Chapter 2 Table of Contents

List of Tables

List of Figures

List of Abbreviations and Acronyms

2016-2035 WRP	TMWA's 2016-2035 Water Resource Plan
af	Acre-Feet
afa	Acre Feet Annually
ASR	Aquifer Storage and Recovery
BCC	Board of Commissioners
BOR	Bureau of Reclamation
cfs	Cubic Feet Per Second
Consensus Forecast	Washoe County Consensus Population Forecast
CSD	Community Services Department
CTMRD	Central Truckee Meadows Remediation District
CTP	Chalk Bluff Water Treatment Plant
DOI	Department of the Interior
DRI	Desert Research Institute
EPA	U.S. Environmental Protection Agency
GTP	Glendale Water Treatment Plant
IPR	indirect potable reuse
LGOC	Local Government Oversight Committee
M&I	Municipal and Industrial
MCL	Maximum Contaminant Level
mg/L	Milligrams Per Liter
MGD	Million Gallons Per Day
MRTP	Mt. Rose Water Treatment Plant
NDEP	Nevada Division of Environmental Protection
NDWR	Nevada Division of Water Resources
NRS	Nevada Revised Statute
NTU	Nephelometric Turbidity Units
PCE	Perchloroethylene
PL	Public Law
PLPT	Pyramid Lake Paiute Tribe
POSW	Privately Owned Stored Water
RAA	Running Annual Average
Regional Plan	Truckee Meadows Regional Plan
Regional Water Plan	Comprehensive Regional Water Management Plan
RPC	Regional Planning Commission
RPGB	Regional Planning Governing Board
Settlement	Negotiated Settlement
STMFP	South Truckee Meadows Facility Plan
STMGID	South Truckee Meadows General Improvement District
TCID	Truckee Carson Irrigation District
TMWA	Truckee Meadows Water Authority

TRA	Truckee Resource Area
TROA	Truckee River Operating Agreement
U.S.	United States
UNR	University of Nevada, Reno
WCHD	Washoe County Health District
WHPP	Wellhead Protection Plans
WQSA	Water Quality Settlement Agreement
WRWC	Western Regional Water Commission

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Chapter 2 Water Resources

Purpose and Scope

This chapter describes various sources of water available to meet the present and future needs in the Planning Area. It also discusses the quality of surface water and groundwater, and describes certain programs concerning pollution prevention and clean up to provide for adequate supplies of municipal and industrial water for the Planning Area.

Summary and Findings

The major findings of this chapter include:

For 20-year regional planning purposes, sustainable water resources are estimated at approximately 190,580 acre feet annually (“afa”), including resources presently dedicated for municipal and industrial (“M&I”) uses and those that may be converted from other uses to M&I. This planning-level estimate of available resources, however, should not be considered a commitment to, nor a guarantee of, the availability of a water allocation for any specific project or parcel.

Recent data show that more than 37,000 afa of effluent water is generated in the Planning Area of which up to approximately 6,000 afa is used for non-potable purposes such as irrigation, construction and dust control; the remainder is returned to the Truckee River, discharged to Swan Lake wetlands or to the ground via infiltration basins. The Nevada Division of Environmental Protection (“NDEP”) has developed amendments to its reclaimed water regulations that allow for groundwater augmentation with highly treated effluent.

The Orr Ditch Decree, issued in 1944, established the number of water rights associated with the Truckee River and all its tributaries by reach, priority, owner and quantity. It is important to note that although surface water rights can be subdivided and/or converted from one use to another, for example from agriculture to M&I use, the overall total number of surface water rights available from the Truckee River has not changed from the amount defined in the Decree.

The primary water rights that applicants for new water service dedicate to the Truckee Meadows Water Authority (“TMWA”) are mainstem Truckee River water rights. Although the number of remaining Truckee River mainstem irrigation water rights available for conversion to M&I use continues to decrease, an analysis in TMWA’s *2016-2035 Water Resource Plan* (“2016-2035 WRP”) shows that over 46,000 acre-feet (“af”) of Truckee River mainstem rights are potentially available for dedication to TMWA to support future will-serve commitments, and this amount is more than enough to meet TMWA’s future water rights requirements through the 20-year planning horizon.

The *Truckee River Operating Agreement* (“*TROA*”) allows for a congressionally authorized interstate allocation of water and change to the operation of the Truckee River system to accommodate multiple beneficial uses for drought supply, endangered and threatened fish species, water quality, California water use, and storage. In addition, operations will enhance riparian habitat, reestablish river canopy, enhance reservoir releases, improve recreational pools in the reservoirs, and improve the process for emergency drawdown procedures for Lake Tahoe.

TROA was signed on September 6, 2008 by the Mandatory Signatory Parties (TMWA, Pyramid Lake Paiute Tribe ["PLPT"]), California, Nevada, and the United States ["U.S."]) and seven other parties; all conditions to implement TROA were finally completed in the fall of 2015.

A total of 8,000 afa of groundwater is currently available for importation from the Honey Lake Valley hydrographic basin to Lemmon Valley by way of existing infrastructure. The timing of such groundwater importation will depend on future land development projects.

Threats to the reliability of the Planning Area's water supply are weather and source water supply contamination, both of which may affect the quantity and quality of available water supplies. Numerous programs are in place within the Planning Area to address existing problems and threats having the potential to affect available water supplies.

Introduction

Water resources identified in this chapter are quantified for 20-year planning purposes in terms of estimated groundwater perennial yield and water rights for hydrographic basins consistent with the Nevada State Engineer's records, yield for the Truckee River system as per TROA, and reclaimed water generated at water reclamation facilities in the Planning Area. Water resources sustainability is discussed with respect to population, future water demand projections, and other factors that affect sustainability; including economic, legal and regulatory considerations in addition to reliability factors such as weather, climate, droughts and source water quality. Programs to address source water quality are described as they relate to sustainability factors.

2.1 Sources of Water

For the purposes of regional water resources planning, water sources are grouped into three general categories: surface water, groundwater and reclaimed water. It should be noted that TMWA further delineates the Truckee Resource Area ("TRA") as those areas whose water supply is the mainstem Truckee River or creek water rights. While not defined specifically as a source of water, the term is used in this discussion. Further discussion regarding the TRA is presented in Chapter 3.

2.1.1 Surface Water

The Truckee River system is the primary source of water supply for the Truckee Meadows. Originating at Lake Tahoe, the Truckee is fed by runoff from seasonal mountain snowpack carried by numerous tributary lakes and creeks. To regulate river flows to meet Floriston rates (as defined in TROA), releases come primarily from Lake Tahoe, Boca Reservoir and from time to time, Donner Lake and Prosser Reservoir through exchange agreements. Independence Lake is used by TMWA for drought supply. Stampede and Prosser Reservoirs are used for wildlife purposes. Figure 2-1 shows the Truckee River system with high, low and average flows at various locations. The Truckee River generally flows to the north from Lake Tahoe through California, crossing into Nevada at Verdi and flowing to the east through the Truckee Meadows to Wadsworth and then northerly to Pyramid Lake, approximately 116 miles by river from Lake Tahoe. Most of the water that flows to the Truckee River by Nevada tributaries comes from the east slope of the Carson Range to Steamboat Creek, while other tributaries flow directly to the Truckee from the north slope of the Carson Range, the Verdi Range and Peavine Mountain.

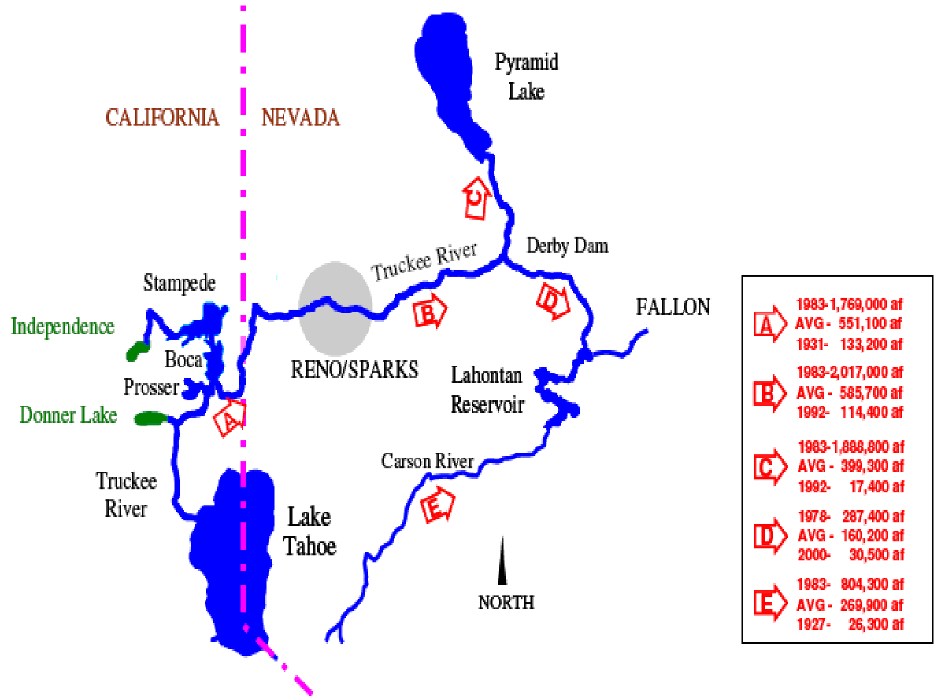

Figure 2-1 Surface Truckee River System with Highest, Lowest and Average Recorded Flows (TMWA, 2010)

Steamboat Creek originates at Washoe Lake and flows 15 miles to the north through Pleasant Valley and the eastern Truckee Meadows to the Truckee River. Along its course it is joined by six perennial creeks: Browns, Galena, Whites, Thomas, Dry and Evans that flow from the Carson Range, and one ephemeral stream (Bailey Creek) from the Virginia Range. Steamboat Creek is significant because of its water rights and those of its tributary creeks. Tributary creeks are shown in Figure 2-2.

Water for various uses is diverted from the Truckee River into a number of ditches, such as the Highland Ditch which conveys water to the Chalk Bluff Water Treatment Plant (“CTP”), and a few irrigators remaining on the ditch. Water diverted for irrigation is conveyed several miles north to Spanish Springs Valley via the Orr Ditch, and to the south via Steamboat, Last Chance and Lake Ditches. Other irrigation ditches serve localized areas of the central Truckee Meadows. In general, historical and current ditch uses are the same: municipal supply, irrigation and hydroelectric generation.

2.1.2 Groundwater

The major hydrographic basins within the Planning Area that supply M&I and/or domestic water include the Truckee Meadows, Truckee Canyon (Verdi/ Mogul), Tracy Segment (East Truckee Canyon), Pleasant Valley, Washoe Valley, Sun Valley, West Lemmon Valley, East Lemmon Valley, Warm Springs Valley and Cold Springs Valley, as shown in Figure 2-3. Developments in the Truckee Meadows, Sun Valley, West Lemmon Valley and Spanish Springs Valley rely on Truckee River water in addition to groundwater while the remaining basins rely on groundwater as the source of water supply. Development in the Red Rock Valley, Antelope Valley and Bedell Flat basins are supplied by domestic wells. The timing of groundwater importation from the Honey Lake Valley hydrographic basin by way of existing infrastructure will depend on future land development projects.

