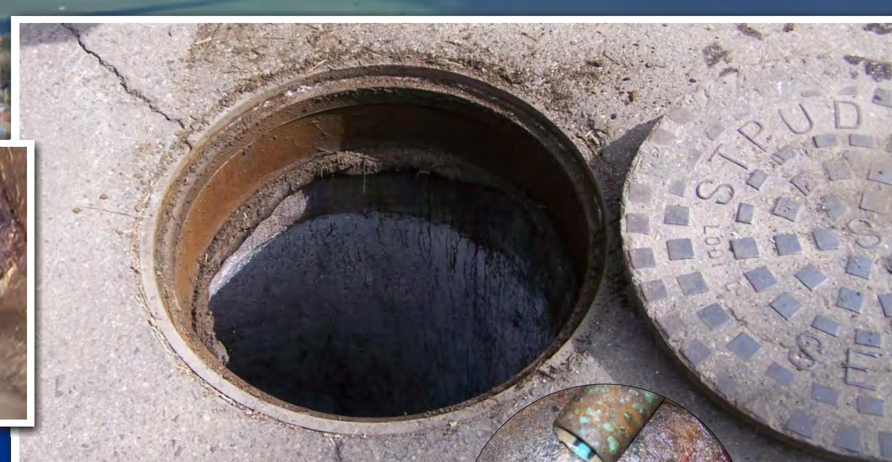
FINAL REPORT

DECEMBER 2009

SOUTH TAHOE PUBLIC UTILITY DISTRICT
Sewer • 1950 • Water

Wastewater Collection System Master Plan



BROWN AND CALDWELL

WASTEWATER COLLECTION SYSTEM MASTER PLAN

Prepared for

South Tahoe Public Utility District

South Lake Tahoe, California

December 30, 2009

BC Project No. 132364

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3-D	3-dimensional
ABS	acrylonitrile butadiene styrene pipe
ACE	asbestos cement epoxy-lined pipe
ACP	asbestos-cement pipe
AGP	Rural Restrictive Zoning – CLCA ,
ANSI/HI	American National Standard Institute/Hydraulic Institute
APN	assessor parcel number
ARV	air release valve
ASCE	American Society of Civil Engineers
ASCE	American Society of Civil Engineers
ATS	automatic transfer swith
AVV	air vacuum valve
BC	Brown and Caldwell
BCE	business case evaluation
BSF	base sanitary flow
CCCSD	Central Contra Costa Sanitary District
CCI	construction cost index
CCTV	closed-circuit television
CIP	Capital Improvement Plan
CIP	cast iron pipe
City	City of South Lake Tahoe
CMMS	computerized maintenance management system
CMOM	capacity, management, operations and maintenance
CMP	campground
COM	commercial
County	El Dorado County
CSO	combined sewer overflows
CTC	California Tahoe Conservancy
d/D	pipe flow depth to diameter ratio
D/S	downstream
DEV	developed
DHI	Danish Hydraulic Institute
DIP	ductile iron pipe
District	South Tahoe Public Utility District
ENR	Engineering News Record
EPA	Environmental Protection Agency
ES	electric stations
FLL	Fallen Leaf Lake
FM	flow monitor
FM	force main
FOG	fats, oils and grease
fps	feet per second .
FVNR	full voltage, non-reversing
GIS	Geographic Information System
gpd/ac	gallons per day per acre
gpm	gallons per minute
GWI	groundwater infiltration
HDPE	high density polyethylene pipe
Heavenly	Heavenly Ski Resort
HGL	hydraulic grade line
hp	horsepower
I/I	infiltration and inflow
IDF	intensity-duration-frequency
IND	industrial
LOS	levels of service
LRWQCB	Lahontan Regional Water Quality Control Board
Lyon	Lyon County Utilities Department
Master Plan	wastewater collection system master plan
MCC	motor control center
MFR	multi-family residential
mgd	million gallons per day
MHT	motel/hotel land use
MSC	miscellaneous
N/A	not applicable
NASSCO	National Association of Sewer Service Companies
NC	non-contributing
NCDC	National Climatic Data Center
NFPA	National Fire Protection Association
NOAA	National Oceanic and Atmospheric Administration
O&M	operations and maintenance
OSHA	Occupational Safety and Health Administration
PACP©	Pipeline Assessment and Certification Program
PAS	plan area statement
PS	point source
PS	pump station
PVC	polyvinyl chloride pipe
RCP	reinforced concrete pipe
RDI/I	rainfall dependent infiltration and inflow
RES	single family residential
RG	rain gauges
RLU	environmentally sensitive land – restricted use
RWQCB	Regional Water Quality Control Board
SASD	Sacramento Area Sewer District
SCADA	supervisory control and data acquisition
SEZ	stream environment zone
SSMP	sewer system management plan
SSMP	sewer system management plan
SSMP	system management plan
SSO	sanitary sewer overflow
STL	steel pipe

STPUD	South Tahoe Public Utility District
SWMM5	Storm Water Management Model 5
SWRCB	California State Water Resources Control Board
TM	technical memorandum
TPZ	timber preserve zoning
TRPA	Tahoe Regional Planning Agency
Truckee	Town of Truckee
US	upstream
USEPA	United States Environmental Protection Agency
USFS	California State Parks and United States Forest Service
UTL	utility
VAC	vacant
VCP	vitrified clay pipe
VFD	variable frequency drive
VV	vacuum valve
VVS	vacuum valve stations
WDR	waste discharge requirements
WDR	waste discharge requirements
WERF	Water Environment Research Foundation
WW	wet weather
WWTP	waste water treatment plant

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EXECUTIVE SUMMARY

This Executive Summary summarizes the findings and recommendations of the Wastewater Collection System Master Plan (Master Plan) for South Tahoe Public Utility District (STPUD or District). The Master Plan was developed using the Asset Management Concepts of Risk and Level of Service and is based on assessments of the hydraulics and physical condition of the collection system. The Master Plan includes recommended improvements to provide adequate hydraulic capacity and improve the collection system's condition and reliability.

Supporting information for this Executive Summary can be found in the Master Plan Introduction and the following Technical Memoranda that were prepared for the Master Plan:

- TM 1 – Level of Service
- TM 2 – Risk Assessment
- TM 3 – Pump Station Condition Assessment
- TM 4 – Design Flow Analysis
- TM 5 – Model Program Selection
- TM 6 – Model Development and Calibration
- TM 7 – Pipeline Condition Assessment
- TM 8 – Hydraulic Evaluation
- TM 9 – Design Criteria
- TM 10 – Capital Improvement Plan

Background

The District collects and treats wastewater from businesses and residents within the District's service area, which encompasses approximately 42 square miles and includes the City of South Lake Tahoe and unincorporated area of El Dorado County within the Tahoe Basin. The collection system includes 42 pumping station facilities, approximately 314 miles of gravity sewers that range in size from 4 inches to 24 inches in diameter, and approximately 22 miles of force mains that range in size from 2.5 inches to 18 inches in diameter.

Study area flows are conveyed to the District's Wastewater Treatment Plant (WWTP). The District's WWTP, last expanded in 1989, has a capacity 7.7 million gallons per day (mgd). Effluent is exported 26 miles to Harvey Place Reservoir in Alpine County. The WWTP treats an average annual flow of 4 mgd. Peak average daily flows of approximately 5 mgd occur during summer holiday weekends. The 2005 New Year's Eve storm saw continuous rainfall measuring 4.71 inches, which caused an instantaneous peak flow of 18.5 mgd at the WWTP.

Sanitary Sewer Overflows

California State Water Resources Control Board (SWRCB) Order No. 2006-003 provides statewide general Waste Discharge Requirements (WDR) for all publicly owned sanitary sewer collection systems in California with more than one mile of sewer pipe. Agencies meeting these criteria must develop a Sewer System Management Plan (SSMP). SSMPs are created to help sewer agencies develop and implement a plan to effectively manage wastewater collection systems. The SSMP will establish goals and present objectives to minimize the number and impact of sanitary sewer overflows (SSO), provide sewer capacity to accommodate design storm flows, and maintain the condition of the collection system such that the District can continue to provide reliable service.

Reported SSO averages for a sample of agencies located throughout the United States range from two to six dry weather SSOs per 100 miles of sewer per year. This information comes from published data by the Water Environment Research Foundation (WERF), American Society of Civil Engineers (ASCE), and the Environmental Protection Agency (EPA) Region 9.

Reported SSOs for the District for 2005 to 2008 ranged from 2.9 to 3.8 per 100 miles, which falls within the middle of the range of national averages. Primary causes for the District's SSOs included grease (30 percent), rags (20 percent), roots (14 percent), debris (7 percent), vandalism (5 percent), pipe damage (2 percent) and unknown causes (23 percent). Each recorded SSO during this period occurred during dry weather.

Seventy percent of the SSOs occurred in 6-inch-diameter pipe. Seventy-nine percent of the SSOs occurred in asbestos cement pipe (ACP). Sixty-seven percent of the SSOs occurred in areas that were cleaned as recent as 2005 or 2006.

Asset Management

This collection system master plan helps the District implement asset management practices and develop an asset-management-driven capital improvement program. Asset management is a process that provides a defined level of collection system performance at the lowest life-cycle cost. The Master Plan addresses four aspects of asset management:

Level of Service. Defining level of service is key to good asset management. Levels of service relate to an agency's main mission—they identify the things most important to customers or the environment. They are key indicators of how an agency will meet its critical institutional goals. Levels of service were developed in five categories:

- Collection system service
- Community health, safety, and environment
- Employee safety
- Regulatory requirements
- Customer service.

This master plan focuses primarily on the first three levels of service:

Risk Assessment. In this Master Plan, a risk assessment helped identify the District's most critical assets and projects. The assessment considered independently an asset's likelihood of failure and consequence of failure in meeting the designated levels of service. An asset's consequences of failure would result in a SSO, injured employee, or injured member of the public. The consequences of SSOs were further evaluated according to the size and location of the SSO.

The asset's likelihood of failure was determined during the hydraulic and condition assessment tasks. The hydraulic assessment evaluated growth in the collection system and the increase of flows from new connections and the effects of wet weather flows. These factors helped determine a failure probability caused by a lack of hydraulic capacity. Failure probabilities were based on structural condition, operational information, maintenance data, and the reliability assessment. The reliability assessment considered such topics as the obsolescence of equipment that may make obtaining spare parts difficult.

Business Case Evaluations (BCE). Business case evaluations incorporate risk, along with social and environmental costs and benefits, when evaluating project alternatives. The BCE process can be applied equally to improvement and replacement projects. The BCE supports a thorough alternatives evaluation and helps ensure that the District's money is put to the best use to meet specified levels of service.

Capital Improvement Program (CIP) Prioritization. Using risk assessment, District staff and the consultant team prioritized projects within the CIP. The resulting CIP is well-documented and founded on asset management principles that allow it to stand up to scrutiny. The CIP is focused on the most critical situations that would lead to a SSO or injury. This approach enables the District to maintain a higher level of service by most efficiently using its limited resources.

Pipeline and Pump Station Condition Assessment

The condition assessment was based on field inspections at 22 pump station facilities completed in 2007 and review of existing pipeline closed-circuit television (CCTV) inspection information collected by the District over the past five to six years. Since 2003, the District conducted CCTV inspection of approximately 44 miles of sewer, which represents 14 percent of the collection system. Approximately 8 percent of the inspected pipe segments had a defect that required a repair. The District repairs these defects as part of its ongoing pipeline rehabilitation program.

Pipeline Condition Assessment. The District's pipes and manholes are generally well maintained, though there is room for improvement in specific areas. The District experiences a moderate number of dry weather SSOs, roughly falling within the range of averages seen by other agencies around the country. Most of these SSOs occur in 6-inch-diameter pipes, which are often difficult to maintain because they are prone to blockage due to their small diameter.

In contrast to the District, most sewer agencies do not clean the majority of their systems every three years; however, the District's cleaning schedule is necessary to maintain the 6-inch-diameter pipes that experience root intrusion and structural problems at a higher rate than larger pipes in other parts of the system. This cleaning program has allowed the District to maintain low levels of dry weather SSOs.

Despite approaching 50 years of age, the District's pipeline infrastructure remains in relatively good condition. The District's ongoing CCTV inspection program identifies pipeline defects that are repaired quickly. The District is improving its inspection frequency and procedures for pipes and manholes, and is on track to inspect the system approximately once every 12 years. In 2008, the District implemented the National Association of Sewer Service Companies (NASSCO) standardized system for rating pipe and manhole defects. CCTV inspections are currently not prioritized.

One area for further improvement is the District's force main maintenance and inspection program. Air relief valves (ARV) on a number of force mains are not being maintained, which puts the District at risk for a force main failure due to corrosion or an ARV spill.

Priority 1 recommended improvement projects focus on areas of high maintenance and poor condition. Approximately 13,000 LF of Priority 1 pipe should be considered for rehabilitation. Additional rehabilitation needs will be identified through the District's ongoing CCTV inspection program and be addressed by an annual program.

Approximately 17,000 LF of Priority 2 sewers should be considered for rehabilitation. The Priority 2 list includes pipes with moderate defects and maintenance levels.

The District identified one additional Priority 1 project—the Highway 89/Fifth Street redundant sewer crossing. This sewer has a high consequence of failure and District staff has identified that it should have a high priority.

Other recommendations from the condition assessment that are not capital projects are listed below:

Maintenance Recommendations

- Prioritize CCTV inspections and develop a plan to evaluate results.
- Inspect stream crossings two times per year and meadow sewers every 18 to 24 months.
- Maintain ARVs on all force mains to help ensure that they operate properly and protect the pipeline from damage. This work will be a shared responsibility between the pump crews and the underground maintenance crews.
- Monitor manholes where there is a force main discharge on an annual basis to evaluate for corrosion damage.

Policy Recommendations

- Minimum pipe diameter should be eight inches. When existing 6-inch pipes are scheduled for rehabilitation or replacement, replace them with 8-inch pipe to reduce maintenance.
- Private building laterals should be tested and renovated on a standard basis as an approach to reduce infiltration and inflow (I/I). Many communities require lateral testing when a property is sold.

Pump Station Condition Assessment. The District has made a significant effort to prevent overflows in the system, and no pump related overflows have occurred since January 2004. The District's pump stations are well maintained; staff is highly knowledgeable and skilled in maintaining and improving the wide variety of pump stations.

The District has several types of pump stations, many of which are 40+ years old. The equipment in these pump stations varies. The District is geographically isolated relative to manufacturers' service facilities. This means the District must have spare parts on hand, and the in-house expertise to make repairs themselves in a timely manner, especially during inclement weather.

The District has retained its staff for many years, which means staff has significant experience and internal knowledge of the pump stations. Replacing employees who retire or leave may be difficult because of their high skill level and knowledge of facilities.

Safety is a concern at some of the District's pump stations because confined space entry procedures are required for entry into the dry wells.

The pumping and vacuum system at Fallen Leaf Lake (FLL) is also a concern. This system requires significant operation and maintenance attention from the District because of its design. The District has spent many hours fine-tuning this system because a failure in the FLL system would have significant consequences. A Business Case Evaluation performed on the FLL system identified cost-effective improvements to select portions of the system that will reduce the District's overall risk.

The pump station condition assessment identified two Priority 1 improvement projects for implementation within the next 10 years. These include the vacuum valve improvements at FFL and the system wide SCADA improvements.

There are 13 Priority 2 pump station projects identified in the 10- to 20-year time frame. These projects fall into two categories: employee safety improvements and maintenance improvements.

Several other recommendations not identified for the CIP that will be implemented by District Staff are listed below:

Safety Recommendations

- Provide wet well fall protection.
- Install combustible gas detectors in wet wells.
- Install bollards to protect the Beecher Pump Station electrical panels from vehicular traffic.
- Install a new electrical cabinet at the Beecher Pump Station.
- Provide Ground Fault Circuit Interrupt protection at the electrical outlets at pump stations
- Evaluate electrical equipment layouts to ensure compliance with "Working Space" requirements.

Structural Recommendations

- Remove metal items in the wet wells (including ladders).

Other Recommendations

- Install standby pumps at Flanders and Taggart pump stations.
- Install redundant sump pumps in dry wells.

Another recommendation included developing a standardized submersible pump station design. These pump stations have less equipment to operate and maintain than wet well/dry well pump stations and are easier for new employees to learn to operate and maintain.

Also, the District has started to use Smart Manhole Covers in a limited number of locations to monitor surcharging in the system and will continue to evaluate their viability in more locations.

Hydraulic Assessment

The hydraulic assessment was based on hydraulic modeling of 231 miles of trunk sewers/force mains and 10 pump stations under current and future flow conditions. The District's Geographic Information System (GIS) data provided the base for the hydraulic model. Flow projections are based on flow monitoring performed by the District and by a subcontractor during this project. Land use information for developing future flow projections came from the City of South Lake Tahoe, El Dorado County, the Tahoe Regional Planning Authority and the United States Forest Service.

Because the District's service area is almost built out only minor increases in average daily flow are anticipated. Peak wet weather flows were based on a 25-year, 24-hour design storm. Table ES-1 summarizes flow projections for the District's service area.

Table ES-1. Model Flow Projections

Scenario	Summer Avg Daily Flow (mgd)	Summer Peak Hourly Flow (mgd)	Peak Hourly Winter Design Storm Flow (mgd)
Current	4.84	8.56	16.75
Future	5.62	8.65	16.98

The hydraulic assessment found two areas within the trunk sewer network and one pump station with inadequate hydraulic capacity to convey future wet weather flows without excessive surcharging or SSOs. This finding led to three hydraulic capacity enhancement projects for the Capital Improvement Plan. These projects include the Al Tahoe and Bijou relief sewer projects. These sewers will be under capacity for the future design flow event. The Tahoe Keys pump station capacity upgrade is also needed. This pump station is currently undersized for the existing and future design flow conditions.

Capital Improvement Plan

Capital improvement projects will mitigate hydraulic and structural deficiencies, reduce maintenance and improve overall system safety, reliability and operation. Information from the hydraulic and condition assessments and the risk assessment were used to prioritize the capital projects into three categories. Individual projects were discussed in the previous sections. The comprehensive Capital Improvement Plan (CIP) is listed in Table ES-2 and shown on Figure ES-1.

Priority 1. Projects with the greatest risk for collection system SSO or employee injury.

Priority 2. Projects that are not needed until development occurs and projects that will reduce maintenance and improve system safety, reliability and redundancy.

Priority 3. Other projects that are not anticipated to occur in the next 20 years.

For the Bijou pump station project, future redevelopment could affect flows and should be taken into account during design. Also, the Douglas County Sewer Improvement District (DCSID) is investigating the possibility of a future gravity bypass into the STPUD system, which would affect flows at Bijou pump station. For the Bijou relief sewer project, there is an ongoing City of South

Lake Tahoe and Caltrans erosion control project in the same vicinity. These agencies are investigating possible relocation of some District sewer mains. These projects should be coordinated.

It is also recommended that the Al Tahoe and Tahoe Keys force main bypass projects be coordinated with the proposed WWTP headworks project.

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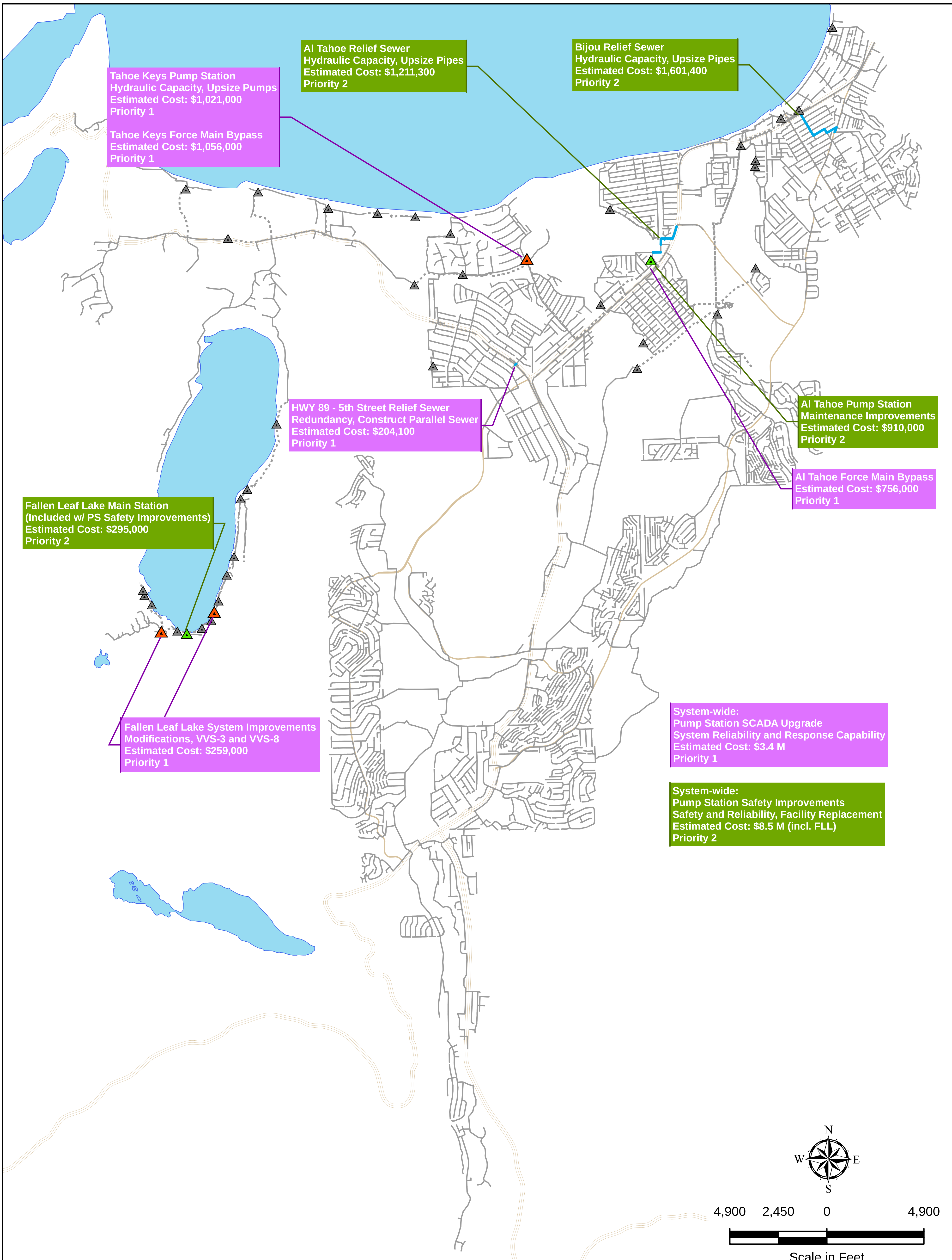
Table ES-2. Capital Improvement Plan

Project and Priority Ranking	Project Type	Project Name	Construction Cost ($)	Design, Administration, Construction Services ($)	Capital Cost ($)	Anticipated Spending ($) per Fiscal Year Ending June 30											
						2009 – 2010	2010 – 2011	2011 – 2012	2012 – 2013	2013 – 2014	2014 – 2015	2015 – 2016	2016 – 2017	2017 – 2018	2018 – 2019	2019-2029	Totals
Pipeline Projects																	
-	Pipeline	Wildwood Sewer Interceptor	-	-	1,653,000						580,000	1,073,000					1,653,000
-	Pipeline	Force Main Bypass - Al Tahoe	630,000	126,000	756,000				756,000								756,000
-	Pipeline	Force Main Bypass – Tahoe Keys	880,000	176,000	1,056,000				1,056,000								1,056,000
-	Pipeline	Cleaning of Sewer Trunk Lines	-	-	554,000								554,000				554,000
1	Pipeline	HWY 89 - 5th St. Relief Sewer	170,100	34,000	204,100		204,100										204,100
1	Pipeline	High Maintenance and Poor Condition Sewer Replacement (Priority 1)	749,970	150,030	900,000		100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000		900,000
2	Pipeline	High Maintenance and Poor Condition Sewer Replacement (Priority 2)	1,666,600	333,400	2,000,000											2,000,000	2,000,000
2	Pipeline	Al Tahoe Relief Sewer (Open-Cut)	1,171,100	234,200	$1,405,300											1,405,300	1,405,300
2	Pipeline	Bijou Relief Sewer	1,334,500	257,000	1,601,400											1,601,400	1,601,400
Pump Station Projects																	
1	Pump Station	SCADA Upgrades	2,835,000	567,000	3,402,000					850,500	850,500	850,500	850,500				3,402,000
1	Pump Station	Tahoe Keys Pump Station Capacity Upgrade	851,000	170,000	1,021,000			1,021,000									1,021,000
1	Pump Station	Fallen Leaf Lake System Improvements (Upgrade VVS #3, Replace VVS #8)	216,000	43,000	259,000					259,000							259,000
2	Pump Station	Al Tahoe Pump Station Maintenance Improvements	751,000	150,000	901,000											901,000	901,000
2	Pump Station	Pump Station Safety Improvements															
		Baldwin Beach	518,800	103,800	622,600											622,600	622,600
		Bellevue	464,300	92,900	557,200											557,200	557,200
		Bijou	1,638,500	327,700	1,966,200											1,966,200	1,966,200
		Johnson	1,365,400	273,100	1,638,500											1,638,500	1,638,500
		Pioneer Village	98,300	19,700	118,000											118,000	118,000
		Pope Beach #1	163,900	32,800	196,700											196,700	196,700
		Pope Beach #2	131,100	26,200	157,300											157,300	157,300
		San Moritz	532,600	106,500	639,100											639,100	639,100
		Taylor Creek	901,300	180,300	1,081,600											1,081,600	1,081,600
		Trout Creek	819,300	163,900	983,200											983,200	983,200
		Venice	163,900	32,800	196,700											196,700	196,700
		FLL Main Station	245,800	49,200	295,000											295,000	295,000
Other Capital Expenditures																	
-	1	Master Plan Update	-	-	350,000											350,000	350,000
-	2	Flow Monitoring and Hydraulic Model Update	-	-	200,000		200,000										200,000
		TOTAL	**18,298,470**	**3,649,530**	**24,714,900**	**0**	**504,100**	**1,121,000**	**1,912,000**	**1,209,500**	**1,530,500**	**2,023,500**	**1,504,500**	**100,000**	**100,000**	**14,709,800**	**24,714,900**

1. Project costs are current to the Tahoe Basin Summer 2009. ENR CCI of 9103. They include a contingency of 35 percent and are AACE Class 5 Order of magnitude.
2. These costs should be adjusted to the construction midpoint at the time of project planning.
3. The allowance for Design, Administration and Construction Services is 20 percent.



BROWN AND CALDWELL

SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure ES-1
Capital Improvement Projects

LEGEND

Pump Station CIP
- Priority 1
- Priority 2
- No Project

Gravity Main CIP
- Priority 2
- No Project

Force Mains

ROADS
- HWY
- Major

P:\132000\132364_STPUD_MP\GIS\mxd\ES_1.mxd

INTRODUCTION

South Tahoe Public Utility District (STPUD or District) owns and maintains a wastewater collection system that serves approximately 17,000 sewer customers in the City of South Lake Tahoe and unincorporated area of El Dorado County within the Tahoe Basin. The collection system conveys wastewater from the District's service area to the District Wastewater Treatment Plant (WWTP). The District last prepared a wastewater collection system master plan in 1986. In January 2007, the District retained Brown and Caldwell (BC) to prepare a new Master Plan.

The Master Plan provides a comprehensive plan for improving the collection system over the next 20 to 30 years. The study includes a hydraulic evaluation and condition assessment and develops a detailed capital improvement plan using the concepts of Asset Management. The Master Plan will facilitate the District's development of its Sewer System Management Plan (SSMP) as required by the State Water Resources Control Board (SWRCB).

This section summarizes the process undertaken to develop this Master Plan and provides background information on the study area, collection system and regulatory drivers.

1.1 Scope of Work

The Master Plan scope of work includes the tasks outlined below. Completed work tasks were documented in technical memoranda and submitted to the District for review. These technical memoranda are included as chapters of this Master Plan report.

Data Collection and Assessment of Wastewater System. Review available information on the collection system and confirm the sub-basin discharge points.

Design Criteria and Level of Service. Develop the Master Plan basis of Asset Management and recommend updates to the District's Design Criteria.

Flow Monitoring and Analysis. Perform dry and wet weather flow monitoring, project current and future wastewater flows, and determine the design storm criteria for infiltration and inflow (I/I) projections.

Condition Assessments. Perform focused condition and reliability assessments on select pipes and pump stations using Asset Management principles; develop alternatives to address condition deficiencies.

Hydraulic Model Development. Develop a hydraulic model of the collection system to identify current and future hydraulic deficiencies and allow the District to make hydraulic evaluations in the future.

System Performance Evaluation and Capacity Assurance Plan. Identify hydraulic deficiencies in the collection system and develop improvement alternatives.

Long Range Capital Improvement Plan Development. Develop capital projects to address conditional and hydraulic deficiencies; prioritize the projects in a CIP using Asset Management principles.

Master Plan Report. Document the Master Plan in a readily useable report.

1.2 Study Area

The Master Plan study area encompasses the District's 42-square mile service area and includes the City of South Lake Tahoe and an unincorporated area of El Dorado County within the Tahoe Basin. The service area is bordered by Hwy 89 North past Cascade Lake, Hwy 89 South to Luther Pass, Hwy 50 East to Nevada state line, and Hwy 50 West before Echo Lake. The service area, illustrated in Figure 1, also includes state parks and USFS land.

1.3 Existing Collection System

The collection system owned and maintained by the District includes 42 pumping station facilities (including pumping stations and vacuum valves), approximately 314 miles of gravity sewers that range in size from 4 inches to 24 inches in diameter, and approximately 22 miles of force mains that range in size from 2 ½ inches to 18 inches in diameter. Flows from the study area are conveyed to the District's wastewater treatment plant (WWTP).

1.4 Wastewater Treatment

The District's WWTP was last expanded in 1989 and has a capacity 7.7 mgd. Effluent is exported 26 miles from Harvey Place Reservoir in Alpine County. The WWTP treats an annual average flow of 4 mgd. Peak average daily flows of approximately 5 mgd occur during summer holiday weekends. The 2005 New Year's Eve storm saw continuous rainfall measuring 4.71 inches and caused an instantaneous peak flow of 18.5 mgd at the WWTP.

1.5 Previous Planning Reports and Information

In 1986, James M. Montgomery Consulting Engineers, Inc., completed the District's previous evaluation of the wastewater collection system. Additional reports and planning documents have been prepared for the collection system and are as follows:

- El Dorado County Parcel GIS, September 2008
- City of South Lake Tahoe 1999 General Plan (Including the 2008 General Plan Housing Element Public Review Draft)
- El Dorado County 2004 General Plan
- Tahoe Regional Planning Agency Community Plan Statement Maps and the Community Plans for Stateline/Ski Run, Bijou/Al Tahoe, and South Y Industrial.
- STPUD Future Connections Facilities Plan, 1995 (Referenced within the 2008 General Plan Housing Element)
- STPUD Emergency Power and/or Storage Facilities Plan, Carollo Engineers, 1991

- STPUD Emergency Power and/or Storage Facilities Plan Amendment 1, Carollo Engineers, 1994

These reports were used, in conjunction with other existing data, to evaluate and develop recommendations for the District's collection system.

1.6 Regulatory

This section summarizes current regulatory requirements and rules. It is intended to provide general discussion of the subject matter covered. To the extent it addresses laws, regulations or court decisions of any jurisdiction, it is not intended as a precise, detailed or thorough summary of the pertinent legal authorities.

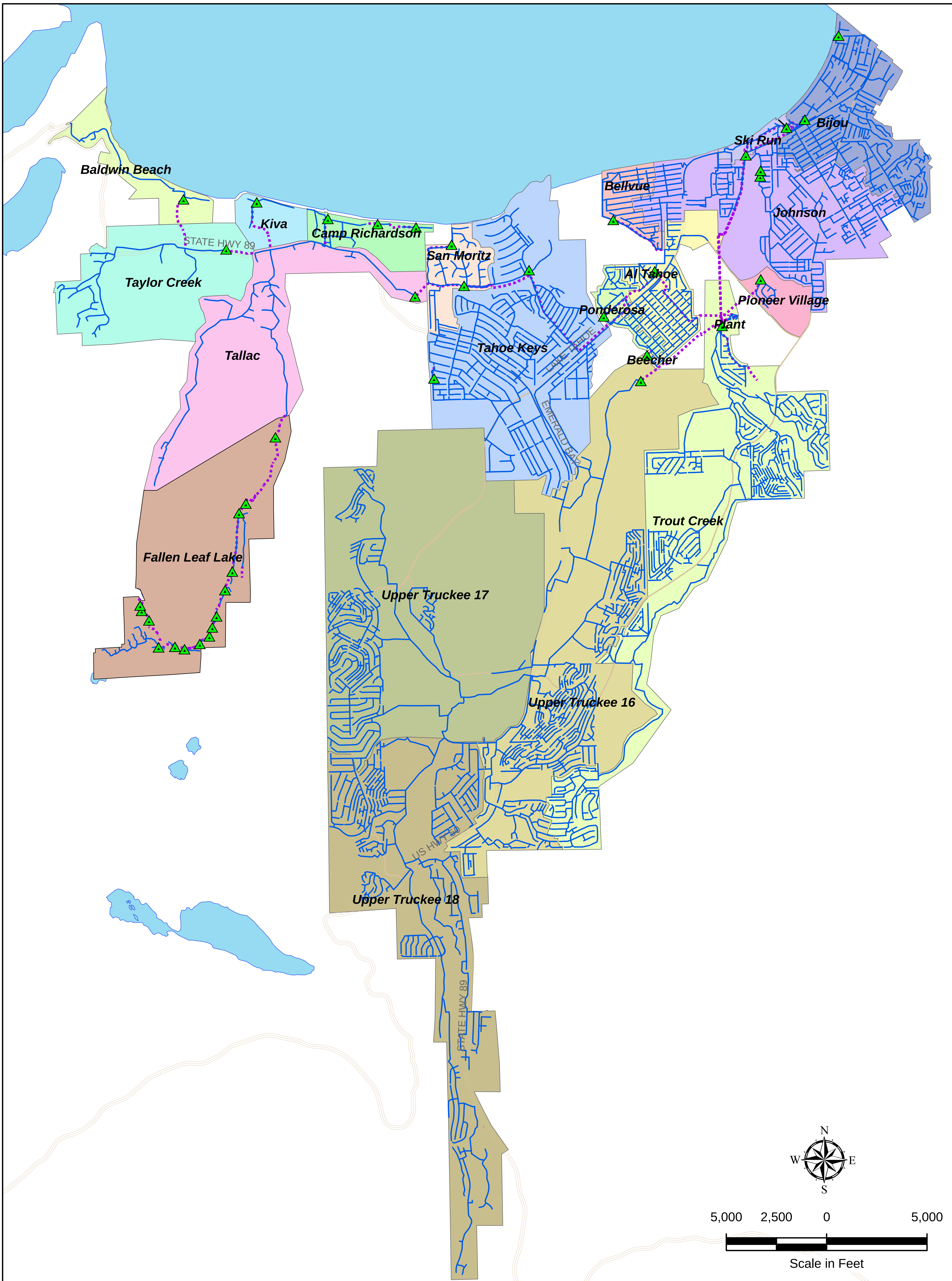
Regulatory Environment. The United States Environmental Protection Agency (USEPA) began drafting Capacity, Management, Operations and Maintenance (CMOM) regulations in the mid-1990s to require owners and operators of publicly owned wastewater collection systems to eliminate SSOs. SSOs occur when wastewater escapes the collection system as a result of blockages or capacity restrictions in the system. The State of California, through its State Water Resources Control Board, has moved forward. The State issued Sewer System Management Plan (SSMP) requirements to achieve the SSO reduction goals of CMOM. Both state and federal regulators have recently taken enforcement actions against collection system agencies in California because of SSOs.

CMOM/SSMP Goals and Components. CMOM and SSMP were developed to help sewer agencies develop and implement a plan to effectively manage a wastewater collection system. This plan will establish goals and present objectives to minimize the number and impact of SSOs, provide sewer capacity to accommodate design storm flows, and maintain and improve the condition of the collection system so the District can continue to provide reliable service.

SSMP. California State Water Resources Control Board (SWRCB) Order No. 2006-003 provides statewide general Waste Discharge Requirements (WDR) for all publicly owned sanitary sewer collection systems in California with more than one mile of sewer pipe. Agencies meeting these criteria must develop a Sewer System Management Plan (SSMP) that includes at least 11 mandatory elements, which are identified in Table 1. The agency's SSMP must be approved by the collection system's governing body. The WDR also requires uniform reporting of all sanitary sewer overflows (SSOs) to a statewide electronic database maintained by the SWRCB. All elements of the SSMP must be in place by specified dates prior to August 1, 2009, for sewer agencies serving populations between 10,000 and 100,000.

Table 1. SSMP Components

Components	Major Goals
1. Goals	Properly manage, operate and maintain all parts of the sanitary sewer system.
2. Organization	Clearly identify the parties responsible for the plan; management, administration and maintenance; and the chain of communication for SSO reporting.
3. Legal Authority	Demonstrate through ordinances, agreements or other legally binding procedures that the agency has the legal authority to: prevent illicit discharges into the sewer system; require that sewers and connections be properly designed and constructed; ensure access for maintenance, inspection and repairs; limit the discharge of fats, oils and grease (FOG); and enforce violation of sewer ordinances.
4. O&M Program	a) Maintain an up-to-date map; b) Regular preventive maintenance activities; c) Develop a prioritized rehabilitation and replacement plan; d) Provide training; e) Provide equipment and replacement part inventories.
5. Design and Performance Provisions	a) Design and construction standards and specifications; b) Procedures and standards for inspecting and testing new sewers.
6. Overflow Emergency Response Plan	a) Proper notification procedures; b) Overflow response program; c) Overflow notification procedures; d) Emergency Response Plan procedures; e) Traffic and crowd control procedures; f) Program to ensure reasonable steps are taken to contain SSO.
7. Fog Control Program	a) Public education and outreach plan; b) FOG disposal plan; c) Legal authority to prevent discharges; d) Grease removal device requirements; e) Authority to inspect grease producing facilities; f) Identification of areas prone to FOG blockages; g) Development and Implementation of FOG source control measures.
8. System Evaluation and Capacity Assurance Plan	a) Evaluation of areas experiencing SSO discharge; b) Develop design criteria; c) Develop a CIP to address identified hydraulic deficiencies; d) Develop a schedule of completion dates.
9. Monitoring, Measurement and Program Modifications	a) Maintain information to establish and prioritize SSMP activities; b) Monitor the implementation and effectiveness of each element; c) Assess the success of the preventive maintenance program; d) Update program elements as necessary; e) Identify and illustrate SSO trends.
10. SSMP Audits	Conduct a program audit at least every two years to evaluate the effectiveness of the SSMP.
11. Communication Program	Communicate on a regular basis with the public on the development, implementation and performance of the SSMP.



SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 1
Master Plan Study Area

BROWN AND CALDWELL

P:\132000\132364_STPUD_MP\GIS\mxd\StudyArea.mxd Dec 22, 2009

BROWN AND CALDWELL

Technical Memorandum

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Prepared for: South Tahoe Public Utility District (District)

Project Title: Wastewater Collection Master Plan

Project No: 132364-002-001

Technical Memorandum No. 1

Subject: Asset Management Introduction and Level of Service (Task 2.1)

Date: December 30, 2009

To: Paul A. Sciuto, Assistant General Manager

From: Peter Bellows, Project Manager
Engineer in Responsible Charge, Ca. Lic. No. C 34337

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Reviewed by: Ken Harlow, Technical Advisor

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1. ASSET MANAGEMENT CONCEPTS FOR THE MASTER PLAN

Asset management is a customer-focused approach providing a defined collection system performance at the lowest life cycle cost. Key asset management questions include:

- What levels of service do our customers need?
- How can we deliver these services at the lowest cost?

This collection system master plan will help the District implement asset management practices and develop a capital improvement program that is asset management driven. There are four aspects of asset management that the master plan will address. They include:

- Levels of Service
- Risk Assessment
- Business Case Evaluations
- Capital Improvement Plan (CIP) Prioritization

A brief introduction to each of these four aspects is provided below. The remainder of this Technical Memorandum (TM) will focus specifically on Levels of Service.

1.1 Levels of Service

A fundamental concept in advanced asset management is defining specific levels of service. Levels of service should relate to the agency's main mission and should be things important to customers or the environment. They are key indicators of how an agency will meet its critical institutional goals.

The service levels that the District establishes as part of this master plan are ultimately supported by the performance indicators and data that are gathered about the collection system on a daily basis. This concept is illustrated on Figure 1-1.

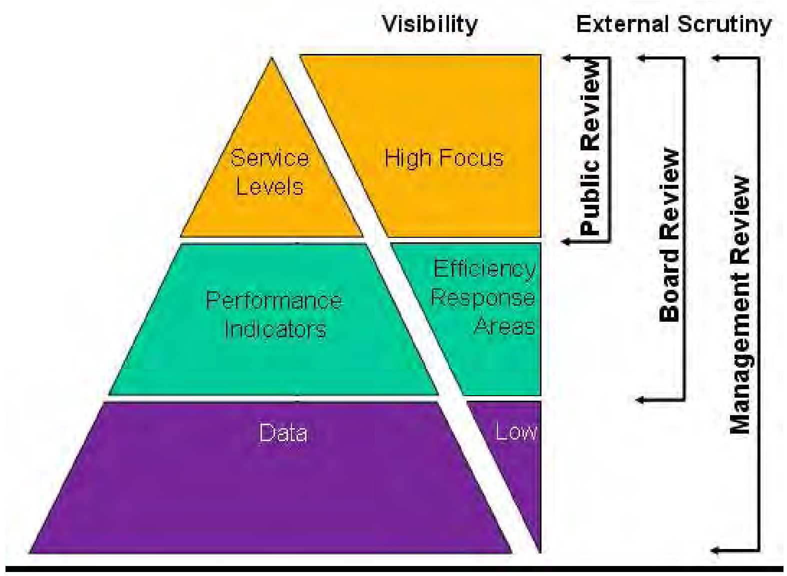

Figure 1-1. Service Levels are supported by Performance Indicators and Underlying Data

For this project, a two-step process is used to develop the District's service levels.

1.1.1 Step 1 – Develop Initial Levels of Service

The first step consists of a workshop with a cross-section of District staff to understand what is important to the District's customers and other stake holders. Initial levels of service can then be identified and used to help guide the hydraulic and condition assessments. It will also be useful to obtain input from the District's elected officials during this process since they are ultimately held responsible for the District's performance by its customers.

1.1.2 Step 2 – Finalize Levels of Service

The next step finalizes the levels of service after enough assessment is performed to determine the costs for meeting the initial levels. This will give the District the opportunity to adjust the levels of service so that they are in line with reasonable rates for the District's customers. This step was performed later in the master planning process, after the hydraulic model and condition assessment tasks were completed.

1.2 Risk Assessment

Risk assessment will be used to identify the District's most critical assets and projects. It is based on separate consideration of likeliness of failure and consequence of failure. Risk may be approached qualitatively, where assets with both high likelihood and high consequence of failure are considered the most "risky," or quantitatively, where consequence expressed in dollars is multiplied by the annual probability of failure to calculate annual risk exposure (also called "risk cost of asset ownership").

In either case, consequences of failure costs need to be comprehensive and include factors such as:

- Social costs (traffic, etc.)
- Image repair costs (Tahoe's pristine environment)
- Legal costs (lost business, claims of damaged homes and other property)

- Fines and penalties (RWQCB, third party lawsuits)
- Injuries to public or District staff

For example, pipes that carry large flows and are difficult to repair because of access problems (e.g. highway or meadow crossings) are likely to have high consequence of failure.

The likelihood of failure is determined during the hydraulic and condition assessment tasks. The hydraulic assessment evaluates growth in the collection system and the increase of flows from new connections and the return frequency of wet weather flows. These factors are used to determine a failure probability due to lack of hydraulic capacity. Failure probabilities related to condition are based on structural condition, operational information, maintenance data, and the reliability assessment. The reliability assessment considers such topics as the obsolescence of equipment that may make obtaining spare parts difficult.

1.3 Business Case Evaluations

Business case evaluations (BCE) incorporate risk as well as social and environmental costs and benefits in the evaluation of project alternatives. The BCE process can be applied equally to improvement and replacement projects. The BCE supports the thorough evaluation of alternatives and helps ensure that the District's money is put to the best use to meet the specified levels of service. For each identified project, the BCE will consider multiple alternatives, always including a "do nothing" alternative. The evaluation will include initial costs plus life-cycle costs, benefits, O&M costs, ongoing rehabilitation and replacement costs, risk costs, and factors such as fines/penalties, emergency repairs, and disruption to the public.

1.4 CIP Prioritization

Finally, these asset management principles are used to prioritize projects within the capital improvement program using a matrix analysis. The resulting capital improvement program is well documented and founded on asset management principles that allow it to easily stand up to scrutiny. The CIP is focused on the most critical situations – those where there is a higher risk of functional failure leading to failure to deliver required service levels. This approach enables the District to maintain a higher level of service by most efficiently using its limited resources.

2. EXISTING LEVEL OF SERVICE CATEGORIES

On June 5, 2007, Brown and Caldwell met with a cross-section of District staff to discuss risk assessment and levels of service with respect to the District's collection system. At that time, the District did not have formal level of service categories for the collection system, though they did have two informal categories that drive the District's management plan.

The primary level of service category that the District used (also its mission statement) was to "furnish our customers with reliable water and wastewater services, and provide these services safely, efficiently, and cost effectively".

The secondary level of service category that the District used was to minimize sewer overflows (SSOs), particularly to sensitive water bodies and their tributaries. These water bodies include Fallen Leaf Lake and Lake Tahoe, which are pristine recreational lakes and sources of drinking water. This level of service category is the primary driver for the District's aggressive Operations and Maintenance program for pipes, manholes and pump stations located in the collection system.

These two level of service categories are supported by performance indicators and data that are collected by the District and maintained in spreadsheets and in the District's Computerized Maintenance Management System (CMMS). Supporting performance indicator data that the District currently tracks include SSOs, sewer footage cleaned each year, and complaint responses.

3. PRELIMINARY LEVEL OF SERVICE CATEGORIES

As the District moves forward, there are other level of service categories (and supporting performance indicators) that they may want to formally adopt and begin tracking. These categories and performance indicators will be helpful as the District develops its Sewer System Management Plan (SSMP) and completes periodic SSMP audits as required by the State's WDR.

Table 1 summarizes the additional level of service categories developed during this master plan that the District may want to consider as they establish a formal asset management program. These categories include:

- Collection system service
- Community health and safety & environment
- Employee health and safety
- Regulatory requirements
- Customer service

With formal level of service categories and performance indicators, the District's CMMS should track and periodically report this indicators. For comparative purposes, published performance data on each of the categories above are included in documents published by Water Environment Research Foundation (WERF) and American Society of Civil Engineers (ASCE).

Table 1. Level of Service Categories

Service Level Category	Service Level		Performance Indicators	Data
	Objective	Quantitative		
Collection System Service	• Proactively maintain the wastewater collection system to minimize service disruptions.	• Number of stoppages per 100 miles of sewer per year shall be less than reported national averages Note: These performance indicators are based on national averages from recent WERF and ASCE collection system studies	• Perform 100% of collection system focused or “enhanced cleaning areas” cleaning on schedule • Perform 100% of grease interceptor inspections on schedule • Perform 80% of collection system cyclic cleaning on schedule • Perform 80% of pump station scheduled maintenance on schedule	• Number of stoppages • Results of stoppage investigations and resolutions • Number of repeat stoppages • Cleaning WO histories • PS WO histories • Grease inspection WO histories
	• Respond quickly and effectively to customer complaints and system failures.	• 80 percent of reported problems or alarms will be responded to within one hour. • 80 percent of problems will have service reinstated within four hours.	• Problem response histories • Alarm response histories	• Complaint logs • SCADA logs
Community Health and Safety & Environment	• Minimize sanitary sewer overflows (SSOs),	• The number of dry weather SSOs per 100 miles of sewer per year shall be less that reported national averages. • Zero wet weather SSOs for storms less frequent than 25-year, 24-hour design rain event	• Number of SSOs • Two levels of redundancy at pump stations (i.e. generator, bypass capability, storage) • Standby pumps at all pump stations.	• SSO reports • Implementation of CIPs • Precipitation data
	• Protect receiving waters (Lake Tahoe, Fallen Leaf Lake) and Stream Environment Zones (SEZ).	• No “beach” closures or SSO notifications in SEZ • Meet SWRCB requirements for bacteriological indicators	• Number of beach closures or SEZ notifications, locations, durations	• Volumes of spills • Water quality sampling reports
	• Protect community from hazards associated with collection system	• No public injuries	• Number of car accidents associated with District • Number of District facility intrusions	• Car accident histories • Other injury histories • No hazardous materials (except fuel)
Employee Health and Safety	• Minimize employee health and safety risks.	• Injury and Illness Incident rate less than industry standard. • 100% compliance with confined space entry procedures	• Injury and Illness Incident rate • Confined space entry permits • Employee safety training. • Safety equipment inventory	
Regulatory Requirements	• Meet the requirements of the Statewide General WDR for Sanitary Sewer Systems (SSMP).	• Complete SSMP according to schedule • Submit SSMP audits as required by the State WDR	• SSMP completion/update dates • SSMP audit dates	
	• Report all overflows as required by State	• Report SSOs within 2 hours per State requirements	• SSO reporting log	• SSO reports
Customer Service	• Provide efficient and timely service to customers	• Respond to connection permits within 7 days		

BROWN AND CALDWELL

Technical Memorandum

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Prepared for: South Tahoe Public Utility District (District)

Project Title: Wastewater Collection Master Plan

Project No: 132364-002-002

Technical Memorandum No. 2

Subject: Asset Management – Risk Assessment Procedures (Task 2.2) and Criticality (Task 4.1)

Date: December 30, 2009

To: Paul A. Sciuto, Assistant General Manager

From: Peter Bellows, Project Manager
Engineer in Responsible Charge, Ca. Lic. No. C 34337

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Reviewed by: Ken Harlow, Technical Advisor

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1. INTRODUCTION

Risk assessment is a procedure that assesses the District's assets in terms of the risk they pose to the provision of required service levels. The assessment is being conducted as part of this master plan to help the District prioritize the capital improvement projects identified during the course of this project. Risk assessment considers both the likeliness of failure and consequence of failure. Risk can be expressed quantitatively in terms of dollars or qualitatively in terms of relative risk. Consequences of failure need to be comprehensive and should include items such as:

- Social costs (traffic, etc.)
- Image repair costs (Tahoe's pristine environment)
- Legal costs (lost business, claims of damaged homes and other property)
- Fines and penalties (RWQCB, third party lawsuits)
- Injuries to public or District staff

On June 5, 2007, Brown and Caldwell met with a cross-section of District staff to discuss the District's collection system assets in terms of risk. The risk assessment discussion was organized into the following topics:

- Grouping assets according to the probability of failure and the consequence of failure.
- Identifying common asset failure mechanisms.
- Identifying consequences of failure.
- Identifying preliminary approaches to determine frequencies of failure.

Information gathered at this workshop serves as the basis for this TM.

2. GROUPING COLLECTION SYSTEM ASSETS

The first step in identifying the District's highest-risk assets (those that have a higher risk of failure and consequence of failure) is grouping the collection system assets. This grouping process started by dividing the collection system assets in four "broad" asset categories called the Primary Asset Class. For the District, the Primary Asset Class includes gravity pipes, manholes, pump stations and force mains.

The next step is identifying the Key Asset Attributes. The Key Asset Attributes are much more detailed and includes items such as pipe material, age and location or whether a pump station has bypass pumping capability.

Based on information gathered at the Risk Assessment workshop, Table 1 summarizes the District's collection system assets.

Table 1. Collection System Primary Asset Classes

Gravity Pipes	Gravity Manholes	Pump Stations	Force Mains
• Age • Capacity • Design Flow • Diameter • Location • Material • Condition	• Age • Location • Material • Condition	• Age • Alarm • Bypass Capability • Capacity • Design Flow • Electrical • Generator • Location • Motor • Condition	• Age • ARV/AVV • Capacity • Design Flow • Redundancy • Location • Material • Condition

3. DETERMINE FAILURE MECHANISMS FOR EACH PRIMARY ASSET CLASS

Once Primary Asset Classes were established, the potential failure mechanisms were determined for each class. These failure mechanisms were identified at the workshop as common asset failure mechanisms within the District. Some additional common failure mechanisms have been added by the consultant, even if the District is not currently experiencing these types of problems. These failure mechanisms are listed below in Table 2. The consequences would lead to either a sanitary sewer overflow (SSO) or an injury.

Table 2. Primary Asset Class Failure Mechanisms

Gravity Pipes	Gravity Manholes	Pump Stations	Force Mains
• Corrosion • Cracks (structural failure) • Root blockage • Root blockage from service lateral • Grease blockage • Washout due to stream scour action • Under-capacity • Construction failure • Infiltration/Inflow	• Corrosion • Washout due to stream scour action • Infiltration/Inflow	• Impeller clog • Pump equipment failure • Motor equipment failure • Electrical equipment failure • Power failure • Under-capacity • Wet well corrosion • Dangerous working environment • SCADA system limitations • Hazards to public	• Corrosion at air pockets • Washout due to stream scour action • Leaking ARV/AVV • Under-capacity

4. IDENTIFY CONSEQUENCES OF FAILURES

Lastly, consequences of failure for were identified for all of the Primary Asset Classes as a whole because there is often overlap. These consequences of failure were identified at the workshop as common or potential consequences failure within the District:

- Low volume Sanitary Sewer Overflow (SSO)
- High volume SSO
- SSO to Environmentally Sensitive Area (water quality impact, impact on other environmentally sensitive areas, regulatory actions and lawsuits)
- Impact to public health
- Service disruption
- Traffic impact (State Highway or Stateline area)
- Injury

5. APPROACHES FOR DETERMINING LIKELIHOOD OF FAILURE

The second key component to the risk assessment is determining the likelihood (probability) of failure. These approaches for evaluating likelihood of failure will be determined during the hydraulic and condition assessment tasks. The hydraulic assessment will evaluate growth in the collection system and the increase of flows from new connections and the return frequency of wet weather flows. These factors can be used to determine a failure probability arising from potential lack of hydraulic capacity. Failure probabilities related to condition will be determined based on structural condition, operational information, maintenance data, and the reliability assessment. The reliability assessment will consider such topics as standby generators to power pump stations during an electrical power failure.

The District did not have a formal condition assessment program for pipes and manholes. For the master plan, NASSCO PACP codes were used to evaluate existing CCTV inspection data.

A pump station condition assessment task is included in this master plan. Recommended pump station improvements will be included in the prioritized capital improvement program.

Technical Memorandum

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Prepared for:	South Tahoe Public Utility District (District)
Project Title:	Wastewater Collection Master Plan
Project No:	132364-004-003

Technical Memorandum No. 3

Subject:	Pump Station Condition Assessment (Task 4.3)
Date:	December 30, 2009
To:	Paul A. Sciuto, Assistant General Manager
From:	Peter Bellows Engineer in Responsible Charge, CA Lic. No. C34337
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Reviewed by:	Christopher Peters, Project Engineer California License No. C 69669

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1. INTRODUCTION

The pump station condition assessments described in this technical memorandum (TM) are part of the South Tahoe Public Utilities District (STPUD or District) Wastewater Collection System Master Plan. A six step process was used to complete the assessments. The steps used for this assessment are as follows:

1. Pump Station Inventory – Pump stations inventory forms were completed by the District.
2. Pump Station Maintenance Histories – A sample of pump station maintenance log books were reviewed by Brown and Caldwell (BC).
3. Select Pump Stations for Inspection – A pump station criticality analysis was completed by BC to select the pump stations for field inspection. The District also identified pump stations for field inspection and the two sets of pump stations were consolidated.
4. Pump Station Condition Assessment Procedures – A field form and procedures for recording field observations was developed.
5. Pump Station Field Observations – BC performed field inspections of the pump stations including pump stations with dry wells designated as permitted confined spaces. Observations were captured on the field forms and photographs.
6. Pump Station Condition Assessment Ratings – Results of the field investigations were evaluated and condition assessment ratings were developed for each inspected pump station. Other observations from the field investigations were also noted.

The information from this TM, along with the collection system hydraulic analysis that is in the process of being completed, will be used in subsequent TMs to complete the risk assessment on the pump stations and develop specific capital improvement projects. The pump station final risk assessment and development of the capital improvement projects cannot be completed until the collection system hydraulic model and capacity analysis is completed.

2. PUMP STATION BACKGROUND INFORMATION

Background information on the pump stations was developed from information obtained from Pump Station Inventory Forms completed by the District on 35 pump stations and the Stanford Generating Station. Pump Station Inventory Forms were not completed on the District's six vacuum valve stations that are located at Fallen Leaf Lake. The District has one additional pump station, Luther Pass Pump Station, which was not included in the condition assessment because there was a comprehensive evaluation performed on this pump station in 2006. In addition, information on the pump station maintenance history was obtained by reviewing log book entries. The following section provides background information on the pump stations.

2.1 Background

The District has 42 pump station facilities located throughout the South Lake Tahoe area where raw sewage spills can occur. This includes the Fallen Leaf Lake collection system with the Main Pump Station, Stanford Generating Station, vacuum valve stations, and electric stations. Figure 2-1 shows the locations of the pump stations, which is based on information from the District's Geographic Information System (GIS) and Fallen Leaf Lake Sewerage System Modification drawings.

Table 2-1 summarizes inventory information for each pump station. This table was developed from the inventory forms completed by the District. A sample Pump Station Inventory Form is included as Attachment A. The completed Pump Station Inventory Forms for each pump station are provided in a separate attachment entitled STPUD Pump Station Inspection Information. Inventory forms were not completed for the vacuum valve stations. However, the original drawings for the Fallen Leaf Lake area were used to complete information on the vacuum valve stations, including piping diameter and length, where available. Along with providing information for Table 2-1, the inventory forms were used in the criticality and condition assessments discussed later in this TM.

During the inventory information gathering, the District identified a number of pump stations that have undergone some type of rehabilitation since the station was originally constructed. Rehabilitation projects typically consisted of replacing or rebuilding pumps and/or motors, converting air ejector stations to electric stations, or coating wet wells. The specific date of each rehabilitation project is provided in Attachment C.

As shown in Table 2-1, the oldest pump station is the Bijou Pump Station and it was constructed in 1955. Eighteen pump stations were constructed in the 1960s or early 1970s. The Fallen Leaf Lake pumping stations and vacuum valves were constructed around 1980. The capacity of the District's pump stations range from less than 100 gallons per minute (gpm) to 3,000 gpm.

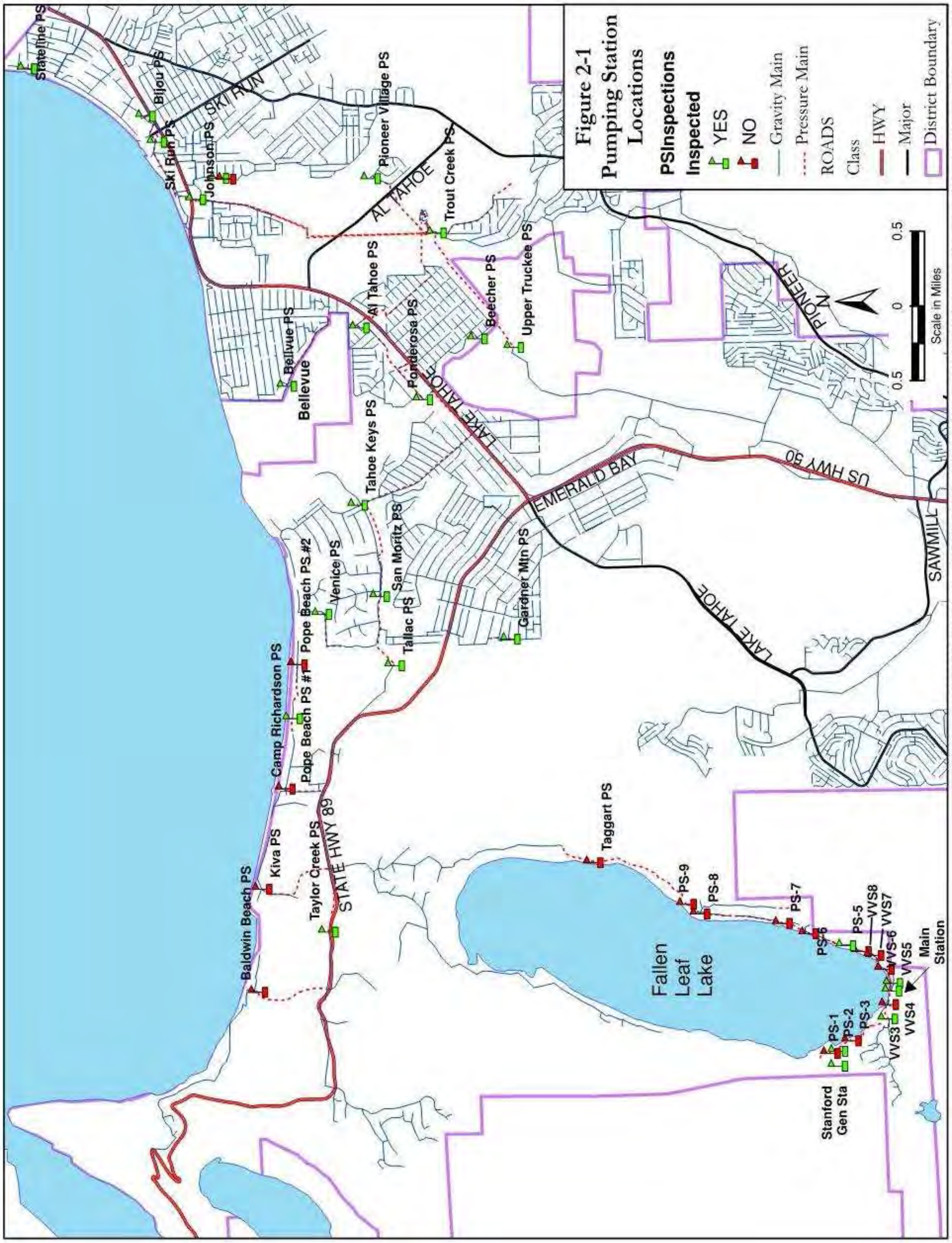

Figure 2-1. Pump Station Locations

Table 2-1. Pump Station Inventory Information

Pump Station Name	Year Built	Year Rehab	Capacity, gpm			Pump Station Type
			Pump #1	Pump #2	Pump #3	
Al Tahoe	1960	1997	3820	3820	3820	Large Submersible
Baldwin Beach	1968	1971	400	400	N/A	Dry Well (Ladder Access)
Beecher	1960	2007	100	100	N/A	Small Submersible
Bellevue	1960	N/A	900	900	N/A	Dry Well (Ladder Access)
Bijou	1955	2000	1600	1800	1800	Dry Well (Ladder Access)
Camp Richardson	1968	N/A	800	800	N/A	Dry Well (Spiral Staircase)
ES-1 Fallen Leaf System	1979	1992	85	85	N/A	Small Submersible
ES-2 Fallen Leaf System	1983	1992	85	85	N/A	Small Submersible
ES-3 Fallen Leaf System	1979	1992	85	85	N/A	Small Submersible
ES-5 Fallen Leaf System	1983	1992	92	92	N/A	Small Submersible
ES-6 Fallen Leaf System	1979	1992	90	N/A	N/A	Small Submersible
ES-7 Fallen Leaf System	1979	1992	85	N/A	N/A	Small Submersible
ES-8 Fallen Leaf System	1979	1992	90	90	N/A	Small Submersible
ES-9 Fallen Leaf System	1979	1992	90	N/A	N/A	Small Submersible
Fairway #1	1995	N/A	80	80	N/A	Small Submersible
Fairway #2	1995	N/A	80	80	N/A	Small Submersible
Flanders	1983	N/A	22	N/A	N/A	Small Submersible
Gardner Mountain	2004	N/A	85	85	N/A	Small Submersible
Johnson	1972	N/A	1750	1750	1500	Dry Well (Ladder Access)
Kiva	1968	N/A	210	210	N/A	Dry Well (Spiral Staircase)
Main Station (Fallen Leaf Lake)	1983	1992	180	180	N/A	Dry Well (Ladder Access)
Pioneer Village	1966	N/A	325	325	N/A	Dry Well (Ladder Access)
Ponderosa	1997	N/A	300	300	N/A	Large Submersible
Pope Beach #1	1973	N/A	100	100	N/A	Dry Well (Ladder Access)
Pope Beach #2	1973	N/A	100+	80+	N/A	Dry Well (Ladder Access)
San Moritz	1966	N/A	900	900	N/A	Dry Well (Ladder Access)
Ski Run	1997	N/A	1025	1045	N/A	Large Submersible
Stateline	1971	1997	80	80	N/A	Small Submersible
Taggart	1979	N/A	N/A	N/A	N/A	Small Submersible
Tahoe Keys	1960	2007	2500	2500	N/A	Dry Well (Spiral Staircase)
Tallac	1968	N/A	2000	2000	N/A	Dry Well (Spiral Staircase)
Taylor Creek	1968	N/A	2100	2100	N/A	Dry Well (Ladder Access)
Trout Creek	1967	N/A	1800	1800	N/A	Dry Well (Ladder Access)
Upper Truckee	1967	N/A	2800	2800	1950	Dry Well (Spiral Staircase)
Venice	1971	N/A	120	120	N/A	Dry Well (Ladder Access)
Vacuum Valve Stations (6 Total)	1979	N/A	N/A			Vacuum Valves

2.2 Pump Station Logs

The District keeps maintenance records in log books located at each pump station. Log book entries chronicle visits by District personnel to the pump stations, whether for routine operation and maintenance checks or in response to service alarms. The District provided BC with 19 log books for review. The log books were reviewed to understand the types of information recorded and the types of problems that occur at the pump stations. The District does not enter this information into its Hansen computerized maintenance management system (CMMS). Also, Supervisory Control and Data Acquisition (SCADA) alarm history in electronic format was not available.

The analysis of the log book information focused on unusual pump station events, usually entered in red ink, such as non-scheduled maintenance procedures, power outages, warning alarms, and electrical or mechanical problems. These events were transcribed into a condensed log to give a general idea of pump station performance. Records were analyzed for the last five years or from the point when the log books began, whichever was most recent, through early September 2007. A summary of the log book red ink entries is provided in a separate attachment titled STPUD Pump Station Inspection Information.

The analysis of pump station logs indicates the following common problems and activities:

- Mechanical:
  - Pump impeller ragging
  - Back flushing of pumps
  - Pump air locking
  - Pump seals leaking
  - Grease accumulation in wet well
  - Check valve slamming
  - Check valve cleaning
  - Pump replacement
  - Sump pump failure
- Electrical and control:
  - Control system problems including variable speed drives
  - Motor failures
  - Power failures
  - SCADA system communication failures
  - Blown fuses and circuit breakers tripping
  - Control voltage failure
  - Removal of rags from bubbler tubes
  - Power surges from power supply
- Standby generator:
  - Generator failure to start
  - Generator not transferring back to main power
- Odor control:
  - Replaced carbon
  - Replaced belts on odor control fan
  - Odor complaints

3. PUMP STATION INSPECTION PROGRAM DEVELOPMENT

This section discusses the inspection program developed to complete the condition assessment of the pump stations. The inspection program was completed in two steps. The first step was completing a criticality assessment to identify pump stations for inspection. The second step was developing the inspection procedures used for the condition assessments.

3.1 Pump Station Criticality Analysis

The District and BC independently identified pump stations for inspection. Table 3-1 lists each pump station. Included in the table are the pump stations identified by the District and BC for inspection. The BC list was developed through a criticality analysis. The criticality analysis was based on likeliness and consequence of a failure occurring. A failure was assumed to result in a Sanitary Sewer Overflow (SSO) that causes untreated wastewater to overflow from the collection system.

The likeliness of a failure was based on the maintenance history of the pump stations. The maintenance history was determined by reviewing the entries in the maintenance log books. Seven pump stations require frequent maintenance. A high rate of maintenance was defined has re-occurring maintenance problems or a relative high number of log book entries relative to the other pumps stations. The most prevalent problems at these pump stations were ragging of pumps, air locking of pumps, frequent variable frequency drive (VFD) faults, and ragging of check valves. Five pump stations were identified as having a moderate rate of maintenance relative to the other pump stations and seven pump stations were identified as having a low rate of maintenance relative to the other pump stations. Maintenance log books were not available or provided for the District's remaining pump stations.

The consequence of a potential failure resulting in an SSO is based on two factors:

- location of the pump station relative to bodies of water (lakes), Stream Environment Zones (SEZ) or water supplies
- Hydraulic capacity of the pump station

Consequences of failure criteria are presented in TM 2, Risk Assessment Procedures, and were discussed with the District at a review meeting on January 24, 2008. The pump station hydraulic capacity is relevant to this analysis because pump stations with large hydraulic capacities likely have flows that could result in more significant impacts from an SSO than small pump stations.

For the criticality analysis, BC prioritized the pump stations into Priority Categories 1, 2, and 3 with 1 being the highest priority. Pump stations were prioritized using the following criteria:

Priority 1: High hydraulic capacity (Big 6 as defined by the District based on flow) or high maintenance

Priority 2: Critical location or moderate maintenance required

Priority 3: All other pump stations

Table 3-1 lists the pump stations and BC's priority categories. Twenty pump stations received a Priority Rating of 1 or 2.

Table 3-1. Pump Station Site Visit Selection Criteria										
Pump Station Name	Year Built	BC Identified Priority	District Selection	Selected for Field Assessment	High Hydraulic Capacity	Critical Location or Seasonal Use		Maintenance		
						Lake/SEZ	H_2O Supply	High	Moderate	Low
Al Tahoe (Big 6)	1960	Priority 1	X	X	X			X		
Baldwin Beach	1968	Priority 2				X				
Beecher	1960	Priority 1		X		X		X		
Bellevue	1960	Priority 2	X	X		X			X	
Bijou (Big 6)	1955	Priority 1	X	X	X			X		
Camp Richardson	1968	Priority 2				X				X
ES-1 Fallen Leaf System	1979	Priority 3					X			
ES-2 Fallen Leaf System	1983	Priority 3	X	X			X			
ES-3 Fallen Leaf System	1979	Priority 3					X			
ES-5 Fallen Leaf System	1983	Priority 3		X			X			
ES-6 Fallen Leaf System	1979	Priority 3					X			
ES-7 Fallen Leaf System	1979	Priority 3					X			
ES-8 Fallen Leaf System	1979	Priority 3					X			
ES-9 Fallen Leaf System	1979	Priority 3					X			
Fairway #1	1995	Priority 3	X	X						
Fairway #2	1995	Priority 3								
Flanders	1983	Priority 3	X							
Gardner Mountain	2004	Priority 3	X	X						X
Johnson (Big 6)	1972	Priority 1	X	X	X			X		
Kiva	1968	Priority 2				X				X
Luther Pass	1995	Priority 3								
Main Station (Fallen Leaf)	1983	Priority 1	X	X			X	X		
Pioneer Village	1966	Priority 3	X	X						X
Ponderosa	1997	Priority 2	X	X		X			X	
Pope Beach #1	1973	Priority 2	X	X		X				
Pope Beach #2	1973	Priority 2				X				
San Moritz	1966	Priority 2	X	X		X			X	
Ski Run	1997	Priority 3	X	X						X
Stateline	1971	Priority 2		X			X			
Taggart	1979	Priority 3	X				X			
Tahoe Keys (Big 6)	1960	Priority 1	X	X	X	X			X	
Tallac	1968	Priority 1	X	X		X				X
Taylor Creek	1968	Priority 1		X		X				X
Trout Creek (Big 6)	1967	Priority 1	X	X	X	X		X		
Upper Truckee (Big 6)	1967	Priority 1	X	X	X	X			X	
Venice	1971	Priority 2	X	X		X		X		
Stanford Generator Station	1992	Priority 3		X						
VVS-#3	1983	Priority 3		X			X			

Table 3-1. Pump Station Site Visit Selection Criteria

Pump Station Name	Year Built	BC Identified Priority	District Selection	Selected for Field Assessment	High Hydraulic Capacity	Critical Location or Seasonal Use		Maintenance		
						Lake/SEZ	H_2O Supply	High	Moderate	Low
VVS-#4	1983	Priority 3					X			
VVS-#5	1983	Priority 3		X			X			
VVS-#6	1983	Priority 3					X			
VVS-#7	1983	Priority 3					X			
VVS-#8	1983	Priority 3					X			

The District independently developed a list of 20 pump stations for inspection based on their understanding of the pump stations and desire for inspection. The District's list of pump stations is also contained in Table 3-1. Thirteen of the District's 20 pump stations appeared within BC's Priority Category 1 or 2. The District and BC jointly decided on the pump stations to complete a condition assessment, which is also shown in Table 3-1.

The scope of work required condition assessments to be performed on 20 pump stations. BC ultimately visited 22 sites because the schedule allowed for extra site visits. Two vacuum valve stations and the Stanford generating station were also visited.

3.2 Pump Station Inspection Procedures

Inspection forms and procedures were developed by BC prior to the inspection program. The inspection forms were submitted to the District for review and comment prior to the inspections.

3.2.1 Condition Assessment Forms

Condition assessment forms were developed to capture specific information on the physical condition and reliability of the pump stations designated for inspection. The condition assessment forms are based on condition assessment forms used on other BC projects and customized to capture specific information needed for this project. A sample of the Pump Station Condition Assessment Form is included as Attachment B. Data collected on the forms is supplemented by photographs taken by the inspection team. Forcemains were not included in this evaluation but will be included in the Pipeline Condition Assessment Technical Memorandum.

Condition and reliability data collected on the forms is grouped into the following categories:

Inventory Confirmation. Basic information provided by the District on the pump station inventory forms was confirmed during the site visits and included the following items:

- Number of pumps
- Standby power
- Pump controls
- Other equipment such as odor control facilities, hoists, flow meter, etc.

Site Condition. Site conditions included the following items:

- Access
- Turf/landscaping maintenance
- Future expansion

Structural Condition. Deteriorated structural condition can lead to staff injuries or SSOs if the pump station fails. Structural conditions were completed visually and included the following items:

- Dry/wet well corrosion
- Building condition including walls, finish, roof, doors, windows, etc.
- Metal corrosion
- Equipment layout (e.g., sufficient working space)

Pumping System. The pumping system was observed to identify specific reliability problems. It should be noted that the pumping system operation was observed under the conditions occurring at the time of the inspection (dry weather flow) and could significantly vary under peak wet weather flow conditions. District staff provided additional information about previous operational problems. The following pumping system components were part of the assessment:

- Pump operation including vibration, cavitation, bearing noise, and motor temperature (assessment of these items was based on conversations with District staff, physical measurements were not performed)
- Pump suction and discharge piping and valves

Standby Generators. Generators are one of the primary sources of redundancy in a pump station. The following components of the generator system were part of the condition assessment:

- Generator size
- Fuel tank storage and spill containment
- Portable generator connections
- Automatic transfer switch

Electrical System. Electrical systems include power systems and control systems. These systems can become antiquated and obsolete sooner than other equipment at a pump station. These systems can become difficult to maintain and find spare parts, which increases the risk of a failure. Observations of the electrical system were made by visual inspection and discussion with District maintenance and electrical staff. An operational assessment of the electrical power and control systems was not performed. The following electrical components were part of the condition assessment:

- Motor control center (MCC) (Power)
- Lighting (Power)
- Controls (Control)
- Alarms and sensors (Control)

Other mechanical systems. These systems do not generally lead to a direct SSO. However, the condition of these systems will factor into the overall assessment in determining if a pump station is part of a capital improvement project. The following components were part of the condition assessment.

- Heating, ventilation, and cooling (HVAC)
- Odor control facilities
- Auxiliary equipment such as hoists and bar screens

The condition assessment forms have a condition and functional system rating for each group. The ratings are from one to five. A general definition of the ratings is as follows:

Rating 1 - Structure or equipment integrity severely compromised by corrosion and wear or systems are unreliable. Possible imminent failure. Structure or equipment is not currently functioning for its intended use.

Rating 2 - Structure or equipment integrity is compromised. Structure or equipment is in service but function or reliability is compromised.

Rating 3 - Visible degradation of equipment or structure. Structure or equipment is in service but maintenance or operational requirements are excessive.

Rating 4 - Well maintained, like-new condition of equipment or structure. Structure or equipment functions as intended.

Rating 5 - New or nearly-new structure or equipment. Structure or equipment functions better than other similar structures or equipment

3.2.2 Condition Assessment Procedures

Condition and reliability assessments were performed by a two-person BC crew with assistance from District maintenance staff. The BC team included an electrical engineer and a civil/mechanical engineer. Initial pump station condition assessments occurred on October 30 and 31, 2007 when 22 pump stations, two vacuum valve stations, and the Stanford Generating Station were visited. The initial assessments did not include the District's electrical staff; therefore, additional assessments that focused on electrical equipment were performed by BC's electrical engineer with the District electrical staff on November 28, 2007. A condition assessment form was completed for each pump station and photos were taken to document the condition of each pump station.

The condition assessments focused on obtaining the information needed to complete the condition assessment forms and determine the overall condition of the pump stations. Consequently, performance testing of the pump station systems including electrical control and SCADA systems, emergency generators, sump pumps, seal water systems, flow meters and odor control systems was not included. Similarly, the pumps were not tested for vibration or bearing problems. These systems are either in on-going operation or operated/tested as part of the regular operations and maintenance program. For example, emergency generator testing and exercising is a part of the District's operation and maintenance program. Issues related to the performance of these systems were provided by District staff. Also, as noted above, log books were reviewed for a number of pump stations to identify continuing or special problems with these systems that may require a capital improvement project to address.

The wet well walls were visually observed during the site visits. The wet wells for Fairway #1, Trout Creek, and Venice were probed for soft concrete and other indications of corrosion such as metal corrosion during the initial visits on October 30 and 31. Generally, the concrete is in good condition; and therefore, the other pump stations were not probed. The dry wells at eight of the pump stations visited are designated as permitted confined spaces. These dry wells were not inspected during the initial round of visits because permitted confined space inspections require specially trained personnel and increase the time of the assessments. Instead, BC performed subsequent inspections of these dry wells on March 10 and 11, 2008.

4. PUMP STATION CONDITION ASSESSMENT

This section presents the results and observations from the condition assessment. A mechanical, structural, and electrical condition assessment was performed on 22 pump stations, the Stanford Generating Station, and the two vacuum valve stations. Based on the information observed, Pump Station Conditions Assessment Forms were completed. The completed Pump Station Condition Assessment Forms are provided in a separate attachment titled STPUD Pump Station Inspection Information.

4.1 Condition Assessment Results

This section discusses the results of the pump station inspections and condition assessment. The District has several different types of pump stations. To help organize the information and make it more presentable, this section places the pump stations into five general categories:

- Small submersible pump stations (small submersible pump stations are defined as pump stations with a hydraulic capacity less than 100 gpm)
- Large submersible pump stations (large submersible pump stations are defined as pump stations with a hydraulic capacity greater than 100 gpm)
- Pump stations with ladder access into dry well
- Pump stations with spiral staircase access into dry well
- Fallen Leaf Lake system

The inspections and results are based on the inspection forms discussed above. Other observations made during the inspections are also noted and included in Attachment C. Based on the condition assessments, a numerical rating from 1 to 5 was given to each category on the condition assessment form. The basis for the numerical ratings is provided in Section 3. The ratings for each category are summarized in Table 4-1. Following Table 4-1 is an explanation of the rating determination for each category. Also included in the table are two categories, redundancy and maintenance, that are not specifically identified on the condition assessment forms. The rating determination for these two categories is also provided following Table 4-1.

STPUD Pump Station Condition Assessment Summary
1 = Imminent failure/unreliable
2 = Compromised condition/reliability
3 = Visible degradation
4 = Well maintained
5 = New condition

Table 4-1. Condition Assessment Criteria

Pump Station	Site	Structural	Pumps and Piping	Standby Power	Electrical Power	Control System	HVAC	Odor Control	Auxiliary Equipment	Redundancy	Maintenance
Small Submersible Pump Stations											
Beecher	4	3	5	NA	2	4	NA	NA	NA	3	2
Fairway #1	4	4	4	NA	3	4	NA	NA	NA	3	3
State Line	4	4	4	NA	4	4	NA	NA	NA	3	3
Large Submersible Pump Stations											
Al Tahoe	4	3	3	4	3	4	4	4	NA	5	2
Gardner Mountain	4	4	4	4	4	4	4	NA	NA	4	4
Ponderosa	4	4	4	4	4	4	4	4	NA	4	3
Ski Run	4	4	4	4	3	4	2	NA	NA	5	4
Pump Stations with Ladder Access into Dry Well											
Bellevue	3	3	4	4	3	4	4	NA	3	5	2
Bijou	4	2	3	3	3	4	4	4	4	5	2
Johnson	4	3	4	4	3	4	4	NA	4	5	2
Pioneer Village	4	3	4	4	3	4	4	NA	NA	4	2
Pope Beach #1	3	4	4	NA	2	4	NA	NA	NA	2	3
San Moritz	4	3	4	4	2	4	4	NA	NA	4	3
Taylor Creek	4	3	4	4	4	4	3	NA	NA	5	4
Trout Creek	4	3	3	4	4	4	4	NA	4	5	2
Venice	4	4	3	4	3	4	4	NA	NA	5	2
Pump Stations with Spiral Staircase Access into Dry Well											
Tahoe Keys	4	3	4	4	4	4	4	3	3	5	3
Tallac	3	3	4	4	4	4	4	NA	NA	5	4
Upper Truckee	3	3	4	4	4	4	3	NA	4	5	3

Pump Station	Site	Structural	Pumps and Piping	Standby Power	Electrical Power	Control System	HVAC	Odor Control	Auxiliary Equipment	Redundancy	Maintenance
Fallen Leaf Lake System											
ES-2 (Small Submersible)	2	4	4	4	3	4	NA	NA	NA	4	3
Vacuum Valve Station 3	2	4	3	NA	NA	NA	NA	4	NA	1	2
ES-5 (Small Submersible)	2	4	4	NA	3	4	NA	NA	NA	3	3
Main Station (Ladder Access)	2	3	3	4	3	4	4	4	NA	4	2
Vacuum Valve Station 5	2	4	3	NA	NA	NA	NA	NA	NA	1	2
Stanford Generating Station	2	4	NA	4	NA	NA	NA	NA	NA	NA	3

Table 4-1. Condition Assessment Criteria

Cells that have a rating of NA (Not Applicable) mean that this condition assessment category was not part of that pump station.

Site. The site category for the Fallen Leaf Lake system was given a rating of 2 because of the severe accessibility issues related to one single-lane road that provides access to District crews as well as all residents and visitors. Also, access is more difficult in the winter because the road is not regularly plowed. Site conditions at the other pump stations are not problematic, and therefore, the other pump stations were given a rating of 3 or 4.

Structural. The District's pump stations are generally in good structural condition. However, age can be an indication of additional risk for structural issues because as facilities age unknown or unseen conditions such as corrosion or settlement can occur. For this evaluation, pump stations 50 years and older were automatically given a rating of 2, pump stations 40 to 50 years old were automatically given a rating of 3, and pump stations less than 40 years old were given a rating of 4.

Pumps and Piping. The ratings for this category were 3 and 4 for all pump stations. No significant problems were observed with the pumps and piping systems.

Standby Power. The ratings for standby power systems were 3 or 4 for all pump stations. The District's standby generators are in good condition.

Electrical Power. The Beecher and Pope Beach #1 Pump Stations have outdoor electric panels that are in poor condition and were given a rating of 2. The motor starters at San Moritz Pump Station are in poor condition; therefore, this pump station was given a rating of 2 for this category.

Control System. The control systems were given a rating of 4 for all the pump stations. Even though the District's control system are not sophisticated, the control systems are generally well maintained.

HVAC. HVAC systems are in good physical condition and were given a rating of 4 with the exception of Ski Run, Taylor Creek, and Upper Truckee Pump Stations. The Ski Run Pump Station heater is not functioning; and therefore was given a rating of 2. The Taylor Creek and Upper Truckee Pump Stations were given a rating of 3.

Odor Control. The Tahoe Keys Pump Station has odor control facilities but this pump station was given a rating of 3 because of odor complaints. The other pump stations with odor control were given a rating of 4 because the systems are in good working condition.

Auxiliary Equipment. Auxiliary equipment consists of hoists, which are generally in good condition; and therefore, were given a rating of 3 or 4 for those pumps stations with auxiliary equipment.

Redundancy. The District's goal is to provide several levels of redundancy at each of the pump stations to prevent SSOs. The redundancy of each facility was evaluated using information from the pump station inventories and site visits. The District has many options for redundancy including the following:

- Standby pump
- Standby power (generators) with several days of fuel storage
- Bypass pump connections for portable pump (stored at Al Tahoe Pump Station)
- Color coded quick plug-in connections for portable generator (stored at Ponderosa Pump Station)
- Onsite storage and collection system storage or ability to overflow to a gravity system
- Backwater valves at resident's homes that are located below the hydraulic grade line
- Spare parts readily available and often located at the site

The ratings for redundancy were based on the following criteria:

Rating 1 - Pump stations with no standby pump and no sump pump in the dry well

Rating 2 - Pump stations with a standby pump, portable pump or portable generator connection, and sump pump in dry well

Rating 3 - Pump stations with a standby pump, portable pump or portable generator connection, sump pump in dry well, and onsite storage or collection system storage or gravity overflow

Rating 4 - Pump stations with an onsite standby generator, standby pump, and sump pump in the dry well

Rating 5 - Pump stations with an onsite standby generator, standby pump, sump pump in the dry well, and another level of redundancy

Maintenance. The ratings for the maintenance categories were based on the review of the pump station log books, discussions with District staff, and observations during site visits. The overall maintenance rating listed in Table 4-1 is based on the lowest rating for the following criteria:

Maintenance record (pump stations that did not have a log book were rated based on the condition assessment site visits):

- High level maintenance pump stations were given a rating of 2.
- Moderate or average level maintenance pump stations were given a rating of 3.
- Low level maintenance pump stations were given a rating of 4.

Dry wells that are permitted confined spaces require extra personnel and time for operation and maintenance activities; therefore, they were given a rating of 3.

Dry wells that are in metal cans and have ladder access are especially difficult to maintain; therefore, they were given a rating of 2.

4.2 Other Observations

Other observations were made during the condition assessments that do not necessarily fall within the analysis presented above. These observations are summarized in the following sections. It should be noted that not all of District's pump stations were visited. The comments provided in these sections may or may not apply to all of the same type of pump stations but are given to provide a list of possible capital improvement projects or maintenance projects. Subsequent TMs will determine whether these recommendations are capital improvement projects or if they become maintenance projects completed by District staff.

4.2.1 General

This section presents a summary of the pump station observations for the condition assessment. Overall, the District has made a significant effort to prevent overflows in the system and no pump related overflows have occurred in the last five years. There are good reasons why no overflows have occurred. The District's pump stations are well maintained and clean and the staff are highly knowledgeable and skilled in maintaining and improving the many different types of pump stations.

Some of the items presented below are directly taken from the Pump Station Condition Assessment Forms and some are observations made by the District and BC team during the site visits.

Safety

- Wet wells do not have fall protection when hatches are open. OSHA requires that fall protection be provided to protect workers from falls over 6 feet. The District should review its safety policy on opening wet well access hatches to ensure compliance.
- Combustible gas detectors are not provided in wet wells. National Fire Protection Association (NFPA) 820 recommends that combustible gas detectors be provided in wet wells.

Operation and Maintenance

- Some of the pump stations have minimal piping supports, especially on the suction side of the pumps. Additional supports would provide two benefits: 1) if properly located, pipe supports allow the removal of valves and equipment without adding temporary supports and 2) properly located piping supports prevent undue strain on the pump suction and discharge nozzles. The pump stations identified without adequate pipe supports were Bijou, Pioneer, Tahoe Keys, Tallac, Taylor Creek, Trout Creek, Upper Truckee, and Venice Pump Stations.
- The District is standardizing on some types of equipment. One example is standardizing on generators manufactured by Katolight and having 200 gallons of fuel storage. Standardizing on equipment will become more important in the future as employees retire and new employees are brought into the system.

Structural

- Most of the metal items in the wet wells (including ladders) have rusted. The ladders should be removed to prevent someone from mistakenly using them to enter the wet well.

Electrical and Controls

- The District has minimal monitoring and data collection with limited SCADA system implementation.
- The Central Control Center does not have a server to manage large amounts of SCADA data.
- Alarms signals are addressed by status change only. Additional alarms such as LOW FUEL and generator HIGH TEMP could improve efficiency.
- "Line-of-Sight" disconnect is an issue at some pump stations.
- Electrical outlets for general appliance use and many sump pumps are not Ground Fault Circuit Interrupt protected.
- Pump stations do not have intrusion alarms.
- Electrical items are generally in good condition well maintained with some disregard for housekeeping. Many panels in the process of performing required modifications were left with "lead dress" or "wire removal" issues and lack wire nuts to cap off bare leads.
- A few sites did not meet "Working Space" requirements per NEC 110-26 Table A1 Working Space.
- Some pump stations did not meet "Not Readily Accessible" requirements per NEC 100 "General".

Other

- Dry wells have only one sump pump. If room is available, a second sump pump would provide redundancy.
- Most pump stations do not have fencing and are vulnerable to vandalism.
- Replacing employees that retire or leave may be difficult because of their high skill level and knowledge of facilities.

- The wet wells are not designed to meet the 1998 American National Standard Institute/Hydraulic Institute (ANSI/HI) for Pump Intake Design.
- Many pump stations are approaching 40 years old or greater.

Preventive Maintenance

Although the focus of the pump station evaluation was condition assessment, information on pump station maintenance was obtained and evaluated. Specifically, pump station maintenance information was obtained from log books, CMMS, and discussion with District staff. We have the following observations regarding preventive maintenance effectiveness and efficiency:

- Based on our site visits and condition assessment, the District's pump stations are generally in good condition and well maintained, which means the District has an effective maintenance program with preventive maintenance activities employed.
- Many of the District's pump stations have a high consequence of failure; however, no SSOs have occurred in the last few years because of a pump station failure
- The District has been able to retain its staff for many years; and therefore, the staff have significant experience and internal knowledge of the pump stations.
- District has several different types of pump stations, many of which are forty plus years old. The equipment in these pump stations also varies.
- Safety is a concern at some of the District's pump stations because of confined space entry procedures are required for entry into the dry wells.
- District is geographically isolated relative to manufacturer's service facilities and readily available spare parts, which requires spare parts and in-house expertise to repairs pumps, especially during inclement weather.

The effectiveness and efficiency of maintenance programs is not easily compared from one system to another. All pump stations and utilities are unique and a one size fits all approach cannot be used to determine the efficiency of a preventive maintenance program. However, some general statements can be made be when comparing preventive maintenance programs.

Performance criteria – The level of service varies from system to system, which affects the preventive maintenance requirements.

Bench marking – Bench marking can be misleading. A high level of service will require a high level of maintenance to meet the level of service and performance. A benchmarking study completed in 1998 by California State University at Sacramento investigated several agencies with pump stations. Several of the agencies that participated in the bench marking study had approximately the same number of pump stations as the District. The frequency of inspection ranged from daily to monthly with inspection crew size ranging from 1 to 2.5 people. Total mechanical and electrical staff ranged from 2 to 9.

Efficiency – Optimal maintenance levels should be evaluated using an asset management approach. Asset management considers levels of service, life cycle cost effectiveness, and risk. A detailed analysis of pump station systems, failure modes, and maintenance histories needs to be evaluated to develop a specific maintenance strategy for each pump station.

SCADA

The District's SCADA system can and should be used in developing an effective and efficient maintenance strategy. The SCADA system can be used to identify predictive and corrective/rehabilitation maintenance needs. The SCADA system should monitor and track status of equipment, equipment run times, time of operation, flow meter data (if available), alarms, and historical information. This information should be included in reports generated on a regular basis.

Typical pump station SCADA alarms include:

- Influent gate closed
- Wet well low and high level
- Pump motor trouble
- Pump power failure
- Combustible gas low and high level
- Combustible gas detector failure
- No pump station flow
- Ventilation fan failure
- Diesel fuel storage low and high level
- Generator failure
- Automatic transfer switch fault
- Fire alarm
- Intrusion alarm
- Electrical room high temperature
- Control power failure
- Pump station power failure

4.2.2 Small Submersible Pump Stations

The electrical cabinets at these pump stations are located in areas subject to damage by vehicles. The Beecher Pump Station is particularly vulnerable to damage because it is located near the street and at the bottom of a hill (See Figure 4-1). Removable bollards may provide added protection at these pump stations. The condition assessment also noted that the wood supports for the electrical cabinet at the Beecher Pump Station are deteriorated and should be replaced. The wet wells for these pump stations are mostly located in the street so traffic is limited to one lane during maintenance. This can also be a potential safety concern.

Figure 4-1. Electrical Cabinet at Beecher Pump Station

4.2.3 Large Submersible Pump Stations

These pump stations are generally reliable pump stations for the District. However, the Al Tahoe Pump Station is a high maintenance pump station with back flushing of pumps and check valves regualarly required and grease buildup in the wet well that requires pump down of the wet well once a week.

4.2.4 Pump Stations with Ladder Access into Dry Well

The dry wells for Bellevue, Pioneer Village, Pope Beach #1, San Moritz, Taylor Creek, and Trout Creek Pump Stations are located in below grade steel cans, which are subject to corrosion if not continuously protected with a cathodic protection system. During the March 10 and 11 site visits, the wall and floor thickness at the Taylor Creek and Venice Pump Stations were measured. At the Taylor Creek Pump Station, the wall thickness ranged from 0.312 to 0.319 inches and the floor thickness ranged from 0.379 to 0.393 inches. At the Venice Pump Station, the wall thickness was 0.290 inches and the floor thickness ranged from 0.386 to 0.430 inches.

Entrance to the dry well of these pump stations is provided through an access shaft with a ladder (See Figure 4-2). It is very difficult to lower and raise equipment and tools into and out of the dry well in this type of pump station. Removing an injured person would be even more difficult.

Figure 4-2. Ladder Access into Dry Well

4.2.5 Pump Stations with Spiral Staircase Access into Dry Well

Entrance to these pumping stations is by a spiral staircase, which, like the pump stations with ladder access, is also difficult to maintain and remove injured personnel. The Upper Truckee Pump Station was identified as a high maintenance pump station. The Upper Truckee Pump Station has required motors for both pumps to be rebuilt or replaced multiple times.

4.2.6 Fallen Leaf Lake System

Fallen Leaf Lake area has a unique pumping system that includes small submersible pumps and a vacuum system. Three pump stations and two vacuum valve stations were visited. The Stanford Generating Station was also visited. The pump stations and vacuum valve stations visited include the following:

- ES-2 (submersible pump station)
- Vacuum Valve Station 3
- ES-5 (submersible pump station)
- Main Station (ladder access to dry well)
- Vacuum Valve Station 5
- Stanford Generating Station

The Fallen Leaf Lake system requires significant operation and maintenance attention from the District. The District has spent countless hours fine-tuning this system. A failure in the Fallen Leaf Lake system has a potential for a high consequence of failure for the District. An overall business case evaluation of alternative systems for Fallen Leaf Lake will be provided in a separate analysis. Also, the gravity pipe that feeds Vacuum Valve Station 3 that is attached to the bridge over Glenn Alpine Creek should be inspected as part of the analysis.

4.3 Conclusions and Future Work

The information from the condition assessment and these observations, along with the ongoing hydraulic capacity analysis, will be used in the risk assessment and development of capital improvement projects. The risk assessment and development of capital improvement projects will be completed in a future TM related to Task 7 – Long Range Capital Improvement Plan Development. Task 7 will determine which projects are capital improvement projects or which projects should be completed by the District as regular system maintenance type projects. Some of the capital improvement projects could be completed as system-wide projects, such as installing combustible gas detectors in wet wells or installing intrusion alarms at each of the pump stations, or the projects could be completed as part of individual pump station improvement projects.

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ATTACHMENT A: CONDITION ASSESSMENT INVENTORY FORM

South Tahoe Public Utility District
Pump Station Inventory Form

1. PUMP STATION NAME:____
2. ADDRESS:____

Background Information

3. Year Built ____

4. Year of 1st Rehabilitation ________________________________
5. Scope of Rehabilitation: ________________________________

6. Year of 2nd Rehabilitation ________________________________
7. Scope of Rehabilitation:________________________________

8. Pump Station Type

☐ Submersible
☐ Concrete Wet Well/Dry Well
☐ Steel Dry Well / Concrete Wet Well
☐ Self Priming Pumps Above Concrete Wet Well
☐ Other: ________________________________

Pump Equipment

	9. Pump 1	16. Pump 2	23. Pump 3	30. Pump 4
Pump Type	☐Vertical ☐Dry Centrifugal ☐Submersible ☐Self Priming ☐Other ________	☐Vertical ☐Dry Centrifugal ☐Submersible ☐Self Priming ☐Other ________	☐Vertical ☐Dry Centrifugal ☐Submersible ☐Self Priming ☐Other ________	☐Vertical ☐Dry Centrifugal ☐Submersible ☐Self Priming ☐Other ________
Pump Manufacturer	10.	17.	24.	31.
Pump Model	11.	18.	25.	32.
Design Flow (nameplate)	12.	19.	26.	33.
Design TDH (nameplate)	13.	20.	27.	34.
Motor Horsepower	14.	21.	28.	35.
Date Installed	15.	22.	29.	36.

South Tahoe Public Utility District
Pump Station Inventory Form

Site/Building

Criteria		Comments
37. Station accessible by boom truck	☐ Y ☐ N	38.
39. Security (fences and gates)	☐ Y ☐ N	40.
41. Turnaround provided	☐ Y ☐ N	42.
43. Bollard protection of critical structures	☐ Y ☐ N	44.
45. Drainage sufficient	☐ Y ☐ N	46.
47. Snow removal provision	☐ Y ☐ N	48.
49. Space available for future expansion	☐ Y ☐ N	50.
51. Fire break (defensible space)	☐ Y ☐ N	52.
53. Landscaping	☐ Y ☐ N	54.
55. Building Roof Type ______________________		56.

Flow Bypass

57. Gravity Bypass Capability Y N
Description ____
____

58. Portable Pump Bypass Capability Y N
Description ____
____

Back-up Power

59. Back-up Power ☐ None ☐ Redundant Power Service ☐ Emergency Generator

60. Generator Location ☐ On-site ☐ Portable (quick connect) ☐ Portable (no quick connect)

61. Generator Startup ☐ Automatic ☐ Manual

Alarms

Criteria		Comments
62. Remote transmission of alarms	☐ Y ☐ N	63.
64. Alarm signals on building exterior	☐ Y ☐ N	65.
66. Fire Alarm	☐ Y ☐ N	67.
68. Intruder Alarm	☐ Y ☐ N	69.
70. Power Failure Alarm	☐ Y ☐ N	71.
72. Pump Failure Alarm	☐ Y ☐ N	73.
74. Other Alarm ______________________	☐ Y ☐ N	75.

South Tahoe Public Utility District
Pump Station Inventory Form

Pump Controls

76. Level Sensor ☐ Bubbler ☐ Floats ☐ Ultrasonic ☐ Other ____________________

77. Level Sensor Redundancy ☐ Y ☐ N

78. Pump Start ☐ Constant Speed ☐ Variable Speed (type________________)

79. Operation ☐ Lead/Lag ☐ Duty/Standby ☐ Other ____________________________

Force Main

80. Diameter (in.)________________ 81. Material_____________________________

82. ☐ ARV 83. ☐ CAV 84. ☐ Surge Control System

Other:

85. Odor Control Facilities ☐ None ☐ Activated Carbon ☐ Chemical Addition using ____________ ☐ Other__________________________

86. Hoists ☐ None ☐ Monorail ☐ Hoist

87. Bar Screen ☐ None ☐ Trash rack (manual clean) ☐ Automatic bar screen ☐ Muffin Monster

88. Flow Meter ☐ None ☐ Ultrasonic ☐ Mag ☐ Other____________________

89. Wet Well Isolation ☐ None ☐ Sluice Gate Operator ☐ Slide Gates ☐ Stop Logs

90. Dry Well Sump Pumps ☐ None ☐ Single ☐ Duplex

91. Wet Well Protection ☐ None ☐ Lining ☐ Coating

Upcoming Projects

92. FY 07/08: ____

93. Proposed: ____

Maintenance Issues

94. ____

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ATTACHMENT B: PUMP STATION CONDITION ASSESSMENT FORM

South Tahoe Public Utility District
Pump Station Condition Assessment Form

1. PUMP STATION NAME: ____________________
2. DATE: ____________________ 3. TIME: ____________________
4. CONSULTANT STAFF: ____________________
5. DISTRICT STAFF: ____________________

Background Information

NOTE: SEE INVENTORY FORM FOR BACKGROUND INFORMATION

Pump Equipment Summary

NOTE: SEE INVENTORY FORM FOR EQUIPMENT NOT LISTED HERE

	Pump 1	Pump 2	Pump 3	Pump 4
Casing Material	6.	7.	8.	9.
Impeller Material	10.	11.	12.	13.

Maintenance Records

	Pump 1	Pump 2	Pump 3	Pump 4
Runtime (hours)	14.	15.	16.	17.
Base Type/Condition Motor Pump	 18. 19. 20.	 21. 22. 23.	 24. 25. 26.	 27. 28. 29.
MTBF (Mean Time Between Failure)	30.	31.	32.	33.
Vibration	34.	35.	36.	37.
Cavitation	38.	39.	40.	41.
Bearing Noise	42.	43.	44.	45.
Bearing Temp.	46.	47.	48.	49.
Most common reason for repair	50.	51.	52.	53.
Other Remarks	54.	55.	56.	57.

South Tahoe Public Utility District
Pump Station Condition Assessment Form

Site

NOTE: SEE INVENTORY FORM FOR SITE INFORMATION NOT LISTED HERE

Access

58. General Condition Rating □1 □2 □3 □4 □5
59. General Functionality Rating □1 □2 □3 □4 □5

Turf / Landscaping

60. General Condition Rating □1 □2 □3 □4 □5
61. General Functionality Rating □1 □2 □3 □4 □5

Future Expansion Area

62. Space available for future expansion □ Y □ N

Building Structure

Superstructure Building

63. General Condition Rating □1 □2 □3 □4 □5
64. General Functionality Rating □1 □2 □3 □4 □5

Criteria		Comments
65. Exterior wall condition	□1 □2 □3 □4 □5□	
66. Interior wall condition	□1 □2 □3 □4 □5□	
67. Exterior finish condition	□1 □2 □3 □4 □5□	
68. Interior finish condition	□1 □2 □3 □4 □5□	
69. Equipment finish condition	□1 □2 □3 □4 □5□	
70. Roof condition	□1 □2 □3 □4 □5□	
71. Door condition	□1 □2 □3 □4 □5□	
72. Window condition	□1 □2 □3 □4 □5□	
73. Pipe support condition	□1 □2 □3 □4 □5□	
74. Grating condition	□1 □2 □3 □4 □5□	
75. Layout OK for equipment access	□ Y □ N	

South Tahoe Public Utility District
Pump Station Condition Assessment Form

Wet Well

76. General Condition Rating □1 □2 □3 □4 □5
77. General Functionality Rating □1 □2 □3 □4 □5

Criteria		Comments
78. Top slab condition	□1 □2 □3 □4 □5□	
79. Interior wall condition	□1 □2 □3 □4 □5□	
80. Hatchway condition	□1 □2 □3 □4 □5□	
81. Hatchway accessible	□ Y □ N	

Pumps, Valves and Piping

Suction Piping and Valve(s)

82. General Condition Rating □1 □2 □3 □4 □5
83. General Functionality Rating □1 □2 □3 □4 □5

Criteria		Comments
84. Velocity < 8 fps	□ Y □ N	
85. At least 5 pipe diameters straight run to pump from last fitting	□ Y □ N	
86. No air entrainment problems	□ Y □ N	
87. No loss of pump prime	□ Y □ N	

Pump

88. General Condition Rating □1 □2 □3 □4 □5
89. General Functionality Rating □1 □2 □3 □4 □5

Criteria		Comments
Pump		
90. Pumps performing near rated capacity	□ Y □ N	
91. Seals functional	□ Y □ N	
92. Seal water system functional	□ Y □ N	
93. Pump parts available	□ Y □ N	
Motor		
94. High efficiency	□ Y □ N	
95. Over-temperature protection	□ Y □ N	

South Tahoe Public Utility District
Pump Station Condition Assessment Form

Discharge Piping and Valve(s)

96. General Condition Rating □1 □2 □3 □4 □5
97. General Functionality Rating □1 □2 □3 □4 □5

Criteria		Comments
Discharge Valve		
98. Accessible for operation and maintenance	□ Y □ N	
99. Horizontal	□ Y □ N	
Check Valve		
100. Accessible for operation and maintenance	□ Y □ N	
101. Horizontal	□ Y □ N	
Flow Meter		
102. Reliable output	□ Y □ N	
103. Sufficient straight run	□ Y □ N	
Piping		
104. Evidence of corrosion	□ Y □ N	
105. Evidence of leaks	□ Y □ N	
106. Hydraulic transient effects	□ Y □ N	
Pump Connections		
107. Isolation from piping strains	□ Y □ N	
108. Restrained in accordance with Hydraulic Institute standards	□ Y □ N	

Back-up Power

NOTE: SEE INVENTORY FORM FOR BACK-UP POWER INFORMATION NOT LISTED HERE

109. General Condition Rating □1 □2 □3 □4 □5
110. General Functionality Rating □1 □2 □3 □4 □5 Comments________________________________

Criteria		Comments
111. Generator size sufficient for pumps and auxiliary equipment	□ Y □ N	
112. Fuel tank sized for 24 hour operation	□ Y □ N	
113. Fuel tank spill containment provisions	□ Y □ N	
114. Outdoor panel location area satisfactory for portable generator	□ Y □ N	
115. Transfer switch condition satisfactory	□ Y □ N	

South Tahoe Public Utility District
Pump Station Condition Assessment Form

Electrical – Power

116. General Condition Rating □1 □2 □3 □4 □5
117. General Functionality Rating □1 □2 □3 □4 □5 Comments___________________________________

Criteria		Comments
MCCs		
118. Condition satisfactory	□ Y □ N	
119. Parts available	□ Y □ N	
Lighting		
120. Suitable for electrical classification	□ Y □ N	

Electrical – Controls

NOTE: SEE INVENTORY FORM FOR CONTROLS INFORMATION NOT LISTED HERE

121. General Condition Rating □1 □2 □3 □4 □5
122. General Functionality Rating □1 □2 □3 □4 □5 Comments___________________________________

Criteria		Comments
Level Controls		
123. Sensors reliable	□ Y □ N	
124. Parts available	□ Y □ N	
VFDs		
125. Parts available	□ Y □ N	
126. Controls stable	□ Y □ N	
	□ Y □ N	

South Tahoe Public Utility District
Pump Station Condition Assessment Form

Heating and Ventilation Equipment

127. General Condition Rating □1 □2 □3 □4 □5
128. General Functionality Rating □1 □2 □3 □4 □5 Comments___________________________________

Criteria		Comments
Wet Well Ventilation		
129. Mechanical ventilation provided	□ Y □ N	
130. Separate from dry well	□ Y □ N	
Dry Well Ventilation		
131. Mechanical ventilation provided	□ Y □ N	
132. Gas detection equipment	□ Y □ N	
133. Ventilation requirements meet NFPA 820	□ Y □ N	
Dehumidification		
134. Effective	□ Y □ N	
Heating		
135. Effective	□ Y □ N	

Odor Control Facilities

NOTE: SEE INVENTORY FORM FOR CONTROLS INFORMATION NOT LISTED HERE

136. General Condition Rating □1 □2 □3 □4 □5
137. General Functionality Rating □1 □2 □3 □4 □5 Comments___________________________________

Criteria		Comments
138. No objectionable odors	□ Y □ N	
139. Accessible for maintenance	□ Y □ N	
140. Reasonable operational cost	□ Y □ N	

Auxiliary Equipment – Hoists

NOTE: SEE INVENTORY FORM FOR HOIST INFORMATION NOT LISTED HERE

141. General Condition Rating □1 □2 □3 □4 □5
142. General Functionality Rating □1 □2 □3 □4 □5

Criteria		Comments
143. Hoist load tested within 10 years	□ Y □ N	
144. Hoists arrangement and location sufficient for required maintenance	□ Y □ N	

South Tahoe Public Utility District
Pump Station Condition Assessment Form

Auxiliary Equipment – Bar Screen

NOTE: SEE INVENTORY FORM FOR BAR SCREEN INFORMATION NOT LISTED HERE

145. General Condition Rating ☐1 ☐2 ☐3 ☐4 ☐5
146. General Functionality Rating ☐1 ☐2 ☐3 ☐4 ☐5

Criteria		Comments
147. Pump damage or pipe blockage due to lack of screening	☐ Y ☐ N	
148. Adequate provisions for screenings removal from building	☐ Y ☐ N	

Safety Issues

☐ 149. Materials Handling
☐ 150. Chemical Exposure
☐ 151. Hydrogen Sulfide Exposure
☐ 152. Traffic Control
☐ 153. Confined Space
☐ 154. Other ____________________

155. Other Maintenance Issues:

____
____
____

156. Comments:

____
____
____

Rating Criteria

General Condition Rating
1 Structure or equipment integrity severely compromised by corrosion and wear. Possible imminent failure.
2 Structure or equipment integrity compromised by corrosion and wear.
3 Visible degradation of equipment or structure
4 Well maintained, like-new condition of equipment or structure
5 New or nearly-new structure or equipment

General Functionality Rating
1 Structure or equipment is not currently functioning for its intended use.
2 Structure or equipment is in service but function is highly impaired
3 Structure or equipment is in service but maintenance or operational requirements are excessive
4 Structure or equipment functions as intended
5 Structure or equipment functions better than other similar structures or equipment

South Tahoe Public Utility District
Pump Station Condition Assessment Form

Photograph Log

Number	Description
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

ATTACHMENT C: PUMP STATION ASSESSMENT SUMMARY

Al Tahoe Pump Station – Large Submersible Pump Station (Big 6)			
Location:	End of Link Road		
Year Built, Rehabilitated:	1960, 1996	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	**Pump 3**
Flow, gpm	3,820	3,820	3,820
Estimated Firm Capacity, gpm	5,200		
Head, feet	80	80	80
Horsepower, hp	100	90	90
Manufacturer (Year Installed)	Flygt (1997)	Flygt (2004)	Flygt (2004)
Pump Controls	Bubbler/Teslo		
Force Main			
Diameter, inches	18		
Length, feet	5,900		
Material	Asbestos Cement (Transite)		
Generator			
Size, kW	300		
Fuel storage, gallons	200		
Maintenance Log Book Summary	This is a high maintenance station compared to the other District pump stations, experiencing frequent warning alarms and electrical/control problems, especially Pump #3. All pumps compared with the other pump stations required more back flushing and periodic de-ragging. Pump #1 appears to be the most reliable operating pump but has the most ragging problems.		
Mechanical/Structural Observations	▪ Access to this pump station could be difficult in a snow storm. The pump station is located behind a commercial area. However, this area is the first location for snow removal. ▪ Redundancy includes a standby generator and two places for bypass pump piping connections. The District also indicated that there is a standby pump and approximately three hours of on-site and collection system storage during average flow conditions. ▪ The District's portable diesel pump is stored at this pump station. ▪ Vandalism is a problem at this pump station as can be seen by the graffiti painted on the building in the picture above. ▪ The wet well experiences a lot of debris on the surface, which requires pump down once per week. ▪ Pump station has an activated carbon odor control system. ▪ 31 Pump Stations including Bellevue, Tahoe Keys, and Ponderosa Pump Stations pump to this station before pumping to the wastewater treatment plant.		
Electrical Observations	▪ Bubbler type liquid level controller (TESCO) from older drives still in use as the pump controller. ▪ There is clutter in front of and within working space of the switchboard.		

Baldwin Beach Pump Station			
Location:	Baldwin Beach Road. (right before parking lot)		
Year Built, Rehabilitated:	1971, N/A **Date inspected:**	**Grid Book Page:**	F-23
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	400	400	
Estimated Firm Capacity, gpm	400		
Head, feet	36.81	36.81	
Horsepower, hp	10	10	
Manufacturer (Year Installed)	Allis-Chalmers	Allis-Chalmers	
Pump Controls	Floats		
Force Main			
Diameter, inches	10		
Length, feet	2,660		
Material	Unknown		
Generator	KatoLight		
Size, kW	50		
Fuel storage, gallons	175 Gallon Diesel		
Maintenance Log Book Summary	No information		
Mechanical/Structural Observations	▪ Pump station input invert elevation is 6218.5. ▪ The top of the head elevation is 6255.31. ▪ Approximately 15' of cast iron pipe connects the pump to the force main.		
Electrical Observations	▪ None reported		

Beecher PS - Small Submersible Pump Station

Location:	Intersection of Beecher Road and Alma Road		
Year Built, Rehabilitated:	1960, 2007 rehabilitated	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	100	100	
Estimated Firm Capacity, gpm	100		
Head, feet	45	45	
Horsepower, hp	2	2	
Manufacturer (Year Installed)	Zoeller (2007)	Zoeller (2007)	
Pump Control	Floats		
Force Main			
Diameter, inches	4		
Length, feet	342		
Material	Steel		
Generator	No generator		

Maintenance Log Book Summary

This was a high maintenance station until new pumps were installed in 2007. Prior to that, the pump station suffered from frequent nonspecific mechanical and electrical problems.

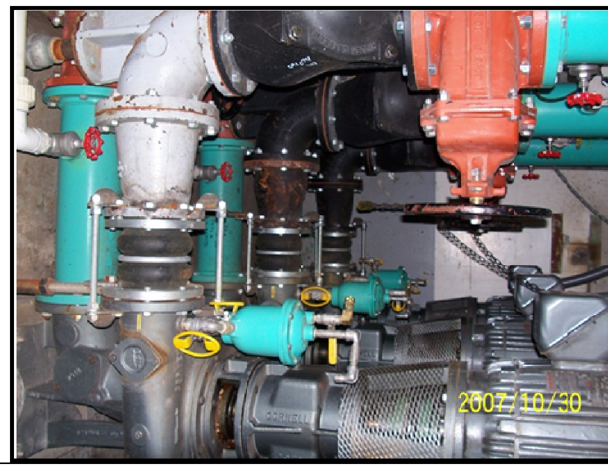
Mechanical/Structural Observations

- This submersible pump station is located in the street. Maintenance in the wet well requires that one lane of traffic be closed; however, the pump station is not located on a busy street.
- The station does not have a standby generator but does have a connection for a portable generator.
- The District indicated that the pump station has approximately four hours of storage. Backwater valves are installed on houses that could be flooded if the pump station fails.
- Wet well was sand blasted and coated in 2007.

Electrical Observations

- Power for pump station is 240 volt, single phase.
- The electrical cabinet is located at the bottom of a hill. There is a potential for a vehicle to damage the electrical cabinet.
- The posts for the electrical cabinet are made out of wood and are deteriorating. The District has strengthened one of the posts.
- Motor start capacitors are integrated into the pump motors.
- The electrical panel interior is not well kept.
- There are unused phase shift capacitors.

Bellevue PS - Pump Station with Ladder Access into Dry Well			
Location:	West end of Bellevue at El Dorado		
Year Built, Rehabilitated:	1960, N/A	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	900	900	
Estimated Firm Capacity, gpm	900		
Head, feet	41	41	
Horsepower, hp	15	15	
Manufacturer (Year Installed)	Smith and Loveless (1960)	Smith and Loveless (1960)	
Pump Control	Ultrasonic		
Force Main			
Diameter, inches	10		
Length, feet	3,098		
Material	Steel		
Generator			
Size, kW	60		
Fuel storage, gallons	200		
Maintenance Log Book Summary	This pump station has a moderate number of miscellaneous maintenance problems.		
Mechanical/Structural Observations	▪ Access to dry well is by ladder requiring a safety belt. This is a confined space entry. ▪ Redundancy includes standby generator and standby pump. The District has indicated that there is approximately 3 hours of storage during average flow conditions. ▪ Removal of equipment is very difficult at this pump station. ▪ Roof was replaced in 2007. ▪ There is no off-street parking or turn around at this pump station.		
Electrical Observations	▪ Power for the pump station is 240 volt Hi-Leg Delta. ▪ Pumps are FVNR starting across line. Miltronic level control is used at this pump station. ▪ Load center feeder is provided at this pump station. Circuit breaker blank covers are missing. ▪ Transfer switch is installed in the existing ATS enclosure.		

Bijou PS - Pump Station with Ladder Access into Dry Well (Big 6)			
Location:	3715 Lake Tahoe Boulevard		
Year Built, Rehabilitated:	1955, N/A	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	**Pump 3**
Flow, gpm	1600	1800	1800
Estimated Firm Capacity, gpm	2000-2400		
Head, feet	75	75	75
Horsepower, hp	75	Unknown	Unknown
Manufacturer (Year Installed)	Vaugn Chopper	Cornell (2000)	Cornell (2000)
Pump Control	Ultrasonic		
Force Main			
Diameter, inches	16 and 12		
Length, feet	13,500		
Material	12" Asbestos Cement (Transite) 16" Steel		
Generator			
Size, kW	300		
Fuel storage, gallons	200		
Maintenance Log Book Summary	This is a high maintenance station. Pump #1 triggered frequent VFD faults. Pumps #1 and #2 are frequently air-locked. A normal to high amount of ragging has occurred compared to the District's other pump stations. The log reported two instances of grease accumulation in the wet well requiring operator attention. One entry indicates that the station was stressed beyond capacity.		
Mechanical/Structural Observations	▪ Redundancy includes standby generator, standby pump, and bypass pump piping connection. The District has indicated that there is less than three hours of on-site and collection system storage during average flow conditions. ▪ Access to dry well is by a ladder. ▪ All the pumps have air release valves on the discharge side of the pumps. This has reduced the amount of air-locking that the pumps have experienced. Air release valve discharge into dry well. ▪ This pump station has a dual force main. This pump station has ball check valves. ▪ Spacing between pumps is limited. ▪ Pump station has carbon absorption odor control unit but it is seldom used because there are no odors. ▪ One of the glass block window sections is missing. ▪ Paint in dry well and wet well is peeling from concrete. Concrete aggregate is exposed in wet well. ▪ Input invert elevation at pump station is 6,228.1, the top of the head elevation is 6,310. ▪ Johnson and Ski Run Pump Stations contribute to these force mains.		
Electrical Observations	▪ VFDs do not have a bypass. Pumps cannot operate without VFDs. ▪ Pumps cannot operate at 100 percent speed without overloading motor. ▪ Pumps are manually switched every day.		

Camp Richardson PS			
Location:	2001 Jameson Beach rd. – left immediately beyond The Beacon parking lot.		
Year Built, Rehabilitated:	1968, N/A **Date inspected:**	**Grid Book Page:**	H-23
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	Unknown	Unknown	
Estimated Firm Capacity, gpm	Unknown		
Head, feet	20.89	20.89’	
Horsepower, hp	15	15	
Manufacturer (Year Installed)	Allis-Chalmer	Allis-Chalmer	
Pump Controls	Bubbler Tube		
Force Main			
Diameter, inches	10		
Length, feet	1,290		
Material	Unknown		
Generator	Katolight		
Size, kW	50		
Fuel storage, gallons	175 Gallon Diesel		
Maintenance Log Book Summary	No information. District Staff commented that there are rocks in the wet well from an unknown origin.		
Mechanical/Structural Observations	▪ Approx pump station input invert elevation is 6208. ▪ The top of the head elevation is 6228.89.		
Electrical Observations	▪ None reported		

ES1 - Fallen Leaf Lake System			
Location:	Stanford Camp, 130 Fallen Leaf		
Year Built, Rehabilitated:	1979, N/A **Date inspected:**	**Grid Book Page:**	E-33
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	85	85	
Estimated Firm Capacity, gpm	85		
Head, feet	9.75	9.75’	
Horsepower, hp	5	5	
Manufacturer (Year Installed)	Peabody Barnes	Peabody Barnes	
Pump Controls	Floats		
Force Main			
Diameter, inches	2 ½		
Length, feet	210		
Material	Polyethylene or PVC		
Maintenance Log Book Summary	No information		
Mechanical/Structural Observations	▪ Approx. 12’ of 4” cast iron pipe is used in the actual pump station before it connects to the 4” PVC force main. ▪ Force Main length and head height measured to ES-2 ▪ Wet well input invert elevation is 6,375.25 ▪ The top of the head elevation is 6,385		
Electrical Observations	▪ The station is run on an electric motor		

ES2 - Fallen Leaf Lake System

Location:	Stanford Camp, Fallen Leaf Lake		
Year Built, Rehabilitated:	1983, N/A	**Date inspected:**	10/31/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	85	85	
Estimated Firm Capacity, gpm	85		
Head, feet	79	79	
Horsepower, hp	5	5	
Manufacturer (Year Installed)	Peabody Barnes (2000)	Peabody Barnes (2000)	
Pump Controls	Floats		
Force Main			
Diameter, inches	2-1/2		
Length, feet	600		
Material	Polyethylene or PVC		
Generator			
Size, kW	Served by Stanford Camp Generator		

Maintenance Log Book Summary	No log book provided. Logs entries placed in Main Station Pump Station.

Mechanical/Structural Observations

- This is a submersible electric pump station with a septic tank that separates the solids and floatable material from the liquid portion. Only the liquid portion is pumped. The solids and floatable material are removed by the District's vactor truck.
- Grease is a problem at this pump station because it collects wastewater from the cafeteria.
- This pump station has overflowed.
- Access to this pump station is very difficult. The pump station is located on Fallen Leaf Lake with only a single lane road.
- This pump station has some odor complaints.
- Concrete aggregate is exposed in wet well.

Electrical Observations

- This pump station has simple duplex pump controls.
- This station sends alarm signals to the Main Station Pump Station at Fallen Leaf Lake.
- The float level control system at this pump station has been problematic.

ES3 - Fallen Leaf Lake System			
Location:	Stanford Camp, 130 Fallen Leaf		
Year Built, Rehabilitated:	1979, N/A **Date inspected:**	**Grid Book Page:**	F-33
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	85	85	
Estimated Firm Capacity, gpm	85		
Head, feet	7.15	7.15	
Horsepower, hp	5	5	
Manufacturer (Year Installed)	Peabody Barnes	Peabody Barnes	
Pump Controls	Floats		
Force Main			
Diameter, inches	2 ½		
Length, feet	705		
Material	Polyethylene		
Maintenance Log Book Summary	No information		
Mechanical/Structural Observations	▪ Approx. 10' of 4" cast iron pipe is used in the actual pump station before it connects to the 2 ½" PVC force main. ▪ Force Main measured to VVS 1 ▪ Wet well input invert elevation is 6,383.54 ▪ Top of head elevation is 6,390.69 ▪ Backup power for this station is provided by the Stanford generator.		
Electrical Observations	▪ This station is run on an electric motor.		

ES5 - Fallen Leaf Lake System			
Location:	East side of Fallen Leaf Lake		
Year Built, Rehabilitated:	1983, N/A	**Date inspected:**	10/31/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	92.2	92.2	
Estimated Firm Capacity, gpm	92.2		
Head, feet	124.5	124.5	
Horsepower, hp	4.7	4.7	
Manufacturer (Year Installed)	ABS (2005)	ABS (2005)	
Pump Controls	Floats		
Force Main			
Diameter, inches	4		
Length, feet	2,660		
Material	PVC		
Generator	No generator		

Maintenance Log Book Summary	No log book provided. Logs entries placed in Main Station Pump Station.
Mechanical/Structural Observations	▪ This is a submersible electric pump station with a septic tank that separates the solids and floatable material from the liquid portion. Only the liquid portion is pumped. The solids and floatable material are removed by the District's vactor truck ▪ This pump station does not have standby power. A portable generator can be connected to it. There are several days of storage available. ▪ Access to this pump station is very difficult. The pump station is located on Fallen Leaf Lake with only a single lane road. ▪ This pump station has some odor complaints.
Electrical Observations	▪ This pump station has simplex pump controls. ▪ This pump station sends alarm signals to Main Station Pump Station at Fallen Leaf Lake. ▪ Control panel needs railing for safety and to make the station "Readily Accessible".

ES6 - Fallen Leaf Lake System

Location:	694 Fallen Leaf		
Year Built, Rehabilitated:	1979, N/A **Date inspected:**	**Grid Book Page:**	G-32
Pumps	**Pump 1**		
Flow, gpm	90		
Estimated Firm Capacity, gpm	0		
Head, feet	61.47		
Horsepower, hp	5		
Manufacturer (Year Installed)	Peabody Barnes		
Pump Controls	Floats		
Force Main			
Diameter, inches	4		
Length, feet	2,896		
Material	PVC		
Maintenance Log Book Summary	No information		
Mechanical/Structural Observations	▪ Approx. 14’ of 6” cast iron pipe is used in the actual pump station from the manhole to the septic tank. ▪ Approx. 8’ of 4” cast iron pipe is used in the actual pump station before it connects to the 4” PVC force main. ▪ Force main length and head height incorporates ES 7 ▪ Wet well input invert elevation is 6,381.03 ▪ The top of the head elevation is 6,442.5 ▪ Pump station rehabilitation scheduled for Summer 2009.		
Electrical Observations	▪ This station is run by an electric motor.		

ES7 - Fallen Leaf Lake System			
Location:	781 Fallen Leaf rd.		
Year Built, Rehabilitated:	1979, 2009 **Date inspected:**	**Grid Book Page:**	G-32
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	90	90	
Estimated Firm Capacity, gpm	90		
Head, feet	60.06’	60.06’	
Horsepower, hp	5	5	
Manufacturer (Year Installed)	Zoeller (2009)	Zoeller (2009)	
Pump Controls	Floats		
Force Main			
Diameter, inches	4		
Length, feet	1,899.5		
Material	PVC		
Maintenance Log Book Summary	No information		
Mechanical/Structural Observations	▪ Approximately 16’ of 6” cast iron pipe is used in the pump station from the manhole to the septic tank ▪ Approximately 15’ of 4” cast iron pipe is used in the pump station before it connects to the 4” PVC force main. ▪ Wet well input invert elevation is 6,382.44 ▪ The top of the head elevation is 6,442.5		
Electrical Observations	▪ This station is run on electric motors.		

ES8 - Fallen Leaf Lake System			
Location:	1021 Fallen Leaf (off road)		
Year Built, Rehabilitated:	1979, N/A **Date inspected:**	**Grid Book Page:**	G-31
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	90	90	
Estimated Firm Capacity, gpm	90		
Head, feet	26.93	26.93'	
Horsepower, hp	4.7	4.7	
Manufacturer (Year Installed)	ABS (2005)	ABS (2005)	
Pump Controls	Floats		
Force Main			
Diameter, inches	4		
Length, feet	6,020		
Material	PVC		
Maintenance Log Book Summary	No information		
Mechanical/Structural Observations	▪ Approximately 23' of 4" cast iron pipe is used in the actual pump station before it connects to the 4" PVC force main. ▪ The force main length and head height incorporates ES9 and Tager Pump Station. ▪ Wet Well input invert elevation is 6,404.86 ▪ The top of the head elevation is 6,431.79		
Electrical Observations	▪ This pump station is run on an electric motor.		

ES9 - Fallen Leaf Lake System			
Location:	1131 Fallen Leaf rd.		
Year Built, Rehabilitated:	1979, N/A **Date inspected:**	**Grid Book Page:**	G-30
Pumps	**Pump 1**		
Flow, gpm	90		
Estimated Firm Capacity, gpm	0		
Head, feet	30.88		
Horsepower, hp	5		
Manufacturer (Year Installed)	Zoeller		
Pump Controls	Floats		
Force Main			
Diameter, inches	4		
Length, feet	5,380		
Material	PVC		
Maintenance Log Book Summary	No information		
Mechanical/Structural Observations	▪ There is approx. 15' of 4"cast iron pipe used in the actual pump station which connects to the 4" PVC ▪ Force main length and head height incorporates Taggert Pump Station. ▪ The wet well input invert elevation is 6,400.91 ▪ The top of the head elevation is 6,431.79 ▪ Duplex station installed Summer 2008.		
Electrical Observations	▪ This pump is run by an electric motor.		

Fairway #1 PS - Small Submersible Pump Station			
Location:	1112 Fairway		
Year Built, Rehabilitated:	1995, N/A	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	80	80	
Estimated Firm Capacity, gpm	80		
Head, feet	79	79	
Horsepower, hp	0.75	0.75	
Manufacturer (Year Installed)	Sta-Rite (1995)	Sta-Rite (1995)	
Pump Controls	Floats		
Force Main			
Diameter, inches	$2 \rightarrow 6$		
Length, feet	30		
Material	ABS		
Generator	No generator		
Maintenance Log Book Summary	No log book provided.		
Mechanical/Structural Observations	▪ This submersible pump station is located in the street. Maintenance in the wet well requires that one lane of traffic be closed. However, the pump station is not located on a busy street. ▪ The station does not have a standby generator. ▪ The pump station has some storage. Backwater valves are installed on houses that could be flooded if a pump fails. ▪ Metal in wet well is corroded (rusted).		
Electrical Observations	▪ This pump station is a float activated electro-mechanical duplex station with running lead/lag.		

Gardner Mountain PS - Small Submersible Pump Station			
Location:	589 Gardner		
Year Built, Rehabilitated:	2004, N/A	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	85	85	
Estimated Firm Capacity, gpm	85		
Head, feet	Unknown	Unknown	
Horsepower, hp	7.5	7.5	
Manufacturer (Year Installed)	Flygt (2004)	Flygt (2004)	
Pump controls	Ultrasonic		
Force Main			
Diameter, inches	4		
Length, feet	840		
Material	Asbestos Cement (Transite)		
Generator			
Size, kW	45		
Fuel storage, gallons	Natural Gas and Propane		
Maintenance Log Book Summary	The log book indicates very little operation and maintenance is required at this pump station.		
Mechanical/Structural Observations	▪ This submersible pump station wet well is located in the driveway. Maintenance in the wet well requires that one lane of traffic be closed. The pump station is not located on a busy street. ▪ Redundancy includes standby generator and standby pump. ▪ Wet Well input inv elevation is 6,277.		
Electrical Observations	▪ This electrical system consists of MCC bucket starters with controls in a separate section.		

Johnson PS - Pump Station with Ladder Access into Dry Well (Big 6)			
Location:	Intersection of Johnson and Lake Tahoe Boulevard		
Year Built, Rehabilitated:	1972, N/A	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	**Pump 3**
Flow, gpm	1,750	1,750	1,500
Estimated Firm Capacity, gpm	2,000 to 2,500		
Head, feet	100	100	100
Horsepower, hp	75	75	75
Manufacturer (Year Installed)	Fairbanks Morse (2003)	Fairbanks Morse (2003)	Vaughn (2008)
Pump Controls	Ultrasonic		
Force Main			
Diameter, inches	Two, 16 & 12 Transite		
Length, feet	840		
Material	Concrete		
Generator			
Size, kW	365		
Fuel storage, gallons	200		
Maintenance Log Book Summary	This is a high maintenance station. Pumps required frequent removal of rags through 2003. Ragging has diminished since 2003. Recently, Pump 1 has experienced air-locking.		
Mechanical/Structural Observations	▪ Redundancy includes standby generator, standby pump, and bypass portable pump piping connection. ▪ Access to dry well is by ladder. This is a permitted confined space entry. ▪ The wet well is cleaned by a vactor truck every month. ▪ The sky light has leaked. ▪ The metal ladder in the wet well is corroded. ▪ The pump station does not have a turn around on the site so vehicles must backup onto a busy street to exit the pump station. ▪ Concrete aggregate exposed in wet well near hatch opening. ▪ Metal items in wet well are corroded (rusted). ▪ Bottom of wet well elevation is 6,234 ▪ The top of the head elevation is 6,310		
Electrical Observations	▪ VFDs are manually set to a particular frequency and motor speed is fixed.		

Kiva Pump Station			
Location:	Kiva Beach Road – Take left fork, Pump Station is in the woods to the right beyond the parking lot.		
Year Built, Rehabilitated:	1968 **Date inspected:**	**Grid Book Page:**	G-23
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	210	210	
Estimated Firm Capacity, gpm	210		
Head, feet	46.5	46.5	
Horsepower, hp	20	20	
Manufacturer (Year Installed)	Wemco - 1969	Wemco - 1969	
Pump Controls	Ultrasonic		
Force Main			
Diameter, inches	6		
Length, feet	2,890		
Material	Unknown		
Generator	Katolight		
Size, kW	60		
Fuel storage, gallons	175 Gallon Diesel		
Maintenance Log Book Summary	High or Low maintenance. degradation		
Mechanical/Structural Observations	▪ Wet well approx input invert elevation is 6,222.5. ▪ The top of the head elevation is 6,268.		
Electrical Observations	▪ None reported		

Main Station - Fallen Leaf Lake System			
Location:	South end of Fallen Leaf Lake		
Year Built, Rehabilitated:	1983, N/A	**Date inspected:**	10/31/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	180	180	
Estimated Firm Capacity, gpm	180		
Head, feet	200	200	
Horsepower, hp	15	15	
Manufacturer (Year Installed)	Paco (1983)	Paco (1983)	
Pump Controls	Floats		
Force Main			
Diameter, inches	4		
Length, feet	13,750		
Material	PVC		
Generator			
Size, kW	Unknown		
Fuel storage, gallons	1,000 gallon Diesel		
Maintenance Log Book Summary	This is a high maintenance pump station. Many log entries appear for mechanical issues at the pump station: oil leaks, frequent oil changes, etc. Frequent alarms including the following: high wet well, high tank, low tank, Vacuum Valve Station alarms. Electric controls and control voltage often require attention. The log book includes information having to do with alarms and irregularities at various vacuum valve stations as well as this pump station.		
Mechanical/Observations	▪ Redundancy includes standby generator. ▪ Power outages can be lengthy because Sierra Pacific Power Company cannot access location easily. ▪ Access to dry well is by ladder. This is a permitted confined space entry. ▪ Pump station has odor control. Odor control carbon units are changed approximately three times per year. ▪ Access to this pump station is very difficult. The pump station is located on Fallen Leaf Lake with only a single lane road. ▪ Existing fuel tank does not have secondary spill containment.		
Electrical Observations	▪ Wet well pump is managed by floats with FVNR starters located in an MCC. ▪ System operates as a Lead/Lag lift station.		

Pioneer Village PS - Pump Station with Ladder Access into Dry Well			
Location:	Intersection of Matheson and Friant		
Year Built, Rehabilitated:	1966, N/A	**Date inspected:**	10/31/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	325	325	
Estimated Firm Capacity, gpm	325		
Head, feet	65	65	
Horsepower, hp	10	10	
Manufacturer (Year Installed)	(1966)	(1966)	
Pump Controls	Ultrasonic		
Force Main			
Diameter, inches	8		
Length, feet	840		
Material	Asbestos Cement (transite)		
Generator			
Size, kW	45		
Fuel storage, gallons	200		
Maintenance Log Book Summary	This is a low maintenance station. Few maintenance issues were reported in the last 5 years: some air locking of pumps and "major graffiti" reported in 2005. Both pump run-time meters indicate that pumps are used relatively infrequently.		
Mechanical/Structural Observations	▪ Access to dry well is by ladder requiring a safety belt. This is a permitted confined space entry. ▪ Redundancy includes standby generator and standby pump. ▪ Removal of equipment is very difficult at this pump station. ▪ Roof was replaced recently. ▪ A fence that surrounds the pump station provides some security. ▪ Floor coating in dry well is peeling. ▪ Concrete aggregate is exposed in wet well. ▪ Sump pump is corroded (rusted). ▪ Wet well wall is rusted in one area indicating possible rebar corrosion.		
Electrical Observations	▪ This pump station is powered by high leg 240 FVNR starter across line. ▪ Level control is by Milltronics ultrasonic meter with interpose relay feed to starters. ▪ The automatic transfer switch enclosure is not well maintained.		

Ponderosa PS - Large Submersible Pump Station			
Location:	Ponderosa Street, Southwest		
Year Built, Rehabilitated:	1997, N/A	**Date inspected:**	10/31/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	300	300	
Estimated Firm Capacity, gpm	300		
Head, feet	34	34	
Horsepower, hp	7.5	7.5	
Manufacturer (Year Installed)	Flygt (1997)	Flygt (1997)	
Pump Controls	Ultrasonic		
Force Main			
Diameter, inches	6		
Length, feet	2,063 to junction 2,050 shared with Tahoe Keys		
Material	PVC (C-900 purple)		
Generator			
Size, kW	40		
Fuel storage, gallons	200		
Maintenance Log Book Summary	Relative to the other District pump stations, this pump station requires an average amount of maintenance. Periodic removal of rags from the pumps has been required, and pump #2 had frequent nonspecific problems in 2004.		
Mechanical/Structural Observations	▪ The wet well is located in the street. However, this pump station is not located on a busy street. ▪ Redundancy includes a standby generator.		
Electrical Observations	▪ This system is MCC bucket with FVNR starters. ▪ Controls are located in a separate MCC section. ▪ The pump station operates in a Lead/Lag mode. ▪ The pump station is powered with 240V High Leg.		

Pope Beach #1 PS - Pump Station with Ladder Access into Dry Well			
Location:	Pope Beach Road, 800 feet east of bend from north to east		
Year Built, Rehabilitated:	1973, N/A	**Date inspected:**	10/31/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	100	100	
Estimated Firm Capacity, gpm	100		
Head, feet	Unknown	Unknown	
Horsepower, hp	3	3	
Manufacturer (Year Installed)	Cornell (1973)	Cornell (1973)	
Pump Controls	Floats		
Force Main			
Diameter, inches	4		
Length, feet	583		
Material	Unknown		
Generator	No generator		
Maintenance Log Book Summary	No log book provided.		
Mechanical/Observations	▪ Redundancy includes standby pump and collection system storage. ▪ Access to this pump station is difficult in the winter. However, this pump station receives very little flow during the winter. ▪ Dry well entry is into a permitted confined space. ▪ Coating on piping is peeling.		
Electrical Observations	▪ Panel mounted FVNR starter in dry well steel can package. ▪ Supply Meter/Main power enclosure is in disrepair.		

Pope Beach Pump Station #2			
Location:	Pope Beach Road (the second station you come to on Pope Beach Road)		
Year Built, Rehabilitated:	1973, N/A **Date inspected:**	**Grid Book Page:**	J-23
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	100+	80+	
Estimated Firm Capacity, gpm	80		
Head, feet	3.42	3.42	
Horsepower, hp	3	3	
Manufacturer (Year Installed)	Cornell	Cornell	
Pump Controls	Probes		
Force Main			
Diameter, inches	4		
Length, feet	1,439		
Material	Unknown		
Maintenance Log Book Summary	No information		
Mechanical/Structural Observations	▪ The pump station approx input invert elevation is 6,221.94 ▪ The top of the head elevation is 6,225.34		
Electrical Observations	▪ None reported		

San Moritz PS - Pump Station with Ladder Access into Dry Well			
Location:	Intersection of Venice Boulevard and Emerald		
Year Built, Rehabilitated:	1966, N/A	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	900	900	
Estimated Firm Capacity, gpm	900		
Head, feet	33	33	
Horsepower, hp	15	15	
Manufacturer (Year Installed)	Cornell	Cornell	
Pump Controls	Ultrasonic		
Force Main			
Diameter, inches	10		
Length, feet	1,500		
Material	Asbestos Cement (Transite)		
Generator			
Size, kW	45		
Fuel storage, gallons	200		
Maintenance Log Book Summary	Relative to the other District's pump stations, this pump station requires an average amount of maintenance. Periodic removal of rags from the bubbler tubes has been required, and Pump #2 was frequently air-locked. In October 2003, a grease blanket developed on the wet well water surface, which caused a high water alarm.		
Mechanical/Structural Observations	▪ Access to dry well is by ladder requiring a safety belt. This is a permitted confined space entry. ▪ Redundancy includes standby generator and standby pump. ▪ Removal of equipment is very difficult.		
Electrical Observations	▪ FVNR starters are controlled by Milltronics ultrasonic meter. ▪ The motor starters are in poor condition.		

Ski Run PS - Large Submersible Pump Station			
Location:	In the alley behind 3651 Lake Tahoe Boulevard		
Year Built, Rehabilitated:	1996/1997, N/A	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	1,025	1,045	
Estimated Firm Capacity, gpm	1,025		
Head, feet	97	97	
Horsepower, hp	47	47	
Manufacturer (Year Installed)	Flygt (1996/1997)	Flygt (1996/1997)	
Pump Controls	Ultrasonic		
Force Main			
Diameter, inches	Two, 12 & 16		
Length, feet	3,270		
Material	Asbestos Cement (Transite)		
Generator			
Size, kW	190		
Fuel storage, gallons	200		

Maintenance Log Book Summary	This is a low maintenance pump station. A few instances appeared where pumps operted high hours and a couple of VFD failures were noted. No de-ragging or other common clogging problems were reported in the log books.
Mechanical/Structural Observations	▪ Access to this pump station could be difficult in a snow storm. The pump station is located behind a commercial area. ▪ Redundancy includes standby generator, standby pump, dual force mains, and gravity overflow to Bijou Pump Station. ▪ Pump station has carbon absorption odor control system but it is not used. ▪ Valve vault hatches get damaged by snow removal equipment. Wet well hatch is scheduled to be replaced because it is difficult to open. ▪ Heater does not work. ▪ Input invert elevation is 6,213 ▪ The top of the head elevation is 6,310 ▪ This pump station joins the 12” force main from the Bijou Pump Station.
Electrical Observations	▪ Stations VFD’s are controlled via PLC. Algorithms for pump speed change as well as level control seems to be incorporated. Two pump operation speed reduction ensures both pumps match flow. ▪ Drive panels have an accumulation of dust.

Stanford Generator Building - Fallen Leaf Lake System			
Location:	Stanford Camp at Fallen Leaf Lake		
Year Built, Rehabilitated:	1992, N/A	**Date inspected:**	10/31/2007
Generator	Kohler		
Size, kW	33		
Fuel storage, gallons	Propane		
Maintenance Log Book Summary	No log book provided.		
Mechanical/Structural Observations	▪ Access to this site is very difficult. The site is located on Fallen Leaf Lake with only a single lane road. ▪ The Stanford Generator Building provides standby power to three electrical pump stations located at Stanford Camp. Propane tanks provide fuel source. ▪ Building is not protected from avalanches, which have almost buried the building in the past.		
Electrical Observations	▪ No electrical observations.		

Stateline PS - Small Submersible Pump Station			
Location:	Intersection of Stateline and Lakeshore Boulevard		
Year Built, Rehabilitated:	1971, 1997	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	80	80	
Estimated Firm Capacity, gpm	80		
Head, feet	15	15	
Horsepower, hp	0.75	0.75	
Manufacturer (Year Installed)	Sta-Rite (1997)	Sta-Rite (1997)	
Pump controls	Floats		
Force Main			
Diameter, inches	4		
Length, feet	45		
Material	Cast Iron		
Generator	No generator		
Maintenance Log Book Summary	No log book provided.		
Mechanical/Structural Observations	▪ This submersible pump station is protected by a fence. ▪ The station does not have a standby generator. Overflows are sent by gravity sewer to Bijou Pump Station.		
Electrical Observations	▪ Duplex pump panel in street side enclosure. Duplex pump operated by floats. ▪ This pump station incorporates alternating pumps.		

Taggart Pump Station				
Location:	Fallen Leaf Road – On lakeshore adjacent to Fallen Leaf Road at Tahoe Mountain Road			
Year Built, Rehabilitated:	1979, N/A **Date inspected:**		**Grid Book Page:**	H-29
Pumps	**Pump 1**			
Flow, gpm	Unknown			
Head, feet	33.71			
Horsepower, hp	Unknown			
Manufacturer (Year Installed)	Unknown			
Pump Controls	Float			
Force Main				
Diameter, inches	4			
Length, feet	1,320			
Material	PVC			
Maintenance Log Book Summary	No information			
Mechanical/Structural Observations	▪ Wet well input invert elevation is 6,398.08 ▪ Top of head elevation is 6,431.79 ▪ This station has no alarm system. ▪ Station only pumps for one residence.			
Electrical Observations	▪ This is an electric pump station ▪ No alarms, handles one house			

Tahoe Keys PS - Pump Station with Spiral Staircase Access into Dry Well (Big 6)			
Location:	Tahoe Keys Boulevard and Venice Drive		
Year Built, Rehabilitated:	1960, N/A	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	2,500	2,500	
Estimated Firm Capacity, gpm	2,500		
Head, feet	75	75	
Horsepower, hp	75	75	
Manufacturer (Year Installed)	Peerless/Krogh (1997)	Peerless/Krogh (1997)	
Pump Controls	Ultrasonic		
Force Main			
Diameter, inches	16		
Length, feet	8,073 to junction. 2,050 shared with Ponderosa.		
Material	Asbestos Cement (Transite)		
Generator			
Size, kW	275		
Fuel storage, gallons	200		
Maintenance Log Book Summary	This station requires an average amount of maintenance relative to other stations. Minor mechanical maintenance issues were reported and resolved without incident, and the bubbler tubes required periodic purging, but with low frequency.		
Mechanical/Structural Observations	▪ Access to dry well is by a spiral staircase. Maintenance with the spiral staircase is difficult. ▪ Redundancy includes standby generator, portable pump bypass piping connection, and standby pump. The District has indicated that there is three and one-half hours of collection system storage based on average flow conditions. This pump station only contains two pumps. ▪ Removal of equipment is very difficult at this pump station. Crane must be used to remove the pumps. Working room around pumps and piping is very limited. ▪ Ladder in wet well is corroded. Coating on piping is peeling. Coating on dry well walls is peeling. Concrete aggregate is exposed in wet well. Rust is present on concrete wet well walls indicating possible rebar corrosion. ▪ Pump 1 concrete equipment pad is cracked. ▪ Odor control is provided at this pump station. ▪ This pumping station has a common suction pipe. Discharge piping has ball check valves in the vertical piping.		
Electrical Observations	▪ This pump system has been converted to the preferred VFD's and has Milltronics ultrasonic level instrument with a float. ▪ VFDs provide flow matching. ▪ This station has backup generator that is not the District's standard (Katolight).		

