WATER QUALITY MANAGEMENT PLAN FOR THE CARSON RIVER

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Prepared for:

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List of Acronyms, Abbreviations and Technical Terms

This revised 208 Plan includes the following abbreviations and acronyms (organized on the basis of organizations, programs, regulatory, technical and units of measurement):

Organizations

BLM	Bureau of Land Management
BWPC	Bureau of Water Pollution Control
CCDS	Carson City Development Services
CRBCOG	Carson River Basin Council of Governments
CRC	Carson River Coalition
CWSD	Carson Water Subconservancy District
CWSRF	Clean Water State Revolving Fund
DRI	Desert Research Institute
EPA	U.S. Environmental Protection Agency
FDA	Food and Drug Administration
IHGID	Indian Hills General Improvement District
IVGID	Incline Village General Improvement District
LCUD	Lyon County Utilities Division
MGSD	Minden Gardnerville Sanitation District
NDEP	Nevada Division of Environmental Protection
NDOT	Nevada Department of Transportation
NDWP	Nevada Division of Water Planning
NRCS	Natural Resources Conservation Service
NVWWTF	North Valley Wastewater Treatment Facility
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

WRCC	Western Regional Climate Center

Programs

CCSWMP	Clear Creek Stormwater Management Plan
NPL	National Priorities List
WET	Water Education for Teachers
WPCP	Water Pollution Control Program

Regulations and Permits

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
NPDES	National Pollutant Discharge Elimination System
NRS	Nevada Revised Statutes

Technical

ΔT	Change in temperature
ΔpH	Change in pH
1,1-DCA	1,1-Dichloroethane
1,1-DCE	1,1-Dichloroethylene
1,2-DCP	1,1 Dichloropropane
1,1,1-TCA	1,1,1-Trichloroethane
A-Avg.	Annual Average
ADWF	Average Dry Weather Flow
A.G.M.	Annual Geometric Mean
amsl	above mean sea level
BMP	Best Management Practice
BOD	Biological Oxygen Demand
CBOD	Carbonaceous Biological Oxygen Demand
CD	Conservation Districts

CDP	Census Designated Places
CRMS	Carson River Mercury Site
DO	Dissolved Oxygen
EDU	Equivalent Domestic Unit
EF	East Fork
EMP	Effluent Management Plan
GID	General Improvement District
ISDS	Individual Sewage Disposal System
IWPP	Integrated Watershed Planning Process
LUST	Leaking Underground Storage Tank
M&R	Monitor and Report
MS4	Municipal Separate Storm Sewer System
MTBE	Methyl tertiary butyl ether
NTU	Nephelometric Turbidity Units
O&M	Operation and Maintenance
PCU	Platinum Cobalt Units
PER	Preliminary Engineering Report
PUD	Public Utilities District
PRP	Potentially Responsible Parties
PWWF	Peak Wet Weather Flow
RC&D	Resource Conservation and Development
RIB	Rapid Infiltration Basin
SAR	Sodium Adsorption Ratio
SBR	Sequential Batch Reactor
SID	Sewer Improvement District
S.V.	Single Value
SWMP	Stormwater Management Plan
SWPPP	Stormwater Pollution Prevention Plan
TCE	Trichloroethene

TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UA	Urbanized Area
UST	Underground Storage Tank
WF	West Fork
WLA	Waste Load Allocation
WQS	Water Quality Standard
WRF	Water Reclamation Facility
WRP	Wastewater Reclamation Plant
WWTF	Wastewater Treatment Facility
WWTP	Wastewater Treatment Plant

Units of Measurement

afy	acre-feet per year
gpd	gallons per day
gpm	gallons per minute
MGD	million gallons per day
mg/L	milligrams per liter
mi^2	square miles
ml	milliliter
ppm	parts per million

EXECUTIVE SUMMARY

Pursuant to Section 208 of the Clean Water Act (CWA), the Carson Water Subconservancy District (CWSD) has developed the Water Quality Management (208) Plan for the Carson River, with a 20-year planning horizon to 2025. For areas receiving a "Designated Area" status (areas having substantial water quality control problems), Section 208 of the CWA requires that activities associated with water pollution issues be planned and managed through an integrated water quality management program. In 2003, the Governor of Nevada designated CWSD as the 208 planning agency for the Carson River Basin.

Pursuant to Section 303(d) of the CWA, Nevada's 303(d) List of Impaired Waterbodies documents areas where water quality standards and designated beneficial uses are not being met or supported. The 2002 303(d) List for the Carson River indicates that: 1) the majority of reaches exceed aquatic life water quality standards; 2) the water quality parameters of concern include temperature, total iron, total phosphorus, turbidity and total suspended solids (TSS); and 3) nonpoint sources are the principal contributors to impaired reaches. The CWA requires that Total Maximum Daily Loads (TMDLs) be developed for waters on the 303(d) List. Nevada Division of Environmental Protection (NDEP) is currently revising the TMDLs for the Carson River Basin.

Potential nonpoint pollution sources include watershed and streambank erosion, irrigation return flow, degraded channel and riparian condition, mining, runoff from urban and agricultural land, and natural conditions. The Carson River Mercury Site (CRMS), a National Priority Listed (NPL) site listed in August 1990, impacts the Carson River and affects Lahontan Reservoir and the Stillwater wetlands. Nonpoint sources of pollution in the Carson River Basin include agriculture, construction, hydrologic modification, habitat modification, silviculture, land disposal (i.e., effluent reuse and septic systems) and urbanization. The effects of nonpoint sources can be lessened by employing Best Management Practices (BMPs), as outlined in the 1994 *Handbook of Best Management Practices.*

Identified sources of pollution in the Carson River Basin include stormwater runoff, contaminant plumes, and septic tank and wastewater treatment facility (WWTF) discharges to groundwater. (No WWTFs discharge to the Carson River, as discharges ceased in 1987). There are four regulated small municipal separate storm sewer systems (MS4s) in the Carson River Basin: Carson City, Douglas County, Indian Hills GID, and NDOT. Each MS4 is required to have an approved Stormwater Management Plan (SWMP) that addresses public education and outreach, public involvement/participation, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention/good housekeeping. Two identified contaminant plumes within the Basin, the Bently and Mallory plumes, are currently being managed under the direction of NDEP. Impacts to groundwater from septic tanks occur throughout the Basin, and have been the subject of more detailed studies by the U.S. Geological Survey (USGS) in Douglas County. The USGS confirmed that the highest nitrate concentrations in groundwater occurred near, or directly under, areas with high concentrations of septic tanks.

Utilities and agencies that operate WWTFs and/or effluent disposal/reuse areas within the Carson River Basin, designated as point sources to groundwater, include:

- Markleeville Public Utilities District (PUD)
- South Tahoe Public Utilities District (STPUD)
- U.S. Fish and Wildlife Service Fish Hatchery
- Incline Village General Improvement District (IVGID)
- North Valley WWTF (NVWWTF)
- Douglas County Sewer Improvement District #1
- Minden Gardnerville Sanitation District (MGSD)
- Indian Hills General Improvement District (IHGID)
- Carson City Wastewater Reclamation Plant (WRP)
- Carson Highlands WWTF
- South Dayton WWTF
- North Dayton WWTF
- Rolling A WWTF
- Silver Springs General Improvement District (GID)
- City of Fallon
- Churchill County

WWTFs with planned expansions by the year 2025 include: IVGID, up to 3.62 million gallons per day (mgd); NVWWTF, up to 2.0 mgd; MGSD, up to 3.7 mgd; Carson City WRP, up to 8.8 mgd; South Dayton WWTF, up to 2.0 mgd; Rolling A WWTF, up to 4.0 mgd; Silver Springs GID, up to 0.6 mgd; and Churchill County; up to 0.75-0.8 mgd. These WWTFs beneficially use treated effluent in a variety of ways including: 1) irrigation water for agricultural lands, parks, golf courses, roadway landscaping and schools; 2) creation of wetlands habitat; and 3) dust control for construction and aggregate operations. Some WWTFs employ evaporation and percolation of effluent through rapid infiltration basins (RIBs) and leach fields, which result in discharges to groundwater.

This updated 208 Plan will allow State and local governments to manage water resources in the Basin by: 1) integrating information concerning existing water quality conditions in the watershed; 2) projecting wastewater loads (point sources) from WWTFs in the Basin; 3) managing runoff volume and quality from urban stormwater control systems; and 4) evaluating effects from nonpoint sources of pollution including agriculture, construction, mining and silviculture. This 208 Plan recommends that additional feasibility studies be conducted to evaluate the environmental and economic effects of potential direct or indirect discharges of treated effluent to the Carson River, a practice that ceased in 1987. NPDES discharge permits of limited time duration could be considered for special circumstances associated with construction activities at WWTFs in the Basin (e.g., plant upgrades or lining of effluent storage reservoirs). Water quality and flow monitoring data collected during time-limited discharges of treated effluent to the Carson River would provide valuable background information for evaluating higher levels of treatment and the effects of longer term discharges. Appropriate wasteload allocations would have to be established prior to permitting any discharge to the Carson River.

SECTION 1.0
INTRODUCTION

This Water Quality Management Plan ("208 Plan") for the Carson River Basin is an update of the 1982 208 Plan. This updated 208 Plan incorporates current information on point and nonpoint sources in the watershed related to population growth and increases in the use of surface and groundwater resources. This 208 Plan looks at existing and projected wastewater loads from wastewater treatment facilities (WWTFs) in the Carson River Basin, stormwater management issues associated with urban runoff and highway construction and other construction projects, and potential nonpoint sources of pollution. This revised 208 Plan incorporates a 20-year planning period for population projections and related changes in both point and nonpoint discharges to the Carson River and to groundwater. Since the 1982 208 Plan was published, the following changes affecting surface water and groundwater quality have occurred:

- The discharge of effluent to the Carson River from WWTFs ceased in 1987 with treated effluent currently being used for irrigation purposes.
- Best management practices (BMPs) have been implemented for ranch and farm operations and urbanized areas with a large emphasis on managing phosphorus.
- Dairy operations have diminished from 14 to 2.

A major difference between the 1982 208 Plan and this updated version is that no total maximum daily loads (TMDLs) to the Carson River or waste load allocations (WLA) are calculated in this 208 Plan.

Potential discharge to the Carson River by WWTFs is an option currently being examined for effluent management, as long as water quality standards (WQS) and TMDLs are complied with. This option may be needed in the future as the availability of effluent land application reuse sites decreases in the Carson River Basin. Discharging treated effluent to the river may also be more cost effective than building additional effluent storage reservoirs and developing reuse sites. Highly treated effluent could be discharged to the river during both low and high flow periods.

Discharge during low flow periods would enhance river flow and promote in-stream beneficial uses. High flow discharges would add effluent to the river during a time when dilution and mixing of treated effluent would be high. This option for dealing with treated effluent should be examined as part of a feasibility study for managing effluent in the Carson River Basin. The impact of increased loading to Lahontan Reservoir has to be considered in any effluent discharge feasibility study for the Carson River and during any process to revise TMDLs. Appropriate wasteload allocations would have to be established prior to permitting any discharge to the Carson River.

This 208 Plan has been prepared in conjunction with the Carson Water Subconservancy District (CWSD), the Nevada Division of Environmental Protection – Bureau of Water Quality Planning (NDEP) and the U.S. Environmental Protection Agency (EPA). The location of the Carson River Basin is shown in Figure 1-1.

1.1 208 Plan Objective

The 208 Plan for the Carson River is a planning document for management of discharges in the Carson River Basin that will be used in permit writing in the future as designated in the Code of Federal Regulations (CFR). The objective of this revised 208 Plan is to allow State and local governments to best manage water resources in the Carson River Basin by integrating the following information for an approximate 20-year planning period (i.e., through 2025):

- Existing water quality conditions in the watershed, identified for specific reaches of the Carson River and groundwater areas.
- Locations of WWTFs, projected wastewater loads, pre-treatment requirements and effluent quality.
- Projected runoff volumes and quality from urban stormwater control systems.
- Anticipated effects of construction-related sources of pollution.
- Effects of nonpoint sources of pollution from agricultural and silvicultural activities, including return flows from irrigated lands.

1.2 Clean Water Act and Section 208

The overall goal of the Clean Water Act (CWA) is to restore and maintain the chemical, physical and biological integrity of the Nation's surface water resources. One important objective of the CWA is to provide the framework upon which individual States can implement regulations to manage the quality of surface waters within their boundaries and surface waters shared with adjoining States. Key elements of the CWA include: 1) determining the WQS, which are the goals for maximum pollutant levels based on the intended use of the water; 2) developing an ongoing monitoring program of current water quality; and 3) implementing strategies to reduce pollutant discharges in order to achieve the water quality goals, maintain acceptable water quality and promote anti-degradation practices.

Under the CWA, the governor of each State was given the authority and mandate to identify the boundaries of areas identified as having substantial water quality control problems as a result of urban-industrial concentrations or other factors. The governor is directed to identify a representative organization to develop areawide waste treatment management plans for each identified area. Section 208 requires that all activities associated with water pollution issues be planned and managed through an integrated areawide water quality management program.

There are four areas within the State of Nevada which have been assigned "Designated Area" status. The designated areas and the agencies responsible for the 208 planning effort are as follows:

- Carson River Basin -- Carson Water Subconservancy District;
- Clark County -- Clark County Comprehensive Planning Agency;
- Lake Tahoe Basin (bi-state) -- Tahoe Regional Planning Agency; and,
- Washoe County except for the Pyramid Lake Paiute Reservation -- Truckee Meadows Regional Planning Agency.

During the 1970s and early 1980s, CRBCOG (Carson River Basin Council of Governments) was the designated 208 planning agency for the Carson River Basin. In 1982, the CRBCOG and

NDEP developed the previous update to the 208 Plan. Sometime later due to funding cuts, CRBCOG was dissolved leaving NDEP with the responsibility for Carson Basin 208 planning.

NDEP recognized that local stakeholders have better insights into the needs of the river, and recommended that the Governor designate CWSD as the 208 planning entity for the Carson River watershed within Nevada. In 2003, the CWSD was designated as the Carson 208 Planning entity.

1.3 Document Organization

A list of acronyms, abbreviations and technical terms is provided before the executive summary to facilitate the reading process. Section 2.0 and 3.0 provide an overview of the physical setting of, and socioeconomic conditions within, the Carson River Basin. Projections of population growth presented in Section 3.0 are derived from previous studies prepared for CWSD and for the individual water and wastewater utilities in the watershed. Section 4.0 provides an overview of water quality issues, looking specifically at Nevada's 2002 303(d) Impaired Waters List.

Sections 5.0 through 7.0 provide an update of existing and projected potential sources of pollution to the Carson River. BMPs and monitoring of potential impacts are also discussed in these sections. Section 5.0 describes wastewater treatment and effluent management facilities. Emphasis is placed on projected wastewater loads and facility expansion by 2025. Other point sources (e.g., urban runoff) are described in Section 6.0. Nonpoint sources (e.g., agricultural runoff) are described in Section 7.0.

Updated watershed information presented in this revised 208 Plan is summarized in Section 8.0. Recommendations for follow-up plan-related activities are also provided in Section 8.0. Section 9.0 lists references cited in the document.

SECTION 2.0
PHYSICAL CHARACTERISTICS OF THE CARSON RIVER BASIN

This section of the revised 208 Plan describes the physical setting of the Carson River Basin, as presented in Brown and Caldwell (2000).

2.1 Location, Topography and Hydrographic Areas

The Carson River Basin (Figure 1-1) covers an area of approximately 3,965 square miles (mi^2) in northwest Nevada (Nevada Division of Water Planning, 1997). Based on topographic features, the watershed is divided into five groundwater basins and a headwaters area located in the Carson Range, a portion of the Sierra Nevada within Alpine County, California. The five groundwater basins (or hydrographic areas) include Carson Valley (no. 105), Eagle Valley (no. 104), Dayton Valley (no. 103), Churchill Valley (no. 102) and Carson Desert (no. 101). These basins, with the exception of a small portion of the Carson Valley Basin (approximately 112 mi^2 in California), are located within Nevada. A total of 606 mi^2 of the Carson River Basin lies within the State of California (Nevada Division of Water Planning, 1997).

The Packard Valley hydrographic area (no. 101A) is located east of the Carson Desert Basin. The White Plains hydrographic area (no. 74) is located at the termination of the Humboldt River Basin, north of the Carson Desert Basin. Potential pollution sources in these hydrographic areas may influence the water quality in the Carson Sink or Stillwater wetlands, but these areas are not direct tributaries to the Carson River (Figure 1-1).

The Carson River Basin is characterized by partly filled alluvial valleys that range in elevation from about 3,000 to 6,000 feet above mean sea level (amsl). The valleys are surrounded by mountains that range in elevation from 6,000 to 11,000 feet amsl. The mountains are flanked by alluvial fans that merge onto the valley floors and floodplains of the Carson River. The headwater area of the Carson River in the Sierra Nevada is at an elevation of 11,000 feet amsl, and the Carson Sink is at an elevation of 3,800 feet amsl.

The Carson Valley hydrographic area is approximately 419 mi^2 in size, and is located between the Carson Range of the Sierra Nevada to the west and the Pine Nut Mountains to the east (Nevada Division of Water Planning, 1997). At the south end of this basin, the East and West Forks of the Carson River enter the valley from the headwaters area and join together as the main stem in the north part of the valley.

Eagle Valley, at approximately 69 mi^2, is the smallest hydrographic area in the watershed (Nevada Division of Water Planning, 1997). It is bounded to the west by the Carson Range, to the north by the Virginia Range, and to the east by Prison Hill. The Carson River does not flow through Eagle Valley, but through the Riverview sub-basin, a portion of the Dayton Valley hydrographic area. Ephemeral streams that flow eastward from the Carson Range through Eagle Valley (e.g., Clear Creek) may reach the Carson River.

The Dayton Valley and Churchill Valley hydrographic areas are located in the east-central part of the watershed. The Dayton Valley hydrographic area, with an area of about 369 mi^2, includes the Dayton and Stagecoach Valleys, and is bounded to the north by the Virginia Range and to the south by the Pine Nut Mountains (Nevada Division of Water Planning, 1997). Hydrographic sub-basins in the Dayton Valley hydrographic area include the Riverview, Mound House, Carson Plains and Stagecoach sub-basins. Major tributaries to the Carson River in the Dayton Valley hydrographic area include Brunswick, El Dorado and Six Mile Canyons, which are ephemeral creeks. Flows in these tributaries are generally of short duration and provide relatively small volumes of water to the Carson River (Maurer, 1997).

The Churchill Valley hydrographic area covers approximately 480 mi^2 and is bounded to the north by the Virginia Range, to the east by the Dead Camel Mountains and to the south by the Desert Mountains (Nevada Division of Water Planning, 1997). The Churchill Valley floodplain is largely occupied by the Lahontan Reservoir, which was created as part of the Newlands Project in 1915, and demarcates the upper and lower portions of the watershed. Truckee River water diverted from Derby Dam near Fernley, Nevada enters the reservoir through the Truckee Canal, also established as part of the Newlands Project (Figure 1-1).

The Carson Desert Basin, at approximately 2,022 mi^2, is the largest of the five major hydrographic areas in the Carson River Basin. The Carson Desert Basin is bounded by the Hot Springs Mountains and East Humboldt Range to the northwest, the Desert Mountains to the south and the Stillwater Range to the east. The Carson River flows eastward from Lahontan Reservoir through a network of irrigation canals. Water from irrigation return flow drains southward to Carson Lake and northeastward to the Stillwater wetlands and the Carson Sink, the terminus of the Carson River. During years of high precipitation and runoff, the Carson Sink may receive surface water flows from the Humboldt Sink (White Plains sub-basin), the terminus of the Humboldt River.

The White Plains and Packard Valley hydrographic areas cover approximately 160 mi^2 and 180 mi^2, respectively.

2.2 Climate

Climatic conditions within the Carson River Basin are summarized in the following tables (Tables 2-1 through 2-4) with precipitation and temperature data from the Minden, Carson City, Lahontan and Fallon weather stations. These data were obtained from the Western Regional Climate Center (WRCC) at the Desert Research Institute (DRI) (WRCC, http://www.wrcc.dri.edu/). Although the headwaters portion of the Carson River Basin in the Sierra Nevada typically receives more than 40 inches per year of precipitation, mostly as snowfall, the hydrographic areas in Nevada receive significantly less precipitation. The average annual values for total precipitation recorded at the Lahontan and Fallon stations (4.56 and 4.98 inches respectively) are about one-half the values recorded at Minden and Carson City (8.32 and 10.49 inches respectively), and about one-tenth of the amount in the headwaters area.

Table 2-1. Climate Data for Minden, Nevada (265191) Average Values for the Period of Record (1/1/1928 to 12/31/2003)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	45.6	50.9	57.1	64	72.6	81.9	90.6	89.5	81.9	70.9	56.4	47.4	67.4
Average Min. Temperature (F)	17.5	21.5	25.2	30	36.8	42.8	47.7	45.6	38.9	30.3	22.8	18.2	31.4
Average Total Precipitation (in.)	1.39	1.13	0.88	0.46	0.49	0.42	0.28	0.3	0.29	0.48	0.86	1.34	8.32
Average Total Snowfall (in.)	5.2	3.1	2.8	1.3	0.2	0.1	0	0	0	0.2	1.2	4.2	18.2
Average Snow Depth (in.)	1	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 97.1%, Min. Temp.: 97.4%, Precipitation: 97.9%, Snowfall: 91.4%, Snow Depth: 88.7%

Table 2-2. Climate Data for Carson City, Nevada (261485) Period of Record Monthly Climate Summary Period of Record: 7/1/1948 to 12/31/2003													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	45.6	50.8	55.8	62.6	71.1	80.5	89	87.5	80.4	69.5	55.6	46.8	66.3
Average Min. Temperature (F)	20.9	24.6	28.5	32.7	39.5	46	50.8	48.8	41.9	33.2	26.1	21.1	34.5
Average Total Precipitation (in.)	1.96	1.47	1.11	0.5	0.58	0.44	0.24	0.25	0.42	0.56	1.22	1.75	10.49
Average Total Snowfall (in.)	6.3	4	3.2	1.1	0.5	0	0	0	0.1	0.2	1.2	4.6	21
Average Snow Depth (in.)	1	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 99.2%, Min. Temp.: 99%, Precipitation: 99.1%, Snowfall: 96.9%, Snow Depth: 94.4%

Table 2-3. Climate Data for Lahontan, Nevada (264349)													
Period of Record Monthly Climate Summary													
Period of Record : 7/1/1948 to 11/30/2003													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	44.5	51.1	57.5	65.3	74.7	84.4	93.7	91.9	82.7	70.4	55.9	45.9	68.2
Average Min. Temperature (F)	22.6	27.1	32.5	38.8	47.1	55.1	63	61.1	52.5	42.2	31.3	23.6	41.4
Average Total Precipitation (in.)	0.51	0.39	0.4	0.36	0.54	0.41	0.25	0.34	0.34	0.26	0.4	0.36	4.56
Average Total Snowfall (in.)	2.1	0.9	1	0.3	0.1	0	0	0	0	0	0.3	1	5.7
Average Snow Depth (in.)	0	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 93.1%, Min. Temp.: 92.9%, Precipitation: 94.3%, Snowfall: 90.7%, Snow Depth: 86.2%

Table 2-4. Climate Data for Fallon Experiment Station, Nevada (262780)													
Period of Record Monthly Climate Summary													
Period of Record : 1/1/1903 to 12/31/2003													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	44.4	51.3	58.8	65.9	74	83.1	92	90	81	69.3	55.4	45.7	67.6
Average Min. Temperature (F)	18	23.1	27.7	33.9	41.3	47.8	53.8	51.3	43.1	33.7	24.7	18.9	34.8
Average Total Precipitation (in.)	0.53	0.53	0.45	0.5	0.61	0.44	0.16	0.23	0.3	0.39	0.37	0.47	4.98
Average Total Snowfall (in.)	2	1	0.9	0.2	0.1	0	0	0	0	0.1	0.5	1.2	5.9
Average Snow Depth (in.)	1	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 97.8%, Min. Temp.: 97.7%, Precipitation: 97.9%, Snowfall: 97.1%, Snow Depth: 95.5%

2.3 Surface Water Hydrology

Annual and monthly precipitation rates and temperatures, accumulated snowpack and runoff characteristics in the headwaters and tributary areas of the Carson River Basin are the major factors that influence hydrologic conditions in the river. The volume and duration of surface water flows also affect water quality conditions in the river and, along with precipitation characteristics, affect groundwater recharge and groundwater quality conditions. This section presents qualitative descriptions and quantitative data for recorded river flows as a framework for assessing water quality conditions.