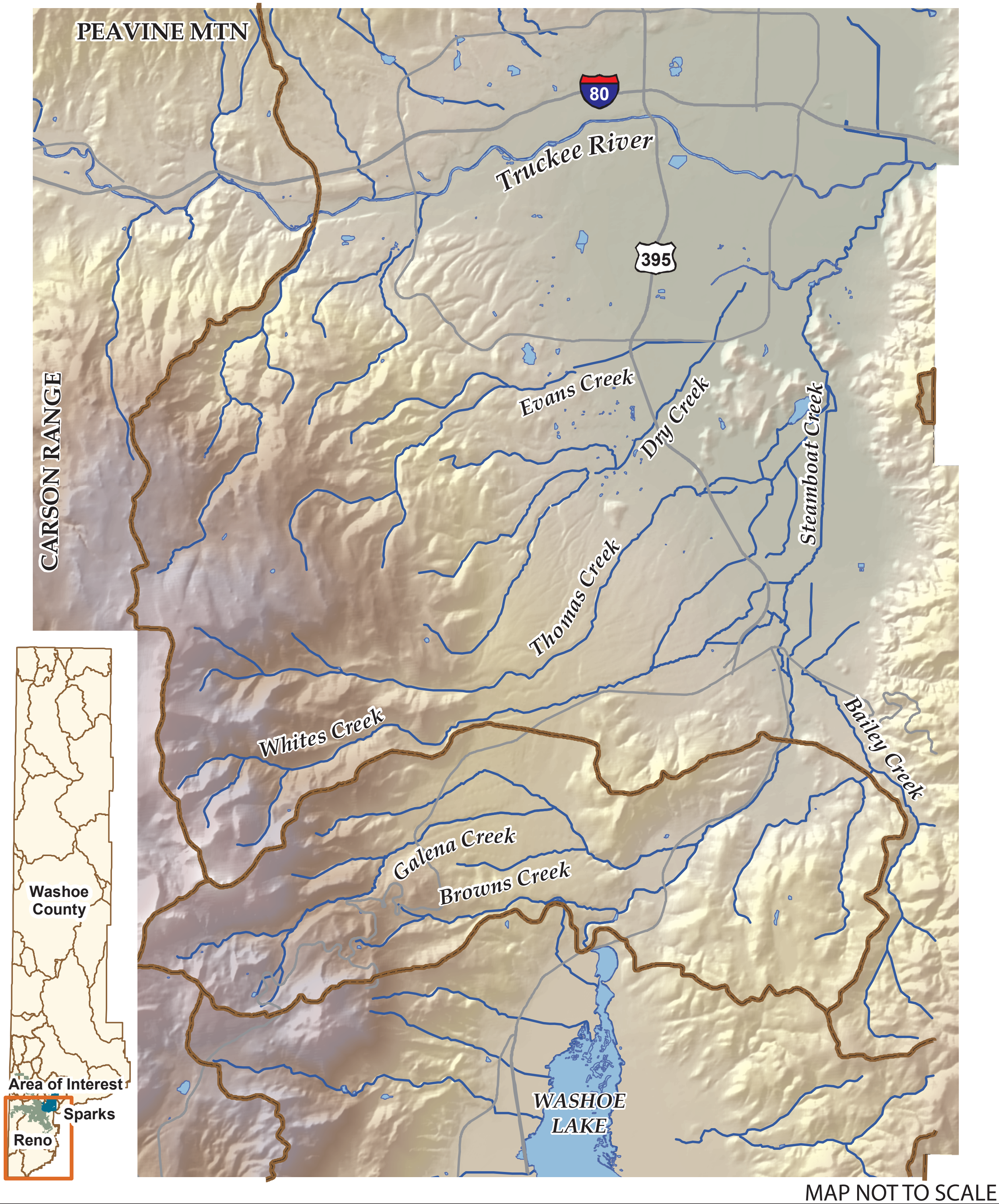

Figure 2-2 Surface Waters Tributary to Steamboat Creek

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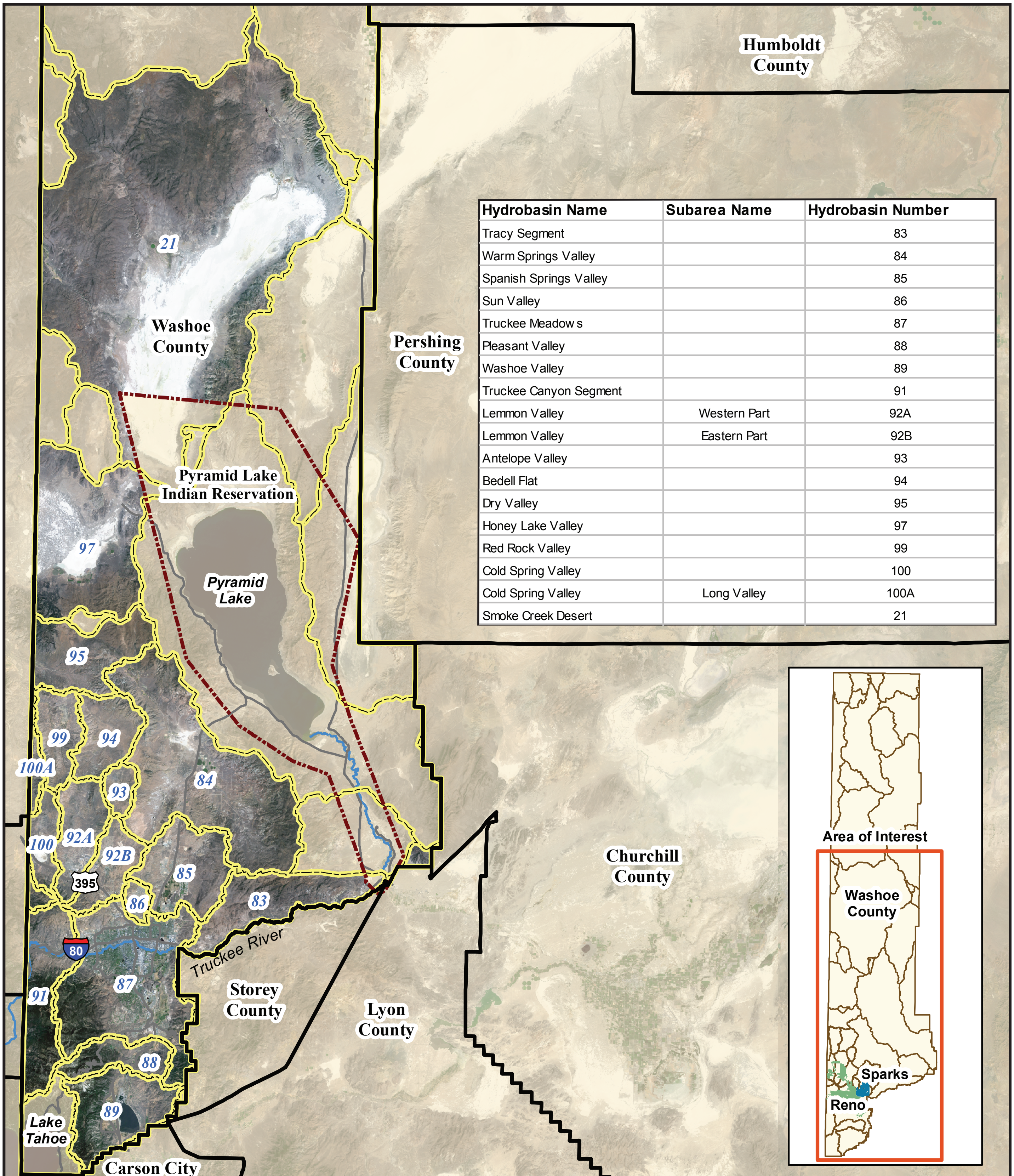

Hydrobasin Name	Subarea Name	Hydrobasin Number
Tracy Segment		83
Warm Springs Valley		84
Spanish Springs Valley		85
Sun Valley		86
Truckee Meadow s		87
Pleasant Valley		88
Washoe Valley		89
Truckee Canyon Segment		91
Lemmon Valley	Western Part	92A
Lemmon Valley	Eastern Part	92B
Antelope Valley		93
Bedell Flat		94
Dry Valley		95
Honey Lake Valley		97
Red Rock Valley		99
Cold Spring Valley		100
Cold Spring Valley	Long Valley	100A
Smoke Creek Desert		21

Figure 2-3 Hydrographic Basins in the Water Baseline Table

0 2.5 5 10 15 20 Miles

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2.1.3 Reclaimed Water

Discharge of treated wastewater from water reclamation facilities is considered effluent; however, effluent which is used for a specific purpose such as irrigation, industrial or commercial, and, which must meet specific water quality standards (other than the standard set for effluent) is considered by the State to be reclaimed water. Recent data show that more than 37,000 afa of effluent water is generated in the Planning Area of which up to approximately 6,000 afa is reclaimed for non-potable purposes such as irrigation, construction and dust control; the remaining effluent is returned to the Truckee River, discharged to Swan Lake wetlands or to the ground. Recent investigation of reclaimed water uses in other regions has shown that reclaimed water can be tailored to meet multiple types of uses. Advances in water treatment technology ensure that reclaimed water can meet the water quality requirements of virtually any need. Although Nevada reclaimed water regulations presently allow for non-potable uses only, highly treated reclaimed water may now be used as a water source for aquifer recharge. Reclaimed water service providers are investigating opportunities for groundwater recharge using reclaimed water as a long-term water resource management strategy.

The NDEP administers reclaimed water regulations which delineate water quality requirements, buffer zones, signage, run-off capture, and other requirements. The NDEP has developed amendments to its reclaimed water regulations that will allow for groundwater recharge. The main local benefit in the use of reclaimed water is that it provides an efficient drought-resistant water source which helps to balance the regional water resources budget.

2.1.4 Water Resources Baseline

Table 2-1, the Water Resources Baseline Table, provides 20-year planning-level estimates for water resources considered to be sustainable using the best available information. The table identifies selected hydrographic basins within the Planning Area and quantifies surface water and groundwater in two ways. Appropriations (water rights), including decreed rights and rights permitted or certificated by the State Engineer for M&I uses and those that may be converted to M&I, are quantified separately from those that cannot be converted to M&I. The table also shows the quantity of groundwater in each basin based on the State Engineer's estimates of perennial yield. In basins where appropriations for M&I uses, or those that may be converted to M&I, are less than the perennial yield estimate, only those water rights actually appropriated are considered. Locations of hydrographic basins included in the table are shown in Figure 2-3. In addition, the table estimates the annual amount of surface water and groundwater transferred into and out of each basin and estimates M&I and domestic well commitments against the identified resources. Basins not listed are not expected to provide M&I water supplies within a 20-year planning timeframe. They are located in relatively undeveloped areas and only limited information exists.

Table 2-1 Water Resource Baseline Table for Washoe County

Updated August 2014

Basin #	Basin	Water Rights: Decreed, State Engineer permitted, and/or certificated rights*	Estimated Perennial Yield	Estimated Sustainable Water Resources	Notes	Imported/ (exported) Supplies	Estimated M&I Commitments	Comments	Estimated Existing Domestic Well Allocation (9)	Comments
		(AFA)**	(AFA)**			(AFA)**	(AFA)**		(AFA)**	
---a---	----b----	----c----	----d----	----e----		----f----	----g----		----h----	----i----
83	**TRACY SEGMENT**									
	Perennial Groundwater	11320	11500	11320	(1)		160	C-1	90	State Engineer Ruling 5747 (early 2007) increasing recharge estimate from 6000 afa to 11500 afa under appeal by various parties. Irrigation (642 afa), Stock (25 afa), Commercial (595 afa) and Industrial (1,927 afa) water right conversion subject to reduction. Mining and Milling water rights (656 afa) may not be available for conversion
84	**WARM SPRINGS V.**									
	Perennial Groundwater	7080	3000	3000	(1)		0	C-1	1020	Irrigation water rights (5,661 afa), Stock (39 afa), Commercial 21 afa), Domestic (570 afa) are subject to conversion reduction. Recreation (28 afa) and Environmental water rights (556 afa) are not available for conversion.
85	**SPANISH SPRINGS V.**									
	Perennial Groundwater	6250	1000	1000	(1)		5370	C-1	430	Water rights and domestic well allocations exceed perennial yield. Irrigation (631 afa), Stock (26 afa) and Commercial (174 afa) water right conversion subject to reduction. Recreation (609 afa) water rights may not be available for conversion.
	Truckee River Importation†				(2)	3920	3920			
86	**SUN V.**									
	Perennial Groundwater	10	25	10	(1)		0	C-1	90	Water rights and domestic well allocations exceed perennial yield. Irrigation water rights (14 afa) are subject to conversion reduction.
	Truckee River Importation†				(2)	2380	2380			
87/88	**TRUCKEE MEADOWS/PLEASANT V**									
	Perennial Groundwater	42340	30000	30000	(3)		23530	C-1	2450	Irrigation (8,654 afa), Stock(70 afa), Commercial (1,046 afa) and Industrial (1,090 afa) water right conversion subject to reduction. Environmental (4,193 afa, Power (979 afa), Recreation (1,063 afa), Wildlife (1,327 afa), Other (245 afa) and Geothermal (20,402 afa) may not be available for conversion.
	Truckee River†	188020***	103000	103000	(4)	(10650)	84000			
	Truckee River-Tributary	36380	--	--	(5)		2350	C-4		
89	**WASHOE V.**									
	Perennial Groundwater	6320	5000	5000	(1)		840	C-1	1750	Irrigation (6179 afa), Stock(65 afa), Commercial (31 afa) and Industrial (0 afa) water right conversion subject to reduction. Mining & Mineral (362 afa), Recreation (954 afa), Wildlife (832 afa) and Other (2 afa) may not be available for conversion.
	Washoe Valley Creeks	25280	--		(5)					Washoe Lake, the headwaters of Steamboat Creek, is fed by McEwen, Bryan, Musgrove, Thompson, Lewers, Davis, White Rock, Little Valley, Franktown, and Ophir creeks.
91	**TRUCKEE CANYON SEGMENT**									
	Perennial Groundwater	3780	2000	2000	(1)		10		530	Irrigation (75 afa), Stock124 afa), Commercial (38 afa), and Industrial (1 afa) subject to conversion reduction. Environmental water rights (32 afa) are not available for conversion.
92A/92B	**LEMMON V. (WEST & EAST)**									
	Perennial Groundwater	2890	1300	1300	(6)		840	C-1	2160	Water rights and domestic well allocations exceed perennial yield. Irrigation (8 afa), Domestic (34 afa), Commercial (40 afa) and Industrial (4 afa) subject to conversion reduction. Environmental water rights (123 afa) and Recreation (46 afa) are not available for conversion.
	Truckee River Importation†				(2)	4350	4350			
	Honey Lake Importation†				(7)	8000	0	C-2		
93	**ANTELOPE V.**									
	Perennial Groundwater	70	150	70	(1)		0	C-1	210	Water rights and domestic well allocations exceed perennial yield. Domestic (12 afa) subject to conversion reduction. Mining and Milling water rights (3 afa) may not be available for conversion.
94	**BEDELL FLAT**									
	Perennial Groundwater	400	300	300	(1)		0	C-1	70	Commercial (9 afa) and Stock (22 afa) subject to conversion reduction.
95	**DRY V.**									
	Perennial Groundwater	3020	3000	3000	(1)		0	C-1	10	Irrigation water rights (25 afa) subject to conversion reduction. NRCS Conservation Easements (3043.67 AFA) not available for conversion.
97	**HONEY LAKE V.**									
	Perennial Groundwater†	14810	13000	13000	(1)	(8000)	0	C-1	30	Irrigation water rights (2029 afa) Stock (29 afa) and Industrial (10 afa) are subject to conversion reduction.
99	**RED ROCK V.**									
	Perennial Groundwater	1080	1200	1080	(1)		0	C-1	380	Irrigation water rights (164 afa) and Stock (3 afa) are subject to conversion reduction. Other (10 afa) water rights may not be available for conversion.
100/100A	**COLD SPRING V./LONG V. SUB AREA**									
	Perennial Groundwater	4680	500-900	500	(8)		2400	C-3	230	Water rights and domestic well allocations exceed perennial yield. Irrigation water rights (1021 afa) are subject to conversion reduction. Environmental water rights (40 afa) are not available for conversion.
21	**SMOKE CREEK DESERT**									
	Perennial Groundwater	56,800	16,000	16000	(12)		0		10	Irrigation water rights (56,252 afa), Stock (89 afa) and Commercial (8 afa) subject to conversion reduction. Water rights issued for Wildlife (449 afa) may be unavailable for conversion to M&I. NRCS Conservation Easements (6652.8 AFA) not available for conversion. Hydrobasin water right adjudication in progress.
Total Estimated Sustainable Water Resources				***190,580***						

NOTES:

*	Water rights include temporary rights, supplemental rights, nonconvertible rights and rights subject to reduction upon conversion based on State Engineer's policy.
**	Water right values rounded to nearest ten acre-feet.
***	Orr Ditch Decree total of approx. 188,024 afa of main stem rights excluding Claims 3 & 4.
--	No data.
†	Exports of water resources not limited to specified hydrobasins and are subject to change based on future needs.
(1)	Groundwater availability based on State Engineer's estimate of Perennial Yield subject to final determination (Tracy Segment ruling currently under appeal).
(2)	Imported allocation of TMWA's resources.
(3)	Groundwater availability for the Truckee Meadows and Pleasant Valley Hydrobasins combined based on State Engineer's estimate of Perennial yield.
(4)	Portion of TROA 119,000 water supply dedicated to supply demand in the Truckee Meadows; excluding 15,950 AFA of groundwater production permitted by State Engineer's Office.
(5)	No State Engineer estimate of perennial yield which could be used for M&I
(6)	Combined State Engineer's estimate of perennial yield for Lemmon Valley West and East.
(7)	Importation of groundwater from Honey Lake Hydrobasin.
(8)	Combined State Engineer's estimate of perennial yield for Cold Spring Valley and Long Valley Sub basin area.
(9)	Based on Washoe County Water Resource GIS database count using Washoe County Assessor's records and State Engineer's Well-Log database, allocation assumes 1 afa per well.
(10)	Water rights based on 4000 afa from STMWRF and 6700 afa from TMWRF. Estimated yield based on 2006 TMWRF, Sparks and Reno data records (ECO:LOGIC)
(11)	2006 reclaimed water data from RSWRF, and Washoe County DWR wastewater influent records for STMWRF, CSWRF and LVWRF (Washoe County, DWR)
(12)	Potential water importation project; Pending water right applications and approval for export from hydrobasin subject to State Engineers' approval.

COMMENTS ON COMMITMENTS

C-1	Groundwater dedications/duty by Washoe County to serve commitments as reported in the January 24, 2007, Fourth Quarter 2006 report to the State Engineer's Office. Not amended to account for supplemental rights.
C-2	Commitments not yet established for imported groundwater. Washoe County may use available uncommitted imported groundwater to serve existing customers in Lemmon Valley. Not amended to account for supplemental rights.
C-3	Based on State Engineer's Manor of Use Records for 2006 and Utilities Inc. water budget for Cold Springs. Not amended to account for supplemental rights.
C-4	Creek rights committed for return flow. Adjusted per the State Engineer based on priority

2.2 Factors Affecting Water Resource Sustainability

This section discusses major trends, events and other factors affecting the sustainability of water resources in the Planning Area. In addition, it describes a procedure to ensure that local government land-use plans are based upon, and in balance with, the sustainable water resources identified in Table 2-1.