Tallac PS - Pump Station with Spiral Staircase Access into Dry Well			
Location:	In meadow, 700 feet West from Corner of West Way and Ward Way		
Year Built, Rehabilitated:	1968, N/A	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	2,000	2,000	
Estimated Firm Capacity, gpm	2,000		
Head, feet	50	50	
Horsepower, hp	40	40	
Manufacturer (Year Installed)	Paco	Paco	
Pump Controls	Ultrasonic		
Force Main			
Diameter, inches	18		
Length, feet	6,557		
Material	Asbestos Cement (Transite)		
Generator			
Size, kW	80		
Fuel storage, gallons	200		
Maintenance Log Book Summary	This is a very low maintenance pump station. In 5 years of log entries, only 10 irregularities were reported, mostly referring to local power failures and very minor issues with the engine block heater.		
Mechanical/Structural Observations	▪ Access to dry well is by a spiral staircase. Maintenance with the spiral staircase is difficult. ▪ Access to this pump station is very difficult in the winter but there is very little flow to the pump station during the winter. ▪ Redundancy includes standby generator and collection system storage. There is no standby pump. ▪ Space and suction piping is available for a third pump. ▪ Coating on piping is peeling.		
Electrical Observations	▪ Motors are wound rotor motors. Secondary windings are used in a DC and current reference scheme to affect resistance speed control. ▪ Generator is not the District's standard (Katolight).		

Taylor Creek PS - Pump Station with Ladder Access into Dry Well			
Location:	Intersection of Emerald Bay Road (Hwy 89) and Cathedral Road		
Year Built, Rehabilitated:	1968, N/A	**Date inspected:**	10/31/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	2,100	2,100	
Estimated Firm Capacity, gpm	2,100		
Head, feet	43	43	
Horsepower, hp	40	40	
Manufacturer (Year Installed)	Allis Chalmers	Allis Chalmers	
Pump Controls	Ultrasonic		
Force Main			
Diameter, inches	12		
Length, feet	1,503		
Material	Unknown		
Generator			
Size, kW	80		
Fuel storage, gallons	200		
Maintenance Log Book Summary	This is a very low maintenance station. In five years of log entries, there were only 14 entries, mostly referring to blown fuses and other minor electrical issues surrounding the Pump 2. Both pumps air-locked at the same time in September 2006.		
Mechanical/Structural Observations	▪ Access to dry well is by ladder and safety belt. Maintenance using a ladder is difficult and can be a safety hazard. This is a permitted confined space. ▪ Access to this pump station is very difficult in the winter but there is very little flow to the pump station during the winter. ▪ Redundancy includes standby generator, collection system storage, and standby pump. ▪ Sump pump is corroded (rusted). ▪ Metal items in wet well are corroded (rusted).		
Electrical Observations	▪ Motors are wound rotor motors. Secondary windings are used in a DC and current reference scheme to affect resistance speed control. ▪ Generator can only operate Pump 1.		

Trout Creek PS - Pump Station with Ladder Access into Dry Well (Big 6)

Location:	Wastewater Treatment Plant		
Year Built, Rehabilitated:	1967, 2009	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	1,800	1,800	
Estimated Firm Capacity, gpm	1,800		
Head, feet	46	46	
Horsepower, hp	30	30	
Manufacturer (Year Installed)	Paco	Paco	
Pump Controls	Ultrasonic		
Force Main			
Diameter, inches	12		
Length, feet	571		
Material	Asbestos Cement (Transite)		
Generator			
Size, kW	100		
Fuel storage, gallons	200		

Maintenance Log Book Summary	This is a very high maintenance pump station. Pump 2 has many maintenance issues including: mechanical (sheared shaft, rebuilt motor, and check valve problems) and electrical and controls (mercoids slipping out of adjustment, settings adjusted frequently, lead changing unexpectedly). Electrical controls were replaced with VFDs to solve this problem. Recently (2007), pump 2 air-locked several times. The backup generator failed to start during routine tests on several occasions. Pumps required a fair amount of rag removal and back flushing throughout the log history. With ramp down times for the VFDs less than 20 seconds, the check valves slam from hydraulic transients. Pump #1 was rebuilt in 2009.
Mechanical/Structural Observations	▪ Access to dry well is by ladder and safety belt. Maintenance using a ladder is difficult and can be a safety hazard. ▪ Redundancy includes standby generator and standby pump. The District has indicated there is three hours of collection system storage during average flow conditions. ▪ Parts for this pump station are difficult to obtain. District must use composite material for impellers because the impellers are no longer fabricated by the pump supplier. ▪ Wet well is located behind building making it difficult to access. ▪ The dry well contains one sump pump. ▪ Overflow of 80,000 gallons occurred in 2004. ▪ Infiltration was apparent at wet well joints.
Electrical Observations	▪ This station has been modified to use a VFD with manual by-pass. MCC buckets are still used as the control – Start/Stop.

Upper Truckee PS - Pump Station with Spiral Staircase Access into Dry Well (Big 6)			
Location:	1,000 feet southwest of Fountain and Beecher Avenue access road		
Year Built, Rehabilitated:	1967	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	**Pump 3**
Flow, gpm	2,800	2,800	1,950
Estimated Firm Capacity, gpm	3,500		
Head, feet	21.2	21.2	21.2
Horsepower, hp	75	75	75
Manufacturer (Year Installed)	Peerless	Peerless (2007)	Krogh (1998)
Pumping Controls	Ultrasonic. Float Controls for Pump 3		
Force Main			
Diameter, inches	18		
Length, feet	5,700		
Material	Asbestos Cement (Transite)		
Generator			
Size, kW	300		
Fuel storage, gallons	200		

Maintenance Log Book Summary	This is a very high maintenance pump station. The log book only goes back to 2004, but contains frequent references to mechanical problems with pumps: leaking seals, slipped drive shaft, driveline problems, new motor in Pump 1, etc. Pump 2 was replaced on March 15, 2007. Flow meters and flow matchers also had a relatively problematic maintenance history.
Mechanical/Structural Observations	▪ Access to dry well is by a spiral staircase. Maintenance using a spiral staircase is difficult. ▪ Access to pump station is by a long access road, which is difficult to access. Wet well is located behind building making it difficult to access. ▪ Redundancy includes standby generator and standby pump. The District has indicated that there is approximately three hours of collection system storage during average flow conditions. ▪ Ladder in wet well shows some signs of corrosion. Concrete aggregate exposed in wet well at hatch opening. ▪ Swing check valves on Pump 1 and 2 discharge piping and ball check valve are provided on Pump 3 discharge piping. ▪ Input invert elevation is 6,230. The top of the head elevation is 6,251.2
Electrical Observations	▪ This station has MCC bucket with magnetic starter for VFD's. ▪ Ultrasonic level instrument with float alarms. ▪ Automatic transfer switch cabinet needs housekeeping.

Vacuum Valve Station #3 (VV3) – Fallen Leaf Lake System			
Location:	Located at the Main Station Pump Station		
Year Built, Rehabilitated:	1983, N/A	**Date inspected:**	10/31/2007
Vacuum Sewer Line			
Diameter, inches	3		
Length, feet	800		
Material	PVC		
Maintenance Log Book Summary	No log book provided. Some alarms triggered and minor alarm problems noted in Main Station Pump Station log book.		
Mechanical/Structural Observations	▪ The vacuum valve stations have been high maintenance for the District. ▪ Vacuum valve stations do not operate when flooded. ▪ Carbon absorption odor control is provided at this vacuum valve station.		
Electrical Observations	▪ Minimal electrical requirement except to support alarm generation.		

Vacuum Valve Station #4 (VV4) – Fallen Leaf Lake System				
Location:	500 Fallen Leaf Road			
Year Built, Rehabilitated:	1979, N/A **Date inspected:**		**Grid Book Page:**	F-34
Vacuum Sewer Line				
Head, feet	5.29			
Diameter, inches	6			
Length, feet	470			
Material	PVC			
Maintenance Log Book Summary	No information			
Mechanical/Structural Observations	▪ The force main is measured to VV5. ▪ Vacuum pump input invert elevation is 6,374.01. ▪ The top of the head elevation is 6,379.3. ▪ Station has no motor, but uses vacuum pressure to move wastewater. ▪ Vacuum valve station is high maintenance. ▪ Vacuum valve station does not operate when flooded.			
Electrical Observations	▪ Minimal electronic equipment required except for alarm system.			

Vacuum Valve Station #5 (VV5) – Fallen Leaf Lake System			
Location:	South of Stanford Camp		
Year Built, Rehabilitated:	1983, N/A	**Date inspected:**	10/31/2007
Vacuum Sewer Line			
Diameter, inches	3		
Length, feet	50		
Material	PVC		
Maintenance Log Book Summary	No log book provided. Alarms for this vacuum valve station are recorded in the Main Station Pump Station log book.		
Mechanical/Structural Observations	▪ This vacuum valve station is located next to the Main Station ▪ The vacuum valve stations have been high maintenance for the District. ▪ Vacuum valve stations do not operate when flooded.		
Electrical Observations	▪ Minimal electrical requirement except to support alarm generation.		

Vacuum Valve Station #6 (VV6) – Fallen Leaf Lake System			
Location:	Fallen Leaf Road, lot between 454 and 440.		
Year Built, Rehabilitated:	1979, N/A **Date inspected:**	**Grid Book Page:**	F-34

Vacuum Sewer Line	
Head, feet	13.5
Diameter, inches	3
Length, feet	150
Material	PVC
Maintenance Log Book Summary	No information
Mechanical/Structural Observations	▪ Approximately 12’ of 6” PVC in pump station from manhole to septic tank. ▪ The force main is measured to top of 1.13’ VCO lift @ 150’. ▪ Vacuum pump input invert elevation is 6,379.5. ▪ The top of the head elevation is 6,393 ▪ One 1.66’ VCO vertical lift at 10’. ▪ One 3.10’ VCO vertical lift at 60’. ▪ One 3.4’ VCO vertical lift at 110’. ▪ One 1.13’ VCO vertical lift at 150’. ▪ Station has no motor, but uses vacuum pressure to move wastewater. ▪ Vacuum valve station is high maintenance. ▪ Vacuum valve station does not operate when flooded.
Electrical Observations	▪ Minimal electronic equipment required except for alarm system.

Vacuum Valve Station #7 (VV7) – Fallen Leaf Lake System				
Location:	500 Fallen Leaf rd.			
Year Built, Rehabilitated:	1979, N/A	**Date inspected:**	**Grid Book Page:**	G-34
Vacuum Sewer Line				
Head, feet	-0.57			
Diameter, inches	3			
Length, feet	670			
Material	PVC			
Maintenance Log Book Summary	No information			
Mechanical/Structural Observations	▪ Approximately 12' of 6" PVC in pump station from manhole to Vacuum tank. ▪ The force main is measured to VVS 6. ▪ Vacuum pump input invert elevation is 6,385.07 ▪ The top of the head elevation is 6,384.5 ▪ One 1.19' VCO vertical lift at 160'. ▪ Station has no motor, but uses vacuum pressure to move wastewater. ▪ Vacuum valve station is high maintenance. ▪ Vacuum valve station does not operate when flooded.			
Electrical Observations	▪ Minimal electronic equipment required except for alarm system.			

Vacuum Valve Station #8 (VV8) – Fallen Leaf Lake System				
Location:	544 Fallen Leaf rd.			
Year Built, Rehabilitated:	1979, N/A **Date inspected:**		**Grid Book Page:**	G-33
Vacuum Sewer Line				
Head, feet	4.03			
Diameter, inches	3			
Length, feet	450			
Material	PVC			
Maintenance Log Book Summary	No information			
Mechanical/Structural Observations	▪ Approximatley 12' of 6" PVC in pump station from manhole to Vacuum tank. ▪ The force main is measured to VV7. ▪ Vacuum pump input invert elevation is 6,383.07. ▪ The top of the head elevation is 6,387.1. ▪ One 2.21' VCO vertical lift at 210'. ▪ Station has no motor, but uses vacuum pressure to move wastewater. ▪ Vacuum valve station is high maintenance. ▪ Vacuum valve station does not operate when flooded. ▪ Farthest station from the Main Station			
Electrical Observations	▪ Minimal electronic equipment required except for alarm system.			

Venice PS - Pump Station with Ladder Access into Dry Well			
Location:	Venice Drive		
Year Built, Rehabilitated:	1971	**Date inspected:**	10/30/2007
Pumps	**Pump 1**	**Pump 2**	
Flow, gpm	120	120	
Estimated Firm Capacity, gpm	120		
Head, feet	10	10	
Horsepower, hp	3	3	
Manufacturer (Year Installed)	Chicago Pump Company (1971)	Chicago Pump Company (1971)	
Pump Controls	Ultrasonic		
Force Main			
Diameter, inches	6		
Length, feet	1843		
Material	PVC		
Generator			
Size, kW	15		
Fuel storage, gallons	Natural gas		
Maintenance Log Book Summary	This station requires an average amount of maintenance relative to other stations. Generally, control tubing was cleaned and/or replaced multiple times and both pumps tended to trip breakers more than usual. Such problems resulted in above average wet well alarms requiring operator visits.		
Mechanical/Structural Observations	▪ Access to dry well is by a ladder. Maintenance using a ladder is difficult. This is a permitted confined space. ▪ Redundancy includes natural gas standby generator and standby pump. The District has indicated that there is approximately three hours of collection system storage during average flow conditions. ▪ Pump #2 was rebuilt in 2004. Staff commented that this pump needs to be replaced. ▪ Coating on piping is peeling. ▪ Infiltration into the wet well joints appears to be occurring. ▪ Input invert elevation is 6,218.63.		
Electrical Observations	▪ Generator has limited working space.		

BROWN AND CALDWELL

Technical Memorandum

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Prepared for: South Tahoe Public Utilities District, South Tahoe, California

Project Title: STPUD Collection Systems Master Plan

Project No: 132364-003

Technical Memorandum No. 4

Subject: Design Flow Analysis Technical Memo (Task 3)

Date: December 30, 2009

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1. INTRODUCTION

This Technical Memorandum 4 (TM 4) describes the land use analysis and base sanitary flow (BSF) projections. Land use analysis is the basis for projecting BSF production throughout the collection system. BSF will be combined with groundwater infiltration (GWI) and rainfall dependent infiltration and inflow (RDI/I) to produce wet weather flows which are used by the hydraulic model to identify hydraulic capacity deficiencies in sewer pipes, pump stations and force mains. GWI and RDI/I projections are described in Task 5.3.

2. LAND USE

The land use analysis is the basis for the base sanitary flow projections and is conducted on a parcel basis. The goal of the land use analysis is to determine the land use of each parcel within the District's service area and to determine if the parcel is currently connected to the wastewater collection system. In some instances, parcel land use designations were modified to better reflect wastewater flow generation. The results of the land use analysis should only be used in conjunction with this master plan and are not official land uses for any other purpose.

Several agencies in the South Tahoe area are involved with land use planning including El Dorado County (County), the City of South Lake Tahoe (City), and the Tahoe Regional Planning Agency (TRPA). In addition, significant land is owned or managed by the California Tahoe Conservancy (CTC), California State Parks and United States Forest Service (USFS) Tahoe Basin Management Unit. Although each of these agencies is involved in land management, TRPA has primary responsibility for land use planning within the South Tahoe Public Utility District (STPUD or District) service area.

2.1 South Tahoe Area

The STPUD is located within El Dorado County. The STPUD boundary covers roughly 42 square miles and ranges from about 6200 feet to over 9000 feet in elevation. Temperatures range from lows near 15°F in the winter to highs near 80°F in the summer.

2.1.1 Area Description

The STPUD service area includes the City of South Lake Tahoe and unincorporated area of El Dorado County within the Tahoe Basin. The service area is bordered by Hwy 89 North past Cascade Lake, Hwy 89 South to Luther Pass, Hwy 50 East to Nevada state line, and Hwy 50 West before Echo Lake. The service area includes state parks and USFS land.

2.1.2 Tourist Trends

According to the Lake Tahoe Visitors Authority, there are general trends that occur with the visitor population, including:

- Over 1 million visitors to the south shore per year
- More visitors in the summer months, particularly the July 4th holiday weekend through August
- Winter tourism mostly occurs on weekends (Friday night through Sunday afternoon)

- There are fewer visitors in the spring and fall

2.2 Information Sources

Several information sources were used to evaluate the land use for the parcels within the STPUD service area. These information sources include the County GIS, City and County General Plans, TRPA Community Plan Statement Maps, and other sources described below.

2.2.1 GIS

STPUD provided an updated County parcel GIS file to BC in September 2008. The GIS parcel file contained information including assessor parcel number (APN), APN status, owner, acreage, land use code and description, and whether it is developed or vacant. The GIS also designated the STPUD wastewater collection system service area boundary. The service area is not anticipated to change in the future.

2.2.2 General Plans

The City of South Lake Tahoe 1999 General Plan, the 2008 General Plan Housing Element Public Review Draft, and the El Dorado County 2004 General Plan provide additional information to the GIS parcel use categorization.

The 2008 General Plan reports an average of 2.50 people per household in South Lake Tahoe. The 2008 General Plan also references the STPUD Future Connections Facilities Plan (1995), which provides for additional development of 116 residential units per year, 133,333 square feet of commercial space, 32 new hotel rooms, and 933 new campsites. Table 4-55 in the 1995 Plan lists TRPA Density Limitations for Residential Uses for the Tahoe Basin of 15 units per acre for multiple-family dwellings and eight units per acre for mobile home dwellings. However, it states that "most, if not all, of the City's twenty mobile home and RV parks are nonconforming and overly dense." Redevelopment of these parks may reduce densities but may not necessarily reduce wastewater flows.

The general plans did not include comprehensive land use maps or tables for the area.

2.2.3 Tahoe Regional Planning Agency (TRPA)

TRPA is an interstate agency whose mission is to cooperatively lead the effort to preserve, restore, and enhance the unique natural and human environment of the Lake Tahoe region now and in the future. TRPA was formed in 1969 by Congress in response to the region's rapid growth.

There were two sources of information from TRPA used for this project: the Plan Area Statement (PAS) Maps and the Community Plans for Stateline/Ski Run, Bijou/Al Tahoe, and South Y Industrial. Both sources provided information about the future allowable development for parcels. Some parcels that were coded as Single Family (RES) in the County GIS database were classified for master planning purposes as multiple-family residential (MFR) and some were changed to non-contributing (NC) status based on information provided by the TRPA documents. The TRPA documents did not include comprehensive land use maps or tables for the study area.

Parcel development allowed by TRPA may be more restrictive than the County land use designations. Also, TRPA land capability limitations may result in a given parcel being unbuildable even though County zoning classifications indicate permissible uses. To be conservative, this master plan considers the least restrictive land use planning which could result in relatively higher BSF.

2.2.4 US Forest Service (USFS)

BC reviewed the November 2006 Land and Resource Management Plan and spoke with Karen Kuentz of the USFS Tahoe Basin Management Unit on October 16, 2008 regarding USFS-owned parcels in the South Tahoe area. Highlights from the phone conversation are listed below:

- Cabins are leased to individuals on a long-term basis, but the land is owned by USFS.
- USFS has purchased urban lots in residential areas through the Santini-Burton Purchase Program. USFS owns around 3000 lots in the South Tahoe basin. The Santini-Burton funds are mostly used up.
- There will not likely be any additional residences on USFS land in the future.
- Although there are no current plans for development, bathrooms may be installed at some point at trailheads, visitor centers, etc.
- TRPA and USFS generally coordinate and work together collaboratively.
- Both USFS and TRPA are in the process of revising the TRPA Regional Plan. These plans are not going to be completed for roughly another year.

The USFS website has maps showing the extent of the fires that occurred the summer of 2007. These maps also show locations of national forests.

2.2.5 Other

Google satellite imagery from the internet was employed to identify schools, campsites, mobile home parks, and offices located on government lands but not identified in the GIS. These parcels would have otherwise been designated NC.

2.3 Parcel Land Use

For this master plan, County land use designations for many parcels were reclassified or consolidated based on wastewater production characteristics. Several parcels were reclassified and some new categories were added for the purpose of accurately projecting BSF. The revised master planning land use categories are summarized in Table 2-1. A database with the original land use codes and the master plan land use codes is in Attachment A.

Table 2-1. Master Planning Parcel Land Use Codes and Description		
Master Plan Code	**Description**	**Types of Parcels**
COM	Commercial	Marinas, Misc. Improved Com, Retail, Parking Lots, Places of Worship, Restaurants, Service Station, Supermarkets, VACANT COMMERCIAL LAND
MHT	Motel/Hotel	Motel/Hotel, Underlying Interest in Time Share Project
IND	Industrial	Hospitals & Convalescent Hospitals, Light Manufacturing, Med/Dental/Vet Offices, Mini-Warehouses (MINI-STORAGE), Misc. Improved Industrial Property, Offices, Warehouses, VACANT INDUSTRIAL LAND
UTL	Utility	Utility including STPUD and others
MFR	Multi-family Residential	Mobile Home Parks, Multi-Unit 2-3 units, Multi-Unit 4+ units, Retirement Housing, VACANT MULTI-RES. LAND 4+ UNITS ALLOWED
CMP	Campgrounds	Campgrounds
MSC	Miscellaneous	Community Oriented Facilities, Fire Suppression Facilities, Misc. Improved Recreational, Schools (lg, med, sm), Unassigned
NC	Non-contributing	Parking Lots, Golf Courses, Garbage Dump, Non-Res Improvements <=2.5 AC., Cemeteries (1), Subj. to Open Space Contract (Not CLCA), VACANT RECREATIONAL LAND, RURAL RESTRICTIVE ZONING - CLCA (ACTIVE), ENV. SENSITIVE LAND - RESTRICTED USE, TIMBER PRESERVE ZONING – ACTIVE, UNASSIGNED
RES	Single Family Residential	Condo's & Townhouses, Residence on leased land, Rural Res. 2.51-20.0 AC. 1 SF Unit, Rural Res. 20+ AC. 1 RES. Unit, Rural Res Land 20+ Minor NON-RES IMPR, Single Fam Res. <=2.5 AC.(INC. MAN. HMS, VAC RURAL RES LAND 2.51-20.0 AC. 1 UNIT, VACANT RES. LAND <=2.5 AC. 1-3 UNITS
PS	Point Source	Large wastewater contributors based on Water Billing Data.
VAC	Currently Vacant but available for future development	VACANT COMMERCIAL LAND, VACANT INDUSTRIAL LAND, VACANT MULTI-RES. LAND 4+ UNITS ALLOWED, VACANT RECREATIONAL LAND, VAC RURAL RES LAND 2.51-20.0 AC. 1 UNIT, VACANT RES. LAND <=2.5 AC. 1-3 UNITS

The County GIS identified land use for each parcel and whether the parcel was vacant (VAC). VAC indicates that the parcel is privately owned and potentially can be developed in the future.

2.3.1 Master Plan Use Codes, Revised Categorization

The County GIS includes a land use category of MSC for miscellaneous. This broad categorization is problematic for developing and calibrating land use-based sanitary flows. Sub-categories under MSC included Rural Restrictive Zoning – CLCA (AGP), Environmentally Sensitive Land – Restricted Use (RLU), and Timber Preserve Zoning (TPZ) in addition to the developed (DEV) and vacant (VAC) sub-categories. For this master plan, all parcels that would contribute no or very little wastewater to the collection system are coded as non-contributing (NC). The AGP, RLU, and TPZ parcels were assigned a NC status based on the restrictive nature of development on these types of parcels. Similarly, parcels owned by CTC were also assigned NC status. The parcels remaining in the MSC category for the master plan include community and recreational facilities, fire suppression facilities, and schools. There are also about 50 MSC parcels that were described as “Unassigned.” These parcels remain in the master plan MSC category.

Several large parcels in the County GIS database are coded as residential in the GIS but they are national forest lands according to the USFS maps. These parcels were designated as NC.

The El Dorado County GP has an Open Space category which is described as designating public lands under governmental title (County, State Parks, BLM, U.S. Bureau of Reclamation, U.S. Forest Service, etc.) and includes state parks, ecological preserves, and public lands acquired specifically for open space uses. This definition was used to identify additional parcels that would not contribute significant wastewater flows to the collection system, which were given the NC classification previously defined. Parcels that fit into this category included property owned by the government (Garbage, City, County, State, District, CTC, and Federal).

Leased cabins on USFS land do not have individual parcels and therefore, cannot be identified or tracked on a parcel basis. These cabins are generally located north of Fallen Leaf Lake and are accessible only during the summer. This area was designated as NC along with other government land and summer flow projections are handled separately as Seasonal Flows in Section 3 of this Tech Memo.

Mobile home parks and Motels were originally coded as commercial in the County GIS. Mobile home parks are categorized as MFR for the master plan. Motels were categorized with hotels as motel/hotel (MHT).

2.3.2 Master Plan Use Codes, Additional Categories

In addition to the new NC category, four more categories were created to facilitate master plan base sanitary flow development. A utility (UTL) category was created; these parcels are considered to contribute no significant flow to the collection system.

Motels are grouped in the commercial category of the County GIS. Motels have different flows and hydrographs than other types of commercial business. Therefore, a new code was created for the master plan for MHT that are not considered point sources. Point sources (PS) are parcels such as large resorts that contribute a large amount of wastewater to the system. Point sources are discussed in more detail below.

A new master plan category was created for campgrounds (CMP). Campgrounds produce wastewater at flows that are different from other land uses and consequently, needed to be separately identified and tracked.

2.3.3 Redevelopment

Redevelopment is taking place in the Stateline are and is being considered in the Y area. In the Stateline area, old motels and other businesses are being torn down to make way for new commercial, lodging and convention space. The redevelopment is expected to produce higher BSFs than existing uses due to higher occupancies and increased visitation, both on a peak basis and annual basis. The impacts of future redevelopment projects on wastewater flows will need to be assessed on a project basis, in part by using the hydraulic model developed with this master plan.

2.4 Planning Scenarios

Visitor population is highest during the summer and winter. For this master plan, summer and winter scenarios for both existing and build-out conditions were developed resulting in a total of four scenarios. The existing scenarios include flows from all contributing parcels that are not currently vacant according to the GIS database. The build-out scenario will include flow from every parcel that can contribute wastewater. The land use acres by master plan category are summarized below in Table 2-2 and are shown on Figure 2-1, Current Land Use, and Figure 2-2, Build-Out Land Use.

Table 2-2 Land Use Acres

Master Plan Use Code	Description	Current, Acres	Build-Out, Acres	Net Increase or (Decrease), Acres
CMP	Campground	418	491	73
COM	Commercial	235	396	161
IND	Industrial	189	223	34
MFR	Multi-Family Residential	369	401	32
MHT	Motel/Hotel	146	146	0
MSC	Miscellaneous	371	388	17
RES	Single Family Residential	3,844	5,159	1,315
UTL	Utility	201	201	0
VAC	Vacant, available for future development	1,560	0	(1,560)
NC	Open Space	19,668	19,595	(73)
PS	Point Source	129	129	0
	Grand Total	**27,132**	**27,132**	**0**

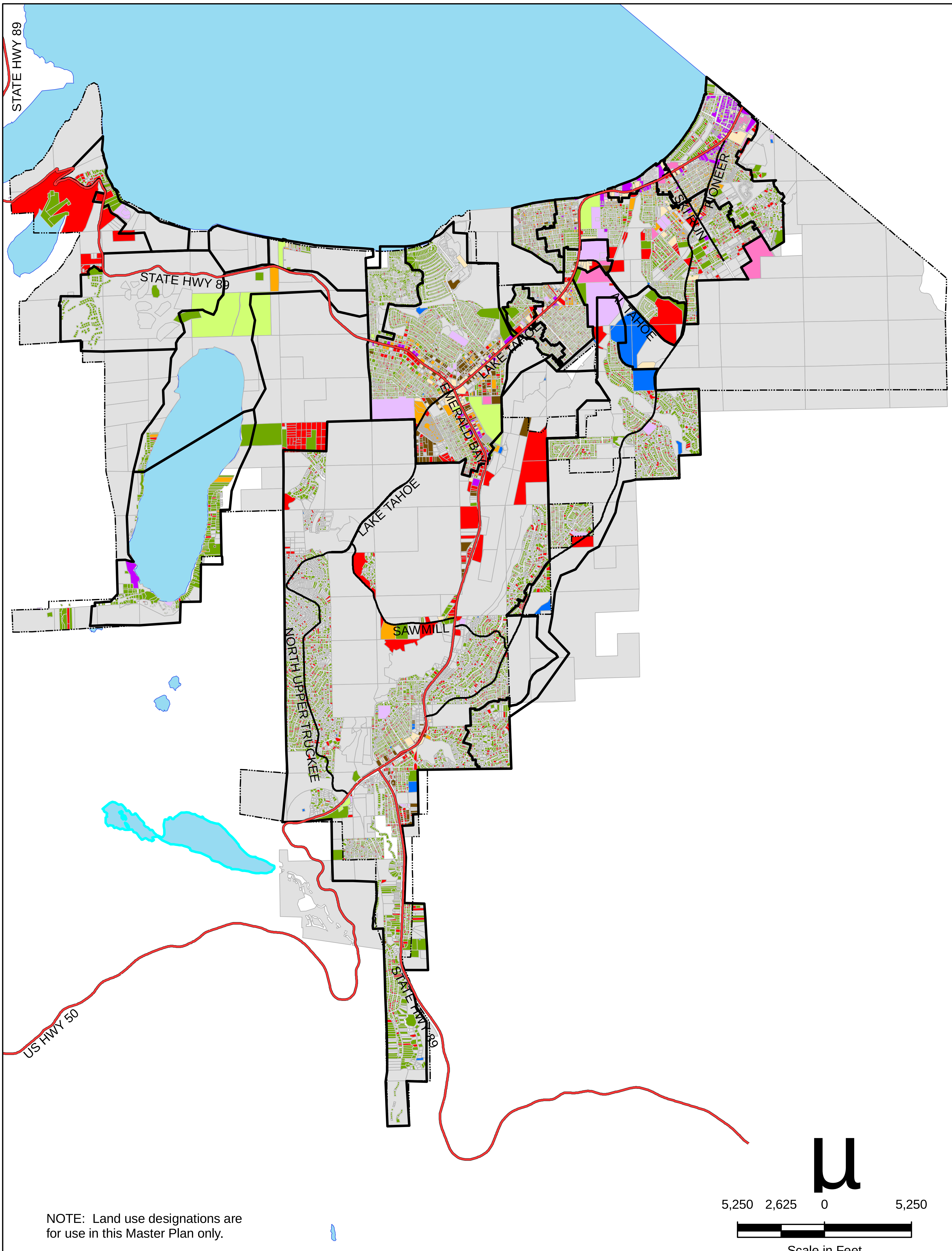
Typically, a dry weather and wet weather scenario is created for a collection system hydraulic evaluation where the wet weather is considered a worst-case scenario due to the RDI/I that can occur during storms. South Tahoe has a highly variable seasonal population. There are visitors in both winter and summer, but generally more people visit in the summer. With the visitor population higher in the summer, both summer (dry season) and winter (wet season) are used to evaluate collection system hydraulics. The differences between the seasonal populations are described below.

2.4.1 Winter Only Flows

Heavenly Ski Resort is a main winter attraction in the South Tahoe area, and is considered a winter-only point source with negligible summer wastewater flow based on water billing data.

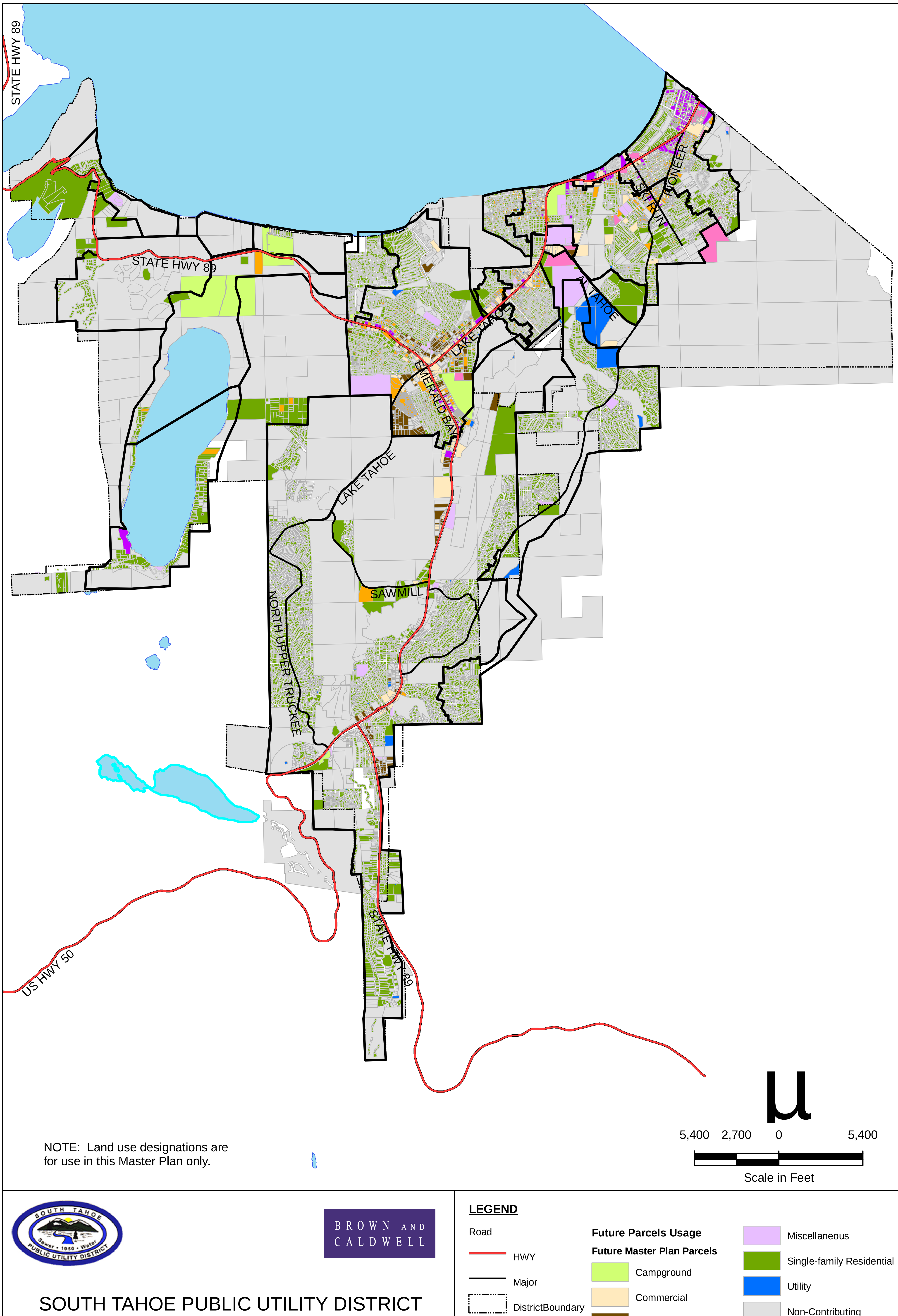
2.4.2 Summer Only Flows

The areas west of the City of South Lake Tahoe around Fallen Leaf Lake and north of Fallen Leaf Lake include campgrounds and cabins that are connected to the collection system but are not accessible during winter months. These areas contribute flow only during the summer. There is a very small permanent population in this area and there is little access to this area for winter visitors. The collection system in this area will not be modeled due to the low flows that exist during the winter and lack of specific information on cabin and campground locations. Summer flows from these areas are discussed in Section 3.3.4



SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 2-1
Current Master Plan Parcel Land Use



SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 2-2
Future Master Plan Parcel Land Use

3. BASE SANITARY FLOW PROJECTIONS

This section summarizes the development of the BSF projections for parcels located within the District's collection system service area. Flow projections for current and build-out scenarios are the base for the development and calibration of the hydraulic model of the District's sewerage network and evaluation of hydraulic deficiencies.

3.1 Data Sources

Data sources used for developing BSF projections include:

- Potable water billing records: 2006 and 2007 quarterly water use for non-residential customers;
- WWTP flow meter: 2001 through May 2008 average daily flows;
- Temporary flow monitoring: 2007 (DW), 2008 (DW and WW);

3.1.1 Water Billing Records

Water usage can be used to estimate wastewater flows. STPUD provided potable water billing records for the complete years of 2006 and 2007. Water customers are billed on a 3-month billing cycle as summarized in Table 3-1. Water billings are based on metered flows for all customers except single family residential. Single family residences pay a flat rate and are not metered.

Table 3-1. Water Billing Cycles

Billing Period	Months (2006/2007)	Season
April-06 and 07	January, February, March	Winter (high)
July-06 and 07	April, May, June	Spring (low)
October-06 and 07	July, August, September	Summer (high)
January-07 and 08	October, November, December	Fall (low)

Winter water use is used to calculate unit flow factors because irrigation is considered to be negligible in the winter. The April billing period was selected for winter water use analysis, corresponding to the period of January 1 through March 31 of 2006 and 2007.

3.1.2 Wastewater Treatment Plant Flow Meter Data

Data from the Wastewater Treatment Plant (WWTP) flow meter and precipitation gauge were provided from January 1, 2001 through May of 2008. Average daily flow and precipitation for that period are plotted on Figure 3-1.

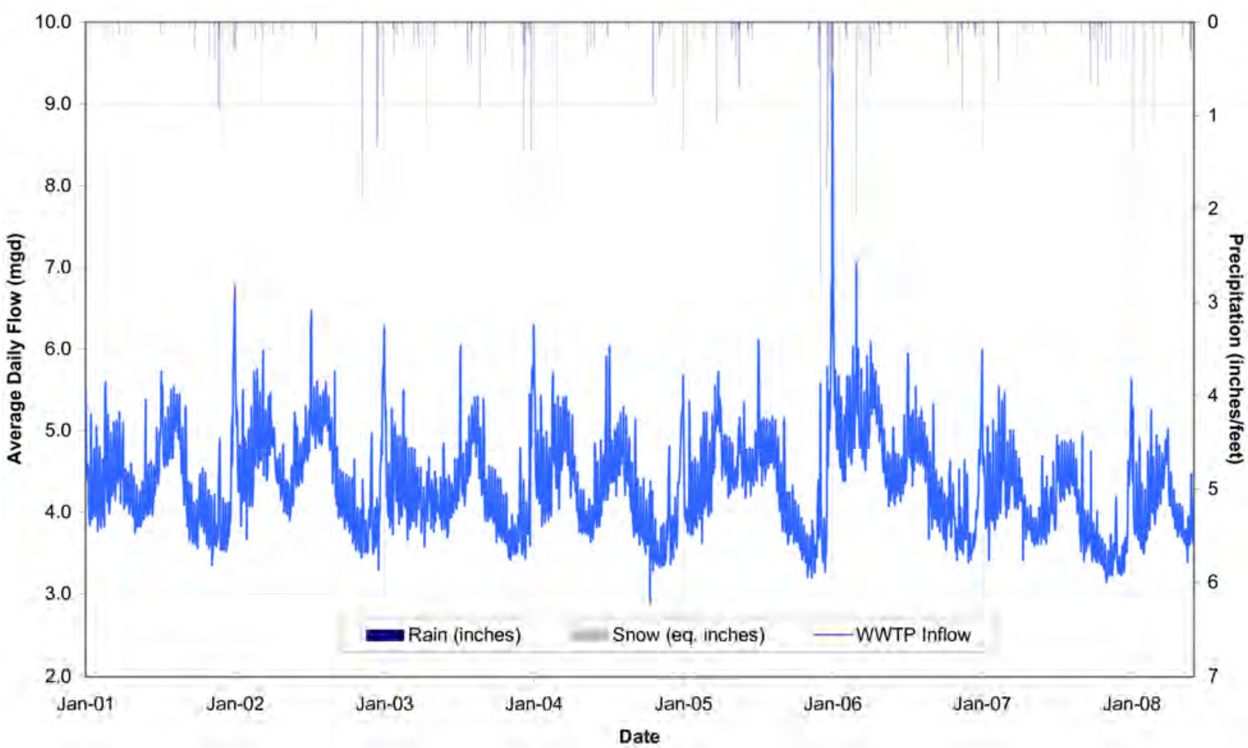


Figure 3-1. WWTP Flow (mgd)

Average daily flow and daily precipitation, January 1, 2001 through May 31, 2008.

The peak daily flow during this period was 9.37 mgd, recorded on December 31, 2005. The WWTP rain gauge recorded 2.00 inches of rain during the day prior to and 2.76 inches on the day of that peak. The minimum recorded average daily flow of 2.89 mgd occurred on October 11, 2004. October and November consistently showed the lowest monthly average flows for all of the years of record.

3.1.3 Flow Monitors and Data

Temporary flow monitoring programs were undertaken on three separate occasions, with the intent of capturing both wet and dry season flow data.

- Wet Season 2007: April 1 to May 11
- Dry Season 2007: August 21 to September 18
- Wet Season 2008: March 31 to May 28

The rain gauges (RG) indicated that there was no significant precipitation during any of the above periods; hence data from all three periods is only pertinent to the analysis of seasonally variable dry season flows. Rain gauge data is presented in Table 3-2 as total inches of precipitation during each flow monitoring period. Very little rain fell during the flow monitoring period.

Table 3-2. Total Precipitation During Flow Monitoring Periods (inches)			
Rain Gauge	2007 Dry Season	2007 Wet Season	2008 Wet Season
RG1	0.70	2.27	0.43
RG2	0.06	0.84	0.96
RG3	n/a	0.91	0.66
RG4	n/a	1.08	1.04
RG5	n/a	0.66	1.14

Note: Only two rain gauges were installed during the 2007 dry season monitoring.

Table 3-3 presents a summary of flow monitor (FM) information for the 16 temporary FM sites selected. The FM and RG sites are shown on Figure 3-2. According to the flow monitoring site reports, some manholes used for flow monitoring in 2007 were inaccessible during the 2008 period, so certain FMs were relocated to nearby manholes as indicated on the figure.

Table 3-3. Temporary Flow Monitor Information							
Meter No.	Sewer Basin	Corresponding Rain Gauge	MH_ID (2007)	MH_ID (2008)	DS pipe Diameter	US pipe Diameter	Comments
1	Taylor Creek	5	TY2	same	18	18	
2	Tallac	5	TL37	same	15	15	
3	Tallac	5	TL1	TL11	24	24	Site change in 2008
4	Tahoe Keys	4	TK5	same	21	21	Sensor on US pipe
5	Tahoe Keys	4	TK26	same	18	18	
6	Bijou	3	BJ5	same	18	18	Sensor on US pipe
7	Bijou	3	BJ181	same	12	12	
8	Ski Run	3	SR4	same	10	10	
9	Al Tahoe	4	AT19	AT22	12	11	Site change in 2008
10	Al Tahoe	4	AT3	same	20	20	Weir meter in 2007 wet
11	Al Tahoe	4	AT43	AT44	8	8	Site change in 2008
12	Upper Truckee	1	UT7	UT13	24	24	Site change in 2008 Sensor on US pipe
13	Trout Creek	2	TR12	same	18	18	
14	Upper Truckee	1	UT254	UT263	15	15	Site change in 2008
15	Upper Truckee	1	UT378	UT165	15	15	Site change in 2008, (diameters=21 inches) Sensor on US pipe
16	Upper Truckee	1	UT166	same	12	12	

3.2 Unit Flow Factors

BSF is projected by applying the appropriate unit flow factor to each parcel. Unit flow factors are based on land use. Parcels with land uses of NC, VAC and UTL do not produce significant wastewater flow and are assigned a unit flow factor of 0 gal/day.

Unit flow factors for all other land uses except RES are based on water billing data. In a non-arid, urban setting such as South Lake Tahoe, landscape irrigation and other non-household water uses are typically at a minimum during wet season winter months, and the amount of municipal water consumed can be consistently correlated with the amount of water returned to the wastewater collection system and is used to estimate BSF. The potable water returned to the collection system as BSF is typically 80 to 90 percent of winter water use. For this project, BSF is estimated to be 90 percent of winter water consumption. Water billing data were assigned to their corresponding parcels and unit BCF rates were calculated on a gallon per day per acre (gpd/ac) basis for each land use classification. Large consumers that will be treated as wastewater point sources were removed prior to this analysis because they would have skewed the averages. Results of the unit flow factor analysis are summarized in Table 3-4.

Table 3-4. Winter Water Use (Average of Apr-06 and 07 Billing)

BC_LU	Description	Avg. Acres Billed	Avg. No. Parcels Billed	Winter Water Use (gpd/acre)
CMP	Campground	86	4	58
COM	Commercial	137	124	1,201
IND	Industrial	66	88	489
MFR	Multi-Family Residential	88	136	3,156
MHT	Motel/Hotel	56	53	2,950
MSC	Miscellaneous	117	16	148

Flow monitor data from FM-13 (during 2007 DW) was used to estimate a typical unit flow factor for RES parcels. The FM-13 tributary area is highly single family residential. The average daily flow from the flow monitoring data was divided by the number of RES parcels. The 2008 General Plan for the City of South Lake Tahoe reports an average of 2.5 people per household, which corresponds to 72 gallons per person per day for RES parcels.

Table 3-5 lists the unit flow factors developed for the consolidated land use categories defined for the hydraulic model. The ability to calibrate the model may require that the flow factors be revised later, along with the estimated point source flows. Flow factors are applied on a per-parcel basis for the RES classification, while factors for all other land uses are applied on an area basis (gpd/acre).

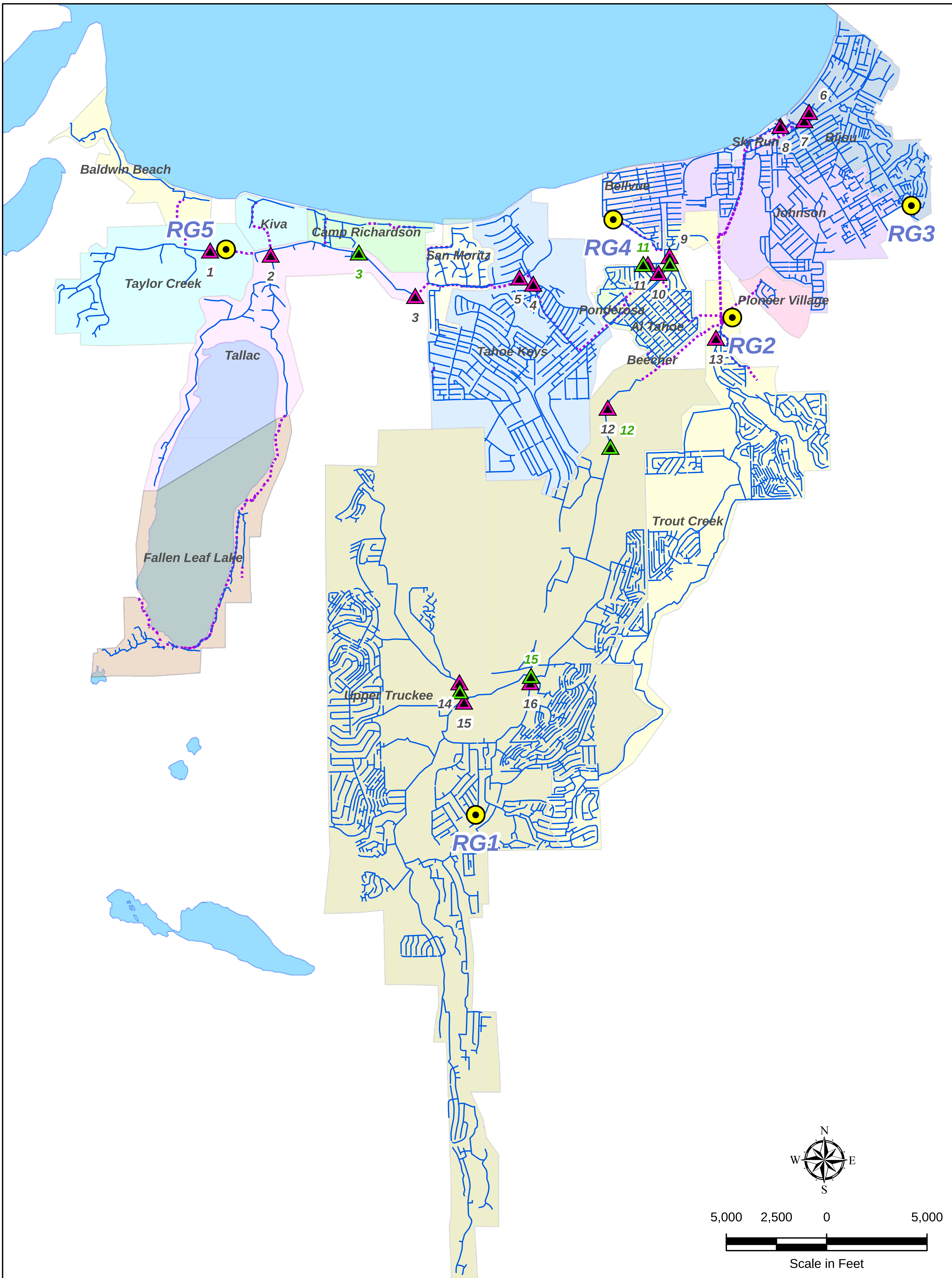


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Figure 3-2
Temporary Flow Monitor and Rain Gauge Locations

P:\132000\132364_STPUD_MP\GIS\mxd\DesignFlow_TM\FlowMonitors.mxd July 28, 2009

Table 3-5. Preliminary Unit Flow Factors from Water Use Data			
Land Use Designation	**Average Winter Water Demand**		**Wastewater Unit Flow Factor [1]**
Campground (CMP)	*n/a*	From summer-only sources	-
Commercial (COM)	1,201	gpd per acre	1,080
Industrial (IND)	489	gpd per acre	440
Multi-Family Residential (MFR)	3,156	gpd per acre	2,840
Motel/Hotel (MHT)	2,950	gpd per acre	2,655
Miscellaneous (MSC)	148	gpd per acre	135
Non-Contributing (NC)	*n/a*	Negligible WW Flow	-
Single Family Residential (RES) [2]	*n/a*	gpd per parcel	180
Utility (UTL)	*n/a*	Negligible	-
Vacant (VAC)	*n/a*	Current LU assumes no WW Flow	-

[1] *Calculated as 90 percent of the winter water demand*
[2] *The RES flow factor is based on flow monitor data from FM-13 during the 2007 dry weather temporary flow monitoring period.*

3.3 Point Sources and Seasonal Flows

A point source is a customer that produces a larger than normal amount of wastewater as compared with its land use-based flow factor. Point sources are singled out so that they can be modeled accurately rather than using a unit flow factor and parcel acreage to estimate the flow. According to water billing data, some parcels are large water consumers only in winter, some only in summer, and others year-round. Only sources with large winter water use (January through March) were identified as point sources based on billing record criteria because it is expected that a significant portion of water used during the summer months is for irrigation.

The campgrounds only contribute flows during the summer. Both summer flow sources and winter point source parcels are shown on Figure 3-3. Criteria used for each season are explained in the following sections.

3.3.1 Point Sources

Water billing records were analyzed to compile a list of large water consumers. Parcels were identified as point sources if billing records indicated that they consumed more than 15,000 gpd of potable water during either the 2006 or 2007 winter billing periods. All point sources are considered year-round sources except Heavenly Valley Ski Resort which is a winter-only point source. As with the unit flow factors, the water use during the winter is also used as the basis for the summer flows to avoid including irrigation water use. The list of point sources is presented in Table 3.6.

Table 3-6. Winter and Year-Round Point Sources				
Point Source	**Original LU Code**	**Parcel No.**	**Billing Address**	**Winter Water Use (gpd)**
Heavenly Valley Ski Resort [1]	MSC	03037004	1500 KELLER RD	18,000
Lake Tahoe Community College (157 sewer units)	MSC	02501034	1 COLLEGE DR	10,500
Marriott Grand Residence Tahoe (APN was 02947001)	MSC	02949001	1001 HEAVENLY VILLAGE WAY	46,000
Marriott-Timber Lodge old (APN was 02947010)	COM	02948004	4100 LAKE TAHOE BLVD	41,500
Embassy/Lake Tahoe Vacation Resort (APN was 02706317)	MHT	02769004	901 SKI RUN BLVD	27,500
Bijou Woods Apartments	MFR	02524110	3421 SPRUCE AVE	26,500
Inn by the Lake	COM	02717015	3300 LAKE TAHOE BLVD	23,000
Tahoe Colony Inn	MHT	02944104	3794 MONTREAL RD	21,000
Tahoe Seasons Resort	MSC	02823101	3901 SADDLE RD	20,500
Tahoe Sands Inn	MHT	02704007	3600 LAKE TAHOE BLVD	20,000
El Dorado County Jail	IND	02501021	1051 AL TAHOE BLVD	18,500
Barton Memorial Hospital	IND	02308103	2170 SOUTH AVE	17,500
TOTAL Current Water Use (Rounded)				291,000 gpd
Current Wastewater Generation (90% of water use)				**260,000 gpd**
Chateau at Heavenly Village				60,000 gpd
Future Wastewater Generation (90% of water use)				**320,000 gpd**

[1]Heavenly Valley Ski Resort has 8-inch and 10-inch water service connections that are likely used for snowmaking operations. Therefore, winter water use listed in the table does not include consumption from the 8-inch and 10-inch water service connections.

3.3.2 Future Point Sources

Future point source wastewater generation was assumed to be the same as current with the exception of the Chateau at Heavenly Village, which is currently under construction/expansion. The Chateau site is located on the north side of Lake Tahoe Blvd. at the state line. Information provided by the District indicates that upon completion, the facility will contain 1,021 sewer units. A sewer unit is assigned for each fixture on a property. Wastewater generation from one sewer unit—calculated from similar facilities such as the Marriott Grand Residence and Marriott Timber Lodge—is approximately 60 gallons per day. Based on those numbers, the Chateau is projected to generate approximately 60,000 gallons per day in the future as indicated in the point source table above.

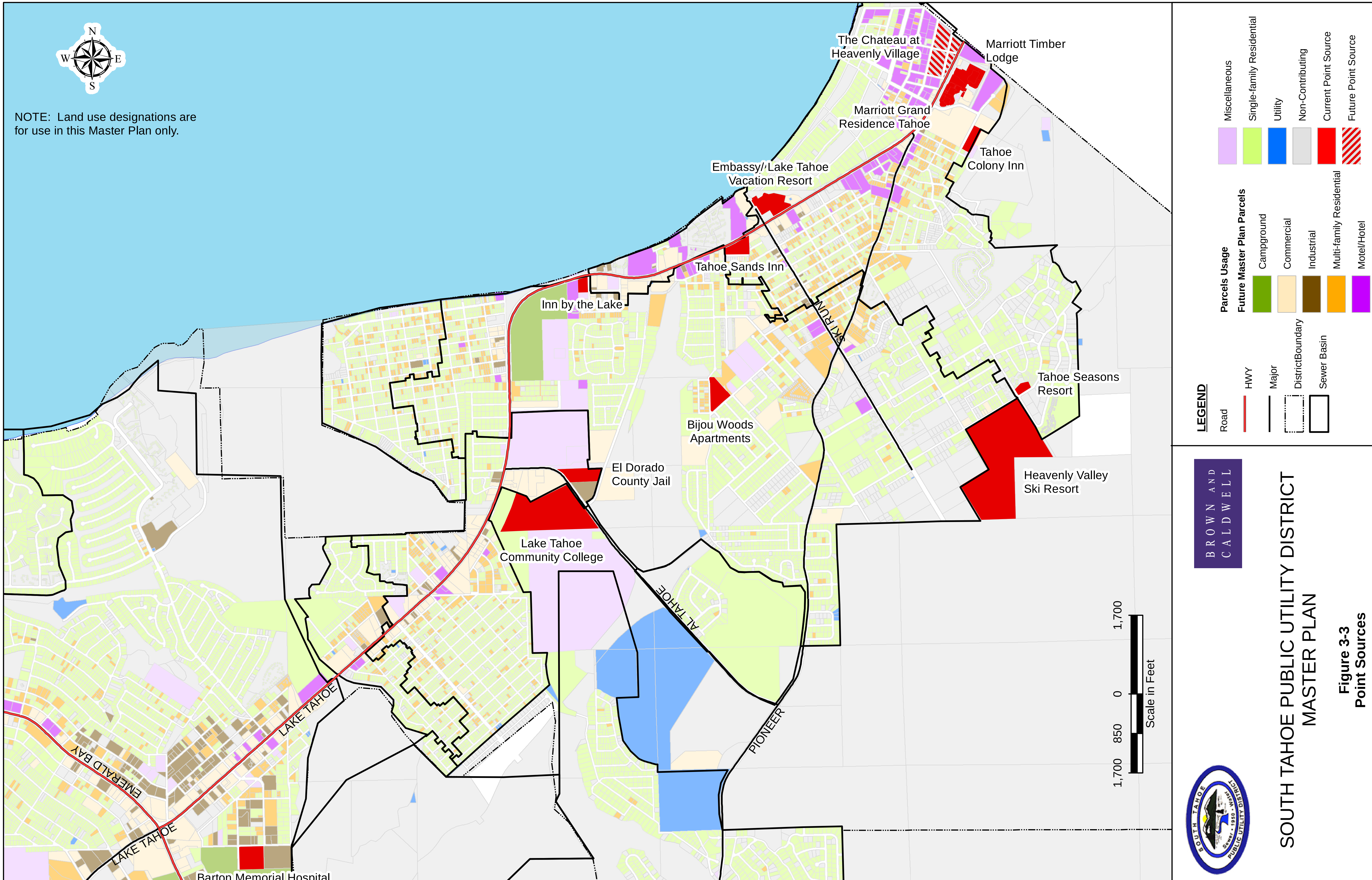

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Figure 3-3
Point Sources

3.3.3 Summer-Only Flow Sources

Summer-only flow sources were identified in order to more accurately model certain areas of the collection system with highly seasonally-dependant flows. Such summer-use areas include Fallen Leaf Lake, Baldwin Beach, Kiva, Camp Richardson, and Pope Beach, among others. Flows from these sources make up a significant portion of the summer BSF in the collection system west of Tallac Pump Station.

Summer-only wastewater generation was estimated directly, based on the number of sewer units assigned to the parcels in the GIS. Summer-only parcels and their estimated wastewater generation factors are listed in Table 3-7.

Table 3-7. Summer Only Flow Sources

Summer Flow Source	LU Code	Parcel No.	Sewer Units	Avg Water Use Factor (gpd/sewer unit)	Avg. Daily WW Generation (gpd)
Camp Richardson (on National Forest Lands)	CMP	03213008	452	60	27,000
Tahoe Valley Campgrounds	CMP	02308108	353	60	21,000
South Lake Tahoe Recreation, Campground by the Lake	CMP	02605005	150	60	9,000
Fallen Leaf Campground (on National Forest Lands)	CMP	01907104	100	60	6,000
KOA	CMP	03501026	61	60	4,000
Cedar Pines Resort, camping (~15) + cabins (>=8)	CMP	03220109	22	60	1,500
Campground	CMP	02308111	12	60	1,000
Church organization owned	CMP	02311146	9	60	500
Fallen Leaf Campground (same APN appears twice in GIS)	CMP	01907104	-	60	-
TOTAL Summer Point Source WW Flow (Rounded)					**70,000 gpd**

Table 3-8 presents a summary of summer-only flows and winter point source wastewater generation.

Table 3-8. Summer-Only and Point Source Flows by Season

Source	CURRENT (gpd)		BUILD-OUT (gpd)	
	Summer	Winter	Summer	Winter
Year-Round	245,000	245,000	305,000	305,000
Winter-Only	0	15,000	0	15,000
Summer-Only	70,000	0	70,000	0
Total (gpd)	**315,000**	**260,000**	**375,000**	**320,000**

3.3.4 Summer Seasonal Flows West of Tallac Pump Station

The District indicated that the area west of the Tallac PS could be considered a summer-only area. Flows from sources in that area are conveyed by the 24-inch gravity sewer to Tallac PS. For hydraulic modeling purposes, flows from this area are estimated using Tallac PS flow data and loaded into the model at the

Tallac PS as a single, summer-only flow source. Hydrographs from the temporary flow monitor (FM-3) located on the 24-inch main just before Tallac PS are plotted in Figure 3-4. For the figure, the peak dry day—no precipitation for at least 5 days prior—was chosen for each of the three FM periods, and their hydrographs superimposed.

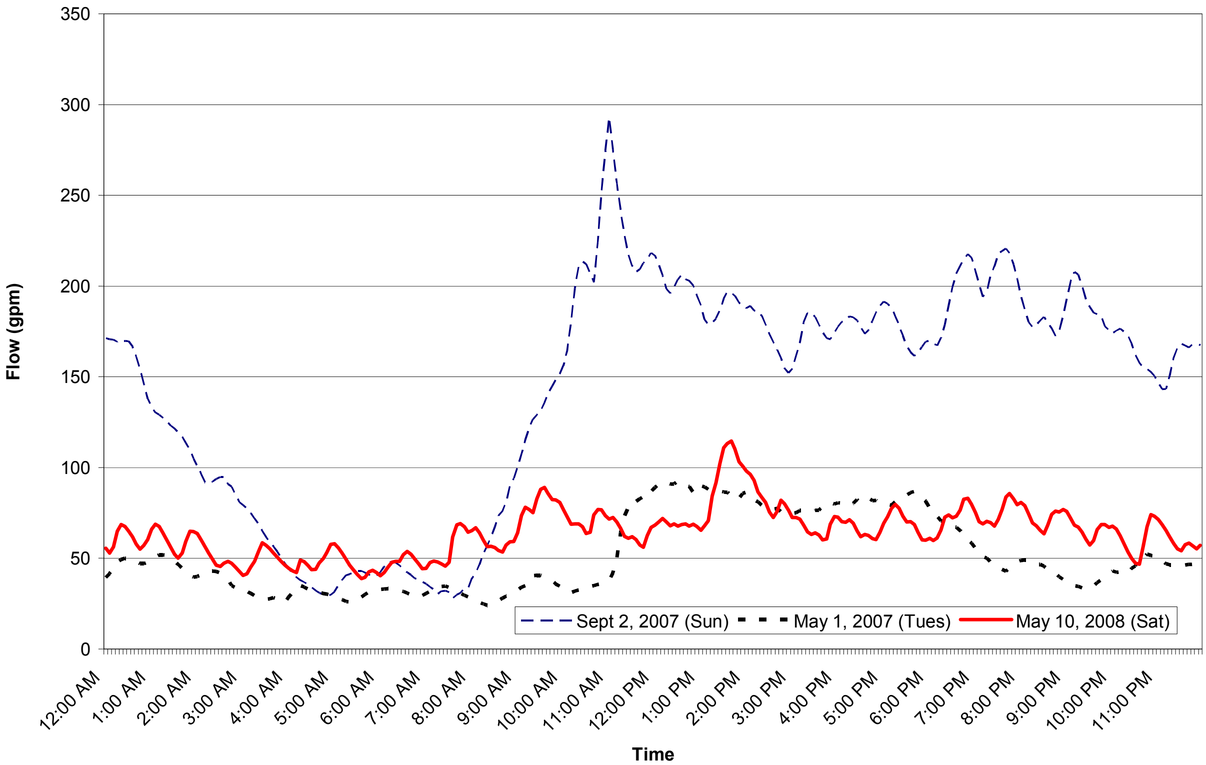

Figure 3-4. Flows Upstream of Tallac PS (mgd)

Peak dry day flows with no antecedent precipitation for the three temporary FM periods

Note that only the 2007 summer flow (red line) resembles the typical diurnal pattern expected for flow from a populated area. Removing GWI, the hydrographs clearly show that winter BSF from this service area is negligible when compared to summer BSF.

3.4 Flow Variations

BSF varies during the day and by land use. Temporary flow monitor data from the 2007 dry-weather months was used to construct diurnal curves for residential and non-residential areas of the STPUD collection system service area. Data from FMs 13, 14, and 15 were used to develop RES diurnal patterns because they serve areas that are almost exclusively comprised of single family residential parcels. The resulting curves depicting weekday, weekend, and holiday weekend flow patterns are presented on Figure 3.5. The curves for a typical weekend and a holiday weekend (Sunday, Sept. 2, 2007) were found to be similar so that use of an exclusive holiday weekend curve could be discontinued without sacrificing accuracy.

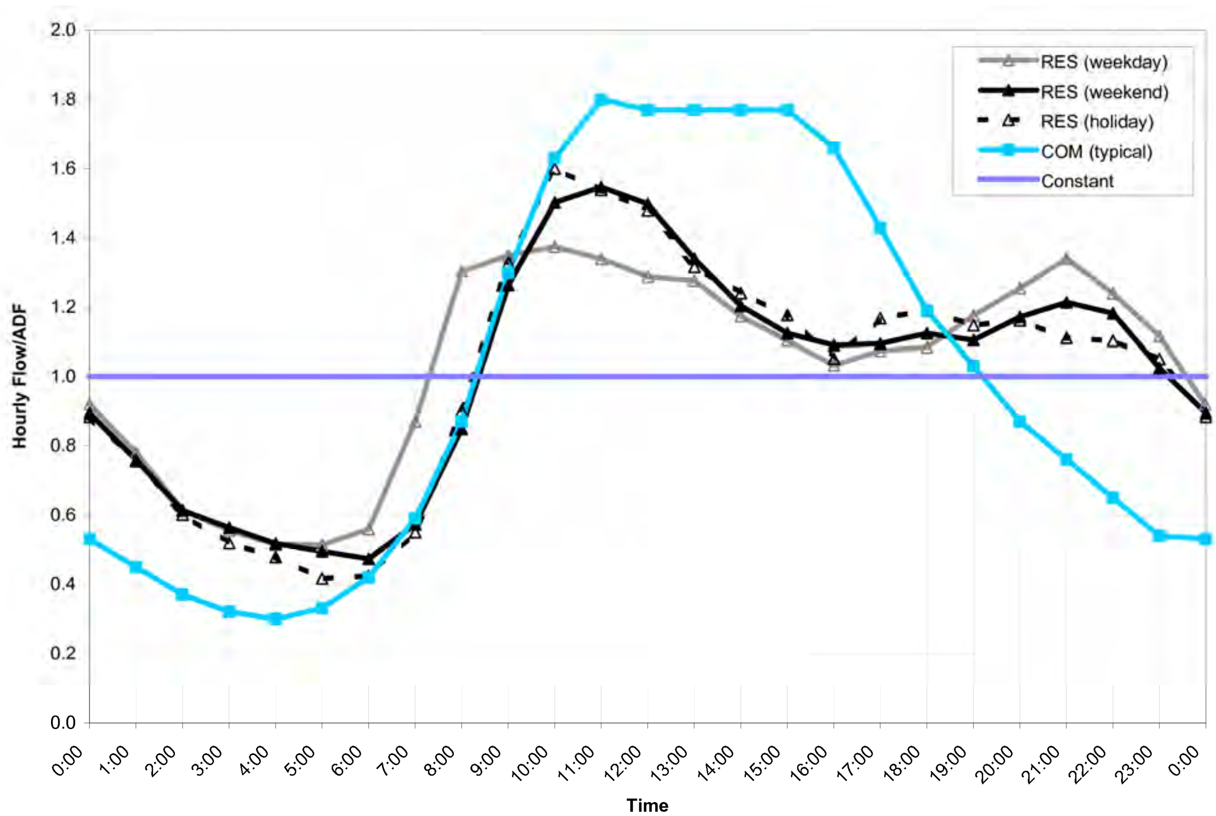

Figure 3-5. Diurnal Curves

The COM curve will be used to represent COM, IND, and MSC land uses. The RES curve will be applied to RES, MFR, and MHT since hotels and motels more closely resemble residences than other commercial establishments. Point sources will be assigned curves individually according to current use.

3.4.1 Weekend Variation

WWTP flow data show a consistent difference between weekday and weekend average daily flows throughout the year, with the weekend flows being higher than weekday flows. For example, during the summer months used for the flow projections made in this TM, the average weekend flow was about 10 percent above the average weekday flow. Figure 3-6 shows a sample of this pattern for the first half of 2006.

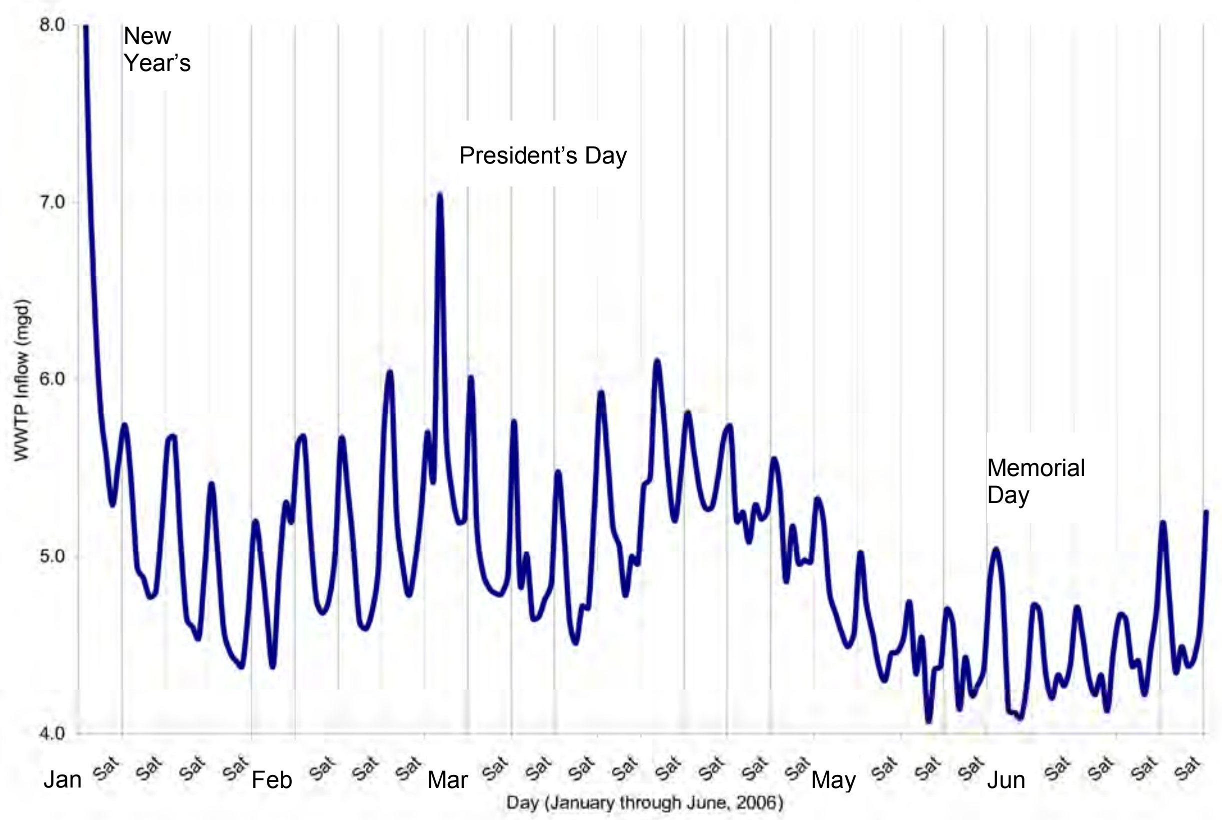

Figure 3-6. WWTP Flow (mgd)

Representative weekday- to-weekend variation of average daily flows

3.4.2 Seasonal Variation

As noted in the Land Use section of this TM, South Tahoe is popular as both a summer and winter vacation destination. Year-round average daily flow data from the WWTP collected for the years 2001 through 2007 is presented on Figure 3-7. The following observations can be inferred from the plot:

- Flows vary throughout the year;
- Elevated flows occur from February through March and again from July through August;
- Summer high season average flows are slightly higher than the winter high season average flows
- Peak flows occur on New Year's Day and Fourth of July

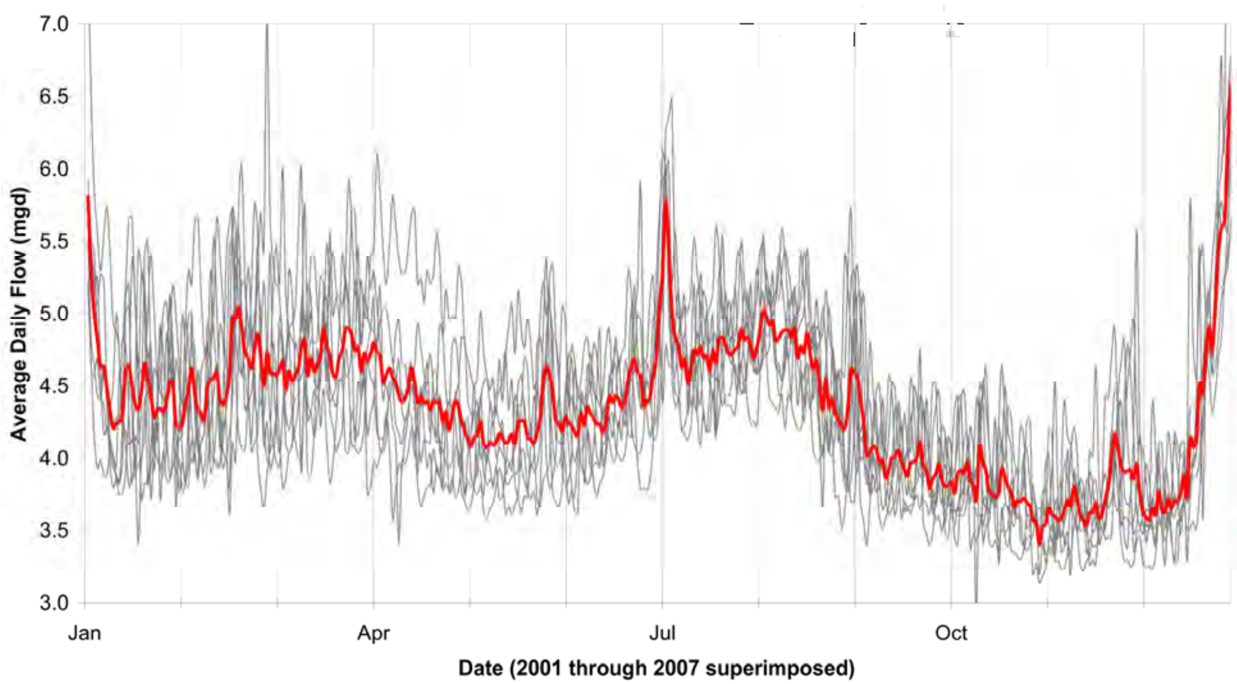

Figure 3-7. Average Daily WWTP Flow (mgd)

Annual variation of average daily flows from 2001 through 2007

3.5 Flow Projections

Unit flow factors from water billing and flow monitoring data were used as a starting point to balance projected wastewater flows with the observed WWTP FM readings.

3.5.1 WWTP Daily Flows

For purposes of projecting and comparing collection system BSFs, the most relevant period for analysis is when the maximum seasonally variable population is present with the minimum amount of seasonal GWI. The season satisfying both those criteria is the summer high season. More significantly, peak summer flows and populations appear to occur on summer weekends. Weekend flows from 2001 through 2007 were averaged starting on the Saturday closest to the beginning of July through Labor Day. From that data, the average summer weekend flow is 5.02 mgd. WWTP average daily flows for each year during that summer period are shown on Figure 3-8.

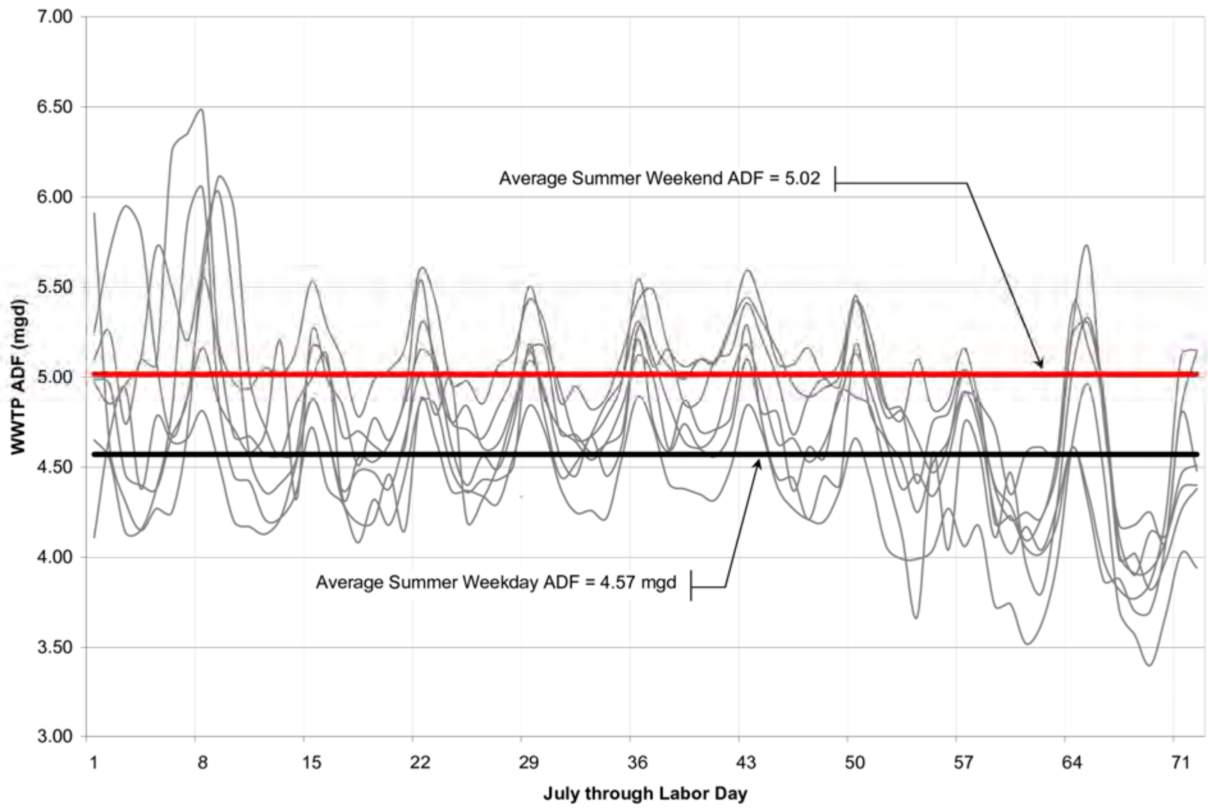

Figure 3-8. WWTP Flow (mgd)

Superimposed average daily flow by year (2001 – 2007)

3.5.2 Current Flow Projection – Average Summer Weekend

Predicted current BSF corresponds to the current land use, summer season scenario. Flow factors were adjusted (Calibrated Unit Flow Factor Used) as described in TM 6 Hydraulic Model Development and Calibration from the initial values presented in Table 3-9. The target flow at the WWTP is based on an average summer weekend flow, which included two major holiday weekends (July 4th and Labor Day weekend).

Table 3-9. Current Base Sanitary Flow

Land Use Category	Initial Unit Flow Factor Used		Calibrated Unit Flow Factor Used		Acres (or DU) in Collection System	Final Contribution to BSF (mgd)
Commercial (COM)	1,100	gpd per acre	1,210	gpd per acre	235 ac	0.286
Industrial (IND)	450	gpd per acre	450	gpd per acre	189 ac	0.085
Multi-Family Residential (MFR)	2,850	gpd per acre	3,135	gpd per acre	369 ac	1.157
Motel/Hotel (MHT)	2,700	gpd per acre	2,970	gpd per acre	146 ac	0.434
Miscellaneous (MSC)	150	gpd per acre	165	gpd per acre	371 ac	0.055
Single Family Residential (RES)	160	gpd per DU	155	gpd per DU	15,667 DU	2.428
Non-Contributing (NC)	0	gpd per acre	0	gpd per acre	19,668 ac	-
Utility (UTL)	0	gpd per acre	0	gpd per acre	201 ac	-
Vacant (VAC)	0	gpd per acre	0	gpd per acre	1,560 ac	-
Summer-Only Sources		n/a		n/a	7 CMP parcels	0.070
Point Sources (w/o Heavenly)		n/a		n/a	11 PS parcels	0.300
					TOTAL Predicted	**4.815**
					Target @ WWTP	**5.02**
					Difference	- 4.3 percent

The amount of dry season GWI is typically estimated by comparing predicted dry flows from contributing parcels to measured flows in a mass balance. Based on the results in Table 3-9, total GWI in the collection system is approximately 0.34 mgd. Flow meter data is useful for determining the local variation in GWI once a satisfactory estimate of overall GWI has been made. The flow factors and estimated GWI flows presented here will form the initial basis for the calibration of the hydraulic model. Should it become necessary to modify the factors during model calibration, such changes will be documented in the model calibration Tech Memo.

3.5.3 Build-Out Flow Projection – Average Summer Weekend

The build-out (future) flow projection is based on the land use projections in Table 2-2 and assumes that all parcels designated VAC will be developed according to their build-out land use code. The unit flow factors for build-out are the same as those used for current flow projections. Table 3-10 presents the build-out flow projection for the average summer weekend.

Table 3-10. Build-Out Base Sanitary Flow				
Land Use Category	Unit Flow Factor		Acres or DU in Collection System	Contribution to BSF (mgd)
Commercial (COM)	1,210	gpd per acre	396 ac	0.479
Industrial (IND)	450	gpd per acre	223 ac	0.100
Multi-Family Residential (MFR)	3,135	gpd per acre	401 ac	1.257
Motel/Hotel (MHT)	2,970	gpd per acre	146 ac	0.434
Miscellaneous (MSC)	165	gpd per acre	388 ac	0.064
Single Family Residential (RES)	155	gpd per DU	18,188 DU	2.819
Non-Contributing (NC)	0	gpd per acre	19,595 ac	-
Utility (UTL)	0	gpd per acre	201 ac	-
Vacant (VAC)	0	gpd per acre	-	-
Summer-Only Sources	n/a		7 CMP parcels	0.070
Point Sources (w/o Heavenly)	n/a		12 PS parcels	0.305
			TOTAL	**5.53**

BROWN AND CALDWELL

Technical Memorandum

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Prepared for: South Tahoe Public Utilities District, South Lake Tahoe, California

Project Title: STPUD Collection Systems Master Plan

Project No: 132364-005-001

Technical Memorandum No. 5

Subject: Model Program Selection (Task 5.1)

Date: December 30, 2009

To: Paul Sciuto, Assistant General Manager

From: Pete Bellows, Project Manager
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TABLE OF CONTENTS

1. INTRODUCTION

This Technical Memorandum 5 (TM 5) summarizes the evaluation process utilized by the South Tahoe Public Utility District (District) to select the hydraulic modeling software for capacity evaluation of the wastewater collection system. This process consisted of a review of seven commercially available hydraulic modeling packages that are commonly used to evaluate wastewater collection systems, model demonstrations by Brown and Caldwell (BC) and software vendors, and the model selection by the District.

2. SOFTWARE EVALUATION

BC initially presented the District with a model summary table describing seven commonly used and commercially available hydraulic modeling software packages. The modeling programs were described in terms of their general features, hydraulic modeling capabilities and features, cost, and other features. This summary table is provided in Attachment A. BC reviewed the features and pros/cons of each software package with the District staff during a teleconference at the outset of the Master Plan project. During this meeting, BC and the District narrowed the evaluation to the following three programs based on the District's needs and the features/capabilities that each program offered:

- MIKE-Urban
- InfoWorks CS
- H_2OMAP Sewer Pro (InfoSewer Pro)

BC made a WebEx model demonstration of H_2OMAP Sewer Pro and InfoWorks CS (models which BC currently holds licenses) to the District in January 2008. After this demonstration, the District selected software vendors to demonstrate their product at the District's office. The District based their selection on the following criteria:

- Model Development: User Interface
- Model Capability: Hydraulic Engine, Data Management
- Results/Output Features
- Compatibility with GIS
- Cost (minimum 4,500 node model)
- Compatibility with the District's Water Modeling software

A description of the three software packages is described in the following sections.

2.1 MIKE-Urban

MIKE-Urban is the product of the Danish Hydraulic Institute (DHI). MIKE-Urban can use the MOUSE hydraulic engine or the Storm Water Management Model 5 (SWMM5) hydraulic engine. MIKE-Urban has a direct link to ArcGIS. This linkage is provided by the MIKE interface, a product of DHI, Inc. MIKE-Urban can model a maximum of 15,000 nodes which would be sufficient to model most systems without needing to simplify the system in order to reduce the number of nodes. A 5000-pipe license of MIKE-Urban with 12 man hours of technical support costs $16,085 (as of January 2008).

Model Development. Models can be developed in MIKE-Urban using a variety of different sources such as ArcGIS, ARC/INFO, or MapInfo GIS. Scanned TIF or BMP aerial images or maps, or DXF maps of streets, parcels, and buildings can be displayed as a background image. This would facilitate digitizing of a network model and confirmation of the network layout.

MIKE-Urban has a Model Checker tool that reviews the input data specified for the selected analysis model. If it encounters an error or gaps with the input data, it will flag the problem areas and propose a correction. This tool is used for correcting any mistakes that may have occurred during data entry.

Modeling Capability. MIKE-Urban is a link-node based model that performs hydrology, hydraulic, and water quality analysis of stormwater and wastewater drainage systems, including water quality control devices. Typical applications of MIKE-Urban include predicting combined sewer overflows (CSO), sanitary sewer overflows (SSO), interconnected pond analysis, open and closed conduit flow analysis, design of new site developments, and analysis of existing stormwater and sanitary sewer systems.

The software solves the complete St. Venant (dynamic flow) equations throughout the drainage network and includes modeling of backwater effects, flow reversal, surcharging, looped connections, pressure flow, tidal outfalls, and interconnected ponds. Flow can also be routed through a variety of different storage elements, such as detention ponds, settling ponds, and lakes.

Results/Output Features. MIKE-Urban's graphical capability includes horizontal plan plots, profile plots, and time series plots. Output results for pipes can be plotted with variable pipe widths and nodes with variable radius to identify those areas of the network that experience the most surcharge, flow, pollutant concentration, etc.

MIKE-Urban automatically generates graphical animations for both horizontal plan plots and profile plots showing values that change with respect to time. Multiple animations can be performed simultaneously. This function makes it possible to plot several different profiles and watch all the results along that profile line, each in a separate window. In addition, profile plots can have two separate vertical axes to allow plotting of variables from two separate unit families, such as flow, head, and water quality concentration. For example, profile plots can be generated with an envelope to show the minimum and maximum values reached during a simulation. Multiple time-series plots can also be generated for various network elements, such as pipe flow, velocity, pollutant concentration, and loading.

GIS Integration. MIKE-Urban is an ArcGIS-based application. MIKE-Urban has a direct link to ArcGIS, providing both a spatial data and visual representation of the stormwater sewer network. In addition, MIKE-Urban simulation results can be directly displayed within the program (i.e., locations of CSO and SSO points, manhole overflows, pipe surcharging, etc.).

2.2 InfoWorks CS

InfoWorks CS is a product of Wallingford Software of England. The InfoWorks CS environment allows for the integration of wastewater network models, treatment plant, and receiving water models. InfoWorks CS can model a maximum of 100,000 nodes .A 100,000 node license and unlimited technical support costs $50,344 (as of January 2008). The pricing is for 100,000 nodes because the software only comes in 1000, 2000, and 100,000 node licenses and STPUD requires at least 4,500 nodes.

Model Development. InfoWorks CS can directly import or graphically create sub-catchment boundaries, over vector map backgrounds. This provides a geographical representation of the contributing area for each manhole, and allows automatic calculation of the total area. In addition, the different surface types and areas can be calculated using accurate area take-off from a vector map containing road and roof areas. These features provide within the model interface functions normally provided by GIS applications in other models.

InfoWorks CS also contains an Industry Standard Relational Database, as used in Microsoft Access and has various data management features. It provides the ability to review current and historical model network versions and attribute data. As well as providing full details of each modification made to the network, it also provides version IDs, date stamps and modeler details. A compare function allows the comparison of two model versions and the creation of a detailed report outlining the differences, including changes to the data flags describing confidence and/or source of all data items.

InfoWorks CS may be configured as a Workgroup providing access to models stored in a central master database. The centralized version control system preserves data integrity and avoids model replication. Model data security, with respect to deletion and recovery, is provided through archive and back up of the master model database. In addition, group project management techniques enable the centralized control of multiple users on multiple projects. This is extremely beneficial when there is more than one person maintaining the model and is accomplished through the InfoWorks CS Administration module.

Model Capability. The software incorporates full solution (dynamic) modeling of backwater effects and reverse flow, open channels, trunk sewers, complex pipe connections and complex ancillary structures. The Time Series simulation engine provides automatic time stepping and implicit numerical solution (St. Venant's), to optimize run time and ensure mathematical stability. The software contains comprehensive diagnostic error checking and warning.

Results/Output Features. Animated presentation of the results in Geographical Plan, Long Section and 3-dimensional (3-D) junction views is available, together with results reporting and flood frequency analysis using tables and graphs. InfoWorks CS incorporates full interactive and animated views of data using geographical plan views, long sections, spreadsheet and time varying graphical data. A 3-D junction view provides for the visual presentation of manholes. Access to the underlying data is available from any graphical or geographical view.

GIS Integration. InfoWorks CS supports the export of network data and maximum results to specific layers in MapInfo Professional 5.0 or Arc GIS. InfoWorks CS provides facilities for the export of network and results data to CSV files, prn (text files) and hyd, hyq, hyv (time varying event files). These may subsequently be imported into Microsoft Access or Excel.

2.3 $H_2$0MAP Sewer Pro

H_2OMAP Sewer Pro is developed by MWHSoft Inc. The H_2OMAP Sewer Pro package, specifically the computational engine, has limitations including no reverse flows, no spill display and no real-time control features used to model complex pump stations. However, the interface and overall data management features are state-of-the-art and compatible with the H_2OMAP Water modeling software package. A 5000-link license of either H_2OMAP Sewer Suite Pro is $10,000.

Model Development. H_2OMAP Sewer Pro offers users functionality to identify and automatically correct network topology problems (e.g., disconnected nodes, cyclic loops) and data flaws (e.g., duplicated pipes or nodes) that may arise from digitizing a model or building it using pre-existing GIS and CAD datasets. In addition, the package provides presentation and data visualization tools including charts and graphs, customizable reports, contours, and other collection system data and results. Every type of facility (loading manholes, chamber manholes, outlets, wet wells, gravity and force mains, and pumps) can be graphed either singly or as a group with any number of like facilities (i.e., show five different gravity mains on the same graph). System load and pipe profiles can also be graphed. The H_2OMAP Sewer Suite includes the load allocator tool, which automatically computes and assigns wastewater loads to the model network.

Model Capability. H_2OMAP Sewer Pro provides both steady-state and semi-dynamic simulation engines. The steady-state engine simulates cumulative peak flows throughout the model network. Peak flows can be adjusted using traditional peaking factor equations programmed into the software. H_2OMAP Sewer Pro provides the capability to model inflow and infiltration.

The semi-dynamic engine simulates time-varying flows and depths throughout the model network. Time-varying gravity flows are calculated using the Muskingum-Cunge equations which are a simplified form of the fully-dynamic Saint-Venant equations. Surcharging is modeled using standard pressurized flow equations which are triggered when depths exceed pipe crown elevations. The combination of Muskingum-Cunge and pressurized flow equations is not equivalent to the solution of the fully-dynamic Saint-Venant equations, and in complex hydraulic situations can give rise to different results. The semi-dynamic engine is capable of calculating a basic hydraulic gradeline.

Results/Output Features. The results of a simulation are stored in a results file that can be uniquely specified. Simulation results are analyzed primarily through the use of animated graphs. By creating a graph or set of graphs and then running a simulation, changes in the flow or head as a function of time at multiple locations within the network can be evaluated. The graphic images or data may be exported to other applications. Tabular output including summaries of the solution results are available and may be exported to other applications.

GIS Integration. H_2OMAP Sewer Pro can export and import data based on user selection, database (logical) queries, or the entire model. Export and import formats include shapefiles, MID/MIF files, text files, and database files. All database formats are directly supported through ODBC connection including Oracle, Access, FoxBase, Paradox, DB4, Excel, and many others. This feature allows the model to be integrated with external GIS and database systems that are deployed by the client. InfoSewer is essentially H_2OMAP Sewer built atop ArcGIS. InfoSewer has the ability to utilize the geodatabase architecture to perform geospatial analysis, infrastructure management and business planning.

3. CONCLUSIONS

Each of the three software packages evaluated for this project are capable of modeling the District's collection system in it's normal operating mode (no gravity transfers between pump station basins). MIKE-Urban and InfoWorks CS are also capable of modeling gravity transfers between basins. The District selected the MWHSoft program, InfoSewer, because it provides the necessary features to model the STPUD collection system, it is the least expensive, and it is compatible with InfoWater, which is being utilized for the STPUD water distribution system model.

ATTACHMENT A: MODEL SELECTION FEATURES TABLE

Category	MIKE SWMM, non-linear reservoir routing (runoff modeling) and Extran	SewerCAT	SewerGEMS	HYDRA	MOUSE / Mike Urban	H2OMAP SewerPro	InfoWorks/InfoNet
General Features							
Data tracking/flagging	No	Yes	No	No	No	No	Yes
Version Control	No	Medium, no backup feature is provided but when a project file is saved, a copy of the previous save is created	Medium, no backup feature is provided but when a project file is saved, a copy of the previous save is created	No	Medium	Medium, incremental copies of sequential saves is stored on local C: drive	Yes, provided through archive and back up of master model database; group management techniques enable centralized control of multiple users on multiple projects
Statistical analysis tools	No	Requires external analysis although data provided	No	No	Requires external analysis although data provided	No	Yes
Import network components from ArcView	Yes	Yes	Yes	No	Yes	Yes	Yes
Background images	TIF, BMP, DXF	Arcview Shape files	ArcView, CAD files, TIFF (plus other image files), DXF	DXF	TIF, BMP, DXF	ArcView, CAD, VPF	ArcView, CAD files TIF, BMP, DXF, AIB land-line data
Graphical animations of results	Yes	Yes	Yes	No	Yes	Yes	Yes
3-D junction view	No	No	No	No	No	No	Yes
Compare Function (comparison of 2 model versions and the creation of report that outlines the differences including data flags describing confidence and/or source of all data items)	Low	No	No	No	No	No	Yes
Modeling of a subset of entire network	Low	Yes	Yes	No	Yes	Yes, with additional module.	Yes
Model merging	No	Yes	Yes	No	No	Yes	Yes
Graphical creation of sub-catchment boundaries	No	No	Yes	No	No	No	Yes
Database type for storing and manipulation network data	ODBC database	ODBC database	ODBC database	DBF database file format	ODBC database	ODBC database	ODBC database
Geodatabase format	Proprietary	Proprietary	ESRI Geodatabase	N/A	ESRI Geodatabase	ESRI Geodatabase	Proprietary
Limitations on labeling	10 characters	30 characters	18 characters	20 characters	7 characters	30 characters	30 characters
Unusual pipe shapes (not circular, arch, elliptical, or box)	Yes	Yes	Yes	No	Yes	Yes	Yes
Real Time Control	Low	Yes	Yes	No	Yes	Yes	Yes
Parent/Child scenario management	No	No	Yes	No	No	Yes	Yes
Maximum number of nodes	Unlimited	Unlimited	Unlimited	Unlimited	15,000	Unlimited	Unlimited
Able to import models from other modeling software (not related to parent company)	No	Yes, XP-SWMM, EPA-SWMM, Hystem	No	SWMM	No	Yes	XP-SWMM
Hydraulics							
Models pipes surcharging	Yes	Yes	Yes, SWMM engine or implicit solution of Saint-Venant equations	Medium, provides output to EPA-SWMM	Yes	Yes	Yes
Computes hydraulic grade lines	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dynamic simulation	Yes	Yes	Yes	No	Yes	Yes	Yes
Gravity Computational Method	Saint Venant Full Solution	Saint Venant Full Solution	Saint Venant Full Solution, or SWMM	Simple Hydrograph Routing	Saint Venant Full Solution	Muskingam-Cunge Solution	Saint Venant Full Solution
Pressurized Computational Method	Preismann Slot	Preismann Slot	Preismann Slot	N/A	Preismann Slot	Pressurized Flow Solution	Preismann Slot / Pressurized Flow
Reverse Flows	Yes	Yes	Yes	No	Yes	No	Yes
Numeric Stability and Accuracy	Poor	Poor	Average	Poor	Average	Poor	Good

[1] MOUSE, sealed manholes at ground level only and user defined lengths in separate file.

Category	MIKE SWMM, non-linear reservoir routing (runoff modeling) and Extran	SewerCAT	SewerGEMS	HYDRA	MOUSE / Mike Urban	H2OMAP SewerPro	InfoWorks/InfoNet
Computational Speed	Slow	Fast	Fast	Fast	Moderate	Fast	Fast
Real Time Control (RTC)	No	Yes	No	No	Yes	No	Yes
Appurtenances							
Variable speed pump stations	Yes	Yes	Yes	No	Yes	Yes	Yes
Constant speed pump stations	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Offline storage	Yes	Yes	Yes	No	Yes	Yes	Yes
Inline storage	Yes	Yes	Yes	No	Yes	No	Yes
Weir/diversions	Medium	Yes	Yes	Low	Yes	No	Yes
Controlled diversions	Medium	Yes	Yes	Low	Yes	Medium	Yes
Flow Generation							
Generates population/customer based flows	Yes	Medium, external software	Yes	Medium	Medium	No	Yes
Generates I/I flows	Medium	Medium, external software	Yes	Medium	Yes	No	Yes
Generates stormwater flows	Yes	Medium, external software	Yes	Medium	Yes	No	Yes
Input/Output							
Menu driven	No	Yes	Yes	Yes	Yes	Yes	Yes
Interfaces with GIS systems	Yes, through add on module MOUSE GIS	Yes	Yes	Yes	Yes, MOUSE GIS module	Yes	Yes
Interfaces with CAD systems	Yes	Yes	Yes	Yes	Medium	Yes	No
Summary output reports	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cost							
Purchase cost	$5,000	N/A, public domain	$20,000 stand-alone; $25,000 with AutoCAD integration	$5,000	$25,000	$15,000	$44,000
Documentation Support							
Complete documentation	Medium	Medium	Medium	Medium	Medium	High	High
Online help system	Low	Yes	Yes	Yes	Yes	Yes	High
Enhanced Features							
Estimates replacement costs	No	No	Yes	Yes	No	No	No
Hardware Requirements							
Operation System	Windows 95 and higher	Windows 95 and higher	Windows 95 and higher	Windows 95 and higher	Windows 95 and higher	Windows 95 and higher	Windows 95 and higher Windows NT preferred
Pentium® chip speed	200 MHz	100 Mhz	1 GHz	90 Mhz	200 Mhz	166 MHz	200 Mhz
RAM	32 MB	24 MB	256 MB	32 MB	32 MB	64 MB	64 MB
Contact details							
Phone:	215/504-8497	425/453-8383	800/727-6555	800/222-5332	215/504-8497	626/568-6868	800/523-0056
Fax:	215/504-8498	425/646-9523	203/597-1488	206/634-0624	215/504-8498	626/568-6870	817/870-1503
E-mail:	dhi@dhi.us	vitasoviczc@cdm.com	info@haestad.com	sales@pizer.com	dhi@dhi.us	sales@mwhsoft.com	agt@overflows.com
Internet address:	www.dhi.us	www.ccee.orst.edu/swmm/sewercat	www.haestad.com	www.pizer.com	www.dhi.us	www.mwhsoft.com	www.overflows.com
Street address:	DHI, Inc.301 South Slate Street Newton, PA 18940	CDM 11811 NE First St., Suite 201, Bellevue, WA 98005	Haestad Methods 37 Brookside Rd. Waterbury, CT 06708	PIZER Inc. 4422 Meridian Ave. N. Seattle, WA 98103	DHI, Inc.301 South Slate Street Newton, PA 18940	300 North Lake Avenue, Suite 1200 Pasadena, CA 91101	AGT 1412 West Magnolia Ave. Fort Worth, TX 76104

[1] MOUSE, sealed manholes at ground level only and user defined lengths in separate file.

BROWN AND CALDWELL

Technical Memorandum

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Prepared for: South Tahoe Public Utility District

Project Title: STPUD Collection System Master Plan

Project No: 132364-005

Technical Memorandum No. 6

Subject: Hydraulic Model Development and Calibration

Date: December 30, 2009

To: Paul Sciuto, Assistant General Manager

From: Pete Bellows, Project Manager
Engineer in Responsible Charge, CA Lic. No. 34337

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1. INTRODUCTION

This Technical Memorandum No. 6 (TM 6) describes the development and calibration of the South Tahoe Public Utility District's (STPUD or District) wastewater collection system hydraulic model. The scope of this task includes dry and wet weather model calibration for current conditions. Future (build-out) scenarios and design storm analysis will be analyzed in the Hydraulic Evaluation TM 8.

The initial dry weather modeling parameters came directly from TM 4, Design Flow Analysis. They were adjusted during the calibration process described in this TM to match flow monitoring data collected during the summer of 2007. The diurnal curves presented in TM 4 were also modified to match observed flow data and an additional curve was developed to represent the Motel/Hotel land use (MHT) category. Finally, ground water infiltration (GWI) was added to the model based on the difference between monitored flow and BSF.

For the wet weather calibration, wet weather GWI was added to account for a higher seasonal groundwater table. The model was then calibrated to wastewater treatment plant (WWTP) influent flow data collected during the selected storm event. Precipitation and flow data recorded at the WWTP and selected pump station flow meter data was used during calibration. No significant precipitation occurred during either of the 2007 or 2008 wet season flow monitoring periods, so that data was not used for wet weather calibration.

This TM is divided into the following three sections:

2. Model Development
3. Dry Weather Flow Calibration
4. Wet Weather Calibration

2. MODEL DEVELOPMENT

The hydraulic modeling program "InfoSewer Suite Pro (v 5.2)" by MWH Soft was used to build the model.

2.1 Information Sources

Information sources used for the model network included the District's collection system GIS for network components and parcels. Additional sources such as as-built drawing, the sewer atlas, pump station condition assessment information sheets, and specific responses by the District to requests for information were used for flow splits, wet well dimensions, and pumping station (PS) controls.

The District provided GIS shapefiles of the collection system mains and manholes with a date stamp of September 19, 2008. Those files formed the basis for the model networks mains and manholes, and were imported into the hydraulic model. Some pipes in the GIS had old manhole IDs assigned to their upstream and downstream ends, so they were renamed according to the table relating old to new IDs supplied by the District. Information fields from GIS utilized by the model include pipe diameter and length, upstream and downstream manhole IDs and inverts, and manhole rim elevations.

The District provided a GIS shapefile of El Dorado County parcels with land use classifications, with a date stamp of May 19, 2008. Only the parcels within the STPUD service area boundary contribute flows to the collection system.

Information regarding pumps and wet wells was taken from TM 3, Pump Station Condition Assessment, and from additional communications supplied by the District in response to specific data requests. Such information included wet well dimensions, overflow levels, on/off level controls, pump design capacity and head, pump speed (fixed vs. variable) and horsepower, and forcemain diameters.

2.2 Network Components

2.2.1 Pipes and Manholes

All pipes having valid (non-zero) upstream (US) and downstream (DS) invert information in GIS were automatically included in the model regardless of diameter or location. Pipes with missing information were either excluded from the model or the missing information was extrapolated from available sources. Pipes were excluded if flows from surrounding parcels could be input to downstream manholes nearby. Pipes were also excluded from the model if they were terminal pipes whose US (terminal) manhole was either not included in the manhole shapefile or lacked rim elevation data. Pipes were included and information extrapolated if they connected two larger network areas. During early model simulations, a number of pipes and manholes were found to have anomalous invert and rim data. Reasonable assumptions were made for those items where possible, and the District supplied additional information in other cases. Pipe diameters that appeared to be incorrect were corrected in the model. For example, a single 6-inch diameter pipe reach with 15-inch pipe up and downstream was changed to 15-inch diameter.

Manholes with two or more outlet pipes are referred to as flow splits. For flow splits occurring within a basin, a routine within the model was used to assign splits based on the pipes' relative diameters, inverts, and slopes. This type of intra-basin split has little effect on system flows.

Two flow splits (overflows) were identified that would be expected to have a significant effect on flow routing: one is near the Johnson PS between Johnson and Ski Run basins and the other is the overflow from Ski Run PS to the Bijou sewer basin. In the Johnson/Ski Run split, the District supplied information indicating that the outlet from manhole JN73 to JN72 is the main outlet, and the overflow invert leading to DS manhole SR25 is approximately 1.5 feet higher. The configuration of these overflows may change in the future according to the District. Pipe JN73-JN72 has adverse grade in the GIS, which is not supported by the automatic flow split feature in the model. Therefore, all flow was manually allocated to the Johnson side (100 percent/0 percent). In the Ski Run/Bijou split, it was assumed that Ski Run PS was functioning during the 2007 DW flow monitoring period. Therefore, the overflow pipe connecting the Ski Run and Bijou basins (SR3-BJ47) was made inactive during each simulation scenarios, causing 100 percent of the flow from the Ski Run basin to flow to the Ski Run wet well, from which it is pumped directly to the WWTP. The overflow can be reactivated to bypass Ski Run PS if required in later scenarios.

All gravity mains were assigned Manning n = 0.013. All forcemains were given the Hazen-Williams friction factor C = 140.

Table 2-1 presents a summary of total length, by diameter, of modeled gravity mains. Approximately 69 percent of the total length of pipe in the collection system was included in the model.

Table 2-1. Modeled Gravity Pipes[1]				
Diameter	Count	Length (ft)	Modeled Length (miles)	Length in GIS
6-inch	2,958	802,633	152	237.0
8-inch	583	150,377	28.5	32.5
10-inch	279	74,789	14.2	16.4
12-inch	172	44,379	8.4	9.5
14-inch	8	2,354	0.4	0.4
15-inch	125	35,126	6.7	8.3
16-inch	10	2,894	0.5	0.5
18-inch	54	15,013	2.8	3.5
21-inch	48	14,897	2.8	2.7
24-inch	28	8,908	1.7	3.4
TOTAL Modeled	**4,265**	**1,151,371**	**218.1**	
Total in GIS	**6,682**	**1,658,474**	**314.1**	
Percent Modeled	**64% of No.**	**69% of Length**		

[1]*Only includes facilities that were "active" during model simulations.*

Table 2-2 presents modeled force mains. Shared force mains—Ponderosa/Tahoe Keys and Ski Run/Bijou/Johnson—were made independent of one another since the model does not allow combined force mains. This was accomplished by modeling the shared portions as if they were parallel forcemains, each one having the same diameter as its respective unshared portion.

Table 2-2. Modeled Forcemains			
PS Start	MH End	Length (ft)	Diameter (in)
Al Tahoe	WWTP	6,013	18
Bijou[1]	WWTP	12,910	16
Bellevue	AT48	3,098	10
Johnson[1]	WWTP	9,241	16
Ponderosa	AT15	2,069	6
San Moritz	TK74	1,499	10
Ski Run[1]	WWTP	12,363	12
Tahoe Keys	AT15	10,122	16
Trout Creek	WWTP	571	12
Upper Truckee	WWTP	5,713	18

[1] *All 3 PSs can pump to either FM interchangeably (16-inch, 12-inch, or both)*

All manhole diameters were set at four feet according to District standards. Dummy manholes, called "Chamber" manholes, were created where pumps connect to forcemains as per the model's standard practice. A total of 4,268 manholes are in the active model network database, including chamber manholes and the dummy WWTP outlet.

After interpolating critical manhole rims and pipe inverts, "orphan" pipes and manholes—those not connected to the working body of the network—were removed, with the exception of the area west of Tallac PS.

As discussed in TM 4, winter BSF from Fallen Leaf Lake and surrounding basins west of Tallac PS were insignificant because of limited winter use. Small summer and winter flows—the latter including rainfall dependent inflow and infiltration (RDI/I)—were estimated for those basins and input into manhole TK1 as "additional manhole loading". Any pipe/manhole combination that was initially imported into the model for that area was left in the model, but all were made inactive during model simulations. Pipes and manholes in the Venice, Beecher, Gardner Mountain, and Ponderosa sewer basins were also made inactive because they all flow to small PSs that were not included in the model. Flows from parcels located within those basins were allocated to the manhole at the downstream end of their respective forcemains. The hydraulic model network is shown on Figure 2-1.

2.2.2 Pumping Stations and Wet Wells

Pumping stations were included in the model if they convey flow between sewer basins or if they pump directly to the WWTP, with the exception of Pioneer Village. Flow from the latter's tributary area (approximately 0.02 mgd) was considered too small to merit the additional complexity of modeling this small PS that pumps to the WWTP. PS modeling parameters were set to reflect normal operating conditions as closely as possible, i.e. with regard to fixed speed or variable speed pumps, on/off levels, wet well dimensions, forcemain configuration, etc. Operating parameters and pump characteristics were supplied by the District and additional information came from the Pump Station Condition Assessment TM.

Pump and wet well information for each modeled PS is summarized in Table 2-3.

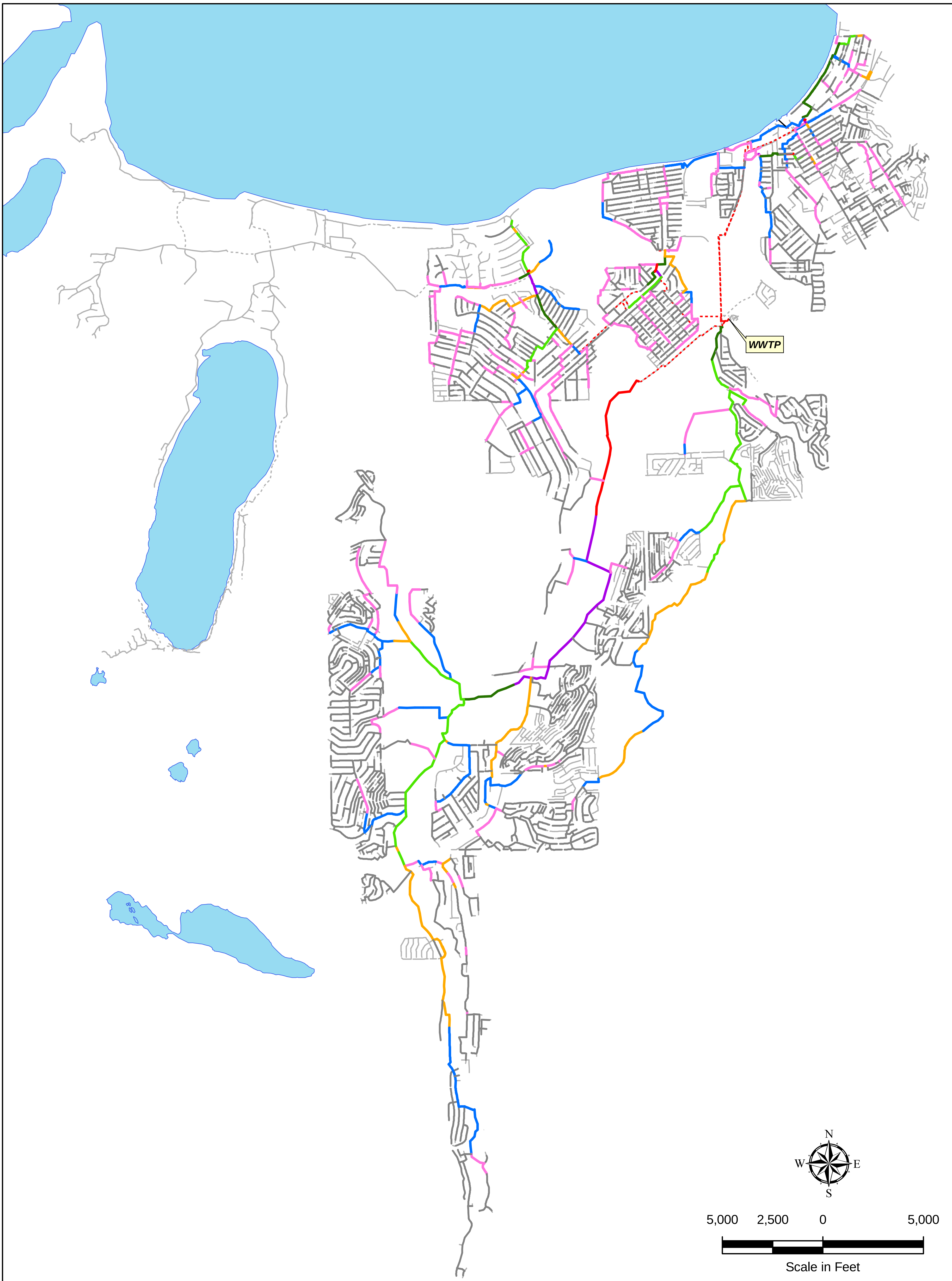
Table 2-3. Modeled Pumping Station and Wet Well Parameters

Pumping Station	WW Dimensions (ft) (LxWxH or Diam. x H, feet)	On Level (feet)	Off Level (feet)	Control	Speed	Design Flow (gpm)	Design Head (feet)	Power (hp)
Al Tahoe	21.5 x 16 x 20.25	12.250	9.000	Inflow	Variable	3,000	80	100
Bijou	18.33 x 5 x 7.16	3.410	2.040	Inflow	Variable	2,200	135	75
Bellevue	5 x 19.66	5.000	1.600	Level	Fixed	300[1]	41	15
Johnson	18.9 x 4 x 16.4	6.000	4.450	Inflow	Variable	1,750	100	75
Ponderosa	11 x 8 x 23.16	4.170	3.670	Level	Fixed	300	34	7.5
San Moritz	8.17 x 19.75	6.420	2.240	Level	Fixed	900	33	15
Ski Run	18 x 8 x 19.66	7.580	6.080	Inflow	Variable	1,025	97	47
Tahoe Keys	6 x 7 x 22.5	5.580	3.910	Inflow	Variable	2,500	75	75
Trout Creek	6 x 17	7.830	4.080	Inflow	Variable	1,800	46	30
Upper Truckee[2]	6 x 21.16	8.080	6.000	Inflow	Variable	2,800	30	75

[1] Bellevue PS was modeled using a pump design flow of 300 gpm (7.5 hp) in order to more accurately match the observed average daily volume. The pump station condition assessment data sheet states that the capacity of each installed pump is 900 gpm, 15 hp.

[2]Diameter was unclear, assumed 6 feet.

Variable speed pumps were modeled using the model's "inflow" control parameter. This causes flow entering the wet well to be pumped out at the same flow rate. Fixed speed pumps were set to operate on the level controls supplied by the District and listed in the Table 2-3. The model allows the utilization of parallel pumps (e.g. lead/lag) with different controls for fixed speed pumps when using level controls. During both dry weather and wet weather simulations, all pumping stations operate with a single pump; lag and stand-by pumps are included in the model but they were made inactive during simulations. In the event that surcharging occurs upstream of a PS due to a pump capacity shortfall, the other pump(s) could be activated. This was not necessary during either of the simulations carried out for the model calibration. Pumping stations and force mains included in the hydraulic model are shown on Figure 2-2.



BROWN AND CALDWELL

SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

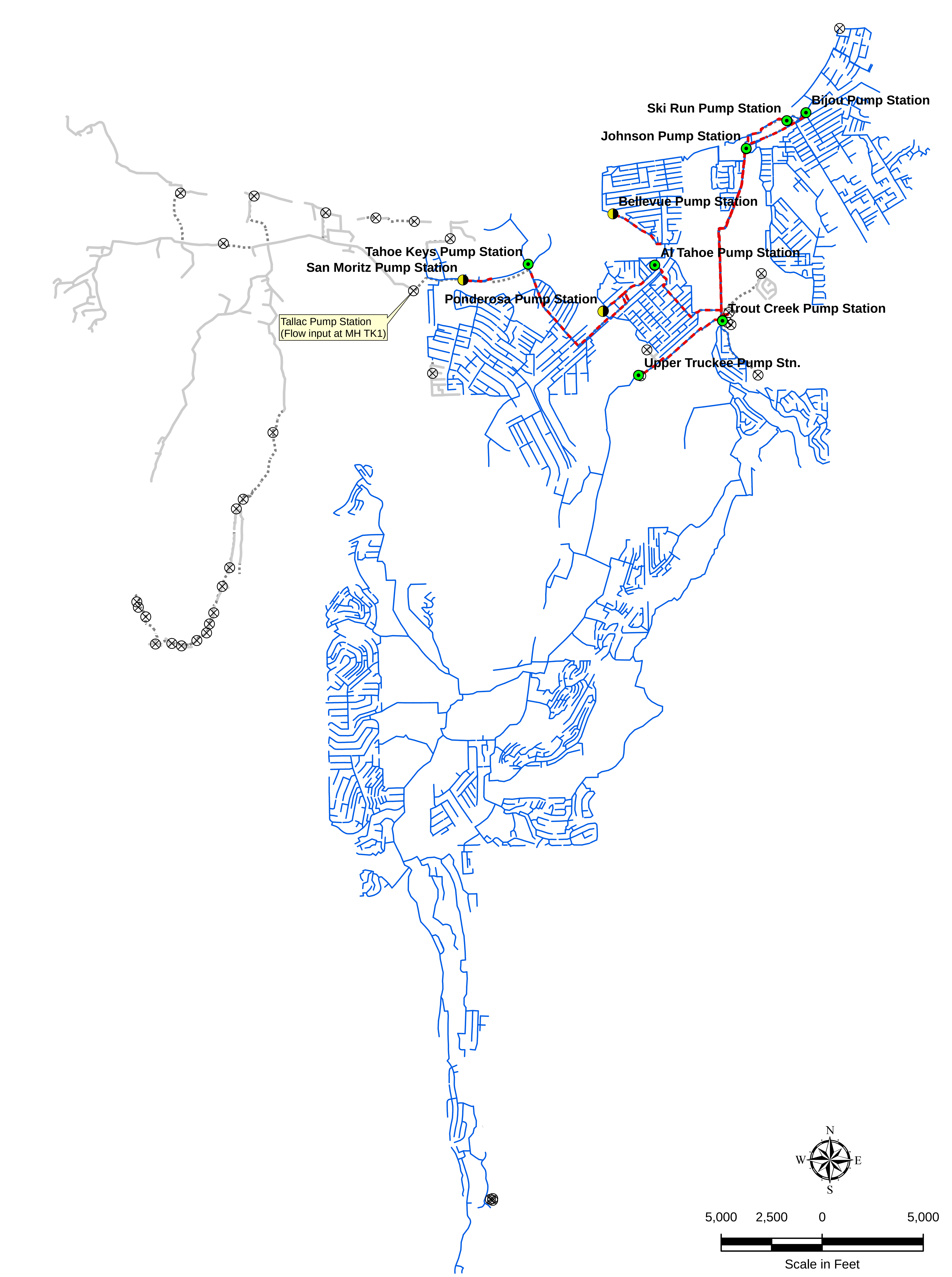
Figure 2-1
Hydraulic Model Network

LEGEND

Active Modeled Gravity Pipes
- 6-inch
- 8-inch
- 10-inch
- 12-inch
- 14, 15, 16-inch
- 18-inch
- 21-inch
- 24-inch

Modeled Force Main
- Various Diameters

Not in Model
- Gravity Main
- Force Main



SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 2-2
Pump Stations and Force Mains

2.3 Flow Allocation

The InfoSewer model has a tool called the "Load Allocator Add-On" that automatically links parcels to loading manholes and then calculates total manhole loads based on a variety of methods. The method used for the model is called the "meter-manhole" allocation method, which assigns parcels to manholes based on the proximity of the parcel centroid to the nearest manhole. The automatic tool does not recognize sewer basin boundaries, topography, or orientation of lateral connections. Therefore, automatic assignments were manually reviewed and adjusted.

Two circumstances required special handling. First, for the area west of Tallac PS, the hydrograph from flow monitor 3 (FM-3) was used directly to approximate the dry weather flow, and was input as "extra manhole loading" at the end of the Tallac PS forcemain (MH TK1). Second, several small PSs were excluded from the model, namely Stateline, Fairway, Venice, Beecher, Gardner Mountain, and Pioneer Village. In those cases, the PS basins' parcels were linked directly to the manholes at the end of their respective forcemains so that loads would enter the system at those manholes.

After manhole assignment, the daily load from each parcel was calculated outside of the model using the unit flow factors presented in TM 4. The Load Allocator was then run, taking the summation of parcel loads in order to calculate each manhole's total load. Since total loading is divided into multiple land use classes at each manhole, the model can apply different diurnal profiles to different portions of the total load at the same manhole. This makes it possible to adjust daily volumes and diurnal profiles for different pieces of the total load independently of one another according to land use. This feature is extremely useful during dry weather calibration.

The flow unit of gallons per minute (gpm) was selected as the model's flow input unit. Although loads are typically entered in mgd, it was thought that many loads were too small for the model's precision, opening the possibility that they could be erroneously truncated. All BSF and GWI flows are therefore input in gpm, and pump design flows are specified in gpm. Model simulation results can be converted to a variety of units using the model's "output units" menu, and are typically expressed in million gallons per day (mgd).

3. DRY WEATHER FLOW CALIBRATION

The model was calibrated to DW flow monitor (FM) data collected during the summer of 2007. DW calibration entailed projecting BSF, matching the shape of FM hydrographs, and distributing GWI. A mass balance between total model inflow vs. outflow and observed data from the WWTP was performed as a check that the model was working properly.

3.1 Flow Data

Dry weather flow monitor data was collected between August 20 and September 18, 2007 at 16 flow monitor sites throughout the collection system. No significant precipitation was recorded during the period. Data from FM-6 was suspect during the DW calibration day, so a different day was used for comparison with modeled results as described below.

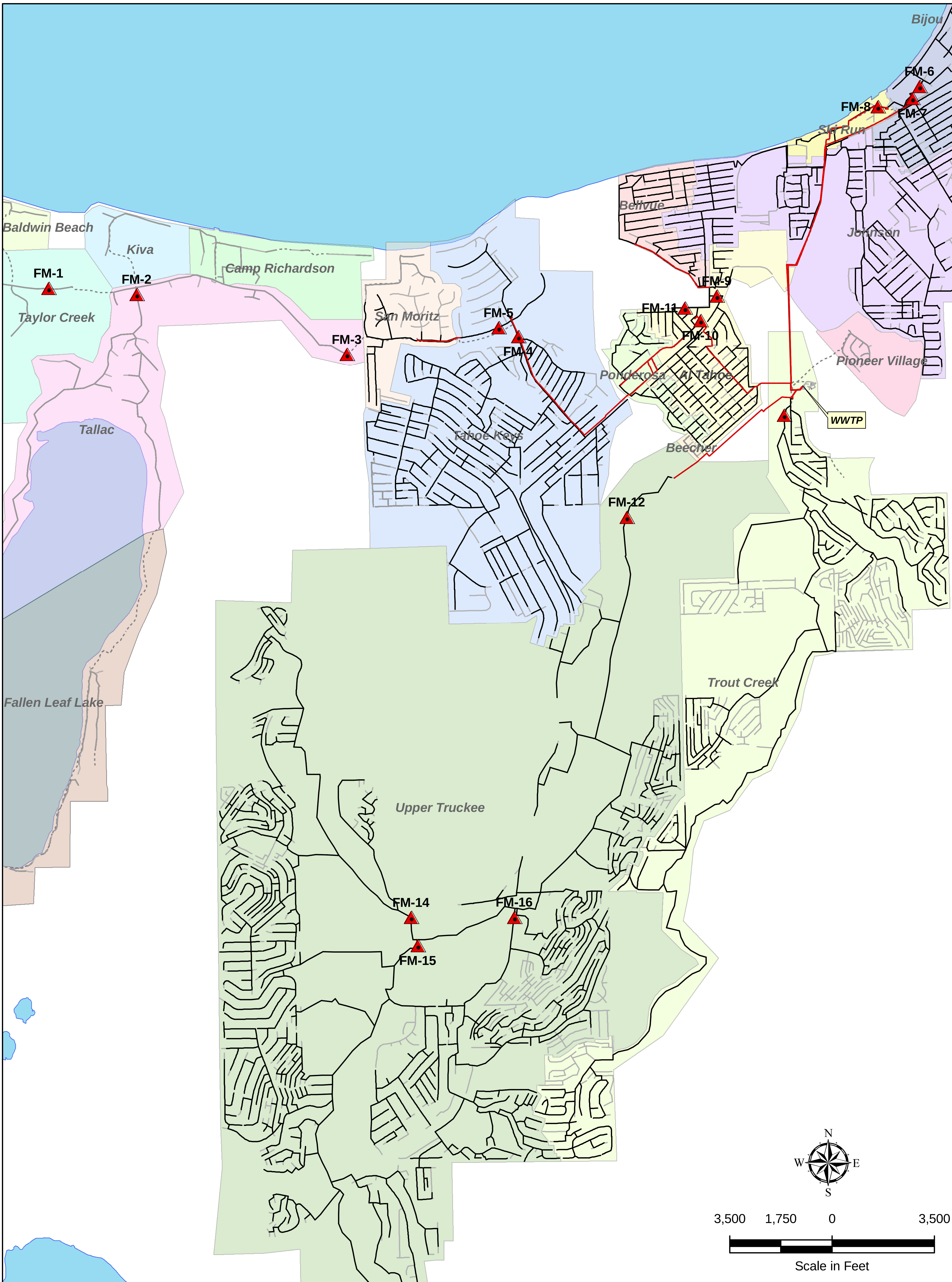
The target flow at the WWTP (presented in TM 4) was 5.02 mgd, corresponding to the average summer weekend flow. The day during the 2007 FM period that most closely approached this value was Sunday, September 2 (Labor Day weekend). Average daily flow recorded that day at the WWTP was 4.96 mgd.

FM site information is presented in Table 3-1. DW FM locations are shown on Figure 3-1.

Table 3-1. 2007 Dry Weather Flow Monitor Information

Meter ID	Manhole ID	Nominal Pipe Diameter (in)	Meter Type*
FM-1	TY2	18	Weir
FM-2	TL37	15	Weir
FM-3	TL1	24	Weir
FM-4	TK5	21	A/V Meter
FM-5	TK26	18	Weir
FM-6	BJ5	18	A/V Meter
FM-7	BJ181	12	Weir
FM-8	SR4	10	Weir
FM-9	AT19	12	Weir
FM-10	AT3	21	A/V Meter
FM-11	AT43	8	Weir
FM-12	UT7	24	A/V Meter
FM-13	TR12	18	A/V Meter
FM-14	UT254	15	Weir
FM-15	UT378	15	A/V Meter
FM-16	UT166	12	Weir

**A/V= Area Velocity*



BROWN AND CALDWELL

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Figure 3-1
2007 Dry Weather Flow Monitoring Locations

3.2 BSF Calibration

Sunday, September 2 was chosen as the DWF calibration day. No rain was recorded for several weeks prior, and the measured flow at the WWTP (4.96 mgd) closely approached the predicted target flow from TM 3 (5.02 mgd). The DWF includes BSF and GWI. The starting point for calibration was based on the flow factors and diurnal curves exactly as they were presented in TM 4. The calibration process sought to match modeled peak flows and volumes to observed data at FM sites 4 through 16, and total volume at the WWTP. The area west of Tallac Pump Station has low BSF flows and was not modeled. The flows from this area were estimated using actual flow data. FM sites 1 through 3 were not used for calibration.

Single family residential (RES) parcels account for the largest proportion of flow in the STPUD collection system. Once the model was run with the initial loads and diurnals, FM basin 13 was analyzed in order to look more closely at the RES flow factors since it is made up exclusively of RES parcels. As a result of this analysis, the RES flow factor was reduced to 155 gpd per parcel. Typically, RES parcels produce closer to 180 gpd. It is important to note that all non-vacant RES parcels in the District were assumed to contribute flow during model simulations. South Tahoe has many vacation properties, so actual, normal occupancy is likely less than that of typical residential areas. Since the actual occupancy is unknown, the average flow per parcel is reduced instead, which is accounted for by a similar reduction in the flow factor.

FM-6 basin was selected to calibrate the MHT category because it consists almost exclusively of RES and MHT parcels. Analysis of the results suggested that the MHT class required its own diurnal pattern since the RES pattern used did not result in a close match with FM-6 data. A MHT diurnal was developed with a much larger and earlier peak than that of RES, and with a more constant flow throughout the day between peaks.

The same process of isolating areas consisting of one uncalibrated land use class amongst calibrated classes was followed until all classes had been analyzed. After completing this analysis, the predicted volume and system loading were still too low throughout the system, except in exclusively RES areas. This was remedied in part by increasing the flow factors for MHT, Commercial (COM), and Multi-Family Residential (MFR) parcels by a factor of 10 percent. Flow factor development for those land use classes was based on average daily winter water use taken over a 3-month period, with all days assumed to be average. Summer flow monitor data indicated that weekend flows were consistently about 10 percent higher than weekday flows. Since the calibration day was a holiday weekend, it follows that wastewater flow factors and flows for these land use classes should be increased proportionately to reflect the higher than average weekend water use.

Figure 3-2 shows the calibrated diurnal curves used to allocate the flows throughout a model simulation day. Table 3-2 lists the calibrated BSF flow factors for each land use category.

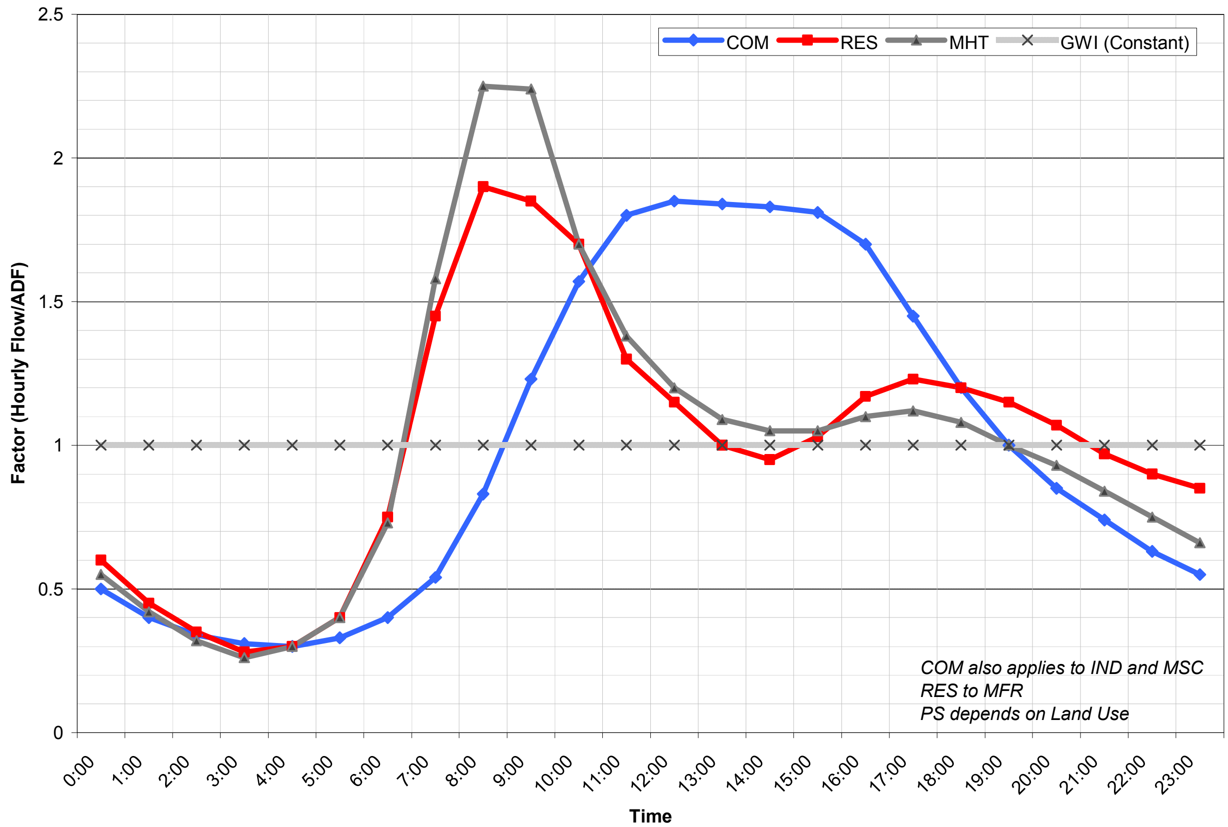

Figure 3-2. Calibrated Diurnal Curves

Table 3-2. Calibrated Unit Flow Factors (Current Land Use)

Land Use Category	TM 3 Flow Factor	Calibrated Flow Factor	Unit	Allocated System Load (mgd)[1]
Campground	Parcel specific	7 Parcels	gpd/parcel	0.070
Commercial	1,100	1,210	gpd/acre	0.286
Industrial	450	450	gpd/acre	0.085
Multi-Family Residential	2,850	3,135	gpd/acre	1.157
Motel/Hotel	2,700	2,970	gpd/acre	0.434
Miscellaneous	150	165	gpd/acre	0.055
Non-Contributing	0	0	gpd/acre	-
Point Source	Varies by source	Varies by source	gpd/parcel	0.300
Single-Family Residential	160	155	gpd/parcel	2.428
Utility	0	0	gpd/acre	-
Vacant	0	0	gpd/acre	-
			TOTAL BSF (mgd) (GWI not included)	4.815

[1]All parcels west of Tallac PS were included in the allocation total given here, but were later substituted by an extra manhole loading in the amount of 0.205 mgd at MH TK1. The total system load (BSF without GWI) for the DWF scenario was 4.76 mgd.

3.3 GWI Calibration

The flow attributed to GWI is roughly equivalent to the difference between the minimum daily flow monitor flow and model flow. For basins where there was a significant difference, a constant flow of GWI was added to make up for it. The manner by which GWI was introduced in this model consisted of calculating this difference in minimum flows, dividing it by the total number of pipes in the corresponding flow monitor basin, and adding the resulting constant inflow to each pipe. The basins requiring adjustment and their estimated GWI flows are listed in Table 3-3. System-wide DW GWI was determined to be 0.260 mgd.

Table 3-3 – DW GWI Factors

FM Basin	GWI (mgd)	GWI (gpm)[1]	GWI per pipe (gpm)
FM-7	0.1400	97.2	0.374
FM-8	0.0500	34.7	1.447
FM-10	0.0175	12.2	0.187
FM-11	0.0400	27.8	1.029
FM-16	0.0125	8.7	0.023
TOTAL	*0.2600*	*180.6*	*0.238 (average/pipe)*

[1]GWI was estimated in mgd while analyzing model results and then converted to gpm, the appropriate model input flow unit.

3.4 Observed vs. Modeled Results

The DW calibration was carried out by comparing modeled results with observed data from the flow monitoring program described above. The flow monitor data was logged using a five-minute timestep, while the model was run with a 2.5 minute pump timestep and a 2.5 minute reporting (sampling) timestep. The target accuracy range for volume calibration is typically ±10 percent of observed, and for peak flow calibration is typically ±15 percent. The total model BSF load was 4.76 mgd, the GWI load was 0.260, and the overall total system loading was 5.02 mgd.

Modeling with 2.5-minute pump station and reporting timesteps resulted in an average daily outflow to the WWTP of 5.14 mgd. Using the same timestep for both pumps and reporting allowed better comparison with flow monitoring data. The small, roughly 2 percent difference in modeled loading vs. outflow is thought to be caused by the modeling platform and how it handles constant speed pumping stations. The sum of the outflows from the three constant speed PSs was approximately 0.13 MG larger than the cumulative volume that entered their wet wells. This is about equal to the excess volume modeled at the WWTP. When the model was run using a one minute pump timestep and a one hour reporting timestep, the total outfall volume matched exactly at 5.02 mgd. That scenario, however, made comparison of flow monitoring and modeled flows more difficult.

Comparisons of ADWF and PDWF are presented in Tables 3-4 and 3-5, respectively. Where the model did not calibrate within the typical accuracy range of flow meters (±15 percent), a potential explanation is provided in these tables. Hydrographs of observed vs. modeled results at all FM locations and the WWTP are presented in Attachment A.

Table 3-4. Observed vs. Modeled Results (Average DWF)				
FM	**Observed ADWF (MG)**	**Modeled ADWF (MG)**	**Difference as Percent of Observed**	**Observations**
1	0.08	n/a	n/a	Not used for calibration
2	0.11	n/a	n/a	Not used for calibration
3	0.20	n/a	n/a	Not used for calibration
4	0.90	1.03	15	
5	0.25	0.21	-16	
6	0.27	0.32	18	FM data on 9/2 showed velocity spikes possibly related to the Labor Day holiday. Comparison was done with FM from second highest day during FM period, 9/16.
7	0.60	0.55	-8	
8	0.22	0.16	-27	District reported the difference was due to Ski Run PS being down.
9	0.12	0.13	8	
10	0.13	0.11	-16	FM data was heavily influenced by pumping (pipes backwatered by Al Tahoe PS and potentially influenced by Ponderosa PS); hence calculated volume is expected to be inaccurate.
11	0.09	0.08	-13	
12	0.39	0.76	93	Sum of ADWF for FMs 14+15+16 is significantly larger than measured flow at FM-12, while FM 12 should actually show the higher volume.
13	0.31	0.30	-2	
14	0.09	0.14	51	Area of Angora Fire, homes were lost, occupancy was probably <100 percent during FM period (about 1½ months following fire),
15	0.28	0.33	18	Same as 14, slightly farther away from burn zone
16	0.18	0.19	1	
WWTP	4.96	5.14	4	WWTP data from 9/02/07 (daily flow) was 4.96 mgd, TM target was 5.02 mgd. Model loading = 4.76 BSF + 0.26 GWI = 5.02 MG

Table 3-5. Observed vs. Modeled Results (Peak DWF)				
FM	Observed PDWF (mgd)	Modeled PDWF (mgd)	Difference as Percent of Observed	Observations
1	0.14	n/a	n/a	Not used for calibration
2	0.18	n/a	n/a	Not used for calibration
3	0.42	n/a	n/a	Not used for calibration
4	1.55	1.81	17	FM peak looks to be cut off, looks good for rest of hydrograph
5	0.91	0.55	-39	Pumped from San Moritz, pump design flow = 0.43 mgd (300 gpm)
6	0.65	0.63	-2	FM data on 9/2 showed unexplained velocity spikes. Comparison was done with FM from second highest day during FM period, 9/16/07.
7	1.01	0.91	-10	
8	0.44	0.25	-45	Could not match peak, District reported the difference was due to Ski Run PS being down.
9	0.20	0.24	20	
10	0.33	0.19	-45	FM data shows influence by pump station (pipes were backwatered), not possible to simulate this situation with the model.
11	0.14	0.11	-25	
12	0.78	1.22	57	Travel time in model was much larger than observed, probable inaccuracy due to interference from flows from Upper Truckee FM 14, 15, and 16 sub basins.
13	0.51	0.47	-8	
14	0.15	0.26	71	Area of Angora Fire, occupancy was probably less than 100 percent during FM
15	0.54	0.55	1	
16	0.36	0.32	-11	
WWTP	n/a	8.15	n/a	No time varying flow meter data was available from the WWTP during the dry season to compare maximum instantaneous peaks

4. WET WEATHER CALIBRATION

The wet weather (WW) calibration was carried out using WWTP rainfall and flow data and PS totalizer flow data collected during the large storm of December 30 through 31, 2005. That storm, dubbed the New Year's storm for this TM, saw continuous rainfall measuring 4.71 inches and caused an instantaneous peak flow of 18.5 mgd to enter the WWTP on December 31. The following sections describe the data collection, calibration storm analysis, and WW calibration process.

4.1 Wet Weather Flow Data

4.1.1 WW Flow Monitoring

Flow monitoring was carried out in 2007 and 2008 with the intention of capturing WW flow data at the flow monitor locations listed in Table 3-1. The few rainfall events observed during that period were not significant enough to cause an appreciable degree of rainfall dependent inflow and infiltration (RDI/I) that could be used for WW calibration. Typically, larger storm events (5- to 10-year storms) are more useful and conservative for WW model calibration. Table 4-1 presents a summary of rainfall occurring during the three temporary flow monitoring periods.

Table 4-1. Total Precipitation During Flow Monitoring Periods

Rain Gauge	2007 Summer 8/19/07—9/18/07	2007 Spring 3/25/07—5/11/07	2008 Spring 3/30/08—6/4/08
RG1	0.70	2.27	0.43
RG2	0.06	0.84	0.96
RG3	n/a	0.91	0.66
RG4	n/a	1.08	1.04
RG5	n/a	0.66	1.14

4.1.2 Historical Rainfall Data

The absence of relevant WW flow monitoring data necessitated the use of historical records for WW model calibration. The largest recent storm for which rainfall and flow data was readily available was the New Year's storm described above. Rainfall data from different National Climatic Data Center (NCDC) rain gauges in and around South Lake Tahoe collected during the largest rainfall events on record since 1998 are presented in Table 4-2. The New Year's storm is the largest continuous storm when total rainfall is summed over its two-day duration, December 30 through December 31 (4.8 inches at the WWTP, 3.7 inches at Minden, and 7.3 inches at Robb's Peak).

Table 4-2. Historical Rainfall Events

Date	HELL HOLE[1]	ROBBS PEAK[1]	MINDEN[1] (inches)	WWTP[2]
1/24/2000	4.3	3.5	0.7	n/a
2/13/2000	3.4	4.2	0.4	n/a
11/8/2002	3.4	4.7	2.5	n/a
12/1/2005	4.4	3.7	1.1	2.7
12/18/2005	3.2	3.3	0.8	1.8
12/21/2005	1.7	2.3	0.6	1.4
12/30/2005	3.0	4.9	1.6	1.8
12/31/2005	-	3.4	2.1	3.0
2/27/2006	2.8	2.7	0.8	2.1

[1]Rain Gauge data is from NCDC daily totals at locations specified.

[2]WWTP is the sum of hourly rainfall data for the days indicated.

4.1.3 Flow Data

The District provided WWTP influent flow data, manually logged at two-hour intervals, for various storms of interest during the 2005/2006 winter season. Previously, the District had supplied average daily flows at the WWTP from January 2000 through May of 2008. The New Year's storm caused the highest average daily flow for this entire 7.5-year period (9.4 mgd), as well as the highest instantaneous peak flow 18.5 mgd.

The two-hour timestep was not ideal for model calibration since a longer averaging period tends to dampen the flows (i.e. lowers peaks and raises minimums). However, it was possible to calibrate the model using a one-hour simulation report (sampling) timestep to compare with the two-hour observed flows and a

2.5-minute report timestep to compare instantaneous peaks. This is described in more detail in the results section.

The district also supplied PS totalizer logs for the PSs included in the model and handwritten runtime logs for Tallac PS. PS totalizer data included daily meter readings taken at more or less the same time each day. Tallac PS data indicated that the meters were usually read two times per week.

4.2 Wet Weather I/I

WW model calibration entails estimating how much total I/I enters the collection system during a storm event, spatially distributing the total amount throughout the collection system area, and then adjusting modeling parameters until modeled flows match observed flows at specified points within an acceptable margin of error.

4.2.1 Collection System Connected Area

Only rainfall that falls on the physical area served by the collection system is assumed to be available to enter the collection system pipes and manholes as I/I. The total area of 6,251 acres used for hydraulic modeling was calculated by taking the sum of the area of all parcels connected to the collection system. Connectivity was based on future land use because it was assumed that area open to future development is already sewered. Therefore, all current and future campground (CMP), COM, industrial (IND), MHT, miscellaneous (MSC), point source (PS), and RES and MFR parcels, as delineated in the Land Use TM, are assumed to contribute I/I flows. The area from non-contributing (NC), vacant (VAC), and utility (UTL) parcels was excluded from the total area.

The entire parcel area was used in the I/I area calculation, with the following three exceptions. First, many very large RES parcels are described in the GIS as being single family residences on otherwise unimproved tracts of land. It was decided that the maximum connected area of any RES parcel should be limited to 3.3 acres; a figure arrived at by looking at average-sized parcels that are currently VAC with future RES land use. Of the 18,188 total future RES parcels, 65 had areas greater than the threshold of 3.3 acres and were correspondingly reduced. Second, two CMP parcels (both with APN 01907104) in the Tallac sewer basin were determined to have very large areas compared with the number of sewer units assigned to them. The I/I area was assumed to be equal to 40 percent of the total area from each parcel. Finally, two parcels were excluded for the following reasons: Heavenly Ski Area (PS with APN 03037004) because the total area given is very large (approximately 60 acres) and the contributing area unknown, and a small MSC parcel (APN 01907104) located next to a UTL parcel far away from any potential sewer connection. Figure 4-1 presents parcels that contribute RDI/I during modeling and sewer basin total contributing areas.

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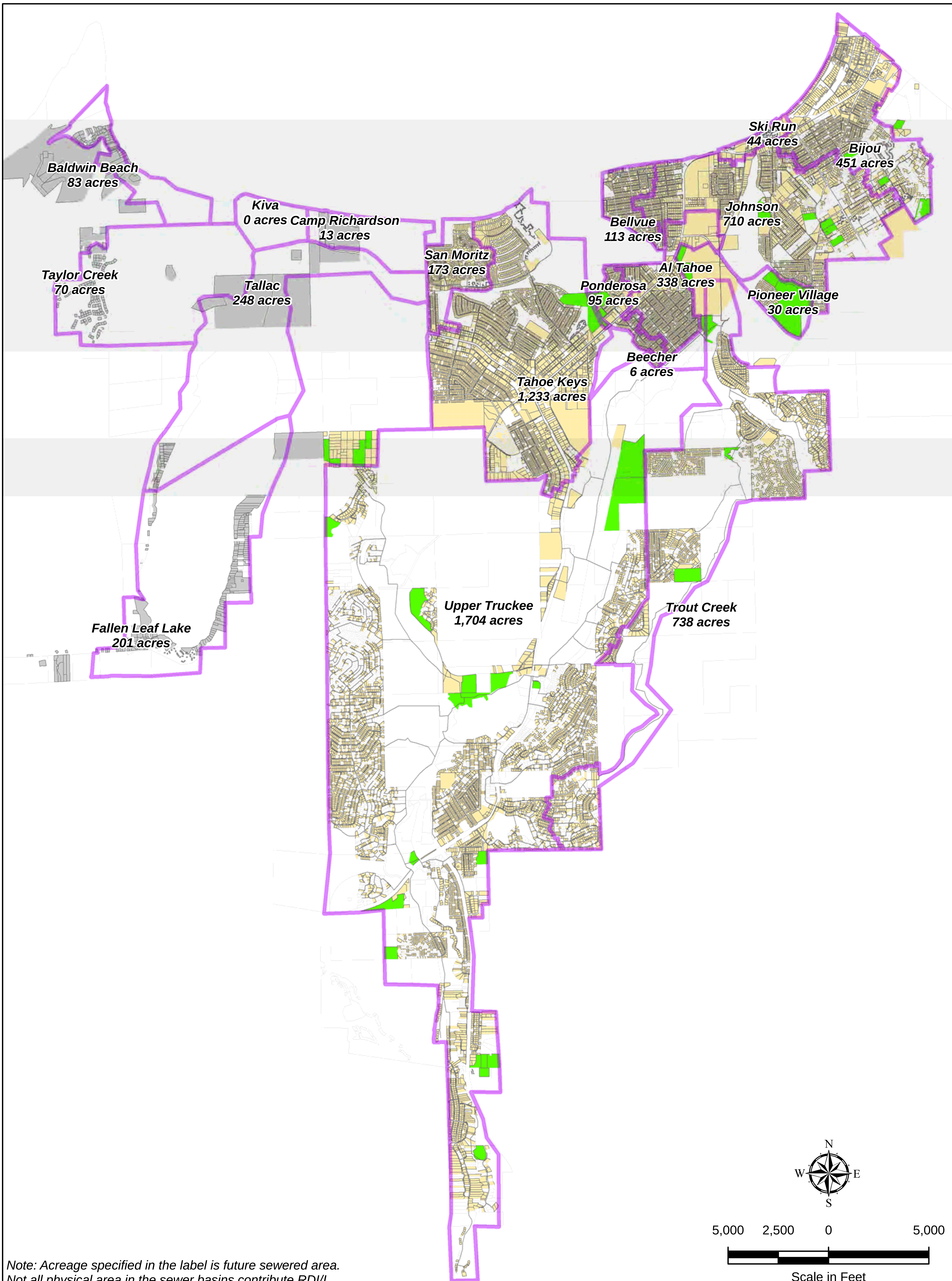

Note: Acreage specified in the label is future sewered area.
Not all physical area in the sewer basins contribute RDI/I.

