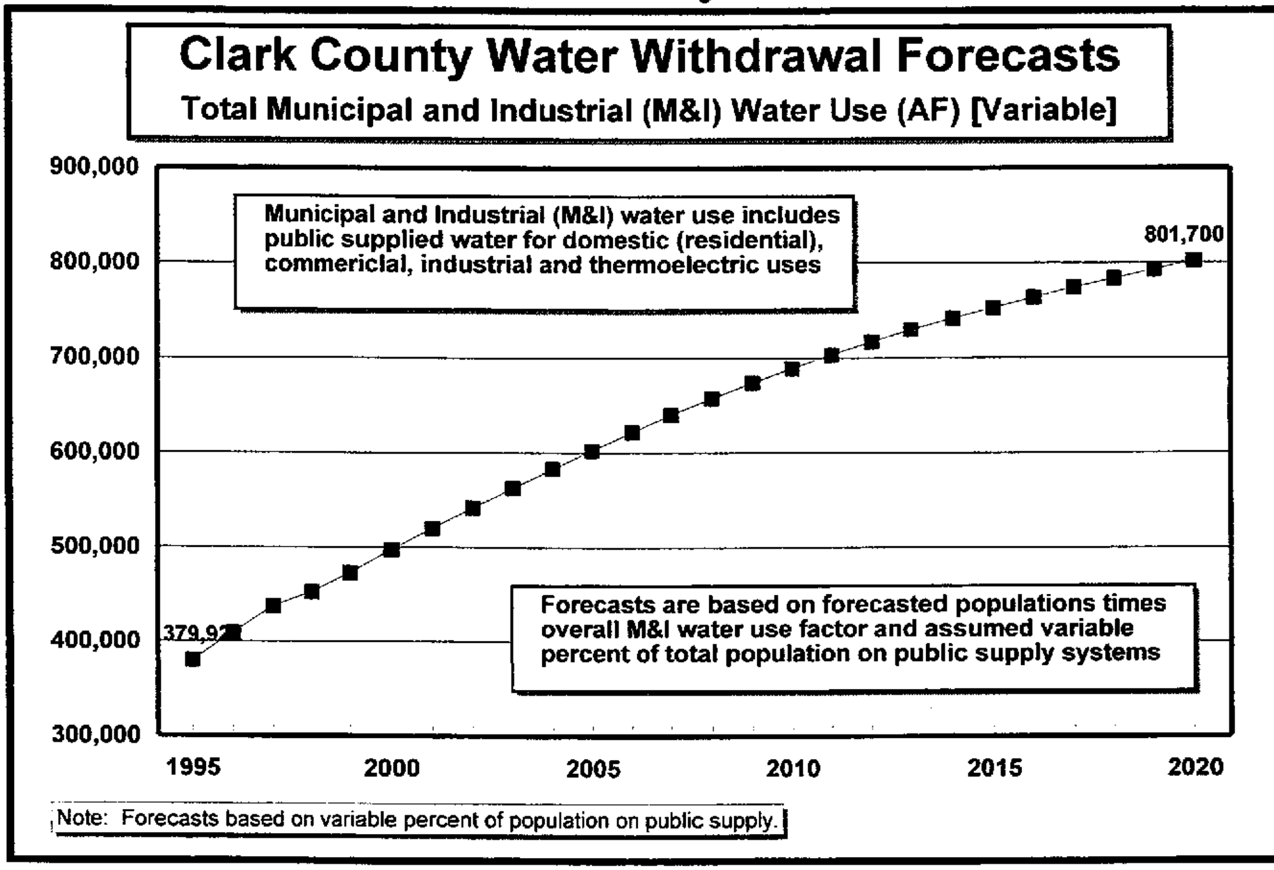

Clark County Population & Employment Forecasts
Total Population (Persons) and Total Covered Employment (Workers)
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
Employment forecasts are based on the forecasted employment/population ratio
2,178,046
1,076,417
463,087
216,188
Population
Employment
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Source Data: Nevada State Demographer; DETR.

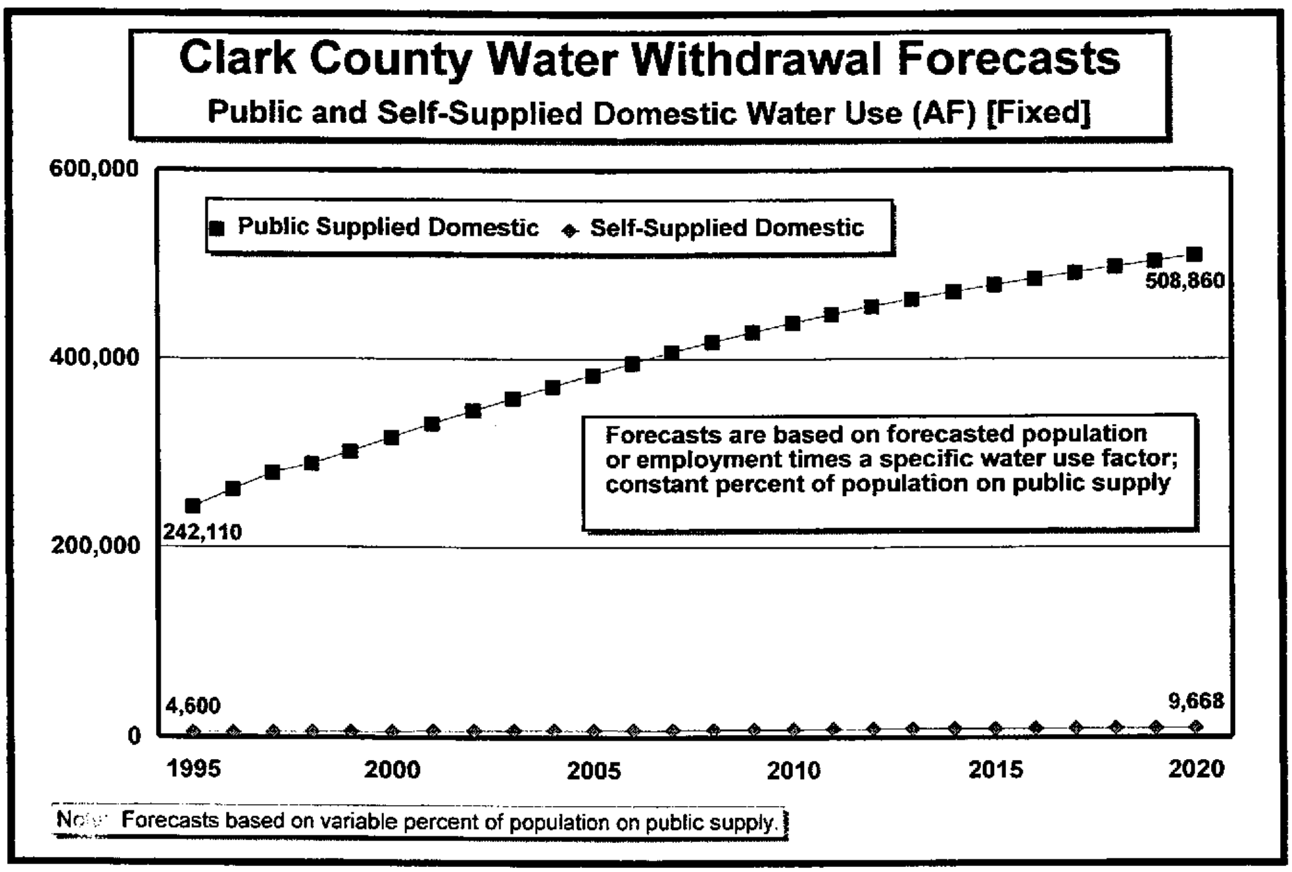
Nevada Water Use Analysis and Forecasts-1





Nevada Water Use Analysis and Forecasts-2





Douglas County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	19,421	15,165	78.08%	12	0.08%	5,690	2,591	5,996
1981	20,410	15,165	74.30%	12	0.08%	5,980	2,591	6,302
1982	20,880	14,709	70.44%	16	0.11%	6,118	2,512	6,447
1983	21,310	14,763	69.28%	16	0.11%	6,244	2,522	6,580
1984	21,990	16,269	73.98%	56	0.35%	6,443	2,772	6,790
1985	23,000	17,185	74.72%	70	0.40%	6,739	2,927	7,101
1986	24,030	17,292	71.96%	46	0.27%	7,041	2,949	7,420
1987	25,070	16,922	67.50%	24	0.14%	7,346	2,890	7,741
1988	25,900	17,144	66.19%	43	0.25%	7,589	2,924	7,997
1989	26,930	18,328	68.06%	13	0.07%	7,891	3,132	8,315
1990	28,070	18,275	65.11%	14	0.08%	8,225	3,123	8,667
1991	28,810	17,719	61.50%	11	0.06%	8,442	3,028	8,895
1992	29,470	17,422	59.12%	13	0.07%	8,635	2,977	9,099
1993	30,390	17,820	58.64%	16	0.09%	8,904	3,045	9,383
1994	34,600	18,294	52.87%	19	0.11%	10,138	3,125	10,683
1995	35,880	19,277	53.73%	19	0.10%	10,513	3,293	11,078
1996	37,480	19,296	51.48%	19	0.10%	10,982	3,297	11,572
1997	39,590	19,567	49.42%	35	0.18%	11,600	3,340	12,224
1998	40,671	20,086	49.39%	35	0.18%	11,917	3,429	12,558
1999	41,753	20,605	49.35%	36	0.17%	12,234	3,517	12,892
2000	42,834	21,123	49.31%	36	0.17%	12,551	3,606	13,225
2001	43,913	21,639	49.28%	36	0.17%	12,867	3,694	13,559
2002	44,989	22,152	49.24%	36	0.16%	13,182	3,782	13,891
2003	46,060	22,663	49.20%	36	0.16%	13,496	3,869	14,222
2004	47,124	23,169	49.17%	37	0.16%	13,808	3,956	14,550
2005	48,180	23,670	49.13%	37	0.15%	14,117	4,041	14,876
2006	49,225	24,165	49.09%	37	0.15%	14,423	4,126	15,199
2007	50,259	24,654	49.05%	37	0.15%	14,726	4,210	15,518
2008	51,279	25,136	49.02%	37	0.15%	15,025	4,292	15,833
2009	52,284	25,609	48.98%	37	0.14%	15,320	4,373	16,143
2010	53,272	26,074	48.94%	36	0.14%	15,609	4,453	16,448
2011	54,242	26,528	48.91%	36	0.14%	15,893	4,530	16,748
2012	55,191	26,972	48.87%	36	0.13%	16,171	4,606	17,041
2013	56,118	27,405	48.83%	36	0.13%	16,443	4,680	17,327
2014	57,022	27,825	48.80%	36	0.13%	16,708	4,752	17,606
2015	57,900	28,233	48.76%	35	0.12%	16,965	4,822	17,877
2016	58,751	28,626	48.72%	35	0.12%	17,215	4,889	18,140
2017	59,574	29,005	48.69%	34	0.12%	17,456	4,954	18,394
2018	60,366	29,369	48.65%	34	0.12%	17,688	5,016	18,639
2019	61,127	29,717	48.61%	34	0.11%	17,911	5,076	18,873
2020	61,854	30,048	48.58%	33	0.11%	18,124	5,133	19,098
Actual Period Average (1980-1997).......			64.80%	8.60%	Standard Deviation (1980-1997)			
Forecast Period Average (1998-2020)....			48.98%	51.88%	Latest/Most Stable Period (1994-1997)			

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person....................	**306.0**	**261.6**	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.3427	0.2930	Acre-feet per person per year
Commercial & Industrial Water Use per Worker..............	**152.7**	Gallons per worker per day (excludes mining)	
[Commercial & Industrial Water Use Coefficient]	0.1710	Acre-feet per worker per year (excludes mining)	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Douglas County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	17,496	5,178	513	--	--	--	--	--
1981	18,387	5,442	539	--	--	--	--	--
1982	18,810	5,567	551	--	--	--	--	--
1983	19,197	5,682	562	--	--	--	--	--
1984	19,810	5,863	580	--	--	--	--	--
1985	20,720	6,132	607	--	--	--	--	--
1986	21,648	6,407	634	--	--	--	--	--
1987	22,585	6,684	662	--	--	--	--	--
1988	23,332	6,905	684	--	--	--	--	--
1989	24,260	7,180	711	--	--	--	--	--
1990	25,287	7,484	741	--	--	--	--	--
1991	25,954	7,681	760	--	--	--	--	--
1992	26,548	7,857	778	--	--	--	--	--
1993	27,377	8,102	802	--	--	--	--	--
1994	31,170	9,225	913	--	--	--	--	--
1995	32,323	9,566	947	32,323	90.09%	9,566	947	11,078
1996	33,764	9,993	989	33,773	90.11%	9,995	987	11,575
1997	35,665	10,555	1,045	35,683	90.13%	10,561	1,040	12,229
1998	36,639	10,843	1,073	36,666	90.15%	10,852	1,066	12,566
1999	37,613	11,132	1,102	37,651	90.18%	11,143	1,092	12,903
2000	38,588	11,420	1,131	38,636	90.20%	11,434	1,118	13,240
2001	39,560	11,708	1,159	39,619	90.22%	11,726	1,143	13,576
2002	40,529	11,995	1,187	40,600	90.24%	12,016	1,169	13,912
2003	41,494	12,280	1,216	41,577	90.27%	12,305	1,194	14,246
2004	42,452	12,564	1,244	42,548	90.29%	12,592	1,218	14,578
2005	43,403	12,845	1,272	43,512	90.31%	12,878	1,243	14,908
2006	44,345	13,124	1,299	44,467	90.33%	13,160	1,267	15,235
2007	45,276	13,400	1,327	45,412	90.36%	13,440	1,290	15,558
2008	46,196	13,672	1,353	46,346	90.38%	13,716	1,313	15,877
2009	47,101	13,940	1,380	47,266	90.40%	13,989	1,336	16,192
2010	47,991	14,203	1,406	48,171	90.42%	14,257	1,358	16,502
2011	48,865	14,462	1,432	49,060	90.45%	14,520	1,380	16,806
2012	49,720	14,715	1,457	49,931	90.47%	14,777	1,400	17,103
2013	50,555	14,962	1,481	50,783	90.49%	15,029	1,420	17,395
2014	51,369	15,203	1,505	51,614	90.52%	15,275	1,440	17,678
2015	52,160	15,437	1,528	52,421	90.54%	15,514	1,459	17,955
2016	52,927	15,664	1,551	53,205	90.56%	15,746	1,476	18,222
2017	53,668	15,883	1,572	53,964	90.58%	15,971	1,494	18,482
2018	54,382	16,094	1,593	54,695	90.61%	16,187	1,510	18,731
2019	55,067	16,297	1,613	55,398	90.63%	16,395	1,525	18,972
2020	55,722	16,491	1,633	56,071	90.65%	16,595	1,540	19,201

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied)...................	**306.0**	**264.2**	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.3427	0.2960	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	**237.7**	Gallons per person per day--self supply	
[Self-Supplied Water Use Coefficient]	0.2662	Acre-feet per person per year	
1995 Estimated Resident Population on Public Supply........	**90.09%**	Percent of total resident population	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

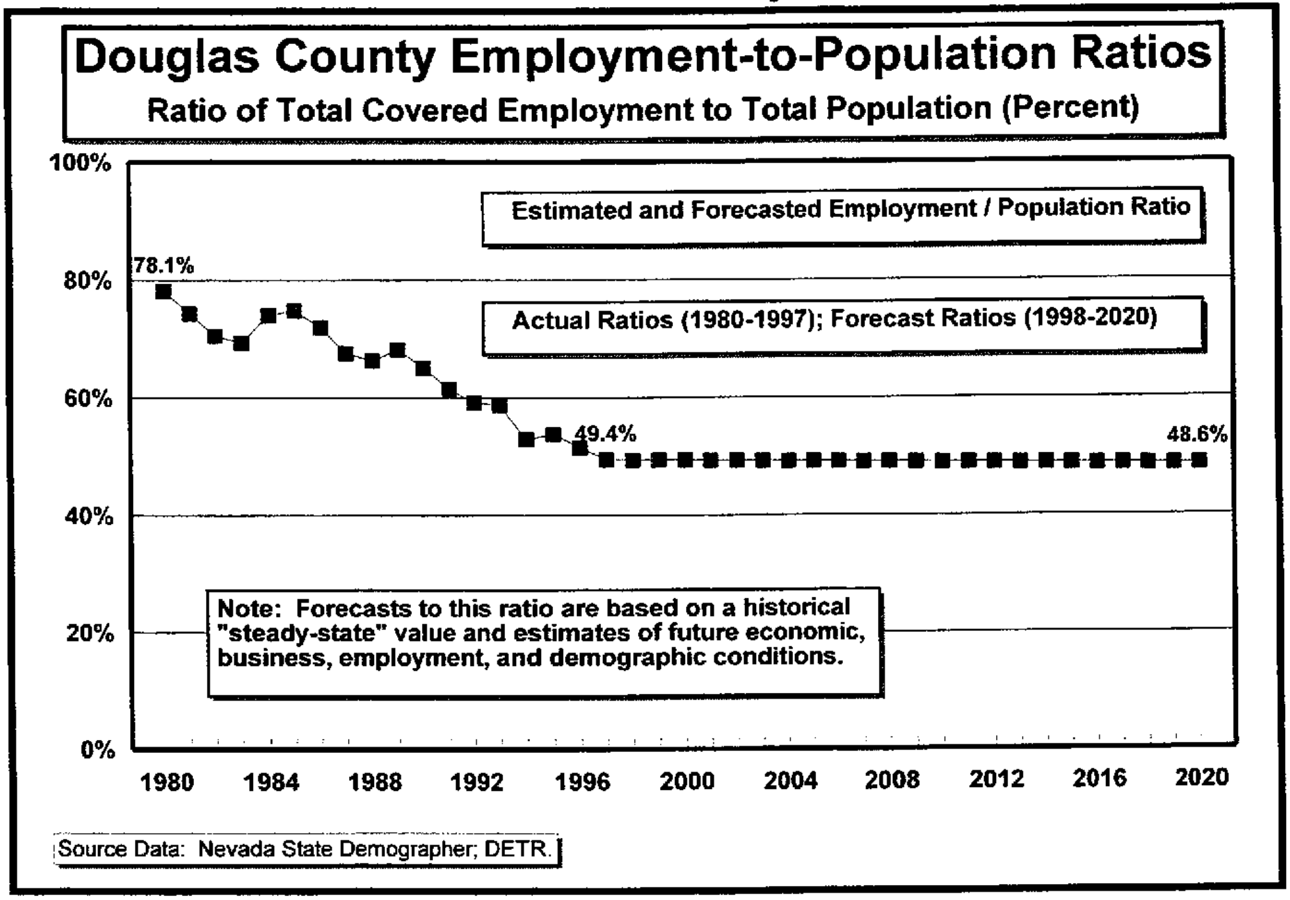
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

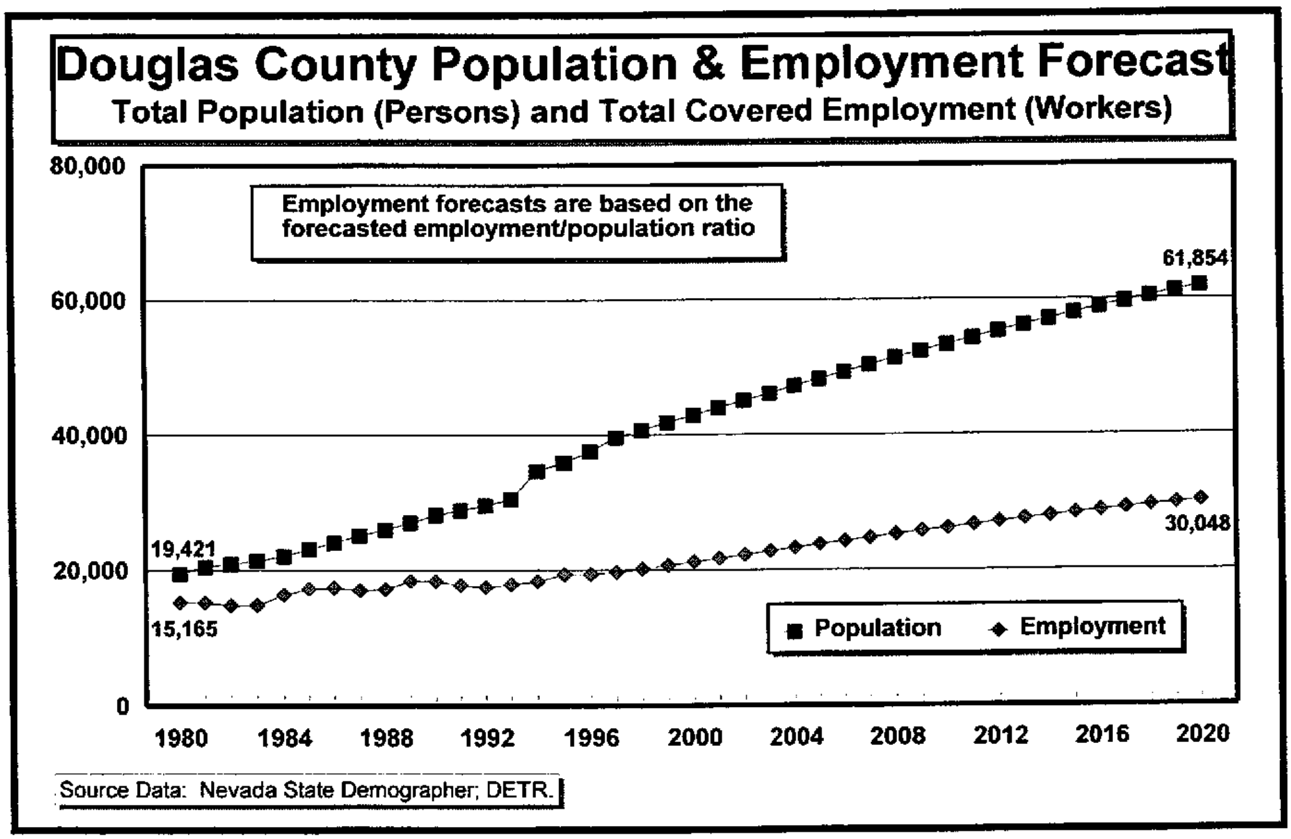
[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

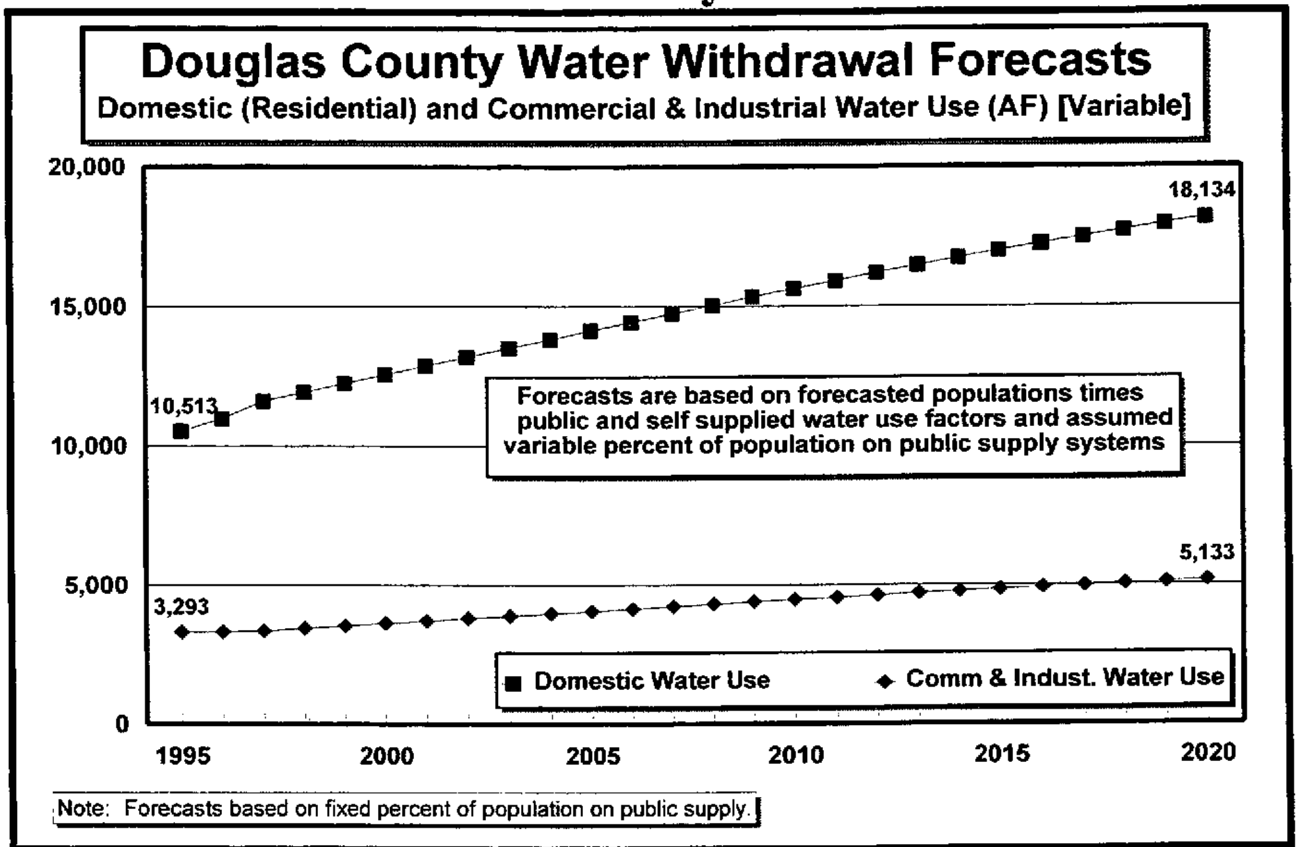
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

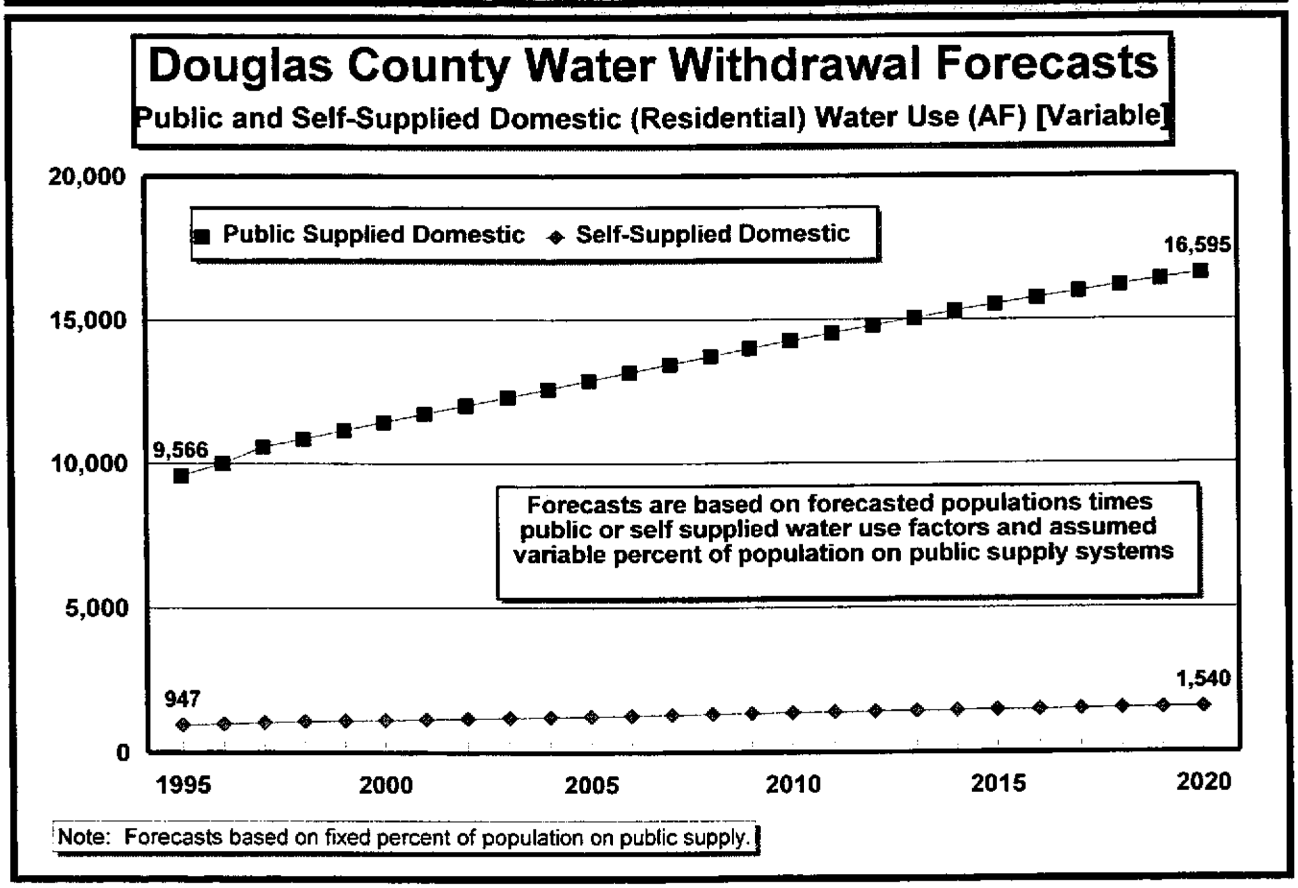
Nevada Socioeconomic Analysis and Forecasts





Nevada Water Use Analysis and Forecasts-1





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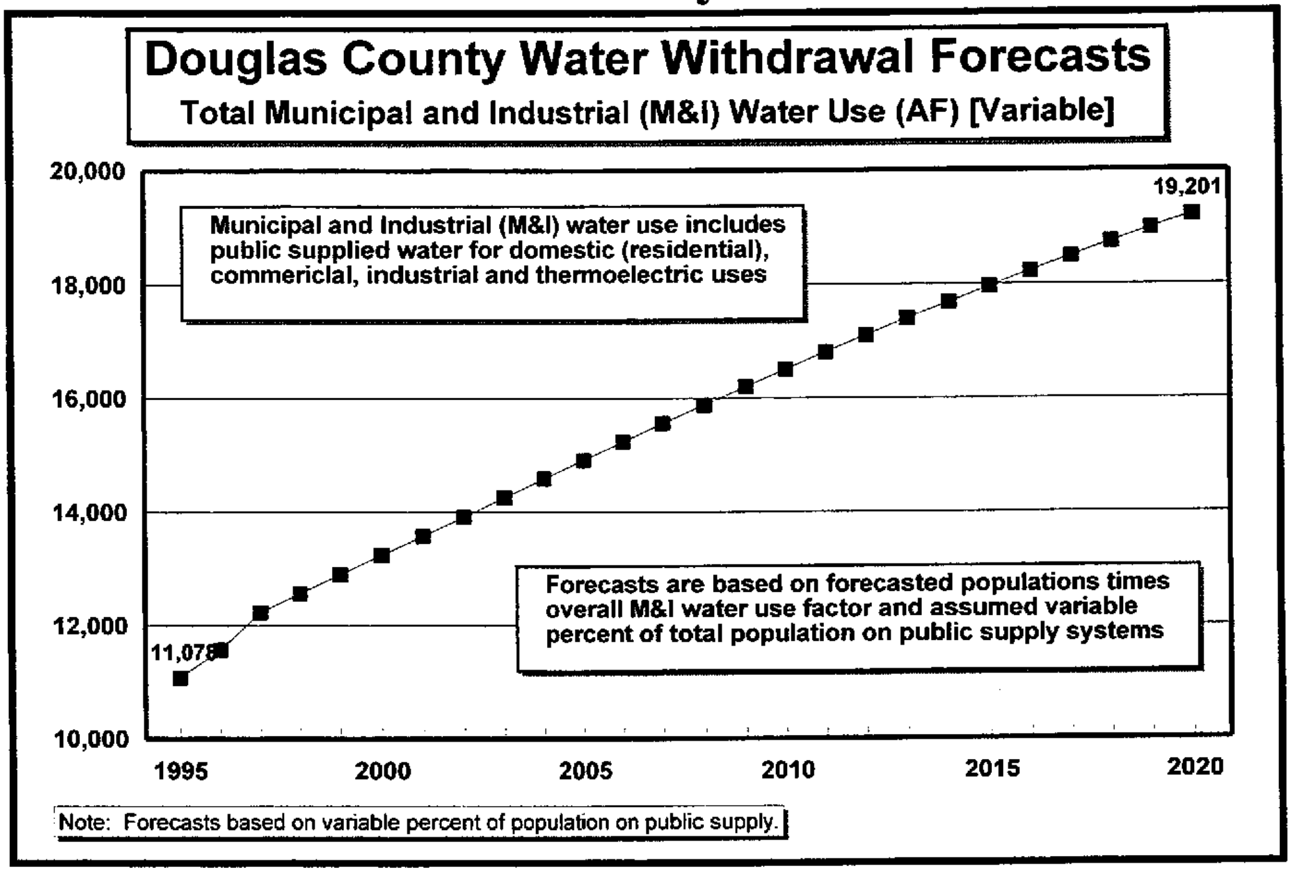
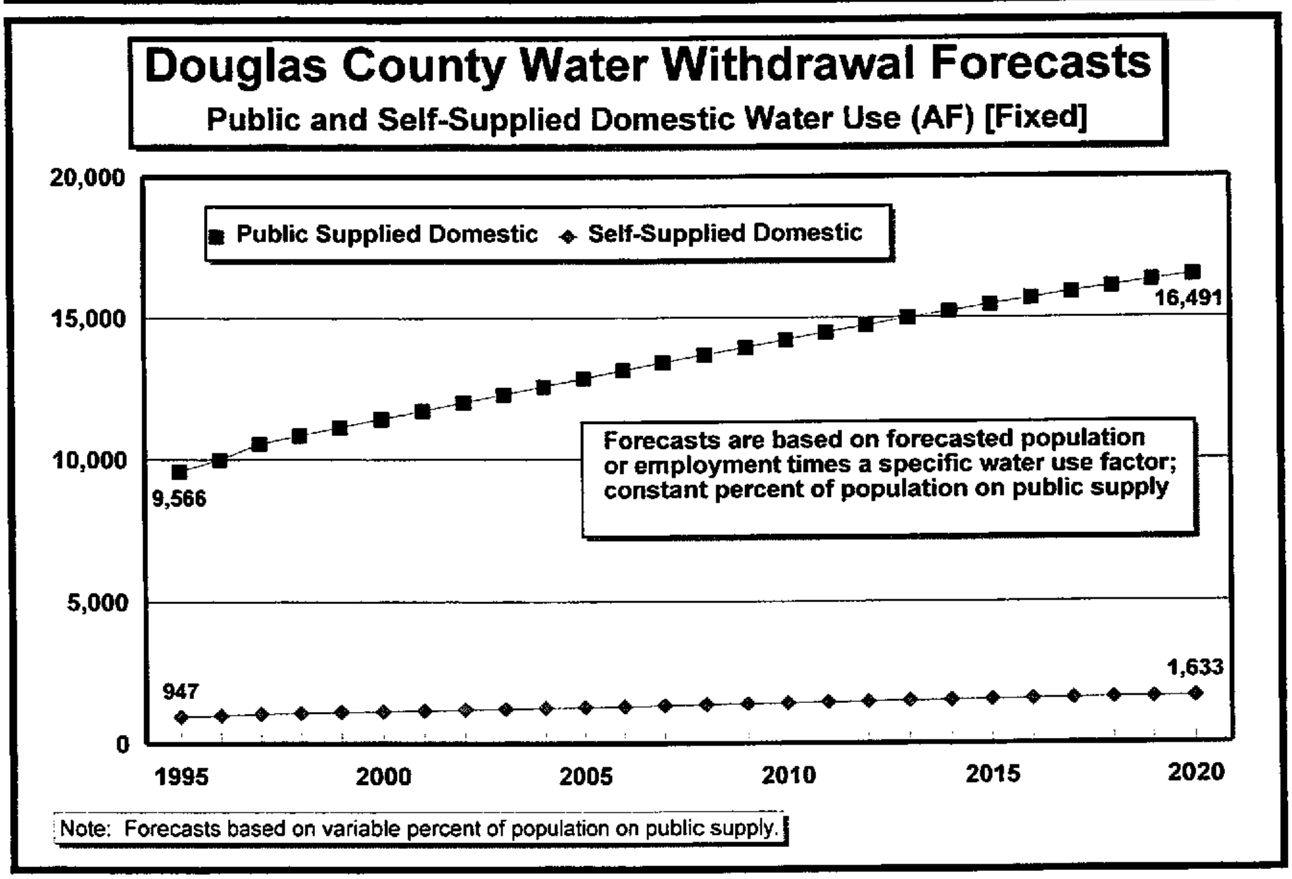




Elko County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	17,269	8,075	46.76%	458	5.67%	4,651	3,543	5,985
1981	18,650	8,961	48.05%	742	8.27%	5,023	3,823	6,464
1982	19,530	9,038	46.28%	810	8.96%	5,260	3,827	6,769
1983	20,450	9,286	45.41%	681	7.33%	5,508	4,002	7,087
1984	21,420	10,133	47.31%	783	7.72%	5,769	4,349	7,424
1985	22,350	10,546	47.19%	774	7.34%	6,020	4,545	7,746
1986	23,320	10,648	45.66%	738	6.93%	6,281	4,609	8,082
1987	24,300	11,432	47.05%	973	8.51%	6,545	4,865	8,422
1988	27,010	13,163	48.73%	1,052	7.99%	7,275	5,633	9,361
1989	31,830	14,767	46.39%	1,180	7.99%	8,573	6,320	11,031
1990	33,770	15,376	45.53%	1,289	8.38%	9,095	6,552	11,704
1991	35,950	15,582	43.34%	1,400	8.98%	9,683	6,596	12,459
1992	37,420	15,940	42.60%	1,393	8.74%	10,079	6,766	12,969
1993	39,340	16,580	42.15%	1,329	8.01%	10,596	7,094	13,634
1994	41,260	17,461	42.32%	1,240	7.10%	11,113	7,545	14,300
1995	43,050	18,370	42.67%	1,295	7.05%	11,595	7,942	14,920
1996	45,630	19,727	43.23%	1,518	7.70%	12,290	8,469	15,814
1997	47,710	20,182	42.30%	1,427	7.07%	12,850	8,723	16,535
1998	49,041	20,750	42.31%	1,426	6.87%	13,209	8,988	16,996
1999	50,360	21,314	42.32%	1,422	6.67%	13,564	9,252	17,454
2000	51,665	21,871	42.33%	1,415	6.47%	13,915	9,514	17,906
2001	52,951	22,421	42.34%	1,406	6.27%	14,262	9,775	18,352
2002	54,217	22,963	42.35%	1,394	6.07%	14,602	10,032	18,790
2003	55,458	23,495	42.36%	1,379	5.87%	14,937	10,286	19,220
2004	56,673	24,015	42.38%	1,362	5.67%	15,264	10,537	19,641
2005	57,857	24,523	42.39%	1,342	5.47%	15,583	10,782	20,052
2006	59,009	25,018	42.40%	1,344	5.37%	15,893	11,011	20,451
2007	60,124	25,497	42.41%	1,344	5.27%	16,193	11,234	20,837
2008	61,200	25,960	42.42%	1,342	5.17%	16,483	11,450	21,210
2009	62,234	26,405	42.43%	1,339	5.07%	16,762	11,659	21,569
2010	63,224	26,832	42.44%	1,334	4.97%	17,028	11,860	21,912
2011	64,166	27,238	42.45%	1,327	4.87%	17,282	12,052	22,238
2012	65,058	27,624	42.46%	1,332	4.82%	17,522	12,229	22,547
2013	65,897	27,987	42.47%	1,335	4.77%	17,748	12,396	22,838
2014	66,681	28,327	42.48%	1,337	4.72%	17,960	12,554	23,110
2015	67,408	28,643	42.49%	1,338	4.67%	18,155	12,700	23,362
2016	68,075	28,934	42.50%	1,337	4.62%	18,335	12,836	23,593
2017	68,681	29,199	42.51%	1,335	4.57%	18,498	12,960	23,803
2018	69,224	29,437	42.52%	1,331	4.52%	18,644	13,073	23,991
2019	69,701	29,647	42.53%	1,325	4.47%	18,773	13,173	24,157
2020	70,113	29,830	42.55%	1,319	4.42%	18,884	13,261	24,299

Actual Period Average (1980-1997).......	45.16%	2.16%	Standard Deviation (1980-1997)
Forecast Period Average (1998-2020)....	42.43%	42.63%	Latest/Most Stable Period (1994-1997)

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person......................	**331.7**	**240.4**	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.3716	0.2693	Acre-feet per person per year
Commercial & Industrial Water Use per Worker...............	**415.2**		Gallons per worker per day (excludes mining)
[Commercial & Industrial Water Use Coefficient]	0.4651		Acre-feet per worker per year (excludes mining)

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Elko County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	16,106	4,368	284	--	--	--	--	--
1981	17,394	4,717	306	--	--	--	--	--
1982	18,215	4,939	321	--	--	--	--	--
1983	19,073	5,172	336	--	--	--	--	--
1984	19,978	5,417	352	--	--	--	--	--
1985	20,845	5,653	367	--	--	--	--	--
1986	21,750	5,898	383	--	--	--	--	--
1987	22,664	6,146	399	--	--	--	--	--
1988	25,191	6,831	444	--	--	--	--	--
1989	29,687	8,050	523	--	--	--	--	--
1990	31,496	8,541	555	--	--	--	--	--
1991	33,529	9,092	590	--	--	--	--	--
1992	34,900	9,464	615	--	--	--	--	--
1993	36,691	9,950	646	--	--	--	--	--
1994	38,482	10,435	678	--	--	--	--	--
1995	40,151	10,888	707	40,151	93.27%	10,888	707	14,920
1996	42,557	11,540	749	42,568	93.29%	11,543	747	15,817
1997	44,497	12,066	784	44,519	93.31%	12,072	778	16,541
1998	45,739	12,403	805	45,773	93.34%	12,412	797	17,006
1999	46,969	12,737	827	47,016	93.36%	12,750	816	17,466
2000	48,186	13,067	848	48,246	93.38%	13,083	834	17,922
2001	49,385	13,392	870	49,459	93.41%	13,412	852	18,372
2002	50,566	13,712	890	50,654	93.43%	13,736	869	18,814
2003	51,724	14,026	911	51,827	93.45%	14,054	886	19,248
2004	52,856	14,333	931	52,975	93.48%	14,366	902	19,674
2005	53,961	14,633	950	54,096	93.50%	14,669	917	20,088
2006	55,035	14,924	969	55,186	93.52%	14,965	932	20,492
2007	56,075	15,206	987	56,244	93.55%	15,252	946	20,883
2008	57,079	15,478	1,005	57,265	93.57%	15,529	960	21,261
2009	58,043	15,740	1,022	58,247	93.59%	15,795	972	21,624
2010	58,966	15,990	1,038	59,188	93.62%	16,050	984	21,972
2011	59,845	16,228	1,054	60,085	93.64%	16,293	995	22,303
2012	60,677	16,454	1,068	60,935	93.66%	16,524	1,005	22,617
2013	61,459	16,666	1,082	61,737	93.69%	16,741	1,015	22,913
2014	62,191	16,865	1,095	62,487	93.71%	16,945	1,023	23,190
2015	62,869	17,048	1,107	63,184	93.73%	17,134	1,030	23,447
2016	63,491	17,217	1,118	63,825	93.76%	17,308	1,036	23,684
2017	64,056	17,370	1,128	64,409	93.78%	17,466	1,042	23,899
2018	64,562	17,508	1,137	64,935	93.80%	17,609	1,046	24,092
2019	65,008	17,628	1,145	65,399	93.83%	17,734	1,049	24,263
2020	65,391	17,732	1,151	65,801	93.85%	17,844	1,051	24,410

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied).....................	331.7	242.1	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.3716	0.2712	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	217.7	Gallons per person per day--self supply	
[Self-Supplied Water Use Coefficient]	0.2439	Acre-feet per person per year	
1995 Estimated Resident Population on Public Supply........	93.27%	Percent of total resident population	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

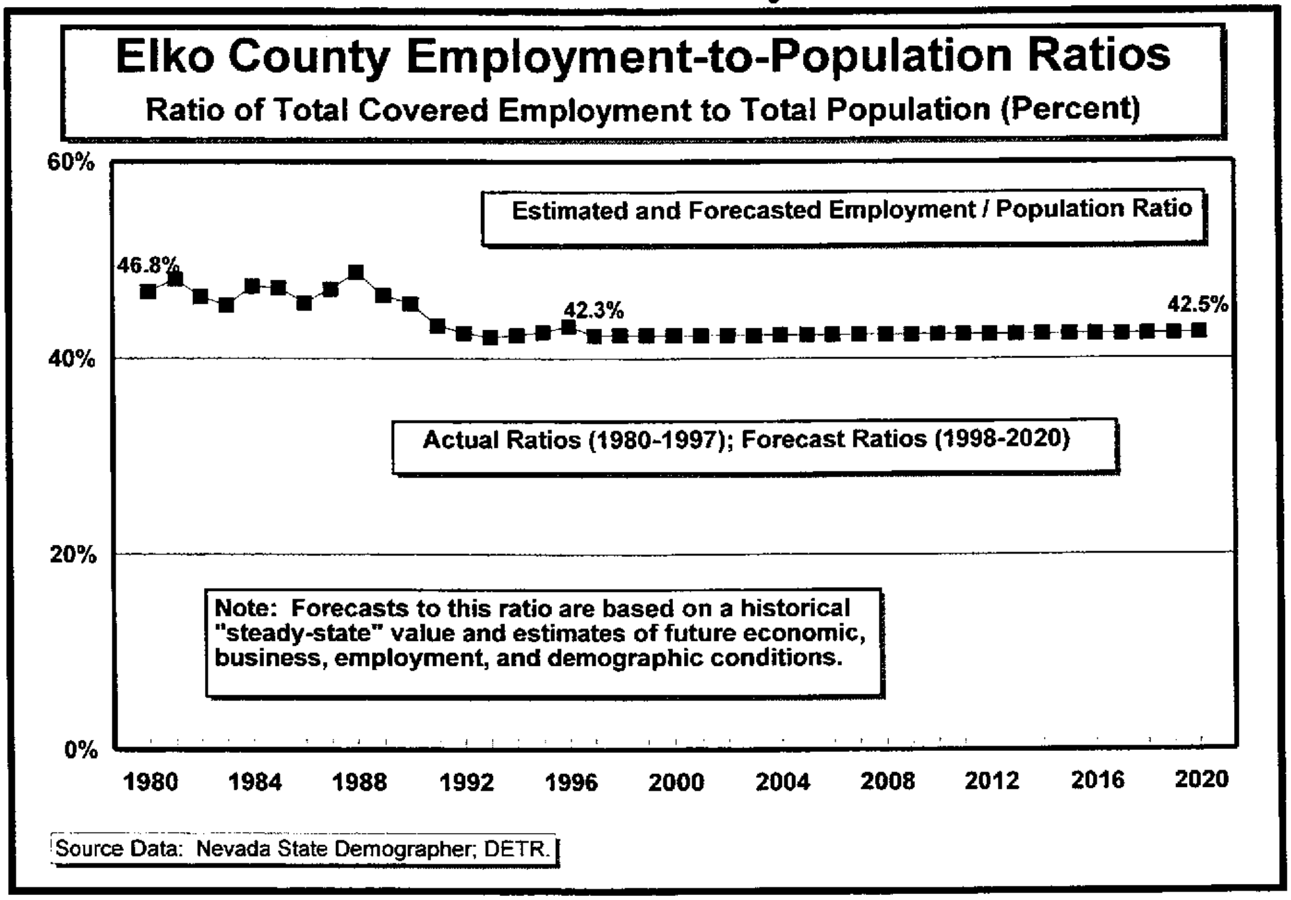
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

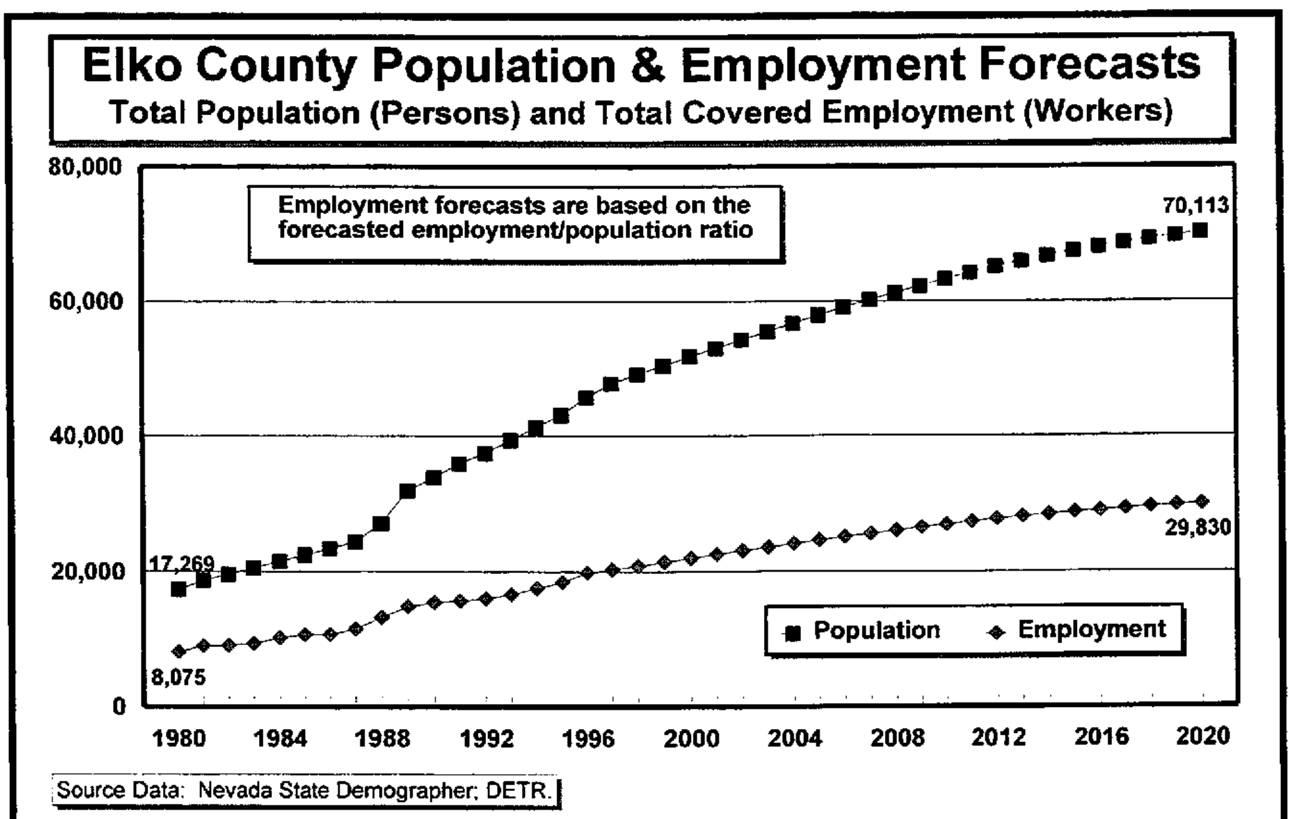
[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

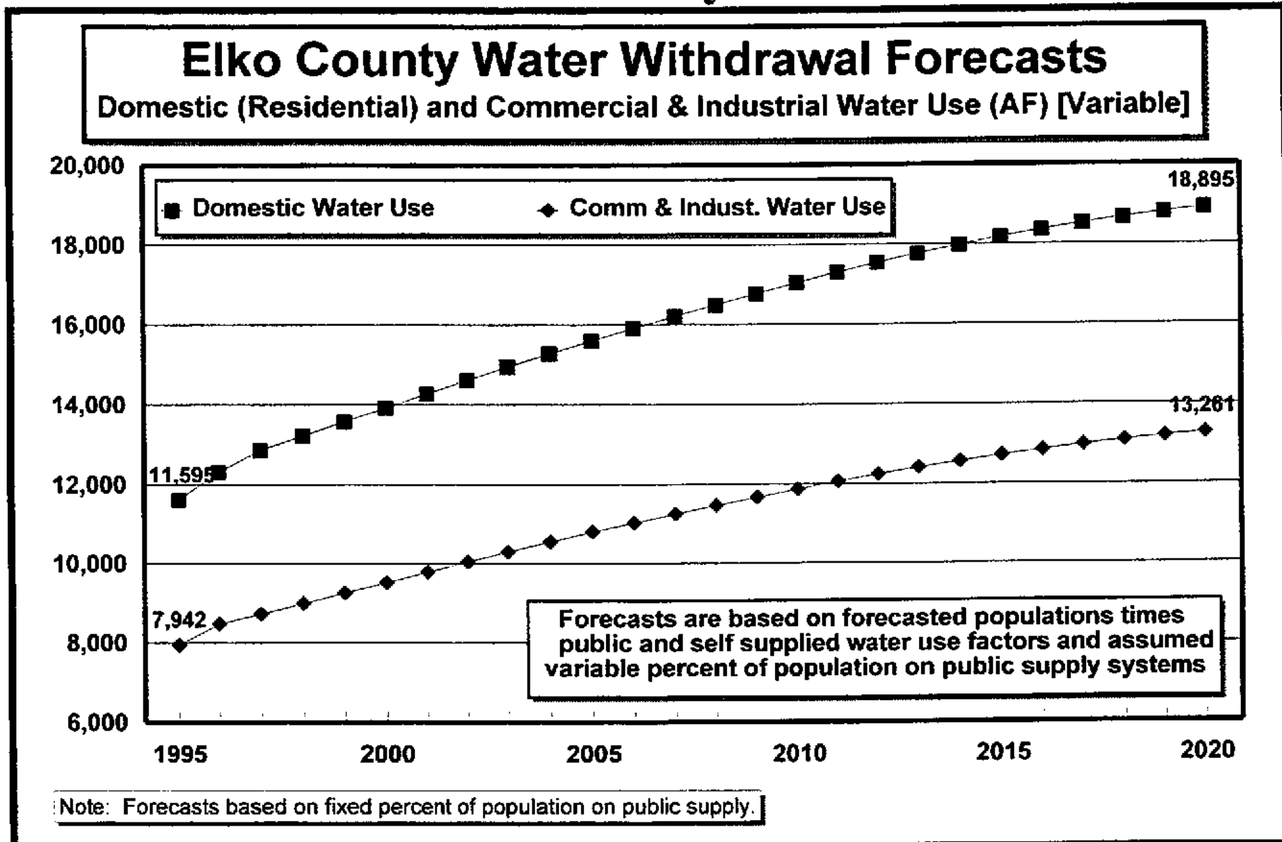
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

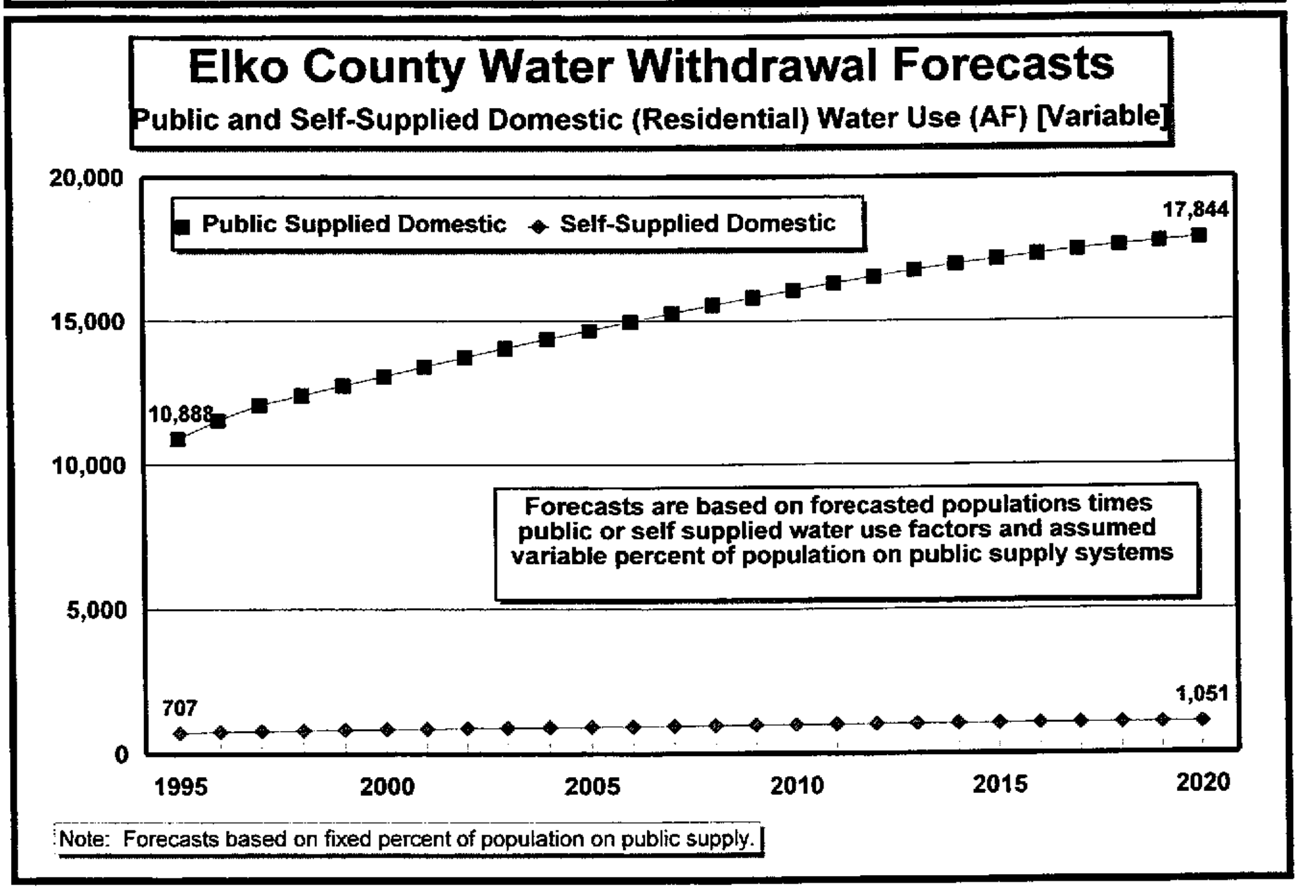
Nevada Socioeconomic Analysis and Forecasts

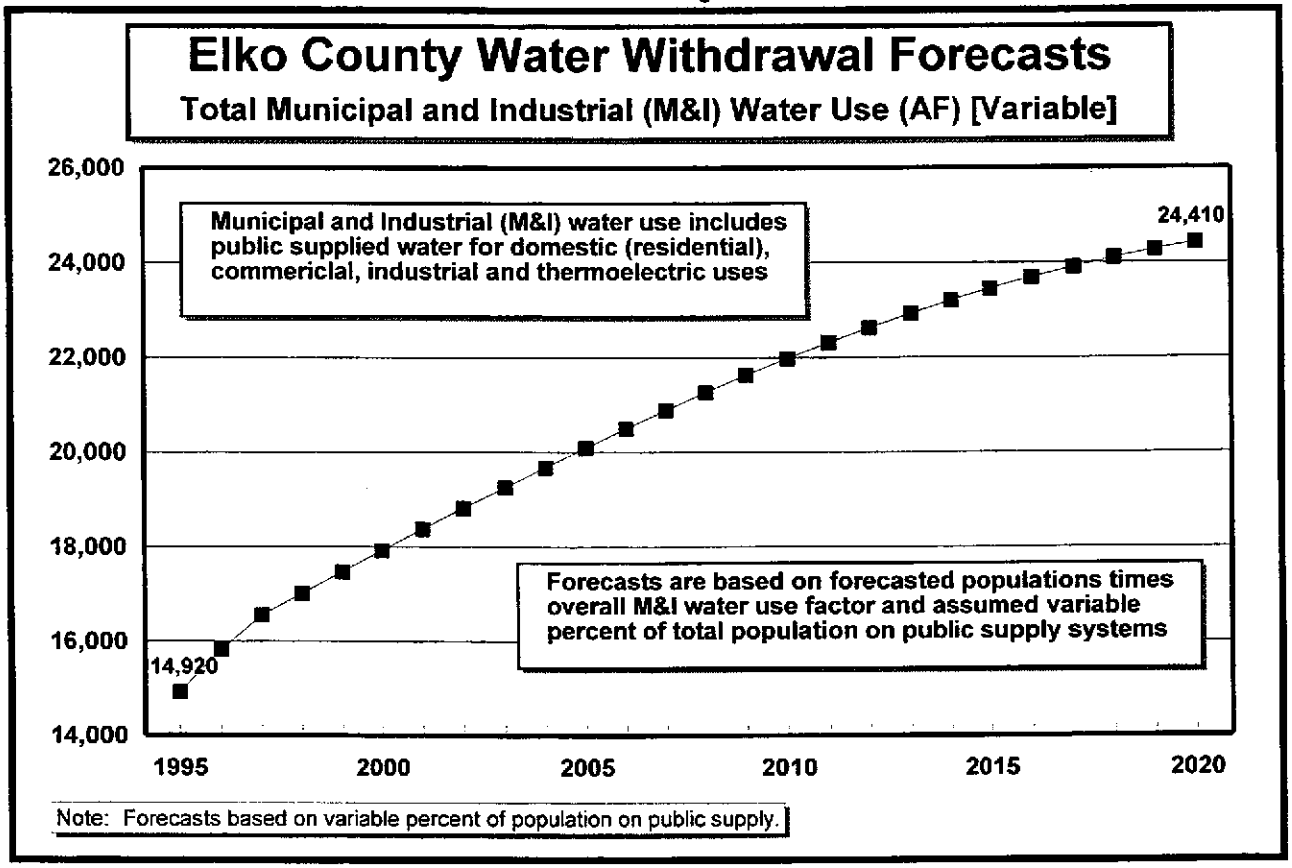


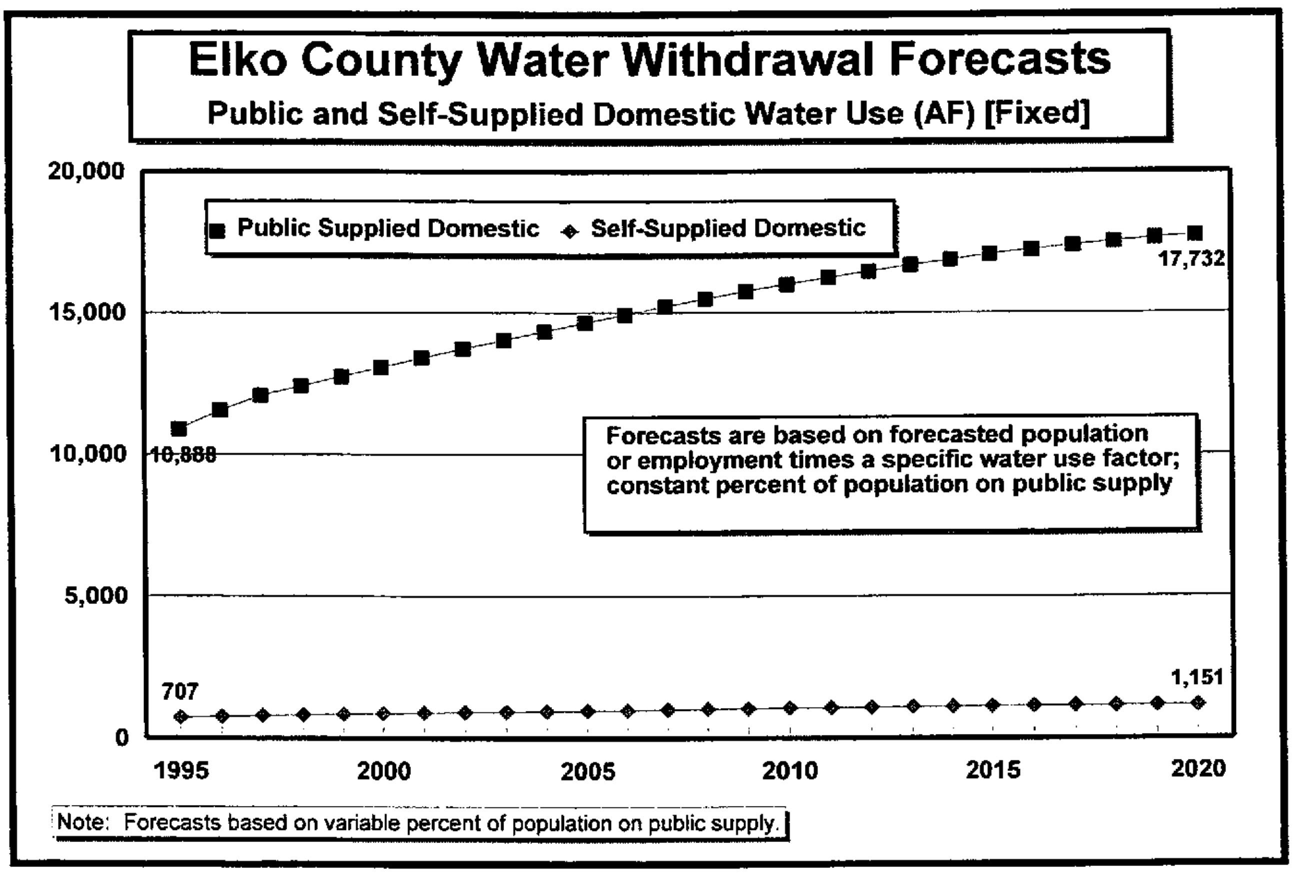


Nevada Water Use Analysis and Forecasts-1






Elko County Water Withdrawal Forecasts
Total Municipal and Industrial (M&I) Water Use (AF) [Variable]
Municipal and Industrial (M&I) water use includes public supplied water for domestic (residential), commericial, industrial and thermoelectric uses
Forecasts are based on forecasted populations times overall M&I water use factor and assumed variable percent of total population on public supply systems
26,000
24,000
22,000
20,000
18,000
16,000
14,000
24,410
14,920
1995
2000
2005
2010
2015
2020
Note: Forecasts based on variable percent of population on public supply.