2.2.1 Sustainability

In November 2008, voters approved Washoe County Question #3, which read "Shall the Truckee Meadows Regional Plan ("Regional Plan") be amended to reflect and to include a policy or policies requiring that local government land-use plans be based upon, and in balance with, identified and sustainable water resources available in Washoe County?" (Appendix E). With this in mind, it is important to understand the meaning of the term "sustainable" with respect to water resources.

Sustainability, in the context of resource planning, is usually defined as the ability to meet present needs while ensuring resource opportunities for future generations that provide optimal economic, social and environmental benefits.

Identification of sustainable water resources for 20-year planning purposes requires consideration of the practical availability of water for M&I purposes as well as for other community-supported values. Surface water and groundwater rights are generally established in Nevada by the appropriation system administered by the State Engineer. Most surface water rights, such as rights for waters of the Truckee River and its tributaries, have also been adjudicated through court decrees. The Truckee River is currently governed by TROA. TROA was negotiated over the course of several decades and was subject to an extensive environmental review based upon abundant historic hydrographic information. TROA is designed to provide long-term sustainable water operations for the multiple stakeholders on the Truckee River system.

The determination of sustainable groundwater supplies begins with the State Engineer's office. Before allowing appropriation of groundwater from a hydrographic basin, the State Engineer makes an assessment of the perennial yield based upon the best available science. If a basin lacks a perennial yield estimate, the local government or water purveyor will work with the State Engineer to use the best available information, and may require or conduct additional studies as deemed necessary to make a decision. For planning-level estimates, if a basin is not fully appropriated (i.e., appropriations are less than the perennial yield) public water purveyors consider only the total water rights actually appropriated, including M&I rights and those that may be converted to M&I. This methodology forms the basis for water resources compiled in Table 2-1. In addition, public water purveyors may exclude water resources that have inadequate quality for municipal use.

Depending on the availability of water rights in the open market, local water purveyors or their customers may acquire water rights from willing sellers in the future as the need for additional water resources arises, prior to the purveyor committing to serve development. Before determining whether to make water service commitments based upon these resources, the water purveyors will, in the case of Truckee River rights, consider the priority and condition of the water right, and whether the right can be transferred to municipal use or storage; in the case of groundwater, the purveyor will consider the priority and condition of the groundwater right, groundwater quality, and the long-term productive capacity of the basin.

This plan relies on the results of evaluations of the sustainability of water resources performed by water purveyors and others which can be used to serve proposed developments contained within local government land-use designations. It should be noted that community values, as reflected in land-use decisions, will significantly influence the population projected to be served by the Planning Area's water resources. To adjust for potential variability over the long-term planning horizon, estimates of sustainable surface water and groundwater resources will constrain the population estimates when calculating the total population that may be supported by the sustainable water resources identified in the Comprehensive Regional Water Management Plan ("Regional Water Plan"). The plan provides guidance on use and allocation of future water resources; however, the existence of a planning-level estimate of available resources should not be considered a commitment to, nor a guarantee of, the availability of a water allocation for any specific project or parcel.

In areas where the approval of commitments through the parceling or subdivision process would tend to create or exacerbate an imbalance between sustainable yield and commitments, the local governments and water purveyors may limit such approvals or may take affirmative actions to mitigate the deficits though mechanisms such as artificial recharge and recovery of groundwater, conjunctive use of available resources, or the use of alternative water resources.

2.2.1.1 Water Resources Sustainability and Population Forecasts

In response to Washoe County voters' concerns that the Regional Plan (Truckee Meadows Regional Planning Agency, 2002) did not contain policies requiring that local government land use plans be based upon, and in balance with, identified and sustainable water resources available within Washoe County, the Washoe County Board of Commissioners ("BCC") in October 2009, proposed certain amendments to the Regional Plan, which were adopted by the Regional Planning Governing Board ("RPGB") in January 2010. The amendments provide for a comparison between the Washoe County Consensus Population Forecast ("Consensus Forecast") and the estimated population that can be supported by the sustainable water resources as identified in the Regional Water Plan. The BCC further proposed, and the RPBG adopted, amendments to the RPGB's Regulations on Procedure to identify the Northern Nevada Water Planning Commission and the Western Regional Water Commission ("WRWC") as the entities to perform a comparison prior to the Regional Planning Commission's ("RPC") adoption of the Consensus Forecast, and make findings as to whether the Consensus Forecast is in balance with sustainable water resources.

According to the amended RPGB Regulations on Procedure, if the draft Consensus Forecast is found to be in balance with the estimated population that can be supported by the sustainable water resources, the Consensus Forecast is finalized and presented to the RPC for adoption. If the Consensus Forecast is found to be greater than the estimated population that can be supported by the sustainable water resources, the RPC may decide to either adopt a modified Consensus Forecast so as not to exceed the sustainable water resources, or to not adopt the Consensus Forecast and possibly take other action, such as initiating amendments to the Regional Plan to change the development form and pattern. Upon finding that the draft Consensus Forecast is greater than the estimated population that can be supported by the sustainable water resources, the WRWC may investigate new or alternative water sources, and/or water demand management strategies that may provide for an increase to its population estimate. Once adopted, the Consensus Forecast is incorporated into the Regional Plan and all local government land use plans must conform to the provisions of the Regional Plan.

2.2.2 Availability of Truckee River Water Rights

The Orr Ditch Decree established the number of water rights associated with the Truckee River and all its tributaries by reach, by priority, by owner, and by quantity. It is important to note that although surface water rights can be subdivided and/or converted from one use to another, for example from agriculture to M&I use, the overall total number of surface water rights available from the Truckee River has not changed from the amount defined in the decree. A sufficient number of water rights are essential for issuing new will-serve commitments. New development must demonstrate that adequate water resources exist to serve a project. Will-serve commitments are only issued when, and if, water resources are available to service the estimated demand of a particular project and drought supplies can support the expansion of new demand. The needed water resources can either be purchased on the open market by an applicant for new water service and dedicated to a water purveyor or purchased directly from TMWA. Those purchasing will-serve commitments directly from TMWA are required to reimburse the utility for the costs it incurred in acquiring, processing and carrying the necessary water rights.

The primary water rights that applicants for new water service dedicate to TMWA are mainstem Truckee River water rights. Although the number of remaining Truckee River mainstem irrigation water rights available for conversion to M&I use continues to decrease, analysis in TMWA's 2035 Water Resource Plan shows that over 46,000 af of Truckee River mainstem rights may potentially be available for dedication to TMWA for future will-serve commitments, and this amount is more than enough to meet TMWA's future water rights requirements through the planning horizon.

New will-serve commitments may also be made by dedication of irrigation or M&I water rights associated with other sources, such as south Truckee Meadows tributary creeks, groundwater basins other than the Truckee Meadows and, in the Lemmon Valley, Cold Springs Valley area, and groundwater rights associated with the Fish Springs Ranch project.

2.2.3 Laws, Regulations, Decrees and Agreements

2.2.3.1 State Water Law

The Nevada Division of Water Resources ("NDWR") within the Nevada Department of Conservation and Natural Resources is responsible for administering and enforcing Nevada water law, which includes the adjudication and appropriation of waters of the state. The appointed administrative head of NDWR is the State Engineer, whose office was created by the Nevada Legislature in 1903. The purpose of the 1903 legislation was to account for all existing water use according to priority.

The Nevada General Water Law Act of 1913 gave jurisdiction over all wells extracting water from definable underground aquifers to NDWR. In 1939, the Nevada Underground Water Act was passed which granted NDWR jurisdiction over all groundwater in the state. Both acts provide that all water within the boundaries of the state, whether above or beneath the surface of the ground, belongs to the public and is subject to appropriation for beneficial use under the laws of the state. Nevada water law is based on two fundamental concepts: prior appropriation and beneficial use. The prior appropriation doctrine, or "first in time, first in right", allows for the orderly use of the state's water resources by granting priority to senior water rights. This concept ensures that senior water rights are protected as new uses for water are allocated. All waters of the state may be appropriated for beneficial use as provided for in the Nevada Revised Statutes ("NRS").

To acquire a permit to appropriate water, an application that identifies the point of diversion and place of use must be filed with the State Engineer who reviews pertinent information and either approves or denies the application. An application is not a water right until a permit is issued; however, an application is significant because it establishes a priority date. Once granted, water rights have the standing of both real and personal property, which means they are conveyed as appurtenances to real property unless they are specifically excluded in a deed of conveyance. When water rights are purchased or sold as personal property or treated separately from real property in a real estate transaction, the water rights are conveyed specifically by a deed of conveyance. Water rights purchases and changes in points of diversion, manners of use and places of use are accomplished by filing the appropriate application with the State Engineer.

A permitted appropriation may be converted to a certificated water right after a filing for proof of beneficial use has been accepted by the State Engineer. If this is not done, the permittee may lose the right to claim title to the water. In addition to permitted and certificated water rights, the State Engineer also administers vested, adjudicated and reserved water rights.

Vested and adjudicated water rights have been acknowledged or designated through a legal process. These rights are usually of the highest priority and typically cannot be retired without legal proceedings. Vested rights are for water that was put to beneficial use before enactment of state water law pertaining to the source water and are typically finalized through an adjudication proceeding. Reserved water rights are created when the federal government withdraws land from the public domain to establish a federal reservation such as a national park, national forest, or Indian reservation. By this action, the government is held to have reserved water rights sufficient for the primary purpose for which the land was withdrawn.

In addition to the types of water rights discussed above, appropriations known as supplemental rights, also exist. Supplemental water rights provide for a secondary source of water to support the fulfillment of a primary water right. For example, the State Engineer may issue water rights for a primary source, such as a creek, using supplemental groundwater rights as a backup to ensure fulfillment of the primary rights when the creek water is not available. Due to the special nature of supplemental rights, conversions for other manners of use are subject to denial, discount or forfeiture.

More and more, M&I uses are typically considered the highest and best manners of use for waters of the state; therefore, it is common for appropriations to be converted from other uses to M&I use. However, of the large number of beneficial uses recognized by the State Engineer, only a few are convertible. Table 2-2 shows some generalized manners of use and comments on the likelihood for conversion to municipal or industrial use. Upon conversion, multiple restrictions may apply.

Table 2-2 Manner of Use and Conversion to M&I

Manner of Use	Comments on Conversion to M&I*
Commercial	Conversion possible
Construction	Conversion not likely as intended for temporary use
Domestic	Conversion possible
Drainage	Conversion not likely
Environmental	Conversion prohibited, intended for temporary use*
Industrial	Conversion possible
Irrigation	Conversion possible
Mining & Mineral	Conversion possible, basin dependent
Power	Conversion not likely as intended as non-consumptive use
Quasi Municipal	Conversion possible
Recreation	Conversion possible
Stock	Conversion possible
Storage	Conversion not directly as right is a precursor to other uses
Wildlife	Conversion possible

* NRS 533 defines "environmental permit" as a temporary permit to appropriate water to avoid the pollution or contamination of a water source. A change of use for which the permit is issued is prohibited.

Historically, only a portion of the water applied for agricultural irrigation was consumed (i.e., not returned to the stream), either by the irrigated vegetation, evaporation or infiltration into the ground. The run-off water that was returned to the stream was available to satisfy the water rights of downstream users. The component of water that is consumed is referred to as the "consumptive use" portion of a water right; the remainder of the water right is the "non-consumptive use" portion. If the non-consumptive use portion of a water right is diverted such that it no longer returns to the stream, it is no longer available to downstream users. A replacement amount of water rights must be acquired and remain in the stream as in-stream flow to ensure that the rights of downstream users are not negatively impacted. In the Truckee Meadows Service Area, most historic agricultural uses of surface water have been converted to municipal uses. The non-consumptive use portion of municipal water diverted from the Truckee River generally flows as wastewater to the Truckee Meadows Water Reclamation Facility ("TMWRF") and returns to the Truckee River after treatment.

Transferring water from one basin to another is common in Nevada and the State Engineer has approved a number of interbasin transfer applications for beneficial uses including irrigation and municipal supply. NRS 533.370 outlines the State Engineer's responsibility to evaluate the merits of applications for interbasin transfers based on the following criteria:

- Whether the applicant has justified the need to import the water from another basin;
- If the State Engineer determines that a plan for conservation of water is advisable for the basin into which the water is to be imported, whether the applicant has demonstrated that such a plan has been adopted and is being effectively carried out;
- Whether the proposed action is environmentally sound as it relates to the basin from which the water is exported;
- Whether the proposed action is an appropriate long-term use which will not unduly limit the future growth and development in the basin from which the water is exported; and

- Any other factor the State Engineer determines to be relevant.

2.2.3.2 Orr Ditch Decree

In 1902, the U.S. withdrew from public entry the lands required for the government's first reclamation project, the Newlands Project located in and around the City of Fallon in Churchill County, Nevada. The following year, the U.S. posted an application to appropriate the water stored in Lake Tahoe. Recognizing that water released for the Newlands Project would be subject to a multitude of upstream diversions with very early priorities, the U.S. first brought suit to condemn the operation of the Tahoe Dam and then filed to adjudicate all uses of Truckee River water within Nevada and to establish a firm water supply for the Newlands Project. The final decree in the water rights adjudication lawsuit is known as the Orr Ditch Decree and was entered in 1944.

The decree is administered by the U.S. District Court Federal Water Master. In combination with the 1935 Truckee River Agreement and the Floriston Rates (see below), the Orr Ditch Decree represents the basis for operation of the Truckee River between Lake Tahoe and Pyramid Lake. It incorporates the provisions of the Truckee River Agreement, which provides for operation of storage facilities, especially Lake Tahoe, to satisfy Truckee River water rights. The Floriston rates, shown in Table 2-3, constitute the chief operation objective on the Truckee River today and originated as a turn-of-the-century flow requirement for run-of-the-river users — hydropower and a pulp and paper mill. While the Orr Ditch Decree establishes water rights for entities within Nevada using the Truckee River's waters, the Truckee River Agreement, as part of that Decree, determines the operational mechanisms to satisfy those rights. The Orr Ditch Decree and the incorporated Truckee River Agreement provides TMWA with its basic water rights for its M&I water system.

Table 2-3 Floriston Rates (cubic feet per second ["cfs"])

Lake Tahoe Elevations	October	November thru February	March	April thru September
Below 6223.00 feet (natural rim)	0	0	0	0
Below 6225.25 feet	400	300	300	500
Between 6225.25 and 6226.00	400	350	350	500
Above 6226.00 feet	400	400	500	500

2.2.3.3 Water Quality Settlement Agreement

During the winter of 1994-95, Nevada Senator Harry Reid initiated a series of multi-party negotiations to see whether resolution could be reached on the issues surrounding the lower Truckee-Carson Rivers that had not been solved in Public Law ("PL") 101-618. Despite failure to reach an overall settlement of those issues, the discussion concerning water quality enhancement for the lower Truckee River continued forward and an agreement was approved by local governments and the PLPT in October 1996.

This agreement among the Cities, County, PLPT, U.S., and the NDEP provides in broad terms that the community and the U.S. would both buy water rights to be used for in-stream flows in the Truckee River in exchange for dismissal of lawsuits by the PLPT. It is expected that the augmentation of flows in the river will enhance its water quality.

As a result of the Water Quality Settlement Agreement ("WQSA"), Reno, Sparks, Washoe County, and the U.S. Government agreed to spend $24 million on the purchase of Truckee River water rights to help improve water quality in the lower Truckee River. In 1997, Reno, Sparks and Washoe County entered an interlocal agreement for the implementation of the WQSA and delegated the implementation to a newly formed committee, the Local Government Oversight Committee ("LGOC"), with authority to acquire water rights, manage and dispose of property, and manage the acquired water rights. Shortly thereafter, the Department of the Interior ("DOI") contracted with the PLPT to assume its duties under the WQSA, with funding provided by the DOI.