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Figure 4-1
RDI/I Contributing Area

4.2.2 Overall R-Factor

The overall R-Factor is defined as the percent of the total volume of rainfall that enters the collection system. It is a good indicator of the tightness of a collection system's pipes and hence the system's overall condition. Figure 4-2 presents an illustration of the rain volume-to-flow relationship for the New Year's storm. It shows the observed WWTP flow compared to standard diurnal curves developed for the STPUD collection system based on historical WWTP flow data (weekdays and weekends rearranged as appropriate). The area between the curves is the total I/I volume attributable to the storm in question.

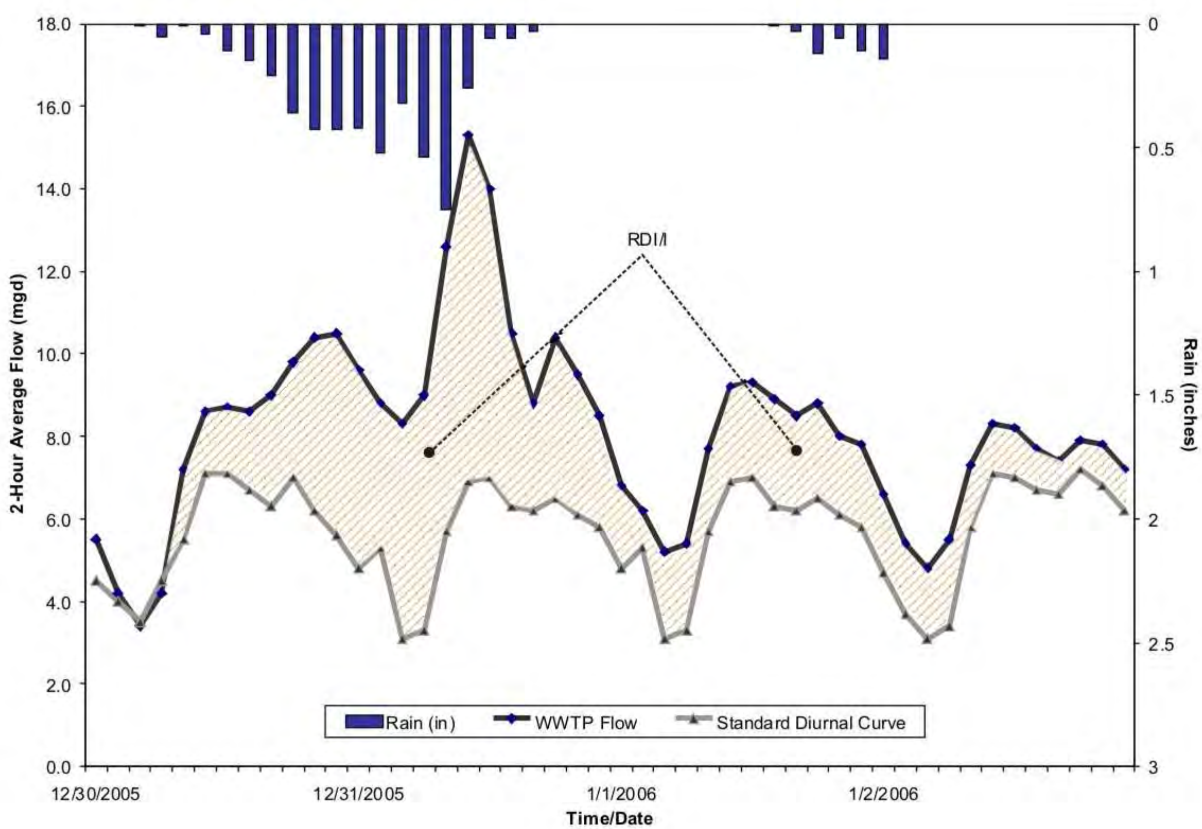


Figure 4-2. System-wide RDI/I Calculation

Various rainfall events occurring before and after the New Year's storm were analyzed in order to estimate an overall R-Factor for use in the hydraulic model. Compared to other storms during the 2005 winter season, the influence that the New Year's storm had on WWTP flows appears to be much more significant, thereby suggesting that its larger R-Factor would provide a more conservative indicator of WW system performance. The calculated overall R-Factor value of 1.14 percent was thereby selected as a starting point for the WW calibration.

4.2.3 Sewer Basin R-Factors

R-Factors vary between sewer basins depending on many different localized conditions such as pipe condition, ground surface (permeable vs. impermeable), number of connections, etc. Rainfall also varies between basins and is generally expected to increase with increasing elevation. During the development of this hydraulic model, rainfall was assumed to be constant over all of the sewer basins; the GIS shows a relatively small range of MH rim elevations—between 6,230 feet and 6,880 feet. Furthermore, the total area is relatively small. This constant rainfall assumption can be further justified by assuming that as the elevation climbs, any additional rainfall usually attributed to rising elevation would be offset at some point by rainfall turning into snowfall. Since the snow level was not precisely known over the duration of the storm, this approximation cannot be verified. The additional precision that could be gained by modifying rainfall spatially, however, would probably be lost due to lack of accurate WW flow monitoring data. In light of those considerations, the constant rainfall assumption was determined to be acceptable.

Each sewer basin drains to a pumping station, from where flow is either pumped to another basin or directly to the WWTP. PS data (totalizers and runtime logs) were used to develop the basin-specific R-Factors. By comparing the relative increase in PS volume during the duration of the storm versus the average dry weather volume for the dry day preceding the storm at each PS, the resulting I/I volume for each basin was estimated. That volume, divided by the rainfall falling on the basin's connected area, gave the basin's relative R-Factor. A scaling factor was developed in order to proportion each basin R-Factor to the overall R-Factor of 1.14 percent.

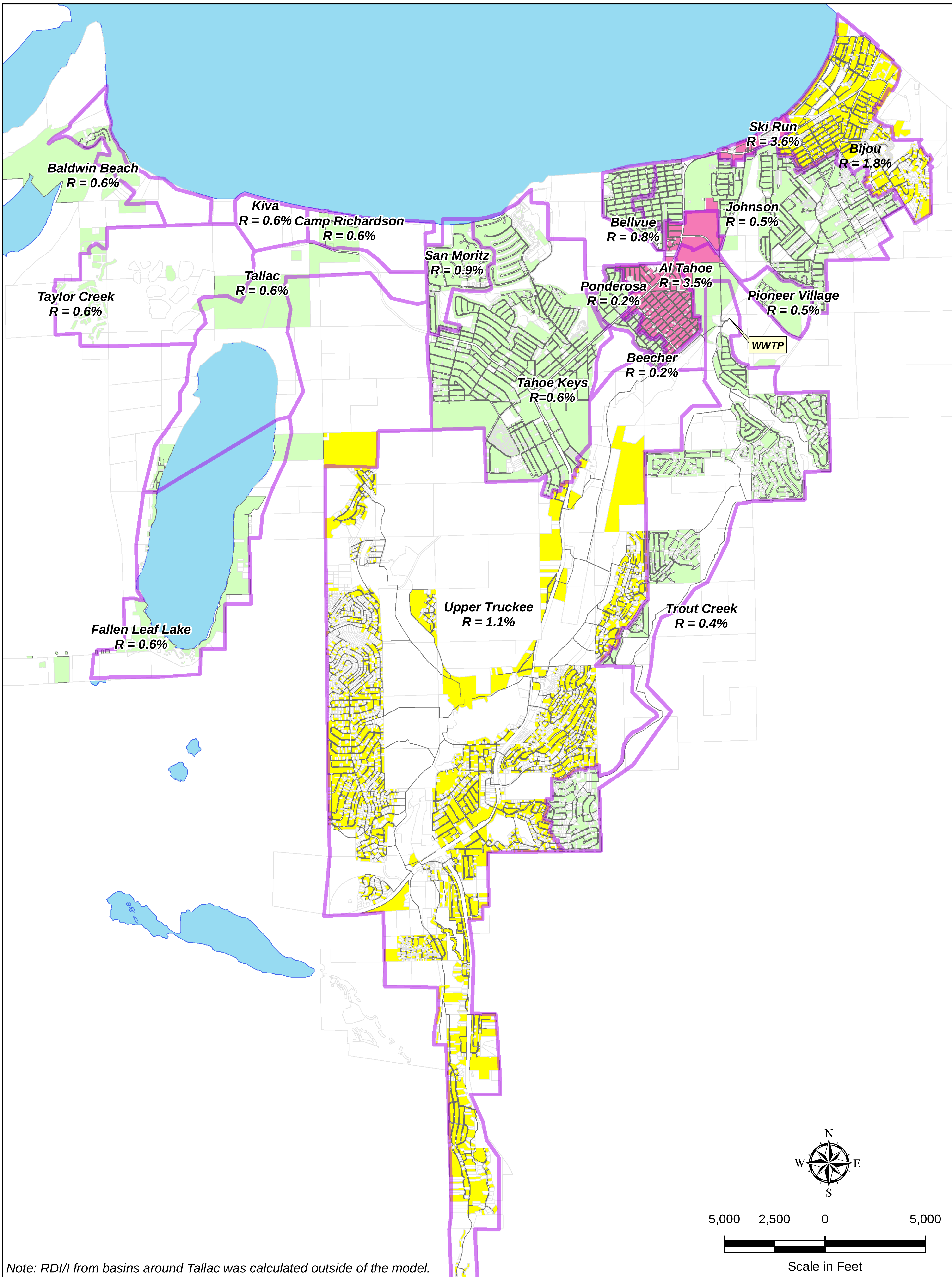
Both the overall R-Factor and the basin R-Factors were adjusted during the iterative calibration process described in the following section. The preliminary calculated R-Factors and final calibrated R-Factors arrived at through that process are presented in Table 4-3. The overall R-Factor determined through calibration was lowered to 0.95 percent. Less than one percent R-Factor is a very low amount of I/I.

Table 4-3. Sewer Basin and Overall R-Factors

Sewer Basin	RDI/I Area (acres)	Preliminary R-Factor (Percent Rainfall)	Calibrated R-Factor (Percent Rainfall)
Al Tahoe	338	4.0	3.3
Bellevue	113	1.0	0.8
Bijou	451	2.1	1.8
Johnson	710	0.6	0.5
Pioneer Village	30	0.6	0.5
Ponderosa (*includes Beecher*)	101	0.3	0.2
San Moritz	173	1.0	0.9
Ski Run	44	4.2	3.5
Tahoe Keys	1,233	0.6	0.5
Tallac (*includes Taylor Creek, Baldwin Beach, Fallen Leaf Lake, Camp Richardson, & Kiva*)	616	1.0	0.9[1]
Trout Creek	738	0.4	0.3
Upper Truckee	1,704	1.3	1.1
Overall	**6,251**	**1.14**	**0.95**

[1] Runtime log data was actually used for I/I volume estimation for these basins. Their R-Factor from that analysis is approximately 0.6 percent.

Sewer basins with their associated R-Factors and contributing areas are shown on Figure 4-3.



Note: RDI/I from basins around Tallac was calculated outside of the model.
R-Factors shown for those basins are equivalent percent rainfall as RDI/I

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Figure 4-3
Sewer Basin R-Factors

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Sewer Basins

RDI/I R Factor (Percent)

- 0 < R < 1.0%
- 1.0% < R < 2.0%
- 3.0% < R < 4.0%
- Non-contributing
- Sewer Basin Boundary
- Modeled Gravity Main

4.3 WW Calibration

Typically, wet weather hydraulic modeling is done using a one hour reporting (sampling) timestep. During calibration of this model, two different timesteps were used in order to try to match both the two-hour average flow data and the instantaneous peak flow. The model uses (1) a one-hour reporting timestep to match the observed average flows and (2) a 2.5-minute reporting timestep to compare with the instantaneous peak. Aside from the timesteps, all other parameters were held constant between models. The calibration strategy aimed to land somewhere between the average and peak datasets, within an acceptable margin of error for both.

High instantaneous peaks at the WWTP are likely due to the combined influence of multiple PSs that pump directly to the WWTP. The model does not attempt to precisely match flows from the variable speed PSs, only to convey all of the simulated flows that enter each PS to a common point (WWTP) so that their hydrographs can be superimposed at approximately the correct time. It is probable that constructive interference occurs at the WWTP from the pumped flows, causing high, short duration peaks at the plant that cannot be replicated in the model.

4.3.1 Model WW Parameters

Wet weather model calibration uses the same BSF factors developed during the DW calibration. It further depends on the development of the following additional sets of modeling parameters:

- The R-Factors discussed in the previous section determine the overall I/I volume to be routed through the model network during the chosen WW simulation period;
- WW GWI, or the additional GWI that occurs because of the higher seasonal groundwater table; and
- The unit hydrograph parameters determine the shape of the I/I hydrograph, or how quickly the I/I enters the system.

WW GWI. Before the New Year's storm, a number of smaller storms had affected the degree of soil saturation, resulting in the elevated minimum flows observed at the WWTP before the calibration period. This was accounted for by injecting 1.3 mgd of WW GWI. This was input in addition to any preexisting DW GWI by introducing a constant flow of 0.212 gpm in each of the 4,265 pipes of the model network. No attempt was made to spatially vary WW GWI between sewer basins for lack of basin flow monitoring data.

R-Factor Hydrograph. The final overall and basin R-Factors were presented in the last column of Table 4-3. The model uses the Tri-triangle method to generate the synthetic unit hydrograph for each input node. That method takes three triangular hydrographs, each defined by the parameters R_i, T_i, and K_i, and superimposes them to create the overall unit hydrograph. For model runs, the 60-minute unit hydrograph was specified. The three sets of three parameters arrived at through calibration are presented in Table 4-4. The R values presented in the table represent the percent of the total basin R-Factor I/I that enters the model in the (1) fast, (2) medium, and (3) slow RTK hydrograph triangles.

Table 4-4. Tri-Triangle Unit Hydrograph Parameters

Parameter	Definition	1	2	3
R_i	Percent of overall I/I volume for each triangular hydrograph, with time to peak "T" and recession constant "K"	50	25	25
T_i	Time to peak (hours)	1	4	12
K_i	Dimensionless recession constant determining duration of influence. Total duration = $T_i(1+K_i)$	2	2	3

The R, T, and K factors were assumed to be the same for all sewer basins. In the absence of flow monitoring data for individual sewer basin calibration, it was not possible to adjust them spatially.

Tallac Sewer Basin. All sewer basin I/I flows, with the exception of Tallac, were developed within the model using the methodology described above. WW flow from the Tallac Basin was developed based on the run-time log analysis, and validated against wet weather flow monitoring data collected in the absence of rain. Model WW flow from Tallac and its tributary basins was input as a constant base flow of 31 gpm plus a constant I/I flow of 180 gpm during the 36 hours following hour 1 of the storm (211 gpm total during those 36 hours). This flow was input at node TK1, corresponding to the end of the Tallac force main. That amount of I/I flow corresponds to basin R-Factors of approximately 0.6 percent for Tallac and its contributing basins.

4.3.2 Calibration Results

Figures 4-4 and 4-5 present the hydrographs from the final WW calibration simulations with one-hour and 2.5-minute reporting timesteps, respectively, plotted against the 2-hour average WWTP flow. WWTP instantaneous peaks are plotted on the 2.5-minute timestep figure. Note that there was no time associated with the instantaneous peak in the data set received, so it was estimated to occur at 11:00 a.m. each day.

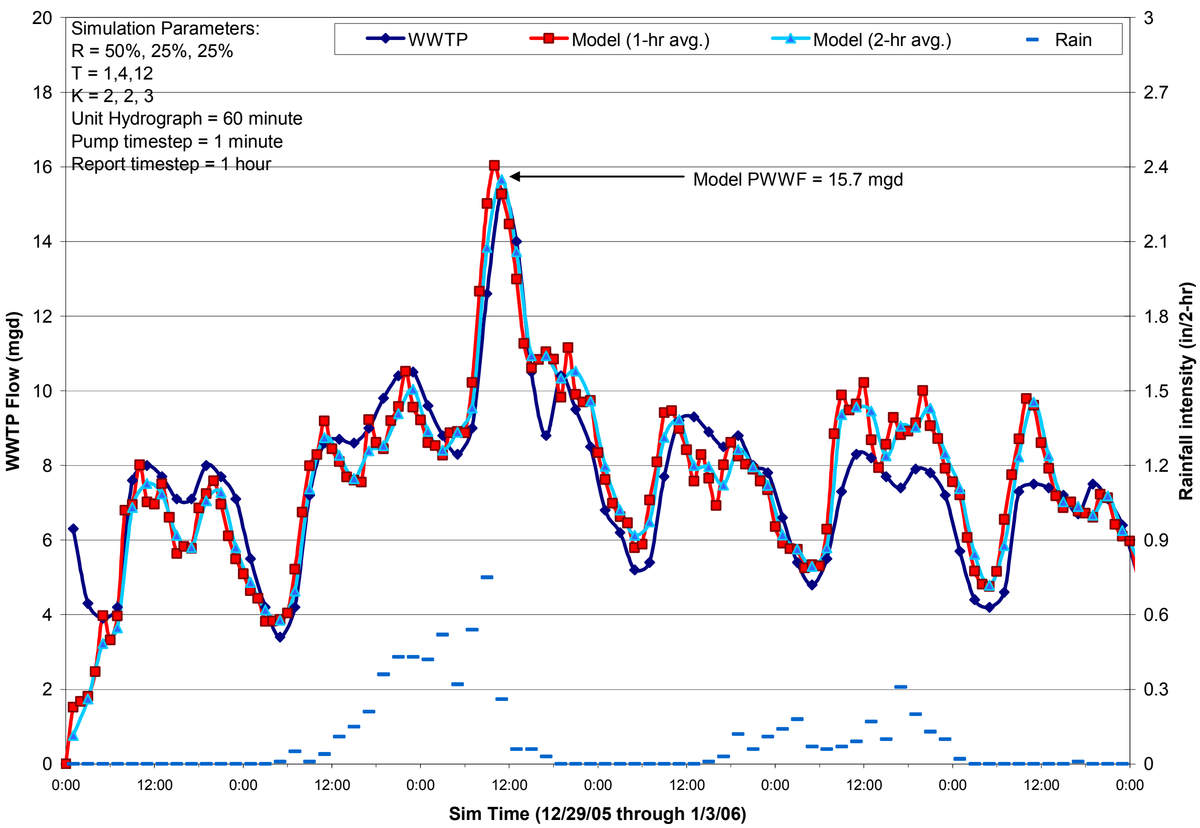


Figure 4-4. Simulation Results (1-hour Report Timestep)

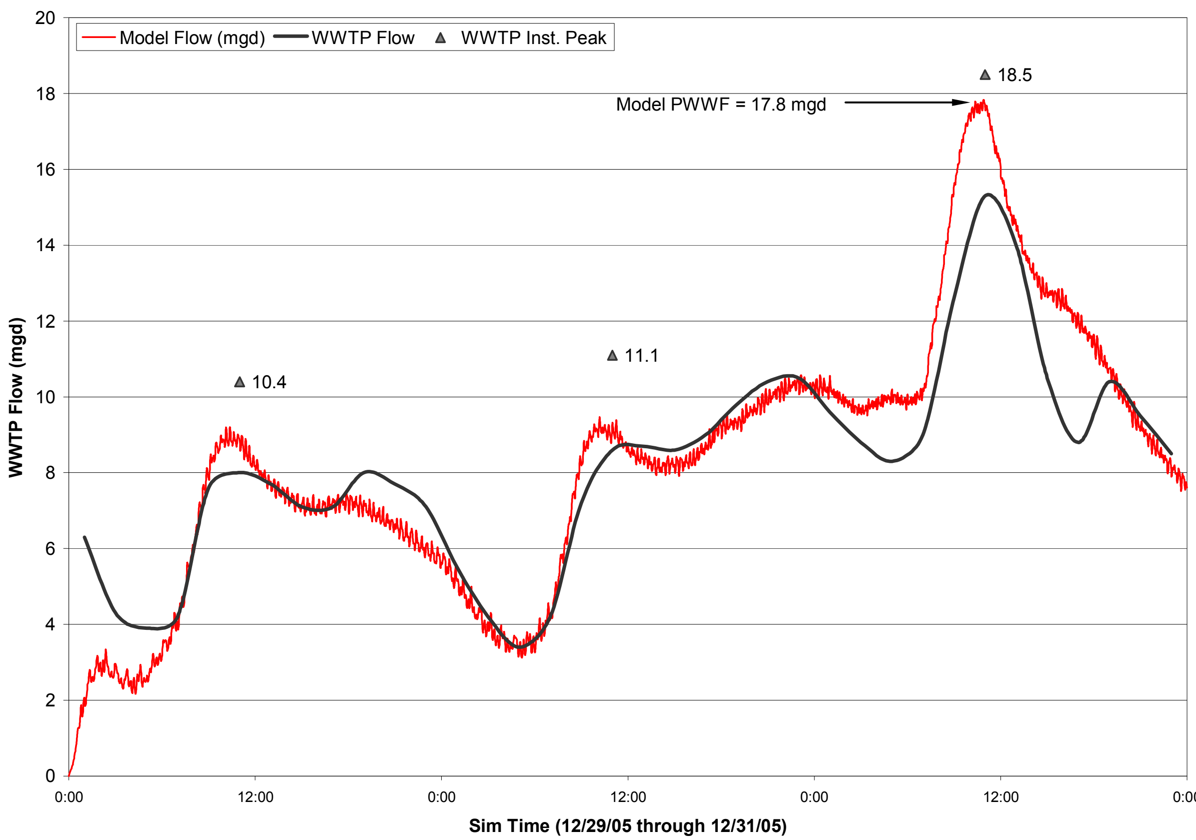


Figure 4-5. Simulation Results (2.5-minute Report Timestep)

4.3.3 Discussion of Results

Initialization. Note that the model hydrograph begins with a flow of zero. The model has an initialization period during the first several hours of the model run. By the beginning of the second day and the start of the rainfall, the model had been initialized and its flow more closely matches the observed hydrograph.

PWWF. The highest observed instantaneous peak at the WWTP occurred on December 31. The two-hour model results show a PWWF of 15.7 mgd, compared with the two-hour observed PWWF peak of 15.3 mgd. The model peak is 2.3 percent higher. The instantaneous observed peak was 18.5 mgd and the 2.5 minute timestep model hits a peak of 17.8 mgd. The model is 3.6 percent lower than the observed peak. According to the District, the maximum flow deliverable to the WWTP is approximately 18.5 mgd. For reasons explained above with respect to the instantaneous peak, it was not expected that the model would match the instantaneous peak exactly.

Both modeled and observed flows can be seen to gradually return to pre-storm minimum flows during the several days following the storm. Since the PWWF are of most interest, this tailing-off period is not critical.

Sanitary Sewer Overflows (SSOs). No SSOs were reported during the New Year's storm, and none were predicted by the model. These results confirm the accuracy of the wet weather calibration.

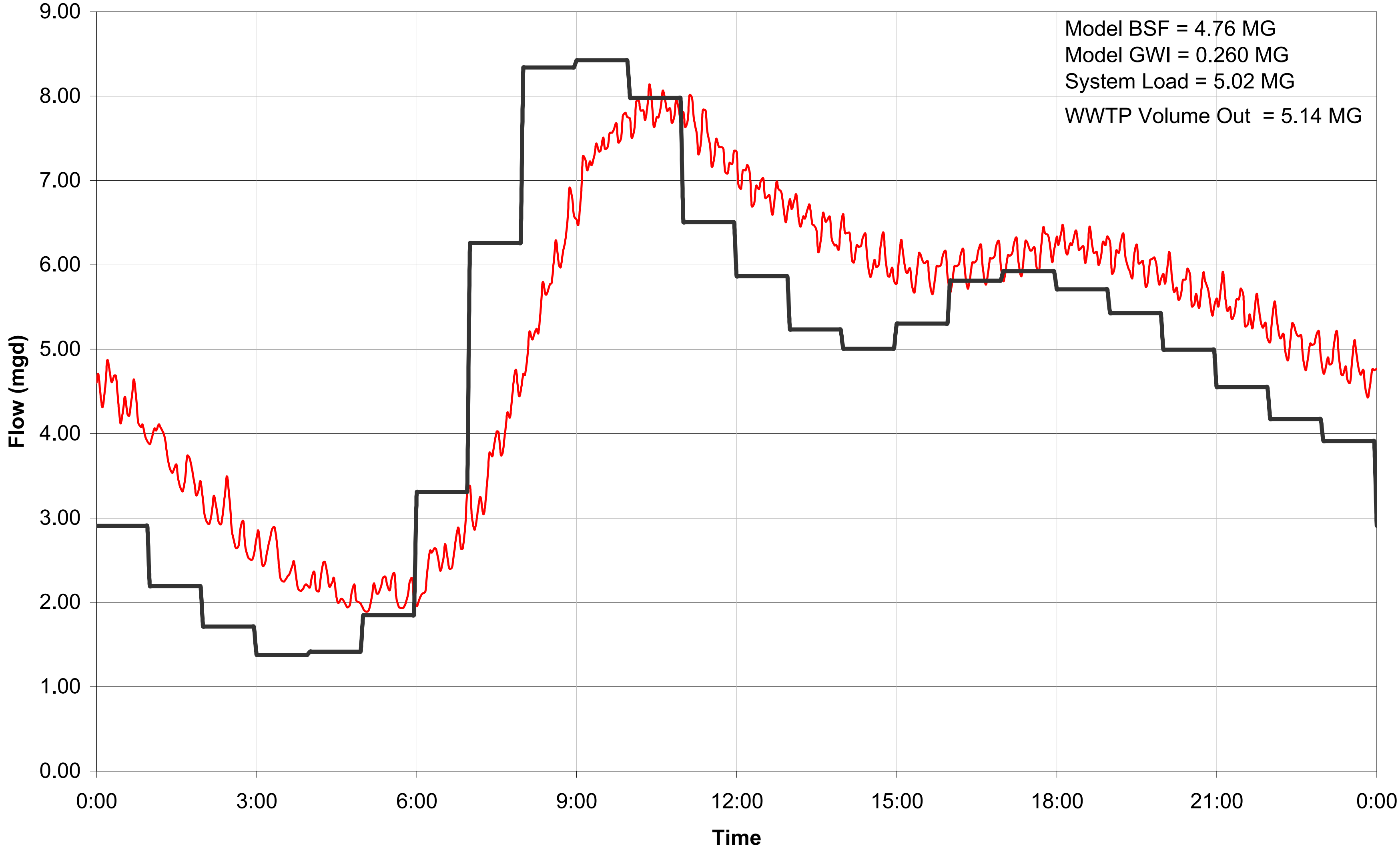
4.4 Future Analysis

This TM discussed the development, DW, and WW calibration of the collection system hydraulic model. The Hydraulic Evaluation TM will discuss design storm development and analysis, future build-out PWWF projections, and collection system capacity analysis.

ATTACHMENT A: OBSERVED VS. MODELED RESULTS

ATTACHMENT A

Model System Flow vs. Model Loading



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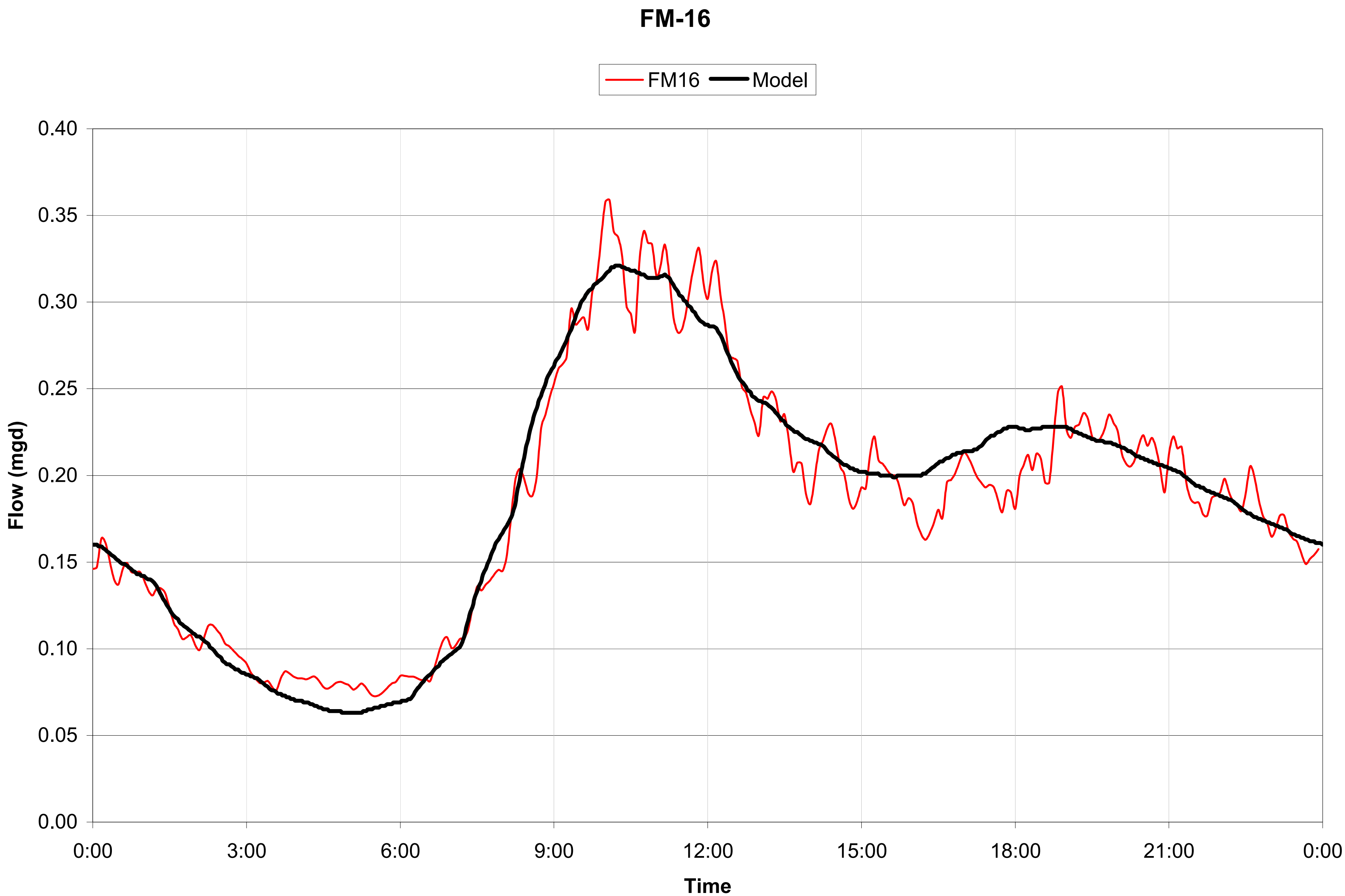
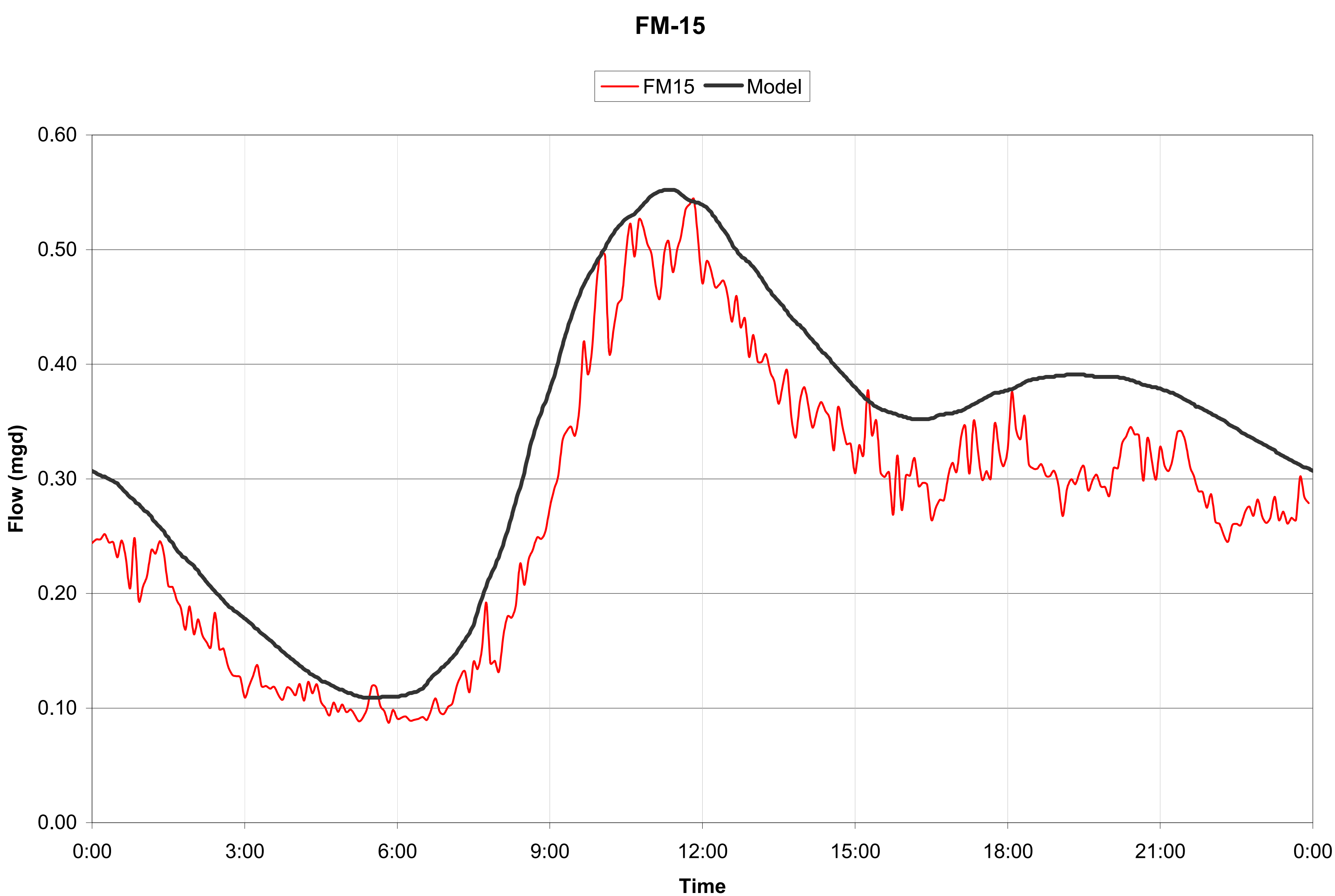
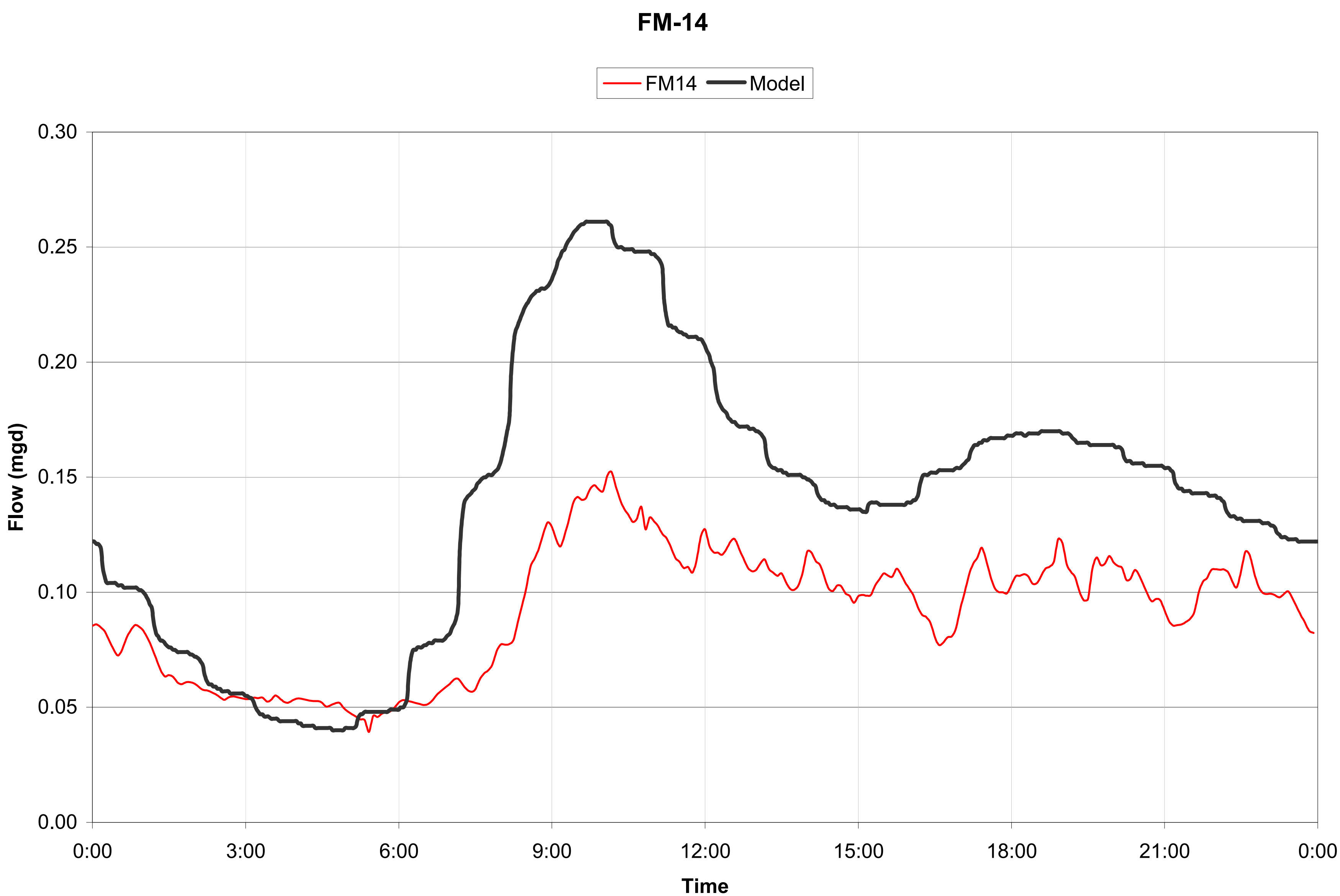
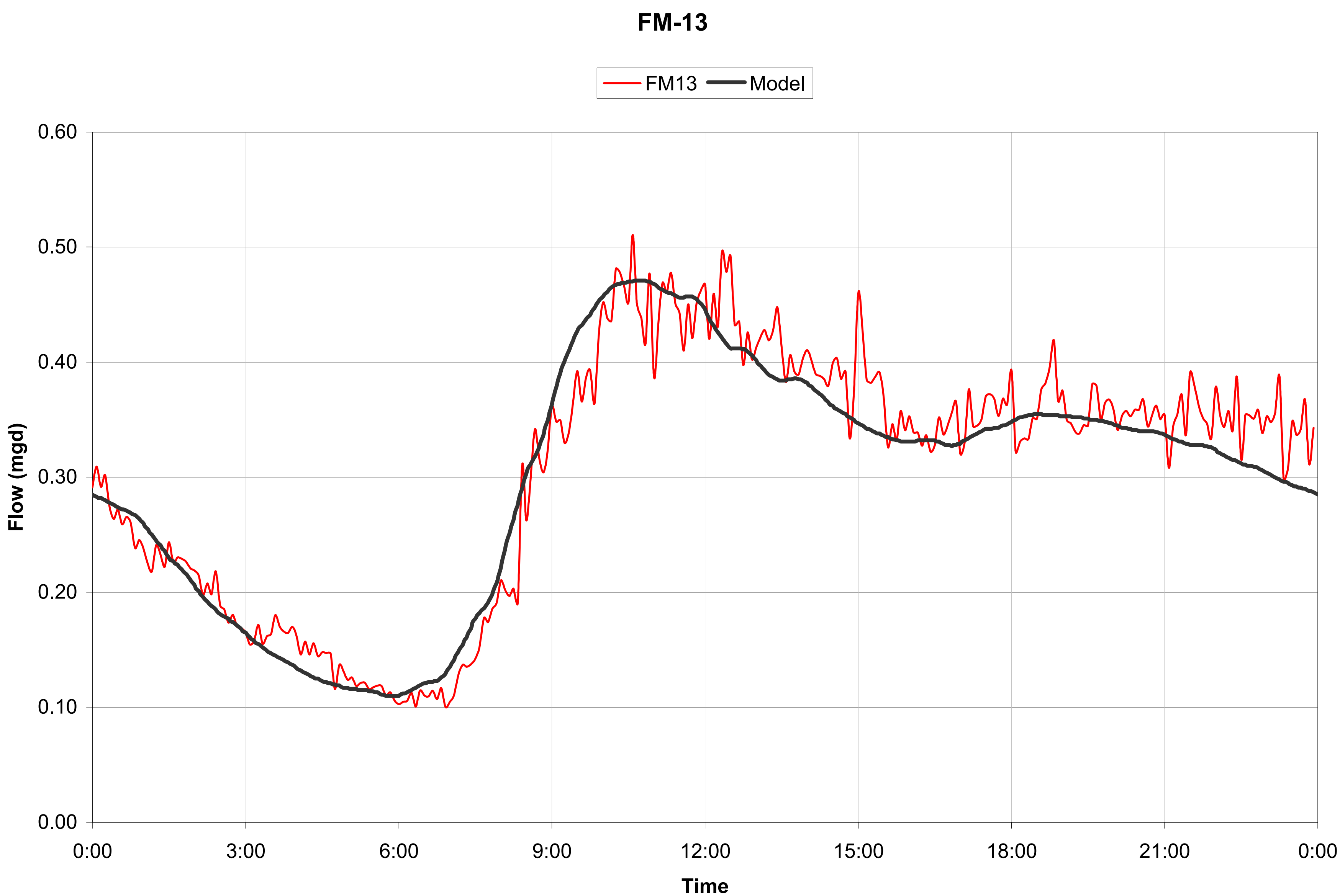

FM-16
FM16
Model
Flow (mgd)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time

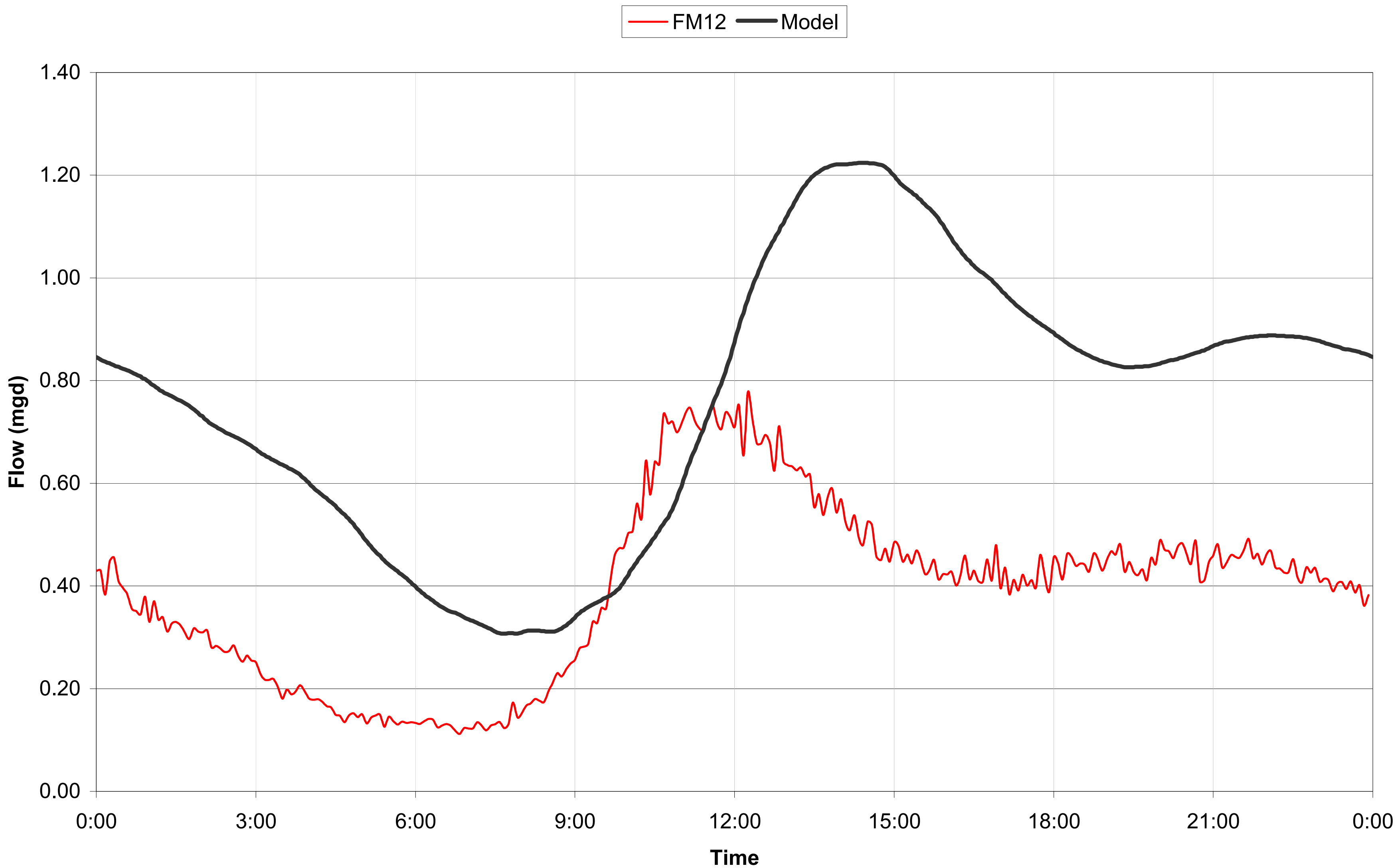

FM-15
FM15
Model
Flow (mgd)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time

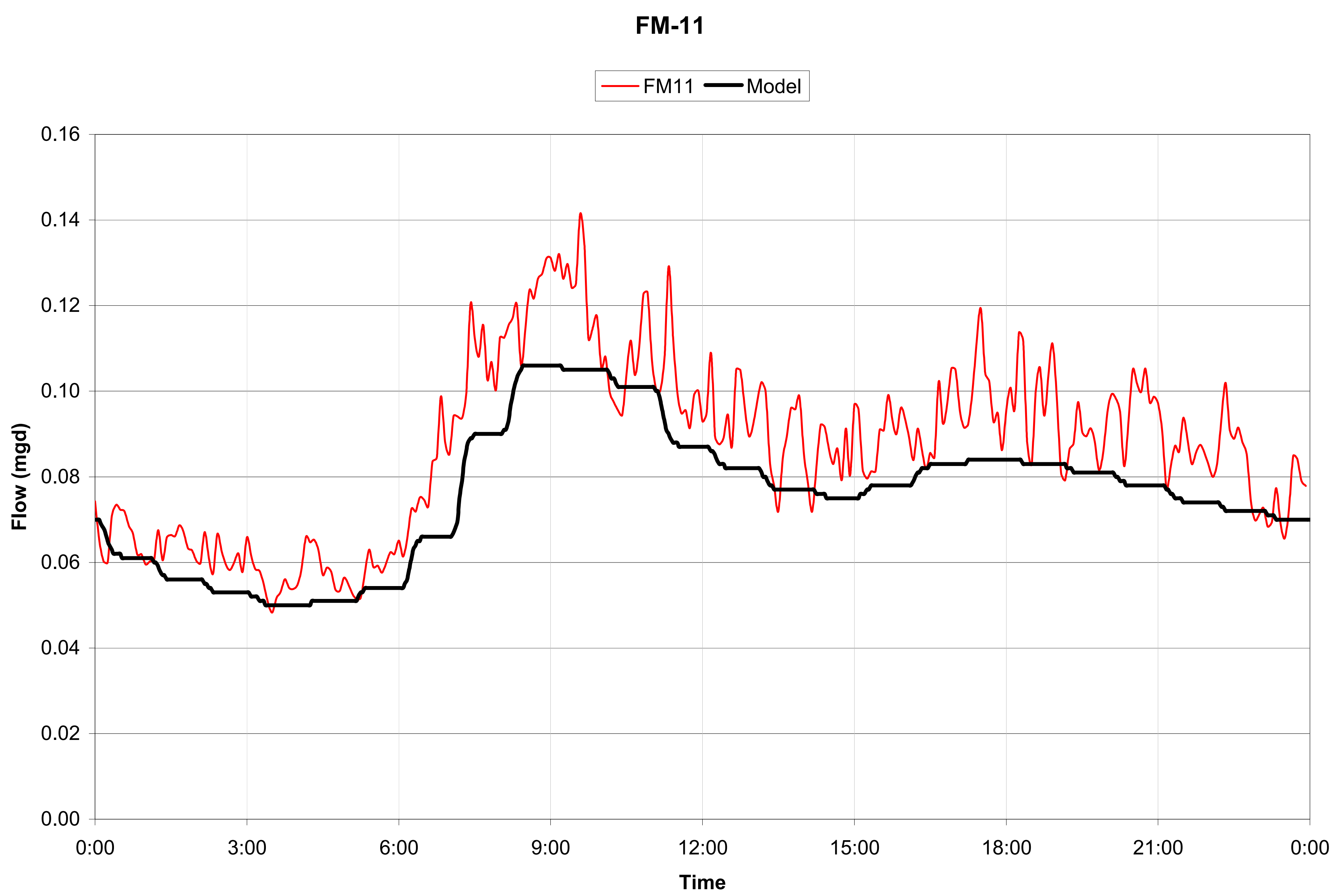


FM-14
FM14
Model
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Flow (mgd)
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time

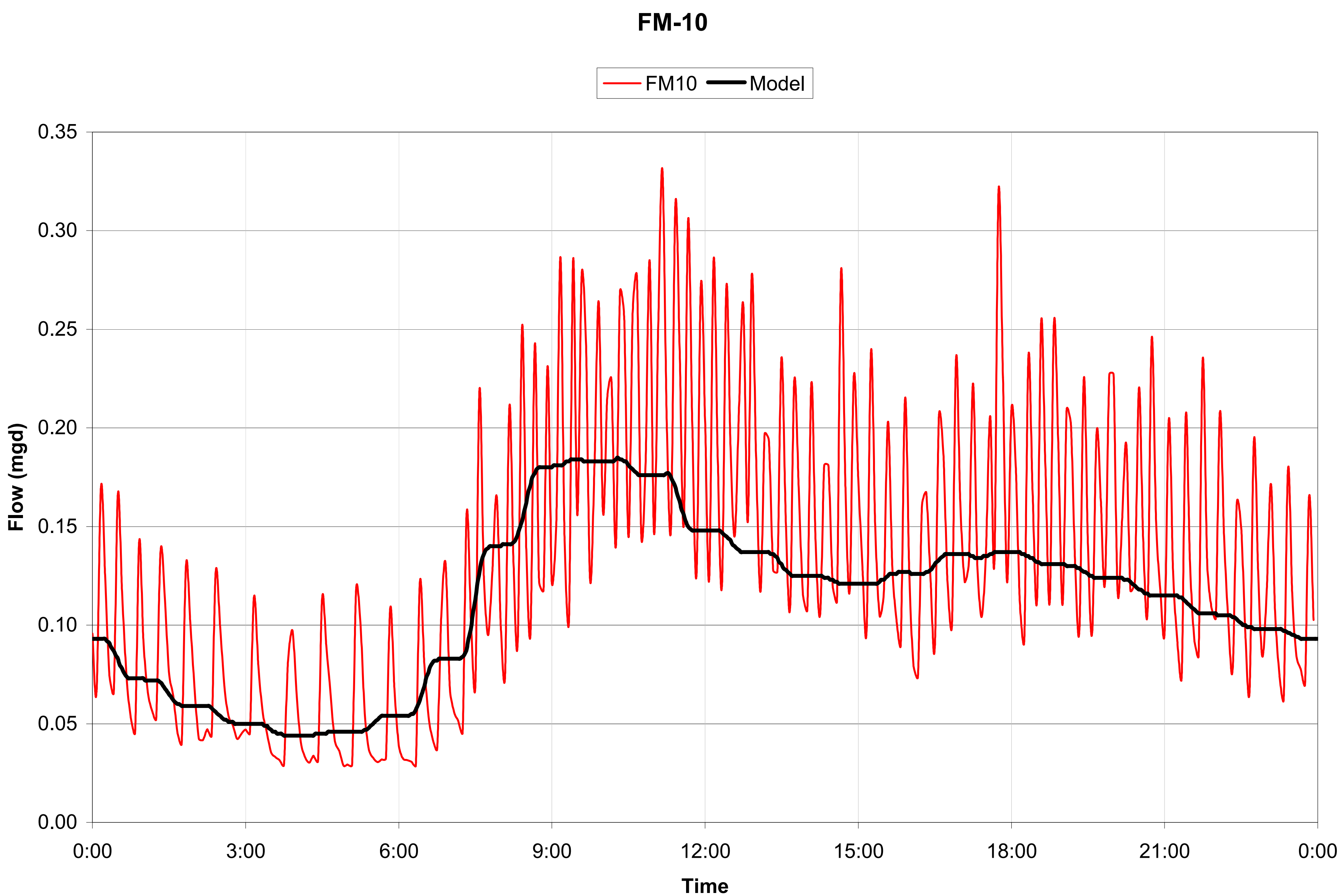

FM-13
FM13
Model
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Flow (mgd)
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time

FM-12

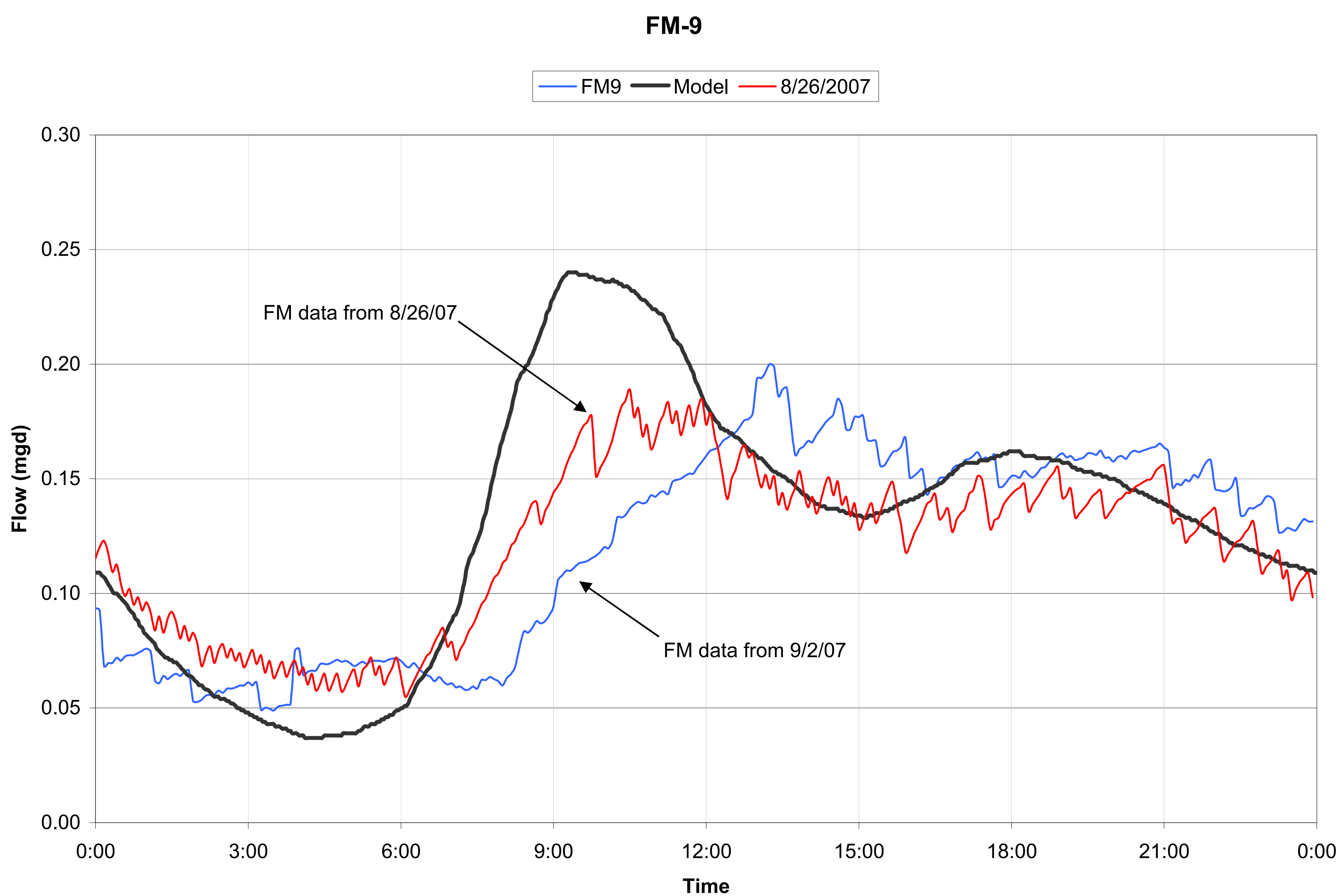

FM12
Model
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Flow (mgd)
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time

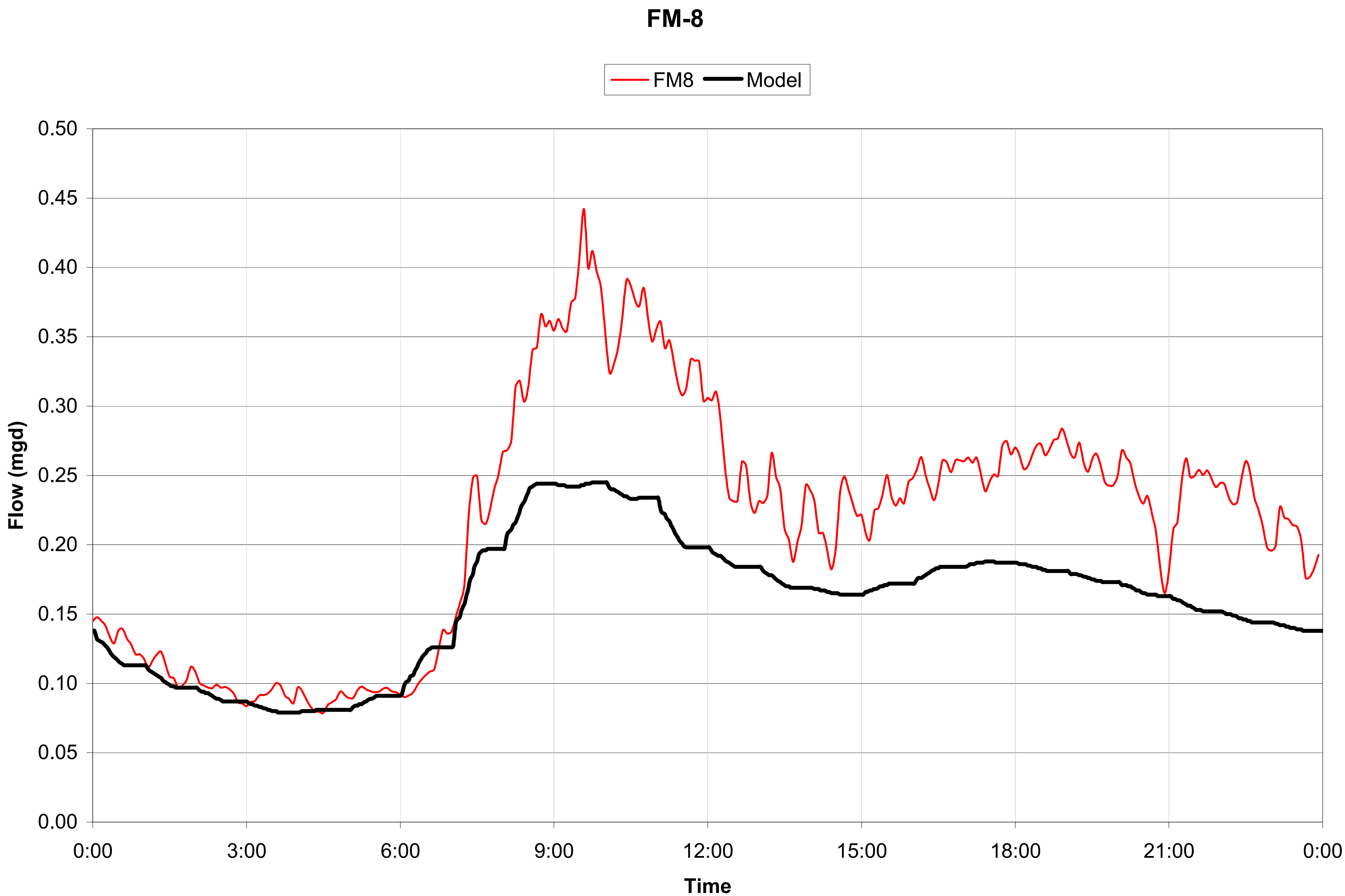


FM-11
FM11
Model
Flow (mgd)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time

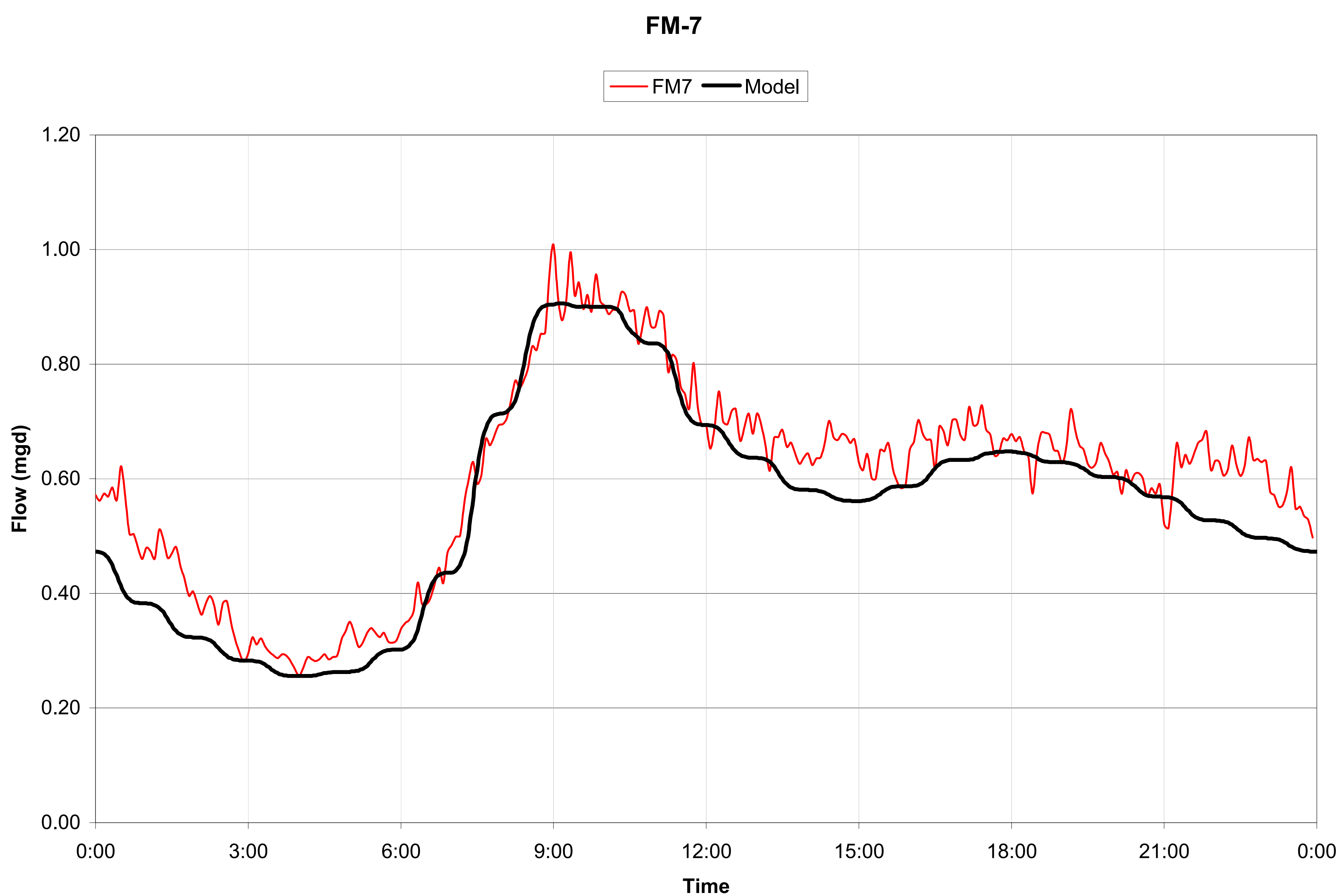


FM-10
FM10
Model
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Flow (mgd)
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time

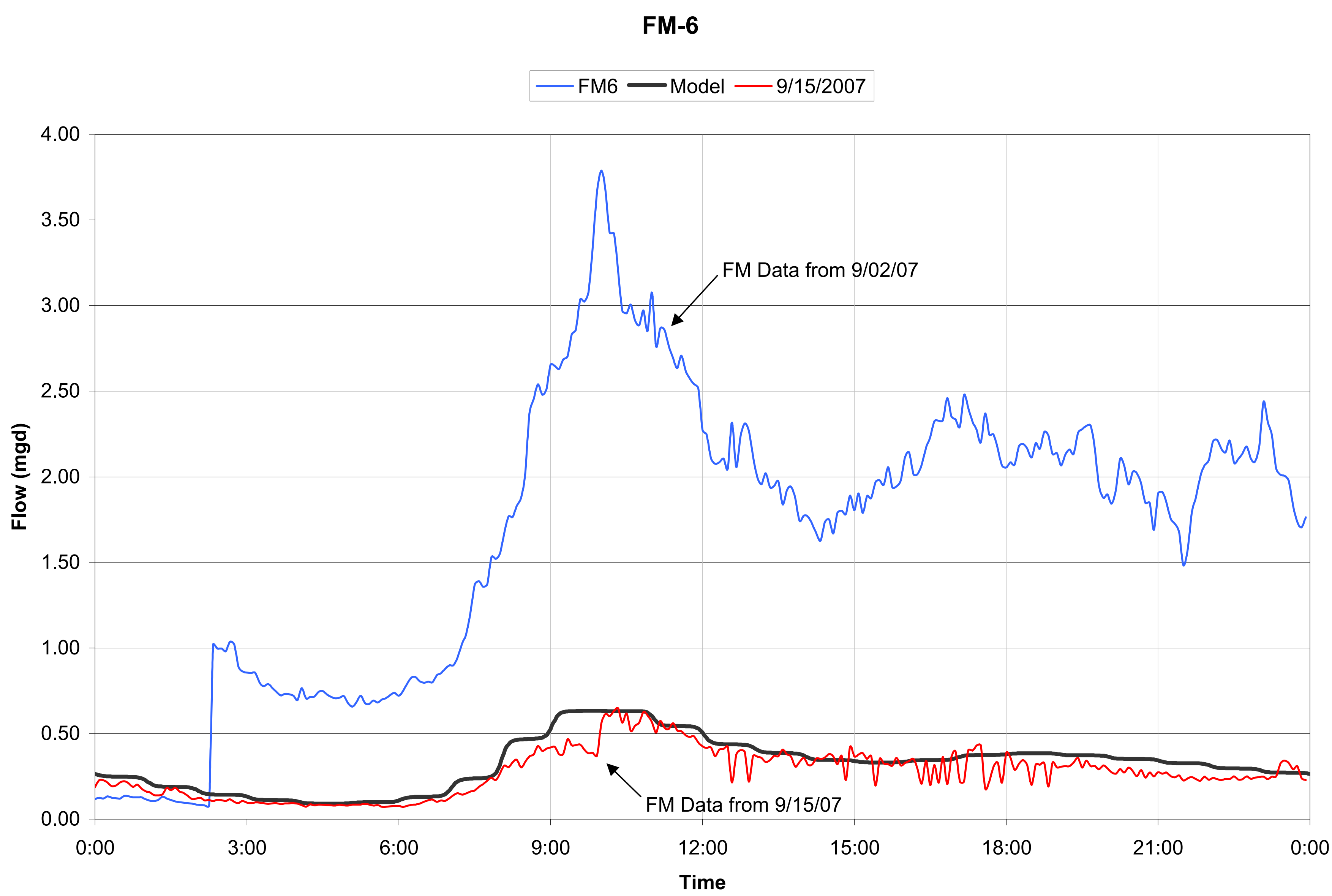

FM-9
FM9
Model
8/26/2007
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Flow (mgd)
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
FM data from 8/26/07
FM data from 9/2/07



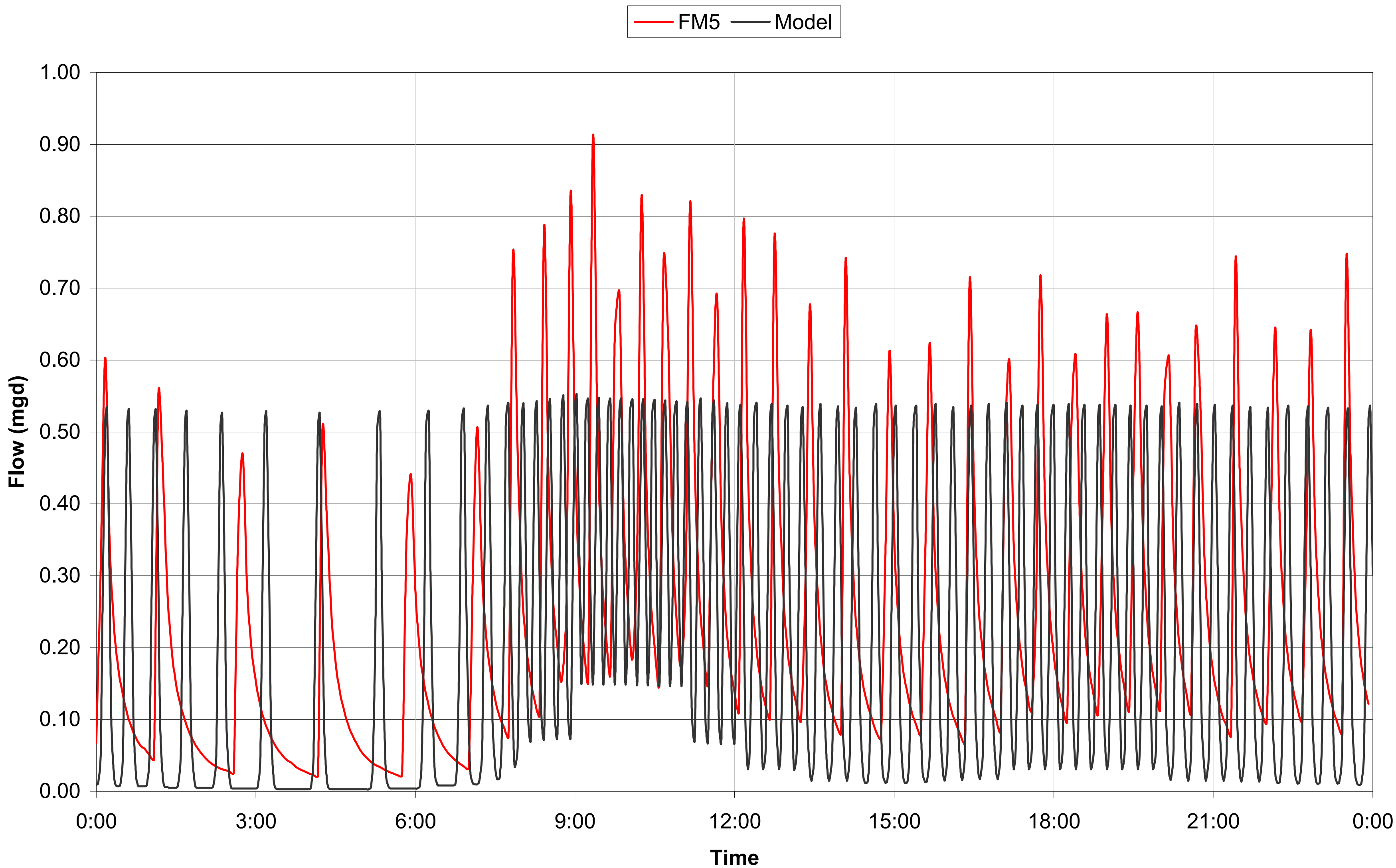
FM-8
FM8
Model
Flow (mgd)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time



FM-7
FM7
Model
Flow (mgd)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time

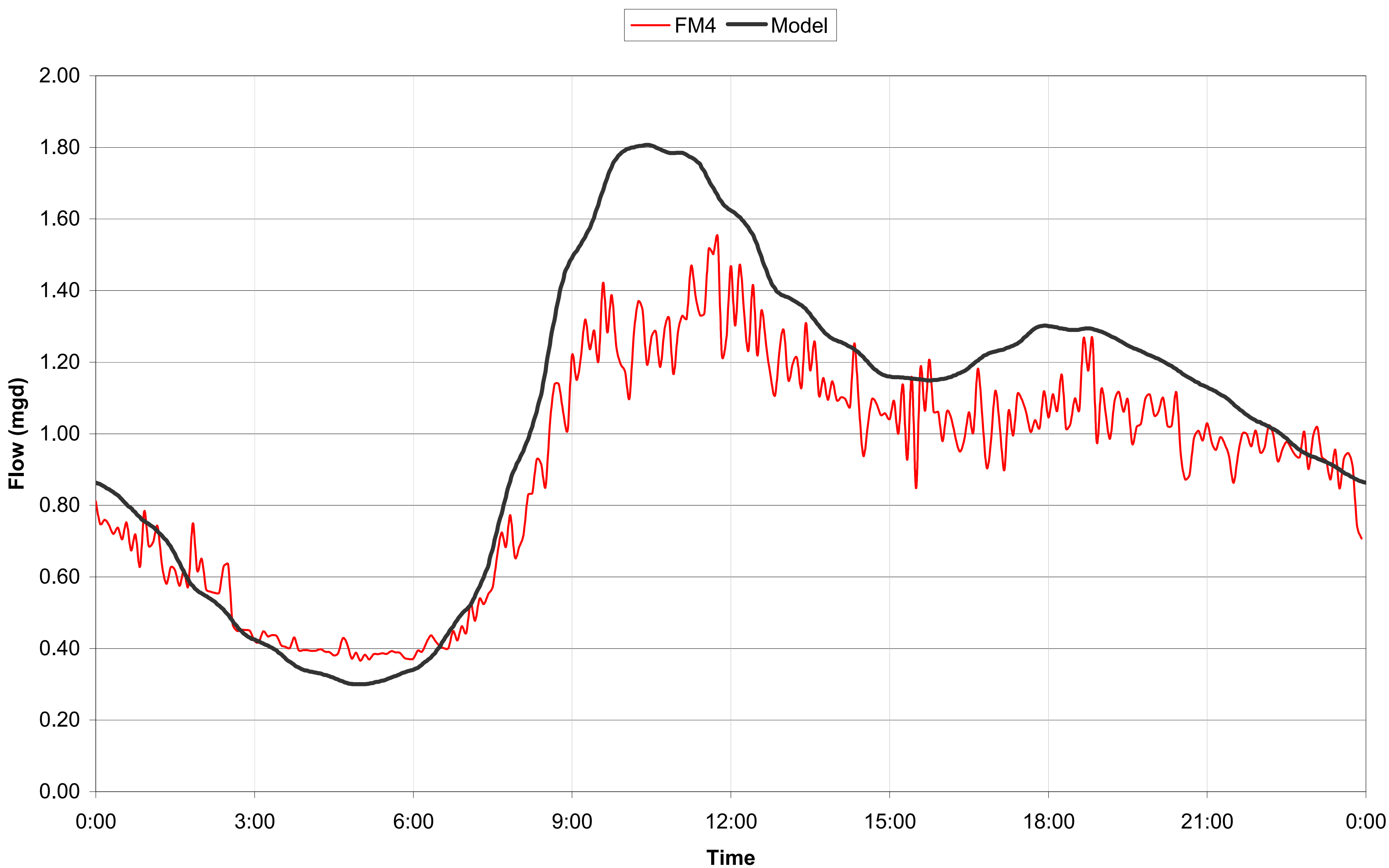

FM-6
FM6
Model
9/15/2007
Flow (mgd)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
FM Data from 9/02/07
FM Data from 9/15/07

FM-5

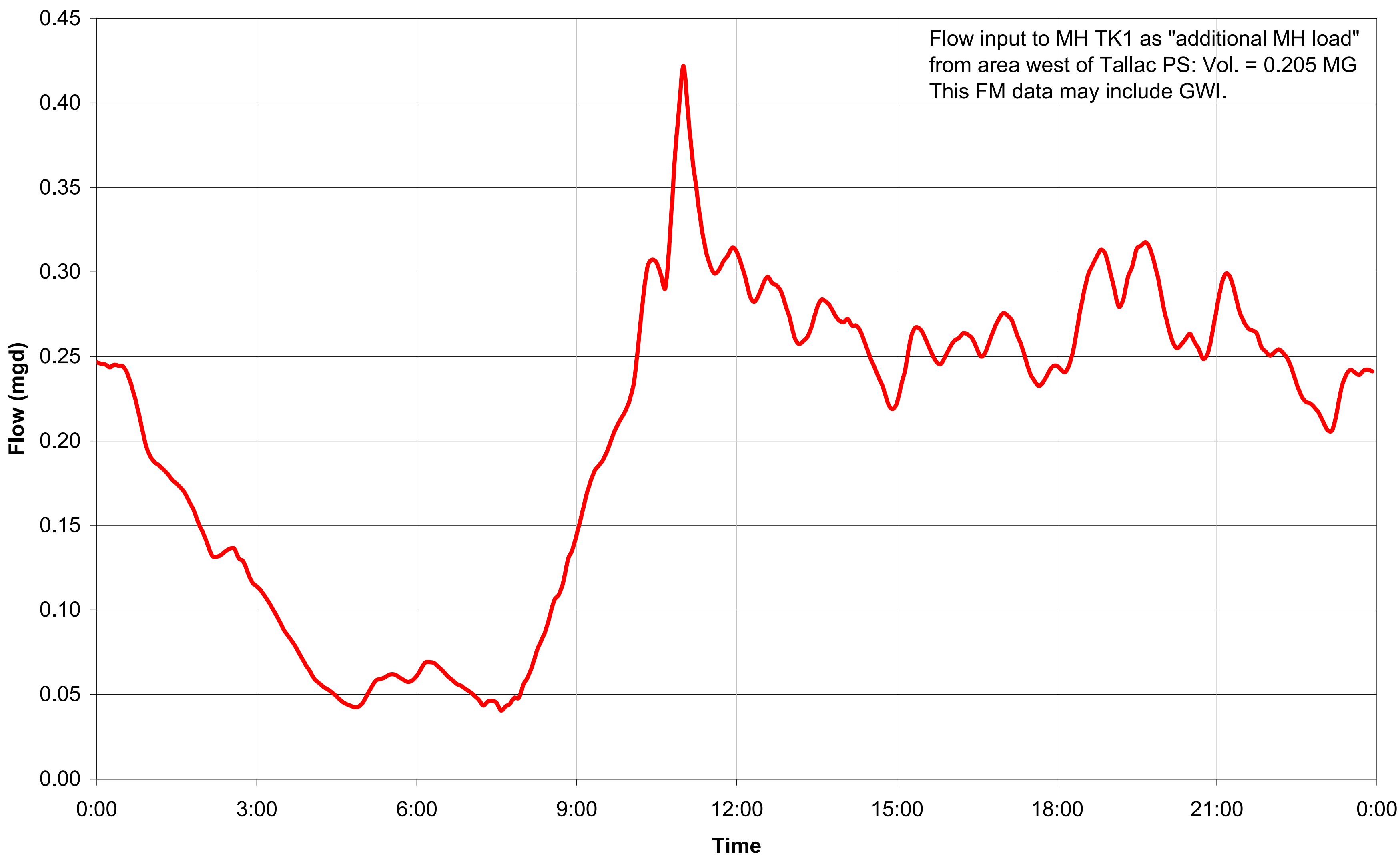


FM5
Model
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Flow (mgd)
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time

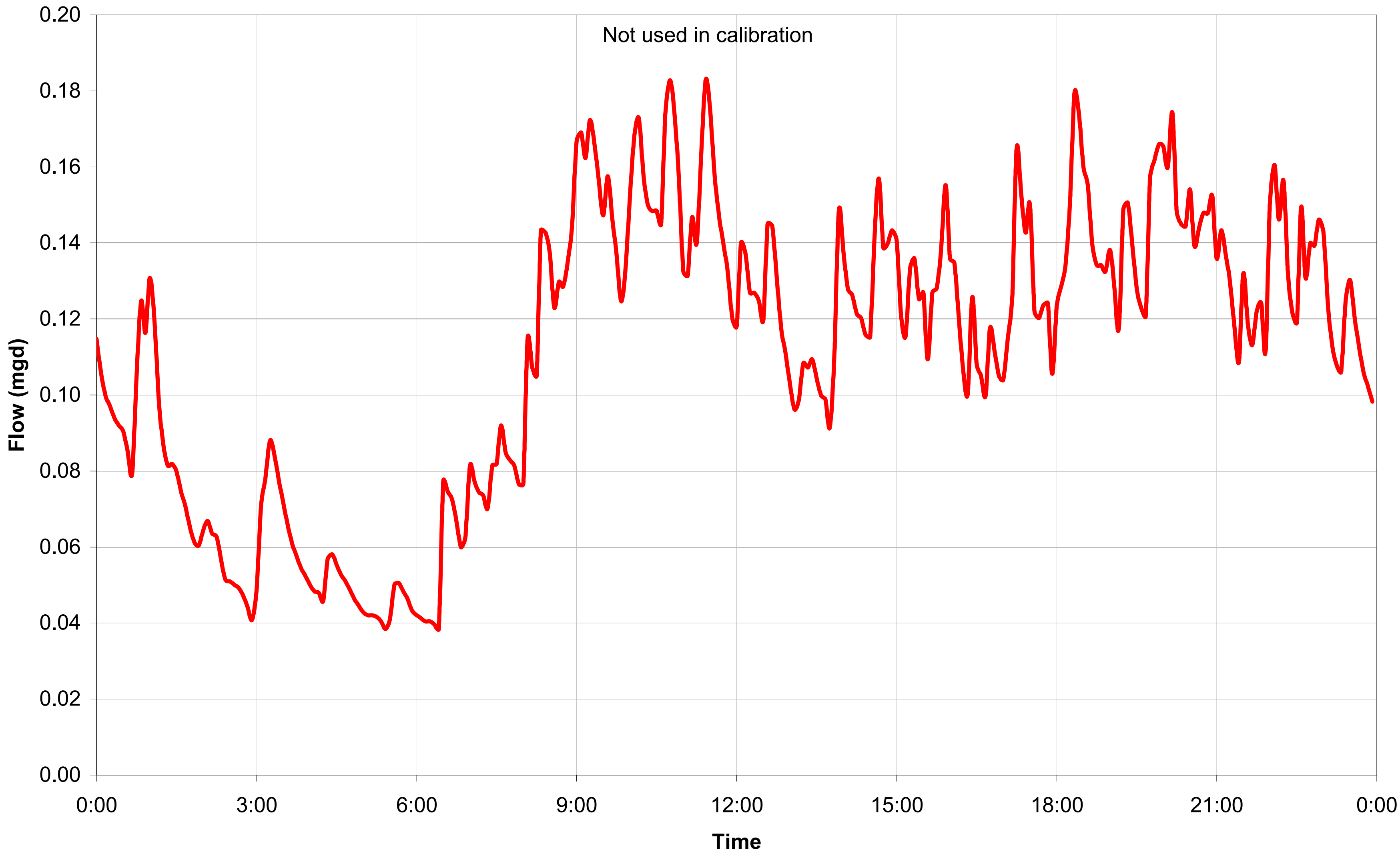
FM-4


FM4
Model
Flow (mgd)
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time

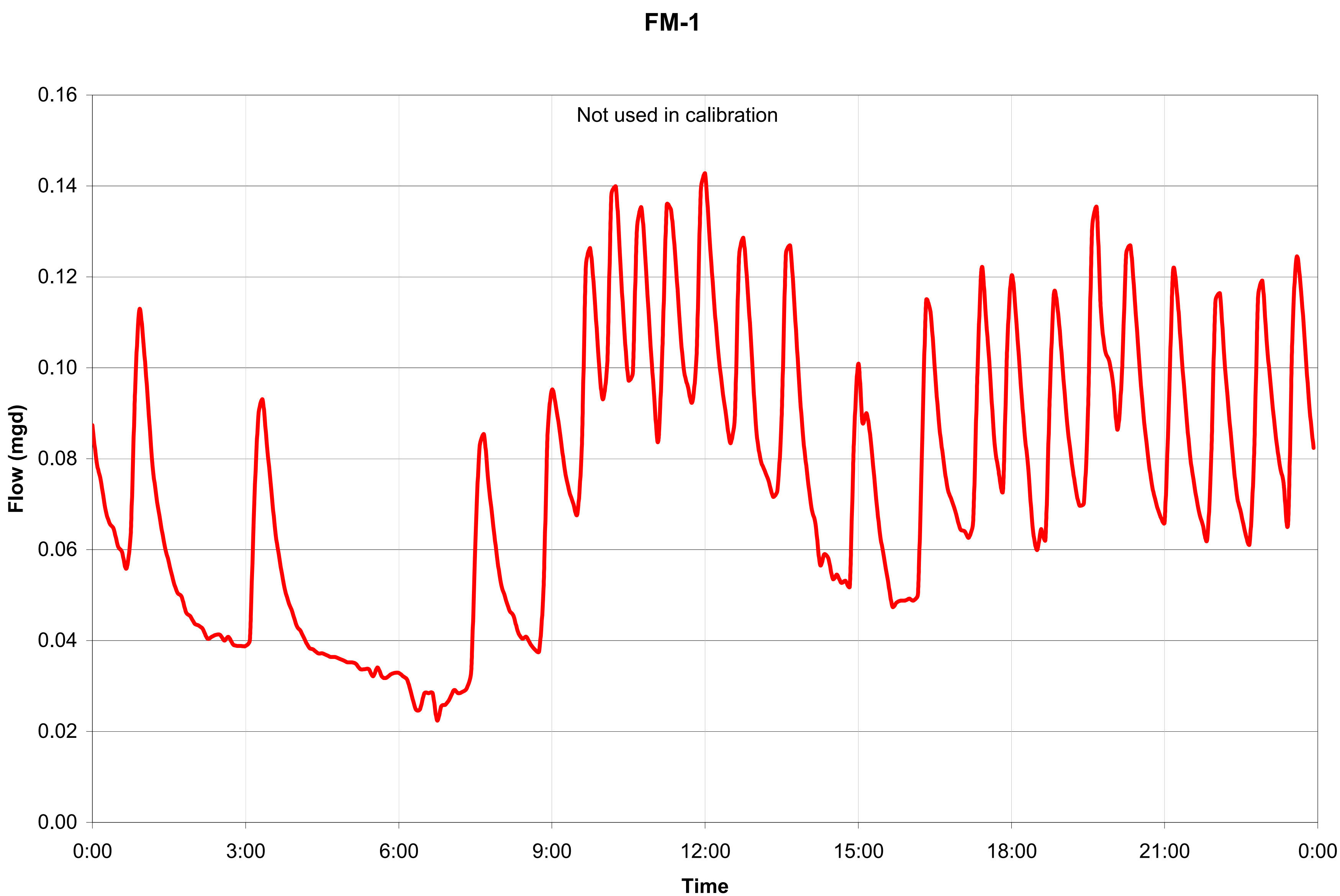
FM-3


Flow input to MH TK1 as "additional MH load"
from area west of Tallac PS: Vol. = 0.205 MG
This FM data may include GWI.
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Flow (mgd)
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time

FM-2



Not used in calibration
Flow (mgd)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time



FM-1
Not used in calibration
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Flow (mgd)
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time

BROWN AND CALDWELL

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Technical Memorandum

Prepared for: South Tahoe Public Utilities District

Project Title: Wastewater Collection Master Plan

Project No: 132364-004-002

Technical Memorandum No. 7

Subject: Pipeline Condition Assessment (Task 4.2)

Date: December 30, 2009

To: Paul A. Sciuto, Assistant General Manager

From: Pete Bellows, Project Manager
Engineer in Responsible Charge, CA Lic. No. 34337

Katherine Hayden, Project Engineer

Erik Zalkin, Project Engineer
California License No. C75392

Reviewed by: Chris Peters, Project Engineer
California License No. 69669

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1. INTRODUCTION

The pipeline condition assessments described in this technical memorandum (TM) are part of the South Tahoe Public Utilities District (STPUD or District) Wastewater Collection System Master Plan. An eight step process was used to complete the assessments. The steps used for this assessment are as follows:

1. Pipeline Inventory – The pipe and manhole data in GIS was reviewed for completeness.
2. CCTV Inspection Data Review – CCTV inspection logs provided by the District were reviewed by Brown and Caldwell (BC) and compiled in electronic format. No additional CCTV investigations were performed as part of this project.
3. Pipe Condition Assessment Procedures – CCTV inspection log defect codes were converted to PACP© defect codes.
4. Pipe Condition Assessment Ratings – PACP© condition grading system was applied to develop two condition ratings for inspected pipes: Structural and Operation and Maintenance (O&M).
5. Select Manholes for Inspection – A manhole criticality analysis was completed by BC to select manholes for field inspection.
6. Manhole Field Observations – BC performed field inspections of critical manholes. Observations were captured on field forms and photographs.
7. Manhole Condition Assessment Ratings – Results of the field investigations were evaluated and condition assessment ratings were developed for each inspected manhole.
8. Pipeline Operations and Maintenance – BC reviewed key District operations performance parameters and maintenance frequencies.
9. Criticality Assessment – BC conducted a criticality assessment to identify the District's most critical pipeline and manhole assets. This information will be used to prioritize capital projects and future O&M activities.

The information from this TM, along with the collection system hydraulic analysis, will be used in subsequent TMs to complete the assessment on the pipelines and develop specific capital improvement projects.

2. COLLECTION SYSTEM BACKGROUND

STPUD was established in 1950 to collect and treat sewage in the City of South Lake Tahoe in lieu of septic tank systems. The STPUD wastewater collection system includes approximately 314 miles of gravity pipeline, 20 miles of force main pipeline for 42 pump stations, and 17,000 customer connections.

2.1 Gravity Pipelines

Gravity pipelines in the collection system are primarily small diameter asbestos cement (ACP) or vitrified clay (VCP). Seventy-five percent of the pipes are ACP and 21 percent are VCP. Sixty-three percent of the pipes are 6-inch-diameter. Pipe diameter and material are illustrated on Figures 2-1 and 2-2, respectively, and summarized in Table 2-1. Pipe lining or coating information was not available in GIS.

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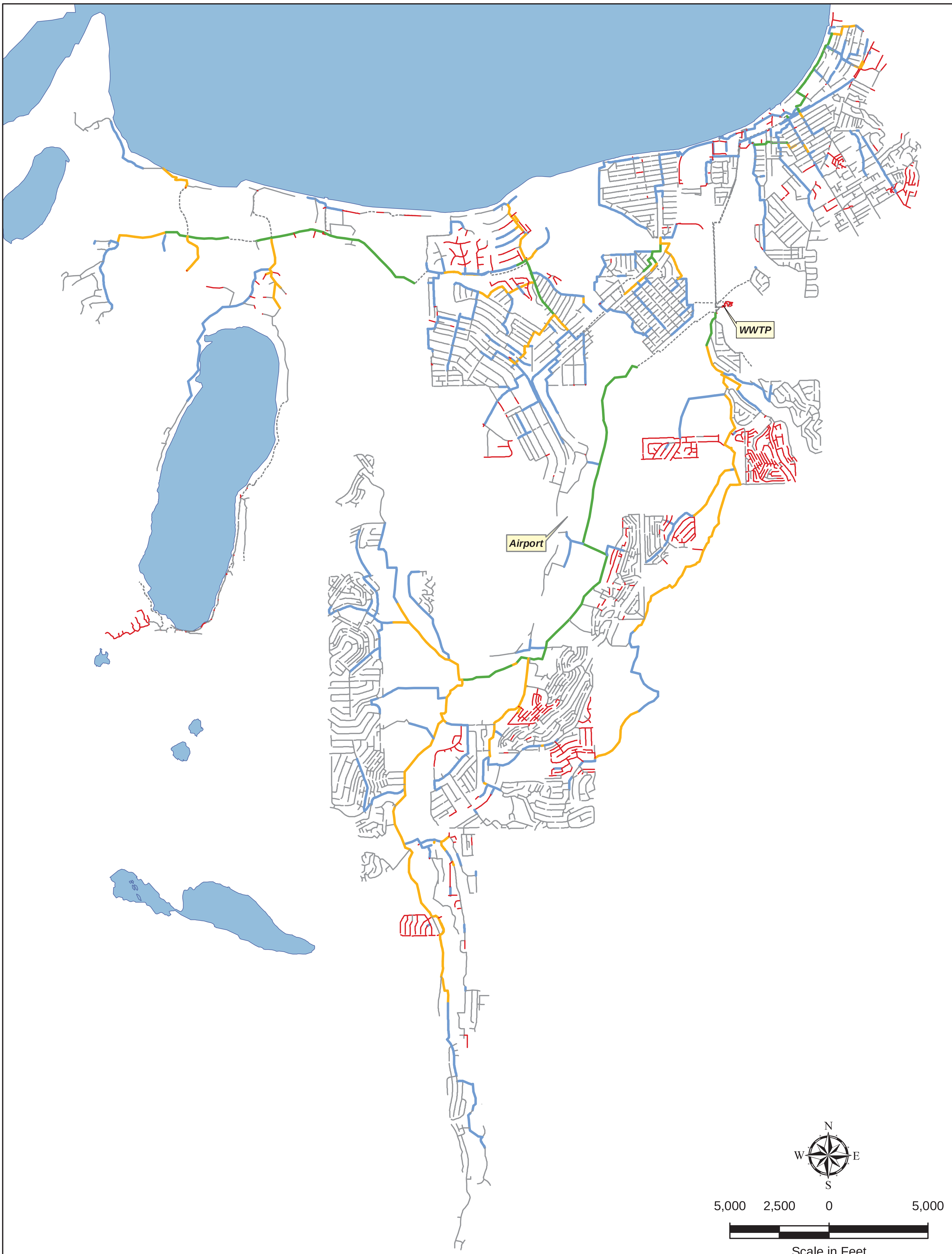


LEGEND

Pipe Diameter

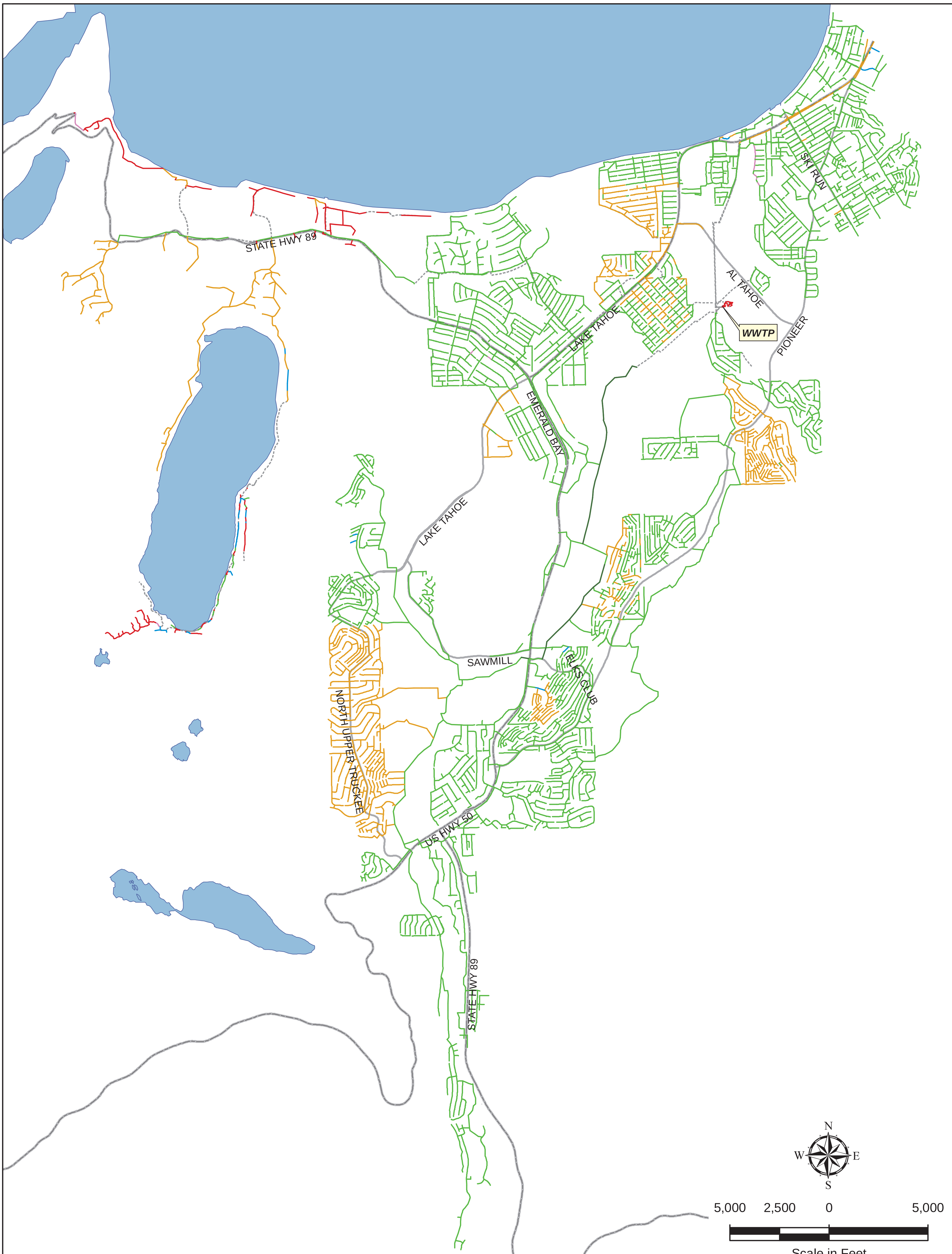
- Unknown
- <= 6-inch
- 8 - 10-inch
- 12 - 16-inch
- 18 - 24-inch

Force Mains

BROWN AND CALDWELL

SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 2-1
Gravity Pipe Diameter



SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 2-2
Gravity Pipe Material

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LEGEND

Pipe Material
- Unknown
- ACP
- VCP
- PVC
- ABS, CIP, DIP, HDPE
- ACE

Force Mains

Road
- HWY
- Major

Diameter, inches	ABS	ACP	CIP	DIP	HDPE	PVC	VCP	UNK	Total	Percent of System (%)
4		79							**79**	**< 1**
6	757	803,337	1,074	325		7,067	219,755	19,796	**1,052,110**	**63**
8	462	130,133				572	38,682	1,632	**171,481**	**10**
10		61,468		240	1,750		19,605	2,940	**86,003**	**5**
12		43,290				27	6,298	470	**50,086**	**3**
14		2,088					0		**2,088**	**< 1**
15		31,557					6,486	5,393	**43,437**	**3**
16		2,694					0		**2,694**	**< 1**
18		13,778					1,855	2,647	**18,279**	**1**
21		4,802					444	8,940	**14,186**	**< 1**
24		17,398					357		**17,755**	**1**
UNK		127,307				1,291	59,680	12,000	**200,277**	**12**
Total	**1,219**	**1,237,931**	**1,074**	**564**	**1,750**	**8,957**	**353,162**	**53,818**	**1,658,474**	
Percent of System (%)	**< 1**	**75**	**< 1**	**< 1**	**< 1**	**< 1**	**21**	**3**		

Table 2-1. Gravity Pipe Material and Diameter Inventory by Length in Feet

2.2 Gravity Manholes

There are approximately 5,700 manholes in the collection system. Manhole material and lining or coating materials were not available in GIS. District staff indicated that most manholes were constructed with pre-cast concrete walls and cone with a poured-in-place manhole base. Some manholes have been rehabilitated with lining or coating systems. Often, the freeze/thaw cycle in the first few feet of soil causes damage to manhole adjustment rings or cones. District staff also reported that they typically find low levels of hydrogen sulfide gas in the manholes and that corrosion is generally only a problem in manholes with cascading force mains. The District should continue to monitor these manholes with a high likelihood of failure and make repairs as necessary.

2.3 Force Mains and Appurtenances

There are 42 pump stations with force mains in the system. Force mains are illustrated in Figure 2-3. Typical force main materials are ACP or plastic (ABS, PE, PVC). The force main inventory is summarized in Table 2-2.

Al Tahoe, Beecher, Bellevue, Bijou, and Tahoe Keys force mains were built by 1960. Fallen Leaf Lake facilities were built in 1983. Fairway #1, Fairway #2, Flanders, Gardner Mountain, Ponderosa and Ski Run force mains were built after 1990. The remaining force main facilities were built in the late 1960's or early 1970's.

According to the District, four pump stations are designed for gravity bypass in the event of a force main failure: Johnson, Bijou, Ski Run, and Stateline. The District's only dual force main system handles Bijou, Ski Run, and Johnson pump stations. In the event of a force main failure on either of these pipelines flows may be able to be bypassed to the other force main, depending on the exact location of the failure. Dual force main systems are not standard for most agencies; however, this level of redundancy is helpful in the event of necessary repairs, maintenance and inspection on the force main. The District should consider constructing redundant force mains for some of their pumping facilities, particularly in areas with a high consequence of failure.

Fourteen force mains are equipped with air release valves (ARVs) or air vacuum valves (AVVs). ARVs automatically vent trapped gases in the force main. Gases trapped at these locations increase the head against which the pump must operate and provide an opportunity for internal pipe corrosion. ARVs are typically located at intermediate high points where gas can accumulate. AVVs are installed at high points in the force main to allow air to enter the system when it is draining. These valves will break a vacuum that can form in a force main and prevent the pipe from collapsing. Combination air valves (CAVs) combine the function of an ARV and AVV into one unit.

Table 2-2. Force Main Inventory Information

Pump Station		Force Main			Bypass Capability	Number of ARV/AVV/CAV
Name	Year Built	Diameter	Material	Length	Gravity/ Force main	
Al Tahoe	1960	18	ACP	5,900	NO / NO	2
Baldwin Beach	1968	10	UNK	2,660	NO / NO	-
Beecher	1960	4	ACP	342	NO / NO	-
Bellevue	1960	10	STL	3,098	NO / NO	-
Bijou	1955	16 12	STL ACP	13,500 13,000	YES / YES	9 5
Camp Richardson	1968	10	UNK	1,290	NO / NO	-
Flanders	1983	UNK	UNK	UNK	NO / NO	-
Gardner Mountain	2004	4	ACP	840	NO / NO	-
Johnson	1972	TIES INTO DUAL BIJOU FORCE MAIN SYSTEM			YES / YES	-
Kiva	1968	6	UNK	2,890	NO / NO	1
Main Station (Fallen Leaf Lake)	1983	4	PVC	13,750	NO / NO	1
Pioneer Village	1966	8	ACP	840	NO / NO	1
Ponderosa	1997	6	PVC	2,063	NO / YES	-
Pope Beach #1	1973	4	UNK	583	NO / NO	-
Pope Beach #2	1973	4	UNK	1,439	NO / NO	-
ES-1	1983	2-½	PE	210	NO / NO	1
ES-2	1983	2-½	PE	600	NO / NO	1
ES-3	1983	2-½	PE	705	NO / NO	1
ES-5	1983	4	PVC	2,660	NO / NO	1
ES-6	1983	4	PVC	2,896	NO / NO	1
ES-7	1983	4	PVC	1,900	NO / NO	1
ES-8	1983	4	PVC	6,020	NO / NO	1
ES-9	1983	4	PVC	5,380	NO / NO	1
San Moritz	1966	10	ACP	1,500	NO / NO	-

Table 2-2. Force Main Inventory Information

Pump Station		Force Main			Bypass Capability Gravity/ Force main	Number of ARV/AVV/CAV
Name	Year Built	Diameter	Material	Length		
Ski Run	1997	TIES INTO DUAL BIJOU FORCE MAIN SYSTEM			YES / YES	-
Stateline	1971	4	CIP	45	YES / NO	-
Taggart	1983	4	PVC	1,320	NO / NO	-
Tahoe Keys	1960	16	ACP	10,123	NO / YES	2
Tallac	1968	18	ACP	6,557	NO / YES[1]	3
Taylor Creek	1968	12	UNK	1,503	NO / NO	2
Trout Creek	1967	12	ACP	571	NO / NO	-
Upper Truckee	1967	18	ACP	5,700	NO / NO	-
Venice	1971	6	PVC	1,843	NO / NO	-
Vacuum Valve Station 3	1983	3	PVC	800	NO / NO	-
Vacuum Valve Station 4	1979	6	PVC	470	NO / NO	-
Vacuum Valve Station 5	1983	3	PVC	50	NO / NO	-
Vacuum Valve Station 6	1979	3	PVC	150	NO / NO	-
Vacuum Valve Station 7	1979	3	PVC	670	NO / NO	-
Vacuum Valve Station 8	1979	3	PVC	450	NO / NO	-

[1]*Tallac forcemain bypass at San Moritz PS*

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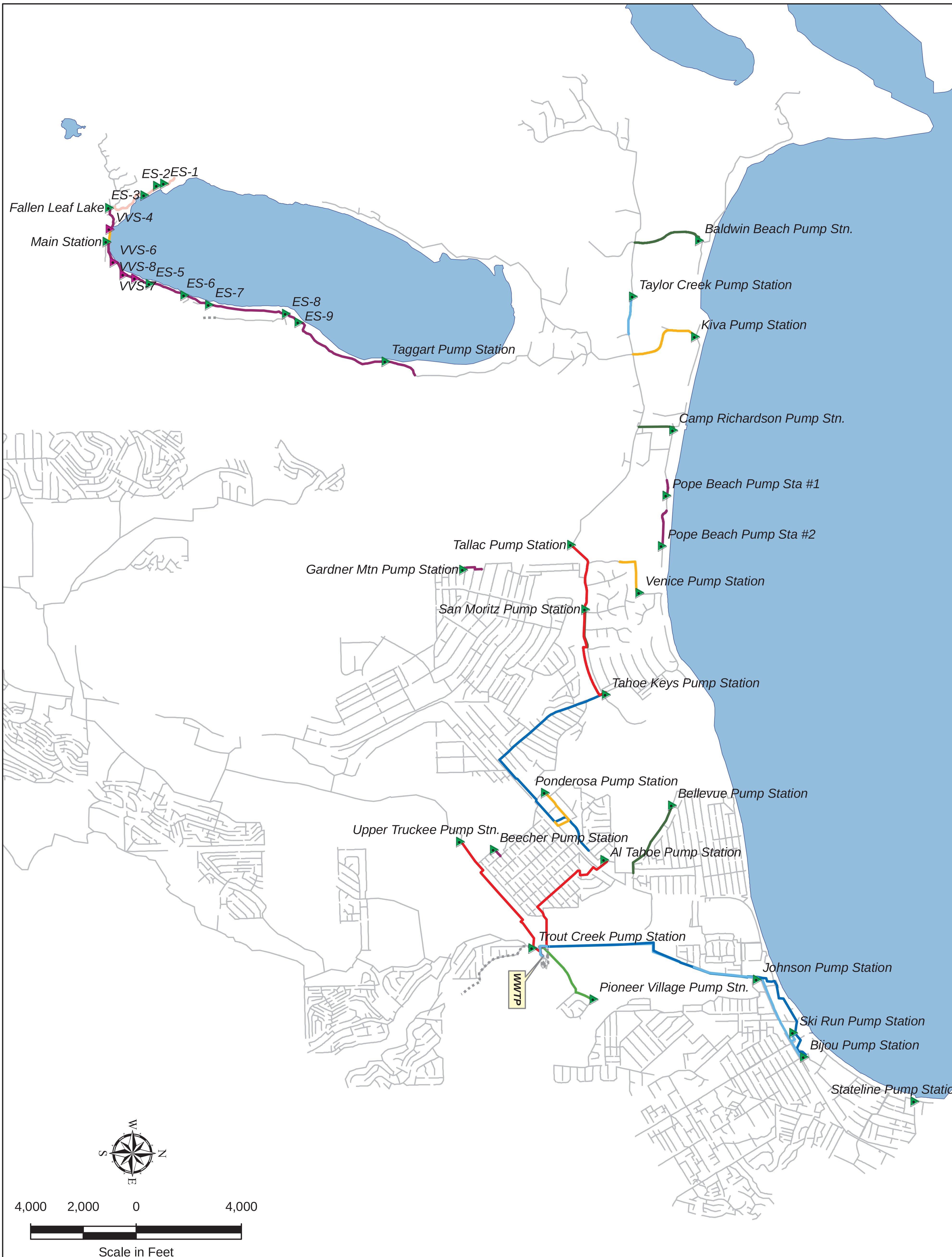


BROWN AND CALDWELL

SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 2-3
Force Mains and Pumping Stations

3. PIPELINE CONDITION ASSESSMENT INSPECTION PROGRAM

This section summarizes the District's current pipeline condition assessment program including data that was evaluated for this TM.

3.1 Inspection Data

The District provided CCTV inspection data gathered during the past five years for this condition assessment. Where multiple inspections were completed for a given reach, only the results from the most recent inspection were considered. At the time this data was gathered, the District's CCTV inspection program was primarily conducted in conjunction with erosion control projects where the District performed pre- and post-construction inspections to verify the integrity of their sewer pipes.

Additional information regarding the District's current inspection program for gravity pipes, manholes and force mains is presented in Section 5.

3.1.1 Data Available

Results from CCTV inspection projects from 2003-2008, listed in Table 4-1, were reviewed and included in the condition assessment. CCTV inspections prior to 2006 were available in hard copy format and were reviewed and transferred into an electronic database (Microsoft Excel) format. CCTV inspections from 2006 to 2008 were performed using the Granite XP software and were available electronically.

Table 3-1. CCTV Inspection Projects, 2003-2008

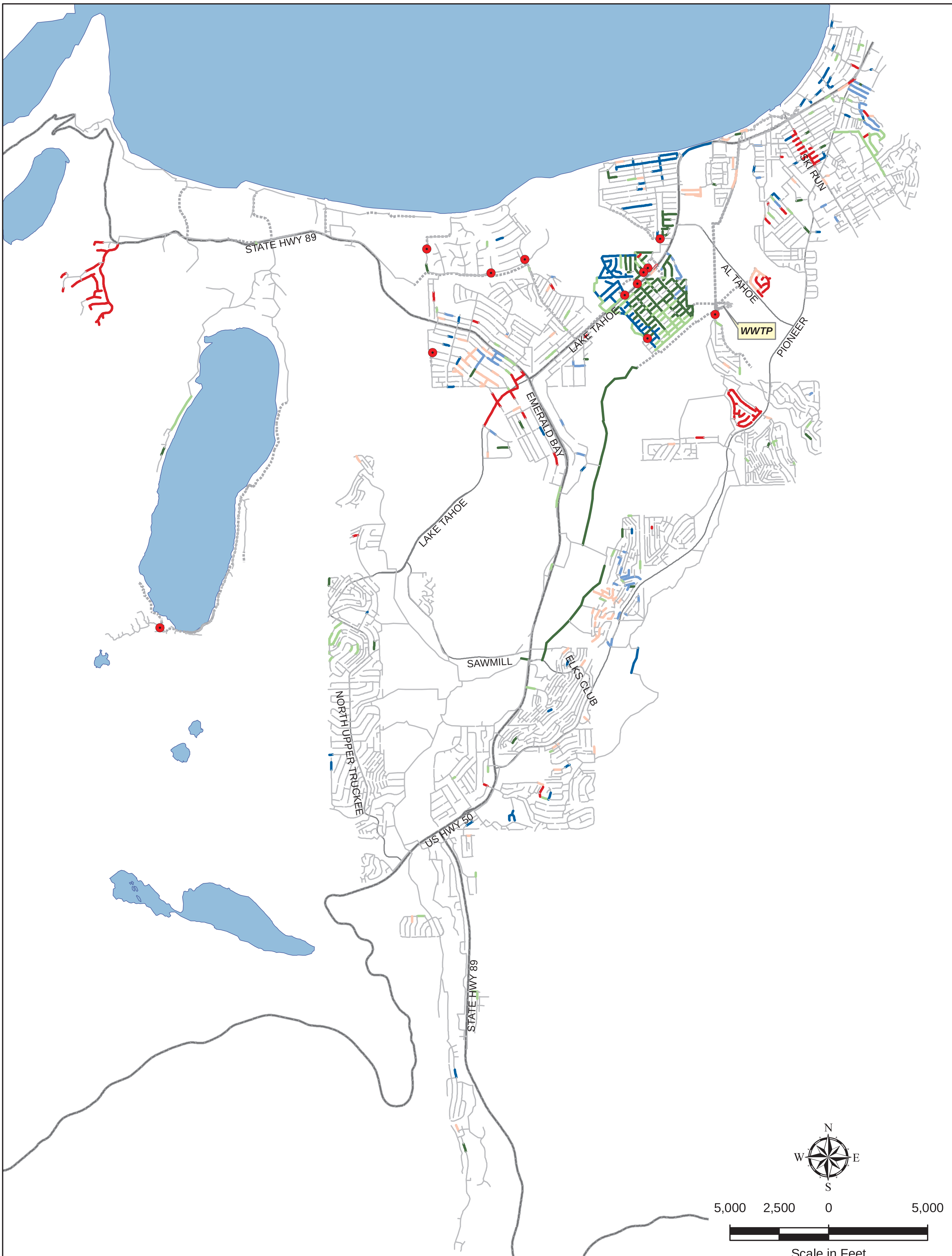
Project	Year(s)
Plateau Circle Project	2003
Ski Run Project	2003
Post Ski Run	2003
South Y	2003
South Y Post	2003
Spring Creek	2003
Springwood	2003
Stateline Project	2003
Pioneer Village	2003-2004
American Legion Tract	2004
Glen Eagles Project	2004
Glorene St. Project	2004
Rufus Allen Project	2004
Sierra Shores	2004
Post Glorene Project	2004-2005
Post Stateline Project	2005
Pre Appalachee 2 Project	2005
Pre Sierra Track 1	2005
Missing MH's and Laterals	2003-2005

Table 3-1. CCTV Inspection Projects, 2003-2008	
Project	**Year(s)**
Al Tahoe PS	2006-2008
Al Tahoe Waterline	2006
Angora 3B	2007
Broken Mains & Lats	2006-2007
Elk's Club	2008
Missing MHs & Lats	2006-2008
Ponderosa PS	2006-2007
Post Hydrotech	2008
Special Projects	2006-2008
Spills	2006-2008

3.1.2 Inspection Summary

Approximately 14 percent of the collection system was inspected in the previous five years. The inspection footage by pipe diameter is presented in Table 3-2. Pipes inspected multiple times were only counted once.

Table 3-2. CCTV Inspection Summary, 2003-2008	
Diameter, inches	**Length, feet**
6	168,296
8	34,999
10	8,289
12	2,544
15	263
18	501
21	7,755
24	7,189
Total	**229,836**
Total Collection System (from GIS)	1,658,474
Percent Inspected, 2003-2008	**13.9%**



BROWN AND CALDWELL

SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 3-1
CCTV and Manhole Inspections 2003-2008

3.2 Smoke Testing

In 2007 and 2008, the District conducted smoke testing in the Sierra Tract, including areas that were subject to wildfires in 2007. This testing included pipelines serving approximately 1,500 homes and businesses. During the tests, District staff did not identify any illegal connections to the collection system such as roof drains, storm drainage or irrigation water. The only potential source of I/I that was identified included 12 private lateral cleanouts without caps and several manhole covers with pick holes. There were not signs of visible pipeline or manhole infiltration. Homeowners with missing cleanout caps were notified to make repairs.

3.3 Defect Coding

Standard defect codes are generally used to characterize the structural and O&M condition of pipes and manholes. In 2006, STPUD changed their CCTV inspection defect coding to the Pipeline Assessment and Certification Program (PACP©) developed by NASSCO. For consistency in the evaluation of sewer pipe condition in this TM, CCTV inspection data prior to PACP© implementation was converted to PACP© defect codes. The defect code conversion and associated Structural Grade or O&M Grade are shown in Table 3-3.

PACP© condition grades generally identify the potential for failure or further deterioration in pipes, and can be described as follows:

1 = Excellent condition, only minor defects, failure unlikely
2 = Good condition, defects have not begun to deteriorate, failure unlikely in 20 years
3 = Fair condition, moderate defects, failure possible in 10 to 20 years
4 = Poor condition, severe defects, failure likely in 5 to 10 years
5 = Immediate attention required

Table 3-3. Defect Codes and Condition Grades

CCTV Inspection Log Description(s)	PACP©		
	Defect Code	Structural Grade	O&M Grade
Crack (C)	C	2	-
Crack Circumferential (CC)	CC	1	-
Crack Longitudinal (CL)	CL	2	-
Crack Multiple	CM	3	-
Crack Open (FC)	FC	2	-
Joint Offset Moderate (JOM)	JOM	1	-
Joint Offset Severe	JOL	2	-
Joint Separated	JSM	1	-
Lining Failure	LF	3	-
Pipe Broken (BVV)	BVV	5	-
Pipe Collapsed/Shifted	XP	5	-
Pipe Deteriorated - Surface Spalling Chemical (SSSC, SV)	SSSC	2	-
Pipe Hole In (HSV, HVV)	HSV	5	-
Debris/Deposits Settled Other (DS)	DSZ	-	2
Deposits Attached Other (DAZ)	DAZ	-	2

Table 3-3. Defect Codes and Condition Grades			
CCTV Inspection Log Description(s)	PACP©		
	Defect Code	Structural Grade	O&M Grade
Grease Heavy	DAGS	-	4
Grease Light (DAGS)	DAGS	-	2
Grease Medium	DAGS	-	3
Joint Gasket Exposed (ISSR)	ISSR	-	2
Joint Infiltration Heavy	IR	-	4
Joint Infiltration Light (Weeper) (IW)	IW	-	2
Joint Infiltration Medium	ID	-	3
Obstacle in Joint (OBJ)	OBJ	-	2
Roots at Defect Heavy	RB	-	4
Roots at Defect Light	RF	-	1
Roots at Defect Medium	RM	-	3
Roots in Barrel Medium (RBB)	RMB	-	4
Roots in Connection Heavy	RBC	-	4
Roots in Connection Light	RFC	-	1
Roots in Connection Medium (RMC)	RMC	-	3
Roots in Joint Heavy (RBJ)	RB	-	4
Roots in Joint Light (RFJ)	RF	-	1
Roots in Joint Medium (RMJ)	RM	-	3
Roots in Lateral Heavy (RBL)	RBL	-	4
Roots in Lateral Light	RFL	-	1
Roots in Lateral Medium (RML)	RML	-	3
Sag (MWLS)	MWLS	-	3
Camera Submerged (MCU)	MCU	-	4
Vermin	V	-	1
Camera Blocked / Abandoned Survey	MSA	-	-
Cannot Load Camera	MSA	-	-
Pipe Material Change (MMC)	MMC	-	-
Point Repair (RPL, RPP)	RPL/RPP	-	-
Reduction	MSC	-	-

4. ADDITIONAL INSPECTIONS

Additional inspections were performed to obtain detailed condition information to fill gaps in the existing inspection data. Existing inspection data were reviewed to identify additional manholes and pipelines for inspection. The selection of manholes and pipelines and an inspection summary are provided below.

Additional inspections performed during the project were confined to inspections of manholes, pump station wet wells and connecting pipelines. Additional CCTV inspections and other forms of condition assessment field investigations were not performed. Discussion of the pump station wet well condition is provided in TM No. 3 – Pump Station Condition Assessment.

4.1 Manhole Inspections

Twelve manholes were identified for inspection as part of this project. They are illustrated in Figure 3-1 alongside the CCTV inspection information. Manholes were selected for inspection based on a criticality assessment which identified manholes with a high likelihood to experience corrosion failure. These manholes were all immediately upstream or downstream of a pump station or force main with a high potential for hydrogen sulfide generation and sulfide related corrosion. An inspection summary for these manholes is shown in Table 4-1.

Table 4-1. 2008 Manhole Inspections

Manhole Number	Inspection Type	Lined or Coated	Location
TK1	Entry	Coated	U/S Tahoe Keys PS
SM56	Surface	-	D/S Venice FM
TK74	Entry	Coated	D/S San Moritz FM
AT15	Surface	Lined	D/S Tahoe Keys FM
AT14	Surface	Lined	D/S Tahoe Keys FM
AT7	Surface	Lined	D/S Tahoe Keys and Ponderosa FM
AT28	Surface	Lined	D/S Ponderosa FM
PD94	Surface	-	D/S Beecher FM
AT48	Surface	Coated	D/S Bellevue FM
TK725	Surface	-	D/S Gardner Mtn FM
FL75	Surface	-	D/E ES-3 FM
TR2	Surface	-	U/S Trout Creek PS

4.2 Force Main Inspections

In the act of completing the selected manhole inspections, BC inspected one force main discharge that was visible from the manhole. This inspection was completed on the San Moritz force main at manhole TK74.

5. PIPELINE OPERATIONS AND MAINTENANCE

The District performs maintenance on the collection system to minimize the occurrence of SSOs, meet State WDR permit requirements and to protect and preserve system integrity.

Pipeline O&M data and practices were provided by District at the pipeline criticality workshop conducted at the outset of the project. Information provided by the District was generally from the time period between 2005 and 2008.

5.1 Sanitary Sewer Overflows (SSOs)

The District provided SSO data for the collection system for a four year period. The initial data provided was in the form of an internal report that specified the location, cause and volume of the SSO. Information from 2007 and 2008 came from the State Water Resources Control Board SSO reporting database. The number and cause of the Districts overflows during from 2005-2008 is presented in Table 5-1. The location of each identified SSO is presented on Figure 5-1.

Reported SSO averages for a sample of agencies located throughout the United States range from 2 to 6 dry weather SSOs per 100 miles of sewer per year. This information comes from published data by the Water Environment Research Foundation (WERF), American Society of Civil Engineers (ASCE), and the Environmental Protection Agency (EPA) Region 9.

Reported SSOs for the District for 2005 to 2008 ranged from 2.9 to 3.8 per 100 miles, falling within the middle of the range of national averages. Primary causes for the SSOs included grease (30 percent), rags (20 percent), roots (14 percent), debris (7 percent), unknown cause (23 percent), pipe damage (2 percent) and vandalism (5 percent). Each of the recorded SSOs during this time period occurred during dry weather.

Seventy percent of the SSOs occurred in 6-inch diameter pipe. Seventy-nine percent of the SSOs occurred in Asbestos Cement Pipe (ACP). Sixty-seven percent of the SSOs occurred in areas that were cleaned as recent as 2005 or 2006.

Table 5-1. Annual SSO Data

Cause	2005	2006	2007	2008	Total
Grease	4.5	5.5	1.5	1.33	12.83
Rags	4.5	2.5	1.5	0	8.5
Roots	1.5	1	2	1.33	5.83
Debris	1.5	0	0	1.33	2.83
Unknown	0	2	2	6	10
Pipe damage	0	0	1	0	1
Vandalism	0	1	1	0	2
Total	**12**	**12**	**9**	**10**	**43**
SSOs per 100 miles	**3.8**	**3.8**	**2.9**	**3.2**	**3.4**

SSOs with multiple causes are reported as fractions of a single SSO.

Debris includes sand and grit, debris and trash.

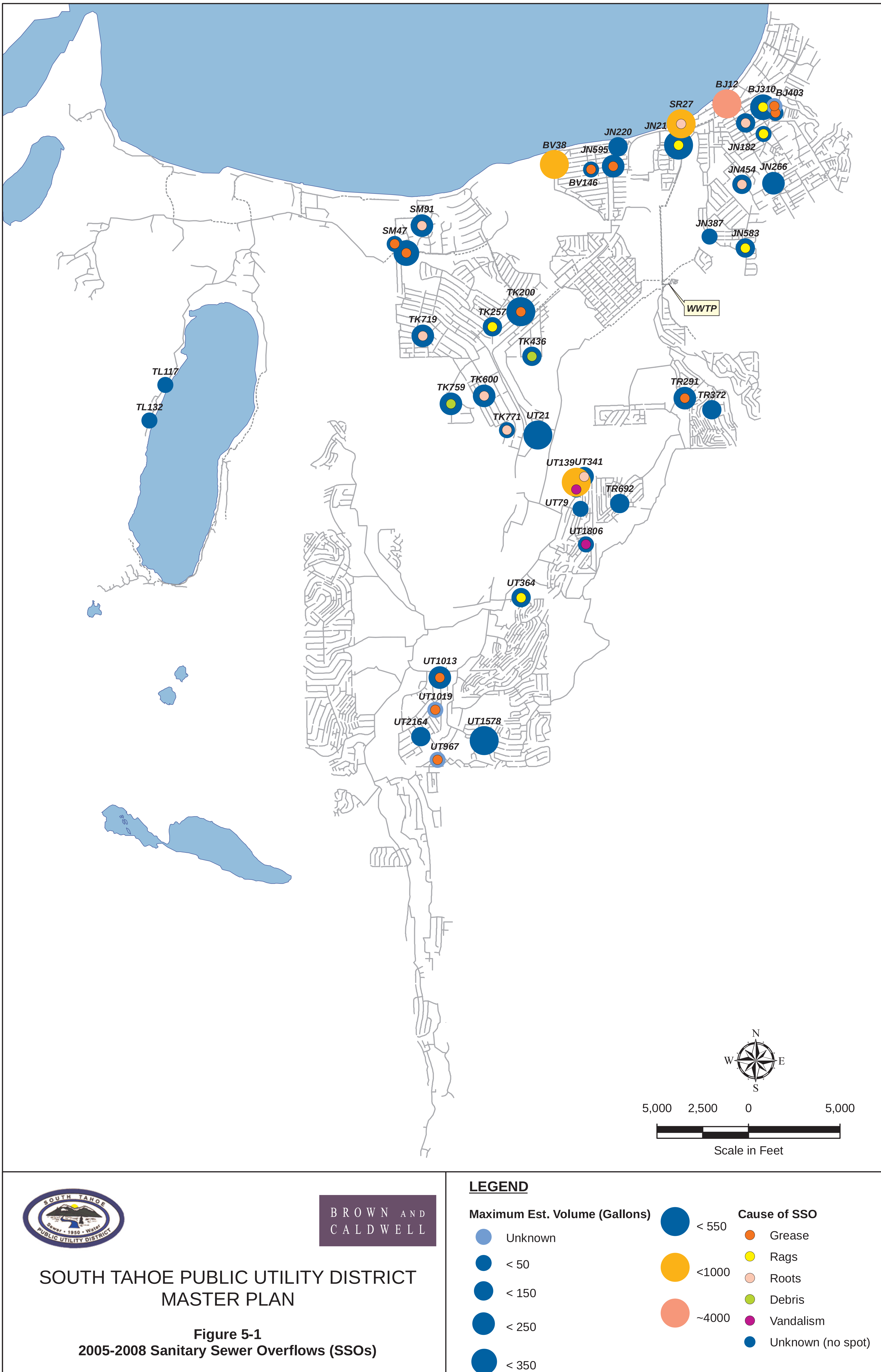


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Figure 5-1
2005-2008 Sanitary Sewer Overflows (SSOs)

5.2 Sewer Pipeline Cleaning

The District performs system-wide sewer cleaning of approximately 80 percent of the gravity sewer system on a 3-year cycle. Approximately 20 percent of the system is located in areas where they cannot maneuver cleaning equipment. These areas are visually inspected. For the last four years the District has averaged approximately 300 miles of cleaning per year. This total includes cleaning some lines multiple times. Generally, flat areas within City limits are cleaned during the winter, and mountainous and flat County areas are cleaned during the summer. STPUD operates three cleaning units: two Hydros (year-round) and one Hydro-Vac (except during cold weather).

Pipes that were cleaned more than one time per year are illustrated on Figure 5-2. According to data from 2005-2006, approximately 214 pipe segments (approximately 56,000 lf) are cleaned at least four times per year. Forty-seven pipes were cleaned as many as 10 times per year and three pipes up to 15 times.

District staff report that their Fats-Oils-Grease (FOG) program has greatly reduced the occurrence of grease in their system, thereby reducing the required amount of sewer cleaning. Most root problems are isolated to the service connections.

5.3 Inspections

The District's new program for CCTV inspection is to conduct a comprehensive inspection of each gravity pipe in the system over a specified period of time. Pipes are inspected by basin and operators generally follow the District's cleaning crews. CCTV crews operate five days per week and televise approximately 12,000 lf per month. At this rate, the District will complete inspection of the gravity system in approximately 12 years.

The District does not have a formal ongoing manhole or force main inspection program; however, manhole integrity is monitored during daily cleaning and CCTV inspection activities. Defects are repaired as they are identified in the field. Force main integrity is currently checked by monitoring pump station performance.

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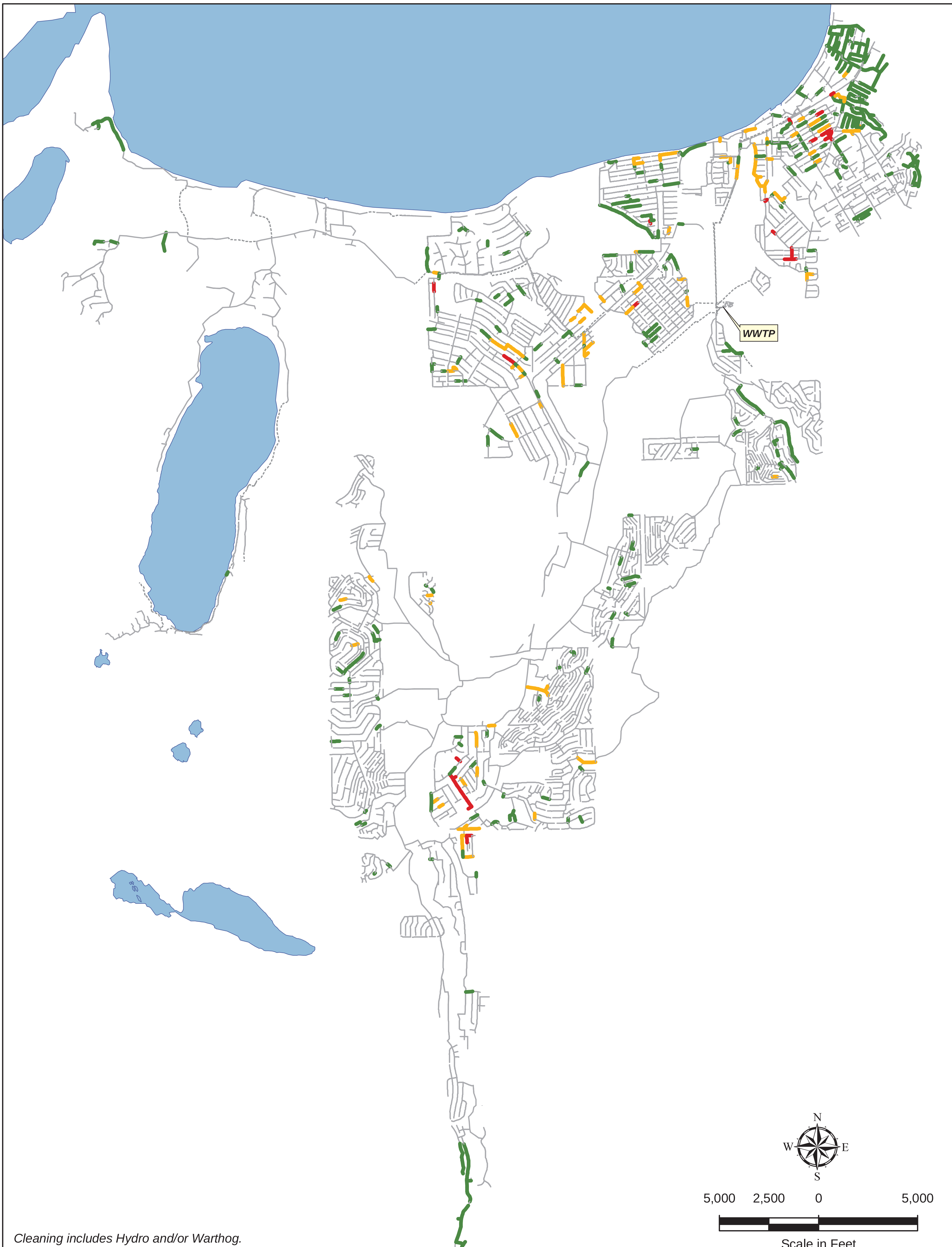

Cleaning includes Hydro and/or Warthog.
Frequency is maximum number of times cleaned in either one-year period.

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Figure 5-2
2005-2006 Gravity Pipe Cleaning Frequency

LEGEND

2005-2006 Multiple Cleanings

- 1x or less
- 2 - 4 x
- 5 - 9 x
- > 10 x

Force Mains

5.4 Spot Repairs

The District makes or contracts out spot repairs for defects identified during CCTV inspections. Areas for these repairs are identified by the District during CCTV inspections. Spot repair locations are summarized in Table 5-3 and illustrated on Figure 5-3. Ninety-five percent of the spot repairs were performed on 6-inch diameter pipe.

Table 5-3. Spot Repair Summary

Project	Pipe Name	Pipe Type	Diameter (in)	Length (ft)	Distance (ft)	Defect	Year	Notes
Pre Sierra	AT201-AT200	ACP	6	2	86.4	Hole	2007	
AL Tahoe P/S	AT282-AT281	ACP	6	2	250.3	Crack	2007	Fixed in 2008
Post Stateline	BJ254-BJ253	ACP	6	2	270.9	Roots	2007	
Post Stateline	BJ255-BJ254	ACP	6	4	91.4	Deterioration	2007	Fixed in 2008
Spills	BJ319-BJ276	ACP	6	2	39.3	Roots/Lateral	2007	
Special Projects	BJ367-BJ366	ACP	6	2	71.5	Deterioration	2007	
Post Stateline	BJ414-BJ413	ACP	6	2	74.4	Roots	2007	
Special Projects	BV124-BV105	ACP	6	2	21.1	Hole	2007	
Ponderosa P/S	PD51-PD49	ACP	6	2	11.8	Crack	2007	Fixed in 2008
Ponderosa P/S	PD57-PD56	ACP	6	2	631	Hole	2007	Pending
Ponderosa P/S	PD59-PD58	ACP	6	2	48.1	Hole	2007	Was PD58-PD59
Ponderosa P/S	PD61-PD60	ACP	6	2	332.7	Crack	2007	
Ponderosa P/S	PD70-PD64	ACP	6	2	49	Deterioration	2007	
Ponderosa P/S	PD70-PD64	ACP	6	2	122.3	Fracture	2007	
Ponderosa P/S	PD70-PD64	ACP	6	2	189.2	Crack	2007	
Ponderosa P/S	PD71-PD64	ACP	6	2	85.3	Crack	2007	
Ponderosa P/S	PD80-PD71	ACP	6	2	315.8	Crack	2007	
Ponderosa P/S	PD92-PD86	ACP	6	2	98.6	Crack	2007	
Ponderosa P/S	PD94-PD86	ACP	6	2	102.9	Hole	2007	
Ponderosa P/S	PD95-PD94	ACP	6	2	357	Crack	2007	
Ponderosa P/S	PD96-PD92	ACP	6	2	5	Crack	2007	
Ponderosa P/S	PD99-PD94	ACP	6	2	145.1	Crack	2007	
Glorena	TK715-TK622	ACP	6	4	189.1	Deterioration	2007	Pending
Glorena	TK781-TK780	ACP	6	2	382.4	Roots	2007	
Spills	TL117-TL116	VCP	6	2	143.4	Roots/Joint	2007	
Spills	TR141-TR89	VCP	6	2	127.5	Crack	2007	
Missing MHs and Lats	TR347-TR236	ACP	6	2	80.3	Crack	2007	Fixed in 2008
Missing MHs and Lats	TR541-TR540	ACP	6	2	41.8	Crack	2007	
Missing MHs and Lats	TR541-TR540	ACP	6	2	256.6	Crack	2007	
Missing MHs and Lats	TR604-TR424	ACP	6	2	15.3	Crack	2007	Fixed in 2008
Missing MHs and Lats	TR604-TR424	ACP	6	2	180.5	Roots	2007	Fixed in 2008
Missing MHs and Lats	TR604-TR424	ACP	6	3	459.4	Roots	2007	

Table 5-3. Spot Repair Summary								
Project	**Pipe Name**	**Pipe Type**	**Diameter (in)**	**Length (ft)**	**Distance (ft)**	**Defect**	**Year**	**Notes**
Special Projects	UT1163-UT1162	ACP	6	2	35.4	Crack	2007	Fixed in 2008
Angora 3A	UT1548-UT1331	VCP	6	4	191	Crack	2007	Pending
Spills	UT1606-UT1391	VCP	6	2	231.4	Roots/Lateral	2007	
Special Projects	UT1752-UT1751	ACP	6	2	165.1	Lateral	2007	
Angora 3A	UT456-UT455	VCP	6	4	273.3	Crack	2007	Fixed in 2008
Angora 3A	UT675-UT674	VCP	6	2	77	Joint I&I	2007	Fixed in 2008
Al Tahoe P/S	AT113-AT112	ACP	6	2	69.4	Deterioration	2008	
Al Tahoe P/S	AT157-AT156	ACP	6	2	131	Crack	2008	
Al Tahoe P/S	AT167-AT166	ACP	6	2	55.5	I&I Deposits	2008	
Al Tahoe P/S	AT208-AT207	ACP	6	2	58.2	Crack	2008	
Al Tahoe P/S	AT282-AT281	ACP	6	2	250.3	Crack	2008	From 2007
Al Tahoe P/S	AT82-AT81	ACP	8	2	35.4	Roots	2008	
Al Tahoe P/S	AT99-AT98	ACP	12	2	2.8	Crack	2008	
Post Stateline	BJ255-BJ254	ACP	6	4	91.4	Deterioration	2008	From 2007
Special Projects	BJ476-BJ437	ACP	6	2	122.1	Crack	2008	
Spills	JN454-JN453	ACP	6	2	83.4	Roots/Lat	2008	
Special Projects	JN530-JN529	ACP	6	2	127.3	Hole/Roots	2008	
Ponderosa P/S	PD51-PD49	ACP	6	2	11.8	Crack	2008	From 2007
Missing MH & Lats	BJ347-BJ292	ACP	6	2	19.5	Roots/Lat	2008	
Spills	SR27-SR23	ACP	8	3	169.3	Roots/Lat	2008	
Spills	TL132-TL131	VCP	6	3	1	Roots/Joint	2008	
Spills	TL132-TL131	VCP	6	3	165	Broken Pipe	2008	
Missing MH & Lats	TR347-TR236	ACP	6	2	80.3	Cir Crack	2008	From 2007
Spills	TR372-TR284	VCP	6	2	42	Roots/Lat	2008	
Spills	TR373-TR372	VCP	6	2	93.1	Roots/Lat	2008	
Missing MH & Lats	TR604-TR424	ACP	6	2	180.5	Crack	2008	From 2007
Missing MH & Lats	TR604-TR424	ACP	6	2	459.4	Roots	2008	From 2007
Special Projects	UT1163-UT1162	ACP	6	2	35.4	Crack	2008	From 2007
Special Projects	UT1603-UT1383	VCP	6	4	8	Roots	2008	
Special Projects	UT1604-UT1603	VCP	6	4	336.9	Roots	2008	
Angora 3A	UT456-UT455	VCP	6	4	273.3	Crack	2008	From 2007
Angora 3A	UT675-UT674	VCP	6	2	77	Joint I&I	2008	From 2007
Add-On	UT808-UT589	VCP	6	2	n/a	Roots/Lateral	2008	

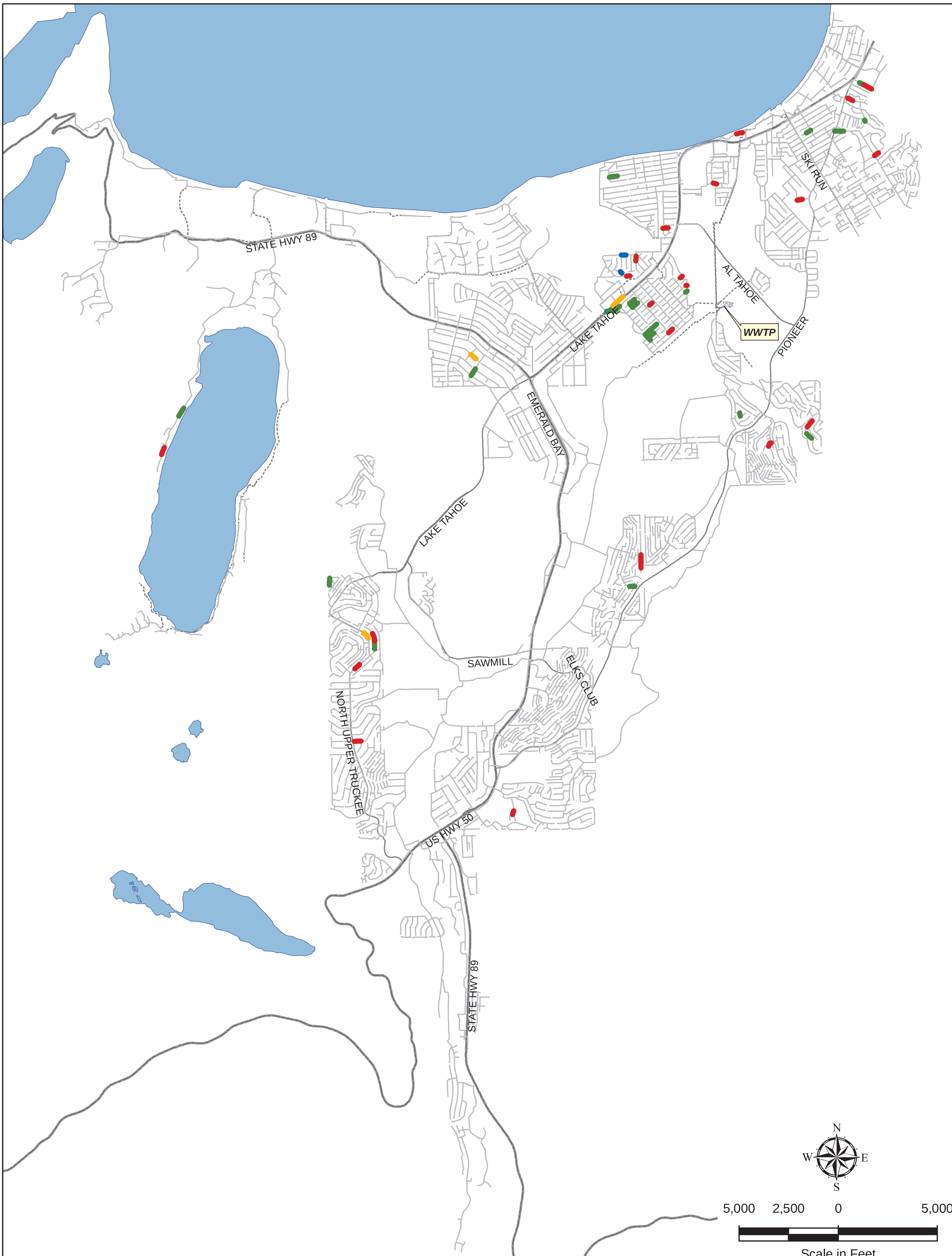

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Figure 5-3
Gravity Main Spot Repairs 2003-2008

LEGEND

Gravity Mains
Force Mains

ROADS

HWY
Major

Gravity Main Spot Repairs

Repaired 2003-2006
Repaired 2007
On 2007 List, Not Repaired
Repaired 2008

5.5 Force Mains and Appurtenances

The District does not have a formal ongoing maintenance program for its force mains or force main ARVs. However, pump station operations are monitored frequently and any significant changes in force main operation would likely be recognized during these inspections. District staff commented that most ARVs have been closed and are not operating as designed. This operating procedure puts the force mains at risk for failure where air pockets can form and corrosion can occur. ARVs that remain open and are not inspected and backflushed have a risk of plugging and consequent SSO. Spills could go undetected for long periods due to this operating procedure.

6. PIPELINE AND MANHOLE CONDITION ASSESSMENT

This section presents the results of the pipe and manhole condition assessment based on the inspection data reviewed for this project. The PACP© condition grading system was applied to develop two condition ratings for inspected pipes: Structural and Operation and Maintenance (O&M). For manholes, the results of the field investigations were evaluated and condition assessment ratings were developed for each inspected manhole.

6.1 Gravity Pipeline Defects

Structural and O&M gravity pipeline defects were identified during the condition assessment. Table 6-1 contains a summary of the frequency of occurrence of all reported defects from CCTV inspection logs.

Approximately 63 percent of the inspected pipe reaches were free of all defects. 90 percent of pipes were free of structural defects and 68 percent were free of maintenance defects. A general overview of pipe conditions is presented in Table 6-2.

Structural Defects

The most common structural defect was SSSC (Surface Deterioration) in the 21-inch and 24-inch diameter Asbestos Cement Epoxy-Lined pipe (ACE). Individual reaches had up to 20 occurrences of this defect. Other structural defects include joint offsets and lining failures; pipes with a hole; or pipes that are broken, cracked or collapsed. Typically, cracks and joint defects occurred at a similar rate in ACP and VCP. Also, 6-inch pipe was worse than 8-inch pipe in all structural ratings.

A total of 15 pipe reaches had at least one severe (PACP© grade 5) structural defect. These pipes are presented in Table 6-3 and illustrated on Figure 6-1. Only one collapsed pipe in Upper Truckee (on Washoan Blvd between Pioneer Trail and Nottaway Drive) was found during all the CCTV inspections. Four pipes with severe defects noted during earlier CCTV inspections had been repaired in later inspections and are designated as such on Figure 6-1. Those repairs are noted in Table 6-3.