Elko County Water Withdrawal Forecasts
Public and Self-Supplied Domestic Water Use (AF) [Fixed]
Public Supplied Domestic
Self-Supplied Domestic
Forecasts are based on forecasted population or employment times a specific water use factor; constant percent of population on public supply
20,000
15,000
10,000
5,000
0
17,732
10,888
707
1,151
1995
2000
2005
2010
2015
2020
Note: Forecasts based on variable percent of population on public supply.

Esmeralda County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	777	248	31.96%	101	40.47%	141	40	144
1981	1,190	397	33.36%	174	43.89%	217	60	221
1982	1,320	460	34.84%	237	51.50%	240	60	245
1983	1,480	400	27.04%	196	48.90%	270	55	275
1984	1,680	473	28.17%	274	57.83%	306	54	312
1985	1,540	431	27.95%	234	54.28%	280	53	286
1986	1,540	409	26.57%	205	50.13%	280	55	286
1987	1,540	376	24.38%	171	45.61%	280	55	286
1988	1,440	434	30.11%	228	52.47%	262	55	267
1989	1,360	411	30.23%	171	41.63%	248	64	252
1990	1,350	367	27.15%	138	37.64%	246	61	250
1991	1,390	409	29.41%	186	45.48%	253	60	258
1992	1,410	395	28.04%	166	41.93%	257	62	262
1993	1,320	381	28.87%	150	39.32%	240	62	245
1994	1,380	424	30.70%	189	44.61%	251	63	256
1995	1,630	322	19.76%	155	48.01%	297	45	302
1996	1,490	295	19.82%	127	43.00%	271	45	276
1997	1,460	327	22.40%	150	45.87%	266	47	271
1998	1,467	328	22.38%	150	45.77%	267	48	272
1999	1,474	330	22.37%	151	45.67%	268	48	273
2000	1,480	331	22.35%	151	45.57%	270	48	275
2001	1,486	332	22.34%	151	45.47%	271	49	276
2002	1,492	333	22.32%	151	45.37%	272	49	277
2003	1,498	334	22.31%	151	45.27%	273	49	278
2004	1,503	335	22.29%	151	45.17%	274	49	279
2005	1,509	336	22.28%	151	45.07%	275	50	280
2006	1,513	337	22.26%	152	44.97%	276	50	281
2007	1,518	338	22.25%	152	44.87%	276	50	282
2008	1,522	338	22.24%	152	44.77%	277	50	282
2009	1,526	339	22.22%	151	44.67%	278	50	283
2010	1,530	340	22.21%	151	44.57%	279	51	284
2011	1,533	340	22.19%	151	44.47%	279	51	284
2012	1,536	341	22.18%	151	44.37%	280	51	285
2013	1,539	341	22.16%	151	44.27%	280	51	286
2014	1,541	341	22.15%	151	44.17%	281	51	286
2015	1,544	342	22.13%	151	44.07%	281	51	286
2016	1,545	342	22.12%	150	43.97%	281	51	287
2017	1,547	342	22.10%	150	43.87%	282	51	287
2018	1,548	342	22.09%	150	43.77%	282	52	287
2019	1,549	342	22.07%	149	43.67%	282	52	287
2020	1,550	342	22.06%	149	43.57%	282	52	288

Actual Period Average (1980-1997).......	27.82%	4.03%	Standard Deviation (1980-1997)
Forecast Period Average (1998-2020)....	22.22%	23.17%	Latest/Most Stable Period (1994-1997)

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person....................	**238.3**	**162.6**	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.2669	0.1821	Acre-feet per person per year
Commercial & Industrial Water Use per Worker..............	**239.5**	Gallons per worker per day (excludes mining)	
[Commercial & Industrial Water Use Coefficient]	0.2683	Acre-feet per worker per year (excludes mining)	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Esmeralda County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	540	101	40	--	--	--	--	--
1981	827	155	61	--	--	--	--	--
1982	918	172	68	--	--	--	--	--
1983	1,029	193	76	--	--	--	--	--
1984	1,168	219	87	--	--	--	--	--
1985	1,070	201	79	--	--	--	--	--
1986	1,070	201	79	--	--	--	--	--
1987	1,070	201	79	--	--	--	--	--
1988	1,001	188	74	--	--	--	--	--
1989	945	178	70	--	--	--	--	--
1990	938	176	70	--	--	--	--	--
1991	966	181	72	--	--	--	--	--
1992	980	184	73	--	--	--	--	--
1993	918	172	68	--	--	--	--	--
1994	959	180	71	--	--	--	--	--
1995	1,133	213	84	1,133	69.51%	213	84	302
1996	1,036	195	77	1,036	69.53%	195	77	277
1997	1,015	191	75	1,015	69.54%	191	75	271
1998	1,020	192	76	1,020	69.56%	192	75	272
1999	1,024	192	76	1,025	69.58%	193	76	274
2000	1,029	193	76	1,030	69.60%	194	76	275
2001	1,033	194	77	1,035	69.61%	194	76	276
2002	1,037	195	77	1,039	69.63%	195	77	277
2003	1,041	196	77	1,043	69.65%	196	77	278
2004	1,045	196	77	1,047	69.67%	197	77	279
2005	1,049	197	78	1,051	69.68%	197	77	280
2006	1,052	198	78	1,055	69.70%	198	78	281
2007	1,055	198	78	1,058	69.72%	199	78	282
2008	1,058	199	78	1,062	69.74%	199	78	283
2009	1,061	199	79	1,065	69.75%	200	78	284
2010	1,063	200	79	1,067	69.77%	200	78	285
2011	1,066	200	79	1,070	69.79%	201	78	285
2012	1,068	201	79	1,072	69.81%	201	78	286
2013	1,070	201	79	1,075	69.82%	202	78	286
2014	1,071	201	79	1,077	69.84%	202	79	287
2015	1,073	202	80	1,078	69.86%	203	79	287
2016	1,074	202	80	1,080	69.88%	203	79	288
2017	1,075	202	80	1,081	69.89%	203	79	288
2018	1,076	202	80	1,082	69.91%	203	79	288
2019	1,077	202	80	1,083	69.93%	203	79	289
2020	1,077	202	80	1,084	69.94%	204	79	289

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied)......................	**238.3**	**167.7**	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.2669	0.1878	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	**150.9**	Gallons per person per day--self supply	
[Self-Supplied Water Use Coefficient]	0.1690	Acre-feet per person per year	
1995 Estimated Resident Population on Public Supply........	**69.51%**	Percent of total resident population	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

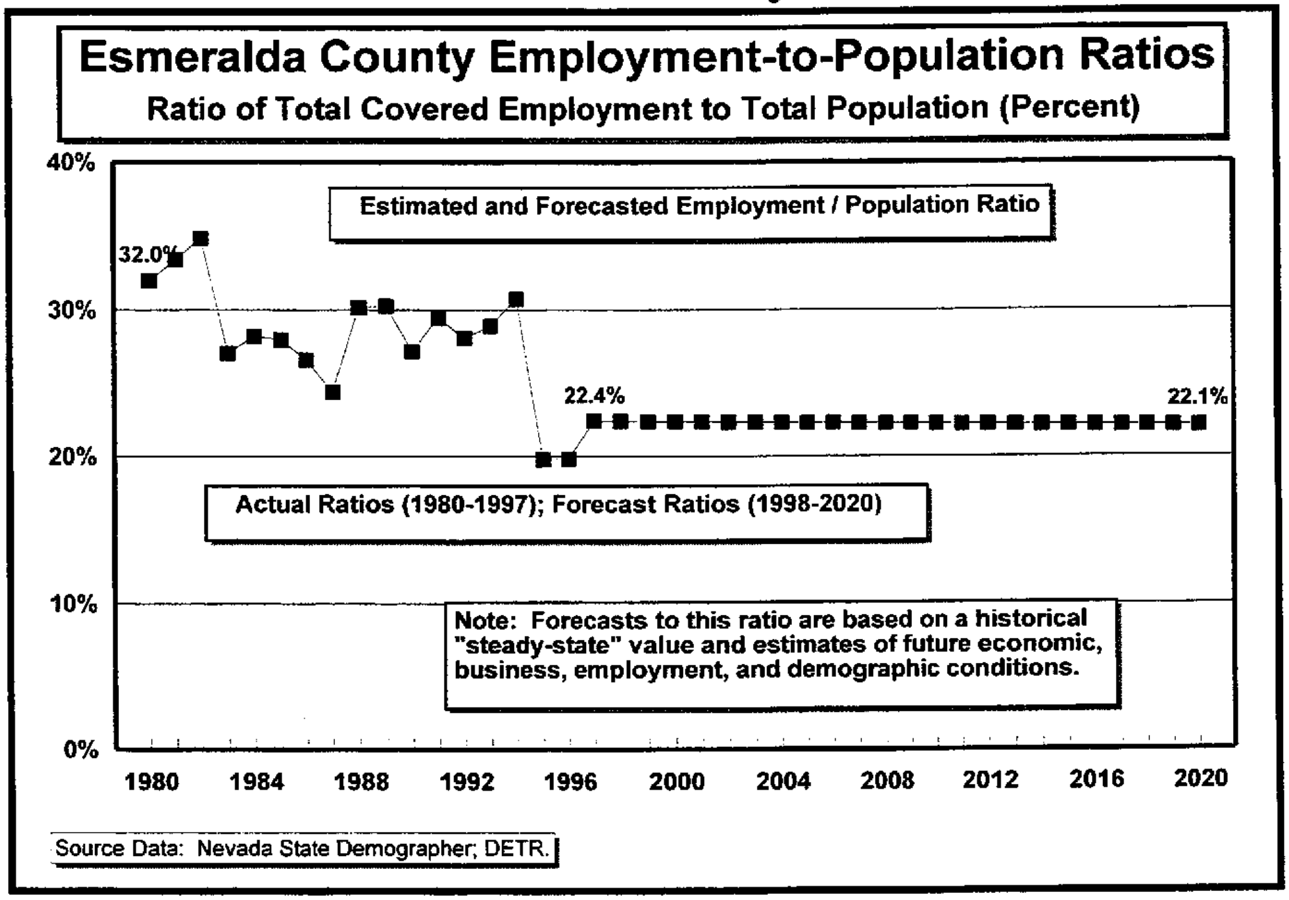
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

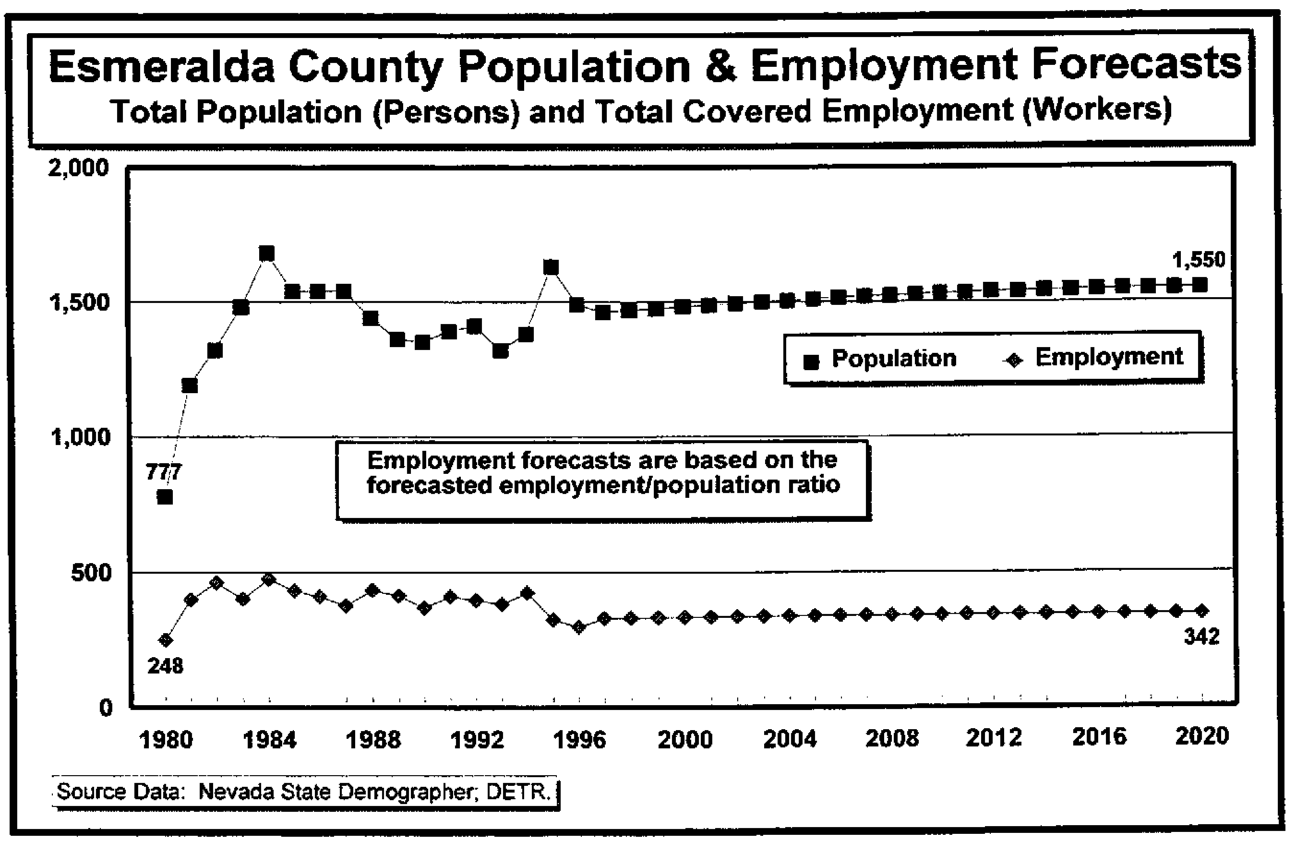
[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

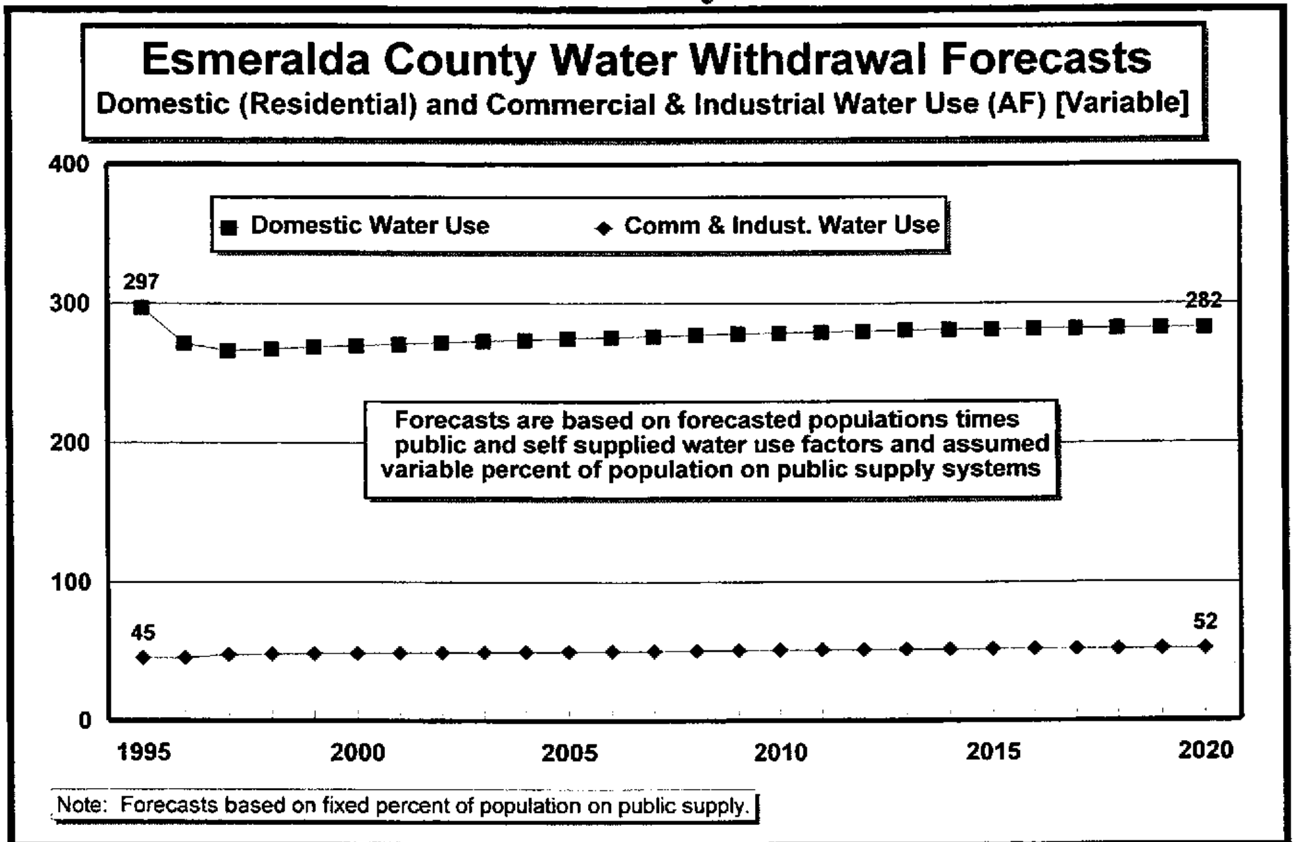
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

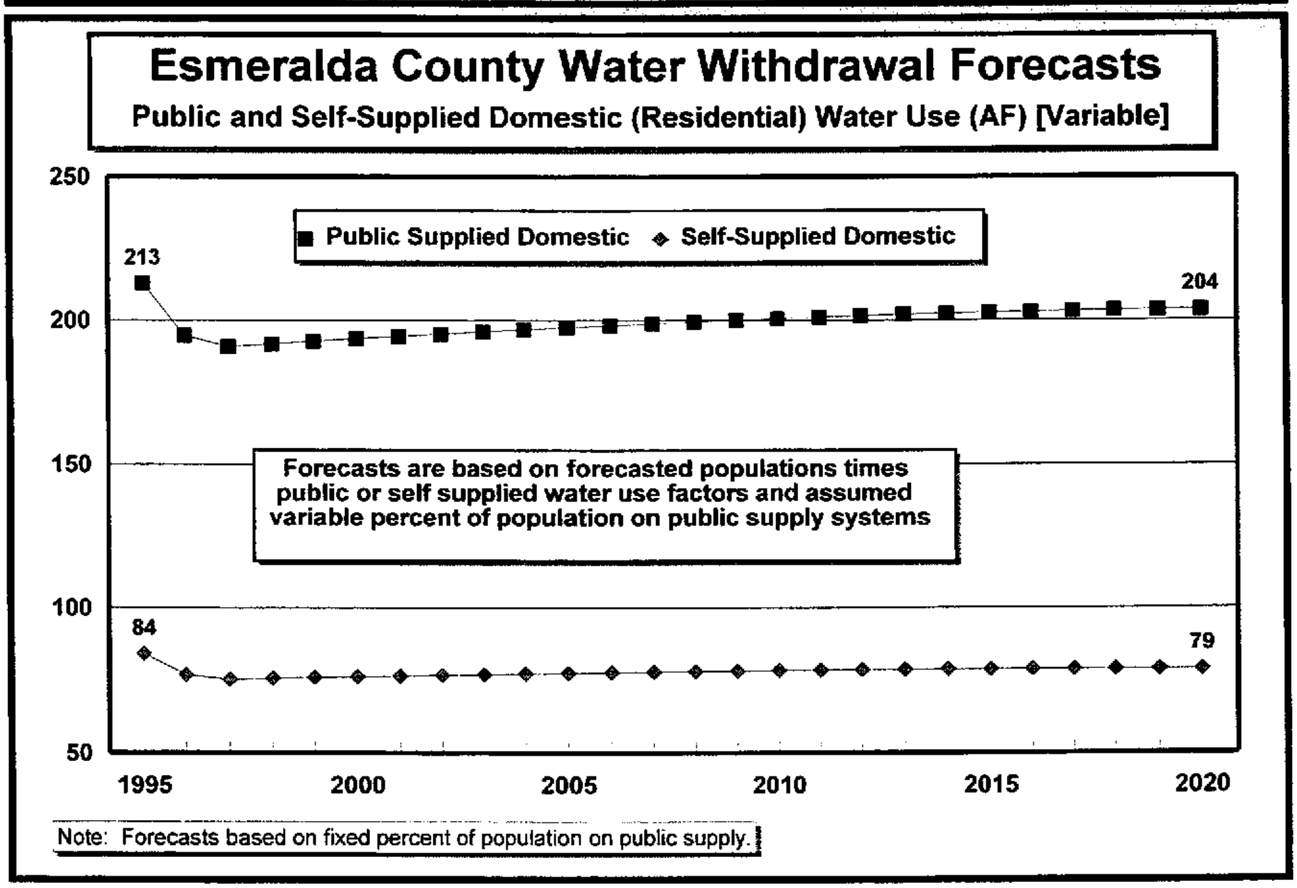
Nevada Socioeconomic Analysis and Forecasts





Nevada Water Use Analysis and Forecasts-1





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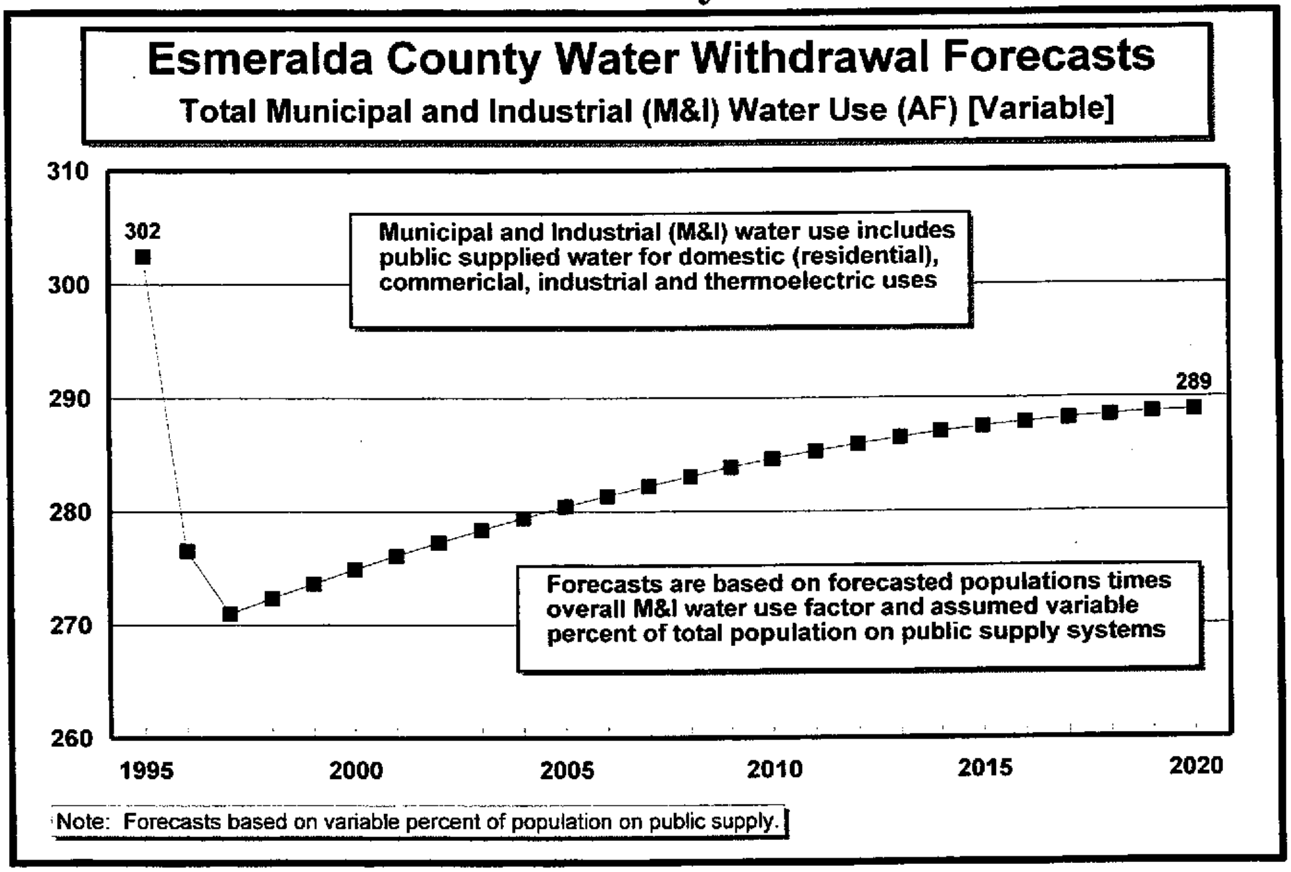
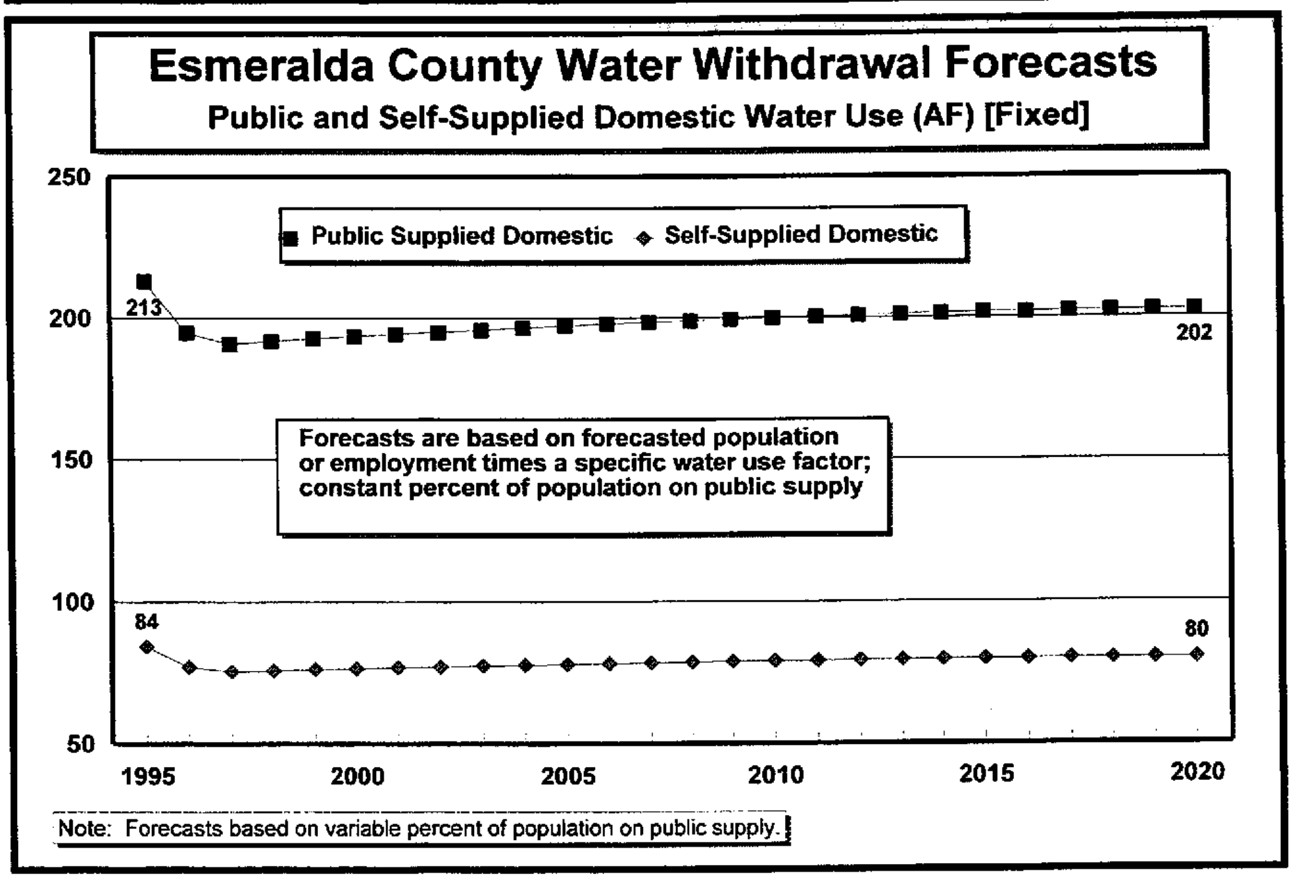




Eureka County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	1,198	619	51.66%	351	56.67%	322	29	323
1981	1,220	618	50.68%	388	62.82%	328	25	329
1982	1,220	556	45.55%	344	61.83%	328	23	329
1983	1,230	561	45.60%	319	56.91%	331	26	331
1984	1,260	702	55.73%	475	67.62%	339	24	339
1985	1,300	1,010	77.71%	636	62.94%	350	40	350
1986	1,330	1,086	81.69%	782	71.99%	358	33	358
1987	1,490	1,456	97.73%	1,129	77.55%	401	35	401
1988	1,510	3,181	210.63%	2,262	71.12%	406	98	407
1989	1,530	3,864	252.52%	3,109	80.46%	411	81	412
1990	1,550	4,026	259.76%	3,599	89.38%	417	46	418
1991	1,560	4,106	263.18%	3,510	85.49%	419	64	420
1992	1,580	4,326	273.81%	3,637	84.08%	425	74	426
1993	1,650	4,518	273.83%	3,912	86.58%	444	65	445
1994	1,550	4,948	319.25%	3,780	76.38%	417	125	418
1995	1,580	4,554	288.21%	3,927	86.23%	425	67	426
1996	1,650	4,867	294.95%	4,178	85.84%	444	74	445
1997	1,660	4,854	292.41%	4,270	87.97%	446	63	447
1998	1,700	4,968	292.26%	4,246	85.47%	457	77	458
1999	1,739	5,080	292.12%	4,215	82.97%	468	93	468
2000	1,777	5,189	291.97%	4,175	80.47%	478	109	479
2001	1,815	5,295	291.83%	4,129	77.97%	488	125	489
2002	1,851	5,398	291.68%	4,074	75.47%	498	142	499
2003	1,886	5,498	291.53%	4,012	72.97%	507	159	508
2004	1,920	5,594	291.39%	3,942	70.47%	516	177	517
2005	1,953	5,687	291.24%	3,950	69.47%	525	186	526
2006	1,984	5,775	291.10%	3,954	68.47%	533	195	534
2007	2,014	5,858	290.95%	3,953	67.47%	541	204	542
2008	2,042	5,937	290.81%	3,947	66.47%	549	213	550
2009	2,068	6,012	290.66%	3,936	65.47%	556	223	557
2010	2,093	6,081	290.51%	3,920	64.47%	563	232	564
2011	2,116	6,145	290.37%	3,900	63.47%	569	241	570
2012	2,137	6,203	290.22%	3,875	62.47%	575	250	576
2013	2,157	6,256	290.08%	3,845	61.47%	580	258	581
2014	2,174	6,303	289.93%	3,811	60.47%	585	267	586
2015	2,189	6,343	289.79%	3,772	59.47%	589	276	590
2016	2,202	6,378	289.64%	3,729	58.47%	592	284	593
2017	2,213	6,407	289.50%	3,682	57.47%	595	292	596
2018	2,222	6,429	289.35%	3,631	56.47%	597	300	599
2019	2,229	6,446	289.21%	3,575	55.47%	599	308	600
2020	2,233	6,455	289.07%	3,516	54.47%	600	315	602

Actual Period Average (1980-1997).......	179.72%	106.90%	Standard Deviation (1980-1997)
Forecast Period Average (1998-2020)....	290.66%	298.71%	Latest/Most Stable Period (1994-1997)

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person.....................	322.9	240.0	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.3616	0.2689	Acre-feet per person per year
Commercial & Industrial Water Use per Worker..............	95.7	Gallons per worker per day (excludes mining)	
[Commercial & Industrial Water Use Coefficient]	0.1072	Acre-feet per worker per year (excludes mining)	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Eureka County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	892	246	76	--	--	--	--	--
1981	909	251	77	--	--	--	--	--
1982	909	251	77	--	--	--	--	--
1983	916	253	78	--	--	--	--	--
1984	939	259	80	--	--	--	--	--
1985	968	267	82	--	--	--	--	--
1986	991	273	84	--	--	--	--	--
1987	1,110	306	94	--	--	--	--	--
1988	1,125	310	96	--	--	--	--	--
1989	1,140	315	97	--	--	--	--	--
1990	1,155	319	98	--	--	--	--	--
1991	1,162	321	99	--	--	--	--	--
1992	1,177	325	100	--	--	--	--	--
1993	1,229	339	104	--	--	--	--	--
1994	1,155	319	98	--	--	--	--	--
1995	1,177	325	100	1,177	74.49%	325	100	426
1996	1,229	339	104	1,229	74.51%	339	104	445
1997	1,237	341	105	1,237	74.53%	341	105	447
1998	1,266	349	108	1,267	74.55%	350	107	458
1999	1,295	358	110	1,297	74.57%	358	110	469
2000	1,324	365	112	1,326	74.59%	366	112	479
2001	1,352	373	115	1,354	74.61%	374	114	489
2002	1,379	381	117	1,381	74.62%	381	117	499
2003	1,405	388	119	1,408	74.64%	389	119	509
2004	1,430	395	122	1,433	74.66%	396	121	518
2005	1,455	401	124	1,458	74.68%	402	123	527
2006	1,478	408	126	1,482	74.70%	409	125	536
2007	1,500	414	127	1,504	74.72%	415	126	544
2008	1,521	420	129	1,526	74.74%	421	128	551
2009	1,541	425	131	1,546	74.75%	427	130	559
2010	1,559	430	132	1,565	74.77%	432	131	566
2011	1,576	435	134	1,583	74.79%	437	132	572
2012	1,592	439	135	1,599	74.81%	441	134	578
2013	1,606	443	136	1,614	74.83%	445	135	583
2014	1,619	447	138	1,627	74.85%	449	136	588
2015	1,631	450	139	1,639	74.87%	452	137	592
2016	1,640	453	139	1,649	74.89%	455	137	596
2017	1,649	455	140	1,658	74.90%	458	138	599
2018	1,655	457	141	1,665	74.92%	459	138	601
2019	1,660	458	141	1,670	74.94%	461	139	603
2020	1,664	459	141	1,674	74.96%	462	139	604

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied)...................	**322.9**	**246.4**	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.3616	0.2760	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	**221.5**		Gallons per person per day--self supply
[Self-Supplied Water Use Coefficient]	0.2481		Acre-feet per person per year
1995 Estimated Resident Population on Public Supply........	**74.49%**		Percent of total resident population

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

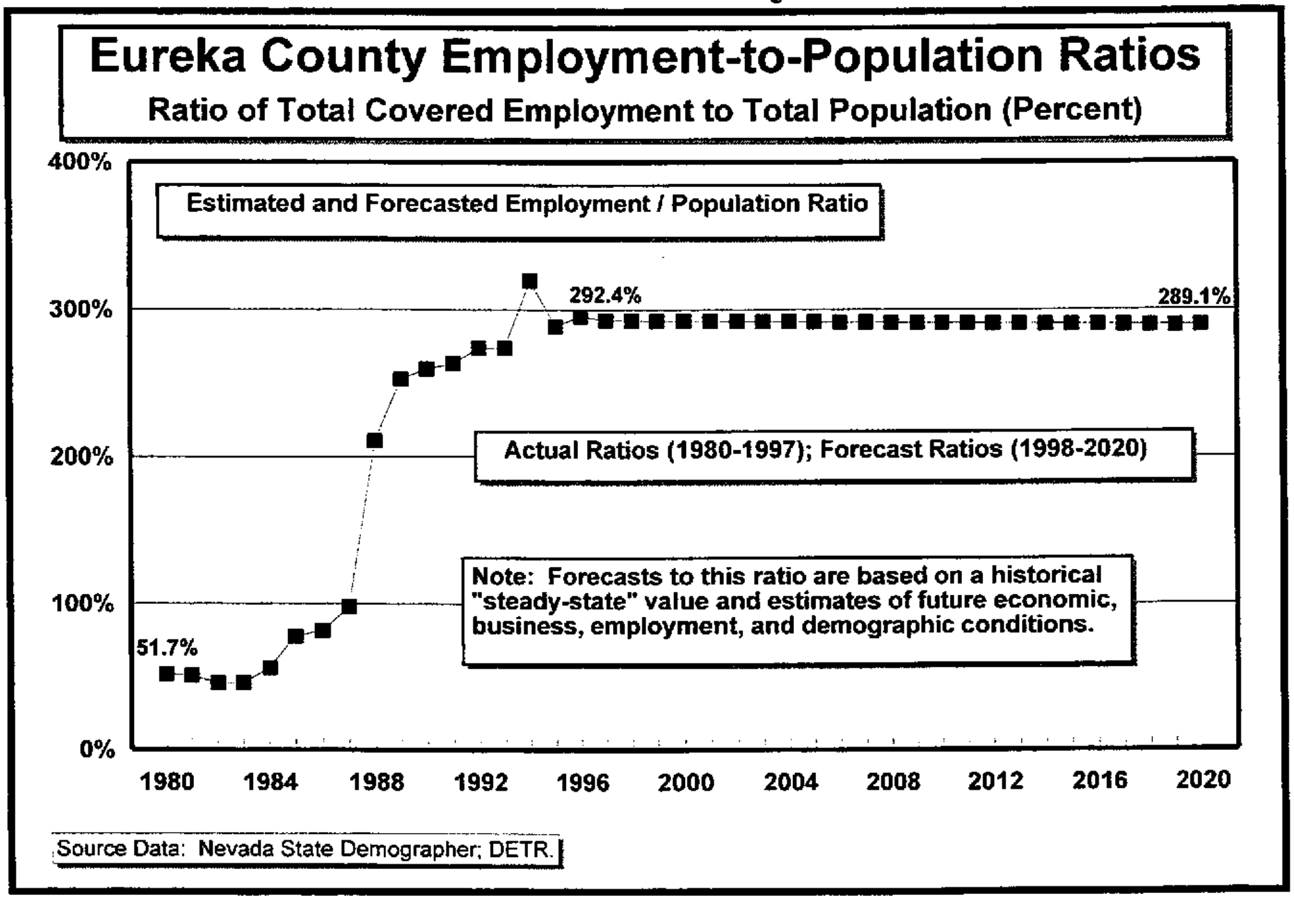
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

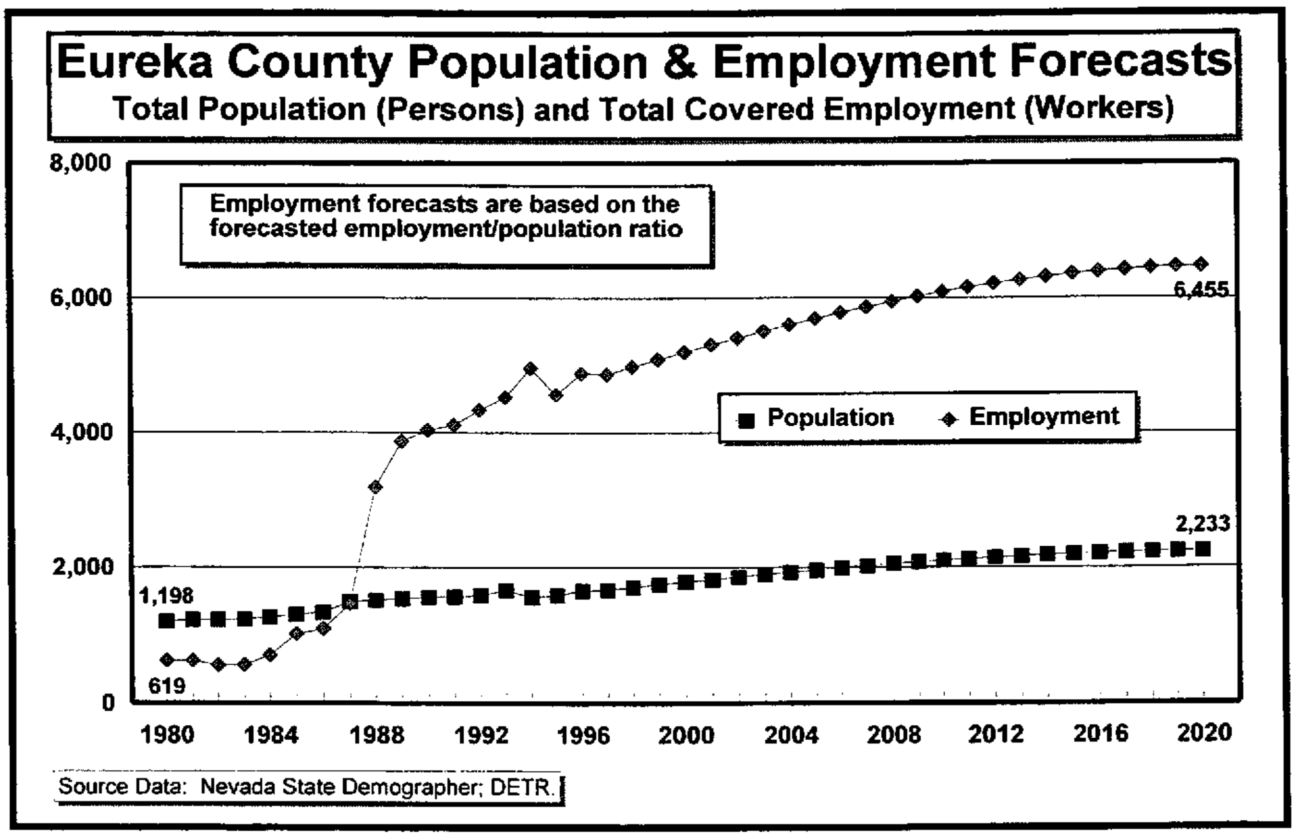
[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

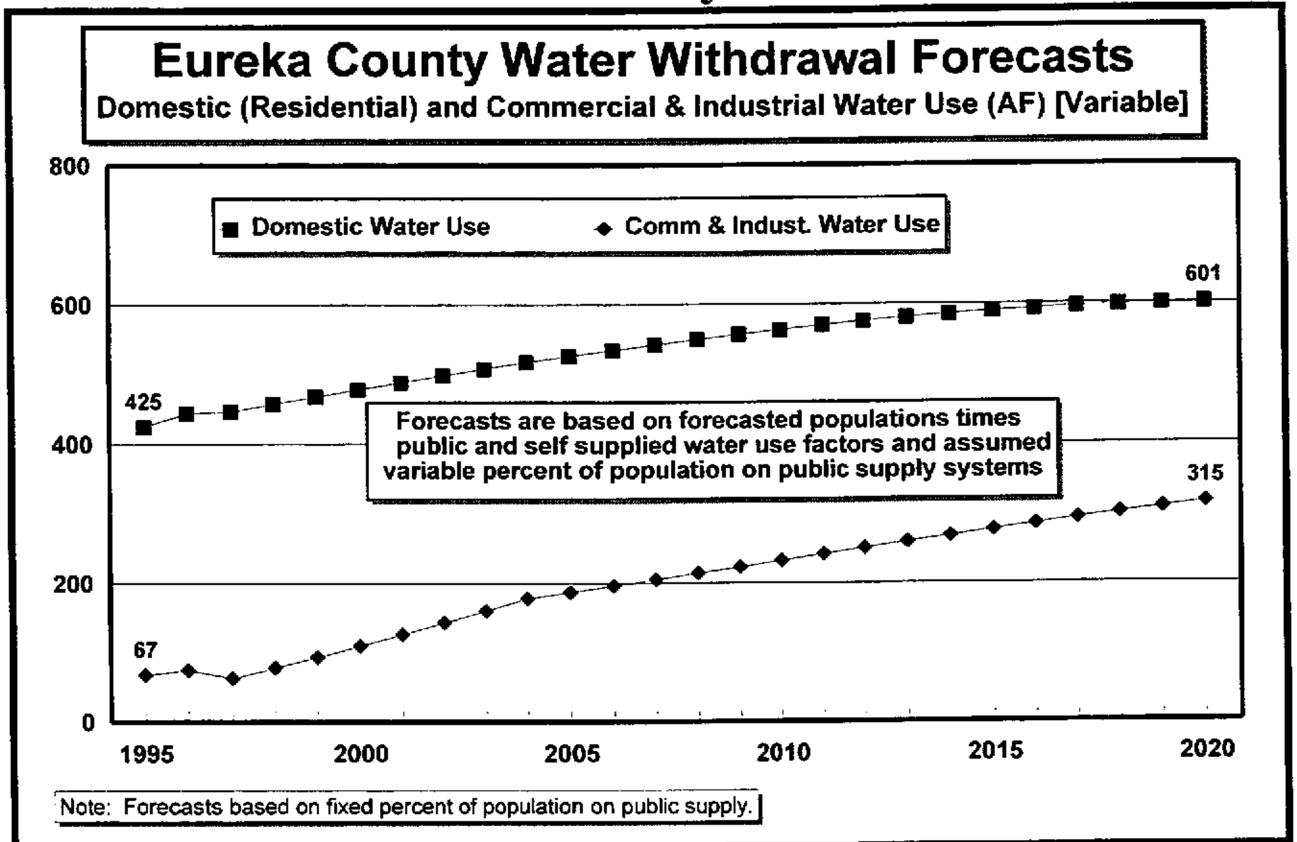
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

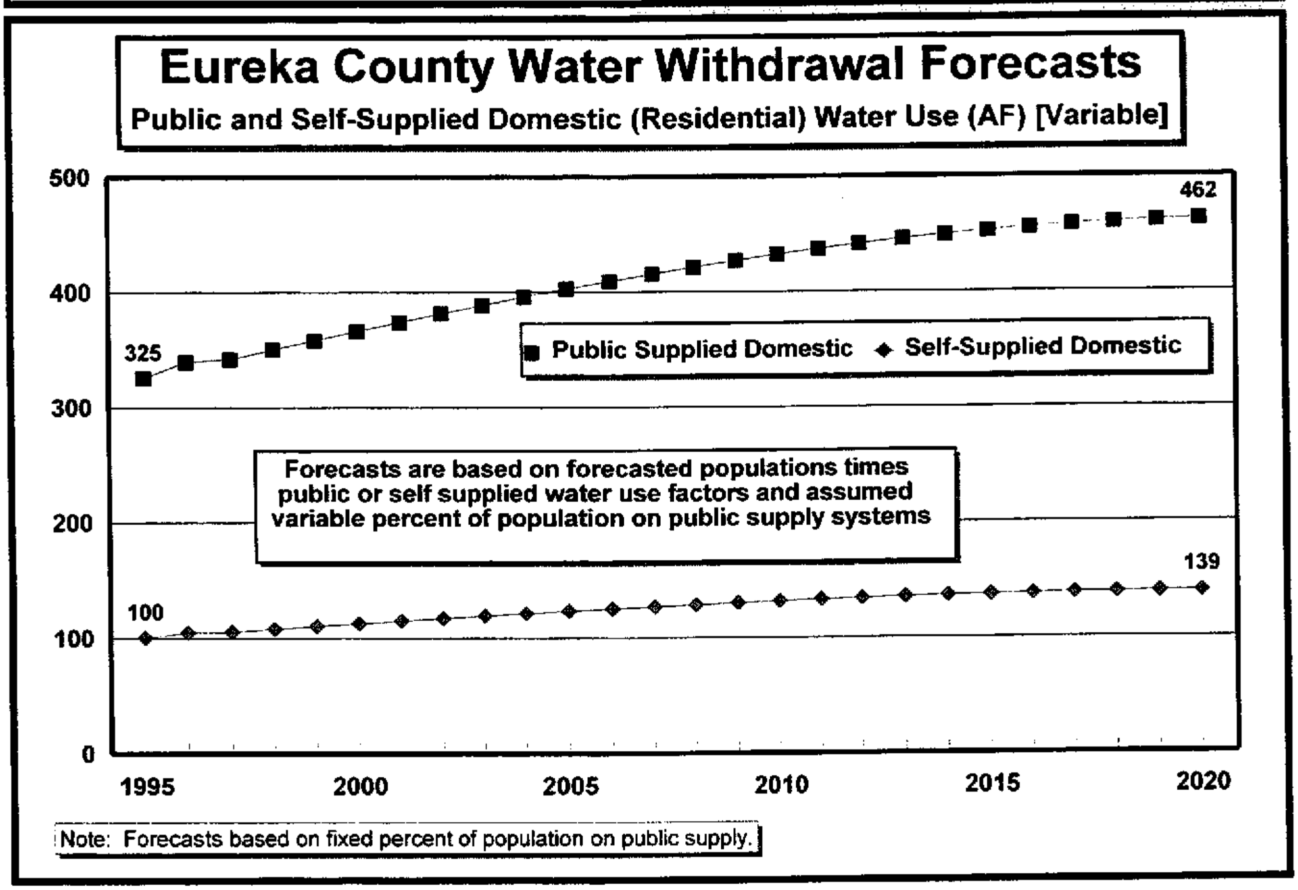
Nevada Socioeconomic Analysis and Forecasts





Nevada Water Use Analysis and Forecasts-1





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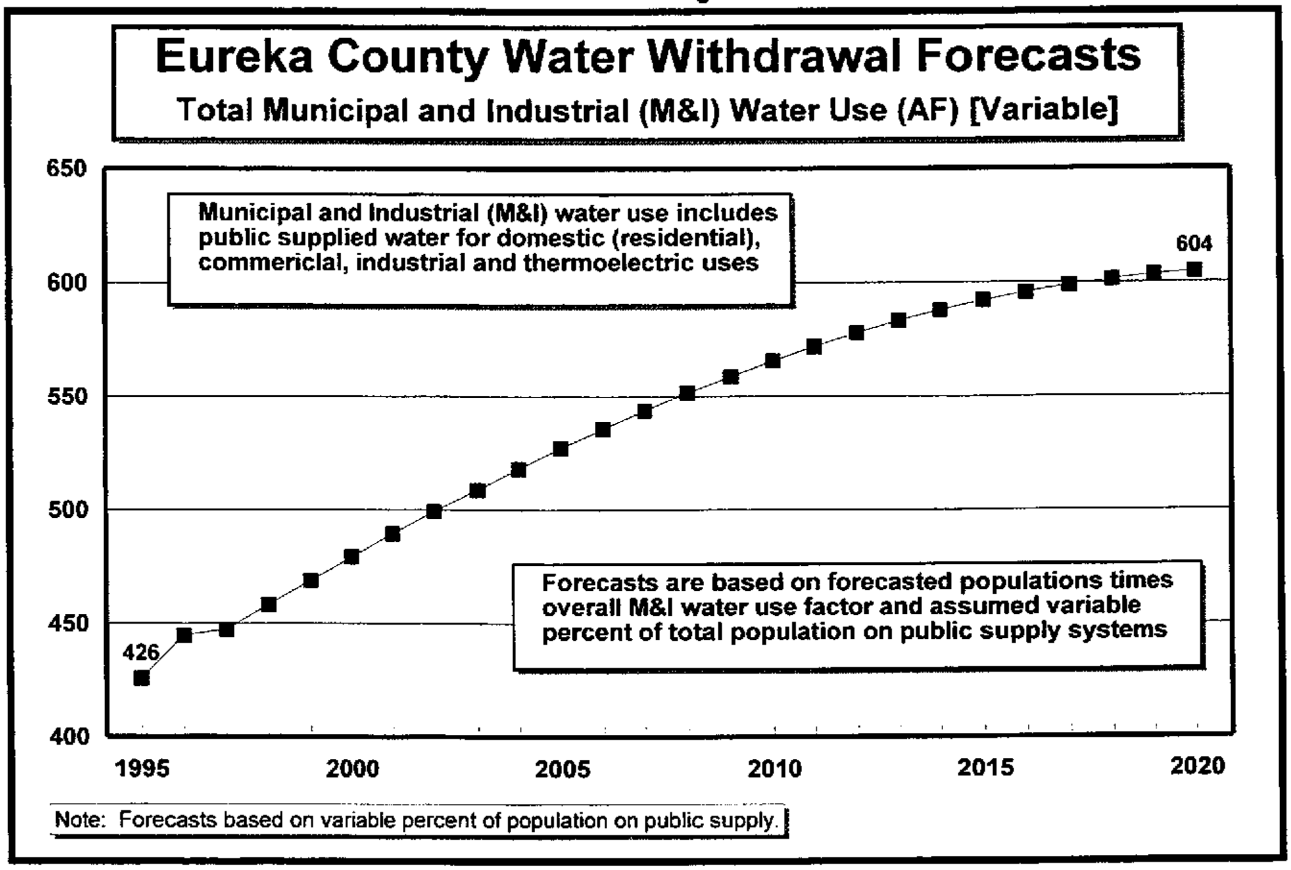
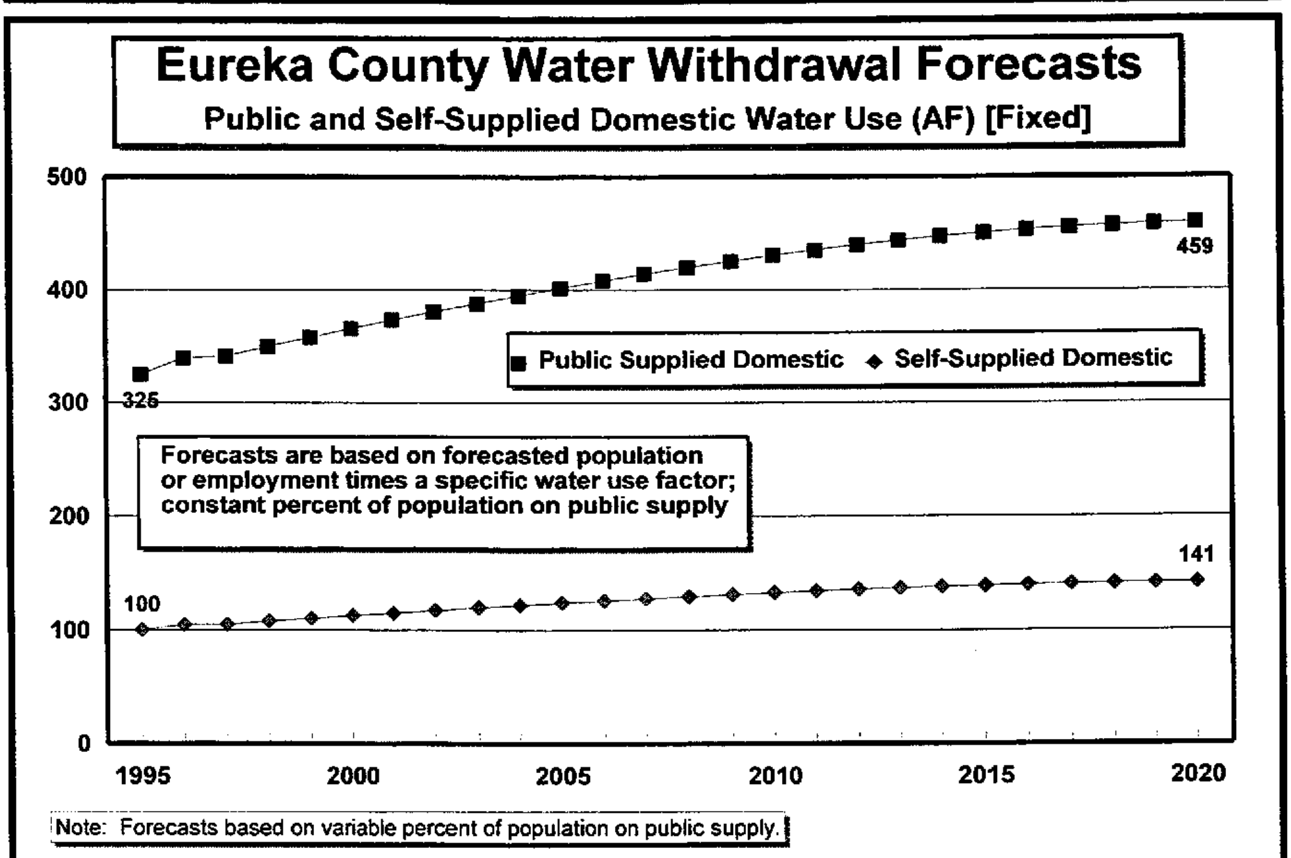




Humboldt County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	9,449	4,196	44.41%	165	3.92%	2,587	1,041	2,440
1981	10,380	4,521	43.56%	277	6.14%	2,841	1,096	2,680
1982	10,920	3,991	36.55%	261	6.53%	2,989	963	2,819
1983	10,960	3,935	35.91%	281	7.15%	3,000	944	2,830
1984	11,190	4,157	37.15%	308	7.40%	3,063	994	2,889
1985	11,260	4,046	35.93%	393	9.71%	3,082	943	2,907
1986	11,220	4,054	36.13%	459	11.33%	3,071	928	2,897
1987	11,490	4,615	40.16%	728	15.77%	3,145	1,004	2,966
1988	12,050	5,599	46.47%	1,167	20.85%	3,299	1,145	3,111
1989	12,580	6,283	49.94%	1,296	20.62%	3,444	1,288	3,248
1990	13,020	6,123	47.03%	1,527	24.94%	3,564	1,187	3,361
1991	13,500	6,671	49.41%	1,761	26.40%	3,696	1,268	3,485
1992	14,000	6,717	47.98%	1,998	29.75%	3,832	1,219	3,615
1993	14,510	7,059	48.65%	2,092	29.63%	3,972	1,283	3,746
1994	15,670	7,253	46.28%	2,075	28.62%	4,290	1,337	4,046
1995	16,270	7,770	47.75%	2,305	29.67%	4,454	1,411	4,201
1996	16,460	8,292	50.38%	2,493	30.07%	4,506	1,498	4,250
1997	17,520	8,554	48.82%	2,451	28.65%	4,796	1,576	4,523
1998	17,985	8,783	48.84%	2,451	27.90%	4,923	1,635	4,643
1999	18,444	9,010	48.85%	2,446	27.15%	5,049	1,695	4,762
2000	18,897	9,233	48.86%	2,438	26.40%	5,173	1,755	4,879
2001	19,343	9,454	48.87%	2,425	25.65%	5,295	1,815	4,994
2002	19,781	9,670	48.89%	2,408	24.90%	5,415	1,875	5,107
2003	20,209	9,882	48.90%	2,387	24.15%	5,532	1,936	5,218
2004	20,627	10,089	48.91%	2,361	23.40%	5,647	1,996	5,326
2005	21,034	10,290	48.92%	2,331	22.65%	5,758	2,055	5,430
2006	21,427	10,485	48.93%	2,297	21.90%	5,866	2,115	5,532
2007	21,808	10,674	48.95%	2,258	21.15%	5,970	2,174	5,630
2008	22,174	10,856	48.96%	2,215	20.40%	6,070	2,232	5,725
2009	22,524	11,030	48.97%	2,168	19.65%	6,166	2,289	5,815
2010	22,858	11,196	48.98%	2,117	18.90%	6,257	2,345	5,901
2011	23,174	11,354	49.00%	2,061	18.15%	6,344	2,400	5,983
2012	23,473	11,503	49.01%	2,002	17.40%	6,426	2,454	6,060
2013	23,752	11,643	49.02%	1,939	16.65%	6,502	2,506	6,132
2014	24,012	11,773	49.03%	1,872	15.90%	6,573	2,557	6,199
2015	24,251	11,894	49.04%	1,802	15.15%	6,638	2,606	6,261
2016	24,468	12,003	49.06%	1,729	14.40%	6,698	2,653	6,317
2017	24,664	12,102	49.07%	1,652	13.65%	6,752	2,699	6,368
2018	24,837	12,190	49.08%	1,573	12.90%	6,799	2,742	6,412
2019	24,987	12,267	49.09%	1,491	12.15%	6,840	2,783	6,451
2020	25,114	12,333	49.11%	1,406	11.40%	6,875	2,822	6,484

Actual Period Average (1980-1997).......	44.03%	5.33%	Standard Deviation (1980-1997)
Forecast Period Average (1998-2020)....	48.97%	48.31%	Latest/Most Stable Period (1994-1997)

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person....................	**348.8**	**244.4**	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.3907	0.2737	Acre-feet per person per year
Commercial & Industrial Water Use per Worker..............	**230.6**		Gallons per worker per day (excludes mining)
[Commercial & Industrial Water Use Coefficient]	0.2583		Acre-feet per worker per year (excludes mining)

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Humboldt County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	6,244	1,769	817	--	--	--	--	--
1981	6,860	1,944	898	--	--	--	--	--
1982	7,216	2,045	944	--	--	--	--	--
1983	7,243	2,052	948	--	--	--	--	--
1984	7,395	2,096	968	--	--	--	--	--
1985	7,441	2,109	974	--	--	--	--	--
1986	7,415	2,101	970	--	--	--	--	--
1987	7,593	2,152	994	--	--	--	--	--
1988	7,963	2,257	1,042	--	--	--	--	--
1989	8,313	2,356	1,088	--	--	--	--	--
1990	8,604	2,438	1,126	--	--	--	--	--
1991	8,921	2,528	1,167	--	--	--	--	--
1992	9,252	2,622	1,211	--	--	--	--	--
1993	9,589	2,717	1,255	--	--	--	--	--
1994	10,355	2,934	1,355	--	--	--	--	--
1995	10,752	3,047	1,407	10,752	66.08%	3,047	1,407	4,201
1996	10,878	3,082	1,423	10,880	66.10%	3,083	1,423	4,250
1997	11,578	3,281	1,515	11,584	66.12%	3,283	1,514	4,525
1998	11,885	3,368	1,555	11,894	66.13%	3,370	1,553	4,646
1999	12,189	3,454	1,595	12,201	66.15%	3,457	1,592	4,765
2000	12,488	3,539	1,634	12,504	66.17%	3,543	1,630	4,883
2001	12,783	3,622	1,673	12,802	66.18%	3,628	1,668	5,000
2002	13,072	3,704	1,711	13,095	66.20%	3,711	1,705	5,114
2003	13,355	3,785	1,748	13,382	66.22%	3,792	1,741	5,225
2004	13,631	3,863	1,784	13,662	66.23%	3,871	1,776	5,334
2005	13,900	3,939	1,819	13,935	66.25%	3,949	1,810	5,440
2006	14,160	4,013	1,853	14,199	66.27%	4,024	1,843	5,543
2007	14,412	4,084	1,886	14,455	66.28%	4,096	1,875	5,643
2008	14,653	4,152	1,918	14,701	66.30%	4,166	1,905	5,738
2009	14,885	4,218	1,948	14,937	66.32%	4,233	1,935	5,830
2010	15,106	4,280	1,977	15,162	66.33%	4,297	1,962	5,917
2011	15,315	4,340	2,004	15,376	66.35%	4,357	1,988	6,001
2012	15,512	4,396	2,030	15,578	66.37%	4,414	2,013	6,079
2013	15,697	4,448	2,054	15,767	66.38%	4,468	2,036	6,152
2014	15,868	4,497	2,076	15,944	66.40%	4,518	2,057	6,221
2015	16,026	4,541	2,097	16,106	66.42%	4,564	2,077	6,284
2016	16,170	4,582	2,116	16,255	66.43%	4,606	2,094	6,341
2017	16,299	4,619	2,133	16,389	66.45%	4,644	2,110	6,393
2018	16,414	4,651	2,148	16,508	66.47%	4,678	2,124	6,439
2019	16,513	4,679	2,161	16,612	66.48%	4,707	2,136	6,479
2020	16,597	4,703	2,172	16,701	66.50%	4,733	2,145	6,513

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied).....................	**348.8**	**253.0**	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.3907	0.2834	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	**227.6**	Gallons per person per day--self supply	
[Self-Supplied Water Use Coefficient]	0.2550	Acre-feet per person per year	
1995 Estimated Resident Population on Public Supply........	**66.08%**	Percent of total resident population	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

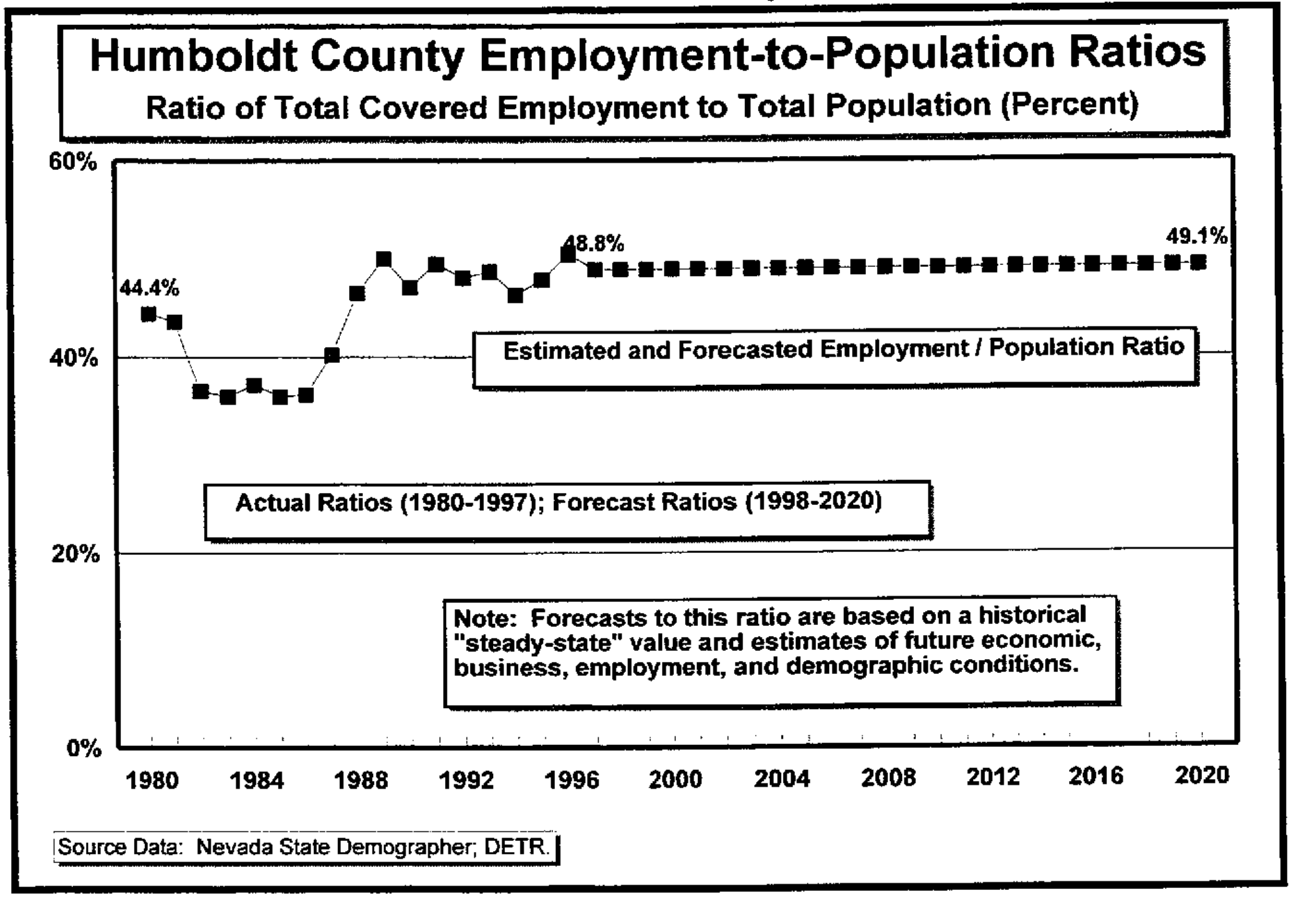
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