Water right purchases by the LGOC and PLPT began in 1998. The purchases have continued through the present time with nearly all of the $24 million having been expended on the purchase of water rights. Presently, the LGOC has acquired approximately 3,283 af of water rights and the PLPT has acquired approximately 2,107 af of water rights.

The LGOC has filed applications to utilize its purchased water rights for wildlife purposes and obtained change permits on approximately 2,314 af with a diversion rate of 15.85 cfs. Applications to change the place and manner of use of approximately 183 af of the LGOC water rights remain pending. The Nevada State Engineer has applied a consumptive use adjustment to the LGOC acquisitions, which originated from lands within the Truckee River basin in order to account for the return flows (which would have accrued back to the Truckee River under the original decreed uses). At the present time, the PLPT has obtained approval of change applications in the amount of approximately 1,378 af. As all of the water rights held by the PLPT are from the Truckee Division of the Newlands Project under Claim 3 of the Orr Ditch Decree, and based upon the past actions of the Nevada State Engineer, it is reasonable to expect that they will not be subject to a consumptive use deduction.

When all of the WQSA funds have been expended and the change applications have been approved, there should be at least 4,535 afa of water under permit for wildlife purposes available from the WQSA acquisitions for augmenting the flow of the lower Truckee River.

Together, the WQSA water rights and the TROA Section 1.E.4 6,700 afa of water rights will provide Water Quality water for augmenting the flow of the lower Truckee River under normal conditions. Since the implementation of TROA, these water rights may be stored in Truckee River reservoirs to provide for water quality flows during drought conditions.

2.2.3.4 Truckee River Settlement and the Truckee River Operating Agreement

The Negotiated Settlement ("Settlement") of the Truckee River provides drought reserves for the Truckee Meadows as well as quells much of the controversy surrounding the operations of the Truckee River system to provide for current water supplies. The Preliminary Settlement Agreement signed May 23, 1989 between Sierra and PLPT was a successful first step to begin solving many Truckee River issues. On November 16, 1990 the Settlement Act (PL 101-618) was enacted. PL 101-618 provides for the interstate allocation of water between California and Nevada on the Carson River, the Lake Tahoe Basin, and the Truckee River Basin subject to the finalization of a new operations agreement for the Truckee River, i.e., TROA. The interstate allocation is an important resolution between the two states and gives TMWA the assurance of what water will continue to flow over the state line and into Nevada. TROA allows TMWA to store a portion of its irrigation water rights and Privately Owned Stored Water ("POSW") in the excess space in the federal reservoirs for drought use in exchange for waiver of its hydroelectric water rights. Some storage under TROA is firm storage which does not evaporate or suffer losses unless it is the only water in the reservoir. Some storage is non-firm storage which spills when the reservoir fills and, in non-Drought Situation years, such storage in excess of certain base amounts is turned over to the U.S. and PLPT to be used for recovery of endangered species and support of the fishery in the lower Truckee River. Total projected demand that TROA will support is 119,000 afa and, in addition, it provides additional drought reserves in the case of a worse-than-worst drought of record. TROA provides TMWA customers with certainty regarding the operation of the system and additional drought supplies for existing as well as new customers. The agreement creates benefits for those who did sign, and non-injury to the water rights of those who do not sign. TROA was signed by the five mandatory signatory parties--TMWA, State of Nevada, State of California, U.S., and PLPT -- on September 6, 2008; it was the culmination of 17-years of difficult negotiation of a new agreement for the operation of the federal reservoirs and TMWA's share of Donner Lake and Independence Lake. As its name implies, the Truckee River Negotiated Settlement is a negotiated agreement among many parties. The Truckee Meadows community both gains and gives up something as part of the Settlement. TMWA's customers are the major participants to making the Settlement a reality, and are also its major beneficiaries. Since TMWA's water customers are the taxpayers and sewer customers of Reno, Sparks, and Washoe County, many of the Settlement's benefits overlap jurisdictional lines in the Truckee Meadows. Benefits and requirements of the Settlement are summarized here:

- Permanent drought storage for TMWA customers to support demands up to 119,000 afa.
- Certainty associated with the Interstate Allocation of the Truckee and Carson Rivers as well as the Tahoe Basin between California and Nevada.
- Certainty regarding the continued operation of the reservoirs to support existing water rights.
- Improved flexibility of river operations to accommodate changing circumstances, policies and values while protecting historic water rights from injury.
- Improved timing of river flows for the threatened and endangered fish species in Pyramid Lake.
- Enhanced minimum reservoir releases.
- Protection from claims that would harm TMWA's water rights.
- Increased recreational pools in the reservoirs.
- Improved fisheries and riparian habitat.
- Improved water quality enhancement through flow augmentation and retiming of flow.
- Water storage for California M&I use as well as environmental uses.

The river system is already the beneficiary of increased communication and cooperation, and solutions are being found regularly to areas of previous impasses through completion of TMWA's retrofit of water meters on flat-rate services, TMWA's annual conservation activities, the 1994 Interim Storage Contract, the 1996 WQSA (between Reno, Sparks, Washoe County, PLPT and the U.S.), the Tahoe-Truckee Sanitation Agency water quality settlement, and PLPT's setting of water quality standards. After signing in 2008, several steps had to occur before TROA could be implemented which were all completed in the fall of 2015 leading to the implementation of TROA on December 1, 2015.

In March 2016, TMWA closed escrow on the purchase of the Truckee Carson Irrigation District's ("TCID") one-half interest (4,750 af) in Donner Lake. In addition to acquiring the water right, TCID agreed to withdraw with prejudice on all pending litigation involving TCID's challenges to the implementation of TROA, and TCID agreed not to file any new challenges to TROA.

2.2.4 Source Water Reliability

This section discusses the reliability of the Planning Area's primary water sources in terms of both quantity and quality for continued municipal purposes. The discussion explores weather-related factors, such as climate change and drought cycles, that can affect the availability of surface water resources seasonally, and groundwater, on a longer-term basis, and water quality issues that can also affect the short- and long-term sustainability of the available water resources. Threats to the reliability of the Planning Area's water supply are weather and source water supply contamination, both of which may affect the quantity and quality of available water supplies.

2.2.4.1 Weather

Weather is the primary determinant in establishing water supply for the Truckee Meadows. Precipitation replenishes the reservoirs and aquifers from which water is used and recycled. While the weather pattern consistently provides precipitation during the winter and spring months, the type of precipitation (snow versus rain), water content of snow, and speed of snowmelt vary from year to year. Water resources managers address water supply uncertainty depending on the source of water. TMWA manages uncertainty through storage of water in upstream reservoirs, conjunctive use of surface and groundwater supplies and continual assessment of the threats to water supply reliability from weather. Purveyors largely or solely dependent on groundwater are concerned more with the long-term effects weather has on aquifer recharge and storage. The key weather-related concerns with ensuring a continued adequate water supply are climate change and drought.

Climate Change

Nevada is part of the Great Basin and for the most part is classified as a high desert climate. Few places in Nevada are as fortunate as the Truckee Meadows which has a river running through it, but that does not change the fact it is a desert with annual average rainfall of 7.5 inches per year. In essence, the region is in perpetual dry conditions interrupted by higher-than-average precipitation years, which make it difficult to delineate the beginning or end of a drought period including its duration.

Weather, particularly precipitation in the form of snowpack, is the primary determinant in establishing drought conditions and the availability of surface and groundwater supplies in the various hydrographic basins. Precipitation replenishes the reservoirs and aquifers from which water is extracted. While the weather pattern consistently provides precipitation during the winter and spring months, the type of precipitation (snow versus rain) and timing of snowmelt runoff can vary greatly from year to year. Simply stated, a larger snowpack produces greater Truckee River flows; conversely, the smaller the snowpack the smaller the flow in the Truckee River. Figure 2-4 compares annual snowpack accumulations to annual Truckee River flows.

The uncertainty of surface water supply is managed, in terms of the overall quantity and the timing of its delivery, through storage of water in upstream reservoirs and injection of treated surface water through a network of wells into aquifers in Lemmon Valley, Spanish Springs and Truckee Meadows. When river flows are available, TMWA manages its surface water resources through conjunctive use with groundwater supplies. This conjunctive use management maximizes use of surface water when it's available, thereby reducing groundwater pumping. This approach allows demands to be met with surface water, and to rest and recharge specific wells when enough surface water is available.

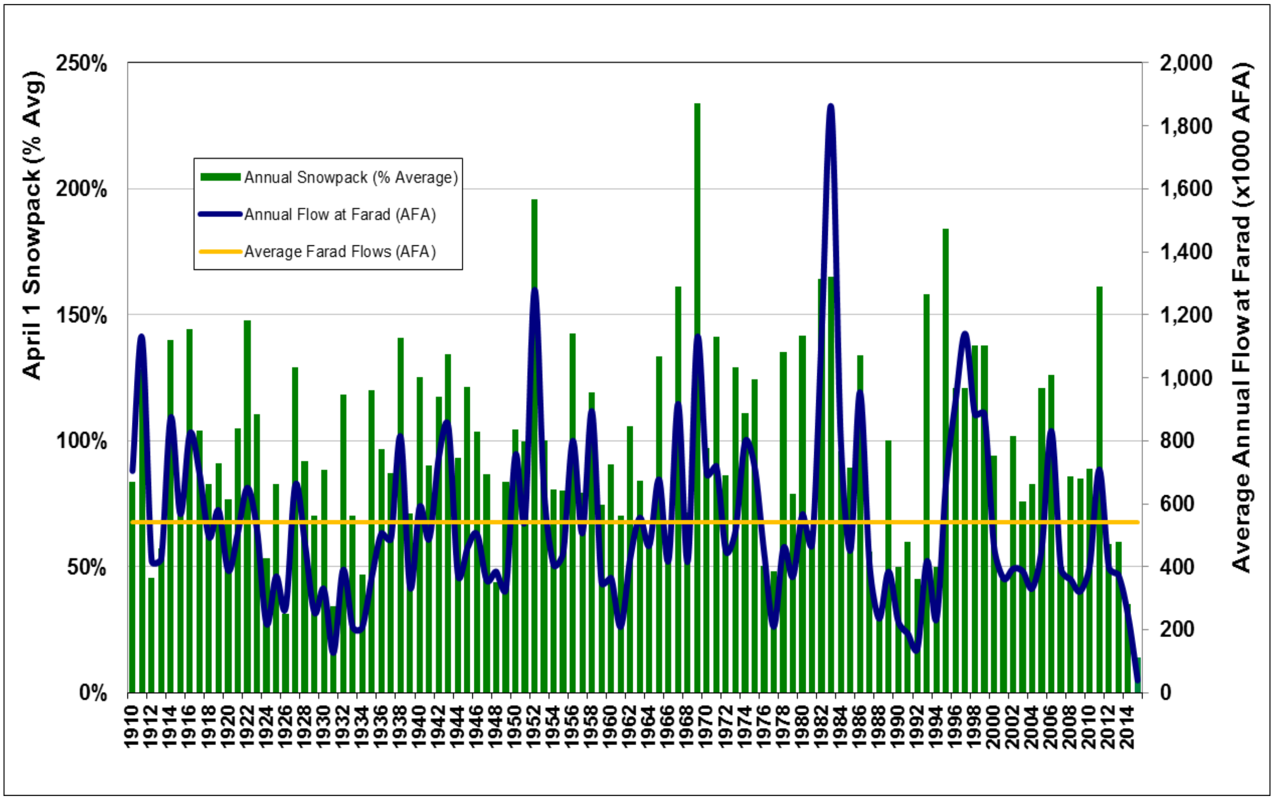

Figure 2-4 Annual Snowpack Percent vs Average and Annual Truckee River Flow at Floriston

Shortages in water resources due to seasonal weather variability can produce adverse environmental and economic conditions such as degradation of the land and the associated biologic ecosystem (i.e., stress to plants, animals, and habitat). Recent changes in the climate have been suggested as the culprit for the high degree of weather variability and deserve more attention as to the impacts to regional water resources. However, studies on the historic hydroclimatic conditions in the region reveal long periods with either extremely wet or dry conditions are common cyclical events when viewed from a much longer timeframe. In order to effectively manage for source water reliability given the uncertainty surrounding annual precipitation, such events and the frequency of their occurrence merit investigation.

For a better understanding of how water resources can be impacted from extreme variability in the Truckee River Basin's weather patterns, TMWA partnered with the Desert Research Institute ("DRI") in 2006 and 2009 to research the possibility of climate change and global warming affecting the Truckee Meadows' water supplies (see TMWA 2016-2035 WRP; Appendix 2-1). The results of that research indicated, at the time the study was done, that historic hydrological records are the best data available for future planning and scientific evidence remains inconclusive as to the effect of climate change on drought conditions within the Truckee Meadows. Since there is a high variability in regional climate data, it has proven difficult to definitively detect long-term climate trends, i.e., some studies project the region becoming wetter while others project a progressively drier environment over time. Given this “noise” in the data and a divergence in the predictions under various climate change models, the 2009 research concluded that continued investigation on this topic is warranted.

In 2015, TMWA partnered with the University of Nevada, Reno (“UNR”) to investigate recent advances in the research of climate change (see TMWA 2016-2035 WRP, Appendix 2-2). The preliminary report indicates that, despite the advancements on climate change research, the debate regarding variation in weather patterns, greenhouse gas emissions, and extreme drought is still ongoing. In many cases simulated climatic projections do not line up with observational data over time. However, it is better established that from a century’s worth of hydrologic records that the high variability in local seasonal river flows is driven, in large part, by oceanic and atmospheric oscillations. Moreover, to adequately evaluate current changes to the availability of water resources as well as the likelihood of future extreme hydrologic conditions, one must take a much broader perspective that incorporates long-term trends into projections. This approach requires hydroclimatic data that extends far beyond modern records. In particular, tree-ring sampling can be used to extend hydroclimatic records many centuries beyond modern records providing insight into long-term changes in the region’s hydrologic conditions.

This point is underscored by the fact that the Lake Tahoe Basin has endured hydroclimatic episodes that persisted for much longer than experienced in modern times. For example, analysis conducted in 2011 on submerged trees in Fallen Leaf Lake revealed a drought that persisted for two centuries (between 1100 and 1200 A.D.). While mega-drought episodes in the area are rare, shorter periods of wet and dry are more common in the region. Figure 2-5 is a map showing the two basins (Truckee indicated by the lime polygon and Carson indicated by the purple polygon) and the location of the tree-ring chronologies (green dots) analyzed in the 2015 report. The report reviewed a variety of tree-ring chronologies that analyzed tree-ring datasets covering multiple watersheds throughout California and Nevada. Further analysis of the data delineated those datasets where correlation within the tree-ring chronology exists between the Truckee and Carson River Basins and regions in the sample in order to construct a workable tree-ring chronology. The tree-ring samples provide an extension to the dataset on the hydrologic conditions of those watersheds as far back 1500 A.D.

The report finds evidence of many occurrences over the past 500 years of wet and dry periods that persisted for multiple years. Of the 211 wet and dry episodes during this period, the average lasted for 2.4 years, with the longest episodes being a nine-year wet period in the early 1980s (1978-1986), and two eight-year droughts in 1841-1848 and 1924-1931. These findings point to different hydrologic patterns emerging in the new millennium when compared to the entire length of record. For example, in the last century this region has experienced three of the strongest wet periods (out of a total of six) and two of the strongest dry periods (out of a total of four) out of the top 10 wet and dry cycles of the past 500 years. However, given the wide range in the spatial locations of the chronologies, the report recommends collecting more tree-ring data from sites located in the Truckee and Carson River watersheds to improve the quality of long-term hydroclimatic picture within the target area.

