South Truckee Meadows Water Reclamation Facility

FACILITY PLAN UPDATE

FINAL

January 2016

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SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY FACILITY PLAN UPDATE

January 2016

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WASHOE COUNTY, NEVADA

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FACILITY PLAN UPDATE

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TECHNICAL MEMORANDUM NO. 1

EXECUTIVE SUMMARY

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WASHOE COUNTY

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EXECUTIVE SUMMARY

1.0 BACKGROUND

Washoe County's (County's) Facility Plan Update for the South Truckee Meadows Water Reclamation Facility (STMWRF) includes an update of the 2008 Facility Plan Update. The last facility Master Plan, titled *Draft Facility Plan Update South Truckee Meadows Water Reclamation Facility 6-mgd Expansion Project* (CH2M, April 2008), began in a period of significant economic and population growth, and was published at a time shortly thereafter where changes had taken place in economic growth, regulatory climate, wastewater quality, and treatment technologies.

STMWRF was originally constructed in 1991 as a 1.5 million gallon per day (mgd) secondary treatment facility. In 2003, the plant capacity was expanded to 4.1 mgd through the addition of a new oxidation ditch, four secondary clarifiers, tertiary filters, chemical building, and associated appurtenant structures. STMWRF is owned by Washoe County (County) and managed by the Washoe County Community Services Department (WCCSD). WCCSD Water Resources staff is responsible for preparing and maintaining a comprehensive Capital Improvement Program and has been proactive in identifying the need for direct evaluation and assessment of elements within the STMWRF and the Steamboat Creek Lift Station (SCLS). Carollo Engineers, Inc. (Carollo) was retained to provide engineering services that would identify potential improvements for the facility through year 2035.

The County has commissioned this STMWRF Facility Master Plan Update to evaluate the current design criteria, establish new criteria as appropriate, and make recommendations for the Capital Improvements Program (CIP). A series of technical memoranda (TM) have been prepared to analyze and document the findings and recommendations throughout this facility planning effort. The TM content is summarized in the following sections.

2.0 TM NO. 2: PLANNING FRAMEWORK

2.1 Wastewater Flow Projections

In order to adequately plan for future wastewater services, projections were completed based on historical wastewater flows, available flow monitoring data, anticipated population, and anticipated development within the service area.

Peaking factors are used to adjust average annual flows to peak hourly flows to correctly determine required infrastructure capacity. For collection systems, peaking factors help to conservatively size future pipes and lift stations to handle peak flows. Peaking factors help sized reclamation facilities to accommodate flows as well as loading rates that fluctuate from day to day. These peaking factors were calculated using 2014 STMWRF daily influent flow data and the continuous eight months of data available from South Meadows permanent flowmeter.

The flow projection for each planning year was calculated by multiplying the projected population times the ERU flow of 237 gallons per day divided by the number of people per dwelling unit (2.56). The buildout flow projection was calculated using the total buildout acreage times the respective unit flow for each land use type, except for the vacant acreage which was assumed to be developed as single family residential land use.

Table 1.1 shows the projected average and peak flows for the STMWRF based on the near term growth projection flow curve. Figure 1.1 shows the historic and projected annual average daily wastewater flows in the STMWRF service area.

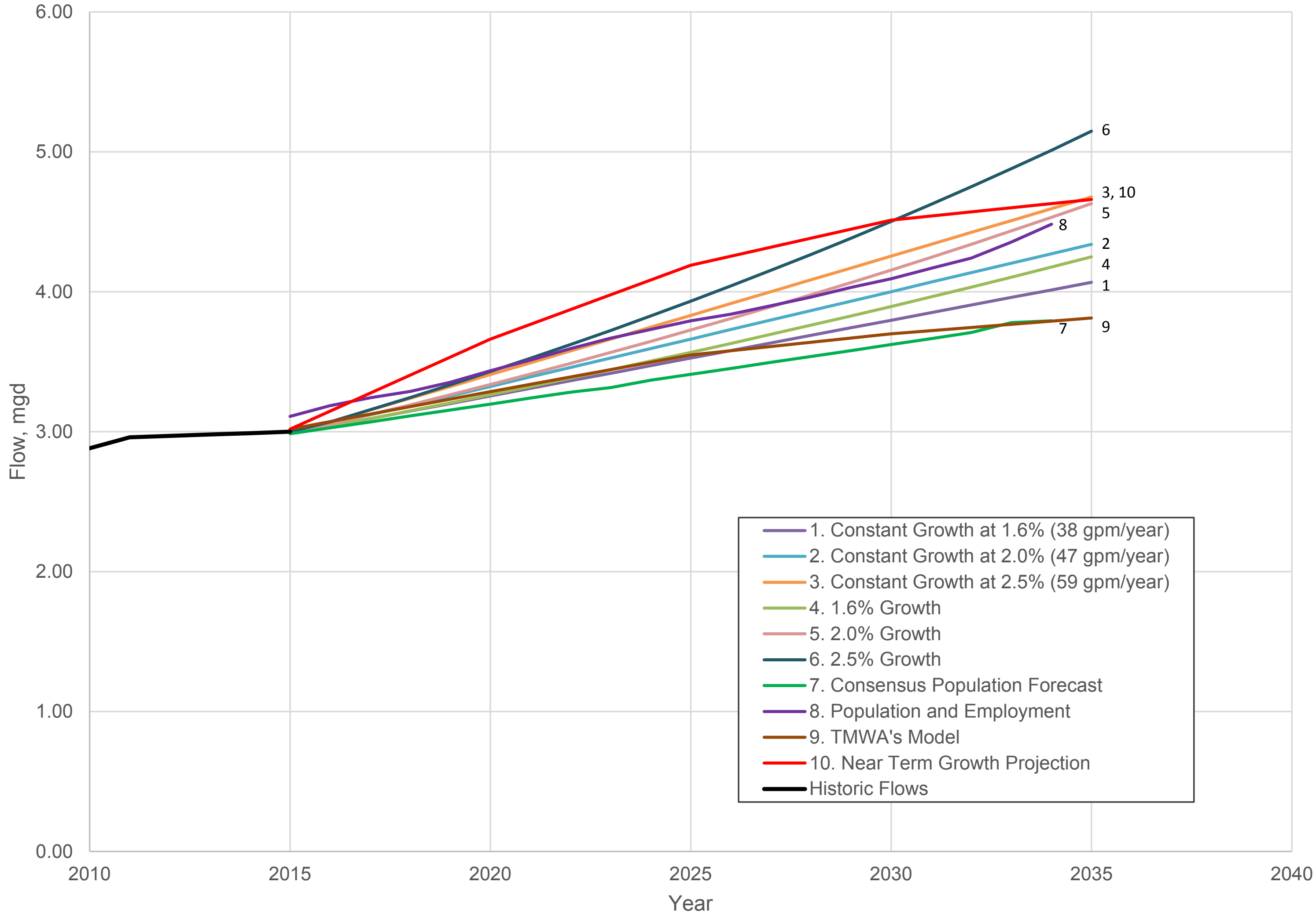
Table 1.1 Projected Wastewater Minimum, Average, and Maximum Flows
STMWRF Facility Plan Update
Washoe County

Year	Ave Flow, mgd	Max Month Flow, mgd	WW Peak Hour Flow, mgd	Total ERUs
2015	3.0	3.4	7.4	14,290
2020	3.6	4.0	8.9	17,150
2025	4.1	4.6	10.1	19,380
2030	4.4	4.9	10.8	20,730
2035	4.5	5.0	11.1	21,360
Buildout	11.6	13.0	28.7	42,963

2.2 Wastewater Characteristics

Influent wastewater quality parameters from August 2010 to July 2011 were collected and reviewed as part of the evaluation for STMWRF. Plant influent samples were taken at the plant headworks, before any of the internal process recycle flows are mixed with the raw wastewater. Concentrations of the following parameters were provided:

- Total Suspended Solids (TSS)
- Five-day Carbonaceous Biochemical Oxygen Demand (cBOD)
- Ammonia
- Total Kjeldahl Nitrogen
- Total Phosphorus



SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY FLOW PROJECTION

FIGURE 1.1

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

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The influent wastewater characteristics were evaluated to determine the average wastewater constituent concentrations and peaking factors. For each constituent, the daily flow was multiplied by the corresponding concentration to obtain the daily load, which was then used for the load trending and peaking factor analysis. These parameters drive the capacity of the secondary treatment system and are critical elements of the plant evaluation completed as part of the facility plan update. Table 1.2 presents the adopted wastewater characteristics for this Facility Plan Update.

Table 1.2 Summary of Adopted Wastewater Characteristic Parameters
STMWRF Facility Plan Update
Washoe County

Parameter	2008 FP Planning Values	2015 FMP Planning Values
cBOD		
Concentration (mg/L)	327	327
Load Peaking Factor	1.45	1.45
TSS		
Concentration (mg/L)	256	276
Load Peaking Factor	1.54	1.54
Ammonia(1)(2)		
Concentration (mg/L)	-	33
Load Peaking Factor	-	-
Total Kjeldahl Nitrogen(1)(2)		
Concentration (mg/L)	-	56
Load Peaking Factor	-	-
Total Phosphorus as P(1)(2)		
Concentration (mg/L)	-	6.4
Load Peaking Factor	-	-

Notes:
(1) Average values do not include loads from centrate or any other recycle streams. Very limited data is available for analysis.
(2) Recommended values are for planning purposes only.

3.0 TM NO. 3: WASTEWATER COLLECTION SYSTEM EVALUATION

Model simulations of existing and future scenarios were used in this study to evaluate planned infrastructure or identify new infrastructure that should be added based on projected growth. The result of this analysis is a set of recommendations in a capital improvement plan that identifies the cost of specific improvements through planning year 2035.

The major wastewater collection system issues that the County will need to address in the near future is collection pipe capacity and collection pipes to new service areas. Currently the STMWRF collection system serves the western portion of the service area via gravity, and the eastern portion via the Steamboat lift station. In the near future, the County plans to serve the southern portion of the planning area by gravity with the Pleasant Valley Interceptor.

There are 142.5 miles of sewer pipe owned by Washoe County in the STM Basin. There are also sewer pipes that drain into the STM Basin that are owned by the City of Reno. Flow from City of Reno areas was used in the hydraulic model and to produce flow projections. The collection system has seven wastewater lift stations of various capacities. The County's hydraulic sewer model is a skeletonized representation of the collection system that only models the Steamboat Creek Lift Station.

A summary of the findings from the hydraulic modeling of the County's wastewater collection system are as follows:

1. The collection system and Steamboat Creek Lift Station has sufficient capacity in 2015.
2. By 2035, 3,520 feet of sewer main near Whitecliff Drive and Parma Way will need to be replaced with a 15-inch pipe. Prior to replacing this pipe flow monitoring should be undertaken to ensure that actual flows are consistent with modeled flows.
3. The Steamboat Creek Lift Station has sufficient capacity through 2035.
4. The Pleasant Valley interceptor can be constructed using smaller pipe diameters than the original design. Construction of new homes in the Reach 4 service area beginning in 2018 will require that the interceptor be in place by 2018.
5. The estimated project cost for the recommendations developed in this TM total approximately $11.9 million.

4.0 TM NO. 4: CONDITION ASSESSMENT

The primary goal for the evaluation and assessment is to visually evaluate the electrical, mechanical, and structural condition of the existing facilities and identify potential improvements. Carollo developed checklists to assist prior to the field review. The checklists were used to document the condition of the facility and photos were taken to document the existing and deficient conditions provided throughout the evaluation. County Operations and Engineering staff, as well as the Contract Operator, SPB Utility Services, participated in the field review and assisted in the evaluation and provided valuable historical information to the field review team.

The field review was conducted on April 22, 2015. Weather and lighting conditions were favorable for the field review. Carollo evaluated the apparent condition of equipment using direct observation methods. As much as practicable, the team assessed the equipment by order of the treatment process. In May 2014, Carollo prepared an evaluation of the Chemical Storage Building facilities recommending rehabilitation and replacement of existing equipment and storage facilities. Therefore, condition assessment of the Chemical Storage Building was not part of this condition assessment effort.

The overall condition of the facility was observed to be significantly superior to many like facilities the Carollo team has evaluated. Much credit for the condition of the facility can be given to the proactive operators and operations and engineering staff that oversees the facility. Table 1.3 presents the recommended projects identified through the condition assessment effort. The estimated project cost for the recommendations presented in this TM total approximately $3.2 million.

Table 1.3 Summary of Rehabilitation Projects Needed within the Planning Period
STMWRF Facility Plan Update
Washoe County

Facility/Process	Equipment[(1)]	Condition[(2)]	Recommendation[(2)]
Steamboat Creek Lift Station	I	I&C equipment obsolete.	Phased replacement and upgrade.
Influent Pump Station	M	Splashing occurs at the top of screw pumps.	Design and add splash protection.
Influent Pump Station	E	Emergency stop button damaged on the west screw pump panel.	Replace
Manual Bar Screen	S	Coating failure in inlet and outlet channel.	Dewater, inspect, repair concrete damage, recoat.
Oxidation Ditch	S	Coating failure.	Dewater, inspect, repair concrete damage, recoat.

Table 1.3	Summary of Rehabilitation Projects Needed within the Planning Period STMWRF Facility Plan Update Washoe County		
Facility/Process	**Equipment[(1)]**	**Condition[(2)]**	**Recommendation[(2)]**
Oxidation Ditch	S	Cracking of concrete structure.	Repair cracks.
Oxidation Ditch	I	Probes and meters will reach end of life within 5-10 years.	Phased replacement.
Secondary Clarifier	S	Coating failure on units 2 and 3.	Dewater, inspect, repair concrete damage, recoat.
Secondary Clarifier	M	Algae buildup on launder weirs.	Evaluate brushes or covers for implementation.
Tertiary Filters	S	Cracking of concrete structure.	Repair cracks.
Tertiary Filters	I	Inlet channel level float inoperable.	Replace or repair.
Chlorine Contact Basin	S	Cracking of concrete structure.	Dewater, inspect, repair concrete damage.
Export Pump Station	M	Pump and piping drains supported by rope; Air release valves have garden hose vice hard piping to floor drains.	Design and replace piping.
Effluent Pump Station	S	Roof leak.	Conduct roof inspection and repair.
Effluent Pump Station	S	Joist above Pump 1 is twisted at electrical conduit attachment.	Reinforce joist and repair deformation.
Effluent Pump Station Electrical Room	M	AC unit freezes evaporative coil in air handler.	Replace AC unit.

Table 1.3	Summary of Rehabilitation Projects Needed within the Planning Period STMWRF Facility Plan Update Washoe County		
Facility/Process	**Equipment[(1)]**	**Condition[(2)]**	**Recommendation[(2)]**
Sand Drying and Sludge Dewatering Beds	--	Degraded.	Minimum refurbishment.

Notes:
(1) Type of Equipment: E = Electrical, I = Instrumentation, M = Mechanical, S = Structural.
(2) See TM No. 4 for additional detail on condition observations and recommendations for mitigation.

5.0 TM NO. 5: PLANT PERFORMANCE AND PROCESS MODEL

This TM summarizes the performance evaluation and process modeling analysis conducted for STMWRF. A capacity evaluation of the existing facility was performed using a combination of process modeling and engineering design criteria for specific unit processes. A biological process model was used to simulate process operation based on inputs for flow, loading, and other operating conditions at STMWRF. Outputs from the model included expected process effluent characteristics, process safety factors and allow able loading to prevent process failure.

5.1 Treatment Process Evaluation

A BioWin process model was configured for the existing oxidation ditch, secondary clarifiers, and tertiary filters at the STMWRF and was calibrated using routine operations and performance data and analyses of supplemental wastewater samples collected between July 23 and August 4, 2015. Very good agreement between all relevant calibration parameters and actual plant data was achieved after calibration was completed (deviation less than 10 percent).

5.1.1 Secondary Treatment Process Evaluation

The treatment capacity and performance of the existing secondary process was evaluated under the current design ADMMF (4.1 mgd) and projected 2035 ADMMF conditions (6.0 mgd) to meet the TN and ammonia treatment goal of less than 7 mg/L TN and less than 2 mg/L, respectively. The STMWRF process model was expanded to include the two aerobic digesters, recuperative rotary drum thickener, and screw press currently under construction to capture suspended solids and nutrient recycles. Simulation results confirm the current rated capacity of 4.1 mgd for the existing secondary treatment facility.

The secondary treatment expansion requirements were evaluation for the case that the facility receives in the future the 2035 projected flows (6.0 mgd ADMMF). Results indicate that the facility needs two additional equal sized oxidation ditches for a total of four ditches in service. In order to realize the maximum capacity of the existing secondary clarifiers, a biological selector is recommended upstream of the oxidation ditches to improve reliable sludge settleability (i.e., reduce the SVI).

5.2 Summary of Capacity Rating of All Existing Facilities

Table 1.4 presents the peak capacity (all units in service) and firm capacity (standby units out of service) for process treatment and hydraulic conveyance for each of the major treatment processes based on the reliability and design criteria developed in TM No. 2.

Table 1.4 Capacity Rating of Existing Facilities
STMWRF Facility Plan Update
Washoe County

Treatment Process or Equipment	Peak Capacity (mgd)	Firm Capacity (mgd)	Comment / Reliability Criteria(1)
Influent Pumping	10.8	5.4	1 UIS + 1 Standby
Screening(2)	24.0	12.0	1 UIS + 1 Standby + 1 bypass channel with manual screen
Scum Pump Stations	1.03	0.78	3 UIS + 1 Standby
Secondary Treatment	NA	4.1 (ADMMF)	No Standby
RAS Pumping	11.52	9.21	4 UIS + 1 Standby
WAS Pumping	1.08	0.54	1 UIS + 1 Standby
Tertiary Filters(3)	10.4	6.7	No Standby
Chlorine Contact Basins(4)	14.7	11.0	3 UIS + 1 Standby
Effluent Pump Station	13.25	9.65	4 UIS + 1 Standby

Notes:
(1) UIS = Unit In-Service; Standby Unit assumed to be largest unit.
(2) Based on 12 mgd peak hour capacity of each screen and ADMMF capacity of 4.1 mgd.
(3) Based on loading rates of 5.0 gpm/sf for peak and 2.9 gpm/sf for ADMMF (2008 Facility Plan).
(4) Capacity is based on assumption of 30 minute chlorine contact time, and adequate chlorine dose to achieve required contact time.

5.3 Optimization Opportunities

Optimization opportunities for current process operation were identified with the goal of enhancing STMWRF effluent quality and for identifying opportunities for labor, power, and chemical cost savings.

Table 1.5 summarizes the optimization opportunities recommended for implementation at STMWRF. Opportunities selected for field implementation are summarized in TM No. 5.

Table 1.5 Identified Optimization Opportunities at STMWRF STMWRF Facility Plan Update Washoe County		
Treatment Process or Equipment	**Opportunity**	**Recommendation**
General	Influent Data Collection	Data collection plan that includes long-term sampling and historical trending of these influent constituents: COD, cBOD, TSS, VSS, pH, alkalinity, ammonia, TKN, total phosphorus, and orthophosphorus.
Oxidation Ditches and Aeration System	DO Profile Sampling	Additional DO profile sampling will verify that the existing aeration control scheme is adequate for peak flow and load, low flow and load, and all diurnal conditions. Cost savings may be realized through more robust instrumentation and control.
Oxidation Ditches and Aeration System	Alternative Ammonia Probes	Assess whether newer equipment may be more reliable and less maintenance intensive in the oxidation ditch environment compared to the current product used. Ammonia probe controlled aeration should further optimize aeration and subsequently reduce aeration cost.
Oxidation Ditches and Aeration System	Assess Fine Bubble Diffuser System	Confirm adequate capacity to supply the necessary oxygen transfer efficiency under projected 2035 ADMMF and loads.
Oxidation Ditches and Aeration System	Daily MLSS and MLVSS Analysis	Conduct several times per week and/or consider a TSS probe installation in the oxidation ditches to improve on solids inventory and tSRT management. Stabilizing solids wasting is critical to maintain low and consistent effluent ammonia.
Secondary Clarifiers	Reduce Algae Growth	Replace or rehab existing chlorine rings in clarifiers to reduce the algae formation in secondary clarifiers effluent launders.
Tertiary Filters	TSS Monitoring	Begin continuous monitoring of secondary effluent turbidity upstream of the filters and filter effluent to understand the performance of the filters particularly during times when the secondary clarifiers are stressed due to high flow rates, high MLSS concentrations, and/or poor sludge settleability

Table 1.5 Identified Optimization Opportunities at STMWRF
STMWRF Facility Plan Update
Washoe County

Treatment Process or Equipment	Opportunity	Recommendation
Tertiary Filters	Coagulation of Filter Influent	Coagulation of filter influent should increase the performance of the filters. For effective and cost-efficient coagulation, pH adjustment for the filter influent will be required.
Tertiary Filters	Filter Media Assessment	Assess the media by analyzing its effective grain size for better particle capture, perform thorough filter media cleaning for possible mud accumulation in the filters, and implement a periodic chlorine shock to reduce biological growth.
Tertiary Filters	Chemical Phosphorus Removal	Should additional phosphorus removal be desired or required, a pilot study could be initiated to assess the filter capacity under addition of metal coagulants upstream of the filters for chemical phosphorus removal.
Tertiary Filters	EcoWash® Installation	Based on pilot and full-scale testing that has been conducted at other locations, it is likely that installing the EcoWash® system at STMWRF would likely reduce the backwash water generated by up to 50 percent (up to 0.24 mgd). Pilot testing is recommended to verify the actual reduction in backwash water generated.
Tertiary Filters	Pre-Conditioning/Algae Removal	Implementation of a DAF process as pre-treatment to filter influent could decrease solids loads and increase performance of the filters.
Chlorine Contact Basins	pH Investigation	Further investigation of the causes for elevated pH in tertiary effluent and its impact on disinfection performance
Chlorine Contact Basins	Additional Instrumentation and Control	Provide online chlorine analyzer (or online surrogate analyzer) immediate down stream of chlorine injection point. Using proposed analyzer to control the chlorine dosage through basins may reduce the chlorine dosages and provide better control on residuals.

6.0 TM NO. 6: FACILITY PLAN

The purpose of this TM is to identify and evaluate alternative processes, which could be implemented at STMWRF. Alternative secondary treatment processes will be identified and discussed in regards to their required components, advantages and disadvantages, and potential capital and/or operation costs. Alternative filter methods and configurations will also be presented.

6.1 Hydraulic Evaluation

The hydraulic model for STMWRF was reviewed and updated to reflect current process and flow conditions. The purpose of the hydraulic evaluation was to identify potential pinch points or hydraulic limitations in the liquids treatment process train. The hydraulic modeling results indicate that all sections of the plant can satisfactorily convey the design ADMMF and PHF flow conditions. No hydraulic bottlenecks were identified during hydraulic model runs at these conditions.

Future flow conditions were also modeled with the addition of secondary and tertiary treatment processes as recommended. Similarly, no hydraulic bottlenecks were identified during hydraulic model runs at these conditions.

6.2 Proposed Expansion Plan

The major facility improvements needed to handle a 6.0 mgd ADMMF and 13.3 mgd peak hour flows include a new perforated plate screen, anaerobic selector zone upstream of the oxidation ditches, two additional oxidation ditches, a new DAF system to remove algae prior to tertiary filters, and four new tertiary filters. The new process units are planned to be similar to the existing facilities in terms of footprint and capacity. Table 1.6 summarizes the existing, planned, and future facilities required for the projected flows in 2035. Figure 1.2 shows the general site layout for the new facilities. The estimated project cost for the recommendations presented in this TM total approximately $41.9 million.

STMWRF - EXPANSION PLAN AND LAYOUT

FIGURE 1.2

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

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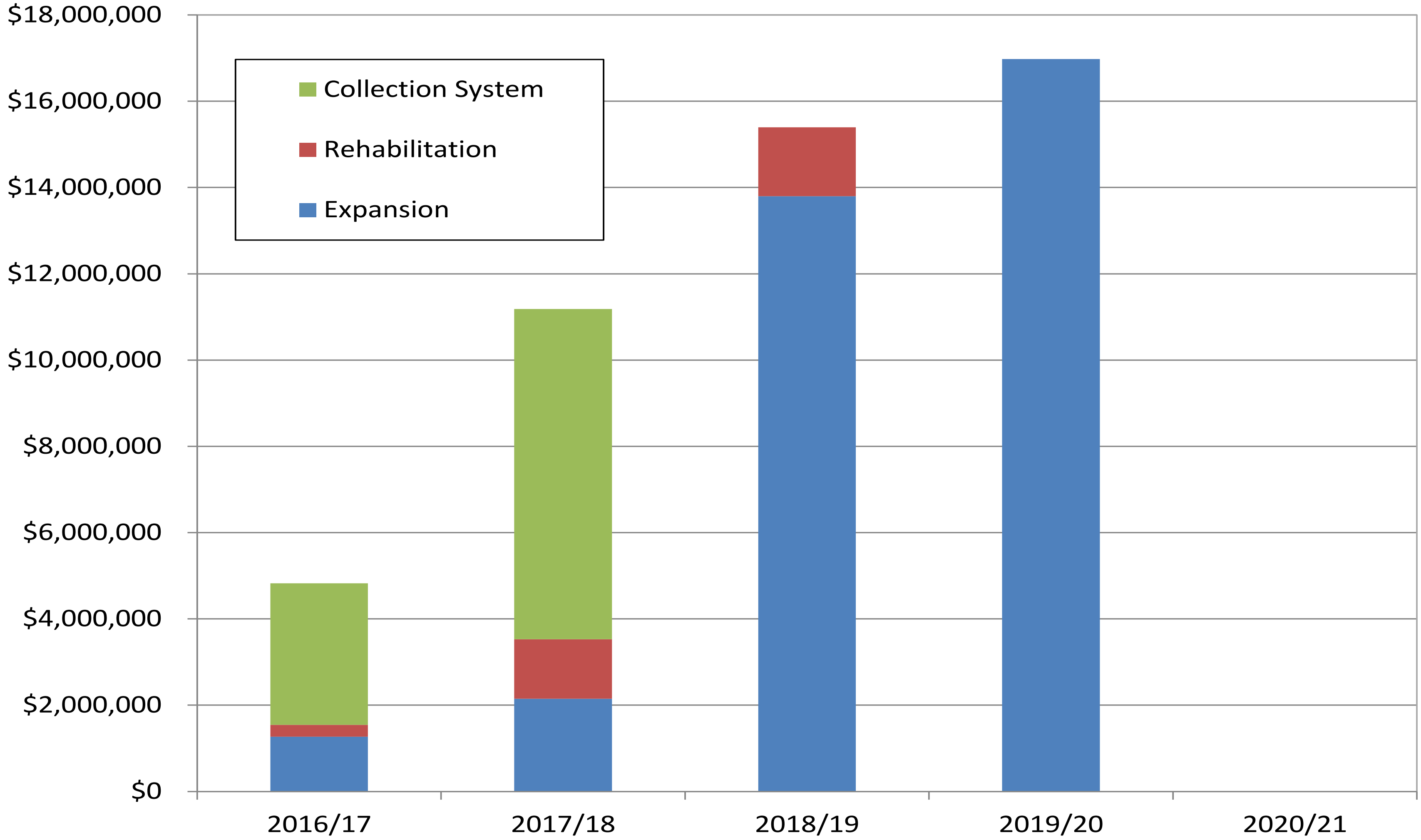
Table 1.6 Summary of Facilities Needed within the Planning Period STMWRF Facility Plan Update Washoe County			
Facility/Process	**No. Existing(1)**	**No. Future Required(2)**	**Total Required(3)**
Headworks Screw Pumps	2	1	3
Anaerobic Basin	-	1	1
Oxidation Ditches	2	2	4
Secondary Clarifiers	4	0	4
DAF System	-	1	1
Tertiary Filters	8	4	12
Chlorine Contact Basins	4	0	4
Effluent Pumps(4)	5	1	6
Export Pumps	5	1	6

Notes:
(1) Existing facilities are operational, under design, or under construction as of January 2015.
(2) Future facilities are required to treat average day maximum month flows of 6 mgd.
(3) Total number of each type of facility for treating 6 mgd ADMMF and 13.3 mgd peak.
(4) Expansion of existing with larger pumps.

7.0 TM NO. 7: OVERALL CIP AND IMPLEMENTATION PLAN

Table 1.7 through 1.9 summarizes the recommended project budgets and fiscal years for the collection system, rehabilitation and renewal, and process expansion projects described in this Facility Plan Update. Figures 1.3 and 1.4 present the 5- and 20-year capital expenditures for STMWRF. Figure 1.5 depicts the cumulative capital expenditures over the 20-year planning period.



5-YEAR PROJECTED CAPITAL EXPENDITURE FOR STMWRF

FIGURE 1.3

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STMWRF FACILITY PLAN UPDATE

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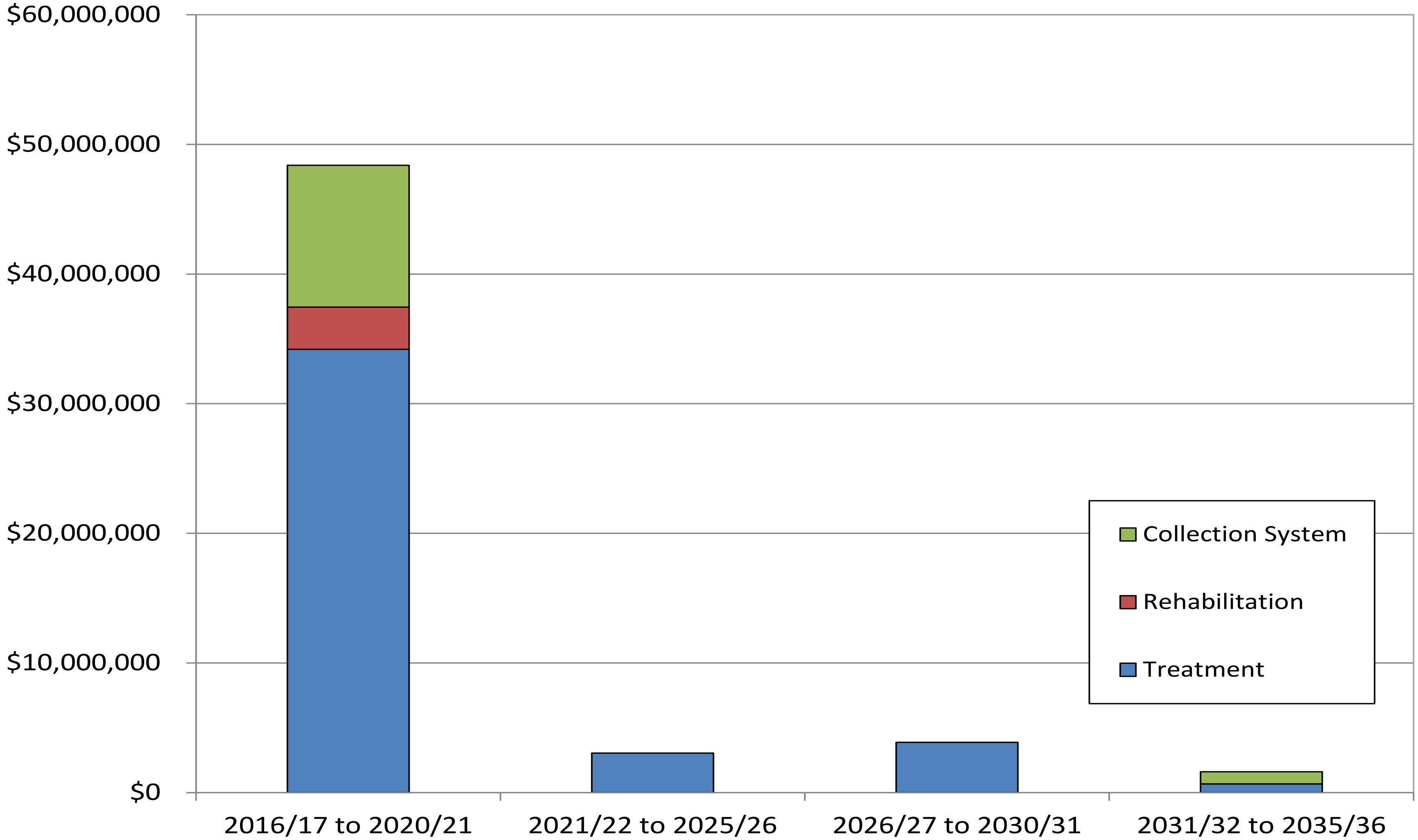

20-YEAR PROJECTED CAPITAL EXPENDITURE FOR STMWRF

FIGURE 1.4

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STMWRF FACILITY PLAN UPDATE

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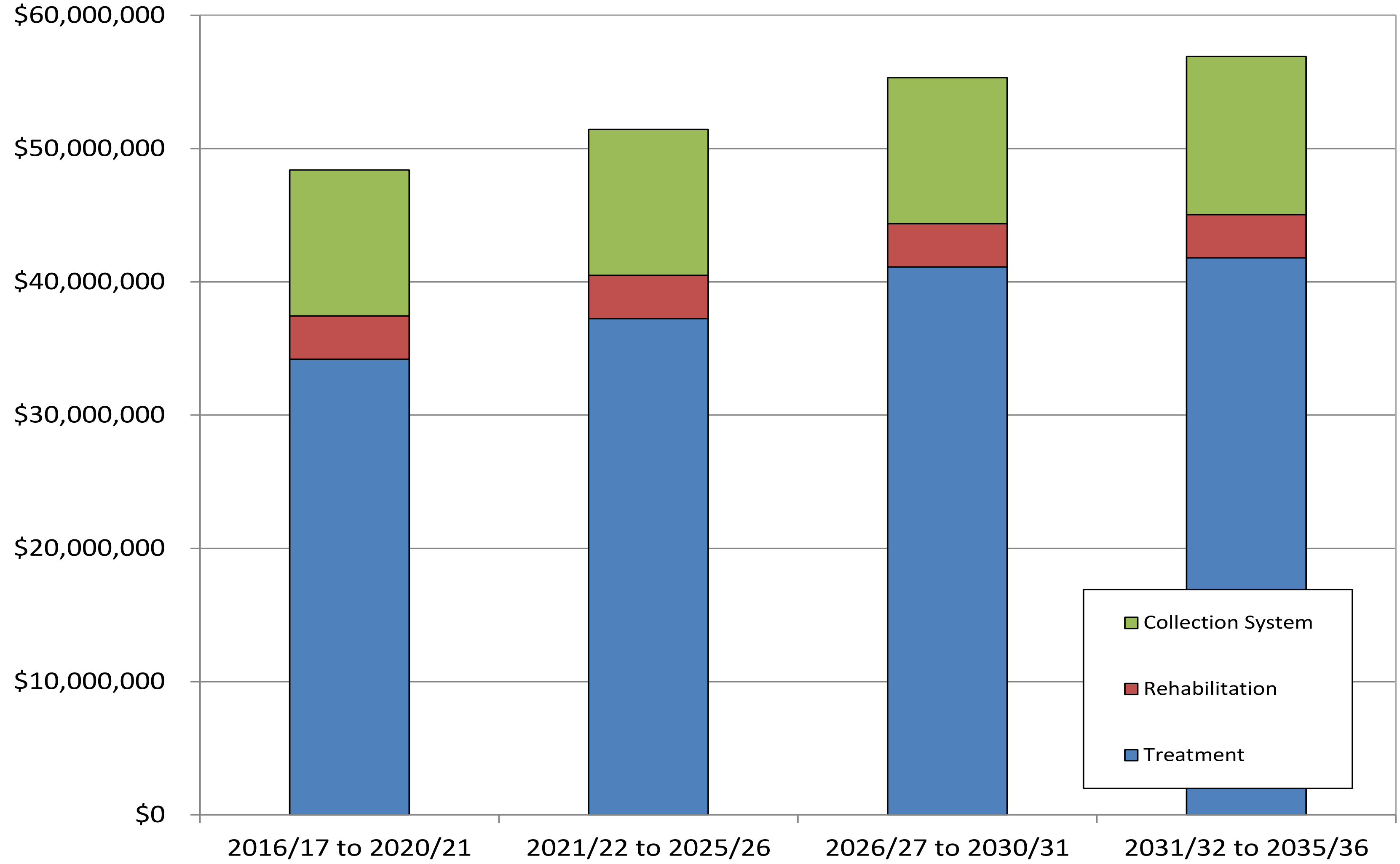

20-YEAR CUMULATIVE COSTS FOR STMWRF

FIGURE 1.5

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

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Table 1.7	Cost Estimates for Wastewater Collection System Projects STMWRF Facility Plan Update Washoe County	
Facility	**Year Needed**	**Cost[1] ($, millions)**
Pleasant Valley Interceptor Reach 3A[2]	2018	1.3
Pleasant Valley Interceptor Reach 3B[2]	2018	4.3
Pleasant Valley Interceptor Reach 4[2]	2018	5.3
3,520 feet of 15-in Sewer Main Near Whitecliff Drive and Parma Way	2035	1.0
Total Project Cost		**11.9**

Note:

(1) Cost based on December 2015 dollars, includes engineering design, inspection, and project management.
(2) See TM 3 for additional detail.

Table 1.8	Cost Estimates for STMWRF Rehabilitation and Renewal Projects STMWRF Facility Plan Update Washoe County	
Project Identification	**Year Needed**	**Cost[1] ($, M)**
Structural Rehabilitation and Renewal Projects	2019	2.7
Other Rehabilitation and Renewal Projects	2017	0.5
Total Project Cost		**3.2**

Note:

(1) Cost based on December 2015 dollars.

Table 1.9 Cost Estimates for STMWRF Expansion Projects
STMWRF Facility Plan Update
Washoe County

Facility	Year Needed	Cost(1) ($, millions)
Influent Raw Wastewater Conveyance – Screw Pumps	2020	2.4
Preliminary Treatment Facilities – Screen No. 3	2032	1.5
Secondary Treatment Facilities – Anaerobic Zone and Two Oxidation Ditches	2020	22.4
Tertiary Filtration Pre-conditioning – DAF	2018	9.4
Tertiary Filtration Facilities – Four Tertiary Filters	2027	6.2
Total Project Cost		**41.9**

Note:
(1) Cost based on December 2015 dollars.

WASHOE COUNTY

SOUTH TRUCKEE MEADOWS
WATER RECLAMATION FACILITY
FACILITY PLAN UPDATE

TECHNICAL MEMORANDUM NO. 2

PLANNING FRAMEWORK

FINAL
January 2016

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SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY
FACILITY PLAN UPDATE

TECHNICAL MEMORANDUM
NO. 2
PLANNING FRAMEWORK

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PLANNING FRAMEWORK

1.0 INTRODUCTION

This technical memorandum presents the planning framework and projections that form the basis for the South Truckee Meadows Water Reclamation Facility (STMWRF) Facility Plan Update. This framework contains a set of assumptions and criteria that have been agreed upon with the County and guide the outcome of this study. The infrastructure recommendations from this study could change if the underlying assumptions change; therefore, the planning framework and assumptions are defined in the following sections so that the foundation of the recommendations can be well understood. The planning framework includes the following:

- Land Use Assumptions
- Population Projections
- Wastewater Unit Load Projections
- Wastewater Flow Projections
- Regulatory Requirements
- Inflow and Infiltration Estimates
- Reliability and Design Criteria

Land use development forms the basis for producing growth trend patterns and projecting future wastewater flows. The land use plan defines the type of growth that is expected to occur in the STMWRF service area as it grows towards buildout.

Population projections are an important component of the master planning framework because they are used to define the growth rate between planning years. The population projections in this facility plan update were correlated with the County's land use plan and the STMWRF service area. Population projections can also be used to verify reasonableness of wastewater flow projections by estimating the gallons per capita (or person) per day (gpcd) flow for each planning year, which can then be correlated to equivalent residential units (ERUs).

The wastewater flow projections are based on the land use plan and population projections as well as historic water demand and wastewater flow ratios. Water demands determine the amount of wastewater that will be produced.

The following four future planning periods in addition to the current year were selected for the facility plan update:

- 2015 (current condition)
- 2020
- 2025
- 2030
- 2035

Wastewater flows were developed for each planning period. Infrastructure and facility recommendations will also be organized by planning period. In addition, buildout of the service area will be considered to develop ultimate wastewater flows and suggest phased expansion of STMWRF.

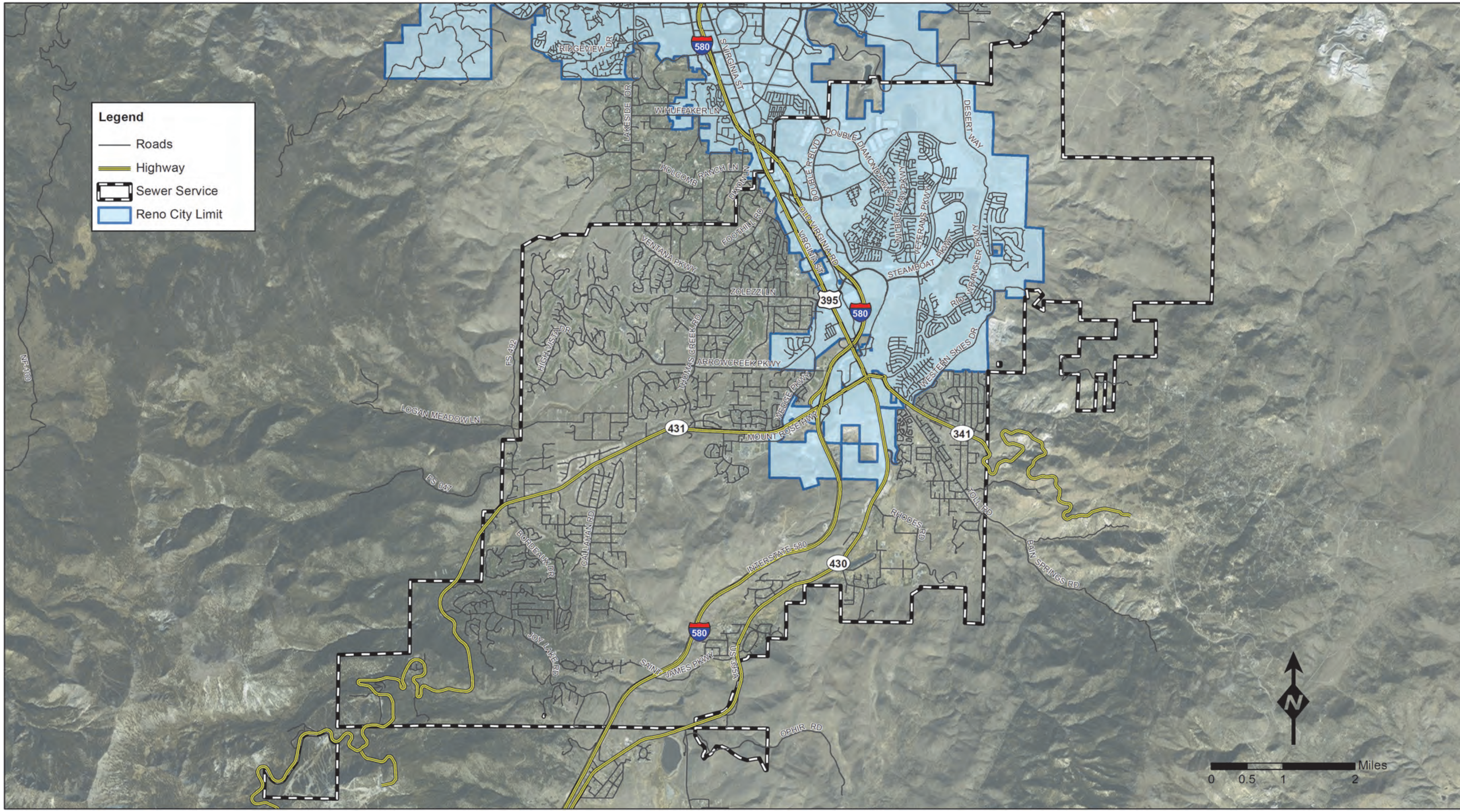
2.0 SERVICE AREA, LAND USE AND COLLECTION SYSTEM

2.1 Service Area

The service area for the STMWRF is shown in Figure 2.1. The service area covers 60.6 square miles near the southern tip of Washoe County, Nevada and represents the maximum service area that could potentially generate flows tributary to STMWRF. The current population of the service area is estimated to be 45,990, with an estimated 36,580 people actually receiving sewer service. This leaves 9,410 people within the service area who are assumed to be on septic systems. Approximately 23,800 people who live in the service area are also within Reno city limits.

2.2 Land Use

Assessor's parcel information provided by the County, land use data from the Truckee Meadows Regional Planning Agency (TMPRA), USGS elevation contours, and aerial imagery were used to determine characteristics of the acreage within the service area. More than half of the area within the service area is currently vacant or undeveloped. Some portions of the service area were considered undevelopable because they have extreme terrain characteristics. The developed area in the STMWRF service area is predominantly residential land use with clusters of commercial and industrial land use along the I-580 corridor. The land use plan is shown in Figure 2.2.



SOUTH TRUCKEE MEADOWS PLANNING AREA

FIGURE 2.1

WASHOE COUNTY

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY PLAN UPDATE

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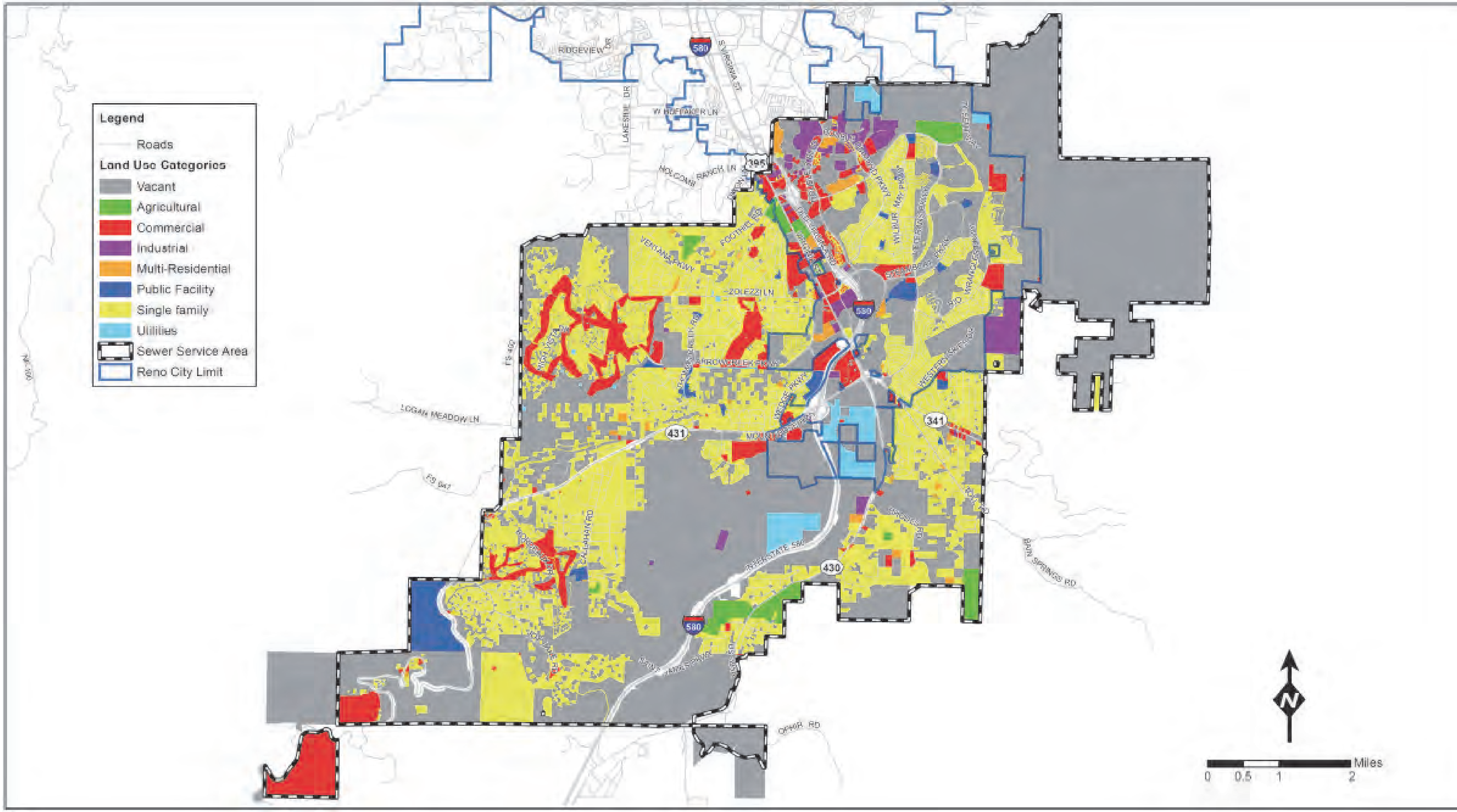

SOUTH TRUCKEE MEADOWS LAND USE PLAN

FIGURE 2.2

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Table 2.1 shows the breakdown of acreage for each land use category in the sewer service area.

Table 2.1 Land Use Within the Service Area
STMWRF Facility Plan Update
Washoe County

Land Use	Total Acreage	Buildout Acreage	2015 Developed Acreage
Single Family	11,074	11,074	5,176
Multi-Residential	265	265	103
Commercial	2,517	2,517	1,383
Industrial	679	679	152
Public Facility	580	580	108
Utilities	595	595	9
Agricultural	614	614	47
Vacant & Developable	10,721	10,721	1,999
Vacant & Undevelopable	11,709	0	0
Total, ac	**38,754**	**27,044**	**8,976**
Total, square miles	**60.6**	**42.3**	**14.0**

2.3 Existing Wastewater Collection System

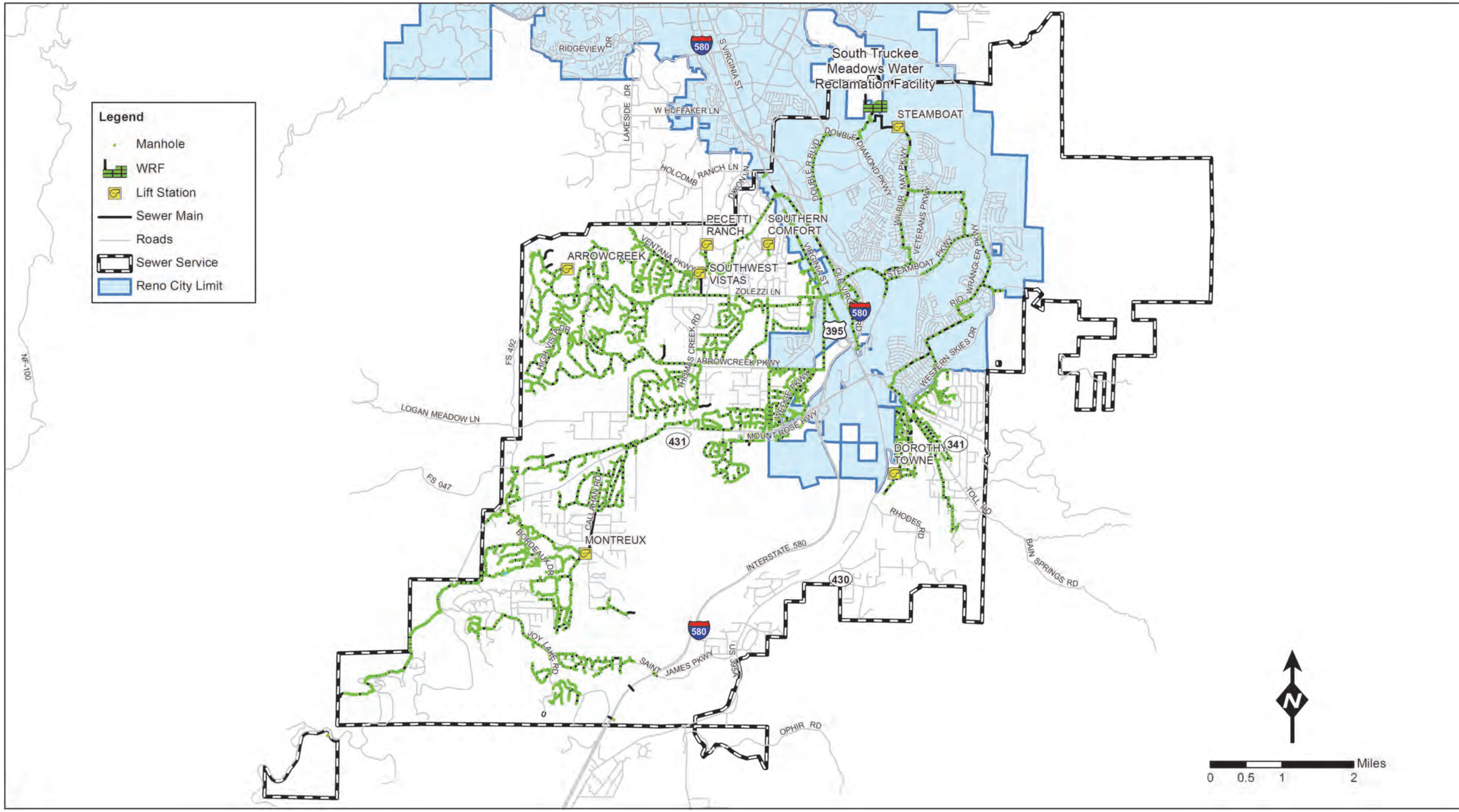
There are 142.5 miles of sewer pipe owned by Washoe County in the STMWRF service area. There are also sewer pipes tributary to the STMWRF service that are owned by the City of Reno. Flow from City of Reno areas was used in the hydraulic model and to produce flow projections, but the pipe capacity in Reno pipes will not be considered in this study. The collection system also has seven wastewater lift stations of various capacities. Figure 2.3 shows the STMWRF existing wastewater facilities.

Some portions of the STMWRF service area are served by septic systems. Figure 2.4 shows properties with septic systems according to the county assessor's parcel information.

3.0 INFLOW AND INFILTRATION EVALUATION

3.1 2011 Flow Monitoring Field Tests

Flow monitoring field test data from a previous study was provided by the County for use in this study. The flow monitoring occurred at 26 locations throughout the STMWRF service area from January 27, 2011 to March 9, 2011. These field tests collected wastewater velocity, depth, and flow in 15-minute increments. Figure 2.5 shows the meter locations for the temporary flow monitoring locations where flows were large enough to collect usable data. Flows obtained from these meters were used to estimate the infiltration of ground water into sewer interceptors in the collection system.



SOUTH TRUCKEE MEADOWS EXISTING WASTEWATER COLLECTION SYSTEM

FIGURE 2.3

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SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY PLAN UPDATE

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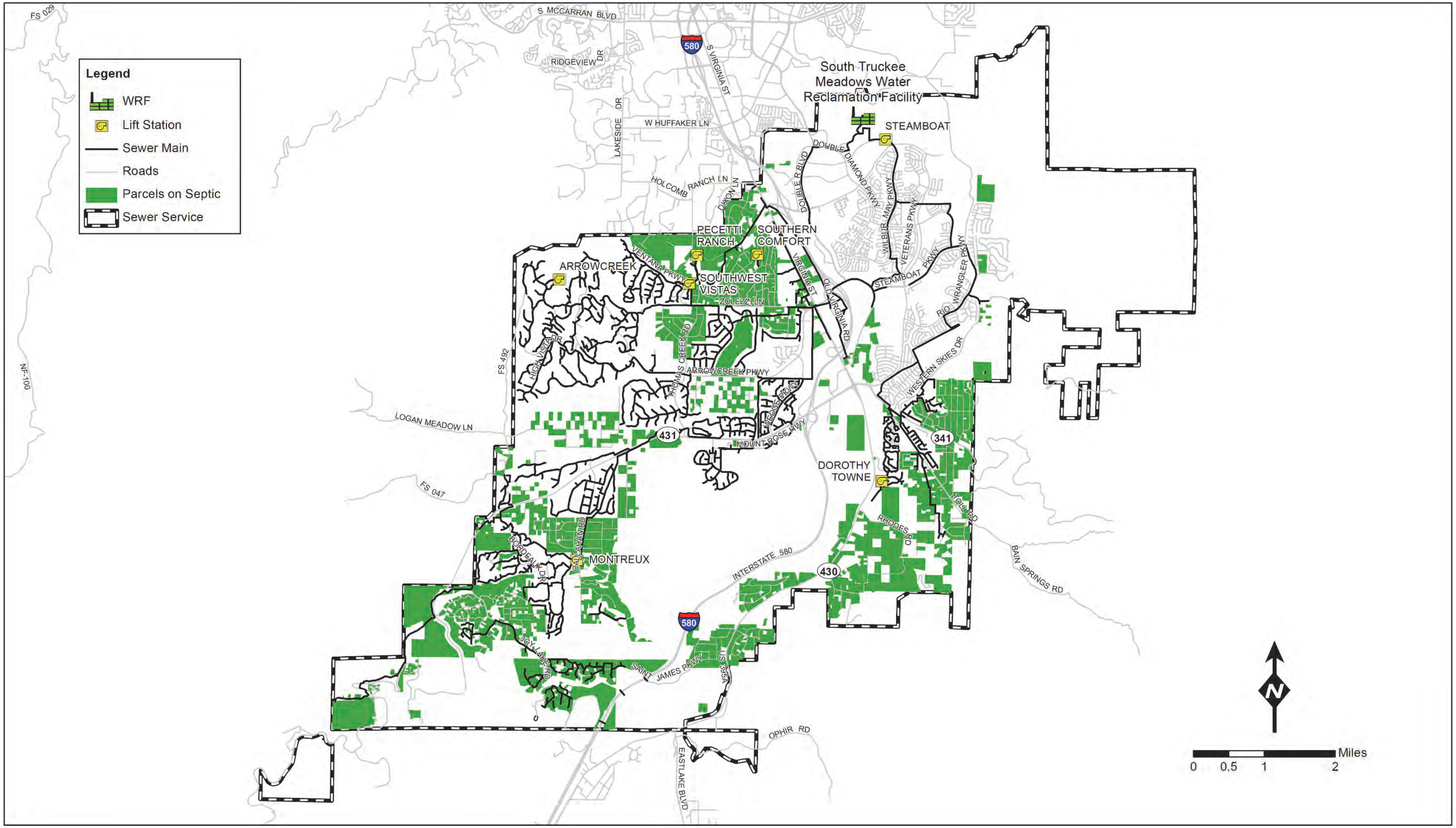

PROPERTY WITH SEPTIC SYSTEMS

FIGURE 2.4

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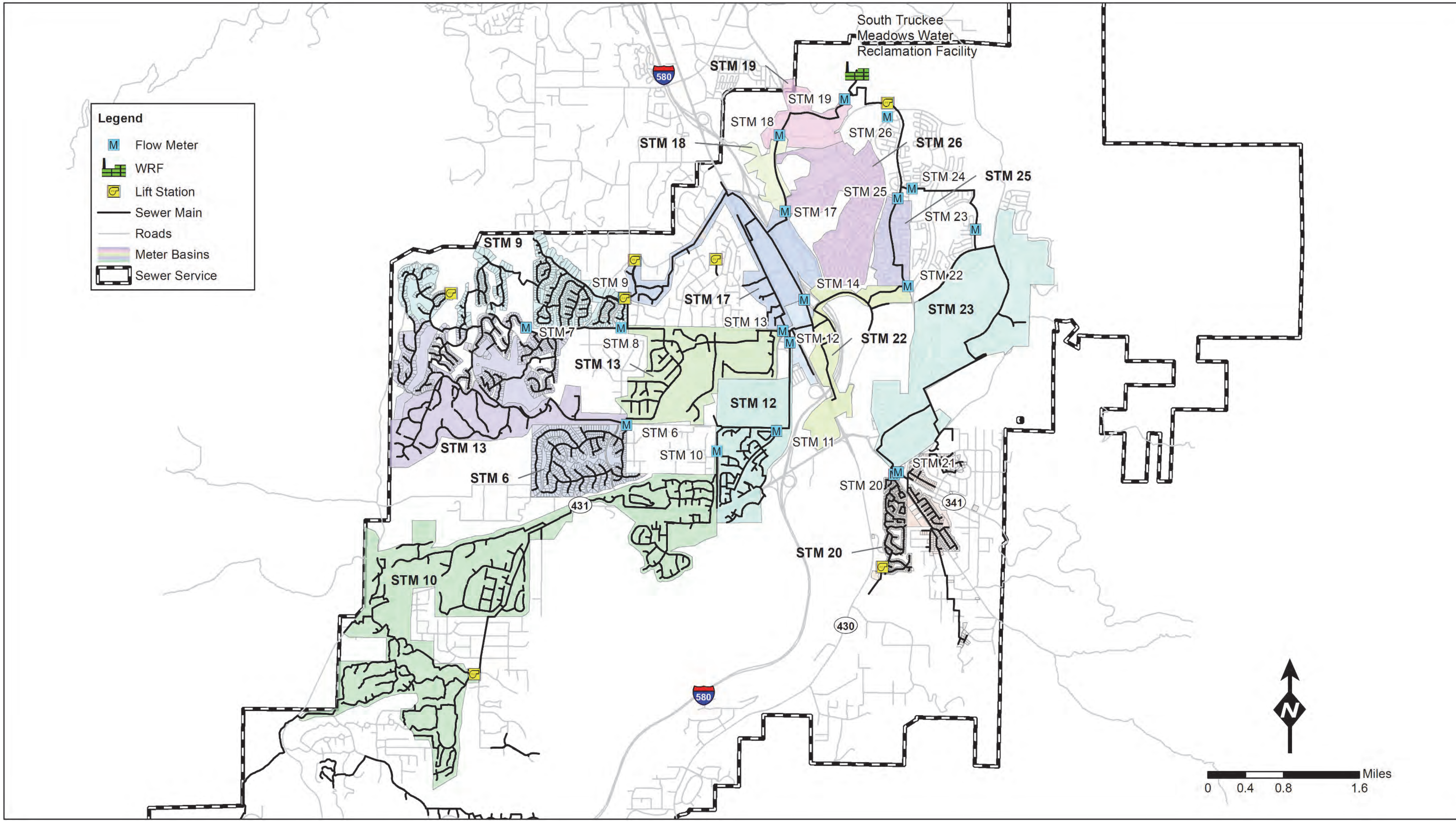

2011 TEMPORARY FLOW MONITORING BASINS

FIGURE 2.5

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Table 2.2 shows the average flows in each basin during the field test period. Some meters were placed in pipes with flows that were too small to be measured accurately.

Table 2.2 Average Basin Flows from 2011 Analysis
STMWRF Facility Plan Update
Washoe County

Meter Name	Upstream Basins	Average Daily Flow, (gpm)	Comments
STM 01	STM 01	N/A	No useful data
STM 02	STM 01, 02	N/A	No useful data
STM 03	STM 01, 02, 03	N/A	No useful data
STM 04	STM 04	N/A	No useful data
STM 05	STM 04, 05	N/A	No useful data
STM 06	STM 06	19	
STM 07	STM 07	28	
STM 08	STM 07, 08	20	
STM 09	STM 09	54	
STM 10	STM 01, 02, 03, 10	203	
STM 11	STM 11	62	
STM 12	STM 01, 02, 03, 10, 11, 12	296	
STM 13	STM 04, 05, 06, 07, 08, 09, 13	225	
STM 14	STM 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14	581	
STM 15	STM 15	N/A	No useful data
STM 16	STM 16	N/A	No useful data
STM 17	STM 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15 , 16, 17	530	
STM 18	STM 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15 , 16, 17, 18	583	
STM 19	STM 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15 , 16, 17, 18, 19	744	
STM 20	STM 20	26	
STM 21	STM 21	34	
STM 22	STM 22	29	
STM 23	STM 20, 21, 23	332	
STM 24	STM 20, 21, 23, 24	432	
STM 25	STM 22, 25	176	
STM 26	STM 26	437	

3.2 Permanent Flow Monitoring

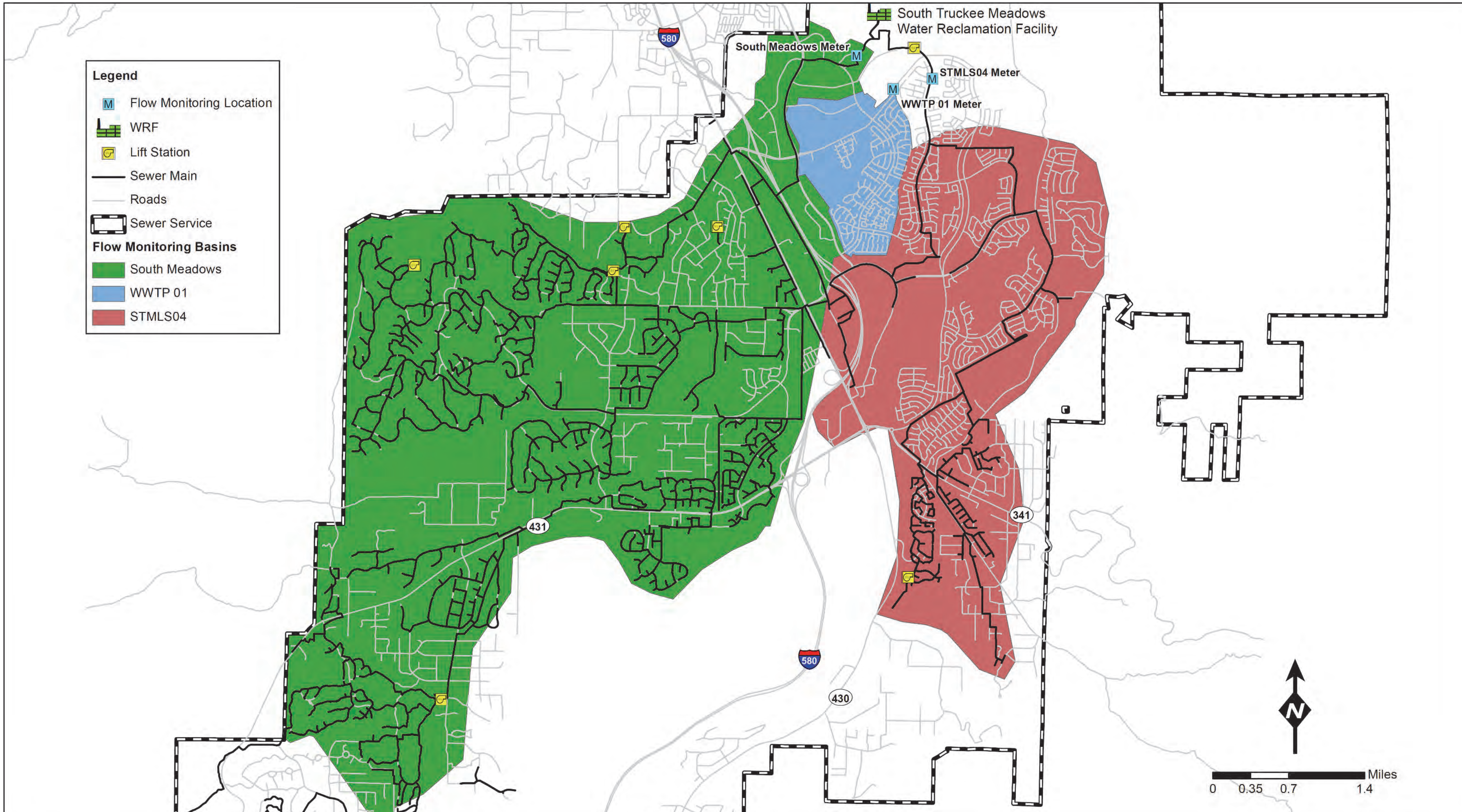
The County maintains permanent flowmeters at three locations in the collection system. Figure 2.6 shows the location of these permanent flow meters and their associated drainage areas. Intermittent flow data from these meter sites was available from August 8, 2014 to March 9, 2015. The STMLS04 meter had flow data in 2014 from October 3 to October 22 and November 19 to December 11. The WWTP01 meter had flow data from August 21 to November 20, 2014, and from January 1 to March 9, 2015. The South Meadow meter had usable flow data from August 21, 2014, to March 9, 2015. The South Meadow flow data was used to establish average weekday and weekend flow patterns and hourly peaking factors. The flow patterns from the South Meadow meter were used to establish current observed minimum and average wastewater flows used in several calculation methods to estimate infiltration for the gravity portion of the service area. All three permanent meters had reliable data in 2014 from October 3 to October 20. Flows measured during this time period were used to estimate infiltration for the entire service area. Table 2.3 shows average daily flows for the permanent flowmeter as well as the net influent flow to the STMWRF from October 3 to 20. The sum of the three permanent meter flows is eight percent higher than the influent flow to the STMWRF. Graphs of the available permanent flow data are included in Appendix B.

Table 2.3 Permanent Flowmeter Average Daily Flow
STMWRF Facility Plan Update
Washoe County

	Permanent Flowmeters				
	South Meadows (Gravity Portion of Sewer Service Area)	STMLS04 (East side of Lift Station Basin)	WWTP 01 (West side of Lift Station Basin)	Sum of Permanent Meter Flow, mgd	STMWRF Net Influent Flow, mgd(1)
Average Daily Flow (Oct 3 to Oct 20, 2014), mgd	1.90	1.22	0.79	3.91	3.61

Note:

(1) STMWRF net influent flow does not include backwash flow, and flow from DD Well 2, STMGID Well 9, and Tessa West Well. The net influent flow going forward is 3.0 mgd, and excludes the well flow.



PERMANENT FLOW MONITORING LOCATIONS

FIGURE 2.6

WASHOE COUNTY

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY PLAN UPDATE

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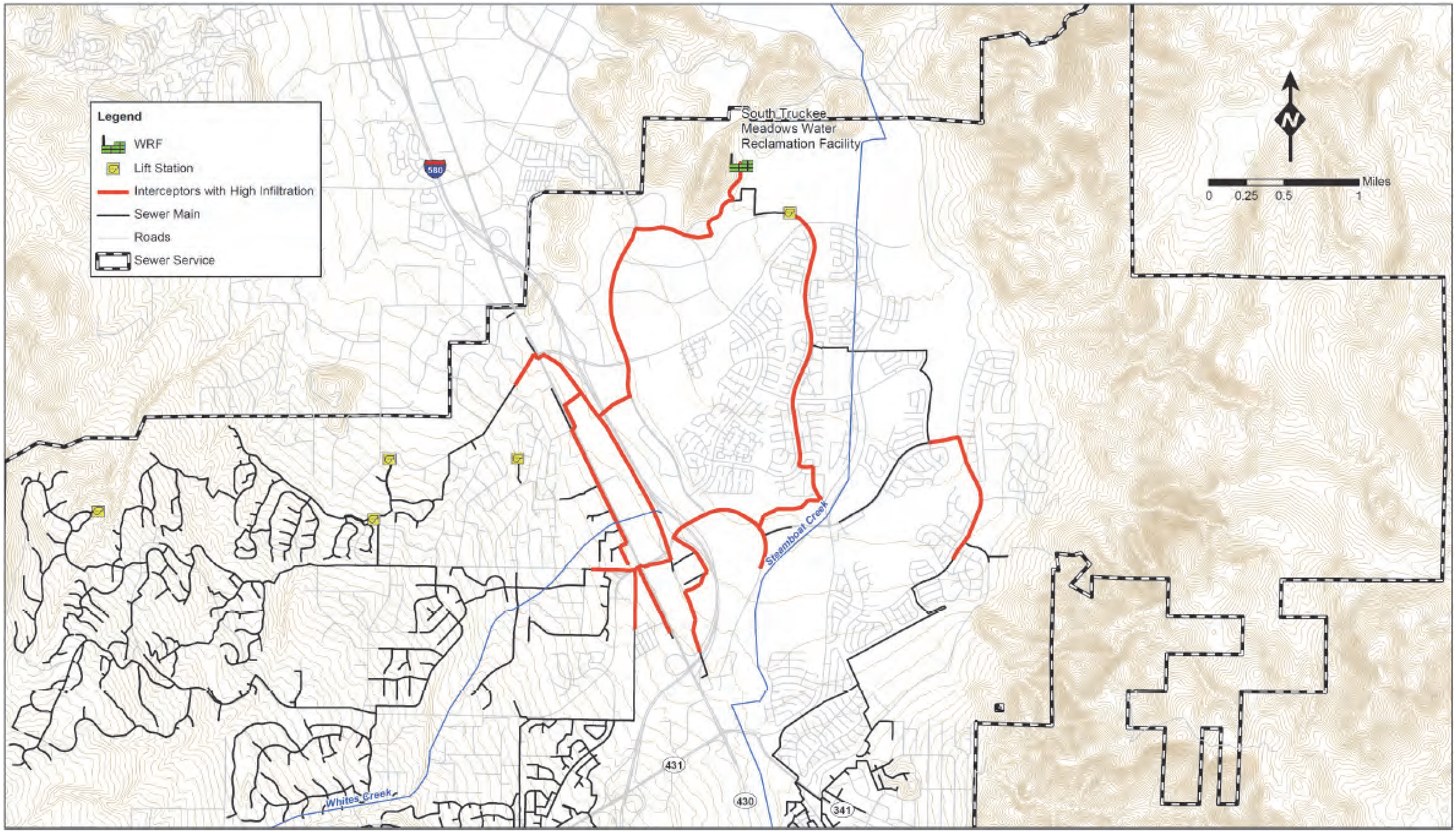
3.3 Inflow and Infiltration Analysis

Washoe County provided a GIS shapefile that identified 13.1 miles (6,900 feet) of sewer interceptors as having significant ground water infiltration. These interceptors are located in the northeast portion of the STMWRF sewer basin immediately upstream of the STMWRF and Steamboat lift station. This area of high infiltration is a relatively flat spot in the area of lowest elevation in the collection system through which Thomas Creek, Whites Creek, and Steamboat Creek all drain. There are also several standing ponds and lakes in addition to the streams in the area which are possible evidence of a high water table that would contribute to ground water infiltrating into sewer mains. Figure 2.7 shows County pipes with known ground water infiltration in the STMWRF service area.

Wastewater flow is often made up of three parts, wastewater produced (WWP) and discharged into the collection system, infiltration of groundwater into the collection system, and inflow from storm events. Most methods of calculating infiltration use average daily flows and minimum daily flows which are identified during flow monitoring field test. Figure 2.8 shows the average weekend flow pattern for the South Meadows permanent flowmeter and identifies some of the variables used to estimate infiltration. The following methods were used to estimate infiltration:

- Wastewater Production Method
- Minimum Flow Factor Method
- Stevens-Schutzbach Method
- Mass Balance
- Average vs. Dry Weather Flow

Inflow calculations are not precise, and each one of the equations listed above provides an estimate of what the actual inflow might be. When used together, the differing estimates provide an indication of the range of inflow that may exist under different conditions. In this study, an estimate of inflow is selected for the analysis. As Washoe County obtains additional information on inflow, adjustments to the inflow estimate may be appropriate. The calculations for each method are provided in the sections that follow.



COLLECTION SYSTEM INFILTRATION LOCATIONS

FIGURE 2.7

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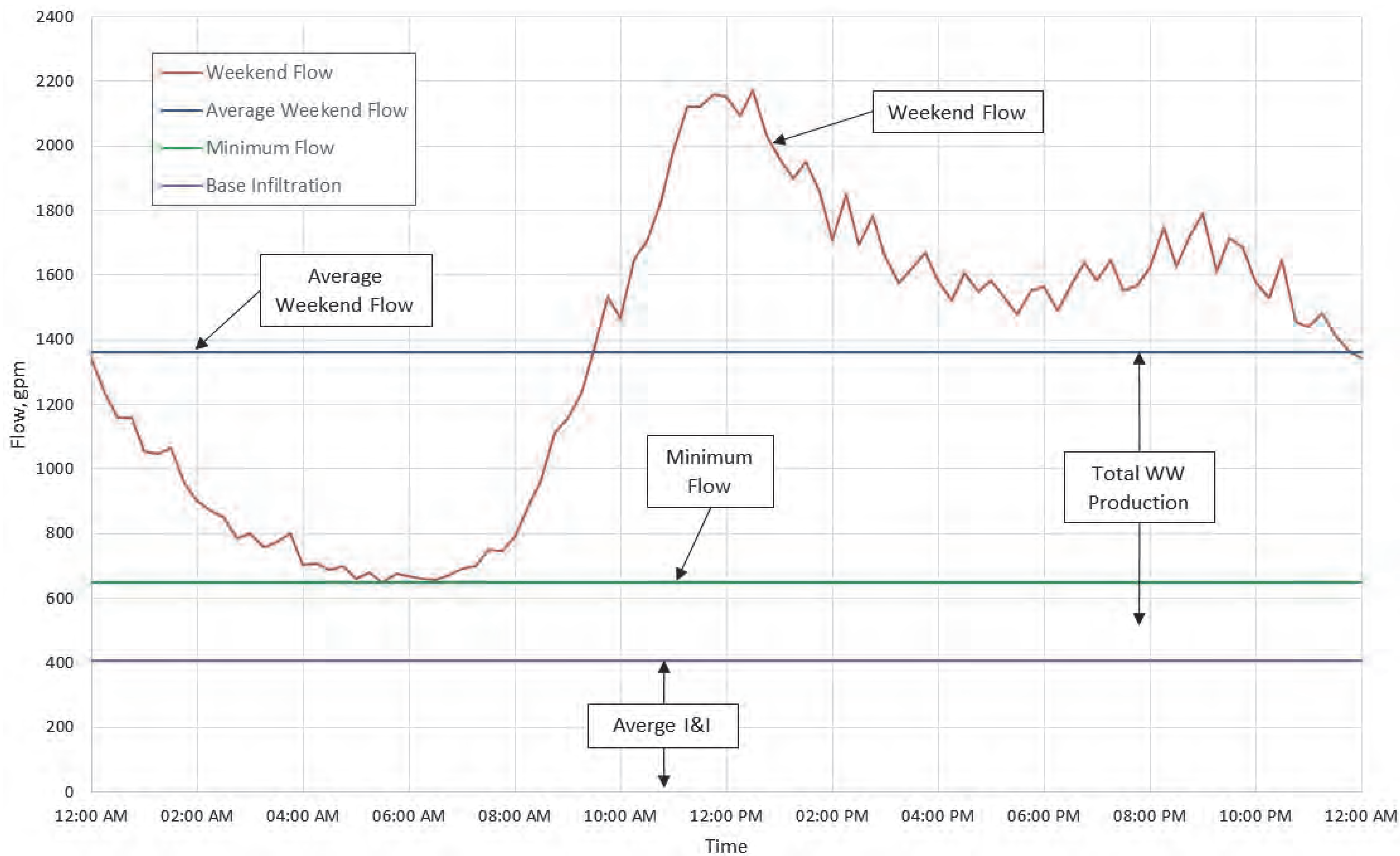

2014 WEEKEND FLOW PATTERN - SOUTH MEADOW PERMANENT FLOWMETER

FIGURE 2.8

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3.3.1 Wastewater Production Method

The wastewater production method uses a factor to estimate the expected ratio of average daily flow to minimum daily flow. This ratio is compared to the actual ratio obtained from monitoring data, and the difference between the two is the estimated infiltration.

$$I = ADF - (ADF - MDF) / X$$

Where:

I = Infiltration

ADF = Average Daily Flow

MDF = Minimum Daily Flow

X = 1 minus the minimum wastewater production factor during nighttime hours.

3.3.2 Minimum Flow Factor Method

This method is derived from an empirical formula that relates wastewater basin size to the basins minimum flow factor (ASCE, 1982). The basin size is determined as its average daily flow in million gallons per day (mgd).

$$I = MDF - 0.22 (ADF - I) ^\wedge 0.202$$

Where:

I = Infiltration

ADF = Average Daily Flow

MDF = Minimum Daily Flow

3.3.3 Stevens-Schutzbach Method

This method uses an empirical formula to relate infiltration to average daily and minimum flows.

$$I = \frac{0.4\ (MDF)}{1 - 0.6\ (MDF / ADF) ^\wedge (ADF ^\wedge 0.7)}$$

Where:

I = Infiltration

ADF = Average Daily Flow

MDF = Minimum Daily Flow

3.3.4 Mass Balance

This method compares the measured average annual daily flow to the calculated average annual daily flow based on land use acreages and corresponding wastewater unit flows. Wastewater unit flows were calculated using unit water demands and the dry weather wastewater return factor. The difference between the measured flow and the calculated dry weather flow is infiltration.

3.3.5 Wet Weather vs Dry Weather Flow

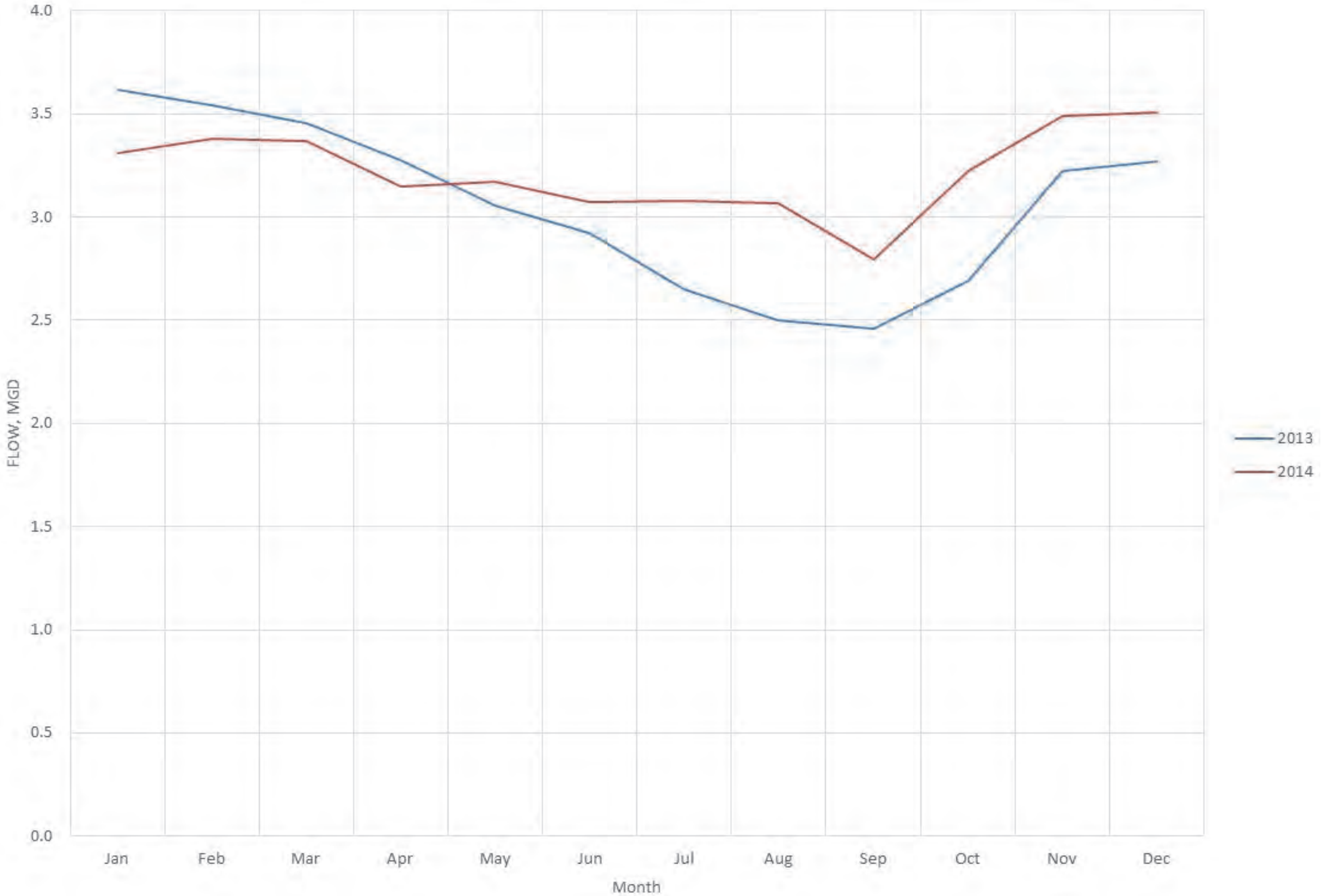
Figure 2.9 shows the average monthly flows to the STMWRF for 2013 and 2014. This method compares seasonal dry weather flow with maximum average monthly or wet weather flow. For both 2013 and 2014, wastewater flows are lowest between July and September. Since the area does not have a significant seasonal population, the fluctuation in average monthly flows is most likely due to infiltration. The minimum average monthly flow is assumed to be the seasonal dry weather flow for the sewer service area. The difference between the July - September flows and the flows that occur during the remainder of the year is assumed to be infiltration.

3.3.6 Infiltration Results

The methods described above produced a range of infiltration estimates. Some methods were not appropriate for all sets of flow data. Infiltration estimates were calculated using the most applicable data and methods. The mass balance and average versus dry weather flow methods were not used with the permanent or 2011 flowmeter data because they require annual average daily flow data which was not available from these sources. The wastewater production, minimum flow factor, and Stevens-Schutzbach methods were not used with the STMWRF influent data because they require data resolution finer than one day increments which was not available from the influent data. Table 2.4 shows the calculated infiltration as a percent of the average flow for each method for permanent and 2011 flowmeters.

Table 2.4 Inflow Estimated Using Flowmeters in the Collection System
STMWRF Facility Plan Update
Washoe County

Inflow Calculation Method	Permanent Meters			Average of 2011 Flowmeter Tests %
	South Meadow %	STMLS04 %	WWTP 01 %	
Wastewater Production (X = 0.8)	35%	40%	14%	21%
Minimum Flow Factor	36%	34%	38%	21%
Stevens-Schutzbach	30%	33%	44%	26%



AVERAGE MONTHLY FLOWS TO THE STMWRF FOR 2013 AND 2014

FIGURE 2.9

WASHOE COUNTY

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY PLAN UPDATE

Table 2.5 shows the calculated infiltration as a percent of the average annual flow for years with complete influent data. Infiltration estimates calculated using the permanent and 2011 flowmeter data represent flows from a portion of the year that may not be representative of the average infiltration throughout the year. However; these infiltration estimates are similar to those obtained using the influent flow data, so this data was still considered in the evaluation.

Table 2.5 Infiltration Estimated Using Daily Influent Flow Records
STMWRF Facility Plan Update
Washoe County

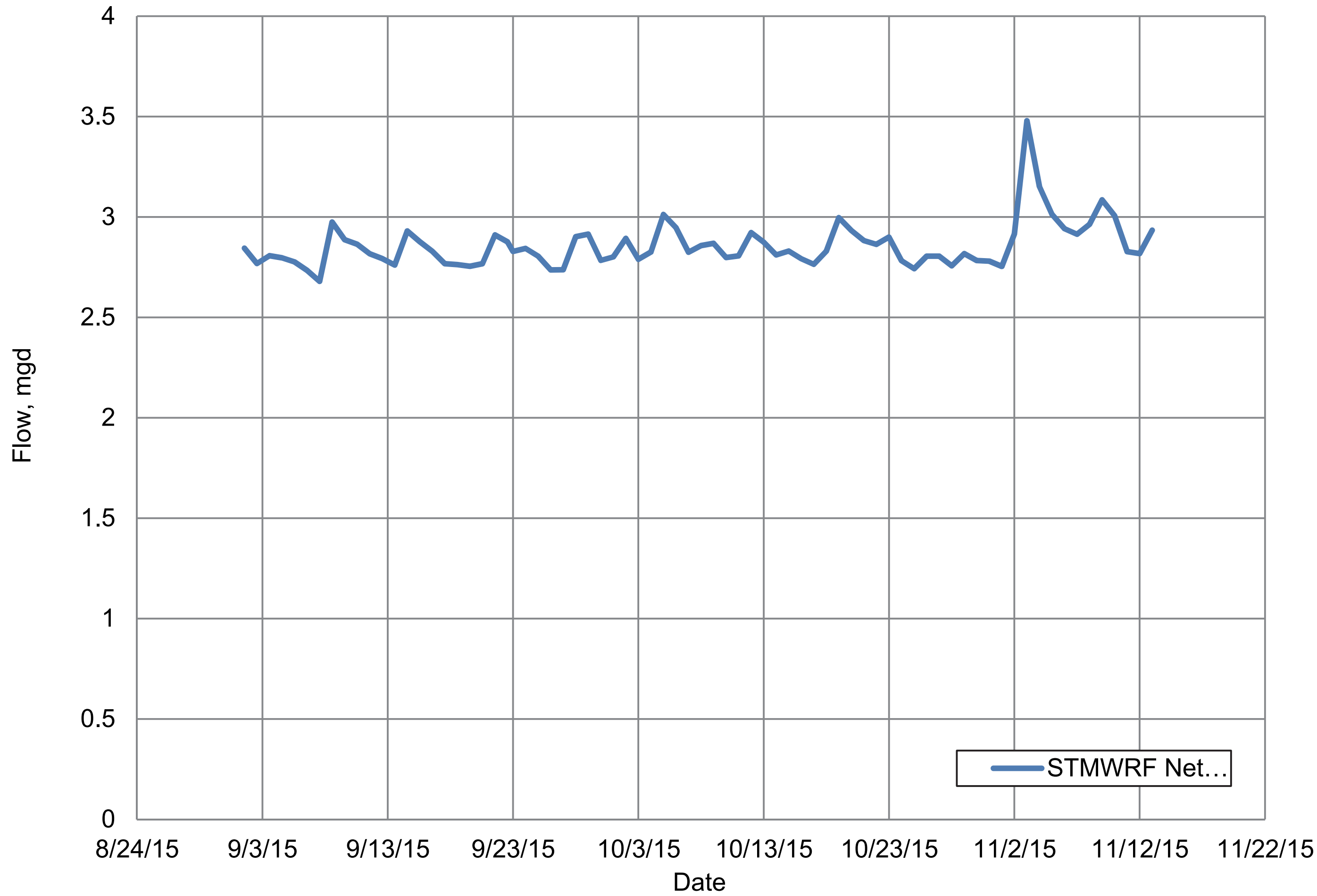
	STMWRF Influent Flows		
Infiltration Calculation Method	**2011 %**	**2013 %**	**2014 %**
Mass Balance (WW factor = 40%)	30%	34%	NA
Average vs Dry Weather Flow Method	NA	32%	20%

Infiltration estimates obtained using 2011 flowmeter data correlate with estimates obtained using influent flow data. Therefore, the infiltration rate for the STMWRF service area is estimated to be 30 percent of average daily flows. This infiltration rate is an average of all of the results obtained from each infiltration calculation method.

The inflows will be entered as a separate load in the County's hydraulic model. This will be useful in the future, not only to have the modeled inflow documented in the model, but it will also provide a place holder that can be easily modified if the inflow estimate changes in the future. The infiltration rate is independent of the average flow, but is reported as a percentage of the average flow for convenience in loading the hydraulic model.

3.4 Storm Inflows

The County provided recent flow data into the STMWRF showing the effect of a storm that dropped approximately one inch of rain. Flows into the plant increased as shown on Figure 2.10. To model storm inflows of a similar magnitude, the volume of this storm was distributed evenly across the manhole nodes in the model, and then peaked using a typical storm peaking factor as shown in Figure 2.11.



WASTEWATER INFLOWS TO THE STMWRF SHOWING A RECENT STORM EVENT

FIGURE 2.10

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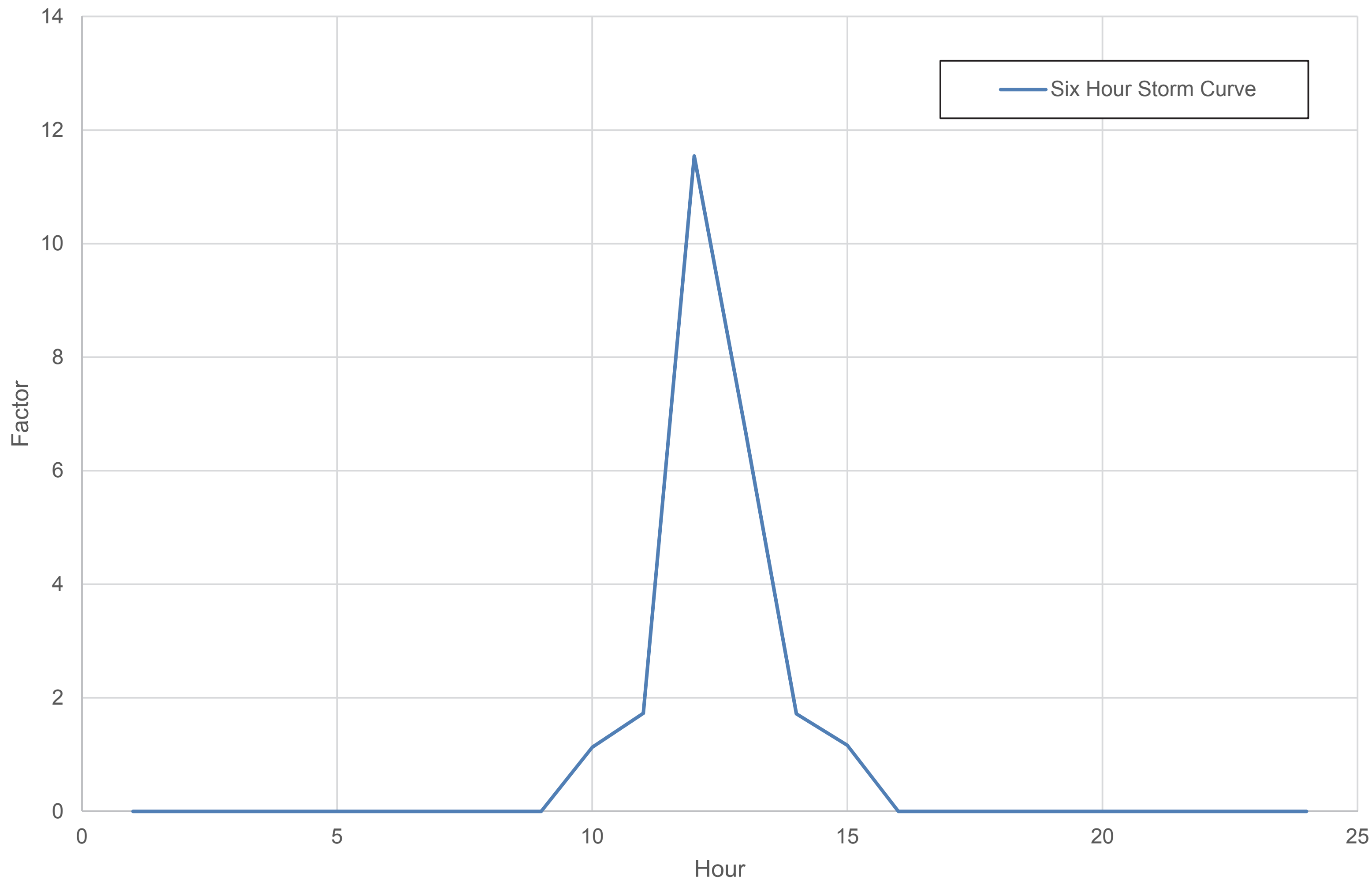

TYPICAL STORM INFLOW PEAKING DIURNAL PATTERN

FIGURE 2.11

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4.0 POPULATION, FLOW AND LOAD PROJECTIONS

4.1 Population Projections

The current population for the STMWRF service area was assumed to be the same as the 2015 population in the Consensus Forecast. The total population includes the STMWRF service area population plus the population currently served by septic tanks. The population served by septic systems was assumed to be 9,410 and was calculated by taking the difference between the 2010 census population in the service area and the population based on the number of sewer connections in the service area. A portion of this population will connect to the collection system in the future and there may be some areas that never connect to the collection system.

Several population growth scenarios for the STMWRF service area were considered. The growth scenarios include:

- **Consensus Forecast:** Population growth according to the Consensus Forecast projection for the STMWRF service area.
- **Populations and Employment:** Population growth according to the Populations and Employment projection for the STMWRF service area.
- **Truckee Meadows Water Authority:** Population increasing by the same percent as the projection created by the Truckee Meadows Water Authority (TMWA) starting with the 2015 population from the Consensus Forecast.
- **Constant Growth:** Population increasing every year by 1.6% (585 people), 2.0% (732 people), and 2.5% (915 people) of the 2015 STMWRF service area population from the Consensus Forecast.
- **Exponential Growth:** Population increasing by 1.6%, 2.0%, and 2.5% every year to 2035 starting with the 2015 STMWRF service area population from the Consensus Forecast.
- **Near Term Growth Projection:** Population increases by higher rates of growth starting at 4% average growth per year in the near term starting with the 2015 STMWRF service area population from the Consensus Forecast and tapers to 0.6% average growth per year by 2035.

County staff reviewed each population projection for the STMWRF service area and determined that the Near Term Growth Projection was most likely based on their experience with the area and the type of growth that is expected. The higher growth predicted in the near future is consistent with recent growth rates, but will still provide a conservative basis for bringing infrastructure on line before current capacities are exceeded.

The future STMWRF service area population was assumed to follow the Near Term Growth Projection with the population served by septic systems remaining constant so that any increase in population is assumed to be within the STMWRF service area.

Table 2.6 shows projected population based on county information. Figure 2.12 shows each of the population projections considered for the STMWRF service area.

Table 2.6 Projected Population Based on Near Term Growth Projection STMWRF Facility Plan Update Washoe County

Year	Septic Area Population	STMWRF Population Connected to Sewer	ERUs Connected to Sewer(1)	Total Service Area Population(2)	Total ERUs within Planning Area(1)
2015	9,410	36,580	14,290	45,990	17,960
2020	9,410	43,900	17,150	53,310	20,820
2025	9,410	49,610	19,380	59,020	23,050
2030	9,410	53,080	20,730	62,490	24,410
2035	9,410	54,670	21,360	64,080	25,030

Notes:

(1) 2.56 people per ERU (or dwelling unit), adapted from Truckee Meadows Regional Planning Agency Projections of Regional Wastewater Generation, November 2014.

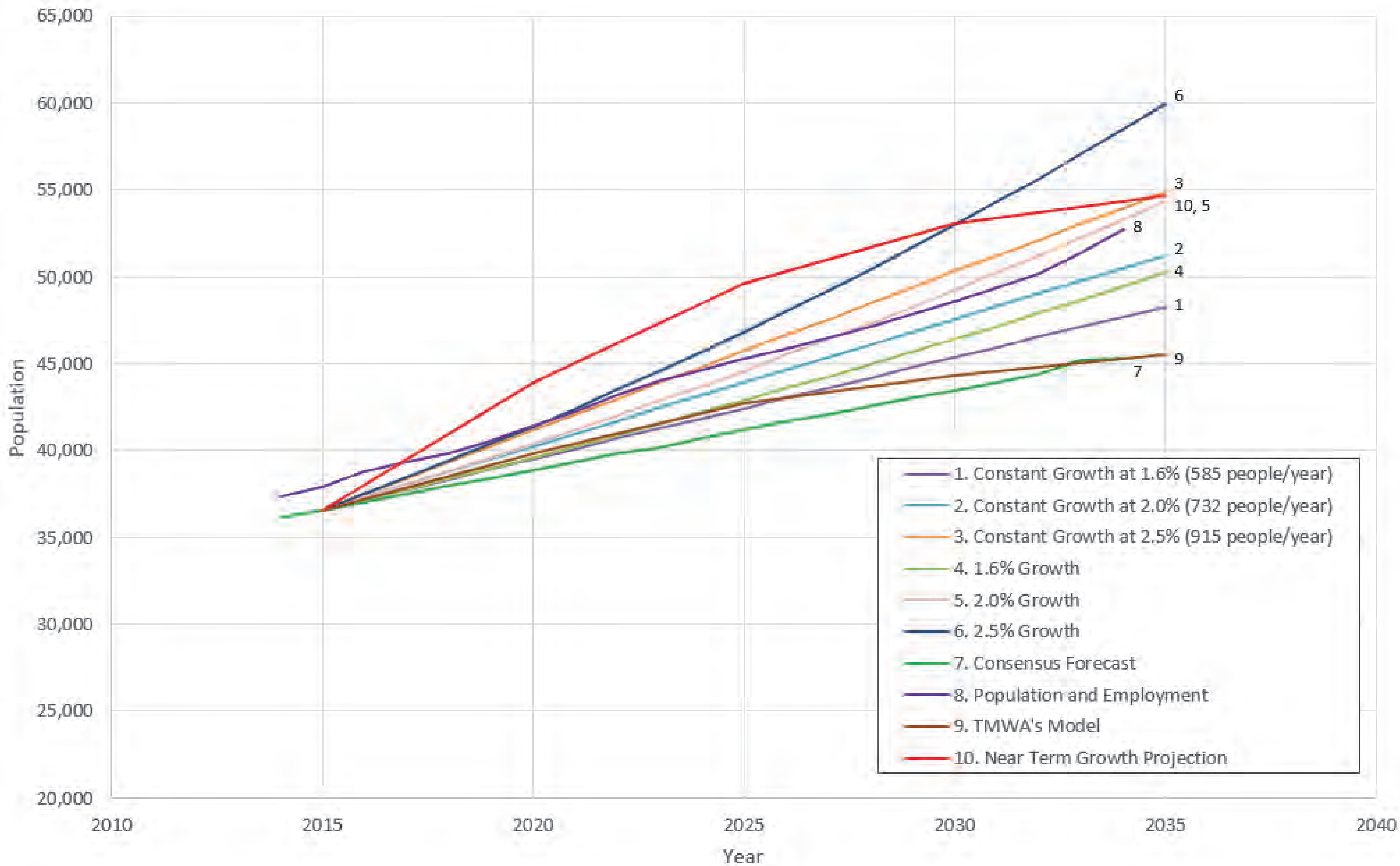
(2) Includes parcels with septic service.

4.2 Equivalent Residential Unit

The Washoe County Department of Water Resources (DWR) defines one equivalent residential unit (ERU) as 270 gallons per day for the purpose of sizing collection system pipes. The average flow per ERU for the available years of data was estimated to be 237 gallons per day per ERU. This number was calculated using the average annual flow to the STMWRF divided by the number of residential parcels connected to the collection system.

The number of people per ERU in the STMWRF service area was assumed to be 2.56. This is consistent with the population in the service area divided by the number of occupied residential parcels.

The ERU flow and people per ERU was used to calculate future wastewater flows from the projected populations.



SOUTH TRUCKEE MEADOWS POPULATION PROJECTION

FIGURE 2.12

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4.3 Wastewater Flow Projections

Wastewater flows are an essential component of the hydraulic modeling data needed to evaluate the capacity of collection system pipes. Wastewater flow projections are developed by first evaluating current flows with current population and currently developed acreages by land use category. Knowing current flow generation on a per capita and a per acre basis provides the foundation for estimating future flows. Unit flow rates in terms of gallons per acre per day are calculated for current flows, and these per acre values are assumed to be consistent as development occurs in the future. To develop flow projections for future years, population growth is correlated with land development to determine the rate of land development. Then the flow increase is calculated by multiplying the unit loads by the developed acres. Future flows can then be applied to pipes in the model.

4.3.1 Historic Wastewater Flows

Table 2.7 shows the historic flow data and peaking factors for the STMWRF from 2010 to 2015. These flows represent the net flow to the facility and do not include backwash flows or flows from the DD Well 2, STMGID Well 9, or Tessa West Well.

Table 2.7 Historic Data
STMWRF Facility Plan Update
Washoe County

Year	Total Average Daily Flow, mgd	Total Peak Daily Flow, mgd	Peaking Factor
2010	2.88	4.39	1.52
2011	2.96	3.71	1.25
2012	N/A	N/A	N/A
2013	2.98	4.19	1.40
2014	2.99	4.69	1.57
2015 (Jan to Mar)	3.00	5.22	1.74

4.3.2 Unit Loads Estimates

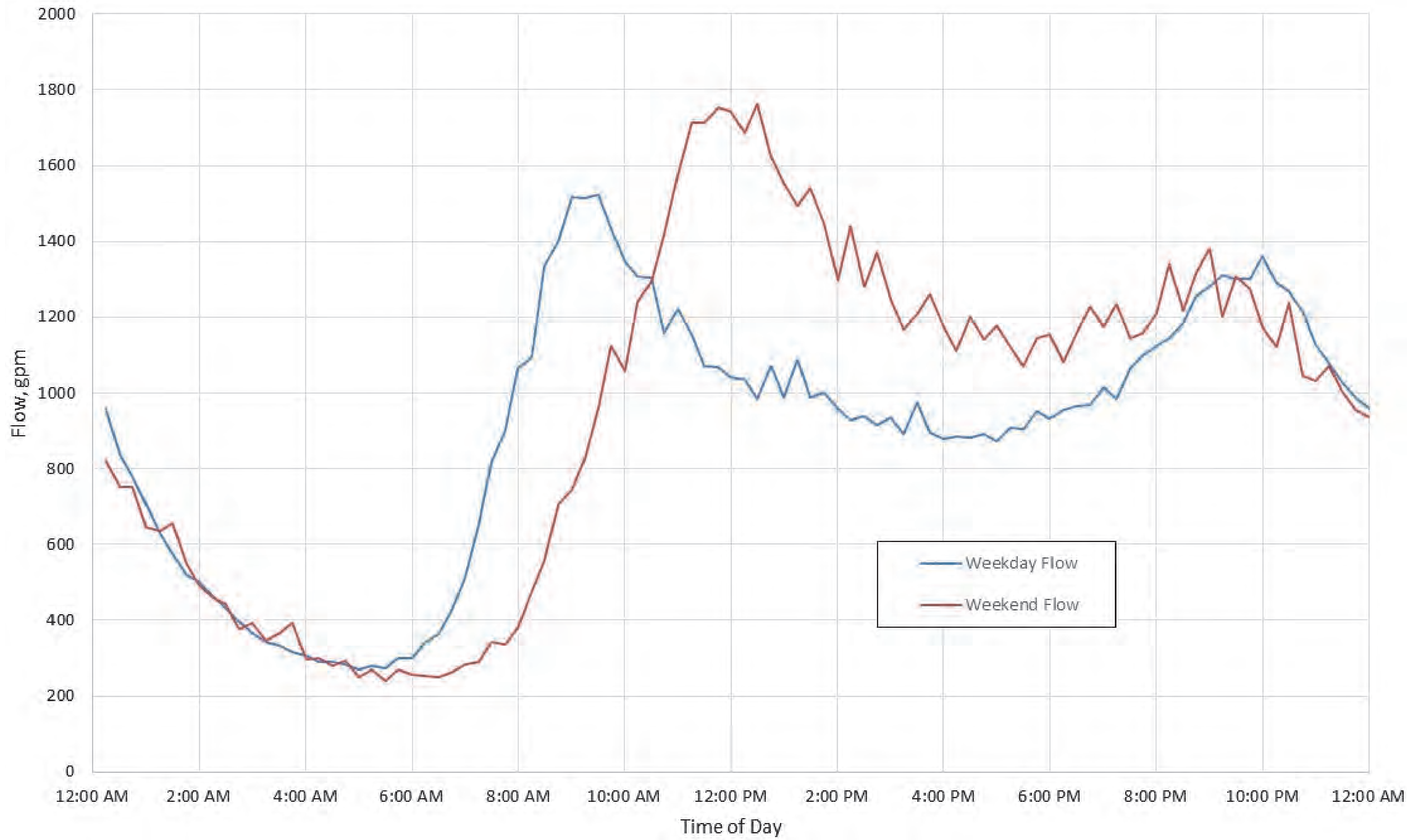
Water consumption data for the STMWRF area was used along with parcel data to estimate the wastewater unit load factors for parcels connected to the collection system. There was no water consumption data available for parcels within the STMWRF service area that receive water from the City of Reno. Unit water demands from Washoe County were applied to City of Reno parcels to estimate the total water demand in the sewer service area. This water demand was compared to the dry weather wastewater flow at the STMWRF to determine that the water to wastewater return factor of 41 percent is a reasonable multiplier to estimate wastewater flows from water flows. Wastewater unit loads were determine by taking known water unit loads and applying the 41 percent return factor to determine wastewater unit loads. Table 2.8 shows the dry weather wastewater unit loads for different land use categories.

Table 2.8 Estimated Unit Wastewater Flows
STMWRF Facility Plan Update
Washoe County

Land Use	2013 Unit Water Demand, gpad	2013 Unit Wastewater Flows (41% return factor), gpad	ERU per Acre
Single Family	1,294	531	2.2
Multi-Residential	352	144	0.6
Commercial	340	139	0.6
Industrial	281	115	0.5
Public Facility	107	44	0.2
Utilities	0	0	0.0
Agricultural	0	0	0.0
Vacant	221	91	0.4

4.3.3 Dry Weather Diurnal Patterns

Diurnal patterns consist of a multiplier for each hour of the day that is multiplied by the average daily flow. Diurnal patterns are created by taking a typical day of flow monitoring data, calculating the average daily flow, then dividing each hourly flow by the average. The permanent flow meter data was used to determine dry weather diurnal patterns for each of the three basins that have a flow meter at the outfall to the basin. Diurnal patterns will be used in the hydraulic model to peak the wastewater flows assigned based on the land use unit loads. Figure 2.13 shows the dry weather weekday and weekend diurnal patterns for the South Meadow permanent flow monitoring basin. Weekend flow patterns usually have a higher peak than the weekday flow pattern. Peaking factors from the weekend diurnal flow pattern will be used to predict model flows. The higher peak will provide conservative flows for testing pipe capacities. Infiltration loads will be added separately from land use loads in the model to simulate wet weather flows. Peaking factors will not be used to peak infiltration loads in the model because infiltration in sewer pipes is relatively constant flow.



2014 SOUTH MEADOWS PERMANENT FLOWMETER DRY WEATHER WEEKDAY AND WEEKEND FLOW

FIGURE 2.13

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4.3.4 Wastewater Peaking Factors

Peaking factors are used to adjust average annual flows to peak hourly flows to correctly determine required infrastructure capacity. For collection systems, peaking factors help to conservatively size future pipes and lift stations to handle peak flows. Peaking factors help sized reclamation facilities to accommodate flows as well as loading rates that fluctuate from day to day.

These peaking factors were calculated using 2014 STMWRF daily influent flow data and the continuous eight months of data available from South Meadows permanent flowmeter. Table 2.9 lists the wastewater peaking factors.

Table 2.9 Wastewater Flow Peaking Factors
STMWRF Facility Plan Update
Washoe County

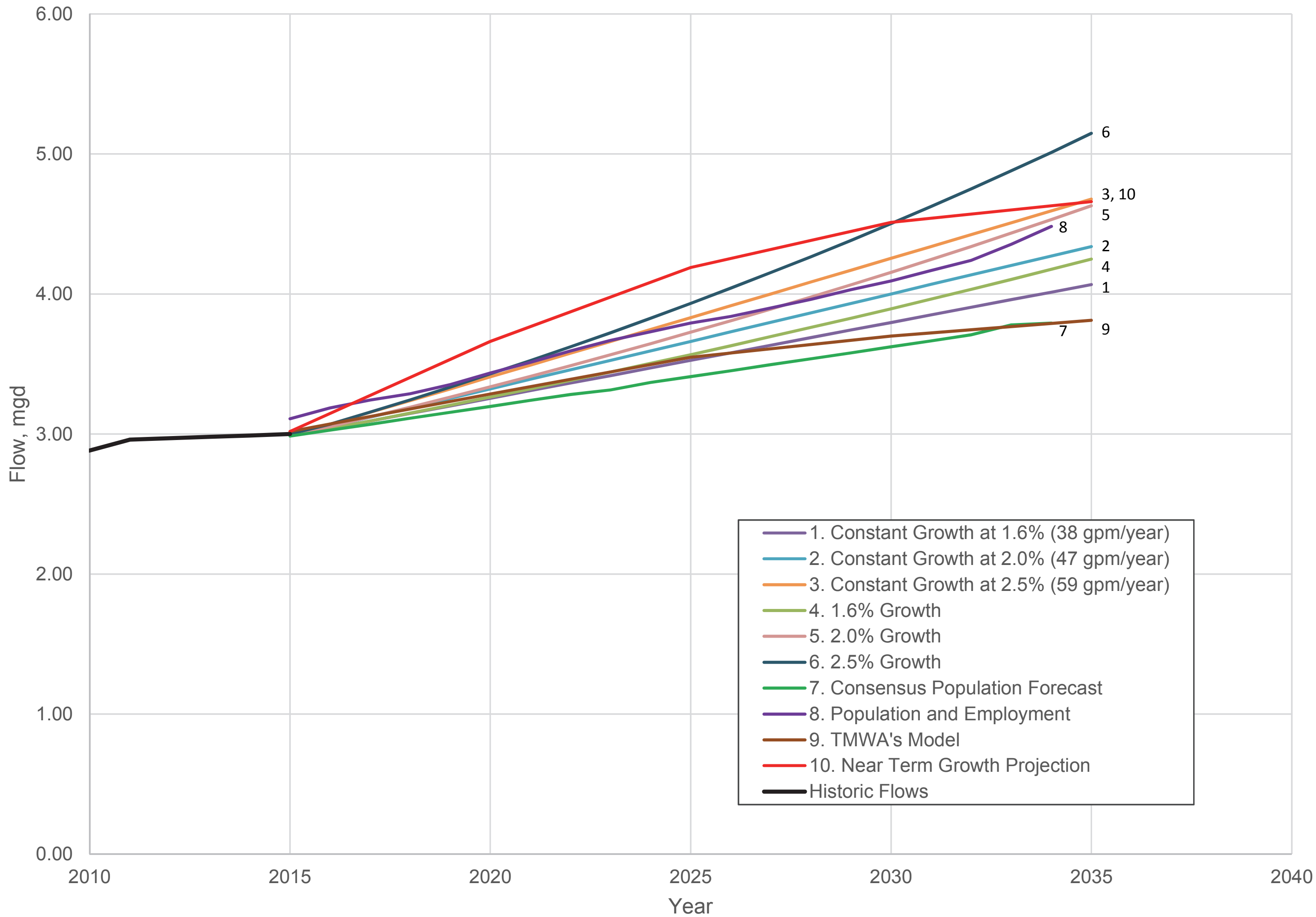
Demand Condition	Peaking Factor
Average Annual Daily Flow, AADF	1.00
Average Daily Maximum Month Flow, ADMMF	1.12
Peak Day Flow, PDF	1.33
Peak Hour Dry Weather Flow, PHDWF	2.10
Peak Hour Wet Weather Flow, PHWWF	2.47

4.3.5 Projected Future Flow

The flow projection for each planning year was calculated by multiplying the projected population times the ERU flow of 237 gallons per day divided by the number of people per dwelling unit (2.56). The buildout flow projection was calculated using the total buildout acreage times the respective unit flow for each land use type, except for the vacant acreage which was assumed to be developed as single family residential land use. Table 2.10 shows the projected average and peak flows for the STMWRF based on the near term growth projection flow curve. Figure 2.14 shows the historic and projected annual average daily wastewater flows in the STMWRF service area.

Table 2.10 Projected Wastewater Minimum, Average, and Maximum Flows
STMWRF Facility Plan Update
Washoe County

Year	Ave Flow, mgd	Max Month Flow, mgd	WW Peak Hour Flow, mgd	Total ERUs
2015	3.0	3.4	7.4	14,290
2020	3.6	4.0	8.9	17,150
2025	4.1	4.6	10.1	19,380
2030	4.4	4.9	10.8	20,730
2035	4.5	5.0	11.1	21,360
Buildout	11.6	13.0	28.7	42,963



SOUTH TRUCKEE MEADOWS FLOW PROJECTION

FIGURE 2.14

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4.4 Wastewater Characteristics

Historical wastewater characteristics used in this facility plan are based on data provided by the County staff. The sampling data available for STMWRF is from August 2010 to July 2011; therefore, the determination of the planning criteria for this facility plan will be based on the influent constituent characteristics for the period of 2010 through 2011. The collected sample is analyzed for total suspended solids (TSS) and five-day Carbonaceous Biochemical Oxygen Demand (cBOD). Other constituents may be measured but are not reported here. The provided data will be compared with previous data used in 2008 facility plan.

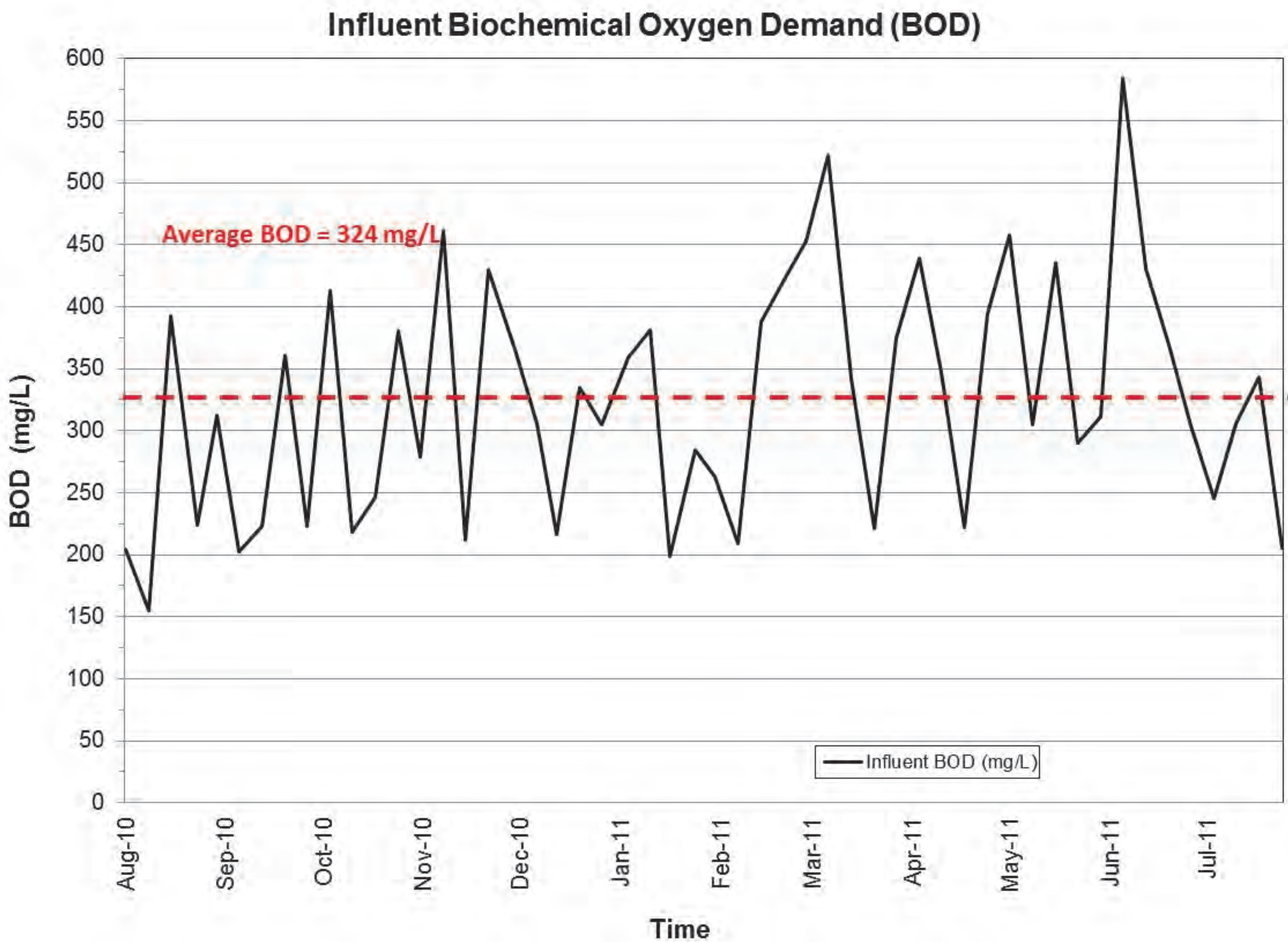
The load variability was evaluated using the daily flow and concentration data. For each constituent, the daily flow was multiplied by the corresponding concentration to obtain the daily load, which was then used for the load trending and peaking factor analysis.

The average day maximum month load (ADMML) peaking factor is based on the maximum ratio between the monthly average daily loads and the annual average day load (AADL) given by the daily load linear trend. A 30-day running average was used to calculate the monthly averages, but it should be noted that the 30-day average includes approximately four data points, as samples are typically collected once per week.

The influent wastewater characteristics were evaluated to determine the average wastewater constituent concentrations, and the load peaking factors. These parameters drive the capacity of the secondary treatment system and are critical elements of the plant capacity evaluation to be completed as part of this master plan.

4.4.1 cBOD

A detailed review and analysis of the provided historical influent cBOD concentration (August 2010 to July 2011) was completed. The annual average cBOD concentration observed in 2006 (approximately 327 mg/L, 2008 Facility Plan) has remained similar to concentrations observed in the 2010 to 2011 data (approximately 324 mg/L). The STMWRF staff has confirmed that the recent cBOD concentrations observed in the facility are within the above mentioned range. The cBOD concentrations for the period from August 2010 to July 2011 are shown in Figure 2.15.



AVERAGE cBOD CONCENTRATIONS - AUGUST 2010 TO JULY 2011

FIGURE 2.15

WASHOE COUNTY

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY PLAN UPDATE

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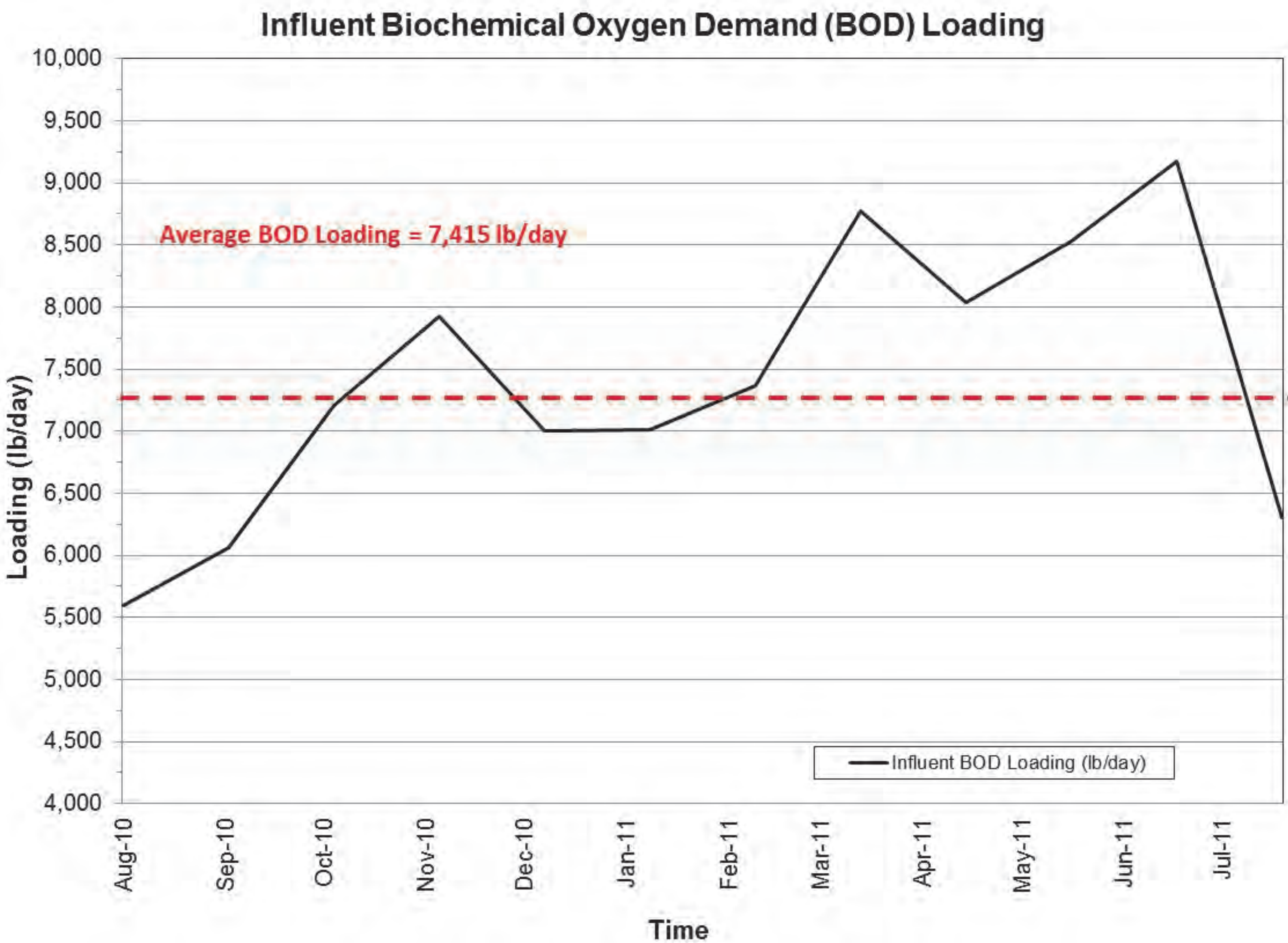
Table 2.11 shows a summary of cBOD concentration.

Table 2.11	Summary of cBOD Concentration STMWRF Facility Plan Update Washoe County								
Month	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2010**	**2011**
January	213	214	287	273	259	378	375		306
February	191	299	247	215	259	253	334		321
March	196	291	272	225	142	215	387		383
April	214	256	259	199	231	219	454		351
May	188	269	338	289	180	197	446		372
June	199	194	306	274	272	245	356		400
July	179	222	294	220	255	-	352		275
August	222	200	505	243	190	395	235	244	
September	205	195	343	194	173	490	290	264	
October	216	218	294	299	260	399	188	314	
November	239	218	269	272	300	343	173	346	
December	225	209	191	138	385	399	337	305	
Annual Average	**207**	**232**	**300**	**237**	**242**	**321**	**327**	**295**	**344**

Notes:
2000 to 2006 data from 2008 Facility Plan
2010 - 2011 data provided by the STMWRF staff for 2015 Facility Plan

Therefore, the recommended design criterion for average cBOD concentration is 327 mg/L. This average is based on the entire 2000 - 2006 (2008 Facility Plan) and 2010 - 2011 period analyzed. This is a conservative value, as it balances both the values from the first and second halves of the data set range.

As discussed above, the daily flow was multiplied by the corresponding concentration to obtain the daily load, which was then used for the cBOD load trending and peaking factor analyses. cBOD loading for the period from August 2010 to July 2011 is shown in Figure 2.16.



AVERAGE cBOD LOADING - AUGUST 2010 TO JULY 2011

FIGURE 2.16

WASHOE COUNTY

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY PLAN UPDATE

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Table 2.12 shows a summary of cBOD loading.

Table 2.12 Summary of cBOD Loading
STMWRF Facility Plan Update
Washoe County

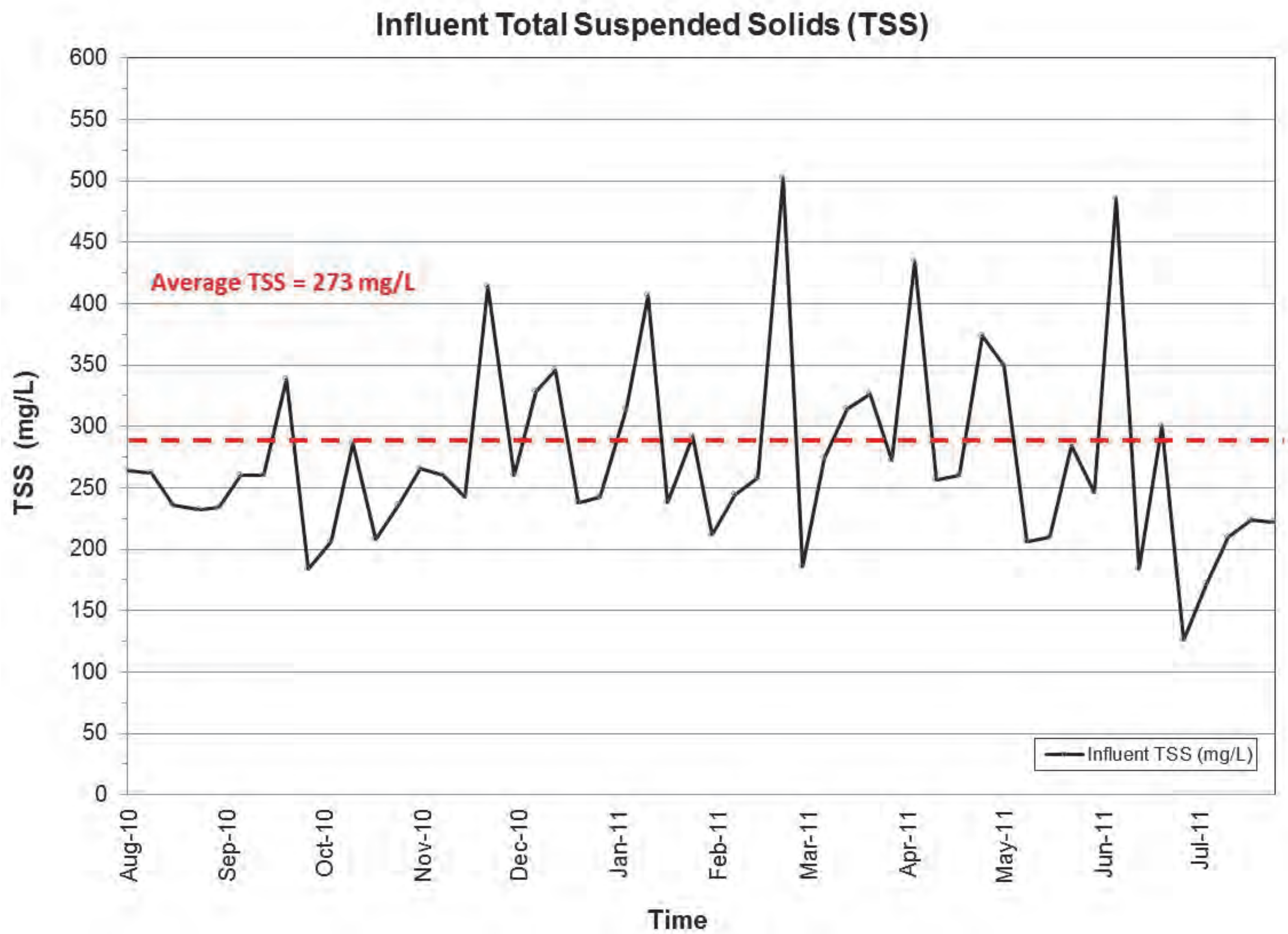
Month	2000	2001	2002	2003	2004	2005	2006	2010	2011
January	1919	2142	3112	3643	3888	6895	7762		7012
February	1752	3192	2884	2690	3888	4891	7610		7368
March	1635	2912	2949	2439	2132	3966	8405		8775
April	1963	2562	3240	2655	3082	3848	9947		8039
May	1725	2692	4228	3808	2552	3853	9723		8532
June	1826	1942	3828	3656	3834	4753	7239		9169
July	1642	2407	3678	2936	3615	-	7979		6301
August	2222	2002	5896	3445	2852	7373	5509	5590	
September	2052	2114	4005	2831	2741	9199	6148	6059	
October	2162	2364	3678	4239	4120	7318	4531	7207	
November	2531	2545	3365	3993	4754	6316	3665	7924	
December	2252	2266	3027	2072	6101	7521	7220	7004	
Annual Average	**1973**	**2428**	**3658**	**3201**	**3630**	**5994**	**7145**	**6757**	**7885**
Peaking Factor	1.28	1.31	1.61	1.32	1.68	1.53	1.39	1.40	1.34

The overall upward trend of the cBOD load is mainly due to the increase in the influent flow over time. However, the peak loading factors observed during 2000 - 2006 (1.39, 2008 Facility Plan) has remained similar to 2010 - 2011 loading factor (approximately 1.37).

Based on the monthly variation in loading and recommended value from the 2008 Facility Plan of 1.45, we recommended ADMML peaking factor of 1.45 for cBOD. This is a conservative value, as it balances both the values from the first and second halves of the data set range.

4.4.2 TSS

Similar to cBOD, the historical influent TSS concentrations were reviewed and analyzed. The annual average concentration has slightly increased from approximately 256 mg/L in 2000 - 2006 (2008 Facility Plan) to approximately 276 mg/L in 2010 - 2011. The average of the entire data set (276 mg/L) is eight percent higher than the 2008 Facility Plan design criteria of 256 mg/L. The STMWRF staff has confirmed that the recent TSS concentration has historically fluctuated around this value, as shown by the relatively flat linear trend of the data. TSS concentrations for the period from August 2010 to July 2011 are shown in Figure 2.17.



AVERAGE TSS CONCENTRATIONS - AUGUST 2010 TO JULY 2011

FIGURE 2.17

WASHOE COUNTY

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY PLAN UPDATE

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Table 2.13 shows a summary of TSS concentration.

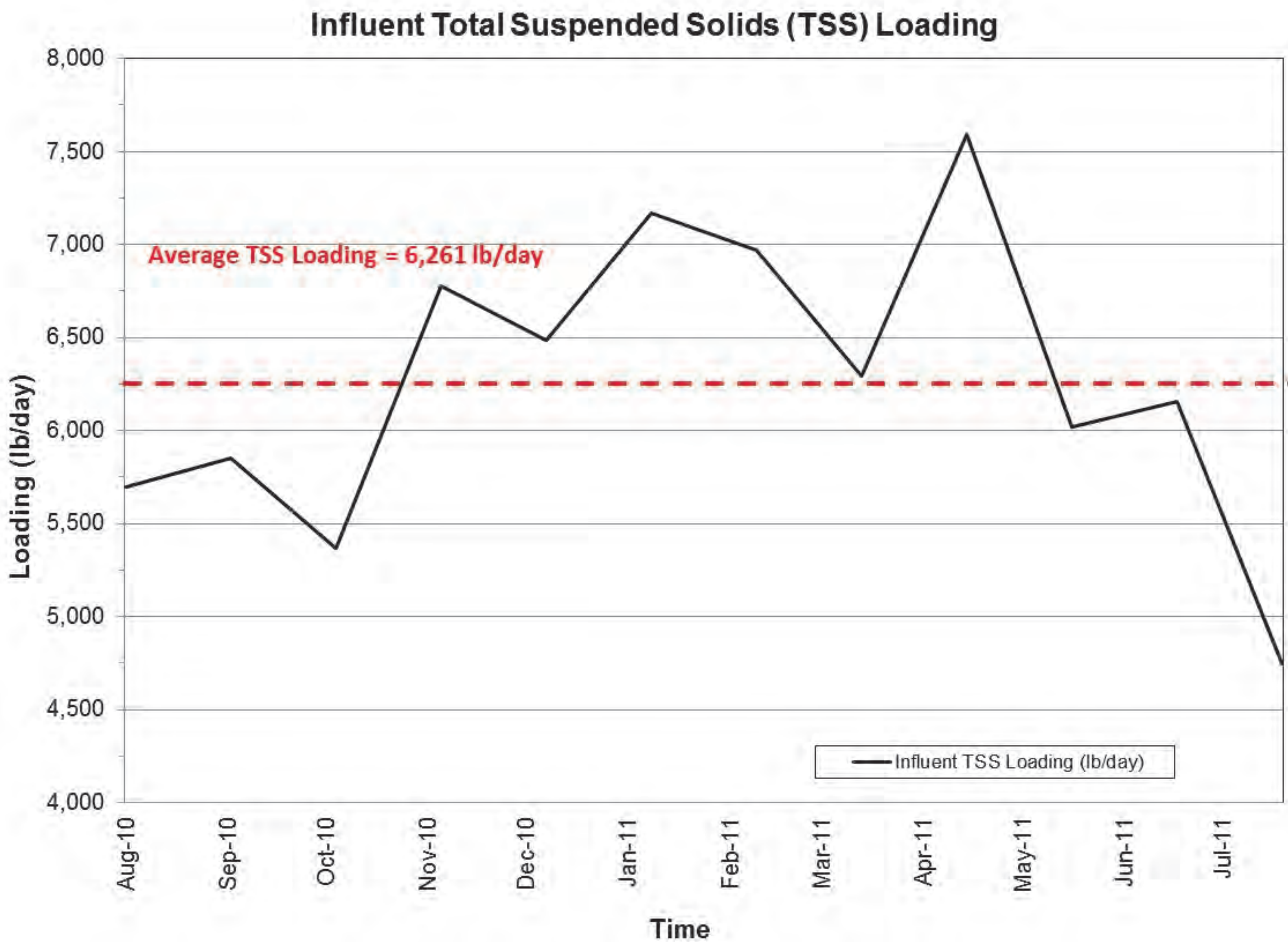
Table 2.13 Summary of TSS Concentration
STMWRF Facility Plan Update
Washoe County

Month	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2010**	**2011**
January	212	235	205	238	232	a	179		313
February	235	254	213	240	566	189	212		304
March	207	247	203	296	322	245	256		274
April	166	234	217	173	234	198	290		331
May	167	231	296	320	203	182	424		263
June	191	223	203	364	208	184	280		268
July	135	258	390	187	270	276	424		207
August	177	286	276	226	390	300	262	249	
September	222	237	274	186	334	306	194	255	
October	160	241	274	259	308	196	153	234	
November	223	322	276	234	294	166	175	296	
December	259	235	264	158	370	177	225	283	
Annual Average	**196**	**250**	**258**	**240**	**311**	**220**	**256**	**263**	**280**

Notes:
2000 to 2006 data from 2008 Facility Plan
2010 - 2011 data provided by the STMWRF staff for 2015 Facility Plan

The recommended design criterion for average TSS concentration is 276 mg/L. This average is based on the conservative value between the recent data set and 2008 Facility Plan value of 256 mg/L.

The overall upward trend of the TSS load is due to the upward trend of influent flow, as well as, relatively small increase in influent TSS concentration over time. However, peak loading factors have decreased over time. TSS loading for the period of August 2010 to July 2011 is shown in Figure 2.18.



AVERAGE TSS LOADING - AUGUST 2010 TO JULY 2011

FIGURE 2.18

WASHOE COUNTY

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY PLAN UPDATE

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Table 2.14 shows a summary of TSS loading.

Table 2.14	Summary of TSS Loading STMWRF Facility Plan Update Washoe County								
Month	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2010**	**2011**
January	1910	2352	2223	3176	3483	-	3705	-	7167
February	2156	2712	2487	3002	8497	3654	4830	-	6972
March	1726	2472	2201	3209	4834	4520	5560	-	6293
April	1523	2342	2715	2309	3122	3479	6354	-	7591
May	1532	2312	3703	4217	2878	3559	9244	-	6020
June	1752	2232	2540	4857	2932	3569	5693	-	6156
July	1238	2797	4879	2495	3828	4933	9611	-	4748
August	1771	2862	3223	3204	5855	5599	6142	5699	-
September	2222	2570	3199	2715	5293	5745	4113	5853	-
October	1601	2613	3428	3672	4881	3595	3688	5367	-
November	2362	3760	3453	3435	4659	3057	3707	6777	-
December	2592	2548	4183	2372	5863	3336	4821	6486	-
Annual Average	**1865**	**2631**	**3186**	**3222**	**4677**	**4095**	**5622**	**6036**	**6421**
Peaking Factor	1.39	1.43	1.53	1.51	1.82	1.4	1.71	1.31	1.38

Therefore, the recommended design criteria for ADMML peaking factor is 1.54 for TSS. This average is based on the recommended value from the 2008 Facility Plan. This is a conservative value, as it balances both the values from the first and second halves of the data set range.

4.4.3 Ammonia and Total Kjeldahl Nitrogen

Influent nitrogen levels are not typically measured at STMWRF. However, for this facility plan, STMWRF has been performing biweekly grab samples since January 2015. These data, and data from the 2008 Facility Plan, are summarized in Table 2.15.

Table 2.15	**Summary of Ammonia and TKN Concentration STMWRF Facility Plan Update Washoe County**	
Time Period	**Average Ammonia Concentration (mg/L)**	**Average TKN Concentration (mg/L)**
2008 Facility Plan		
3/20/2007	25	40
3/21/2007	50	73
3/22/2007	20	22
3/23/2007	18	40
3/26/2007	22	39
3/29/2007	28	53
3/30/2007	22	59
Average	**26**	**47**
Recent Data Collected for 2015 Facility Plan		
1/15/2015	53	90
1/28/2015	31	52
2/4/2015	43	72
2/28/2015	17	28
3/12/2015	32	55
3/26/2015	25	43
Average	**33**	**56**

In addition, STMWRF will perform special sampling for this facility plan. The sampling will include seven to eight composite samples over a two week period. Results obtained will be compared with values presented in Table 2.15. The concentrations and peak load factors recommended for ammonia, TKN, and total phosphorus are for the planning purposes only.

Data available to review nitrogen species is very limited, but available data suggest that ammonia and TKN concentrations have increased from 2008 Facility Plan as shown in Table 2.15. However, it is hard to draw conclusions to document the increase in concentrations. Therefore, based on the available data, the recommended planning criteria for ammonia and TKN concentration is 33 mg/L and 56 mg/L, respectively. These are conservative values, as it balances both the values from the first and second halves of the data set range. The ammonia and TKN concentrations have historically fluctuated around these values, with the most recent data showing a slight increasing trend (Table 2.15). The ADMML peaking factor cannot be estimated based on available data.

4.4.4 Total Phosphorus

Similar to Nitrogen, influent phosphorus levels are not typically measured at STMWRF. However, for this facility plan, STMWRF staff has been performing biweekly grab samples since January 2015. These data, and data from the 2008 Facility Plan, are summarized in Table 2.16.

Table 2.16 Summary of Total Phosphorus Concentration STMWRF Facility Plan Update Washoe County

Time Period	Average Total Phosphorus Concentration (mg/L)
2008 Facility Plan	
3/20/2007	4.0
3/21/2007	8.7
3/22/2007	5.1
3/23/2007	4.6
3/26/2007	5.1
3/29/2007	7.3
3/30/2007	7.5
Average	**6.0**
Recent Data Collected for 2015 Facility Plan	
1/15/2015	5.4
1/28/2015	6.6
2/4/2015	6.6
2/28/2015	6.6
3/12/2015	6.6
3/26/2015	6.9
Average	**6.4**

Similar to data available for nitrogen, limited data is available for phosphorus. Available data show that recent total phosphorus concentration has increased from the 2008 Facility Plan. However, it is hard to draw conclusions to document the increase in concentrations due to very limited data points. Based on the available data, the recommended planning criteria for total phosphorus concentration is 6.4 mg/L. This is a conservative value, as it balances both the values from the first and second halves of the data set range. The total phosphorus concentration has historically fluctuated around this value, with the most recent data showing a slight increasing trend (Table 2.16). The ADMML peak factor for total phosphorus cannot be estimated based on available data.

Table 2.17 summarizes the wastewater characteristic parameters adopted for this facility plan.

Table 2.17 Summary of Adopted Wastewater Characteristic Parameters STMWRF Facility Plan Update Washoe County

Parameter	2008 FP Planning Values	2015 FMP Planning Values
cBOD		
Concentration (mg/L)	327	327
Load Peaking Factor	1.45	1.45
TSS		
Concentration (mg/L)	256	276
Load Peaking Factor	1.54	1.54
Ammonia(1)(2)		
Concentration (mg/L)	-	33
Load Peaking Factor	-	-
Total Kjeldahl Nitrogen(1)(2)		
Concentration (mg/L)	-	56
Load Peaking Factor	-	-
Total Phosphorus as P(1)(2)		
Concentration (mg/L)	-	6.4
Load Peaking Factor	-	-

Notes:
(1) Average values do not include loads from centrate or any other recycle streams. Very limited data is available for analysis.
(2) Recommended values are for planning purposes only.

5.0 REGULATORY REQUIREMENTS

STMWRF operates under state and local issued permits governing the quantity of wastewater to be treated, the resulting quality of effluent, the effluent's ultimate use or disposal, and the fate of the residual solids. The following sections summarize the current regulatory requirements and operating permits for the STMWRF.

5.1 State of Nevada Regulations

Two State agencies are concerned with the use, reuse, and quality of the water resources within Washoe County: 1) the Nevada Division of Environmental Protection (NDEP), and 2) the Nevada Division of Water Resources (NDWR).

NDEP (through its Bureau of Water Pollution Control) is the principal regulatory and permitting agency governing the placement and operation of wastewater treatment facilities in Nevada. Depending on the type of discharge and considering the waters that may be impacted, NDEP may issue the following types of permits:

1. Discharges to surface water bodies are permitted under the National Pollutant Discharge Elimination System (NPDES) Program pursuant to Section 402 of the federal Clean Water Act as amended and the State of Nevada Water Pollution Control Law, Chapter 445A of the Nevada Revised Statutes (NRS 445A.300 to 445A.730).
2. Discharges that may impact subsurface waters, and other waters of the State that are not covered under the NPDES permits, are permitted pursuant to Water Pollution Control Law and referred to as the State's Water Pollution Control (WPC) Permits.
3. Injections into underground sources of drinking waters, as authorized pursuant to Section 1422 of the Safe Drinking Water Act (SDWA) and the State Water Pollution Control Law, are permitted under the Underground Injection Control Program.

STMWRF is a zero discharge plant where effluent produced is either reused by various reclaimed system customers or is stored during low reuse demand seasons. Therefore, STMWRF is permitted under the Water Pollution Control Law. The permit conditions are developed by NDEP and are subject to a 30-day public review and comment period prior to the permit being issued. If no adverse public comment is received, NDEP issues the permit as proposed. If adverse public comment is received, NDEP may modify the permit conditions or hold a hearing to determine whether the proposed conditions should be modified. Discharge permits are issued by NDEP for a five-year period and must be renewed or reissued each five years. Washoe County is currently permitted to discharge 4.1 mgd from STMWRF. Table 2.18 shows details about STMWRF's current discharge permit.

Table 2.18 Current Discharge Permit
STMWRF Facility Plan Update
Washoe County

Permit Number	Facility Name	Expiration	Receiving Water
NS0040024	STMWRF	2018	Effluent Reuse/Sanitary Sewer

NDWR's mission is to conserve, protect, manage, and enhance the State's water resources for Nevada's citizens through the appropriation and reallocation of public waters. NDWR manages water resources, including treated wastewater and groundwater, through monitoring existing uses, reallocating water to new uses, and ensuring that Nevada's growth can be based on a sustained yield. The role of NDWR in monitoring wastewater is to set limits to the amount that may be used for specific purposes as part of the State's water conservation efforts.

The two State agencies also work in conjunction with one another in particular areas of overlap. For example, NDEP works in conjunction with NDWR to review subdivisions (available water quantity) with the aim of preventing water pollution.

5.1.1 Applicable Laws and Regulations

State environmental laws and regulations are defined by the Nevada Revised Statutes (NRS) and the Nevada Administrative Code (NAC). The NRS refers to Nevada Law and the NAC refers to rules and regulations derived from the NRS. The NAC defines water quality standards and beneficial uses for Washoe County and were developed and adopted by the NDEP.

The following statutes, rules, and regulations apply to the STMWRF:

- NRS 533.005 to 533.560 "Adjudication of Vested Water Rights; Appropriation of Public Waters"
- NAC 445A.070 to 445A.348 "Water Pollution Control"
- NAC 445A.11704 to 445A.2234 "Standards for Water Quality"
- NAC 445A.228 to 445A.263 "Discharge Permits"
- NAC 445A.274 to 445A.280 "Use of Treated Effluent"
- NAC 445A.283 to 445A.292 "Treatment Works"

5.1.2 Local Regulations

Within the State, NDEP has primary authority for permitting wastewater treatment, effluent discharge, and effluent reuse. As the water quality is monitored and new standards are developed, the discharge permits will need to be updated to accommodate these changes.

5.2 Other Regulations of Concern

There are other various regulations and/or permits that Washoe County must meet. Such regulations involve limitations on biosolids, air quality, stormwater and water reuse. Each of these regulations as well as anticipated changes are summarized below and presented in Table 2.19.

Table 2.19	Summary of Other Permits / Regulations of Concern STMWRF Facility Plan Update Washoe County				
Facility	**Biosolids**	**Air Quality (tons per year)**	**Storm Water**	**Water Reuse**	**Land Use**
STMWRF	Dispersed back into collection system(1)	Exempt(2)	NDEP Stormwater General Permit	See Discharge Permit	STMWRF is on County owned property

Notes:

(1) STMWRF is currently implementing solids handling facilities within the site, which will require a biosolids disposal permit in the near future.
(2) STMWRF is currently exempt from air quality permitting requirements, but may be required in the future.

5.2.1 Biosolids

Currently, biosolids generated at the STMWRF are returned to the collection system and are conveyed to the Truckee Meadows Water Reclamation Facility (TMWRF) for further treatment and disposal. This practice is authorized by an existing agreement with the City of Reno.

A solids handling facility is under construction at STMWRF and the existing permit will be revised to include requirements for the new biosolids process. No additional permitting, outside the basic discharge permit, will be required if solids are handled onsite. However, disposal of the treated solids must be included in the discharge permit.

STMWRF would require a biosolids disposal permit from the Washoe County Department of Health if the facility were to dispose biosolids at the Lockwood Regional Landfill (solid waste management regulations). If STMWRF implements biosolids land application, permits would be required from the EPA and NDEP (40 CFR 503 and 40 CFR 268).

5.2.2 Air Quality

Currently, there is no air quality permit for STMWRF, however, once the solids facility is in operation, STMWRF is required to comply with air quality permits issued by the Washoe County Health Department (NRS 445B). This permit limits emissions from equipment in the treatment process as well as hydrogen sulfide gas. Air quality permits are subject to change when new treatment processes are implemented and/or new equipment is required. Currently, Washoe County has an air quality permit from the Washoe County Air Quality Management Division to operate an emergency back-up generator (Appendix A).

5.2.3 Stormwater

As shown in Table 2.19, the STMWRF maintains a NDEP stormwater general permit for the site.

5.2.4 Water Reuse

Water reuse is a safe, reliable solution to managing limited water resources. The STMWRF currently produces reuse quality effluent used for irrigation of parks and golf courses. Expanded discharge will require the STMWRF to identify areas where the additional effluent will be applied. The changes to the reclaimed water system should be documented in a revised Effluent Management Plan.

5.2.5 Land Use

STMWRF has adequate land to expand treatment facilities into the future. The development of residential homes in close proximity to the treatment facilities will require a strong "good neighbor" approach to odor control as well as sound and lighting mitigation.

5.3 Potential Future Regulations

Based on the information provided by the Washoe County staff, potential changes to the current discharge permit are not anticipated during the planning period.

6.0 RELIABILITY AND DESIGN CRITERIA

6.1 Collection System

This section describes the "standards of measurement" that were used to evaluate the performance of the existing wastewater system, as well as define the capacity requirements of future improvements. The capacities of gravity sewers, force mains, and lift stations were based on these performance and design criteria. These performance criteria are based upon the Washoe County Department of Water Resources (DWR) gravity sewer collection design standards and common engineering practices.

6.1.1 Pipe Capacities

Sewer capacities are dependent on many factors. These include roughness of pipe, maximum allowable depth of flow, and limiting velocity and slope. The Continuity Equation and Manning's Equation are used for steady-flow hydraulic calculations. The Manning's Coefficient 'n' is a friction coefficient that varies with respect to pipe material, size of pipe, depth of flow, smoothness of joints, root intrusion, and other factors. For gravity sewers, the Manning's coefficient ranges between 0.011 and 0.017. For planning purposes, an 'n' value of 0.012 was used for this project, except where modified during calibration. It should also be noted that DWR requires the use of 0.012 for the design of PVC, reinforced concrete, and ductile iron pipe.

6.1.2 Minimum Slopes

In order to minimize the settlement of solids in the flow and promote scour, it is standard design practice to specify that a minimum velocity of 2.5 feet per second (fps) be maintained when the pipe is flowing half full. At this velocity, the sewer flow will typically provide self-cleaning for the pipe. Due to the hydraulics of a circular pipe, the velocity for half pipe flow approaches the velocity of nearly full pipe flow. Table 2.20 lists the minimum slopes for maintaining self-cleaning velocities with d/D = 0.5 or 1.0. The minimum slope listed in the table is 0.0008 ft/ft, which is the minimum practical slope for gravity sewer construction. Greater slopes are desirable if they are compatible with existing topography.

DWR regulations require velocities not to exceed ten fps in gravity sewer mains.

Table 2.20 Recommended Minimum Slopes for Circular Pipes
STMWRF Facility Plan Update
Washoe County

Pipe Size (inches)	Minimum Slope(1) (2) (ft/ft)	Pipe Capacity(3)	
		(mgd)	(cfs)
8	0.0045	0.57	0.88
10	0.0033	0.70	1.08
12	0.0026	1.02	1.58
14	0.0021	1.38	2.14
15	0.0020	1.59	2.46
16	0.0018	1.80	2.78
18	0.0015	2.28	3.53
20	0.0014	2.82	4.36
21	0.0013	3.11	4.81
24	0.0011	4.06	6.28

Notes:
(1) Slopes are calculated using Manning's Equation for full pipe flow with a minimum velocity of 2.5 fps for all diameters.
(2) Sewers larger than 24 inches should have a slope ≥ 0.0008.
(3) Pipe Capacity based on full pipe flow.

6.1.3 Changes in Pipe Size

When a smaller sewer joins a larger sewer, the invert of the larger sewer will be lowered sufficiently to maintain the same energy gradient. Since Geographic Information System (GIS) data is available for the County's existing sewer mains, this information will be used for the sewer inverts in the hydraulic model when available. For master planning purposes, proposed sewer inverts were matched at manholes when smaller sewers joined larger sewers and the 2.5 fps minimum velocity criteria was used when sizing future pipes.

6.1.4 Manholes

Manholes should be placed at all pipeline intersections, angle points grade changes, tangent points, sewer line curves and the terminus of all collector mains. Manholes should have a minimum depth of five feet from finish grade to invert. It is recommended that manholes be placed according to the maximum allowable manhole spacing shown in Table 2.21.

Table 2.21 Recommended Maximum Manhole Spacing
STMWRF Facility Plan Update
Washoe County

Sewer Curve Radius (feet)	Maximum Manhole Spacing (feet)
Greater than 400	400
400 to 200	200
Less than 200	Not acceptable

6.1.5 Lift Stations

A firm pumping capacity equal to the peak daily flow is often used to determine the size of lift stations. The lift station should be able to provide a "firm" pumping capacity with the largest pump out of service.

6.1.6 Normal Operation

Lift station wet well sizing takes into consideration the fill time, based on average flow, and the minimum pump cycle time. Sound engineering practice dictates that the minimum wet well volume in gallons be one quarter of the product of the minimum pump cycle time, in minutes, and the total pump capacity, in gallons per minute. The volume of the wet well should provide a retention period not to exceed 30 minutes of average daily design flow. In addition, regional lift stations should be provided with additional wet well capacity for redundancy. When selecting the minimum cycle time, the pump manufacturer's duty cycle recommendations shall be utilized. Starting and stopping more than seven times an hour for any one pump is not recommended.

6.1.7 Emergency Operation

The objective of emergency operation is to protect public health by preventing sewer back-ups and subsequent discharge into streets and other public or private property. The most common emergency would be a power outage. All County lift stations should be equipped with standby generators to provide a backup power supply.

Specific wet well sizing and back-up power requirements should be based on individual station location, response time, capacities, and severity of impacts from any sanitary sewer overflow.

6.1.8 Force Mains

Force mains should be sized for normal operating velocities between three and seven fps to provide scour velocity so that the solids deposited while the pumps are off will be transported when the pumps are operating. Pipe retention times should also be considered in sizing force mains and low-pressure systems (LPS) to avoid excessive sulfide generation.

Manholes to which force main(s) or LPS discharge should be constructed with sewer shield coating to prevent attack of concrete by sulfates. Force mains should be dropped into manholes to prevent raw sewage from splashing against the manhole walls and releasing odors. Odor control of discharges from force mains and LPS may be required if they are located in close proximity to homes/businesses or in areas of frequent odor complaints.

6.1.9 Gravity Sewer Planning Guidelines

The following are some additional general sewer planning guidelines:

- Gravity sewers should be designed and constructed to have a minimum four feet of cover or sufficient depth to serve the ultimate drainage area.
- Gravity sewers should be designed and constructed with a minimum four feet of separation between the flowline of drainage ditches and the crown of the sewer.
- Gravity sewers and force mains should have a minimum separation of 18 inches from potable water.
- Manholes should provide a minimum 0.1 foot of invert drop across the manhole.

6.1.10 Pipe Evaluation and Design

When designing sewers, it is common practice to use flow depth criteria. This criterion is expressed as a ratio of maximum depth of dry weather flow to pipe diameter (d/D). The design d/D ratio set by DWR is 0.8.

The hydraulic criteria used for sizing the proposed gravity sewers will have a greater factor of safety than the criteria used to evaluate the capacity of the existing system due to the uncertainties in making projections of future flows. The proposed difference between the design criteria and the existing system criteria allows full use of the existing sewer capacities and prevents unnecessary pipe replacement. This approach avoids the problem of replacing or upgrading existing sewers prematurely.

6.1.11 Criteria Summary

Table 2.22 summarizes the performance and design criteria used to evaluate the wastewater system.