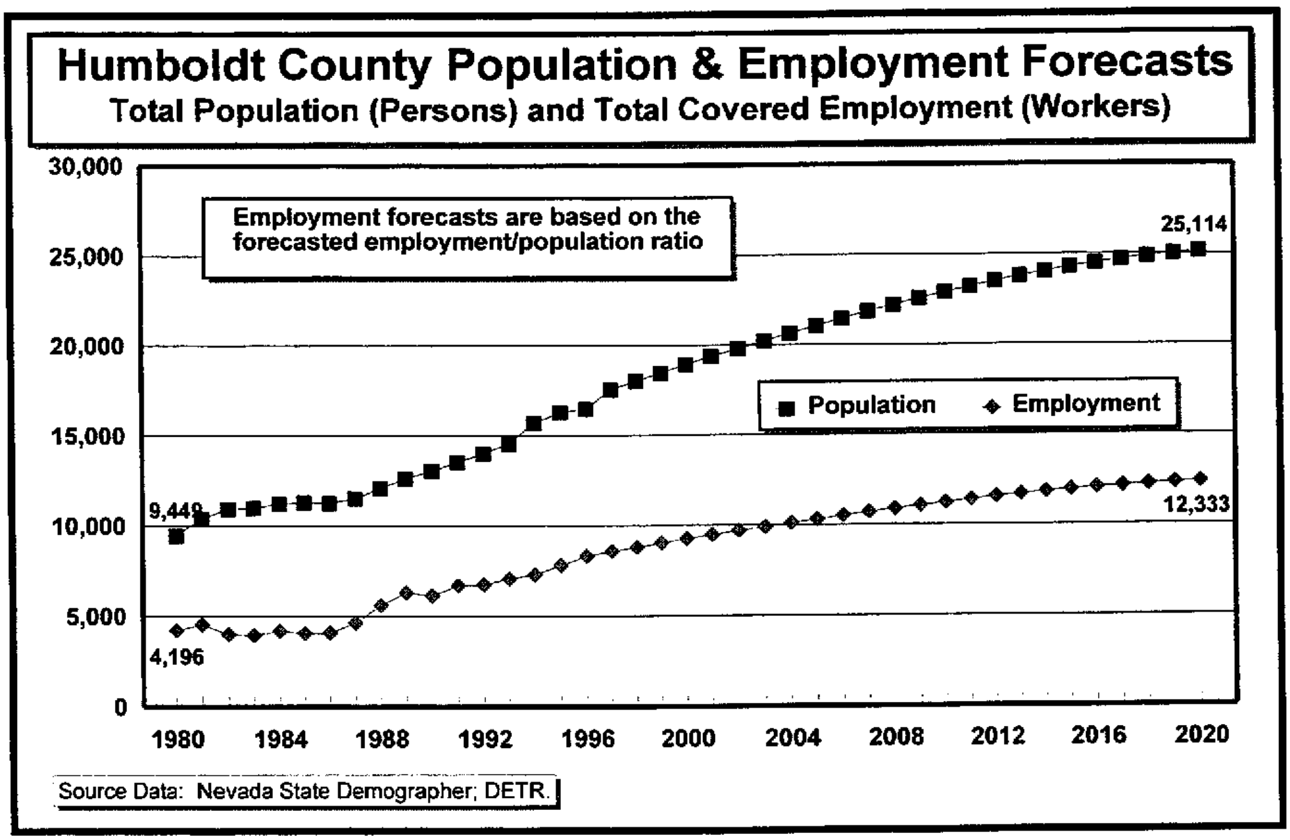
[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

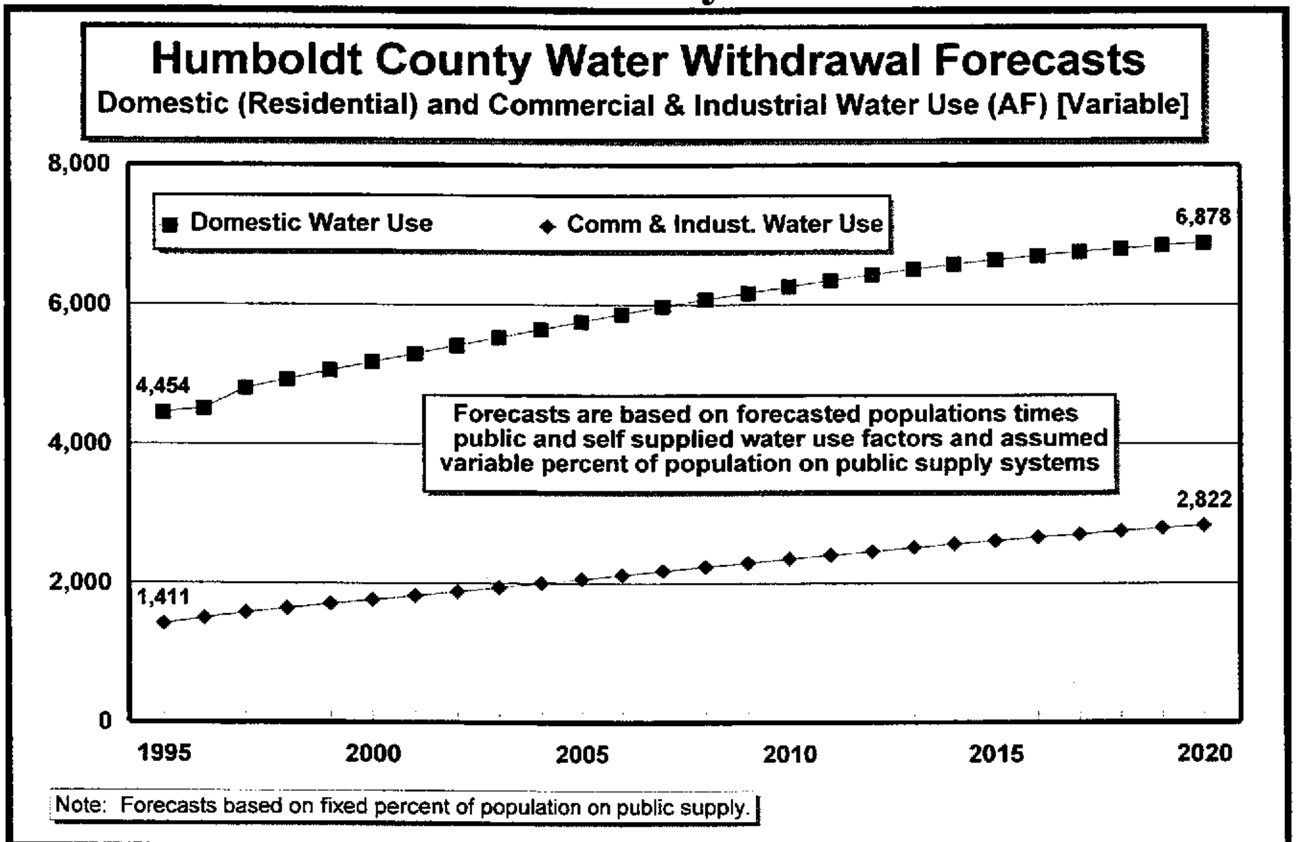
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

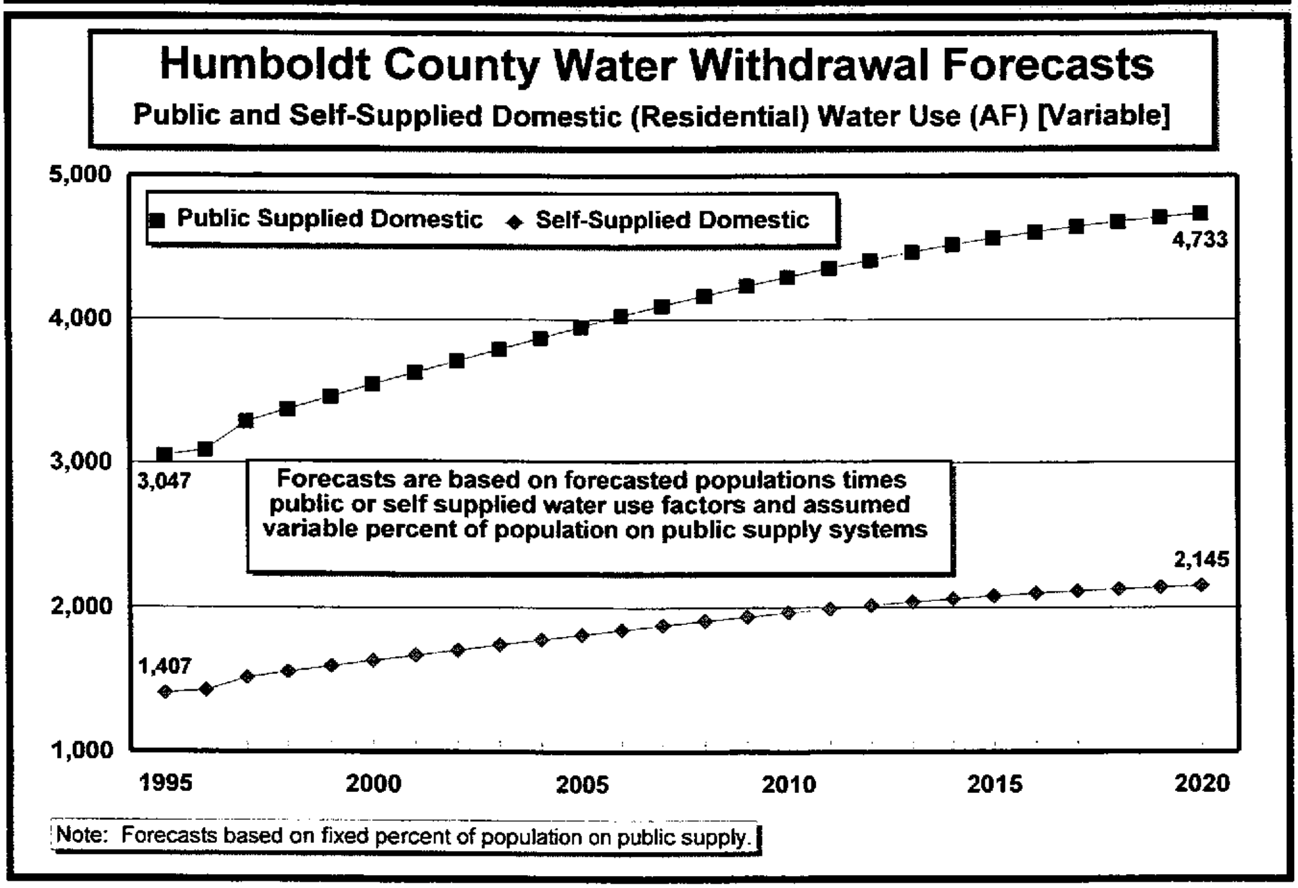
Nevada Socioeconomic Analysis and Forecasts





Nevada Water Use Analysis and Forecasts-1





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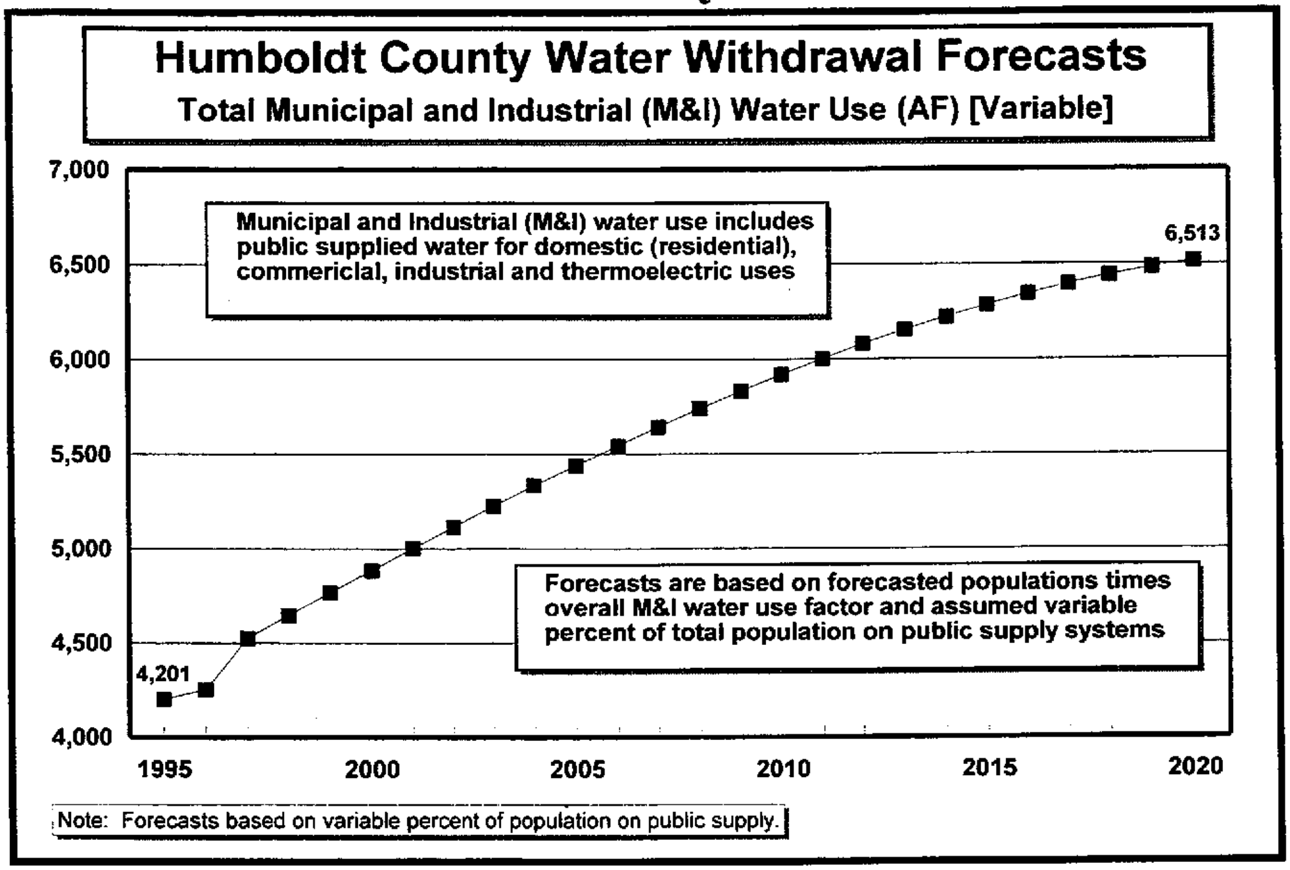
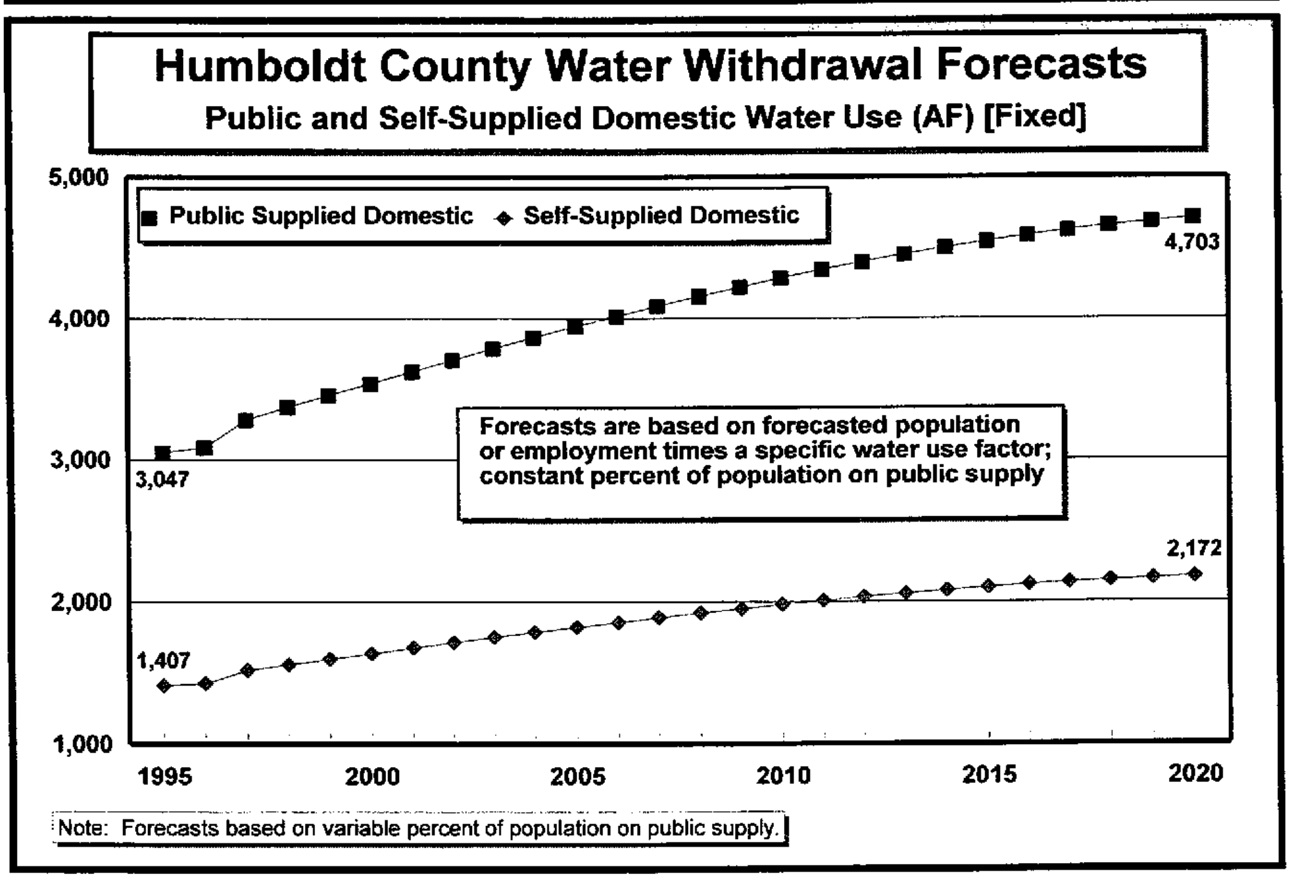




Lander County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	4,076	2,048	50.25%	994	48.51%	856	111	900
1981	5,010	2,195	43.80%	1,153	52.56%	1,053	110	1,107
1982	5,000	1,879	37.58%	1,015	54.02%	1,050	91	1,104
1983	4,720	1,621	34.35%	802	49.45%	992	86	1,043
1984	4,590	1,669	36.37%	818	48.99%	964	90	1,014
1985	4,520	1,691	37.40%	845	49.97%	950	89	998
1986	4,510	1,617	35.86%	731	45.19%	947	93	996
1987	4,600	2,099	45.63%	1,123	53.51%	966	103	1,016
1988	5,480	2,471	45.09%	1,169	47.33%	1,151	137	1,211
1989	6,270	2,868	45.74%	1,379	48.06%	1,317	157	1,385
1990	6,340	2,626	41.42%	1,360	51.79%	1,332	133	1,401
1991	6,370	2,570	40.35%	1,284	49.95%	1,338	135	1,407
1992	6,380	2,559	40.12%	1,229	48.02%	1,340	140	1,409
1993	6,430	2,346	36.49%	1,029	43.87%	1,351	139	1,420
1994	6,410	2,407	37.55%	983	40.82%	1,347	150	1,416
1995	6,440	2,465	38.27%	1,082	43.91%	1,353	146	1,423
1996	6,710	2,696	40.19%	1,213	44.97%	1,410	156	1,482
1997	7,030	2,708	38.52%	1,290	47.64%	1,477	149	1,553
1998	7,097	2,733	38.51%	1,294	47.36%	1,491	151	1,568
1999	7,163	2,757	38.49%	1,298	47.08%	1,505	154	1,582
2000	7,226	2,780	38.47%	1,301	46.80%	1,518	156	1,596
2001	7,287	2,802	38.46%	1,304	46.52%	1,531	158	1,610
2002	7,345	2,824	38.44%	1,306	46.24%	1,543	160	1,622
2003	7,401	2,844	38.43%	1,307	45.96%	1,555	162	1,635
2004	7,454	2,863	38.41%	1,308	45.68%	1,566	164	1,647
2005	7,505	2,882	38.40%	1,308	45.40%	1,577	166	1,658
2006	7,553	2,899	38.38%	1,308	45.12%	1,587	168	1,668
2007	7,598	2,915	38.37%	1,307	44.84%	1,596	169	1,678
2008	7,640	2,930	38.35%	1,306	44.56%	1,605	171	1,688
2009	7,680	2,944	38.34%	1,304	44.28%	1,614	173	1,697
2010	7,717	2,957	38.32%	1,301	44.00%	1,621	174	1,705
2011	7,751	2,969	38.31%	1,298	43.72%	1,628	176	1,712
2012	7,782	2,980	38.29%	1,294	43.44%	1,635	177	1,719
2013	7,810	2,989	38.27%	1,290	43.16%	1,641	179	1,725
2014	7,835	2,998	38.26%	1,285	42.88%	1,646	180	1,731
2015	7,857	3,005	38.24%	1,280	42.60%	1,651	182	1,736
2016	7,876	3,011	38.23%	1,274	42.32%	1,655	183	1,740
2017	7,892	3,016	38.21%	1,268	42.04%	1,658	184	1,743
2018	7,904	3,019	38.20%	1,261	41.76%	1,661	185	1,746
2019	7,914	3,022	38.18%	1,253	41.48%	1,663	186	1,748
2020	7,920	3,023	38.17%	1,245	41.20%	1,664	187	1,750
Actual Period Average (1980-1997).......			40.28%	4.15%	Standard Deviation (1980-1997)			
Forecast Period Average (1998-2020)....			38.34%	38.63%	Latest/Most Stable Period (1994-1997)			

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person......................	245.4	187.6	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.2748	0.2101	Acre-feet per person per year
Commercial & Industrial Water Use per Worker...............	94.0	Gallons per worker per day (excludes mining)	
[Commercial & Industrial Water Use Coefficient]	0.1053	Acre-feet per worker per year (excludes mining)	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Lander County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	3,276	702	154	--	--	--	--	--
1981	4,027	863	190	--	--	--	--	--
1982	4,019	861	189	--	--	--	--	--
1983	3,794	813	179	--	--	--	--	--
1984	3,689	790	174	--	--	--	--	--
1985	3,633	778	171	--	--	--	--	--
1986	3,625	777	171	--	--	--	--	--
1987	3,697	792	174	--	--	--	--	--
1988	4,404	944	208	--	--	--	--	--
1989	5,039	1,080	238	--	--	--	--	--
1990	5,096	1,092	240	--	--	--	--	--
1991	5,120	1,097	241	--	--	--	--	--
1992	5,128	1,099	242	--	--	--	--	--
1993	5,168	1,107	244	--	--	--	--	--
1994	5,152	1,104	243	--	--	--	--	--
1995	5,176	1,109	244	5,176	80.37%	1,109	244	1,423
1996	5,393	1,155	254	5,394	80.39%	1,156	254	1,483
1997	5,650	1,211	266	5,653	80.41%	1,211	266	1,554
1998	5,704	1,222	269	5,709	80.43%	1,223	268	1,569
1999	5,757	1,233	271	5,763	80.45%	1,235	270	1,583
2000	5,808	1,244	274	5,815	80.47%	1,246	272	1,598
2001	5,856	1,255	276	5,865	80.49%	1,257	274	1,611
2002	5,903	1,265	278	5,914	80.51%	1,267	276	1,625
2003	5,948	1,274	280	5,960	80.53%	1,277	278	1,637
2004	5,991	1,284	282	6,004	80.55%	1,286	280	1,649
2005	6,032	1,292	284	6,047	80.57%	1,296	281	1,661
2006	6,070	1,301	286	6,087	80.59%	1,304	283	1,672
2007	6,107	1,308	288	6,125	80.61%	1,312	284	1,682
2008	6,141	1,316	289	6,161	80.63%	1,320	286	1,692
2009	6,173	1,323	291	6,194	80.65%	1,327	287	1,701
2010	6,202	1,329	292	6,226	80.67%	1,334	288	1,710
2011	6,230	1,335	294	6,255	80.69%	1,340	289	1,718
2012	6,255	1,340	295	6,281	80.71%	1,346	290	1,725
2013	6,277	1,345	296	6,305	80.74%	1,351	290	1,731
2014	6,297	1,349	297	6,327	80.76%	1,356	291	1,737
2015	6,315	1,353	298	6,347	80.78%	1,360	292	1,742
2016	6,330	1,356	298	6,363	80.80%	1,363	292	1,747
2017	6,343	1,359	299	6,378	80.82%	1,366	292	1,751
2018	6,353	1,361	299	6,389	80.84%	1,369	292	1,754
2019	6,360	1,363	300	6,399	80.86%	1,371	292	1,756
2020	6,366	1,364	300	6,405	80.88%	1,372	292	1,758

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied).....................	**245.4**	**191.3**	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.2748	0.2142	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	**172.3**	Gallons per person per day--self supply	
[Self-Supplied Water Use Coefficient]	0.1930	Acre-feet per person per year	
1995 Estimated Resident Population on Public Supply........	**80.37%**	Percent of total resident population	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

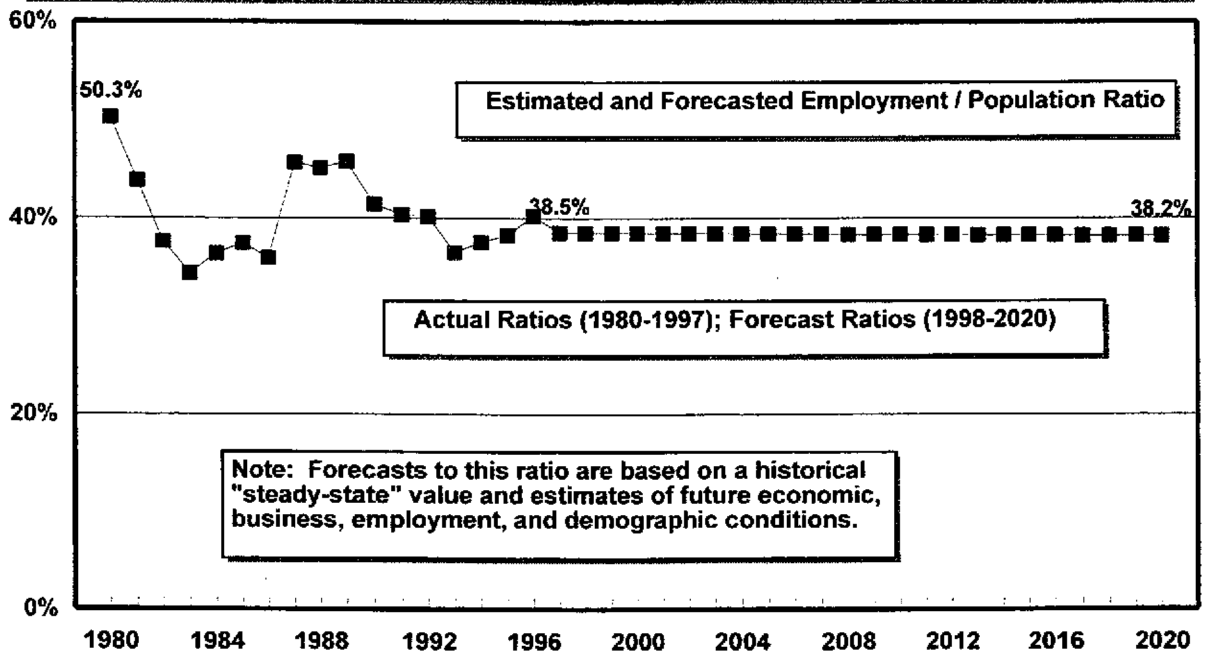
[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Nevada Socioeconomic Analysis and Forecasts

Lander County Employment-to-Population Ratios

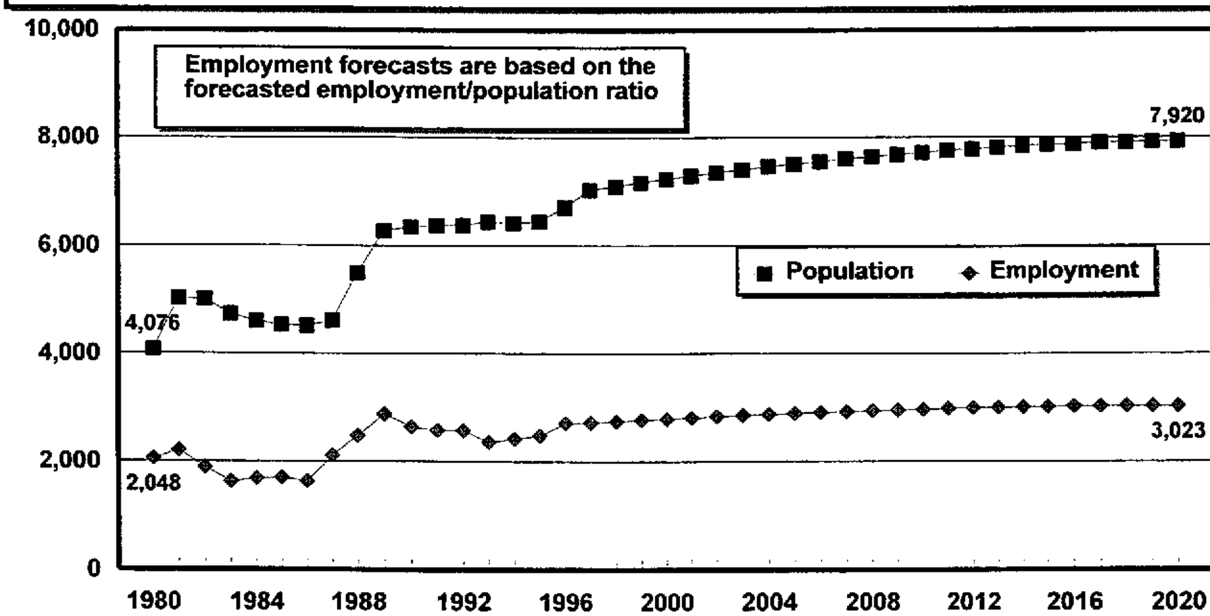
Ratio of Total Covered Employment to Total Population (Percent)



Source Data: Nevada State Demographer; DETR.

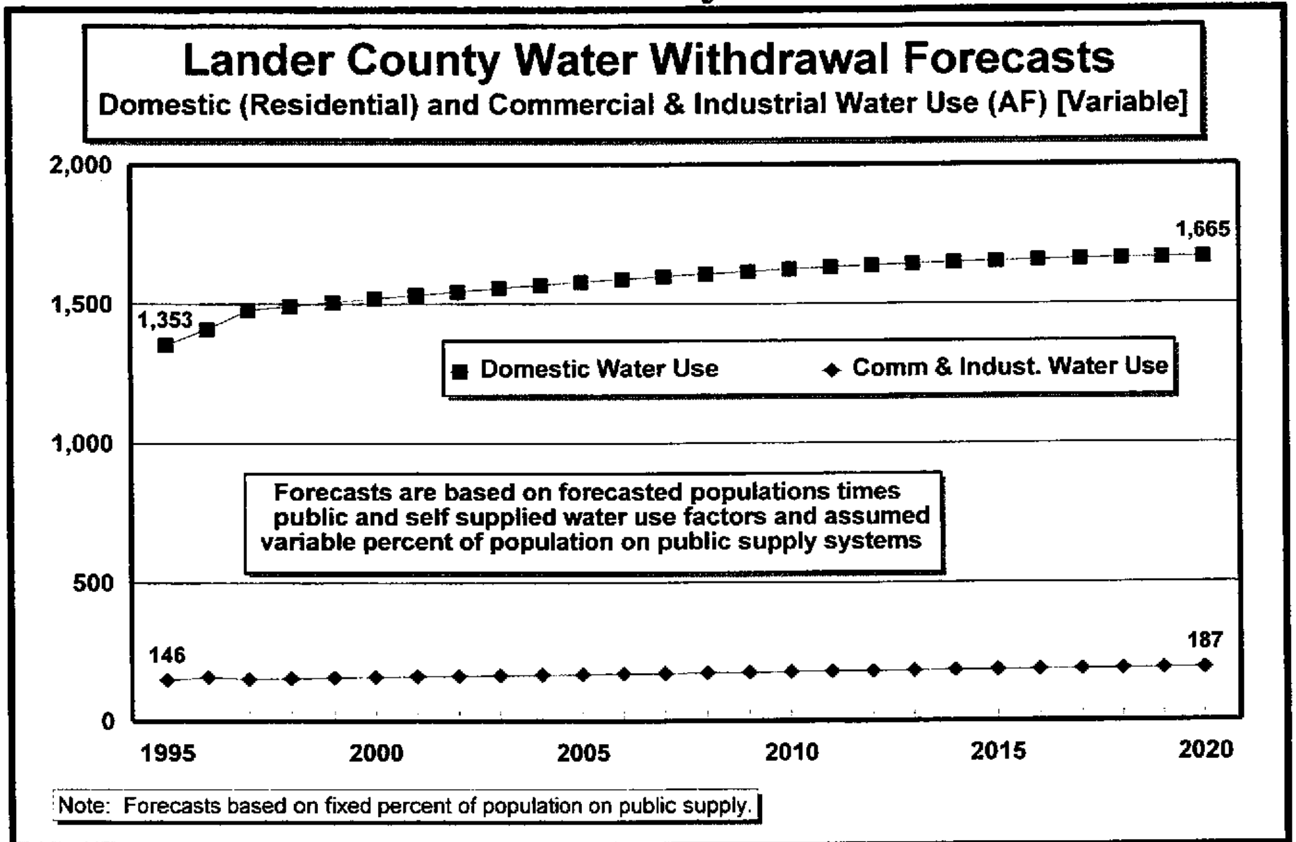
Lander County Population & Employment Forecasts

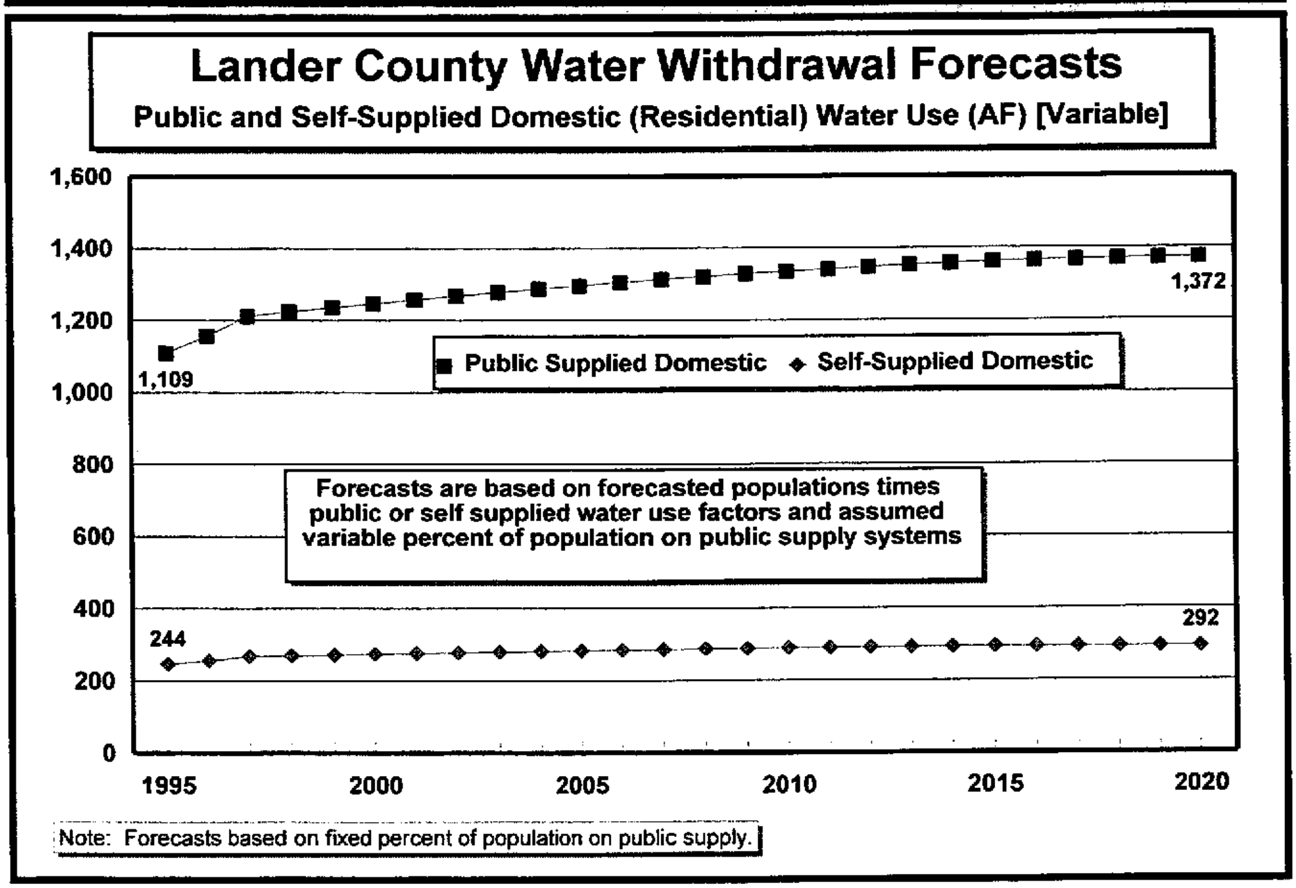
Total Population (Persons) and Total Covered Employment (Workers)



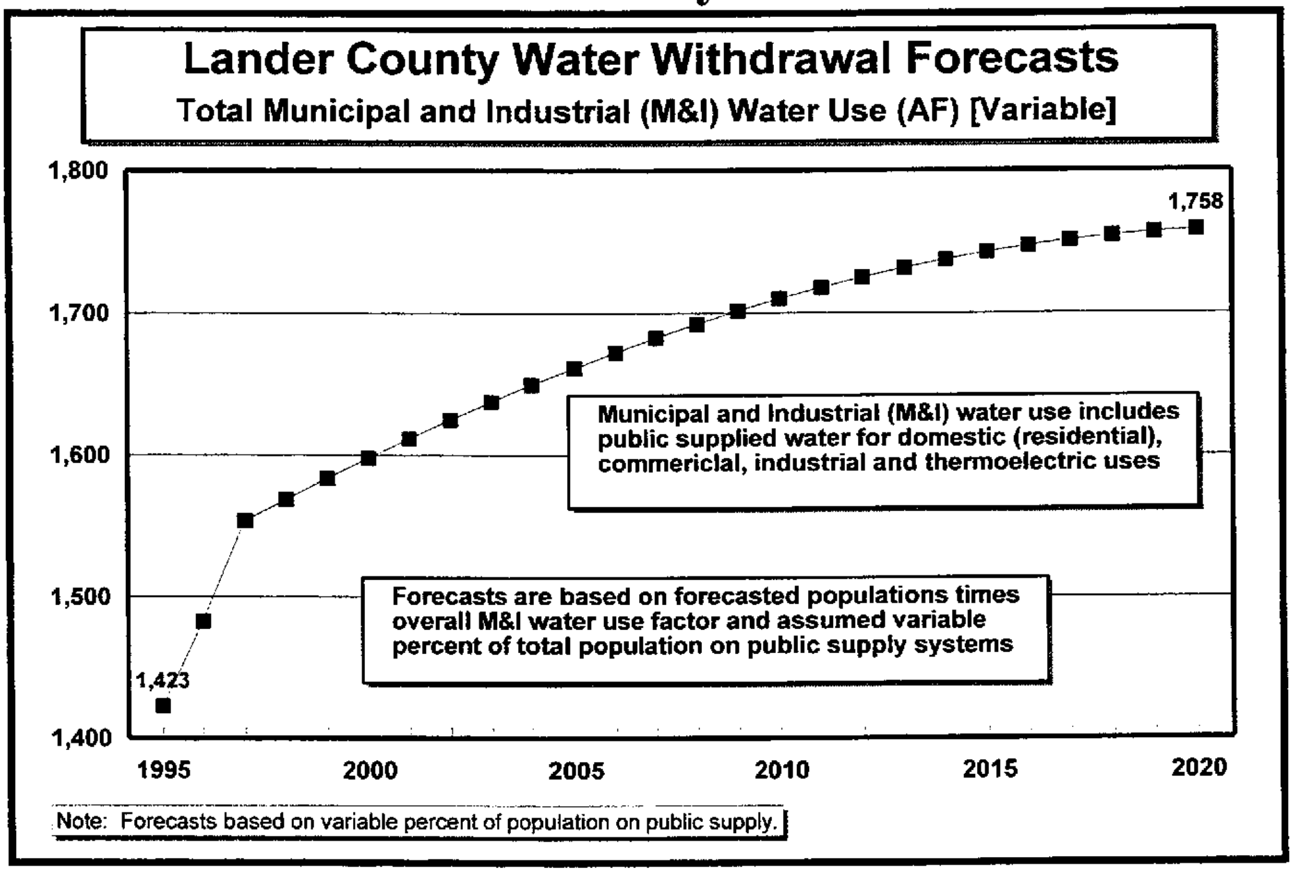
Source Data: Nevada State Demographer; DETR.

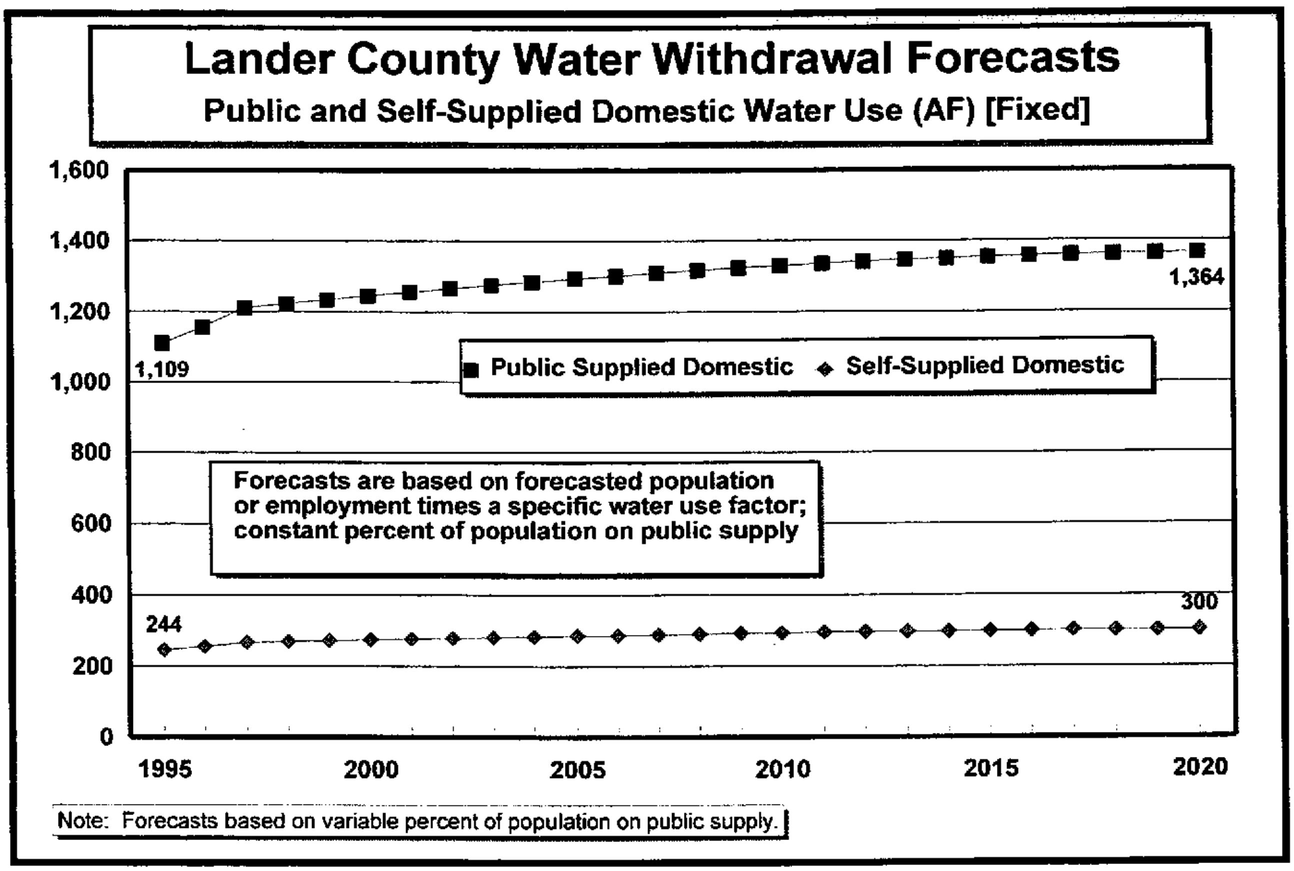
Nevada Water Use Analysis and Forecasts-1





Nevada Water Use Analysis and Forecasts-2





Lincoln County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	3,732	1,337	35.83%	305	22.80%	1,230	247	1,407
1981	3,760	1,572	41.82%	247	15.68%	1,240	317	1,418
1982	3,770	1,691	44.86%	120	7.12%	1,243	376	1,422
1983	3,760	1,594	42.39%	96	6.02%	1,240	358	1,418
1984	3,770	1,748	46.37%	67	3.82%	1,243	402	1,422
1985	3,780	1,693	44.80%	47	2.75%	1,246	394	1,426
1986	3,780	1,673	44.27%	22	1.29%	1,246	395	1,426
1987	3,790	1,681	44.36%	20	1.18%	1,250	397	1,429
1988	3,800	1,809	47.60%	24	1.31%	1,253	427	1,433
1989	3,800	1,817	47.83%	27	1.48%	1,253	428	1,433
1990	3,810	1,827	47.95%	27	1.46%	1,256	431	1,437
1991	3,870	1,738	44.92%	19	1.12%	1,276	411	1,459
1992	4,080	1,589	38.94%	15	0.92%	1,345	377	1,539
1993	4,130	1,630	39.48%	14	0.85%	1,362	387	1,558
1994	4,320	1,665	38.54%	13	0.80%	1,424	395	1,629
1995	4,110	1,535	37.36%	15	0.97%	1,355	364	1,550
1996	4,020	1,416	35.22%	18	1.27%	1,325	334	1,516
1997	4,110	1,463	35.60%	13	0.89%	1,355	347	1,550
1998	4,130	1,466	35.51%	13	0.88%	1,362	348	1,557
1999	4,149	1,469	35.42%	13	0.86%	1,368	348	1,565
2000	4,167	1,472	35.33%	13	0.85%	1,374	349	1,571
2001	4,184	1,475	35.24%	12	0.84%	1,380	350	1,578
2002	4,201	1,477	35.15%	12	0.83%	1,385	350	1,584
2003	4,217	1,479	35.07%	12	0.82%	1,390	351	1,590
2004	4,232	1,480	34.98%	12	0.80%	1,395	351	1,596
2005	4,247	1,482	34.89%	12	0.79%	1,400	352	1,602
2006	4,260	1,483	34.80%	12	0.78%	1,405	352	1,607
2007	4,273	1,483	34.72%	11	0.77%	1,409	352	1,612
2008	4,285	1,484	34.63%	11	0.76%	1,413	352	1,616
2009	4,296	1,484	34.54%	11	0.74%	1,416	352	1,620
2010	4,307	1,484	34.46%	11	0.73%	1,420	352	1,624
2011	4,316	1,483	34.37%	11	0.72%	1,423	352	1,628
2012	4,325	1,483	34.28%	11	0.71%	1,426	352	1,631
2013	4,332	1,482	34.20%	10	0.70%	1,428	352	1,634
2014	4,339	1,480	34.11%	10	0.68%	1,431	352	1,637
2015	4,345	1,479	34.03%	10	0.67%	1,433	351	1,639
2016	4,351	1,477	33.94%	10	0.66%	1,434	351	1,641
2017	4,355	1,475	33.86%	10	0.65%	1,436	350	1,642
2018	4,358	1,472	33.77%	9	0.64%	1,437	350	1,644
2019	4,361	1,469	33.69%	9	0.62%	1,438	349	1,645
2020	4,363	1,466	33.60%	9	0.61%	1,438	349	1,645
Actual Period Average (1980-1997).......			42.12%	4.28%	Standard Deviation (1980-1997)			
Forecast Period Average (1998-2020)....			34.55%	36.68%	Latest/Most Stable Period (1994-1997)			

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person....................	**430.9**	**294.3**	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.4827	0.3297	Acre-feet per person per year
Commercial & Industrial Water Use per Worker..............	**213.6**	Gallons per worker per day (excludes mining)	
[Commercial & Industrial Water Use Coefficient]	0.2392	Acre-feet per worker per year (excludes mining)	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Lincoln County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	2,916	982	248	--	--	--	--	--
1981	2,938	990	250	--	--	--	--	--
1982	2,945	992	250	--	--	--	--	--
1983	2,938	990	250	--	--	--	--	--
1984	2,945	992	250	--	--	--	--	--
1985	2,953	995	251	--	--	--	--	--
1986	2,953	995	251	--	--	--	--	--
1987	2,961	998	252	--	--	--	--	--
1988	2,969	1,000	252	--	--	--	--	--
1989	2,969	1,000	252	--	--	--	--	--
1990	2,977	1,003	253	--	--	--	--	--
1991	3,023	1,019	257	--	--	--	--	--
1992	3,188	1,074	271	--	--	--	--	--
1993	3,227	1,087	274	--	--	--	--	--
1994	3,375	1,137	287	--	--	--	--	--
1995	3,211	1,082	273	3,211	78.13%	1,082	273	1,550
1996	3,141	1,058	267	3,141	78.15%	1,059	267	1,516
1997	3,211	1,082	273	3,213	78.17%	1,083	273	1,551
1998	3,226	1,087	274	3,229	78.19%	1,088	274	1,558
1999	3,241	1,092	276	3,244	78.20%	1,093	275	1,566
2000	3,256	1,097	277	3,260	78.22%	1,098	276	1,573
2001	3,269	1,102	278	3,274	78.24%	1,103	276	1,580
2002	3,282	1,106	279	3,288	78.26%	1,108	277	1,586
2003	3,295	1,110	280	3,301	78.28%	1,112	278	1,593
2004	3,307	1,114	281	3,314	78.30%	1,117	279	1,599
2005	3,318	1,118	282	3,326	78.32%	1,121	280	1,604
2006	3,328	1,122	283	3,338	78.34%	1,125	280	1,610
2007	3,338	1,125	284	3,348	78.36%	1,128	281	1,615
2008	3,348	1,128	285	3,359	78.38%	1,132	281	1,620
2009	3,356	1,131	285	3,368	78.40%	1,135	282	1,624
2010	3,365	1,134	286	3,377	78.42%	1,138	282	1,628
2011	3,372	1,136	287	3,385	78.44%	1,141	283	1,632
2012	3,379	1,139	287	3,393	78.46%	1,143	283	1,636
2013	3,385	1,141	288	3,400	78.48%	1,146	283	1,639
2014	3,390	1,142	288	3,406	78.50%	1,148	283	1,642
2015	3,395	1,144	289	3,412	78.52%	1,150	283	1,645
2016	3,399	1,145	289	3,417	78.54%	1,151	284	1,647
2017	3,402	1,147	289	3,421	78.56%	1,153	284	1,649
2018	3,405	1,147	290	3,425	78.58%	1,154	284	1,650
2019	3,407	1,148	290	3,428	78.60%	1,155	283	1,652
2020	3,409	1,149	290	3,430	78.62%	1,156	283	1,653

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied).....................	**430.9**	**300.8**	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.4827	0.3370	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	**271.1**	Gallons per person per day--self supply	
[Self-Supplied Water Use Coefficient]	0.3037	Acre-feet per person per year	
1995 Estimated Resident Population on Public Supply........	**78.13%**	Percent of total resident population	

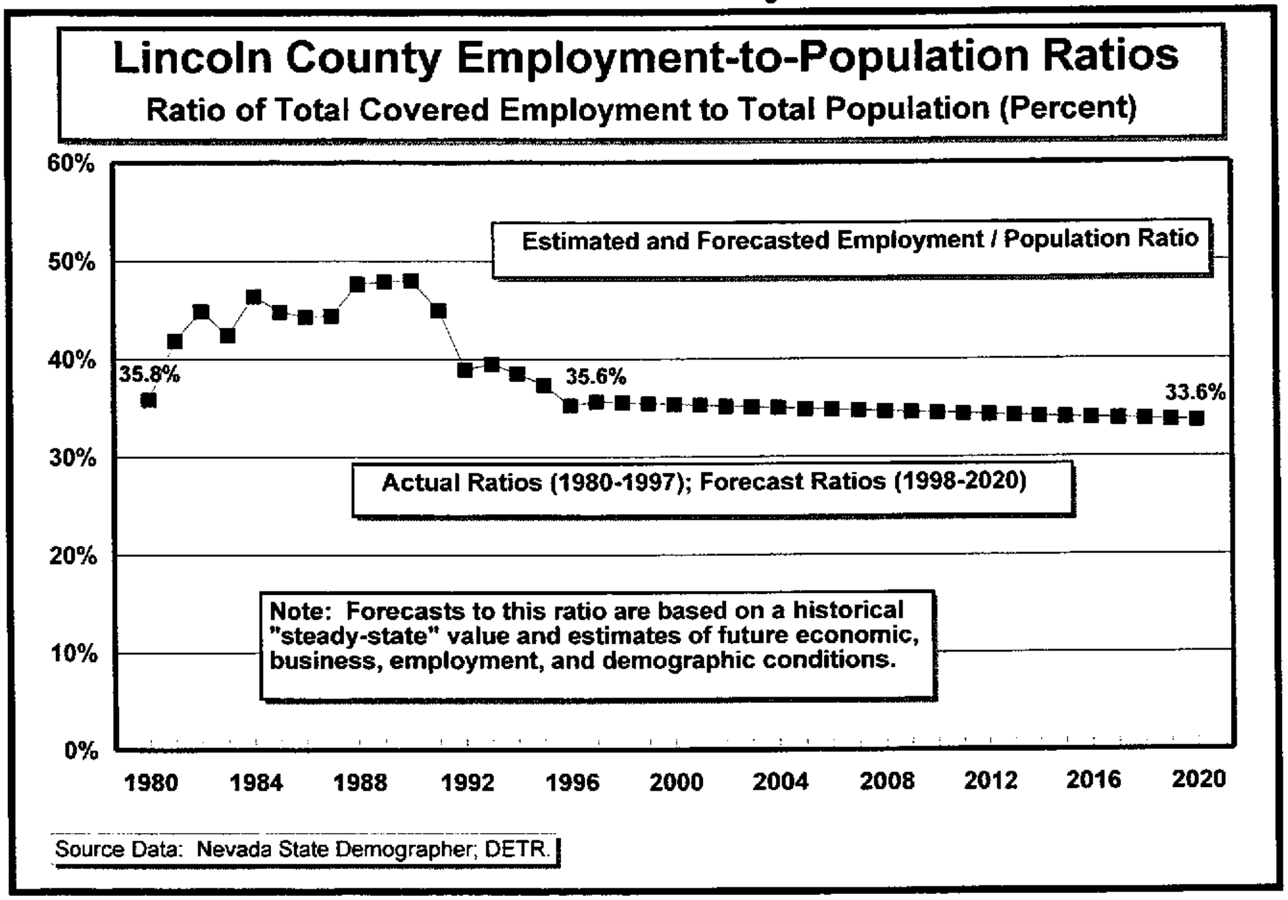
Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

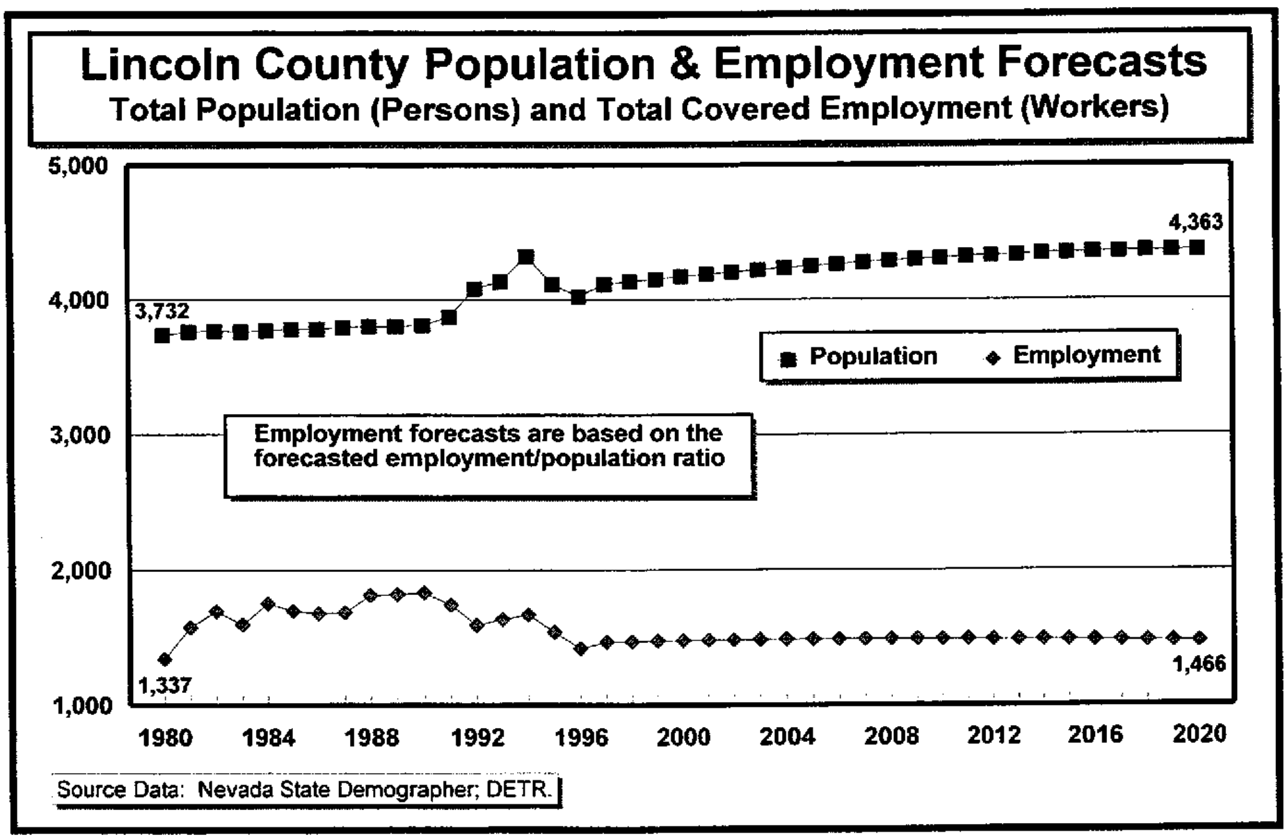
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

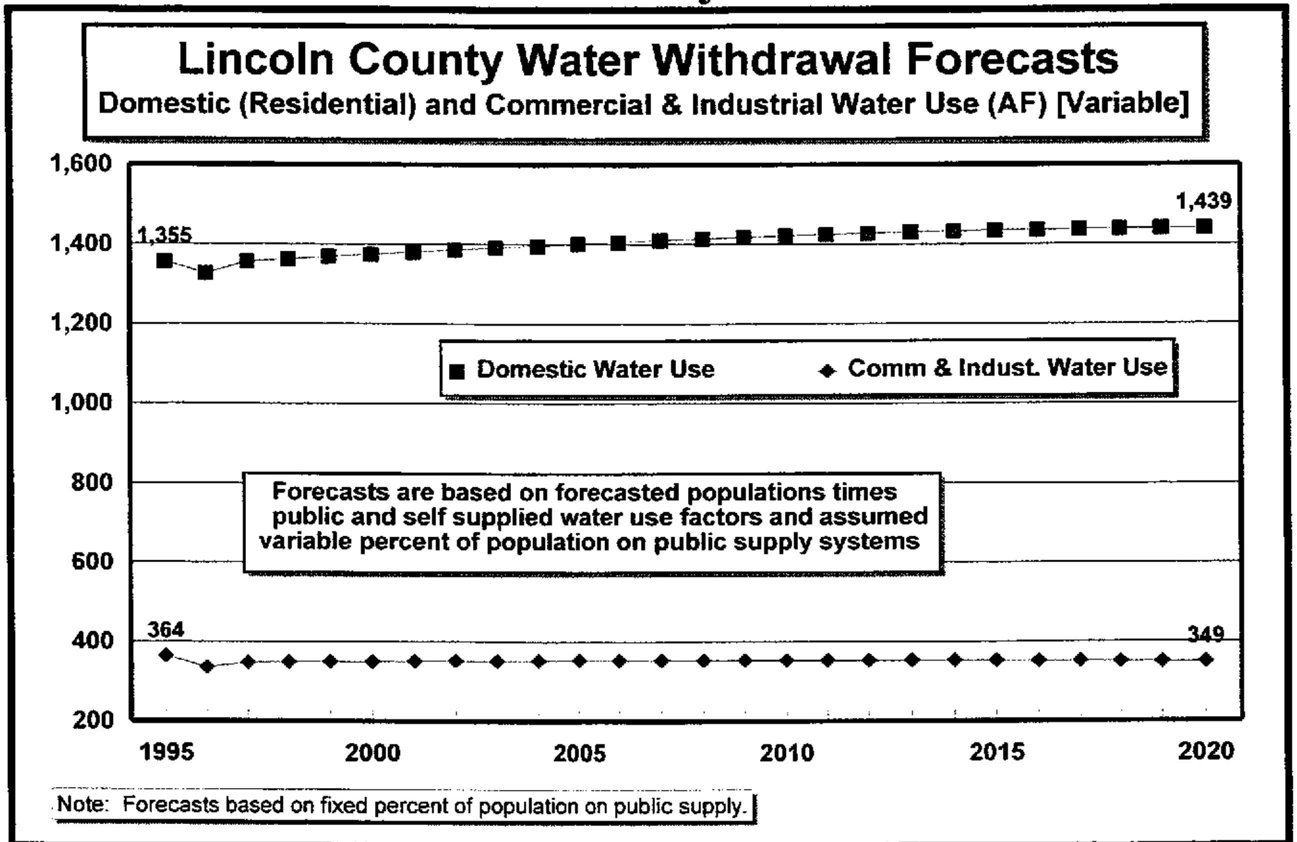
[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

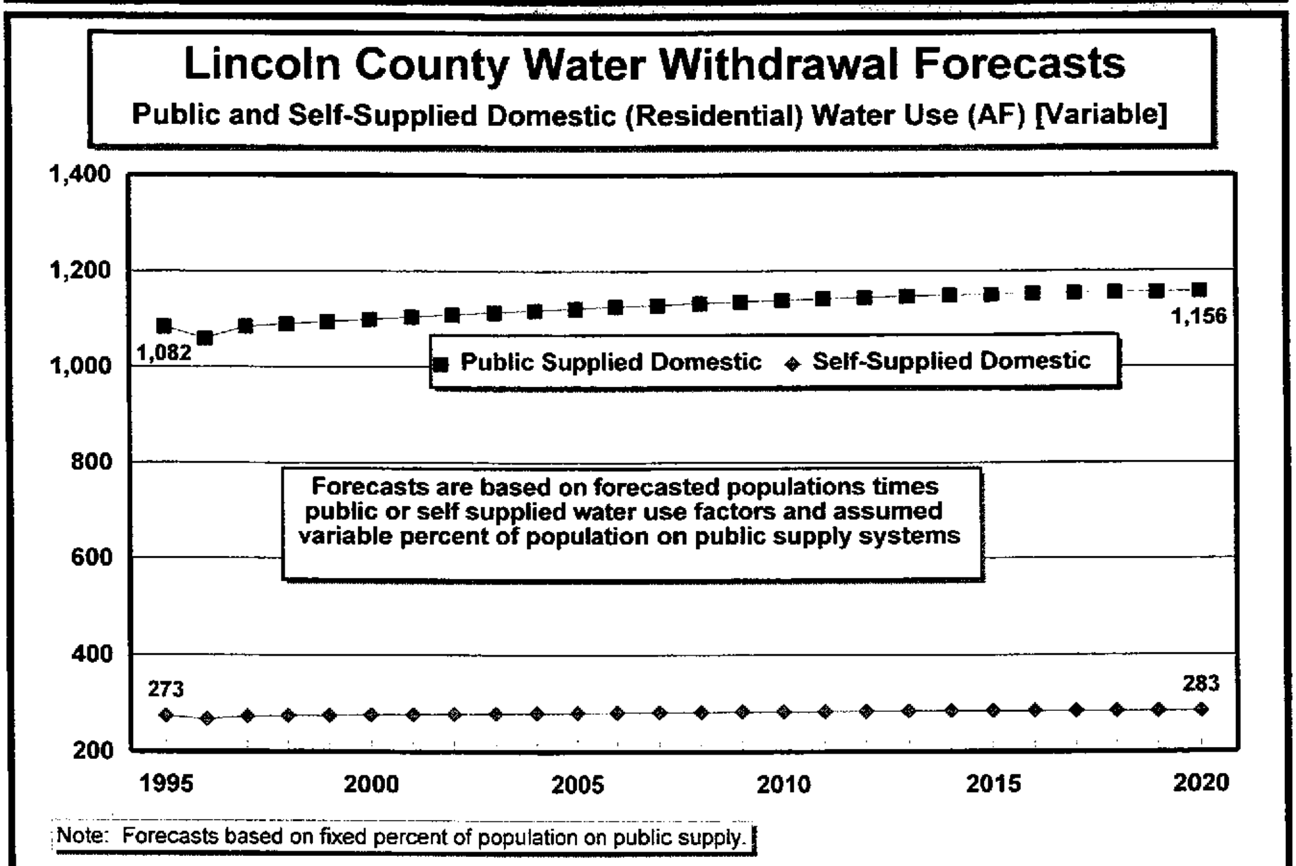
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.