O&M Defects

The most common O&M defects were roots, sags, infiltration, and grease. A number of pipes had been cleaned prior to CCTV inspection, which likely reduced the frequency and severity of grease and debris deposits observed. Roots and infiltration are illustrated on Figure 6-2, and grease is illustrated on Figure 6-3. Warthog cleaning is included with the roots and grease observations because it is typically used for reaches with high levels of fine roots and grease. BC observed the following trends during the assessment:

- I/I defects were three times worse in VCP than ACP.
- Roots were seven times worse in VCP than ACP.

- Roots were three times worse in 6-inch than all other diameters except the 21/24-inch Upper Truckee sewer.
- Root and grease occurrences were much less frequent (three to six times) in lines that had been cleaned at least once.

Table 6-1. CCTV Inspection Results – Defect Occurrences

CCTV Inspection Log Description(s)	PACP Code	Number Occurrences By Pipe Material					TOTAL
		ACP	ACE	PVC	RCP	VCP	
Number of Reaches Inspected	-	667	41	13	1	201	**923**
Linear Feet Inspected	-	165,691	14,944	1,596	257	47,588	**230,076**
Percent of Total Inspected		72%	7%	< 1%	< 1%	21%	
STRUCTURAL							
Crack (C)	C	1				1	**2**
Crack Circumferential (CC)	CC	11	4			1	**16**
Crack Longitudinal (CL)	CL	4	6			3	**13**
Crack Multiple	CM	1	2			1	**4**
Crack Open (FC)	FC	5					**5**
Joint Offset Moderate (JOM)	JOM	20	5			7	**32**
Joint Offset Severe	JOL	2					**2**
Joint Separated	JSM	1					**1**
Pipe Broken (BVV)	BVV	2				3	**5**
Pipe Collapsed/Shifted	XP					1	**1**
Pipe Deteriorated - Surface Spalling Chemical (SSSC, SV)	SSSC	21	207			1	**229**
Pipe Hole In (HSV, HVV)	HSV	8	1			1	**10**
Lining Failure	LF	23					**23**
Point Repair (RPL, RPP)	RPL/RPP	40	1			8	**49**
O&M							
Debris/Deposits Settled Other (DS)	DSZ	17				7	**24**
Deposits Attached Other (DAZ)	DAZ	4	8			1	**13**
Grease Heavy	DAGS	4				1	**5**
Grease Light (DAGS)	DAGS	52	83		1	3	**139**
Grease Medium	DAGS	6					**6**
Joint Gasket Exposed (ISSR)	ISSR	10					**10**
Joint Infiltration Heavy	IR	2	2			1	**5**
Joint Infiltration Light (Weeper) (IW)	IW	2				4	**6**
Joint Infiltration Medium	ID	6	3			3	**12**
Obstacle in Joint (OBJ)	OBJ	7	1				**8**
Roots at Defect Heavy	RB						**0**
Roots at Defect Light	RF	2				1	**3**
Roots at Defect Medium	RM	1					**1**
Roots in Barrel Medium (RBB)	RMB	3				1	**4**

Table 6-1. CCTV Inspection Results – Defect Occurrences

CCTV Inspection Log Description(s)	PACP Code	Number Occurrences By Pipe Material					TOTAL
		ACP	ACE	PVC	RCP	VCP	
Roots in Connection Heavy	RBC	7					**7**
Roots in Connection Light	RFC					1	**1**
Roots in Connection Medium (RMC)	RMC	2				4	**6**
Roots in Joint Heavy (RBJ)	RB	2				3	**5**
Roots in Joint Light (RFJ)	RF	22	199			120	**341**
Roots in Joint Medium (RMJ)	RM	8				38	**46**
Roots in Lateral Heavy (RBL)	RBL	30				18	**48**
Roots in Lateral Light	RFL	10				12	**22**
Roots in Lateral Medium (RML)	RML	14				14	**28**
Vermin	V	2					**2**
MISCELLANEOUS							
Camera Blocked / Abandoned Survey	MSA	19	1			5	**25**
Cannot Load Camera	MSA	19				8	**27**
Pipe Material Change (MMC)	MMC	53	1	5		4	**63**
Camera Submerged (MCU)	MCU	24		1		8	**33**
Reduction	MSC					1	**1**
Sag (MWLS)	MWLS	89	1			32	**122**

Table 6-2. General Overview of Pipe Conditions

# Pipes	Pipe Condition
923	Total reaches inspected
27	Could not load camera/inspect
802	Free of **structural** defects
607	Free of **maintenance** defects
565	Free of all defects

Table 6-3. Severe Structural Defects, By Pipe ID

Hole in Pipe	Pipe Broken	Collapsed
JN206-JN205	BJ393-BJ392	UT534-UT533
PD57-PD56	PD16-PD15	
SR27-SR23	TR949-TR897	
TR455-TR454	TY72-TY71	
TY49-TY41		
UT191-UT105		
UT48-UT47		

6.2 Gravity Pipeline Condition Ratings

BC utilized the PACP© Condition Grading System to assign a condition and O&M rating and index to each inspected pipeline segment. According to NASSCO PACP© documentation, this grading system provides the ability to "quantitatively measure the difference in pipe condition between one inspection and subsequent inspections, and to prioritize among different pipe segments." This system provides a rating that considers the total number of defects in the pipe while also considering the most severe defects. The pipeline rating index is calculated using the following procedure:

1. Calculate the Segment Grade Scores for Structural and O&M by multiplying the number of defect occurrences by the respective grade (1 through 5).
2. Calculate the Pipe Rating by adding the Segment Grade Scores for all five grades.
3. Calculate the Pipe Ratings Index by dividing the Pipe Rating by the number of defects. If the pipe has no defects, the Pipe Ratings Index is zero.

BC calculated the Pipe Ratings Index (PRI) for each inspected pipe segment for Structural and O&M condition. These ratings are illustrated on Figures 6-4 (Structural PRI) and 6-5 (O&M PRI).

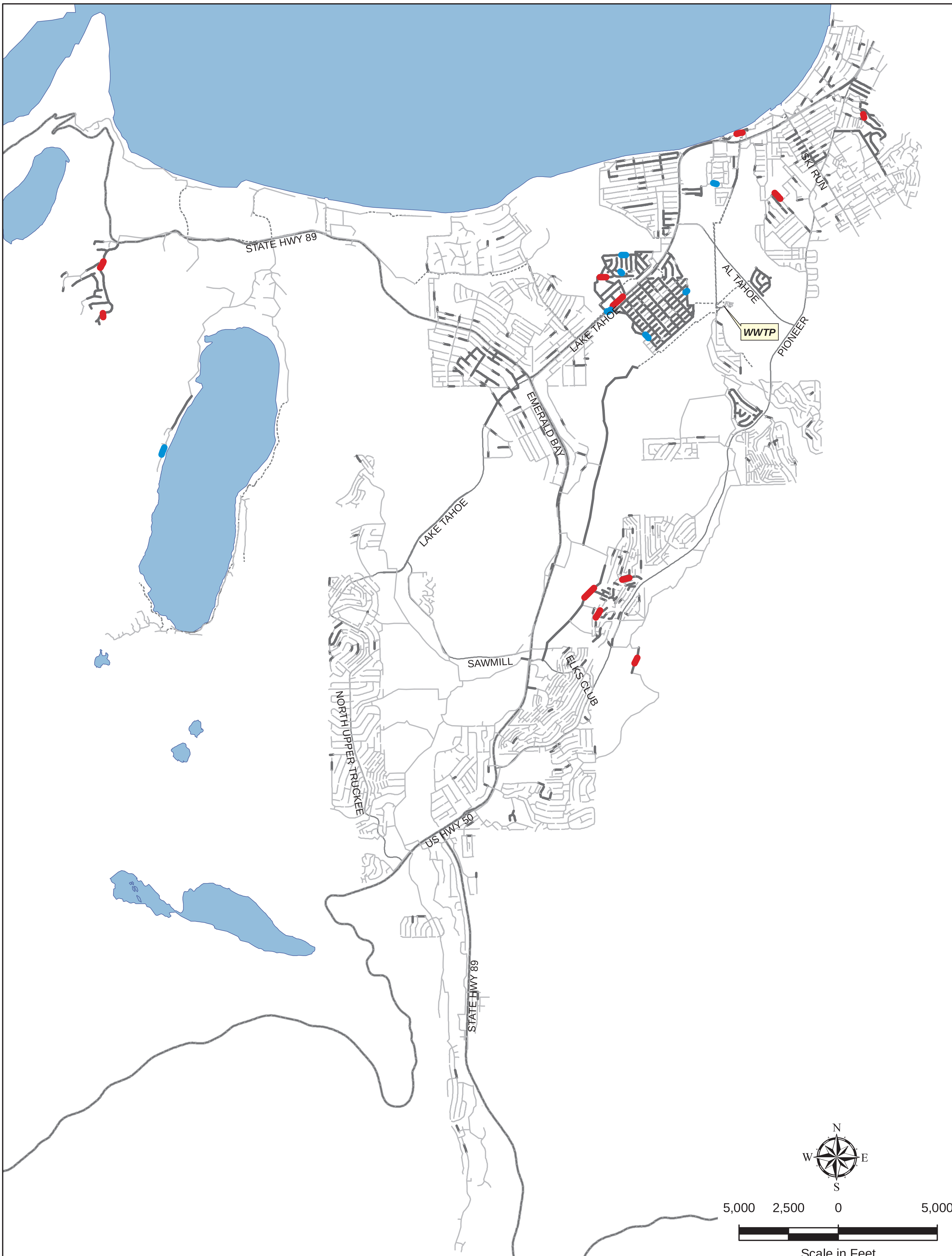

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Figure 6-1
Severe Defects 2003-2008

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LEGEND

Gravity Mains
- CCTV Inspected
- Not Inspected

Force Mains

Severe Defects from CCTV
- Existing
- Repaired

ROADS
- HWY
- Major

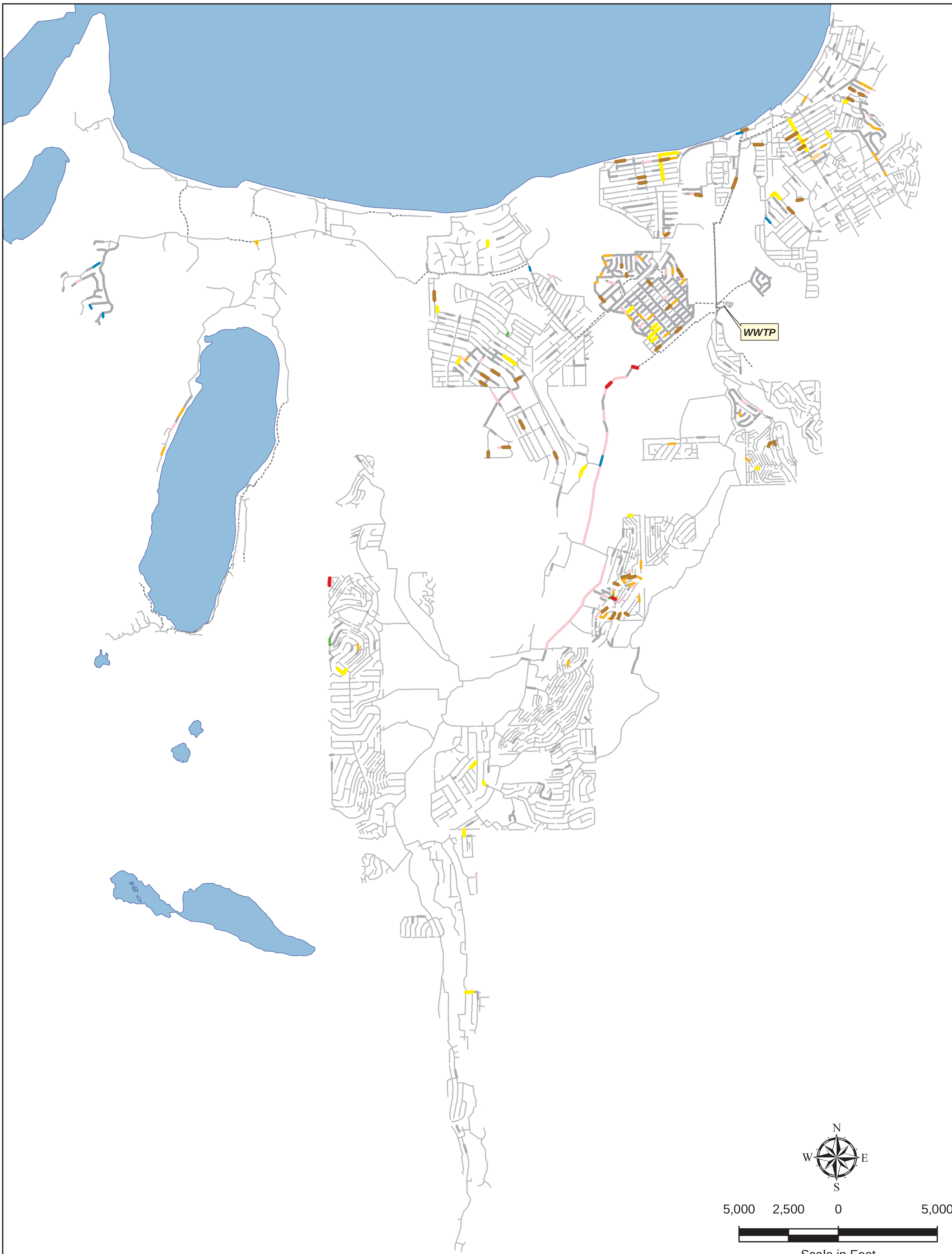

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Figure 6-2
CCTV Inspection Results: Roots and Infiltration

LEGEND

Infiltration
- Heavy
- Medium
- Light

Roots
- Heavy
- Medium
- Light

Warthog
- 2006

Gravity Mains
- CCTV Inspected
- Not Inspected

Force Mains

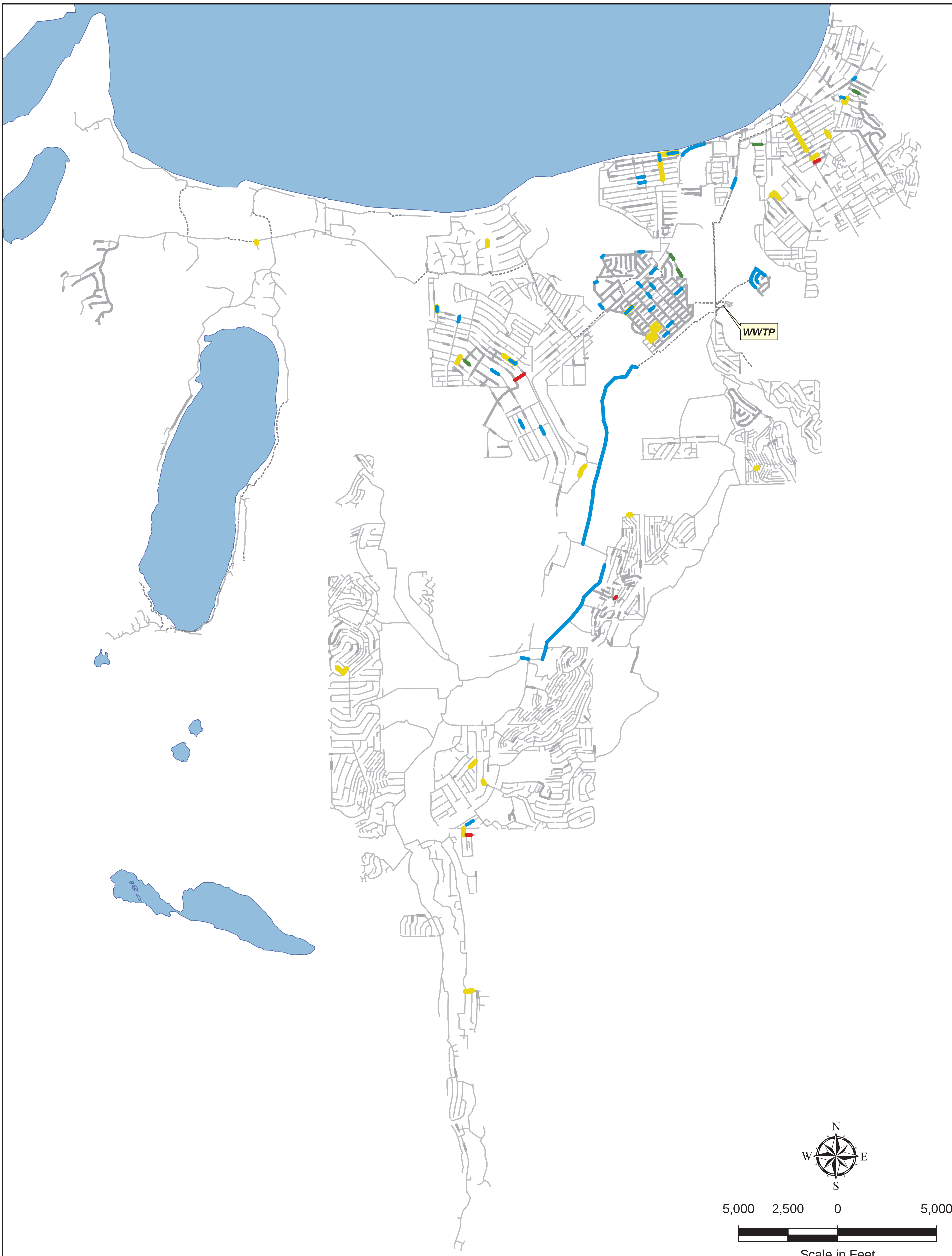

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Figure 6-3
CCTV Inspection Results: Grease

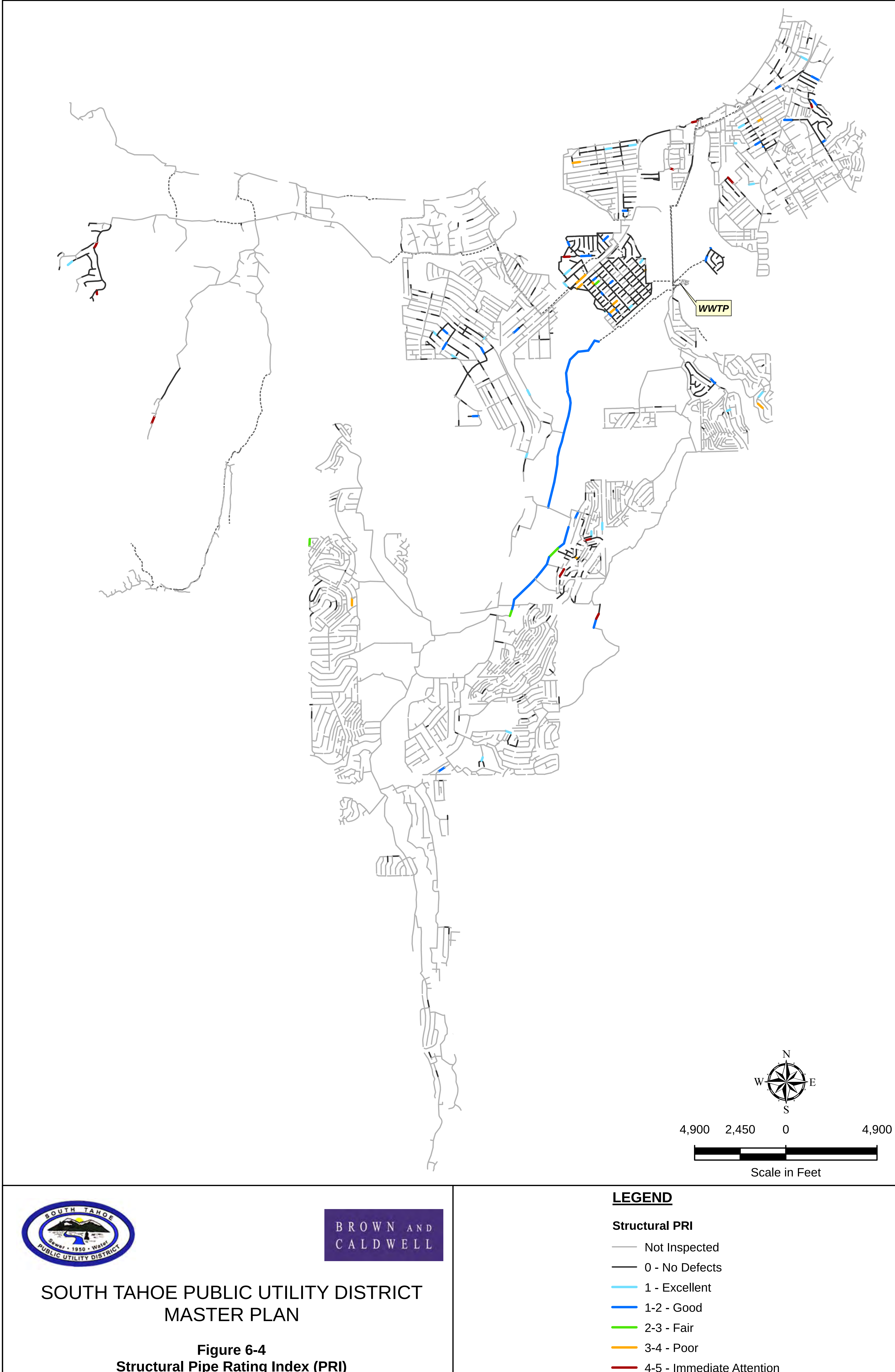

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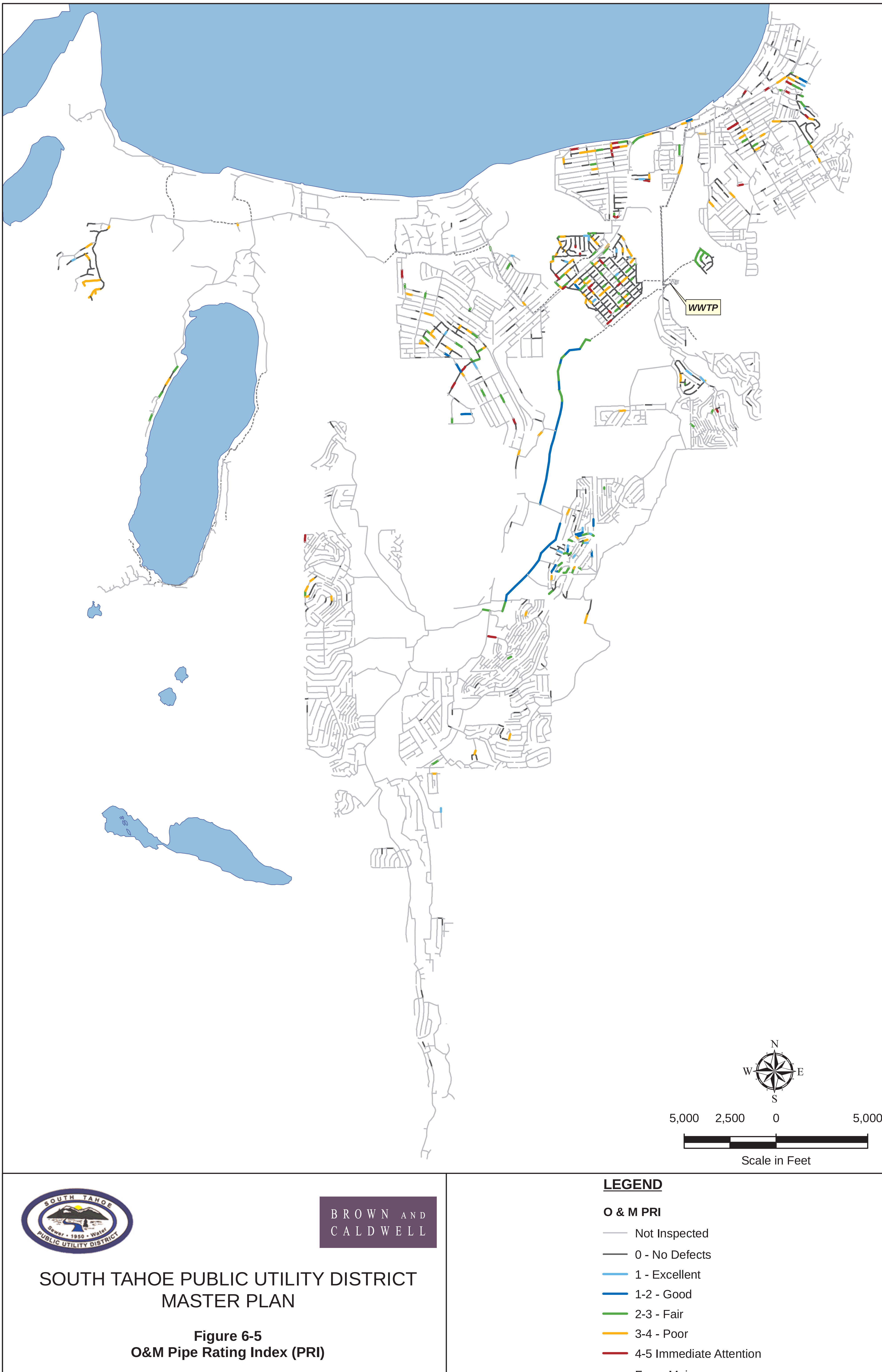
Figure 6-4
Structural Pipe Rating Index (PRI)

P:\132000\132364_STPUD_MP\GIS\mxd\CCTV\CCTV_PRI.mxd



SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 6-5
O&M Pipe Rating Index (PRI)

6.3 Manhole Condition Ratings

Manhole condition ratings were calculated for the corrosion and structural (non-corrosion) condition of the walls, bench, chimney, and the liner condition, where applicable. The assigned condition grades for observed defects in manholes are based on the condition grades in the PACP© Condition Grading System (see Section 3.3) developed for rating pipes. Table 6-5 summarizes the condition assessment of the manholes inspected in 2008. Structural condition grades were assigned for corrosion and structural (non-corrosion) defects; a condition descriptor number was listed for Frame/Cover; and O&M condition grades were assigned for roots (no sediment, minor infiltration, and no grease or vermin were observed).

Table 6-5. 2008 Manhole Condition Assessment

Manhole Number	Inspection Type	Lined or Coated	Location	Manhole Condition						
				Structural Grade[2]		O&M Grade	Frame/ Cover[1]	Overall Description	Rating
				Corrosion	Structural (Non-Corrosion)	Roots[3]			
TK1	Entry	Coated	U/S Tahoe Keys PS	4	1	1	1	Holes and corrosion behind failed coating	4
SM56	Surface	-	D/S Venice FM	0	1	1	1	No corrosion	1
TK74	Entry	Coated	D/S San Moritz FM	4	1	1	1	Hollows behind coating	4
AT15	Surface	Lined	D/S Tahoe Keys FM	0	1	1	1	CIPP lining wrinkled	1
AT14	Surface	Lined	D/S Tahoe Keys FM	0	1	1	1	Complete PVC lining	1
AT7	Surface	Lined	D/S Ponderosa/Tahoe Keys FM	0	1	1	1	Concrete Mortar lining	1
AT28	Surface	Lined	D/S Ponderosa FM	0	1	1	1	No defects	1
PD94	Surface	-	D/S Beecher FM	0	4	1	1	Chimney hole and potentially broken grade ring	4
AT48	Surface	Coated	D/S Bellevue FM	0	1	2	1	A lot of turbulence during FM discharge	1
TK725	Surface	-	D/S Gardner Mtn FM	1	1	1	2	White deposits walls/chimney, replaced cover	1
FL75	Surface	-	D/E ES-3 FM	3	1	1	5	Deposits and muddy appearance; ¾" bench penetration	3
TR2	Surface	-	U/S Trout Creek PS	0	1	2	1	No defects	1

[1] *Note: These numbers are descriptive and not a rating system. 1 = Sound: None or Rust or Pitted (Seals and Seats Properly); 2 = Cracked; 3 = Broken; 5 = Corroded or Pitted (Won't Seal or Seat Properly)*

[2] *0= None; 1= Roughness or Deposits (Corrosion); 2= Spalling (Corrosion); 3 = Exposed Aggregate (Corrosion), Lining Failure; 4 = Hole, Aggregate Missing (Corrosion), Void, Multiple Fractures; 5 = Rebar Visible or Corroded, More Than Ripples (Corrosion)*

[3] *1 = None; 2= Fine/Hair Thickness*

6.4 Force Mains

The force main discharge pipe at manhole TK74 that was inspected during the manhole inspections was observed to also be in good condition. District staff commented that a 20-foot segment of the 12-inch diameter Bijou/Johnson/Ski Run force main was replaced in 2005. The pipe was in extremely good condition. In 2007, the District reported a force main spill at Fallen Leaf Lake due to a hole in the PVC pipe. No additional inspection information was available for review.

7. PIPELINE CRITICALITY ASSESSMENT

A risk assessment was performed to identify critical pipeline assets so that the District can prioritize future repair projects and inspection/maintenance activities. The assessment is based on the asset management principles of consequence of failure and likelihood of failure. A failure was assumed to result in a Sanitary Sewer Overflow (SSO) which causes untreated wastewater to overflow from the collection system. These concepts were previously discussed in detail in TM No. 2 - Risk Assessment Procedures.

7.1 Consequence of Failure

Potential risk costs associated with the failure of an asset with a high consequence of failure include:

- Repair costs
- Social costs (traffic, etc.)
- Image repair costs (Tahoe's pristine environment)
- Legal costs (lost business, claims of damaged homes and other property)
- Fines and penalties (RWQCB, third party lawsuits)

Some of these costs (social, image, legal) are often difficult to predict and it is often helpful to think of them in terms of qualitative groups rather than quantitative costs. At the Risk Assessment Workshop in June 2007, District staff and BC qualitatively grouped areas of the system with a high consequence of failure. These areas, which meet the criteria shown below, are identified on Figure 7-1.

- Stream Environment Zone (SEZ)
- Proximity to lake or water body
- Proximity to water supply source
- Seasonal (limited access in the event of a failure)
- Traffic impact (pipes within 30 feet of the centerline of a State highway, including the Stateline area)
- Pipes with high flows (> 0.5 mgd average daily flow)

The Lahontan manholes are also shown on Figure 7-1 and summarized in Table 7-1. These 32 manholes were previously identified by the District for the Lahontan Regional Water Quality Control Board. For a period of time the District was required to monitor these manholes for SSO potential. They are situated in areas that are considered to have a high consequence of failure.

Table 7-1. Lahontan Manholes Project Report - Stream Environment Zone Manholes					
Number	**U/S MH**	**Street Name**	**No Winter Access**	**Type of SEZ**	**Notes**
1	TY38	Allikuk		Creek	Spring Creek
2	TY42	Spring Creek SEZ	X	Creek	Meadow, Spring Creek
3	TY55	Pomo	X	Creek	Close to Spring Creek bank
4	BB9	Baldwin Beach	X	Lake	On beach in sand (Lake Tahoe)
5	TL108	Dam	X	Lake	50' from FLL
6	TL134	Cathedral	X	Lake	200' from FLL
7	TL35	Guard Station		Lake	Up gradient, may remove from list (only one connection)
8	TL66	Cathedral	X	Creek/Lake	100' from FLL, near creek
9	TL62	Last Camp Area	X	Creek	500' from creek, FLL area
10	CR1	Jameson Beach		Lake	300' from Lake Tahoe at Camp Richardson PS
11	CR14	Camp Richardson		Lake	30' from Lake Tahoe, manhole on beach
12	TL39	Fallen Leaf		-	Remove from list
13	TL41	Camp 12 Fallen Leaf	X	Lake	Takes all flow from Cathedral & Fallen Leaf Lake System
14	CR5	Jameson Beach		Creek	Line follows creek
15	UT656	Angora Creek		Creek	Line follows Angora Creek
16	UT449	Mountain Trout		Creek	20' from Angora Creek
17	UT828	San Bernardino		Creek	5-10' from creek
18	UT820	San Bernardino		River	100'-200' from Upper Truckee River
19	UT1232	Hwy 50 (Bridge)		River	400' from Upper Truckee River
20	UT253	Sawmill Golf Course		River	Upstream inverted siphon crossing Upper Truckee River
21	UT2188	Grass Lake		River	Near bank of Upper Truckee River
22	UT164	Elks Club		River	50' from Upper Truckee River
23	BV39	Lilly		Creek	Meadow
24	TK281	Michael		Meadow	Meadow
25	TK365	Lake Tahoe (Motel 6)		Meadow	Meadow
26	TK282	Sky Meadows	X	Meadow	Meadow
27	PD53	Ponderosa		River	On bank of Upper Truckee River
28	UT74	Onnontioga	X	River	Near Upper Truckee River
29	AT18	Lake Tahoe (Meeks)		Meadow	Meadow
30	TR217	Golden Bear		Creek	Trout Creek
31	BJ57	Lakeshore		Lake	200' from Lake Tahoe, takes all Stateline flows
32	JN381	Regina		Lake	Below Heavenly problem area - roots

7.2 Likelihood of Failure

The second key component to the risk assessment is determining the likelihood (probability) of failure. Failure probabilities related to condition can be determined based on structural condition, operational information, and maintenance data. As discussed in TM No. 2, there are a number of pipeline and manhole failure mechanisms that can identify them as having a high likelihood of failure. Some of these characteristics are shown in Table 7-2.

Table 7-2. Pipeline and Manhole Failure Mechanisms		
Gravity Pipes	**Gravity Manholes**	**Force Mains**
• Corrosion • Cracks (structural failure) • Root blockage • Root blockage from service lateral • Grease blockage • Washout due to stream scour action • Under-capacity • Construction activities • Infiltration/Inflow	• Corrosion • Washout due to stream scour action • Infiltration/Inflow	• Corrosion at air pockets • Washout due to stream scour action • Leaking ARV/AVV • Blockage due to low velocities • Failure due to surge pressures associated with high velocities

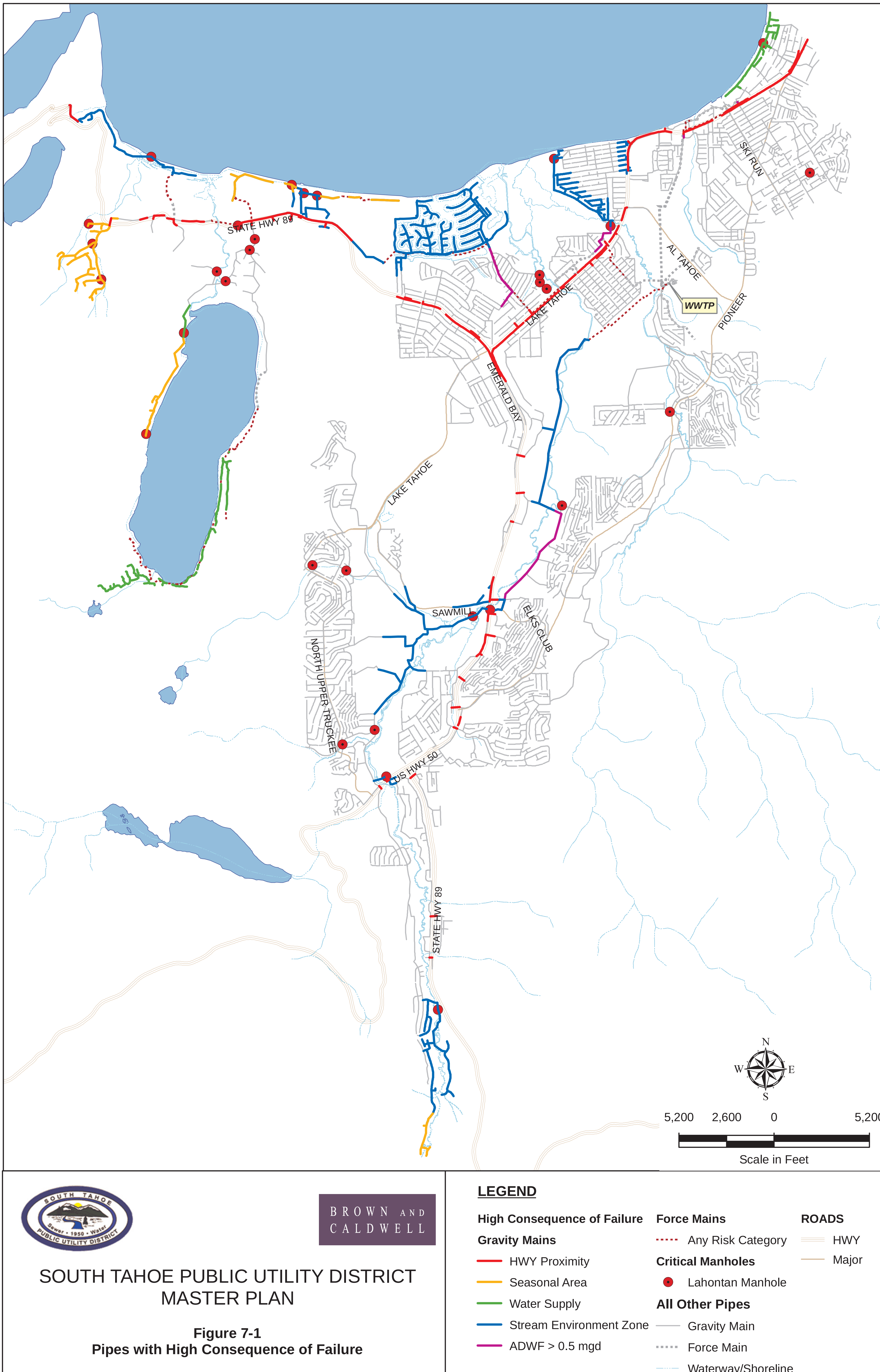
Through the review of condition assessment and maintenance information (and engineering experience with other collection systems) we have identified pipeline and manhole assets with a higher than normal probability of failure. These assets meet the following criteria:

- Pipes that currently require high maintenance (cleaning, root cutting, grease clearing four or more times per year)
- 6-inch diameter pipes (70 percent of SSOs and 95 percent of the spot repairs occurred in 6-inch pipes)
- Force mains with ARV/AVV mechanisms (at risk for SSO or pipe failure because ARV/AVVs are not being maintained)
- Stream crossings (at risk for washout during a flood)
- Pipes and manholes downstream of force main discharges (at risk for failure due to corrosion)

Pipes meeting these criteria are shown on Figure 7-2. Other key structural failure mechanisms were not included in the criteria because we were not able to distinguish any significant failure trends through review of the condition assessment data. Stream crossing were identified using the District's GIS stream layer and confirmed with aerial photography.

7.3 Critical Pipes and Manholes

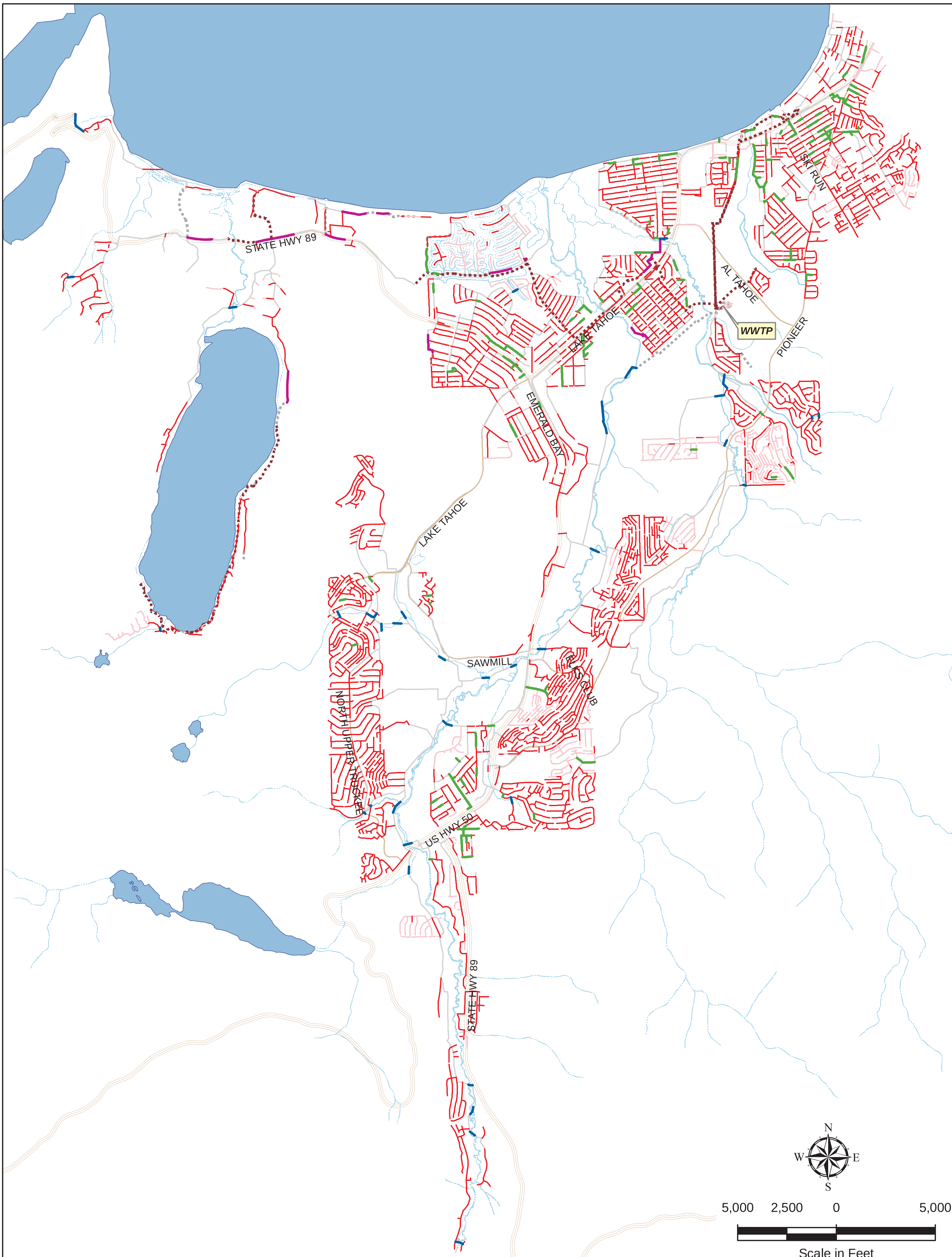
The District's most critical pipeline assets are shown in the areas of union with the high consequence and high likelihood of failure assets. These are areas where the District should focus their maintenance and rehabilitation activities. These assets are illustrated on Figure 7-3 and listed in Attachment C.



BROWN AND CALDWELL

SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 7-1
Pipes with High Consequence of Failure



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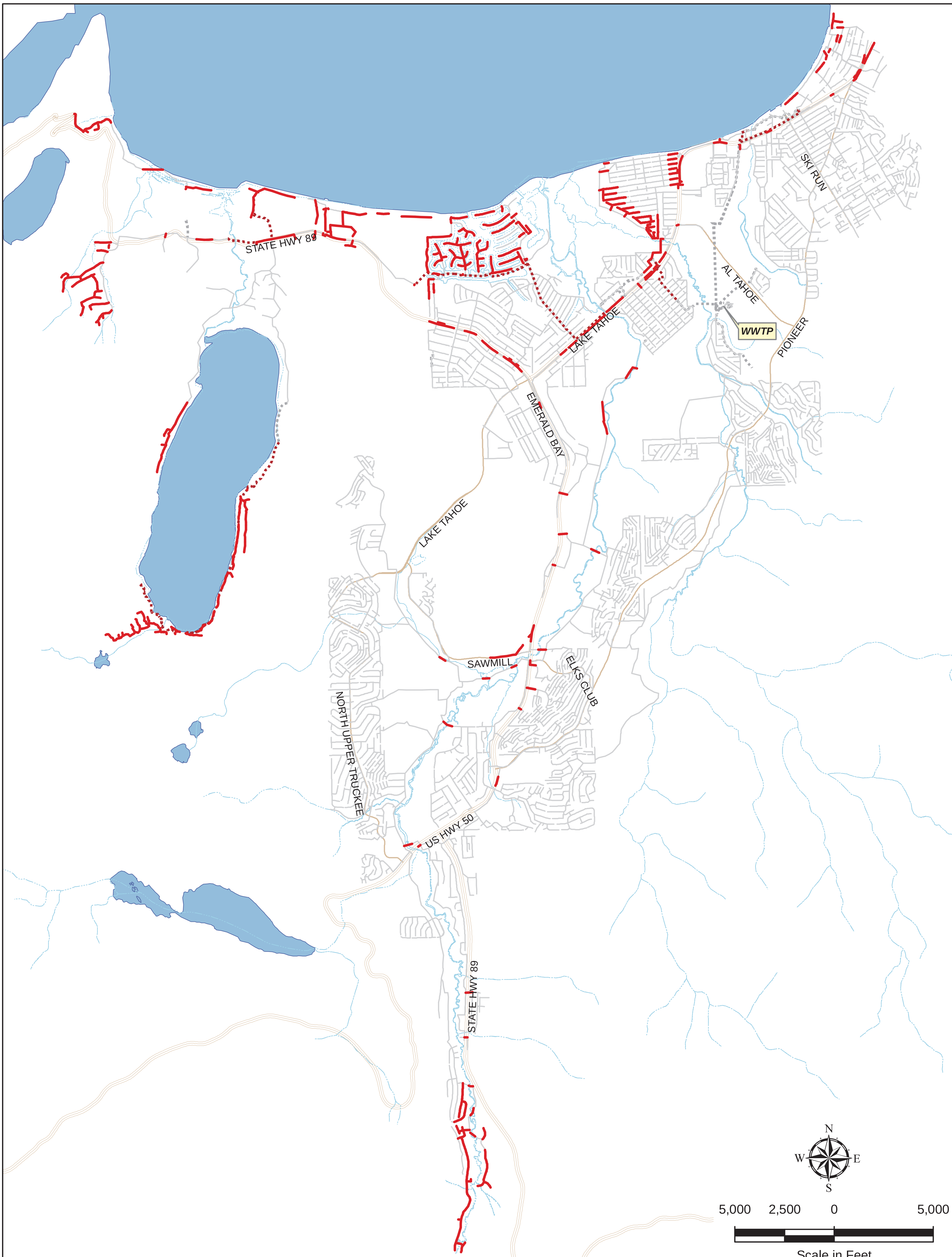
SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 7-2
Pipes with Higher Likelihood of Failure



BROWN AND CALDWELL

SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 7-3
Critical Pipes
(High Likelihood and Consequence of Failure)

LEGEND

Critical Pipes

Gravity Mains

Any High Likelihood

Force Mains

ARVs Installed

All Other Pipes

Gravity Main

Force Main

ROADS

HWY

Major

Waterway/Shoreline

8. CONCLUSIONS AND RECOMMENDATIONS

Based on the information reviewed for this condition and maintenance assessment, we can make the following conclusions and recommendations.

8.1 Conclusions

The STPUD wastewater collection system pipes and manholes are generally well maintained, though there is room for improvement in specific areas. The District experiences a moderate number of dry weather SSOs, roughly falling within the range of averages seen by other agencies around the country. Most of these SSOs occur in 6-inch diameter pipes, which are often difficult to maintain. The District has not experienced any recent wet weather SSOs.

The District has a high frequency of cleaning activities. Most sewer agencies do not clean the majority of their systems every three years. However, much of this cleaning is necessary due to the 6-inch diameter pipes in their system that experience root intrusion and structural problems at a higher rate than other parts of the system. This cleaning program has allowed the District to maintain low levels of dry weather SSOs.

Much of the Districts pipeline infrastructure is approaching 50 years of age, yet it remains in relatively good condition. The District's ongoing CCTV inspection program identifies pipeline defects and they are repaired quickly. The District is improving their inspection frequency and procedures for pipes and manholes. They are on track to inspect the system approximately once every 12 years. They recently implemented the NASSCO standardized system for rating pipe and manhole defects. CCTV inspections are currently not prioritized.

One area of weakness is the District's pipeline maintenance and inspection program for force mains. ARVs on a number of force mains are not being maintained as designed. This puts the District at risk for a force main failure due to corrosion or an ARV spill. This part of the District's program currently is at the highest risk for SSOs.

8.2 Recommendations

The following general recommendations will help the District meet its specified level of service for operating and maintaining the pipeline system. Specific capital improvement projects to address system deficiencies will be developed in the Capital Improvement Plan TM.

8.2.1 General

- Document causes for all identified SSOs. This will help the District focus and direct their O&M program.

8.2.2 Improvement Projects

- Confirm that the pipes with severe defects have been repaired. If not, they should be re-inspected or added to the capital improvement program.
- Prioritize future capital improvement projects from CCTV inspection based on asset criticality.
- Implement repairs that reduce the need for intense or overly-frequent pipeline maintenance.
- Allocate adequate budget to address the likely increase in pipeline repairs that will be identified with the new CCTV inspection program.

8.2.3 Inspections

- Reprioritize the pipeline CCTV inspection program based on asset criticality. The District's most critical assets should be inspected more frequently than the rest of the system.
- Document manhole inspections using the NASSCO standards during pipe cleaning and CCTV inspection activities.
- Monitor corrosion at manholes downstream of force main discharges. Inspect manholes previously not inspected that meet this criterion.
- Develop a plan to evaluate new CCTV data (in-house, consultant, etc).
- Develop a program to inspect the force main system. The EPA recommendation[1] for sewer force mains O&M includes an annual inspection and evaluation consisting of:
  - Route inspections
  - Assess integrity of force main surface and pipeline connections
  - Assess valving arrangement and leakage
  - If there is an excessive increase in pump head, assess if headloss increase is due to grease build-up and if pipeline pigging is required.

8.2.4 Maintenance

- Utilize the new CMMS to develop a criticality-based maintenance program. The District's most critical assets should be maintained at a higher level than less critical assets.
- Inspect and backflush ARVs monthly. This frequency can be adjusted based on each force main's individual requirements.

[1] United States Environmental Protection Agency. 2000. EPA 832-F-00-071 – Wastewater Technology Fact Sheet: Sewers, Force Main.

ATTACHMENT A – SAMPLE CCTV INSPECTION REPORT

CUES, Inc.
3600 Rio Vista Avenue
Orlando, FL 32805
Phone: 407-849-0190
Fax: 407-425-1569

GRANITE XP
Pipeline Inspection and Integration Software

Observations by Inspections

SITE DATA

Mainline ID:	City:	Address:
UT155-UT91	SLT	EASEMENT

Upstream node:	Downstream node:	Pipe type:	Pipe shape:	Pipe height:	Pipe width:
UT155	UT91	ACG	C	21	

INSPECTION DATA

Scheduled Date:	Start date/time:	End date/time:
8/6/2008 1:04:59 PM	8/6/2008 1:09:37 PM	8/6/2008 2:34:22 PM

Surveyed footage:	Status:	Operator:	Work order No.:
473.1	Stopped	Jason Chatham	332189

Reason:	Weather:	Condition:
C	1	SAT1

Comments

OBSERVATIONS

Footage	Rev.	Length	Clock From	Clock To	Code	Modifiers/Severity	Rating
0.0	No				START WITH FLOW		
0.0	No				AMH		
0.0	No				MWL		
0.0	No	473.1	3	5	DAGS		
0.0	No	473.1	7	9	DAGS		
45.8	No	7.2	12	12	SZ		
49.6	No	3.4	7	10	SAM		
57.2	No		12	2	RFJ		
84.7	No		7	8	SAM		
84.8	No		4	5	SZ		
86.2	No		3	5	SZ		
86.2	No		7	9	SZ		
107.6	No		12	1	RFJ		

CUES, Inc.
3600 Rio Vista Avenue
Orlando, FL 32805
Phone: 407-849-0190
Fax: 407-425-1569

OBSERVATIONS

Footage	Rev.	Length	Clock From	Clock To	Code	Modifiers/Severity	Rating
107.6	No		11	12	RFJ		
173.8	No		4	5	SAM		
173.8	No		12		SZ		
193.8	No		7	9	SAM		
206.4	No		11	12	SZ		
262.0	No		10	11	RFJ		
287.4	No		1	2	RFJ		
327.9	No		7	8	SAM		
340.6	No		4	5	SAM		
404.4	No		4	5	SAM		
414.6	No		10	11	RFJ		
417.2	No		7	8	SAM		
441.0	No		9	10	RFJ		
473.1	No		3		TF		
473.1	No				AMH		
473.1	No				STOP		

ATTACHMENT B – MANHOLE INSPECTION PHOTOS

South Tahoe Public Utility District
Manhole Inspection Photo Log
March 11, 2008

Manhole No. TK1 Location: Keys and Venice (U/S Tahoe Keys PS)

Description: Coated Concrete

Description: Holes and corrosion behind failed coating. Coating Failures at Bottom of MH

Manhole No.: SM56 Location: Venice (D/S Venice FM)

Description: Force Main Discharge onto Bench

Description: Unlined Concrete – No corrosion

Manhole No.: TK74 Location: Venice & Lucerne (D/S San Moritz FM)

Description: Mortar Coating Pulling Away From Chimney

Description: Hollow Behind Coating Near FM Discharge

Manhole No.: AT15 Location: Sussex &Brockway (D/S Tahoe Keys FM)

Description: Wrinkled CIPP Lining w/ Black Slime 3/4” to 3/8” thick

Description: 18” Discharge

Manhole No.: AT14 Location: Sussex &Macinaw (D/S Tahoe Keys FM)

Description: PVC Lined Concrete

Description: Estimated Flow Depth – 6”

Manhole No.: AT7 Location: HWY 50 & Reno (D/S Tahoe Keys and Ponderosa FM)

Description: 30” Diameter Cover

Description: Concrete Mortar Lining – Good Condition

Manhole No.: AT28 Location: Silverdollar & HWY 50 (D/S Ponderosa FM)

Description: 30” Diameter Cover

Description: Lined Concrete – Minor Wrinkles and Black Slime

Manhole No.: PD94 Location: Lodi & Alma (D/S Beecher FM)

Description: Hole in Chimney, Loose MH Frame. Potentially broken grade ring.

Description: Unlined Concrete

Manhole No.: AT 48 Location: Easement in Forest Service Wetland (D/S Bellevue FM)

Description: Light Roots Intrusion, Unlined Concrete

Description: 90 Deg Bend on End of Forcemain, a Lot of Turbulence during Pump Discharge

Manhole No.: TK 725 Location: Gardner & Clement (D/S Gardner Mtn. FM)

Description: Replaced MH Cover

Description: White Deposits on Unlined Concrete

Manhole No.: FL75 Location: Gate to Fallen Leaf Lake (D/S ES-3 FM)

Description: White and Yellow Deposits on Unlined Concrete

Description: Crumbly Concrete Bench (3/4" Penetration)

Manhole No.: TR2 Location: 1275 Meadow Crest (U/S Trout Creek PS)

Description: Unlined Concrete – No Corrosion.

Description: Estimated Flow Depth – 6”

ATTACHMENT C – CRITICAL PIPES

Attacment C-1
Critical Force Mains

Critical Force Mains	Risk Zones				Portion of FM*
	SEZ	H2O Supply	Seasonal	Highway	
Taylor Creek				x	All
Kiva		x	x		All
Tallac	x				All
San Moritz	x				All
Tahoe Keys	x			x	US/Middle
Al Tahoe				x	US
Bijou 16-inch				x	US
Bijou 12-inch				x	Middle
ES-1		x			All
ES-2		x			All
ES-3		x			All
ES-5		x			All
ES-6		x			All
ES-7		x			All
ES-8		x			All
ES-9		x			All
Main Station FLL		x			All
VVS-4		x			All
VVS-6		x			All
VVS-7		x			All
VVS-8		x			All

** Actual location of air valve should be confirmed and plotted on GIS*

Attachment C-2
Critical Gravity Mains

Pipe Name	Material	Length (ft)	Likelihood of Failure				Consequence of Failure					
			Diameter (in)	Max. Times Clean/Year	Stream/ Creek Xing	W/I 1,000 ft. DS of FM	ADWF >0.5 mgd	SEZ	Water Supply	Seasonal	HWY Proximity	# Risk Factors
0-BB2		9	-	-	-	-	-	1	-	-	-	1
0-BB35		11	-	-	-	-	-	1	-	-	-	1
0-BJ113	ACP	124	-	-	-	-	-	-	1	-	-	1
0-BJ123	ACP	8	-	-	-	-	-	-	1	-	-	1
0-BJ123	ACP	7	-	-	-	-	-	-	1	-	-	1
0-BJ92	ACP	45	-	-	-	-	-	-	1	-	-	1
0-CR19		10	-	-	-	1	-	1	-	-	-	1
0-CR30		10	-	-	-	-	-	1	-	-	-	1
0-CR33		12	-	-	-	-	-	1	-	-	-	1
0-F34-106		375	-	-	-	-	-	-	1	-	-	1
0-FL2		172	-	-	-	-	-	-	1	-	-	1
0-FL57	PVC	17	6	-	-	-	-	-	1	-	-	1
0-FL86		6	-	-	-	-	-	-	1	-	-	1
0-FL89		23	-	-	-	-	-	-	1	-	-	1
0-JN10	ACP	9	-	-	-	-	-	-	-	-	1	1
0-SR38	ACP	298	-	-	-	-	-	-	-	-	1	1
0-TL23		11	-	-	-	-	-	1	-	-	-	1
0-TL35		11	6	-	-	-	-	-	-	-	1	1
0-TL35		11	6	-	-	-	-	-	-	-	1	1
0-UT1233	ACP	136	-	-	-	-	-	1	-	-	1	2
AT110-AT71	VCP	362	6	-	-	-	-	-	-	-	1	1
AT111-AT110	ACP	361	6	1	-	-	-	-	-	-	1	1
AT11-AT1	VCP	37	18	-	-	1	1	-	-	-	-	1
AT12-AT11	VCP	138	18	-	-	1	1	-	-	-	-	1
AT13-AT12	VCP	249	18	-	-	1	1	-	-	-	-	1
AT14-AT13	VCP	208	18	-	-	1	1	-	-	-	-	1
AT15-AT14	VCP	306	18	-	-	1	1	-	-	-	-	1
AT16-AT2	VCP	279	24	-	-	1	1	-	-	-	-	1
AT17-AT16	VCP	397	18	-	-	1	1	-	-	-	-	1
AT18-AT17	VCP	391	18	-	-	1	1	-	-	-	-	1
AT23-AT22	VCP	307	6	-	-	-	-	-	-	-	1	1
AT24-AT23	VCP	277	6	-	-	-	-	-	-	-	1	1
AT25-AT4	ACP	247	6	-	-	-	-	-	-	-	1	1
AT2-AT1	VCP	78	24	-	-	1	1	-	-	-	-	1
AT48-AT18	VCP	300	12	-	-	1	-	1	-	-	-	1
AT49-AT48	VCP	121	8	-	1	-	-	1	-	-	-	1
AT57-AT56	VCP	103	-	-	-	-	-	-	-	-	1	1
AT6-AT5	ACP	431	6	-	-	-	-	-	-	-	1	1
AT8-AT7	ACP	251	8	7	-	-	-	-	-	-	1	1
BB1-0		15	-	-	-	-	-	1	-	-	-	1
BB10-BB9		1012	6	1	-	-	-	1	-	-	-	1
BB22-BB21		206	6	2	-	-	-	1	-	-	-	1
BB23-BB22		399	6	2	-	-	-	1	-	-	-	1
BB24-BB23		202	6	2	-	-	-	1	-	-	-	1
BB25-BB2		349	6	1	-	-	-	1	-	-	-	1
BB26-BB25		142	6	1	-	-	-	1	-	-	-	1
BB27-BB26		381	6	1	-	-	-	1	-	-	-	1
BB28-BB27		411	6	-	-	-	-	1	-	-	-	1
BB29-BB24		269	6	2	-	-	-	1	-	-	-	1
BB30-BB29		360	6	1	-	-	-	1	-	-	-	1
BB31-BB30		121	6	1	-	-	-	1	-	-	-	1
BB32-BB31		198	6	1	-	-	-	1	-	-	-	1
BB33-BB24		345	6	2	-	-	-	1	-	-	-	1
BB34-BB33		184	6	1	-	-	-	1	-	-	-	1
BB35-BB31		113	6	1	-	-	-	1	-	-	-	1
BB36-BB35	CIP	1074	6	1	1	-	-	1	-	-	1	2
BB37-BB36		65	6	1	-	-	-	1	-	-	1	2
BJ111-BJ110	ACP	324	6	2	-	-	-	-	1	-	-	1
BJ112-SPCSTLNLIFT	ACP	323	-	-	-	-	-	-	1	-	-	1
BJ113-BJ112	ACP	351	-	-	-	-	-	-	1	-	-	1
BJ122-BJ121	ACP	298	6	2	-	-	-	-	1	-	-	1
BJ123-BJ112	ACP	349	-	-	-	-	-	-	1	-	-	1
BJ130-BJ120	ACP	342	6	-	-	-	-	-	1	-	-	1
BJ208-BJ207	VCP	158	8	12	-	-	-	-	-	-	1	1
BJ213-BJ212	ACP	138	6	1	-	-	-	-	-	-	1	1
BJ214-BJ213	VCP	104	-	1	-	-	-	-	-	-	1	1
BJ215-BJ214	VCP	461	-	1	-	-	-	-	-	-	1	1
BJ257-BJ213	VCP	515	-	1	-	-	-	-	-	-	1	1
BJ37-BJ36	VCP	154	-	2	-	-	-	-	-	-	1	1
BJ38-BJ37	VCP	116	-	2	-	-	-	-	-	-	1	1

Pipe Name	Material	Length (ft)	Likelihood of Failure				Consequence of Failure					
			Diameter (in)	Max. Times Clean/Year	Stream/ Creek Xing	W/I 1,000 ft. DS of FM	ADWF >0.5 mgd	SEZ	Water Supply	Seasonal	HWY Proximity	# Risk Factors
BJ39-BJ38	VCP	120	-	2	-	-	-	-	-	-	1	1
BJ40-BJ39	VCP	14	-	2	-	-	-	-	-	-	1	1
BJ41-BJ40	VCP	130	-	1	-	-	-	-	-	-	1	1
BJ42-BJ41	VCP	255	-	1	-	-	-	-	-	-	1	1
BJ43-BJ42	VCP	30	-	1	-	-	-	-	-	-	1	1
BJ44-BJ43	VCP	325	-	1	-	-	-	-	-	-	1	1
BJ49-BJ17	ACP	405	6	1	-	-	-	-	1	-	-	1
BJ50-BJ49	ACP	420	6	1	-	-	-	-	1	-	-	1
BJ55-BJ24	ACP	259	6	1	-	-	-	-	1	-	-	1
BJ56-BJ55	ACP	190	6	1	-	-	-	-	1	-	-	1
BJ60-BJ59	ACP	180	6	2	-	-	-	-	1	-	-	1
BJ62-BJ61	ACP	374	6	4	-	-	-	-	-	-	1	1
BJ83-BJ51	ACP	413	6	1	-	-	-	-	1	-	-	1
BJ84-BJ83	ACP	203	6	1	-	-	-	-	1	-	-	1
BV110-BV83	VCP	58	6	1	-	-	-	1	-	-	-	1
BV111-BV110	VCP	278	6	2	-	-	-	1	-	-	-	1
BV112-BV111	VCP	271	6	2	-	-	-	1	-	-	-	1
BV14-BV13	VCP	207	6	-	-	-	-	1	-	-	-	1
BV15-BV14	VCP	387	6	1	-	-	-	1	-	-	-	1
BV16-BV15	VCP	341	6	1	-	-	-	1	-	-	-	1
BV26-BV25	VCP	68	6	1	-	-	-	1	-	-	-	1
BV27-BV26	VCP	59	6	1	-	-	-	1	-	-	-	1
BV28-BV27	VCP	73	6	1	-	-	-	1	-	-	-	1
BV29-BV28	VCP	48	6	1	-	-	-	1	-	-	-	1
BV30-BV29	VCP	102	6	1	-	-	-	1	-	-	-	1
BV31-BV30	VCP	78	6	1	-	-	-	1	-	-	-	1
BV32-BV31	VCP	98	6	1	-	-	-	1	-	-	-	1
BV33-BV4	VCP	335	6	-	-	-	-	1	-	-	-	1
BV3-BV2	VCP	169	6	1	-	-	-	1	-	-	-	1
BV40-BV39	ACP	42	6	1	-	-	-	1	-	-	-	1
BV41-BV40	ACP	398	6	1	-	-	-	1	-	-	-	1
BV43-BV14	VCP	290	6	1	-	-	-	1	-	-	-	1
BV44-BV43	VCP	358	6	1	-	-	-	1	-	-	-	1
BV45-BV44	VCP	291	6	1	-	-	-	1	-	-	-	1
BV48-BV20	VCP	255	6	1	-	-	-	1	-	-	-	1
BV49-BV48	VCP	107	6	1	-	-	-	1	-	-	-	1
BV4-BV3	VCP	87	6	1	-	-	-	1	-	-	-	1
BV50-BV49	VCP	169	6	1	-	-	-	1	-	-	-	1
BV51-BV50	VCP	340	6	1	-	-	-	1	-	-	-	1
BV52-BV25	VCP	268	6	3	-	-	-	1	-	-	-	1
BV53-BV52	VCP	260	6	3	-	-	-	1	-	-	-	1
BV54-BV53	VCP	82	6	1	-	-	-	1	-	-	-	1
BV55-BV54	VCP	198	6	1	-	-	-	1	-	-	-	1
BV56-BV55	VCP	93	6	1	-	-	-	1	-	-	-	1
BV57-BV56	VCP	63	6	1	-	-	-	1	-	-	-	1
BV58-BV26	VCP	214	6	-	-	-	-	1	-	-	-	1
BV5-BV4	VCP	334	6	2	-	-	-	1	-	-	-	1
BV60-BV28	VCP	134	6	1	-	-	-	1	-	-	-	1
BV61-BV60	VCP	144	6	1	-	-	-	1	-	-	-	1
BV62-BV61	VCP	140	6	13	-	-	-	1	-	-	-	1
BV63-BV62	VCP	76	6	2	-	-	-	1	-	-	-	1
BV64-BV63	VCP	126	6	2	-	-	-	1	-	-	-	1
BV68-BV67	ACP	232	6	1	-	-	-	1	-	-	-	1
BV6-BV5	VCP	295	6	2	-	-	-	1	-	-	-	1
BV76-BV43	ACP	281	6	1	-	-	-	1	-	-	-	1
BV77-BV76	VCP	228	6	1	-	-	-	1	-	-	-	1
BV78-BV77	VCP	215	6	1	-	-	-	1	-	-	-	1
BV79-BV78	VCP	356	6	1	-	-	-	1	-	-	-	1
BV80-BV79	VCP	342	6	1	-	-	-	1	-	-	-	1
BV82-BV48	VCP	81	6	1	-	-	-	1	-	-	-	1
BV83-BV82	VCP	179	6	1	-	-	-	1	-	-	-	1
BV84-BV83	VCP	311	6	1	-	-	-	1	-	-	-	1
BV85-BV54	VCP	47	6	1	-	-	-	1	-	-	-	1
BV86-BV85	VCP	106	6	4	-	-	-	1	-	-	-	1
BV87-BV86	VCP	40	6	4	-	-	-	1	-	-	-	1
BV88-BV87	ACP	97	6	2	-	-	-	1	-	-	-	1
BV89-BV88	ACP	120	6	2	-	-	-	1	-	-	-	1
BV90-BV89	ACP	111	6	2	-	-	-	1	-	-	-	1
BV91-BV90	VCP	271	6	1	-	-	-	1	-	-	-	1
BV92-BV91	VCP	278	6	1	-	-	-	1	-	-	-	1

Attachment C-2
Critical Gravity Mains

Pipe Name	Material	Length (ft)	Likelihood of Failure				Consequence of Failure					# Risk Factors
			Diameter (in)	Max. Times Clean/Year	Stream/ Creek Xing	W/I 1,000 ft. DS of FM	ADWF >0.5 mgd	SEZ	Water Supply	Seasonal	HWY Proximity	
BV92-JN710	VCP	308	6	1	-	-	-	1	-	-	-	1
BV93-BV62	VCP	262	6	1	-	-	-	1	-	-	-	1
BV94-BV93	VCP	213	6	1	-	-	-	1	-	-	-	1
BV95-BV94	VCP	383	6	1	-	-	-	1	-	-	-	1
BV96-BV95	VCP	106	6	1	-	-	-	1	-	-	-	1
BV97-BV63	VCP	281	6	2	-	-	-	1	-	-	-	1
BV98-BV95	VCP	353	6	1	-	-	-	1	-	-	-	1
BV98-BV97	VCP	450	6	3	-	-	-	1	-	-	-	1
CR1-0		31	-	-	-	-	-	1	-	-	-	1
CR10-CR9		353	6	-	-	-	-	1	-	-	-	1
CR11-CR10		201	6	-	-	-	-	1	-	-	-	1
CR16-CR2		290	6	1	-	-	-	1	-	-	-	1
CR17-CR16		411	6	1	-	-	-	1	-	-	-	1
CR18-CR17		408	6	1	-	-	-	1	-	-	-	1
CR19-CR5		212	-	1	-	1	-	1	-	-	-	1
CR20-CR19		546	-	1	-	1	-	1	-	1	-	2
CR21-CR20		119	-	1	-	1	-	1	-	1	-	2
CR22-CR21		318	6	1	-	1	-	1	-	1	-	2
CR23-0		316	-	-	-	1	-	1	-	1	-	2
CR24-CR23		260	6	-	-	1	-	1	-	1	-	2
CR25-0		288	-	-	-	-	-	1	-	1	-	2
CR26-CR25		516	6	-	-	-	-	1	-	1	-	2
CR27-CR7		410	6	1	-	-	-	1	-	-	-	1
CR28-CR27		323	6	-	-	-	-	1	-	-	-	1
CR29-CR28		251	6	-	-	-	-	1	-	-	-	1
CR3-0		125	-	-	-	-	-	1	-	-	-	1
CR30-CR10		169	6	-	-	-	-	1	-	-	-	1
CR31-CR14	VCP	393	6	1	-	-	-	1	-	1	-	2
CR32-CR31		373	6	1	-	-	-	1	-	-	-	1
CR33-CR32		438	6	1	-	-	-	1	-	-	-	1
CR34-0		518	-	-	-	-	-	1	-	1	-	2
CR35-CR34		163	6	-	-	-	-	1	-	1	-	2
CR6-CR5		502	6	1	-	-	-	1	-	-	-	1
CR7-CR6		235	6	-	-	-	-	1	-	-	-	1
CR8-CR7		359	6	1	-	-	-	1	-	-	-	1
CR9-CR8		294	6	-	-	-	-	1	-	-	-	1
E34-110-E37-109		209	-	-	-	-	-	-	1	-	-	1
E34-116-F34-107		113	-	-	-	-	-	-	1	-	-	1
E34-117-E34-116		94	-	-	-	-	-	-	1	-	-	1
E37-109-F34-107		81	-	-	-	-	-	-	1	-	-	1
F34-082-F34-081		9	-	-	-	-	-	-	1	-	-	1
F34-106-F34-105		8	-	-	-	-	-	-	1	-	-	1
FL1-0		14	-	-	-	-	-	-	1	-	-	1
FL10-FL9		237	6	1	-	-	-	-	1	-	-	1
FL11-FL10	ACP	173	6	1	-	-	-	-	1	-	-	1
FL12-FL11		152	6	1	-	-	-	-	1	-	-	1
FL13-FL12	PVC	365	6	1	-	-	-	-	1	-	-	1
FL14-FL13		165	6	1	-	-	-	-	1	-	-	1
FL15-FL14	PVC	129	6	1	-	-	-	-	1	-	-	1
FL16-FL15		254	6	1	-	-	-	-	1	-	-	1
FL17-FL16		116	6	1	-	-	-	-	1	-	-	1
FL18-FL17		154	6	1	-	-	-	-	1	-	-	1
FL19-FL18		338	6	1	-	-	-	-	1	-	-	1
FL2-0		60	-	-	-	-	-	-	1	-	-	1
FL20-FL19		193	6	1	-	-	-	-	1	-	-	1
FL21-FL20		327	6	1	-	-	-	-	1	-	-	1
FL22-0		20	-	-	-	-	-	-	1	-	-	1
FL23-FL22		190	6	1	-	-	-	-	1	-	-	1
FL24-FL23	ACP	230	6	1	-	-	-	-	1	-	-	1
FL25-FL24	PVC	279	6	1	-	-	-	-	1	-	-	1
FL26-FL25	PVC	121	6	1	-	-	-	-	1	-	-	1
FL27-FL26	PVC	342	6	-	-	-	-	-	1	-	-	1
FL28-FL27	PVC	410	6	1	-	-	-	-	1	-	-	1
FL29-FL28	PVC	85	6	1	-	-	-	-	1	-	-	1
FL30-FL22	ACP	315	6	1	-	-	-	-	1	-	-	1
FL32-0		43	-	-	-	-	-	-	1	-	-	1
FL33-FL32	ACP	322	6	1	-	-	-	-	1	-	-	1
FL34-FL33	ACP	375	6	-	-	-	-	-	1	-	-	1
FL35-FL32		152	6	2	-	-	-	-	1	-	-	1
FL36-FL35	PVC	127	6	1	-	-	-	-	1	-	-	1

Pipe Name	Material	Length (ft)	Likelihood of Failure				Consequence of Failure					
			Diameter (in)	Max. Times Clean/Year	Stream/ Creek Xing	W/I 1,000 ft. DS of FM	ADWF >0.5 mgd	SEZ	Water Supply	Seasonal	HWY Proximity	# Risk Factors
FL37-FL36	PVC	220	6	1	-	-	-	-	1	-	-	1
FL38-0		43	-	-	-	-	-	-	1	-	-	1
FL39-FL38	ACP	363	6	1	-	-	-	-	1	-	-	1
FL3-FL2	PVC	283	6	1	-	-	-	-	1	-	-	1
FL41-FL38	ACP	297	6	-	-	-	-	-	1	-	-	1
FL42-0		34	-	-	-	-	-	-	1	-	-	1
FL43-FL42	ACP	218	6	1	-	-	-	-	1	-	-	1
FL44-FL42		15	-	-	-	-	-	-	1	-	-	1
FL46-FL42		70	-	1	-	-	-	-	1	-	-	1
FL48-0		17	-	-	-	-	-	-	1	-	-	1
FL49-FL48		38	6	1	-	-	-	-	1	-	-	1
FL4-FL3		66	6	1	-	-	-	-	1	-	-	1
FL50-FL48	PVC	203	6	1	-	-	-	-	1	-	-	1
FL52-0		287	-	-	-	-	-	-	1	-	-	1
FL53-0		53	-	-	-	-	-	-	1	-	-	1
FL54-FL53	ACP	83	6	1	-	-	-	-	1	-	-	1
FL56-FL54	ACP	101	6	1	-	-	-	-	1	-	-	1
FL58-FL57	PVC	199	6	1	-	-	-	-	1	-	-	1
FL5-FL4		290	6	1	-	-	-	-	1	-	-	1
FL60-FL58		327	6	-	-	-	-	-	1	-	-	1
FL61-FL60		245	6	1	-	-	-	-	1	-	-	1
FL62-		15	-	-	-	-	-	-	1	-	-	1
FL62-0		29	-	-	-	-	-	-	1	-	-	1
FL63-FL62		48	6	-	-	-	-	-	1	-	-	1
FL64-FL63		80	6	1	-	-	-	-	1	-	-	1
FL65-FL64	ACP	243	6	1	-	-	-	-	1	-	-	1
FL66-FL62		134	6	-	-	-	-	-	1	-	-	1
FL67-FL66		15	-	1	-	-	-	-	1	-	-	1
FL68-FL63		159	6	1	-	-	-	-	1	-	-	1
FL69-FL68		36	6	1	-	-	-	-	1	-	-	1
FL6-FL5	PVC	356	6	1	-	-	-	-	1	-	-	1
FL70-0		29	-	-	-	-	-	-	1	-	-	1
FL71-FL70	PVC	276	6	1	-	-	-	-	1	-	-	1
FL72-FL71	PVC	95	6	1	-	-	-	-	1	-	-	1
FL73-FL70		24	6	1	-	-	-	-	1	-	-	1
FL74-FL73	PVC	286	6	1	-	-	-	-	1	-	-	1
FL75-FL73	PVC	168	6	1	1	-	-	-	1	-	-	1
FL76-FL75	DIP	77	6	1	-	-	-	-	1	-	-	1
FL77-FL76	DIP	88	6	-	-	-	-	-	1	-	-	1
FL78-FL77	DIP	160	6	-	-	-	-	-	1	-	-	1
FL79-FL78		116	6	-	-	-	-	-	1	-	-	1
FL7-FL2	PVC	164	6	1	-	-	-	-	1	-	-	1
FL80-FL79		267	6	-	-	-	-	-	1	-	-	1
FL82-FL80		25	-	-	-	-	-	-	1	-	-	1
FL86-FL85		315	-	-	-	-	-	-	1	-	-	1
FL87-FL86		203	-	-	-	-	-	-	1	-	-	1
FL88-FL87		227	-	-	-	-	-	-	1	-	-	1
FL89-FL88		167	-	-	-	-	-	-	1	-	-	1
FL8-FL7	ACP	275	6	1	-	-	-	-	1	-	-	1
FL92-FL91		103	-	-	-	-	-	-	1	-	-	1
FL93-FL92		148	-	-	-	-	-	-	1	-	-	1
FL94-FL93		212	-	-	-	-	-	-	1	-	-	1
FL95-FL94		128	-	-	-	-	-	-	1	-	-	1
FL96-FL95		225	-	-	-	-	-	-	1	-	-	1
FL9-FL7	PVC	83	6	1	-	-	-	-	1	-	-	1
G32-062-G32-061	ACP	349	6	-	-	-	-	-	1	-	-	1
JN100-JN99	ACP	199	-	-	-	-	-	1	-	-	1	2
JN101-JN100	ACP	380	-	-	-	-	-	1	-	-	1	2
JN102-JN101	ACP	368	-	-	-	-	-	1	-	-	1	2
JN103-JN102	ACP	109	-	-	-	-	-	1	-	-	-	1
JN165-JN164	ACP	453	10	8	-	-	-	1	-	-	-	1
JN168-JN102	ACP	190	-	-	-	-	-	1	-	-	1	2
JN169-JN168	ACP	154	-	-	-	-	-	1	-	-	-	1
JN221-JN220	ACP	416	6	1	-	-	-	1	-	-	-	1
JN321-JN320	ACP	401	6	1	-	-	-	1	-	-	-	1
JN3-JN2	ACP	191	-	2	-	-	1	-	-	-	-	1
JN536-JN535	ACP	361	6	1	-	-	-	1	-	-	-	1
JN539-JN538	ACP	408	6	1	-	-	-	1	-	-	-	1
JN540-JN539	ACP	146	6	1	-	-	-	1	-	-	-	1
JN648-JN647	ACP	367	6	1	-	-	-	1	-	-	-	1

Pipe Name	Material	Length (ft)	Likelihood of Failure				Consequence of Failure					
			Diameter (in)	Max. Times Clean/Year	Stream/ Creek Xing	W/I 1,000 ft. DS of FM	ADWF >0.5 mgd	SEZ	Water Supply	Seasonal	HWY Proximity	# Risk Factors
JN650-JN649	VCP	396	6	3	-	-	-	1	-	-	-	1
JN651-JN650	VCP	219	6	1	-	-	-	1	-	-	-	1
JN77-JN76	VCP	256	-	-	-	-	-	-	-	-	1	1
JN98-JN97	ACP	142	-	-	-	-	-	1	-	-	1	2
JN99-JN98	ACP	194	-	-	-	-	-	1	-	-	1	2
KV1-0		34	-	-	-	-	-	1	-	1	-	2
KV10-KV9		368	6	-	-	-	-	1	-	1	-	2
KV11-KV1		435	6	-	-	-	-	1	-	1	-	2
KV2-KV1		350	6	-	-	-	-	1	-	1	-	2
KV3-KV2		372	6	1	-	-	-	1	-	1	-	2
KV4-KV3		327	6	-	-	-	-	1	-	1	-	2
KV5-KV4		323	6	-	-	-	-	1	-	1	-	2
KV6-KV1		387	6	-	-	-	-	1	-	1	-	2
KV7-KV6		405	6	-	-	-	-	1	-	1	-	2
KV8-KV7		428	6	-	-	-	-	1	-	1	-	2
KV9-KV8		389	6	-	-	-	-	1	-	1	-	2
PD56-PD55	ACP	395	6	-	-	-	-	-	-	-	1	1
PD57-PD56	ACP	706	6	-	-	-	-	-	-	-	1	1
SM1-0	ACP	20	-	-	-	-	-	1	-	-	-	1
SM100-SM98	ACP	422	6	1	-	-	-	1	-	-	-	1
SM13-SM12	ACP	490	6	1	-	-	-	1	-	-	-	1
SM15-SM14	ACP	185	-	1	-	-	-	1	-	-	-	1
SM16-SM15	ACP	310	-	1	-	-	-	1	-	-	-	1
SM21-SM20	ACP	270	-	1	-	-	-	1	-	-	-	1
SM22-SM21	ACP	285	-	1	-	-	-	1	-	-	-	1
SM27-SM26	ACP	426	8	13	-	-	-	1	-	-	-	1
SM2-SM1	ACP	20	-	-	-	-	-	1	-	-	-	1
SM33-SM12	ACP	127	6	1	-	-	-	1	-	-	-	1
SM34-SM33	ACP	247	6	1	-	-	-	1	-	-	-	1
SM35-SM15	ACP	363	-	1	-	-	-	1	-	-	-	1
SM36-SM15	ACP	414	-	1	-	-	-	1	-	-	-	1
SM37-SM36	ACP	372	-	1	-	-	-	1	-	-	-	1
SM39-SM21	ACP	350	-	1	-	-	-	1	-	-	-	1
SM40-SM39	ACP	249	-	1	-	-	-	1	-	-	-	1
SM41-SM40	ACP	194	-	1	-	-	-	1	-	-	-	1
SM42-SM41	ACP	373	-	1	-	-	-	1	-	-	-	1
SM43-SM4	ACP	145	-	-	-	-	-	1	-	-	-	1
SM44-SM43	ACP	228	6	3	-	-	-	1	-	-	-	1
SM45-SM23	ACP	285	8	5	-	-	-	1	-	-	-	1
SM47-SM46	ACP	405	8	4	-	1	-	1	-	-	-	1
SM48-SM47	ACP	409	6	4	-	1	-	1	-	-	-	1
SM49-SM55	ACP	167	6	1	-	-	-	1	-	-	-	1
SM52-SM51	ACP	432	6	1	-	-	-	1	-	-	-	1
SM53-SM52	ACP	398	6	1	-	-	-	1	-	-	-	1
SM54-SM53	ACP	408	6	1	-	-	-	1	-	-	-	1
SM55-SM54	ACP	306	6	1	-	-	-	1	-	-	-	1
SM56-SM48	ACP	396	6	4	-	1	-	1	-	-	-	1
SM57-SM25	ACP	239	6	1	-	-	-	1	-	-	-	1
SM59-SM58	ACP	197	6	1	-	-	-	1	-	-	-	1
SM65-SM33	ACP	288	6	1	-	-	-	1	-	-	-	1
SM66-SM65	ACP	324	6	1	-	-	-	1	-	-	-	1
SM67-SM36	ACP	405	-	1	-	-	-	1	-	-	-	1
SM68-SM67	ACP	387	-	1	-	-	-	1	-	-	-	1
SM69-SM68	ACP	94	-	-	-	-	-	1	-	-	-	1
SM70-SM36	ACP	285	-	1	-	-	-	1	-	-	-	1
SM71-SM70	ACP	376	-	1	-	-	-	1	-	-	-	1
SM72-SM71	ACP	390	-	1	-	-	-	1	-	-	-	1
SM73-SM72	ACP	109	-	1	-	-	-	1	-	-	-	1
SM74-SM39	ACP	323	-	1	-	-	-	1	-	-	-	1
SM75-SM41	ACP	292	-	1	-	-	-	1	-	-	-	1
SM76-SM75	ACP	116	-	1	-	-	-	1	-	-	-	1
SM77-SM76	ACP	210	-	1	-	-	-	1	-	-	-	1
SM80-SM79	ACP	285	6	1	-	-	-	1	-	-	-	1
SM81-SM80	ACP	415	6	1	-	-	-	1	-	-	-	1
SM82-SM81	ACP	392	6	1	-	-	-	1	-	-	-	1
SM83-SM58	ACP	364	6	1	-	-	-	1	-	-	-	1
SM84-SM83	ACP	361	6	1	-	-	-	1	-	-	-	1
SM88-SM65	ACP	477	6	1	-	-	-	1	-	-	-	1
SM89-SM67	ACP	407	-	1	-	-	-	1	-	-	-	1
SM90-SM89	ACP	91	-	1	-	-	-	1	-	-	-	1

Pipe Name	Material	Length (ft)	Likelihood of Failure				Consequence of Failure					
			Diameter (in)	Max. Times Clean/Year	Stream/ Creek Xing	W/I 1,000 ft. DS of FM	ADWF >0.5 mgd	SEZ	Water Supply	Seasonal	HWY Proximity	# Risk Factors
SM91-SM71	ACP	218	-	-	-	-	-	1	-	-	-	1
SM92-SM91	ACP	355	-	-	-	-	-	1	-	-	-	1
SM93-SM92	ACP	269	-	1	-	-	-	1	-	-	-	1
SM96-SM95	ACP	274	-	2	-	-	-	1	-	-	-	1
SM97-SM91	ACP	340	-	1	-	-	-	1	-	-	-	1
SM98-SM95	ACP	260	6	2	-	-	-	1	-	-	-	1
SM99-SM98	ACP	279	-	1	-	-	-	1	-	-	-	1
SR38-SR37	ACP	147	6	6	-	-	-	-	-	-	1	1
SR39-SR38	ACP	356	-	-	-	-	-	-	-	-	1	1
TK1-0	ACP	82	-	-	-	1	-	1	-	-	-	1
TK102-TK51	ACP	138	-	1	-	-	-	1	-	-	-	1
TK104-TK52	ACP	319	-	1	-	-	-	1	-	-	-	1
TK105-TK104	ACP	314	-	1	-	-	-	1	-	-	-	1
TK106-TK105	ACP	317	-	1	-	-	-	1	-	-	-	1
TK107-TK106	ACP	326	6	1	-	-	-	1	-	-	-	1
TK108-1K53	ACP	311	-	-	-	-	-	1	-	-	-	1
TK109-TK54	ACP	334	6	1	-	-	-	1	-	-	-	1
TK110-TK109	ACP	398	6	1	-	-	-	1	-	-	-	1
TK111-TK110	ACP	410	6	1	-	-	-	1	-	-	-	1
TK112-TK111	ACP	309	6	1	-	-	-	1	-	-	-	1
TK115-TK58	ACP	126	6	1	-	-	-	1	-	-	-	1
TK116-TK115	ACP	134	6	1	-	-	-	1	-	-	-	1
TK117-TK69	ACP	232	-	-	-	-	-	1	-	-	-	1
TK166-TK102	ACP	330	-	-	-	-	-	1	-	-	-	1
TK167-TK166	ACP	341	-	-	-	-	-	1	-	-	-	1
TK16-TK15	ACP	306	-	1	-	-	-	1	-	-	-	1
TK266-TK208	ACP	360	6	1	-	-	-	-	-	-	1	1
TK267-TK266	ACP	160	6	1	-	-	-	-	-	-	1	1
TK268-TK210	ACP	240	6	1	-	-	-	-	-	-	1	1
TK28-TK27	ACP	301	8	-	-	1	-	1	-	-	-	1
TK29-TK28	ACP	322	8	1	-	1	-	1	-	-	-	1
TK30-TK29	ACP	349	8	1	-	1	1	1	-	-	-	2
TK31-TK30	ACP	191	-	1	-	-	-	1	-	-	-	1
TK32-TK31	ACP	291	-	1	-	-	-	1	-	-	-	1
TK333-TK332	ACP	381	6	1	-	-	-	-	-	-	1	1
TK334-TK268	ACP	404	6	1	-	-	-	-	-	-	1	1
TK335-TK334	ACP	399	6	1	-	-	-	-	-	-	1	1
TK336-TK335	ACP	410	6	1	-	-	-	-	-	-	1	1
TK33-TK32	ACP	352	-	1	-	-	-	1	-	-	-	1
TK45-TK12	ACP	273	6	1	-	-	-	1	-	-	-	1
TK467-TK466	ACP	267	6	-	-	-	-	-	-	-	1	1
TK468-TK467	ACP	202	6	-	-	-	-	-	-	-	1	1
TK469-TK468	ACP	137	6	-	-	-	-	-	-	-	1	1
TK46-TK45	ACP	336	-	1	-	-	-	1	-	-	-	1
TK475-TK474	ACP	136	6	-	-	-	-	-	-	-	1	1
TK47-TK46	ACP	284	-	2	-	-	-	1	-	-	-	1
TK48-TK47	ACP	251	-	1	-	-	-	1	-	-	-	1
TK505-TK504	ACP	327	6	-	-	-	-	-	-	-	1	1
TK513-TK512	ACP	107	-	-	-	-	-	-	-	-	1	1
TK515-TK514	ACP	312	12	12	-	-	-	-	-	-	1	1
TK516-TK515	ACP	397	8	12	-	-	-	-	-	-	1	1
TK518-TK517	ACP	229	6	-	-	-	-	-	-	-	1	1
TK519-TK518	ACP	227	6	-	-	-	-	-	-	-	1	1
TK520-TK519	ACP	400	6	-	-	-	-	-	-	-	1	1
TK521-TK520	ACP	118	6	-	-	-	-	-	-	-	1	1
TK527-TK526	ACP	349	6	-	-	-	-	-	-	-	1	1
TK528-TK527	ACP	339	6	-	-	-	-	-	-	-	1	1
TK529-TK528	ACP	159	-	-	-	-	-	-	-	-	1	1
TK534-TK514	ACP	233	10	4	-	-	-	-	-	-	1	1
TK535-TK534	ACP	230	10	5	-	-	-	-	-	-	1	1
TK582-TK542	ACP	282	6	5	-	-	-	-	-	-	1	1
TK60-TK59	ACP	154	6	1	-	-	-	1	-	-	-	1
TK61-TK60	ACP	460	6	1	-	-	-	1	-	-	-	1
TK629-TK560	ACP	380	-	-	-	-	-	-	-	-	1	1
TK62-TK61	ACP	338	6	1	-	-	-	1	-	-	-	1
TK68-TK25	ACP	218	-	1	-	-	-	1	-	-	-	1
TK69-TK68	ACP	192	-	1	-	-	-	1	-	-	-	1
TK70-TK69	ACP	275	-	1	-	-	-	1	-	-	-	1
TK71-TK70	ACP	283	-	1	-	-	-	1	-	-	-	1
TK72-TK71	ACP	275	-	1	-	-	-	1	-	-	-	1

Pipe Name	Material	Length (ft)	Likelihood of Failure				Consequence of Failure					
			Diameter (in)	Max. Times Clean/Year	Stream/ Creek Xing	W/I 1,000 ft. DS of FM	ADWF >0.5 mgd	SEZ	Water Supply	Seasonal	HWY Proximity	# Risk Factors
TK73-TK72	ACP	251	-	1	-	-	-	1	-	-	-	1
TK74-TK30	ACP	73	8	-	-	1	1	1	-	-	-	2
TK97-TK49	ACP	159	-	1	-	-	-	1	-	-	-	1
TK98-TK97	ACP	407	-	1	-	-	-	1	-	-	-	1
TL1-0	ACP	27	-	-	-	-	-	1	-	-	-	1
TL116-TL115	VCP	363	6	-	-	-	-	-	-	1	-	1
TL117-TL116	VCP	479	6	-	-	-	-	-	-	1	-	1
TL118-TL117	VCP	402	6	-	-	-	-	-	-	1	-	1
TL119-TL118	VCP	372	6	-	-	-	-	-	-	1	-	1
TL120-TL119	VCP	170	6	1	-	-	-	-	-	1	-	1
TL121-TL120	VCP	345	6	1	-	-	-	-	-	1	-	1
TL122-TL121	VCP	43	6	1	-	-	-	-	-	1	-	1
TL126-TL119	VCP	219	6	1	-	-	-	-	-	1	-	1
TL127-TL126	VCP	119	6	1	-	-	-	-	-	1	-	1
TL128-TL127	VCP	402	6	1	-	-	-	-	-	1	-	1
TL129-TL128	VCP	96	6	1	-	-	-	-	-	1	-	1
TL130-TL129	VCP	228	6	1	-	-	-	-	-	1	-	1
TL131-TL129	VCP	181	6	1	-	-	-	-	-	1	-	1
TL132-TL131	VCP	386	6	1	-	-	-	-	1	1	-	2
TL133-TL132	VCP	396	6	1	-	-	-	-	1	1	-	2
TL134-TL133	VCP	378	6	1	-	-	-	-	1	1	-	2
TL135-TL134	VCP	117	6	1	-	-	-	-	1	1	-	2
TL14-TL13	ACP	401	24	-	-	1	-	1	-	-	1	2
TL15-TL14	ACP	351	24	-	-	1	-	1	-	-	1	2
TL16-TL15	ACP	255	24	-	-	1	-	1	-	-	1	2
TL18-TL17		75	-	-	-	-	-	1	-	-	1	2
TL19-TL18		136	-	-	-	-	-	1	-	-	1	2
TL20-TL12		259	6	-	-	-	-	1	-	-	1	2
TL21-TL20		219	6	-	-	-	-	1	-	-	-	1
TL23-TL22		365	-	-	-	-	-	1	-	-	1	2
TL24-TL20		290	6	-	-	-	-	1	-	-	-	1
TL29-TL28		235	-	-	-	-	-	-	-	-	1	1
TL30-TL28	ACP	349	24	-	-	1	-	-	-	-	1	1
TL31-TL30	ACP	401	24	-	-	1	-	-	-	-	1	1
TL32-TL31	ACP	404	24	-	-	1	-	-	-	-	1	1
TL33-TL32	ACP	372	24	-	-	1	-	-	-	-	1	1
TL34-TL33	ACP	403	24	-	-	1	-	-	-	-	1	1
TL35-TL34		88	6	1	-	-	-	-	-	-	1	1
TY28-TY27	VCP	135	6	-	-	-	-	-	-	1	-	1
TY29-TY18	VCP	180	6	2	-	-	-	-	-	-	1	1
TY35-TY34	VCP	305	6	1	-	-	-	-	-	1	-	1
TY36-TY35	VCP	205	6	1	-	-	-	-	-	1	-	1
TY37-TY26	VCP	381	6	1	-	-	-	-	-	1	-	1
TY38-TY37	VCP	415	6	2	-	-	-	-	-	1	-	1
TY3-TY2	ACP	399	18	1	-	1	-	-	-	-	1	1
TY42-TY41	VCP	210	6	1	-	-	-	-	-	1	-	1
TY43-TY42	VCP	371	6	1	-	-	-	-	-	1	-	1
TY44-TY43	VCP	407	6	1	-	-	-	-	-	1	-	1
TY45-TY44	VCP	401	6	1	-	-	-	-	-	1	-	1
TY46-TY45	VCP	186	6	1	-	-	-	-	-	1	-	1
TY47-TY46	VCP	278	6	-	-	-	-	-	-	1	-	1
TY48-TY47	VCP	291	6	1	-	-	-	-	-	1	-	1
TY4-TY3	ACP	397	18	1	-	1	-	-	-	-	1	1
TY56-TY55	VCP	336	6	1	-	-	-	-	-	1	-	1
TY57-TY56	VCP	482	6	1	-	-	-	-	-	1	-	1
TY58-TY57	VCP	178	6	1	-	-	-	-	-	1	-	1
TY59-TY58	VCP	182	6	1	-	-	-	-	-	1	-	1
TY60-TY45	VCP	326	6	-	-	-	-	-	-	1	-	1
TY61-TY60	VCP	312	6	-	1	-	-	-	-	1	-	1
TY62-TY61	VCP	301	6	-	-	-	-	-	-	1	-	1
TY63-TY62	VCP	331	6	1	-	-	-	-	-	1	-	1
TY64-TY63	VCP	181	6	1	-	-	-	-	-	1	-	1
TY65-TY46	VCP	183	6	1	-	-	-	-	-	1	-	1
TY66-TY65	VCP	386	6	1	-	-	-	-	-	1	-	1
TY67-TY66	VCP	154	6	1	-	-	-	-	-	1	-	1
TY70-TY69	VCP	192	6	1	-	-	-	-	-	1	-	1
TY71-TY70	VCP	305	6	1	-	-	-	-	-	1	-	1
TY72-TY71	VCP	209	6	1	-	-	-	-	-	1	-	1
TY73-TY61	VCP	144	6	-	-	-	-	-	-	1	-	1
TY74-TY73	VCP	132	6	1	-	-	-	-	-	1	-	1

Pipe Name	Material	Length (ft)	Likelihood of Failure				Consequence of Failure					
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TY75-TY74	VCP	307	6	1	-	-	-	-	-	1	-	1
TY76-TY66	VCP	418	6	1	-	-	-	-	-	1	-	1
TY77-TY76	VCP	308	6	1	-	-	-	-	-	1	-	1
TY78-TY77	VCP	191	6	1	-	-	-	-	-	1	-	1
TY79-TY78	VCP	145	6	1	-	-	-	-	-	1	-	1
TY80-TY71	VCP	456	6	1	-	-	-	-	-	1	-	1
TY81-TY80	VCP	100	6	1	-	-	-	-	-	1	-	1
TY82-TY78	VCP	441	6	1	-	-	-	-	-	1	-	1
TY83-TY82	VCP	373	6	1	-	-	-	-	-	1	-	1
TY84-TY83	VCP	325	6	1	-	-	-	-	-	1	-	1
TY85-TY84	VCP	268	6	1	-	-	-	-	-	1	-	1
TY86-TY85	VCP	446	6	1	-	-	-	-	-	1	-	1
TY87-TY80	VCP	228	6	1	-	-	-	-	-	1	-	1
TY88-TY82	VCP	327	6	1	-	-	-	-	-	1	-	1
UT10-UT9	ACP	474	24	-	1	-	1	1	-	-	-	2
UT1153-UT1152	ACP	365	6	-	-	-	-	-	-	-	1	1
UT1154-UT1153	ACP	99	6	-	-	-	-	-	-	-	1	1
UT11-UT10	ACP	42	24	-	1	-	1	1	-	-	-	2
UT121-UT120	ACP	135	6	-	-	-	-	-	-	-	1	1
UT1231-UT1230	ACP	428	8	-	1	-	-	1	-	-	-	1
UT12-UT11	ACP	393	24	-	1	-	1	1	-	-	-	2
UT13-UT12	ACP	256	24	-	1	-	1	1	-	-	-	2
UT1-SPCPPRLIFT001	ACP	229	24	-	1	-	-	1	-	-	-	1
UT2116-UT2012	ACP	341	6	3	-	-	-	-	-	-	1	1
UT2126-UT2020	ACP	162	-	1	-	-	-	-	-	-	1	1
UT2187-UT2186	ACP	216	10	1	1	-	-	1	-	-	-	1
UT2192-UT2191	ACP	235	10	-	1	-	-	1	-	-	-	1
UT2193-UT2192	ACP	164	6	-	1	-	-	1	-	-	-	1
UT2197-UT2196	ACP	343	6	1	-	-	-	1	-	-	-	1
UT2198-UT2197	ACP	148	6	1	-	-	-	1	-	-	-	1
UT2249-UT2185	ACP	418	6	1	-	-	-	1	-	-	-	1
UT2250-UT2249	ACP	184	6	1	-	-	-	1	-	-	-	1
UT2251-UT2250	ACP	312	6	1	-	-	-	1	-	-	-	1
UT2252-UT2251	ACP	338	6	1	-	-	-	1	-	-	-	1
UT2253-UT2252	ACP	391	6	1	-	-	-	1	-	-	-	1
UT2254-UT2253	ACP	424	6	1	-	-	-	1	-	-	-	1
UT2255-UT2254	ACP	324	6	1	-	-	-	1	-	-	-	1
UT2258-UT2257	ACP	307	8	-	1	-	-	1	-	-	-	1
UT2261-UT2260	ACP	427	6	1	-	-	-	1	-	-	-	1
UT2262-UT2197	ACP	228	6	1	-	-	-	1	-	-	-	1
UT2263-UT2262	ACP	86	6	-	-	-	-	1	-	-	-	1
UT2264-UT2197	ACP	269	6	1	-	-	-	1	-	-	-	1
UT2265-UT2264	ACP	212	6	1	-	-	-	1	-	-	-	1
UT2266-UT2265	ACP	189	6	1	-	-	-	1	-	-	-	1
UT2287-UT2251	ACP	397	6	1	-	-	-	1	-	-	-	1
UT2288-UT2287	ACP	422	6	1	-	-	-	1	-	-	-	1
UT2291-UT2290	ACP	304	6	1	-	-	-	1	-	-	-	1
UT2292-UT2261	ACP	179	6	1	-	-	-	1	-	-	-	1
UT2293-UT2262	ACP	315	6	-	-	-	-	1	-	-	-	1
UT2295-UT2265	ACP	397	6	1	-	-	-	1	-	-	-	1
UT2296-UT2295	ACP	403	6	2	-	-	-	1	-	-	-	1
UT2297-UT2296	ACP	403	6	2	-	-	-	1	-	-	-	1
UT2298-UT2297	ACP	299	6	2	-	-	-	1	-	-	-	1
UT2299-UT2298	ACP	390	6	2	-	-	-	1	-	-	-	1
UT2300-UT2299	ACP	396	6	2	-	-	-	1	-	-	-	1
UT2301-UT2300	ACP	213	6	2	-	-	-	1	-	-	-	1
UT2302-UT2301	ACP	113	6	1	-	-	-	1	-	-	-	1
UT2336-UT2291	ACP	384	6	1	-	-	-	1	-	-	-	1
UT2337-UT2336	ACP	423	6	1	-	-	-	1	-	-	-	1
UT2338-UT2337	ACP	388	6	-	-	-	-	1	-	-	-	1
UT2339-UT2338	ACP	145	6	1	-	-	-	1	-	-	-	1
UT233-UT159	ACP	392	8	-	1	-	-	1	-	-	-	1
UT2340-UT2339	ACP	435	6	1	-	-	-	1	-	-	-	1
UT2341-UT2300	ACP	317	6	2	-	-	-	1	-	-	-	1
UT2342-UT2341	ACP	335	6	2	-	-	-	1	-	-	-	1
UT2343-UT2342	ACP	446	6	2	-	-	-	1	-	-	-	1
UT2344-UT2343	ACP	211	6	1	-	-	-	1	-	-	-	1
UT2345-UT2344	ACP	401	6	2	-	-	-	1	-	1	-	2
UT2346-UT2345	ACP	390	6	2	-	-	-	1	-	1	-	2
UT2347-UT2346	ACP	150	6	2	-	-	-	-	-	1	-	1

Attachment C-2
Critical Gravity Mains

Pipe Name	Material	Length (ft)	Likelihood of Failure				Consequence of Failure					# Risk Factors
			Diameter (in)	Max. Times Clean/Year	Stream/ Creek Xing	W/I 1,000 ft. DS of FM	ADWF >0.5 mgd	SEZ	Water Supply	Seasonal	HWY Proximity	
UT2375-UT2339	ACP	360	6	1	-	-	-	1	-	-	-	1
UT2376-UT2375	ACP	90	6	1	-	-	-	1	-	-	-	1
UT2377-UT2346	ACP	380	6	2	-	-	-	-	-	1	-	1
UT2378-UT2377	ACP	440	6	2	-	-	-	-	-	1	-	1
UT2379-UT2378	ACP	375	6	2	-	-	-	-	-	1	-	1
UT2380-UT2379	ACP	255	6	2	1	-	-	-	-	1	-	1
UT2381-UT2380	ACP	146	6	2	1	-	-	-	-	1	-	1
UT2382-UT2381	ACP	164	6	2	-	-	-	-	-	1	-	1
UT238-UT237	ACP	404	6	1	-	-	-	1	-	-	-	1
UT239-UT238	ACP	187	6	1	-	-	-	1	-	-	-	1
UT2403-UT2379	ACP	383	6	-	-	-	-	-	-	1	-	1
UT2405-UT2381	ACP	252	6	2	-	-	-	-	-	1	-	1
UT2406-UT2405	ACP	120	6	2	-	-	-	-	-	1	-	1
UT242-UT164	ACP	229	6	-	-	-	-	1	-	-	1	2
UT243-UT242	ACP	300	6	-	-	-	-	-	-	-	1	1
UT253-UT252	ACP	282	12	-	1	-	-	1	-	-	-	1
UT257-UT256	ACP	315	18	-	1	-	-	1	-	-	-	1
UT267-UT266	ACP	359	15	-	1	-	-	1	-	-	-	1
UT27-UT26	ACP	409	6	1	-	-	-	-	-	-	1	1
UT284-UT283	ACP	417	6	7	-	-	-	-	-	-	1	1
UT295-UT173	ACP	119	-	1	-	-	-	-	-	-	1	1
UT2-UT1	ACP	301	24	-	1	-	1	1	-	-	-	2
UT356-UT355	ACP	400	6	1	-	-	-	1	-	-	1	2
UT357-UT356	ACP	219	6	1	-	-	-	1	-	-	-	1
UT358-UT237	ACP	377	6	1	-	-	-	1	-	-	-	1
UT359-UT358	ACP	399	6	1	-	-	-	1	-	-	-	1
UT360-UT359	ACP	399	6	1	-	-	-	1	-	-	-	1
UT361-UT360	ACP	132	6	1	-	-	-	1	-	-	-	1
UT3-UT2	ACP	330	24	-	1	-	1	1	-	-	-	2
UT42-UT41	ACP	449	21	-	1	-	1	1	-	-	-	2
UT555-UT356	ACP	430	6	1	-	-	-	1	-	-	1	2
UT592-UT389	ACP	233	12	-	1	-	-	1	-	-	-	1
UT593-UT592	ACP	265	10	-	1	-	-	1	-	-	-	1
UT72-UT71	ACP	402	6	-	-	-	-	-	-	-	1	1
UT9-UT8	ACP	480	24	-	1	-	1	1	-	-	-	2

BROWN AND CALDWELL

Technical Memorandum

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Prepared for: South Tahoe Public Utility District

Project Title: STPUD Collection System Master Plan

Project No: 132364-005

Technical Memorandum No. 8

Subject: Hydraulic Evaluation

Date: December 30, 2009

To: Paul Sciuto, Assistant General Manager

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LIST OF TABLES

1. INTRODUCTION

This Technical Memorandum (TM) No. 8 describes the hydraulic evaluation of the South Tahoe Public Utility District's (STPUD or District) wastewater collection system. The scope of this task includes evaluating calibrated summer and winter models for current and future (build-out) conditions.

The dry weather and wet weather modeling parameters are discussed in TM 6, Hydraulic Model Development and Calibration.

This TM is divided into the following three sections:

1. Evaluation Scenarios
2. Hydraulic Analysis
3. Hydraulic Evaluation Results

2. EVALUATION SCENARIOS

The scenarios being evaluated for hydraulic deficiencies are summer and winter for both current and future conditions. Both the winter and summer scenarios run over a weekend to simulate the peak number of residents and visitors. The land use used and the base flow projections for both scenarios are discussed in detail in TM 4, Design Flow Analysis. Both summer and winter future scenarios include the new Chateau at Heavenly Valley redevelopment as an additional point source. Other specific future redevelopment projects in the Stateline and "Y" areas are not quantified at this time and are not included in the model's future scenarios.

Some portions of the service area have strong seasonal variation in occupancy and corresponding base sanitary flow variation. Certain parcels are singled out such as the campgrounds west of Tallac Pump Station (PS) and Heavenly Ski Resort (Heavenly) because of their seasonal variations. However, the rainfall dependent inflow/infiltration (RDI/I) contribution is independent of occupation, so the summer-only parcels are included in the winter analysis for the RDI/I portion of the flow. The summer scenarios include flow from the campgrounds west of Tallac PS. The flows from Heavenly Ski Resort are reduced for the summer scenarios because it is assumed that the ski resort is less full in the summer than the winter. The winter scenarios do not include campground flows from west of Tallac PS. The base flow and rainfall dependent flow are based on Tallac pump station data for the area west of Tallac PS as discussed in TM 4. The design storm used for the winter scenario is the 25-year average recurrence interval based on the NOAA Precipitation Frequency Data Server Fallen Leaf Lake location.

The existing scenarios include 1,560 acres of vacant (VAC) parcels that can be built out in the future. There are a total of 7,537 acres within the collection system service area in the future scenario. The land use is discussed in detail in TM 4.

Table 2-1 summarizes the flows for the current and future scenarios.

Table 2-1. Projected Model Flows			
Scenario	Summer Avg Daily Flow (mgd)	Summer Peak Hourly Flow (mgd)	Peak Winter Design Storm Flow (mgd)
Current	4.84	8.56	16.75
Future	5.62	8.65	16.98

[1]The Design Storm used is 25-year average recurrence interval, 24-hour duration storm.

3. HYDRAULIC ANALYSIS

The hydraulic model is used to analyze the performance of the existing collection system under existing and future design flow conditions. This section describes the criteria that were used and analysis performed to determine potential hydraulic capacity deficiencies for the pipes, pump stations, and force mains.

There were no overflows predicted in the collection system and minimal surcharge with the 2005 New Year's storm applied to the current scenario. Other very large storm conditions were evaluated including a 10-year and 25-year storm, under which the model predicted no overflows in the collection system.

3.1 Evaluation Criteria

3.1.1 Pipes

There are two main criteria used to evaluate the capacity of the modeled gravity pipes and manholes: surcharging and potential overflow locations. A pipe is considered surcharged when the hydraulic grade line (HGL) climbs above the crown of the pipe. The model's output results include the ratio of water depth to pipe diameter (d/D). If the model's output maximum d/D is greater than one, the pipe is considered throttled. The model's output also includes an *adjusted maximum d/D*, which adjusts the d/D value according to the relative upstream and downstream positions of the HGL. If the adjusted maximum d/D is equal to one, but the maximum d/D is less than one, the pipe has adequate capacity but the flow is throttled at some point downstream, causing backwatering upstream. Pipes with flat slopes are easily surcharged, but are not reported as such unless the appropriate flow conditions exist to cause surcharging.

Possible locations for sanitary sewer overflows (SSOs) are predicted in the model when surcharging causes the HGL to reach the ground surface at a manhole. Manholes where SSOs are expected to occur are reported as being "full" in the model results report. It is possible that one throttle-surcharged pipe can cause flooding in various upstream manholes.

3.1.2 Pump Stations

The pump station evaluation is very basic and only considers hydraulic capacity compared to the predicted maximum model flows. The firm capacity of each pump station was taken from the Pump Station Condition Assessment Tech Memo (TM 3). If the firm capacity is less than the maximum hourly flow predicted in the model, the pump station capacity should be further evaluated.

3.1.3 Force Mains

The force main evaluation is based on a maximum allowable velocity of eight feet per second (fps). According to Pumping Station Design, Second Edition by Robert Sanks, when velocities exceed this amount, there is a risk of excessive water hammer. The evaluated velocity in the force mains are based on the maximum hourly modeled flow for the force mains connected to variable speed pump stations and the pump station firm capacity for the force mains connected to constant speed pump stations.

Also according to Pumping Station Design, the lowest velocity required to keep grit moving is 2 fps and the velocity desirable to re-suspend settled solids is 3.5 fps.

3.2 Storms

Typically, storms with higher rainfall intensities are used for evaluating pipe capacity as opposed to long-duration, high-volume storms that might be used to evaluate system storage. Various storms were reviewed including the storms in the 1980's that were used to evaluate the District's storage, as discussed below. Several storms were analyzed during the hydraulic evaluation: the 2005 New Year's Eve storm, the 10-year synthetic storm, and the 25-year synthetic storm. The largest real storm and corresponding waste water treatment plant (WWTP) flow in the past 10 years came from the New Year's storm. The storms used for the hydraulic sensitivity analysis are also described below.

The seasonal groundwater infiltration (GWI) rate used for this analysis is based on the calibration described in TM 6, Hydraulic Model Development and Calibration. A flow of 1.3 million gallons per day (mgd) of wet weather GWI was input in addition to summer GWI by introducing a constant flow of 0.212 gpm in each of the 4,265 pipes of the model network.

3.2.1 1980's Storms

There were two large storms in the 1980's (February 1982 and February 1986) that caused large flows at the wastewater treatment plant. These treatment plant flows were used as part of the storage analysis as described in the "Emergency Power and/or Storage Facilities Final Project Report" (July 1991) and "Addendum I" (June 1994). The project report states that 13 inches of rain fell over 11 consecutive days during the larger 1986 storm, but there was limited data available for areas within the District boundary for either of these storms. The closest weather station with the most complete data during the 1986 storm was Robb's Peak (NOAA COOP ID 047489), located above 9,000 feet in the mountains to the northwest of South Lake Tahoe. Records there reported a total of 28.5 inches of precipitation over nine days during the 1986 storm. It is unknown if precipitation at that location fell as rain or snow, the latter typically being reported as equivalent inches of rain. This data was scaled down by a factor of two based on the total rainfall volumes to approximate the rainfall occurring in South Lake Tahoe. Figure 3-1 shows the estimated storm at the treatment plant for the period of February 12 through 20, 1986.

This storm, although long in duration and high in volume, had lower hourly precipitation than the 2005 New Year's storm and the 10-year and 25-year synthetic storms.

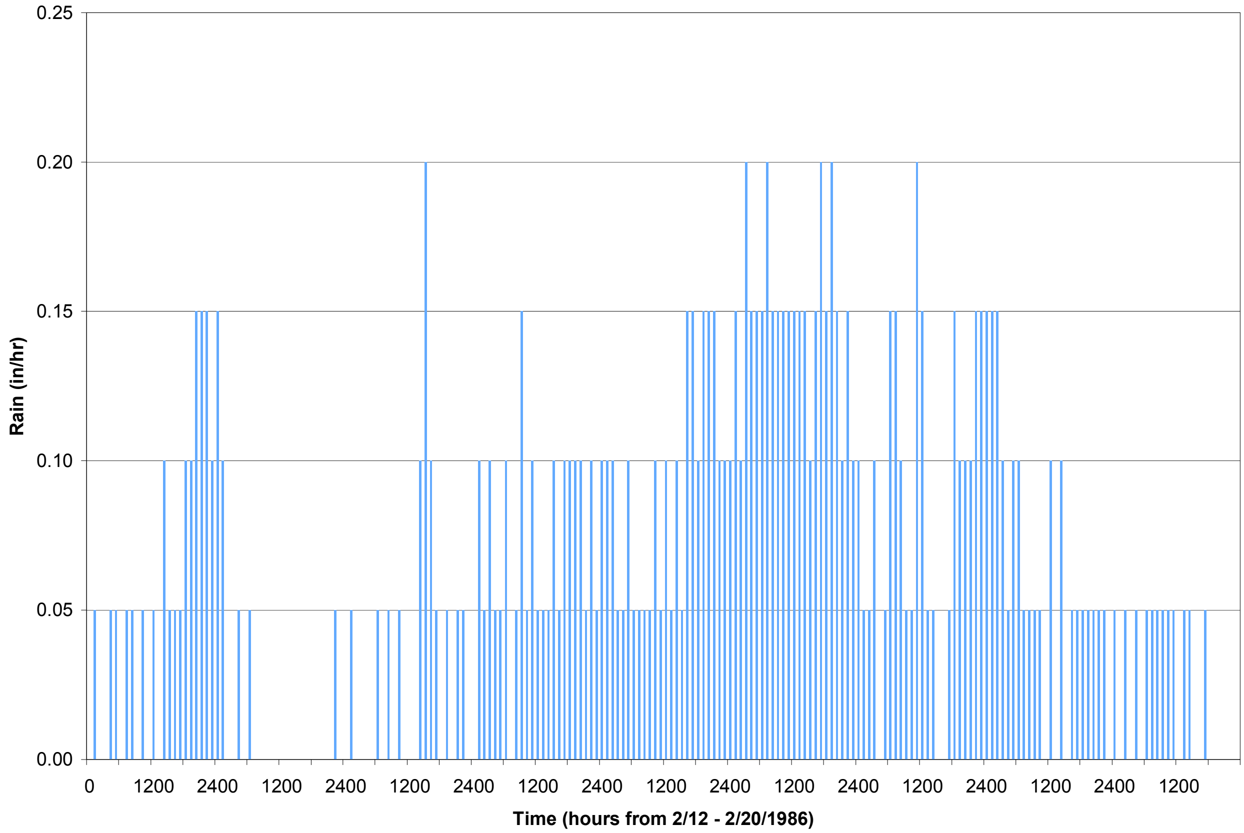

Figure 3-1 Approximate February 1986 Storm in South Lake Tahoe

3.2.2 New Year's Eve Storm 2005

The 2005 New Year's Eve storm started in the early morning hours of December 30, 2005 and continued for about a day and a half. The National Climatic Data Center's (NCDC) Event Record for flooding occurring in El Dorado County on December 31, 2005 stated, "This was the all-time record flood on Trout Creek in South Lake Tahoe and Tahoe Valley, flooding U.S. Highway 50." The peak hourly rainfall was 0.4 inches and the cumulative depth was 4.76 inches, as shown in Figure 3-2. In addition to the length and high intensity of this storm, it occurred within two days of a prior snow/rain storm, thereby probably raising soil saturation and increasing groundwater infiltration and surface runoff rates. This is the storm to which the hydraulic model was calibrated using available historical flow data.

The model showed no overflows and minimal surcharging under the current scenario with the New Year's Eve storm. The additional flow caused by development in the future scenario caused a couple of overflows and extended the length of surcharged pipe, but the system performed well overall as discussed in Section 4.

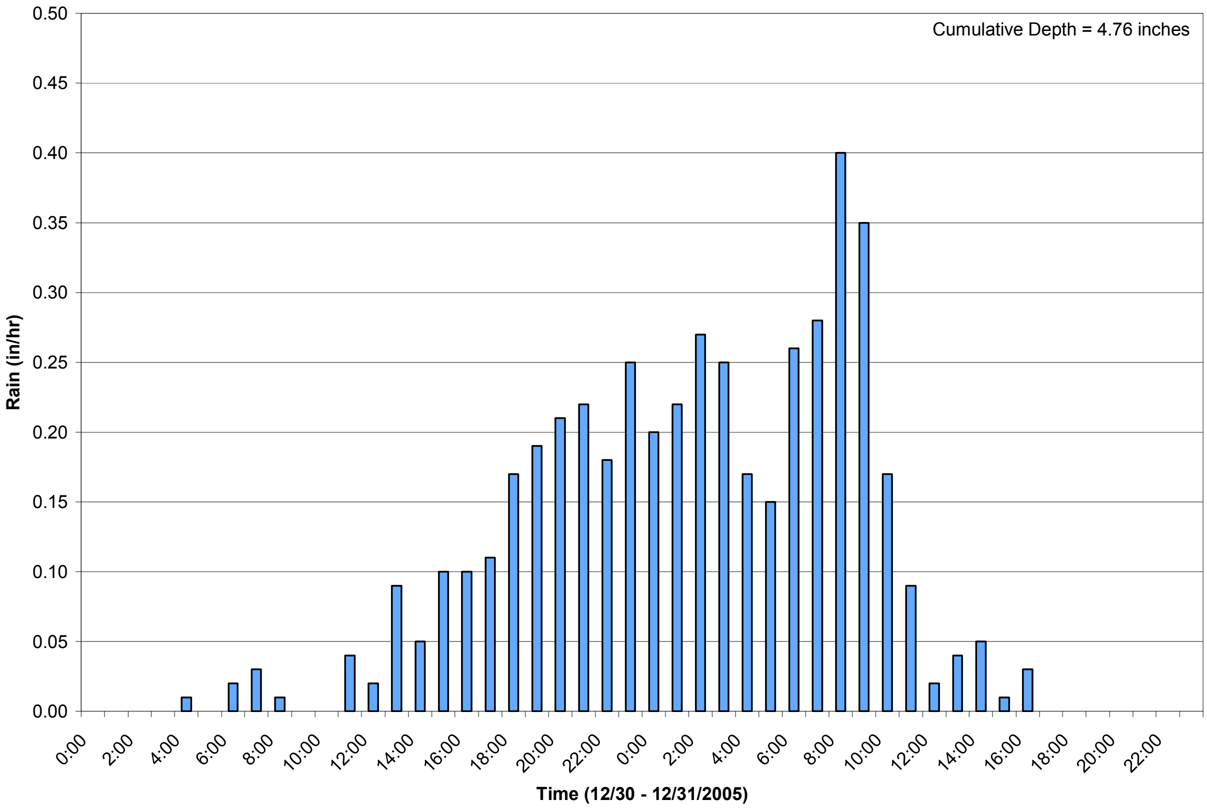

Figure 3-2. New Year's Eve Storm 2005

3.2.3 Other Storms

Two additional storms were developed based on Intensity-Duration-Frequency (IDF) curve data for South Lake Tahoe from the National Oceanic and Atmospheric Administration (NOAA) website: the 10-year and 25-year storms, both of 24-hour duration. The IDF curve data is based on a rain gauge located north of Fallen Leaf Lake adjacent to Lake Tahoe. Figure 3-3 shows both storms on the same plot.

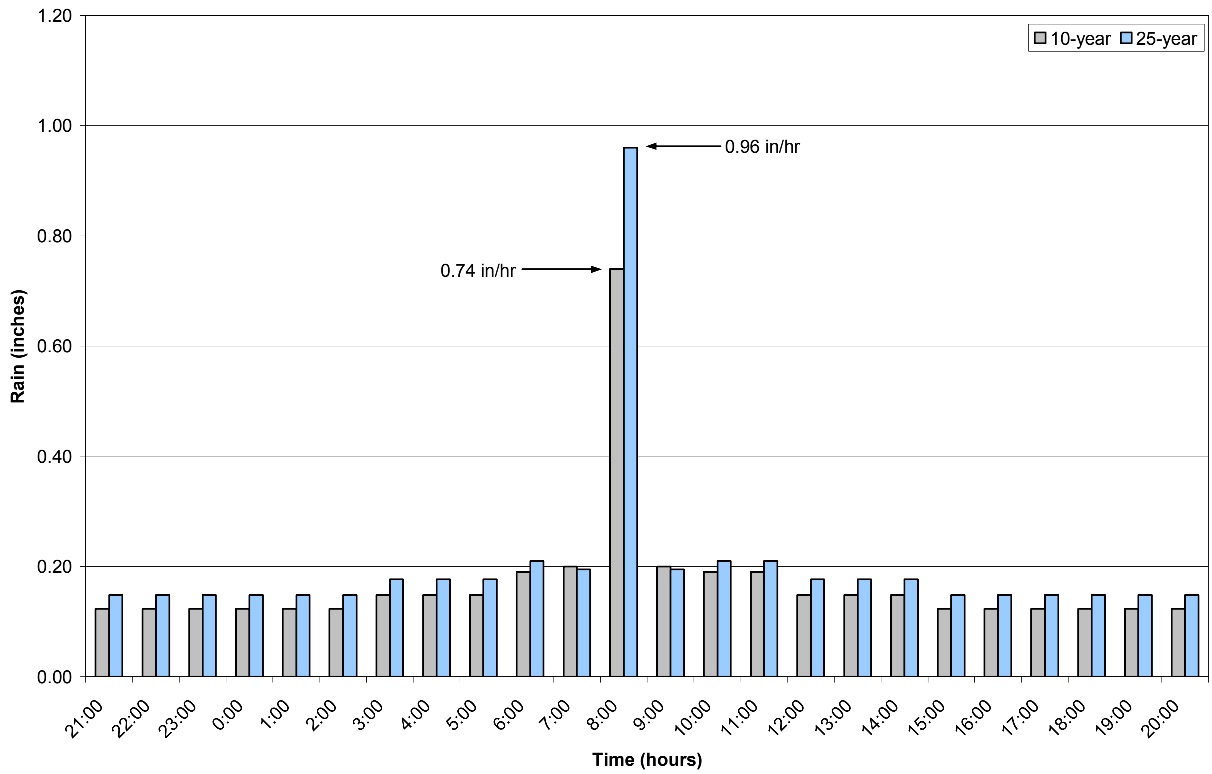

Figure 3-3. 10-year and 25-year Design Storms

The design storms were developed as 24-hour storms and include the 1-hour, 2-hour, 3-hour, 6-hour, and 12-hour intensities as defined in the IDF data. As a conservative measure, the peak hour of the design storms was set at 8:00 am to coincide with the higher collection system flows that occur in the morning.

Figure 3-4 presents a comparison of the 10-year, 25-year, and New Year's storm IDF curves.

The 10-year storm had a similar effect on the collection system as the New Year's storm. Therefore, the results will be focused on the New Year's Storm, because it was the largest actual storm in recent history, and the 25-year storm.

The model showed no overflows and surcharging in the same areas as the New Year's storm under the current scenario with the 25-year storm. With the additional flow caused by future development and the larger storm flow, additional overflows and surcharging were predicted in the same reaches of pipe as were predicted under the New Year's storm. The system performed well overall as discussed in Section 4.

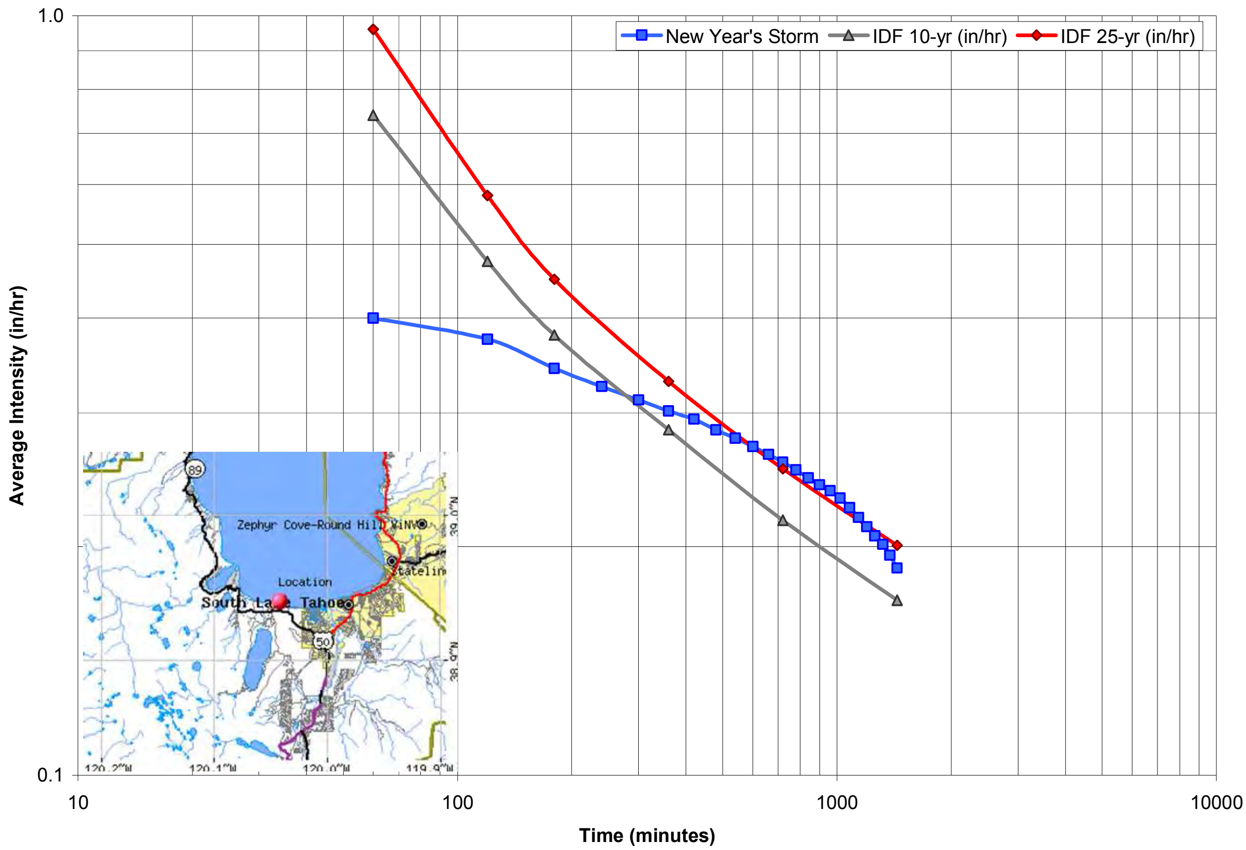

Figure 3-4. IDF Curve Comparison

4. DISCUSSION OF RESULTS

The goal of this evaluation is to identify existing and potential future hydraulic deficiencies in the District's collection system. The results for the current and future summer and winter scenarios are discussed below for the modeled collection system pipes and pump stations.

The District's collection system was originally designed to accommodate a potential population that is greater than what is now expected to be the build-out population. Various organizations including the California Tahoe Conservancy have purchased vacant land in order to limit development, improve water quality in Lake Tahoe, preserve the scenic beauty and recreational opportunities of the region, provide public access, preserve wildlife habitat areas, and manage and restore lands to protect the natural environment. The parcels that are purchased are prevented from future development and therefore limit the growth in population that could contribute to higher flows in the future. To be conservative, the future land use scenario developed for this master plan in TM 5 (Design Flow Analysis) considers the least restrictive land use planning, which could result in relatively higher base sanitary flow. Even with this conservative measure, the collection system has substantial reserve capacity for handling wet weather including snow melt.

4.1 Pipe Capacities

Pipe capacity was evaluated using the criteria described above: surcharge state and potential overflow locations. The hydraulic evaluation results are summarized below.

4.1.1 Summer

There were no overflows and no capacity related surcharging in the model for both the current and future summer (dry weather) scenarios.

4.1.2 Winter

The results for the current and future New Year's and 25-Year Storm scenarios are shown on Figures 4-1 through 4-4. The collection system performed very well for both current and future scenarios.

Pipes with adverse and flat slopes are shown accordingly. Pipes with adverse and flat grades and surcharged pipes are presented in Tables A-1 and A-2, respectively, in Attachment A. Potential overflow sites for the future scenarios are listed in Table 4-1. Figures A-1, A-2, and A-3 depict the longitudinal sections of the reaches with potential overflows, showing the position of the HGL during the peak hours of the New Year's, 10-year, and 25-year storm scenarios. Flat pipes and pipes with adverse slope do not appear to cause hydraulic issues in adjacent pipes.

Overflows only occur in one concentrated area (along the 8-inch pipe between Highway 50 and Al Tahoe PS) in the Al Tahoe basin for the future scenario due to an increase in base flow associated with potential future development according to the parcel land use. For most of the surcharged pipes with the exception of the overflows in Al Tahoe and the surcharging in the Bijou basin, the HGL falls either just above the crown of pipe or at least five feet below ground surface. A relief sewer project, Wildwood Relief Sewer Project, is already planned for the pipes shown as surcharged in the Bijou basin. Other major areas of surcharging include the long 21-inch/24-inch Upper Truckee trunk sewer south of the airport and the 8-inch trunk sewer along HWY 89 just south of HWY 50.

Table 4-1 Potential Overflows During Future Scenarios

MH	New Year's Storm	10-Year Storm	25-year Storm
AT49			X
AT50			X
AT51		X	X
AT52	X	X	X
AT53		X	X
AT54	X	X	X

4.2 Pump Station Capacities

Projected flows to each modeled pumping station (PS) during each scenario were taken as the flow in the pipe(s) immediately upstream of the wet well. In most cases, the downstream inverts at the wet wells were unknown, so slopes were set arbitrarily. This has no bearing on the model results. Reported inflows were compared with PS firm capacities to identify potential capacity deficiencies. The comparison of peak inflow vs. firm capacity is presented in Table 4-2.

PSs with three pumps were assumed to operate in a lead/lag configuration with one unused back-up pump. As an approximation, firm capacity was estimated as two thirds of the sum of the design flow from two of the pumps: F.C. = $2/3 \times (Q_{p1,design} + Q_{p2,design})$. PSs with 2 pumps were assumed to consist of a duty pump and a stand-by pump. Firm capacity for those stations is the design capacity of one pump. According to the model results, the hourly peak flow exceeds the fixed capacity of the Al Tahoe and Tahoe Keys PSs. However, it is unknown if there have been any capacity-related problems at these pump stations in the field.

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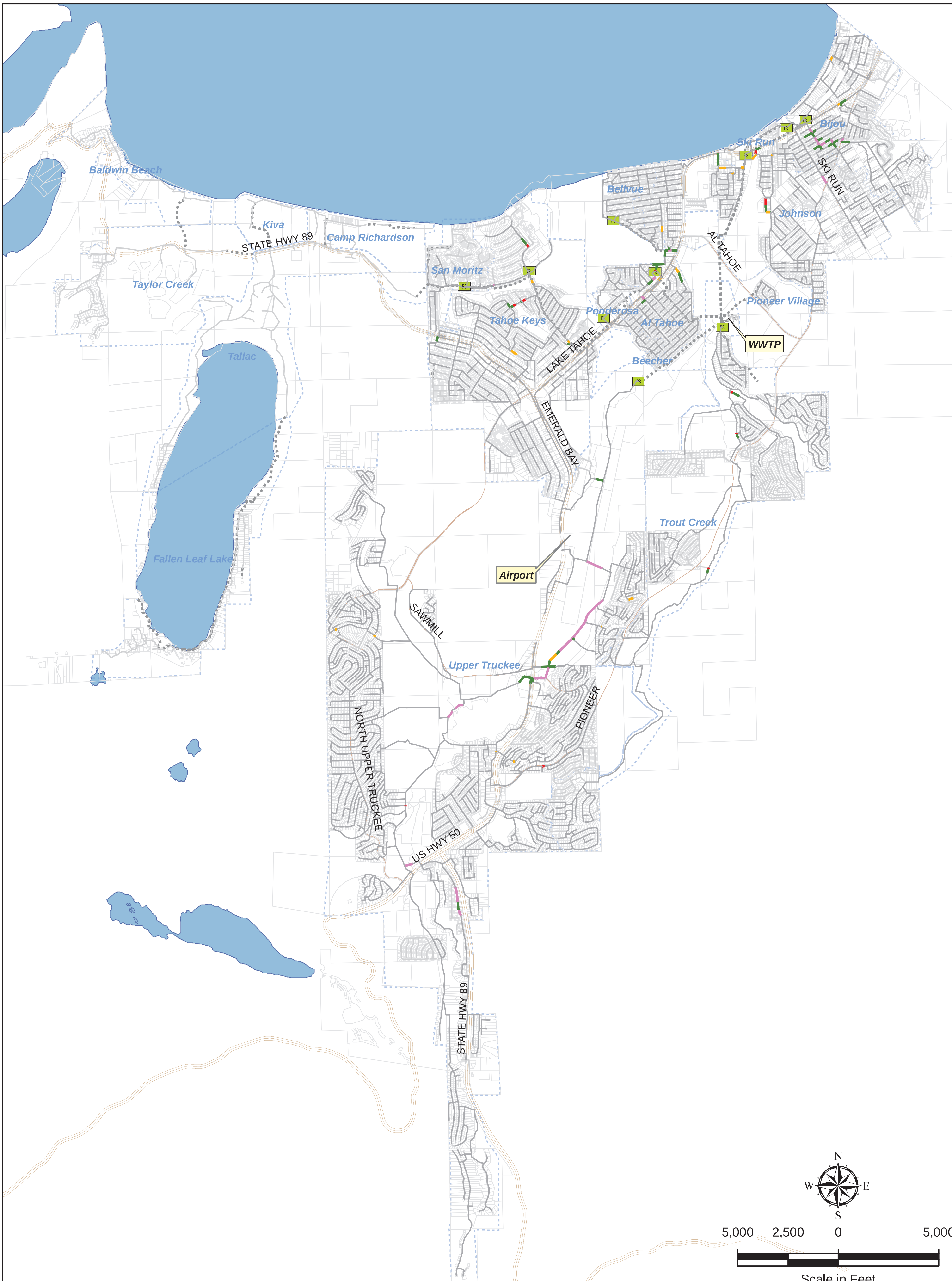

LEGEND

Current New Year's Pipe Surcharge State

- d/D < 1 (No Surcharge)
- Backwater
- Throttled
- Adverse Grade
- Flat Grade
- Modeled Pump Station

Sewer Basins

- Force Main

Not in Model

- Gravity Main

Road

- HWY
- MAJOR

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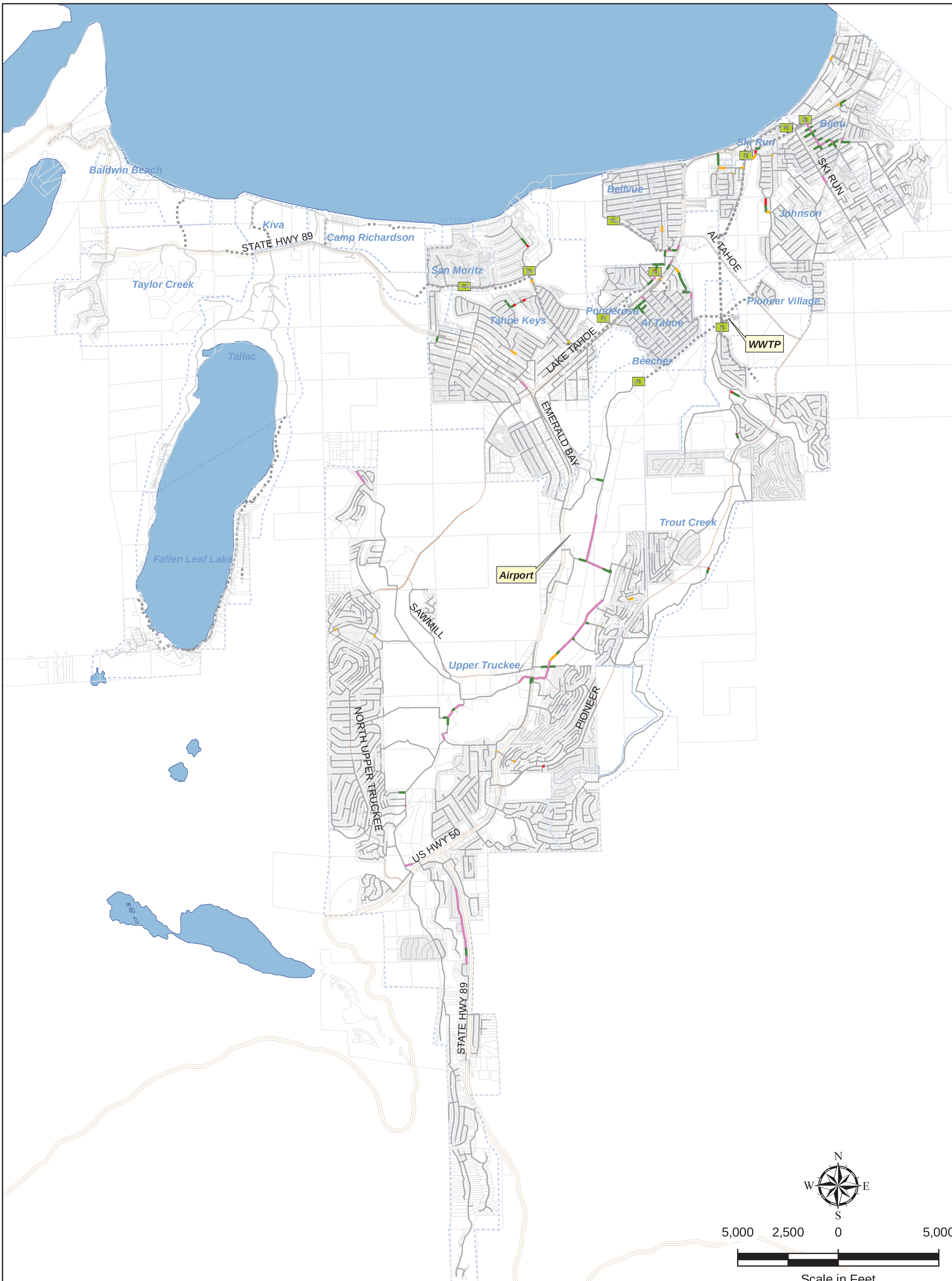
SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 4-1
Current Winter Scenario (New Year's Storm)



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MASTER PLAN

Figure 4-2
Current Winter Scenario (25-Year Design Storm)

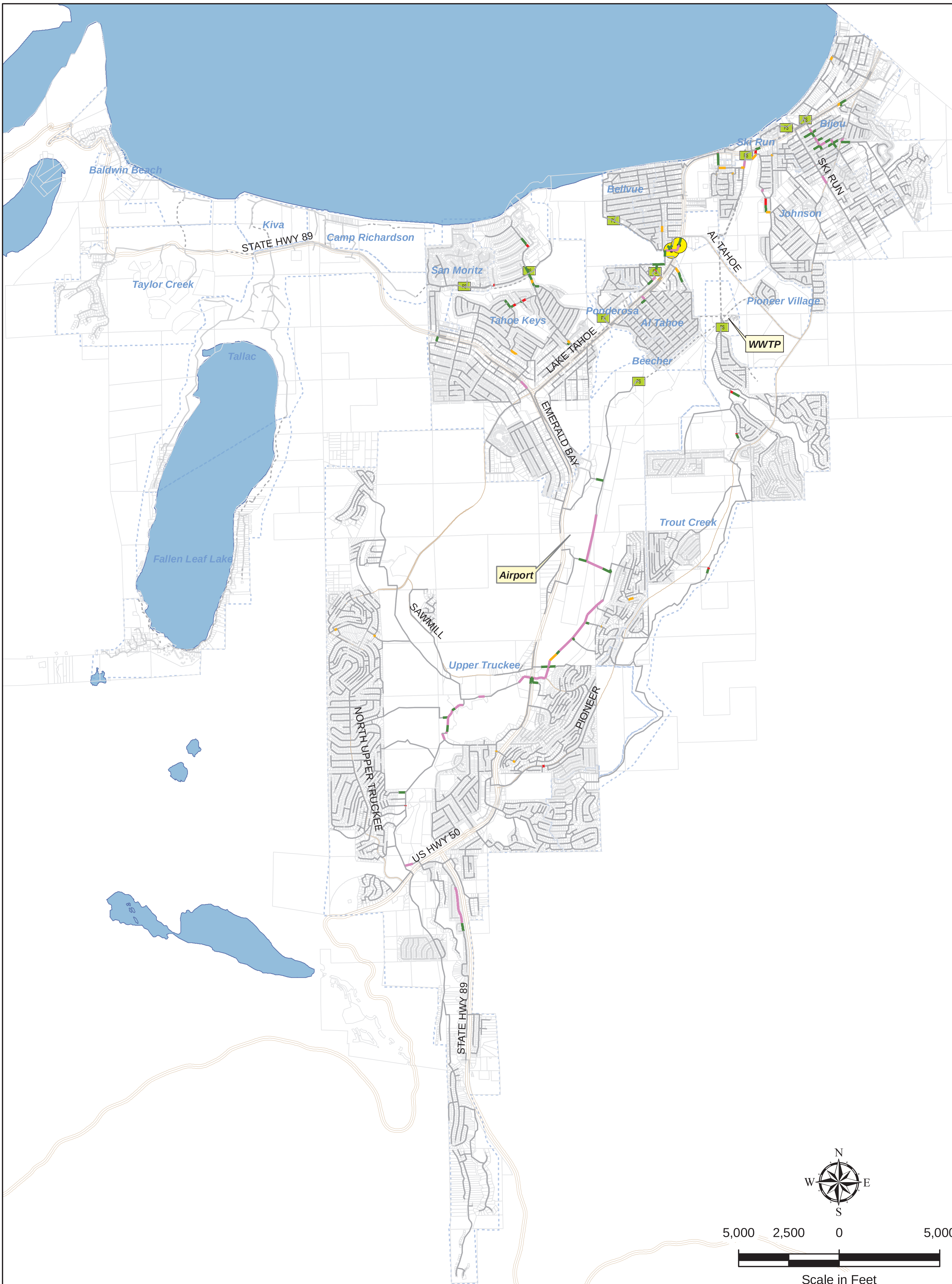
LEGEND

Current 25-yr Design
Pipe Surcharge State
- d/D < 1 (No Surcharge)
- Backwater
- Throttled
- Adverse Grade
- Flat Grade
- Modeled Pump Station

Sewer Basins
- Force Main

Not in Model
- Gravity Main

Road
- HWY
- MAJOR



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MASTER PLAN

Figure 4-3
Future Winter Scenario (New Year's Storm)

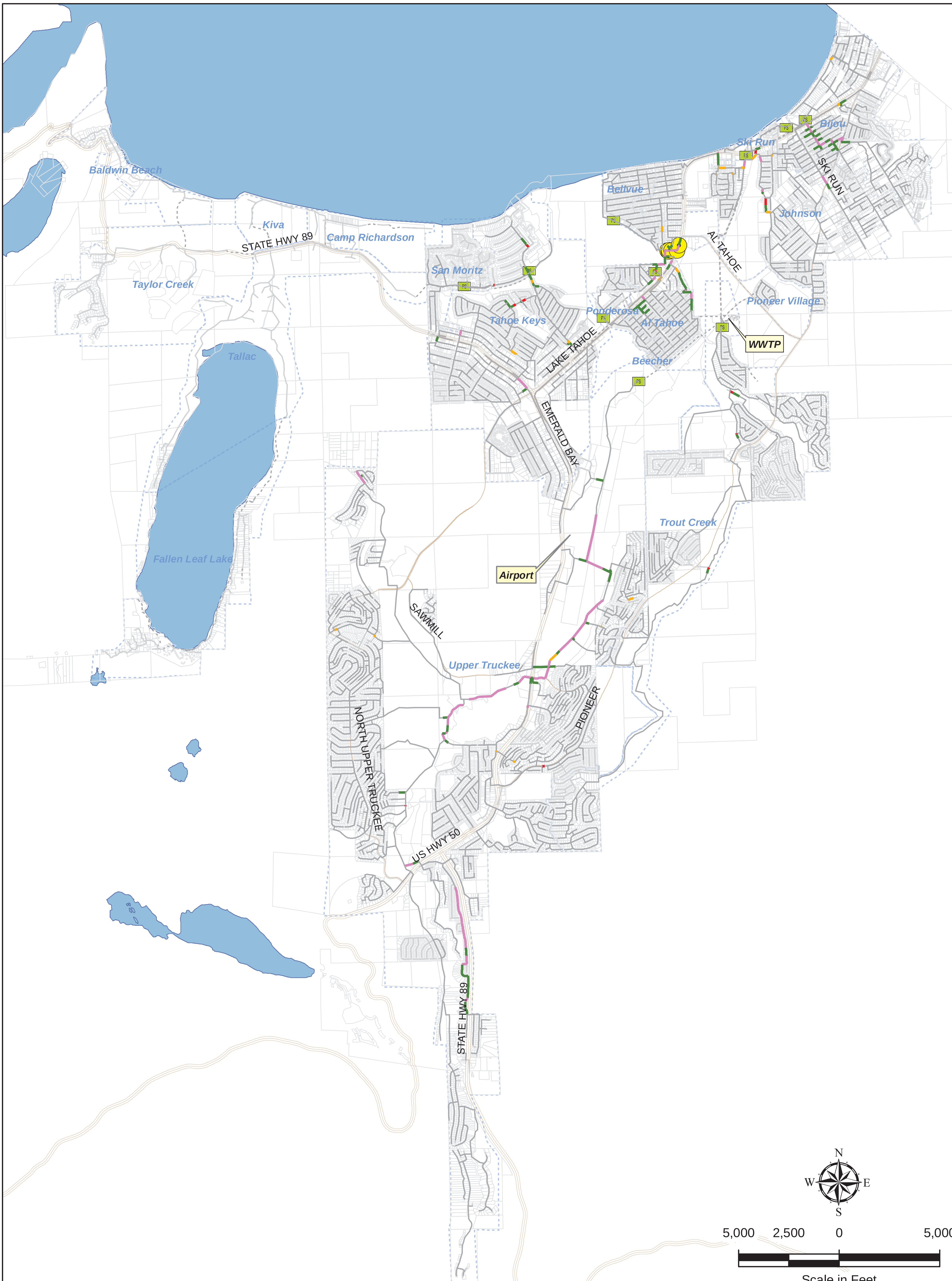
LEGEND

Pipe Surcharge State
- d/D < 1 (No Surcharge)
- Backwater
- Throttle
- Adverse Grade
- Flat Grade
- Potential Overflow
- Modeled Pump Station

Sewer Basins
- Force Main

Not in Model
- Gravity Main

Road
- HWY
- MAJOR



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MASTER PLAN

Figure 4-4
Future Winter Scenario (25-Year Design Storm)

LEGEND

Pipe Surcharge State
- d/D < 1 (No Surcharge)
- Backwater
- Throttle
- Adverse Grade
- Flat Grade
- Potential Overflow
- Modeled Pump Station

Sewer Basins

Force Main

Not in Model
- Gravity Main

Road
- HWY
- MAJOR

Table 4-2 Model Inflow vs. PS Firm Capacity									
	Current Model Max Flow (GPM)				Future Model Max Flow (GPM)				
Pumping Station	DWF	New Year's	10YR	25YR	DWF	New Year's	10YR	25YR	Firm Capacity (GPM)
Modeled[1]									
Al Tahoe[3]	2,872	4,731	4,940	5,510	3,047	5,475	*5,475*	*5,475*	5,200[4]
Bellevue	184	306	306	328	207	327	327	350	900
Bijou[5]	1,113	2,078	2,081	2,279	449	2,159	2,162	2,360	2,400
Johnson	887	1,306	1,281	1,355	1,040	1,455	1,431	1,505	2,000
Ponderosa	142	176	178	183	67	201	203	209	300
San Moritz	170	353	365	409	178	361	374	417	900
Ski Run	177	351	368	409	178	351	369	410	1,025
Tahoe Keys[3]	1,955	2,807	2,904	3,240	2,083	3,334	*3,334*	*3,334*	2,500
Trout Creek	381	747	716	765	443	844	812	868	1,800
Upper Truckee	850	2,608	2,480	2,751	1,128	2,788	2,659	2,930	3,500
Not Modeled[2]									
Beecher	11	13	13	13	5	13	13	13	100
Gardner Mtn	31	47	51	57	35	51	56	61	85
Pioneer Village	24	41	44	49	25	42	44	49	325
Venice	33	74	83	94	34	74	83	95	120

[1]Flow through pipe(s) having the PS wet well as their downstream node
[2]Flow in the pipe leaving the PS force main's terminal manhole less flow from upstream pipe(s)
[3]The fixed speed pump stations upstream did not run during the peak hour for the 10-year and 25-year storms. This caused a decrease in the future peak hourly flow at these locations. Therefore, the New Year's Storm flow is reported for all three wet weather scenarios.
[4]Firm capacity for Al Tahoe in this table was estimated using pump curves provided by the District.
[5]Flows may increase at the Bijou PS in the future. The Douglas County Sewer Improvement District is investigating the possibility of a future gravity bypass into the STPUD system, which would affect flows at Bijou PS.