Carson River Setting

The East and West Forks of the Carson River flow from their headwaters in California in a northerly direction into the Carson Valley hydrographic area (Figure 1-1). Within the Carson Valley, both forks flow through an intricate and complex irrigation and diversion system. In the northern portion of the valley, the forks join to form the Carson River. The river continues north through the Riverview sub-basin of the Dayton Valley hydrographic area before turning northeast and passing through Brunswick Canyon. As the river emerges from Brunswick Canyon, it enters Dayton Valley where it turns east and flows into Churchill Valley to the Lahontan Reservoir. The reservoir also receives a portion of Truckee River flows released from Derby Dam through the Truckee Canal. The water stored in Lahontan Reservoir is used in the downstream agricultural area of the Carson Desert hydrographic area as part of the Newlands Irrigation Project. The eastern margin of the reservoir coincides with the hydrographic boundary. Within the Carson Desert hydrographic area, the river either flows south to Carson Lake or east through numerous canals to the Carson Sink and the Stillwater wetlands.

A schematic flow diagram of the Carson River prepared by the U.S. Geological Survey (USGS) is presented as Figure 2-1 (USGS, 1996). This schematic depicts the major tributaries to the river, gaging stations maintained by the USGS, irrigation conveyance features (diversions, drains, canals and sloughs), storage facilities including reservoirs and ponds, areas of municipal and irrigation use and terminal areas at Carson Lake and the Carson Sink.

Carson River Flow Data

Flows in the Carson River are monitored by a number of USGS gaging stations, shown in Figure 2-2. These gaging stations generally define Carson River flows between hydrographic basins and political boundaries. The gages with relatively long and continuous periods of record, used in this report, are summarized in the Table 2-5. Flows measured in the 2003 water year (October 1, 2002 through September 30, 2003) and average annual flow data for the period of record for these gaging stations are summarized in Table 2-6. Appendix A contains a map of gaging stations (Figure A-1; same as Figure 2-2) and hydrographs (Figures A-2 through A-6) depicting total annual flows at each gaging station for the period of record through the 2003 water year (USGS, http://waterdata.usgs.gov/nv/nwis).

Table 2-5. Carson River Gaging Stations

USGS Gaging Station ID Number	Gaging Station Name and Location	Period of Record
10309000	East Fork Carson River near Gardnerville, NV	1940-Present
10310000	West Fork Carson River near Woodfords, CA	1938-Present
10311000	Carson River near Carson City, NV	1939-Present
10312000	Carson River near Fort Churchill, NV	1911-Present
10312150	Carson River below Lahontan Reservoir	1966-Present

Table 2-6. Carson River Flow Data (values in acre-feet)

USGS Gaging Station ID Number	Gage Name/Location	Flow for Water Year 2003	Average Annual Flow
10309000	East Fork Carson River near Gardnerville, NV	225,446	265,139
10310000	West Fork Carson River near Woodfords, CA	64,762	75,264
10311000	Carson River near Carson City, NV	218,407	295,109
10312000	Carson River near Fort Churchill, NV	198,710	271,343
10312150	Carson River below Lahontan Reservoir	262,616	363,668

Inflows of the Carson River to the Carson Valley for the 2003 water year totaled approximately 290,208 acre-feet per year (afy), including 225,446 afy in the East Fork and 64,762 afy in the West Fork. Carson River flows that leave the Carson Valley, including irrigation tail water, are measured at the gaging station, located near Carson City. For the 2003 water year, this gage measured 218,407 afy. Carson River flows leaving the Dayton Valley basin at the Fort Churchill gaging station for the 2003 water year were 198,710 afy. Releases from Lahontan Reservoir to the Carson River, which include Truckee River water conveyed by the Truckee Canal, were 262,616 afy for the 2003 water year (USGS, http://waterdata.usgs.gov/nv/nwis). All of these values are below the average annual discharge measurements for these gaging stations for their respective periods of record (Table 2-6).

As indicated previously, Carson River flows will vary from year to year as a function of precipitation. For example, in the 1977 drought year, approximately 42,360 afy flowed past the Carson City gaging station. During the 1993 high-water year, 826,700 afy was recorded at this gaging station (USGS, http://waterdata.usgs.gov/nv/nwis).

SECTION 3.0

SOCIOECONOMIC CONDITIONS IN THE CARSON RIVER BASIN

The physical setting of the Carson River Basin has somewhat influenced the occurrence and size of population centers. Localized urban and residential areas (often located along or near the river) are separated by larger areas of ranchlands and farmlands. Elevated topographic features such as hills and mountain ranges also separate population centers. These topographic constraints have also influenced the disposition of private and public lands.

3.1 Socioeconomic Conditions

The following socioeconomic descriptions of Counties within the Carson River Basin were presented in a series of overviews prepared in 1999 by the Nevada Division of Water Planning (NDWP), and are updated with recent data from the Nevada State Demographer.

Douglas County (Carson Valley Hydrographic Area)

Douglas County's population is primarily concentrated in the Carson Valley, which contains the towns of Minden and Gardnerville, the East Valley and Indian Hills areas and the Stateline/Kingsbury area of Lake Tahoe. The 2000 census indicated a total population in the County of 41,259 persons. Of this total, 31,979 persons were counted in Census Designated Places (CDPs) in the County (the remaining population was presumably located on residences and ranches in the Carson Valley because of the limited housing areas in the Stateline/Kingsbury area). In 2000, the population of the Gardnerville Ranchos CDP was 11,054 persons, the Gardnerville CDP was 3,357 persons, the Minden CDP was 2,836 persons, the Johnson Lane CDP was 4,837 persons and the Indian Hills CDP was 4,407 persons.

A 2002 County population estimate by the State Demographer of 43,189 persons indicates a population increase of about 5 percent over the two-year period. The number of housing units in 2000 for the County was estimated at 16,401 units, and the number of persons per household in 2000 was estimated at 2.5. The population density in the County was approximately 58 persons

per mi^2 for a County-side area of 710 mi^2. The average age of Douglas County's population was estimated at 38.1 years in 1997 (NDWP, 1999a).

Douglas County's ratio of covered employment (i.e., workers covered under State and Federal unemployment insurance programs) to its 1997 total population (a proxy measure of the County's labor force participation rate) was estimated at about 49 percent, the fourth highest of any County in Nevada (after Eureka and Washoe Counties and Carson City). This percentage results, in part, from somewhat higher employment rates in the Stateline area (i.e., casino workers who live in California). However, many workers in Carson City reside in the Carson Valley (NDWP, 1999a).

Jobs in the service industry accounted for approximately 57 percent, and jobs in the wholesale and retail trades accounted for approximately 12 percent of total employment in Douglas County. Service industry jobs accounted for approximately 53 percent of Douglas County residents' payrolls. Trade jobs accounted for approximately 9 percent of total payrolls, and manufacturing jobs accounted for approximately 11 percent of total payrolls. The highest average annual salary in Douglas County in 1997 was in the mining industry (with only 35 workers) that, at $47,738 per worker, was estimated to be about 90 percent greater than the County's average annual salary of about $25,000 per worker (the per capita income in 1999 was estimated at $27,288). The lowest average annual salary of about $18,000 was in the County's wholesale and retail trade sector. Based on U.S. Department of Commerce job classifications, Douglas County's agriculture services industry was estimated to have 593 workers and comprise approximately 2.2 percent of all employment in 1996 (NDWP, 1999a).

Carson City (Eagle Valley and Riverview Hydrographic Areas)

Carson City's population was estimated at 52,457 persons in 2000 and 54,311 persons in 2002, resulting in a 3.5 percent increase for the approximate two-year period. During the years between 1990 and 2000, Carson City's population growth averaged approximately 3.0 percent per year. The average age of Carson City residents in 1997 was estimated at 38.3 years, compared to Nevada's overall population's average age estimate of 35.6 years by NDWP

(1999b). Based on the 2000 population, Carson City's population density was about 366 persons per mi^2, for an area of 143 mi^2. This statistic designates Carson City as one of the more densely populated areas in Nevada (the average population density in the State was 16.1 persons per mi^2; NDWP, 1999b). The number of households counted in the 2000 census totaled 20,171, resulting in a value of 2.44 persons per household.

Carson City's ratio of covered employment to its total population was estimated at about 55 percent, the third highest in Nevada (the statewide average labor force participation rate was about 50 percent). This ratio for Carson City results from an employment migration pattern where persons working in Carson City live in adjoining Washoe, Douglas, Storey and Lyon counties (NDWP, 1999b). On the basis of a total covered employment of 27,821 workers in 1997 (excluding agriculture), the estimated 9,112 jobs in the city's government sector (Federal, State and municipal) represented about 33 percent of the total. Approximately 3,700 jobs in the manufacturing sector accounted for approximately 13 percent of total employment, and retail jobs accounted for 21 percent. Government jobs accounted for about 40 percent, manufacturing jobs accounted for about 15 percent, and combined wholesale and retail trade jobs accounted for about 15 percent of total payrolls in 1997 (NDWP, 1999b).

The highest average annual salary earned in Carson City in 1997 was in the mining industry, at $42,183 per worker per year (note that this industry had only ten workers). Government jobs paid an average salary of $33,703 per worker per year (24.7 percent greater than Carson City's all-industry average salary). The lowest average annual salary was in Carson City's wholesale and retail trade jobs. The salary was $19,150 per worker per year (about 71 percent of the overall average annual wage of $27,021; the per capita income in 1999 was estimated at $20,943) (NDWP, 1999b).

Based on U.S. Department of Commerce employment figures, the combined number of agriculture, forestry and fishing related employment was estimated at 259 workers in 1996 (less than one percent of all jobs within Carson City). Of this total, 228 workers were in the agricultural services, forestry and fishery occupations, primarily consisting of workers in

landscaping and lawn service jobs. Only 31 workers were in farming occupations (NDWP, 1999b). Although government jobs dominate Carson City's employment and payroll, manufacturing employment in Carson City was one of the highest in Nevada (trailing Las Vegas, Reno and South Lake Tahoe). Gaming revenues in 1997 were estimated to be less than one percent statewide (gaming revenues for Carson City's casinos were reported with those of Carson Valley).

Lyon County (Dayton Valley and Churchill Valley Hydrographic Area)

The Lyon County communities of socioeconomic interest to this 208 Plan are Mound House, Dayton, Stagecoach and Silver Springs. The population of Lyon County was estimated at 34,501 persons in 2000, including the cities of Fernley and Yerington that are not located in the Carson River Basin. The number of households in Lyon County in 2000 was estimated at 13,007, resulting in a value of 2.61 persons per household (the number of households in the County increased to 14,828 in 2002). In 2000, the Dayton and Silver Springs CDPs, which includes Stagecoach, had estimated populations of 5,907 and 4,708 persons, respectively. By 2002, the population in Lyon County was estimated to grow about 10 percent to 37,879 persons, averaging just below five percent per year. Between 1990 and 2000, Lyon County's population growth averaged 5.7 percent per year (NDWP, 1999c).

Because of the geographic dispersion of population centers in various hydrographic basins (Truckee, Carson and Walker River Basins), some of the following statistics may not be completely representative of the communities in the Carson River Basin. In 1997, the average age of Lyon County's population was estimated at about 38 years, making the County the sixth "oldest" in the State. Based on the 1997 population estimate, the population density of Lyon County was approximately 15 persons per mi^2, the fifth highest in Nevada after Carson City, Clark, Douglas and Washoe Counties (the average population density was estimated at 16 persons per mi^2 for the entire State; NDWP, 1999c). Approximately 25 percent of Lyon County's ratio of its 1997 covered employment to its 1997 total population was about 25 percent (compared to a statewide average labor force participation rate of about 50 percent). This statistic takes into account the fact that the Dayton area serves as a "bedroom" community for

Carson City and other areas with higher employment rates. Based on Lyon County's 1997 total covered employment of 7,658 persons (excluding agriculture), the largest concentration of employment was in the service industries, which totaled 2,053 workers and accounted for about 27 percent of all jobs in 1996. Manufacturing accounted for 1,505 workers in 1997, and accounted for about 20 percent of total employment (the highest percentage of manufacturing employment for any County in Nevada). Note that the majority of these jobs were concentrated in and around Fernley and, to a lesser extent, Dayton (NDWP, 1999c).

Lyon County's all-industry average wage rate was $23,770 per worker per year in 1997 (the lowest in Nevada; the per capita income in 1999 was estimated at $18,543). The highest wage rate in Lyon County in 1997 belonged to State government workers, who earned an average of $34,853 per year. Service industry jobs averaged $19,161 per year in 1997. Manufacturing employment, which has shown the most rapid growth in recent years, averaged $29,419 in annual earnings (NDWP, 1999c).

Churchill County (Carson Desert Hydrographic Area)

Churchill County's population was estimated at 23,983 persons in 2000 and 24,022 persons in 2002, resulting in a 0.2 percent increase for the approximate two-year period. In 1997, the average age of Churchill County's population was estimated at about 35 years, statistically close to Nevada's overall average age of 35.6 years. Based on 1997 population estimates, Churchill County's population density was estimated at approximately five persons per mi^2, the seventh highest in Nevada (NDWP, 1999d). Based on the 2000 population, Churchill County's population density was about 5 persons per mi^2, for an area of 4,929 mi^2. This statistic designates Churchill County as the least populated County in the Carson River Basin, and in Nevada (the average population density in the State was 16.1 persons per mi^2; NDWP, 1999d). The number of households counted in the 2000 census totaled 8,912, resulting in a value of 2.64 persons per household.

The Lahontan Valley area of Churchill County contains the Newlands Irrigation Project, which consists of two divisions (the Carson Division and the Truckee Division) totaling some 60,000

acres of water-righted farmland, and is one of the most productive agricultural regions in Nevada. The Carson Division consists of approximately 56,000 water-righted acres lying all within Churchill County, and receives its surface irrigation water from Lahontan Reservoir and the combined flows of the Carson River and diverted Truckee River flows. The Truckee Division, which consists of approximately 4,000 water-righted acres lying within both Churchill and Lyon counties, is served solely by Truckee River waters diverted via the Truckee Canal. The Truckee Canal, completed in 1906, represents the hydrologic link between the Truckee and Carson River Basins, transferring waters from the lower Truckee River at Derby Dam via a 32.5 mile long canal to Lahontan Reservoir on the lower Carson River (Brown and Caldwell, 2000).

Churchill County's ratio of its 1997 covered employment to its 1997 total population was estimated at about 32 percent (compared to an estimated statewide average labor force participation rate of about 50 percent) (NDWP, 1999d). This statistic likely underestimates the County's labor force participation rate due to the number of agricultural jobs. Typically, some seasonal agricultural jobs are unreported and sole proprietorships in agriculture are not counted in the State and County employment figures. In addition, this statistic results from the "bedroom community" status of Churchill County for persons working in Carson City, Fernley (Lyon County) and the Reno-Sparks area of Washoe County.

The greatest percentage of Churchill County workers were in the service industries, which accounted for about 34 percent of total employment in 1997. Total government jobs also accounted for a large portion of the County's overall employment levels at about 23 percent. Churchill County's agricultural, forestry and fishing employment was estimated at 782 jobs in 1995, comprising approximately 7 percent of all employment within Churchill County as compared to 14 percent in 1970 (NDWP, 1999d).

The highest average annual salary earned in Churchill County in 1997 was in transportation and public utility jobs at $39,646 per worker. Service industry jobs, which accounted for over one-third of all County jobs, paid an average salary of $23,907 per worker. The lowest average annual salary was in the County's wholesale and retail trade jobs, at $15,176 per worker per year

(NDWP, 1999d). These jobs paid only 61.3 percent of the County's overall average annual wage in 1997. Relative to Nevada's seventeen counties, Churchill County's 1997 average wage rate was the second lowest.

3.2 Projected Population Growth and Land Use Changes

Population growth and economic development activities in the Carson River Basin since 1982, when the previous 208 Plan was published, have resulted in significant land use changes that are projected to continue over the next 20 years. Former open-range and agricultural lands have been converted to both low-density (i.e., one unit per acre or more) and relatively high-density (i.e., four or more units per acre) housing developments, commercial areas and industrial areas. To date, these land use changes have been particularly important in the Gardnerville Ranchos, Gardnerville, Minden, East Valley and Indian Hills areas of Douglas County, Carson City, the Mound House and Dayton areas of Lyon County and the Fallon area of Churchill County. It is anticipated that similar land use changes will continue over the next 20 years around and within the more developed and urbanized portions of the Basin. Such growth will be accompanied by a more centralized population, and associated growth of water supply and wastewater treatment systems. Land use planning efforts for these areas in the Carson River Basin are summarized below.

3.2.1 Douglas County

According to the Nevada State Demographer, the projected population of Douglas County in 2024 is 61,652 persons (2004). Douglas County does not have population projections that differ from the Nevada State Demographer's, unlike other counties in the Carson River Basin. Pursuant to the Douglas County Master Plan, adopted in 1996, the County established an Open Space and Agricultural Lands Preservation Plan ("Open Space Plan") in 2000. This has led the way in establishing approximately 848 acres in conservation/agricultural easements in the County. These areas are held by the Natural Resources Conservation Service (NRCS) and include portions of the River Fork Ranch and Sturgis Ranch. A select number of Master Plan goals guided the development of the Open Space Plan, as follows:

- To adopt a variety of appropriate growth management tools to direct future growth and land use.
- To establish goals, policies, implementation strategies and controls to protect and enhance the environmental and natural resources of Douglas County, including open spaces, wetlands, drainage ways, floodplains, steep slopes, forest lands, watersheds, range lands, scenic vistas, water resources and air quality.
- To protect and enhance the County's agricultural resources, to maintain these lands as a significant viable economic resource, and to preserve the Right to Farm by County ordinance.
- To ensure orderly development and limit the potential adverse effects of natural hazards, such as earthquake and flood hazards.
- To protect the water resources of Douglas County, which are vital to the very existence and well being of the citizens and future generations of the County.
- To protect and enhance the wildlife of Douglas County.

According to the Douglas County "Open Space Plan", there are 38,551 acres of zoned agricultural land in Douglas County, with 26 farms and ranches of 500 acres or more. Also, according to the Douglas County plan, 20,000 to 30,000 acres of agricultural area in Douglas County will need to be preserved for the goals of the plan to be achieved. Table 3-1 presents existing apportionment of acreage in Douglas County.

Table 3-1. Douglas County Acreage Values		
Total Douglas County Acreage	455,228	
Conservation/Agricultural Easements	848	
Flood Zone Conservation Easements	250	
Open Space/Common Areas	975	
Golf Course Open Space	773	
Tentative Open Space/Conservation Easements	687	
Open Common Area	644	
Historic Open Space	19	
Golf Course/Flood Zone	91	
Subtotal	4,287	0.94%
Bureau of Land Management	161,436	
Bureau of Indian Affairs	57,023	
Washoe Tribe	2,724	
USFS	82,175	
Other Federal	569	
State of Nevada	1,544	
Subtotal	305,471	67.10%
Douglas County	2,227	
Fire Districts	28	
Other Municipalities/Utilities	3,246	
School District	314	
Subtotal	5,815	1.28%
Remaining Acreage	139,655	30.68%

3.2.2 Carson City

The projected population for Carson City for 2025 is 80,000 persons (Carollo, 2003). Carson City updated its Land Use Plan Element to the Master Plan in 1996. Vacant and undeveloped public and private lands identified in the Land Use Plan were classified into zoning areas and included open areas around the airport, farmlands, scattered vacant tracts within neighborhoods and the foothills and mountains that surround the city. The Land Use Element of the Master Plan established guidelines for zoning areas and defined development thresholds by determining land use designations and standards for development and redevelopment of land within Carson City. Given the assumption that not all currently undeveloped land should be preserved as open space, the Land Use Plan Element identified the need for additional residential, commercial and industrial development, and for parks and other public uses. As shown in Table 3-2, the Land

Use Plan Element identified a total of 9,715 additional residential units on undeveloped land that would support a population increase of about 22,775 additional persons within Carson City.

Table 3-2. Estimated Undeveloped Number of Units in Carson City		
	Number of Units	**Additional Population**
Draft Land Use Plan (vacant)	5,109	12,262
Approved but not built	4,062	9,749
Apartments	381	762
Total	**9,715**	**22,773**

Subsequently, in 2000, Carson City developed its Open Space Plan that identified four categories for lands to be preserved:

- High visual values.
- Important environmental conditions.
- Areas important to the public health, safety and welfare.
- Areas of cultural/recreational importance.

Areas with environmental and public welfare importance include watersheds, wetlands, natural drainages and other areas subject to flooding and wellhead protection zones. Areas with cultural and recreational importance include historic sites, public lands, and equestrian, hiking or biking trails. Many of the lands that Carson City has committed to preserve as open space have been obtained through purchases or other legal agreements such as an easement or subdivision agreement. Priority areas for open space preservation included lands along the Carson River and the moderate to steep hillsides surrounding Carson City (i.e., urban interface with public lands). Given Carson City's Open Space Plan, Quality-of-Life initiative and existing land use zoning, some minor land use changes within the City could occur.

The 1996 Land Use Plan Element to the Master Plan indicated that there are 2,213 acres of agricultural land in Carson City. Of that area, 504 acres are developed and 1,709 acres are vacant. Vacant lands are defined as parcels without improvements or having only partial improvements. A total of 6,924 acres were identified as conservation reserve, with 1,167 acres of that being developed and 5,757 acres listed as vacant.

3.2.3 Lyon County

The projected population for Lyon County in 2025 is 50,000 persons (Brown and Caldwell, 2004b). In 2002, a Central Lyon County Land Use Plan was developed for the Mound House, Dayton and Silver City areas of the County. Dayton was identified as having: 1) an older central area with a unique historic character, with residential and commercial uses side by side; and 2) a growing suburban community to the east along the Highway 50 corridor. Within these two areas, four sub-areas were identified in the Land Use Plan:

- A mixed use area that includes the Golf Course, schools, Library, Senior Citizens Center, industrial park and a variety of housing units.
- An area located north and west of the Highway 50 corridor with single family homes on predominantly 6,000 square-foot lots, a general commercial corridor and neighborhood facilities.
- An area referred to as the "River District", located along the Carson River (above the floodway/floodplain), with large-lot single family homes and large ranches in this corridor (a number of these ranch lands are slated for residential development).
- The Mark Twain - Stagecoach area, located along the Highway 50 corridor east of Dayton and bordering on Storey County, with a mixture of housing and commercial development.