Table 2.22 Wastewater System Criteria Summary
STMWRF Facility Plan Update
Washoe County

Flow Velocity in feet per second (fps)	
Gravity Mains	2.5 fps ≤ V ≤ 10 fps
Force Mains	3 fps ≤ V ≤ 7 fps
Pipe Slope	
The minimum pipe slope is the slope at which the flow velocity is least 2.5 fps when flowing half full.	
Flow Depth, d/D, (for peak hour flows)	
d/D for All Sewer Pipes	= 0.80
Headloss in Existing Pipes	
Gravity Pipes (PVC, Ductile Iron, Concrete)	Manning's N = 0.012
Gravity Pipes (High Density Polyethylene)	Manning's N = 0.011
Pressure Pipes	Hazen William's C = 120
Changes in Pipe Size	
When a smaller sewer joins a larger one	Sewer crowns will be matched
Headloss at Manholes	
All Manholes	Provide 0.1' Invert Drop
Peaking Factors and Unit Loads	
Minimum Peaking Factor	3.0 (or as approved by DWR)
ERU	270 gpd

6.2 Water Reclamation Facility

A summary of existing (for current flows) and recommended (for projected flows) facility reliability criteria for selected major treatment processes is presented in Table 2.23. A detailed list of design criteria for the facilities listed in these tables can be found in the Section 6 Facility Plan Update of this report.

Table 2.23 Reliability Criteria Summary STMWRF Facility Plan Update Washoe County

	Existing Reliability Criteria 3.4 mgd	Recommended Reliability Criteria 5.1 mgd$^{(1)}$	Comments
Steamboat Creek Lift Station	1 duty + 1 standby		
Headworks Influent Pumping	1 duty + 1 standby		
Screening	1 duty + 1 standby + manual bypass channel		
Grit Removal	1 duty + 1 standby		
Oxidation Ditches	1 duty + 1 standby		Current operation is with all units in service
Secondary Clarifiers	3 duty + 1 standby		Current operation is with all units in service
RAS Pumping	4 duty + 1 standby		
WAS Pumping	1 duty + 1 standby		
Tertiary Sand Filters	8 duty		
Chlorine Contact Basins	4 duty		
Sodium Hypochlorite Feed Pumps	4 duty + 1 standby		
Effluent Pumping (Reservoir)	4 duty + 1 standby		Standby pump = one of the larger units
Export Pumping (Reuse)	4 duty + 1 standby		
Aerobic Digesters$^{(2)}$	2 duty		
Rotary Drum Thickener$^{(2)}$	1 duty		
Screw Presses$^{(2)}$	2 duty		

Notes:

(1) Recommended reliability criteria will be developed during the preparation of the Draft Facility Plan Update, and information will be populated for the complete Draft submittal.

(2) New solids handling facility currently under construction; sized to process solids generated from 6 mgd ADMMF.

APPENDIX A – AIR QUALITY PERMIT

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

January 14, 2015

Washoe County Community Services
South Truckee Meadows Water Reclamation Facility
John Hulett, Senior Environmental Engineer
PO Box 11130
Reno, NV 89502

Re: Air Quality Permit to Operate

Dear Mr. Hulett:

The Washoe County Air Quality Management Division (AQMD) has reviewed the plans provided for the proposed digester building to be located at the South Truckee Meadows Water Reclamation Facility at 8500 Alexander Lake Dr in Reno, NV.

This letter is considered an official notification of temporary exemption from the air quality permitting requirements for this facility. The temporary exemption shall expire 180 days after completion construction of the facility. Prior to the expiration of this exemption the South Truckee Meadows Water Reclamation Facility must take gas samples from the digester exhaust gas stream. The gas sample results must be submitted to the AQMD within 15 days of receipt of the results. The AQMD will use the analysis of the exhaust gas constituents for a final determination of permitting applicability for the facility.

It is a condition of this temporary exemption that South Truckee Meadows Water Reclamation Facility provide written notification when:

1. **CONSTRUCTION:** Construction of the digester facility has been completed.

2. **OPERATION:** Steady State operation of the facility has been established.

3. **NOTIFICATION:** Provide 10 days notification prior to the sampling of the digester exhaust gas so that the AQMD may be present to observe.

If any changes to the design or proposed function of the digester facility occur, please contact the AQMD to confirm the temporary exempt status still applies. If future changes to the operation occur, including the types or quantities of chemicals used, please contact the AQMD to confirm the continued exempt status of the facility. It is recommended that a copy of this letter be maintained for future reference.

If you have any further questions, please contact me at (775) 784-7204.

Sincerely,

Collin Emmerson P.E.
Environmental Engineer I

Public Health

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

January 13, 2015

Mr. John Hulett
Washoe County Community Service Department
8500 Alexander Lake Dr.
Reno, NV 89502

Dear Mr. Hulett:

The Washoe County Air Quality Management Division (AQMD) has reviewed your application for an Authority to Construct/Permit to Operate an Emergency Back-up Generator located at 8500 Alexander Lake Dr. in Washoe County, Nevada. The operation of this equipment, as proposed in your application received January 6, 2015, has been approved with the conditions listed below. You may consider this letter as your official authority to operate pending receipt of the actual permit.

CONDITIONS OF OPERATION LISTED ON THIS PERMIT

A. **ALTERATIONS:** This permit becomes void upon any change of ownership or address or any alteration of permitted equipment.

B. **POSTING:** The permit shall be posted on or near the equipment listed above. The permit shall be readily available at all times while the equipment is operating.

C. **MODIFICATION OF EQUIPMENT:** Any modification of the equipment listed above other than normal repair and maintenance will require a new Permit.

D. **RECORDS:** Any records of operation which effect the potential of the source to emit air pollutants, such as fuel or products consumed, products produced, hours of operation, chemicals or supplies used in source operation, must be maintained for a period of at least 5 years and made available to the control officer upon request.

E. **EQUIPMENT FAILURE:** All upset or breakdown conditions resulting in increased emissions or air pollutants shall be reported in compliance with District regulations, sections 020.075 and 020.076.

F. **ACCESS:** The control officer will provide access to the facility to inspect operations and equipment covered under this permit whenever necessary to determine compliance with this permit and any other air pollution limitations specified in District regulations

<u>**Emergency Back-up Generator**</u>: Additional Conditions:

1. **ANNUAL PRODUCTION:** The annual throughput/consumption figures must be submitted in writing to the AQMD no later than the 20th of the month, approximately 6 weeks prior to the expiration date of the permit or anticipated project completion.

2. **MAINTENANCE:** The internal combustion engine shall be properly maintained according to the manufacturer's specifications.

3. **OPACITY:** Emissions from the process stack(s) must not exceed 20% opacity or Ringelmann number 1 for more than 3 minutes per hour -- Section 040.005.A.

4. **APPLICABILITY:** Emergency standby generators constructed (with a manufactured date after April 1, 2006), modified, or reconstructed after July 11, 2005 are subject to 40 CFR Part 60, Subpart IIII - New Source Performance Standards for Stationary Compression Ignition Internal Combustion Engines. Generators constructed prior to June 12, 2006, are subject to 40 CFR Part 63, Subpart ZZZZ - Area Source Standards for Reciprocating Internal Combustion Engines (RICE). Existing residential, commercial and institutional emergency standby generators at area sources of HAP that operate less than 100 hours per year for nonemergency use, of which less than 15 hours are obligated for demand response programs, are exempt from 40 CFR part 63, subpart ZZZZ.

5. **HOUR METER:** All emergency standby generators must be equipped with an operational non-resettable hour meter.

6. **ANNUAL USAGE:** Emergency standby generator(s) may operate up to 100 hours per calendar year for engine maintenance and testing purposes. Up to 50 hours of the 100 hours may be used for emergency demand response for Energy Emergency Alert Level 2 situations, responding to situations where there is at least a 5 percent or more change in voltage, and operating to head off potential voltage collapse or line overloads that could result in local or regional power disruption. Any operation in excess of these limits will result in the generator(s) being classified as non-emergency and will be subject to the applicable requirements of 40 CFR Part 63, Subpart ZZZZ - Area Source Standards for Reciprocating Internal Combustion Engines (RICE).

7. **UPSETS:** There is no hourly limit on the use of emergency standby generators during emergency situations.

8. **REPORTING:** The annual report of hours of operation must include the total hours operated for maintenance/testing purposes separate from the actual hours of emergency operations.

9. **PEAK SHAVING:** Emergency standby generators may not be used for peak shaving or to generate income for a facility by supplying power to an electric grid or otherwise supplying non-emergency power.

10. **POLLUTION CONTROL EQUIPMENT:** Operators of emergency standby generators equipped with pollution control equipment must install, configure, operate, and maintain the engine and pollution control device(s) according to the manufacturer's emission-related written instructions.

11. **PARTICULATE FILTER:** Generators equipped with a diesel particulate filter must have an operational backpressure monitor to notify the operator when the high backpressure limit is approached.

12. **ULTRA LOW SULFUR DIESEL:** In accordance with 40 CFR part 60, Subpart IIII, all generators constructed after June 12, 2006, must use Ultra Low Sulfur Diesel (ULSD) with a maximum 15 ppm sulfur content.

Upon recipe of this letter, the District must be contacted to schedule the initial compliance inspection. Once the determination has been made that the equipment is operating in compliance with all District Regulations, the annual Permit to Operate may be issued. An invoice will be mailed to you at that time for the permit fees. Upon receipt of the fees, Permit to Operate #A15-0002 will be issued for the Emergency Back-up Generator.

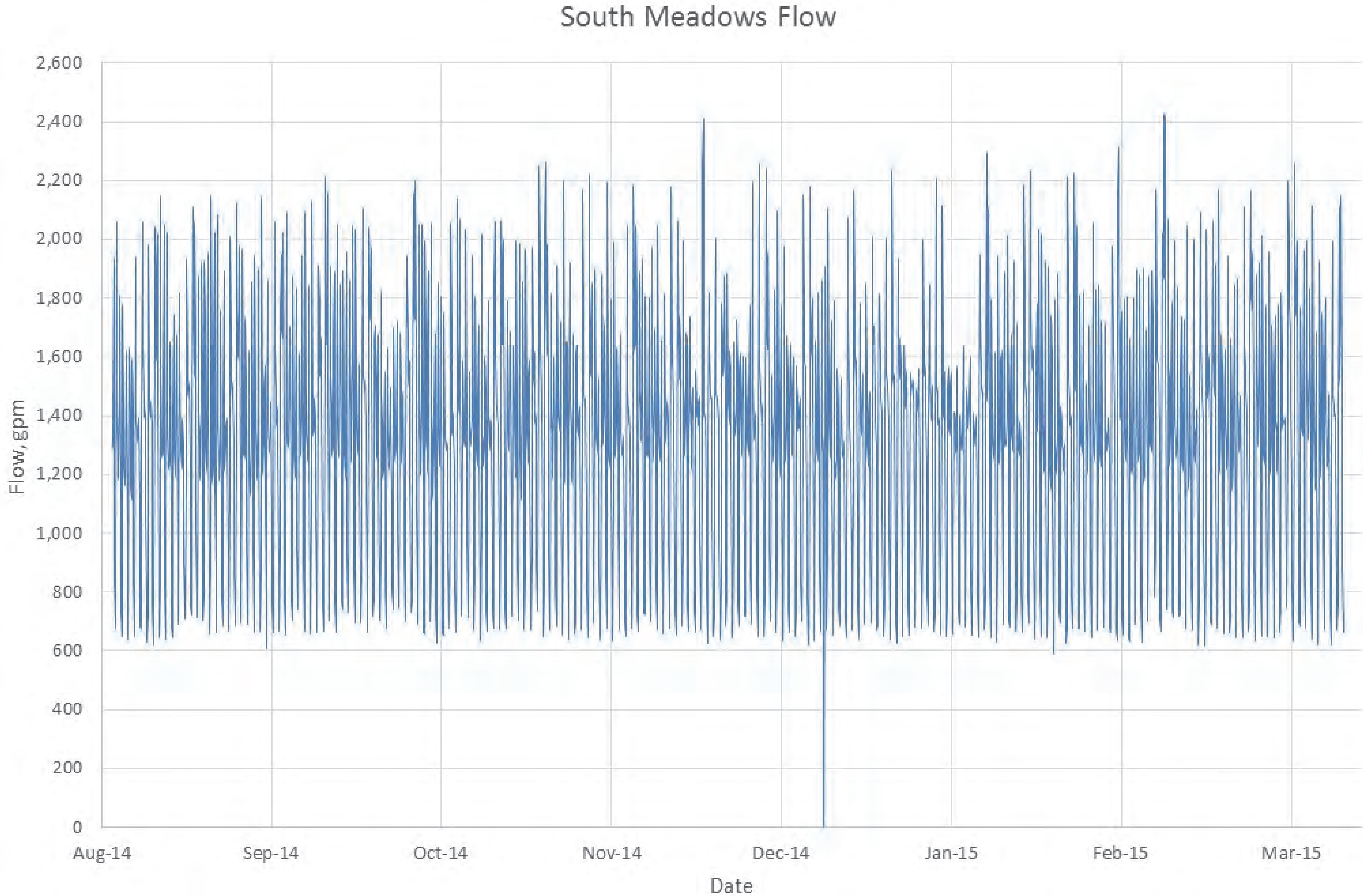
If you have any questions, please do not hesitate to contact me at (775) 784-7204.

Sincerely,

Collin Emmerson

Collin Emmerson P.E.
Environmental Engineer I

APPENDIX B – STMWRF PERMANENT FLOWMETER DATA

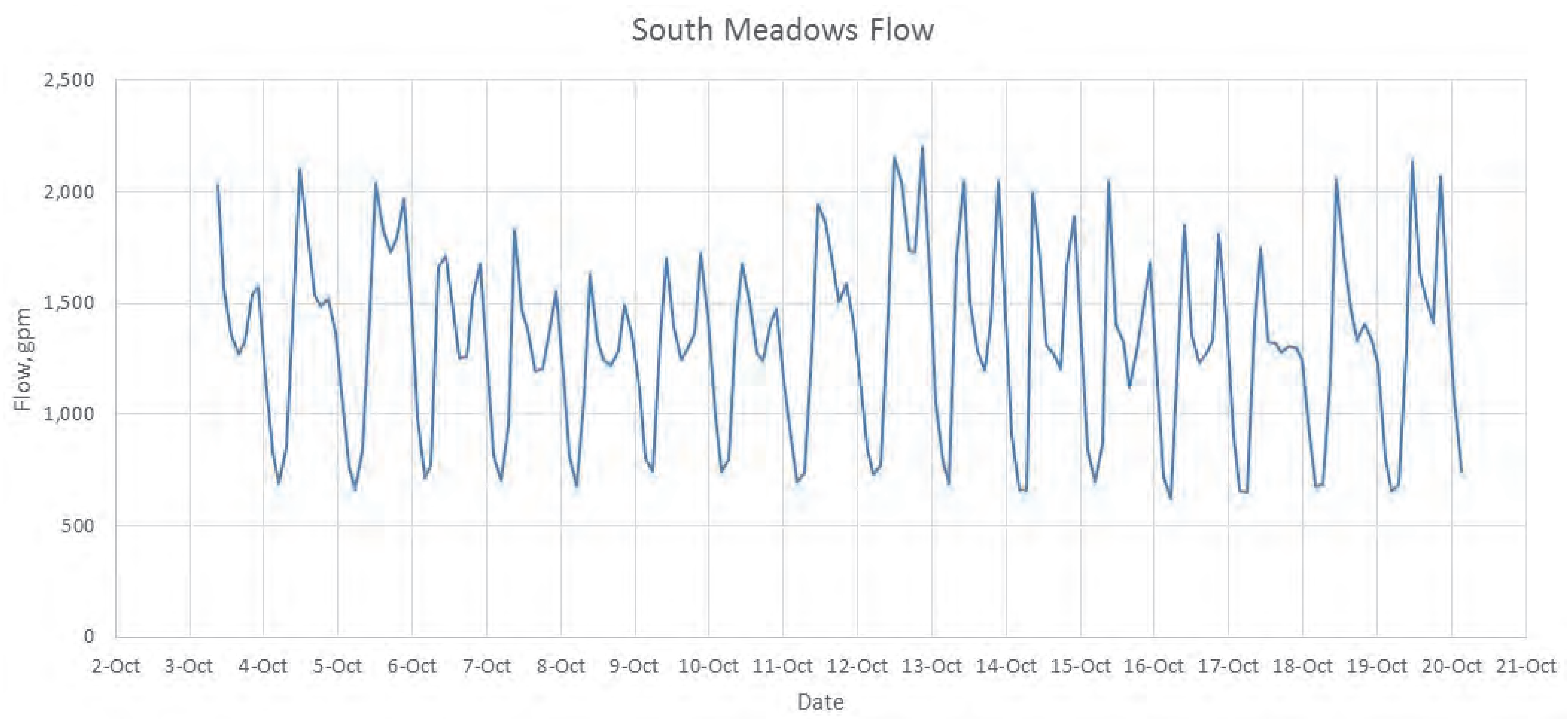


SOUTH TRUCKEE MEADOWS COMPLETE FLOW DATA FROM AUGUST 25, 2014 TO MARCH 9, 2015

FIGURE B.1

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE



SOUTH TRUCKEE MEADOWS FLOW DATA FROM OCTOBER 3 TO OCTOBER 20, 2014

FIGURE B.2

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

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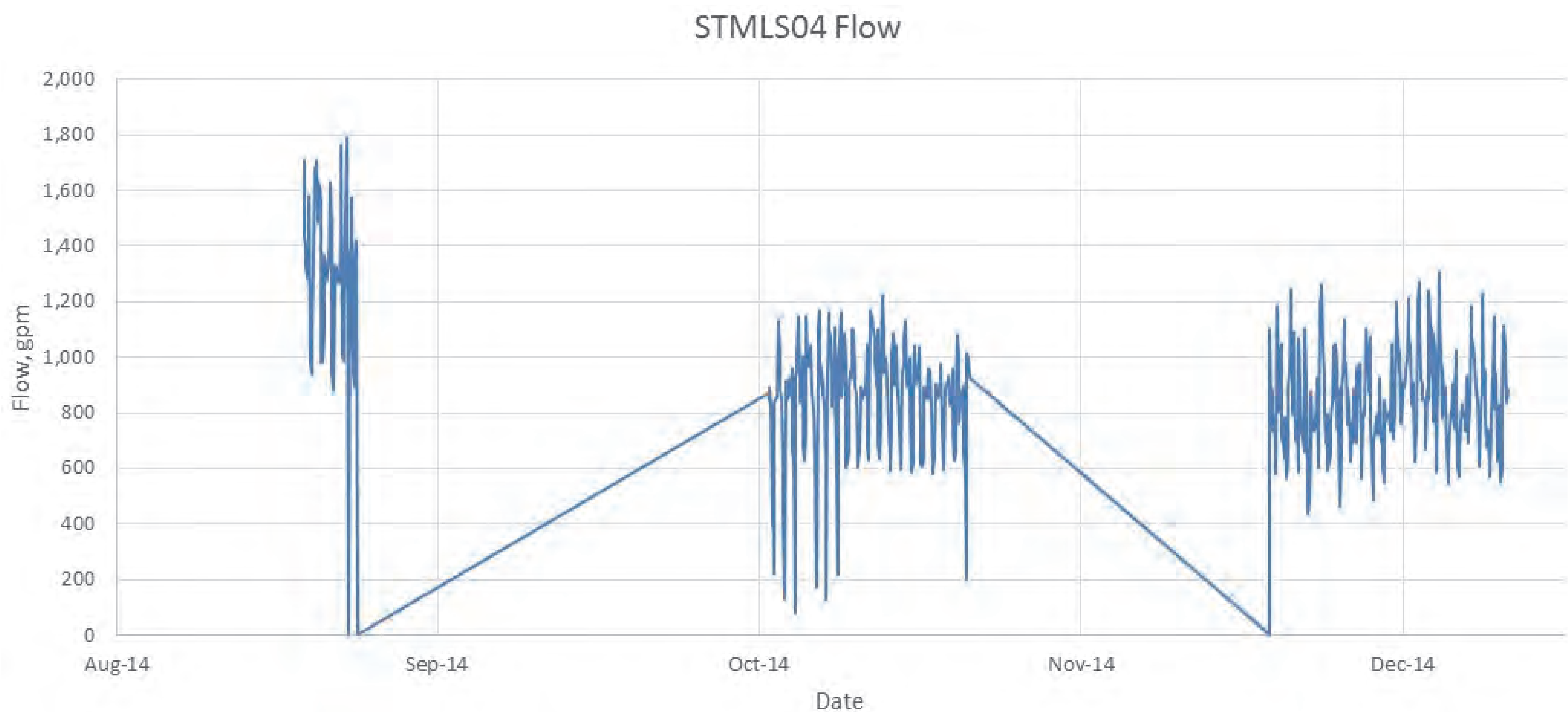
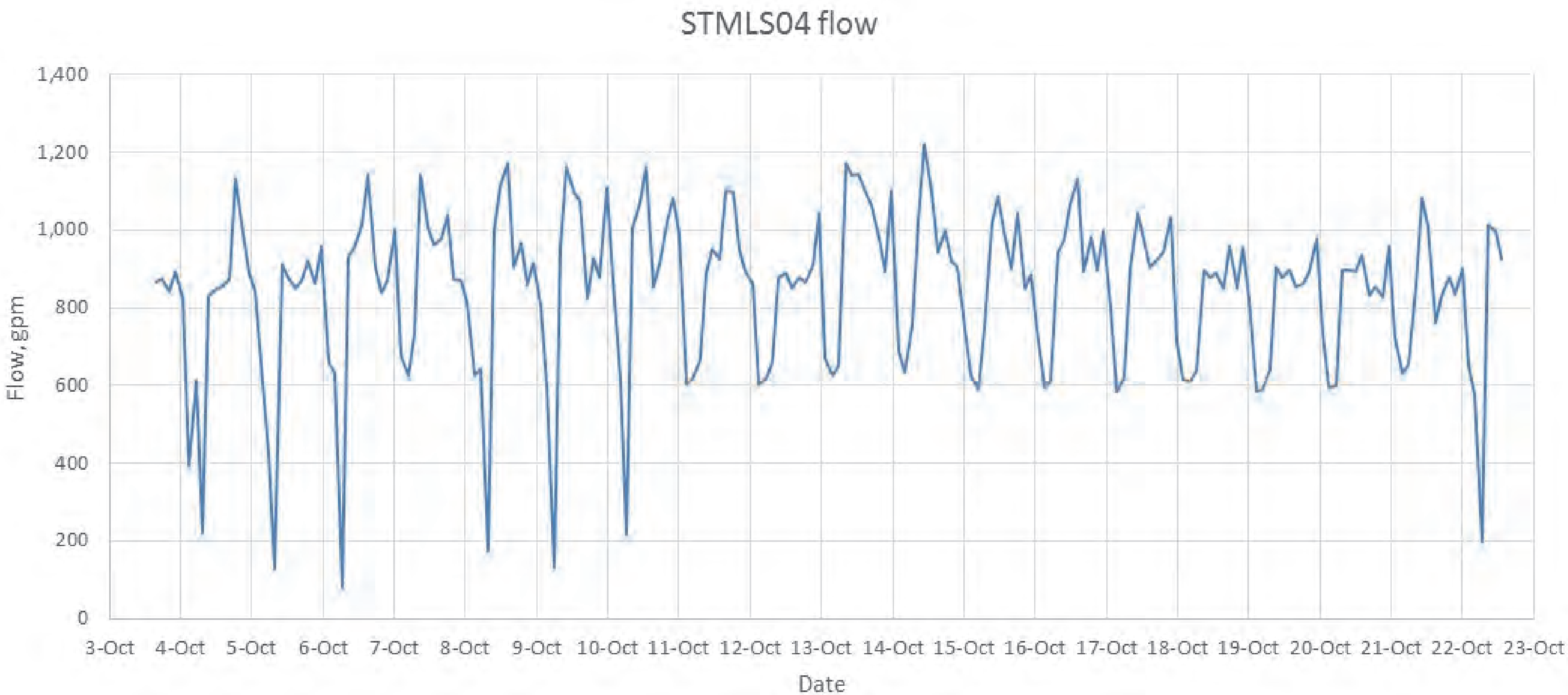


STMLS04 COMPLETE FLOW DATA FROM AUGUST 21 TO DECEMBER 16, 2014

FIGURE B.3

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

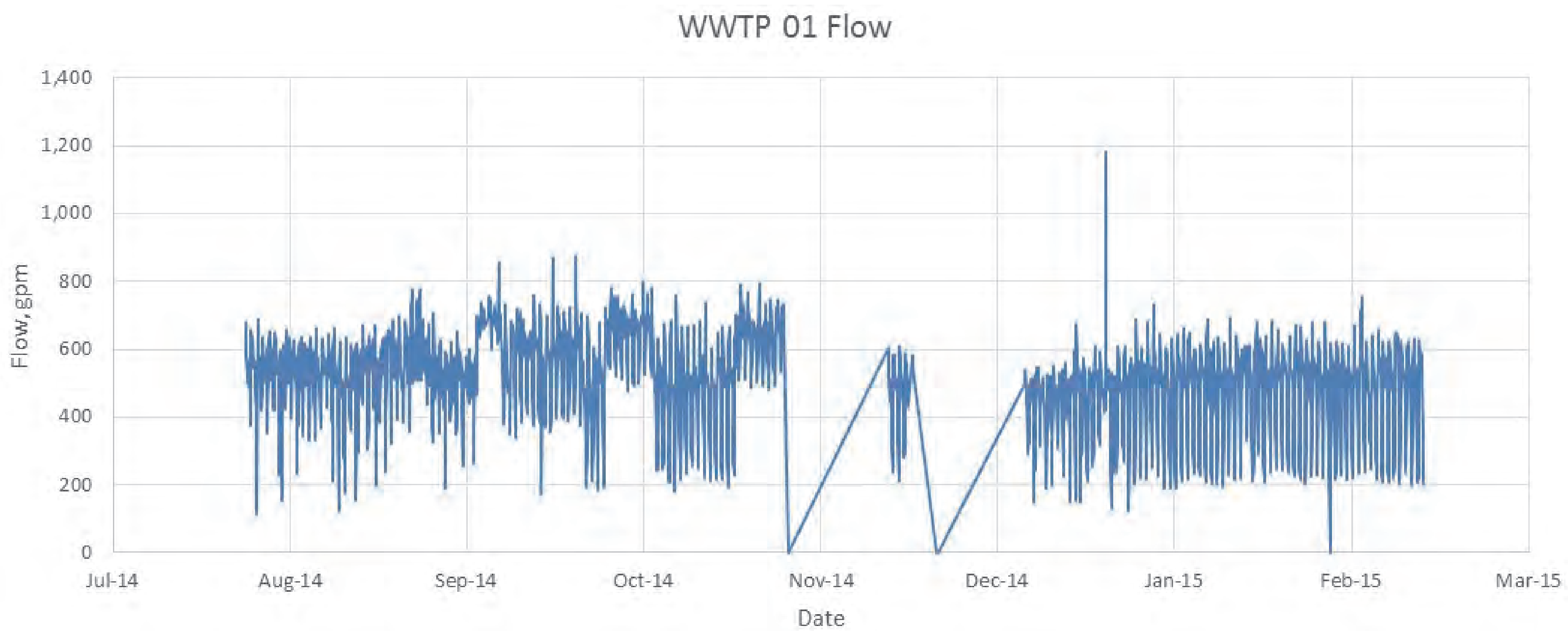
carollo



STMLS04 FLOW DATA FROM OCTOBER 3 TO OCTOBER 20, 2014

FIGURE B.4

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

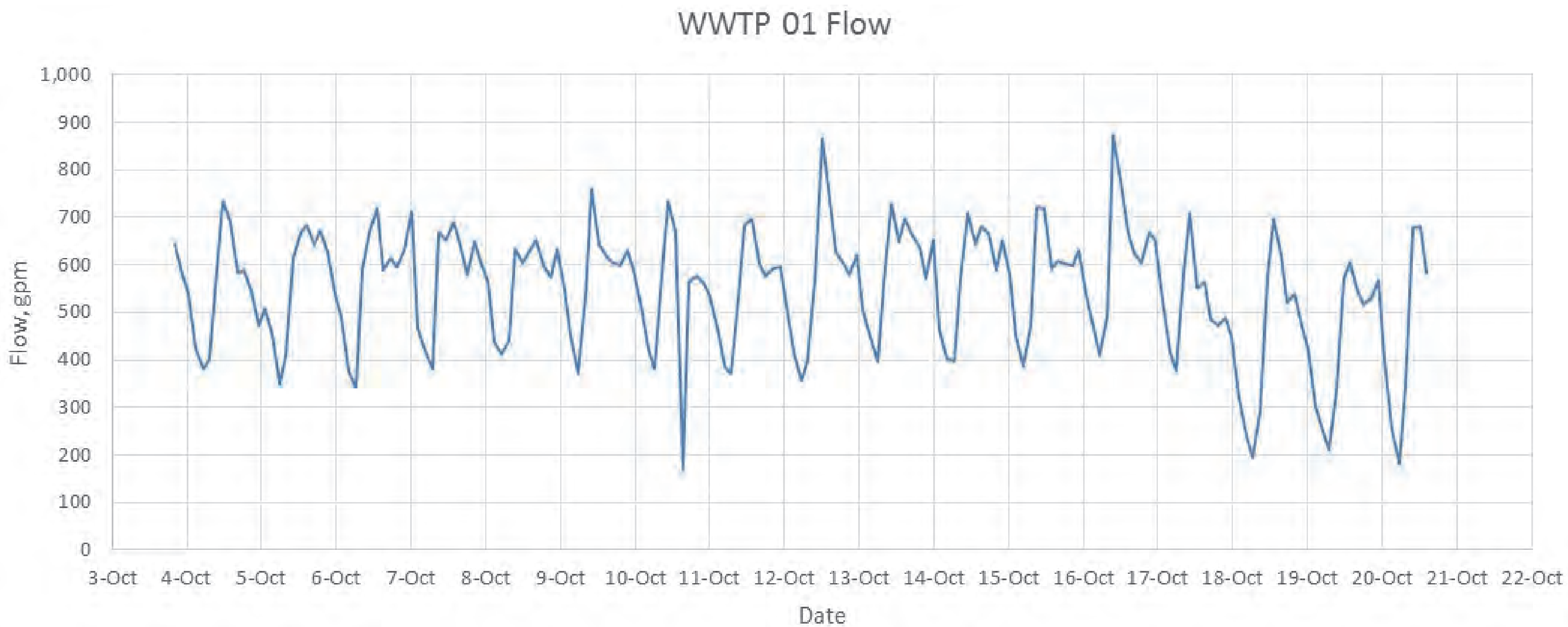


WWTP 01 COMPLETE FLOW DATA FROM AUGUST 21 TO DECEMBER 16, 2014

FIGURE B.5

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE



WWTP 01 FLOW DATA FROM OCTOBER 3 TO OCTOBER 20, 2014

FIGURE B.6

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

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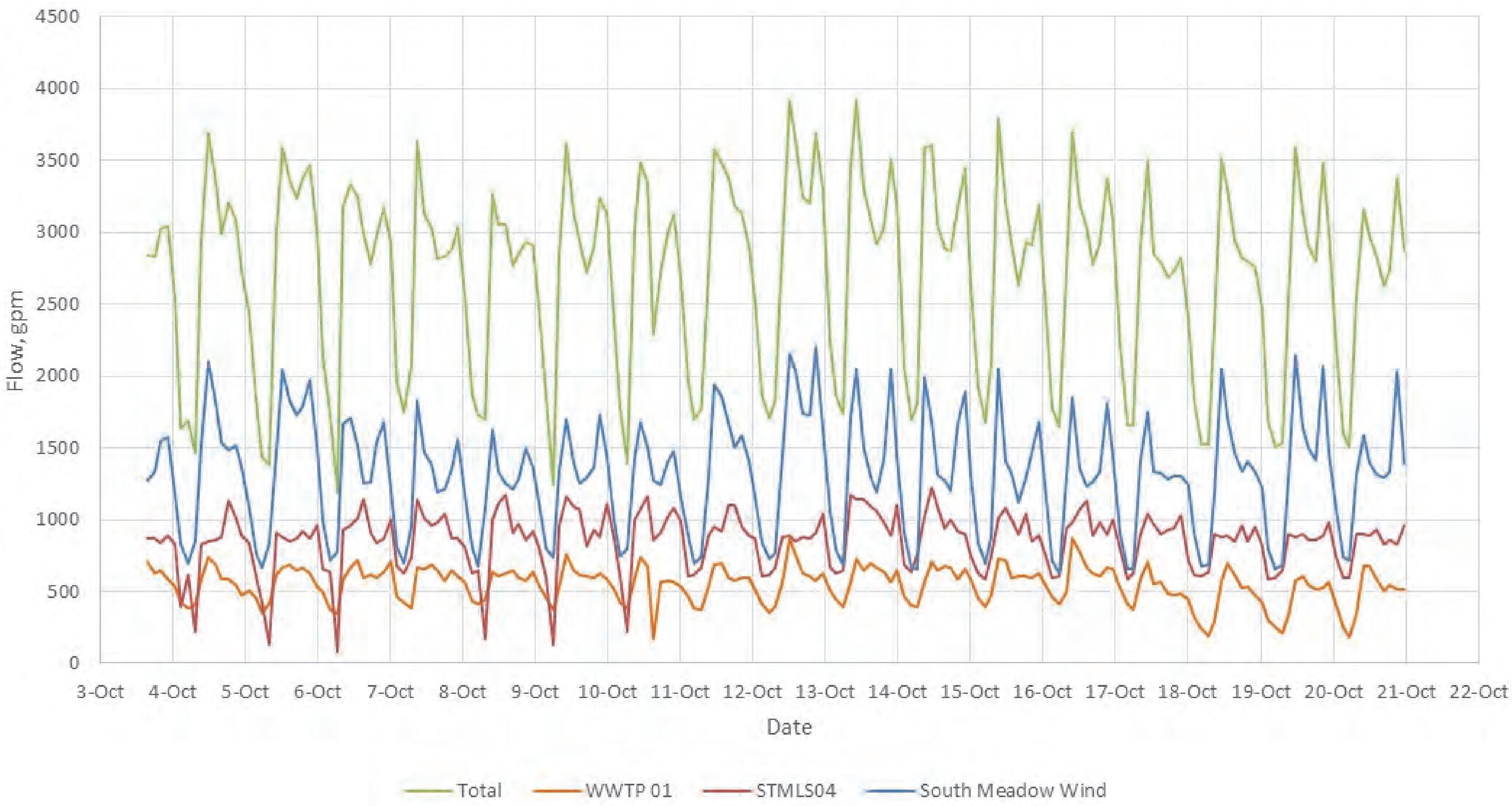

TOTAL FLOW AND FLOW FOR ALL THREE METERS FROM OCTOBER 3 TO OCTOBER 20, 2014

FIGURE B.7

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

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WASHOE COUNTY

**SOUTH TRUCKEE MEADOWS
WATER RECLAMATION FACILITY
FACILITY PLAN UPDATE**

TECHNICAL MEMORANDUM NO. 3

WASTEWATER COLLECTION SYSTEM EVALUATION

FINAL
January 2016

1 EAST LIBERTY STREET, SUITE 424 • RENO, NEVADA 89501 • P. 775.324.4427 • F. 775.324.5128

WASHOE COUNTY

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY
FACILITY PLAN UPDATE

TECHNICAL MEMORANDUM
NO. 3

WASTEWATER COLLECTION SYSTEM EVALUATION

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WASTEWATER COLLECTION SYSTEM EVALUATION

1.0 INTRODUCTION

This wastewater collection system evaluation for the South Truckee Meadows (STM) collection system identifies the infrastructure and associated capital improvements that the system will need to provide service to existing customers as well as to provide service to new customers. An understanding of the existing collection system is important to identify capacity limitations as well as unused capacity that could serve new growth. The tool for this type of evaluation is the hydraulic model, which has been constructed and calibrated to correctly represent existing infrastructure and flows. The yardstick by which the wastewater system is evaluated is the design criteria. Design criteria define the performance that a well-designed wastewater system should satisfy to provide reliable service, have sufficient redundant capacity, and ensure capacity while not incurring unnecessary costs. Design criteria are set based on industry standards, regulatory requirements, engineering experience, and the utility's tolerance for risk vs. collection system performance. The design criteria used to evaluate the STM collection system were outlined in Section 4.3 of Technical Memorandum No. 2, "Planning Framework." (TM 2) and summarized in TM 3. Model simulations of existing and future scenarios were used in this study to evaluate planned infrastructure or identify new infrastructure that should be added based on projected growth. The result of this analysis is a set of recommendations in a capital improvement plan that identifies the cost of specific improvements through planning year 2035.

The major wastewater collection system issues that Washoe County (County) will need to address in the near future is collection pipe capacity and collection pipes to new service areas. Currently the STM collection system serves the western portion of the service area via gravity, and the eastern portion via the Steamboat lift station. In the near future, the County plans to serve the southern portion of the STM planning area by gravity with the Pleasant Valley Interceptor.

This technical memorandum builds upon the planning assumptions of TM 2. Selected segments of TM 2 are included in this document for completeness. This technical memorandum, TM 3, covers the wastewater collection system evaluation, including a capital improvement plan. The following sections are included in this chapter:

- **South Truckee Meadows Wastewater Infrastructure:** This section documents the characteristics of the current wastewater collection system.
- **Wastewater Loads:** This section describes the wastewater flows and load allocation that was used in the hydraulic model.

- **Collection System Analysis:** This section describes the results of the hydraulic model analysis, and the evaluation of the collection system against the design criteria.
- **Capital Improvement Plan:** This section lists recommended collection system capital improvements, along with estimated costs and triggers for when the improvements should be constructed.

2.0 SUMMARY OF PLANNING STUDIES

This collection system capacity evaluation builds upon previous studies that have been completed for the county. The studies that have been referenced are as follows:

"Land Use Data for the South Truckee Meadows Water Reclamation Facility Service Area" by the Truckee Meadows Regional Planning Agency – This document describes the growth that is planned in the STM area.

"Washoe County Consensus Forecast" – This document contains the population projections for the County area that have been used to estimate the rate of growth in the service area.

"Washoe County Department of Water Resources Gravity Sewer Collection Design Standards" – This document describes the design standards that have been applied to the collection system capacity evaluation.

"South Truckee Meadows Sewer Collection System Flow Monitoring" by CH2MHill – This technical memorandum contains the flow monitoring data that was used for diurnal curves in the model.

"Steamboat Sewage Lift Station Historical Flows and capacity Analysis Report" Technical Memorandum by Shaw Engineering – This document contains the results of a capacity evaluation of the Steamboat Springs Lift Station that was completed in 2003.

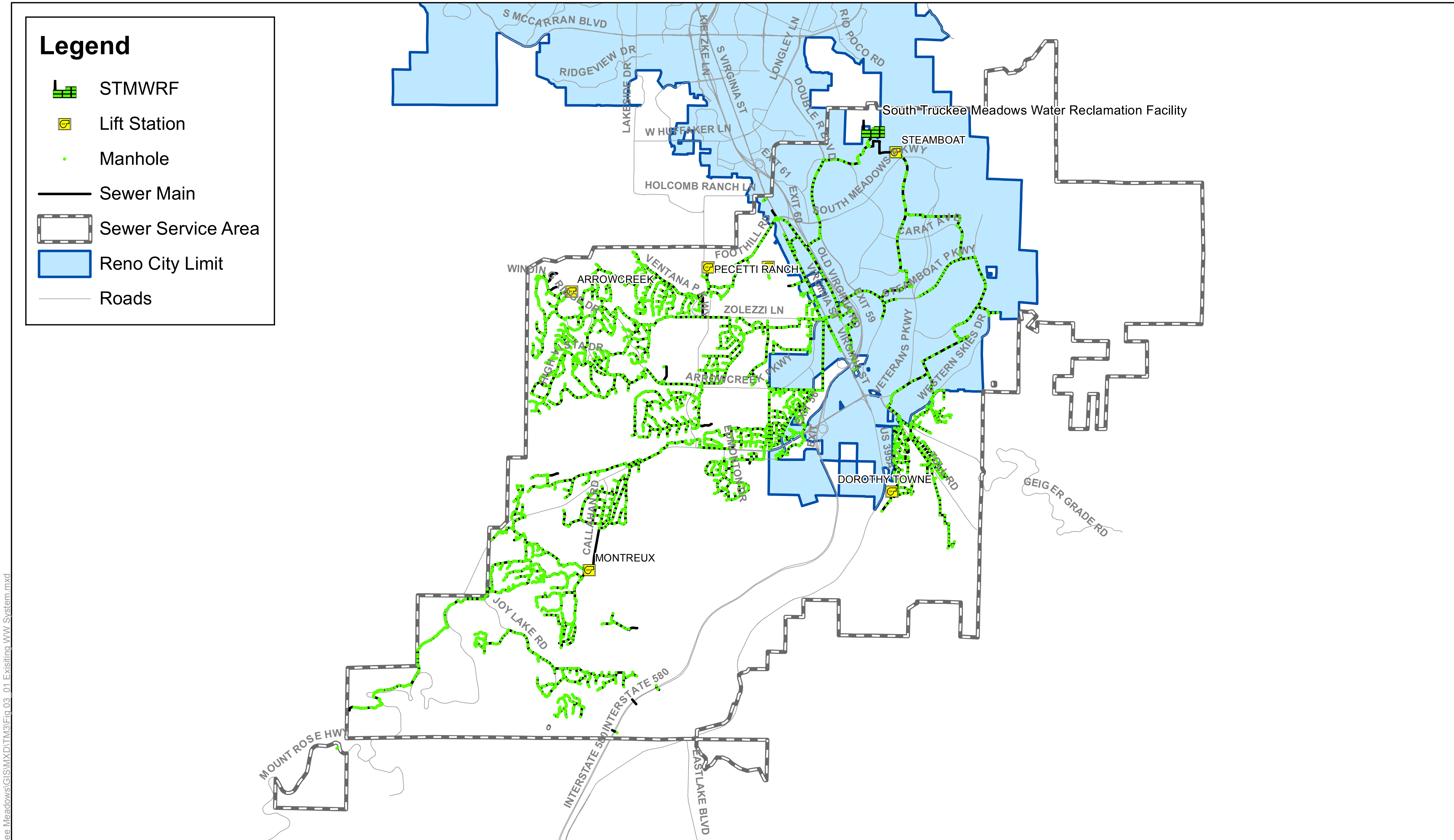
"Large Diameter Sewer Pipe Assessment" by Brown and Caldwell – This document was used to confirm some of the large pipe diameter characteristics in the STM area.

3.0 SOUTH TRUCKEE MEADOWS WASTEWATER INFRASTRUCTURE

There are 142.5 miles of sewer pipe owned by Washoe County in the STM Basin. There are also sewer pipes that drain into the STM Basin that are owned by the City of Reno. Flow from City of Reno areas was used in the hydraulic model and to produce flow projections. Table 3.1 summarizes the pipe lengths and diameters in the STM system.

Table 3.1 STM Collection System Pipe Lengths and Diameters STMWRF Facility Plan Update Washoe County		
Diameter (in)	**Length (ft)**	**Length (mile)**
Gravity Sewer Mains		
6-in or smaller	11,569	2.2
8	577,555	109.4
10	28,038	5.3
12	28,082	5.3
15	30,249	5.7
18	19,839	3.8
21	1,085	0.2
24	6,979	1.3
27	4,177	0.8
30	25,043	4.7
36	4,539	0.9
Force Mains		
4	5,902	1.1
6	1,694	0.3
10	3,550	0.7
16	4,165	0.8
Total	**752,466**	**142.5**

The collection system has seven wastewater lift stations of various capacities. The County's hydraulic sewer model is a skeletonized representation of the collection system that only models the Steamboat lift station. The Steamboat Lift Station has three pumps, each with a design capacity of 1,440 gallons per minute (gpm). The Steamboat lift station has a firm capacity of 2,880 gpm and a total capacity of 4,320 gpm. Figure 3.1 shows the STM 2015 wastewater collection system infrastructure.



SOUTH TRUCKEE MEADOWS EXISTING WASTEWATER COLLECTION SYSTEM

FIGURE 3.1

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: September 28, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig 03_01 Existing WW System.mxd

4.0 WASTEWATER LOADS

The STM collection system conveys wastewater from three sources to the South Truckee Meadows Water Reclamation Facility (STMWRF) for treatment. These flows are:

- Wastewater flows from customers.
- Infiltration from the groundwater in areas where the water table is high and groundwater can infiltrate through joints and cracks.
- County wells that can be pumped into the collection system to augment reclaimed water supplies, particularly during low flow times in the collection system. Flows from these wells are not included in the capacity evaluation in this study because the wells are not needed during peak flow times.

4.1 Dry Weather Wastewater Flows

Dry weather wastewater flows have been estimated using the growth projections and land use information provided by the County and documented in TM 2. The wastewater flows are also expressed in terms of Equivalent Residential Units (ERU) for convenience in allocating development flows to pipe capacity. Table 3.2 summarizes the projected wastewater flows and peaking factors.

Table 3.2 Projected Wastewater Minimum, Average, and Maximum Flows
STMWRF Facility Plan Update
Washoe County

Year	Ave Flow, mgd	Max Month Flow, mgd	WW Peak Hour Flow, mgd	Total ERUs
2015	3.0	3.4	7.4	14,290
2020	3.6	4.0	8.9	17,150
2025	4.1	4.6	10.1	19,380
2030	4.4	4.9	10.8	20,730
2035	4.5	5.0	11.1	21,360
Buildout	11.6	13.0	28.7	42,963

4.2 Diurnal Patterns

Diurnal patterns are used to adjust average daily flows to represent the flows that would occur at each hour of the day in the model. The diurnal patterns in the County's hydraulic model were developed from flow monitoring data documented in "South Truckee Meadows Sewer Collection System Flow Monitoring - 2011" by CH2M. Loads that were added to future scenarios in the model were assigned diurnal patterns based on the 2011 flow monitoring basin location. Weekend flows typically have higher peak flows so the weekend diurnal pattern is used and multiplied by the average daily flow to obtain flows throughout the day. The diurnal patterns produce a peak flow that is lower than the total peak flow at the STMWRF because the diurnal patterns are applied only to the dry weather flow and not the inflow, which does not have a diurnal flow pattern.

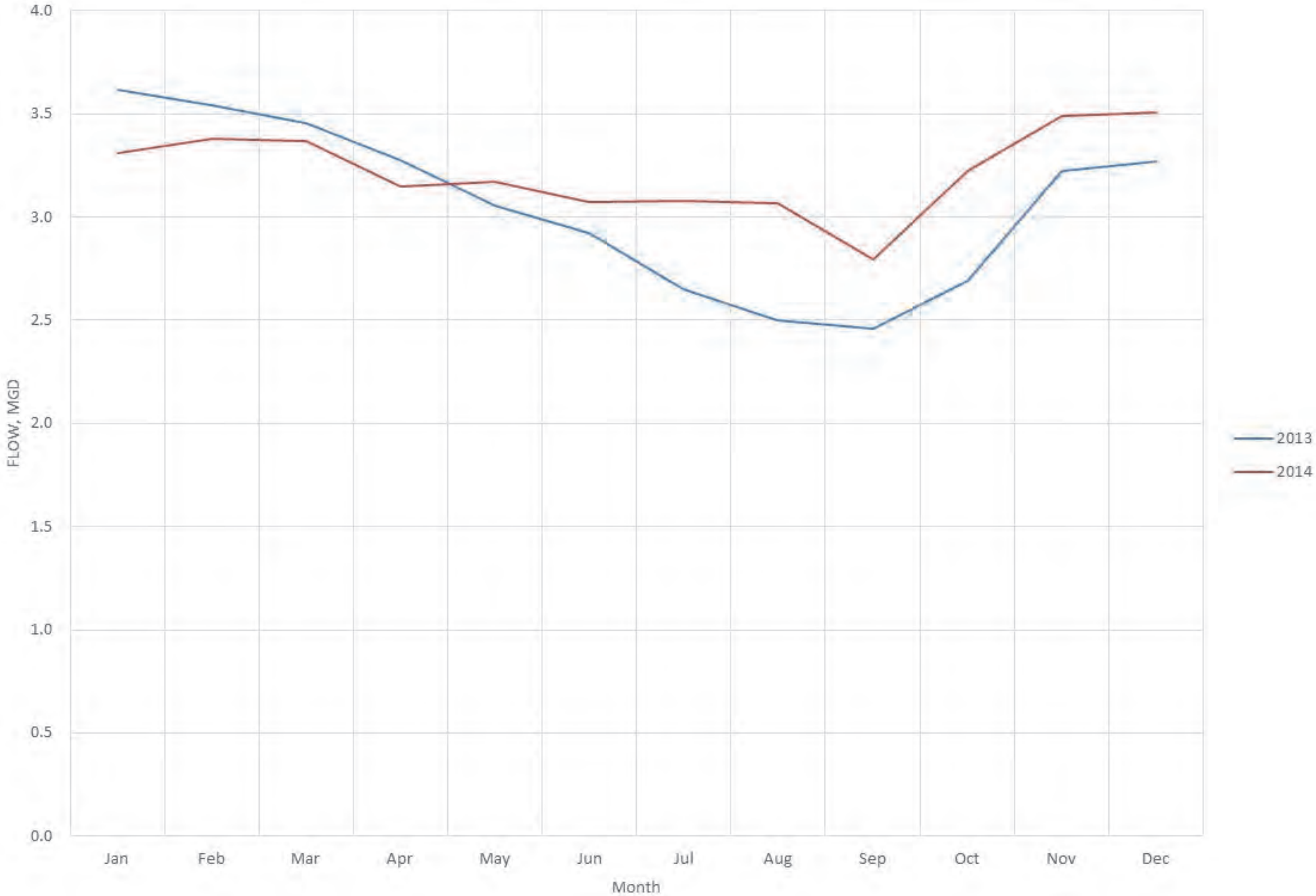
4.3 Inflows

An evaluation was completed to determine an appropriate estimate for inflows into the STM collection system. Several different methods of calculating inflow were considered, along with an evaluation of the seasonal wastewater flows into the plant. This evaluation was documented in TM 2. For this capacity evaluation, a constant flow equal to 30% of the average annual daily flow was added separately to each loading manhole in the model to simulate the additional infiltration flow that occurs. This evaluation is based on the seasonal flows documented in Figure 3.2.

4.4 Wastewater Load Allocation

Wastewater flows that are projected in the model have been developed based on the available information, and for each portion of the service area, the most reliable information is used to estimate wastewater flows. Details of the wastewater flow estimation approach can be found in TM 2. Information used to estimate wastewater flows have been allocated in priority as follows:

1. Where water billing data is available, wastewater flows are estimated as a percentage of water demand based on the customer type for each property parcel:
    a. Single family: 30%
    b. Commercial and industrial: 85%
    c. Multi-Family and Public facilities: 50%
2. Existing development in Reno and existing development on septic systems is based on land use plan categories and corresponding unit load estimates.
3. Inflow is assumed to be 30% of average daily flows, with most of the inflow coming from the northern part of the service area.
4. Where approved developments have been defined, estimated wastewater flow is calculated as the approved dwelling units * 270 gal/housing unit/day (ERU).
5. Where development may occur but has not been approved, a unit load for each land use category is used: 388 gal/acre/day for residential and 289 gal/acre/day for commercial.



AVERAGE MONTHLY FLOWS TO THE STMWRF FOR 2013 AND 2014

FIGURE 3.2

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Table 3.3 summarizes the wastewater load estimates based on the estimation methods explained above for the entire collection system. Appendix A contains Figure A.1 that shows the load allocation by parcel for the South Truckee Meadows service area. Table 3.4 shows the flow estimates that are specific to the Pleasant Valley Interceptor.

Table 3.3 Average Daily Wastewater Flow Summary for STM Collection System
STMWRF Facility Plan Update
Washoe County

Source of Existing Flow Estimate				**Average Flow, mgd**
1. Parcels with 2013 Water Billing Data:				1.4
30% of single family residential water billing data				
85% of commercial and industrial water billing data				
50% of multi-family residential and public facility water billing				
2. Existing Reno Parcels:				0.70
	Land Use		2013 WW Unit Loads, gpad	
	SINGLE FAMILY		388	
	MULTI-RESIDENTIAL		176	
	COMMERCIAL		289	
	INDUSTRIAL		239	
	PUBLIC FACILITY		54	
3. Infiltration:				0.90
30% of total flow to STMWRF in 2013				
Total 2013 Wastewater Flow				**3.0**
Additional Flows by 2035				
4. 2013 Water Billing Data for parcels on septic that:				0.40
Same proportions by land use as above				
5. Dwelling units per acre taken from the County's GIS parcel shapefile:				1.8
(Approved Dwelling Unit/acre) * (Acreages) * (270 gpad)				
Subtotal Additional 2035 Load				2.2
Total 2035 Wastewater Flow				**5.2**
Additional Flows by Buildout				
6. Development class from "STMWRF_parcels_withActual_DU_acre" shapefile:				6.4
	Development Class	Corresponding Land Use	2013 WW Unit Loads, gpad	
	1	SINGLE FAMILY	388	
	2 - 4	COMMERCIAL	289	
	5	None	0	
Subtotal Additional Buildout Load				6.4
Total Buildout Wastewater Flow				**11.6**

Table 3.4	Average Daily Wastewater Flow Summary for Pleasant Valley Buildout Flows STMWRF Facility Plan Update Washoe County		
Source of Existing Flow Estimate			**Average Flow, mgd**
1. Parcels with 2013 Water Billing Data:			0.026
30% of single family residential water billing data			
85% of commercial and industrial water billing data			
50% of multi-family residential and public facility water billing			
2. Existing Reno Parcels:			0.0004
Land Use		2013 WW Unit Loads, gpad	
SINGLE FAMILY		388	
MULTI-RESIDENTIAL		176	
COMMERCIAL		289	
INDUSTRIAL		239	
PUBLIC FACILITY		54	
3. Infiltration:			0.01
30% of total flow to STMWRF in 2013			
Total 2013 Wastewater Flow			**0.04**
Additional Flows by 2035			
4. 2013 Water Billing Data for parcels on septic that:			0.053
Same proportions by land use as above			
5. Dwelling units per acre taken from the County's GIS parcel shapefile:			0.14
(Approved Dwelling Unit/acre) * (Acreages) * (270 gpad)			
Subtotal Additional 2035 Load			
Total 2035 Wastewater Flow			**0.19**
Additional Flows by Buildout			
6. Development class from "STMWRF_parcels_withActual_DU_acre" shapefile:			1.47
Development Class	Corresponding Land Use	2013 WW Unit Loads, gpad	
1	SINGLE FAMILY	388	
2 - 4	COMMERCIAL	289	
5	None	0	
Subtotal Additional Buildout Load			1.47
Total Buildout Wastewater Flow			**1.70**

5.0 COLLECTION SYSTEM ANALYSIS

5.1 Collection System Model

The STM model was created and calibrated by Washoe County. The model uses the InfoSewer model software. The model is skeletonized to include the major interceptors where manhole invert elevations have been verified. Carollo reviewed the model and calibration and found the model to be suitable for the capacity evaluations in this study, after a few invert elevations were adjusted based on feedback from the County. The only other change made to the model was to add the new wastewater loads to represent current and future flow conditions.

5.2 Design Criteria Summary

Design or performance criteria define the standard of acceptability for wastewater collection system capacity. The goal of performance criteria is to help ensure that collection system infrastructure is adequately sized while also avoiding excessive costs and hydrogen sulfide problems from oversized infrastructure. The performance criteria used in this study was reviewed and accepted by the County. Table 3.5 summarizes the performance and design criteria used to evaluate the wastewater collection system, also documented in Table 2.2 of TM 2.

Table 3.5 Wastewater System Criteria Summary
STMWRF Facility Plan Update
Washoe County

Flow Velocity in feet per second (fps)	
Gravity Mains	2.5 fps ≤ V ≤ 10 fps
Force Mains	3 fps ≤ V ≤ 7 fps
Pipe Slope	
The minimum pipe slope is the slope at which the flow velocity is least 2.5 fps when flowing half full.	
Flow Depth, d/D, (for peak hour flows)	
d/D for All Sewer Pipes	= 0.80
Headloss in Existing Pipes	
Gravity Pipes (PVC, Ductile Iron, Concrete)	Manning's N = 0.012
Gravity Pipes (High Density Polyethylene)	Manning's N = 0.011
Pressure Pipes	Hazen William's C = 120
Changes in Pipe Size	
When a smaller sewer joins a larger one	Sewer crowns will be matched
Headloss at Manholes	
All Manholes	Provide 0.1' Invert Drop
Peaking Factors and Unit Loads	
Minimum Peaking Factor	3.0 (or as approved by DWR)
ERU	270 gpd

5.3 Existing Collection System Evaluation

The collection system model showed that the collection system has sufficient capacity for current conditions. Figure 3.3 shows that there are no pipes that are out of capacity for current flows. Pipe velocities were also compared with the criteria and velocities in gravity mains are less than 10 ft/sec and velocities in force mains are less than 7 ft/sec.

5.4 Steamboat Lift Station

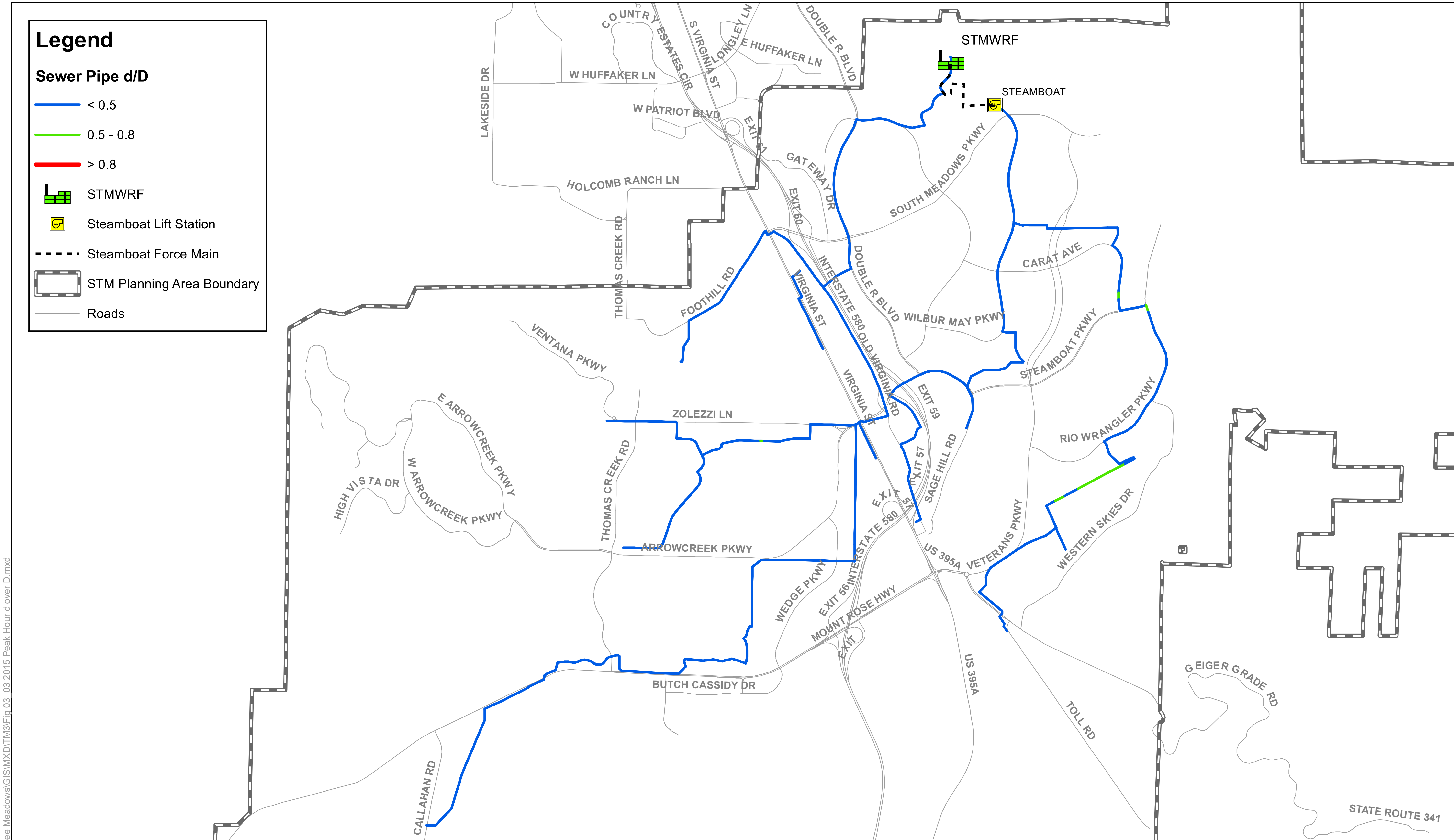
To determine the capacity requirements for the Steamboat Lift Station, Table 3.6 was created to identify gravity flows to the Steamboat lift station. By 2035, the Steamboat Lift Station will have an average daily flow of 2.0 mgd, and a peak flow of about 2.9 mgd. The lift station firm capacity is 4.1 mgd, so the Steamboat lift station has sufficient capacity beyond planning year 2035.

Table 3.6 Flow Split between Gravity and Steamboat Basins
STMWRF Facility Plan Update
Washoe County

Year	Gravity Flow, mgd	Steamboat Flow, mgd	Total
2013	3.1	0.0	3.1
2014	2.1	1.2	3.2
2015	1.7	1.3	3.0
2015 model	1.7	1.3	3.0
2035 model	3.1	2.0	5.1
BO model	5.1	6.4	11.5

5.5 Future Sewer Mains

Figure 3.4 shows the collection system with the major interceptors that may be required to serve the flows by 2035. There is one pipe that appears to be out of capacity and this pipe will be included in the 2035 CIP. When a pipe in the model show insufficient capacity, it is important to check the invert data to ensure that the cause of the capacity limitation is not data related. Appendix B shows plan and profiles for pipes with insufficient capacity under dry weather infiltration flow conditions. In each case, pipe invert elevations should be verified first before undertaking action to increase capacity. Flows should then be verified with flow monitoring prior to designing or new pipe. In the event that a pipe needs increased capacity, the pipe would be sized for buildout flows, not 2015 flows. The model analysis shows that there are a few gravity pipes in 2035 that have a velocity greater than 10 ft/sec.



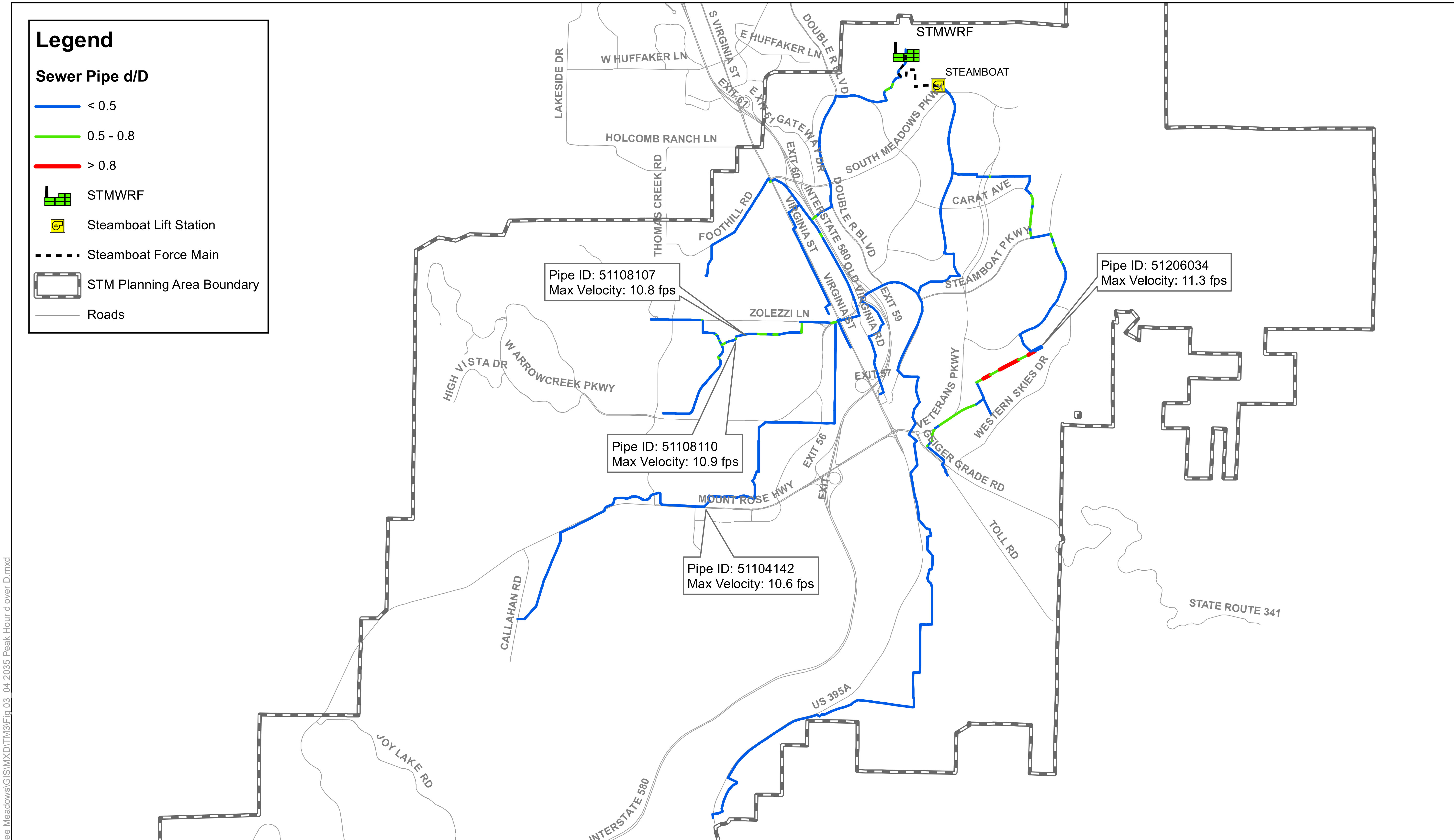
2015 SEWER MAIN d/D MODEL RESULTS

FIGURE 3.3

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: September 29, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig 03_03 2015 Peak Hour d over D.mxd



2035 SEWER MAIN d/D MODEL RESULTS

FIGURE 3.4

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

Date: September 30, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig 03_04 2035 Peak Hour d over D.mxd

Figure 3.5 shows the pipes and capacity in terms of d/D at buildout of the service area. One new interceptor has been added to serve land areas in the northeast portion of the service area. The timing of this interceptor is not known, but is expected to be sometime after 2035, so the cost of this interceptor is not included in the Capital Improvement program (CIP) for this study.

5.6 Wet Weather

For the past several years Washoe County has been in a drought. Flow data used in this analysis is from this period of time and may not reflect additional flows caused during wet weather. Washoe County experienced a one in ten year storm event on November 3, 2015 and saw additional flows of approximately 0.4 mgd to STMWRF. Further analysis was conducted to account for this additional flow and was detailed in TM 2.

Figure 3.6 shows the pipes and capacity in terms of d/D at buildout of the service area during wet weather flow conditions. Appendix C Shows details of the pipe segments that are out of capacity with storm inflows.

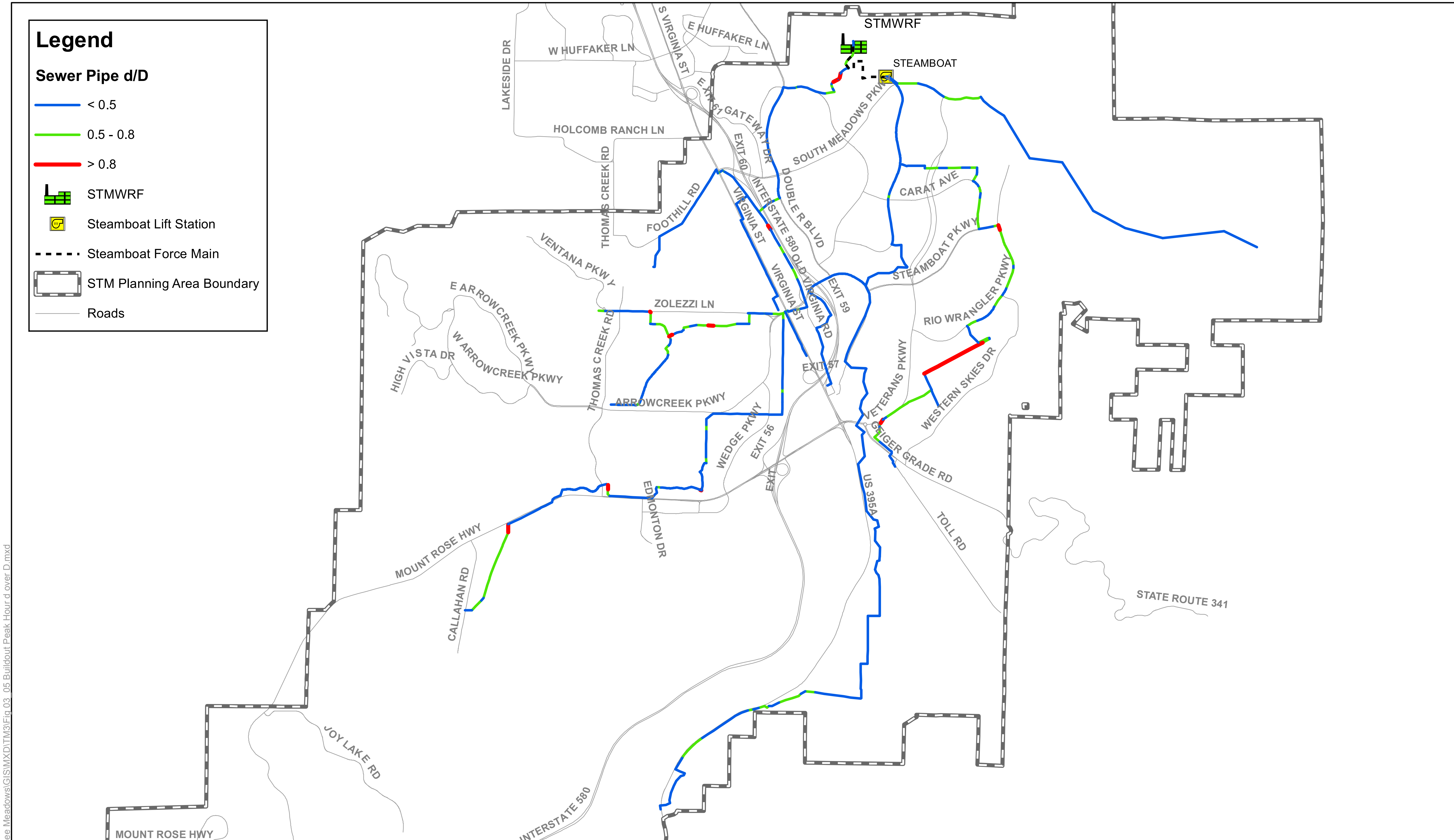
5.7 Pleasant Valley Interceptor

The Pleasant Valley Interceptor has been planned to serve the southern portion of the STM service area. This interceptor has been designed and a portion of the interceptor has been placed in service. Reaches 3A, 3B, and 4 have not been constructed yet. The pipe Reach definition and service area boundaries as presented in this TM were provided by the County. This interceptor is planned to serve areas where new growth is planned, and also to serve some existing developments that are currently served with septic systems. When constructed, the interceptor will begin near the southern part of the South Truckee Meadows service area, and travel north to the Steamboat lift station, which is just south of the STMWRF. Figure 3.7 shows the Pleasant Valley Interceptor in relation to the overall service area.

Washoe County provided Carollo with the collection system model that included the Pleasant Valley Interceptor for this study. This model is an extended period simulation model, so the model predicts the change in flow through each hour of the day. Peak flows are calculated using the diurnal flow patterns that were created from the flow monitoring data. Carollo modified the model by allocating wastewater loads to the appropriate location along the interceptor using the wastewater flow calculations described in Section 2.0.

The model was used to predict wastewater flows for both 2035 flow conditions and the flows that are expected when the entire service area develops, i.e., buildout. Storm inflows were included in the wastewater calculations.

Pipe capacity is measured in terms of maximum water depth to pipe diameter, or d/D. Figure 3.8 shows the maximum water depth that occurred in each pipe Reach during the model simulations.



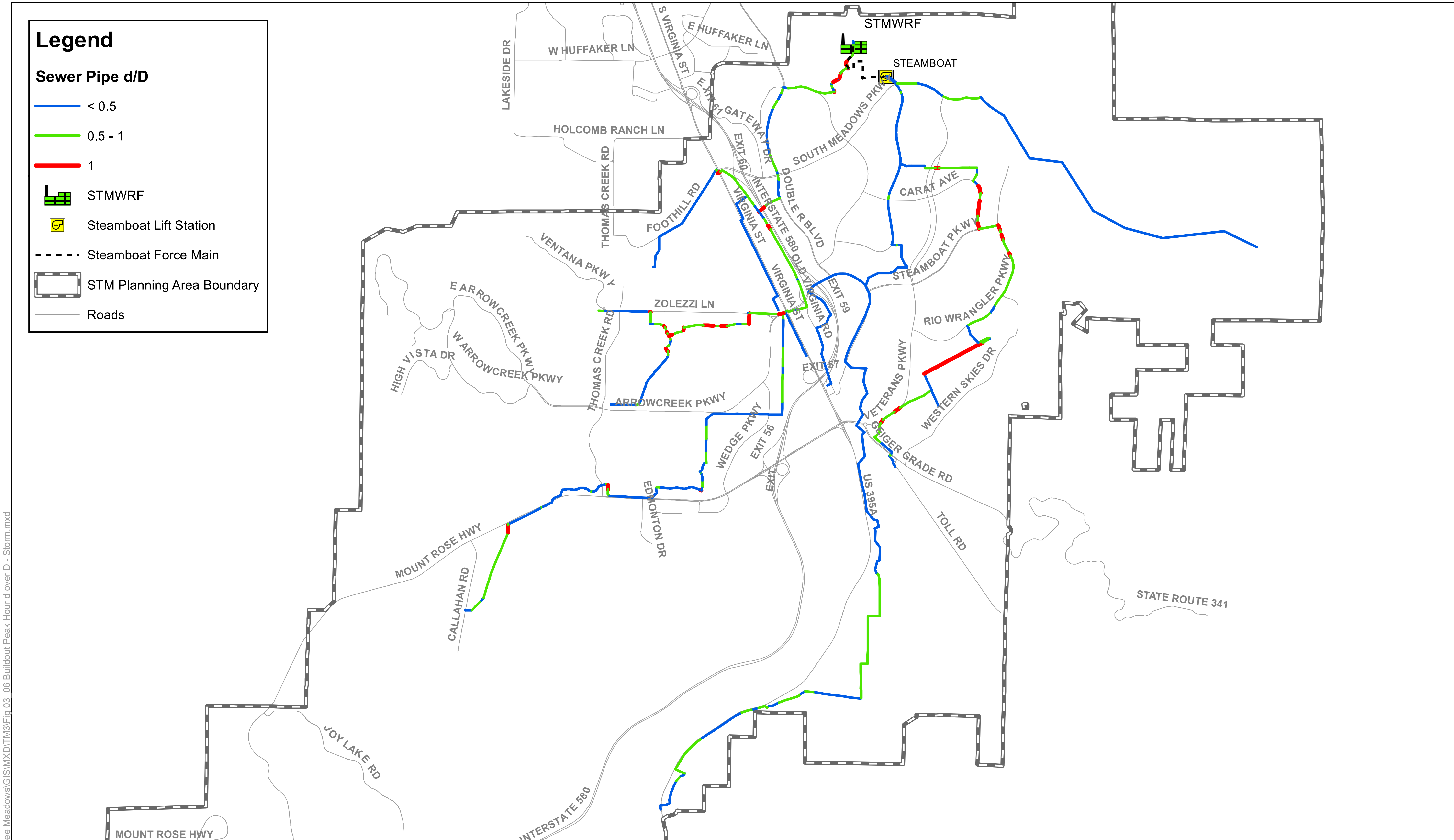
Date: November 24, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig 03_05 Buildout Peak Hour d over D.mxd

BUILDOUT, DRY WEATHER WITH INFILTRATION, SEWER MAIN d/D MODEL RESULTS

FIGURE 3.5

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE



BUILDOUT, WET WEATHER WITH INFILTRATION, SEWER MAIN d/D MODEL RESULTS

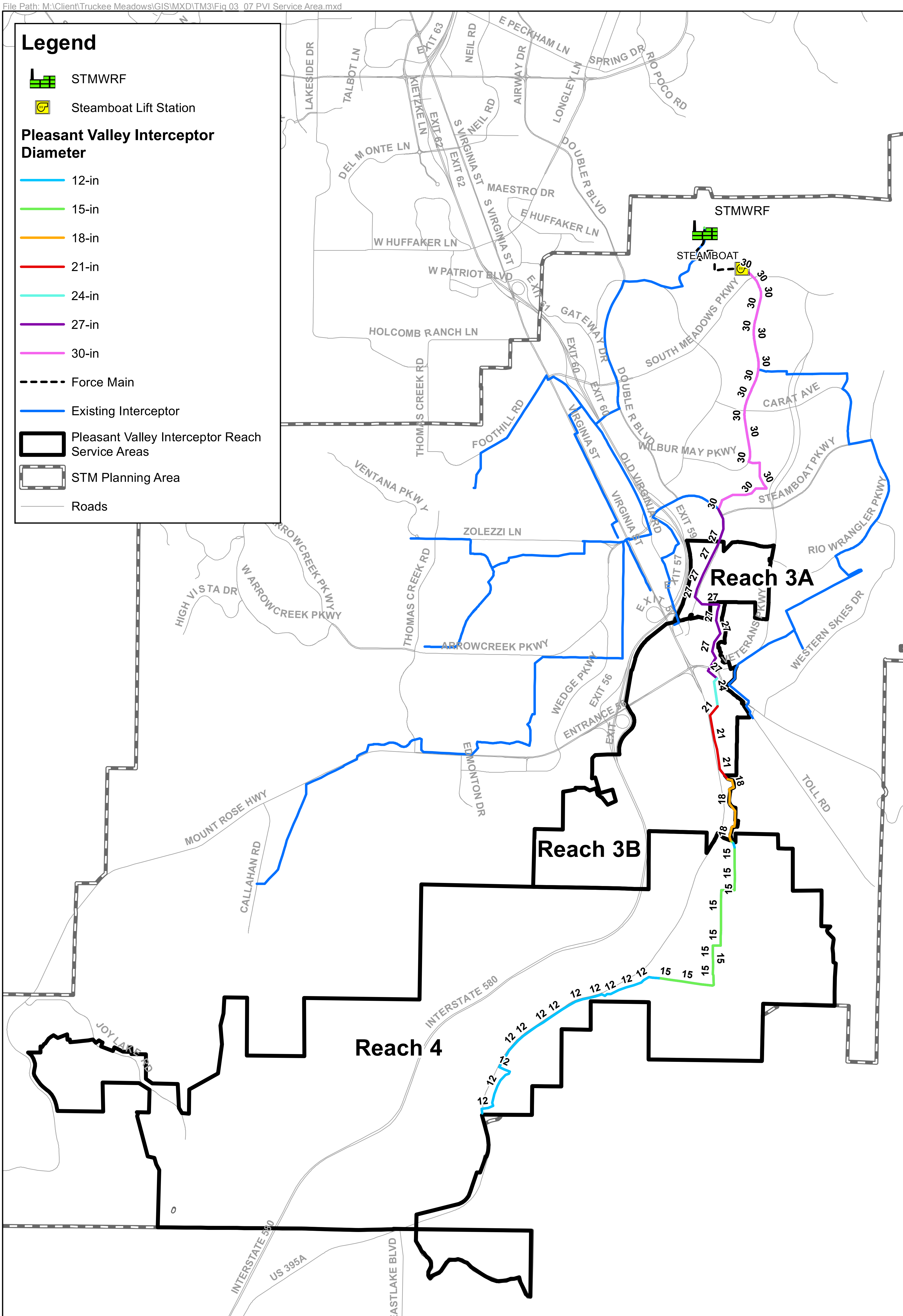
FIGURE 3.6

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: November 24, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig 03_06 Buildout Peak Hour d over D - Storm.mxd

Date: November 30, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig 03_07 PVI Service Area.mxd



PLEASANT VALLEY INTERCEPTOR SHOWING SERVICE AREA - PIPE DIAMETERS AS DESIGNED

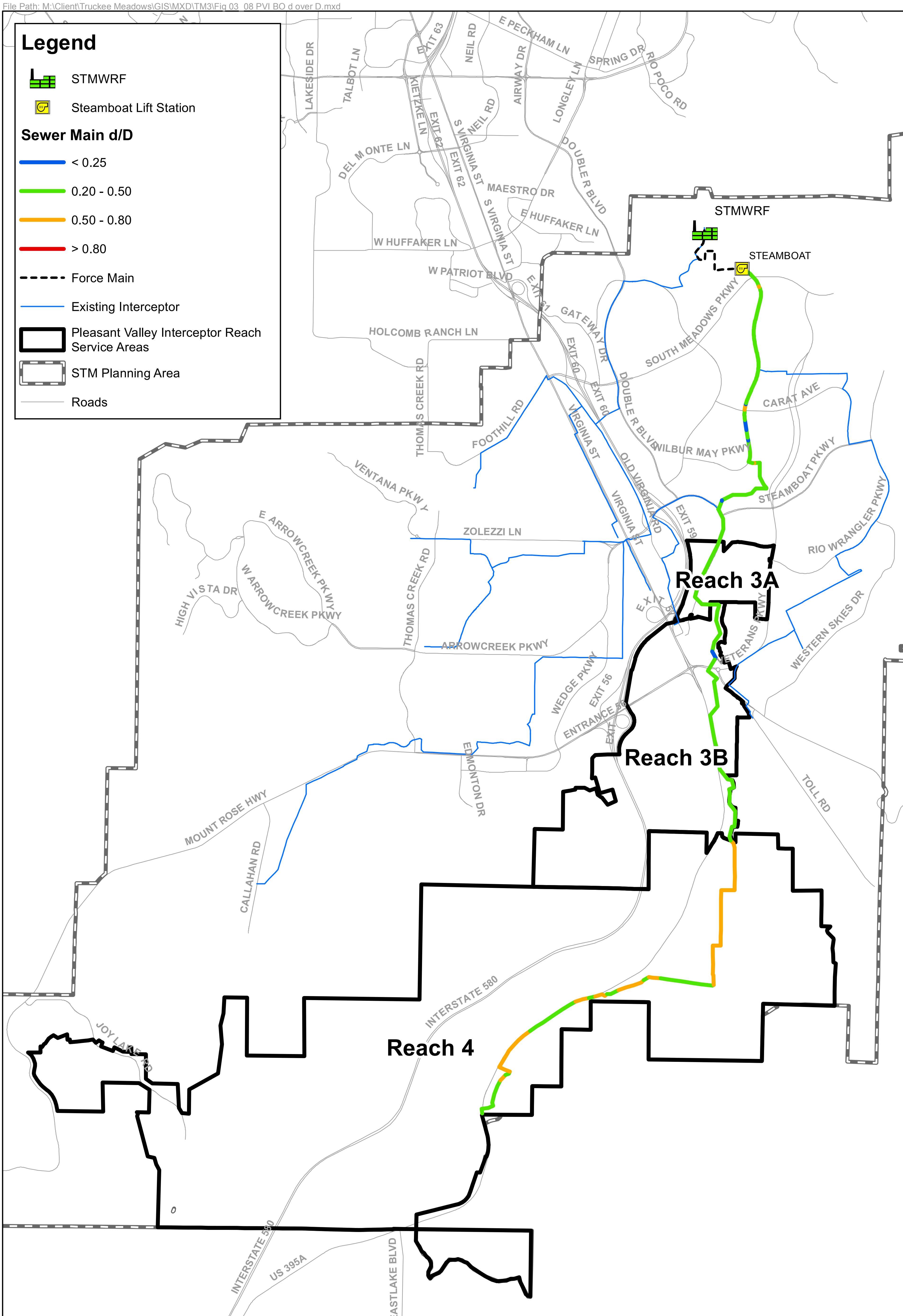
FIGURE 3.7

WASHOE COUNTY

PLEASANT VALLEY INTERCEPTOR CAPACITY ANALYSIS

carollo

Date: November 30, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig 03_08 PVI BO d over D.mxd



MAXIMUM d/D IN EACH PIPE REACH OF THE PLEASANT VALLEY INTERCEPTOR - DESIGNED PIPE DIAMETERS

FIGURE 3.8

WASHOE COUNTY

PLEASANT VALLEY INTERCEPTOR CAPACITY ANALYSIS

carollo

Table 3.7 shows the maximum d/D that occurred in each Reach, by diameter for planned pipe sizes. The d/D values in the table suggest that this interceptor may be oversized.

Table 3.7 Maximum d/D in Each Pleasant Valley Interceptor Reach, by Pipe Diameter - Designed Pipe Sizes STMWRF Facility Plan Update Washoe County

Reach	Pipe Diameter, in	Maximum, d/D
3A	27	0.3
3B	24	0.35
3B	21	0.39
3B	18	0.47
4	15	0.57
4	12	0.69

For planning purposes, the pipe capacity can also be expressed in terms of ERUs within each pipe Reach. Table 3.8 presents the capacity information in terms of ERUs.

Table 3.8 Pleasant Valley Interceptor Capacity Information, in Terms of ERUs - Designed Pipe Diameters STMWRF Facility Plan Update Washoe County

Reach	Pipe Diameter, in	Capacity, ERU	ERUs at 2035	ERUs at Buildout
3A	27	21,094	1,169	6,251
3B	24	14,996	1,147	5,893
3B	21	12,239	1,137	5,835
3B	18	7,909	1,137	5,317
4	15	5,657	1,137	5,243
4	12	3,131	533	3,808

5.7.1 Revised Pipe Diameters

During analysis of the Pleasant Valley Interceptor, results showed that the currently designed pipe sizes for the interceptor had capacity above what was needed. Further analysis was done to see if the pipe sizes could be reduced and still provide the needed capacity.

Figure 3.9 shows the pipe diameters that the Pleasant Valley Interceptor could be reduced to. Figure 3.10 shows the maximum depth that was shown in the model, in terms of d/D, with the reduced pipe diameters.

Date: November 30, 2015
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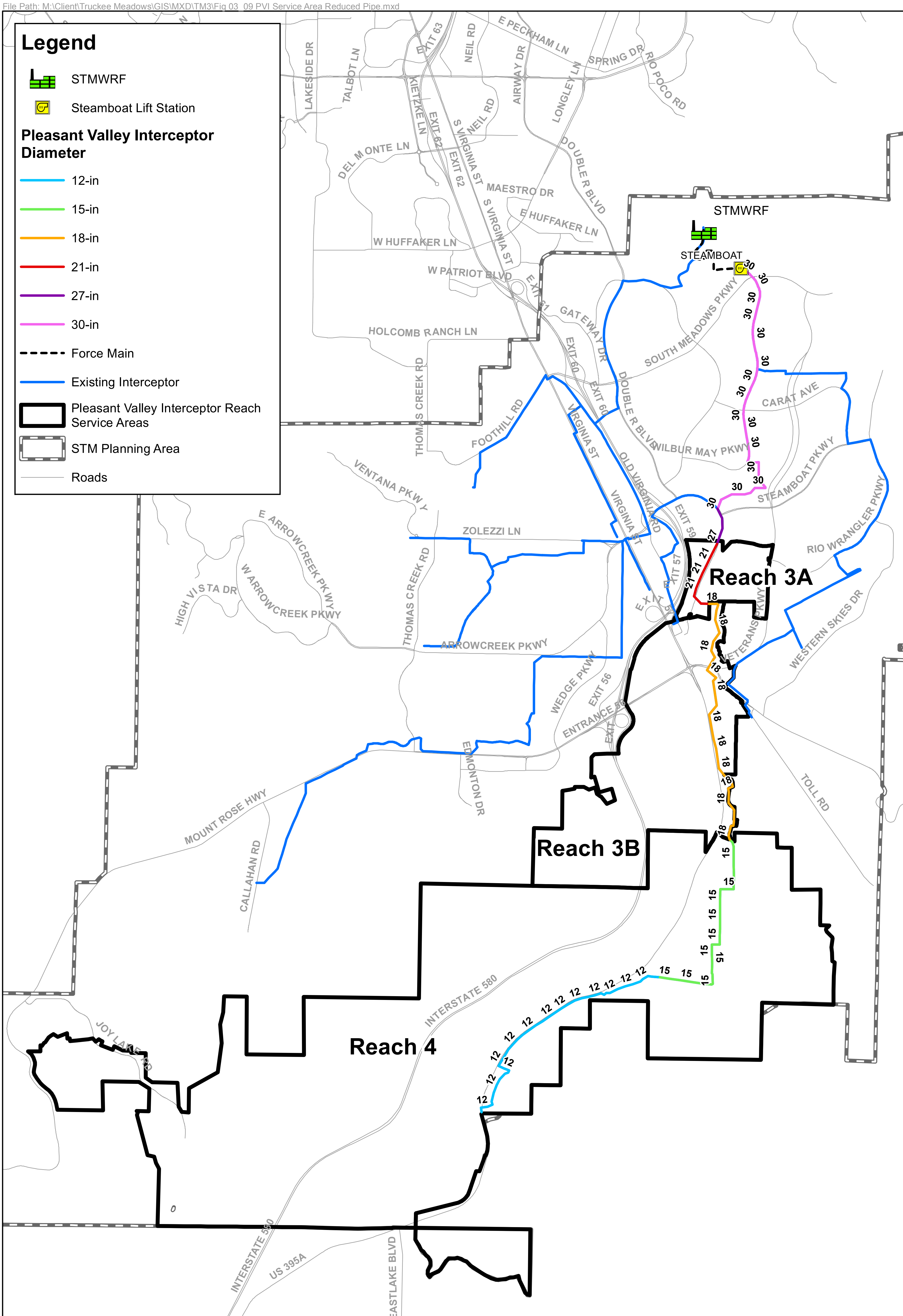


PLEASANT VALLEY INTERCEPTOR SHOWING SERVICE AREA - REDUCED PIPE DIAMETERS

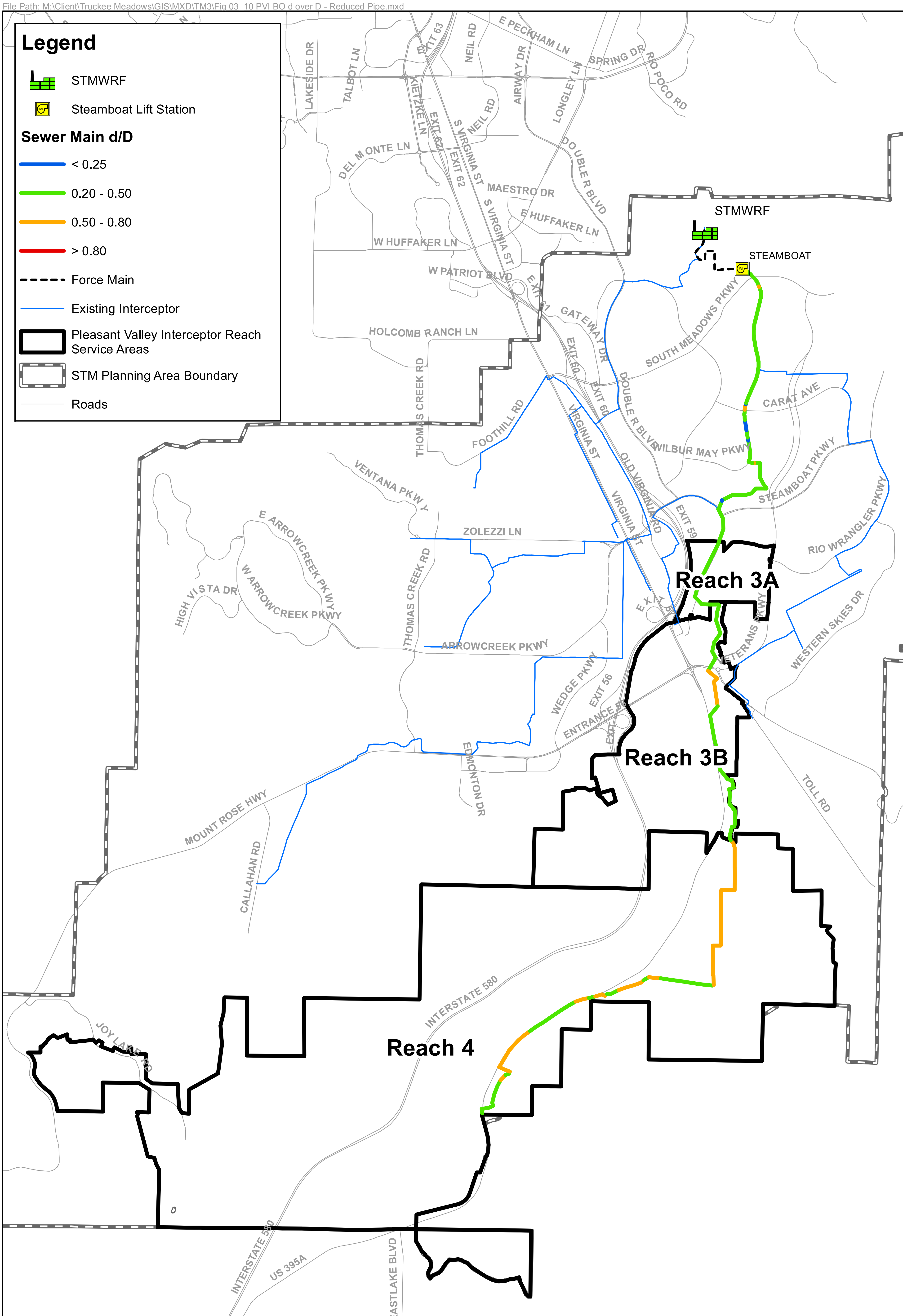
FIGURE 3.9

WASHOE COUNTY

PLEASANT VALLEY INTERCEPTOR CAPACITY ANALYSIS

carollo

Date: November 30, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig 03_10 PVI BO d over D - Reduced Pipe.mxd



MAXIMUM d/D IN EACH PIPE REACH OF THE PLEASANT VALLEY INTERCEPTOR WITH REDUCED PIPE DIAMETERS

FIGURE 3.10

WASHOE COUNTY

PLEASANT VALLEY INTERCEPTOR CAPACITY ANALYSIS

carollo

Table 3.9 shows the maximum d/D that occurred in each Reach, by diameter for reduced pipe diameters.

Table 3.9 Maximum d/D in Each Pleasant Valley Interceptor Reach, by Pipe Diameter - Reduced Pipe Diameters
STMWRF Facility Plan Update
Washoe County

Reach	Pipe Diameter, in	Maximum d/D
3A	21	0.42
3B	18	0.54
4	15	0.57
4	12	0.69

For planning purposes, the pipe capacity can also be expressed in terms of ERUs within each pipe Reach. Table 3.10 presents the capacity information in terms of ERUs.

Table 3.10 Pleasant Valley Interceptor Capacity Information, in Terms of ERUs - Reduced Sizes
STMWRF Facility Plan Update
Washoe County

Reach	Pipe Diameter, in	Capacity, ERU	ERUs at 2035	ERUs at Buildout
3A	21	10,956	1,169	6,251
3B	18	6,964	1,153	5,989
4	15	5,657	1,137	5,243
4	12	3,131	533	3,824

6.0 CAPITAL IMPROVEMENT PLAN

Unit costs have been developed for the capital improvements for each project recommended herein. This cost estimate was prepared in accordance with the guidelines of the Association for the Advancement of Cost Engineers (AACE) International for a Class 4 estimate. Table 3.11 summarizes the AACE International cost estimate classification system, the level of project definition (percent of design), uses, cost estimating methodologies and expected accuracy of Class 1 through 5 estimates. Design work would need to be undertaken to obtain more precise cost estimates.

Table 3.11 AACE Cost Estimate Classification Summary STMWRF Facility Plan Update Washoe County				
Estimate Class	**Maturity Level of Project Definition Deliverables – (Level of Engineering Design)**	**End Use**	**Typical Cost Estimating Methodology Used**	**Expected Accuracy Range (Low/High)**
Class 5	0% to 2%	Conceptual screening	Capacity factored, parametric models, judgment or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -10% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

6.1 Project Cost Development Methodology

To develop project costs for each capital improvement project, unit costs for pipelines, pump stations, and other infrastructure are developed based on information from R.S. Means and other unit cost sources including bid tabs. When multiplied by the capacity or size of the facility, the unit construction cost is the cost that the City should expect to pay a contractor to construct the facility. The City will have other expenses including design, inspection, contingency, and project management that are included in the overall project cost. The project cost is obtained by multiplying the construction cost by a factor of 1.4. Table 3.12 contains an opinion of probable unit construction costs for the recommended projects. The unit cost development is included in Appendix D.

Table 3.12 Unit Cost Summary STMWRF Facility Plan Update Washoe County			
Component	Construction Cost	Project Cost(1)	Planning Year
Pleasant Valley Interceptor Reach 3A(2)	$940,00	$1,320,000	2018
Pleasant Valley Interceptor Reach 3B(2)	$3,100,000	$4,330,000	2018
Pleasant Valley Interceptor Reach 4(2)	$3,780,000	$5,290,000	2018
3,520 feet of 15-in Sewer Main Near Whitecliff Drive and Parma Way	$660,000	$930,000	2035
South Meadows Pkwy East Interceptor Pipe Diameter (inches) / Pipe Length (feet) 12 / 7,251 15 / 6,691 18 / 2,627 21 / 3,609 27 / 3,343	-	-	Buildout
2020 Planning Period Total	**$7,820,000**	**$10,940,000**	
2025 Planning Period Total	**-**	**-**	
2035 Planning Period Total	**$660,000**	**$930,000**	

Notes:

(1) Construction Cost x 1.4 (engineering design, inspection, and project management).
(2) These costs are for the reduced pipe diameters. For the original design, use project costs from the pipeline design projects.

6.2 Project Phasing

The time that the Pleasant Valley Interceptor needs to be expanded by constructing Reaches 3A, 3B, and 4 depends upon the timing of growth that may occur in future developments. Developers are planning to begin construction by 2018 so the pipeline will need to be in place by that time. Eighty percent of the development in the Pleasant Valley Interceptor area is expected to occur in Reach 4. When Reach 4 is completed, some developments that currently are on septic systems can be converted to the public sewer.

The County has been working to develop the portion of the cost of the Pleasant Valley interceptor for the parcels in Reach 4 to develop an appropriate ERU cost for each residential parcel. Appendix E contains a project memorandum with the estimated cost for parcels in Reach 4.

6.3 Recommendations Summary

1. The collection system and Steamboat Lift station has sufficient capacity in 2015.
2. By 2035, 3,520 feet of sewer main near Whitecliff Drive and Parma Way will need to be replaced with a 15-inch pipe. Prior to replacing this pipe flow monitoring should be undertaken to ensure that actual flows are consistent with modeled flows.
3. The Steamboat lift station has sufficient capacity through 2035.
4. The Pleasant Valley interceptor can be constructed using smaller pipe diameters than the original design. Construction of new homes in the Reach 4 service area beginning in 2018 will require that the interceptor be in place by 2018.

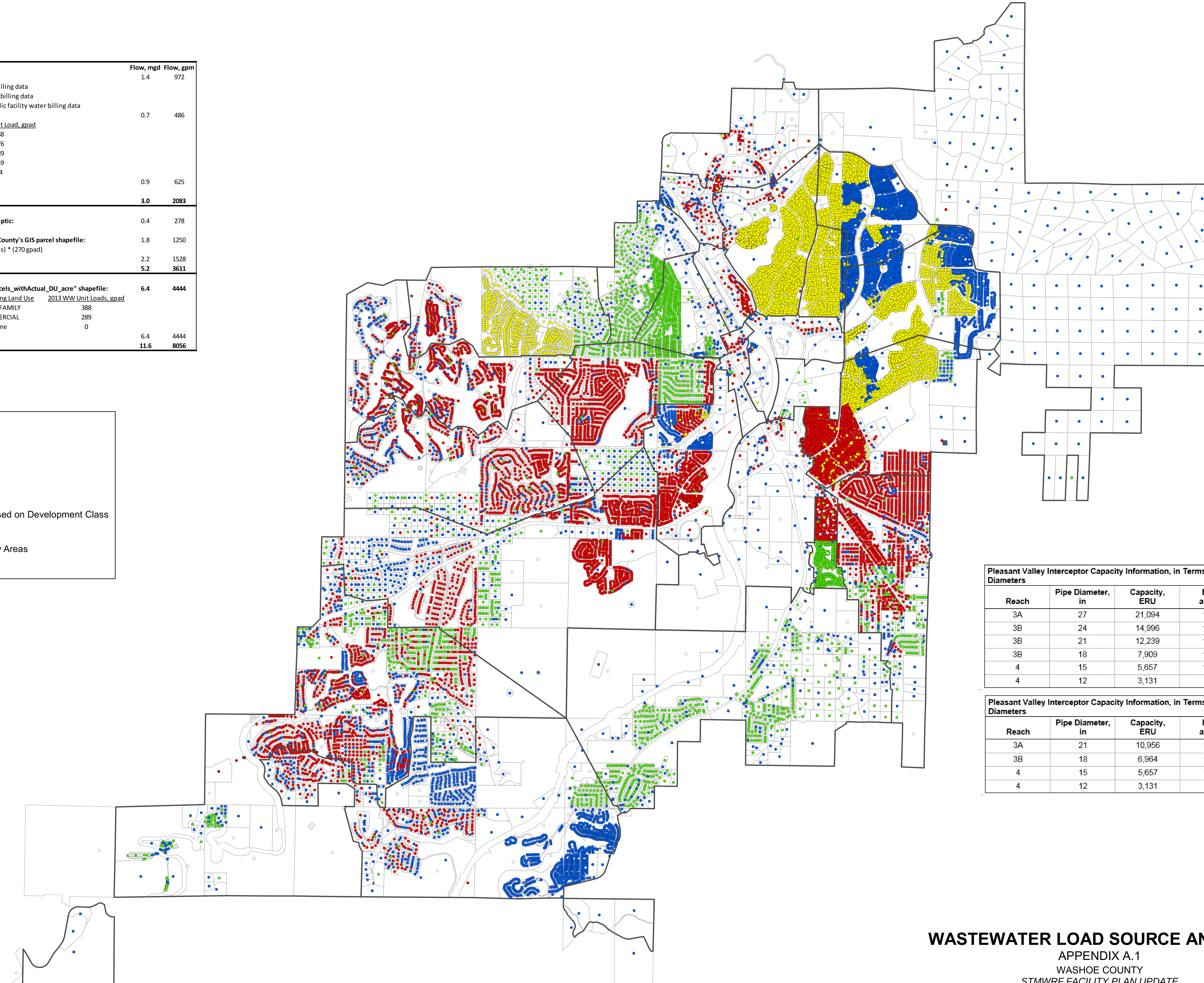
APPENDIX A – FUTURE LOAD ALLOCATION METHODS

Source of Existing Flow Estimate			Flow, mgd	Flow, gpm
1. Parcels with 2013 Water Billing Data			1.4	972
30% of single family residential water billing data				
85% of commercial and industrial water billing data				
50% of multi-family residential and public facility water billing data				
2. Existing Reno Parcels			0.7	486
Land Use	2013 WW Unit Load, gpad			
SINGLE FAMILY	388			
MULTI-RESIDENTIAL	176			
COMMERCIAL	289			
INDUSTRIAL	239			
PUBLIC FAMILITY	54			
3. Infiltration			0.9	625
30% of total flow to STMWRF in 2013				
Total 2013 Wastewater Flow			**3.0**	**2083**
Additional Flows by 2035				
4. 2013 Water Billing Data for parcels on septic:			0.4	278
Same proportions by land use as above				
5. Dwelling units per acre taken from the County's GIS parcel shapefile:			1.8	1250
(Approved Delling Unit/acre) * (Acreages) * (270 gpad)				
Subtotal Additional 2035 Load			2.2	1528
Total 2035 Wastewater Load			**5.2**	**3611**
Additional Flows by Buildout				
6. Development class from "STMWRF_parcels_withActual_DU_acre" shapefile:			**6.4**	**4444**
Development Class	Corresponding Land Use	2013 WW Unit Loads, gpad		
1	SINGLE FAMILY	388		
2 - 4	COMMERCIAL	289		
5	None	0		
Subtotal Additional Buildout Load			6.4	4444
Total Buildout Watewater Flow			**11.6**	**8056**

Legend

Load Source

- 2013 Water Billing Data
- Land Use Unit Load
- Dwelling Units per Acre
- Land Use Unit Load based on Development Class
- Unbuildable
- Model Loading Tributary Areas
- Parcels



Pleasant Valley Interceptor Capacity Information, in Terms of ERUs - Designed Pipe Diameters

Reach	Pipe Diameter, in	Capacity, ERU	ERUs at 2035	ERUs at Buildout
3A	27	21,094	1,169	6,251
3B	24	14,996	1,147	5,893
3B	21	12,239	1,137	5,835
3B	18	7,909	1,137	5,317
4	15	5,657	1,137	5,243
4	12	3,131	533	3,808

Pleasant Valley Interceptor Capacity Information, in Terms of ERUs - Reduced Pipe Diameters

Reach	Pipe Diameter, in	Capacity, ERU	ERUs at 2035	ERUs at Buildout
3A	21	10,956	1,169	6,251
3B	18	6,964	1,153	5,989
4	15	5,657	1,137	5,243
4	12	3,131	533	3,824

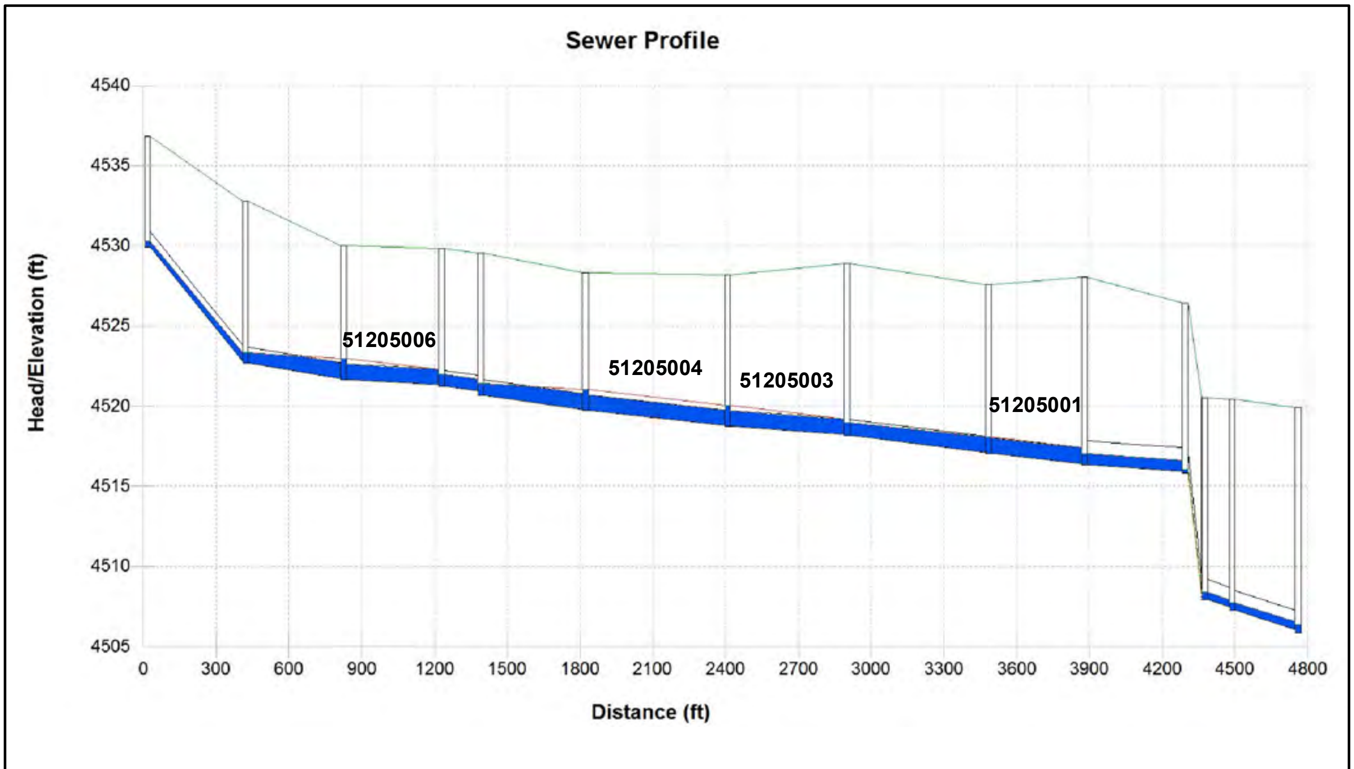
WASTEWATER LOAD SOURCE ANALYSIS

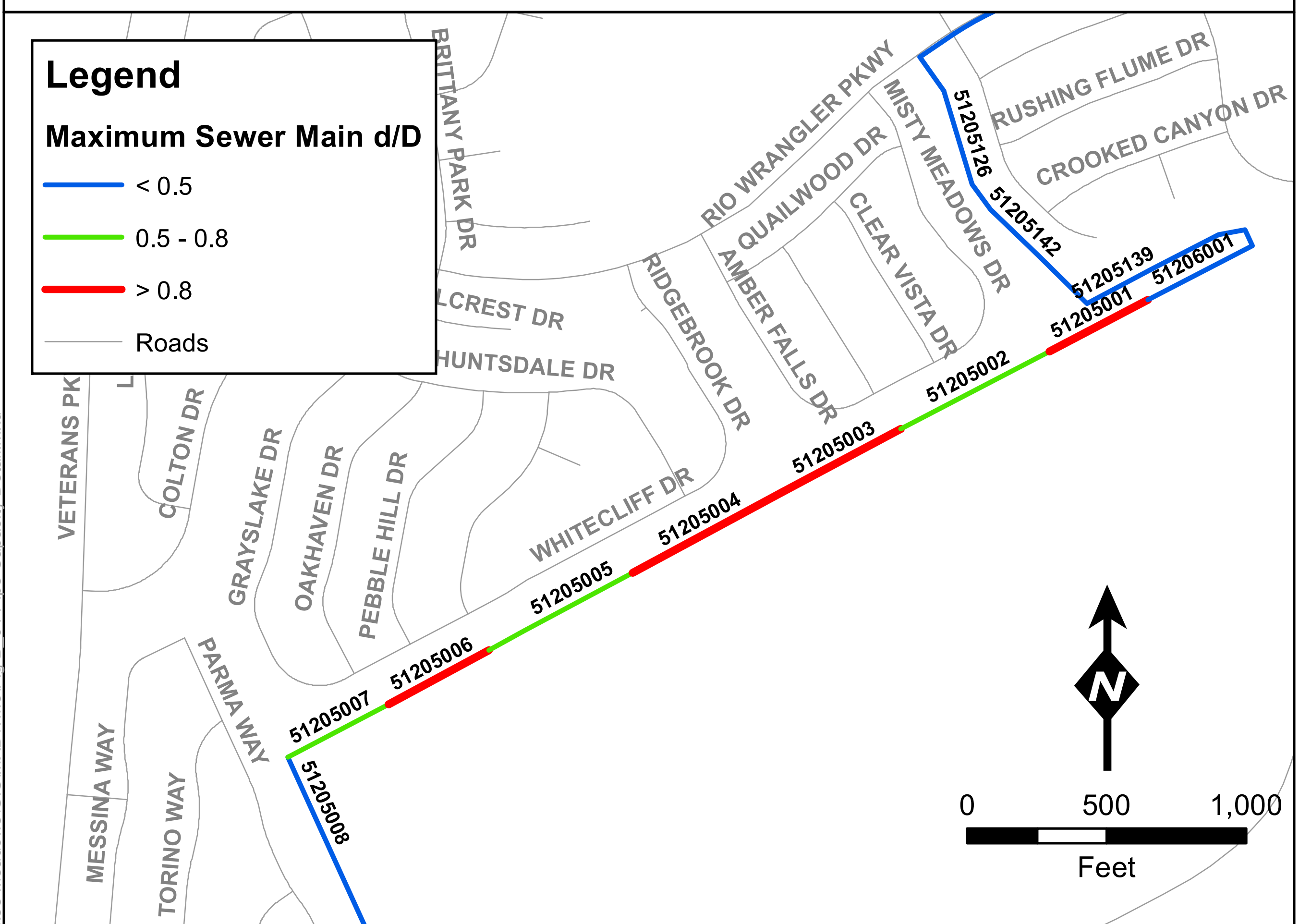
APPENDIX A.1

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

APPENDIX B – PIPE SEGMENTS OUT OF CAPACITY - DRY WEATHER, WITH INFILTRATION





SEWER MAIN PLAN AND PROFILE WITH d/D NEAR WHITECLIFF DR. AND PARMA WAY, 2035

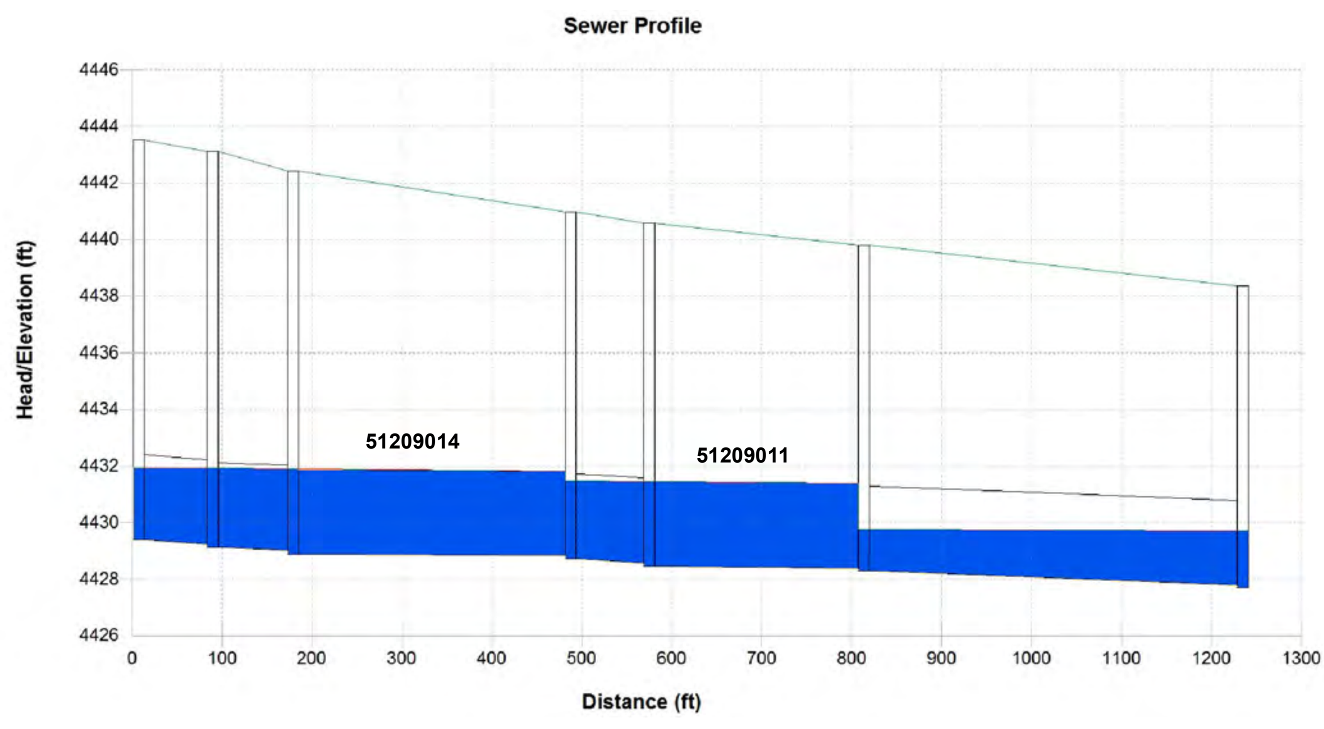
FIGURE B-1

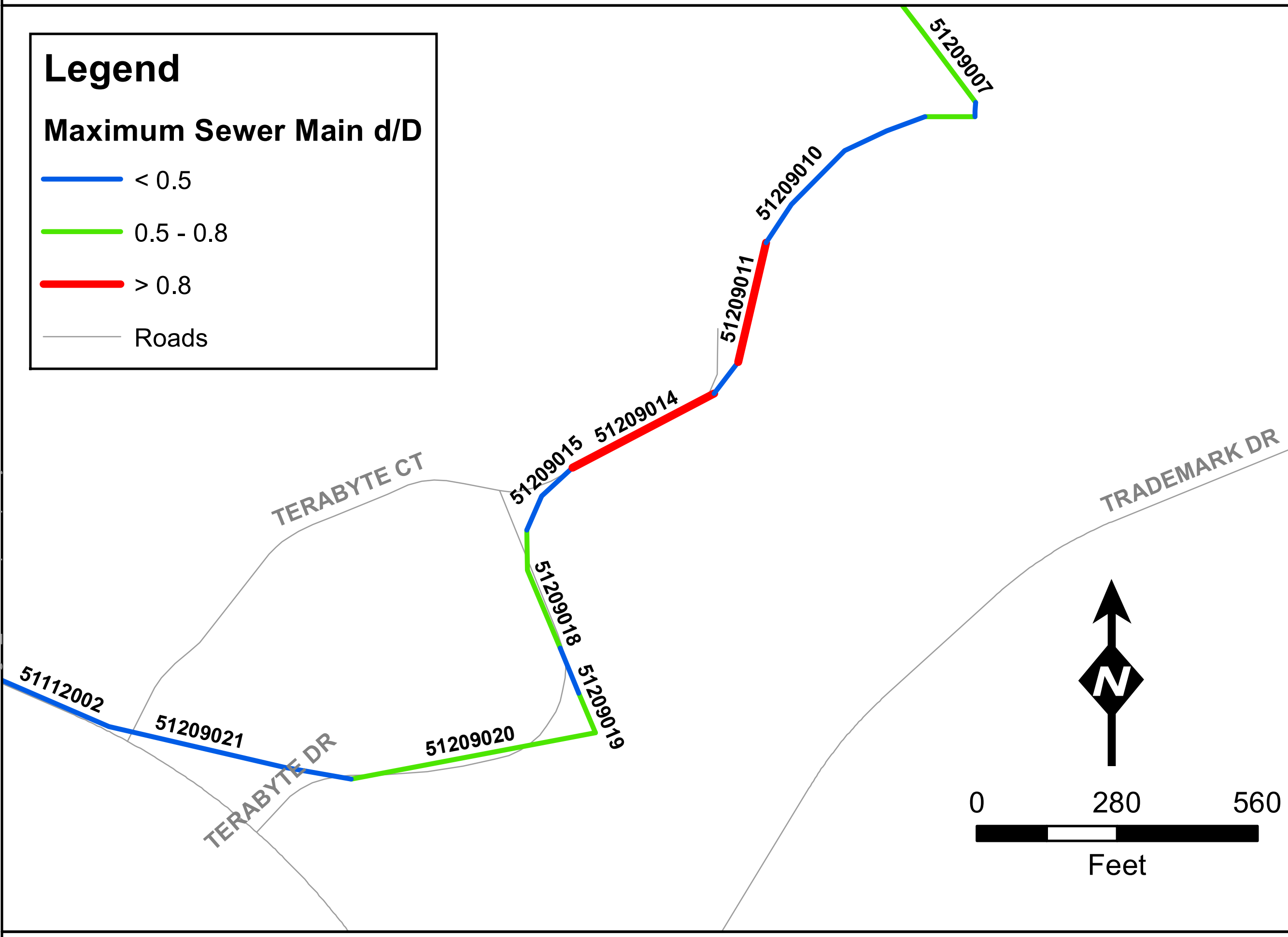
WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

Date: December 01, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig B_01 Pipe Capacity Detail.mxd





SEWER MAIN PLAN AND PROFILE WITH d/D NEAR TERABYTE DR. AND TERABYTE CT., BUILDOUT

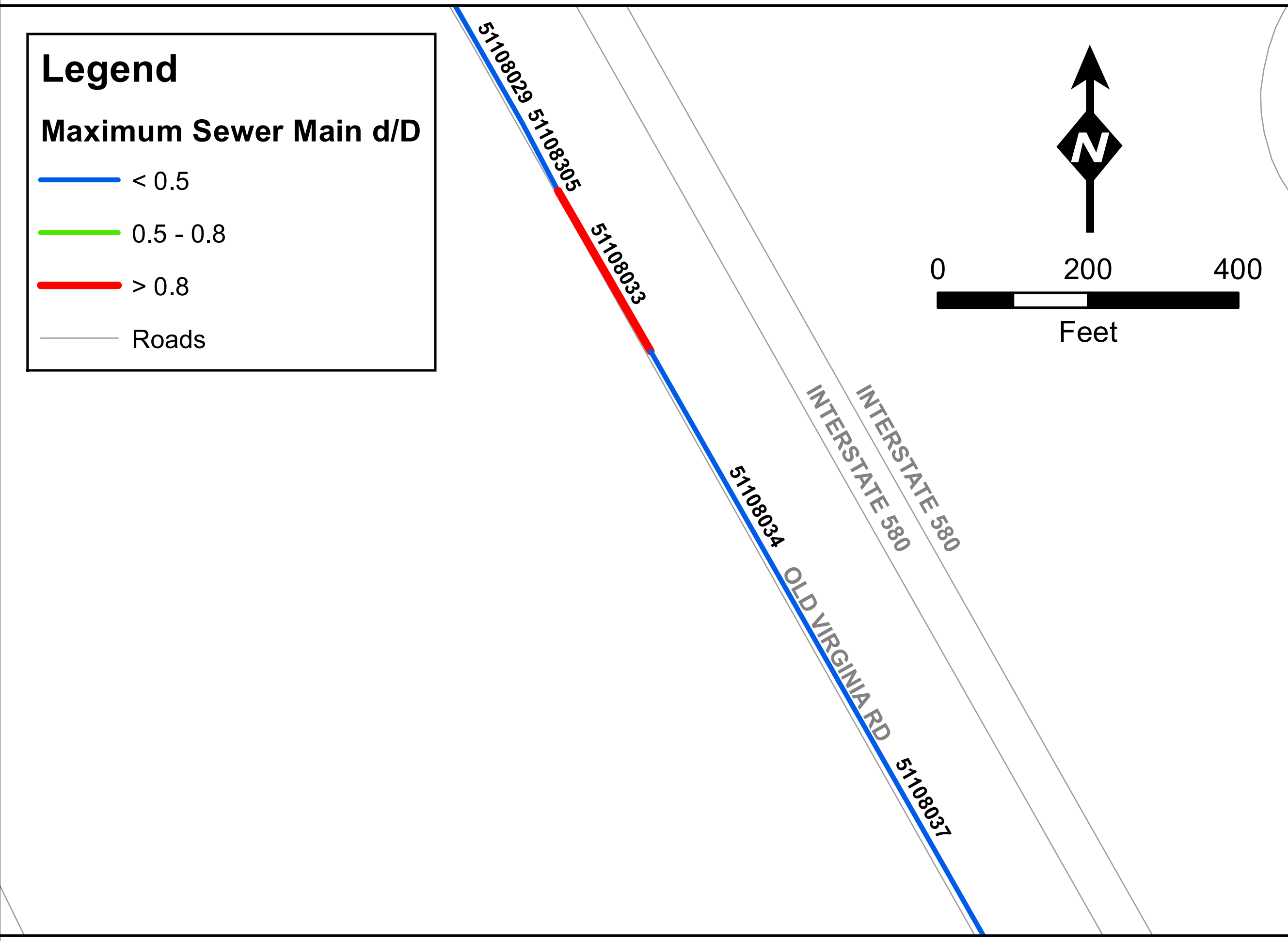
FIGURE B-2

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

Date: December 01, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig B_02 BO Pipe Capacity Detail 36-in.mxd



SEWER MAIN PLAN AND PROFILE WITH d/D NEAR OLD VIRGINIA RD. 2,000 FT NORTH OF AVELINA CT., BUILDOUT

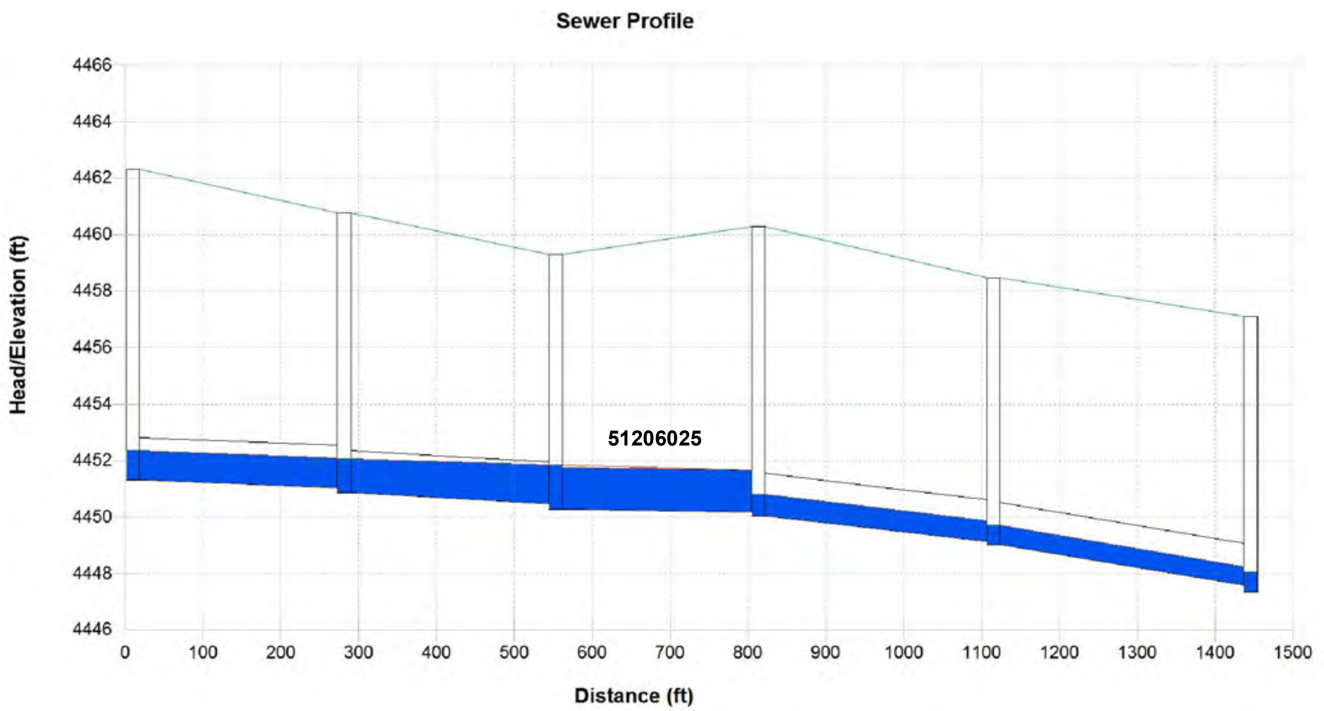
FIGURE B-3

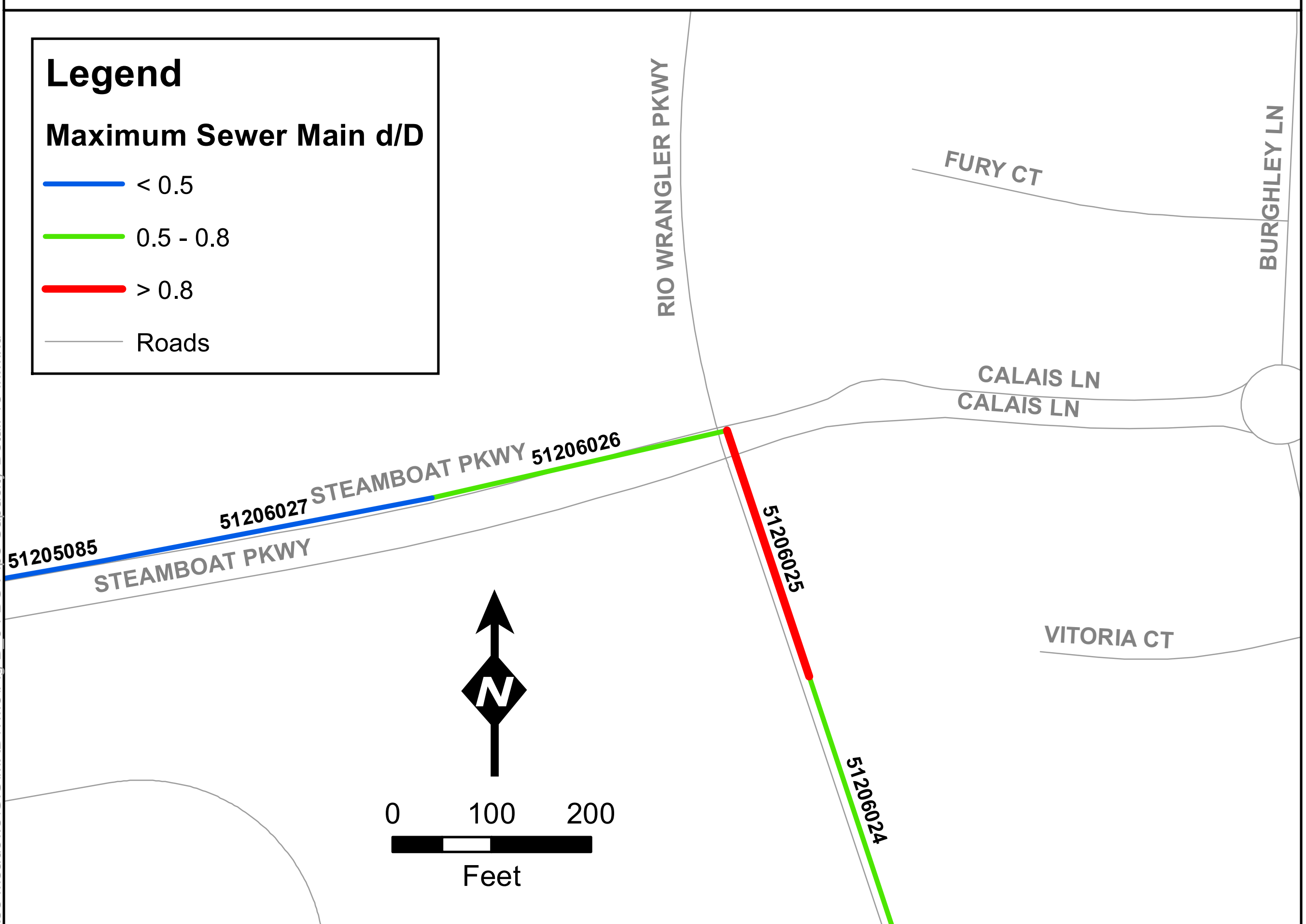
WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

Date: December 01, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig B_03 BO Pipe Capacity Detail 27-in.mxd





SEWER MAIN PLAN AND PROFILE WITH d/D ON RIO WRANGLER PKWY. AND STEAMBOAT PKWY, BUILDOUT

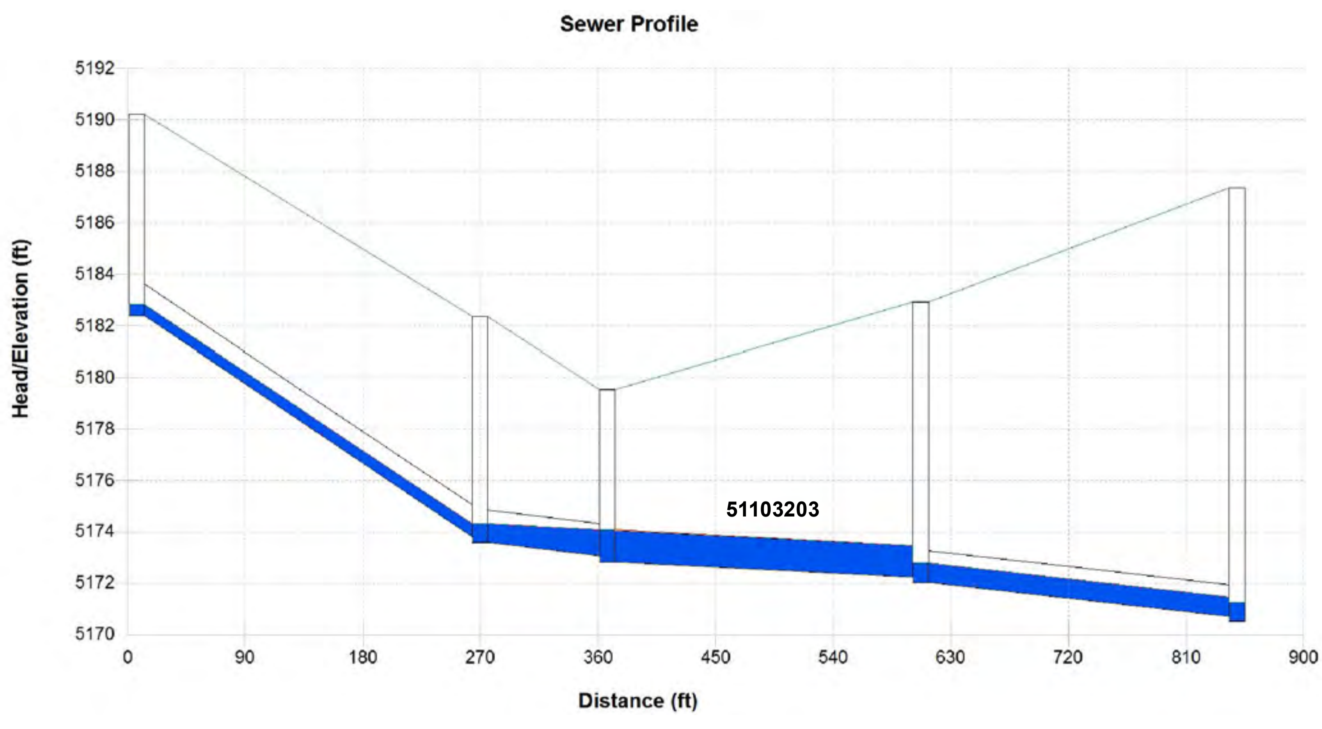
FIGURE B-4

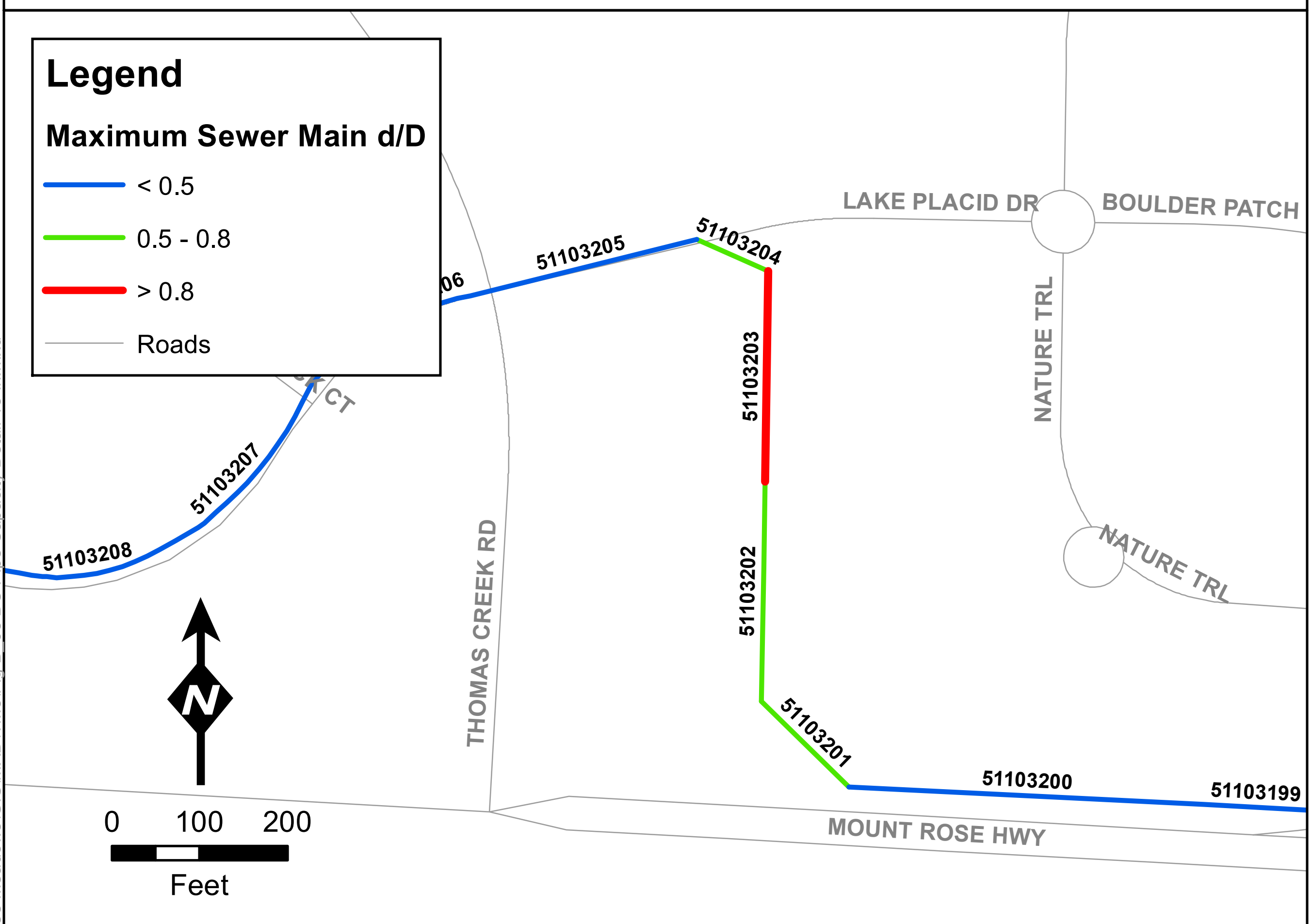
WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: December 01, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig B_04 BO Pipe Capacity Detail 18-in.mxd

carollo





SEWER MAIN PLAN AND PROFILE WITH d/D NEAR LAKE PLACID DR. AND THOMAS CREEK RD., BUILDOUT

FIGURE B-5

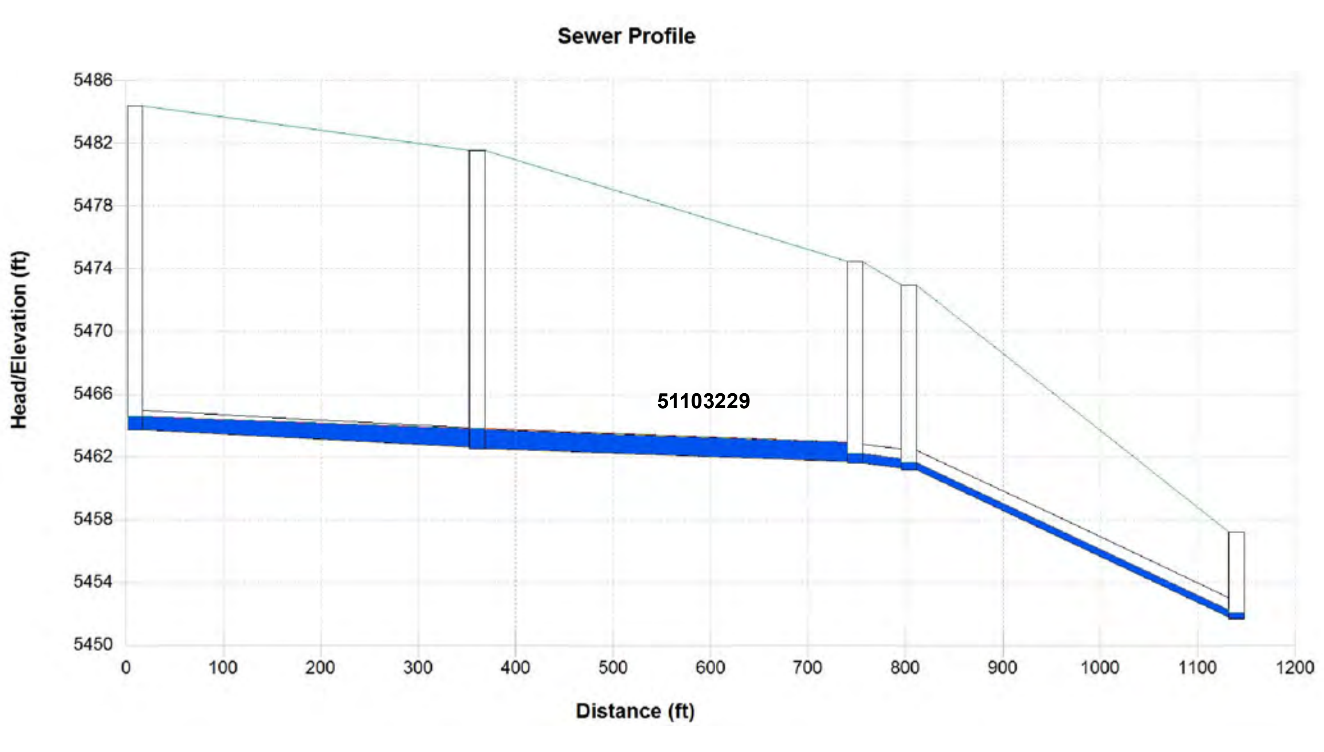
WASHOE COUNTY

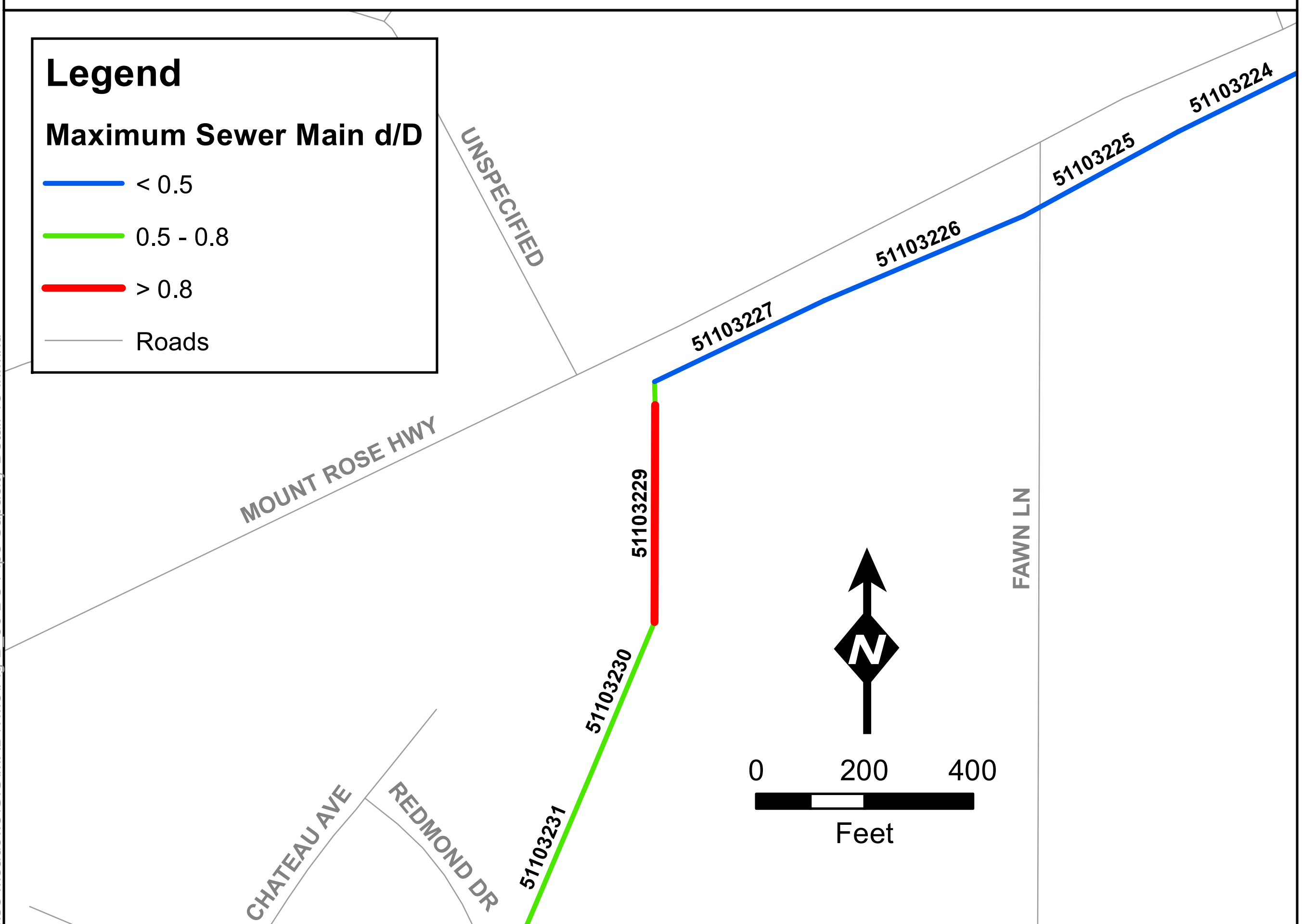
STMWRF FACILITY PLAN UPDATE

Date: December 01, 2015

File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig B_05 BO Pipe Capacity Detail 15-in.mxd

carollo





SEWER MAIN PLAN AND PROFILE WITH d/D NEAR MOUNT ROSE HWY AND FAWN LN, BUILDOUT

FIGURE B-6

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

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Date: December 01, 2015
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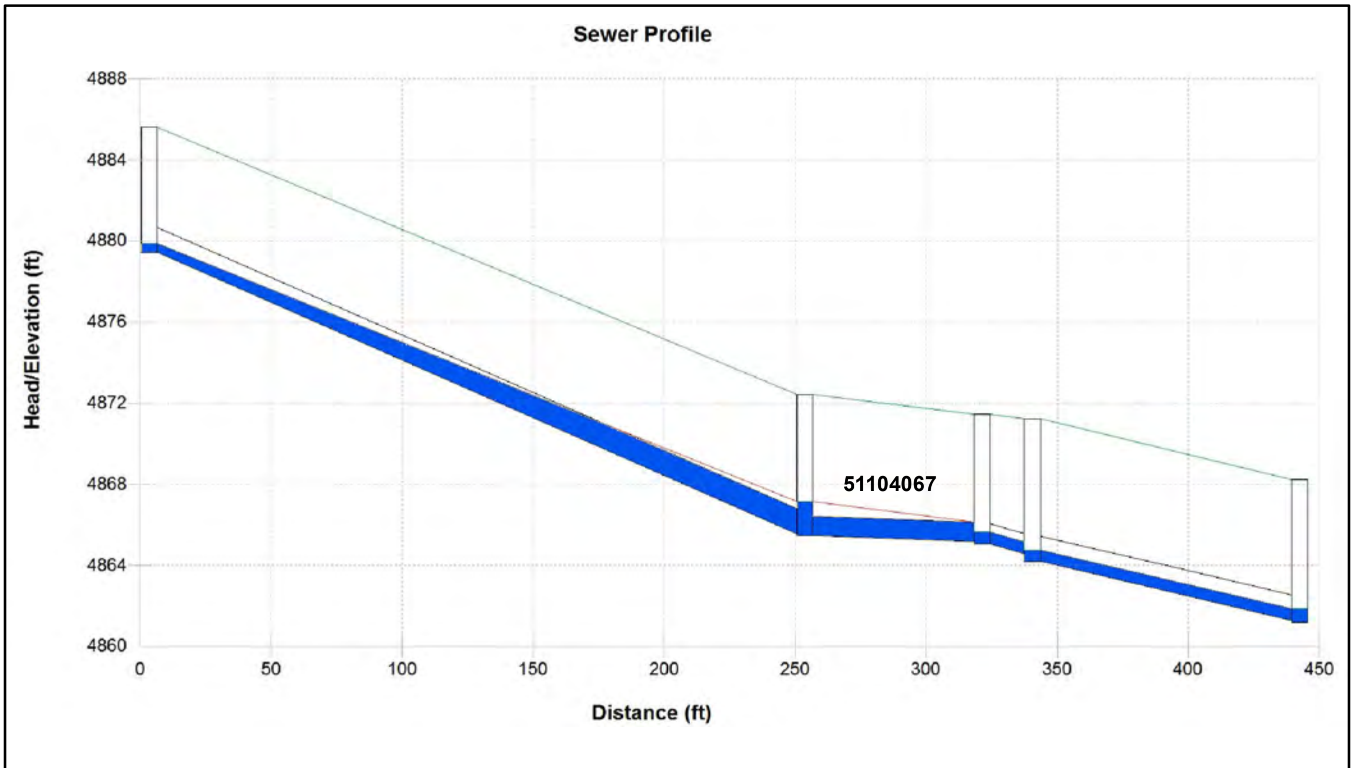
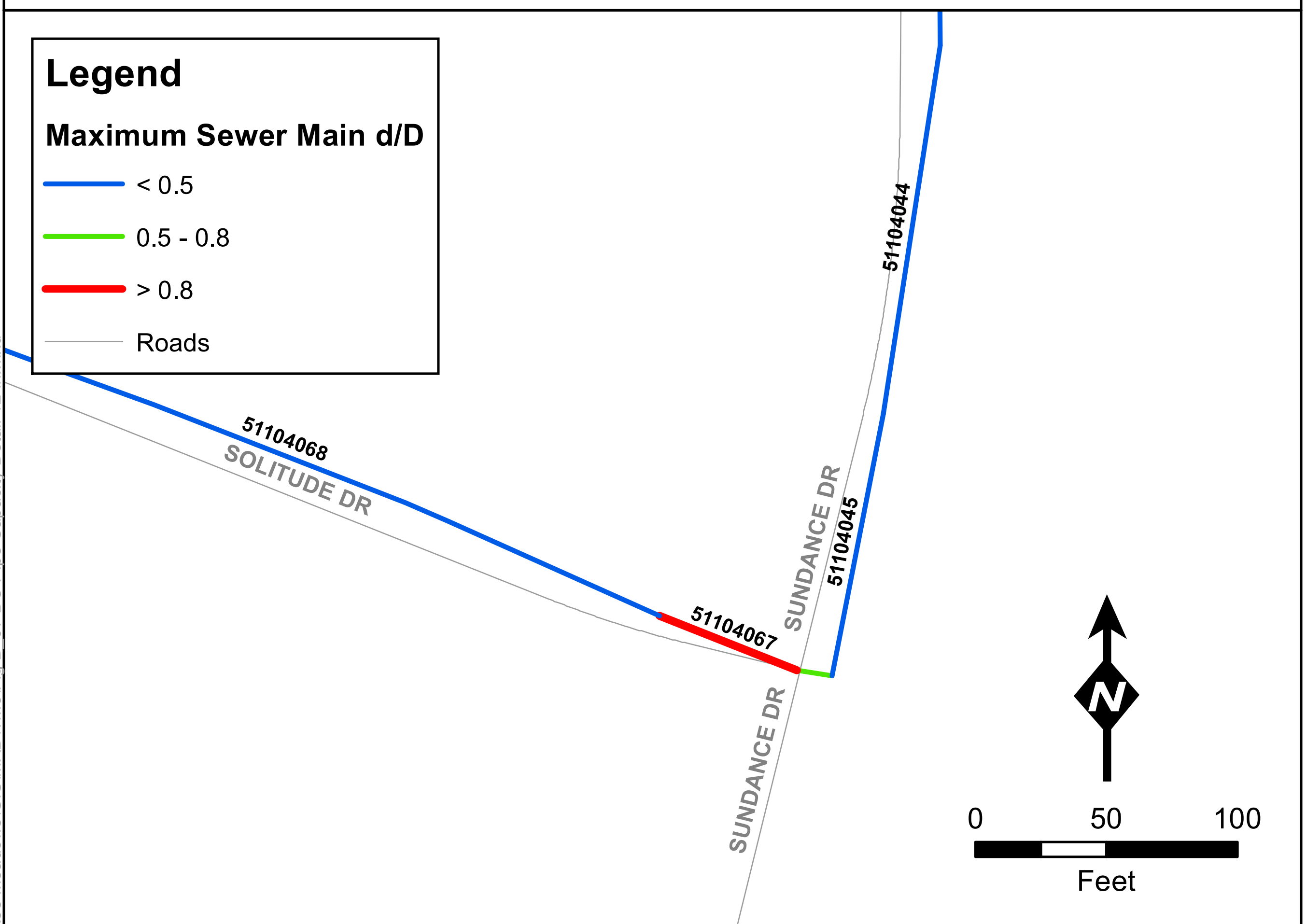