4.3 Force Main Velocities

None of the force main velocities exceeded eight feet per second as shown in Table 4-3. There are two pump stations that appear to have a maximum velocity below two feet per second, Ski Run and Venice. When velocities do not go above two feet per second, grit can settle in the force main. Also, there are several pump stations with maximum velocities below 3.5 fps, which is the desirable velocity to re-suspend any settled solids.

Pump Station	FM Diameter (in)	Max Q (gpm)[2]	Max Velocities (fps)
Modeled			
Al Tahoe	18	5,475	6.9
Bellevue[1,3]	10	900	3.7
Bijou	16	2,360	3.8
Johnson	16	1,505	2.4
Ponderosa[1]	6	300	3.4
San Moritz[1]	10	900	3.7
Ski Run	12	410	1.2
Tahoe Keys	16	3,334	4.9
Trout Creek	12	868	3.7
Upper Truckee	18	2,930	3.7
Not Modeled			
Beecher[1]	4	100	2.6
Gardner Mtn.[1]	4	85	2.2
Pioneer Village[1]	8	325	2.1
Venice[1]	6	120	1.4

Table 4-3 Force Main Velocities

[1]The Maximum Q is based on the firm pumping capacity for these constant speed pump stations.

[2]Max scenario is "Future 25-Year Design Storm" except for Tahoe Keys and Al Tahoe "Future New Year's Storm"

[3]Bellevue PS was modeled using a pump design flow of 300 gpm (7.5 hp) in order to more accurately match the observed average daily volume. The pump station condition assessment data sheet states that the capacity of each installed pump is 900 gpm, 15 hp.. Calculated velocity for 300 gpm would be ~ 1.2 ft/sec.

4.4 Capital Improvement Plan

The results from the hydraulic analysis described in this TM and the condition assessment TMs will be used to develop projects in a Capital Improvement Plan. The Capital Improvement Plan TM will also account for existing projects the District has planned.

ATTACHMENT A: SURCHARGED PIPES AND POTENTIAL OVERFLOWS

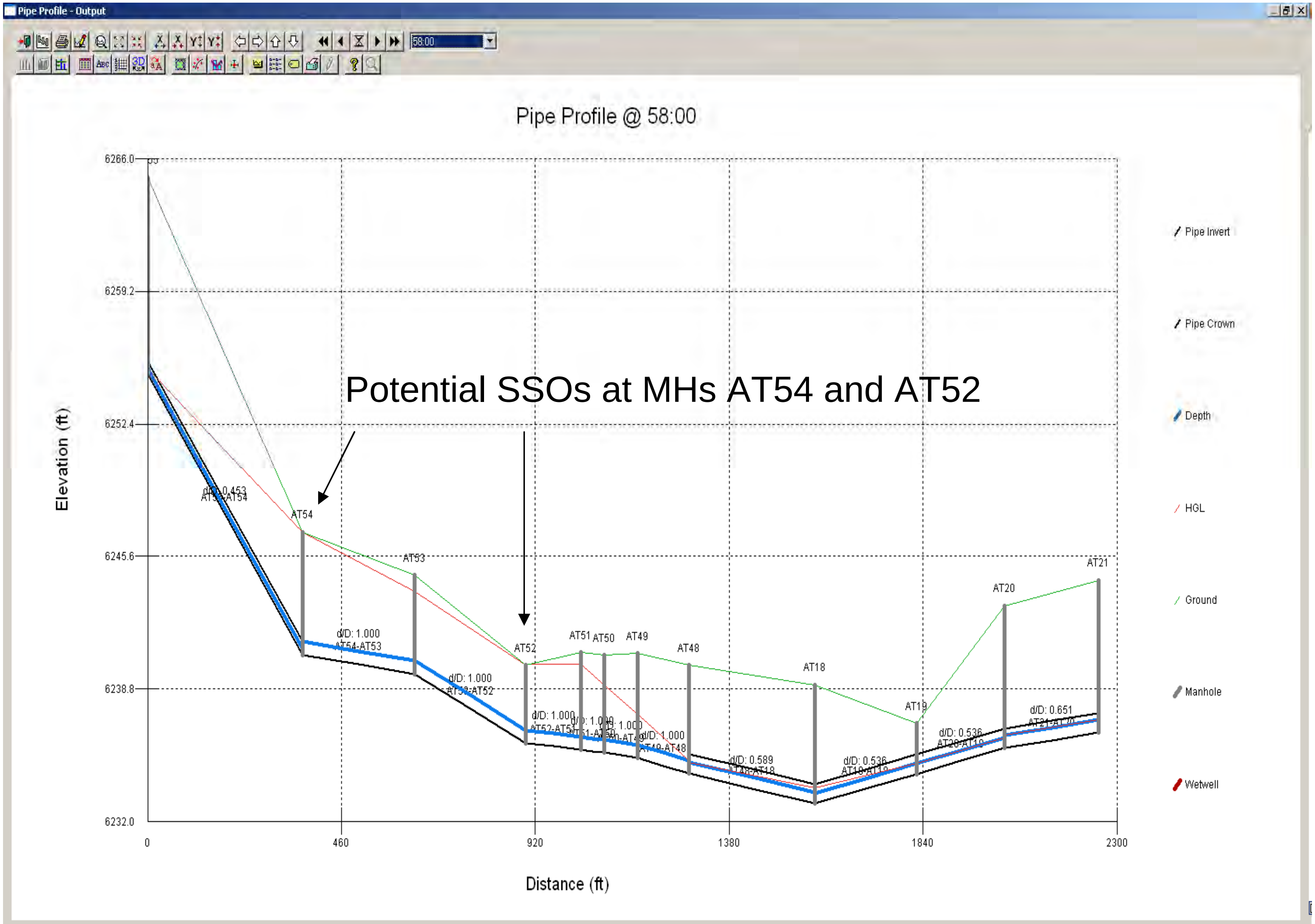

Figure A-1 New Year’s Storm with Future BSF

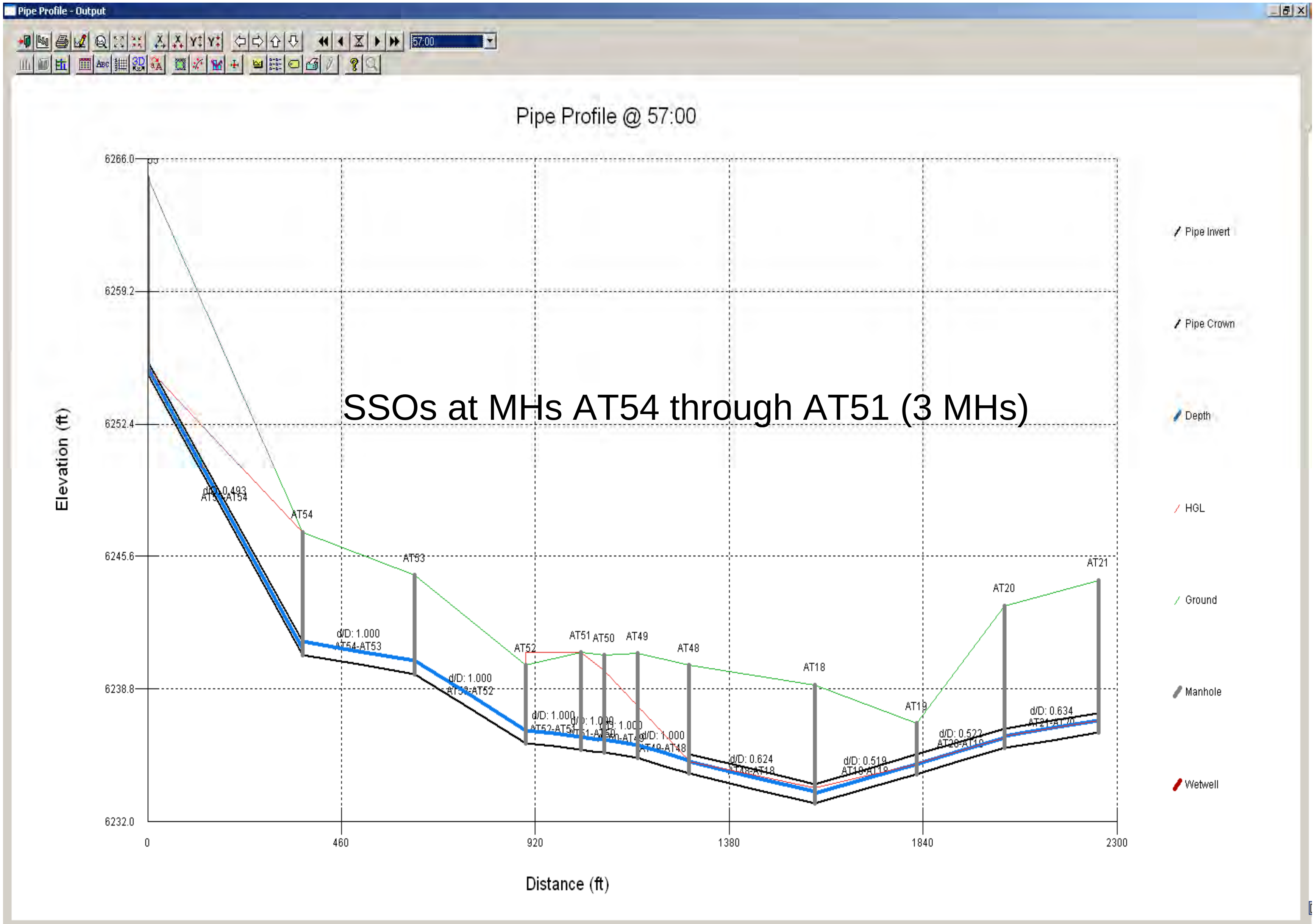

Figure A-2 10-yr future with Future BSF

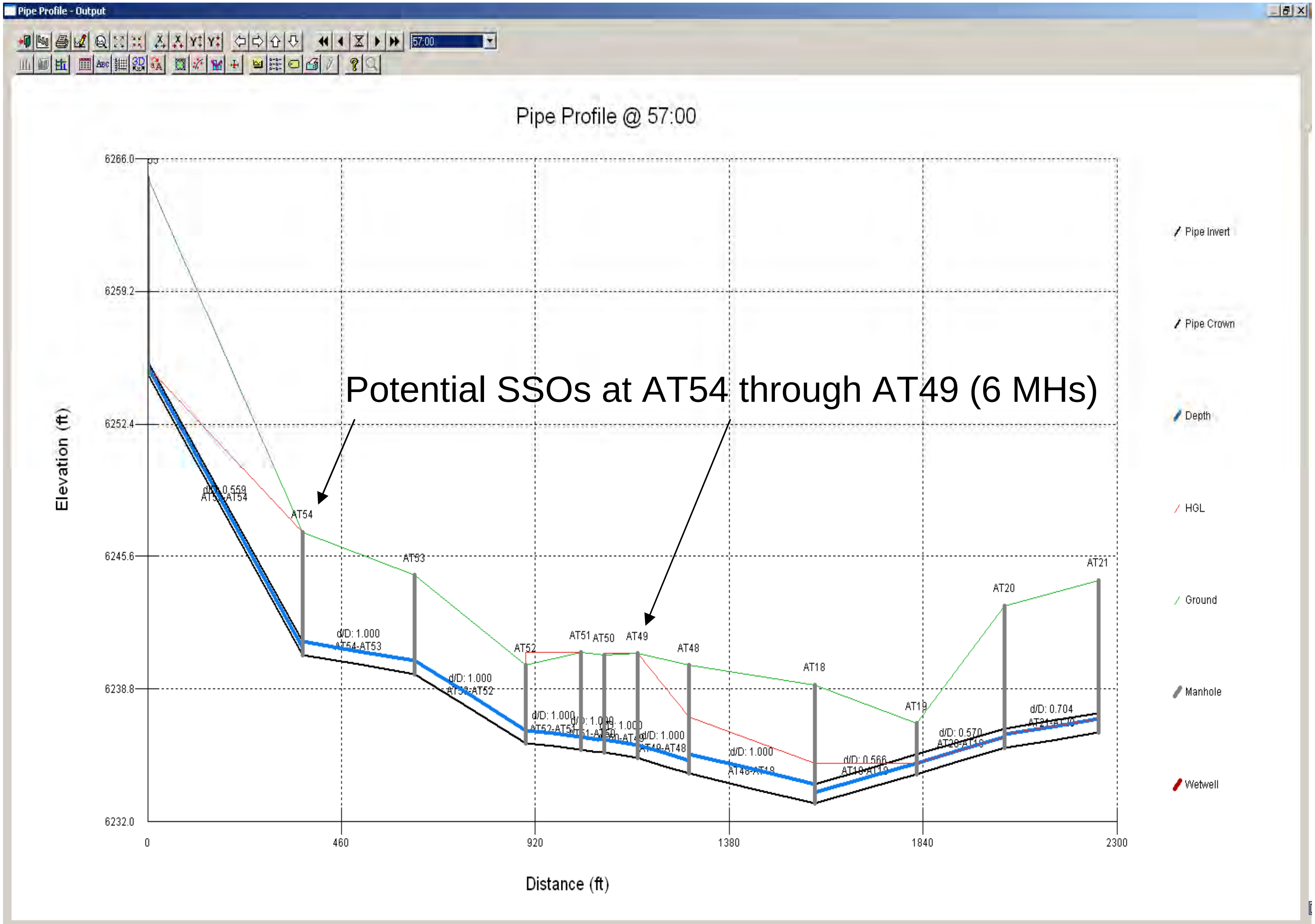

Figure A-3 25-year storm with Future BSF

Table A-1. Pipes with Adverse or Flat Slope	
Pipe Name	**Slope**
AT2-AT1	-0.009
JN11-JN10	-0.01
JN124-JN123	-0.009
JN139-JN68	-0.001
JN73-JN72	-0.005
TK133-TK132	-0.006
TK15-TK14	-0.002
TK74-TK30	-0.001
TK80-TK79	-0.007
TR212-TR211	-0.027
TR425-TR424	-0.02
TR70-TR43	-0.017
UT2140-UT2043	-0.001
UT819-UT615	-0.001
AT25-AT4	0
AT95-AT60	0
BJ208-BJ207	0
BJ25-BJ24	0
BV92-JN710	0
JN104-JN37	0
JN141-JN140	0
JN16-JN15	0
JN25-JN24	0
JN478-JN477	0
JN5-JN4	0
JN743-JN112	0
JN8-JN7	0
TK243-TK242	0
TK4-TK3	0
TK89-TK88	0
UT104-UT53	0
UT158-UT157	0
UT308-UT307	0
UT449-UT448	0
UT657-UT656	0
UT978-UT977	0
UT989-UT760	0

Key for Table A-2	
Surcharge State	**Condition**
1	Backwatered
2	Throttled
3	Adverse Grade
4	Flat

Table A-2. Current New Year's Storm						
Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
AT14-AT13	18	0.003	4.296	3.741	2	Yes
AT15-AT14	18	0.018	4.305	3.756	1	
AT16-AT2	24	0.002	2.425	1.185	1	
AT17-AT16	18	0.002	2.188	1.876	1	
AT2-AT1	24	-0.009	3.1	1.527	3	
AT25-AT4	6	0	0.003	0.024	4	
AT29-AT8	8	0.003	0.339	1.5	1	
AT42-AT16	8	0.021	0.283	1.254	1	
AT48-AT18	12	0.005	1.235	3.061	1	
AT49-AT48	8	0.007	0.607	3.17	1	
AT50-AT49	8	0.003	0.602	2.664	2	Yes
AT51-AT50	8	0.003	0.602	2.666	2	Yes
AT52-AT51	8	0.003	0.453	2.004	2	Yes
AT53-AT52	8	0.013	0.45	1.989	1	
AT8-AT7	8	0.004	0.613	2.714	2	Yes
AT89-AT51	6	0.02	0.147	1.155	1	
AT95-AT60	12	0	0.803	7.664	4	
AT96-AT95	12	0.002	0.793	1.557	1	
AT97-AT96	12	0.002	0.762	1.496	1	
BJ208-BJ207	8	0	0.458	2.025	4	
BJ209-BJ208	8	0.041	0.23	1.017	1	
BJ234-BJ196	10	0.004	1.026	2.909	2	Yes
BJ235-BJ234	6	0.006	0.037	0.287	1	
BJ242-BJ208	6	0.007	0.235	1.845	1	
BJ25-BJ24	18	0	0.968	0.837	4	
BJ275-BJ234	10	0.007	0.975	2.765	1	
BJ276-BJ275	8	0.007	0.745	3.302	2	Yes
BJ277-BJ276	8	0.007	0.696	3.219	2	Yes
BJ278-BJ277	8	0.007	0.638	2.828	2	Yes
BJ279-BJ278	8	0.01	0.63	2.79	1	
BJ280-BJ279	6	0.021	0.605	4.777	2	Yes
BJ281-BJ280	6	0.01	0.005	0.04	1	
BJ282-BJ234	6	0.007	0.006	0.049	1	
BJ315-BJ276	6	0.006	0.028	0.221	1	
BJ321-BJ277	6	0.015	0.01	0.077	1	
BJ322-BJ277	6	0.02	0.039	0.31	1	
BJ327-BJ280	6	0.029	0.473	3.73	1	
BJ330-BJ280	6	0.015	0.121	0.954	1	
BJ366-BJ328	6	0.005	0.451	3.553	2	Yes
BJ367-BJ366	6	0.04	0.441	3.472	1	
BV92-JN710	6	0	0	0.038	4	
JN104-JN37	6	0	0.007	0.2	4	
JN11-JN10	10	-0.01	0.49	12.299	3	
JN12-JN11	8	0.004	0.12	0.526	1	
JN124-JN123	8	-0.009	0.435	21.141	3	
JN139-JN68	10	-0.001	0.389	14.605	3	
JN140-JN139	10	0.005	0.38	1.075	1	
JN141-JN140	10	0	0.379	1.063	4	
JN142-JN141	6	0.195	0.124	1.208	1	

Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
JN16-JN15	21	0	1.228	1.48	4	
JN25-JN24	6	0	0.087	41.221	4	
JN260-JN186	8	0.001	0.282	1.246	2	Yes
JN478-JN477	6	0	0.006	0.091	4	
JN5-JN4	15	0	0.497	1.043	4	
JN73-JN72	8	-0.005	0.052	23.38	3	
JN74-JN73	8	0.024	0.049	0.217	1	
JN743-JN112	18	0	0.69	0.59	4	
JN8-JN7	15	0	0.493	1.089	4	
TK131-TK80	12	0.016	0.613	1.208	1	
TK133-TK132	12	-0.006	0.602	11.576	3	
TK134-TK133	12	0.002	0.602	1.185	1	
TK15-TK14	14	-0.002	0.172	8.714	3	
TK176-TK134	12	0.002	0.509	1.001	1	
TK243-TK242	6	0	0.005	0.087	4	
TK4-TK3	21	0	2.441	1.57	4	
TK50-TK15	14	0.002	0.147	0.212	1	
TK561-TK560	8	0.04	0.136	0.602	1	
TK74-TK30	12	-0.001	1.692	3.284	3	
TK80-TK79	12	-0.007	0.632	13.101	3	
TK89-TK88	12	0	0.6	1.15	4	
TK90-TK89	6	0.049	0.005	1.177	1	
TR212-TR211	15	-0.027	0.486	8.997	3	
TR213-TR212	15	0.005	0.486	0.612	1	
TR425-TR424	15	-0.02	0.236	9.266	3	
TR426-TR425	15	0.011	0.236	0.297	1	
TR70-TR43	15	-0.017	0.109	9.403	3	
TR71-TR70	15	0.016	0.108	0.136	1	
UT104-UT53	6	0	0.024	0.187	4	
UT1231-UT1230	8	0.002	0.423	1.857	2	Yes
UT155-UT91	21	0.001	3.75	2.404	2	Yes
UT156-UT155	21	0.001	3.761	2.575	2	Yes
UT157-UT156	21	0.004	3.764	2.42	1	
UT158-UT157	21	0	3.772	2.421	4	
UT159-UT158	21	0.001	3.772	2.426	1	
UT160-UT159	21	0.001	3.69	2.373	2	Yes
UT161-UT160	21	0.001	3.694	2.373	2	Yes
UT162-UT161	21	0.001	3.702	2.376	2	Yes
UT163-UT162	21	0.001	3.705	2.378	2	Yes
UT164-UT163	21	0.001	3.712	2.384	2	Yes
UT165-UT164	21	0.006	3.691	2.374	1	
UT166-UT165	12	0.008	0.925	2.686	1	
UT1697-UT1696	6	0.004	0.245	2.022	2	Yes
UT1698-UT1697	6	0.004	0.241	1.879	2	Yes
UT1699-UT1698	6	0.004	0.236	1.841	1	
UT1700-UT1699	6	0.004	0.23	2.002	2	Yes
UT18-UT17	8	0.012	0.133	0.588	1	
UT2140-UT2043	8	-0.001	0.238	34.109	3	
UT233-UT159	8	0.005	0.063	0.279	1	
UT240-UT159	6	0.042	0.054	0.423	1	

Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
UT242-UT164	6	0.002	0.026	0.897	1	
UT251-UT165	21	0.001	2.779	1.99	1	
UT252-UT251	21	0.001	2.786	2.018	1	
UT308-UT307	12	0	0.774	1.477	4	
UT380-UT379	15	0.002	1.959	2.76	2	Yes
UT381-UT380	15	0.002	1.961	2.47	2	Yes
UT383-UT382	15	0.002	1.962	2.737	2	Yes
UT384-UT383	15	0.002	1.962	2.692	2	Yes
UT41-UT40	21	0.001	3.79	2.432	2	Yes
UT42-UT41	21	0.001	3.798	2.438	2	Yes
UT449-UT448	10	0	0.161	0.453	4	
UT47-UT46	21	0.001	3.759	2.577	2	Yes
UT48-UT47	21	0.001	3.734	2.401	2	Yes
UT49-UT48	21	0.001	3.738	2.402	2	Yes
UT657-UT656	10	0	0.019	0.121	4	
UT819-UT615	15	-0.001	1.334	11.383	3	
UT90-UT49	21	0.001	3.74	2.396	2	Yes
UT91-UT90	21	0.001	3.754	2.573	2	Yes
UT92-UT91	6	0.011	0.039	1.904	1	
UT978-UT977	6	0	0.029	0.23	4	
UT989-UT760	6	0	0.005	0.121	4	

Table A-2. Future New Year's Storm						
Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
AT131-AT89	6	0.015	0.01	0.077	1	
AT14-AT13	18	0.003	5.085	4.443	2	Yes
AT15-AT14	18	0.018	5.08	4.442	1	
AT16-AT2	24	0.002	2.402	1.18	1	
AT17-AT16	18	0.002	2.127	1.853	1	
AT2-AT1	24	-0.009	3.113	1.533	3	
AT25-AT4	6	0	0.003	0.024	4	
AT29-AT8	8	0.003	0.347	1.538	1	
AT42-AT16	8	0.021	0.286	1.266	1	
AT48-AT18	12	0.005	1.384	2.725	1	
AT49-AT48	8	0.007	1.091	4.833	2	Yes
AT50-AT49	8	0.003	1.087	4.813	2	Yes
AT51-AT50	8	0.003	1.087	4.816	2	Yes
AT52-AT51	8	0.003	0.938	4.151	2	Yes
AT53-AT52	8	0.013	0.935	4.14	2	Yes
AT54-AT53	8	0.004	0.907	4.009	2	Yes
AT55-AT54	8	0.039	0.653	2.892	1	
AT8-AT7	8	0.004	0.633	2.804	2	Yes
AT89-AT51	6	0.02	0.147	1.161	1	
AT90-AT89	6	0.031	0.136	1.069	1	
AT95-AT60	12	0	0.824	7.728	4	
AT96-AT95	12	0.002	0.813	1.596	1	
AT97-AT96	12	0.002	0.782	1.536	1	
BJ208-BJ207	8	0	0.477	2.108	4	
BJ209-BJ208	8	0.041	0.241	1.07	1	
BJ234-BJ196	10	0.004	1.057	2.998	2	Yes
BJ235-BJ234	6	0.006	0.038	0.296	1	
BJ242-BJ208	6	0.007	0.242	1.902	1	
BJ25-BJ24	18	0	1.007	0.869	4	
BJ275-BJ234	10	0.007	1.005	2.851	1	
BJ276-BJ275	8	0.007	0.767	3.398	2	Yes
BJ277-BJ276	8	0.007	0.716	3.221	2	Yes
BJ278-BJ277	8	0.007	0.658	2.914	2	Yes
BJ279-BJ278	8	0.01	0.649	2.876	1	
BJ280-BJ279	6	0.021	0.624	4.919	2	Yes
BJ281-BJ280	6	0.01	0.005	0.043	1	
BJ282-BJ234	6	0.007	0.006	0.05	1	
BJ315-BJ276	6	0.006	0.029	0.228	1	
BJ321-BJ277	6	0.015	0.01	0.077	1	
BJ322-BJ277	6	0.02	0.04	0.317	1	
BJ327-BJ280	6	0.029	0.491	3.868	1	
BJ330-BJ280	6	0.015	0.122	0.963	1	
BJ366-BJ328	6	0.005	0.468	3.689	2	Yes
BJ367-BJ366	6	0.04	0.458	3.608	1	
BV92-JN710	6	0	0	0.038	4	
JN104-JN37	6	0	0.007	0.2	4	
JN11-JN10	10	-0.01	0.519	12.475	3	
JN12-JN11	8	0.004	0.136	0.596	1	
JN124-JN123	8	-0.009	0.482	21.623	3	

Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
JN139-JN68	10	-0.001	0.445	15.072	3	
JN140-JN139	10	0.005	0.436	1.233	1	
JN141-JN140	10	0	0.435	1.221	4	
JN142-JN141	6	0.195	0.152	1.208	1	
JN16-JN15	21	0	1.367	1.518	4	
JN20-JN19	6	0.003	0.211	1.828	2	Yes
JN25-JN24	6	0	0.091	42.55	4	
JN260-JN186	8	0.001	0.306	1.355	2	Yes
JN478-JN477	6	0	0.006	0.092	4	
JN5-JN4	15	0	0.527	1.057	4	
JN66-JN65	10	0.001	0.536	1.711	2	Yes
JN73-JN72	8	-0.005	0.053	24.133	3	
JN74-JN73	8	0.024	0.05	0.223	1	
JN743-JN112	18	0	0.773	0.662	4	
JN8-JN7	15	0	0.522	1.103	4	
TK1-TK-WW	24	0.012	4.803	6.436	1	
TK11-TK1	14	0.007	0.229	0.33	1	
TK131-TK80	12	0.016	0.653	1.287	1	
TK133-TK132	12	-0.006	0.641	11.986	3	
TK134-TK133	12	0.002	0.64	1.26	1	
TK15-TK14	14	-0.002	0.173	9.016	3	
TK176-TK134	12	0.002	0.545	1.072	1	
TK177-TK176	12	0.002	0.534	1.05	1	
TK2-TK1	24	0.002	4.31	3.281	1	
TK243-TK242	6	0	0.005	0.088	4	
TK3-TK2	21	0.002	2.608	2.683	1	
TK4-TK3	21	0	2.608	1.677	4	
TK5-TK4	21	0.006	2.609	1.678	1	
TK50-TK15	14	0.002	0.148	0.212	1	
TK535-TK534	10	0.004	0.922	2.901	2	Yes
TK536-TK535	10	0.004	0.919	2.873	2	Yes
TK561-TK560	8	0.04	0.146	0.647	1	
TK6-TK5	21	0.008	2.608	1.678	1	
TK7-TK6	10	0.007	0.193	0.546	1	
TK74-TK30	12	-0.001	1.692	3.318	3	
TK80-TK79	12	-0.007	0.672	13.592	3	
TK89-TK88	12	0	0.635	1.22	4	
TK90-TK89	6	0.049	0.005	1.196	1	
TR212-TR211	15	-0.027	0.531	9.367	3	
TR213-TR212	15	0.005	0.53	0.668	1	
TR425-TR424	15	-0.02	0.261	9.663	3	
TR426-TR425	15	0.011	0.261	0.328	1	
TR70-TR43	15	-0.017	0.121	9.815	3	
TR71-TR70	15	0.016	0.121	0.152	1	
UT104-UT53	6	0	0.025	0.196	4	
UT1231-UT1230	8	0.002	0.449	1.97	2	Yes
UT155-UT91	21	0.001	3.97	2.545	2	Yes
UT156-UT155	21	0.001	3.982	2.575	2	Yes
UT157-UT156	21	0.004	3.986	2.562	1	
UT158-UT157	21	0	3.997	2.564	4	

Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
UT159-UT158	21	0.001	3.998	2.571	2	Yes
UT160-UT159	21	0.001	3.911	2.516	2	Yes
UT161-UT160	21	0.001	3.912	2.516	2	Yes
UT162-UT161	21	0.001	3.921	2.516	2	Yes
UT163-UT162	21	0.001	3.925	2.519	2	Yes
UT164-UT163	21	0.001	3.933	2.525	2	Yes
UT165-UT164	21	0.006	3.91	2.515	1	
UT166-UT165	12	0.008	0.991	2.692	1	
UT1697-UT1696	6	0.004	0.259	2.024	2	Yes
UT1698-UT1697	6	0.004	0.254	1.985	2	Yes
UT1699-UT1698	6	0.004	0.249	1.945	2	Yes
UT1700-UT1699	6	0.004	0.244	2.01	2	Yes
UT1701-UT1700	6	0.004	0.239	1.867	2	Yes
UT18-UT17	8	0.012	0.162	0.716	1	
UT1874-UT1701	6	0.004	0.229	1.793	1	
UT2140-UT2043	8	-0.001	0.255	35.63	3	
UT233-UT159	8	0.005	0.065	0.288	1	
UT240-UT159	6	0.042	0.058	0.454	1	
UT242-UT164	6	0.002	0.027	0.886	1	
UT243-UT242	6	0.005	0.027	0.212	1	
UT251-UT165	21	0.001	2.937	1.969	2	Yes
UT252-UT251	21	0.001	2.945	1.996	2	Yes
UT258-UT257	18	0.002	2.972	2.95	2	Yes
UT308-UT307	12	0	0.831	1.588	4	
UT36-UT35	21	0.001	4.029	2.773	2	Yes
UT37-UT36	21	0.001	4.034	2.779	2	Yes
UT38-UT37	21	0.001	4.046	2.595	2	Yes
UT380-UT379	15	0.002	2.052	2.754	2	Yes
UT381-UT380	15	0.002	2.053	2.587	2	Yes
UT382-UT381	15	0.003	2.054	2.589	1	
UT383-UT382	15	0.002	2.054	2.736	2	Yes
UT384-UT383	15	0.002	2.055	2.692	2	Yes
UT385-UT384	15	0.002	1.888	2.378	2	Yes
UT386-UT385	15	0.002	1.889	2.381	1	
UT387-UT386	15	0.002	1.889	2.687	2	Yes
UT389-UT388	15	0.002	1.89	2.679	2	Yes
UT39-UT38	21	0.001	4.057	2.811	2	Yes
UT40-UT39	21	0.001	4.066	2.61	2	Yes
UT41-UT40	21	0.001	4.012	2.574	2	Yes
UT42-UT41	21	0.001	4.022	2.582	2	Yes
UT43-UT42	21	0.003	4.028	2.588	1	
UT449-UT448	10	0	0.17	0.476	4	
UT47-UT46	21	0.001	3.982	2.575	2	Yes
UT48-UT47	21	0.001	3.956	2.543	2	Yes
UT49-UT48	21	0.001	3.956	2.545	2	Yes
UT50-UT49	6	0.017	0.034	2.178	1	
UT567-UT384	10	0.032	0.191	0.54	1	
UT611-UT398	6	0.037	0.084	0.664	1	
UT657-UT656	10	0	0.022	0.127	4	
UT68-UT40	10	0.007	0.224	0.632	1	

Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
UT73-UT43	8	0.019	0.165	0.732	1	
UT819-UT615	15	-0.001	1.392	11.89	3	
UT90-UT49	21	0.001	3.957	2.536	2	Yes
UT91-UT90	21	0.001	3.973	2.581	2	Yes
UT92-UT91	6	0.011	0.041	1.931	1	
UT978-UT977	6	0	0.031	0.243	4	
UT989-UT760	6	0	0.005	0.126	4	

Table A-2. Current 25-Year Year Storm						
Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
AT107-AT66	8	0.004	0.338	1.466	1	
AT109-AT66	6	0.009	0.013	0.101	1	
AT135-AT99	12	0.002	0.872	1.699	1	
AT136-AT135	10	0.003	0.633	1.746	1	
AT14-AT13	18	0.003	4.935	4.306	2	Yes
AT15-AT14	18	0.018	4.932	4.309	1	
AT16-AT2	24	0.002	2.29	1.127	1	
AT166-AT165	10	0.002	0.624	1.907	2	Yes
AT17-AT16	18	0.002	2.058	1.792	1	
AT2-AT1	24	-0.009	3.007	1.481	3	
AT22-AT21	12	0.002	1.158	2.403	2	Yes
AT23-AT22	6	0.02	0.038	0.296	1	
AT25-AT4	6	0	0.004	0.03	4	
AT29-AT8	8	0.003	0.424	1.836	1	
AT30-AT29	8	0.004	0.413	1.791	1	
AT42-AT16	8	0.021	0.339	1.492	1	
AT48-AT18	12	0.005	1.14	3.061	1	
AT49-AT48	8	0.007	0.786	3.453	2	Yes
AT50-AT49	8	0.003	0.784	3.448	2	Yes
AT51-AT50	8	0.003	0.788	3.473	2	Yes
AT52-AT51	8	0.003	0.598	2.606	2	Yes
AT53-AT52	8	0.013	0.601	2.624	1	
AT54-AT53	8	0.004	0.574	2.463	2	Yes
AT66-AT30	8	0.003	0.354	1.534	1	
AT68-AT30	6	0.018	0.049	0.381	1	
AT8-AT7	8	0.004	0.769	3.338	2	Yes
AT89-AT51	6	0.02	0.196	1.539	1	
AT95-AT60	12	0	0.938	7.743	4	
AT96-AT95	12	0.002	0.925	1.82	1	
AT97-AT96	12	0.002	0.889	1.75	1	
AT98-AT97	12	0.002	0.883	1.715	1	
AT99-AT98	12	0.001	0.875	1.836	2	Yes
BJ196-BJ186	12	0.003	1.234	2.569	2	Yes
BJ197-BJ196	6	0.007	0.05	0.391	1	
BJ208-BJ207	8	0	0.558	2.293	4	
BJ209-BJ208	8	0.041	0.283	1.243	1	
BJ234-BJ196	10	0.004	1.168	3.273	2	Yes
BJ235-BJ234	6	0.006	0.044	0.342	1	
BJ240-BJ196	6	0.014	0.014	0.105	1	
BJ242-BJ208	6	0.007	0.29	2.259	1	
BJ25-BJ24	18	0	1.089	0.923	4	
BJ275-BJ234	10	0.007	1.118	3.138	1	
BJ276-BJ275	8	0.007	0.856	3.755	2	Yes
BJ277-BJ276	8	0.007	0.805	3.521	2	Yes
BJ278-BJ277	8	0.007	0.745	3.249	2	Yes
BJ279-BJ278	8	0.01	0.744	3.254	1	
BJ280-BJ279	6	0.021	0.719	5.623	2	Yes
BJ281-BJ280	6	0.01	0.007	0.051	1	
BJ282-BJ234	6	0.007	0.007	0.058	1	

Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
BJ315-BJ276	6	0.006	0.035	0.267	1	
BJ321-BJ277	6	0.015	0.012	0.095	1	
BJ322-BJ277	6	0.02	0.048	0.375	1	
BJ327-BJ280	6	0.029	0.563	4.4	1	
BJ330-BJ280	6	0.015	0.145	1.135	1	
BJ366-BJ328	6	0.005	0.551	4.258	2	Yes
BJ367-BJ366	6	0.04	0.545	4.242	1	
BV92-JN710	6	0	0	0.039	4	
JN104-JN37	6	0	0.008	0.206	4	
JN11-JN10	10	-0.01	0.518	12.493	3	
JN12-JN11	8	0.004	0.132	0.571	1	
JN124-JN123	8	-0.009	0.479	21.595	3	
JN139-JN68	10	-0.001	0.422	14.987	3	
JN140-JN139	10	0.005	0.413	1.167	1	
JN141-JN140	10	0	0.408	1.155	4	
JN142-JN141	6	0.195	0.138	1.208	1	
JN16-JN15	21	0	1.285	1.495	4	
JN25-JN24	6	0	0.096	42.315	4	
JN260-JN186	8	0.001	0.323	1.377	2	Yes
JN478-JN477	6	0	0.007	0.095	4	
JN5-JN4	15	0	0.522	1.054	4	
JN73-JN72	8	-0.005	0.057	24	3	
JN74-JN73	8	0.024	0.054	0.24	1	
JN743-JN112	18	0	0.742	0.628	4	
JN8-JN7	15	0	0.52	1.102	4	
TK131-TK80	12	0.016	0.651	1.283	1	
TK133-TK132	12	-0.006	0.64	11.925	3	
TK134-TK133	12	0.002	0.64	1.259	1	
TK15-TK14	14	-0.002	0.2	8.988	3	
TK176-TK134	12	0.002	0.542	1.065	1	
TK177-TK176	12	0.002	0.531	1.045	1	
TK243-TK242	6	0	0.006	0.09	4	
TK4-TK3	21	0	2.494	1.604	4	
TK50-TK15	14	0.002	0.172	0.244	1	
TK535-TK534	10	0.004	0.914	2.901	2	Yes
TK536-TK535	10	0.004	0.91	2.873	2	Yes
TK561-TK560	8	0.04	0.159	0.701	1	
TK74-TK30	12	-0.001	1.676	3.254	3	
TK80-TK79	12	-0.007	0.671	13.55	3	
TK89-TK88	12	0	0.648	1.236	4	
TK90-TK89	6	0.049	0.006	1.177	1	
TR212-TR211	15	-0.027	0.493	9.293	3	
TR213-TR212	15	0.005	0.493	0.621	1	
TR425-TR424	15	-0.02	0.243	9.559	3	
TR426-TR425	15	0.011	0.243	0.306	1	
TR70-TR43	15	-0.017	0.119	9.708	3	
TR71-TR70	15	0.016	0.119	0.149	1	
UT104-UT53	6	0	0.031	0.244	4	
UT1231-UT1230	8	0.002	0.462	2.025	2	Yes
UT155-UT91	21	0.001	3.927	2.563	2	Yes

Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
UT156-UT155	21	0.001	3.93	2.552	2	Yes
UT157-UT156	21	0.004	3.931	2.528	1	
UT158-UT157	21	0	3.968	2.528	4	
UT159-UT158	21	0.001	3.975	2.553	2	Yes
UT160-UT159	21	0.001	3.89	2.498	2	Yes
UT161-UT160	21	0.001	3.896	2.503	2	Yes
UT162-UT161	21	0.001	3.9	2.507	2	Yes
UT163-UT162	21	0.001	3.898	2.506	2	Yes
UT164-UT163	21	0.001	3.901	2.508	2	Yes
UT165-UT164	21	0.006	3.881	2.496	1	
UT166-UT165	12	0.008	1.004	2.686	1	
UT1697-UT1696	6	0.004	0.267	2.076	2	Yes
UT1698-UT1697	6	0.004	0.264	2.05	2	Yes
UT1699-UT1698	6	0.004	0.26	2.023	2	Yes
UT1700-UT1699	6	0.004	0.256	2.007	2	Yes
UT1701-UT1700	6	0.004	0.253	1.968	2	Yes
UT1728-UT1511	6	0.005	0.297	2.306	2	Yes
UT18-UT17	8	0.012	0.157	0.685	1	
UT1874-UT1701	6	0.004	0.246	1.915	2	Yes
UT1887-UT1728	6	0.005	0.299	2.242	2	Yes
UT1997-UT1874	6	0.004	0.241	2.082	2	Yes
UT1998-UT1997	6	0.004	0.239	1.872	2	Yes
UT1999-UT1998	6	0.004	0.238	2.062	2	Yes
UT2000-UT1999	8	0.004	0.234	1.025	1	
UT2001-UT2000	6	0.004	0.23	2.036	2	Yes
UT2140-UT2043	8	-0.001	0.29	35.296	3	
UT233-UT159	8	0.005	0.078	0.335	1	
UT240-UT159	6	0.042	0.066	0.512	1	
UT242-UT164	6	0.002	0.032	0.889	1	
UT251-UT165	21	0.001	2.878	1.992	2	Yes
UT252-UT251	21	0.001	2.892	2.042	2	Yes
UT308-UT307	12	0	0.868	1.641	4	
UT36-UT35	21	0.001	4.022	2.774	2	Yes
UT37-UT36	21	0.001	4.03	2.781	2	Yes
UT38-UT37	21	0.001	4.036	2.805	2	Yes
UT380-UT379	15	0.002	2.038	2.76	2	Yes
UT381-UT380	15	0.002	2.04	2.57	2	Yes
UT382-UT381	15	0.003	2.041	2.572	1	
UT383-UT382	15	0.002	2.041	2.737	2	Yes
UT384-UT383	15	0.002	2.042	2.689	2	Yes
UT385-UT384	15	0.002	1.878	2.365	1	
UT387-UT386	15	0.002	1.88	2.687	2	Yes
UT389-UT388	15	0.002	1.885	2.681	2	Yes
UT39-UT38	21	0.001	4.041	2.813	2	Yes
UT40-UT39	21	0.001	4.044	2.806	2	Yes
UT41-UT40	21	0.001	3.995	2.568	2	Yes
UT42-UT41	21	0.001	3.998	2.57	2	Yes
UT43-UT42	21	0.003	3.998	2.572	1	
UT449-UT448	10	0	0.189	0.516	4	
UT47-UT46	21	0.001	3.953	2.575	2	Yes

Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
UT48-UT47	21	0.001	3.935	2.519	2	Yes
UT49-UT48	21	0.001	3.945	2.532	2	Yes
UT50-UT49	6	0.017	0.039	2.251	1	
UT567-UT384	10	0.032	0.208	0.589	1	
UT611-UT398	6	0.037	0.1	0.778	1	
UT657-UT656	10	0	0.024	0.128	4	
UT68-UT40	10	0.007	0.186	0.513	1	
UT73-UT43	8	0.019	0.189	0.835	1	
UT819-UT615	15	-0.001	1.41	11.817	3	
UT90-UT49	21	0.001	3.935	2.525	2	Yes
UT91-UT90	21	0.001	3.942	2.548	2	Yes
UT92-UT91	6	0.011	0.049	2.034	1	
UT978-UT977	6	0	0.038	0.274	4	
UT989-UT760	6	0	0.006	0.127	4	

Table A-2. Future 25-Year Year Storm						
Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
AT107-AT66	8	0.004	0.346	1.501	1	
AT109-AT66	6	0.009	0.013	0.103	1	
AT131-AT89	6	0.015	0.014	0.11	1	
AT135-AT99	12	0.002	0.893	1.739	1	
AT136-AT135	10	0.003	0.648	1.788	1	
AT14-AT13	18	0.003	4.656	4.051	2	Yes
AT146-AT107	6	0.008	0.012	0.091	1	
AT15-AT14	18	0.018	4.666	4.07	1	
AT16-AT2	24	0.002	3.38	1.643	1	
AT165-AT136	10	0.002	0.635	2.274	1	
AT166-AT165	10	0.002	0.638	1.842	2	Yes
AT17-AT16	18	0.002	3.129	2.665	2	Yes
AT18-AT17	18	0.003	3.194	2.741	1	
AT19-AT18	12	0.006	1.197	2.356	1	
AT2-AT1	24	-0.009	4.16	2.048	3	
AT200-AT166	10	0.002	0.605	1.67	1	
AT201-AT200	6	0.008	0.054	0.419	1	
AT22-AT21	12	0.002	1.183	2.412	2	Yes
AT23-AT22	6	0.02	0.039	0.299	1	
AT230-AT200	8	0.011	0.551	2.399	1	
AT25-AT4	6	0	0.004	0.03	4	
AT29-AT8	8	0.003	0.433	1.876	1	
AT30-AT29	8	0.004	0.422	1.83	1	
AT42-AT16	8	0.021	0.342	1.505	1	
AT48-AT18	12	0.005	2.082	4.04	2	Yes
AT49-AT48	8	0.007	1.458	6.402	2	Yes
AT50-AT49	8	0.003	1.461	6.427	2	Yes
AT51-AT50	8	0.003	1.469	6.477	2	Yes
AT52-AT51	8	0.003	1.291	5.624	2	Yes
AT53-AT52	8	0.013	1.306	5.698	2	Yes
AT54-AT53	8	0.004	1.303	5.586	2	Yes
AT55-AT54	8	0.039	0.944	4.127	1	
AT66-AT30	8	0.003	0.362	1.569	1	
AT68-AT30	6	0.018	0.05	0.385	1	
AT8-AT7	8	0.004	0.789	3.425	2	Yes
AT89-AT51	6	0.02	0.197	1.546	1	
AT90-AT89	6	0.031	0.182	1.423	1	
AT95-AT60	12	0	0.958	9.958	4	
AT96-AT95	12	0.002	0.945	1.86	1	
AT97-AT96	12	0.002	0.909	1.79	1	
AT98-AT97	12	0.002	0.903	1.754	1	
AT99-AT98	12	0.001	0.896	1.845	2	Yes
BJ196-BJ186	12	0.003	1.27	2.581	2	Yes
BJ197-BJ196	6	0.007	0.054	0.418	1	
BJ208-BJ207	8	0	0.577	2.379	4	
BJ209-BJ208	8	0.041	0.296	1.3	1	
BJ234-BJ196	10	0.004	1.201	3.365	2	Yes
BJ235-BJ234	6	0.006	0.045	0.351	1	
BJ240-BJ196	6	0.014	0.014	0.105	1	

Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
BJ242-BJ208	6	0.007	0.297	2.316	1	
BJ25-BJ24	18	0	1.129	0.956	4	
BJ275-BJ234	10	0.007	1.149	3.227	1	
BJ276-BJ275	8	0.007	0.879	3.855	2	Yes
BJ277-BJ276	8	0.007	0.826	3.615	2	Yes
BJ278-BJ277	8	0.007	0.766	3.34	2	Yes
BJ279-BJ278	8	0.01	0.765	3.345	1	
BJ280-BJ279	6	0.021	0.74	5.782	2	Yes
BJ281-BJ280	6	0.01	0.007	0.053	1	
BJ282-BJ234	6	0.007	0.008	0.058	1	
BJ308-BJ275	6	0.007	0.254	1.966	1	
BJ315-BJ276	6	0.006	0.035	0.274	1	
BJ321-BJ277	6	0.015	0.012	0.095	1	
BJ322-BJ277	6	0.02	0.049	0.382	1	
BJ327-BJ280	6	0.029	0.582	4.546	1	
BJ328-BJ327	6	0.025	0.577	5.114	2	Yes
BJ330-BJ280	6	0.015	0.147	1.144	1	
BJ332-BJ330	6	0.103	0.114	0.899	1	
BJ366-BJ328	6	0.005	0.569	4.403	2	Yes
BJ367-BJ366	6	0.04	0.563	4.386	1	
BJ380-BJ330	6	0.007	0.023	0.176	1	
BV92-JN710	6	0	0	0.039	4	
JN104-JN37	6	0	0.008	0.206	4	
JN11-JN10	10	-0.01	0.547	15.686	3	
JN12-JN11	8	0.004	0.148	0.641	1	
JN124-JN123	8	-0.009	0.527	26.838	3	
JN139-JN68	10	-0.001	0.478	18.377	3	
JN140-JN139	10	0.005	0.469	1.324	1	
JN141-JN140	10	0	0.465	1.314	4	
JN142-JN141	6	0.195	0.167	1.317	1	
JN16-JN15	21	0	1.424	1.532	4	
JN20-JN19	6	0.003	0.225	1.826	2	Yes
JN25-JN24	6	0	0.1	51.821	4	
JN260-JN186	8	0.001	0.347	1.486	2	Yes
JN261-JN260	8	0.059	0.336	1.481	1	
JN478-JN477	6	0	0.007	0.096	4	
JN5-JN4	15	0	0.552	1.067	4	
JN59-JN58	10	0.002	0.608	1.912	2	Yes
JN66-JN65	10	0.001	0.569	1.713	2	Yes
JN67-JN66	10	0.002	0.57	1.614	1	
JN73-JN72	8	-0.005	0.058	29.396	3	
JN74-JN73	8	0.024	0.056	0.246	1	
JN743-JN112	18	0	0.825	0.7	4	
JN8-JN7	15	0	0.549	1.116	4	
JN82-JN20	8	0.013	0.108	0.477	1	
TK1-TK-WW	24	0.012	4.405	6.131	1	
TK11-TK1	14	0.007	0.251	0.361	1	
TK131-TK80	12	0.016	0.691	1.362	1	
TK133-TK132	12	-0.006	0.679	14.327	3	
TK134-TK133	12	0.002	0.678	1.334	1	

Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
TK15-TK14	14	-0.002	0.2	10.77	3	
TK154-TK89	12	0.002	0.678	1.333	1	
TK176-TK134	12	0.002	0.578	1.135	1	
TK177-TK176	12	0.002	0.566	1.114	1	
TK2-TK1	24	0.002	3.942	3.128	1	
TK243-TK242	6	0	0.006	0.091	4	
TK3-TK2	21	0.002	2.662	2.675	1	
TK4-TK3	21	0	2.662	1.712	4	
TK463-TK438	8	0.002	0.344	1.729	2	Yes
TK5-TK4	21	0.006	2.662	1.712	1	
TK50-TK15	14	0.002	0.173	0.244	1	
TK534-TK514	10	0.005	0.982	3.159	2	Yes
TK535-TK534	10	0.004	0.978	2.899	2	Yes
TK536-TK535	10	0.004	0.974	2.798	2	Yes
TK561-TK560	8	0.04	0.169	0.746	1	
TK575-TK536	10	0.002	0.343	0.972	1	
TK6-TK5	21	0.008	2.661	1.712	1	
TK7-TK6	10	0.007	0.21	0.591	1	
TK74-TK30	12	-0.001	1.701	3.315	3	
TK80-TK79	12	-0.007	0.711	15.988	3	
TK89-TK88	12	0	0.684	1.302	4	
TK90-TK89	6	0.049	0.006	1.196	1	
TR212-TR211	15	-0.027	0.538	10.848	3	
TR213-TR212	15	0.005	0.538	0.677	1	
TR425-TR424	15	-0.02	0.268	11.096	3	
TR426-TR425	15	0.011	0.268	0.337	1	
TR70-TR43	15	-0.017	0.131	11.26	3	
TR71-TR70	15	0.016	0.131	0.165	1	
UT104-UT53	6	0	0.032	0.253	4	
UT1231-UT1230	8	0.002	0.488	2.138	2	Yes
UT1232-UT1231	8	0.054	0.481	2.129	1	
UT155-UT91	21	0.001	4.148	2.665	2	Yes
UT156-UT155	21	0.001	4.151	2.668	2	Yes
UT157-UT156	21	0.004	4.152	2.671	1	
UT158-UT157	21	0	4.193	2.671	4	
UT159-UT158	21	0.001	4.2	2.697	2	Yes
UT160-UT159	21	0.001	4.111	2.64	2	Yes
UT161-UT160	21	0.001	4.118	2.646	2	Yes
UT162-UT161	21	0.001	4.122	2.65	2	Yes
UT163-UT162	21	0.001	4.12	2.649	2	Yes
UT164-UT163	21	0.001	4.123	2.651	2	Yes
UT165-UT164	21	0.006	4.102	2.638	1	
UT166-UT165	12	0.008	1.069	2.692	1	
UT1697-UT1696	6	0.004	0.281	2.186	2	Yes
UT1698-UT1697	6	0.004	0.278	2.156	2	Yes
UT1699-UT1698	6	0.004	0.274	2.127	2	Yes
UT170-UT169	12	0.001	0.921	1.981	2	Yes
UT1700-UT1699	6	0.004	0.269	2.098	2	Yes
UT1701-UT1700	6	0.004	0.265	2.065	2	Yes
UT1728-UT1511	6	0.005	0.345	2.603	2	Yes

Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
UT1729-UT1728	6	0.058	0.007	0.053	1	
UT18-UT17	8	0.012	0.179	0.786	1	
UT1874-UT1701	6	0.004	0.257	1.997	2	Yes
UT1887-UT1728	6	0.005	0.346	2.616	2	Yes
UT1997-UT1874	6	0.004	0.251	2.071	2	Yes
UT1998-UT1997	6	0.004	0.249	1.95	2	Yes
UT1999-UT1998	6	0.004	0.248	2.053	2	Yes
UT2000-UT1999	8	0.004	0.243	1.065	1	
UT2001-UT2000	6	0.004	0.237	2.031	2	Yes
UT2002-UT2001	6	0.004	0.231	1.807	2	Yes
UT2003-UT2002	6	0.004	0.226	1.766	1	
UT2004-UT2003	6	0.004	0.22	1.722	1	
UT2005-UT2004	6	0.004	0.211	1.659	1	
UT2006-UT2005	6	0.004	0.213	1.968	1	
UT2007-UT2006	6	0.004	0.211	1.654	1	
UT2008-UT2007	6	0.004	0.212	2.086	1	
UT2009-UT2008	6	0.003	0.21	1.873	2	Yes
UT2010-UT2009	6	0.004	0.206	1.601	1	
UT2011-UT2010	6	0.004	0.205	2.075	1	
UT2012-UT2011	8	0.004	0.207	0.906	1	
UT2140-UT2043	8	-0.001	0.307	40.938	3	
UT233-UT159	8	0.005	0.08	0.344	1	
UT234-UT233	8	0.003	0.077	1.49	1	
UT240-UT159	6	0.042	0.07	0.546	1	
UT242-UT164	6	0.002	0.033	0.907	1	
UT243-UT242	6	0.005	0.034	0.259	1	
UT251-UT165	21	0.001	3.034	1.952	2	Yes
UT252-UT251	21	0.001	3.051	2.006	2	Yes
UT253-UT252	21	0.007	3.056	1.963	1	
UT255-UT254	18	0.002	3.075	2.997	2	Yes
UT256-UT255	18	0.002	3.084	2.976	2	Yes
UT257-UT256	18	0.002	3.09	2.966	2	Yes
UT258-UT257	18	0.002	3.095	2.948	2	Yes
UT259-UT258	18	0.002	3.093	2.706	2	Yes
UT260-UT259	18	0.002	3.096	3.024	2	Yes
UT308-UT307	12	0	0.925	1.75	4	
UT36-UT35	21	0.001	4.275	2.757	2	Yes
UT37-UT36	21	0.001	4.283	2.765	2	Yes
UT38-UT37	21	0.001	4.289	2.789	2	Yes
UT380-UT379	15	0.002	2.13	2.76	2	Yes
UT381-UT380	15	0.002	2.132	2.686	2	Yes
UT382-UT381	15	0.003	2.133	2.689	2	Yes
UT383-UT382	15	0.002	2.134	2.737	2	Yes
UT384-UT383	15	0.002	2.134	2.692	2	Yes
UT385-UT384	15	0.002	1.963	2.472	2	Yes
UT386-UT385	15	0.002	1.965	2.476	1	
UT387-UT386	15	0.002	1.965	2.685	2	Yes
UT388-UT387	15	0.002	1.965	2.477	1	
UT389-UT388	15	0.002	1.97	2.68	2	Yes
UT39-UT38	21	0.001	4.294	2.8	2	Yes

Pipe Name	Diameter (in)	Slope (%)	Maximum Flow (mgd)	Maximum Adjusted Velocity (ft/s)	Surcharge State	Throttled
UT40-UT39	21	0.001	4.298	2.83	2	Yes
UT41-UT40	21	0.001	4.22	2.712	2	Yes
UT42-UT41	21	0.001	4.222	2.715	2	Yes
UT43-UT42	21	0.003	4.223	2.716	1	
UT44-UT43	21	0.005	4.15	2.669	1	
UT449-UT448	10	0	0.197	0.539	4	
UT47-UT46	21	0.001	4.176	2.678	2	Yes
UT48-UT47	21	0.001	4.157	2.661	2	Yes
UT49-UT48	21	0.001	4.167	2.674	2	Yes
UT50-UT49	6	0.017	0.04	2.275	1	
UT567-UT384	10	0.032	0.216	0.613	1	
UT592-UT389	12	0.005	0.504	0.991	1	
UT611-UT398	6	0.037	0.104	0.807	1	
UT657-UT656	10	0	0.028	0.132	4	
UT68-UT40	10	0.007	0.251	0.711	1	
UT73-UT43	8	0.019	0.2	0.883	1	
UT819-UT615	15	-0.001	1.468	13.28	3	
UT90-UT49	21	0.001	4.157	2.668	2	Yes
UT91-UT90	21	0.001	4.164	2.674	2	Yes
UT92-UT91	6	0.011	0.051	2.058	1	
UT978-UT977	6	0	0.039	0.287	4	
UT989-UT760	6	0	0.007	0.131	4	

BROWN AND CALDWELL

Technical Memorandum

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Prepared for: South Tahoe Public Utilities District, South Tahoe, California

Project Title: STPUD Collection Systems Master Plan

Project No: 132364-003

Technical Memorandum No. 9

Subject: Design Criteria (Task 2.4)

Date: December 30, 2009

To: Paul Sciuto, Assistant General Manager

From: Peter Bellows, Project Manager
Engineer in Responsible Charge, Ca. Lic. No. C 34337

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1. INTRODUCTION

This Technical Memorandum (TM) No. 9 reviews the South Tahoe Public Utility District's (STPUD or District) existing design criteria and compares it to industry standards and typical criteria for a wastewater collection system. The scope of this task includes recommending updates to the criteria based on this review and analysis performed in other tasks. This task does not address non-technical criteria and specifications such as general provisions, regulations, fees, etc.

Several local standards were reviewed including Town of Truckee (Truckee) Engineering Standards, Central Contra Costa Sanitary District (CCCSD) Standard Specifications, Sacramento Area Sewer District (SASD formerly County Sanitation District 1 of Sacramento, CA) Sanitary Trunk Sewer Design Manual, City of Reno Public Works Design Manual, and Lyon County Utilities Department (Lyon) Wastewater Lift Station Package Design Standards. El Dorado County and Placer County Standard Specifications and Design Standards have only limited coverage of sewer systems.

It is recommended that the District's criteria be focused on replacement and rehabilitation as opposed to collection system expansion due to the restrictive nature of development in the area.

2. REVIEW OF EXISTING DISTRICT DESIGN CRITERIA

The STPUD criteria currently include parts of Administrative Code Section 4 listing general requirements and a set of standard details. These documents are described below. A copy of Administrative Code Section 4 and the standard details are in Attachment A.

2.1 Administrative Code Section 4

Section 4 includes the following subsections: General Provisions, Sewer Permits, Sewer Specifications, Sewer Construction, Sewer Fees/Rates/Schedules, Use of Public Sewers, Maintenance and Repair of Sewers, and Sewer Capacity. This document mentions both public sewers and sewer laterals, but focuses mainly on laterals.

The subsection that mainly pertains to design criteria is the Public Sewer Specifications section. Parts of the Public Sewer Construction section, Use of Public Sewers section, and Maintenance and Repair of Sewers section also include some design criteria. The current District criteria does not contain several items that are key to design such as trench design, pipe rehabilitation procedures, and pump station and force main design.

2.2 Standard Details

The District details include the following: manhole, drop manhole, sewer clean out, grease interceptor installation, sewer main flush inlet, sewer lateral connection, sewer lateral installation, sewer lateral abandonment, sewer lateral replacement at crossing of pipe trench, and force main replacement at crossing of pipe trench detail.

3. RECOMMENDED DESIGN AND CONSTRUCTION CRITERIA

The categories of recommended general and specific criteria are discussed in this section. These criteria will help ensure the quality of the design and construction of sewer related structures. Design criteria cover flow projections and other related design work. Construction criteria cover requirements for constructing pipelines and manholes.

Table 1 lists a compilation of recommended criteria for the District. The table indicates where the existing District standards cover the recommended criteria and lists examples for criteria that are not currently covered. The CCCSD standards are the most comprehensive for collection systems similar to the District's system. It is recommended that the District expand its design and construction criteria to include the topics in Table 1 and consider the listed example criteria as guidance for developing its own criteria.

Further discussion of these criteria is below.

Table 1. Recommended Design and Construction Criteria				
Category	**Criteria**	**Current District Criteria**	**Example Criteria**	**Comments**
Design Criteria				
Flows	Flows		STPUD Wastewater Master Plan and Peaking factor	
Pipe Design	Pipe Friction Factor n		CCCSD Standard Spec Section 4-01.C.3	
	Pipe % Full		CCCSD Standard Spec Section 4-01.C.1	
	Pipe - Minimum Size		CCCSD Standard Spec Section 4-02.A.1	
	Pipe Slope		CCCSD Standard Spec Section 4-01.C.2 and 4-02.A.4, excluding the ductile iron requirements.	
	Pipe - Rehab: Slip lining, CIPP		Green Book Standard Specs for Public Works Construction and Contractor Requirements	
Manholes	MH Spacing		CCCSD Standard Spec Section 4-03.A.1	
Construction Criteria				
Sewer Pipe	Pipe - Materials		CCCSD Standard Spec Section 18-01	Incorporate District approved materials from this section.
	Trench	S6-D1, D2		
	Pipe - Cleaning and Testing		CCCSD Standard Spec Section 18-03	
	Water/Sewer Pipe Separation	S6-D4	CDPH Guidance Criteria for the Separation of Water Mains and Non-Potable Pipelines	In the case that the District's separation requirements as shown in the Detail cannot be met, the CDPH (formerly DHS) document outlines special construction guidelines.
Laterals	Lateral Connections & Installation	S7-D6, D7		
	Sewer Lateral Abandonment	S7-D8		
	Sewer Lateral Replacement at Crossing of Pipe Trench	S7-D9		
	Sewer Clean-Outs	S7-D3		
	Sewer Main Flush Inlet	S7-D5		

Table 1. Recommended Design and Construction Criteria				
Category	**Criteria**	**Current District Criteria**	**Example Criteria**	**Comments**
Manholes	MH - Materials	S7-D1	For additional pre-cast requirements:	
	MH Diameter	S7-D1		
	MH - Rehab MH - Frame & Cover		Green Book Standard Specs for Public Works Construction City of Reno Detail R-218	
	MH - Bases	S7-D1	Cast-in-Place	
	MH - Connections for Side Sewers	S7-D1, Note 5		
Force Main Design	Materials			Consider adopting pipe materials for water distribution system with appropriate modifications for wastewater
	Connections	S5-D1, D2		
	Thrust Restraint			Consider adopting thrust restraints for water distribution system
	Supports	S5-D3		
	Manhole Connection			No standard details were found. Force main discharges should minimize turbulence. The discharge transition is typically accomplished at a manhole or similar structure and the discharge is submerged, thereby maintaining a constant static head on the force main for the pumping system. Keeping the force main full also reduces the potential for corrosion of the force main.
	Sewer Force Main Replacement at Crossing of Pipe Trench	S7-D10		

Table 1. Recommended Design and Construction Criteria

Category	Criteria	Current District Criteria	Example Criteria	Comments
Execution, Excavation and Backfill	USA		Call USA North 811	
	Traffic Control		City/County Requirements	
	Erosion		BMP's	
	Shoring		Cal OSHA	
	Dewatering		CCCSD/Green Book	
	Excavation - Bottom of trench		CCCSD/Green Book	
	Bedding Material	District MH Detail		
	Geotextile		CCCSD/Green Book	
	Backfill	District MH Detail		
	Foundation		CCCSD/Green Book	
	Cover	District MH Detail		
	Controlled Density Fill		CCCSD/Green Book	
	MH	S7-D1, D2		
	Casing	S5-D4, D5		
Restoration	AC Concrete-Sidewalk	S6-D1	City of South Lake Tahoe/County City of South Lake Tahoe/County	
	Concrete-Gutter		City of South Lake Tahoe/County	
	Concrete-Driveway		City of South Lake Tahoe/County	
	Base		City of South Lake Tahoe/County	
	Sub-base		City of South Lake Tahoe/County	
	Compaction		City of South Lake Tahoe/County	
FOG	Grease trap		CCCSD Standard Spec Section 4-03.F.1 and 4-03.F.2	
	Grease interceptor		CCCSD Standard Spec Section 4-03.F.1 and 4-03.F.2	
Details	Grease trap		CCCSD Standard Spec Section 22-44, 45, 46, and 47	
	Grease interceptor	S7-D4	CCCSD Standard Spec Section 22-44, 45, 46, and 47	

3.1 Design Criteria

Design criteria should provide standard methods of determining pipe diameter, slope, length, roughness coefficient for Manning's equation, design capacity, full pipe capacity, design flow and the percent of full pipe capacity utilized.

3.1.1 Design Flow

As part of the Sewer Master Plan, a hydraulic model was developed and calibrated using flow meter data. The average daily flow should be estimated using the method described in TM 6 Hydraulic Model Calibration, in which the calibrated model base flow per land use and GWI are discussed. Table 2 lists the calibrated unit flow factors by land use and the amount of dry weather GWI for calculating average daily flow.

Table 2. Unit Flow Factors by Land Use

Land Use Category	TM 3 Flow Factor	Calibrated Flow Factor	Unit	Allocated System Load (mgd)[1]
Campground	Parcel specific	7 Parcels	gpd/parcel	0.070
Commercial	1,100	1,210	gpd/acre	0.286
Industrial	450	450	gpd/acre	0.085
Multi-Family Residential	2,850	3,135	gpd/acre	1.157
Motel/Hotel	2,700	2,970	gpd/acre	0.434
Miscellaneous	150	165	gpd/acre	0.055
Non-Contributing	0	0	gpd/acre	-
Point Source	Varies by source	Varies by source	gpd/parcel	0.300
Single-Family Residential	160	155	gpd/parcel	2.428

A peaking factor of 3.5 should be used to estimate peak wet weather flow. This peaking factor is based on dividing the modeled hourly peak during a 25-year design storm by the average daily base flow.

3.1.2 Pipe Design

Minimum pipe sizes and standards are used so that the collection system is designed to be reliable and to require minimal maintenance. The recommend criteria for pipes are based on analysis performed on this project. For example, a recommendation based on the pipeline condition assessment was to increase the minimum size of pipe to 8 inches due to the hydraulic and maintenance issues associated with 6-inch pipe.

3.2 Construction Criteria

Construction criteria include standard details and specifications for new construction and rehabilitation of existing facilities. The District already has details that address many aspects of design criteria for new pipes and manholes. Gaps in the existing criteria can be filled with information from other agencies.

The review of listed sources found few specifications for sewer rehabilitation. The most information was found in the APWA Green Book and the Louisiana Tech Trenchless Technology Center website (www.coes.latech.edu/ttc/), which does research on the latest rehabilitation methods. Rehabilitation methods continue to be developed and the appropriate method depends on a variety of factors including host pipe material, condition, and surrounding soil. The District may decide to handle rehabilitation on a case by case basis instead of adopting standards.

3.3 Execution, Excavation and Backfill

The current District standards do not contain criteria for many of the construction-related categories, but relies instead on District/Inspector approval. In order to provide consistent quality and type of construction, the criteria listed in Table 1 are recommended for the District.

3.4 Restoration

Surface restoration should be in accordance with either the City or County depending on which agency has jurisdiction.

3.5 FOG

The District currently has a detail for a grease interceptor. Additional language and a detail can be added for grease traps.

3.6 Pump Stations

The Master Plan recommends that the District develop a standard design for submersible pump stations which can used to replace existing pump stations and construct new pump stations. None of the standards from other agencies that were reviewed for this TM have appropriate pump station standards that the District could adopt. The District should develop its own standard design based on its experience, specialized needs based on its location, and need to standardize valves, pumps, generators, and electronic equipment. A list of standard specifications and drawings that was used for the Lyon County Wastewater Lift Station package is in Attachment B as an example of what should be included for standard pump station design criteria.

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ATTACHMENT A: ADMINISTRATIVE CODE SECTION 4 AND STPUD STANDARD DETAILS

SECTION 4 SEWER

Section 4.1 General Provisions.

4.1.1 ***Rules and Regulations.*** The following rules and regulations respecting sewer construction, disposal of sewage, drainage of buildings and connection to the sewer works of the District are adopted. All related work shall be performed according to the Uniform Plumbing Code or as otherwise specified herein.

4.1.2 ***Purpose.*** This Section is intended to provide certain minimum standards, provisions and requirements for design, methods of construction, and use of materials in sanitary sewage facilities, and in side sewers hereafter installed, altered or repaired. This Section shall not apply retroactively and, in the event of an alteration or repair hereafter made, it shall apply only to the new materials and methods used. This Section is also intended to provide a schedule of annual charges for sewer services, payable in advance.

4.1.3 ***Failure to Use Public Sewer Unlawful.*** Following the effective date of this Section 4, it shall be unlawful for any person to connect, construct, install, provide, maintain or use any other means of sewage disposal from any building in the District except by connection to a public sewer in the manner as provided in this Section 4.

4.1.4 ***Plumbing, Inspection, Compensation.*** The Board shall employ the General Manager to perform the duties of inspecting the installation, connection, maintenance and use of all sewer laterals and plumbing, sewerage, sanitary drainage work and related facilities within the boundaries of the District. The General Manager may assign such inspection duties to his/her designee.

4.1.5 ***Powers and Authorities of Inspectors.*** The officers, inspectors and any duly authorized employees of the District shall wear or carry evidence establishing his or her position as such and upon exhibiting the proper credentials and identification shall be permitted to enter in and upon any and all buildings, industrial facilities and properties for the purposes of inspection, reinspection, observation, measurement, sampling, testing or otherwise performing such duties as may be necessary for the enforcement of the provisions of Ordinances, rules and regulations of the District.

4.1.6 ***Right of Entry by District.*** Authorized representatives of the District shall have the right of ingress to and egress from a customer's property at reasonable hours for any purpose reasonably related to this Section 4, and all Ordinances, rules, regulations, and specifications of the District duly adopted or amended.

Section 4.2 Sewer Permits.

4.2.1 ***Sewer Permit Required.*** No unauthorized person shall uncover, make any connections with or opening into, use, alter or disturb any public sewer or appurtenance, perform any work on any sewer or drainage system or construct a sewer lateral without first obtaining a written sewer permit from the District and paying all required fees and connection charges. The application for a sewer permit shall be on a form approved and provided by the District.

4.2.2 ***Grant of Permit by Board Optional.*** The granting of such permit shall be optional with the Board.

4.2.3 ***Classes of Permits.*** There shall be two (2) classes of permits, as follows:

(a) Sewer lateral construction permit.

(b) Public sewer construction permit.

4.2.4 ***Plans, Profiles, and Specifications Required.*** The application for a permit for public sewer construction shall be accompanied by complete plans, profiles and specifications prepared by a Registered Civil Engineer showing all details of the proposed work based on an accurate survey of the ground and complying with all applicable provisions of the Ordinances, rules and regulations of District. The application, together with the plans, profiles and specifications, shall be examined by the General Manager or his/her designee who shall approve them as submitted or require them to be modified as he/she deems necessary for proper installation. After examination by the General Manager, or his/her designee, the application, plans, profiles and specifications shall be submitted to the Board at its next regular meeting for its consideration. When the Board is satisfied that the proposed work is proper and the plans, profiles and specifications are sufficient and correct, it shall order the issuance of a permit predicated upon the payment of all connection charges, fees, and furnishing of bonds as may be required by the District. The permit shall prescribe such terms and conditions as the Board finds necessary in the public interest.

4.2.5 ***Special Power of Attorney.*** The legal owner of record of a parcel of real property may give an acknowledged Special Power of Attorney to any person for the purpose of applying to the District for a sewer permit.

4.2.6 ***Agreement.*** The application for a sewer permit, as set forth in Section 4.6.4, shall constitute an agreement to comply with all of the provisions, terms and requirements of the Ordinances, rules and regulations of the District, and with the plans and specifications filed with the application, if any, together with such corrections or modifications as may be made or permitted by the District. Such agreement shall be binding upon the applicant and may be altered only by the District upon the written request for the alteration by the applicant.

4.2.7 ***Compliance With Permit.*** After approval of the application, as evidenced by the issuance of a sewer permit, no changes shall be made in the occupancy, use, location, grade, materials or other details from those described in the permit or as shown on the plans and specifications for which the sewer permit was issued without the express written permission from the District, the District Inspector, or other authorized representative, or the filing of a new application.

4.2.8 ***<u>Fees and Connection Charges.</u>*** All connection charges, fees and other charges in the District, and in areas annexed thereto as set forth in the Ordinances, rules and regulations of the District, shall be paid and complied with in the manner provided in said Ordinances, rules and regulations. All fees collected on behalf of the District shall be deposited with the proper authority, as determined by the District, to receive such funds.

4.2.9 ***<u>Permits for Sewers Outside District Jurisdiction.</u>*** A permit shall not be granted to connect any lot or parcel of land outside or excluded from the District to any public sewer in or under the jurisdiction of the District unless a petition for annexation is filed with the Clerk of the District. All provisions of annexation to the District, as heretofore or hereafter fixed, shall be prior to issuing a sewer permit. All sewer work constructed shall be inspected in accordance with Sections 4.4.8 and 4.4.10.

4.2.10 ***<u>Time Limits On Sewer Permits.</u>*** A sewer permit for construction of a public or sewer lateral shall be null and void:

a) If construction project is not accepted by County or City for the proposed improvement to be served by the sewer; or

b) If the County or City voids or cancels either the application or permit for construction of the proposed improvement to be served by the sewer.

4.2.11 ***<u>Easements or Right-of-Way.</u>*** In the event that an easement is required for the extension of the public sewer or the making of connections, the applicant shall procure and have accepted by the Board a proper easement or grant of right-of-way as determined by the District to allow the laying and maintenance of such extension or connection.

4.2.12 ***<u>Street Excavation Permit.</u>*** A separate permit must be secured by owners or contractors intending to excavate in a public street for the purpose of installing or repairing sewers or making sewer connections from the State, County, City or any other public entity with appropriate jurisdiction.

Section 4.3 <u>Public Sewer Specifications.</u>

4.3.1 ***<u>Design and Construction Standards.</u>*** Minimum standards for the design and construction of public sewers within the District shall be in accordance with the applicable provisions of the Ordinances, rules, regulations and with the current District specifications for public sewer construction. The District may permit modifications or may require higher standards as conditions dictate, in the District's discretion.

4.3.2 ***<u>Separate Sewers.</u>*** No two adjacent lots fronting on the same street shall be permitted to join in the use of the same sewer lateral. Every building or industrial facility must be

separately connected with a public sewer if such public sewer exists in the street upon which the property abuts or in an easement which will serve said property.

4.3.3 ***Connection to Public Sewer.*** The connection of the sewer lateral into the public sewer shall be made at the lateral or "Y" or "T" branch, if such lateral or "Y" or "T" branch is available at a suitable location. Where no "Y" or "T" branch is available, a neat hole may be cut into the public sewer to receive the sewer lateral with entry in the downstream direction at an angle of about forty-five degrees (45º). A wye saddle shall be used for the connection and in no case shall the pipe protrude inside the main sewer. The invert of the sewer lateral at the point of connection shall be made and the connection made secure and watertight. The connection to the public sewer shall be made in the presence of the District Inspector and under the District Inspector's supervision and direction and in accordance with the applicable provisions of the Ordinances, rules, regulations and the District's current specifications for sewer construction. Any damage to the public sewer shall be repaired at the expense of the applicant to the satisfaction of the District Inspector.

4.3.4 ***Control Manholes.*** When required by the District, the owner of any property served by a sewer lateral carrying industrial wastes shall install a suitable control manhole to facilitate observation, sampling and measurement of wastes. Such manhole, when required, shall be accessible and safely located, and shall be constructed in accordance with plans approved by the District. The manhole shall be installed by the owner at his expense and shall be maintained by the owner so as to be safe and accessible at all times.

4.3.5 ***Sewer Materials.*** The sewer lateral shall be cast iron soil pipe, meeting current applicable standards; or other suitable material established and incorporated by the District into current specifications for sewer construction. Joints shall be of the same material and shall be tight and waterproof.

4.3.6 ***Minimum Size and Slope.*** The size and slope of the sewer lateral shall be subject to the approval of the Inspector, but in no event shall the diameter be less than four (4) inches. The slope of such 4-inch pipe shall be not less than one-fourth (¼) inch per foot.

4.3.7 ***Sewer Too Low.*** In all buildings in which any sewer lateral is too low to permit gravity flow to the public sewer, sanitary sewage carried by such sewer lateral shall be lifted by artificial means, approved by the District Inspector, and discharged to the public sewer at the expense of the owner.

4.3.8 ***Sewer Lateral.*** Whenever possible the sewer lateral should be brought to the building at an elevation below the basement floor. No sewer lateral shall be laid parallel to or within three (3) feet of any bearing wall, which might thereby be weakened. The depth shall be sufficient to afford protection from frost. The sewer lateral shall be laid at uniform grade and in straight alignment insofar as possible. Changes in direction shall be made only with properly curved pipe and fittings of the same material.

4.3.9 ***Existing Sewer Laterals.*** Existing sewer laterals may be used in connection with new and/or remodeled buildings only when such existing sewer lateral are determined by the District to have passed a current air test, or an air test conducted within the prior ten (10) years. If the air test fails in the lower lateral, the District will perform a CCTV inspection and repair any major structural damage or blockages and/or place into the Asset Management System for minor structural damage or repair. If the air test fails in the upper lateral, the owner shall repair ore replace upper lateral piping and air test pipe again. After the lateral passes inspection, either by air test or CCTV inspection, it will be certified for ten (10) years from the date of the inspection. (Reference Ordinance No. 507-08 effective June 1, 2008)

4.3.10 ***Sewer Laterals for New Construction*.** After installation of the upper sewer lateral by the property owner, the upper lateral shall pass an air test. If the air test fails, the owner shall repair or replace the lateral and air test the pipe again. The District will perform a CCTV inspection of the lower sewer lateral and repair any major structural damage or blackages and/or place into the Asset Management System for minor structural damage or repair. After the lateral passes inspection, either by air test or CCTV inspection, it will be certified for ten (10) years from the date of the inspection. (Reference Ordinance No. 507-08 effective June 1, 2008)

4.3.11 ***Remodeling, Additions, Change of Use*.** At the time of Remodeling, all new plumbing fixtures shall be Low Water Use Plumbing Fixtures. These fixtures shall be installed and maintained and shall not be replaced with fixtures which allow greater water use.

Section 4.4 Public Sewer Construction.

4.4.1 ***Compliance With Local Regulations.*** Any person constructing a sewer within a street shall comply with all State, City and County laws, ordinances, rules and regulations pertaining to the cutting of pavement, opening, barricading, lighting and protecting of trenches, backfilling and repaving thereof and shall obtain all permits and pay all fees required by the public entity having jurisdiction prior to the issuance of a permit by the District.

4.4.2 ***Construction Requirements.*** Construction and inspection of sewer laterals shall be in accordance with all applicable requirements of the County, the City, State of California, and provisions of the Ordinances, rules, regulations, and current specifications for sewer construction.

4.4.3 ***Liability.*** The District and its directors, officers, agents and employees shall not be liable for any injury or death to any person or damage to any property arising during or arising out of the performance of any work by any applicant. The applicant shall indemnify, defend and hold harmless the District, its directors, officers, agents and employees from and against any and all liabilities, losses, claims, damages, costs and expenses caused by, arising from or related to sewer construction or other related work performed pursuant to this Section 4.4, including but not limited to, any and all attorneys', paralegal and expert fees and expenses, except where caused by the active negligence, sole negligence, or willful misconduct of the District. Applicant shall be solely liable for any defects in the performance of applicant's work or any failure which may develop in such work.

4.4.4 ***Persons Authorized to Perform Work.*** Only licensed contractors shall be authorized to perform the work of public sewer construction within the District. All terms and conditions of the permit issued by the District to the applicant shall be binding on the contractor. The requirements of this Section shall apply to sewer laterals installed and/or connected to public sewer construction.

4.4.5 ***Grade Stakes.*** Grade and line stakes shall be set by a Registered Civil Engineer prior to the start of construction on any public sewer. The contractor shall be responsible for accurately transferring grades to grade bars and sewer invert.

4.4.6 ***Joints and Connections.*** All excavations required for the installation of a sewer lateral shall be open trench work unless otherwise approved by the District. Pipe laying and backfill shall be performed in accordance current applicable standards, except that no backfill shall be placed until the work has been inspected. All work shall be in accordance with the applicable provisions of the Ordinances, rules, regulations, and current specifications for sewer construction.

4.4.7 ***Protection of Excavation.*** The applicant shall maintain such barriers, lights and signs as are required by law or necessary to give warning to the public at all times that a sewer is under construction and of any dangerous condition which may be encountered as a result. The applicant shall also protect the public in the use of the sidewalk against any such conditions in connection with the construction of the public sewer. Streets, sidewalks, parkways and other property disturbed in the course of the work shall be reinstalled in a manner satisfactory to the District, the City, County, or any other public entity having jurisdiction. All required shoring shall be properly installed before the District Inspector enters the excavation.

4.4.8 ***All Work To Be Inspected.*** All sewer construction work shall be inspected by the District Inspector or an inspector authorized by and acting for the District to ensure compliance with all requirements of the District. No sewer shall be covered at any point until it has been inspected, tested and accepted by the District. No sewer shall be connected to the District's public sewer until the work covered by the sewer permit has been completed, tested, inspected and approved by the District Inspector.

4.4.9 ***Notification.*** It shall be the duty of the person doing the work authorized by a sewer permit to notify the District in writing that said work is ready for inspection. Such notification shall be given not less than twenty-four (24) hours before the work is to be inspected. It shall be the duty of the person doing the work to make sure that the work shall comply with the tests required by the District before giving the above notification.

4.4.10 ***Inspection.*** The District will inspect sewer construction, as described below.

a) ***Sewer Lateral.*** The sewer lateral inspection will verify proper installation, connection and use of materials.

b) ***Rough Plumbing.*** A rough plumbing inspection may be performed to verify compliance with the issued application and sewer permit. An air test may be required of the building sewer lateral in accordance with current District air testing specifications. There shall be no further construction until the District Inspector has accepted this work.

c) ***Final Inspection.*** A final inspection may be conducted by the District after the City and/or County Building Department has made its final inspection. The District's final inspection will verify that the plumbing fixtures and their location(s) are as specified in the construction plans, the application and sewer permit issued .

4.4.11 ***Nonconforming Work.*** When any work has been inspected and the work or any portion of the work is not approved and no certification of satisfactory completion given, a written notice to that effect shall be given instructing the owner of the property, or the agent of such owner, to repair such work or portion of such work as authorized by the permit in accordance with the Ordinances, rules and regulations of the District.

4.4.12 ***As-Built Drawings.*** "As-Built" drawings showing the actual location of all mains, structures, Y's, T's, laterals and cleanouts shall be filed with the District before final acceptance of the work.

Section 4.5 Sewer Fees, Rates, and Schedules. (Reference Ord. No. 495-06)

4.5.1 ***All Costs Paid By Owner.*** All costs and expenses incident to the installation and connection of any sewer or other work for which a permit has been issued shall be paid by the owner.

4.5.2 ***Fees for Sewer Connection.*** Sewer connection charges shall be determined as follows:

a) A sewer connection fee shall be paid to the District by the applicant desiring connection to the District sewer system based upon the number of sewer units which are required to serve the improvements on the property. (Refer to Section 4.5.7 - Sewer Rate Schedule No. 1.)

b) At any time sewer capacity is added to any property for which the initial connection charge has been previously paid in an amount which did not include such additional capacity, as a condition to such property remaining connected to the District sewer system, there shall be a subsequent connection charge to provide for the additional sewer capacity requirements. (Refer to Section 4.5.7 - Sewer Rate Schedule No.1.)

c) A fee shall be paid to the District for issuing a sewer permit to connect and inspect a sewer lateral. (Refer to Section 4.5.9 - Sewer Rate Schedule No. 3.)

d) A fee shall be paid to the District for issuing a permit to install and inspect a wye saddle. (Refer to Section 4.5.10 - Sewer Rate Schedule No. 4.)

e) A re-inspection fee may be charged by the District for re-inspection of non-conforming condemned work. (Refer to Section 4.5.11 - Sewer Rate Schedule No. 5.)

f) Sewer connection fees as determined from time to time by the Board shall apply to all new connections. Connection fee revenue shall be used to evaluate potential projects related to the sewer enterprise of the District; to plan, study, undertake, complete and finance such capital projects; to pay the costs incurred by the District to provide and inspect new connections, including the portion of the connector's obligation for the accumulated equity in the sewer enterprise and the District's costs in coordinating with other governmental entities to facilitate such connection.

g) Neither this provision, nor payment of the connection fees described in this Section shall constitute approval of any capital project.

4.5.3 ***Fees and Bond for Public Sewer Construction.***

a) A fee, in an amount deemed necessary by the District to pay all engineering, inspection and other costs required to ensure compliance with the terms of the sewer permit and with the Ordinances, rules and regulations of the District, shall be paid by the applicant to the District prior to the time the sewer permit is issued, for reviewing plans and specifications, issuing a sewer permit and inspecting the installation of public sewer mains, laterals and all appurtenances. If the fee fixed by the District is less than the actual cost to the District, the applicant shall be liable for the excess cost to the District.

b) Prior to the issuance of a permit for public sewer construction, the applicant shall furnish to the District a faithful performance and payment bond or cash deposit in the amount of the total estimated cost of the work. Said bond to be secured by a surety or sureties satisfactory to the District. The cash deposit or faithful performance and payment bond shall be in a form as authorized and approved by the District and shall be conditioned upon the performance of the terms and conditions of the sewer permit and the payment of all subcontractors and material suppliers and shall guarantee the correction of faulty workmanship and the replacement of defective materials for a period of one (1) year after the date of acceptance of the work.

4.5.4 ***General Rates - Sewer Service.*** There is hereby established an annual service charge as established by the Ordinances, rules and regulations of the District, for connection to the sewers of the District. New connections shall be billed from the first of the month, six months after the final sewer lateral connection inspection at the property line. (Reference Ordinance No. 505-08 Effective May 3, 2008)

4.5.5 ***Special Charges.*** Facilities in or about residential, commercial and industrial establishments discharging extraordinary amounts of waste into the District's sewer system shall be subject to such charges and to such conditions as may be established by the Board.

4.5.6 ***Schedule of Units.*** The following is a schedule of the number of units to be applied to each type of connection to the sewer system of the District:

a) Homes and Apartments: A minimum of three (3) units for each home or each apartment plus an additional unit for each bath or half-bath in excess of two baths, except that the minimum for a home or apartment having only one bath and only one bedroom, which is equipped with low water-use fixtures, or for a studio apartment, is two (2) units.

b) Motels/Hotels/Timeshares: Each bath with shower and/or standard bathtub with less than seventy-five (75) gallon overflow capacity, one (1) unit. Bathtubs with overflow capacity equal to or greater than seventy-five (75) gallons shall require one (1) additional unit. Each kitchen, one (1) unit.

c) Restaurant: One (1) unit per restroom; five (5) units for the first twenty (20) seats, whether indoor seats or outdoor seats, plus one (1) additional unit for every twenty (20) indoor seats or fraction over twenty (20). The first twenty (20) seats of outdoor seating shall not require any units; outdoor seating in excess of the first twenty (20) seats shall require one-half (.5) units per twenty (20) seats; one (1) additional unit for every forty (40) outdoor seats or fraction over forty (40). For the purpose of this Section, where a bar is operated in connection with a restaurant, bar stools will be counted as seats. Commercial establishments that sell food but which have no eating or seating on the property shall be counted as other commercial in sub-paragraph (j).

d) Service Stations: Five (5) units, one (1) unit per RV dump.

e) Mobile Home/Trailer Parks, Campgrounds: Three (3) units per trailer space that will accommodate a trailer in excess of forty (40) feet in length and twelve (12) feet in width with a sewer connection provided; one (1) unit per trailer space for all other trailer spaces with a sewer connection provided. One (1) unit per two trailer spaces without a sewer connection provided.

f) Laundromats: Two (2) units per washing machine.

g) Swimming Pools, hot tubs, used in connection with a commercial establishment: Two (2) units per swimming pool and hot tub.

h) Taverns without food facilities: Five (5) units, plus one (1) unit per restroom.

a) Meeting Rooms, Banquet/Ballroom Facilities: One (1) unit per 100-person of maximum room capacity, or fraction thereof, as designed by the Fire Chief with authority in the jurisdiction.

j) All other commercial establishments: One (1) sewer unit per five (5) fixture units as defined in the Uniform Plumbing Code.

4.5.7 - SCHEDULE 1

A fee of Three Thousand Two Hundred and Seventy-Four ($3,274.00) per sewer unit to be connected to the collection system, or so added, with a minimum of Three Thousand Two Hundred and Seventy-Four Dollars ($3,274.00), will be collected.

4.5.8 - SCHEDULE 2

An administrative fee of Three Hundred Dollars ($300.00) will be collected for unreported connections and discharges.

4.5.9 - SCHEDULE 3

A fee of Fifty Dollars ($50.00) will be collected for issuing a permit to connect and inspect a sewer lateral.

4.5.10 - SCHEDULE 4

A fee of Fifty Dollars ($50.00) will be collected for issuing a permit to install and inspect a wye saddle.

4.5.11 - SCHEDULE 5

A fee of Fifty Dollars ($50.00) may be charged for re-inspection of condemned work.

4.5.12 - SCHEDULE 6

The annual sewer service charge shall be as follows:

Type of Connection	Annual Service Charge per Unit	Quarterly Service Charge per Unit	Minimum Service Charge per Unit
Homes	$108.60	$27.15	$9.05
Multi-Family Residences	$108.12	$27.03	$9.01
Motels, Hotels, and Timeshares	$102.96	$25.74	$8.58
Restaurants	$116.16	$29.04	$9.68
Service Stations	$116.16	$29.04	$9.68
Mobile Home/Trailer Parks, Campgrounds	$101.88	$25.47	$8.49
Laundromats	$116.16	$29.04	$9.68
Automobile Service Garages	$116.16	$29.04	$9.68
Taverns without Food Facilities	$116.16	$29.04	$9.68
All other Commercial Establishments	$116.16	$29.04	$9.68

Use of Public Sewers.

4.6.1 ***Sewer Required.*** The owner of any building situated within the District requiring sewage disposal is required, at the owner's expense, to connect said building directly with the proper public sewer in accordance with the provisions of this Section 4, within ninety (90) days after receipt of notice by the agency with authority to do so, unless, due to extraordinary circumstances, special permission is granted to owner.

4.6.2 ***Unlawful Deposit.*** Except as provided in this Section 4.6, it shall be unlawful to construct or maintain any privy, privy vault, septic tank, cesspool, seepage pit or other facility intended or used for the disposal of sewage.

4.6.3 ***Occupancy Prohibited.*** No building, industrial facility or other structure requiring sewage disposal shall remain occupied until the Owner of the property has complied with all rules and regulations of the District.

4.6.4 ***Application for Sewer Permit.*** Prior to connecting with the public sewer, the owner of the property to be provided sewer service by the District shall apply for a sewer permit on a form approved and provided by the District.

4.6.5 ***Abandonment of Private Facilities.*** At such time as a public sewer becomes available to a property served by a private sewage disposal system, as provided in Section 4.6.1, a direct connection shall be made to the public sewer in compliance with the Ordinances, rules and regulations of District, and any septic tanks, cesspools, and similar private sewage disposal facilities shall be abandoned and filled with suitable material as determined by the District Inspector.

4.6.6 ***Duty of Sewer Service User to Report.*** It shall be the duty of each owner of property connected to the District sewer system to report to the District all facilities discharging waste into the District sewer. As to any facilities which are not so reported, they shall be deemed to have been connected to the District sewer from the date, as determined by the District, that the property was first connected to the District sewer.

4.6.7 ***Unreported Connections and Discharges.*** Upon discovery of the unreported connections and discharges to the District sewer system, the District shall charge all current charges and fees, including all current connection charges, plus a ten percent (10%) basic penalty, up to three (3) years back charges for current sewer service fees, a ten percent (10%) penalty on such back charges, and the current administrative fee for unreported connections and discharges. (Refer to Schedule No. 2, Section 4.5.8.) The owner of said property may, at his option, abate the unreported connection(s) immediately or pay all of the above charges and fees. If the owner elects to abate the unreported connection(s) or can demonstrate sufficient proof to the District Customer Service Manager or authorized representative that the unreported sewer connection(s) existed prior to the purchase of such property by owner, then the District may only charge up to three (3) years back charge for current sewer service fees. If the owner fails to complete any of the above options, all charges and fees shall be deemed charges for the purposes of collection and enforcement, and the property shall be subject to disconnection procedures for delinquent charges as provided in Section 6.6.

4.6.8 ***Disposal of Wastes***. It shall be unlawful for any person to place, deposit, or permit to be deposited upon public or private property within the District, or in any area under the jurisdiction of the District, any human or animal excrement, garbage, chemical, or other objectionable waste.

4.6.9 ***Drainage into Public Sewers Prohibited.*** No leaders from roofs and no surface drains for rain water shall be connected to any District sewer. No surface or sub-surface drainage or rain water, storm water, seepage, cooling water or unpolluted industrial process waters shall be permitted to enter any public sewer by any device or method whatsoever.

4.6.10 ***Treatment of Wastes Required.*** It shall be unlawful to discharge into any stream or watercourse any sewage, industrial wastes, or other polluted waters, as provided by the Water Quality Control Plan for the Lahontan Region, North and South Basins, the Porter-Cologne Water Quality Act and the provisions of this Section 4.

4.6.11 ***Types of Waste Prohibited.*** Except as hereinafter provided, no person shall discharge or cause to be discharged any of the following described waters or wastes into any public sewer:

a) Any liquid or vapor having a temperature higher than 150º F.

b) Any water or waste which contains more than two hundred fifty (250) parts per million, by weight, of fat, oil or grease.

a) Any gasoline, benzine, naphtha, fuel oil or other flammable or explosive liquid, solid or gas.

b) Any garbage that has not been properly shredded. Properly shredded garbage shall mean the wastes from the preparation, cooking and dispensing of food that has been shredded to such degree that all particles will be carried freely under the flow conditions normally prevailing in public sewers, with no particle greater than one-half (½) inch in dimension.

c) Any ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, or any other solid or viscous substance capable of causing obstruction to the flow in sewers or other interference with the proper operation of the sewer system.

d) Any waters or wastes having a pH lower than 5.5 or higher than 9.0 or having any other corrosive property capable of causing damage or hazard to structures or equipment of the sewer system or personnel of the District.

e) Any waters or wastes containing a toxic or poisonous substance in sufficient quantity to injure or interfere with any sewage treatment process, constitute a hazard to humans or animals, or create any hazard in the receiving waters of the sewage treatment plant.

a) Any waters or wastes containing suspended solids or dissolved matter of such character and quantity that unusual attention or expense is required to handle such materials at the sewage treatment plant.

a) Any noxious or malodorous gas or substance capable of creating a public nuisance.

j) Any septic tank sludge.

k) Any industrial wastewater that is in violation of applicable industrial general pre-treatment regulation for existing and new sources of pollution as set forth in 40 CFR, part 403, adopted by the Environmental Protection Agency under authorization of the 1977 Amendments to the Clean Water Act, and the industrial wastewater pre-treatment program and rules and regulations of the District. In the event of a violation to this Section 4.6.11, the entire costs which may be incurred by the District for abating, enforcing, administering, and monitoring compliance will be the sole responsibility of the owner/discharger.

4.6.12 ***Preliminary Treatment of Wastes.*** Prior to the admission into the District's sewers of any waters or wastes having (a) a 5-day Biochemical Oxygen Demand greater than three hundred (300) milligrams per liter (mg/l) by weight, or (b)objectionable characteristics or constituents not within the maximum limits provided for in Section 4.6.11, or ©) excess quantities and rates of discharge, the District may require preliminary treatment of such waters or wastes.

Plans, specifications and any other pertinent information relating to proposed preliminary treatment facilities shall be submitted for the approval of the District and no construction of such facilities shall be commenced until said approval is obtained in writing.

4.6.13 ***Grease Interceptors/Traps Required.*** Grease, oil and sand interceptors/traps shall be provided when they are necessary for the proper handling of liquid wastes containing grease in excessive amounts, any flammable wastes, sand and other harmful ingredients; except that such interceptors shall not be required for buildings used exclusively for residential purposes. All interceptors/traps shall be of a type and capacity approved by the District and shall be located as to be readily and easily accessible for cleaning and inspection. Sizing of grease interceptors/traps shall be in accordance with current District policy.

4.6.14 ***Special Agreements.*** No statement contained in this Section 4.6 shall be construed as preventing any special agreement or arrangement between the District and any owner and/or applicant whereby waste of unusual strength or character may be accepted by the District for treatment, subject to payment therefore by the owner and/or applicant and subject to such terms and conditions as may be required by the District. Prior to the discharge of any such waste into the District sewer system, the owner and/or applicant shall enter into an agreement with the District in such form as approved by the District which agreement shall constitute a special permit to discharge such waste into the District sewer system. The agreement may provide as follows:

a) ***Discharge Requirements.*** The agreement may limit the maximum concentration of contaminants, chemicals or other materials contained in any waste to be discharged into the District's sewer system. Such limits shall be determined by the District in its sole discretion, and may be modified by the District at any time.

a) ***Proposed Discharge and Treatment.*** The agreement may require the owner and/or applicant to submit information and perform analyses regarding the volume, composition and proposed treatment of the waste to be discharged into the District's sewer system and any other information concerning such discharge as may be requested by the District in its sole discretion. The District shall evaluate such information and, based upon its evaluation, determine whether the owner and/or applicant should be permitted to connect to and discharge such waste into the District's sewer system.

a) ***Connections, Inspections and Sampling.*** The agreement may restrict the locations of any connections to the District's sewer system through which such discharges will occur. The District may, in its sole discretion, inspect and approve any such connections. The District shall have the right to inspect treatment systems and connection facilities, collect discharge samples and provide for the testing of any such samples in order to verify compliance with the terms of the agreement and any other requirements of the special permit.

b) ***Fees, Costs and Expenses.*** The agreement may establish fees, as determined by the District in its sole discretion, for the issuance of the special permit. The agreement may require the owner and/or applicant to pay all costs and expenses incurred by the District in reviewing the application, inspecting discharge connections, sampling and testing discharges and issuing the special permit. Such fees, costs and expenses shall be paid prior to execution of the agreement and issuance of the special permit. All fees, costs and expenses incurred after execution of the agreement and issuance of the special permit shall constitute a sewer service charge that shall be billed and payable in accordance with Section 6 of this Administrative Code.

4.6.15 ***<u>Protection from Damage.</u>*** No unauthorized person shall maliciously, willfully or negligently break, damage, destroy, uncover, deface or tamper with any structure, improvements, appurtenance or equipment which is a part of the District's sewer system. Any person violating this provision shall be subject to the penalties provided by law.

4.6.16 ***<u>Construction or Location of Improvements</u>*****.** Except as expressly reserved or permitted in any grant of easement or judgment in eminent domain, it shall be unlawful for any person to construct or locate improvements of any kind or type in, on or over the surface of any easement owned or acquired by the District.

Section 4.7 <u>Maintenance and Repair of Sewers.</u>

4.7.1 ***<u>Measurements and Tests.</u>*** All measurements, tests and analyses of the waters and wastes to which reference is made in Sections 4.6.10 and 4.6.11 shall be determined upon suitable samples taken at the control manhole provided for in Section 4.3.4. In the event that no special manhole has been required, the control manhole shall be considered to be the nearest downstream manhole in the District sewer from the point at which the sewer lateral is connected.

4.7.2 ***Maintenance of Sewer Laterals.*** Sewer laterals shall be maintained by the owner of the property served thereby.

4.7.3 ***Maintenance of Pretreatment Facilities.*** Where preliminary treatment facilities are provided for any waters or wastes, they shall be continuously maintained by the owner in efficient operation, at such owner's expense.

4.7.4 ***Maintenance of Grease Interceptors/Traps .*** All grease, oil and sand interceptors/traps shall be continuously maintained by the owner in efficient operation, at such owner's expense.

4.7.5 ***Procedures for Handling Stoppages.*** Whenever the District discovers or is notified of a stoppage or spill, the District shall dispatch a maintenance crew to the location. The maintenance crew shall check the main line at the location to determine if there is a stoppage in the main line. If a stoppage is discovered in the main line, the District will proceed to clear the stoppage. If a stoppage is not found in the main line but is found in the portion of the sewer lateral between the main line and the foundation of any wall, the owner shall be notified that the clearing of the stoppage or clean up of the spill shall be the responsibility of the owner. If the stoppage is proven to be caused by faulty pipe installation or faulty pipe of the sewer lateral line between the main line and the nearer property line, the District will pay for the repairs.

4.7.6 ***Emergency Repairs by District.*** Whenever, in the judgment of the District Inspector, immediate repairs, clean up, or other activities must be performed to a sewer lateral in order to preserve public health or to prevent damage or injury to the District sewer, the District Inspector may, without notice to the property owner, cause such repairs, clean up or other activities to be performed and may contract with a private contractor for such purposes or may perform such repairs, clean up or other activities with District personnel.

4.7.7 ***Reimbursement of District.*** The property owner serviced by a sewer lateral shall reimburse the District for the costs of all repairs, clean up or other activities, made or contracted for by the District pursuant to Section 4.7.6. Such charges shall be billed to the property owner and shall be deemed delinquent thirty (30) days after mailing an invoice for such charges to the property owner and may be collected under the provisions of Section 6.4.

Section 4.8 Sewer Capacity.

4.8.1 ***Schedule of Sewer Units***. The schedule of sewer units, as established in Section 4.5.6, shall be applicable to this Section 4.8.

4.8.2 ***Current Equity.*** The present estimated capacity within the District's service area is Eighty-Six Thousand Four Hundred Thirty-Three (86,433) sewer units. The present sewer fund equity, after deduction for accumulated depreciation of the fixed assets of the District, is approximately One Hundred Ten Million Six Hundred Thirty-Nine Thousand Three Hundred Nineteen Dollars ($110,639,319), which is approximately One Thousand Two Hundred Eighty Dollars ($1,280) per sewer unit.

4.8.3 ***Rate Relief for Excess Sewer Units.*** (Reference Ordinance No. 506-08 effective May 17, 2008) By December 15, 2008, on the form provided by the District, the owner of a parcel with Excess Sewer Units may apply to the District to participate in the Excess Sewer Capacity Program for the relief of service charges for Excess Sewer Units. The applicant requesting such rate relief shall allow the District full and adequate inspection of the parcel, including any improvements, and the sewer lines and related connection to enable the District to determine if the parcel has any Excess Sewer Units. The applicant may be required to test or remove underground piping, draining lines or the sewer lateral for verification of the sewer capacity required on the parcel and that all fixtures on the parcel are low water-use fixtures. Upon a property owner's application to the District for participation in the Excess Sewer Capacity Program, the billing of quarterly sewer service charges will be suspended on any Excess Sewer Units until such time as they are transferred, pursuant to Administrative Code Section 4.8.14, or put into use on the same parcel. The adjusted service charge, reflecting the suspension of charges on any Excess Sewer Units, shall be effective for the first complete billing cycle after the date of the District's approval of the application and verification of any Excess Sewer Units on the same parcel. A property owner with verified Excess Sewer Capacity will receive a credit for any quarterly charges associated with the verified Excess Sewer Capacity in an amount equal to any suspended sewer service charges for Excess Sewer Capacity. Excess Sewer Units may be transferred to another parcel, pursuant to Administrative Code Section 4.8.14, or may be later used on the same parcel. The owner of a parcel with Excess Sewer Units may acquire sewer capacity, in addition to those units but only in the same manner, with the same priority, and subject to payment of the same fees, as any other parcel which might need to obtain additional sewer capacity, and only if the District has available sewer capacity at the time the owner requests the additional sewer service.

4.8.4 ***Authority.*** No sewer capacity shall be issued which does not comply with the criteria set forth in this Section 4.8 or which would violate any law, including any order or judgment of a court of competent jurisdiction or the orders of competent governmental authorities, including the waste discharge orders of the California Regional Water Quality Control Board - Lahontan Region.

4.8.5 ***Inspection.*** Inspection of existing or new sewer piping, as provided in Section 4.4.10, may be required.

4.8.6 ***Existing Demand.*** When available estimates indicate that existing sewer capacity demand will exceed the sewer capacity available for issuance at the rate established by this Section 4.8, no further Change in Use sewer capacity shall be issued except upon action of the Board.

Notwithstanding any of the provisions of this Section 4.8.7, the issuance of Change in Use sewer capacity shall be limited as provided in Sections 4.8.8, 4.8.9 and 4.8.16.

4.8.7 ***Application.*** Application for Change in Use sewer capacity shall be made on a form provided by the District and shall include complete plans and specifications for the contemplated work of improvement for which such sewer capacity is desired. The application shall not be deemed complete or received by the District unless and until it is accompanied by such plans and specifications.

4.8.9 ***Attributes.*** Attributes existing on developed property have been treated as additional, subordinate rights or privileges of that property and, depending upon whether such attributes were lawfully created, were permitted to continue. Such attributes include coverage, square footage within structures, uses, and utility services, including sewer capacity rights and water demand.

4.8.10 ***Transfer of Attributes.*** The Tahoe Regional Planning Agency, the City, and the County permit certain transfers of various attributes and the right to attributes from one property to another in accordance with the Amended Regional Plan for the Lake Tahoe Basin, including the "Growth Management Provisions" of its Code of Ordinances and local government codes.

4.8.11 ***Transfer of Sewer Capacity.*** (Reference Ord. 458 Effective 2/01/96) Sewer capacity rights are and have been appurtenant to and inseparable from property. In order to accommodate the transfer programs of the Tahoe Regional Planning Agency, the City, and the County, the District has adopted rules and regulations from time to time regarding proposed transfer of the right to discharge into the collection, treatment, and export facilities of the District.

4.8.12 ***Transfer of Equity.*** District's existing customers have an equity credit equal to One Thousand Two Hundred Eighty dollars ($1,280.00) per sewer unit which may be used toward the current connection fees when transferring capacity rights.

4.8.13 ***Costs of Transferring Sewer Capacity.*** It is necessary and appropriate that the cost of transferring sewer capacity rights be paid by those who request such transfers to occur.

4.8.14 ***Conditions to Transfer.*** (Reference Ordinance No. 506-08 effective May 17, 2008) Transfer of Excess Sewer Units shall be allowed only through December 31, 2012, and shall adhere to the following conditions, and no sewer permit shall be issued for a primary parcel until there is compliance with all of the following conditions:

- **a)** ***Conforming with General Plan.*** The use of the primary property shall conform to the applicable City or County General Plan.
- **b)** ***Approvals.*** The applicant for a transfer of Excess Sewer Units shall secure all

prior approvals for the transfer required from the City or County and the Tahoe Regional Planning Agency.

c) ***Payment of Fees and Taxes.*** All existing sewer connection fees, transfer fees, and the County property taxes shall be paid for the primary and secondary parcels.

d) ***Satisfaction of Liens.*** All liens upon the secondary parcel of property shall be satisfied, or in the alternative, written concurrence shall be obtained from any lienholder, which written concurrence shall save the District free and harmless from any and all claims arising out of the transfer of Excess Sewer Units from the secondary parcel.

e) ***No Change in Use.*** The transfer of Excess Sewer Units shall not increase the estimated measurement of flow and strength of wastewater discharged to the treatment facilities.

f) ***Restoration to Natural Condition.*** No transfer of all sewer units shall be made from a secondary property that has not had complete restoration to its natural condition.

g) ***Removal of Sewer Lateral.*** Where all sewer units are transferred from a secondary property, the lateral sewer connection(s) of the secondary property shall be removed, plugged and sealed in a manner satisfactory to the District within thirty (30) days after approval of the transfer. Physical inspection of the properly plugged sewer connection(s) shall be made by a District Inspector.

h) ***Disconnection of Water Utilities.*** Where all sewer units are transferred from a secondary property, all water service utilities for the secondary property shall be capped and disconnected to the satisfaction of the District within thirty (30) days after approval of the transfer. Physical inspection of the properly capped water connection(s) shall be made by a District Inspector.

i) ***Exception to Disconnection and Removal.*** Where only a portion of the Excess Sewer Units of a secondary property are transferred, subsections 4.8.14(f), 4.8.14(g) and 4.8.14(h), above shall apply. Any use which remains on the secondary parcel shall have sufficient sewer capacity to accommodate such use as determined by the District.

j) ***Approval of Transfer*****.** The Board authorizes the General Manager or his/her designee to approve transfer of Excess Sewer Units only after he/she finds the following:

a) That each and every foregoing provision of this Section 4.8 has been complied with;

b) That the provisions of Sections 4.2.5, 4.2.7 and 4.6.4 for issuing a sewer permit to the primary property have been complied with;

c) That a completed Transfer of Sewer Capacity Rights Application is submitted to the District.

4.8.15 ***Additional Procedures.*** The District's Board may from time to time adopt, by Board action, additional procedures relating to the issuance of sewer capacity.

STPUD's STANDARD NOTES AND DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

Sewer . 1950 . Water   A PUBLIC AGENCY
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GENERAL NOTES

DATE:	JAN 2009
SCALE:	NO SCALE
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FILE:	STANDARDS
SHEET:	G1

STPUD STANDARD NOTES AND DETAILS
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SHEET: G2
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GENERAL NOTES

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GENERAL NOTES:

1) CONTRACTOR SHALL HAVE SIGNED PLANS IN HIS POSSESSION PRIOR TO COMMENCEMENT OF WORK.

2) THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING ALL UTILITY COMPANIES AND/OR UTILITY DISTRICTS AS TO THE LOCATION OF ALL UNDERGROUND FACILITIES. LOCATION AND DEPTH OF EXISTING UTILITIES WHERE SHOWN ON PLANS ARE BASED ON BEST AVAILABLE INFORMATION. NO GUARANTEE IS MADE AS TO THE ACCURACY OF THIS INFORMATION OR THAT ALL UTILITIES ARE SHOWN. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO LOCATE, PROTECT, AND MAINTAIN ALL EXISTING UTILITIES. THE CONTRACTOR OR ANY SUBCONTRACTOR FOR THIS CONTRACTOR SHALL NOTIFY MEMBERS OF UNDERGROUND SERVICE ALERT 48 HOURS IN ADVANCE OF PERFORMING EXCAVATION WORK BY CALLING UNDERGROUND SERVICE ALERT 811. EXCAVATION IS DEFINED AS BEING 18 OR MORE INCHES OF DEPTH BELOW THE EXISTING SURFACE.

3) THE CONTRACTOR SHALL POTHOLE ALL UTILITY CROSSINGS ALONG THE PIPELINE ALIGNMENT IN ADVANCE OF INSTALLATION. THE CONTRACTOR SHALL REPORT THE RESULTS OF THE POTHOLE TO THE ENGINEER 48 HOURS (NOT TO INCLUDE WEEKENDS OR HOLIDAYS) PRIOR TO UNDERTAKING ANY CORRECTIVE ACTION BY THE CONTRACTOR REGARDING FACILITY LOCATION OR ALIGNMENT, THE CONTRACTOR SHALL NOTIFY THE ENGINEER. SHOULD ANY CORRECTIVE WORK BE DONE PRIOR TO NOTIFICATION, THE ENGINEER ASSUMES NO LIABILITY FOR THE COSTS INCURRED FOR THIS WORK.

4) CONTRACTOR TO BE RESPONSIBLE FOR THE PROTECTION OF ALL EXISTING MONUMENTS AND ANY OTHER SURVEY MARKERS DURING CONSTRUCTION. ALL SUCH MONUMENTS OR MARKERS DESTROYED DURING CONSTRUCTION SHALL BE REPLACED AT CONTRACTOR'S EXPENSE.

5) THE CONTRACTOR SHALL APPLY EITHER WATER OR DUST PALLIATIVE OR BOTH, AS REQUIRED AT THE OPTION OF THE OWNER OR HIS REPRESENTATIVE, FOR THE ALLEVIATION OR PREVENTION OF DUST NUISANCE.

6) THE CONTRACTOR SHALL COMPLY WITH THE TAHOE REGIONAL PLANNING AGENCY STANDARD CONDITIONS OF APPROVAL.

7) THE CONTRACTOR SHALL COMPLY WITH THE STATE WATER QUALITY CONTROL BOARD WASTE DISCHARGE REQUIREMENTS FOR THIS PROJECT.

8) ALL BARREN AREAS, AND AREAS DISTURBED BY CONSTRUCTION ACTIVITY SHALL BE REVEGETATED BY THE CONTRACTOR IN ACCORDANCE WITH THE TAHOE REGIONAL PLANNING AGENCY HANDBOOK OF BEST MANAGEMENT PRACTICES. APPLICATION OF A MULCH MAY ENHANCE VEGETATIVE ESTABLISHMENT. ALL LANDSCAPED AREAS DISTURBED SHALL BE RESTORED BY A LICENSED LANDSCAPE CONTRACTOR (STATE OF CALIFORNIA C-27 LICENSE) AT THE CONTRACTORS EXPENSE. CONTRACTORS EQUIPMENT AND EMPLOYEE VEHICLES SHALL PARK ON EXISTING PAVED SURFACES OR EXISTING COMPACTED ROAD SHOULDERS. NO EQUIPMENT OR VEHICLES SHALL BE PLACED OUTSIDE THE STATE, CITY, OR COUNTY RIGHT OF WAY. ANY DISTURBANCE OF PRIVATE PROPERTY SHALL BE RESTORED BY THE CONTRACTOR AT THEIR EXPENSE.

9) ALL EXCESS MATERIAL FROM THE PROJECT IS TO BE REMOVED FROM THE SITE AND DISPOSED OF AT A SITE APPROVED BY THE TAHOE REGIONAL PLANNING AGENCY AND THE DISTRICT AT THE CONTRACTORS EXPENSE.

10) ALL INTERTIES BETWEEN NEW WATER MAINS AND THE EXISTING WATER SYSTEM, INCLUDING NEW WATER SERVICE CONNECTIONS, AND FIRE HYDRANT INSTALLATIONS AND TRANSFERS, SHALL ONLY BE MADE AFTER ALL PRESSURE TESTING AND DISINFECTION REQUIREMENTS ARE SATISFACTORILY MET. THE CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE ALL BLOW OFF'S NECESSARY FOR FLUSHING AND SAMPLING OF ALL NEW WATER MAINS AS REQUIRED BY THE CALIFORNIA STATE DEPARTMENT OF HEALTH SERVICE AND PROJECT SPECIFICATIONS.

11) AFTER THE NEW MAIN IS PLACED INTO SERVICE, THE EXISTING WATER MAINS, WHERE SHOWN ON THE PROJECT DRAWINGS, ARE TO BE ABANDONED IN PLACE BY CUTTING OUT A SECTION OF PIPE AND WELDING A CAP ON THE END OF THE PIPELINE, OR OTHER APPROVED METHOD OF CAPPING. BLIND-FLANGE CAPPING SHALL BE UTILIZED WHERE POSSIBLE. ALL EXPOSED CORPORATION STOPS ON THE EXISTING WATER MAINS ARE TO BE LEFT IN PLACE IN THE CLOSED POSITION. FOR CORPORATION STOPS THAT HAVE NOT BEEN EXPOSED, THE CAPPING OF THE END OF THE SERVICE LINE USING AN APPROVED COMPRESSION FITTING SHALL BE ACCEPTABLE. EXISTING FIRE HYDRANTS TO BE ABANDONED AT THE ISOLATION VALVE, REMOVED FROM THE PROJECT AREA AND RETURNED TO THE DISTRICT, BY THE CONTRACTOR. THE ISOLATION VALVE IS TO BE BLIND FLANGED OR CAPPED BY OTHER APPROVED METHOD.

12) ALL EXISTING WATER SERVICES FOR THIS PROJECT SHALL BE ABANDONED PER NOTE NO. 11. ONLY NEW WATER SERVICE CONNECTIONS WHERE SHOWN ON THE PROJECT PLANS SHALL BE INSTALLED PER THE DISTRICTS STANDARD DETAILS AND PROJECT DRAWINGS. THE LOCATIONS OF ALL EXISTING WATER SERVICES SHALL BE VERIFIED AND MARKED IN THE FIELD.

13) THE CONTRACTOR SHALL PROVIDE, ON ALL NON-CONDUCTIVE PIPING, CONTINUOUS 10-GAUGE PTW INSULATED SOLID COPPER TRACER WIRE ALONG THE PIPELINE AND PROVIDE ACCESS TO TRACER WIRE AT ALL VALVE BOX INSTALLATIONS. THIS SHALL ALSO APPLY TO ALL CONDUCTIVE PIPING UNLESS PERMANENTLY BONDED AT EACH JOINT. ALL TRACER WIRE CONNECTIONS SHALL BE MADE USING ONLY COPPER SPLIT NUT CONNECTORS. ALL TRACER WIRE CONNECTIONS AND SPLICES SHALL BE COMPLETELY ENCAPSULATED USING SCOTCH CAST 85-14 RESIN SPLICING KIT AS MANUFACTURED BY 3M OR APPROVED EQUIVALENT.

14) A MINIMUM HORIZONTAL SEPARATION OF 10 FEET SHALL BE MAINTAINED BETWEEN NEW WATER MAINS AND EXISTING SANITARY SEWER. NO PIPE JOINT SHALL BE PLACED WITHIN 10 FEET OF THAT CROSSING AND A MINIMUM VERTICAL CLEARANCE OF 1 FOOT ABOVE THE SEWER SHALL BE MAINTAINED. WHERE IT IS IMPRACTICAL TO MAINTAIN THE MINIMUM VERTICAL CLEARANCE, THE PIPELINE SHALL BE ENCASED WITH A 2 SACK SLURRY 10 FEET EACH SIDE OF SEWER.

15) ALL EXCAVATIONS SHALL BE BACKFILLED OR TRENCH PLATED AT THE END OF EACH DAYS WORK PER THE SPECIFICATIONS. EXCAVATIONS WITHIN EXISTING PAVED AREAS SHALL BE COLD PATCHED TO MATCH THE EXISTING PAVEMENT AT THE END OF EACH DAYS WORK. ALL TRENCH PLATES SHALL BE NON-SKID TYPE AND HAVE COLD PATCH APPLIED TO THE EDGE FOR TRAFFIC APPROACH AND DEPARTURE.

16) WHERE NEW WATER MAINS ARE BEING INSTALLED IN PAVED SECTIONS THE MAXIMUM WIDTH FOR ASPHALT REPLACEMENT THE CONTRACTOR SHALL BE COMPENSATED FOR IS THE MAXIMUM CLEAR TRENCH WIDTH FOR THE PIPELINE SIZE BEING INSTALLED PLUS 12 INCHES AS PROVIDED IN THE CONTRACT SPECIFICATIONS. THE CONTRACTOR SHALL REPLACE ALL TRAFFIC STRIPING THAT IS DISTURBED DURING CONSTRUCTION.

17) THE CONTRACTOR SHALL PROTECT AND BE RESPONSIBLE FOR ANY DISTURBANCE OR CONTAMINATION TO ANY DRY WELLS, STORM WATER COLLECTION OR RETAINAGE SYSTEMS ALONG THE PROJECT SITE. THE CONTRACTOR SHALL BE AWARE THAT THE STOCK PILING OF MATERIAL UPON ANY DRAINAGE THE CITY OF SOUTH LAKE TAHOE SPECIFICATIONS AT THE CONTRACTORS EXPENSE.

18) PRIOR TO CONSTRUCTION ACTIVITY THE CONTRACTOR SHALL SUBMIT TO THE ENGINEER FOR APPROVAL A TRAFFIC CONTROL PLAN FOR HANDLING TRAFFIC THROUGH THE PROJECT SITE. ALL TRAFFIC CONTROL MEASURES SHALL MEET OR EXCEED THE REQUIREMENTS AS OUTLINED IN THE STATE OF CALIFORNIA MANUAL OF TRAFFIC CONTROLS (CAL TRANS) 1990 EDITION. ALL ADVANCED WARNING SIGNS SHALL BE 48" X 48" MINIMUM. A FLAGGER SHALL BE LOCATED FAR ENOUGH IN ADVANCED TO SLOW OR STOP TRAFFIC THROUGH THE WORK AREA. ALL PORTABLE DELINEATORS SHALL BE PLACED A MAXIMUM OF 20 FEET APART.

19) CONTRACTOR SHALL MAINTAIN THE CONTINUOUS FLOW OF TRAFFIC AT ALL TIMES DURING CONSTRUCTION ACTIVITY. AFTER WORKING HOURS ALL TRAFFIC BARRIERS SHALL BE REMOVED AND TRAFFIC RETURNED TO NORMAL.

20) CONTRACTOR SHALL REMOVE ALL MATERIAL GENERATED BY ANY ASPHALT SAW CUTTING OPERATION IMMEDIATELY AFTER SAW CUTTING BY USING ADEQUATELY SIZED VACUUMING EQUIPMENT TO ACCOMMODATE THE REMOVAL PROCESS.

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GENERAL NOTES

DATE: JAN 2009

SCALE: NO SCALE

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FILE: STANDARDS

SHEET: G3

BMP GENERAL NOTES:

1) ON-SITE WORK SHALL BE PERFORMED FROM 8 AM TO 6 PM, MONDAY THROUGH FRIDAY. WORK OUTSIDE THESE HOURS MUST BE APPROVED BY THE DISTRICT A MINIMUM OF 48-HOURS BEFORE THE ABNORMAL WORKING HOURS ARE SCHEDULED TO BEGIN.

2) NOISE SHALL BE REDUCED BY MANDATORY USE OF MUFFLERS ON ALL CONSTRUCTION VEHICLES AND EQUIPMENT. WHERE FEASIBLE, SOLENOID PAVEMENT BREAKERS WILL BE USED IN LIEU OF AIR POWERED JACK HAMMERS.

3) NOISE GENERATING ACTIVITIES WILL BE LIMITED TO THE HOURS OF 8:00 AM TO 6:00 PM.

4) THE CONTRACTOR SHALL PROVIDE A WATER TRUCK TO WATER AREAS AS NECESSARY TO CONTROL DUST.

5) CONTRACTOR SHALL PROVIDE CRUSHED ROCK IN AREAS OF TEMPORARY CONSTRUCTION ACCESS TO MINIMIZE MIGRATION OF SEDIMENT.

6) ALL DISTURBED AREAS SHALL BE REVEGATED WITH NATIVE SPECIES PER TRPA BEST MANAGEMENT PRACTICES (BMP). EXISTING VEGETATION REMOVED DURING CONSTRUCTION SHALL BE CHIPPED AND MULCHED ON SITE AND STORED FOR USE DURING REVEGETATION.

7) ALL TREES AND NATURAL VEGETATION TO REMAIN ON SITE SHALL BE PROTECTED PER TRPA BMP-8.

8) DRIP LINE INFILTRATION TRENCHES SHALL BE INSTALLED PER TRPA BMP-43, WHERE REQUIRED.

9) SOIL AND CONSTRUCTION MATERIAL SHALL NOT BE TRACKED OFF THE CONSTRUCTION SITE. GRADING OPERATIONS SHALL CEASE IN THE EVENT THAT DANGER OF VIOLATING THIS CONDITION EXISTS.

10) DURING CONSTRUCTION, ENVIRONMENTAL PROTECTION DEVICES, SUCH AS EROSION CONTROL, DUST CONTROL AND VEGETATION PROTECTION DEVICES SHALL BE MAINTAINED AT ALL TIMES.

11) LOOSE SOIL MOUNDS OR SURFACES SHALL BE PROTECTED FROM WIND OR WATER EROSION BY BEING APPROPRIATELY COVERED WHEN CONSTRUCTION IS NOT IN ACTIVE PROGRESS OR WHEN REQUIRED BY TRPA.

12) EXCAVATED MATERIAL SHALL BE STORED UPGRADE FROM THE EXCAVATED AREA WHENEVER POSSIBLE. NO MATERIAL SHALL BE STORED IN ANY STREAM ENVIRONMENT ZONE (SEZ) OR WET AREA.

13) ONLY EQUIPMENT OF A SIZE AND TYPE THAT WILL DO THE LEAST AMOUNT OF DAMAGE, UNDER PREVAILING SITE CONDITIONS AND CONSIDERING THE NATURE OF THE WORK TO BE PERFORMED, WILL BE USED.

14) NO WASHING OF VEHICLES OR HEAVY EQUIPMENT, INCLUDING CEMENT MIXERS, SHALL BE PERMITTED ANYWHERE ON THE SUBJECT PROPERTY UNLESS AUTHORIZED BY TRPA IN WRITING.

15) NO VEHICLE OR HEAVY EQUIPMENT SHALL BE ALLOWED IN A STREAM ENVIRONMENT ZONE (SEZ) OR WET AREA EXCEPT AS AUTHORIZED BY TRPA.

16) ALL CONSTRUCTION SHALL BE WINTERIZED BY OCTOBER 15 TO REDUCE THE WATER QUALITY IMPACTS ASSOCIATED WITH WINTER WEATHER AS FOLLOWS:

A. FOR THE SITES THAT WILL BE INACTIVE BETWEEN OCTOBER 15 AND MAY 1:

16.1. TEMPORARY EROSION CONTROLS SHALL BE INSTALLED
16.2. TEMPORARY VEGETATION PROTECTION FENCING SHALL BE INSTALLED
16.3. DISTURBED AREAS SHALL BE STABILIZED
16.4. ONSITE CONSTRUCTION SLASH AND DEBRIS SHALL BE CLEANED UP AND REMOVED
16.5. WHERE FEASIBLE, MECHANICAL STABILIZATION AND DRAINAGE IMPROVEMENTS SHALL BE INSTALLED
16.6. SPOIL PILES SHALL BE REMOVED FROM THE SITE

B. FOR THE SITES THAT WILL BE ACTIVE BETWEEN OCTOBER 15 AND MAY 1, IN ADDITION TO THE ABOVE REQUIREMENTS:

1.1. PERMANENT MECHANICAL EROSION CONTROL DEVICES SHALL BE INSTALLED, INCLUDING PAVING OF THE DRIVEWAYS AND PARKING AREAS.
1.2. PARKING OF VEHICLES AND STORAGE OF BUILDING MATERIALS SHALL BE RESTRICTED TO PAVED AREAS.

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GENERAL NOTES

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ABBREVIATIONS:

AB	AGGREGATE BASE
AC	ASPHALT CONCRETE
APPX	APPROXIMATELY
AVE	AVENUE
&	AND
CF	CUBIC FEET
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CPLG	COUPLING
CPS	COPPER PIPE SIZE
CSLT	CITY OF SOUTH LAKE TAHOE
DI	DRAINAGE INLET
DIA	DIAMETER
DIP	DUCTILE IRON PIPE
E	EXISTING
EA	EACH
ELEC	ELECTRIC
ELEV	ELEVATION
ELL	ELBOW
EOP	EDGE OF PAVEMENT
FG	FINISHED GRADE
FH	FIRE HYDRANT
FL	FLOW LINE
FLG	FLANGE
FM	FORCE MAIN
FS	FIRE SERVICE
G	GAS
GA	GAUGE
GALV	GALVANIZED
GB	GRADE BREAK
GPM	GALLONS PER MINUTE
GS	GAS SERVICE, GROUND SHOT
H	HEIGHT
HEX	HEXAGONAL
HORZ	HORIZONTAL
HWY	HIGHWAY
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
INV	INVERT
IPS	IRON PIPE SIZE
JT	JOINT
L	LENGTH
LF	LINEAR FEET
LN	LANE
LOC	LOCATION
LT	LEFT
MAX	MAXIMUM
MECH	MECHANICAL
MFR	MANUFACTURER
MH	MANHOLE
MJ	MECHANICAL JOINT
MIN	MINIMUM
MISC MTL	MISCELLANEOUS METAL
MUTCD	MANUAL ON TRAFFIC CONTROL DEVICES
N	NORTH
N/A	NOT APPLICABLE
NIC	NOT IN CONTRACT
NO	NUMBER
NTS	NOT TO SCALE
OC	ON CENTER
OD	OUTSIDE DIAMETER
OHU	OVER HEAD UTILITY
PCC	PORTLAND CEMENT CONCRETE
PE, POLY	POLYETHYLENE
PL	PROPERTY LINE
PP	POWER POLE
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PTW	PIPELINE TRACER WIRE
PVC	POLYVINYL CHLORIDE
QTY	QUANTITY
R	RADIUS
RCP	REINFORCED CONCRETE PIPE
REF	REFERENCE
REQ'D	REQUIRED
REVEG	REVEGETATION
RJ	RESTRAINED JOINT
RT	RIGHT
ROW, R/W	RIGHT-OF-WAY
SCH	SCHEDULE
SD	STORM DRAIN
SDMH	STORM DRAIN MANHOLE
SQ FT	SQUARE FOOT
SHT	SHEET
SPEC	SPECIFICATIONS
SPPCO	SIERRA PACIFIC POWER COMPANY
SQ	SQUARE
SS	SANITARY SEWER, STAINLESS STEEL
SSL	SANITARY SEWER LATERAL
SSMH	SANITARY SEWER MANHOLE
ST	STREET
STA	STATION
STD	STANDARD
STL	STEEL
STPUD	SOUTH TAHOE PUBLIC UTILITY DISTRICT
STR	STRUCTURE
TEL	TELEPHONE
TAN	TANGENT
TBC	TOP BACK CURB
TBD	TO BE DETERMINED
TEMP	TEMPORARY
TG	TOP OF GRATE
TR	TOP OF RIM
TRPA	TAHOE REGIONAL PLANNING AGENCY
TW	TRAVELED WAY
TYP	TYPICAL
UG	UNDERGROUND
USFS	UNITED STATES FOREST SERVICE
UTIL	UTILITY
V	VERTICAL
VAR	VARIES
W	WATER
W/	WITH
WM	WATER METER
WS	WATER SERVICE
WV	WATER VALVE
YD	YARD

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GENERAL NOTES

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LEGEND

EXISTING:

EDGE OF PAVEMENT:	—— EOP —— EOP ——
SEWER FORCE MAIN:	—— 16" STEEL FM ——
SEWER:	—— SS —— SS ——
WATER:	—— W —— W ——
GAS:	—— GAS —— GAS ——
OVERHEAD UTILITY:	—— OHU —— OHU ——
TELEPHONE:	—— TEL —— TEL ——
CABLE TV	—— CATV —— CATV ——
STORM DRAIN:	—— SD —— SD ——
PROPERTY LINE:	————————
RIGHT-OF-WAY:	—— R/W —— R/W ——
WATER & GAS VALVE:	
FIRE HYDRANT:	
MANHOLE:	
UTILITY VAULT:	
DROP INLET:	
SIGN:	
LIGHT:	
14" PINE TREE:	∅14"P

PROPOSED:

WATER MAIN LINE:	————————
SVC & FH LINES:	————————
90° ELBOW:	
45° ELBOW:	
TEE:	
CROSS:	
REDUCER:	
WATER VALVE:	

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REQUIREMENTS FOR WATER SERVICE HOOKUP: (PAGE 1)

1) Obtain a permit from the South Tahoe Public Utility District (District) for each connection to the system. No work is to be performed until a permit has been obtained. You must Call the CUSTOMER SERVICE OFFICE to schedule an inspection – please have your APN and\or Sewer Permit number when calling. No inspection will be scheduled without this information.

2) Type K rigid copper pipe shall be installed from the District valve to the downstream side of the meter box with any existing nipple being removed from the District valve. An insulated coupled shall be located immediately downstream of the water meter unless the new water line or District supply in non–metallic pipe.

3) A water service line one and half inch (1.5") or larger, must use a factory made resetter with a high by–pass.

4) The water service line downstream of the meter box shall be constructed of Copper Type L, Copper Type K, Polyethylene Class 200 PSI, or other suitable material approved by the District. For piping requirements at the meter, see Water Meter Installation Detail. For tracing purposes #12 or #14 insulated solid copper wire shall be installed the entire length of all plastic services and attached to the pipe.

5) The size of the water service line shall be subject to the approval of the District, it shall not be smaller than three–quarter inch (3/4") per single family dwelling.

6) Water service lines shall not run or be in the same trench with the building sewer or other drainage piping unless the building sewer drainage piping is of materials approved for use within the building.

7) When the building sewer or drainage piping is of materials not approved for use inside a building, the water service line, at all points, shall have a minimum of twenty four inches (24") of separation from the sewer or drainage piping.

8) All water service lines shall be a minimum of forty two inches (42") below grade. Water service lines shall be bedded with clean material.

9) An individual shut–off valve must be installed outside the building foundation in a permanently accessible location. For easy access in the winter, it is recommended that the valve standpipe be left at least six inches (6") above final grade and capped. The valve must be constructed of brass with non–corrosive working parts. The valve must have a one–quarter (1/4") turn on/off capability with non–mettalic seating properties.

10) If an auxiliary water source currently exists on the property, a connection can only be made to the District's water system if the auxiliary water source is properly destroyed or proper back flow protection is installed and maintained per District standards.

11) Abandoned auxiliary sources of water must first be verified and approved by the District prior to connection to the District system. If a private well exists, contact the El Dorado County Environmental Management office at: (530) 573–3450. This contact MUST be made immediately and prior to water service installation.

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: G7

GENERAL NOTES

SOUTH TAHOE PUBLIC UTILITY DISTRICT
Sewer . 1950 . Water A PUBLIC AGENCY
1275 Meadow Crest Drive South Lake Tahoe, California 96150
Phone (530) 544–6474 Fax (530) 541–4319
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REQUIREMENTS FOR WATER SERVICE HOOKUP: (PAGE 2)

12) If potential for contamination to the District's potable water supply exists (i.e. Auxiliary Water Supply, Hydronic Heating, Boilers, Swimming Pools, Solar Heating Systems, Fire Sprinkler Systems, etc.) An approved Backflow Assembly will be required. Backflow Assembly shall be installed above grade and in the horizontal position. If Assembly is placed outside of the structure, it shall be install between the water meter and the building foundation. If the Assembly is placed inside the structure it shall be installed within twenty four inches (24") of where the water service enters the structure. Backflow Assembly must have freeze protection.

12A) Hydronic heating will not require a backflow assembly if it is a "closed loop system" with a "stand alone" reservoir for make-up water. The system must have a Double Wall heat exchanger. All systems must be approved by a District inspector to be exempt from a backflow assembly.

13) All Fire Protection Systems require an approved Back Flow assembly installed on the Fire Line.

14) Back Flow Assemblies must be tested, by a District approved certified tester, after initial installation and annually thereafter. Test results need to be sent to the District's Customer Service Department.

15) All Water Services, Water Meters and Back Flow Assemblies shall be left exposed and be leak proof under static line pressure until witnessed and inspected. DO NOT stack water boxes or cover any work until it has been inspected and approved by the District inspector.

16) Meter box installation shall consist of three inch (3") rigid foam insulation placed inside the meter box on top of the meter. No "spray on" type rigid foam insulation will be accepted and rigid insulation SHALL NOT be attached to the lid. The meter box lid shall have a centered two inch (2") diameter hole to accommodate the meter reading system.

17) If work is approved, the inspector will notify you verbally or an Acceptance Notice will be left at the jobsite. If work is not approved, a Correction notice will be left at the jobsite. Please call for re-inspection. Excessive re-inspection may be subject to additional inspection fees.

18) A second meter inspection will take place approximately two (2) weeks after the initial water service inspection it will include correct installation of boxes, proper insulation and meter tolerances. The Inspector will lock-off the meter if it is not properly installed in the meter box.

19) If you have any questions regarding your water service hookup, call the District Inspectors at: (530) 544-6474 ext. 6226, 6227, 6228 or 6229.

20) It is the responsibility of the property owner, developer and/or general contractor to ensure that all work is performed by an appropriately licensed contractor.

REQUIREMENTS FOR SEWER HOOKUP:
(PAGE 1)

1) Obtain a permit from the South Tahoe Public Utility District (District) for each connection to the system. No work is to be performed until a permit has been obtained. You must call the CUSTOMER SERVICE OFFICE to schedule an inspection – please have your APN and\or Sewer Permit number when calling. No inspection will be scheduled without this information. DO NOT cover any work until it has been inspected and approved by a District Inspector.

2) The building sewer line shall be constructed of cast iron soil pipe, vitrified clay, SDR–26, ABS or other suitable material approved by the District.

3) The size of the building sewer line shall be a minimum four inches (4"). A sewer lateral larger than four inches, will require the installation of a manhole. When saddling a sewer main a "Romac" brand saddle will be required.

4) Joints between all approved types of pipe shall be made by means of an adapter coupling approved for this purpose. UPC 2003, Section 705.0

5) The slope of the sewer line shall not be less than one–quarter inch per foot (1/4"/foot). The minimum under a driveway shall be thirty inches (30"). If it less than thirty inches (30") in depth, the pipe shall be cast iron.

6) No building sewer line shall be laid parallel to and within three feet (3') of a bearing wall foundation unless the foundation footing extends below the sewer line.

7) The sewer line shall be placed on a bed of sand or compacted rock free earth. The backfill around the sewer line shall be free of rock.

8) <u>After lateral has been inspected and backfilled, lateral shall be air tested. (See Requirements For Air Testing Sewer Laterals)</u>

9) A cleanout shall be installed at the sewer system lateral connection (See Building Sewer Installation Detail). The cleanout riser shall the same size as the lateral. The cleanout closest to the District's sewer main is to be in a concrete box with a metal lid marked "SEWER".

10) Cleanouts shall be placed in every building sewer line at the junction of the soil pipe stubout and at intervals not to exceed one hundred feet (100') in straight runs.

11) If total change of horizontal lateral direction exceeds 135 degrees (135°), an extra cleanout shall be required. Ninety degree (90°) elbows shall not be permitted.

DATE:	SCALE:	DRAWN:	FILE:	SHEET:
JAN 2009	NO SCALE	MAM	STANDARDS	G9

GENERAL NOTES

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1275 Meadow Crest Drive South Lake Tahoe, California 96150
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REQUIREMENTS FOR SEWER HOOKUP:
(PAGE 2)

12) Shoring or sloping shall be required per the current Cal—OSHA standards, for any sewer line trench.

13) All cleanouts shall be brought to within ten inches (10") of finished grade and shall be installed in an approved box set to finish grade.

14) Drainage piping serving fixtures which have flood level rims located below the elevation of the next upstream manhole cover of the public sewer serving such piping shall be protected from back flow of sewage by installing an approved type of back water valve. Fixtures above such elevation shall not discharge through the back water valve. UPC 2003, section 710.1

15) If a backwater valve is required, it shall be located between the building stubout and the house cleanout. The backwater valve shall be accessible for inspection and repair at all times. The backwater valve shall be enclosed in a masonry pit, fitted with an adequately sized, removable cover marked "SEWER". Back water valves shall comply with UPC 2003, Section 710.6

16) If work is approved, the inspector will notify you verbally or an Acceptance Notice will be left at the jobsite. If work is not approved, a Correction notice will be left at the jobsite. Please call for re—inspection. Excessive re—inspection may be subject to additional inspection fees.

17) Abandoned septic tanks, cesspools or dry wells MUST be pumped and limed by a Licensed Pumper, tagged and then backfilled with clean material at the time of sewer hookup. California Health and safety Code Section 14—1000

18) If you have any questions regarding your sewer hookup, call the District Inspectors at: (530) 544—6474 ext. 6226, 6227, 6228 or 6229.

19) It is the responsibility of the property owner, developerand/or general contractor to ensure that all work is performed by an appropriately licensed contractor.

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: G10

GENERAL NOTES

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REQUIREMENTS FOR AIR TESTING SEWER LATERALS:

1) Please call the CUSTOMER SERVICE OFFICE to schedule an inspection—pleasehave your APN and\or Sewer Permit number whencalling. No inspection will be scheduled without this information. In order to pass, a South Tahoe Public Utility District (District) Inspector must witness the air test.

2) If buried, the clean out at the building and at the property line shall be installed in an approved box (see clean out detail) and set to finish grade.

3) Sewer lateral shall be completely backfilled at time of test.

4) Insert inflatable plug into the building clean out and position it immediately downstream of the clean out "Y". Inflate the plug.

5) Insert another inflatable plug through the property line clean out until reaches the sewer main. Inflate the plug.

6) Insert air test (pass through) plug into the property line clean out standpipe and inflate plug to form air seal in stand pipe.

7) Pressurize the line to three and a half pounds per square inch (3.5 PSI) through the air test plug. Remove filler hose from air test plug. The line shall be allowed a maximum loss in pressure of a half pound (0.5 PSI) in five (5) minutes. If the loss exceeds a half pound (0.5 PSI), the test may be attempted one additional time. A second loss of pressure constitutes failure of the line. The pressure gauge shall read in one pound (1 PSI) increments and be clearly readable in the three to four pound (3.0 to 4.0 PSI) range.

8) Sewer laterals that fail the air pressure test shall be repaired or replaced at the property owner's expense. All repairs or replacements shall be inspected by a District Inspector prior to backfilling. An air test will be required after repair of the sewer lateral.

9) If faulty installation is suspected on an existing sewer lateral from the property line to the main and will be required to be repaired or replaced, the District SHALL be notified prior to removal so that a District Inspector may document the faulty work.

10) If you have any questions regarding your sewer hookup, call the District Inspectors at: (530) 544-6474 ext. 6226, 6227, 6228 or 6229.

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: G11

GENERAL NOTES

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GREASE INTERCEPTOR SIZING POLICY

ADMINISTRATIVE CODE SECTION 4.6.11(b):
TYPES OF WASTE PROHIBITED:

Except as hereinafter provided, no person shall discharge or cause to be discharged any of the following described waters to any public sewer:

Any water or waste which contains more than 250 parts per million, by weight, of fat, oil or grease.

ADMINISTRATIVE CODE SECTION 4.6.13:
GREASE INTERCEPTORS/TRAPS REQUIRED:

Grease, oil and sand interceptors/traps shall be provided when they are necessary for the proper handling of liquid wastes containing grease in excessive amounts, any flammable waste, sands and other harmful ingredients; except that such interceptors shall not be required for buildings used exclusively for residential purposes. All interceptors/traps shall be of a type and capacity approved by the District and shall be located as to be readily and easily accessible for cleaning and inspection. Sizing of grease interceptors/traps shall be in accordance with current District policy.

POLICY:
To determine the appropriate size grease interceptor to be installed at new installations and for remodel or retrofit of existing equipment, the business operator or his agent shall abide by the following table:

UPC TABLE H-1

GRAVITY GREASE INTERCEPTOR SIZING

DFU's (1)	INTERCEPTOR VOLUME
8	500 gallons
21	750 gallons
35	1,000 gallons
90	1,250 gallons
172	1,500 gallons
216	2,000 gallons
307	2,500 gallons
342	3,000 gallons
428	4,000 gallons
576	5,000 gallons
720	7,500 gallons
2112	10,000 gallons
2640	15,000 gallons

(1) The maximum allowable DFU's plumbed to the kitchen drain lines that will be connected to the grease interceptor.