Lincoln County Employment-to-Population Ratios
Ratio of Total Covered Employment to Total Population (Percent)
60%
50%
40%
30%
20%
10%
0%
Estimated and Forecasted Employment / Population Ratio
35.8%
35.6%
33.6%
Actual Ratios (1980-1997); Forecast Ratios (1998-2020)
Note: Forecasts to this ratio are based on a historical "steady-state" value and estimates of future economic, business, employment, and demographic conditions.
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Source Data: Nevada State Demographer; DETR.

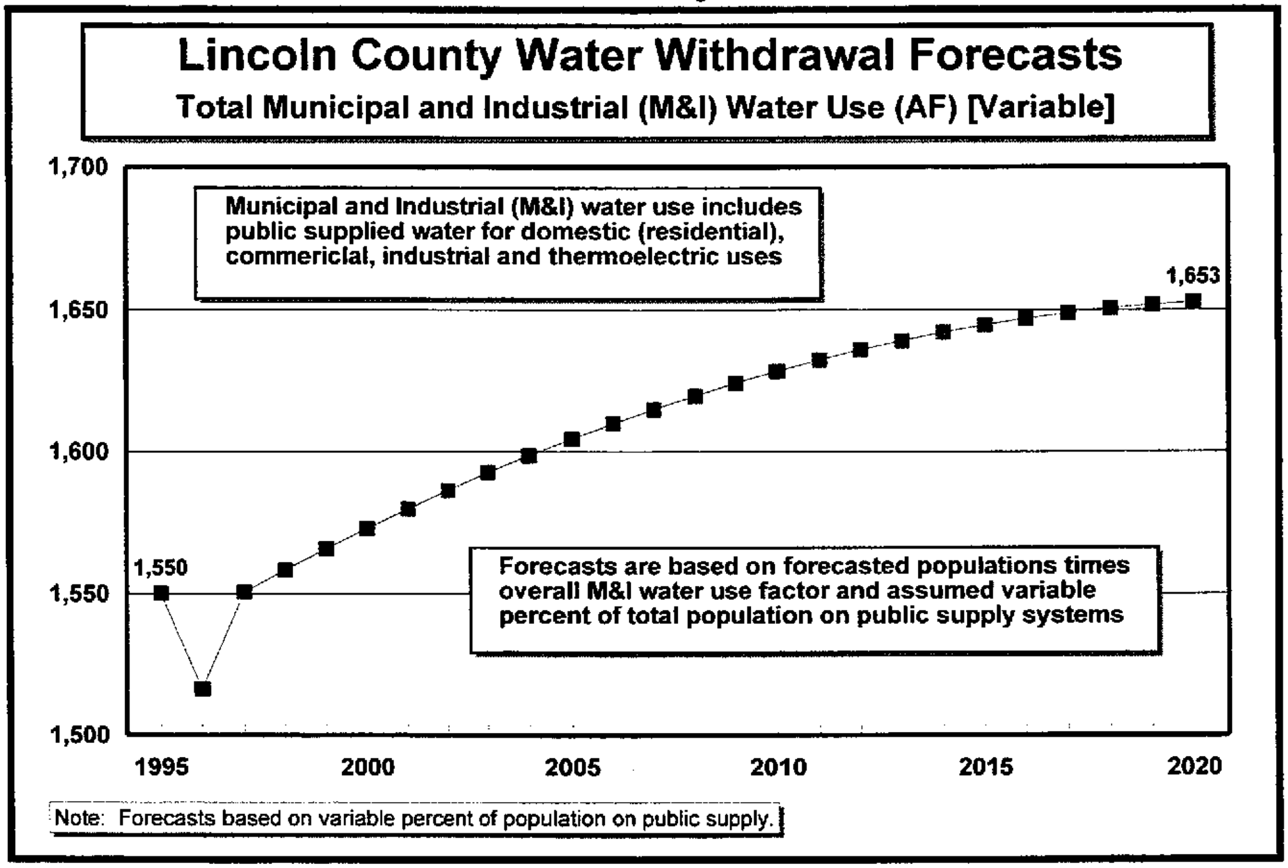

Lincoln County Population & Employment Forecasts
Total Population (Persons) and Total Covered Employment (Workers)
5,000
4,000
3,000
2,000
1,000
4,363
3,732
Population
Employment
Employment forecasts are based on the forecasted employment/population ratio
1,337
1,466
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Source Data: Nevada State Demographer; DETR.

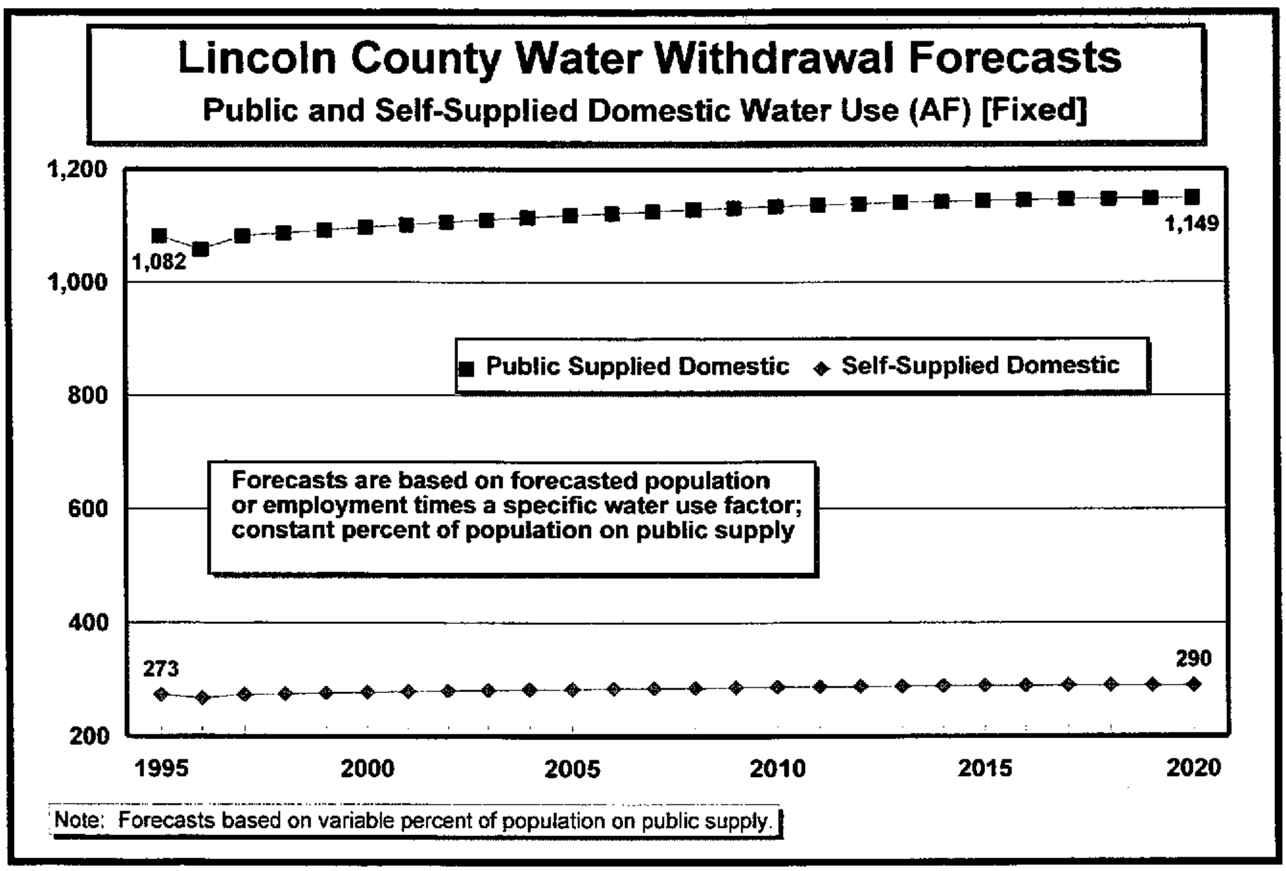
Nevada Water Use Analysis and Forecasts-1





Nevada Water Use Analysis and Forecasts-2





Lyon County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	13,594	2,516	18.50%	153	6.10%	2,133	3,059	2,939
1981	14,160	2,958	20.89%	371	12.53%	2,222	3,350	3,061
1982	14,600	2,904	19.89%	177	6.09%	2,291	3,531	3,156
1983	15,080	2,958	19.62%	190	6.41%	2,367	3,585	3,260
1984	15,680	3,289	20.98%	193	5.88%	2,461	4,009	3,390
1985	16,460	3,499	21.26%	131	3.74%	2,583	4,361	3,559
1986	17,160	3,828	22.31%	104	2.70%	2,693	4,823	3,710
1987	18,340	4,094	22.32%	91	2.23%	2,878	5,182	3,965
1988	19,220	4,764	24.79%	100	2.10%	3,016	6,039	4,155
1989	20,150	5,088	25.25%	172	3.38%	3,162	6,365	4,356
1990	20,590	5,288	25.68%	165	3.12%	3,231	6,634	4,451
1991	21,430	5,415	25.27%	157	2.89%	3,363	6,809	4,633
1992	22,410	5,562	24.82%	186	3.35%	3,517	6,961	4,845
1993	23,750	5,995	25.24%	160	2.66%	3,727	7,556	5,135
1994	25,360	6,504	25.65%	144	2.21%	3,980	8,235	5,483
1995	26,580	7,051	26.53%	182	2.58%	4,171	8,894	5,746
1996	28,480	7,296	25.62%	224	3.06%	4,470	9,157	6,157
1997	30,370	7,658	25.22%	190	2.48%	4,766	9,670	6,566
1998	31,479	7,940	25.22%	194	2.44%	4,940	10,029	6,805
1999	32,596	8,223	25.23%	197	2.40%	5,115	10,392	7,047
2000	33,721	8,509	25.23%	201	2.36%	5,292	10,758	7,290
2001	34,850	8,797	25.24%	204	2.32%	5,469	11,125	7,534
2002	35,983	9,085	25.25%	207	2.28%	5,647	11,495	7,779
2003	37,116	9,373	25.25%	210	2.24%	5,825	11,864	8,024
2004	38,248	9,661	25.26%	213	2.20%	6,002	12,234	8,269
2005	39,377	9,949	25.27%	215	2.16%	6,180	12,604	8,513
2006	40,499	10,235	25.27%	217	2.12%	6,356	12,971	8,756
2007	41,613	10,519	25.28%	219	2.08%	6,530	13,337	8,996
2008	42,715	10,801	25.29%	220	2.04%	6,704	13,699	9,235
2009	43,805	11,079	25.29%	222	2.00%	6,874	14,058	9,470
2010	44,878	11,353	25.30%	223	1.96%	7,043	14,412	9,702
2011	45,932	11,623	25.30%	223	1.92%	7,208	14,760	9,930
2012	46,966	11,887	25.31%	224	1.88%	7,371	15,102	10,154
2013	47,976	12,146	25.32%	224	1.84%	7,529	15,437	10,372
2014	48,959	12,398	25.32%	223	1.80%	7,683	15,764	10,585
2015	49,914	12,643	25.33%	223	1.76%	7,833	16,082	10,791
2016	50,837	12,880	25.34%	222	1.72%	7,978	16,390	10,991
2017	51,727	13,109	25.34%	220	1.68%	8,118	16,688	11,183
2018	52,580	13,328	25.35%	219	1.64%	8,252	16,974	11,367
2019	53,395	13,538	25.35%	217	1.60%	8,380	17,249	11,544
2020	54,170	13,738	25.36%	214	1.56%	8,501	17,510	11,711
Actual Period Average (1980-1997).......			23.32%	2.50%	Standard Deviation (1980-1997)			
Forecast Period Average (1998-2020)....			25.29%	25.75%	Latest/Most Stable Period (1994-1997)			

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person......................	**210.7**	**140.1**	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.2360	0.1569	Acre-feet per person per year
Commercial & Industrial Water Use per Worker...............	**1,155.9**	Gallons per worker per day (excludes mining)	
[Commercial & Industrial Water Use Coefficient]	1.2948	Acre-feet per worker per year (excludes mining)	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Lyon County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	12,453	1,971	163	--	--	--	--	--
1981	12,972	2,053	169	--	--	--	--	--
1982	13,375	2,117	175	--	--	--	--	--
1983	13,815	2,186	180	--	--	--	--	--
1984	14,364	2,273	188	--	--	--	--	--
1985	15,079	2,386	197	--	--	--	--	--
1986	15,720	2,488	205	--	--	--	--	--
1987	16,801	2,659	219	--	--	--	--	--
1988	17,607	2,786	230	--	--	--	--	--
1989	18,459	2,921	241	--	--	--	--	--
1990	18,863	2,985	246	--	--	--	--	--
1991	19,632	3,107	256	--	--	--	--	--
1992	20,530	3,249	268	--	--	--	--	--
1993	21,757	3,443	284	--	--	--	--	--
1994	23,232	3,676	303	--	--	--	--	--
1995	24,350	3,853	318	24,350	91.61%	3,853	318	5,746
1996	26,091	4,129	341	26,097	91.63%	4,130	340	6,158
1997	27,822	4,403	363	27,836	91.66%	4,405	361	6,568
1998	28,838	4,563	377	28,859	91.68%	4,567	374	6,809
1999	29,861	4,725	390	29,891	91.70%	4,730	386	7,052
2000	30,891	4,888	403	30,930	91.72%	4,895	398	7,296
2001	31,926	5,052	417	31,974	91.75%	5,060	410	7,542
2002	32,964	5,216	430	33,022	91.77%	5,226	422	7,788
2003	34,002	5,381	444	34,070	91.79%	5,392	434	8,035
2004	35,039	5,545	458	35,118	91.82%	5,557	446	8,281
2005	36,073	5,708	471	36,163	91.84%	5,723	458	8,527
2006	37,101	5,871	485	37,203	91.86%	5,887	470	8,772
2007	38,121	6,033	498	38,236	91.89%	6,051	482	9,014
2008	39,132	6,192	511	39,259	91.91%	6,213	493	9,255
2009	40,129	6,350	524	40,270	91.93%	6,373	504	9,492
2010	41,113	6,506	537	41,267	91.95%	6,530	515	9,727
2011	42,079	6,659	550	42,247	91.98%	6,686	525	9,957
2012	43,026	6,809	562	43,209	92.00%	6,838	536	10,183
2013	43,951	6,955	574	44,149	92.02%	6,986	546	10,403
2014	44,852	7,098	586	45,065	92.05%	7,131	555	10,618
2015	45,726	7,236	597	45,955	92.07%	7,272	564	10,827
2016	46,572	7,370	608	46,817	92.09%	7,409	573	11,029
2017	47,387	7,499	619	47,648	92.12%	7,540	582	11,224
2018	48,169	7,623	629	48,447	92.14%	7,667	589	11,411
2019	48,916	7,741	639	49,210	92.16%	7,787	597	11,590
2020	49,625	7,853	648	49,936	92.18%	7,902	604	11,760

Assumptions:

	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied)...................	**210.7**	**141.3**	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.2360	0.1582	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	**127.3**		Gallons per person per day--self supply
[Self-Supplied Water Use Coefficient]	0.1426		Acre-feet per person per year
1995 Estimated Resident Population on Public Supply........	**91.61%**		Percent of total resident population

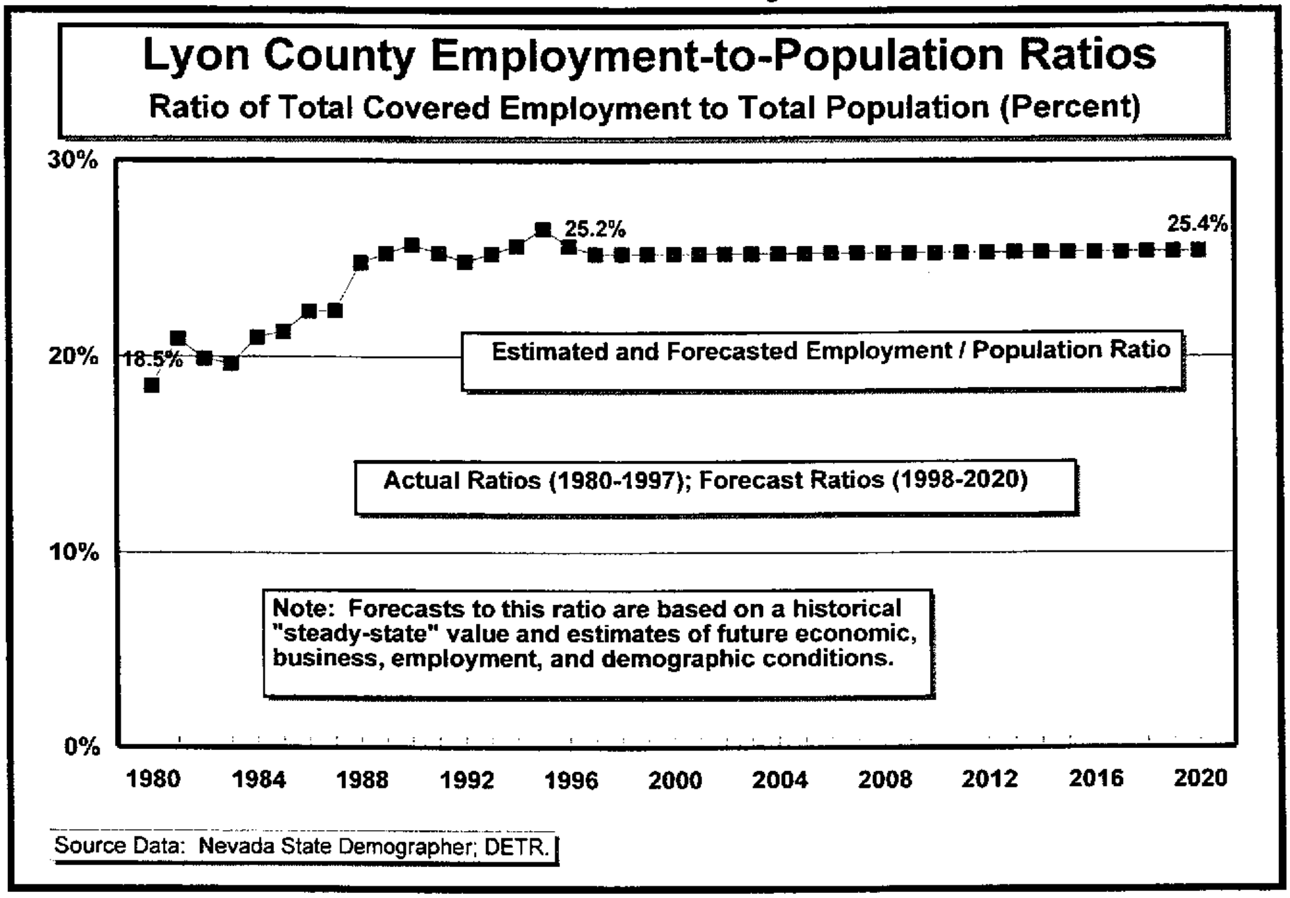
Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

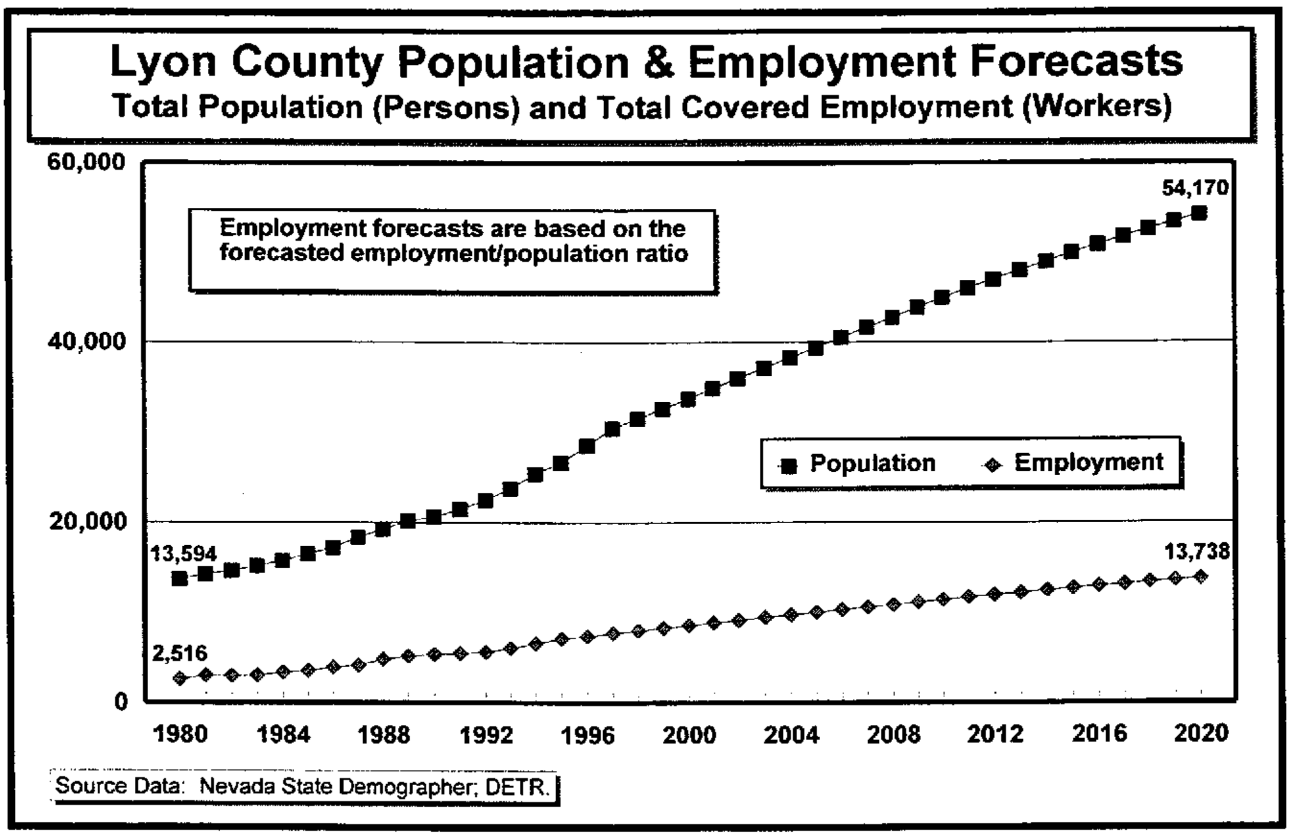
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

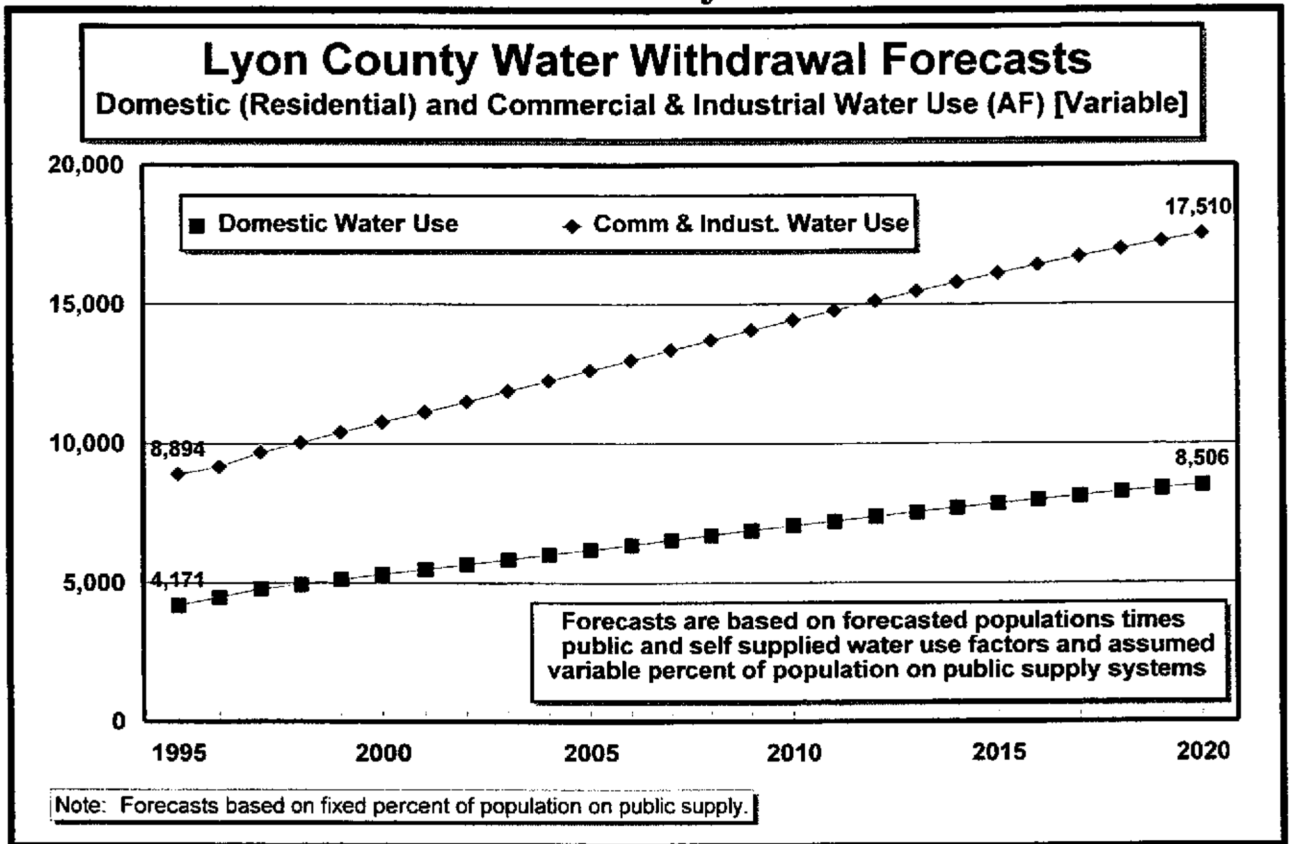
[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

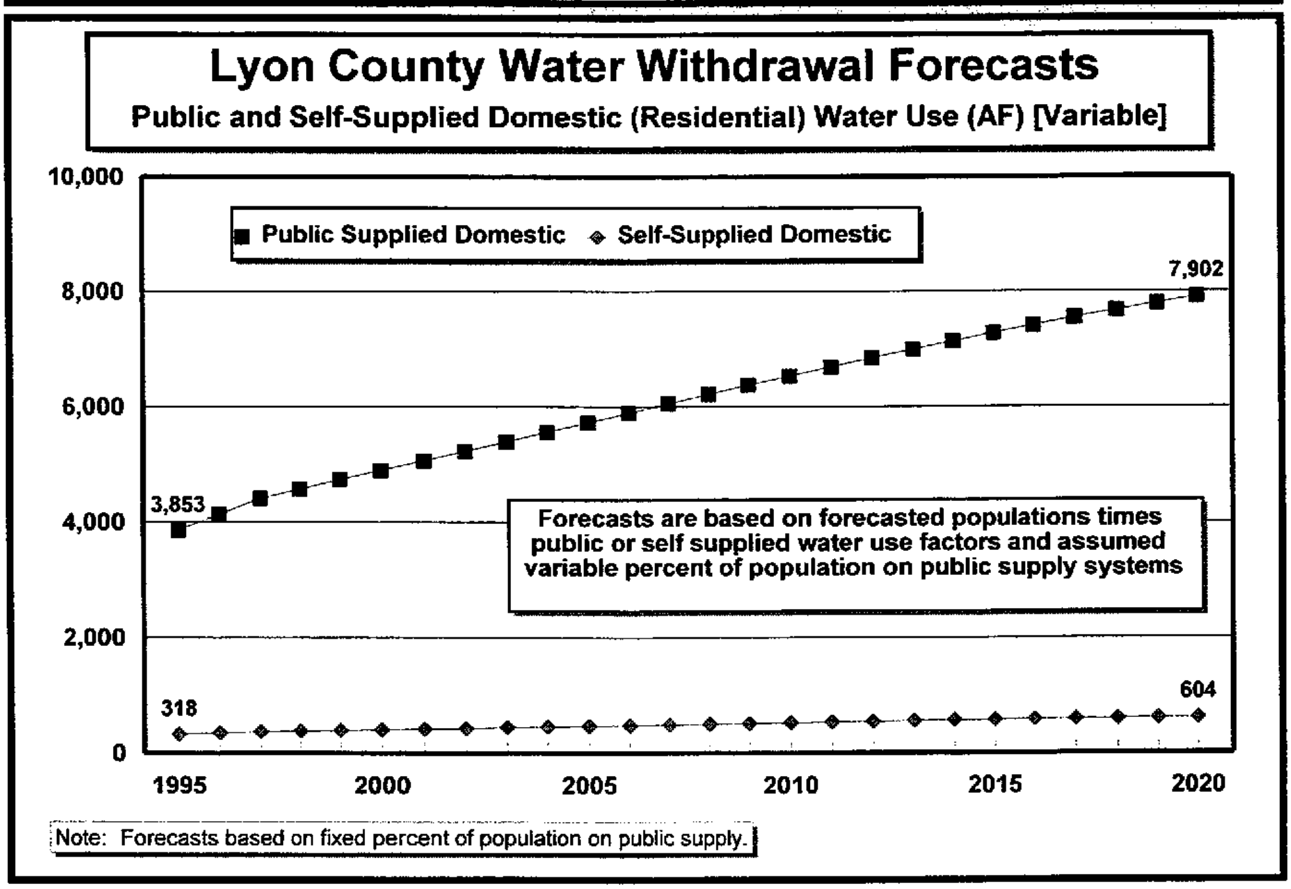
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.


Lyon County Employment-to-Population Ratios
Ratio of Total Covered Employment to Total Population (Percent)
30%
20%
10%
0%
18.5%
25.2%
25.4%
Estimated and Forecasted Employment / Population Ratio
Actual Ratios (1980-1997); Forecast Ratios (1998-2020)
Note: Forecasts to this ratio are based on a historical "steady-state" value and estimates of future economic, business, employment, and demographic conditions.
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Source Data: Nevada State Demographer; DETR.

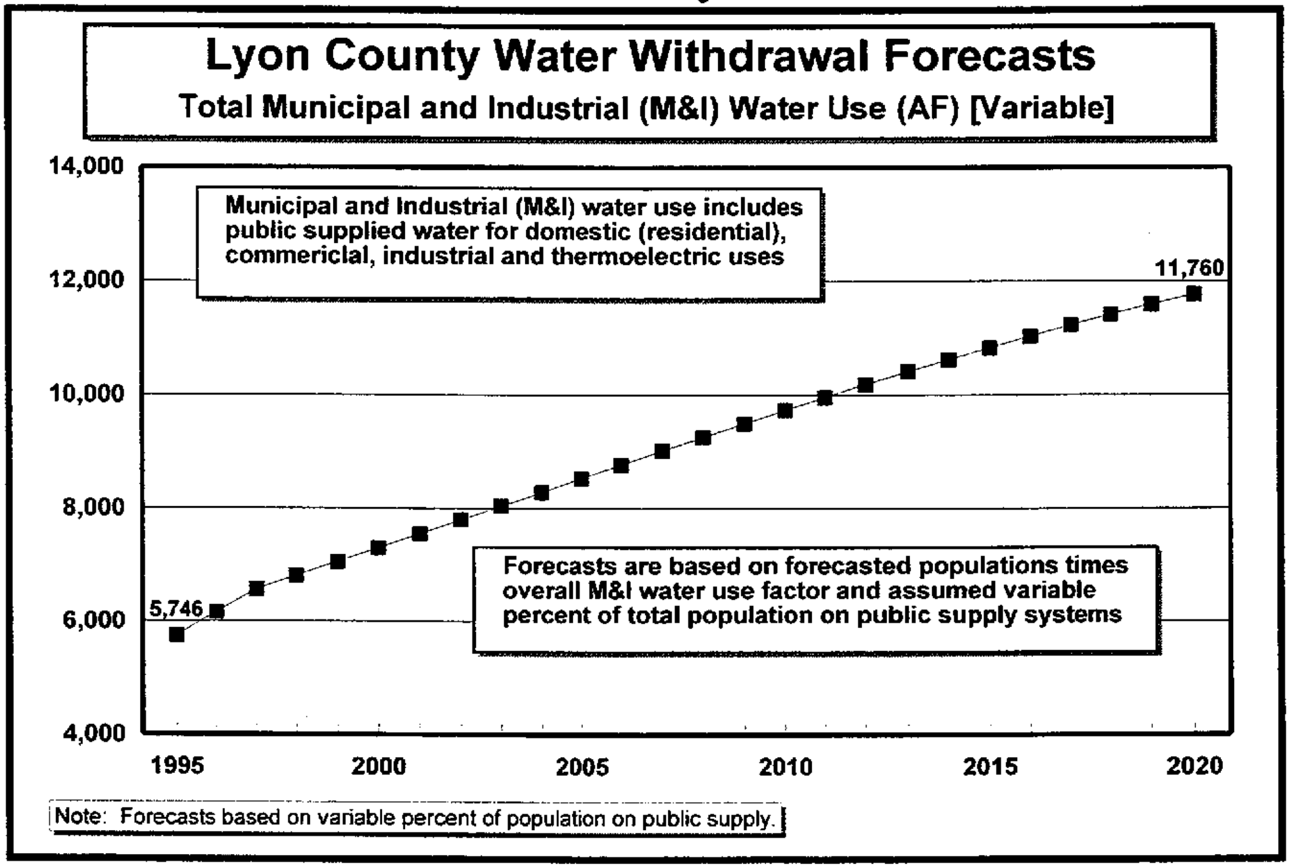

Lyon County Population & Employment Forecasts
Total Population (Persons) and Total Covered Employment (Workers)
60,000
40,000
20,000
0
54,170
Employment forecasts are based on the forecasted employment/population ratio
Population
Employment
13,594
13,738
2,516
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Source Data: Nevada State Demographer; DETR.

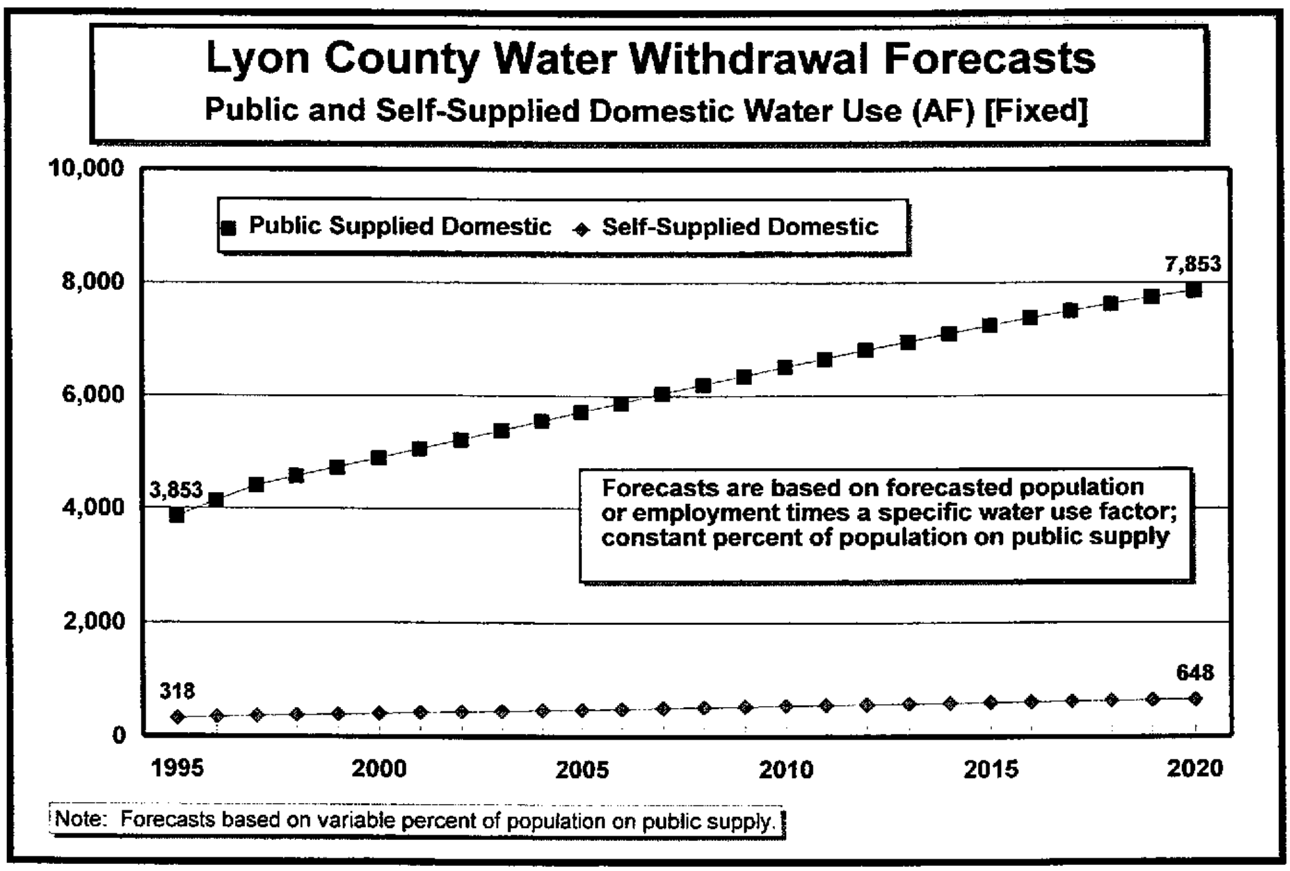
Nevada Water Use Analysis and Forecasts-1





Nevada Water Use Analysis and Forecasts-2





Mineral County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	6,217	2,273	36.56%	134	5.91%	1,070	279	1,164
1981	6,230	2,309	37.07%	204	8.82%	1,072	274	1,167
1982	6,220	2,224	35.76%	103	4.63%	1,070	276	1,165
1983	6,200	2,359	38.05%	215	9.10%	1,067	279	1,161
1984	6,180	2,389	38.65%	285	11.93%	1,063	274	1,157
1985	6,180	2,335	37.78%	284	12.16%	1,063	267	1,157
1986	6,200	2,329	37.57%	330	14.17%	1,067	261	1,161
1987	6,270	2,358	37.61%	413	17.53%	1,079	253	1,174
1988	6,400	2,553	39.89%	526	20.62%	1,101	264	1,198
1989	6,460	2,618	40.53%	633	24.18%	1,111	259	1,210
1990	6,470	2,573	39.76%	603	23.43%	1,113	257	1,212
1991	6,460	2,541	39.33%	439	17.27%	1,111	274	1,210
1992	6,560	2,739	41.75%	407	14.87%	1,129	304	1,228
1993	6,510	2,607	40.04%	392	15.04%	1,120	289	1,219
1994	6,410	2,548	39.75%	377	14.78%	1,103	283	1,200
1995	6,700	2,545	37.99%	396	15.55%	1,153	280	1,255
1996	6,810	2,494	36.63%	389	15.61%	1,172	274	1,275
1997	6,860	2,356	34.34%	316	13.41%	1,180	266	1,285
1998	6,893	2,355	34.17%	315	13.36%	1,186	266	1,291
1999	6,924	2,354	34.00%	313	13.31%	1,191	266	1,297
2000	6,955	2,353	33.83%	312	13.26%	1,197	266	1,302
2001	6,984	2,351	33.66%	311	13.21%	1,202	266	1,308
2002	7,011	2,348	33.49%	309	13.16%	1,206	266	1,313
2003	7,037	2,345	33.33%	308	13.11%	1,211	266	1,318
2004	7,062	2,342	33.16%	306	13.06%	1,215	265	1,322
2005	7,086	2,338	32.99%	304	13.01%	1,219	265	1,327
2006	7,108	2,333	32.83%	302	12.96%	1,223	265	1,331
2007	7,128	2,328	32.66%	301	12.91%	1,226	264	1,335
2008	7,148	2,323	32.50%	299	12.86%	1,230	264	1,338
2009	7,165	2,317	32.34%	297	12.81%	1,233	263	1,342
2010	7,182	2,311	32.18%	295	12.76%	1,236	263	1,345
2011	7,196	2,304	32.02%	293	12.71%	1,238	262	1,348
2012	7,210	2,297	31.86%	291	12.66%	1,240	261	1,350
2013	7,221	2,289	31.70%	289	12.61%	1,242	261	1,352
2014	7,232	2,281	31.54%	287	12.56%	1,244	260	1,354
2015	7,241	2,272	31.38%	284	12.51%	1,246	259	1,356
2016	7,248	2,263	31.22%	282	12.46%	1,247	258	1,357
2017	7,254	2,254	31.07%	280	12.41%	1,248	257	1,358
2018	7,258	2,244	30.91%	277	12.36%	1,249	256	1,359
2019	7,261	2,233	30.76%	275	12.31%	1,249	255	1,360
2020	7,262	2,222	30.60%	273	12.26%	1,249	254	1,360

Actual Period Average (1980-1997).......	38.28%	1.81%	Standard Deviation (1980-1997)
Forecast Period Average (1998-2020)....	32.36%	37.18%	Latest/Most Stable Period (1994-1997)

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person....................	**211.7**	**153.6**	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.2371	0.1720	Acre-feet per person per year
Commercial & Industrial Water Use per Worker..............	**116.3**	Gallons per worker per day (excludes mining)	
[Commercial & Industrial Water Use Coefficient]	0.1303	Acre-feet per worker per year (excludes mining)	

Note: One acre-foot (AF) is equivalent to approximately 325.851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Mineral County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	4,910	863	207	--	--	--	--	--
1981	4,920	865	207	--	--	--	--	--
1982	4,912	863	207	--	--	--	--	--
1983	4,896	860	206	--	--	--	--	--
1984	4,880	858	206	--	--	--	--	--
1985	4,880	858	206	--	--	--	--	--
1986	4,896	860	206	--	--	--	--	--
1987	4,951	870	209	--	--	--	--	--
1988	5,054	888	213	--	--	--	--	--
1989	5,101	896	215	--	--	--	--	--
1990	5,109	898	215	--	--	--	--	--
1991	5,101	896	215	--	--	--	--	--
1992	5,180	910	218	--	--	--	--	--
1993	5,141	903	217	--	--	--	--	--
1994	5,062	889	213	--	--	--	--	--
1995	5,291	930	223	5,291	78.97%	930	223	1,255
1996	5,378	945	227	5,379	78.99%	945	226	1,275
1997	5,417	952	228	5,420	79.01%	952	228	1,285
1998	5,443	956	229	5,447	79.03%	957	229	1,291
1999	5,468	961	230	5,474	79.05%	962	230	1,298
2000	5,492	965	231	5,499	79.07%	966	230	1,303
2001	5,515	969	232	5,523	79.09%	971	231	1,309
2002	5,537	973	233	5,546	79.11%	975	232	1,315
2003	5,557	977	234	5,569	79.13%	979	232	1,320
2004	5,577	980	235	5,590	79.15%	982	233	1,325
2005	5,596	983	236	5,610	79.17%	986	234	1,329
2006	5,613	986	237	5,628	79.19%	989	234	1,334
2007	5,629	989	237	5,646	79.21%	992	235	1,338
2008	5,644	992	238	5,663	79.23%	995	235	1,342
2009	5,658	994	238	5,678	79.25%	998	235	1,345
2010	5,671	997	239	5,693	79.27%	1,000	236	1,348
2011	5,683	999	240	5,706	79.29%	1,003	236	1,352
2012	5,693	1,000	240	5,718	79.31%	1,005	236	1,354
2013	5,703	1,002	240	5,729	79.33%	1,007	236	1,357
2014	5,711	1,004	241	5,738	79.35%	1,008	236	1,359
2015	5,718	1,005	241	5,747	79.37%	1,010	236	1,361
2016	5,724	1,006	241	5,754	79.39%	1,011	236	1,362
2017	5,728	1,007	241	5,760	79.41%	1,012	236	1,364
2018	5,732	1,007	242	5,765	79.43%	1,013	236	1,365
2019	5,734	1,008	242	5,768	79.45%	1,014	236	1,366
2020	5,735	1,008	242	5,771	79.47%	1,014	236	1,366

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied)....................	**211.7**	**156.9**	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.2371	0.1757	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	**141.3**	Gallons per person per day--self supply	
[Self-Supplied Water Use Coefficient]	0.1583	Acre-feet per person per year	
1995 Estimated Resident Population on Public Supply........	**78.97%**	Percent of total resident population	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

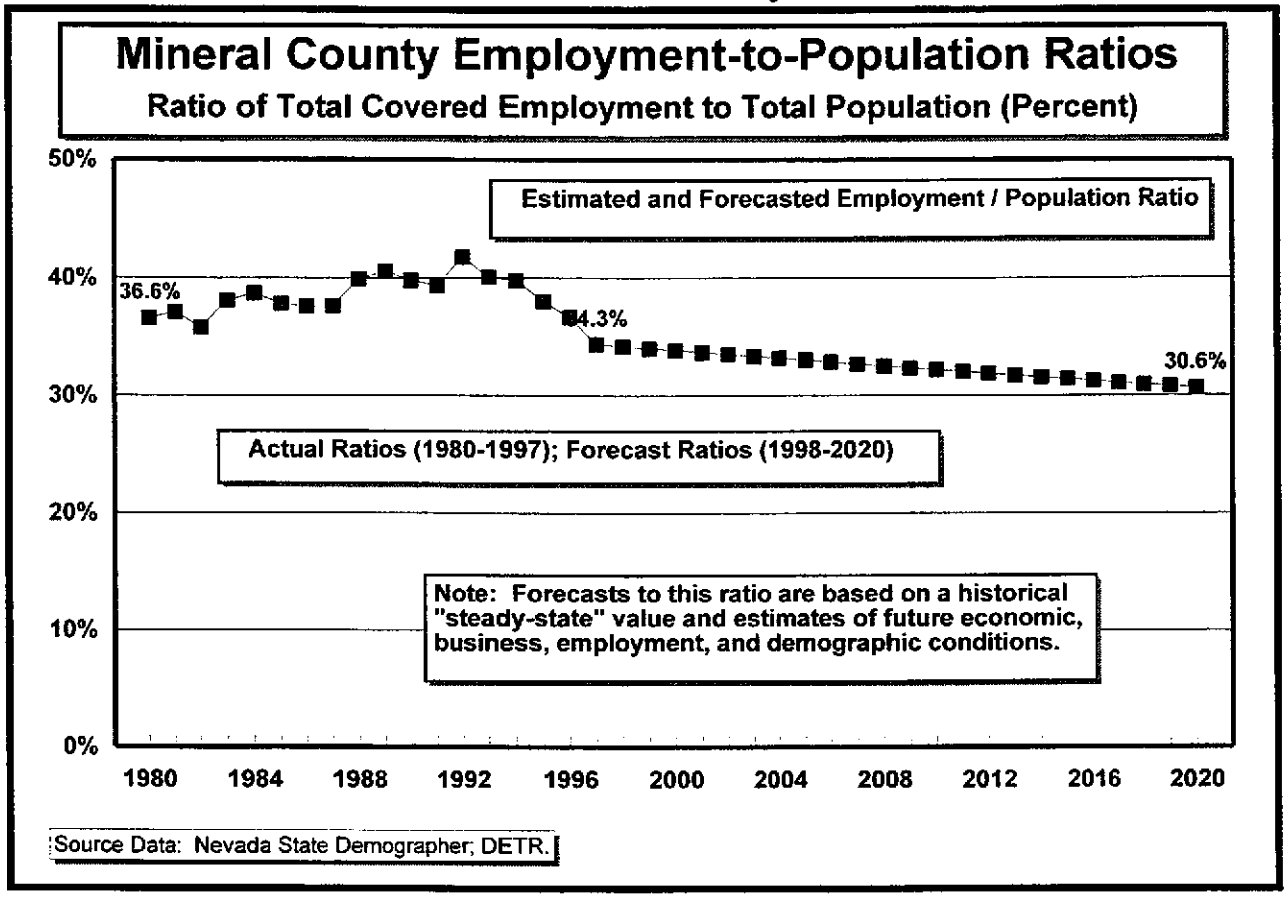
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

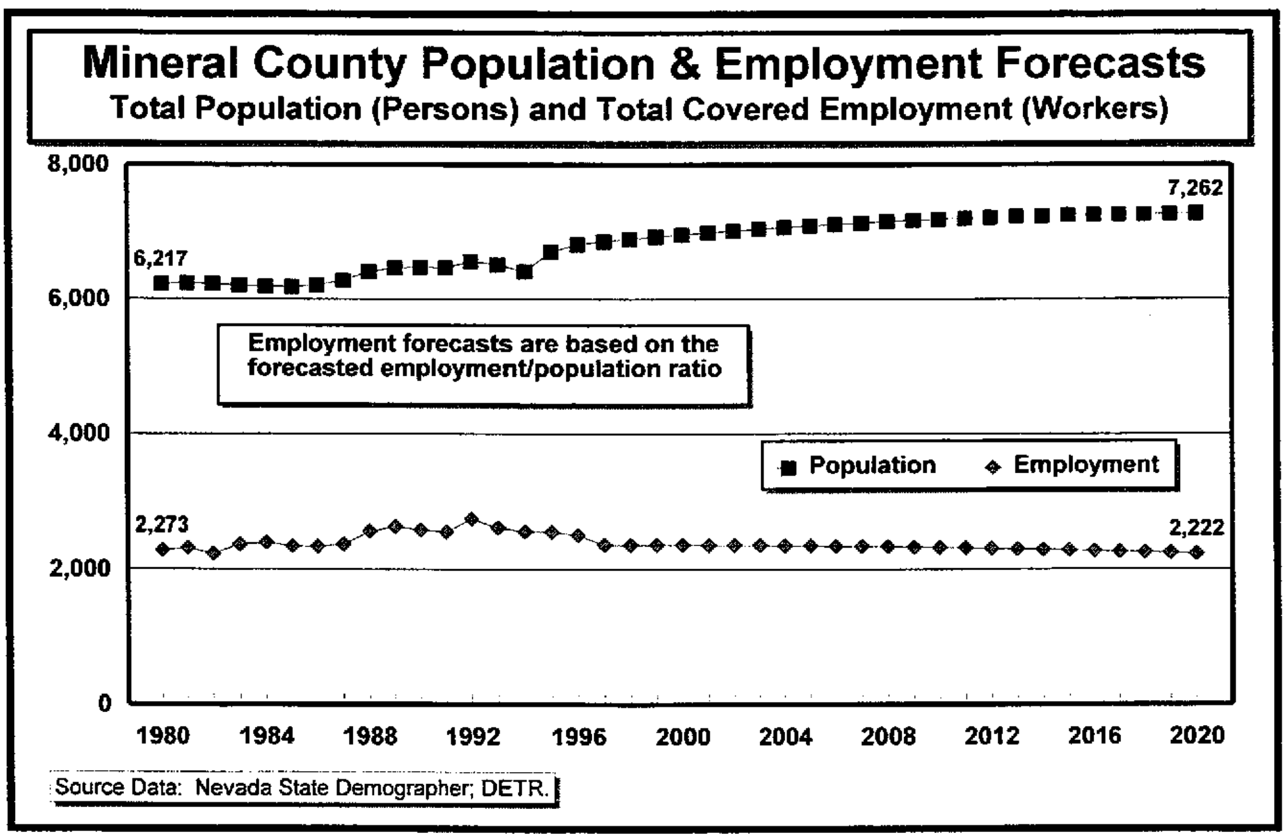
[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

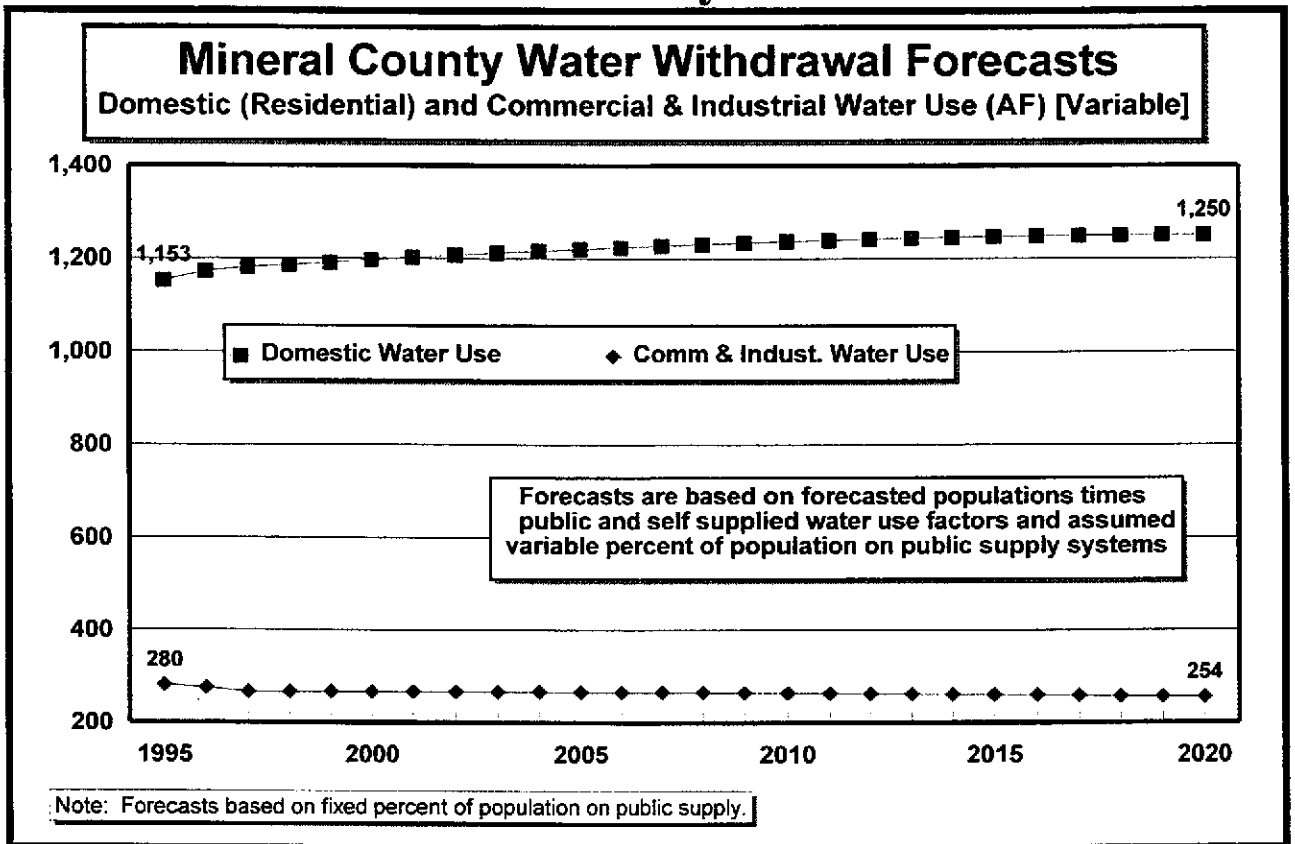
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

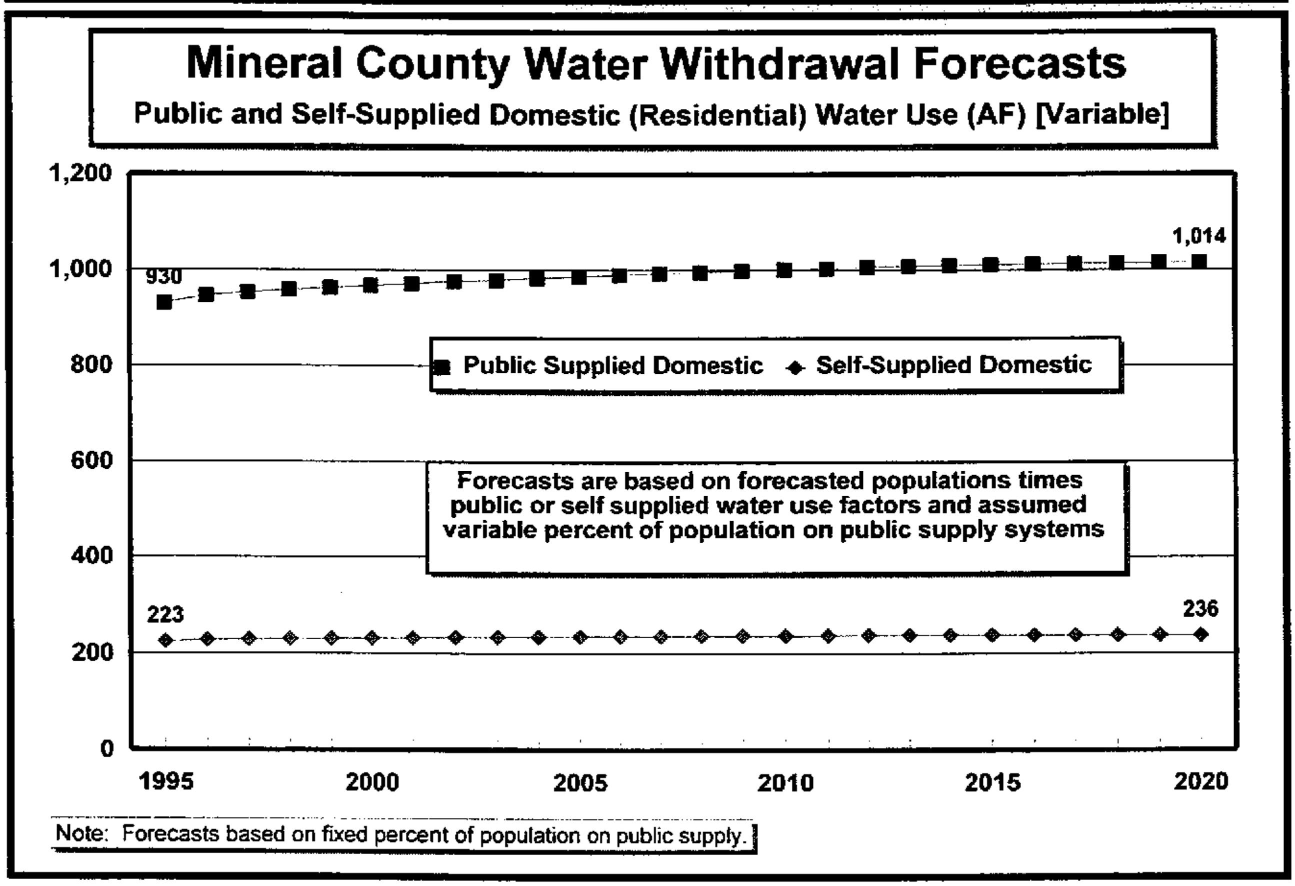
Nevada Socioeconomic Analysis and Forecasts



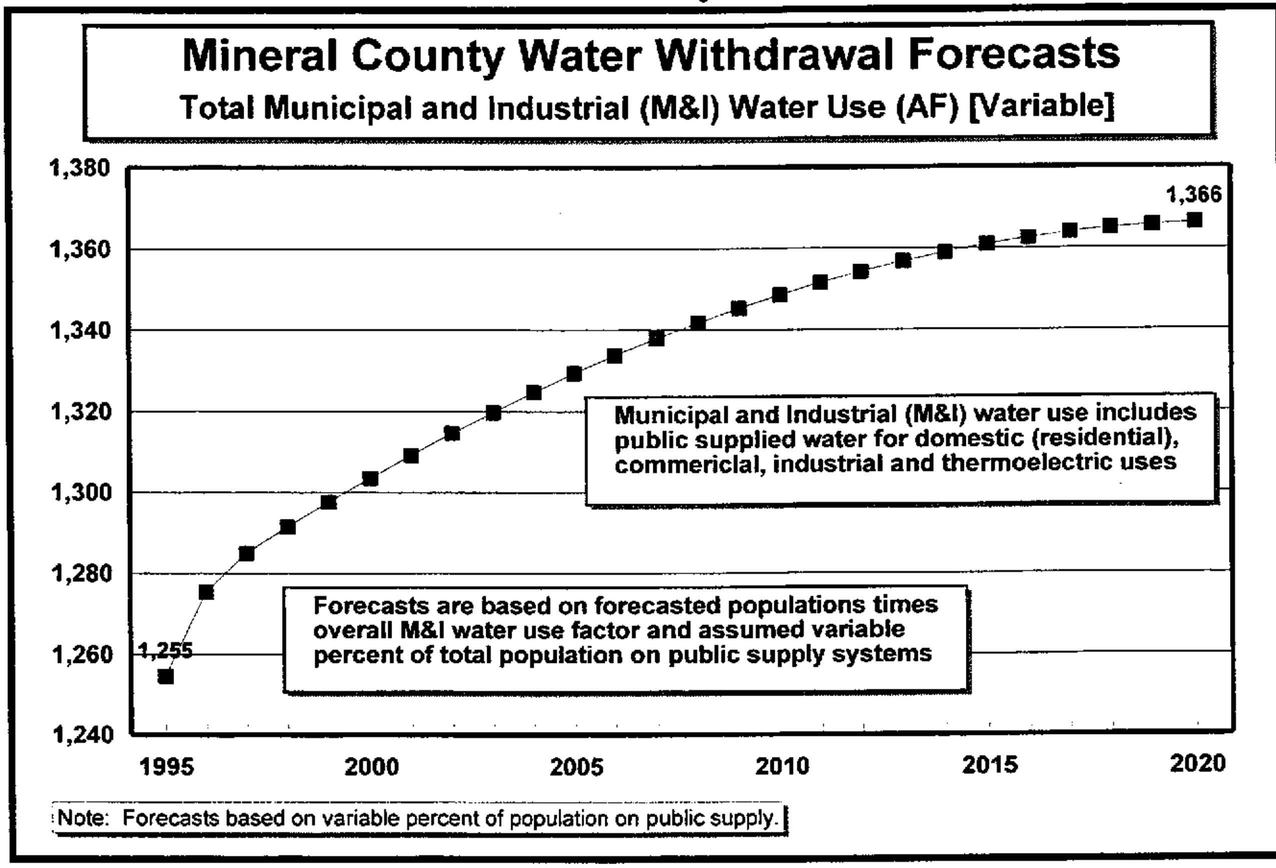


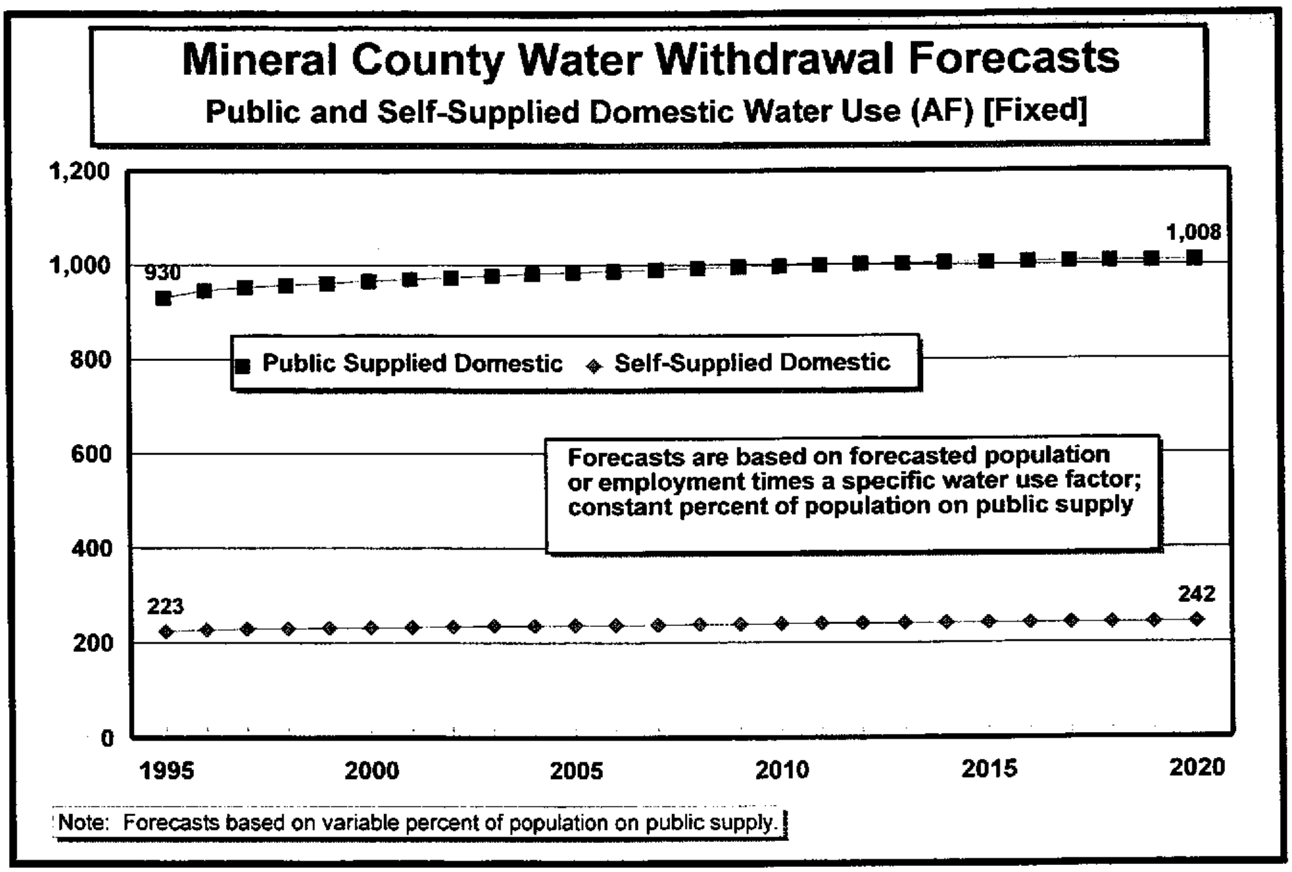
Nevada Water Use Analysis and Forecasts-1