The Land Use Plan for these Dayton areas concluded that:

- The agricultural base of the community is gradually being converted to suburban land uses.
- The water rights must be protected relative to retention in the basin.
- There is a critical need to create a corridor plan for Highway 50 and the land uses that front/interface on a cooperative basis between the Nevada Department of Transportation (NDOT) and Lyon County.
- There is a critical need to define the river corridor relative to open space, flood control and adequate setbacks of development.
- The Dayton area is projected to grow in a mixed use pattern with a forecast population of 30,000 to 35,000 persons within the 20 year horizon.
- The historic connection of the Comstock with Silver City, Dayton and Mound House complements the existing character and enhances tourism.

- Neighborhood parks should be located in newly developing residential areas at a size of eight to ten acres. These should be placed approximately in relation to 400 to 500 homes.
- The County Commission seriously study existing animal migration patterns within Dayton Valley, Moundhouse and Silver Springs and seek measures that protect these corridors.
- Lyon County put in place land use review mechanisms that allow for planned unit developments that promote privately provided, dedicated open space.

Mound House has been an industrial area since the early Comstock mining boom in the 1860s (i.e., ore processing, support facilities and mine-related businesses). Presently, the area is a mixture of older industrial, mining uses, a variety of residential housing and newer industrial uses with commercial activities focused along Highway 50.

The Land Use Plan recommended that the County:

- Create an industrial/commercial zoning category along Highway 50.
- Improve the quality of residential housing and implement code enforcement policies for existing properties.
- Require better buffers around residential and industrial properties.
- Maintain historic and cultural features related to the Comstock for tourism.
- Develop open space corridors to allow for access to the foothills, animal migration and visual aesthetics.

Over the next 20 years, Mound House and, in particular, the Dayton area will be subjected to significant development pressure for residential housing and related commercial businesses. Industrial development is likely to be focused in Mound House but will also occur in the Dayton industrial park. The average annual rate of growth in the Dayton area over the past 8 years has been about 12 percent, based on utility records for water system hook-ups. The Lyon County Commissioners have approved the construction of up to 1,200 new residential units per year in the Dayton and Mound House areas that, as a function of market conditions, may increase the annual average growth rate. Part of the reason for the focus of residential development in western Lyon County is the limited growth potential in both the Carson Valley and Carson City.

Although the Silver Springs portion of Lyon County was not included in the 2002 Land Use Plan, it is assumed that growth in this area will generally follow the development projected for Dayton.

3.2.4 Churchill County

The projected population for Churchill County in 2025 is 52,000 persons (Brown and Caldwell, 2004a). Churchill County's 2003 update to its Master Plan presents policies developed to establish the physical extent and the character of the community within a 20-year planning period and quantifies the cost of the planned growth to the community in terms of additional infrastructure, services and required facilities. Water issues were identified as having the potential for imposing limitations on growth, and the County recognizes that a decline in acreage under irrigation will impact the environment and reduce recharge to groundwater aquifers that sustain the County's water supply. The Master Plan Update identified the following land use goals:

- Commercial areas, which maintain compactness.
- Definition, zoning and maintenance of lands presently controlled by Federal and other agencies to permit optimum use in accordance with the Master Plan.
- Protection of water areas, range lands, mountains and open views from development that would destroy their values.
- Development of commercial areas which maintain a compactness within a service region to create a high level of shopper convenience and drawing power rather than strip development.
- Coordinated city/County planning programs.

The land use element of the Master Plan recognizes that the population of the County will continue to increase and that most new residents have moved here from larger urban or metropolitan areas, which is a trend that is likely to continue. Despite some natural limitations and localized constraints, such as the uncertainty of the water allocation and the large areas of land controlled by Federal government agencies, Churchill County has sufficient space and resources to meet the needs of future development. The Master Plan update recognizes that: 1) this anticipated future growth be accommodated while maintaining the quality of life currently

enjoyed by the County's residents; and 2) the inherent increases in infrastructure and services be held to an efficient minimum so as not to impose increased tax burdens on the residents. These factors weighed heavily in the development of the land use plan element.

The general concept of the land use plan element is to provide for commercial, industrial and residential expansion in a concentric fashion from the existing urban center of Fallon under the following concepts:

- Allowing for gradual expansion of the County's services as the growth occurs and not requiring the provision of remote facilities.
- Retaining farmland for agricultural use.
- Directing urban development to vacant parcels in existing areas of like development.
- Preserving the County's agricultural and open spaces, and the character of Churchill County.
- Providing greater financial justification of the future development of County or joint city/County services such as water and sewage.
- Providing justification for increased joint city/County planning efforts.

Table 3-3 presents land use designations as of March 2003. Given the very large percentage of public and Federal lands in the County, the Master Plan land use plan element addresses Federal land use management issues and supports the continued multiple use of public lands. Churchill County's policies are intended to further agriculture, mining and recreation as economic benefits.

Table 3-3. Land Use Designation for Churchill County (March 2003)

Land Area	Acres	Percent of County
Federal	2,706,841	86.0
BLM	2,608,958	83.0
Bureau of Reclamation	8,347	0.27
Military	13,817	0.44
Other	45,620	1.45
Tribal	50,890	1.62
State	8,113	0.25
Local Government	35,349	1.12
TCID	4,275	0.14
Private Lands	423,346	13.46
Total County	**3,144,320**	

Acreages in agriculture are decreasing in Churchill County. In 1997, there were 53,933 acres in cropland and 129,058 acres in farmland in Churchill County. The average farm size was 253 acres. These acreages decreased from 1992 when there were 56,921 acres of cropland and 268,043 acres in farmland. The average farm size was 507 acres. In 1982, at the time when the previous 208 Plan was drafted, there were 64,023 acres in cropland and 356,330 acres in farmland. The average farm size was 717 acres. Decreasing agricultural acreages are giving rise to residential development. Churchill County anticipates that it will experience more residential growth in the form of smaller lot subdivisions than previous housing developments, and continued expansion of commercial business along Highway 50. The County plans to develop its own water and wastewater infrastructure to accommodate such development in accordance with the land use element of the 2003 Master Plan update. Initially, such development will occur along the western and northern boundaries of the City of Fallon.

SECTION 4.0
WATER QUALITY ISSUES

This section of the revised 208 Plan describes water quality issues in the Carson River Basin. The physical characteristics of the Basin and the stresses placed on the environment by rapid population growth and urbanization of previously irrigated agricultural lands, as described in Sections 2.0 and 3.0, have the potential to degrade water quality. This potential is increased due to the sensitivity of the Basin's water resources to low flow or drought conditions.

4.1 Nevada's 2002 303(d) Impaired Waters List

Section 303(d) of the CWA requires that states develop a list of waterbodies needing additional work beyond existing controls to achieve or maintain water quality standards. Water quality standards include the assignment of beneficial uses (such as irrigation, aquatic life, etc.) and numeric water quality criteria for the support of these uses. Appendix B summarizes the water quality standards for the Carson River from the Nevada-California stateline to Lahontan Reservoir. Appendix B also contains sampling locations for NDEP's Carson River Ambient Monitoring Network, Carson River Basin beneficial uses, and NDEP's *History of Carson River Water Quality Standards* (2004b).

The criteria for listing a waterbody on the 303(d) list were developed to identify only those waterbody segments for which there is adequate documentation that beneficial uses are not being supported and water quality standards are not being met. In general, a waterbody was included on the 2002 303(d) List when there was adequate documentation that beneficial uses were not being supported and/or beneficial use standards were not being met during the five-year period 1997 through 2001. Nevada's 2002 303(d) List of Impaired Waterbodies for the Carson River Basin is shown in Table 4-1 below.

Table 4-1. Nevada's 2002 303(d) List – Carson River Basin

Waterbody Name	Reach Description	Pollutant or Stressor of Concern	Beneficial Use of Concern	Comments
Bryant Creek	Near Stateline	Arsenic (total)	MDS	
		Copper	AQ(cwf)	
		Iron (total)	AQ(cwf)	
		Nickel	MDS	
		Temperature	AQ(cwf)	
		Total suspended solids	AQ(cwf)	
		Turbidity	AQ(cwf)	
EF Carson River	Stateline to Highway 395	Iron (total)	AQ(cwf)	
		Turbidity	AQ(cwf)	
EF Carson River	Highway 395 to Highway 88	Temperature	AQ(cwf)	
		Turbidity	AQ(cwf)	
	Highway 88 to Muller Lane	Iron (total)	AQ(cwf)	
		Temperature	AQ(cwf)	
		Total phosphorus	AQ(cwf)	
		Turbidity	AQ(cwf)	
WF Carson River	Stateline to Muller Lane	Iron (total)	AQ(cwf)	
		Temperature	AQ(cwf)	
		Total phosphorus	AQ(cwf)	
		Turbidity	AQ(cwf)	
EF/WF Carson River	Genoa Lane to EF Carson River at Muller Lane and to WF Carson River at Muller Lane	Iron (total)	AQ(cwf)	
		Temperature	AQ(cwf)	
		Total phosphorus	AQ(cwf)	
		Total suspended solids	AQ(cwf)	
		Turbidity	AQ(cwf)	
Carson River	Genoa Lane to Cradlebaugh Bridge	Iron (total)	AQ(cwf)	
		Temperature	AQ(cwf)	
		Total phosphorus	AQ(cwf)	
		Total suspended solids	AQ(cwf)	
		Turbidity	AQ(cwf)	
Carson River	Cradlebaugh Bridge to Mexican Ditch Gage	Iron (total)	AQ(cwf)	
		Temperature	AQ(cwf)	
		Total phosphorus	AQ(cwf)	
		Total suspended solids	AQ(cwf)	
		Turbidity	AQ(cwf)	
Carson River	Mexican Ditch Gage to New Empire	Iron (total)	AQ(cwf)	
		Temperature	AQ(cwf)	
		Total phosphorus	AQ(cwf)	
		Turbidity	AQ(cwf)	
Carson River	New Empire to Dayton Bridge	Iron (total)	AQ(wwf)	
		Mercury (total)	AQ(wwf)	
		Total phosphorus	AQ(wwf)	
		Total suspended solids	AQ(wwf)	

Table 4-1. Nevada's 2002 303(d) List – Carson River Basin -- Continued

Waterbody Name	Reach Description	Pollutant or Stressor of Concern	Beneficial Use of Concern	Comments
Carson River	Dayton Bridge to Weeks	Iron (total)	AQ(wwf)	
		Mercury (total)	AQ(wwf)	Superfund site, fish consumption advisory
		Total phosphorus	AQ(wwf)	
		Total suspended solids	AQ(wwf)	
		Turbidity	AQ(wwf)	
Carson River	Weeks to Lahontan Dam	Iron (total)	AQ(wwf)	
		Mercury (total)	AQ(wwf)	Superfund site, fish consumption advisory
		Total phosphorus	AQ(wwf)	
		Total suspended solids	AQ(wwf)	
		Turbidity	AQ(wwf)	
Carson River	Lahontan Reservoir to Carson Sink	Mercury	AQ(wwf)	Superfund site, fish consumption advisory
Clear Creek	Origin to Gaging Station in Sec 1, T14N, R19E	pH	AQ(cwf)	pH standard to be revised in near future resulting in delisting for Clear Creek.
Stillwater Marsh	Area of Stillwater Marsh east of Westside Road and north of the community of Stillwater	Arsenic	MDS	Original listing dates back to 1993. Uncertain about the basis for the listing.
		Boron	IRR	
		Mercury	AQ(wwf)	Fish consumption advisory
Brockliss Slough	Above Carson River	Iron (total)	AQ(cwf)	
		Temperature	AQ(cwf)	
		Total phosphorus	AQ(cwf)	
		Turbidity	AQ(cwf)	
Indian Creek	At Stateline	Total phosphorus	AQ(cwf)	
All waters below Lahontan Dam in Lahontan Valley	n/a	Mercury	AQ(wwf)	Fish consumption advisory

MDS = Municipal or Domestic Supply
AQ (cwf) = Propagation of Aquatic Life (coldwater fishery)
AQ (wwf) = Propagation of Aquatic Life (warmwater fishery)

The table indicates the pollutant or stressor of concern for each listed river reach in the Carson River Basin along with the primary beneficial use of concern. A majority of the Carson reaches are on the list due to exceedances of aquatic life water quality standards. Of the pollutants of concern, temperature, total iron, total phosphorus, turbidity and total suspended solids (TSS) are the most common. It is believed that there are multiple nonpoint sources which contribute to exceedances of the standards and have led to the 303(d) Listings in Table 4-1. The suite of potential sources include (but are not limited to) watershed and streambank erosion, irrigation return flows, degraded channel and riparian conditions, mining, stormwater runoff from urban

and agricultural land, and natural conditions. Nonpoint sources are discussed in more detail in Section 6.0.

4.1.1 Flow Condition Effects

As shown in Table 4-1 (Nevada's 2002 303(d) List), the most common water quality standard exceedances occur with total phosphorus, iron, TSS, turbidity and temperature. Each of these parameters is affected by water quantity to varying degrees. In the Carson system, high flows typically occur from April through June with low flows typically occurring from approximately mid-July through September. During the high flow periods, higher sediment loads are transported resulting in elevated TSS and turbidity levels. The low flow periods occur during some of the hottest weather contributing to elevated water temperatures in the river. Exceedances of the total phosphorus and iron standards occur throughout the year.

4.1.2 Carson River Mercury Site (CRMS)

The Carson River Basin, from New Empire in Carson City to Stillwater and the Carson Sink, was designated a National Priority Listed (NPL) site under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA or Superfund) in August 1990. As a result of the historic Comstock mining operations, mercury has accumulated in the river and lake sediments, and concentrations that exceed the recommended level for human consumption have been found in fish tissue. Mercury levels in gamefish, such as walleye and white bass, in Lahontan Reservoir routinely exceed Food and Drug Administration (FDA) action levels for mercury of 1 part per million (ppm). In 1998, a walleye was documented as having 16 ppm of mercury in its tissue, a record high (EPA, 1990).

4.1.3 Lahontan Reservoir

Lahontan Reservoir is the only large storage reservoir in the Carson River Basin. Lahontan Reservoir is located approximately 18 miles west of Fallon, Nevada on the Carson River and impounds water from both the Carson River and the Truckee River through the Truckee Canal. Lahontan Reservoir has a storage capacity of approximately 295,000 acre-feet and supplies irrigation water for the Newlands Project.

In addition to being included within the CRMS, Lahontan Reservoir has also experienced eutrophic conditions. Also, high suspended sediment loadings from the Carson River to Lahontan Reservoir cause turbid water in Lahontan Reservoir. The high turbidity interferes with the recreational use and aesthetic enjoyment of the reservoir. A partially off-setting benefit of high turbidity in the reservoir is that algal growth is somewhat limited due to lack of light. If the levels of suspended solids are less, algal growths will increase, probably to the point of reducing light transmission to existing levels. Studies are underway to better understand how the reservoir quality has changed since treated wastewater discharges were removed from the system in the 1980s.

4.1.4 Stillwater Wetlands

The Stillwater wetlands are located in the Lahontan Valley east of Fallon. The wetlands are one of the largest stopping grounds for migrating birds along the Pacific flyway and a primary nesting area for thousands of shorebirds. The Stillwater wetlands are made up of fresh water ponds and sloughs, brackish-water marshes and alkali flats. Different areas of the wetland contain different plants and invertebrates that attract more than 160 species of birds and many other animals. In peak usage years, 350,000 ducks and 350,000 shore birds use the refuge. The bird species using the wetlands include White Faced Ibis, Snowy Plovers, Long Billed Curlews, Peregrine Falcons, Sandpipers, Tundra Swans, Great Blue Herons and Avocets. Also, the Lahontan Valley hosts the largest concentration of wintering Bald Eagles (as many as 70) in Nevada (Fallon Convention and Tourism Authority, 2002).

Mercury-contaminated sediments from the CRMS also affect the Stillwater wetlands. In 1999, the U.S. Fish and Wildlife Service (USFWS) and the EPA initiated a joint investigation to evaluate mercury contamination in Lahontan Valley. The goal of this effort was to identify wetlands in Lahontan Valley where fish and wildlife were at high risk of mercury-related effects. They found that methylmercury concentrations in about half of the invertebrate samples exceeded concentrations associated with long-term reductions in avian productivity, but concentrations were well below levels associated with major toxic effects. The study also looked at the effects of agricultural drainage becoming one of the main sources of water to wetland areas, bringing

with it increased concentrations of total dissolved solids (TDS) and major and trace elements (Tuttle et al., 1999).

4.2 Groundwater Issues in the Carson River Basin

Overview

The chemical quality of groundwater in the Carson River Basin results from the type of geologic materials that comprise the various bedrock and basin-fill aquifers, the travel or residence time and flow path of groundwater flow through these materials, the source of recharge to the aquifers and the temperature of the groundwater. In general, thermal waters contain greater concentrations of certain constituents (e.g., fluoride and TDS). The geochemical characteristics of groundwater will vary within and between individual hydrographic basins.

The Carson River Basin is part of the Basin-and-Range province of northwest Nevada, which is characterized by uplifted mountain blocks and adjacent basins filled with unconsolidated and consolidated sediments. The sedimentary rocks consist of Carson River channel and floodplain deposits and alluvial fan deposits from numerous tributary streams along the base of the uplifted mountain blocks. These deposits form the basin-fill aquifers, which may be subdivided into younger (Quaternary) and older (Tertiary) materials. Locally, volcanic rock aquifers occur within the basin-fill deposits. Groundwater flow in volcanic rocks and bedrock within the mountain blocks is generally compartmentalized and characterized by fracture flow.

Basin-fill aquifers are recharged by percolation of Carson River surface flows, percolation of tributary stream flows (i.e., runoff) along the alluvial fans that surround the valley floors, subsurface groundwater flow from the mountain blocks and the percolation of precipitation during winter months. On the basin scale, groundwater generally flows from the basin margins towards the Carson River, and then follows the course of the river down the slope of the individual hydrographic basins that comprise the watershed. Groundwater elevation contours and flow paths typically follow topographic contours.

Groundwater principally flows through unconsolidated sediments in the basin-fill aquifers via discontinuous coarser-grained layers (i.e., sand and gravel horizons or beds), which may occur in both the alluvial fan and paleo-channel (fluvial) environments. Locally, groundwater flows along preferential pathways composed of more transmissive materials (i.e., sands and gravels) as compared to finer-grained deposits (i.e., clays and fine silts). Groundwater flow is also influenced by localized and discontinuous confining layers in the fluvial and floodplain environments, particularly where finer-grained deposits overlie coarser grained sediments. These hydrostratigraphic relationships locally produce artesian (flowing) conditions and may affect groundwater elevations and depth to groundwater in the basin-fill aquifers. In addition, upwelling of thermal waters from depth along range-bounding faults may also contribute to artesian conditions and influence water quality.

Leaking Underground Storage Tanks (LUSTs)

Groundwater and soil contamination is occurring in the Carson River Basin from numerous Leaking Underground Storage Tanks (LUSTs). NDEP maintains a list of the number of LUSTs and Corrective Action (non-regulated) sites in the State. As of July 30, 2004, the following numbers of sites were listed in the Carson River Basin:

- Douglas County (Gardnerville, Minden and Genoa) – 79 sites
- Carson City – 208 sites
- Lyon County (Dayton, Moundhouse and Silver Springs) – 32 sites
- Fallon – 95 sites

The majority of underground storage tanks (USTs) contain petroleum products (gasoline, diesel, heating oil, kerosene, jet fuel). When USTs leak, contamination of soil and groundwater can occur. Most LUST sites are contaminated by gasoline, and typical contaminants of concern for such sites are benzene, toluene, ethylbenzene and xylenes, together referred to as BTEX compounds and making up the most hazardous components of gasoline leaks. The benzene in a ten gallon gasoline leak can contaminate 12 million gallons of water. Methyl tertiary butyl ether (MTBE) is another component of gasoline that is a contaminant of concern from LUSTs (Ryan, http://bcn.boulder.co.us/basin/waterworks/lust.html). MTBE is of concern because it dissolves easily in water and does not very readily adhere to soil. This allows MTBE to migrate farther

and faster in groundwater than other components of gasoline. MTBE does not break down very easily and is generally more resistant to natural biodegradation than other components of gasoline (EPA, 2003).

Large Groundwater Contamination Sites

There are several large groundwater contamination sites in the Carson River Basin. These sites include the Bently Plume in Douglas County caused by an electric plant and the Mallory Plume in Carson City. The pollutants of concern for the Bently plume include 1,1,1-Trichloroethane (1,1,1-TCA), trichloroethene (TCE), 1,1-Dichloroethylene (1,1-DCE) and 1,2-Dichloropropane (1,2-DCP). The pollutants of concern associated with the Mallory plume are 1,1-DCE, 1,1-Dichloroethane (1,1-DCA) and 1,1,1-TCA.

Septic Tanks

Septic tanks have a large impact on the quality of groundwater in the Carson River Basin. A USGS report titled, *Trends in Nitrate and Dissolved-Solids Concentrations in Ground Water, Carson Valley, Douglas County, Nevada, 1985-2001*, indicated that the highest nitrate concentrations in groundwater occurred near or directly under areas having high concentrations of parcels with septic tanks (Rosen, 2003). Of the 27 wells with long-term records sampled in the study for nitrate and TDS in Douglas County from 1985 to 2001, all wells that showed increasing trends in nitrate and TDS were in areas that used septic waste-disposal systems. It was concluded that the likely cause of the nitrate concentration increase is the increase in septic-tank usage over the past 40 years. Reasons for pinpointing septic tank leach fields included that wastewater application and agricultural areas did not appear to have elevated nitrate concentrations. Also, fertilizer applications to domestic lawns were ruled out because data did not show seasonal application fluctuations, nor did precipitation events cause nitrate concentrations to fluctuate, indicating that nitrate was derived from a constant source, consistent with septic systems (Rosen, 2003).

The study showed that in some locations in the Carson Valley, there was a consistent increase in nitrate concentrations in more than 50 percent of long-term monitoring wells. Some of the

increases recorded were on the order of five times the initial concentration recorded at the beginning of the monitoring program, indicating continued concentration increases are likely in the Carson Valley, with elevated concentrations becoming more common. Nitrate contamination could persist for a very long time in the Carson Valley, even if human nitrate inputs were stopped. Age dating has indicated that it takes 30 to 40 years for recharge water to reach wells that are 200 feet deep. Also of concern is that the study shows that the highest nitrate concentrations are near the Carson River, indicating the nitrate loading may affect the river in some locations (Rosen, 2003).

The study indicated that not all wells near septic tanks exhibit increasing nitrate concentrations indicating that several factors may affect nitrate concentrations. Those factors include how long the septic tank has been in use, efficiency of leach-field grasses, clay layers above where the well is screened, and the location of the well in respect to septic tanks (Rosen, 2003).

According to the study, TDS increased in areas where septic tanks were located, although the same wells associated with increasing nitrate concentrations were not always associated with statistically significant increases in TDS. This could be occurring because nitrate concentration increases are small compared to TDS concentrations and are therefore not be easily seen. Other explanations include that nitrate may be taken up by plants, but other chemicals, such as chloride and sodium, would enter the groundwater and increase TDS concentrations, nitrate and TDS may not be from the same sources in all areas, and shallow wells could be affected by pumping, recharge, and climate changes that may not have an affect on nitrate concentrations. The study did indicate that, in general, TDS concentrations are higher in areas with large concentrations of septic tanks. Further work must be done to determine groundwater recharge rates to determine what may be expected in the future in respect to nitrate concentrations in public and domestic wells (Rosen, 2003).