SEWER MAIN PLAN AND PROFILE WITH d/D AT SOLITUDE DR. AND SUNDANCER DR., BUILDOUT

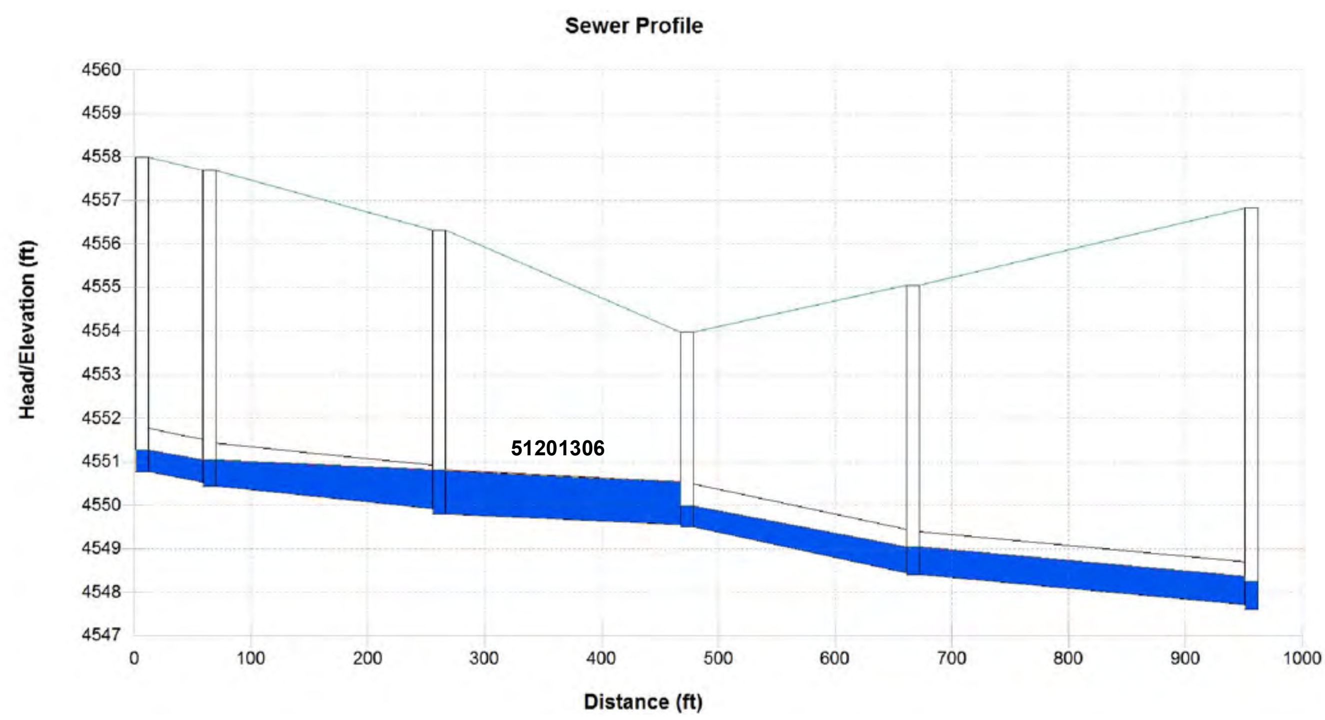
FIGURE B-7

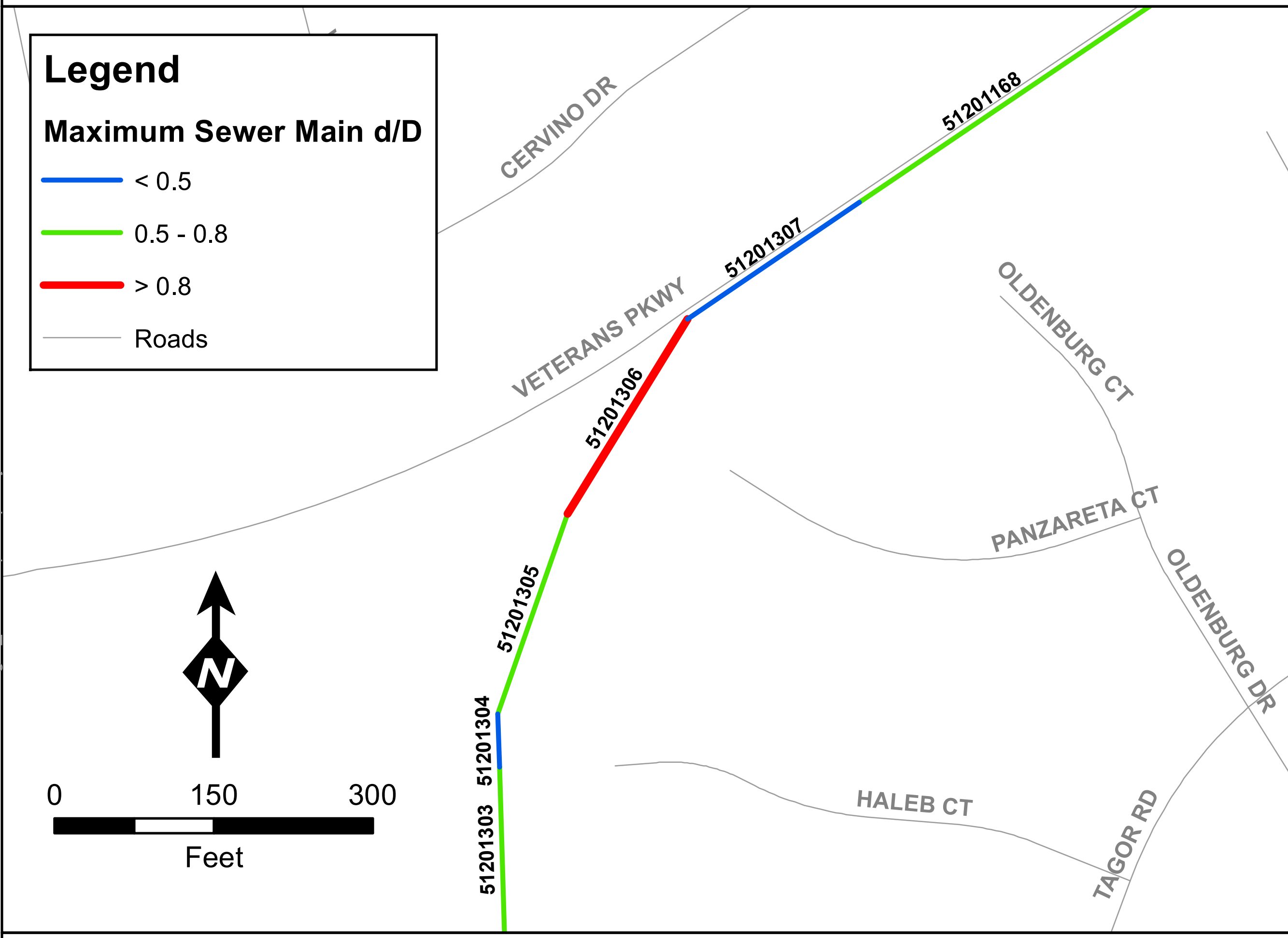
WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: December 01, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig B_07 BO Pipe Capacity Detail 12-in.mxd

carollo





SEWER MAIN PLAN AND PROFILE WITH d/D ON VERERANS PKWY NEAR PANZARETA CT., BUILDOUT

FIGURE B-8

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

Date: December 01, 2015
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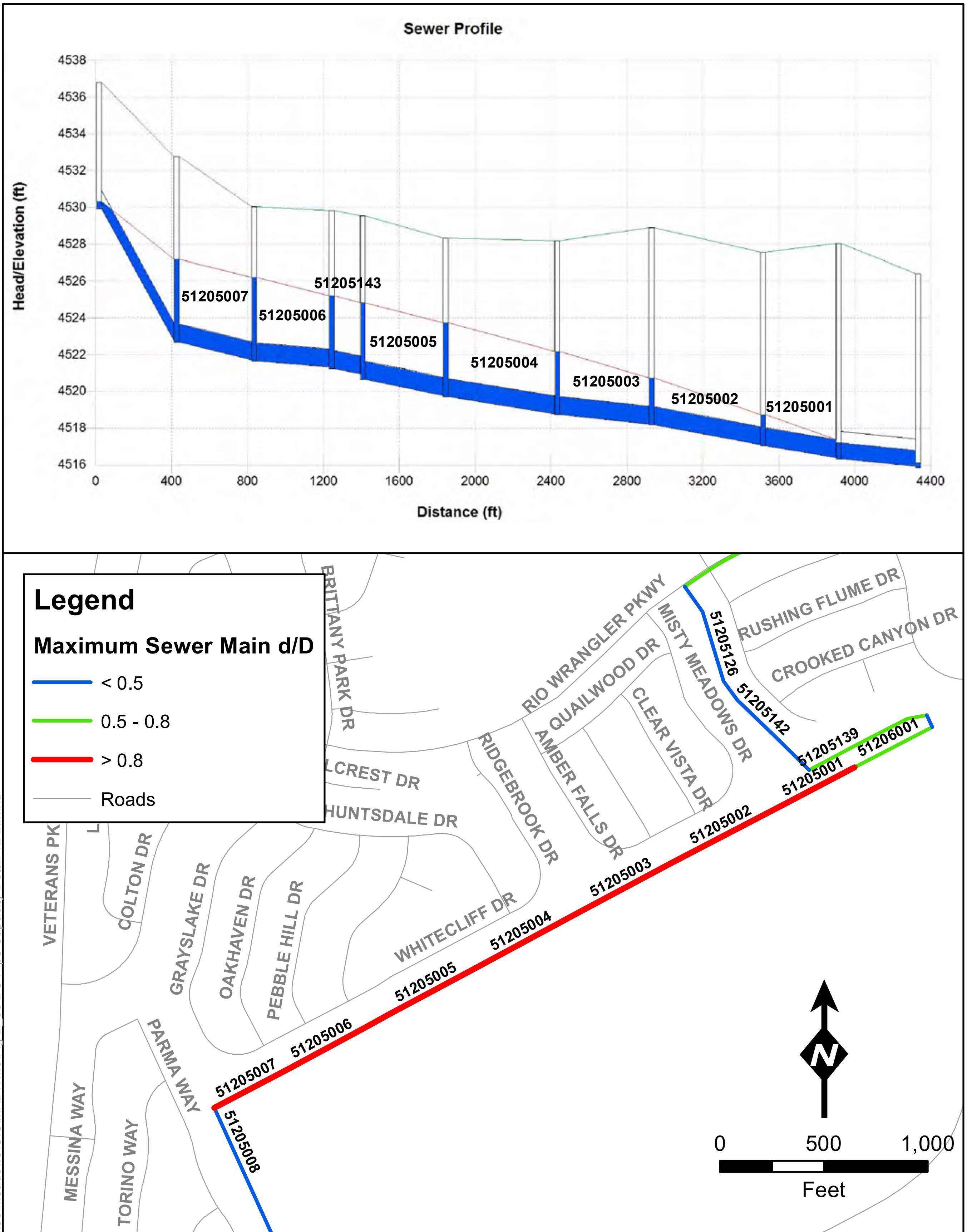

SEWER MAIN PLAN AND PROFILE WITH d/D NEAR WHITECLIFF DR. AND PARMA WAY, BUILDOUT

FIGURE B-9

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: December 01, 2015
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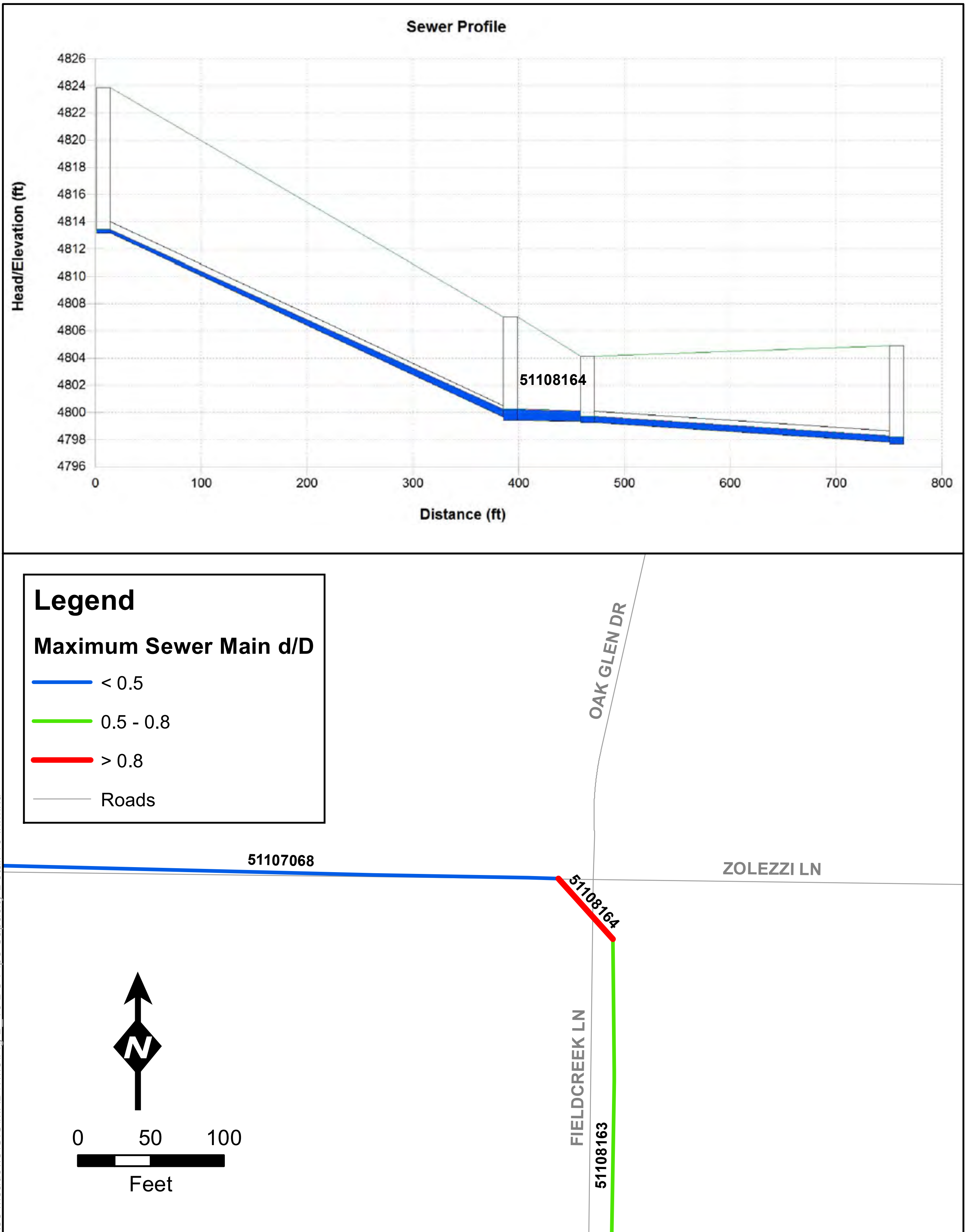

SEWER MAIN PLAN AND PROFILE WITH d/D ON OAK GLEN DR. AND ZOLEZZI LN., BUILDOUT

FIGURE B-10

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: December 01, 2015
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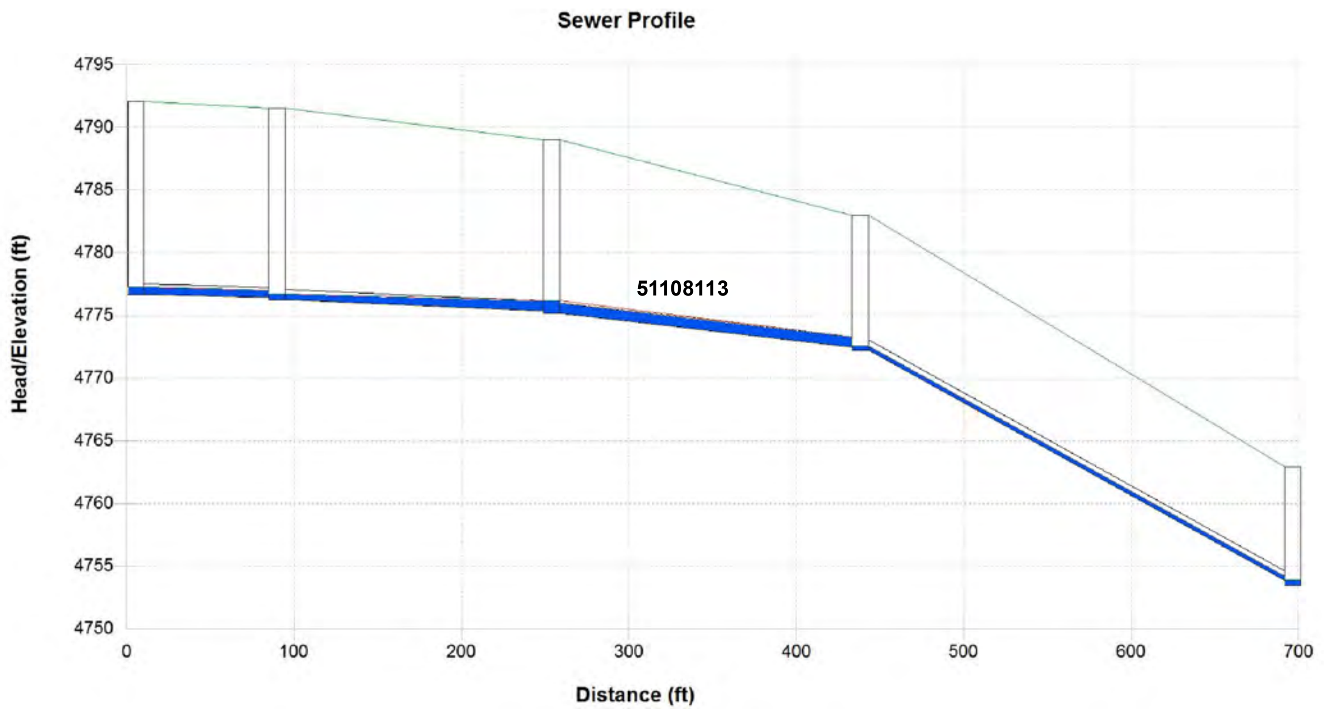

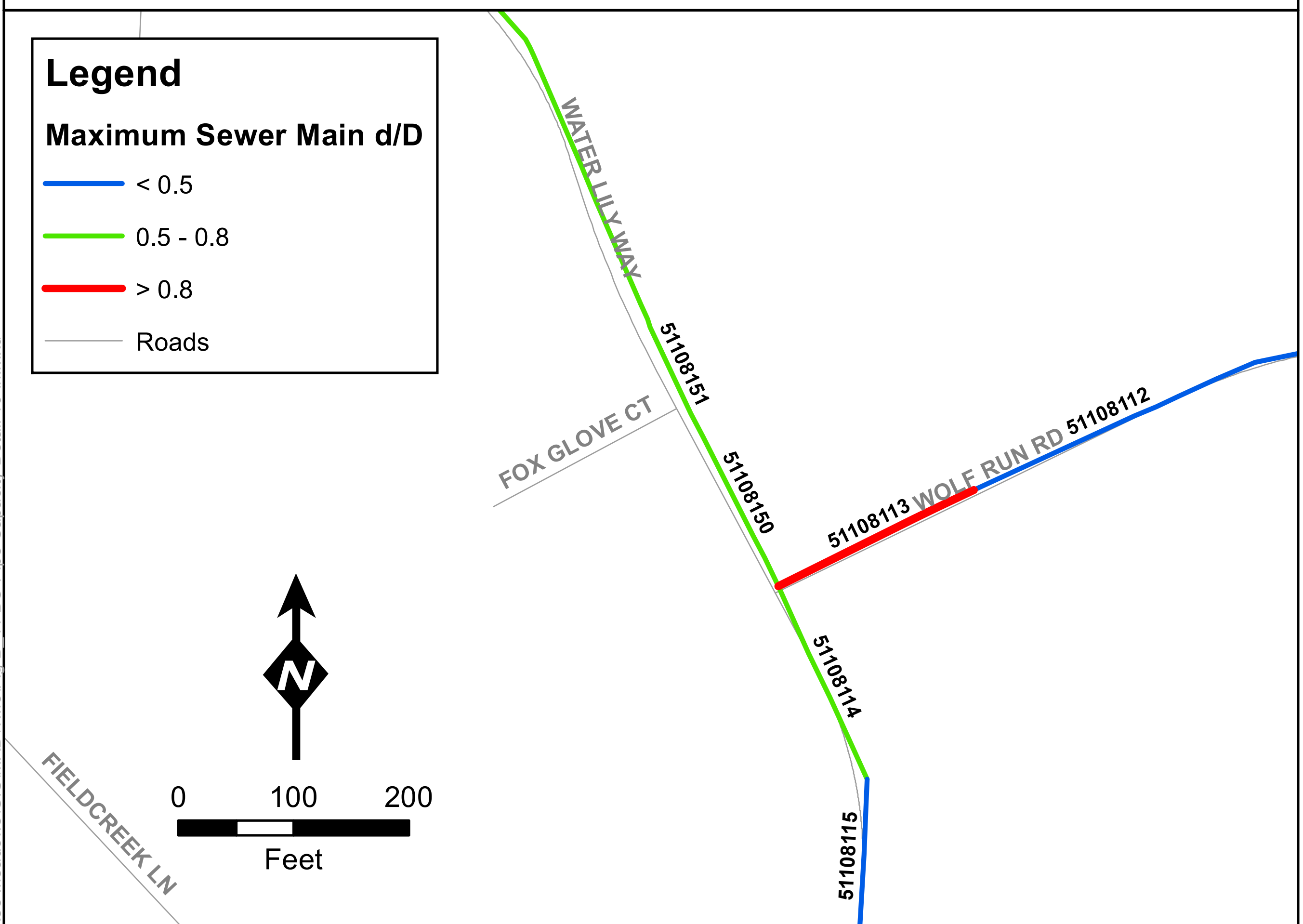

SEWER MAIN PLAN AND PROFILE WITH d/D ON WATER LILY WAY AND WOLF RUN RD., BUILDOUT

FIGURE B-11

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

Date: December 01, 2015
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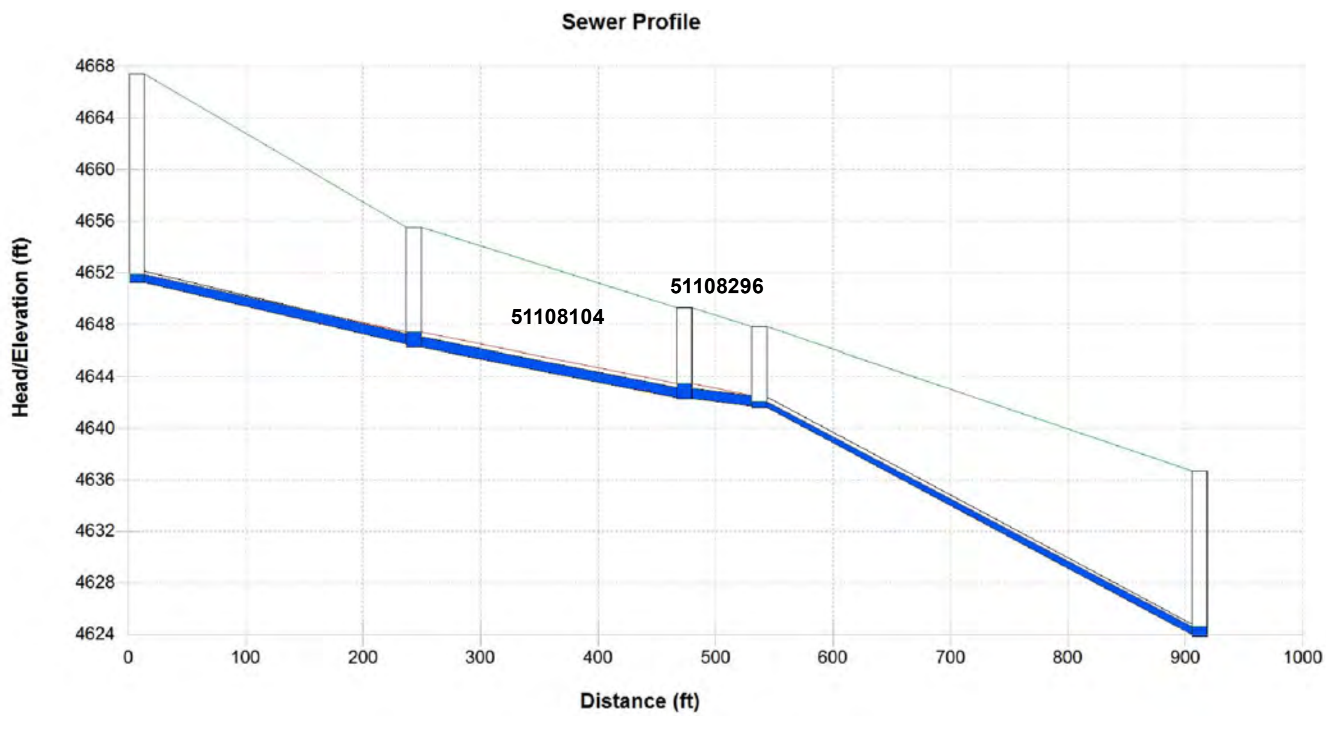
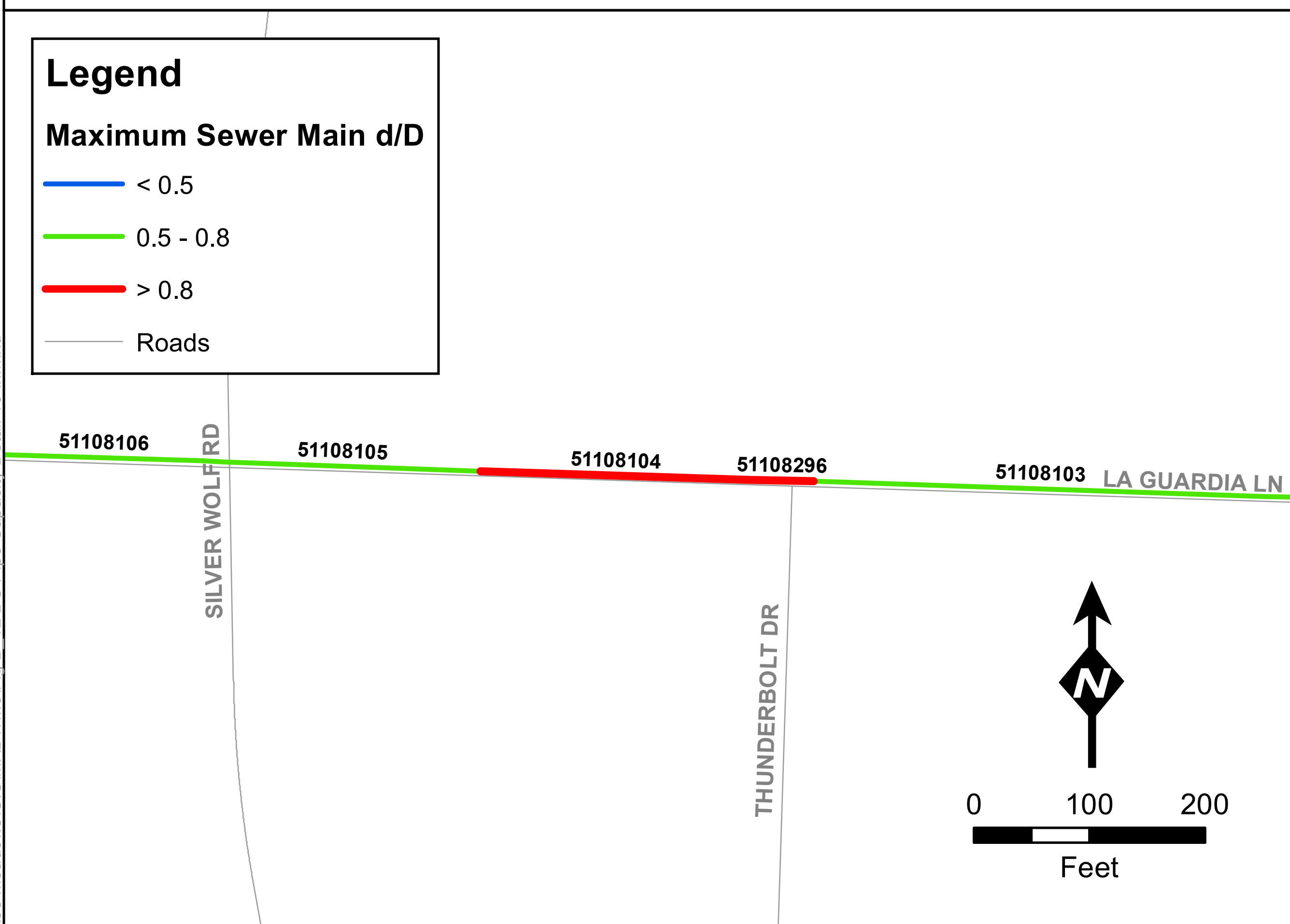




SEWER MAIN PLAN AND PROFILE WITH d/D ON LA GUARDIA LN. AND THUNDERBOLT DR., BUILDOUT

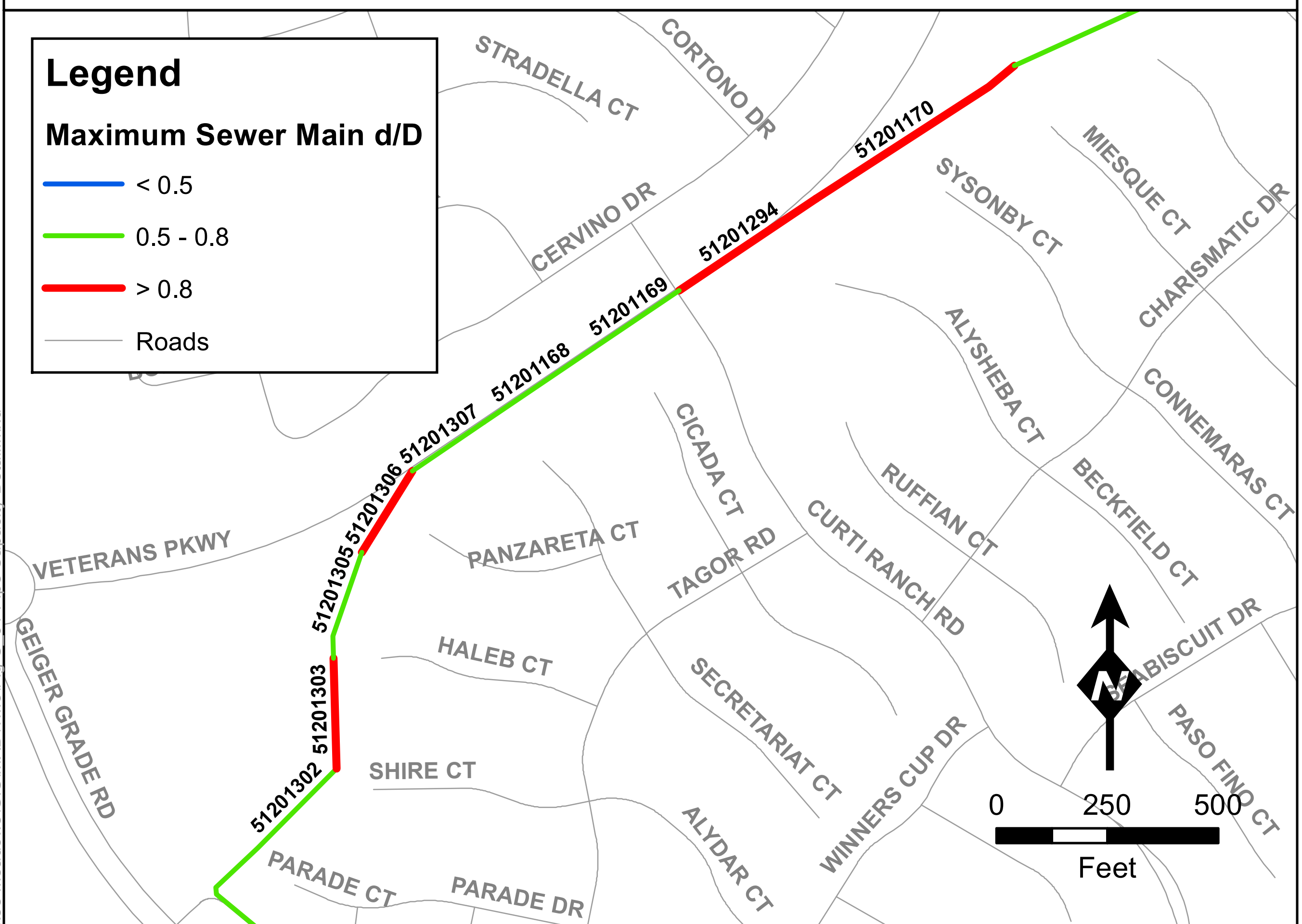
FIGURE B-12

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: December 01, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig B_12 BO Pipe Capacity Detail 10-in.mxd

APPENDIX C – PIPE SEGMENTS OUT OF CAPACITY - WET WEATHER, WITH INFILTRATION



SEWER MAIN PLAN AND PROFILE WITH d/D NEAR VETERANS PKWY AND CURTI RANCH RD, BUILDOUT

FIGURE C-1

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

Date: December 01, 2015
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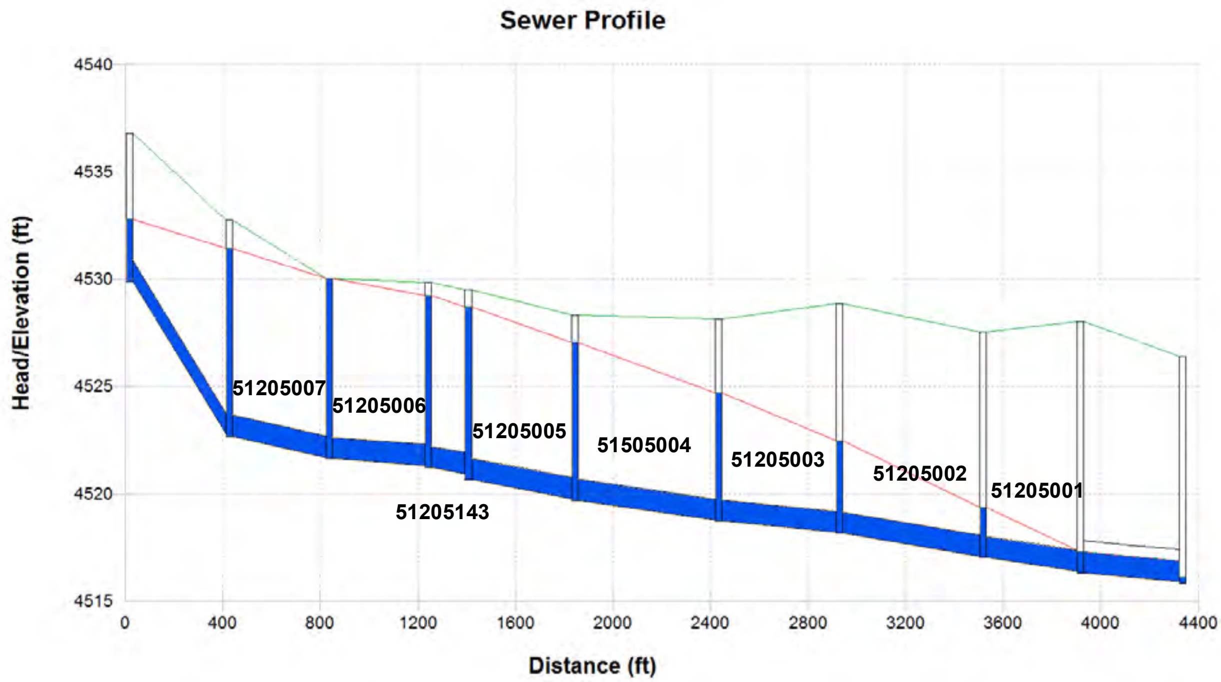

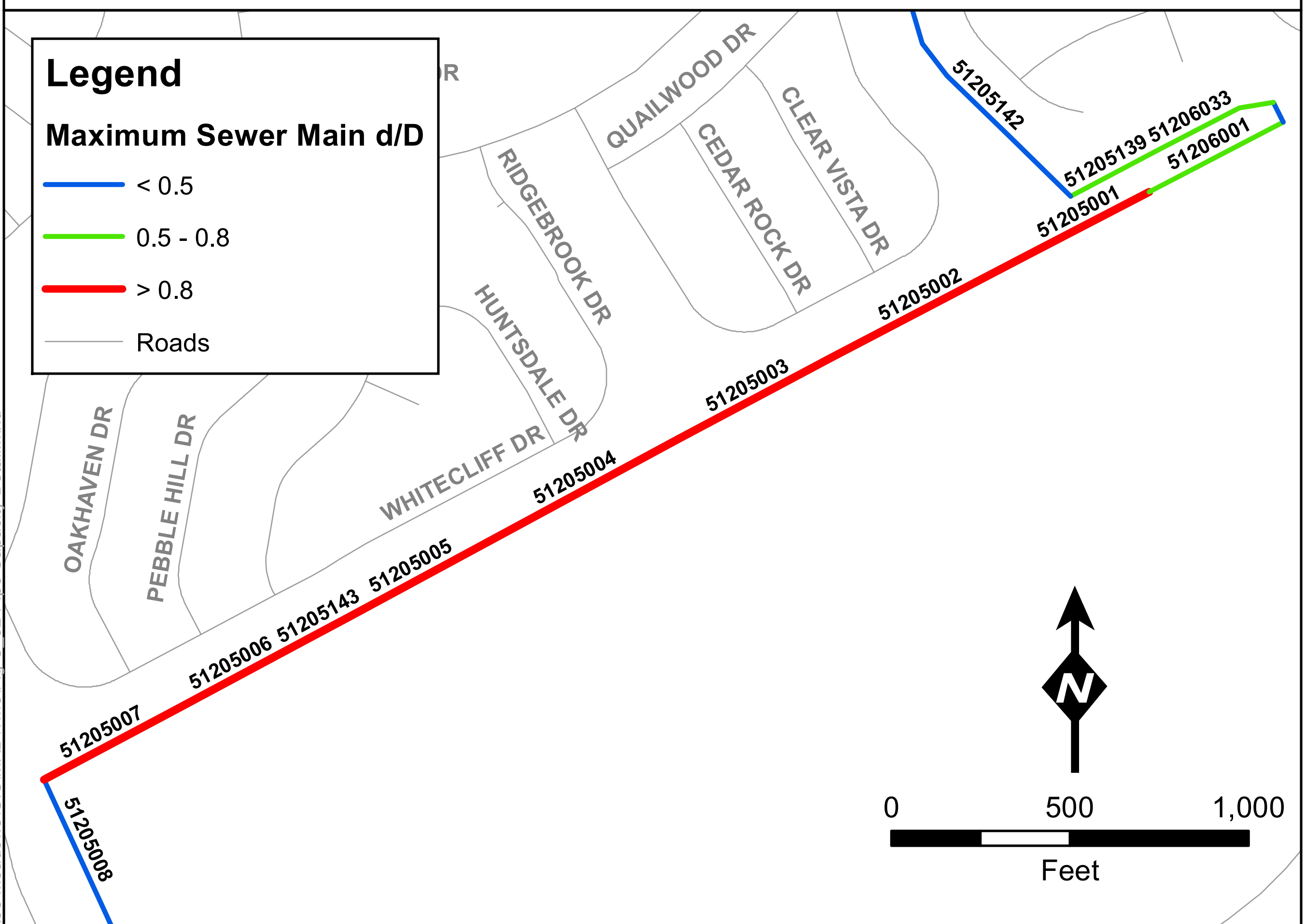

SEWER MAIN PLAN AND PROFILE WITH d/D NEAR WHITECLIFF DR. AND PARMA WAY, BUILDOUT

FIGURE C-2

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

Date: December 01, 2015
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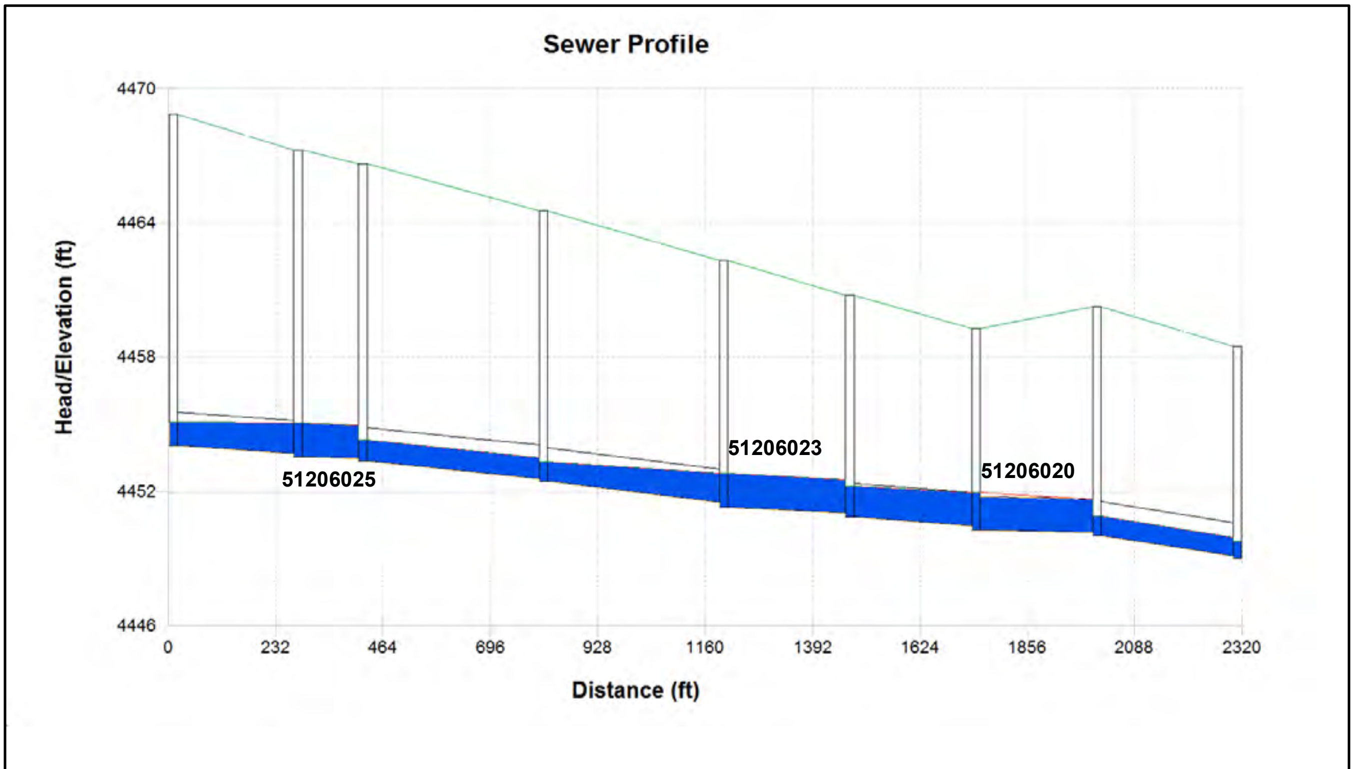

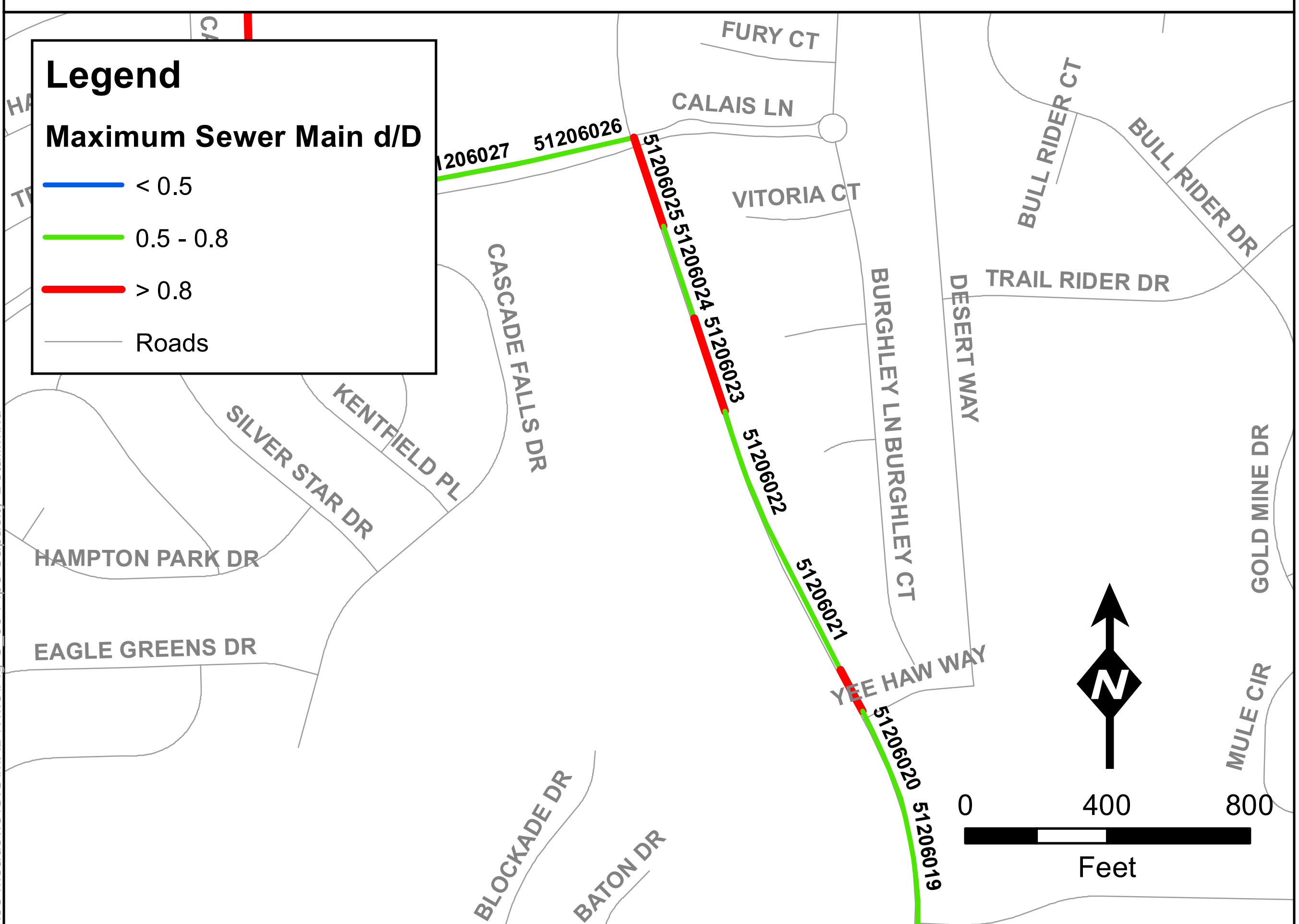

SEWER MAIN PLAN AND PROFILE WIT H d/D NEAR RIO WRANGLER PKWY AND YE E HAW WAY, BUILDOUT

FIGURE C-3

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: December 01, 2015
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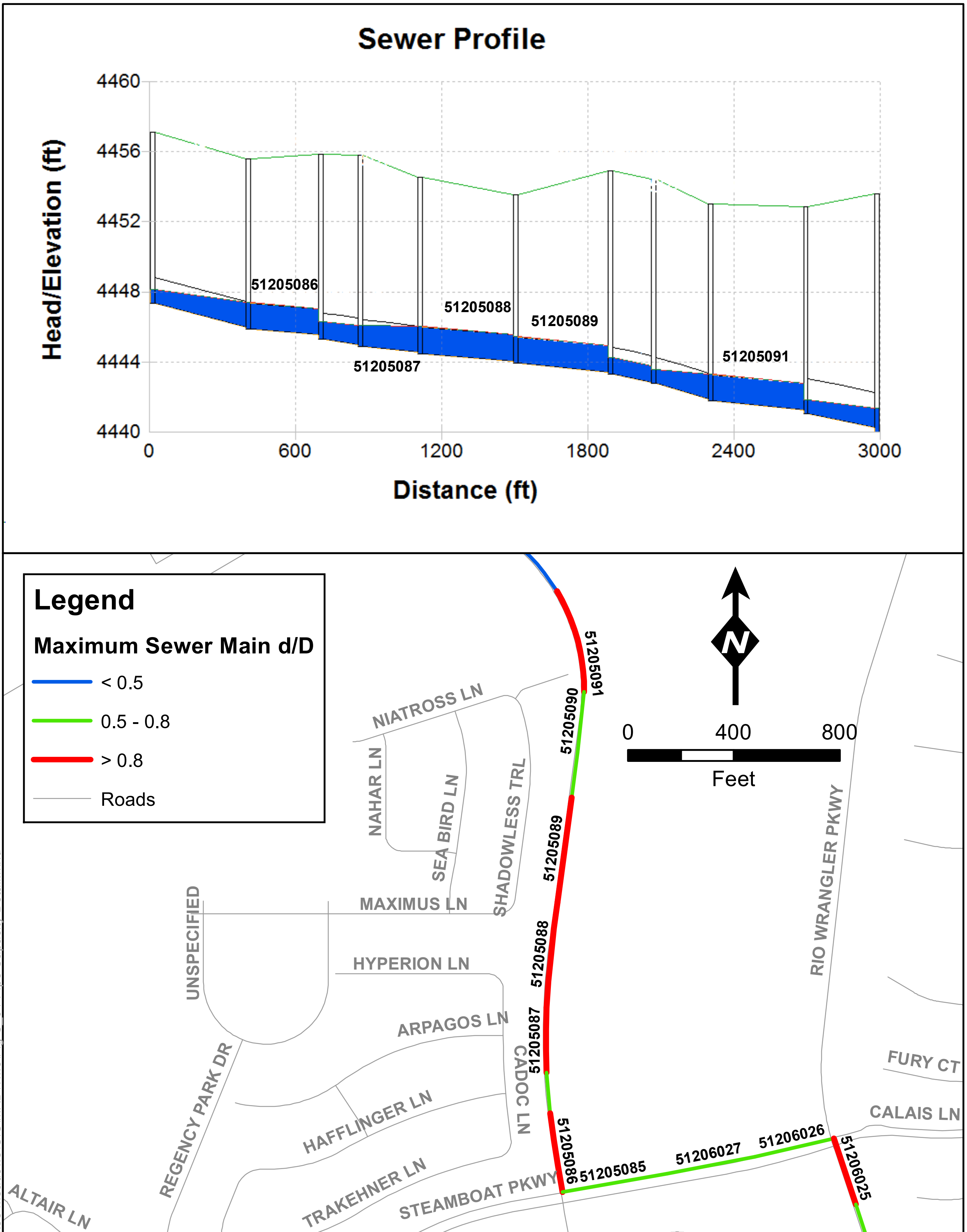

SEWER MAIN PLAN AND PROFILE WITH d/D NEAR CARAT AVE. AND STEAMBOAT PKWY., BUILDOUT

FIGURE C-4

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: December 01, 2015
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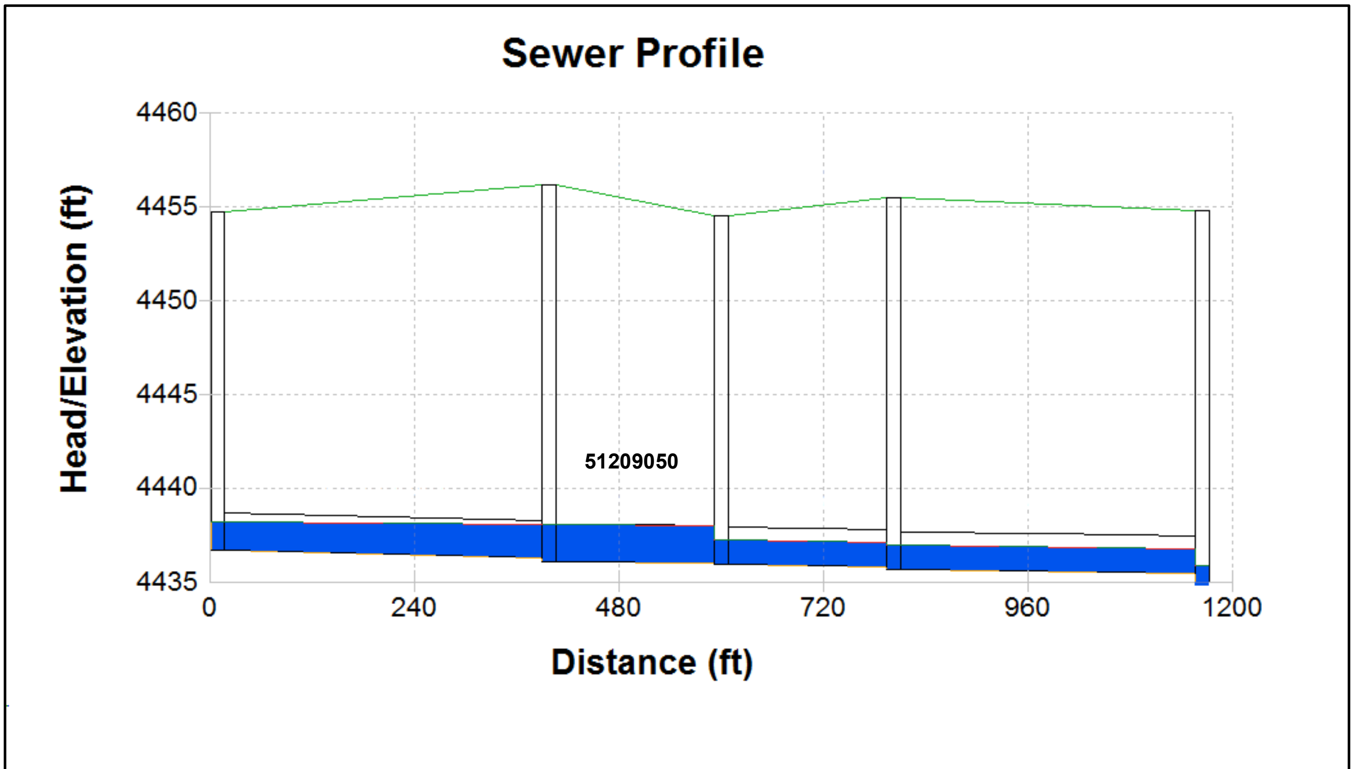

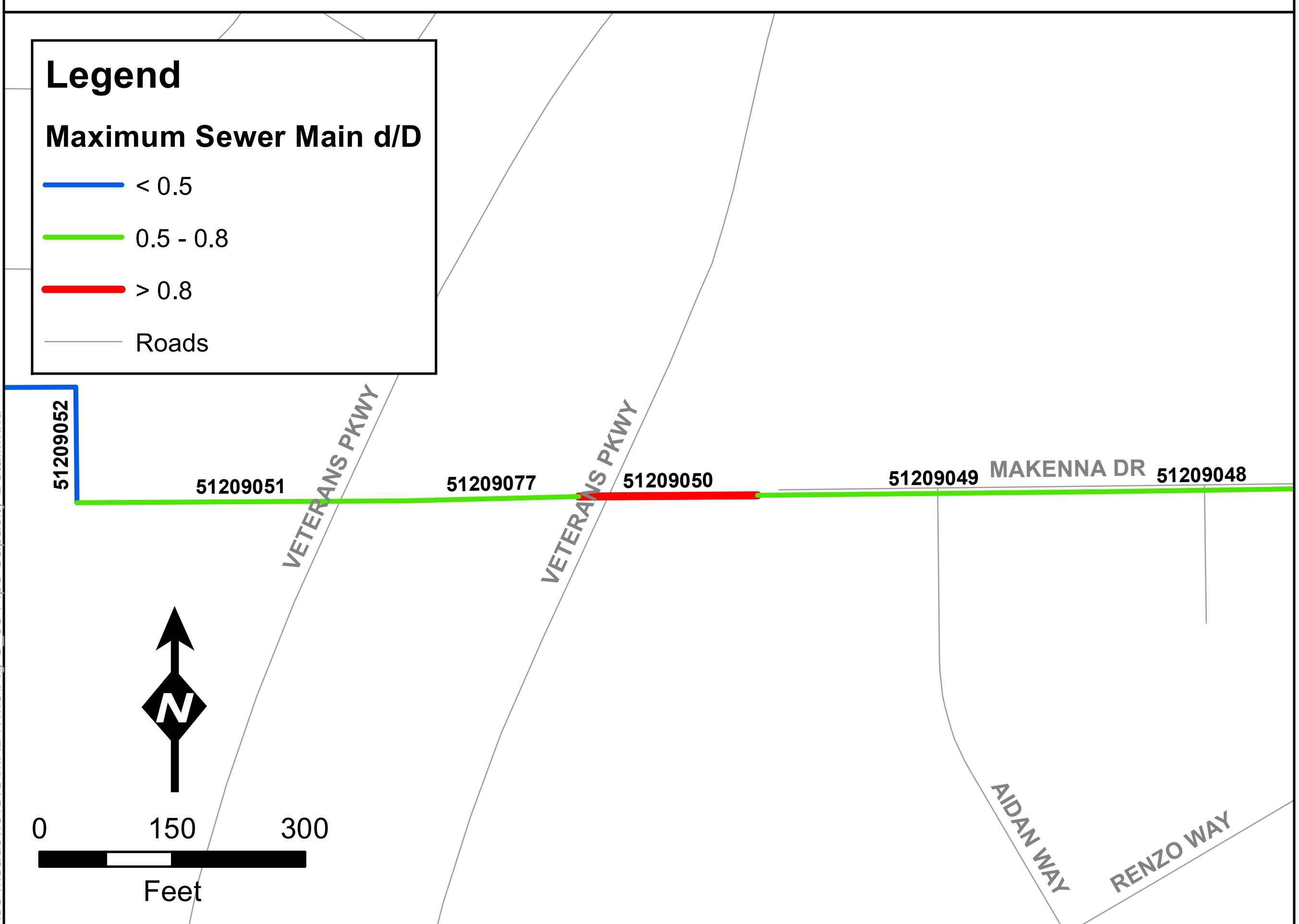

SEWER MAIN PLAN AND PROFILE WITH d/D NEAR MAKENNA DR. AND VETERANS PKWY., BUILDOUT

FIGURE C-5

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

Date: December 01, 2015
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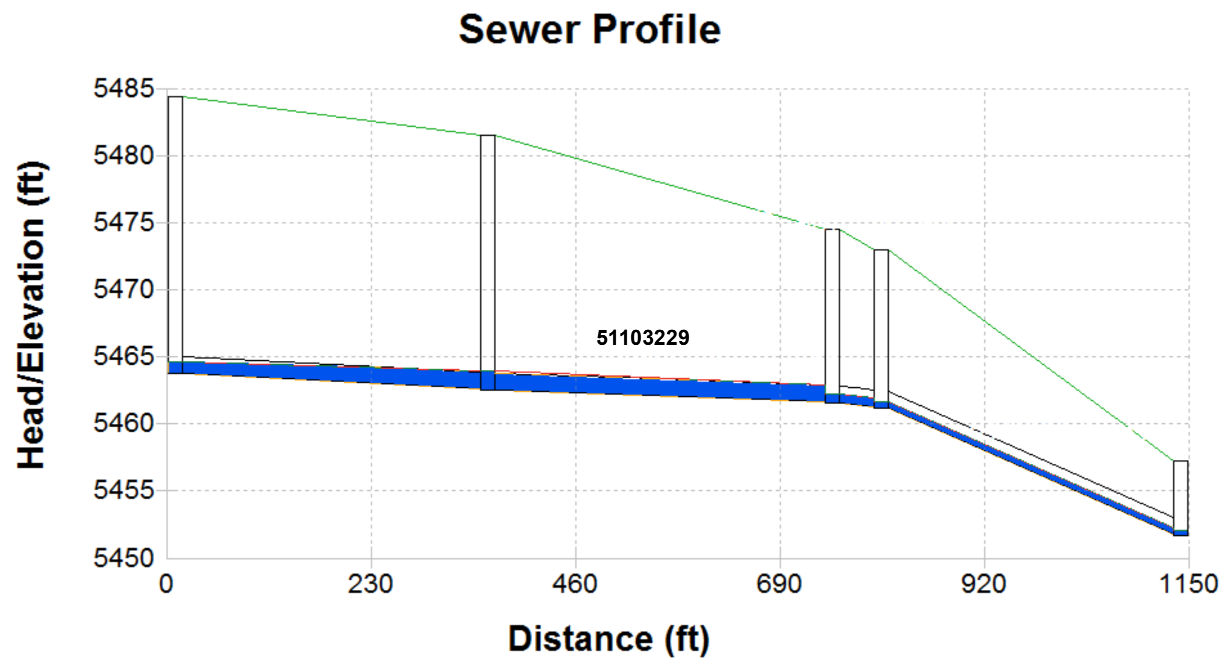

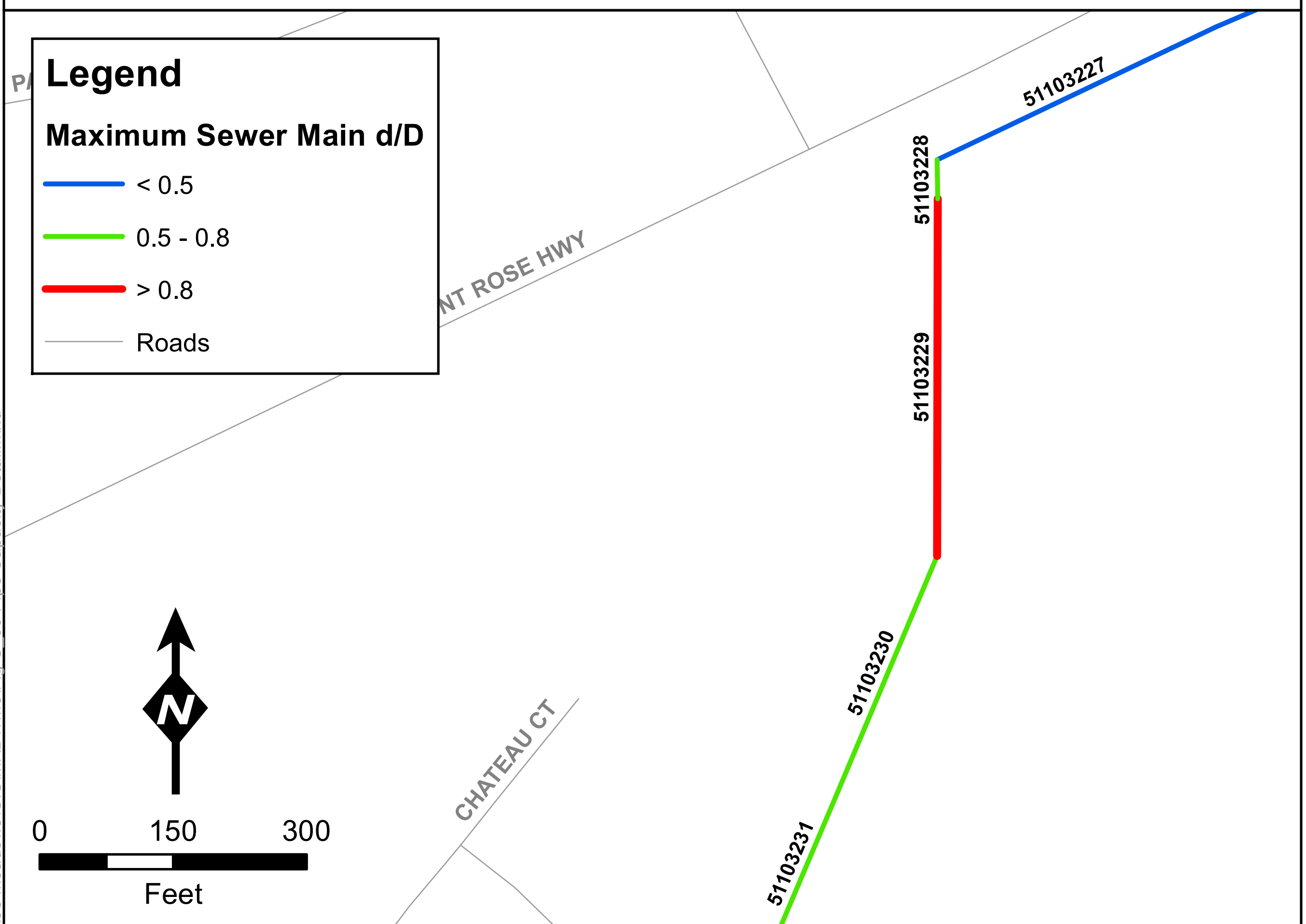

SEWER MAIN PLAN AND PROFILE WITH d/D NEAR MOUNT ROSE HWY. AND MOUNTAIN RANCH RD., BUILDOUT

FIGURE C-6

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: December 01, 2015
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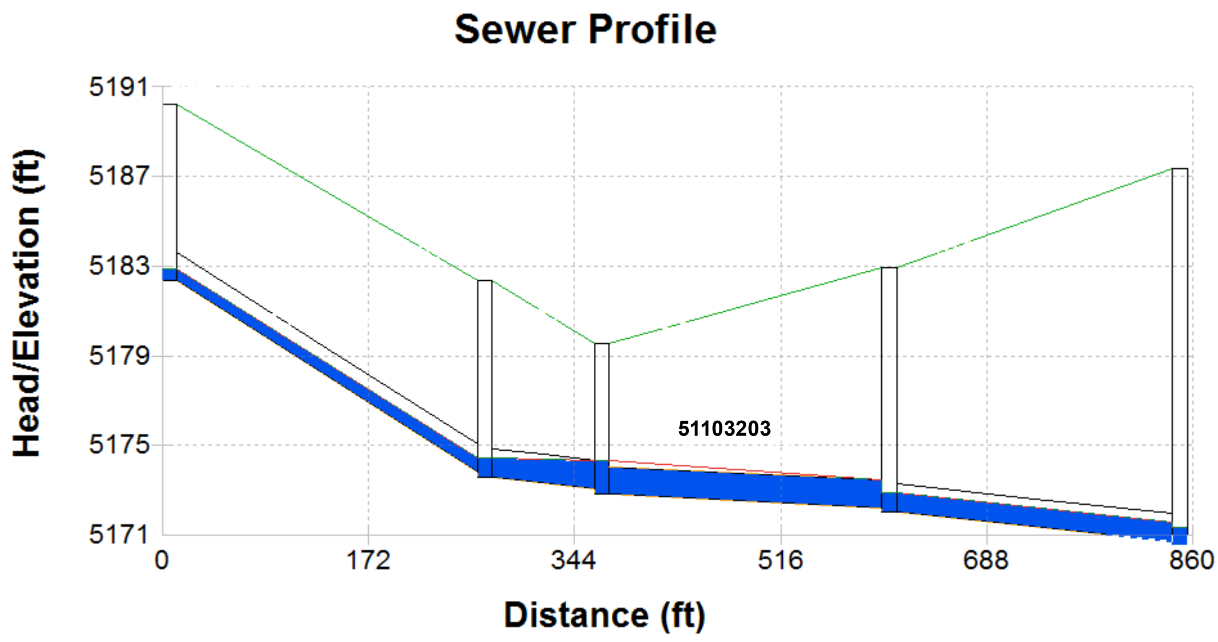
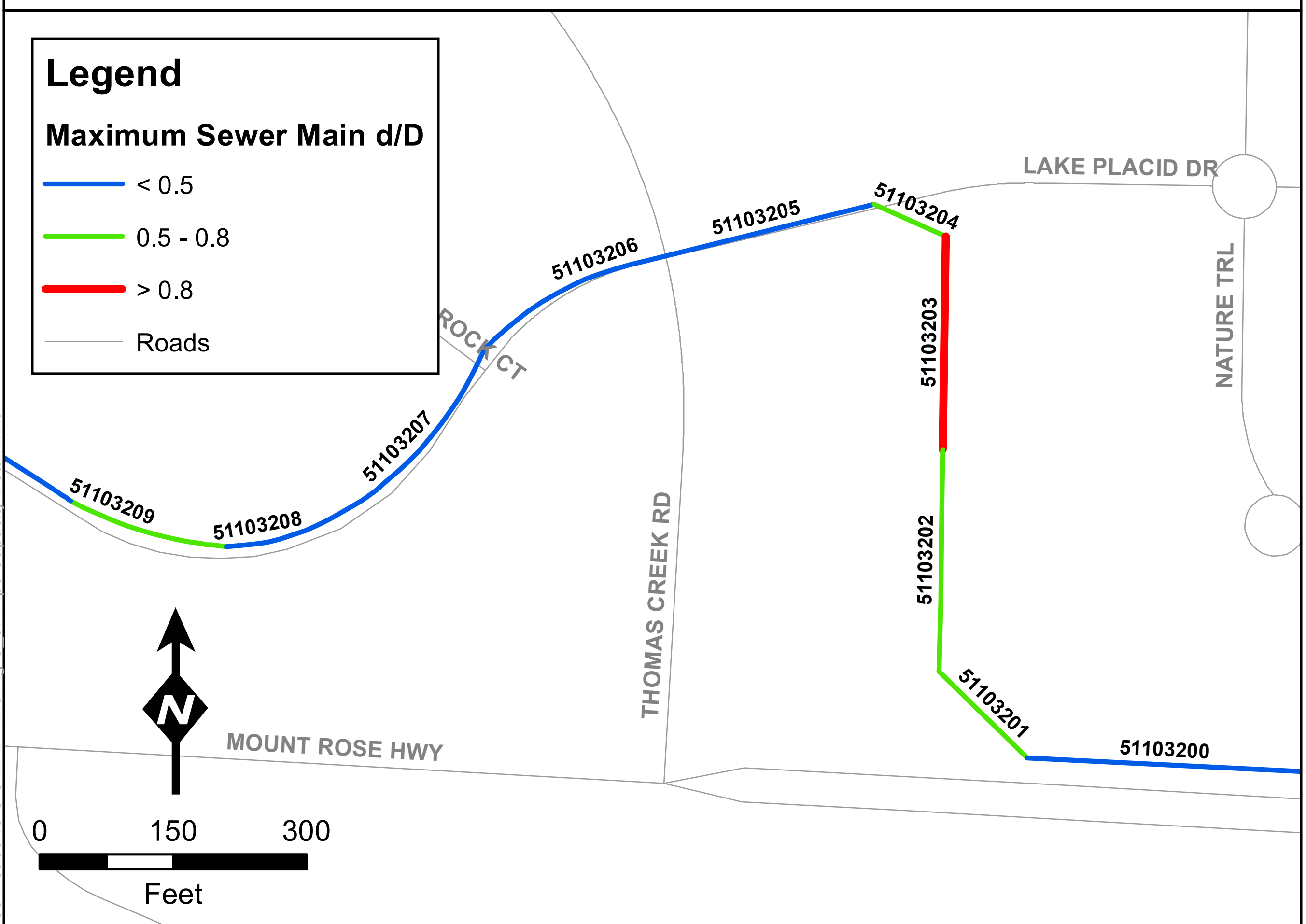




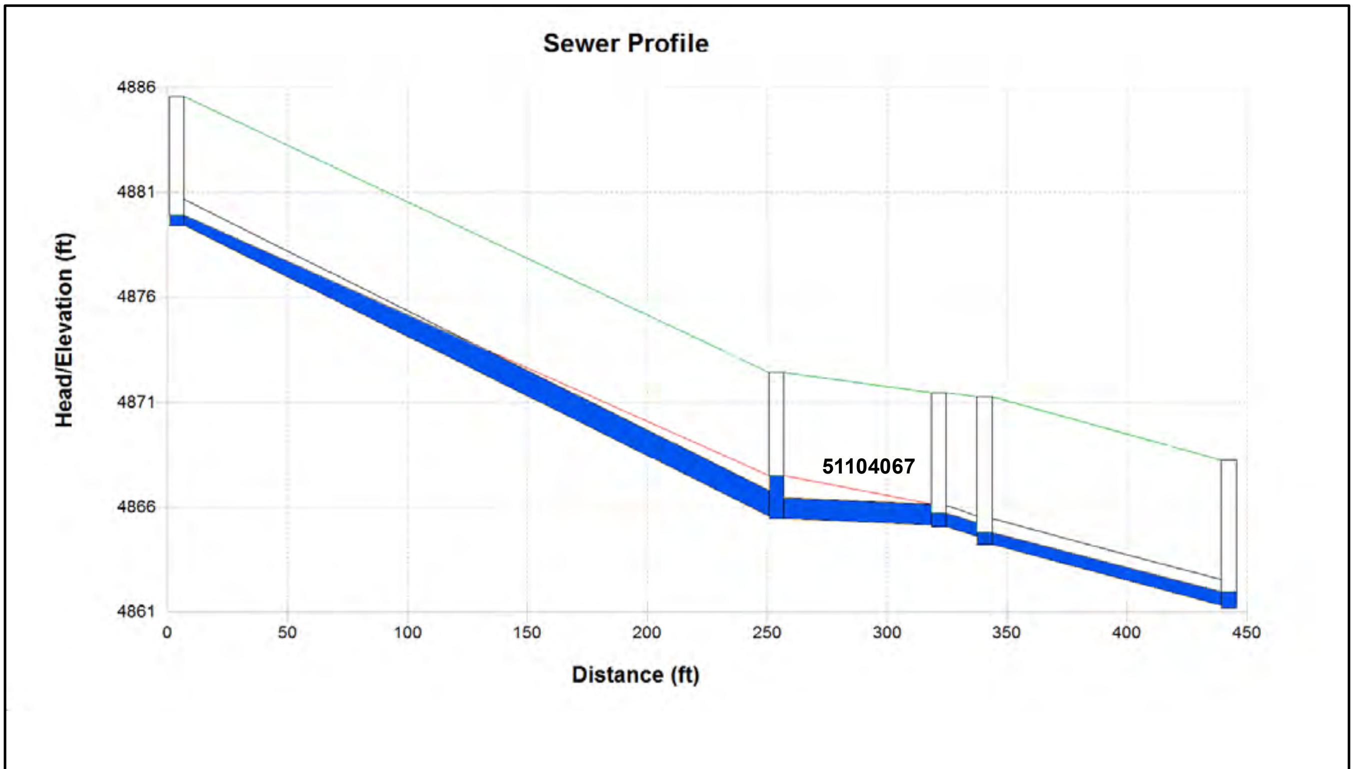
SEWER MAIN PLAN AND PROFILE WITH d/D NEAR LAKE PLACID DR. AND NATURE TRL., BUILDOUT

FIGURE C-7

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: December 01, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig C_07 Pipe Capacity Detail.mxd



SEWER MAIN PLAN AND PROFILE WITH d/D NEAR SOLITUDE DR. AND SUNDANCE DR., BUILDOUT

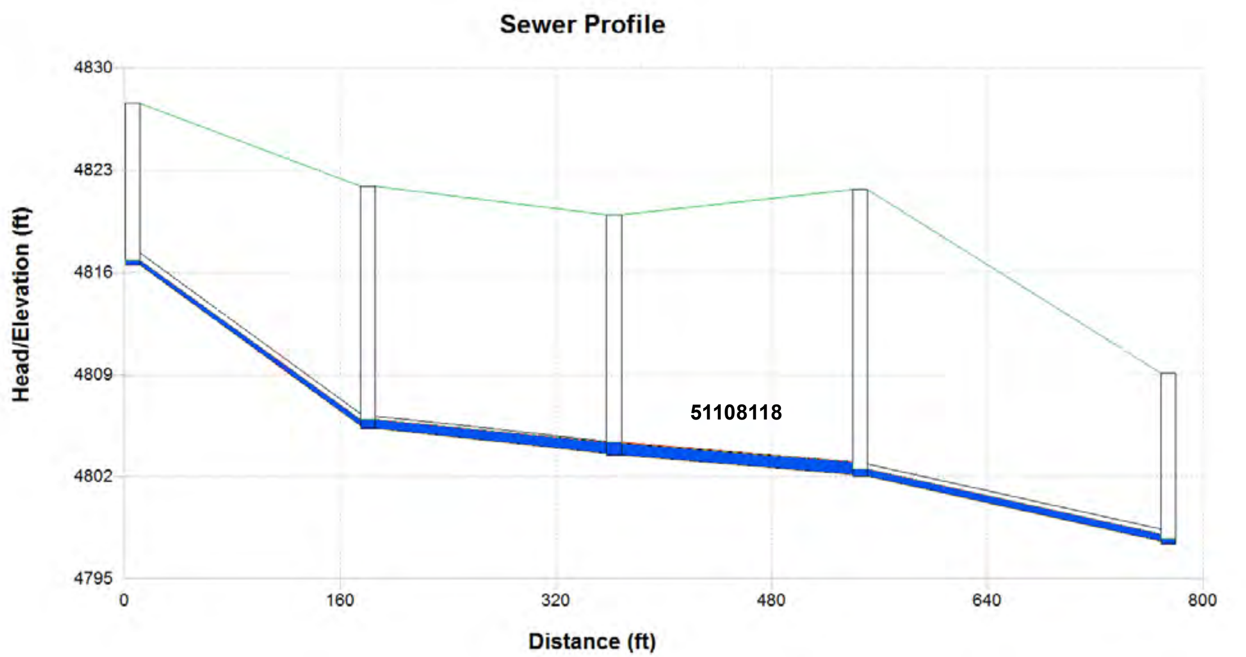
FIGURE C-8

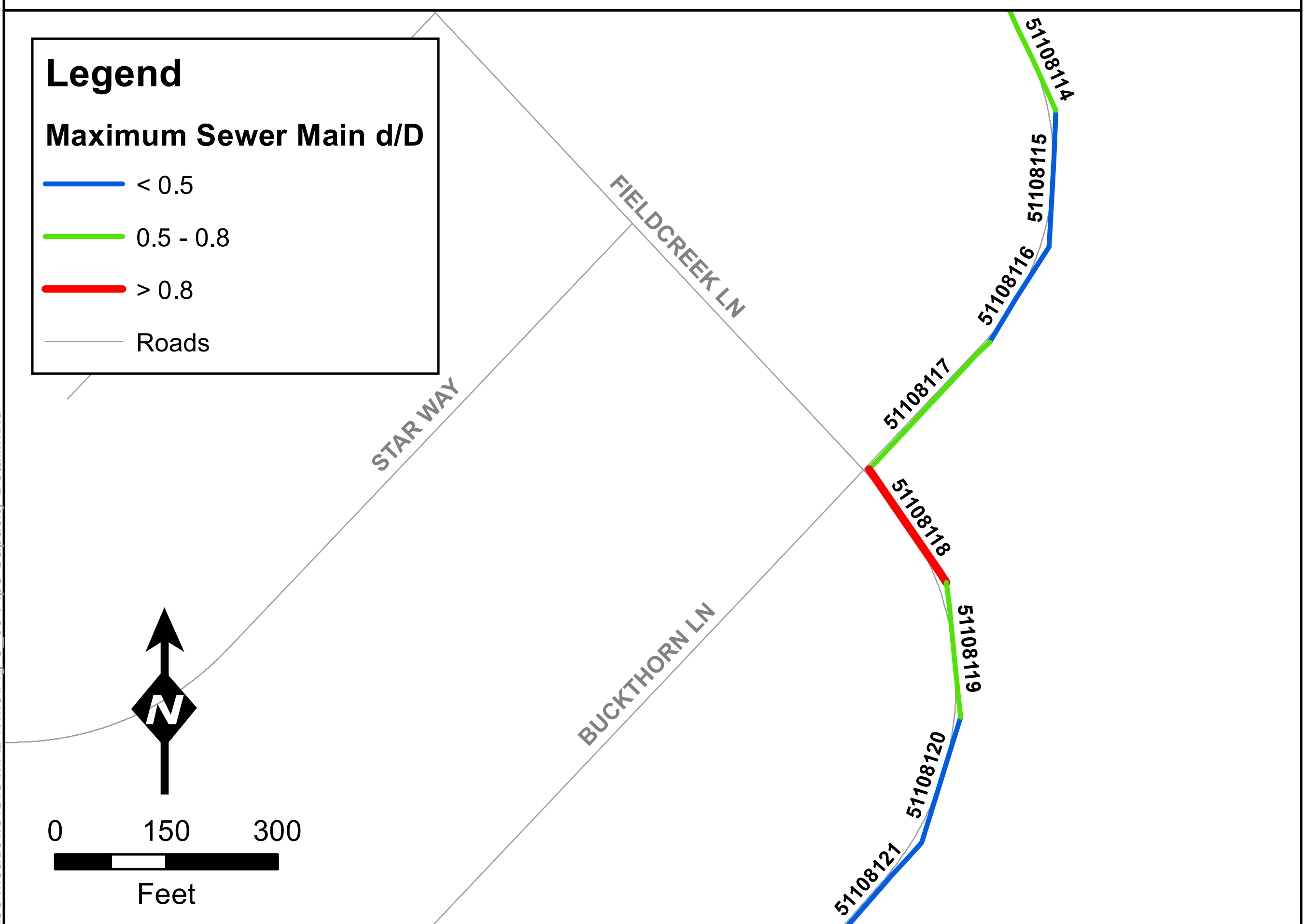
WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

Date: December 01, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig C_08 Pipe Capacity Detail.mxd





SEWER MAIN PLAN AND PROFILE WITH d/D NEAR FIELDCREEK LN. AND BUCKTHORN LN., BUILDOUT

FIGURE C-9

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

Date: December 01, 2015
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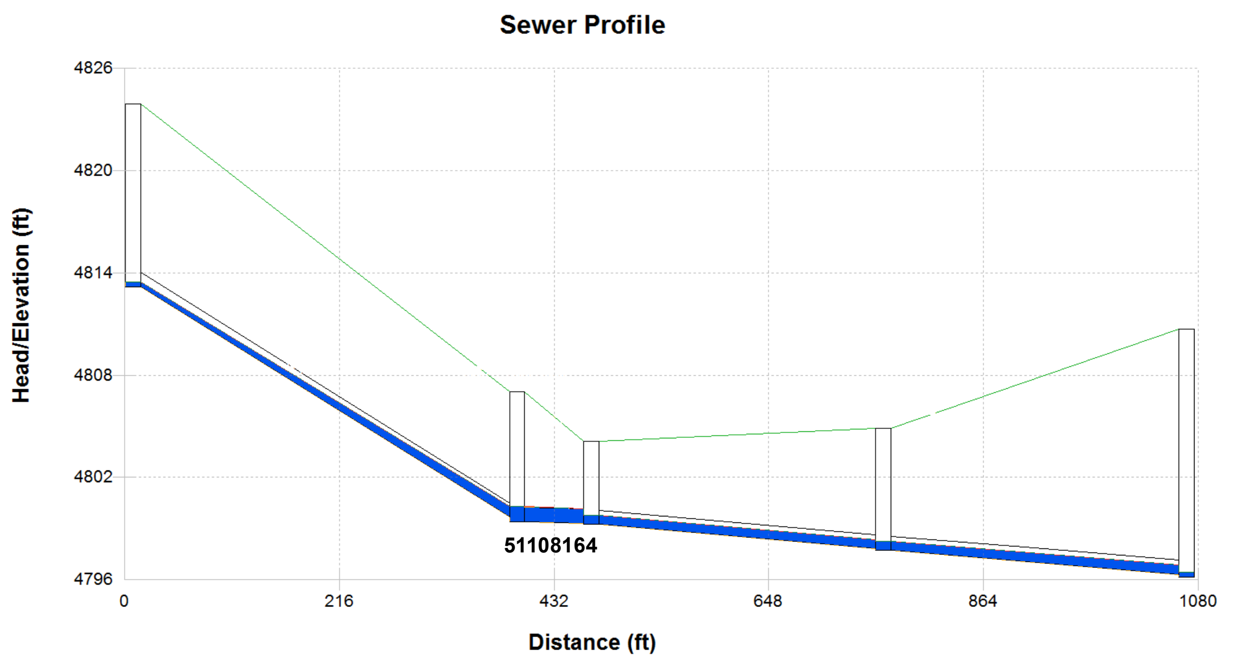
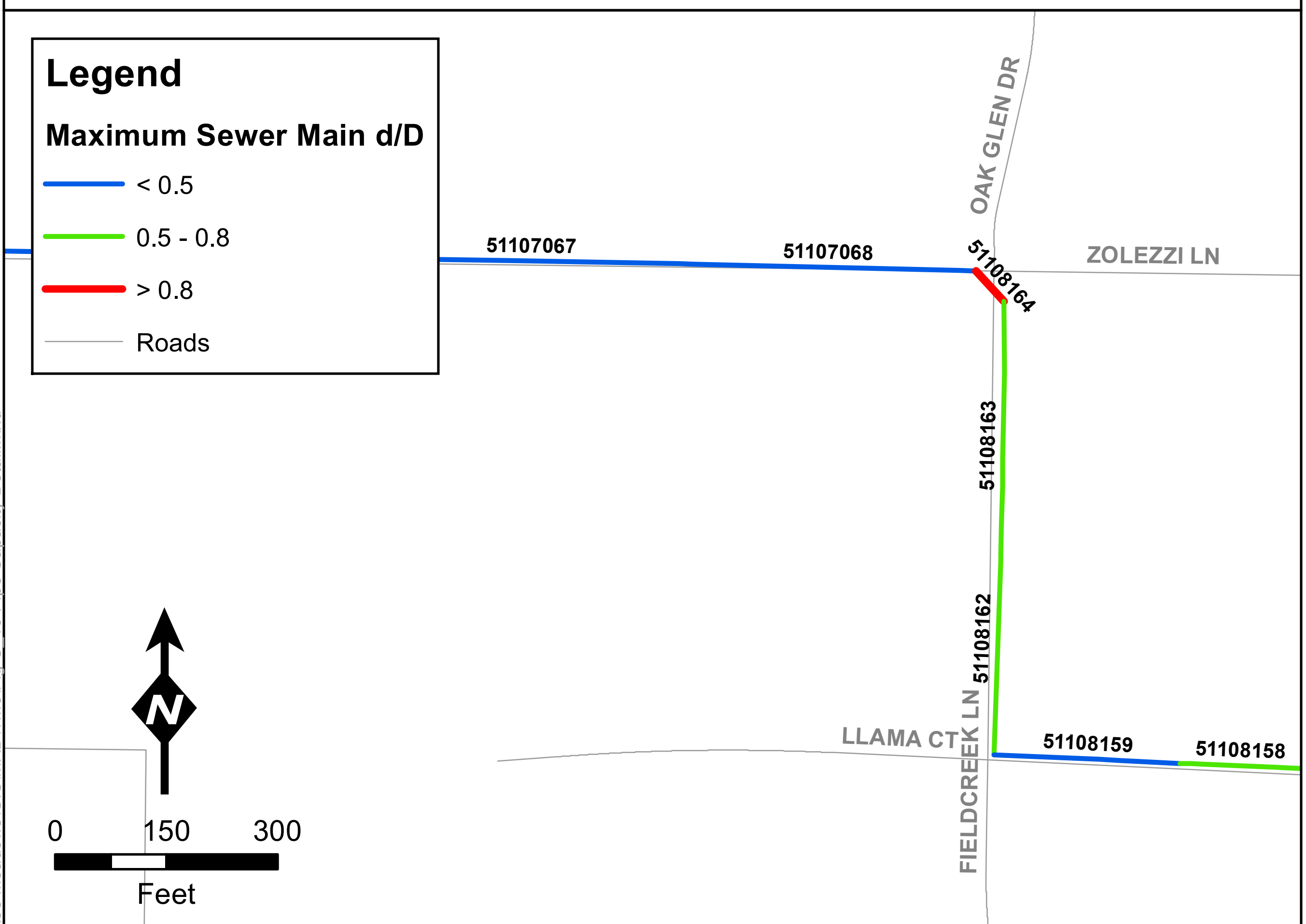




SEWER MAIN PLAN AND PROFILE WITH d/D NEAR ZOLEZZI LN. AND OAK GLEN DR., BUILDOUT

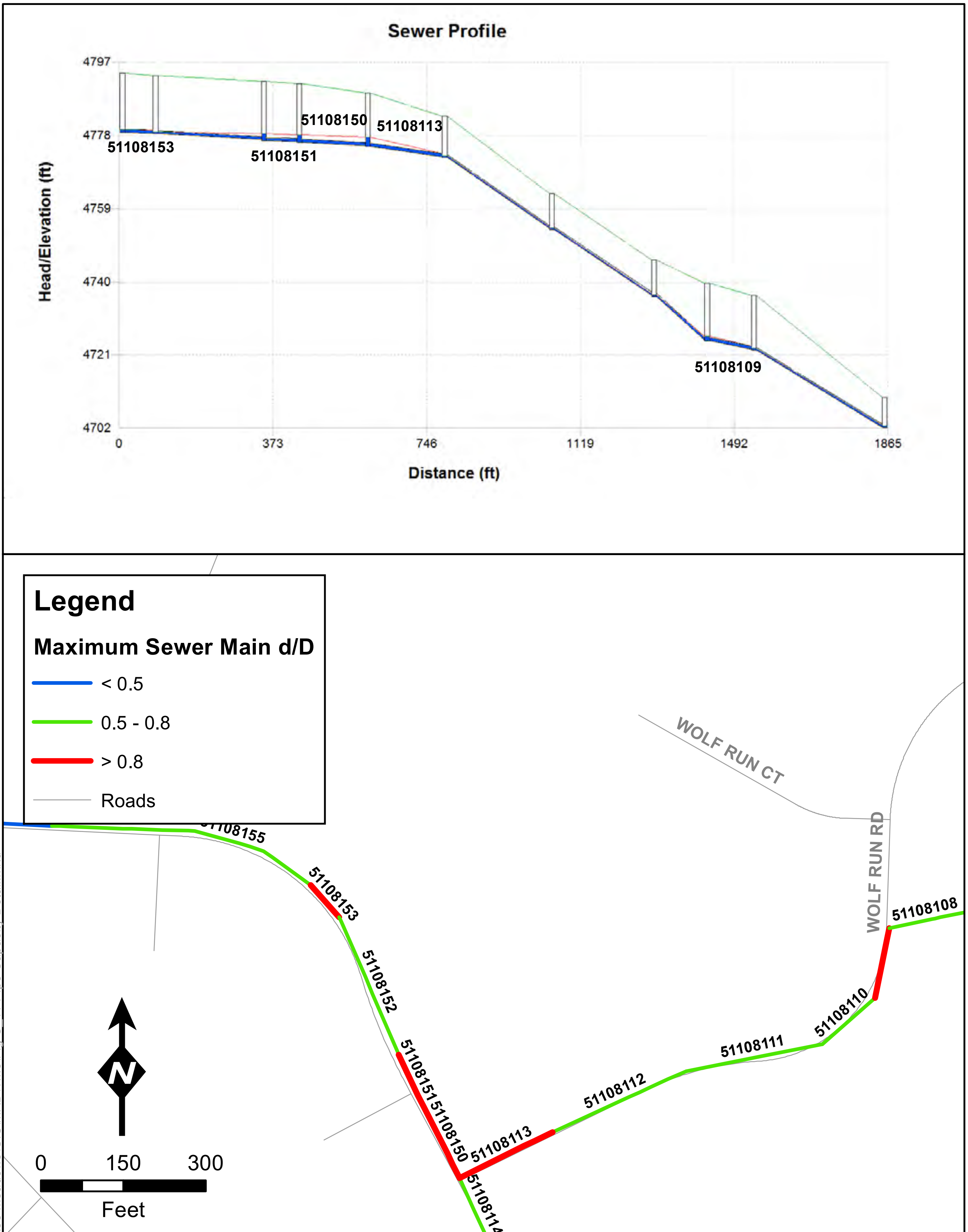
FIGURE C-10

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: December 01, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig C_10 Pipe Capacity Detail.mxd

carollo



SEWER MAIN PLAN AND PROFILE WITH d/D NEAR WATER LILY WAY AND WOLF RUN RD., BUILDOUT

FIGURE C-11

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

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Date: December 01, 2015
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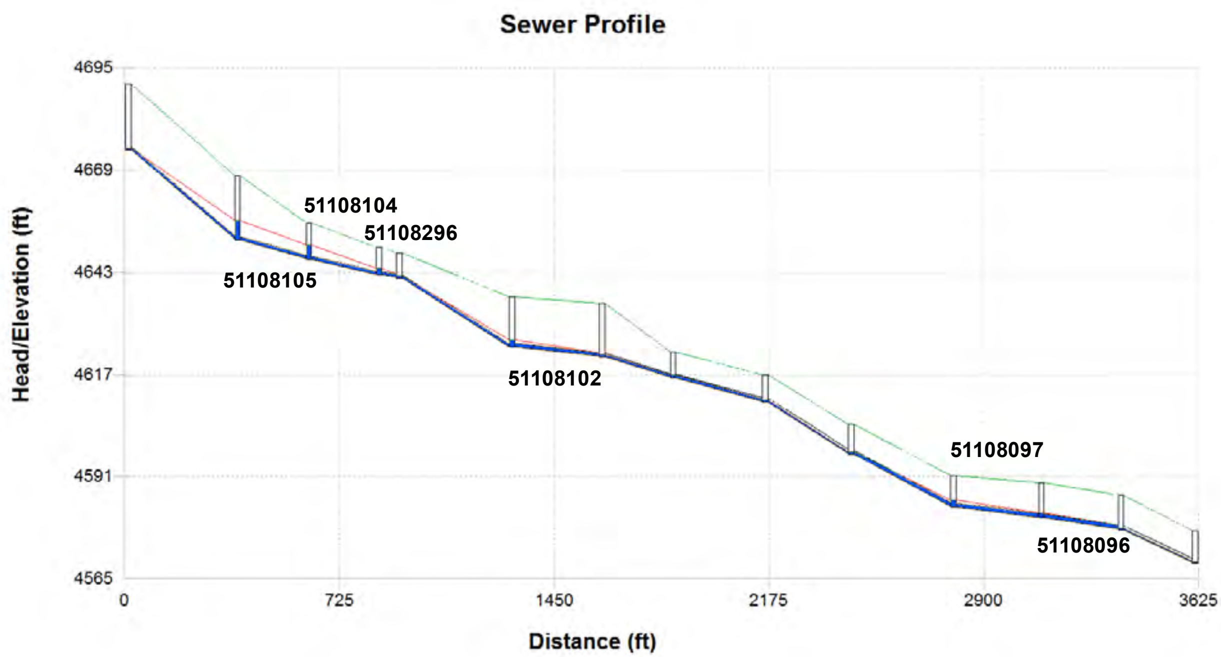

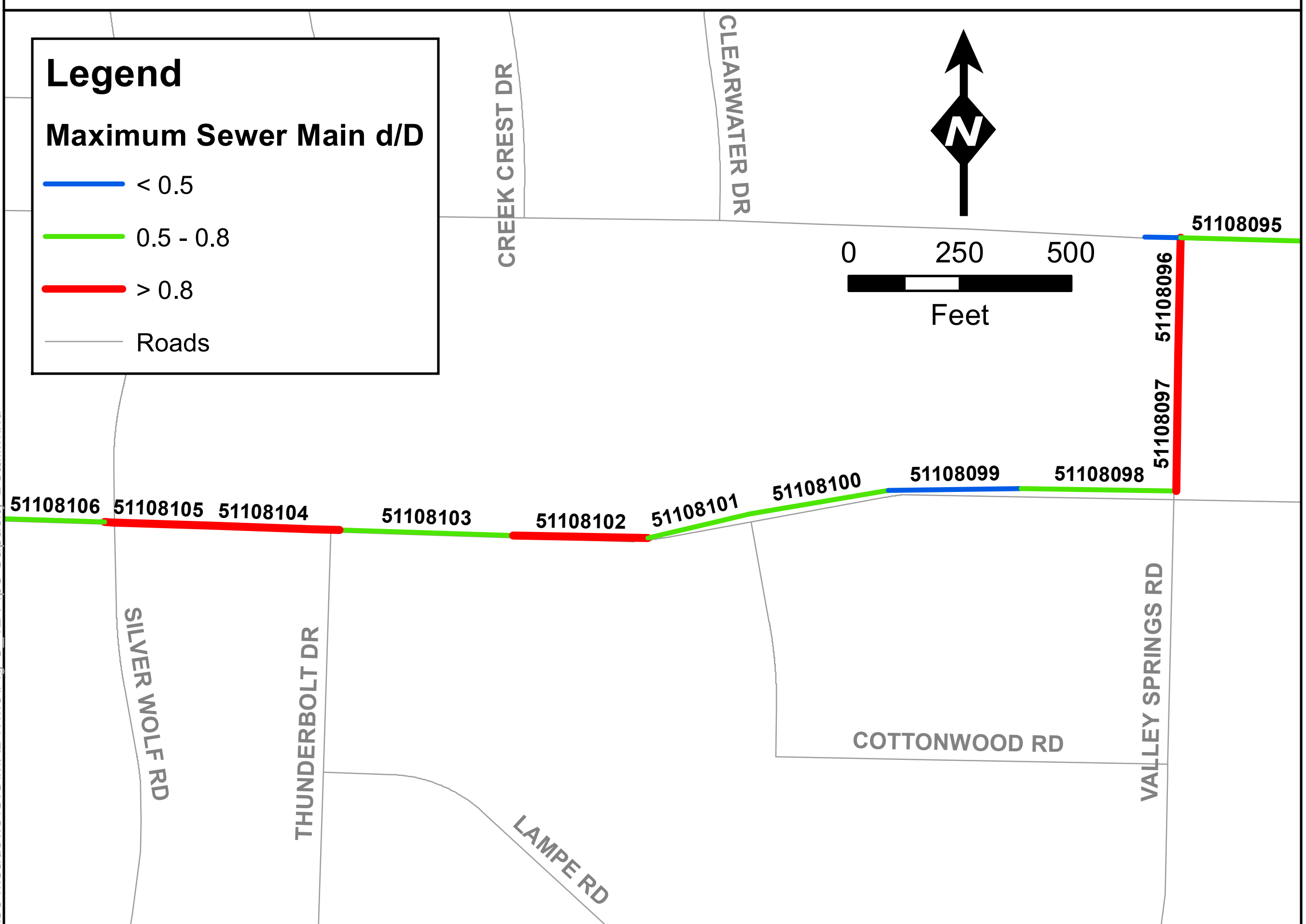

SEWER MAIN PLAN AND PROFILE WITH d/D NEAR LA GUARDIA LN. AND THUNDERBOLT DR., BUILDOUT

FIGURE C-12

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

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Date: December 01, 2015
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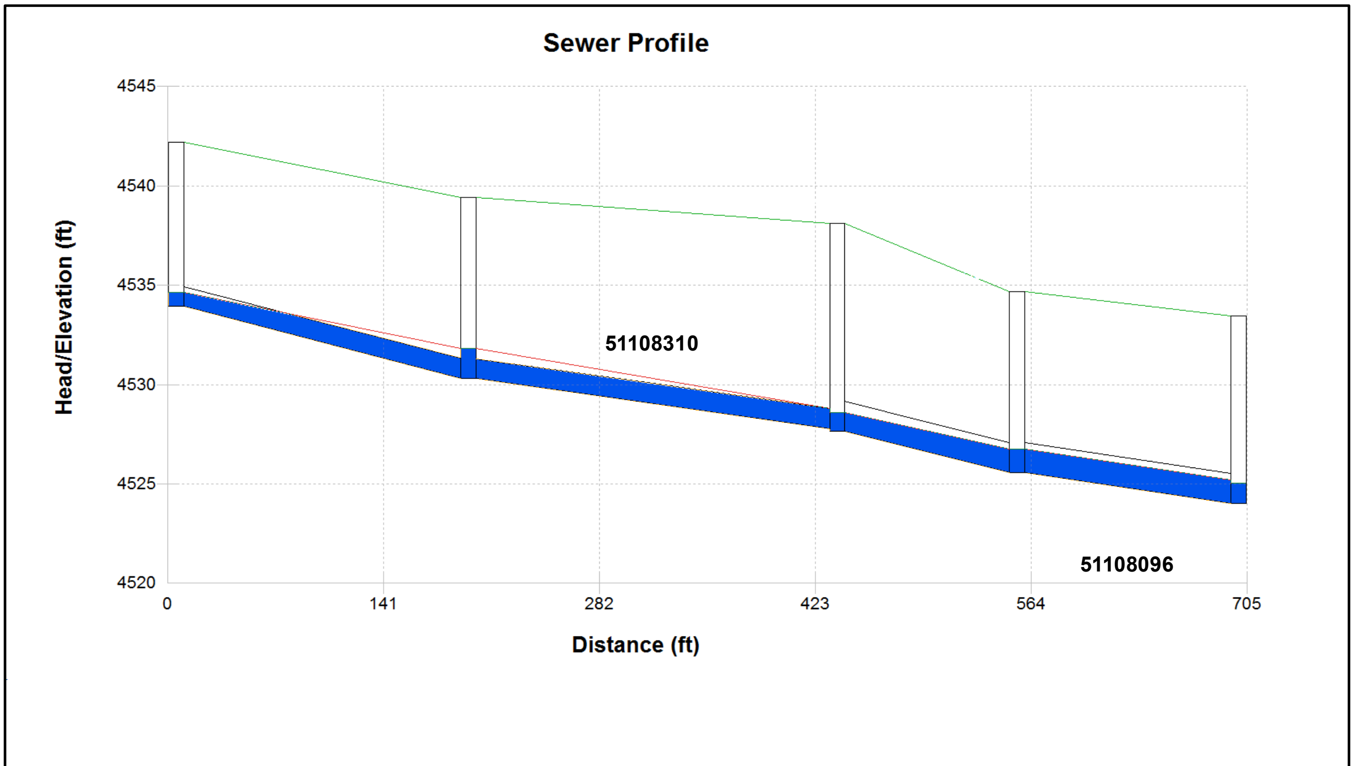

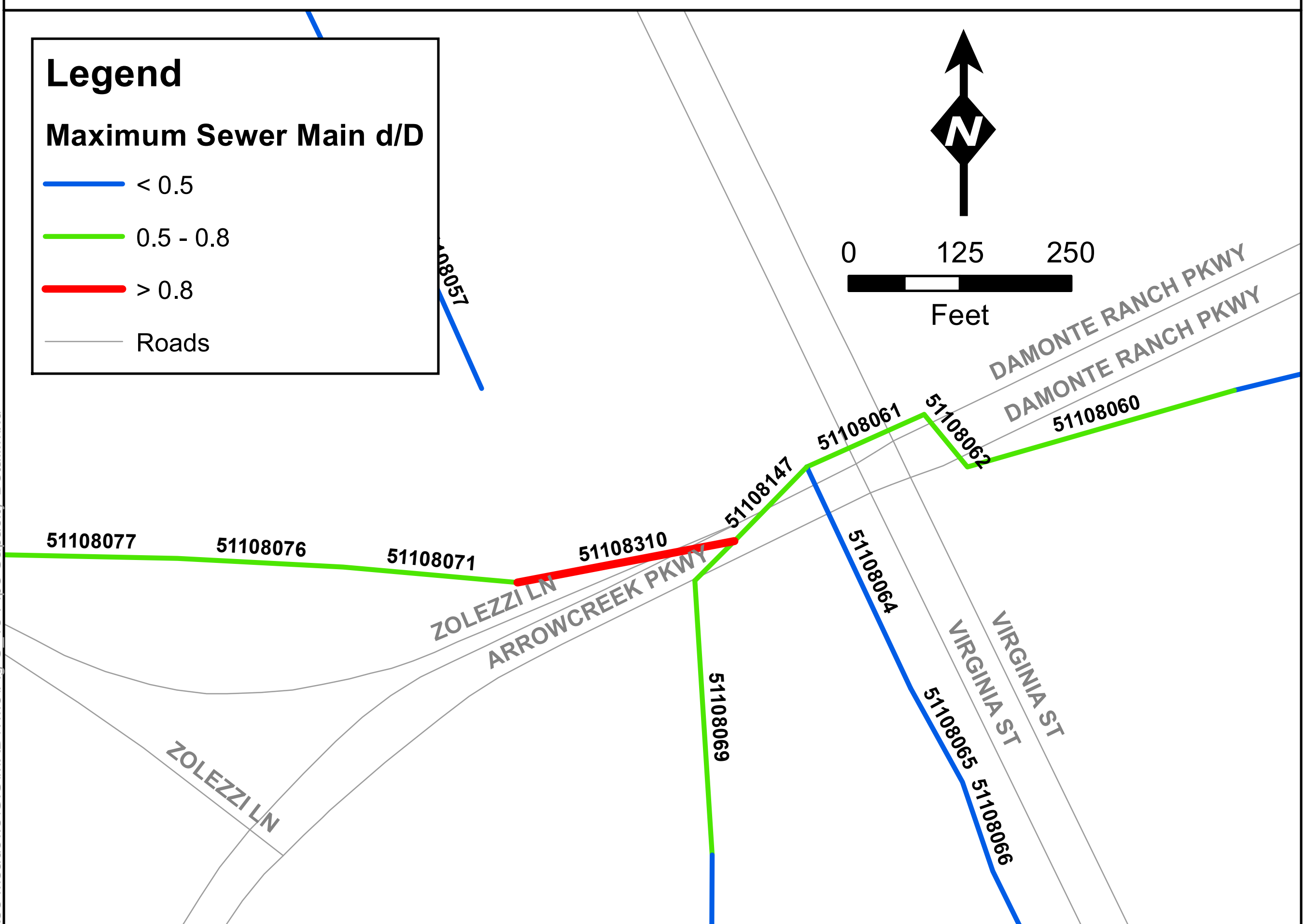

SEWER MAIN PLAN AND PROFILE WITH d/D NEAR VIRGINIA ST. AND ARROW CREEK PKWY., BUILDOUT

FIGURE C-13

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

Date: December 01, 2015
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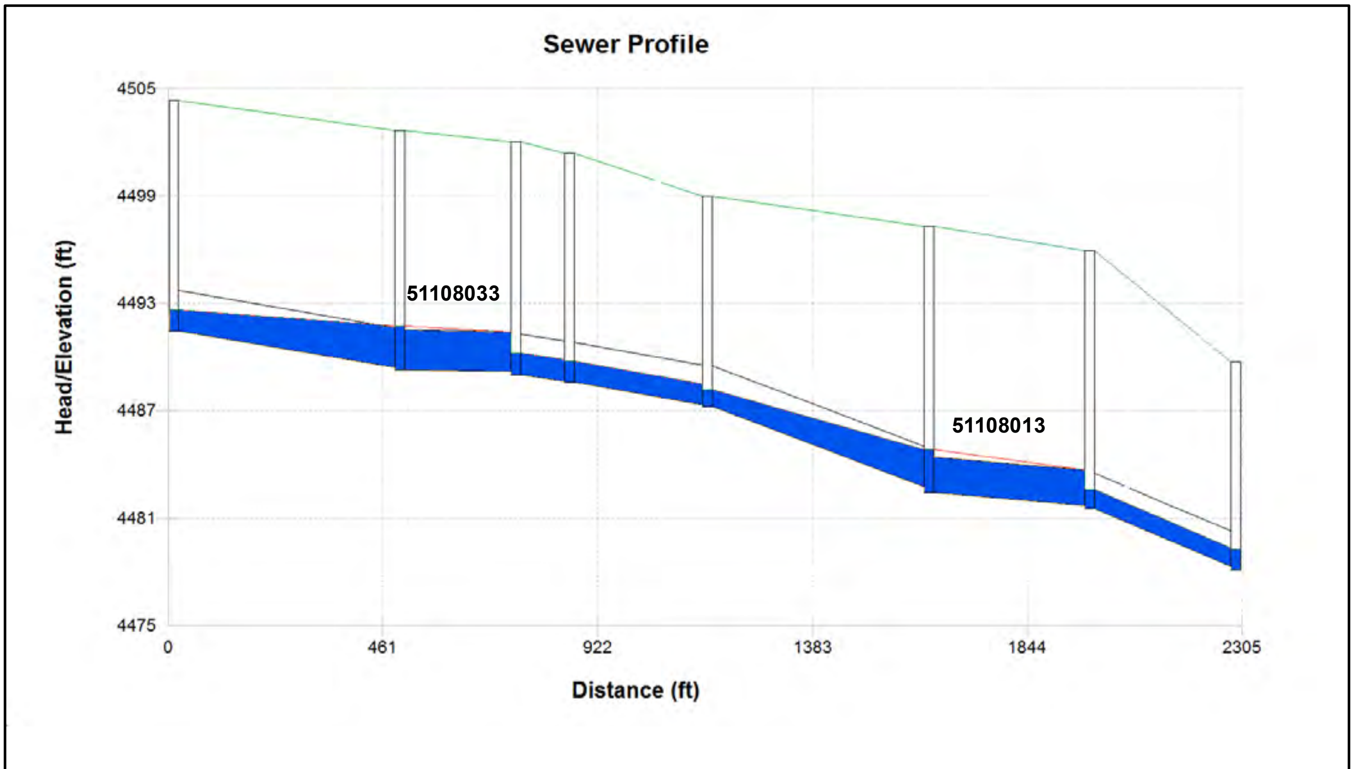

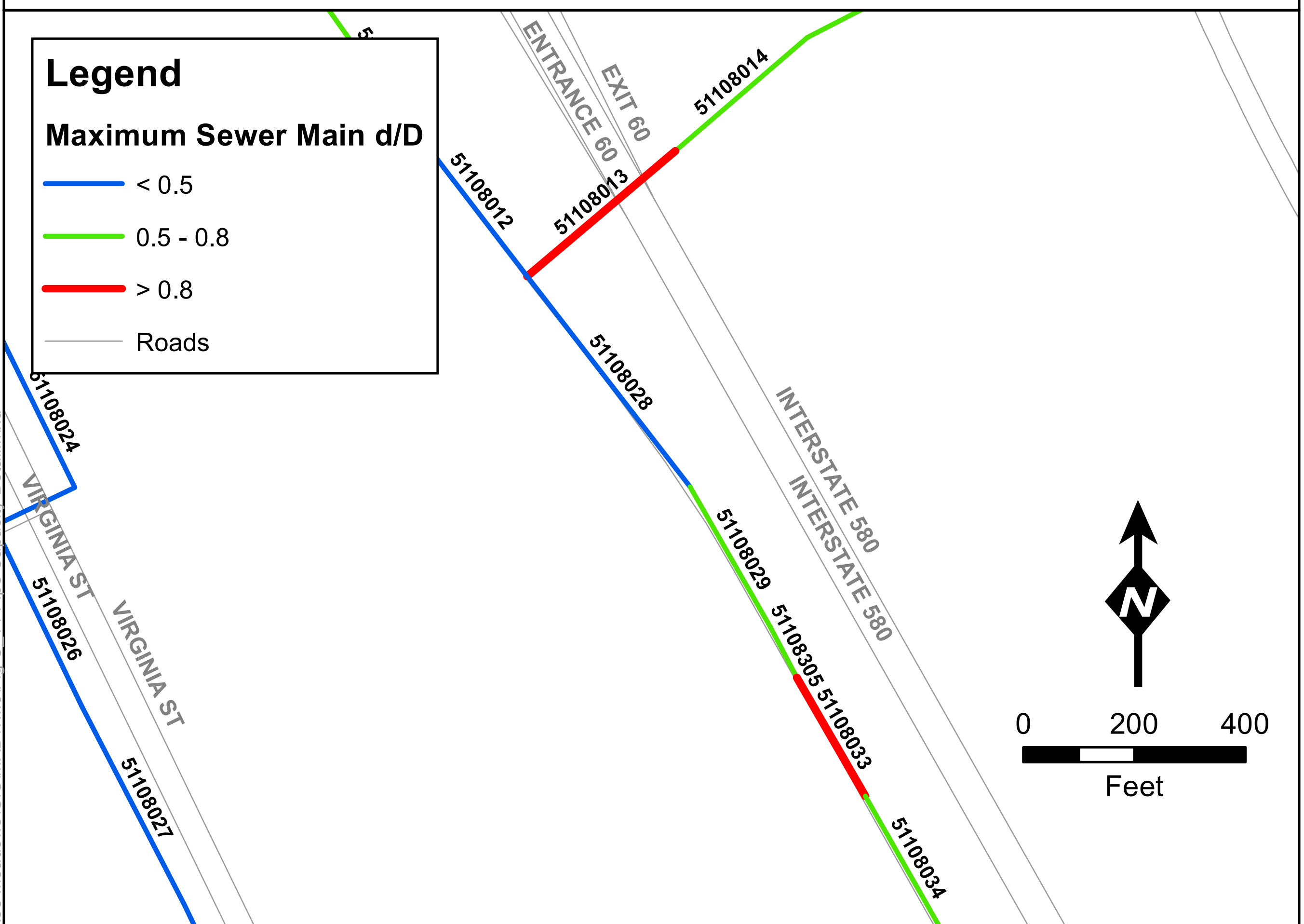

SEWER MAIN PLAN AND PROFILE WITH d/D NEAR I-580 AND SOUTH MEADOWS PKWY., BUILDOUT

FIGURE C-14

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: December 01, 2015
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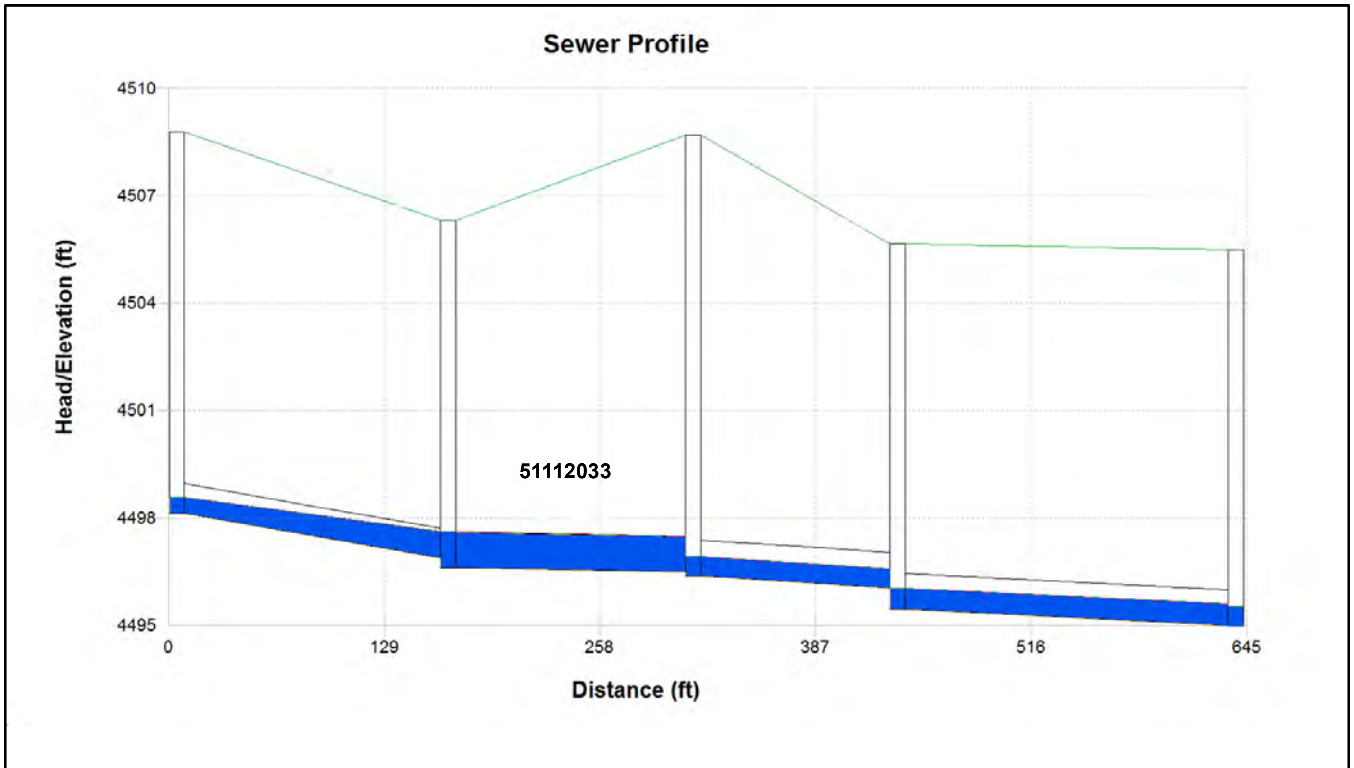

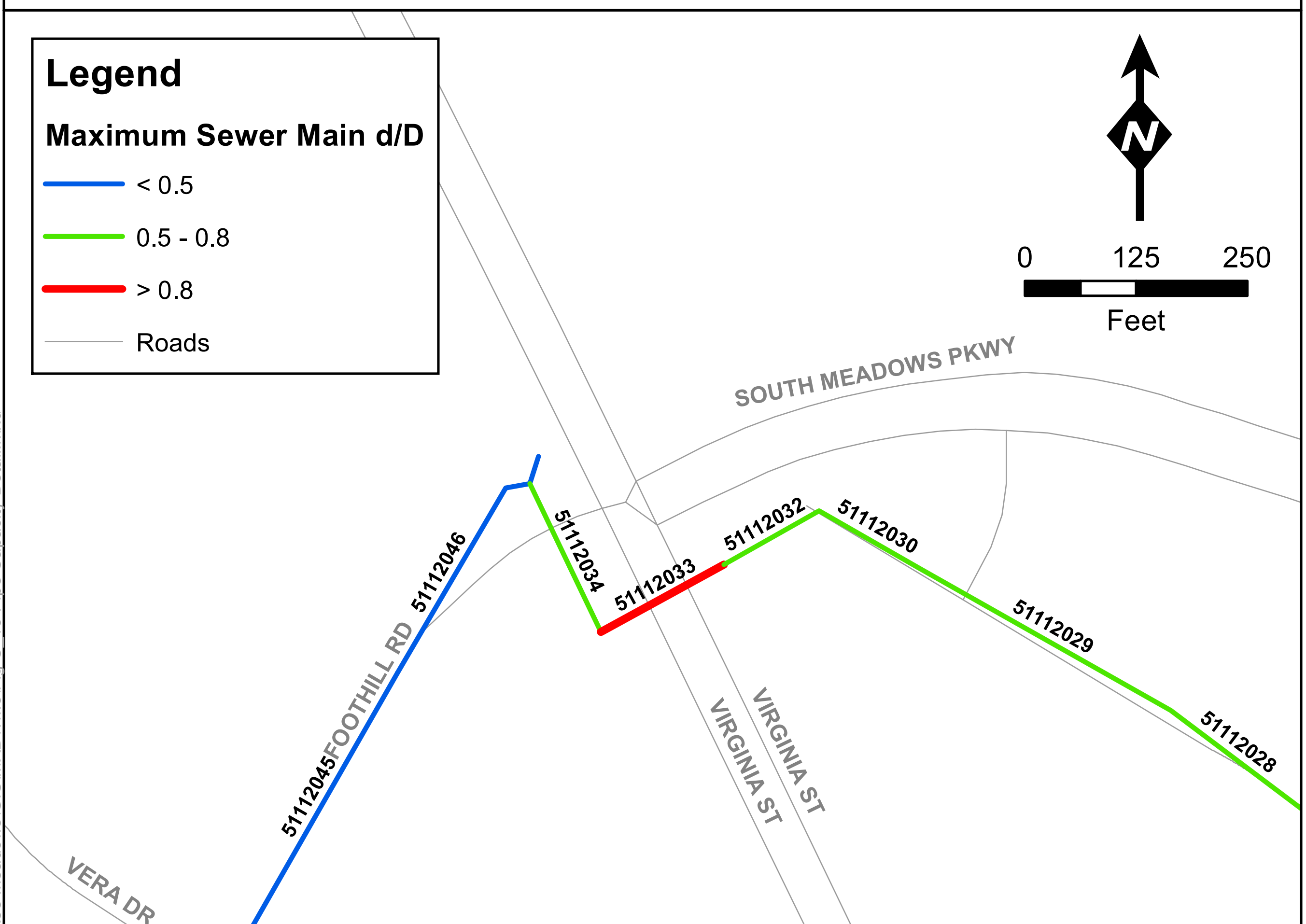

SEWER MAIN PLAN AND PROFILE WITH d/D NEAR VIRGINIA ST. AND SOUTH MEADOWS PKWY., BUILDOUT

FIGURE C-15

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

Date: December 01, 2015
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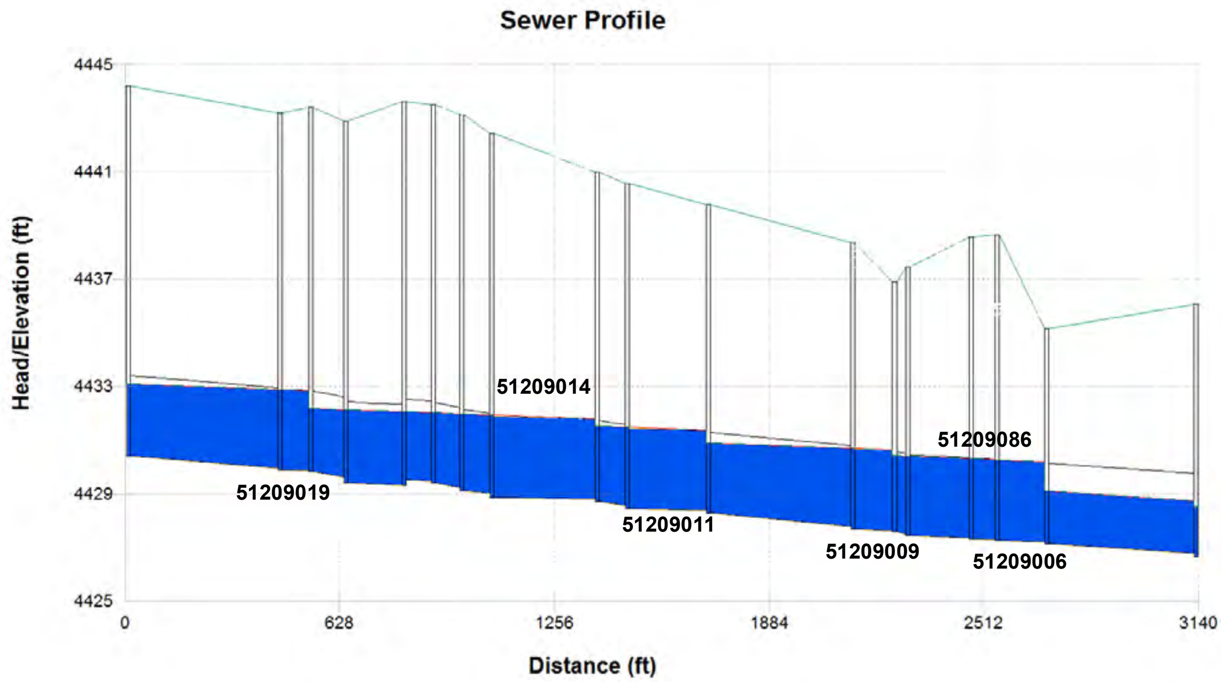

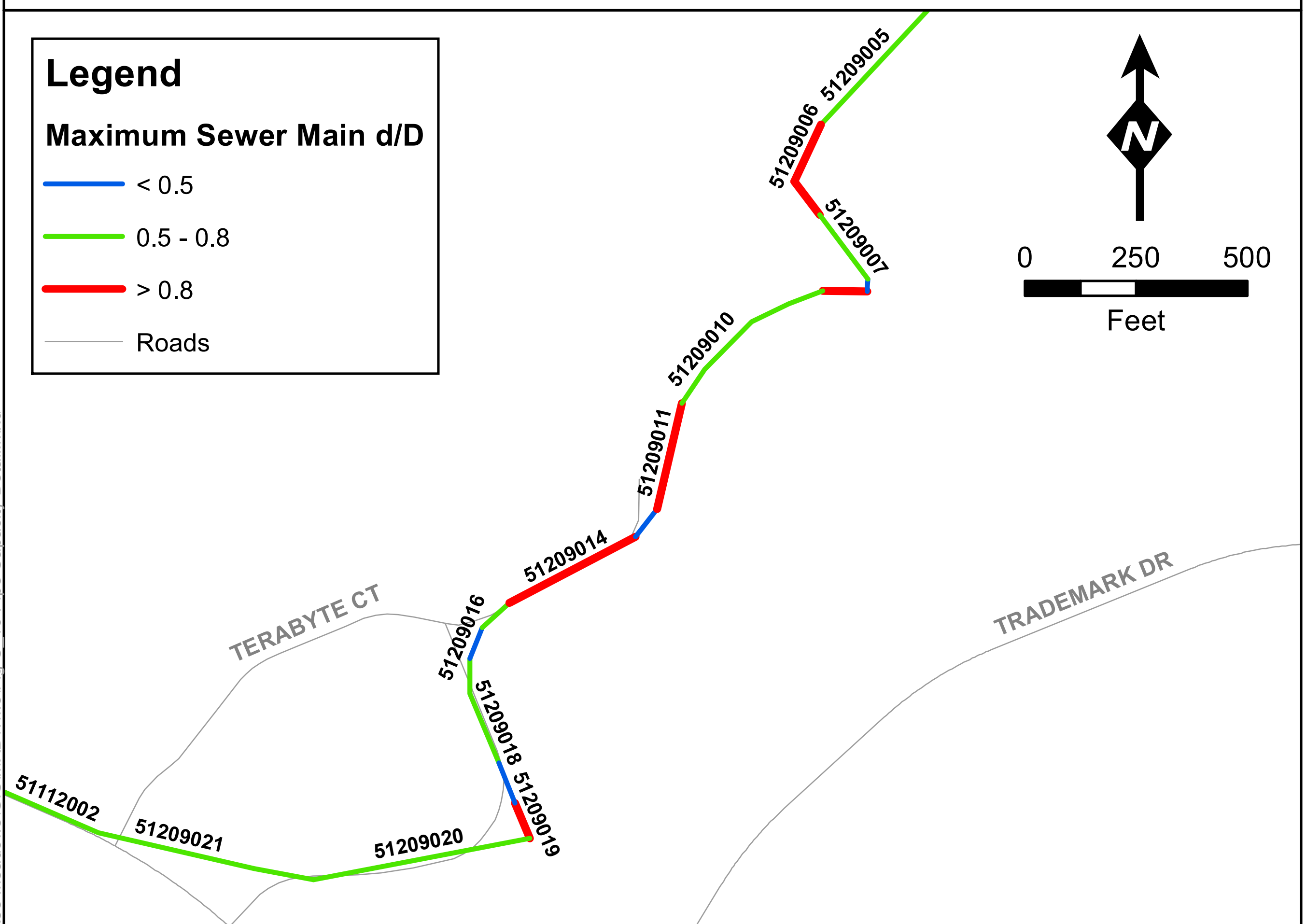

SEWER MAIN PLAN AND PROFILE WITH d/D NEAR TERABYTE DR. AND TERABYTE CT., BUILDOUT

FIGURE C-16

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

carollo

Date: December 01, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM3\Fig C_16 Pipe Capacity Detail.mxd

APPENDIX D – UNIT COSTS

PLANNING COST ESTIMATE

PROJECT :	**STMWRF Facility Plan Update**	**LOCATION FACTOR:**	**0.968**
JOB # :	**9873A.00**	**DATE :**	July-15
CLIENT :	**Washoe County**	**ENR :**	10037
ELEMENT :	**Gravity Sewer Main Construction**	**BY :**	SJT

	DESCRIPTION	QUAN	UNIT	MATERIAL & LABOR	SUB	UNIT COST	SUBTOTAL	TOTAL
PIPE	12" Sdr-35 Pvc Sewer Pipe, In Trench	1	LF	$17.84	$0.00	$17.84	$17.84	
	TOTAL PIPING (per LF)							**$17.84**
EXCAV	EARTHWORK							
& BACKFILL	Cat 225 Trackhoe, 1Cy Bucket, Class B (Medium Digging), 0-16' D	1.1	CY	$4.78	$0.00	$4.78	$5.31	
	Trench Bracing	1.0	LF	$15.49	$0.00	$15.49	$15.49	
	Imported Pipe Bed & Zone/Confined Structure Backfill, Class A Material	0.2	CY	$60.62	$0.00	$60.62	$11.71	
	Native Trench Backfill/Unconfined Struct. Bf, Class A Material	0.9	CY	$13.09	$0.00	$13.09	$11.63	
	10% Site Specific Requirements	1	LS	$4.41	$0.00	$4.41	$4.41	
	TOTAL EARTHWORK (per LF)							**$48.55**
PAVING	Asphalt Pavement Cutting	8.0	inFT	$.73	$0.00	$0.73	$5.81	
DEMO &	Remove 4"-6" Asphalt Pavement	0.6	SY	$6.23	$0.56	$6.78	$3.77	
REPLACEMENT	4" Ac Paving On 8" Abc	0.6	SY	$30.49	$2.44	$32.93	$18.30	
	TOTAL PAVING (per LF)							**$27.87**
	TOTAL MANHOLE (per LF)							**$6.25**
	OVERHEAD (10%)							**$10.05**
	CONSTRUCTION PROFIT (6%)							**$6.03**
	SALES TAX (50% of above costs at 8.1%)							**$4.07**
	CONTINGENCY (20%)							**$20.10**
	GENERAL CONDITIONS (15%)							**$15.08**
	TOTAL CONSTRUCTION COST, LF							**$155.85**
	TOTAL PROJECT COST (1.4 times Const Cost), LF							**$218.19**

PLANNING COST ESTIMATE

PROJECT :	**STMWRF Facility Plan Update**	**LOCATION FACTOR:**	**0.968**
JOB # :	**9873A.00**	**DATE :**	July-15
CLIENT :	**Washoe County**	**ENR :**	10037
ELEMENT :	**Gravity Sewer Main Construction**	**BY :**	SJT

	DESCRIPTION	QUAN	UNIT	MATERIAL & LABOR	SUB	UNIT COST	SUBTOTAL	TOTAL
PIPE	15" Sdr-35 Pvc Sewer Pipe, In Trench	1	LF	$19.83	$0.00	$19.83	$19.83	
	TOTAL PIPING (per LF)							**$19.83**
EXCAV	EARTHWORK							
& BACKFILL	Cat 225 Trackhoe, 1Cy Bucket, Class B (Medium Digging), 0-16' D	1.8	CY	$4.78	$0.00	$4.78	$8.63	
	Trench Bracing	1.0	LF	$15.49	$0.00	$15.49	$15.49	
	Imported Pipe Bed & Zone/Confined Structure Backfill, Class A Material	0.2	CY	$60.62	$0.00	$60.62	$13.66	
	Native Trench Backfill/Unconfined Struct. Bf, Class A Material	1.5	CY	$13.09	$0.00	$13.09	$20.09	
	10% Site Specific Requirements	1	LS	$5.79	$0.00	$5.79	$5.79	
	TOTAL EARTHWORK (per LF)							**$63.65**
PAVING	Asphalt Pavement Cutting	8.0	inFT	$.73	$0.00	$0.73	$5.81	
DEMO &	Remove 4"-6" Asphalt Pavement	0.6	SY	$6.23	$0.56	$6.78	$3.96	
REPLACEMENT	4" Ac Paving On 8" Abc	0.6	SY	$30.49	$2.44	$32.93	$19.21	
	TOTAL PAVING (per LF)							**$28.97**
	TOTAL MANHOLE (per LF)							**$9.10**
	OVERHEAD (10%)							**$12.16**
	CONSTRUCTION PROFIT (6%)							**$7.29**
	SALES TAX (50% of above costs at 8.1%)							**$4.92**
	CONTINGENCY (20%)							**$24.31**
	GENERAL CONDITIONS (15%)							**$18.23**
	TOTAL CONSTRUCTION COST, LF							**$188.46**
	TOTAL PROJECT COST (1.4 times Const Cost), LF							**$263.85**

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PLANNING COST ESTIMATE

PROJECT :	**STMWRF Facility Plan Update**	**LOCATION FACTOR:**	**0.968**
JOB # :	**9873A.00**	**DATE :**	July-15
CLIENT :	**Washoe County**	**ENR :**	10037
ELEMENT :	**Gravity Sewer Main Construction**	**BY :**	SJT

	DESCRIPTION	QUAN	UNIT	MATERIAL & LABOR	SUB	UNIT COST	SUBTOTAL	TOTAL
PIPE	18" C-700 Vcp In Open Trench	1	LF	$51.64	$0.00	$51.64	$51.64	
	TOTAL PIPING (per LF)							**$51.64**
EXCAV	EARTHWORK							
& BACKFILL	Cat 225 Trackhoe, 1Cy Bucket, Class B (Medium Digging), 0-16' D	1.9	CY	$4.78	$0.00	$4.78	$9.29	
	Trench Bracing	1.0	LF	$15.49	$0.00	$15.49	$15.49	
	Imported Pipe Bed & Zone/Confined Structure Backfill, Class A Material	0.3	CY	$60.62	$0.00	$60.62	$15.68	
	Native Trench Backfill/Unconfined Struct. Bf, Class A Material	1.6	CY	$13.09	$0.00	$13.09	$21.21	
	10% Site Specific Requirements	1	LS	$6.17	$0.00	$6.17	$6.17	
	TOTAL EARTHWORK (per LF)							**$67.83**
PAVING	Asphalt Pavement Cutting	8.0	inFT	$.73	$0.00	$0.73	$5.81	
DEMO &	Remove 4"-6" Asphalt Pavement	0.6	SY	$6.23	$0.56	$6.78	$4.14	
REPLACEMENT	4" Ac Paving On 8" Abc	0.6	SY	$30.49	$2.44	$32.93	$20.12	
	TOTAL PAVING (per LF)							**$30.08**
	TOTAL MANHOLE (per LF)							**$9.10**
	OVERHEAD (10%)							**$15.86**
	CONSTRUCTION PROFIT (6%)							**$9.52**
	SALES TAX (50% of above costs at 8.1%)							**$6.43**
	CONTINGENCY (20%)							**$31.73**
	GENERAL CONDITIONS (15%)							**$23.80**
	TOTAL CONSTRUCTION COST, LF							**$245.97**
	TOTAL PROJECT COST (1.4 times Const Cost), LF							**$344.36**

PLANNING COST ESTIMATE

PROJECT :	STMWRF Facility Plan Update	LOCATION FACTOR:	0.968
JOB # :	9873A.00	DATE :	July-15
CLIENT :	Washoe County	ENR :	10037
ELEMENT :	Gravity Sewer Main Construction	BY :	SJT

	DESCRIPTION	QUAN	UNIT	MATERIAL & LABOR	SUB	UNIT COST	SUBTOTAL	TOTAL
PIPE	21" C-700 Vcp In Open Trench	1	LF	$60.95	$0.00	$60.95	$60.95	
	TOTAL PIPING (per LF)							$60.95
EXCAV	EARTHWORK							
& BACKFILL	Cat 225 Trackhoe, 1Cy Bucket, Class B (Medium Digging), 0-16' D	2.1	CY	$4.78	$0.00	$4.78	$9.95	
	Trench Bracing	1.0	LF	$15.49	$0.00	$15.49	$15.49	
	Imported Pipe Bed & Zone/Confined Structure Backfill, Class A Material	0.3	CY	$60.62	$0.00	$60.62	$17.75	
	Native Trench Backfill/Unconfined Struct. Bf, Class A Material	1.7	CY	$13.09	$0.00	$13.09	$22.27	
	10% Site Specific Requirements	1	LS	$6.55	$0.00	$6.55	$6.55	
	TOTAL EARTHWORK (per LF)							$72.01
PAVING	Asphalt Pavement Cutting	8.0	inFT	$.73	$0.00	$0.73	$5.81	
DEMO &	Remove 4"-6" Asphalt Pavement	0.6	SY	$6.23	$0.56	$6.78	$4.33	
REPLACEMENT	4" Ac Paving On 8" Abc	0.6	SY	$30.49	$2.44	$32.93	$21.04	
	TOTAL PAVING (per LF)							$31.18
	TOTAL MANHOLE (per LF)							$9.10
	OVERHEAD (10%)							$17.32
	CONSTRUCTION PROFIT (6%)							$10.39
	SALES TAX (50% of above costs at 8.1%)							$7.02
	CONTINGENCY (20%)							$34.65
	GENERAL CONDITIONS (15%)							$25.99
	TOTAL CONSTRUCTION COST, LF							$268.60
	TOTAL PROJECT COST (1.4 times Const Cost), LF							$376.05

APPENDIX E – PLEASANT VALLEY REACH 4 INTERCEPTOR CAPACITY

1 East Liberty Street, Suite 424
Reno, Nevada 89501
P. 775.324.4427

PROJECT MEMORANDUM

Project Name:	South Truckee Meadows Wastewater Reclamation Facility Plan Update	**Date:**	December 7, 2015
Client:	Washoe County	**Project Number:**	9873A.00
Prepared By:	Richard Humpherys		
Reviewed By:	Kelli Callahan		
Subject:	Pleasant Valley Interceptor Reach 4 Capacity and Cost Allocation		
Distribution:	Rick Warner		

1.0 BACKGROUND

The Pleasant Valley Interceptor will serve developments in Pleasant Valley, and planned developments are located in the southern part of the service area. Serving these developments will require the entire interceptor be constructed. Carollo has been tasked with providing the pipe capacity information necessary for Washoe County to prepare an equitable impact fee assessment for the developments that are planned over the next twenty years. The pipe sizes needed to serve development through 2035 are presented in this memorandum, then the cost of this pipe is allocated based on the number of planned Equivalent Residential Units (ERUs).

The Pleasant Valley Interceptor has been previously planned and designed, with the most current engineering work complete in 2005. Changes in the development patterns and anticipated building timing indicate that build-out sewer flows to the interceptor may occur well into the future.

In developing an equitable cost allocation for development thought to occur in the near-term, interceptor pipe sizes are being planned for a 20-year (2035) build condition, which results in smaller pipe sizes than what is envisioned for the full build-out condition. While Washoe County may indeed elect to construct a larger sewer interceptor to accommodate build out sewer flows, using the 2035 build condition and resulting reduced pipe size provides for a more equitable fee allocation for development utilizing the sewer interceptor in the near-term.

2.0 WASTEWATER FLOWS

Table 1 shows the average daily wastewater flows in the 2035 planning period along with the ERUs associated with these flows. The Pleasant Valley Interceptor is divided into three sections, called Reaches, and the wastewater loading is allocated to each Reach.

Table 1 Wastewater Flow Projections

Reach	2035 Loads (gpm)	Cumulative Loads (gpm)	Loads ERU
4	313	313	1,670
3B	10	324	1,725
3A	4	328	1,749

Carollo developed a wastewater collection system model configured to evaluate 2035 wastewater flows in the Pleasant Valley Interceptor, to determine an appropriate pipe diameter associated with these flows. The County's design performance criterion for pipe capacity is to have the depth/diameter (d/D) equal to or less than 0.8 for peak hour flows. The model predicted that interceptor Reaches 3A, 3B, and 4 can be twelve inches in diameter. Figure 1 shows the range of d/D values along the length of the pipeline. The minimum ERU capacity for each Reach is shown in Table 2.

Table 2 ERU Capacity for Pipes in Each Section of the Pleasant Valley Interceptor

Reach	Pipe Size	Pipe Capacity of the Limiting Reach (gpm)	Peaking Factor	Average Flow (gpm)	Pipe Capacity (ERU)
4	12"	1,445	2.50	585	3,120
3B	12"	1,094	2.50	443	2,362
3A	12"	1,141	2.50	462	2,464

Appendix A shows the unit cost of a 12-inch pipe at an average depth of 16 feet for the Pleasant Valley Interceptor. Using these costs, the Project cost of the pipes in each reach is provided in Table 3.

Table 3 Project Costs for Each Pleasant Valley Interceptor Reach

Reach	Pipe Size	Pipe Length	Project Cost/ft.	Project Cost
4	12"	22,135	$ 193	$4,283,000
3B	12"	12,758	$ 193	$2,468,000
3A	12"	3,506	$ 193	$678,000
TOTAL		**38,399**		**$7,429,000**

Note: ENR CCI = 10037

3.0 PLEASANT VALLEY INTERCEPTOR COST ALLOCATION FOR REACH 4 PROPERTIES

World Properties, Inc. is proposing to construct and pay for the Pleasant Valley Interceptor Reach 4. Reaches 3A and 3B will be constructed and paid for by either Washoe County or development. Development within Reach 4 is also required to pay a proportionate surcharge fee, based upon projected 2035 sewer flows, for Reaches 3A, 3B, and 4 easement costs, and for Reach 3A and 3B construction costs. Note: Interceptor fees for Reaches 1 and 2 are included in Washoe County's base sewer connection fee.

To date, Washoe County has expended $633,570 for pipeline and access easements for Reach 4, and $1,555,203 for pipeline and access easements for Reaches 3A and 3B. Construction for the Reach 3A and 3B interceptor segments is estimated at $3,146,000.

1,670 ERU are projected for development within Reach 4 by 2035. Modest growth within Reach 3A and 3B is anticipated, with 79 ERU added by 2035.

The appropriate fee allocation to development within Reach 4 is determined by the following methodology:

1. Reach 4 construction will be the responsibility of World Properties, Inc., thus a future surcharge to Washoe County's sewer connection fee is not required.
2. Reach 4 pipeline and access easements, which have been secured and paid by Washoe County, are subject to additional fees. Reach 4 easements total $633,570 and will allocated to the 1,670 ERU within Reach 4, or $379 per ERU.
3. Reach 3A and 3B pipeline and access easements, which have been secured and paid by Washoe County, are subject to additional fees. Reach 3A and 3B easements total $1,555,203 and will allocated to the 1,749 ERUs within Reaches 3A, 3B and 4, or $889 per ERU.
4. Development within Reach 4 is subject to the proportionate cost of pipeline capacity within Reaches 3A and 3B. Reach 3A and 3B construction costs total $3,146,000, and will be allocated to the 1,749 ERUs within Reaches 3A, 3B and 4, or $1,799 per ERU.

Utilizing a 20-year planning horizon and sizing the Pleasant Valley sewer interceptor for the projected 2035 sewer flows, development within Reach 4 should be subject to an interceptor surcharge of $3,067, in addition to Washoe County's base sewer connection fee.

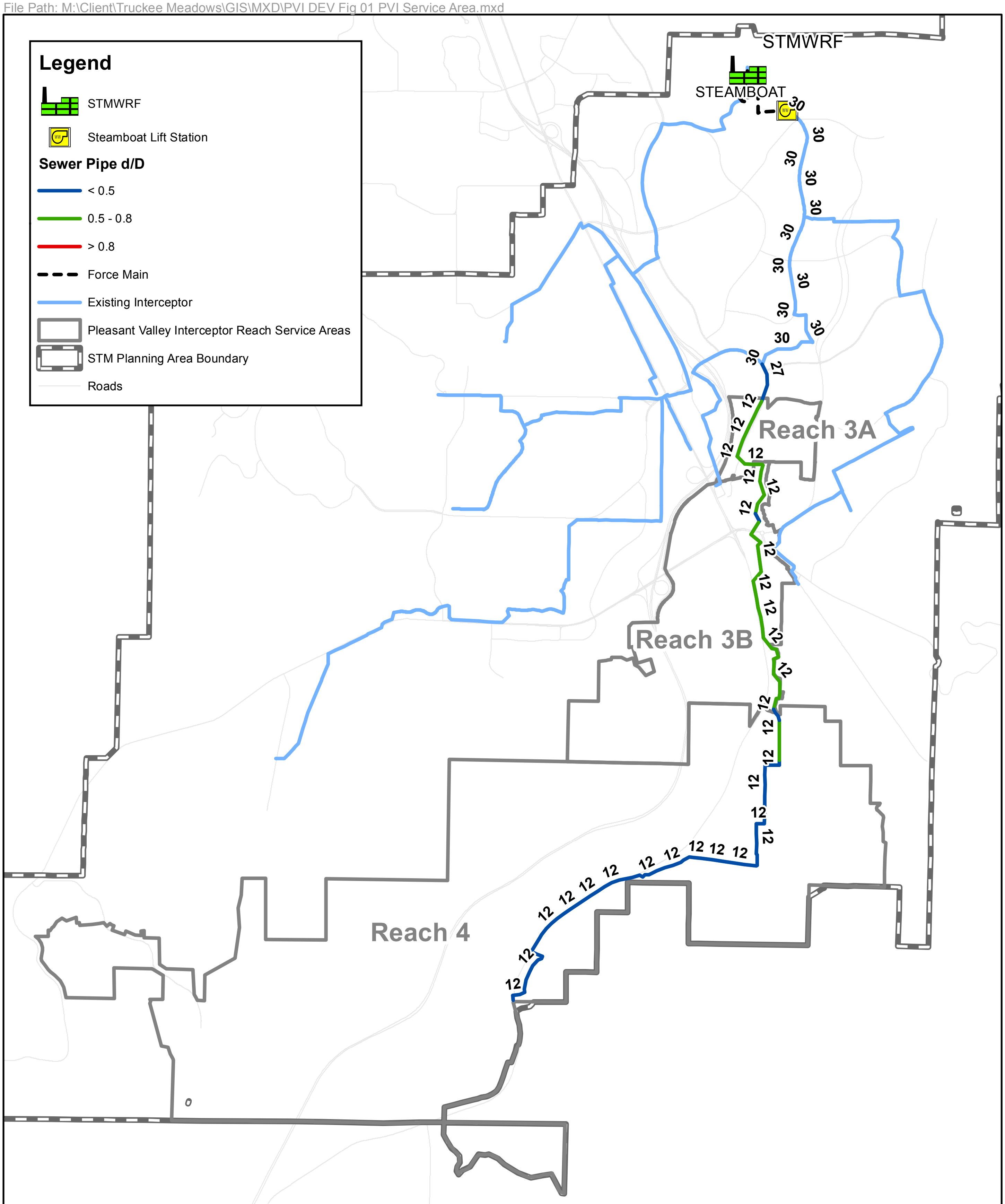
Please contact us if you have any questions regarding this study.

This document is released for the purpose of information exchange review and planning only under the authority of Keli A. Callahan December 7, 2015 State of Nevada PE License No. 17285.

Prepared By:

Keli A. Callahan

Date: November 23, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\PVI DEV Fig 01 PVI Service Area.mxd



PLEASANT VALLEY INTERCEPTOR SHOWING SERVICE AREA

FIGURE 1

WASHOE COUNTY

PLEASANT VALLEY INTERCEPTOR CAPACITY

carollo

APPENDIX A – PIPELINE UNIT COSTS

PLANNING COST ESTIMATE

PROJECT :	**STMWRP Facility Plan Update**				**LOCATION FACTOR:**		**0.887**	
JOB # :	**9873A.00**				**DATE :**		November-15	
CLIENT :	**Washoe County**				**ENR :**		10037	
ELEMENT :	**Gravity Sewer Main Construction**				**BY :**		NWD	

	DESCRIPTION	QUAN	UNIT	MATERIAL & LABOR	SUB	UNIT COST	SUBTOTAL	TOTAL
PIPE	12" Sdr-35 Pvc Sewer Pipe, In Trench	1	LF	$16.34	$0.00	$16.34	$16.34	
	TOTAL PIPING (per LF)							**$16.34**
EXCAV	EARTHWORK							
& BACKFILL	Cat 225 Trackhoe, 1Cy Bucket, Class B (Medium Digging), 0-16' D	1.1	CY	$4.38	$0.00	$4.38	$4.86	
	Trench Bracing, 3' W X 10' D, Wood Planks & X-Bracing	1.0	LF	$14.19	$0.00	$14.19	$14.19	
	Imported Pipe Bed & Zone/Confined Structure Backfill, Class A Material	0.2	CY	$55.55	$0.00	$55.55	$10.73	
	Native Trench Backfill/Unconfined Struct. Bf, Class A Material	0.9	CY	$11.99	$0.00	$11.99	$10.66	
	10% Site Specific Requirements	1	LS	$4.04	$0.00	$4.04	$4.04	
	TOTAL EARTHWORK (per LF)							**$44.49**
PAVING	Asphalt Pavement Cutting	8.0	in FT	$0.67	$0.00	$0.67	$5.32	
DEMO &	Remove 4"-6" Asphalt Pavement	0.6	SY	$5.70	$0.51	$6.21	$3.45	
REPLACEMENT	4" Ac Paving On 8" Abc	0.6	SY	$27.94	$2.24	$30.18	$16.76	
	TOTAL PAVING (per LF)							**$25.54**
MANHOLE	Manhole (spaced every 500 ft.)	1	EA	$5.73	$0.00	$5.73	$5.73	**$5.73**
	OVERHEAD (10%)							**$8.64**
	CONSTRUCTION PROFIT (6%)							**$5.18**
	SALES TAX (65% of above costs at 9.8%)							**$5.50**
	CONTINGENCY (15%)							**$13.82**
	GENERAL CONDITIONS (15%)							**$12.96**
	TOTAL CONSTRUCTION COST, LF							**$138.20**
	TOTAL PROJECT COST (1.4 times Const Cost), LF							**$193.47**

WASHOE COUNTY

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY FACILITY PLAN UPDATE

TECHNICAL MEMORANDUM NO. 4 CONDITION ASSESSMENT

FINAL

January 2016

1 EAST LIBERTY STREET, SUITE 424 • RENO, NEVADA 89501 • P. 775.324.4427

WASHOE COUNTY

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY (STMWRF)

TECHNICAL MEMORANDUM
NO. 4
CONDITION ASSESSMENT

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CONDITION ASSESSMENT

1.0 PROJECT BACKGROUND

The South Truckee Meadows Water Reclamation Facility (STMWRF) was originally constructed in 1991 as a 1.5 million gallon per day (mgd) secondary treatment facility. In 2003, the plant capacity was expanded to 4.1 mgd through the addition of a new oxidation ditch, four secondary clarifiers, tertiary filters, chemical building, and associated appurtenant structures. STMWRF is owned by Washoe County (County) and managed by the Washoe County Community Services Department (WCCSD). WCCSD Water Resources staff is responsible for preparing and maintaining a comprehensive Capital Improvement Program and has been proactive in identifying the need for direct evaluation and assessment of elements within the STMWRF and the Steamboat Creek Lift Station (SCLS). Carollo Engineers, Inc. (Carollo) was retained to provide engineering services that would identify potential improvements for the facility through year 2035.

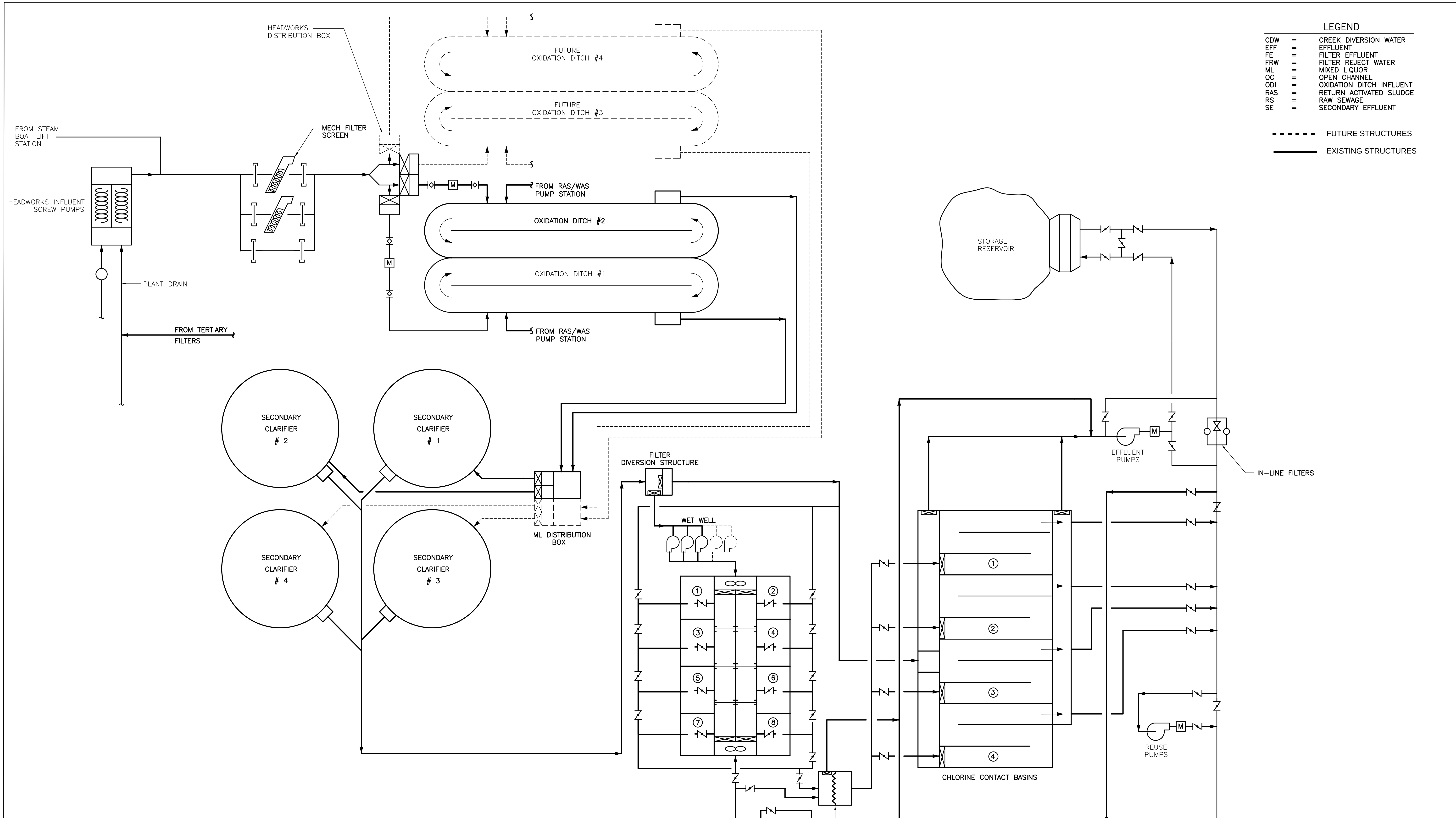
The primary goal for the evaluation and assessment is to visually evaluate the electrical, mechanical, and structural condition of the existing facilities and identify potential improvements.

Carollo developed checklists to assist prior to the field review. The checklists were used to document the condition of the facility, and are provided as written in the field, in Appendix A. Additionally, photos were taken to document the existing and deficient conditions provided throughout this report and specific deficiencies are documented in Appendix B. County Operations and Engineering staff, as well as the Contract Operator, SPB Utility Services, participated in the field review and assisted in the evaluation and provided valuable historical information to the field review team.

2.0 FIELD REVIEW AND EVALUATION

The field review was conducted on April 22, 2015. Weather and lighting conditions were favorable for the field review. Carollo evaluated the apparent condition of equipment using direct observation methods. As much as practicable, the team assessed the equipment by order of the treatment process. The specific equipment and unit processes for the evaluation are shown on Process Flow Diagrams, Figure 4.1 and 4.2 include:

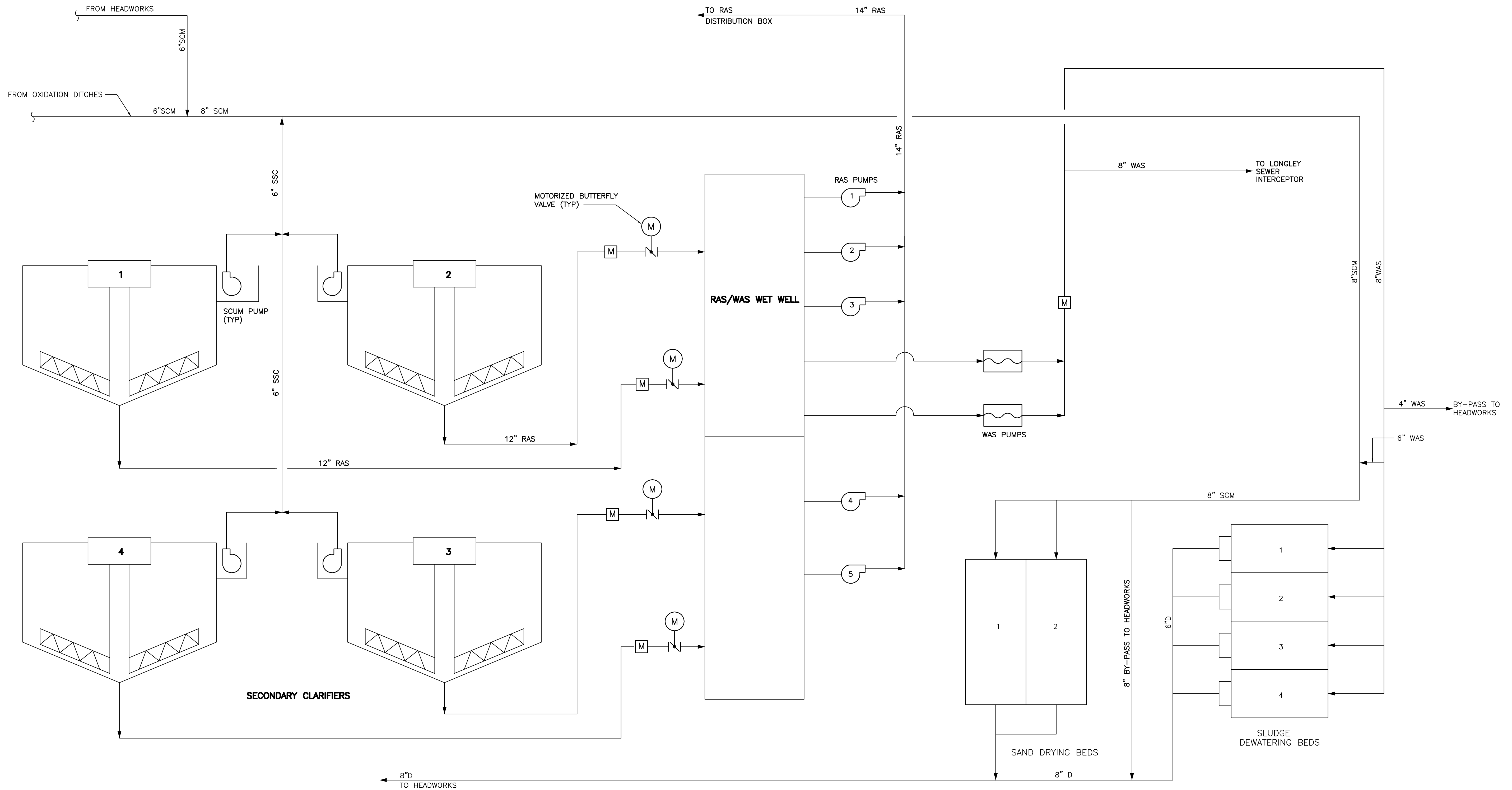
- Steamboat Creek Lift Station
- Headworks Influent Pumping
- Headworks Mechanical Screening
- Headworks Manual Bar Screen



FACILITY PROCESS FLOW DIAGRAM

FIGURE 4.1

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE



RAS/WAS PROCESS FLOW DIAGRAM

FIGURE 4.2

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

- Oxidation Ditches
- Secondary Clarification
- Filters
- Blowers
- Return Activated Sludge (RAS) and Waste Activated Sludge (WAS) Pumping Station
- Chlorine Contact Basins
- Reuse Pump Station
- Effluent Pump Station
- Sand Drying and Sludge Watering Beds

No teardowns or destructive testing was performed. Equipment evaluations were categorized with using the following guidelines:

Equipment Status

- **O**-Operation
- **NO**-Non-Operational

Equipment Condition

- **NV**-No visible issues
- **M**-Visible condition issue, but not significant at this time
- **R**-Visible condition issue, should be part of a scheduled repair program
- **S**-Severe Visible condition issue, requires immediate attention

Safety or Code Violations

- **CV**-Code violation
- **SI**-Safety issue

In May 2014, Carollo prepared an evaluation of the Chemical Storage Building facilities recommending rehabilitation and replacement of existing equipment and storage facilities. Therefore, condition assessment of the Chemical Storage Building was not part of this condition assessment effort. A copy of the Chemical Storage Building evaluation is provided in Appendix C.

3.0 FACILITY EVALUATION

The facility evaluation presented herein focuses on the existing condition of the equipment. The evaluation was performed on thirteen distinct process areas. Where applicable, structures, mechanical equipment, and electrical equipment were evaluated for each area. Splitter structures (i.e. Headworks Distribution Box, Mixed Liquor Distribution Box) were observed to be in good condition, although a formal visual assessment was not performed. The County may consider scheduling preventive maintenance to perform a condition inspection on the various splitter structures within the site. Coordination would be required, as the structures would need to be taken out of service to perform the inspection. As a general note, the overall condition of the facility was observed to be significantly superior to many like facilities the Carollo team has evaluated. Much credit for the condition of the facility can be given to the proactive operators and operations and engineering staff that oversees the facility.

3.1 Steamboat Creek Lift Station

The Steamboat Creek Lift Station (SCLS) is located off site and supplies Headworks Screening Building with raw sewage via a force main. The SCLS is a wet well/dry well style lift station with a concrete cylindrical wet well (Photo 4.1) and a dry well containing the lift pumps (Photo 4.2). The lift station was manufactured by Smith and Loveless. Electrical and communication equipment is located above grade (Photo 4.3). The site is equipped with a backup emergency diesel generator (Photo 4.4).

Photo 4.1 - SCLS Wet Well

Photo 4.2 - SCLS Dry Well

Photo 4.3 - SCLS Local Control Panel

Photo 4.4 - SCLS Backup Emergency Diesel Generator

3.1.1 Steamboat Creek Lift Station Condition

The Steamboat Creek Lift Station is operational. Table 4.1 provides a summary of the field comments, significant findings, and condition deficiencies.

**Table 4.1 Steamboat Creek Lift Station
STMWRF Facility Plan Update
Washoe County**

Equipment	Equipment Status	Condition	Comments
Motors	O	NV	
Pumps	O	NV	
Electrical Equipment	O	NV	
Instrumentation	O	M	I & C equipment is obsolete (1)
Emergency Diesel Generator	O	NV	

Notes:
(1) Photos of deficiencies are included in Appendix B.

3.2 Influent Pumping Station

The Influent Pumping Station (IPS) is located adjacent to the Headworks Screening Facility. Two enclosed Archimedes screw pumps lift influent wastewater from the gravity sewer to the Headworks Screening Facility. Plant drains are also returned to the head of the plant via drain line into the pump suction basin. Photo 4.5 illustrates the overall configuration of the IPS. Photo 4.6 illustrates the common concrete suction basin for both pumps, located at the base of the pumps. The suction basin contains a manually-operated cast iron gate and level instrumentation. Photo 4.7 illustrates the IPS motor and drive units.