Nevada Water Use Analysis and Forecasts-2





Nye County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	9,048	6,790	75.05%	1,054	15.52%	2,271	625	2,405
1981	11,000	7,909	71.90%	1,340	16.95%	2,761	715	2,924
1982	13,040	8,669	66.48%	1,434	16.54%	3,273	788	3,466
1983	13,480	8,613	63.89%	1,133	13.16%	3,383	815	3,583
1984	14,570	9,154	62.83%	1,222	13.35%	3,657	864	3,873
1985	14,570	9,783	67.15%	884	9.04%	3,657	969	3,873
1986	14,680	9,894	67.40%	992	10.02%	3,685	969	3,902
1987	15,200	10,119	66.57%	1,201	11.87%	3,815	971	4,041
1988	15,760	10,860	68.91%	1,533	14.12%	3,956	1,016	4,189
1989	17,540	11,570	65.97%	1,907	16.48%	4,402	1,052	4,663
1990	18,190	11,220	61.68%	1,949	17.37%	4,566	1,010	4,835
1991	19,110	10,860	56.83%	1,633	15.03%	4,796	1,005	5,080
1992	20,080	10,020	49.90%	1,451	14.48%	5,040	933	5,338
1993	20,550	8,752	42.59%	1,261	14.41%	5,158	816	5,463
1994	20,720	8,341	40.26%	1,116	13.38%	5,201	787	5,508
1995	23,050	8,496	36.86%	1,296	15.25%	5,785	784	6,127
1996	25,240	8,390	33.24%	1,375	16.39%	6,335	764	6,709
1997	27,610	8,648	31.32%	1,363	15.76%	6,930	793	7,339
1998	28,680	8,976	31.30%	1,388	15.46%	7,198	826	7,624
1999	29,755	9,306	31.28%	1,411	15.16%	7,468	860	7,910
2000	30,834	9,636	31.25%	1,432	14.86%	7,739	893	8,196
2001	31,913	9,966	31.23%	1,451	14.56%	8,010	927	8,483
2002	32,990	10,295	31.20%	1,468	14.26%	8,280	961	8,770
2003	34,062	10,621	31.18%	1,483	13.96%	8,549	995	9,055
2004	35,127	10,945	31.16%	1,495	13.66%	8,817	1,029	9,338
2005	36,181	11,265	31.13%	1,505	13.36%	9,081	1,063	9,618
2006	37,221	11,580	31.11%	1,512	13.06%	9,342	1,096	9,894
2007	38,244	11,889	31.09%	1,517	12.76%	9,599	1,130	10,166
2008	39,248	12,192	31.06%	1,519	12.46%	9,851	1,162	10,433
2009	40,230	12,488	31.04%	1,519	12.16%	10,097	1,195	10,694
2010	41,185	12,775	31.02%	1,515	11.86%	10,337	1,226	10,948
2011	42,112	13,052	30.99%	1,509	11.56%	10,570	1,257	11,194
2012	43,007	13,320	30.97%	1,500	11.26%	10,794	1,287	11,432
2013	43,867	13,576	30.95%	1,488	10.96%	11,010	1,316	11,661
2014	44,689	13,820	30.93%	1,473	10.66%	11,217	1,345	11,879
2015	45,471	14,051	30.90%	1,456	10.36%	11,413	1,372	12,087
2016	46,210	14,269	30.88%	1,436	10.06%	11,598	1,398	12,284
2017	46,903	14,472	30.86%	1,413	9.76%	11,772	1,422	12,468
2018	47,548	14,660	30.83%	1,387	9.46%	11,934	1,446	12,639
2019	48,143	14,832	30.81%	1,359	9.16%	12,083	1,467	12,797
2020	48,684	14,988	30.79%	1,328	8.86%	12,219	1,488	12,941
Actual Period Average (1980-1997).......			57.16%	13.81%	Standard Deviation (1980-1997)			
Forecast Period Average (1998-2020)....			31.04%	35.42%	Latest/Most Stable Period (1994-1997)			

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person.....................	347.7	224.1	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.3895	0.2510	Acre-feet per person per year
Commercial & Industrial Water Use per Worker...............	97.2	Gallons per worker per day (excludes mining)	
[Commercial & Industrial Water Use Coefficient]	0.1089	Acre-feet per worker per year (excludes mining)	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Nye County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	6,175	1,601	670	--	--	--	--	--
1981	7,507	1,946	815	--	--	--	--	--
1982	8,899	2,307	966	--	--	--	--	--
1983	9,199	2,385	999	--	--	--	--	--
1984	9,943	2,577	1,080	--	--	--	--	--
1985	9,943	2,577	1,080	--	--	--	--	--
1986	10,018	2,597	1,088	--	--	--	--	--
1987	10,373	2,689	1,126	--	--	--	--	--
1988	10,755	2,788	1,168	--	--	--	--	--
1989	11,970	3,103	1,300	--	--	--	--	--
1990	12,413	3,218	1,348	--	--	--	--	--
1991	13,041	3,380	1,416	--	--	--	--	--
1992	13,703	3,552	1,488	--	--	--	--	--
1993	14,024	3,635	1,523	--	--	--	--	--
1994	14,140	3,665	1,535	--	--	--	--	--
1995	15,730	4,077	1,708	15,730	68.24%	4,077	1,708	6,127
1996	17,225	4,465	1,870	17,229	68.26%	4,466	1,869	6,711
1997	18,842	4,884	2,046	18,851	68.28%	4,886	2,044	7,342
1998	19,572	5,073	2,125	19,587	68.29%	5,077	2,122	7,628
1999	20,306	5,263	2,205	20,326	68.31%	5,269	2,200	7,915
2000	21,042	5,454	2,285	21,068	68.33%	5,461	2,279	8,203
2001	21,779	5,645	2,365	21,811	68.35%	5,654	2,357	8,492
2002	22,514	5,836	2,445	22,553	68.36%	5,846	2,435	8,780
2003	23,245	6,025	2,524	23,292	68.38%	6,037	2,513	9,067
2004	23,972	6,214	2,603	24,026	68.40%	6,228	2,590	9,352
2005	24,691	6,400	2,681	24,753	68.41%	6,416	2,667	9,634
2006	25,401	6,584	2,758	25,471	68.43%	6,602	2,742	9,912
2007	26,099	6,765	2,834	26,178	68.45%	6,785	2,816	10,187
2008	26,784	6,943	2,908	26,871	68.47%	6,965	2,888	10,456
2009	27,454	7,116	2,981	27,550	68.48%	7,141	2,959	10,719
2010	28,106	7,285	3,052	28,211	68.50%	7,313	3,027	10,975
2011	28,738	7,449	3,120	28,853	68.52%	7,479	3,094	11,224
2012	29,349	7,608	3,187	29,474	68.53%	7,640	3,158	11,465
2013	29,936	7,760	3,251	30,071	68.55%	7,795	3,219	11,696
2014	30,497	7,905	3,311	30,642	68.57%	7,943	3,278	11,917
2015	31,031	8,044	3,369	31,186	68.58%	8,084	3,333	12,128
2016	31,535	8,174	3,424	31,701	68.60%	8,217	3,385	12,327
2017	32,008	8,297	3,476	32,185	68.62%	8,343	3,434	12,514
2018	32,448	8,411	3,523	32,635	68.64%	8,459	3,480	12,688
2019	32,854	8,516	3,567	33,052	68.65%	8,567	3,521	12,849
2020	33,224	8,612	3,608	33,432	68.67%	8,666	3,559	12,995

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied)....................	**347.7**	**231.4**	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.3895	0.2592	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	**208.3**	Gallons per person per day--self supply	
[Self-Supplied Water Use Coefficient]	0.2333	Acre-feet per person per year	
1995 Estimated Resident Population on Public Supply........	**68.24%**	Percent of total resident population	

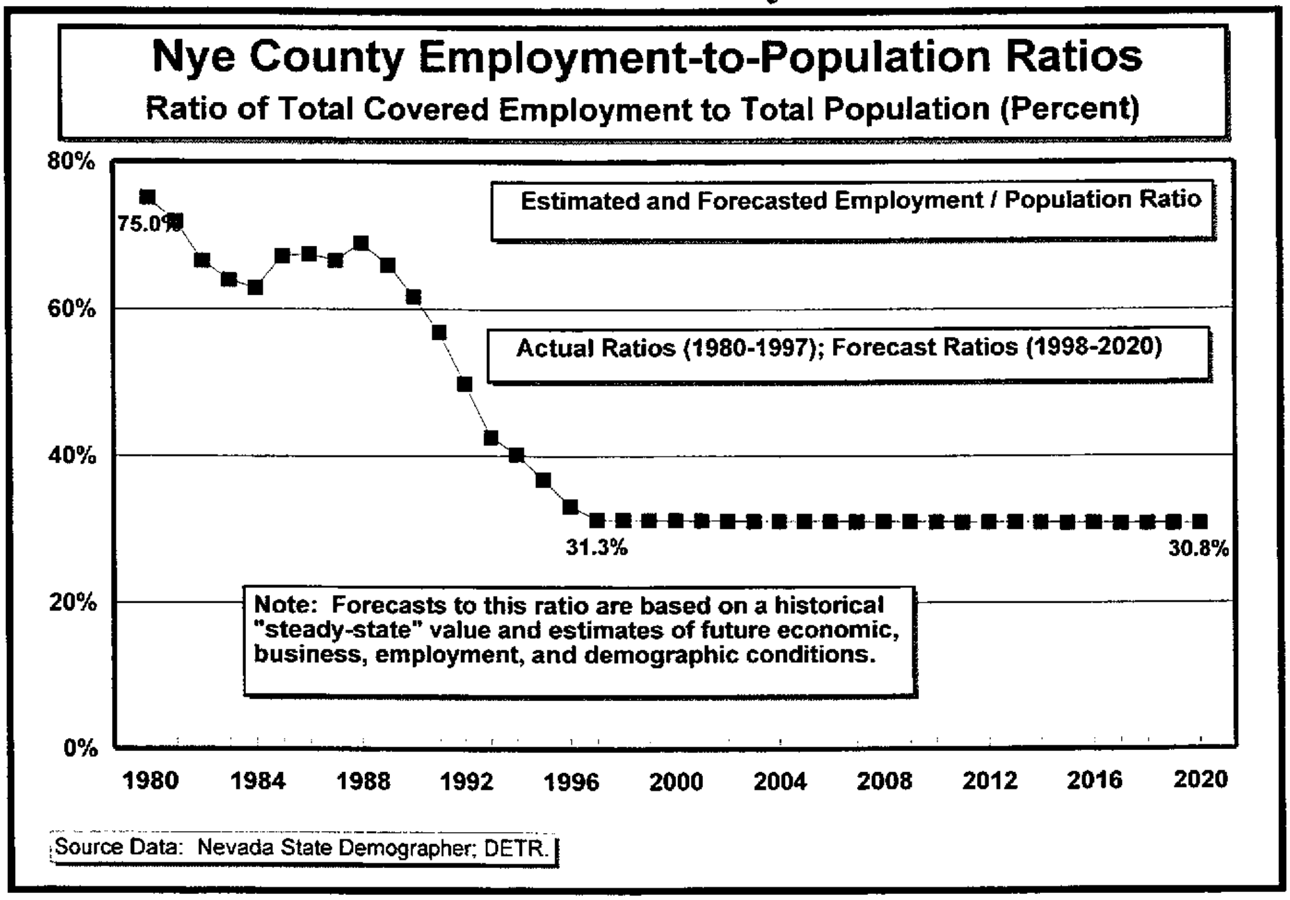
Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

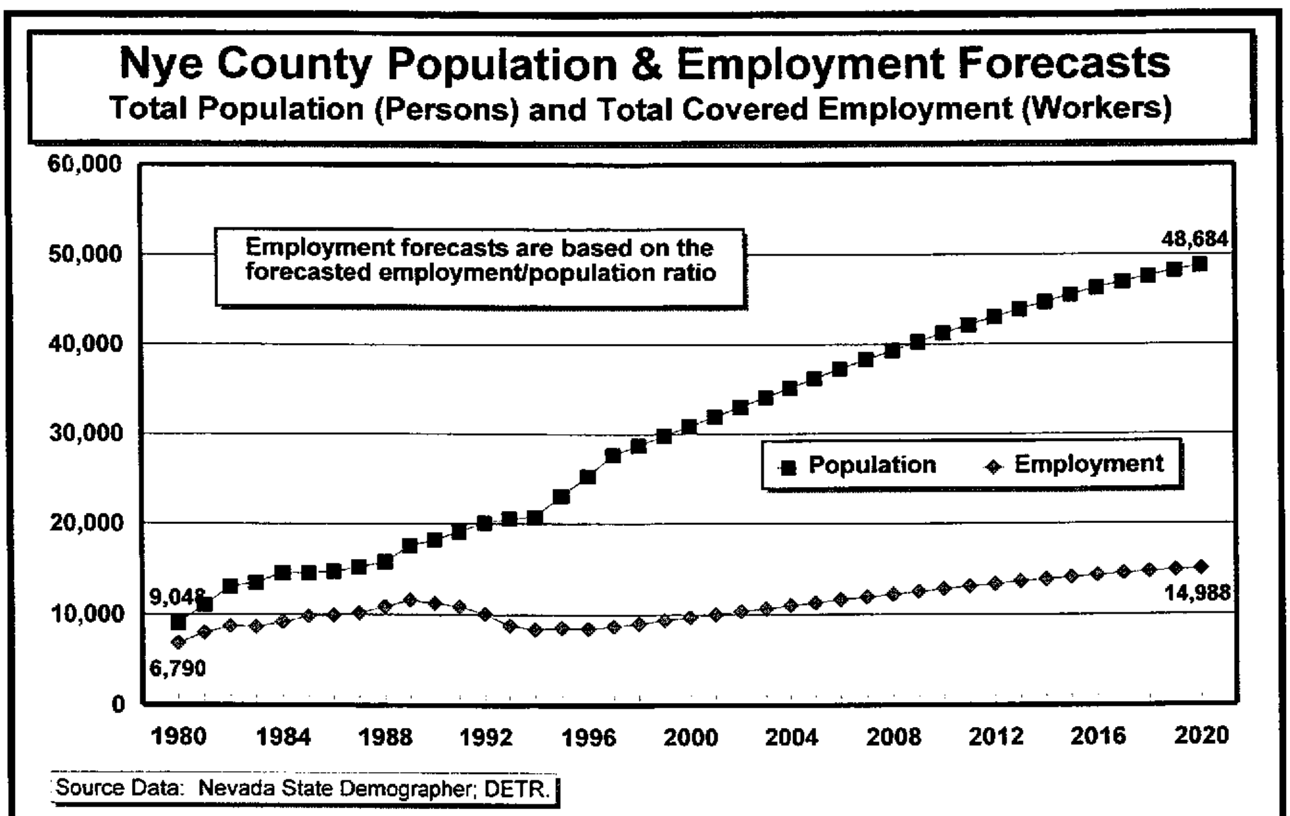
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

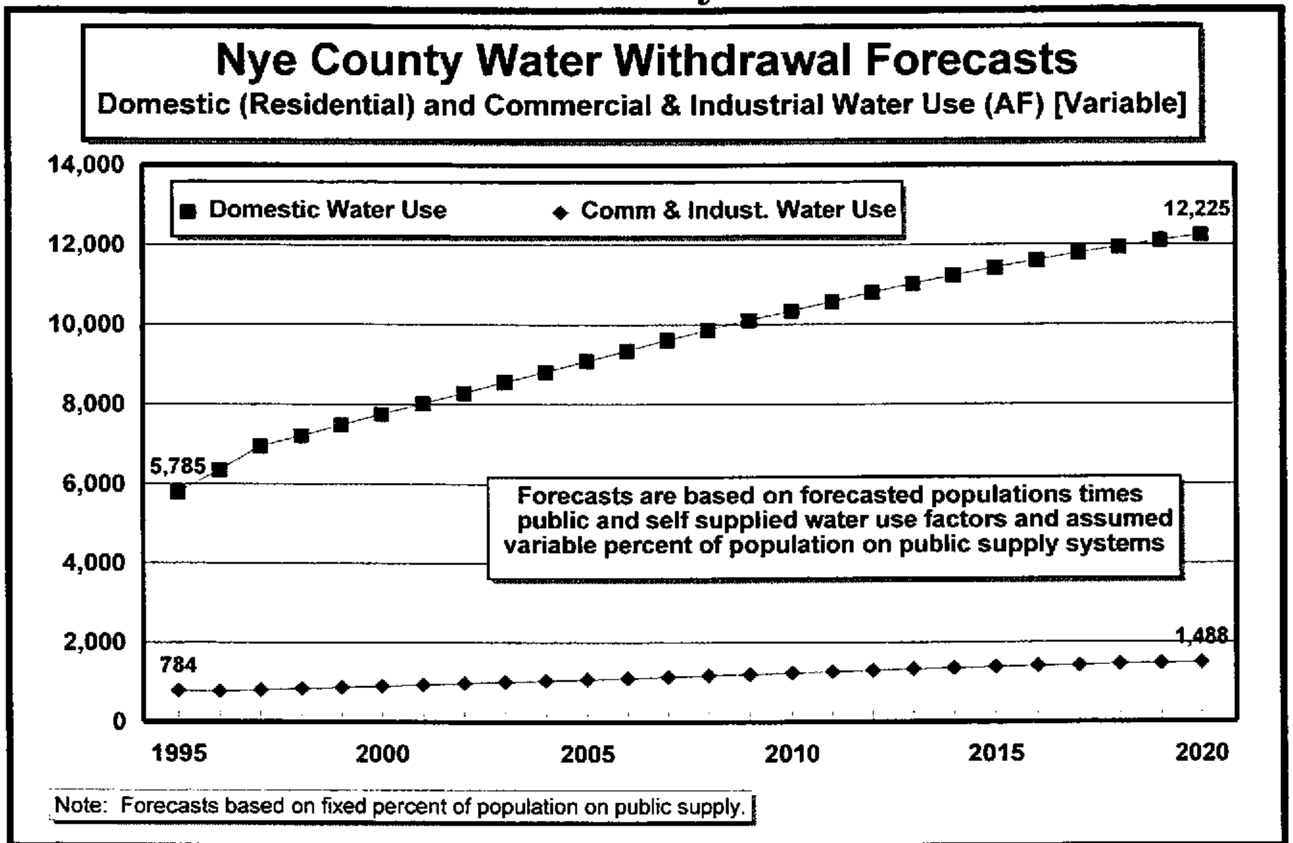
[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

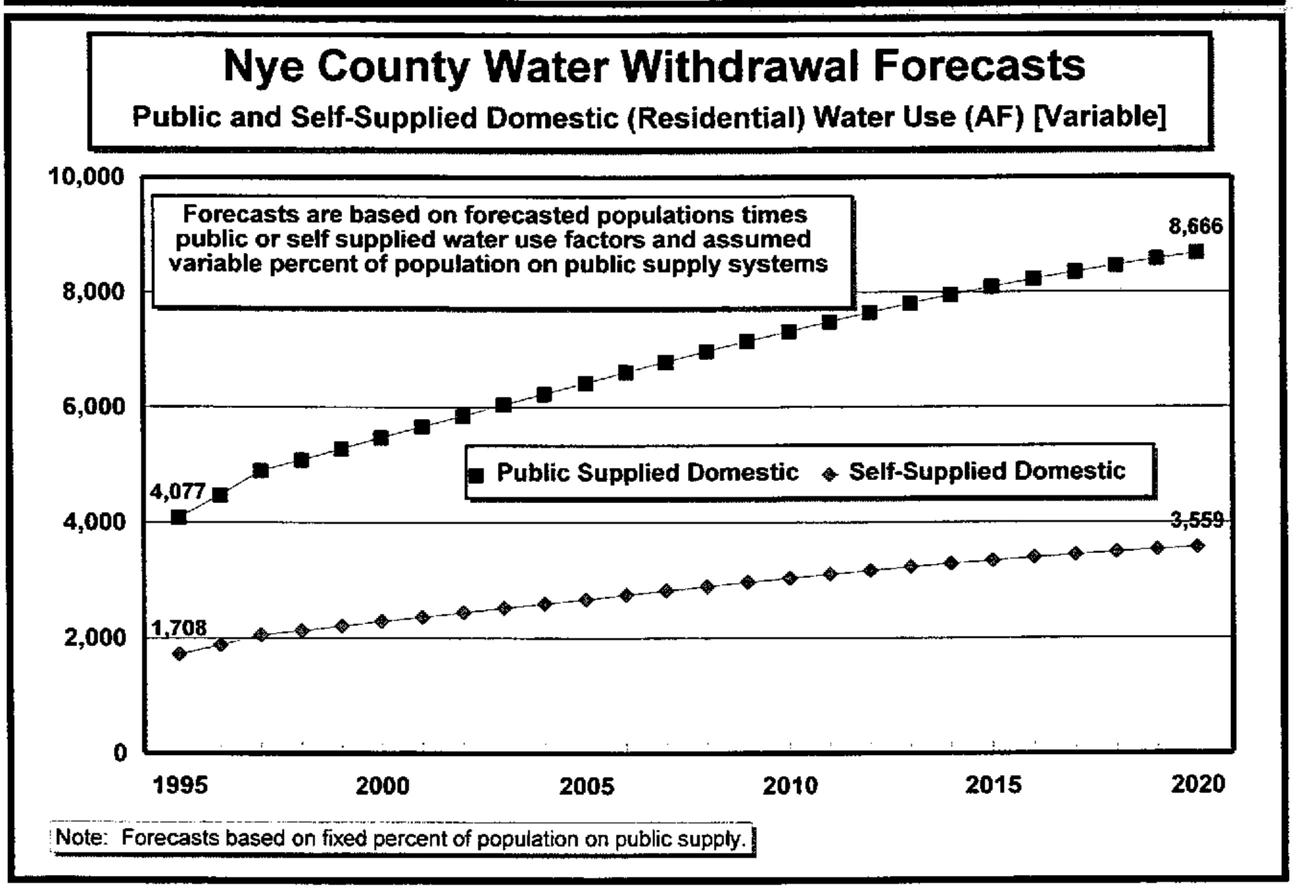
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.


Nye County Employment-to-Population Ratios
Ratio of Total Covered Employment to Total Population (Percent)
Estimated and Forecasted Employment / Population Ratio
Actual Ratios (1980-1997); Forecast Ratios (1998-2020)
Note: Forecasts to this ratio are based on a historical "steady-state" value and estimates of future economic, business, employment, and demographic conditions.
75.0%
31.3%
30.8%
80%
60%
40%
20%
0%
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Source Data: Nevada State Demographer; DETR.

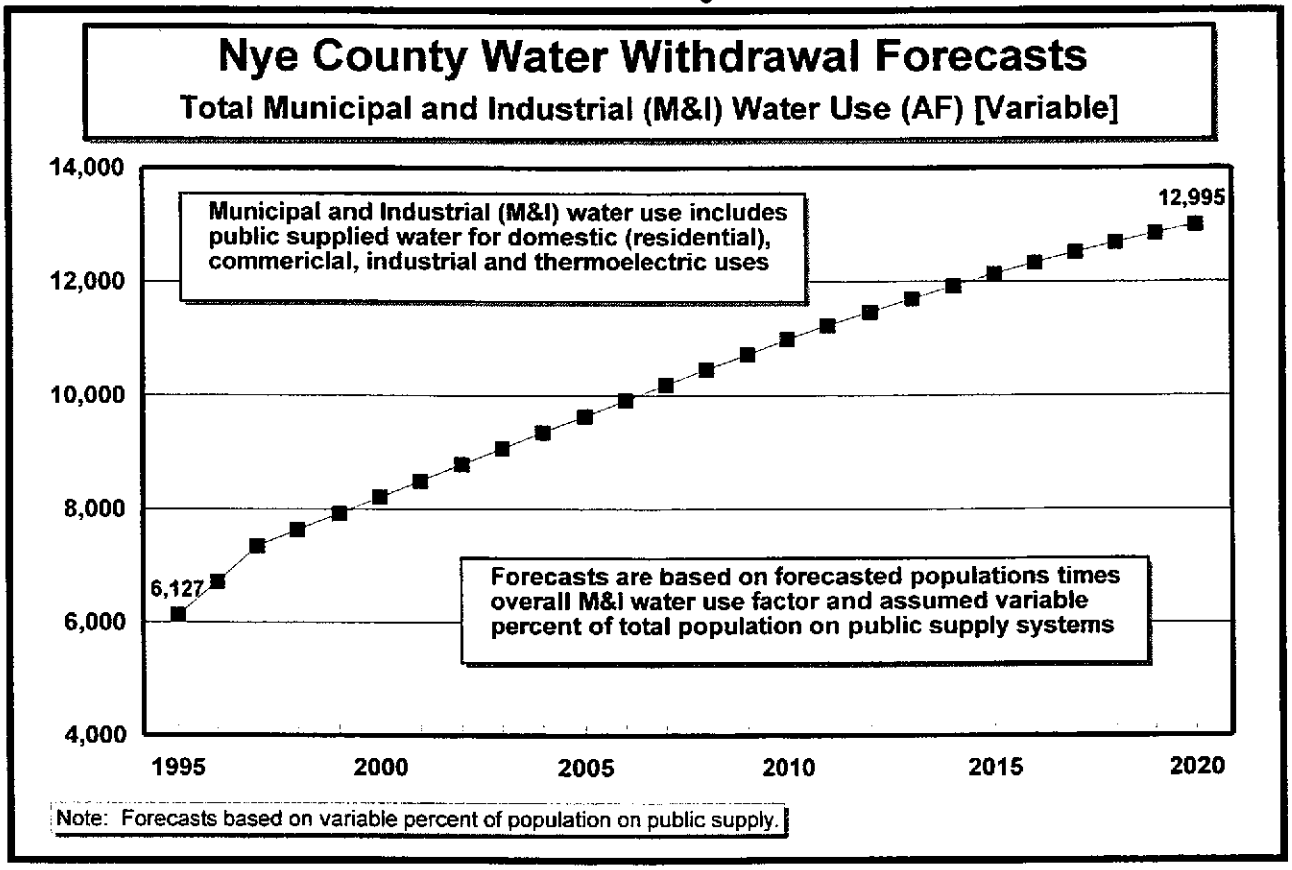

Nye County Population & Employment Forecasts
Total Population (Persons) and Total Covered Employment (Workers)
Employment forecasts are based on the forecasted employment/population ratio
Population
Employment
48,684
9,048
6,790
14,988
60,000
50,000
40,000
30,000
20,000
10,000
0
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Source Data: Nevada State Demographer; DETR.

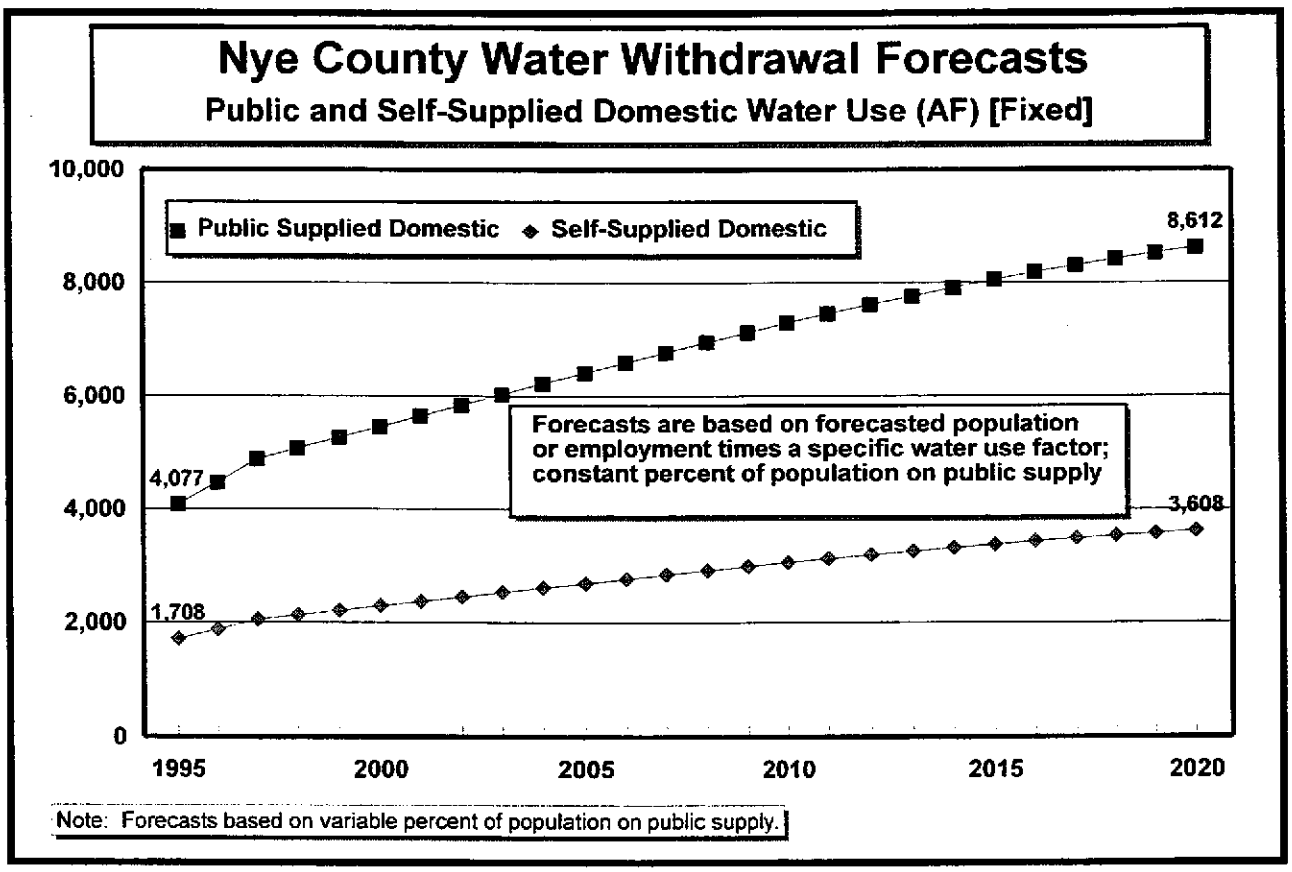
Nevada Water Use Analysis and Forecasts-1





Nevada Water Use Analysis and Forecasts-2





Pershing County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	3,408	1,047	30.73%	226	21.55%	890	283	1,151
1981	3,610	1,376	38.11%	475	34.52%	942	310	1,219
1982	3,720	1,266	34.03%	339	26.74%	971	319	1,257
1983	3,710	1,095	29.50%	229	20.96%	968	298	1,253
1984	3,650	1,052	28.82%	218	20.75%	953	287	1,233
1985	3,660	1,069	29.21%	195	18.21%	955	301	1,236
1986	3,830	1,247	32.57%	196	15.71%	1,000	362	1,294
1987	4,110	1,349	32.83%	448	33.17%	1,073	310	1,388
1988	4,380	1,674	38.23%	654	39.06%	1,143	351	1,480
1989	4,470	1,724	38.57%	691	40.07%	1,167	356	1,510
1990	4,550	1,760	38.69%	683	38.82%	1,188	371	1,537
1991	4,700	1,743	37.09%	653	37.47%	1,227	375	1,588
1992	4,800	1,741	36.27%	661	37.99%	1,253	372	1,621
1993	4,690	1,719	36.66%	623	36.22%	1,224	378	1,584
1994	4,790	1,740	36.32%	681	39.14%	1,250	365	1,618
1995	5,140	1,886	36.69%	682	36.17%	1,342	414	1,736
1996	6,260	2,147	34.30%	817	38.05%	1,634	458	2,115
1997	6,600	2,276	34.48%	861	37.83%	1,723	487	2,229
1998	6,759	2,330	34.47%	872	37.43%	1,764	502	2,283
1999	6,915	2,382	34.45%	882	37.03%	1,805	516	2,336
2000	7,068	2,434	34.43%	891	36.63%	1,845	531	2,388
2001	7,218	2,484	34.42%	900	36.23%	1,884	545	2,438
2002	7,364	2,533	34.40%	908	35.83%	1,922	560	2,487
2003	7,506	2,581	34.38%	914	35.43%	1,959	574	2,535
2004	7,644	2,627	34.36%	920	35.03%	1,995	587	2,582
2005	7,777	2,671	34.35%	925	34.63%	2,030	601	2,627
2006	7,905	2,714	34.33%	929	34.23%	2,063	614	2,670
2007	8,027	2,754	34.31%	932	33.83%	2,095	627	2,712
2008	8,144	2,793	34.30%	934	33.43%	2,126	640	2,751
2009	8,255	2,830	34.28%	935	33.03%	2,155	652	2,788
2010	8,359	2,864	34.26%	935	32.63%	2,182	664	2,824
2011	8,457	2,896	34.24%	933	32.23%	2,207	676	2,857
2012	8,548	2,926	34.23%	931	31.83%	2,231	687	2,887
2013	8,632	2,953	34.21%	928	31.43%	2,253	697	2,916
2014	8,708	2,978	34.19%	924	31.03%	2,273	707	2,942
2015	8,777	3,000	34.18%	919	30.63%	2,291	716	2,965
2016	8,838	3,019	34.16%	913	30.23%	2,307	725	2,985
2017	8,891	3,036	34.14%	905	29.83%	2,321	733	3,003
2018	8,936	3,049	34.12%	897	29.43%	2,332	741	3,018
2019	8,973	3,060	34.11%	888	29.03%	2,342	748	3,031
2020	9,001	3,068	34.09%	878	28.63%	2,349	754	3,040
Actual Period Average (1980-1997).......			34.62%	3.25%	Standard Deviation (1980-1997)			
Forecast Period Average (1998-2020)....			34.28%	35.45%	Latest/Most Stable Period (1994-1997)			

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person....................	341.5	233.0	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.3825	0.2610	Acre-feet per person per year
Commercial & Industrial Water Use per Worker..............	307.3		Gallons per worker per day (excludes mining)
[Commercial & Industrial Water Use Coefficient]	0.3442		Acre-feet per worker per year (excludes mining)

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Pershing County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	3,010	795	95	--	--	--	--	--
1981	3,188	842	100	--	--	--	--	--
1982	3,285	867	103	--	--	--	--	--
1983	3,276	865	103	--	--	--	--	--
1984	3,223	851	102	--	--	--	--	--
1985	3,232	853	102	--	--	--	--	--
1986	3,382	893	107	--	--	--	--	--
1987	3,629	958	114	--	--	--	--	--
1988	3,868	1,021	122	--	--	--	--	--
1989	3,947	1,042	124	--	--	--	--	--
1990	4,018	1,061	127	--	--	--	--	--
1991	4,150	1,096	131	--	--	--	--	--
1992	4,239	1,119	134	--	--	--	--	--
1993	4,142	1,094	130	--	--	--	--	--
1994	4,230	1,117	133	--	--	--	--	--
1995	4,539	1,199	143	4,539	88.31%	1,199	143	1,736
1996	5,528	1,460	174	5,529	88.33%	1,460	174	2,115
1997	5,828	1,539	184	5,831	88.35%	1,540	183	2,230
1998	5,968	1,576	188	5,973	88.37%	1,577	187	2,284
1999	6,106	1,612	192	6,112	88.40%	1,614	191	2,337
2000	6,242	1,648	197	6,249	88.42%	1,650	195	2,390
2001	6,374	1,683	201	6,383	88.44%	1,686	199	2,441
2002	6,503	1,717	205	6,514	88.46%	1,720	202	2,490
2003	6,628	1,750	209	6,642	88.48%	1,754	206	2,539
2004	6,750	1,782	213	6,765	88.51%	1,786	209	2,586
2005	6,868	1,813	216	6,885	88.53%	1,818	212	2,631
2006	6,981	1,843	220	7,000	88.55%	1,848	215	2,675
2007	7,089	1,872	223	7,110	88.57%	1,877	218	2,717
2008	7,192	1,899	227	7,215	88.59%	1,905	221	2,757
2009	7,290	1,925	230	7,315	88.62%	1,932	224	2,795
2010	7,382	1,949	233	7,410	88.64%	1,957	226	2,831
2011	7,468	1,972	235	7,498	88.66%	1,980	228	2,865
2012	7,549	1,993	238	7,581	88.68%	2,002	230	2,896
2013	7,623	2,013	240	7,657	88.71%	2,022	232	2,925
2014	7,690	2,031	242	7,727	88.73%	2,040	234	2,951
2015	7,751	2,047	244	7,790	88.75%	2,057	235	2,975
2016	7,805	2,061	246	7,846	88.77%	2,072	236	2,996
2017	7,851	2,073	247	7,895	88.79%	2,085	237	3,015
2018	7,891	2,084	249	7,937	88.82%	2,096	238	3,030
2019	7,923	2,092	250	7,971	88.84%	2,105	238	3,043
2020	7,948	2,099	250	7,998	88.86%	2,112	239	3,054

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied)....................	**341.5**	**235.7**	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.3825	0.2641	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	**212.4**		Gallons per person per day--self supply
[Self-Supplied Water Use Coefficient]	0.2379		Acre-feet per person per year
1995 Estimated Resident Population on Public Supply........	**88.31%**		Percent of total resident population

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

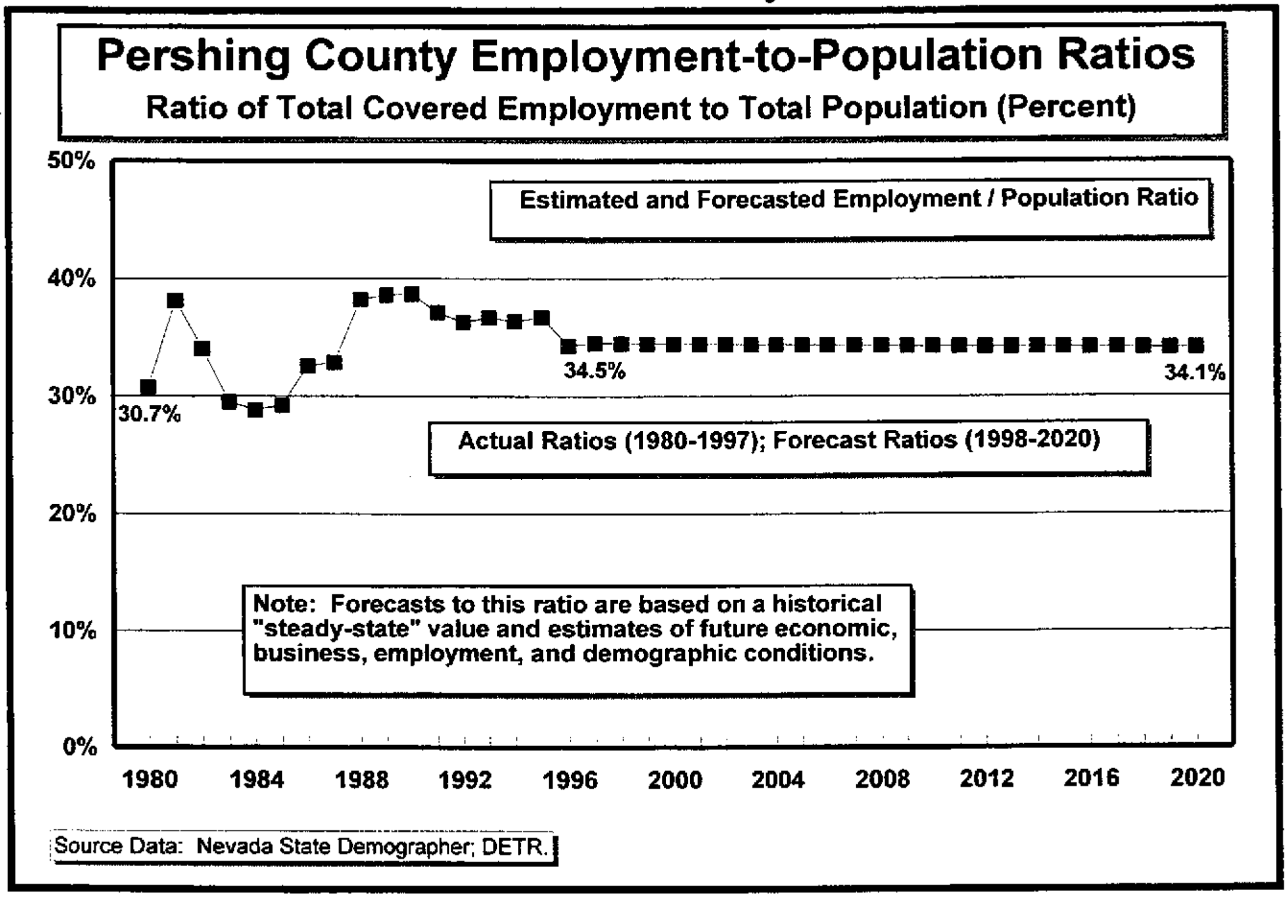
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

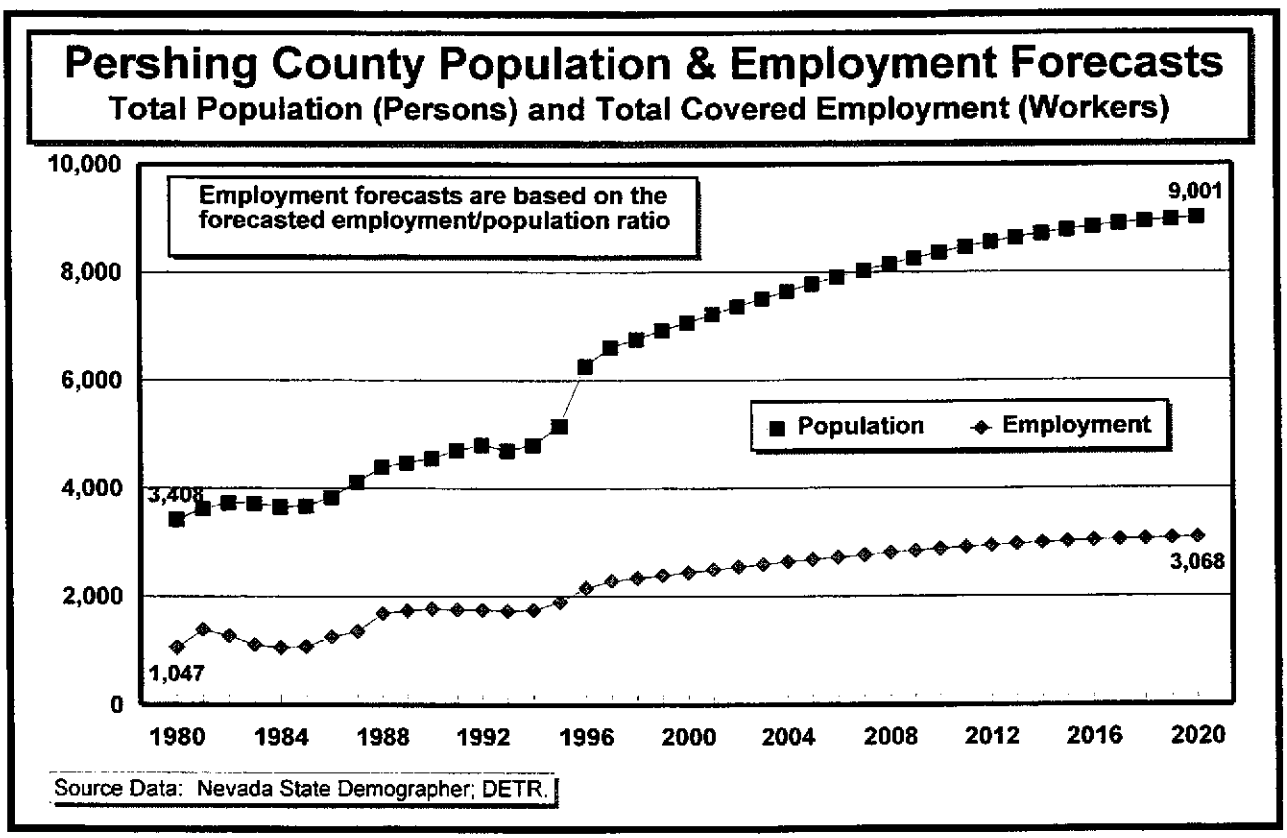
[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

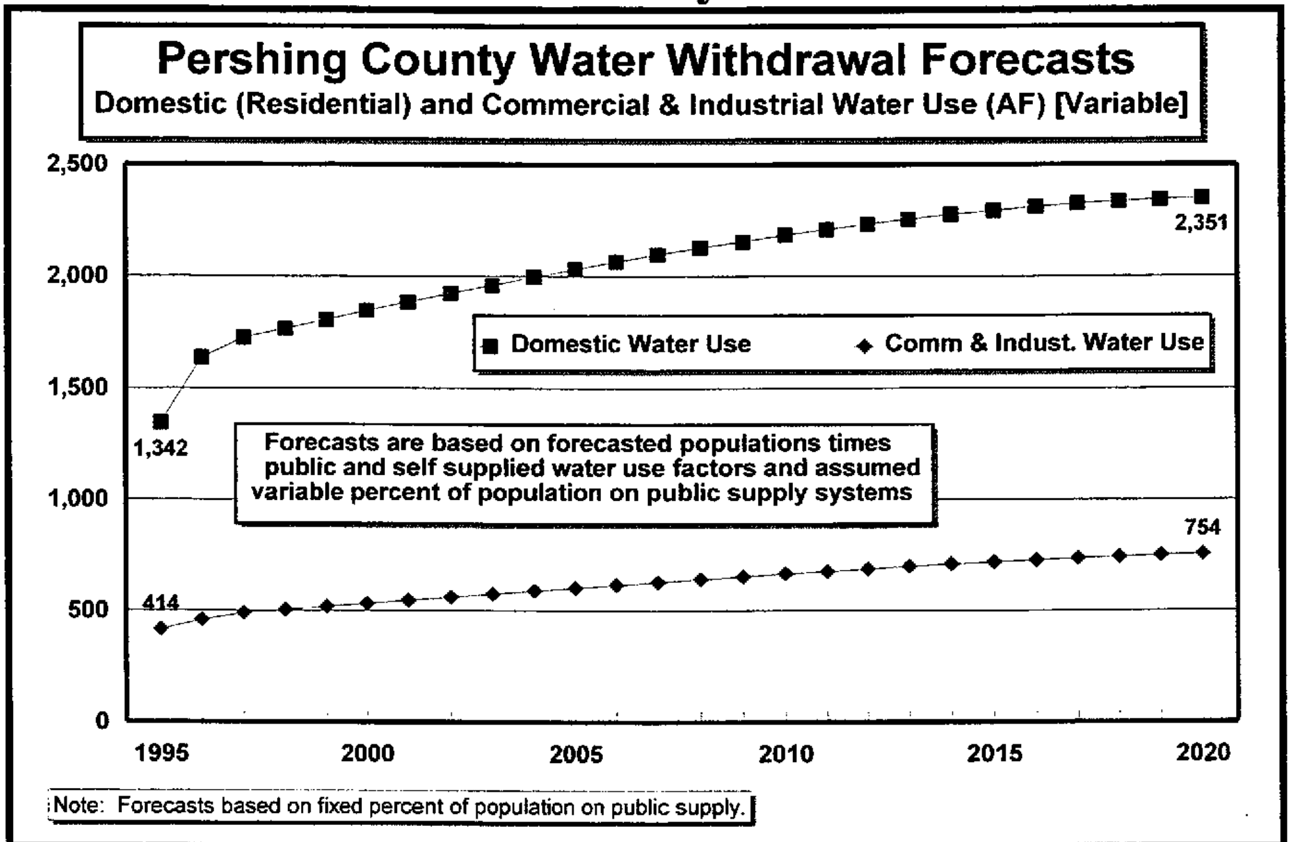
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

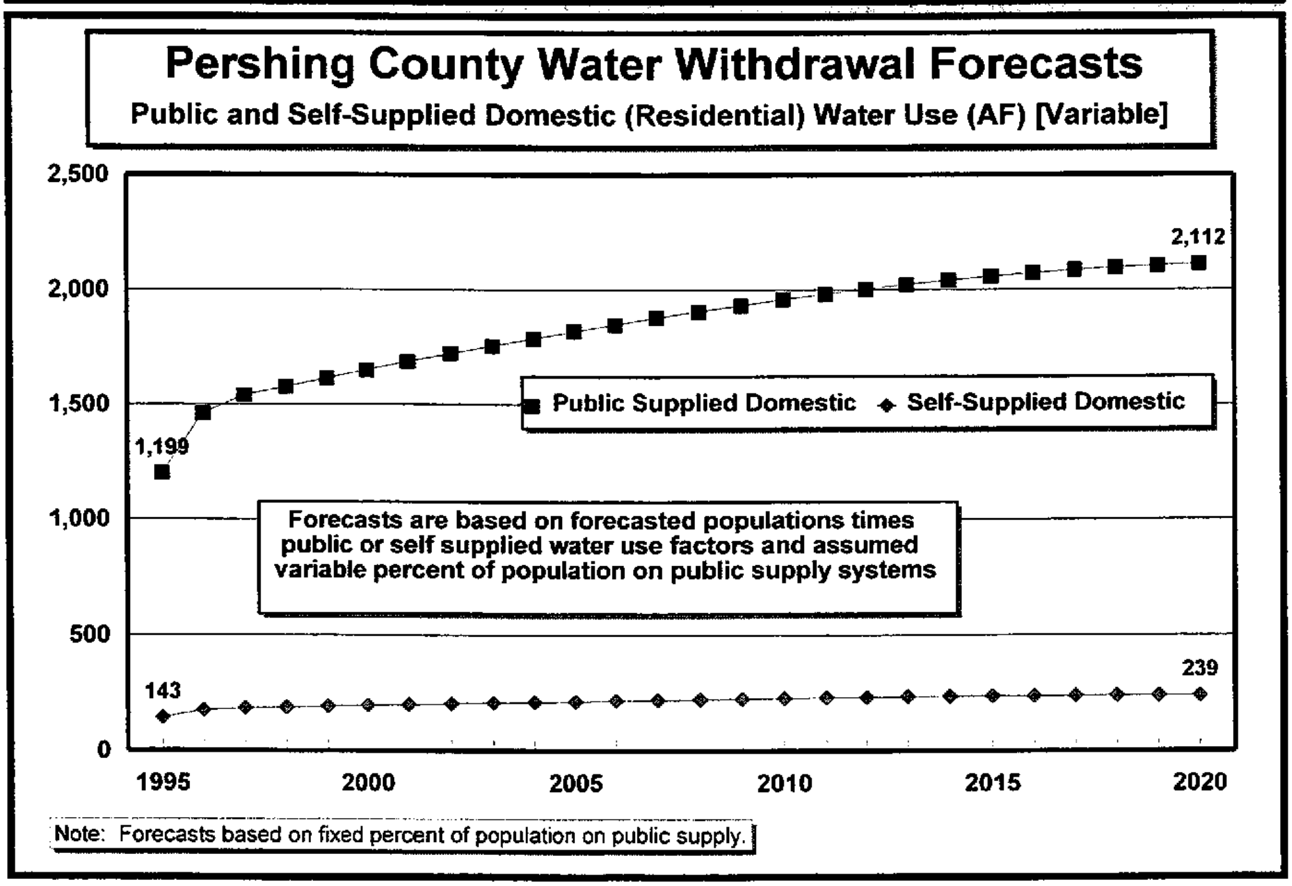
Nevada Socioeconomic Analysis and Forecasts



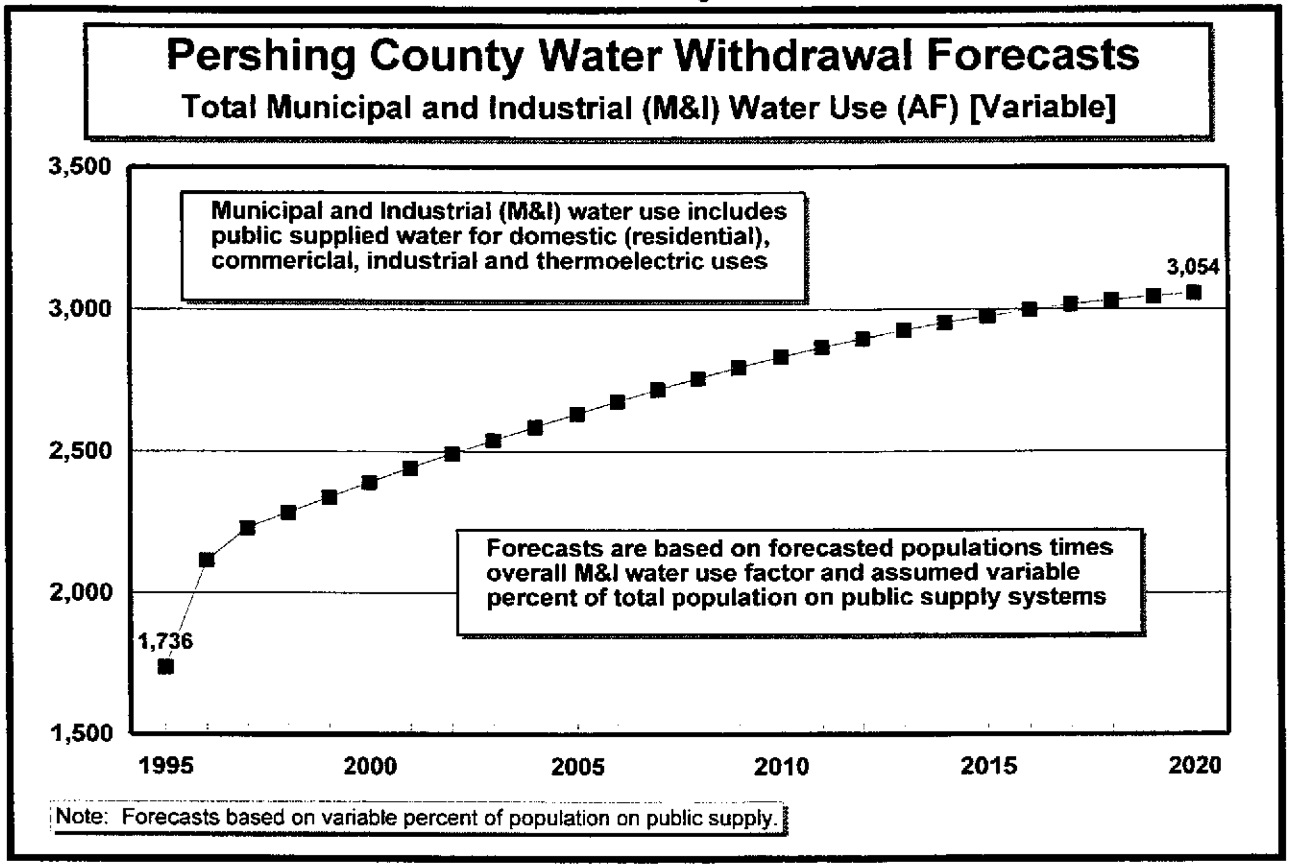


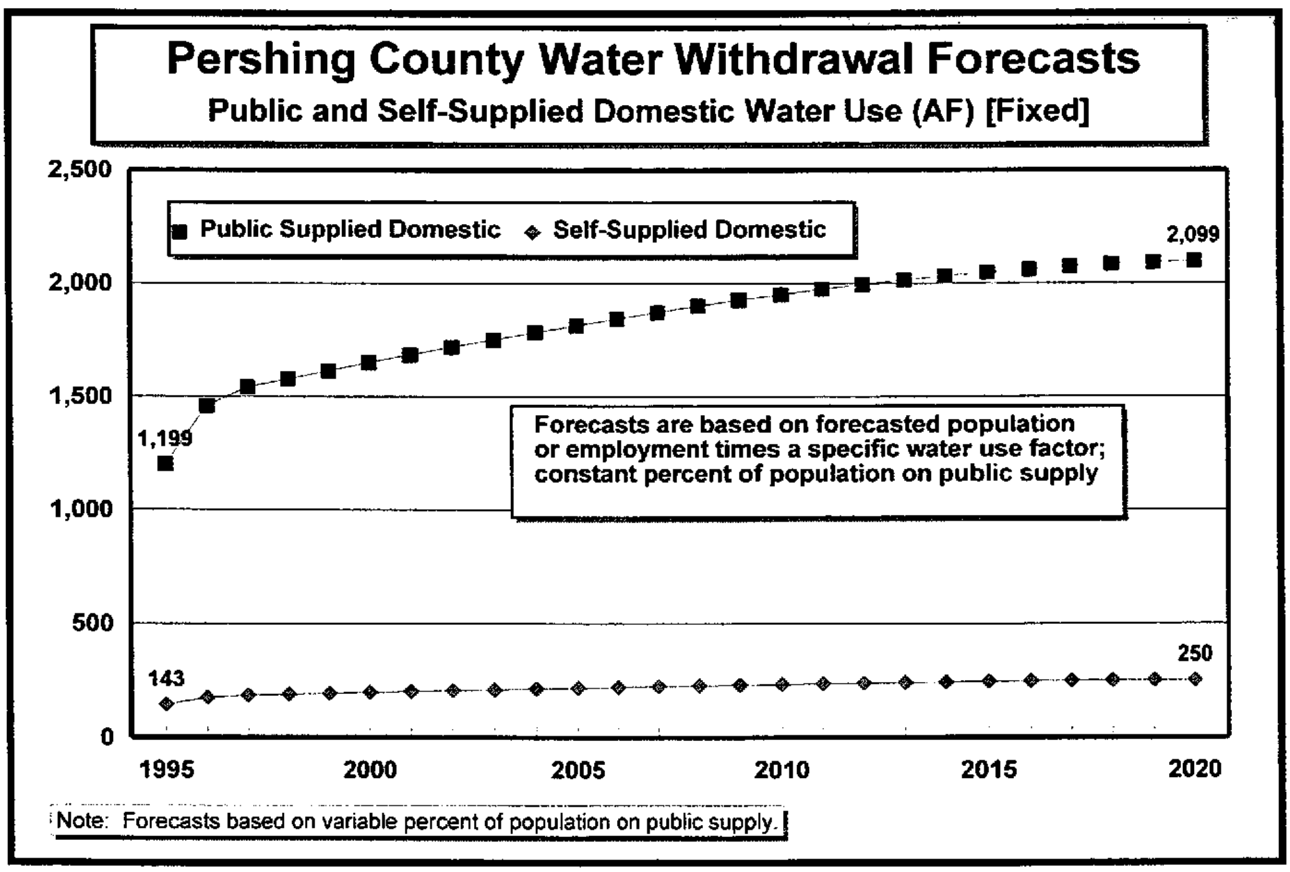
Nevada Water Use Analysis and Forecasts-1





Nevada Water Use Analysis and Forecasts-2





Storey County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	1,503	714	47.52%	290	40.54%	160	44	153
1981	1,590	769	48.33%	329	42.81%	169	46	161
1982	1,690	642	37.98%	220	34.24%	180	44	172
1983	1,730	691	39.95%	287	41.48%	184	42	176
1984	1,780	722	40.54%	276	38.28%	189	47	181
1985	1,850	580	31.36%	126	21.72%	197	47	188
1986	1,960	543	27.69%	68	12.48%	208	50	199
1987	2,130	631	29.62%	101	15.94%	226	55	216
1988	2,140	637	29.76%	77	12.02%	227	59	217
1989	2,480	726	29.28%	130	17.84%	264	62	252
1990	2,560	737	28.77%	159	21.64%	272	60	260
1991	2,720	727	26.72%	134	18.46%	289	62	276
1992	2,820	689	24.44%	97	14.04%	300	62	286
1993	2,850	669	23.46%	87	12.95%	303	61	289
1994	3,100	698	22.53%	93	13.31%	329	63	315
1995	3,200	724	22.63%	81	11.24%	340	67	325
1996	3,320	869	26.19%	100	11.48%	353	80	337
1997	3,520	967	27.47%	105	10.86%	374	90	357
1998	3,605	993	27.54%	107	10.76%	383	93	366
1999	3,690	1,019	27.61%	109	10.66%	392	95	375
2000	3,773	1,044	27.68%	110	10.56%	401	98	383
2001	3,855	1,070	27.75%	112	10.46%	410	100	391
2002	3,936	1,095	27.82%	113	10.36%	418	103	400
2003	4,016	1,120	27.89%	115	10.26%	427	105	408
2004	4,094	1,144	27.96%	116	10.16%	435	107	416
2005	4,170	1,169	28.03%	118	10.06%	443	110	423
2006	4,244	1,192	28.10%	119	9.96%	451	112	431
2007	4,316	1,216	28.17%	120	9.86%	459	115	438
2008	4,386	1,238	28.24%	121	9.76%	466	117	445
2009	4,454	1,261	28.31%	122	9.66%	473	119	452
2010	4,519	1,282	28.38%	123	9.56%	480	121	459
2011	4,581	1,303	28.45%	123	9.46%	487	123	465
2012	4,640	1,323	28.52%	124	9.36%	493	125	471
2013	4,697	1,343	28.59%	124	9.26%	499	127	477
2014	4,751	1,362	28.66%	125	9.16%	505	129	482
2015	4,801	1,380	28.73%	125	9.06%	510	131	487
2016	4,848	1,397	28.81%	125	8.96%	515	133	492
2017	4,892	1,413	28.88%	125	8.86%	520	135	497
2018	4,932	1,428	28.95%	125	8.76%	524	136	501
2019	4,968	1,442	29.02%	125	8.66%	528	138	504
2020	5,001	1,455	29.10%	125	8.56%	531	139	508

Actual Period Average (1980-1997).......	31.35%	7.85%	Standard Deviation (1980-1997)
Forecast Period Average (1998-2020)....	28.31%	24.70%	Latest/Most Stable Period (1994-1997)

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person....................	143.0	94.9	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.1602	0.1063	Acre-feet per person per year
Commercial & Industrial Water Use per Worker..............	93.3	Gallons per worker per day (excludes mining)	
[Commercial & Industrial Water Use Coefficient]	0.1045	Acre-feet per worker per year (excludes mining)	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Storey County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	953	105	54	--	--	--	--	--
1981	1,008	111	58	--	--	--	--	--
1982	1,071	118	61	--	--	--	--	--
1983	1,096	121	63	--	--	--	--	--
1984	1,128	125	65	--	--	--	--	--
1985	1,172	130	67	--	--	--	--	--
1986	1,242	137	71	--	--	--	--	--
1987	1,350	149	77	--	--	--	--	--
1988	1,356	150	78	--	--	--	--	--
1989	1,572	174	90	--	--	--	--	--
1990	1,622	179	93	--	--	--	--	--
1991	1,724	190	99	--	--	--	--	--
1992	1,787	197	102	--	--	--	--	--
1993	1,806	200	103	--	--	--	--	--
1994	1,965	217	112	--	--	--	--	--
1995	2,028	224	116	2,028	63.38%	224	116	325
1996	2,104	232	120	2,105	63.39%	232	120	337
1997	2,231	246	128	2,232	63.41%	247	127	357
1998	2,285	252	131	2,286	63.42%	253	131	366
1999	2,338	258	134	2,341	63.44%	259	134	375
2000	2,391	264	137	2,394	63.45%	264	136	383
2001	2,443	270	140	2,447	63.47%	270	139	392
2002	2,495	276	143	2,499	63.49%	276	142	400
2003	2,545	281	146	2,550	63.50%	282	145	408
2004	2,594	287	148	2,600	63.52%	287	148	416
2005	2,643	292	151	2,649	63.53%	293	150	424
2006	2,690	297	154	2,697	63.55%	298	153	432
2007	2,735	302	156	2,744	63.57%	303	156	439
2008	2,780	307	159	2,789	63.58%	308	158	446
2009	2,822	312	161	2,832	63.60%	313	160	453
2010	2,864	316	164	2,874	63.61%	318	163	460
2011	2,903	321	166	2,915	63.63%	322	165	466
2012	2,941	325	168	2,953	63.64%	326	167	472
2013	2,977	329	170	2,990	63.66%	330	169	478
2014	3,011	333	172	3,025	63.68%	334	171	484
2015	3,043	336	174	3,058	63.69%	338	173	489
2016	3,072	339	176	3,089	63.71%	341	174	494
2017	3,100	342	177	3,117	63.72%	344	176	498
2018	3,126	345	179	3,144	63.74%	347	177	503
2019	3,149	348	180	3,168	63.76%	350	178	506
2020	3,169	350	181	3,189	63.77%	352	179	510

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied)....................	**143.0**	**98.6**	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.1602	0.1105	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	**88.4**	Gallons per person per day--self supply	
[Self-Supplied Water Use Coefficient]	0.0990	Acre-feet per person per year	
1995 Estimated Resident Population on Public Supply........	**63.38%**	Percent of total resident population	