4.3 Total Maximum Daily Loads

In 1982, Carson River TMDLs were developed and presented in the previous 208 Plan. The TMDLs addressed maximum allowable daily loads for dissolved oxygen (DO), biological

oxygen demand (BOD), orthophosphates, nitrate, and TDS. Upon recent examination, NDEP has concluded that the 1982 TMDLs are confusing, unusable, and in need of revision. NDEP is currently in the process of working towards updated and appropriate TMDLs for the Carson River. (Appendix C contains NDEP's *Carson River TMDL Status Report* (2002a) and *Conceptual Plan for Water Quality Standard Evaluations and TMDL Development in Nevada* (2004)). Although the current Carson River TMDLs are under revision, they are in effect until new TMDLs are approved.

SECTION 5.0
WASTEWATER TREATMENT FACILITIES

Discharges to the Carson River from WWTFs ceased in 1987. The elimination of point discharges to the Carson River significantly changed how discharges from WWTFs are dealt with. WWTFs in the Carson River Basin can currently handle discharges in two ways; one option is discharging wastewater to effluent management areas such as RIBs and leach fields, and the other option is discharging wastewater to winter storage reservoirs where effluent is held until it can be reused as surface irrigation on community and private lands such as golf courses, ranches, farms, residential developments, schools and parks or to provide water for wetlands. Discharges to effluent reuse areas are regulated as point sources, but in practice, these discharges act as potential nonpoint sources of pollution. This complicates wastewater discharges, as they must be thought of holistically. Not only must the quality of water discharged be considered, but the BMPs employed in areas where the water is discharged must also be considered.

5.1 Current and Projected Wastewater Facilities

A number of planning documents have been developed to evaluate water demands and wastewater loading rates for the communities in the Carson River Basin. Although most of the following documents focus on the water supply side, several address the beneficial use of treated effluent from WWTFs.

- AMEC Infrastructure: *Effluent Management Plan for the Silver Springs Water Reclamation Facility*, Prepared for the Silver Springs GID, 2001
- Brown and Caldwell: *Water Resource Analysis for the Carson River Watershed*, Prepared for the Carson Water Subconservancy District, 2000
- Brown and Caldwell: *Interim Water Master Plan*, Prepared for Carson City Development Services, 2002
- Brown and Caldwell: *Water and Wastewater Facilities Plan*, Prepared for Churchill County Planning Department, 2003
- Brown and Caldwell: *Churchill County Wastewater Facilities Preliminary Engineering Report*, Prepared for Churchill County Planning Department, 2003

- Brown and Caldwell: *Water Facilities Master Plan*, Prepared for Lyon County -- Utilities Division, draft in process
- Brown and Caldwell: *Wastewater Facilities Master Plan*, Prepared for Lyon County -- Utilities Division, draft in process
- Brown and Caldwell: *Comprehensive Water Master Plan*, Prepared for Carson City Development Services, draft in process
- HDR Engineering, Inc.: *Reuse Master Plan Update*, Prepared for Carson City Development Services, 2001
- HDR Engineering, Inc.: *Wetlands Capacity Study*, Prepared for Incline Village GID, 1999
- Kennedy/Jenks Consultants: *Water Resource Analysis of the Upper Carson River Basin*, Prepared for the Carson Water Subconservancy District, 1998
- Nevada Division of Water Planning: *Carson River Chronology*, 1997
- Nevada Division of Water Planning: *Douglas County Socioeconomic Overview*, 1999
- Nevada Division of Water Planning: *Carson City Socioeconomic Overview*, 1999
- Nevada Division of Water Planning: *Lyon County Socioeconomic Overview*, 1999
- Nevada Division of Water Planning: *Churchill County Socioeconomic Overview*, 1999
- Vasey Engineering: *Carson Valley Comprehensive Water Plan*, Prepared for Douglas County Public Works Department, 1994
- Vasey Engineering: *Carson Valley Wastewater Plan*, Prepared for Douglas County, 1993
- Water Inc.: *Carson Valley Population and Municipal and Industrial Water Use Forecasts*, Prepared for the Carson Valley Water Authority, 1998
- Water Research and Development, Inc.: *Final Draft Churchill County Water Resources Plan*, 2000

In addition to these reports, the following utilities/agencies with existing or planned effluent management operations within the Basin were contacted to provide supplemental information:

- Markleeville Public Utilities District (PUD)
- South Tahoe PUD
- U.S. Fish and Wildlife Service (USFWS) Fish Hatchery
- Incline Village General Improvement District (GID)
- Douglas County Sewer Improvement Districts (SID)
- Minden-Gardnerville Sanitation District (MGSD)
- Indian Hills GID

- Carson City Development Services (CCDS)
- State Prison Farm
- Lyon County – Dayton Utilities
- Silver Springs GID
- City of Fallon
- Churchill County

The water demand and wastewater load projections through 2025 for the Carson River Basin are based on the reports and information sources listed above. Beginning with 2000 census data, or estimates for counties with populations outside of the Basin, Table 5-1 summarizes the water demand information in five-year increments for each County based on: 1) the State Demographer population projections with revisions based on current County planning documents; and 2) the per capita consumption rates described in recent planning documents, held constant for the 20-year planning period (0.30 afy for Carson Valley; 0.21 afy for Carson City; 0.22 afy for Lyon County; and 0.27 afy for Churchill County) (Brown and Caldwell, 2000). Water demand for the Alpine County portion of the Carson River Basin is not quantified at the present time.

Table 5-1. Population and Water Demand Estimates for the Carson River Basin 2000 - 2025

	Douglas County (Carson Valley)		Carson City		Lyon County (Carson River Corridor)		Churchill County		Total	
Year	Population (persons)	Water Demand (acre-feet)	Population (persons)	Water Demand (acre-feet)	Population (persons)	Water Demand (acre-feet)	Population (persons)	Water Demand (acre-feet)	Population (persons)	Water Demand (acre-feet)
2000	33,875	10,163	52,455	12,805	14,195	3,123	23,980	6,475	124,505	30,777
2005	35,905	10,772	56,145	11,790	22,710	4,996	26,875	7,256	141,635	34,814
2010	38,450	11,535	58,840	12,356	28,700	6,314	29,490	7,962	155,480	38,167
2015	41,525	12,458	61,650	12,947	33,280	7,322	32,055	8,655	168,510	41,382
2020	44,640	13,392	64,120	13,465	37,860	8,329	34,565	9,333	181,185	44,519
2025	47,540	14,262	65,955	13,851	42,440	9,337	37,055	10,005	192,990	47,455

notes: population estimates rounded to nearest 5 persons; 2000 population of Mound House, Dayton, Stagecoach and Silver Springs compiled from a variety of sources, including utility hook-ups; population growth in the Dayton area is based on current development plans, not State Demographer projections; population growth in Carson City and Churchill County may be greater than projected by the State Demographer; per capita water consumption in Douglas, Lyon and Churchill Counties may decrease over time as a result of land use changes and the implementation of conservation measures

Current and projected wastewater loads and facilities in the Nevada portion of the Carson River Basin are summarized in Table 5-2, with capacity values listed as average dry weather flow

(ADWF). This information has been provided to CWSD by the utilities and agencies listed above. Figures 5-1 through 5-5 depict the locations of these point sources. Sections 5.1.1 through 5.1.5 discuss current and projected wastewater facilities. The information for Alpine County includes the Markleeville PUD and the South Tahoe PUD. The information for Douglas County (Carson Valley) includes Incline Village GID, the Douglas County SID, the Minden-Gardnerville Sewer District and the Indian Hills GID. The information for Carson City includes State Prison lands. The information for Lyon County includes the Lyon County Utilities Division (Dayton and Mound House) and the Silver Springs GID. The information for Churchill County includes the City of Fallon and the proposed County wastewater utility, which is currently in a preliminary design phase. Available discharge permits are included in Appendix D of this revised 208 Plan.

Table 5-2. Current and Projected Wastewater Facilities in the Nevada portion of the Carson River Basin

Facility Name	Current Treatment Rate / Capacity (MGD)	Projected Wastewater Load and Capacity Expansion by 2025 (MGD)	Current Discharge Points / Effluent Reuse Locations	Projected Discharge Points / Effluent Reuse Locations to Meet Expansion Needs
Douglas County				
Lahontan National Fish Hatchery	30-day average rate – 3.0, Daily max – 4.5 / 30-day average rate – 3.0, Daily max – 4.5	No plans for expansion	•Allerman Irrigation Canal	N/A
IVGID	1.4 / 2.14	ADWF = 2.35 PWWF = 3.62	•Schneider Ranch •Wetlands Enhancement Facility •Bently Agrowdynamics Kirman Tract	•Schneider Ranch •Wetlands Enhancement Facility •Bently Agrowdynamics Kirman Tract
NVWWTF	0.45 / 0.45	Phased expansion to 2.0	•IVGID wetlands •Emergency discharge to on-site plots	•Construction of single pond with design capacity of 2.0 MGD (winter) •On- and off-site reuse • Carson River for in-stream flow enhancement
DCSID	2.1 / 3.75	No plans for expansion	•Bently Agrowdynamics •Park Cattle Company •Buckeye Creek Reservoir	N/A
MGSD	2.3 / 2.3	3.7 by 2015	•Storage reservoirs •MGSD irrigation fields at Muller Lane and Ironwood Fields •Galeppi, Park and Bently sites	•Storage reservoirs •MGSD irrigation fields at Muller Lane and Ironwood Fields •Galeppi, Park and Bently sites
IHGID	0.5 / 0.6	No plans for expansion	•Irrigation for residential landscaping, Golf Course and other public facilities	N/A
Carson City				
Carson City WRP	6.9 / 6.9	8.8	•Irrigation for golf courses, roadway landscaping, city parks, schools and Nevada State Prison •Winter storage at golf course water features, Prison Farm and Brunswick Canyon Reservoir	•Additional parks and schools, Silver Saddle Ranch, the State Capitol Complex and other City facilities •Wintertime storage at upgraded Brunswick Canyon Reservoir
Lyon County				
Carson Highlands WWTF	0.05 / 0.06	N/A – flows will be routed to South Dayton WWTF	•Down-gradient leach fields	N/A
South Dayton WWTF	Lagoon = 0.26, SBR = 0.20 / Lagoon = 0.26, SBR = 0.20	2.0	•Fill water hazards at nearby golf course •2 RIBs allowing percolation to groundwater	•Irrigation beneficial uses for development landscaping, golf courses, County parks and schools and private ranches •Infiltration to groundwater using RIBs, construction of wetlands for wildlife habitat, recreational uses and the polishing of effluent for potential discharge to the Carson River during the winter months •Winter storage will be part of the County's effluent management plan (EMP)
North Dayton WWTF	0.16 / 0.16	N/A – flows will be routed to Rolling A WWTF	•Land applications site adjacent to facility	N/A
Rolling A WWTF	0.125 / 0.125	4.0	•Within the WWTF (washing of screen materials and other facility components) •3 RIBs allowing percolation to groundwater	•Irrigation beneficial uses for development landscaping, golf courses, County parks and schools and private ranches •Infiltration to groundwater using RIBs, construction of wetlands for wildlife habitat, recreational uses and the polishing of effluent for potential discharge to the Carson River during the winter months •Winter storage will be part of the County's effluent management plan (EMP)
Silver Springs GID	0.249 / 0.249	0.6	•Irrigation of Silver Springs airport facility and adjacent alfalfa fields	•120 acres of irrigation
Churchill County				
City of Fallon	1.0 / 2.2	No plans for expansion	•Discharge to New River Drain	N/A
Churchill County	N/A / Fallon golf course – 0.15, BLM land – 0.25 (when built)	0.75 - 0.8	N/A	•Land application and irrigation beneficial use on adjacent farm areas, and/or conveyance to Stillwater wetlands

5.1.1 Alpine County

The Markleeville PUD currently has the capacity to treat 40,000 gallons per day (gpd) of wastewater, with no plans for expansion by 2025. The Markleeville PUD facility consists of a mechanically aerated oxidation pond and two evaporation-percolation ponds used to store overflow from the main oxidation pond when needed. All three ponds are unlined and subsurface flow moves towards Markleeville Creek. The treated effluent quality is shown in Table 5-3.

Table 5-3. Markleeville PUD Effluent Quality Data

Date (quarterly)	pH	Filtered BOD (mg/L)	TDS (mg/L)	Chloride (mg/L)
1/20/2003	7.58	13.3	219	22.1
4/7/2003	7.47	16.6	208	22.9
7/14/2003	7.39	27.7	208	25.0
10/14/2003	7.45	12.9	232	26.1
1/19/2004	7.78	19.1	199	21.4
4/20/2004	7.39	No Data	225	22.7

Figure 5-1 shows the location of the treatment works and the effluent reuse areas.

South Tahoe PUD

South Tahoe PUD currently operates treatment works in the Lake Tahoe Basin. The plant currently has a capacity of 7.75 million gallons per day (MGD). Treated effluent is conveyed via a "final plant" pumping station and a 10.4-mile pressure pipeline ("A" line) to the Luther Pass pump station. From the Luther Pass pump station, treated effluent is conveyed via the 4.3-mile "B" line (pressure line) along the Highway 89 right-of-way to the vicinity of the Alpine County line. From this point, the effluent is conveyed by the 10.7-mile gravity line ("C" line) to the Harvey Place Reservoir outlet.

The Harvey Place Reservoir, which replaced the Indian Creek Reservoir in 1989, has a capacity of 3,800 acre-feet including 800 acre-feet of flood storage (an additional 250 acre-feet of dead

storage is also available). Reuse facilities (crop irrigation) are located at various ranches in Diamond Valley, Wade Valley and Fredricksburg (Figure 5-1).

5.1.2 Douglas County

The utilities and agencies with treatment works and/or effluent disposal/reuse areas in Douglas County are described below. All treatment works and effluent disposal/reuse areas are shown in Figure 5-2.

USFWS Fish Hatchery

The Lahontan National Fish Hatchery is operated by the U.S. Department of Interior – Fish and Wildlife Service on a 25-acre site in the southern portion of the Carson Valley (Figure 5-2). The Fish Hatchery produces Lahontan cutthroat trout eggs and fish for recovery efforts in the Truckee River and Walker River Basins in California and Nevada. The facility uses well water from four production wells at an average daily flow rate of about two million gallons. Water at 54°F is pumped from the wells to an intake structure at the hatchery where it passes through pack columns for removal of excess nitrogen gas (during the winter, 100 gallons per minute (gpm) is chilled to 45°F using a 100-ton compressor unit because the chilled water is necessary for female brood stock to produce viable eggs). The water is then distributed to pipelines, which supply the raceways, the nursery and isolation rooms and the brood rearing units. From September through March, 80 percent of the water is recirculated. Water is pumped through a biofilter to remove ammonia, exposed to ultraviolet light to remove pathogens and mechanically aerated before it is reused. After the water is used for fish production, it flows through one of two 20 x 120-foot settling ponds for solids removal, and is then pumped to the Allerman irrigation canal. The solids from the settling pond are pumped to a small sludge pond. The sludge is dredged from the pond once every ten years and sent to the County landfill.

Discharges to the Allerman irrigation canal are permitted by NEV60043 for a 30-day average rate of 3.0 MGD and a daily maximum rate of 4.5 MGD. The quality of the discharged water generally varies between 1.0 and 20 milligrams per liter (mg/L) for total nitrogen, about 2.0 mg/L for BOD, 1 to 10 mg/L TSS and 0.2 to 0.7 mg/L total phosphorus. The permit has no discharge

limitations for these constituents. The USFWS anticipates that the Fish Hatchery will continue to operate in this manner for the foreseeable future.

Incline Village GID

The Incline Village General Improvement District (IVGID) WWTF in the Lake Tahoe Basin operates at an ADWF rate of approximately 1.4 MGD for a base population of approximately 9,000 persons (the permitted plant capacity is currently at 2.14 MGD). The average annual and peak populations are typically 40 to 45 and 80 to 90 percent greater than the base population, respectively. The Incline Village Master Plan assumes that population growth will remain consistent at six percent for each five-year period, and that the ratio of peak wet weather flow (PWWF) to ADWF is estimated at approximately 1.54:1.0. Based on these assumptions, the ADWF in 2025 is anticipated to be approximately 2.35 MGD, and the PWWF would be 3.62 MGD.

Treated effluent from the WWTF is conveyed by force main to Spooner Summit via a 16-inch diameter pipeline. From the summit, the effluent is conveyed via gravity to three outfall locations in the Carson Valley: the Schneider Ranch, the Wetlands Enhancement Facility and the Bently Agrowdynamics Kirman Tract. These effluent management areas are shown in Figure 5-2. Discharge of treated effluent is permitted under NEV30009. However, this discharge permit will need to be revised to meet the facility expansion.

IVGID is permitted to discharge up to 2.14 MGD of treated effluent, which is delivered to the constructed wetlands located halfway between Carson City and Minden, approximately one mile east of Highway 395. The 900-acre project site constructed above the Carson River floodplain is adjacent to Hot Springs Mountain where thermal waters keep the ground from freezing during the winter months over an area of about 100 acres (the preexisting thermal wetlands area is not part of the constructed wetlands). The constructed wetlands contain cells of standing water for aquatic life and migrating waterfowl, and serve to promote both percolation and evaporation. In addition to the constructed wetlands, the project site includes an overflow area, a location for seasonal storage, a floodplain area, the hot springs area and uplands and northern areas. Three

types of habitat exist at the site including uplands, permanent wetlands and seasonal wetlands. Effluent quality entering the constructed wetlands is summarized in Table 5-4.

Table 5-4. Incline Village Water Reclamation Facility (WRF) Effluent Quality

Parameter	Average Quality from 6/03 through 5/04	
	Permit Limit (average)	Effluent Quality (2003-04)
Flow at wetlands	1.66 MGD	0.91 MGD
BOD 5 (mg/L)	30	7
CBOD (mg/L)	M&R	4
TSS (mg/L)	30	10
Phosphorus (mg/L)	M&R	0.4
TDS (mg/L)	M&R	238
CL2 residual (mg/L)	M&R	0.2
Fecal coliform (No/100ml)	23	8
Ammonia-N	M&R	11
Nitrate-N	M&R	3
Dissolved Oxygen (mg/L)	Not less than 2.0 for any single sample	5.0
pH	Between 6.0 and 9.0 standard units	7.15

Douglas County NVWWTF

Douglas County operates the North Valley WWTF (NVWWTF) that serves residential communities (Johnson Lane, Mountain View and Genoa Lakes areas), several commercial/industrial centers and the County's airport complex. The NVWWTF will eventually serve the new North County commercial center (the County currently contracts with Indian Hills GID for treatment and effluent management services from the commercial center). The NVWWTF is an extended aeration activated sludge process with an internal secondary clarifier at the end of the aeration basin. The facility consists of influent flow measurement and pump station, primary screening, a secondary activated sludge process with clarification, effluent chlorination and sludge storage. The current plant capacity is 0.45 MGD, and phased expansions are planned to treat an ultimate build-out capacity of 2.0 MGD. The 2.0 MGD expansion would serve a minimum of 8,000 Equivalent Domestic Units (EDUs), based on a hydraulic loading rate

of 250 gpd. Douglas County anticipates that the 2.0 MGD treatment capacity would actually serve up to 12,000 EDUs, based on current hydraulic loading rates (anticipated maximum build-out capacity for the service area is 13,000 EDUs).

The NVWWTF is operated under NEV60025, which includes specific provisions to allow discharge of treated effluent to the IVGID wetlands, and for emergency discharge of treated effluent to onsite irrigation plots with notification to NDEP when a discharge occurs. This discharge permit will need to be revised to meet the facility expansion. Douglas County currently contracts with IVGID for disposal of 0.3 MGD (average daily flow rate) of treated effluent in the wetlands. The quality of the treated effluent coming from the NVWWTF can be seen in Table 5-5. Given future capacity limitations of the IVGID wetlands to accept NVWWTF treated effluent, Douglas County has developed a plan for effluent management at the 2.0 MGD build-out capacity. The plan evaluated several alternatives, and the recommended project is to construct a single pond with a design capacity of 2.0 MGD. Given this winter storage capacity, the County is developing summer disposal/reuse alternatives including on- and off-site reuse and potential discharges to the Carson River for in-stream flow enhancement.

Table 5-5. Douglas County North Valley Wastewater Treatment Facility Effluent Quality

Parameter	**Permit Limit**	**Average Quality Jan-02 to Dec-03**
CBOD	30 mg/l	9.56 mg/l
TSS	30 mg/l	9.84 mg/l
Fecal Coliform	23CFU/100 ml	1.72 CFU/100 ml
Parameter	**Permit Limit**	**Average Quality Sept-03 to May-04**
Kjeldahl as N	NA	2.8 mg/l
Ammonia as N	NA	NA
Nitrite as N	NA	NA
Nitrate as N	M&R	11.45 mg/l
Total Nitrogen as N	M&R	15.37 mg/l

Douglas County Sewer Improvement District #1

Douglas County SID's Wastewater Reclamation Plant, located near Round Hill, Nevada in the Lake Tahoe Basin, currently treats 2.1 MGD. Although the design flow of the wastewater

reclamation plant (WRP) is 3.75 MGD, no increase in treatment rates by 2025 is anticipated due to growth limitations in the Lake Tahoe Basin. Approximately 700 million gallons annually is exported to the Carson Valley via a force main to the top of Kingsbury Grade, and by gravity flow in a pipeline that is located in the upper section of Kingsbury Grade. The gravity pipeline crosses Kingsbury Grade south of the intersection of Foothill Road and Muller Lane, follows Foothill Road a short distance and continues east along Muller Lane to three effluent management areas in the Valley (Figure 5-2).

The effluent management areas in the Carson Valley consist of the Bently Agrowdynamics land application site, permitted by NEV96003, the Park Cattle Company land application site, permitted by NEV2000501, and the Buckeye Creek Reservoir winter storage facility. The winter storage consists of three reservoirs with a combined capacity of 1,800 acre-feet. Effluent is typically stored from November through April, and discharged to the Bently Agrowdynamics land application site and the Park Cattle Company land application site during the irrigation season. Treated effluent stored in the reservoirs and discharged to the land application site meets the requirements of the two permits.

Minden Gardnerville Sanitation District

The Minden Gardnerville Sanitation District (MGSD) operates a WWTF in the town of Minden that treats wastewater flows from the Gardnerville Ranchos, Gardnerville and Minden areas. Current treatment rates are about 2.3 MGD ADWF with an anticipated flow rate of 3.7 MGD ADWF by 2015. Although this value may be extrapolated beyond 2015, no specific information is available to support a projected increase beyond 3.7 MGD. Maximum monthly flows have historically amounted to 0.4 to 0.5 MGD above the average daily flows, based on the 1994 Master Plan for the MGSD Wastewater Treatment Plant.

The treatment facility is permitted under NEV40027 with effluent discharged to three locations including the storage reservoirs, the MGSD irrigation fields (18-acres at Muller Lane and 10-acres at Ironwood fields) and off-site agricultural reuse at the Galeppi, Park and Bently sites.

Effluent quality meets all permit requirements. The current discharge permit will have to be revised to meet the facility expansion.