SHEET: G12
FILE: STANDARDS
DRAWN: MAM
SCALE: NO SCALE
DATE: JAN 2009

GENERAL NOTES

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REVISED: FEBRUARY 19, 2009 M.A.M.
RESET ALL DETAILS TO 1:20 SCALE ADDED BORDERS IN MODEL SPACE FOR ALIGNMENT
(PER MATTHEW MENDOZA, ENG. DEPT.)
REVISED: FEBRUARY 4, 2009 M.A.M.
CLEANED UP LAYERS, CHANGED TO LAYERS TO REPRESENT TRUE COLOR CHART (I.E. LAYER 1 IS RED AND SO ON)
CHANGED VIEWPORT LAYER TO DEFPOINTS LAYER TO REMOVE EXTRA LAYER
THESE CHANGES WHERE MADE IN PREPARATION OF THE NEW STPUD CAD STANDARDS
(PER MATTHEW MENDOZA, ENG. DEPT.)
REVISED: JANUARY 30, 2009 M.A.M.
CHANGED NOTE 8 TO THE REQUIREMENT TO WATER SERVICE HOOKUP
ADDED NOTE 12A TO THE REQUIREMENT TO WATER SERVICE HOOKUP
CHANGED NOTE 15 THE REQUIREMENT FOR SEWER HOOKUP
CHANGED REDUCED PRESSURE DETAILS, CHANGED REQUIREMENT FOR GAL STEEL SLEEVE TO PVC SLEEVE
(PER JAMES CULLEN, CS DEPT.)
REVISED: JANUARY 28, 2009 M.A.M.
ADDED: DETAIL FOR CONCRETE CAP OVER SEWER MAIN IN STREAM BED
(PER RANDY CURTIS, MANAGER OF WATER OPERATIONS
UPDATED PDF'S FOR 2009 , IN PUBLIC DRIVE UNDER FORMS
CHANGED TITLE BLOCK LAYOUT AND CHANGED PAGE NUMBERING SYSTEM TO REFLECT SECTIONS MADE VIEW PORT LARGER ATTEMPT TO 1:20 SCALE AS STANDARD FOR LAYOUTS
(PER MATTHEW MENDOZA, ENG. DEPT.)
REVISED: JANUARY 27, 2009 M.A.M.
ADDED: DETAIL FOR WATER METER PIT SETTER AS OPTIONAL METER BOX INSTALLATION
(PER JAMES CULLEN, CS DEPT.)
REVISED: JANUARY 16, 2009 M.A.M.
CHANGED: DETAIL WATER METER 3/4" TO 1"
ADDED: TOP VIEW TO DETAIL AND REBAR ANCHOR
(PER JAMES CULLEN, CS DEPT.)
REVISED: JANUARY 15, 2009 M.A.M.
ADDED: DETAIL FUTURE 3/4" METER BOX
RESET PAGE NUMBERS AND DETAIL NUMBERS
(PER MATTHEW MENDOZA, ENG. DEPT.)
REVISED: NOVEMBER 13,2008 M.A.M.
ADDED: DETAIL SAFETY BOLLARD
(PER MATTHEW MENDOZA, ENG. DEPT.)
REVISED: OCTOBER 21,2008 M.A.M.
ADDED: LINE 19 TO REQUIREMENTS FOR BUILDING SEWER HOOKUP AND ADDED LINE 20 TO REQUIREMENTS FOR WATER SERVICE HOOK UP
(PER LISA COYNER, CS DEPT)
REVISED: JUNE 6, 2008 M.A.M.
ADDED: "PTW" PIPELINE TRACER WIRE TO THE ABBREVIATIONS
REVISED: MAY 1, 2008 M.A.M.
REVISED DETAILS "D16, D17 AND D18" ADDED STEEL SLEEVE AND OPTIONAL DRAIN TEXT, AND ADDED NOTE ON SLEEVE.
REVISED: APRIL 3, 2008 M.A.M.
ADDED "REQUIREMENTS FOR AIR TESTING SEWER LATERALS"
(PER JAMES CULLEN, CS DEPT)
REVISED: MARCH 31, 2008 M.A.M.
CHANGED SECTION AND FOLDER ONE FROM "NOTES AND FORMS" TO "GENERAL NOTES"
(PER LISA COYNER, CS DEPT); SAVED ALL PDF'S AS PORTRAIT INSTEAD OF LANDSCAPE FOR STPUD WEB SITE
(PER MARY ALSBURY, IS DEPT)
REVISED: MARCH 25, 2008 M.A.M.
ADDED NOTE #2 TO THE $1\frac{1}{2}$" TO 2" WATER METER DETAIL, RENUMBER EXISTING NOTES 2-8 TO 3-9
(PER JAMES CULLEN, CS DEPT)
REVISED: MARCH 19, 2008 M.A.M.
ADD REDUCED PRESSURE PRINCIPLE DETECTOR ASSEMBLY $2\frac{1}{2}$" TO 10" DETAIL, REMOVED DOUBLE CHECK VALVE DETAILS
(PER JAMES CULLEN, CS DEPT)
REVISED: MARCH 18, 2008 M.A.M.
UPDATED FONT SIZING ON SEVERAL DETAILS
REVISED: MARCH 10, 2008 M.A.M.
ADDED GREASE INTERCEPTOR POLICY AND DETAIL
(PER JAMES CULLEN, CS DEPT)
REVISED: FEBRUARY 18, 2008 M.A.M.
ADDED 6' FENCE, SWING GATE AND INFILTRATION TRENCH DETAILS
(PER JULIE RYAN, ENG DEPT)
REVISED: JANUARY 21, 2008 M.A.M.
MATTHEW COMPILES AND REVISES DETAILS

JANUARY 18, 2007
STPUD ENGINEERING DEPARTMENT - STANDARD NOTES AND DETAILS

KEEP THIS DRAWING CURRENT FOR USE ON ALL PROJECTS.
WRITE PROTECTED: SEE MATTHEW, WANDA OR JOHN TO DISCUSS CHANGES.

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: R1

REVISION NOTES

SOUTH TAHOE PUBLIC UTILITY DISTRICT
Sewer . 1950 . Water A PUBLIC AGENCY
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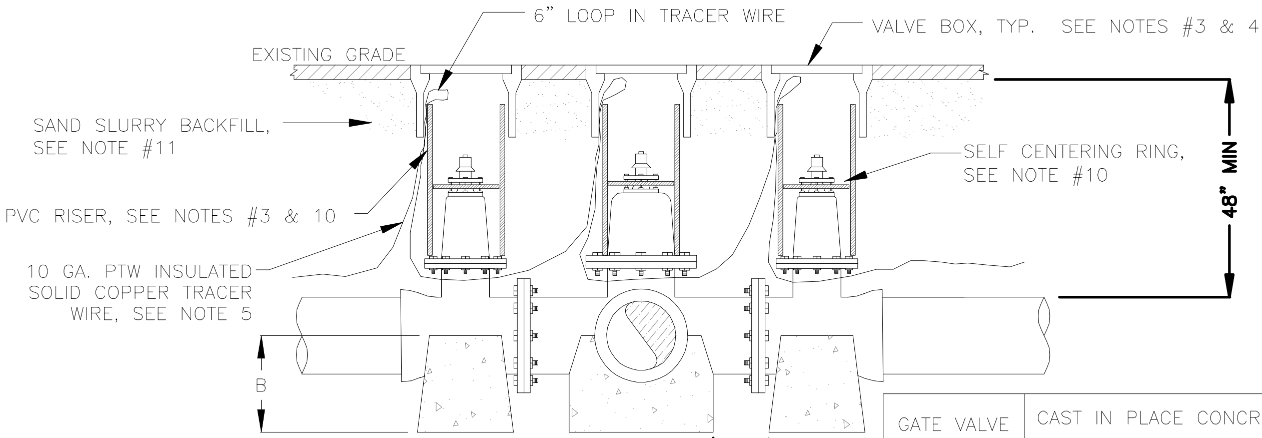

GATE VALVE SIZE	SUPPORT BLOCK DIMENSION
6"	USE 1- 4"X8"X16" PRECAST STRUCTURAL SUPPORT BLOCK
8"	
10"	

GATE VALVE SIZE	CAST IN PLACE CONCRETE	
	A (FT)	B (FT)
12"	2.0	2.0
14"	2.5	2.5
16"	3.0	3.0
18"	3.0	3.0

NOTES:

1) GATE VALVES FOURTEEN INCH (14") DIAMETER AND SMALLER SHALL BE MUELLER OR APPROVED EQUAL AS PER AWWA C-509, RESILIENT RUBBER SEAT RING, WEDGE DISC, NON-RISING STEM. BRONZE STEM NUT AND O-RING SEALS ABOVE AND BELOW THE THRUST COLLAR, WITH TWO INCH (2") SQUARE OPERATING NUT. VALVES SIXTEEN INCH (16") AND LARGER SHALL BE BUTTERFLY VALVES AS SPECIFIED AND SUBMITTED FOR APPROVAL.

2) THE MAIN LINE VALVE CLUSTER SHALL CONSIST OF A FLANGED TEE AND FLANGED X MECHANICAL JOINT VALVES OR FLANGED COUPLING ADAPTERS.

3) VALVE BOX RISER PIPE TO BE EIGHT INCH (8") PVC, SDR-35 AND INSTALLED PERPENDICULARLY CENTERED AROUND AND COVERING THE UPPER VALVE BONNET AND OPERATOR.

4) VALVE BOX SHALL BE CHRISTY G5 BOX WITH METAL LID MARKED "WATER"

5) THE 10 GA. PTW TRACER WIRE SHALL BE ROUTED FROM THE NEW MAIN, LOOPED THROUGH THE VALVE BOXES AND CLAMPED TO THE EXISTING WATER MAIN USING STAINLESS STEEL CLAMPS. CONTINUITY BETWEEN ALL NEW AND EXISTING PIPELINES SHALL BE MAINTAINED.

6) EXPOSED NUTS AND BOLTS ON MJ FITTINGS TO BE PAINTED WITH TWO COATS OF KOPPERS 505, TNEMEC 46-450, AMERON OR EQUAL 15 MILS EACH COAT.

7) ALL FLANGES TO BE BURIED, COAT ENTIRE ASSEMBLY WITH PETROLATUM SATURATED FABRIC TAPE WRAP SYSTEM IN ACCORDANCE WITH STPUD REQUIREMENTS.

8) CONCRETE FOR SUPPORT BLOCKS SHALL BE FORMED TO MAINTAIN MINIMUM TWO INCH (2") CLEARANCE FROM FLANGE BOLTS.

9) PRE CAST STRUCTURAL SUPPORT BLOCKS SHALL BE SOLID AND CONFORM TO ASTM C90.

10) PROVIDE AND INSTALL SELF CENTERING ALIGNMENT RING WITH SLIDING ADJUSTER AS MANUFACTURED BY THE AMERICAN FLOW CONTROL CORP. AND SUPPLIED FOR A TRENCH ADAPTER VALVE BOX ASSEMBLY.

11) THE REQUIREMENTS FOR TRENCH BACK FILL AT ALL INTER TIE VALVE CLUSTERS SHALL INCLUDE THE PLACEMENT OF TWO SACK SAND SLURRY WITHIN 3' OF ALL VALVE BOXES BETWEEN THE AB PIPE ZONE MATERIAL AND BOTTOM OF AC PAVEMENT. THIS REQUIREMENT SHALL NOT APPLY TO SINGLE VALVE INSTALLATIONS.

12) FOR ALL VALVE OPERATING NUTS EXCEEDING FORTY EIGHT INCHES (48") BURY THE CONTRACTOR SHALL PROVIDE VALVE OPERATOR EXTENSIONS WITH TRASH RINGS TO A MINIMUM DEPTH OF THIRTY SIX INCHES (36").

A
1

WATER VALVE ASSEMBLY

NO SCALE

SHEET: S1-D1
FILE: STANDARDS
DRAWN: MAM
SCALE: NO SCALE
DATE: JAN 2009

WATERLINE DETAILS

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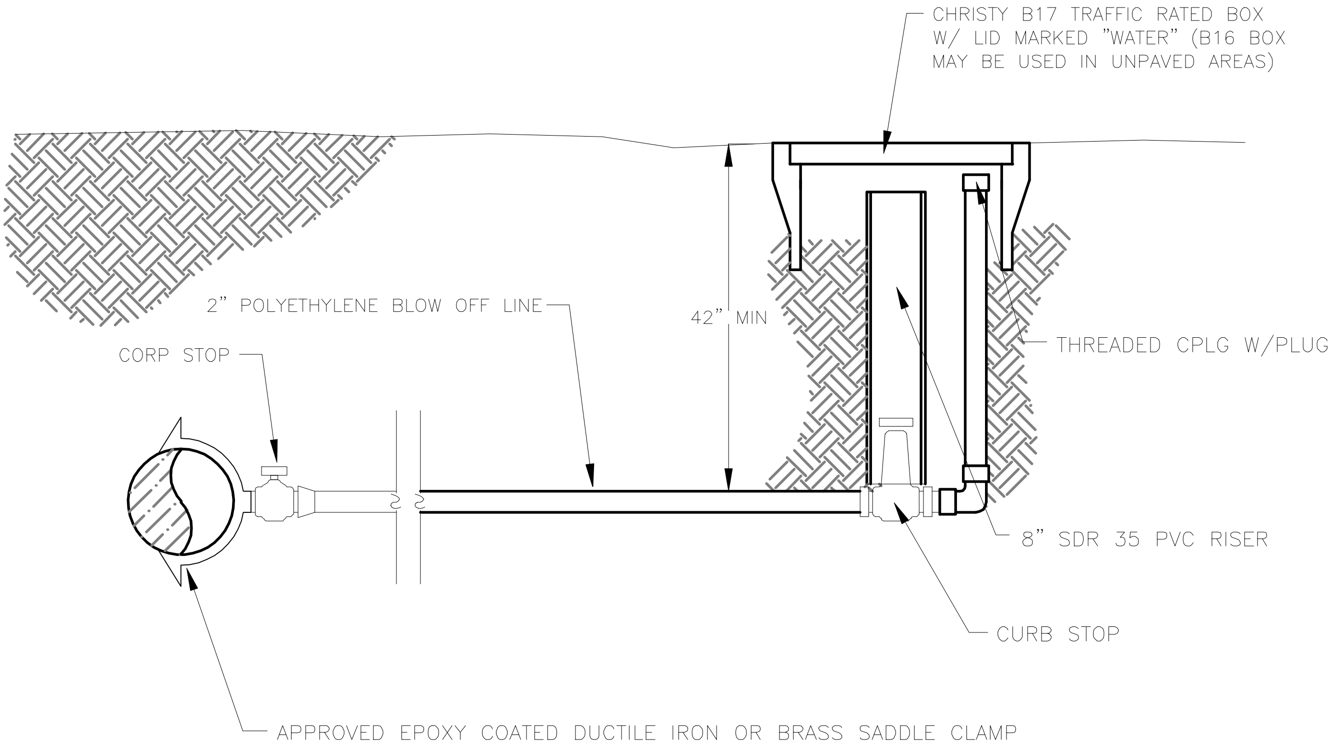

NOTES:

1) ALL BLOW OFFS ARE TO BE REMOVED AFTER USE BY CLOSING THE CORP STOP AT THE MAIN AND REMOVING ALL APPURTENANCES

2" BLOW OFF

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NO SCALE

DATE:	SCALE:	DRAWN:	FILE:	SHEET:
JAN 2009	NO SCALE	MAM	STANDARDS	S1-D2

WATERLINE DETAILS

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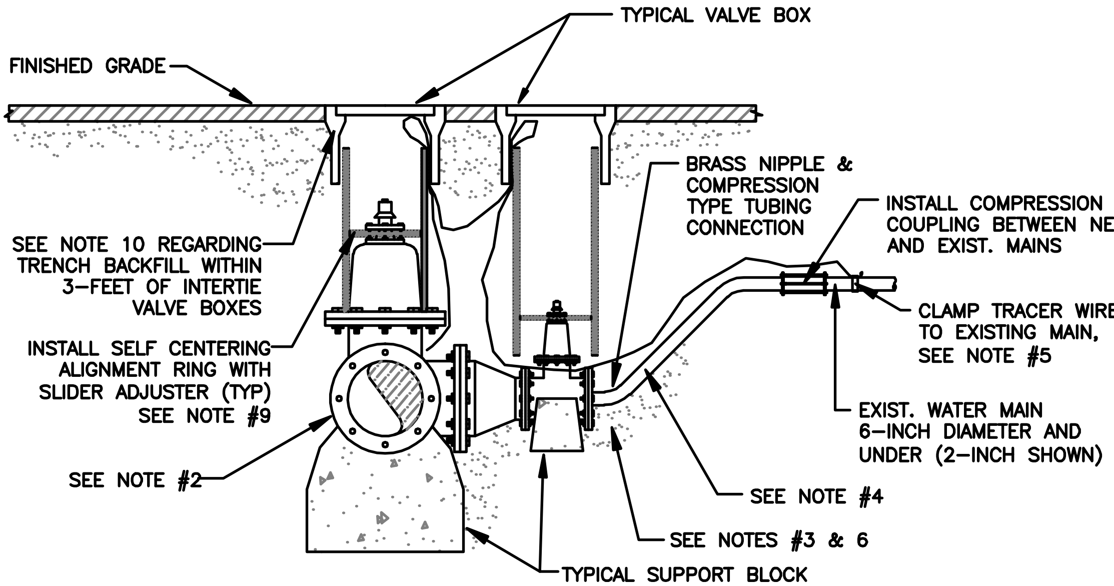

NOTES:

1) ALL INTERTIES TO EXISTING WATER MAINS UNDER SIX INCH (6") SHALL CONSIST OF VALVES AND FITTINGS AS SPECIFIED AND CONFORMING TO AWWA C-509 AND C-110.

2) THE MAIN LINE VALVE CLUSTER SHALL CONSIST OF A FLANGED TEE AND FLANGED X MECHANICAL JOINT VALVES, OR FLANGED X FLANGED GATE VALVES WITH COUPLING ADAPTERS.

3) FOR WATER MAINS TWO INCH (2") AND UNDER THE INTERTIE BRANCH SHALL CONSIST OF A FLANGED BELL REDUCER FROM THE NEW WATER MAIN TEE TO 6" X 6" FLANGED GATE VALVE AND SIX INCH (6") COMPANION FLANGE THREADED FOR THE APPROPRIATE SIZE INTERTIE PIPING.

4) THE INTERTIE SHALL CONSIST OF 200 PSI CLASS POLYETHYLENE TUBING HAVING THE SAME INSIDE DIAMETER AS CORRESPONDING SIZES OF IRON PIPE FOR 3/4" TO 1" LINES AND COPPER PIPE SIZE FOR 1 1/2" TO 2" LINES AND COUPLED TO THE EXISTING WATER MAIN USING AN APPROVED 4 BOLT COMPRESSION COUPLING.

5) THE 10 GA. PTW TRACER WIRE SHALL BE ROUTED FROM THE NEW MAIN, LOOPED THROUGH THE VALVE BOXES AND CLAMPED TO THE EXISTING WATER MAIN USING STAINLESS STEEL CLAMPS. CONTINUITY BETWEEN ALL NEW AND EXISTING PIPELINES SHALL BE MAINTAINED.

6) FOR WATER MAINS OVER TWO INCH (2") THE INTERTIE BRANCH SHALL CONSIST OF A FLANGED BELL REDUCER FROM THE NEW MAIN SIZE TO 6" X 6" FLANGED GATE VALVE, 6" X APPROPRIATE SIZE FLANGED BELL REDUCER AND FLANGE X MJ COUPLING ADAPTER.

7) ALL FLANGES TO BE BURIED, COAT ENTIRE ASSEMBLY WITH PETROLATUM SATURATED FABRIC TAPE WRAP SYSTEM IN ACCORDANCE WITH THE SPECIFICATIONS.

8) CONCRETE FOR SUPPORT BLOCKS SHALL BE FORMED TO MAINTAIN A MINIMUM TWO INCH 2" CLEARANCE FROM FLANGE BOLTS.

9) PROVIDE AND INSTALL SELF-CENTERING ALIGNMENT RING WITH SLIDING ADJUSTER AS MANUFACTURED BY THE AMERICAN FLOW CONTROL CORP. AND SUPPLIED FOR A TRENCH ADAPTER VALVE BOX ASSEMBLY.

10) THE REQUIREMENTS FOR TRENCH BACKFILL AT ALL INTERTIE VALVE CLUSTERS SHALL INCLUDE THE PLACEMENT OF TWO SACK SAND SLURRY WITHIN THREE FEET (3') OF ALL VALVE BOXES BETWEEN THE AB PIPE ZONE MATERIAL AND BOTTOM OF AC PAVEMENT. THIS REQUIREMENT SHALL NOT APPLY TO SINGLE VALVE INSTALLATIONS.

INTERTIE TO EXISTING MAINS UNDER 6"

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NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S1-D3

WATERLINE DETAILS

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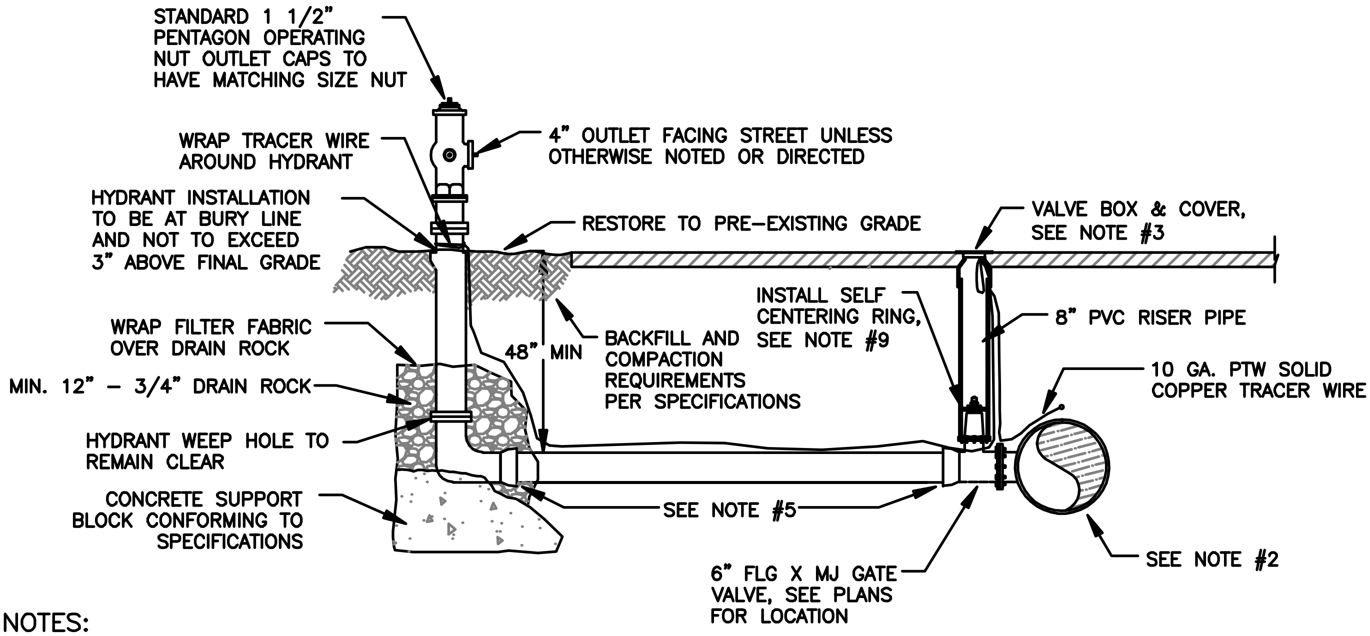

NOTES:

1) FIRE HYDRANT SHALL BE MUELLER A-423 "CENTURION" OR WATEROUS PACER TRAFFIC MODEL WB6700P WITH 2-2 1/2" HOSE NOZZLES AND 1-4" PUMPER NOZZLE AND CONFORM TO AWWA C-502-80. HYDRANTS WITHIN THE CITY OF SOUTH LAKE TAHOE SHALL BE PAINTED WITH A MINIMUM OF THREE COATS OF SPRAY MATE "ALUMINUM METALLIC", COLOR CODE 0180 OR APPROVED EQUAL.

2) FIRE LINE TEE ON NEW MAIN SHALL BE DUCTILE IRON MJ X MJ WITH 6" FLANGED BRANCH THE SAME PRESSURE RATING AS THE PIPELINE BEING INSTALLED.

3) GATE VALVE SHALL BE MJ X FLANGED RESILIENT WEDGE GATE VALVE EPOXY LINED AND COATED. WITH CHRISTY G5 VALVE BOX AND METAL LID STAMPED "WATER".

4) HYDRANT THRUST BLOCK SHALL HAVE A MINIMUM BEARING SURFACE OF 6 SQ. FEET. ALL FLANGES TO BE BURIED, COAT ENTIRE ASSEMBLY WITH PETROLATUM SATURATED FABRIC TAPE WRAP SYSTEM IN ACCORDANCE WITH STPUD REQUIREMENTS, CONCRETE FOR THRUST BLOCKS SHALL BE FORMED TO MAINTAIN A MINIMUM CLEARANCE OF TWO INCHES (2") FROM FLANGE BOLTS.

5) THE ENTIRE HYDRANT ASSEMBLY FROM THE MAIN TO THE HYDRANT SHALL BE RESTRAINED. FIRE LINE, GATE VALVE AN HYDRANT MECHANICAL JOINTS TO BE INSTALLED WITH US PIPE MJ GRIPPER GLAND, EBAA-IRON MEGALUG 1100SD SERIES FOR DUCTILE IRON PIPE. RESTRAINED JOINTS FOR PVC PIPE SHALL BE EBAA-IRON MEGALUG SERIES 2000 OR 1100PV OR APPROVED EQUAL.

6) HYDRANT ASSEMBLY SHALL PASS HYDROSTATIC PRESSURE AND DISINFECTION TESTING AS SPECIFIED ALONG WITH NEW PIPELINE PRIOR TO BEING PLACED INTO SERVICE.

7) HYDRANTS SHALL BE LOCATED AS SHOWN ON THE PROJECT DRAWINGS, TWO FEET (2') INSIDE R.O.W. OR AS DIRECTED BY THE DISTRICT ENGINEER AND MUST HAVE A MINIMUM OF TEN FEET (10') CLEARANCE FROM ANY DRIVEWAY. THE EXACT LOCATIONS FOR THE FIRE HYDRANT INSTALLATIONS WILL BE DETERMINED IN THE FIELD.

8) HYDRANTS SHALL BE INSTALLED WITH THE BOTTOM OF THE PUMPER NOZZLE A MINIMUM OF EIGHTEEN INCHES (18") ABOVE THE GROUND.

9) PROVIDE AND INSTALL SELF-CENTERING ALIGNMENT RING WITH SLIDING ADJUSTER AS MANUFACTURED BY THE AMERICAN FLOW CONTROL CORP. AND SUPPLIED FOR A TRENCH ADAPTER VALVE BOX ASSEMBLY.

10) FOR ALL VALVE OPERATING NUTS EXCEEDING 48" BURY THE CONTRACTOR SHALL PROVIDE VALVE OPERATOR EXTENSIONS WITH TRASH RINGS TO A MINIMUM DEPTH OF THIRTY SIX INCHES (36").

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FIRE HYDRANT

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S1-D4

WATERLINE DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

Sewer . 1950 . Water A PUBLIC AGENCY
1275 Meadow Crest Drive South Lake Tahoe, California 96150
Phone (530) 544-6474 Fax (530) 541-4319
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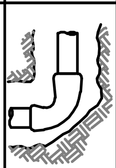
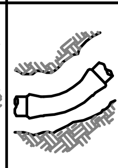
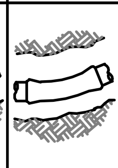
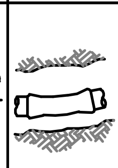
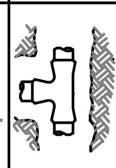
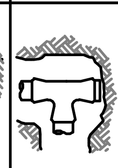
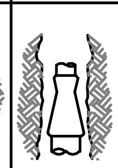
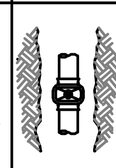
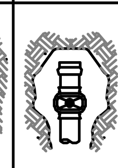
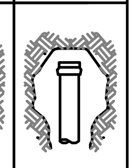
FITTING AND PIPE RESTRAINT LENGTH REQUIREMENTS

TYPE OF FITTING			90° ELBOW	45° ELBOW	22.5° ELBOW	11.25° ELBOW	TEE BRANCH*	TEE W/ PLUG	REDUCER**	VALVE INLINE	VALVE AT END	DEAD END
TYPICAL INSTALLATION												
SIZE OF PIPE	6"	PVC	14'	6'	3'	2'	10'*	14'	41'	42'	42'	42'
		DIP	16'	7'	4'	2'	10'*	16'	61'	63'	63'	63'
	8"	PVC	18'	8'	4'	2'	10'*	18'	41'	55'	55'	55'
		DIP	21'	9'	5'	2'	10'*	21'	62'	82'	82'	82'
	10"	PVC	22'	6'	5'	3'	4'*	22'	43'	66'	66'	66'
		DIP	25'	10'	5'	3'	6'*	25'	63'	99'	99'	99'
	12"	PVC	26'	11'	6'	3'	15'	26'	43'	78'	78'	78'
		DIP	29'	12'	6'	3'	23'	29'	64'	117'	117'	117'
	14"	PVC	29'	12'	6'	3'	25'	29'	43'	90'	90'	90'
		DIP	33'	14'	7'	4'	39'	33'	64'	133'	133'	133'
	16"	PVC	33'	14'	7'	4'	36'	33'	44'	101'	101'	101'
		DIP	36'	15'	8'	4'	55'	36'	65'	150'	150'	150'
	18"	PVC	36'	15'	8'	4'	46'	36'	62'	112'	112'	112'
		DIP	40'	17'	8'	4'	71'	40'	92'	167'	167'	167'
	24"	PVC	45'	19'	9'	4'	76'	45'	62'	144'	144'	144'
		DIP	51'	21'	10'	4'	116'	51'	92'	214'	214'	214'

* MINIMUM 10' RESTRAINED LENGTH ON EACH RUN ON BOTH SIDES OF BRANCH
** LENGTHS GIVEN ARE VALID FOR UP TO 4" INCREASE IN NOMINAL DIAMETER FROM SIZE SHOWN

NOTES:

1) ALL MINIMUM RESTRAINT LENGTH CALCULATIONS BASED ON MINIMUM 10' PIPE LENGTH'S. MINIMUM PIPE LENGTH'S FOR DUCTILE IRON PIPE FITTINGS BASED ON POLYETHYLENE ENCASEMENT.

2) NUTS AND BOLTS ON ALL MJ FITTINGS SHALL BE PAINTED WITH TWO COATS OF KOPPERS 505, TNEMEC 46-450', AMERON OR EQUAL, 15 MILS EACH COAT.

3) ALL FLANGES TO BE BURIED, COAT ENTIRE ASSEMBLY WITH PETROLATUM SATURATED FABRIC TAPE TAPE WRAP SYSTEM IN ACCORDANCE WITH SPECIFICATIONS.

4) CONCRETE THRUST BLOCKING MAY BE REQUIRED IN CONJUNCTION WITH MECHANICAL THRUST RESTRAINT SYSTEMS IF DETERMINED NECESSARY BY THE ENGINEER.

5) VALVES PLACED IN A RUN OF PIPE OR AT A DEAD END TO BE RESTRAINED PER DEAD END RESTRAINT LENGTHS.

6) ALL VALVE CLUSTERS (CROSS OR TEE) USE THE RESTRAINT LENGTHS FOR THE 90° ELBOW.

6) RESTRAINED LENGTHS BASED UPON TYPE 5 TRENCH CONDITIONS AND "SM" SOIL TYPE.

A 1 RESTRAINT LENGTH SCHEDULE

NO SCALE

SHEET: S1-D5 | FILE: STANDARDS | DRAWN: MAM | SCALE: NO SCALE | DATE: JAN 2009

WATERLINE DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT
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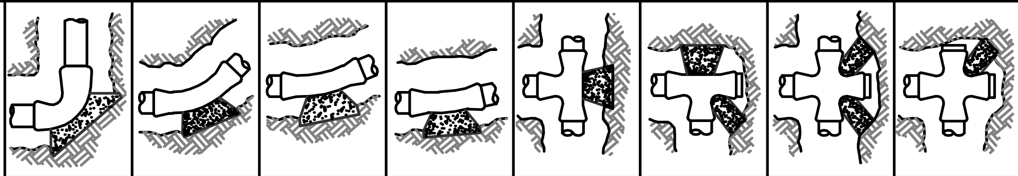
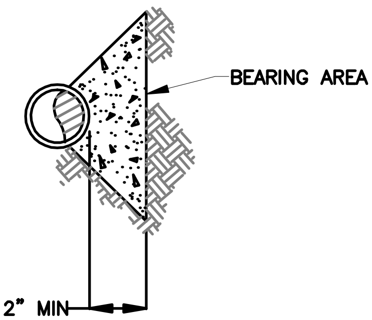
THRUST BLOCK AREA REQUIRED – SQUARE FEET

	TYPE OF FITTING	90° ELBOW	45° ELBOW	22.5° ELBOW	11.25° ELBOW	TEE BRANCH	TEE W/ PLUG	CROSS W/ PLUG	CROSS W/ PLUGS
TYPICAL INSTALLATION									
SIZE OF PIPE	6"	4	4	2	2	4	4	4	4
	8"	10	6	3	3	10	10	10	10
	10"	12	8	4	4	15	15	15	15
	12"	16	10	6	6	20	20	20	20
	14"	21	12	6	6	22	21	22	21
	16"	27	15	8	8	22	27	27	27
	18"	45	25	13	13	32	45	45	45
	24"	65	35	18	18	45	65	65	65

SECTION



NOTES:

1) JOINTS, FLANGE BOLTS AND FACE OF PLUGS TO BE KEPT CLEAR OF CONCRETE.

2) BLOCKS MUST BE POURED AGAINST UNDISTURBED SOIL.

3) THRUST BLOCKS TO BE CONSTRUCTED OF CLASS 423–C–2500 OR BETTER P.C.C.

4) THRUST BLOCKS AREA IS BASED ON TEST PRESSURE OF 150 PSI AND A HORIZONTAL SOIL BEARING STRENGTH OF 1500 PSI.

5) NUTS AND BOLTS ON ALL MJ FITTINGS SHALL BE PAINTED WITH TWO COATS OF KOPPERS 505, TNEMEC 46–450', AMERON OR EQUAL, 15 MILS EACH COAT.

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TYPICAL THRUST BLOCK

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S1–D6

WATERLINE DETAILS

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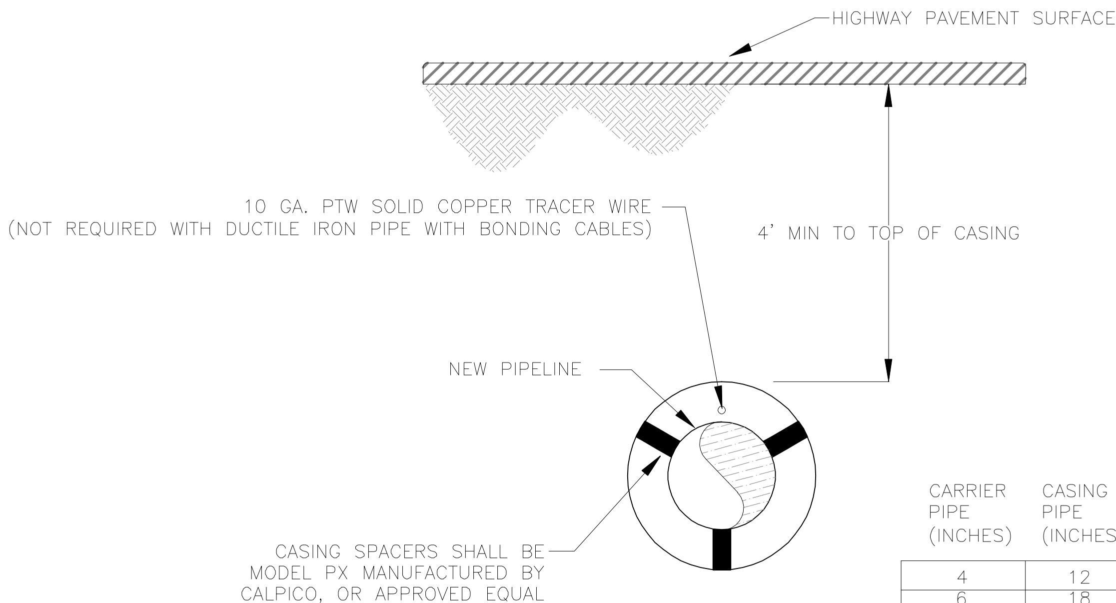

CARRIER PIPE (INCHES)	CASING PIPE (INCHES)	WALL THICKNESS (INCHES)
4	12	5/16
6	18	5/16
8	20	5/16
10	24	3/8
12	24	3/8
16	30	1/2
20	36	1/2

NOTES:

1) ALL WORK PERFORMED WITHIN THE CAL-TRANS R.O.W., CITY OF SOUTH LAKE TAHOE R.O.W. OR EL DORADO COUNTY R.O.W. SHALL CONFORM TO THE ENCROACHMENT PERMIT ISSUED FOR THIS PROJECT.

2) ALL CASING END SEALS SHALL BE CALPICO MODEL C CUSTOM PULL-ON CASING END SEALS OR APPROVED EQUAL.

3) ALL CARRIER PIPING SHALL BE DUCTILE IRON WITH TR FLEX RESTRAINED JOINT, OR APPROVED EQUAL. CARRIER PIPE SHALL EXTEND A MINIMUM OF SIX LINEAR FEET (6 LF). OUTSIDE OF CASING UNLESS OTHERWISE NOTED ON PLANS.

4) THE CONTRACTOR SHALL SET UP AND MAINTAIN BARRIERS AS SPECIFIED COMPLETELY AROUND BOTH BORE AND RECEIVING PITS DURING THE DURATION OF CONSTRUCTION IN THE AREA.

BORE CASING – CROSSING PAVED HIGHWAY

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NO SCALE

SHEET: S1-D7
FILE: STANDARDS
DRAWN: MAM
SCALE: NO SCALE
DATE: JAN 2009

WATERLINE DETAILS

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1275 Meadow Crest Drive South Lake Tahoe, California 96150
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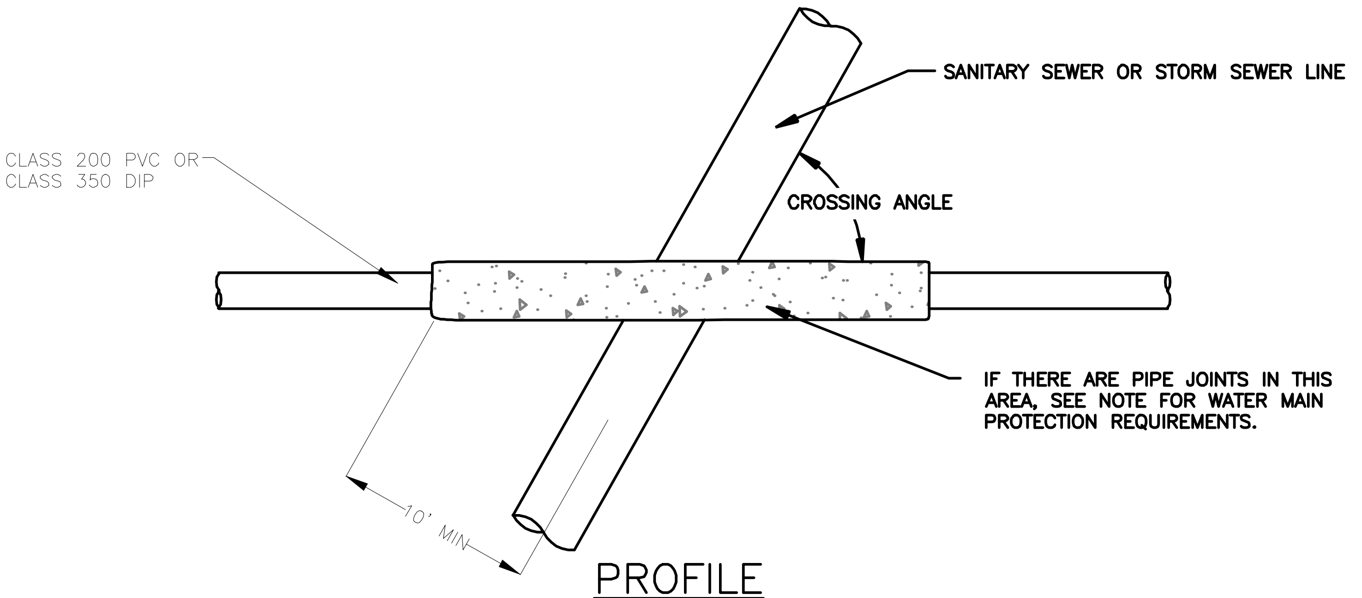
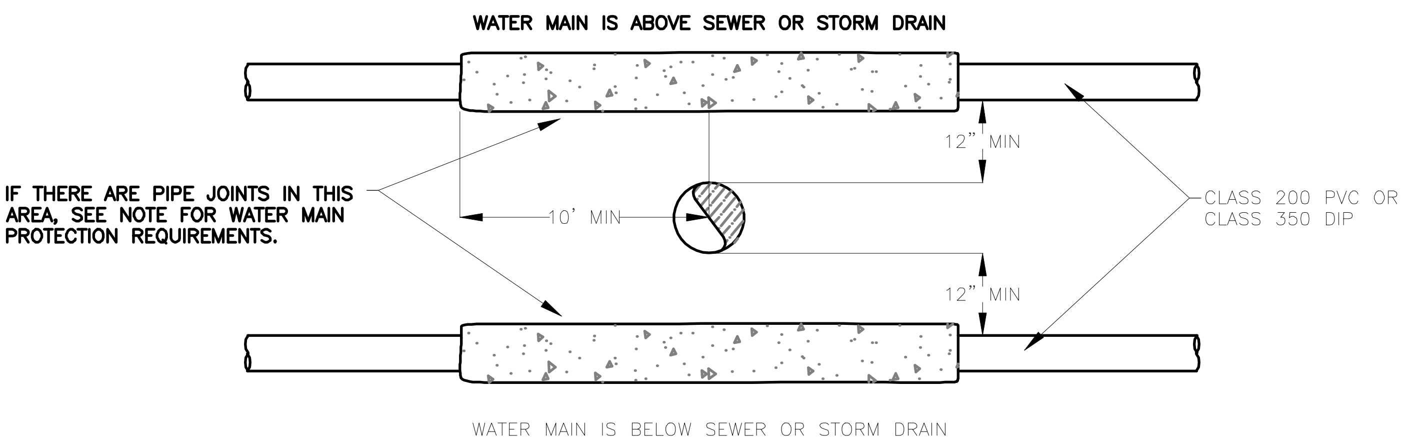
PLAN VIEW



PROFILE



NOTE:

WHERE THE WATER MAIN IS BELOW THE SEWER LINE, WHERE THE WATER MAIN IS LESS THAN EIGHTEEN INCHES (18") CLEAR ABOVE THE SEWER LINE OR WHERE A TEN FOOT (10') HORIZONTAL SEPARATION CANNOT BE MAINTAINED, THE AREA OF CROSSING MUST BE CONSTRUCTED IN SUCH A MANNER THAT:

A) THE WATER MAIN IS CONSTRUCTED SUCH THAT THERE ARE NO PIPE JOINTS FOR A DISTANCE OF AT LEAST TEN FEET (10') ON EACH SIDE OF THE POINT OF CROSSING, OR;

B) THE WATER MAIN OR SEWER MAIN IS TOTALLY ENCASED IN AT LEAST FOUR INCHES (4") OF TWO (2) SACK SAND CEMENT SLURRY FOR A DISTANCE OF AT LEAST TEN FEET (10') ON EACH SIDE OF THE POINT OF CROSSING, OR;

C) THE WATER MAIN OR SEWER MAIN IS INSTALLED IN A PIPE SLEEVE THAT EXTENDS, WITHOUT JOINTS, AT LEAST TEN FEET (10') ON EACH SIDE OF THE POINT OF CROSSING.

WATER MAIN PROTECTION AT SEWER CROSSING

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NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S1-D8

WATERLINE DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

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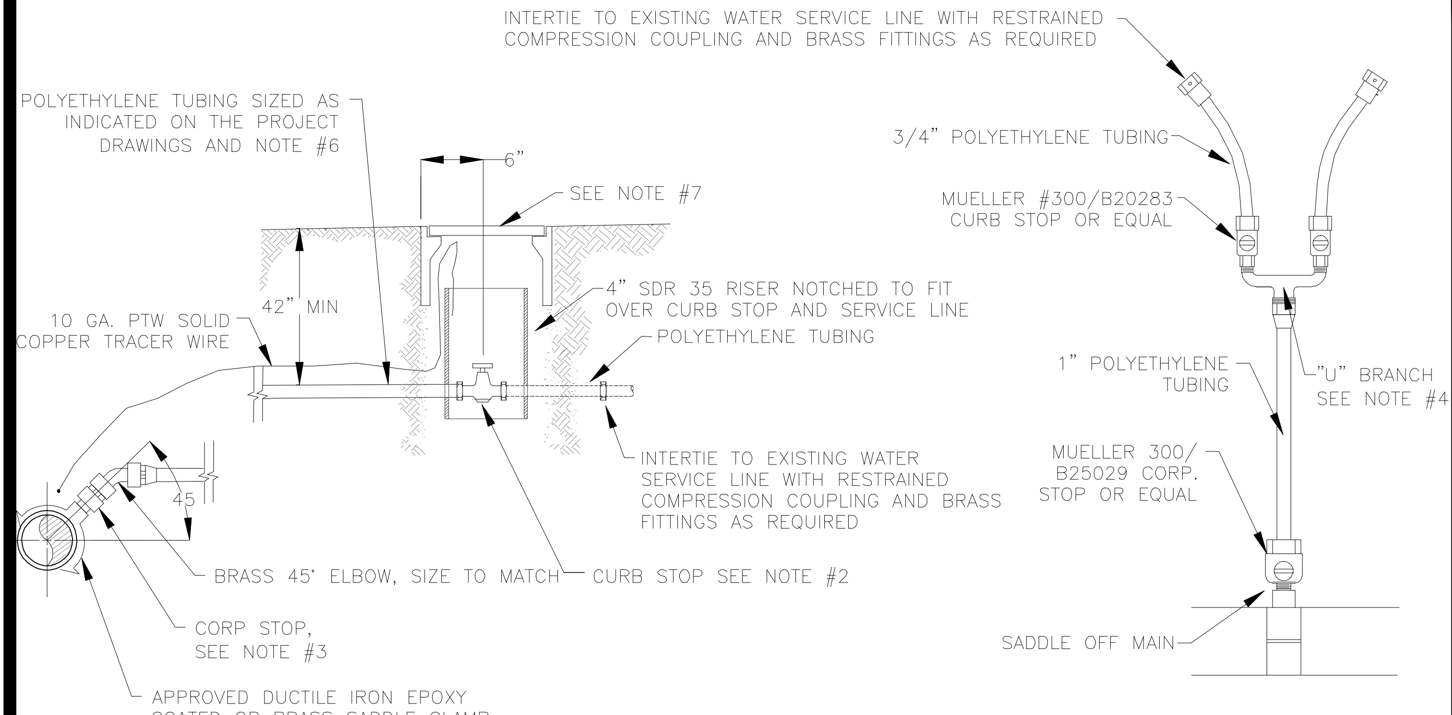

DOUBLE SERVICE

NOTES:

1) ALL SERVICE CONNECTIONS SHALL CONFORM TO AWWA C-800-84 AND BE INSTALLED FROM THE NEW MAIN TO EACH EXISTING SERVICE LINE.

2) NEW CURB-STOP SHALL BE SIZED AS INDICATED ON PLANS AND BE MUELLER #300/B20283 OR APPROVED EQUAL.

3) CORPORATION STOP SHALL BE SIZED AS INDICATED ON PLANS AND BE MUELLER #300/B25029 OR APPROVED EQUAL FOR 3/4" TO 1" USE MUELLER #300/25028 OR APPROVED EQUAL FOR 1 1/2" TO 2".

4) SINGLE HOUSE SERVICE SHALL BE 3/4" POLYETHYLENE WITH 3/4" FITTINGS. DOUBLE HOUSE SERVICE SHALL BE 1" POLYETHYLENE TO FORD #U68-43 SPACING "U" BRANCH OR EQUAL WITH TWO 3/4" CURB-STOPS AND SERVICE CONNECTIONS.

5) ALL WATER SERVICES SHALL HAVE A HAND-TAMPED SAND BEDDING NINE INCHES (9") ABOVE AND BENEATH THE TUBING AND SHALL HAVE SIX INCHES (6") MINIMUM CLEARANCE ON EACH SIDE.

6) ALL WATER SERVICE SHALL BE POLYETHYLENE 200 PSI CLASS IRON PIPE SIZE FOR 3/4" TO 1". COPPER TUBE SIZE FOR 1 1/2" TO 2". PIPE STIFFENER INSERTS TO BE USED AT ALL CONNECTIONS.

7) WATER VALVE BOX SHALL BE CHRISTY G5 FOR SINGLE SERVICE, AND CHRISTY B9 FOR DOUBLE SERVICE OR APPROVED EQUAL WITH A METAL LID MARKED "WATER". WATER VALVE BOX PLACED IN TRAFFIC OR PARKING AREAS SHALL HAVE A CONCRETE COLLAR INSTALL. COLLAR SHALL BE SIX INCHES (6") AROUND BOX, CONCRETE SHALL BE 2500 PSI MIN.

8) ALL CORP-STOPS, CURB-STOPS AND POLYETHYLENE SERVICE LINES SHALL BE DISINFECTED AND HYDROSTATIC TESTED ALONG WITH THE NEW MAIN PRIOR TO BEING PLACED INTO SERVICE.

9) ALL TUBING CONNECTIONS SHALL BE THE COMPRESSION TYPE; MUELLER OR APPROVED EQUAL.

10) 10 GA. PTW SOLID COPPER TRACER WIRE SHALL BE INSTALLED FROM THE NEW MAIN ALONG NEW SERVICE LINE TO THE VALVE BOX REGARDLESS OF NEW WATER MAIN TYPE. ON CONDUCTIVE TYPE PIPELINES THE TRACER WIRE SHALL BE CLAMPED USING APPROVED STAINLESS STEEL CLAMPS.

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WATER SERVICE

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S2-D1

WATER SERVICE & METER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT
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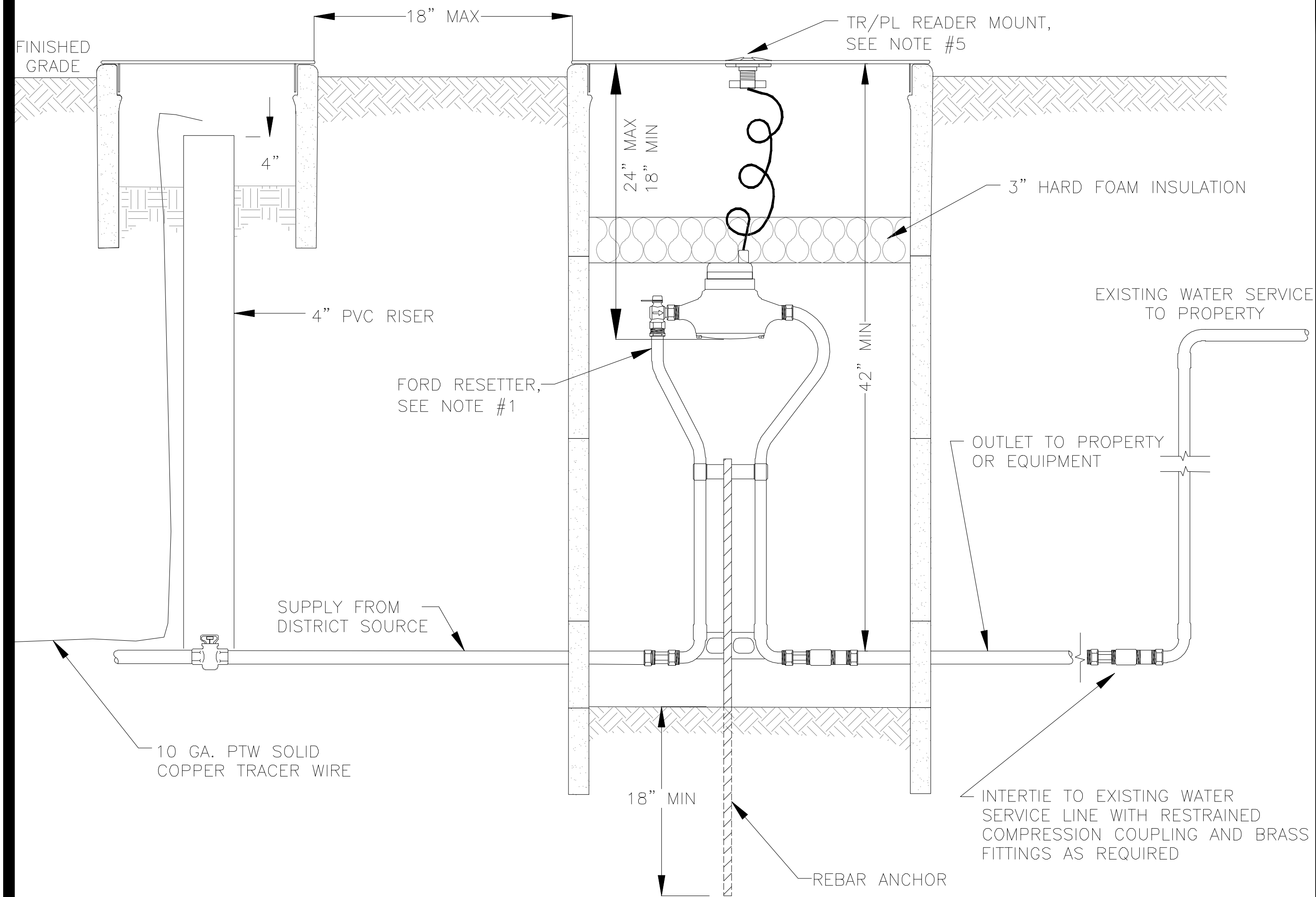

NOTES:

1) METER SHALL BE SENSUS SRII TR/PL, REGISTERING IN 100 CUBIC FEET (CF) AND MUST BE PROPERLY MOUNTED ON FORD RESETTER MODEL VB43-W FOR THREE QUARTER INCH (3/4") OR FORD MODEL VB44-W FOR ONE INCH (1") OR APPROVED EQUIVALENT. RESETTER SHALL BE ANCHORED WITH #4 REBAR DRIVEN A MINIMUM OF EIGHTEEN INCHES (18") INTO THE SOIL AND TIED TO THE BRASS SECTIONS OF THE RESETTER WITH TIE WIRE.

2) METER SHALL BE INSTALLED AT A DEPTH OF NOT LESS THAN EIGHTEEN INCHES (18") AND NOT MORE THAN TWENTY FOUR INCHES (24") MEASURED FROM THE TOP OF THE METER BOX TO THE BOTTOM OF THE METER.

3) REQUIRED INSULATED COUPLER SHALL BE LOCATED IMMEDIATELY DOWNSTREAM OF RESETTER OR IF RESETTERS ARE NOT USED, IMMEDIATELY DOWNSTREAM OF METER.

4) METER BOX IN NON-TRAFFIC AREAS SHALL BE "CHRISTY" MODEL B16 WITH STEEL B16 LID OR APPROVED EQUIVALENT INSTALLED NO LESS THAN TWO INCHES (2") ABOVE FINISHED GRADE. BOXES LOCATED IN TRAFFIC OR PARKING AREAS SHALL BE H20 LOAD RATED INSTALLED HALF AN INCH (1/2") BELOW FINISHED GRADE. PROVIDE THREE INCHES (3") RIGID INSULATION ABOVE METER IN BOX.

5) CONTRACTOR SHALL PROVIDE TWO INCH (2") HOLE CENTERED IN METER BOX LID AND INSTALL TR/PL READER MOUNT.

6) METER BOX SHALL BE WITHIN EIGHTEEN INCHES (18") OF DISTRICT SERVICE VALVE BOX.

WATER METER 3/4" TO 1"

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NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S2-D2

WATER SERVICE & METER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT
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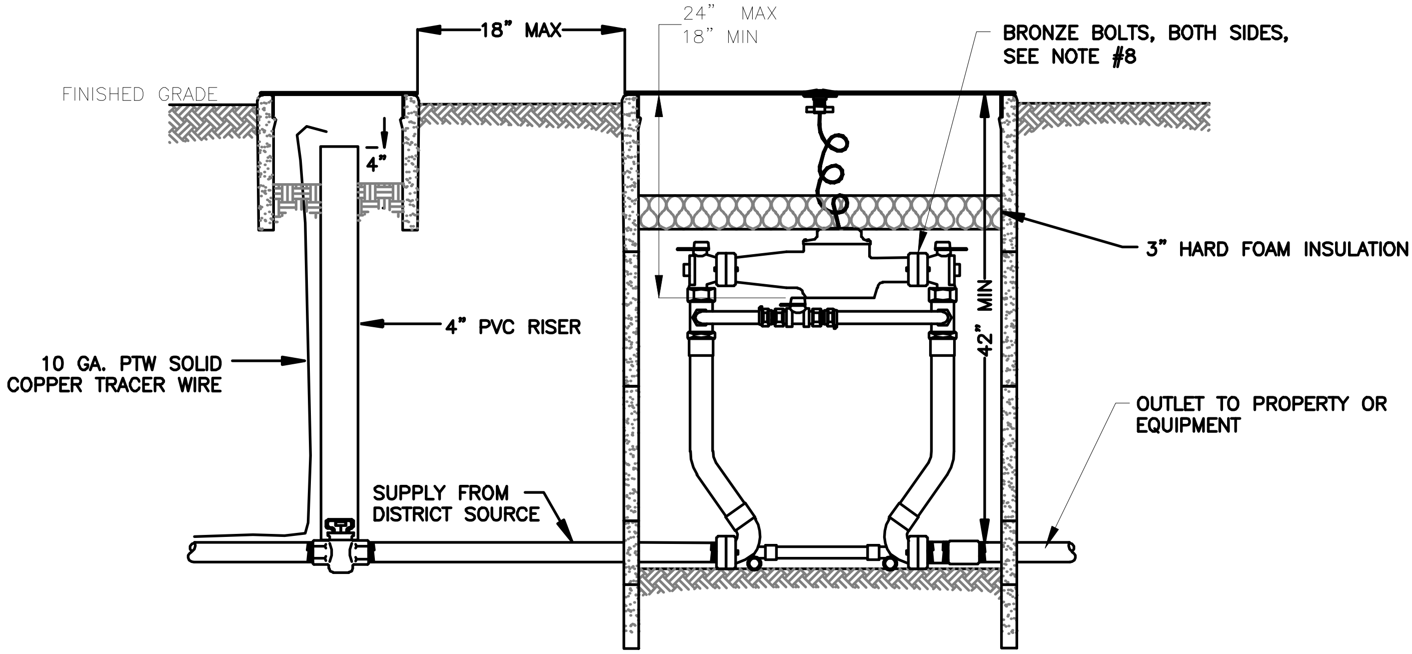

NOTES:

1) METERS USED FOR DOMESTIC WATER SERVICE SHALL BE SENSUS SR TR/PL REGISTERING IN 100 CF OR APPROVED EQUAL. METERS USED FOR FIRE LINES SHALL BE SENSUS W–160 DRS TURBO–METER REGISTERING IN 100 CF. ONE AND A HALF INCH (1 1/2") METERS SHALL BE INSTALLED USING FORD RESETTER MODEL VBB46–HB. FOR TWO INCH (2") METERS FORD MODEL VBB47–HB OR APPROVED EQUIVALENT SHALL BE USED.

2) IN LIEU OF RESETTER, METER CAN BE MOUNTED ON TYPE K RIGID COPPER PIPE WITH FORD MODEL BFA13–666W ANGLE BALL VALVE FOR ONE AND A HALF INCH (1 1/2") OR BFA13–777W ANGLE BALL VALVE FOR TWO INCH (2"). OVERALL DIMENSIONS MUST EQUAL THAT OF RESETTER INCLUDING ONE INCH (1") FORD MODEL B11–44–W VALVE IN BYPASS.

3) METER SHALL BE INSTALLED AT A DEPTH OF NOT LESS THAN EIGHTEEN INCHES (18") AND NOT MORE THAN TWENTY FOUR INCHES (24") MEASURED FROM THE TOP OF THE METER BOX TO THE BOTTOM OF THE METER (SEE DETAIL).

4) REQUIRED INSULATED COUPLER SHALL BE LOCATED IMMEDIATELY DOWNSTREAM OF RESETTERS OR IF RESETTERS ARE NOT USED, IMMEDIATELY DOWNSTREAM OF METER AND BYPASS.

5) METER BOX IN NON–TRAFFIC AREAS SHALL BE "CHRISTY" MODEL B36 WITH METAL LID OR APPROVED EQUIVALENT INSTALLED NO LESS THAN TWO INCHES (2") ABOVE FINISHED GRADE. BOXES LOCATED IN OR NEAR TRAFFIC AREAS SHALL BE H20 LOAD RATED INSTALLED A HALF INCH (1/2") BELOW FINISHED GRADE. PROVIDE THREE INCHES (3") RIGID INSULATION ABOVE METER IN BOX.

6) CONTRACTOR SHALL PROVIDE TWO INCH (2") HOLE CENTERED IN METER BOX LID AND INSTALL TR/PL READER MOUNT.

7) USE OF TWO OR MORE RESETTERS IN A STACKED ARRANGEMENT REQUIRES THE USE OF A RIGID METAL SUPPORT DRIVEN EIGHTEEN INCHES (18") INTO THE SOIL BELOW THE METER. SUPPORT MUST BE TIED WITH PERMANENT TIES AT THREE EVENLY SPACED LOCATIONS TO THE RESETTER OR PIPING.

8) METER BOX SHALL BE WITHIN EIGHTEEN INCHES (18") OF DISTRICT SERVICE VALVE BOX.

9) BRONZE BOLTS AT METER FLANGES ONLY.

WATER METER 1 1/2" TO 2"

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NO SCALE

SHEET: S2–D3	FILE: STANDARDS	DRAWN: MAM	SCALE: NO SCALE	DATE: JAN 2009

WATER SERVICE & METER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

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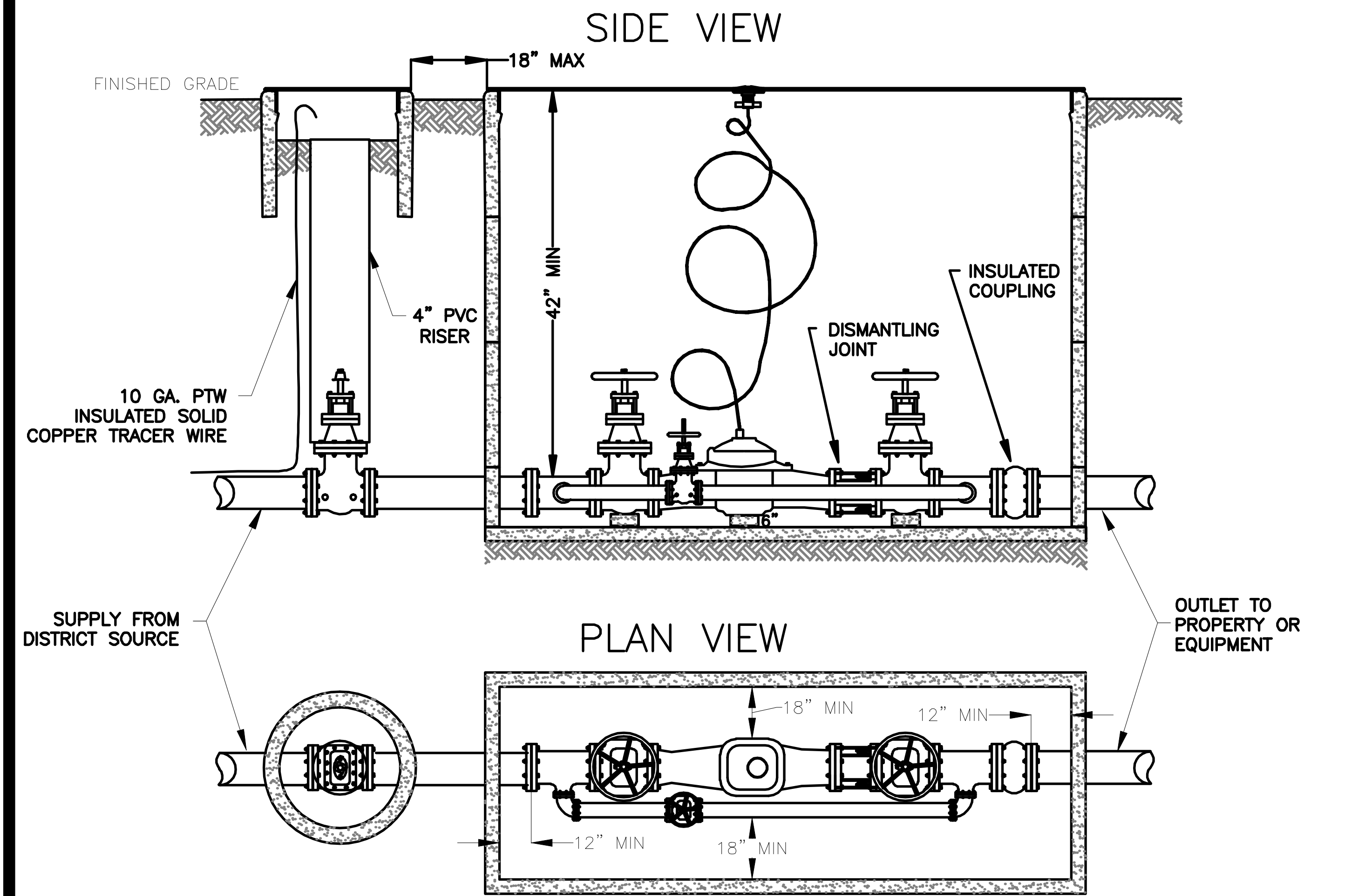

NOTES:

1) METER SHALL BE SENSUS SERIES "W" TURBO OR SHR COMPOUND AS REQUIRED REGISTERING IN 100 CF.

2) METER SHALL BE INSTALLED AT A DEPTH OF NOT LESS THAN THIRTY SIX INCHES (36") AND NOT MORE THAN FORTY EIGHT INCHES (48") MEASURED FROM THE TOP OF THE METER BOX TO THE TOP OF THE SUPPLY PIPE.

3) REQUIRED DISMANTLING JOINT SHALL BE INSTALLED ON THE DOWNSTREAM OF METER AND UPSTREAM OF BYPASS ISOLATION VALVE.

4) METER BYPASS SHALL BE NO LESS THAN TWO NOMINAL PIPE SIZES LESS THAN THE METER SIZE FOR NON-CRITICAL SERVICES AND FULL METER SIZE FOR CRITICAL SERVICES.

5) REQUIRED INSULATED COUPLER SHALL BE LOCATED IMMEDIATELY DOWNSTREAM OF METER AND BYPASS.

6) METER BOX SHALL BE JENSEN PRE-CAST #466TA-1 WITH STEEL H-20 TRAFFIC LOAD #4878AT-TRF LID OR APPROVED EQUIVALENT INSTALLED AT 1 1/2" TO 2" ABOVE THE FINISHED GRADE IN NON TRAFFIC AREAS OR 1/2" BELOW FINISHED GRADE IN TRAFFIC AREAS.

7) CONTRACTOR SHALL PROVIDE TWO INCH (2") HOLE CENTERED IN METER BOX LID AND INSTALL TR/PL READER MOUNT.

8) METER BOX SHALL BE WITHIN EIGHTEEN INCHES (18") OF DISTRICT SERVICE VALVE BOX.

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WATER METER 4" TO 6"

NO SCALE

DATE:	SCALE:	DRAWN:	FILE:	SHEET:
JAN 2009	NO SCALE	MAM	STANDARDS	S2-D4

WATER SERVICE & METER DETAILS

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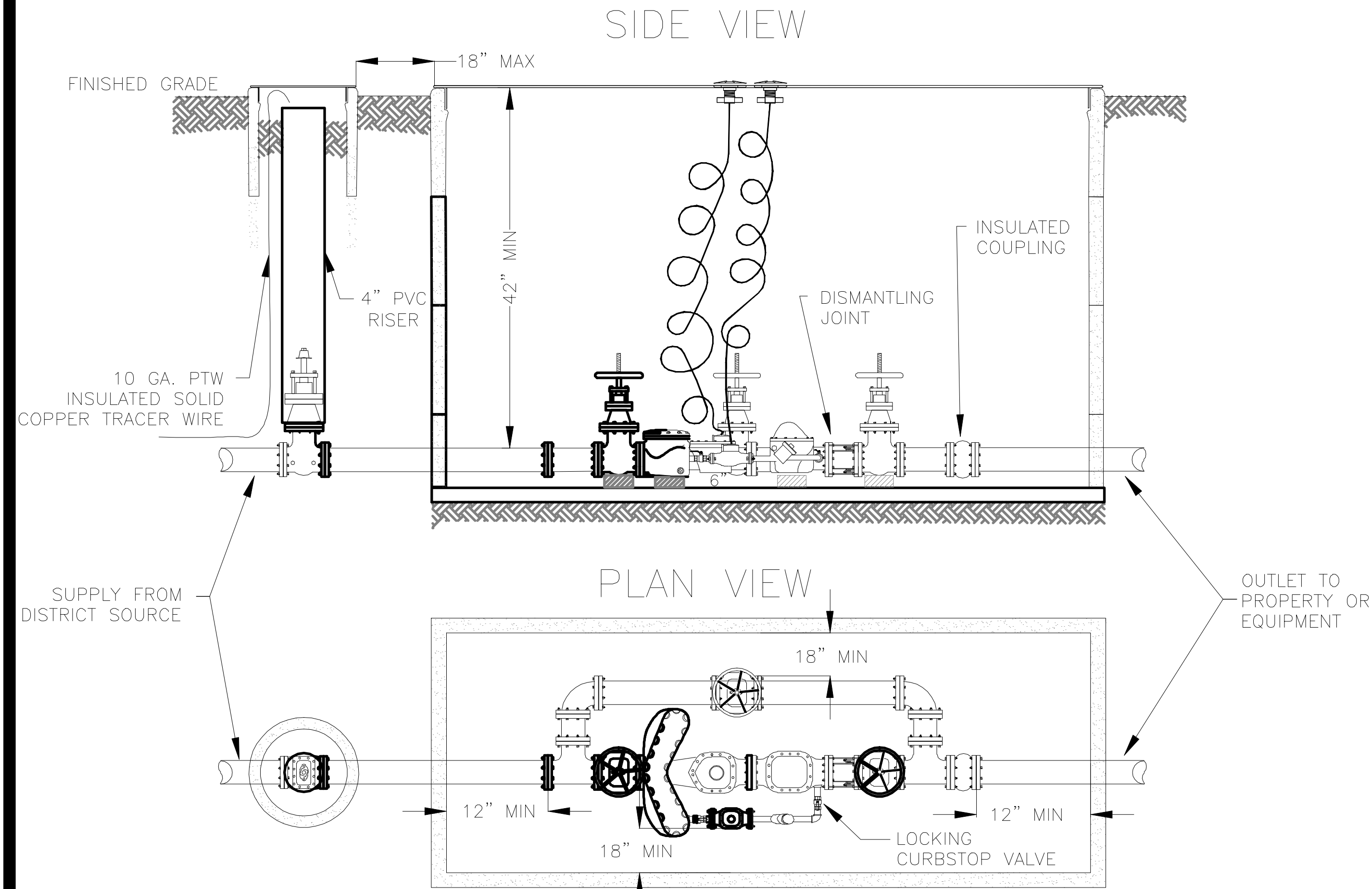


NOTES:

1) METER SHALL BE SENSUS REGISTERING IN 100 CF.

2) METER SHALL BE INSTALLED AT A DEPTH OF NOT LESS THAN THIRTY SIX INCHES (36") AND NOT MORE THAN FORTY EIGHT INCHES (48") MEASURED FROM THE TOP OF THE METER BOX TO THE TOP OF THE SUPPLY PIPE.

3) REQUIRED DISMANTLING JOINT SHALL BE INSTALLED ON THE DOWNSTREAM OF METER AND UPSTREAM OF BYPASS ISOLATION VALVE.

4) METER BYPASS SHALL BE NO LESS THAN TWO NOMINAL PIPE SIZES LESS THAN THE METER SIZE FOR NON-CRITICAL SERVICES AND FULL METER SIZE FOR CRITICAL SERVICES.

5) REQUIRED INSULATED COUPLER SHALL BE LOCATED IMMEDIATELY DOWNSTREAM OF METER AND BYPASS.

6) METER BOX SHALL BE JENSEN PRE-CAST #466TA-1 WITH STEEL H-20 TRAFFIC LOAD #4878AT-TRF LID OR APPROVED EQUIVALENT INSTALLED AT 1 1/2" TO 2" ABOVE THE FINISHED GRADE IN NON TRAFFIC AREAS OR 1/2" BELOW FINISHED GRADE IN TRAFFIC AREAS.

7) CONTRACTOR SHALL PROVIDE TWO INCH (2") HOLE CENTERED IN METER BOX LID AND INSTALL TR/PL READER MOUNT.

8) METER BOX SHALL BE WITHIN EIGHTEEN INCHES (18") OF DISTRICT SERVICE VALVE BOX.

9) MAINLINE AND BYPASS SHUT OFF VALVES SHALL BE OS&Y VALVES.

A
1

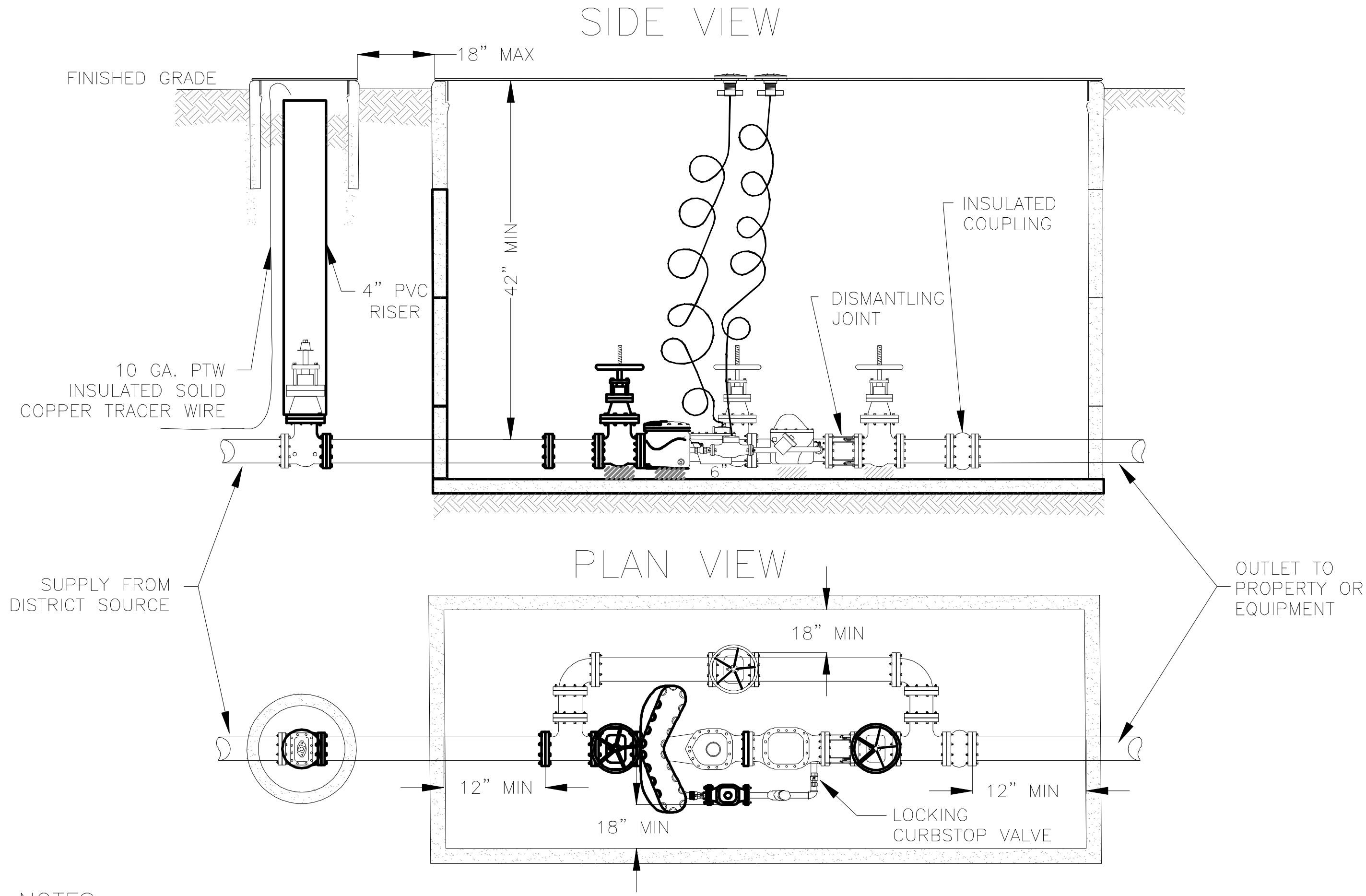
COMPOUND METER INSTALLATION

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S2-D5

WATER SERVICE & METER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT
Sewer . 1950 . Water A PUBLIC AGENCY
1275 Meadow Crest Drive South Lake Tahoe, California 96150
Phone (530) 544-6474 Fax (530) 541-4319
WWW.STPUD.US



NOTES:

1) METER SHALL BE SENSUS REGISTERING IN 100 CF.

2) METER SHALL BE INSTALLED AT A DEPTH OF NOT LESS THAN THIRTY SIX INCHES (36") AND NOT MORE THAN FORTY EIGHT INCHES (48") MEASURED FROM THE TOP OF THE METER BOX TO THE TOP OF THE SUPPLY PIPE.

3) REQUIRED DISMANTLING JOINT SHALL BE INSTALLED ON THE DOWNSTREAM OF METER AND UPSTREAM OF BYPASS ISOLATION VALVE.

4) METER BYPASS SHALL BE NO LESS THAN TWO NOMINAL PIPE SIZES LESS THAN THE METER SIZE FOR NON-CRITICAL SERVICES AND FULL METER SIZE FOR CRITICAL SERVICES.

5) REQUIRED INSULATED COUPLER SHALL BE LOCATED IMMEDIATELY DOWNSTREAM OF METER AND BYPASS.

6) METER BOX SHALL BE JENSEN PRE-CAST #466TA-1 WITH STEEL H-20 TRAFFIC LOAD #4878AT-TRF LID OR APPROVED EQUIVALENT INSTALLED AT 1 1/2" TO 2" ABOVE THE FINISHED GRADE IN NON TRAFFIC AREAS OR 1/2" BELOW FINISHED GRADE IN TRAFFIC AREAS.

7) CONTRACTOR SHALL PROVIDE TWO INCH (2") HOLE CENTERED IN METER BOX LID AND INSTALL TR/PL READER MOUNT.

8) METER BOX SHALL BE WITHIN EIGHTEEN INCHES (18") OF DISTRICT SERVICE VALVE BOX.

9) MAINLINE AND BYPASS SHUT OFF VALVES SHALL BE OS&Y VALVES.

COMPACT FIRE LINE WATER METER INSTALLATION: 4" TO 10"

A
1

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S2-D6

WATER SERVICE & METER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

Sewer . 1950 . Water   A PUBLIC AGENCY
1275 Meadow Crest Drive South Lake Tahoe, California 96150
Phone (530) 544-6474   Fax (530) 541-4319
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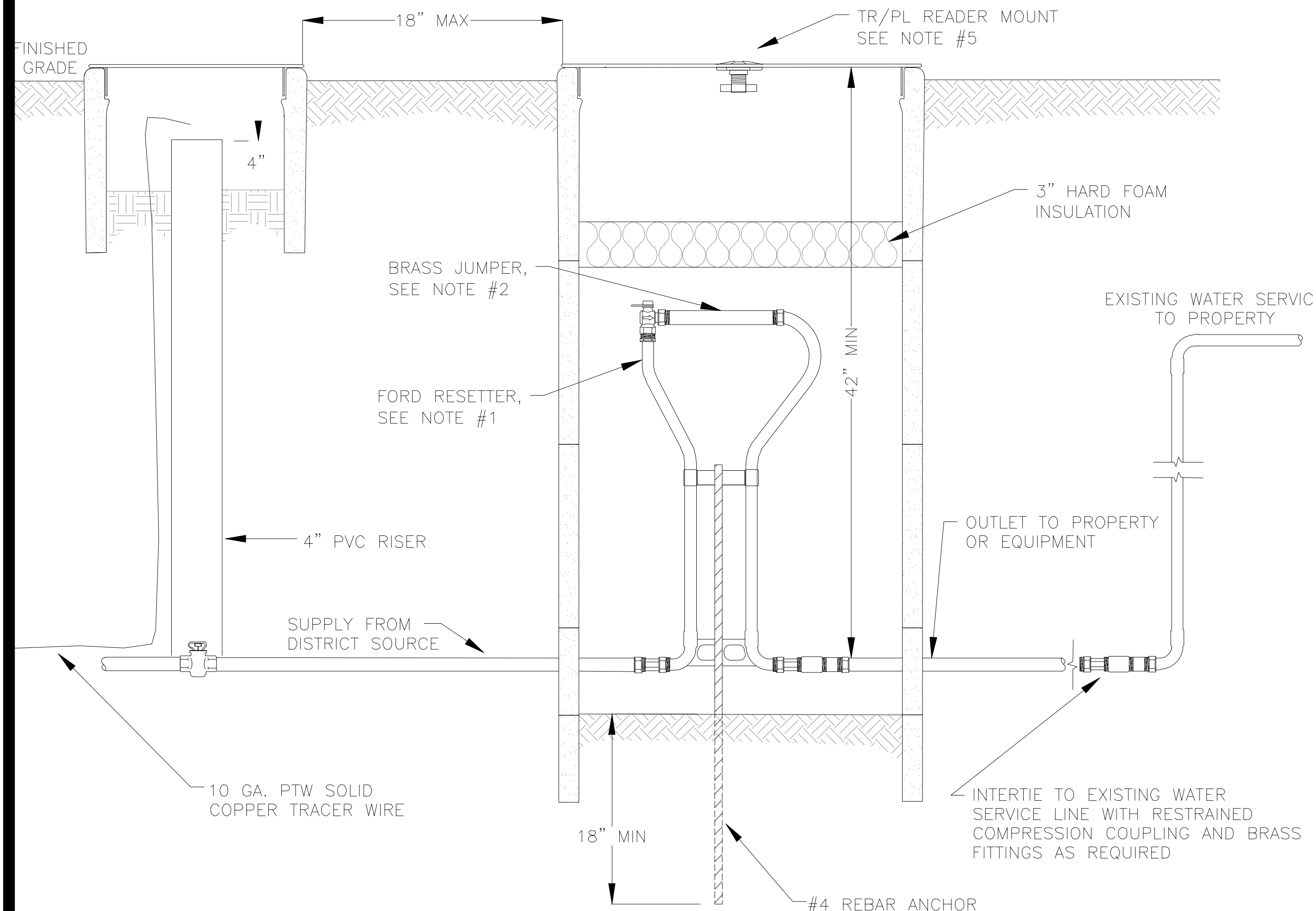

NOTES:

1) RESETTER SHALL BE FORD RESETTER, MODEL VB43-W FOR THREE QUARTER INCH (3/4") OR APPROVED EQUIVALENT. RESETTER SHALL BE ANCHORED WITH #4 REBAR DRIVEN A MINIMUM OF EIGHTEEN INCHES (18") INTO THE SOIL AND TIED TO THE BRASS SECTIONS OF THE RESETTER WITH TIE WIRE.

2) BRASS JUMPER SHALL BE A ONE INCH (1") BRASS NIPPLE, NINE INCHES (9") LONG. RUBBER GASKETS SHALL BE USED ON EACH END OF THE BRASS JUMPER.

3) REQUIRED INSULATED COUPLER SHALL BE LOCATED IMMEDIATELY DOWNSTREAM OF RESETTER OR IF RESETTERS ARE NOT USED, IMMEDIATELY DOWNSTREAM OF METER.

4) METER BOX IN NON-TRAFFIC AREAS SHALL BE "CHRISTY" MODEL B16 WITH STEEL B16 LID OR APPROVED EQUIVALENT INSTALLED NO LESS THAN TWO INCHES (2") ABOVE FINISHED GRADE. BOXES LOCATED IN TRAFFIC OR PARKING AREAS SHALL BE H20 LOAD RATED INSTALLED A HALF INCH (1/2") BELOW FINISHED GRADE. PROVIDE THREE INCHES (3") RIGID INSULATION ABOVE RESETTER IN BOX.

5) CONTRACTOR SHALL PROVIDE 2" HOLE CENTERED IN METER BOX LID AND INSTALL TR/PL READER MOUNT.

6) METER BOX SHALL BE WITHIN EIGHTEEN INCHES (18") OF DISTRICT SERVICE VALVE BOX.

FUTURE 3/4" METER BOX

A
1

NO SCALE

SHEET: S2-D7	FILE: STANDARDS	DRAWN: MAM	SCALE: NO SCALE	DATE: JAN 2009

WATER SERVICE & METER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

Sewer . 1950 . Water   A PUBLIC AGENCY
1275 Meadow Crest Drive   South Lake Tahoe, California 96150
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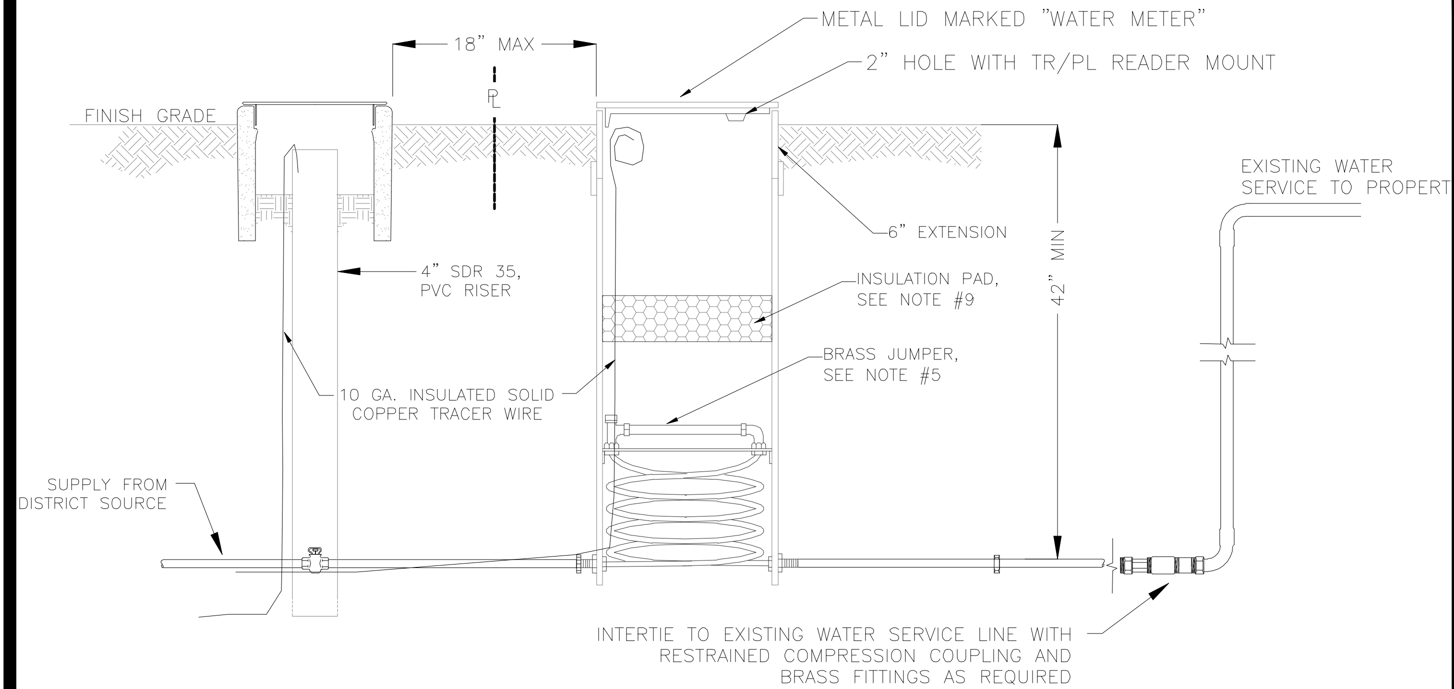

NOTES:

1) METER PITS SHALL BE INSTALL ON THE CUSTOMER SIDE OF THE PROPERTY LINE, AS CLOSE TO PROPERTY LINE AS POSSIBLE.

2) METER PIT FOR SINGLE THREE QUARTER INCH (3/4") METER SHALL BE MUELLER 15" SINGLE COIL METER PIT, MODEL #250CS1536FSBN OR APPROVED EQUAL.

3) METER PIT FOR ONE INCH (1") SINGLE METER SHALL BE MUELLER 18" SINGLE COIL METER PIT, MODEL #330CS1836FSBN OR APPROVED EQUAL.

4) METER PIT FOR DOUBLE THREE QUARTER INCH (DBL 3/4") METER SHALL BE MUELLER 18" DOUBLE COIL METER PIT, MODEL #250CD1836FSBN OR APPROVED EQUAL.

5) BRASS JUMPER SHALL BE A ONE INCH (1") BRASS NIPPLE, NINE INCHES (9") LONG. RUBBER GASKETS SHALL BE USED ON EACH END OF THE BRASS JUMPER.

6) ALL METER PITS SHALL HAVE ONE SIX INCH (6") EXTENSION.

7) INLET SIZE SHALL BE AS REQUIRED TO MATCH WATER SERVICE AND METER SIZE.

8) METER PITS PLACED IN TRAFFIC OR PARKING AREAS REFER TO DETAIL "METER PIT—WITHIN TRAFFIC AREAS" FOR INSTALLATION.

9) FOUR INCH (4") INSULATION PAD SHALL BE MUELLER #790022 FOR FIFTEEN INCH (15") METER PITS AND MODEL #790153 FOR EIGHTEEN INCH (18") METER PITS, OR APPROVED EQUAL.

10) ALL METER PITS SHALL HAVE A METAL LID MARKED "WATER METER", WITH A TWO INCH (2") HOLE. CONTRACTOR SHALL PROVIDE AND INSTALL TR/PL READER MOUNT.

11) ALL BACKFILL AROUND METER PIT, SHALL BE PLACED IN TWELVE INCH (12") LIFTS OF CLASS TWO AGGREGATE BASE COMPACTED TO 95% RELATIVE COMPACTION.

FUTURE 3/4" METER PIT

1
A

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S2-D8

WATER SERVICE & METER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT
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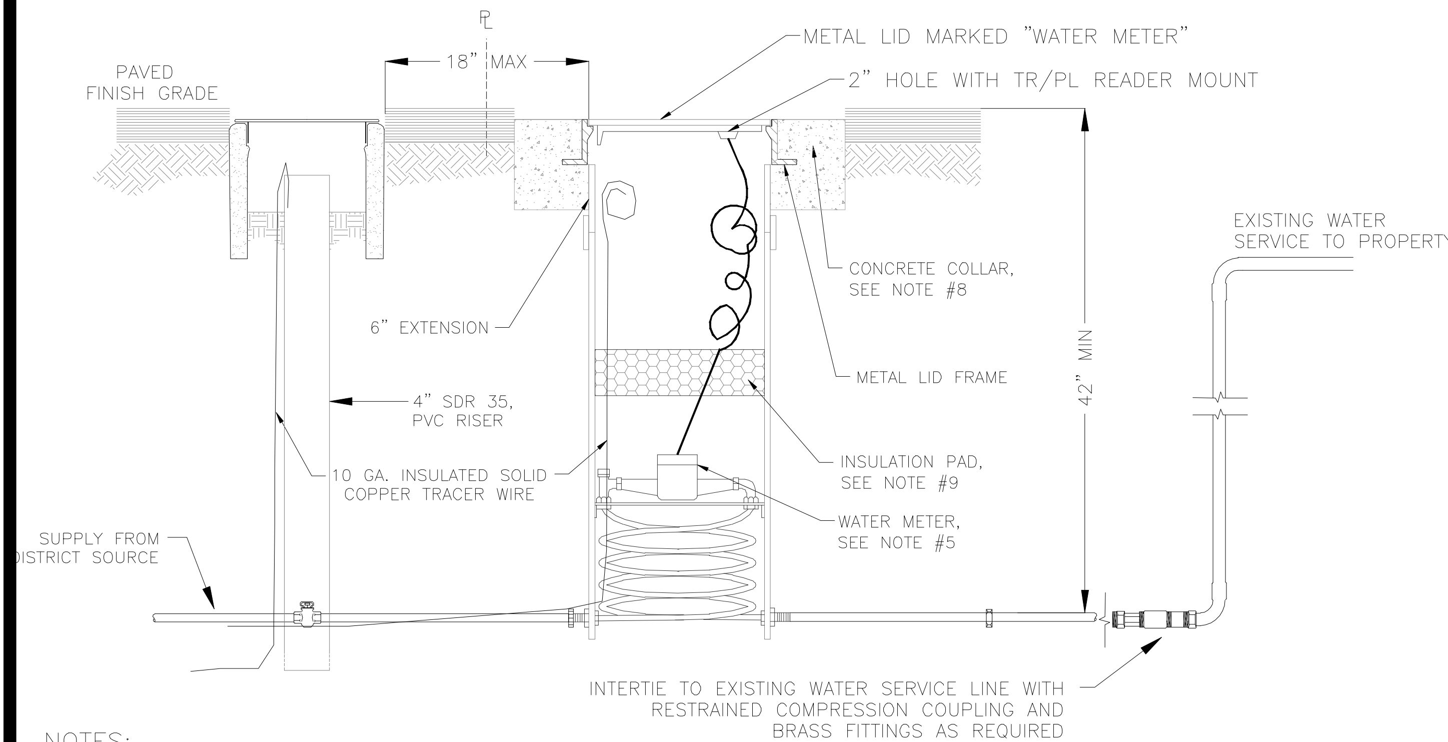

NOTES:

1) METER PITS SHALL BE INSTALL ON THE CUSTOMER SIDE OF THE PROPERTY LINE, AS CLOSE TO PROPERTY LINE AS POSSIBLE.

2) METER PIT FOR SINGLE THREE QUARTER INCH (3/4") METER SHALL BE MUELLER 15" SINGLE COIL METER PIT, MODEL #250CS1536FSBN OR APPROVED EQUAL.

3) METER PIT FOR ONE INCH (1") SINGLE METER SHALL BE MUELLER 18" SINGLE COIL METER PIT, MODEL #330CS1836FSBN OR APPROVED EQUAL.

4) METER PIT FOR DOUBLE THREE QUARTER INCH (DBL 3/4") METER SHALL BE MUELLER 18" DOUBLE COIL METER PIT, MODEL #250CD1836FSBN OR APPROVED EQUAL.

5) METER SHALL BE SENSUS SRII TR/PL, REGISTERING IN 100 CUBIC FEET (CF) SIZE AS REQUIRED BY PLANS.

6) ALL METER PITS SHALL HAVE ONE SIX INCH (6") EXTENSION.

7) INLET SIZE SHALL BE AS REQUIRED TO MATCH WATER SERVICE AND METER SIZE.

8) METER PITS PLACED IN TRAFFIC OR PARKING AREA SHALL HAVE A METAL LID FRAME MUELLER MODEL #700097 FOR FIFTEEN INCH (15") AND #700098 FOR EIGHTEEN INCH (18") METER PITS. CONTRACTOR SHALL PLACE SIX INCH (6") BY EIGHT INCH (8") CONCRETE COLLAR AROUND METAL LID FRAME. CONCRETE SHALL BE A 2500 PSI MIN. BOXES LOCATED IN TRAFFIC AREAS SHALL BE INSTALLED HALF AN INCH (1/2") BELOW FINISHED GRADE.

9) FOUR INCH (4") INSULATION PAD SHALL BE MUELLER #790022 FOR FIFTEEN INCH (15") METER PITS AND MODEL #790153 FOR EIGHTEEN INCH (18") METER PITS, OR APPROVED EQUAL.

10) ALL METER PITS SHALL HAVE A METAL LID MARKED "WATER METER", WITH A TWO INCH (2") HOLE. CONTRACTOR SHALL PROVIDE AND INSTALL TR/PL READER MOUNT.

11) ALL BACKFILL AROUND METER PIT, SHALL BE PLACED IN TWELVE INCH (12") LIFTS OF CLASS TWO AGGREGATE BASE COMPACTED TO 95% RELATIVE COMPACTION.

METER PIT— WITHIN TRAFFIC AREA

1
A

NO SCALE

SHEET: S2-D9
FILE: STANDARDS
DRAWN: MAM
SCALE: NO SCALE
DATE: JAN 2009

WATER SERVICE & METER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

Sewer . 1950 . Water A PUBLIC AGENCY
1275 Meadow Crest Drive South Lake Tahoe, California 96150
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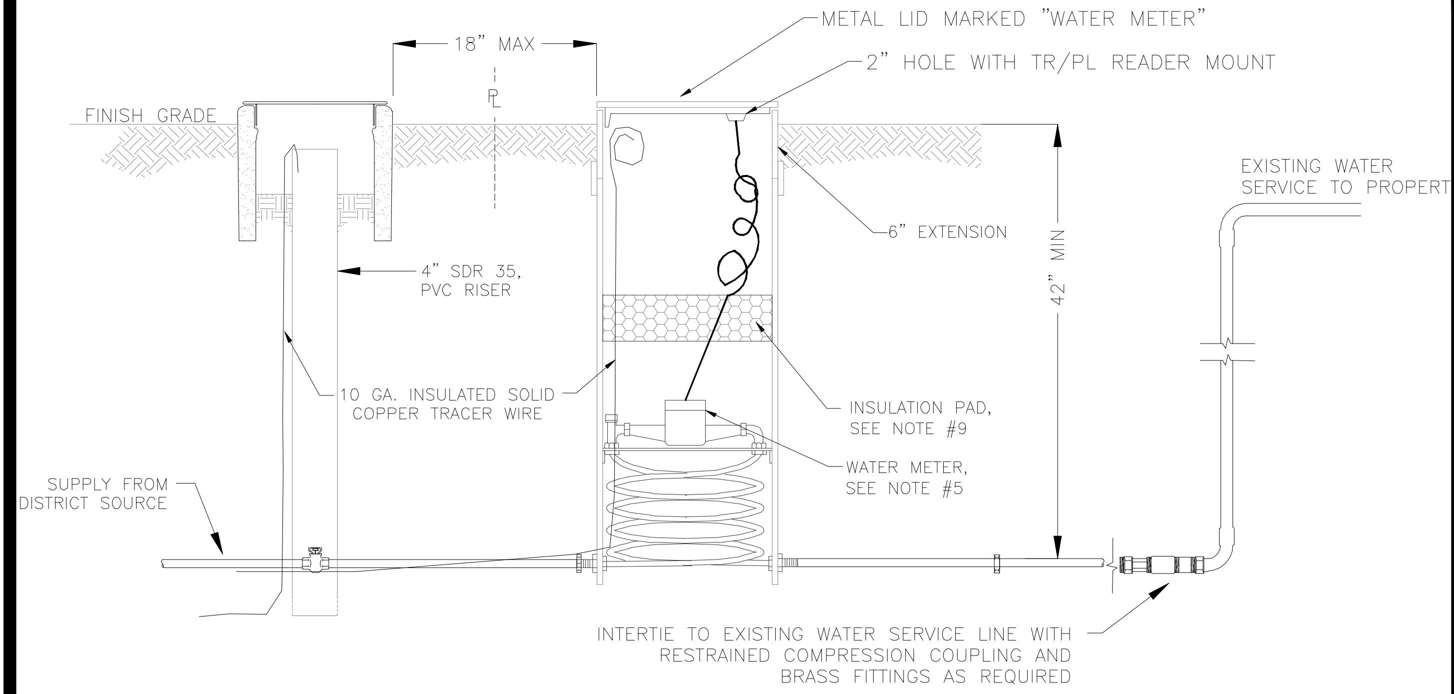

NOTES:

1) METER PITS SHALL BE INSTALL ON THE CUSTOMER SIDE OF THE PROPERTY LINE, AS CLOSE TO PROPERTY LINE AS POSSIBLE.

2) METER PIT FOR SINGLE THREE QUARTER INCH (3/4") METER SHALL BE MUELLER 15" SINGLE COIL METER PIT, MODEL #250CS1536FSBN OR APPROVED EQUAL.

3) METER PIT FOR ONE INCH (1") SINGLE METER SHALL BE MUELLER 18" SINGLE COIL METER PIT, MODEL #330CS1836FSBN OR APPROVED EQUAL.

4) METER PIT FOR DOUBLE THREE QUARTER INCH (DBL 3/4") METER SHALL BE MUELLER 18" DOUBLE COIL METER PIT, MODEL #250CD1836FSBN OR APPROVED EQUAL.

5) METER SHALL BE SENSUS SRII TR/PL, REGISTERING IN 100 CUBIC FEET (CF) SIZE AS REQUIRED BY PLANS.

6) ALL METER PITS SHALL HAVE ONE SIX INCH (6") EXTENSION.

7) INLET SIZE SHALL BE AS REQUIRED TO MATCH WATER SERVICE AND METER SIZE.

8) METER PITS PLACED IN TRAFFIC OR PARKING AREAS REFER TO DETAIL "METER PIT—WITHIN TRAFFIC AREAS" FOR INSTALLATION.

9) FOUR INCH (4") INSULATION PAD SHALL BE MUELLER #790022 FOR FIFTEEN INCH (15") METER PITS AND MODEL #790153 FOR EIGHTEEN INCH (18") METER PITS, OR APPROVED EQUAL.

10) ALL METER PITS SHALL HAVE A METAL LID MARKED "WATER METER", WITH A TWO INCH (2") HOLE. CONTRACTOR SHALL PROVIDE AND INSTALL TR/PL READER MOUNT.

11) ALL BACKFILL AROUND METER PIT, SHALL BE PLACED IN TWELVE INCH (12") LIFTS OF CLASS TWO AGGREGATE BASE COMPACTED TO 95% RELATIVE COMPACTION.

METER PIT— OUTSIDE TRAFFIC AREA

1
A

NO SCALE

SHEET: S2-D10	FILE: STANDARDS	DRAWN: MAM	SCALE: NO SCALE	DATE: JAN 2009	**WATER SERVICE & METER DETAILS**	SOUTH TAHOE PUBLIC UTILITY DISTRICT

SOUTH TAHOE PUBLIC UTILITY DISTRICT
Sewer . 1950 . Water   A PUBLIC AGENCY
1275 Meadow Crest Drive   South Lake Tahoe, California 96150
Phone (530) 544-6474   Fax (530) 541-4319
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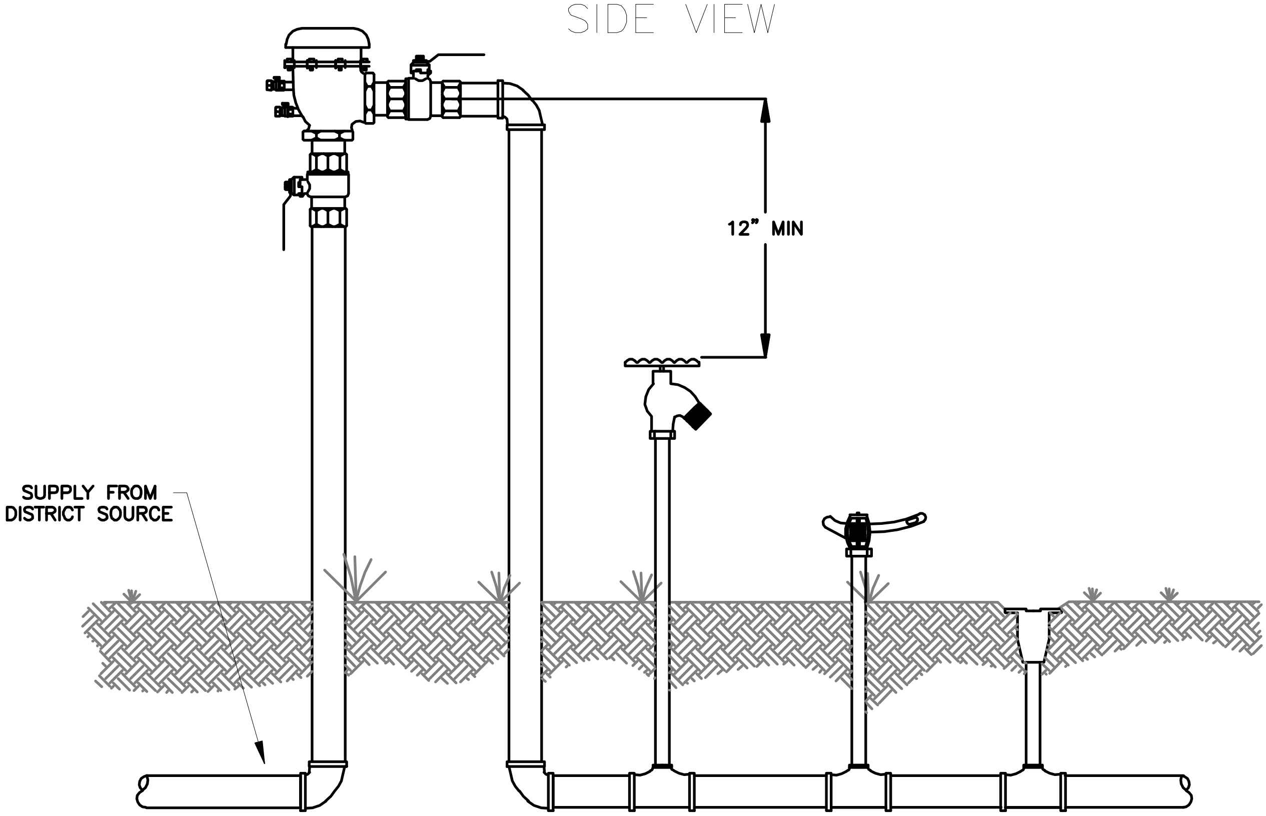
SIDE VIEW



NOTES:

1) BACK FLOW ASSEMBLY MUST MEET DISTRICT SPECIFICATIONS, CALL BEFORE ORDERING.

2) ASSEMBLY MUST BE AT A MINIMUM OF TWELVE INCHES (12") ABOVE THE HIGHEST DOWNSTREAM USE AND NOT BE MORE THAN FORTY EIGHT INCHES (48") ABOVE SURROUNDING GRADE.

3) ASSEMBLIES MUST BE INSTALLED ABOVE GRADE IN AN UPRIGHT POSITION ONLY.

4) ENCLOSURE FOR OUTDOOR OR INDOOR PROTECTION OF THE ASSEMBLY IS ALLOWED, BUT MUST PROVIDE IMMEDIATE TOP ACCESS OF TWELVE INCHES (12") FOR TESTING AND MAINTENANCE

5) TEST COCKS ARE REQUIRED TO FACE AWAY FROM WALLS AND NEAREST STATIONARY OBJECT AND AT NO TIME BE LESS THAN TWENTY FOUR INCHES (24") CLEARANCE.

6) THERE MUST BE NO BRANCH PIPING CONNECTED TO THE SUPPLY PIPE BETWEEN THE DISTRICTS SUPPLY AND THE ASSEMBLY.

7) ALL MEASUREMENTS ARE FROM THE LOWEST OR WIDEST PART OF THE ASSEMBLY.

8) ALL ASSEMBLIES ARE SUSCEPTIBLE TO FREEZING AND SHALL BE ADEQUATELY FREEZE PROTECTED.

9) NO ASSEMBLIES OR ENCLOSURES ARE TO BE INSTALLED OVER THE WATER METER VAULT OR WITHIN TWO FEET (2') OF SAME, TO ALLOW ACCESS FOR MAINTENANCE OF WATER METER.

PRESSURE VACUUM BREAKER BACKFLOW ASSEMBLY 1/2" TO 2"

A
1

NO SCALE

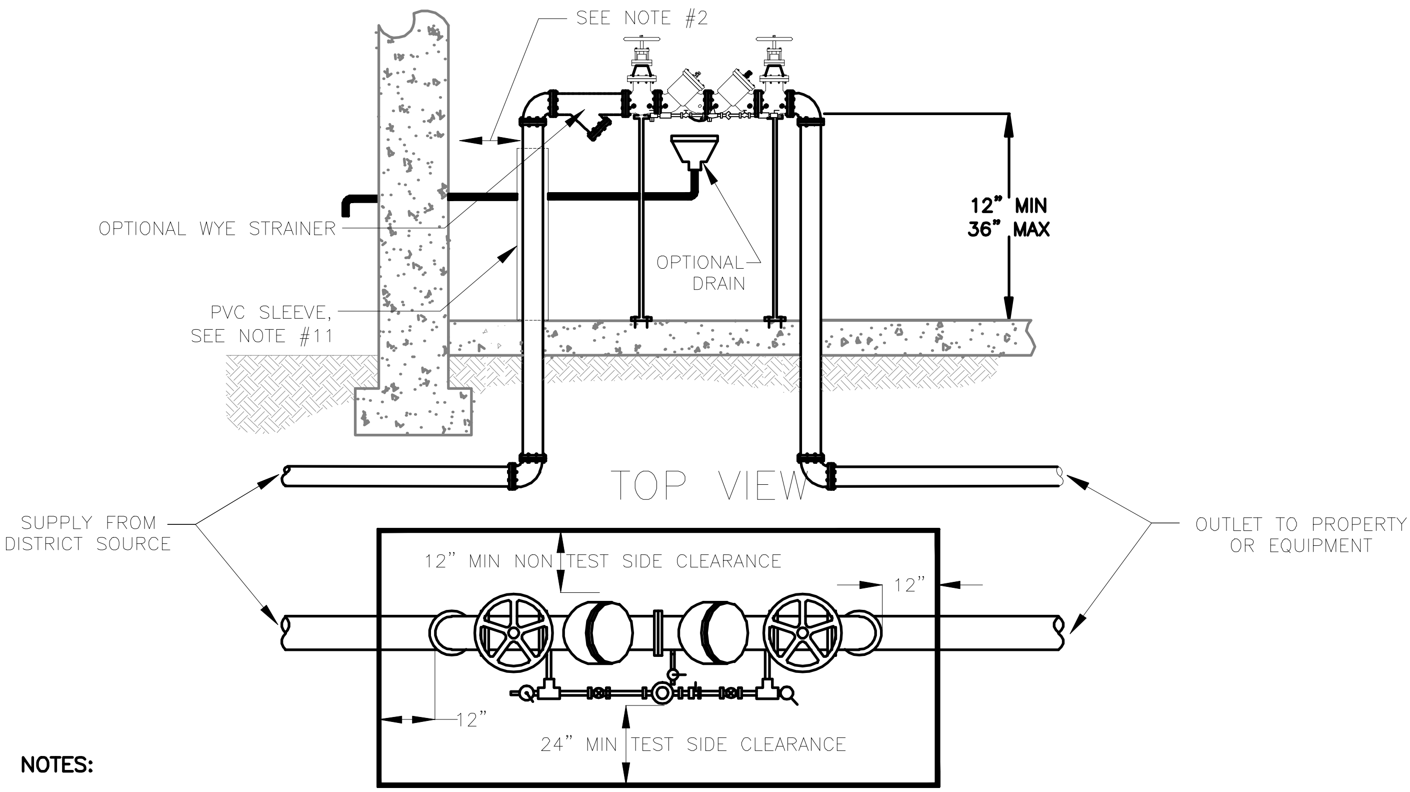
SHEET: S3-D1
FILE: STANDARDS
DRAWN: MAM
SCALE: NO SCALE
DATE: JAN 2009

BACK FLOW PREVENTER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

Sewer . 1950 . Water A PUBLIC AGENCY
1275 Meadow Crest Drive South Lake Tahoe, California 96150
Phone (530) 544-6474 Fax (530) 541-4319
WWW.STPUD.US

SIDE VIEW



NOTES:

1) BACKFLOW ASSEMBLY MUST MEET DISTRICT SPECIFICATIONS, CALL BEFORE ORDERING.

2) ASSEMBLIES MUST BE INSTALLED ABOVE GRADE IN A HORIZONTAL POSITION. ASSEMBLIES PLACED OUTSIDE OF THE STRUCTURE SHALL BE INSTALLED BETWEEN THE WATER METER AND THE FOUNDATION OF THE STRUCTURE. ASSEMBLIES PLACED INSIDE THE STRUCTURE SHALL BE INSTALLED WITHIN TWENTY FOUR INCHES (24") OF WHERE THE SERVICE ENTERS THE STRUCTURE.

3) ENCLOSURE FOR OUTDOOR OR INDOOR PROTECTION OF THE ASSEMBLY IS ALLOWED, BUT MUST PROVIDE IMMEDIATE TOP ACCESS OF TWELVE INCHES (12") FOR TESTING AND MAINTENANCE

4) TEST COCKS ARE REQUIRED TO FACE AWAY FROM WALLS AND NEAREST STATIONARY OBJECT AND AT NO TIME BE LESS THAN TWENTY FOUR INCHES (24") CLEARANCE.

5) BYPASS METER SHALL BE 5/8" SENSUS SRII TR/PL, REGISTERING IN 100 CF.

6) THERE MUST BE NO BRANCH PIPING CONNECTED TO THE SUPPLY PIPE BETWEEN THE DISTRICTS SUPPLY AND THE ASSEMBLY.

7) ALL MEASUREMENTS ARE FROM THE LOWEST OR WIDEST PART OF THE ASSEMBLY.

8) ALL ASSEMBLIES ARE SUSCEPTIBLE TO FREEZING AND SHALL BE ADEQUATELY FREEZE PROTECTED.

9) ADEQUATE DRAINAGE FROM THE ASSEMBLY MUST BE PROVIDED.

10) BACK FLOW ASSEMBLY MUST BE TESTED UPON INSTALLATION BY A DISTRICT APPROVED CERTIFIED TESTER.

11) WATER SERVICE SHALL BE PROTECTED WITH A SCH 40 PVC PIPE SLEEVE (TYPICALLY ONE SIZE LARGER THAN THE WATER SERVICE).

REDUCED PRESSURE PRINCIPLE DETECTOR ASSEMBLY 2 1/2" TO 10"

A
1

NO SCALE

DATE:	SCALE:	DRAWN:	FILE:	SHEET:
JAN 2009	NO SCALE	MAM	STANDARDS	S3-D2

BACK FLOW PREVENTER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

Sewer . 1950 . Water A PUBLIC AGENCY
1275 Meadow Crest Drive South Lake Tahoe, California 96150
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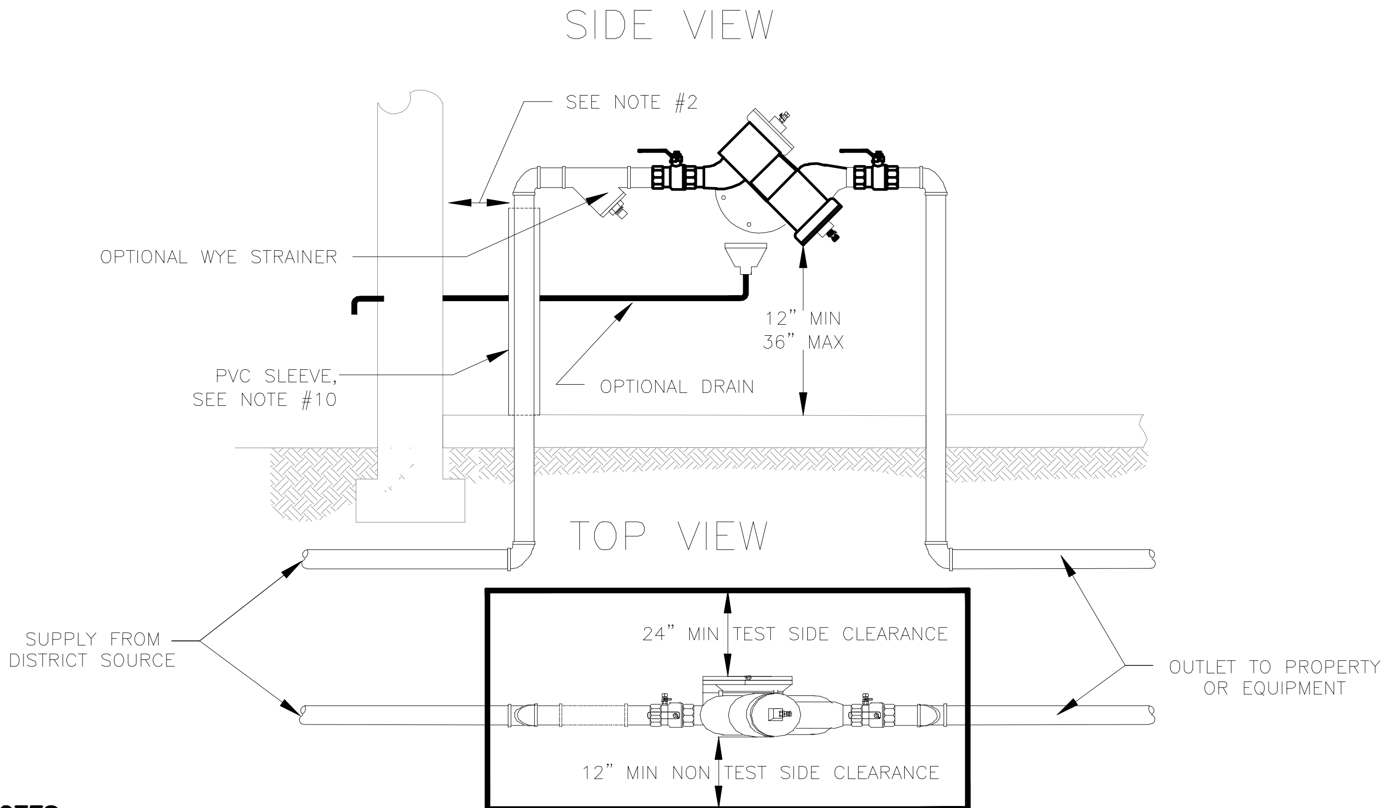

NOTES:

1) BACKFLOW ASSEMBLY MUST MEET DISTRICT SPECIFICATIONS, CALL BEFORE ORDERING.

2) ASSEMBLIES MUST BE INSTALLED ABOVE GRADE IN A HORIZONTAL POSITION. ASSEMBLIES PLACED OUTSIDE OF THE STRUCTURE SHALL BE INSTALLED BETWEEN THE WATER METER AND THE FOUNDATION OF THE STRUCTURE. ASSEMBLIES PLACED INSIDE THE STRUCTURE SHALL BE INSTALLED WITHIN TWENTY FOUR INCHES (24") OF WHERE THE SERVICE ENTERS THE STRUCTURE.

3) ENCLOSURE FOR OUTDOOR OR INDOOR PROTECTION OF THE ASSEMBLY IS ALLOWED, BUT MUST PROVIDE IMMEDIATE TOP ACCESS OF TWELVE INCHES (12") FOR TESTING AND MAINTENANCE.

4) TEST COCKS ARE REQUIRED TO FACE AWAY FROM WALLS AND NEAREST STATIONARY OBJECT AND AT NO TIME BE LESS THAN TWENTY FOUR (24") CLEARANCE.

5) THERE MUST BE NO BRANCH PIPING CONNECTED TO THE SUPPLY PIPE BETWEEN THE DISTRICTS SUPPLY AND THE ASSEMBLY.

6) ALL MEASUREMENTS ARE FROM THE LOWEST OR WIDEST PART OF THE ASSEMBLY.

7) ALL ASSEMBLIES ARE SUSCEPTIBLE TO FREEZING AND SHALL BE ADEQUATELY FREEZE PROTECTED.

8) ADEQUATE DRAINAGE FROM THE ASSEMBLY MUST BE PROVIDED.

9) BACK FLOW ASSEMBLY MUST BE TESTED UPON INSTALLATION BY A DISTRICT APPROVED CERTIFIED TESTER.

10) WATER SERVICE SHALL BE PROTECTED WITH A SCH 40 PVC PIPE SLEEVE (TYPICALLY ONE SIZE LARGER THAN THE WATER SERVICE).

REDUCED PRESSURE PRINCIPLE BACKFLOW ASSEMBLY 3/4" TO 2"

A
1

NO SCALE

SHEET:	FILE:	DRAWN:	SCALE:	DATE:
S3-D3	STANDARDS	MAM	NO SCALE	JAN 2009

BACK FLOW PREVENTER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

Sewer . 1950 . Water A PUBLIC AGENCY
1275 Meadow Crest Drive South Lake Tahoe, California 96150
Phone (530) 544-6474 Fax (530) 541-4319
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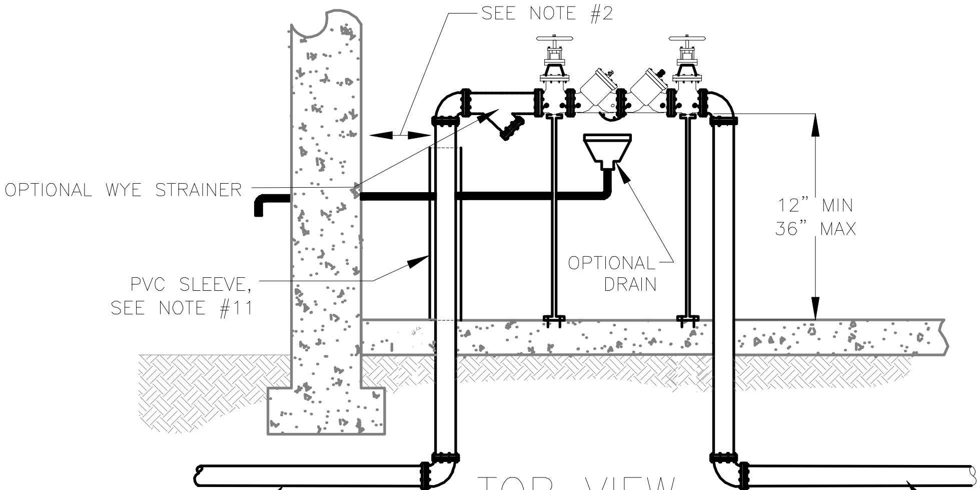
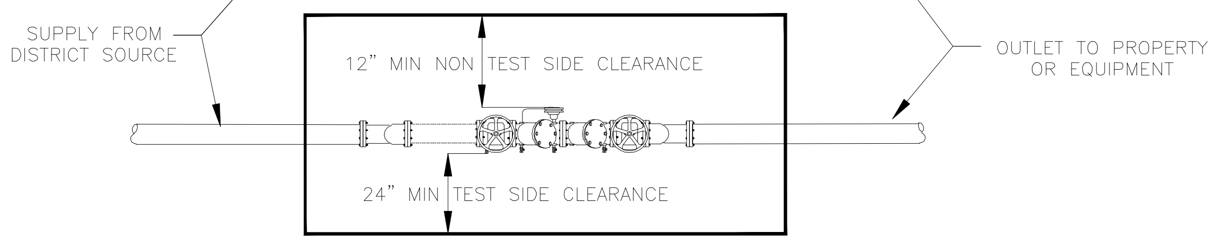
SIDE VIEW



TOP VIEW



NOTES:

1) BACKFLOW ASSEMBLY MUST MEET DISTRICT SPECIFICATIONS, CALL BEFORE ORDERING.

2) ASSEMBLIES MUST BE INSTALLED ABOVE GRADE IN A HORIZONTAL POSITION. ASSEMBLIES PLACED OUTSIDE OF THE STRUCTURE SHALL BE INSTALLED BETWEEN THE WATER METER AND THE FOUNDATION OF THE STRUCTURE. ASSEMBLIES PLACED INSIDE THE STRUCTURE SHALL BE INSTALLED WITHIN TWENTY FOUR INCHES (24") OF WHERE THE SERVICE ENTERS THE STRUCTURE.

3) ENCLOSURE FOR OUTDOOR OR INDOOR PROTECTION OF THE ASSEMBLY IS ALLOWED, BUT MUST PROVIDE IMMEDIATE TOP ACCESS OF TWELVE INCHES (12") FOR TESTING AND MAINTENANCE.

4) TEST COCKS ARE REQUIRED TO FACE AWAY FROM WALLS AND NEAREST STATIONARY OBJECT AND AT NO TIME BE LESS THAN TWENTY FOUR INCHES (24") CLEARANCE.

5) THERE MUST BE NO BRANCH PIPING CONNECTED TO THE SUPPLY PIPE BETWEEN THE DISTRICTS SUPPLY AND THE ASSEMBLY.

6) IF A BACK FLOW ASSEMBLY IS REQUIRED AND HAS NOT BEEN INSTALLED IMMEDIATELY DOWNSTREAM OF THE METER/DISTRICT VALVE, THE ENTIRE LENGTH OF THE WATER SERVICE FROM THAT POINT TO THE BACK FLOW ASSEMBLY SHALL BE ENCASED IN SIX INCHES (6") OF CONCRETE.

7) BACK FLOW ASSEMBLY MUST BE TESTED UPON INSTALLATION BY A DISTRICT APPROVED CERTIFIED TESTER.

8) ALL MEASUREMENTS ARE FROM THE LOWEST OR WIDEST PART OF THE ASSEMBLY.

9) ALL ASSEMBLIES ARE SUSCEPTIBLE TO FREEZING AND SHALL BE ADEQUATELY FREEZE PROTECTED.

10) ADEQUATE DRAINAGE FROM THE ASSEMBLY MUST BE PROVIDED.

11) WATER SERVICE SHALL BE PROTECTED WITH A SCH 40 PVC PIPE SLEEVE (TYPICALLY ONE SIZE LARGER THAN THE WATER SERVICE).

REDUCED PRESSURE PRINCIPLE BACKFLOW ASSEMBLY 2 1/2" TO 10"

A
1

NO SCALE

SHEET: S3-D4
FILE: STANDARDS
DRAWN: MAM
SCALE: NO SCALE
DATE: JAN 2009

BACK FLOW PREVENTER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

Sewer . 1950 . Water A PUBLIC AGENCY
1275 Meadow Crest Drive South Lake Tahoe, California 96150
Phone (530) 544-6474 Fax (530) 541-4319
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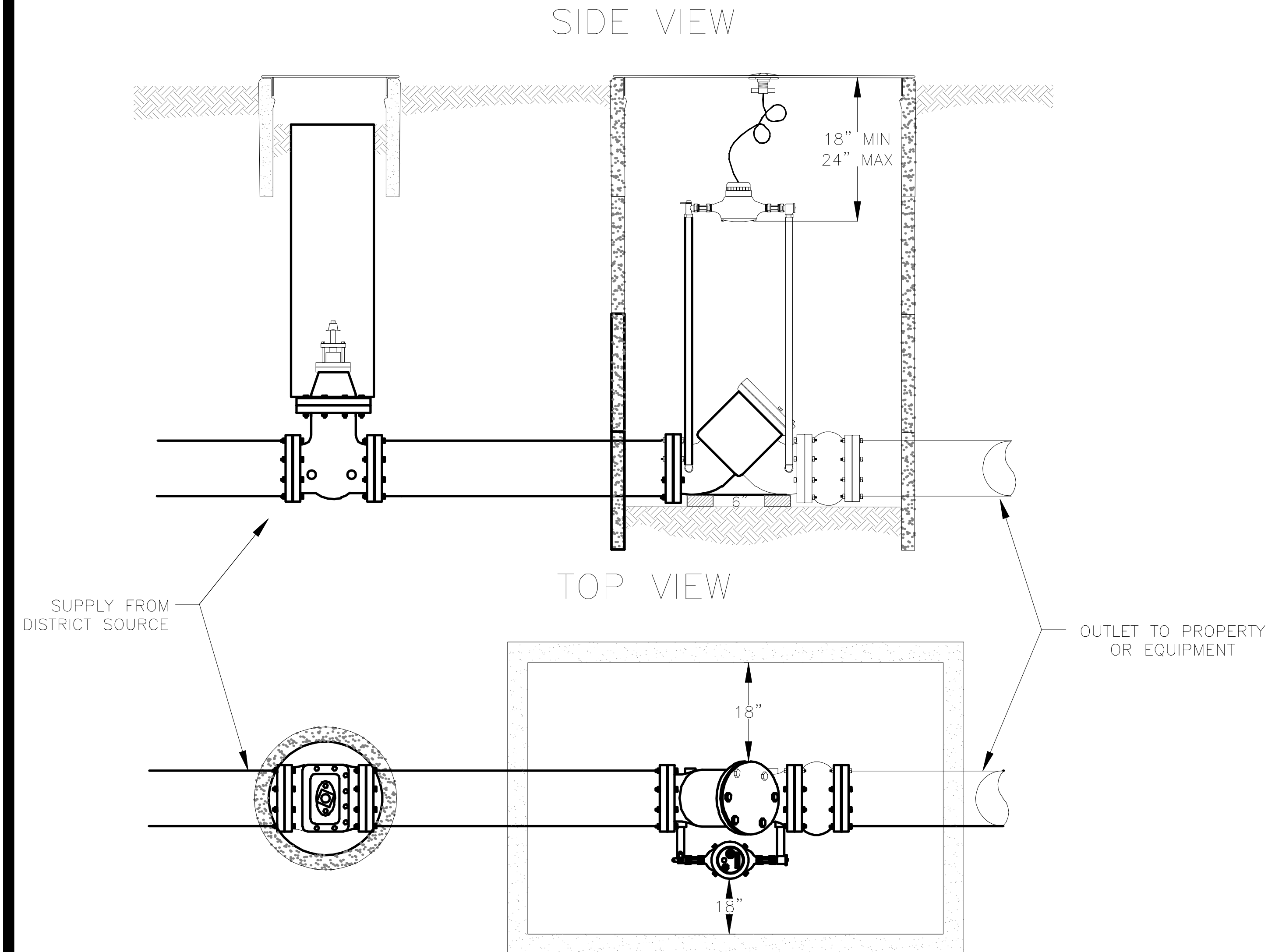

NOTES:

1) BYPASS METER SHALL BE 3/4" SENSUS SRII TR/PL REGISTERING IN 100 CF.

2) BYPASS METER SHALL BE INSTALLED AT A DEPTH OF NOT LESS THAN EIGHTEEN INCHES (18") AND NOT MORE THAN TWENTY FOUR INCHES (24") MEASURED FROM THE TOP OF THE METER BOX TO THE BOTTOM OF THE METER.

3) REQUIRED INSULATED COUPLER SHALL BE LOCATED IMMEDIATELY DOWNSTREAM OF CHECK VALVE AND METERED BYPASS.

4) METER BOX IN NON-TRAFFIC AREAS SHALL BE "CHRISTY" MODEL B-52 WITH STEELB-52F3 LID OR APPROVED EQUAL INSTALLED TWO INCHES (2") ABOVE FINISH GRADE. BOXES LOCATED IN TRAFFIC OR PARKING AREAS SHALL BE H20 LOAD RATED INSTALLED A HALF INCH (1/2") BELOW FINISH GRADE.

5) CONTRACTOR SHALL PROVIDE TWO INCH (2") HOLE CENTERED IN METER BOX LID AND INSTALL TR/PL READER MOUNT. CONTRACTOR SHALL PROVIDE THREE FEET (3') OF EXCESS METER READER WIRE.

6) METER BOX SHALL BE WITHIN EIGHTEEN INCHES (18") OF DISTRICT SERVICE VALVE BOX.

DETECTOR CHECK VALVE
3" TO 12"

A
1

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S3-D5

BACK FLOW PREVENTER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT
Sewer . 1950 . Water A PUBLIC AGENCY
1275 Meadow Crest Drive South Lake Tahoe, California 96150
Phone (530) 544-6474 Fax (530) 541-4319
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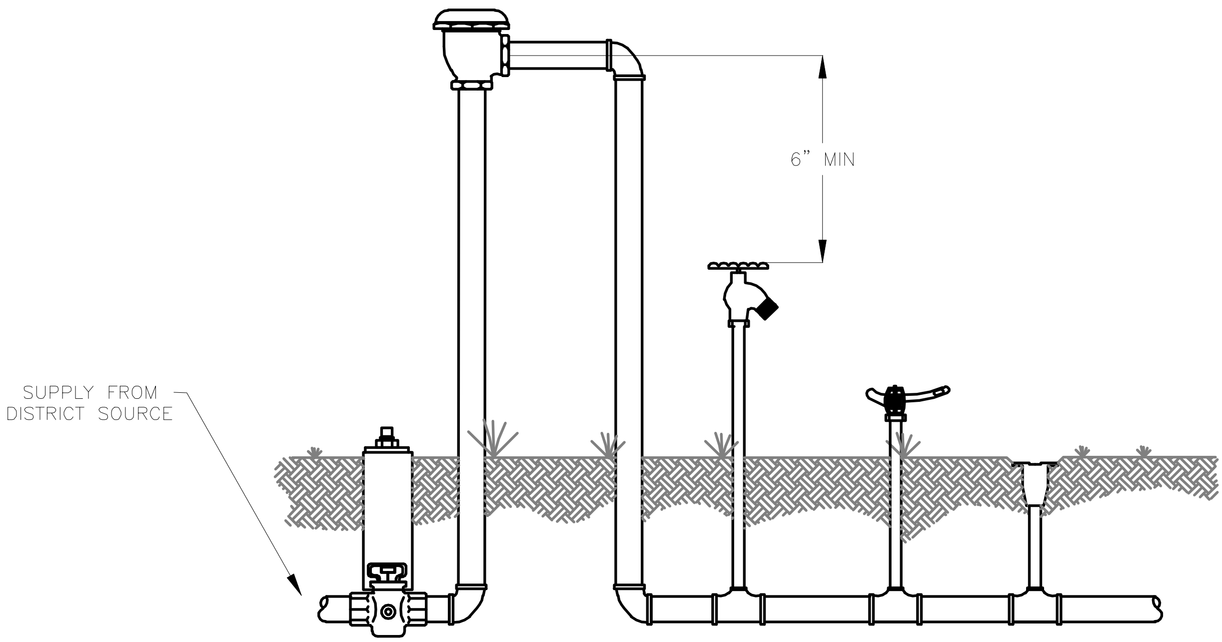
SIDE VIEW



NOTES:

1) BACK FLOW DEVICE MUST MEET DISTRICT SPECIFICATIONS, CALL BEFORE ORDERING.

2) NO SHUT OFF VALVES OF ANY TYPE ARE ALLOWED DOWNSTREAM OF VACUUM BREAKER.

3) ASSEMBLY MUST BE AT A MINIMUM OF SIX INCHES (6") ABOVE THE HIGHEST DOWNSTREAM USE AND NOT MORE THAN FORTY EIGHT INCHES (48") ABOVE SURROUNDING GRADE.

4) ASSEMBLIES MUST BE INSTALLED ABOVE GRADE IN AN UPRIGHT POSITION ONLY.

5) ENCLOSURE FOR OUTDOOR OR INDOOR PROTECTION OF THE ASSEMBLY IS ALLOWED, BUT MUST PROVIDE IMMEDIATE ACCESS FOR TESTING AND MAINTENANCE.

6) THERE MUST BE NO BRANCH PIPING CONNECTED TO THE SUPPLY PIPE BETWEEN THE DISTRICT'S SUPPLY AND THE ASSEMBLY.

7) ALL MEASUREMENTS ARE FROM THE LOWEST OR WIDEST PART OF THE ASSEMBLY.

8) ALL ASSEMBLIES ARE SUSCEPTIBLE TO FREEZING AND SHALL BE ADEQUATELY FREEZE PROTECTED.

9) NO ASSEMBLIES OR ENCLOSURES ARE TO BE INSTALLED OVER THE WATER METER VAULT OR WITHIN TWO FEET (2') OF SAME TO ALLOW ACCESS FOR MAINTENANCE OR WATER METER.

ATMOSPHERIC VACUUM BREAKER BACKFLOW DEVICE 1/2" TO 2"

A
1

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S3-D6

BACK FLOW PREVENTER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

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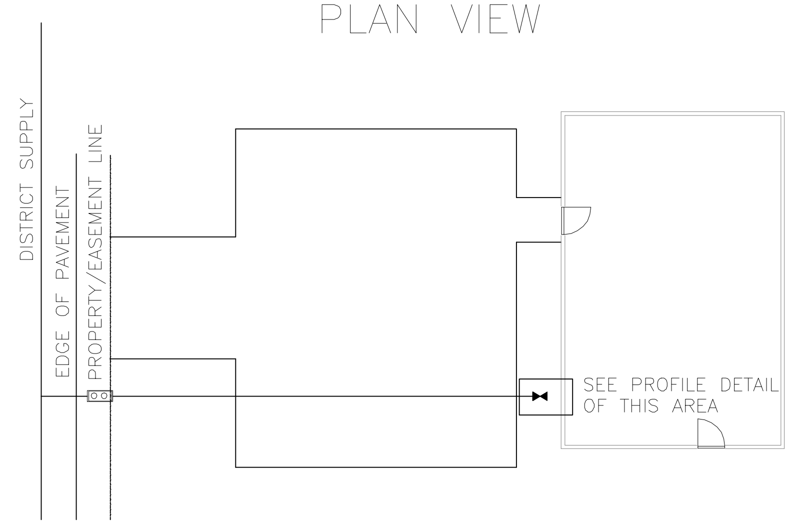
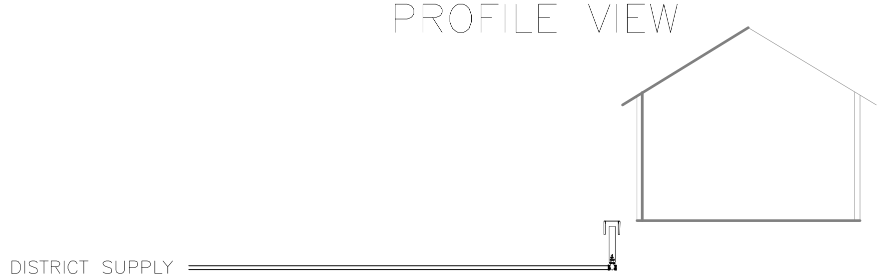
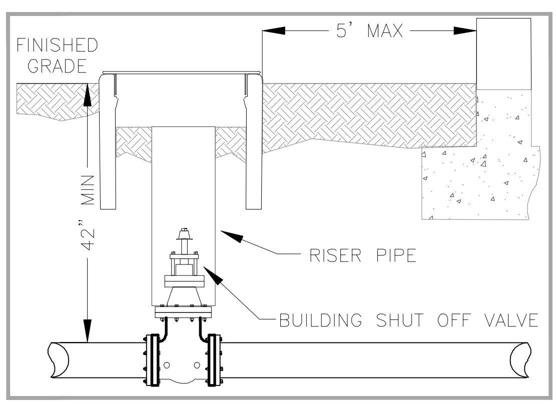
PLAN VIEW



PROFILE VIEW



DETAIL



NOTES:

1) SHUT OFF VALVE OUTSIDE THE FOUNDATION IN AN ALWAYS ACCESSIBLE LOCATION.

2) VALVE MUST BE RESILIENT SEATED WITH A TWO INCH (2") OPERATING NUT.

BUILDING SHUT OFF VALVE 3" TO 12"

A
1

NO SCALE

DATE:	SCALE:	DRAWN:	FILE:	SHEET:
JAN 2009	NO SCALE	MAM	STANDARDS	S4-D1

WATER SHUT OFF & ABANDONMENT DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

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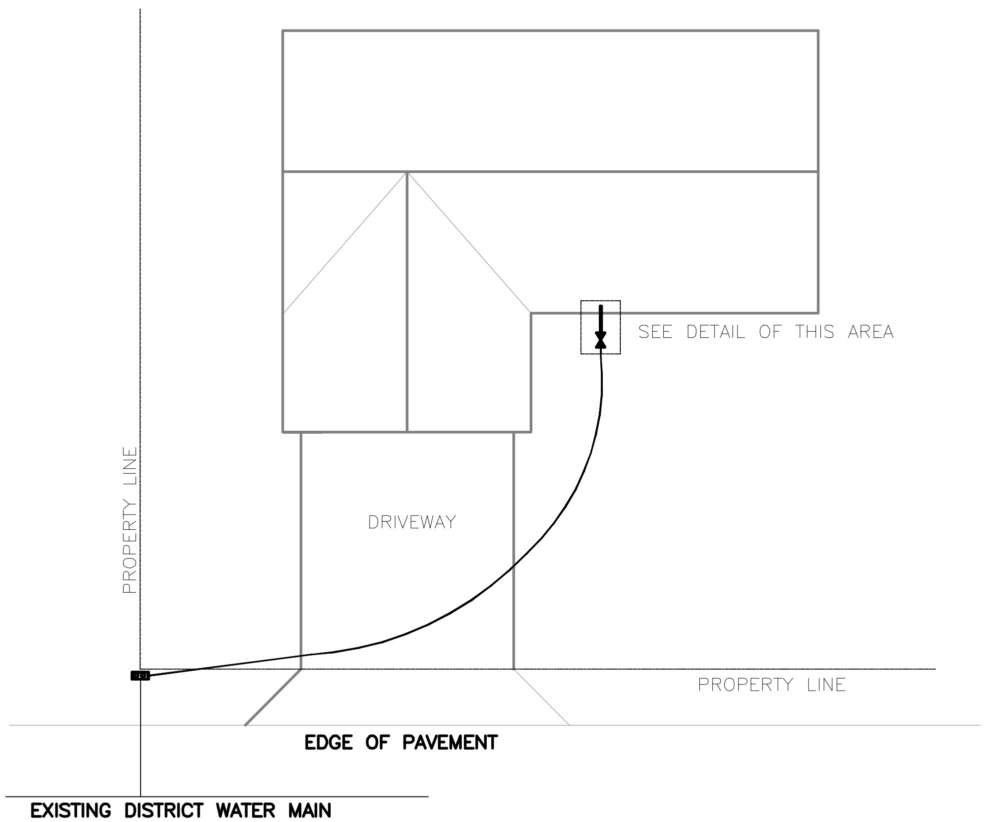
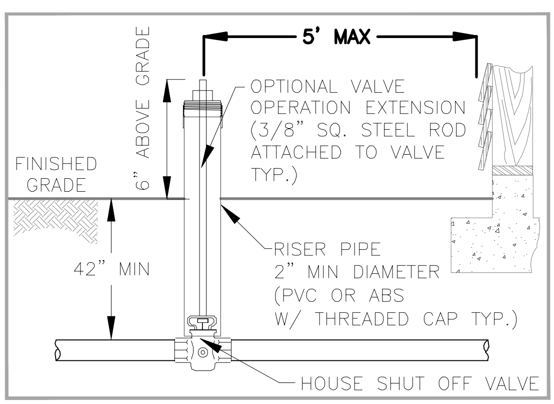
PLAN VIEW



DETAIL



NOTES:

1) SHUT OFF VALVE OUTSIDE THE FOUNDATION IN AN ALWAYS ACCESSIBLE LOCATION.

2) VALVE MUST BE CONSTRUCTED OF BRASS WITH NON-CORROSIVE WORKING PARTS.

3) VALVE MUST HAVE ONE QUARTER (1/4) TURN ON/OFF CAPABILITY.

HOUSE SHUT OFF VALVE
3/4" TO 2"

A
1

NO SCALE

SHEET:	FILE:	DRAWN:	SCALE:	DATE:
S4-D2	STANDARDS	MAM	NO SCALE	JAN 2009

WATER SHUT OFF & ABANDONMENT DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

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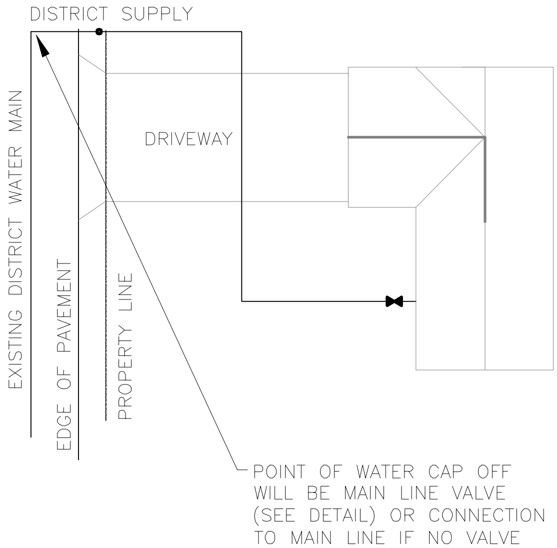
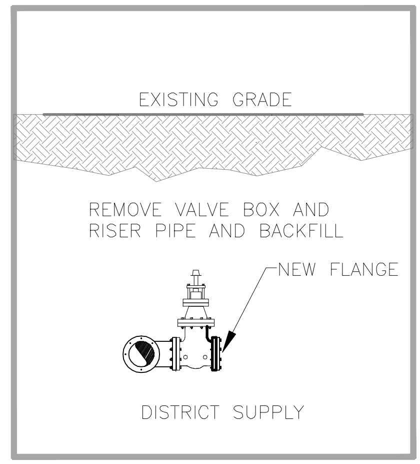
PLAN VIEW



DETAIL



NOTES:

1) UNDERGROUND SERVICE ALERT (USA) 811 TO BE NOTIFIED A MINIMUM OF 48 HOURS BEFORE ANY EXCAVATION.

2) ALL WATER SERVICE(S) TO BE CAPPED SHALL BE FIELD LOCATED BY DISTRICT INSPECTORS.

3) DO NOT DEMOLISH ANY BUILDING UNTIL WATER SERVICE CAP OFF LOCATION FOR THAT BUILDING IS EXCAVATED AND CONFIRMED.

4) WATER SERVICE(S) WILL BE CAPPED AT THE MAIN LINE VALVE OR CONNECTION TO MAIN LINE IF NO VALVE. FINAL CAP OFF LOCATION SHALL BE FIELD VERIFIED AND APPROVED BY THE DISTRICT.

5) WATER SERVICE(S) MUST BE SEVERED AT THE CAP OFF POINT IN A WORKMANSHIP LIKE MANNER APPROPRIATE FOR THE TYPE OF PIPE TO BE CAPPED. A MINIMUM OF SIX FEET (6') OF PIPING DOWNSTREAM OF THE CAP OFF POINT SHALL BE REMOVED.