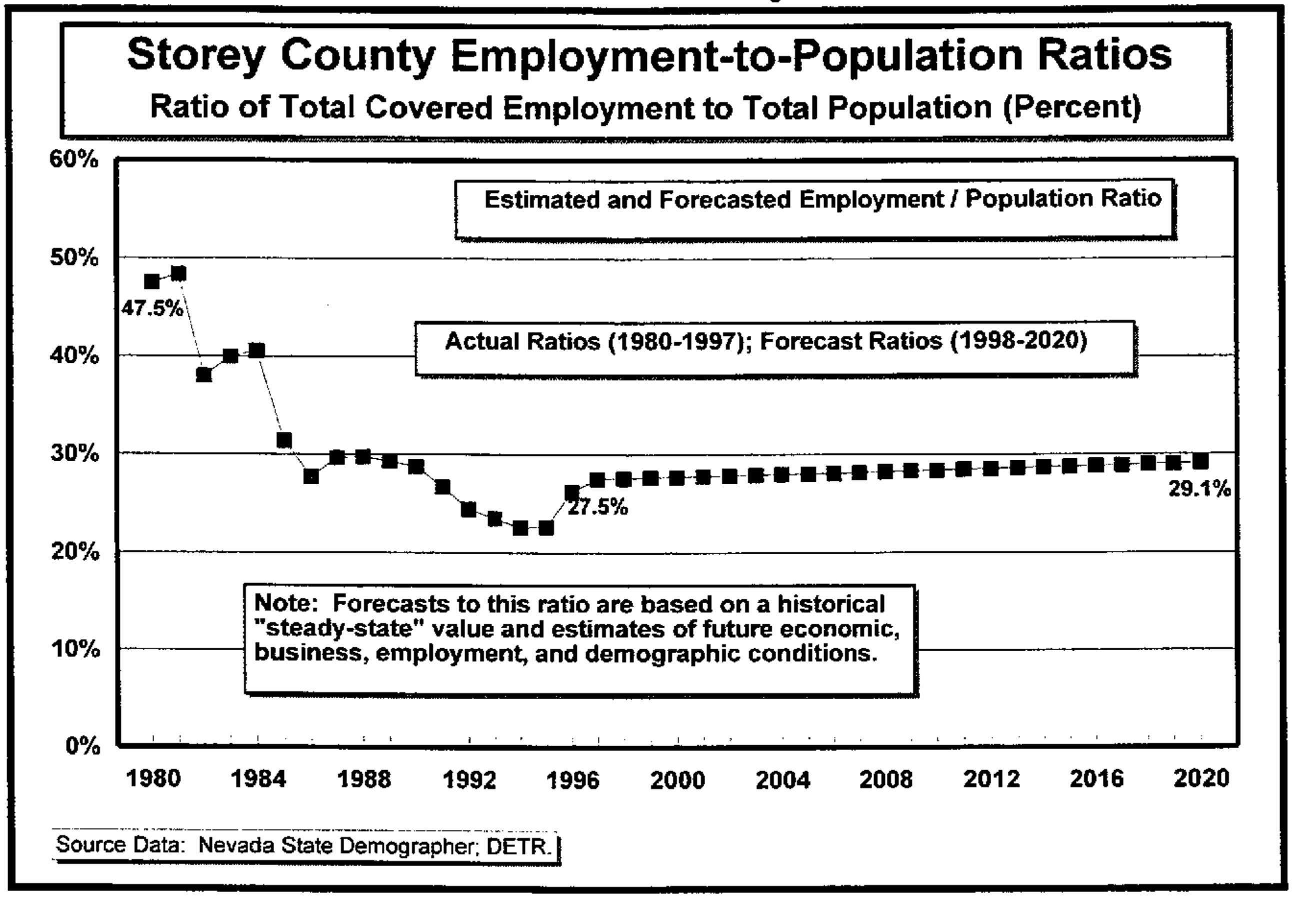
Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

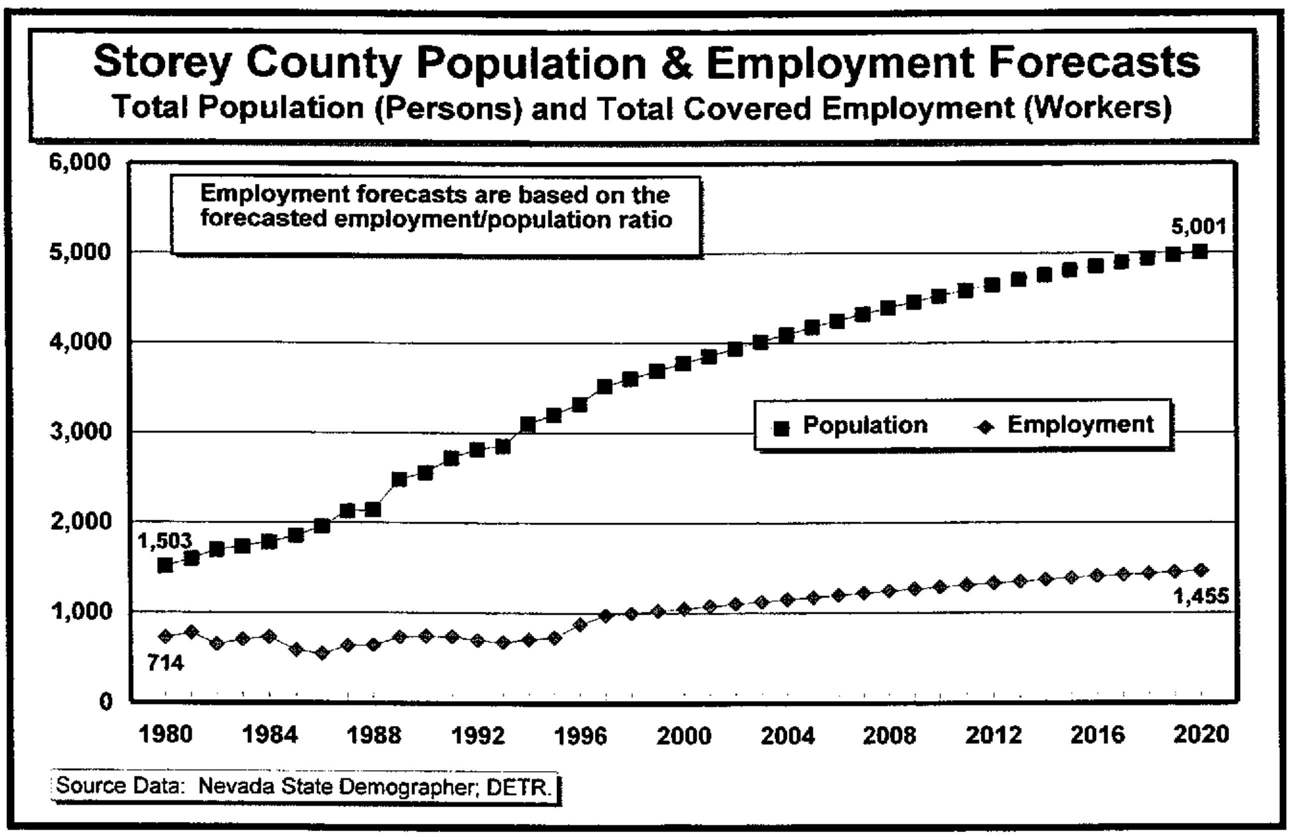
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

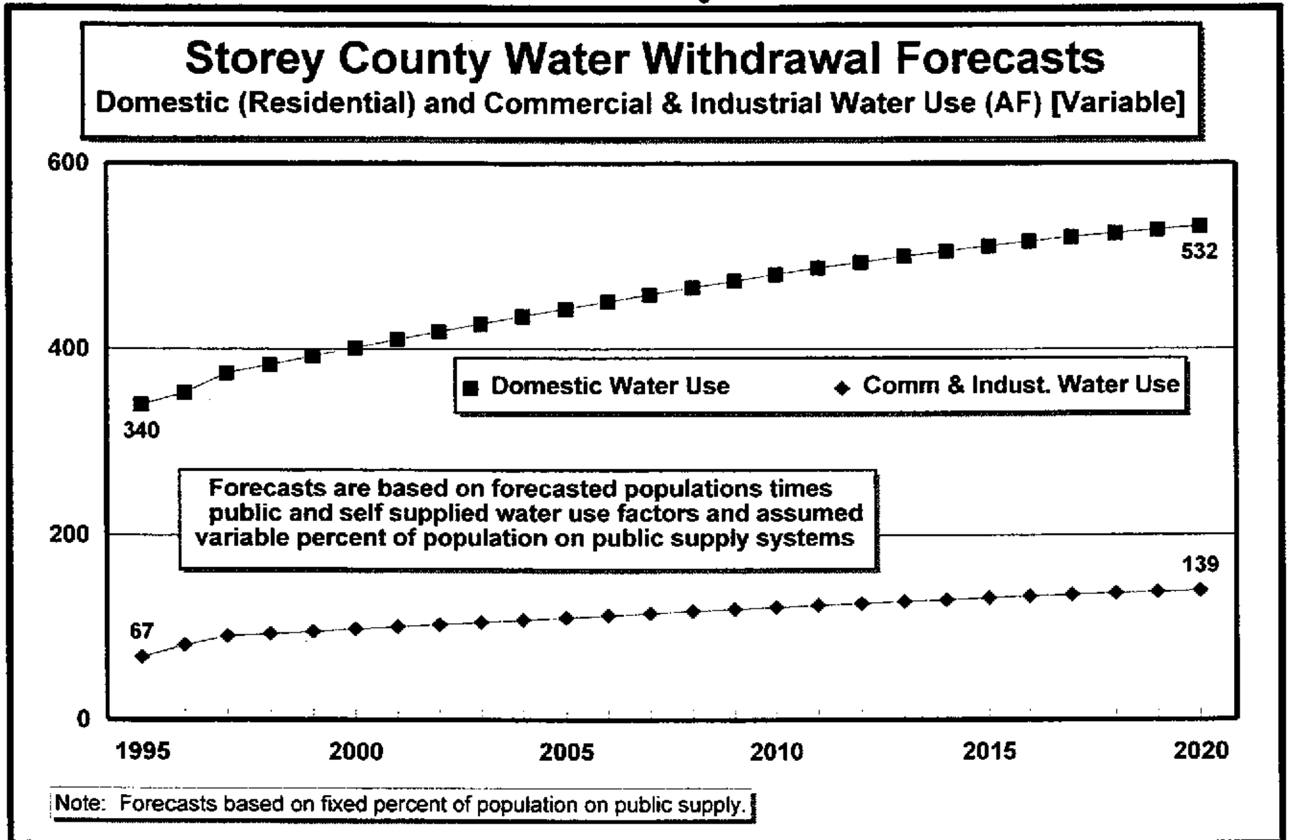
[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

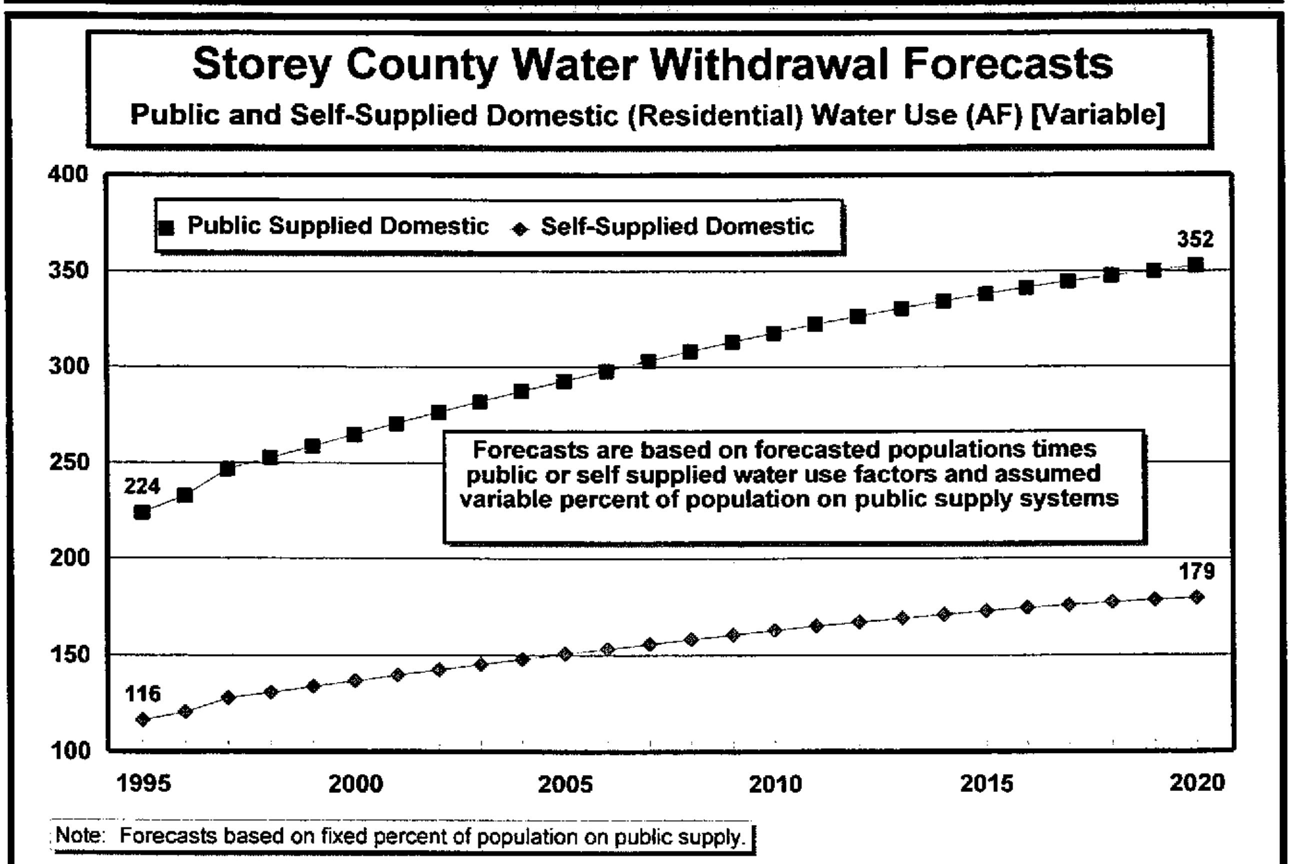
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.


Storey County Employment-to-Population Ratios
Ratio of Total Covered Employment to Total Population (Percent)
Estimated and Forecasted Employment / Population Ratio
Actual Ratios (1980-1997); Forecast Ratios (1998-2020)
47.5%
27.5%
29.1%
Note: Forecasts to this ratio are based on a historical "steady-state" value and estimates of future economic, business, employment, and demographic conditions.
60%
50%
40%
30%
20%
10%
0%
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Source Data: Nevada State Demographer; DETR.

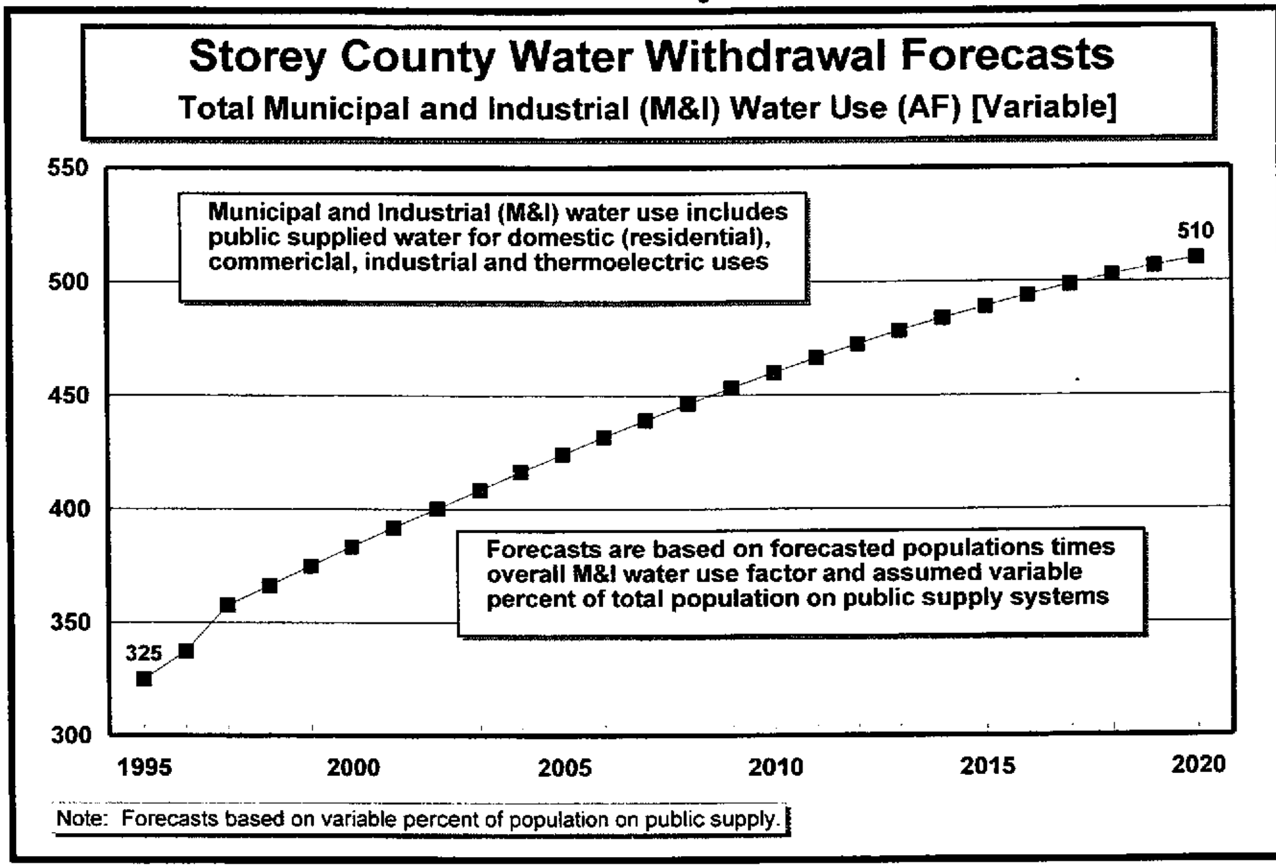

Storey County Population & Employment Forecasts
Total Population (Persons) and Total Covered Employment (Workers)
Employment forecasts are based on the forecasted employment/population ratio
Population
Employment
1,503
5,001
714
1,455
6,000
5,000
4,000
3,000
2,000
1,000
0
1980
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Source Data: Nevada State Demographer; DETR.

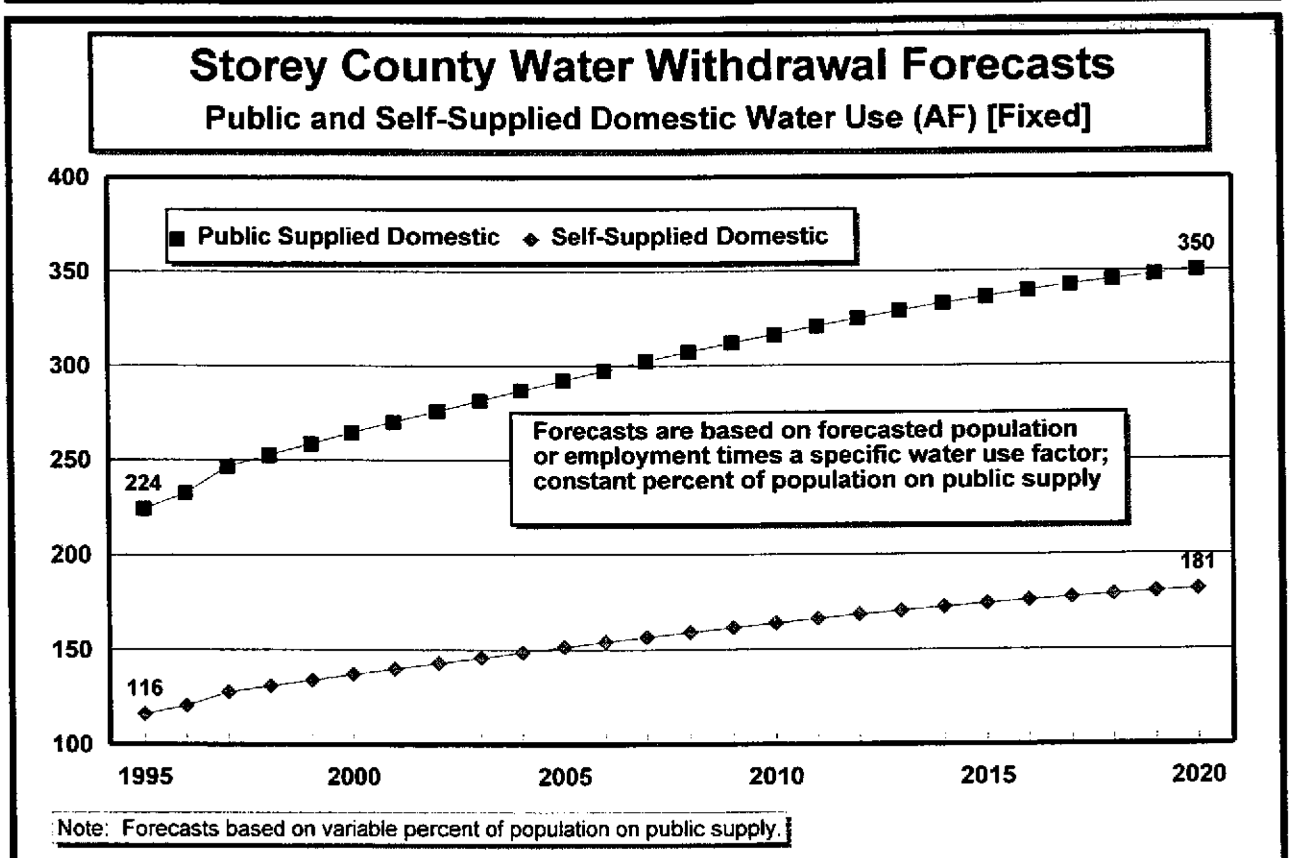
Nevada Water Use Analysis and Forecasts-1





Nevada Water Use Analysis and Forecasts-2





Washoe County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	193,623	112,581	58.14%	978	0.87%	38,174	16,267	52,812
1981	201,680	112,771	55.92%	864	0.77%	39,762	16,311	55,009
1982	205,130	110,195	53.72%	662	0.60%	40,443	15,965	55,950
1983	210,990	109,752	52.02%	601	0.55%	41,598	15,910	57,549
1984	218,320	116,043	53.15%	718	0.62%	43,043	16,810	59,548
1985	224,580	119,421	53.18%	702	0.59%	44,277	17,304	61,255
1986	232,270	124,380	53.55%	759	0.61%	45,794	18,019	63,353
1987	238,360	129,886	54.49%	920	0.71%	46,994	18,798	65,014
1988	244,890	135,404	55.29%	1,229	0.91%	48,282	19,557	66,795
1989	251,580	139,320	55.38%	1,433	1.03%	49,601	20,098	68,620
1990	257,120	142,671	55.49%	1,513	1.06%	50,693	20,575	70,131
1991	263,710	141,156	53.53%	1,328	0.94%	51,992	20,381	71,928
1992	266,755	143,157	53.67%	892	0.62%	52,592	20,736	72,759
1993	271,850	148,274	54.54%	709	0.48%	53,597	21,509	74,148
1994	279,820	156,424	55.90%	662	0.42%	55,168	22,704	76,322
1995	291,050	163,151	56.06%	613	0.38%	57,382	23,691	79,385
1996	303,240	169,684	55.96%	600	0.35%	59,786	24,645	82,710
1997	308,700	174,863	56.64%	656	0.38%	60,862	25,392	84,199
1998	315,488	178,663	56.63%	656	0.37%	62,200	25,946	86,051
1999	322,264	182,455	56.62%	655	0.36%	63,536	26,499	87,899
2000	329,021	186,234	56.60%	654	0.35%	64,869	27,050	89,742
2001	335,752	189,996	56.59%	652	0.34%	66,196	27,598	91,578
2002	342,448	193,737	56.57%	649	0.34%	67,516	28,144	93,404
2003	349,104	197,453	56.56%	646	0.33%	68,828	28,686	95,220
2004	355,710	201,140	56.55%	642	0.32%	70,131	29,224	97,022
2005	362,260	204,792	56.53%	637	0.31%	71,422	29,757	98,808
2006	368,745	208,406	56.52%	632	0.30%	72,700	30,285	100,577
2007	375,158	211,977	56.50%	626	0.30%	73,965	30,806	102,326
2008	381,490	215,502	56.49%	619	0.29%	75,213	31,321	104,053
2009	387,735	218,974	56.48%	611	0.28%	76,444	31,828	105,757
2010	393,884	222,391	56.46%	603	0.27%	77,657	32,327	107,434
2011	399,929	225,748	56.45%	594	0.26%	78,849	32,818	109,083
2012	405,863	229,040	56.43%	584	0.26%	80,018	33,299	110,701
2013	411,677	232,263	56.42%	574	0.25%	81,165	33,771	112,287
2014	417,364	235,413	56.40%	563	0.24%	82,286	34,231	113,838
2015	422,917	238,485	56.39%	551	0.23%	83,381	34,681	115,352
2016	428,327	241,476	56.38%	539	0.22%	84,447	35,119	116,828
2017	433,588	244,380	56.36%	526	0.22%	85,485	35,544	118,263
2018	438,691	247,195	56.35%	512	0.21%	86,491	35,956	119,655
2019	443,631	249,916	56.33%	498	0.20%	87,465	36,355	121,002
2020	448,400	252,539	56.32%	483	0.19%	88,405	36,739	122,303
Actual Period Average (1980-1997).......			54.81%	1.49%	Standard Deviation (1980-1997)			
Forecast Period Average (1998-2020)....			56.48%	56.14%	Latest/Most Stable Period (1994-1997)			

Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person.....................	**269.7**	**176.0**	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.3021	0.1972	Acre-feet per person per year
Commercial & Industrial Water Use per Worker...............	**130.1**	Gallons per worker per day (excludes mining)	
[Commercial & Industrial Water Use Coefficient]	0.1458	Acre-feet per worker per year (excludes mining)	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Washoe County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	174,835	34,808	3,366	--	--	--	--	--
1981	182,111	36,256	3,506	--	--	--	--	--
1982	185,226	36,876	3,566	--	--	--	--	--
1983	190,517	37,930	3,668	--	--	--	--	--
1984	197,136	39,248	3,796	--	--	--	--	--
1985	202,789	40,373	3,904	--	--	--	--	--
1986	209,733	41,755	4,038	--	--	--	--	--
1987	215,232	42,850	4,144	--	--	--	--	--
1988	221,128	44,024	4,258	--	--	--	--	--
1989	227,169	45,227	4,374	--	--	--	--	--
1990	232,171	46,223	4,470	--	--	--	--	--
1991	238,122	47,407	4,585	--	--	--	--	--
1992	240,871	47,955	4,638	--	--	--	--	--
1993	245,472	48,871	4,726	--	--	--	--	--
1994	252,669	50,304	4,865	--	--	--	--	--
1995	262,809	52,322	5,060	262,809	90.30%	52,322	5,060	79,385
1996	273,816	54,514	5,272	273,885	90.32%	54,527	5,260	82,724
1997	278,746	55,495	5,367	278,886	90.34%	55,523	5,342	84,227
1998	284,876	56,716	5,485	285,089	90.36%	56,758	5,447	86,093
1999	290,994	57,934	5,603	291,285	90.39%	57,992	5,551	87,957
2000	297,096	59,148	5,720	297,467	90.41%	59,222	5,654	89,816
2001	303,173	60,358	5,837	303,628	90.43%	60,449	5,756	91,668
2002	309,220	61,562	5,954	309,762	90.45%	61,670	5,857	93,512
2003	315,230	62,759	6,069	315,861	90.48%	62,884	5,956	95,345
2004	321,195	63,946	6,184	321,919	90.50%	64,090	6,055	97,166
2005	327,109	65,124	6,298	327,928	90.52%	65,287	6,151	98,971
2006	332,965	66,290	6,411	333,882	90.55%	66,472	6,247	100,759
2007	338,756	67,442	6,522	339,773	90.57%	67,645	6,340	102,529
2008	344,474	68,581	6,632	345,595	90.59%	68,804	6,431	104,277
2009	350,113	69,704	6,741	351,340	90.61%	69,948	6,521	106,001
2010	355,665	70,809	6,848	357,001	90.64%	71,075	6,608	107,700
2011	361,123	71,896	6,953	362,571	90.66%	72,184	6,694	109,371
2012	366,481	72,962	7,056	368,042	90.68%	73,273	6,776	111,012
2013	371,731	74,008	7,157	373,408	90.70%	74,341	6,857	112,621
2014	376,867	75,030	7,256	378,661	90.73%	75,387	6,935	114,195
2015	381,880	76,028	7,353	383,794	90.75%	76,409	7,010	115,734
2016	386,766	77,001	7,447	388,801	90.77%	77,406	7,082	117,233
2017	391,516	77,946	7,538	393,675	90.79%	78,376	7,151	118,693
2018	396,125	78,864	7,627	398,409	90.82%	79,319	7,218	120,110
2019	400,585	79,752	7,713	402,995	90.84%	80,232	7,281	121,482
2020	404,891	80,609	7,796	407,429	90.86%	81,115	7,341	122,808

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied)....................	**269.7**	177.7	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.3021	0.1991	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	**160.0**	Gallons per person per day--self supply	
[Self-Supplied Water Use Coefficient]	0.1792	Acre-feet per person per year	
1995 Estimated Resident Population on Public Supply........	**90.30%**	Percent of total resident population	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

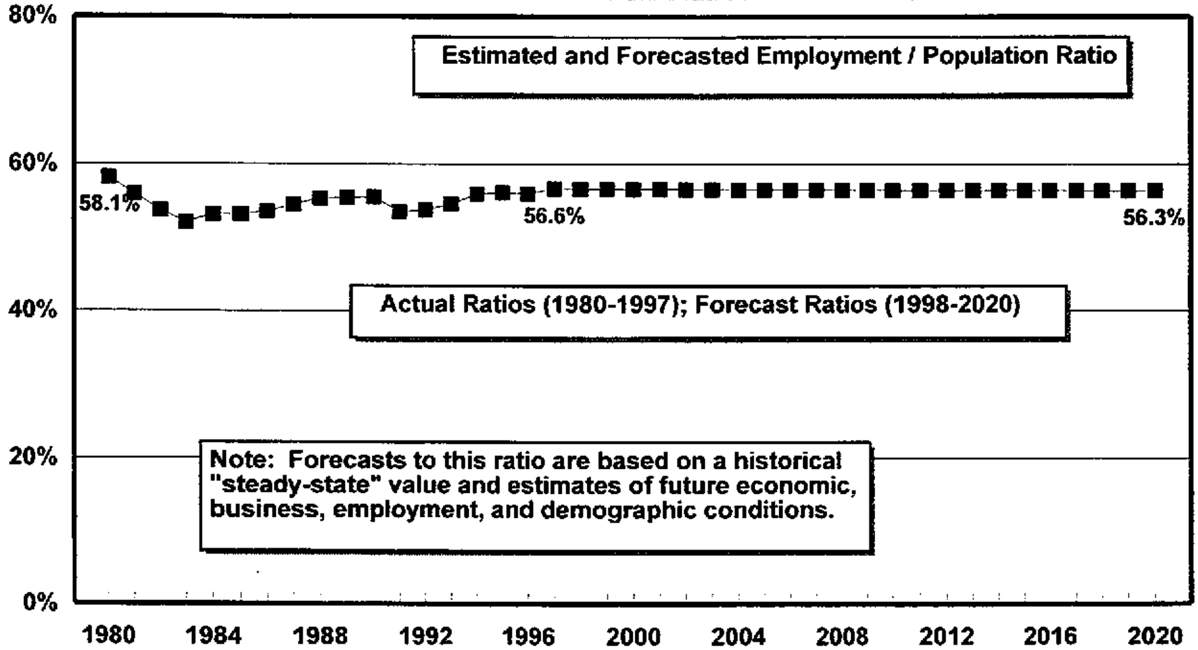
[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

Nevada Socioeconomic Analysis and Forecasts

Washoe County Employment-to-Population Ratios

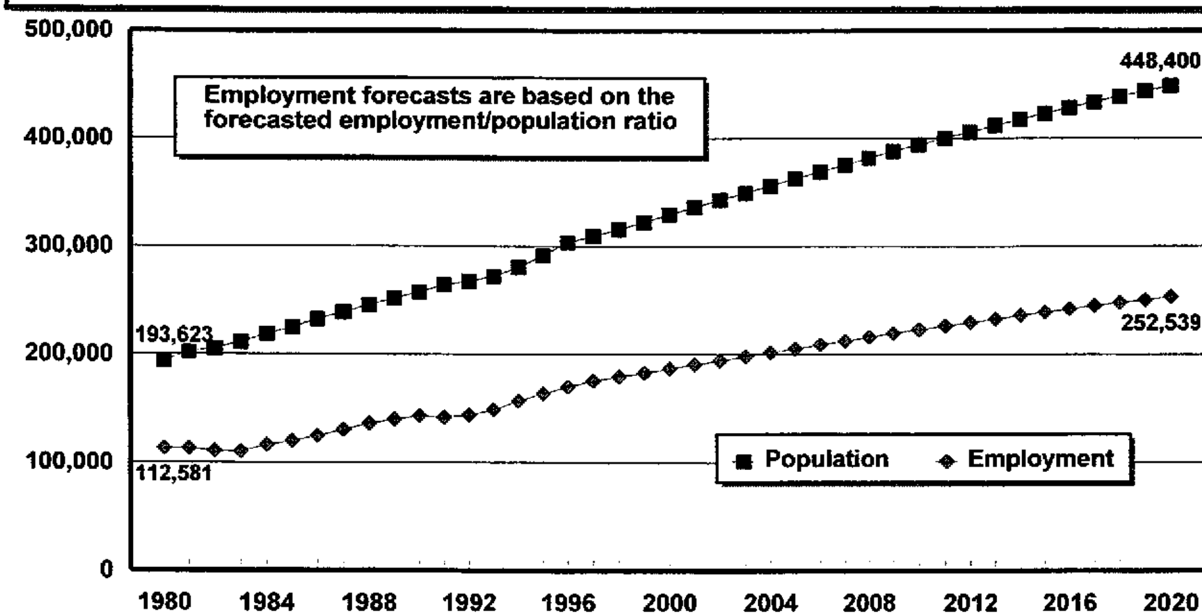
Ratio of Total Covered Employment to Total Population (Percent)



Source Data: Nevada State Demographer; DETR.

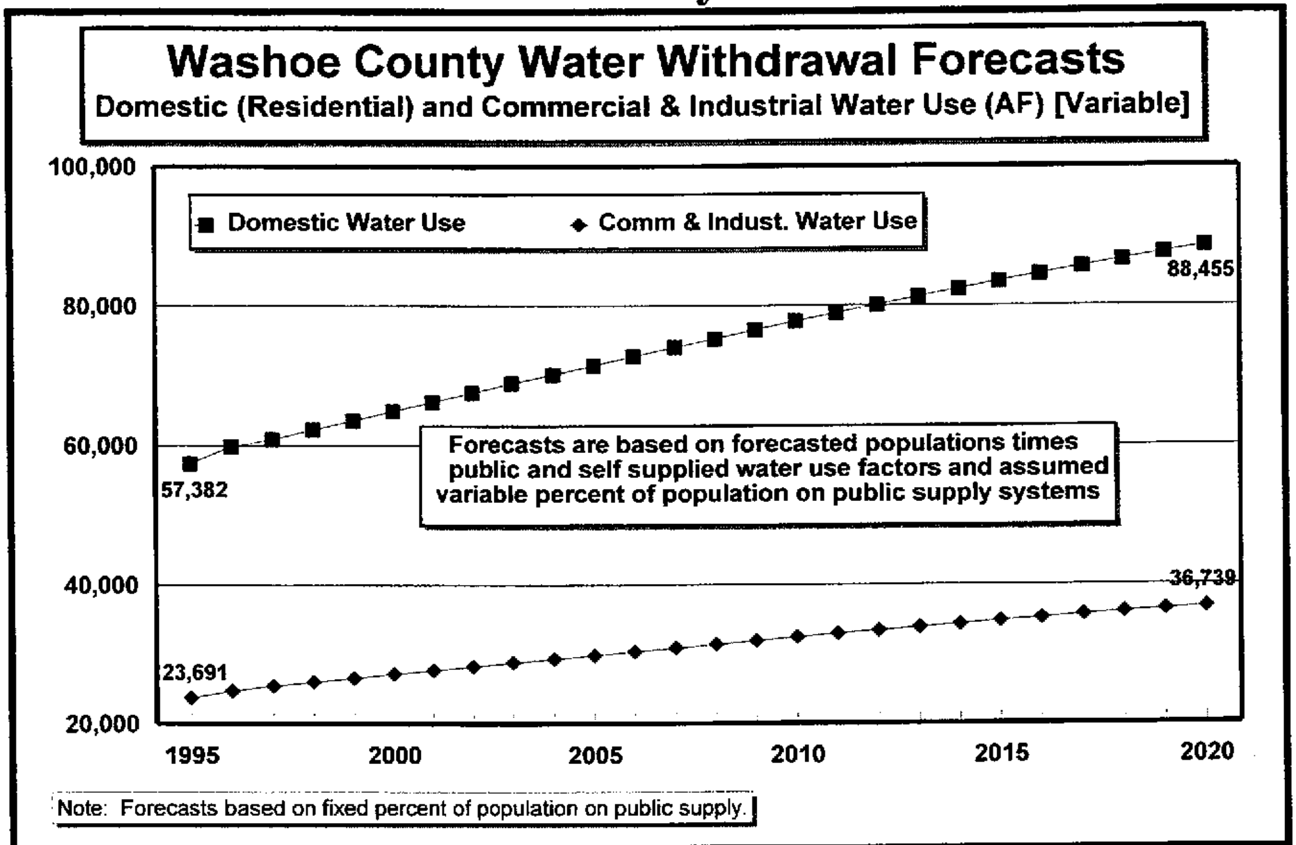
Washoe County Population & Employment Forecasts

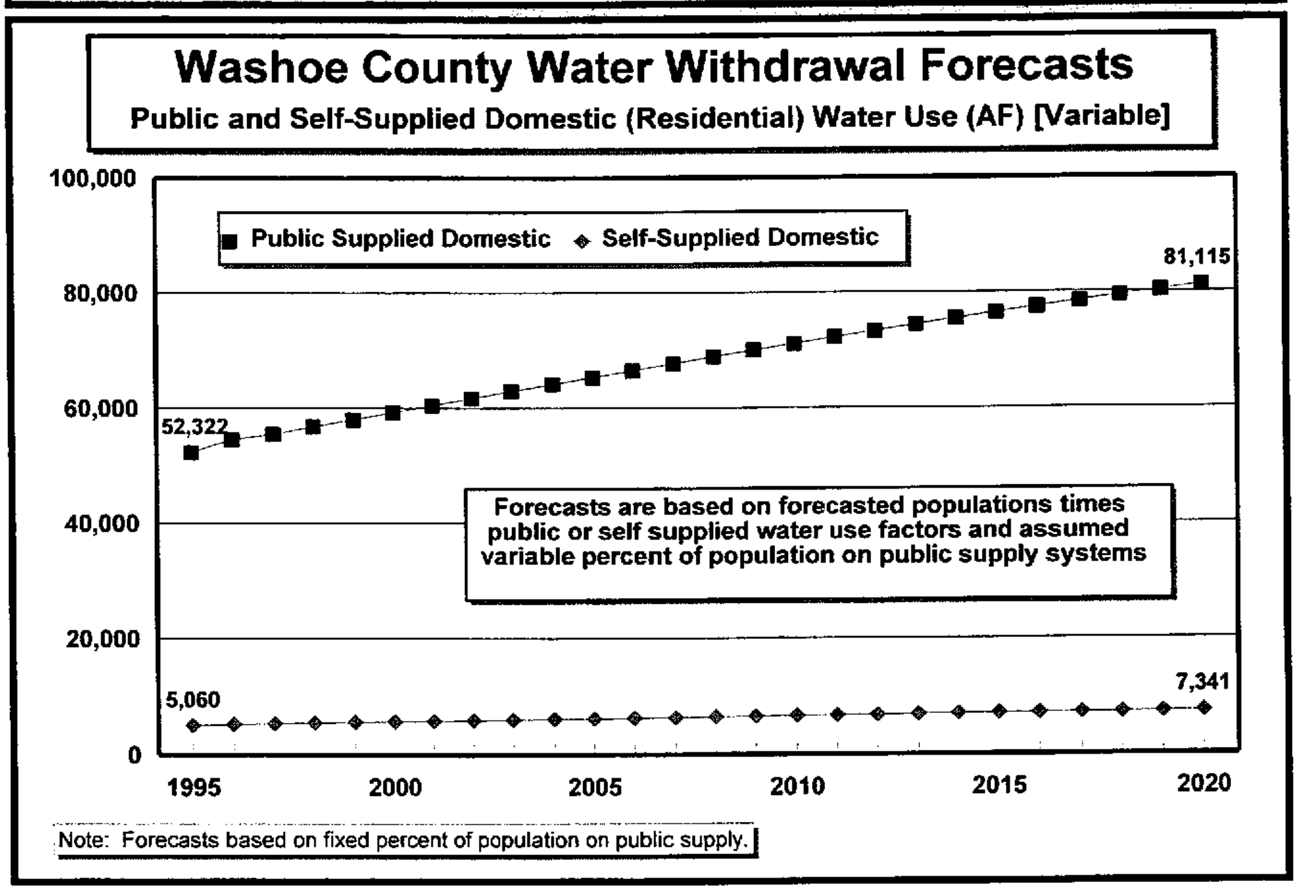
Total Population (Persons) and Total Covered Employment (Workers)



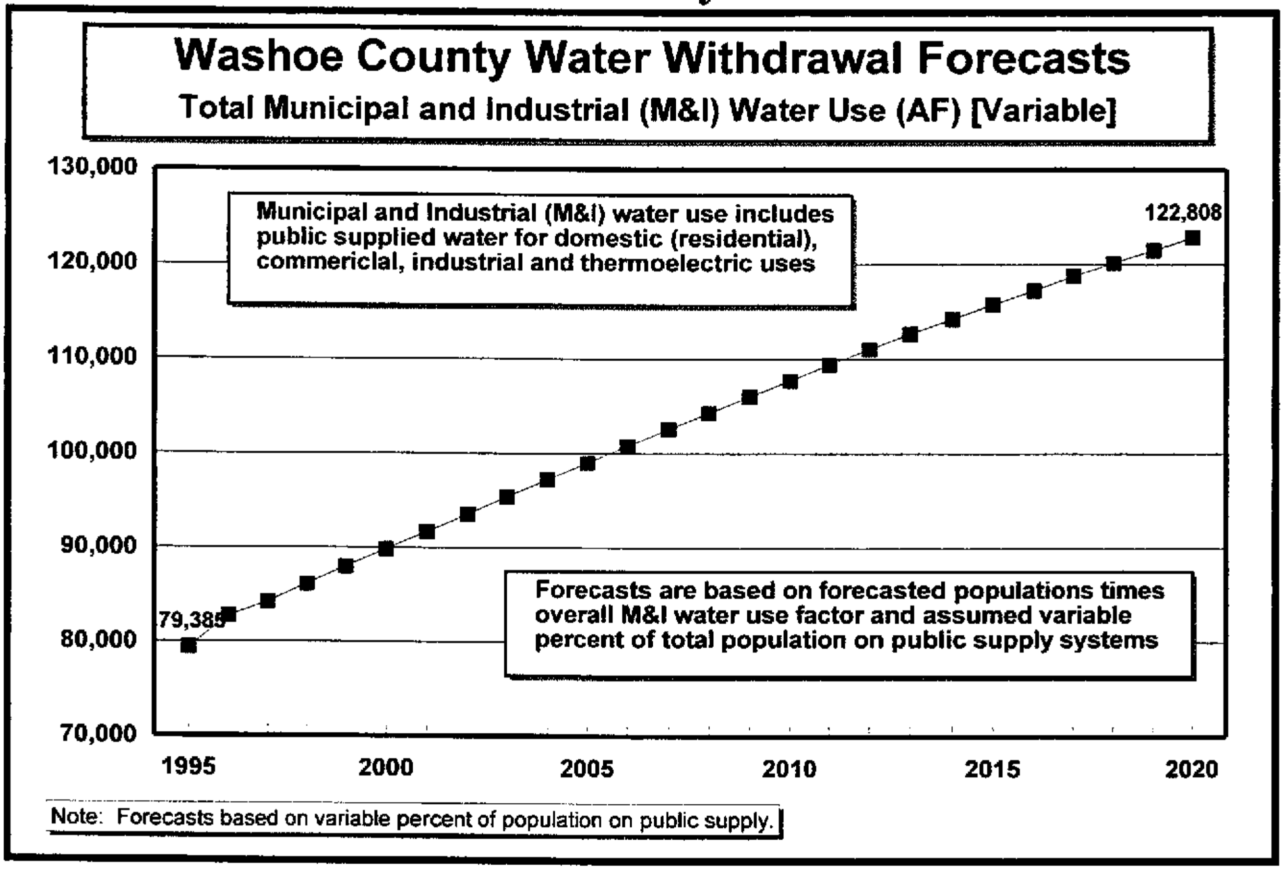
Source Data: Nevada State Demographer; DETR.

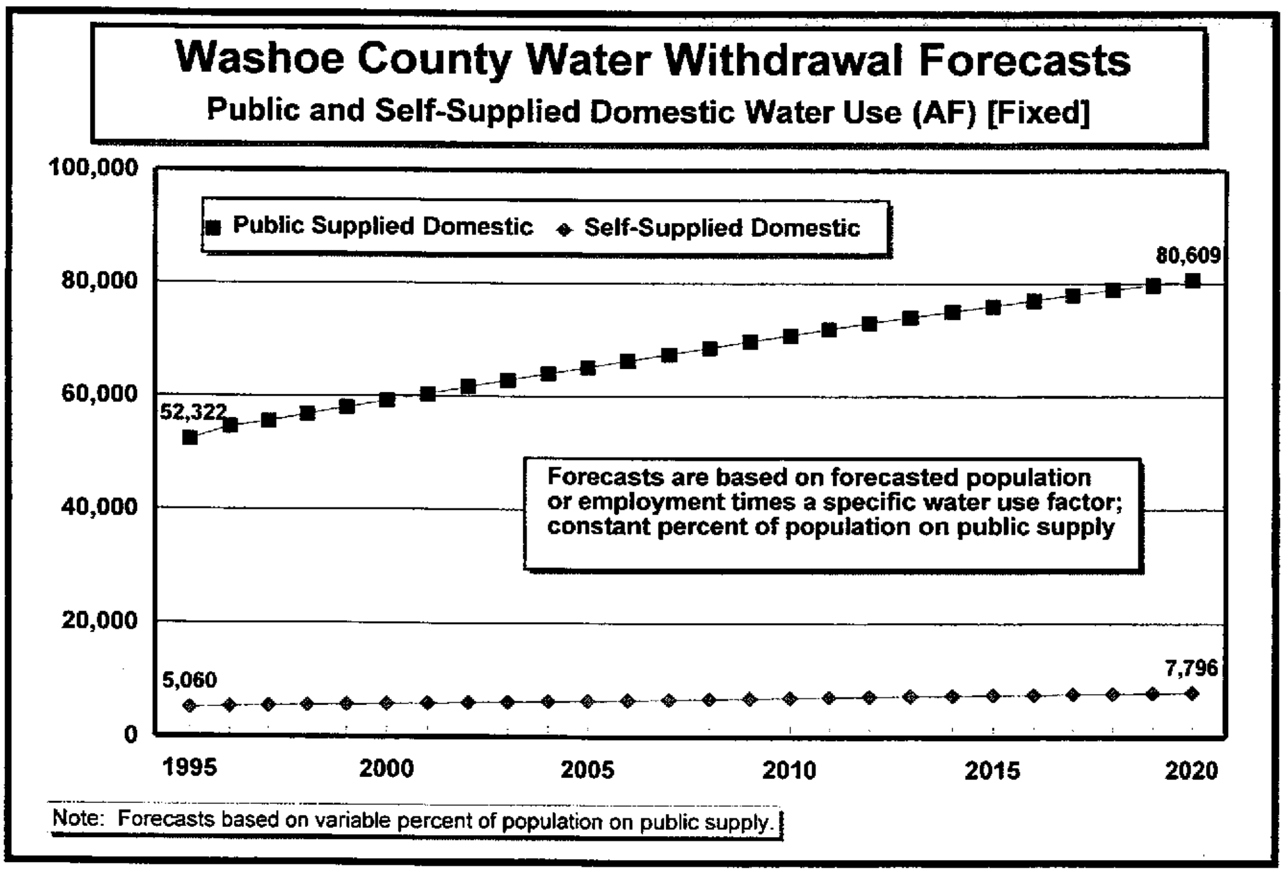
Nevada Water Use Analysis and Forecasts-1





Nevada Water Use Analysis and Forecasts-2





White Pine County Water Withdrawal Forecasts

Part 1-Domestic, Commercial & Industrial, M&I Water Use Estimates/Forecasts (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Estimated and Forecasted Resident Population	Estimated and Forecasted Total Covered Employment	Employment/ Population Ratio	Estimated and Forecasted Mining Employment	Share of Total Covered Employment	Forecasted Total Domestic (Residential) Water Use[1]	Forecasted Total Commercial and Industrial Water Use[2]	Forecasted Municipal & Industrial (M&I) Water Use [1] [3]
1980	8,167	3,120	38.21%	339	10.86%	2,744	190	2,968
1981	8,030	3,494	43.51%	541	15.48%	2,698	201	2,918
1982	7,870	2,895	36.78%	359	12.40%	2,644	173	2,860
1983	7,790	2,718	34.88%	416	15.31%	2,618	157	2,831
1984	7,710	2,750	35.67%	477	17.33%	2,591	155	2,802
1985	7,710	2,712	35.18%	412	15.20%	2,591	157	2,802
1986	7,890	2,816	35.69%	513	18.23%	2,651	157	2,868
1987	8,000	2,878	35.98%	463	16.07%	2,688	165	2,908
1988	8,390	3,191	38.04%	656	20.56%	2,819	173	3,049
1989	8,650	3,718	42.99%	982	26.42%	2,906	187	3,144
1990	9,410	3,919	41.65%	886	22.59%	3,162	207	3,420
1991	9,480	3,517	37.10%	519	14.77%	3,185	204	3,445
1992	9,570	3,277	34.25%	408	12.45%	3,216	196	3,478
1993	9,540	3,148	33.00%	339	10.78%	3,206	191	3,467
1994	9,270	3,433	37.03%	418	12.17%	3,115	206	3,369
1995	9,770	4,230	43.30%	615	14.53%	3,283	246	3,551
1996	10,400	4,077	39.20%	902	22.12%	3,495	216	3,780
1997	10,640	3,938	37.01%	767	19.48%	3,575	216	3,867
1998	10,766	3,982	36.98%	772	19.38%	3,618	219	3,913
1999	10,889	4,024	36.96%	776	19.28%	3,659	221	3,957
2000	11,007	4,065	36.93%	779	19.18%	3,698	224	4,000
2001	11,120	4,103	36.90%	783	19.08%	3,737	226	4,042
2002	11,229	4,141	36.87%	786	18.98%	3,773	229	4,081
2003	11,334	4,176	36.85%	788	18.88%	3,808	231	4,119
2004	11,433	4,209	36.82%	790	18.78%	3,842	233	4,155
2005	11,527	4,241	36.79%	792	18.68%	3,873	235	4,189
2006	11,616	4,270	36.76%	793	18.58%	3,903	237	4,222
2007	11,700	4,298	36.73%	794	18.48%	3,931	239	4,252
2008	11,778	4,323	36.71%	794	18.38%	3,957	241	4,281
2009	11,850	4,347	36.68%	794	18.28%	3,982	242	4,307
2010	11,917	4,368	36.65%	794	18.18%	4,004	244	4,331
2011	11,978	4,387	36.62%	793	18.08%	4,025	245	4,353
2012	12,033	4,404	36.60%	795	18.05%	4,043	246	4,373
2013	12,082	4,418	36.57%	796	18.02%	4,060	247	4,391
2014	12,125	4,431	36.54%	797	17.99%	4,074	248	4,407
2015	12,162	4,441	36.51%	798	17.97%	4,087	248	4,420
2016	12,193	4,449	36.49%	798	17.94%	4,097	249	4,431
2017	12,217	4,454	36.46%	798	17.92%	4,105	249	4,440
2018	12,235	4,458	36.43%	798	17.89%	4,111	250	4,447
2019	12,247	4,459	36.41%	797	17.87%	4,115	250	4,451
2020	12,253	4,457	36.38%	795	17.84%	4,117	250	4,453

Actual Period Average (1980-1997)......	37.75%	3.10%	Standard Deviation (1980-1997)
Forecast Period Average (1998-2020)....	36.68%	39.13%	Latest/Most Stable Period (1994-1997)
Assumptions:	M&I Factor	Domestic only	
M&I / Total Domestic Water Use per Person......................	352.4	300.0	Gallons per person per day
[M&I/Total Domestic Water Use Coefficients]	0.3948	0.3360	Acre-feet per person per year
Commercial & Industrial Water Use per Worker..............	60.9		Gallons per worker per day (excludes mining)
[Commercial & Industrial Water Use Coefficient]	0.0682		Acre-feet per worker per year (excludes mining)

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

[1] Estimated water use is based on constant percent of total resident population being on public supplied water systems. See Part 2 of this table

[2] Excludes mining employment and mining water use.

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

White Pine County Water Withdrawal Forecasts

Part 2-Estimated M& I and Public & Self-Supplied Domestic Water Use (Acre-Feet)

Years: Actuals 1980-1997; Forecasts 1998-2018	Forecasted Population on Public Water Systems [1]	Forecasted Public Supplied Domestic Water Use [1]	Forecasted Self Supplied Domestic Water Use [1]	Forecasted Population on Public Water Systems [2]	Variable Percent of Population on Public Supply	Forecasted Public Supplied Domestic Water Use [2]	Forecasted Self Supplied Domestic Water Use [2]	Forecasted Municipal & Industrial (M&I) Water Use [2] [3]
1980	7,519	2,547	197	--	--	--	--	--
1981	7,393	2,504	194	--	--	--	--	--
1982	7,246	2,454	190	--	--	--	--	--
1983	7,172	2,429	188	--	--	--	--	--
1984	7,098	2,404	186	--	--	--	--	--
1985	7,098	2,404	186	--	--	--	--	--
1986	7,264	2,461	191	--	--	--	--	--
1987	7,365	2,495	193	--	--	--	--	--
1988	7,724	2,616	203	--	--	--	--	--
1989	7,964	2,698	209	--	--	--	--	--
1990	8,664	2,935	227	--	--	--	--	--
1991	8,728	2,956	229	--	--	--	--	--
1992	8,811	2,984	231	--	--	--	--	--
1993	8,783	2,975	230	--	--	--	--	--
1994	8,535	2,891	224	--	--	--	--	--
1995	8,995	3,047	236	8,995	92.07%	3,047	236	3,551
1996	9,575	3,243	251	9,577	92.09%	3,244	250	3,781
1997	9,796	3,318	257	9,801	92.11%	3,320	256	3,869
1998	9,912	3,358	260	9,920	92.14%	3,360	258	3,916
1999	10,025	3,396	263	10,035	92.16%	3,399	260	3,961
2000	10,134	3,433	266	10,146	92.18%	3,437	262	4,005
2001	10,238	3,468	269	10,254	92.21%	3,473	264	4,047
2002	10,339	3,502	271	10,357	92.23%	3,508	266	4,087
2003	10,434	3,534	274	10,455	92.25%	3,541	267	4,126
2004	10,526	3,565	276	10,550	92.27%	3,573	269	4,163
2005	10,613	3,595	278	10,639	92.30%	3,604	270	4,198
2006	10,695	3,622	281	10,724	92.32%	3,632	272	4,232
2007	10,772	3,649	283	10,804	92.34%	3,660	273	4,263
2008	10,844	3,673	284	10,879	92.37%	3,685	274	4,293
2009	10,910	3,696	286	10,949	92.39%	3,709	275	4,320
2010	10,972	3,716	288	11,013	92.41%	3,730	275	4,345
2011	11,028	3,735	289	11,072	92.44%	3,750	276	4,368
2012	11,079	3,753	291	11,126	92.46%	3,769	276	4,389
2013	11,124	3,768	292	11,174	92.48%	3,785	277	4,408
2014	11,164	3,781	293	11,217	92.51%	3,799	277	4,425
2015	11,197	3,793	294	11,254	92.53%	3,812	277	4,439
2016	11,226	3,802	295	11,285	92.55%	3,822	277	4,451
2017	11,248	3,810	295	11,310	92.58%	3,831	276	4,461
2018	11,265	3,816	296	11,330	92.60%	3,838	276	4,469
2019	11,276	3,819	296	11,343	92.62%	3,842	275	4,474
2020	11,281	3,821	296	11,351	92.64%	3,845	274	4,477

Assumptions:	M&I Factor	Domestic only	
M&I / Domestic Use/Person (Public Supplied)........................	**352.4**	**302.4**	Gallons per person per day--public supply
[Public Supplied Water Water Use Coefficients]	0.3948	0.3387	Acre-feet per person per year
Domestic Water Use per Person - Self-Supplied Water.......	**271.9**	Gallons per person per day--self supply	
[Self-Supplied Water Use Coefficient]	0.3045	Acre-feet per person per year	
1995 Estimated Resident Population on Public Supply........	**92.07%**	Percent of total resident population	

Note: One acre-foot (AF) is equivalent to approximately 325,851 gallons.

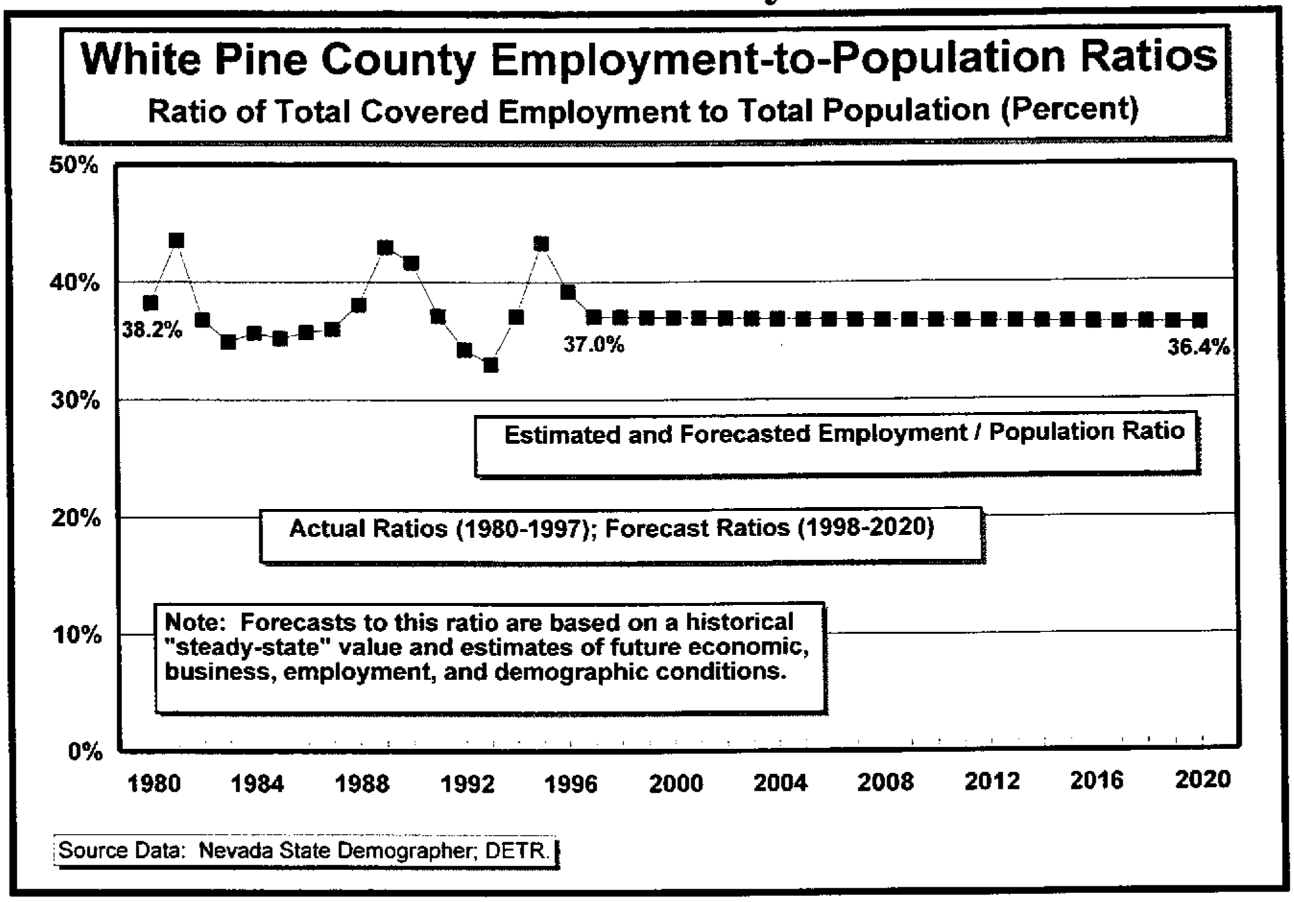
[1] Estimates/forecasts are based on constant percent of total resident population being on public supplied water systems.

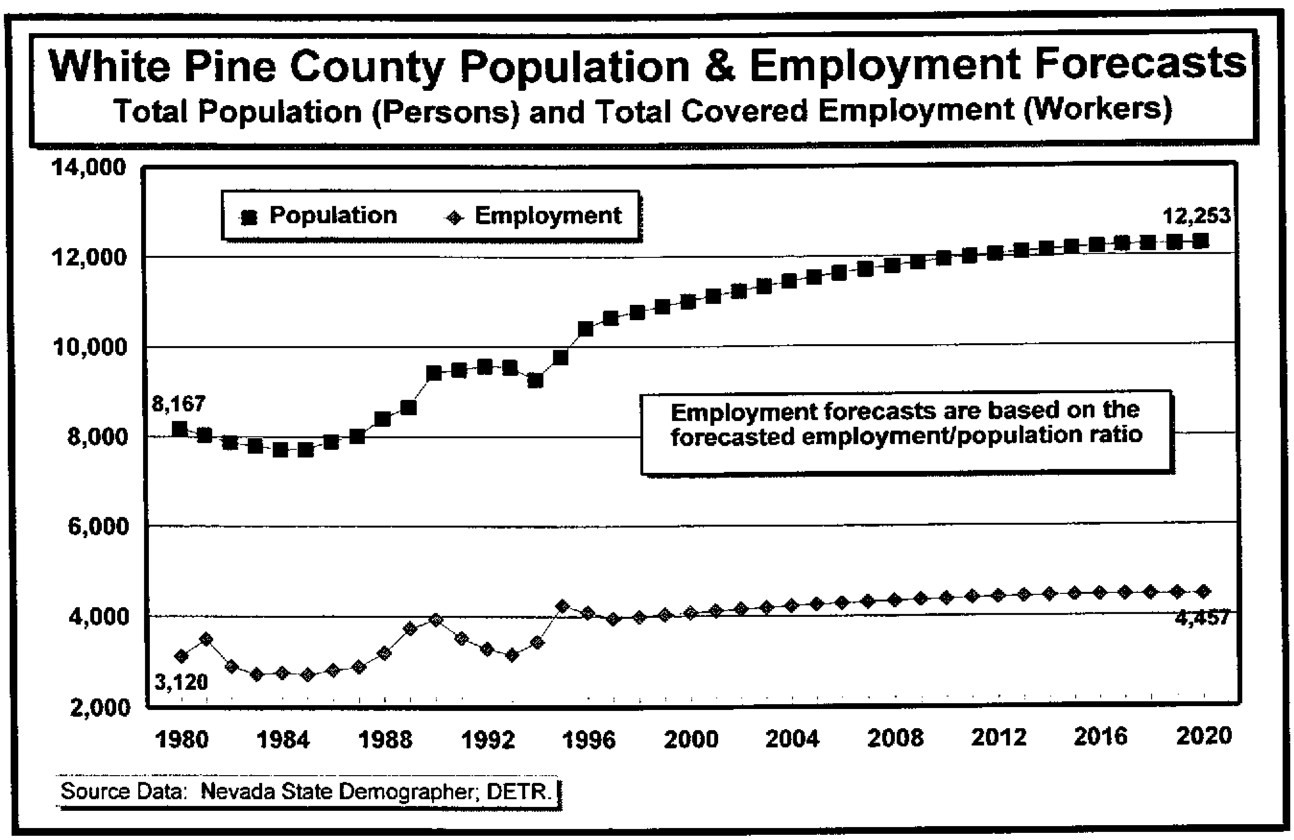
[2] Estimates/forecasts are based on a variable percent of total resident population on public supplied water systems for the years 1996 through 2

[3] M&I water use includes public supplied water for domestic (residential), commercial, industrial and thermoelectric uses.