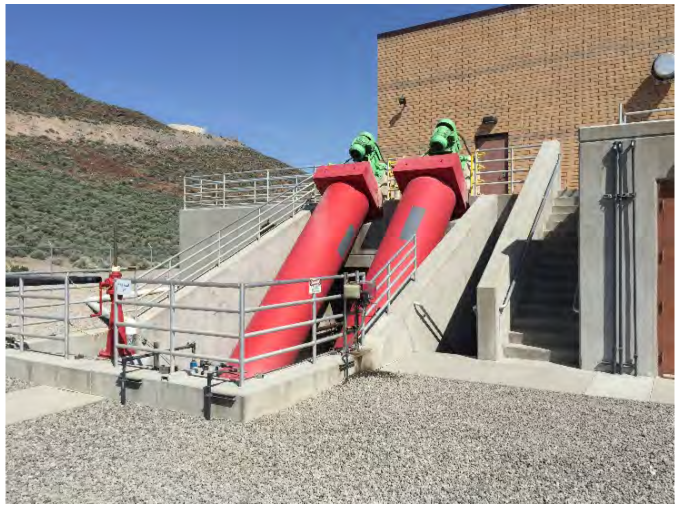


Photo 4.5 - Overall View Influent Pumping Station

Photo 4.6 - Archimedes Screw Pump Suction Basin

Photo 4.7 - Archimedes Screw Pump Drives

3.2.1 Influent Pumping Station Condition

The IPS is operational and no significant findings were noted. Table 4.2 provides a summary of the field comments and condition deficiencies.

Table 4.2 Influent Pumping Station
STMWRF Facility Plan Update
Washoe County

Equipment	Equipment Status	Condition	Comments
Pump Suction Basin and Pump Structure	O	NV	
Lift Pumps	O	M	Splashing occurs the top of the lift pumps(1)
Motors and Drives	O	M	The Emergency Stop Button is damaged on the west screw pump(1)
Coatings	O	NV	
Electrical Equipment	O	NV	
Walkways and Handrails	O	NV	
Head Works Electrical Room	O	NV	

Notes:
(1) Photos of deficiencies are included in Appendix B

3.3 Headworks Mechanical Screening

The Headworks Mechanical Screens are located adjacent to the IPS. The Headworks Mechanical Screens have been in service approximately one year. The equipment includes mechanical screens, washer-compactor, gates, control panels, and electrical room. Photo 4.8 illustrates the mechanical screen. Photo 4.9 illustrates the mechanical screen controls, located in the adjacent electrical room. Each screen can be isolated by a motor-operated gate, illustrated in Photo 4.10. Screenings from the mechanical screens are washed and compacted by the washer-compactor, illustrated in Photo 4.11. The washer-compactors are provided with a local control panel illustrated in Photo 4.12. The washer-compactor discharges to a container located on the exterior of the structure, illustrated in Photo 4.13.

Photo 4.8 - Mechanical Screen

Photo 4.9 - Mechanical Screen Control Panels

Photo 4.10 - Motor Operated Gates - Screens

Photo 4.11 - Washer-Compactors

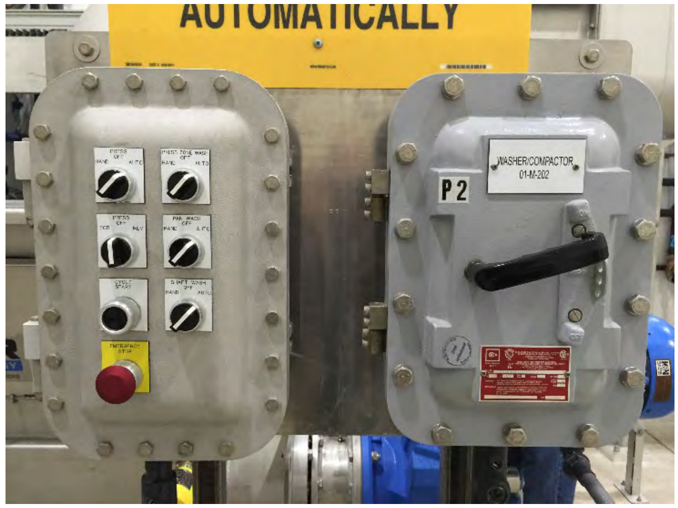


Photo 4.12 - Washer-Compactor LCP

Photo 4.13 - Washer-Compactor Discharge Container

3.3.1 <u>Mechanical Headworks Condition</u>

The Mechanical Headworks are operational and no significant findings were noted. Table 4.3 provides a summary of the field comments and condition deficiencies.

Table 4.3	Mechanical Headworks Condition STMWRF Facility Plan Update Washoe County		
Equipment	**Equipment Status**	**Condition**	**Comments**
Mechanical Head Works Screens and Gates	O	M	Corrosion is occurring at various locations on the screen and gates structure(1)
Washer Compactor	O	NV	
Motors and Drives	O	NV	)
Coatings	O	NV	
Electrical Equipment	O	NV	
Walkways and Handrails	O	NV	
Head Works Electrical Room	O	M	VFDs for Nos. 1, 2, 3, and 5 mechanical mixers are obsolete (1)
Notes: (1) Photos of deficiencies are included in Appendix B			

3.4 Headworks Manual Bar Screen

The Mechanical Headworks can be bypassed through the Manual Bar Screen. The Manual Bar Screen is located in an open channel outside the Headworks Building Complex, illustrated in Photo 4.14.

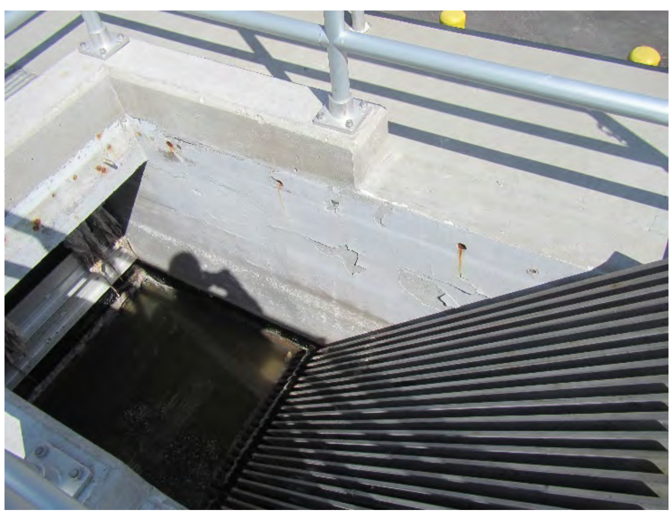


Photo 4.14 - Manual Bar Screen and Channel

3.4.1 Manual Bar Screen Condition

The Manual Bar Screen is operational. Table 4.4 provides a summary of the field comments, significant findings, and condition deficiencies.

Table 4.4 Manual Bar Screen Condition
STMWRF Facility Plan Update
Washoe County

Equipment	Equipment Status	Condition	Comments
Manual Bar Screen	O	NV	
Manual Bar Screen Channel Coatings	O	R	Coating failure has occurred in the Bar Screen inlet and outlet channel (1)
Walkways and Handrails	O	NV	

Notes:
(1) Photos of deficiencies are included in Appendix B

3.5 Oxidation Ditches

The facility has two Oxidation Ditches that serve as the primary treatment for the facility, illustrated in Photo 4.15 and Photo 4.16. The Oxidation Ditches are aerated with fine bubble diffusers illustrated in Photo 4.17. Mixing is provide by five Mechanical Mixers. Instrumentation includes dissolved oxygen probe and meter (Photo 4.18), ammonia and nitrate probes and meters (Photo 4.19 and 4.20), and thermal mass air flow probe and meter (Photo 4.21 and 4.22).

Photo 4.15 - Oxidation Ditches

Photo 4.16 - Oxidation Ditches

Photo 4.17 - Fine Bubble Aeration

Photo 4.18 - Dissolved Oxygen Probe and Meter

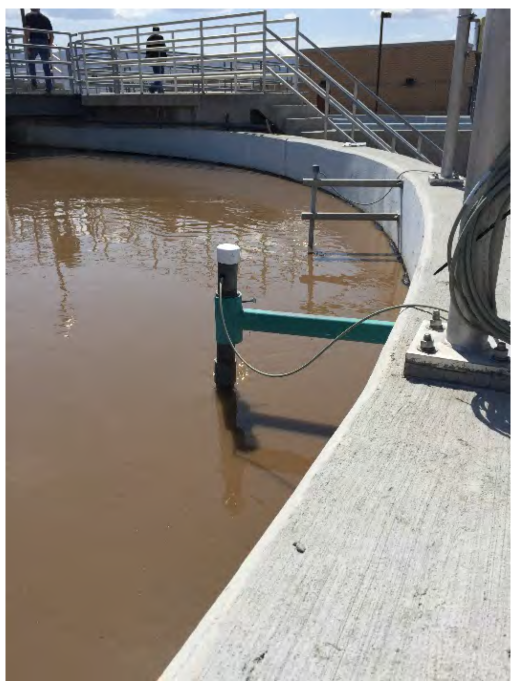


Photo 4.19 - Oxidation Ditch Instrument Probes

Photo 4.20 - Meter with Sun Shade

Photo 4.21 - Thermal Mass Air Flow Sensor

Photo 4.22 - Thermal Mass Air Flow Meter Readout

3.5.1 <u>Oxidation Ditch Condition</u>

The Oxidation Ditches are operational. Table 4.5 provides a summary of the field comments, significant findings, and condition deficiencies.

Table 4.5 Oxidation Ditch
STMWRF Facility Plan Update
Washoe County

Equipment	Equipment Status	Condition	Comments
Oxidation Ditch Structure	O	M	1. Coating failure has occurred [(1)]. 2. Cracks at several locations [(1)]
Fine Bubble Diffusers	O	NV	
Air Piping	O	M	Small air leaks noted
Mechanical Mixers	O	NV	
Instrumentation	O	M	1. Some of the local meter panels do not have sun shade protection [(1)] 2. Probes and meters will likely reach end of useful life within 5-10 years[(1)]
Electrical Equipment	O	NV	
Walkways and Handrails	O	NV	

<u>Notes:</u>
(1) Photos of deficiencies are included in Appendix B

3.6 Secondary Clarification

The facility has four Secondary Clarifiers that serve as the secondary treatment for the facility. A typical Secondary Clarifier is illustrated in Photo 4.23. The Secondary Clarifiers are equipped with drive mechanisms 4.24, and local control panels 4.25. Each Secondary Clarifier has a launder weir (Photo 4.26) and an outlet structure (Photo 4.27).

Photo 4.23 - Clarifier No. 3 Overall

Photo 4.24 - Clarifier No. 1 Drive

Photo 4.25 - Clarifier No. 3 Local Control Panel

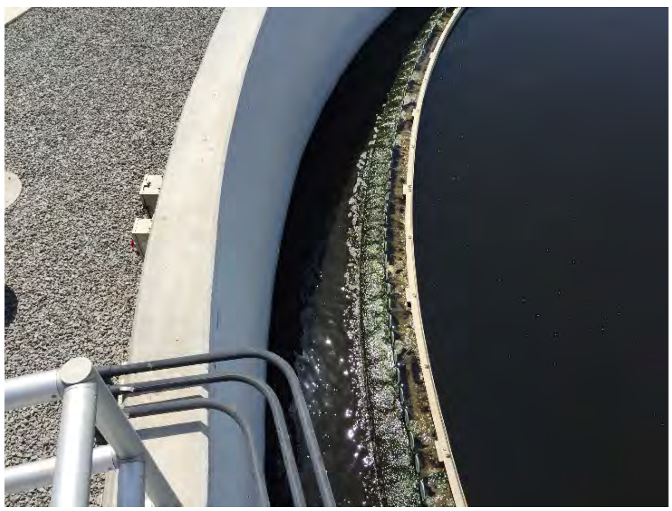


Photo 4.26 - Clarifier No. 2 Launder

Photo 4.27 - Secondary Clarifier Discharge

3.6.1 Secondary Clarifier Condition

The Secondary Clarifiers are operational. Table 4.6 provides a summary of the field comments, significant findings, and condition deficiencies.

Table 4.6 Secondary Clarifiers
STMWRF Facility Plan Update
Washoe County

Equipment	Equipment Status	Condition	Comments
Secondary Clarifier Structure	O	M	1. Some coating failure has occurred in Secondary Clarifier Nos. 2 and 3[(1)] 2. Some concrete spalling on Secondary Clarifier No. 1 floor [(1)]
Motor and drives	O	NV	
Launder	O	M	Algae build up on the launder V-Notch weirs creating a maintenance issue [(1)]; Consider brushes or covers for mitigation
Electrical Equipment	O	NV	
Walkways and Handrails	O	NV	

Notes:
(1) Photos of deficiencies are included in Appendix B.

3.7 Tertiary Filters

The Tertiary Filters are housed in the structure illustrated in Photo 4.28. There are eight filter cells, and three air lift pumps (Photo 4.29) associated with the filters. The Secondary Clarifiers gravity flow to the Tertiary Filters via the Filter Diversion Structure. The Tertiary Filters gravity flow to the Chlorine Contact Basins. There are two rapid mixers associated with the Tertiary Filters (Photo 4.30). Metering stations for the air lift pumps are located at grade (Photo 4.31).

Photo 4.28 - Tertiary Filters

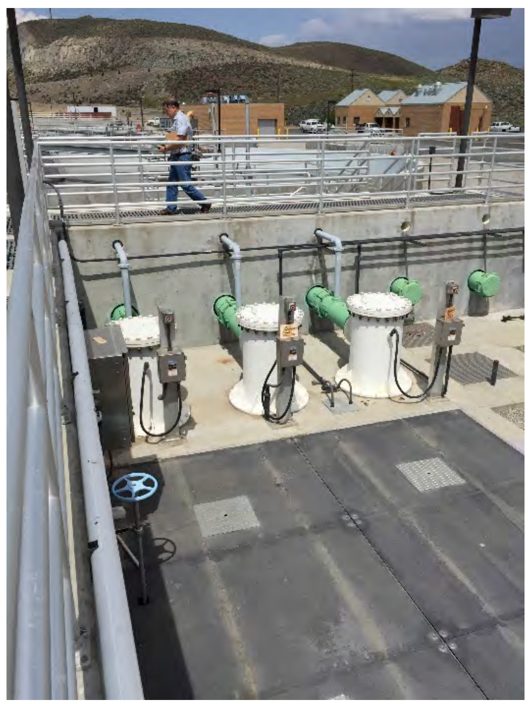


Photo 4.29 - Tertiary Filter Air Lift Pumps

Photo 4.30 - Tertiary Filter Rapid Mixer

Photo 4.31 - Air Lift Pump Instrumentation

3.7.1 <u>Tertiary Filter Condition</u>

The Tertiary Filters are operational. Table 4.7 provides a summary of the field comments, significant findings, and condition deficiencies.

Table 4.7	Tertiary Filters STMWRF Facility Plan Update Washoe County		
Equipment	**Equipment Status**	**Condition**	**Comments**
Filter Structure	O	M	Minor cracking of the concrete structure was observed [1]
Pumps	O	NV	
Instrumentation	O	M	The filter inlet channel mechanical level float is nonoperational
Walkways and Handrails	O	NV	

Notes:
(1) Photos of deficiencies are included in Appendix B.

3.8 Blowers

The Blowers are housed in a combined electrical mechanical room illustrated in Photos 4.32, 4.33, and 4.34, respectively. The Blower intake filters are housed on the building roof. The Blowers supply air to each Oxidization Ditch via piping running below deck level at the Oxidation Ditches. Air flow from the Blowers is controlled via a flow paced air flow setpoint. The air supplied to the Oxidation Ditches is dispersed via fine bubble diffusers. Each Blower has a local Control Panel (Photo 4.35).

Photo 4.32 - Blower Electrical Room

Photo 4.33 - Blower Electrical Room

Photo 4.34 - Blower Room

Photo 4.35 - Blower Local Control Panel

3.8.1 Blower Condition

The Blowers are operational, except Blower No. 2 that was out of service for routine preventive maintenance. Table 4.8 provides a summary of the field comments, significant findings, and condition deficiencies.

Table 4.8 Blowers
STMWRF Facility Plan Update
Washoe County

Equipment	Equipment Status	Condition	Comments
Blowers	O	NV	
Electrical Equipment	O	NV	
Instrumentation	O	NV	
Structural	O	NV	

3.9 RAS and WAS Pumping Station

The RAS and WAS Pumping Station is located in the basement below the associated RAS/WAS Electrical Room. The RAS and WAS pumps are illustrated in Photo 4.36. The RAS and WAS Electrical Room is illustrated in Photo 4.37. The RAS and WAS pumps take suction on the RAS/WAS Wet Well. RAS is pumped to the Oxidation Ditches. WAS is currently pumped to the Longley Sewer Interceptor. A construction project is now in progress to process WAS on site.

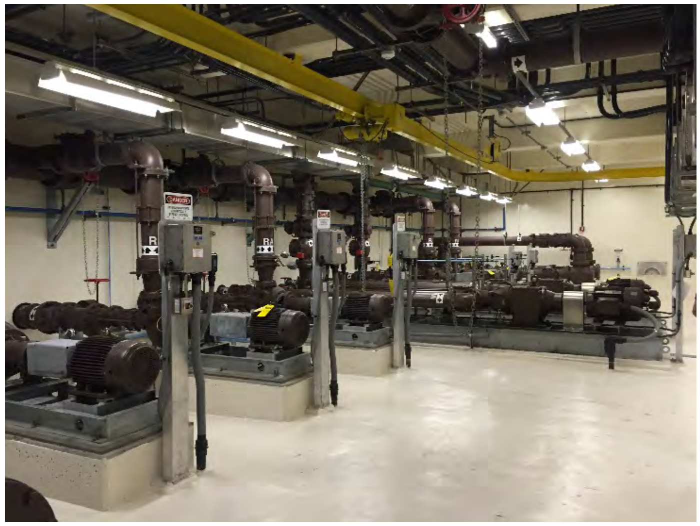


Photo 4.36 - RAS/WAS Room

Photo 4.37 - RAS/WAS Electrical Room

3.9.1 RAS and WAS Pumping Station Condition

The RAS and WAS Pumping Station is operational. Table 4.9 provides a summary of the field comments, significant findings and condition deficiencies.

Table 4.9	RAS and WAS Pumping Station STMWRF Facility Plan Update Washoe County		
Equipment	**Equipment Status**	**Condition**	**Comments**
Motors	O	NV	
Pumps	O	NV	
Electrical Equipment	O	NV	
Instrumentation	O	NV	
Walkways and Handrails	O	NV	

3.10 Chlorine Contact Basins

The Chlorine Contact Basins, illustrated in Photo 4.38, are a baffled concrete structure that receive Tertiary Filters effluent, and discharge to the Effluent Pump Station and Reuse Pump Station Wet Wells. There are four basins. Chlorine is metered from the Chemical Building. The Chlorine Contact Basins are sampled and continuously monitored for chlorine residual and turbidity. The sample pumps and sampling equipment is located in the in the Reuse Pump Station. Chlorine residual and Turbidity sampling equipment are illustrated in Photo 4.39 and 4.40, respectively.

Photo 4.38 - Chlorine Contact Basins

Photo 4.39 - Chlorine Contact Basins Chlorine Sampling Piping

Photo 4.40 - Chlorine Contact Basins Turbidity Sample Pump and Piping

3.10.1 <u>Chlorine Contact Basin Condition</u>

The Chlorine Contact Basins are operational. Table 4.10 provides a summary of the field comments, significant findings, and condition deficiencies.

Table 4.10	Chlorine Contact Basins STMWRF Facility Plan Update Washoe County		
Equipment	**Equipment Status**	**Condition**	**Comments**
Structural	O	M	Small cracks in structure[1]
Instrumentation	O	NV	
Walkways and Handrails	O	NV	

Notes:
(1) Photos of deficiencies are included in Appendix B.

3.11 Export Pump Station

The Export Pump Station has five vertical turbine pumps, illustrated in Photo 4.41, that supply end users with reuse water. The pumps take a suction on the Export Pump Station Wet Well (not inspected). The Export Pump Station has a surge tank, illustrated in Photo 4.42, located on the exterior of the building. The Export Pump Station electrical equipment is located adjacent to the pumps, illustrated in Photo 4.43.

Photo 4.41 - Export Pump Station Vertical Turbine Pumps

Photo 4.42 - Export Pump Station Surge Tank

Photo 4.43 - Export Pump Station Electrical Equipment

3.11.1 Export Pump Station Condition

The Export Pump Station is operational. Operations staff indicated that the surge tank was recently inspected (under a separate contract) and appears to be in good condition. Table 4.11 provides a summary of the field comments, significant findings and condition deficiencies.

Table 4.11	Export Pump Station STMWRF Facility Plan Update Washoe County		
Equipment	**Equipment Status**	**Condition**	**Comments**
Motors	O	NV	
Pumps	O	NV	
Piping	O	M	1. Pump and piping drains are supported by rope or wire [(1)] 2. Air release valves have garden hose vice hard piping to the floor drains [(1)]
Electrical Equipment	O	NV	
Instrumentation	O	NV	
Structural	O	NV	

Notes:
(1) Photos of deficiencies are included in Appendix B.

3.12 Effluent Pump Station

The Effluent Pump Station is equipped with five vertical turbine pumps, illustrated in Photo 4.44, that supply end users with reuse water. The pumps take a suction on the Effluent Pump Station Wet Well (not inspected). The Effluent Station has a surge tank, illustrated in Photo 4.45, located on the exterior of the building. The Effluent Pump Station electrical equipment is located in the adjacent attached Electrical Room, illustrated in Photo 4.46, 4.47, and 4.48. The Effluent Pump Station houses the old Plant Water Booster Station (Photo 4.49). Plant water is now supplied by the Reuse Pump Station.

Photo 4.44 - Effluent Pump Station Vertical Turbine Pumps

Photo 4.45 - Effluent Pump Station Surge Tank

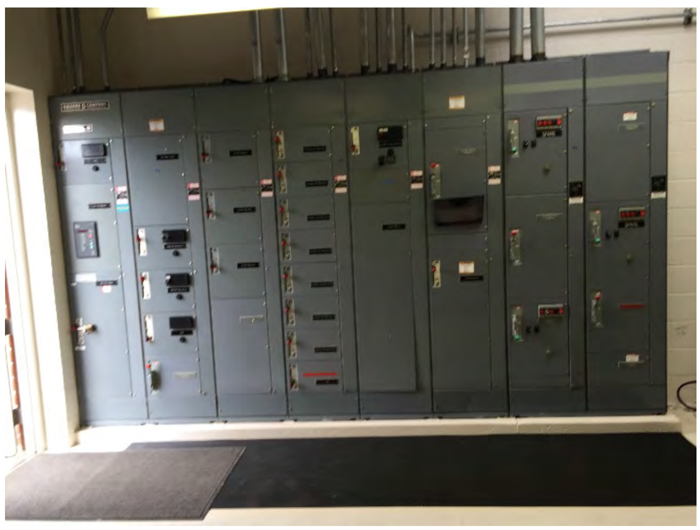


Photo 4.46 - Effluent Pump Station Electrical Room

Photo 4.47 - Effluent Pump Station Variable Frequency Drive Nos. 1 and 2

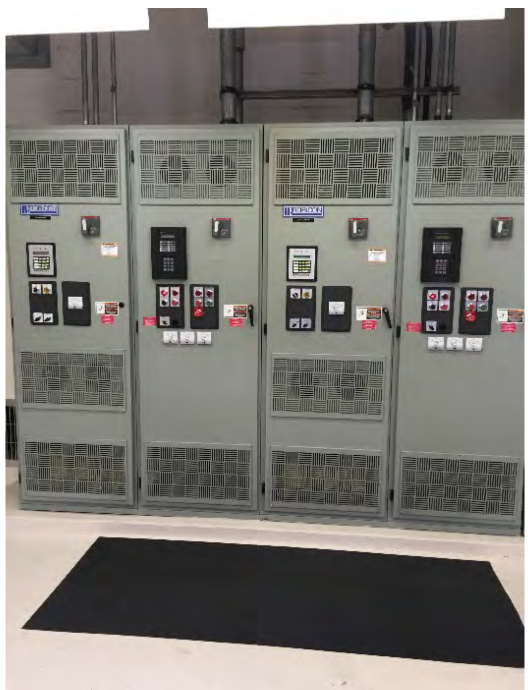


Photo 4.48 - Effluent Pump Station Variable Frequency Drive Nos. 4 and 5

Photo 4.49 - Plant Water Booster Station

3.12.1 Effluent Pump Station Condition

The Effluent Pump Station is operational. Table 4.12 provides a summary of the field comments, significant findings, and condition deficiencies.

Table 4.12 Effluent Pump Station
STMWRF Facility Plan Update
Washoe County

Equipment	Equipment Status	Condition	Comments
Motors	O	NV	
Pumps	O	NV	
Plant Water Booster Pumps	O	M	Station should cleaned and preserved(1)
Electrical Equipment	O	M	VFDs 4 and 5 are obsolete (1)
Instrumentation	O	NV	
HVAC	O		Staff reports the AC unit often freezes the evaporative coil within the air handler unit (1)
Structural	O	R	1. The joist above Pump 1 is twisted at electrical conduit attachment (1) 2. There is a roof leak at the wall (1)

Notes:
(1) Photos of deficiencies are included in Appendix B

3.13 Sand Drying and Sludge Dewatering Beds

The Sand Drying and Sludge Dewatering Beds are currently not used and were assessed to document the existing condition. Sand Drying and Sludge Dewatering Beds are illustrated in Photo 4.50 and 4.51, respectively.

Photo 4.50 - Sand Drying Beds

Photo 4.51 - Sludge Dewatering Beds

3.13.1 <u>Sand Drying and Sludge Dewatering Bed Condition</u>

The Sand Drying and Sludge Dewatering Beds are not operational. Table 4.13 provides a summary of the field comments, significant findings, and condition deficiencies.

Table 4.13	Sand Drying and Sludge Watering Beds STMWRF Facility Plan Update Washoe County		
Equipment	**Equipment Status**	**Condition**	**Comments**
Structure	NO	R	
Walkways and Handrails	O	NV	

4.0 SUMMARY OF DEFICIENCIES AND RECOMMENDED CORRECTIVE ACTION

Table 4.14 summarizes the condition deficiencies, provides recommendations, and identifies potential improvements.

Table 4.14	Summary of Deficiencies and Recommendations STMWRF Facility Plan Update Washoe County		
Location	**Equipment**	**Condition**	**Recommendation**
IPS	Screw Pumps	Splashing occurs at the top of the lift pumps.	Design and add splash protection.
Steamboat Creek Lift Station	Instrumentation	I & C equipment is obsolete.	Phased replacement and upgrade.
Steamboat Creek Lift Station	Standby Generator	Preventive maintenance.	Perform load test annually.
IPS	Emergency Stop Button	The Emergency Stop Button is damaged on the west screw pump.	Replace.
Headworks Electrical Room	Mixer VFDs	VFDs Nos. 1, 2, 3 and 5 are obsolete.	Phase replacement of obsolete VFDs.
Mechanical Headworks Building	Mechanical Screens and Gates	Corrosion is occurring at various locations on the screens and gates.	Contact the Manufacturer/Design Engineer/Contractor for resolution.
Manual Bar Screen	Channel Structure	Coating failure has occurred in the inlet and outlet channel.	Dewater, conduct an inspection and repair concrete damage and recoat.

Table 4.14 Summary of Deficiencies and Recommendations
STMWRF Facility Plan Update
Washoe County

Location	Equipment	Condition	Recommendation
Oxidation Ditch	Structure	Coating failure has occurred.	Systematically dewater, conduct an inspection and repair concrete damage and recoat.
Oxidation Ditch	Structure	Cracks at various locations.	Conduct concrete repairs.
Oxidation Ditch	Air Piping	Small air leaks.	Repair. Check pipe support or for flange misalignment if issue persists.
Oxidation Ditch	Instrumentation	Some of the local meter panels do not have sun shade protection.	Design and install shade protection.
Oxidation Ditch	Instrumentation	Probes and meters will likely reach end of useful life within 5-10 years.	Phased replacement of probes and meters.
Secondary Clarifier	Structure	Some coating failure has occurred (Nos. 2 and 3).	Systematically dewater, conduct an inspection and repair concrete damage and recoat. All clarifiers should be inspected.
Secondary Clarifier	Launder	Algae build up on the launder V-Notch weirs creating a maintenance issue.	Continue chlorination for the short term. Evaluate covers or brushes.
Tertiary Filters	Structure	Minor cracking of the concrete structure was observed.	Conduct concrete repairs.
Tertiary Filters	Instrumentation	The filter inlet channel mechanical level float is nonoperational.	Repair.

Table 4.14 Summary of Deficiencies and Recommendations STMWRF Facility Plan Update Washoe County

Location	Equipment	Condition	Recommendation
Chlorine Contact Basin	Structural	Small cracks in structure.	Systematically dewater, conduct an inspection, and repair visible and non-visible concrete damage.
Export Pump Station	Drain Piping	Pump and piping drains are supported by rope or wire.	Design and replace piping.
Export Pump Station	Drain Piping	Air release valves have garden hose vice hard piping to the floor drains.	Design and replace piping.
Effluent Pump Station	Plant Water Booster Pumps	Station should cleaned and preserved.	Clean and preserve.
Effluent Pump Station	Electrical Equipment	VFDs 4 and 5 are obsolete.	Phase replacement of obsolete VFDs.
Effluent Pump Station	Roof	There is a roof leak at the wall.	Conduct and roof inspection by a qualified roofing contractor. Repair.
Effluent Pump Station	Structural	The joist above Pump No. 1 is twisted at electrical conduit attachment.	Reinforce joist. Repair deformation.
Effluent Pump Station Electrical Room	HVAC	AC unit often freezes the evaporative coil within the air handler unit.	Replace AC unit.
Sand Drying and Sludge Dewatering Beds	Not Used	Degraded.	In order to maintain the permit for the drying and dewatering beds, recommend minimum refurbishment.

5.0 ENGINEERS OPINION OF PROBABLE CONSTRUCTION COST

The estimated project cost for the recommendations presented in the previous section total approximately $3.7 million. The estimate breakdown by area is included in Appendix D. The estimates are based on standard methodologies and best practices as prescribed by the Association for the Advancement of Cost Engineering (AACE) International. This is a Class 5 cost estimate and, in accordance with AACE International, the expected accuracy of the cost estimate is as follows:

- Low range: -15 percent to -30 percent
- High range: +20 percent to +50 percent

During the period between the site visit and development of this technical memorandum, some equipment identified for rehabilitation or replacement, has been proactively addressed. This includes fixing air piping leaks and installing sun shade protection for the local meter panels at the Oxidation Ditches. In addition, the County is planning an electrical equipment upgrade that will address obsolete VFDs and instrumentation and has an existing CIP project to rehabilitate the plant water booster station at the Effluent Pump Station. When considering the overall capital improvement plan for STMWRF, these recommended rehabilitation / replacement items are considered completed and are not included in Technical Memorandum No. 7, Overall CIP and Implementation Plan.

APPENDIX A – CHECK LISTS

Structural Evaluations

Structure: Influent Pump Station & Screening Structure

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)	Not Visible	None			
Walls	Good some grease	See Comment ~~None~~	M in walls		@ wetwell not coated channels coated looks good
Ceiling ___N/A		None			
Other; Describe		None			

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ✓N/A					
Windows ✓N/A					
Insulation ✓N/A					
Other; Describe		Stucco good			

Notes:

Very hard to get pictures of ~~cat~~ coating due to brightness

Coating bad at screens

Channel coating bad older installation.

Pictures:

Structural Evaluations

Structure: Headworks

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)		Excellent			Brand new
Walls		Excellent			↓
Ceiling ___N/A		Excellent			↓
Other; Describe					↓

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ___N/A			R		Some chalking
Windows ___N/A					
Insulation ___N/A					
Other; Describe					

Notes: One year old
Channels well coated
They like the screens
they like the washer/compactor (but not as much)

Pictures:

Structural Evaluations

Structure: CCBx

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)					
Walls	*(M)	very minor chipping			N. Side
Ceiling ___N/A					
Other; Describe					

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ___N/A					
Windows ___N/A					
Insulation ___N/A					
Other; Describe					

Notes: Blockout for gate spalling at beam Edge Distance reduced

Pictures:

Structural Evaluations

Structure: Sludge Drying Beds

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)			Yes (R)		Grates are cracked at South end
Walls	Yes		Yes (R)		
Ceiling ___N/A					
Other; Describe					

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ___N/A					
Windows ___N/A					
Insulation ___N/A					
Other; Describe					

Notes:

Pictures:

Structural Evaluations

Structure: RAS/WAS Pump Station

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)		Good	None		
Walls		Good	↓		
Ceiling ___N/A		Good	↓		
Other; Describe					

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ___N/A	Good		very minor		
~~Windows~~ ✓ N/A					
Insulation ___N/A	~~Can't~~				Can't See
Other; Describe					

Notes:

Basement Same condition as main floor
Good/Good/Good

Monorail in good condition
Insignificant spalling on basement floor

Pictures:

Structural Evaluations

Structure: Effluent Pump Station Attached Elect Room

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)		Worn			
Walls		Excellent			
Ceiling ___N/A		Excellent			Joist deformed at Electric hanger(s) above P1
Other; Describe					

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ___N/A	Good				
Windows ___✓N/A					
Insulation ___✓N/A					
Other; Describe					

Notes: Roof leak against wall

Pictures:

Structural Evaluations

Structure: Blower Building + Elec Room adjacent

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)		Good			
Walls		Very Good			
Ceiling ___N/A		Good But Dirty			
Other; Describe					

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ___N/A	Excellent	Minor	Yes		
Windows ✓ N/A					
Insulation ✓ N/A					None visible
Other; Describe					

Notes:

Pictures:

Structural Evaluations

Structure: Tertiary Filters

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)		None			
Walls		None	Yes @ north		
Ceiling /N/A					
Other; Describe					

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ___N/A					
Windows ___N/A					
Insulation ___N/A					
Other; Describe					

Notes:

Pictures:

Structural Evaluations

Structure: ReUse ~~E S Street~~ Pump Station

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)		Excellent			
Walls		"			
Ceiling ___N/A		"			
Other; Describe					

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ___N/A	Excellent		Slight		
~~Windows~~ _✓_N/A					
~~Insulation~~ _✓_N/A					
Other; Describe					

Notes: Drain pipes ~~jerry~~ jerry rigged. Need permanent fix.

Roll up door

Pictures:

Structural Evaluations

Structure: Secondary Clarifier #1

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)	(R) Some				
Walls			None Visible		
Ceiling ✓ N/A					
Other; Describe					

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ✓ N/A					
Windows ✓ N/A					
Insulation ✓ N/A					
Other; Describe					

Notes: ______

Pictures:

Structural Evaluations

Structure: Secondary Clarifier #2

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)					Not visible
Walls		Some issues			
Ceiling ✓ N/A					
Other; Describe					

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ✓ N/A					
Windows ✓ N/A					
Insulation ✓ N/A					
Other; Describe					

Notes: ____________________

Pictures:

Structural Evaluations

Structure: Secondary Clarifier No 3

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)			~~too~~		Not Visible
Walls		Some Peeling	None		At water surface
Ceiling ___N/A					
Other; Describe					

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ___N/A					
Windows ___N/A					
Insulation ___N/A					
Other; Describe					

Notes:

Pictures:

Structural Evaluations

Structure: Secondary Clarifier No 4

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)					Not Visible
Walls		Good			Better than others
Ceiling ___N/A					
Other; Describe					

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ___N/A					
Windows ___N/A					
Insulation ___N/A					
Other; Describe					

Notes:

Pictures:

Structural Evaluations

Structure: Oxidation Ditch 1

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)					Not Visible
Walls		Good	None		
Ceiling ✓ N/A					
Other; Describe					

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ___N/A					
Windows ___N/A					
Insulation ___N/A					
Other; Describe					

Notes:

Two places show cracks @ Handrail/Guard posts See Pictures one in Oxidation ditch 2 set

Pictures:

Structural Evaluations

Structure: Oxidation Ditch 2

Structural Issues. Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention)

Element	Spalling (Corrosion on metals)	Coating	Cracks	Other	Comments
Floors (slabs)					Can't see
Walls		Peeling	Crack		Crack @ walkway support
Ceiling _✓_N/A					
Other; Describe					

Architectural Issues

Element	Hardware	Flaking	Fading	Other	Comments
Doors ___N/A					
Windows ___N/A					
Insulation ___N/A					
Other; Describe					

Notes: ______

Pictures:

Equipment Evaluations

Equipment : LIFT STATION SCREW PUMPS Equipment Markings: CPC INTERALIFT NO 1 (EAST) NO 2 (WEST)

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges				N/A	
Instruments				O	UT level (ADDING 1)
Motors				O	
Drives				O	
Couplings				O	
Pump/ Component/ Mechanism				O	
Pipe and Equipment Supports				✓ O	
Vibration/Noise				✓ O	
Safety Devices				??,	E STOP Need Repair (WEST) #2
Lubrication				✓	
Grating/Handrails				✓ O	
Operator Comments	Replaced Lane Box, no issues.				
Photo Comments	splashing @ top of pump				
Name Plate Data					
Other; Describe	CAST IRON GATE w/ MAN. OP.				
Misc Comments	Splashing on west side on Dock				

Equipment Evaluations

Equipment : Sec Clarifier Equipment Markings: 1-4

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges				O	
Instruments				O	
Motors				O	
Drives				O	
Couplings				O	
Pump/ Component/ Mechanism				O	
Pipe and Equipment Supports				O	
Vibration/Noise				O	
Safety Devices				O	
Lubrication				O	
Grating/Handrails				O	
Operator Comments	Algae issues - minor.				
Photo Comments	–				
Name Plate Data					
Other; Describe	Some Coating Failure Above water line				
Misc Comments					

Equipment Evaluations

Equipment : Blower E Room Equipment Markings: ✓

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges				O	
Instruments				O	
Motors				N/A	
Drives				N/A	
Couplings				N/A	
Pump/ Component/ Mechanism				N/A	
Pipe and Equipment Supports				O	
Vibration/Noise				O	
Safety Devices				O	
Lubrication				N/A	
Grating/Handrails				N/A	
Operator Comments	no issues				
Photo Comments					
Name Plate Data					
Other; Describe					
Misc Comments					

Equipment Evaluations

Equipment : Drying Beds - Equipment Markings: ____________________

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				NO	
Gauges				N/A	
Instruments				N/A	
Motors				N/A	
Drives				N/A	
Couplings				N/A	
Pump/ Component/ Mechanism				NO	
Pipe and Equipment Supports				N/A	
Vibration/Noise				N/A	
Safety Devices				N/A	
Lubrication					
Grating/Handrails				O	
Operator Comments	Damaged. —				
Photo Comments					
Name Plate Data					
Other; Describe	Consider upgrade to maintain permit				
Misc Comments					

Equipment Evaluations

Equipment : Mixers Equipment Markings: 1-5

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges					
Instruments					
Motors				O	
Drives				O	
Couplings				O	
Pump/ Component/ Mechanism				O	
Pipe and Equipment Supports				O	
Vibration/Noise				O	
Safety Devices				O	
Lubrication				O	
Grating/Handrails				O	
Operator Comments	Mixer's need to address Trip on loss of power –				
Photo Comments					
Name Plate Data					
Other; Describe					
Misc Comments					

Equipment Evaluations

Equipment : BASIN 1/2 Equipment Markings: NH3, DO Nitrate

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges				O	
Instruments				O	
Motors				O	
Drives				O	
Couplings				O	
Pump/ Component/ Mechanism				O	
Pipe and Equipment Supports				O	
Vibration/Noise				O	
Safety Devices				O	
Lubrication				O	
Grating/Handrails				O	
Operator Comments					
Photo Comments					
Name Plate Data	Minor Air Leaks @ Flex Coupling				
Other; Describe					
Misc Comments					

Equipment Evaluations

Equipment : Head work Equipment Markings: New!

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges				O	
Instruments				O	
Motors				O	
Drives				O	
Couplings				O	
Pump/ Component/ Mechanism				O	
Pipe and Equipment Supports				O	
Vibration/Noise				O	
Safety Devices				O	
Lubrication				O	
Grating/Handrails				O	
Operator Comments	GATES - motor op				
Photo Comments	Minor Corrosion on Screen frame/GATES				
Name Plate Data					
Other; Describe	HATCHES - See Light Through - No Leaks				
Misc Comments					

Equipment Evaluations

Re Wolf

Equipment : Export Pumps Equipment Markings: 1-5

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges				O	
Instruments				O	
Motors				O	
Drives				O	
Couplings				O	
Pump/ Component/ Mechanism				O	
Pipe and Equipment Supports				O	
Vibration/Noise				O	
Safety Devices				O	
Lubrication				O	
Grating/Handrails				NA	
Operator Comments	Drain Piping Needs Support/Replace				
Photo Comments					
Name Plate Data					
Other; Describe					
Misc Comments					

Equipment Evaluations

Equipment : washer/Compressor Equipment Markings: Hubo

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges				O	
Instruments				O	
Motors				O	
Drives				O	
Couplings				O	
Pump/ Component/ Mechanism				O	
Pipe and Equipment Supports				O	
Vibration/Noise				O	
Safety Devices				O	
Lubrication				O	
Grating/Handrails				O	
Operator Comments	New				
Photo Comments					
Name Plate Data	See pics				
Other; Describe					
Misc Comments					

Equipment Evaluations

Equipment : Diffusers Equipment Markings: Aero-Strip / Aero Meter

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges				N/A ↓	
Instruments					
Motors					
Drives					
Couplings					
Pump/ Component/ Mechanism					
Pipe and Equipment Supports					
Vibration/Noise					
Safety Devices					
Lubrication				↓	
Grating/Handrails				O	
Operator Comments	No issues - Recently Replaced. Running off SCFM Set point not DO Level.				
Photo Comments					
Name Plate Data	Ammonia/ Nitrate probes				
Other; Describe					
Misc Comments					

Equipment Evaluations

Equipment : Submersible mixer 'E' Equipment Markings: Electrum

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges				NA	
Instruments				O	
Motors				O	
Drives				←	1,2,3 old
Couplings				n/A	#5 old.
Pump/ Component/ Mechanism				N/A	
Pipe and Equipment Supports				↓	
Vibration/Noise				↓	
Safety Devices				↓	
Lubrication				↓	
Grating/Handrails				↓	
Operator Comments					
Photo Comments	#5 old, Reg update, #1,2,3 old may Reg upgrade.				
Name Plate Data	see pic's				
Other; Describe					
Misc Comments					

Equipment Evaluations

Equipment : Hendwork Electrical Bldg Equipment Markings: Hello

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges					
Instruments					
Motors					
Drives					
Couplings					
Pump/ Component/ Mechanism					
Pipe and Equipment Supports					
Vibration/Noise					
Safety Devices					
Lubrication					
Grating/Handrails				✓	
Operator Comments					
Photo Comments	Washer Compactor LCP / MCC Screen'S' LCP				
Name Plate Data					
Other; Describe					
Misc Comments					

Equipment Evaluations

Equipment : RAS/WAS Building Equipment Markings: ____________

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges				O	
Instruments				O	
Motors				O	
Drives				O	
Couplings				O	
Pump/ Component/ Mechanism				O	
Pipe and Equipment Supports				O	
Vibration/Noise				O	
Safety Devices				O	
Lubrication				O	
Grating/Handrails				O	
Operator Comments	no issues				
Photo Comments					
Name Plate Data					
Other; Describe	Like new condition				
Misc Comments					

Equipment Evaluations

Equipment : Filters Equipment Markings: Parkinson

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges				O	
Instruments				O	
Motors				O	
Drives				O	
Couplings				O	
Pump/ Component/ Mechanism				O	
Pipe and Equipment Supports				O	
Vibration/Noise				O	
Safety Devices				O	
Lubrication				O	
Grating/Handrails				O	
Operator Comments	NO PH Adjustment. —				
Photo Comments	1 Float missing				
Name Plate Data					
Other; Describe					
Misc Comments					

Equipment Evaluations

Equipment : Blowers Equipment Markings: 1-5

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges				O	
Instruments				O	
Motors				O	
Drives				O	
Couplings				O	
Pump/ Component/ Mechanism				O	
Pipe and Equipment Supports				O	
Vibration/Noise				O	
Safety Devices				O	
Lubrication				O	
Grating/Handrails				O	
Operator Comments	# 03-LCP-ABL-2 OOC missing motor Being Robert. normal maintenance				
Photo Comments					
Name Plate Data	Filters on Roof				
Other; Describe					
Misc Comments					

Equipment Evaluations

Equipment : Effluent Pump Room Equipment Markings: 1-5

Mechanical or Electrical Equipment Issues: Fill in for Applicable Problems (M-Visible but not significant at this time, needs monitoring; R-Should be part of a scheduled repair program; S-Severe, needs immediate attention, O/NO-Operational, Non-Operational, CV-Code Violation)

Element	Corrosion	Leaks	Safety	Operational	Comments
General Conditions				O	
Gauges				O	
Instruments				O	
Motors				O	
Drives				O	
Couplings				O	
Pump/ Component/ Mechanism				O	
Pipe and Equipment Supports				O	
Vibration/Noise				O	
Safety Devices				O	
Lubrication				O	
Grating/Handrails				O	
Operator Comments	Some conduit support issues in				
Photo Comments	Roof. Structure - See pics				
Name Plate Data	VFD'S - 495 obsolute				
Other; Describe	HVAC - Freezes up				
Misc Comments	Roof leak				

APPENDIX B – PHOTO ARCHIVE OF DEFICIENCIES

Photo 1 - Splashing occurs at the top of the lift pumps

Photo 2 - IPS Damage Emergency Stop Button

Photo 3 - VFDs Nos. 1, 2, 3, and 5 Mechanical mixers are obsolete

Photo 4 - Corrosion is accruing at various location on the screen and gates structure

Photo 5 - Coating failure has occurred in the inlet and outlet channel at the manual Bar Screen

Photo 6 - Coating failure has occurred at the Oxidation Ditch


Photo 7 - Cracks at Oxidation Ditch


Photo 8 - Cracks at Oxidation Ditch

Photo 9 - Cracks at Oxidation Ditch

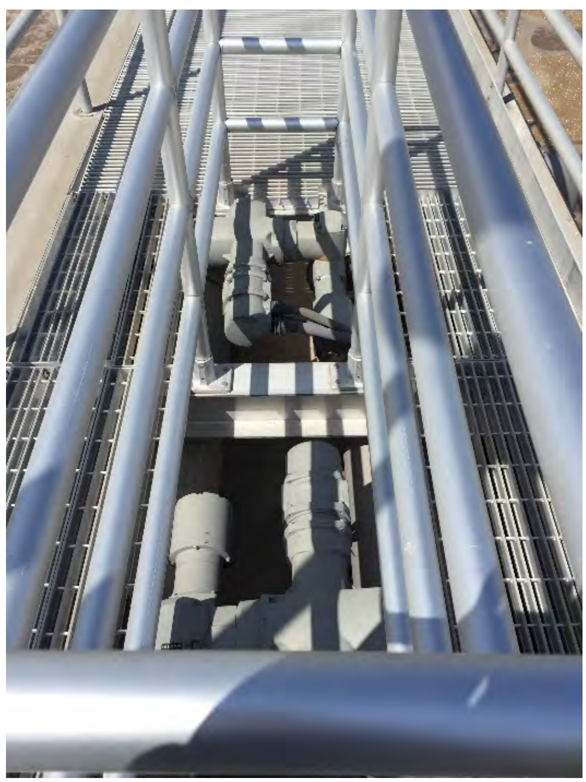


Photo 10 - Air Leaks at Aeration Piping

Photo 11 - Some of the local meter panels do not have sun shade protection at the Oxidation Ditch

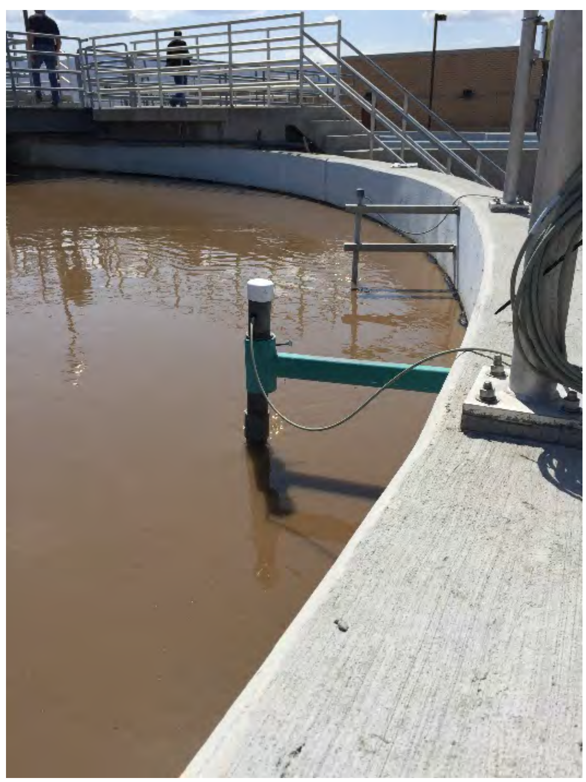


Photo 12 - Probes and meters at the Oxidation Ditch will likely reach end of life within 5-10 years

Photo 13 - Coating failure has occurred Secondary Clarifier No 2

Photo 14 - Coating failure has occurred Secondary Clarifier No 3

Photo 15 - Algae build up on the launderer V-Notch weirs at the Secondary Clarifier creating a maintenance issue

Photo 16 - Minor cracking of the concrete structure was observed at the Tertiary Filters

Photo 17 - Minor Concrete cracking at the Chlorine Contact Basin

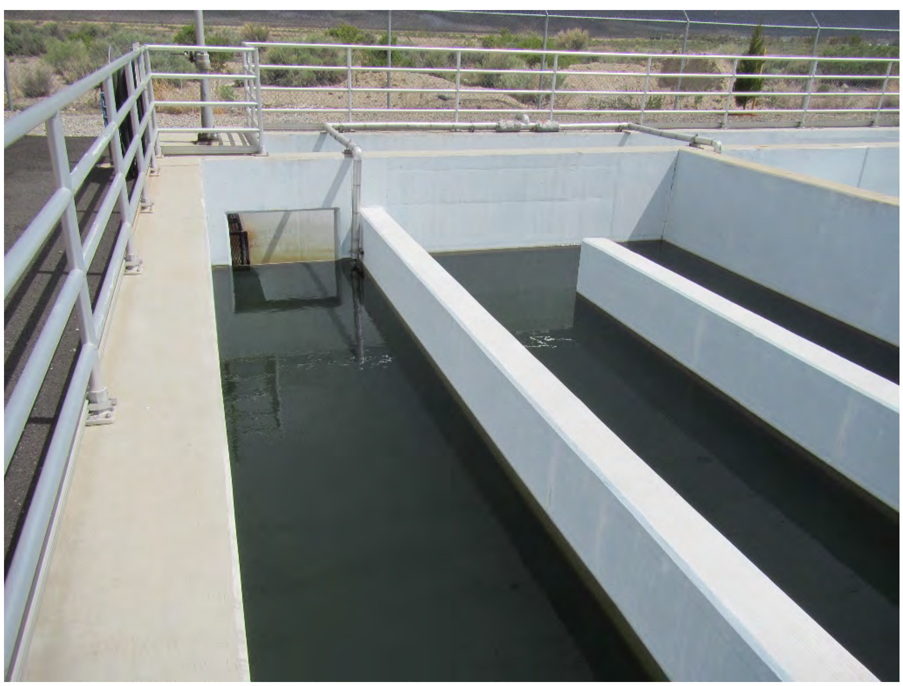


Photo 18 - Minor Concrete cracking at the Chlorine Contact Basin

Photo 19 - Minor Concrete cracking at the Chlorine Contact Basin

Photo 20 - Pump and piping drains are supported by rope or wire

Photo 21 - Air release valves have garden hose vice hard piping to the floor drains

Photo 22 - NPW Station should cleaned and preserved

Photo 23 - Effluent Pump Station VFDs 4 and 5 are obsolete

Photo 24 - Effluent Pump Station roof leak at the wall

Photo 25 - Effluent Pump Station joist above Pump 1 is twisted at electrical conduit attachment

Photo 26 - Effluent Pump Station joist above Pump 1 is twisted at electrical conduit attachment

Photo 27 - Effluent Pump Station Electrical Room AC unit often freezes the evaporative coil within the air handler unit-Compressor and Condenser

Photo 28 - Effluent Pump Station Electrical Room AC unit often freezes the evaporative coil within the air handler unit- Air Handler Unit

Photo 29 - The Sand Drying and Sludge Dewatering Beds are degraded

Photo 30 - Steamboat Creek Lift Station I & C equipment is obsolete

APPENDIX C – CHEMICAL STORAGE BUILDING REHABILITATION EVALUATION

WASHOE COUNTY
COMMUNITY SERVICES DEPARTMENT - WATER RESOURCES

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY

CHEMICAL STORAGE BUILDING REHABILITATION EVALUATION

May 2014

FINAL

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KELLI A. CALLAHAN
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5/28/14

WASHOE COUNTY

COMMUNITY SERVICES DEPARTMENT - WATER RESOURCES

SOUTH TRUCKEE MEADOWS RECLAMATION FACILITY CHEMICAL STORAGE BUILDING REHABILITATION EVALUATION

FINAL
May 2014

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pw://Carollo/Documents/Client/NV/Washoe County/9503A00/Deliverables/CSB Rehab Eval

WASHOE COUNTY COMMUNITY SERVICES DEPARTMENT - WATER RESOURCES

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY
CHEMICAL STORAGE BUILDING REHABILITATION EVALUATION

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1.0 PROJECT BACKGROUND

The South Truckee Meadows Water Reclamation Facility (STMWRF) was originally constructed in 1991 as a 1.5 million gallon per day (mgd) secondary treatment facility. In 2003, the plant capacity was expanded to 4.1 mgd through the addition of a new oxidation ditch, four secondary clarifiers, tertiary filters, and associated appurtenant structures and equipment, including a new chemical building. STMWRF is owned by Washoe County (County) and managed by the Washoe County Community Services Department (WCCSD). WCCSD Water Resources staff is responsible for preparing and maintaining a comprehensive Capital Improvement Program and has been proactive in identifying the need for evaluation of the chemical facilities at STMWRF. Carollo Engineers, Inc. (Carollo) was retained to provide engineering services for the Chemical Storage Building Rehabilitation Evaluation project (Project).

The existing Chemical Storage Building (CSB) has been in service for nearly fifteen years. Although the equipment appears to be in good operating condition, the primary goal of this Project is to enhance operator safety at STMWRF by improving chemical storage and handling “best practices” within the CSB. The evaluation includes actions necessary to evaluate selected equipment within the CSB. The field review and this evaluation will focus on code compliance, operator safety, and the material condition related to the safe operation and reliability of selected equipment within the CSB including:

- Bulk delivery area
- Two sodium hypochlorite bulk storage tanks and secondary containment tanks
- One alum bulk storage tank and secondary containment tank
- Chemical piping and fittings
- Pumps
- Chemical sumps and sump discharge lines

2.0 CODE REVIEW

The review presented herein examines code requirements associated with the use and storage of the chemicals utilized within the existing CSB – liquid sodium hypochlorite (12.5 percent solution) and liquid aluminum sulfate (alum). Currently, the alum system is not being used and the system has been flushed with water. The code review includes the following applicable codes and their associated amendments by the Washoe County Building Department:

- 2012 International Building Code (IBC)
- 2012 International Fire Code (IFC)
- 2012 International Mechanical Code (IMC)
- 2012 Uniform Plumbing Code (UPC)
- 2011 National Electric Code (NEC)
- National Fire Protection Association

2.1 Chemical Classification

The classifications of the chemicals stored within the CSB are defined within Chapter 2 of the IBC. Sodium hypochlorite and alum are both defined as corrosive and pose health hazards. Table 1 presents a summary of the chemical classifications for these two chemicals.

Table 1 Chemical Classification Summary
South Truckee Meadows Water Reclamation Facility Chemical Storage Building Rehabilitation Evaluation
Washoe County Community Services Department – Water Resources

Classification	Definition (per IBC)	Sodium Hypochlorite	Alum
Toxic	Any chemical with a median lethal dose in excess of the value listed within Section 202.	No	No
Corrosive	A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the point of contact.	Yes	Yes
Oxidizer	A material that readily yields oxygen or other oxidizing gas, or that readily reacts to promote or initiate combustion of combustible materials and, if heated or contaminated, can result in vigorous self-sustained decomposition.	No (1)	No
Health Hazard	A classification of a chemical for which there is statistically significant evidence that acute or chronic health effects are capable of occurring in exposed persons. The term "health hazard" includes chemicals that are *toxic* or *highly toxic*, and *corrosive*	Yes	Yes

Table 1	Chemical Classification Summary South Truckee Meadows Water Reclamation Facility Chemical Storage Building Rehabilitation Evaluation Washoe County Community Services Department – Water Resources		
Classification	**Definition (per IBC)**	**Sodium Hypochlorite**	**Alum**
Physical Hazard	A chemical for which there is evidence that it is a combustible liquid, cryogenic fluid, explosive, flammable (solid, liquid or gas), organic peroxide (solid or liquid), oxidizer (solid or liquid), oxidizing gas, pyrophoric (solid, liquid or gas), unstable (reactive) material (solid, liquid or gas) or water-reactive material (solid or liquid).	No	No
Hazardous Material	Those chemicals or substances that are physical hazards or health hazards as classified in Section 307 and the International Fire Code, whether the materials are in usable or waste condition.	Yes	Yes

Notes:

(1) Though sodium hypochlorite is an oxidizing agent, it is not considered a harmful oxidizer in the range of 5.0 – 12.5 percent per a formal interpretation by NFPA in 2004.

2.2 Occupancy Classification

The CSB falls under the IBC high-hazard Group H-4 occupancy classification.

The reason for the Group H-4 classification is that the CSB has a storage capacity of 12,000 gallons of sodium hypochlorite and 6,000 gallons of alum – corrosive materials. This volume exceeds the maximum allowable quantity per control area of hazardous material posing a health hazard as presented within IBC Table 301.1(2).

In accordance with IBC 903.2.5, automatic sprinkler systems for fire suppression are required in all Group H-4 occupancies. In addition, IBC 415.3 requires an automatic fire detection system be provided. Maintenance of the existing fire suppression and detection systems is performed quarterly by Simplex-Grinnell to verify operation. Fire sprinkler systems are currently installed within the CSB and maintenance of this system is performed quarterly by Simplex-Grinnell to verify operation.

For mixed occupancies, the IBC states that that each portion of the building shall be individually classified. The associated electrical room is classified as a Group F-2 occupancy. Per IBC 508.4, a minimum two-hour fire separation is required between the two occupancies where automatic sprinkler systems are installed.

2.3 Storage Requirements

In accordance with IFC Section 5004, rooms, buildings or areas used for the storage of hazardous material liquids in individual vessels having a capacity of more than 55 gallons, or in which the aggregate capacity of multiple vessels exceeds 1,000 gallons, liquid spill control and secondary containment are required.

2.3.1 Spill Control

Spill control is intended to prevent the flow of liquids into adjoining areas. Floors in indoor locations and similar surfaces in outdoor locations shall be constructed to contain a spill from the largest single vessel by one of the following methods:

- Liquid-tight sloped or recessed floors in indoor locations similar to outdoor locations.
- Liquid-tight floors in indoor locations or similar areas in outdoor locations provided with liquid-tight raised or recessed sills or dikes.
- Sumps and collections systems.
- Other approved engineered systems.

2.3.2 Secondary Containment

Secondary containment for hazardous material liquid storage is required by IFC Table 5004.2.2 by one of the following methods:

- Liquid-tight sloped or recessed floors in indoor locations similar to outdoor locations.
- Liquid-tight floors in indoor locations or similar areas in outdoor locations provided with liquid-tight raised or recessed sills or dikes.
- Sumps and collections systems.
- Drainage systems leading to an approved discharge location.
- Other approved engineered systems.

Indoor secondary containment systems shall be designed to contain a spill from the largest individual vessel plus the design flow volume of the fire protection water flow calculated to discharge from the fire-extinguishing system into the secondary containment system for a period of 20 minutes.

An approved monitoring method shall be provided to detect hazardous materials in the secondary containment system. Where secondary containment is subject to the intrusion of water, a monitoring method for detecting water shall be provided. Where monitor devices are provided, they shall be connected to an approved visual or audible alarm.

2.4 Emergency Alarm

Per Section 5004.9 of the IFC, an approved manual emergency alarm system shall be provided in buildings, rooms or areas used for storage of hazardous materials. Emergency alarm-initiating devices shall be installed outside of each interior exit or exit access door of storage buildings, rooms, or areas. Activation of an emergency alarm-initiating device shall sound a local alarm to alert occupants of an emergency situation involving hazardous materials.

2.5 Hazard Communication

Per Section 407 of the IFC, requires that material safety data sheets (MSDS) for all hazardous materials shall be readily available on the premises as a paper copy or where approved shall be permitted to be readily retrievable.

Visible hazard identification signs as specified in NFPA 704 for the specific material contained shall be placed on stationary containers and aboveground tanks and at entrances to locations where hazardous materials are stored, dispensed, used, or handled and at specific entrances and locations designated by the fire code official.

3.0 FIELD REVIEW AND EVALUATION OF THE CHEMICAL STORAGE BUILDING

On March 11, 2014, Carollo conducted a field review of the CSB with the assistance of plant operations staff at STMWRF. A field checklist was prepared and used as a guide for the review. The completed checklist is presented in Appendix A. The evaluation presented herein focuses on providing the best practices for chemical handling and storage, and identifies deficient conditions and practices. The evaluation is divided into five areas:

1. Bulk delivery area
2. Two sodium hypochlorite tanks and one alum bulk storage tank and their respective secondary containment tanks
3. Chemical piping and fittings
4. Chemical delivery pumps
5. Chemical sumps and sump discharge lines

3.1 Bulk Delivery Area Description

The CSB bulk delivery area for the sodium hypochlorite and alum bulk storage tanks is located on the north side of the CSB. The bulk delivery area is provided with two fill lines for receiving truck deliveries through Camlock style Type B disconnects. Each fill location is equipped with a ball isolation valve. Sodium hypochlorite and alum are delivered at the same location. A small containment area is provided to capture chemical spillage from the fill lines. The containment area drains are connected to the CSB common building floor drains that gravity drain to Manhole Number 6 (MH-6). No isolation valve is provided for the containment drain. The CSB bulk delivery area is illustrated in Photo 1. The CSB bulk delivery Emergency Shower and Eye Wash Station (ESEWS) is located adjacent to the CSB bulk delivery area, illustrated in Photo 2. The ESEWS is equipped with flow sensors to notify the plant operators through the supervisory control and data acquisition (SCADA) system when the ESEWS is activated.

Photo 1 CSB Bulk Delivery Area

Photo 2 CSB Bulk Delivery Area ESEWS

3.1.1 <u>Bulk Delivery Area Best Practices</u>

Current best practices for bulk chemical delivery areas differ from the existing CSB installation as follows:

Condition: The existing chemical delivery area has sodium hypochlorite and alum delivered at the same location.

Best Practice: A dedicated and segregated chemical delivery area and containment sump should be provided for each chemical type. Segregated chemical delivery areas and containment sumps prevent unwanted chemical reactions during leakage or a chemical spill.

Condition: The existing tuck loading area does not slope significantly towards the containment sump to capture a spill from a chemical delivery truck.

Best Practice: Chemical delivery tuck loading areas should be sloped toward the containment sump. In the event the delivery truck leaks or spills chemical during a delivery of bulk chemical, away from the containment sump, the resultant spillage will be directed to the containment sump vice the environment.

Condition: The bulk loading area containment drains back to MH-6, and ultimately to the head of facility process. In the event of a chemical spill, the facility process may be upset from a large dose of unwanted chemical.

Best Practice: Bulk loading containment areas generally drain to a sump area where any spillage can be processed to a hazardous waste disposal facility.

Condition: The isolation valve installed at the bulk loading station was originally a diaphragm valve in accordance with the Record Drawings. A ball valve is currently installed.

Best Practice: Ball valves are not normally used in sodium hypochlorite systems unless they contain a hole drilled in the upstream side of the ball and are normally labeled as such from the manufacturer. No label was present on the sodium hypochlorite system fill line. When a ball valve is closed, fluid is trapped inside the ball. Sodium hypochlorite, which off-gases, can cause pressure to build up inside the ball as the trapped chemical decomposes within the ball after the valve has been closed. The high pressure that may develop from this off gassing could cause the valve body to shatter.

Condition: Given the winter climate in Washoe County, it is unlikely tepid water would be delivered during the winter months at the exterior mounted ESEWS when activated.

Best Practice: ANSI Z358.1-2009 requires the water temperature range to a ESEWS be within a 60 – 100 degrees F range. The ESEWS should be provided with tepid potable water.

Condition: No documentation was present for ESEWS testing required by ANSI Z358.1-2009.

Best Practice: In addition to weekly activation currently performed, a periodic flow test of both the shower (minimum 20 gallons per minute [gpm]) and the eyewash station (minimum 0.4 gpm) should be conducted in accordance with ANSI Z358.1-2009.

3.2 Sodium Hypochlorite and Alum Bulk Storage and Secondary Containment Tanks Background

There are two 6,000 gallon sodium hypochlorite tanks and one 6,000 gallon alum tank located in the CSB. Each primary tank is contained within a secondary, open top tank, or commonly referred to as a secondary contained tank. In the event a leak occurs in the tank, the annular space between the primary and the secondary tank fills, containing the leakage from primary tank. This arrangement prevents discharge of hazardous material to the environment. Each tank is equipped with the following appurtenances:

- Overflow
- Vent
- Ultra sonic level detector with local and remote indications
- High and low level alarms
- Man way
- Access ladder

The sodium hypochlorite and alum tanks and secondary containment tanks are illustrated in Photo 3. Currently, the bulk alum tank is not being used and the system has been flushed with water.

Photo 3 Sodium Hypochlorite and Alum Tanks

3.2.1 Sodium Hypochlorite and Alum and Secondary Containment Tank Best Practices

Current best practices for sodium hypochlorite and alum tanks and secondary containment tanks differ from the existing CSB installation as follows:

Condition: No instrumentation is provided in the annular space for leak monitoring.

Best Practice: An optical or conductivity sensor is normally installed to monitor the annular space between the primary and secondary tanks to warn operators of a leak in the primary tank.

Condition: Only a ladder is present at each tank. No work platforms or other safety equipment is present to allow operator access to the ultra sonic level detector, man way, and pipes and fittings on top of the tanks for routine maintenance and inspection.

Best Practice: Performing any work from the existing ladder is unsafe. Proper ladder safety is to always have three points of contact with the ladder. Platforms, access ladders, handrails, and other safety devices are needed to allow safe access to the top of the sodium hypochlorite tanks for routine access.

Condition: No mechanical anchoring is present for the primary tanks. The existing anchoring only consists of stainless steel angles bolted to the foundation with no mechanical connection to secondary containment tank.

Best Practice: The IBC requires tanks and other structures to be seismically anchored to resist both lateral and vertical forces from a seismic event, based to the specific seismic conditions present at the location.

Condition: At the time of this evaluation, the tank man way was allowed to remain ajar with a utility hose installed to allow water addition to the tank required for some maintenance operations. Since the site visit, this practice is discontinued by Plant staff.

Best Practice: Man ways are normally kept shut to prevent chlorine vapor from entering the building. If operational requirements necessitate addition of water to the tanks, a fill connection should be added or water can added from the bulk delivery loading station.

Condition: A leak occurred in the tank suction pipe inside the annular space for both of the sodium hypochlorite bulk tanks between the primary and secondary containment tanks. To repair the suction pipe a rectangular hole was cut in the secondary containment tank for access. A patch was fabricated for the access hole.

Best Practice: Secondary containment tank repairs are normally not allowed if the structure of the secondary containment tank has been compromised. It was unclear if documentation exists that demonstrates proper engineering was performed to assure the secondary containment maintained its structurally integrity and if the repair is leak tight. Additionally, no documentation was available that demonstrated a leak lest was performed on the repair.

Condition: There is no drain in the secondary containment.

Best Practice: Secondary containments normally have an installed bulkhead fitting and capped drain valve. If a leak occurs in the primary tank, there is no convenient method to remove the contents of the annular space without a drain.

3.3 Chemical Piping and Fittings Background

Sodium hypochlorite and alum piping extends from the bulk loading area, bulk storage tanks, chemical pumps to several discharge locations. The piping material is Schedule 80 Poly Vinyl Chloride (PVC). There are mixtures of solvent welded, flanged, unions, and some threaded fittings. The majority of the valves are diaphragm style, with some ball valves installed at distribution flow meters. A solenoid actuated diaphragm valve is located at the suction of each tank for open/close operation. It appears that all piping located outside the CSB is direct buried PVC. Most of the chemical piping is illustrated in Photo 4 and Photo 5.

Photo 4 Sodium Hypochlorite and Alum Piping North Interior Wall of CSB

Photo 5 Sodium Hypochlorite Piping and Fittings at the Suction of the Sodium Hypochlorite Tank

3.3.1 <u>Chemical Piping and Fittings Best Practices</u>

Current best practices for chemical piping and fittings differ from the existing CSB installation as follows:

Condition: Leaks were present in the sodium hypochlorite piping and fittings. Leaks were present at valves, flange joints, and threaded joints. Some solvent welded fittings also showed evidence of seepage.

Best Practice: Acceptable leakage in a chemical system is zero. As PVC ages, it becomes brittle. It is common for aging PVC piping to require more leak repair. Leaks are often caused from mechanical and hydraulic shock to the piping system, thermal expansion and contraction, or insufficient or removed pipe supports. As PVC ages, it is very difficult to perform a lasting solvent joint repair because the PVC exterior of the PVC pipe has been contaminated with paint and chemicals. For a solvent welded joint repair in a chemical system, the critical joint surfaces must be free of contamination or the solvent welded joint repair will fail prematurely. When a leak occurs, it is more effective to replace the sections of pipe rather than patch the leak.

Condition: Gauge lines on some pumps do not have diaphragm seals installed.

Best Practice: All gauges in chemical systems should be equipped with diaphragm seals. Diaphragm seals prevent corrosion and plugging of the gauges by isolating the chemical from the gauge. Diaphragm seals allow for gauge calibration without operator exposure to hazardous chemical.

Condition: Gauges are not calibrated.

Best Practice: It is customary to have a gauge calibration program. Proper system performance and trouble shooting is difficult for operators without calibrated gauges.

Condition: Mechanical joints, valve bodies, flanged joints, and threaded joints do not have spray shields installed.

Best Practice: Spray shields protect operators from chemical spray when a leak occurs at a mechanical joint.

Condition: Sagging piping was observed in several locations.

Best Practice: Sagging piping can cause leakage at pipe joints, particularly on solvent welded joints. The pipe sag results in compression or tension of the solvent welded joints and cause premature joint failure. Sagging pipe is the result of inadequate or missing pipe supports.

Condition: Bowed piping was observed in several locations.

Best Practice: Bowed piping can cause leakage at pipe joints, particularly on solvent welded joints. The pipe bowing results in a tensile force applied to the solvent welded joints and cause premature joint failure. Bowed pipe is normally the result of inadequate thermal expansion features in the piping system such as expansion joints or expansion loops, or improperly adjusted pipe supports.

Condition: A modification to the suction piping was installed with Schedule 40 PVC pipe.

Best Practice: Schedule 40 PVC has inadequate structural properties to be used in a municipal chemical system. Schedule 80 PVC pipe is the proper material. Plant staff noted that they will replace all Schedule 40 PVC with Schedule 40 PVC.

Condition: Threaded joints were present in the system.

Best Practice: Threaded joints in sodium hypochlorite systems are inappropriate. Threaded joints are sealed with Teflon tape or pipe sealant. A 12.5 percent sodium hypochlorite solution is incompatible with Teflon tape or pipe sealant. All threaded joints should be removed and replaced with either flanged or union joints. Plant staff noted that Teflon tape is no longer being used on threaded joints.

Condition: There is no high flow switch to actuate the tank suction valves that will automaticity close the suction valves in the event of a rupture of the suction piping down stream of the valves.

Best Practice: Automatic actuation of the suction valves can prevent discharge of hazardous waste to the environment.

Condition: Much of the suction and discharge piping is located in a area where a major leak will not be directed to the containment sump. The alum and sodium hypochlorite solution piping share common areas and are not segregated. A small drainage grove is provided to direct leakage to the containment sumps.

Best Practice: Curbing the chemical area to direct leakage to the containment sumps will prevent release of hazardous material into the environment. Segregating the alum and sodium hypochlorite solution will prevent hazardous chemical reactions for occurring in the event of a spill of leakage.

Condition: The sodium hypochlorite discharge header is configured so that no cross connection is provided between the pumps. Currently three (3) pumps supply the Creek Water Diversion and the Chlorine Contact Basin, and two (2) pumps supply four (4) Secondary Clarifiers, Tertiary Filters, Return Activated Sludge (RAS) pump discharge, and the influent manhole.

Best Practice: Significant operational flexibility can be achieved by providing cross connection piping and isolation valves between the two (2) sodium hypochlorite discharge headers.

Condition: Buried piping could not be inspected, but it appears to be direct bury, single wall PVC.

Best Practice: Chemical delivery piping outside a containment should be double contained or be located in a containment trench. A break in the chemical delivery piping below grade could result in release of hazardous material to the environment.

3.4 Chemical Delivery Pumps Background

The alum and sodium hypochlorite chemical systems are equipped with variable speed peristaltic pumps. The alum chemical system has locations for three (3) pumps. All alum pumps are Waston Marlow 504 Du model pumps. Only two pumps are currently installed. The sodium hypochlorite system has locations for five (5) pumps. Three (3) are Waston Marlow 504 Du model pumps and two (2) are Bredel Holland SP-15 model pumps. The smaller capacity pumps supply the Creek Water Diversion and the Chlorine Contact Basin, while the larger capacity Bredel Holland SP-15 model pumps supply the four (4) Secondary Clarifiers, Tertiary Filters, RAS pump discharge, and the influent manhole.

3.4.1 Chemical Delivery Pumps Best Practices

Condition: A pressure relief valve (PRV) adjuster on a pump discharge is broken.

Best Practice: Replace.

Condition: Most PRV's have paint on the valve adjustment screw.

Best Practice: Mechanical parts of equipment that require adjustment should not be painted.

Condition: The peristaltic pumps do not have hose cavity leak detection.

Best Practice: The exciting peristaltic pumps are nearing end of life. Replacement pumps should be equipped with hose cavity leak detection.

Condition: The peristaltic pumps do not have pulsation dampers at the pump discharge.

Best Practice: Most manufacturers of peristaltic pumps recommend pulsation dampers at the pump discharge to prevent hydraulic shock to the piping system.

Condition: Pump connections at the hose to system showed stress to the hose.

Best Practice: Pump house keeping pads do not compensate for the staged height of the suction and discharge piping for the Waston Marlow 504 Du model pumps. When new pumps are installed, the house keeping pad should be adjusted to prevent stress to the hose or the piping heights adjusted.

3.5 Chemical Sumps Background and Sump Discharge Lines

There are two chemical containment sumps located adjacent to the north interior wall of the CSB. Each sump contains chemical system piping. A small drainage groove located below the chemical piping is provided to direct leakage to the containment sumps. Each sump is equipped with a float switch to activate a high-level alarm in the event of a major leak. Each sump has a drain isolation valve that allows containing leakage in the sump. The sump drains drain by gravity to the common building drain piping system. The drain piping drains to MH-6, and ultimately back to the head of the facility. Each chemical sump is covered with Fiberglass Reinforced Plastic (FRP) grating.

The chemical containment sump located adjacent to the sodium hypochlorite bulk storage tanks has a volume of approximately twelve hundred (1,200) gallons. The chemical containment sump located adjacent to the alum bulk storage tank has a volume of approximately nine hundred (900) gallons.

3.5.1 Chemical Sump and Sump Discharge Lines Best Practices

Condition: Only gravity drainage is available to remove spilled or leaked chemical from the chemical sumps.

Best Practice: In the event of major leak or need to dispose of a large amount of chemical, the current piping configuration only allows for gravity drainage back to the facility process. Alternately, a temporary pump could be installed. It is customary to have a small non-metallic vertical centrifugal sump pump (i.e. manufactured by Vanton Pump or Metpro Corporation) to allow controlled drainage of the sumps to a hazardous waste hauler.

Condition: The containment sumps are not coated.

Best Practice: The containment sumps should be coated with a chemical resistant coating to prevent damage to the concrete.

Condition: The existing drainage groove does not capture all possible leakage from the system.

Best Practice: A concrete curb should be installed to contain all system leakage. As it exists, leaks or spills from exposed suction piping and the pumps are not contained or directed to the containment sumps. The curb should split the sodium and alum chemical areas, and extend east of the bulk storage tanks.

Condition: The ESEWS located near the alum containment sump is too close to an area where a leak or spray could occur.

Best Practice: The ESEWS should be accessed by the operators within 10 seconds and located a maximum of 55 feet from a hazardous area.

Condition: No documentation was present to verify testing required by ANSI Z358.1-2009 at the two (2) ESEWS located inside the CSB.

Best Practice: In addition to weekly activation currently performed, a periodic flow test of both the shower (minimum 20 gpm) and the eyewash station (minimum 0.4 gpm) should be conducted in accordance with ANSI Z358.1-2009.

Condition: The floor coating located adjacent to the chemical area has areas of coating failure.

Best Practice: Strip and recoat the floor.

4.0 RECOMMENDATIONS

Recommendations presented herein focus on providing the best practices for chemical handling and storage. The recommendations are divided into five areas, and parallel the Evaluation.

- Bulk delivery area
- Two sodium hypochlorite tanks and one alum bulk storage tank and their respective secondary containment tanks
- Chemical piping and fittings
- Chemical delivery pumps
- Chemical sumps and sump discharge lines

4.1 Bulk Delivery Area

1. A dedicated and segregated chemical delivery area and containment sump should be provided for each chemical type. A proposed location for the bulk alum delivery is the exterior south side of the CSB, adjacent the to alum pumps and piping.
2. Chemical delivery truck loading areas should be enlarged and sloped toward the containment sump.
3. Consideration should be given to providing a sump or buried tank to contain any from a delivery truck chemical spill.
4. Diaphragm valves should be installed at the loading stations.
5. The ESEWS should be provided with tepid potable water.
6. Obtain the test equipment necessary to perform periodic flow testing for the ESEWS as required by ANSI Z358.1-2009.

4.2 Sodium Hypochlorite and Alum Bulk Storage and Secondary Containment Tanks

1. Install an optical or conductivity sensor in the secondary containment tank annular space.

2. Install platforms, access ladders, handrails, and other safety devices to allow safe access to the top of the sodium hypochlorite tanks and alum tanks.
3. Perform structural analysis of the tanks and install seismic anchoring.
4. Add an auxiliary fill connection to the bulk supply line.
5. The secondary containment tanks for the sodium hypochlorite should be replaced. Additionally, the existing repairs should be leak tested in the interim.
6. The new secondary containment tanks should be provided with a means of draining.

4.3 Chemical Piping and Fittings

1. Much of the sodium hypochlorite system has leaks. Recommend replacing any run of piping that has previously leaked.
2. Install with diaphragm seal on all gauges.
3. Calibrate gauges.
4. Install spray shields at all mechanical joints.
5. Evaluate all pipe supports and add supports as necessary.
6. Evaluate the expansion joints or expansion loops, and add as required.
7. Replace any piping that is not schedule 80 PVC.
8. Replace all threaded joints with flanges or unions.
9. Add a high flow switch to actuate the tank suction valves.
10. Add curbing to form a containment area.
11. Add cross connection piping and isolation valves between the two (2) sodium hypochlorite discharge headers.
12. Consider adding chemical trenches where direct bury chemical piping is located.

4.4 Pumps

1. Repair or replace any PRV that is in disrepair.
2. Remove paint on PRV adjustment screws.
3. Replace chemical feed peristaltic pumps and equip with hose cavity leak detection sensors.
4. Install pulsation dampers at all peristaltic pump discharges.
5. Re-plumb the suction and discharge piping.

4.5 Chemical Sumps and Sump Discharge Lines

1. Add a non-metallic vertical centrifugal sump pump to allow controlled drainage of the sumps to a hazardous waste hauler.
2. Coat the containment sumps.
3. Move the ESEWS located near the alum containment sump.
4. Strip and recoat the floor in the CSB.

5.0 ENGINEERS OPINION OF PROBABLE CONSTRUCTION COST

The estimated project cost for the recommendations presented in the previous section total approximately $1.46 million. The estimate breakdown by area is included in Appendix B. The estimates are based on standard methodologies and best practices as prescribed by the Association for the Advancement of Cost Engineering (AACE). This is a Class 4 cost estimate and, in accordance with AACE, the expected accuracy of the cost estimate is as follows:

- Low range: -15% to -30%
- High range: +20% to +50%

APPENDIX A – CHEMICAL SYSTEM EVALUATION CHECKLIST

3/11/14
JPN

Chemical System Evaluation Checklist

	Attribute	Comments
	TANKS	
√	Vent Present and unobstructed	present
√	Overflow present and unobstructed	NO Flush Connection on overflow
√	Containment volume adequate or double contained tank	Repair of S.C., untested
√	Level instrument/alarms	present
√	If double contained, annuls/leak detection present	NONE
√	Automatic high flow isolation valve present and operational	NONE - Auto Valve/no control for high flow event
√	Material condition of tank	SEC Containment Repair
√	Ladder and safety cage present	Access to top of Tank By Ladder only, no plantform
√	MSDS present/Tank labled	present
√	Tank anchorage	not sezmicly anchored
	PIPING	
√	Supports adequate	Bowing & Sagging present
√	Splash shields on mechanical joints	None
√	Leaks (document with pictures/mark on drawing)	Many
√	Piping labeled with flow direction/system	yes

	Attribute	Comments
✓	Redundant/alternative pump & piping configurations exist?	NO
✓	Piping installed per drawing and P&ID Document all discrepancies.	Some Modification
✓	Proper piping material installed	Some Sch 40 installed
✓	Check for threaded joints presence of Teflon tape.	present - leaks
	VALVES	
✓	Inspect valves for orientation and leakage and operation	Ball valves w/o orifice
✓	Splash guards at joints	None
✓	Motor operated valve electrical connection sealed	some electric connections loose
	SUMPS	
✓	Float or other level alarm present and operational	present
✓	Sump drain present/isolable	- interior - yes - Loading station - NO
✓	Sump size adequate	- No
✓	Sump drains are identified/labeled	- NO
✓	Sump separation by chemical type	- NO
✓	Coating/Condition	NO coating
✓	Grating/condition/material	present, ok
✓	Electrical connections sealed;	some unsealed

	Attribute	Comments
✓	Pump present and condition	none – gravity
	LOADING STATION	
✓	Chemical Segregation/Identification	NOT SEGREGATED
✓	Check valve in loading line	not present
✓	Wash-down hose for bulk fill area. For use on truck/fittings/ hoses/containment area following a delivery.	none present
✓	Strainer basket	present
✓	Spill protection	loading area does not slope to sump
✓	Adequate truck access	could be larger
✓	Lighting	ok
✓	Emergency Shower/Eye Wash	not tested per ANSI
	PUMPS	
✓	Foundations/Housekeeping pad/Mounting	to low or too high
✓	Leakage	yes
✓	Leak detection alarms for diaphragm and peristaltic pumps	NO
✓	Material Condition	operable – 100C
✓	Document name plate data	present

	Attribute	Comments
✓	Electrical disconnect present	Yes
✓	Flexible couplings	non present
✓	Calibration columns	present/vented
	GENERAL	
✓	Emergency Eye Wash Stations Thermal protected/tested/location	Yes
✓	Spill containment/curbing present	NO
✓	Coatings-Condition	poor
✓	Structural condition of concrete	Some damage
✓	Adequate ventilation	Yes
✓	Flow meters/rotameters	Non present on small pumps
✓	Pressure gauges/instruments	NO CAL, NO Diaphram.
✓	Safety devices	Some PRV'S broke ADJ. Screw
✓	Siphon breaks	Yes
✓	Fire Projection/fire extinguishers	Yes
✓	Flushing connections	Yes, should be capped
✓	Hoses for wash down of chemical area	NO

APPENDIX B – ENGINEER'S PROBABLE OPINION OF CONSTRUCTION COST

PROJECT SUMMARY

Estimate Class: 4

Project:	**SouthTruckee Meadows Water Reclamation Facility Chemical Storage Building Rehabliation Evaluation**		
Client:	**WCDWR**	**PM:**	**Callahan**
Location:	**Reno, NV**	**Date:**	**May 16, 2014**
Zip Code:	**89503**	**By:**	Wesley
Carollo Job #	**9503A.00**	**Reviewed:**	**Chan**

NO.	DESCRIPTION		TOTAL
01	Bulk Delivery Area		$186,000
02	Storage Tanks		$236,000
03	Piping and Fitings		$206,000
04	Pumps		$37,000
05	Sumps		$138,000
	TOTAL DIRECT COST		**$803,000**
	Contingency	20.0%	$163,000
	Subtotal		**$966,000**
	General Contractor Overhead, Profit & Risk	10.0%	$98,000
	Subtotal		**$1,064,000**
	Escalation to Mid-Point	5.0%	$54,000
	Subtotal		**$1,118,000**
	Sales Tax	7.8%	$88,000
	Subtotal		**$1,206,000**
	Bid Market Allowance	5.0%	$61,000
	TOTAL ESTIMATED CONSTRUCTION COST		**$1,267,000**
	Engineering, Legal & Administration Fees	10.0%	$130,000
	Owner's Reserve for Change Orders	5.0%	$64,000
	TOTAL ESTIMATED PROJECT COST		**$1,461,000**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

APPENDIX D – ENGINEERS OPINION OF PROBABLE CONSTRUCTION COST

PROJECT SUMMARY

Project:	SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY FACILITY PLAN UPDATE	Estimate Class:	5
Client:	Washoe County	PM:	Callahan
Location:	Reno, NV	Date:	4-Dec-15
Zip Code:	89503	By:	Wesley
Carollo Job #	9873A.00	Reviewed:	Callahan

Location	Equipment	Condition	Recommendation	TOTAL
Steamboat Creek Lift Station	Instrumentation	I & C equipment is obsolete	Phased replacement and upgrade	$150,000.00
IPS	Screw Pumps	Splashing occurs the top of the lift pumps	Design and add splash protection	$2,000.00
IPS	Emergency Stop Button	The Emergency Stop Button is damaged on the west screw pump	Replace	$1,000.00
Head Works Electrical Room	Mixer VFD's	VFD's No's. 1, 2, 3 and 5 Mechanical mixers are obsolete	Phase replacement of obsolete VFD's	$25,000.00
Mechanical Head Works Building Screens and Gates	Mechanical Screens and Gates	Corrosion is occuring at various location on the screen and gates structure	Contact the Manufacturer/Design Engineer/Contractor for resolution	
Manual Bar Screen	Channel Structure	Coating failure has occurred in the inlet and outlet channel	Dewater, conduct an inspection and repair concrete damage and recoat	$15,000.00
Oxidation Ditch	Structure	Coating failure has occurred	Systemically dewater, conduct an inspection and repair concrete damage and recoat	$1,000,000.00
Oxidation Ditch	Structure	Cracks at various locations	Conduct concrete repairs	$20,000.00
Oxidation Ditch	Air Piping	Small Air Leaks	Repair; Check pipe support or for flange misalignment if issue persists	$1,000.00
Oxidation Ditch	Instrumentation	Some of the local meter panels do not have sun shade protection	Design and install Shade protection	$3,000.00
Oxidation Ditch	Instrumentation	Probes and meters will likely reach end of life within 5-10 years	Phased replacement of probes and meters	$75,000.00
Secondary Clarifier	Structure	Some coating failure has occurred Units 2 and 3	Systemically dewater, conduct an inspection and repair concrete damage and recoat; All clarifiers should be inspected	$400,000.00
Secondary Clarifier	Launder	Algae build up on the launder V-Notch weirs creating a maintenance issue	Continue chlorination for the short term; Evaluate covers or brushes	$50,000.00
Tertiary Filters	Structure	Minor cracking of the concrete structure was observed	Conduct concrete repairs	$10,000.00
Tertiary Filters	Instrumentation	The filter inlet channel mechanical level float is nonoperational	Repair	$500.00
Chlorine Contact Basin	Structural	Small cracks in structure	Systemically dewater, conduct an inspection and repair visible and non-visible concrete damage	$10,000.00

PROJECT SUMMARY | Estimate Class: 5

Project:	SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY FACILITY PLAN UPDATE		
Client:	Washoe County	PM:	Callahan
Location:	Reno, NV	Date:	4-Dec-15
Zip Code:	89503	By:	Wesley
Carollo Job #	9873A.00	Reviewed:	Callahan

Location	Equipment	Condition	Recommendation	TOTAL
Reuse Pump Station	Drain Piping	Pump and piping drains are supported by rope or wire	Design and replace piping	$10,000.00
Reuse Pump Station	Drain Piping	Air release valves have garden hose vice hard piping to the floor drains	Design and replace piping	$5,000.00
Effluent Pump Station	Plant Water Booster Pumps	Station should cleaned and preserved	Clean and preserve	$1,000.00
Effluent Pump Station	Electrical Equipment	VFD's 4 and 5 are obsolete	Phased Replacement	$200,000.00
Effluent Pump Station	Roof	There is a roof leak at the wall	Conduct and roof inspection by a qualified roofing contractor; Repair	$5,000.00
Effluent Pump Station	Structural	The joist above Pump 1 is twisted at electrical conduit attachment	Reinforce Joist; Repair deformation	$5,000.00
Effluent Pump Station Electrical Room	HVAC	AC unit often freezes the evaporative coil within the air handler unit	Replace AC Unit	$9,000.00
Sand Drying and Sludge Dewatering Beds	Not Used	Degraded	In order to maintain the permit for the Drying and dewatering beds, recommend minimum refurbishment	$25,000.00

TOTAL DIRECT COST		**$2,022,500**
Contingency	20.0%	$404,500
Subtotal		**$2,427,000**
General Contractor Overhead, Profit & Risk	10.0%	$242,700
Subtotal		**$2,669,700**
Escalation to Mid-Point	0.0%	$0
Subtotal		**$2,669,700**
Sales Tax	7.725%	$103,117.16
Subtotal		**$2,772,817**
General Conditions	10.0%	$277,282
TOTAL ESTIMATED CONSTRUCTION COST		**$3,050,099**
Engineering, Legal & Administration Fees	20.0%	$610,020
TOTAL ESTIMATED PROJECT COST		**$3,660,119**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

WASHOE COUNTY

SOUTH TRUCKEE MEADOWS
WATER RECLAMATION FACILITY
FACILITY PLAN UPDATE

TECHNICAL MEMORANDUM NO. 5

PLANT PERFORMANCE AND PROCESS MODEL

FINAL
January 2016

1 EAST LIBERTY STREET, SUITE 424 • RENO, NEVADA 89501 • P. 775.324.4427 • F. 775.324.5128

WASHOE COUNTY, NEVADA

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY

TECHNICAL MEMORANDUM
NO. 5
PLANT PERFORMANCE AND PROCESS MODEL

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PLANT PERFORMANCE AND PROCESS MODEL

1.0 INTRODUCTION

This technical memorandum (TM) summarizes the performance evaluation and process modeling analysis of the South Truckee Meadows Water Reclamation Facility's (STMWRF) secondary treatment process. A capacity evaluation of the existing facility is presented along with discussion of the expansion needs to treat the projected Average Daily Maximum Month Flow (ADMMF) design capacity for the 2035 planning horizon.

STMWRF's current permitted capacity is 4.1 mgd ADMMF and 4.5 Peak (or maximum) Daily Flow (PDF). STMWRF was originally commissioned in 1990 with a major expansion completed in 2004 that added bar screens, tertiary filters, and chlorine contact basins. In 2006, the County began planning its next expansion project, however, shortly thereafter the major treatment expansion was postponed due to declining growth and the start of an economic recession. In 2014, construction of a headworks expansion and modification was completed, adding perforated plate screens and washer compactor with flexibility to expand in the future. The declining growth experienced in the late 2000s has reversed and in late 2014 influent flows to the facility have peaked at approximately 3.66 mgd ADMMF. PDF around 4.5 mgd have been observed in February 2015. Thus, the facility is approaching, and at times exceeding, the 80 percent threshold of its permitted capacity and is therefore initiating the evaluation of design requirements for a capacity expansion. As part of the 2008 Facility Plan Update, STMWRF's capacity was reevaluated. At that time, STMWRF’s new headworks, tertiary filters, and the disinfection system were rated for a hydraulic capacity of 6 mgd, with the exception of influent/headworks pumping and the secondary treatment, consisting of two oxidation ditches followed by secondary clarification. The planning period for this facility plan update is 20 years, running from 2015 through 2035. The projected ADMMF flow for this planning horizon is 5 mgd ADMMF (see TM 2 "Basis of Planning"). For consistency with the other new treatment processes on site, this facility plan will use a design ADMMF of 6 mgd.

TM 5 is structured into the following sections:

Section 1 provides a brief introduction and background, summary of current and anticipated permit discharge requirements, and current and projected wastewater influent flows and loads.

Section 2 summarizes the existing and near-term future liquid and solid stream processes along with relevant design criteria. Current operational strategies are summarized and treatment performance evaluated with regards to general process performance and nutrient removal.

Section 3 introduces the approach to process modeling and calibration of the model to current plant operation and performance.

Section 4 evaluates the existing treatment capacity based on current influent flows and loads under ADMMF treatment conditions and the expansion requirements to meet the projected ADMMF capacity for 2035 of 6.0 mgd.

Section 5 summarizes recommendations for optimization opportunities to increase capacity and/or enhance effluent quality.

Section 6 provides recommendations for field implementation based on the optimization opportunities provided in the previous section.

2.0 CURRENT AND ANTICIPATED PERMIT REQUIREMENTS

2.1 Current Permit Requirements

As outlined in Technical Memorandum No. 2 - Planning Framework, STMWRF is a zero discharge facility in which all tertiary effluent is used for off-site reclaimed water application. If the instantaneous reclaimed water demand is less than the tertiary effluent production, a portion of the tertiary effluent is stored in an on-site reservoir to meet peak demands during the irrigation season. Under the current Nevada Division of Environmental Protection (NDEP) wastewater discharge permit (NS0040024 Draft - to expire in 2018), the facility is currently permitted to discharge 4.1 mgd ADMMF to Huffaker Reservoir. The current permit limits and anticipated future effluent limits for STMWRF are summarized in Table 5.1. Effluent total nitrogen (TN) concentrations are not to exceed a monthly maximum of 10 mg/L-N. Effluent five-day carbonaceous biochemical oxygen demand (cBOD5) and total suspended solids (TSS) concentrations are each limited to a 30-day average of 30 mg/L and a 45 mg/L daily maximum. STMWRF does not have limits for ammonia or nitrate (other than included in the TN limit) or phosphorus. Based on information provided by the County, potential changes to the current discharge permit limits are not anticipated during the foreseeable planning period; however, it should be noted that the existing permit will be revised to include requirements for the new biosolids process under construction at STMWRF.

2.2 Anticipated Permit Requirements

While permit limits are not anticipated to change in the foreseeable future, water quality in the Huffaker Reservoir has been evaluated in previous years in conjunction with nutrient discharges from the STMWRF. A study conducted by CH2MHill for Washoe Country DWR in 2012 (TM South Truckee Meadows Water Reclamation Facility: Reclaimed Water Quality Management Study, August 2012) recommended ammonia effluent concentrations be maintained below 2 mg/L (at correspondingly higher nitrate effluent concentrations), to help stabilize the redox conditions in the reservoir sediment. The study was in part motivated by severe clogging issues reported by reuse customers apparently attributed to excessive algae growth in water from the reservoir. The study also concluded that the hypereutrophic designation of the reservoir based on a TP concentration over 100 ug/L cannot be changed as the reservoir is primarily fed with treated STMWRF effluent, which will contain phosphorus even using the most advanced phosphorus removal technologies. The phosphorus concentration in Huffaker Reservoir is currently 2 mg/L.

Table 5.1 Comparison of Current and Future Permit Limits
STMWRF Facility Plan Update
Washoe County

	Current Permit (1)		**Anticipated Future Permit**
Capacity			
Flow, mgd	4.1 4.5	ADMMF PDF	No anticipated change
cBOD, mg/L	30 / 45	30-day/ Daily Maximum	
TSS, mg/L	30 / 45	30-day/ Daily Maximum	
Total Nitrogen, TN, mg/L	10 Treatment goal: 7 mg/L	Monthly Maximum	
Ammonia, mg/L	NDL(2)	-	
Nitrate, mg/L	NDL	-	
Total Phosphorus, mg/L	NDL	-	

Notes:
(1) Adopted from Draft Permit No. NS0040024.
(2) NDL: No Discharge Limit.

The Nevada Department of Environmental Protection (NDEP) is currently working on revising the water reuse categories to include indirect potable reuse (IPR). The IPR regulation may follow California (CA) Title 22. If the County decides to implement IPR, they may have to follow California Title 22 for recycled water (filtration and disinfection). The summary of CA Title 22 for recycled water is as follows.

1. Filtered wastewater for recycled purposes should meet the following criteria:
   a. Has been coagulated and passed through filter media pursuant to the following:
      1) At a rate that does not exceed 5 gallons per minute per square foot of surface area in mono, dual or mixed media gravity, upflow or pressure filtration systems, or does not exceed 2 gallons per minute per square foot of surface area in traveling bridge automatic backwash filters.

2) The turbidity of the filtered wastewater does not exceed any of the following:
   a) An average of 2 NTU within a 24-hour period.
   b) 5 NTU more than 5 percent of the time within a 24-hour period.
   c) 10 NTU at any time.

Disinfected tertiary recycled water should meet the following criteria.

1. The filtered wastewater has been disinfected by either:
   a. A chlorine disinfection process following filtration that provides a CT (the product of total chlorine residual and modal contact time measured at the same point) value of not less than 450 milligram-minutes per liter at all times with a modal contact time of at least 90 minutes, based on peak dry weather design flow.
   b. A disinfection process that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 99.999 percent of the plaque forming units of F-specific bacteriophage MS2, or polio virus in the wastewater. A virus that is at least as resistant to disinfection as polio virus may be used for purposes of the demonstration.
2. The median concentration of total coliform bacteria measured in the disinfected effluent does not exceed an MPN of 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed and the number of total coliform bacteria does not exceed an MPN of 23 per 100 milliliters in more than one sample in any 30 day period. No sample shall exceed an MPN of 240 total coliform bacteria per 100 milliliters.

Based on discussions with the County staff, this Facility Plan Update will consider potential turbidity requirements similar to CA Title 22.

3.0 HISTORICAL WASTEWATER FLOWS AND CHARACTERISTICS

This section analyzes historical wastewater influent flow and load trends as a basis for the subsequent process performance evaluation.

3.1 Wastewater Characteristics

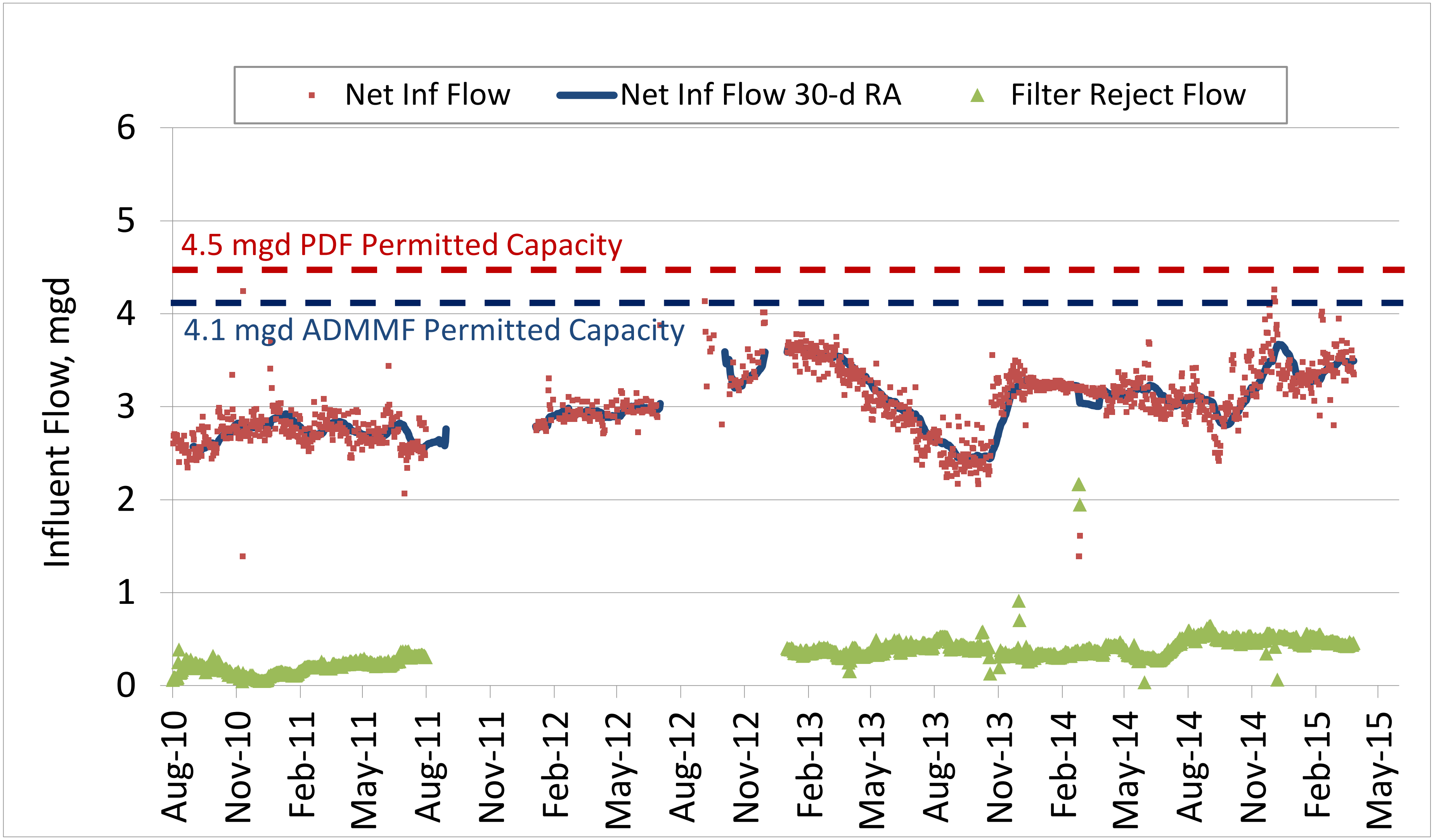
Historical wastewater characteristics are based on data provided by the County. Daily average wastewater flows and temperature are available between August 2010 and April 2015; however, the data set is incomplete and several periods with no available data were encountered as the STMWRF does not have an obligation to conduct compliance monitoring for conventional pollutants in the wastewater influent. Five-day cBOD and TSS sampling data is available from August 2010 to July 2011. Short-term sampling data are also available between January and April 2015, where bi-weekly influent grab samples were collected for analysis. Grab samples collected in 2015 were also analyzed for ammonia, total Kjeldahl nitrogen (TKN), and total phosphorus (TP).

Daily average wastewater flows for the facility are presented in Figure 5.1. It should be noted that these flows represent the net raw wastewater flow to the facility and do not include tertiary filter backwash flows or flows from the DD Well 2, STMGID Well 9, or Tessa West Well. Net influent flows have, on average, increased slightly over the past five years of operation. Annual variations in net influent flow have occurred each year since 2012, where flows typically increased during the month of October and declined after the winter months. However, the degree of fluctuation in this annual trend has varied significantly for the past 3 years. Thirty-day average flows in January 2013 and December 2014 exceeded 3.6 mgd plant influent flow, which is 88 percent of the current 4.1 mgd treatment capacity. Net influent flow has averaged 73 percent (3.0 mgd) since January 2015.

Influent five-day cBOD loading, calculated from weekly samples between 2010 and 2011, are presented in Figure 5.2. Daily influent cBOD loading in 2015 is calculated from bi-weekly grab samples. No loading data are available between 2011 and 2015 due to the removal of cBOD influent monitoring requirement from the discharge permit. The cBOD loading to STMWRF is highly variable and ranges from approximately 4,700 ppd (150 mg/L) to 11,000 ppd (460 mg/L) between 2010 and 2011; loading values calculated from grab samples in 2015 are also within this range and exhibit similar variability. Note that cBOD loads shown for November 10, 2010 (16,878 ppd), March 9, 2011 (13,191 ppd), and June 8, 2011 (15,780 ppd) are likely outliers due to either uncommonly high BOD concentration or influent flow measurements on these days and are not believed to be representative of the influent wastewater cBOD characteristics. It is difficult to accurately establish seasonal variability in the historical loading to the facility from the available data, which means that conservatively it should be assumed that high peak loadings can occur at any time of the year, also in conjunction with ADMMF.

Influent TSS loading values, calculated from weekly samples between 2010 and 2011, are presented in Figure 5.3. Again, TSS loading in 2015 was calculated from bi-weekly grab samples. Similar to cBOD loading, TSS loading to the facility is highly variable and ranges from approximately 4,000 ppd (180 mg/L) to 9,000 ppd (375 mg/L) between 2010 and 2011; loading values calculated from grab samples in 2015 are similar in magnitude and variability. As for BOD, it is difficult to establish any seasonal TSS loading trends.

Thirty-day average daily wastewater temperature typically fluctuates seasonally from 16 degrees Celsius to 24 degrees Celsius (Figure 5.4). A minimum 30-day average temperature of 13.9 degrees Celsius was observed between February and April 2013, which is proposed as the winter design temperature to be used in process modeling to determine the current and future treatment capacity. In this capacity analysis, it is assumed that the influent ADMMF may occur in the months of February through April when wastewater temperatures are at a minimum (see discussion for Figure 5.1). This is a very conservative assumption for the capacity evaluation as more recent years have shown an influent flow pattern with ADMMF observed around October when wastewater temperatures peak.



INFLUENT WASTEWATER FLOW

FIGURE 5.1

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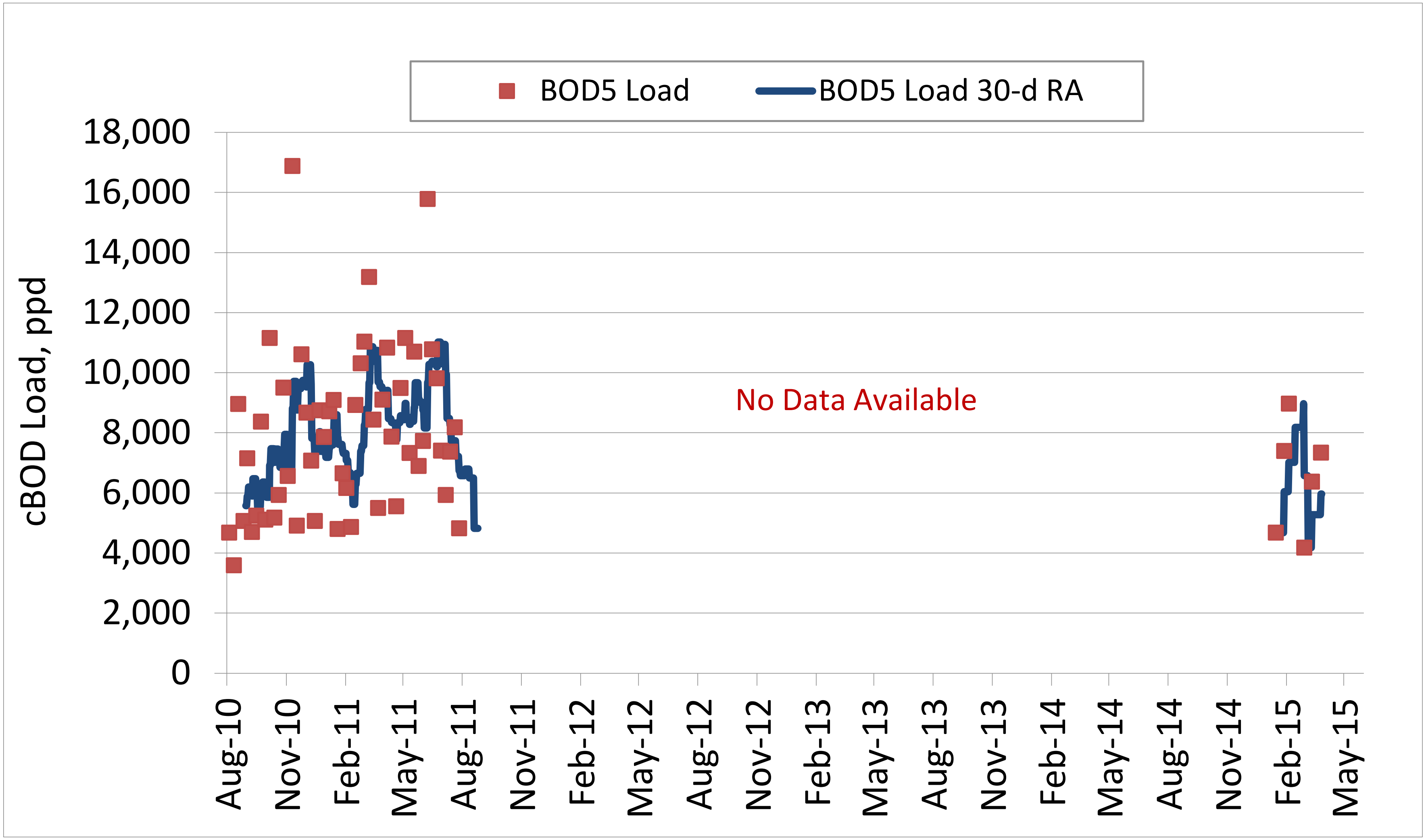

INFLUENT WASTEWATER cBOD LOAD

FIGURE 5.2

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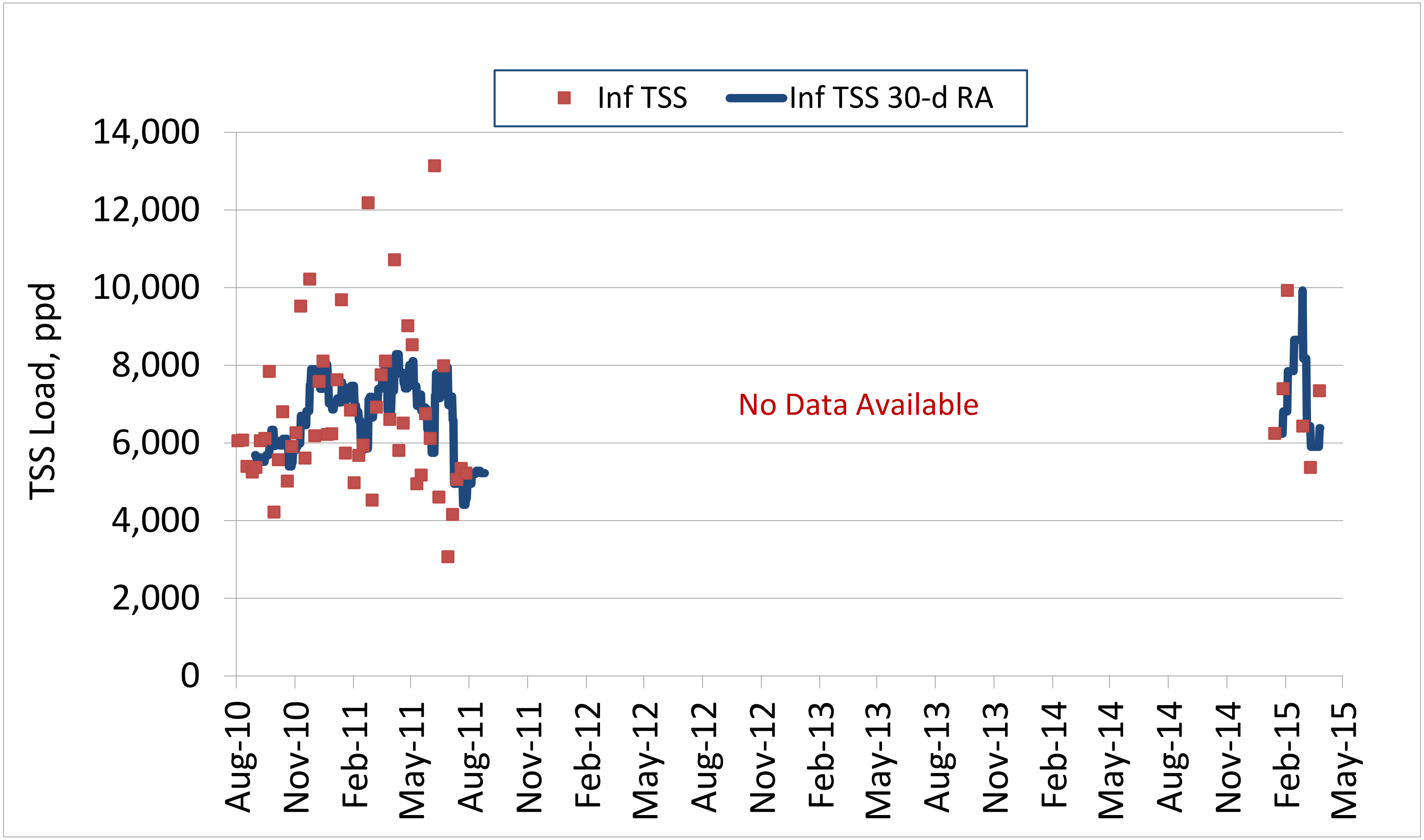

INFLUENT WASTEWATER TSS LOAD

FIGURE 5.3

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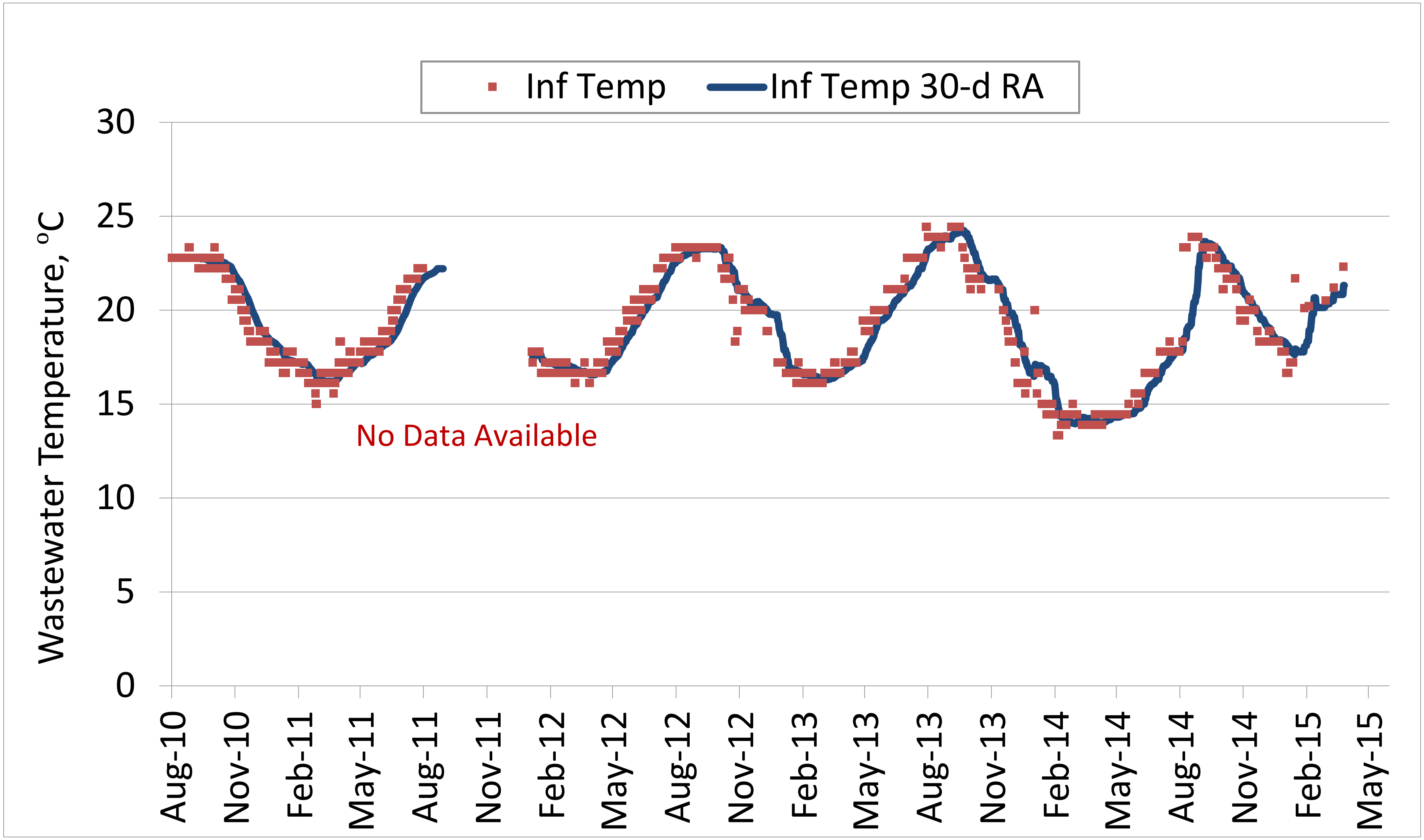

INFLUENT WASTEWATER TEMPERATURE

FIGURE 5.4

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Additional influent wastewater characteristic data is available based on analyses from bi-weekly grab samples collected in 2015. Influent ammonia and TKN loads averaged 1,073 ppd (33.5 mg/L-N) and 1,187 ppd (56.7 mg/L-N), respectively, yielding an ammonia to TKN ratio of approximately 0.6, which is a typical value for domestic wastewater. The cBOD to TKN ratio in the oxidation ditch influent is 3.6, which suggests that there is adequate influent carbon to achieve typically moderate levels of denitrification. The fact that nitrogen removal is exceptional at the facility indicates that simultaneous nitrification/denitrification occurs in the ditches (see discussion further below in Section 3.5.2 and Figure 5.12).

Average influent total phosphorus loading was 208 ppd (6.5 mg/L-P) during the same period of time. Average influent orthophosphate (OP) concentrations were previously characterized in a Master's Thesis conducted by Mettler (2015) during six sampling events between January and September 2014. Samples were collected every hour for a 24-hour period and then averaged for each sampling event. OP concentrations ranged from 2.5 mg/L-P to 3.8 mg/L-P, with an average value of 3.1 mg/L-P. Average influent total and soluble chemical oxygen demand (tCOD and sCOD) concentrations were also characterized by Mettler (2015) during three similar sampling events between May and September 2014. The tCOD concentrations ranged from 525 mg/L to 636 mg/L, with an average concentration of 538 mg/L. The sCOD concentrations ranged from 72 mg/L to 93 mg/L, with an average concentration of 80 mg/L. Assuming the average tCOD concentration and the average influent cBOD concentration between 2010 and 2015 (312 mg/L), the influent wastewater exhibits a tCOD to cBOD ratio of 1.7 which is low compared to typical domestic wastewater, with a ratio typically around 2. The tCOD to cBOD ratio for cBOD concentrations in 2015 (202 mg/L) is 2.7, which is on the high side of the typical domestic wastewater range. The possible reason for higher ratio could be due to suppressed "true" cBOD concentration due to the nitrification inhibitor used in the cBOD analysis.

No influent alkalinity is currently available for the past five years of operation.

3.2 Wastewater Flows and Loading Projections

Wastewater flow and load projections for ADMMF (design) conditions were adopted from TM No. 2 and used in process modeling presented in this TM. The data basis for developing these criteria is based on August 2010 to July 2011 and recent flow data from June to September 2015. Prior to final design of any facilities it is recommended to verify that relevant influent concentrations have not changed over time through more frequent influent sampling and analysis and flow and load peaking factor verification.

3.3 Flow Peaking Factors

The flow peaking factors for Average Day Annual Flows (ADAF), ADMMF, PDF, and Peak Hour Dry and Wet Weather Flows (PHDWF and PHWWF) shown in Table 5.2 were adopted from TM 2 and used to defined current and future projected design flows to the STMWRF.

Table 5.2 Wastewater Flow Peaking Factors
STMWRF Facility Plan Update
Washoe County

Flow Factor Name	Peaking Factor(1) (2)	Existing Design Flows	2035 Design Flows
Annual Daily Average Flow, ADAF	1	3.0	4.5
Average Daily Maximum Month Flow, ADMMF	1.12	3.4	5.0
Peak Day Flow, PDF	1.33	4.0	5.4
Peak Hour Dry Weather Flow, PHDWF	2.10	6.3	8.4
Peak Hour Wet Weather Flow, PHWWF	2.47	7.4	11.1

Notes:
(1) Peaking factors were calculated using 2014 daily influent flow data and the continuous 8 months of data available for the South Meadows permanent flowmeter.
(2) All peaking factors are relative to the Average Day Annual Flow (ADAF).

Table 5.3 compares recent wastewater influent flow and loading data collected in winter 2015 (January and April, 2015) to the design ADMMF flow and load assumptions developed in TM 2 for the currently permitted treatment capacity of 4.1 mgd ADMMF, and the projected future design flows in 2035 (6 mgd ADMMF). To determine peak flows for the current design and projected 2035 conditions, the ADAF was multiplied by the peaking factors provided in Table 5.2.

Data for influent nitrogen is very limited. Available data suggest that ammonia and TKN concentrations have increased from the 2008 Facility Plan as shown in TM No. 2. However, it is difficult to draw conclusions from the increase in concentrations shown by the limited dataset. Therefore, as a conservative planning criteria, the ammonia and TKN ADMML peaking factor of 1.54 was adopted from TSS. The ADMML peaking factor for phosphorus based on January to April data was 1.05. However, a more conservative planning criteria ADMML peaking factor of 1.45 was adopted from the chosen cBOD peaking factor for the current design and projected 2035 conditions.

Table 5.3 Current and Projected 2035 Wastewater Flows and Loading
STMWRF Facility Plan Update
Washoe County

	Actual Plant Data (Jan-Apr., 2015)(2)	Current Design Conditions(3)	Projected Conditions-2035(3)
Flows			
ADAF, mgd	3	3.7	5.4
ADMMF, mgd	3.4	4.1	6.0
Peak Daily Flow (PDF), mgd	4	4.9	7.1
Influent Loads			
@ ADAF			
cBOD, ppd	5,004	9,983	14,610
COD	-	-	-
TSS, ppd	5,479	8,426	12,331
VSS, ppd	-	-	-
TKN, ppd	1,401	1,710	2,502
NH_4-N, ppd	826	1,008	1,474
Total-P (P), ppd	160	195	286
@ ADMMF			
cBOD, ppd	9,802	18,726	27,404
COD	-	-	-
TSS, ppd	11,541	17,866	26,146
VSS, ppd	-	-	-
TKN, ppd	3,275	3,620	5,298
NH_4-N, ppd	1,949	2,163	3,165
Total-P (P), ppd	239	367	538
Concentrations @ ADAF(1)			
cBOD, mg/L	200	327	
COD, mg/L	-	-	
TSS, mg/L	219	276	
VSS, mg/L	-	-	
TKN, mg/L	56	56	

Table 5.3 **Current and Projected 2035 Wastewater Flows and Loading**
STMWRF Facility Plan Update
Washoe County

<table>
<tr><th></th><th>Actual Plant Data (Jan-Apr., 2015)(2)</th><th>Current Design Conditions(3)</th><th>Projected Conditions-2035(3)</th></tr>
<tr><td>NH_4-N, mg/L</td><td>33</td><td colspan="2">33</td></tr>
<tr><td>Total-P (as P), mg/L</td><td>6.4</td><td colspan="2">6.4</td></tr>
<tr><td>Concentrations @ ADMMF(1)</td><td></td><td colspan="2"></td></tr>
<tr><td>cBOD, mg/L</td><td>267</td><td colspan="2">423</td></tr>
<tr><td>COD, mg/L</td><td>-</td><td colspan="2">-</td></tr>
<tr><td>TSS, mg/L</td><td>296</td><td colspan="2">380</td></tr>
<tr><td>VSS, mg/L</td><td>-</td><td colspan="2">-</td></tr>
<tr><td>TKN, mg/L</td><td>84</td><td colspan="2">77(4)</td></tr>
<tr><td>NH_4-N, mg/L</td><td>50</td><td colspan="2">46(5)</td></tr>
<tr><td>Total-P (as P), mg/L</td><td>6.5</td><td colspan="2">8.3(6)</td></tr>
</table>

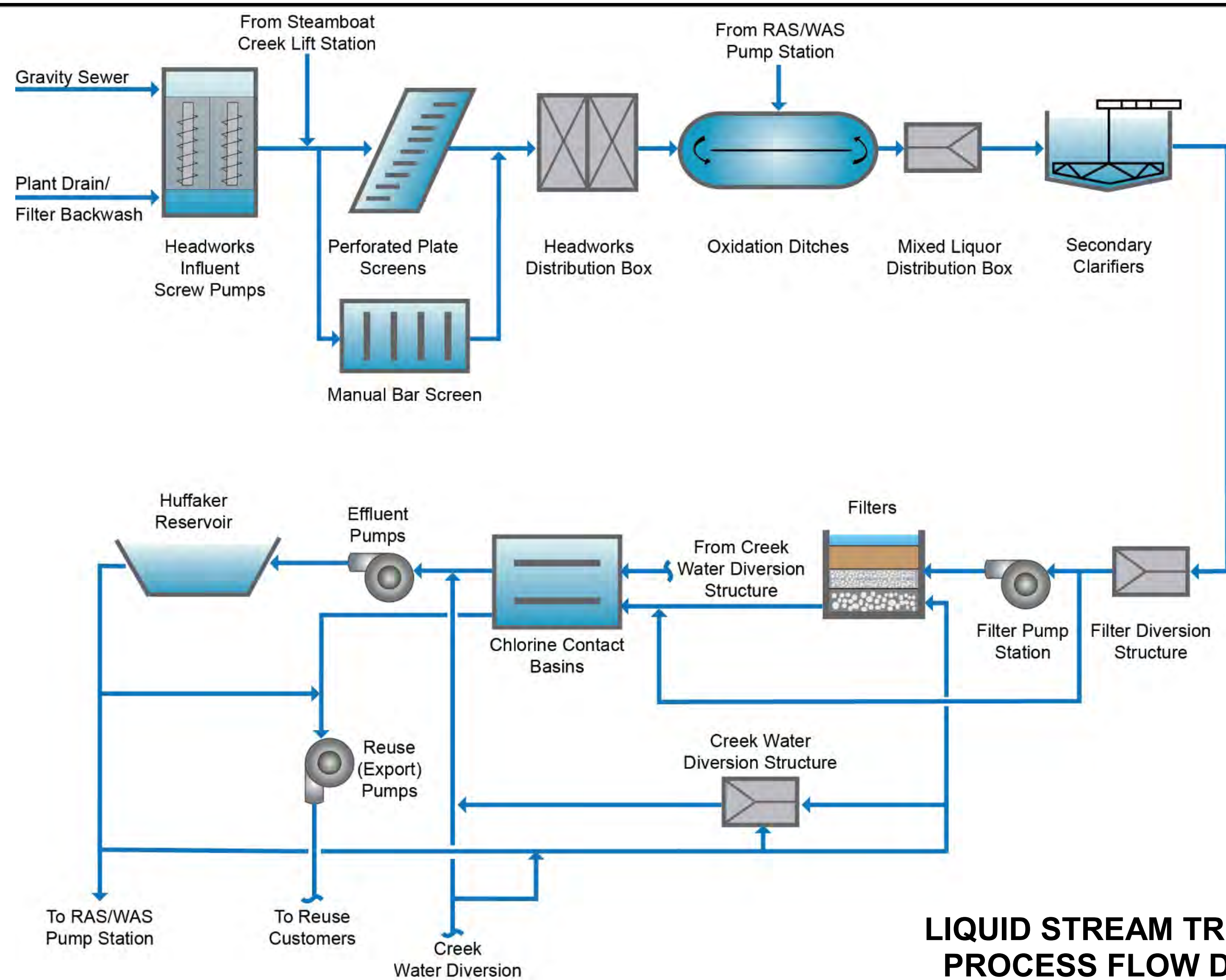
Notes:
(1) Load based influent concentrations, unless otherwise noted.
(2) Average loads are calculated from data collected between January 1 and March 27, 2015. Average flows are calculated from data collected between June and September 2015.
(3) Based on the direction form County Staff, ADMMF of 6.0 mgd was used for projected condition 2035. Flows have not been adopted from TM 2 "Planning Framework".
(4) TKN load peaking factor of 1.54 assumed from data collected between January 1 and March 27, 2015.
(5) NH_4 load peaking factor of 1.54 assumed from data collected between January 1 and March 27, 2015.
(6) Total-P load peaking factor of 1.45 adopted from the BOD peaking factor presented in TM 2 "Planning Framework".

4.0 EXISTING PLANT DESCRIPTION

The existing liquid treatment facilities at STMWRF are depicted in the simplified liquid flow schematic in Figure 5.5. A complete summary of the existing liquid treatment facilities and equipment is available in TM No. 6. A brief description of the liquid treatment facilities at the STMWRF is provided below:

- **Steamboat Creek Lift Station.** Raw sewage is pumped from the Steamboat Creek Lift Station to the influent screenings channel where it is combined with flow conveyed by gravity to STMWRF.

- **Influent pumping.** Raw sewage enters by gravity sewer and is conveyed to the headworks, which is a concrete structure equipped with raw sewage pumps. Wastewater is then pumped to the influent screens.



LIQUID STREAM TREATMENT PROCESS FLOW DIAGRAM

FIGURE 5.5

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- **Influent screening.** Wastewater flows through perforated plate-style screens to remove debris. The debris is then washed and compacted.

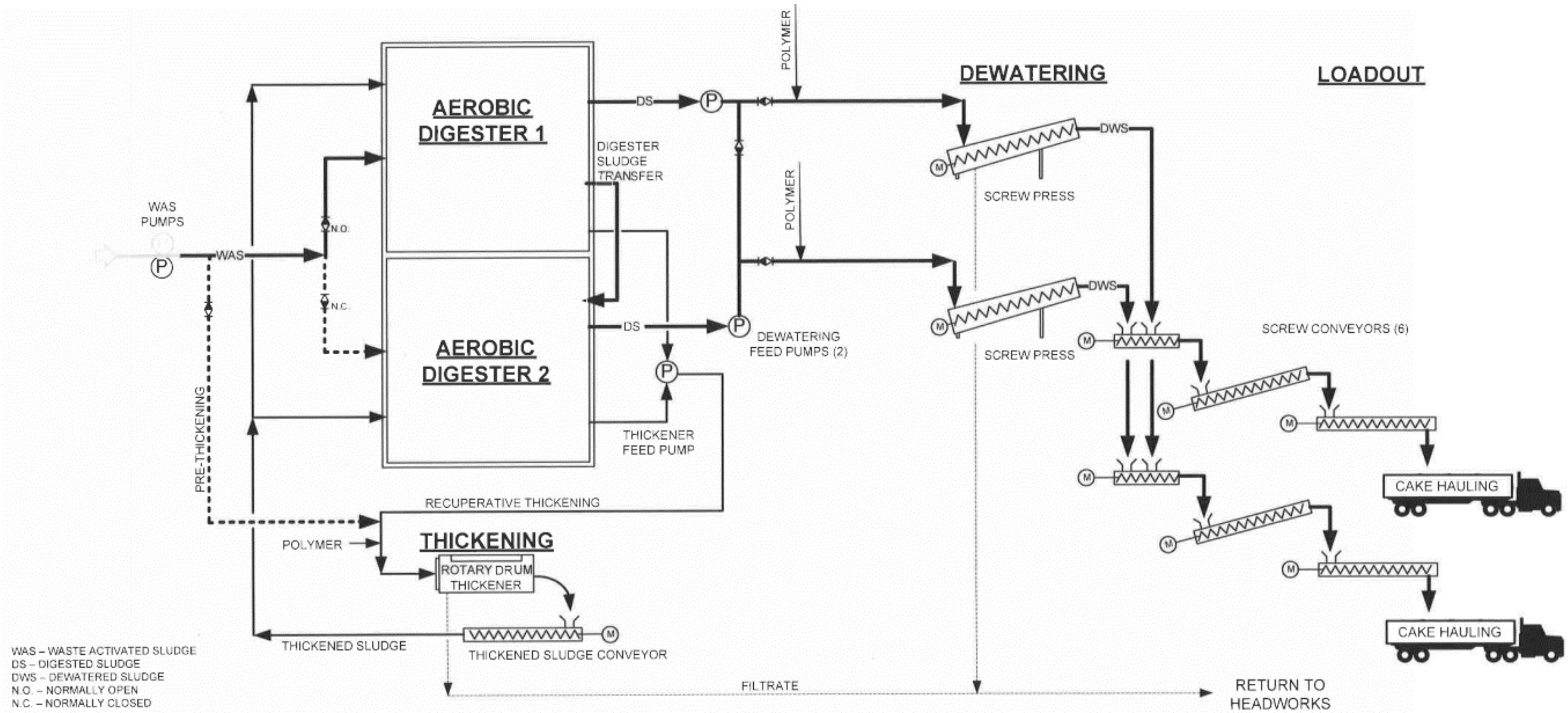
- **Oxidation ditches.** The screened wastewater is biologically treated in two oxidation ditches. Submerged mixers circulate the wastewater around the ditches. Return activated sludge (RAS) is distributed to the ditches through a RAS flow distribution structure. Aeration blowers supply air to the ditches to support the biological treatment process through submerged diffusers.

- **Secondary clarification.** Four circular secondary clarifiers receive the effluent from the oxidation ditches for solids/liquid separation of the activated sludge. The settled solids, RAS, are pumped back to the oxidation ditches to maintain treatment, wasting a portion to control the process biology.

- **Tertiary Filters.** STMWRF uses a total of eight continuous, upflow, moving bed, granular media filters, each contains four modules of 50 square feet (ft^2) of surface area. The filters are divided into two parallel banks of four cells each and can be operated separately to filter plant effluent and creek water or effluent returned from the storage reservoir simultaneously. Each filter is continuously cleaned by lifting the sand at the bottom of the filter with an air-lift pump to the surface, where the sand and entrapped solids particles are separated. The cleaned sand falls back on top of the filter bed and the solids that are removed are carried back to the headworks with the reject water. The historical backwash flow rate to the STMWRF headworks is 0.4 mgd since 2010.

- **Disinfection and Final Reuse / Disposal.** Tertiary filter effluent is disinfected in the chlorine contact basins in order to meet final discharge permit requirements. Disinfected effluent is then conveyed by pumps to either the Huffaker Reservoir or directly to reuse customers.

STMWRF currently discharges all waste activated sludge (WAS) to the Truckee Meadows Water Reclamation Facility (TMWRF) collection system. A project is under construction to add solids treatment facilities at STMWRF and is discussed in detail in TM No. 6. A diagram of the existing solids stream flow at the facility is shown in Figure 5.6.



Based on CH2MHILL Biosolids Facility Design Documents (PWP No.: WA-2014-X, 2014)

SOLIDS STREAM TREATMENT PROCESS FLOW DIAGRAM

FIGURE 5.6

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4.1 Summary of Design Criteria

Design criteria for existing facilities at the STMWRF are summarized in Table 5.4.

Table 5.4 Summary of Liquid Treatment Facilities
STMWRF Facility Plan Update
Washoe County

Parameter	Units	Design Criteria
Steamboat Creek Lift Station		
Type	-	Self-priming centrifugal
Number of pumps	each	3
Capacity, each	gpm	1,440
Horsepower	hp	25
Influent Pumping		
Raw Sewage Pipeline, diameter	in	36
Type	-	Enclosed Screw
Number of pumps	each	2
Capacity, each	gpm	3,750
Horsepower	hp	40
Influent Flowmeter		
Type	-	Magnetic
Number	each	2
Size, diameter	in	20
Capacity, each	mgd	10
Influent Screening		
Type	-	Self-cleaning Perforated Plate Screen
Screen Orifice Diameter	inch	0.25 (6 mm)
Number of Screens	each	2
Bypass Influent Screen		
Type	-	Manually cleaned
Number	each	1
Bar Spacing	in	1
Oxidation Ditches		
Each ditch Influent Pipeline, diameter	in	20
Number of ditches	each	2
Volume, each	cf	211,000
Depth	ft	14

Table 5.4 Summary of Liquid Treatment Facilities STMWRF Facility Plan Update Washoe County		
Parameter	**Units**	**Design Criteria**
Aeration Diffusers Type	-	Fine Bubble Membrane Panels
Propeller Mixers Type	-	Submerged Propeller
Propeller Mixers Number per Ditch	each	3
Aeration Blowers		
Type	-	Multi-stage Centrifugal
Number	each	5
Motor Size	hp	3 @ 200, 2 @100
Capacity	scfm	3 @ 2480, 2 @1450
Secondary Clarifiers		
Each Clarifier Influent Pipeline, diameter	in	24
Type	-	Circular
Number	each	4
Diameter	ft	80
Sidewater Depth	ft	13.5
RAS and WAS Pumps		
RAS Pump Type	-	Dry pit, end suction, centrifugal
Number of RAS Pumps	each	5
Capacity, Each	gpm	1600
Horsepower	hp	20
WAS Pump Type	-	Progressing Cavity
Number of WAS Pumps	each	2
Capacity, Each	gpm	375
Horsepower	hp	75
Secondary Scrum Pumps		
Type	-	Submersible centrifugal
Number	each	4
Capacity, each	gpm	180
Horsepower, each	hp	3
Filtration		
Filter Influent Pipeline, diameter	in	30-48
Type	-	Moving bed, continuous backwash
Number	each	8

Table 5.4 Summary of Liquid Treatment Facilities STMWRF Facility Plan Update Washoe County		
Parameter	**Units**	**Design Criteria**
Media Depth	in	80
Surface Area, Each	sf	200
Reject Rate	gpm	416
Air Compressor Type	-	Rotary Screw
Air Compressor Number	each	2
Air Compressor Capacity, each	scfm	117
Air Compressor Horsepower	hp	30
Filter Reject Water Pump Number	each	2
Filter Reject Water Pump Type	-	Submersible
Filter Reject Water Pump Capacity, each	gpm	180
Filter Reject Water Pump Horsepower	hp	5
Rapid Mixer Type	-	Mechanical, pitch-blade turbine, top mount
Rapid Mixer Number	each	2
Rapid Mixer Horsepower	hp	5
Rapid Mixer Basin Volume	gal	1900
Chlorine Contact Basins		
Contact Basin Influent Pipeline, diameter	in	30-48
Number of Basins	each	4
Volume per Basin	gal	10,200
Contact Basin Effluent Pipeline, diameter	in	30
Sodium Hypochlorite System		
Number of Storage Tanks	each	2
Capacity, each	gal	6500
Number of Feed Pumps	each	5
Capacity, each	gph	25
Effluent Pumping (to Reservoir)		
Pump Type	-	Vertical Turbine
Number of pumps	each	5
Pump Capacity, each	gpm	1@1400, 4@2500
Horsepower, each	hp	1@75, 4@150

Table 5.4 Summary of Liquid Treatment Facilities STMWRF Facility Plan Update Washoe County		
Parameter	**Units**	**Design Criteria**
Export Pumping (to Reuse)		
Pump Type	-	Vertical Turbine
Number of pumps	each	5
Pump Capacity, each	gpm	2100
Horsepower, each	hp	350
Creek Water Pumping		
Pump Type	-	Horizontal centrifugal, self-priming
Number of pumps	each	1
Pump Capacity, each	gpm	1600
Horsepower, each	hp	25
2W Booster Pumps		
Number	each	2
Capacity	gpm	1@25, 1@125
Horsepower	hp	1@1.5, 1@10

4.2 Current Operational Strategies

4.2.1 Process Monitoring and Data Collection

STMWRF currently monitors daily flows to the oxidation ditches after plant influent flows are combined with filter backwash water. BOD and TSS are occasionally monitored along with ammonia, TKN, and phosphorus.

Additional process monitoring in secondary treatment includes continuous monitoring of dissolved oxygen immediately upstream and downstream of the aeration diffusers in Ditch Nos. 1 and 2 for a total of four probes. The DO setpoint in the aeration zone of the ditches is 2 mg/L. The measured DO concentration upstream of the aeration system is typically close to zero. The aeration is controlled on basis of a constant air flow set point of 3,500 scfm that follows an on/off cycling throughout the day. Aeration is shut off between 2:00 a.m. and 6:00 a.m., 1:00 p.m. to 3:00 p.m., 4:00 p.m. to 5:00 p.m., 7:00 p.m. to 8:00 p.m., and 11:00 p.m. to 12:30 a.m. This aeration scheme was developed to treat peak influent loading rates, implemented since October 2014 in order to save aeration energy while balancing ammonia and nitrate removal. Prior to this aeration control strategy, the blowers were in operation 18 hours per day. Per information from plant staff, the new aeration schedule has overall lowered ammonia and nitrate concentrations in the effluent. Oxygen Reduction Potential (ORP) is also measured in the ditches but readings are not used for process control.

Ammonia and nitrate is continuously monitored in the oxidation ditch mixed liquor splitter box. The nitrate setpoint in the secondary effluent is 5 mg/L and typically nitrate concentrations are significantly below this threshold. Nitrate readings are generally reliable, while ammonia probe readings are not. Both probes are recalibrated monthly. Therefore, a possible aeration strategy to control the blower operation based on ammonia concentrations in the mixed liquor is not used.

Effluent monitoring assesses mixed liquor settling characteristics, pH, and suspended solids in the final tertiary treated effluent. Solids inventory is controlled by targeting a constant mixed liquor TSS concentration of about 2000 mg/L and adjusting solids wasting accordingly. On a daily basis, microscopic examination of activated sludge assists in plant operation. The mixers in the oxidation ditch are set and adjusted as necessary to target an activated sludge cross flow velocity of 1 ft/sec velocity. The tertiary filter effluent turbidity is checked on a monthly basis.

4.2.2 Solids Inventory

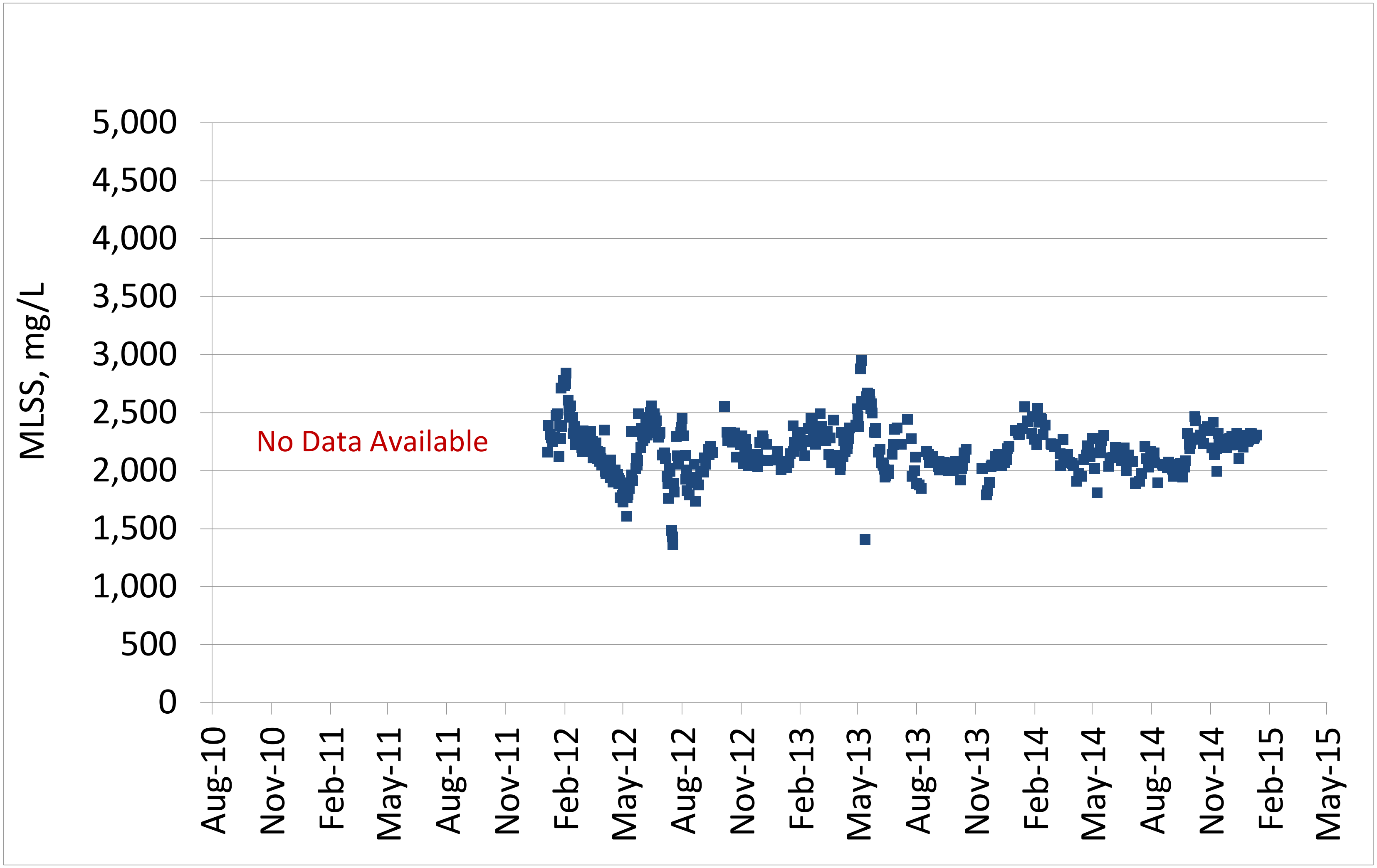
The averaged mixed liquor suspended solids (MLSS) concentration of the two oxidation ditches is presented as a function of time in Figure 5.7. MLSS concentration has typically ranged from 2,000 to 2,500 mg/L since 2012, with an average concentration of 2,186 mg/L. Operational staff typically maintains ditch concentrations below 2,400 mg/L.

While the County is willing to explore operating at higher MLSS concentrations, they have concerns regarding foaming and increased filament concentrations associated with operating a heavier oxidation ditch.

4.2.3 Solids Retention Time

The total solids retention time (tSRT) is a key operating parameter for nitrification and general process stability. The minimum tSRT required to achieve nitrification is wastewater temperature dependent. A minimum design temperature of 13.9 degrees Celsius (C) (57.0 degrees Fahrenheit (F)) was used as the design assumption based on historical plant data shown in Figure 5.4.

The waste activated sludge (WAS) load and tSRT for the past five years of operations are shown in Figure 5.8. The tSRT data are only available since 2014 due to the lack of overlapping ditch MLSS concentrations and WAS solids load required for its calculation. The WAS solids concentration, in general, appears to increase from 3,500 mg/L in 2010 to 5,700 mg/L in 2015. Increasing WAS solids load is in agreement with the slightly increasing influent TSS loading shown in Figure 5.3 and discussed in TM 2. The tSRT values are relatively stable and range from approximately 10 to 15 days; the average tSRT from the available data is 11.7 days. An abnormal spike in tSRT was observed in September 2014, resulting from an unexplained, sharp decline in WAS solids load.



- MLSS concentrations are the average of both oxidation ditches

AVERAGE OXIDATION DITCH MLSS CONCENTRATION

FIGURE 5.7

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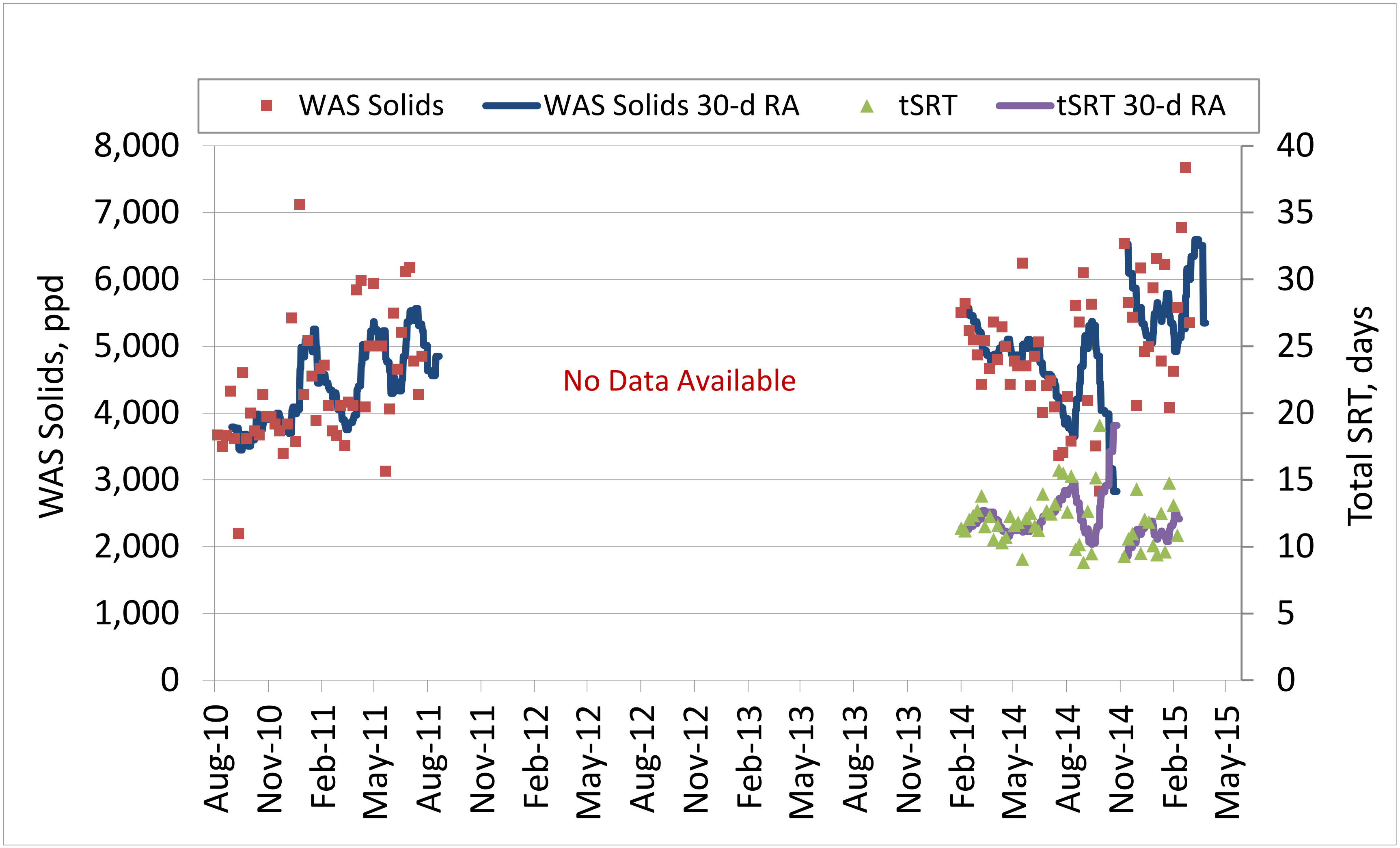

WASTE ACTIVATED SLUDGE SOLIDS AND TOTAL SOLIDS RETENTION TIME

FIGURE 5.8

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Based on this data and historical effluent ammonia concentrations (see Section 3.5.1), a tSRT of approximately 11.7 days is sufficient for full nitrification (effluent ammonia concentrations below 1-2 mg/L. A minimum design tSRT of 9.0 days is proposed to be used to maintain full nitrification at minimum design wastewater temperatures.

4.2.4 Dissolved Oxygen Profile

The current aeration strategy at STMWRF was adopted in October 2014 and is based on a facility performance evaluation conducted by Mettler (2015). For this current aeration scheme (for details see Section 4.2.1), a comprehensive dissolved oxygen (DO) profile was developed by Mettler (2015) for periods when aeration was turned on and off in the oxidation ditch. DO readings were taken at depths of 3.5 and 7.0 feet at 12 sections within each ditch. The DO concentration during the aeration on/off cycle at each location was determined to be the average of the measurements taken at the two depths, and are presented in Figure 5.9. Average DO readings from the two DO probes located in each ditch are also presented. The corresponding locations of each DO sample point are shown in Figure 5.10.

In the aerated zone, DO concentrations increase from less than 0.2 mg/L to greater than 2.0 mg/L at the end of the aerated zone. DO concentrations then begin to steadily decrease through the first turn of the oxidation ditch and across the entire length of the unaerated channel adjacent to the aerated zone. By transition zone 6, DO concentrations in the ditch have declined to below 0.2 mg/L. This DO profile in the ditches was used for the calibration of the process model.

4.3 Evaluation of Existing Processes

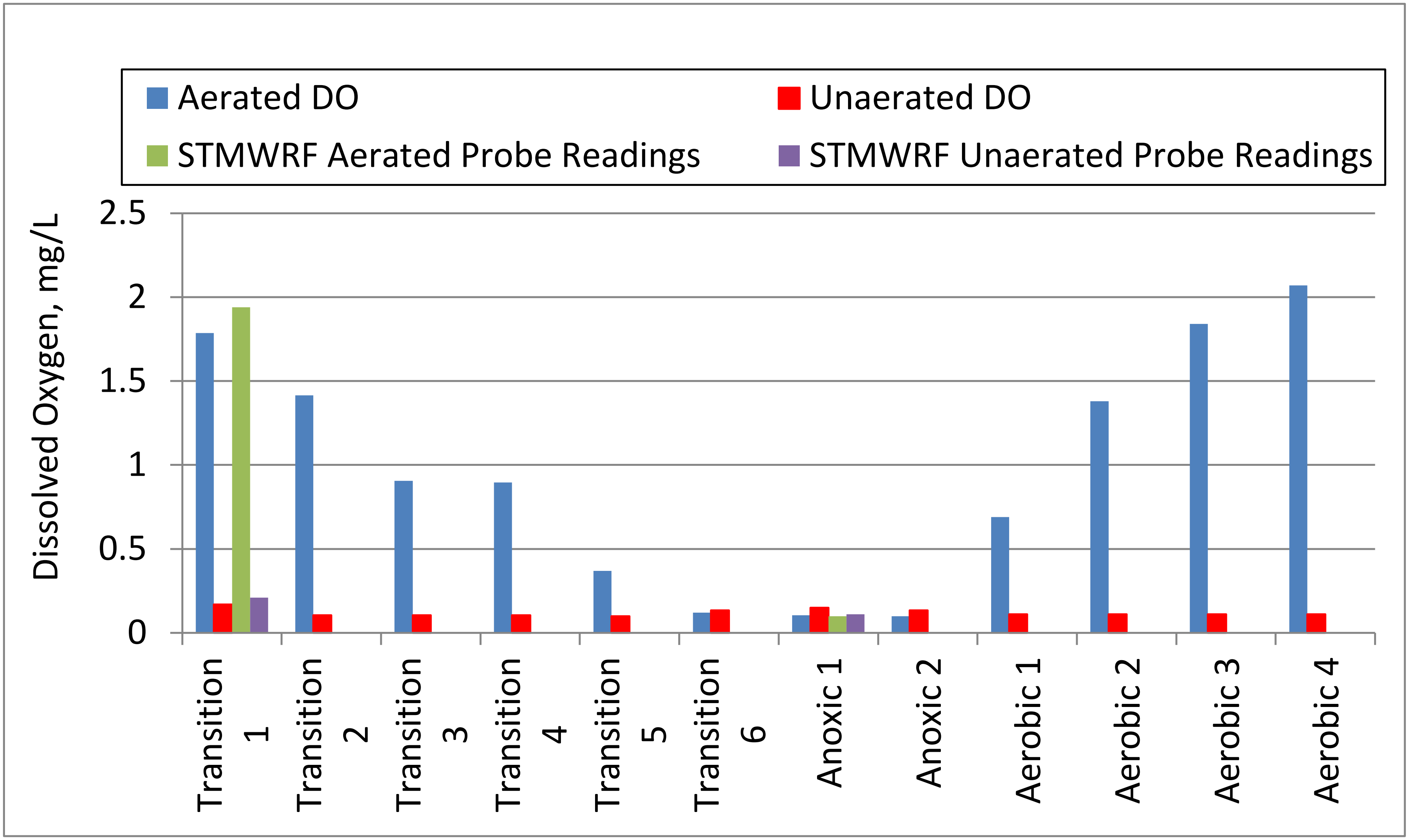
4.3.1 Nitrification

Effluent ammonia concentration and tSRT is presented in Figure 5.11. In general, STMWRF achieves at times full nitrification with concentrations below 2 mg/L-N, but full nitrification has also been frequently lost. Nitrification performance improved after March 2013 and remains typically below the operational goal from the County of 2.0 mg/L.

There have been several periods during which concentrations have approached, and even exceeded, 8 mg/L ammonia. Spikes between the months of May and November may indicate that oxygen supply or transfer was challenged under warmer wastewater temperatures. The spike in winter 2014/2015 may have been caused by rapid fluctuations in solids inventory management.

4.3.2 Nitrogen Removal

Effluent nitrate and total nitrogen concentration are presented in Figure 5.12 and Figure 5.13, respectively. STMWRF achieves quite low effluent nitrate concentration ranging from 1.0 to 5.0 mg/L-N. An average effluent nitrate concentration of 2.3 mg/L-N has



- Sample Locations for DO Profiles November 7 and November 25, 2014. Data adopted from Mark Mettler thesis from University of Nevada Reno, Figure 5-55.