6) THE PLUGGING OF THE SEVERED WATER SERVICE(S) MUST BE MADE WITH A NEW IRON FLANGE AND GASKET APPROPRIATE FOR THAT SIZE WATER SERVICE.

7) NO WORK SHALL BE COVERED UNTIL INSPECTED AND APPROVED BY THE DISTRICT.

8) THE DISTRICT SHALL BE GIVEN A MINIMUM OF TWENTY FOUR (24) HOURS NOTICE TO INSPECT ALL WORK ASSOCIATED WITH CAPPING OF LATERAL(S).

ABANDON WATER SERVICE 3" TO 12"

A
1

NO SCALE

SHEET: S4-D3
FILE: STANDARDS
DRAWN: MAM
SCALE: NO SCALE
DATE: JAN 2009

WATER SHUT OFF & ABANDONMENT DETAILS

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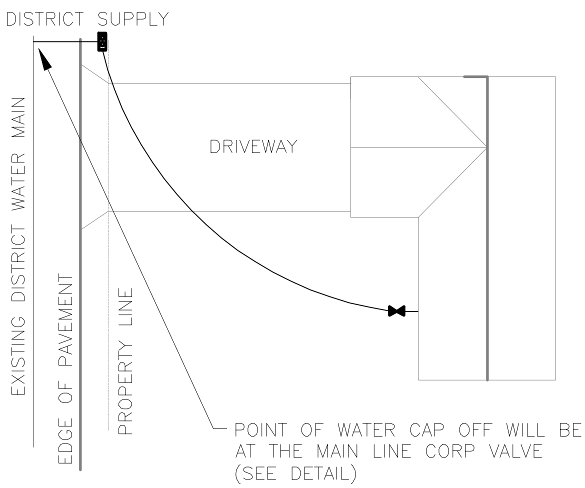
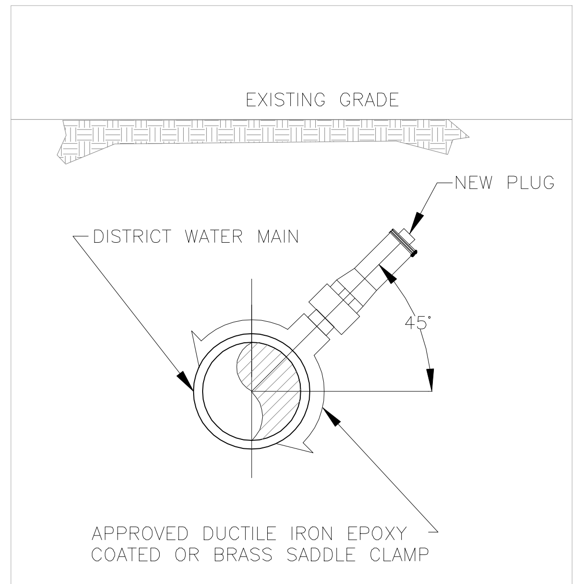
PLAN VIEW



DETAIL



NOTES:

1) UNDERGROUND SERVICE ALERT (USA) 811 TO BE NOTIFIED A MINIMUM OF FORTY EIGHT (48) HOURS BEFORE ANY EXCAVATION.

2) ALL WATER SERVICE(S) TO BE CAPPED SHALL BE FIELD LOCATED BY DISTRICT INSPECTORS.

3) DO NOT DEMOLISH ANY BUILDING UNTIL WATER SERVICE CAP OFF LOCATION FOR THAT BUILDING IS EXCAVATED AND CONFIRMED.

4) WATER SERVICE(S) WILL BE CAPPED AT THE MAIN LINE CORP VALVE. FINAL CAP OFF LOCATION SHALL BE FIELD VERIFIED AND APPROVED BY THE DISTRICT.

5) WATER SERVICE(S) MUST BE SEVERED AT THE CAP OFF POINT IN A WORKMANSHIP LIKE MANNER APPROPRIATE FOR THE TYPE OF PIPE TO BE CAPPED. A MINIMUM OF SIX FEET (6') OF PIPING DOWNSTREAM OF THE CAP OFF POINT SHALL BE REMOVED.

6) THE PLUGGING OF THE SEVERED WATER SERVICE(S) MUST BE MADE WITH A NEW IRON OR BRASS PLUG APPROPRIATE FOR THAT SIZE WATER SERVICE.

7) NO WORK SHALL BE COVERED UNTIL INSPECTED AND APPROVED BY THE DISTRICT.

8) THE DISTRICT SHALL BE GIVEN A MINIMUM OF TWENTY FOUR (24) HOURS NOTICE TO INSPECT ALL WORK ASSOCIATED WITH CAPPING OF LATERAL(S).

ABANDON WATER SERVICE 3/4" TO 2"

A
1

NO SCALE

SHEET:	FILE:	DRAWN:	SCALE:	DATE:
S4-D4	STANDARDS	MAM	NO SCALE	JAN 2009

WATER SHUT OFF & ABANDONMENT DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

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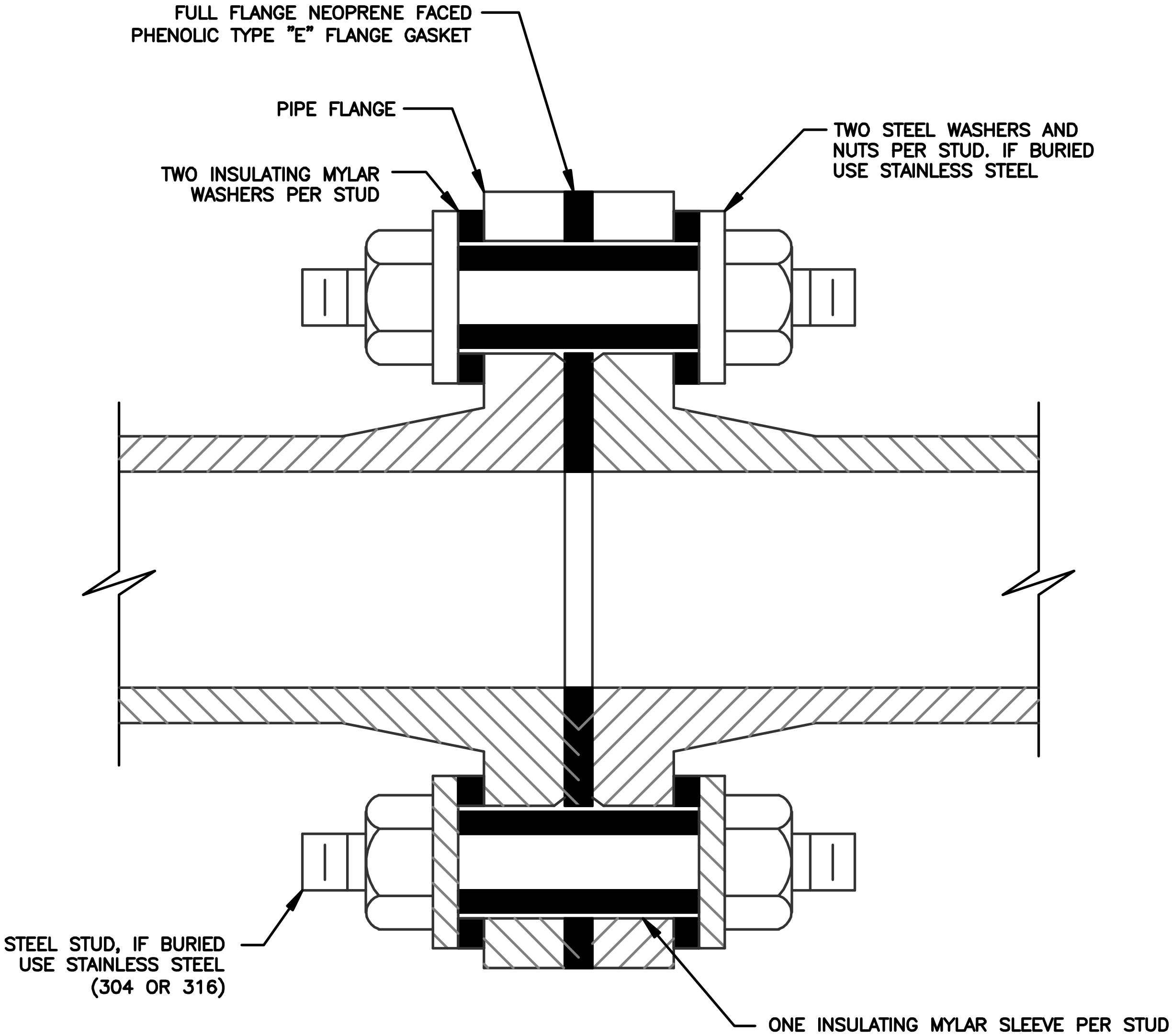

NOTE:

IF FLANGE IS TO BE BURIED, COAT ENTIRE ASSEMBLY WITH PETROLATUM SATURATED FABRIC TAPE WRAP SYSTEM IN ACCORDANCE WITH THE SPECIFICATIONS.

A
1

PIPE FLANGE INSULATION

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S5-D1

MISC PIPE DETAILS

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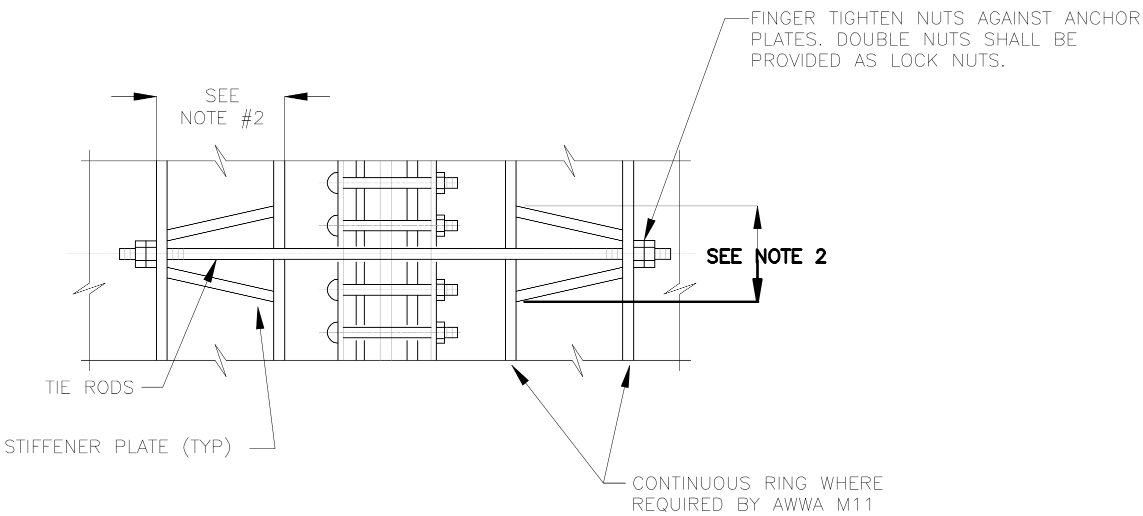
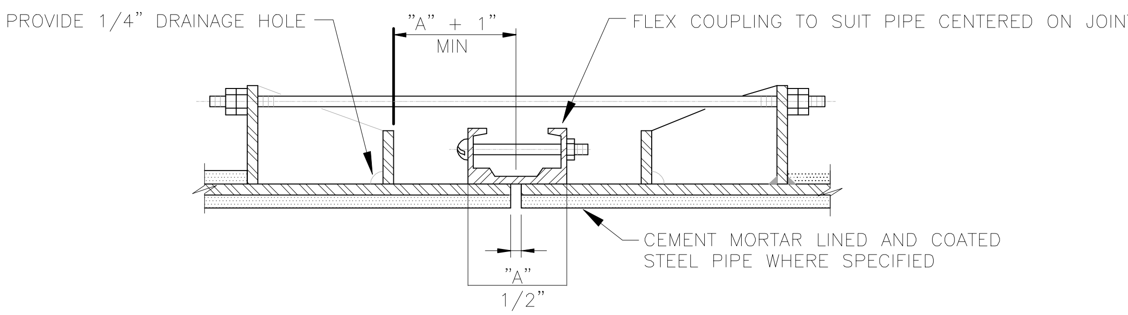
PLAN VIEW



PROFILE VIEW



NOTE:

1) ALL FLEXIBLE COUPLINGS SHALL HAVE TIE RODS UNLESS SPECIFICALLY INDICATED OTHERWISE ON THE DRAWINGS.

2) DESIGN SHALL BE BASED ON DESIGN PRESSURE (SEE SPECS)

3) ANCHOR LUGS AND TIE RODS FOR STEEL PIPE SHALL BE DESIGNED BY PIPE MANUFACTURER IN ACCORDANCE WITH AWWA M11 STEEL PIPE MANUAL (ASMODIFIED BY THE SPECS)

4) GRIND ALL CORNERS SMOOTH.

5) COAT ALL SURFACES WITH EPOXY PAINT PER SPECS. REPAIR CUT PIPE WITH EPOXY AS SPECIFIED ELSEWHERE, ALSO REPAIR ANY DAMAGE FROM WELDING CONTINUOUS RING, TO EXISTING STEEL PIPE AS SPECIFIED.

STEEL PIPE FLEXIBLE COUPLING TIE DOWN

A
1

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S5-D2

MISC PIPE DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT
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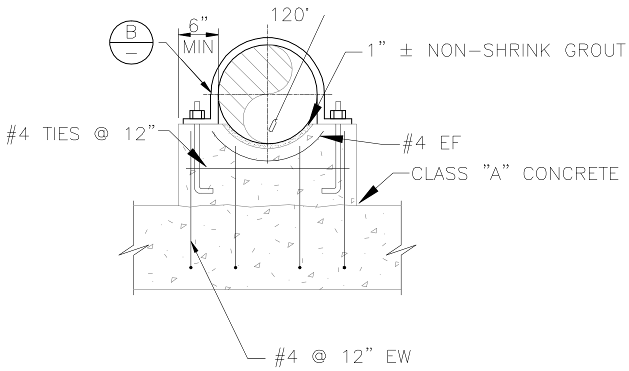
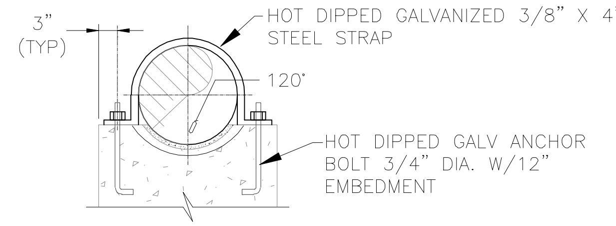
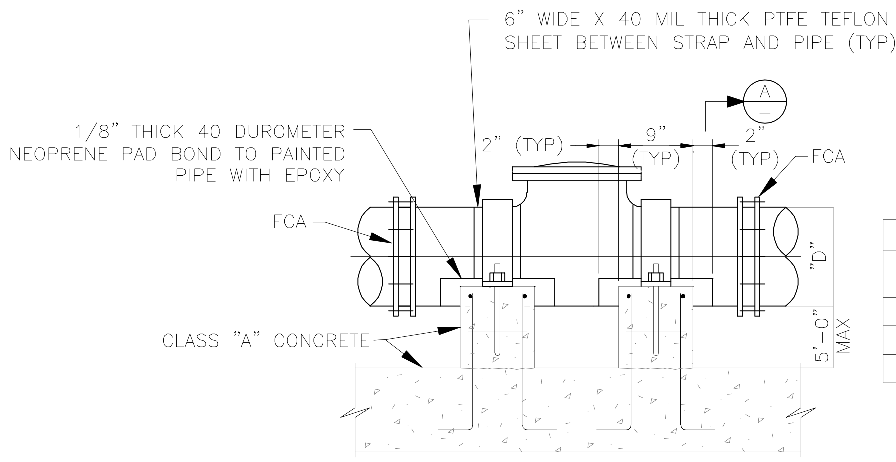
A SECTION



B STRAP DETAIL





SCHEDULE		
PIPE SIZE	STRAP SIZE	ANCHOR BOLT DIA
8"-12"	FB 1/4"X4"	1/2"ø
14"-24"	FB 5/16"X4"	5/8"ø
26"-36"	FB 3/8"X4"	3/4"ø

NOTES:

1) FOR ISOLATED SUPPORTS CONSTRUCT 2'-0" (D + 12") X 12" THICK FOOTING WITH #4 @ 10" EW T&B. SUPPORT SHALL BE ON UNDISTURBED SOIL OR TYPE II AGGREGATE BASE COMPACTED TO 95% RELATIVE COMPACTION.

2) MAX VERTICAL LOAD - 6000 LBS.

A/1 CONCRETE PIPE SUPPORT

NO SCALE

SHEET: S5-D3
FILE: STANDARDS
DRAWN: MAM
SCALE: NO SCALE
DATE: JAN 2009

MISC PIPE DETAILS

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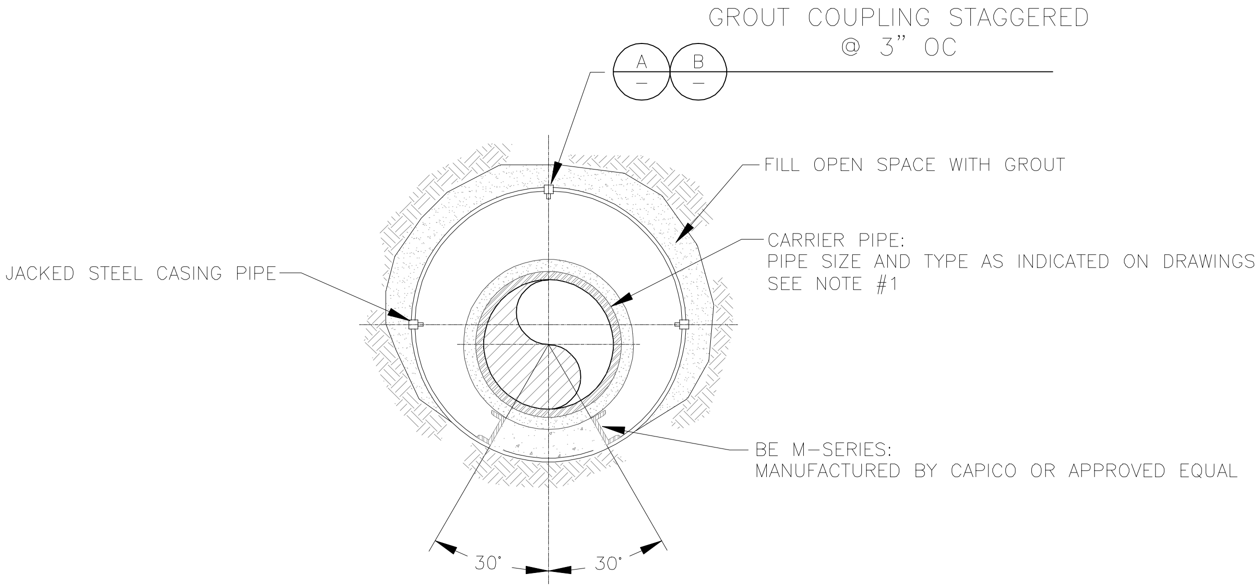

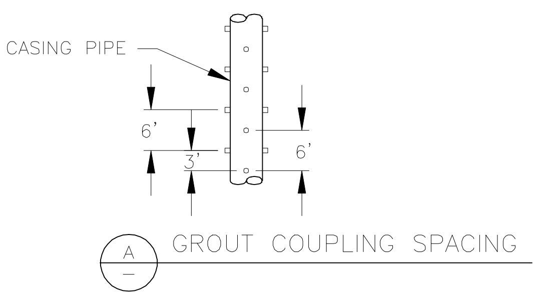

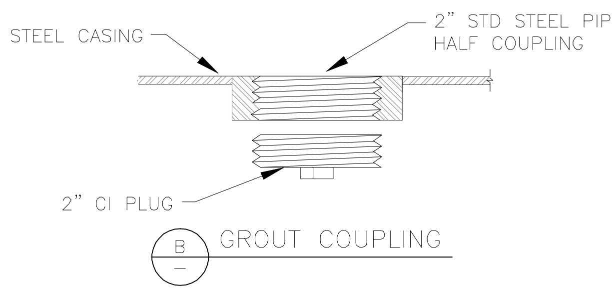

NOTE:
CARRIER PIPE SHALL BE ENCASED IN POLYETHYLENE MATCHING NEW PIPE INSTALLED ON EITHER SIDE OF CASING PIPE.

A
1

PIPE IN JACKED STEEL CASING

NO SCALE

SHEET:	FILE:	DRAWN:	SCALE:	DATE:
S5-D4	STANDARDS	MAM	NO SCALE	JAN 2009

MISC PIPE DETAILS

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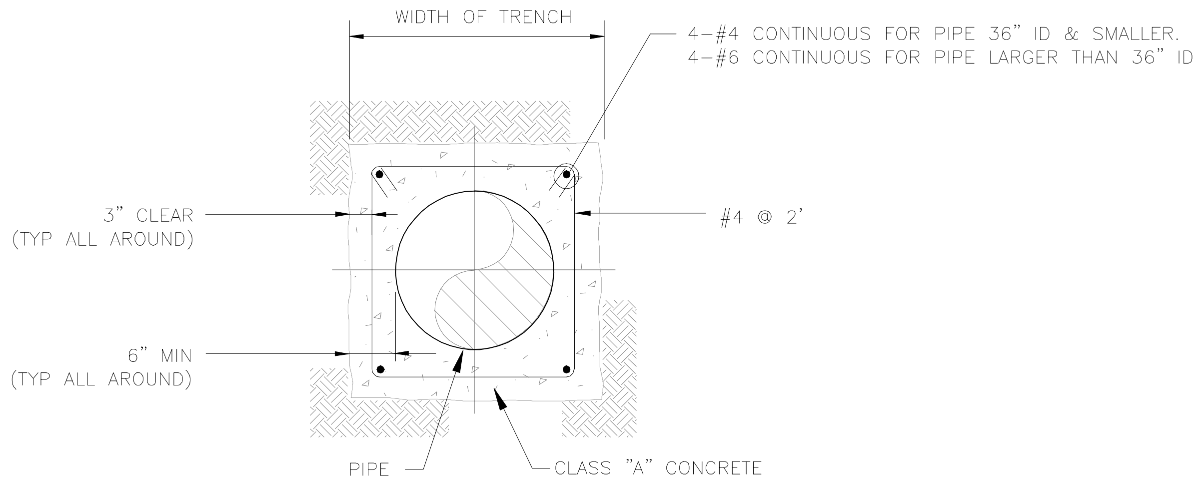
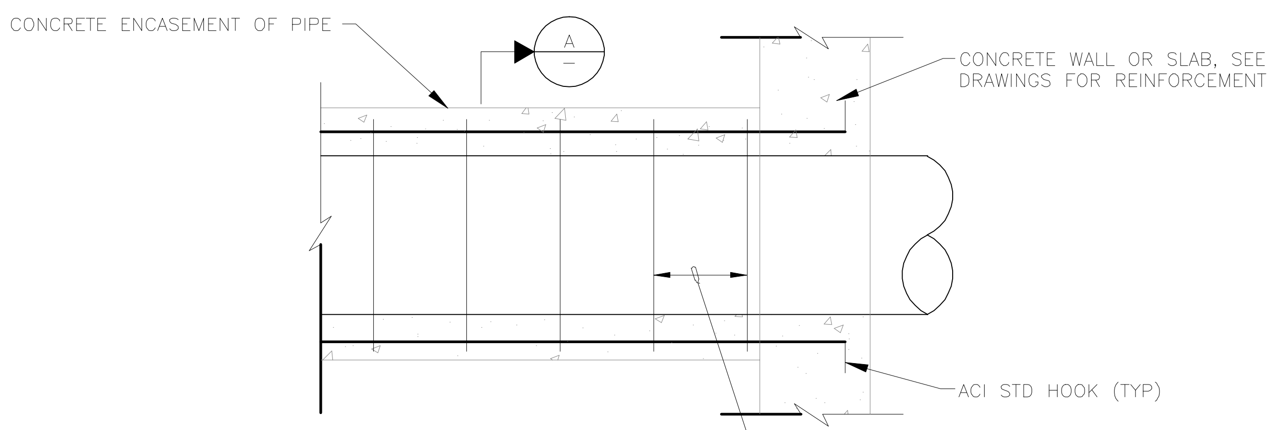


A — SECTION



B — SECTION

CONCRETE ENCASEMENT

A
1

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S5-D5

MISC PIPE DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT
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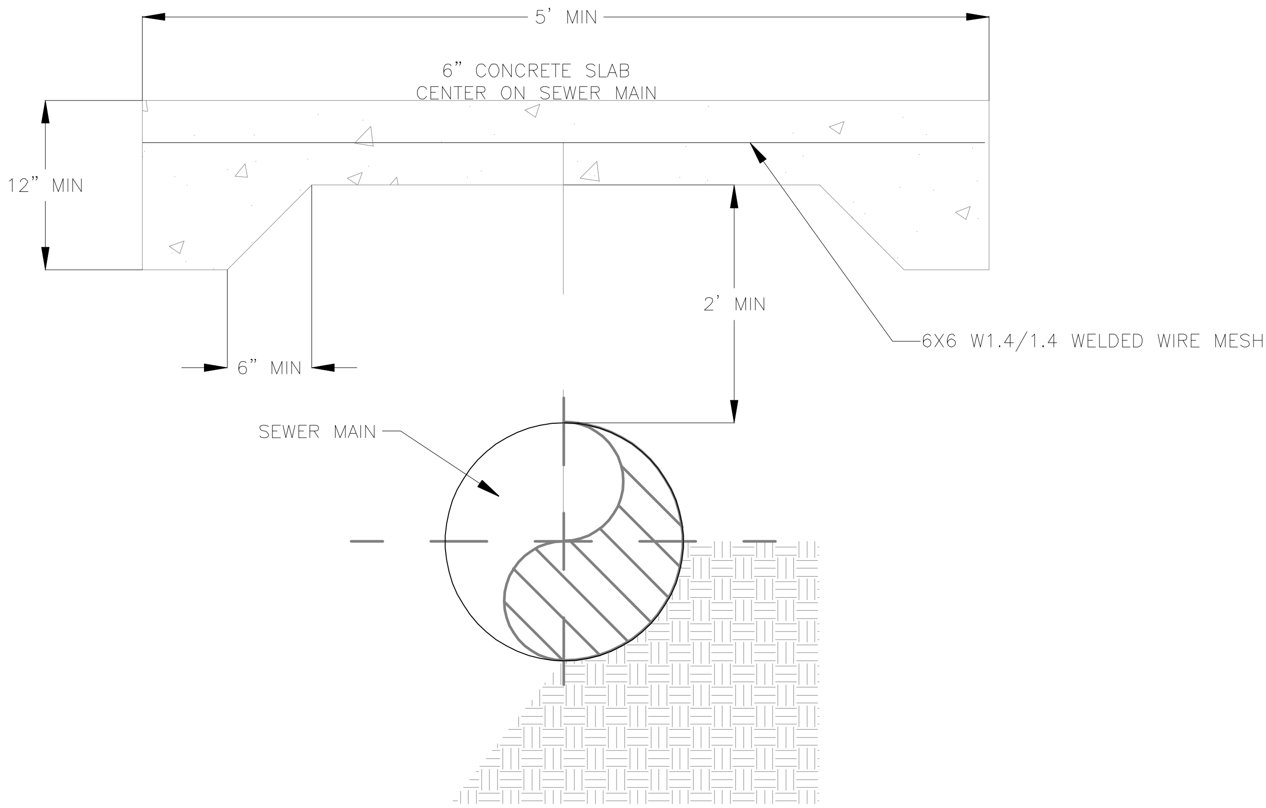

NOTES:

1) CONCRETE SHALL BE 5000 PSI MIN, PLACE CONCRETE ON UNDISTURBED NATIVE MATERIAL.

2) WELDED WIRE MESH SHALL BE SUPPORTED TO BE PLACED APPROXIMATELY IN THE MIDDLE OF THE SLAB. OVERLAP WIRE MESH PANELS A MINIMUM OF SIX INCHES (6") AND CONNECT WITH TIE WIRE.

3) NO REQUIREMENT TO USE FORMS IF NATIVE MATERIAL IS STABLE AND HOLDS THE VERTICAL EDGES.

4) ROUGH FINISH ALL CONCRETE: CHIP OFF FINS EXCEEDING A QUARTER INCH (1/4") IN HEIGHT PATCH ANY DEFECTS. OTHERWISE, SURFACES SHALL BE LEFT WITH TEXTURE IMPARTED BY FORMS.

5) NO REQUIREMENT FOR CONCRETE CAP AT ABUTMENTS.

6) NO REQUIREMENT FOR CAP TO BE TIED TO ABUTMENT OR POURED AT THE SAME TIME.

CONCRETE CAP FOR SEWER MAIN IN STREAM BED

A
1

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S5-D6

MISC PIPE DETAILS

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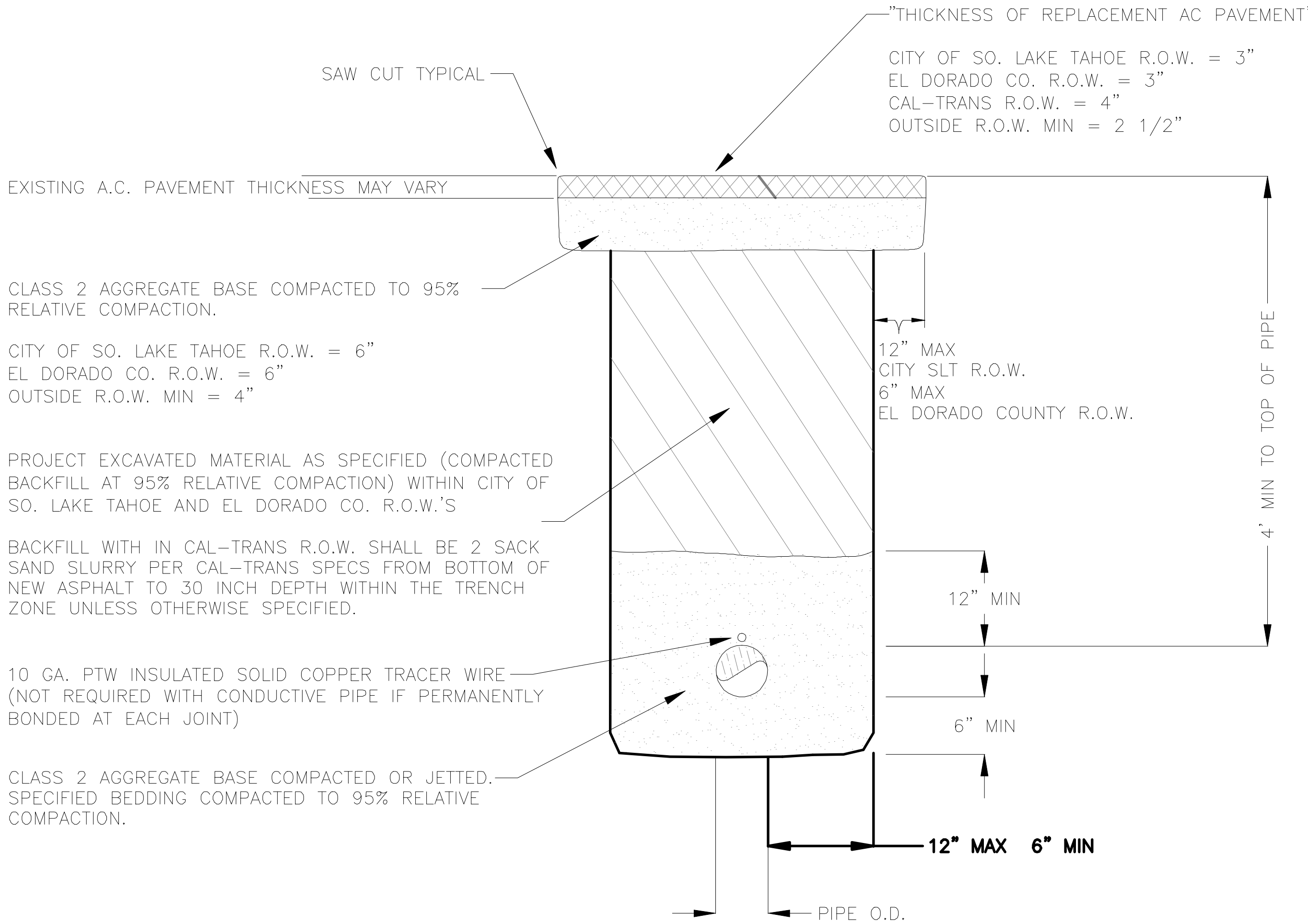

NOTES:

1) ALL A.C. TRENCH PAVEMENT REPLACEMENT PLACED OUTSIDE THE CAL-TRANS R.O.W. EXCEEDING THREE INCHES (3") SHALL BE PLACED ONE LIFT.

2) CONTRACTOR PAY ITEM FOR TRENCH WIDTH PLUS TWELVE INCHES (12") IN EL DORADO COUNTY RIGHT OF WAY AND TWENTY FOUR INCHES (24") IN CITY OF SOUTH LAKE TAHOE RIGHT OF WAY, TO SAW CUT. TRENCH WIDTH AND TRENCH PAVEMENT REPLACEMENT EXCEEDING MAXIMUM AS DESCRIBED HERE IN AND IN THE SPECIFICATIONS SHALL BE COMPLETED AT NO ADDITIONAL EXPENSE TO THE DISTRICT.

3) CONTRACTOR SHALL REPLACE ALL TRAFFIC STRIPING DISTURBED BY CONSTRUCTION.

TRENCH DETAIL— WITHIN PAVED AREAS

A
1

NO SCALE

SHEET:	FILE:	DRAWN:	SCALE:	DATE:
S6-D1	STANDARDS	MAM	NO SCALE	JAN 2009

TRENCH AND PAVEMENT DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT
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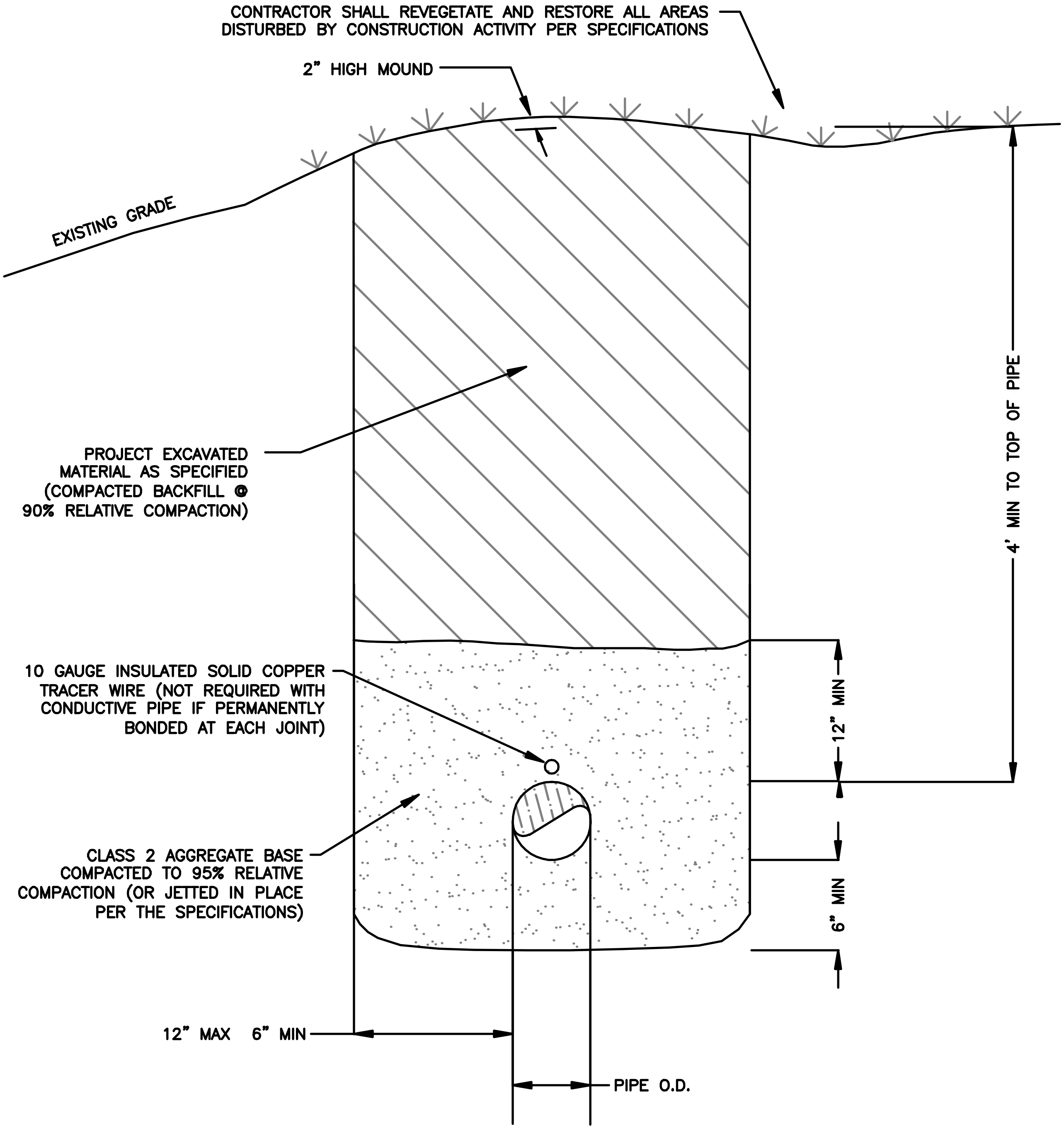

TRENCH DETAIL—
OUTSIDE PAVED AREAS

A
1

NO SCALE

DATE:	SCALE:	DRAWN:	FILE:	SHEET:
JAN 2009	NO SCALE	MAM	STANDARDS	S6-D2

TRENCH AND PAVEMENT DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

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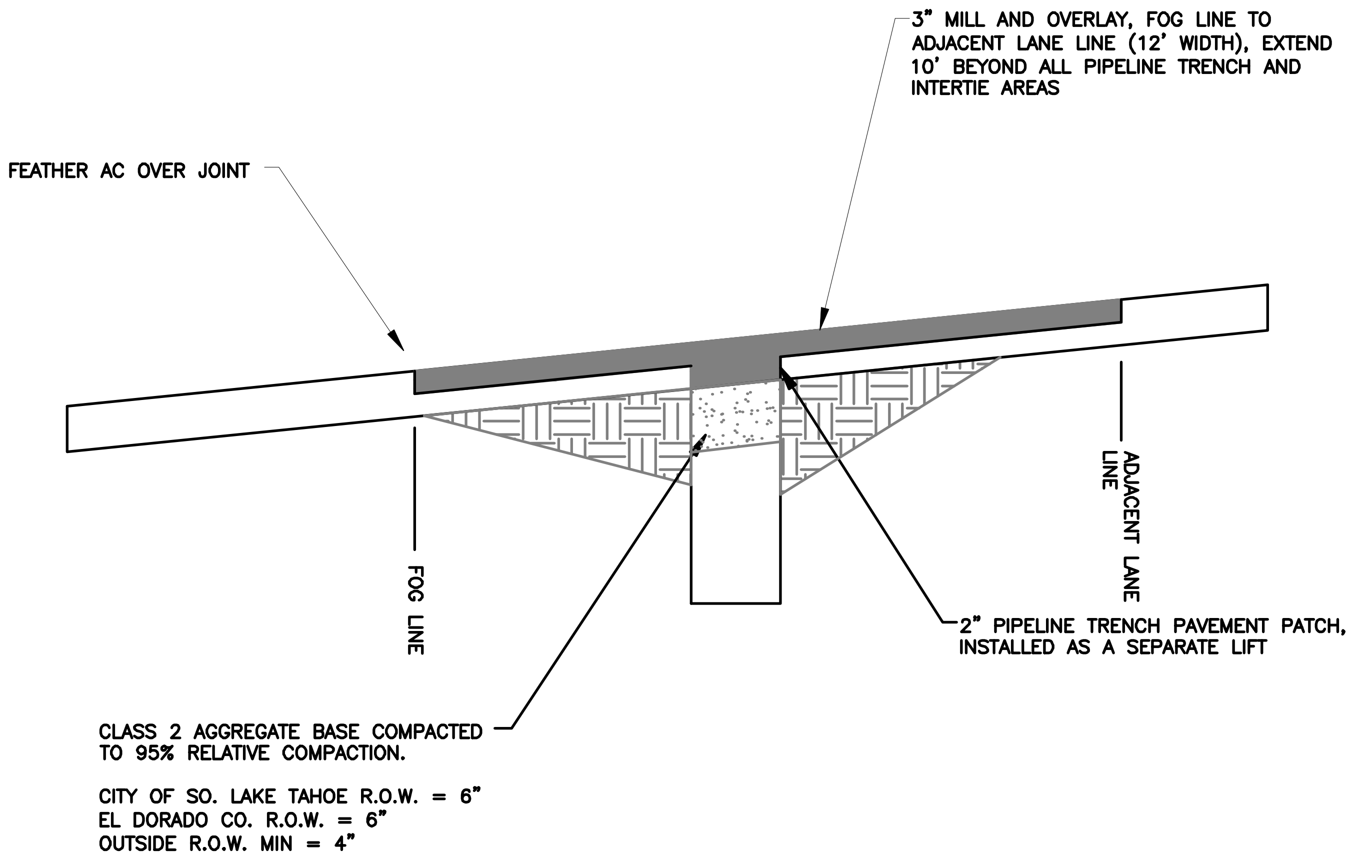

NOTE:

1) APPLY TAC COAT AND INSTALL PETROMAT PAVEMENT REINFORCEMENT FOR PERPENDICULAR ROAD CROSSINGS TWICE AS WIDE AS THE TRENCH WIDTH.

3" MILL AND OVERLAY
12' WIDTH PAVEMENT

A
1

NO SCALE

DATE:	SCALE:	DRAWN:	FILE:	SHEET:
JAN 2009	NO SCALE	MAM	STANDARDS	S6-D3

TRENCH AND PAVEMENT DETAILS

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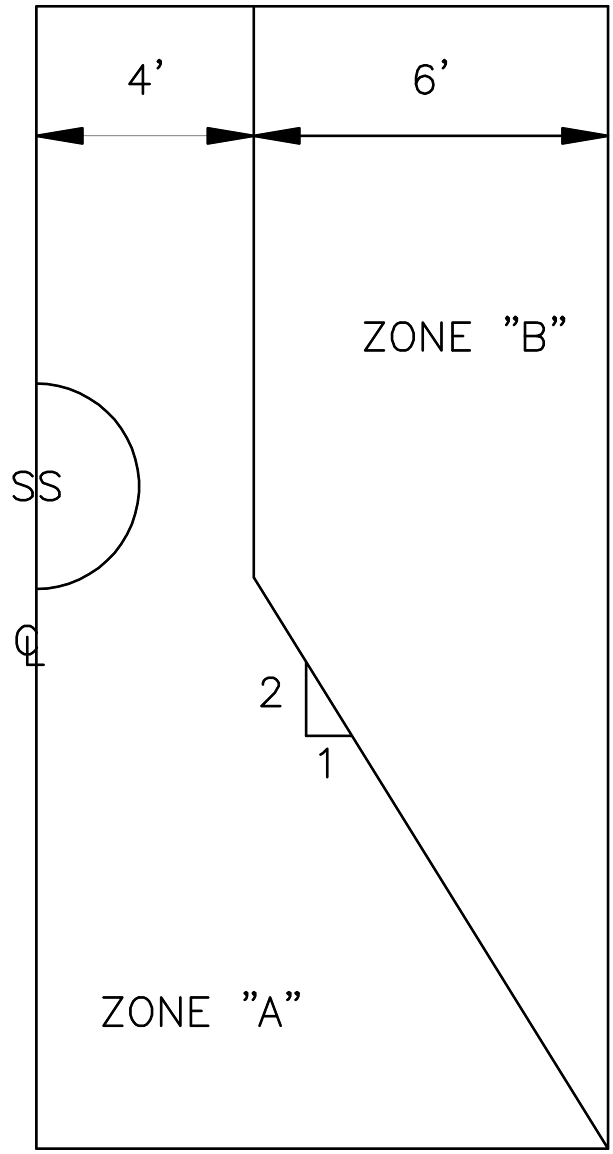

NOTES:

1) PARALLEL CONSTRUCTION WILL BE ALLOWED ONLY WHEN TEN FEET (10') SEPARATION BETWEEN SEWER AND WATER MAINS CANNOT BE MAINTAINED.

2) WATER MAIN INSTALLATION IN ZONE "A" IS PROHIBITED.

3) PARALLEL WATER MAIN INSTALLATION IN ZONE "B" MUST BE A.W.W.A. C900 CLASS 200, OR A.W.W.A. C150 D.I.P. CLASS 350.

A
1

TRENCH SECTION FOR PARALLEL CONSTRUCTION

NO SCALE

SHEET:	FILE:	DRAWN:	SCALE:	DATE:		
S6-D4	STANDARDS	MAM	NO SCALE	JAN 2009	TRENCH AND PAVEMENT DETAILS	SOUTH TAHOE PUBLIC UTILITY DISTRICT

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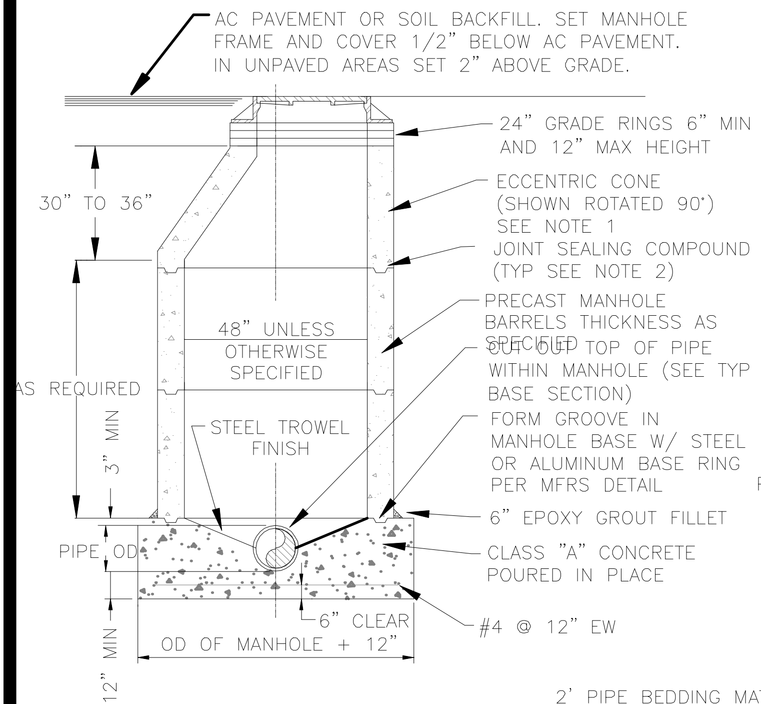
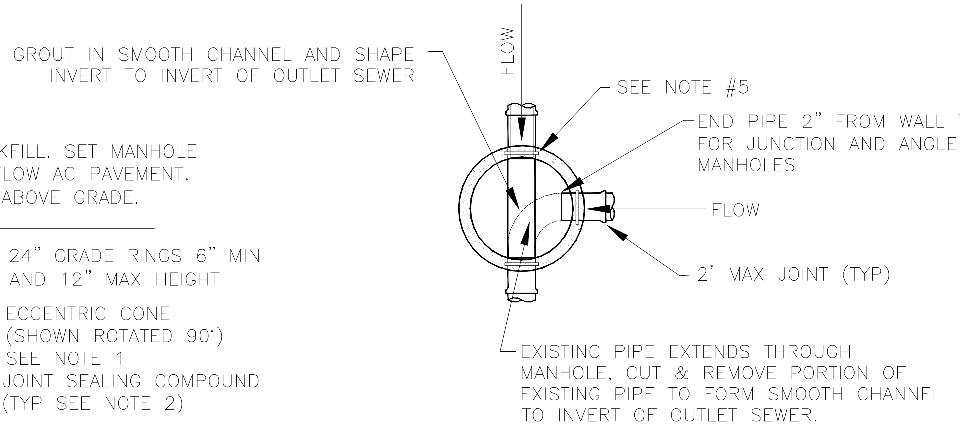
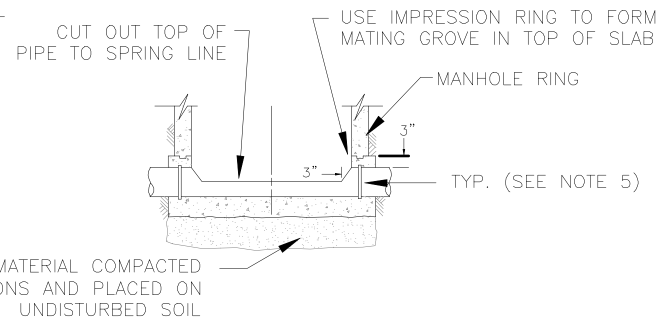




BRANCH INLET – TYPICAL SECTION

NO SCALE



MANHOLE BASE – TYPICAL SECTION

NO SCALE

NOTES:

1) LOCATE MANHOLE COVER ON DOWNSTREAM SIDE OF MANHOLE. TWENTY FOUR INCH (24") MANHOLE FRAME AND COVER TO BE SUPPLIED BY DISTRICT.

2) JOINT SEALING COMPOUND SHALL BE: "RAM-NEK" BY K.T. SNYDER COMPANY; OR APPROVED EQUAL.

3) FOR SHALLOW MANHOLES, THE CONTRACTOR SHALL SUBSTITUTE A PRE CAST CONCRETE MANHOLE CAP, DESIGNED FOR H-20 TRAFFIC LOADING, IN LIEU OF THE ECCENTRIC CONE. THE TWENTY FOUR INCH (24") OPENING SHALL BE LOCATED IN THE CENTER OF THE MANHOLE CAP. PROVIDE A DESIGN SUBMITTAL, PREPARED AND SEALED BY A QUALIFIED REGISTERED ENGINEER, DEMONSTRATING COMPLIANCE WITH REQUIRED LOADING CRITERIA.

4) FOR MANHOLE PENETRATIONS MAKE TRANSITION FROM DIFFERING PIPE MATERIALS AT THE CENTER OF THE MANHOLE, PROVIDING A TWELVE INCH (12") LONG "U" SHAPED OPEN CHANNEL TRANSITION SECTION OF HAND FORMED CONCRETE TO PROVIDE A UNIFORM TRANSITION BETWEEN THE TWO PIPE MATERIALS.

5) ALL MANHOLE PIPE PENETRATIONS SHALL BE PROVIDED WITH A FLANGE OR OTHER SUBSTANTIAL DEVICE WELDED ONTO OR CAST INTEGRALLY WITH THE PIPE. SUCH DEVICE SHALL BE SUBJECT TO THE ENGINEER'S REVIEW AND SHALL BE ADEQUATE TO RESTRAIN LATERAL MOVEMENT DUE TO TEMPERATURE DIFFERENTIALS IN THE PIPE. FOR MANHOLES WITH PVC PIPE CONNECTIONS, FOR A WATERTIGHT SEAL TO BE ACHIEVED THE CONTRACTOR SHALL UTILIZE A FLEXIBLE ELASTOMERIC GASKET MATERIAL CAPABLE OF ACCOMMODATING THE DIFFERENTIAL THERMAL EXPANSION AND CONTRACTION BETWEEN THE CONCRETE AND PVC PIPE.

6) BASE OF MANHOLE SHOULD BE SMOOTH BE SMOOTH AND CONTOURED TO SLOPE TOWARDS PIPE.

A
1

MANHOLE

NO SCALE

SHEET: S7-D1
FILE: STANDARDS
DRAWN: MAM
SCALE: NO SCALE
DATE: JAN 2009

SEWER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT
Sewer . 1950 . Water A PUBLIC AGENCY
1275 Meadow Crest Drive South Lake Tahoe, California 96150
Phone (530) 544-6474 Fax (530) 541-4319
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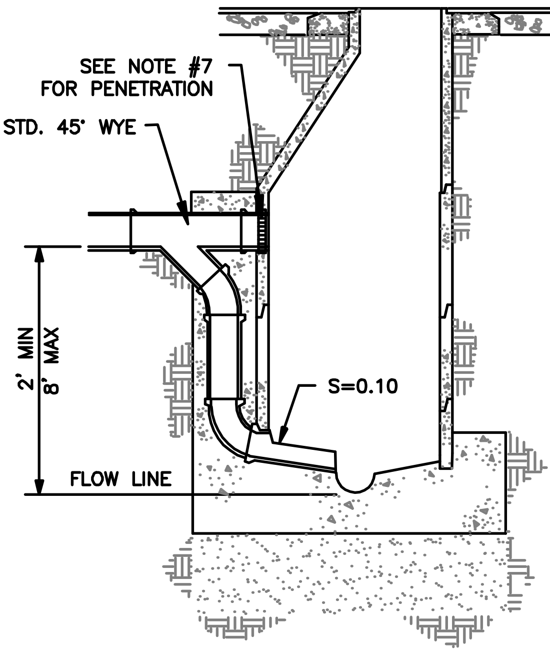
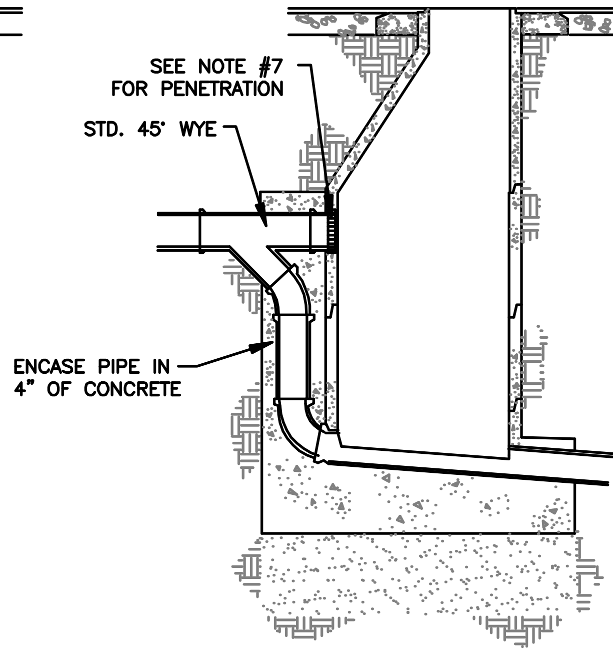


LATERAL TO MAIN



MAIN TO MAIN

NOTES:

1) DROP MANHOLES ARE TO BE USED ON ALL SANITARY SEWERS WITH MORE THAN TWO FEET (2') VERTICAL DROP AT MANHOLE. DROP SHALL NOT EXCEED EIGHT FEET (8') AT ANY MANHOLE.

2) MAINS SHALL BE SLOPED TO FALL AT LEAST ONE TENTH OF A FOOT (0.1') ACROSS MANHOLE SECTIONS.

3) ALL OTHER DIMENSIONS, NOTES AND REQUIREMENTS AS SHOWN ON STANDARD MANHOLE DETAIL SHALL APPLY TO DROP MANHOLES.

4) DIMENSIONS NOT SHOWN ARE GIVEN ON STANDARD MANHOLE DETAIL.

5) ALL JOINTS AND CONNECTIONS TO NEW OR EXISTING MANHOLES SHALL BE WATERTIGHT.

6) ALL JOINTS SHALL BE SEALED WITH: "RAM-NEK" BY K.T. SNYDER COMPANY OR APPROVED EQUAL.

7) PENETRATIONS AT WYE SHALL HAVE LINKSEAL OR APPROVED EQUAL; PENETRATION SHALL BE TROWEL SMOOTH INSIDE AND OUT WITH NON-SHRINK GROUT OVER LINKSEAL.

A
1

DROP MANHOLE

NO SCALE

SHEET: S7-D2	FILE: STANDARDS	DRAWN: MAM	SCALE: NO SCALE	DATE: JAN 2009	**SEWER DETAILS**	SOUTH TAHOE PUBLIC UTILITY DISTRICT

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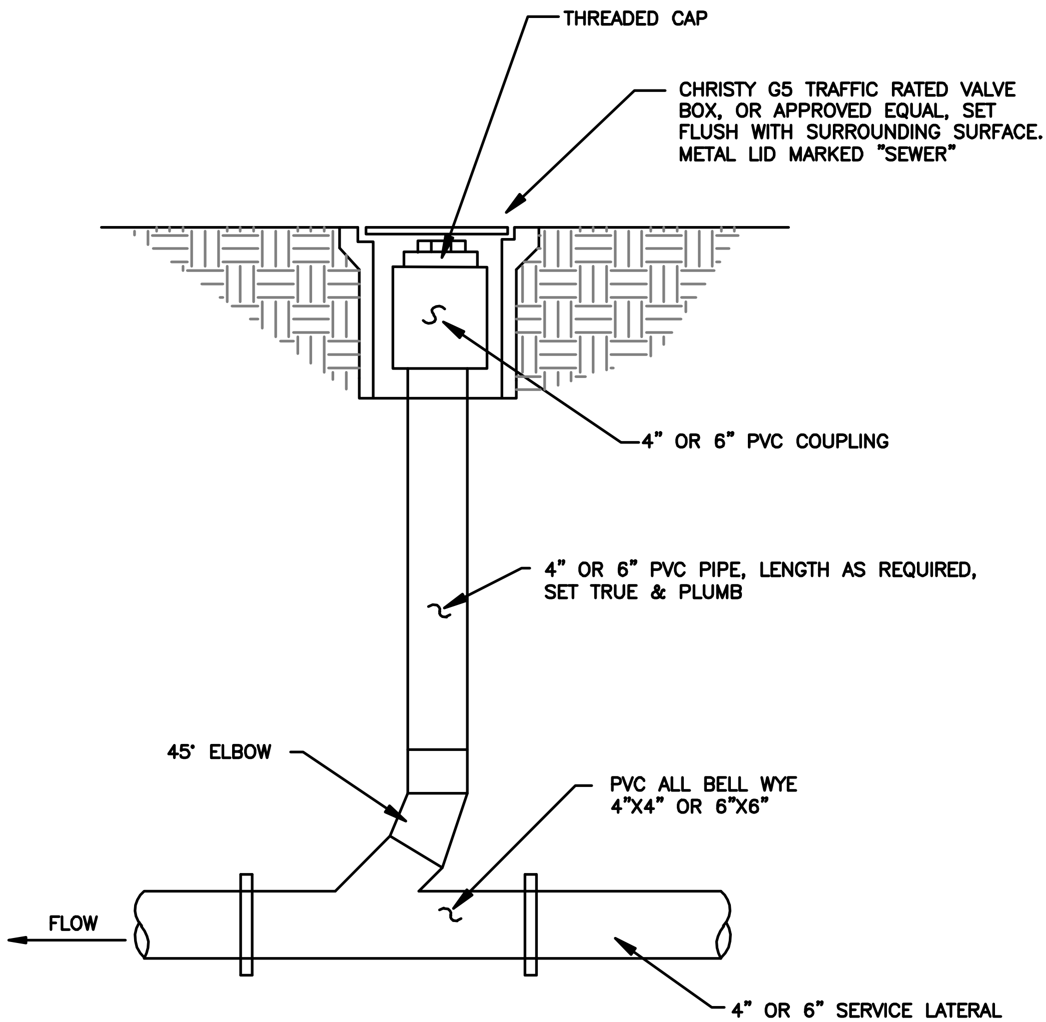

A
1

SEWER CLEAN OUT

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S7-D3

SEWER DETAILS

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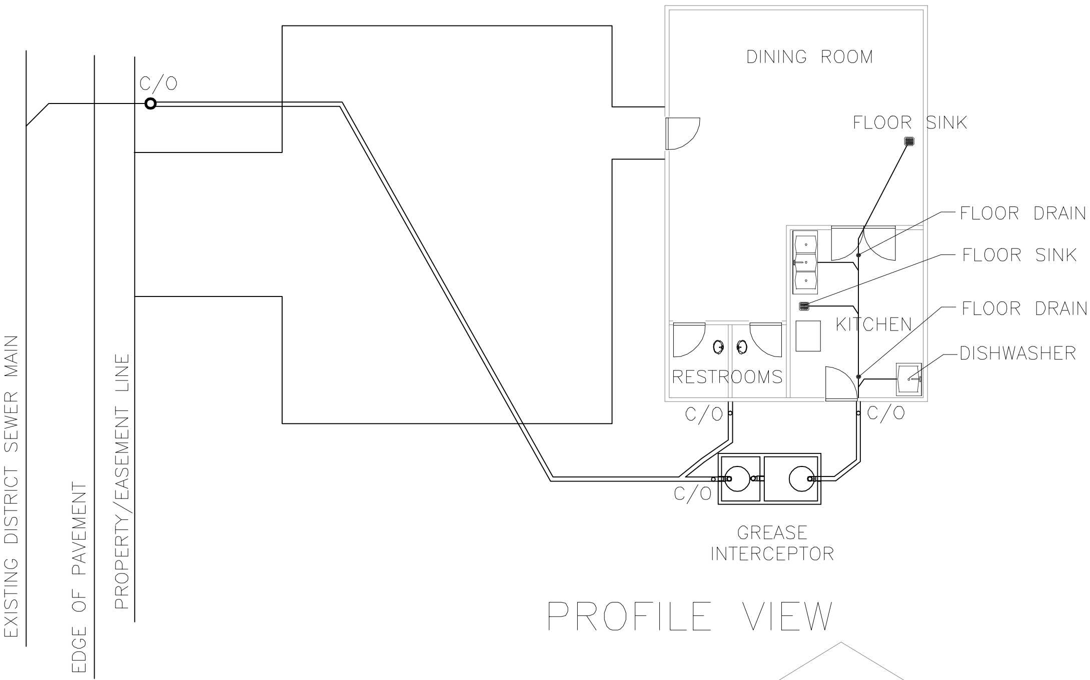
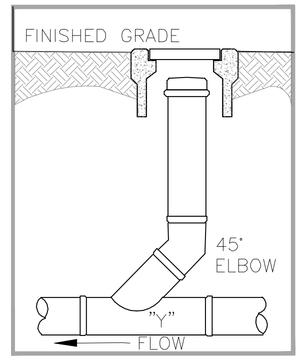
PLAN VIEW



DETAIL



PROFILE VIEW

NOTES:

1) GREASE INTERCEPTOR SHOULD BE LOCATED NEAR WASTE SOURCE AND MUST BE EASILY ACCESSIBLE FOR INSPECTION AND CLEANING.

2) MANHOLE COVERS TO BE EXTENDED TO GRADE RISERS AND FRAME TO BE SEALED WITH "RAM-NEK" OR APPROVED EQUAL.

3) ALL PIPING IMMEDIATELY OUTSIDE OF THE BUILDING SHALL NOT BE LESS THAN FOUR INCHES (4").

4) CLEANOUTS ARE REQUIRED AT BUILDING STUBOUT AND IMMEDIATELY DOWNSTREAM OF THE INTERCEPTOR.

5) ALL PIPING INSTALLATION MUST MEET THE CURRENT DISTRICT REQUIREMENT FOR BUILDING SEWER HOOKUP.

6) INTERCEPTOR SHALL BE PLACED ON A COMPACTED BASE IF DETERMINED BY THE DISTRICT, FIRM DRY MATERIAL WILL BE REQUIRED.

A
1

GREASE INTERCEPTOR INSTALLATION

NO SCALE

SHEET: S7-D4	FILE: STANDARDS	DRAWN: MAM	SCALE: NO SCALE	DATE: JAN 2009	**SEWER DETAILS**

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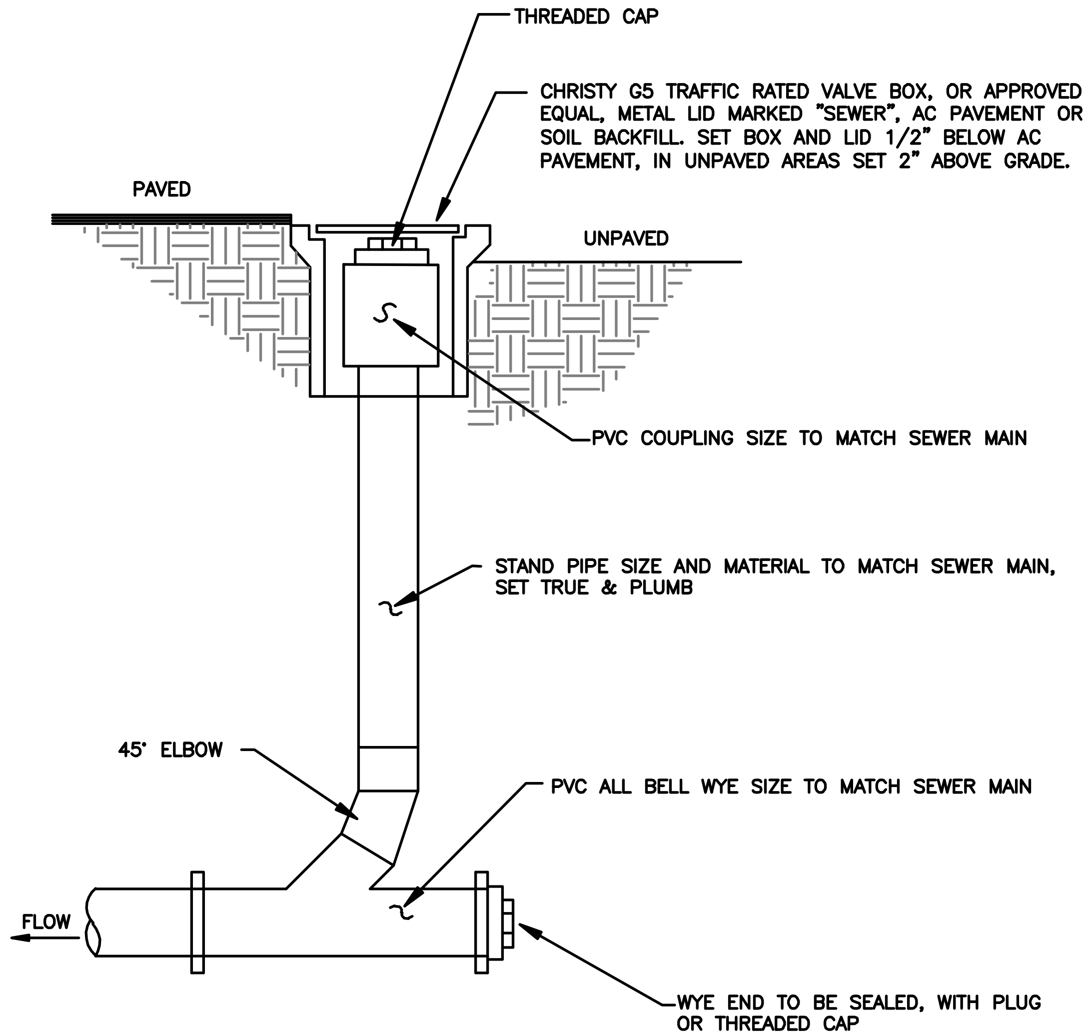

A
1

SEWER MAIN FLUSH INLET

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S7-D5

SEWER DETAILS

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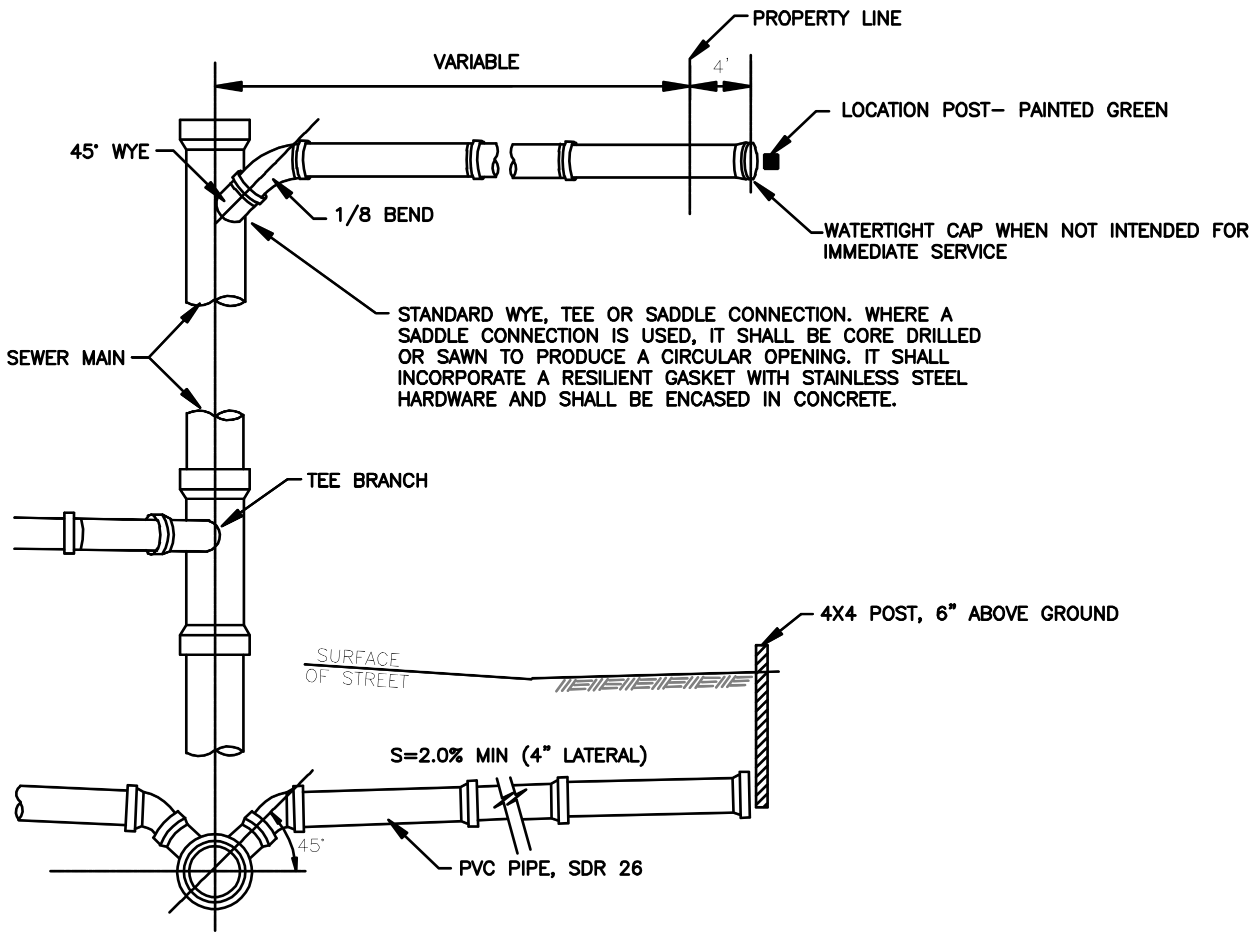

NOTES:

1) ALL JOINTS AND CONNECTIONS SHALL BE WATERTIGHT.

2) ALL BUILDING SEWERS SHALL HAVE A MINIMUM GROUND COVER OF THREE FEET (3') OVER THE TOP OF PIPE.

3) ALL LATERALS SIX INCHES (6") AND LARGER SHALL BE CONNECTED TO SEWER MAIN USING A STANDARD MANHOLE.

A
1

SEWER LATERAL CONNECTION

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S7-D6

SEWER DETAILS

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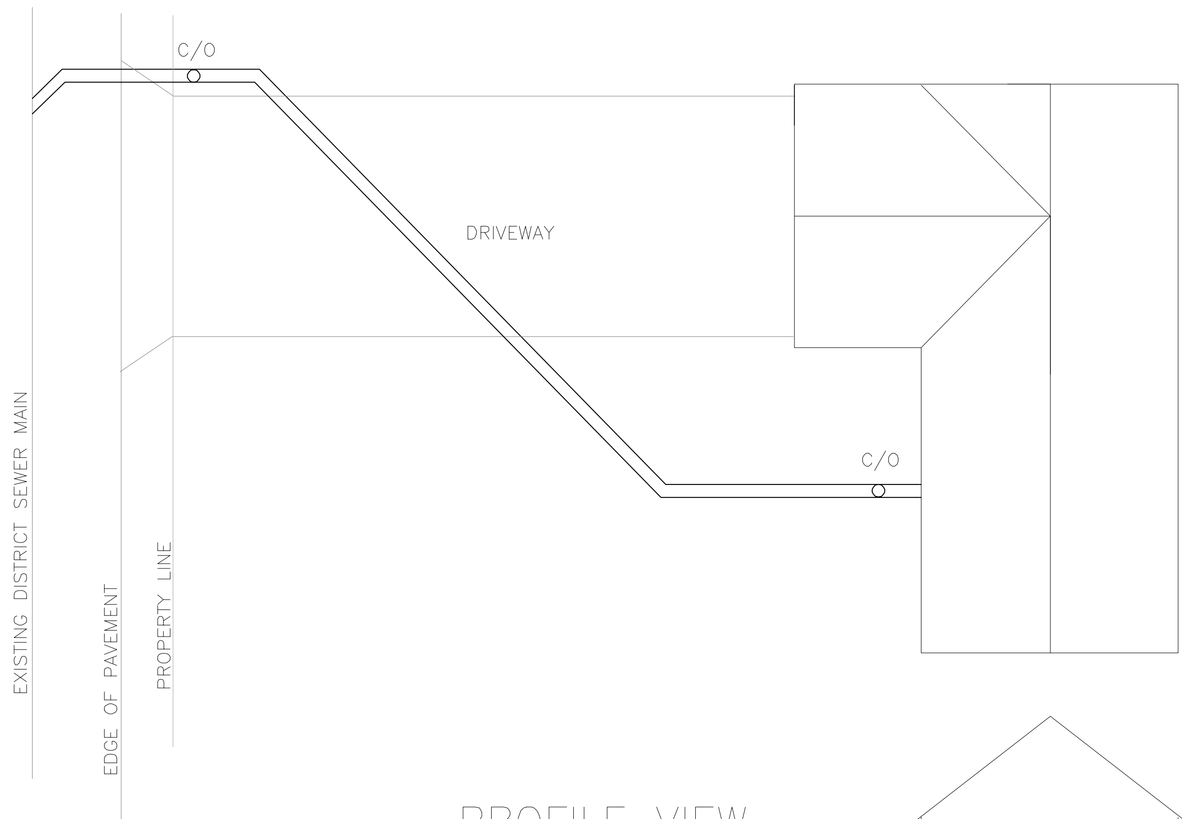
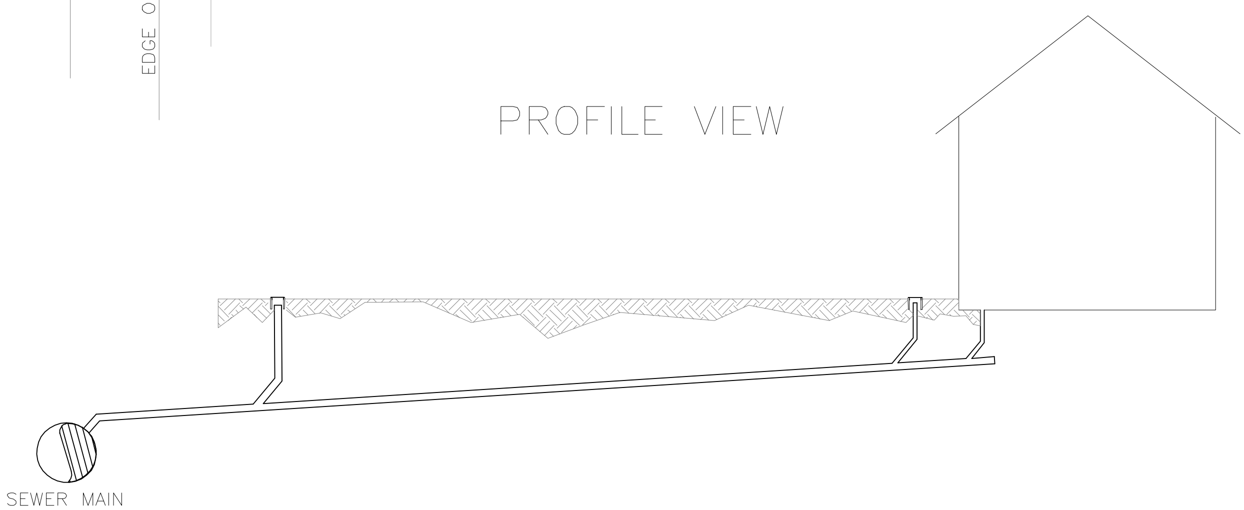
PLAN VIEW



PROFILE VIEW



NOTE:

1) ALL CLEANOUTS (C/O) AT THE PROPERTY LINE TO BE BROUGHT TO GRADE AND SET IN CHRISTY G5 TRAFFIC RATED VALVE BOX, OR APPROVED EQUAL, SET FLUSH WITH SURROUNDING SURFACE. METAL LID MARKED "SEWER".

SEWER LATERAL INSTALLATION

A
1

NO SCALE

SHEET:	FILE:	DRAWN:	SCALE:	DATE:
S7-D7	STANDARDS	MAM	NO SCALE	JAN 2009

SEWER DETAILS

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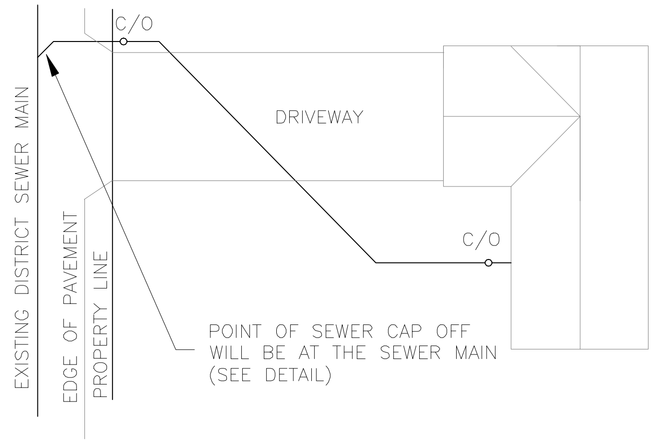
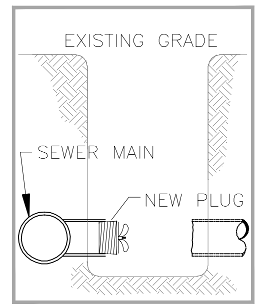
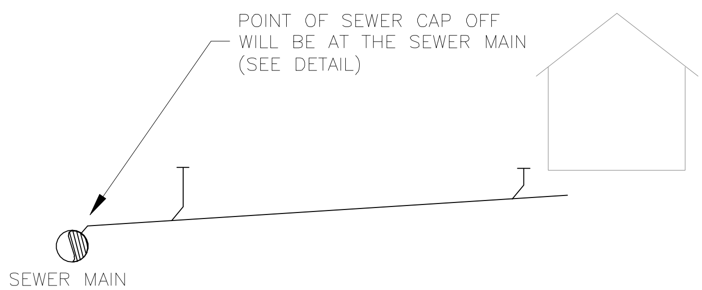
PLAN VIEW



DETAIL



PROFILE VIEW



NOTES:

1) UNDERGROUND SERVICE ALERT (USA) 811 TO BE NOTIFIED A MINIMUM OF 48 HOURS BEFORE ANY EXCAVATION.

2) ALL LATERAL(S) TO BE ABANDONED SHALL BE FIELD MARKED BY DISTRICT INSPECTORS.

3) DO NOT DEMOLISH ANY BUILDING UNTIL LATERAL ABANDONMENT LOCATION FOR THAT BUILDING IS EXCAVATED AN CONFIRMED.

4) LATERAL(S) WILL BE CAPPED AT THE COLLECTION SYSTEM MAIN. FINAL CAP OFF LOCATION SHALL BE FIELD VERIFIED AND APPROVED BY THE DISTRICT.

5) LATERAL(S) MUST BE SEVERED AT THE ABANDONMENT POINT IN A WORKMANSHIP LIKE MANNER APPROPRIATE FOR THE TYPE OF PIPE TO BE CAPPED. A MINIMUM OF SIX FEET (6') OF PIPING UPSTREAM OF THE ABANDONMENT POINT SHALL BE REMOVED.

6) THE PLUGGING OF SEVERED LATERAL(S) MUST BE MADE WITH A NEW RUBBER TEST PLUG APPROPRIATE FOR THAT SIZE LATERAL

7) NO WORK SHALL BE COVERED UNTIL INSPECTED AND APPROVED BY THE DISTRICT.

8) THE DISTRICT SHALL BE GIVEN A MINIMUM OF A ONE WORKING DAY NOTICE TO INSPECT ALL WORK ASSOCIATED WITH THE CAPPING OF LATERAL(S).

A
1

SEWER LATERAL ABANDONMENT

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S7-D8

SEWER DETAILS

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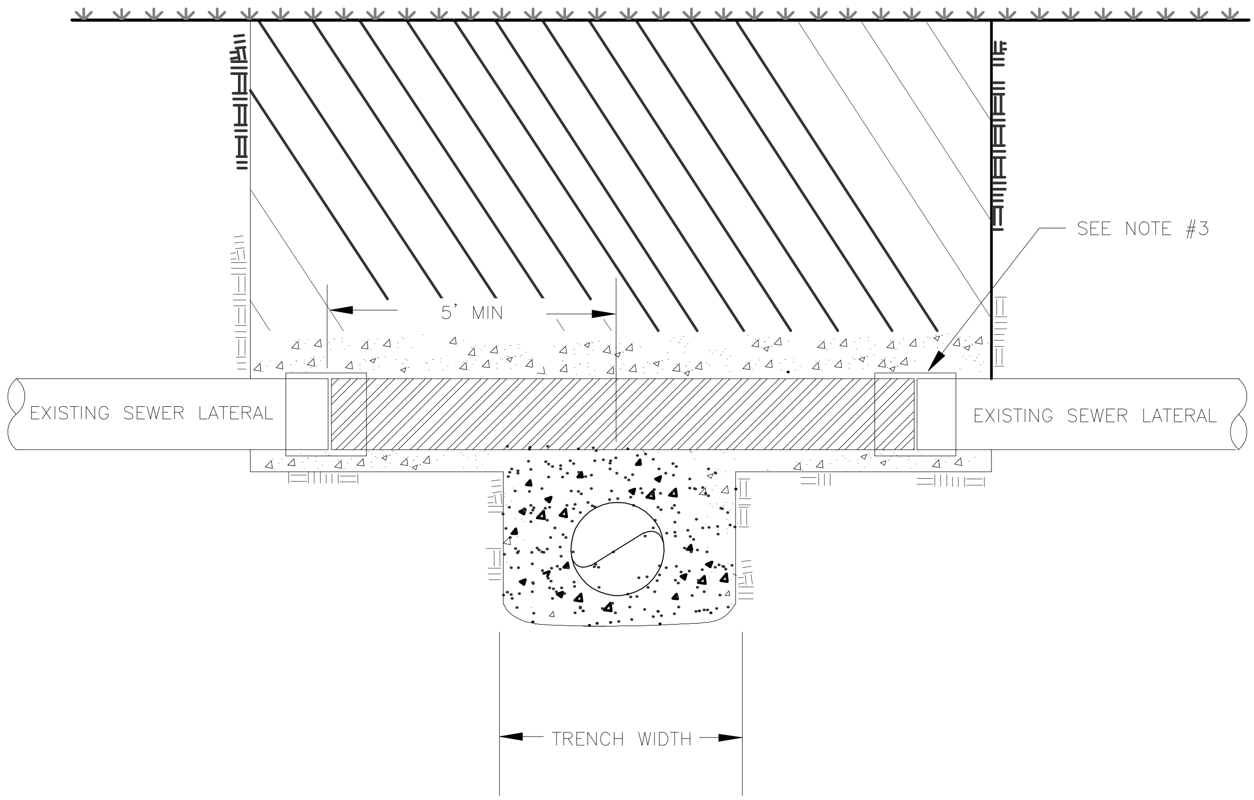

NOTES:

1) WHERE NEW WATERLINE CROSSES EXISTING SEWER LATERALS AND THE SEWER LATERAL IS DAMAGED DURING CONSTRUCTION, THE LATERAL SHALL BE CUT AND REPLACED FOR A DISTANCE OF AT LEAST FIVE FEET (5') ON EACH SIDE OF THE POINT OF CROSSING.

2) ALL SEWER LATERAL REPLACEMENT PIPING SHALL BE PVC SDR 26 UNLESS NOTED OR APPROVED BY THE ENGINEER.

3) ALL COUPLING, ADAPTERS AND MATERIALS USED TO CONNECT PVC SDR 26 PIPING TO OTHER PIPE MATERIALS SHALL BE AS RECOMMENDED BY THE PIPE MANUFACTURE AND APPROVED BY THE DISTRICT.

4) ALL SEWER LATERAL REPAIRS SHALL BE BACKFILLED WITH COMPACTED OR JETTED CLASS 2 AGGREGATE BASE MATERIAL AS REQUIRED BY THE ENGINEER.

SEWER LATERAL REPLACEMENT AT CROSSING OF PIPE TRENCH

A
1

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S7-D9

SEWER DETAILS

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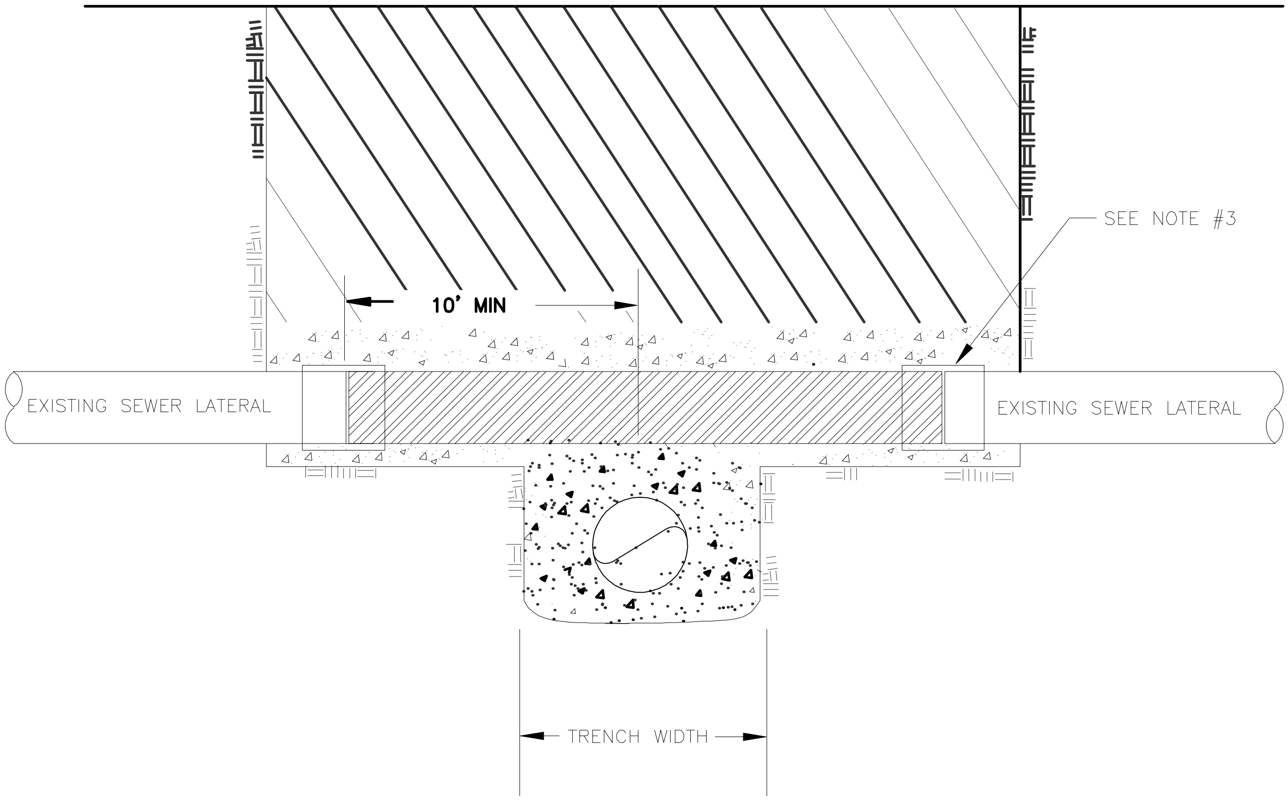

NOTES:

1) WHERE NEW WATERLINE CROSSES EXISTING SEWER FORCE MAIN. THE FORCE MAIN SHALL BE CUT AND REPLACED FOR A DISTANCE OF AT LEAST TEN FEET (10') ON EACH SIDE OF THE POINT OF CROSSING.

2) FORCE MAIN REPLACEMENT PIPING SHALL BE PVC C900 UNLESS OTHERWISE NOTED OR APPROVED BY THE ENGINEER.

3) ALL COUPLING, ADAPTERS AND MATERIALS USED TO CONNECT PVC C900 PIPING SHALL BE AS RECOMMENDED BY THE PIPE MANUFACTURE AND APPROVED BY THE DISTRICT.

SEWER FORCE MAIN REPLACEMENT AT CROSSING OF PIPE TRENCH

A
1

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S7-D10

SEWER DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

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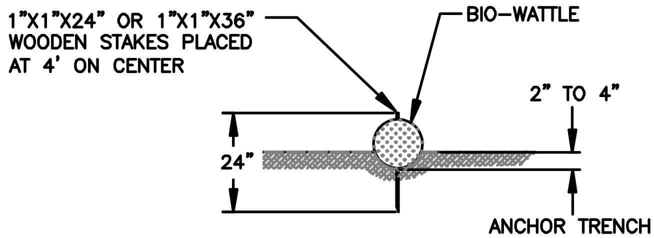
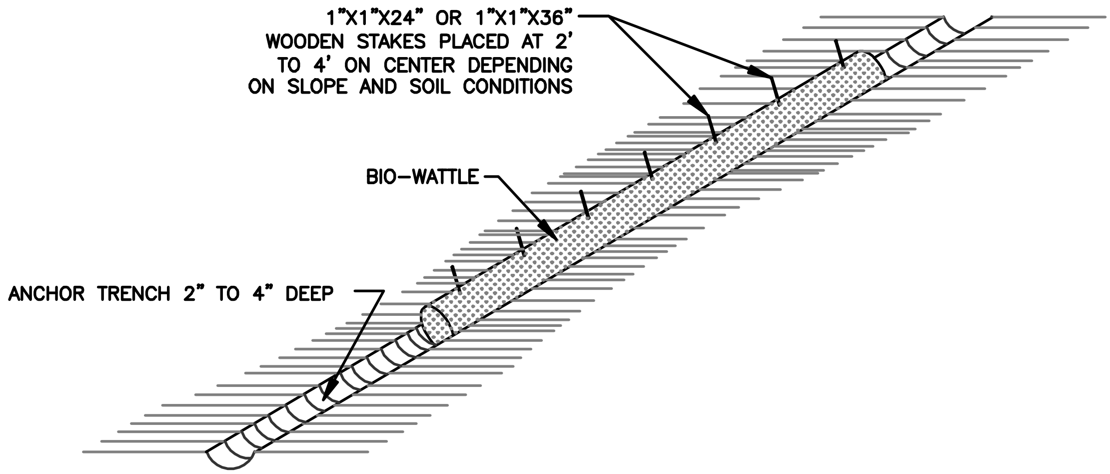
EMBEDDING DETAIL



ANCHORING DETAIL



NOTE:

1) SEDIMENT CONTROL BARRIERS USED ON SLOPES, AS CHECK DAMS OR AS SEDIMENT TRAPS SHALL BE BIO-WATTLES AS DISTRIBUTED BY BON-TERRA AMERICA INC. OR APPROVED EQUAL AND INSTALLED AS RECOMMENDED BY THE MANUFACTURE.

A
1

COIR LOG PLACEMENT

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S8-D1

BMP DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT
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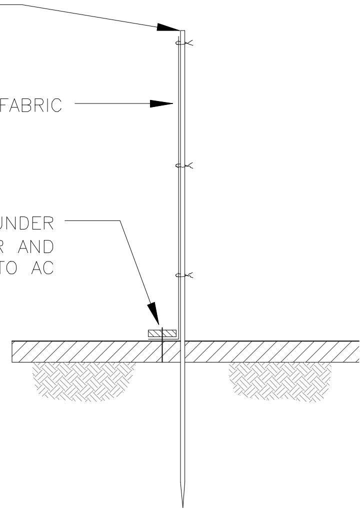
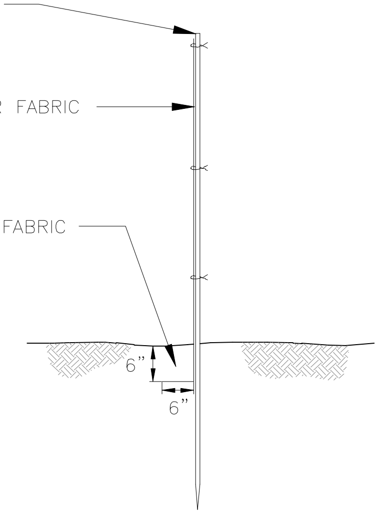
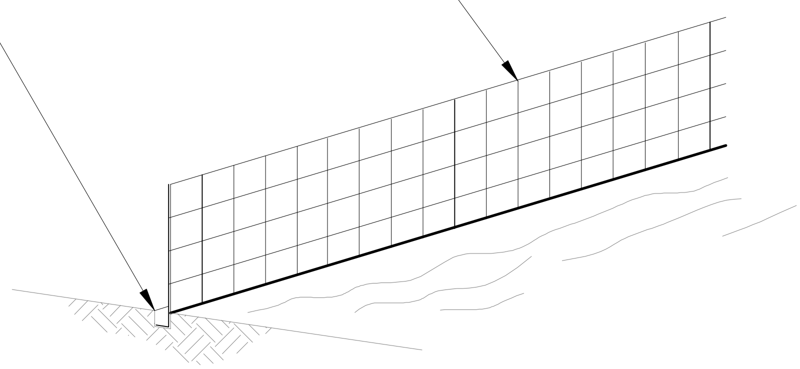


FENCE IN PAVEMENT SECTION



FENCE IN NATIVE SOIL



NOTE:

1) PLACE FENCING SUCH THAT STORM RUNOFF CANNOT PASS UNDER OR AROUND.

A
1

FILTER FABRIC FENCE

NO SCALE

SHEET: S8-D2	FILE: STANDARDS	DRAWN: MAM	SCALE: NO SCALE	DATE: JAN 2009	**BMP DETAILS**

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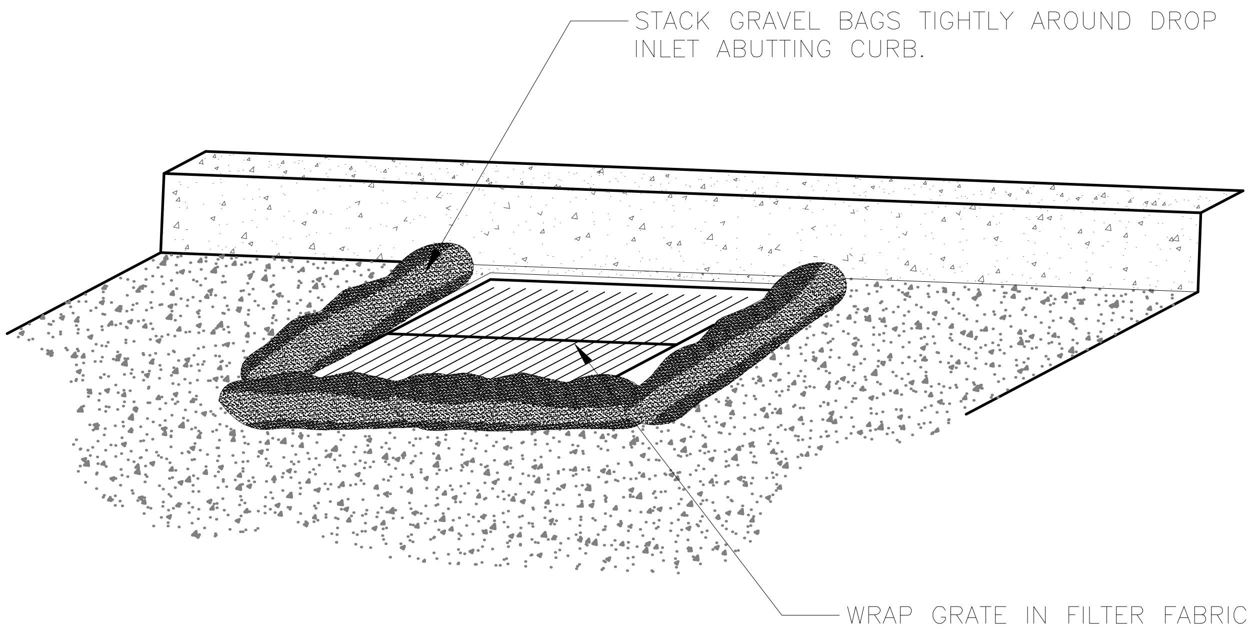
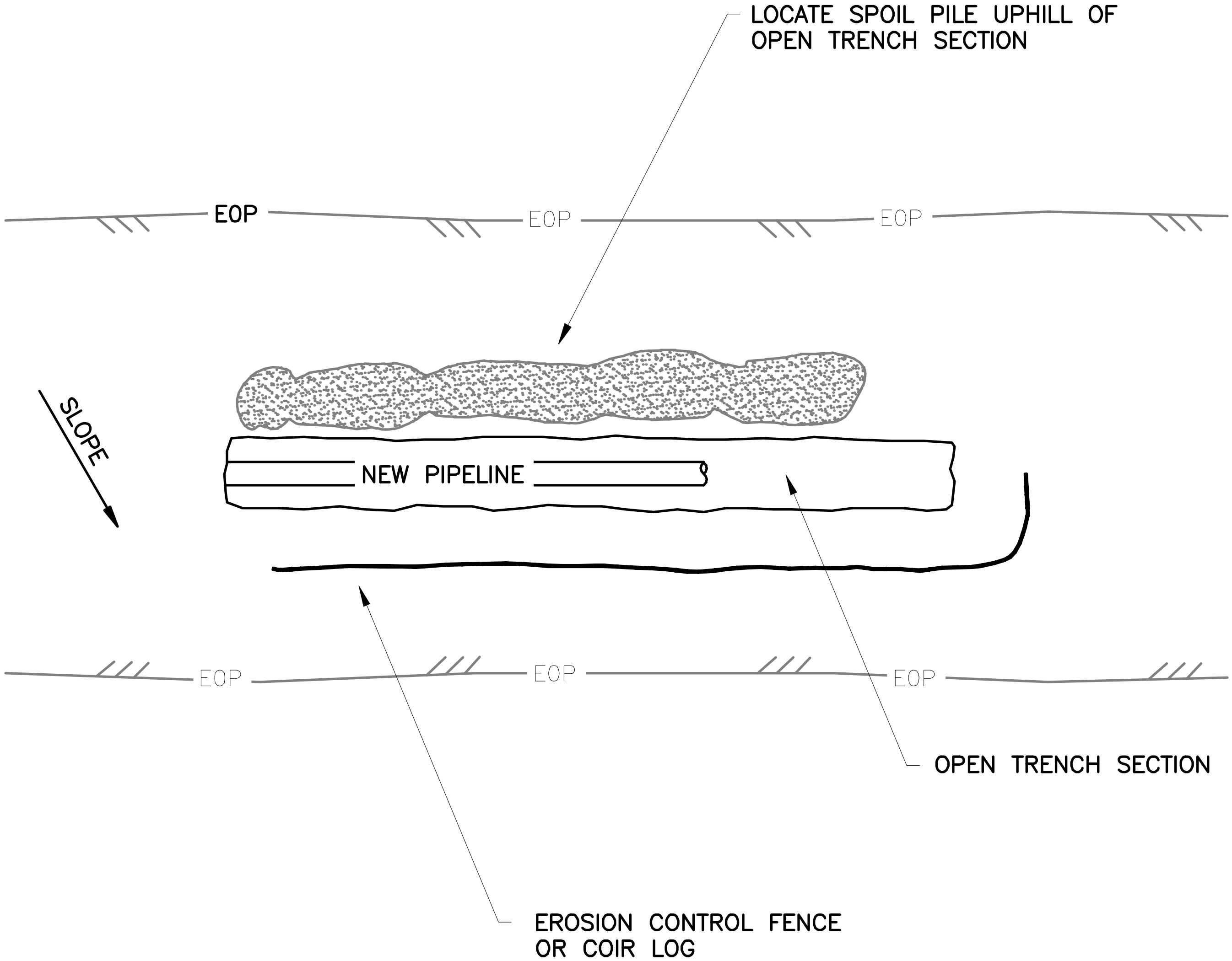


DRAINAGE INLET SEDIMENT PROTECTION

A
1

NO SCALE

SHEET: S8-D3	FILE: STANDARDS	DRAWN: MAM	SCALE: NO SCALE	DATE: JAN 2009	**BMP DETAILS**	SOUTH TAHOE PUBLIC UTILITY DISTRICT Sewer . 1950 . Water A PUBLIC AGENCY 1275 Meadow Crest Drive South Lake Tahoe, California 96150 Phone (530) 544-6474 Fax (530) 541-4319 WWW.STPUD.US



NOTE:

1) RELOCATE EROSION CONTROL FENCE/COIR LOG AS CONSTRUCTION PROGRESSES

A
1
TYPICAL OPEN TRENCH SECTION

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S8-D4

BMP DETAILS

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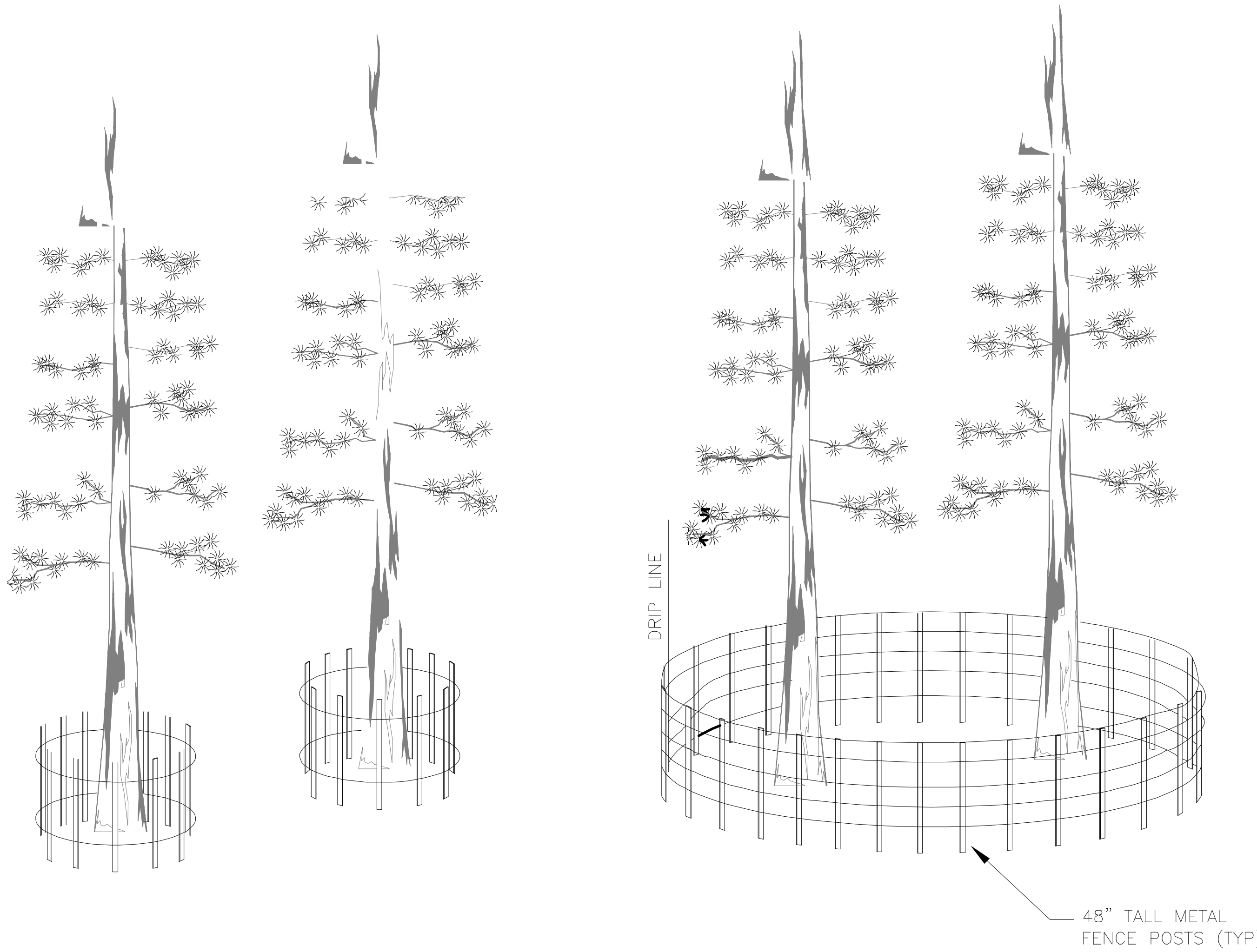

INCORRECT

CORRECT

NOTES:

1) PLACING ANY MATERIAL —TEMPORARY OR OTHERWISE— WITHIN PROTECTIVE FENCING OR ENTERING PROTECTION AREAS MAY RESULT IN A FINE. (TRPA SEC. 65.2.1 I AND J)

2) FORTY EIGHT INCH (48") ORANGE PLASTIC FENCING TYPICAL, METAL OR WIRE MESH FENCING MAY BE REQUIRED PER TRPA.

A/1 VEGETATION PROTECTION FENCING

NO SCALE

DATE:	SCALE:	DRAWN:	FILE:	SHEET:
JAN 2009	NO SCALE	MAM	STANDARDS	S8-D5

BMP DETAILS

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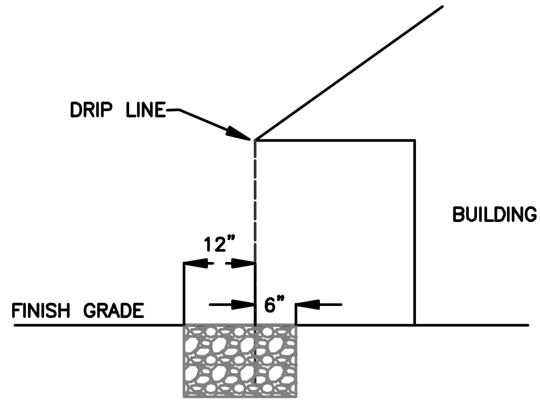
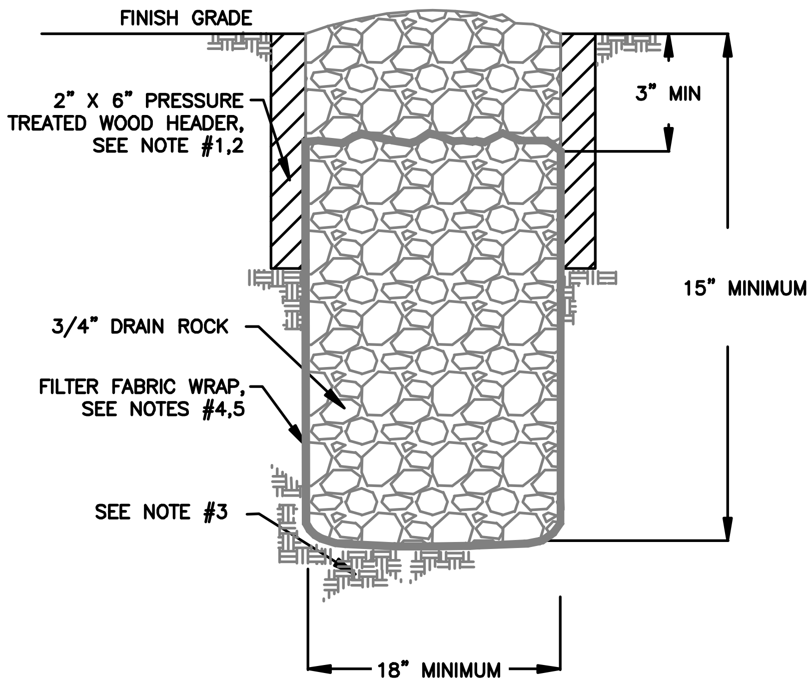


SEE NOTE #6
DETAIL A



NOTES:

1) WOOD HEADER NOT REQUIRED ON ONE SIDE, IF THAT SIDE OF THE TRENCH IS IN CONTACT WITH A FOOTING, FOUNDATION, STRUCTURE THAT WILL HOLD THE DRAIN ROCK IN PLACE.

2) WOOD HEADER SHALL BE STAKED A MINIMUM EVERY THREE FEET (3'). STAKES AND BRACING SHALL NOT BE IN TRENCH.

3) NO COMPACTION REQUIRED BELOW TRENCH BEYOND WHAT IS NECESSARY TO STABILIZE THE TRENCH SIDEWALLS.

4) FILTER FABRIC SHALL BE NON-WOVEN, HAVE A MINIMUM OF FOUR OUNCE PER SQUARE YARD ($4oz/yd^2$) WEIGHT AND SHALL CONFORM TO ASTM D-4751, D-4355 AND D-4491.

5) FILTER FABRIC SHALL LINE TRENCH TO THREE INCHES (3") BELOW FINISH GRADE, BE OVERLAPPED A MINIMUM OF SIX INCHES (6") AND HAVE MINIMUM THREE INCHES (3") OF DRAIN ROCK PLACED OVER THE TOP OF THE WRAP.

6) IF THE INFILTRATION TRENCH IS TO BE USED AS A DRIP LINE TRENCH THEN USE THE ALIGNMENT DETAIL A.

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INFILTRATION TRENCH

NO SCALE

SHEET: S8-D6	FILE: STANDARDS	DRAWN: MAM	SCALE: NO SCALE	DATE: JAN 2009	BMP DETAILS

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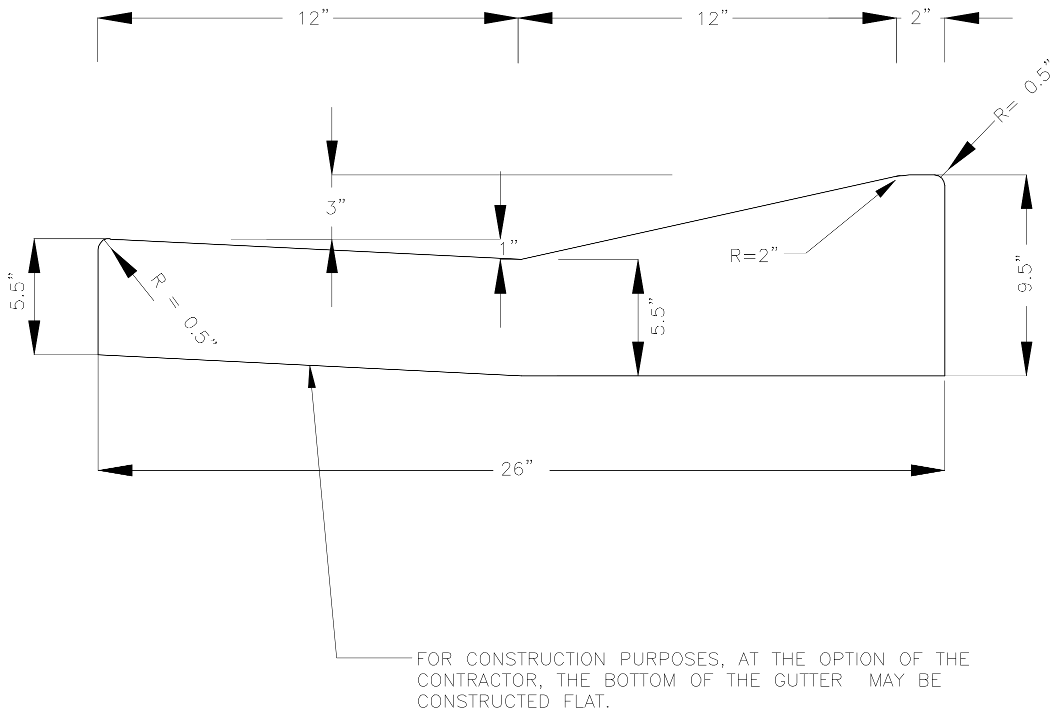

NOTES:

1) LOCATE 1/2" PREMOLDED TRANSVERSE EXPANSION JOINTS OF ASPHALT IMPREGNATED CELOTEX IN CURB AND GUTTER AT 20' INTERVALS.

2) CONCRETE TO CONFORM TO SPECIFICATIONS (WITH 6% AIR ENTRAINMENT).

3) THE MATERIALS AND METHOD OF PLACEMENT SHALL CONFORM TO THE SPECIFICATIONS UNDER SECTION COVERING CONCRETE PLACEMENT.

4) CURB AND GUTTER SHALL BE SPRAYED UNIFORMLY WITH A CLEAR PIGMENTED CURING COMPOUND, THE MATERIAL, METHOD AND RATE OF APPLICATION SHALL CONFORM TO THE SPECIFICATIONS.

5) ALL CURB AND GUTTER SHALL BE WATER TESTED.

6) REPLACEMENT OF ASPHALT CURB AND GUTTERS SHALL MATCH THE CONFIGURATION OF THE EXISTING FACILITIES.

A
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ROLLED CURB SECTION

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S9-D1

MISC DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

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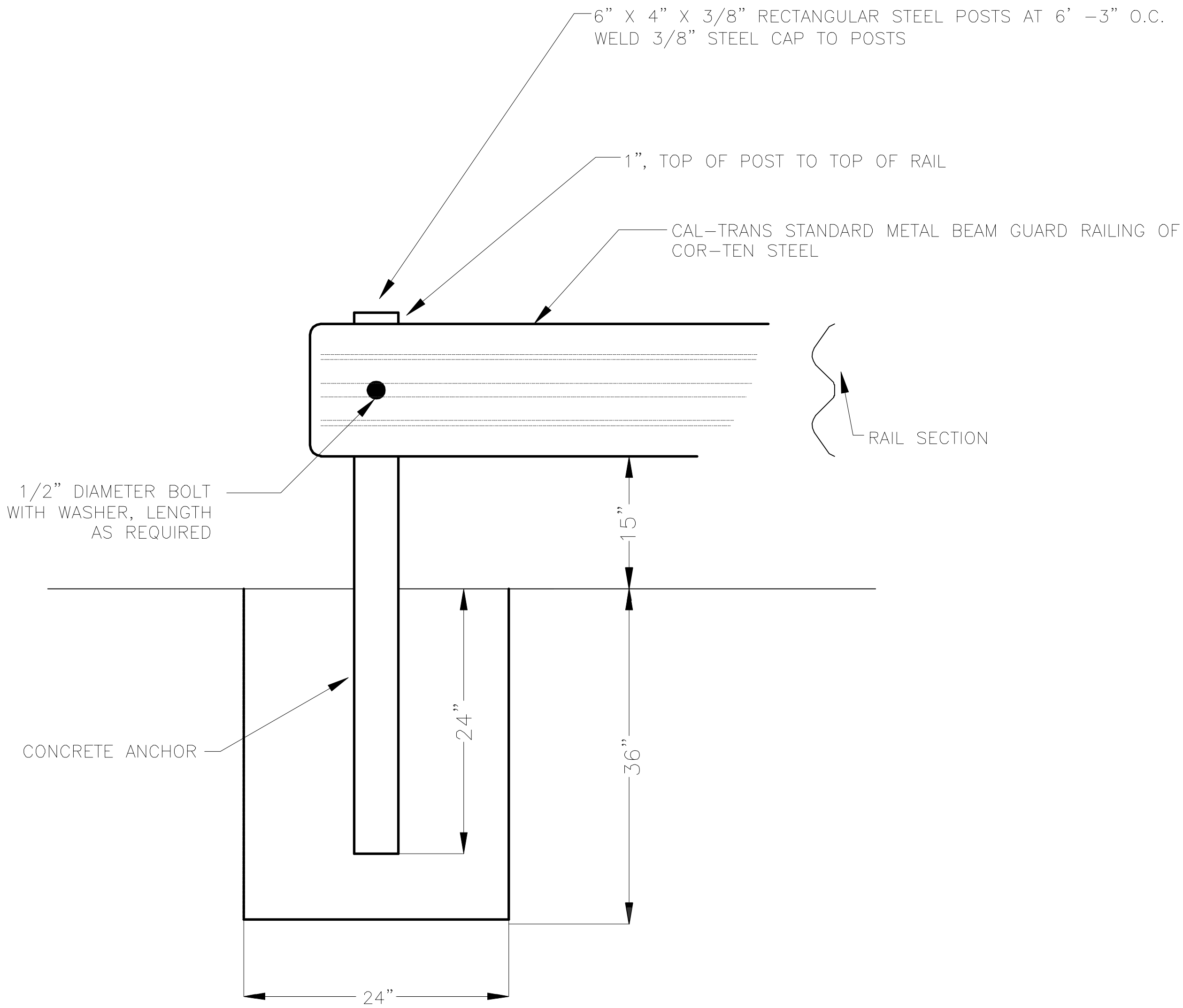

NOTES:

1) WELD TWO INCH (2") DIA X TWO INCH (2") THREADED STEEL NIPPLE ON POST CAPS AT ENDS AND EACH THIRD POST.

2) PROVIDE ROUNDED END SECTION FOR GUARD RAIL. PROVIDE SHOP DRAWING OF THIS AND PROPOSED RAILING.

3) PROVIDE RAIL SPLICES IN ACCORDANCE WITH CAL-TRANS STANDARD PLAN A77A,

A
1

VEHICLE BARRIER

NO SCALE

SHEET: S9-D2	FILE: STANDARDS	DRAWN: MAM	SCALE: NO SCALE	DATE: JAN 2009

MISC DETAILS

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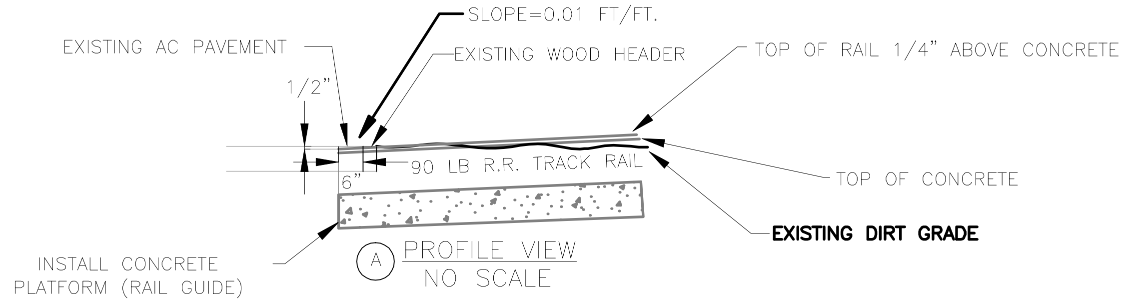

PROFILE VIEW
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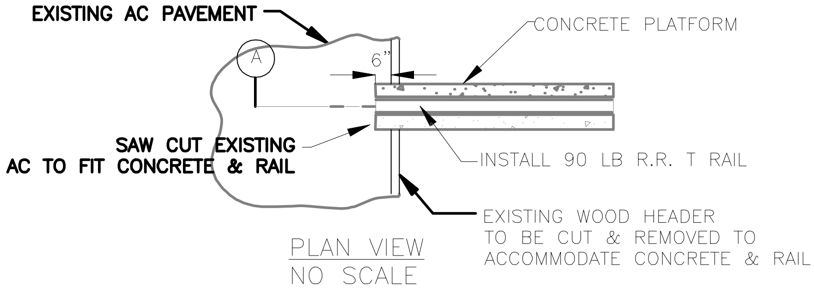

PLAN VIEW
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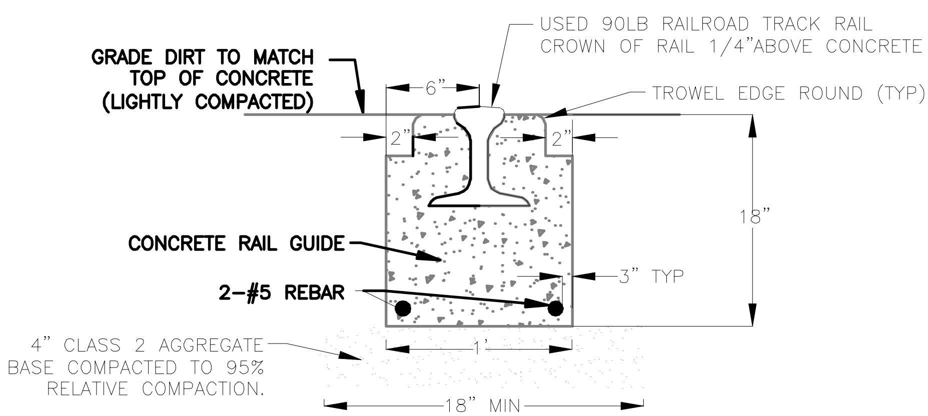


RAILROAD TRACK RAIL
END VIEW

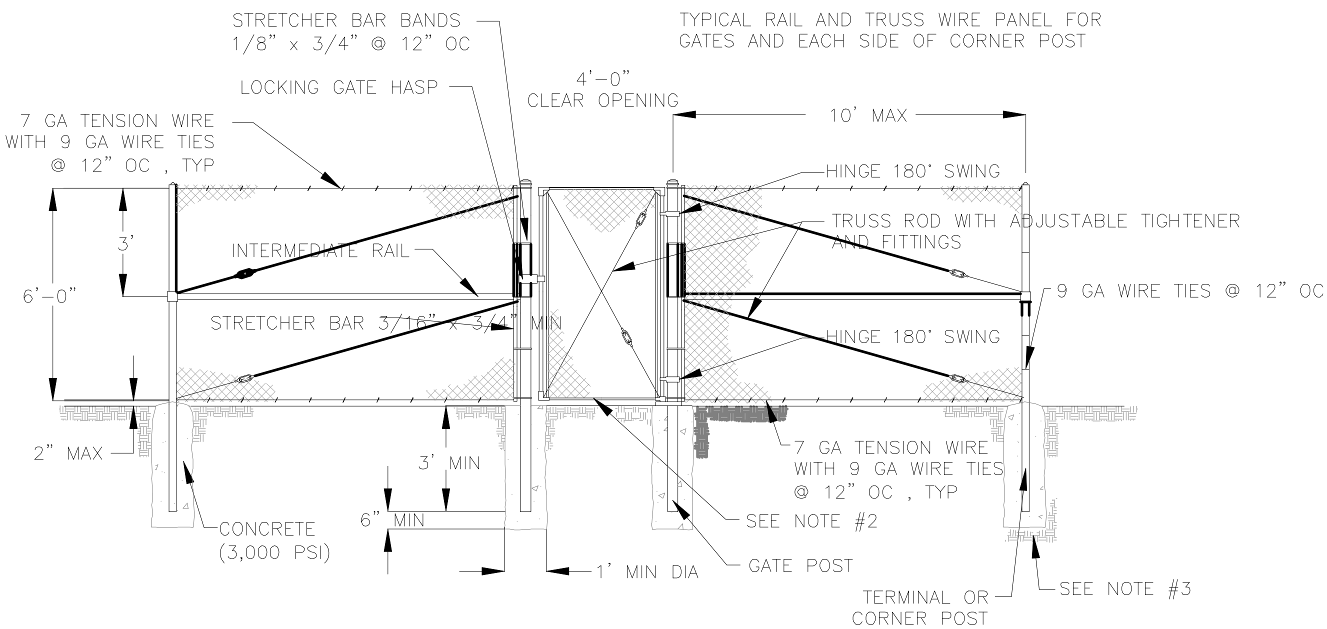
A
1

SNOW REMOVAL RAILS

NO SCALE

SHEET: S9-D3	FILE: STANDARDS	DRAWN: MAM	SCALE: NO SCALE	DATE: JAN 2009	**MISC DETAILS**	SOUTH TAHOE PUBLIC UTILITY DISTRICT Sewer . 1950 . Water A PUBLIC AGENCY 1275 Meadow Crest Drive South Lake Tahoe, California 96150 Phone (530) 544-6474 Fax (530) 541-4319 WWW.STPUD.US

POST AND MATERIALS TABLE	
TERMINAL POST	2 7/8" OD SCH 40 PIPE
INTERMEDIATE RAIL	2 3/8" OD SCH 40 PIPE
GATE POST	4" OD SCH 40 PIPE
CHAIN LINK FABRIC	9 GA WIRE 2" DIAMOND WIRE
GATE FRAMES	1 7/8" OD SCH 40 PIPE
TENSION WIRE	7 GA GALV COIL SPRING STEEL
TRUSS RODS	3/8" GAL STEEL



NOTES:

1) PAINT GATE AND FENCE BLACK WITH VINYL COATING

2) USE VERTICAL AND HORIZONTAL STRETCHER BARS TO CONNECT FABRIC TO FRAME. STRETCHER BAR AND BANDS SHALL BE SAME SIZE AS THOSE SHOWN IN THE PLANS.

3) ALL CONCRETE SHALL BE PLACED ON UNDISTURBED SOIL OR A MINIMUM OF SIX INCHES (6") OF COMPACTED CLASS TWO AGGREGATE BASE COMPACTED TO 95% RELATIVE COMPACTION.

4) CONCRETE SHALL BE MOUNDED AND SLOPED TO DRAIN WATER AWAY FROM THE POST,

6' CHAIN LINK FENCE WITH WALK GATE

A
1

NO SCALE

SHEET: S9-D4
FILE: STANDARDS
DRAWN: MAM
SCALE: NO SCALE
DATE: JAN 2009

MISC DETAILS

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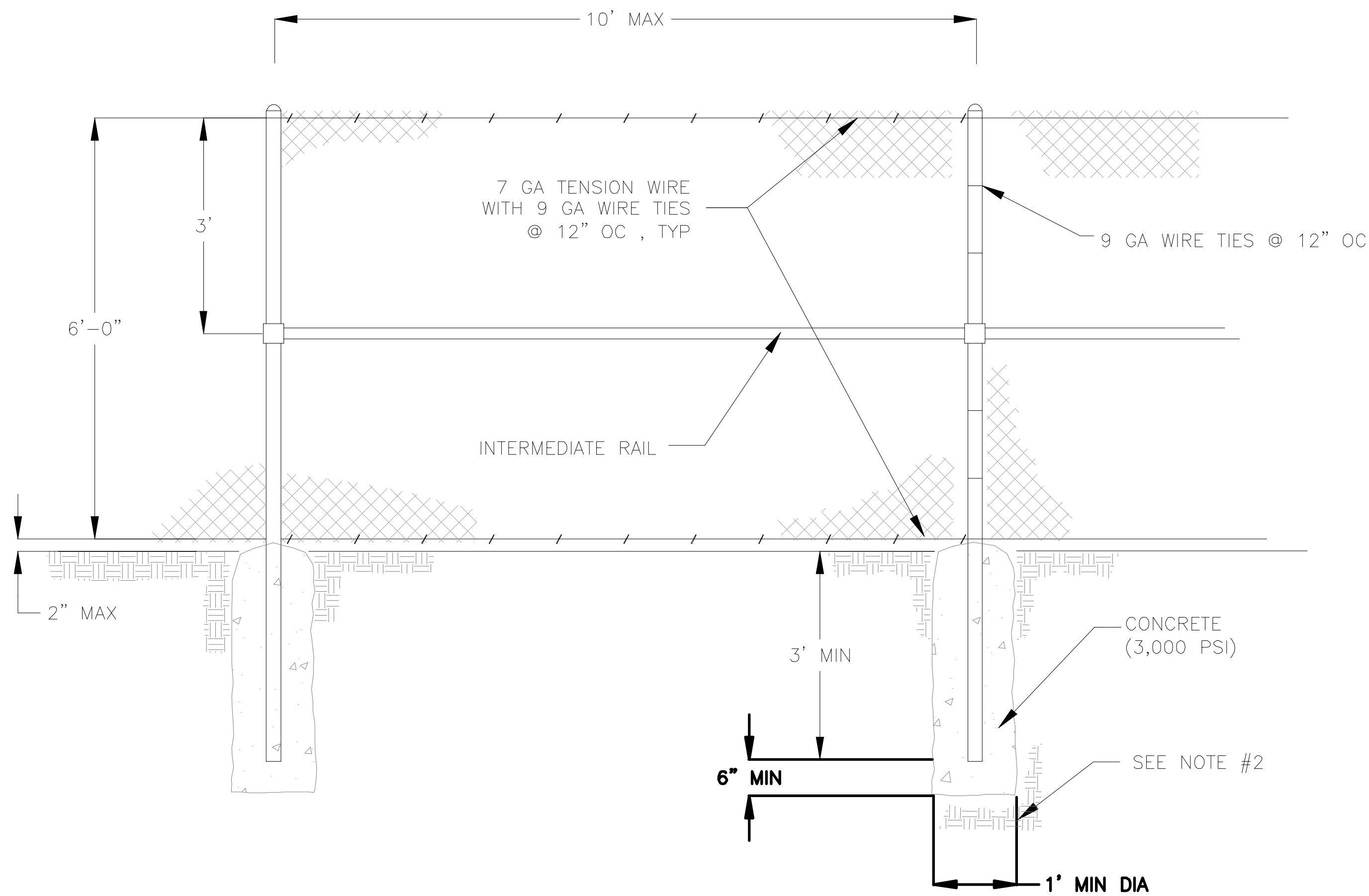
POST AND MATERIALS TABLE	
LINE POST	2 3/8" OD SCH 40 PIPE
CHAIN LINK FABRIC	9 GA WIRE 2" DIAMOND WIRE
TENSION WIRE	7 GA GALV COIL SPRING STEEL
INTERMEDIATE RAIL	2 3/8" OD SCH 40 PIPE



NOTES:

1) PAINT FENCE BLACK WITH VINYL COATING

2) ALL CONCRETE SHALL BE PLACED ON UNDISTURBED SOIL OR A MINIMUM OF SIX INCHES (6") OF COMPACTED CLASS TWO AGGREGATE BASE COMPACTED TO 95% RELATIVE COMPACTION.

3) CONCRETE SHALL BE MOUNDED AND SLOPED TO DRAIN WATER AWAY FROM THE POST,

6' CHAIN LINK FENCE TYPICAL
LINE POST TO LINE POST

A
1

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S9-D5

MISC DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

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POST AND MATERIALS TABLE	
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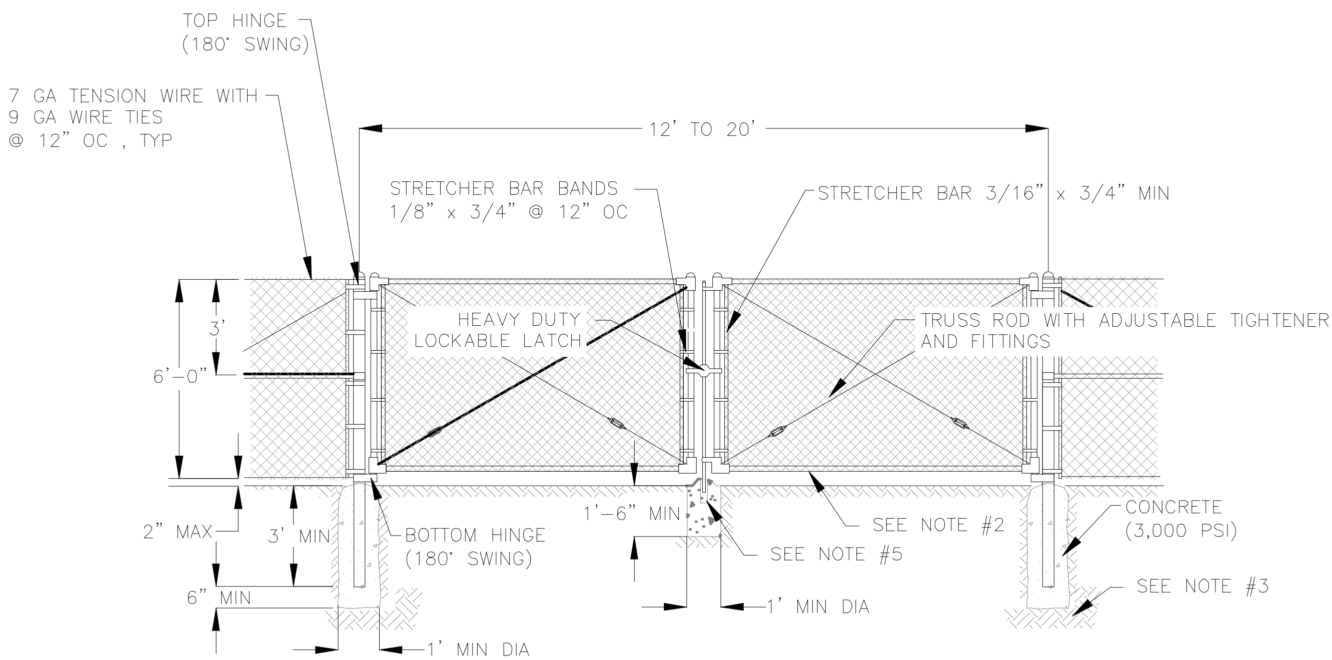
TENSION WIRE	7 GA GALV COIL SPRING STEEL
TRUSS RODS	3/8" GAL STEEL



NOTES:

1) PAINT GATE AND FENCE BLACK WITH VINYL COATING

2) USE VERTICAL AND HORIZONTAL STRETCHER BARS TO CONNECT FABRIC TO FRAME. STRETCHER BAR AND BANDS SHALL BE SAME SIZE AS THOSE SHOWN IN THE PLANS.

3) ALL CONCRETE SHALL BE PLACED ON UNDISTURBED SOIL OR A MINIMUM OF SIX INCHES (6") OF COMPACTED CLASS TWO AGGREGATE BASE COMPACTED TO 95% RELATIVE COMPACTION.

4) CONCRETE SHALL BE MOUNDED AND SLOPED TO DRAIN WATER AWAY FROM THE POST.

5) DROP ROD TO SET SIX INCHES (6") MINIMUM INTO CENTER CONCRETE FOOTING WHEN IN THE CLOSED POSITION. DROP ROD HOLE SHALL BE THREE QUARTER INCH (3/4") MINIMUM SCHEDULE 40 PVC, SET TWELVE INCHES (12") DEEP AND CENTERED INTO CONCRETE.

6' CHAIN LINK FENCE WITH DOUBLE VEHICLE GATE

A
1

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S9-D6

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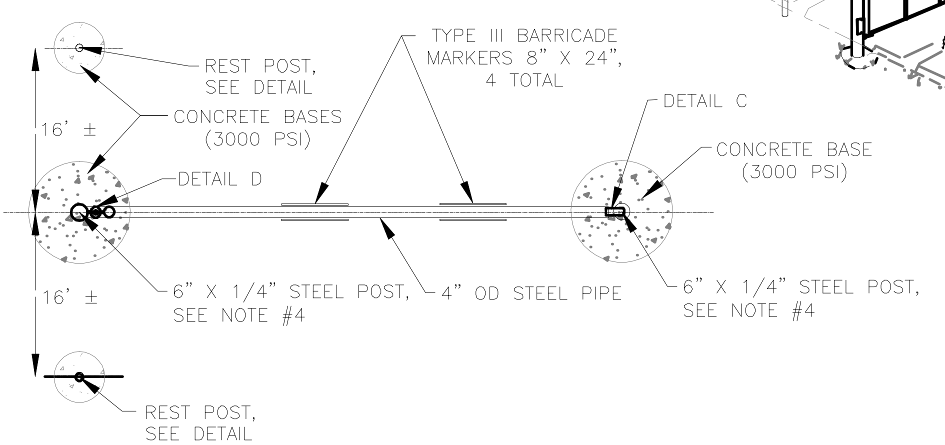
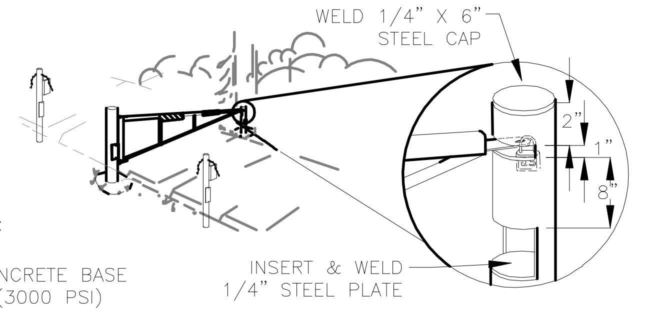
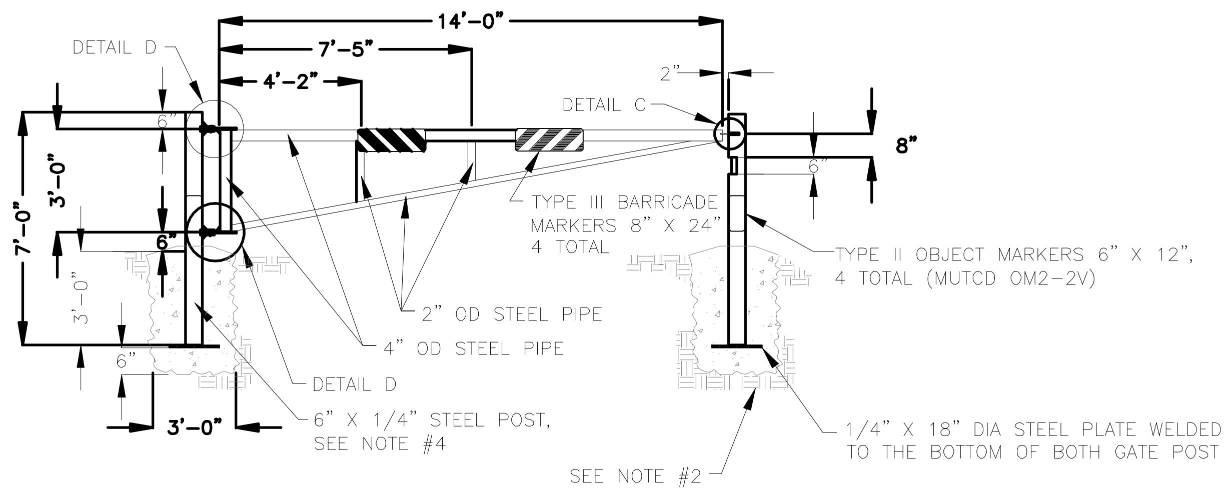
PLAN VIEW





PERSPECTIVE VIEW

PROFILE VIEW



NOTES:

1) ALL EXPOSED PLATES/PIPE/TUBE/POST SHALL BE PRIMED AND PAINTED, EXTERIOR PAINT TO BE BLACK VINYL TWO (2) COATS.

2) ALL CONCRETE SHALL BE PLACED ON UNDISTURBED SOIL OR A MINIMUM OF SIX INCHES (6") OF COMPACTED CLASS TWO AGGREGATE BASE COMPACTED TO 95% RELATIVE COMPACTION.

3) CONCRETE SHALL BE MOUNDED AND SLOPED TO DRAIN WATER AWAY FROM THE POST,

4) ALL POST SHALL BE FILLED WITH 3000 PSI CONCRETE.

5) ALL WELDS TO SHALL BE 1/4" AND GROUND SMOOTH.

6) STEEL STRUCTURAL TUBE OF EQUAL STRENGTH MAY BE USED INSTEAD OF PIPE.

A
1

SWING GATE

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S9-D7

MISC DETAILS

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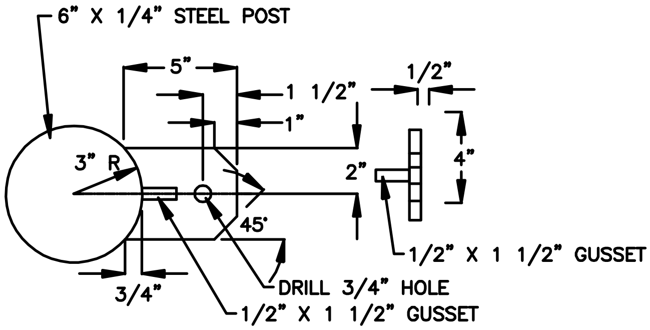
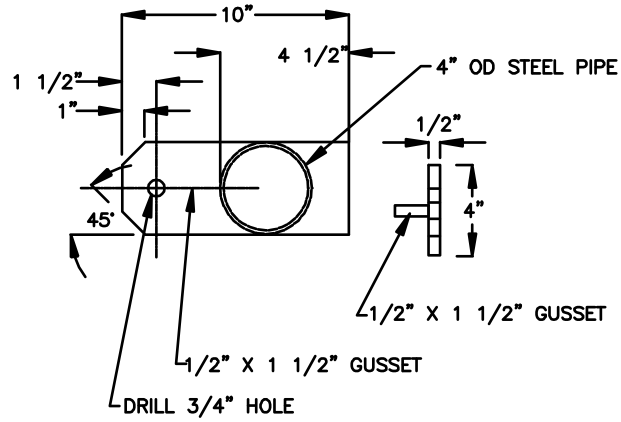
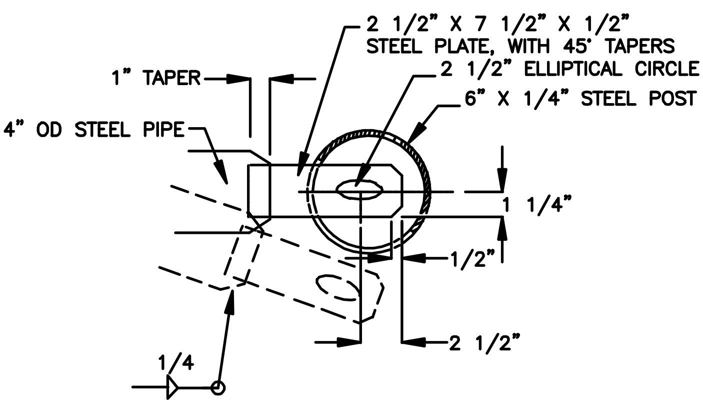
DETAIL "A"
6" STEEL POST GATE HINGE PLATE (4 EA)



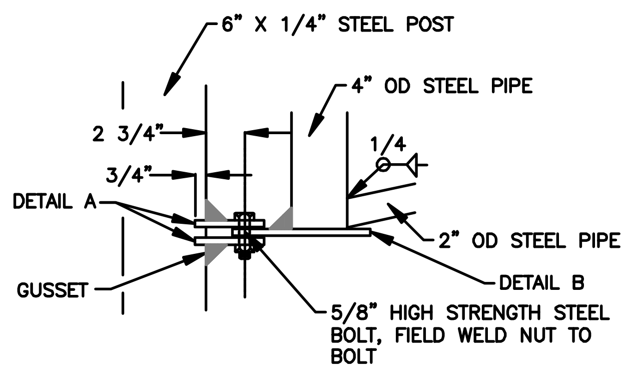
DETAIL "B"
4" STEEL PIPE TOP/BOTTOM HINGE PLATE (2 EA)



DETAIL "C"
LOCK PLATE



DETAIL "D"
GATE HINGE ASSEMBLY



A
1

SWING GATE — DETAILS

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S9-D8

MISC DETAILS

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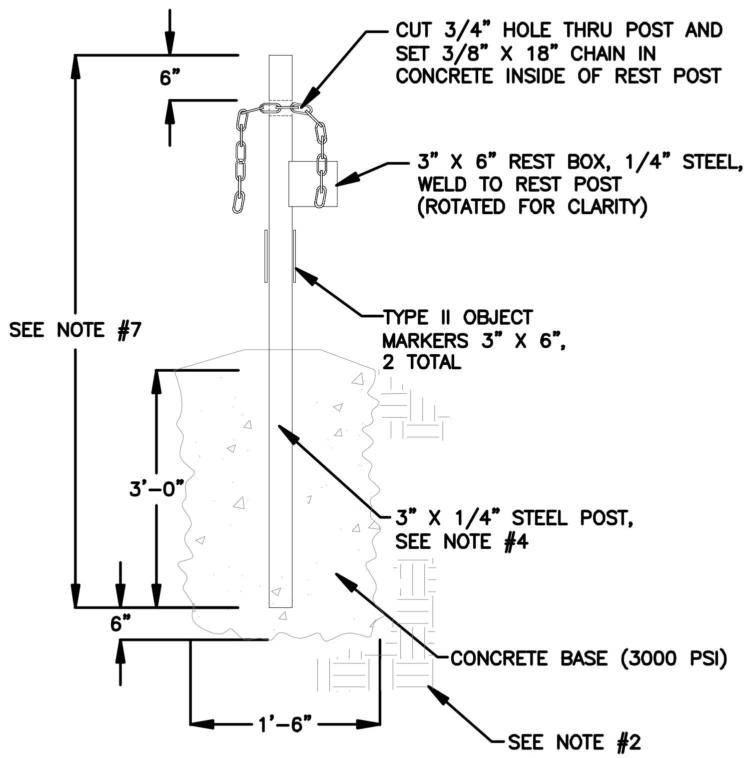
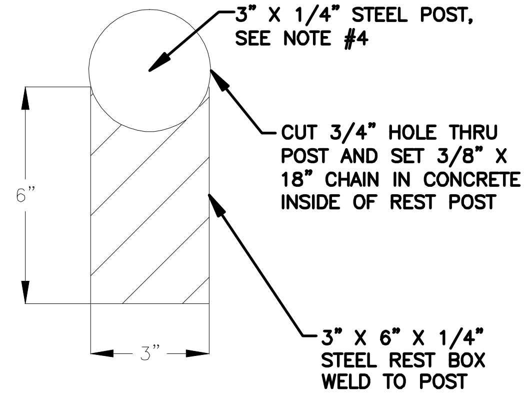
PROFILE VIEW



PLAN VIEW



NOTES:

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3) CONCRETE SHALL BE MOUNDED AND SLOPED TO DRAIN WATER AWAY FROM THE POST,

4) ALL POST SHALL BE FILLED WITH 3000 PSI CONCRETE.

5) ALL WELDS TO SHALL BE 1/4" AND GROUND SMOOTH.

6) STEEL STRUCTURAL TUBE OF EQUAL STRENGTH MAY BE USED INSTEAD OF PIPE.

7) REST POST HEIGHT AS NEEDED TO PUT CHAIN AT THE SAME HEIGHT AS THE TOP RAIL OF THE SWING GATE, WHEN THE GATE IS OPEN.