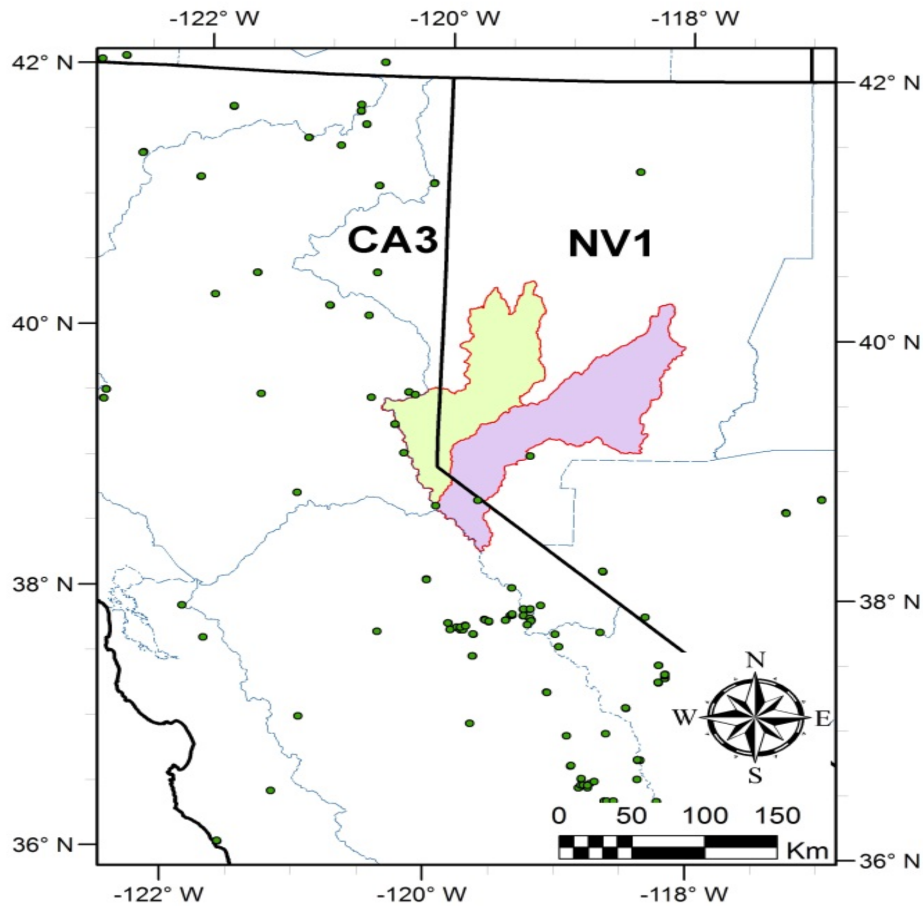

Figure 2-5 Location of Tree-ring Chronologies Used in the 2015 Report

The 2015 report provides evidence that the highly cyclical nature of both wet and dry episodes is not a new phenomenon. However, given that half of the strongest 10 episodes occurred in the last century, it would suggest variations in weather extremes are becoming stronger and more frequent. This high degree of variability between wet and dry weather patterns, coupled with a high degree of uncertainty regarding the duration of either event, makes managing for water source reliability particularly challenging. Management becomes a delicate balance between selling enough water in wet years to keep costs of service low, and ensuring adequate conservation of storage is achieved during periods of drought. In order to confidently manage for both potential conditions, TMWA ensures its reserves are such that they can meet service demands for extended periods of drought, meanwhile assessing snowpack and river flows annually in order to reevaluate management strategies should conditions worsen or improve. This continual reassessment of source water supplies and management tactics is the best defense against reservoir depletion as well as unnecessary economic stress to both the utility and customer base.

The winter snowpack is the primary source of water for replenishment of upstream reservoirs. As the snowpack grows over the course of the winter, water is stored until the spring stream flow runoff period. In high-snowpack-years, this melting can provide stream flows well into the summer months. Given that prolonged drought periods can occur in the region, DRI has been conducting cloud seeding in the Lake Tahoe and Truckee River Basins for more than 25 years. The purpose of cloud seeding technology is to enhance snowfall from storm events thereby increasing the overall snowpack in the Tahoe and Truckee Basins. DRI's cloud seeding program consists of three phases; 1) prepping the cloud seeding generators to distribute the seed when the proper storm presents itself; 2) applying seeding to the clouds of wintertime storms; and 3) analyzing the subsequent weather data during the cloud seeding periods to determine effectiveness. DRI's study estimates cloud seeding increases the precipitation rate by approximately 0.01 inches per hour. During the prior 18 seasons it has been estimated that the DRI state program yielded snow water increases ranging from 8,000 to 30,000 afa, with an annual average of about 18,250 afa. For the 2014/15 winter season it was estimated the cloud seeding program increased the snow water by approximately 11,513 afa (See TMWA 2016-2035 WRP, Appendix 2-3 for the complete report). However, while it cannot be estimated how much of the additional snowfall increases streamflow, groundwater recharge, or reservoir storage would occur, any increase in the snowpack can have a positive effect on the region's water supply.

In the fall of 2010, the U.S. Bureau of Reclamation ("BOR") proposed a Truckee River basin study, authorized by the 2009 Secure Water Act (PL 111-11) under the Climate Change Adaptation Program. The Secure Water Act provides for federal cost-share funding and the BOR to conduct comprehensive, collaborative studies in western states river basins to evaluate the impacts of climate change and define options for meeting future water demands. Preliminary discussions have taken place with WRWC member agency staff and other local stakeholders. Findings from the study were released on February 2, 2016 and indicated that the region will likely experience an increase in mean annual temperature of five degrees over the next century. In addition, the findings suggest a 10-20 percent increase in the frequency and magnitude of floods affecting the Reno Sparks area. The complete report can be found at:

http://www.usbr.gov/watersmart/bsp/docs/finalreport/truckee/tbsbasinstudy.pdf.

As a consequence of the merger of Washoe County's water utility, South Truckee Meadows General Improvement District ("STMGID") and TMWA, the WRWC inherited a long-term precipitation monitoring project from Washoe County which started in the mid 1990's. The project involves the collection of rain and snowfall using precipitation "can" gauges. The precipitation gauges are inexpensive, low tech, and simple to operate. As such the project has, over the last twenty years, expanded to include 77 sites where precipitation data are being collected in seven hydrographic basins including Cold Spring Valley, Lemmon Valley, Bedell Flat, Antelope Valley, Dry Valley, Smoke Creek Desert and Duck Lake Valley. The project is unique in the Planning Area as it represents the only long-term historic data record collected over a wide geographic area.

The significance of this data collection effort becomes apparent when attempting to understand the hydrobasin microclimates which dominate the planning area. Currently, regional precipitation and climate models fail to predict observed microclimate conditions. Long-term data collection from a precipitation "can" gauge network in Washoe County provides a means of potentially calibrating regional models so they can be downscaled to better simulate microclimate conditions. The importance of refining these regional models will provide insight into climate variability trends as well as providing a more accurate analysis of hydrobasin recharge and perennial yield estimates. The information gleaned from these analyses will be key to planning the future of available water resources.

Droughts

The State of Nevada defines drought as follows:

> "Drought is a complex physical and social phenomenon of widespread significance. Drought is not usually a statewide phenomenon; differing situations in the state make drought local or regional in focus. Despite all the problems droughts have caused, drought has proven difficult to define. There is no universally accepted definition because drought, unlike flood, is not a distinct event and drought is often the result of many complex factors acting on and interacting within the environment. Complicating the problem of a drought definition is the fact that drought often has neither a distinct beginning nor end. It is recognizable only after a period of time and, because a drought may be interrupted by short spells of one or more wet months, its termination is difficult to recognize. The most commonly used drought definitions are based on: 1) meteorological and/or climatological conditions, 2) agricultural problems, 3) hydrological conditions, 4) economic considerations and 5) induced drought problems. Each type of drought will vary in severity, but all are closely related and caused by lack of precipitation."

The State of Nevada Drought Plan sets forth the State's definition for each of the five types of droughts. The role of a water purveyor is to secure reliable water resources to meet its customers' requirements, including mitigating the risks that droughts can impose on water resources. Water purveyors need to monitor for meteorological, hydrological and induced droughts as these have direct effects on availability of surface water to water right holders along the Truckee River and availability of groundwater in hydrogeographic basins during low-precipitation years. Depleted reservoir storage, both upstream and subsurface, has a direct impact on water supplies during drought periods. Consecutive (three or more) years of low-precipitation in the Lake Tahoe and Truckee River Basins are likely to negatively impact the storage in both Lake Tahoe and Boca Reservoir. The length of a drought period is solely a function of meteorological conditions over a period of years.

A good indicator of an impending dry-year water supply is snowpack accumulation. Measured on April 1 of each year, the water content of the snowpack is used to forecast the amount of water that will run off each spring to help fill upstream reservoirs and provide river flows through the year. Figure 2-6 shows snowpack for the Truckee River basin over the past 30 years.

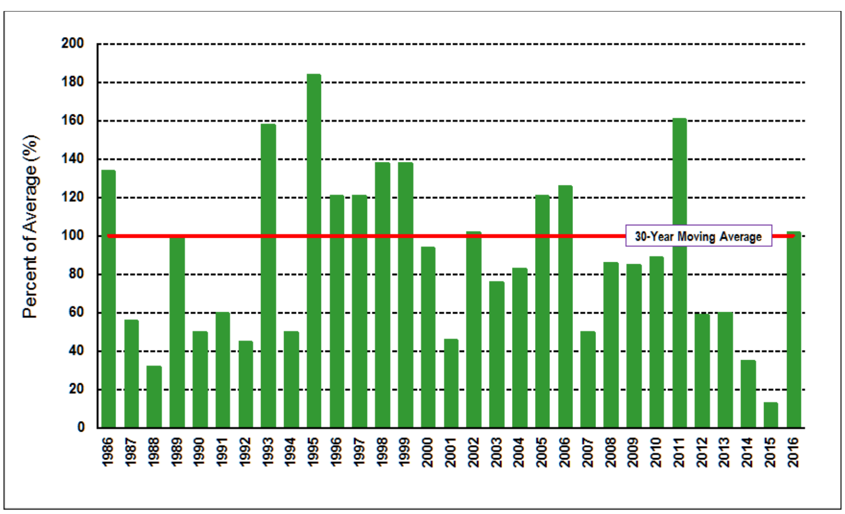

Figure 2-6 30-year Historic Snowpack for the Truckee River Basin (TMWA 2016-2035 WRP)

During the various drought periods, TMWA relies on POSW surface water drought reserves which are only used to meet customer demand when the more critical dry years within the drought period are experienced. Based on past history it is not until at least the third or fourth dry year in a row that upstream reserves may have to be used. In the 1987 through 1994 drought of record, only in the summer of 1991 and 1992 were upstream reserves required to meet demands. It is important to also note that the use of reserves has only occurred between the months of June and October, primarily during the irrigation season. Similarly in 2015, TMWA began using its upstream reserves in June through October. In those years where Floriston Rates were not met through the irrigation season, by November flows in the Truckee River were once again sufficient enough to meet wintertime production needs. TMWA's current water planning is based on the hydrology of 1987-1994, the worst drought on record. In the most recent drought period, drought reserves were required to meet TMWA customer demands in both 2014 and more so in 2015. 2015 was the driest in the last 100 years with the lowest snowpack in recorded history.

Since 1980, there have been four periods of varying degrees of hydrologic drought within the Truckee River system: 1987-1994 (eight years); 2001 to 2004 (four years); 2007 to 2010 (four years) and the current period of 2012-2015 (four years). The past 30 years includes the 1987 to 1994 drought period which is considered the worst drought of record over the 106 years of recorded flow in the Truckee River. The severity of each drought's impact during those periods listed in Table 2-4 is revealed by the quantity of upstream drought reserves (or POSW) that TMWA had to release during a particular year to meet customer demands.

Table 2-4 Loss of Floriston Rate and Use of POSW During Drought Periods Since 1980

	Year	Date Floriston not Met	Use of POSW (af)	Year	Date Floriston not Met	Use of POSW (af)	Year	Date Floriston not Met	Use of POSW (af)	Year	Date Floriston not Met	Use of POSW (af)
	-a-	---b---	---c---	-d-	---e---	---f---	-g-	---h---	---i---	-j-	---k---	---l---
1	1987		0	2000		0	2007		0	2012		0
2	1988	Aug 20	0	2001		0	2008	Nov 23	0	2013		0
3	1989		0	2002	Nov 28	0	2009	Oct 17	0	2014	Jul 29	4,900
4	1990	Aug 26	0	2003	Dec 8	0	2010		0	2015	Apr 7	11,700
5	1991	Jul 26	3,100	2004	Sep 23	0						
6	1992	Jun 5	9,000			0						
7	1993	Sep 26	0									
8	1994		0									

Figure 2-7 compares the four most recent drought periods. The similarity between drought periods is evident with differences appearing in the length of the drought period and its impact on the level of Lake Tahoe.