OXIDATION DITCH DO PROFILE

FIGURE 5.9

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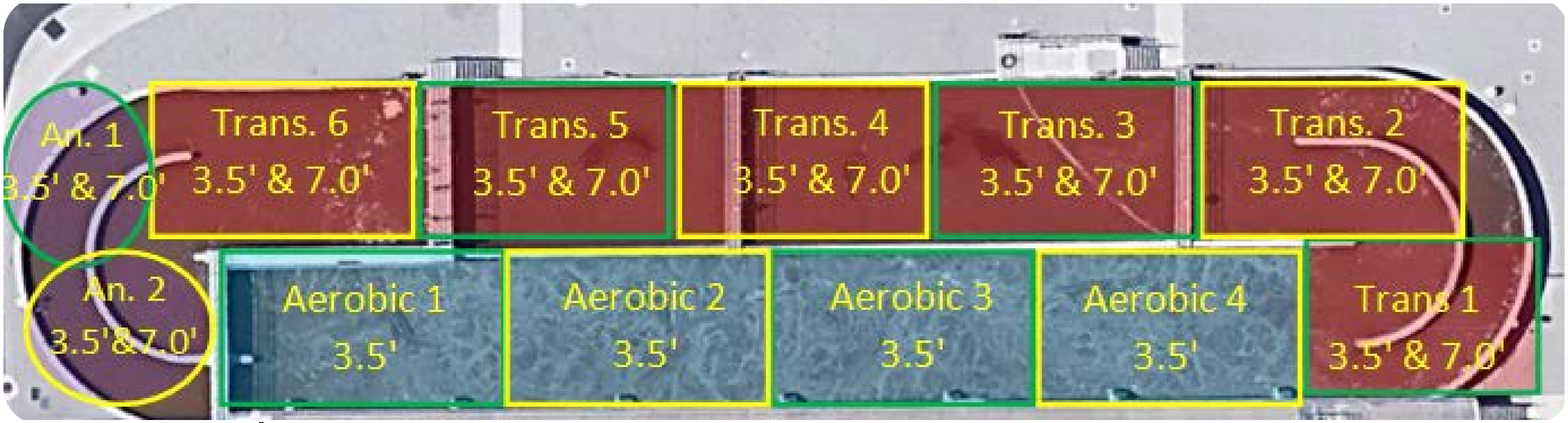

- Sample Locations for DO Profiles November 7 and November 25, 2014. Data adopted from Mark Mettler thesis from University of Nevada Reno, Figure 5-55.

OXIDATION DITCH DO READING LOCATIONS

FIGURE 5.10

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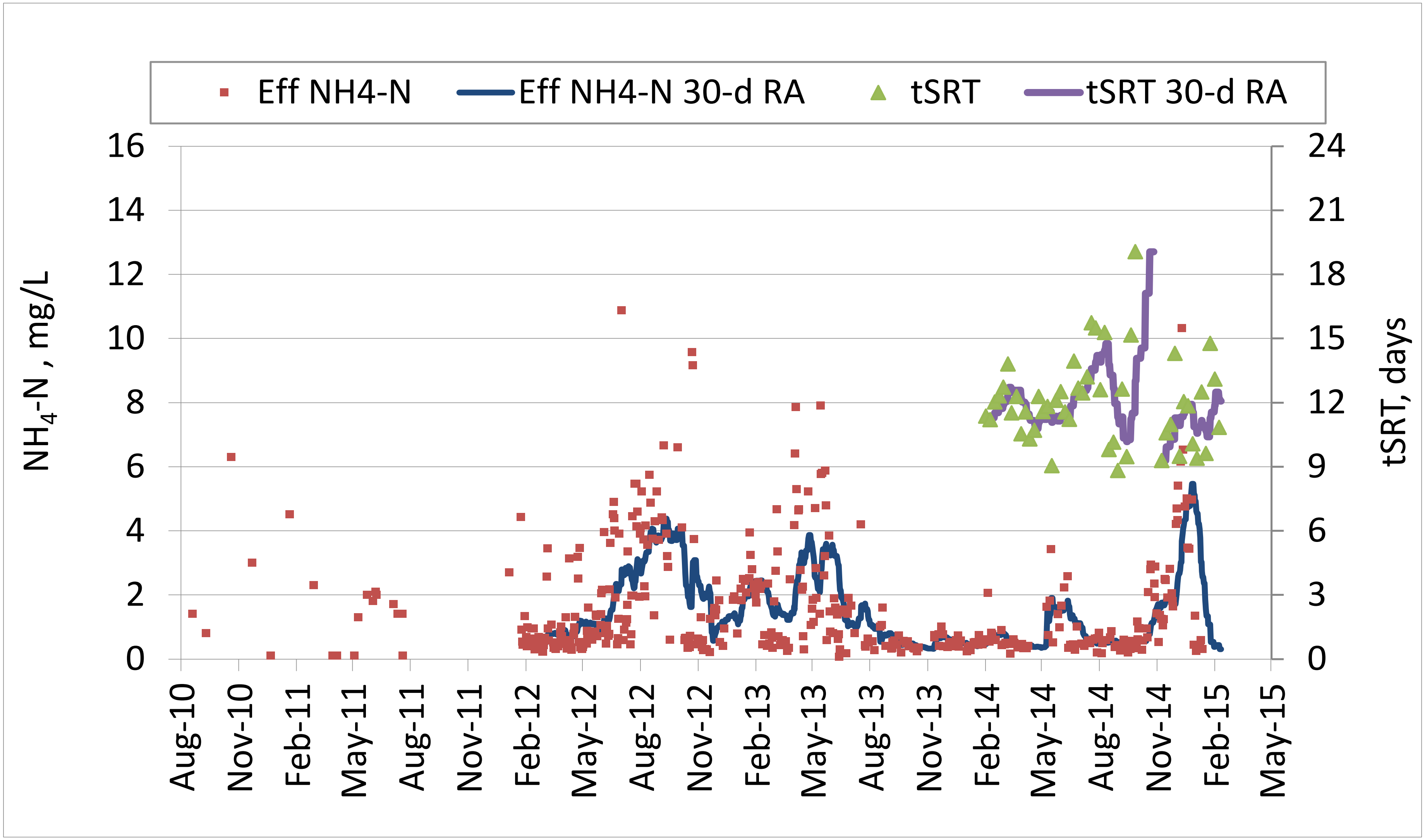

EFFLUENT AMMONIA CONCENTRATIONS AND tSRT

FIGURE 5.11

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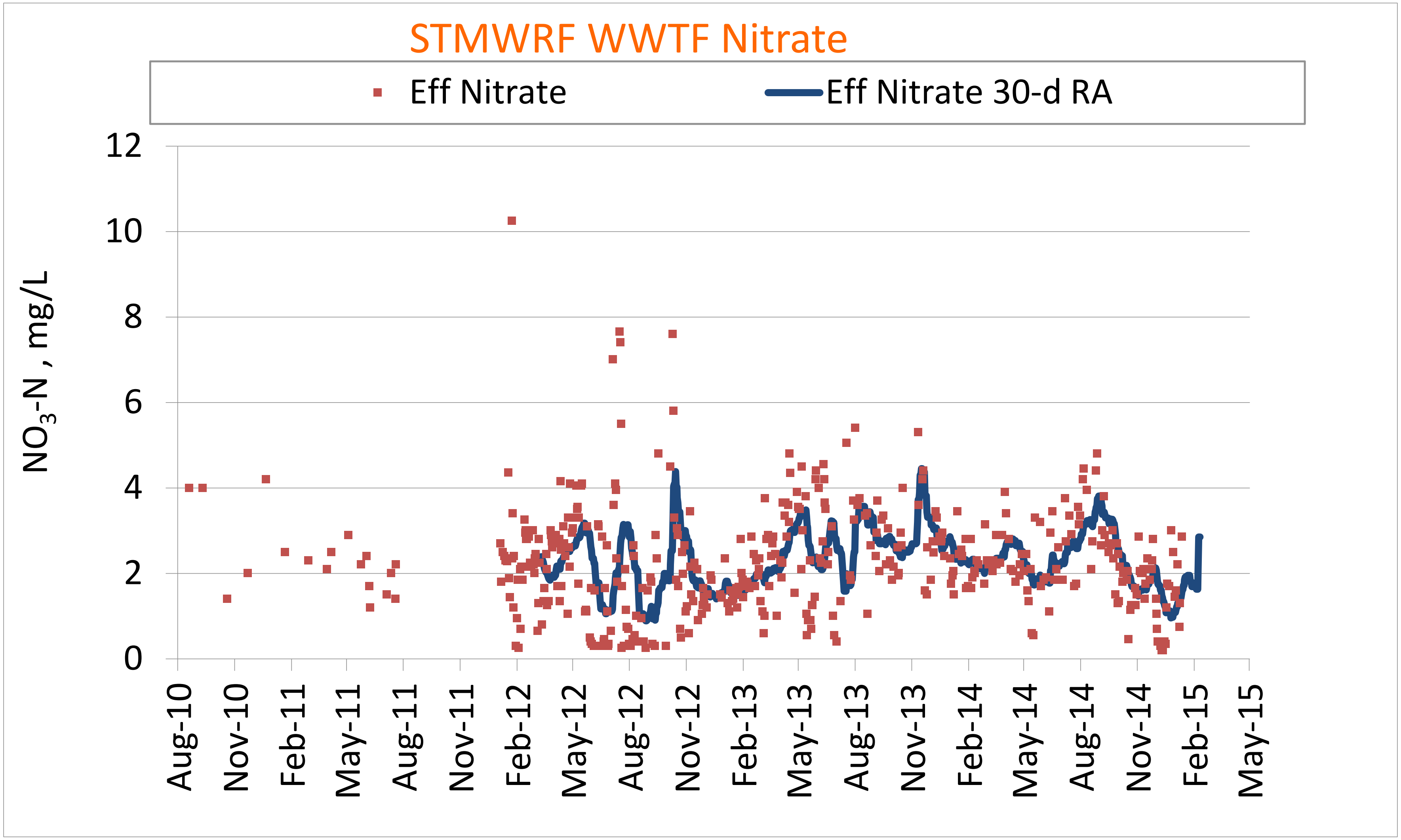

EFFLUENT NITRATE CONCENTRATIONS

FIGURE 5.12

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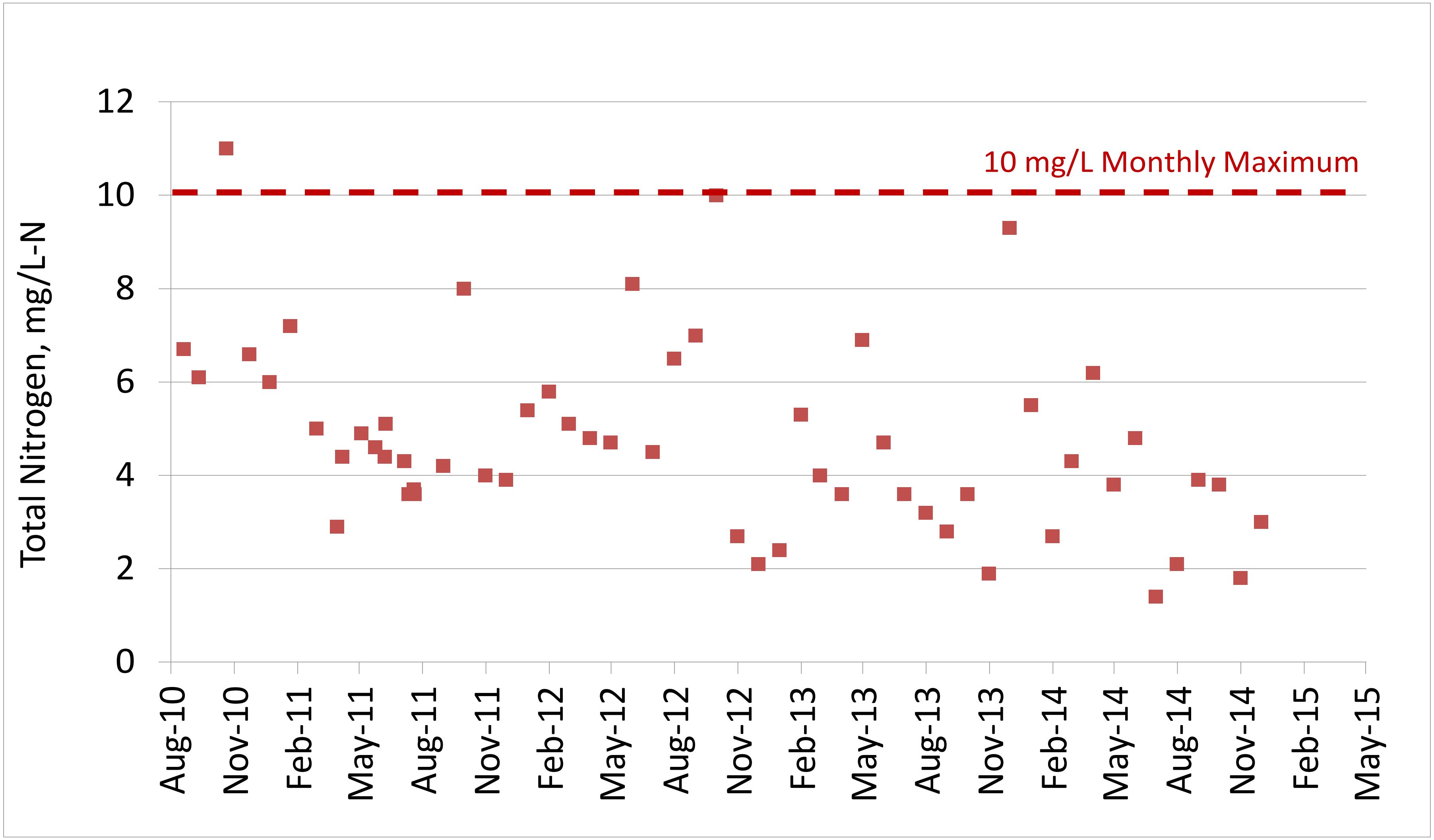

EFFLUENT TOTAL NITROGEN CONCENTRATIONS

FIGURE 5.13

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been maintained since 2010 with an operational goal from the County of 5.0 mg/L. Relative to effluent ammonia concentrations presented in Figure 5.11, effluent nitrate concentrations have remained fairly consistent with fewer spikes in concentration. This pattern has been observed at other oxidation ditch facilities in the U.S. and is caused primarily by a lack of aeration control to provide sufficient oxygen to nitrifiers.

Effluent TN concentrations in Figure 5.13 appear to have decreased for the last five monthly values shown. This is a likely result of the intermittent oxidation ditch aeration begun in the Spring of 2014.

4.3.3 Phosphorus

Effluent total phosphorus (TP) concentrations are presented as a function of time in Figure 5.14. STMWRF's process operation is not targeting biological phosphorus removal and does not currently monitor influent or effluent for ortho-phosphate (OP) concentrations. The data provided suggests that STMWRF achieves marginal TP removal in the secondary and tertiary treatment system, with effluent total phosphorus concentration ranging from 1.0 mg/L to 2.5 mg/L-P. Data collected since January 2015 indicates that the average influent TP concentration to the ditches is 6.45 mg/L-P.

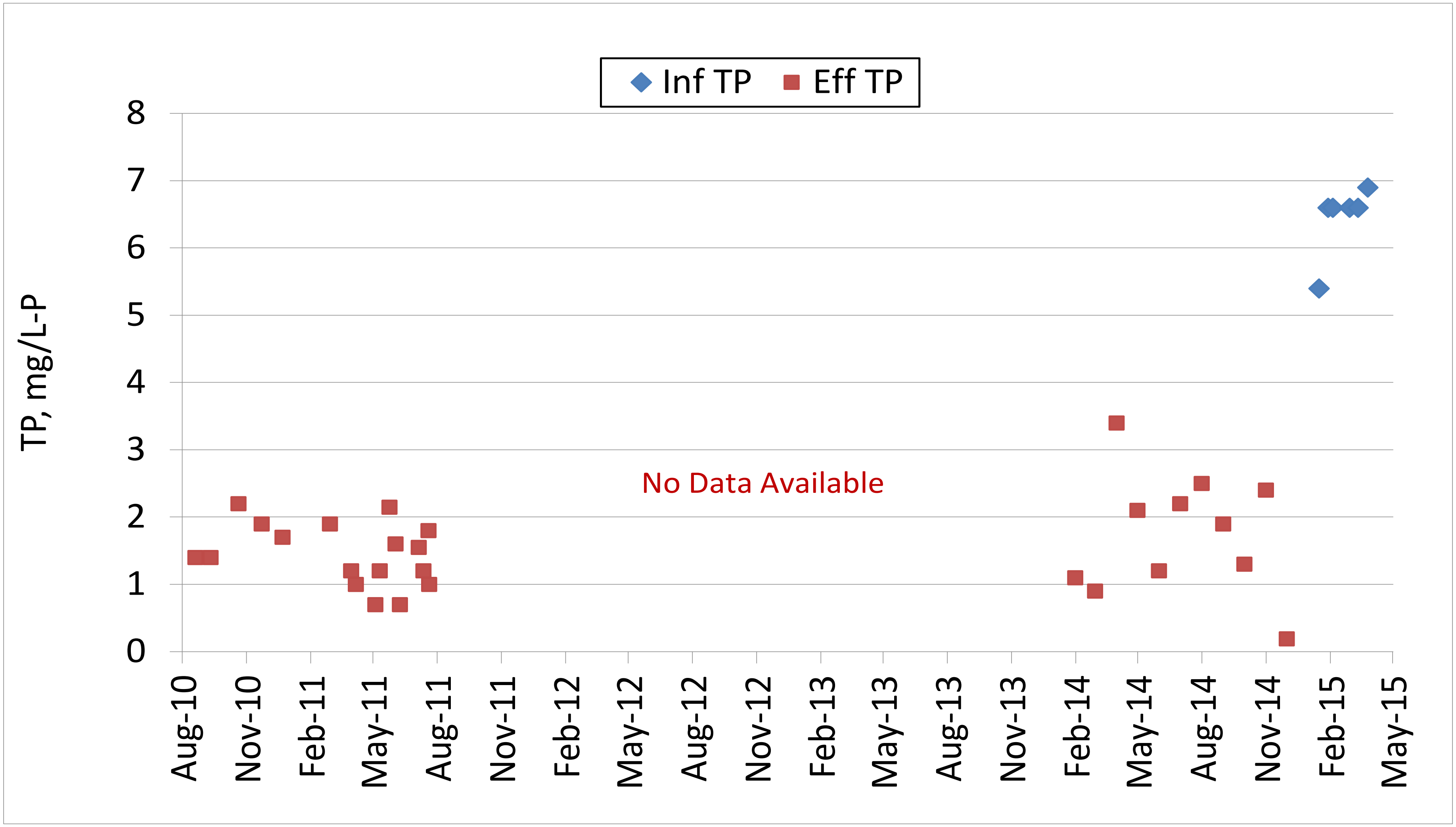
4.3.4 Secondary Clarification and Solids Settleability

The capacity and general performance of the secondary clarifiers is assessed looking at historical solids loading rate (SLR), surface overflow rate (SOR), sludge volume index (SVI), secondary effluent TSS data (not available for this facility) in conjunction with a solids flux analysis or state point analysis (SPA).

Limited SVI data for the facility is presented in Figure 5.15. SVI values typically range from 150 mL/g to 250 mL/g, with an average SVI of 199 mL/g since 2012. Typically, SVI values above 150 mL/g are considered elevated and challenging for settling performance due to filament growth.

For the capacity evaluation, an SVI of 200 mL/g was chosen as an appropriate design assumption at this time for STMWRF reflecting that the facility experiences commonly challenging SVI conditions without being overly conservative (Figure 5.15 and Appendix A, Figure A.1).

In conjunction with an assumed SVI design value, a clarifier safety factor (CSF) is defined to evaluate the clarifier capacity. The CSF ensures that the capacity rating for the clarifiers is sufficient to handle peak hydraulic loading rates and other variations that occur in full-scale biological systems. The CSF describes a safety margin between safe clarifier operation and clarifier failure based on the SPA. The recommended design CSF for a given plant is typically calculated as the ratio of hydraulic peak flow and average day maximum month flow (applying a recommended internal safety factor of 20 percent):



INFLUENT AND EFFLUENT TOTAL PHOSPHORUS CONCENTRATIONS

FIGURE 5.14

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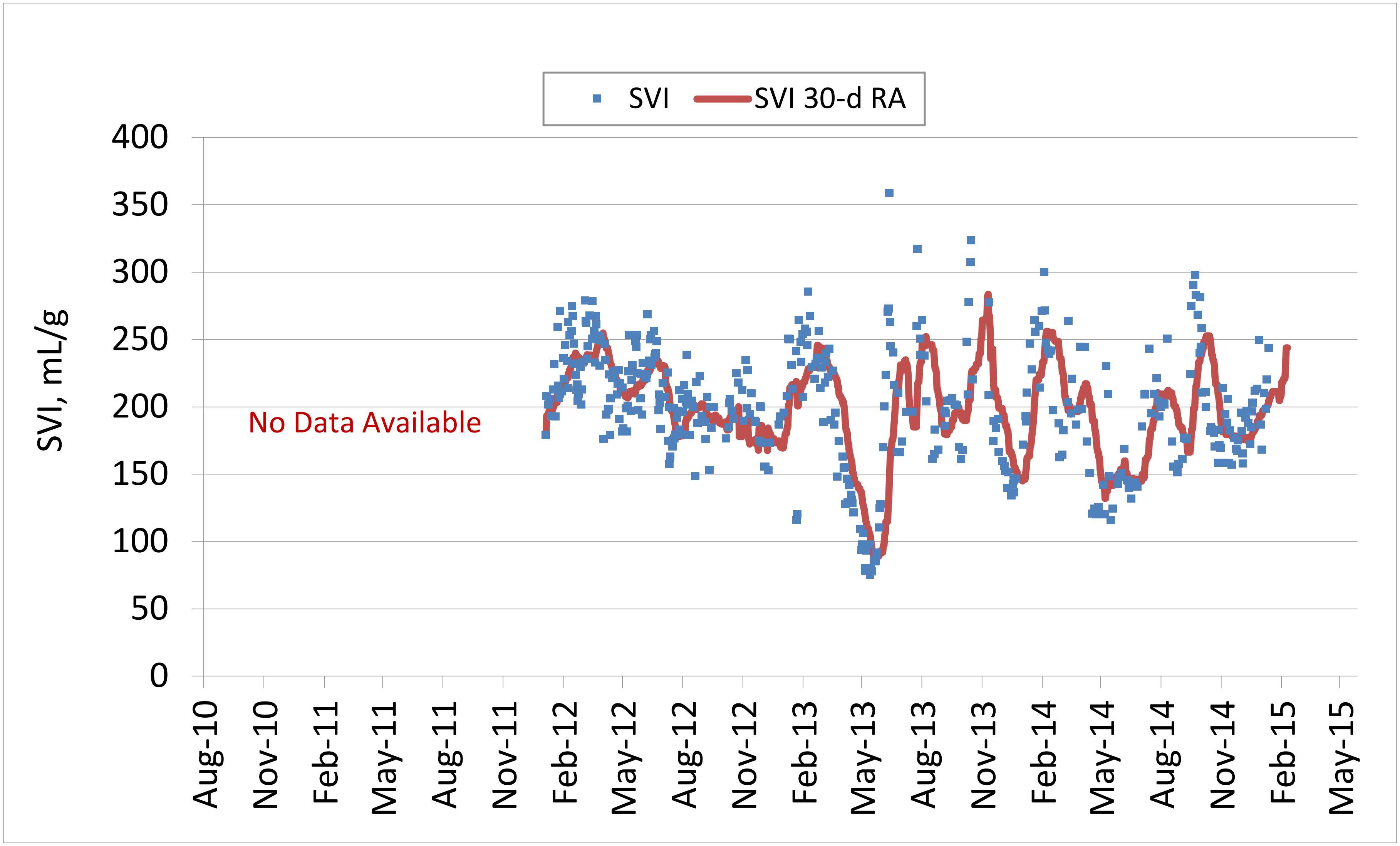

SLUDGE VOLUME INDEX

FIGURE 5.15

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$$CSF = \frac{\frac{Peak \cdot 4 - hr \cdot flow}{ADAF}}{\frac{ADMMF}{ADAF}} \cdot 1.2 = 2.6$$

Because the STMWRF has tertiary filters in place, the minimum CSF was significantly reduced from 2.6 to approximately 1.1 on basis that any peak flow conditions beyond ADMMF that may result in increased sludge blankets and potentially elevated secondary effluent TSS concentrations can be mitigated prior to final discharge during tertiary filtration.

4.3.5 Tertiary Filtration

Effluent cBOD and TSS concentrations after tertiary filtration and disinfection are presented in Figure 5.16 and Figure 5.17, respectively. Both effluent cBOD and TSS concentrations have been well below the 30-day average limit of 30 mg/L over the past five years of operation. Effluent TSS concentrations averaged 3.4 mg/L since 2010.

4.3.6 Summary

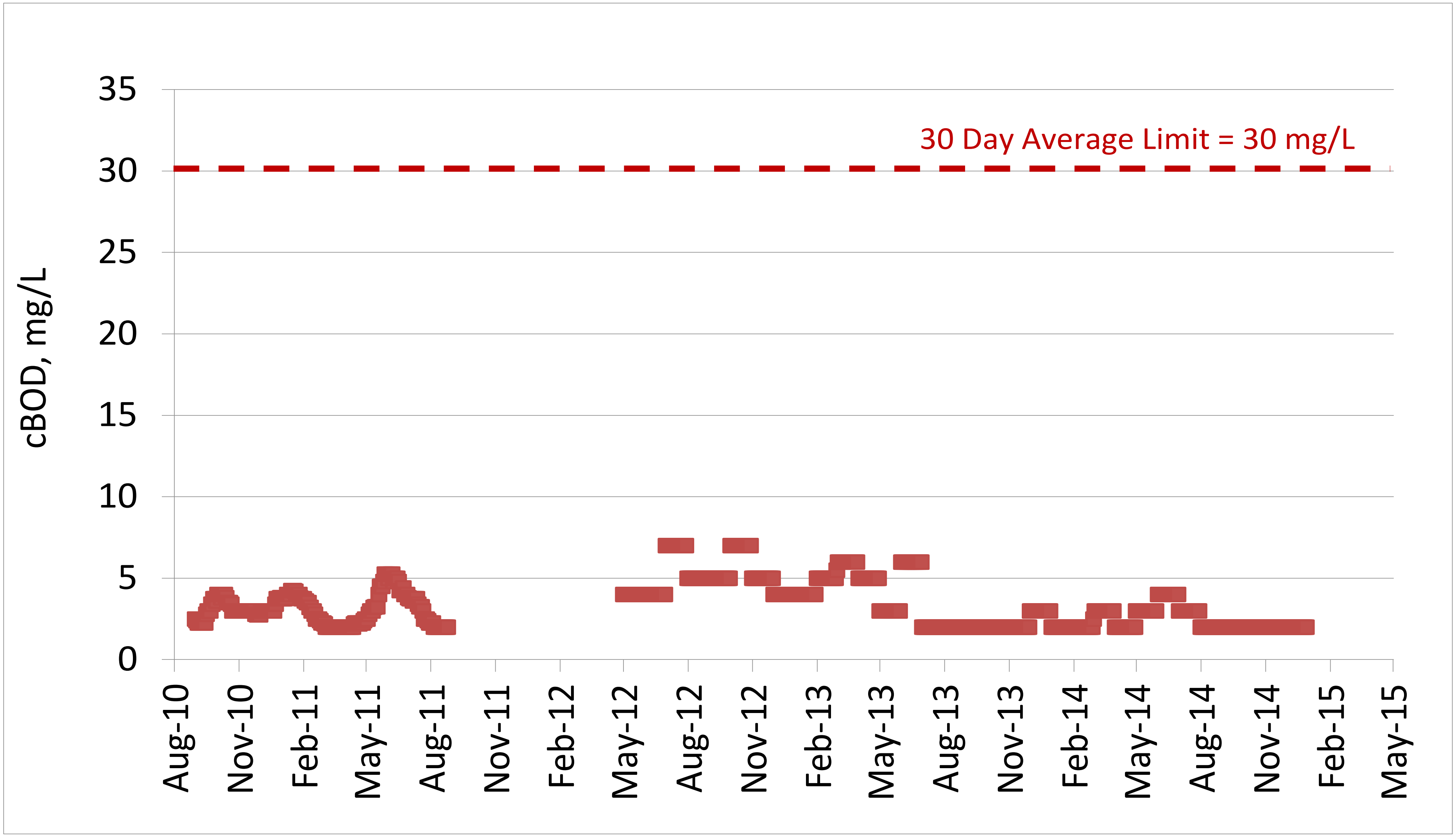
In summary, the existing treatment is meeting current permit requirements, however, there are times when slight treatment upsets are observed. These upsets can be controlled with process optimization (described below).

5.0 PROCESS MODELING SUMMARY

5.1 BioWin Model Setup and Calibration

A BioWin process model was configured for the existing oxidation ditch, secondary clarifiers, and tertiary filters at the STMWRF and was calibrated using routine operations and performance data and analyses of supplemental wastewater samples collected between July 23 and August 4, 2015. Note that the existing configuration does not include the solids handling facilities currently under construction.

Table B.1 in Appendix B summarizes the inputs used for the process model calibration based on operations and performance data and supplemental sample analyses in late July and early August 2015. During the model calibration, certain wastewater influent characteristics were adjusted to better match observed plant performance during the same period in terms of effluent quality, mixed liquor suspended solids concentration, and solids production. Very good agreement between all relevant calibration parameters and actual plant data was achieved after calibration was completed (deviation less than 10 percent). The adopted calibration parameters are shown in Table B.2 in Appendix B. Calibration of the STMWRF process model was typical, in that only a very small number of default parameters needed to be changed to result in a very close match with actual plant data. The complete data set from the supplemental sampling during July and August 2015, which



EFFLUENT CBOD CONCENTRATIONS

FIGURE 5.16

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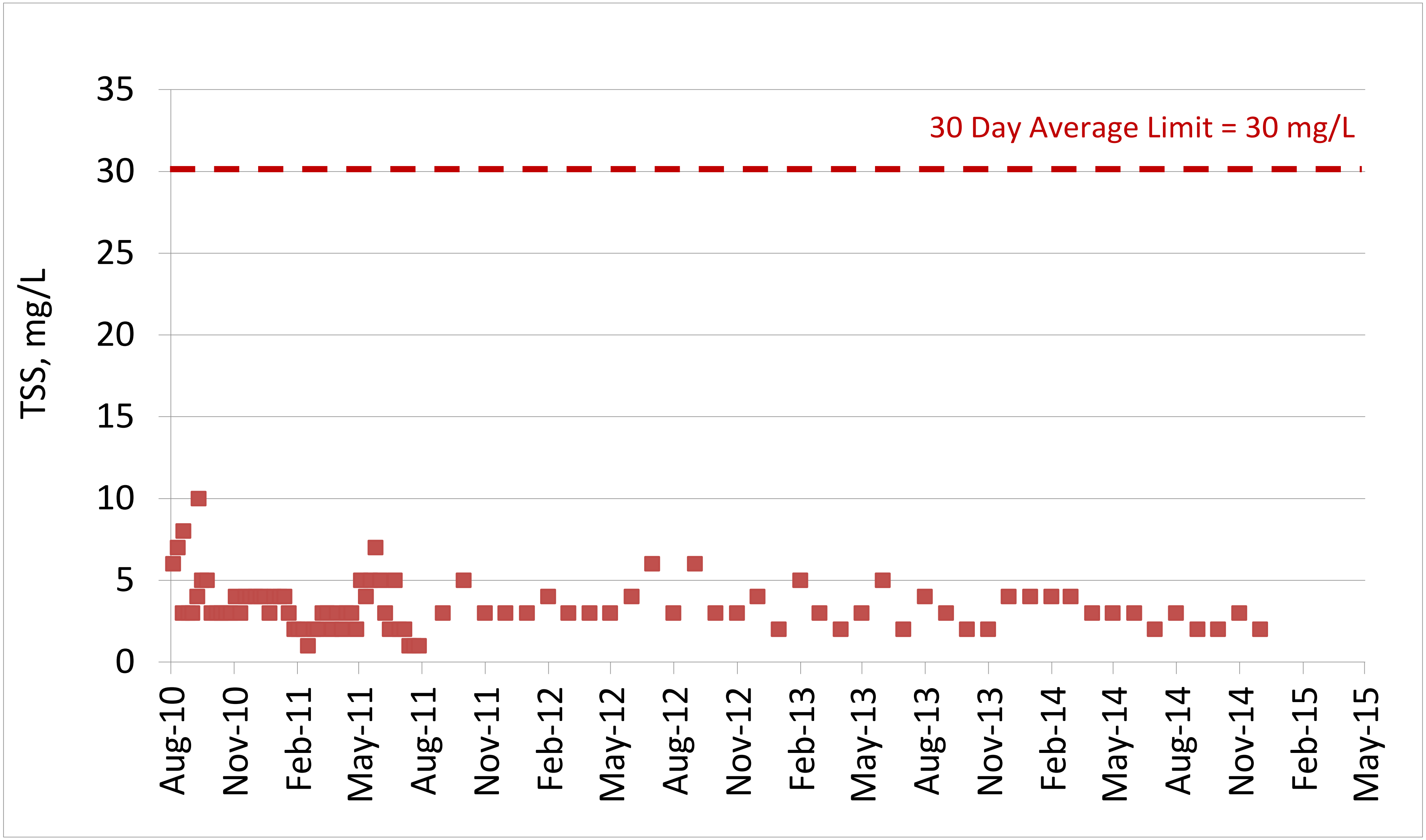

EFFLUENT TSS CONCENTRATIONS

FIGURE 5.17

WASHOE COUNTY
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was used to calibrate the model, is summarized in Table B.3 in Appendix B. The calibrated BioWin process model summary is included in Appendix C.

6.0 Capacity and Performance Evaluation

6.1 Existing Secondary Treatment Capacity Evaluation

The treatment capacity and performance of the existing secondary process was evaluated under the current design ADMMF (4.1 mgd) and projected 2035 ADMMF conditions (6.0 mgd) (see Table 5.3) to meet the TN and ammonia treatment goal of less than 7 mg/L TN and less than 2 mg/L, respectively. The STMWRF process model was expanded to include the two aerobic digesters, recuperative rotary drum thickener, and screw press currently under construction to capture suspended solids and nutrient recycles.

The capacity analysis was conducted using the calibrated BioWin process model for the case that one of the four secondary clarifiers is taken out of service in winter conditions while near-term solids handling facilities are in operation.

A SPA was conducted to identify the maximum MLSS concentration (up to 4,000 mg/L) and SLR that the three clarifiers in service can handle while still maintaining a SCF of more than 1.1 when processing ADMMF and loads. The simulation was run at the minimum 30-day design temperature of 13.9 degrees Celsius and the corresponding minimum design tSRT of 9.2 days.

Simulation results confirm the current rated capacity of 4.1 mgd for the existing secondary treatment facility (Table 5.5). The process model summary is included in Appendix C.

6.2 Future Secondary Treatment Expansion Needs

The secondary treatment expansion requirements were evaluation for the case that the facility receives in the future the 2035 projected flows (6.0 mgd ADMMF). Results indicate that the facility needs one additional equal sized oxidation ditch for a total of three ditches in service. In order to realize the maximum capacity of the existing secondary clarifiers, a biological selector is recommended upstream of the oxidation ditches to improve reliable sludge settleability (i.e., reduce the SVI).

Table 5.5 summarizes the results from process modeling under the current ADMMF and projected future flows and loads for the year 2035.

The CSF under the 2035 flows and load projections is borderline in meeting the recommended minimum requirement of 1.0. The difference does not seem relevant enough to recommend construction of a fifth secondary clarifier. This is supported by overall reasonable projections for SLR and SOR even with all four units in service. However, we recommend a biological selectors zone to reduce SVI's to less than 160.

Table 5.5 BioWin Capacity and Performance Results STMWRF Facility Plan Update Washoe County		
Parameter	**Current Secondary Treatment Capacity**	**Future Projection 2035**
ADMMF, mgd	4.1	6.0
Temperature, °C	14.0	14.0
Anaerobic selector zone		1
Total volume, MG		0.25
Oxidation Ditch		
Units in service	2	4
MLSS, mg/L	4,776	3,470
total SRT, days	10.0	10.0
Secondary Clarifier		
Total Units	4	4
SVI	200	160
WAS TSS, ppd	14,000	20,500
All Units in service		
SLR, ppd/ft^2	15.6	17.5
SOR, gpd/ft^2	204	228
CSF	1.48	1.33
One Unit Out of Service		
SLR, ppd/ft^2	20.9	21.8
SOR, gpd/ft^2	272	284
CSF	1.11	1.06
Effluent		
TN, mg/L	7.0	6.6
NH_4-N, mg/L	2.3	3.7
NO_3-N, mg/L	0.2	0.1
NO_2-N, mg/L	2.1	0.5
TP, mg/L	2.7	2.1

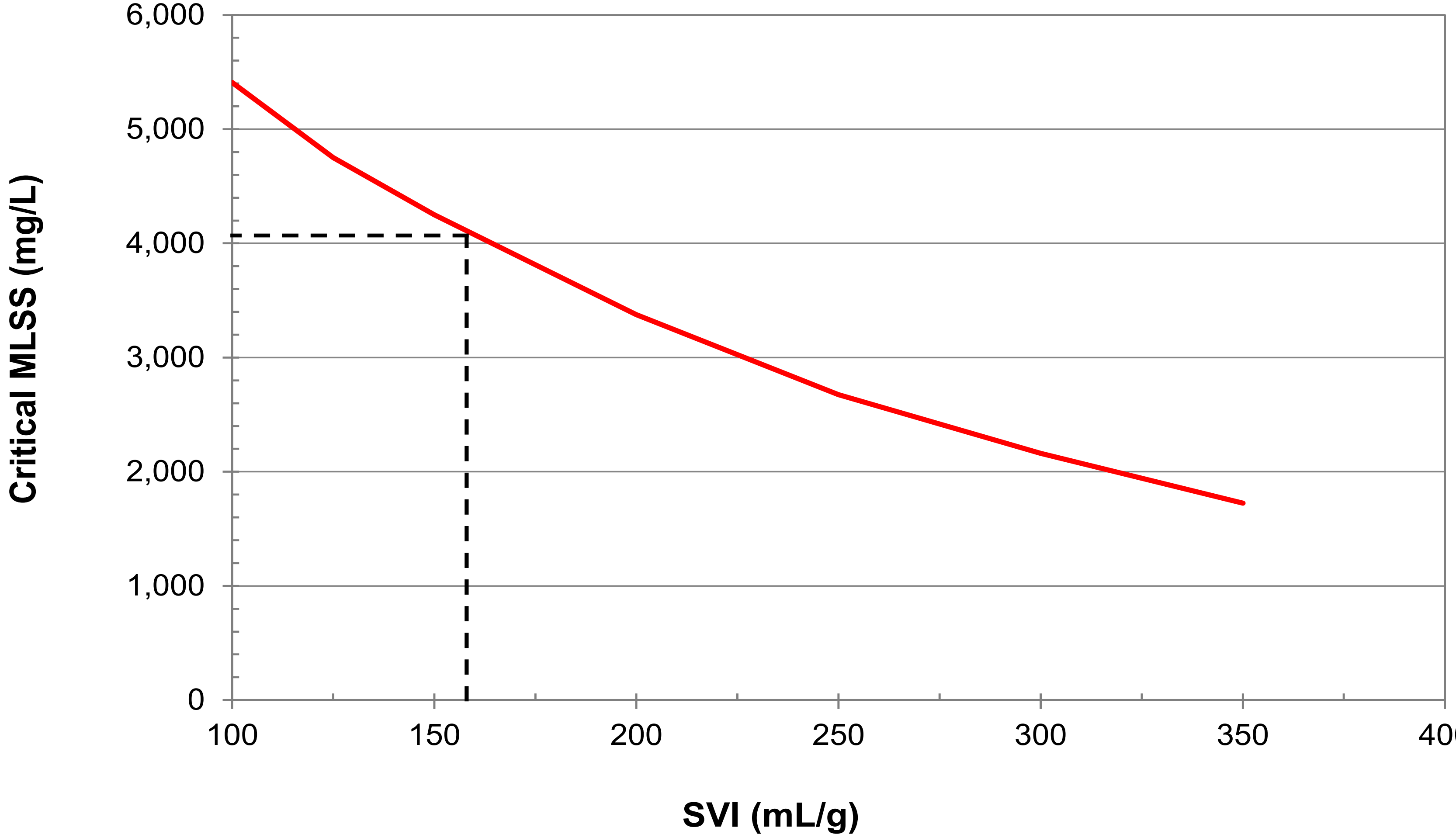
It should be noted that the recommended design assumption for SVI of 200 mL/g has a large impact on the capacity evaluation. Typically, a value of 150 mL/g is used as the threshold between well-settling sludge (SVI <150 mL/g) and bulking sludge (SVI >150 mL/g). Figures 5.18 and 5.19 show the relationship between the design SVI, represented by the 90th percentile SVI value, and critical mixed liquor concentration at which the clarifiers would be overloaded at peak wet weather flows for current and 2035 conditions. The figures show the benefits of reducing the design SVI value (i.e., improving the sludge settleability). Note that a backup means of controlling sludge settleabilty, such as standby polymer addition, is necessary to prevent clarifier overloading if the SVI exceeds 150 mL/g and there the plant is experiencing peak flows.

Likewise, the high design load peaking factors for cBOD and TSS developed in TM 2 have a relevant impact on the plant capacity rating as they result in elevated MLSS concentrations. Most facilities, however, anticipate additional foaming, compromised settling characteristics, and reduced oxygen transfer efficiency at such elevated MLSS concentrations.

As discussed above, the facility does not currently target biological phosphorus removal; therefore, the modeled reduction in effluent total phosphorus is largely attributed to the removal of particulate phosphorus and limited uptake of phosphorus into cell biomass.

6.3 Summary of Capacity Rating of All Existing Facilities

The peak capacity (all units in service) and firm capacity (standby units out of service) for process treatment and hydraulic conveyance is summarized for each of the major treatment processes based on the reliability and design criteria developed in TM 2 in Table 5.6.



DESIGN SVI VS CRITICAL MLSS - CURRENT CONDITIONS

FIGURE 5.18

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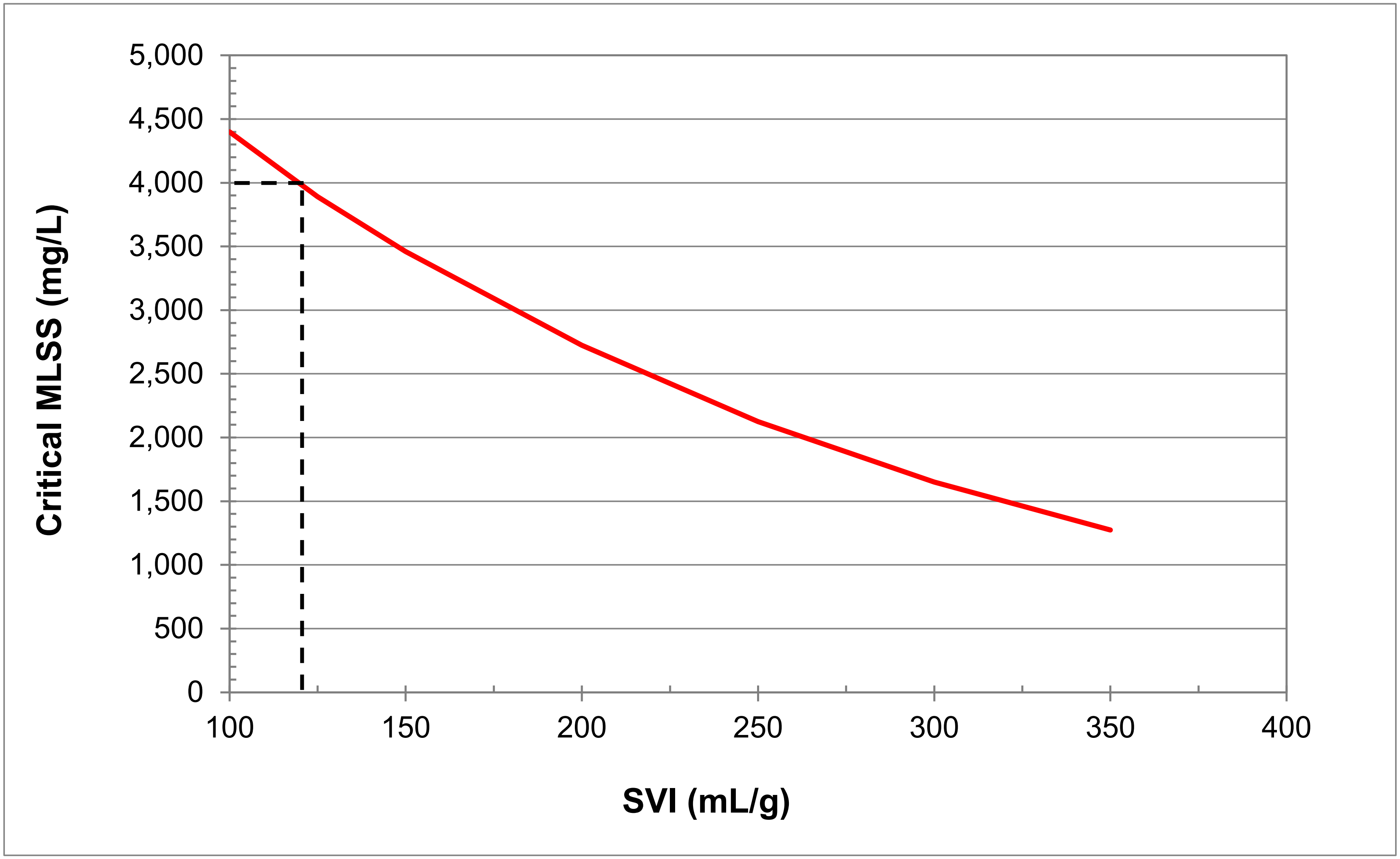

DESIGN SVI VS CRITICAL MLSS - PROPOSED 2035 CONDITIONS

FIGURE 5.19

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Table 5.6 Capacity Rating of Existing Facilities STMWRF Facility Plan Update Washoe County			
Treatment Process or Equipment	**Peak Capacity (mgd)**	**Firm Capacity (mgd)**	**Comment / Reliability Criteria(1)**
Influent Pumping	10.8	5.4	1 UIS + 1 Standby
Screening(2)	24.0	12.0	1 UIS + 1 Standby + 1 bypass channel with manual screen
Scum Pump Stations	1.03	0.78	3 UIS + 1 Standby
Secondary Treatment	NA	4.1 (ADMMF)	No Standby
RAS Pumping	11.52	9.21	4 UIS + 1 Standby
WAS Pumping	1.08	0.54	1 UIS + 1 Standby
Tertiary Filters(3)	10.4	6.7	No Standby
Chlorine Contact Basins(4)	14.7	11.0	3 UIS + 1 Standby
Effluent Pump Station	13.25	9.65	4 UIS + 1 Standby

Notes:
(1) UIS = Unit In-Service; Standby Unit assumed to be largest unit.
(2) Based on 12 mgd peak hour capacity of each screen and ADMMF capacity of 4.1 mgd.
(3) Based on loading rates of 5.0 gpm/sf for peak and 2.9 gpm/sf for ADMMF (2008 Facility Plan).
(4) Capacity is based on assumption of 30 minute chlorine contact time, and adequate chlorine dose to achieve required contact time.

7.0 OPTIMIZATION OPPORTUNITIES

This section identifies optimization opportunities for current process operation with the goal of enhancing STMWRF effluent quality and for identifying opportunities for labor, power, and chemical cost savings.

7.1 General

Despite the adequate process monitoring at STMWRF to meet reporting requirements, influent wastewater data collection has been historically limited. Influent data that is not currently being collected, but is important for an accurate assessment of process performance includes COD, cBOD, TSS, VSS, pH, alkalinity, ammonia, TKN, total phosphorus, and orthophosphorus. A revised data collection plan that includes long-term sampling and historical trending of these influent constituents would help to verify and refine current STMWRF process modeling.

Prior to final design of any facilities, it is recommended to verify that relevant influent concentrations have not changed over time through more frequent influent sampling and analysis and flow and load peaking factor verification. Sampling and analysis should also include the impacts of the solids handling recycle stream once the solids handling facilities are placed in service.

Chemical application is not necessary to produce effluent ammonia concentrations below the goal of 2 mg/L and TN concentrations below 7 mg/L. In case STMWRF should decide to target additional phosphorus removal in the future (there is currently no permit driver), this could be achieved with the addition of ferric or alum coagulants that may be added to the secondary clarifier or tertiary filter influent. Other oxidation ditch facilities in the U.S. have successfully implemented biological phosphorus removal by constructing a small anaerobic selector upstream of existing oxidation ditches to promote the proliferation of phosphorus accumulating organisms (PAOs).

7.2 Headworks

The headworks has been newly designed and constructed recently with a hydraulic capacity of 12 mgd. To handle 2035 peak flow of 13.3 mgd with one unit out of service, one additional screen shall be installed.

7.3 Oxidation Ditch and Aeration Systems

Continuing to improve DO and aeration control to stabilize nitrification without compromising the exceptional nitrogen removal is paramount in recommending oxidation ditch performance improvements. Recommended optimization opportunities include:

1. Additional DO Profile Sampling. Additional DO profile sampling will verify that the existing aeration control scheme is adequate for peak flow and load, low flow and load, and all diurnal conditions. It may be that additional cost savings could be materialized by controlling aeration through a cascaded control loop including online monitoring of DO, air flow, ORP, ammonia, and nitrate. It is our understanding that County staff are in the process of purchasing additional DO probe(s) to conduct more regular DO analysis and profiles.

2. Evaluate Alternative Ammonia Probes. It is recommended to evaluate alternative ammonia probes or analyzers to assess whether newer equipment may be more reliable and less maintenance intensive in the oxidation ditch environment compared to the current product used. Testing vendor equipment may allow pilot testing of ammonia and nitrate based aeration control systems. Ammonia probe controlled aeration should further optimize aeration and subsequently reduce aeration cost.

3. Assess Fine Bubble Diffuser System. Evaluate the fine bubble diffuser system to confirm adequate capacity to supply the necessary oxygen transfer efficiency under projected 2035 ADMMF and loads.

4. Daily MLSS and MLVSS Analysis. Conduct MLSS and MLVSS analyses several times per week and/or consider a TSS probe installation in the oxidation ditches (with

supplemental laboratory TSS and VSS analyses) to improve on solids inventory and tSRT management. Stabilizing solids wasting is critical to maintain low and consistent effluent ammonia.

7.4 Secondary Clarifiers

Further attempts should be made to eliminate filaments from the treatment process and mitigate proliferation in order to lower the SVIs throughout the year, increase secondary clarifier capacity, and protect the downstream tertiary filters. Implementing a of selector zone upstream of existing oxidation ditches (anoxic/aerobic zone) should improve the settling characteristics and thus increase secondary clarifier capacity. Refer to TM No. 6 for additional detail on this alternative.

7.5 Tertiary Filters

Four additional tertiary filters are recommended to treat flows and loads anticipated in the planning period. Refer to TM No. 6 for additional detail on the alternative. The tertiary filters were designed and constructed with a sufficient hydraulic capacity of 6 mgd. It is our understanding, however, that the existing tertiary filters have trouble performing, and reductions of BOD, TSS, and nutrients across the filters are minimal. Recommended optimization opportunities include:

1. TSS Monitoring. Begin continuous monitoring of secondary effluent turbidity upstream of the filters and filter effluent to understand the performance of the filters particularly during times when the secondary clarifiers are stressed due to high flow rates, high MLSS concentrations, and/or poor sludge settleability.
2. Coagulation of Filter Influent. Coagulation of filter influent should increase the performance of the filters. Proper coagulation is essential for good filtration performance – especially when treating a blend of secondary effluent and stored final effluent from the reservoir. For effective and cost-efficient coagulation, pH adjustment for the filter influent will be required. Further, to reduce the cost of pH adjustment and coagulation, the County could consider performing pH adjustment and coagulation on Reservoir water only. This option will require further investigation.
3. Filter Media Assessment. Visual observation during site visit revealed biological growth on the media. Also, the media is approximately ten years old. These factors are suspected to be impacting filter performance. To increase performance of the filters, the County should assess the media by analyzing its effective grain size for better particle capture, perform thorough filter media cleaning for possible mud accumulation in the filters, and implement a periodic chlorine shock to reduce biological growth.
4. Chemical Phosphorus Removal. Should additional phosphorus removal be desired or required, a pilot study could be initiated to assess the filter capacity under addition of metal coagulants upstream of the filters for chemical phosphorus removal.

5. In recent years, STMWRF observes algae growth on secondary clarifier effluent launders and within stored reservoir water, increasing solids loads to the tertiary filters and subsequently reducing the filter efficiency due to clogging pores. Dissolved air floatation (DAF) units have been successfully implemented in the industry to reduce suspended solids and nutrients (especially due to algae) in secondary effluent or reservoir water. Implementation of a DAF process as pre-treatment to filter influent could decrease solids loads and increase performance of the filters. Refer to TM No. 6 for additional detail on this alternative. As this is an ongoing challenge at STMWRF, a pilot study should be initiated to confirm the DAF process as a viable option to reduce algae in the process and improve filter efficiency.
6. EcoWash® Installation. The EcoWash® system is a proven, effective retrofit that could be installed on the DynaSand® filters at the STMWRF to decrease the amount of backwash water that is currently conveyed to the head of the plant. The exact amount that the EcoWash® system can decrease the backwash water and reduce energy costs is not known without conducting a pilot test. However, based on pilot and full-scale testing that has been conducted at other locations, it is likely that installing the EcoWash® system at STMWRF would likely reduce the backwash water generated by up to 50 percent (up to 0.24 mgd). However, our recommendation is to verify the actual reduction in backwash water generated by pilot testing the process. To determine if the DynaSand® filters should be retrofitted with the EcoWash® system, the following next steps are recommended:
    a. Determine the remaining life of the existing DynaSand® filters at the plant.
    b. Determine if the existing DynaSand® filters will meet future water quality goals at the STMWRF.
    c. Assuming the remaining useful life of the existing filters is adequate and their ability to meet future water quality goals is verified, obtain a quote from Parkson for the retrofit of the existing DynaSand® filters at the STMWRF.
    d. Conduct a cost benefit analysis to determine if the cost associated with retrofitting the existing DynaSand® filters and the resulting decrease in energy costs and increase in treatment plant capacity at the STMWRF is worth the benefit that will be realized from the retrofit.

7.6 Disinfection

The existing chlorine contact basins were designed and constructed with a sufficient hydraulic capacity of 6 mgd. These facilities are adequate to treat future flows and loads throughout the 2035 planning horizon. Recommended optimization opportunities include:

1. pH Investigation. The elevated tertiary effluent pH highly influences disinfection because it influences the ratio of hypochlorous acid (HOCl) and hypochlorite ions (OCl-). Lower pH favors the formation of HOCl (a more effective disinfectant), while high pH values favor the formation of OCl- (a less effective disinfectant). Also, since chlorine

is less effective at higher pH, high chlorine dosage may be required. Besides pH, tertiary effluent chemistry (high nitrite and ammonia), temperature, chlorine concentration, and contact time also affect chlorination efficiency. Therefore, we recommend further investigation the causes for elevated pH in tertiary effluent and its impact on disinfection performance.

2. Sodium Hypochlorite System Improvements. The County is currently implementing a rehabilitation project specific to the sodium hypochlorite system and adjustments will be made to the system, including modifications to the chlorine addition delivery system.
3. Additional Instrumentation Control. Provide online chlorine analyzer (or online surrogate analyzer) immediate down stream of chlorine injection point. By using proposed analyzer to control the chlorine dosage through basins may probably reduce the chlorine dosages and provide better control on residuals.

7.7 SCADA and P&ID Improvements

Currently, several improvements are on-going on the existing SCADA system. Depending on the type of field implementation the County selects, some modifications to the SCADA system may be required.

8.0 RECOMMENDATIONS FOR FIELD IMPLEMENTATION

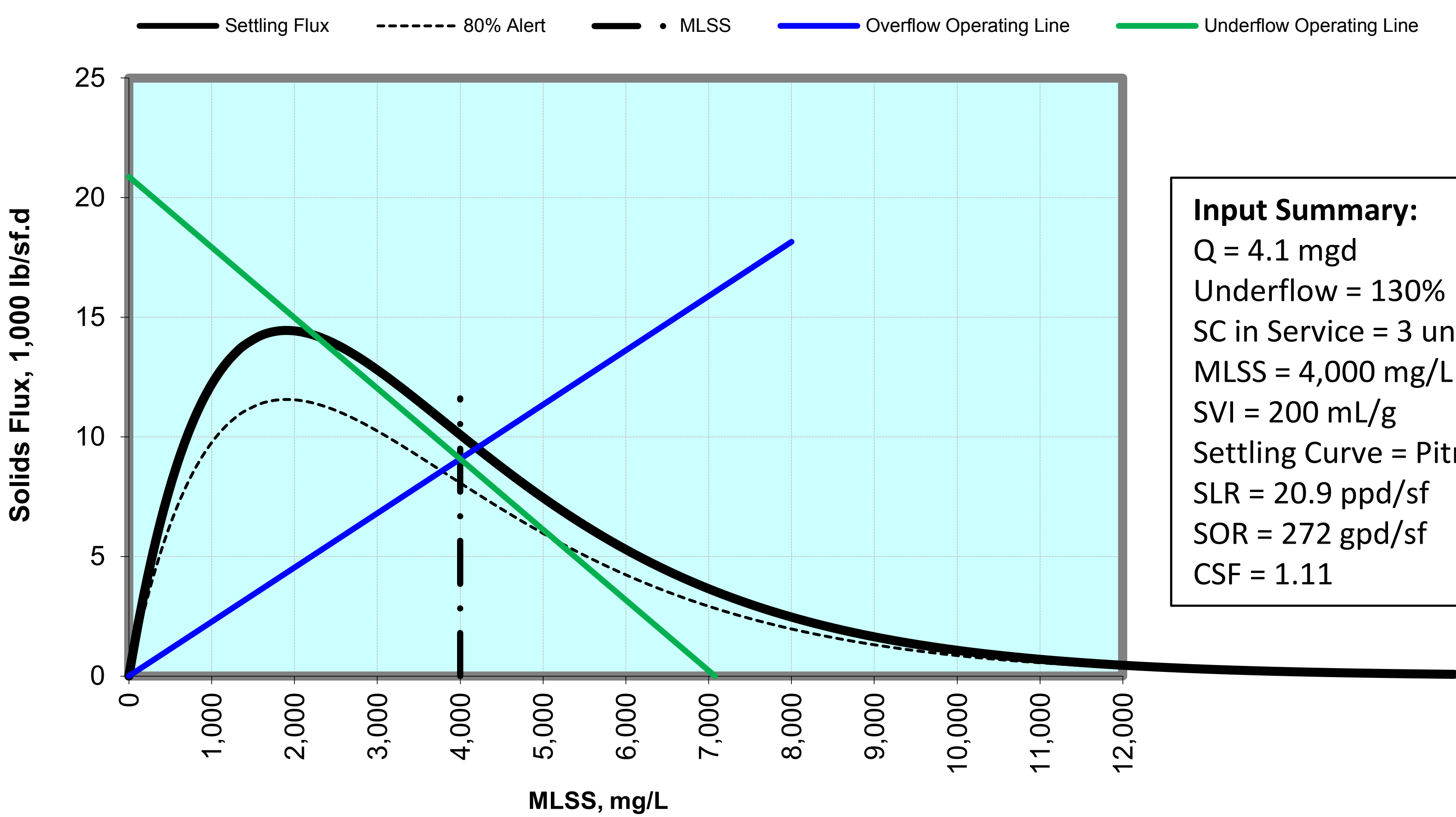
1. Dynamic simulation of oxidation ditch performance was used to evaluate alternative blower operation schedules. The simulations showed that continuous blower operation using DO-based aeration air flow rate control would result in comparable power costs with more consistent oxidation ditch nitrification/denitrification, especially with higher future influent flows and loads. The total aeration air flow rate would be controlled based on a DO probe located downstream of diffuser grid 3 and a DO setpoint of approximately 1.5 mg/L. The proportional air flow rate to diffuser grid 1 or 2 would be reduced (or shut-off completely) using the manual valves on the respective drop legs in order to match oxygen transfer capacity with current flows and loads.
2. Replace or rehab existing chlorine rings in clarifiers to reduce the algae formation in secondary clarifiers effluent launders.
3. Perform assessment of filter media by analyzing its effective grain size for better particle capture, perform thorough filter media cleaning for possible mud accumulation in the filters, and implement a periodic chlorine shock to reduce biological growth.
4. Performance bench-scale testing on pH adjustment on reservoir water using different chemicals. Further, perform testing of coagulation on combined secondary effluent and reservoir water. On-site pilot testing of DAF for algae removal to decrease solids and nutrients loading to the tertiary filters and increase its performance and efficiency.

5. To better control chlorine dosages within the chlorine contact basins (CCB) and maintain proper chlorine residual with the distribution system, provide chlorine analyzer at the front end of the CCB.

APPENDIX A – SECONDARY CLARIFICATION - STATE POINT ANALYSIS

A State Point Analysis was conducted on the current design ADMMF conditions (Figure A.1) assuming one of three clarifiers out of service. The oxidation ditch MLSS concentration and SVI used during the analysis are 4,000 mg/L (prediction from process modeling) and 200 mL/g (design assumption), respectively. Under these conditions the clarifiers would operate with a CSF of 1.11, and at an acceptable solids loading rate (SLR) of 20.9 ppd/ft2, and surface overflow rate (SOR) of 272 gpd/ft2.

A State Point Analysis was also conducted on the projected 2035 design conditions and is presented in Figure A.2. Again, the CSF was calculated assuming four of five total clarifiers in service at an ADMMF of 5.72 mgd flow. The oxidation ditch MLSS concentration and SVI used during the analysis were the same as those used during the state point analysis at current design conditions. At the projected 2035 operating conditions the clarifiers would operate with a CSF of 1.06, and at an acceptable solids loading rate (SLR) of 21.8 ppd/ft^2, and surface overflow rate (SOR) of 284 gpd/ft^2.



Input Summary:
Q = 4.1 mgd
Underflow = 130%
SC in Service = 3 units
MLSS = 4,000 mg/L
SVI = 200 mL/g
Settling Curve = Pitman
SLR = 20.9 ppd/sf
SOR = 272 gpd/sf
CSF = 1.11

CURRENT DESIGN CONDITIONS

FIGURE A.1

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

carollo

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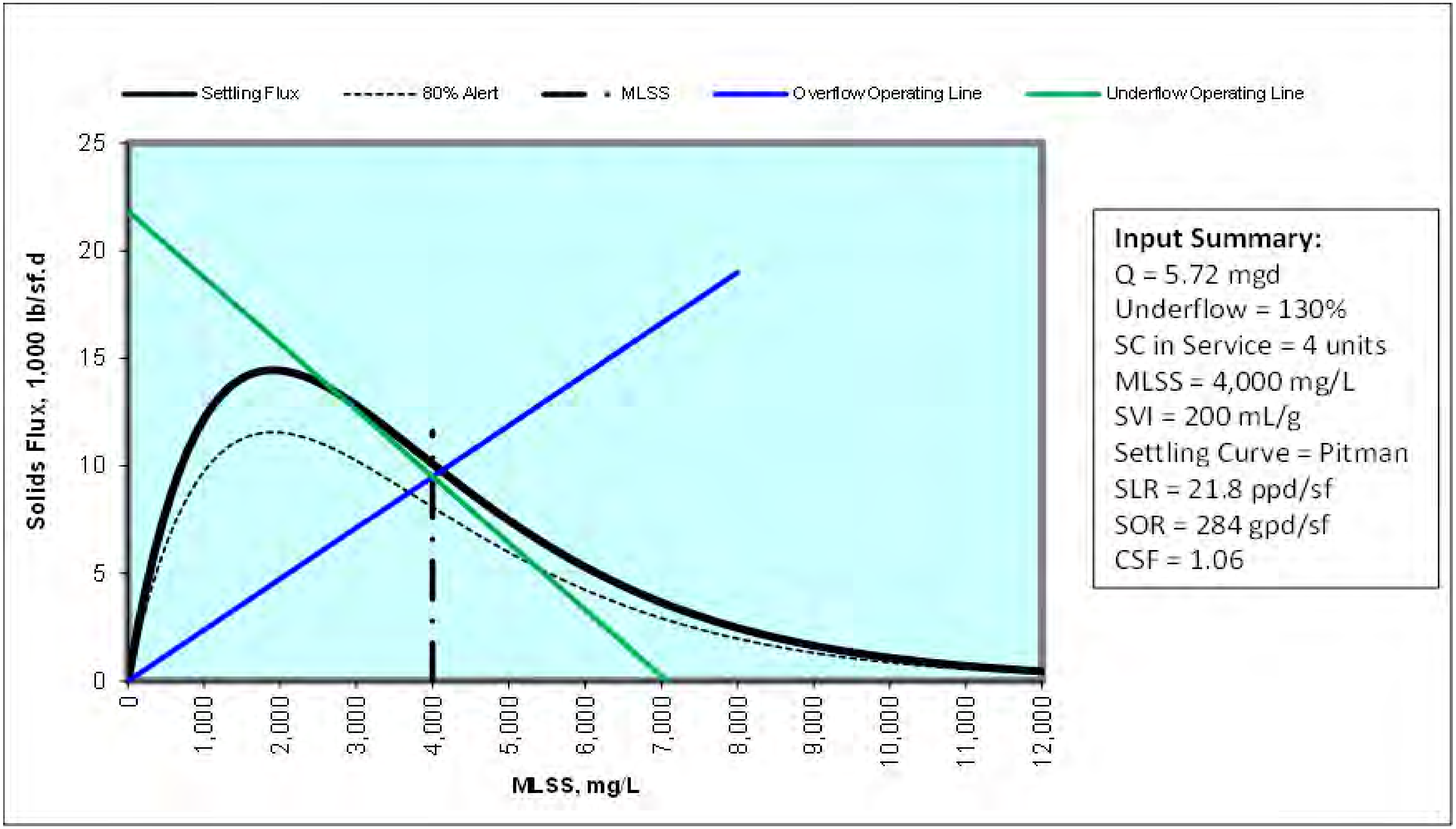

PROJECTED 2035 CONDITIONS - STATE POINT ANALYSIS

FIGURE A.2

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

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APPENDIX B – PROCESS MODEL CALIBRATION RESULTS

Table B.1 summarizes the BioWin input parameters used during the model calibration and compares the facility performance as simulated by BioWin to the actual plant performance. The actual plant data used to calibrate the BioWin model was collected during late July and early August, 2015. In general, the simulated system performance was in very close agreement with the actual plant data and differed by less than 10 percent.

Table B.1 Existing Facility BioWin Calibration
STMWRF Facility Plan Update
Washoe County

Parameter	Number of Samples	Plant Data July 23 – August 3, 2015	BioWin Calibration
Influent			
Q, mgd		2.93	2.93(1)
TSS, mg/L	7	254	258
VSS, mg/L	7	229	233
COD, mg/L	7	573	573(1)
cBOD, mg/L	6	245	255
TKN, mgN/L	7	37.2	37.2
NH3, mgN/L	7	25.9	26.1
TP, mgP/L	7	4.49	4.49(1)
pH	7	7.47	7.47(1)
Alkalinity, mg/L as $CaCO_3$	6	254	254(1)
Mixed liquor			
TSS, mg/L	4	2,639	2,817
VSS, mg/L	4	2,441	2,330
TKN, mgN/L	3	145	189
NH3, mgN/L	3	19.0	1.9
NO2, mg/L	1	0.09	0.00
TP, mgP/L	1	41	60
OP, mgP/L	1	12	0.3
Return activated sludge			
Q, mgd			1.77
TSS, mg/L	6	6,100	8,437
VSS, mg/L	4	5,475	6,977
COD, mg/L	1	10,000	10,692
cBOD, mg/L	1	1,000	1,956
TKN, mgN/L	1	440	561
NH3, mgN/L	1	32.0	1.0
NO2, mg/L	1	0.12	0.18
TP, mgP/L	1	160	180
OP, mgP/L	1	61	0.2
pH	1	6.94	6.89

Waste activated sludge			
Q, mgd			0.065(1)
TSS, lb/d			4,577
SRT, d			16.4
Secondary effluent			
TSS, mg/L	5	3	4
COD, mg/L	2	73	37
cBOD, mg/L	2	3	3
TKN, mgN/L	4	2.1	3.4
NH3, mgN/L	5	1.5	1.7
NO3, mg/L	4	0.39	0.14
TP, mgP/L	6	1.48	0.49
OP, mgP/L	6	1.18	0.41
pH	6	7.85	6.91
Alkalinity, mg/L as $CaCO_3$	6	215	171
Temperature, degree C	6	23.4	23.4(1)

Notes:
(1) Input value to Biowin simulator.

Table B.2 summarizes the adopted BioWin wastewater parameters used during process modeling and compares them to the previous BioWin calibration by Mettler (2015), based on data from May 7 and 8, 2014, and model default values. Generally, the calibration values are in closer agreement with the BioWin default values when compared to the previous calibration by Mettler.

Table B.2 Adopted BioWin Calibration Parameters in this Study STMWRF Facility Plan Update Washoe County			
Parameter	**BioWin Default**	**Mettler (2015) Calibration**	**Carollo Calibration**
F_{bs} (gCOD/g total COD) [(1)]	0.16	**0.11**	0.16
F_{ac} (gCOD/g readily biodegradable COD)	0.15	**0.02**	0.15
F_{xsp} (gCOD/g slowly degradable COD) [(1)]	0.75	0.75	**0.80**
F_{us} (gCOD/g total COD)	0.05	**0.098**	0.05
F_{up} (gCOD/g total COD) [(1)]	0.13	0.13	**0.20**
F_{na} (gNH3-N/g TKN)	0.66	**0.37**	**0.702**
F_{nox} (gN/gOrganic N)	0.50	0.50	0.50
F_{nus} (gN/gTKN)	0.02	**0.15**	0.02
F_{upN} (gN/gCOD)	0.035	0.035	0.035
F_{po4} (gPO4-P/gTP)	0.50	**0.8**	0.50
F_{upP} (gP/gCOD)	0.0110	0.0011	0.0110

Notes:
(1) Values in bold - Deviations from BioWin default parameters

The following kinetic and stoichiometric parameters were also adjusted based on the whole-plant Biotran simulation model:

- Particulate biodegradable inert COD:VSS ratio (mgCOD/mgVSS) = 1.65 (BioWin default = 1.60)
- Aerobic/anoxic DO half saturation constant (mgO2/L) = 0.15 (BioWin default = 0.05)

Table B.3 Supplemental Wastewater Samples (July 23 to August 4, 2015)
STMWRF Facility Plan Update
Washoe County

Sample Location	Units	Parameters	Sampling Dates							
			7/23/2015	7/25/2015	7/26/2015	7/27/2015	7/29/2015	8/1/2015	8/3/2015	8/4/2015
Plant Influent	MG/L	Carbonaceous BOD	160	210	166	165		200		200
Plant Influent	MG/L	Chemical Oxygen Demand	600	540	423	620	570	660		600
Plant Influent	MG/L	Ammonia, as Nitrogen	26	21	23	31.2	27	27		26
Plant Influent		Ammonia Distillation	Complete	Complete	Complete	Complete	Complete	Complete		Complete
Plant Influent	PH	PH	7.94	6.97	7.2	7.4	7.82	7.3		7.66
Plant Influent	MG/L	Total Phosphorous as P	5	5.6	3.2	5.6	5.3	4.2		2.6
Plant Influent	°C	Temperature at pH	24.7	20.7	23.5	23.1	23.1	22.7		23.6
Plant Influent	MG/L	TOTAL KJELDAHL NITROGEN (IN WATER MG/L)	42	34	30	42.4	42	39		31
Plant Influent	MG/L	Total Suspended Solids (TSS)	440	210	141	238	200	280		260
Plant Influent	MG/L	Total Volatile Suspended Solids	400	220	129	215	190	240		220
Plant Influent	MG/L	Total Nitrogen		34						
Plant Influent	MG/L	ALKALINITY, BICARBONATE		260	263	305	86	310		300
Plant Influent	MG/L	ALKALINITY, TOTAL		260	263	305	86	310		300
Ditch Effluent		NITRATE				0.00				
Ditch Effluent		NITRITE				0.09				
Ditch Effluent	MG/L	Ammonia, as Nitrogen	28	12		17				
Ditch Effluent		Ammonia Distillation	Complete	Complete		Complete				
Ditch Effluent		Orthophosphate, as P		12						
Ditch Effluent	MG/L	Total Nitrogen	160	160						
Ditch Effluent		Total Phosphorous as P		41						
Ditch Effluent	MG/L	TOTAL KJELDAHL NITROGEN (IN WATER MG/L)	160	160		116				
Ditch Effluent	MG/L	Total Suspended Solids (TSS)	3200	2300		2355	2600			
Ditch Effluent	MG/L	Total Volatile Suspended Solids	3300	2000		2164	2400			
Secondary Effluent	MG/L	ALKALINITY, BICARBONATE	220	220	212	210		220	208	
Secondary Effluent		ALKALINITY, CARBONATE							0	
Secondary Effluent		HYDROXIDE AS CALCIUM CARBONATE							0	
Secondary Effluent	MG/L	ALKALINITY, TOTAL	220	220	212	210		220	208	
Secondary Effluent		NITRATE		0.3	0.3	0.8			0	
Secondary Effluent		Carbonaceous BOD			3.8				2	
Secondary Effluent	MG/L	Chemical Oxygen Demand	71	75						
Secondary Effluent	MG/L	Ammonia, as Nitrogen	1.8		1.4	1.2		1.6	1.4	
Secondary Effluent		Ammonia Distillation	Complete	Complete	Complete			Complete	Complete	
Secondary Effluent	MG/L	Orthophosphate, as P	0.36	1.3	1.2	1.2		1.8	1.3	
Secondary Effluent	PH	PH	8.24	7.89	7.7	7.9		7.8	7.6	
Secondary Effluent		Total Nitrogen		1.3	2.3	2.6				
Secondary Effluent	MG/L	Total Phosphorous as P	1.7	2.1	1.2	1.2		1.4	1.3	
Secondary Effluent	°C	Temperature at pH	24.3	22.7	23.4	24		22.5	23.1	
Secondary Effluent		TOTAL KJELDAHL NITROGEN (IN WATER MG/L)		0.99	2.3	2.0		3.1		
Secondary Effluent	MG/L	Total Suspended Solids (TSS)	3	4	4.5	1.8		4		
Filter Effluent	MG/L	Ammonia, as Nitrogen	0.94	0.56		0.82	0.7	0.67		0.37
Filter Effluent		Ammonia Distillation	Complete	Complete		Complete	Complete	Complete		Complete
Filter Effluent		TN				2.4				
Filter Effluent	MG/L	TOTAL KJELDAHL NITROGEN (IN WATER MG/L)	1.7			2	1.7	1.4		1.4
Filter Effluent	MG/L	Total Suspended Solids (TSS)	1	2		4	12	11		14
Filter Effluent		NITRATE				0.42				
Filter Effluent		NITRITE				0.052				
Filter Effluent		Carbonaceous BOD								
Filter Effluent		Chemical Oxygen Demand						70		
Contact Basin Effluent	MG/L	NITRATE	0.89	0.46		0.41	0.2	0.47		
Contact Basin Effluent	MG/L	Ammonia, as Nitrogen	0.28			0.25	0.39	0.29		
Contact Basin Effluent		Ammonia Distillation	Complete	Complete		Complete	Complete	Complete		
Contact Basin Effluent	MG/L	TOTAL KJELDAHL NITROGEN (IN WATER MG/L)	0.91	1.1		1.1		1.2		
Contact Basin Effluent	MG/L	Carbonaceous BOD		2.5						
Contact Basin Effluent	MG/L	Chemical Oxygen Demand		78						
Contact Basin Effluent	MG/L	Orthophosphate, as P		1.2		1.2		1.5		
Contact Basin Effluent	MG/L	Total Nitrogen		1.6		1.5				
Contact Basin Effluent	MG/L	Total Phosphorous as P		2.1		0.98		1.3		
Contact Basin Effluent	MG/L	Total Suspended Solids (TSS)		4		3				
Contact Basin Effluent	MG/L	ALKALINITY, BICARBONATE						190		
Contact Basin Effluent	MG/L	ALKALINITY, CARBONATE								
Contact Basin Effluent	MG/L	HYDROXIDE AS CALCIUM CARBONATE								
Contact Basin Effluent	MG/L	ALKALINITY, TOTAL						190		
Contact Basin Effluent		PH						7.58		
Contact Basin Effluent		Temperature at pH						21.7		
Reservoir		NITRATE				0	0.93		0	
Reservoir		NITRITE				0			0	
Reservoir	MG/L	Ammonia, as Nitrogen	0.97	0.85		0.7	0.77		0.55	
Reservoir		Ammonia Distillation	Complete	Complete		Complete	Complete		0	
Reservoir	MG/L	Orthophosphate, as P	1.2	0.98		1.1	0.88			
Reservoir	MG/L	Total Nitrogen	1.5			1.5			1.7	
Reservoir	MG/L	Total Phosphorous as P	1.2	2.1		0.96	1.1			
Reservoir	MG/L	TOTAL KJELDAHL NITROGEN (IN WATER MG/L)	1.5			1.5	1.9		1.7	
Reservoir	MG/L	Total Suspended Solids (TSS)	7	9		11	18		26.1	
Reservoir		ALKALINITY, BICARBONATE				200			195	
Reservoir		ALKALINITY, TOTAL				200			203	
Reservoir		pH				8.22			8.4	
Reservoir		Temperature at pH				23.9			23.3	
RAS/WAS	MG/L	Total Suspended Solids (TSS)	5900	6000		5700	5800	6000		7200
RAS/WAS	MG/L	Total Volatile Suspended Solids		5600			5000	5200		6100
RAS/WAS	MG/L	NITRATE								
RAS/WAS	MG/L	NITRITE								0.12
RAS/WAS	MG/L	Carbonaceous BOD								1000
RAS/WAS	MG/L	Chemical Oxygen Demand								10000
RAS/WAS	MG/L	Ammonia, as Nitrogen								32
RAS/WAS	MG/L	Ammonia Distillation								Complete
RAS/WAS	MG/L	Orthophosphate, as P								61
RAS/WAS	PH	PH								6.94
RAS/WAS	MG/L	Total Nitrogen								440
RAS/WAS	MG/L	Total Phosphorous as P								160
RAS/WAS	°C	Temperature at pH								23.4
RAS/WAS	MG/L	TOTAL KJELDAHL NITROGEN (IN WATER MG/L)								440
Filter Backwash	MG/L	Total Suspended Solids (TSS)	31			39	53			68
Filter Backwash	MG/L	Total Volatile Suspended Solids								34

Note: Samples were collected by STMWRF Staff and Analyzed by WetLab in Sparks, NV

APPENDIX C – PROCESS MODEL PRINTOUTS

BioWin user and configuration data

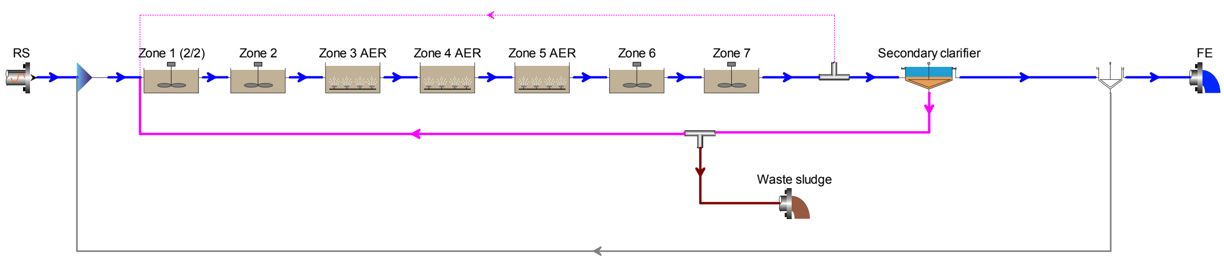
Project details

Project name: STMWRF master plan update
Project ref.: 9873A.00
Plant name: South Truckee Meadows Water Reclamation Facility
User name: Ron Appleton

Created: 7/5/2015
Saved: 12/23/2015

Steady state solution
Total SRT: 16.3667 days
Temperature: 23.4°C

Flowsheet



Configuration information for all COD Influent units

Operating data Average (flow/time weighted as required)

Element name	RS
Time	1.0000
Flow	2.92958875411239
TCOD mgCOD/L	572.9990
TKN mgN/L	37.2047
TP mgP/L	4.4896
NO3-N mgN/L	0
pH	7.4700
Alk mmol/L	5.0800
ISSinf mgISS/L	25.0000
SCa mg/L	80.0000
SMg mg/L	15.0000
DO mg/L	0

Element name	RS
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.8000
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.2000
Fna - Ammonia [gNH3-N/gTKN]	0.7020
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.5000
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0110

FZbh - OHO COD fraction [gCOD/g of total COD]	0.0200
FZbm - Methylotroph COD fraction [gCOD/g of total COD]	1.000E-4
FZaob - AOB COD fraction [gCOD/g of total COD]	1.000E-4
FZnob - NOB COD fraction [gCOD/g of total COD]	1.000E-4
FZaao - AAO COD fraction [gCOD/g of total COD]	1.000E-4
FZbp - PAO COD fraction [gCOD/g of total COD]	1.000E-4
FZbpa - Propionic acetogens COD fraction [gCOD/g of total COD]	1.000E-4
FZbam - Acetoclastic methanogens COD fraction [gCOD/g of total COD]	1.000E-4
FZbhm - H2-utilizing methanogens COD fraction [gCOD/g of total COD]	1.000E-4
FZe - Endogenous products COD fraction [gCOD/g of total COD]	0

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
RAS/WAS Splitter	Flowrate [Side]	0.065
ML Return Splitter	Flowrate [Side]	536

Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Zone 1 (2/2)	0.3220	3,075.0000	14.000	Un-aerated
Zone 2	0.3060	2,922.0000	14.000	Un-aerated
Zone 3 AER	0.4294	4,100.0000	14.000	122
Zone 4 AER	0.4294	4,100.0000	14.000	122
Zone 5 AER	0.4294	4,100.0000	14.000	122
Zone 6	0.3060	2,922.0000	14.000	Un-aerated
Zone 7	0.9661	9,225.0000	14.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Zone 1 (2/2)	0
Zone 2	0
Zone 6	0
Zone 7	0

Element name	Average Air flow rate [ft3/min (20C, 1 atm)]
Zone 3 AER	885.4
Zone 4 AER	885.4
Zone 5 AER	885.4

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Zone 1 (2/2)	2.5656	0.0432	0.8200	0.4413	10.0000
Zone 2	2.5656	0.0432	0.8200	0.4413	10.0000
Zone 3 AER	2.5656	0.0432	0.8200	6.6000	19.7000
Zone 4 AER	2.5656	0.0432	0.8200	6.6000	19.7000

Zone 5 AER	2.5656	0.0432	0.8200	6.6000	19.7000
Zone 6	2.5656	0.0432	0.8200	0.4413	10.0000
Zone 7	2.5656	0.0432	0.8200	0.4413	10.0000

Configuration information for all Ideal clarifier units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Secondary clarifier	2.0308	2.011E+4	13.500

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Secondary clarifier	Ratio	0.50

Element name	Average Temperature	Reactive	Percent removal	Blanket fraction
Secondary clarifier	Uses global setting	No	99.9100	0.0500

Configuration information for all Point clarifier units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Filters	Flowrate [Under]	0.5

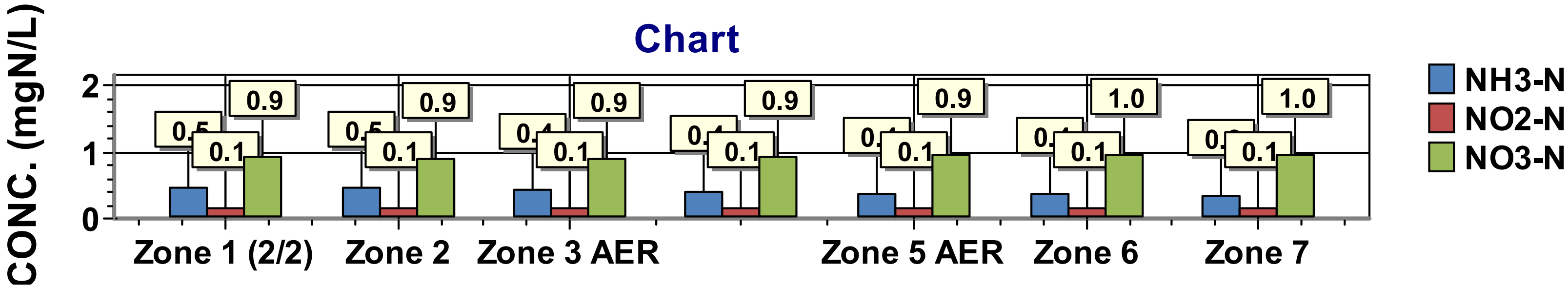
Element name	Percent removal
Filters	80.0000

BioWin Album

Album page - Tables 1

Elements	Flow [mgd]	TSS [mgTSS/L]	VSS [mgVSS/L]	TCOD [mg/L]	SCOD [mg/L]	TCBOD [mg/L]	SCBOD [mg/L]	TKN [mgN/L]	STKN [mgN/L]	NH3-N [mgN/L]	NO2-N [mgN/L]	NO3-N [mgN/L]	TP [mgP/L]	SPO4 [mgP/L]	pH []	Alk [mmol/L]	Temp. [deg. C]
RS	2.9296	261.7289	235.9815	572.9990	185.5600	255.8067	111.2295	37.2047	29.6106	26.1177	0	0	4.4896	2.2448	7.4700	5.0800	23.4000
Plant influent	3.4296	226.3453	203.8552	497.3777	162.9297	219.2158	95.1756	32.2572	25.5904	22.3578	0.0217	0.1391	4.0262	2.0521	7.3584	4.8140	23.4000
Zone 7	541.0469	2,618.0169	2,149.4660	3,327.7026	30.3348	511.7258	1.1129	171.7826	2.0350	0.3279	0.1486	0.9543	54.3085	0.9228	6.8783	3.2645	23.4000
Secondary clarifier	3.3646	3.5343	2.9018	34.7863	30.3348	1.8022	1.1129	2.2641	2.0350	0.3279	0.1486	0.9543	0.9949	0.9228	6.8783	3.2645	23.4000
FE	2.8646	0.8302	0.6817	31.3805	30.3348	1.2748	1.1129	2.0888	2.0350	0.3279	0.1486	0.9543	0.9397	0.9228	6.8783	3.2645	23.4000
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Waste sludge	0.0650	7,846.9820	6,442.5945	9,913.5353	30.3348	1,531.5730	1.1129	510.8195	2.0350	0.3279	0.1486	0.9543	160.9357	0.9228	6.8783	3.2645	23.4000
Filters (U)	0.5000	19.0265	15.6213	54.2985	30.3348	4.8238	1.1129	3.2686	2.0350	0.3279	0.1486	0.9543	1.3108	0.9228	6.8999	3.2645	23.4000

Elements	TSS [lb TSS/d]	VSS [lb VSS/d]	TKN [lb N/d]	TP [lb P/d]
RS	6,398.9061	5,769.4180	909.6033	109.7646
Waste sludge	4,256.6055	3,494.7936	277.0947	87.2998



Album page - Tables 2

Elements	# of diffusers []	Air flow rate [ft3/min (20C, 1 atm)]	Air flow rate / diffuser [ft3/min (20C, 1 atm)]	OTR [lb/hr]	SOTR [lb/hr]	SOTE [%]	DO [mg/L]
Zone 3 AER	122.0000	885.3956	7.2573	127.3065	358.2042	39.6489	0.3730
Zone 4 AER	122.0000	885.3956	7.2573	121.7019	358.2042	39.6489	0.6773
Zone 5 AER	122.0000	885.3956	7.2573	116.7262	358.2042	39.6489	0.9475

Elements	OUR - Carbonaceous [mgO/L/hr]	OUR - Nitrification [mgO/L/hr]	OUR - Total [mgO/L/hr]
Zone 1 (2/2)	7.5198	1.3971	8.9169
Zone 2	2.5843	0.3637	2.9480
Zone 3 AER	11.5694	4.9913	16.5607
Zone 4 AER	11.9814	6.0055	17.9869
Zone 5 AER	12.0694	6.3214	18.3908
Zone 6	11.7719	5.6867	17.4586
Zone 7	9.4493	2.9258	12.3751

Elements	Zbh [mgCOD/L]	Zbmeth [mgCOD/L]	Zbp [mgCOD/L]	Zaob [mgCOD/L]	Znob [mgCOD/L]	Zaao [mgCOD/L]	Zbpa [mgCOD/L]	Zbam [mgCOD/L]	Zbhm [mgCOD/L]	Ze [mgCOD/L]	Xsp [mgCOD/L]	Xi [mgCOD/L]
Zone 5 AER	843.5083	0.5040	0.3679	17.1175	9.9496	0.7058	0.0850	0.0744	0.0172	666.3894	43.9819	1,715.1483
Zone 2	843.4197	0.5040	0.3680	17.1123	9.9466	0.7059	0.0851	0.0745	0.0173	666.2832	44.6631	1,715.1483

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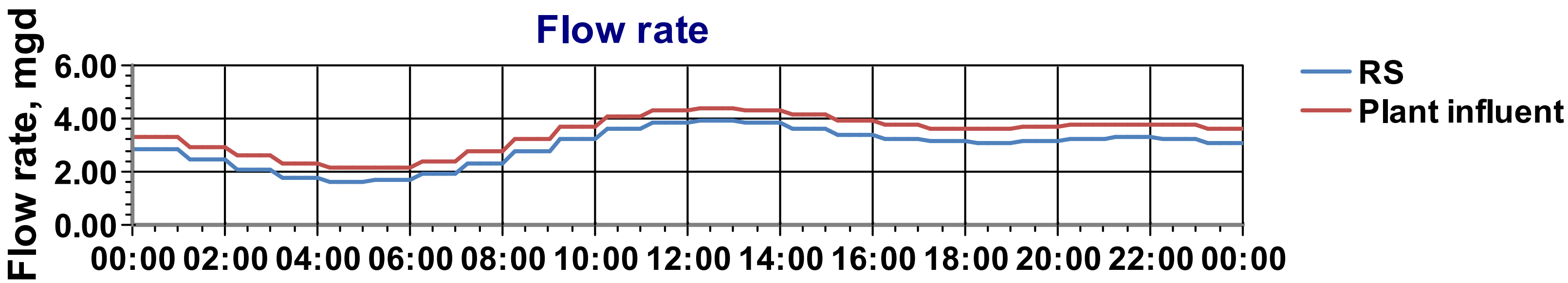
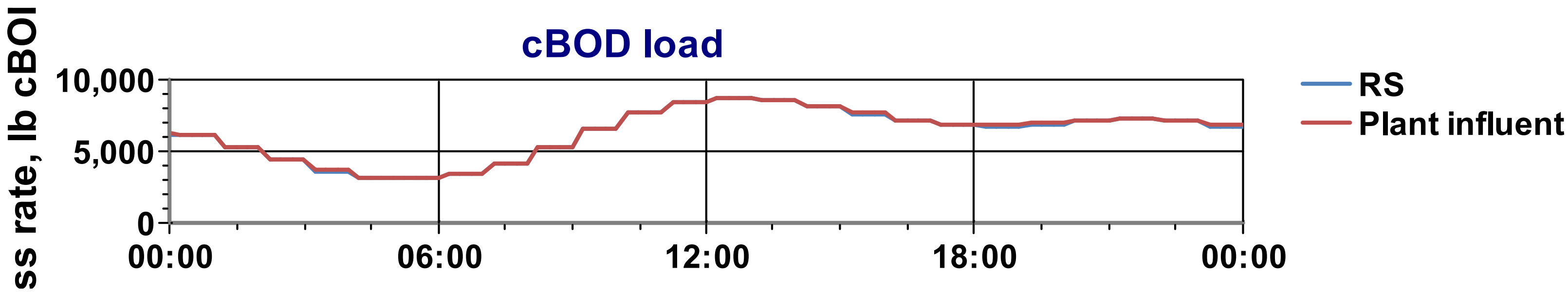


Album page - RS load 1



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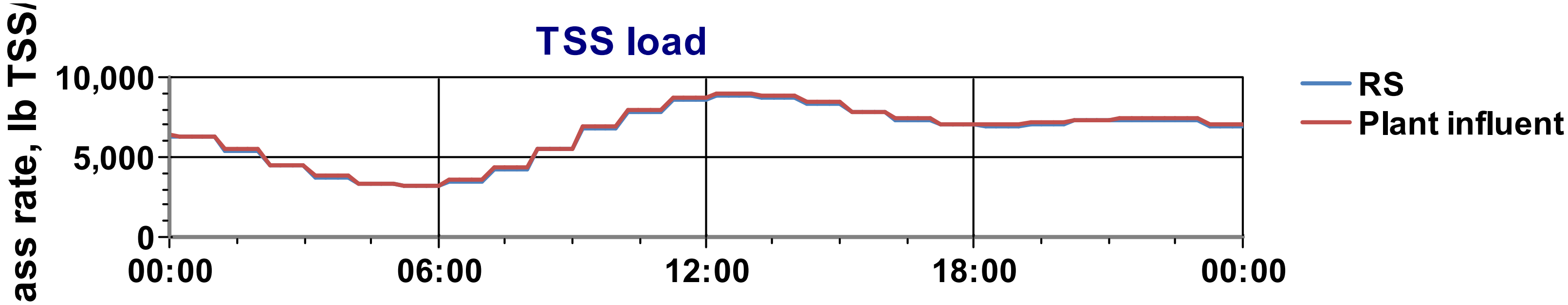

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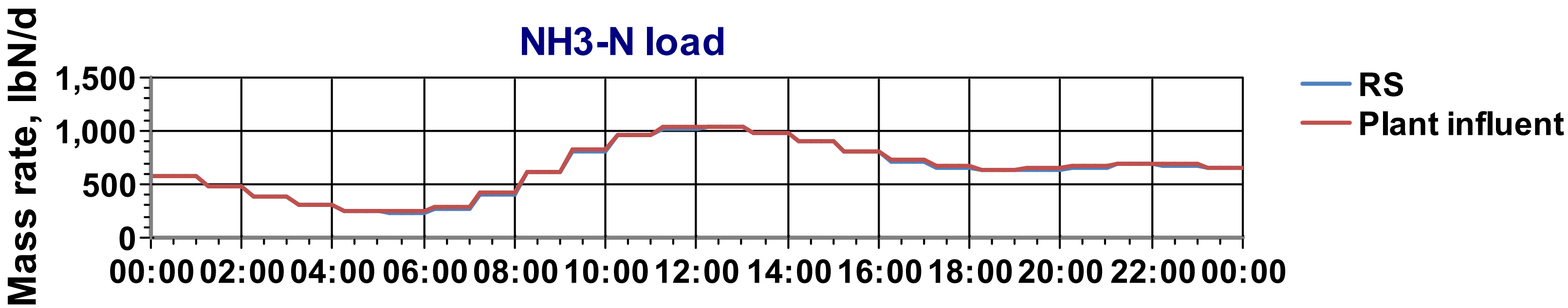
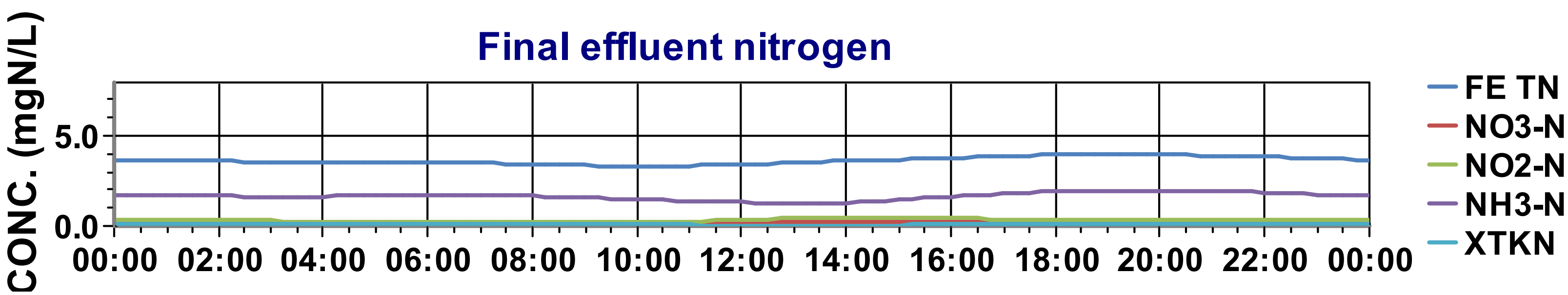


Album page - RS load 2



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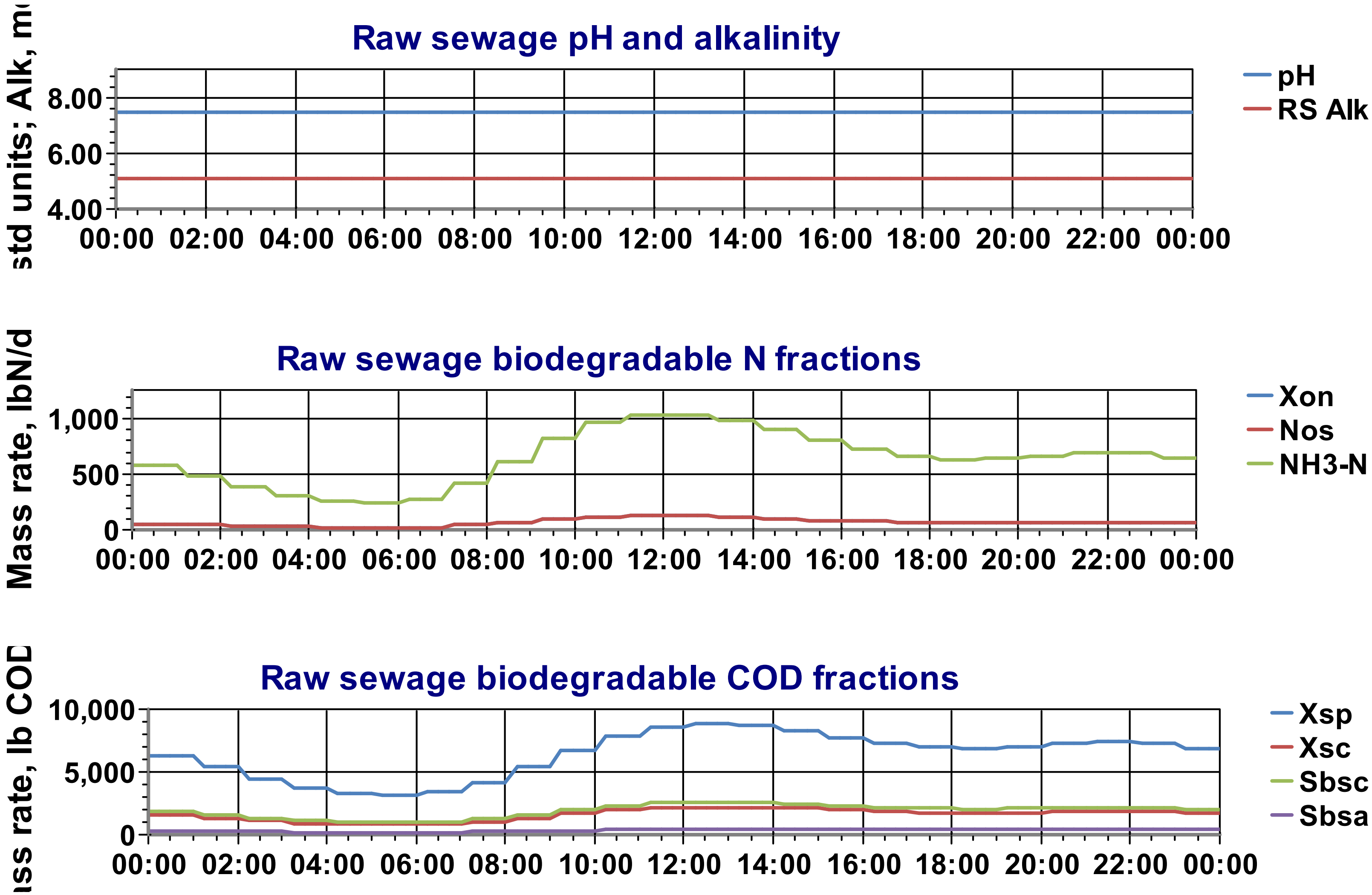

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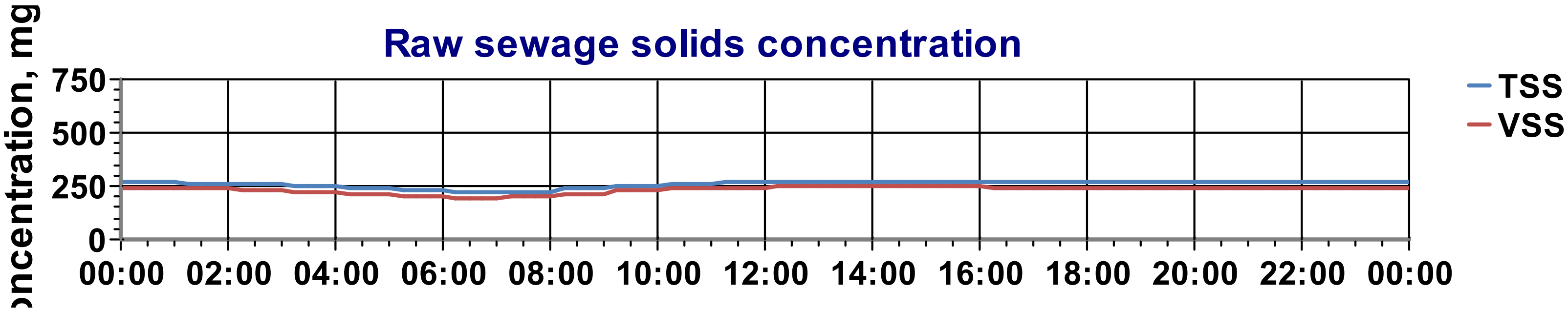
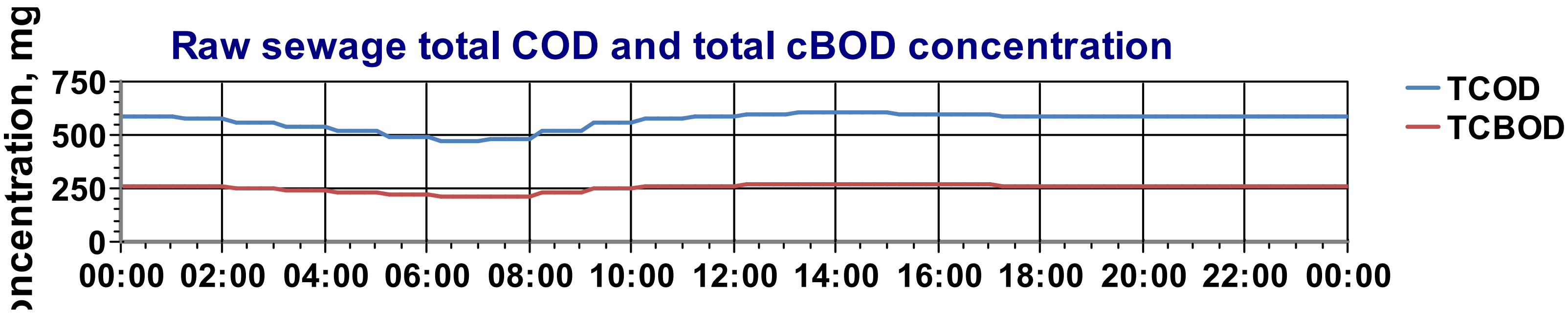
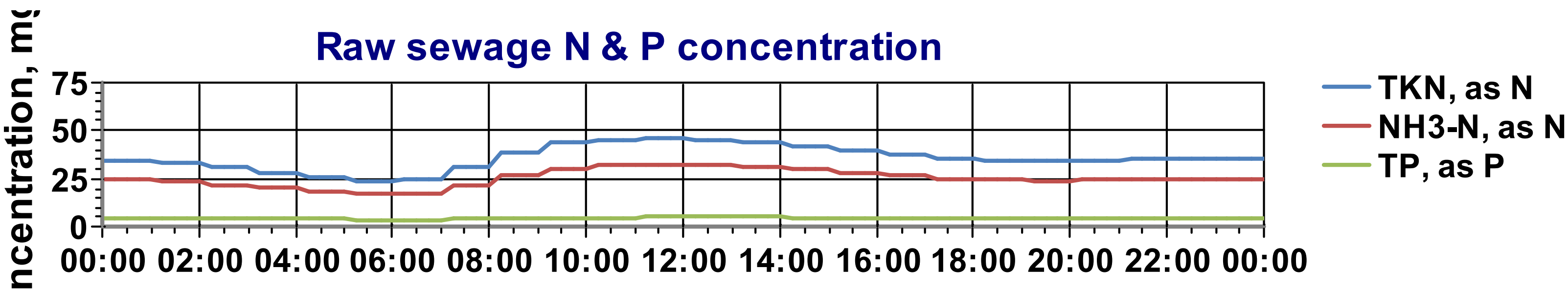
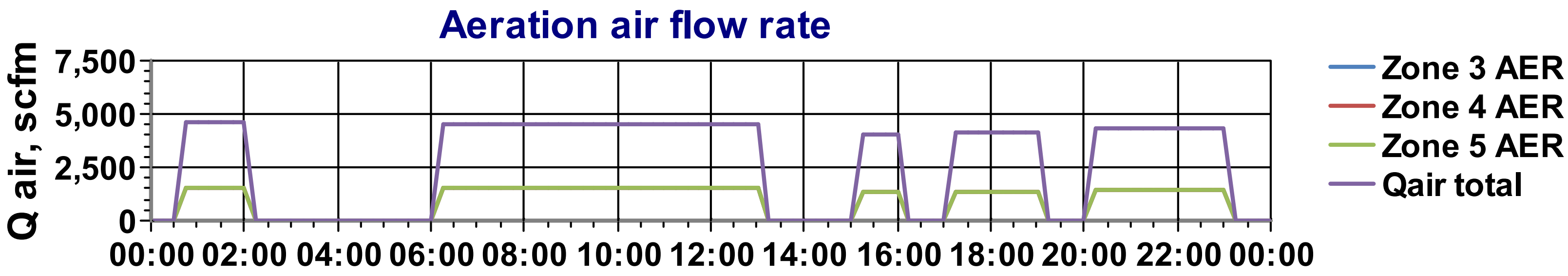
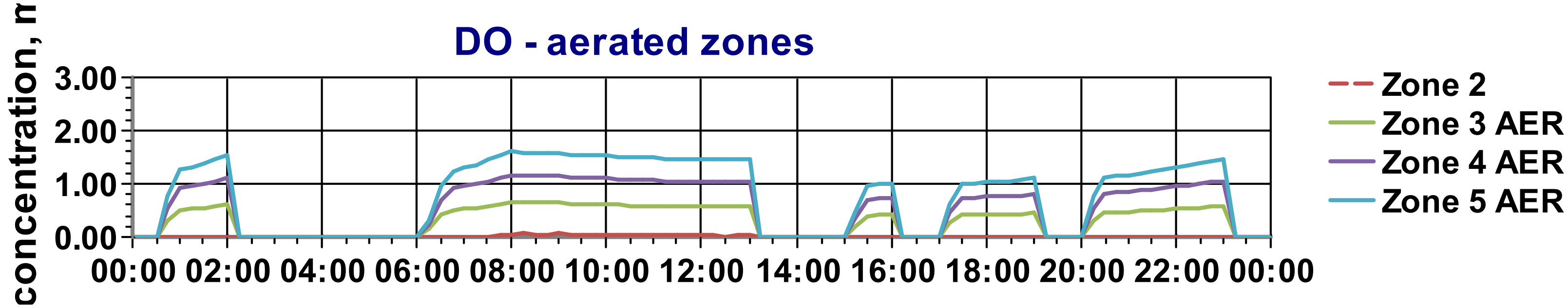


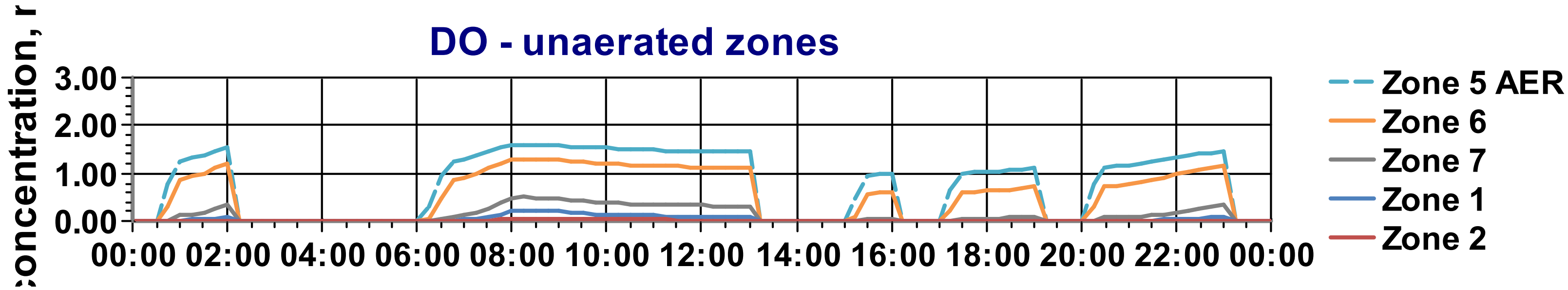




Album page - Aeration 1







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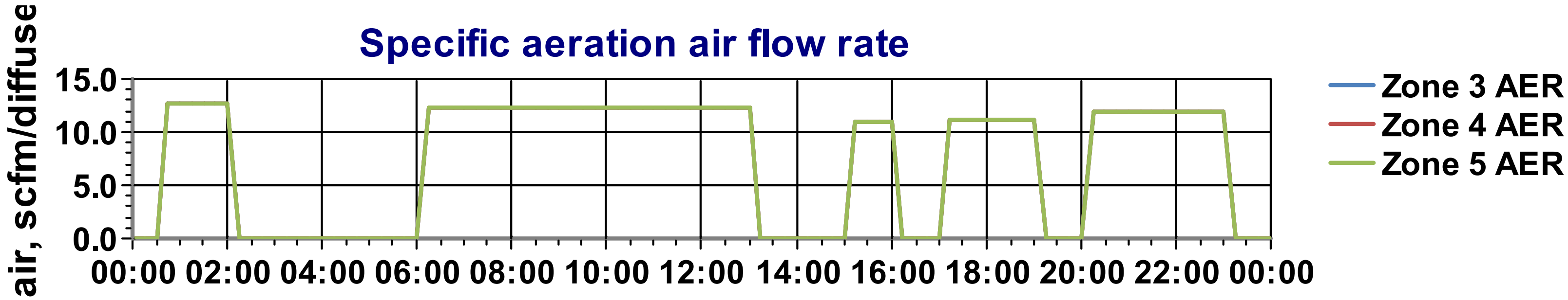
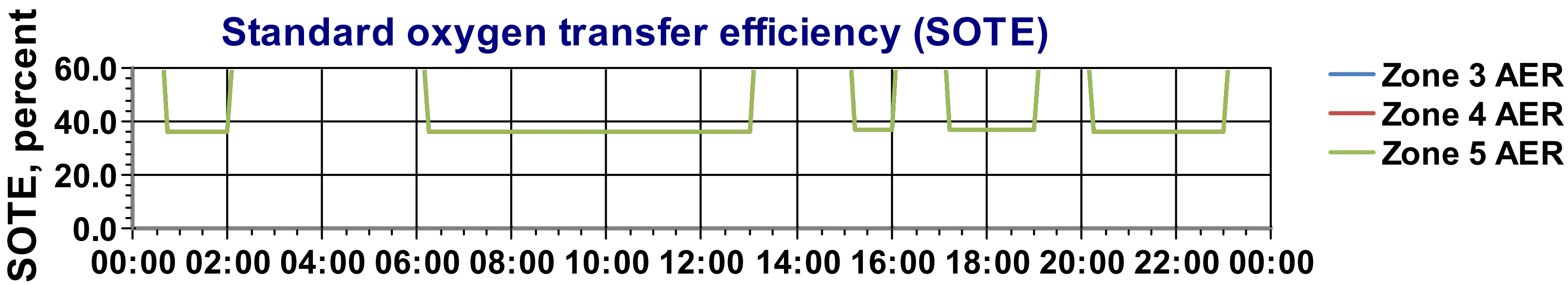
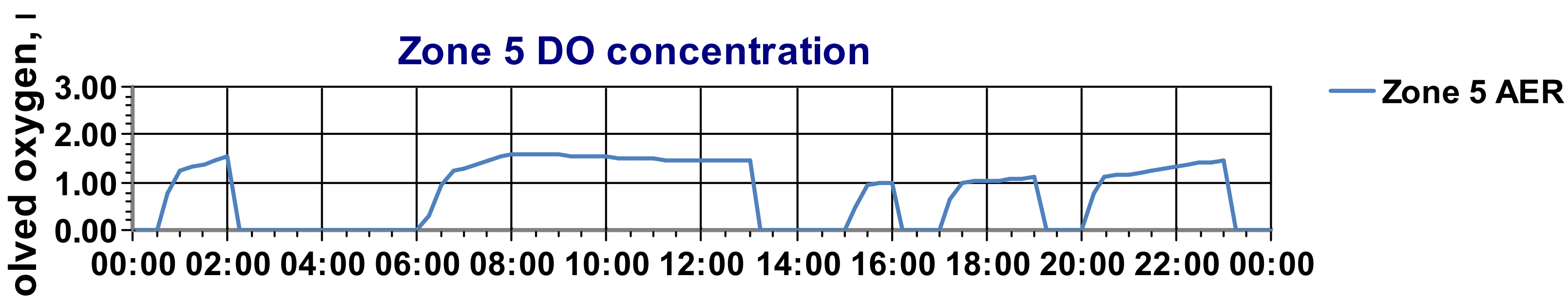
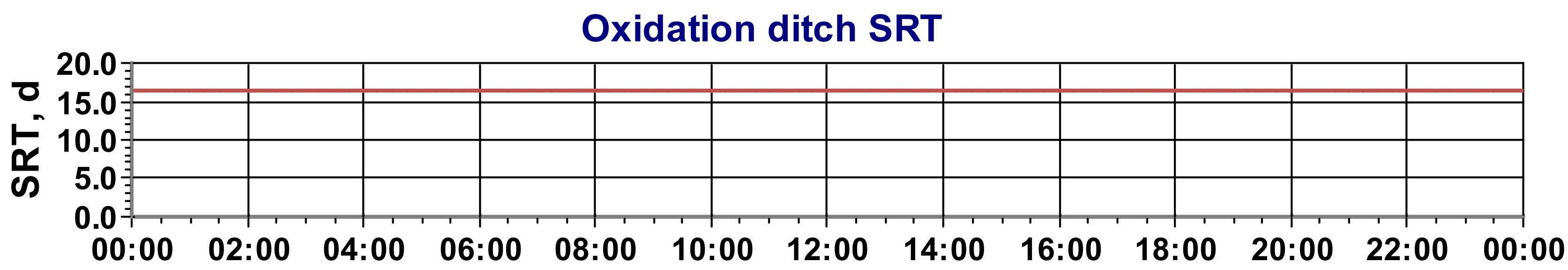
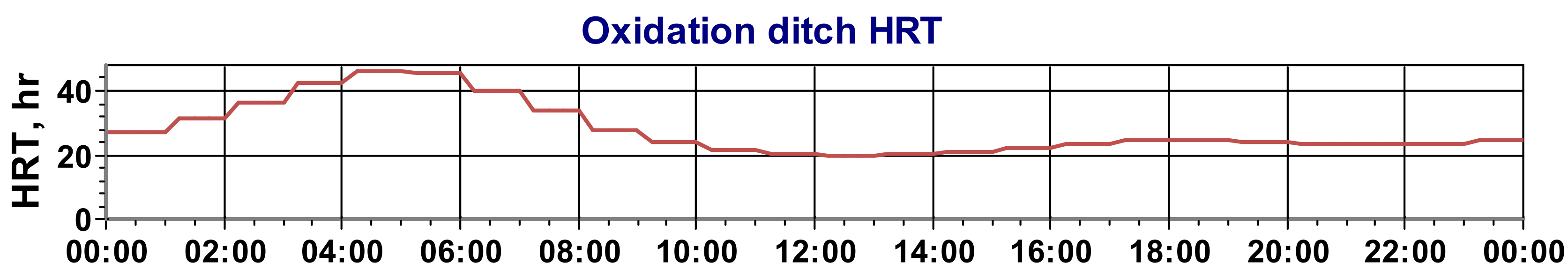


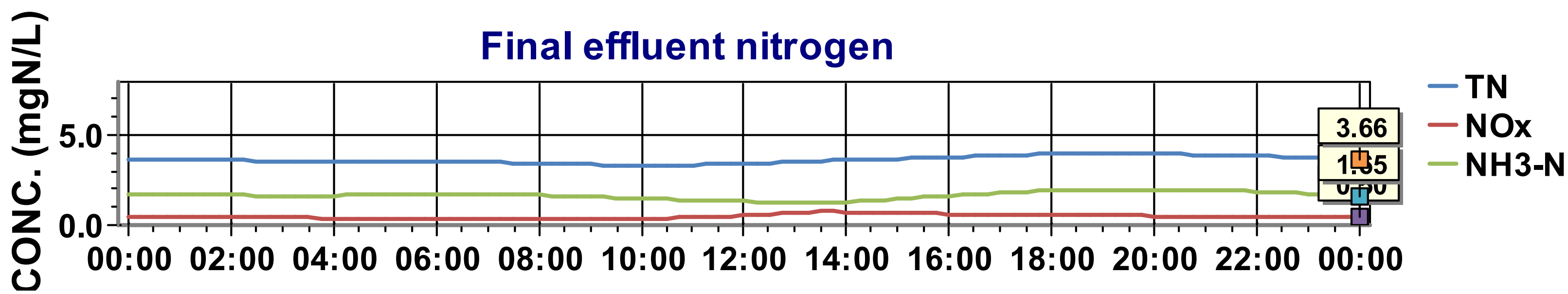




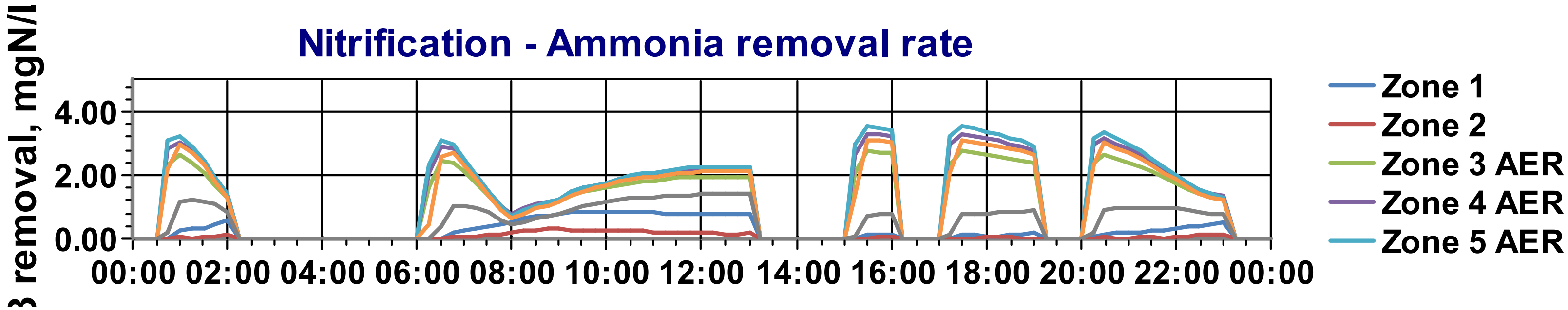
Album page - Ox ditch

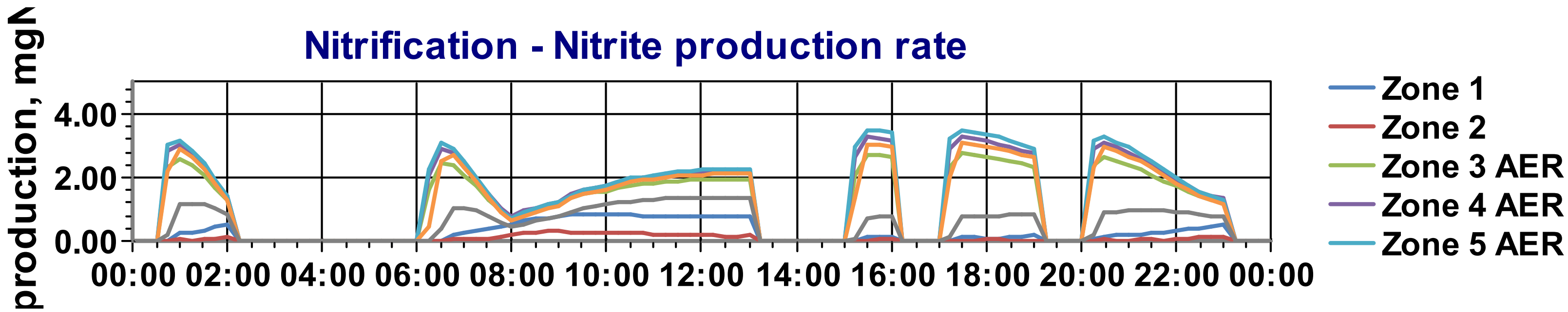


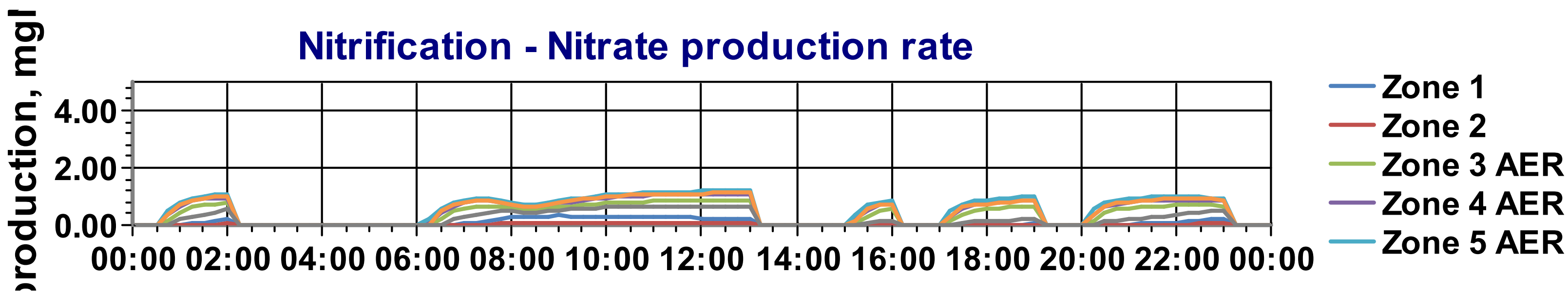




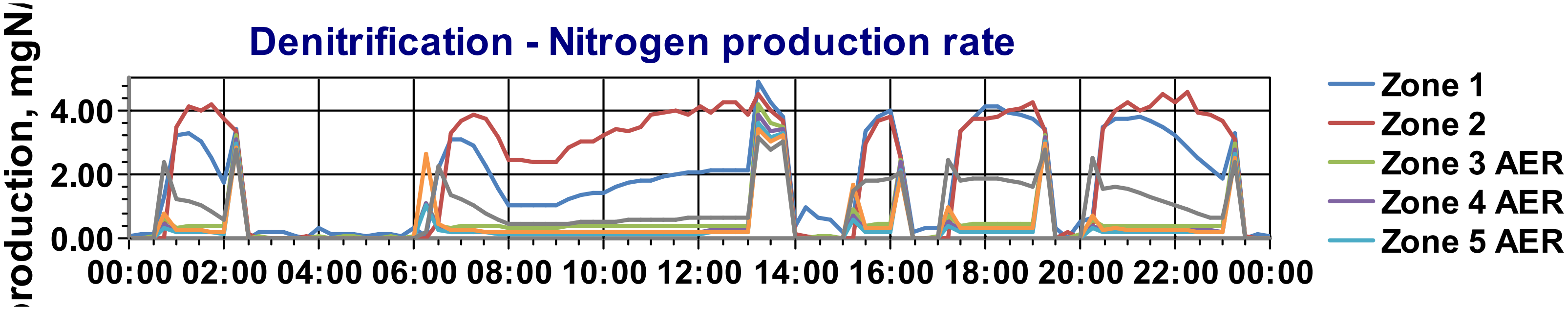
Album page - Nitrification rate

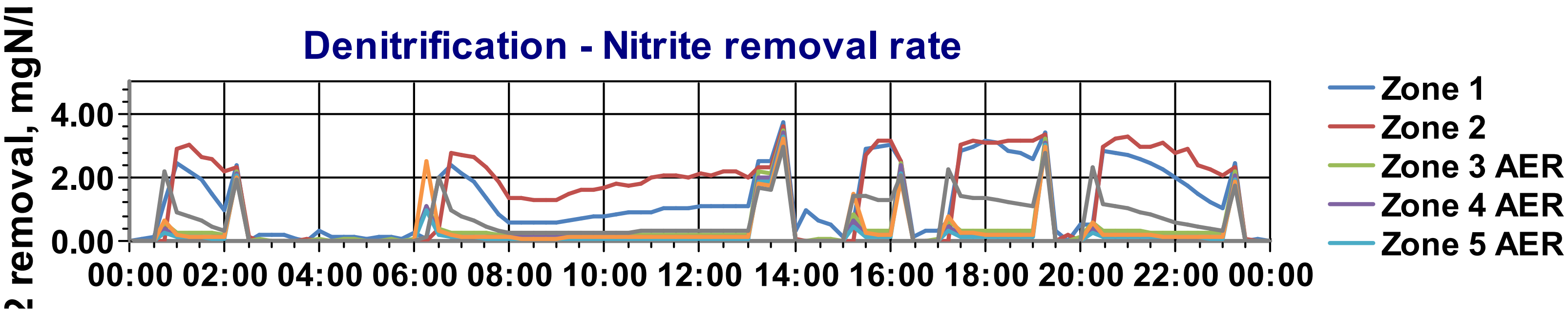


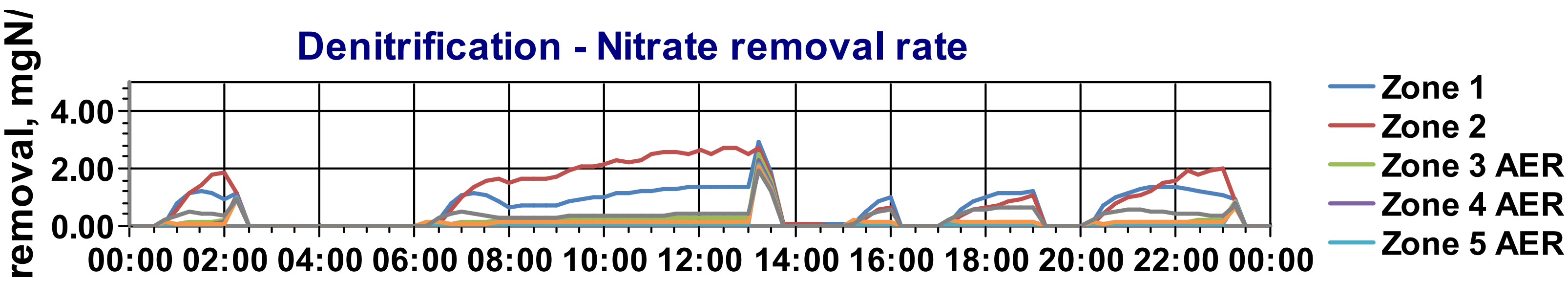




Album page - Denitrification rate







Global Parameters

Common

Name	Default	Value	
Hydrolysis rate [1/d]	2.1000	2.1000	1.0290
Hydrolysis half sat. [-]	0.0600	0.0600	1.0000
Anoxic hydrolysis factor [-]	0.2800	0.2800	1.0000
Anaerobic hydrolysis factor (AS) [-]	0.0400	0.0400	1.0000
Anaerobic hydrolysis factor (AD) [-]	0.5000	0.5000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.1500	0.1500	1.0290
Ammonification rate [L/(mgN d)]	0.0400	0.0400	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.5000	0.5000	1.0000
Endogenous products decay rate [1/d]	0	0	1.0000

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9000	0.9000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.7000	0.7000	1.0000
Byproduct NH4 logistic slope [-]	50.0000	50.0000	1.0000
Byproduct NH4 inflection point [mgN/L]	1.4000	1.4000	1.0000
AOB denite DO half sat. [mg/L]	0.1000	0.1000	1.0000
AOB denite HNO2 half sat. [mgN/L]	5.000E-6	5.000E-6	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiHNO2 [mmol/L]	0.0050	0.0050	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.7000	0.7000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.1000	0.1000	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiNH3 [mmol/L]	0.0750	0.0750	1.0000

OHO

Name	Default	Value	
Max. spec. growth rate [1/d]	3.2000	3.2000	1.0290
Substrate half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.6200	0.6200	1.0290
Anoxic decay rate [1/d]	0.2330	0.2330	1.0290
Anaerobic decay rate [1/d]	0.1310	0.1310	1.0290
Fermentation rate [1/d]	1.6000	1.6000	1.0290
Fermentation half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Fermentation growth factor (AS) [-]	0.2500	0.2500	1.0000
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

pH

Name	Default	Value
OHO low pH limit [-]	4.0000	4.0000
OHO high pH limit [-]	10.0000	10.0000
Autotrophs low pH limit [-]	5.5000	5.5000
Autotrophs high pH limit [-]	9.5000	9.5000
OHO low pH limit (anaerobic) [-]	5.5000	5.5000
OHO high pH limit (anaerobic) [-]	8.5000	8.5000

Switches

Name	Default	Value
Aerobic/anoxic DO half sat. [mgO2/L]	0.0500	0.0500
Anoxic/anaerobic NOx half sat. [mgN/L]	0.1500	0.1500
AOB DO half sat. [mgO2/L]	0.2500	0.2500
NOB DO half sat. [mgO2/L]	0.5000	0.5000
Anoxic NO3(->NO2) half sat. [mgN/L]	0.1000	0.1000
Anoxic NO3(->N2) half sat. [mgN/L]	0.0500	0.0500
Anoxic NO2(->N2) half sat. (mgN/L)	0.0100	0.0100
NH3 nutrient half sat. [mgN/L]	0.0050	0.0050
P nutrient half sat. [mgP/L]	0.0010	0.0010
Autotroph CO2 half sat. [mmol/L]	0.1000	0.1000
H2 low/high half sat. [mgCOD/L]	1.0000	1.0000
Synthesis anion/cation half sat. [meq/L]	0.0100	0.0100

Common

Name	Default	Value
Biomass volatile fraction (VSS/TSS)	0.9200	0.9200
Endogenous residue volatile fraction (VSS/TSS)	0.9200	0.9200
N in endogenous residue [mgN/mgCOD]	0.0700	0.0700
P in endogenous residue [mgP/mgCOD]	0.0220	0.0220
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6500
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6500

AOB

Name	Default	Value
Yield [mgCOD/mgN]	0.1500	0.1500
AOB denite NO2 fraction as TEA [-]	0.5000	0.5000
Byproduct NH4 fraction to N2O [-]	0.0025	0.0025
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

NOB

Name	Default	Value
Yield [mgCOD/mgN]	0.0900	0.0900
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

OHO

Name	Default	Value
Yield (aerobic) [-]	0.6660	0.6660
Yield (fermentation, low H2) [-]	0.1000	0.1000
Yield (fermentation, high H2) [-]	0.1000	0.1000
H2 yield (fermentation low H2) [-]	0.3500	0.3500
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.7000	0.7000
CO2 yield (fermentation, low H2) [-]	0.7000	0.7000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Endogenous fraction - aerobic [-]	0.0800	0.0800
Endogenous fraction - anoxic [-]	0.1030	0.1030

Endogenous fraction - anaerobic [-]	0.1840	0.1840
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield (anoxic) [-]	0.5400	0.5400
Yield propionic (aerobic) [-]	0.6400	0.6400
Yield propionic (anoxic) [-]	0.4600	0.4600
Yield acetic (aerobic) [-]	0.6000	0.6000
Yield acetic (anoxic) [-]	0.4300	0.4300
Yield methanol (aerobic) [-]	0.5000	0.5000
Adsorp. max. [-]	1.0000	1.0000
Max fraction to N2O at high FNA over nitrate [-]	0.0500	0.0500
Max fraction to N2O at high FNA over nitrite [-]	0.1000	0.1000

General

Name	Default	Value
Molecular weight of other anions [mg/mmol]	35.5000	35.5000
Molecular weight of other cations [mg/mmol]	39.1000	39.1000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.3000	0.3000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.1500	0.1500
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.0500	0.0500
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.0100	0.0100
Bubble rise velocity (anaerobic digester) [cm/s]	23.9000	23.9000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.3500	0.3500
Anaerobic digester gas hold-up factor []	1.0000	1.0000
Tank head loss per metre of length (from flow) [m/m]	0.0025	0.0025

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.0000	17.0000	1.0240
Kl for CO2 [m/d]	10.0000	10.0000	1.0240
Kl for NH3 [m/d]	1.0000	1.0000	1.0240
Kl for CH4 [m/d]	8.0000	8.0000	1.0240
Kl for N2 [m/d]	15.0000	15.0000	1.0240
Kl for N2O [m/d]	8.0000	8.0000	1.0240
Kl for O2 [m/d]	13.0000	13.0000	1.0240

Henry's law constants

Name	Default	Value	
CO2 [M/atm]	3.4000E-2	3.4000E-2	2,400.0000
O2 [M/atm]	1.3000E-3	1.3000E-3	1,500.0000
N2 [M/atm]	6.5000E-4	6.5000E-4	1,300.0000
N2O [M/atm]	2.5000E-2	2.5000E-2	2,600.0000
NH3 [M/atm]	5.8000E+1	5.8000E+1	4,100.0000
CH4 [M/atm]	1.4000E-3	1.4000E-3	1,600.0000
H2 [M/atm]	7.8000E-4	7.8000E-4	500.0000

Physico-chemical rates

Name	Default	Value	
Struvite precipitation rate [1/d]	3.000E+10	3.000E+10	1.0240
Struvite redissolution rate [1/d]	3.000E+11	3.000E+11	1.0240
Struvite half sat. [mgTSS/L]	1.0000	1.0000	1.0000
HDP precipitation rate [L/(molP d)]	1.000E+8	1.000E+8	1.0000
HDP redissolution rate [L/(mol P d)]	1.000E+8	1.000E+8	1.0000
HAP precipitation rate [molHDP/(L d)]	5.000E-4	5.000E-4	1.0000

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.918E-14	6.918E-14

HDP solubility product [mol/L]	2.750E-22	2.750E-22
HDP half sat. [mgTSS/L]	1.0000	1.0000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.0100	0.0100
Al to P ratio [molAl/molP]	0.8000	0.8000
Al(OH)3 solubility product [mol/L]	1.259E+9	1.259E+9
AlHPO4+ dissociation constant [mol/L]	7.943E-13	7.943E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.0100	0.0100
Fe to P ratio [molFe/molP]	1.6000	1.6000
Fe(OH)3 solubility product [mol/L]	0.0500	0.0500
FeH2PO4++ dissociation constant [mol/L]	5.012E-22	5.012E-22

Aeration

Name	Default	Value
Alpha (surf) OR Alpha F (diff) [-]	0.5000	0.5000
Beta [-]	0.9500	0.9500
Surface pressure [kPa]	101.3250	86.0370
Fractional effective saturation depth (Fed) [-]	0.3250	0.3250
Supply gas CO2 content [vol. %]	0.0350	0.0350
Supply gas O2 [vol. %]	20.9500	20.9500
Off-gas CO2 [vol. %]	2.0000	2.0000
Off-gas O2 [vol. %]	18.8000	18.8000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Surface turbulence factor [-]	2.0000	2.0000
Set point controller gain []	1.0000	1.0000

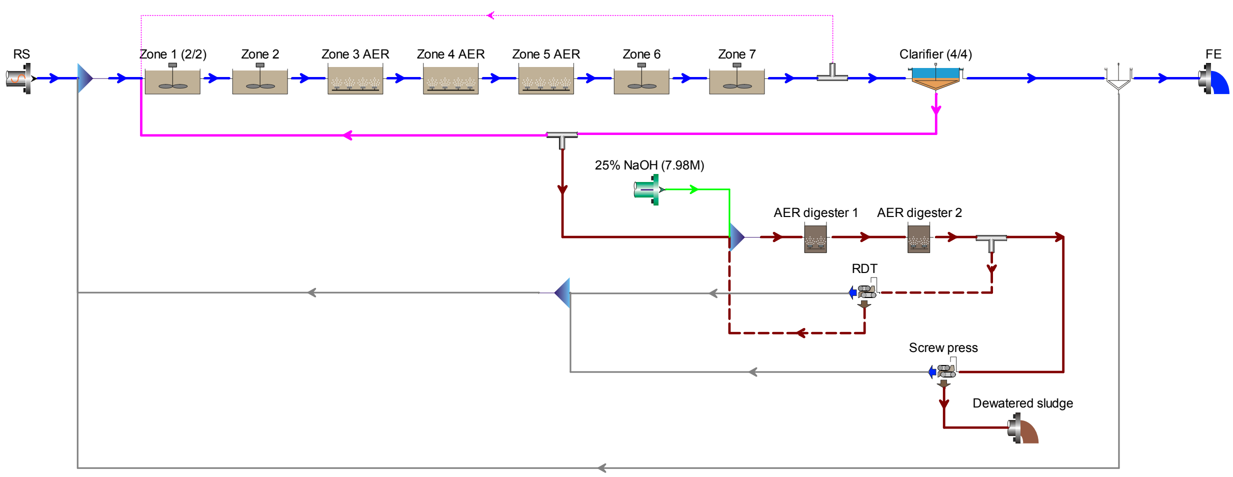
BioWin user and configuration data

Project details
Project name: STMWRF master plan update
Project ref.: 9873A.00
Plant name: South Truckee Meadows Water Reclamation Facility
User name: Ron Appleton

Created: 7/5/2015
Saved: 12/18/2015

SRT: **** days
Temperature: 14.0°C

Flowsheet



Configuration information for all COD Influent units

Operating data Average (flow/time weighted as required)

Element name	RS
Time	1.0000
Flow	4.27457396240205
TCOD mgCOD/L	966.4214
TKN mgN/L	73.5425
TP mgP/L	8.2979
NO3-N mgN/L	0
pH	7.4700
Alk mmol/L	5.0800
ISSinf mgISS/L	34.5000
SCa mg/L	80.0000
SMg mg/L	15.0000
DO mg/L	0

Element name	RS
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	**0.8000**
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	**0.2000**
Fna - Ammonia [gNH3-N/gTKN]	**0.7020**

Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.5000
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0110
FZbh - OHO COD fraction [gCOD/g of total COD]	0.0200
FZbm - Methylotroph COD fraction [gCOD/g of total COD]	1.000E-4
FZaob - AOB COD fraction [gCOD/g of total COD]	1.000E-4
FZnob - NOB COD fraction [gCOD/g of total COD]	1.000E-4
FZaao - AAO COD fraction [gCOD/g of total COD]	1.000E-4
FZbp - PAO COD fraction [gCOD/g of total COD]	1.000E-4
FZbpa - Propionic acetogens COD fraction [gCOD/g of total COD]	1.000E-4
FZbam - Acetoclastic methanogens COD fraction [gCOD/g of total COD]	1.000E-4
FZbhm - H2-utilizing methanogens COD fraction [gCOD/g of total COD]	1.000E-4
FZe - Endogenous products COD fraction [gCOD/g of total COD]	0

Configuration information for all Stream (SV) Influent units

Operating data Average (flow/time weighted as required)

Element name	25% NaOH (7.98M)
Zbh mgCOD/L	0
Zbmeth mgCOD/L	0
Zaob mgCOD/L	0
Znob mgCOD/L	0
Zaao mgCOD/L	0
Zbp mgCOD/L	0
Zbpa mgCOD/L	0
Zbam mgCOD/L	0
Zbhm mgCOD/L	0
Ze mgCOD/L	0
Xsp mgCOD/L	0
Xsc mgCOD/L	0
Xi mgCOD/L	0
Xon mgN/L	0
Xop mgP/L	0
Xin mgN/L	0
Xip mgP/L	0
Spha mgCOD/L	0
PP-lo mgP/L	0
PP-hi mgP/L	0
Sbsc mgCOD/L	0
Sbsa mgCOD/L	0
Sbsp mgCOD/L	0
Sbmeth mgCOD/L	0
SbH2 mgCOD/L	0
CH4 mg/L	0
NH3-N mgN/L	0
Nos mgN/L	0
N2O-N mgN/L	0
NO2-N mgN/L	0
NO3-N mgN/L	0
N2 mgN/L	0
PO4-P (incl. MeP) mgP/L	0
Sus mgCOD/L	0
Nus mgN/L	0
ISSinf mgISS/L	0
XStru mgISS/L	0
XHDP mgISS/L	0
XHAP mgISS/L	0
SMg mg/L	0
SCa mg/L	0
Me mg/L	0
SCat meq/L	7,980.0000
SAn meq/L	0
SCO2 mmol/L	0

UD1 mg/L	0
UD2 mg/L	0
UD3 mgVSS/L	0
UD4 mgISS/L	0
DO mg/L	0
Flow	3E-5

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
RAS/WAS Splitter	Flowrate [Side]	0.117
ML Return Splitter	Flowrate [Side]	536
RDT feed splitter	Flowrate [Side]	0.117

Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Zone 1 (2/2)	0.3220	3,075.0000	14.000	Un-aerated
Zone 2	0.3060	2,922.0000	14.000	Un-aerated
Zone 3 AER	0.4294	4,100.0000	14.000	122
Zone 4 AER	0.4294	4,100.0000	14.000	122
Zone 5 AER	0.4294	4,100.0000	14.000	122
Zone 6	0.3060	2,922.0000	14.000	Un-aerated
Zone 7	0.9661	9,225.0000	14.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Zone 1 (2/2)	0
Zone 2	0
Zone 3 AER	1.0
Zone 4 AER	1.5
Zone 5 AER	2.0
Zone 6	0
Zone 7	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Zone 1 (2/2)	2.5656	0.0432	0.8200	0.4413	10.0000
Zone 2	2.5656	0.0432	0.8200	0.4413	10.0000
Zone 3 AER	2.5656	0.0432	0.8200	6.6000	19.7000
Zone 4 AER	2.5656	0.0432	0.8200	6.6000	19.7000
Zone 5 AER	2.5656	0.0432	0.8200	6.6000	19.7000
Zone 6	2.5656	0.0432	0.8200	0.4413	10.0000
Zone 7	2.5656	0.0432	0.8200	0.4413	10.0000

Configuration information for all Ideal clarifier units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Clarifier (4/4)	2.0308	2.011E+4	13.500

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Clarifier (4/4)	Ratio	0.50

Element name	Average Temperature	Reactive	Percent removal	Blanket fraction
Clarifier (4/4)	Uses global setting	No	99.9200	0.0500

Configuration information for all Point clarifier units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Filters	Flowrate [Under]	0.5

Element name	Percent removal
Filters	80.0000

Configuration information for all Aerobic Digester units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
AER digester 1	0.3502	2,401.0000	19.500	544
AER digester 2	0.3502	2,401.0000	19.500	544

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
AER digester 1	1.0
AER digester 2	1.0

Local biological parameters

Element name	Aerobic/anoxic DO half sat. [mgO2/L]
AER digester 1	0.0500
AER digester 2	0.0500

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
AER digester 1	2.5656	0.0432	0.8200	0.4413	10.0000
AER digester 2	2.5656	0.0432	0.8200	0.4413	10.0000

Configuration information for all Dewatering unit units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
RDT	Fraction	0.37
Screw press	Fraction	0.11

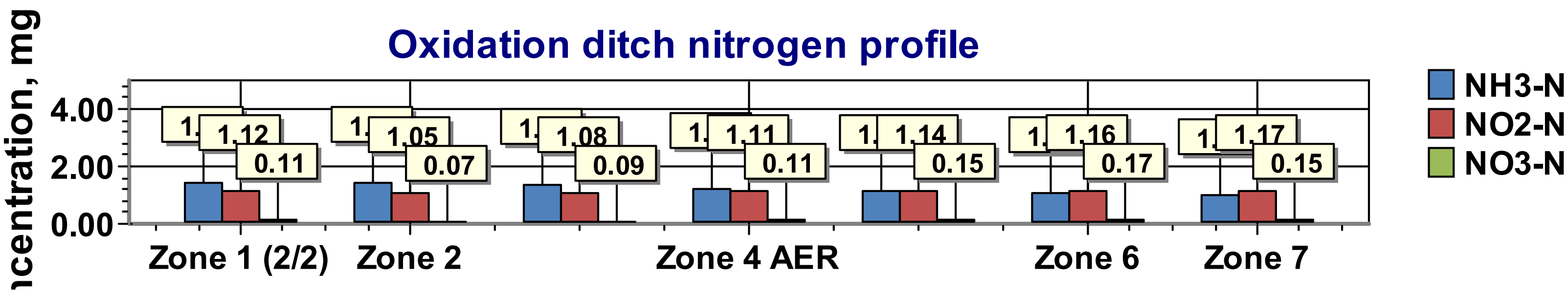
Element name	Percent removal
RDT	92.5000
Screw press	92.5000

BioWin Album

Album page - Tables 1

Elements	Flow [mgd]	TSS [mgTSS/L]	VSS [mgVSS/L]	TCOD [mg/L]	SCOD [mg/L]	TCBOD [mg/L]	SCBOD [mg/L]	TKN [mgN/L]	STKN [mgN/L]	NH3-N [mgN/L]	NO2-N [mgN/L]	NO3-N [mgN/L]	TP [mgP/L]	SPO4 [mgP/L]	pH []	Alk [mmol/L]	Temp. [deg. C]
RS	4.2746	433.7675	398.0069	966.4214	312.9659	431.4440	187.5999	73.5425	59.2341	51.6269	0	0	8.2979	4.1490	7.4700	5.0800	14.0000
Plant influent	4.8771	430.6941	391.1386	918.3965	280.5137	385.8105	164.5682	68.2933	52.4587	45.4839	0.2073	0.1157	10.1594	5.4834	7.3170	4.6320	14.0000
Clarifier (4/4)	5.0019	5.6960	4.8586	57.8317	50.4361	2.9358	1.3089	5.1400	4.7458	2.2692	2.0121	0.1566	2.7651	2.6411	6.5230	1.5793	14.0000
FE	4.5019	1.2657	1.0796	52.0795	50.4361	1.6704	1.3089	4.8334	4.7458	2.2692	2.0121	0.1566	2.6687	2.6411	6.5230	1.5793	14.0000
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RAS/WAS Splitter (U)	0.1170	14,296.2950	12,198.1842	18,618.9982	50.8291	4,104.3733	1.3334	993.0705	3.5792	1.1176	1.4775	0.1516	313.6819	2.3780	6.5174	1.5571	14.0000
Digester feed mixer	0.1603	23,906.6884	20,163.6789	30,968.3474	50.4910	4,814.6058	1.1219	1,598.4550	3.3354	0.8512	1.0919	1.3900	524.8151	21.9760	7.6918	2.9005	14.0000
AER digester 1	0.1494	20,862.0537	17,518.0846	26,977.9359	53.7775	3,548.4537	2.4639	1,380.6508	4.1862	2.6615	0.0000	0.0000	483.3883	49.1527	6.6155	2.3359	14.0000
AER digester 2	0.1494	19,958.9168	16,682.4065	25,776.3384	49.6120	2,695.3265	0.5509	1,295.9022	2.6789	0.1319	0.0504	4.7377	483.2988	74.9586	6.1865	1.0018	14.0000
RDT feed splitter	0.0324	19,958.9168	16,682.4065	25,776.3384	49.6120	2,695.3265	0.5509	1,295.9022	2.6789	0.1319	0.0504	4.7377	483.2988	74.9586	6.1865	1.0018	14.0000
Dewatered sludge	0.0035	169,843.5886	141,961.6010	218,975.2973	49.6120	22,932.1734	0.5509	11,007.5692	2.6789	0.1319	0.0504	4.7377	3,549.7948	74.9586	6.1865	1.0018	14.0000
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Filters (U)	0.5000	45.5857	38.8835	109.6235	50.4361	14.3287	1.3089	7.9010	4.7458	2.2692	2.0121	0.1566	3.6336	2.6411	6.4775	1.5794	14.0000
RDT	0.0737	2,376.0615	1,986.0008	3,112.3175	49.6120	321.3575	0.5509	156.6341	2.6789	0.1319	0.0504	4.7377	123.5706	74.9586	6.1493	1.0026	14.0000
Screw press	0.0288	1,679.4780	1,403.7703	2,214.4324	49.6120	227.3075	0.5509	111.4995	2.6789	0.1319	0.0504	4.7377	109.3191	74.9586	6.1493	1.0026	14.0000

Elements	TSS [lb TSS/d]	VSS [lb VSS/d]	TKN [lb N/d]	TP [lb P/d]
RS	15,473.8082	14,198.1193	2,623.4861	296.0125
	-	-	-	-
RAS/WAS Splitter (U)	13,959.0784	11,910.4572	969.6462	306.2829
Digester feed mixer	31,985.6007	26,977.6963	2,138.6293	702.1687
AER digester 1	26,004.7931	21,836.4966	1,720.9974	602.5491
AER digester 2	24,879.0225	20,794.8142	1,615.3572	602.4376
RDT feed splitter	5,390.8904	4,505.9071	350.0223	130.5387
Dewatered sludge	4,986.5736	4,167.9641	323.1800	104.2213
	-	-	-	-
Filters (U)	190.2157	162.2493	32.9684	15.1619
RDT	1,461.6099	1,221.6680	96.3518	76.0132
Screw press	404.3168	337.9430	26.8423	26.3174



Album page - Tables 2

Elements	# of diffusers []	Air flow rate [ft3/min (20C, 1 atm)]	Air flow rate / diffuser [ft3/min (20C, 1 atm)]	OTR [lb/hr]	SOTR [lb/hr]	SOTE [%]	DO [mg/L]
Zone 3 AER	122.0000	3,386.3750	27.7572	340.9381	1,076.1201	31.1432	1.0000
Zone 4 AER	122.0000	2,517.7284	20.6371	250.0135	843.9278	32.8499	1.5000
Zone 5 AER	122.0000	2,743.6694	22.4891	249.6389	905.5451	32.3457	2.0000

Elements	OUR - Carbonaceous [mgO/L/hr]	OUR - Nitrification [mgO/L/hr]	OUR - Total [mgO/L/hr]
Zone 1 (2/2)	12.5159	3.2828	15.7987
Zone 2	3.0541	0.7908	3.8449
Zone 3 AER	30.0037	13.0934	43.0971
Zone 4 AER	29.5643	13.8359	43.4002
Zone 5 AER	29.2156	14.0800	43.2957
Zone 6	27.9310	13.1920	41.1229
Zone 7	19.1998	7.8164	27.0162

Elements	Zbh [mgCOD/L]	Zbmeth [mgCOD/L]	Zbp [mgCOD/L]	Zaob [mgCOD/L]	Znob [mgCOD/L]	Zaao [mgCOD/L]	Zbpa [mgCOD/L]	Zbam [mgCOD/L]	Zbhm [mgCOD/L]	Ze [mgCOD/L]	Xsp [mgCOD/L]	Xi [mgCOD/L]
Zone 5 AER	2,234.6810	0.9962	0.8476	43.8982	12.5079	1.0483	0.2505	0.2226	0.0588	918.5463	166.4033	2,819.1520
Zone 2	2,234.0003	0.9963	0.8477	43.8812	12.5030	1.0484	0.2507	0.2228	0.0592	918.3354	168.3163	2,819.1961

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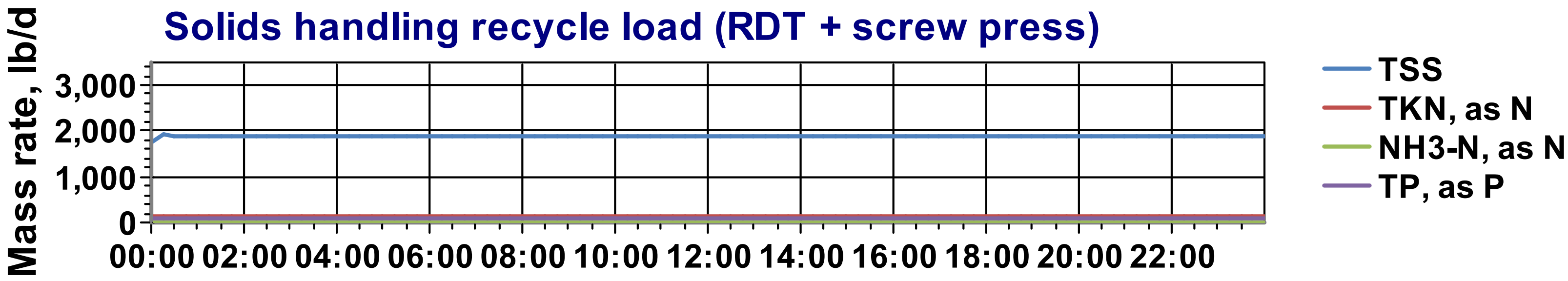

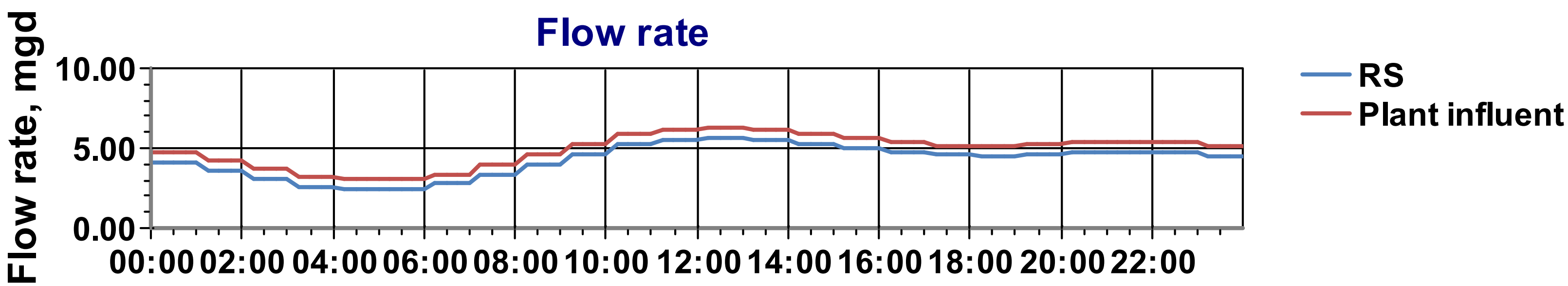

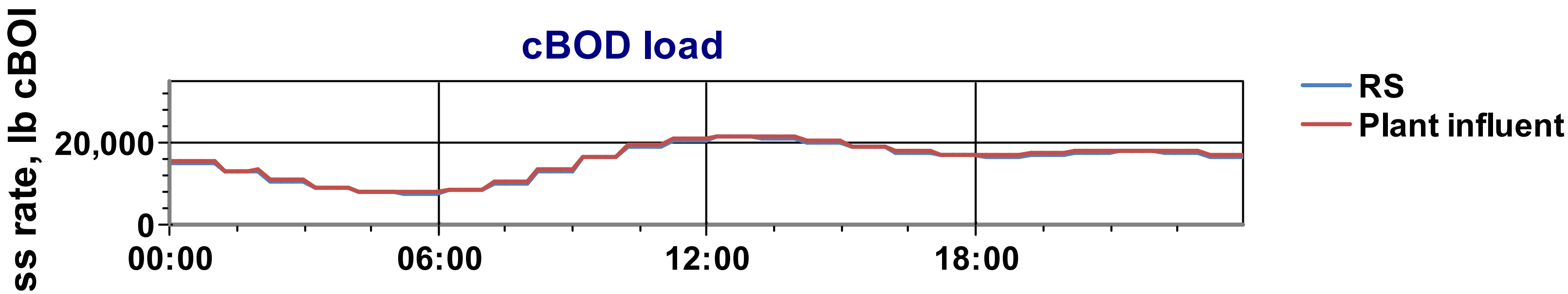

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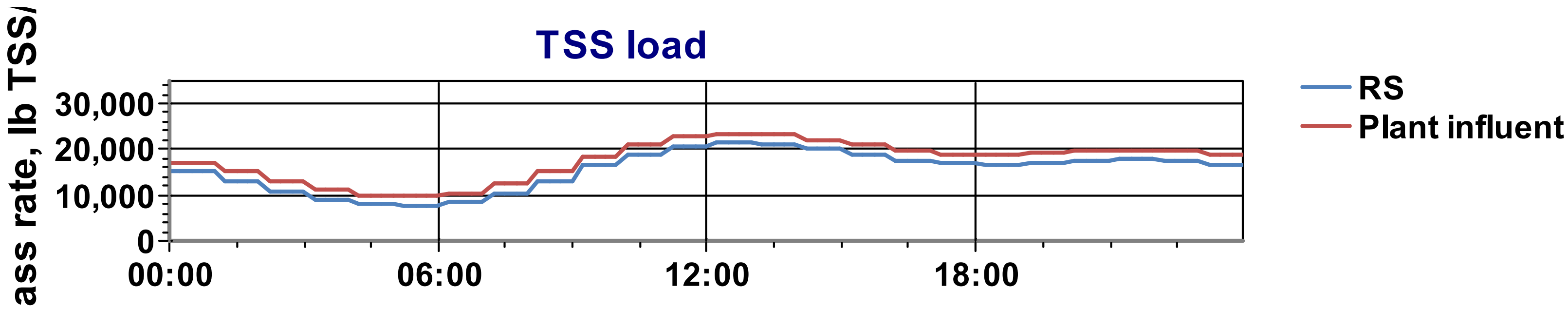