Indian Hills GID

The Indian Hills General Improvement District (IHGID) serves the northern portion of the Carson Valley adjacent to Carson City (Figure 5-2). The current population of Indian Hills is approximately 5,800 persons with an anticipated build-out population of 6,000 persons by 2006. The existing WWTF has a design capacity of 600,000 gpd ADWF, and IHGID currently has an effluent management capacity of 500,000 gpd with no plans for expansion by 2025. Effluent management, permitted under NEV80039, consists of irrigation beneficial use for residential landscaping, the Golf Course and other public facilities in the subdivision. Effluent quality meets all permit requirements.

5.1.3 Carson City

Carson City's WRP has a permitted flow/design capacity of 6.9 MGD. Wastewater flows by 2025 are projected to be 8.8 MGD based on population projections of 80,000 persons by 2025 (Carollo, 2003). This value was reduced from 9.3 MGD because Lyon County decided to serve the Mound House area by facilities other than conveyance of wastewater to Carson City. Treated effluent is principally used for the irrigation of golf courses, roadway landscaping, city parks and other facilities (e.g., Lone Mountain cemetery), schools and the Nevada State Prison Farm. The major reuse areas are shown on Figure 5-3.

Average consumption for the three golf courses includes 0.64 MGD at the Empire Ranch Golf Course, 1.02 MGD at the Eagle Valley Golf Course, and 0.48 MGD at the Silver Oak Golf Course. The Nevada State Prison Farm ("Prison Farm") accepts up to 1.27 MGD, or a total of 1,427 acre-feet per year (Carson City, 2003a). Parks and schools accept the remainder of the effluent during the irrigation season. Wintertime treated effluent storage is provided in golf course water features, the Prison Farm and at the Brunswick Canyon Reservoir. The Brunswick Canyon Reservoir has a permitted storage capacity of 3,288 acre-feet. Approximately 2,000 acre-feet per year is "lost" from the reservoir via evaporation and seepage into the bedrock

aquifer (Berryman and Hennigar, 2004), which was based on reclaimed water production and utilization for years 1998 through 2003. Springs and seeps of the effluent occur around the reservoir and are monitored and reported to NDEP. Some seepage losses from Brunswick Reservoir enter the Carson River, and Carson City is currently examining options for lining Brunswick Reservoir (Berryman and Hennigar, 2004).

The Prison Farm, operating as Silver State Industries – Ranch/Dairy Operations consists of approximately 1,000 acres, of which 600 or so acres are irrigated with treated effluent. Typical consumption for the 600 or so acres is 1,200 to 1,400 acre-feet per season, with alfalfa, grains and grass as the principal crops. Sprinkler and flood irrigation techniques are used on the Prison Farm.

Existing water pollution control permits associated with Carson City's WRP include:

- NEV90008 – WRP landscape and animal control
- NEV92015 – Empire Ranch Golf Course
- NEV92021 – Eagle Valley Golf Course
- NEV92030 – Nevada State Prison Farm
- NEV2001513 – Nevada State Prison Farm
- NEV93006 – Carson City Parks and Facilities
- NEV94015 – Silver Oak Golf Course

Facility expansion will necessitate revision of these discharge permits.

The two-year average effluent quality and general permit requirements for the Carson City WRP are presented in Table 5-6.

Table 5-6. Carson City WRP Effluent Quality		
	Average Quality from 4/00 – 9/02	
Parameter	Permit Limit (average)	Effluent Quality (2000-2002)
CBOD	30	10.23
TSS	30	5.36
Fecal Coliform	2.2	0.82
Kjeldahl-N	M&R	20.39
Ammonia-N	M&R	18.60
Nitrite-N	M&R	0.40
Nitrate-N	M&R	1.79
Total Nitrogen	M&R	22.60

Additional irrigation reuse areas projected through 2025 include additional parks and schools, the Silver Saddle Ranch, the State Capitol complex and other City facilities (HDR, 2001). Wintertime storage is anticipated to be provided by an upgraded Brunswick Canyon Reservoir (modified to limit the seepage through bedrock fractures), other valley-based storage areas to be identified and infiltration basin sites to be identified.

5.1.4 Lyon County

Mound House and Dayton Areas

Lyon County Utilities Division (LCUD) currently provides sewer collection services and operates four WWTFs in the Mound House and Dayton areas. These WWTFs include the Carson Highlands, North Dayton, South Dayton and Rolling A plants. Figure 5-4 shows the locations of the WWTFs operated by the County in the Carson River Basin.

Carson Highlands WWTF

The Carson Highlands WWTF was installed in 1985 with a design capacity of 60,000 gpd and currently operates at 50,000 gpd. Treated effluent from the WWTF is discharged into down-gradient leach fields constructed in alluvial fan materials. The Carson Highlands WWTF is permitted under NEV40032 and has not achieved permit requirements for effluent quality. Table 5-7 summarizes influent and effluent quality and presents the discharge limitations under NEV40032. This plant is scheduled to be replaced with a package plant in early 2005 that will

achieve permit compliance. Treated effluent will continue to be discharged to the existing leach field.

Table 5-7. Carson Highlands WWTF Operating Data and Permit Requirements

Parameter	Influent Quality[a]		Effluent Quality[a]		Permit Requirements	
	Average	Peak	Average	Peak	Average	Peak
BOD, mg/L	213	280	23	34	30	45
TSS, mg/L	211	377	17	42	30	45
Nitrate, mg/L	NA	NA	3	9	NA	NA
Total nitrogen, mg/L	NA	NA	22	34	7[b]	NA

[a]Data averaged from 2000 to first quarter 2003.

[b]Permit requirement is 10 mg/L, with 7 mg/L for full compliance.

South Dayton WWTF

The South Dayton WWTF consists of two treatment circuits: 1) a lagoon system, permitted to operate at 0.26 MGD, provides aerobic treatment in the primary lagoons and partial facultative treatment, settlement and sludge storage in the secondary lagoons; and 2) a mechanical Sequential Batch Reactor (SBR) plant, permitted to operate at 0.20 MGD, that provides aeration, solids settlement and chlorination (disinfection). Effluent from the two circuits is used to fill the ponds (i.e., water hazards at the nearby golf course) and is permitted to percolate to groundwater from two Rapid Infiltration Basins (RIBs), respectively.

The South Dayton WWTF is permitted under NEV10017, and is currently out of compliance due to nitrate loading to groundwater from one or more of the lagoons. This permit will have to be revised to meet the facility expansion. LCUD and NDEP are evaluating compliance-mandated upgrades to the facility, and construction of these upgrades should be completed in late 2005. Table 5-8 summarizes influent and effluent quality and presents the discharge limitations under NEV10017.

Table 5-8. South Dayton WWTF Operating Data and Permit Requirements						
	Influent Quality[a]		Effluent Quality[a]		Permit Requirements	
Parameter	Average	Peak	Average	Peak	Average	Peak
BOD, mg/L	243.5	460.0	14.4	92.0	30	45
TSS, mg/L	196.9	550.0	10.1	16.0	30	45
Nitrate, mg/L	NA	NA	1.3	3.5	NA	NA
Total nitrogen, mg/L	NA	NA	5.4	17.0	7[b]	NA

[a]Data averaged from 2000 to first quarter 2003.
[b]Permit requirement is 10 mg/L, with 7 mg/L for full compliance.

North Dayton WWTF

The current treatment rate and capacity of the North Dayton WWTF is 0.16 MGD. The North Dayton WWTF consists of a treatment lagoon system, with four lagoons operated in series. Clarified effluent from the final treatment lagoon is managed at an adjacent land application site. The North Dayton WWTF is permitted under NEV87022 and currently complies with all permit discharge limitations. LCUD anticipates that flows reporting to the North Dayton WWTF will be routed to the Rolling A WWTF, and the North Dayton WWTF will be abandoned once development in this portion of the service area encroaches on its location.

Rolling A WWTF

The current treatment rate and capacity of the Rolling A WWTF is 0.125 MGD. The Rolling A WWTF employs SBR technology (i.e., activated sludge process), which is capable of nitrification and denitrification of treated effluent. This process uses aeration to remove nitrogen, BOD and TSS using heterotrophic bacteria that oxidize organic matter. Waste sludge is pumped to the aerobic digester that serves to further reduce the solids and organic material in the waste sludge through aeration. Effluent from the aeration step is disinfected using liquid sodium hypochlorite (pathogenic bacteria are killed with a combination of chlorine concentration and contact time in the chlorine basin, with a minimum detention time of 30 minutes). Chlorinated effluent is either used within the WWTF (e.g., washing of screen materials and other facility components) or disposed of using three RIBs that allow percolation to groundwater. The Rolling A WWTF is permitted under NEV200500 and currently complies with all permit requirements. This

discharge permit will have to be revised to meet facility expansion. Table 5-9 summarizes influent and effluent quality and presents the discharge limitations under NEV2000500.

Table 5-9. Rolling A WWTF Operating Data and Permit Requirements

Parameter	Influent Quality[a]		Effluent Quality[a]		Permit Requirements	
	Average	Peak	Average	Peak	Average	Peak
BOD, mg/L	300.0	620.0	7.7	35	30	45
TSS, mg/L	851.4	1200.0	11.3	17.0	30	45
Nitrate, mg/L	NA	NA	1.0	1.0	NA	NA
Total nitrogen, mg/L	NA	NA	NA	NA	7[b]	NA

[a]Data averaged from 2000 to first quarter 2003.

[b]Permit requirement is 10 mg/L, with 7 mg/L for full compliance.

Mound House and Dayton Area Master Planning

Wastewater master planning is currently in progress for the LCUD service area, and includes the following treatment capacities and effluent management concepts for the nominal 20-year planning period (to 2025):

- The Rolling A and South Dayton WWTFs will be the only two operating facilities, each with a treatment capacity of approximately 2.0 MGD ADWF (flows formerly reporting to the North Dayton WWTF will report to the Rolling A WWTF, and flows formerly reporting to the Carson Highlands WWTF will report to the South Dayton WWTF).
- In addition to the Carson Highlands subdivision, additional portions of Mound House (new development and existing areas with septic systems) will be provided with sewer collection services. All wastewater from Mound House will be conveyed to the South Dayton WWTF via a combination gravity line and force main, which will provide sewer collection services to additional development between Mound House and central Dayton. Portions of Dayton currently using individual septic systems may also be provided with sewer collection services.
- The approximate 2.0 MGD treatment capacities planned for the South Dayton and Rolling A WWTFs will be sufficient to handle wastewater flows from an additional 12,000 residential or EDUs, based on the conservative planning basis of 200 gpd/EDU. Most of the new EDUs will be in the Dayton area.

- Effluent management will primarily consist of irrigation beneficial uses for development landscaping, golf courses, County parks and schools and private ranches. Additional effluent management activities will include infiltration to groundwater using RIBs, construction of wetlands for wildlife habitat, recreational uses and the polishing of effluent for potential discharge to the Carson River during the winter months. Storage of effluent during the nominal three-month winter period (December through February) for later use during the irrigation season will also be part of the County's effluent management plan (EMP).

These master planning concepts indicate that the current treatment capacity of approximately 0.8 MGD will be increased five-fold to 4.0 MGD over the next 20 years. The projected wastewater loads in the LCUD service area are anticipated to be the single largest point source increases in the Carson River Basin for the planning period (Brown and Caldwell, 2004b).

Silver Springs GID

The Silver Springs Water Reclamation Facility (WRF) is authorized to operate its treatment plant to 249,000 gpd under permit NEV99017, and is authorized to discharge the treated effluent using sprinklers (or other spray irrigation methods) for irrigation reuse (pasture and/or alfalfa crop) to the Silver Springs airport facility and adjacent alfalfa field. Treated effluent is pumped to the reuse areas via a 12-inch force main from the WRF storage pond, with a 42-day retention period at a treatment rate of 200,000 gpd. Effluent quality from the WRF meets the discharge requirements listed in the water pollution control permit. Figure 5-4 shows the location of the reuse areas.

Wintertime irrigation operations (i.e., land application) are planned for 8-hour daylight periods when freezing temperatures are not anticipated. An emergency-only discharge of treated effluent to an adjacent field with adequate percolation would be conducted if winter operations were suspended by prolonged freezing conditions. NDEP does not allow the discharge of effluent to frozen or saturated ground. The WRF is anticipated to expand to 600,000 gpd at build-out (through 2025), with approximately 120 acres of irrigation. The discharge permit will have to be revised to meet facility expansion.

5.1.5 Churchill County

City of Fallon

The City of Fallon operates a WWTF that employs SBR technology (i.e., activated sludge process). The plant was constructed in 2000 and opened in 2001. The City of Fallon has six pump stations and approximately 35 miles of sewer mains. The plant capacity is 2.2 MGD, and the current flow to the plant is approximately 1.0 MGD. The plant was designed with a projected 20-year capacity. The WWTF discharges to the New River Drain. The locations of the WWTF and discharge point are shown in Figure 5-5. Average effluent quality and general permit requirements for the City of Fallon WWTF are presented in Table 5-10.

Table 5-10. City of Fallon WWTF Effluent Quality

Parameter	Average Quality	
	Permit Limit (average)	Effluent Quality
CBOD	30	4
TSS	30	1.3
Fecal Coliform	200	137
Kjeldahl-N	M&R	2.21
Ammonia-N	M&R	0.65
Nitrite-N	N/A	--
Nitrate-N	M&R	0.90
Total Nitrogen	10	2.83

Churchill County

Churchill County is in the process of developing its own water and wastewater utility, or contracting such services, to achieve the following objectives: 1) bring existing individual water systems into compliance with State regulations for fire flow requirements, system redundancy and the availability of water during emergencies; 2) allow citizens within its service area to have access to potable water that will meet the new arsenic drinking water standard in the most cost effective manner possible; 3) eliminate existing and new individual septic tanks that source contaminants to the shallow groundwater table in the proposed service area; and 4) provide

sufficient infrastructure that will allow the County to support and manage growth in a manner consistent with its Master Plan (and land use element, described above). The County will initiate its utility services to existing and proposed development immediately west of the City of Fallon (Figure 5-5).

Wastewater planning for the Churchill County service area is described in the July 2003 Facilities Plan (Brown and Caldwell, 2003a), and has been modified by the subsequent Preliminary Engineering Report (PER) for Wastewater Facilities (Brown and Caldwell, 2003b). A temporary WWTF (package plant) will be constructed on the Fallon Golf Course with an initial treatment capacity of approximately 150,000 gpd. This facility will be used to replace the existing Pine Grove WWTF and, in addition to servicing the Pine Grove subdivision with its existing collection system, will provide sewer collection services to new and existing residential and commercial customers centered around the golf course and the Highway 50 corridor immediately west of Fallon. Effluent management will consist of golf course fairway irrigation, the creation of water hazards and wetlands on the golf course and, during the nominal three-month winter period, storage on the golf course and percolation of effluent to groundwater via RIBs, also located on the golf course.

Churchill County proposes to construct a permanent WWTF located approximately two miles north of the golf course on U.S. Bureau of Land Management (BLM) property (Figure 5-5). This facility will be initially constructed to treat 250,000 gpd of wastewater, and will be designed and constructed to accommodate future expansions consistent with the July 2003 Facilities Plan (Brown and Caldwell, 2003a). Churchill County anticipates that approximately 3 to 4 EDUs per acre will be developed. Projections of wastewater loads through the 20-year planning period indicate a treatment capacity of approximately 750,000 to 800,000 gpd by 2025. The permanent WWTF will likely be constructed with SBR technology. Treated effluent will be managed by land application and irrigation beneficial use on adjacent farm areas, and/or conveyance to the Stillwater wetlands.

5.2 BMP Implementation

The 1994 edition of the *Handbook of Best Management Practices* issued by the State of Nevada indicates that WWTFs should manage effluent so that it does "not impact the environment or public health and safety, and that the wastewater management system should be designed to prevent discharges to the environment and to the fullest extent possible, recycle wastes through soil and vegetation". In addition, "design criteria must be in accordance with applicable Federal, State and local regulations, industry standards and completed by a qualified professional engineer". The 1994 Handbook indicates that the most desirable BMP option for WWTF point sources is mandating that the design of facilities comply with all regulations and available technology. The Handbook recommends recycling treated effluent through soil and vegetation rather than discharging directly to the environment.

The Handbook indicates two main policy-related BMP implementation components that will allow for the successful operation of wastewater management systems: 1) creating an overall wastewater management plan where the system must be "designed, engineered, constructed and maintained as a system"; and 2) establishing and implementing an operation and maintenance (O&M) plan. Before a WWTF can be constructed or expanded, an overall waste management plan (e.g., EMP) must be in place. NDEP's permitting process facilitates forward thinking and integrated planning for the future, rather than a reaction to a specific wastewater management problem. A comprehensive O&M plan considers all maintenance and inspection of the system, and preparation for contingency and emergency responses. The O&M plan would ensure public health and safety, as well as the safety of wildlife and livestock (1994). Each WWTF in the Carson River Basin has an updated O&M plan.

BMPs used at WWTFs in the Carson River Basin include measures to control water moving onto and out of the facilities. The facilities are bermed and have run-on controls to prevent stormwater from moving onto the facilities. Effluent reuse areas (RIBs, leach fields, and irrigation areas) are managed to prevent seepage to the river and environment. All possible measures are used to contain the effluent within the WWTF and reuse areas.

NDEP currently requires EMPs to be submitted for review as part of the Nation Pollutant Discharge Elimination System (NPDES)/Water Pollution Control Program (WPCP) application process for the construction of new WWTFs, or the expansion of existing WWTFs (the NDEP guideline WTS-1B for preparing EMPs is presented in Appendix E). Site-specific BMPs for treated effluent are typically described in these EMPs. Site-specific provisions for direct discharges to groundwater via RIBs or leach fields are presented in each permit.

Specific effluent limitations are contained within the State of Nevada groundwater permits for every constituent present in a discharge that has the potential to degrade the waters of the State. Discharge effluent limits are developed based on a review of the discharge characterization data, site characterization data including but not limited to soil types, attenuation capacity, etc., potential contaminant mobilization from the soil, depth to groundwater, and current and potential uses of the groundwater. The potential for effluent discharge to degrade area surface waters is also considered (NDEP, 2002b).

In addition to effluent limitations, groundwater permits contain monitoring requirements for flow measurement and water quality sampling. The sampling frequency, the sample type, the parameters to be monitored, the parameter limitations, the analytical methods, and the reporting frequency are determined by NDEP (NDEP, 2002b).

Under the State groundwater permits, major dischargers are inspected at least once a year to verify compliance with the terms of the permit. Samples are taken from at least one-third of the major dischargers annually. Under the water pollution control permits, O&M inspections are also conducted. NDEP is responsible for issuing permits and regulating dischargers. WWTFs are also regulated on a local or community level. Table 5-11 summarizes the local agencies or governments that regulate existing WWTFs in the Carson River Basin.

Table 5-11. Point Source Management Agencies	
Management Agency	**Wastewater Treatment Facility**
Alpine County Environmental Health Services	Markleeville PUD
Alpine County Environmental Health Services	South Tahoe PUD
USFWS	Lahontan National Fish Hatchery
Incline Village GID	IVGID WWTF
Douglas County	NVWWTF
SID #1	DCSID WWTF
Minden-Gardnerville Sanitation District	Minden-Gardnerville WWTF
Indian Hills GID	Indian Hills GID WWTF
City of Carson City	Carson City Wastewater Plant
Lyon County	Carson Highlands WWTF South Dayton WWTF North Dayton WWTF Rolling A WWTF
Silver Springs GID	Silver Springs WRF
City of Fallon	Fallon Sewer System
Churchill County	Churchill County WWTF

Biosolids from the WWTFs listed in Table 5-11 are currently applied to selected irrigation areas in the Carson River Basin (e.g., Bently Agrowdynamics in Carson Valley). Given their use as fertilizer over a relatively wide agricultural area, the use of biosolids is considered part of a nonpoint source. The Federal rule for biosolids discharge is contained in 40 CFR Part 503, and, in Nevada, Federal regulations and operating criteria are implemented and permitted by the NDEP – Bureau of Water Pollution Control (BWPC).

Currently NDEP indicates that Nevada is not an approved State under the 503 regulations, nor is the State pursuing adoption of an EPA-approved program. However, administration of the 503 regulations is with NDEP with oversight by Region IX EPA. NDEP's primary requirement for application of biosolids to agricultural areas is that the land application site owner obtains a Nevada Groundwater Discharge Permit prior to biosolids application. NDEP also requires the maintenance of site restrictions as outlined in the 503 regulations.

The Nevada Groundwater Discharge Permit may be issued as a temporary or permanent permit. The temporary permit can be issued within a one or two-week period and is valid up to six months. A permanent discharge permit typically requires approximately a three-month review period prior to issuance, depending on site complexity (e.g., potential land application sites for long-term biosolids application).

5.3 Financing of Wastewater Facility Expansion and Construction

Funding for expansion and construction of new WWTFs in the Carson River Basin is accomplished through the use of State and Federal loans (Clean Water State Revolving Fund (CWSRF)), Federal grants (U.S. Department of Agriculture (USDA) and U.S. Army Corps of Engineers (USACE) grants) and developer connections fees.

In Nevada, the CWSRF provides loans to municipalities to assist them in financing the construction of WWTFs. NDEP lists the following requirements for receiving a loan under the CWSRF:

- Complete a Facility Plan.
- NDEP will complete an Environmental Review, based on the Environmental Assessment included in the Facility Plan.
- After the Facility Plan is approved and the Environmental Review is completed, begin design of the project.
- Apply for the loan. Loan applications are provided by NDEP.
- Submit a sewer use ordinance and user charge system for review and modify if necessary.
- Submit plans and specifications for review and approval.
- Secure the services of Bond Counsel. The loan is in the form of a bond. All steps to sell a bond on the open market must be followed, except that the bond is sold to the State Treasurer at below market rate. The bond must be a General Obligation Bond and must be sold in accordance with the provisions of Nevada Revised Statutes (NRS) Chapter 350.

From 1989 to 2004, Nevada was allotted over $110 million in CWSRF Title VI funds, receiving over $6 million of that in 2004. The Nevada CWSRF Project Priority List for 2005 includes projects in the Carson River Basin:

- Incline Village GID – Replacement of treated effluent discharge pipeline (phased).
- Lyon County – South Dayton Wastewater Treatment Plant (WWTP) – convert plant to SBR – eliminate lagoons.
- Douglas County (SID #1) – Round Hill Reservoir lining project and improve secondary clarifiers.
- Lyon County – Rolling A expansion of WWTP and expand irrigation and wetland use.
- Lyon County – South Dayton WWTP expansion – provide service to Mound House, etc.
- Lyon County – Connect individual sewage disposal system (ISDS) to community sewer.
- Silver Springs GID – Expansion of collection system.
- Churchill County – New WWTF.

SECTION 6.0
OTHER POINT SOURCES

In addition to current WWTF discharges to groundwater, the second major type of point source in the Carson River Basin is stormwater runoff. Throughout the United States, polluted stormwater runoff is a leading cause of impairment to the nearly 40 percent of surveyed U.S. water bodies which do not meet WQS (EPA, 2000a). Stormwater runoff is discharged directly into local water bodies through storm sewer systems, and if the stormwater runoff carries pollutants, it can impair fish, wildlife and aquatic life habitats; bring about a loss in aesthetic value; and cause threats to public health through contamination of drinking water supplies and recreational waterways.