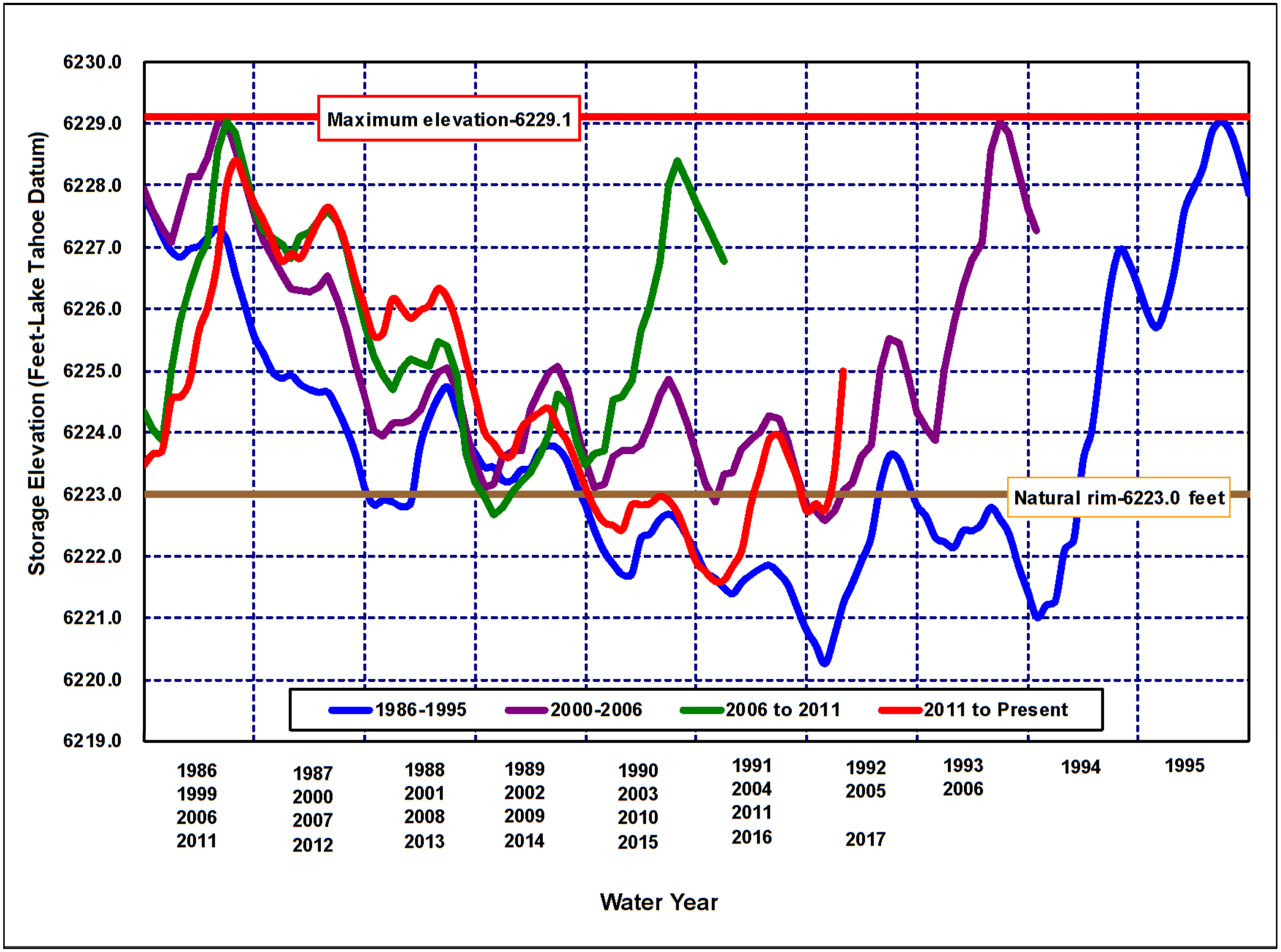

Figure 2-7 Lake Tahoe Elevations During Drought Periods

- *1987 to 1994 Drought Period.* During the 1987/1988 winter, it became apparent that runoff from the snowpack would be significantly below normal. By August 20 of 1988, the Floriston Rates could not be met and POSW was needed by late August to meet customer demands. By the end of August, emergency steps were taken by local government to curb water use to maintain carryover storage for 1989. Outside water use was limited to one-day-a-week in late August. A comparison of water use during the months of August through October 1987 to water use during the same period in 1988, revealed that drought actions reduced production by about 3,400 af, or about 15 percent reduction. Precipitation through the 1988/1989 winter produced a 100 percent of average snowpack for the Truckee River Basin. Floriston rates were met throughout the 1989 irrigation season. Water supply conditions returned to below average in 1990. Local irrigation ditches were cut-off in late August due to low flows in the Truckee River. Lake Tahoe dropped below its natural rim in September 1990, resulting in no flow into the Truckee River. The winter of 1990/1991 was one of the lowest precipitation periods on record prior to March of 1991. Even with the unusually heavy March precipitation, the snowpack in the Truckee River Basin only measured 60 percent of average on April 1, 1991. Local irrigation ditches were cut-off July 26 when Floriston Rates could not be met.

- During 1992, Floriston Rates could not be met after June 5 the earliest date on U.S. District Court Water Master’s records up to that date; it was the worst year of the drought period with snowpack less than 50 percent of average and no outflow from Lake Tahoe. After utilizing 9,000 af of Independence Lake water (POSW), 8,500 af remained in drought storage at the end of 1992. The net depletion of Independence Lake was 6,000 af during 1992. The snowpack in 1993 was over 150 percent of average. As a result of the heavy snowpack during the 1992/1993 winter, the elevation of Lake Tahoe increased significantly rising above its natural outlet elevation. Although 1993 was a significant improvement over 1991 and 1992, it was not enough to enable Tahoe to sustain Floriston rates. Floriston Rates were only met until September 26, 1993.

- The 1994 snowpack in the Truckee Basin was just 50 percent of average on April 1. The elevation of Lake Tahoe stayed below its natural rim from the fall of 1993 through all of 1994. No releases were able to be made from Lake Tahoe in 1994.

- The abundant snowfall of 1995 and subsequent runoff brought the elevation of Lake Tahoe back above its natural outlet elevation. Tahoe rose 6 feet in 1995, ending up four feet above its rim in July 2015. The significantly above average 1995 snowpack year was reinforced by above-average snowfall in 1996 which effectively ended the 1987 to 1994 drought period. Total natural flows during the 1987 to 1994 water years were 83 percent of the total natural flows from 1929 to 1936 water years and thus, more severe than the previous design drought period of 1928 to 1935.

- 2000 to 2004 Drought Period. Reservoirs were full leading into the 2000/2001 snow season, but snowpack within the Truckee River Basin was below average in 2000 and continued that pattern again in 2001. While there was an improvement over 2001 in the amount of snowpack and runoff in 2002-2004, it was not enough to end the start of another drought period. Although TMWA did not need to utilize any POSW to meet customer demands during this drought period, the reduced water availability made it difficult to sustain the required Floriston Rates in December 2002 and again from late 2003 into early 2004. In September 2004 Floriston Rate storage was exhausted and normal-river flows were not met again until the end of February 2005 which ended up being a 125 percent of average snowpack year in the Truckee River Basin. Due to heavy precipitation and flooding in late December 2005/early January 2006 the elevation of Lake Tahoe rose significantly. In fact, almost 11 inches of precipitation was recorded at the U.S. Geological Survey ("USGS") Farad gauging station over a two-week period (Dec 21, 2005 to Jan 3, 2006). An above average snowpack was recorded again (126 percent of average) in the Truckee River Basin in 2006. Lake Tahoe and all Truckee River Basin reservoirs filled as a result of the streamflow runoff that was produced the following spring. Those two consecutive above average snowpack years (2005 and 2006 respectively) effectively ended the 5-year drought period.

- 2007 to 2010 Drought Period. Although the phenomenal snowpack of 2006 refilled Lake Tahoe, the 2007 snowpack was 50 percent of average and turned out to be the start of another drought period. Snowpack in the Truckee Basin was 51, 86, 85, and 89 percent of average for the years 2007, 2008, 2009, and 2010, respectively. Lake Tahoe dropped below its natural rim in October 2008 but the snowpack of 2009 was a slight recovery year and did not impact TMWA reserves in 2009 or 2010. The 161 percent of average snowpack in 2011 was sufficient to nearly fill Lake Tahoe and end this brief drought period. TMWA's drought reserves were not impacted and were not required for use during this drought period.

- 2012 to 2015 Drought Period. This drought period followed on the heels of the 2007 to 2010 drought period and separated by only one year of recovery. Snowpack in the Truckee Basin was 59, 60, 35, and 13 percent of average for the years 2012, 2013, 2014, and 2015, respectively. The snowpack and runoff of 2015 ranked it as the worst year on record. Not since recordings began have there been four consecutive low-runoff years as severe as these four. On July 29, 2014 Floriston Rate water supplies were exhausted and TMWA had to release its drought reserves from POSW in August through September. The total amount of upstream reserve TMWA required in 2014 was 4,900 af.

- Due to the severe lack of the 2015 snowpack, Floriston Rate water supplies were exhausted on April 19, 2015. As natural river flows slowly diminished through May and June, the only ditch and diversions operating were TMWA's Highland Ditch that supplies the CTP and the Glendale Water Treatment Plant ("GTP") diversion. TMWA began releasing upstream reserves on June 18 and continued to do so through the month of October. TMWA began the summer season with approximately 29,000 af in upstream storage and released approximately 11,700 af to meet customer demands.

Important observations to be drawn from reviewing the historical Truckee River hydrology and drought periods include:

- Truckee River supplies are available the majority of the year under meteorologic and hydrologic drought situations.

- Donner and Independence Lakes typically fill each spring under meteorologic and hydrologic drought situations.

- Drought periods vary in duration, from a few years up to eight years based on recorded history.

- Truckee River water sources used to provide Floriston Rates diminish early in the late spring and/or summer of extreme, low-precipitation years.

- Water levels in the reservoirs, particularly Lake Tahoe, are depleted gradually over three to four years, but can refill rapidly ending a hydrologic drought period.

- "Recovery" or high-precipitation years may not end a drought period but do interrupt the drought period, helping replenish reserves and/or producing sufficient Truckee River flows for the following year and negating the need to use upstream reserves.

- Use of upstream reserves may not be necessary in every drought period; only in the extreme, low-snowpack years of a drought period does TMWA use its upstream reserves.

Other Purveyors

With the exception of TMWA and Sun Valley General Improvement District, the remaining water purveyors rely on groundwater resources to meet customer demands. While the effects of drought on surface water is readily apparent, groundwater recharge during drought is delayed and is more difficult to assess. For this reason, water systems which rely solely on groundwater need to be more vigilant about monitoring their resource and would be well served to consider alternative contingency supplies. In addition, sole source providers may need to adopt more stringent drought standards to meet demand during prolonged dry periods.

2.2.4.2 Groundwater Recharge

Groundwater recharge is affected not only by long-term precipitation and runoff trends, but also by the effects of development, which could exacerbate any diminished recharge resulting from weather related changes. Policy 1.3.b, in Chapter 1, and local development codes provide for the protection of groundwater recharge areas in most natural drainage ways, however conversion of irrigated land and conveyance ditches to urban uses is a concern for some locations. Figure 2-8 shows areas considered to have good recharge potential. Studies have shown that surface irrigation serves as a source of secondary or incidental recharge to the groundwater system. Secondary recharge occurs as seepage from conveyance ditches and as deep percolation of water applied to fields and pastures; primarily by means of flood irrigation practices. Groundwater level declines associated with diminished agricultural irrigation have been documented in the South Truckee Meadows by Yeamans and Broadhead (1988) and Consulting Engineering Services (1998).

Diminishing groundwater recharge is a concern in the Spanish Springs Valley hydrographic basin, where as much as 67 percent of the total groundwater recharge has been from Orr Ditch leakage and irrigation practices (Hadiaris, 1988 and USGS, 1996). The State Engineer's office has acknowledged this secondary recharge in its perennial yield estimate and has issued water rights appropriations accordingly, some of which are dedicated for M&I use. TMWA and local land use planners are implementing a water resource management strategy to decrease reliance on groundwater and increase Truckee River water use in the basin to help alleviate this concern.

2.2.4.3 Aquifer Storage and Recovery

A major advantage for water purveyors with both surface and groundwater resources is the potential flexibility afforded by conjunctive resource management. One particular program is Aquifer Storage and Recovery ("ASR") which is a practice of storing surface water underground, during times of low demand, to enhance groundwater storage for use during periods of high demand or to enhance storage reserves for use during periods of drought. TMWA, prior to consolidation with Washoe County's water utility and STMGID, was engaged in an ASR program with some of its production wells. Following consolidation TMWA has expanded its ASR program to include groundwater systems within the TRA.

During the winter season, many of TMWA's wells are used to inject treated surface water into the groundwater aquifer for storage and future peak season use. The injection of treated surface water for ASR in the Truckee Meadows has increased from 81 af as part of TMWA's 1993 pilot program, to 3,700 af in 2015. The total amount of water injected since 2001 includes 25,100 af in the Truckee Meadows aquifer, 4,650 af into the West Lemmon Valley and 720 af into the Spanish Springs Valley hydrographic basins. Details regarding TMWA's current ASR activities are outlined in Chapter 3 of TMWA's 2016-2035 WRP.

TMWA is enhancing groundwater resources in the Mt. Rose Fan area through conjunctive use management of surface water and groundwater. Due to dependence upon groundwater and the continued decline in water levels aggravated by drought in this area, it is necessary to provide a supplemental source of supply for the water systems located on the upper Mt. Rose and Galena Fan areas. These areas rely primarily on groundwater wells (both municipal and domestic) for their water supply. Recent drought has severely limited the amount of recharge to local aquifers. With the full resources of the consolidated water utility available, immediate construction of the facilities to implement conjunctive use management has begun. This will improve reliability for both TMWA customers and domestic well owners by mitigating the continued decline of groundwater levels in the area.

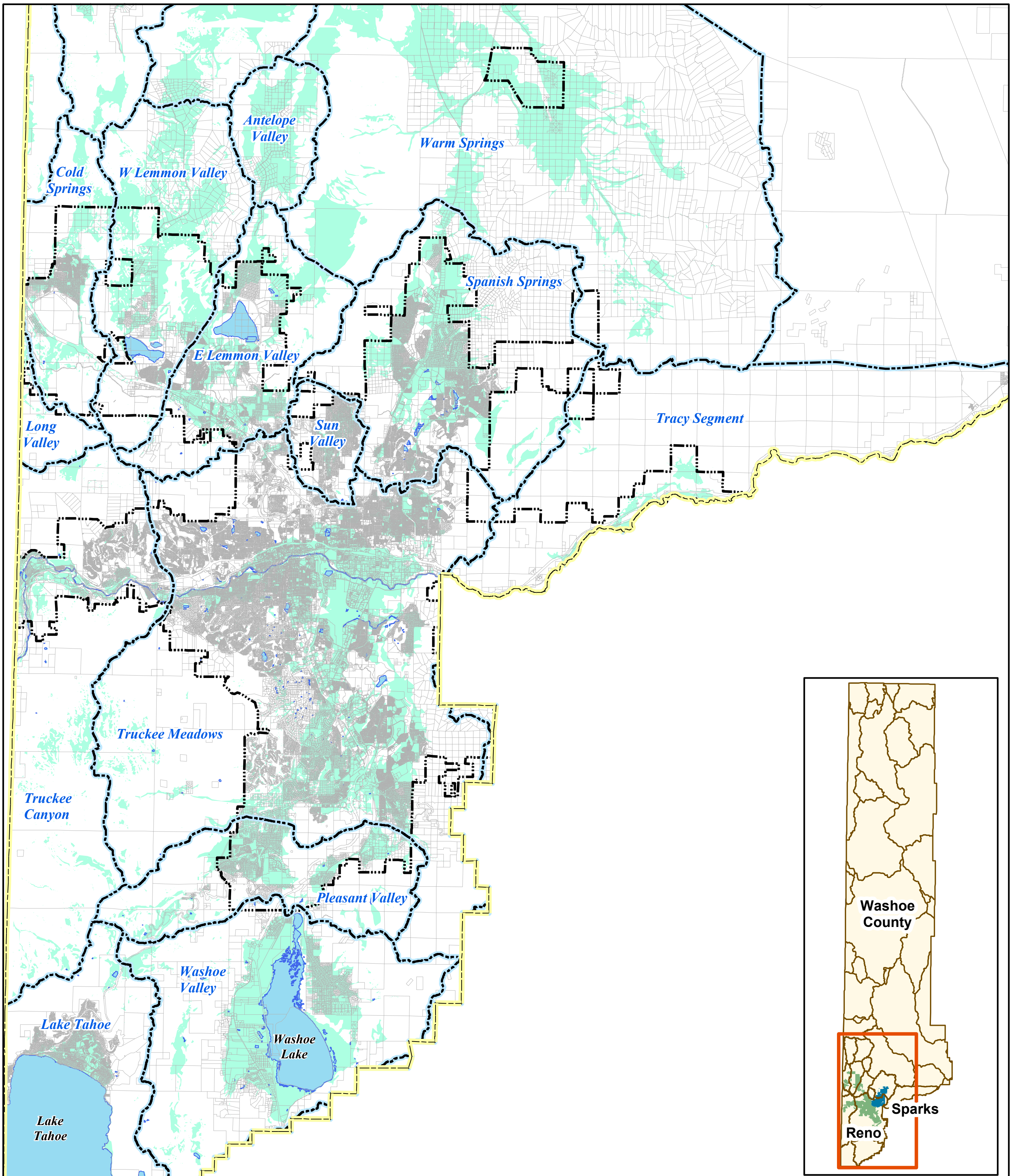

Figure 2-8 Areas of Good Potential Recharge

Areas of Good Recharge Potential

TMSA Boundary

Hydrobasin Boundary

0 1 2 3 4 5 Miles

Consisting of several projects, TMWA is investing in facilities that will provide for the ability to deliver treated surface water from local creeks and the Truckee River to the following:

- Arrowcreek/Mt. Rose Conjunctive-Use Facilities;
- Expanded Conjunctive-Use Facilities/ASR Program;
- (Former) STMGID Conjunctive-Use Facilities; and
- Mt. Rose Water Treatment Plant.