A
1

REST POST

NO SCALE

DATE: JAN 2009	SCALE: NO SCALE	DRAWN: MAM	FILE: STANDARDS	SHEET: S9-D9

MISC DETAILS

SOUTH TAHOE PUBLIC UTILITY DISTRICT

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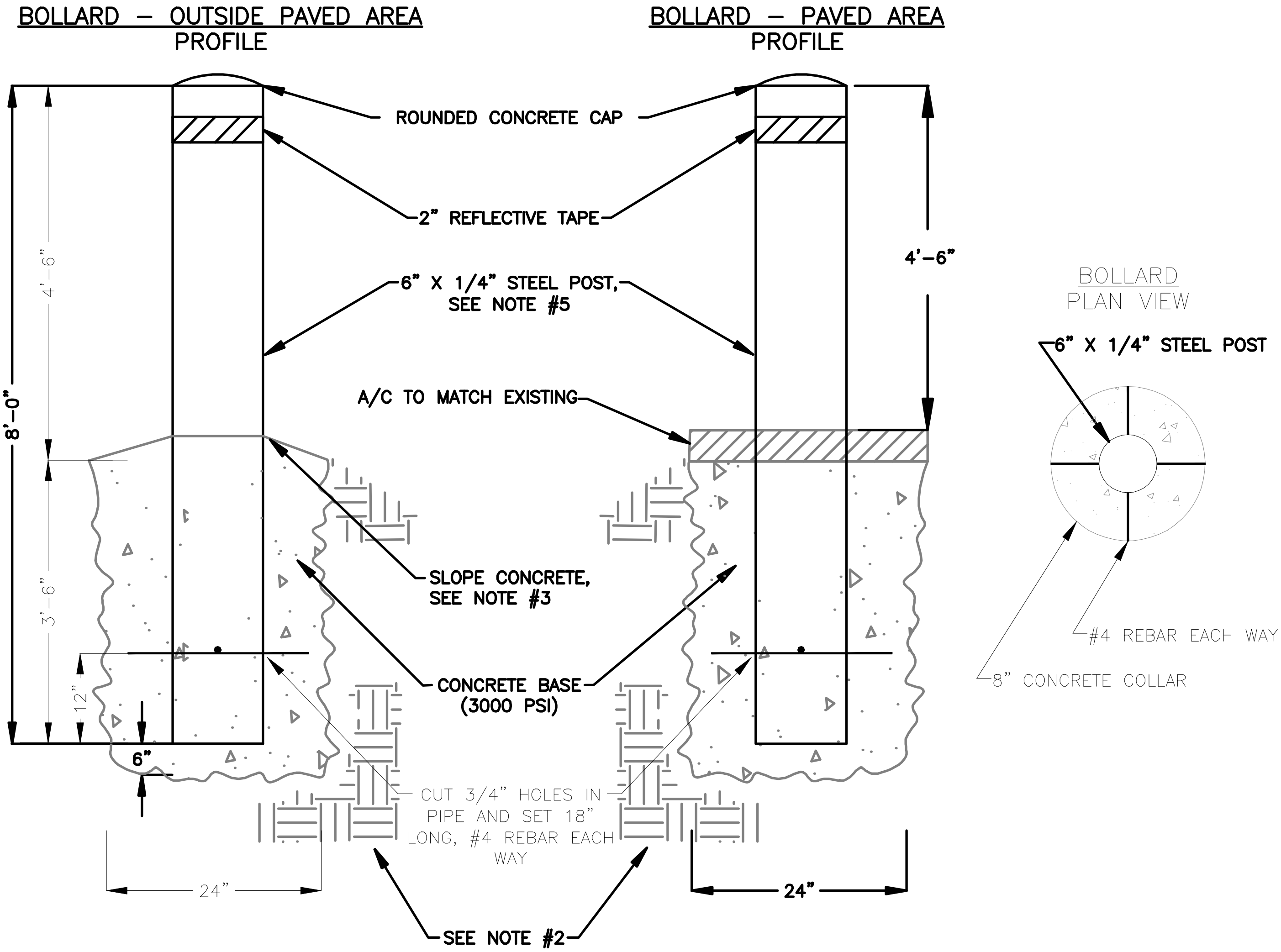

NOTES:

1) BOLLARDS WITHIN THE CITY OF SOUTH LAKE TAHOE USED AS FIRE HYDRANT PROTECTION SHALL BE BE PAINTED WITH A MINIMUM OF THREE (3) COATS OF SPRAY MATE "ALUMINUM METALLIC", COLOR CODE 0180, OR APPROVED EQUAL. BOLLARDS WITHIN EL DORADO COUNTY SHALL BE PAINTED WITH A MINIMUM OF THREE (3) COATS OF "TRAFFIC YELLOW" SHERWIN-WILLIAMS SHER-CRYL B66-300, OR APPROVED EQUAL.

2) ALL CONCRETE SHALL BE PLACED ON UNDISTURBED SOIL OR A MINIMUM OF SIX INCHES (6") OF COMPACTED CLASS TWO AGGREGATE BASE COMPACTED TO 95% RELATIVE COMPACTION.

3) CONCRETE COLLAR SHALL BE A MINIMUM OF EIGHT INCHES (8") AROUND BOLLARD. BOLLARDS PLACED OUTSIDE THE PAVED AREA SHALL HAVE THE CONCRETE MOUNDED AND SLOPED TO DRAIN WATER AWAY FROM THE POST.

4) ALL CONCRETE SHALL BE A MINIMUM OF 3000 PSI CONCRETE. BOLLARDS SHALL BE FILLED AND CAPPED WITH CONCRETE.

5) BOLLARDS SHALL BE SIX INCHES (6") IN DIAMETER AND SHALL BE SCHEDULE 40 GALVANIZED STEEL PIPE OR QUARTER INCH (1/4") STRUCTURAL STEEL TUBE.

6) THE BOLLARD SHALL BE PLACED A MINIMUM OF TWO AND HALF FEET (2.5') FROM THE CENTER OF THE FIRE HYDRANT AND OFFSET TO AVOID OBSTRUCTING THE USE OF THE FIRE HYDRANTS NOZZLES.

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1

SAFETY BOLLARDS

NO SCALE

DATE: JAN 2009
SCALE: NO SCALE
DRAWN: MAM
FILE: STANDARDS
SHEET: S9-D10

MISC DETAILS

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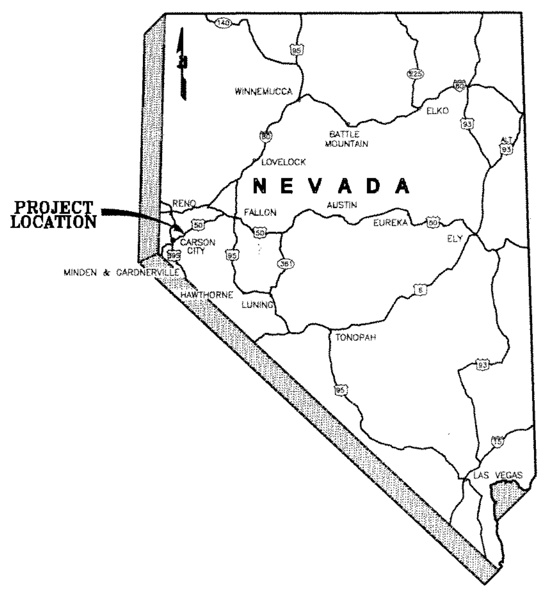
WWW.STPUD.US

ATTACHMENT B: LYON COUNTY WASTEWATER LIFT STATION PACKAGE STANDARD DRAWING LIST

LYON COUNTY UTILITIES DEPARTMENT

WASTEWATER LIFT STATION PACKAGE

LYON COUNTY NUMBER XXXXXX-XXX



VICINITY MAP
NO SCALE

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3	G-2	STANDARD SYMBOLS, AND NOTES
4	G-3	SITE PLAN
		LIFT STATION
5	LS-1	LIFT STATION PLAN AND SECTIONS
6	LS-2	LIFT STATION SECTION
7	LS-3	LIFT STATION MECHANICAL STANDARD DETAILS
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9	LS-5	EQUIPMENT MOUNTING DETAILS
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14	S-3	PUMPING STATION LOWER SECTION
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26	P-1	SYMBOLS-1
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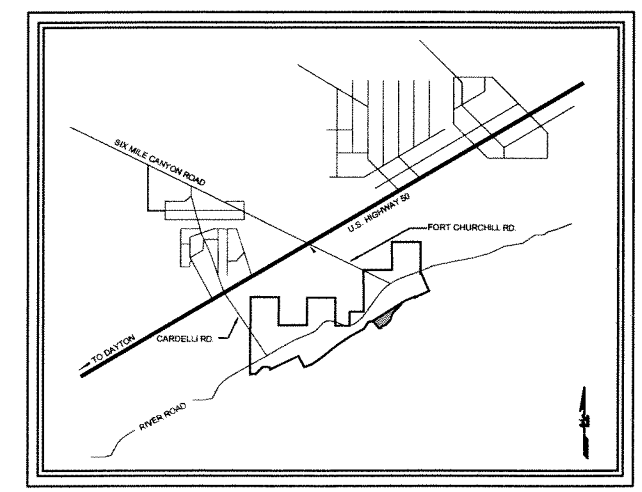
29	P-4	INSTALLATION DETAILS
30	P-5	PROCESS AND INSTRUMENTATION DIAGRAM
31	P-6	INSTRUMENTATION AND CONTROL PANEL LAYOUT



SITE LOCATION MAP
NO SCALE

William K. Faisst, P.E.
PROJECT ENGINEER
BROWN AND CALDWELL

Mike Workman
UTILITIES DIRECTOR
LYON COUNTY
UTILITIES DEPARTMENT
AUTHORITY

BROWN AND CALDWELL

STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
PERMIT NUMBER NEVADA XXXXX

BROWN AND CALDWELL

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Walnut Creek, CA 94596-3864
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Technical Memorandum

Prepared for: South Tahoe Public Utility District, South Tahoe, California

Project Title: STPUD Collection Systems Master Plan

Project No: 132364-003

Technical Memorandum No. 10

Subject: Capital Improvement Plan (Task 7.0)

Date: December 30, 2009

To: Paul Sciuto, Assistant General Manager

From: Pete Bellows, Project Manager
Engineer in Responsible Charge, Ca. Lic. No. C 34337

Alex Park, Project Engineer
California. Lic. No. C 64117

Reviewed by: Chris Peters, Project Engineer
California. Lic. No. C 69669

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1. INTRODUCTION

This Technical Memorandum (TM) No. 10 presents the development of the long-term capital improvement plan and other recommendations for the South Tahoe Public Utility District (STPUD or District). Capital project and other recommendations for the collection system are based on asset management principles that include specific levels of service for the collection system, risk assessments, and business case evaluations.

The individual capital projects are prioritized and combined together with existing District capital projects to make the capital improvement program. The capital improvement program is divided into three categories:

- Projects to be completed in the next 10 years
- Projects to be completed in 10 to 20 years
- Projects to be completed after 20 years

The near term projects which are to be completed in the next 10 years are developed in the greatest detail and individual project description sheets are attached. Projects to be completed in 10 to 20 years are developed to less detail and projects to be completed after 20 years are identified but cost estimates are not prepared. One recommendation of this master plan is to periodically update the condition, maintenance, and hydraulic assessments contained in the previous TMs and adjust the capital projects and capital improvement program accordingly. It is anticipated that one or more updates will occur over the next 20 years and the features of the capital projects to be completed after 20 years will be developed in more detail.

2. CAPITAL PROJECT DEVELOPMENT PROCESS

Using the principles of asset management, capital projects are developed for the District to mitigate unacceptable risks of meeting specified levels of service. The capital project development process is shown on Figure 2-1.

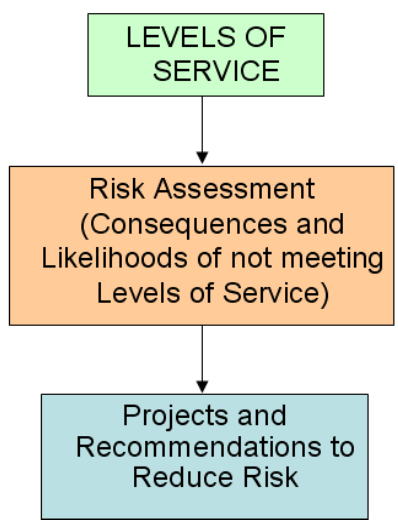


Figure 2-1. Capital Project Development Process – Maintain Required Level of Service

If a capital project has several alternatives, a Business Case Evaluation (BCE) is used to select the best alternative. BCEs consider capital and operational and maintenance (O&M) costs and the risk costs associated with the project. This gives the most complete alternative analysis.

2.1 Level of Service

Five categories of levels of service (LOS) are identified in the Asset Management Introduction and Level of Service TM No. 1 and are listed below. The capital improvement projects presented in this TM primarily address the first three LOS categories. This includes Collection System Service; Community Health, Safety and Environment; and Employee Safety. The other listed LOS categories are primarily related to the daily operation and customer service activities performed by the District and were not evaluated as part of this master plan.

- Collection System Service
  - Proactive maintenance to minimize disruptions
  - Quick and effective response to emergencies and potential SSOs
- Community Health, Safety, Environment
  - Minimize sanitary sewer overflows (SSOs)
  - Protect receiving waters and Stream Environment Zones (SEZs)
  - Protect community from safety hazards
- Employee Safety
  - Minimize employee safety risks
- Regulatory Requirements
  - Sewer System Management Plan/ Wastewater Discharge Requirement (SSMP/WDR)
  - SSO Reporting
- Customer Service
  - Efficient and timely service

2.2 Risk Assessment

Capital projects and other improvement recommendations are developed using risk assessments. The risk assessment evaluates the consequence and likelihood of not meeting the District's LOS.

2.2.1 Consequence of Failure

The primary consequences of failure for not meeting a level of service are tied to an SSO occurrence and employee/public safety as summarized in Table 2-1. Employee/public safety is primarily related to pump stations.

Table 2-1. Collection System Consequences of Not Meeting LOS			
Level of Service	**Objectives**	**Pump Stations**	**Pipelines**
Collection System Service	Proactive Maintenance Quick Response	SSO SSO	SSO SSO
Community Health, Safety, and Environment	Minimize SSOs Receiving Waters/SEZs CS Hazards	SSO SSO Injuries	SSO SSO
Employee Safety	Minimize Risks	Injuries	

The consequence of pipeline or pump station SSO were prioritized to identify facilities with high consequences of failure. Three levels of consequence of an SSO were identified and are summarized below. Consequence level 1 represents the worst consequences. It should be remembered that the District's goal is to avoid all SSOs; however, evaluating the consequence of an SSO helps to prioritize where the District should focus its efforts first.

- Consequence level 1 – large volume SSOs
  - "Big 6" pump stations or pipes with high flows (more than 0.5 mgd dry weather flow)
- Consequence level 2 – SSOs in environmentally sensitive areas or in areas that are difficult to repair
  - SEZ
  - Proximity to lake or water body
  - Proximity to water supply source
  - Seasonal (limited access in the event of a failure)
  - Traffic impact (pipes within 30 feet of the centerline of a State highway, including the Stateline area)
- Consequence level 3 – other locations
  - All others

The consequence levels for SSOs are shown on Figure 2-2.

The other consequences are related to community safety and employee safety. The locations within the collection system of pump stations that have a significant likelihood of not meeting these two District LOS does not matter to the risk evaluation and so all pump stations have the same consequence level.

2.2.2 Likelihood of Failure

The likelihood of SSOs, public safety, and employee safety failure were evaluated in the Pump Station and Pipeline Condition Assessment TMs No. 3 and No. 7 and the Hydraulic Evaluation TM No. 8. All three types of failures were identified for the pump stations but only SSO failures were identified for the pipelines.

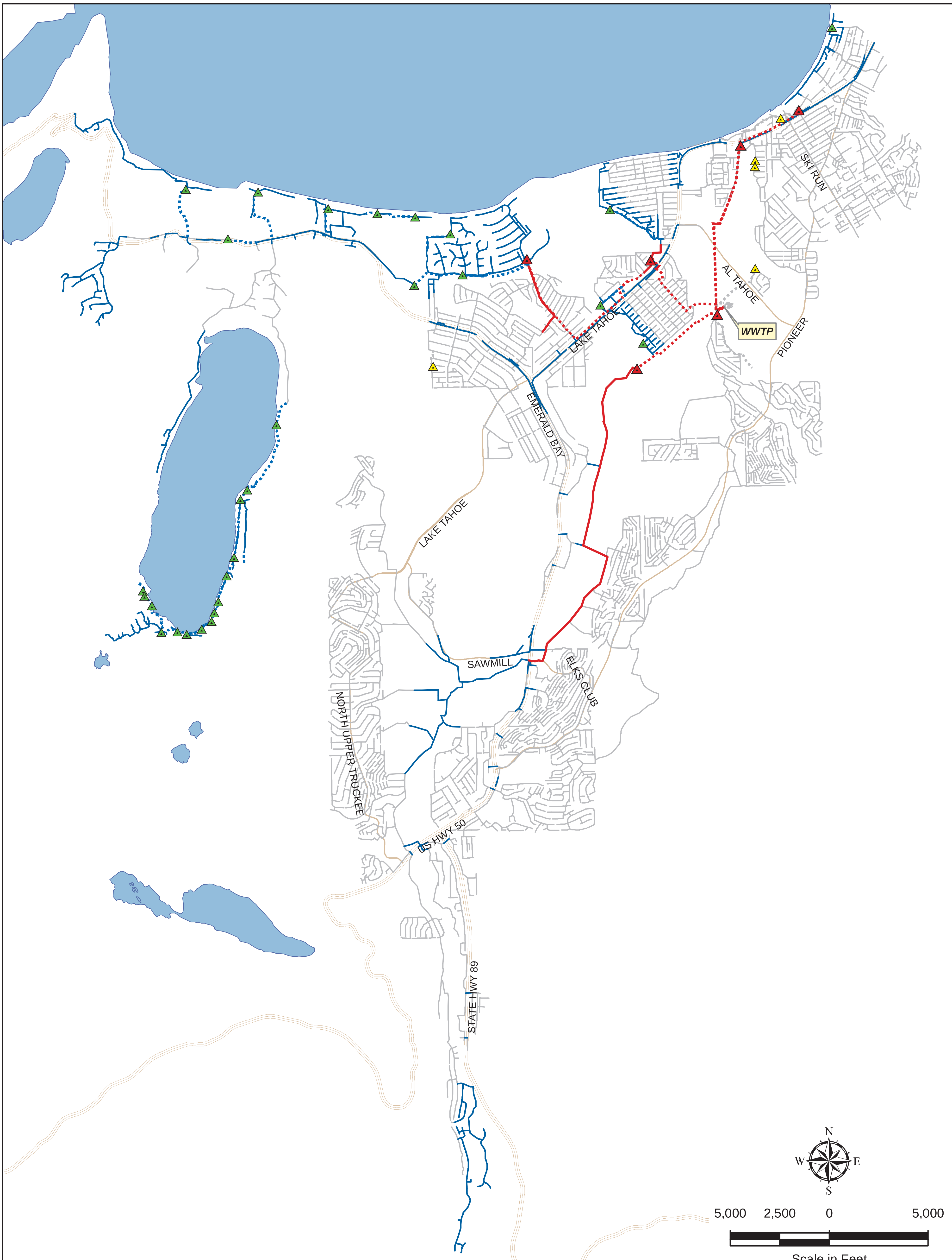
Pump station likelihood of failure is based on the results of the condition and reliability assessment and the hydraulic evaluation. Approximately 50 percent of the pump stations were inspected as part of this project. In some cases, similar pump station classes (such as vacuum valves or steel dry well pump stations) have been grouped together when making recommendations because not every pump station was inspected.

Pipeline likelihood of SSOs is based on the condition and maintenance assessment and the hydraulic evaluation. The condition assessment is based on available closed-circuit television (CCTV) inspections and manhole inspections performed as part of this project. The percent of pipelines and associated manholes that were actually inspected is small so the results were used to extrapolate to the rest of the collection system.

Pipelines pose threats to public safety primarily when a failure has occurred that results in a SSO and these threats are already included in the SSO analysis. Pipeline manholes are confined spaces which pose a threat to employee safety, but manholes are an inherent part of collection systems and are spread throughout the collection system. Consequently, the likelihood of an employee injury related to pipeline confined space entry is not considered.

2.3 Business Case Evaluation

The Fallen Leaf Lake (FLL) collection system has historically been a source of high maintenance and risk for the District. The FLL system includes 16 pump/vacuum stations and 1 generating station. The potential improvements identified for this area have multiple implementation alternatives. Often, when there are multiple methods to address the potential risks of not meeting the LOS, a Business Case Evaluation (BCE) is performed to identify the most cost effective, long-term improvement project. A BCE evaluates the feasibility and costs of various options. For this project, a BCE was performed for the proposed improvement project at Fallen Leaf Lake. The BCE is presented later in this TM.



LEGEND
Consequence of Failure

Pump Stations	Gravity Mains	ROADS
High (1)	High (1)	HWY
Medium (2)	Medium (2)	Major
Low (3)	Low (3)	

Force Mains
- High (1)
- Medium (2)
- Low (3)

BROWN AND CALDWELL

SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 2-2
Consequence of Failure Ranking

3. PUMP STATION CAPITAL IMPROVEMENT PROJECTS AND RECOMMENDATIONS

3.1 Risk Assessments

Pump station risk assessments cover the three primary LOS of community health, safety, and environment; collection system service; and employee safety. Each LOS is addressed below.

The likelihood aspect of the risk assessments is based on information from the Pump Station Condition Assessment TM No. 3 and Hydraulic Evaluation TM No. 8. These TMs focused on 25 of the 42 pump station facilities in the District's collection system. The results of the risk assessment are extrapolated to include the remaining pump stations in Section 3.1.5.

3.1.1 Community Health, Safety, and Environment Risks – SSOs

Community health, safety, and environment LOS has two failures modes: SSOs and public safety. This section evaluates SSO risks. Public safety risks are evaluated in the following section.

The likelihood of an SSO is based on information from TM 3 and the categories and ratings are listed in Table 3-1. Condition failures are based on the following criteria from TM 3: structural, pumps and piping, standby power, electrical power, and control systems. The condition of the HVAC, odor control and auxiliary equipment is not related to causing an SSO so these criteria were not considered.

Table 3-1. Community Health, Safety, and Environment – Likelihood of Pump Station SSOs

Category	1	2	3	4	5
Condition	Imminent failure/unreliable	Compromised condition/reliability	Visible degradation	Well maintained	New condition
Reliability	No standby pump and no sump pump in dry well	Standby pump, portable pump or portable generator connection, and sump pump in dry well/severe accessibility issues	Same as 2, with onsite storage or collection system storage or gravity overflow	Onsite standby generator, standby pump, and sump pump in dry well	Same as 4 with another level of redundancy
Hydraulic	Under capacity - current	Under capacity - future	Not used	Not used	Not under capacity

Pump stations have three levels of consequence of failure when evaluating SSO risks. These levels of consequence of failure are discussed in Section 2.2.1.

The pump station SSO risk matrix evaluation is presented in Table 3-2. Pump stations included in the orange and yellow highlighted areas are at the highest SSO risks.

Table 3-2. Risk Assessment for Community Health, Safety, and Environment Pump Station SSOs			
	Consequence		
Likelihood	1	2	3
1	1	2	0
2	1	7	0
3	4	5	3
4	0	1	1
5	0	0	0

Priority 1 (Orange)

Three pump stations that were evaluated for this project are designated with Priority 1 risk for community health, safety and environment SSOs. This list includes Tahoe Keys pump station and two vacuum valve stations (VVS) at Fallen Leaf Lake. Tahoe Keys pump station does not have enough hydraulic capacity for the current and future 25-year, 24-hour design flows. VVS-3 and VVS-5 are also at risk for SSOs due to their lack of redundancy and high maintenance requirement. All six of the VVS and the eight electric stations (ES) will be addressed in more detail as part of the Fallen Leaf Lake BCE which is presented in Section 3.2.

Priority 2 (Yellow)

Eight pump stations that were evaluated for this project are designated with Priority 2 risk for community health, safety and environment SSOs. These pump stations are included in the Priority 2 category based on their condition and reliability assessments. This category includes the following pump stations: Beecher, Bijou, Pope Beach #1, San Moritz, ES-2, ES-5, Main Station, and Stanford Generating Station. ES-2, ES-5, Main Station, and Stanford Generating Station will be addressed in more detail as part of the Fallen Leaf Lake BCE which is presented in Section 3.2. Descriptions of the required improvements are provided below and in TM 3. Only one of the pump stations requires a capital improvement due to the specialized contractor required to make the repair. The remaining improvements can be provided by District staff and are not included in the CIP.

- Bijou pump station has evidence of corrosion (exposed aggregate) in the wet well. A capital improvement project to rehabilitate the wet well is needed. The proposed rehabilitation should be made with a plastic liner system such as Linabond that will resist future corrosion. This project will be performed by a specialty contractor and is included in the CIP. This pump station also has poor ratings for maintenance and employee safety and the District may choose to replace this pump station beyond the initial 10-year CIP. The District may want to reconsider this project if pump station replacement in 10 to 20 years is likely.
- The electrical panel at Beecher pump station is in poor condition and requires replacement. The current panel location is located in an area that could be struck by vehicles. The new panel should be protected from vehicle traffic with removable bollards. These improvements will be made by District staff.
- Pope Beach #1 pump station received poor assessment ratings for electrical and redundancy. The supply meter and main power enclosure are in disrepair. There is also no quick connect for backup power in the event of a power failure. These improvements will be made by District staff.
- The San Moritz pump station motor starters are in poor condition and should be replaced. This improvement will be made by District staff.

Priority 3

The remaining 14 pump stations that were evaluated for this project are designated with Priority 3 risk for community health, safety and environment SSOs. Capital improvement projects are not anticipated at these pump stations within the next 20 years.

3.1.2 Community Health, Safety, and Environment Risks – Public Safety

The community health, safety, and environment LOS also includes a public safety failure risk. The principle public injury risk is related to unauthorized entry into a pump station. Pump stations have rotary equipment, high voltage, and hazardous confined space areas. Entry into these areas is presently controlled by locked doors, heavy manholes lids, and fences in some cases. Additional security could be provided by intruder alarms which are connected to each pump station's Supervisory Control and Data Acquisition (SCADA) system. The ratings for likelihood of a public injury are listed in Table 3-3

Table 3-3. Community Health, Safety, and Environment – Likelihood of Public Injury

Category	1	2	3	4	5
Public Safety	Not used	Not used	No Intruder Alarm	No Fence	Not used

Consequences of a public injury are not related to the pump station location so only one level of consequence is used for evaluating public safety risks.

The public safety risk matrix evaluation is presented in Table 3-4. Pump stations included in the orange and yellow highlighted areas are at the highest public safety risk.

Table 3-4. Risk Assessment for Pump Station Public Safety

Likelihood	Consequence
1	0
2	0
3	25
4	0
5	0

Priority 1 (Orange)

No pump stations evaluated for this project are designated with Priority 1 for public safety risk.

Priority 2 (Yellow)

No pump stations evaluated for this project are designated with Priority 2 for public safety risk.

Priority 3

All 25 pump stations evaluated for this project are designated with Priority 3 for public safety risk. However, intruder alarms could be included as part of a SCADA improvement project that is identified below. Otherwise, a capital improvement project for intrusion alarms is not anticipated within the next 20 years.

3.1.3 Collection System Service Risks

Collection system service risks are related to SSOs. The risk assessment considers maintenance requirements and the District's ability to respond to alarm conditions. The likelihood of maintenance problems is based on review of maintenance log books and discussions with District staff. The District ability to quickly and effectively respond to alarm conditions before an SSO occurs is related to the SCADA system. The District has a basic SCADA system which provides limited alarm information. The likelihood of failures ratings are listed in Table 3-5.

Table 3-5. Collection System Service – Likelihood of Pump Station SSO

Category	1	2	3	4	5
Maintenance Requirement	Maintenance related SSOs	High level maintenance	Moderate or Average level maintenance	Low level maintenance	Not used
Problem Response	No SCADA	Basic SCADA	Not used	Detailed SCADA	Not used

Pump stations have three levels of consequence of failure when evaluating SSO risks. These levels of consequence of failure are discussed in Section 2.2.1.

The collection system service risk matrix evaluation is presented in Table 3-6. Pump stations included in the orange and yellow highlighted areas have the highest risk of SSOs.

Table 3-6. Risk Assessment for Pump Station Collection System Service SSOs

	Consequence		
Likelihood	1	2	3
1	0	0	0
2	6	15	4
3	0	0	0
4	0	0	0
5	0	0	0

Priority 1 (Orange)

No pump stations evaluated for this project are designated with Priority 1 for collection system service risk.

Priority 2 (Yellow)

Twenty-one pump station facilities evaluated for this project are designated with Priority 2 for collection system service risk because of the SCADA systems.

In addition, the following pump stations have high maintenance requirements: Beecher, Al Tahoe, Bijou, Johnson, Trout Creek, Upper Truckee, VVS-3, VVS-5, and Fallen Leaf Lake Main Station. Capital improvement projects at Bijou, Johnson, Trout Creek and Upper Truckee pump stations are anticipated in the next 10 to 20 years. Improvements are anticipated at Al Tahoe in the next 10 years due to SSO risk. Improvements at Fallen Leak Lake are addressed in the Business Case Evaluation. Improvements should be made to reduce maintenance levels and costs, improve reliability and standardize equipment. Beecher received new pumps in 2007 which appear to have addressed maintenance problems.

Priority 3

No pump stations evaluated for this project are designated with Priority 3 for collection system service risk.

3.1.4 Employee Safety Risks

Employee risk LOS is related to employee injury. TM 3 was reviewed to identify pump stations with access to their dry wells that are permitted confined space entries with vertical ladders and permitted confined space entries with spiral staircases. The pump stations with vertical ladders pose additional chance of employee injury because of the fall hazard and additional difficulty in extracting an injured employee. The likelihood of employee injury is summarized in Table 3-7.

Table 3-7. Employee Safety – Likelihood of Employee Injury

Category	1	2	3	4	5
Employee Safety	Imminent danger	Permitted confined space, vertical ladder	Permitted confined space, spiral staircase	Non-permitted confined space	Not used

The employee safety risk matrix evaluation is presented in Table 3-8. Pump stations included in the orange and yellow highlighted areas are at the highest risk for an employee injury due to safety deficiencies. This category includes pump stations that are permitted confined spaces that require ladder access into drywells. Consequence of failure only includes one category because the pump station location is irrelevant when considering employee safety.

Table 3-8. Risk Assessment for Pump Station Employee Safety

Likelihood	Consequence
1	0
2	10
3	3
4	12
5	0

Priority 1 (Orange)

No pump stations evaluated for this project are designated with Priority 1 for employee safety risk.

Priority 2 (Yellow)

Ten pump stations evaluated for this project are designated with Priority 2 for employee safety risk. This category includes the following pump stations: Bijou, Bellevue, Pioneer Village, Pope Beach #1, San Moritz, Taylor Creek, Trout Creek, Venice, Johnson, and the Fallen Leaf Lake Main Station. Improvements at Fallen Leak Lake are addressed in the Business Case Evaluation. As these pump stations reach the end of their useful lives beyond the next 10 years, capital improvement projects should include safety improvements that reduce the risk of employee injury. This risk is currently being mitigated with fall protection measures within the pump stations.

Priority 3

15 pump stations evaluated for this project are designated with Priority 3 for employee safety risk. Some of these pump stations have employee safety risk associated with permitted confined space entry and spiral staircases such as Upper Truckee, Tahoe Keys, and Tallac. Capital improvement projects to address employee safety are not anticipated at these pump stations within the next 20 years.

3.1.5 Risk Assessment Summary

A summary of the pump station risk assessment is presented in Table 3-9. As noted above, the risk assessment is based on the condition assessment and hydraulic evaluation of 25 pump station facilities. The collection system has a total of 42 collection system pump stations and the results of the risk assessment were extrapolated to identify other pump stations with similar risks.

Pump stations not evaluated were matched to the 25 pump stations based upon similarity in characteristics, including:

- Year built
- Year rehabilitated
- Pump station type
- Location
- Number of pumps
- Pump type
- Pump design flow
- Pump manufacturer and model
- Motor horsepower
- Force main diameter, length, material

The pump stations with an almost direct correlation of characteristics, resulting in a high confidence in the extrapolation to the uninspected pump stations are:

Fairway #1	→	Fairway #2
Pope Beach #1	→	Pope Beach #2
ES-2	→	ES-1, and -3
ES-5	→	ES-6, -7, -8, and -9
VVS-3 and -5	→	VVS-4, -6, -7 and -8

The other pump station extrapolations are:

Tallac	→	Camp Richardson and Kiva
San Moritz	→	Baldwin Beach
ES-2	→	Flanders and Taggart (note: no standby pump)

The 25 pump station facilities evaluated for the project as well as the 17 pump stations with extrapolated risk assessments are included in Table 3-9.

Table 3-9. Pump Station Facilities Risk Assessment

Pump Station	Year Built	Year Rehab	Community Health, Safety and Environment: SSO	Community Health, Safety and Environment: Public Safety	Collection System Service: Maintenance	Collection System Service: SCADA[d]	Employee Safety
Small Submersible Pump Stations							
Beecher	1960	2007	2[a]	3	2	2	3
Fairway #1	1995	N/A	3	3	3	2	3
Fairway #2	1995	N/A	3	3	3	2	3
Stateline	1971	1997	3	3	3	2	3
Large Submersible Pump Stations							
Al Tahoe	1960	1996	3	3	2	2	3
Gardner Mountain	2004	N/A	3	3	3	2	3
Ponderosa	1997	N/A	3	3	3	2	3
Ski Run	1996	N/A	3	3	3	2	3
Pump Stations with Ladder Access into Dry Well							
Bellevue	1960	N/A	3	3	3	2	2
Bijou	1955	2000	2	3	2	2	2
Johnson	1972	N/A	3	3	2	2	2
Pump Stations with Spiral Staircase Access into Dry Well							
Tahoe Keys	1960	2007	1	3	3	2	3
Tallac	1968	N/A	3	3	3	2	3
Camp Richardson	1968	N/A	3	3	3	2	3
Kiva	1968	N/A	3	3	3	2	3
Upper Truckee	1967	N/A	3	3	3	2	3
Pump Stations with Ladder Access into Steel Dry Well							
Pioneer Village	1966	N/A	3	3	3	2	2
Pope Beach #1	1973	N/A	2[a]	3	3	2	2
Pope Beach #2	1973	N/A	2[a]	3	3	2	2
San Moritz	1966	N/A	2[a]	3	3	2	2
Baldwin Beach	1971	N/A	2[a]	3	3	2	2

Table 3-9. Pump Station Facilities Risk Assessment							
			Community Health, Safety and Environment		Collection System Service		
Pump Station	Year Built	Year Rehab	SSO	Public Safety	Maintenance	SCADA[d]	Employee Safety
Taylor Creek	1968	N/.A	3	3	3	2	2
Trout Creek	1967	2009	3	3	2	2	2
Venice	1971	N/A	3	3	2	2	2
Pump Station With Ladder Access into Dry Well (FLL)							
Main Station (FLL)	1983	1992	2	3	2	2	2
Vacuum Valve Stations (FLL)							
VVS-3	1983	N/A	1	3	2	2	3
VVS-5	1983	N/A	1	3	2	2	3
VVS-4	1983	N/A	1	3	2	2	3
VVS-6	1983	N/A	1	3	2	2	3
VVS-7	1983	N/A	1	3	2	2	3
VVS-8	1983	N/A	1	3	2	2	3
Electric Stations (FLL)							
ES-5	1983	1992	2	3	3	2	3
ES-6	1979	1992	1[a,c]	3	3	2	3
ES-7	1979	1992	1[a,c]	3	3	2	3
ES-8	1979	1992	2	3	3	2	3
ES-9	1979	1992	1[a,c]	3	3	2	3
ES-2	1983	1992	2	3	3	2	3
ES-1	1979	1992	2	3	3	2	3
ES-3	1979	1992	2	3	3	2	3
Taggart	1983	N/A	2	3	3	2	3
Other Pump Station Facilities							
Flanders (Small Submersible)	1983	N/A	1[a,c]	3	3	2[b]	3
Stanford Generating Station	1992	N/A	2	3	3	2	3

= *Assessment extrapolated from the above non-highlighted pump station*

[a] = *Improvements to be performed as part of maintenance activities, not CIP projects*
[b] = *No remote alarms per the Pump Station Inventory Form*
[c] = *Only one pump per the Pump Station Inventory Form*
[d] = *The District decided to upgrade SCADA at all pump stations*

3.2 Fallen Leaf Lake Business Case Evaluation

The risk assessment identified unacceptable SSO risks for the FLL collection system because of high maintenance requirements and reliability concerns. The District is interested in considering a range of alternatives to address the FLL collection system. As discussed above, asset management principles can be applied to the evaluation of alternatives through the use of a business case evaluation (BCE). A BCE considers capital and O&M costs and the short-term and long-term risks associated with each alternative. Short term risks usually are constructed related while long-term risks are associated with the potential for SSOs to occur in the future.

BCE has a six-step process that monetizes the costs for capital, operations and maintenance, and risk associated with each alternative. A 30-year net present value (NPV) analysis is then performed to identify the most cost-effective solution for improving the system. The six-step process is outlined below.

- Step 1: Define the Problem
- Step 2: Collect Data on the Situation
- Step 3: Identify Alternatives
- Step 4: Screen Alternatives
- Step 5: Develop Cost Information
- Step 6: Compare Alternatives based on NPV

3.2.1 Problem Definition

Problems with the FLL collection system fall into two categories: reliability concerns and excessive maintenance requirements. District staff has stated that the vacuum system causes the most problems and has the highest likelihood of failure. Reliability concerns associated with simplex pumps at electric stations can be addressed by the District as O&M projects and will not be considered in the BCE. Reliability concerns with the vacuum system are related to long suction main distances (particularly to VVS-8) and flooding (particularly from the County storm drain at VVS-3).

O&M costs for the FLL collection system are high for the number of dwelling units service. The District would like to reduce the amount of O&M costs it expends on this system.

3.2.2 Data Collection

To prepare for this BCE, the following data collection tasks were performed as a basis for this analysis:

- Reviewed record drawings of the system.
- Interviewed District O&M staff.
- Reviewed annual labor and energy costs.
- Researched available information on alternative collection systems similar to FLL.

Review of available information indicated that the FLL collection system was installed between 1979 and 1983 as a combined pressure and vacuum flow system and serves approximately 200 dwelling units. The vacuum system was manufactured by AIRVAC and currently has six vacuum valve stations (VVS-3, VVS-4, VVS-5, VVS-6, VVS-7 and VVS-8). Three original vacuum valve stations and all original ejector stations were converted to nine electric pumping stations (ES-1, ES-2, ES-3, ES-5, ES-6, ES-7, ES-8, and ES-9) which consist of simplex or duplex submersible pump systems. The system also includes 2,600 lf of vacuum main, 17,000 lf of pressure main, 19,000 lf of gravity sewer, and the Main Pumping Station which houses the vacuum system equipment and centrifugal pumps to pump the wastewater collected in the vacuum system.

The FLL system requires moderate to heavy maintenance and is not easily accessible during winter. Maintenance to the FLL system costs the District almost $83,000 per year for labor and energy which is equivalent to $415 per year per dwelling unit served.

The geotechnical characteristic of the ground surrounding Fallen Leaf Lake is hard rock, in which it is difficult and expensive to install a typical gravity sewer system. The Fallen Leaf Lake development is served by a narrow, single-lane road along the shore of the lake. The system has a high consequence of failure due to its proximity to the lake, which has recreational uses and also serves as a water supply. The FLL collection system is illustrated in Figure 3-2.

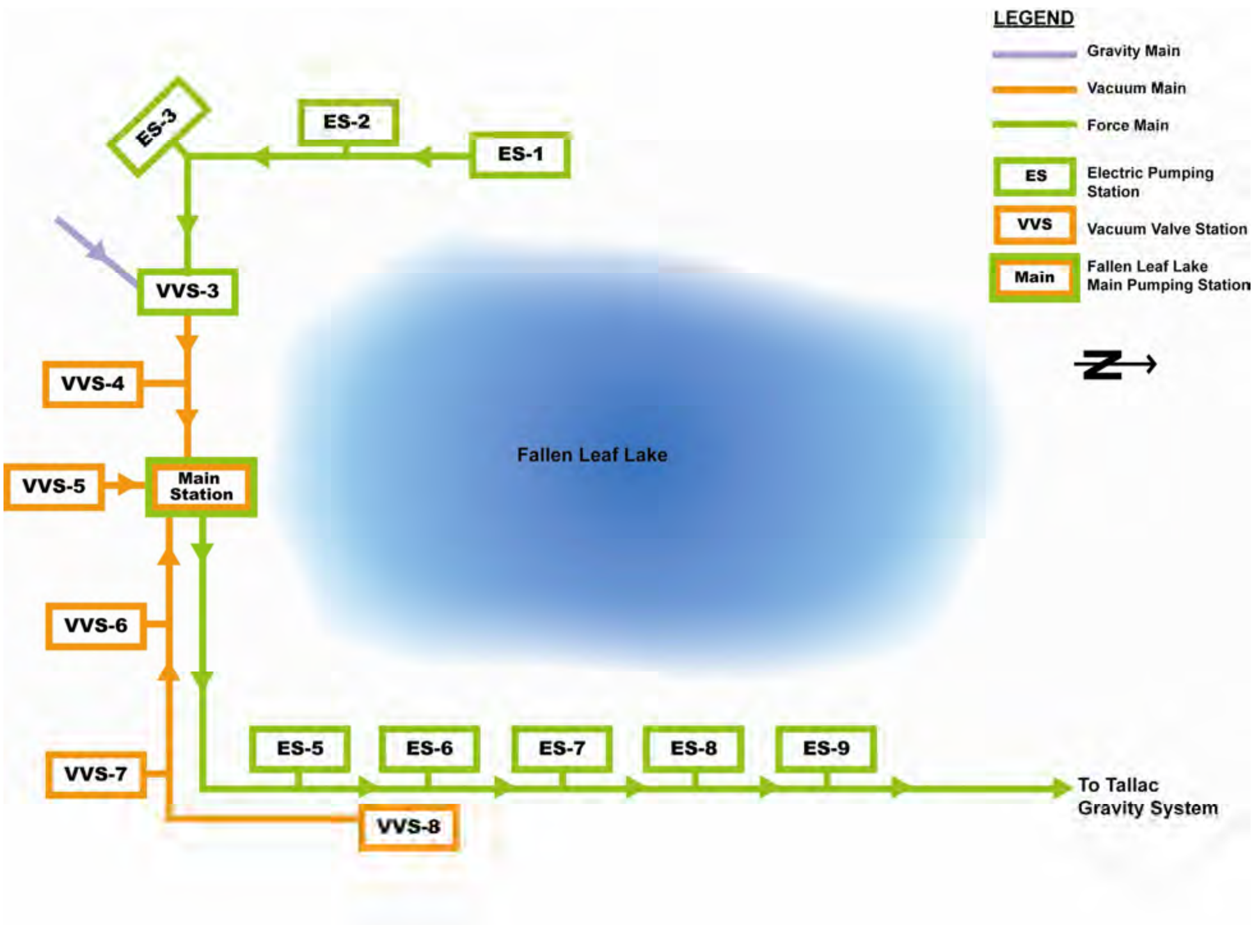


Figure 3-2. Fallen Leaf Lake Collection System

3.2.3 Identify and Screen Alternatives

BC met with District staff at a workshop in May 2009 to discuss alternatives for improving the FLL system. The following alternatives were developed and discussed at the workshop. Several of the alternatives were deemed "not feasible" for reasons included in the discussions below. Because the electric stations were recently upgraded and are functioning as designed, the District indicated that this part of the system should be left in place. The focus of the BCE alternatives revolves around improvements to the vacuum system.

Alternative 1 – Status Quo/Do Nothing

The first alternative for a BCE is the "Status Quo/Do Nothing" alternative. This alternative typically has the highest level of risk and it is the alternative to which all other alternatives are compared. The risk associated with the "Status Quo/Do Nothing" alternative is unacceptable to the District but it will be evaluated for comparison purposes. The "Status Quo/Do Nothing" alternative includes the Priority 2 project of upgrading the FLL Main Station to address safety and maintenance issues in 2019.

Alternative 2 – Replace vacuum system with gravity

Alternative 2 includes replacing the vacuum system with a gravity system. While this alternative is feasible conceptually, it could not be completed without deep excavation (more than 20 ft.) in rock in the existing single lane road. This alternative is not possible without closing access to some parts of FLL for an extended period of time which would disrupt residents, visitors, and emergency services. The District determined this option is not feasible because of implementation risks due to access needs at all parts of FLL.

Alternative 3 – Replace vacuum system with storage

Alternative 3 includes replacing the vacuum system with onsite storage at each vacuum valve location. This alternative would require the construction of storage vaults at each vacuum valve location, which may require closing access to some parts of FLL for a short period of time. This alternative would also require frequent pumping of the storage tanks, which would increase large truck (Vactor) traffic on the single lane road serving FLL. The District determined this option is not feasible because of implementation risks associated with the anticipated significant increase in traffic in FLL.

Alternative 4 – Replace entire vacuum system with electric pumping stations

Alternative 4 includes replacing the vacuum system with electric pumping stations in the same manner that ES-1, ES-2 and ES-3 previously replaced existing air ejector stations. For this alternative, VVS-5, VVS-6, VVS-7, and VVS-8 would be replaced with electric pumping stations that would then be tied into the existing 4-inch diameter PVC force main that serves the FLL Main Station. VVS-3 and VVS-4 would also be converted to electric pumping stations which would tie into the existing 6-inch diameter PVC vacuum line which would be converted into a force main. Some modifications to the force main may be necessary at the existing vacuum lift locations. Stanford Generating Station could serve as a backup power source for some or all of the new electric stations. This should be evaluated during the preliminary design of the improvements.

The District determined that this is a feasible alternative and that it could likely be implemented in phases if necessary. Phase 1 would include the conversion of VVS-5, VVS-6, VVS-7, and VVS-8 where the District has the most issues currently. Improvements to VVS-3, VVS-4 and FLL Main Station could be implemented as part of the second phase. The second phase is anticipated to occur in 2014.

Alternative 5 – Replace VVS-8 and upgrade VVS-3

Alternative 5 focuses on VVS-3 and VVS-8 which were identified as the vacuum valves with the highest risk. VVS-3 is subject to flooding and VVS-8 is at the end of a long suction main which can result in a reduction of capacity. VVS-3 would be reconstructed to preclude flooding. This could require relocating VVS-3 away from the flood area. VVS-8 would be replaced with a new electric station consisting of duplex submersible pumping system, septic tank wet well, valves and piping, control system, and connection to the 4-inch force main.

The District determined that this is a feasible alternative. The alternative includes the Priority 2 project of upgrading the FLL Main Station to address safety and maintenance issues in 2019.

Alternative 6 – Upgrade the existing vacuum system

Alternative 6 includes making upgrades to the existing vacuum system by relocating or reconstructing the valve vaults so that they cannot be inundated with water during flooding events. This alternative would require the construction of new vaults at each vacuum valve location, which may require closing access to some parts of FLL for a short period of time. This alternative may also require acquiring additional easements to relocate some vault locations which may not be possible in some areas due to the topography. This alternative would also not resolve the current issues at VVS-8 where there is often not enough suction to open the valve. The District determined this option is not a preferred long-term solution because of the continuing risk associated with the vacuum system and therefore should be eliminated.

Alternative 7 – On-site treatment

Alternative 7 includes replacing the vacuum system with onsite wastewater treatment (septic system) at each vacuum valve location. This alternative is not feasible due to RWQCB regulations and the risk of drinking water source contamination.

3.2.4 Develop Cost Information

The next step in the BCE is the development of cost information for each of the proposed alternatives. For the NPV analysis an inflation rate of 3.5 percent and a discount rate of 5 percent were assumed. Capital costs for construction of pipelines and pumping stations were developed utilizing the cost criteria presented in the Section 5. Labor and energy costs for operations and maintenance were provided by the District. The primary risk costs associated with each alternative is a RWQCB fine for an SSO to Fallen Leaf Lake. The *annual* risk cost for Alternative 1 was assumed to be approximately $50,000 ($1 million fine and economic loss every 20 years). System rehabilitation and renewal costs were estimated at $50,000 per year.

For Alternative 4, risk costs were assumed to decrease by 50 percent and labor costs were assumed to decrease by 25 percent; energy costs and system renewal costs were assumed to remain the same.

For Alternative 5, risk costs were assumed to decrease by 25 percent and labor costs were assumed to decrease by 12 percent; energy costs and system renewal costs were assumed to remain the same.

3.2.5 Net Present Value Analysis

The results of the Net Present Value Analysis are summarized below and in Attachment A. Alternatives 1, 4, and 5 were the only remaining alternatives after the District determined that Alternatives 2, 3, 6, and 7 were not feasible for reasons stated in the previous section.

- Alternative 1 – Status Quo / Do Nothing – upgrade FLL Main Station
  - Capital Cost: $295,000
  - NPV: $4,792,000
  - Benefit over "Status Quo / Do Nothing" Alternative: $0
- Alternative 4 – Replace vacuum system with pumping stations; leave ES in place; upgrade FLL Main Station.
  - Capital Cost: $1,543,000
  - NPV: $4,980,000
  - Benefit over "Status Quo / Do Nothing" Alternative: ($187,000)

- Alternative 5 – Relocate VVS-3 and replace VVS-8 with a pumping station; leave remainder of vacuum system and ES in place; upgrade FLL Main Station.
    - Capital Cost: $554,000
    - NPV: $3,312,000
    - Benefit over "Status Quo / Do Nothing" Alternative: $1,480,000

3.2.6 BCE Results and Recommendation

The BCE evaluation of Alternatives 1, 4, and 5 illustrates that a comprehensive replacement of the vacuum system is not cost-effective (Alternative 4). However, replacing VVS-8 and relocating VVS-3 (Alternative 5) would reduce the overall system risk, have lower capital costs, and have lowest net present value by $1,480,000. Alternative 5 is the recommended improvements for the FLL collection system. Also, it is recommended that the gravity pipe upstream of VVS-3 that is attached to the bridge over Glenn Alpine Creek be inspected (based on discussions from TM 3).

3.3 Capital Improvement Projects

Improvement projects for Priority 1 and 2 pump stations will help prevent SSOs, improve maintenance and safety. Projects are listed in Table 3-10 and project developments are discussed below. Design capacity is the future peak wet weather design flow from the hydraulic model.

Table 3-10. Pump Station Capital Projects

Project Name	Design Capacity, gpm
Next 10 Years	
Tahoe Keys Pump Station Capacity Upgrade	3,334
Fallen Leaf Lake Reliability Improvement	
VVS-3	100
VVS-8	100
SCADA Improvement	N/A
10 to 20 Years	
Al Tahoe Pump Station Maintenance Improvement	5,475
Bellevue Pump Station Improvement	350
Bijou Pump Station Improvement	2,360
Johnson Pump Station Improvement	1,505
Pioneer Village Pump Station Improvement	49
Pope Beach #1 Pump Station Improvement	100
Pope Beach #2 Pump Station Improvement	80
San Moritz Pump Station Improvement	417
Baldwin Beach Pump Station Improvement	400
Taylor Creek Pump Station Improvement	1,000
Trout Creek Pump Station Improvement	868
Venice Pump Station Improvement	95
FLL Main Pump Station Improvement	180

Note: Pump station design capacity based on design flows from the hydraulic model. These flows should be confirmed and updated following future wet weather flow monitoring.

3.3.1 Next 10 years

Projects to address the Priority 1 risks should be implemented in the next 10 years. In addition, the District desires to update the SCADA system within the next 10 years even though the SCADA system update was determined to be Priority 2.

Tahoe Keys Pump Station Capacity Upgrade

The existing pump station has inadequate hydraulic capacity under existing and build-out wet weather conditions which could result in a SSO. Build out PWWF is 3,334 gpm. This project would include replacing the two existing pumps. The existing pumps are no longer manufactured so additional modifications at the pump station may be needed to accommodate new pumps.

Fallen Leaf Lake Reliability Improvement

The existing VVS-8 should be replaced with a new electric station that includes duplex submersible pumps, septic tank wet well, valves and piping, control system, and connection to the 4-inch force main. The existing VVS-3 should be relocated away from the existing flood area to provide better access and reduce the chance of the vacuum valves being flooded. It is anticipated that the work at VVS-3 and VVS-8 will be included in one project.

SCADA Improvement

The SCADA system needs to be expanded to include every pumping facility and to transmit a larger array of alarms that will allow the District's crews to respond to problems better prepared. The SCADA system should also include intruder alarms to alert the District if there is an unauthorized entry into a pump station. The Central Control Center needs a server to manage the increased amount of SCADA data and allow better monitoring and tracking of the alarms, status of equipment, equipment run times, etc. This information should be readily available in reports generated on a regular basis.

It is anticipated that the SCADA system will be one project that can be implemented in several phases.

3.3.2 10 to 20 years

Thirteen pump station projects are identified to be completed in the 10 to 20 year time frame. These projects fall into two categories, employee safety improvements and maintenance improvements.

Employee Safety Pump Station Improvements

Twelve existing pump stations that have wet wells that are only accessible by ladder and are permitted confined spaces should be modified/replaced to eliminate these potential hazards to employee safety and to simplify maintenance. The pump station projects are listed in Table 3-10. The design flow is based on the hydraulic evaluation in TM 8.

As discussed later in this section, it is recommended that the District consider adopting a standardized pump station design for replacing these pump stations with new submersible pump stations. The submersible pump stations would eliminate the dry well safety issues, save construction costs, and simplify operations and maintenance. New pump stations could be implemented in several phases over several years.

Pump Station Maintenance Improvements

Seven pump stations were identified as having excessive maintenance requirements. Five of the seven pump stations with excessive maintenance are recommended to be modified/replaced to address employee safety issues. Maintenance problems at these pump stations should be addressed during the planned modifications/replacement.

Beecher pump station was recently renovated which should have addressed its historic maintenance problems.

This leaves Al Tahoe with continuing maintenance issues. The maintenance project for this pump station is envisioned to include modification of pump piping and replacement of pipes for cost estimating purposes. The detailed scope of improvements will be determined during design.

3.3.3 Current District Projects

The District does not have any additional pump station projects beyond what is currently being planned for this Master Plan.

3.4 Other Pump Station Recommendations

Besides capital projects, the condition and hydraulic evaluations developed other recommendations for the District's pump stations.

3.4.1 O&M Projects

Several items were noted during the pump station condition assessments that should be addressed but do not warrant a capital improvement project. Instead, these improvements can be implemented by the District's O&M staff. The District has a very capable O&M staff that undertakes projects to improve the operation and reduce maintenance of pump stations. The recommended projects for District staff to implement are summarized below.

Safety

- Wet wells should have fall protection when hatches are open. OSHA requires that fall protection be provided to protect workers from falls over 6 feet. The District should review its safety policy on opening wet well access hatches to ensure compliance.
- Combustible gas detectors should be installed in wet wells. National Fire Protection Association (NFPA) 820 recommends that combustible gas detectors be provided in wet wells.
- Beecher Pump Station needs removable bollards to protect its electrical panels from vehicular traffic.
- The electrical cabinet at the Beecher Pump Station has deteriorated wooden supports that need to be replaced.
- Electrical outlets at pump stations should be Ground Fault Circuit Interrupt protected.
- Electrical equipment layouts should be evaluated to ensure compliance "Working Space" requirements in NEC 110-26 Table A1 Working Space and "Not Readily Accessible" requirements in NEC 100 General.

Structural

- Metal items in the wet wells (including ladders) should be removed.

Other

- Two pump stations (Flanders and Taggart) have only one pump. A second pump should be installed so the pumping system can operate as duty/standby. This would increase the reliability of these stations.

- Dry wells have only one sump pump. A second sump pump should be installed to provide redundancy.

3.4.2 Recommendations

Other recommendations concerning the District's pump stations are related to staffing and standardized pump station design.

Staffing

The District has been able to retain its staff for many years; and therefore, the staff has significant experience and internal knowledge of the pump stations. Replacing employees that retire or leave with similarly knowledgeable employees may be difficult because of the current employees' high skill level and knowledge of facilities. One strategy to help alleviate this problem is to standardize pump station equipment. New employees would need less time to become familiar with operating and maintaining standardized equipment and small spare part inventories would be needed.

The District is standardizing on some types of equipment. One example is standardizing on generators manufactured by Katolight and having 200 gallons of fuel storage. This approach should be broadened to include controls, pumps, motors, electrical equipment, and ancillary equipment.

Standardization of Pump Station Design

The District should standardize its pump station design. Many pump stations will be over 50 years old during this master plan's planning period and many pump station have inherent deficiencies in their design that increases maintenance costs and risk of injury to employees. These design deficiencies include dry wells that are permitted confined spaces with ladder access.

A standardized pump station design should consider submersible pump stations. Submersible pump stations are less costly to build and maintain. With standardized equipment, submersible pumps can be readily pulled and repaired on site or at the District's yard and standard submersible replacement pumps can be installed to maintain pumping redundancy.

Standardized submersible pump station designs have less equipment to operate and maintain than wet well/dry well pump stations. They are also easier for new employees to learn to operate and maintain.

4. PIPELINE CAPITAL IMPROVEMENT PROJECTS AND RECOMMENDATIONS

Pipeline capital project development was completed in the same manner as the pump station capital project development. Capital projects are based on the results of the condition and maintenance assessment and the hydraulic evaluation. The following sections describe the risk assessment that was performed for the District's pipeline assets.

4.1 Risk Assessment

Pipeline risk assessments cover two of the three LOS which are addressed below: community health, safety, and environment and collection system service. No employee safety LOS applied to the pipelines.

The likelihood aspect of the risk assessments is based on information from the Pipeline Condition Assessment TM (TM 7) and Hydraulic Evaluation TM (TM 8). The majority of the collection system was evaluated in the hydraulic analysis; however the condition assessment evaluated the available CCTV inspection data (approximately 14 percent of the collection system) and cleaning frequency data. Where there was no condition assessment data, the risk assessment was based on the available hydraulic evaluation data and cleaning frequency data.

4.1.1 Community Health, Safety, and Environment

Pipelines have three levels of consequence of failure when evaluating SSO risks. These levels of consequence of failure are discussed in Section 2.2.1. The likelihood of an SSO related to the Community Health, Safety, and Environment LOS is based on information from TM 7 and TM 8 and is listed in Table 4-1. These pipes were previously presented graphically in TM 7 and TM 8.

Table 4-1. Community Health, Safety, and Environment Related Likelihood of Pipeline SSO

Category	1	2	3	4
Condition	PACP Rating 4-5	PACP Rating 3-4	PACP Rating 2-3	PACP Rating 0-2
Hydraulics	Under capacity - current	Under capacity - future	Slightly surcharged – future	Not under capacity
I/I (R-factor)	R>10	R = 5–10	R = 2-5	R<2

The SSO risk matrix evaluation for Community Health, Safety, and Environment is presented in Table 4-2. Pipelines included in the orange highlighted areas are at the highest risk for an SSO.

Table 4-2 Risk Assessment for Community Health, Safety, and Environment Related Pipeline SSOs (Pipe Length, lf)

Likelihood	Consequence			
	1	2	3	Total
1	-	947	2,464	3,412
2	397	2,501	5,793	8,691
3	17,648	14,878	79,538	112,064
4	7,530	250,461	1,276,316	1,534,307
Total	25,575	268,788	1,364,111	1,658,474

Priority 1 (Orange)

3,412 feet of pipelines that were evaluated as part of the hydraulic and condition assessments are designated with Priority 1 risk for SSO related to community health, safety, and environment. These pipes include pipes with a Condition PACP Rating 4 to 5. There were no pipes that were considered under capacity during the current scenario nor any R-factors more than 10.

Priority 2 (Yellow)

2,898 feet of pipelines that were evaluated as part of the hydraulic and condition assessments are designated with Priority 2 risk for SSO related to community health, safety, and environment. These pipes include pipes with PACP Rating 3 to 4 and pipes that were considered under capacity during the future scenario. There were no R-factors between 5 and 10.

There are two capacity related projects that include several reaches that are Priority 2: Al Tahoe Relief Sewer Project and Bijou Relief Sewer Project. Not all of the reaches in these two relief sewer projects fall into the Consequence of 1 or 2 and therefore do not fall within the Priority 2 (Yellow) category according to Table 4-2. However, the Priority 3 reaches that are part of these two relief sewer projects will be assigned a Priority 2 rating in the risk assessment summary and will be part of the scheduled Priority 2 projects.

Priority 3

The remaining pipelines that were evaluated for this project are included in the Priority 3 category (no shading). Capital improvement projects are not anticipated on these pipelines within the next 20 years.

4.1.2 Collection System Service

Pipelines have three levels of consequence of failure when evaluating SSO risks. These levels of consequence of failure are discussed in Section 2.2.1. The likelihood of an SSO related to the Collection System Service LOS is based on information from TM 7 and is listed in Table 4-1. These pipes were previously presented graphically in TM 7.

Table 4-3. Collection System Service Related Likelihood of Pipeline SSO

Category	1	2	3	4
Maintenance	PACP Rating 4-5	PACP Rating 3-4	PACP Rating 2-3	PACP Rating 0-2
Cleaning Frequency	Not Used	Cleaned more than 4/yr	Cleaned 2-4/yr	Cleaned ≤1/yr

The SSO risk matrix evaluation for Collection System Service is presented in Table 4-4. Pipelines included in the orange highlighted areas are at the highest risk for an SSO.

Table 4-4 Risk Assessment for Collection System Service Related Pipeline SSOs (Pipe Length, lf)

	Consequence			
Likelihood	1	2	3	Total
1	-	1,532	8,134	9,667
2	-	10,503	61,704	72,207
3	3,683	31,240	106,509	141,431
4	21,893	225,513	1,187,764	1,435,170
Total	25,575	268,788	1,364,111	1,658,474

Priority 1 (Orange)

9,667 feet of pipelines that were evaluated as part of the condition assessment are designated with Priority 1 risk for SSO. These pipes include pipes with maintenance PACP Rating of 4 to 5.

Priority 2 (Yellow)

10,503 feet of pipelines that were evaluated as part of the condition assessment are designated with Priority 2 risk for SSO. These pipes include pipes with maintenance PACP Rating of 3 to 4 or that are cleaned more than 4 times per year.

Priority 3

The remaining pipelines that were evaluated for this project are included in the Priority 3 category (no shading). Capital improvement projects are not anticipated on these pipelines within the next 20 years.

4.1.3 Risk Assessment Summary

The risk assessment for the pipelines evaluated community health, safety, and environment LOS and collection system service LOS. Priority 1, 2, and 3 pipe reaches were identified for each of these two LOS. Table 4-5 summarizes combined priority for each pipe reach where the minimum priority number of the two (community health, safety, and environment LOS and collection system service LOS priorities was assigned as the overall priority. Also, the entire project lengths for the Al Tahoe Relief Sewer Project and Bijou Relief Sewer Project were included in Priority 2.

This overall risk assessment can be used to prioritize maintenance and condition related pipeline rehabilitation and replacement projects.

Table 4-5 Combined Priority

Overall Priority[1]	Length
1	13,078
2	16,716[2]
3	1,628,680

[1]*Lowest value of the priority assigned in the community health, safety, and environment LOS and collection system service LOS risk assessments.*
[2]*Includes 2,995 lf from Bijou and 529 lf from Al Tahoe that were P3*

4.2 Capital Improvement Projects

Improvement projects for Priority 1 and 2 pipelines will help prevent SSOs. This section outlines the proposed pipeline projects that will be implemented in the first ten years and those that will be implemented beyond ten years. The pipeline CIP priorities are shown on Figure 4-1.

4.2.1 Next 10 Years

High Maintenance and Poor Condition

Approximately 13,000 lf of Priority 1 pipe sewer replacement should be considered for rehabilitation. Additional rehabilitation needs will be identified from the District's ongoing CCTV inspection program. These rehabilitation needs will be addressed by an annual program.

Hwy 89-5th Street Relief Sewer

District staff identified this pipe as a high risk highway crossing. It is recommended that a parallel sewer be constructed using jack and bore to provide redundancy for this 12-inch gravity trunk sewer.

4.2.2 10 to 20 Years

Pipe and Manhole Rehabilitation

Approximately 17,000 lf of Priority 2 pipe sewer replacement should be considered for rehabilitation. Additional rehabilitation needs will be identified from the District's ongoing CCTV inspection program. These rehabilitation needs will be addressed by an annual program.

Al Tahoe Relief Sewer

Replace 1,284 lf of 8-inch, 300 lf of 12-inch, and 397 lf of 18-inch VCP trunk sewer that is determined to be under capacity in the future during a 25-year design storm. Pipe reaches that are replaced within two pipe sizes of the original diameter can be pipe burst, which could reduce the cost of construction. The future increase in estimated base flow for this project is contributed by a currently vacant parcel that has a commercial land use designation.

Bijou Relief Sewer

Replace 1,057 lf of 6-inch, 1,150 lf of 8-inch, 500 lf of 10-inch, and 290 lf of 12-inch ACP trunk sewer that is determined to be under capacity in the future during a 25-year design storm. This project must be constructed using the open cut construction method because the pipe material is ACP.

4.2.3 Current District Projects

Wildwood Sewer Interceptor

This project should be coordinated with the Bijou Relief Sewer capacity project.

Force Main Bypass– Al Tahoe and Tahoe Keys

This project includes teeing off the force main or discharge header with a camlock to allow force main bypass in the event that the Al Tahoe Pump Station Force Main or Tahoe Keys Pump Station Force Main needed repair. Another option of constructing parallel force mains was evaluated for bypassing the force mains. However, this option was much more expensive than installing tees on the existing force main.

Cleaning of Sewer Trunk Line

The District is planning on contracting to have portions of its trunk sewers cleaned, specifically the "Myers Trunk" from Hwy 50 to Hwy 50.

4.3 Other Pipeline Recommendations

The condition and hydraulic assessments identified other recommendations that are not capital projects.

Maintenance Projects

The District's pipeline maintenance staff should implement or continue the following work.

- Prioritize CCTV inspections and develop plan to evaluate results.
- Inspect stream crossings two times per year and meadow sewers every 18 to 24 months.
- Maintain ARVs on all forcemains to ensure their proper operation and protect the pipeline from damage. This work will be a shared responsibility between the pump crews and the underground maintenance crews.

- Monitor manholes where force main's discharge on an annual basis to evaluate corrosion.

Policies

Several policies are recommended to ensure the proper long term operation and maintenance of the collection system pipelines.

- Minimum pipe diameter should be eight inches. When existing 6-inch pipes are scheduled for rehabilitation or replacement, they should be replaced with 8-inch pipe to reduce maintenance.
- Private building laterals should be tested and renovated on a standard basis to control infiltration and inflow. Many communities require lateral testing when a property is sold.

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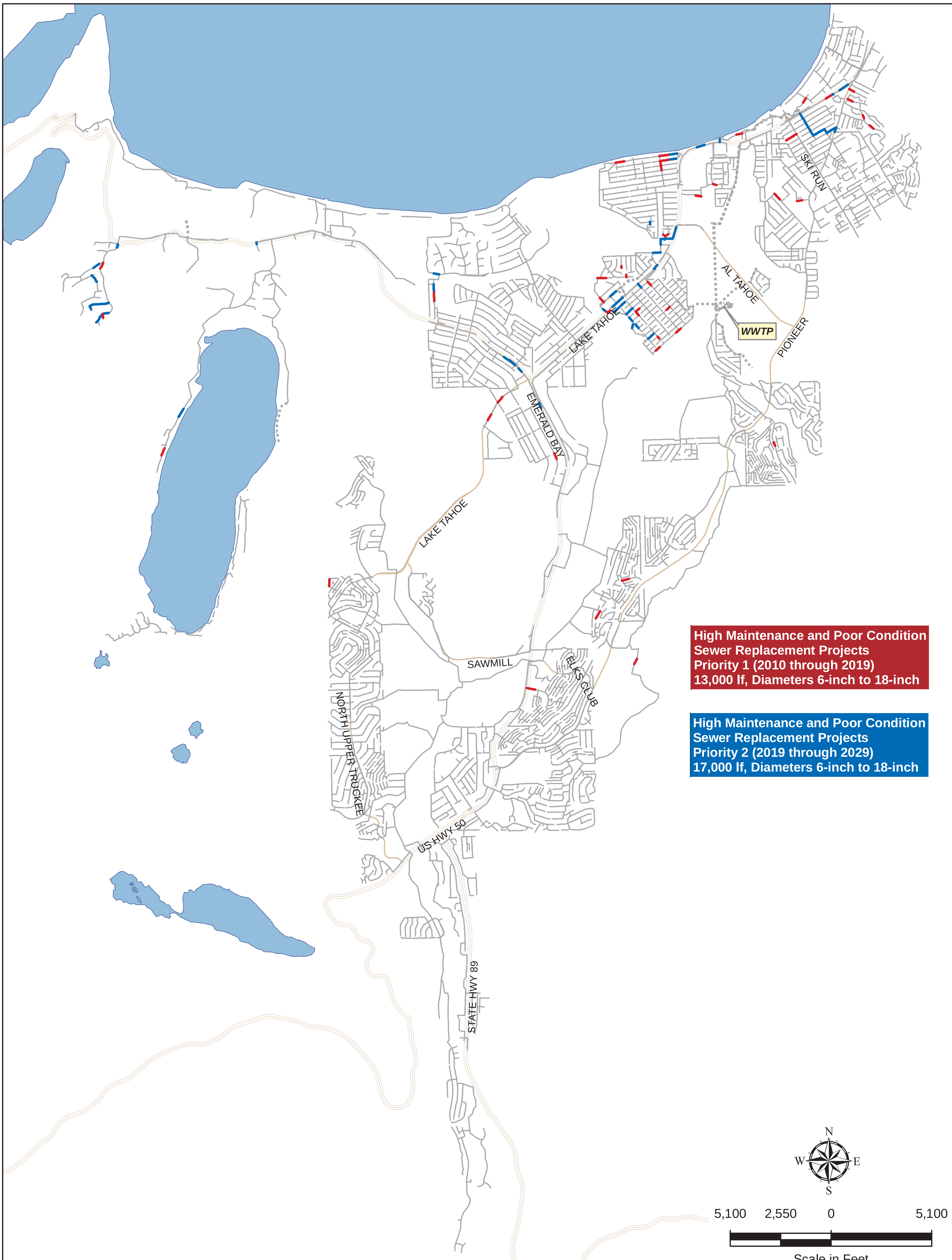


LEGEND

Priority Pipes for CIP Projects

- P1 (0 - 10 years)
- P2 (10 - 20 years)
- P3 (Not Priority)

Force Mains

ROADS

- HWY
- Major

BROWN AND CALDWELL

SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 4-1
Pipeline CIP Priority Ranking

5. CAPITAL IMPROVEMENT PROGRAM

This section summarizes the development of construction and capital costs and the prioritization and integration of recommended capital projects into the District's current capital improvement program. Capital improvement projects developed for this master plan are shown on Figure 5-1.

5.1 Other Capital Projects

Sections 3 and 4 of this TM identify capital projects to address specific problems in the collection system. Other types of projects are also needed for the proper operation of the collection system. These projects are:

1. Pipe and Manhole Rehabilitation. The District currently spends about $50,000-$100,000 per year on spot repairs. Therefore, $100,000 will be allocated yearly for pipe and manhole rehabilitation for the period between 2010 and 2019. As the collection system increases in age, the annual expenditure is likely to need to increase. For the period between 2020 and 2029, the annual expenditure is projected to increase to $200,000.
2. Wet weather flow monitoring
3. Master Plan Update

Capital improvement project worksheets were developed for each of the projects identified to occur within the next ten years. These worksheets provide a detailed summary of the proposed project including a project description, proposed pipe lengths and diameters, pump station capacities, project costs, schedule and a map illustrating the proposed improvements.

5.2 Construction Costs

This section describes the development of construction costs for recommended improvements to the District's collection system. Construction costs are based on recent bid tab unit costs which are discussed below.

5.2.1 Cost Index

A good indicator of changes over time in construction costs is the Engineering News Record (ENR) 20-city Construction Cost Index (CCI), which is computed from prices of construction materials and labor, and based on a value of 100 in 1913. Cost data for the ladder access pump stations in this TM are based on an ENR, CCI of 9103.

5.2.2 Pipelines

Construction Methods

Three construction methods are considered for this master plan: open cut, pipe bursting, and jack and bore.

Open Cut Construction. Open cut construction is the traditional method of installing sewer pipe and consists of excavating a trench along the alignment of the existing sewer reach, removing the existing sewer pipe, and installing a new sewer pipe. The new pipe can be at the same or a different pipe diameter as the existing pipe.

Pipe Bursting. Pipe bursting is a trenchless method of constructing replacement sewer pipe. The replacement sewer can be of the same or slightly larger diameter (up to two nominal pipe diameter sizes) as the existing pipe. Pipe bursting is not recommended for asbestos-cement pipe (ACP) because of regulatory concerns about asbestos. The Bay Area Air Quality Management District released a compliance advisory in June 2006 requiring notification from planning and public works departments when 100 linear feet or more of ACP is disturbed. The advisory states that the bursting and reaming processes have been determined by EPA to make the AC pipe friable and therefore becomes a regulated asbestos-containing material waste. EPA has determined that bursted ACP in the ground is an active asbestos waste disposal site.

The District does not prefer to use the pipe bursting method because much of the District collection system is ACP.

Jack and Bore. Jack and bore construction is used to cross highways, streams, and other areas where open cut construction is not allowed. The process typically includes boring a hole and inserting a steel casing pipe. The sewer pipe is then placed inside the casing pipe.

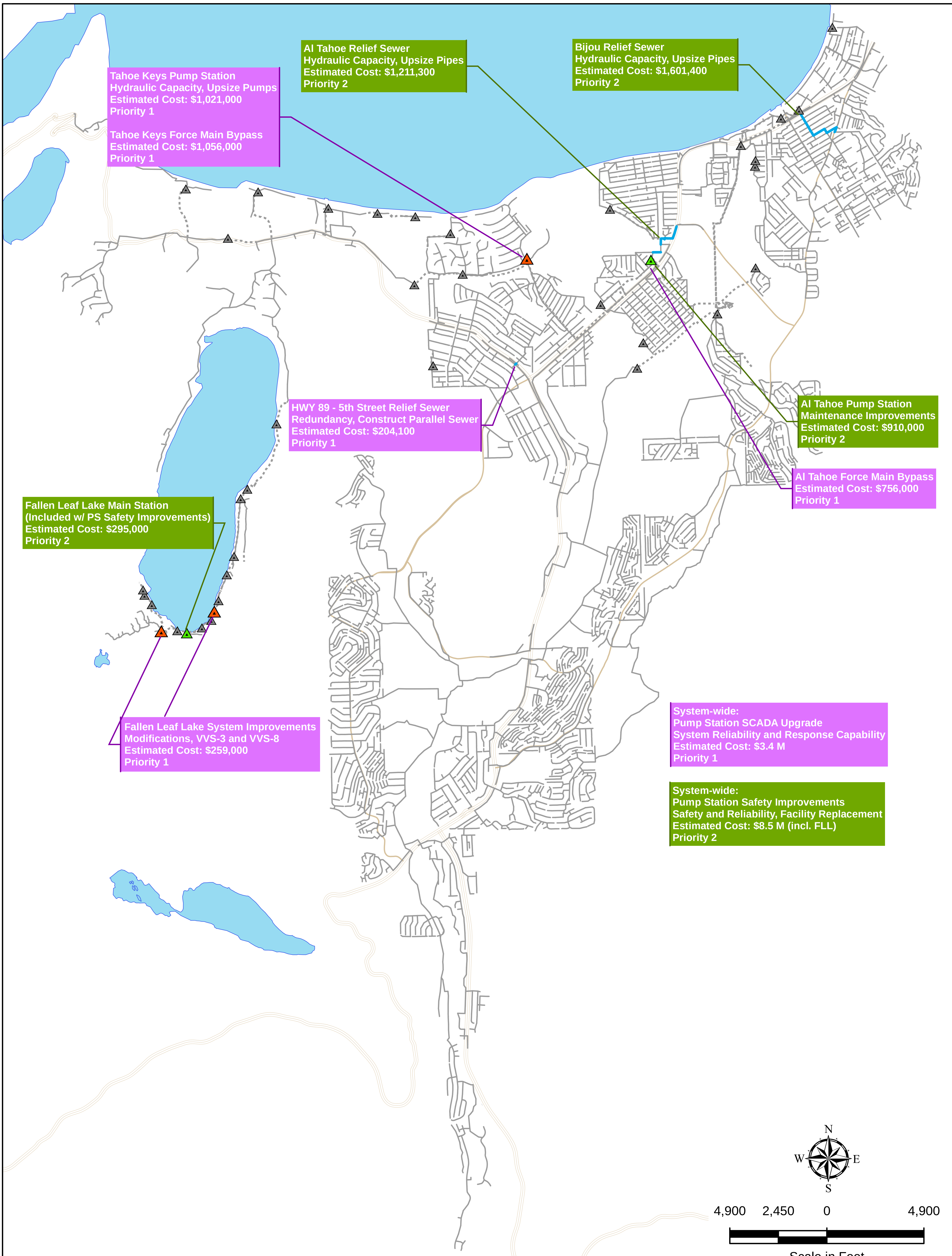
Planning Level Unit Costs

Planning level costs developed for this master plan are based on planning level unit costs and preliminary pipeline lengths and diameters. Planning level unit costs were developed from bid tabs from recent pipeline construction projects in Northern California and confirmed with bid results from two recent District sewer projects.

The planning level unit costs are presented in Table 5-1 and include the base unit cost of the pipe and other items such as mobilization; demobilization; traffic control; sheeting, shoring and bracing; excavation and dewatering; standard manholes at typical intervals; typical surface restoration; and erosion, and sediment and storm water control.

Table 5-1. Sewer Pipe Unit Construction Cost

Diameter (in)	Open-Cut Cost with MH $/lf	Pipe Bursting Cost with MH $/lf	Jack and Bore Cost with MH $/lf
8	$299	$202	$389
10	$308	$220	$400
12	$370	$264	$480
15	$462	$330	$601
18	$455	$396	$592
21	$531	$462	$691
24	$607	$528	$789



BROWN AND CALDWELL

SOUTH TAHOE PUBLIC UTILITY DISTRICT
MASTER PLAN

Figure 5-1
Capital Improvement Projects

LEGEND

Pump Station CIP
- Priority 1
- Priority 2
- No Project

Gravity Main CIP
- Priority 2
- No Project

Force Mains

ROADS
- HWY
- Major

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5.2.3 Pump Stations

Planning level pump station costs are based on the cost curves for submersible pump stations from Pumping Station Design, Second Edition by Robert L. Sanks. This book is an industry standard for pump station design and is shown on Figure 5-2.

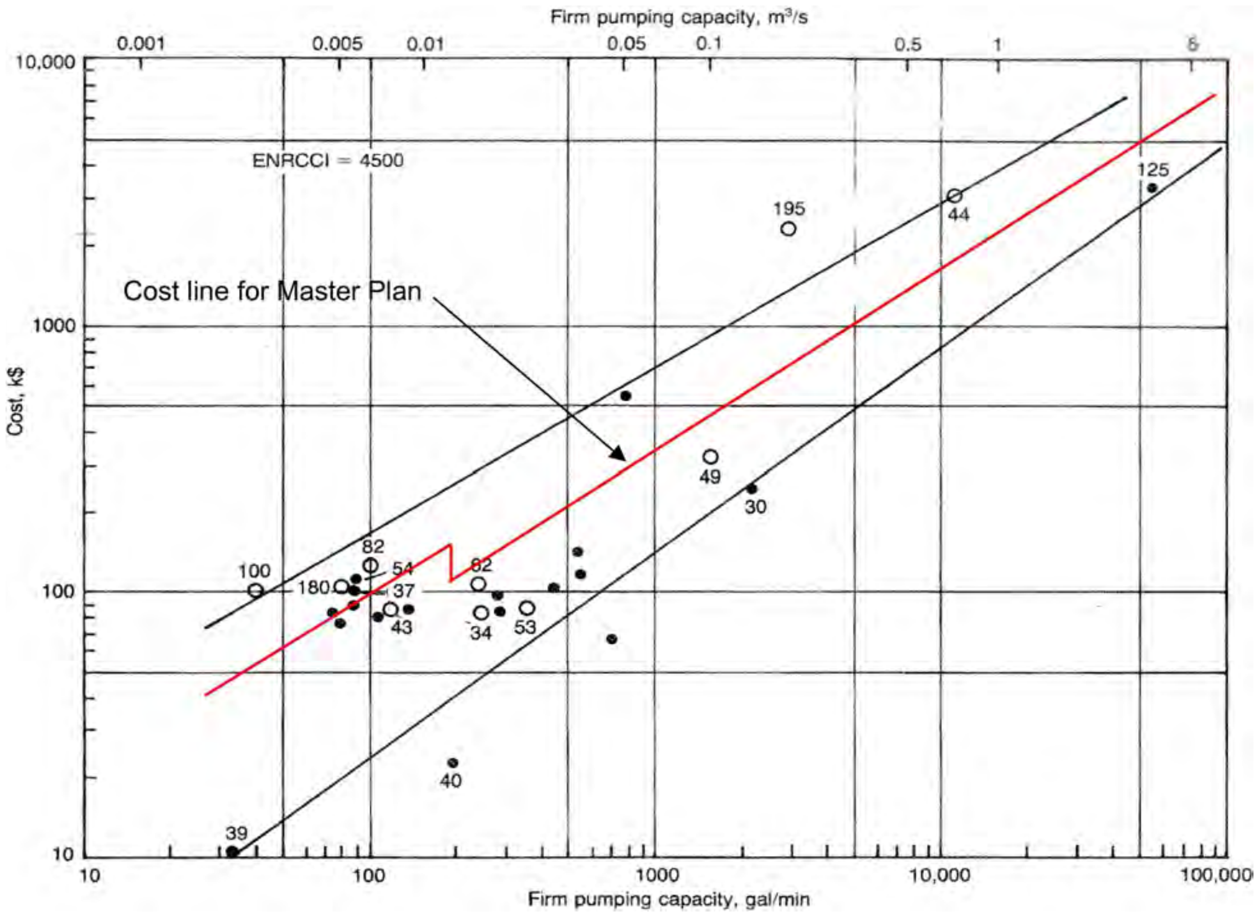


Figure 5-2. Planning Level Pump Station Construction Costs

Jones et Al, 2008. Pumping Station Design, Revised Third Edition, Garr M. Jones (Editor-in-Chief), Elsevier Inc., 2008.

The figure shows a range of planning level pump station costs. For this project, the median planning level pump station costs are used to estimate pump station costs, except for smaller submersible pump stations with capacities less than 200 gpm. The smaller pump station costs were estimated to be 60 percent of the pump station cost curve, which includes stand-by power.

5.2.4 Contingency

A contingency of 35 percent is added to the planning level costs to obtain planning level construction costs. Planning level projects have many inherent uncertainties and it is appropriate to include a contingency allowance to cover the potential additional construction costs associated with the uncertainties. Uncertainties associated with planning-level projects include unexpected geotechnical conditions, extraordinary utility relocation, alignment changes, and permits. All of these uncertainties can increase the construction cost.

5.3 Capital Costs

The total capital investment necessary to complete a project consists of expenditures for design and construction period engineering and administration of the project. Engineering services associated with projects are estimated at 15 percent of the construction cost and include preliminary investigations and reports, site and route surveys, geotechnical explorations, preparation of drawings and specifications, construction services, surveying and staking, and sampling and testing of materials. Administrative charges are estimated at 5 percent of the construction cost and include legal fees, financing expenses, administrative costs, and interest during construction. The total allowance for engineering and administrative costs is 20 percent of the construction cost.

5.4 Capital Program Summary

The capital projects with their estimated construction and capital costs are listed in Table 5-2. The capital projects are integrated into the District's existing capital improvement program for the first 10 years (FY 2009 through FY 2019) and capital projects recommended for later implementation are listed to occur between FY 2020 and 2029.

Capital project worksheets were developed for collection system capital project designated for implementation in the next 10 years. The worksheets are provided in Attachment B and contain details on the planning level construction and capital costs. Planning level construction and project costs for projects designated for implementation between 2019 and 2029 are contained in Attachment C. Capital improvement program cost development is also provided in Attachment C. Attachment D provides a detailed list of the pipes with overall priority 1 and 2 ratings.

Table 5-2. Capital Improvement Plan

Project and Priority Ranking	Project Type	Project Name	Construction Cost ($)	Design, Administration, Construction Services ($)	Capital Cost ($)	Anticipated Spending ($) per Fiscal Year Ending June 30											
						2009 - 2010	2010 - 2011	2011 - 2012	2012 - 2013	2013 - 2014	2014 - 2015	2015 - 2016	2016 - 2017	2017 - 2018	2018 - 2019	2019-2029	Totals
Pipeline Projects																	
-	Pipeline	Wildwood Sewer Interceptor	-	-	1,653,000						580,000	1,073,000					1,653,000
-	Pipeline	Force Main Bypass - Al Tahoe	630,000	126,000	756,000				756,000								756,000
-	Pipeline	Force Main Bypass – Tahoe Keys	880,000	176,000	1,056,000				1,056,000								1,056,000
-	Pipeline	Cleaning of Sewer Trunk Lines	-	-	554,000								554,000				554,000
1	Pipeline	HWY 89 - 5th St. Relief Sewer	170,100	34,000	204,100		204,100										204,100
1	Pipeline	High Maintenance and Poor Condition Sewer Replacement (Priority 1)	749,970	150,030	900,000		100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000		900,000
2	Pipeline	High Maintenance and Poor Condition Sewer Replacement (Priority 2)	1,666,600	333,400	2,000,000											2,000,000	2,000,000
2	Pipeline	Al Tahoe Relief Sewer (Open-Cut)	1,171,100	234,200	$1,405,300											1,405,300	1,405,300
2	Pipeline	Bijou Relief Sewer	1,334,500	257,000	1,601,400											1,601,400	1,601,400
Pump Station Projects																	
1	Pump Station	SCADA Upgrades	2,835,000	567,000	3,402,000					850,500	850,500	850,500	850,500				3,402,000
1	Pump Station	Tahoe Keys Pump Station Capacity Upgrade	851,000	170,000	1,021,000			1,021,000									1,021,000
1	Pump Station	Fallen Leaf Lake System Improvements (Upgrade VVS #3, Replace VVS #8)	216,000	43,000	259,000					259,000							259,000
2	Pump Station	Al Tahoe Pump Station Maintenance Improvements	751,000	150,000	901,000											901,000	901,000
		Pump Station Safety Improvements															
		Baldwin Beach	518,800	103,800	622,600											622,600	622,600
		Bellevue	464,300	92,900	557,200											557,200	557,200
		Bijou	1,638,500	327,700	1,966,200											1,966,200	1,966,200
		Johnson	1,365,400	273,100	1,638,500											1,638,500	1,638,500
		Pioneer Village	98,300	19,700	118,000											118,000	118,000
		Pope Beach #1	163,900	32,800	196,700											196,700	196,700
		Pope Beach #2	131,100	26,200	157,300											157,300	157,300
		San Moritz	532,600	106,500	639,100											639,100	639,100
		Taylor Creek	901,300	180,300	1,081,600											1,081,600	1,081,600
		Trout Creek	819,300	163,900	983,200											983,200	983,200
		Venice	163,900	32,800	196,700											196,700	196,700
2	Pump Station	FLL Main Station	245,800	49,200	295,000											295,000	295,000
Other Capital Expenditures																	
-	1	Master Plan Update	-	-	350,000											350,000	350,000
-	2	Flow Monitoring and Hydraulic Model Update	-	-	200,000		200,000										200,000
		TOTAL	**18,298,470**	**3,649,530**	**24,714,900**	**0**	**504,100**	**1,121,000**	**1,912,000**	**1,209,500**	**1,530,500**	**2,023,500**	**1,504,500**	**100,000**	**100,000**	**14,709,800**	**24,714,900**

1. Project costs are current to the Tahoe Basin Summer 2009. ENR CCI of 9103. They include a contingency of 35 percent and are AACE Class 5 Order of magnitude

2. These costs should be adjusted to the construction midpoint at the time of project planning.

3. The allowance for Design, Administration and Construction Services is 20 percent.

ATTACHMENT A- BUSINESS CASE EVALUATION

South Tahoe Public Utility District
Fallen Leaf Lake Collection System
Alternatives Net Present Value Analysis

Agency: South Tahoe Public Utility District

Project/Problem: Fallen Leaf Lake Collection System

		Risk Premium	Sensitivity Adjustments (%)			Results		
			Benefits	Capital Costs	Other Costs	Capital Cost	30-year NPV	Benefit over Status Quo
Alternative 1	Status quo - Do nothing					$295,000	($4,792,909)	
Alternative 4	Replace all VVS with ES; leave ES in place					$1,543,000	($4,979,878)	($186,969)
Alternative 5	Upgrade VVS-3 and replace VVS-8					$554,000	($3,312,024)	$1,480,885

Year of analysis: 2009
Escalation rate: 3.50%
Discount rate: 5.00%

Select one
- (●) All entries in dollars
- ( ) All entries in thousands of dollars

Note: "Status quo" refers to Alternative 1

South Tahoe Public Utility District
Fallen Leaf Lake Collection System
Life Cycle Alternative Cost Analysis ($000s)
Alternative 4 - Replace all VVS with ES; leave ES in place

From Summary Sheet:		Risk adjustments (+/- percent):	
Year of analysis	2009	Benefits	
Escalation rate	3.50%	Capital costs	
Discount rate	5.00%	Running costs	

Expressed in 2009 dollars, unescalated -- dollars

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Capital Outlays																														
Replace VV with Pumping Stations	713,000																													
Phase 2 VV Replacement						535,000																								
Mian Station Upgrade						295,000																								
Capital outlay 4																														
Capital outlay 5																														
Capital outlay 6																														
Total capital outlays	713,000					830,000																								
Benefits:																														
Benefit 1																														
Benefit 2																														
Benefit 3																														
Total benefits																														
Annual Running Costs:																														
Labor	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500	52,500
Sump Pumping	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Vacuum Power																														
ES Power	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900
Running cost 5																														
Running cost 6																														
Running cost 7																														
Running cost 8																														
Total running costs	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400	67,400
Annual Risk Costs:																														
SSO to Lake	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Risk cost 2																														
Risk cost 3																														
Risk cost 4																														
Risk cost 5																														
Total risk costs	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
R&R Costs:																														
System Renewal	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
R&R cost 2																														
R&R cost 3																														
R&R cost 4																														
R&R cost 5																														
Total refurbishments	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Net Benefit/(cost)	(855,400)	(142,400)	(142,400)	(142,400)	(142,400)	(972,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)	(142,400)

Expressed in escalated dollars with sensitivity adjustments

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Capital Outlays																														
Replace VV with Pumping Stations	713,000																													
Phase 2 VV Replacement						635,412																								
Mian Station Upgrade						350,367																								
Capital outlay 4																														
Capital outlay 5																														
Capital outlay 6																														
Total capital outlays	713,000					985,780																								
Benefits:																														
Benefit 1																														
Benefit 2																														
Benefit 3																														
Total benefits																														
Annual Running Costs:																														
Labor	52,500	54,338	56,239	58,208	60,245	62,354	64,536	66,795	69,132	71,552	74,056	76,648	79,331	82,108	84,981	87,956	91,034	94,220	97,518	100,931	104,464	108,120	111,904	115,821	119,875	124,070	128,413	132,907	137,559	142,374
Sump Pumping	2,000	2,070	2,142	2,217	2,295	2,375	2,459	2,545	2,634	2,726	2,821	2,920	3,022	3,128	3,237	3,351	3,468	3,589	3,715	3,845	3,980	4,119	4,263	4,412	4,567	4,726	4,892	5,063	5,240	5,424
Vacuum Power																														
ES Power	12,900	13,352	13,819	14,302	14,803	15,321	15,857	16,412	16,987	17,581	18,197	18,834	19,493	20,175	20,881	21,612	22,368	23,151	23,962	24,800	25,668	26,567	27,496	28,459	29,455	30,486	31,553	32,657	33,800	34,983
Running cost 5																														
Running cost 6																														
Running cost 7																														
Running cost 8																														
Total running costs	67,400	69,759	72,201	74,728	77,343	80,050	82,852	85,752	88,753	91,859	95,074	98,402	101,846	105,411	109,100	112,919	116,871	120,961	125,195	129,577	134,112	138,806	143,664	148,692	153,896	159,283	164,858	170,628	176,600	182,781
Annual Risk Costs:																														
SSO to Lake	25,000	25,875	26,781	27,718	28,688	29,692	30,731	31,807	32,920	34,072	35,265	36,499	37,777	39,099	40,467	41,884	43,350	44,867	46,437	48,063	49,745	51,486	53,288	55,153	57,083	59,081	61,149	63,289	65,504	67,797
Risk cost 2																														
Risk cost 3																														
Risk cost 4																														
Risk cost 5																														
Total risk costs	25,000	25,875	26,781	27,718	28,688	29,692	30,731	31,807	32,920	34,072	35,265	36,499	37,777	39,099	40,467	41,884	43,350	44,867	46,437	48,063	49,745	51,486	53,288	55,153	57,083	59,081	61,149	63,289	65,504	67,797
R&R Costs:																														
System Renewal	50,000	51,750	53,561	55,436	57,376	59,384	61,463	63,614	65,840	68,145	70,530	72,998	75,553	78,198	80,935	83,767	86,699	89,734	92,874	96,125	99,489	102,972	106,576	110,306	114,166	118,162	122,298	126,578	131,009	135,594
R&R cost 2																														
R&R cost 3																														
R&R cost 4																														
R&R cost 5																														
Total refurbishments	50,000	51,750	53,561	55,436	57,376	59,384	61,463	63,614	65,840	68,145	70,530	72,998	75,553	78,198	80,935	83,767	86,699	89,734	92,874	96,125	99,489	102,972	106,576	110,306	114,166	118,162	122,298	126,578	131,009	135,594
Net escalated benefit/(cost)	(855,400)	(147,384)	(152,542)	(157,881)	(163,407)	(1,154,906)	(175,046)	(181,173)	(187,514)	(194,077)	(200,869)	(207,900)	(215,176)	(222,707)	(230,502)	(238,570)	(246,920)	(255,562)	(264,506)	(273,764)	(283,346)	(293,263)	(303,527)	(314,151)	(325,146)	(336,526)	(348,304)	(360,495)	(373,112)	(386,171)

Life cycle cost analysis

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
PVs in 2009	(855,400)	(140,366)	(138,360)	(136,384)	(134,436)	(904,899)	(130,622)	(128,756)	(126,917)	(125,103)	(123,316)	(121,555)	(119,818)	(118,106)	(116,419)	(114,756)	(113,117)	(111,501)	(109,908)	(108,338)	(106,790)	(105,265)	(103,761)	(102,278)	(100,817)	(99,377)	(97,957)	(96,558)	(95,179)	(93,819)
NPV as of 2009	(4,979,878)																													

From Summary Sheet:		Risk adjustments (+/- percent):	
Year of analysis	2009	Benefits	
Escalation rate	3.50%	Capital costs	
Discount rate	5.00%	Running costs	

South Tahoe Public Utility District
Fallen Leaf Lake Collection System
Life Cycle Alternative Cost Analysis ($000s)
Alternative 5 - Upgrade VVS-3 and replace VVS-8

Expressed in 2009 dollars, unescalated -- dollars

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Capital Outlays															
VVS-3 upgrade	81,000														
VVS-8 replaced with ES	178,000														
Main Statin Upgrade											295,000				
Capital outlay 4															
Capital outlay 5															
Capital outlay 6															
Total capital outlays	**259,000**										**295,000**				
Benefits:															
Benefit 1															
Benefit 2															
Benefit 3															
Total benefits															
Annual Running Costs:															
Labor	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600
Sump Pumping	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Vacuum Power	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200
ES Power	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700
Running cost 5															
Running cost 6															
Running cost 7															
Running cost 8															
Total running costs	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**
Annual Risk Costs:															
SSO to Lake	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500
Risk cost 2															
Risk cost 3															
Risk cost 4															
Risk cost 5															
Total risk costs	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**
R&R Costs:															
System Renewal															
R&R cost 2															
R&R cost 3															
R&R cost 4															
R&R cost 5															
Total refurbishments															
Net Benefit/(cost)	**(373,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(409,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**

Year	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Capital Outlays															
VVS-3 upgrade															
VVS-8 replaced with ES															
Main Statin Upgrade															
Capital outlay 4															
Capital outlay 5															
Capital outlay 6															
Total capital outlays															
Benefits:															
Benefit 1															
Benefit 2															
Benefit 3															
Total benefits															
Annual Running Costs:															
Labor	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600	61,600
Sump Pumping	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Vacuum Power	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200
ES Power	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700	9,700
Running cost 5															
Running cost 6															
Running cost 7															
Running cost 8															
Total running costs	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**	**76,500**
Annual Risk Costs:															
SSO to Lake	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500
Risk cost 2															
Risk cost 3															
Risk cost 4															
Risk cost 5															
Total risk costs	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**	**37,500**
R&R Costs:															
System Renewal															
R&R cost 2															
R&R cost 3															
R&R cost 4															
R&R cost 5															
Total refurbishments															
Net Benefit/(cost)	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**	**(114,000)**

Expressed in escalated dollars with sensitivity adjustments

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Capital Outlays															
VVS-3 upgrade	81,000														
VVS-8 replaced with ES	178,000														
Main Statin Upgrade											416,127				
Capital outlay 4															
Capital outlay 5															
Capital outlay 6															
Total capital outlays	**259,000**										**416,127**				
Benefits:															
Benefit 1															
Benefit 2															
Benefit 3															
Total benefits															
Annual Running Costs:															
Labor	61,600	63,756	65,987	68,297	70,687	73,161	75,722	78,372	81,115	83,954	86,893	89,934	93,082	96,340	99,712
Sump Pumping	2,000	2,070	2,142	2,217	2,295	2,375	2,459	2,545	2,634	2,726	2,821	2,920	3,022	3,128	3,237
Vacuum Power	3,200	3,312	3,428	3,548	3,672	3,801	3,934	4,071	4,214	4,361	4,514	4,672	4,835	5,005	5,180
ES Power	9,700	10,040	10,391	10,755	11,131	11,521	11,924	12,341	12,773	13,220	13,683	14,162	14,657	15,170	15,701
Running cost 5															
Running cost 6															
Running cost 7															
Running cost 8															
Total running costs	**76,500**	**79,178**	**81,949**	**84,817**	**87,786**	**90,858**	**94,038**	**97,329**	**100,736**	**104,262**	**107,911**	**111,688**	**115,597**	**119,643**	**123,830**
Annual Risk Costs:															
SSO to Lake	37,500	38,813	40,171	41,577	43,032	44,538	46,097	47,710	49,380	51,109	52,897	54,749	56,665	58,648	60,701
Risk cost 2															
Risk cost 3															
Risk cost 4															
Risk cost 5															
Total risk costs	**37,500**	**38,813**	**40,171**	**41,577**	**43,032**	**44,538**	**46,097**	**47,710**	**49,380**	**51,109**	**52,897**	**54,749**	**56,665**	**58,648**	**60,701**
R&R Costs:															
System Renewal															
R&R cost 2															
R&R cost 3															
R&R cost 4															
R&R cost 5															
Total refurbishments															
Net escalated benefit/(cost)	**(373,000)**	**(117,990)**	**(122,120)**	**(126,394)**	**(130,818)**	**(135,396)**	**(140,135)**	**(145,040)**	**(150,116)**	**(155,370)**	**(576,935)**	**(166,437)**	**(172,262)**	**(178,291)**	**(184,531)**
Life cycle cost analysis															
PVs in 2009	(373,000)	(112,371)	(110,766)	(109,184)	(107,624)	(106,086)	(104,571)	(103,077)	(101,605)	(100,153)	(354,188)	(97,312)	(95,922)	(94,552)	(93,201)
NPV as of 2009	**(3,312,024)**														

Year	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Capital Outlays															
VVS-3 upgrade															
VVS-8 replaced with ES															
Main Statin Upgrade															
Capital outlay 4															
Capital outlay 5															
Capital outlay 6															
Total capital outlays															
Benefits:															
Benefit 1															
Benefit 2															
Benefit 3															
Total benefits															
Annual Running Costs:															
Labor	103,201	106,814	110,552	114,421	118,426	122,571	126,861	131,301	135,897	140,653	145,576	150,671	155,945	161,403	167,052
Sump Pumping	3,351	3,468	3,589	3,715	3,845	3,980	4,119	4,263	4,412	4,567	4,726	4,892	5,063	5,240	5,424
Vacuum Power	5,361	5,549	5,743	5,944	6,152	6,367	6,590	6,821	7,060	7,307	7,562	7,827	8,101	8,385	8,678
ES Power	16,251	16,820	17,408	18,018	18,648	19,301	19,976	20,676	21,399	22,148	22,923	23,726	24,556	25,416	26,305
Running cost 5															
Running cost 6															
Running cost 7															
Running cost 8															
Total running costs	**128,164**	**132,650**	**137,293**	**142,098**	**147,071**	**152,219**	**157,547**	**163,061**	**168,768**	**174,675**	**180,788**	**187,116**	**193,665**	**200,443**	**207,459**
Annual Risk Costs:															
SSO to Lake	62,826	65,024	67,300	69,656	72,094	74,617	77,229	79,932	82,729	85,625	88,622	91,723	94,934	98,256	101,695
Risk cost 2															
Risk cost 3															
Risk cost 4															
Risk cost 5															
Total risk costs	**62,826**	**65,024**	**67,300**	**69,656**	**72,094**	**74,617**	**77,229**	**79,932**	**82,729**	**85,625**	**88,622**	**91,723**	**94,934**	**98,256**	**101,695**
R&R Costs:															
System Renewal															
R&R cost 2															
R&R cost 3															
R&R cost 4															
R&R cost 5															
Total refurbishments															
Net escalated benefit/(cost)	**(190,990)**	**(197,674)**	**(204,593)**	**(211,754)**	**(219,165)**	**(226,836)**	**(234,775)**	**(242,992)**	**(251,497)**	**(260,299)**	**(269,410)**	**(278,839)**	**(288,599)**	**(298,700)**	**(309,154)**
Life cycle cost analysis															
PVs in 2009	(91,869)	(90,557)	(89,263)	(87,988)	(86,731)	(85,492)	(84,271)	(83,067)	(81,880)	(80,711)	(79,557)	(78,421)	(77,301)	(76,196)	(75,108)

ATTACHMENT B- CAPITAL PROJECT WORKSHEETS

South Tahoe Public Utility District
Wastewater Collection System Master Plan
Capital Project

Project Name:	Wildwood Sewer Interceptor	**Priority:**	1
Project Purpose:			
Project Location:			
Construction Cost:			
Capital Cost:	$1,653,000		
Existing Pipeline:			
Justification:			

Project Description

District to provide information

South Tahoe Public Utility District
Wastewater Collection System Master Plan
Capital Project

Project Name: Force Main Bypass – Al Tahoe **Priority:** 1
Project Purpose: Provide redundancy for the Al Tahoe Force Main
Project Location: Al Tahoe Pump Station and downstream
Construction Cost: $595,000
Capital Cost: $714,000
Existing Pipeline: 6013 lf of 18-inch Force Main
Justification: Redundancy for a critical force main

Project Description

Two options were evaluated for bypassing the existing Al Tahoe PS 18-inch force main:

1) Construct an 18-inch redundant force main that connects to the Upper Truckee force main via Sierra Blvd (approximately 5750 lf) sharing the portion along Sierra Blvd with Tahoe Keys Force Main Bypass; or

2) Install tees with isolation valves at 1000-foot intervals along the existing forcemain.

Recommendations

- The second option was much cheaper than the first option ($3.2 million).

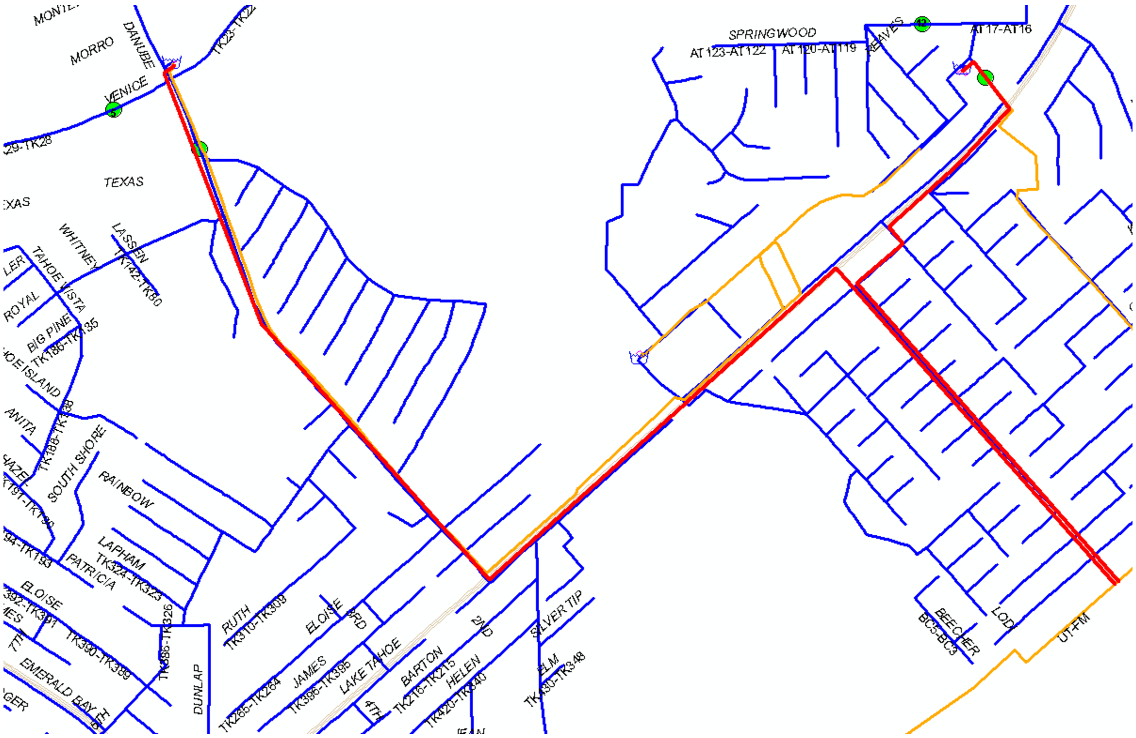
Other Factors

- Upper Truckee has just under the capacity needed to provide a max velocity of 10 fps during future PWWF (11.4 mgd capacity vs 12.1 mgd combined flow). This is close enough to accept this option. The combined flows would create a velocity less than 11 fps.
- Cost per tee includes equipment rentals, site preparation, earthwork, tee, blind flange, valves and fittings, testing, bypassing during construction, and valve box.

Cost Estimate

Description	Location	
Tee off Existing 18" Force Main and two Isolation Valves	Al Tahoe PS	$90,000
"	Station 10+00	$90,000
"	Station 20+00	$90,000
"	Station 30+00	$90,000
"	Station 40+00	$90,000
"	Station 50+00	$90,000
"	Station 60+00	$90,000
	Construction Cost	$630,000
	Engineering and Overhead Cost, 20%	$126,000
	Capital Cost	$756,000

Alternative (Parallel Force Main)



Description	Location								Construction Method
Tee off Existing Force Main and two Isolation Valves	Al Tahoe PS							$85,000	Open Cut
	Al Tahoe PS to Hwy 4	18	-inch pipe	525	lf @	$455	/lf =	$239,100	Open Cut
	Under Hwy 4	18	-inch pipe	100	lf @	$592	/lf =	$59,200	Jack and Bore
	Hwy 4 to Sierra	18	-inch pipe	1765	lf @	$455	/lf =	$803,800	Open Cut
	1/2 cost to UT FM (Sierra)	18	-inch pipe	3360	lf @	$228	/lf =	$765,100	Open Cut
		Subtotal		5750				$1,952,200	
		Contingency, 35%						$683,300	
		Construction Cost						$2,635,500	
		Engineering and Overhead Cost, 20%						$527,100	
		Capital Cost						$3,162,600	

South Tahoe Public Utility District
Wastewater Collection System Master Plan
Capital Project

Project Name:	Force Main Bypass –Tahoe Keys	**Priority:**	1
Project Purpose:	Provide redundancy for the Tahoe Keys Force Main		
Project Location:	Tahoe Keys Pump Station and downstream		
Construction Cost:	$825,000		
Capital Cost:	$990,000		
Existing Pipeline:	10,122 lf of 18-inch Force Main		
Justification:	Redundancy for a critical force main		

Project Description

Two options were evaluated for bypassing the existing Tahoe Keys PS 16-inch force main:

1) Construct a 16-inch redundant force main that runs parallel to the existing 16-inch force main sharing the portion along Sierra Blvd with Al Tahoe Force Main Bypass; or

2) Install tees with isolation valves at 1000-foot intervals along the existing forcemain.

Recommendations

- The second option was much cheaper than the first option ($7.9 million).

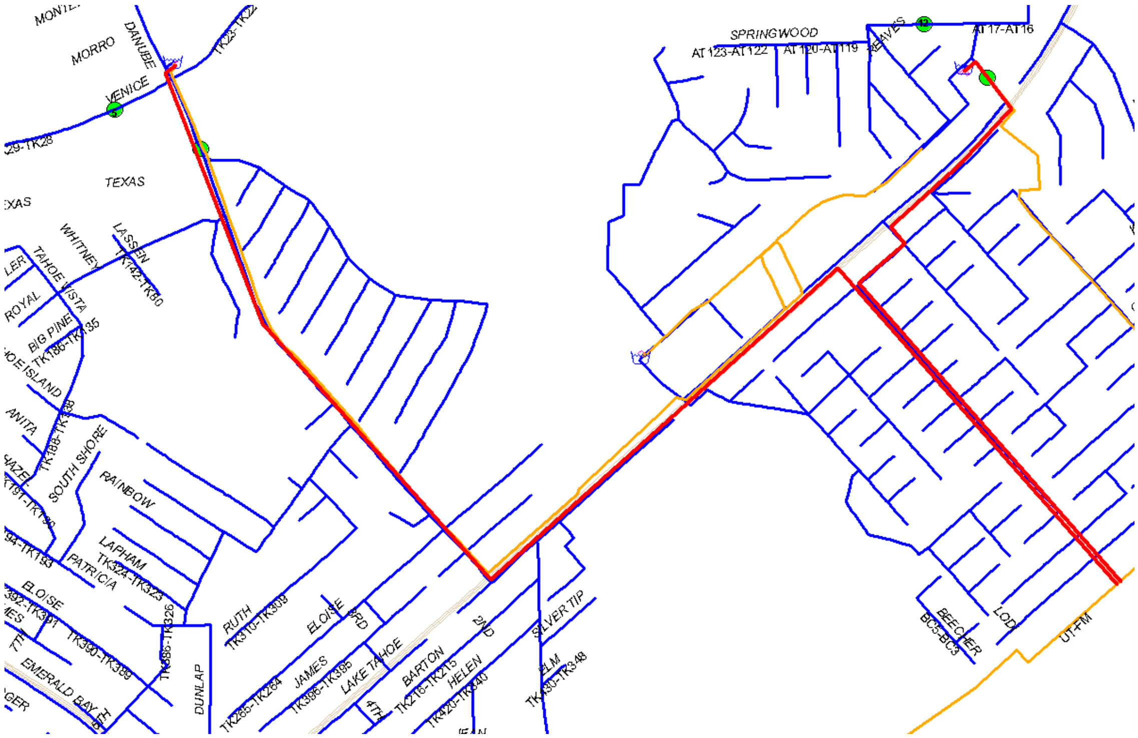
Other Factors

- Upper Truckee has just under the capacity needed to provide a max velocity of 10 fps during future PWWF (11.4 mgd capacity vs 12.2 mgd combined flow). This is close enough to accept this option. The combined flows would create a velocity less than 11 fps.
- Cost per tee includes equipment rentals, site preparation, earthwork, tee, blind flange, valves and fittings, testing, bypassing during construction, and valve box.

Cost Estimate

Description	Location	
Tee off Existing 16" Force Main and two Isolation Valves	Al Tahoe PS	$80,000
"	Station 10+00	$80,000
"	Station 20+00	$80,000
"	Station 30+00	$80,000
"	Station 40+00	$80,000
"	Station 50+00	$80,000
"	Station 60+00	$80,000
"	Station 70+00	$80,000
"	Station 80+00	$80,000
"	Station 90+00	$80,000
"	Station 100+00	$80,000
	Construction Cost	$880,000
	Engineering and Overhead Cost, 20%	$176,000
	Capital Cost	$1,056,000

Alternative (Parallel Force Main)



Description	Location								Construction Method
Tee off Existing 16" Force Main and two Isolation Valves	Tahoe Keys PS							$75,000	Open Cut
	Tahoe Keys PS to Sierra	16	-inch pipe	8670	lf @	$462	/lf =	$4,005,500	Open Cut
	1/2 cost to UT FM (Along Sierra)	18	-inch pipe	3360	lf @	$228	/lf =	$765,100	Open Cut

Subtotal	12030	$4,845,600
Contingency, 35%		$1,696,000
Construction Cost		$6,541,600
Engineering and Overhead Cost, 20%		$1,308,300
Capital Cost		$7,849,900

South Tahoe Public Utility District
Wastewater Collection System Master Plan
Capital Project

Project Name:	Cleaning of Sewer Trunk Lines	**Priority:**	1
Project Purpose:			
Project Location:			
Construction Cost:			
Capital Cost:	$554,000		
Existing Pipeline:			
Justification:			

Project Description

The District has identified the Myers trunk near Hwy 50 as a trunk that needs to be cleaned.

South Tahoe Public Utility District
Wastewater Collection System Master Plan
Capital Project

Project Name: Hwy 89-5th Street Relief Sewer **Priority:** 1
Project Purpose: Redundancy
Project Location: In Tahoe Keys basin along 5th Street crossing Hwy 89
Construction Cost: $170,100
Capital Cost: $204,100
Existing Pipeline: 75 lf of 12-inch trunk sewer
Justification: STPUD staff identified this as a high risk highway crossing.

Recommendations

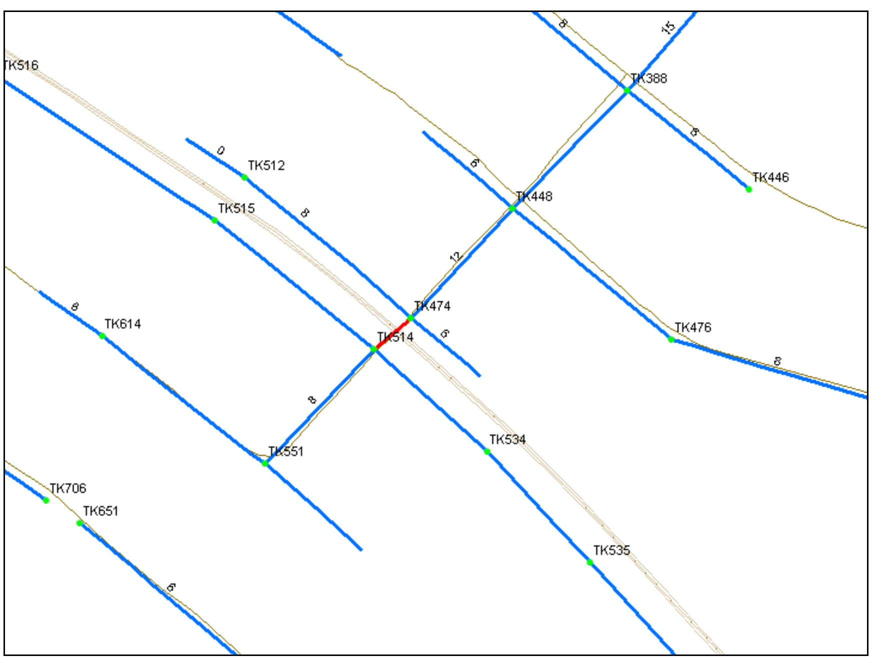
- Construct 75 lf of parallel 12-inch pipe using jack and bore construction.

Other Factors

- Highway crossing is cost difficult to estimate accurately at the planning level.

Cost Estimate

Pipe ID	Upstream Manhole	Downstream Manhole	Location			Construction Method
TK514-TK474	TK514	TK474	5th St crossing Hwy 89	12 -inch pipe 75 lf @ $480 /lf =	$36,000	Jack and Bore
				Mobilization	$90,000	
				Subtotal	$126,000	
				Contingency, 35%	$44,100	
				Construction Cost	$170,100	
				Engineering and Overhead Cost, 20%	$34,000	
				Capital Cost	$204,100	



South Tahoe Public Utility District
Wastewater Collection System Master Plan
Capital Project

Project Name:	High Maintenance and Poor Condition Sewer Replacement	**Priority:**	1
Project Purpose:	Structural and Maintenance Repairs		
Project Location:	Various		
Construction Cost:	$749,970		
Capital Cost:	$900,000		
Existing Pipeline:	6- to 18-inch diameter		

Project Description

Replace Priority 1 pipes and manholes and other pipelines identified from CCTV inspections.

South Tahoe Public Utility District
Wastewater Collection System Master Plan
Capital Project

Project Name:	Pump Station SCADA Upgrades	**Priority:**	1
Project Purpose:	Reliability and Quick Response		
Project Location:	All Pump Stations		
Construction Cost:	$2,835,000		
Capital Cost:	$3,402,000		

Justification: Existing SCADA does not have alarms such as intruder alarms, hi- and low-level alarms, etc. that increase the reliability and improve the response time when problems occur at the pump stations.

Recommendations

Update existing SCADA to include alarms like Intrusion alarm, Influent gate closed, Wet well low and high level, Pump motor trouble, Pump power failure, Combustible gas low and high level, Combustible gas detector failure, No pump station flow, Ventilation fan failure, Diesel fuel storage low and high level, Generator failure, Automatic transfer switch fault, Fire alarm, Electrical room high temperature, Control power failure, and Pump station power failure.

Other Factors

- Costs vary depending on the size and the equipment requirements of the pump station. The unit cost per pump station is an estimated average cost.

Cost Estimate

Item	Approximate Cost
Cost per pump station	$50,000
Subtotal for 42 PS	$2,100,000
Contingency, 35%	$735,000
Construction Cost	$2,835,000
Engineering and Overhead Cost, 20%	$567,000
Capital Cost	$3,402,000

South Tahoe Public Utility District
Wastewater Collection System Master Plan
Capital Project

Project Name: Tahoe Keys Pump Station Capacity Upgrade **Priority:** 1
Project Purpose: Hydraulic capacity
Project Location: Tahoe Keys Pump Station
Construction Cost: $851,000
Capital Cost: $1,021,000
Existing Capacity: 2500 gpm
Justification: Existing pump station has inadequate hydraulic capacity under existing and build-out wet weather (New Year's 05/06, 10-year, and 25-year design storm) conditions which could result in a SSO. Build out PWWF is 3334 gpm.

Recommendations

- Replace existing 1 duty and 1 stand-by pumps with larger pumps

Other Factors

- Existing pumps are Peerless/Krogh vertical pumps. Peerless is no longer related to Krogh and neither Krogh nor Peerless provide dry well vertical pumps now. Carver pumps has taken over Krogh. A Flygt A-C non-clog pump may be comparable to the original Krogh pump. Pump cost is estimated using a submersible pump that can be installed in a dry-pit configuration.

Cost Estimate

Item	Notes	Approximate Cost
Cost per pump	Manufacturer Provided Cost, includes	$100,000
Installation cost	Estimated as 1/2 pump cost	$50,000
Gate & Check Valves estimate	Estimate similar to previous projects	$25,000
Controller (cost per VFD)		$40,000
Subtotal per pump		$215,000
Pumps (2 pumps total)		$430,000
Switch Boards	Main & Transfer Switches	$45,000
Generator	Assume 400kW for AT	$100,000
Fuel storage tank		$15,000
Wiring it up		$40,000
	Subtotal	$630,000
	Contingency, 35%	$221,000
	Construction Cost	$851,000
	Engineering and Overhead Cost, 20%	$170,000
	Capital Cost	$1,021,000

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South Tahoe Public Utility District
Wastewater Collection System Master Plan
Capital Project

Project Name: Fallen Leaf Lake (FLL) System Improvements **Priority:** 1
Project Purpose: Reliability
Project Location: Vacuum Valve Station (VVS) #3 and VVS#8
Construction Cost: $216,000
Capital Cost: $259,000

Justification: VVS#3 is flooded annually by the adjacent creek. VVS#8 has failed in the past.

Recommendations

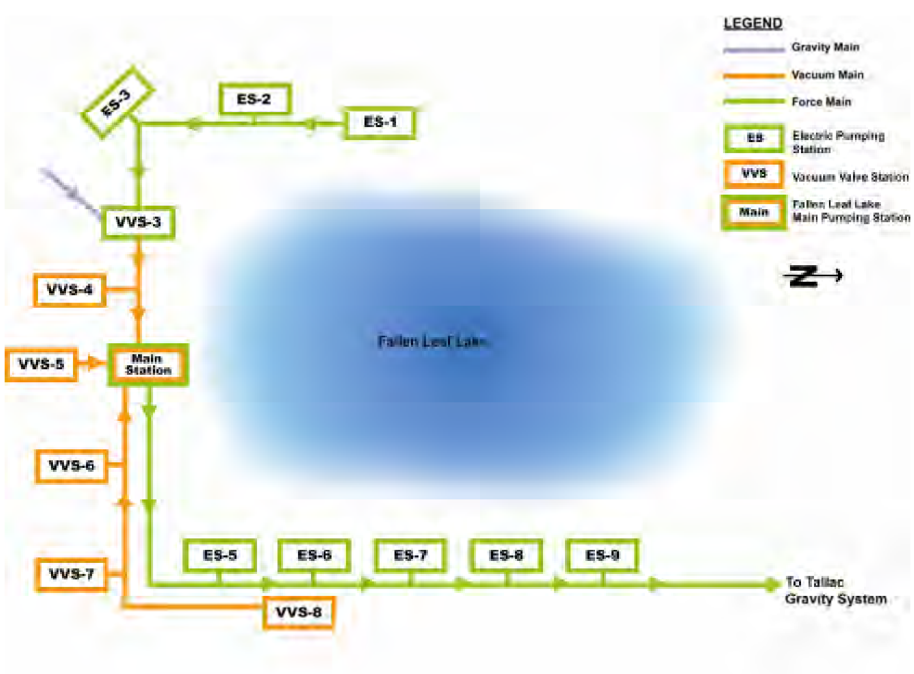
- Relocate VVS#3
- Convert VVS#8 to an electric pumping station (ES), tie into existing FLL force main, and plug the pipe between VVS#7 and VVS#8.

Other Factors

- There may be an additional cost for acquiring property associated with the relocation of VVS#3.

Cost Estimate

Item	Notes	Approximate Cost
VVS#3 Relocation	Includes new pre-cast VVS structure and pipe relocation	$50,000
VVS#8 Replacement	Includes new pump and pre-cast wet well	$110,000
	Subtotal	$160,000
	Contingency, 35%	$56,000
	Construction Cost	$216,000
	Engineering and Overhead Cost, 20%	$43,000
	Capital Cost	$259,000



ATTACHMENT C- CAPITAL PROJECT COST DEVELOPMENT

South Tahoe Public Utility District
Wastewater Collection System Master Plan
Capital Project

Project Name:	High Maintenance and Poor Condition Sewer Replacement	**Priority:**	2
Project Purpose:	Structural and Maintenance Repairs		
Project Location:	Various		
Construction Cost:	$1,666,600		
Capital Cost:	$2,000,000		
Existing Pipeline:	6- to 18-inch diameter		

Project Description

Replace Priority 2 pipes and manholes and other pipelines identified from CCTV inspections.

South Tahoe Public Utility District
Wastewater Collection System Master Plan
Capital Project

Project Name: Al Tahoe Relief Sewer **Priority:** 2
Project Purpose: Hydraulic capacity
Project Location: Along HWY 4 from Al Tahoe Blvd. and west to Al Tahoe Pump Station
Construction Cost: $1,051,800
Capital Cost: $1,262,200
Existing Pipeline: 1,284 lf of 8-inch, 300 lf of 12-inch. and 397 lf of 18-inch trunk sewer
Justification: Existing trunk sewer has inadequate hydraulic capacity under build-out 25-year design storm conditions which results in excessive surcharging close to ground surface. Existing trunk sewer has hydraulic capacity of 0.39 mgd to 2.81 mgd while the PWWF ranges from 0.94 mgd to 3.17 mgd.

Recommendations

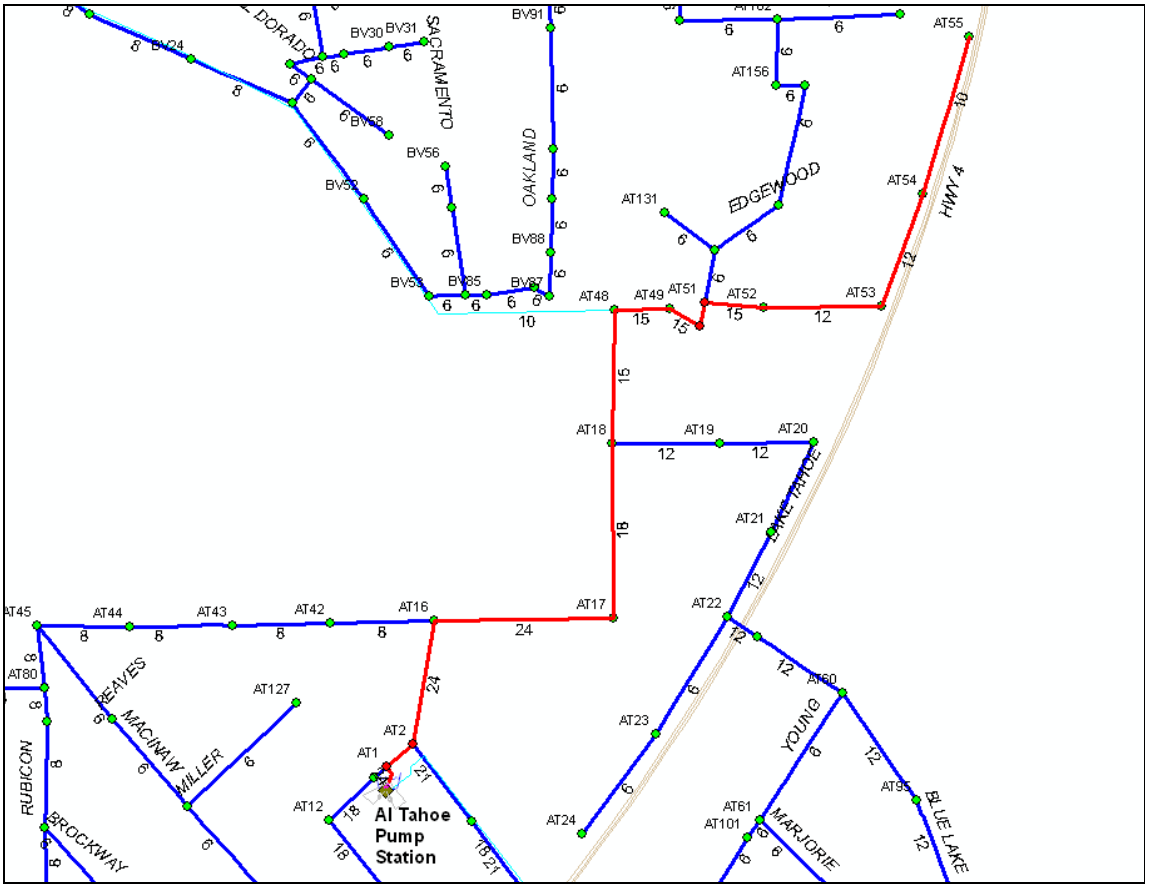
- Replace 368 lf of existing 8-inch with 10-inch
- Replace 529 lf of existing 8-inch with 12-inch
- Replace 387 lf of existing 8-inch with 15-inch
- Replace 300 lf of existing 12-inch with 15-inch
- Replace 397 lf of existing 18-inch with 24-inch

Other Factors

- 634 lf of pipe is adjacent to HWY 4
- The rest of the project is located mostly in unpaved areas

Cost Estimate

Pipe ID	Upstream Manhole	Downstream Manhole	Location								Construction Method
AT55-AT54	AT55	AT54	Lake Tahoe Blvd/Hwy 4	10	-inch pipe	368	lf @	$220	/lf =	$81,000	Pipe Burst
AT54-AT53	AT54	AT53	Lake Tahoe Blvd/Hwy 4	12	-inch pipe	266	lf @	$264	/lf =	$70,100	Pipe Burst
AT53-AT52	AT53	AT52	Upstream of Al Tahoe PS to Lake Tahoe Blvd/Hwy 4	12	-inch pipe	264	lf @	$264	/lf =	$69,600	Pipe Burst
AT52-AT51	AT52	AT51	Upstream of Al Tahoe PS to Lake Tahoe Blvd/Hwy 4	15	-inch pipe	132	lf @	$462	/lf =	$60,900	Open Cut
AT51-AT50	AT51	AT50	Upstream of Al Tahoe PS to Lake Tahoe Blvd/Hwy 4	15	-inch pipe	55	lf @	$462	/lf =	$25,500	Open Cut
AT50-AT49	AT50	AT49	Upstream of Al Tahoe PS to Lake Tahoe Blvd/Hwy 4	15	-inch pipe	79	lf @	$462	/lf =	$36,300	Open Cut
AT49-AT48	AT49	AT48	Upstream of Al Tahoe PS to Lake Tahoe Blvd/Hwy 4	15	-inch pipe	121	lf @	$462	/lf =	$56,000	Open Cut
AT48-AT18	AT48	AT18	Upstream of Al Tahoe PS to Lake Tahoe Blvd/Hwy 4	15	-inch pipe	300	lf @	$462	/lf =	$138,500	Open Cut
AT17-AT16	AT17	AT16	Upstream of Al Tahoe PS to Lake Tahoe Blvd/Hwy 4	24	-inch pipe	397	lf @	$528	/lf =	$241,200	Open Cut
				Subtotal						$779,100	
				Contingency, 35%						$272,700	
				Construction Cost						$1,051,800	
				Engineering and Overhead Cost, 20%						$210,400	
				Capital Cost						$1,262,200	



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South Tahoe Public Utility District
Wastewater Collection System Master Plan
Capital Project

Project Name:	Bijou Relief Sewer	**Priority:**	2
Project Purpose:	Hydraulic capacity		
Project Location:	Sonora/Aspen/Wildwood/Larch Ave from Lake Tahoe Blvd to Pioneer Trail		
Construction Cost:	$1,334,500		
Capital Cost:	$1,601,400		
Existing Pipeline:	1,057 lf of 6-inch, 1,150 lf of 8-inch, 500 lf of 10-inch. and 290 lf of 12-inch trunk sewer		
Justification:	Existing trunk sewer has inadequate hydraulic capacity under build-out 25-year design storm conditions which results in excessive surcharging close to ground surface. Existing trunk sewer has hydraulic capacity of 0.27 mgd to 1.17 mgd while the PWWF ranges from 0.57 mgd to 1.28 mgd.		

Recommendations

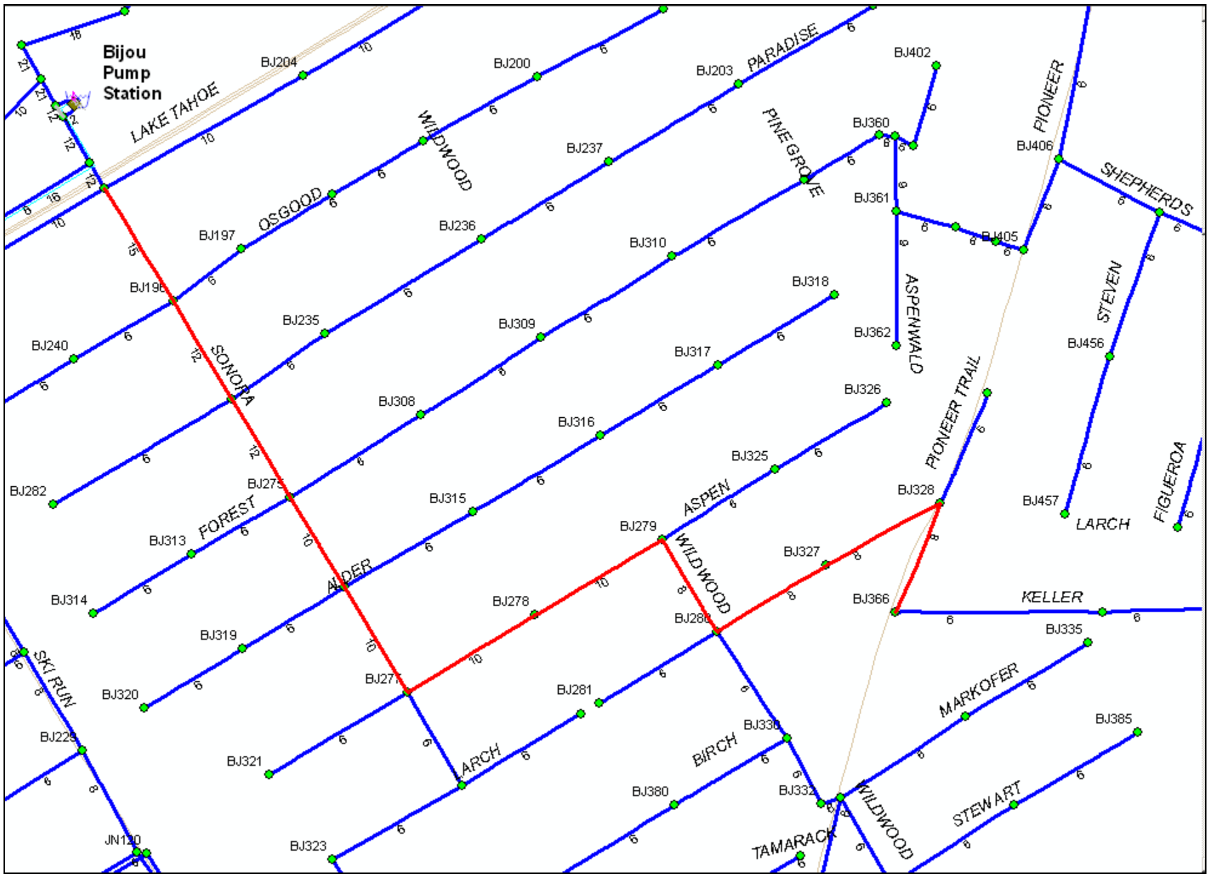
- Replace 1,057 lf of existing 6-inch with 8-inch
- Replace 1,150 lf of existing 8-inch with 10-inch
- Replace 500 lf of existing 10-inch with 12-inch
- Replace 290 lf of existing 12-inch with 15-inch

Other Factors

- Coordinate with Wildwood Relief Sewer project
- Pipe is ACP and pipe bursting cannot be done with ACP.

Cost Estimate

Pipe ID	Upstream Manhole	Downstream Manhole	Location								Construction Method
BJ366-BJ328	BJ366	BJ328	Pioneer Trail	8	-inch pipe	259	lf @	$299	/lf =	$77,300	Open Cut
BJ328-BJ327	BJ328	BJ327	Larch Ave	8	-inch pipe	284	lf @	$299	/lf =	$85,100	Open Cut
BJ327-BJ280	BJ327	BJ280	Larch Ave	8	-inch pipe	280	lf @	$299	/lf =	$83,900	Open Cut
BJ280-BJ279	BJ280	BJ279	Wildwood Ave	8	-inch pipe	234	lf @	$299	/lf =	$70,000	Open Cut
BJ279-BJ278	BJ279	BJ278	Aspen Ave	10	-inch pipe	325	lf @	$308	/lf =	$100,000	Open Cut
BJ278-BJ277	BJ278	BJ277	Aspen Ave	10	-inch pipe	325	lf @	$308	/lf =	$100,000	Open Cut
BJ277-BJ276	BJ277	BJ276	Sonora Ave	10	-inch pipe	270	lf @	$308	/lf =	$83,000	Open Cut
BJ276-BJ275	BJ276	BJ275	Sonora Ave	10	-inch pipe	230	lf @	$308	/lf =	$70,900	Open Cut
BJ275-BJ234	BJ275	BJ234	Sonora Ave	12	-inch pipe	250	lf @	$370	/lf =	$92,300	Open Cut
BJ234-BJ196	BJ234	BJ196	Sonora Ave	12	-inch pipe	250	lf @	$370	/lf =	$92,400	Open Cut
BJ196-BJ186	BJ196	BJ186	Sonora Ave	15	-inch pipe	289	lf @	$462	/lf =	$133,600	Open Cut
				Subtotal						$988,500	
				Contingency, 35%						$346,000	
				Construction Cost						$1,334,500	
				Engineering and Overhead Cost, 20%						$257,000	
				Capital Cost						$1,601,400	



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Al Tahoe Pump Station Maintenance Improvements

Al Tahoe Pump Station		Approximate Cost
Maintenance Improvements	Assume improvement cost is 25% of replacement cost	$556,000
	Subtotal	$556,000
	Contingency, 35%	$195,000
	Construction Cost	$751,000
	Engineering and Overhead Cost, 20%	$150,000
	Capital Cost	$901,000

STPUD Master Plan
Pump Station Safety Improvements
(Replace Pump Stations w/ Ladder Access)

Ladder Access Pump Station	Firm Capacity (gpm)	% of Curve	Curve Value	Baseline Cost Estimate (incl. ENRCC factor)	35% contingency	Construction Cost	20% Engineering & Overhead	Capital Cost
Baldwin Beach	400	100%	190,000	$ 384,349	$ 134,522	$ 518,871	$ 103,774	$ 622,645
Bellevue	350	100%	170,000	$ 343,891	$ 120,362	$ 464,253	$ 92,851	$ 557,104
Bijou	2360	100%	600,000	$ 1,213,733	$ 424,807	$ 1,638,540	$ 327,708	$ 1,966,248
Johnson	1505	100%	500,000	$ 1,011,444	$ 354,006	$ 1,365,450	$ 273,090	$ 1,638,540
Pioneer Village	49	60%	60,000	$ 72,824	$ 25,488	$ 98,312	$ 19,662	$ 117,975
Pope Beach #1	100	60%	100,000	$ 121,373	$ 42,481	$ 163,854	$ 32,771	$ 196,625
Pope Beach #2	80	60%	80,000	$ 97,099	$ 33,985	$ 131,083	$ 26,217	$ 157,300
San Moritz	417	100%	195,000	$ 394,463	$ 138,062	$ 532,526	$ 106,505	$ 639,031
Taylor Creek	2100	100%	550,000	$ 1,112,589	$ 389,406	$ 1,501,995	$ 300,399	$ 1,802,394
Trout Creek	868	100%	300,000	$ 606,867	$ 212,403	$ 819,270	$ 163,854	$ 983,124
Venice	95	60%	100,000	$ 121,373	$ 42,481	$ 163,854	$ 32,771	$ 196,625
FLL Main Station	180	60%	150,000	$ 182,000	$ 63,700	$ 245,700	$ 49,140	$ 294,840
					TOTALS	$ 7,643,708	$ 1,528,742	$ 9,172,450
					Rounded	$ 7,643,700	$ 1,528,700	$ 9,172,400

NOTES:

1- Costs in the figure were corrected to an ENRCCI of 4500 by means of the following equation:
Cf=Cpx(ENRCCI(f)/ENRCCI(p))
Cotst were updated (to 2009) using the updated ENRCCI factor:
The multiplier is 9103/4500 = 2.0 Included in Baseline Cost formula in column E

2- Curve value taken as approximately the middle of the cluster of data points near (100,100)
Value was reduced to 60% of the curve value as per adjustment for smaller stations (<200 gpm) used in Bay Area estimate.

3- Table states that engineering and legal fee, land, administration, and interest must be added (last column)
Curves are based on construction cost (including extra work) of pumping stations only

4- 35% Contingency, 20% Engineering and overhead cost

5 - Pump station design capacity based on design flows from the hydraulic model.
These flows should be confirmed and updated following future wet weather flow monitoring.

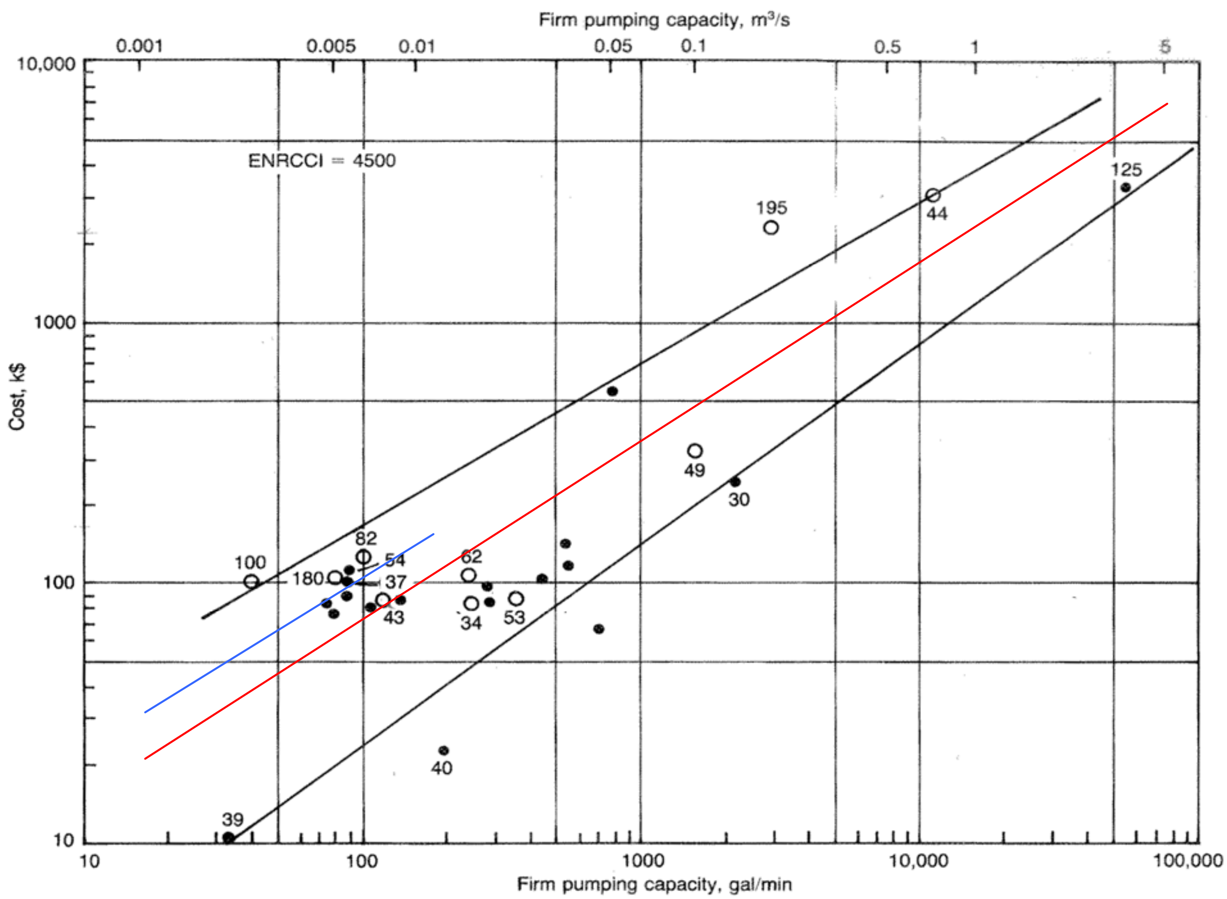

Figure 29-3. Construction costs of submersible-pump wastewater pumping stations. No standby power = solid circles, has standby power = open circles. The numbers are TDH in feet.

Red line: approximate median of cost range

Blue line: approximate median of smaller capacity pumping stations (cluster of solid pts. near 100,100)

ATTACHMENT D- PRIORITY 1 AND 2 PIPE RECOMMENDATIONS

Attachment D - Combined Priority Pipes							
Priority 1				Priority 2			
US MH	DS MH	Length	Diameter	US MH	DS MH	Length	Diameter
TY49	TY41	352	8	BJ278	BJ277	325	8
JN220	JN219	419	6	PD57	PD56	706	6
JN319	JN219	233	8	TK582	TK542	282	6
JN166	JN165	455	10	JN221	JN220	416	6
TK686	TK685	316	6	TY56	TY55	336	6
TL132	TL131	386	6	AT50	AT49	79	8
UT534	UT533	364	6	TL117	TL116	479	6
UT284	UT283	417	6	TK516	TK515	397	8
AT276	AT275	317	8	AT8	AT7	251	8
JN438	JN319	244	8	JN165	JN164	453	10
BJ417	BJ416	269	6	AT17	AT16	397	18
TY72	TY71	209	6	BJ279	BJ278	325	8
AT131	AT89	137	6	TY76	TY66	418	6
JN530	JN529	173	6	TY80	TY71	456	6
JN206	JN205	402	6	TK515	TK514	312	12
JN454	JN453	274	6	AT55	AT54	368	8
PD50	PD49	116	6	AT52	AT51	132	8
PD58	PD55	70	8	JN31	JN30	422	10
PD15	PD14	131	8	PD82	PD81	210	8
AT90	AT89	174	6	PD68	PD67	239	8
TR265	TR264	182	6	PD61	PD60	366	6
AT155	AT154	100	6	TY57	TY56	482	6
PD16	PD15	321	6	TY81	TY80	100	6
PD59	PD58	181	8	BV62	BV61	140	6
JN174	JN173	295	6	TY43	TY42	371	6
BJ6	BJ5	253	18	TY58	TY57	178	6
UT191	UT105	423	6	TY71	TY70	305	6
TK663	TK662	371	8	TK535	TK534	230	10
BJ263	BJ228	310	6	AT70	AT69	278	6
BJ347	BJ292	280	6	PD55	PD54	232	8
BJ207	BJ206	292	8	PD64	PD63	446	6
BJ393	BJ392	181	6	AT54	AT53	266	8
AT34	AT33	245	8	AT53	AT52	264	8
AT195	AT194	228	6	AT51	AT50	55	8
PD104	PD103	129	6	TY59	TY58	182	6
AT290	AT289	269	6	BJ234	BJ196	250	10
TK666	TK665	334	8	AT49	AT48	121	8
BV99	BV70	447	8	AT48	AT18	300	12
PD3	PD2	304	6	BJ196	BJ186	289	12
BJ264	BJ263	313	6	BJ277	BJ276	270	8
BJ353	BJ298	278	6	BJ275	BJ234	250	10
AT143	AT142	248	6	BJ280	BJ279	234	6
AT144	AT143	241	6	BJ327	BJ280	280	6
SR27	SR23	301	6	BJ366	BJ328	259	6
SM28	SM27	434	8	BJ210	BJ209	532	8
TR455	TR454	301	10	BJ208	BJ207	158	8
UT1752	UT1751	363	6	PD19	PD9	375	6
TOTAL LENGTH		13,078		PD77	PD76	237	6
				BJ276	BJ275	230	8
				BJ328	BJ327	284	6
				TL35	TL34	88	6
				AT25	AT4	247	6
				PD95	PD94	374	6
				SR38	SR37	147	6
				SM27	SM26	426	8
				SM45	SM23	285	8
				TY32	TY25	183	10
				TOTAL LENGTH		16,716	