The NPDES Stormwater Program was mandated by Congress under the CWA. The Stormwater Program has two phases used for dealing with stormwater discharges and uses the NPDES permitting mechanism to require the implementation of stormwater runoff controls. Entities regulated under the Stormwater Program must obtain coverage under an NPDES stormwater permit and implement stormwater pollution prevention plans (SWPPPs) or stormwater management plans (SWMPs) (both using BMPs) to prevent the discharge of pollutants into receiving waters.

The Phase II Final Rule was published in the Federal Register on December 8, 1999 and took effect on March 10, 2003 and requires NPDES permit coverage for stormwater discharges from the following activities:

- Certain regulated small municipal separate storm sewer systems (MS4s). (Small MS4s are any MS4 that is not a medium or large MS4 covered by Phase I of the NPDES Stormwater Program. Regulated small MS4s are all small MS4s located in urbanized areas (UAs) as defined by the Bureau of the Census, and those small MS4s located outside of a UA that are designated by NPDES permitting authorities.)
- Construction activity disturbing between one and five acres of land (i.e., small construction activities).

Under the small MS4 Stormwater Program, operators of regulated small MS4s are required to:

- Apply for NPDES permit coverage.
- Develop a SWMP that includes the six minimum control measures.
- Implement the SWMP using appropriate stormwater management controls or BMPs.
- Develop measurable goals for the program.
- Evaluate the effectiveness of the program.

Four MS4s have been issued permits in the Carson River Basin: the Carson City MS4, the Douglas County MS4, the Indian Hills GID MS4, and a statewide stormwater permit issued to NDOT. Three of the four SWMPs have been submitted: the Carson City MS4 SWMP (September 2003), the Douglas County Clear Creek SWMP (CCSWMP) (September 2003) and the Indian Hills GID MS4 SWMP (September 2003). All three were submitted in September 2003. The NDOT SWMP is currently being reviewed by NDEP. The six minimum control measures required for characterization in the SWMP are:

1. Public education and outreach
2. Public involvement/participation
3. Illicit discharge detection and elimination
4. Construction site runoff control
5. Post-construction runoff control
6. Pollution prevention/good housekeeping

6.1 Existing Point Source Locations

As indicated above, there are three completed SWMPs in the Carson River Basin: the Carson City MS4 SWMP, the Douglas County CCSWMP and the IHGID MS4 SWMP. The NDOT SWMP is currently being reviewed by NDEP. In the Carson City MS4 service area, all storm drains are routed to an outfall at Kings Canyon Creek, which eventually reaches the Carson River. The Douglas County CCSWMP has two storm drain discharge outfalls. One outfall is a sand/oil/water separator on Vista Grande Boulevard, and the second is the NDOT culvert on U.S.

Highway 395 receiving discharge from a privately maintained stormwater system. The NDOT culvert discharges to a dirt channel reaching Clear Creek. IHGID discharges to an NDOT drainage along Highway 395. NDOT has numerous outfalls located along its highway systems in the Carson River Basin.

6.2 Projected Point Source Locations

In the Carson City MS4 service area, future locations of outfalls for stormwater are currently in the process of being determined. In the immediate future, stormwater will still be discharged to the Kings Canyon Creek outfall.

There are no projected changes for discharges in the Douglas County Clear Creek area. In the future, discharges will continue at the sand/oil/water separator on Vista Grande Boulevard and from the NDOT culvert on U.S. Highway 395 to a dirt channel reaching Clear Creek.

There are no projected changes for discharges from the IHGID MS4. Discharges will continue to be to the NDOT drainage along U.S. Highway 395.

NDOT outfalls will increase and change as new roads are constructed in the Carson River Basin, and current outfalls may be altered pending recommendations from NDEP upon completion of the review of NDOT's SWMP.

6.3 Best Management Practices

The 1994 *Handbook of Best Management Practices* lists several BMPs to deal with urban runoff. These include:

- Street Runoff Collection
- Storm Drain Structures
- Sandbag Curb Inlet Sediment Barrier
- Culverts
- Snow Disposal Practices

- Road Salt Storage and Related Practices
- Street Cleaning Practices
- Construction Site Practices

6.4 Monitoring

Stormwater monitoring is carried out under the NPDES. As was indicated, stormwater discharge permits must be obtained for construction activities and by MS4s before discharging. Permit compliance is determined by NDEP. While NDEP is responsible for determining overall compliance with NPDES permits, when a SWMP is drafted, the agency drafting the plan is responsible for outlining who will implement and monitor the six minimum control measures outlined in the plan, including monitoring for illicit discharges, monitoring construction and post-construction runoff, and monitoring pollution prevention/good housekeeping activities. The Carson City MS4 designated CCDS as the monitoring agency for its SWMP (2003b). For the Douglas County CCSWMP, Douglas County Community Development Department was designated as the monitoring agency (2003). The IHGID MS4 designated the IHGID Field Operations Division as the responsible entity for all monitoring except ensuring pollution prevention/good housekeeping, for which IHGID Development Services is responsible (2003). NDOT Headquarters initiates directives to implement their SWMP. The Environmental Services Division's Water Quality Specialist manages and coordinates permit compliance and oversees the development and implementation of the SWMP (NDOT, draft in review).

6.5 BMP Implementation

Methods used for BMP implementation as outlined in SWMPs include: public education, ordinances and sanctions, the assignment of responsible entities for implementing SWMP and training of MS4 employees. Public education through various media sources is used to emphasize ways in which the public can prevent pollution to stormwater through the use of BMPs on their own properties. Ordinances for construction sites dealing with erosion and sediment controls, trash management, site plan review and site inspection are developed and enforced by MS4s. Sanctions for noncompliance contained in the ordinances include fines for permit violation, stop work orders or permit revocation. Ordinances for post-construction

stormwater management require on-site BMPs for the lifespan of the project. SWMPs are required to list the agencies responsible for BMP implementation within the MS4. Clear designation of the responsible entity for BMP implementation does not allow BMP issues to fall by the wayside. Training of MS4 employees brings about proper BMP implementation as employees become skilled in the proper protocols for street sweeping, vehicle maintenance, management of a maintenance and storage yard, utility repair and construction, road deicing material application and storage, etc.

SECTION 7.0
NONPOINT SOURCES

Nonpoint, or diffuse, sources of pollution are defined to be a pollution source that is "diffused to the extent that it is not readily discernible and cannot be confined to a discrete conveyance" (NRS 445A.335). According to the 1994 *Handbook of Best Management Practices*, the following major activities are recognized by the State and EPA as having the potential to generate nonpoint source pollution in Nevada.

- Construction
- Hydrologic Modification
- Habitat Modification
- Irrigation and Drainage
- Cropland
- Livestock Grazing
- Feedlots/Animal Holding Units
- Silviculture
- Resource Extraction
- Urban Runoff
- Land Disposal
- Waste Management Activities
- Atmospheric Deposition

Each of these activities capable of generating nonpoint source pollution is thoroughly described in the 1994 Handbook.

The major difference in water allocation practices from when the 1982 208 Plan was drafted and currently is that point discharges from WWTFs to the Carson River ceased in 1987. This caused WWTFs to begin using surface irrigation for reuse of their wastewater. Effluent from WWTFs is currently reused as surface irrigation on community and private lands such as golf courses, ranches, farms, residential developments, schools and parks. In using effluent as irrigation water,

it has the potential to generate nonpoint source pollution associated with improper irrigation management practices.

7.1 Existing Nonpoint Sources

Numerous locations in the Carson River Basin have the potential to produce nonpoint source pollution, including small and large producers. Small producers (e.g., homeowners over-fertilizing their lawns, over-watering and discharging to gutters) are difficult to pinpoint and quantify because they operate at such a small scale. Larger producers (e.g., large farms, construction sites and mine sites) are more easily identified because of their size. Nonpoint producers are difficult to list because there are no regulations, no permits issued and no discharges quantified.

Existing and potential nonpoint sources in the Carson River Basin are presented below.

Agriculture

Agriculture lands are those used for raising stock and/or crop production. The potential nonpoint sources associated with agriculture are disturbance of land due to animal trampling and grazing, cultivation of land for crop production, improper management of irrigation water necessary to raise crops and livestock and improper management of drainage water.

Irrigation and Drainage

Improper management of irrigation and drainage water (return flows, runoff and leachate) independent of the management of irrigated land can, by itself, allow pollutants to enter surface water or groundwater. Pollutants include: sediment, organic solids, pesticides, salts, metals, bacteria, viruses and other microorganisms.

Livestock Grazing

Improper grazing practices can lead to reduced infiltration and increased runoff and erosion. Livestock management plans should consider livestock location, density and available forage.

Feedlots/Animal Holding Units

Feedlots and animal holding units are regulated by the NPDES if large quantities of animals are confined. For small storage areas, BMPs should be implemented to contain the pollutants present in manure, bedding materials and wastewater.

Agriculture in Carson River Basin

The quantity of agricultural acreage in the Carson River Basin is discussed by County. According to the Douglas County "Open Space Plan", there are 38,551 acres of zoned agricultural land in Douglas County, with 26 farms and ranches of 500 acres or more. Also, according to the Douglas County plan, 20,000 to 30,000 acres of agricultural area in Douglas County will need to be preserved for the goals of the plan to be achieved. Carson City's 1996 Land Use Plan Element to the Master Plan indicated that there are 2,213 acres of agricultural land in Carson City. Of that area, 504 acres are developed and 1,709 acres are vacant. Vacant lands are defined as parcels without improvements or only having partial improvements. A total of 6,924 acres were identified as conservation reserve, with 1,167 acres of that being developed and 5,757 acres listed as vacant. In Churchill County, agricultural acreages are decreasing. In 1997, there were 53,933 acres in cropland and 129,058 acres in farmland. The average farm size was 253 acres. These acreages decreased from 1992, when there were 56,921 acres of cropland and 268,043 acres in farmland. The average farm size was 507 acres.

Douglas County is attempting to preserve agricultural lands through programs for financing compensation or development right transfers. Churchill County also wants to maintain its ranchlands and open space by expanding concentrically from Fallon.

Carson City and Lyon County, specifically Dayton, are converting agriculture lands to suburban lands. In both areas, population growth and development are moving into agriculture areas.

There are two dairies in the Carson River Basin: Churia Dairy located in Gardnerville, Nevada with approximately 150 head of cattle; and the Prison Dairy located in Carson City, Nevada with approximately 243 head. (The Prison Dairy is also permitted to contain 555 horses, 352 calves

and feeder steers.) The owner of the Churia Dairy is currently considering either building a pond to contain dairy effluent or selling the herd.

Construction

Construction projects include the manufacturing of buildings, roads, utility lines or other facility improvements. The 1994 *Handbook of Best Management Practices* indicates that the primary pollutant generated at construction sites is sediment, as runoff from construction activities has the potential to generate more sediment per unit acre than from any other land use.

Major construction projects within the Carson River Basin are located mainly within the Carson City area. Construction projects associated with NDOT roadway projects are potential nonpoint sources of pollution. The largest roadway project in the Carson City area is the U.S. Highway 395 Bypass being constructed on the north end of Carson City. A new hospital is also being constructed at the north end of Carson City. New housing subdivisions being built in Carson City and Dayton also have the potential to create nonpoint sources. Construction of new shopping centers associated with population growth also has the potential to increase nonpoint sources of pollution.

Hydrologic Modifications

Hydrologic modifications consist of flow regulation/modification (i.e., diversion of river water for irrigation purposes), streambank modification/destabilization, channelization, dredging, dam construction and bridge construction. Hydrologic modifications can result from natural conditions or human activities including straightening, widening, deepening, or relocating existing channels and clearing or snagging operations. Hydrologic modifications can increase sediment loading, decrease or interfere with surface water contact to overbank areas, and destroy riparian areas and wildlife habitat (Nevada Division of Environment Protection and Nevada Division of Conservation Districts, 1994).

In the Carson River Basin, hydrologic modifications include the diversion of water from the river for irrigation purposes. Diversion structures used for irrigation purposes also constitute

hydrologic modifications to the river. Other hydrologic modifications include the historic channelization of the river, as well as levees constructed along portions of the river for flood control. Channel changes have led to streambank erosion problems that contribute to nonpoint source loads.

Habitat Modifications

The 1994 *Handbook of Best Management Practices* indicates that habitat modification is the loss of riparian habitat as a result of hydrologic modifications, trampling and overgrazing by all forms of livestock, and silvicultural and mining activities. Habitat modifications can result in degraded water quality, loss of livestock forage, reduced numbers and diversity of fish and wildlife, reduced property values and increased potential for severe flooding. The loss of riparian vegetation increases runoff and erosion by increasing soils exposure to the drying effects of wind and sun, reduces the water storage capacity of the riparian area, reduces shade which increases thermal loading in the river and reduces sediment filtration that is necessary for building streambanks, wet meadows and floodplains.

In the Carson River Basin, habitat modifications are occurring mainly as a result of hydrologic modifications such as diversion of water from the Carson River for irrigation purposes and destruction of streambanks due to erosion caused by overgrazing and trampling of the streambank area by all forms of livestock. Destruction of riparian vegetation due to overgrazing and trampling of streambanks has also increased thermal loading in the Carson River.

Mining

Mining activities can be a source of nonpoint pollutants such as sediments, salts, metal and organic compounds. Mine sites can continue to be a source on nonpoint pollutants after their closure.

One of the mining locations contributing nonpoint sources is the abandoned Leviathan Sulfur Mine, an inactive sulfur mine on the eastern slope of the Sierra Nevada in Alpine County, California. The Leviathan Mine drains into Leviathan Creek, which is a tributary to Bryant

Creek and the East Fork of the Carson River. Operation of the mine began in 1863 for extraction of copper sulfate for processing silver ore in the Comstock mining region of Nevada. In 1872, mining operations stopped because of high sulfur and low copper content of the ore. In 1954, the mine was transformed into an open pit mine to extract sulfur ore. Approximately 22 million tons of overburden and waste rock were removed for ore extraction and placed into and along the channels of Leviathan and Aspen Creeks, facilitating acid mine drainage to Leviathan Creek. Low pH and high metals content of the acid mine drainage have eliminated aquatic life in Leviathan and Bryant Creeks downstream of the mine. Fish kills have occurred in Leviathan and Bryant Creeks and the East Fork Carson River, which is 10 miles downstream of the site, as a result of the acid mine drainage. Creeks and rivers downstream of the mine are historical habitat for the Lahontan cutthroat trout (*Onchorhynchus clarki henshawi*), a federally listed endangered species, and cutthroat trout still inhabit the East Fork Carson River. The mine has been nonoperational since 1962 (EPA, 2000b).

In 1997, the Washoe Tribe of Nevada and California asked EPA to get involved to address contamination from the Leviathan Mine site. EPA intervention at the mine site was also supported by local governments in California and Nevada. Of particular concern to the Washoe Tribe of Nevada and California were the effects of evaporation pond overflow.

A number of measures to prevent contamination included attempts to treat pond water through lime neutralization and attempts to create more storage capacity in the ponds. These measures proved to be inadequate, however, and the Leviathan Mine was proposed for NPL listing in October 1999 and listed on the NPL in May 2000 (EPA, 1999; EPA, 2004b). With that listing, the EPA was made responsible for the coordination of cleanup plan activities with all of the stakeholders. This includes coordinating with local and state agencies from California and Nevada, the U.S. Forest Service, the U.S. Fish and Wildlife Service and with the Potentially Responsible Parties (PRPs). The Washoe Tribe is also heavily involved with Leviathan Mine issues to ensure the protection of the area's traditional tribal uses (EPA, 2004b).

Cleanup efforts at the Leviathan Mine site include the use of an innovative two-phase lime treatment developed by the State of California with the University of California, Davis. This treatment has been successful in eliminating the worst acid discharge by capturing millions of gallons of water throughout the year and treating it all during the summer months. Atlantic Richfield is capturing and neutralizing most remaining acid rock drainage. A full-scale biological treatment system designed by the University of Nevada, Reno has had success in treating one of the seeps year-round. EPA researchers have also tested several new mine treatment technologies at the Leviathan Mine site that improved the water quality of Leviathan and Bryant Creeks during the summers of 2001, 2002 and 2003 while the systems were operating. During 2003, the biological treatment system captured and treated all the acidic drainage from the Aspen Seep. Atlantic Richfield used lime treatment systems to treat mine drainage from the Delta Seep and Channel Underdrain during summer months. The California Regional Water Quality Control Board – Lahontan Region captured acidic waste from the Adit Seep and Pit Underdrain, treating the entire year's accumulation in a three-week period in the summer. Pond overflow has been prevented since 1999 (EPA, 2004b). The next phase of cleanup at the Leviathan Mine site consists of implementing year-round capture and treatment of acid mine drainage. Currently five alternatives addressing cleanup at the Leviathan Mine site are being considered by the EPA (EPA, 2004c).

The second mining contributor of nonpoint source pollution is the CRMS, which as of June 2004 is the only site in Nevada listed on the Superfund NPL. The site includes mercury-contaminated soils at former mill sites, mercury contamination in waterways adjacent to the mill sites and mercury contamination in sediments, fish and wildlife over more than a 50 mile length of the Carson River, beginning near Carson City, Nevada and extending downstream to the Lahontan Valley. Contamination is a result of the Comstock mining era of the late 1800s, when mercury was imported to the area for processing of gold and silver ore. Ore mined from the Comstock Lode was transported to mill sites, where it was crushed and mixed with mercury to amalgamate the precious metals. The mills were located in Virginia City, Silver City, Gold Hill, Dayton, Six Mile Canyon, Gold Canyon and adjacent to the Carson River between New Empire and Dayton.

During the mining era, an estimated 7,500 tons of mercury were discharged into the Carson River drainage, primarily in the form of mercury-contaminated tailings (i.e., waste rock) (EPA, 1990).

Mercury can currently be found in the sediments and adjacent floodplain of the Carson River and in the sediments of Lahontan Reservoir, Carson Lake, Stillwater Wildlife Refuge and Indian Lakes. Also, tailings with elevated mercury levels are still present at and around the historic mill sites, particularly in Six Mile Canyon. This site was listed as a "Superfund" site in 1990 under the CERCLA (EPA, 1990).

Cleanup of the CRMS began in 1991 with the removal of mercury-contaminated tailings from near Dayton, Nevada. That same year, a second removal action was completed at a park in Dayton. After the site was listed on the Superfund NPL list, EPA began a Remedial Investigation and Feasibility Study at the site, which included collection and laboratory analysis of hundreds of samples. Areas sampled included surface and sub-surface soils, sediments, groundwater, vegetation, garden crops and indoor air. As part of this assessment, EPA established a site-specific cleanup level of 870 ppm mercury for contaminated soils in residential areas. Four areas in Dayton, Nevada and Silver City, Nevada were found to exceed the cleanup level. In 1995, EPA adopted a final cleanup plan for the area that called for the excavation of the contaminated soils to a maximum depth of two feet, backfilling with clean soil, and offsite disposal of the contaminated soil. Cleanup work was carried out from August 1998 through December 1999 in Dayton and Silver City. Approximately 9,000 cubic yards of contaminated soil were excavated. Approximately 500 cubic yards of that soil was determined to be high mercury soil and had to be disposed of out of state at an approved thermal treatment facility. During cleanup work, the foundation of a 19th century mill building was discovered by a project archaeologist. Pools of elemental mercury and high mercury soils were discovered.

In 1997, EPA began an ecological effects study to determine the adverse impacts associated with mercury. Along with the ecological effects study, other studies have been completed to examine the formation and degradation of methylmercury in contaminated sediments, whether contaminated sediments in Lahontan Reservoir are a significant source of mercury to wildlife,

transport of mercury in Stillwater National Wildlife Refuge, and mercury loading into and from the Lahontan Reservoir. Further investigations will continue through at least 2005, when EPA will evaluate costs and benefits of cleaning up mercury contamination in the Carson River, Lahontan Reservoir and Stillwater Wetlands (EPA, 2004a).

Silviculture

Silvicultural practices can degrade water quality in receiving waterbodies through increased erosion, loss of riparian habitats and increase in organic debris. Increased erosion can increase sediment loads, loss of riparian habitats can lead to thermal loading, and increased organic debris can deplete dissolved oxygen.

Forestry operations take place predominantly on U.S. Forest Service (USFS) and BLM land. BLM and USFS lands will be maintained in the Carson River Basin, and silvicultural practices on these lands, mostly affecting tributaries to the Carson River, will be a potential source of nonpoint pollution. Silvicultural activities in the Carson River Basin are currently occurring in Alpine County, California.

Historical logging in the Carson River Basin has had lasting effects on the health of the river. Logging was practiced on a large scale, deforesting the slopes of the Eastern Sierra, increasing the potential for erosion and large sediment loads to the river. The river was also used to float logs downstream using splash dams, which damaged the channels, streambanks and riparian habitat along the river. These historic logging practices have had lasting effects on the watershed.

Land Disposal

Land disposal includes effluent reuse and septic systems. Land disposal can be a source of nutrients, salts, metals and organic compounds to groundwater and surface water. Septic tanks primarily affect groundwater, but more studies need to be done to determine potential affects on surface water. Irrigation using treated effluent can impact both groundwater and surface water.

Groundwater is affected by infiltration of the irrigation reuse water, and surface water is affected by irrigation return flows to the river.

As discussed previously in Section 4.2, septic tanks have a large impact on the quality of groundwater in the Carson River Basin. A USGS report titled, *Trends in Nitrate and Dissolved-Solids Concentrations in Ground Water, Carson Valley, Douglas County, Nevada, 1985-2001*, indicated that the highest nitrate concentrations in groundwater occurred near or directly under areas having high concentrations of parcels with septic tanks (Rosen, 2003). Of 27 wells with long-term records sampled in the study for nitrate and TDS in Douglas County from 1985 to 2001, all wells that showed increasing trends in nitrate and TDS were in areas that used septic waste-disposal systems (Rosen, 2003). Additional studies should be done to determine the potential impacts of septic tanks to surface water in the Carson River Basin.

Effluent reuse in the Carson River Basin may be an important source of phosphorus to the Carson River. A USGS report titled, *Sources of Phosphorus to the Carson River Upstream from Lahontan Reservoir, Nevada and California, Water Years 2001-02*, indicated that because treated municipal-sewage effluent has elevated concentrations of phosphorus, drainwater from agricultural lands irrigated with effluent reuse water are a potentially large source of phosphorus. The study showed that the largest increases in phosphorus loading among reaches of river in the Carson Valley are associated with agriculture, particularly fields permitted to irrigate with treated effluent. The study indicated that a 20-fold increase in orthophosphate concentration occurred in a 1.5 mile reach between the East Fork of the Carson River at Muller Lane and the East Fork of the Carson River above the confluence with the West Fork of the Carson River. Agricultural lands in that reach are irrigated almost exclusively with treated effluent (Alvarez and Seiler, 2004). More studies are needed to quantify the phosphorus contribution to the Carson River associated with irrigation using treated effluent.

7.2 Projected Nonpoint Source Locations

Changes in the type and quantity of potential nonpoint sources in the future would result from future land use changes in the Carson River Basin. Specifically, some agricultural lands are

expected to be taken out of production over time and converted to residential and commercial development or conservation easements, gradually reducing agricultural nonpoint source contributions. However, as land is developed for residential and commercial purposes, there are concerns about encroachment into the riparian corridor. The river needs room to migrate and room is needed to sustain the riparian vegetation needed for a healthy aquatic system. Stormwater runoff from potential pollutants moving off the developed lands will be managed by stormwater systems, and may be regulated as point sources. Therefore, future water quality conditions in the Carson River Basin will be less affected by agricultural lands.