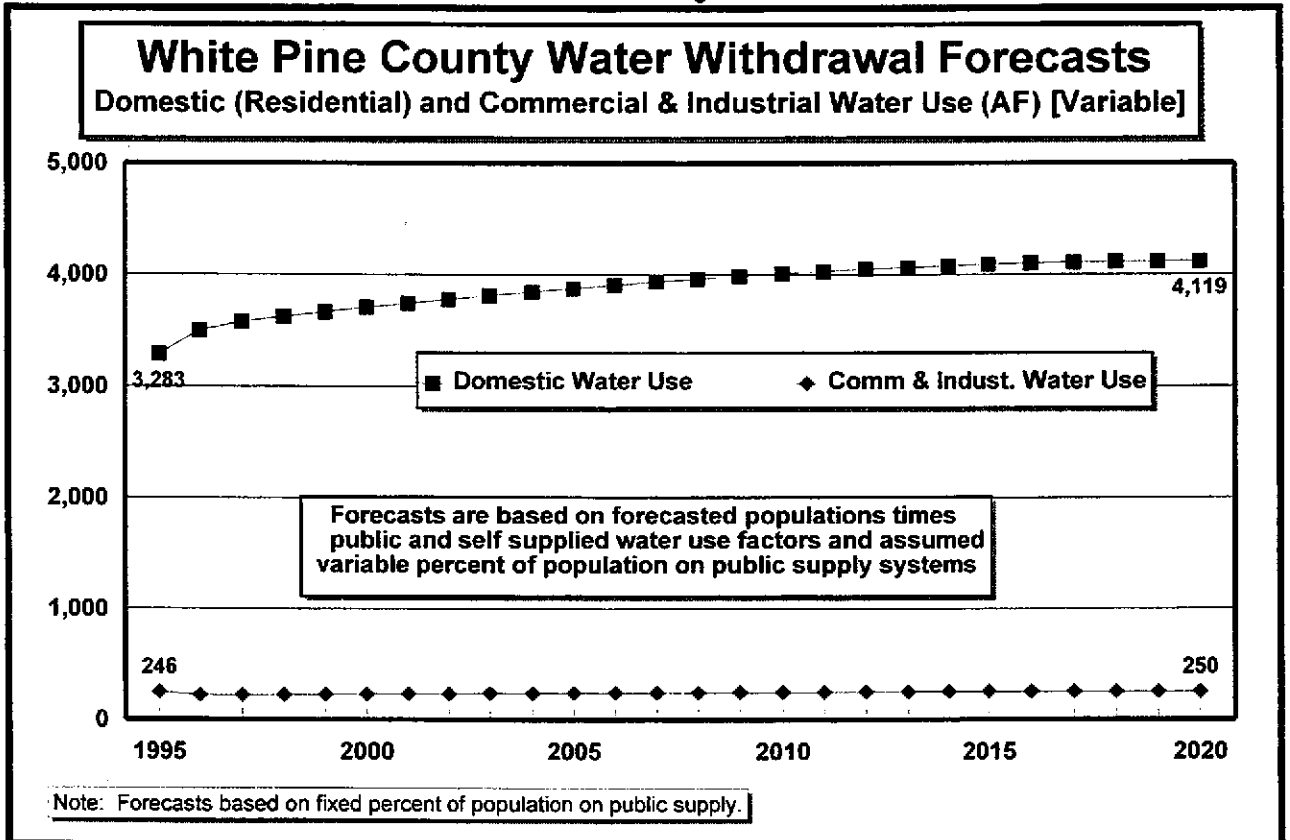
Sources: Population estimates--State Demographer; Population forecasts--NDWP; Employment--DETR; Employment forecasts--NDWP.

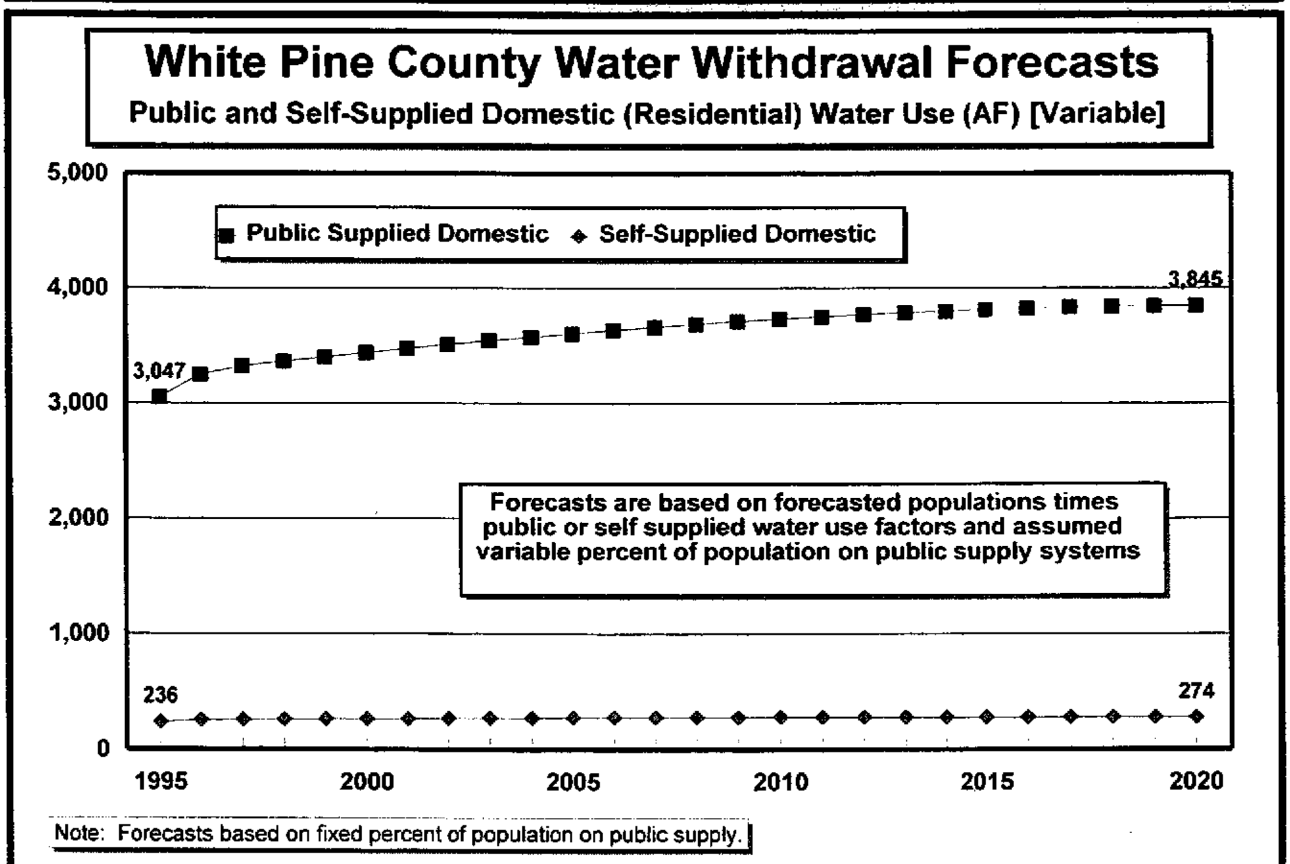
Nevada Socioeconomic Analysis and Forecasts



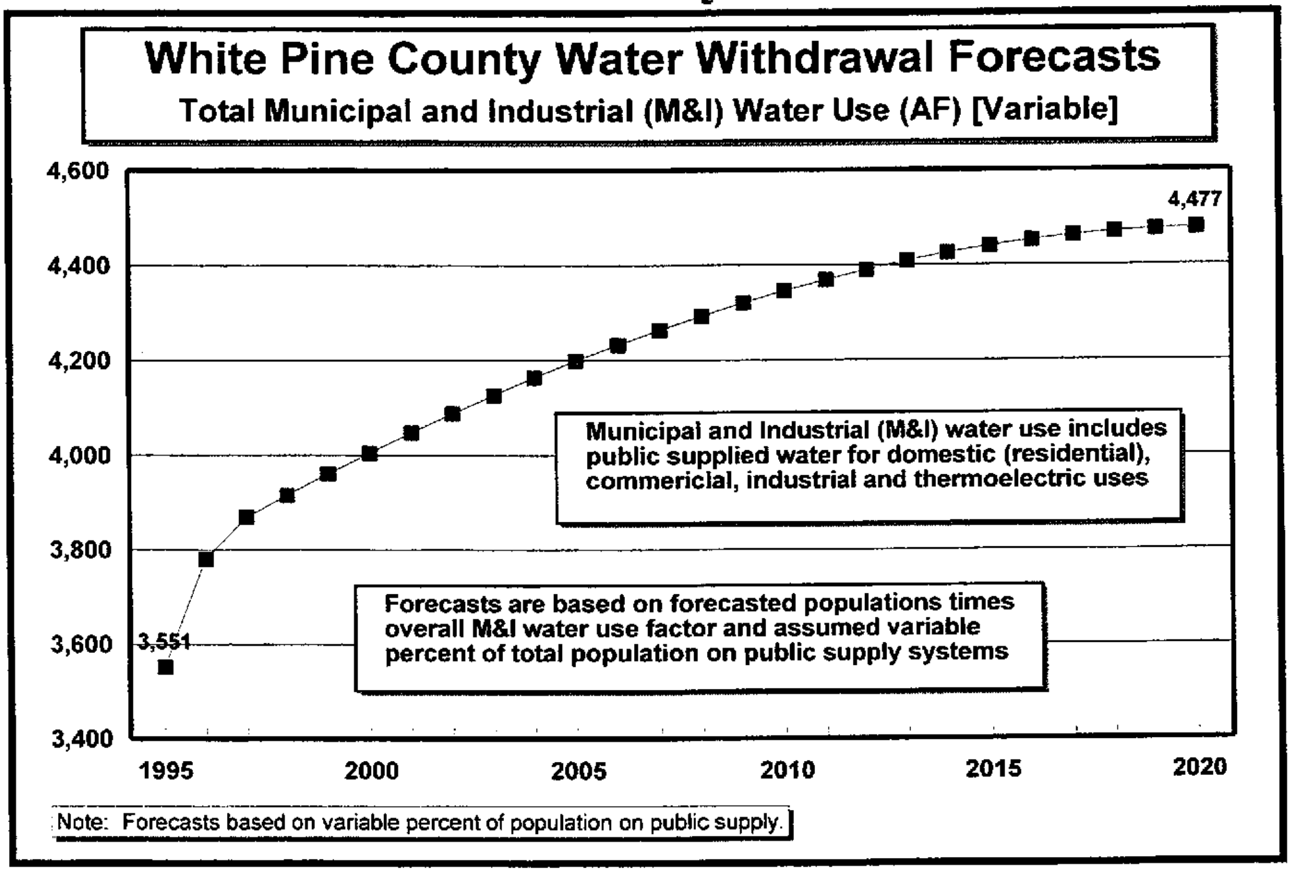


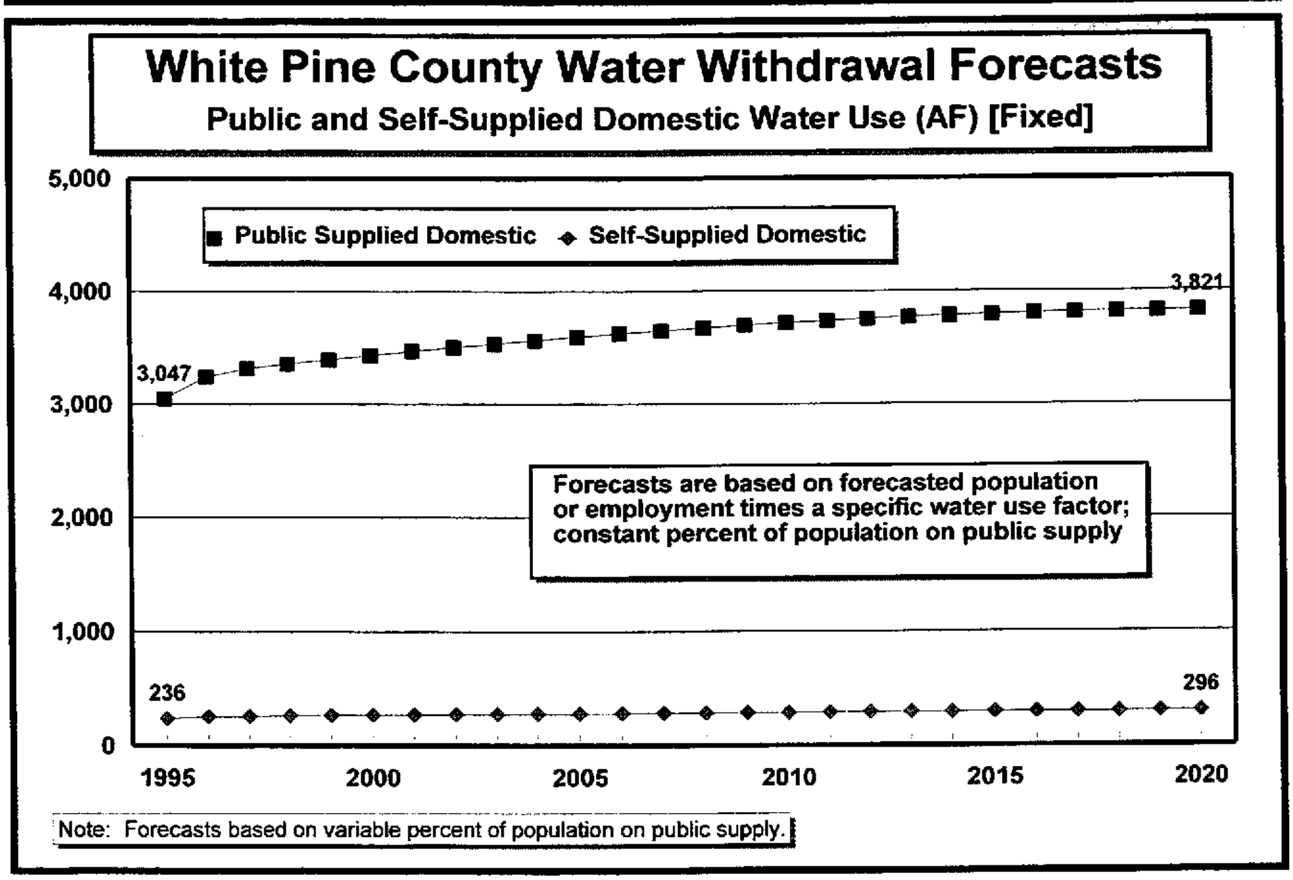
Nevada Water Use Analysis and Forecasts-1





Nevada Water Use Analysis and Forecasts-2





Nevada State Water Plan

Appendix 4 – Forecasts of Nevada and County Irrigated Acreage

Nevada Agricultural Summary

Irrigated Acreage, Farm Marketings and Farm-Related Employment

State/County	1974	1978	1982	1987	1990	1995
NEVADA						
Irrigated Acres	777,510	881,151	829,761	766,968	728,350	715,439
Farm Marketings ($000s)	$145,458	$204,047	$250,610	$271,904	$326,888	$301,630
Total Agricultural-Related Employment	5,895	7,728	7,863	10,033	11,487	13,142
Farm Workers	4,570	5,639	5,140	5,628	5,260	3,962
Agricultural-Services Workers	1,325	2,089	2,723	4,405	6,227	9,180
Carson City						
Irrigated Acres	1,727	2,667	2,720	1,632	600	2,431
Farm Marketings ($000s)	$286	$409	$608	$978	$918	$681
Total Agricultural-Related Employment	62	117	123	213	217	215
Farm Workers	17	39	45	47	40	29
Agricultural-Services Workers	45	78	78	166	177	186
Churchill County						
Irrigated Acres	52,472	56,484	55,777	62,539	61,400	56,094
Farm Marketings ($000s)	$30,927	$24,630	$36,282	$35,979	$38,348	$34,165
Total Agricultural-Related Employment	617	775	814	890	829	782
Farm Workers	617	775	732	727	678	572
Agricultural-Services Workers	0	0	82	163	151	210
Clark County						
Irrigated Acres	11,290	10,116	6,062	7,594	7,050	7,755
Farm Marketings ($000s)	$8,921	$13,056	$14,605	$16,529	$18,618	$20,133
Total Agricultural-Related Employment	941	1,441	1,799	2,684	4,315	6,298
Farm Workers	284	409	413	445	406	302
Agricultural-Services Workers	657	1,032	1,386	2,239	3,909	5,996
Douglas County						
Irrigated Acres	45,264	46,881	39,562	41,285	41,400	38,640
Farm Marketings ($000s)	$7,856	$9,953	$10,290	$10,242	$11,324	$10,788
Total Agricultural-Related Employment	327	304	350	461	485	508
Farm Workers	302	280	283	323	286	211
Agricultural-Services Workers	25	24	67	138	199	297
Elko County						
Irrigated Acres	234,838	224,624	256,932	235,188	210,150	213,903
Farm Marketings ($000s)	$24,438	$32,730	$40,456	$45,362	$53,071	$40,635
Total Agricultural-Related Employment	859	1,005	922	1,167	1,079	830
Farm Workers	828	940	858	1,034	943	638
Agricultural-Services Workers	31	65	64	133	136	192
Esmeralda County						
Irrigated Acres	7,658	8,881	12,116	9,273	7,900	11,286
Farm Marketings ($000s)	$1,301	$2,309	$4,090	$4,329	$6,163	$6,824
Total Agricultural-Related Employment	65	87	63	84	68	48
Farm Workers	65	87	63	74	68	48
Agricultural-Services Workers	0	0	0	10	0	0
Eureka County						
Irrigated Acres	31,247	49,806	33,372	28,606	44,700	32,780
Farm Marketings ($000s)	$3,753	$7,210	$9,514	$8,996	$11,254	$10,229
Total Agricultural-Related Employment	134	223	171	157	139	138
Farm Workers	134	223	171	157	139	105
Agricultural-Services Workers	0	0	0	0	0	33

Nevada Agricultural Summary

Irrigated Acreage, Farm Marketings and Farm-Related Employment

State/County	1974	1978	1982	1987	1990	1995
Humboldt County						
Irrigated Acres	143,800	151,906	158,718	100,972	134,750	142,558
Farm Marketings ($000s)	$17,723	$35,389	$37,910	$38,371	$55,565	$50,959
Total Agricultural-Related Employment	593	691	660	746	711	623
Farm Workers	566	619	537	593	539	368
Agricultural-Services Workers	27	72	123	153	172	255
Lander County						
Irrigated Acres	31,994	48,474	28,820	35,663	31,200	36,192
Farm Marketings ($000s)	$4,518	$6,170	$6,113	$8,257	$9,563	$7,195
Total Agricultural-Related Employment	165	179	129	129	133	113
Farm Workers	165	163	129	129	133	108
Agricultural-Services Workers	0	16	0	0	0	5
Lincoln County						
Irrigated Acres	18,879	12,844	11,892	14,322	15,600	15,629
Farm Marketings ($000s)	$2,517	$3,718	$4,265	$3,537	$7,096	$8,526
Total Agricultural-Related Employment	149	164	159	178	178	154
Farm Workers	149	164	159	178	178	149
Agricultural-Services Workers	0	0	0	0	0	5
Lyon County						
Irrigated Acres	76,883	91,349	79,093	93,218	63,600	60,975
Farm Marketings ($000s)	$16,030	$22,283	$31,876	$51,120	$50,832	$48,190
Total Agricultural-Related Employment	587	716	643	827	789	719
Farm Workers	553	664	573	685	643	482
Agricultural-Services Workers	34	52	70	142	146	237
Mineral County						
Irrigated Acres	5,442	3,633	5,193	0	5,800	2,900
Farm Marketings ($000s)	$358	$506	$1,027	$1,039	$2,228	$2,518
Total Agricultural-Related Employment	24	40	38	50	51	40
Farm Workers	24	40	38	38	41	35
Agricultural-Services Workers	0	0	0	12	10	5
Nye County						
Irrigated Acres	27,860	33,397	30,240	29,331	12,200	14,742
Farm Marketings ($000s)	$3,437	$6,314	$6,256	$6,094	$11,342	$13,208
Total Agricultural-Related Employment	190	270	236	317	338	299
Farm Workers	171	238	209	262	268	209
Agricultural-Services Workers	19	32	27	55	70	90
Pershing County						
Irrigated Acres	35,681	40,286	38,837	42,796	31,100	27,368
Farm Marketings ($000s)	$14,975	$25,706	$29,124	$19,303	$27,871	$25,584
Total Agricultural-Related Employment	243	329	258	230	258	194
Farm Workers	243	329	217	230	231	176
Agricultural-Services Workers	0	0	41	0	27	18
Storey County						
Irrigated Acres	115	90	41	0	0	300
Farm Marketings ($000s)	$0	$0	$0	$0	$0	$0
Total Agricultural-Related Employment	0	0	0	0	0	0
Farm Workers	0	0	0	0	0	0
Agricultural-Services Workers	0	0	0	0	0	0

Nevada Agricultural Summary

Irrigated Acreage, Farm Marketings and Farm-Related Employment

State/County	1974	1978	1982	1987	1990	1995
Washoe County						
Irrigated Acres	27,994	61,750	28,028	32,131	34,600	27,048
Farm Marketings ($000s)	$4,293	$7,026	$9,595	$12,382	$13,887	$13,877
Total Agricultural-Related Employment	601	1,004	1,229	1,532	1,569	1,969
Farm Workers	251	430	494	478	450	367
Agricultural-Services Workers	350	574	735	1,054	1,119	1,602
White Pine County						
Irrigated Acres	24,366	37,963	42,358	32,418	26,300	24,839
Farm Marketings ($000s)	$4,125	$6,638	$8,599	$9,386	$8,808	$8,118
Total Agricultural-Related Employment	201	250	232	266	249	210
Farm Workers	201	239	219	228	217	163
Agricultural-Services Workers	0	11	13	38	32	47

Notes: Irrigated acreage figures for 1974, 1978, 1982 and 1987 are from the Bureau of the Census. Agriculture Division; irrigated acreage figures for 1990 are estimates from the U.S. Geological Survey (USGS); irrigated acreage for 1995 are based on estimates by the Nevada Division of Water Planning (NDWP). Ag. Services Workers includes agricultural service workers as well as forestry and fishery workers.

Nevada Forecasted Irrigation and Livestock Water Use

Irrigated Acreage, Water Duty, Irrigation Water Use, Livestock Water Use and Total Agricultural Water Use (Acres and Acre-Feet per Year)

State/County	1995	2000	2005	2010	2015	2020
Total Nevada						
Total Irrigated Acreage	715,439	727,500	715,563	700,742	683,247	665,753
Total Irrigation Water Use	3,113,585	3,160,754	3,109,348	3,045,636	2,970,521	2,895,406
Percent of Agricultural Withdrawals	99.80%	99.79%	99.79%	99.79%	99.79%	99.79%
Based on Irrigation Water Duty of	4.4	4.3	4.3	4.3	4.3	4.3
Total Livestock Water Use	6,329	6,624	6,524	6,402	6,259	6,116
Percent of Agricultural Withdrawals	0.20%	0.21%	0.21%	0.21%	0.21%	0.21%
As a Percent of Irrigation Use	0.203%	0.210%	0.210%	0.210%	0.211%	0.211%
Total Agricultural Water Use	3,119,914	3,167,378	3,115,872	3,052,038	2,976,780	2,901,522
Carson City						
Total Irrigated Acreage	2,431	1,651	1,605	1,553	1,494	1,436
Total Irrigation Water Use	10,710	7,271	7,071	6,840	6,583	6,326
Based on Irrigation Water Duty of	4.4					
Total Livestock Water Use	11	8	7	7	7	7
As a Percent of Irrigation Use	0.105%					
Total Agricultural Water Use	10,721	7,279	7,078	6,847	6,590	6,333
Churchill County						
Total Irrigated Acreage	56,094	54,523	54,130	53,685	53,191	52,696
Total Irrigation Water Use	256,553	249,370	247,571	245,537	243,275	241,012
Based on Irrigation Water Duty of	4.6					
Total Livestock Water Use	672	653	649	643	637	631
As a Percent of Irrigation Use	0.262%					
Total Agricultural Water Use	257,225	250,023	248,219	246,180	243,912	241,644
Clark County						
Total Irrigated Acreage	7,755	7,580	7,566	7,552	7,539	7,525
Total Irrigation Water Use	40,292	39,384	39,312	39,239	39,167	39,095
Based on Irrigation Water Duty of	5.2					
Total Livestock Water Use	280	274	273	273	272	272
As a Percent of Irrigation Use	0.695%					
Total Agricultural Water Use	40,572	39,658	39,585	39.512	39.439	39,366
Douglas County						
Total Irrigated Acreage	38,640	37,877	37,266	36.554	35.746	34,937
Total Irrigation Water Use	189,544	185,799	182,805	179.311	175.346	171,381
Based on Irrigation Water Duty of	4.9					
Total Livestock Water Use	258	253	248	244	238	233
As a Percent of Irrigation Use	0.136%					
Total Agricultural Water Use	189,802	186,052	183,054	179,555	175,585	171,614
Elko County						
Total Irrigated Acreage	213,903	214,007	211,077	207,396	203,001	198,606
Total Irrigation Water Use	908,645	909,087	896,641	881,004	862,335	843,667
Based on Irrigation Water Duty of	4.2					
Total Livestock Water Use	1,703	1,703	1,680	1,651	1,616	1,581
As a Percent of Irrigation Use	0.187%					
Total Agricultural Water Use	910,347	910,790	898,321	882,655	863,951	845,248

Nevada Forecasted Irrigation and Livestock Water Use

Irrigated Acreage, Water Duty, Irrigation Water Use, Livestock Water Use and Total Agricultural Water Use (Acres and Acre-Feet per Year)

State/County	1995	2000	2005	2010	2015	2020
Esmeralda County						
Total Irrigated Acreage	11,286	10,794	10,636	10,400	10,090	9,781
Total Irrigation Water Use	49,687	47,522	46,826	45,786	44,424	43,062
Based on Irrigation Water Duty of	4.4					
Total Livestock Water Use	123	118	116	114	110	107
As a Percent of Irrigation Use	0.248%					
Total Agricultural Water Use	49,810	47,640	46,942	45,899	44,534	43,169
Eureka County						
Total Irrigated Acreage	32,780	38,024	37,493	36,783	35,902	35,021
Total Irrigation Water Use	124,859	144,833	142,812	140,105	136,749	133,394
Based on Irrigation Water Duty of	3.8					
Total Livestock Water Use	157	182	179	176	172	168
As a Percent of Irrigation Use	0.126%					
Total Agricultural Water Use	125,016	145,015	142,991	140,281	136,921	133,561
Humboldt County						
Total Irrigated Acreage	142,558	144,936	141,487	136,988	131,536	126,084
Total Irrigation Water Use	599,845	609,851	595,337	576,406	553,466	530,525
Based on Irrigation Water Duty of	4.2					
Total Livestock Water Use	627	638	623	603	579	555
As a Percent of Irrigation Use	0.105%					
Total Agricultural Water Use	600,472	610,488	595,959	577,009	554,044	531,080
Lander County						
Total Irrigated Acreage	36,192	34,548	34,115	33,568	32,912	32,256
Total Irrigation Water Use	161,382	154,050	152,119	149,680	146,757	143,833
Based on Irrigation Water Duty of	4.5					
Total Livestock Water Use	336	321	317	312	306	300
As a Percent of Irrigation Use	0.208%					
Total Agricultural Water Use	161,718	154,370	152,436	149,992	147,063	144,133
Lincoln County						
Total Irrigated Acreage	15,629	15,477	15,412	15,308	15,167	15,026
Total Irrigation Water Use	65,537	64,899	64,626	64,192	63,601	63,010
Based on Irrigation Water Duty of	4.2					
Total Livestock Water Use	123	122	121	120	119	118
As a Percent of Irrigation Use	0.188%					
Total Agricultural Water Use	65,660	65,021	64,747	64,313	63,720	63,128
Lyon County						
Total Irrigated Acreage	60,975	61,317	60,643	59,884	59,045	58,207
Total Irrigation Water Use	306,926	308,649	305,252	301,435	297,213	292,991
Based on Irrigation Water Duty of	5.0					
Total Livestock Water Use	448	451	446	440	434	428
As a Percent of Irrigation Use	0.146%					
Total Agricultural Water Use	307,374	309,100	305,698	301,875	297,647	293,419

Nevada Forecasted Irrigation and Livestock Water Use

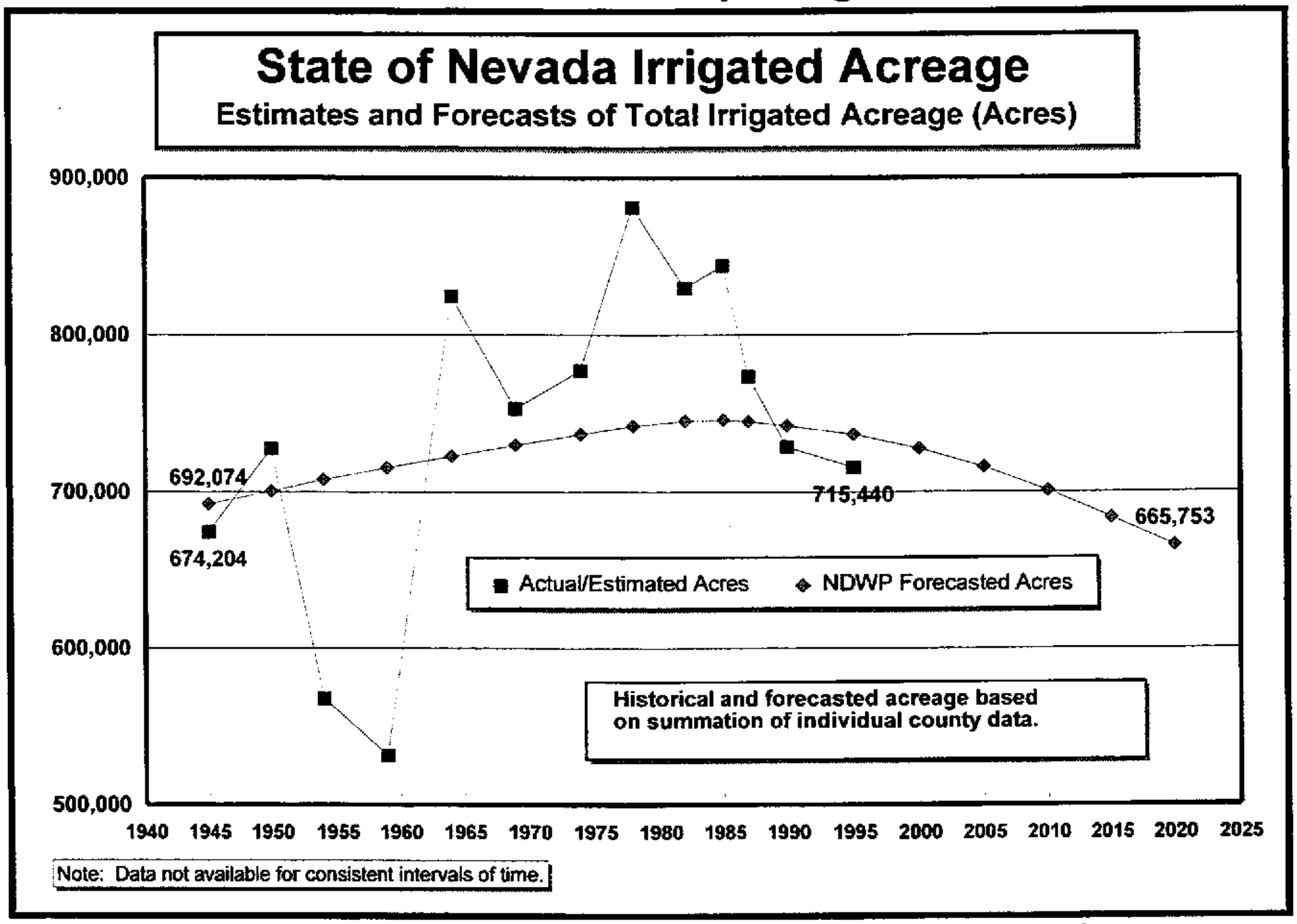
Irrigated Acreage, Water Duty, Irrigation Water Use, Livestock Water Use and Total Agricultural Water Use (Acres and Acre-Feet per Year)

State/County	1995	2000	2005	2010	2015	2020
Mineral County						
Total Irrigated Acreage	2,900	5,004	4,894	4,751	4,576	4,401
Total Irrigation Water Use	15,682	27,059	26,467	25,691	24,744	23,797
Based on Irrigation Water Duty of	5.4					
Total Livestock Water Use	34	58	57	55	53	51
As a Percent of Irrigation Use	0.214%					
Total Agricultural Water Use	15,716	27,117	26,524	25,746	24,797	23,848
Nye County						
Total Irrigated Acreage	14,742	20,060	19,775	19,446	19,073	18,701
Total Irrigation Water Use	60,233	81,962	80,801	79,454	77,931	76,409
Based on Irrigation Water Duty of	4.1					
Total Livestock Water Use	739	1,006	992	975	957	938
As a Percent of Irrigation Use	1.227%					
Total Agricultural Water Use	60,973	82,968	81,792	80,429	78,888	77,347
Pershing County						
Total Irrigated Acreage	27,368	29,079	28,441	27,688	26,831	25,974
Total Irrigation Water Use	116,962	124,275	121,546	118,330	114,667	111,004
Based on Irrigation Water Duty of	4.3					
Total Livestock Water Use	258	274	268	261	253	245
As a Percent of Irrigation Use	0.220%					
Total Agricultural Water Use	117,220	124,548	121,814	118,591	114,919	111,248
Storey County						
Total Irrigated Acreage	300	237	235	232	230	227
Total Irrigation Water Use	1,008	797	789	780	771	763
Based on Irrigation Water Duty of	3.4					
Total Livestock Water Use	0	0	0	0	0	0
As a Percent of Irrigation Use	0.000%					
Total Agricultural Water Use	1,008	797	789	780	771	763
Washoe County						
Total Irrigated Acreage	27,048	25,716	24,671	23,483	22,176	20,869
Total Irrigation Water Use	121,533	115,551	110,853	105,516	99,644	93,772
Based on Irrigation Water Duty of	4.5					
Total Livestock Water Use	291	277	266	253	239	225
As a Percent of Irrigation Use	0.240%					
Total Agricultural Water Use	121,824	115,828	111,119	105,769	99,882	93,996
White Pine County						
Total Irrigated Acreage	24,839	26,671	26,117	25,471	24,739	24,007
Total Irrigation Water Use	84,187	90,395	88,520	86,329	83,848	81,366
Based on Irrigation Water Duty of	3.4					
Total Livestock Water Use	269	289	283	276	268	260
As a Percent of Irrigation Use	0.319%					
Total Agricultural Water Use	84,456	90,684	88,803	86,605	84,115	81,626

Notes: 1995 irrigation figures based on U.S. Geological Survey (USGS) estimates, modified by the Nevada Division of Water Planning (NDWP). Forecasts through 2020 based on 1995 usage rates and relationships and NDWP forecasted irrigaged acreage amounts. Livestock water use as a percent of irrigation water use based on 1990 USGS studies.

Sources: Irrigated Acreage--USGS and NDWP; Irrigated Acreage forecasts--NDWP; Irrigation Water Duty--USGS; Livestock water use rate--USGS.

Nevada Forecasts of County Irrigated Acreage



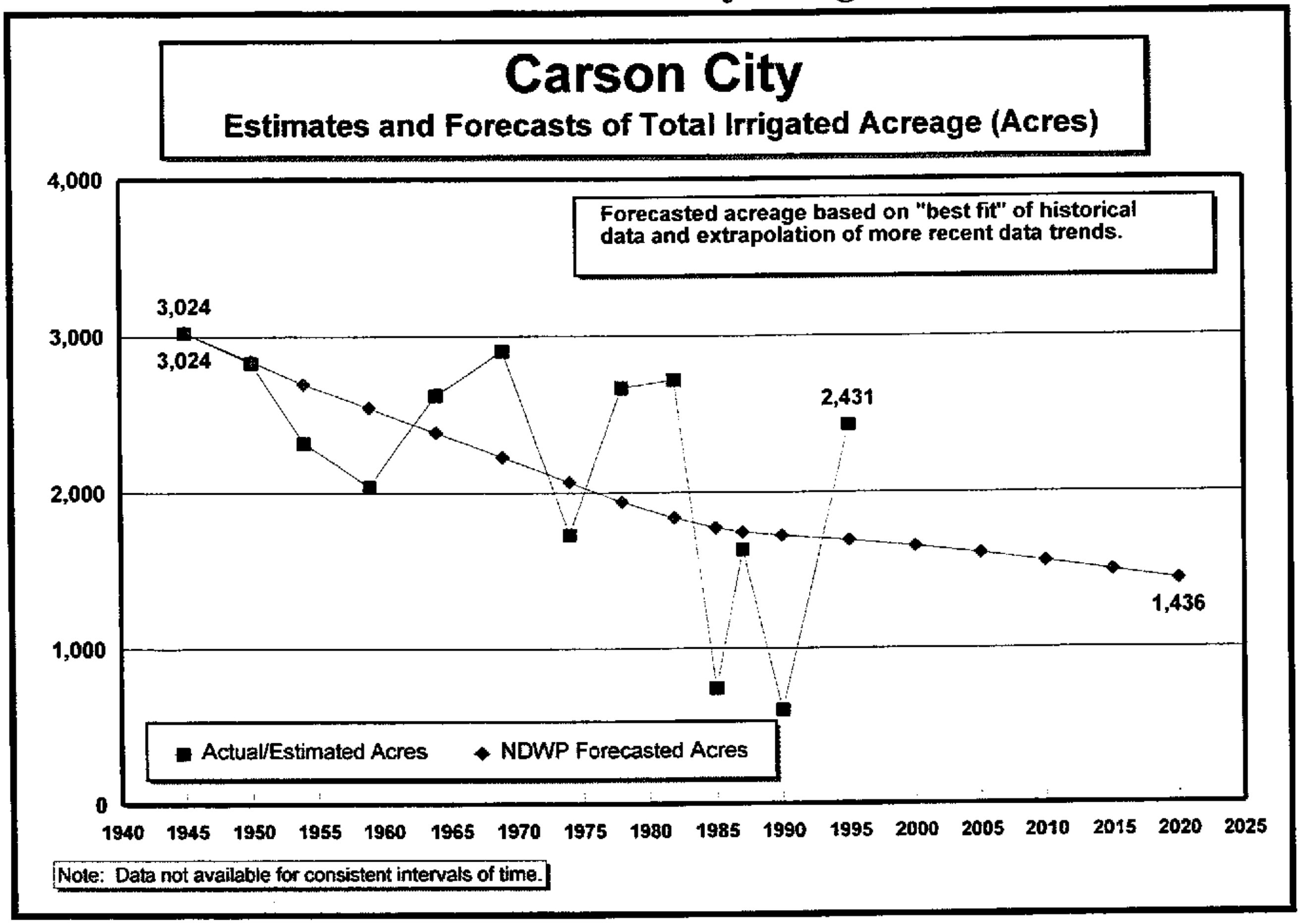
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

State of Nevada

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	674,204	692,074
1950	727,498	700,148
1954	567,498	707,659
1959	531,158	715,105
1964	824,520	722,456
1969	752,998	729,655
1974	777,510	736,621
1978	881,151	741,919
1982	829,761	745,001
1985	843,760	745,545
1987	773,588	744,601
1990	728,350	742,109
1995	715,440	736,388
2000		727,500
2005		715,563
2010		700,742
2015		683,247
2020		665,753

Nevada Forecasts of County Irrigated Acreage



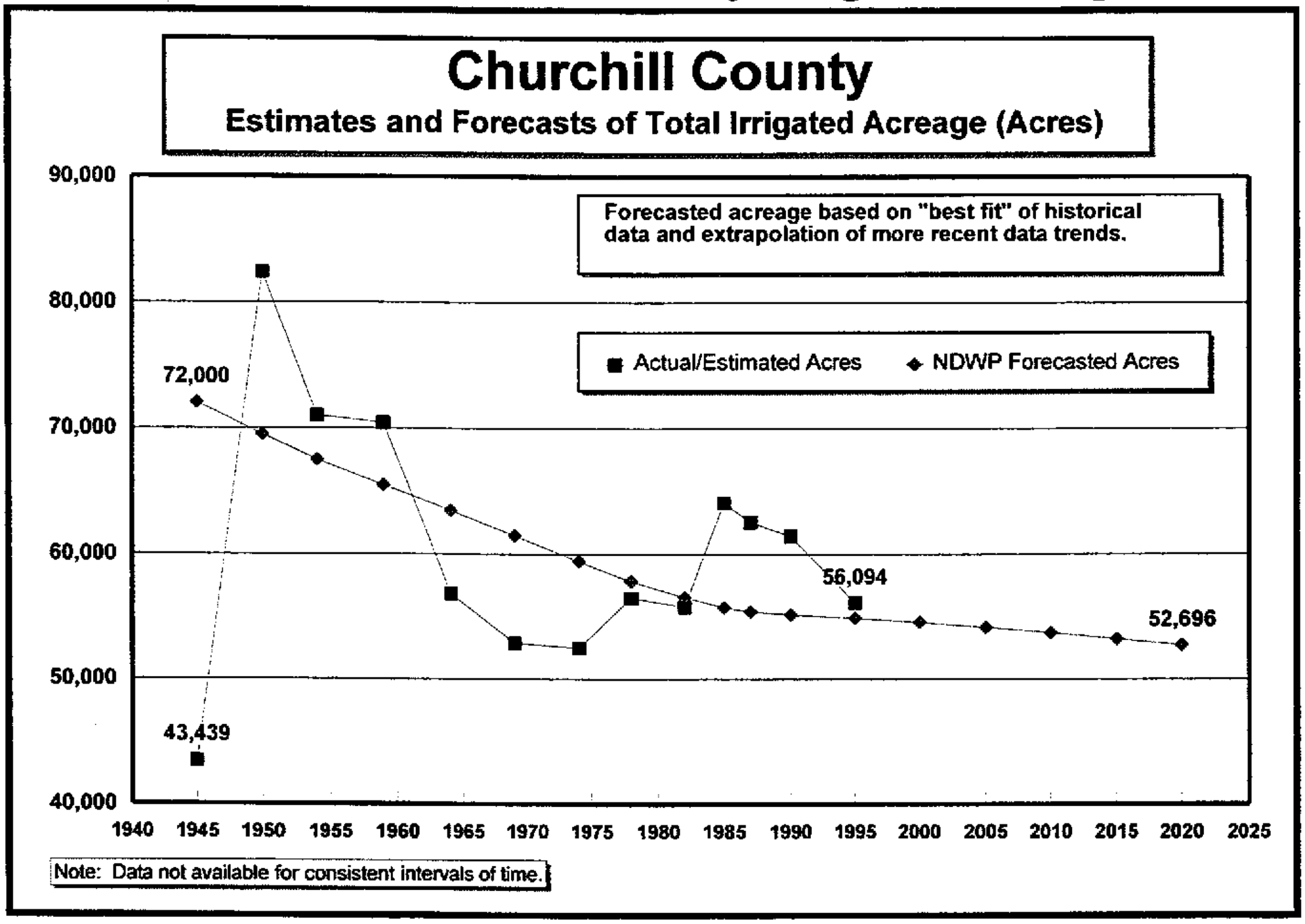
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Carson City

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	3,024	3,024
1950	2,830	2,843
1954	2,317	2,695
1959	2,035	2,541
1964	2,622	2,384
1969	2,905	2,224
1974	1,727	2,064
1978	2,667	1,937
1982	2,720	1,833
1985	740	1,769
1987	1,632	1,741
1990	600	1,719
1995	2,431	1,689
2000		1,651
2005		1,605
2010		1,553
2015		1,494
2020		1,436

Nevada Forecasts of County Irrigated Acreage



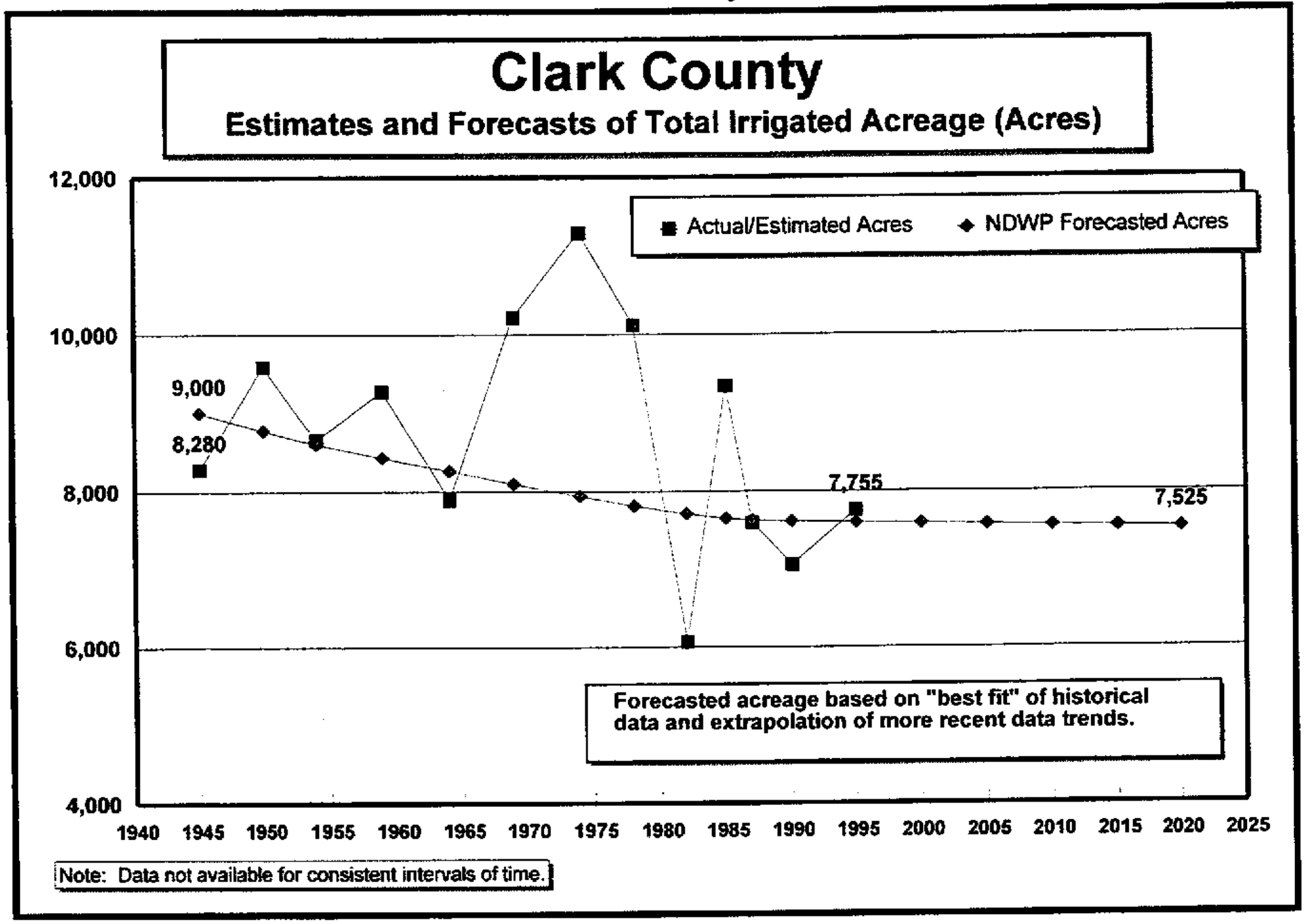
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Churchill County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	43,439	72,000
1950	82,390	69,480
1954	70,995	67,479
1959	70,425	65,468
1964	56,800	63,452
1969	52,862	61,434
1974	52,472	59,419
1978	56,484	57,812
1982	55,777	56,515
1985	64,080	55,721
1987	62,539	55,385
1990	61,400	55,152
1995	56,094	54,864
2000		54,523
2005		54,130
2010		53,685
2015		53,191
2020		52,696

Nevada Forecasts of County Irrigated Acreage



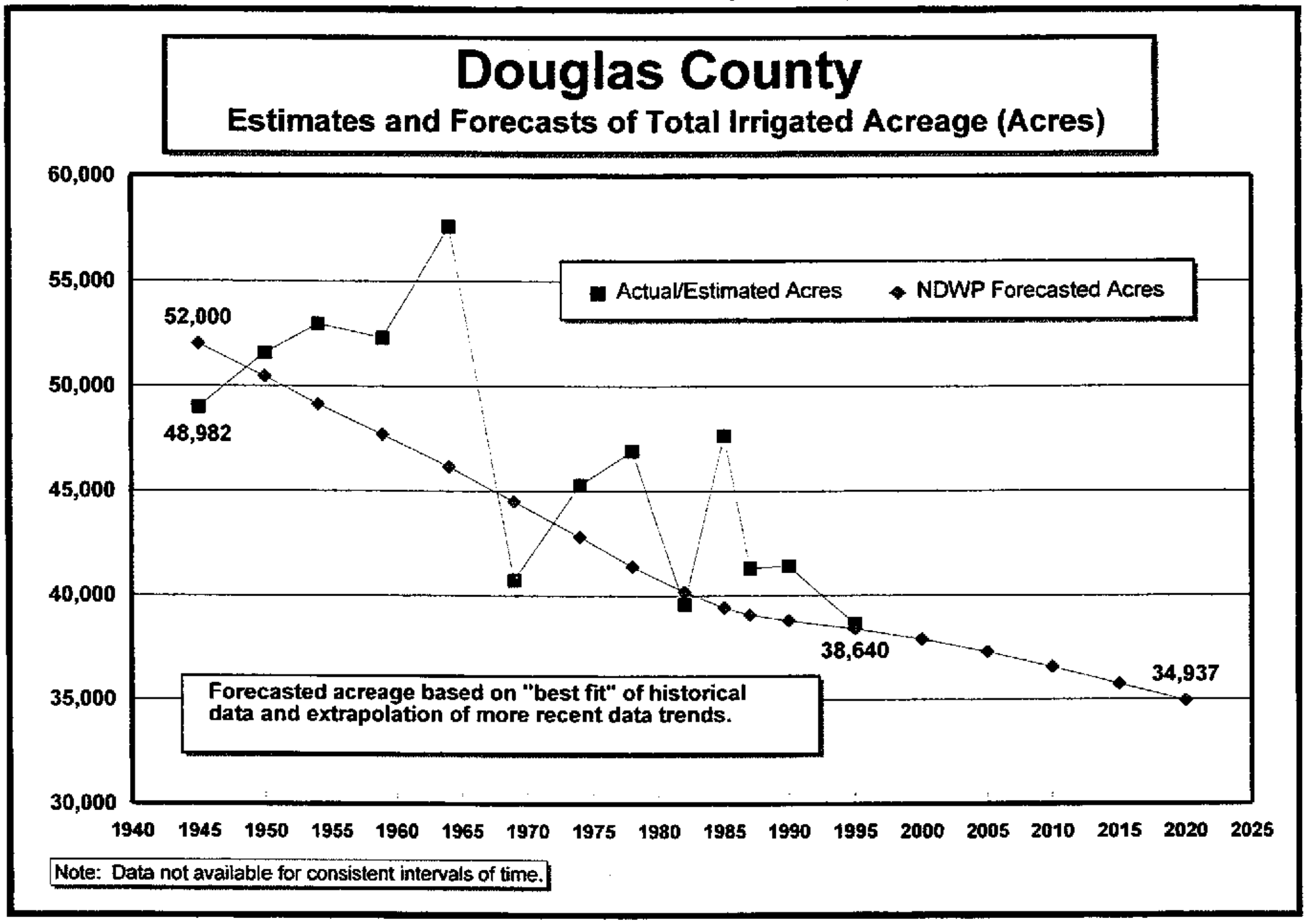
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Clark County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	8,280	9,000
1950	9,591	8,775
1954	8,658	8,600
1959	9,276	8,428
1964	7,892	8,259
1969	10,218	8,094
1974	11,290	7,932
1978	10,116	7,805
1982	6,062	7,705
1985	9,340	7,646
1987	7,594	7,622
1990	7,050	7,608
1995	7,755	7,594
2000		7,580
2005		7,566
2010		7,552
2015		7,539
2020		7,525

Nevada Forecasts of County Irrigated Acreage



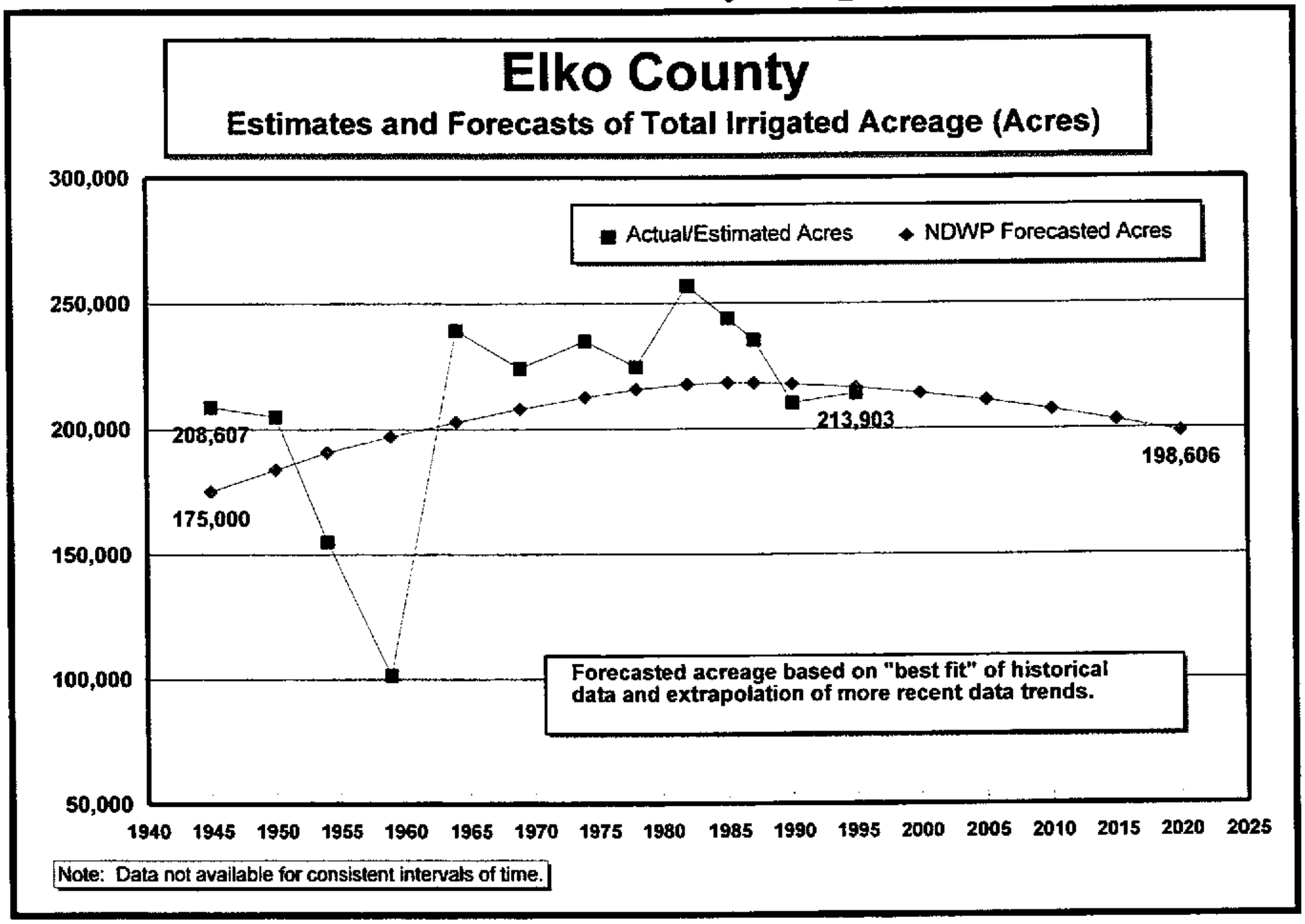
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Douglas County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	48,982	52,000
1950	51,564	50,440
1954	52,946	49,108
1959	52,274	47,665
1964	57,593	46,120
1969	40,726	44,488
1974	45,264	42,779
1978	46,881	41,362
1982	39,562	40,167
1985	47,620	39,399
1987	41,285	39,050
1990	41,400	38,772
1995	38,640	38,380
2000		37,877
2005		37,266
2010		36,554
2015		35,746
2020		34,937

Nevada Forecasts of County Irrigated Acreage



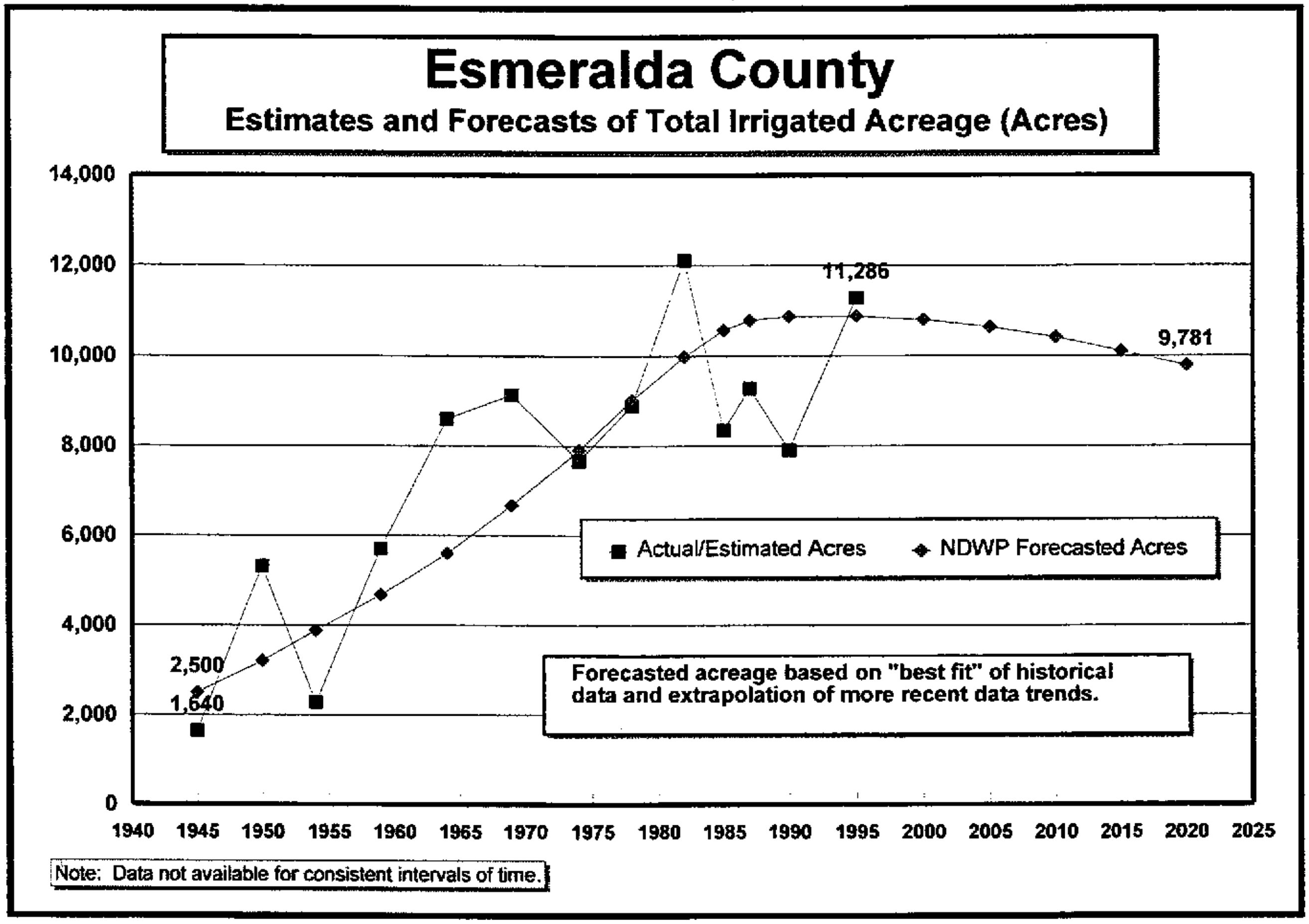
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Elko County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	208,607	175,000
1950	204,844	183,750
1954	155,026	190,549
1959	101,593	196,884
1964	239,265	202,693
1969	224,072	207,912
1974	234,838	212,486
1978	224,624	215,588
1982	256,932	217,460
1985	243,960	218,103
1987	235,188	218,034
1990	210,150	217,502
1995	213,903	216,155
2000		214,007
2005		211,077
2010		207,396
2015		203,001
2020		198,606

Nevada Forecasts of County Irrigated Acreage



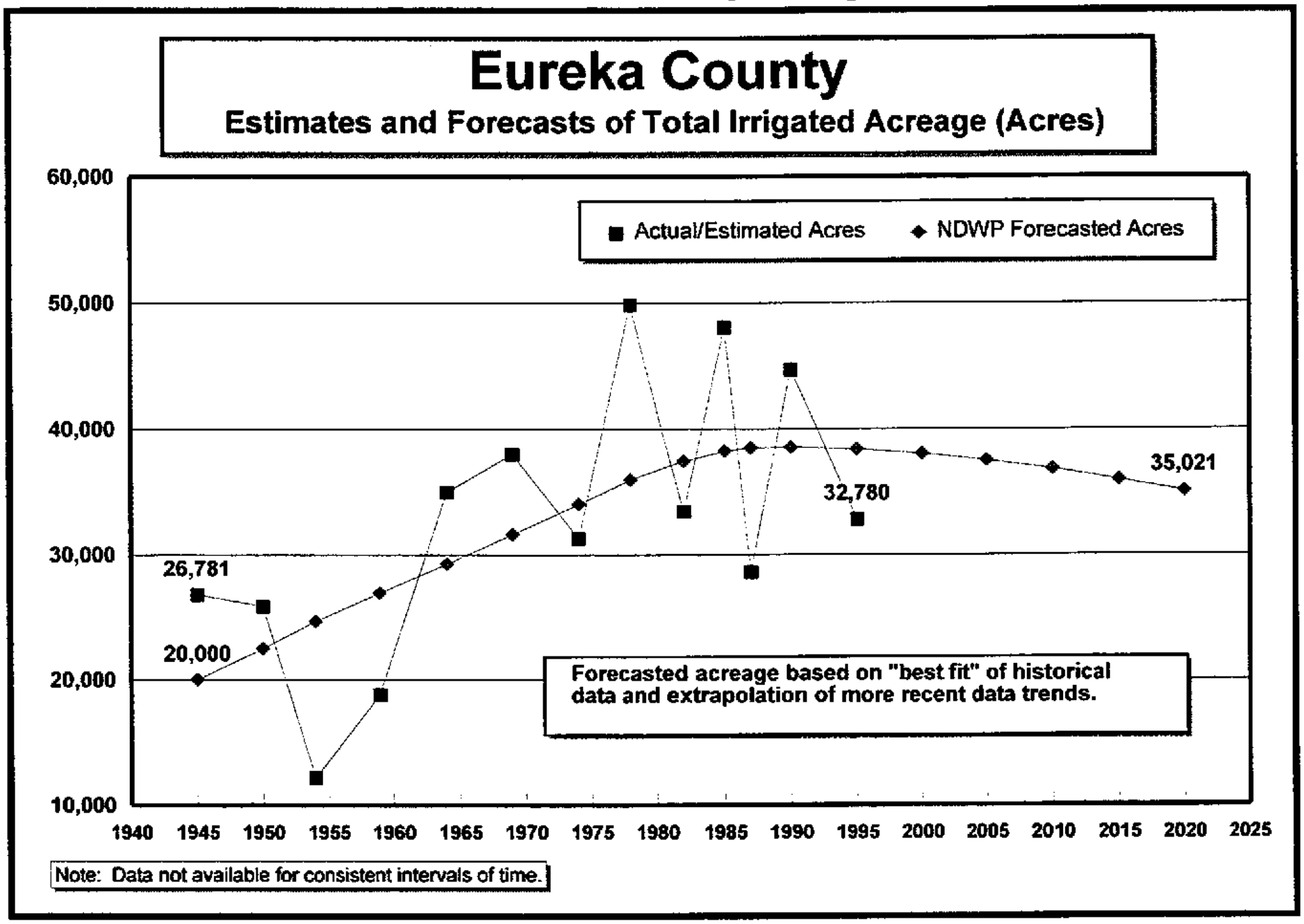
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Esmeralda County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	1,640	2,500
1950	5,314	3,188
1954	2,268	3,870
1959	5,700	4,668
1964	8,595	5,597
1969	9,130	6,668
1974	7,658	7,893
1978	8,881	9,006
1982	12,116	9,968
1985	8,340	10,562
1987	9,273	10,781
1990	7,900	10,867
1995	11,286	10,872
2000		10,794
2005		10,636
2010		10,400
2015		10,090
2020		9,781