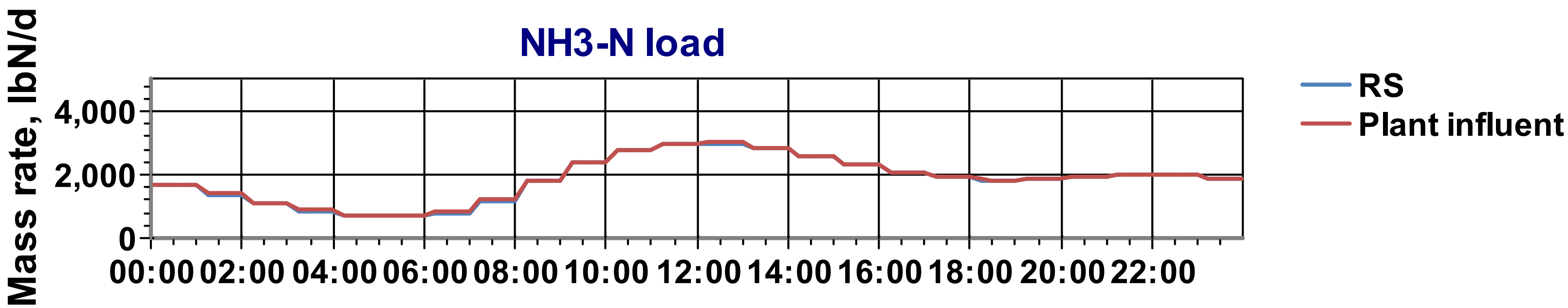

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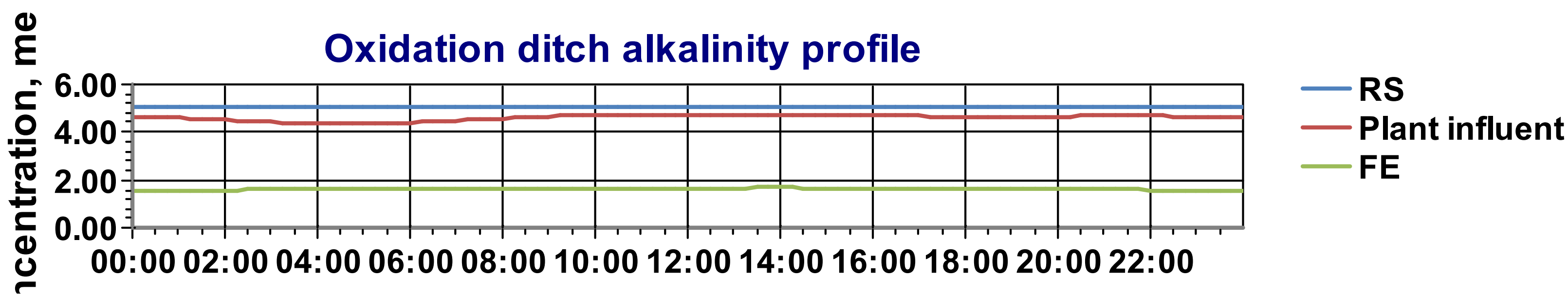

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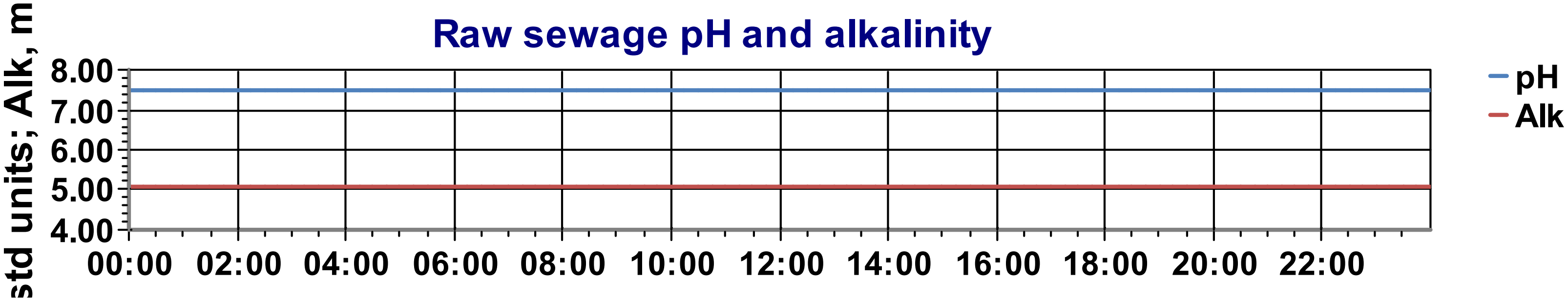

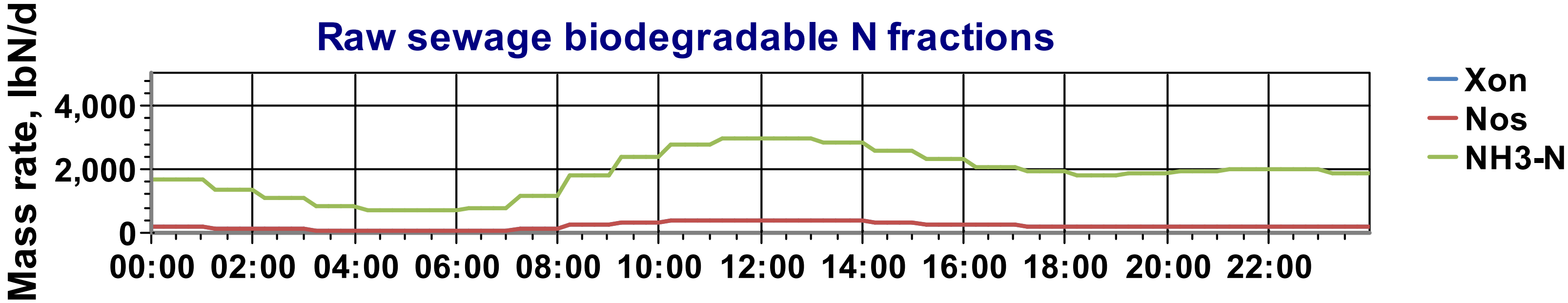

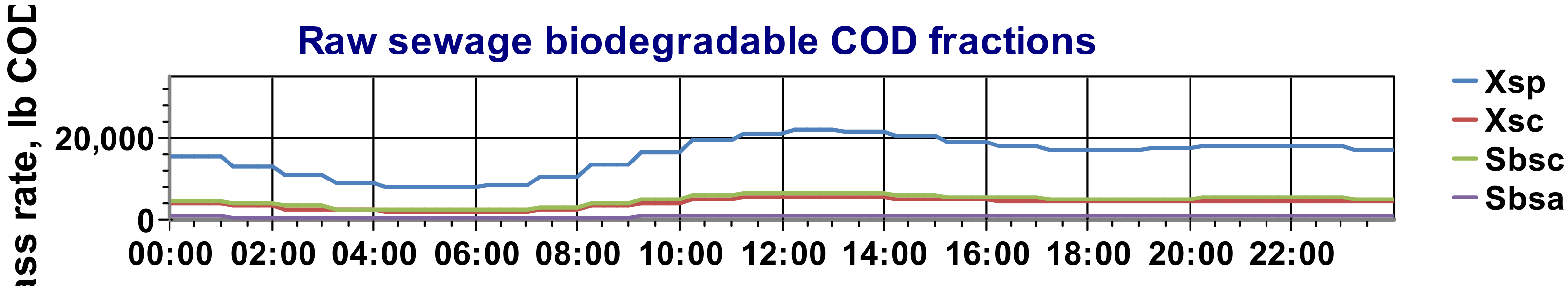

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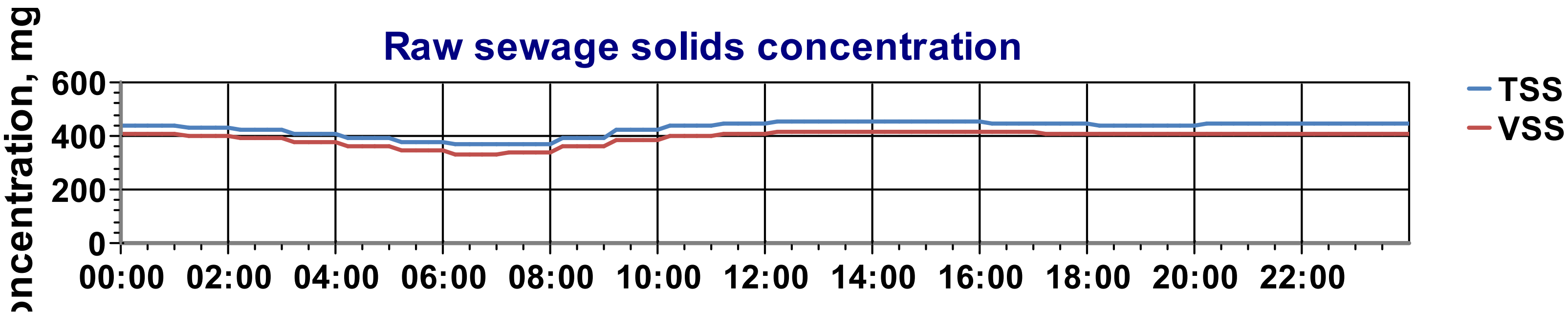

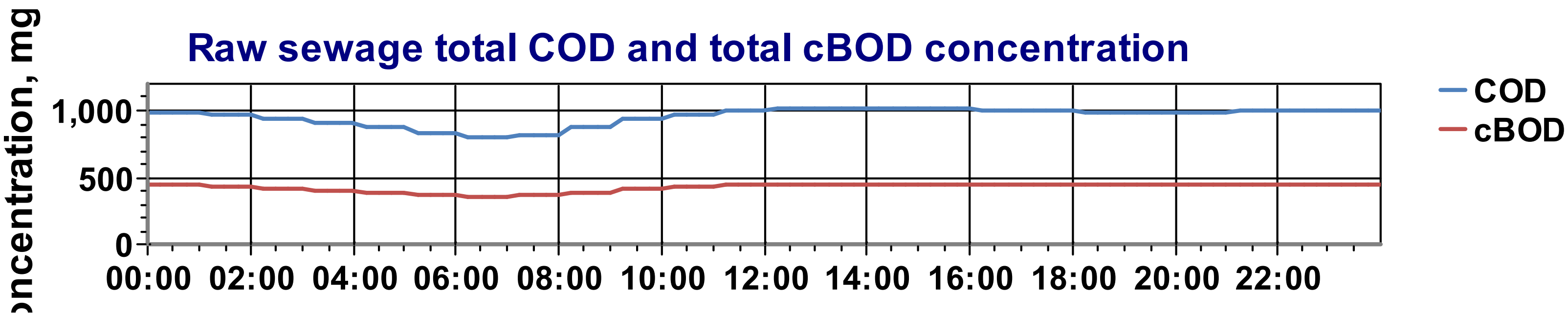

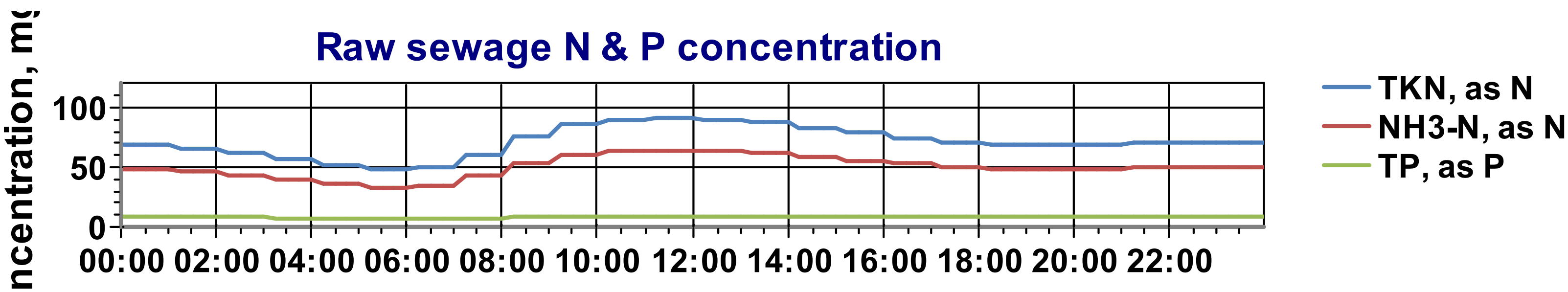

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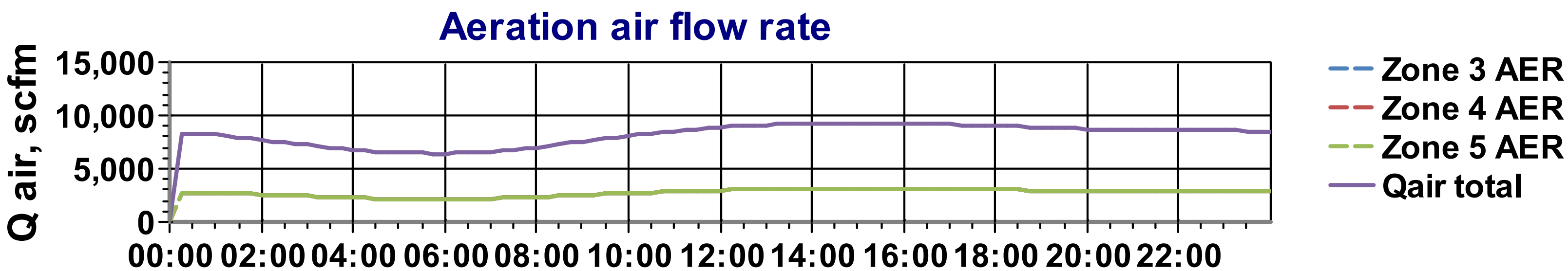

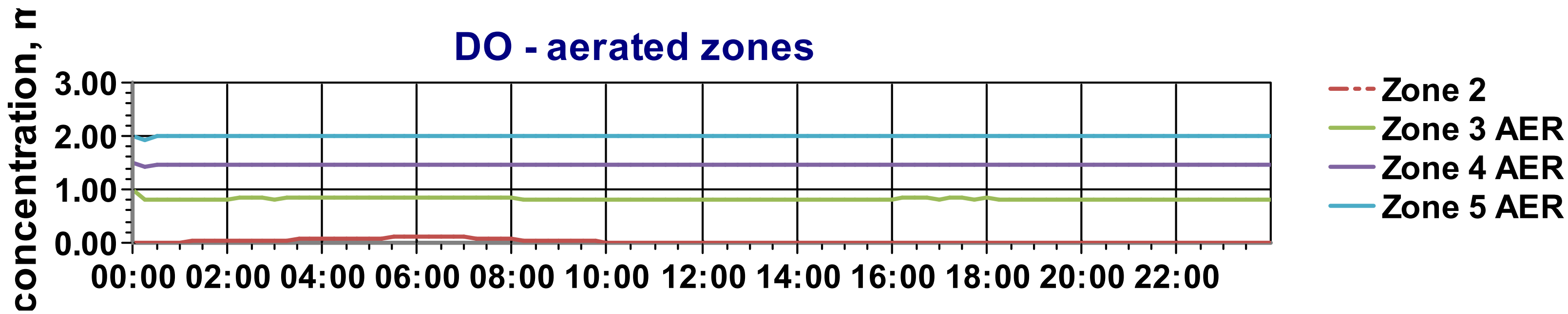

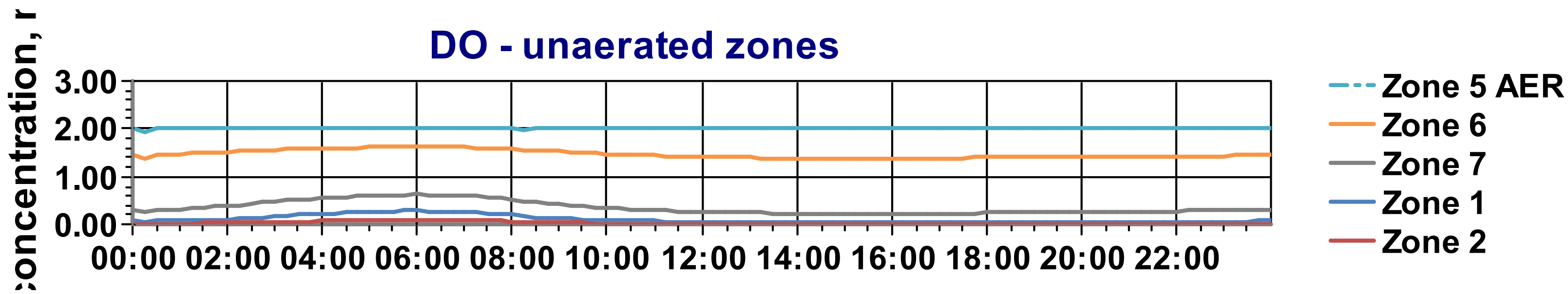

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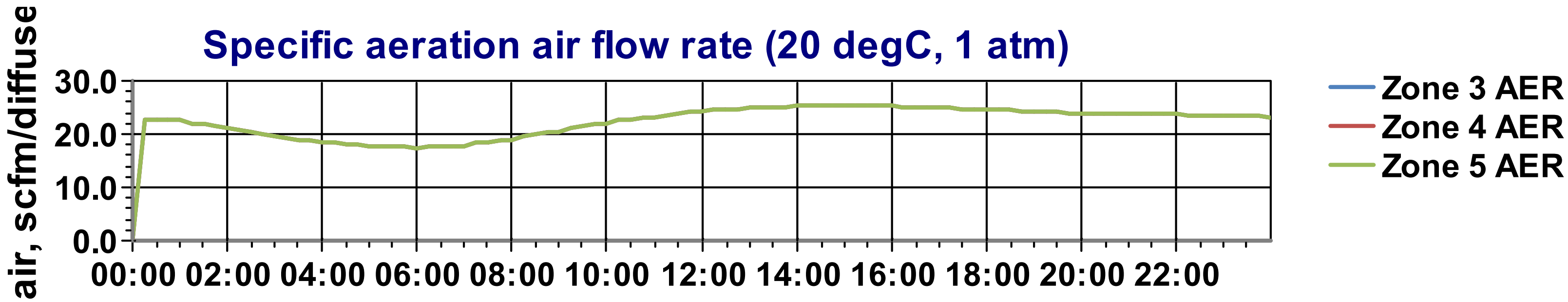

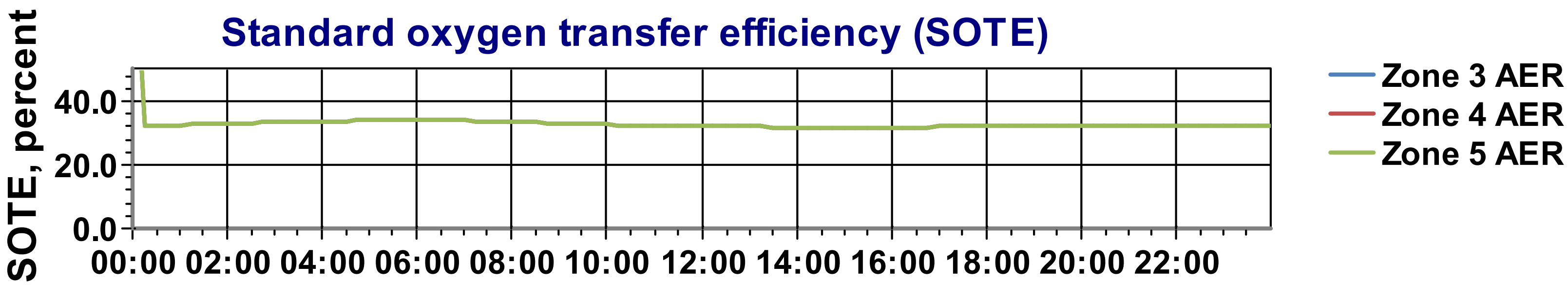

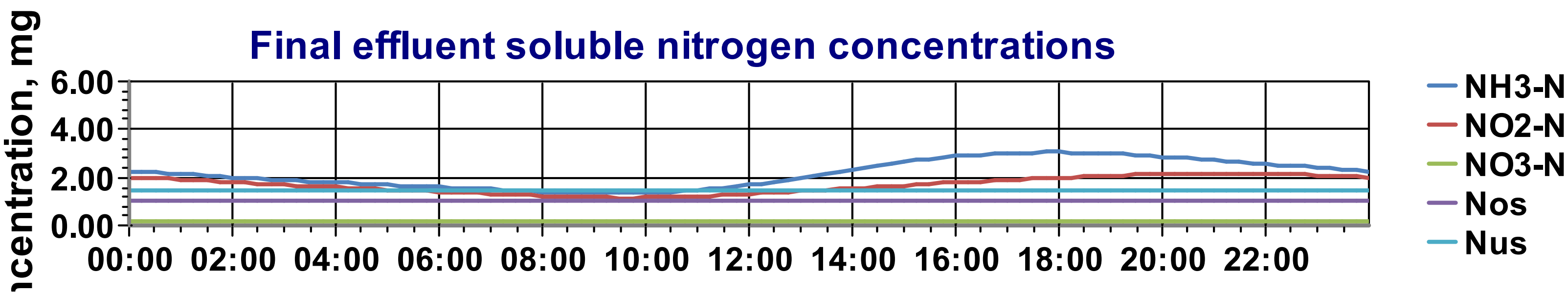

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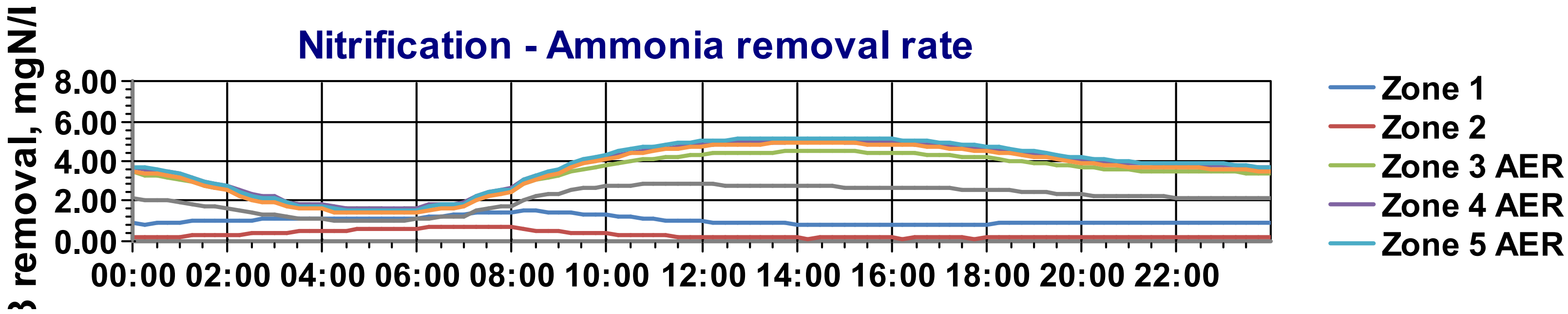

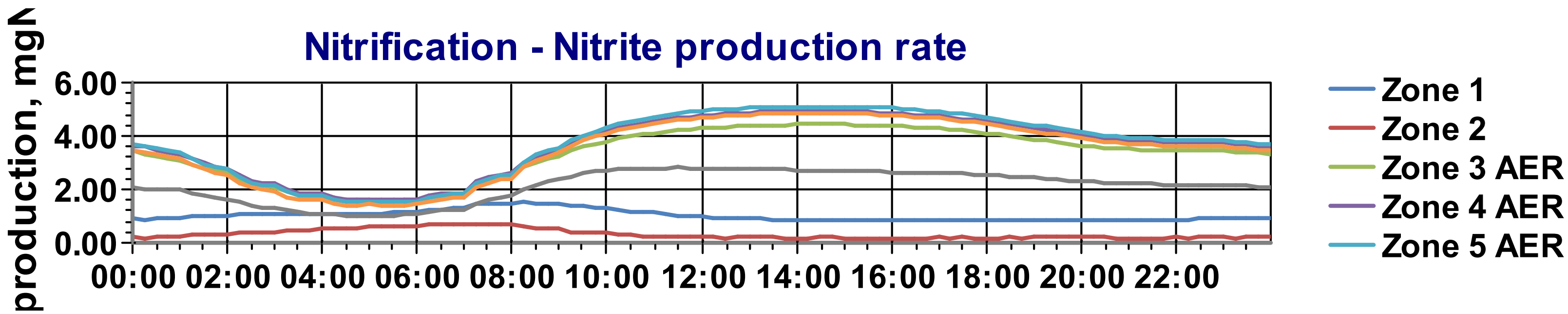

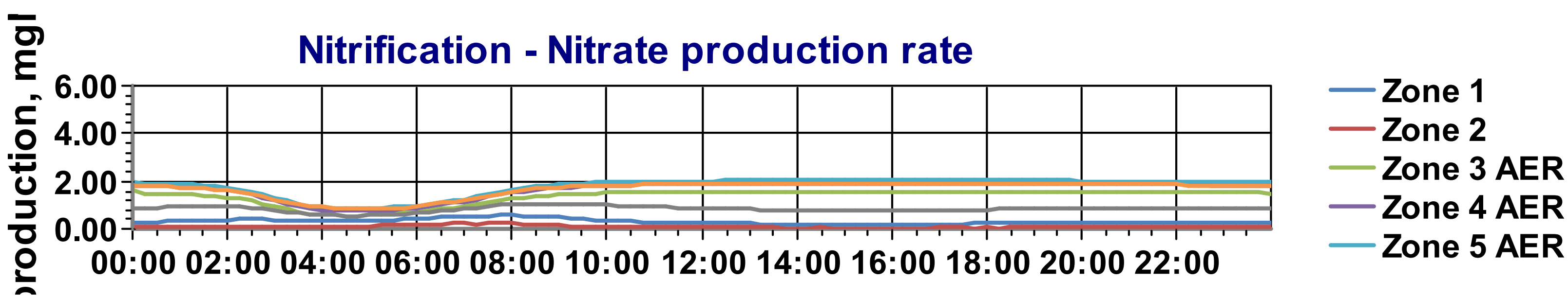

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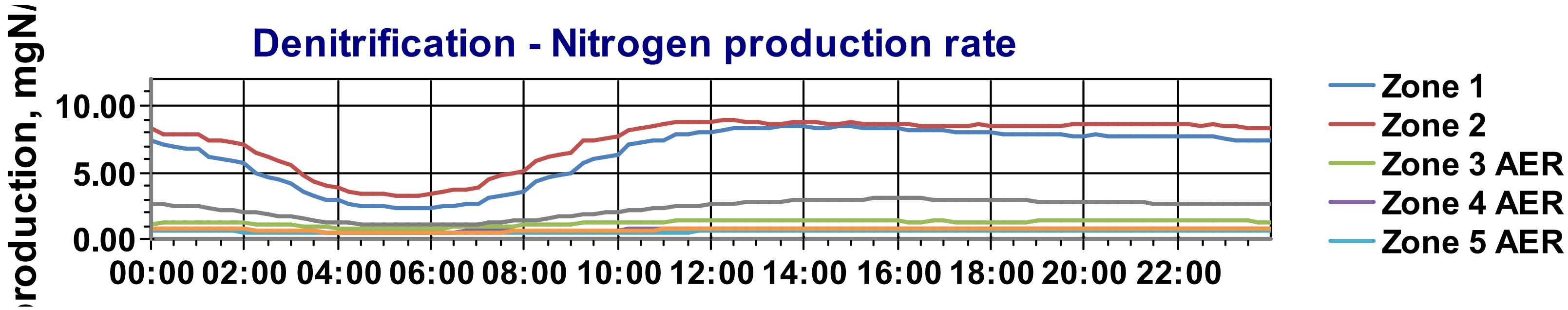

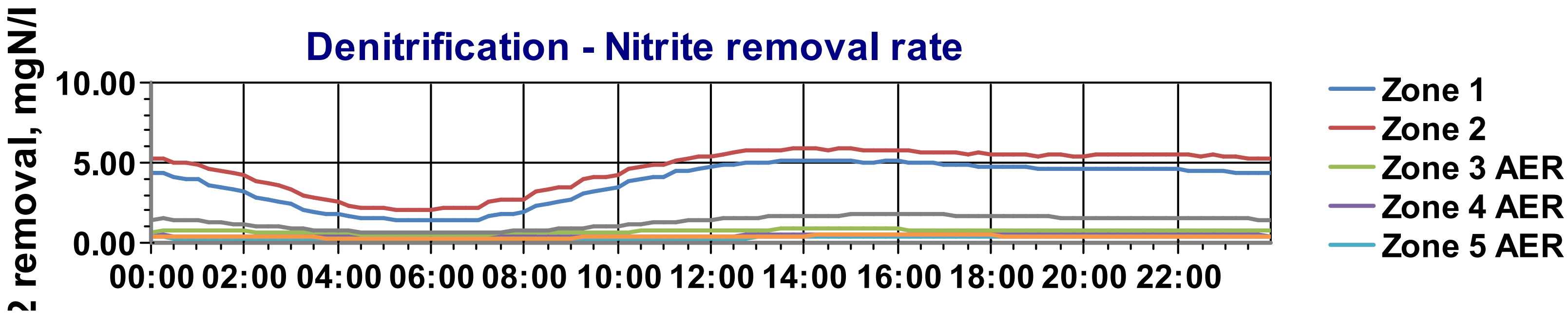

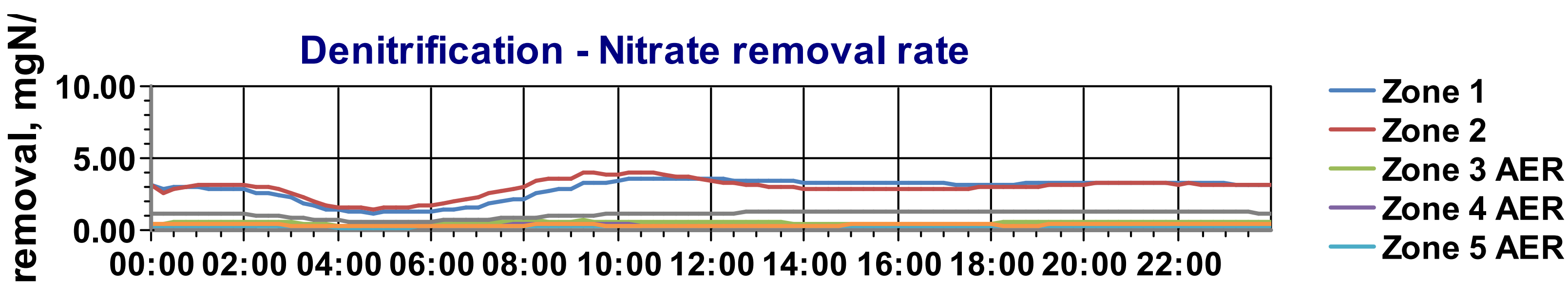

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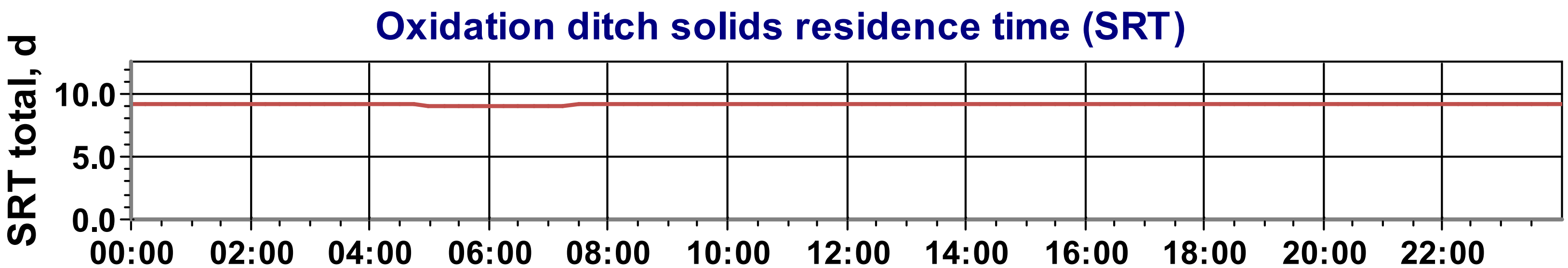

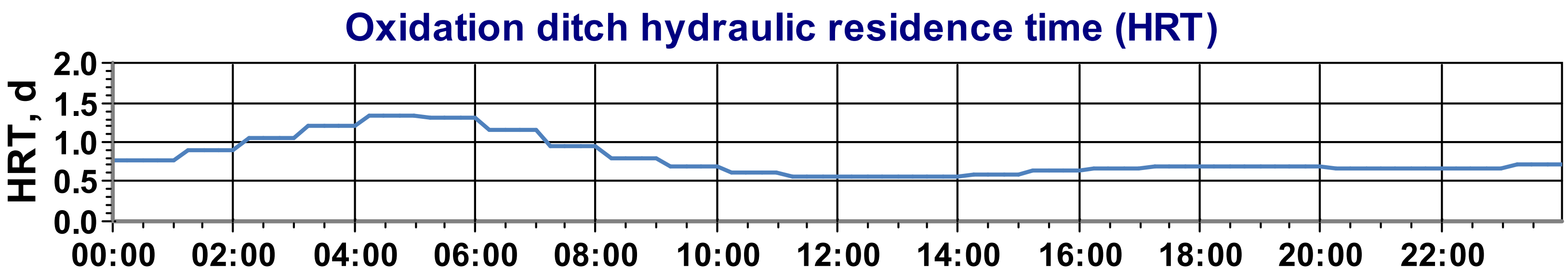

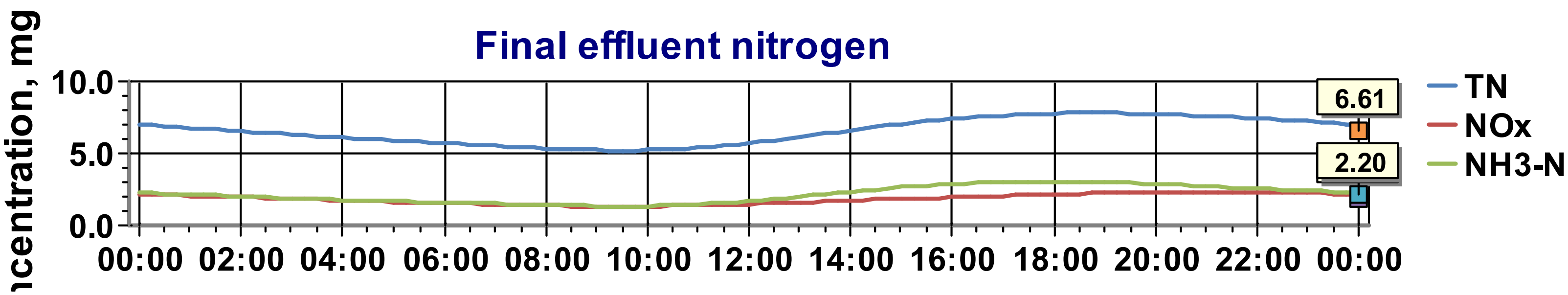

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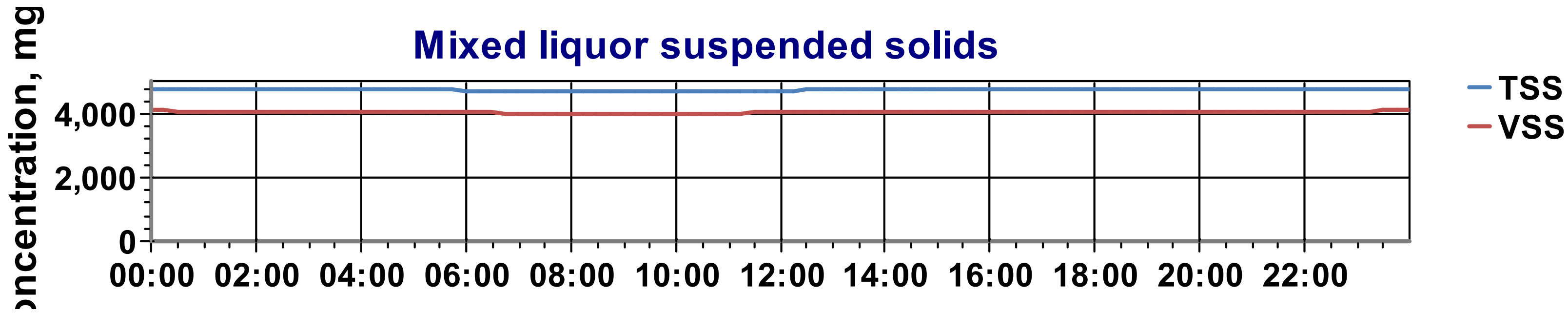

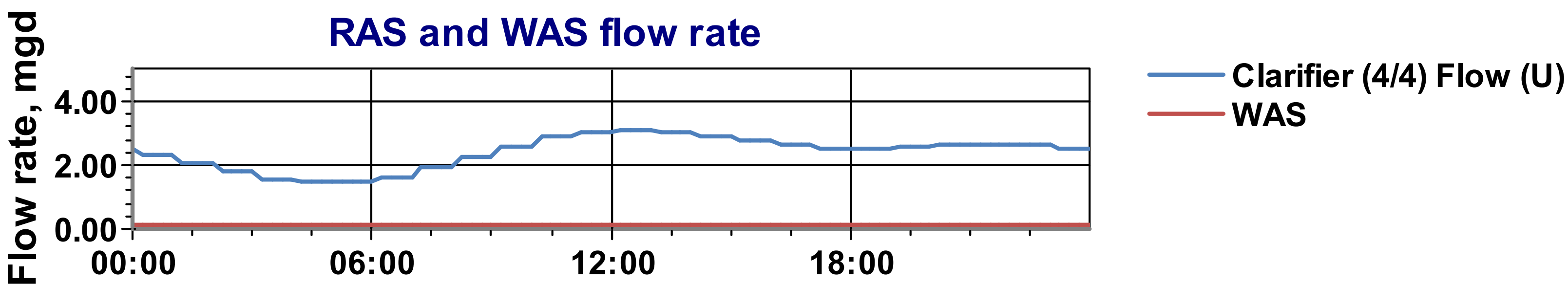

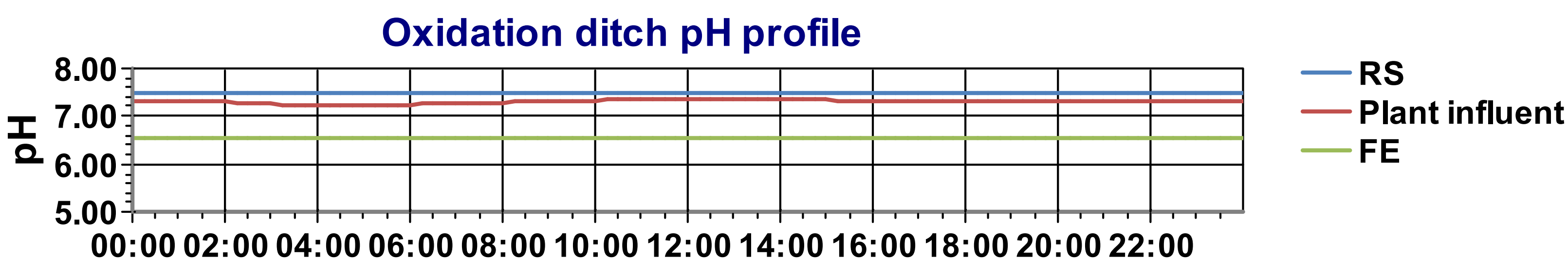

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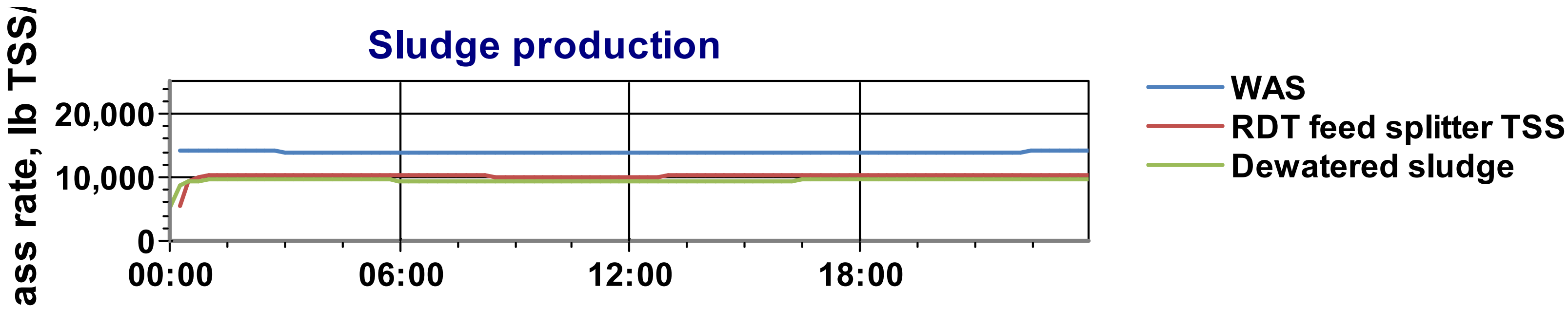

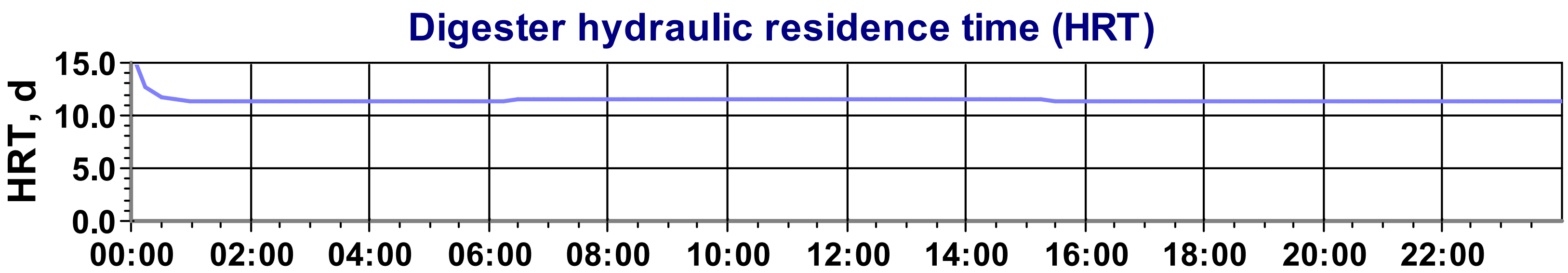

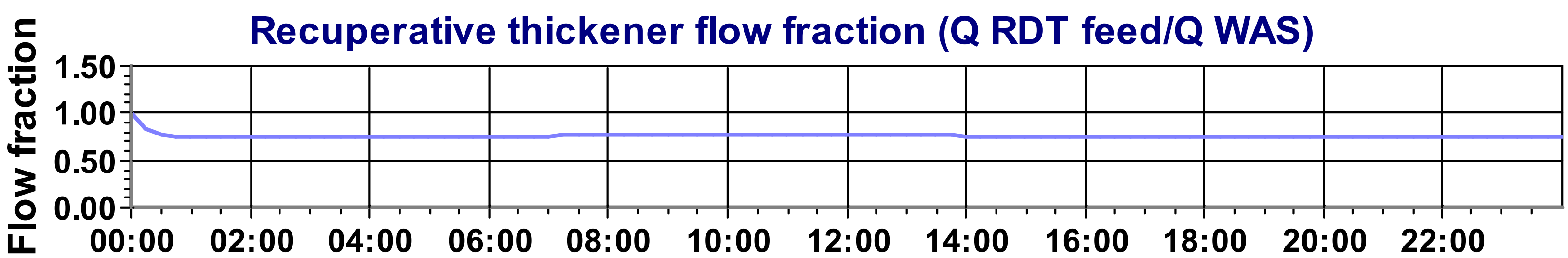

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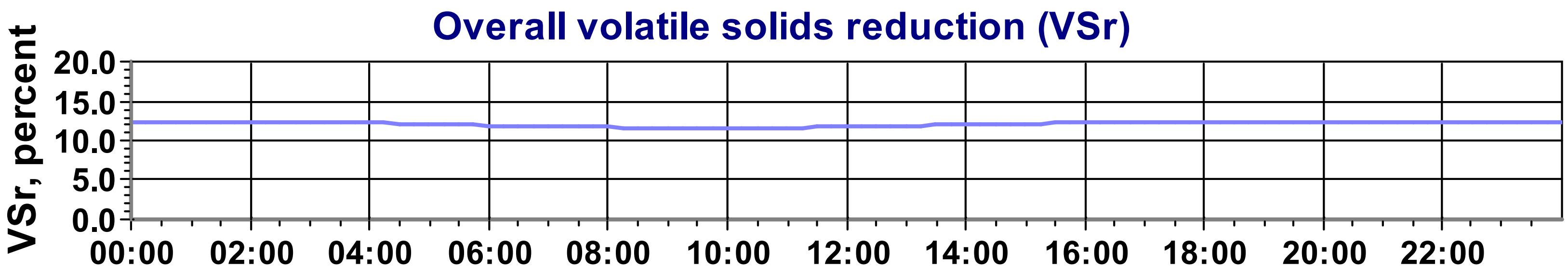

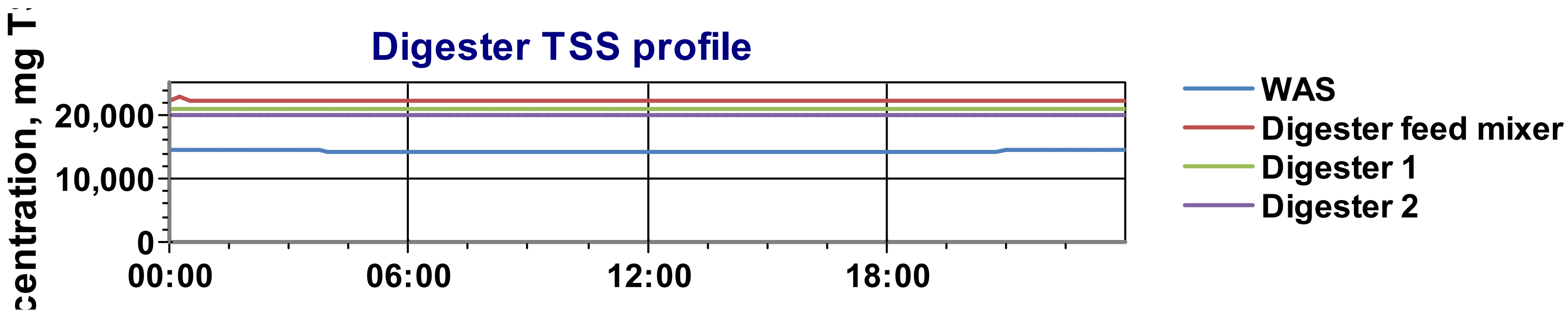

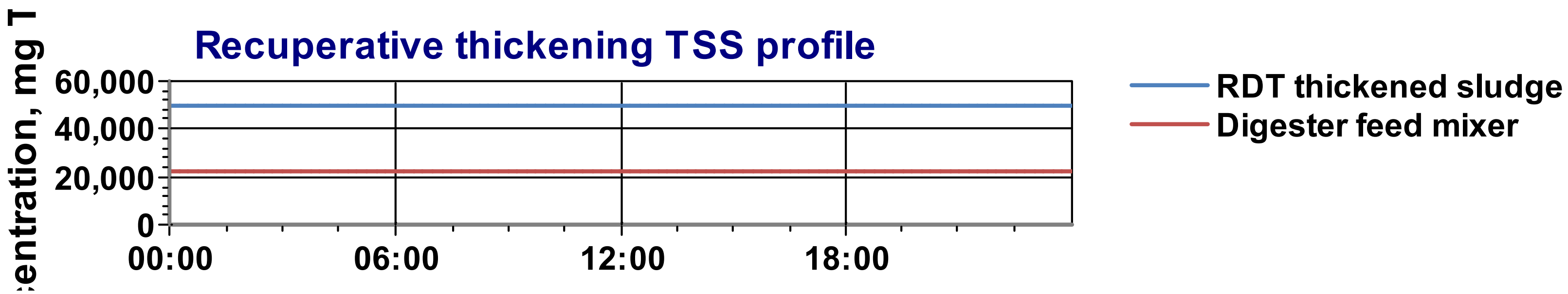

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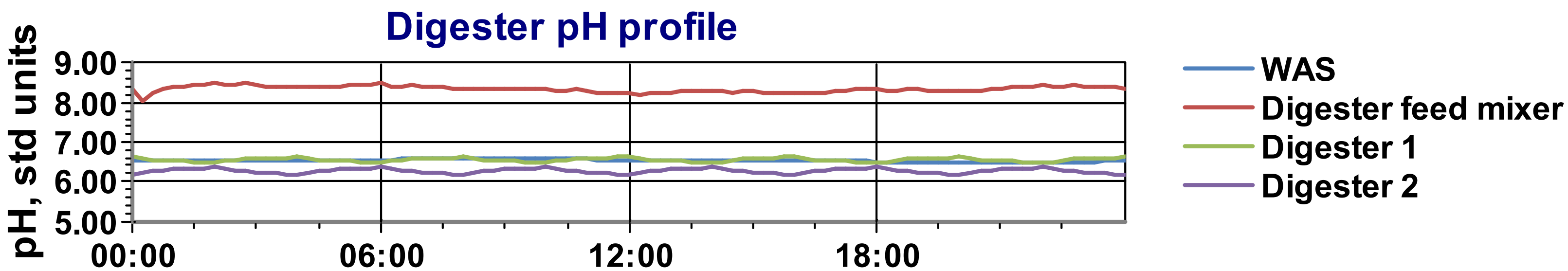

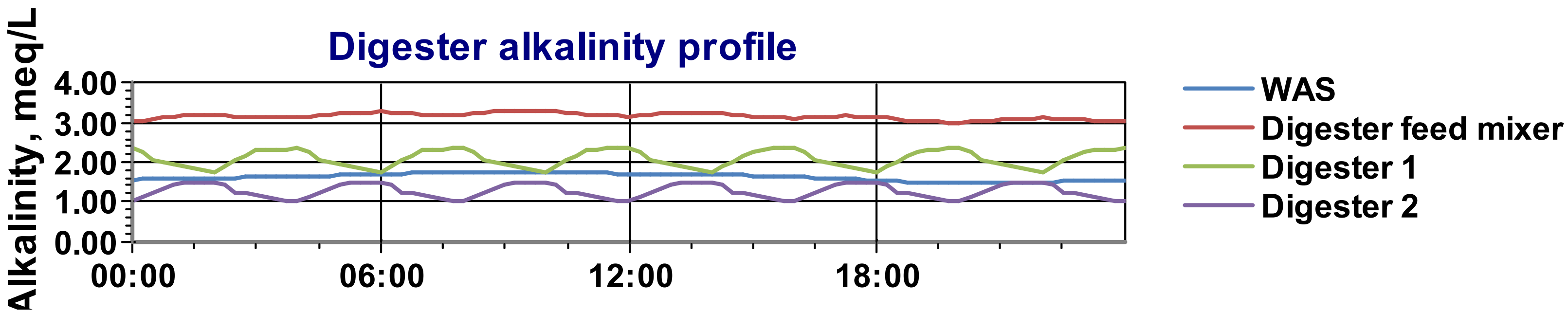

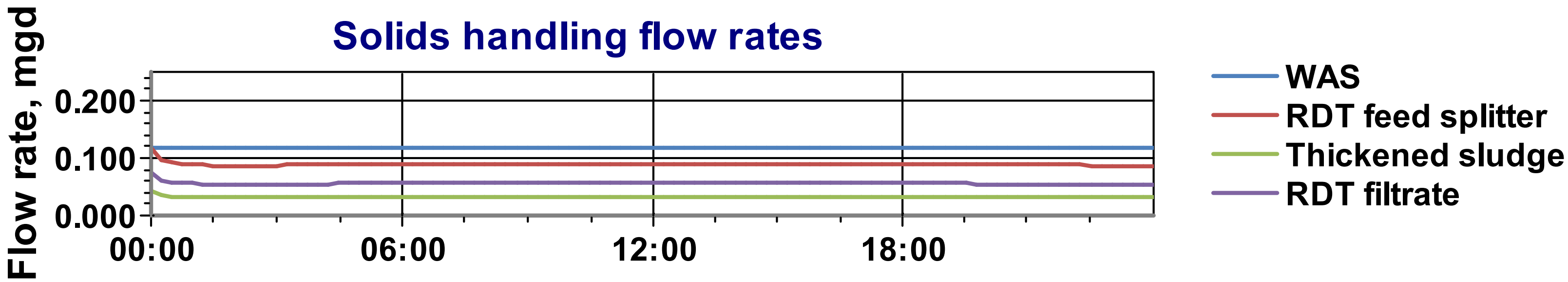

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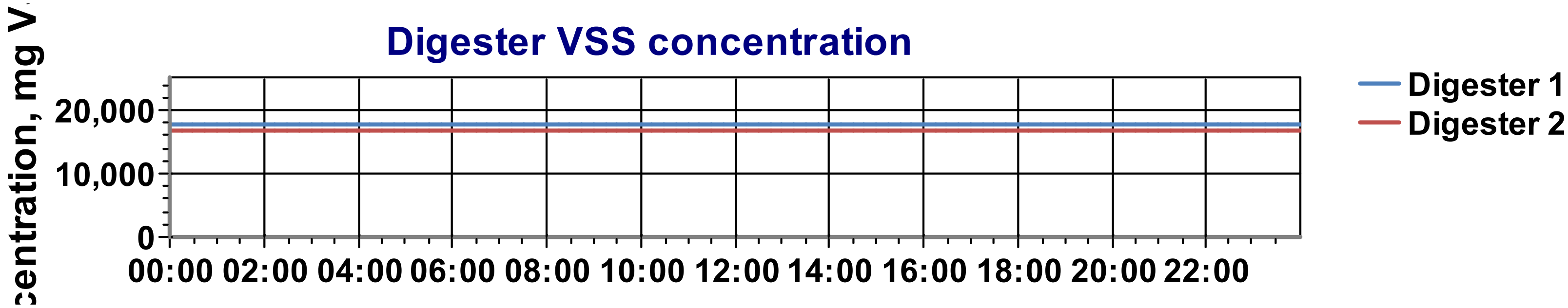
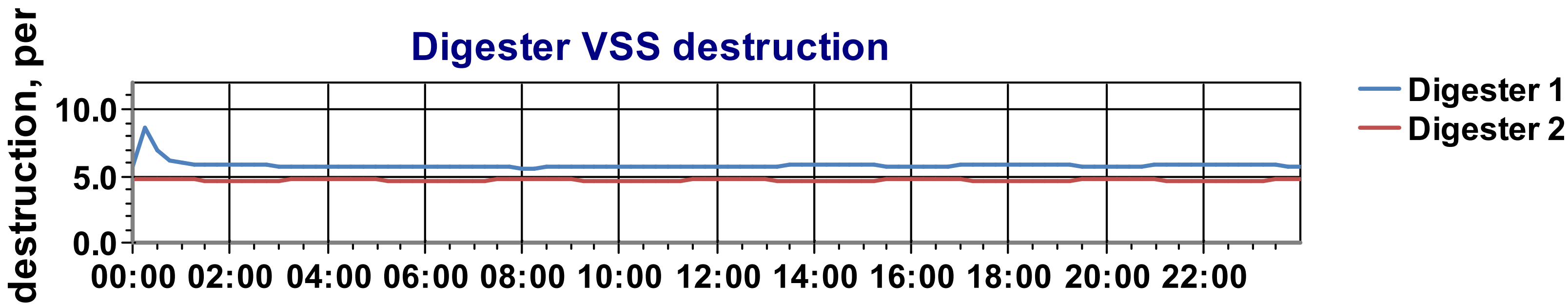
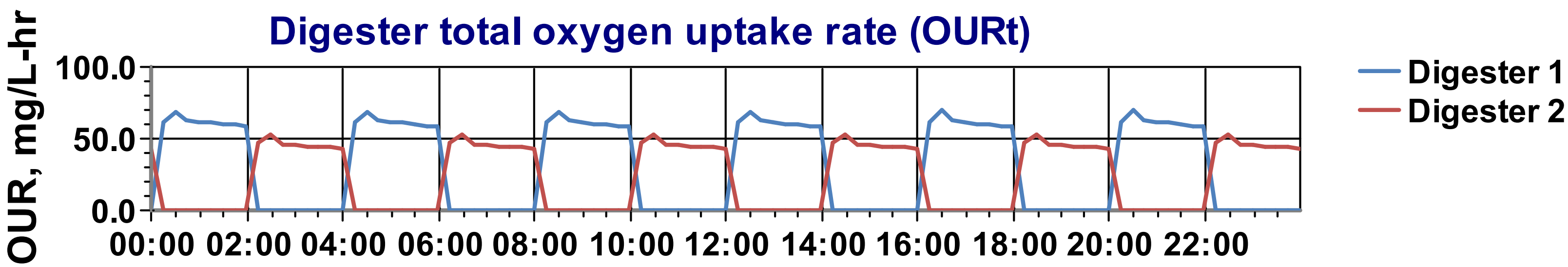
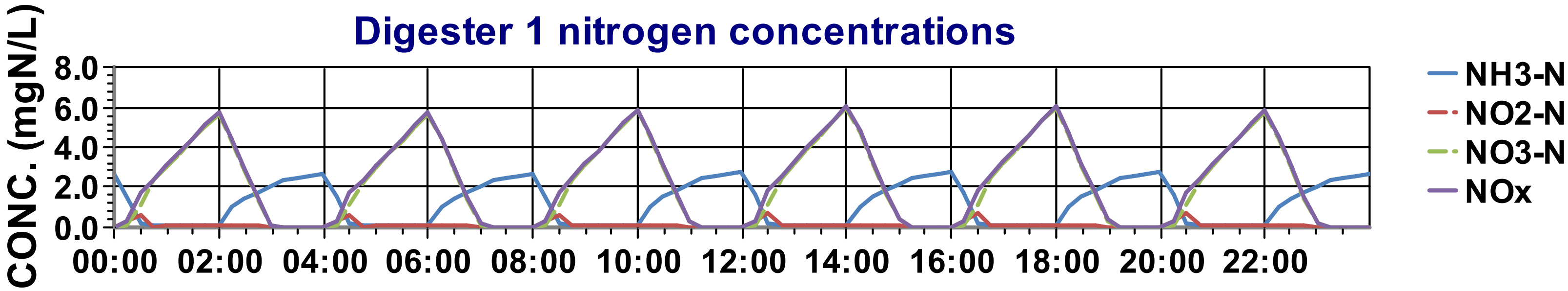
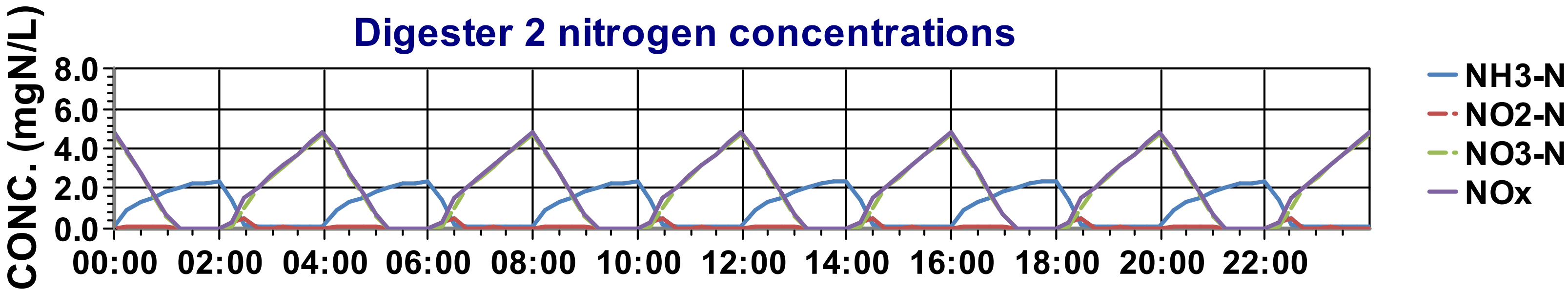


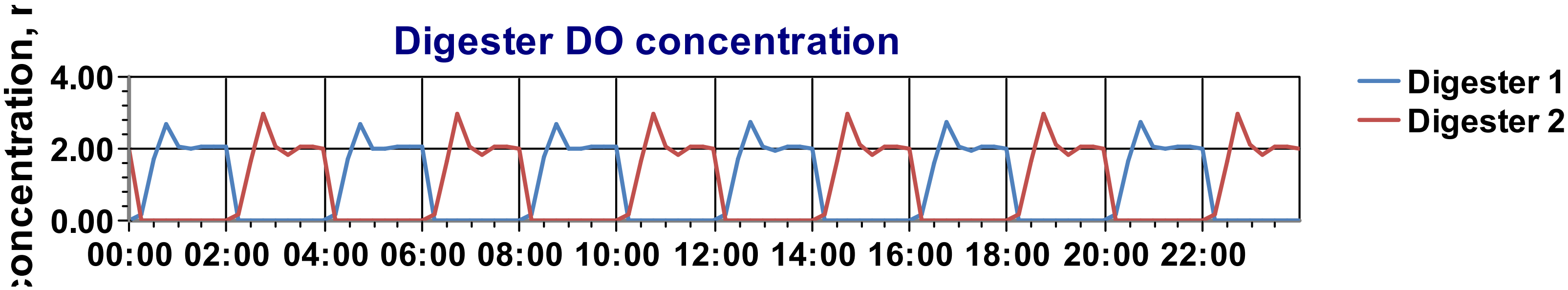




Album page - Digester 5







Global Parameters

Common

Name	Default	Value	
Hydrolysis rate [1/d]	2.1000	2.1000	1.0290
Hydrolysis half sat. [-]	0.0600	0.0600	1.0000
Anoxic hydrolysis factor [-]	0.2800	0.2800	1.0000
Anaerobic hydrolysis factor (AS) [-]	0.0400	0.0400	1.0000
Anaerobic hydrolysis factor (AD) [-]	0.5000	0.5000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.1500	0.1500	1.0290
Ammonification rate [L/(mgN d)]	0.0400	0.0400	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.5000	0.5000	1.0000
Endogenous products decay rate [1/d]	0	0	1.0000

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9000	0.9000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.7000	0.7000	1.0000
Byproduct NH4 logistic slope [-]	50.0000	50.0000	1.0000
Byproduct NH4 inflection point [mgN/L]	1.4000	1.4000	1.0000
AOB denite DO half sat. [mg/L]	0.1000	0.1000	1.0000
AOB denite HNO2 half sat. [mgN/L]	5.000E-6	5.000E-6	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiHNO2 [mmol/L]	0.0050	0.0050	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.7000	0.7000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.1000	0.1000	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiNH3 [mmol/L]	0.0750	0.0750	1.0000

OHO

Name	Default	Value	
Max. spec. growth rate [1/d]	3.2000	3.2000	1.0290
Substrate half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.6200	0.6200	1.0290
Anoxic decay rate [1/d]	0.2330	0.2330	1.0290
Anaerobic decay rate [1/d]	0.1310	0.1310	1.0290
Fermentation rate [1/d]	1.6000	1.6000	1.0290
Fermentation half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Fermentation growth factor (AS) [-]	0.2500	0.2500	1.0000
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

pH

Name	Default	Value
OHO low pH limit [-]	4.0000	4.0000
OHO high pH limit [-]	10.0000	10.0000
Autotrophs low pH limit [-]	5.5000	5.5000
Autotrophs high pH limit [-]	9.5000	9.5000
OHO low pH limit (anaerobic) [-]	5.5000	5.5000
OHO high pH limit (anaerobic) [-]	8.5000	8.5000

Switches

Name	Default	Value
Aerobic/anoxic DO half sat. [mgO2/L]	0.0500	**0.1500**
Anoxic/anaerobic NOx half sat. [mgN/L]	0.1500	0.1500
AOB DO half sat. [mgO2/L]	0.2500	0.2500
NOB DO half sat. [mgO2/L]	0.5000	0.5000
Anoxic NO3(->NO2) half sat. [mgN/L]	0.1000	0.1000
Anoxic NO3(->N2) half sat. [mgN/L]	0.0500	0.0500
Anoxic NO2(->N2) half sat. (mgN/L)	0.0100	0.0100
NH3 nutrient half sat. [mgN/L]	0.0050	0.0050
P nutrient half sat. [mgP/L]	0.0010	0.0010
Autotroph CO2 half sat. [mmol/L]	0.1000	0.1000
H2 low/high half sat. [mgCOD/L]	1.0000	1.0000
Synthesis anion/cation half sat. [meq/L]	0.0100	0.0100

Common

Name	Default	Value
Biomass volatile fraction (VSS/TSS)	0.9200	0.9200
Endogenous residue volatile fraction (VSS/TSS)	0.9200	0.9200
N in endogenous residue [mgN/mgCOD]	0.0700	0.0700
P in endogenous residue [mgP/mgCOD]	0.0220	0.0220
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.6000	**1.6500**
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	**1.6500**

AOB

Name	Default	Value
Yield [mgCOD/mgN]	0.1500	0.1500
AOB denite NO2 fraction as TEA [-]	0.5000	0.5000
Byproduct NH4 fraction to N2O [-]	0.0025	0.0025
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

NOB

Name	Default	Value
Yield [mgCOD/mgN]	0.0900	0.0900
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

OHO

Name	Default	Value
Yield (aerobic) [-]	0.6660	0.6660
Yield (fermentation, low H2) [-]	0.1000	0.1000
Yield (fermentation, high H2) [-]	0.1000	0.1000
H2 yield (fermentation low H2) [-]	0.3500	0.3500
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.7000	0.7000
CO2 yield (fermentation, low H2) [-]	0.7000	0.7000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Endogenous fraction - aerobic [-]	0.0800	0.0800
Endogenous fraction - anoxic [-]	0.1030	0.1030

Endogenous fraction - anaerobic [-]	0.1840	0.1840
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield (anoxic) [-]	0.5400	0.5400
Yield propionic (aerobic) [-]	0.6400	0.6400
Yield propionic (anoxic) [-]	0.4600	0.4600
Yield acetic (aerobic) [-]	0.6000	0.6000
Yield acetic (anoxic) [-]	0.4300	0.4300
Yield methanol (aerobic) [-]	0.5000	0.5000
Adsorp. max. [-]	1.0000	1.0000
Max fraction to N2O at high FNA over nitrate [-]	0.0500	0.0500
Max fraction to N2O at high FNA over nitrite [-]	0.1000	0.1000

General

Name	Default	Value
Molecular weight of other anions [mg/mmol]	35.5000	35.5000
Molecular weight of other cations [mg/mmol]	39.1000	39.1000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.3000	0.3000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.1500	0.1500
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.0500	0.0500
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.0100	0.0100
Bubble rise velocity (anaerobic digester) [cm/s]	23.9000	23.9000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.3500	0.3500
Anaerobic digester gas hold-up factor []	1.0000	1.0000
Tank head loss per metre of length (from flow) [m/m]	0.0025	0.0025

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.0000	17.0000	1.0240
Kl for CO2 [m/d]	10.0000	10.0000	1.0240
Kl for NH3 [m/d]	1.0000	1.0000	1.0240
Kl for CH4 [m/d]	8.0000	8.0000	1.0240
Kl for N2 [m/d]	15.0000	15.0000	1.0240
Kl for N2O [m/d]	8.0000	8.0000	1.0240
Kl for O2 [m/d]	13.0000	13.0000	1.0240

Henry's law constants

Name	Default	Value	
CO2 [M/atm]	3.4000E-2	3.4000E-2	2,400.0000
O2 [M/atm]	1.3000E-3	1.3000E-3	1,500.0000
N2 [M/atm]	6.5000E-4	6.5000E-4	1,300.0000
N2O [M/atm]	2.5000E-2	2.5000E-2	2,600.0000
NH3 [M/atm]	5.8000E+1	5.8000E+1	4,100.0000
CH4 [M/atm]	1.4000E-3	1.4000E-3	1,600.0000
H2 [M/atm]	7.8000E-4	7.8000E-4	500.0000

Physico-chemical rates

Name	Default	Value	
Struvite precipitation rate [1/d]	3.000E+10	3.000E+10	1.0240
Struvite redissolution rate [1/d]	3.000E+11	3.000E+11	1.0240
Struvite half sat. [mgTSS/L]	1.0000	1.0000	1.0000
HDP precipitation rate [L/(molP d)]	1.000E+8	1.000E+8	1.0000
HDP redissolution rate [L/(mol P d)]	1.000E+8	1.000E+8	1.0000
HAP precipitation rate [molHDP/(L d)]	5.000E-4	5.000E-4	1.0000

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.918E-14	6.918E-14
HDP solubility product [mol/L]	2.750E-22	2.750E-22
HDP half sat. [mgTSS/L]	1.0000	1.0000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.0100	0.0100
Al to P ratio [molAl/molP]	0.8000	0.8000
Al(OH)3 solubility product [mol/L]	1.259E+9	1.259E+9
AlHPO4+ dissociation constant [mol/L]	7.943E-13	7.943E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.0100	0.0100
Fe to P ratio [molFe/molP]	1.6000	1.6000
Fe(OH)3 solubility product [mol/L]	0.0500	0.0500
FeH2PO4++ dissociation constant [mol/L]	5.012E-22	5.012E-22

Aeration

Name	Default	Value
Alpha (surf) OR Alpha F (diff) [-]	0.5000	0.5000
Beta [-]	0.9500	0.9500
Surface pressure [kPa]	101.3250	86.0370
Fractional effective saturation depth (Fed) [-]	0.3250	0.3250
Supply gas CO2 content [vol. %]	0.0350	0.0350
Supply gas O2 [vol. %]	20.9500	20.9500
Off-gas CO2 [vol. %]	2.0000	2.0000
Off-gas O2 [vol. %]	18.8000	18.8000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Surface turbulence factor [-]	2.0000	2.0000
Set point controller gain []	1.0000	1.0000

Notes

Simultaneous nitrification/denitrification (SND) DO switch* = 0.15 mg/L (default = 0.05 mg/L)
**Aerobic/anoxic DO half-saturation coefficient*

BioWin user and configuration data

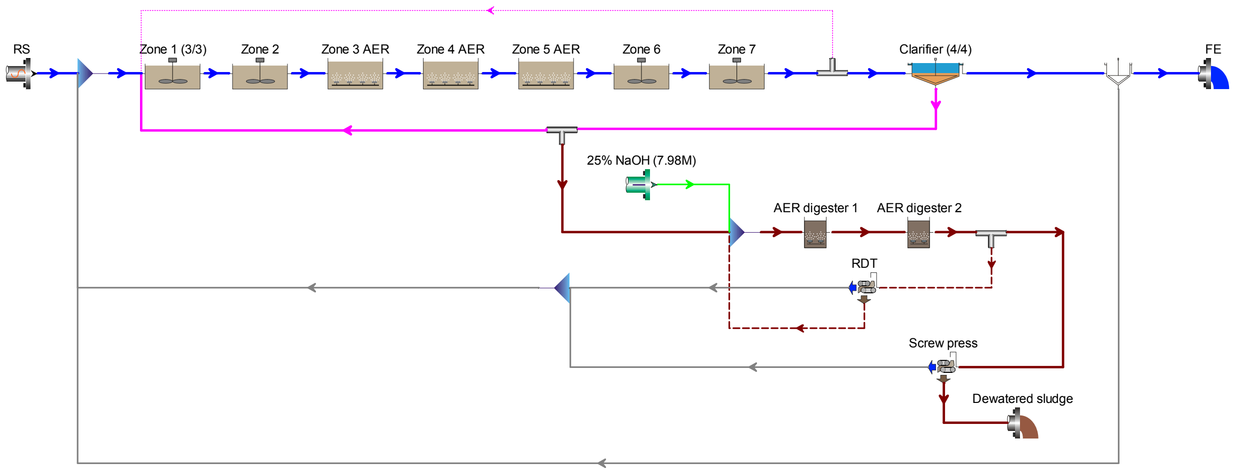
Project details

Project name: STMWRF master plan update
Project ref.: 9873A.00
Plant name: South Truckee Meadows Water Reclamation Facility
User name: Ron Appleton

Created: 7/5/2015
Saved: 12/21/2015

SRT: **** days
Temperature: 14.0°C

Flowsheet



Configuration information for all COD Influent units

Operating data Average (flow/time weighted as required)

Element name	RS
Time	1.0000
Flow	6.25541249714
TCOD mgCOD/L	966.4215
TKN mgN/L	73.5425
TP mgP/L	8.2979
NO3-N mgN/L	0
pH	7.4700
Alk mmol/L	5.0800
ISSinf mgISS/L	34.5000
SCa mg/L	80.0000
SMg mg/L	15.0000
DO mg/L	0

Element name	RS
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.8000
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.2000
Fna - Ammonia [gNH3-N/gTKN]	0.7020

Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.5000
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0110
FZbh - OHO COD fraction [gCOD/g of total COD]	0.0200
FZbm - Methylotroph COD fraction [gCOD/g of total COD]	1.000E-4
FZaob - AOB COD fraction [gCOD/g of total COD]	1.000E-4
FZnob - NOB COD fraction [gCOD/g of total COD]	1.000E-4
FZaao - AAO COD fraction [gCOD/g of total COD]	1.000E-4
FZbp - PAO COD fraction [gCOD/g of total COD]	1.000E-4
FZbpa - Propionic acetogens COD fraction [gCOD/g of total COD]	1.000E-4
FZbam - Acetoclastic methanogens COD fraction [gCOD/g of total COD]	1.000E-4
FZbhm - H2-utilizing methanogens COD fraction [gCOD/g of total COD]	1.000E-4
FZe - Endogenous products COD fraction [gCOD/g of total COD]	0

Configuration information for all Stream (SV) Influent units

Operating data Average (flow/time weighted as required)

Element name	25% NaOH (7.98M)
Zbh mgCOD/L	0
Zbmeth mgCOD/L	0
Zaob mgCOD/L	0
Znob mgCOD/L	0
Zaao mgCOD/L	0
Zbp mgCOD/L	0
Zbpa mgCOD/L	0
Zbam mgCOD/L	0
Zbhm mgCOD/L	0
Ze mgCOD/L	0
Xsp mgCOD/L	0
Xsc mgCOD/L	0
Xi mgCOD/L	0
Xon mgN/L	0
Xop mgP/L	0
Xin mgN/L	0
Xip mgP/L	0
Spha mgCOD/L	0
PP-lo mgP/L	0
PP-hi mgP/L	0
Sbsc mgCOD/L	0
Sbsa mgCOD/L	0
Sbsp mgCOD/L	0
Sbmeth mgCOD/L	0
SbH2 mgCOD/L	0
CH4 mg/L	0
NH3-N mgN/L	0
Nos mgN/L	0
N2O-N mgN/L	0
NO2-N mgN/L	0
NO3-N mgN/L	0
N2 mgN/L	0
PO4-P (incl. MeP) mgP/L	0
Sus mgCOD/L	0
Nus mgN/L	0
ISSinf mgISS/L	0
XStru mgISS/L	0
XHDP mgISS/L	0
XHAP mgISS/L	0
SMg mg/L	0
SCa mg/L	0
Me mg/L	0
SCat meq/L	7,980.0000
SAn meq/L	0
SCO2 mmol/L	0

UD1 mg/L	0
UD2 mg/L	0
UD3 mgVSS/L	0
UD4 mgISS/L	0
DO mg/L	0
Flow	3E-5

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
RAS/WAS Splitter	Flowrate [Side]	0.1771
ML Return Splitter	Flowrate [Side]	536
RDT feed splitter	Fraction	0.00

Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Zone 1 (3/3)	0.4831	4,613.0000	14.000	Un-aerated
Zone 2	0.4590	4,383.0000	14.000	Un-aerated
Zone 3 AER	0.6441	6,150.0000	14.000	184
Zone 4 AER	0.6441	6,150.0000	14.000	184
Zone 5 AER	0.6441	6,150.0000	14.000	184
Zone 6	0.4590	4,383.0000	14.000	Un-aerated
Zone 7	1.4492	1.384E+4	14.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Zone 1 (3/3)	0
Zone 2	0
Zone 3 AER	1.0
Zone 4 AER	1.5
Zone 5 AER	2.0
Zone 6	0
Zone 7	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
Zone 1 (3/3)	2.5656	0.0432	0.8200	0.4413	10.0000
Zone 2	2.5656	0.0432	0.8200	0.4413	10.0000
Zone 3 AER	2.5656	0.0432	0.8200	6.6000	19.7000
Zone 4 AER	2.5656	0.0432	0.8200	6.6000	19.7000
Zone 5 AER	2.5656	0.0432	0.8200	6.6000	19.7000
Zone 6	2.5656	0.0432	0.8200	0.4413	10.0000
Zone 7	2.5656	0.0432	0.8200	0.4413	10.0000

Configuration information for all Ideal clarifier units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Clarifier (4/4)	2.0308	2.011E+4	13.500

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Clarifier (4/4)	Ratio	0.50

Element name	Average Temperature	Reactive	Percent removal	Blanket fraction
Clarifier (4/4)	Uses global setting	No	99.9200	0.0500

Configuration information for all Point clarifier units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Filters	Flowrate [Under]	0.5

Element name	Percent removal
Filters	80.0000

Configuration information for all Aerobic Digester units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
AER digester 1	0.3502	2,401.0000	19.500	544
AER digester 2	0.3502	2,401.0000	19.500	544

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
AER digester 1	1.0
AER digester 2	1.0

Local biological parameters

Element name	Aerobic/anoxic DO half sat. [mgO2/L]
AER digester 1	0.0500
AER digester 2	0.0500

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
AER digester 1	2.5656	0.0432	0.8200	0.4413	10.0000
AER digester 2	2.5656	0.0432	0.8200	0.4413	10.0000

Configuration information for all Dewatering unit units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
RDT	Fraction	0.37
Screw press	Fraction	0.11

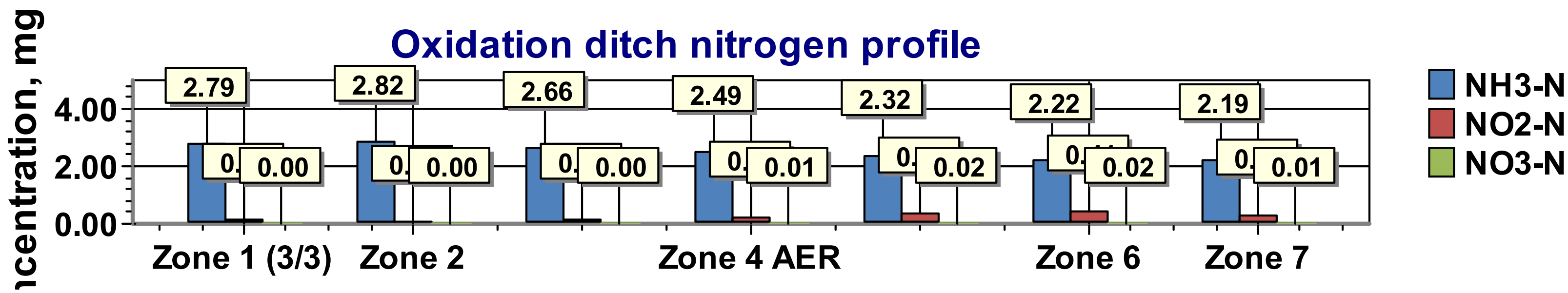
Element name	Percent removal
RDT	92.5000
Screw press	92.5000

BioWin Album

Album page - Tables 1

Elements	Flow [mgd]	TSS [mgTSS/L]	VSS [mgVSS/L]	TCOD [mg/L]	SCOD [mg/L]	TCBOD [mg/L]	SCBOD [mg/L]	TKN [mgN/L]	STKN [mgN/L]	NH3-N [mgN/L]	NO2-N [mgN/L]	NO3-N [mgN/L]	TP [mgP/L]	SPO4 [mgP/L]	pH []	Alk [mmol/L]	Temp. [deg. C]
RS	6.2554	433.7675	398.0069	966.4215	312.9659	431.4441	187.6000	73.5425	59.2341	51.6268	0	0	8.2979	4.1490	7.4700	5.0800	14.0000
Plant influent	6.9139	432.7676	393.9818	931.2039	288.0079	398.1909	169.8434	69.7203	54.0962	46.9837	0.0856	0.0783	9.7804	5.1589	7.3475	4.7399	14.0000
Clarifier (4/4)	7.0793	5.5328	4.7246	58.1393	50.9497	2.9984	1.3461	6.4807	6.0970	3.7313	0.4543	0.0056	2.1599	2.0382	6.5746	1.7955	14.0000
FE	6.5793	1.1907	1.0167	52.4969	50.9497	1.7016	1.3461	6.1795	6.0970	3.7313	0.4543	0.0056	2.0644	2.0382	6.5746	1.7955	14.0000
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RAS/WAS Splitter (U)	0.1771	13,866.5170	11,844.5817	18,076.3895	51.3038	4,158.9879	1.3380	966.1915	4.7338	2.3982	0.3208	0.0052	306.7365	1.8687	6.5595	1.7378	14.0000
Digester feed mixer	0.1771	13,864.1696	11,842.5766	18,073.3295	51.2951	4,158.2836	1.3377	966.0280	4.7330	2.3978	0.3207	0.0052	306.6846	1.8684	8.9967	3.0891	14.0000
AER digester 1	0.1771	17,196.2379	14,510.6417	22,256.0834	56.1422	3,769.6951	3.1823	1,164.2979	4.1751	2.6416	0.0000	0.0000	404.5918	31.7899	6.6308	2.1150	14.0000
AER digester 2	0.1771	18,620.6652	15,618.3114	24,034.9869	50.7661	3,317.3093	0.5518	1,233.0455	2.7275	0.1667	2.2999	3.3993	454.5708	54.8744	6.0826	0.7300	14.0000
RDT feed splitter	0.1771	18,620.6652	15,618.3114	24,034.9869	50.7661	3,317.3093	0.5518	1,233.0455	2.7275	0.1667	2.2999	3.3993	454.5708	54.8744	6.0826	0.7300	14.0000
Dewatered sludge	0.0187	163,416.6539	137,067.7238	210,538.4726	50.7661	29,108.7178	0.5518	10,800.1099	2.7275	0.1667	2.2999	3.3993	3,562.6461	54.8744	6.0826	0.7300	14.0000
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Filters (U)	0.5000	62.6689	53.5152	132.3842	50.9497	20.0613	1.3461	10.4432	6.0970	3.7313	0.4543	0.0056	3.4163	2.0382	6.5290	1.7955	14.0000
RDT	0.0000	2,216.7459	1,859.3228	2,906.0305	50.7661	395.4039	0.5518	149.1940	2.7275	0.1667	2.2999	3.3993	102.4573	54.8744	6.0435	0.7305	14.0000
Screw press	0.1585	1,561.0886	1,309.3822	2,061.5157	50.7661	278.6167	0.5518	105.8729	2.7275	0.1667	2.2999	3.3993	88.3835	54.8744	6.0435	0.7305	14.0000

Elements	TSS [lb TSS/d]	VSS [lb VSS/d]	TKN [lb N/d]	TP [lb P/d]
RS	22,644.3757	20,777.5322	3,839.2098	433.1847
	-	-	-	-
RAS/WAS Splitter (U)	20,494.3115	17,505.9496	1,428.0032	453.3477
Digester feed mixer	20,494.3141	17,505.9517	1,428.0033	453.3477
AER digester 1	25,419.8491	21,449.9430	1,721.0902	598.0763
AER digester 2	27,525.4682	23,087.3243	1,822.7144	671.9563
RDT feed splitter	27,525.4655	23,087.3220	1,822.7142	671.9562
Dewatered sludge	25,461.0556	21,355.7728	1,682.7061	555.0764
	-	-	-	-
Filters (U)	261.4985	223.3030	43.5764	14.2550
RDT	0.0002	0.0002	0.0000	0.0000
Screw press	2,064.4099	1,731.5491	140.0081	116.8798



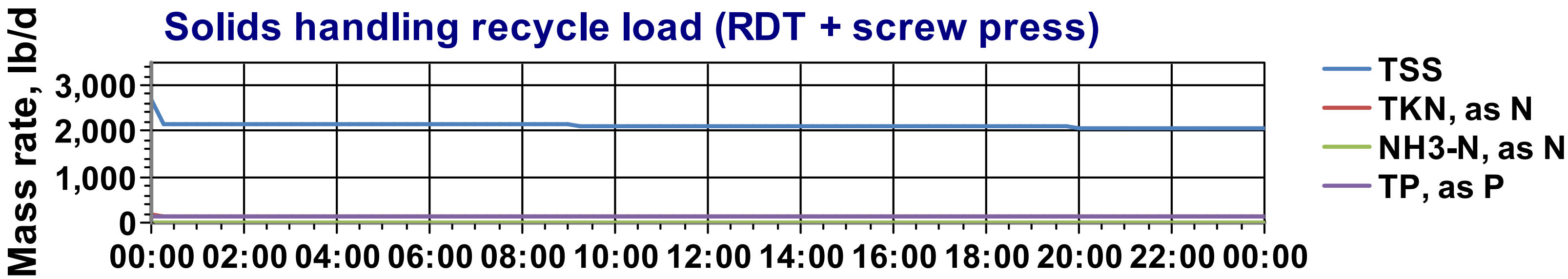
Album page - Tables 2

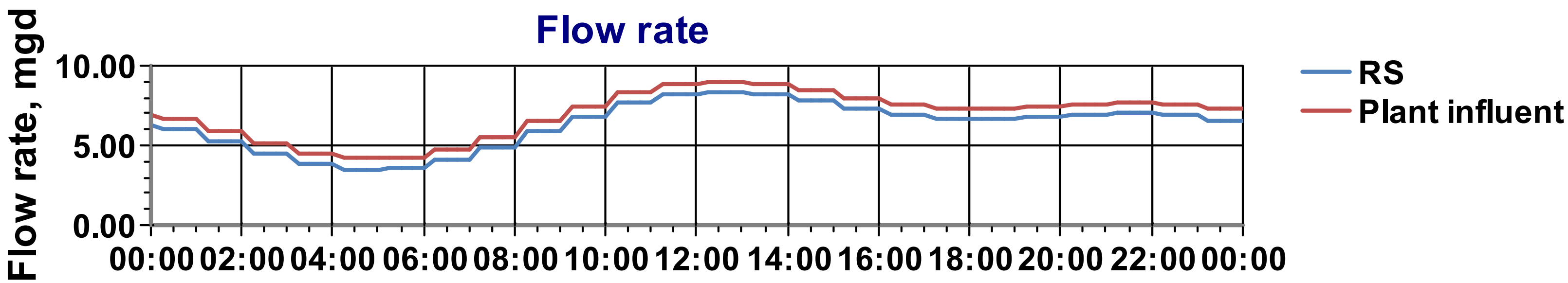
Elements	# of diffusers []	Air flow rate [ft3/min (20C, 1 atm)]	Air flow rate / diffuser [ft3/min (20C, 1 atm)]	OTR [lb/hr]	SOTR [lb/hr]	SOTE [%]	DO [mg/L]
Zone 3 AER	184.0000	4,317.4934	23.4646	447.5888	1,412.7471	32.0679	1.0000
Zone 4 AER	184.0000	3,445.7456	18.7269	347.8602	1,174.2124	33.3965	1.5000
Zone 5 AER	184.0000	3,732.3352	20.2844	345.6215	1,253.7143	32.9197	2.0000

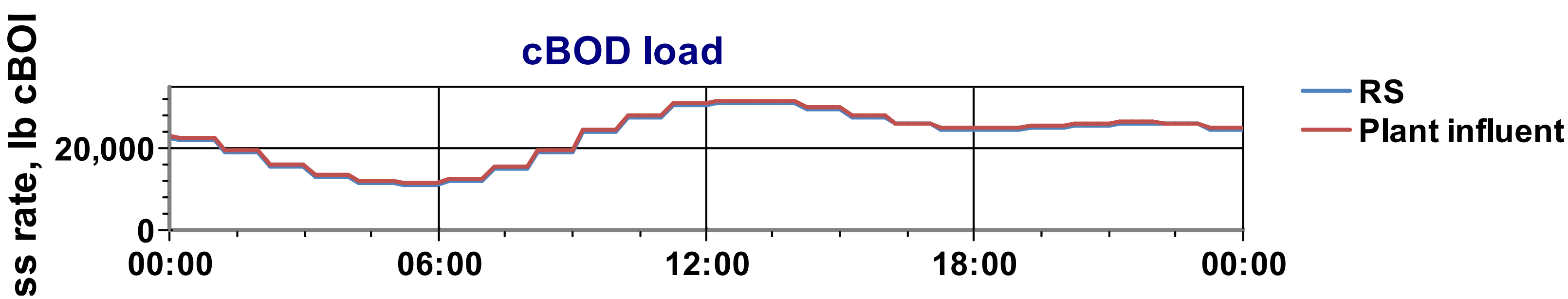
Elements	OUR - Carbonaceous [mgO/L/hr]	OUR - Nitrification [mgO/L/hr]	OUR - Total [mgO/L/hr]
Zone 1 (3/3)	2.7223	0.5815	3.3039
Zone 2	0.5552	0.1252	0.6805
Zone 3 AER	33.9732	13.9999	47.9732
Zone 4 AER	32.1774	14.8591	47.0365
Zone 5 AER	31.4109	15.2091	46.6200
Zone 6	29.2251	13.8191	43.0442
Zone 7	11.9232	4.4364	16.3596

Elements	Zbh [mgCOD/L]	Zbmeth [mgCOD/L]	Zbp [mgCOD/L]	Zaob [mgCOD/L]	Znob [mgCOD/L]	Zaao [mgCOD/L]	Zbpa [mgCOD/L]	Zbam [mgCOD/L]	Zbhm [mgCOD/L]	Ze [mgCOD/L]	Xsp [mgCOD/L]	Xi [mgCOD/L]
Zone 5 AER	2,247.0116	0.9761	2.9594	43.2531	2.5201	1.1631	0.2719	0.2381	0.0668	829.6078	196.2955	2,691.9987
Zone 2	2,245.5981	0.9762	2.9586	43.2190	2.5191	1.1631	0.2724	0.2386	0.0674	829.2761	199.8046	2,692.0311

Album page - RS load 1







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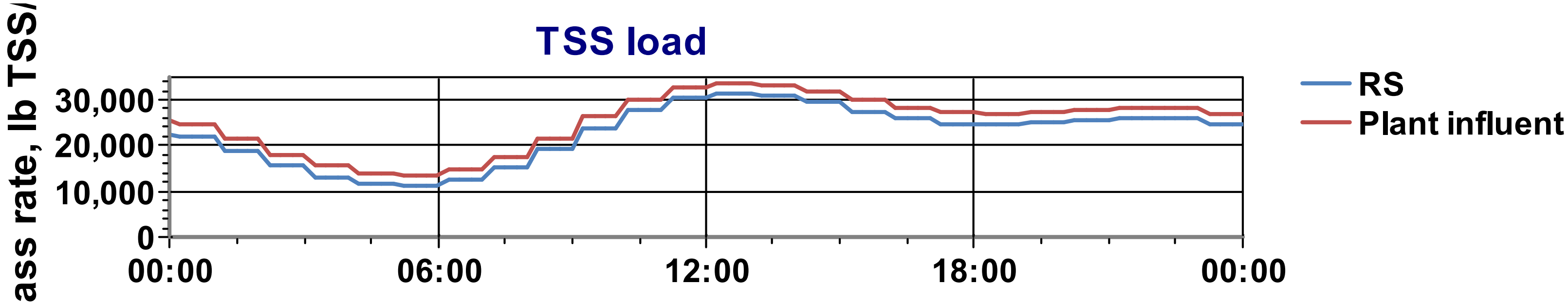

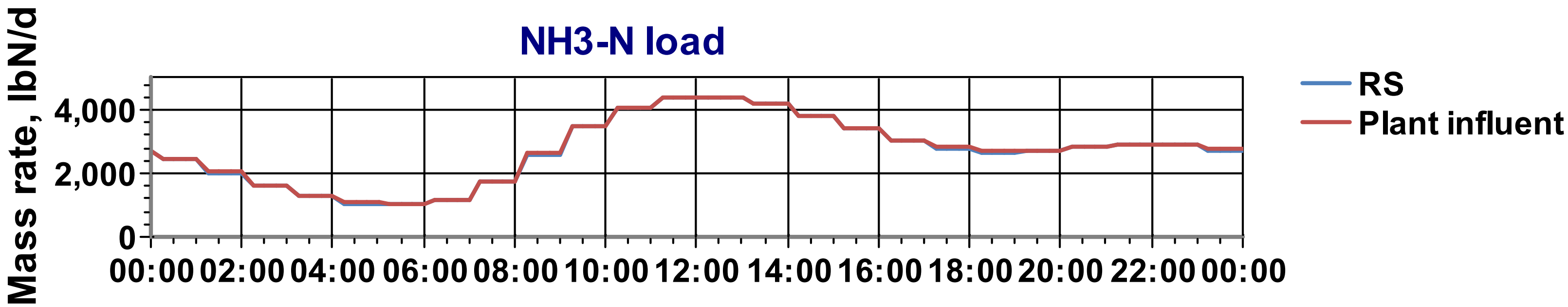

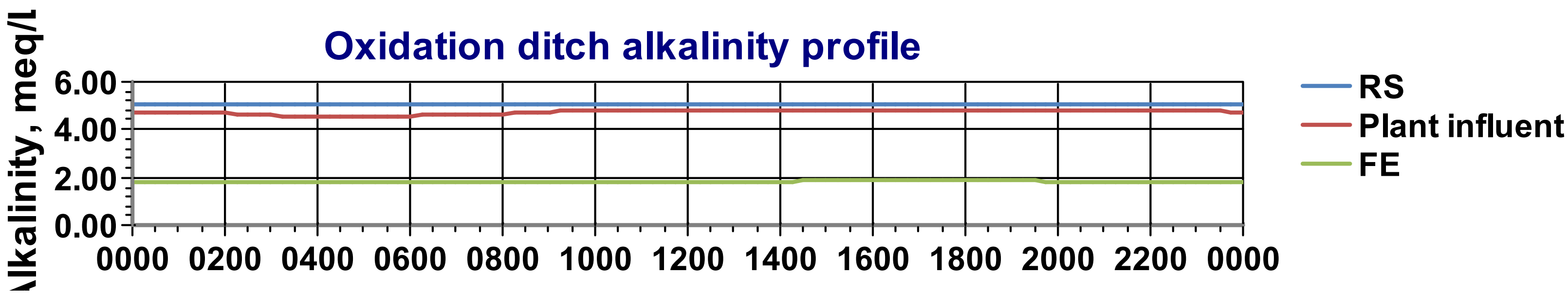

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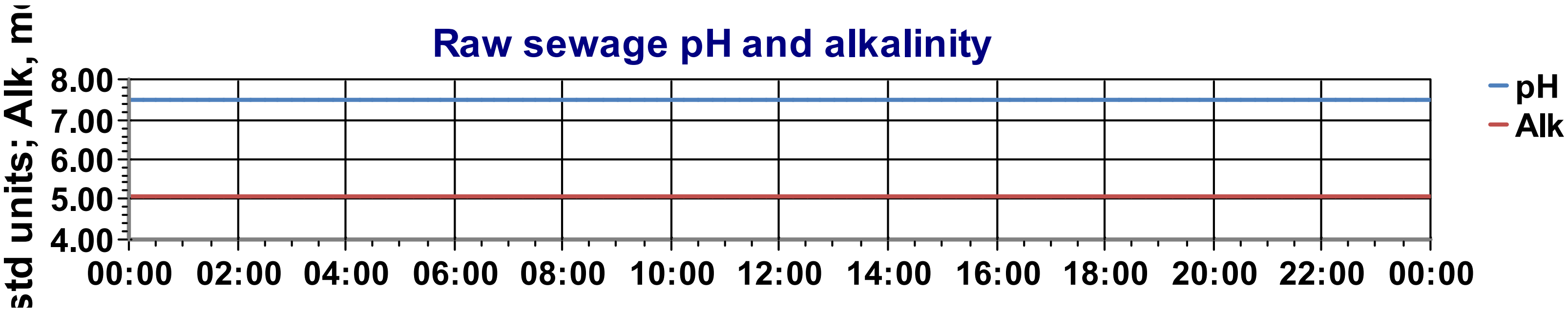

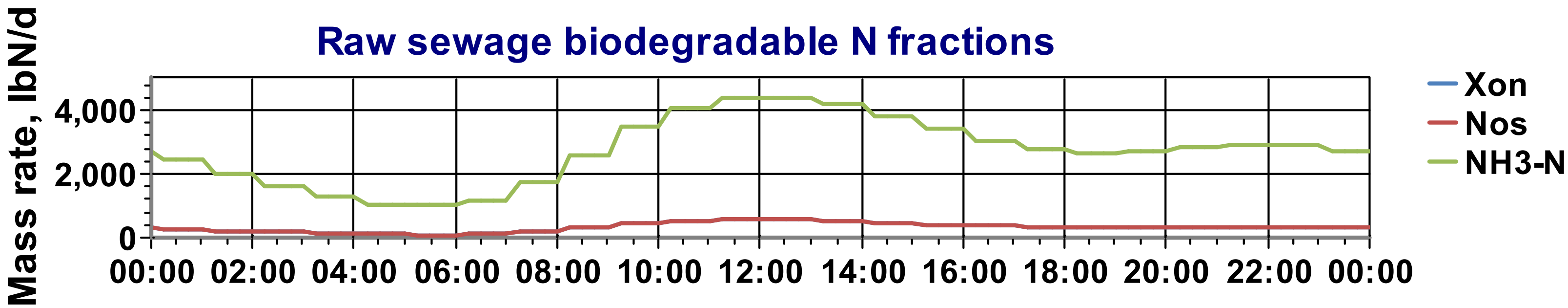

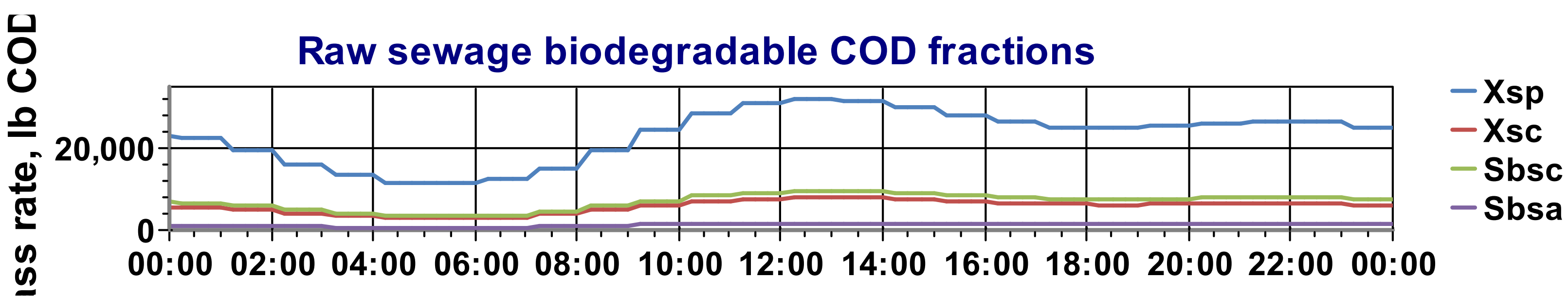

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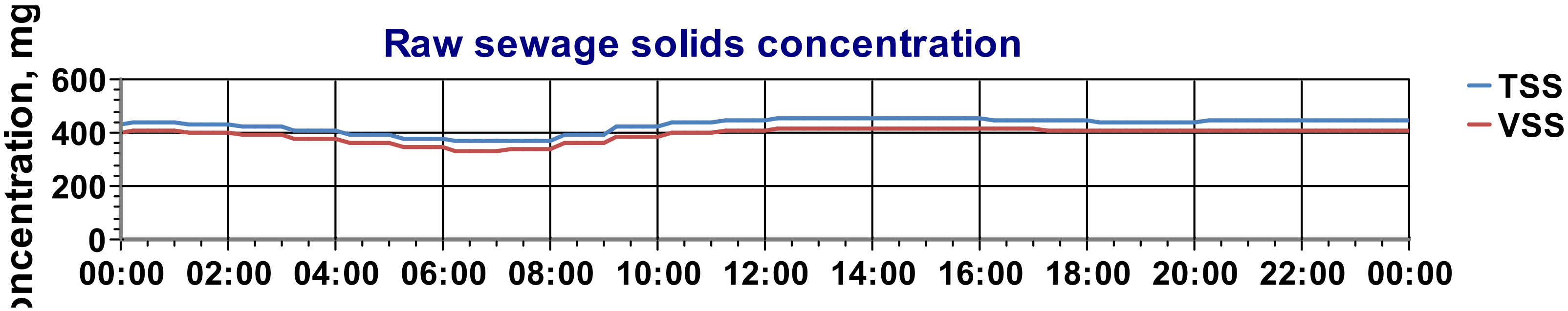

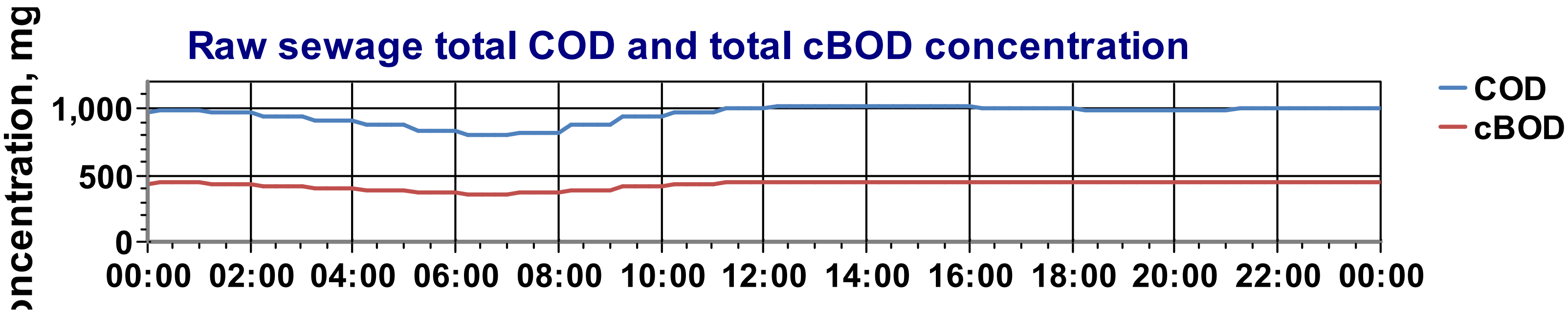

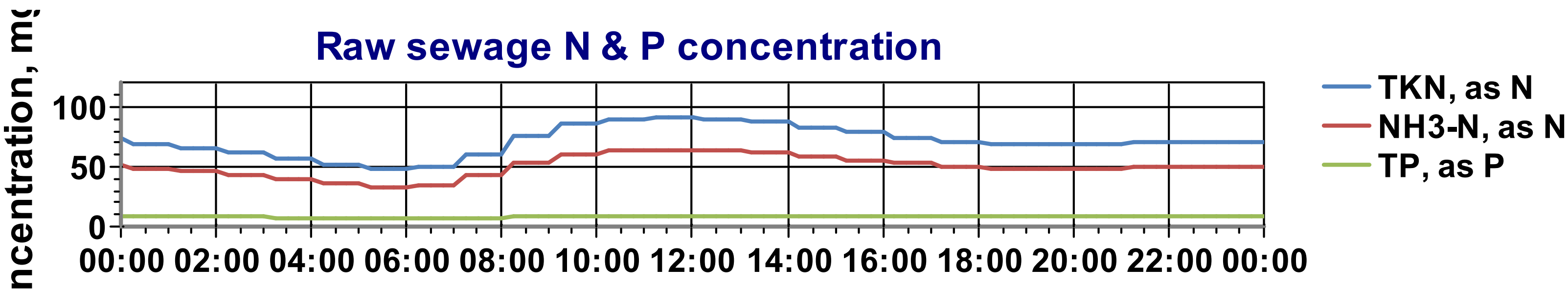

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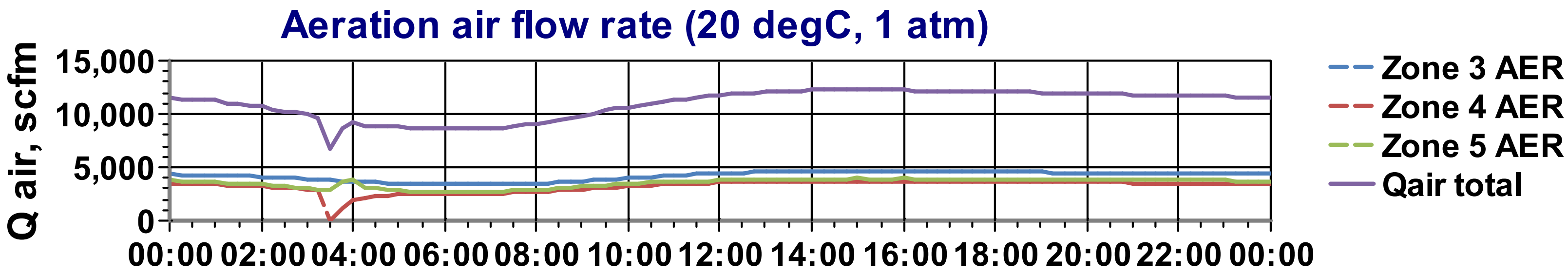

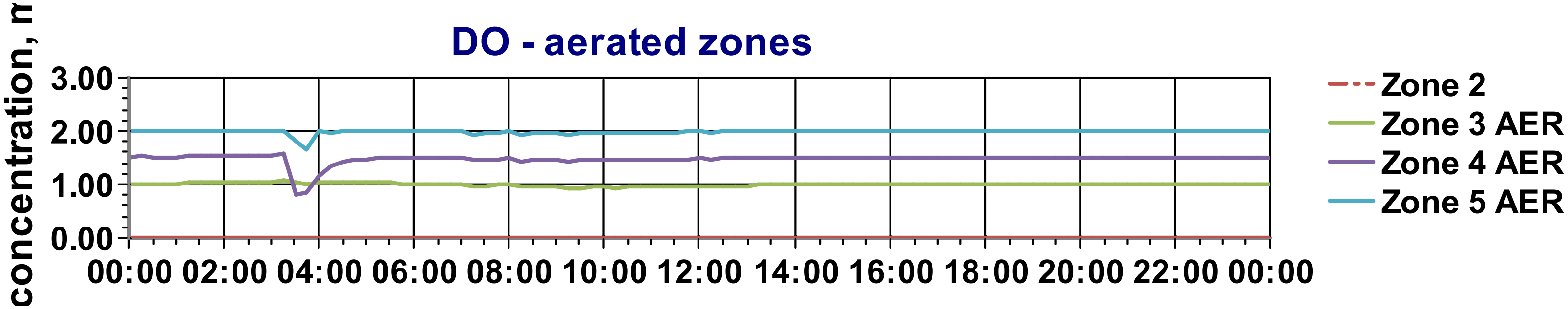

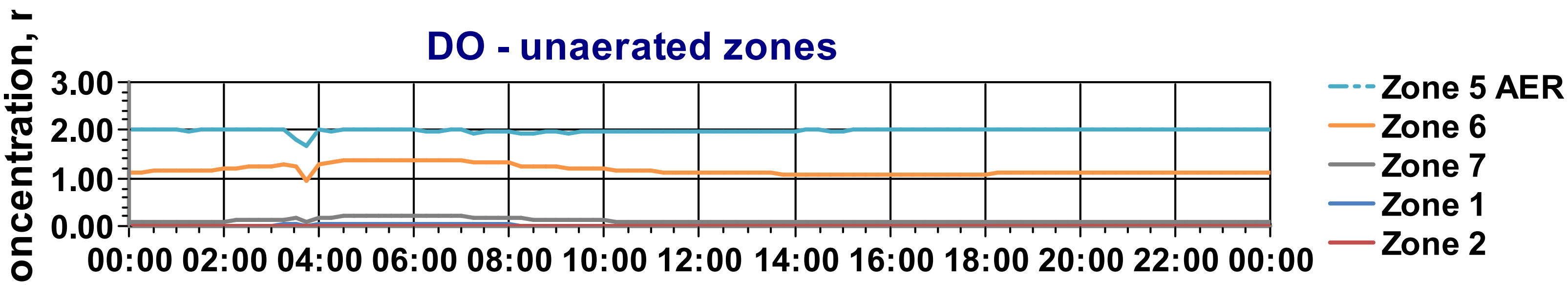

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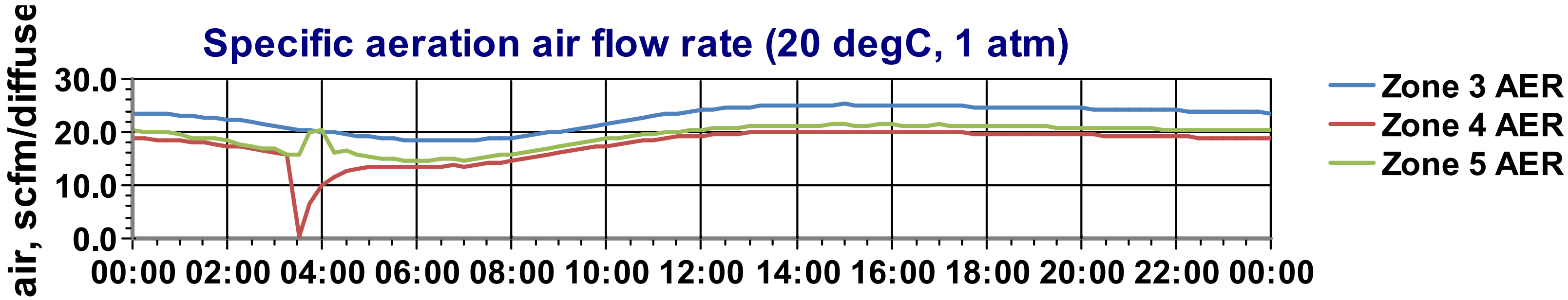

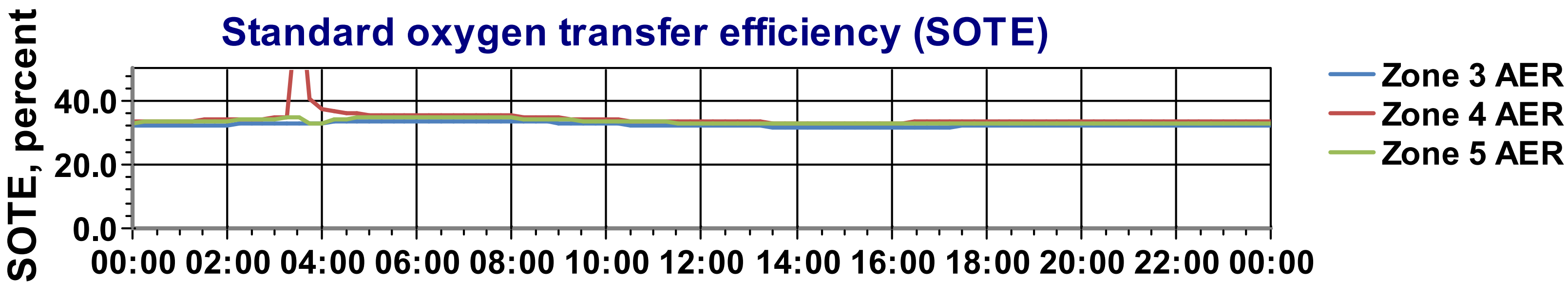

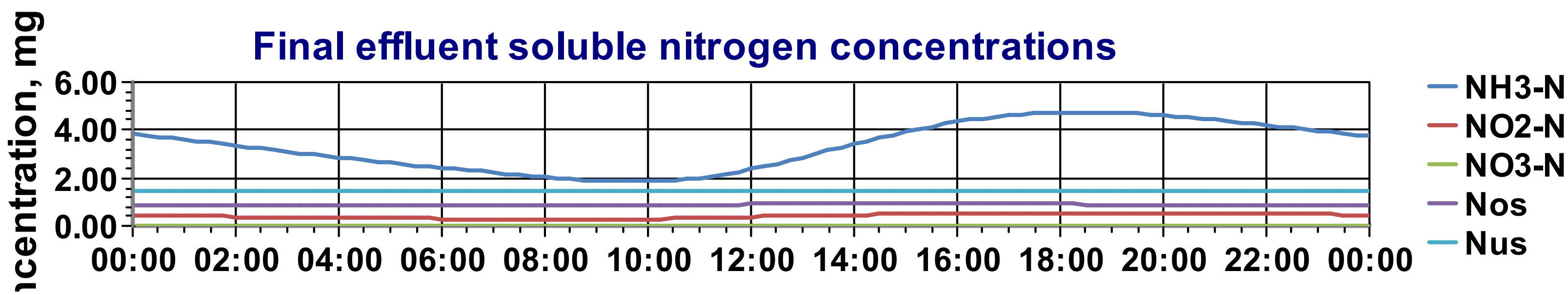

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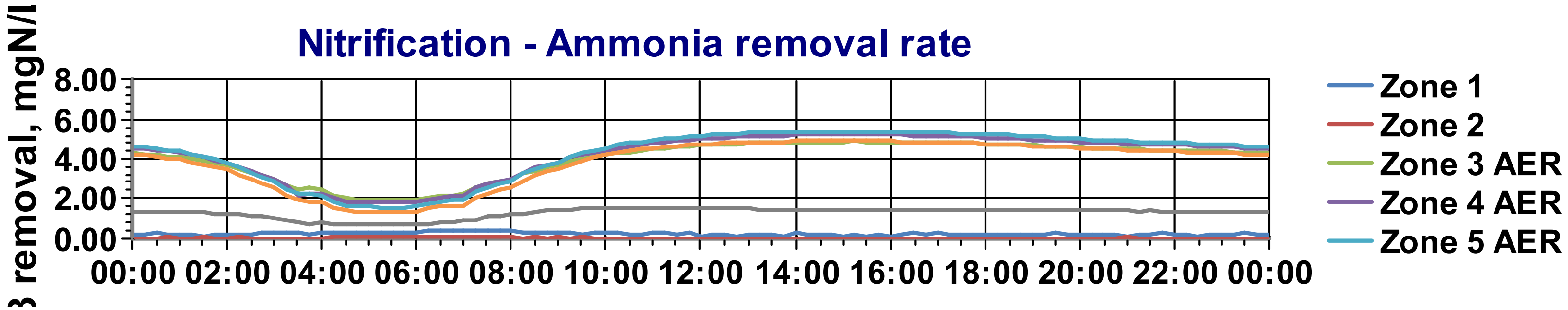

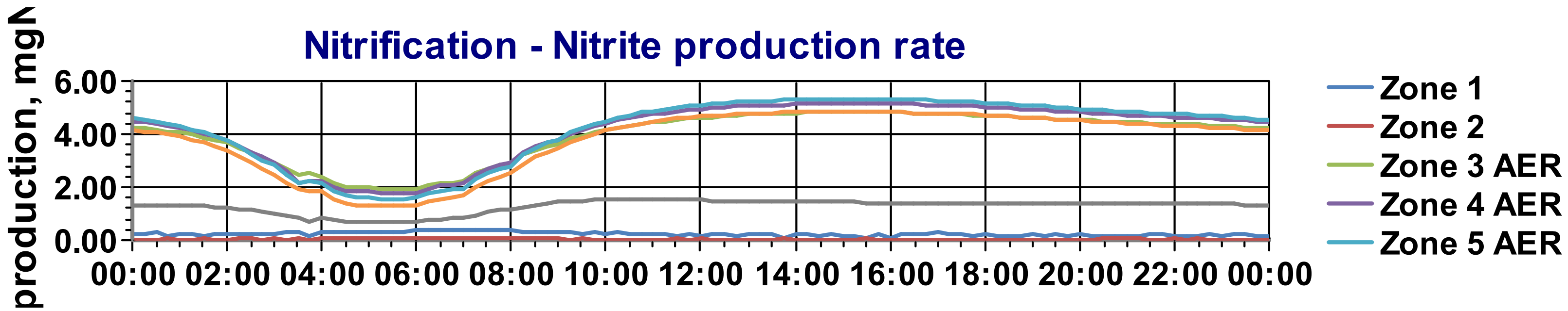

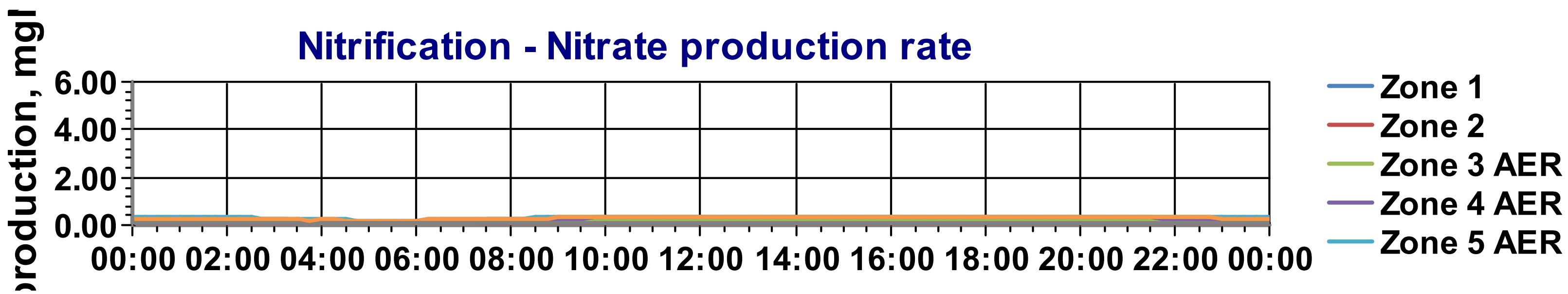

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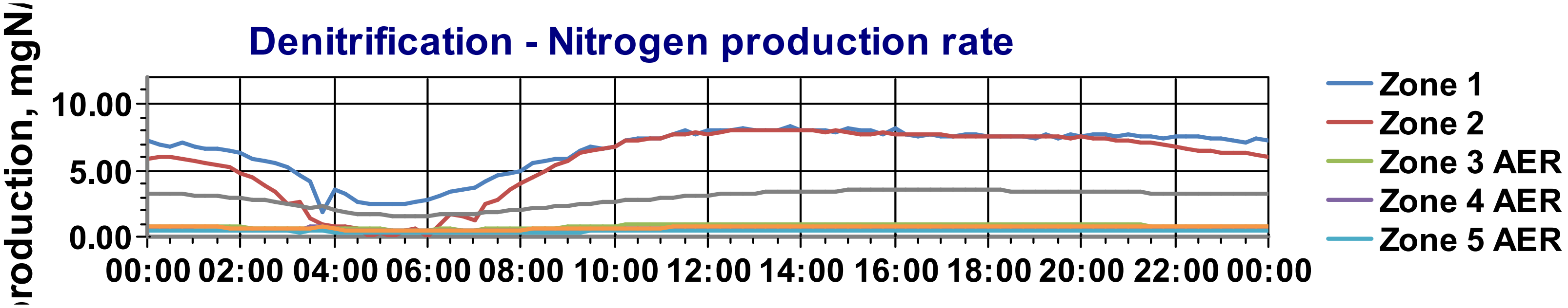

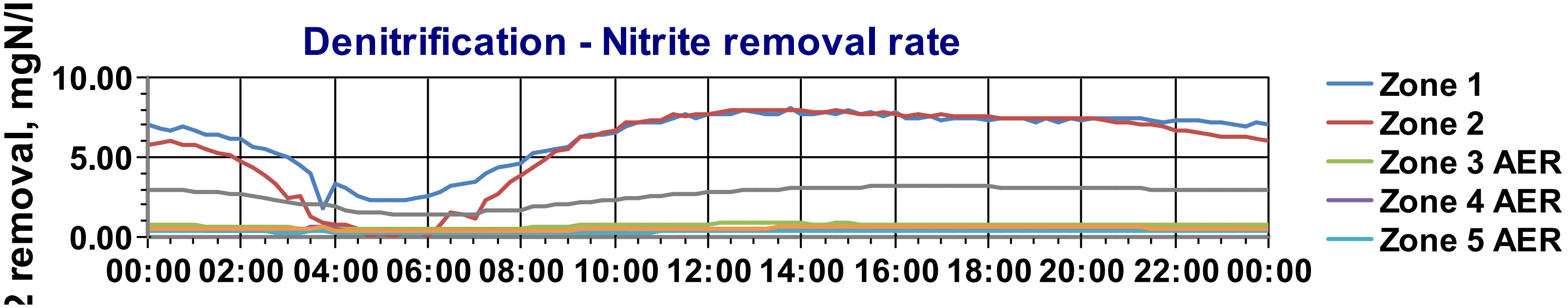

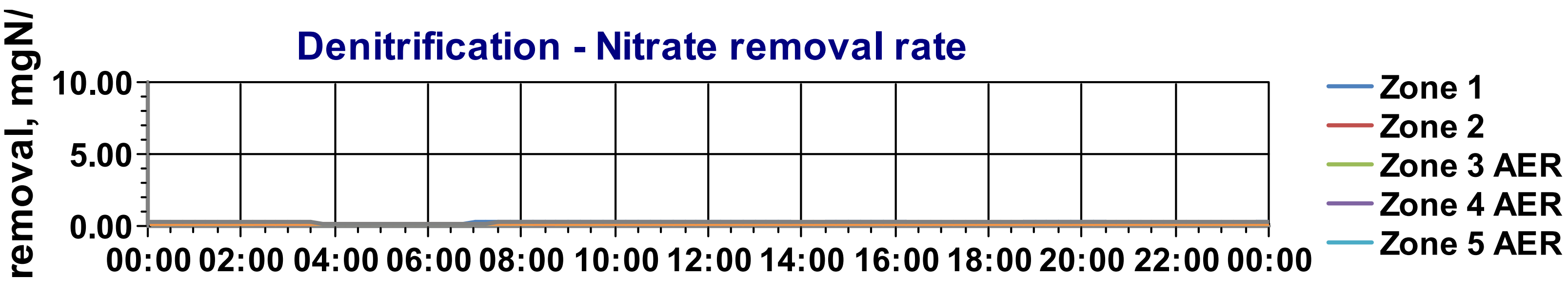

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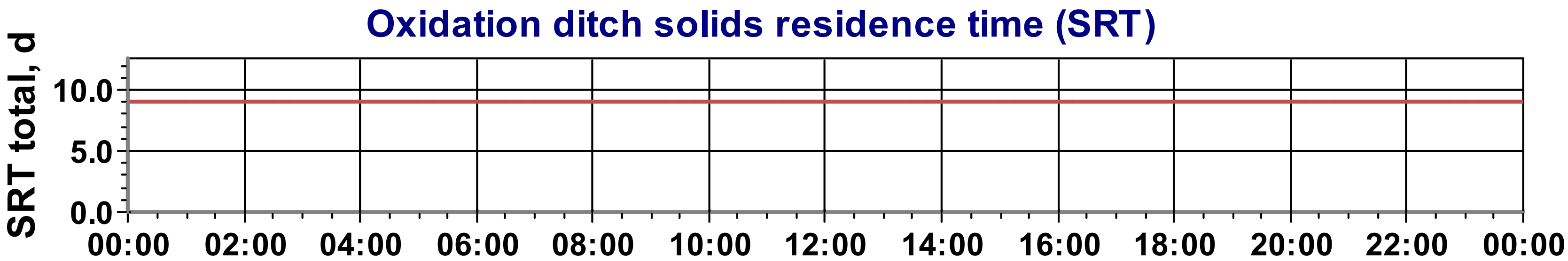

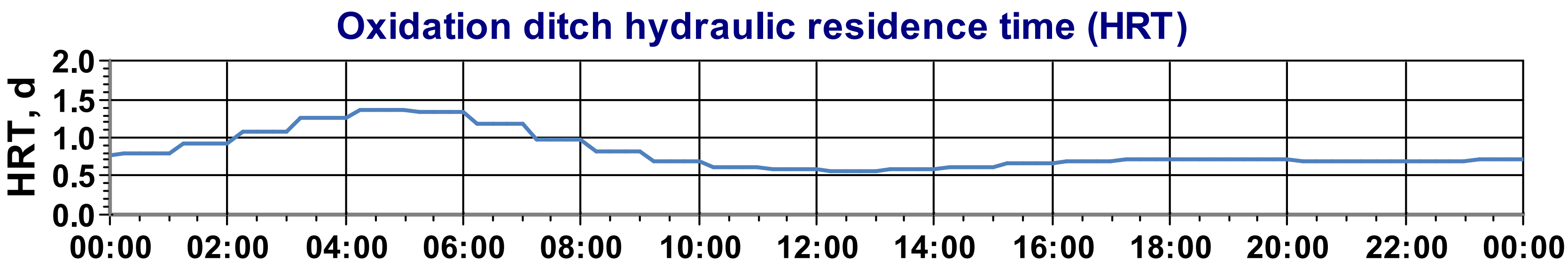

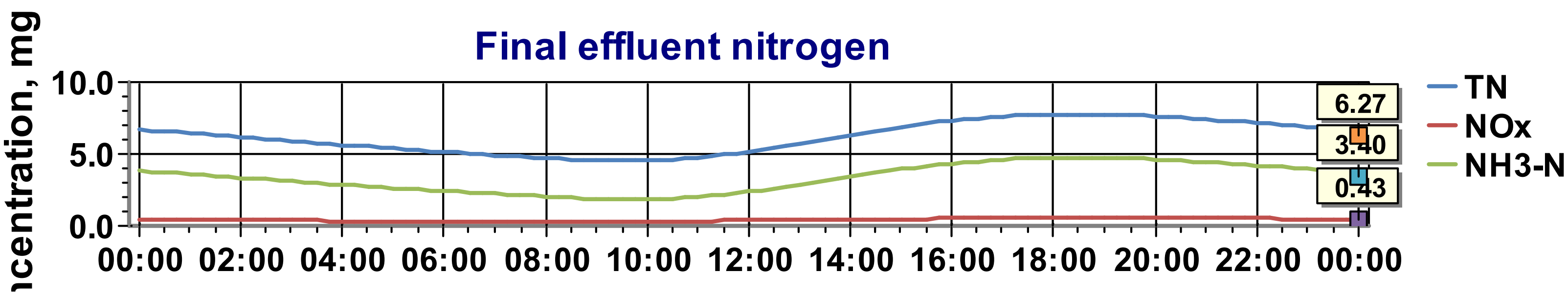

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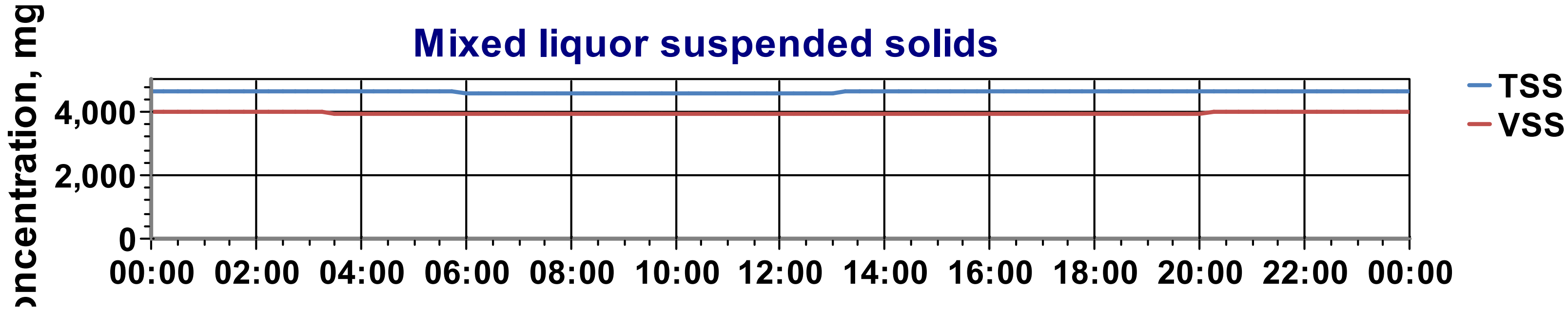

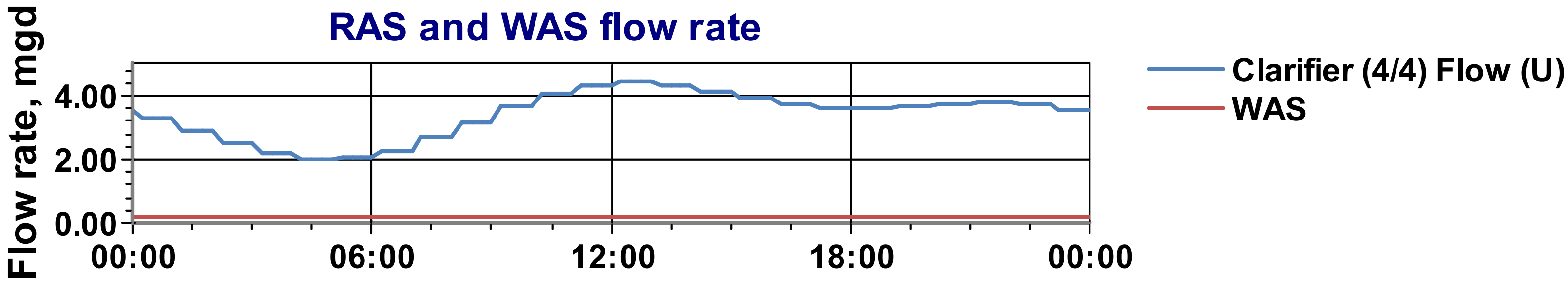

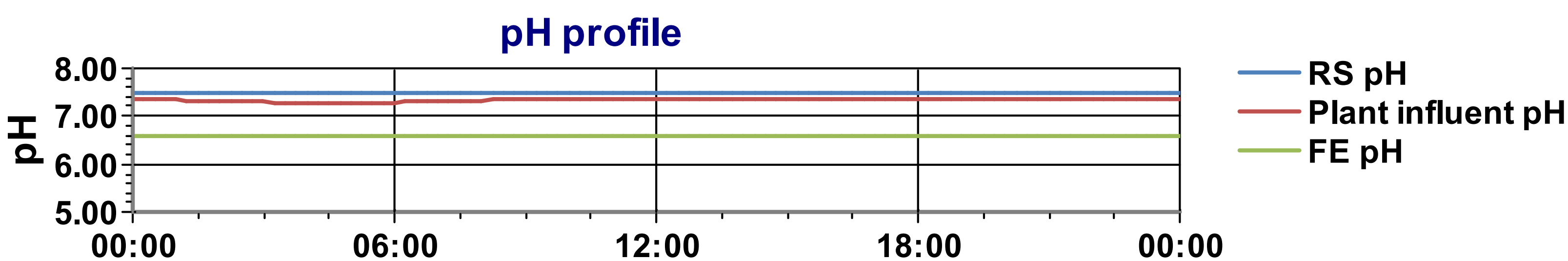

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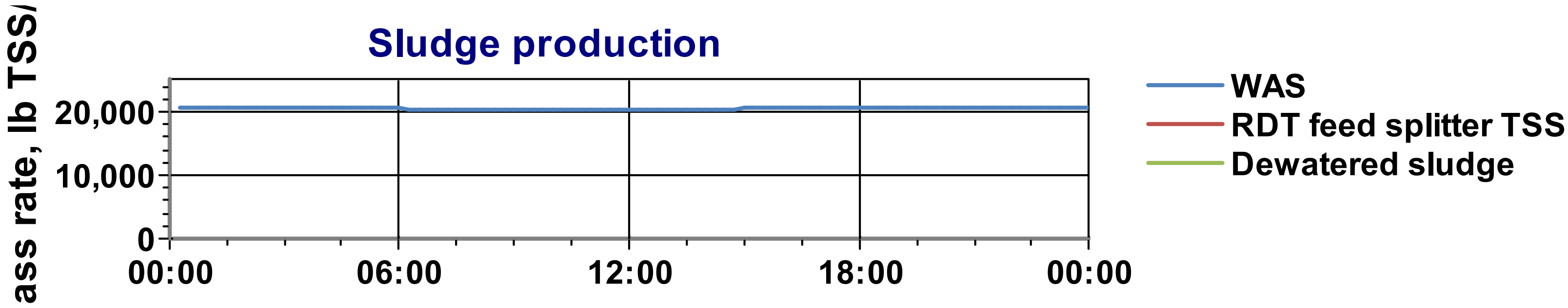

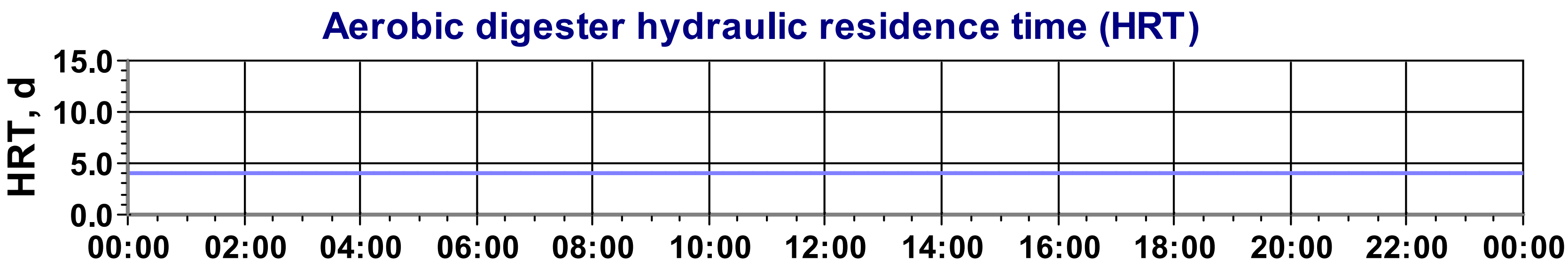

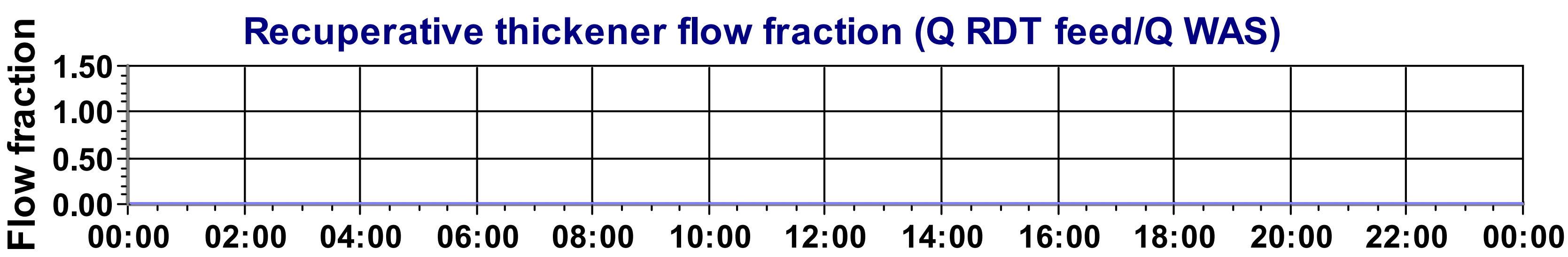

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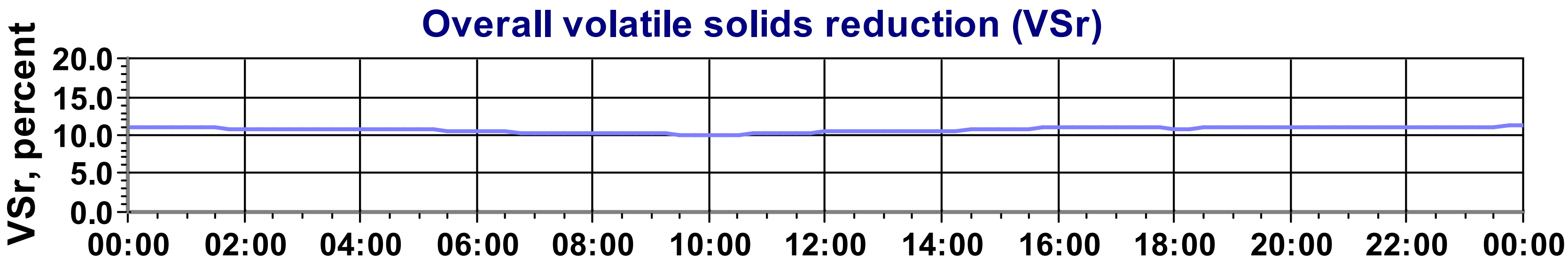

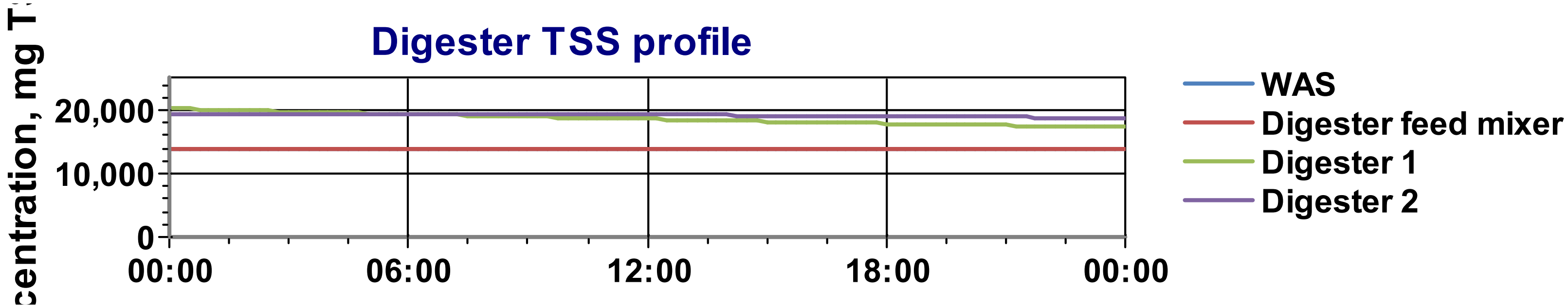

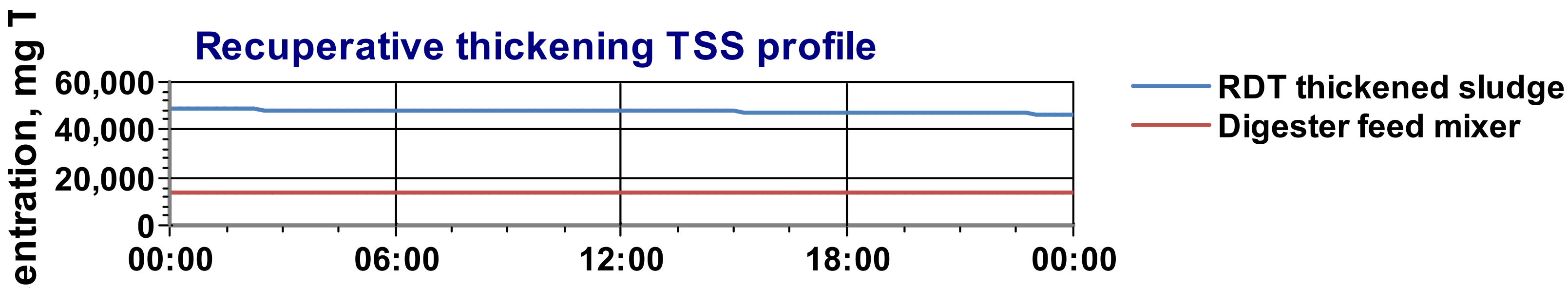

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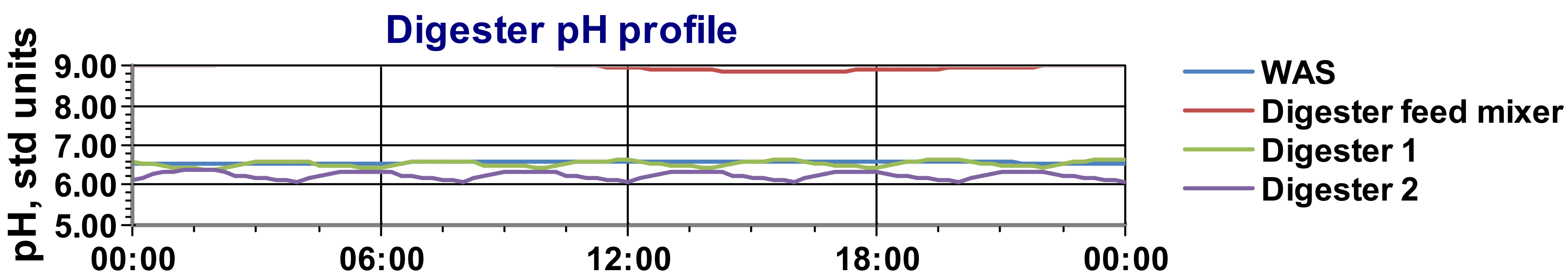

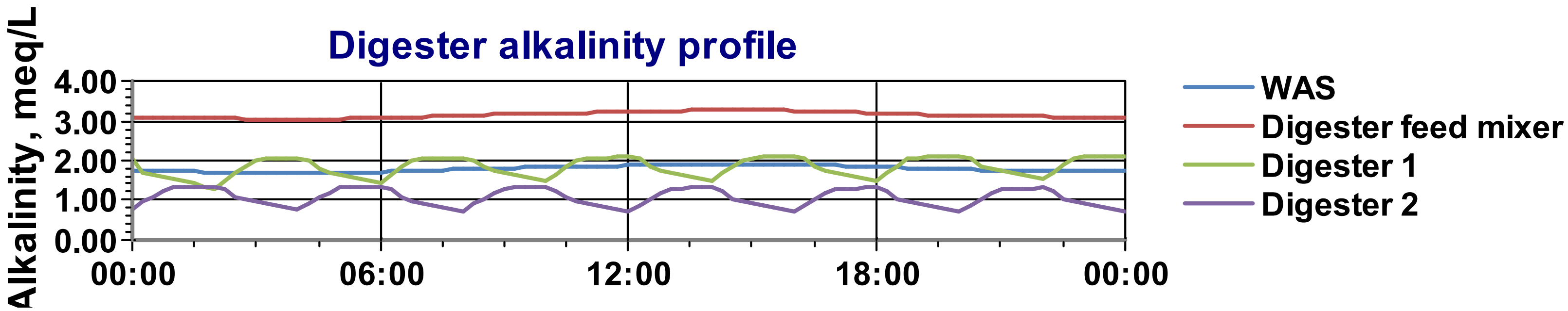

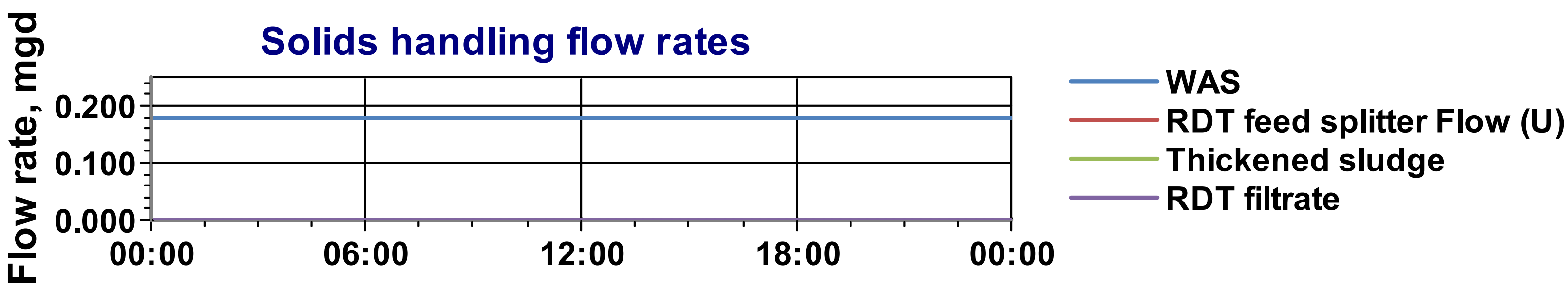

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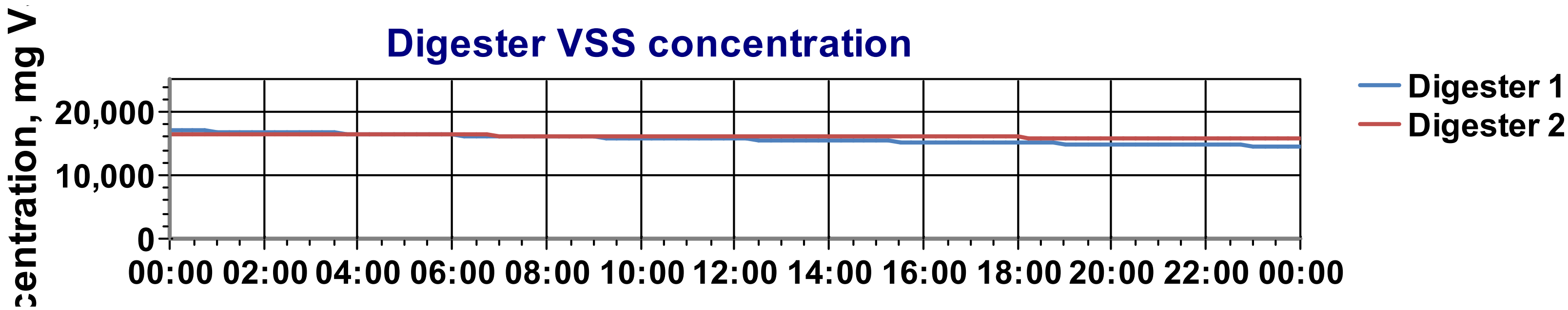

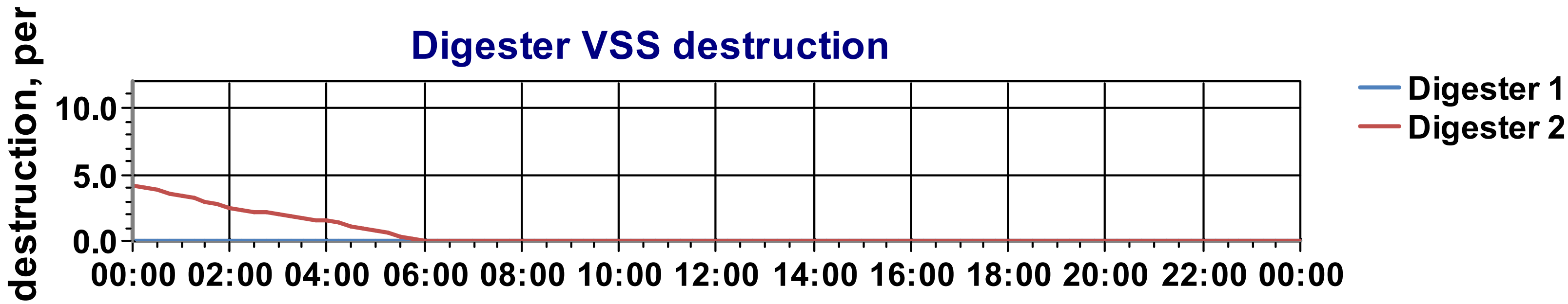

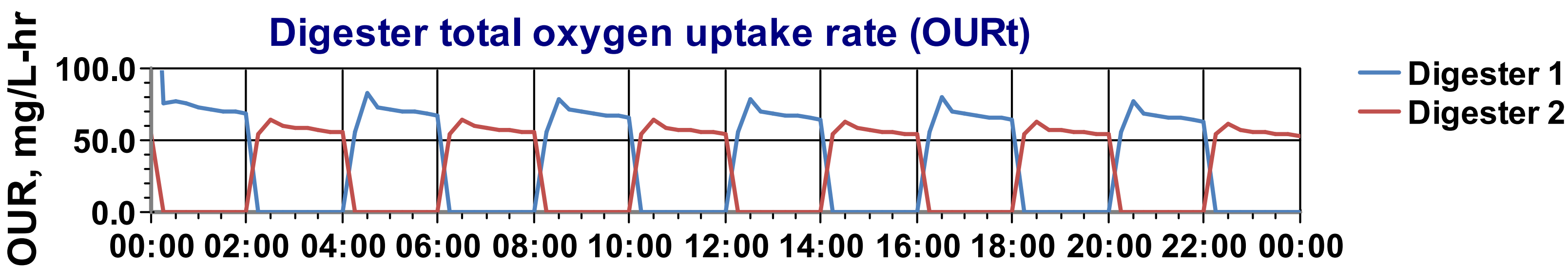

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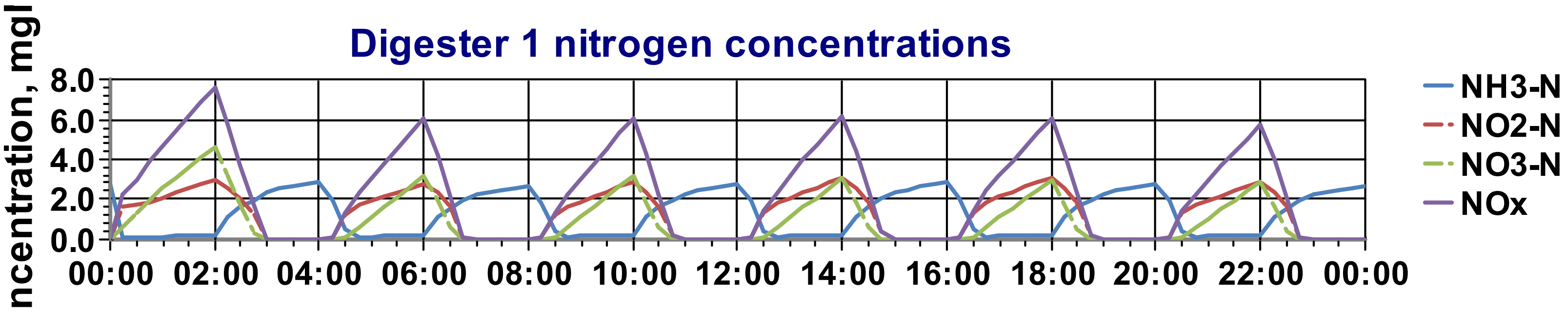

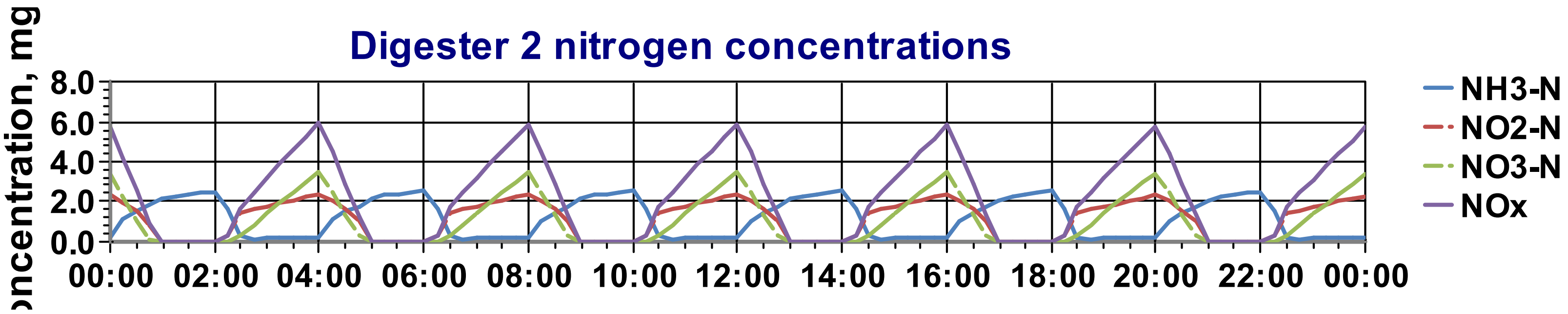

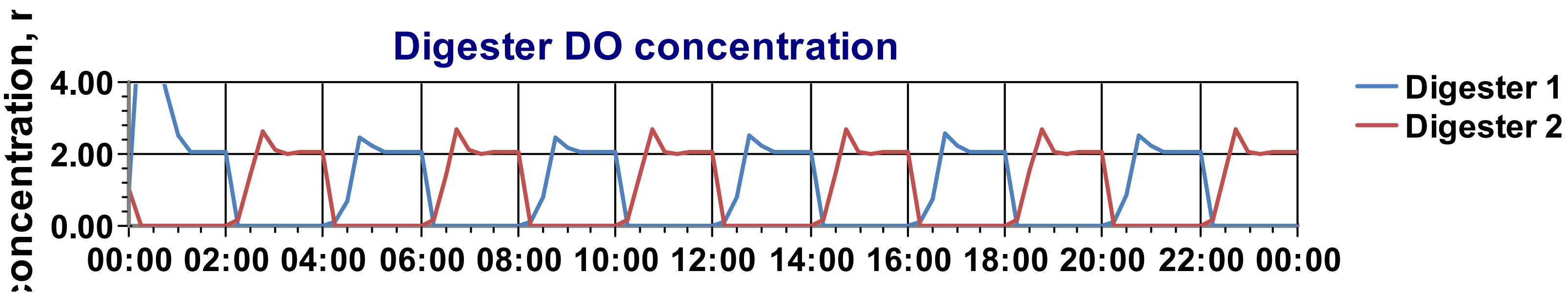

Global Parameters

Common

Name	Default	Value	
Hydrolysis rate [1/d]	2.1000	2.1000	1.0290
Hydrolysis half sat. [-]	0.0600	0.0600	1.0000
Anoxic hydrolysis factor [-]	0.2800	0.2800	1.0000
Anaerobic hydrolysis factor (AS) [-]	0.0400	0.0400	1.0000
Anaerobic hydrolysis factor (AD) [-]	0.5000	0.5000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.1500	0.1500	1.0290
Ammonification rate [L/(mgN d)]	0.0400	0.0400	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.5000	0.5000	1.0000
Endogenous products decay rate [1/d]	0	0	1.0000

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9000	0.9000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.7000	0.7000	1.0000
Byproduct NH4 logistic slope [-]	50.0000	50.0000	1.0000
Byproduct NH4 inflection point [mgN/L]	1.4000	1.4000	1.0000
AOB denite DO half sat. [mg/L]	0.1000	0.1000	1.0000
AOB denite HNO2 half sat. [mgN/L]	5.000E-6	5.000E-6	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiHNO2 [mmol/L]	0.0050	0.0050	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.7000	0.7000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.1000	0.1000	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiNH3 [mmol/L]	0.0750	0.0750	1.0000

OHO

Name	Default	Value	
Max. spec. growth rate [1/d]	3.2000	3.2000	1.0290
Substrate half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.6200	0.6200	1.0290
Anoxic decay rate [1/d]	0.2330	0.2330	1.0290
Anaerobic decay rate [1/d]	0.1310	0.1310	1.0290
Fermentation rate [1/d]	1.6000	1.6000	1.0290
Fermentation half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Fermentation growth factor (AS) [-]	0.2500	0.2500	1.0000
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

pH

Name	Default	Value
OHO low pH limit [-]	4.0000	4.0000
OHO high pH limit [-]	10.0000	10.0000
Autotrophs low pH limit [-]	5.5000	5.5000
Autotrophs high pH limit [-]	9.5000	9.5000
OHO low pH limit (anaerobic) [-]	5.5000	5.5000
OHO high pH limit (anaerobic) [-]	8.5000	8.5000

Switches

Name	Default	Value
Aerobic/anoxic DO half sat. [mgO2/L]	0.0500	0.1500
Anoxic/anaerobic NOx half sat. [mgN/L]	0.1500	0.1500
AOB DO half sat. [mgO2/L]	0.2500	0.2500
NOB DO half sat. [mgO2/L]	0.5000	0.5000
Anoxic NO3(->NO2) half sat. [mgN/L]	0.1000	0.1000
Anoxic NO3(->N2) half sat. [mgN/L]	0.0500	0.0500
Anoxic NO2(->N2) half sat. (mgN/L)	0.0100	0.0100
NH3 nutrient half sat. [mgN/L]	0.0050	0.0050
P nutrient half sat. [mgP/L]	0.0010	0.0010
Autotroph CO2 half sat. [mmol/L]	0.1000	0.1000
H2 low/high half sat. [mgCOD/L]	1.0000	1.0000

Common

Name	Default	Value
Biomass volatile fraction (VSS/TSS)	0.9200	0.9200
Endogenous residue volatile fraction (VSS/TSS)	0.9200	0.9200
N in endogenous residue [mgN/mgCOD]	0.0700	0.0700
P in endogenous residue [mgP/mgCOD]	0.0220	0.0220
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6500
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6500

AOB

Name	Default	Value
Yield [mgCOD/mgN]	0.1500	0.1500
AOB denite NO2 fraction as TEA [-]	0.5000	0.5000
Byproduct NH4 fraction to N2O [-]	0.0025	0.0025
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

NOB

Name	Default	Value
Yield [mgCOD/mgN]	0.0900	0.0900
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

OHO

Name	Default	Value
Yield (aerobic) [-]	0.6660	0.6660
Yield (fermentation, low H2) [-]	0.1000	0.1000
Yield (fermentation, high H2) [-]	0.1000	0.1000
H2 yield (fermentation low H2) [-]	0.3500	0.3500
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.7000	0.7000
CO2 yield (fermentation, low H2) [-]	0.7000	0.7000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Endogenous fraction - aerobic [-]	0.0800	0.0800
Endogenous fraction - anoxic [-]	0.1030	0.1030
Endogenous fraction - anaerobic [-]	0.1840	0.1840

COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield (anoxic) [-]	0.5400	0.5400
Yield propionic (aerobic) [-]	0.6400	0.6400
Yield propionic (anoxic) [-]	0.4600	0.4600
Yield acetic (aerobic) [-]	0.6000	0.6000
Yield acetic (anoxic) [-]	0.4300	0.4300
Yield methanol (aerobic) [-]	0.5000	0.5000
Adsorp. max. [-]	1.0000	1.0000
Max fraction to N2O at high FNA over nitrate [-]	0.0500	0.0500
Max fraction to N2O at high FNA over nitrite [-]	0.1000	0.1000

General

Name	Default	Value
Molecular weight of other anions [mg/mmol]	35.5000	35.5000
Molecular weight of other cations [mg/mmol]	39.1000	39.1000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.3000	0.3000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.1500	0.1500
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.0500	0.0500
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.0100	0.0100
Bubble rise velocity (anaerobic digester) [cm/s]	23.9000	23.9000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.3500	0.3500
Anaerobic digester gas hold-up factor []	1.0000	1.0000
Tank head loss per metre of length (from flow) [m/m]	0.0025	0.0025

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.0000	17.0000	1.0240
Kl for CO2 [m/d]	10.0000	10.0000	1.0240
Kl for NH3 [m/d]	1.0000	1.0000	1.0240
Kl for CH4 [m/d]	8.0000	8.0000	1.0240
Kl for N2 [m/d]	15.0000	15.0000	1.0240
Kl for N2O [m/d]	8.0000	8.0000	1.0240
Kl for O2 [m/d]	13.0000	13.0000	1.0240

Henry's law constants

Name	Default	Value	
CO2 [M/atm]	3.4000E-2	3.4000E-2	2,400.0000
O2 [M/atm]	1.3000E-3	1.3000E-3	1,500.0000
N2 [M/atm]	6.5000E-4	6.5000E-4	1,300.0000
N2O [M/atm]	2.5000E-2	2.5000E-2	2,600.0000
NH3 [M/atm]	5.8000E+1	5.8000E+1	4,100.0000
CH4 [M/atm]	1.4000E-3	1.4000E-3	1,600.0000
H2 [M/atm]	7.8000E-4	7.8000E-4	500.0000

Physico-chemical rates

Name	Default	Value	
Struvite precipitation rate [1/d]	3.000E+10	3.000E+10	1.0240
Struvite redissolution rate [1/d]	3.000E+11	3.000E+11	1.0240
Struvite half sat. [mgTSS/L]	1.0000	1.0000	1.0000
HDP precipitation rate [L/(molP d)]	1.000E+8	1.000E+8	1.0000
HDP redissolution rate [L/(mol P d)]	1.000E+8	1.000E+8	1.0000
HAP precipitation rate [molHDP/(L d)]	5.000E-4	5.000E-4	1.0000

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.918E-14	6.918E-14
HDP solubility product [mol/L]	2.750E-22	2.750E-22
HDP half sat. [mgTSS/L]	1.0000	1.0000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.0100	0.0100
Al to P ratio [molAl/molP]	0.8000	0.8000
Al(OH)3 solubility product [mol/L]	1.259E+9	1.259E+9
AlHPO4+ dissociation constant [mol/L]	7.943E-13	7.943E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.0100	0.0100
Fe to P ratio [molFe/molP]	1.6000	1.6000
Fe(OH)3 solubility product [mol/L]	0.0500	0.0500
FeH2PO4++ dissociation constant [mol/L]	5.012E-22	5.012E-22

Aeration

Name	Default	Value
Alpha (surf) OR Alpha F (diff) [-]	0.5000	0.5000
Beta [-]	0.9500	0.9500
Surface pressure [kPa]	101.3250	86.0370
Fractional effective saturation depth (Fed) [-]	0.3250	0.3250
Supply gas CO2 content [vol. %]	0.0350	0.0350
Supply gas O2 [vol. %]	20.9500	20.9500
Off-gas CO2 [vol. %]	2.0000	2.0000
Off-gas O2 [vol. %]	18.8000	18.8000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Surface turbulence factor [-]	2.0000	2.0000
Set point controller gain []	1.0000	1.0000

Notes

Simultaneous nitrification/denitrification (SND) DO switch* = 0.15 mg/L (default = 0.05 mg/L)
**Aerobic/anoxic DO half-saturation coefficient*

APPENDIX D – REFERENCES

Mettler, M. (2015). *Development of a Biological Process Model for Optimizing Nutrient Removal at South Truckee Meadows Water Reclamation Facility* (Master thesis). Retrieved from the University of Nevada Reno.