The Leviathan and CRMS site will continue on as sources of nonpoint pollution. From the CRMS site, mercury can currently be found in the sediments and adjacent floodplain of the Carson River and in the sediments of Lahontan Reservoir, Carson Lake, Stillwater Wildlife Refuge and Indian Lakes. Tailings with elevated mercury levels are still present at and around the historic mill sites, particularly in Six Mile Canyon (EPA, 1990).

7.3 Best Management Practices

The 1994 *Handbook of Best Management Practices* lists BMPs that can reduce the potential for nonpoint source pollution from locations having the potential to generate pollution in Nevada. BMPs recommended in the 1994 Handbook will be discussed.

7.3.1 Agriculture

Agricultural BMPs are divided into two categories: farming and livestock. It must be noted that agricultural BMPs will have to be used to deal with potential nonpoint sources of pollution from agricultural lands associated with their use as areas for effluent reuse by WWTFs.

Farming BMPs are described in the 1994 Handbook. Farming BMPs include the following:

- Irrigation Water Management
- Irrigated Cropland Management
- Native Meadowland Irrigation Management
- Salinity Control

- Chiseling or Subsoiling
- Soil Amendment, Fertilizer, and Pesticide Management

Livestock BMPs, as discussed in the 1994 Handbook, include:

- Planned Grazing System
- Proper Grazing Use
- Range Improvements
- Livestock Facilities
- Fencing

7.3.2 Construction

BMPs for construction activities include the following:

- Development Site Plan
- Grading Season and Practices
- Access Roads
- Dust Control
- Topsoil Management

These BMPs are described in detail in the 1994 Handbook.

7.3.3 Hydrologic Modifications

BMPs for dealing with hydrologic modifications are described in chapters titled "Watershed Management" and "Erosion and Sediment Controls" in the 1994 *Handbook of Best Management Practices*. BMPs include:

- Critical Area Protection
- Critical Area Stabilization
- Stream Protection and Stabilization
- Erosion and Sediment Control Structures
- Proper Grazing Use

7.3.4 Habitat Modifications

BMPs employed to reduce the occurrence of habitat modifications include the following:

- Critical Area Protection
- Critical Area Stabilization
- Stream Protection and Stabilization
- Erosion and Sediment Control Structures
- Proper Grazing Use

7.3.5 Mining

Mining BMPs included in the 1994 Handbook are as follows:

- Mineral Exploration
- Excavation Stabilization
- Surface Runoff Management
- Waste Rock Dump Management
- Impoundment Management
- Reclamation

7.3.6 Silviculture

BMPs listed in the 1994 Handbook associated with silviculture in the "Forest Resource Management" chapter include:

- Accepted Forest Practices
- Wildland/Urban Interface Management
- Fuels Management

7.3.7 Land Disposal

BMPs used to deal with nonpoint sources associated with land disposal, including effluent reuse and septic tanks, include the following:

- Irrigation Water Management
- Irrigation Cropland Management
- Native Meadowland Irrigation Management

- Soil Amendment, Fertilizer, and Pesticide Management
- Waste Management Systems

7.4 Monitoring

Federal and State agencies, as well as university programs carry out monitoring of waterways for impacts from nonpoint sources of pollution. Not all monitoring is set up to look specifically at the efficacy of BMPs, but that can be a byproduct of a monitoring program.

7.4.1 Federal

On the Federal level, one of the agencies involved in water quality and quantity monitoring is the USGS. One of the main tasks of the USGS is to maintain and collect hydrologic data. Data collected includes surface water flow rate and stage, water levels in wells and chemical and physical water quality data for streams, lakes, springs and wells. The hydrologic database maintained by the USGS can help to determine if BMP implementation is having an affect on waterways. Water quality monitoring by the USGS is not done directly to assess nonpoint source pollutants.

The NRCS is also involved in monitoring associated with nonpoint sources. The NRCS works with watershed groups on streambank erosion programs and other projects monitoring nonpoint sources. The NRCS runs the soil surveys program, which provides soils maps, data about the physical and chemical properties of those soils and information derived from that data about issues associated with the soil. These surveys provide information that allows for sustainability of the soil and protection of water quality, wetlands and wildlife habitat.

7.4.2 State

NDEP is responsible for performing long-term water quality monitoring in the Carson River Basin. Water quality monitoring is conducted through NDEP's Ambient Monitoring Network (Appendix B, Figure B-1) that has been going on from the late-1960s through the present. Like data maintained by the USGS, the hydrologic data maintained by NDEP can aid in the determination of BMP effectiveness.

NDEP is assisted by the Department of Wildlife with monitoring concerning water quality issues associated with the Carson River fisheries.

7.4.3 Local

Local agencies providing monitoring for nonpoint sources of pollution include Conservation Districts (CD). CDs are local, which enables them to quickly see any issues arising with improper land use management. Quick determination of an issue by a CD can prevent major problems from developing.

7.4.4 University Programs

The University of Nevada, Reno, although not expressly charged with monitoring, assists NDEP and Federal agencies with monitoring through technical studies carried out to determine the effectiveness of BMPs on agricultural land. DRI provides similar assistance to NDEP and Federal agencies through technical studies of surface water and groundwater quality.

7.5 BMP Implementation

The main vehicle for nonpoint source control is the Nevada Nonpoint Source Program, which operates under the authority and funding of the CWA Section 319 and is guided by the State Management Plan (revised in 1999) and other guidance documents provided by the U.S. EPA (NDEP, 1999). Nevada's Nonpoint Source Program is largely non-regulatory and is based on public education/outreach, technology transfer, implementation of BMPs and demonstration projects. Nevada's Nonpoint Source Program also relies on watershed groups, namely the CWSD, for development of Nonpoint Source Program implementation strategies in the Carson River Basin (NDEP, 1999). The makeup and function of the CWSD is described below, along with watershed education programs practiced in the Carson River Basin.

7.5.1 CWSD

In 1989, the CWSD was designated by the Nevada Legislature as the responsible entity for watershed management and planning for the Carson River Watershed ("watershed"). At that

time, the CWSD included only three counties (Douglas, Carson City and Lyon). Churchill County, Nevada and Alpine County, California joined the CSWD in 1999 and 2001, respectively.

The guiding principle of the CWSD is to ensure that watershed issues are addressed in a comprehensive and holistic manner. The organization consists of a 13-member Board of Directors made up of elected and non-elected officials from the five counties along the Carson River as well as two agricultural representatives. CWSD Board of Directors meetings are held on a monthly basis and are open to the public. Meeting agendas are posted at numerous locations throughout the watershed. The CWSD website also contains meeting minutes and agendas, as well as special events and activities sponsored by the CWSD and other watershed organizations. To further assure public involvement, CWSD develops steering and technical advisory committees for projects and programs to ensure appropriate stakeholder involvement in decision-making and project implementation.

The CWSD is the lead agency for the integrated watershed planning process (IWPP) and the coordinating agency for the Carson River Coalition (CRC). The CRC, formed in 1998, is a diverse group of dedicated citizens, Federal, State and local agencies and organizations, universities and environmental groups representing all regions of the watershed. The purpose of the CRC is to form relationships so that problems, threats and issues are addressed in a spirit of communication and cooperation. The group is a critical element of the IWPP. CRC meetings are held on a regular basis and are open to the public. These meetings provide a format for the exchange of information regarding projects and programs so that all stakeholders are provided the opportunity to view the bigger picture of how their particular project can benefit the whole.

Within the CRC are working groups that are dedicated to issues such as water quality, water resources, land use, natural resources, education and outreach and interagency cooperation. Special committees are formed as needed to address specific concerns.

NDEP works with the CWSD to develop nonpoint source program implementation strategies for the Carson River watershed.

7.5.2 Watershed Education

Public awareness and participation by community members in watershed projects and programs is critical in protecting the watershed. Numerous ongoing outreach programs and activities have been successfully implemented.

Carson River Workdays

This program is coordinated through Western Nevada Resource Conservation and Development (RC&D) and has involved thousands of community members throughout the watershed in river restoration activities for over a decade.

River Wranglers

River Wranglers is a program that works with local schools by having older students mentor younger students on river restoration and water quality.

Project WET (Water Education for Teachers)

Water festivals and special events such as Project WET (Water Education for Teachers) focus on community water education. These events are held on an annual basis at rotating locations throughout the watershed.

University of Nevada Cooperative Extension's Living on the Land Program

This program is specifically aimed at providing owners of small ranches tools for operating their ranches in a way that helps to protect water quality.

Eagles and Agriculture

The annual Eagles and Agriculture workshop and tour show the benefits that agriculture provides to wildlife and the community.

Trout In the Classroom

Programs such as Trout In the Classroom are implemented in local schools to familiarize students with water issues.

Explore Your Watershed

This program was developed by the CRC Education Working Group and is designed for use by schools, organizations and the general public. This program involves the Our Lifeline in the Desert map, which provides an opportunity for place-based learning in a fun and artistic manner. An interactive website brings the map to life and provides the opportunity for the general public to learn about vital resources and to participate in the watershed process.

The Carson River Report

The Carson River Report is a monthly informational program on local access television provided by the CWSD. This program, hosted by the CWSD General Manager, explores different areas of the watershed, provides information on specific programs, issues and concerns and provides the general public the opportunity to learn about where they live from the comfort of their own home.

7.6 Funding, Technical and Program Assistance for Nonpoint Source Programs

Section VI of NDEP's State Management Plan – Nonpoint Source Management Program outlines federal, state and local programs that address nonpoint source pollution (1999). Many of the programs described offer financial, technical and program assistance. Section VI is reproduced in Appendix F.

SECTION 8.0
SUMMARY AND RECOMMENDATIONS

Updated information through the year 2025 on WWTF expansions, socio-economic patterns, and point and nonpoint sources in the Carson River Basin presented in this 208 Plan will provide the basis for future water and wastewater management planning efforts. Since the 1982 208 Plan was published, the following changes affecting surface water and groundwater quality in the watershed have occurred: 1) the discharge of treated effluent to the Carson River from WWTFs ceased in 1987, with treated effluent currently being used for irrigation purposes; 2) there has been increased residential development throughout the watershed and within the river corridor with increased wastewater loading, changes in stormwater runoff, and other impacts upon the riparian corridor; 3) BMPs have been implemented for ranch and farm operations and urbanized areas; and 4) the number of dairy operations in the Basin has decreased. Of primary concern for the Carson River is the control of nonpoint source pollution (including thermal loading due to lack of riparian vegetation, streambank erosion, etc.).

The use of BMPs throughout the Carson River Basin has increased since the 1982 208 Plan was published. Of particular importance has been the recognition of the improvements associated with agricultural BMPs (e.g., cattle grazing) along the river, brought about by a greater understanding of the effects of human activities on watershed health. Related educational activities concerning the value of BMP implementation have become a high priority for agencies such as CWSD, which has initiated a number of programs to involve and educate the public concerning water quality issues. As a result of public outreach involving a diverse group of stakeholders, river restoration projects and conservation easements have promoted improved water quality conditions in the Carson River. Streambank stabilization projects and conservation easements have helped to remove sediment loading from discrete areas along the river.

SWMPs are being implemented in the Carson River Basin. The Stormwater Program, implemented under the NPDES Phase II Final Rule as of March 10, 2003, requires that small MS4s and construction activities disturbing between one and five acres of land obtain discharge

permits. Phase II required permitting of four entities in the Carson River Basin: the Carson City MS4, Douglas County MS4, IHGID MS4 and NDOT. Phase II brought about a heightened awareness of stormwater effects on water quality, and also increased the use of BMPs at construction sites.

Also of importance is WWTF effluent management in the Carson River Basin. The policy change that prohibited point discharges of treated effluent from WWTFs to the Carson River in 1987 resulted in lower flows during the summer months and the removal of a large source of nutrient loading to the river and Lahontan Reservoir. Subsequently, these point sources were placed to beneficial use (e.g., surface agricultural and landscape irrigation and land application) and alternative methods of disposal (e.g., evaporation and percolation to groundwater using RIBs and leach fields). Treated effluent that is used as a source for agricultural and landscape irrigation may contribute to nonpoint source loading to the Carson River, which is an important factor in determining the environmental and ecological health of the river.

Two alternatives have been identified for future effluent management activities: 1) under a higher level of treatment, WWTFs could be permitted to directly or indirectly discharge to the Carson River, although it is uncertain if WQS will be met even with tertiary treatment; or 2) the current system of wastewater reuse as described in this revised 208 Plan would be continued. Discharging to the Carson River would involve significant WWTF improvements to produce a quality of effluent that would achieve reach-specific WQS, allow for aquatic life propagation, and comply with TMDLs to be established by NDEP. Discharges of treated effluent would also result in a higher quantity of streamflow that may have both economic (i.e., water for agricultural operations) and ecological (i.e., water for riparian habitat) benefits that would be beneficial during critical low flow periods. This option may also be needed in the future as the availability of effluent land application reuse sites lowers in the Carson River Basin.

Discharging treated effluent to the river may be more cost effective than building additional effluent storage reservoirs and developing reuse sites. Discharge of treated effluent should be examined as part of a feasibility study for managing effluent in the Carson River Basin. The

impact of increased loading to Lahontan Reservoir has to be considered in any effluent discharge feasibility study for the Carson River and during any process to revise TMDLs. Revised TMDLs would be needed to allocate wasteloads as part of the discharge permitting process. Implementation of this recommendation should be carefully planned with input from all stakeholders in the watershed.

Given the projected demand for reuse water associated with an increasing population base, potential discharges of treated effluent to the Carson River would not likely modify current reuse practices. If discharges to the river are not permitted, as more treated effluent is generated, the following activities would likely be implemented: 1) additional winter storage facilities would have to be constructed to store the effluent during the non-irrigation season (approximately three months during the winter); 2) more extensive reuse distribution systems would have to be constructed; and 3) adequate BMPs to prevent additional nonpoint source loading that may result from increased irrigation use would have to be implemented.

As part of this implementation, it is recommended that NPDES discharge permits of limited time duration be considered for specific circumstances associated with wastewater-related construction activities (e.g., plant upgrades, effluent management facilities, or lining of effluent storage reservoirs). Such discharge permits could be for seasonal discharges only (i.e., during the winter months), when effluent reuse would not be feasible. Water quality and flow monitoring data collected during the discharge of treated effluent to the Carson River would provide valuable background information for evaluating more long-term surface discharge alternatives, which would help in the restoration of in-stream flows during low-flow summer months and drought periods.

As described above, future water quality conditions in the Carson River Basin will be directly linked to how surface water and groundwater resources respond to increasing population, water demands and wastewater loads. All treated effluent will either be evaporated, taken up by crops or landscape vegetation, temporarily stored in soils and unsaturated alluvium and/or discharged to groundwater or to the river. These effluent management practices will need to be evaluated in

the context of increasing water resource demands, which should have the net effect of reducing groundwater elevations in alluvial materials from which groundwater supplies are extracted and reducing natural discharges to the river.

SECTION 9.0

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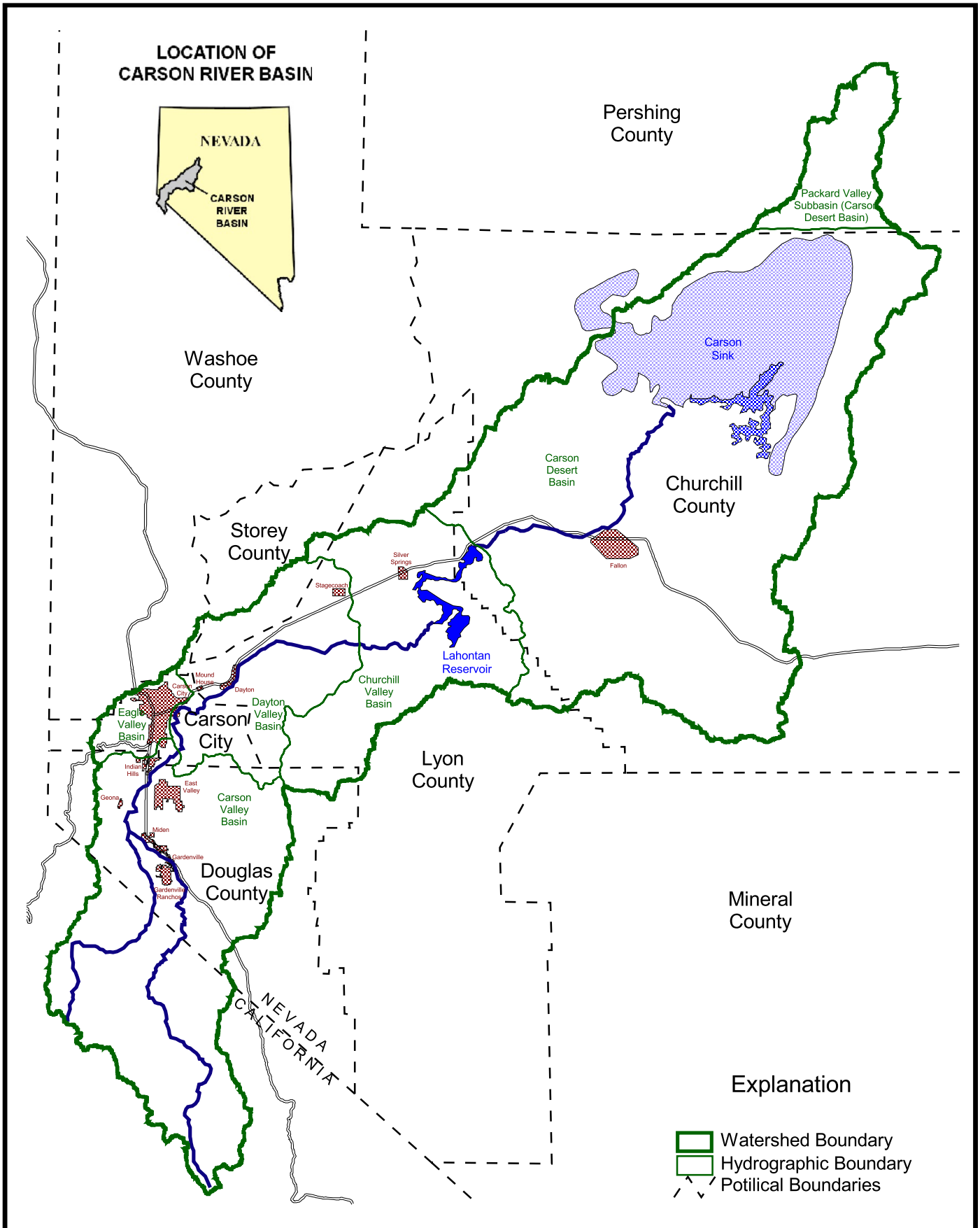

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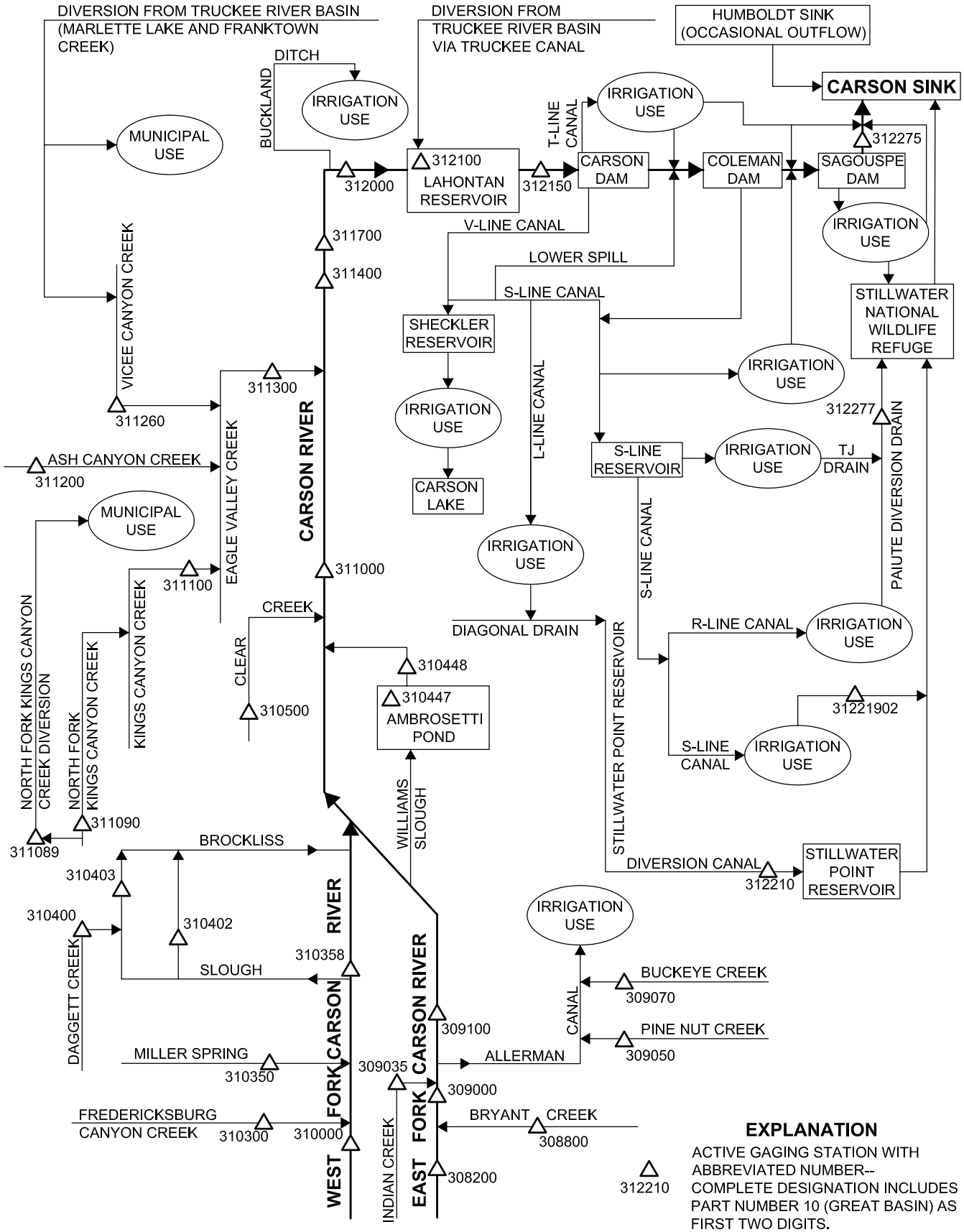
Figure 1-1

Carson River
Basin Location Map



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Jan 2005	25623	**Water Quality Management (208) Plan for the Carson River Basin**	Figure 2-1 Schematic Flow Diagram of Carson River

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Carson Water Subconservancy District