Nevada Forecasts of County Irrigated Acreage



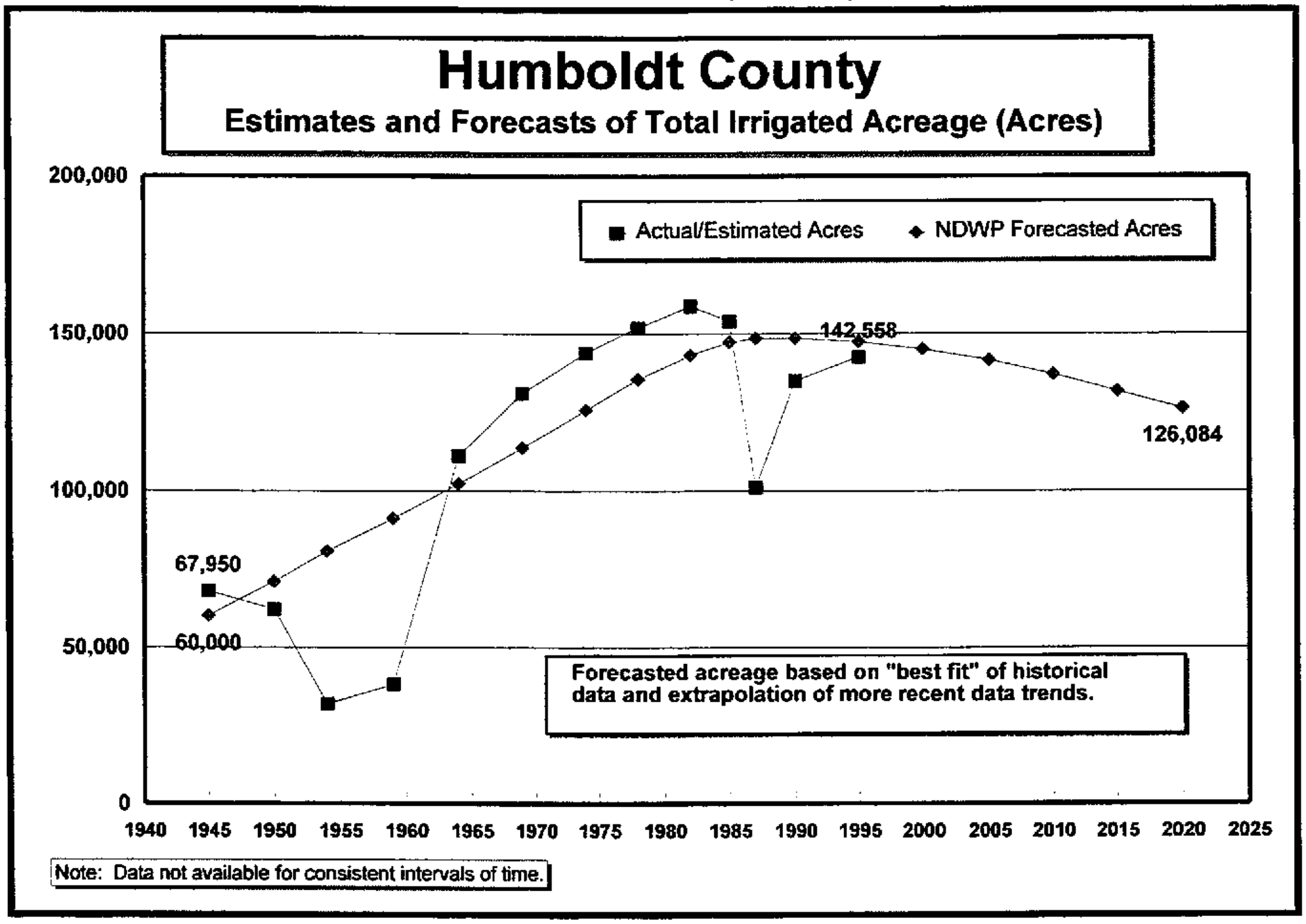
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Eureka County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	26,781	20,000
1950	25,853	22,500
1954	12,167	24,660
1959	18,807	26,904
1964	34,945	29,218
1969	37,986	31,584
1974	31,247	33,985
1978	49,806	35,915
1982	33,372	37,404
1985	48,040	38,221
1987	28,606	38,479
1990	44,700	38,519
1995	32,780	38,367
2000		38,024
2005		37,493
2010		36,783
2015		35,902
2020		35,021

Nevada Forecasts of County Irrigated Acreage



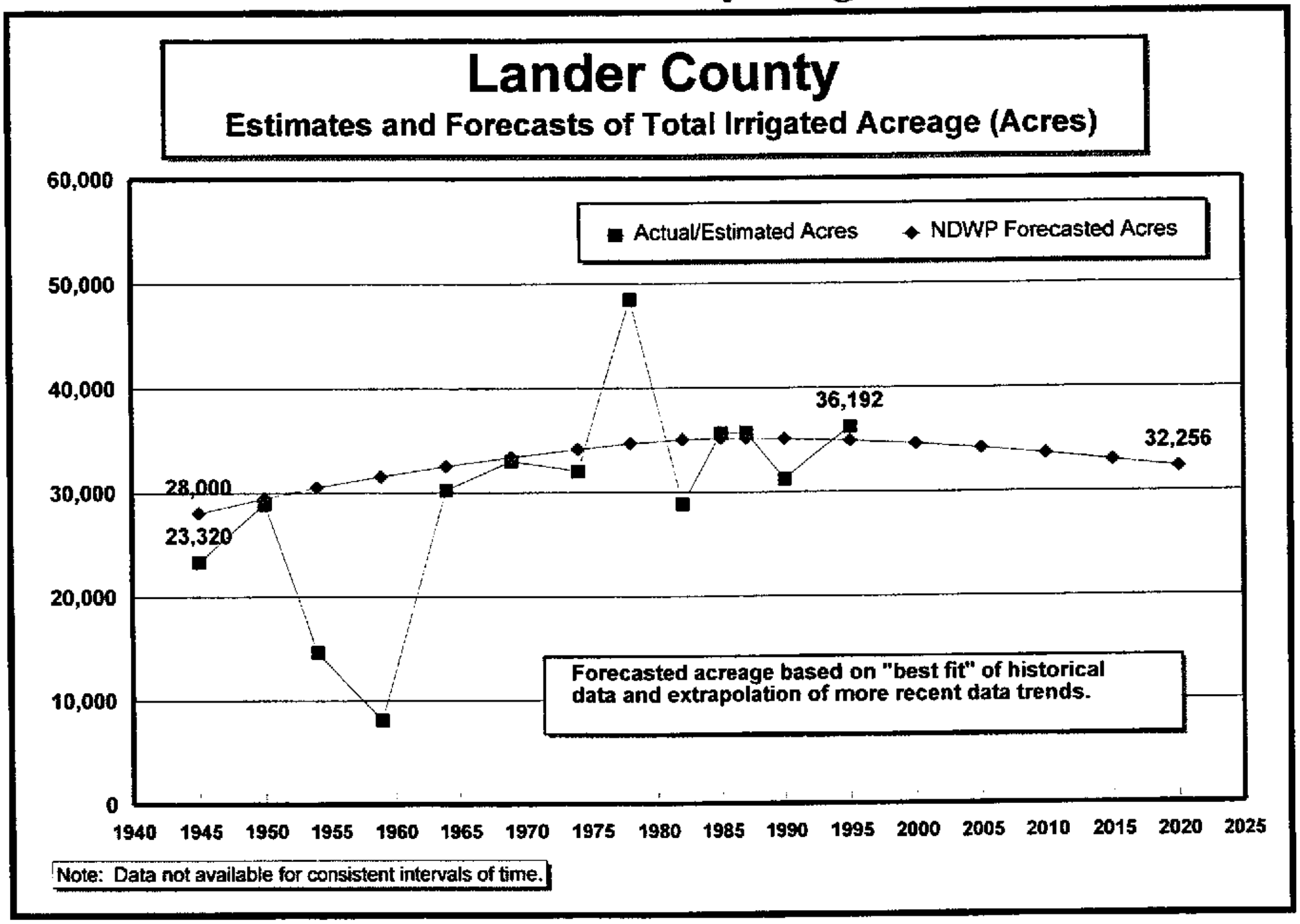
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Humboldt County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	67,950	60,000
1950	62,063	70,800
1954	31,775	80,542
1959	38,106	90,980
1964	111,115	102,044
1969	130,970	113,636
1974	143,800	125,636
1978	151,906	135,445
1982	158,718	143,039
1985	153,890	147,164
1987	100,972	148,391
1990	134,750	148,420
1995	142,558	147,263
2000		144,936
2005		141,487
2010		136,988
2015		131,536
2020		126,084

Nevada Forecasts of County Irrigated Acreage



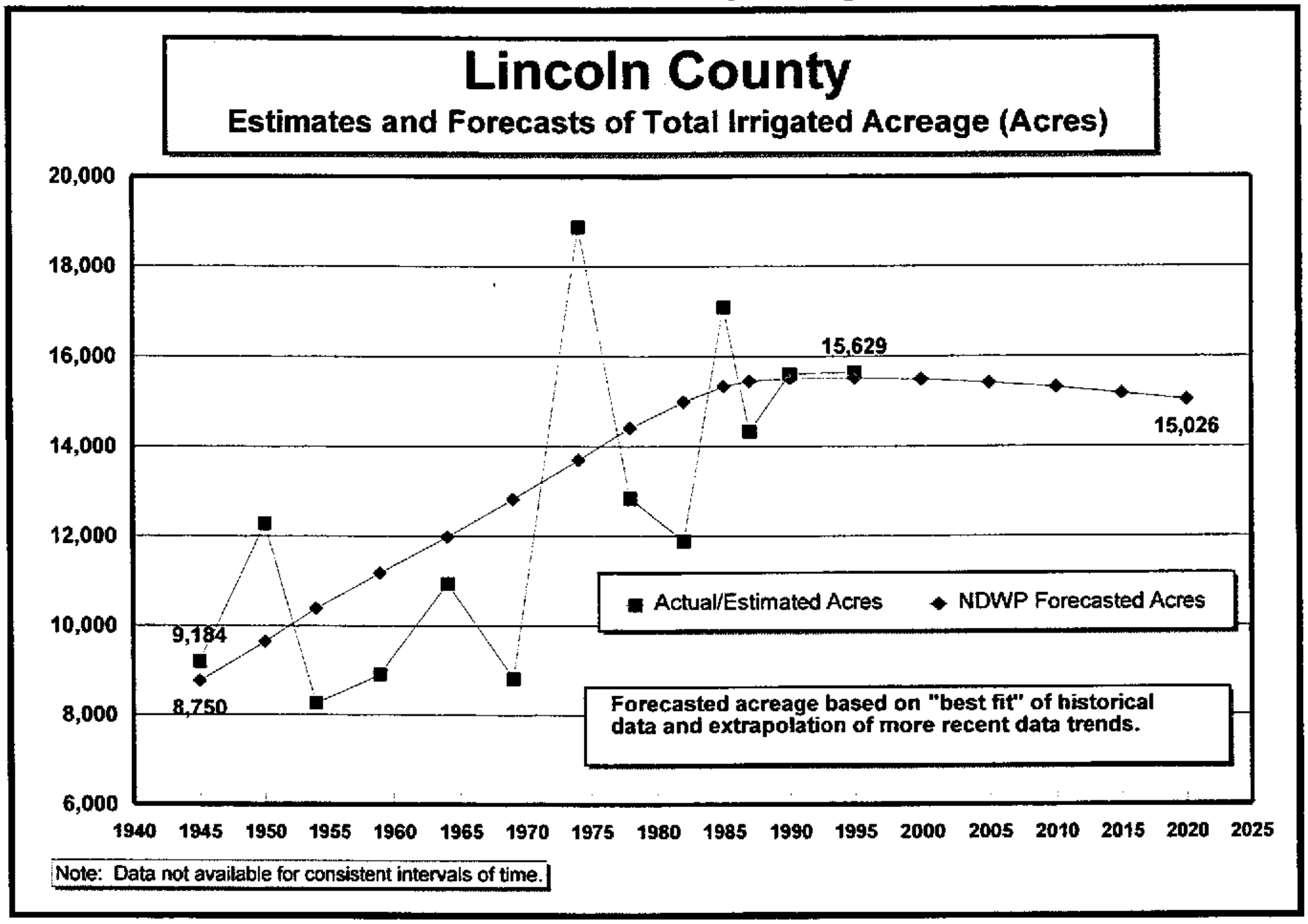
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Lander County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	23,320	28,000
1950	28,893	29,400
1954	14,622	30,494
1959	8,136	31,521
1964	30,213	32,473
1969	32,966	33,340
1974	31,994	34,114
1978	48,474	34,651
1982	28,820	34,991
1985	35,640	35,124
1987	35,663	35,128
1990	31,200	35,056
1995	36,192	34,862
2000		34,548
2005		34,115
2010		33,568
2015		32,912
2020		32,256

Nevada Forecasts of County Irrigated Acreage



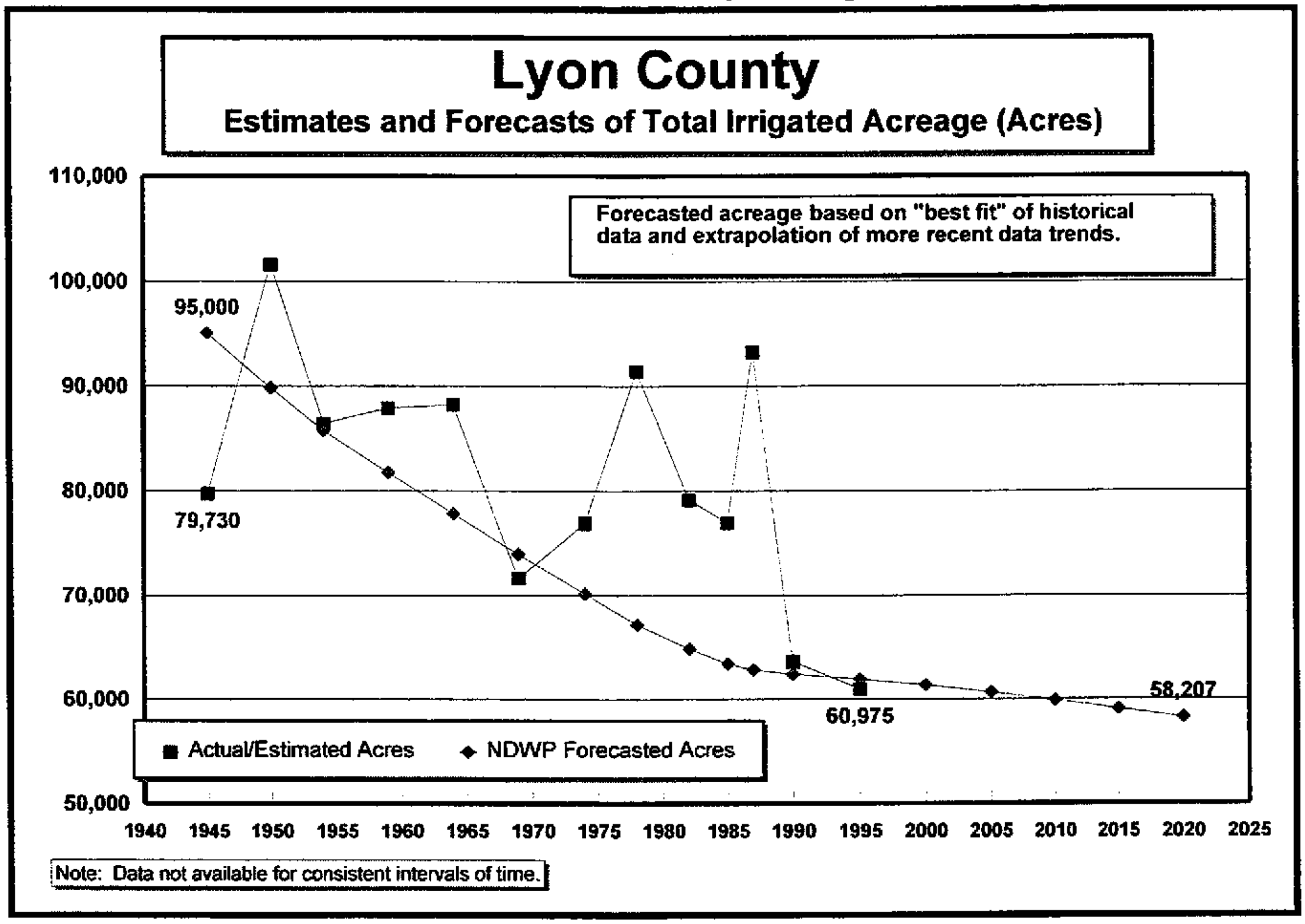
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Lincoln County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	9,184	8,750
1950	12,276	9,625
1954	8,256	10,376
1959	8,895	11,159
1964	10,935	11,974
1969	8,809	12,818
1974	18,879	13,689
1978	12,844	14,407
1982	11,892	14,982
1985	17,090	15,318
1987	14,322	15,441
1990	15,600	15,491
1995	15,629	15,504
2000		15,477
2005		15,412
2010		15,308
2015		15,167
2020		15,026

Nevada Forecasts of County Irrigated Acreage



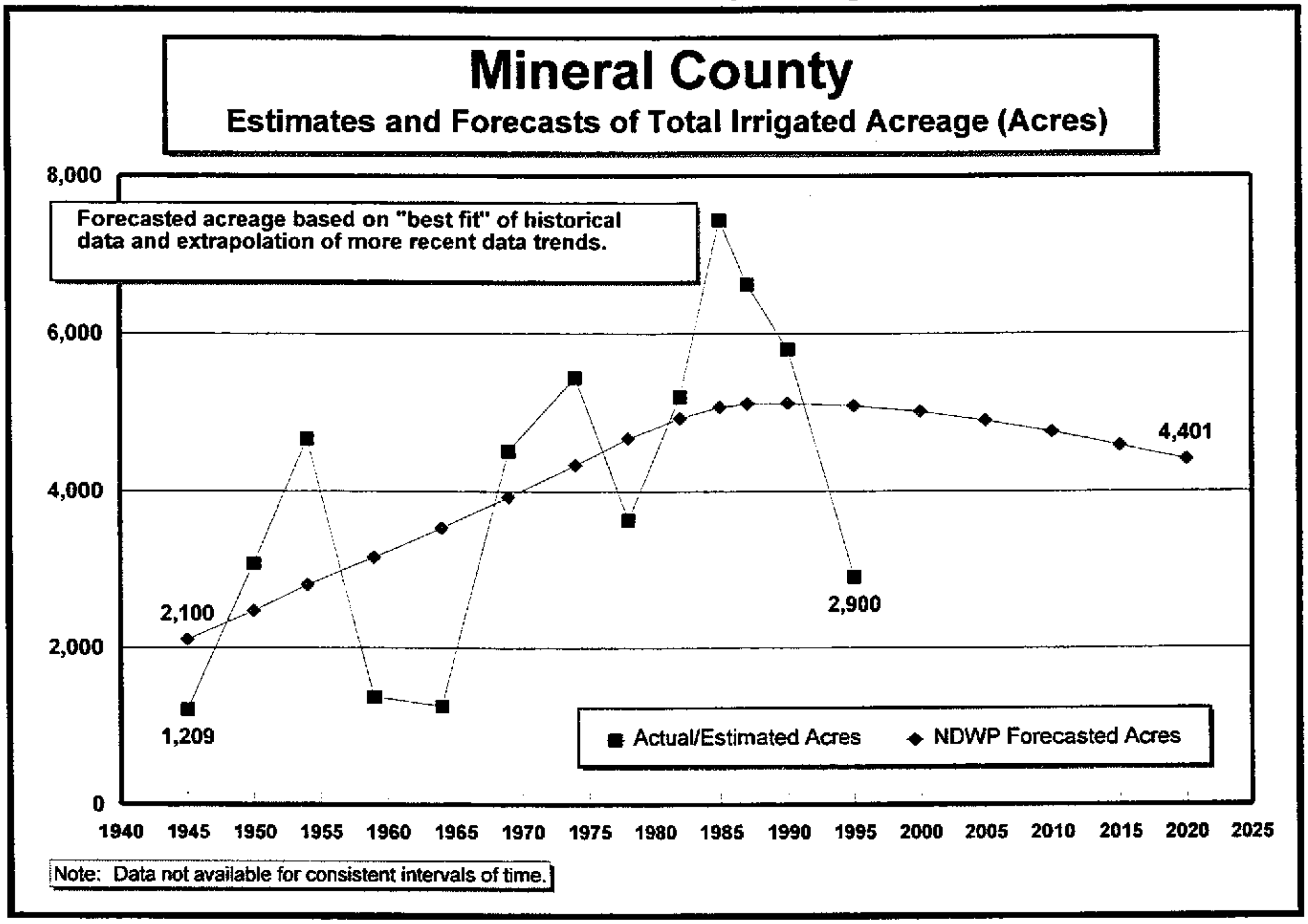
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Lyon County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	79,730	95,000
1950	101,585	89,775
1954	86,385	85,717
1959	87,868	81,714
1964	88,200	77,776
1969	71,632	73,910
1974	76,883	70,126
1978	91,349	67,169
1982	79,093	64,823
1985	76,920	63,406
1987	93,218	62,814
1990	63,600	62,405
1995	60,975	61,906
2000		61,317
2005		60,643
2010		59,884
2015		59,045
2020		58,207

Nevada Forecasts of County Irrigated Acreage



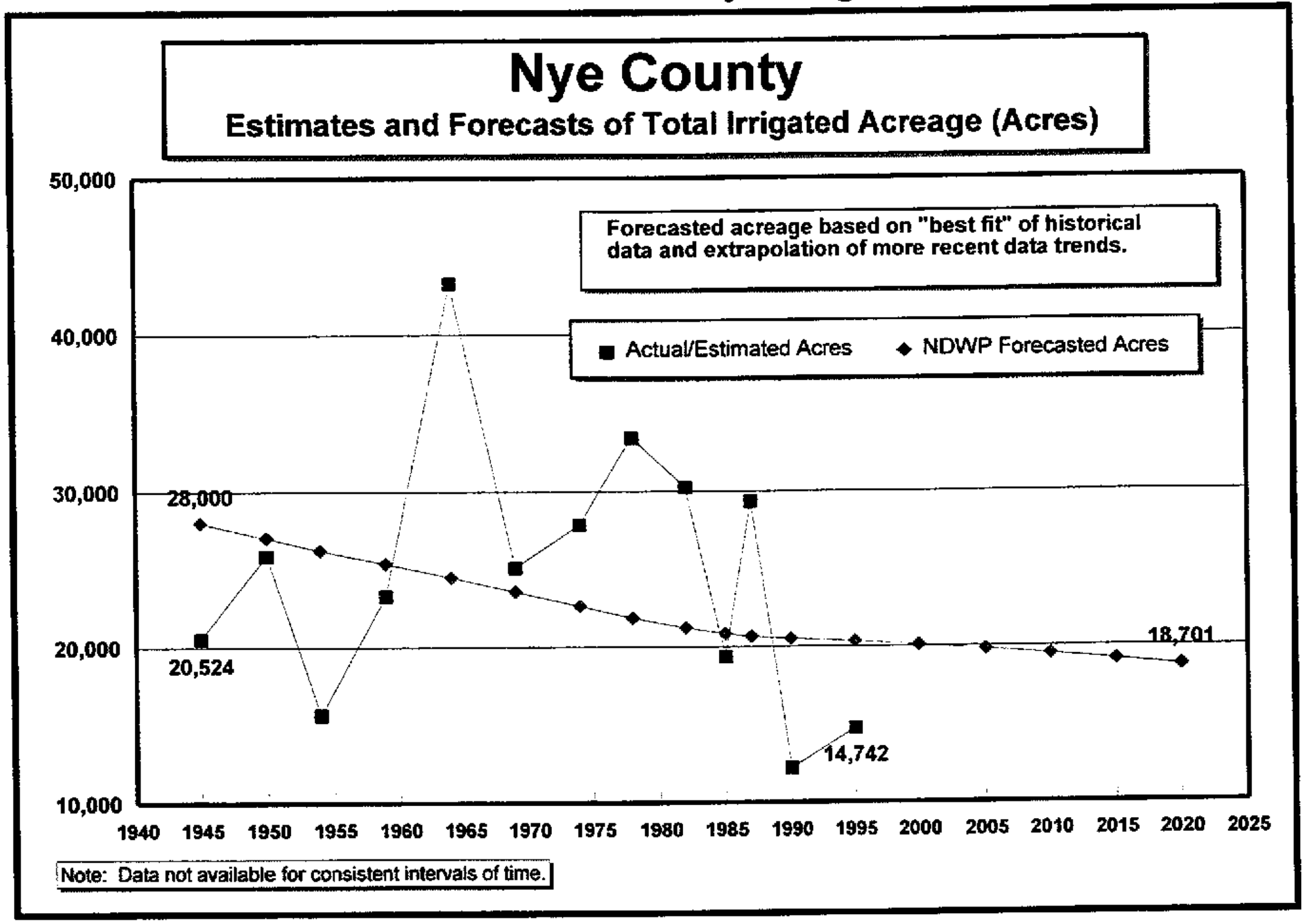
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Mineral County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	1,209	2,100
1950	3,077	2,468
1954	4,664	2,798
1959	1,375	3,152
1964	1,250	3,527
1969	4,511	3,920
1974	5,442	4,328
1978	3,633	4,662
1982	5,193	4,922
1985	7,440	5,065
1987	6,620	5,108
1990	5,800	5,112
1995	2,900	5,077
2000		5,004
2005		4,894
2010		4,751
2015		4,576
2020		4,401

Nevada Forecasts of County Irrigated Acreage



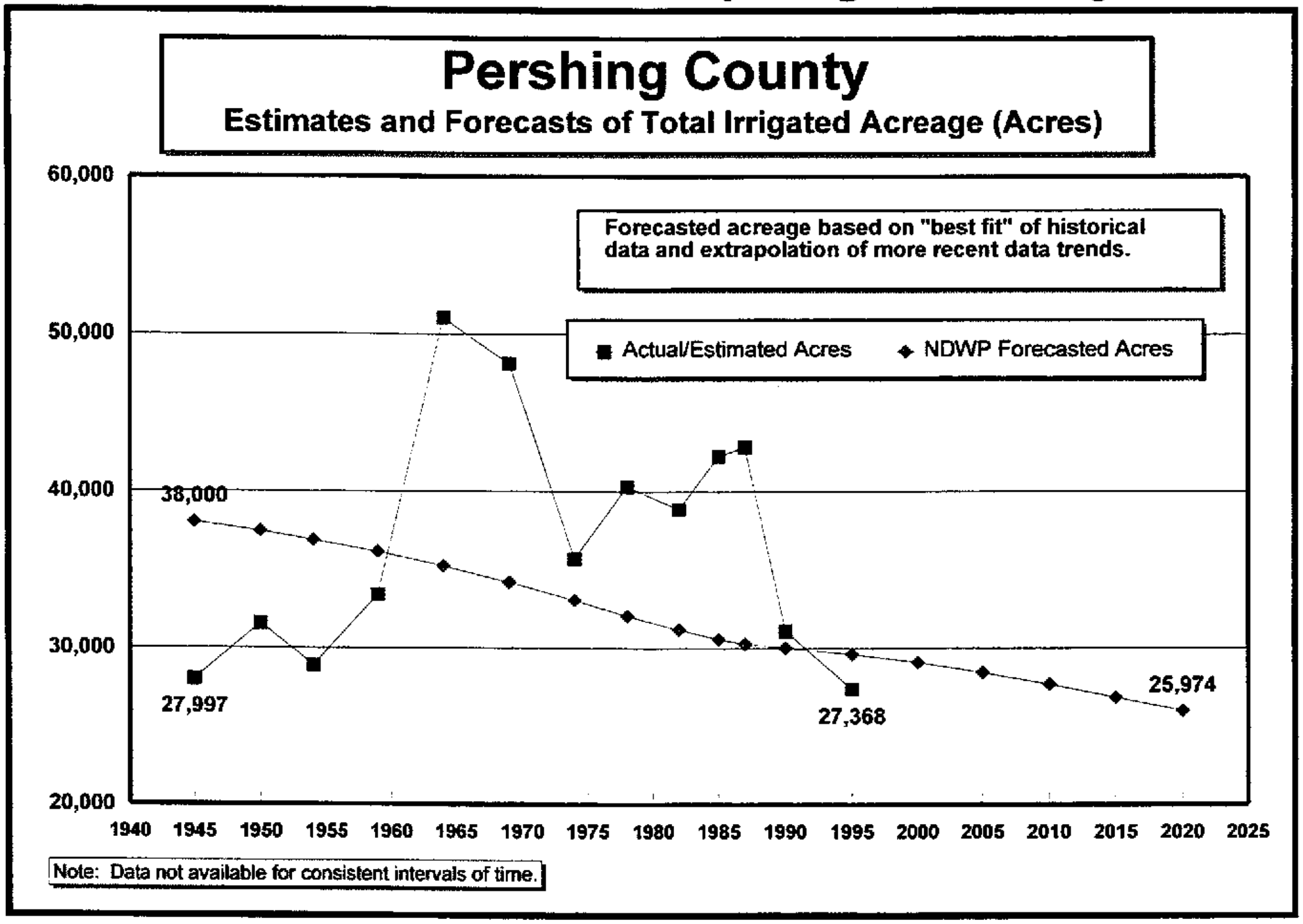
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Nye County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	20,524	28,000
1950	25,864	27,020
1954	15,639	26,209
1959	23,292	25,358
1964	43,266	24,470
1969	25,092	23,552
1974	27,860	22,610
1978	33,397	21,842
1982	30,240	21,204
1985	19,350	20,801
1987	29,331	20,621
1990	12,200	20,484
1995	14,742	20,296
2000		20,060
2005		19,775
2010		19,446
2015		19,073
2020		18,701

Nevada Forecasts of County Irrigated Acreage



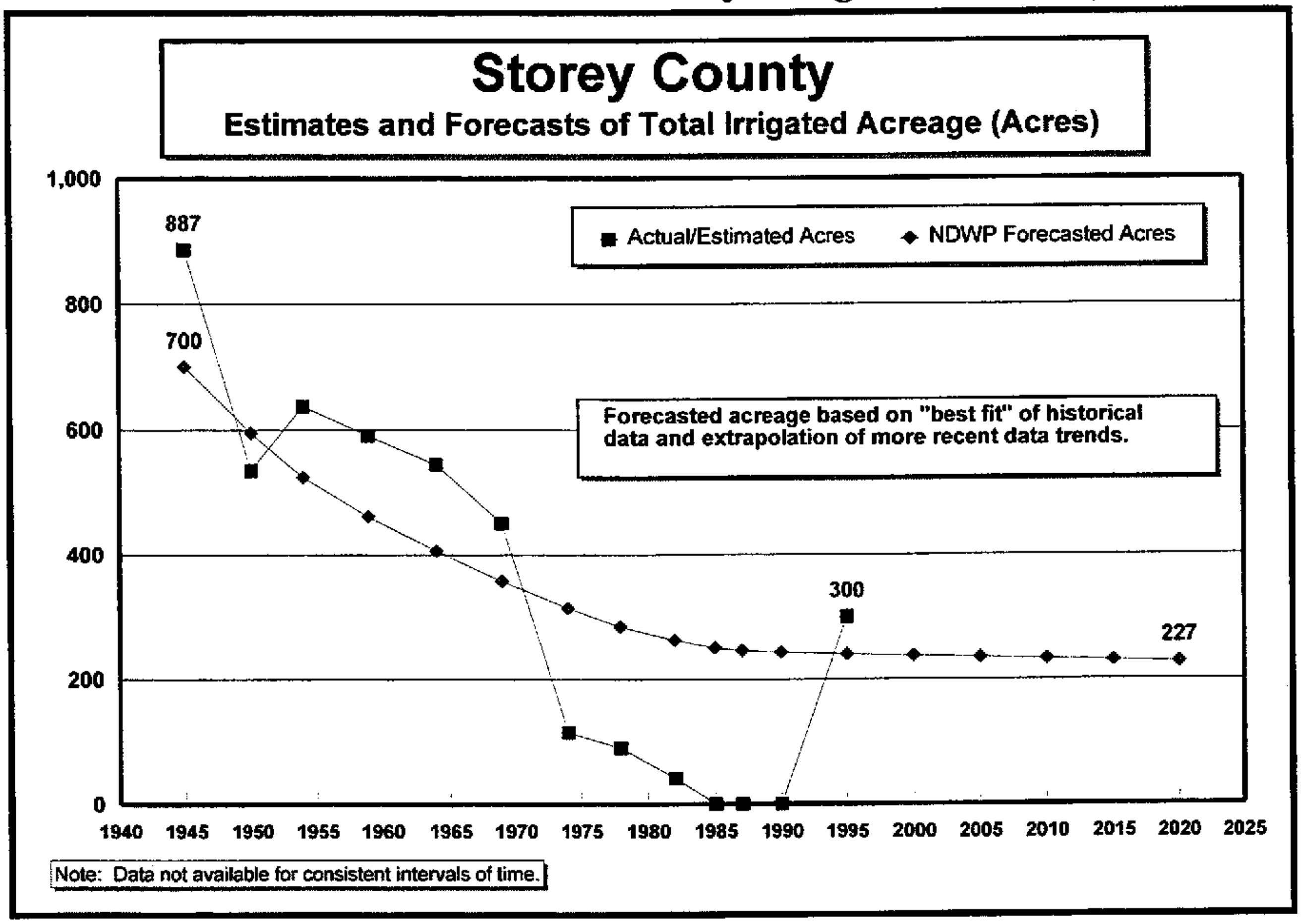
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Pershing County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	27,997	38,000
1950	31,547	37,430
1954	28,893	36,846
1959	33,361	36,105
1964	51,019	35,217
1969	48,109	34,192
1974	35,681	33,044
1978	40,286	32,036
1982	38,837	31,140
1985	42,220	30,533
1987	42,796	30,240
1990	31,100	29,984
1995	27,368	29,596
2000		29,079
2005		28,441
2010		27,688
2015		26,831
2020		25,974

Nevada Forecasts of County Irrigated Acreage



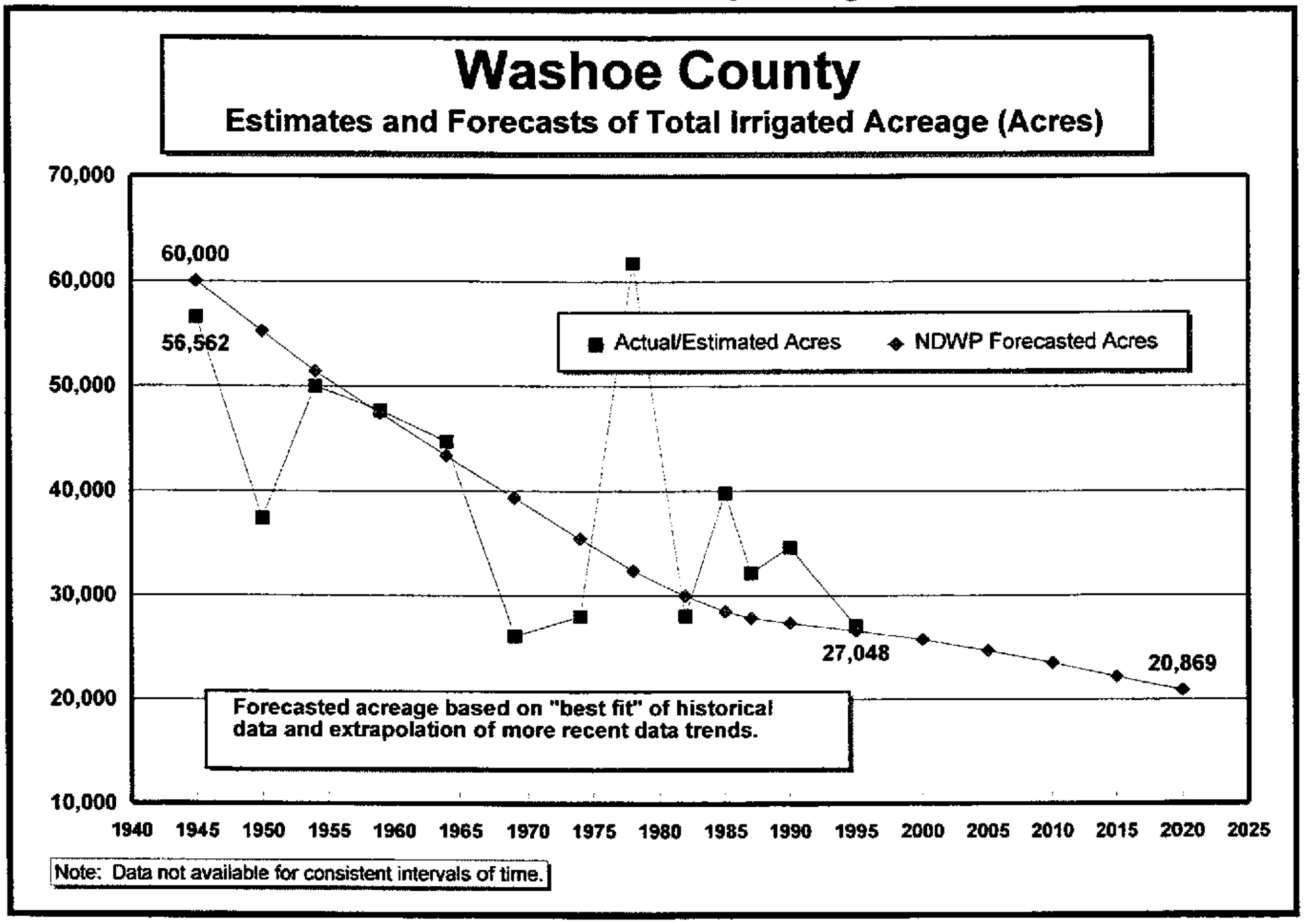
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Storey County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	887	700
1950	535	595
1954	637	524
1959	591	461
1964	544	405
1969	450	357
1974	115	314
1978	90	284
1982	41	262
1985	0	250
1987	0	245
1990	0	243
1995	300	240
2000		237
2005		235
2010		232
2015		230
2020		227

Nevada Forecasts of County Irrigated Acreage



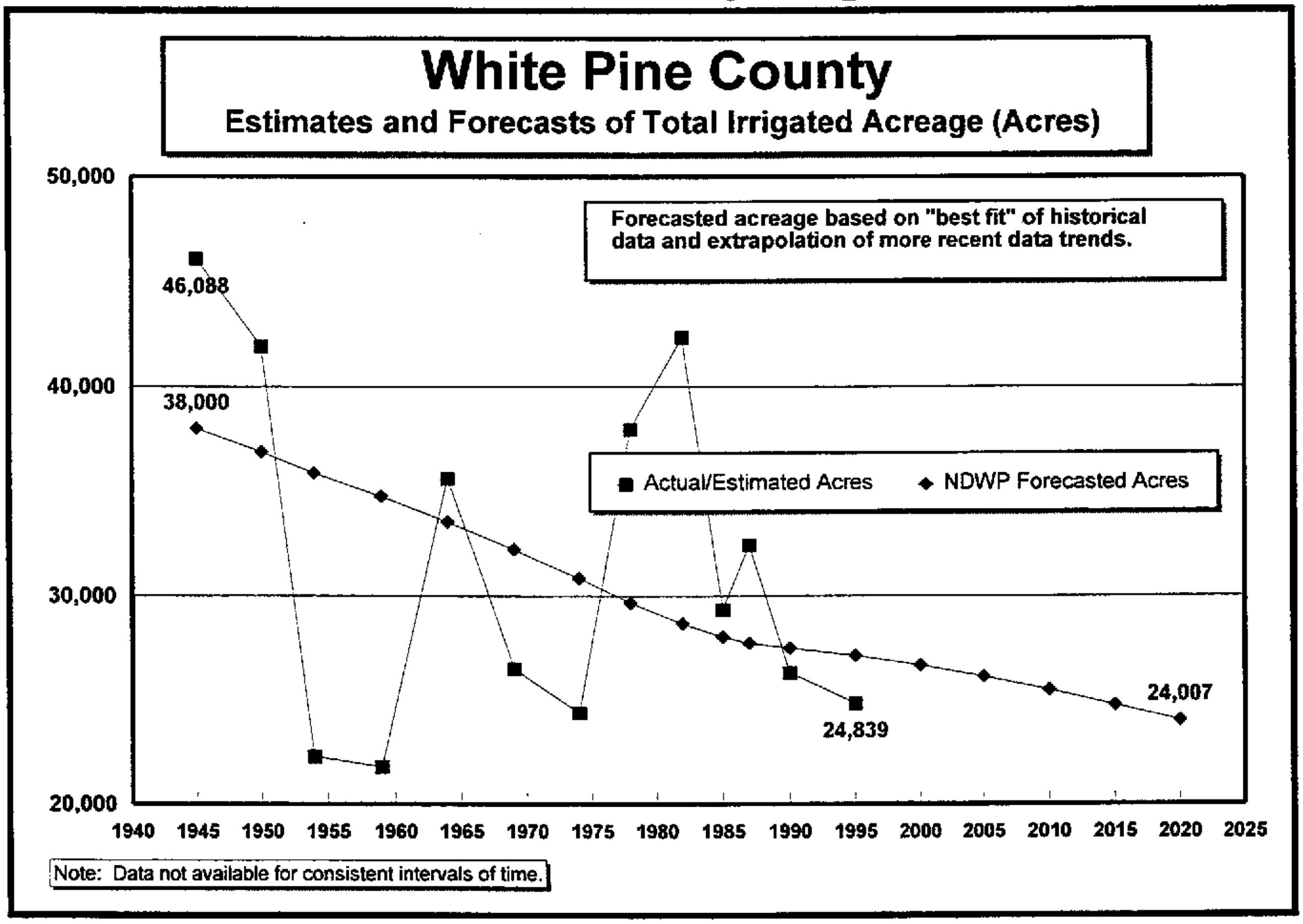
Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

Washoe County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	56,562	60,000
1950	37,351	55,200
1954	49,967	51,336
1959	47,635	47,357
1964	44,673	43,332
1969	26,076	39,324
1974	27,994	35,391
1978	61,750	32,348
1982	28,028	29,928
1985	39,770	28,450
1987	32,131	27,803
1990	34,600	27,298
1995	27,048	26,598
2000		25,716
2005		24,671
2010		23,483
2015		22,176
2020		20,869

Nevada Forecasts of County Irrigated Acreage



Sources: Historical data (1945-1982, 1987)--U.S. Bureau of the Census, Agriculture Division; 1985, 1990--U.S. Geological Survey (USGS); 1995 estimate and 2000-2020 forecasts--Nevada Division of Water Planning (NDWP).

White Pine County

Estimates and Forecasts of Total Irrigated Acreage (Acres)

Years	County Estimated Irrigaged Acreage	County Forecasted Irrigated Acreage
1945	46,088	38,000
1950	41,921	36,860
1954	22,283	35,857
1959	21,789	34,739
1964	35,593	33,516
1969	26,484	32,202
1974	24,366	30,811
1978	37,963	29,647
1982	42,358	28,657
1985	29,320	28,014
1987	32,418	27,717
1990	26,300	27,475
1995	24,839	27,125
2000		26,671
2005		26,117
2010		25,471
2015		24,739
2020		24,007

Nevada State Water Plan

Appendix 5 – Nevada and County Water Withdrawal Forecast Summaries

<u>TABLE:</u>

Nevada Estimated and Forecasted Water Use by Sector

Revised: 12/3/98

Estimated (1995) and Forecasted (2000-2020) Water Use (Acre-Feet/Year)

State/County	1995	2000	2005	2010	2015	2020
Total Nevada						
Total Water Withdrawals (Use)[1]	**4,041,385**	**4,250,474**	**4,339,289**	**4,392,604**	**4,404,012**	**4,391,150**
Total Municipal & Industrial Use[2]	524,861	665,876	789,701	893,593	972,639	1,034,228
Total Domestic (Residential) Use[3]	360,710	455,464	538,090	607,467	660,315	701,338
Domestic--Public Supplied[4]	342,605	434,063	514,277	581,756	633,300	673,563
Domestic--Self Supplied	18,105	21,401	23,813	25,711	27,016	27,775
Commercial and Industrial Use	172,407	220,355	261,880	296,905	323,811	344,919
Public Use and Losses[5]	48,472	61,195	72,313	81,707	88,930	94,582
Thermoelectric Use[6]	65,449	67,085	68,427	69,522	70,412	71,223
Total Mining Use[7]	274,434	278,996	282,708	284,965	283,764	277,566
Mine Processing (consumptive)	89,164	90,947	92,402	93,289	93,469	92,751
Mine Dewatering (nonconsumptive)	185,270	188,049	190,306	191,676	190,296	184,815
Total Agriculture Withdrawals[8]	3,119,914	3,167,378	3,115,872	3,052,038	2,976,780	2,901,522
Irrigation Water Withdrawals	3,113,585	3,160,754	3,109,348	3,045,636	2,970,521	2,895,406
Livestock Water Use	6,329	6,624	6,524	6,402	6,259	6,116
Carson City	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Total Water Withdrawals (Use)[1]	**20,932**	**19,121**	**20,273**	**21,195**	**21,810**	**22,084**
Total Municipal & Industrial Use[2]	9,342	10,885	12,146	13,226	14,051	14,562
Total Domestic (Residential) Use[3]	7,096	8,262	9,212	10,024	10,641	11,020
Domestic--Public Supplied[4]	6,463	7,533	8,410	9,161	9,736	10,094
Domestic--Self Supplied	633	728	803	863	905	926
Commercial and Industrial Use	2,274	2,601	2,891	3,134	3,316	3,423
Public Use and Losses[5]	840	979	1,092	1,189	1,264	1,310
Thermoelectric Use[6]	0	0	0	0	0	0
Total Mining Use[7]	0	0	0	0	0	0
Mine Processing (consumptive)	0	0	0	0	0	0
Mine Dewatering (nonconsumptive)	0	0	0	0	0	0
Total Agriculture Withdrawals[8]	10,721	7,279	7,078	6,847	6,590	6,333
Irrigation Water Withdrawals	10,710	7,271	7,071	6,840	6,583	6,326
Livestock Water Use	11	8	7	7	7	7
Churchill County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Total Water Withdrawals (Use)[1]	**286,299**	**280,894**	**280,578**	**279,893**	**278,809**	**277,552**
Total Municipal & Industrial Use[2]	3,573	4,329	4,957	5,559	6,106	6,569
Total Domestic (Residential) Use[3]	3,457	4,159	4,730	5,269	5,749	6,142
Domestic--Public Supplied[4]	2,151	2,618	3,013	3,396	3,748	4,051
Domestic--Self Supplied	1,306	1,541	1,718	1,874	2,001	2,091
Commercial and Industrial Use	1,423	1,716	1,975	2,226	2,457	2,656
Public Use and Losses[5]	1,053	1,276	1,461	1,638	1,799	1,936
Thermoelectric Use[6]	22,963	23,537	24,008	24,392	24,704	24,989
Total Mining Use[7]	179	183	186	187	188	186
Mine Processing (consumptive)	179	183	186	187	188	186
Mine Dewatering (nonconsumptive)	0	0	0	0	0	0
Total Agriculture Withdrawals[8]	257,225	250,023	248,219	246,180	243,912	241,644
Irrigation Water Withdrawals	256,553	249,370	247,571	245,537	243,275	241,012
Livestock Water Use	672	653	649	643	637	631

Nevada Estimated and Forecasted Water Use by Sector

Revised: 12/3/98

Estimated (1995) and Forecasted (2000-2020) Water Use (Acre-Feet/Year)

Clark County	1995	2000	2005	2010	2015	2020
Total Water Withdrawals (Use)[1]	**468,353**	**593,711**	**705,116**	**796,686**	**864,092**	**915,976**
Total Municipal & Industrial Use[2]	379,921	497,297	602,373	688,843	752,578	801,698
Total Domestic (Residential) Use[3]	246,709	322,712	390,636	446,410	487,385	518,845
Domestic--Public Supplied[4]	242,109	317,052	384,217	439,570	480,458	512,048
Domestic--Self Supplied	4,600	5,660	6,418	6,840	6,926	6,797
Commercial and Industrial Use	121,066	160,681	194,748	222,822	243,561	259,588
Public Use and Losses[5]	32,283	42,256	51,185	58,532	63,948	68,122
Thermoelectric Use[6]	25,337	25,970	26,490	26,914	27,258	27,572
Total Mining Use[7]	2,386	2,434	2,473	2,496	2,501	2,482
Mine Processing (consumptive)	2,386	2,434	2,473	2,496	2,501	2,482
Mine Dewatering (nonconsumptive)	0	0	0	0	0	0
Total Agriculture Withdrawals[8]	40,572	39,658	39,585	39,512	39,439	39,366
Irrigation Water Withdrawals	40,292	39,384	39,312	39,239	39,167	39,095
Livestock Water Use	280	274	273	273	272	272
Douglas County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Total Water Withdrawals (Use)[1]	**203,955**	**202,625**	**201,683**	**200,139**	**197,942**	**195,483**
Total Municipal & Industrial Use[2]	11,078	13,240	14,908	16,502	17,955	19,201
Total Domestic (Residential) Use[3]	10,513	12,552	14,120	15,615	16,973	18,134
Domestic--Public Supplied[4]	9,566	11,434	12,877	14,256	15,514	16,594
Domestic--Self Supplied	947	1,118	1,243	1,358	1,459	1,540
Commercial and Industrial Use	3,293	3,606	4,041	4,453	4,822	5,133
Public Use and Losses[5]	347	415	467	517	563	602
Thermoelectric Use[6]	0	0	0	0	0	0
Total Mining Use[7]	0	0	0	0	0	0
Mine Processing (consumptive)	0	0	0	0	0	0
Mine Dewatering (nonconsumptive)	0	0	0	0	0	0
Total Agriculture Withdrawals[8]	189,802	186,052	183,054	179,555	175,585	171,614
Irrigation Water Withdrawals	189,544	185,799	182,805	179,311	175,346	171,381
Livestock Water Use	258	253	248	244	238	233
Elko County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Total Water Withdrawals (Use)[1]	**936,593**	**941,310**	**932,063**	**919,146**	**902,557**	**885,190**
Total Municipal & Industrial Use[2]	14,920	17,922	20,088	21,972	23,447	24,410
Total Domestic (Residential) Use[3]	11,595	13,917	15,587	17,034	18,164	18,895
Domestic--Public Supplied[4]	10,888	13,083	14,669	16,050	17,134	17,843
Domestic--Self Supplied	707	834	917	984	1,030	1,051
Commercial and Industrial Use	7,942	9,514	10,782	11,859	12,700	13,261
Public Use and Losses[5]	1,355	1,628	1,824	1,995	2,129	2,217
Thermoelectric Use[6]	0	0	0	0	0	0
Total Mining Use[7]	5,354	5,461	5,548	5,602	5,612	5,569
Mine Processing (consumptive)	5,354	5,461	5,548	5,602	5,612	5,569
Mine Dewatering (nonconsumptive)	0	0	0	0	0	0
Total Agriculture Withdrawals[8]	910,347	910,790	898,321	882,655	863,951	845,248
Irrigation Water Withdrawals	908,645	909,087	896,641	881,004	862,335	843,667
Livestock Water Use	1,703	1,703	1,680	1,651	1,616	1,581

Nevada Estimated and Forecasted Water Use by Sector

Estimated (1995) and Forecasted (2000-2020) Water Use (Acre-Feet/Year)

Revised: 12/3/98

Esmeralda County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Total Water Withdrawals (Use)[1]	**62,809**	**60,864**	**60,379**	**59,467**	**58,131**	**56,666**
Total Municipal & Industrial Use[2]	302	275	280	285	287	289
Total Domestic (Residential) Use[3]	297	270	275	279	281	282
Domestic--Public Supplied[4]	213	194	197	200	203	204
Domestic--Self Supplied	84	76	77	78	79	79
Commercial and Industrial Use	45	48	50	51	51	52
Public Use and Losses[5]	45	41	42	42	43	43
Thermoelectric Use[6]	0	0	0	0	0	0
Total Mining Use[7]	12,613	12,865	13,071	13,197	13,222	13,120
Mine Processing (consumptive)	12,613	12,865	13,071	13,197	13,222	13,120
Mine Dewatering (nonconsumptive)	0	0	0	0	0	0
Total Agriculture Withdrawals[8]	49,810	47,640	46,942	45,899	44,534	43,169
Irrigation Water Withdrawals	49,687	47,522	46,826	45,786	44,424	43,062
Livestock Water Use	123	118	116	114	110	107
Eureka County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Total Water Withdrawals (Use)[1]	**244,422**	**266,445**	**266,116**	**264,464**	**260,570**	**254,354**
Total Municipal & Industrial Use[2]	426	479	527	566	592	604
Total Domestic (Residential) Use[3]	425	478	525	563	589	601
Domestic--Public Supplied[4]	325	366	402	432	452	462
Domestic--Self Supplied	100	112	123	131	137	139
Commercial and Industrial Use	67	109	186	232	276	315
Public Use and Losses[5]	34	38	42	45	47	48
Thermoelectric Use[6]	4,637	4,753	4,848	4,926	4,989	5,046
Total Mining Use[7]	114,243	116,053	117,524	118,418	117,749	114,783
Mine Processing (consumptive)	19,222	19,606	19,920	20,111	20,150	19,995
Mine Dewatering (nonconsumptive)	95,021	96,446	97,604	98,306	97,599	94,788
Total Agriculture Withdrawals[8]	125,016	145,015	142,991	140,281	136,921	133,561
Irrigation Water Withdrawals	124,859	144,833	142,812	140,105	136,749	133,394
Livestock Water Use	157	182	179	176	172	168
Humboldt County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Total Water Withdrawals (Use)[1]	**686,584**	**699,031**	**686,501**	**669,042**	**646,369**	**621,976**
Total Municipal & Industrial Use[2]	4,201	4,883	5,440	5,917	6,284	6,513
Total Domestic (Residential) Use[3]	4,454	5,174	5,759	6,259	6,641	6,878
Domestic--Public Supplied[4]	3,047	3,543	3,949	4,297	4,564	4,733
Domestic--Self Supplied	1,407	1,630	1,810	1,962	2,077	2,145
Commercial and Industrial Use	1,411	1,755	2,055	2,345	2,606	2,822
Public Use and Losses[5]	381	443	493	537	570	591
Thermoelectric Use[6]	3,226	3,307	3,373	3,427	3,471	3,511
Total Mining Use[7]	76,640	77,865	78,861	79,466	79,038	77,095
Mine Processing (consumptive)	15,077	15,379	15,625	15,775	15,805	15,683
Mine Dewatering (nonconsumptive)	61,563	62,486	63,236	63,692	63,233	61,412
Total Agriculture Withdrawals[8]	600,472	610,488	595,959	577,009	554,044	531,080
Irrigation Water Withdrawals	599,845	609,851	595,337	576,406	553,466	530,525
Livestock Water Use	627	638	623	603	579	555

Nevada Estimated and Forecasted Water Use by Sector

Revised: 12/3/98

Estimated (1995) and Forecasted (2000-2020) Water Use (Acre-Feet/Year)

Lander County	1995	2000	2005	2010	2015	2020
Total Water Withdrawals (Use)[1]	**198,983**	**192,403**	**191,009**	**188,907**	**185,825**	**182,025**
Total Municipal & Industrial Use[2]	1,423	1,598	1,661	1,710	1,742	1,758
Total Domestic (Residential) Use[3]	1,353	1,518	1,577	1,622	1,651	1,665
Domestic--Public Supplied[4]	1,109	1,246	1,296	1,334	1,360	1,372
Domestic--Self Supplied	244	272	281	288	292	292
Commercial and Industrial Use	146	156	166	174	182	187
Public Use and Losses[5]	168	189	196	202	206	208
Thermoelectric Use[6]	0	0	0	0	0	0
Total Mining Use[7]	35,598	36,170	36,635	36,917	36,723	35,833
Mine Processing (consumptive)	7,550	7,701	7,824	7,899	7,914	7,854
Mine Dewatering (nonconsumptive)	28,048	28,469	28,810	29,018	28,809	27,979
Total Agriculture Withdrawals[8]	161,718	154,370	152,436	149,992	147,063	144,133
Irrigation Water Withdrawals	161,382	154,050	152,119	149,680	146,757	143,833
Livestock Water Use	336	321	317	312	306	300
Lincoln County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Total Water Withdrawals (Use)[1]	**67,516**	**66,884**	**66,642**	**66,230**	**65,651**	**65,063**
Total Municipal & Industrial Use[2]	1,550	1,573	1,604	1,628	1,645	1,653
Total Domestic (Residential) Use[3]	1,355	1,374	1,400	1,420	1,433	1,439
Domestic--Public Supplied[4]	1,082	1,098	1,121	1,138	1,150	1,156
Domestic--Self Supplied	273	276	280	282	283	283
Commercial and Industrial Use	364	349	352	352	351	349
Public Use and Losses[5]	138	140	143	145	146	147
Thermoelectric Use[6]	0	0	0	0	0	0
Total Mining Use[7]	0	0	0	0	0	0
Mine Processing (consumptive)	0	0	0	0	0	0
Mine Dewatering (nonconsumptive)	0	0	0	0	0	0
Total Agriculture Withdrawals[8]	65,660	65,021	64,747	64,313	63,720	63,128
Irrigation Water Withdrawals	65,537	64,899	64,626	64,192	63,601	63,010
Livestock Water Use	123	122	121	120	119	118
Lyon County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Total Water Withdrawals (Use)[1]	**325,076**	**330,054**	**329,601**	**328,640**	**327,027**	**325,002**
Total Municipal & Industrial Use[2]	5,746	7,296	8,527	9,727	10,827	11,760
Total Domestic (Residential) Use[3]	4,171	5,293	6,181	7,045	7,837	8,506
Domestic--Public Supplied[4]	3,853	4,895	5,723	6,530	7,272	7,902
Domestic--Self Supplied	318	398	458	515	564	604
Commercial and Industrial Use	8,894	10,758	12,604	14,412	16,082	17,510
Public Use and Losses[5]	672	853	997	1,138	1,266	1,375
Thermoelectric Use[6]	1,400	1,435	1,464	1,487	1,506	1,524
Total Mining Use[7]	2,565	2,616	2,658	2,684	2,689	2,668
Mine Processing (consumptive)	2,565	2,616	2,658	2,684	2,689	2,668
Mine Dewatering (nonconsumptive)	0	0	0	0	0	0
Total Agriculture Withdrawals[8]	307,374	309,100	305,698	301,875	297,647	293,419
Irrigation Water Withdrawals	306,926	308,649	305,252	301,435	297,213	292,991
Livestock Water Use	448	451	446	440	434	428

Nevada Estimated and Forecasted Water Use by Sector

Revised: 12/3/98

Estimated (1995) and Forecasted (2000-2020) Water Use (Acre-Feet/Year)

Mineral County	1995	2000	2005	2010	2015	2020
Total Water Withdrawals (Use)[1]	**19,713**	**31,196**	**30,667**	**29,929**	**28,992**	**28,022**
Total Municipal & Industrial Use[2]	1,255	1,303	1,329	1,348	1,361	1,366
Total Domestic (Residential) Use[3]	1,153	1,197	1,219	1,236	1,246	1,250
Domestic--Public Supplied[4]	930	966	986	1,000	1,010	1,014
Domestic--Self Supplied	223	230	234	236	236	236
Commercial and Industrial Use	280	266	265	263	259	254
Public Use and Losses[5]	45	47	47	48	49	49
Thermoelectric Use[6]	0	0	0	0	0	0
Total Mining Use[7]	2,520	2,570	2,612	2,637	2,642	2,621
Mine Processing (consumptive)	2,520	2,570	2,612	2,637	2,642	2,621
Mine Dewatering (nonconsumptive)	0	0	0	0	0	0
Total Agriculture Withdrawals[8]	15,716	27,117	26,524	25,746	24,797	23,848
Irrigation Water Withdrawals	15,682	27,059	26,467	25,691	24,744	23,797
Livestock Water Use	34	58	57	55	53	51

Nye County	1995	2000	2005	2010	2015	2020
Total Water Withdrawals (Use)[1]	**76,615**	**101,291**	**102,073**	**102,507**	**102,457**	**101,958**
Total Municipal & Industrial Use[2]	6,127	8,203	9,634	10,975	12,128	12,995
Total Domestic (Residential) Use[3]	5,785	7,740	9,083	10,340	11,417	12,225
Domestic--Public Supplied[4]	4,077	5,461	6,416	7,313	8,084	8,666
Domestic--Self Supplied	1,708	2,279	2,667	3,027	3,333	3,559
Commercial and Industrial Use	784	893	1,063	1,226	1,372	1,488
Public Use and Losses[5]	1,378	1,845	2,166	2,468	2,727	2,922
Thermoelectric Use[6]	0	0	0	0	0	0
Total Mining Use[7]	7,695	7,846	7,969	8,044	8,053	7,977
Mine Processing (consumptive)	7,057	7,198	7,313	7,384	7,398	7,341
Mine Dewatering (nonconsumptive)	638	648	655	660	655	636
Total Agriculture Withdrawals[8]	60,973	82,968	81,792	80,429	78,888	77,347
Irrigation Water Withdrawals	60,233	81,962	80,801	79,454	77,931	76,409
Livestock Water Use	739	1,006	992	975	957	938

Pershing County	1995	2000	2005	2010	2015	2020
Total Water Withdrawals (Use)[1]	**121,216**	**129,257**	**126,831**	**123,860**	**120,366**	**116,780**
Total Municipal & Industrial Use[2]	1,736	2,390	2,631	2,831	2,975	3,054
Total Domestic (Residential) Use[3]	1,342	1,845	2,030	2,183	2,292	2,351
Domestic--Public Supplied[4]	1,199	1,650	1,818	1,957	2,057	2,112
Domestic--Self Supplied	143	195	212	226	235	239
Commercial and Industrial Use	414	531	601	664	716	754
Public Use and Losses[5]	134	185	204	219	230	236
Thermoelectric Use[6]	0	0	0	0	0	0
Total Mining Use[7]	2,106	2,148	2,182	2,203	2,208	2,191
Mine Processing (consumptive)	2,106	2,148	2,182	2,203	2,208	2,191
Mine Dewatering (nonconsumptive)	0	0	0	0	0	0
Total Agriculture Withdrawals[8]	117,220	124,548	121,814	118,591	114,919	111,248
Irrigation Water Withdrawals	116,962	124,275	121,546	118,330	114,667	111,004
Livestock Water Use	258	274	268	261	253	245

Nevada Estimated and Forecasted Water Use by Sector

Revised: 12/3/98

Estimated (1995) and Forecasted (2000-2020) Water Use (Acre-Feet/Year)

Storey County	1995	2000	2005	2010	2015	2020
Total Water Withdrawals (Use)[1]	**3,533**	**3,470**	**3,562**	**3,638**	**3,698**	**3,742**
Total Municipal & Industrial Use[2]	325	383	424	460	489	510
Total Domestic (Residential) Use[3]	340	401	443	480	510	532
Domestic--Public Supplied[4]	224	264	293	318	338	352
Domestic--Self Supplied	116	136	150	163	173	179
Commercial and Industrial Use	67	98	110	121	131	139
Public Use and Losses[5]	34	40	44	48	51	53
Thermoelectric Use[6]	1,826	1,872	1,909	1,940	1,964	1,987
Total Mining Use[7]	258	263	267	270	270	268
Mine Processing (consumptive)	258	263	267	270	270	268
Mine Dewatering (nonconsumptive)	0	0	0	0	0	0
Total Agriculture Withdrawals[8]	1,008	797	789	780	771	763
Irrigation Water Withdrawals	1,008	797	789	780	771	763
Livestock Water Use	0	0	0	0	0	0
Washoe County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Total Water Withdrawals (Use)[1]	**218,983**	**225,228**	**230,998**	**235,595**	**238,823**	**240,931**
Total Municipal & Industrial Use[2]	79,385	89,816	98,971	107,699	115,733	122,808
Total Domestic (Residential) Use[3]	57,382	64,876	71,438	77,683	83,419	88,455
Domestic--Public Supplied[4]	52,322	59,222	65,287	71,075	76,409	81,114
Domestic--Self Supplied	5,060	5,654	6,151	6,608	7,010	7,341
Commercial and Industrial Use	23,691	27,050	29,757	32,327	34,681	36,739
Public Use and Losses[5]	9,308	10,532	11,605	12,629	13,571	14,400
Thermoelectric Use[6]	6,060	6,212	6,336	6,437	6,519	6,595
Total Mining Use[7]	717	731	743	750	752	746
Mine Processing (consumptive)	717	731	743	750	752	746
Mine Dewatering (nonconsumptive)	0	0	0	0	0	0
Total Agriculture Withdrawals[8]	121,824	115,828	111,119	105,769	99,882	93,996
Irrigation Water Withdrawals	121,533	115,551	110,853	105,516	99,644	93,772
Livestock Water Use	291	277	266	253	239	225
White Pine County	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Total Water Withdrawals (Use)[1]	**99,803**	**106,689**	**105,196**	**103,265**	**100,893**	**98,345**
Total Municipal & Industrial Use[2]	3,551	4,005	4,198	4,345	4,439	4,477
Total Domestic (Residential) Use[3]	3,283	3,699	3,874	4,006	4,089	4,119
Domestic--Public Supplied[4]	3,047	3,437	3,604	3,730	3,812	3,845
Domestic--Self Supplied	236	262	270	275	277	274
Commercial and Industrial Use	246	224	235	244	248	250
Public Use and Losses[5]	258	291	305	315	322	325
Thermoelectric Use[6]	0	0	0	0	0	0
Total Mining Use[7]	11,560	11,791	11,980	12,095	12,118	12,025
Mine Processing (consumptive)	11,560	11,791	11,980	12,095	12,118	12,025
Mine Dewatering (nonconsumptive)	0	0	0	0	0	0
Total Agriculture Withdrawals[8]	84,456	90,684	88,803	86,605	84,115	81,626
Irrigation Water Withdrawals	84,187	90,395	88,520	86,329	83,848	81,366
Livestock Water Use	269	289	283	276	268	260

Notes: "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows.

[1] Total Water Withdrawals are equal to Total Domestic Use plus Commercial and Industrial Use plus Public Use and Losses plus Thermoelectric Use plus Total Mining Use plus Total Agriculture Withdrawals.

[2] Total Municipal & Industrial (M&I) Use equals public supplied water for domestic, commercial, industrial, and thermoelectric uses.

[3] Total Domestic Use equals the total residential use, both indoors and outdoors (i.e., residential landscaping).

[4] Domestic Public Supplied water use is residential use of water supplied by public supply water systems.

[5] Public Use and Losses is forecasted as a percent of total M&I water use based on historical trends.
[6] Thermoelectric Use includes water used for geothermal power plants and cooling water for conventional plants.
[7] Total Mining Use includes both consumptive and non-consumptive uses (i.e., mining dewatering).
[8] Total Agriculture Withdrawals includes both irrigation and livestock water use.

Sources: Nevada State Demographer; Nevada Department of Employment, Training and Rehabilitation (DETR); U.S. Geological Survey (USGS); and Nevada Division of Water Planning (NDWP); Irrigated acreage and 1995 irrigation water withdrawals based on USGS estimates modified by NDWP; Forecasts through 2020 based on 1995 usage rates and NDWP forecasts of population, employment, business conditions and estimated irrigated acreage. Livestock water use based on a constant percent of irrigation water use,

Nevada State Water Plan

Appendix 6 – Nevada and County Socioeconomic Overviews

(Incorporated by Reference)

Incorporated into the Nevada State Water Plan by reference only are separate socioeconomic overviews for the total state and each county offering detailed written, table, and graphical analysis in support of the State Water Plan.

Socioeconomic Overviews:

State of Nevada
Carson City
Churchill County
Clark County
Douglas County
Elko County
Esmeralda County
Eureka County
Humboldt County
Lander County
Lincoln County
Lyon County
Mineral County
Nye County
Pershing County
Storey County
Washoe County
White Pine County