WASHOE COUNTY

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY FACILITY PLAN UPDATE

TECHNICAL MEMORANDUM NO. 6 FACILITY PLAN

FINAL

January 2016

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WASHOE COUNTY

SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY
FACILITY PLAN UPDATE

TECHNICAL MEMORANDUM
NO. 6
FACILITY PLAN

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1.0 INTRODUCTION

Washoe County's (County's) Facility Plan Update for the South Truckee Meadows Water Reclamation Facility (STMWRF) includes an update of the 2008 Facility Plan Update. This Technical Memorandum (TM) discusses the liquid and solids treatment facilities at STMWRF and provides an expansion plan and capital cost estimate information for the facility through the 20-year planning period.

STMWRF was originally constructed in 1991. The last major expansion project at the facility was completed in 2002 when STMWRF was expanded to a maximum month average day flow (MMADF) capacity of 4.1 million gallons per day (mgd).

The last facility Master Plan, titled *Draft Facility Plan Update South Truckee Meadows Water Reclamation Facility 6-mgd Expansion Project* (CH2M, April 2008), began in a period of significant economic and population growth, and was published at a time shortly thereafter where changes had taken place in economic growth, regulatory climate, wastewater quality, and treatment technologies. The County has commissioned this STMWRF Facility Master Plan Update to evaluate the current design criteria, establish new criteria as appropriate, and make recommendations for the Capital Improvements Program (CIP). The planning period for this master plan report is 20 years, running from 2015 through 2035.

The purpose of this TM is to identify and evaluate alternative processes, which could be implemented at STMWRF. Alternative secondary treatment processes will be identified and discussed in regards to their required components, advantages and disadvantages, and potential capital and/or operation costs. Alternative filter methods and configurations will also be presented. Alternative disinfection methods will be evaluated for comparison to the current operational methods and costs.

2.0 SUMMARY OF PLANNING STUDIES

This section is a summary of previous planning studies completed for STMWRF. The recommendations and conclusions of previous planning studies are summarized in the following sections in chronological order.

2.1 Draft Facility Plan Update

The Draft Facility Plan Update South Truckee Meadows Water Reclamation Facility 6 mgd Expansion Project, dated April 2008, was prepared by CH2M. This report was a planning study to increase STMWRF's treatment capacity to 6 mgd (peak month flow permitted capacity). The key recommendations and conclusions are summarized as follows:

- Recommended a new headworks facility and secondary treatment (new bioreactors operating in parallel with the existing oxidation ditches and using existing secondary clarifiers).
- Biosolids practice recommendation was to continue sending WAS to the Truckee Meadows Water Reclamation Facility (TMWRF) for as long as TMWRF has available capacity, then process onsite.
- Recommended increased reclaimed water use and unrestricted pumping criteria to balance disposal of increased wastewater flows.
- Summarized potential institutional and regulatory requirements for the 6 mgd expansion, as well as potential regulatory issues.

2.2 South Truckee Meadows Water Reclamation Facility: Reclaimed Water Quality Management Study

The South Truckee Meadows Water Reclamation Facility: Reclaimed Water Quality Management Study (Technical Memorandum), dated August 2012, was prepared by CH2M. The goal of this study was to investigate reclaimed water quality and provide recommendations to improve water quality in accordance with applicable regulatory agencies and to mitigate nuisance algae that hinder filter performance and adversely impact equipment in the water distribution system. The key recommendations and conclusions are summarized as follows:

- Further study and sampling of the nuisance algae was recommended since the issue of filter clogging was not repeated during the sampling for this study. Therefore, it was recommended to have sampling contracts, protocols, and bottles/equipment ready to collect samples during a clogging event for microscopic evaluations.
- Recommendations were to adjust plant operations to reduce ammonia concentrations in treated water. This can be accomplished by gradually increasing aeration to promote the growth of nitrifiers (increasing nitrification) within the mixed liquor system. It was also recommended that new nitrate analyzers be installed within the oxidation ditches to monitor ammonia reduction by monitoring a product of nitrification, nitrate. The recommended target secondary treatment effluent ammonia (NH3-N) concentration was 2 mg/L.
- A secondary recommendation was to encourage destratification of the reservoir to improve water quality by creating shifts in the algal community if operational changes within the treatment system did not decrease ammonia levels within the reservoir, or if operational changes are not desired. The destratification system would consist of a blower and diffuser system within the reservoir; additional capital and operations and maintenance costs would be incurred.

- As a follow up to the jar tests conducted in this study (alum and ferric chloride addition were tested), full-scale field testing of chemical coagulants was recommended for the continuous backwash filters to increase hydraulic filter capacity.
- Water quality modeling was recommended to investigate and forecast boron and salinity concentrations within the reservoir. The recommended trigger point for implementing the water quality modeling efforts is when reservoir effluent boron concentrations exceed 3.0 mg/L with quarterly sampling.

2.3 South Truckee Meadows Water Reclamation Facility Biosolids Management Project Process Basis for Design

The South Truckee Meadows Water Reclamation Facility Biosolids Management Project Process Basis for Design Technical Memorandum, dated January 2014, was prepared by CH2M. This TM documents the design criteria, component sizing requirements, and basic control strategy for the new solids stabilization and dewatering facilities at STMWRF. See the TM for specific recommendations.

2.4 Thesis: Development of a Biological Process Model for Optimizing Nutrient Removal at South Truckee Meadows Water Reclamation Facility

The Thesis: Development of a Biological Process Model for Optimizing Nutrient Removal at South Truckee Meadows Water Reclamation Facility study, dated May 2015, was prepared by M. Mettler at the University of Nevada, Reno. This study was a master's thesis studying the algal issue at STMWRF via computer modeling of the wastewater process (BioWin). The key recommendations and conclusions are summarized as follows:

- BioWin modeling results suggested that excessive aeration resulted in high concentrations of nitrate and nitrite, and low concentrations of ammonia. Different aeration schemes were tested and confirmed improved nutrient removal with non-aeration periods.
- Further modeling was recommended to review/calibrate the stoichiometric and kinetic parameters for STMWRF. Long-term study of the proposed, modified aeration scheme was also recommended to assure that there is no buildup of nutrients within the oxidation ditches.

3.0 DESCRIPTION OF EXISTING FACILITIES

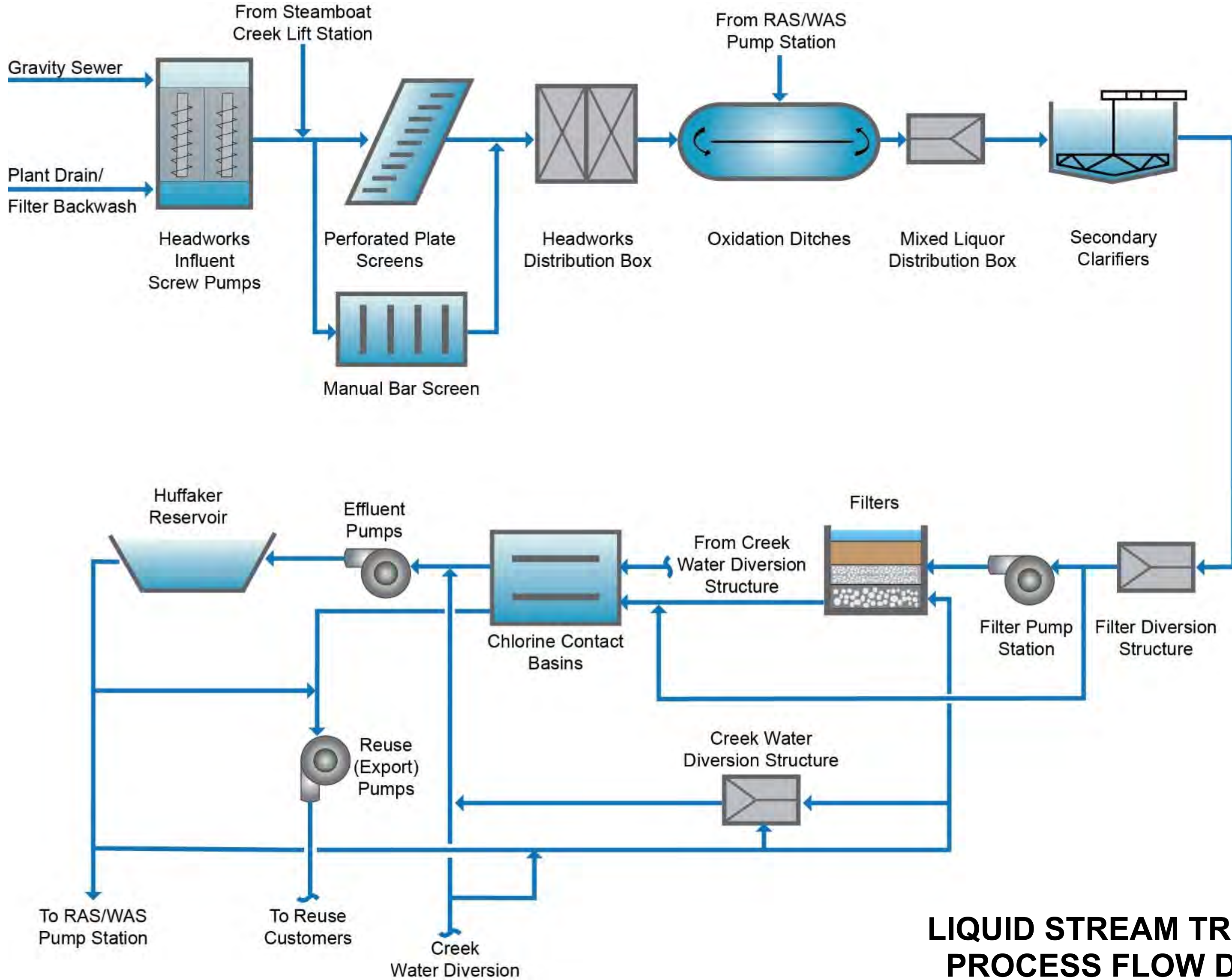
This section provides a description of the existing wastewater facilities, including: 1) treatment facilities, 2) support facilities, 3) plant access, 4) parking for staff and visitors, and 5) surrounding areas.

3.1 Existing Liquid Treatment Facilities

STMWRF is an activated sludge plant that biologically treats wastewater to tertiary treatment standards. After the initial screening, raw wastewater is directed to the oxidation ditches for biological removal of nutrients and nitrogen. Secondary clarifiers are then utilized to achieve separation of the effluent (liquids) and activated sludge (solids). Secondary effluent is conveyed to the continuous backwash Tertiary Filters and disinfected in the Chlorine Contact Basins. Tertiary effluent is either conveyed to the Effluent Pumps for storage in the Huffaker Reservoir or to the Export Pumps for its final use in the Reclaimed Water Distribution System. STMWRF is a zero discharge plant, so the tertiary effluent may be reused on site for non-potable water demands, stored in the Huffaker Reservoir, or conveyed to reuse water customers in the service area.

The liquid treatment facilities at STMWRF are depicted in the simplified liquid flow schematic, Figure 6.1, while design criteria information is presented in Table 6.1. The overall site plan identifying the various process areas is presented in Figure 6.2. The liquid treatment facilities at the STMWRF include the following:

- Steamboat Creek Lift Station. Raw sewage is collected at the Steamboat Creek Lift Station and is pumped to the headworks facility, just upstream of the screens.
- Influent Pumping. In addition to the pumped influent flow, raw sewage enters by gravity sewer and is conveyed to the influent pumps at the Headworks Building. The influent pumps are housed in a concrete structure where the influent wastewater is then pumped to the influent screens.
- Influent Screening. Wastewater flows through two perforated plate-style screens to remove debris. There is also a bypass channel with a manual bar screen, should the two perforated plate screens be out of service. The screenings are then washed and compacted and conveyed to the dumpster area where the solids are hauled to the landfill.
- Oxidation Ditches. The screened wastewater is biologically treated in oxidation ditches. Submerged mixers circulate the wastewater around the ditches. Return activated sludge (RAS) is distributed to the ditches through a RAS flow distribution structure. Aeration blowers supply air to the ditches to support the biological treatment process through submerged diffusers.



LIQUID STREAM TREATMENT PROCESS FLOW DIAGRAM

FIGURE 6.1

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

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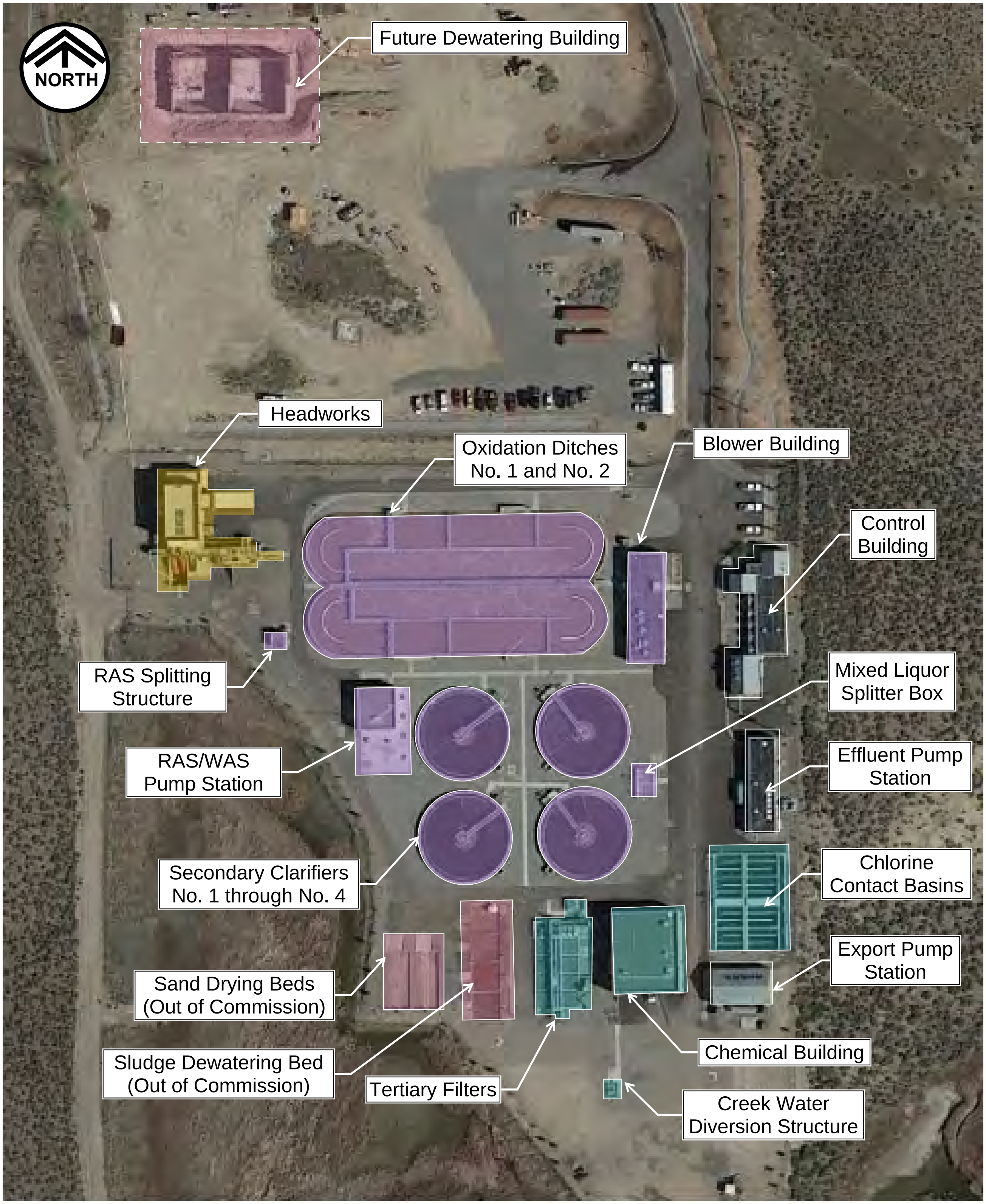

Legend:

- Preliminary Treatment
- Secondary Treatment
- Tertiary Treatment
- Solids Handling

GENERAL SITE PLAN AND PROCESS AREAS

FIGURE 6.2

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

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- Secondary Clarifiers. Circular secondary clarifiers receive the effluent from the oxidation ditches, and are used to achieve solids/liquid separation of the activated sludge, or mixed liquor, and produce a clear secondary effluent ready for filtration. The settled solids, RAS, are pumped back to the oxidation ditches to maintain treatment, wasting a portion to control the process biology.
- Tertiary Filters. Granular media filters provide final polishing of the secondary effluent. The filter pump station lifts the secondary effluent into the filter beds, which allows the water to percolate through the granular media, being polished in the process. The granular media is continuously cleaned by lifting the dirty sand at the bottom of the filter to the top of the filter and then backwashing the particles separated from the sand back to the headworks.
- Disinfection and Final Reuse/Disposal. Tertiary filter effluent is disinfected in the chlorine contact basins in order to meet final discharge permit requirements. Disinfected effluent is then conveyed by the Effluent Pump Station to the Huffaker Reservoir or the Export Pump Station to existing reuse customers.

Table 6.1 Summary of Liquid Treatment Facilities
STMWRF Facility Plan Update
Washoe County

Parameter	**Units**	**Design Criteria**
Steamboat Creek Lift Station		
Type	-	Self-priming centrifugal
Number of pumps	each	3
Capacity, each	gpm	1,440
Horsepower	hp	25
Influent Pumping		
Raw Sewage Pipeline, diameter	in	36
Type	-	Enclosed Screw
Number of pumps	each	2
Capacity, each	gpm	3,750
Horsepower	hp	40
Influent Flowmeter		
Type	-	Magnetic
Number	each	2
Size, diameter	in	20
Capacity, each	mgd	10

Table 6.1 Summary of Liquid Treatment Facilities STMWRF Facility Plan Update Washoe County

Parameter	Units	Design Criteria
Influent Screening		
Type	-	Self-cleaning Perforated Plate Screen
Screen Orifice Diameter	inch	0.25 (6 mm)
Number of Screens	each	2
Bypass Influent Screen		
Type	-	Manually cleaned
Number	each	1
Bar Spacing	in	1
Oxidation Ditches		
Each ditch Influent Pipeline, diameter	in	20
Number of ditches	each	2
Volume, each	cf	211,000
Depth	ft	14
Aeration Diffusers Type	-	Fine Bubble Membrane Panels
Propeller Mixers Type	-	Submerged Propeller
Propeller Mixers Number per Ditch	each	3
Aeration Blowers		
Type	-	Multi-stage Centrifugal
Number	each	5
Motor Size	hp	3 @ 200, 2 @100
Capacity	scfm	3 @ 2,480, 2 @1,450
Secondary Clarifiers		
Each Clarifier Influent Pipeline, diameter	in	24
Type	-	Circular
Number	each	4
Diameter	ft	80
Sidewater Depth	ft	13.5

Table 6.1	Summary of Liquid Treatment Facilities STMWRF Facility Plan Update Washoe County	
Parameter	**Units**	**Design Criteria**
RAS and WAS Pumps		
RAS Pump Type	-	Dry pit, end suction, centrifugal
Number of RAS Pumps	each	5
Capacity, Each	gpm	1,600
Horsepower	hp	20
WAS Pump Type	-	Progressing Cavity
Number of WAS Pumps	each	2
Capacity, Each	gpm	375
Horsepower	hp	75
Secondary Scum Pumps		
Type	-	Submersible centrifugal
Number	each	4
Capacity, each	gpm	180
Horsepower, each	hp	3
Filtration		
Filter Influent Pipeline, diameter	in	30-48
Type	-	Moving bed, continuous backwash
Number	each	8
Media Depth	in	80
Surface Area, Each	sf	200
Reject Rate	gpm	416
Air Compressor Type	-	Rotary Screw
Air Compressor Number	each	2
Air Compressor Capacity, each	scfm	117
Air Compressor Horsepower	hp	30
Filter Reject Water Pump Number	each	2
Filter Reject Water Pump Type	-	Submersible
Filter Reject Water Pump Capacity, each	gpm	180
Filter Reject Water Pump Horsepower	hp	5

Table 6.1 Summary of Liquid Treatment Facilities STMWRF Facility Plan Update Washoe County		
Parameter	**Units**	**Design Criteria**
Rapid Mixer Type	-	Mechanical, pitch-blade turbine, top mount
Rapid Mixer Number	each	2
Rapid Mixer Horsepower	hp	5
Rapid Mixer Basin Volume	gal	1,900
Chlorine Contact Basins		
Contact Basin Influent Pipeline, diameter	in	30-48
Number of Basins	each	4
Volume per Basin	gal	10,200
Contact Basin Effluent Pipeline, diameter	in	30
Sodium Hypochlorite System		
Number of Storage Tanks	each	2
Capacity, each	gal	6,500
Number of Feed Pumps	each	5
Capacity, each	gph	25
Effluent Pumping (to Reservoir)		
Pump Type	-	Vertical Turbine
Number of pumps	each	5
Pump Capacity, each	gpm	1@1400, 4@2500
Horsepower, each	hp	1@75, 4@150
In-line Screens		
Type	-	In-line automatic backwash screens
Number of units	each	2
Screens per unit	each	2
Mesh Size	micron	100
Export Pumping (to Reuse)		
Pump Type	-	Vertical Turbine
Number of pumps	each	5
Pump Capacity, each	gpm	2,100
Horsepower, each	hp	350

Table 6.1	Summary of Liquid Treatment Facilities STMWRF Facility Plan Update Washoe County	
Parameter	**Units**	**Design Criteria**
Creek Water Pumping		
Pump Type	-	Horizontal centrifugal, self-priming
Number of pumps	each	1
Pump Capacity, each	gpm	1,600
Horsepower, each	hp	25
2W Booster Pumps		
Number	each	2
Capacity	gpm	1@25, 1@125
Horsepower	hp	1@1.5, 1@10

3.2 Existing Solids Treatment Facilities

STMWRF currently discharges waste activated sludge (WAS) to the TMWRF collection system. A project is currently being constructed to add solids treatment facilities at STMWRF. The design calls for new aerobic digesters with jet aeration, WAS thickening via rotary drums, and dewatering via screw presses. This facility is expected to be online in the third quarter of 2016. STMWRF has wedge wire filter beds that are currently not in use.

3.3 Existing Support Facilities

The support facilities at STMWRF include controls and electrical systems.

3.3.1 Communication System

STMWRF's field inputs and outputs are wired to Allen-Bradley Controllogix PLC system with RS Logix 5000 programming software. Ethernet and fiber optic cables link the PLCs and human-machine interface HMI workstations. In 2012, STMWRF began an upgrade to its electrical, mechanical, and computer process control systems and continues to update SCADA software programming and upgrade electrical and control systems wiring, as needed. The County has standardized on Wonderware Intouch HMI, Wonderware Historian and Rockwell VantagePoint Servers, and Allen Bradley PLCs with RS Logix programming software.

3.3.2 Electrical System

NV Energy provides three independent power services to STMWRF. A main plant transformer steps down the service to 480 volts. Power is distributed throughout STMWRF via a main switchboard, essential load switchboard, motor control centers (MCC), and distribution/lighting panels. NV Energy also provides two separate 480-volt services to the Export Pump Station and Creek Water Pump Station.

STMWRF has one diesel generator for standby power. A load-shedding strategy is programmed to shed non-essential loads during a power failure.

3.4 Plant Access and Parking

STMWRF access is via a plant access road off of Alexander Lake Road. There is a gate at the end of the plant access road near the Control Building. A recent plant access road project was completed that modified the width of the driveway and added landscaping. A new spur was added on the plant access road to the new solids handling facility. There are five parking spaces north of the Control Building by the STMWRF access gate.

3.5 Surrounding Areas

STMWRF has no immediate neighbors around the facility. Alexander Lake Road and Huffaker Reservoir are to the north, Alexander Lake is east, warehouses are south, and natural, unimproved areas are to the west. Due to STMWRF's location, there are no known buffer zone issues.

4.0 PLANT HYDRAULICS

The hydraulic model for STMWRF was developed to reflect current process and flow conditions. In general, the hydraulic profile for a plant is used to confirm that sufficient hydraulic gradient is provided in the design to allow the wastewater to flow through the unit processes by gravity. In addition, the unit processes should be able to convey the maximum flow without causing a hydraulic washout of the treatment plant. Sufficient freeboard must be provided to prevent liquid from splashing over the sides under conditions of high water level. The plant must also be able to fully process minimum flow without undesirable settling of solids throughout the treatment train. The purpose of the hydraulic evaluation was to identify potential pinch points or hydraulic limitations in the liquids treatment process train, and also determine the available head in the hydraulic profile for potential future process additions.

Flow projections, as developed in TM No. 2, Planning Framework, are shown in Table 6.2. Note that for treatment plant facilities, an average day maximum month flow (ADMMF) of 6.0 mgd is consistent with the available capacity of some unit processes, and based on County staff direction, will be the basis of unit process sizing for 2035 conditions. The hydraulic modeling results indicate that all areas of the plant can satisfactorily convey the design flow (ADMMF) and peak hour flow (PHF) flow conditions.

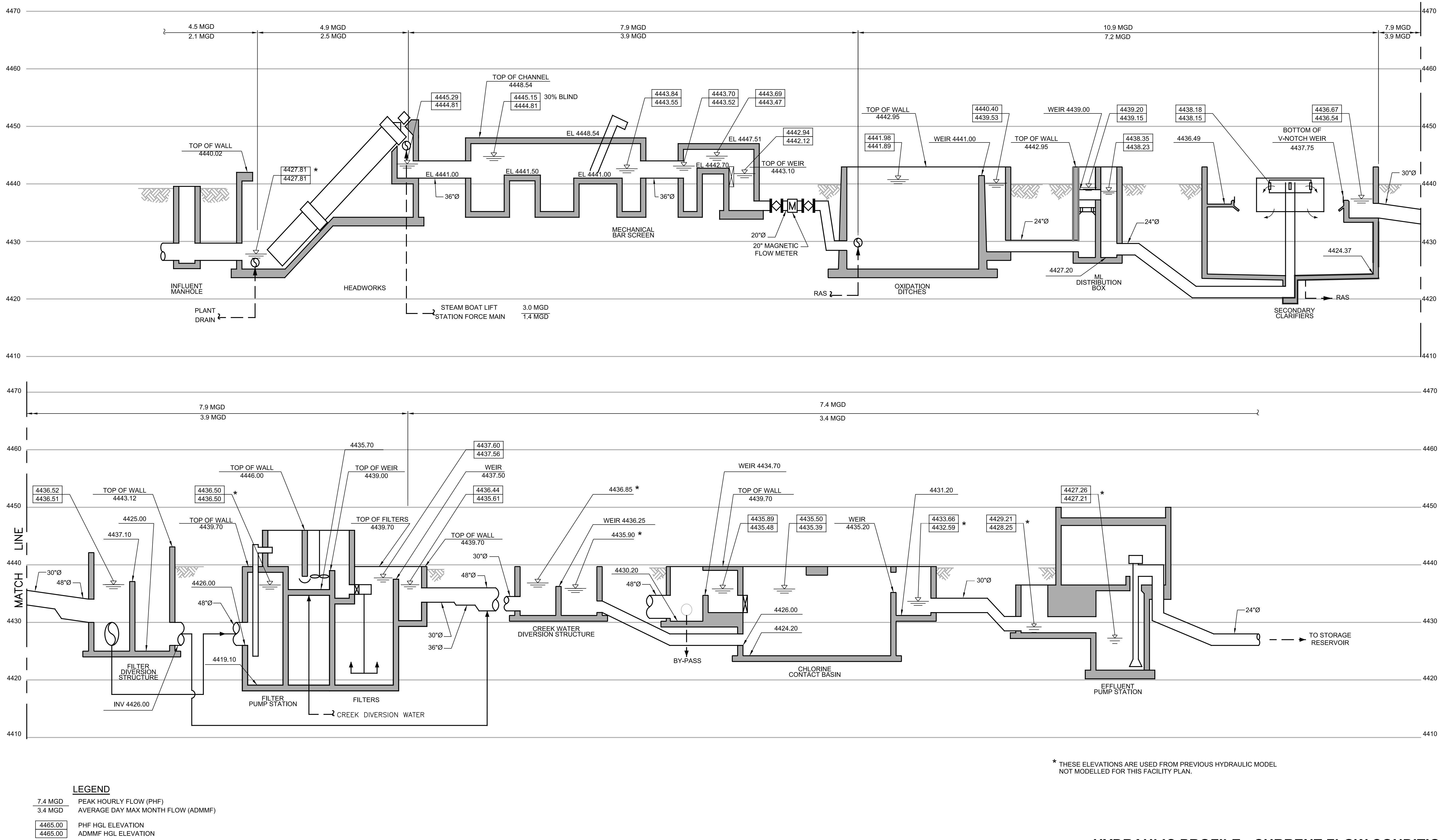
Table 6.2	Projected Wastewater Average and Maximum Flows STMWRF Facility Plan Update Washoe County		
Year	**Average Day Flow, mgd**	**Max Month Flow, mgd**	**Peak Hour Flow, mgd**
2015	3.0	3.4	7.4
2020	3.6	4.0	8.9
2025	4.1	4.6	10.1
2030	4.4	4.9	10.8
2035	4.5	5.0	11.1
2035 STMWRF(1)	5.4	6.0	13.3

Notes:
(1) To match existing unit processes, facility planning based on 6.0 mgd ADMMF.

4.1 General Assumptions

The hydraulic calculations for STMWRF represent the flow the path through the entire plant for one process unit. The flow path and amount flow for each unit is shown for current and 2035 conditions in Figure 6.3 and Figure 6.4. Various assumptions were used for hydraulic calculations. The weir elevations used in the calculations are based on the STMWRF 2012 Rehabilitation and Enhancement Project drawings (Project No. WA-2013-13, drawings dated 9/2012) and STMWRF Expansion Project (Project No. PWP-WA-2001-114, drawings dated 12/2000). The general assumptions are summarized in Table 6.3.

Table 6.3	STMWRF Assumptions for Hydraulic Calculations STMWRF Facility Plan Update Washoe County
Process Unit	**Assumption(s)**
Pipes	Absolute Roughness = 0.0004
Secondary Clarifiers	Effluent launder width = 2.5 ft. 6 in between v-notches Head loss = 4 inch
Oxidation Ditch	Head loss = 7 inch
Bar screens	30% Blockage Head loss = 12 inch

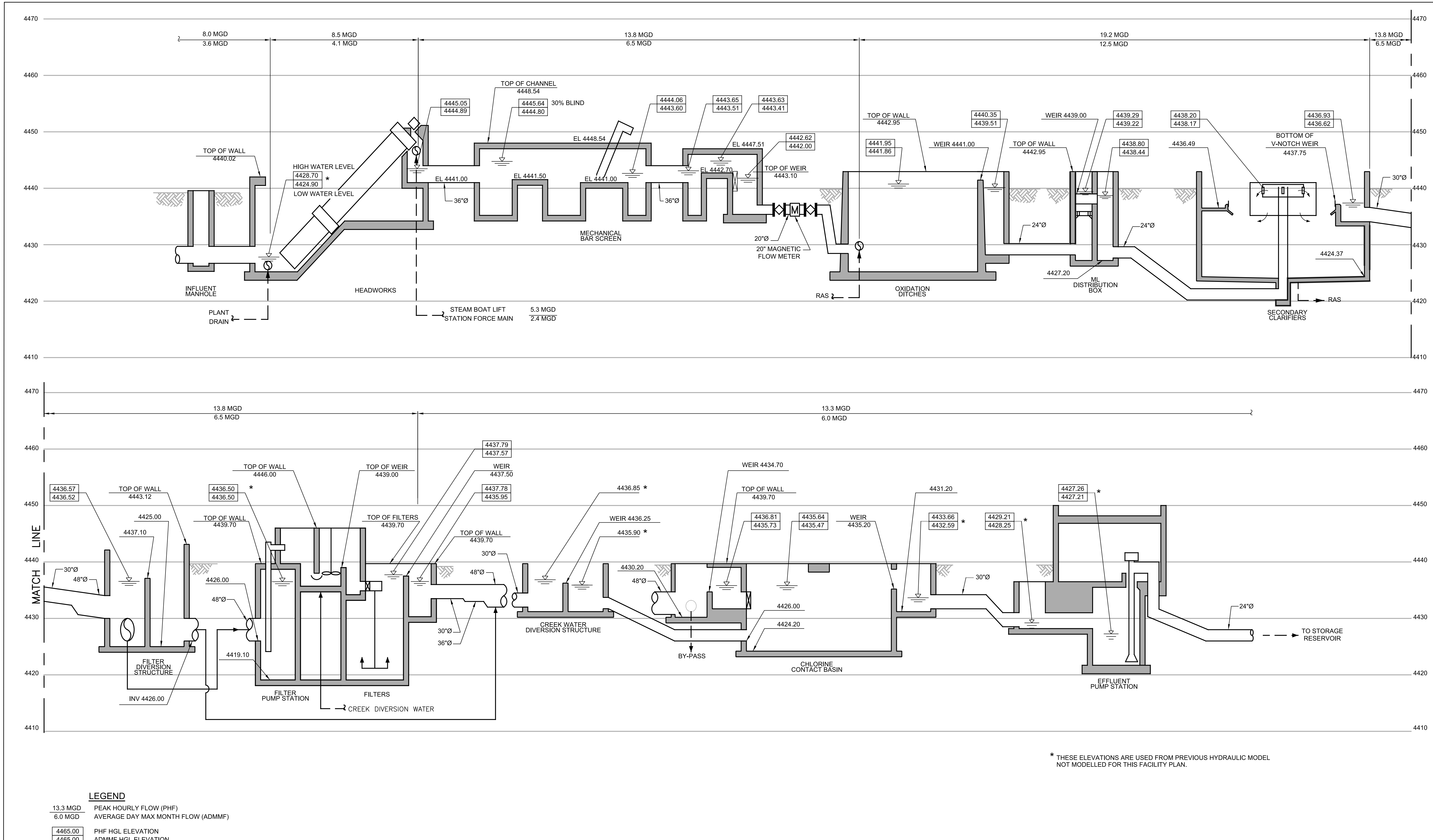


HYDRAULIC PROFILE - CURRENT FLOW CONDITION

FIGURE 6.3

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE



HYDRAULIC PROFILE - YEAR 2035 FLOW CONDITION

FIGURE 6.4

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4.2 Hydraulic Profile - Existing Flow Conditions

The hydraulics of the existing unit processes were analyzed for the existing ADMMF (3.4 mgd) and peak hour wet weather flow (PHWWF) (7.4 mgd). Figure 6.3 illustrates the hydraulic profile for existing flow condition. The preliminary treatment, secondary treatment, and tertiary treatment processes are able to convey the existing peak flow condition of 7.4 mgd. During the hydraulic analysis, no high velocities or submerged weirs were observed.

4.2.1 Headworks

The headworks provides preliminary treatment, designed to handle the peak hour flow as it enters the plant, and should be able to convey entire flow to the secondary treatment process. Currently, there are two channels each with mechanical screens. The hydraulic analysis for the existing flow condition assumes that during PHF one screen will be in service and one will be standby.

The hydraulic analysis predicts that there is 3 feet of freeboard at the entrance to the headworks. The downstream end of the headworks contains two weir gates that split the flow to the two existing oxidation ditches. A third weir gate was provided during design to convey flow to a future oxidation ditch. Depending on the selected alternative for implementation, an additional weir may need to be installed to provide flow to a fourth oxidation ditch. The existing headworks can convey PHF of 7.4 mgd without any additional screens.

4.2.2 Secondary Treatment

The secondary treatment process includes, two 20-inch influent pipes to the ditches, two oxidation ditches, two 24-inch mixed liquor pipes to the splitter box, one mixed liquor splitter box, and four secondary clarifiers. The hydraulic analysis for the existing secondary flow condition assumed that during PHF, both oxidation ditches and all four clarifiers are in service. Based on the hydraulic analysis results, the secondary treatment process has hydraulic capacity to handle 10.9 mgd (7.4 mgd influent flow + 3.0 mgd RAS flow + 0.5 mgd recycled flow).

4.2.3 Tertiary Treatment

Tertiary treatment includes tertiary filtration and disinfection. The secondary effluent and storage reservoir water can be filtered and disinfected together. Filtration includes the filter diversion structure, wet well, pump station, and two filter banks (each with four filters). Based on the hydraulic analysis, the tertiary filters have the hydraulic capacity to convey the peak flow of 7.4 mgd.

Disinfection is provided by four chlorine contact basins. The basins are used to provide disinfection for both secondary effluent and storage reservoir water. The chlorine contact basins, related piping, and weirs have the hydraulic capacity to convey the peak flow of 7.4 mgd.

4.3 Hydraulic Profile - 2035 Flow Conditions

The hydraulics of the future unit processes were analyzed for an ADMMF of 6.0 mgd and PHF of 13.3 mgd. The future unit process layout includes the addition of two oxidation ditches and four additional filters. Refer to Figure 6.4 for the hydraulic profile representing the future flow condition. With these processes in service, the preliminary treatment, secondary treatment, and tertiary treatment processes are able to convey the 2035 to convey design peak flow condition of 13.3 mgd. During the hydraulic analysis, the filter effluent weir was submerged. Therefore, attention should be given to the available head when implementing new filters.

4.3.1 <u>Headworks</u>

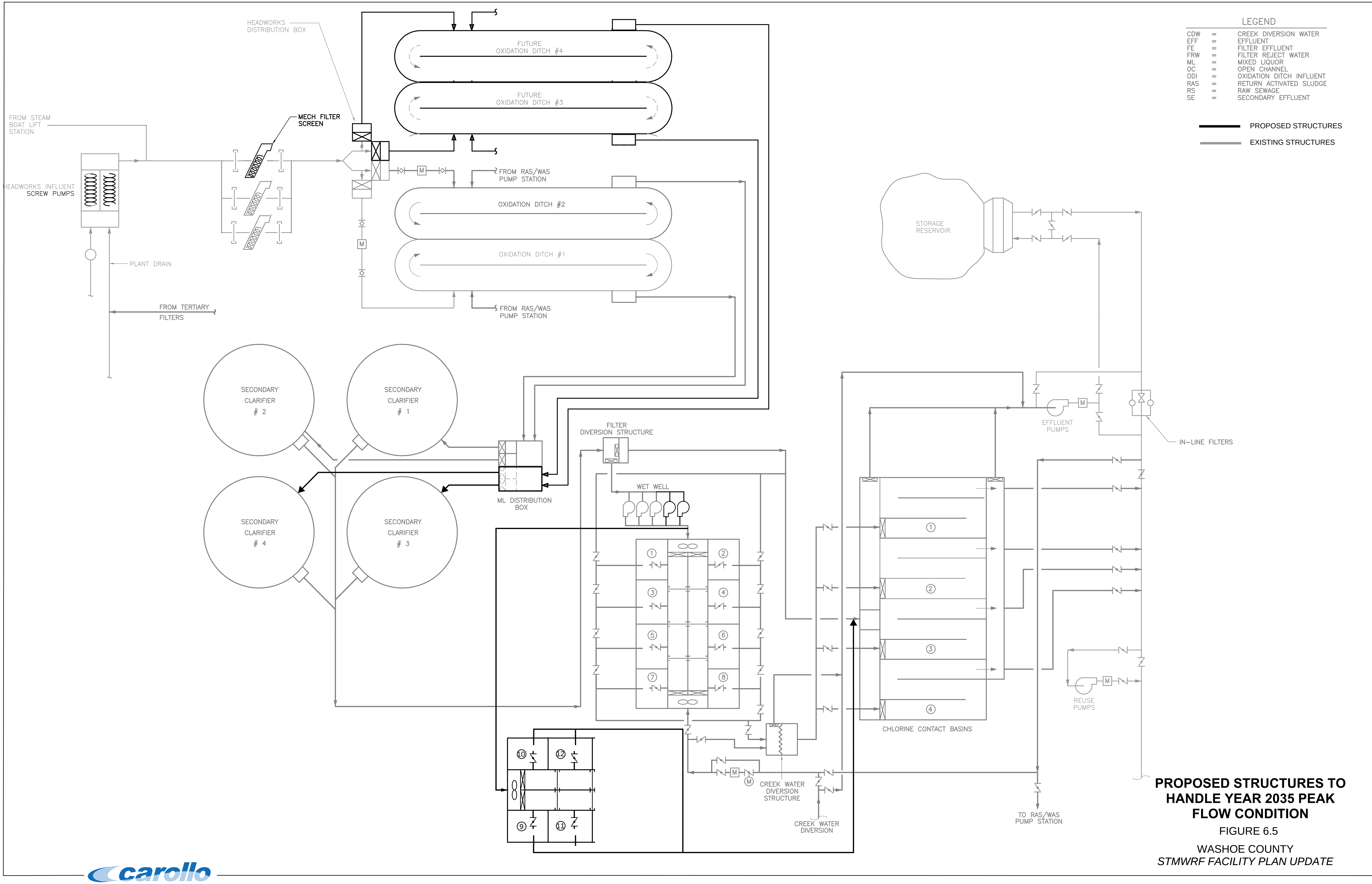
The hydraulic analysis of design peak flow of 13.3 mgd assumed three channels each with mechanical screens, two screens in service and one standby. Additionally, assumptions included four weir gates in operation to split flow to all four oxidation ditches. The hydraulic analysis suggests that there is approximately 3 feet of freeboard at the entrance to the headworks. The existing headworks can convey PHF of 13.3 mgd without any submerged weirs.

4.3.2 <u>Secondary Treatment</u>

For this hydraulic analysis, it was assumed that two new oxidation ditches will be added along with two 20-inch influent pipes to the ditches, two 24-inch mixed liquor pipes to splitter box, and a mixed liquor splitter box (Figure 6.5). Based on the hydraulic analysis results, the secondary treatment process will have a hydraulic capacity of 19.3 mgd (13.3 mgd influent flow + 5.5 mgd RAS flow + 0.5 mgd recycled flow).

4.3.3 <u>Tertiary Treatment</u>

An additional filter bank (four filters) along with influent box, influent piping, and effluent piping was assumed for 2035 conditions. The tertiary filters have the hydraulic capacity to convey the peak flow condition of 13.3 mgd. However, the hydraulic calculations resulted in the submergence of the filter effluent box. Further, the hydraulic calculations for the plant indicate that the head available between the secondary clarifiers and the chlorine contact basins for the addition of a future tertiary filtration system is approximately 5 feet, before backing up water over the secondary clarifier effluent weirs. Future filters must have less than 5 feet of headloss in order to be inserted into the existing hydraulic profile. Hydraulic calculations also suggested the chlorine contact basins, related piping, and weirs have the hydraulic capacity to handle peak flow of 13.3 mgd.



PROPOSED STRUCTURES TO HANDLE YEAR 2035 PEAK FLOW CONDITION

FIGURE 6.5

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5.0 PROPOSED LIQUID TREATMENT PROCESSES

Flow projections, as developed in TM No. 2, Planning Framework, are shown in Table 6.3. For the treatment plant facilities, an average day maximum month flow of 6.0 mgd is consistent with the available capacity of some existing unit processes, and based on County staff direction, will be the basis of unit process sizing for 2035 conditions. Therefore, proposed influent conveyance and tertiary treatment facilities (DAF, filters, disinfection), effluent pumping, and export pumping facilities should be sized to convey a total peak hour wet weather flow of 13.3 mgd. Secondary treatment facilities should be sized to convey 6.0 mgd average day maximum month flow by year 2035. Proposed liquid treatment facilities are included in the following sections.

5.1 Influent Raw Wastewater Conveyance

As shown in Table 6.3, the estimated flow within the service area by 2035 is 11.1 mgd. As presented in TM 3: Wastewater Collection System Evaluation, the 2035 PHF from the Steamboat Creek Lift Station is estimated at 2.9 mgd, and the existing pumps have adequate capacity to convey the estimated 2035 PHF. The remainder of the influent flow to STMWRF is conveyed by gravity. The projected gravity influent flow is estimated at 8.2 mgd, which is tributary to the influent screw pumps located at the STMWRF Headworks Building.

There are two influent screw pumps rated at 3,750 gpm (5.4 mgd) each. During peak flow conditions, a future upgrade to the screw pumps is recommended to adequately convey 8.2 mgd. A third screw pump at 2,000 gpm should be added, to provide a firm capacity of 8.2 mgd, with one pump out of service. Provisions have been made at the Headworks Building for a third screw pump to be added in the future. To match existing screw pump equipment, the County may decide to implement a third screw pump at 3,750 gpm.

5.2 Influent Screening

The function of the influent screening process is to remove large solids from the wastewater stream, thereby protecting downstream equipment. In 2014, the new screening and washer/compactor facilities were commissioned under the 2012 Rehabilitation and Enhancement Project, PWP No. WA-2013-3. This project implemented two new perforated-plate style bar screens and two new washer compactors with provisions for a future screen when expansion to 6 mgd ADMMF is required. Based on the planning framework presented in TM 2, the additional screen will be needed by year 2035. Because the facilities were recently implemented and designed for the 20-year planning horizon, no additional alternatives analysis for influent screening was completed.

5.3 Secondary Treatment

The function of the secondary, or biological, treatment process is to remove biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), suspended and non-settleable colloidal solids, nitrogen, and sometimes phosphorous from the wastewater to below acceptable effluent limits.

Biological treatment processes use attached growth and suspended growth processes to maintain biological activity. Suspended growth processes use biomass suspended in the wastewater to perform the required biological transformations. Suspended growth systems include sequencing batch reactors, activated sludge processes, and membrane bioreactors. Attached growth processes use biomass attached to media to perform the required biological transformations. In these applications, the attached growth forms a film on the media, referred to as biofilm. Attached growth systems include trickling filters, rotating biological contactors, and packed bed reactors. Integrated fixed film activated sludge (IFAS) incorporates both suspended and attached biological growth processes.

Biological processes typically operate in a continuous flow mode of operation but can also operate in a batch process mode. The biological process includes mixed liquor suspended solids (MLSS) composed of wastewater, microorganisms, and inert biodegradable and non-biodegradable suspended and colloidal mater. A recycle stream is typically used in the biological treatment process to maintain the microorganism population within the treatment process. The solids retention time (SRT) and hydraulic retention time (HRT) of the biological process are critical to achieving adequate biological treatment.

Biological nitrogen removal takes place in two steps:

1. Nitrification - aerobic oxidation of ammonia to nitrite and nitrate by Ammonia Oxidizing Bacteria (AOBs) using CO2 as carbon source.
2. Denitrification - anoxic reduction of nitrate and nitrite to nitrogen gas by Nitrate/Nitrite Oxidizing Bacteria (NOBs) using organic carbon as carbon source (i.e. soluble organic carbon present in the wastewater, organic carbon derived from the system biomass - endogenous processes, supplemental carbon – methanol, acetate, etc.).

Biological nitrogen removal can be achieved by a variety of processes such as:

- Suspended Growth
  - Activated Sludge
  - Membrane Bioreactors (MBRs)
- Fixed Film
  - Biologically Active Filters (BAFs)
  - Moving Bed Bioreactors (MBBRs)
  - Nitrifying Trickling Filters (NTFs)

- Fluidized Bed Reactors (FBRs)
- Combined or Hybrid processes (Suspended Growth and Fixed Film)
  - Integrated Fixed-Film Activated Sludge (IFAS)

Given the characteristics of STMWRF and planned effluent disposal and reuse alternatives, operation intense and complex processes such as BAFs, MBBRs, NTFs, and FBRs are not recommended. On the other hand, processes that offer easier operation and implementation should be considered for the future. Four alternative methods of secondary treatment processes are presented for consideration at STMWRF:

1. Continuing conventional treatment with implementation of an upstream anaerobic selector zone,
2. MBR,
3. IFAS, and
4. Converting existing oxidation ditches to aeration basins.

These alternatives require different equipment, basin sizes, and maintenance attention. A description of each follows.

5.3.1 Oxidation Ditches with Upstream Anaerobic Zone

A detailed description of the existing process evaluation and biological process modeling efforts is detailed in TM 5. TM 5 also details the relationship between the MLSS concentration in the oxidation ditches, the settleability of sludge, and the secondary clarifiers' capacity.

STMWRF has implemented the oxidation ditch configuration bioreactor system, an activated sludge configuration that consists of a "race track" bioreactor through which mixed liquor is aerated and recirculated while treatment is accomplished. The system is designed to operate at high solids retention time, which allows better removal of nitrogen in cold regions. Aeration is provided by submerged diffusers and diffuser piping. Denitrification is achieved in the STMWRF oxidation ditch through simultaneous nitrification/denitrification (SND) and formation of anoxic "pockets" as the mixed liquor circulates around the tank.

This alternative implements a selector zone (anoxic/aerobic zone) upstream of the oxidation ditches. This selector zone is recommended to improve the settling characteristics of the secondary clarifiers and thereby increase secondary clarifier capacity without constructing new facilities. For this alternative, two additional oxidation ditches are required along with the new selector zone.

The selector zone will be 0.25 MG, with three baffles and three mixers. This volume will provide approximately 60 minutes HRT within the basin. Additional structures (e.g. splitter box, effluent box, etc.) and equipment (e.g. mixers, ORP, or DO probe) will be required. In addition, instrumentation and controls related to mixers and probe will also be required.

For planning purposes, two additional oxidation ditches are recommended in addition to the anaerobic selector zone. This is based on treating an ADMMF of 6.0 mgd and considers the additional load from the solids handling facility. The County should consider constructing the additional oxidation ditches in phases, which would allow for adequate data collection and analysis of the system with the solids handling facility in service. Based on the actual data and impact of the recycle stream load, STMWRF could potentially process 6.0 mgd with the anaerobic zone and one additional oxidation ditch. Further, should the County decide to construct a new facility to achieve IPR within the service area, it is possible that the oxidation ditches could be retrofitted as membrane bioreactors. The footprint of three oxidation ditches retrofitted to MBRs will provide more than adequate capacity for serving existing reuse customers and providing influent flow to a future treatment facility designed for IPR.

5.3.1.1 Components Required for Future Expansion Phases

Based on the biological process modeling performed and described in TM 5, the components needed for future expansion of the conventional treatment system have been identified and are listed in Table 6.4. Based on the selected phasing, preliminary layouts of the facilities are presented in Figure 6.6 and Figure 6.7.

Table 6.4 Alternative 2 – Expansion with Selector Zone and Oxidation Ditch
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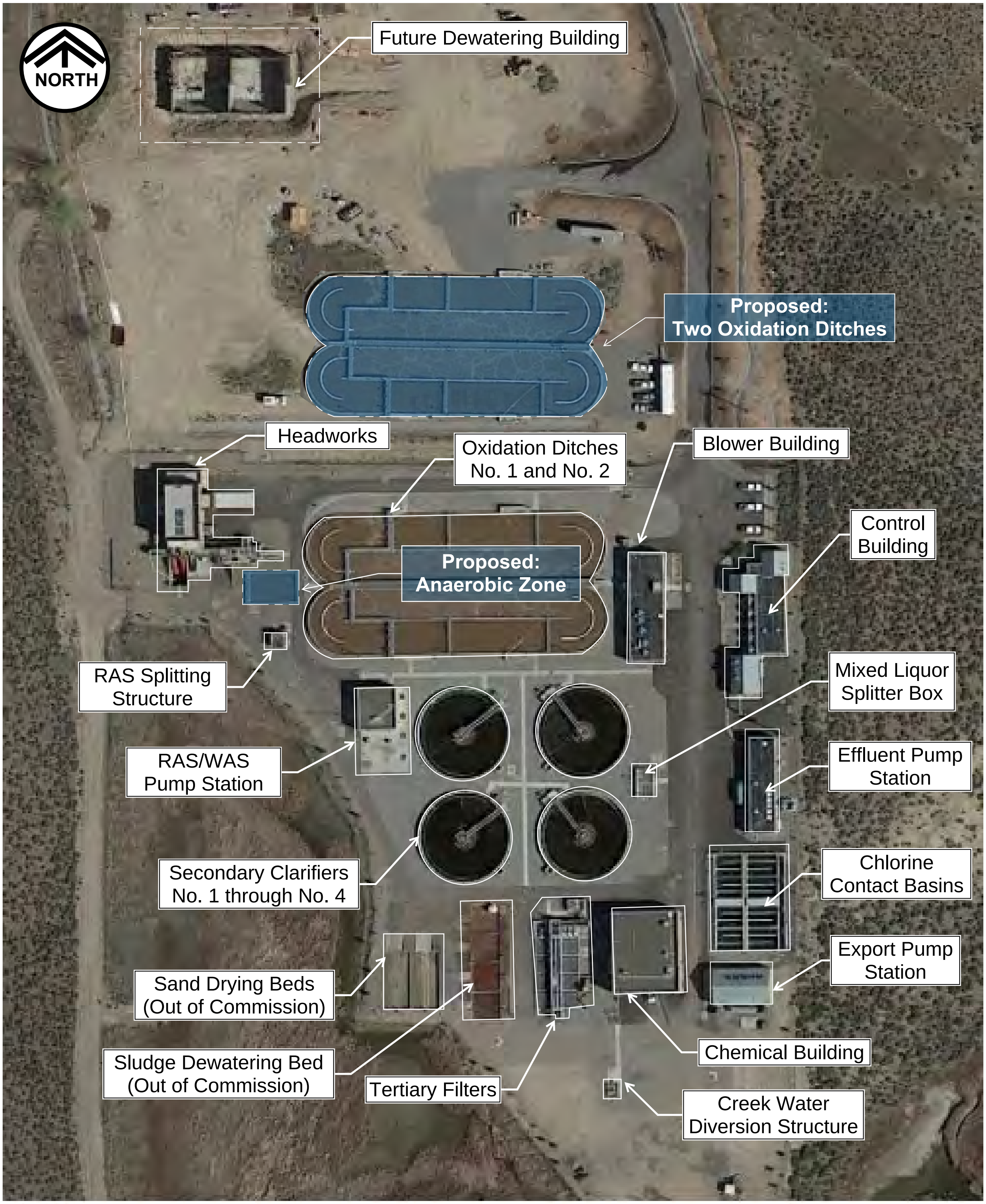
Washoe County

	Current Facilities 4.1 mgd (ADMMF)	2035 Facilities 6 mgd (ADMMF)
Conventional Treatment Components		
Total No. of Perforated Plate Screens	2	3
Screens Capacity, total	4.1 mgd	6 mgd
No. of Washer/Compactor Systems	2	2
Washer/Compactor System Capacity, total	4.1 mgd	6 mgd
Total Number of Selector Basins	-	1
Total Number of Selector Zones		3
Selector Zone Volume, Total	-	0.25 MG
Total No. of Oxidation Ditches	2	4
Oxidation Ditch Volume, Total	3.15 MG	6.3 MG
MLSS, mg/L (1)	4,000	3,000
Secondary Clarifiers	4 x 80 ft	4 x 80 ft
Design SVI, mL/g	150	

Note:
(1) Required to maintain a minimum aerobic SRT of 9.0 days under ADMMF loading conditions.



Legend:

Existing Facilities

Proposed Facilities

PROPOSED SECONDARY TREATMENT EXPANSION

ANAEROBIC ZONE AND TWO OXIDATION DITCHES

FIGURE 6.6

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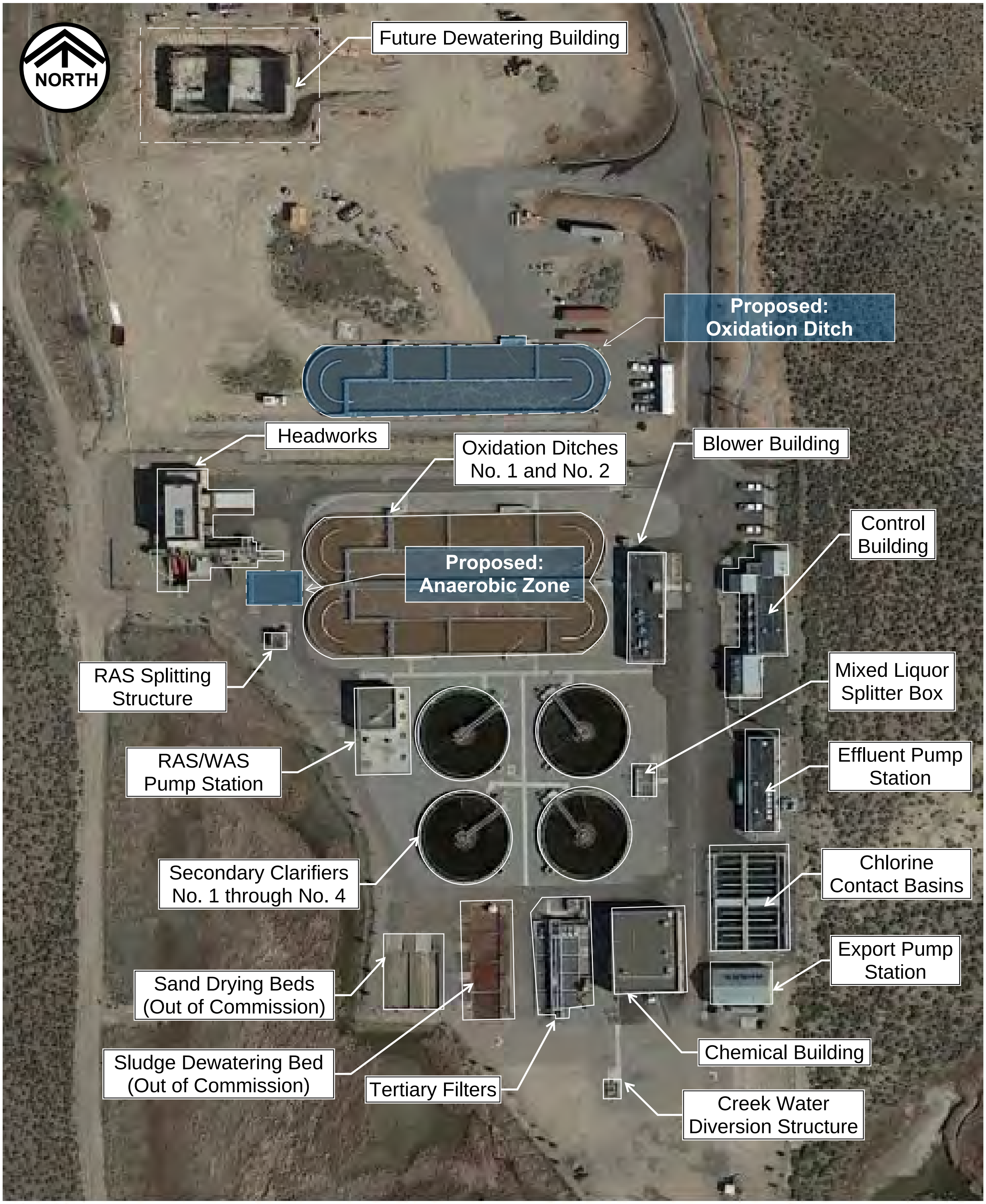

Legend:

Existing Facilities

Proposed Facilities

PROPOSED SECONDARY TREATMENT EXPANSION

ANAEROBIC ZONE AND ONE OXIDATION DITCH

FIGURE 6.7

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The estimated construction costs for future expansion with oxidation ditches are presented in Table 6.5.

The estimated construction costs for future expansion with an anaerobic selector zone and two oxidation ditches are presented in Table 6.5. The County may decide to phase construction of the oxidation ditches. In that case, the direct cost of building the selector zone and one ditch would be $15.1 million.

Table 6.5 Estimated Construction Cost – Selector Zone with Oxidation Ditches STMWRF Facility Plan Update Washoe County

	2035 Facilities 6 mgd (ADMMF)
Preliminary Systems	
Perforated Plate Screen (addition of headworks effluent weir box for two new ditches)	$1.50 M
Secondary Systems	
Selector Zone(2)	$1.40 M
Oxidation Ditches (including aeration blowers and systems), piping, and RAS/WAS Pumping	$21.0 M
Total	**$23.9 M(1)**

Note:

(1) The preliminary estimated cost is an AACEI Class 5 cost estimate. This cost only includes headworks modification and secondary treatment with anaerobic selector basin costs for comparative purposes. This does not include tertiary treatment, solids handling and engineering/administrative costs inclusive in the total project costs.

(2) Based on the final location of the selector basin, pumping may be required (cost does not include pumping). Selector basin cost estimate assumes that there is enough head available for gravity system.

5.3.2 Membrane Bioreactors

The MBR process utilizes suspended growth biological treatment in an activated sludge process followed by membrane filtration to achieve solids-liquid separation. The MBR treatment train is similar to the conventional treatment process except that membranes replace the secondary clarifiers and tertiary filters. Because the process incorporates a membrane barrier, it produces a low turbidity effluent that is not impacted by quality changes in the feed water. The effluent TSS concentration is low enough that tertiary filtration is not required. In addition, the process produces a very consistent treated effluent turbidity, promoting optimal operation of downstream treatment processes, such as disinfection. Finally, because the MBR system generally operates at a longer SRT, some endogenous destruction of the biomass occurs within the process. Therefore, total sludge production from the facility may be reduced compared with the conventional activated sludge system.

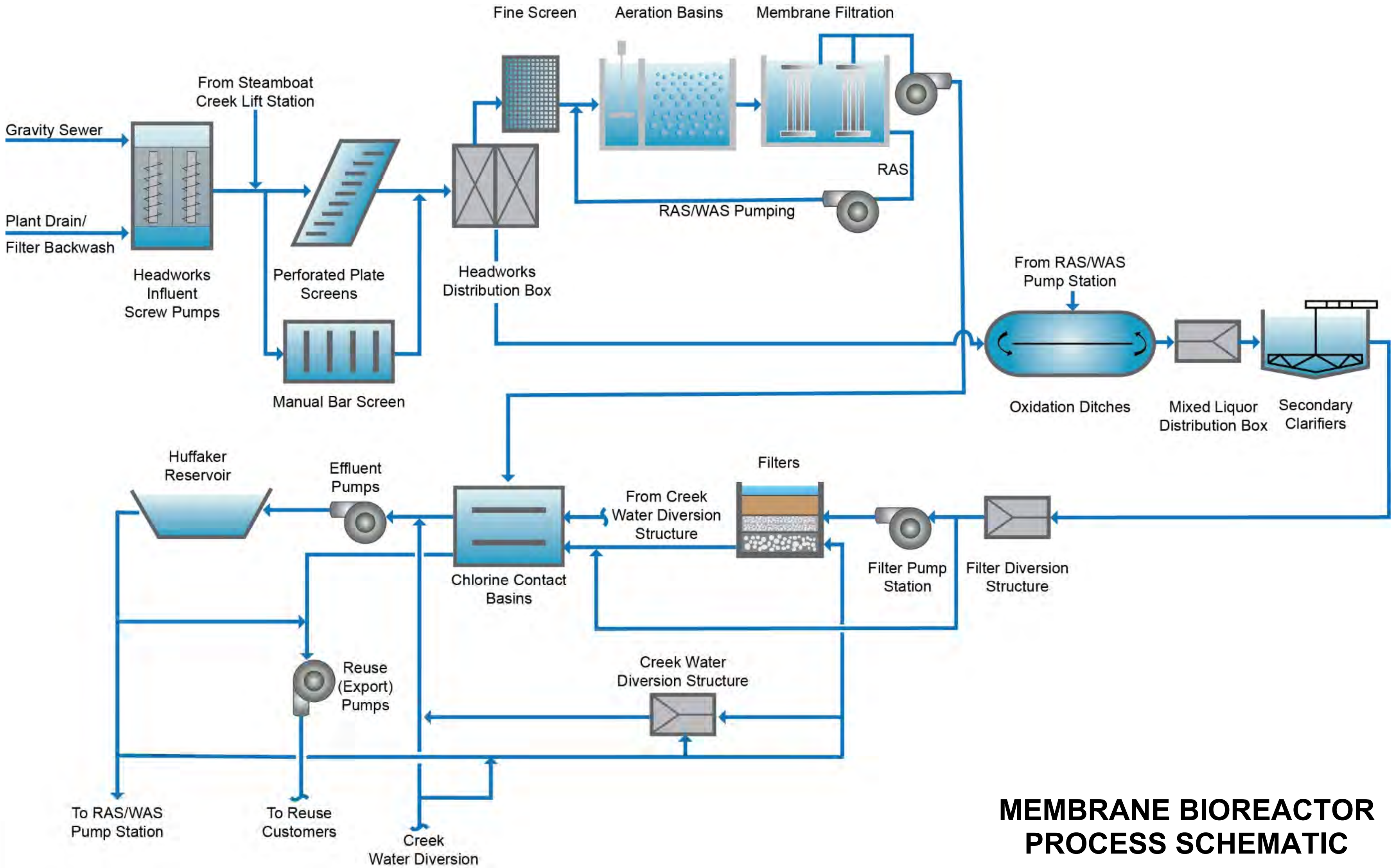
In contrast to a conventional treatment system, in a MBR system, the MLSS concentration in the aeration basins is not driven by the solids loading capacity of solids-liquid separation process, or influenced by the settling characteristics of the activated sludge. Typically, the biological reactors (i.e. aeration basins) in MBR systems operate at MLSS concentrations in the range of 9,000 to 12,000 mg/L, compared with approximately 2,500 to 3,000 mg/L in a conventional activated sludge system. The higher MLSS provides the benefit of greater treatment capacity per unit volume of aeration basin. In order to minimize the solids buildup near the membrane surface, which would reduce the flow of water through the membranes, membrane agitation air is introduced to scour the membrane surface. This air is typically provided in addition to the biological process air requirements.

Similar to conventional treatment, the aeration basins for an MBR process include internal zones and recycle flows that can be arranged to achieve various different process configurations and selection of treatment processes. Figure 6.8 shows the process schematic with the addition of MBR facilities. Also, similar to the conventional BNR alternative, the excess solids wasted from the secondary system (MBR) are sent to solids digestion and handling facilities designed for the ultimate disposal or use of the solids. The WAS from a MBR process is typically approximately 1 percent solids.

All MBR systems require screening of the influent to protect the membranes. In systems that incorporate hollow-fiber membranes (most systems), it is important that abrasive solids, hair and other stringy materials be removed prior to membrane filtration. To accomplish this, MBR systems require fine screening of the feed water in the range of 1- to 3-mm perforated-plate type screens. This is a finer screening requirement than the existing 6-mm step screens that are currently installed at STMWRF. Abrasive solids can wear through the membrane fibers and cause failures, while hair and other stringy materials wrap around the fibers and cause clumping of the mixed liquor and are very difficult to remove. Ideally, fine screens should be installed upstream of the aeration basins in order to screen all the wastewater entering the treatment process.

5.3.2.1 Designing and Procuring Membrane Systems

As described above, the various membrane system suppliers offer unique and proprietary systems, equipment, and treatment methods. Each system has different requirements for cleaning, air scouring, and control systems. Therefore, it’s very difficult to design a treatment plant that could accept any one of multiple different types of membrane systems. It is recommended to pre-qualify and pre-select a membrane system before designing the treatment basins, air and process piping, cleaning facilities, and control systems to accommodate the specific membrane system in the most cost-efficient and effective manner.



MEMBRANE BIOREACTOR PROCESS SCHEMATIC

FIGURE 6.8

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Total estimated life cycle costs are critical to selection of a membrane system and must be evaluated carefully between system suppliers. The initial capital costs to purchase the equipment will vary significantly and have a large impact on the actual operating costs. A detailed and fair comparison of equipment, power, operating, chemical cleaning, and replacement costs must be undertaken to determine which system can provide the best value for STMWRF.

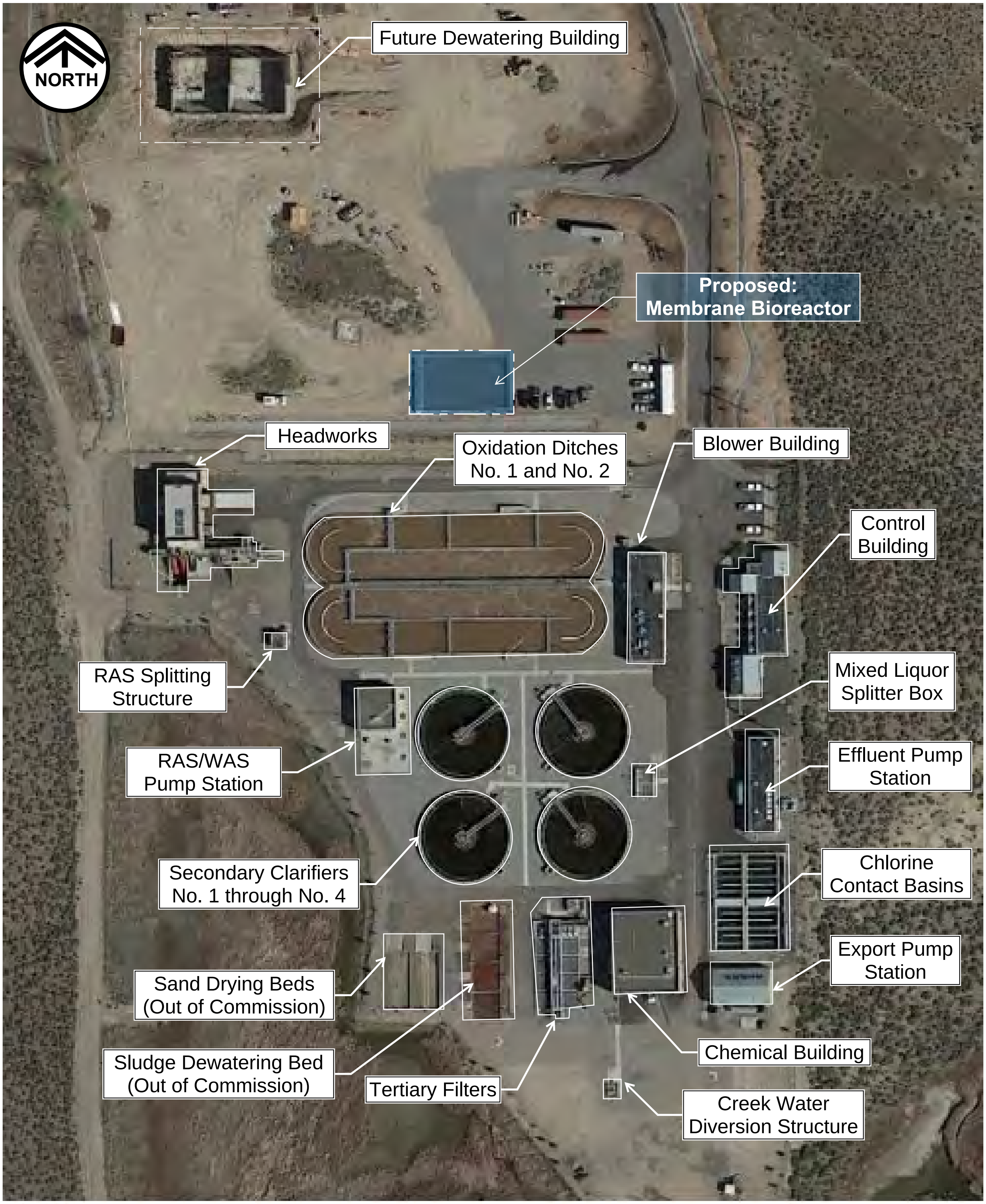
5.3.2.2 Preliminary Sizing of a MBR System

For purposes of illustration, a preliminary sizing evaluation was completed for STMWRF assuming use of the GE/Zenon ZeeWeed®500d system.

A listing of the required components and ancillary equipment for a MBR system is as follows:

- Fine screening (2 mm likely)
- Grit Removal
- Membrane cassettes and modules
- Concrete membrane basins with covers
- Overhead Bridge Crane
- Permeate and air scour header pipes
- Permeate and back pulse pumps
- Back pulse tank
- Membrane air scour blowers
- Membrane cleaning system (with Clean-In-Place chemicals)
- Compressed air system
- Programmable logic controller (PLCs) and control systems

The main process components needed for future expansion phases of a MBR treatment system have been identified and are listed in Table 6.6. A preliminary layout of the facilities is shown in Figure 6.9.



Legend:

- Existing Facilities
- Proposed Facilities

PROPOSED SECONDARY TREATMENT EXPANSION

MEMBRANE BIOREACTOR (MBR)

FIGURE 6.9

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Table 6.6	**Alternative 3 – Expansion with MBR System STMWRF Facility Plan Update Washoe County**	
	Current Facilities 4.1 mgd (ADMMF)	**2035 Facilities 6 mgd (ADMMF)**
MBR Required Components		
Total No. of Perforated Plate Screens	2	3
Screens Capacity, total	4.1 mgd	6 mgd
No. of Washer/Compactor Systems	2	2
Washer/Compactor System Capacity, total	4.1 mgd	6 mgd
Grit Removal	--	6 mgd
Total No. of Fine Screens	--	2
Fine Screens Capacity, each	--	6 mgd
Total No. of Oxidation Ditches	2	2
Oxidation Ditch Volume, Total	3.15 MG	3.15 MG
Membrane Tanks Volume, Total		1.2 MG
Total No. of Membrane Cassettes(1)(2)	--	12
Membrane Air Scour Capacity (Firm capacity)	--	7,000 scfm
Secondary Clarifiers	4 x 80 ft diameter	4 x 80 ft diameter

Notes:

(1) Based on a similar project with installed GE/Zenon ZeeWeed®500d System.
(2) Assumes MBR system would be installed in addition to existing conventional system for future capacity.

The estimated construction costs for preliminary and secondary treatment utilizing MBR components needed for future expansion are presented in Table 6.7.

Table 6.7 Estimated Construction Cost – MBR System STMWRF Facility Plan Update Washoe County	
	2035 Facilities 6 mgd (ADMMF)
Preliminary Systems	
Perforated Plate Screen	$1.40 M
Secondary Systems	
MBR System includes grit removal, fine screen, basins, membranes, and ancillary equipment(1) and structures	$28.2 M
Total	**$29.6 M(2)**

Notes:

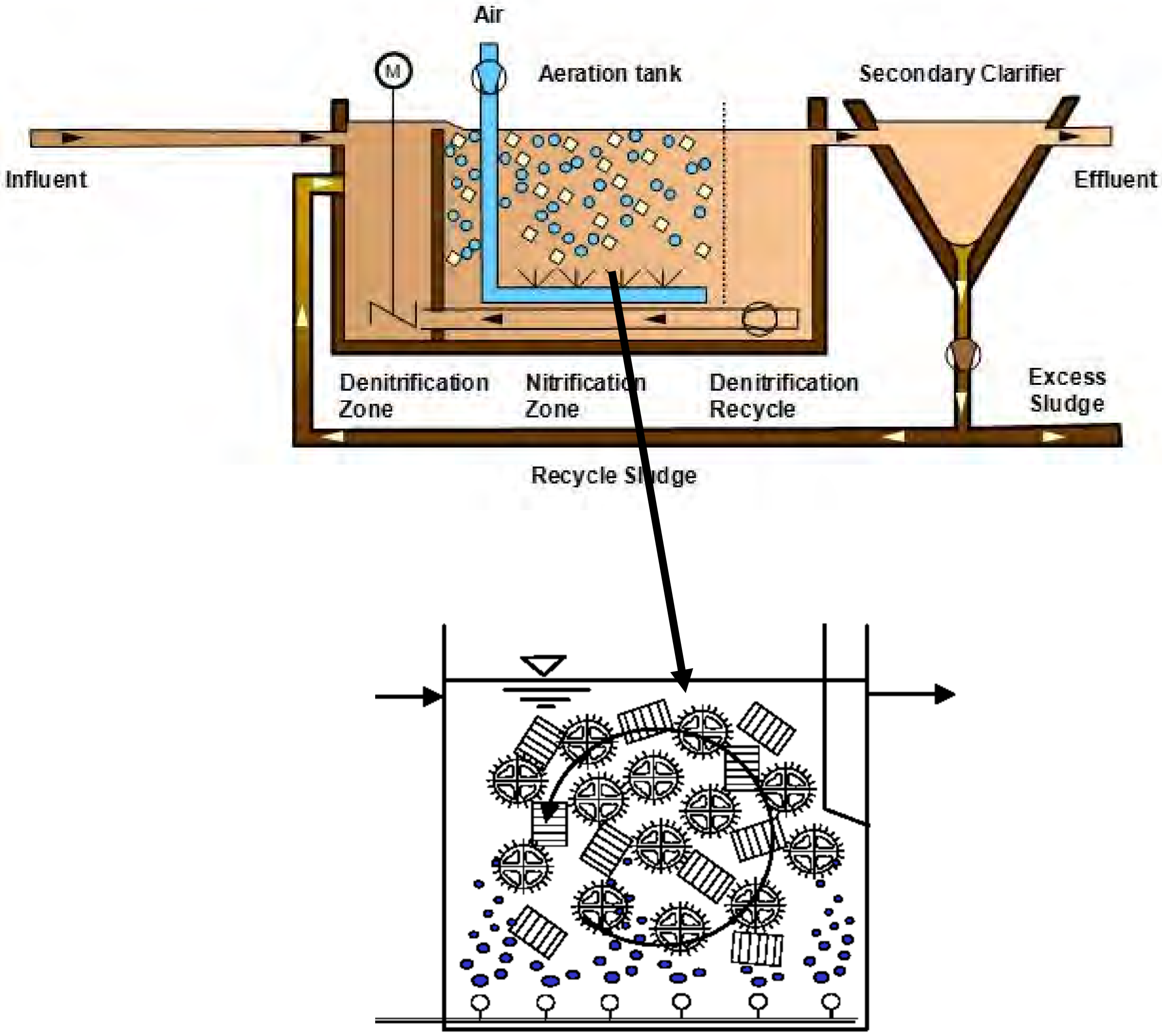
(1) Based on a ZeeWeed®500d System.
(2) The preliminary estimated cost is an AACEI Class 5 cost estimate. This cost only includes preliminary and secondary treatment costs for comparative purposes. The cost is based on the similar type projects. This does not include disinfection, solids handling and engineering/administrative costs inclusive in the total project costs.

5.3.3 Integrated Fixed Film Activated Sludge

Attached growth processes, like integrated fixed film activated sludge (IFAS), differ from the more traditional attached growth processes in that in the modern process, the media is submerged below the water surface. Consequently, for suspended growth processes, aeration must be introduced, but increased contact times are possible. Modern attached growth processes are relatively new technologies to the wastewater treatment industry.

The IFAS process occurs in a similar configuration as the conventional activated sludge process, consisting of an activated sludge basin along with a sedimentation/clarification process. For the modern attached growth processes, preliminary effluent enters the reactor containing the media and the attached biomass. The effluent from the reactor basin passes through a clarifier before proceeding to tertiary treatment. Settled sludge is wasted from the process. The IFAS process schematic is shown in Figure 6.10. In an IFAS process, the TSS concentration in the bioreactor effluent is high, similar to suspended growth processes. Aeration is used to provide oxygen and mixing in the process. Slow speed mixers are used for mixing in the post denitrification application. Screens must be used to maintain the media in each reactor. Multiple reactors can be used to select/control the bacteria for each application. The media used in this process provide a large surface area for bacteria to grow within a small unit volume.

The IFAS system has some important advantages, especially the ability to partially control biomass inventory (or SRT). In addition, the suspended biomass does not have to be attached to media - resulting in a reduction in the total surface area of the required media. Two different kinds of media that can be used with the IFAS system are free-floating and fixed. The free-floating media consist of small plastic elements that have positive buoyancy.



IFAS PROCESS FLOW DIAGRAM

FIGURE 6.10

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Fixed media is typically attached to a frame that can be lowered to the floor of the basin. Fixed media can consist of either rigid media (like structured packing used in trickling filters) or pliable media (typically attached to a frame that allows for limited media movement). The different types of media are pictured in Figure 6.11.

Free-floating media require fine screens upstream of the basin to prevent plugging of the screens in the basin itself. Coarse bubble aeration is required to achieve enough turbulence to ensure a good distribution of the media throughout the basin depth. The coarse air also helps to prevent plugging of the basin's screens. The free-floating media allows greater treatment capacity for a given basin volume, due to its greater surface area.

IFAS is a potentially good solution for several applications:

- Existing activated sludge treatment plants that require expansion but have limited site availability
- Facilities with marginal final clarifier performance and significant risk for washout
- Facilities with adequate leniency in the existing plant hydraulic profile
- Facilities where nitrification is required in a cold climate.

The IFAS process is not economical compared to the conventional activated sludge process for a new WRF design with adequate available land area. However, the IFAS process does require a smaller footprint compared to other processes and can be desirable if the basins need to be covered to minimize visual or odor issues. In general, the IFAS process is more economical than MBR processes.

The main disadvantages of these technologies are the high capital cost of the media and the higher cost for aeration. IFAS reactors must be run at higher dissolved oxygen (DO) concentrations (typically ≥ 4 mg/L) compared to suspended growth activated sludge so that the oxygen can diffuse through the biofilm layers. In addition, coarse bubble diffusers are needed for mixing (floating media) and scouring (fixed media). Having to operate at a higher DO concentration coupled with using coarse bubble instead of fine bubble diffusers means air requirements can be 25 to 50 percent higher than conventional activated sludge.

Some of the design challenges include paying close attention to the reactor hydraulic flow patterns to minimize dead zones and prevent uneven distribution of floating media, providing sufficient head to overcome the loss through the retention screens, the need for fine screening of the influent, the potential for media loss, and the potential for predatory worms if fixed media is used.

IFAS FLOATING AND FIXED MEDIA OPTIONS

FIGURE 6.11

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The following is a listing of the major suppliers of IFAS systems:

- AnoxKaldnes (Kruger)
- Meteor (Infilco Degremont)
- Linpor (Mixing and Mass Transfer Technologies)
- Brentwood Industries.

A preliminary sizing evaluation of an IFAS system was completed for comparison purposes to conventional treatment system. The results are presented in Table 6.8 below. A preliminary layout of the facilities is shown in Figure 6.12.

Table 6.8 Alternative 3 – Expansion with IFAS System
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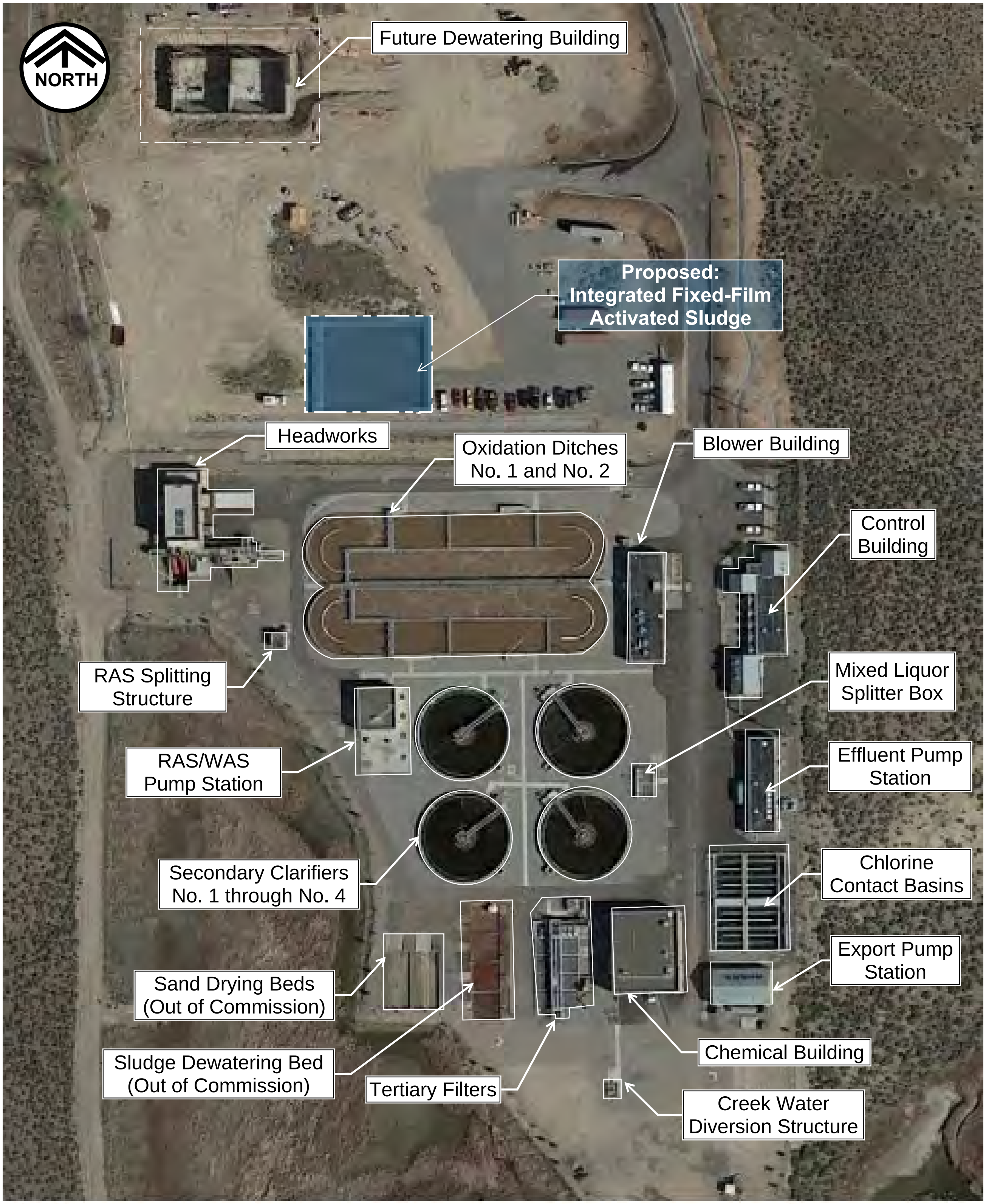
	Current Facilities 4.1 mgd (ADMMF)	2035 Facilities 6 mgd (ADMMF)
IFAS Required Components		
Total No. of Perforated Plate Screens	2	3
Screens Capacity, total	4.1 mgd	6 mgd
No. of Washer/Compactor Systems	2	2
Washer/Compactor System Capacity, total	4.1 mgd	6 mgd
Total No. of Oxidation Ditches	2	2
Oxidation Ditch Volume, Total	3.15 MG	3.15 MG
Aeration Basins/IFAS Tanks Volume, Total(1)(2)		2.1 MG
IFAS Air Scour Capacity (Firm capacity)(2)	--	6,500 scfm
Secondary Clarifiers	4 x 80 ft diameter	4 x 80 ft diameter

Notes:
(1) Assumes the system Sludge Volume Index <150 mL/g.
(2) Based on a similar project using AnoxKaldnes (Kruger).

The estimated construction costs for preliminary and secondary treatment utilizing IFAS components needed for future expansion are presented in Table 6.9.



Legend:

Existing Facilities

Proposed Facilities

PROPOSED SECONDARY TREATMENT EXPANSION

INTEGRATED FIXED-FILM ACTIVATED SLUDGE

FIGURE 6.12

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Table 6.9 Estimated Construction Cost – IFAS System STMWRF Facility Plan Update Washoe County	
	2035 Facilities 6 mgd (ADMMF)
Preliminary Systems	
Perforated Plate Screen	$1.40 M
Secondary Systems	
IFAS System includes basins, IFAS media, and ancillary equipment and structures	$24.0 M
Total	**$25.4 M(1)**

Notes:

(1) The preliminary estimated cost is an AACEI Class 5 cost estimate. This cost only includes preliminary and secondary treatment costs for comparative purposes. The cost is based on the similar type projects. This does not include disinfection, solids handling and engineering/administrative costs inclusive in the total project costs.

5.3.4 Convert Existing Oxidation Ditches to a Modified Ludzak-Ettinger Activated Sludge Configuration

Another secondary treatment process option that was evaluated was conversion of the existing oxidation ditches to a modified Ludzak-Ettinger (MLE) process and construction of a third oxidation ditch with an MLE configuration. This option was evaluated because a “once-through” MLE configuration has better plug-flow characteristics compared to an oxidation ditch. The MLE configuration includes a mechanically-mixed pre-anoxic zone, an aerated aerobic zone, and mixed liquor recycle pumps to recirculate the nitrified mixed liquor back to the pre-anoxic zone.

The existing oval tanks would be converted into a single-pass aeration tank by constructing a full-height divider wall across the oxidation ditch channel immediately downstream of the mixed liquor outlet box. The existing oxidation ditch influent and RAS pipes would be extended to discharge immediately downstream of the new divider wall. Two submerged baffles would be constructed downstream of the divider wall to create a multiple-stage pre-anoxic zone with a volume of approximately 20 percent of the total tank volume. Mechanical mixers would be used in the pre-anoxic zone to maintain mixed liquor solids in suspension and minimize oxygen transfer. Fine bubble diffusers in a full-floor configuration would be used to provide aeration throughout the aerobic zone. Submersible ultra-low-head/high-flow axial flow pumps would be installed on the divider wall to pump a controlled mixed liquor flow rate from the end of the aerobic zone into the pre-anoxic zone.

Process simulation, using STMWRF’s BioWin® model, showed that while the MLE configuration provided efficient nitrification, as expected, overall nitrogen removal was insufficient to meet the final effluent TN goal of 7 mg/L-N. Mixed liquor recycle rates up to

400 percent of the future ADMMF (24 mgd) were tested to maximize the denitrification efficiency of the pre-anoxic zone.

The MLE configuration was not evaluated further because simulation of this process option showed that the final effluent TN goal could not be met.

5.3.5 Secondary Treatment Recommendation

Table 6.10 summarizes the advantages and disadvantages of the each secondary treatment process evaluated.

Table 6.10 Comparison of Secondary Treatment Process
STMWRF Facility Plan Update
Washoe County

Advantages	Disadvantages
Oxidation Ditch with Anaerobic Selector Zone	
• Current operations • Current maintenance • Lowest O&M costs • Improved secondary clarifier capacity • Lowest expansion capital cost	• Requires the same number of secondary clarifiers as a conventional system • Largest footprint • Site likely limited to a maximum of 6 mgd ADMMF capacity • More susceptible to biological upsets (filament impacts on settling) • Process typically requires aeration, secondary clarification, and tertiary filtration to achieve Class A+ reclaimed water
Membrane Bioreactor	
• MBR process acts as an ultimate barrier to particulate matter and produces high quality effluent with low BOD, TSS, and turbidity • No secondary clarification or filtration is required to achieve Class A+ reclaimed water • Total process has smaller footprint • Easy modular expansions • Greater flexibility for future (more capacity on-site w/smaller footprint) • Fully automated operation	• Highest capital costs to convert existing capacity and expand in future • Highest O&M • Most complex O&M • Fine screening required to protect membranes

IFAS	
• Increased capacity in a smaller footprint • Can eliminate an aeration basins • Can provide sufficient nitrification in cold weather	• Air requirements, and therefore energy costs, are 25-50% higher than conventional treatment systems • Requires the same number of secondary clarifiers as a conventional system • May require chemical aid for efficient sedimentation
Convert Existing Oxidation Ditches to Modified Ludzak-Ettinger (MLE) Activated Sludge Configuration	
• Single-pass aeration tank provides better plug-flow characteristics for more efficient nitrification • Pre-denitrification zone should improve sludge settleability	• Fine-bubble diffusers would be required throughout the entire aerobic zone • Multiple DO probes and aeration air control valves would be required to meet process oxygen demands throughout the aeration tank • Dedicated mixed liquor recycle pumps and recycle pump control would be required • MLE configuration reduces nitrogen removal through SND

Based on the evaluation above and the fact that there is sufficient space at the STMWRF property, it is recommended to continue with a conventional treatment system with the addition of an upstream anaerobic selector zone at STMWRF. The conventional system offers the lowest capital and long-term operation costs of the systems described above.

5.4 Filtration

The purpose of tertiary filtration is to remove suspended solids and particulate matter that carry over from the biological treatment process and/or secondary clarifiers, and to condition the water, providing a high-quality filtrate to optimize the efficiency of the disinfection process. Based on STMWRF's current permit, tertiary filtration is required to provide a Class A reclaimed water. Based on information provided by Washoe County staff, new regulations are being drafted by NDEP for Class A+ reclaimed water. Probable regulations for Class A+ reclaimed water will specify turbidity limits of 2 NTU or less based on a 24-hour average, with no exceedances of 5 NTU more than 5 percent of the time within a 24 hour period, and no exceedances of 10 NTU at any time.

Based on these potential requirements for producing Class A+ reclaimed water, operation of the existing tertiary filters will continue to be required, with rehabilitation as described in TM 4. In addition, due to the blending of reservoir water with secondary effluent during the irrigation season, an upstream polishing step will be required. Installation of a dissolved air flotation (DAF) process will provide the necessary treatment to mitigate the impact of algae on the downstream filters as well as the filter effluent turbidity. As discussed with Washoe

County staff, a DAF process is considered and discussed below. In addition to a new DAF system, there are several recommended rehabilitation improvements necessary for the existing filters.

5.4.1 Rehabilitate Existing Tertiary Filters

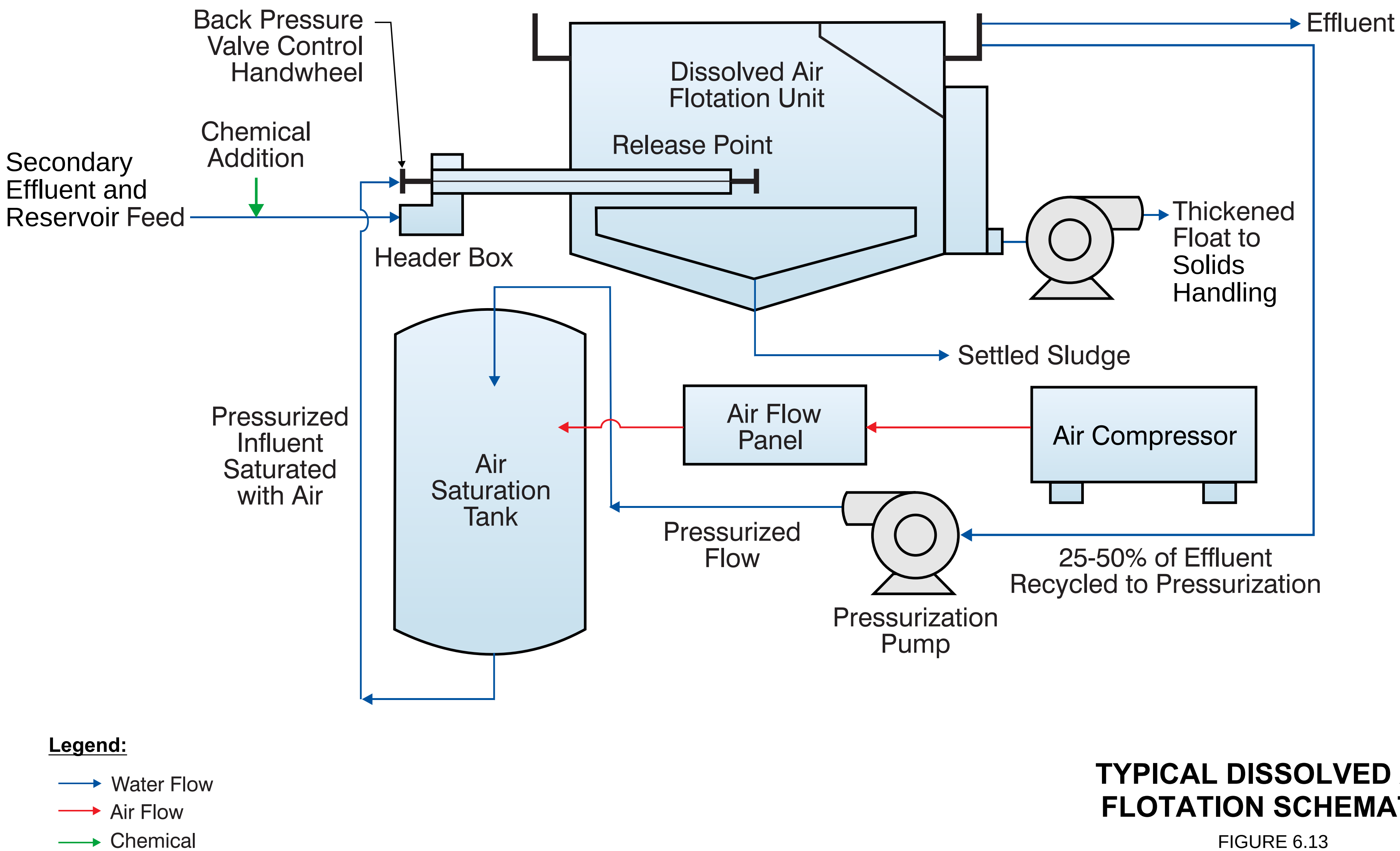
During a site visit in March 2015, crust formation was observed on the filter media, which indicates the loss of capacity due to biological formation on the media. In addition, it is expected that short circuiting may be occurring in the filters. It is recommended that the filter media sieve analysis be performed to determine the viability of the existing media. The purpose of the sieve analysis will be to: 1) check the state of the existing media in the continuous backwash filters, 2) compare the existing media to the originally specified media, and 3) to perform an inspection of the filter internals. Regardless of the recommended filter media sieve analysis recommendation, the following recommendations are necessary to enhance overall filter operation.

Enhanced backwash through air lances, or the installation of Mega Lift, is recommended. Additionally, periodic shock chlorination is recommended to reduce biological formation on the filter media. Finally, in an effort to reduce algae influent to the filter process, it is recommended that the County install algae sweeps (brushes) on the secondary clarifier launders to help reduce algae in the secondary effluent. During this project, Carollo also prepared a project memorandum regarding potential installation of DynaSand® EcoWash® to provide intermittent backwashing instead of continuous backwashing. Operating in this mode reduces the amount of reject water produced from sand washing, thereby increasing available plant capacity due to the reduced volume of backwash water. This project memorandum is included in Appendix A, EcoWash® Memorandum.

5.4.2 Dissolved Air Floatation System

DAF systems are commonly used in industrial applications for solids removal and DAF thickeners for solids thickening. DAF thickeners are widely used to thicken waste activated sludge solids in wastewater treatment plants.

The DAF process introduces tiny air bubbles that attach to the solid particles causing them to float to the surface of the tank, allowing for removal of the floated solids with a skimming mechanism. Since the rate at which the air bubbles carry particles to the surface is faster than the typical rate of particle settling in the gravity sedimentation process, the hydraulic loading rate of DAF systems can be significantly higher than gravity sedimentation basins (up to 2 gallons per minute per square foot [gpm/sf] or higher compared to 0.6 gpm/sf for sedimentation clarifiers). In DAFs, coagulants and polymers are used to increase floc size only enough to allow for sufficient air bubble to floc attachment to cause the floc to rise with the air bubbles. As a result, chemical doses for DAF tend to be lower than for gravity settling for some type of light solids, such as algae solids. A simplified schematic of a typical DAF system is shown in Figure 6.13.



TYPICAL DISSOLVED AIR FLOTATION SCHEMATIC

FIGURE 6.13

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

Air, under pressure, is dissolved in a side-stream of water, which can be a portion of the influent flow or the effluent flow and injected into the DAF influent flow. The pressurized air is delivered to an air dissolution tank where it is mixed with the carry water which is either a portion of the DAF influent or effluent. This carry water typically ranges from 15 to 50 percent of the DAF influent flow rate. The optimum amount of pressurized air and carry water required is determined by the amount of air required for proper flotation at each installation. Recycle flow is typically used for wastewater applications to prevent destabilization of flocs in the influent.

Upon entering the DAF, the carry water pressure is released using a back-pressure control valve and the super-saturated air is released from the liquid with formation of tiny air bubbles. The air bubbles attach to the suspended solids material raising the suspended particles to the liquid surface and forming a floating sludge layer, or float, that is removed by a skimmer. Heavier solids settle to the bottom of the tank where a sludge collector mechanism rakes the solids to a sludge sump for removal. Clarified effluent then flows over the effluent weir for discharge.

To improve the performance of the DAF, coagulant and/or polymer is usually injected into the influent flow upstream of the DAF. An in-line static mixer is often utilized to mix the chemical evenly throughout the feed flow.

5.4.2.1 Preliminary Sizing of a DAF System

A preliminary sizing evaluation was completed for STMWRF for covered DAF units. The preliminary sizing of the DAF system is based on design AAF of 5.4 mgd, ADMMF of 6.0 mgd, and design peak flow (Table 6.11).

Table 6.11 Preliminary Sizing of DAF System
STMWRF Facility Plan Update
Washoe County

Parameter	Design Criteria
Design Average Annual Flow (AAF), mgd	5.4
Design Peak Flow, mgd	13.3
Number of DAF Clarifiers	2
Number of Operating DAF Clarifiers at AAF	1
Diameter, feet	50
Average Total Flow Rate to DAF Clarifiers, mgd	5.4
Average Hydraulic Loading Rate, gpm/sf(1)	1.0
Peak Hydraulic Loading Rate, gpm/sf(1)	2.1
Recycle Rate(1)	20% to 50%
Average Influent TSS or Turbidity	10 NTU

Notes:
(1) Hydraulic loading rate and recycling rate is based on previous similar projects.

A listing of the required components and ancillary equipment for the system is as follows:

- Covered DAF Units
- Recirculation pumps
- Chemical systems (i.e. polymer, alum)
- DAF Mechanism
- Circular Tanks
- Compressed air system
- Recycle pumps
- Programmable logic controller (PLCs) and control systems

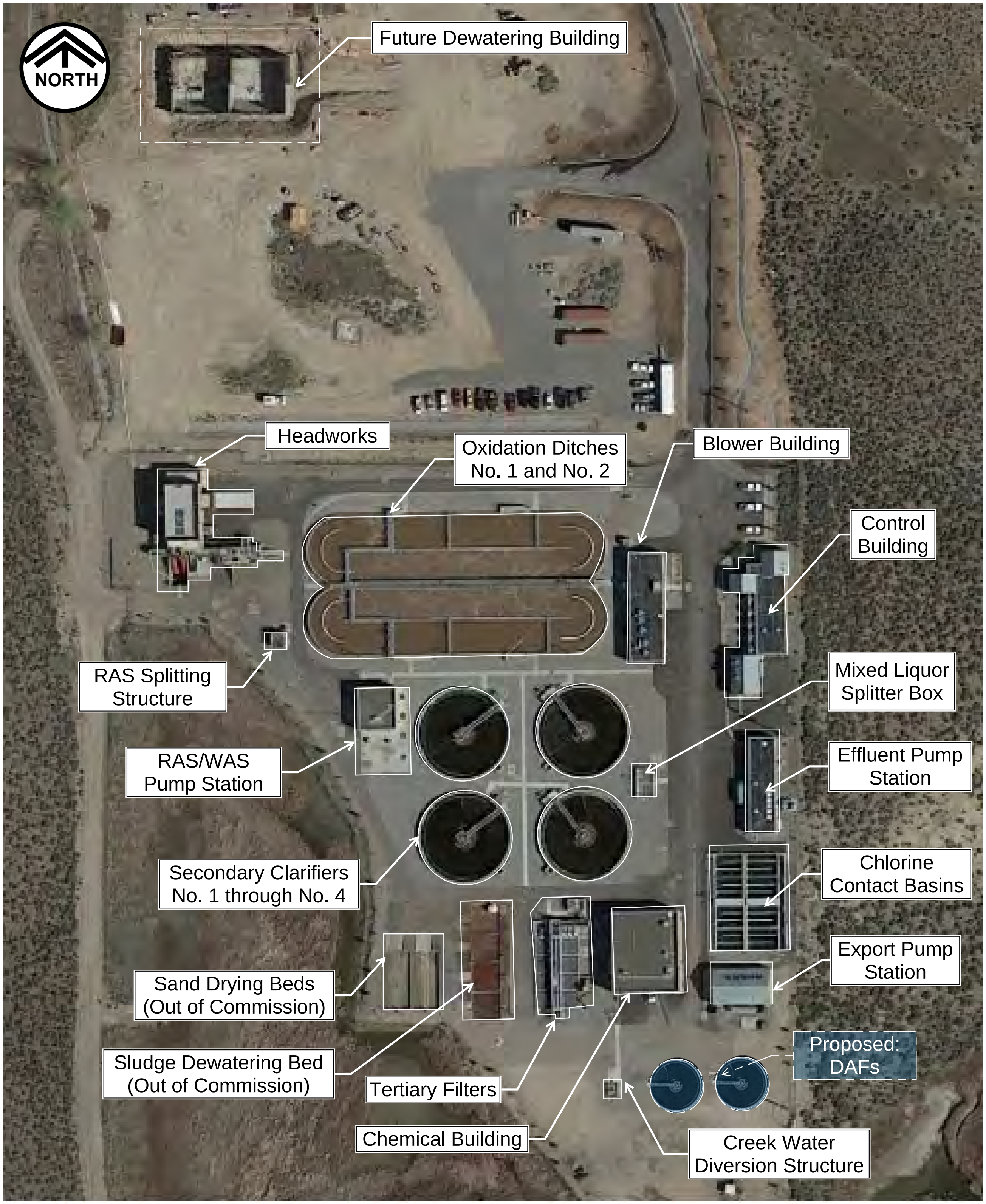
The estimated construction costs for a new DAF system is presented in Table 6.12.

Table 6.12 Tertiary Filters Pre-Conditioning – DAF System
STMWRF Facility Plan Update
Washoe County

	2035 Facilities 6 mgd (ADMMF)
Covered DAF System includes DAF mechanism, two 50-foot diameter circular tanks, recycle pumps, chemical feed systems, and ancillary equipment(1)	$9.40 M

Notes:
(1) The preliminary estimated cost is an AACEI Class 5 cost estimate. Cost estimate is based on previous similar projects cost.

Table 6.13 summarizes the advantages and disadvantages of a new DAF system for pre-conditioning. A preliminary layout of the facilities is shown in Figure 6.14.



Legend:

Existing Facilities

Proposed Facilities

PROPOSED TERTIARY PRE-CONDITIONING EXPANSION

DAF THICKENER

FIGURE 6.14

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

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Table 6.13 Tertiary Filtration Preconditioning with DAF STMWRF Facility Plan Washoe County	
Advantages	**Disadvantages**
DAF	
• Provides proven performance for removing light particles such as algae, which are difficult to settle • Usually achieves lower effluent turbidity than settling, typically 0.5 NTU • Less sensitive to temperature, especially cold temperatures as is common in settling • Startup time is very short, approximately 30 minutes • Able to adequately handle varying hydraulic loadings due to diurnal pattern • Low coagulant dose (low chemical costs) and shorter flocculation time	• Capital cost for new unit process implementation • Increased power cost due to need for compressor and recycle pump

5.4.3 Filtration Recommendation

The existing tertiary filters have a PHF capacity of 11.5 mgd, where 13.3 mgd is required. To match existing equipment and footprint, new tertiary filters should be constructed in phases to provide an additional PHF capacity. A bank of four new filters is recommended for implementation to meet 2035 flow conditions. This phased expansion will allow STMWRF to be able to treat influent flow within the planning period, then expand as needed beyond the planning period. In addition, a DAF system is recommended for implementation upstream of the tertiary filters to provide pre-conditioning and removal of algae and other solids prior to filtration.

5.5 Disinfection

STMWRF currently uses liquid sodium hypochlorite (NaOCl), a high-concentration bleach solution, as the means of primary disinfection to achieve the fecal coliform limits as required per permit. Due to the high amount of solids carry-over from the secondary clarifiers, which end up in the chlorine contact basins and suspected poor mixing at the chlorine contact basins, a relatively high dose of chlorine is being applied in order to consistently meet the permit limitations.

A project (Chemical Storage Building Rehabilitation Phase 1) is currently in the design phase to rehabilitate the chemical storage building and NaOCl system, by adding additional storage, replacing the chemical metering pumps, as well as relocating the delivery points at the chlorine contact basins to improve mixing. The installation of DAFs for pre-conditioning of the secondary effluent prior to filtration would allow the filters to more efficiently remove the remaining solids prior to disinfection. During the Chemical Storage Building Rehabilitation Phase 1 project, NaOCl usage and costs will be reviewed and updated. With the modifications to the NaOCl system and the addition of a DAF system, annual chemical costs are expected to be reduced.

5.5.1 Disinfection Recommendation

Based on discussions with County staff, anticipated regulations for Class A+ reclaimed water are currently being drafted by the State. It is anticipated that the regulations will include some requirements similar to California Title 22 (i.e. turbidity, CT). The Title 22 CT requirements are not likely to be implemented in this planning period, therefore based on County staff direction, new turbidity requirements, as previously discussed, are considered for this plan.

The County is currently undergoing design for the NaOCl system modifications, which will include work at the existing chlorine contact basins. The modifications made under the Chemical Storage Building Rehabilitation Phase 1 project, combined with the recommended capital improvements for the tertiary filtration system will provide adequate disinfection during the planning period with the ability to meet proposed turbidity requirements.

Should CT requirements be implemented in the future, STMWRF should consider alternative disinfection technology like UV disinfection to meet both turbidity and CT requirements, and an alternatives analysis be performed at that time. Another option would be to expand the existing chlorine contact basins to provide additional treatment volume and contact time.

5.6 Effluent Pumping and Export Pumping

Effluent pumps are used to convey treated water to the reservoir. The water level in the reservoir varies seasonally depending on reuse demand. Due to variation in reservoir water level, the capacity of the effluent pumps is greatly affected. When the reservoir is full, the pumping head required to deliver is more than when the reservoir is empty. Existing effluent pumps have sufficient firm capacity (12.8 mgd) to transport current peak flow (7.4 mgd) with one out of service. Typically, pump stations are designed to pump the peak hour flow with the largest unit out of service. Based on this criteria, to pump the design peak flow of 13.3 mgd, one additional 1,400 gpm pump will be required. Table 6.14 shows additional effluent pumping required for design conditions.

Export pumps are used to convey treated effluent to reuse sites. The required capacity of the export pumps is dependent on the requirements of the reuse system. To estimate export pumping capacity, we assumed that all treated effluent will be reused. However, to ensure all water is reused within the planning period, new reuse sites need to be identified or developed. Table 6.14 shows additional export pumping required for design conditions.

Table 6.14 Effluent Pumping and Export Pumping – Expansion
STMWRF Facility Plan Update
Washoe County

	Current Facilities 4.1 mgd (ADMMF)	2035 Facilities 6 mgd (ADMMF)(2)
Effluent Pumping (to Reservoir)(1)		
Pump Type	Vertical Turbine	Vertical Turbine
Number of pumps	5	6
Pump Capacity, each, gpm	1@1400, 4@2500	2@1400, 4@2500
Total Pump Capacity, gpm (mgd)	11,400 (16.4)	12,800 (18.4)
Horsepower, each, hp	1@75, 4@150	2@75, 4@150
Total Horsepower, hp	675	750
Export Pumping (to Reuse) (1)		
Pump Type	Vertical Turbine	Vertical Turbine
Number of pumps	5	6
Pump Capacity, each, gpm	2,100	2,100
Total Pump Capacity, gpm (mgd)	10,500 (15.1)	12,600 (18.1)
Horsepower, each, hp	350	350
Total Horsepower, hp	1,750	2,100

Note:
(1) Need to handle design peak flow of 13.3 mgd with one large pump as standby.
(2) Assumes that the total peak flow is handled by either effluent pumps or export pumps. Expansion assumes no change in previous design criteria used to size pumps.

6.0 SOLIDS TREATMENT PROCESSES

As noted previously, a project is currently being constructed to add solids treatment facilities at STMWRF. The design calls for adding aerobic digesters with jet aeration, WAS thickening via rotary drums, and dewatering via screw presses. This facility is expected to be online in the third quarter of 2016. This facility has been designed for solids processing associated with an ADMMF of 6.0 mgd. Therefore, expansion of the facility, once constructed, will not be required during the planning period.

7.0 RECYCLE STREAM MANAGEMENT

STMWRF currently operates one unit process that generates waste streams, which along with plant drain are recycled back through the plant. Treatment capacity, chemicals, and energy are expended to treat these side streams, which contain constituents and suspended solids. As flows to the plant continue to increase along with side stream from the solids handling, recycle stream management becomes important to improve performance, reduce costs, and continue permit compliance.

Existing processes that generate significant recycle streams includes tertiary filter backwash waste and plant drain. Recycle contributes flow and solids loading to the influent loading. Estimated future side stream flows are presented in Table 6.15. Washoe County is planning to replace their existing continuous backwash filters with EcoWash® resulting in decreased flow and solids loading to the influent. Currently, STMWRF convey their solids to TMWRF for process. Once the solids handling facility is online, it will add side stream to the influent loading. The solids dewatering side stream will contain constituents like, ammonia, nitrate, phosphorus, and solids. Estimated future side stream flows are presented in Table 6.16.

Table 6.15 Estimated Existing Side Stream Flows
STMWRF Facility Plan Update
Washoe County

Description(1)(2)	Average Flow Data, mgd(3)	Average TSS, mg/L (lb/day)	Average Ammonia, mg/L (lb/day)
Reject/Backwash Clarifier	0.475	39 (155)	4.8 (20)
Solids Dewatering pressate(3)	0.106	922 (685)	2.8 (2.5)

Notes:
(1) Estimates are based on information provided by the STMWRF Staff.
(2) Phosphorus is not included in this estimated as STMWRF currently does not have any TP discharge limit.
(3) Existing side stream flows are based on a total plant flow of 4.1 mgd (ADMMF).

Estimated existing and design recycle flows and ammonia loadings are not significant compare to influent loading. However, solids loading in the influent will increase due to recycle stream from solids handling process. Estimate recycle stream loads may not have significant impact on plant treatment capacity, however, may increase MLSS concentration. Based on estimates, no recycle stream management is required. However, to minimize nutrients and solids loading from the side stream, the sludge handling process should be operated as recommended in this facility plan.

Table 6.16 Estimated Future Side Stream Flows STMWRF Facility Plan Update Washoe County			
Description(1)(2)	**Average Flow Data, mgd(4)**	**Average TSS, mg/L (lb/day)**	**Average Ammonia, mg/L (lb/day)**
Reject/Backwash Clarifier(3)	0.155	39 (51)	56.5
Solids Dewatering pressate(5)	0.15	956 (1260)	1.3 (1:7)

Notes:

(1) Estimates are based on information provided by the STMWRF Staff.
(2) Phosphorus is not included in this estimated as STMWRF currently does not have any TP discharge limit.
(3) Assuming EcoWash® and approximately 2.57 percent backwash water to influent flow.
(4) Values estimated without sludge digestion and based on model results.
(5) The projected side stream flows are based on a total plant flow of 6.0 mgd (ADMMF).

8.0 EFFLUENT REUSE

The County is currently working with other agencies to consider a regional plan for effluent reuse, therefore, this update is based on future expansion plans from the *2016 Facility Plan Update, Technical Memorandum, Effluent Reuse Planning Update* (Appendix B).

8.1 Current Operations

Current operations are described in Section 6.2 of this TM. Refer to Figure 6.1 for the liquid stream treatment process flow diagram.

STMWRF currently produces effluent classified as Class A Reclaimed Water as defined in the Nevada Administrative Code (N.A.C.) 445A.276. This class of reclaimed water is allowed for spray irrigation of land used as a cemetery, commercial lawn, golf course, greenbelt, or park. The quality of the effluent is regulated by Permit NS0040024. The operators regularly monitor the plant effluent post chlorine contact basin (Internal Outfall 002) and report the results to Nevada Division of Environmental Protection (NDEP).

The effluent is stored in Huffaker Reservoir, which is currently being improved with a new liner to prevent loss of the reclaimed water due to seepage. When reuse demands exceed the available effluent produced by STMWRF, the stored reservoir water is filtered and disinfected prior to being pumped to reuse customers in the distribution system.

These regulation requirements are discussed in detail in TM 2 – Planning Framework. Additional detail on existing irrigation methods and management are provided in the previous TM included in Appendix B.

8.2 Future Requirements

Based on information provided by Washoe County staff, new regulations are being drafted by NDEP for Class A+ reclaimed water. Probable regulations for Class A+ reclaimed water will specify turbidity limits of 2 NTU or less based on a 24-hour average, with no exceedances of 5 NTU more than 5 percent of the time within a 24 hour period, and no exceedances of 10 NTU at any time. NDEP is working with a Reuse Steering Committee to develop draft regulations for consideration during the 2017 Legislative Session.

The improved quality of reclaimed water will expand uses for potable purposes in the State. Potable use for reclaimed water can be either indirect potable reuse (IPR) or direct potable reuse (DPR). IPR is the advanced treatment of reclaimed water to very high standards before discharging to an environmental buffer (i e. groundwater basin, river, lake, etc.), to later be withdrawn and sent to the water treatment plant. DPR is similar in that it is the advanced treatment of reclaimed water, but instead of discharging the treated water to an environmental buffer, it is held in an engineered storage basin (ESB). Since DPR is not currently being considered by the State, the remainder of this discussion focuses on IPR opportunities.

IPR is a viable reuse alternative that will allow treated effluent to supplement water supplies. IPR is currently trending in the industry due to water shortages and drought in the arid Southwest. The evaluation for the application of each reuse alternative should be on a case by case basis. There are several states that have IPR regulations, with Nevada to soon be one of them. The states that have IPR regulations have successfully permitted reuse facilities that augment their water supplies. With the advancement of technology, IPR is cost effective, safe, and reliable solutions to water shortage issues.

Other than the anticipated reuse regulations for Class A+ reclaimed water, the recently updated *Effluent Reuse Planning Technical Memorandum* (January 2016) is applicable. The water reuse demands have slightly decreased from 2008 (2,600 ac-ft/year) to 2015 (2,350 ac-ft/year).Refer to the following sections included in the technical memorandum in Appendix B.

- Development of Future Reuse Sites
- Water Balance Modeling
- Reuse Water Quality Management
- Distribution System Modeling and Expansion Planning

9.0 PLANT UTILITIES AND SUPPORT FACILITIES

The purpose of this section is to describe the existing plant utility systems and propose facilities to accommodate future plant expansions. The main utility systems include: potable water, plant sewer, and drain system. Other utility systems are briefly described namely:

plant communication system, HVAC system, and hot water. The cost of additional utilities is included in the cost of each individual process improvement and will not be discussed in this Section.

9.1 Potable Water

9.1.1 Existing Facilities

The existing potable water system supplies water to the Control Building, Headworks, RAS/WAS Pump Station, Chemical Storage Building, Effluent Pump Station, and Solids Handling Facility, as well as all the fire protection facilities and HVAC units in the plant.

Figure 6.15 illustrates the existing potable water distribution system at STMWRF. The potable water is supplied by an 8-inch pipeline running east and west between the new Solids Handling Facility and the existing Headworks and Oxidation Ditches, and north and south along the western plant boundary. Backflow preventers are installed to protect the potable water system, and are installed north of the blower building where STMWRF's network connects to the main service pipeline.

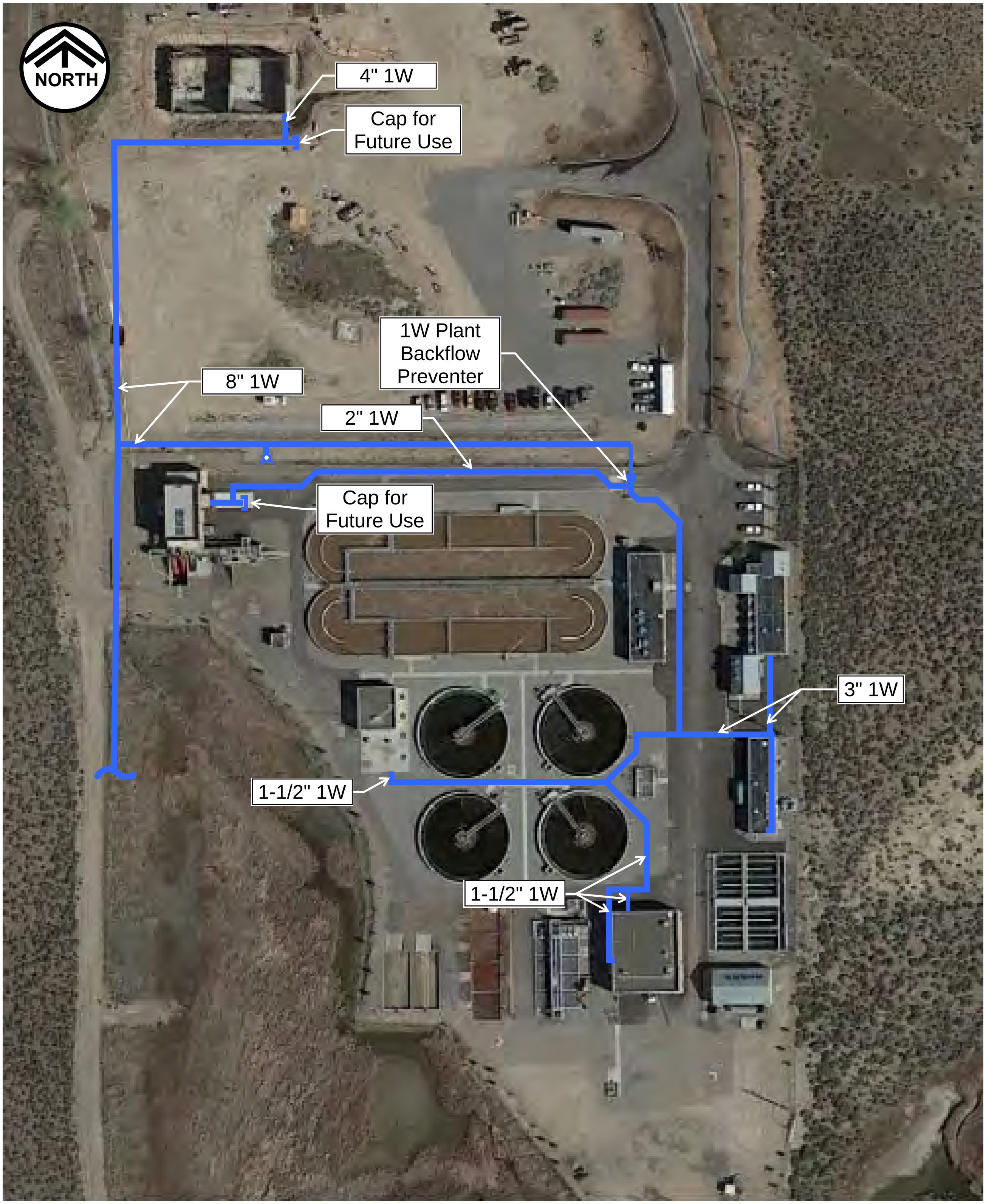
9.1.2 Proposed Future Facilities

As STMWRF is expanded, the potable water distribution system will have to be expanded to meet the future demands. The major support buildings at STMWRF have existing potable water (1W) service. Stub-outs and caps were provided on the 2-inch and 8-inch potable water pipelines serving the headworks and solids handling facilities. It is assumed that the existing 8-inch pipeline would continue to be the backbone of the distribution system. The pipe sizes and location should be confirmed during detailed design.

9.2 Plant Drain Systems

9.2.1 Existing Facilities

Drain lines from the Control Building, Chlorine Contact Basins, Chemical Storage Building, RAS/WAS Pump Station, and Solids Handling Facility flow by gravity to the Headworks. Process drainage from the Tertiary Filters and Secondary Clarifier No. 4 are returned to the Headworks. Process drainage from Secondary Clarifiers Nos. 1, 2, and 3 are returned to the Mixed Liquor Distribution Structure. Process drainage from the In-Line Filter is returned to the Sand Drying Beds, which then drains to the plant drain system tributary to the Headworks. Figure 6.16 illustrates the existing plant drain systems at STMWRF.



Legend:

Existing 1W Waterline

EXISTING POTABLE WATER SYSTEM

FIGURE 6.15

WASHOE COUNTY
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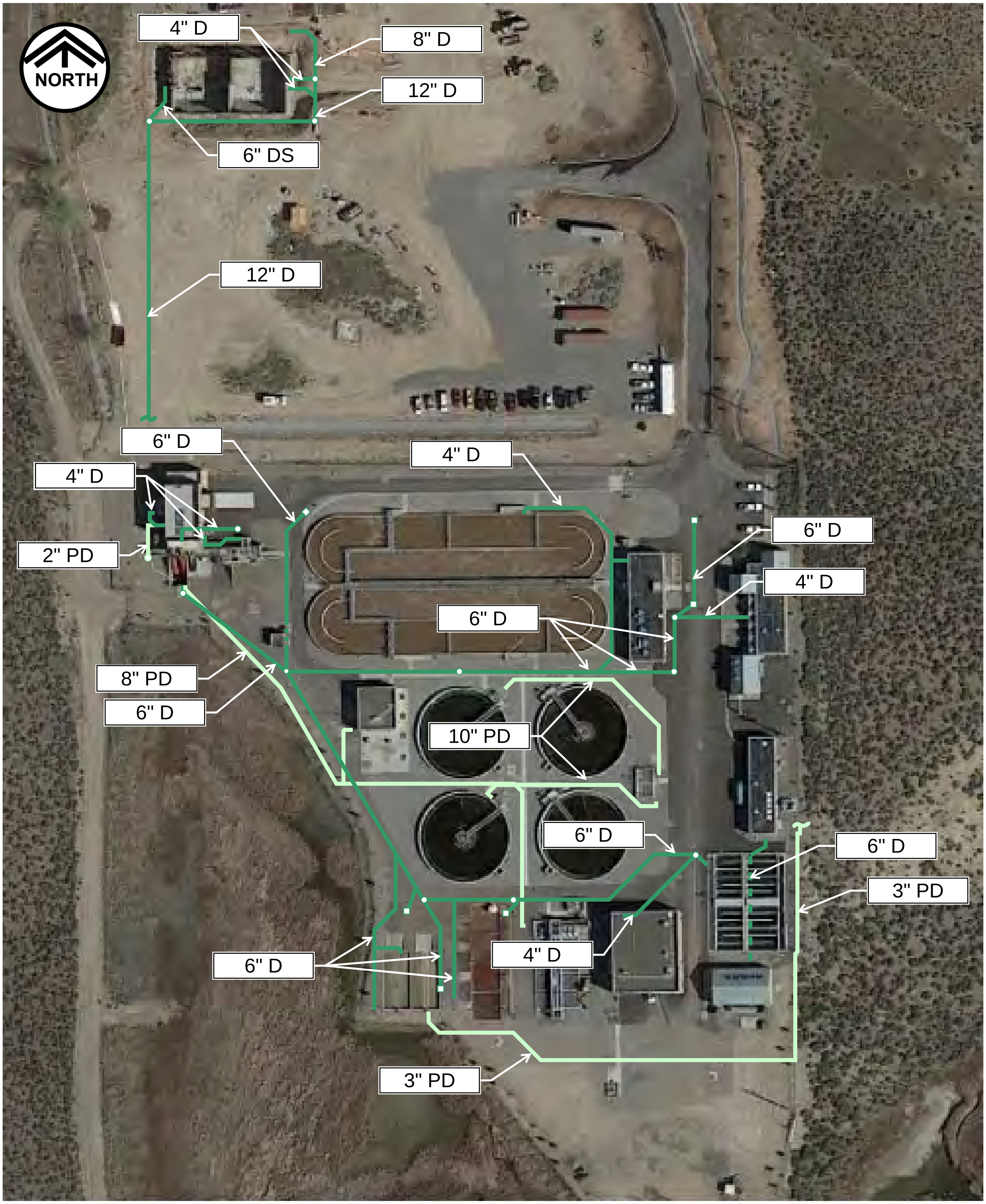


Legend:

Plant Drain Pipe

Process Drain Pipe

Catch Basin

Storm Manhole

Abbreviations:

D	Drain
PD	Process Drainage
DS	Digested Sludge

EXISTING PLANT DRAIN SYSTEM

FIGURE 6.16

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

9.2.2 Proposed Future Facilities

As the plant is expanded, particularly at secondary treatment and tertiary treatment pre-conditioning, drain lines and process drain lines shall be connected to the existing system. At that time, confirmation should be made of the adequacy of the existing drain pipeline sizing to convey the additional drain flows.

9.3 Storm Drainage

Storm water is collected at various catch basins located throughout the site. This collected water is tributary to the plant drain system and is conveyed by gravity to the Headworks. On the west side of the Headworks, storm drainage is directed to the culvert located just west of the fence line. Storm drainage from the new Solids Handling Facility will be directed to the new detention pond that is tributary to the existing drainage channel (to be re-aligned) along the western edge of the property line.

9.4 Electrical Manhole Drainage

Currently, the electrical manholes in the facility are not drained. It is recommended that future projects include the design of drainage systems for electric manholes. An evaluation of existing manholes is recommended in order to identify the critical units and propose alternatives to mitigate the problem on existing units. It is also recommended that all the existing conduits be sealed at the manholes. It is strongly advised that construction inspection personnel be aware of this problem and take strict actions during construction activities to avoid improper installation that could lead to drainage issues in the future.

9.5 Additional Items

9.5.1 HVAC System

STMWRF has several independent HVAC systems. The Headworks Screening Building, Blower Building, RAS/WAS Pump Station, Chemical Storage Building, and Solids Handling Building have their separate HVAC system. The systems rely mainly on air handling units for air conditioning and heating. Ventilation is provided mainly by roof-mounted ventilators, exhaust fans, and gravity ventilators. The HVAC system is controlled by thermostats, smoke detectors, and airflow switchers. Alarms are provided to warn operators of malfunctioning in the system. Electrical and computer rooms are equipped with packaged AC units. Package heating units are provided in the Chemical Storage Building, the RAS/WAS Pump Station, and the Solids Handling Building (bathroom, blower room, equipment room, truck bays). The Headworks Screening Building is also equipped with an evaporative cooler.

Future HVAC facilities will be provided as needed and as part of each individual project. New systems should be consolidated with the existing facilities through SCADA.

9.5.2 Hot Water System

Most of the hot water systems for personnel and laboratory use installed at STMWRF are stand-alone units, some of them installed under sinks.

9.5.3 Communication System

The communication system within the plant includes: telephones, two-way radio, cell phones, and computers. Telephones, for inside and outside communication, are available in the Control Building. Plant operators and key personnel are equipped with two-way radios for internal communication. This system is the main communication means for plant operation and maintenance crews. Some key personnel are provided with cellular phones. The plant operators and staff have their individual e-mail address with access to the plant computer network. This system is largely used for inside and outside communication. In addition, wireless access to e-mails is provided through the IT Network and cellular phones.

The communication system should be expanded to accommodate future plant expansions. As the communication means evolve, the existing system should be upgraded. Upgrades are currently being implemented under a separate contract.

10.0 PROPOSED EXPANSION PLAN AND SITE LAYOUT

The major facility improvements needed to handle a 6.0 mgd ADMMF and 13.3 mgd peak hour flows include a new perforated plate screen, anaerobic selector zone upstream of the oxidation ditches, two additional oxidation ditches, a new DAF system to remove algae prior to tertiary filters, and four new tertiary filters. The new process units are planned to be similar to the existing facilities in terms of footprint and capacity. Table 6.17 summarizes the existing, planned, and future facilities required for the projected flows in 2035. Figure 6.17 shows the general site layout for the new facilities.

STMWRF - EXPANSION PLAN AND LAYOUT

FIGURE 6.17

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

carollo

Table 6.17	Summary of Facilities Needed within the Planning Period STMWRF Facility Plan Update Washoe County		
Facility/Process	**No. Existing(1)**	**No. Future Required(2)**	**Total Required(3)**
Headworks Screw Pumps	2	1	3
Anaerobic Basin	-	1	1
Oxidation Ditches	2	2	4
Secondary Clarifiers	4	0	4
DAF System	-	1	1
Tertiary Filters	8	4	12
Chlorine Contact Basins	4	0	4
Effluent Pumps	5	1	6
Export Pumps	5	1	6

Notes:
(1) Existing facilities are operational, under design, or under construction as of January 2015.
(2) Future facilities are required to treat average day maximum month flows of 6 mgd.
(3) Total number of each type of facility for treating 6 mgd ADMMF and 13.3 mgd peak.
(4) Expansion of existing with larger pumps.

11.0 IMPLEMENTATION SCHEDULE AND COST

This section presents the implementation schedule and cost estimates for the proposed new wastewater facilities identified through the year 2035 for STMWRF. The expansion of certain treatment facilities needs to be started immediately. Project phasing and triggers are discussed to define when the design of project improvements should be started, so that future expansions can be operational in time to meet the flows. The use of these triggers should prevent both overloading the plant processes as well as overbuilding, yet provide time for design and construction of projects.

11.1 Planning Concepts

There are several basic planning concepts that were followed in planning the proposed expansions of the process facilities. These include:

1. Provide facilities that are compatible with processes already constructed.
2. Recommend treatment processes which are the same or similar to existing facilities, where possible, to minimize and simplify the number of different unit operations.
3. Adopt new technology when the potential cost savings and/or performance enhancements outweigh the drawbacks associated with implementing new processes in parallel with or in place of existing proven processes.

4. Size recommended process units to match existing units, when possible, for uniformity and symmetry of layout.
5. Provide for incremental expansion to minimize idle capacity.
6. Establish project timing to minimize the inconvenience and effort in managing a series of construction projects.
7. Provide a flexible layout to accommodate changes in treatment technology and to reserve space for future facilities.

11.2 Influent Flow Projections

The population projections and flow projections presented in *TM 2: Planning Framework* predicts that the average wastewater flow from the STMWRF service area will be 4.5 mgd by the year 2035. Based on County staff direction, this Facility Plan Update for the treatment facilities at STMWRF is based on an average influent flow of 5.4 mgd through the planning period. Wastewater flow projections for STMWRF Facilities were presented in Table 6.2.

Table 6.18 summarizes the various peaking factors used in this Facility Plan Update. Refer to *TM 2: Planning Framework* for the derivation of these factors.

Table 6.18 Summary of STMWRF Flow Parameters
STMWRF Facility Plan Update
Washoe County

	2015 Facility Plan Update Planning Value	
Parameter	**Peaking Factor**	**Flow (mgd)**
Influent Flow Planning Capacities		
Annual Average Flow (AAF)	--	5.4
Average Day Max Month Flow (ADMMF)	1.12	6.0
Peak Day Flow (PDF)	1.33	7.2
Peak Hour Dry Weather Flow (PHDWF)	2.10	11.3
Peak Hour Wet Weather Flow (PHWWF)	2.47	13.3

11.3 Influent Load Projections

TM 2: Planning Framework presents extensive information on the influent wastewater characteristics, including the five-day carbonaceous biochemical oxygen demand ($cBOD_5$), total suspended solids (TSS), ammonia, total Kjeldahl nitrogen and total phosphorus. The water quality data is based on samples collected from the influent. Table 6.19 summarizes the wastewater characteristic parameters adopted for this facility plan.

Table 6.19	STMWRF Influent Constituent Summary STMWRF Facility Plan Update Washoe County	
Parameter	**Average Influent Concentration (mg/L)**	**Load Peaking Factors**
Carbonaceous Biochemical Oxygen Demand (BOD_5)	327.0	1.45
Total Suspended Solids (TSS)	276.0	1.54
Ammonia-nitrogen (NH_4-N)	33.0	--
Total Kjeldahl Nitrogen (TKN)	56.0	--
Total Phosphorus (TP)	6.4	--

11.4 Implementation Triggers

For the purposes of this Facility Plan Update, phased implementation for expansion is developed assuming the future flows and loads match the projected values. However, as has occurred in the past, future conditions could affect the actual wastewater flows and loads. Therefore, actual flows and loads should be compared to the projections regularly so that facilities are constructed as needed in accordance with the actual increases in wastewater flow. Using this approach, planning and facility construction can be adjusted to respond to actual growth.

Initiating the design and construction of new facilities using actual growth conditions means that new facilities should be implemented based on flow and load "triggers." These flow and load triggers are established by considering the lead-time required for design and construction of new facilities. Using the required lead-time and the projected rate of growth, a trigger flow value can be established, which when reached "triggers" the design of new facilities. The triggers established for a treatment expansion will provide the required lead-time only if the rate of growth is equal to the assumed rate of growth. If the growth rate is slower than projected, the construction of an increment of treatment capacity can be delayed until it is required. Conversely, if the growth rate is faster than projected, the increment of treatment capacity needs to be constructed earlier than anticipated.

Generally, facility expansions should be phased in five- to ten-year increments over the planning period. These increments are large enough to provide a reasonable economy of scale and yet small enough to minimize the investment in potentially idle facilities. The phased implementation of proposed facilities presented in this chapter is for the purpose of developing the capital improvement plan (CIP) and funding requirements. Based on County staff direction, a five-year lead-time is used for planning purposes.

11.4.1 Trigger Curves

Trigger curves for the individual treatment processes at STMWRF are presented in Appendix C. These curves show the projected flow, the estimated and projected treatment capacity of STMWRF, and the phasing of process expansions.

The indicated project phasing shows the recommended sizing and timing of the treatment process expansions. The timing represents the year in which the process expansion becomes operational, so the trigger point for start of design precedes the year indicated by the estimated time needed for design, bidding, construction, and start-up.

11.5 Cost Estimating

11.5.1 Contingency and Markups

Cost estimates were developed using cost information for the major components in each area. The costs include both materials and labor/installation. For major equipment items, budget level quotes were obtained from the vendor. To account for lack of detailed design information, allowances for miscellaneous piping and utilities, site work, and electrical/instrumentation was applied (where applicable) as follows:

- Miscellaneous Piping & Utilities 20%
- Sitework 10%
- Electrical/Instrumentation 20%

Markups, applied in a compounding manner, were applied to the subtotal calculated for the major equipment components and allowances above, as follows:

- Contingency 20%
- General Conditions 10%
- Nevada Sales Tax & Use Tax(1) 7.725%
- Contractor Overhead and Profit (OH&P) 10%
- Engineering, Legal & Administrative 20%

(1) Assume Sales tax and Use Tax applies to 50% of Total Direct Costs.

11.5.2 Operations and Maintenance Costs

Where applicable, O&M costs were factored into evaluation of alternatives. O&M costs were developed based on projected energy consumption, chemical usage, and estimated labor costs. These were developed from a review of existing O&M costs, estimates of future costs, input from County staff, and operating information from similar wastewater treatment facilities. Table 6.20 summarizes the O&M cost components used in this Facility Plan Update.

Table 6.20	Operations and Maintenance Cost Components STMWRF Facility Plan Update Washoe County
Category	**Cost per Million Gallons Treated ($, hundreds)**
Electrical Energy	$0.087 / kWhr
O & M Labor	$50 / hr
Chemicals – Sodium Hypochlorite	$0.85 / gallon

11.6 Capital Improvement Plan

Cost estimates for the facilities recommended in this Facility Plan Update are included in Table D.1 through Table D.5 in Appendix D. These costs were developed and presented in the various TMs within this report. Refer to the specific TMs for a detailed discussion of the recommended facilities.

Note that in some cases where costs were developed for comparison of alternatives, not all of the common facilities associated with the alternatives were included. Consequently, differences may exist between such cost estimates used for comparison of alternatives and those included here. The costs presented here and the final cost estimate presented at the end of each TM account for all project components including major process piping, utility tunnels, electrical substations, and odor control facilities, among others.

Table 6.21 presents the proposed expansion projects at STMWRF.

Table 6.21 Cost Estimates for STMWRF Expansion Projects
STMWRF Facility Plan Update
Washoe County

Facility	Year Needed	Cost(1) ($, millions)
Influent Raw Wastewater Conveyance – Screw Pumps	2020	2.4
Preliminary Treatment Facilities – Screen No. 3	2032	1.5
Secondary Treatment Facilities – Anaerobic Zone and Two Oxidation Ditches	2020	22.4
Tertiary Filtration Pre-conditioning – DAF(2)	2018	9.4
Tertiary Filtration Facilities – Four Tertiary Filters	2027	6.2
Total		**41.9**

Note:
(1) Cost based on December 2015 dollars.
(2) DAF cost estimate based on slightly lower contingencies and markups. See Appendix B.

APPENDIX A – ECOWASH® MEMORANDUM

TECHNICAL MEMORANDUM

Project:	South Truckee Meadows Water Reclamation Facility (STMWRF) Facility Plan	**Issue Date:**	May 13, 2015
Prepared For:	Washoe County DWR		
Prepared By:	Carollo Engineers	**Project No.:**	9873A.00

The purpose of this memorandum is to present the result of a preliminary analysis that was completed to determine the applicability of retrofitting the existing Parkson DynaSand® filters at the Washoe County South Truckee Meadows Water Reclamation Facility (STMWRF) with the EcoWash® technology.

Background

The Parkson DynaSand® filter is a continuous, upflow, granular media filter with continuous backwashing. During the filtration process the system cleans the sand bed so that the filter is not shut down during backwashing. Feed water is passed upwards through the sand bed and exits the top of the filter as clean water. At the same time, sand can be removed from the bottom, cleaned, and returned to the top. A small portion of the filtered water is used to wash the sand and leaves the filter as a reject stream.

The DynaSand® EcoWash® filter provides continuous filtration like the standard DynaSand® filter with intermittent backwashing instead of continuous backwashing. Operating in this mode reduces the amount of reject water produced from sand washing. Previous full-scale testing conducted by Parkson, showed that the EcoWash® feature reduced operation and maintenance time, significantly reduced the capacity lost and the costs associated with reprocessing backwash water, as well as reduced the energy requirements by 60 to 90 percent as compared to operation in a continuous backwashing mode.

Title 22 validation testing was conducted on a full-scale DynaSand® EcoWash® in the fall of 2012 at a full-scale installation in Pompano Beach, Florida. Title 22 conditional acceptance for use in the production of recycled water in California was granted by the California Department of Public Health, now the Division of Drinking Water, in January of 2013. The slides from a PowerPoint presentation that was given at the 2014 Annual California Water Environment Association conference describe the Ecowash® process and the validation testing that was conducted (Attachment A). During the Title 22 validation testing, the DynaSand® EcoWash® filter was operated under the conditions listed in Table 1.

Table 1 Experimental Design of the Title 22 Performance Testing of the DynaSand® EcoWash® Filter

Experiment Number	Mode of Operation	Airlift ON (min./hour)	Airlift OFF (min./hour)	Hydraulic Loading Rate (1) (gpm/ft^2)	Air Flow, SCFH	Headloss Override Set Point (2), inches
1	Standard backwash	Continuously	0	4.4	80	31
2	EcoWash® backwash occurs 50% of the time	30	30	4.4	80	31
3	EcoWash® backwash occurs 10% of the time	6	54	4.4	80	31

Notes:
1. The plant flow rate is limited by the Reuse Utilities Plant pump capacity which does not allow for a sustained hydraulic loading rate of more than 4.4 gpm/ft^2.
2. Set point reflects the difference in water level at the influent and effluent of the filter.

During the Title 22 performance testing, the following observations were made:

- The DynaSand® EcoWash® was capable of meeting the Title 22 recycled water turbidity requirement of 2.0 NTU regardless of the mode of backwash operation 99.5 percent of the time.
- There was very little difference in filter effluent turbidity between the different backwashing modes of operation.
- The operational filter headloss increased as the backwash frequency was reduced. During the continuous backwash mode, the headloss through the filter was 18.4 inches and increased to 22.7 inches as the backwash frequency decreased to 10 percent.
- The reject water generation rate decreased from 5.67 percent to 2.51 and 1.25 percent for the 50 percent and 10 percent backwash mode, respectively (see Table 2). This reduction in reject water by using the EcoWash® function correlates to a reduction of backwash water of 56 and 78 percent for the 50 percent and the 10 percent backwash modes, respectively.

As a result of the Title 22 validation testing, the DynaSand® EcoWash® filter is conditionally accepted and is an alternative that can be considered to minimize the backwash water generated by a continuous backwash filter.

Table 2 Summary of Reject Water Generation

Exp. No.	Backwash Condition	Reject Water Generated, % of feed flow	Reduction in Reject Water by Using the EcoWash® Function, %
1	Standard	5.67	-
2	50% mode	2.51	55.7
3	10% mode	1.25	77.9

Historical Performance of the Dynasand® Continuous Backwash Filter at the STMWRF

The amount of water treated and the backwash water that was generated by the DynaSand® continuous backwash filter at the South Truckee Meadows water reclamation facility over two time periods (i.e., 2010-11 and 2013 to 2015) is presented in the probability graphs shown in Figures 1 and 2. The variation in percent reject water of the filters for these two time periods shown in the form of probability graphs is presented in Figures 3 and 4. As can be seen in Figure 3, during the period of 2010-11, the 50 and 95 percentile reject value was 6.7 percent and 12.2 percent, respectively. During the period of 2013-15, the measured reject value increased from what is was in 2010-11. As can be seen in Figure 4, the measured 50 and 95 percentile reject value during the 2013-15 period was 10.8 and 14 percent, respectively. This reject water is sent back to the head of the plant and decreases plant capacity.

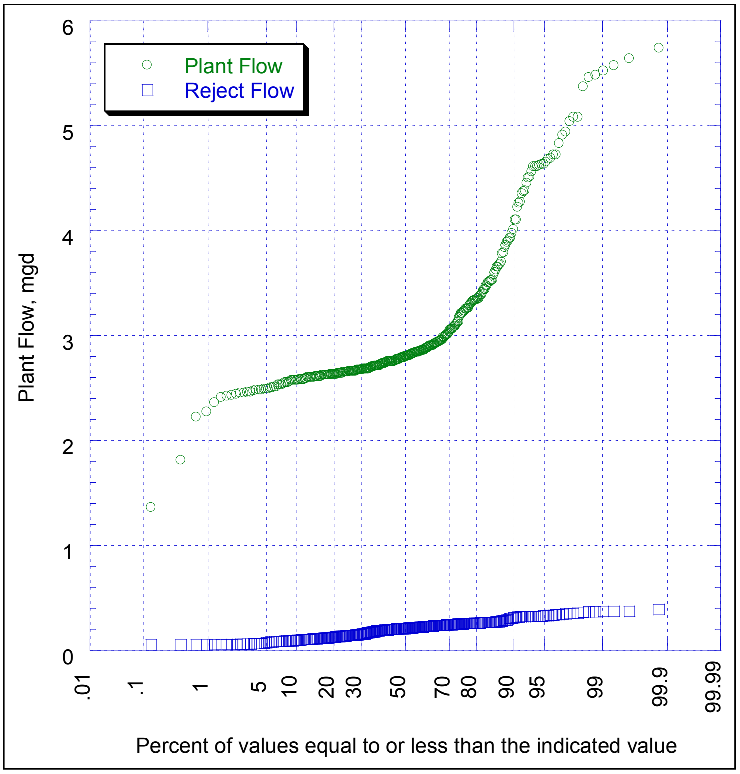


Figure 1 Plant and Reject Water From 2010-2011

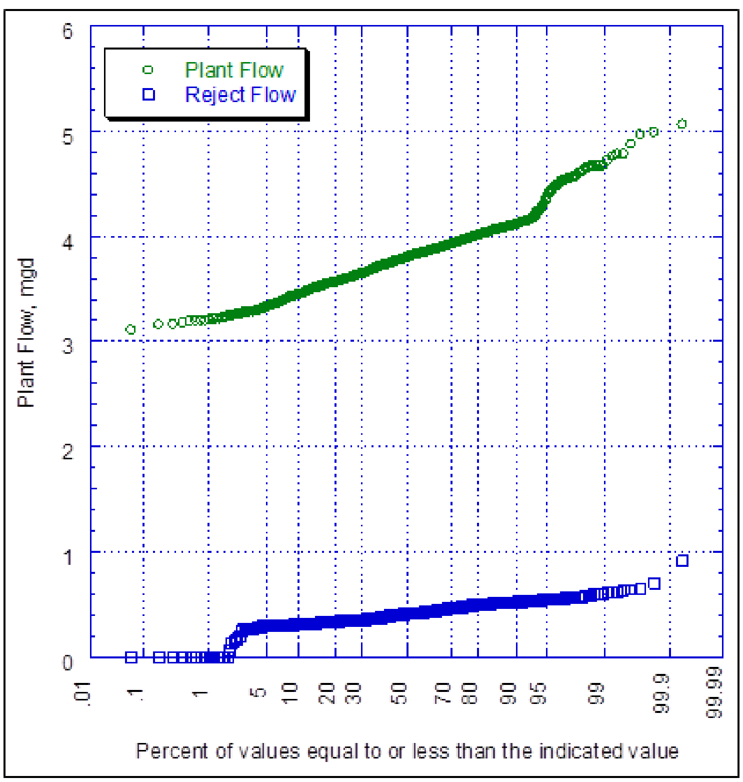


Figure 2 Plant and Reject Water From 2013-2015

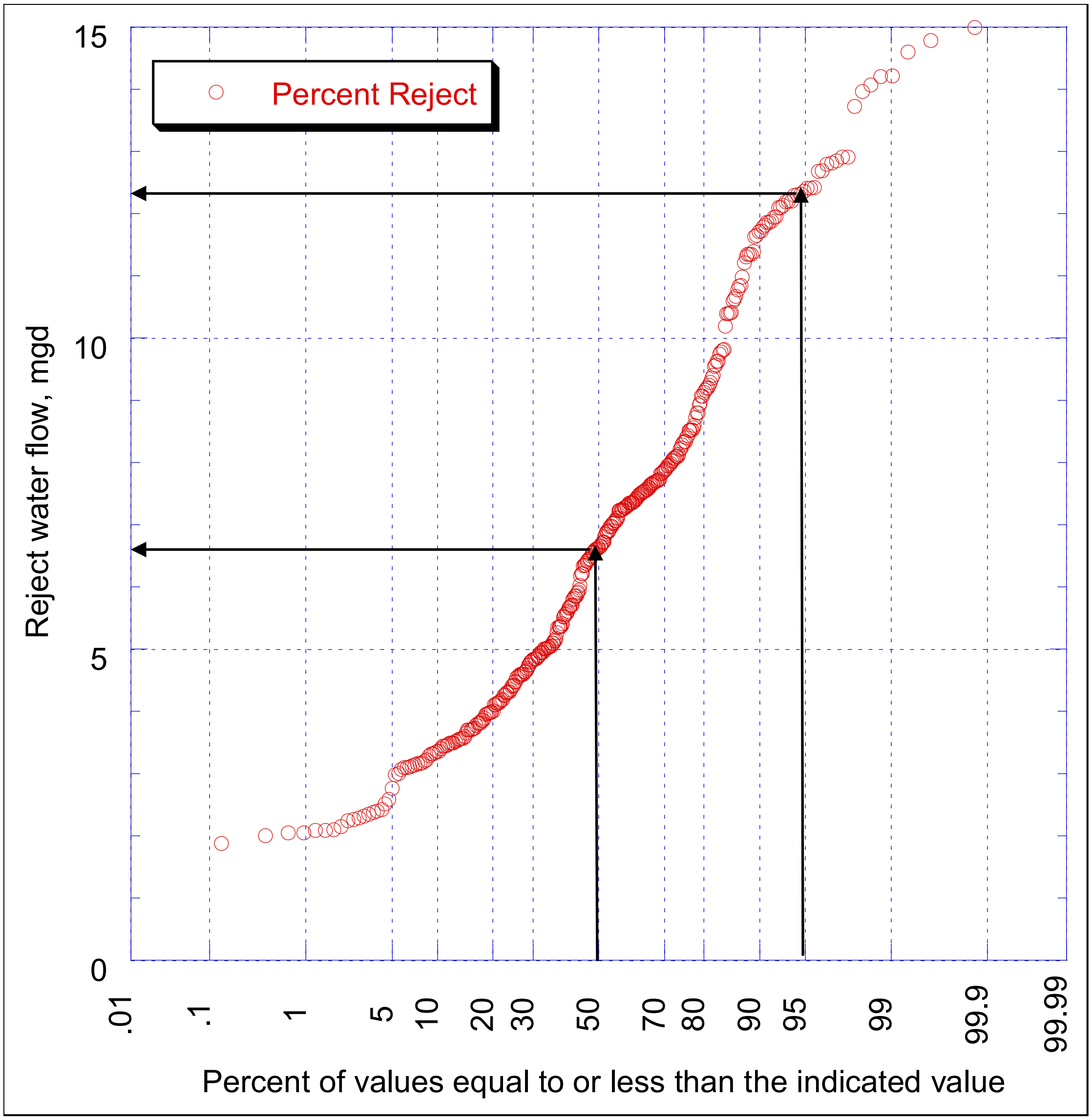


Figure 3 Variability in filter reject water measured during 2010-11

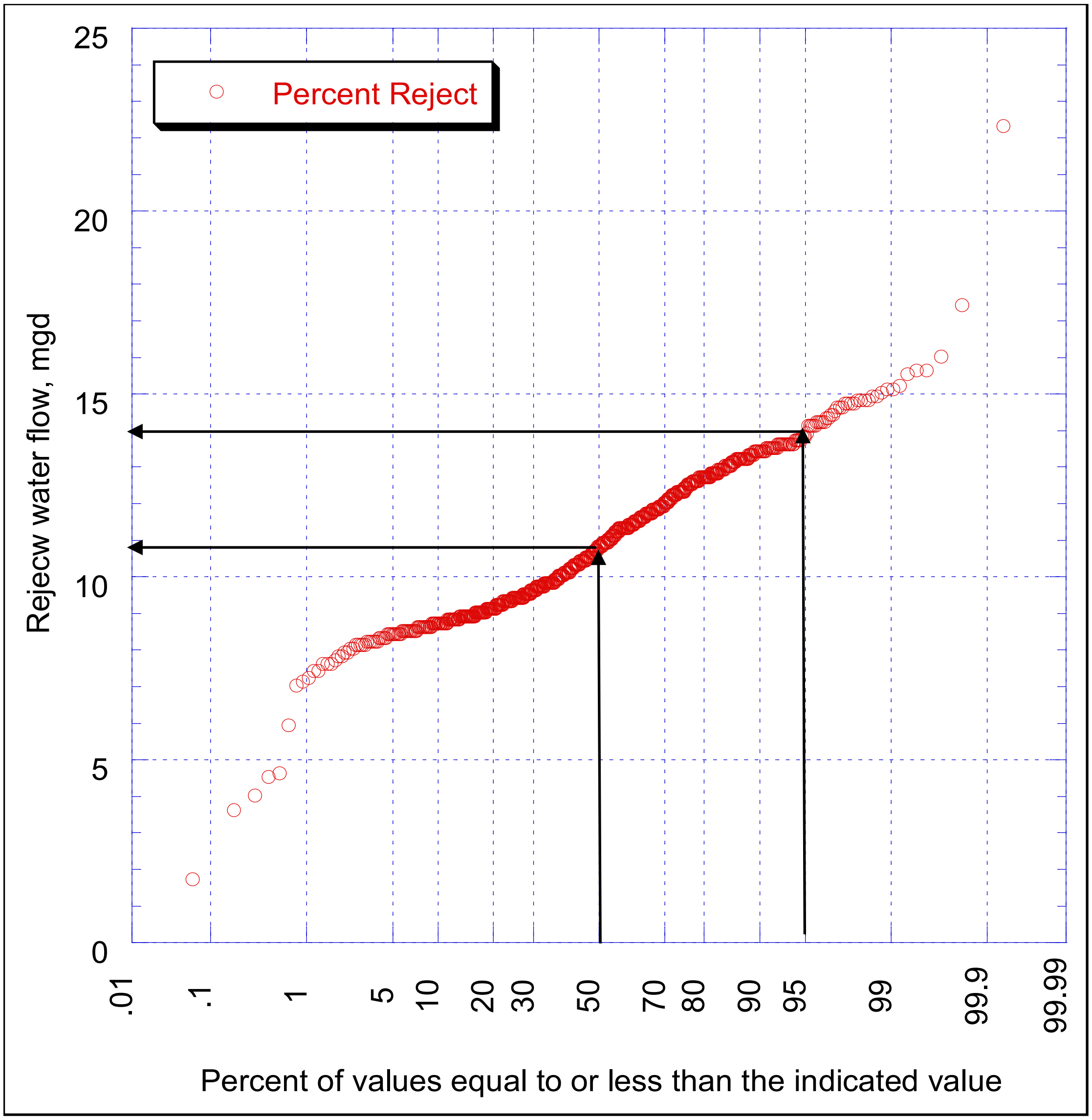


Figure 4 Variability in filter reject water measured during 2013-15

Potential Applicability Dynasand® Continuous Backwash Filter at the STMWRF

During the Title 22 performance testing that was conducted at the full-scale installation in Pompano Beach, Florida, a 56 and 78 percent reduction in reject water generated was observed for the 50 percent and the 10 percent backwash modes, respectively. It is unknown the exact backwash percentage mode that the filters at the STMWRF would need to operate. This backwash percentage mode is highly dependent on the filter influent water quality. However, if the retrofitted DynaSand® EcoWash® filters were able to operate in a 50 percent mode, the backwash rates could potentially be decreased to 4.8 percent. If the retrofitted DynaSand® EcoWash® filters were able to operate at a 10 percent backwash mode, the average backwash rates could potentially be decreased to 2.3 percent.