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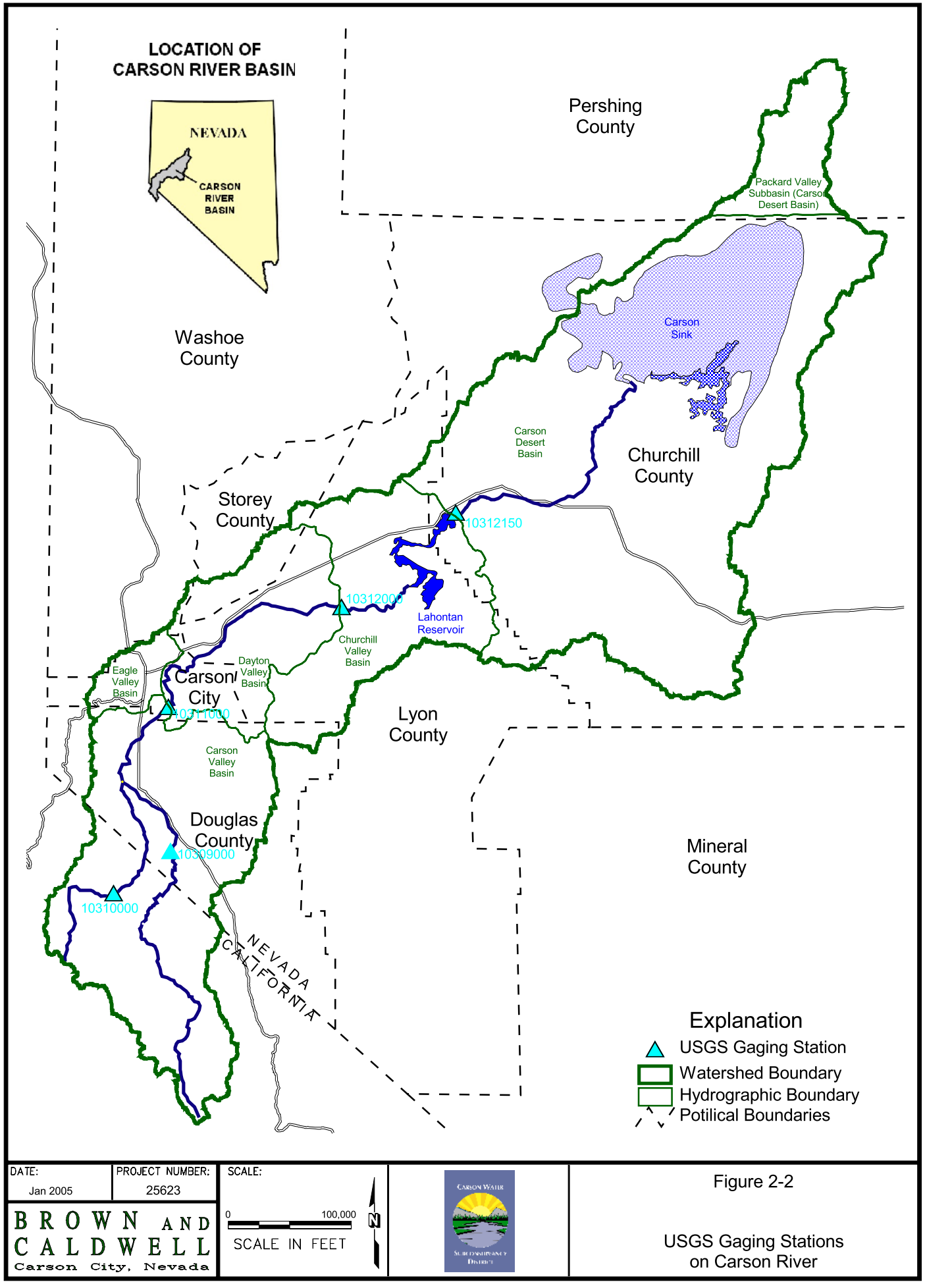

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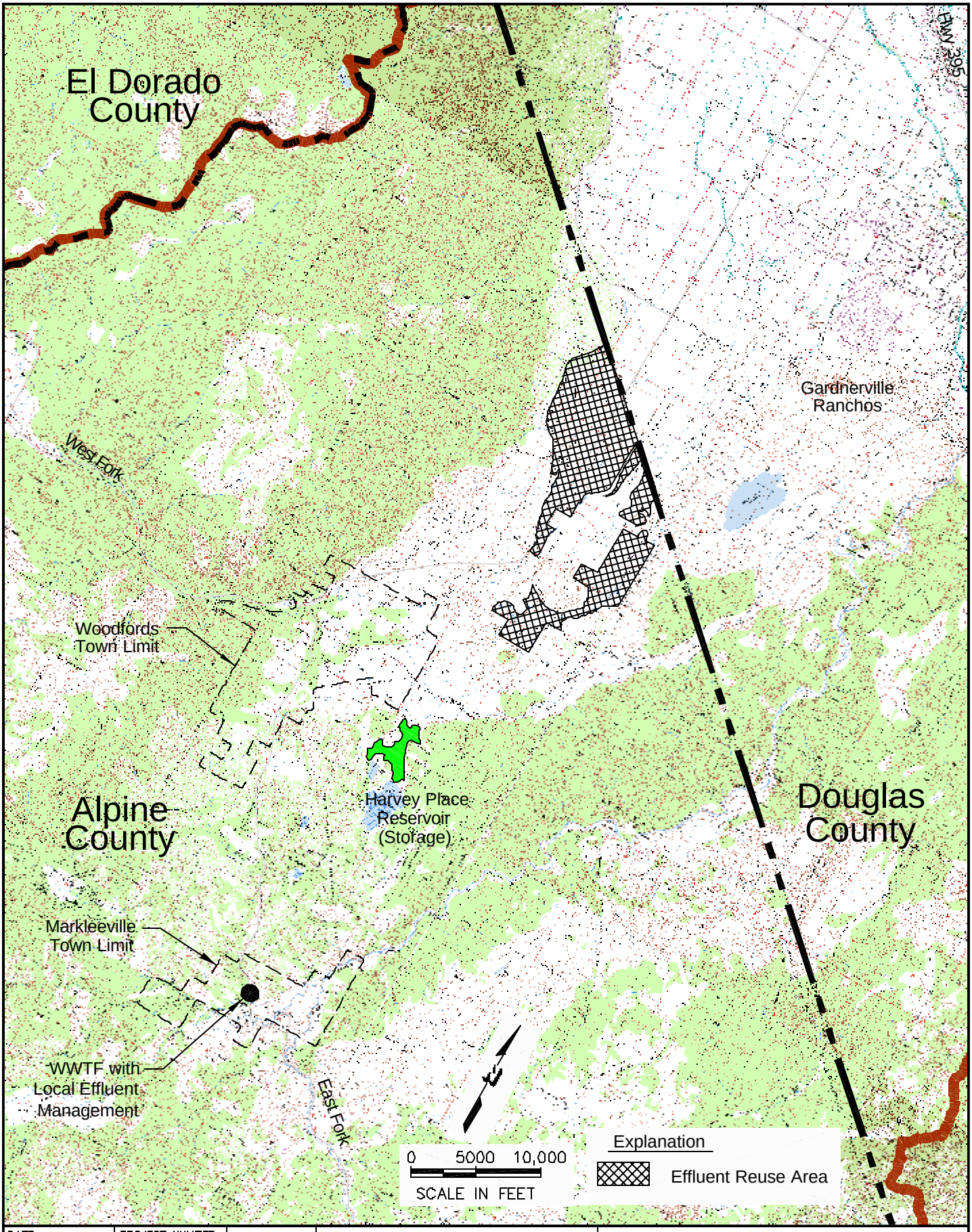
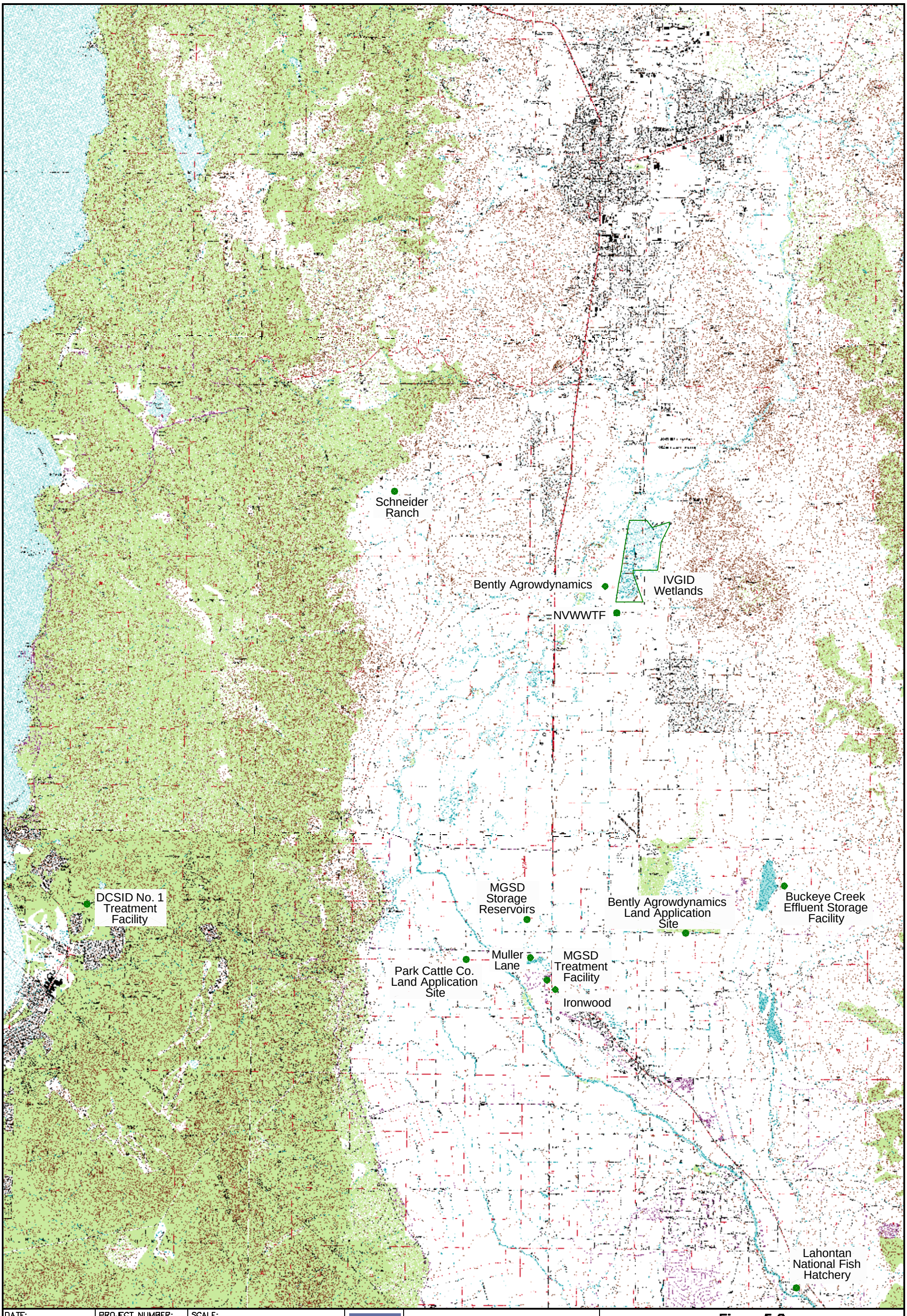
Figure 2-2

USGS Gaging Stations
on Carson River



DATE: Jan 2005	PROJECT NUMBER: 25623	**Water Quality Management (208) Plan for the Carson River Basin**	Figure 5-1
BROWN AND CALDWELL Carson City, Nevada			Treatment Works and Effluent Reuse Areas in Alpine County



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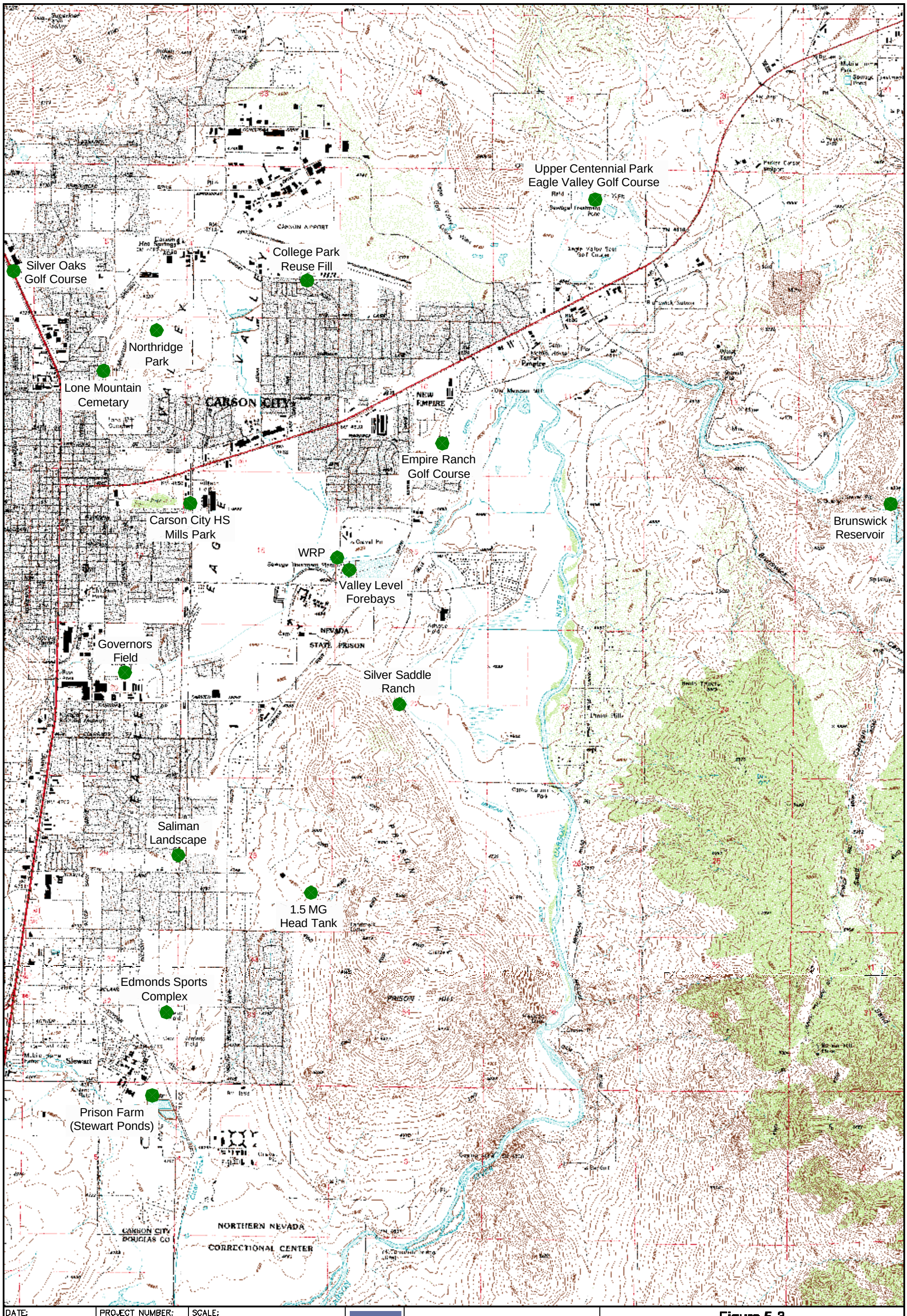
BROWN AND CALDWELL Carson City, Nevada				



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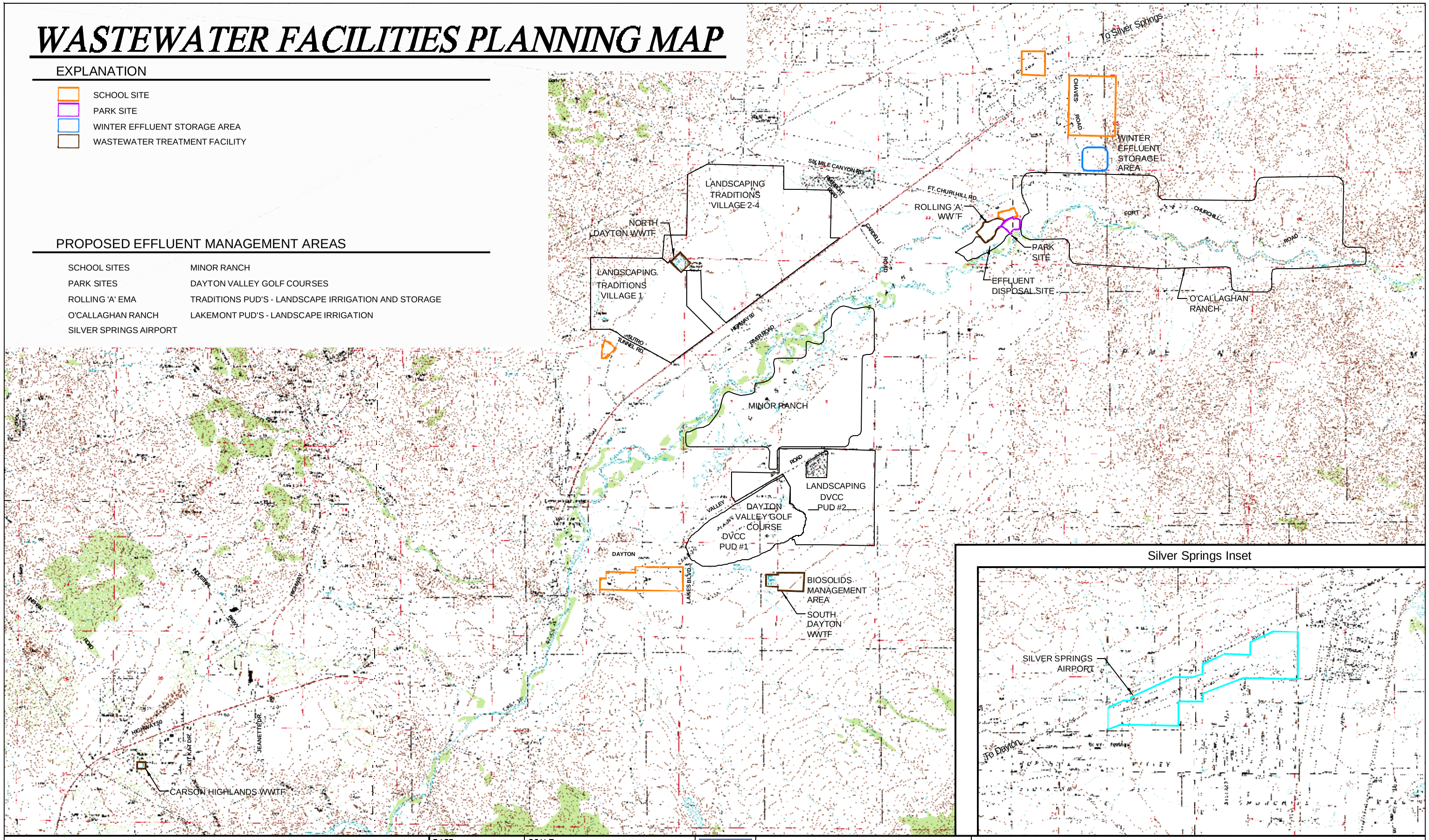
WASTEWATER FACILITIES PLANNING MAP

EXPLANATION

- SCHOOL SITE
- PARK SITE
- WINTER EFFLUENT STORAGE AREA
- WASTEWATER TREATMENT FACILITY

PROPOSED EFFLUENT MANAGEMENT AREAS

SCHOOL SITES	MINOR RANCH
PARK SITES	DAYTON VALLEY GOLF COURSES
ROLLING 'A' EMA	TRADITIONS PUD'S - LANDSCAPE IRRIGATION AND STORAGE
O'CALLAGHAN RANCH	LAKEMONT PUD'S - LANDSCAPE IRRIGATION
SILVER SPRINGS AIRPORT	



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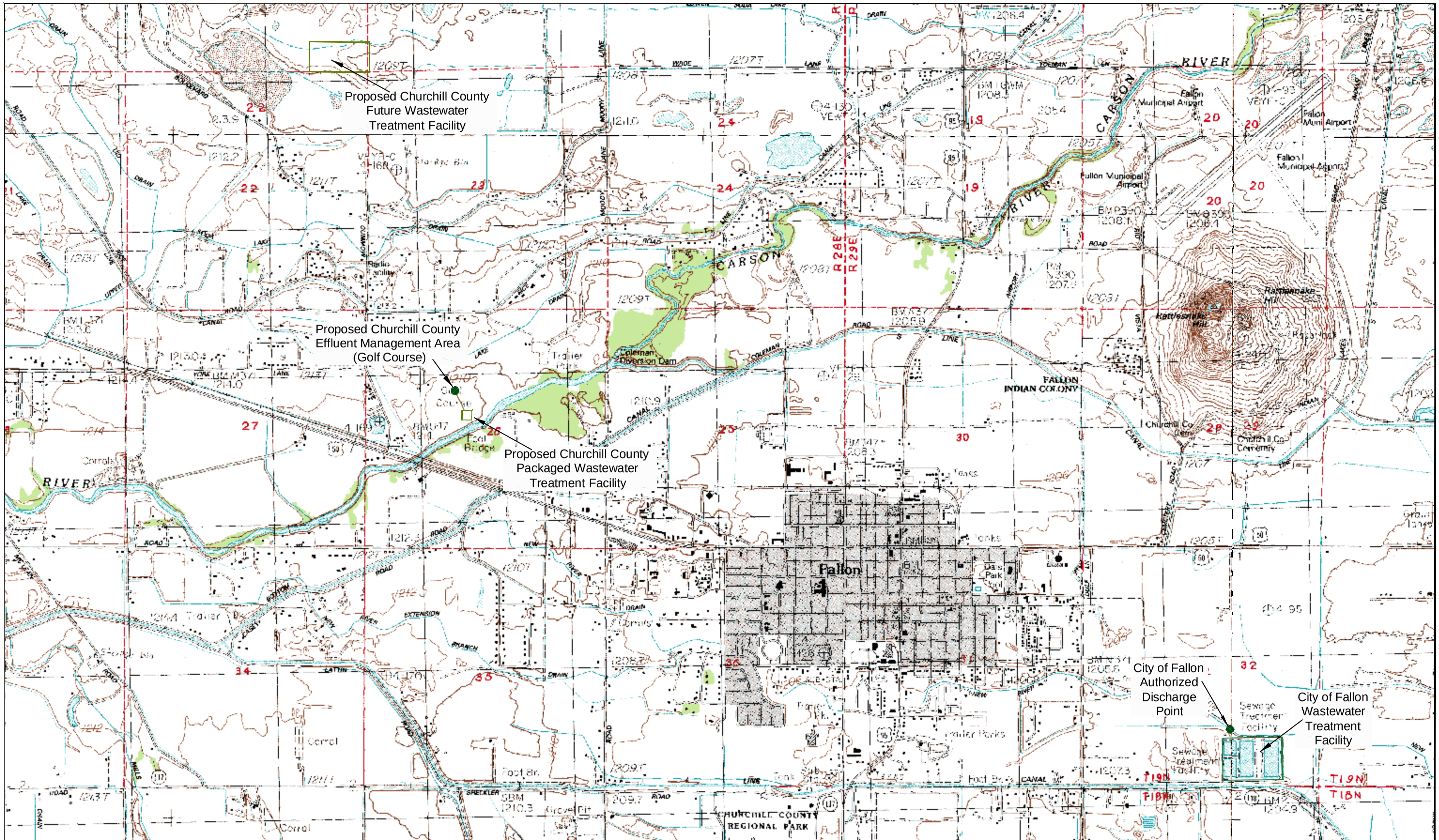
Water Quality Management (208) Plan for the Carson River Basin

Figure 5-4

Treatment Works and Effluent Reuse Areas in Lyon County



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Water Quality Management 208 Plan for the Carson River Basin

Figure 5-5

Treatment Works and Effluent Reuse Areas in Churchill County