The Arrowcreek/Mt. Rose Conjunctive-Use Facilities, Phase 1 can deliver up to 1,500 gallons per minute ("gpm") of surface water primarily during the winter months. This allows TMWA to not pump its production wells in the Arrowcreek and Mt. Rose water systems. The project began operation in April of 2015.

TMWA is also expanding its ASR in this area. ASR occurs during the fall, winter and spring. The first wells scheduled to be equipped for recharge are Arrowcreek 2, Tessa West and Mt Rose 3. An additional component of the overall ASR program is Phase 2 of the Arrowcreek/Mt. Rose conjunctive-use facilities. This project will allow delivery of surface water into the upper portions of the Mt. Rose/Galena water system for use in recharging additional wells.

The third project, the STMGID Conjunctive-Use Facilities, will provide surface water primarily during the winter months for an area which predominantly serves former STMGID customers, located in the vicinity of the Saddlehorn neighborhood. The facilities will be constructed in 2017/2018, benefiting TMWA customers and domestic well owners by providing surface water to protect and restore groundwater resources. The project will consist of a new booster pump station and about 8,100 feet of pipe to be located on Arrowcreek Parkway. These facilities will deliver about 1,000 gpm to the STMGID Tanks 4 and 5 zones during the winter months.

Lastly, in order to develop supplemental surface water supplies that will provide for the long-term sustainability of the local groundwater aquifer, TMWA is implementing a plan to construct a small water treatment plant off of Whites and Thomas Creeks. This plan was approved as part of Washoe County's 2002 South Truckee Meadows Facility Plan ("STMFP"). The STMFP recognized that, "The upper treatment plant is an integral component of the recommended water supply plan. Most importantly, it will provide recharge water and/or offset winter groundwater pumping in the upper Mt. Rose fan area."

The Mt. Rose Water Treatment Plant ("MRTP") is expected to be constructed with a production capacity of up to 4 million gallons per day ("MGD"). When adequate Whites and Thomas Creek flows are available, a portion of the flow will be diverted to the MRTP leaving sufficient flows to maintain wildlife and habitat needs, as well as downstream irrigation requirements. It is anticipated that of the 4,852 afa of water rights available for M&I use off of Whites and Thomas Creeks, an estimated 3,200 af will be diverted in a typical year. Further details are discussed in Chapter 6 of TMWA's 2035 Water Resource Plan.

Golden Valley, a sub-basin of the East Lemmon Valley hydrographic basin, has been developed with more than 600 homes on domestic wells and septic systems. Water quality and quantity has been deteriorating since the 1980s. Washoe County, after six years of a federally supported pilot project, initiated a long-term groundwater recharge project in 2002, funded by Golden Valley property owners. The project injects approximately 80 af of water per year to help offset declining water levels and improve water quality.

2.2.4.4 Reclaimed Water

Weather-related factors have little long-term effect on reclaimed water as a source of water supply. Reclaimed water is drought resistant in that water reclamation facilities receive, treat and discharge relatively constant average annual flows. Winter storage may limit the amount of reclaimed water for irrigation in some areas of the Planning Area.

More and more, reclaimed water is being viewed as an asset especially by communities where water resources are limited. The popularity of reclaimed water as a sustainable source of water is growing, especially as it relates to the concept of indirect potable reuse ("IPR"). IPR is a method of using reclaimed water which is treated to very high standards and reintroduced indirectly, via an environmental buffer, to a potable surface- or groundwater supply. Amendments to state regulations to permit reclaimed water for IPR have been recently approved by the NDEP.

In addition to reclaimed water's usefulness for agricultural irrigation and as a potential sustainable potable water resource through IPR, competition by industry has grown substantially. Industrial and commercial users see the value of reclaimed water both as an economical alternative as well as a "green" method of doing business. The high quality and sustainable nature of the reclaimed water is currently spurring competition for the resource.

2.2.5 Source Water Quality

This section includes an overview of source water quality, identifies potential sources or causes of water supply contamination and briefly describes programs and measures to protect, improve and maintain source water quality. Source water refers to surface water and groundwater sources before diversion for municipal use.

TMWA includes source water protection within its source water quality assurance program, and describes management of high turbidity events in the Truckee River, toxic spills, other emergencies and the Truckee River Fund, among other measures in its 2035 Water Resource Plan. Source water protection for groundwater includes Wellhead Protection Plans ("WHPP"), the Central Truckee Meadows Remediation District and other efforts to manage human-caused and naturally-occurring contaminants.

2.2.5.1 Truckee River Water Quality

The water quality of the Truckee River is normally excellent. Surface water is of exceptional quality because base flows are composed of Sierra Nevada Mountain snowpack runoff and seepage or spring flow. Typical water quality data are shown in Table 2-5. Mineral concentrations are very low, and turbidity levels are typically less than five nephelometric turbidity units ("NTU"). Higher than average turbidity events can occur in the Truckee River during periods of floods, storm runoff and/or algae growth associated with low flows and warm temperatures in summer.

Table 2-5 Typical Mineral Concentrations of Surface Water

Constituent	Minimum	Average	Maximum
Total Dissolved Solids, mg/L	34	86	132
Total Suspended Solids, mg/L	1	13	20,000*
pH	6.8	7.7	9.6
Temperature, degrees C	0.0	0.5	20.0

*High turbidity events only, such as the July 1992 flash flood on Gray Creek. mg/L = milligrams per liter

TMWA's ability to treat surface water at its treatment facilities during possible events of high turbidity and chemical or biological contamination is a major factor in Truckee River reliability. Three types of possible contamination events are identified:

- Turbidity events – low frequency events that are flushed by river flows within hours.
- Non-persistent toxic spills – spills of substances that would be flushed by river flows, usually within an eight-hour period.
- Persistent toxic spills - spills lasting more than two to four days that do not flush through the river channel.

Higher than average turbidity events can occur in the Truckee River during periods of floods, storm runoff and/or algae growth associated with low flows and warm temperatures in summer. Turbidity at conventional filtration plants is removed through chemical stabilization (coagulation and flocculation), followed by sedimentation and filtration. All surface water is treated at the CTP or GTP before distribution. The modern treatment facilities at the CTP and GTP have greatly reduced the water supply risks associated with turbidity events. Both CTP and GTP are designed to operate during intermittent turbidity events as high as 4,100 NTU lasting five to 10 days, but it is more practical to shut the plants down and let the turbid water pass by to avoid significant clean-up efforts and costs at the treatment plants. Should a turbidity event occur that exceeds TMWA's ability to treat the water to required standards, it is possible to operate the system with only wells to supply an average day demand, more than sufficient to meet current indoor or winter daily demands of approximately 35-39 MGD.

Few toxic spills have occurred on the Truckee River and none were of major proportion. The most recent event was a sewage spill near Squaw Valley, California which occurred in the spring of 2015. The spill was diluted 1000:1 by the flow within the Truckee River; no noticeable impact was seen at either CTP or GTP. Major toxic spills that would render the Truckee River unusable have not been recorded. However, toxic spills into rivers throughout the U.S. do occur, such as the Gold King mine spill into the Animas River in Colorado. Some of the toxic spills have rendered water supplies unusable for an extended period of time. In the event of an incident on the Truckee River, the contaminant might be diluted and washed downstream within a day depending on the flow rate in the river at the time. TMWA might be able increase river flows through release of its stored water. These steps are likely to mitigate any contaminant that does not readily absorb into the river bed.

Past resource plans and a recent review of U.S. Department of Transportation data identified several types of hazardous materials commonly transported through the Truckee River watershed. They include:

Ammonia perchlorate	Hydrogen sulfide	White phosphorous
Anhydrous ammonia	Nitro cellulose (wet)	Propargyl alcohol
Chlorine	Propane	Sulfuric acid
Cyanide	Petroleum naphtha	Sodium hydroxide
Hydrochloric acid	Phosphoric acid	

These chemicals represent ingredients used in the formation of products ranging from rocket fuel to pesticides. Although most are extremely toxic it is likely that all would be flushed past TMWA's treatment plant intakes within one day. Chemicals that would likely adhere to the river bed include manufactured pesticides, herbicides, and fungicides. Each chemical would require a specific response depending on location, duration, and other factors of the water quality emergency. In the event of a spill, it is currently possible to operate using distribution storage and wells while the water quality emergency is being assessed.

In 2007, research was completed at the UNR on behalf of TMWA (see TMWA's 2030 Water Resource Plan Appendix E), to quantify the risk of a spill to the Truckee River using data that was previously not available. The analysis has shown no recorded contamination event from rail or highway transportation. The data also suggests that accidents tend to occur more frequently during the loading and unloading of trucks and rail cars. This suggests that the area of highest risk is downstream of TMWA's intake facilities in the City of Sparks where there is a rail yard and a large number of warehouses and shipping companies.

Also completed by UNR in 2008 was a risk analysis and assessment accompanied by the development of a contaminant transport model of the Truckee River from Tahoe City to the GTP. The results of this research are provided in Appendix E of TMWA's 2030 Water Resource Plan, and include travel times for various classes of chemicals at different flow rates. The model is used to quantify the time periods required for the river to flush a spill from different possible locations, which will aid operation of the surface water treatment plants should a contaminant event on the river occur.

While a toxic spill into the Truckee River is clearly a concern, this is an extremely rare event and such an event has not occurred to this date. However, depending upon the time of year, TMWA is able to operate without the river for a period of hours to days using system distribution storage and its production wells. A detailed plan cannot be developed for a major emergency on the Truckee River that would anticipate all possible combinations of circumstances requiring emergency actions. Variables include location, size, and type of spill; time of year; levels of reservoirs and streams; customer demands; and other factors. The supply of water available from TMWA's production wells enables TMWA to meet demands for average indoor water use throughout the year. The consolidation and integration of Washoe County and STMGID water systems into TMWA has resulted in additional interconnections with adjacent water systems.

These water systems, located within South Truckee Meadows, Hidden Valley, Spanish Springs and Lemmon Valley, rely on groundwater wells and provide an increased source of off-river supply during an extreme event and/or extended river outage. The consolidation and integration of the Washoe County water systems also brings additional off-river resources and facilities to TMWA, including Thomas, Whites and Galena Creek water resources, the Longley Lane groundwater treatment plant, and the North Valleys Importation Project. In addition to relying on its wells, other steps to reduce water use during an extreme event and/or extended river outage could include:

- Call for voluntary, then mandatory water conservation, including watering restrictions (e.g., once per week during summer months), reduced laundry at commercial properties, use of paper plates in restaurants, no use of potable water for non-potable purposes, and other measures.

- Engage all wells on the TMWA system for full operation subject to Health Department approval. This would include the use of wells that do not meet drinking water standards.

- Modify flows in the Truckee River to either flush, dilute, or isolate the contaminant.

- Utilize extraordinary treatment processes in the pre-treatment section of the water plants. An example of this might be neutralizing pH through chemical additions in the pre-settling basin or addition of granular-activated carbon to filters. The likelihood of these steps being successful will depend on the type of contaminant and its concentration.

- Acquire the use of all water in local irrigation ponds, recreational lakes, etc., to the extent that water can be conveyed to TMWA's treatment plants through ditches or other means.

- Use isolated portions of the storm drain system and ditch system for conveying water from unusual source locations to the water treatment plants. This might include installing sandbag check dams in certain ditches, along with low head pumps, in order to move water up-gradient in a ditch to a treatment plant. For example, the creeks in the South Truckee Meadows might be conveyed to the GTP by collecting the water in Steamboat Creek, pumping it into Pioneer Ditch, and through step pumping to Glendale.

- Temporarily pump the discharge from the Sparks Marina to the GTP.

- Use TROA storage for emergency “worse than worst case water supply” to flush the river of contaminants.

Besides the types of spill events described above, there may be other events that interfere with the availability of Truckee River water. For example, in April 2008, an earthquake triggered a rock slide destroying a 200-ft section of flume along the Highland Ditch in the Mogul area. This incapacitated the primary raw water supply for CTP just as customer demands were increasing with the onset of springtime temperatures. Raw water supply to CTP was restored that same day via the Orr Ditch Pump Station at a limited capacity of approximately 60 MGD, but more supply was required. The GTP was brought on-line early in order to help meet those increasing customer demands. Within a few weeks a temporary pumping station along the river was also set up to provide enough raw water in order for CTP to resume operating at its full capacity of 83 MGD. By July the damaged section of flume was bypassed with a 54-inch aboveground high density polyethylene pipe and gravity flow from the river to CTP was restored at a limited capacity of about 26 MGD. The Orr Ditch Pump Station was used to supplement the additional 57 MGD or so that the CTP required to operate at full capacity. The earthquake event fast-tracked the Mogul Bypass Project with approximately 8,400-ft of 69-inch steel pipe placed underground along with over 5,850 feet of reinforced concrete boxes to enclose the Highland Canal.

Though it cannot be predicted when a river interruption event will occur or what the nature of an event will be, TMWA plans for, and practices, scenarios to manage emergency events. The more extraordinary measures that can be engaged are believed to only apply in an extreme, “worse than historic” event that would occur in the peak of the summertime irrigation with contamination occurring between Boca and the Steamboat Ditch diversion. Most combinations of scenarios as to time, place, and nature of event are manageable with existing production facilities and management options without taking drastic measures. It must be emphasized that these are broad guidelines only. They are not intended as a definitive instruction list as to the response which should be taken in any given emergency situation. An event, should one occur, must be evaluated on its specific conditions, and a response plan devised accordingly.

2.2.5.2 Tributary Water Quality

Truckee River tributary streams that join the Truckee River upstream of water treatment plants have the potential to adversely affect raw water quality. These streams are generally of the same exceptional quality as the Truckee River. Stream flows are maintained by snowmelt runoff and snowmelt infiltration in the upper watershed that provides base flows. Lower in the watershed, the water quality of these streams is subject to degradation caused by urban runoff. One example is Chalk Creek, which has become a perennial stream due to urban irrigation. Chalk Creek now transports nitrogen, phosphorus, and total dissolved solids to the river, three pollutants of concern within the Truckee River ecosystem.

The Truckee Meadows Regional Watershed Management Program (i.e., Truckee Meadows Regional Storm Water Quality Management Program) is responsible for monitoring and improving the condition of Truckee River tributaries in the urbanized watershed. The Program has collaborated with the University of Nevada Cooperative Extension and the Washoe Storey Conservation District to conduct baseline watershed assessments of many of those tributaries. The program has conducted annual assessments and published assessment reports since 2005. Results and recommendations are reported most recently in the Truckee River Watershed Assessment, 2009. A number of the tributaries are included on Nevada's 303(d) Impaired Waters List, although none are shown as high priority for total maximum daily loading development.

Mercury
The presence of mercury in Steamboat Creek does not threaten drinking water quality in the Planning Area; however, it has raised concerns about the potential for stream restoration work to cause remobilization and accumulation elsewhere in the environment. Mercury originated at Washoe Lake where Comstock-era gold and silver mills utilized mercury to process ore. Since that time, mercury has been distributed in the stream channel and on the streambanks. Recent studies indicate that streambank stabilization could reduce mercury loading to the creek, but that wetland construction may exacerbate the production of methylmercury, a bioavailable form of mercury. The Regional Transportation Commission has extensively studied mercury in the Steamboat Creek floodplain as part of the South East Connector project, which on completion will encapsulate the roadway approximately 300,000 cubic yards of soil containing mercury.

2.2.5.3 Groundwater Quality

Groundwater quality degradation can be the result of naturally occurring constituents or contaminants introduced by human activities, which can affect the sustainability of groundwater resources by potentially impairing its quality. As municipal well fields were developed over time, portions of aquifers with poor water quality were identified and avoided. Today, the areas of good quality groundwater that can be easily or economically captured are fairly well defined and developed.

Anthropogenic Contaminants
Organic solvents, hydrocarbons and nitrate are the most significant human-caused groundwater contamination in the Truckee Meadows and surrounding groundwater basins. Nitrate contamination of groundwater resulting from overly-dense septic systems and the hydrocarbon and solvent contamination from past industrial practices emphasize the importance of source water protection efforts. The map in Figure 2-9 depicts rough outlines of the extent and nature of some of the current threats to groundwater that TMWA, Reno, Sparks, Washoe County, and NDEP are monitoring and managing.

Solvent and Fuel Contamination
Water quality in a large portion of the aquifer underlying the central Truckee Meadows is affected by the presence of tetrachloroethylene (also known as perchloroethylene or "PCE"). This solvent was used extensively from the 1950s through the 1980s as a degreaser by various commercial establishments and is presently used by the dry cleaning, automobile service, and chemical manufacturing industries. In the 1980s the U.S. Environmental Protection Agency ("EPA") identified PCE as a hazardous/toxic material and required municipal water systems to initiate water quality monitoring. In 1987, water quality tests on several of Sierra Pacific Power Company's (now TMWA's) production wells revealed the presence of PCE.

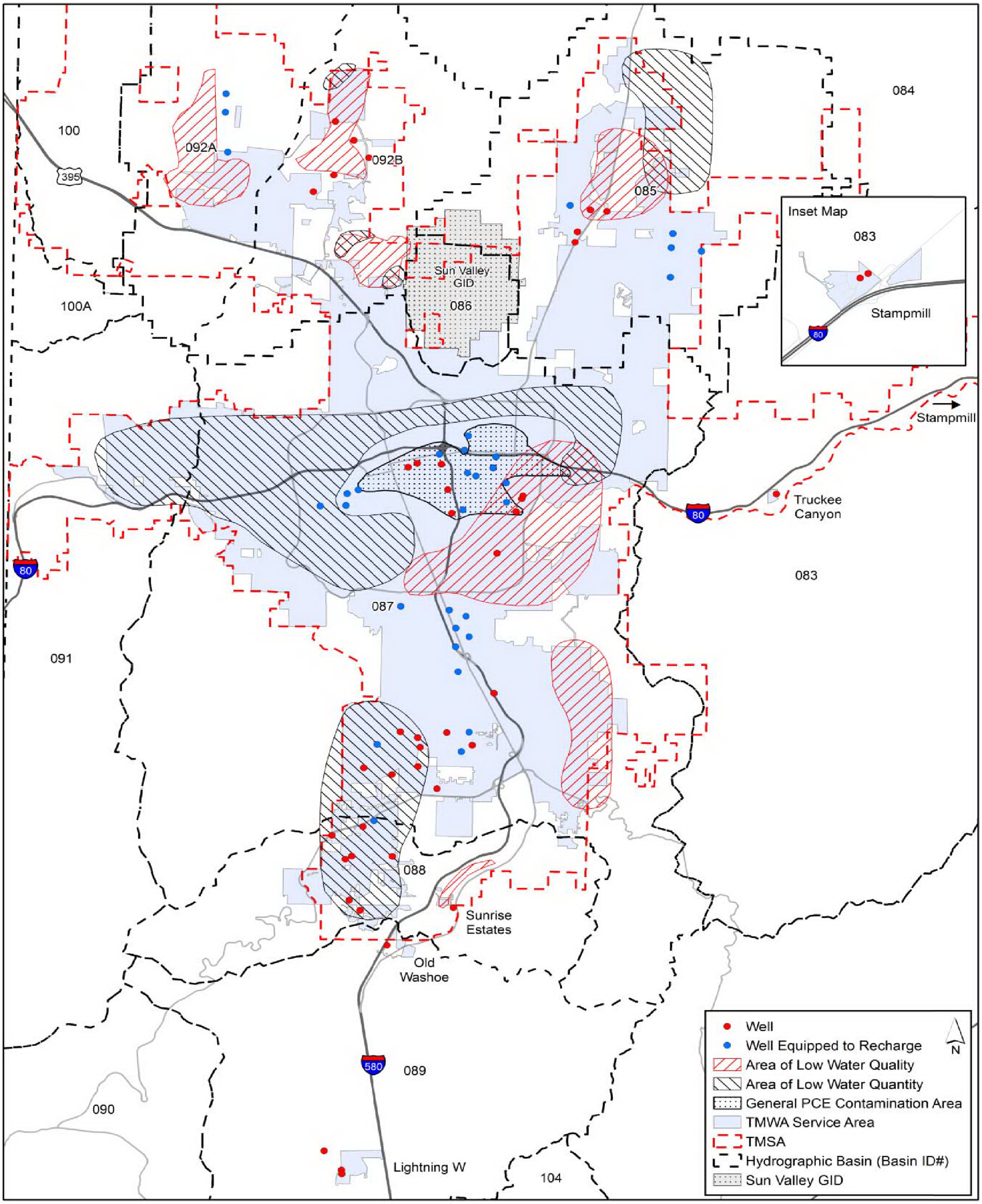

Figure 2-9 Production and Recharge Wells and Areas of Water Quality Concern

(Source: TMWA 2035 WRP)

Department of Water Resources

Notes: The Scale and configuration of all Information shown heron are approximate only and are not intended as a guide for design or survey work. Reproduction is not permitted without prior written permission from the Washoe County Department of Water Resources.
November, 2010

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In 1994, NDEP completed studies concluding that the PCE contamination impacting these wells was widespread (occurring over a 16-square mile area) and likely to have originated over time from hundreds of possible sources. Many of the likely sources were businesses that had been out of operation for many years. Since existing state and local environmental regulations were not adequate at that time for addressing a problem of this nature, dealing with the PCE problem in the central Truckee Meadows would require creation of a federal Superfund site through Comprehensive Environmental Response, Compensation, and Liability Act of 1980 or changes in state and local legislation.

In 1995, the Nevada Legislature passed Senate Bill 489 (NRS 540A) requiring the formation of a remediation district once a groundwater contamination problem is certified by NDEP and/or the Washoe County Health District ("WCHD"). Both agencies provided letters of certification in August of that year. In 1997, NRS 540A was amended to provide a funding mechanism to support groundwater remediation activities and the Central Truckee Meadows Remediation District ("CTMRD") was formed later that year. The CTMRD program is administered on behalf of the BCC by the Washoe County Community Services Department ("CSD").

Since the creation of the CTMRD program, CSD has worked closely with other program stakeholders (NDEP, Reno, Sparks, TMWA, WCHD) to develop and implement the 2003 Remediation Management Plan to prevent, protect, and mitigate groundwater contamination by PCE in the central Truckee Meadows. This is being accomplished through: groundwater treatment; groundwater monitoring; wellfield management; potential source area delineation and assessment; source management; and site remediation activities.

Groundwater near the Reno-Stead Airport in the West Lemmon Valley hydrographic basin is also affected by solvent contamination. This PCE plume, identified in 1994, is connected with US Air Force activities at the Stead Air Force Base, which was active during the 1940s and 1950s. The potential exists for this contamination to migrate to TMWA production wells; however, corrective actions are successfully controlling migration and cleaning up the contaminated groundwater. Remediation plans are being implemented by responsible parties under the direction and oversight of the NDEP.

Hydrocarbon fuel and organic solvent contamination originating from the Sparks Tank Farm and adjacent rail yard affects groundwater underlying the southern-most part of Sparks. The contamination forms a plume that roughly parallels I-80, extending from the tank farm to Sparks Marina Lake. The plume is being hydraulically contained with extraction wells, and contaminated groundwater is treated onsite. NDEP is overseeing and directing the ongoing, onsite remediation of contaminated soils and groundwater.

Other, less significant hydrocarbon contamination sites, resulting from leaking underground storage tanks, are being remediated under the supervision of NDEP and the WCDHD.

Nitrate Contamination

Nitrate contamination from septic systems has been identified in a small number of isolated locations in the Planning Area. Elevated nitrate concentrations in groundwater have been documented in Spanish Springs Valley (Washoe County, 2002), and New Washoe City (McKay, 1989). While desert soils are known to contain nitrate, which, when disturbed or irrigated, can cause significant spikes in nitrate contamination, the effect is temporary; whereas, septic leachate is a persistent, long-term, source of nitrate. In Spanish Springs, nitrate contamination affects municipal wells, which prompted NDEP to require corrective action involving mandatory sewering to eliminate the nitrogen source.

A 2008 report to the Regional Water Planning Commission, entitled *Septic Nitrate Baseline Data and Risk Assessment Study for Washoe County,* reported the results of a literature review, data compilation and analysis of data gaps to identify potential areas of concern and prioritize areas for further study. The study identified 16 areas of concern in seven hydrographic basins: Truckee Meadows, Lemmon Valley, Cold Springs, Spanish Springs, Truckee Canyon, Pleasant Valley and Washoe Valley. The report concluded that more than 18,000 septic systems exist in Washoe County and that 79 percent to 95 percent of all septic systems in a particular hydrographic basin are found within the individual areas of concern. Septic system densities ranged from 50 to 350 per square mile. The highest risks were attributed to high septic density, shallow depth to groundwater and the shortest distance to sensitive receptors. Of the areas having sufficient data, those ranked highest for management action are consistent with areas having known impacts, such as Spanish Springs Valley.

In 2006, Washoe County began requiring Spanish Springs homeowners to connect to the municipal sewer in the areas of highest septic system densities. Washoe County's water resources management strategy and facility plan for Spanish Springs, mentioned earlier in this chapter, will help to address nitrate contamination in groundwater.

In April 2016, a study tilted *Phase II: Septic Nitrate Baseline Data and Risk Assessment Study for Washoe County* was in the process of being completed. The study was a follow-up to the recommendations in the Phase I study that identified numerous data gaps in nine of the 16 areas identified for evaluation. This subsequent phase involved the collection and testing of water samples from domestic wells to help better quantify the groundwater nitrate concentrations in the study areas. Preliminary results indicated that high density septic areas in east Washoe Valley and the Heppner subdivision in Lemmon Valley have concentrations in excess of the primary drinking water standard, or Maximum Contaminant Level ("MCL") of 10 mg/l nitrate. In addition, a portion of wells sampled in the Mt Rose and Verdi high density septic areas indicate concentrations of nitrate at the MCL. Washoe County will be conducting an outreach program to notify domestic well owners in the affected areas about the results of the study and provide them with informational literature about nitrate in drinking water and potential mitigation alternatives.

Wellhead Protection Plans

Purveyors that manage wellfields develop WHPP to protect groundwater quality through the delineation of zones of groundwater movement to municipal supply wells, and through the subsequent management of potential contaminant sources within those areas. The programs follow standard requirements set forth by the NDEP, including substantial modeling efforts to accurately delineate well capture zones, travel times, and to identify groundwater recharge zones. Also included are inventories of potential contamination sources and locations, contaminant source management strategies, future well sites and their wellhead protection areas, contingency plans, and a public education program. Public purveyors that manage wellfields in the Planning Area have either achieved the NDEP endorsement for WHPPs or are currently pursuing such.

Naturally Occurring Constituents

Geothermal groundwater, arsenic and radioactive constituents are the most significant naturally-occurring groundwater contaminants present in the Truckee Meadows and surrounding basins.

Geothermal Areas

Groundwater resource sustainability is constrained in part due to the presence of geothermal groundwater, most notably at the Moana Hot Springs geothermal area in south-central Reno and the Steamboat Springs geothermal area in the southeast Truckee Meadows and Pleasant Valley. A small number of wells in the south Truckee Meadows have concentrations of antimony exceeding the drinking water standard. It is speculated that the antimony is related to Steamboat

Springs geothermal activity to the south. Smaller geothermal areas also exist in Spanish Springs Valley, Washoe Valley near New Washoe City, Warm Springs Valley and west Reno at the River Inn. Geothermal water derived from these areas is generally neither potable nor developed for municipal use. Large centers of municipal pumping peripheral to geothermal areas can induce geothermal water migration to production wells. Consequently, the prevention of geothermal groundwater migration as a result of municipal well pumping is considered in designing and operating municipal well fields.

Arsenic
In January 2006, the EPA reduced the drinking water standard for arsenic from 0.050 milligrams per liter ("mg/L") to 0.010 mg/L. Approximately one-third of all public water systems in Washoe County are affected by this regulatory change.

Most purveyors have achieved compliance using the running annual average ("RAA") provisions of the EPA's arsenic rule. The RAA allows purveyors to collect quarterly compliance samples and report the average arsenic concentration measured in the distribution system before the first water customer. TMWA reports that the reduced arsenic standard affects 11 of its 30 wells; however, water from most of these wells is blended, or is piped to GTP for centralized treatment. In addition, TWMA reports that nine of the former Washoe County wells and two former STMGID wells are affected.

Radionuclides
Naturally-occurring radioactive particles are regulated by the Safe Drinking Water Act. In 2006, the radionuclides rules were updated with the addition of a drinking water standard of 0.030 mg/L for uranium. The changes affect only one water system in the Planning Area, the Lightning W system in Washoe Valley, which uses a centralized uranium treatment facility to achieve compliance.

Although the EPA proposed a drinking water standard for radon gas in 1997, the rule remains in draft form and has not been finalized. There is no firm regulatory schedule for radon gas.

Groundwater Rule
The EPA's Groundwater Rule became effective in December 2009 and requires water systems to evaluate individual water sources in the event that microbial contamination is detected in the water distribution system. If a water source is determined to have construction deficiencies or is found to be susceptible to microbial contamination (i.e., aquifer which lacks clay confining layer), water systems will be required to disinfect that water source ("4-log disinfection" for fecal/virus contamination) prior to the first water customer. Sources that currently receive 4-log disinfection are exempt from the rule.

It is estimated that there are 200 existing groundwater wells and three springs in the planning area that do not currently receive 4-log disinfection and are subject to the Groundwater Rule.

2.2.5.4 Reclaimed Water Quality

Reclaimed water generated at the major water reclamation facilities in the Planning Area is among the cleanest in the nation. The various water reclamation facilities provide different levels of treatment depending on permit limitations and the intended use of the reclaimed water. For example, reclaimed water produced at TMWRF, by far the largest facility, is of adequate quality for discharge to the Truckee River, and for use as irrigation water with minimal restrictions. The NDEP regulates the use of reclaimed water, including minimum treatment levels in addition to requirements for bacteriological quality and buffer zones for spray irrigation. Section 4.3 briefly discusses newly amended State reclaimed water regulations containing standards for “exceptional quality” reclaimed water.

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