In the summer of 2012, a DynaSand® EcoWash® filter was piloted at the Napa Sanitation District Soscol Water Recycling Facility (SWRF). The purpose of the testing was to determine if the DynaSand® EcoWash® filter would effectively treat a secondary/clarified pond effluent blend. During the pilot testing, the EcoWash® system was operated in an intermittent mode with the backwash frequency ranging from 2 to 6 minutes every hour. At a backwash frequency of 2 to 6 minutes every hour, the DynaSand® EcoWash® filter generated backwash water at 1.31 and 2.41 percent of the influent flow rate. The filter feed water blend had a low turbidity value and was easy to filter. As a result of the pilot testing conducted at the SWRF, it was determined that the DynaSand® EcoWash® was effective at reducing the backwash water while producing a high quality effluent.

As part of the Phase 1 recycled water expansion project at the SWRF, the District staff considered retrofitting their existing filters with the EcoWash® system while installing the EcoWash® system on new filters to be installed. The equipment cost quote shown in Table 3 was obtained in 2012 for retrofitting different numbers of filters. As shown, the equipment cost per module decreased as more filters were retrofitted. The filter reject water at the SWRF was sent back to the oxidation ponds and not to the head of the plant. Because the backwash water was not sent to the head of the plant, the amount of backwash water generated at the SWRF does not impact the plant capacity. Therefore, the District decided not to retrofit the existing DynaSand® filters with the EcoWash® system since it would not increase the amount of recycled water that the SWRF could generate.

Table 3 Summary of Equipment Costs for the EcoWash® Retrofit

Number of Filters	Modules	Quoted Equipment Cost	Equipment Cost per Module
One	10	$144,000	$14,400
Two	20	$255,000	$11,250
Four	40	$336,000	$84,000

The EcoWash® system is a proven, effective retrofit that could be installed on the DynaSand® filters at the STMWRF to decrease the amount of backwash water that is currently conveyed to the head of the plant. The exact amount that the EcoWash® system can decrease the backwash water and reduce energy costs is not known without conducting a pilot test. However, based on pilot and full-scale testing that has been conducted at other locations, it is likely that installing the EcoWash® system at STMWRF would likely reduce the backwash water generated by 50 percent.

Conclusions and Recommendations

To determine if the DynaSand® filters should be retrofitted with the EcoWash® system, the following next steps are recommended:

- Determine the remaining life of the existing DynaSand® filters at the plant.

- Determine if the existing DynaSand® filters will meet future water quality goals at the STMWRF.
- Assuming the remaining useful life of the existing filters is adequate and their ability to meet future water quality goals is verified, obtain a quote from Parkson for the retrofit of the existing DynaSand® filters at the STMWRF.
- Conduct a cost benefit analysis to determine if the cost associated with retrofitting the existing DynaSand® filters and the resulting decrease in energy costs and increase in treatment plant capacity at the STMWRF is worth the benefit that will be realized from the retrofit.

Prepared By:

KAC:cll

Attachment A

Validation Testing of A Continuous Backwash Filter In an Intermittent Mode of Operation

May 2, 2014

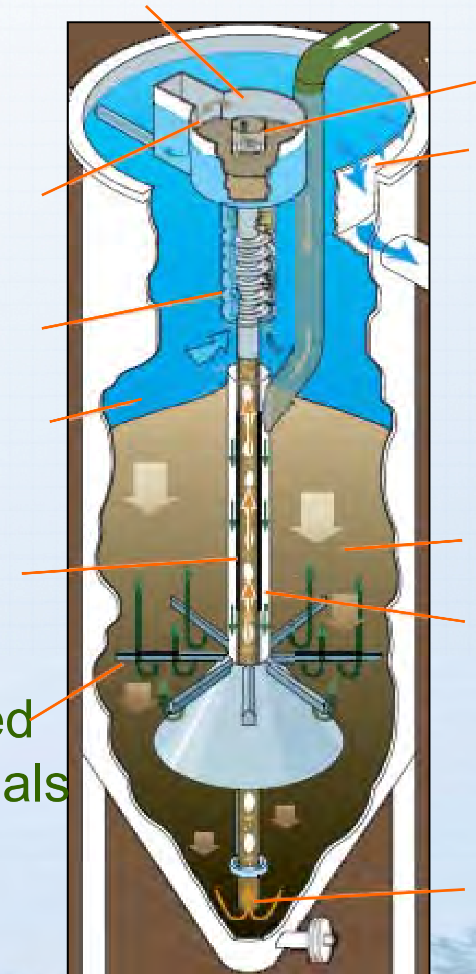
Keith Bourgeous
Nicola Fontaine
Andy Salveson

I will Present

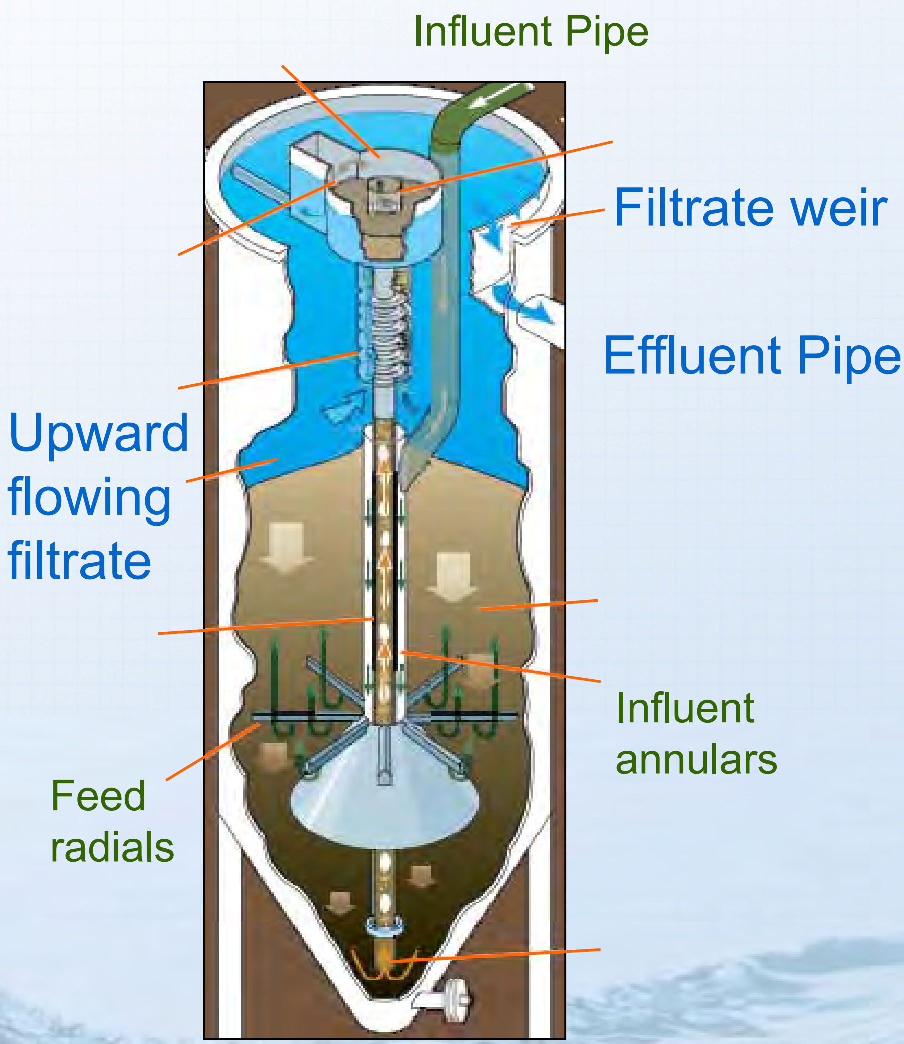
- Description of the Continuous Backwash Filter
- Description of the Ecowash^{TM} Filter
- Description of the Site where the Ecowash^{TM} validation testing was conducted
- Results of the experimental validation testing

Description of the Continuous Backwash Filter

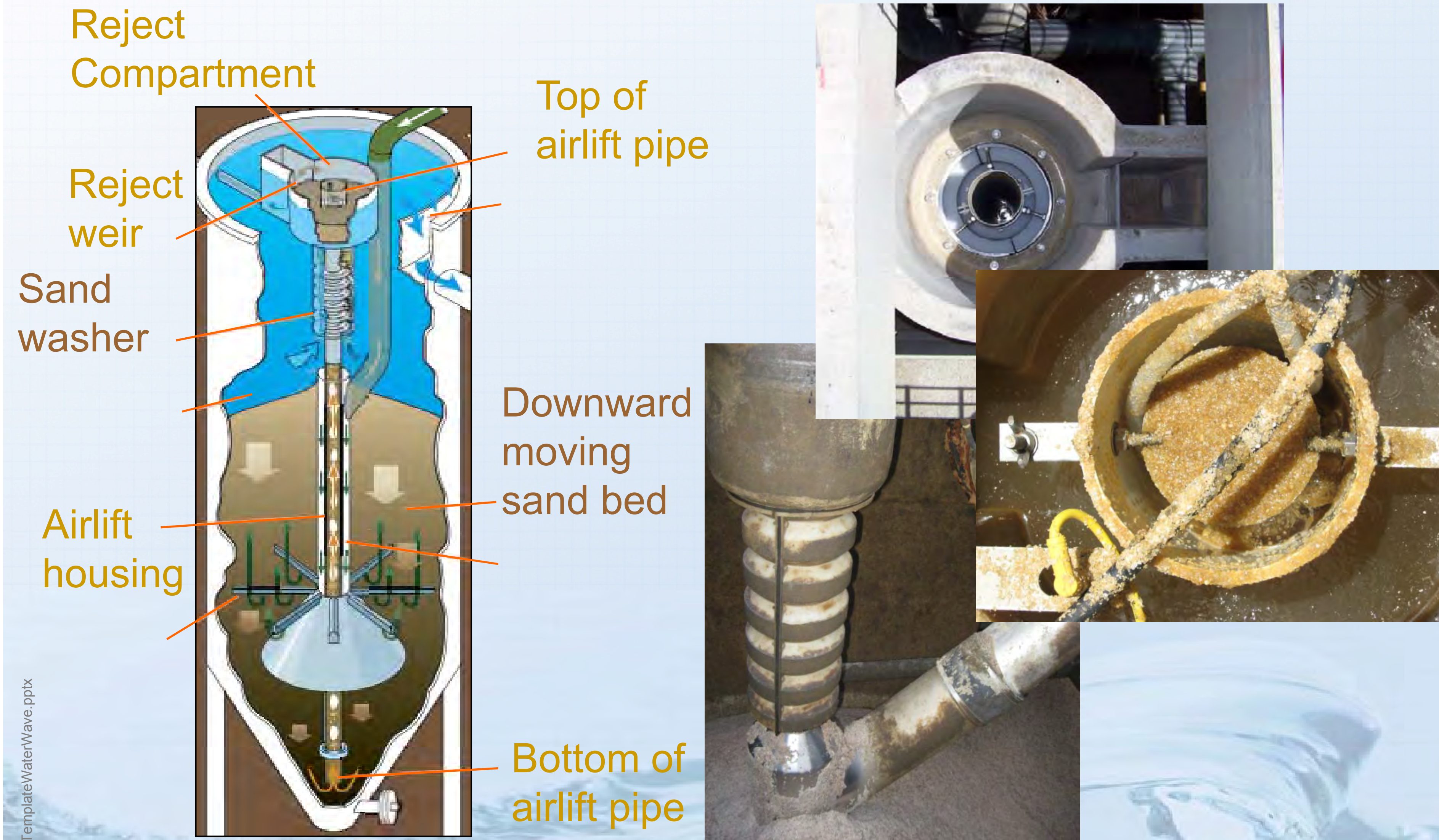
Continuous Backwash Influent Path



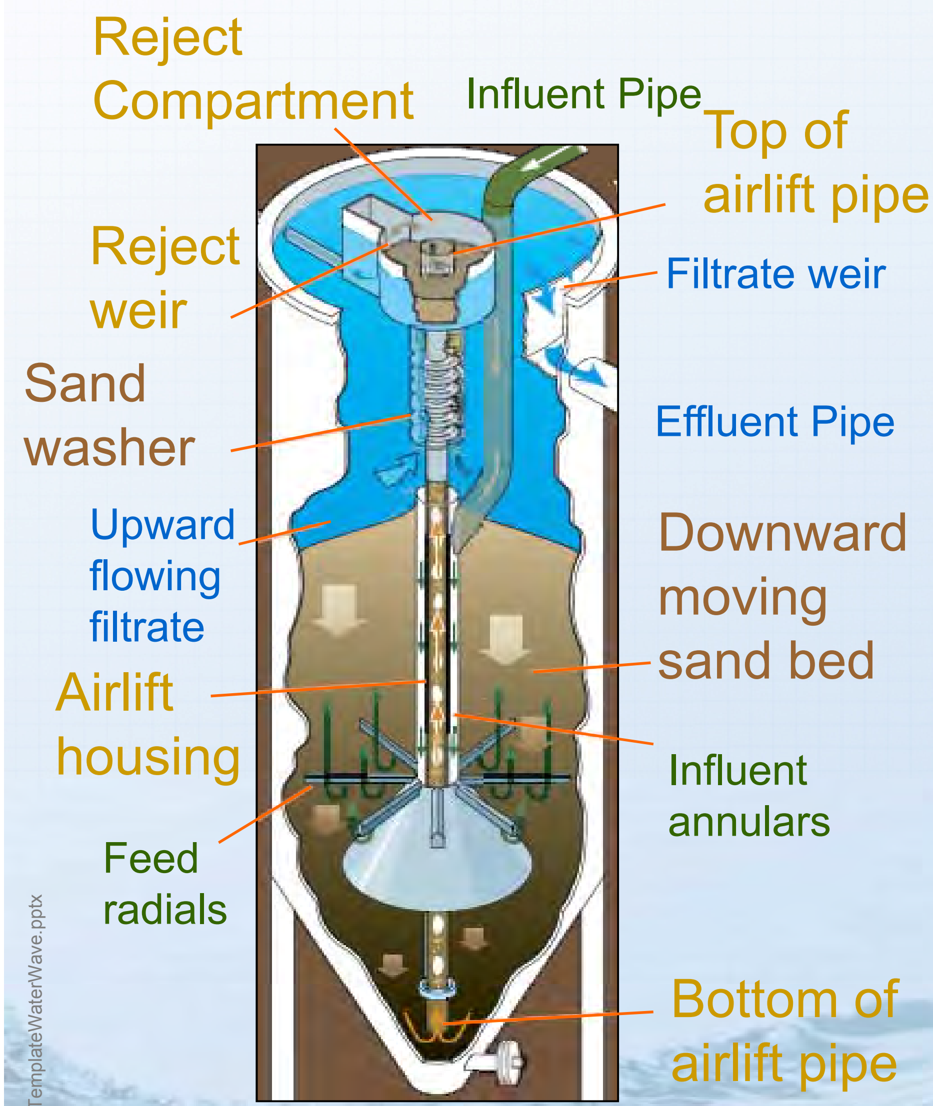
Continuous Backwash Flow Path



Continuous Backwash-Reject Water



Continuous Backwash



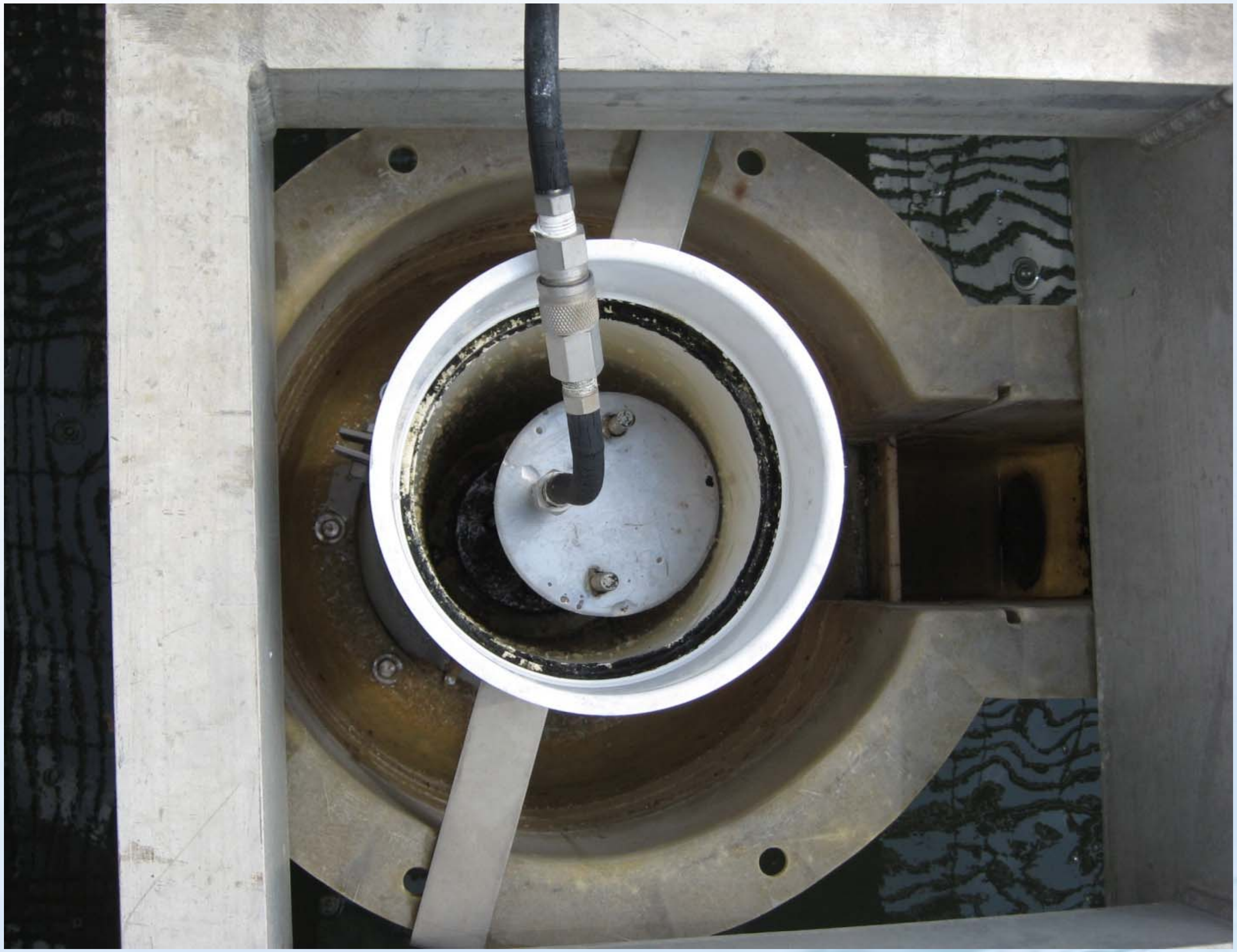
Title 22 Testing Was Conducted in Late 1980s

- The Filters have been conditionally accepted to produce recycled water up to a hydraulic loading rate of 5 gpm/ft^2
- Conditions of Acceptance
  - Complete recycling of media every three to four hours
  - Media Design Specifications

	Media Depth, inches	Effective Size, mm	Uniformity Coefficient
Sand	40	1.30	1.50

The Continuous Backwash Filter Has Been Producing Recycled Water Nationwide

Challenges with the Reject Water Generation Rate



The backwash weir setting directly effects the reject water generation rate; should be changed frequently

In Practice, the Reject Weir Setting Is Not Changed, Which Causes

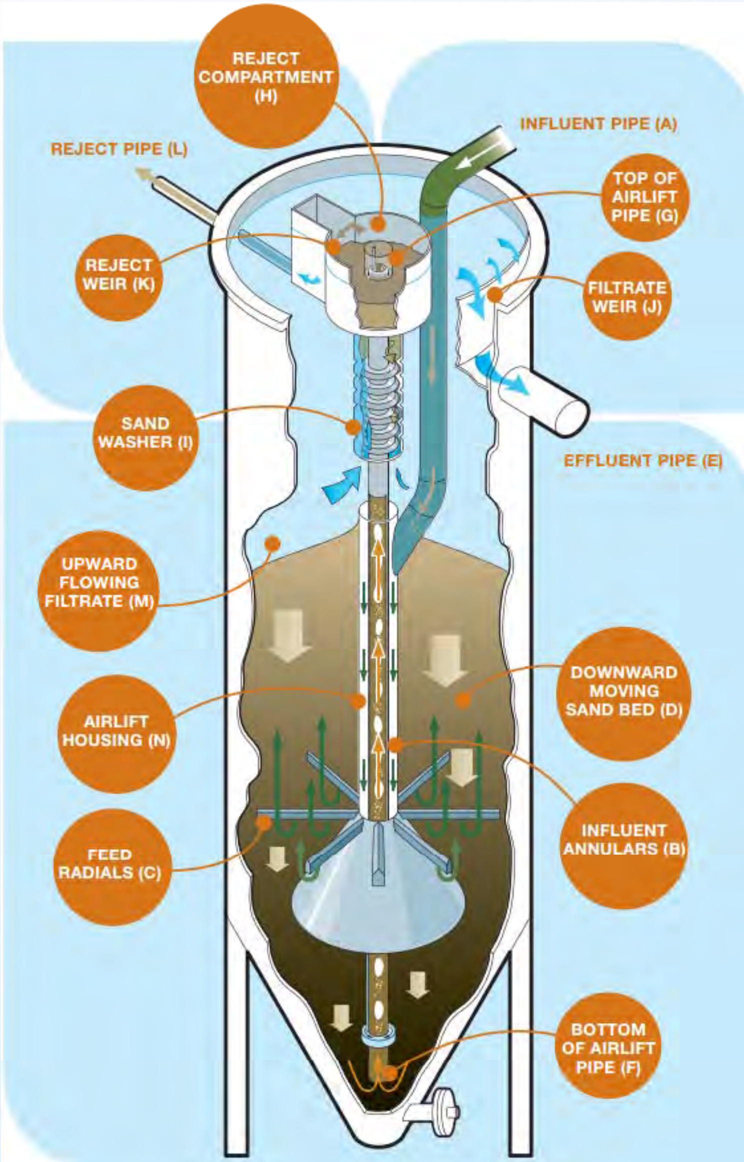
Elevated reject water generation

Comparison of Reject Water Generation Rates

Filter	Range of Filter Loading Rates Tested, gpm/ft^2	Reject Water Generation Rate Range, %
High Rate Disk Filter	6-16	1-1.5
Continuous Backwash Filter	<2	12.6-21.4

How can the reject water generation rate be optimized?

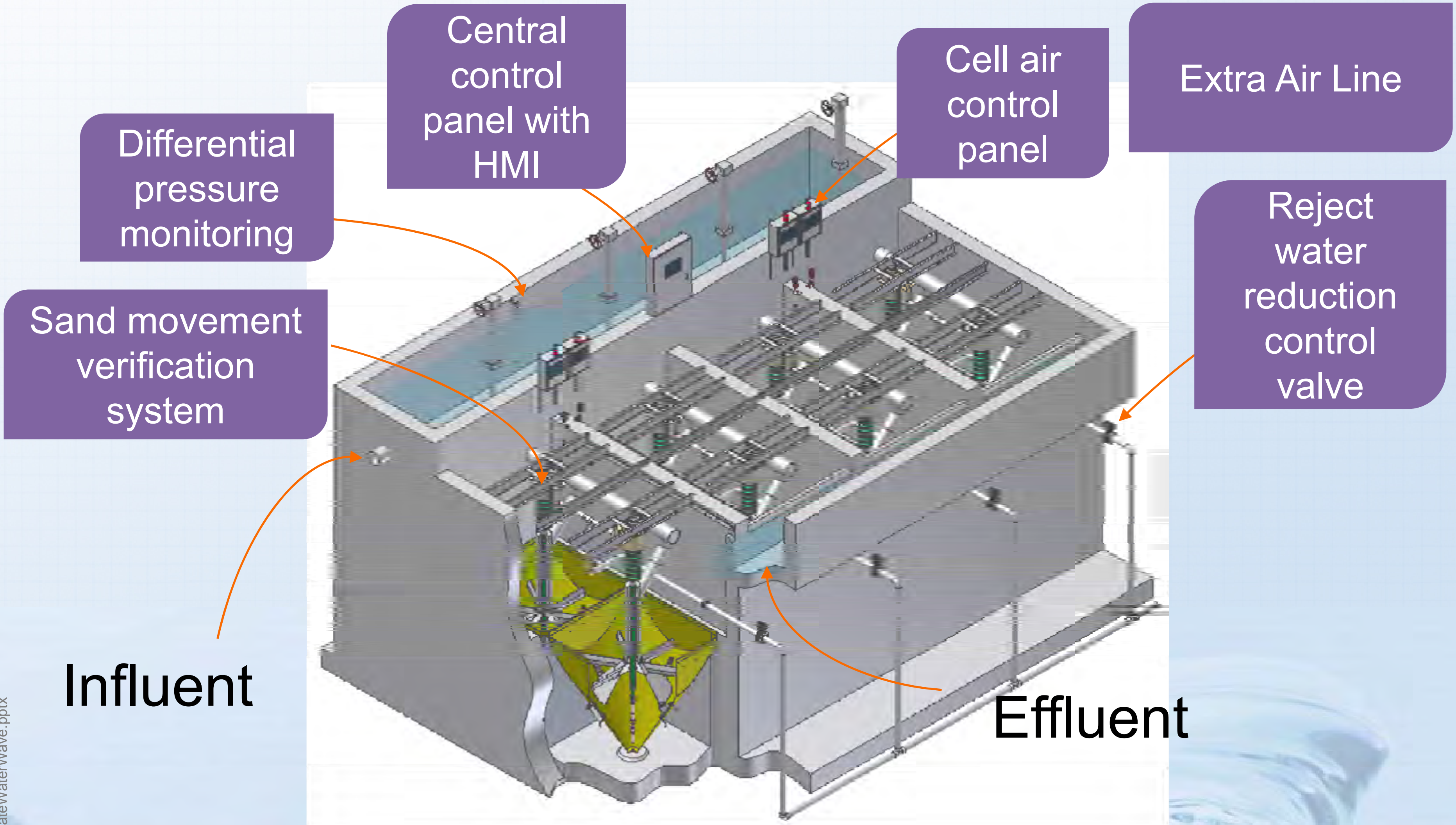
Concept of the Dynasand EcoWash™



- To reduce reject/backwash water production by operating the filter with intermittent backwash cycles
- Going to operate the filter like a traditional granular media filter

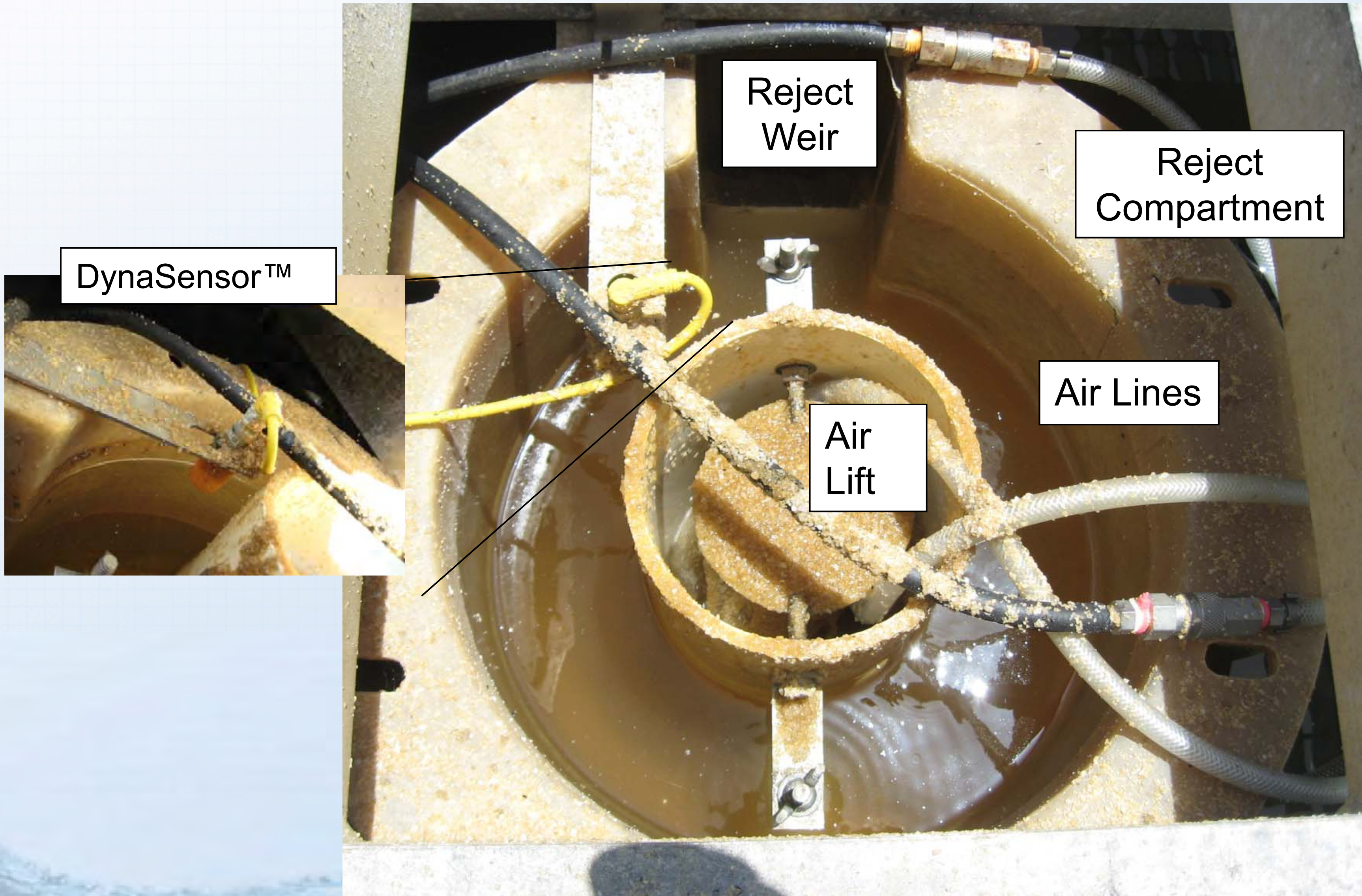
Description of the EcoWash^{TM} Filter

Additional Filter Components of the EcoWash^{TM} System



Courtesy of Parkson

EcoWash™ Filter Components



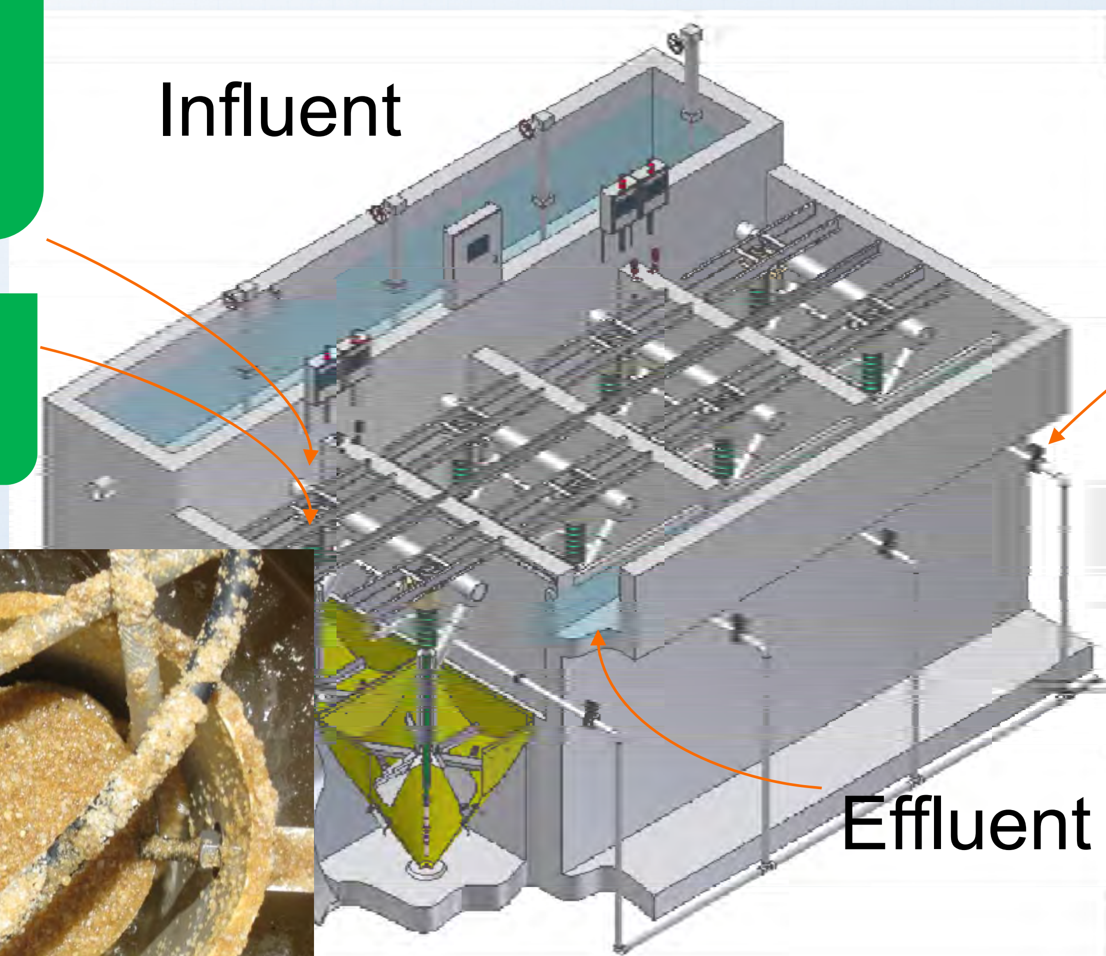
Status of Filter Components During Backwash Operation

Sand and Backwash Water Movement **OCCURRING**

Air sent to the Air Lifts

Reject water Control Valves **OPEN**

Backwash Water Being Generated

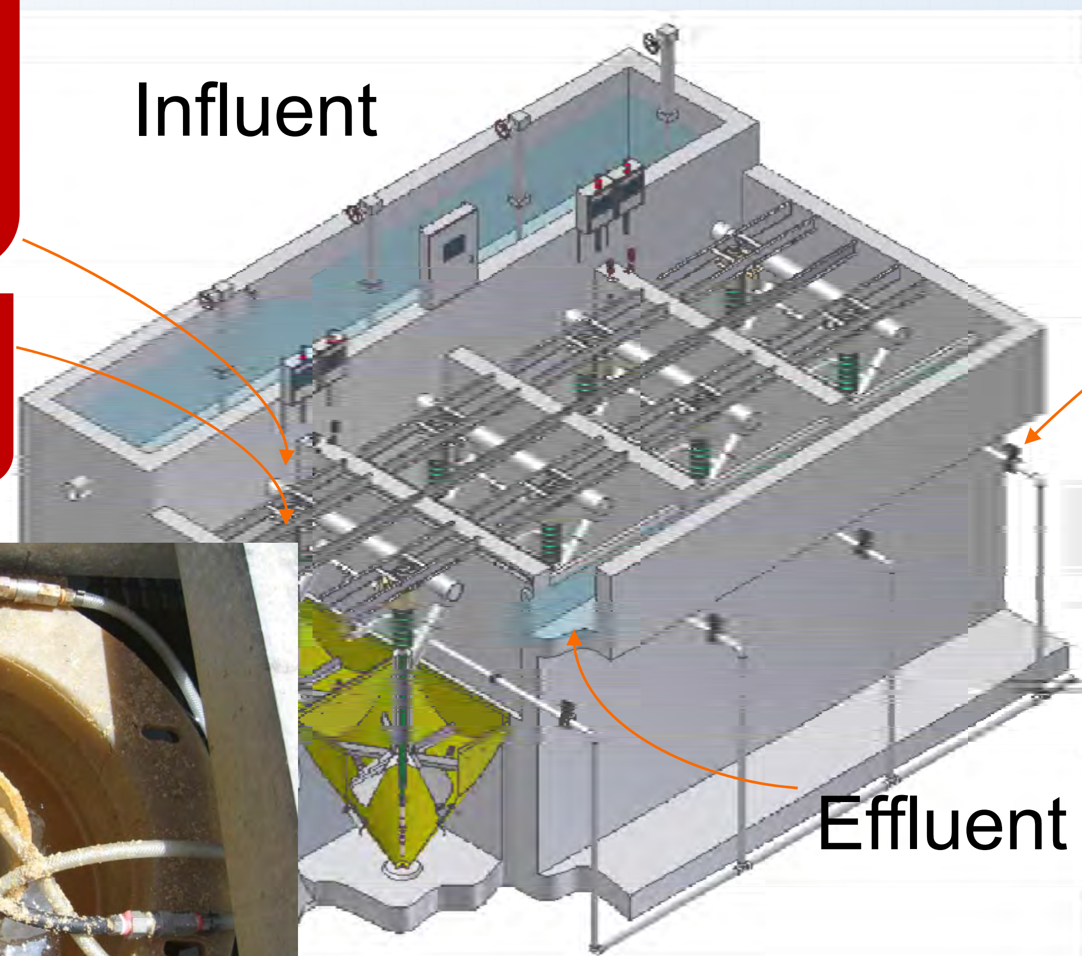


Courtesy of Parkson

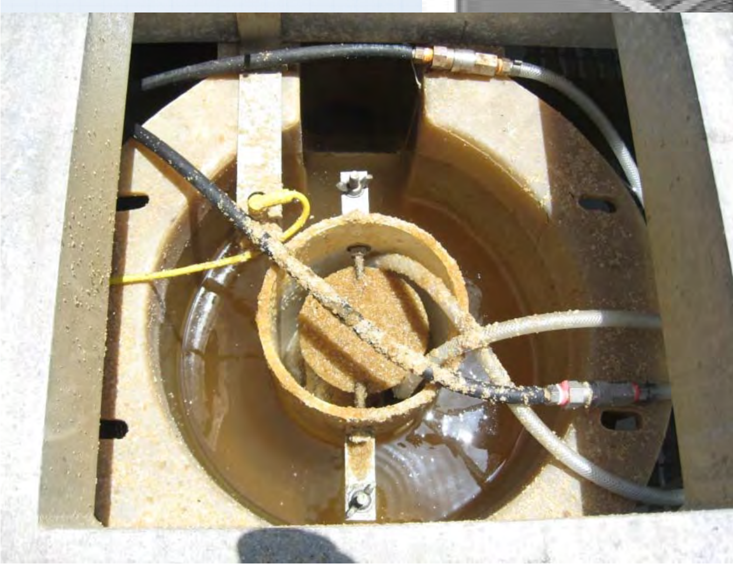
Status of Filter Components Without the Backwash

Sand and Backwash Water Movement **NOT OCCURRING**

NO Air Sent to the Air Lifts



Courtesy of Parkson



Reject Water Control Calves **CLOSED**

NO Backwash Water Being Generated

EcoWash™ System Operation

- An operator programs the backwash ON and OFF times
- Inlet water level is measured to monitor headloss across the filters

EcoWash^{TM} System Operation

- Airlift/reject starts at the programmed time or at programmed headloss set-point
- The backwash runs for the pre-set period of time or until the differential pressure is reduced
- High headloss will override the time set point and allows the backwash to happen

Description of the Site Where the EcoWash™ Validation Testing Was Conducted

Validation Testing Was Conducted in Pompano Beach, Florida

Oasis Reuse Water Utilities

Scalps water from the Broward County North Regional WWTP ocean outfall

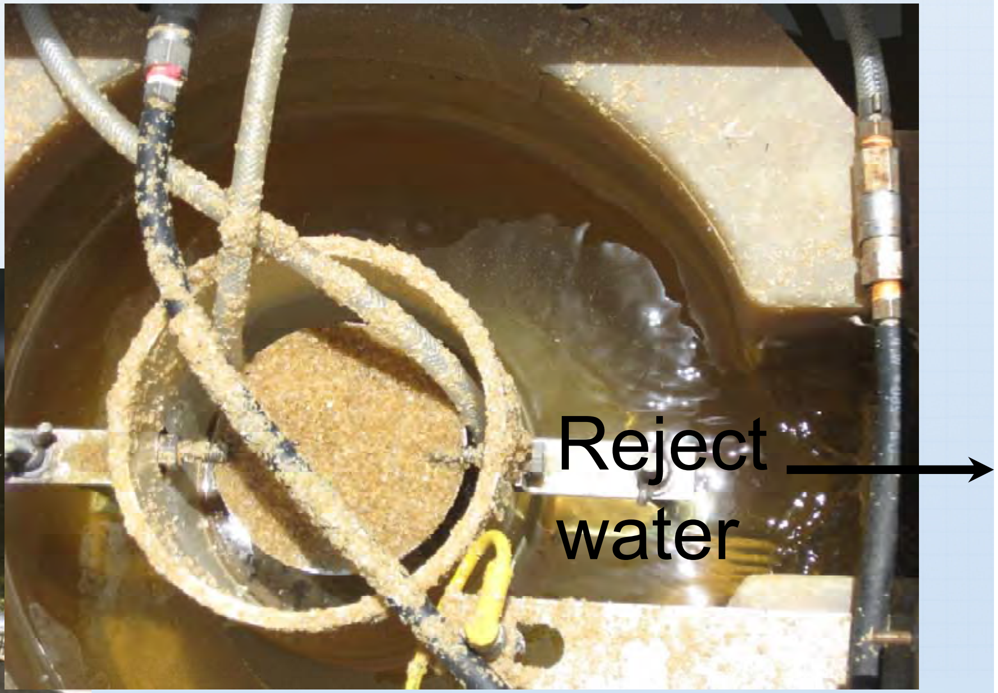
The Oasis Facility Produces Disinfected Tertiary Effluent Used For

Golf course irrigation

Agricultural and residential irrigation

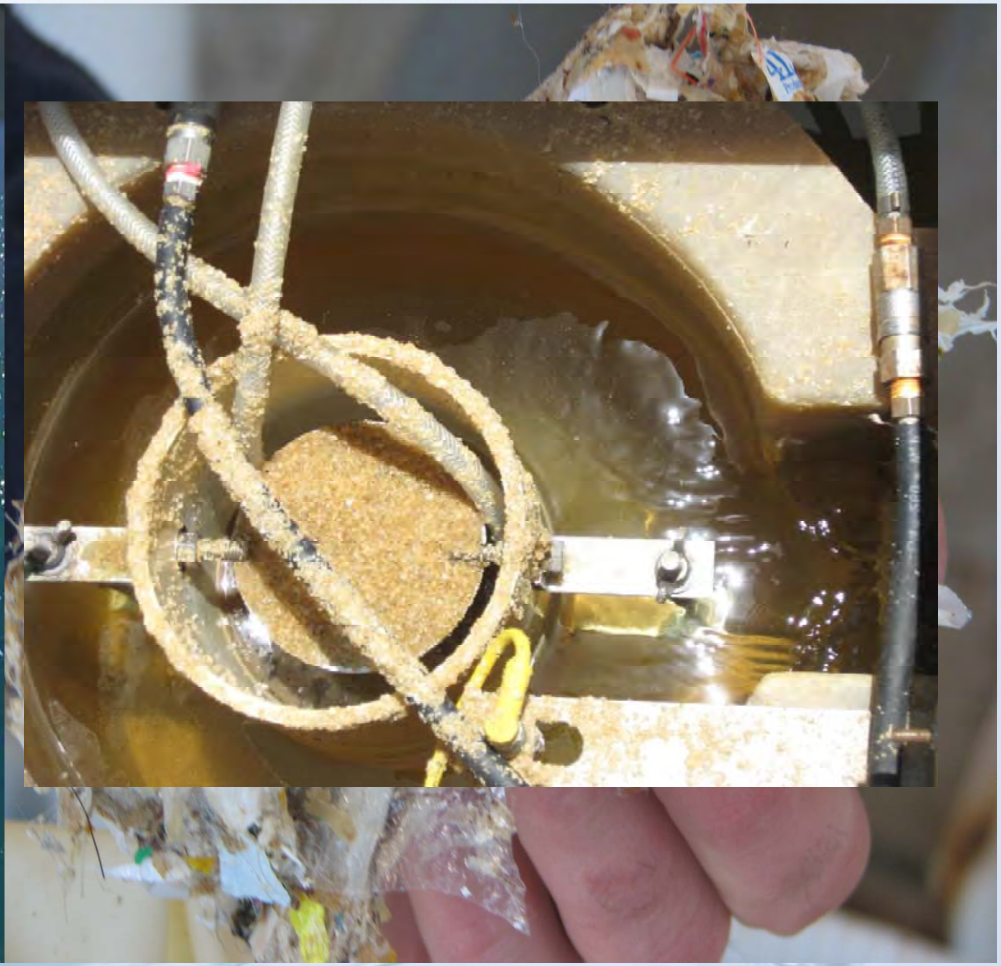
Plant Process Efficiency Is Very Important Since

They get charged for the secondary effluent taken from the outfall



The get charged for the reject water discharged to the sewer

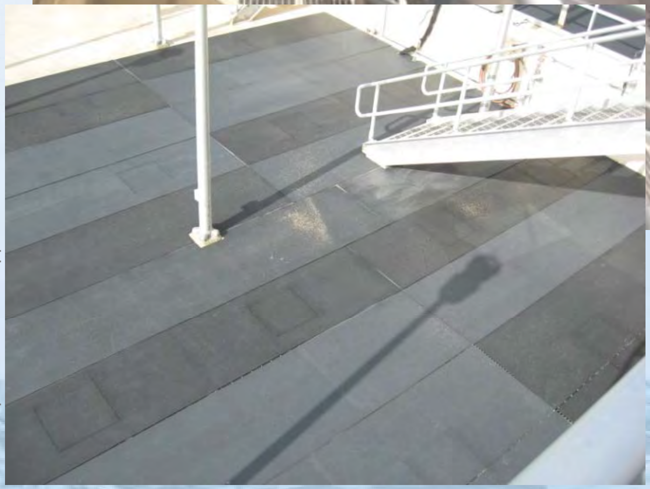
Neutrally Buoyant Solids Are Challenging With These Filters



Fine Screens Are Used For Plastics Removal

Chlorine is added to keep the filter bed clean

Pompano Beach EcoWash^{TM} Filter



Results of the EcoWash^{TM} Validation Testing

EcoWash™ Experimental Testing Plan

Experiment No.	Mode of Operation	Airlift ON – Backwashing, min/hr of operation	Airlift OFF – Not Backwashing, min/hr of operation	Flow Rate, gpm/ft²	Air Flow SCFH	Headloss Override Setting, inches
1	continuous backwash operation	Continuously	0	4.4 [1]	80	31
2	50% backwash	30	30	4.4 [1]	80	31
3	10% backwash	6	54	4.4 [1]	80	31
(1) The flow rate is limited by the pump capacity of the plant, which does not allow for a sustainable hydraulic loading rate greater than 4.4 gpm/ft².						

CarolloTemplateWaterWave.pptx

Summary of Experimental Variables

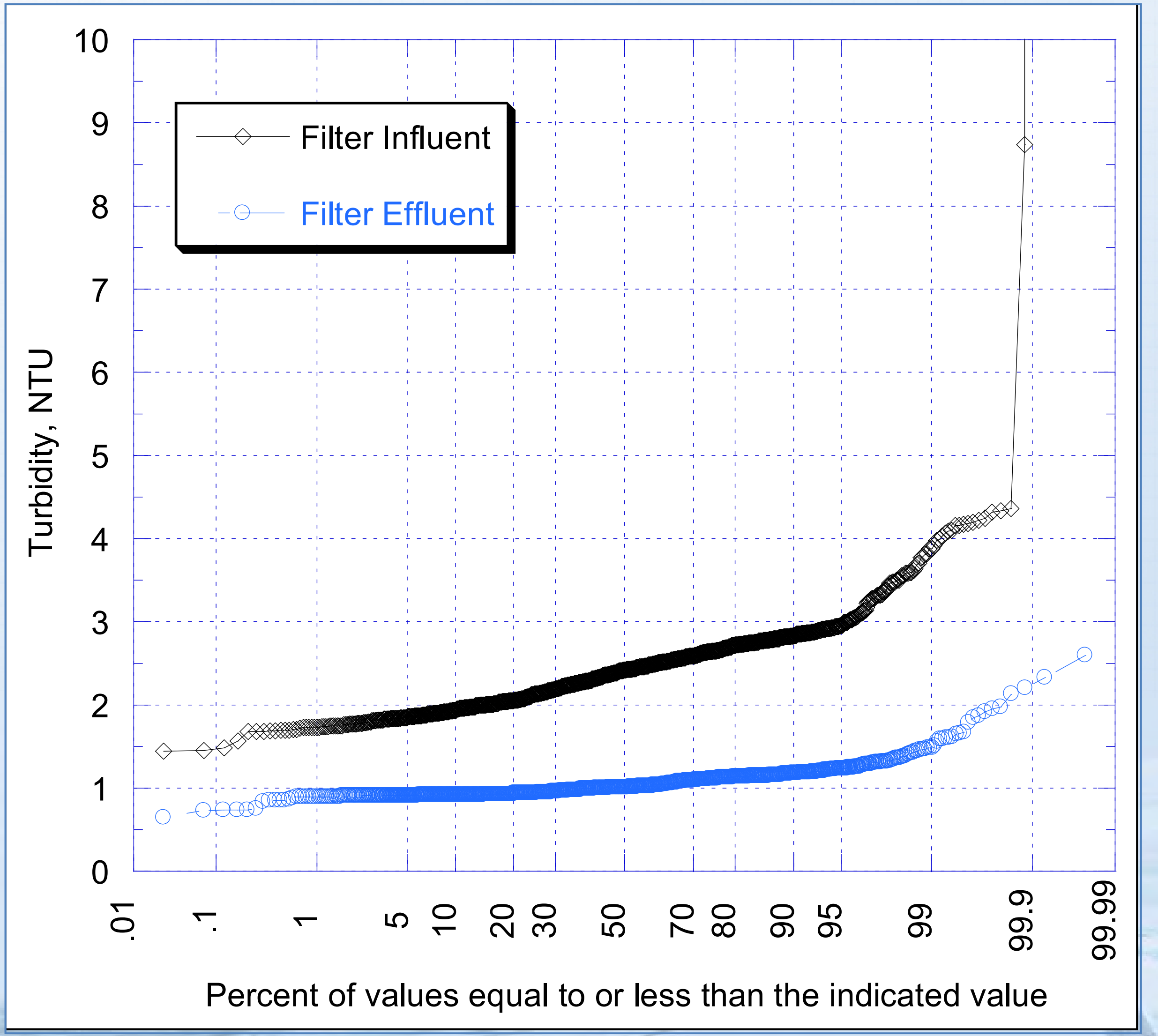
Source	Continuously Measured Parameter	Parameter Measured Via Grab Samples
Filter Influent	Turbidity and Flow Rate	Total Suspended Solids (TSS)
Filter Effluent	Turbidity	TSS
Filter	Headloss and Reject Flow Rate	

Summary of Experimental Conditions

Experiment No.	Backwash Condition	Test Duration, days	Average Time of Operation [1] per day, hours	Average Flow Rate, gpm	Average Hydraulic Loading Rate, gpm/ft^2
1	Continuous (100%)	6	5.79	3,077	3.85
2	50% Mode	6	6.78	3,536	4.42
3	10% Mode	6	5.94	3,080	3.85

(1) These values represent an average of the daily averages.

Turbidity Performance During the Continuous Backwash Test



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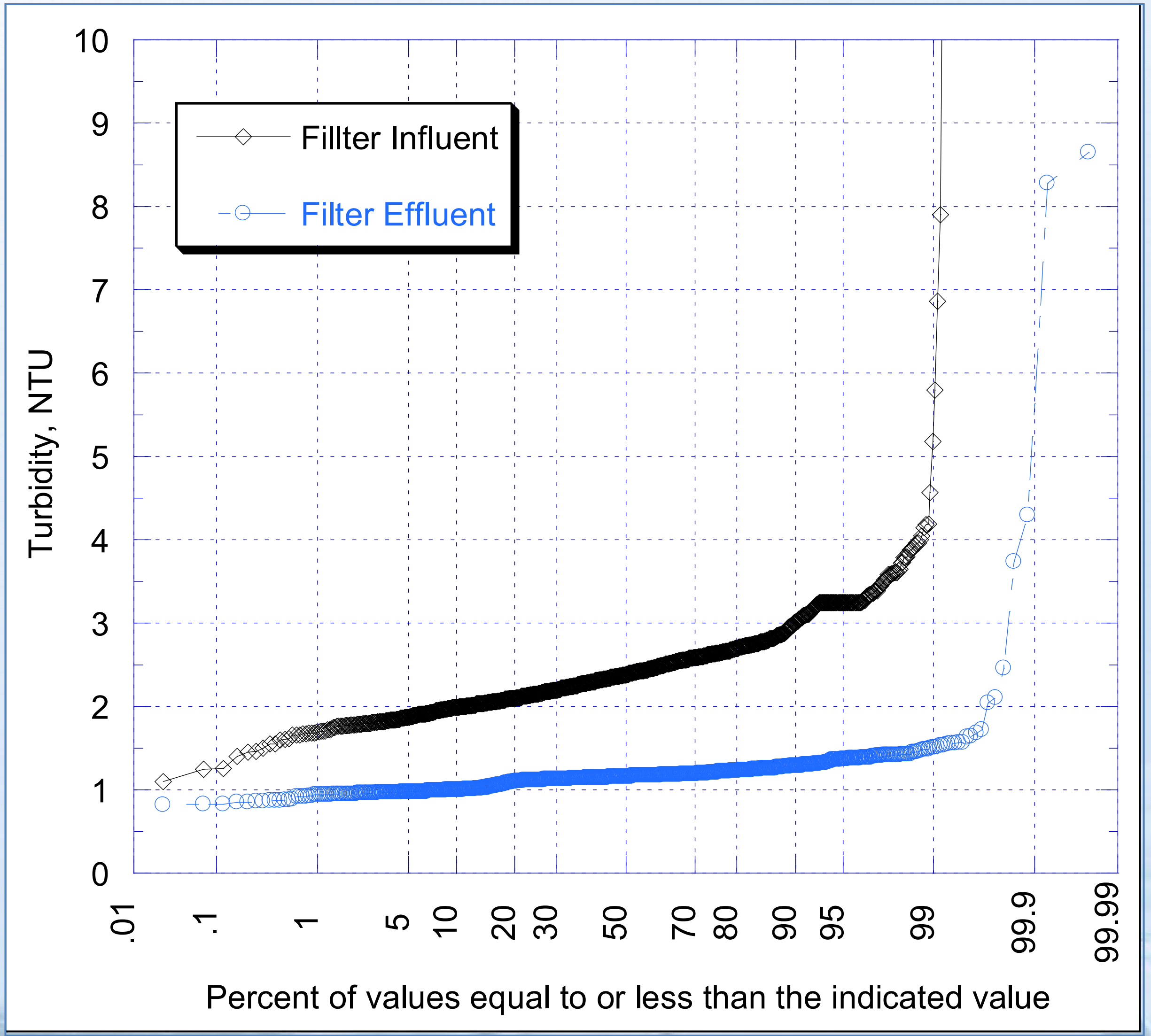
Turbidity Performance During the 50 Percent Backwash Test



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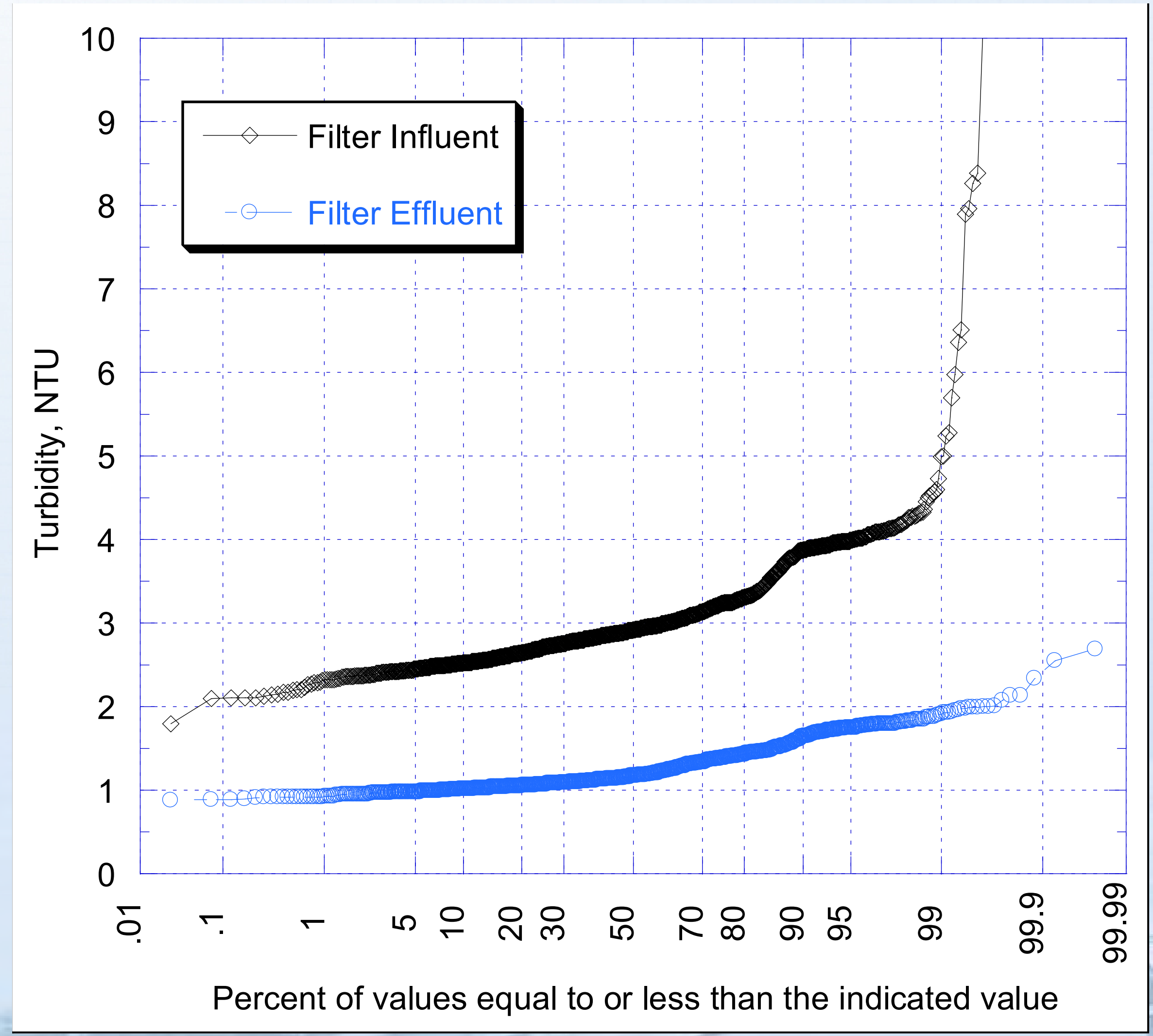
Turbidity Performance During the 10 Percent Backwash Test



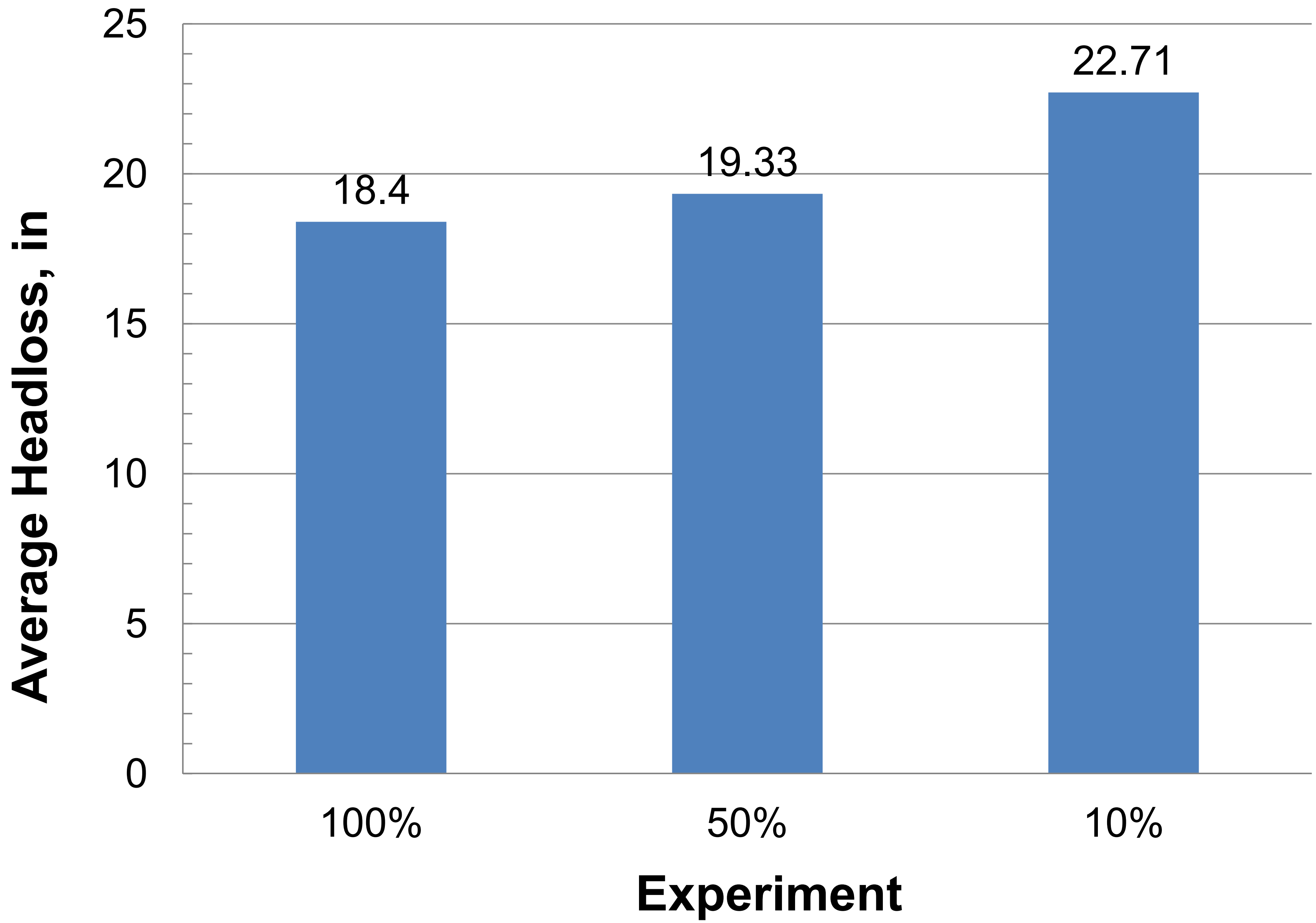
Summary of Turbidity Results

Experiment No.	Backwash Condition	Average Influent Turbidity, NTU	Average Effluent Turbidity, NTU
1	Continuous (100%)	2.48	1.04
2	50% Mode	2.59	1.17
3	10% Mode	3.10	1.25

Summary of TSS Results

Experiment No.	Backwash Condition	Influent, TSS	Effluent, TSS	Percent Removal
1	Continuous (100%)	3.20	0.98	69
2	50% Mode	2.82	0.83	70
3	10% Mode	3.00	0.82	75

Effect Of Backwash Condition On Headloss



Reject Water Generated

Experiment No.	Backwash Condition	Reject Water Generated, % of feed flow	Reduction in Reject Water by Using EcoWash™ Function, %
1	Continuous (100%)	5.67	——
2	50% Mode	2.51	55.7
3	10% Mode	1.25	77.9

Summary and Conclusions

- The EcoWash™ met the Title 22 turbidity limit of 2 NTU 99.5 percent of the time for all conditions
- Decreasing the backwash water did not impact the filter effluent turbidity
- Decreasing the backwash frequency improved TSS removal
- Operating the filter in 50 percent backwash mode decreased the reject water generated from 5.67 to 2.51 percent
- Operating the filter in 10 percent backwash mode decreased the reject water further to 1.25 percent

Questions

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APPENDIX B – 2016 FACILITY PLAN UPDATE, TECHNICAL MEMORANDUM, EFFLUENT REUSE PLANNING UPDATE

TECHNICAL MEMORANDUM CH2MHILL

Washoe County Community Services Department South Truckee Meadows Water Reclamation Facility

Effluent Reuse Planning Update

PREPARED FOR:	Washoe County Community Services Department
PREPARED BY:	Paul Steele/CH2M HILL
COPIES:	Jerry Dehn/CH2M HILL Phil Ryan/CH2M HILL
DATE:	January 20, 2016

PROFESSIONAL ENGINEER - STATE OF NEVADA
PAUL M. STEELE
Exp: 6-30-16
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No. 23752
01-20-16

Introduction

In January, 2008 CH2M HILL and Stantec published Technical Memorandum No. 5 - Effluent Reuse Planning as part of the STMWRF 6 MGD Expansion Project Facility Plan. This memorandum serves as an update to the 2008 memorandum to account for changes that have occurred at the facility and in the region since 2008, and to update the reuse expansion recommendations to account for these updated conditions.

The South Truckee Meadows Water Reclamation Facility (STMWRF) currently provides non-potable reuse water for over 300 customers in Washoe County, Nevada. During 2011 through 2015, approximately 2,350 acre-feet (ac-ft) per year of reuse water has been used to irrigate commercial and residential areas, parks, schools, and golf courses throughout the service area. The STMWRF facility has a current average daily influent flow of approximately 3.0 MGD and exports an annual average of 2.6 MGD to reuse customers. The average annual influent flow is projected to grow to approximately 4.5 MGD by 2035, and Washoe County has installed a liner in Huffaker Reservoir that should greatly reduce water lost due to seepage. Projected population growth, in combination to reduced water loss require that the County develop additional reuse sites and other disposal options for STMWRF effluent.

This memo includes the following sections:

1.0 Current Reuse System and Practices

2.0 Development of Future Reuse Sites

3.0 Water Balance Modeling

4.0 Reuse Water Quality Management

1.0 Current Reuse System and Practices

This section provides background on the current configuration and management of STMWRF, Huffaker Reservoir, and existing irrigation reuse sites.

1.1 STMWRF Operation

The STMWRF is located near the north end of South Truckee Meadows in the southern vicinity of Washoe County, Nevada. The facility is currently the sole source of reuse water for the South Truckee Meadows Effluent Service Area (STMESA).

Currently, STMWRF has a treatment capacity of 4.2 MGD. The current annual average day flow to the facility is approximately 3.0 MGD. Once the influent enters the plant, it is treated with the following processes:

- Headworks – trash removal with mechanical screens and manual bypass bar screen
- Secondary Treatment – two 1,600,000 gallon oxidation ditches with fine bubble diffusers and four available 80-foot diameter secondary clarifiers for solids separation
- Filtration – eight 200-square-foot continuous backwash sand media filters
- Disinfection – sodium hypochlorite feed with 300,000 gallon contact basin
- Solids handling – waste sludge currently discharged to Truckee Meadows Water Reclamation Facility (TMWRF) for solids processing, dewatering and ultimate disposal. A new biosolids facility that includes two 350,000 gallon aerobic digesters with jet mixing and aeration, a rotary drum thickener, and two dewatering screw presses is currently under construction.

The processes result in a plant effluent that meets the present Nevada Class A standards for the use of treated effluent. These requirements are outlined in Appendix C. A process flow diagram of the facility from Carollo's STMWRF Facility Plan Update has been included as Figure 1.1, below.

Historically, the annual influent into the STMWRF plant has been insufficient to satisfy the demands of the existing STMWRF reuse customers. To rectify this situation, reuse water has been augmented with supplemental water from Whites and Thomas Creeks and wells that are now owned by the Truckee Meadows Water Authority (TMWA). The County's water rights for White's Creek and Thomas Creek are approximately 550 and 700 acre-feet, respectively. On an annual average basis, the plant's influent is 3.0 MGD, water losses total 0.9 MGD and export flow is approximately 2.6 MGD. The creek and well water flow has traditionally made up the approximate 0.5 MGD gap between total effluents and the plant influent.

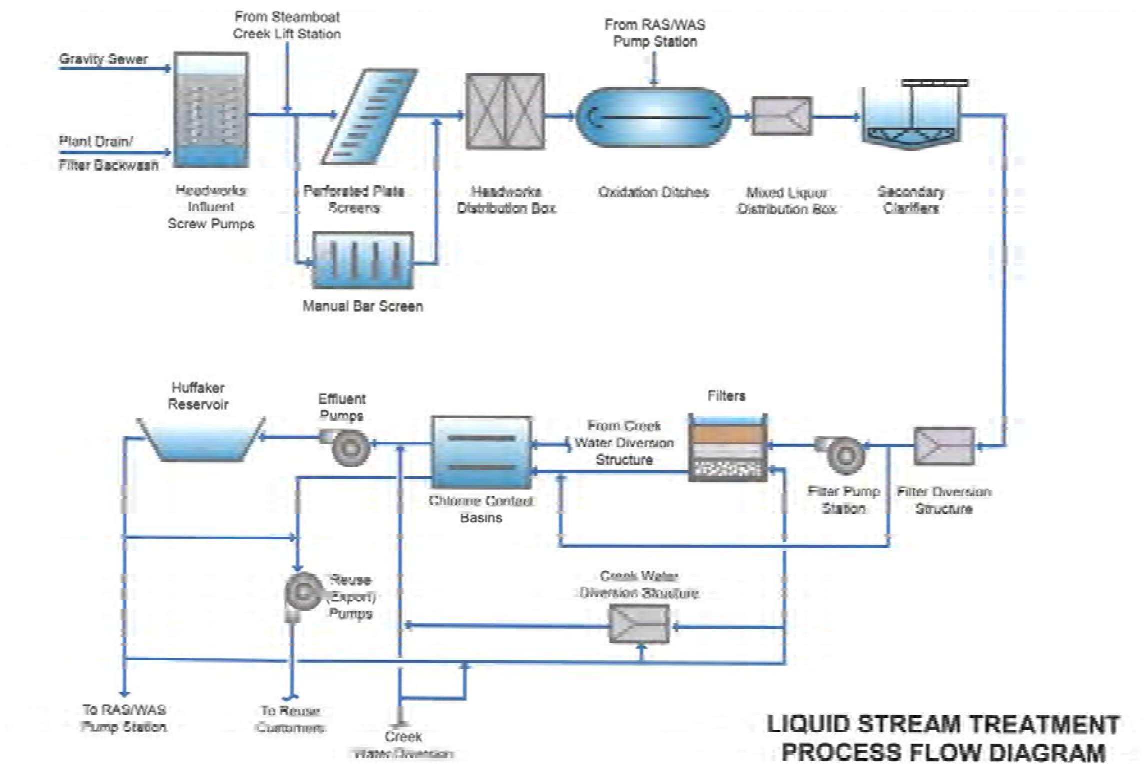


FIGURE 1.1
STMWRF Process Flow Diagram

Washoe County has extended the liner of Huffaker Reservoir up to an elevation of 4525 ft, equivalent to 2,000 acre-feet of lined storage. The addition of this liner will reduce the seepage loss from the reservoir by approximately 0.65 MGD on average, while the completion of the Biosolids Facility will eliminate another loss of 0.07 MGD that is currently pumped to TMWRF as waste activated sludge. These changes will result in STMWRF's effluent flow totaling approximately 0.2 MGD more than the annual average reuse demand for a total annual excess just over 200 acre feet.

STMWRF treated effluent is pumped to Huffaker Reservoir for storage. Stored water is then filtered and disinfected prior to being pumped into the reuse distribution system. The reuse distribution system consists of over 34 miles of distribution piping, the 6.0 million gallon (MG) Fieldcreek Reservoir, and the 2.1 MG Arrowcreek Tank. The primary pump stations consist of the Effluent Pump Station, which lifts STMWRF effluent from the treatment plant to Huffaker Reservoir, the Export Pump Station at STMWRF which pressurizes the distribution system and fills Fieldcreek Reservoir, and the Fieldcreek A and B Pump Stations at the Fieldcreek Reservoir that pressurize the Arrowcreek pressure zone and fill the Arrowcreek Tank. Each discharge location within the system has an individual metered point-of-connection with a totalizing flow meter and an isolation valve. The flow meters are read on a monthly basis to record monthly flow data and to identify any distribution system issues. The layout of the reuse system is shown in Appendix A.

TABLE 1.1
Comparison of Current and After Liner and Biosolids Influent Flows, Export Flows and Losses

Flow	Current Condition (MGD)	After Liner and Biosolids Construction (MGD)
Inflows		
Influent Flow	3.00	3.00
Outflows		
Export Flow	2.60	2.60
WAS Flow to TMWRF	0.07	0.00
Net Evaporation and Precipitation Losses	0.11	0.11
Seepage Loss	0.72	0.07
Total Outflows	**3.50**	**2.78**
Surplus or Deficit	**-0.50**	**0.22**

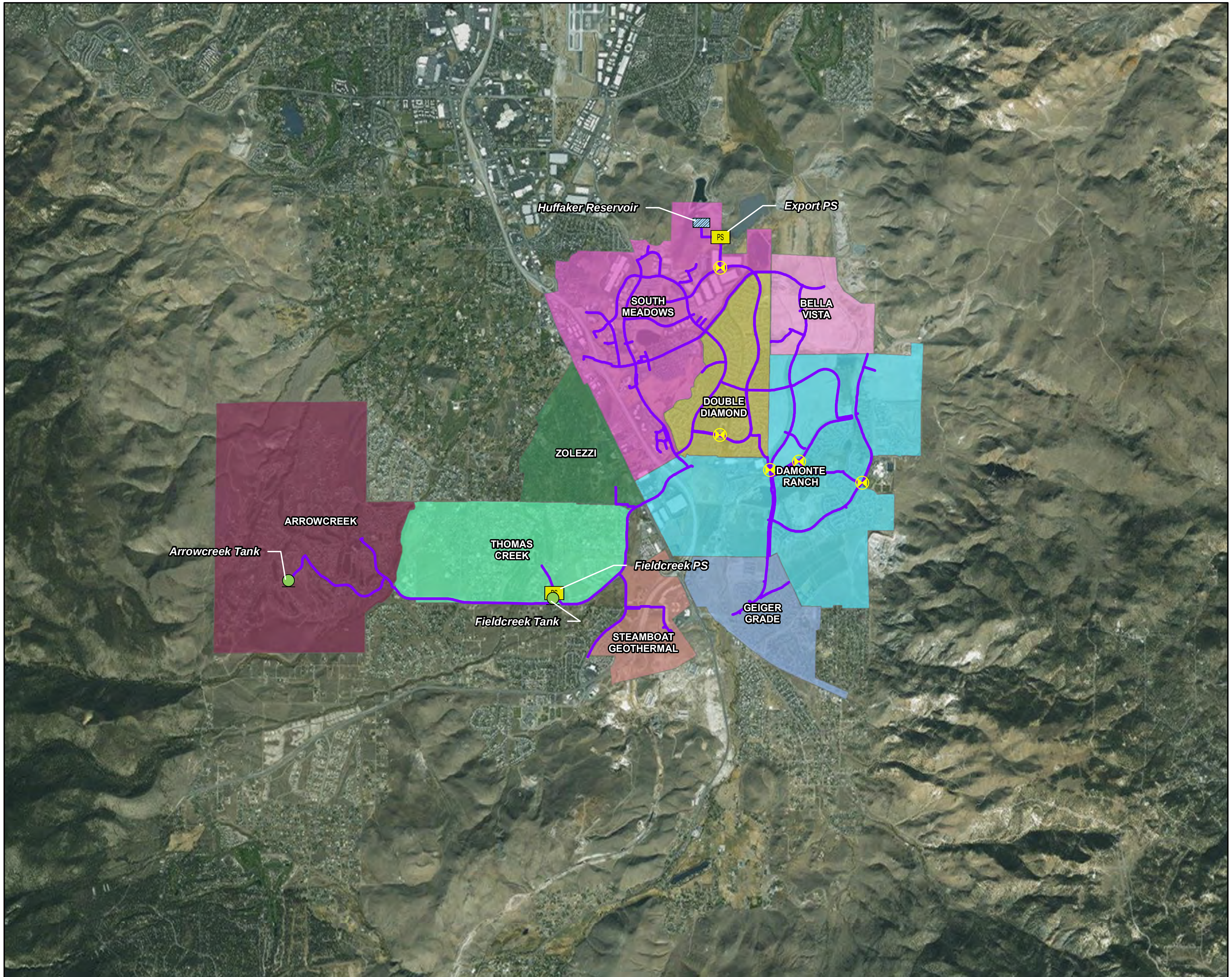
1.2 Current Reuse Water Demands

The reuse water distribution system has been separated into various neighborhoods as shown in the system maps inserted below. The current demands are shown for each area in Table 1.2.

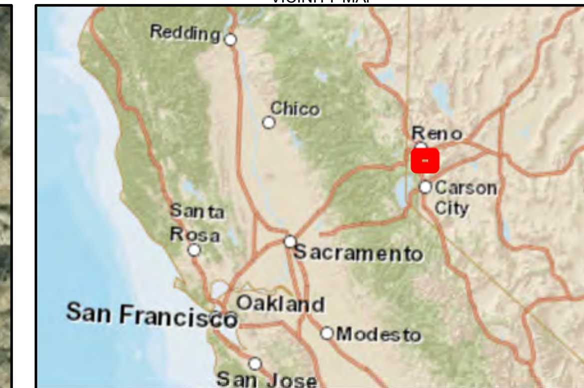
TABLE 1.2
Current Reuse Demand by Neighborhood

Neighborhood	Current Reuse Demand (acre-feet/year)
Arrowcreek	679
Bella Vista Ranch	30
Damonte Ranch	466
Double Diamond	107
Geiger Grade	16
South Meadows	467
Steamboat Geothermal[1]	161
Thomas Creek	370
Zolezzi	57
Total	**2,353**

Note: 1. Current Steamboat Geothermal "neighborhood" demand is from irrigated athletic fields, commercial and residential customers near the Mt. Rose Highway exit off of I-580.



VICINITY MAP

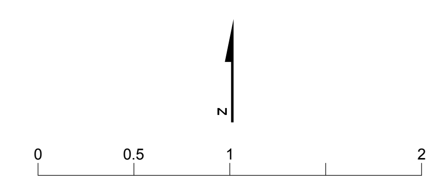


LEGEND

- Existing Pipes
- Reservoir
- Tank
- Pump Station
- Valve

Subdivision Area

- GEIGER GRADE
- BELLA VISTA
- DAMONTE RANCH
- DOUBLE DIAMOND
- SOUTH MEADOWS
- ZOLEZZI
- THOMAS CREEK
- ARROWCREEK
- STEAMBOAT GEOTHERMAL



Current Reuse System Map

South Truckee Meadows Water Reclamation Facility Effluent Reuse Planning Update

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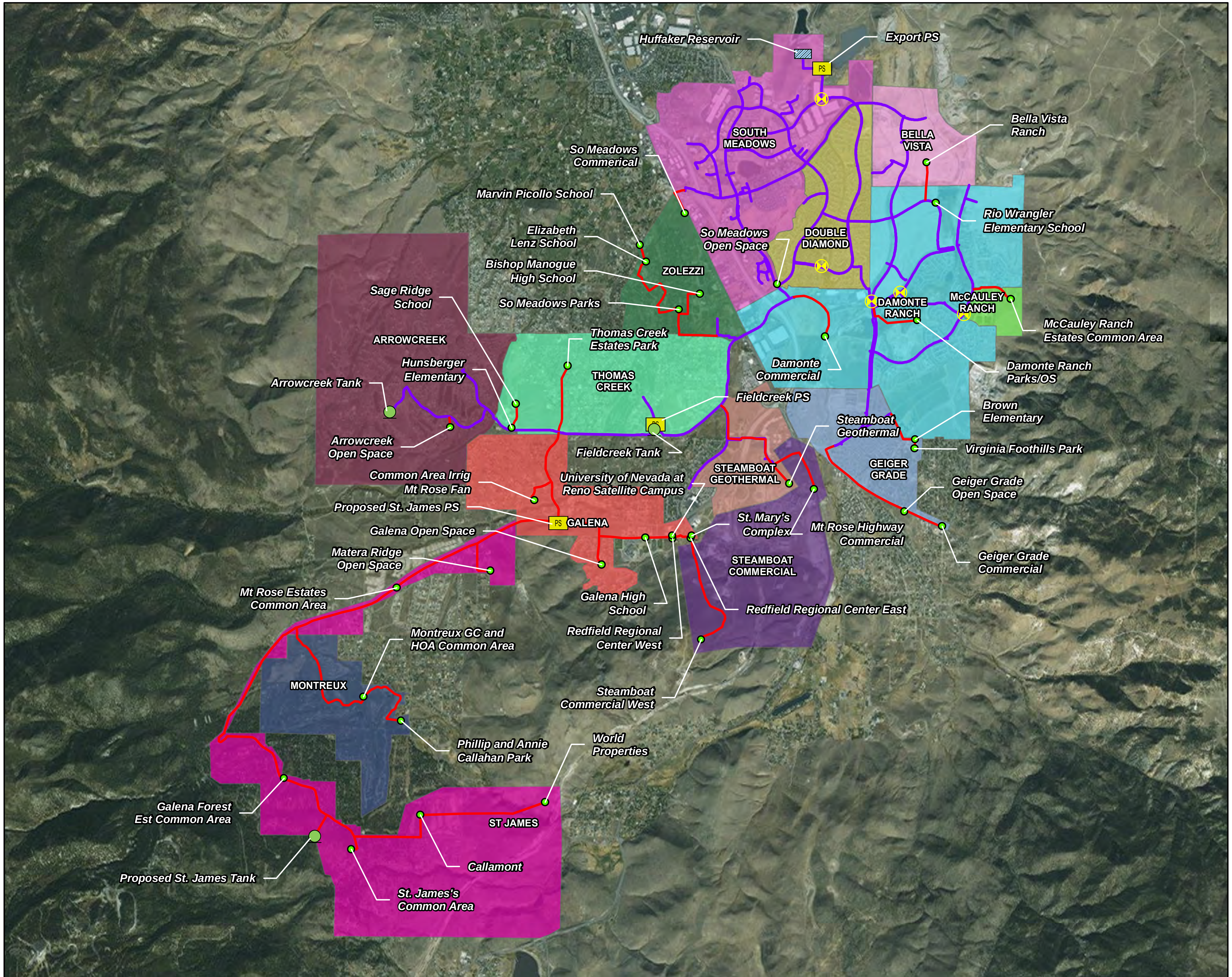
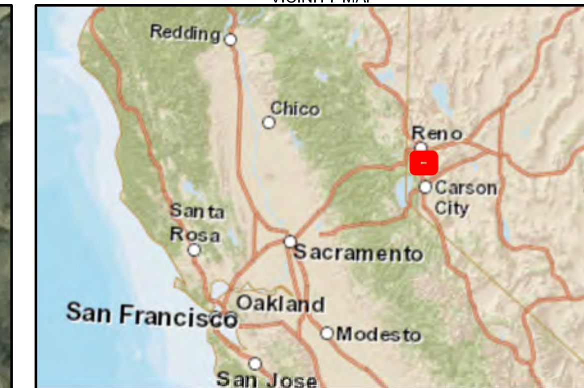


VICINITY MAP



LEGEND

- Regional Reuse Sites
- Existing Pipes
- Proposed Pipes
- Reservoir
- Tank
- Pump Station
- Valve

Subdivision Area

- GEIGER GRADE
- BELLA VISTA
- McCAULEY RANCH
- DAMONTE RANCH
- DOUBLE DIAMOND
- SOUTH MEADOWS
- ZOLEZZI
- THOMAS CREEK
- ARROWCREEK
- GALENA
- STEAMBOAT GEOTHERMAL
- ST JAMES
- MONTREUX
- STEAMBOAT COMMERCIAL

N

0 0.5 1 2

Miles

Reuse System Expansion Map by Project Area

South Truckee Meadows Water Reclamation Facility Effluent Reuse Planning Update

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2.0 Development of Future Reuse Sites

CH2M HILL updated the future reuse sites presented in the 2008 memo with the input of Washoe County staff. The sites are very similar to the sites presented in 2008, though Steamboat Commercial East was eliminated, several schools were added, a couple of sites were renamed, and total demands were updated for several sites where development expectations have changed in the years since the original memo. Annual and peak reuse water demands for these areas are also summarized in Table 2.1. This table associates each of the reuse sites within a relevant project area that correspond to the development projects. The reuse water demands presented in Table 2.1 form the basis for the distribution system modeling and development project cost estimates discussed in later sections of this TM.

TABLE 2.1
Projected Future Reuse Water Sites

Future Reuse Site Name	Annual Demand (ac-ft/yr)[a]	Peak Demand (gpm)[b]
Arrowcreek		
Arrowcreek Open Space	22	99
Total Arrowcreek	**22**	**99**
Bella Vista		
Bella Vista Ranch	213	959
Total Bella Vista	**213**	**959**
Damonte Ranch		
Damonte Commercial	71	320
Damonte Ranch Parks/OS	314	1414
Rio Wrangler School	4	18
Total Damonte Ranch	**389**	**1752**
Galena		
Galena High School	70	315
Galena Open Space	12	54
Redfield Regional Center East	62	279
Redfield Regional Center West	34	153
St. Mary's Complex	2	9
UNR Satellite Campus	9	41
Common Area Irrig Mt Rose Fan	114	514
Total Galena	**303**	**1365**

TABLE 2.1
Projected Future Reuse Water Sites

Future Reuse Site Name	Annual Demand (ac-ft/yr)[a]	Peak Demand (gpm)[b]
Geiger Grade		
Geiger Grade Commercial	4	18
Geiger Grade Open Space	17	77
Brown Elementary	4	18
Virginia Foothills Park	16	72
Total Geiger Grade	**41**	**185**
McCauley Ranch		
McCauley Ranch Estates Common Area	19	86
Total McCauley Ranch	**19**	**86**
Montreux		
Phillip and Annie Callahan Park	5	23
Montreux GC (practice area only)	80	360
Montreux HOA Common Area	30	135
Total Montreux	**115**	**518**
South Meadows		
So Meadows Commercial	74	333
So Meadows Open Space	69	311
Total South Meadows	**143**	**644**
Steamboat Commercial		
Mt. Rose Highway Commercial	9	41
Steamboat Commercial West	34	153
Total Steamboat Commercial	**43**	**194**
Steamboat Geothermal		
Steamboat Geothermal	1,000	3,000
Total Steamboat Geothermal	**1,000**	**3,000**
St. James		
Matera Ridge Park Site	46	207
Mt. Rose Estates Common Area	40	180
Callamont	30	135
St. James Common Area	276	1243

TABLE 2.1
Projected Future Reuse Water Sites

Future Reuse Site Name	Annual Demand (ac-ft/yr)[a]	Peak Demand (gpm)[b]
Galena Forest Estates Common Area	54	243
World Properties	287	1293
Total St. James	**733**	**3,302**
Thomas Creek		
Thomas Creek Estates Park	11	50
Hunsberger Elementary	3	14
Sage Ridge School	12	54
Total Thomas Creek	**26**	**117**
Zolezzi		
Elizabeth Lenz School	24	108
Marvin Picollo School	10	45
So Meadows Parks	9	41
Bishop Manogue High School	0	0
Total Zolezzi	**43**	**194**
Total[c]	**3,090**	**12,414**

a – represents estimated annual reuse water demand estimated for each of the sites

b – calculated based on demands in the peak irrigation month of July representing 18 percent of the annual irrigation water demand and assuming that all irrigation occurs evenly over a 7 hour period at night.

c – total of all individual sites areas throughout entire system

Existing and future reuse water demands for the project areas defined in the report are shown in Table 2.2 below.

Existing demands in the table were based on the actual metered usage from each reuse water meter in the system and was sorted by the GIS location of the individual meters. The 2035 demands assume that all of the projects listed in the project timeline below have been completed, while none of the excluded projects have. The buildout demand assumes that the existing demands on the system are unchanged, and that all of the new reuse sites have been added. The presently identified sites can support 5,443 acre-feet of reuse water. Estimated 2035 water demand is 4,098 acre-feet, based on the selected reuse sites shown below. With proper management, the presently identified sites can accommodate 20 years of demand.

TABLE 2.2
Current and Future Reuse Demand by Project Area

Project Area	Current Reuse Demand (acre-feet/year)	Estimated 2035 Demand (acre-feet/year)	Estimated Buildout Demand (acre-feet/year)
Arrowcreek	679	679	701
Bella Vista Ranch	30	243	243
Damonte Ranch	466	855	855
Double Diamond	107	107	107
Galena	0	0	303
Geiger Grade	16	16	57
McCauley Ranch	0	0	19
Montreux	0	0	115
South Meadows	467	610	610
Steamboat Commercial	0	0	43
Steamboat Geothermal[1]	161	1,161	1,161
St. James	0	0	733
Thomas Creek	370	370	396
Zolezzi	57	57	100
Total	**2,353**	**4,098**	**5,443**

Note: 1. Current Steamboat Geothermal demand is from irrigated athletic fields, commercial and residential customers near the Mt. Rose Highway exit off of I-580, and is not existing ORMAT demand.

3.0 Water Balance Modeling

The aforementioned TM No. 5 completed in 2008 included a water balance model of Huffaker reservoir to quantify flows in and out of the reservoir. This update of the 2008 study utilizes the same water balance model that was created in 2008, but updated it to account for current and future flow rates, and the impact of the currently in progress reservoir lining project. A list of all modifications to the 2008 water balance model are shown in Table 3.1.

TABLE 3.1
Summary of Modifications made to the 2008 Water Balance Model

Model Component	Modification
Reservoir Liner	• Set reservoir liner elevation to 4525 ft. • Altered the seepage equation to estimate 4,000 gallons of seepage per day per acre of

TABLE 3.1
Summary of Modifications made to the 2008 Water Balance Model

Model Component	Modification
	reservoir water surface. This seepage rate approximates the estimated seepage out of the reservoir during 2013 and 2014 during periods when the water surface elevation was below the liner.
STMWRF Inflow	• Altered STMWRF inflow to match the county provided flow projections that cover the period from 2015-2035.
Creek Water Inflow	• Assumed creek water inflow will be zero now that seepage has been greatly reduced through the addition of the reservoir liner.
Reuse Demand	• Updated existing reuse demand based on metered data and developed new estimates for future projected reuse demand based on the identified reuse sites and projects discussed in Section 2, above. • Updated monthly distribution of irrigation flows based on the metered demands from 2011-2015.
Distribution Losses	• Added a section to estimate the amount of water loss in the distribution system to account for the 12% difference between the export meter flow rate and the sum of customer meters.

The following sections discuss the model inputs and assumptions, methods for model calibration, as well as the results and potential outcomes of various model scenarios.

3.1 Water Balance Model Results and Conclusions

The water balance model aids in assessing the future balance of supply and demand and reservoir conditions in order to plan reuse system expansion to correspond with influent flow growth and the need to dispose of treated effluent. This section discusses the results and presents a timeline for when several effluent disposal options may be implemented.

Water Balance Model Results

With the completion of the reservoir lining project, Huffaker Reservoir will be close to balanced.

Over the last several years, reuse water had to be added from other sources, including creeks and wells in order for the County to meet all of the reuse water flow demands from its customers. The primary reason for the system's inability to meet reuse demands was seepage loss. In 2013 and 2014, seepage losses averaged approximately 720,000 gal/day, or 830 acre-feet/year, which is approximately 25% of the plant's influent. To eliminate seepage, the County has raised the liner to an elevation of 4525 feet and realty reduce the overall seepage from the system. As a result, over the projected year 2016 (November 2015 – October 2016) Huffaker Reservoir will end the year with 221 acre-feet more than it started. This difference is approximately 5% of the plant's influent flow, and indicates that the system is only slightly out of balance under current conditions. See the reservoir volume figure shown in Figure 3.1 below.

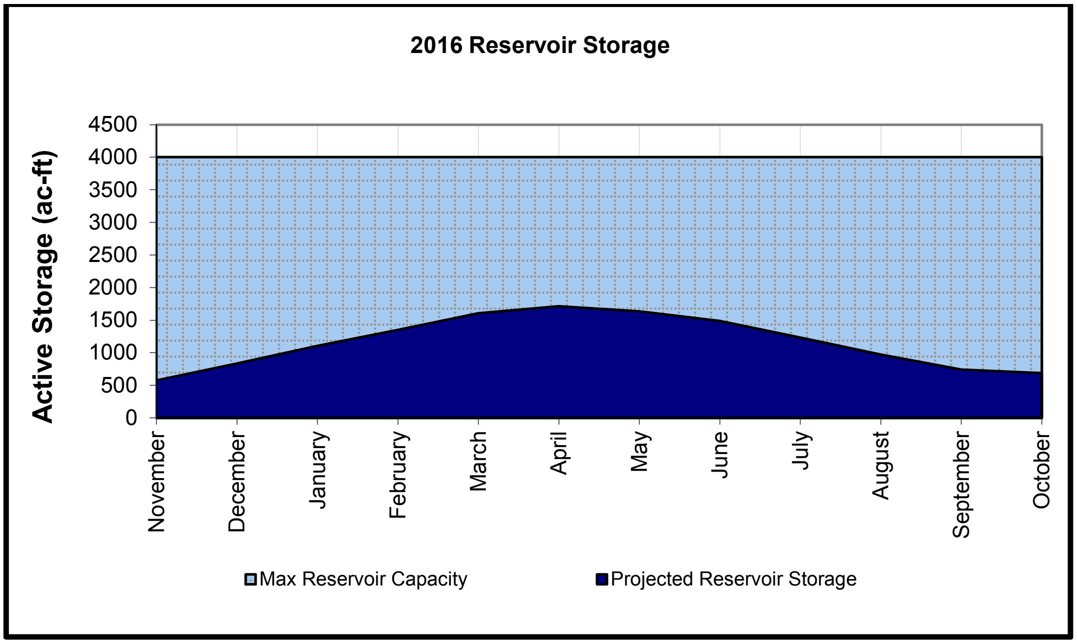

FIGURE 3.1
Water balance model results showing reservoir levels modeled for 2016

Influent flow growth makes this balance short-lived.

Influent flow projections for the facility indicate that the facility will see influent flows increase approximately 130 acre-feet a year in the first five years of operation. This growth in influent flow, without developing additional reuse sites, would lead to the water level exceeding the new liner elevation by approximately the year 2020.

In order to control the water level in the storage reservoir, a series of implementation projects have been developed based upon the relative costs of each option (developed later in this report) and the likely timeline of the developments occurring. The summary timeline of development is shown in Figure 3.2.

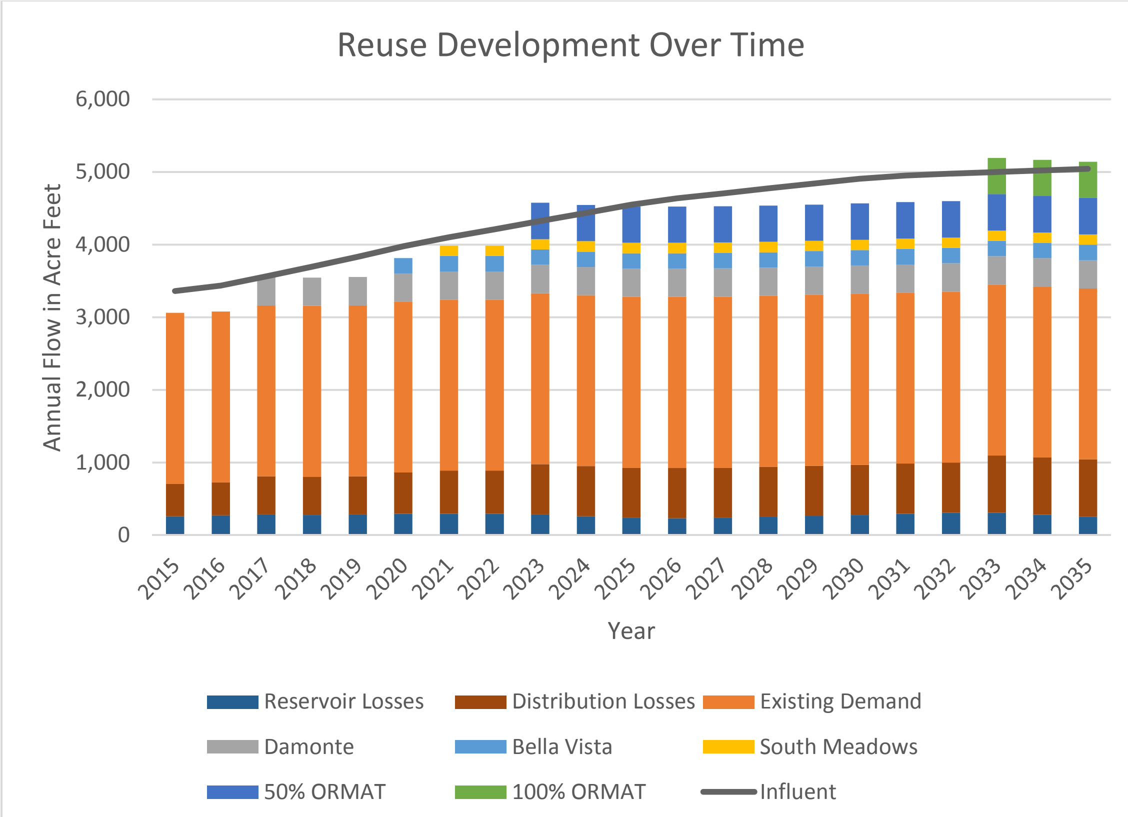

FIGURE 3.2
Water balance model results showing the STMWRF influent flow rate and the ultimate fate of the plant's effluent in the reuse system. Reservoir losses include seepage, evaporation and precipitation, and distribution losses account for water loss in the reuse distribution system.

Water Balance Model Conclusions and Recommendations

The results from the water balance model scenarios indicate that balance of reuse water supply and demand within the STMESA will be an issue in the future. The following conclusions can be drawn from the model results:

- Additional reuse sites will need to be added in the near term to avoid accumulating effluent.
- It is not possible to introduce the entire 1,000 acre-feet per year demand for the Steamboat Geothermal project (ORMAT) at the same time without utilizing creek rights or another water source like the TMWRF-STMWRF interconnect pipeline. This proposed timeline assumed that the demand could be phased by adding 500 acre-feet per year in 2023, and the second 500 acre-feet per year in 2033.
- The timing and magnitude of rainfall events can significantly impact overall demands on the system. For example, the total irrigation water delivered in 2013 was 22% higher than the total amount delivered in 2011. Properly developing reuse projects to keep the system in an approximate balance, but the inherent year-to-year variability could render the system out of balance if a few high or low use years occurred consecutively.

- The projected year after bringing on a major reuse development may lead to a short term water deficit, especially if the new demands are higher than the projected demands. As a result, it is recommended that the County retain rights to the creek water to augment supply if it is ever required in the future.
- The water balance shown above includes many assumptions that have significant margins of error and are also more variable than the projection suggests. Therefore it is recommended that the County pursue additional effluent disposal options. Four such options have been outlined in Section 6 of this report.

4.0 Reuse Water Quality Management

Reuse water use for irrigation has the potential to impact plant health, soil productivity, longevity of irrigation systems, and water quality of groundwater and surface water bodies. However, with careful water quality management, most of these problems can be avoided or substantially mitigated. The management of reuse water quality has been documented in the 2008 technical memorandum, reviewed in detail in CH2M HILL's 2012 "Reclaimed Water Quality Management Study" and is under review by Carollo Engineers, Inc. in a facility plan for the STMWRF facility that is being completed concurrent with this report. Many of the parameters discussed in the prior studies were recently measured as part of a July 7, 2015 Water Quality Report. The updated results are shown in Table 4.1 below.

4.1 Constituent Descriptions

Descriptions of several of the parameters shown in Table 4.1 are included below. These descriptions have largely been reproduced from the 2008 technical memorandum.

Nutrients

Nutrients in reuse water provide fertilizer benefits to plants. However, an excess amount of these nutrients can cause problems related to excessive growth, delayed or uneven maturity, or reduced quality. Nutrients in wastewater include nitrogen, phosphorus, potassium, zinc, calcium, magnesium, iron, manganese, boron, and sulfur.

Nitrogen is generally the nutrient of greatest concern because of potential impacts on surface and groundwater quality. Total nitrogen (Total-N) is the measure of all primary sources of N (TKN + nitrate-N (NO_3-N) + nitrite-N). Typically, Total-N concentrations between 5 to 30 mg/L are considered to have slight to moderate restrictions on use for irrigation. Reuse water from STMWRF had an average Total-N concentration of 2.2 mg/L, indicating there is no restriction for plants based on the nitrogen content of the wastewater.

Boron

If Boron concentrations are too high, toxicities can occur in plants. Boron toxicity is typically expressed by leaf burn starting at the terminal tips of leaves. Boron-related concerns are discussed in more detail below.

Salinity and Related Constituents

Salinity is one of the major concerns related to using reuse water for irrigation. Too much salt can result in plant toxicity and at higher levels, impacts to ground water salinity can become a concern. Electrical conductivity levels of 810 µmhos/cm were on the very lower end of the threshold range for slight to moderate restrictions on use.

TABLE 4.1
Reuse Water Quality Results for STMWRF

Analyte	Concentration	Range for "Slight to Moderate" Restrictions on Use[e]
Nitrate (NO_3-N) (mg/L)	0.64	
Total Nitrogen (mg/L)	2.2	5-30
Total Kjehldahl Nitrogen (TKN) (mg/L)	1.6	
Alkalinity, Bicarbonate (mg/L $CaCO_3$)	190	92-519
Alkalinity, Carbonate (mg/L $CaCO_3$)	< 2	
Boron (mg/L)	2.2	0.7-3.0
Calcium (mg/L)	27	
Chloride (mg/L)	110	> 106
Electrical Conductivity (µmhos/cm)	810	700 – 3,000
Magnesium (mg/L)	12	
Sodium (mg/L)	110	> 69
Sulfate (mg/L)	26	
Total Dissolved Solids (TDS) (mg/L)	460	450-2000
Arsenic (mg/l)	0.13	> 0.10
pH	7.46	< 6.5 or > 8.4

Total dissolved solids (TDS) are the amount of soluble organic and inorganic substances within a volume of water and are another way of measuring salinity. Reuse STMWRF water had an average TDS concentration of 460 mg/L, which is slightly above the threshold for slight to moderate restrictions on use (Table 4.1). However, as with conductivity, TDS levels are on the lower end of the threshold for slight restrictions on use. Further concerns about TDS levels are reproduced below.

Sodium is also a concern. Plant roots absorb sodium and transport it to plant leaves where it accumulates and can become toxic. Leaves can also directly absorb sodium, which makes sprinkler irrigation a concern when effluent sodium levels are high. Sodium levels were higher than the threshold, with an average of 110 mg/L. Irrigation water that is high in sodium can also cause soil dispersion and reduced soil permeability in fine-textured soils when sodium is present in unbalanced concentrations relative to other cations.

Chloride also contributes to the total salt concentration. Turfgrass is not particularly sensitive to chloride but certain shrub species are sensitive and can be affected at relatively low concentrations (~120 mg/L). Measured chloride levels for STMWRF reuse water were 110 mg/L, which are below the threshold for slight to moderate restrictions on use (Table 4.1).

Bicarbonate can also be found in high levels in reuse water. Excessive levels of bicarbonate can increase the pH of the soil and reduce permeability and can contribute to plugging of drip emitters. STMWRF reuse water had an average bicarbonate concentration of 190 mg/L $CaCO_3$. This is with the range for slight to moderate restrictions on use.

pH

The optimum pH for most turgrasses ranges from 5.5 to 7.0. Most reuse water tends to be between 6.5 and 8.4. The pH of the STMWRF reuse water was measured at 7.46, which is slightly higher than the optimum desired pH. Even though pH does not directly affect plant health, it is a good way to observe other constituents and can provide insight into the chemical properties of the soil. Also, reuse water with a pH between 7 and 8 has a slight to moderate potential to plug drip irrigation systems (Pettygrove and Asano, 1984).

Arsenic

Arsenic toxicity to plants vary widely, ranging from 12 mg/L for Sudan grass to less than 0.05 mg/L for rice. Measured chloride levels for STMWRF reuse water were 0.13 mg/L, which are slightly above the threshold for slight to moderate restrictions on use (Table 4.1). CH2M HILL recommends that the County sample for arsenic quarterly, and also recommends observing any impacts on vegetation if concentrations rise above 0.15 mg/L, and to take corrective action if concentrations rise.

4.2 Water Quality Discussion

From the 2012 Water Quality Management Study:

> *The reservoir is hypereutrophic (i.e., high concentrations of TP) which is expected as it is primarily comprised of treated effluent from a conventional secondary treatment system with TP concentrations of approximately 2 mg/L. High concentrations of nutrients results in large quantities of algal growth, as observed, which can impair filtration equipment both within the treatment plant and the distribution system. Other water parameters that require attention are boron and salinity concentrations within the reservoir as they can adversely impact plant growth when applied in excessive quantities.*
>
> *Nuisance algae is one of the more immediate water quality concerns as it potentially reduces hydraulic capacity of the continuous backwash filters and clogs irrigation filters within the water distribution system.*

Of particular concern at present are the reservoir concentrations of boron and total dissolved solids. The 2012 study noted that these parameters had not reached a concerning level at the time, but the concentrations were being mitigated as the reservoir was completely emptied each year and was being diluted with creek and well water. The reservoir will likely not be emptied every year, and creek and well water will no longer be utilized. The discussion from the 2012 study has been reproduced below.

> *While boron is an essential micronutrient required for plant growth, it can be toxic if available in excessive quantities at the root zone. Historic boron concentrations within the STMWRF reclaimed water has been recorded as 1.9 mg/L on average with more recent effluent concentrations approaching 3 mg/L. Concentrations of this magnitude (approximately 2 mg/L) can adversely impact plant growth of certain agricultural plant species such as stone fruits (e.g., peaches, plums, nectarines, cherries, etc.). Turf grasses, such as Kentucky Bluegrass, are more tolerant of high boron levels than more ornamental landscape vegetation and will grow in soils with boron levels as high as 10 ppm (Harivandi).*
>
> *Total dissolved solids (i.e., salinity) can also reduce plant growth when available in high concentrations. Current salinity concentrations within Huffaker reservoir are on the lower threshold limits of restricted used. However, leaching practices can be used to prevent salinity toxicity from occurring. This practice can also be applied to boron concentrations, but unfortunately boron moves slower through the soli-water matrix and requires approximately 3 times the leaching water as compared to salinity.*
>
> *Boron and salinity concentrations are not expected to increase dramatically if the reservoir is drawn down annually; however, it is known that the water demand is not expected to keep up with STMWRF effluent flow rates. As water is retained within the reservoir from year to year, it is then anticipated that both boron and salinity will gradually increase in concentration if all other factors (climate, groundwater infiltration, source water concentrations, etc.) remain equal. It is therefore recommended that the County investigate dynamics of both salinity and boron with respect to future water demands. A water quality model, such as CE-QUAL-W2, could be used to forecast future concentrations within the reservoir and estimate when it will exceed threshold values. It is anticipated that near future boron concentrations will decrease because of the recent use of supplemental creek water which is expected to slightly dilute concentrations. Timing of producing such a model is not required until boron concentrations increase to 3.0 mg/L or if water users anticipate irrigating less tolerant vegetation such as fruit trees.*

CH2M HILL recommends that quarterly sampling for boron and TDS concentrations be performed to confirm that concentrations are not increasing, and to take action should boron concentrations exceed 3.0 mg/L, as noted above.

Algae growth was another significant water quality concern discussed in the previous memos. The primary recommendation for reducing algae growth in the reservoir was reducing the effluent ammonia and total nitrogen levels together as much as is feasible with the biological treatment process. This process of reducing the effluent nutrient load will be covered more comprehensively in Carollo's STMWRF Facility Plan Update Technical Memorandum.

Washoe County has stated the intention to maintain compliance with Class A effluent standards even as these standards become more stringent in regards to turbidity and chlorine contact time. The County should implement progressive steps as outlined in the 2012 "Reclaimed Water Quality Management Study", which include destratification of Huffaker Reservoir and a flocculation and sedimentation system to improve the quality of the water sent to the effluent filters.

5.0 Distribution System Modeling and Expansion Planning

5.1 Hydraulic Model Description

The first step in modeling the distribution system was to update a County provided InfoWater™ hydraulic model of the reuse water distribution system by incorporating present demands. The model was updated by utilizing County provided Geographic Information System (GIS) information on the location of the existing reuse meters and associating these reuse meters with the nearest node in the hydraulic model. The reuse meters were assigned a flow rate based on the total demand at the meter recorded during July 2013, the highest demand month in the historical data set. Annual demands were converted to flow rates by assuming that the July 2013 total demand was utilized during a seven hour overnight period.

The future reuse sites were incorporated into the InfoWater™ model by extending service lines from the existing system to the various site locations. The majority of the added sites were incorporated into the main system pressure zone provided by Fieldcreek Tank. Sites in the Galena project area and one site in the Steamboat Commercial project area are at an elevation that require being served off of the Arrowcreek pressure zone. The St. James and Montreux project areas are at a higher elevation. The model assumed the construction of a new pump station and storage tank to create a third pressure zone in the system to serve these areas. The expanded system map is shown in Appendix A.

The future reuse sites were reflected in the system in the approximate order that the future projects are likely to be constructed. For example, the Damonte project was modeled with only the existing system online. The Bella Vista project was modeled with the existing demands and the demands for Damonte already present in the system. Any deficiencies in the existing system have been identified along with the date that the deficiency will begin to adversely impact the reuse water distribution system as a whole.

Most of the projects identified below can be constructed directly off of the existing distribution system with a few exceptions. These are:

- The St. James and Steamboat Commercial projects both assume that the Galena project has already been built.
- The Montreux project assumes that both the Galena project has been completed and the St. James project has been completed to the location of the proposed tank.

5.2 Future Demand Modeling

Hydraulic Model Assumptions and Criteria

The demand information provided by the County included total flow measured by a particular water meter for a given month. From this information, CH2M HILL took the highest demand month in the data set, July 2013, and assumed all of the irrigation occurred evenly over a seven hour overnight period to reflect the highest demand instances in the system. New pipelines were sized assuming a velocity of approximately five feet per second at this peak flow assumption for the new sites. All pressure nodes in the system were modeled assuming that a minimum pressure of 30 psi needed to be maintained at each service connection.

Hydraulic Model Results – New Projects Hydraulics

Each of the new projects were able to be installed without over taxing any of the system's pumping stations or trunk lines. A portion of the Steamboat Commercial project area and the entire Galena project area are at elevations that require being served from the Arrowcreek pressure zone. St. James and Montreux are at an even higher elevation and must be served off of a new pressure zone downstream of the Arrowcreek zone. The Fieldcreek pump station can still supply the required flow to these areas without expansion, but will no longer be operable in off-peak power times only due to the increased demand.

5.3 Project Area Cost Estimates

CH2M HILL has evaluated the costs for the extensions of the reuse water system for each of the projects identified in Section 2. For each scenario, pipeline cost was estimated as $15 per diameter-inch per foot of length. Each pipeline was evaluated for construction difficulty and applied a pipe-specific multiplier based on the installation type. The five possible installation types and multipliers for each type are summarized below.

1. Open Country – Multiplier = 0.74;

   The open country condition is fairly self-explanatory. It consists of an unpaved route in a non-forested area with a 3 to 6 foot depth of cover.

2. Gravel Road – Multiplier = 0.90;

   Similar to open country, but requires aggregate backfill and replacement of the gravel road surface.

3. Low Urban – Multiplier = 1.0;

   Defined as pipeline construction with about 3 to 6 foot depth of cover in normally excavatable soils on a paved street in an urban setting. Existing utilities, traffic, and work space are also assumed to be consistent with conditions encountered in wider feeder streets in modern residential subdivision settings.

4. Medium Urban – Multiplier = 1.19;

   The medium urban factor is characteristic of fairly congested urban business areas and is typically applied to arterial streets and modern commercial areas serving residential areas.

5. Tunneling – Multiplier = 4.0;

   This factor is applied to crossings of major highways by the jack-and-bore method, and includes a suitable carrier and casing pipe.

The total length of pipe is multiplied by the multiplier specific to that pipe segment to establish the equivalent length of low urban pipe for the section. This equivalent length is multiplied by $15/D-in/ft to estimate a total cost for the installation of the pipeline for that section. A 15% allowance for appurtenances such as valves and hydrants has been assumed for each estimate, as has a 15% multiplier for engineering and a 30% contingency.

A total cost for each project is presented in the Table 5.2 below, along with a summary of each project's annual demand in acre feet and cost per acre foot to extend service to the relevant area. Detailed cost estimates are included in Appendix B.

Table 5.2
Estimated Construction Costs by Project Area

Project Area	Projected Reuse Demand (acre-feet/year)	Estimated Construction Cost	Cost Per Acre-Foot
Arrowcreek	22	$ 49,000	$ 2,227
Bella Vista Ranch	213	$ 425,000	$ 1,995
Damonte Ranch	389	$ 1,224,000	$ 3,147
Galena	303	$ 4,788,000	$ 15,802
Geiger Grade	41	$ 1,070,000	$ 26,098
McCauley Ranch	19	$ 219,000	$ 11,526
Montreux	115	$ 1,804,000	$ 15,687
South Meadows	143	$ 338,000	$ 2,364
Steamboat Commercial	43	$ 1,361,000	$ 31,651
Steamboat Geothermal	1000	$ 4,617,000	$ 4,617
St. James	733	$ 17,774,000	$ 24,248
Thomas Creek	26	$ 534,000	$ 20,538
Zolezzi	43	$ 1,517,000	$ 35,279

From the analysis, the most economical projects are Bella Vista Ranch, Arrowcreek, South Meadows, Damonte Ranch and Steamboat Geothermal. Based on input from the County, Damonte Ranch, Bella Vista and South Meadows will be completed prior to any other projects, which is reflected in the timeline presented in Figure 3.2. Steamboat Geothermal has been selected to complete the required demand. Arrowcreek was not included in the timeline primarily because the small demand is insignificant to the overall system's water balance. Constructing this project is certainly economical, and may be pursued at any time without significantly impacting the system's water balance. The Galena project has a higher cost per acre foot than any of the selected options, but there is heavy interest and County preference to extend service in to this area. These factors could lead to the Galena project being constructed within the planning period.

The cost estimates are defined as AACE Class 5 estimates due to the limited information available in the preparation of the estimate. The expected accuracy ranges for this class estimate are –20 to –50 percent on the low side and +30 to +100 percent on the high side. In addition, estimates under $500,000 generally reflect short pipe lengths. Relatively minor changes in the assumed endpoints on the order of a couple hundred yards could introduce substantial changes to the overall costs of the options not reflected in the expected accuracy range that is standard for Class 5 estimates.

The cost estimates shown, which include any resulting conclusions on project financial or economic feasibility or funding requirements, have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project and resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors. Therefore, the final project costs will vary from the estimate presented here. Because of these factors, project feasibility, benefit/cost ratios, risks, and funding needs must be carefully reviewed prior to making specific financial decisions or establishing project budgets to help ensure proper project evaluation and adequate funding.

5.4 Steamboat Geothermal Scenarios

There is a large degree of uncertainty regarding the connection to Steamboat Geothermal, or ORMAT. In two emails dated 10/29/15 and 11/3/15, CH2M HILL was informed of ORMAT projected total reuse water volume and flow rates. These were that a hybrid cooling system could utilize 1,000 acre-feet per year with a peak flow of 3,000 gpm and a future reuse water only cooling system with a peak flow rate of 6,500 gpm. Water quality is a particular concern for supplying water to ORMAT. Poor water quality, particularly high TDS levels, can cause problems with ORMAT's equipment. All the projections below assume that water quality recommendations included in Carollo's STMWRF Facility Plan Update have been implemented and the resulting water quality is acceptable to ORMAT.

The new facility model included the demands for the hybrid system with pipes sized to be large enough to eventually accommodate the larger 6,500 gpm flow rate. It is not certain that ORMAT would desire to invest the estimated $4.6 million in the infrastructure required to support the eventual peak flow of 6,500 gpm. Therefore, Washoe County expressed a desire to present ORMAT with several different connection options and the corresponding costs and peak flow rates that would be possible through the connections. The results of this modeling are shown in Table 5.2 below.

The existing system has a 10-inch branch line only around a quarter mile from the ORMAT facility. In addition, the trunk line between the Export pump station and the Fieldcreek tank is approximately a mile and a quarter from the facility. Therefore, connections that are 10-inches and smaller can be constructed much more economically than larger lines that can carry more flow, but are inherently flow limited. The table below shows that if ORMAT kept their demand below 1,200 gallons per minute, the extension could be constructed off of the existing 10-inch line and would cost around a quarter million dollars. Larger flow rates require a parallel pipe back to the 24-inch trunk line between the Export pump station and Fieldcreek tank. Selecting an option below the 16-inch main to the trunk line will make the 1,000 acre-foot per year demand assumed in the water balance model impossible, and the additional demand would have to be obtained through some of the other projects. Detailed cost estimates for the various options are included in Appendix B. Please also note that the least expensive options are subject to the same sensitivity as the other estimates below $500,000 noted above. If the endpoint is only 200 yards further from the existing 10-inch line than was assumed in this memo, the change in endpoint would introduce a 50% error in the cost estimate, and add $100,000 to the least expensive estimate.

Table 5.2

Steamboat Geothermal Cost Estimates by Connection Type

Description	Approximate Peak Flow Rate (gpm)	Annual Water Use (acre-feet/year)[1]	Estimated Construction Cost
24-inch main to trunk line	7,000	2,300	$ 4,617,000
20-inch main to trunk line	4,900	1,600	$ 3,848,000
18-inch main to trunk line	4,000	1,300	$ 3,463,000
16-inch main to trunk line	3,100	1,000	$ 3,078,000
12-inch main to trunk line	1,800	600	$ 2,309,000
10-inch connection to 10-inch branch line	1,200	400	$ 247,000
8-inch connection to 10-inch branch line	800	250	$ 198,000

Notes: 1. Annual water use assumes an average flow rate that is approximately two-thirds of the noted peak flow rate, and is in operation 24 hours a day for the four warmest months of the year with no flow for the other eight months, which is consistent with ORMAT's description of a hybrid cooling system. A wet cooling system could be operated year round and would use substantially more flow as a result.

5.5 Conclusions

- The selected project areas for expansion are far more economical than any of the remaining alternatives. All of the selected alternatives can be constructed for less than $5,000 per acre-foot. None of the remaining options with a significant future demand can be constructed for less than $15,000 per acre-foot. This indicates that effluent disposal after the end of the present planning period may become significantly more expensive than what is indicated in the present study, and should be taken into account for long term planning.
- The Galena project has some non-cost benefits that may result in it being constructed prior to some of the lower cost per acre-foot projects.
- Fifty seven percent of the planned reuse expansion is extending service to a single customer as a part of the Steamboat Geothermal project. As noted above, the STMWRF Reuse System is not capable of supplying the entirety of this projected demand immediately upon connection. This requires flexibility on the part of the ORMAT, or requires the County to utilize creek water or another supplemental water source to meet the demand.
- If the Steamboat Geothermal project proves to not be viable, or is constructed with a lower total demand as discussed above, the County will have to replace the demand with the Galena and St. James projects, at a much higher cost per acre-foot.

6.0 Potential Alternative Reuse and Disposal Methods

Future reuse water demand projections used in the water balance model and in the InfoWater models were largely based upon connection of new irrigated areas for golf courses, parks, schools, open space, commercial landscapes, and roadway medians. The one exception was the additional inclusion of the industrial reuse demand for cooling at the Steamboat Geothermal facility.

In order to ensure enough reuse water is available to meet future demands and that the reservoir capacity is not exceeded, several additional options may need to be considered to add a stable effluent disposal source and increase the resiliency of the system. Any significant disruption in the demand for reuse water, may include wetter climate conditions or the partial or complete loss of a major customer like the Arrowcreek Golf Course. An evaluation matrix of these alternatives is presented in Table 6.1.

Criteria	Alt 1: Rapid Infiltration Basins	Alt 2: South Meadows Agricultural Fields	Alt 3: Indirect Potable Reuse	Alt 4: Regionalized Reuse System
Location relative to service area	Potential to site basins within STMERA - Best soils on Westside of service area but groundwater uses higher there - Groundwater on Eastside of service area is lower quality and with less potable use but soil conditions are more restrictive	Located within the South Meadows project area, which is already largely built-out with reuse water distribution infrastructure.	Indirect potable reuse would occur within the existing STMERA.	Potential to distribute reuse water through the TMWRF system to the north
Infrastructure requirements	Spreading basins constructed over permeable soils with conveyance to basins	New service connections to existing reuse water mains and submains.	Significant additional advanced water treatment infrastructure would be required. Separate disposal infrastructure from the existing reuse system would be required if IPR is only used on a portion of the STMWRF effluent.	Interconnection between STMWRF and TMWRF reuse water distribution systems
Regulatory requirements	Revisions to STMWRF EMP - New waste discharge permit for rapid infiltration to groundwater.	No additional regulatory requirements beyond current reuse regulations.	Regional agencies are presently contemplating an IPR feasibility phase to complete by 2020.	Revisions to STMWRF and TMWRF EMPs
Operational requirements	STMWRF operators would need to monitor basins regularly and periodically rake basins to maintain permeability.	STMWRF operators would have to coordinate with the ag fields regarding when and how much water to send to control reservoir levels.		Coordination between STMWRF and TMWRF operators

7.0 Conclusions

Major conclusions that can be drawn from this TM are summarized as:

- Current reuse water demands within the STMESA are at 2,350 ac-ft/yr, and will be approximately in balance with influent flow after the completion of the lining project.
- Demands on creek diversions for supplemental water supply have diminished to zero with the completion of the new liner project. However, it is recommended that the County retain those water rights as they may be needed periodically.
- Additional reuse sites will have to be constructed in the near term to maintain a water balance with the projected STMWRF influent flows.
- The County will maintain a State of Nevada Class A effluent as water quality standards get tighter, and this may require more treatment infrastructure.
- The most economical reuse projects are Damonte Ranch, Bella Vista, South Meadows and Steamboat Geothermal. The Galena project has some non-cost benefits that may result in it being considered alongside some of the projects that have a lower cost per acre-foot.
- Slightly more than half of the planned future reuse site development comes from the development of the Steamboat Geothermal project. If this project either fails to materialize, or is constructed at a much lower flow rate, the County will have to pursue much more expensive reuse projects, such as Galena and St. James, or pursue an alternative method to dispose of excess effluent like the interconnect pipeline.
- There are four potential alternative reuse and disposal methods that could be pursued to add stability to the system in the event of a supply or demand disruption such as a wet year with low irrigation demand or the loss of a major customer like Arrowcreek.
- Water quality recommendations outlined in the 2012 Reclaimed Water Quality Management Study, such as reservoir destratification and flocculation and sedimentation should be implemented to improve reuse water quality, and will be necessary in order to supply a more quality sensitive customer like ORMAT.

8.0 References

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Appendix A – Project Mapping

Hydraulic Model Results – Capacity of Existing Infrastructure to Convey Additional Demands

The hydraulic model noted several places where system pressures will be below 30 psi at buildout. These junctions are summarized below.

Table A.1

Existing Junctions with Low Pressures

Junction Number	Pressure (PSI)	Note
Fieldcreek		
J52	1.86	Near Fieldcreek Tank
J54	2.72	Near Fieldcreek Tank
J58	3.16	Near Fieldcreek Tank
J572	3.59	Near Fieldcreek Tank
J60	3.59	Near Fieldcreek Tank
J45	10.07	Near Fieldcreek Tank
J41	10.08	Near Fieldcreek Tank
Arrowcreek		
J390	11.55	Near Arrowcreek Tank
J278	13.28	Near Arrowcreek Tank
J68	13.28	Near Arrowcreek Tank
J64	9.88	Near Arrowcreek Tank
Southern End of Existing System		
J472	5.59	end of system
J470	9.63	end of system
McCauley Ranch		
J63	15.62	No appropriate connection nearby to supply higher head

The existing junctions with low pressures are either near one of the two tanks, at a high elevation without adequate means to boost the flow, or are at the end of the system and close to the Steamboat Geothermal demand. The locations are shown in Figure A.1, below.

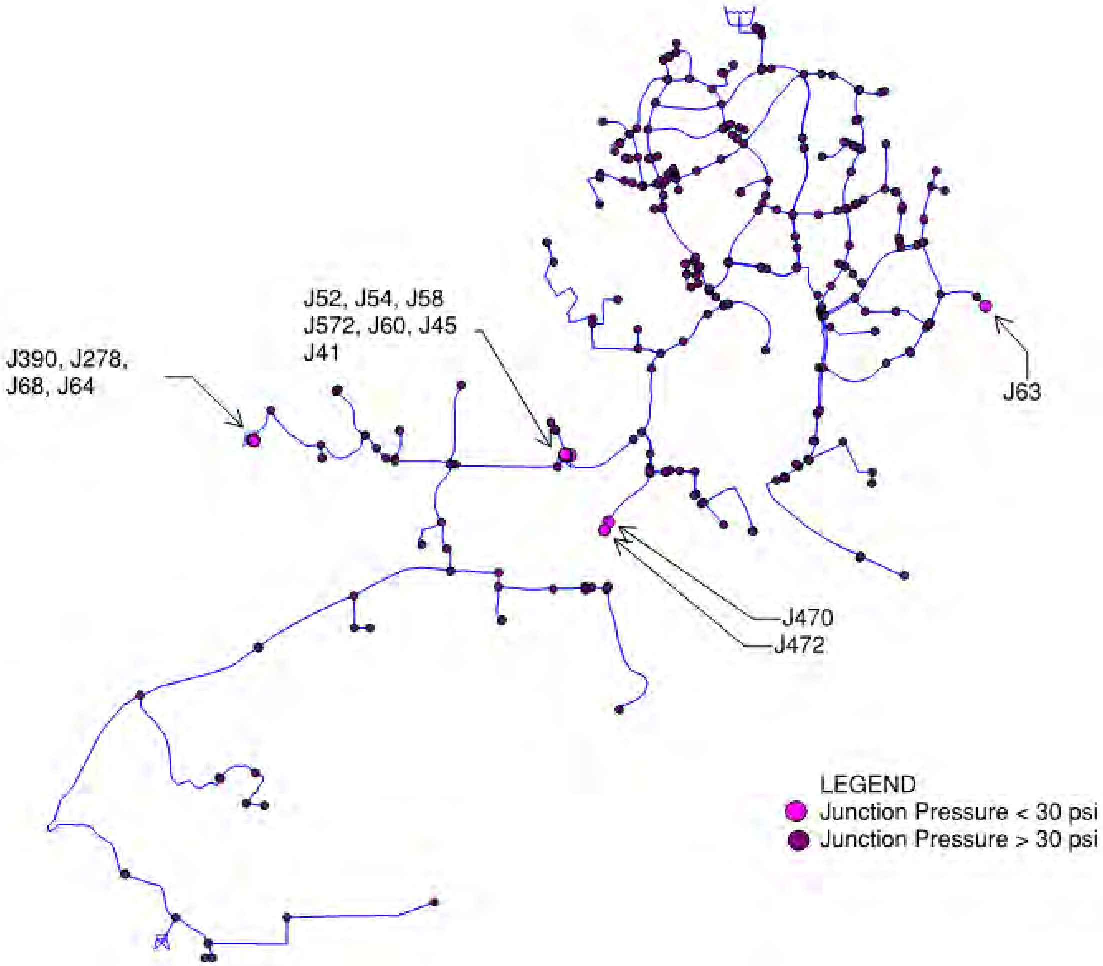

FIGURE A.1
Map of junctions with insufficient pressure at Buildout

The end of system nodes near the Steamboat Geothermal demand can be served by a small booster pump if necessary after the new demand is realized. Similarly, J63, McCauley Ranch, could also be served by a small pump. The other nodes are on the tank sites for the Fieldcreek and Arrowcreek tanks. Some of these nodes have no demand, and others nodes (like at Arrowcreek) may be located on the map at a higher elevation than the service point is in reality.

There are also a few areas in the system with high pipe velocities as shown in Figure A.2.

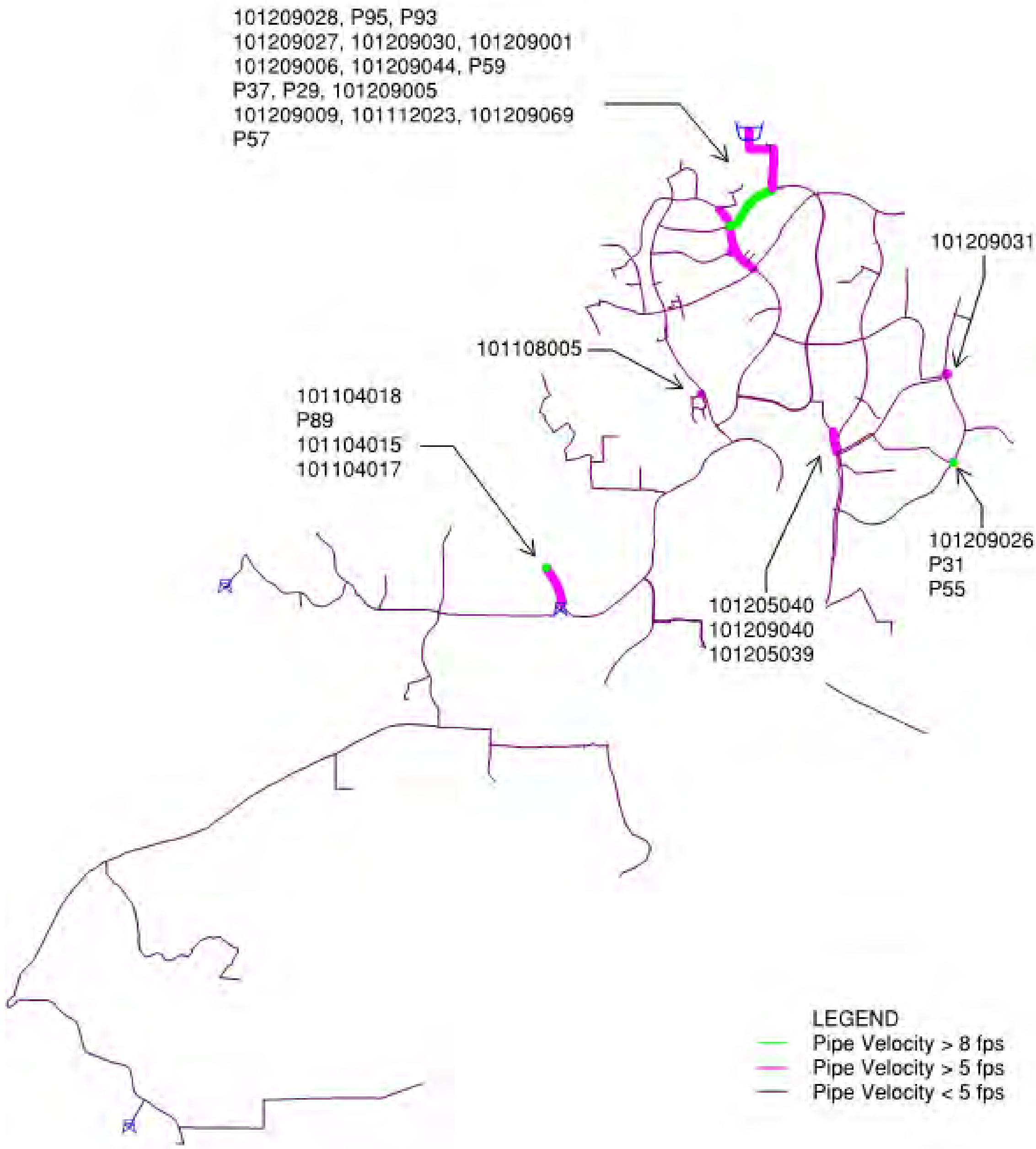

FIGURE A.2
Map of pipes with high velocities at buildout

The only significant area of high pipe velocities was in the pipes leading away from the Export pump station. The velocities modeled in the pipes do not appear to be sufficiently high to warrant a parallel piping project or other capacity increase in that area.

Appendix B –Project Cost Estimates

Arrowcreek

Cost Estimate for Arrowcreek

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost	Extended Total Cost
P231	4	579.02	0.85	492.17	$ 60.00	$ 29,530
					Subtotal	$ 29,530
					Appurtenances (15%)	$ 4,430
					Subtotal	$ 33,960
					Engineering/CM/Admin (15%)	$ 5,094
					Contingency (30%)	$ 10,188
					Project Total	**$ 49,000**

Bella Vista

Cost Estimate for Bella Vista

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost	Extended Total Cost
P325	10	1,998.07	0.85	1,698.36	$ 150.00	$ 254,754
					Subtotal	$ 254,754
					Appurtenances (15%)	$ 38,213
					Subtotal	$ 292,967
					Engineering/CM/Admin (15%)	$ 43,945
					Contingency (30%)	$ 87,890
					Project Total	**$ 425,000**

Damonte

Cost Estimate for Damonte

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost	Extended Total Cost
P165	6	3,437.26	1.00	3,437.26	$ 90.00	$ 309,353
P319	12	784.19	1.00	784.19	$ 180.00	$ 141,154
P321	12	2,097.24	0.74	1,551.96	$ 180.00	$ 279,352
P271	4	65.48	1.00	65.48	$ 60.00	$ 3,929
					Subtotal	$ 733,789
					Appurtenances (15%)	$ 110,068
					Subtotal	$ 843,857
					Engineering/CM/Admin (15%)	$ 126,579
					Contingency (30%)	$ 253,157
					Project Total	**$ 1,224,000**

Galena

Cost Estimate for Galena

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)		Unit Cost		Extended Total Cost
P151	16	1,027.94	1.04	1,065.97	$	240.00	$	255,834
P197	6	94.15	0.85	80.03	$	90.00	$	7,202
P199	4	64.36	0.85	54.71	$	60.00	$	3,282
P233	10	2,123.99	1.00	2,123.99	$	150.00	$	318,599
P235	10	632.82	1	632.82	$	150.00	$	94,923
P249	8	291.11	1.00	291.11	$	120.00	$	34,933
P251	6	734.74	0.85	624.53	$	90.00	$	56,208
P253	8	1,413.85	1.00	1,413.85	$	120.00	$	169,662
P255	6	101.09	1	101.09	$	90.00	$	9,098
P257	4	48.83	1.00	48.83	$	60.00	$	2,930
P295	16	1,246.11	1.72	2,146.19	$	240.00	$	515,085
P301	8	1,767.96	1.00	1,767.96	$	120.00	$	212,155
P305	16	30.72	1.00	30.72	$	240.00	$	7,373
P309	16	2,815.51	1.00	2,815.51	$	240.00	$	675,722
P313	16	0.22	1	0.22	$	240.00	$	53
P331	6	1,553.81	1.00	1,553.81	$	90.00	$	139,843
P333	10	2,441.50	1.00	2,441.50	$	150.00	$	366,225
P345	4	41.3	1	41.30	$	60.00	$	2,478
						Subtotal	$	2,871,606
						Appurtenances (15%)	$	430,741
						Subtotal	$	3,302,346
						Engineering/CM/Admin (15%)	$	495,352
						Contingency (30%)	$	990,704
						Project Total	**$**	**4,788,000**

Geiger Grade

Cost Estimate for Geiger Grade

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost	Extended Total Cost
P153	4	2,145.37	1.00	2,145.37	$ 60.00	$ 128,722
P155	4	488.32	1.00	488.32	$ 60.00	$ 29,299
P221	4	5,822.39	1.00	5,822.39	$ 60.00	$ 349,343
P241	4	80.52	1.00	80.52	$ 60.00	$ 4,831
P243	4	2,162.79	1.00	2,162.79	$ 60.00	$ 129,767
					Subtotal	$ 641,963
					Appurtenances (15%)	$ 96,295
					Subtotal	$ 738,258
					Engineering/CM/Admin (15%)	$ 110,739
					Contingency (30%)	$ 221,477
					Project Total	**$ 1,070,000**

McCauley Ranch

Cost Estimate for McCauley Ranch

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost		Extended Total Cost	
P159	4	1,698.32	1.00	1,698.32	$	60.00	$	101,899
P323	4	582.46	0.85	495.09	$	60.00	$	29,705
						Subtotal	$	131,605
						Appurtenances (15%)	$	19,741
						Subtotal	$	151,345
						Engineering/CM/Admin (15%)	$	22,702
						Contingency (30%)	$	45,404
						Project Total	**$**	**219,000**

Montreux

Cost Estimate for Montreux

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)		Unit Cost		Extended Total Cost
P137	8	6,775.88	1.00	6,775.88	$	120.00	$	813,106
P139	6	72.24	1.00	72.24	$	90.00	$	6,502
P141	4	1,913.74	1.00	1,913.74	$	60.00	$	114,824
P143	4	1,858.51	1.00	1,858.51	$	60.00	$	111,511
P337	4	806.57	0.74	596.86	$	60.00	$	35,812
						Subtotal	$	1,081,754
						Appurtenances (15%)	$	162,263
						Subtotal	$	1,244,017
						Engineering/CM/Admin (15%)	$	186,603
						Contingency (30%)	$	373,205
						Project Total	**$**	**1,804,000**

St. James

Cost Estimate for St. James

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)		Unit Cost		Extended Total Cost
P121	12	326.45	1.00	326.45	$	180.00	$	58,761
P125	6	32.52	1	32.52	$	90.00	$	2,927
P129	16	3,268.14	1.00	3,268.14	$	240.00	$	784,354
P131	12	689.29	1	689.29	$	180.00	$	124,072
P133	12	4,641.33	0.85	3,945.13	$	180.00	$	835,439
P135	16	12,185.12	1.00	12,185.12	$	240.00	$	2,924,429
P237	18	5,689.08	1.00	5,689.08	$	270.00	$	1,536,052
P239	6	51.25	1.00	51.25	$	90.00	$	4,613
P259	12	6,622.73	0.74	4,900.82	$	180.00	$	1,192,091
P273	16	4,836.46	1.00	4,836.46	$	240.00	$	1,160,750
P275	6	1,422.62	1.00	1,422.62	$	90.00	$	128,036
P285	16	1,869.14	1.00	1,869.14	$	240.00	$	448,594
P287	16	1,272.86	0.74	941.92	$	240.00	$	305,486
P315	16	4,550.19	1.00	4,550.19	$	240.00	$	1,092,046
P335	6	685.29	0.74	507.11	$	90.00	$	61,676
						Subtotal	$	10,659,325
						Appurtenances (15%)	$	1,598,899
						Subtotal	$	12,258,224
						Engineering/CM/Admin (15%)	$	1,838,734
						Contingency (30%)	$	3,677,467
						Project Total	**$**	**17,774,000**

South Meadows

Cost Estimate for South Meadows

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost	Extended Total Cost
P279	6	1,813.08	1.19	2,157.57	$ 90.00	$ 194,181
P219	6	95.06	1.00	95.06	$ 90.00	$ 8,555
					Subtotal	$ 202,736
					Appurtenances (15%)	$ 30,410
					Subtotal	$ 233,147
					Engineering/CM/Admin (15%)	$ 34,972
					Contingency (30%)	$ 69,944
					Project Total	**$ 338,000**

Steamboat Commerical

Cost Estimate for Steamboat Commerical

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost	Extended Total Cost
P111	4	3,641.01	1.00	3,641.01	$ 60.00	$ 218,461
P349	6	6,644.29	0.74	4,916.77	$ 90.00	$ 597,986
					Subtotal	$ 816,447
					Appurtenances (15%)	$ 122,467
					Subtotal	$ 938,914
					Engineering/CM/Admin (15%)	$ 140,837
					Contingency (30%)	$ 281,674
					Project Total	**$ 1,361,000**

Steamboat Geothermal

Cost Estimate for Proposed Steamboat Geothermal Scenario #1

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost	Extended Total Cost
P101	24	5,335.93	1.26	6,714.67	$ 360.00	$ 2,417,281
P113	24	1,319.59	0.74	976.50	$ 360.00	$ 351,539
					Subtotal	$ 2,768,820
					Appurtenances (15%)	$ 415,323
					Subtotal	$ 3,184,143
					Engineering/CM/Admin (15%)	$ 477,621
					Contingency (30%)	$ 955,243
					Project Total	**$ 4,617,000**

Thomas Creek

Cost Estimate for Thomas Creek

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)		Unit Cost		Extended Total Cost
P213	4	1,357.84	1.19	1,615.83	$	60.00	$	96,950
P247	4	103.36	1.19	123.00	$	60.00	$	7,380
P317	4	3,599.07	1.00	3,599.07	$	60.00	$	215,944
						Subtotal	$	320,274
						Appurtenances (15%)	$	48,041
						Subtotal	$	368,315
						Engineering/CM/Admin (15%)	$	55,247
						Contingency (30%)	$	110,494
						Project Total	**$**	**534,000**

Zolezzi

Cost Estimate for Zolezzi

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost	Extended Total Cost
P263	4	2,174.41	1.00	2,174.41	$ 60.00	$ 130,465
P185	4	3,111.74	1.00	3,111.74	$ 60.00	$ 186,704
P261	4	216.35	1.00	216.35	$ 60.00	$ 12,981
P265	6	5,485.81	1.00	5,485.81	$ 90.00	$ 493,723
P267	6	955.44	1.00	955.44	$ 90.00	$ 85,990
					Subtotal	$ 909,863
					Appurtenances (15%)	$ 136,479
					Subtotal	$ 1,046,342
					Engineering/CM/Admin (15%)	$ 156,951
					Contingency (30%)	$ 313,903
					Project Total	**$ 1,517,000**

Cost Estimate 24-inch

Cost Estimate for Proposed Steamboat Geothermal Scenario #1

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost	Extended Total Cost
P101	24	5,335.93	1.26	6,714.67	$ 360.00	$ 2,417,281
P113	24	1,319.59	0.74	976.50	$ 360.00	$ 351,539
					Subtotal	$ 2,768,820
					Appurtenances (15%)	$ 415,323
					Subtotal	$ 3,184,143
					Engineering/CM/Admin (15%)	$ 477,621
					Contingency (30%)	$ 955,243
					Project Total	**$ 4,617,000**

Cost Estimate 20-inch

Cost Estimate for Proposed Steamboat Geothermal Scenario #2

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)		Unit Cost		Extended Total Cost
P101	20	5,335.93	1.26	6,714.67	$	300.00	$	2,014,401
P113	20	1,319.59	0.74	976.50	$	300.00	$	292,949
						Subtotal	$	2,307,350
						Appurtenances (15%)	$	346,103
						Subtotal	$	2,653,453
						Engineering/CM/Admin (15%)	$	398,018
						Contingency (30%)	$	796,036
						Project Total	**$**	**3,848,000**

Cost Estimate 18-inch

Cost Estimate for Proposed Steamboat Geothermal Scenario #3

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost	Extended Total Cost
P101	18	5,335.93	1.26	6,714.67	$ 270.00	$ 1,812,961
P113	18	1,319.59	0.74	976.50	$ 270.00	$ 263,654
					Subtotal	$ 2,076,615
					Appurtenances (15%)	$ 311,492
					Subtotal	$ 2,388,107
					Engineering/CM/Admin (15%)	$ 358,216
					Contingency (30%)	$ 716,432
					Project Total	**$ 3,463,000**

Cost Estimate 16-inch

Cost Estimate for Proposed Steamboat Geothermal Scenario #4

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost	Extended Total Cost
P101	16	5,335.93	1.26	6,714.67	$ 240.00	$ 1,611,521
P113	16	1,319.59	0.74	976.50	$ 240.00	$ 234,359
					Subtotal	$ 1,845,880
					Appurtenances (15%)	$ 276,882
					Subtotal	$ 2,122,762
					Engineering/CM/Admin (15%)	$ 318,414
					Contingency (30%)	$ 636,829
					Project Total	**$ 3,078,000**

Cost Estimate 12-inch

Cost Estimate for Proposed Steamboat Geothermal Scenario #5

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost	Extended Total Cost
P101	12	5,335.93	1.26	6,714.67	$ 180.00	$ 1,208,641
P113	12	1,319.59	0.74	976.50	$ 180.00	$ 175,769
					Subtotal	$ 1,384,410
					Appurtenances (15%)	$ 207,662
					Subtotal	$ 1,592,072
					Engineering/CM/Admin (15%)	$ 238,811
					Contingency (30%)	$ 477,621
					Project Total	**$ 2,309,000**

Cost Estimate 10-inch

Cost Estimate for Proposed Steamboat Geothermal Scenario #6

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost	Extended Total Cost
P321	10	8.38	1.26	10.55	$ 150.00	$ 1,582
P113	10	1,319.59	0.74	976.50	$ 150.00	$ 146,474
					Subtotal	$ 148,056
					Appurtenances (15%)	$ 22,208
					Subtotal	$ 170,265
					Engineering/CM/Admin (15%)	$ 25,540
					Contingency (30%)	$ 51,079
					Project Total	**$ 247,000**

Cost Estimate 8-inch

Cost Estimate for Proposed Steamboat Geothermal Scenario #7

Pipe Name	Diameter (in)	Length (ft)	Multiplier	Equivalent Length (ft)	Unit Cost	Extended Total Cost
P321	8	8.38	1.26	10.55	$ 120.00	$ 1,265
P113	8	1,319.59	0.74	976.50	$ 120.00	$ 117,180
					Subtotal	$ 118,445
					Appurtenances (15%)	$ 17,767
					Subtotal	$ 136,212
					Engineering/CM/Admin (15%)	$ 20,432
					Contingency (30%)	$ 40,864
					Project Total	**$ 198,000**

Appendix C –Supporting Documents

FACTSHEET
(pursuant to NAC 445A.236)

Permittee Name: WASHOE COUNTY UTILITY SERVICES DIVISION
4930 ENERGY WAY
RENO, NV - 89502

Permit Number: NS0040024

Location: SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY, WASHOE
8500 ALEXANDER LAKE ROAD, RENO, NV - 89511
LATITUDE: 39.457703, LONGITUDE: -119.743681
TOWNSHIP: 18N, RANGE: 20E, SECTION: 4

Outfall / Well Num	Outfall / Well Name	Location Type	Well Log Num	Outfall City	Outfall State	Outfall Zip	Outfall County	Latitude	Longitude	Receiving Water
001	PARSHALL FLUME/HEADWORKS	Internal Outfall		RENO	NV	89502	WASHOE	39.458333	-119.6583	GROUNDWATER OF THE STATE
002	POST CHLORINE CONTACT BASIN PRIOR TO EFFLUENT PUMP STATION	Internal Outfall		RENO	NV	89502	WASHOE	39.458333	-119.6583	GROUNDWATER OF THE STATE
004	MONITORING WELL A	Monitoring Well		RENO	NV	89502	WASHOE	39.457870	-119.7443	GROUNDWATER OF THE STATE
005	MONITORING WELL B	Monitoring Well		RENO	NV	89502	WASHOE	39.459630	-119.7445	GROUNDWATER OF THE STATE
006	MONITORING WELL C	Monitoring Well		RENO	NV	89502	WASHOE	39.457807	-119.7440	GROUNDWATER OF THE STATE

General:

The Permittee has applied for renewal of water pollution control discharge permit NS0040024 to operate a wastewater reclamation plant. The plant provides tertiary treatment of domestic residential and commercial sewage generated in the South Truckee Meadows service area. The plant utilizes an activated sludge process to biologically treat influent wastewater to tertiary treatment standards in the aerated "race track" type oxidation ditch systems to reduce BOD and nitrogen. Activated sludge generated in the treatment process is either returned to the oxidation ditches as return activated sludge, or removed as waste activated sludge, which is pumped to the Truckee Meadows Water Reclamation Facility (TMWRF) via a City of Reno sanitary sewer interceptor. After clarification, the effluent is then passed through tertiary sand filters and chlorine contact basins for disinfection. The treated effluent is then pumped to a wet well where it may be mixed with creek water to supplement flow. The effluent is then pumped into the effluent export pipeline for reuse deliveries during the irrigation season. The lined Huffaker Reservoir adjacent to the plant provides winter and emergency storage for the treated effluent.

The tertiary treated, denitrified and disinfected effluent is delivered via reuse pipeline for landscape irrigation at several permitted golf courses, miles of common and median roadway areas, the South Valley Sports Complex, South Meadows Business Park, and other permitted sites located both east of Highway 395 and west of Highway 395 in the greater southwest Reno and southern Truckee Meadows area.

Discharge Characteristics:

During the current permit period which began on October 4, 2007, STMWRF had one documented exceedance. On September 23, 2011, STMWRF reported a Total Coliform violation of 104 CFU/100ml. There were no obvious reasons for the violation. Chlorine residual was satisfactory at the time the sample was taken and treatment at the plant had been very stable. Two samples prior to and one sample after the violation were all within the permit limits.

Receiving Water:

The receiving waters are groundwater of the State of Nevada at various reuse irrigation sites and the effluent reservoir. Depth to groundwater near the plant site is approximately 4 to 7 feet below ground surface. The groundwater is monitored quarterly at the plant site and near the effluent storage reservoir in Monitoring Wells A, B, and C.

Summary of Changes From Previous Permit:

Due to new Permit naming conventions at NDEP, Bureau of Water Pollution Control, the permit ID has been changed from NEV40024 to NS0040024. This change does not reflect a change in the type of permit being issued. NEV and NS permits are for groundwater discharges to the State of Nevada. These are not to be confused with “NV” permits which are reserved for NPDES Permitting.

BOD and TSS monitoring have been removed from the influent monitoring requirements. As such the percent removal has also been removed from the monitoring requirements. The facility will continue to be required to meet the appropriate effluent limitations set for these parameters.

The requirement for monitoring both electrical conductivity and total dissolved solids (TDS) is duplicative in that they measure essentially the same thing. The quarterly electrical conductivity monitoring in the groundwater monitoring wells will be removed since TDS is considered to be more precisely measured in the lab. The annual TDS monitoring requirement will be changed to a quarterly requirement in lieu of the electrical conductivity monitoring.

During the past five annual monitoring periods for priority pollutant metals, the samples have consistently been below the Nevada priority pollutant reference values. The sampling period for metals has been changed to one time per permit cycle in the 4th year for submission with the renewal application.

Proposed Effluent Limitations:

WWTP Discharge Limitations Table for Sample Location 001 (Internal Outfall) To Be Reported Monthly

	Discharge Limitations			Monitoring Requirements			
Parameter	**Base**	**Quantity**	**Concentration**	**Monitoring Loc**	**Sample Loc**	**Measurement Frequency**	**Sample Type**
Flow rate	30 Day Average	<= 4.1 Million Gallons per Day (Mgal/d)		Intake	001	Continuous	METER
Flow rate	Daily Maximum	<= 4.5 Million Gallons per Day (Mgal/d)		Intake	001	Continuous	METER

WWTP Discharge Limitations Table for Sample Location 002 (Internal Outfall) To Be Reported Monthly

	Discharge Limitations			Monitoring Requirements			
Parameter	**Base**	**Quantity**	**Concentration**	**Monitoring Loc**	**Sample Loc**	**Measurement Frequency**	**Sample Type**
Coliform, total general	30 Day Average		<= 2.2 Most Probable Number per 100ml T (MPN/100mL)	Effluent Gross	002	Weekly	DISCRT
Coliform, total general	Daily Maximum		<= 23 Most Probable Number per 100ml T (MPN/100mL)	Effluent Gross	002	Weekly	DISCRT
Nitrogen, total	Monthly Maximum		<= 10 Milligrams per Liter (mg/L)	Effluent Gross	002	Monthly	DISCRT
pH, minimum	Monthly Minimum		>= 6 Standard Units (SU)	Effluent Gross	002	Monthly	DISCRT
Flow rate	30 Day Average	M&R Million Gallons per Day (Mgal/d)		Effluent Gross	002	Weekly	DISCRT
Flow rate	Daily Maximum	M&R Million Gallons per Day (Mgal/d)		Effluent Gross	002	Weekly	DISCRT
BOD, carbonaceous, 05 day, 20 C	Daily Maximum		<= 45 Milligrams per Liter (mg/L)	Effluent Gross	002	Weekly	COMPOS
BOD, carbonaceous, 05 day, 20 C	30 Day Average		<= 30 Milligrams per Liter (mg/L)	Effluent Gross	002	Weekly	COMPOS
Solids, total suspended	30 Day Average		<= 30 Milligrams per Liter (mg/L)	Effluent Gross	002	Weekly	COMPOS
Solids, total suspended	Daily Maximum		<= 45 Milligrams per Liter (mg/L)	Effluent Gross	002	Weekly	COMPOS
pH, maximum	Monthly Maximum		<= 9 Standard Units (SU)	Effluent Gross	002	Monthly	DISCRT

WWTP Discharge Limitations Table for Sample Location 002 (Internal Outfall) To Be Reported Once During The Permit Term

	Discharge Limitations			Monitoring Requirements			
Parameter	**Base**	**Quantity**	**Concentration**	**Monitoring Loc**	**Sample Loc**	**Measurement Frequency**	**Sample Type**
Chromium, total (as Cr)	Single Sample		M&R Milligrams per Liter (mg/L)	Effluent Gross	002	Once Per Permit Term [1]	DISCRT
Copper, total (as Cu)	Single Sample		M&R Milligrams per Liter (mg/L)	Effluent Gross	002	Once Per Permit Term [1]	DISCRT
Lead, total (as Pb)	Single Sample		M&R Milligrams per Liter (mg/L)	Effluent Gross	002	Once Per Permit Term [1]	DISCRT
Mercury, total (as Hg)	Single Sample		M&R Milligrams per Liter (mg/L)	Effluent Gross	002	Once Per Permit Term [1]	DISCRT
Nickel, total (as Ni)	Single Sample		M&R Milligrams per Liter (mg/L)	Effluent Gross	002	Once Per Permit Term [1]	DISCRT
Selenium, total (as Se)	Single Sample		M&R Milligrams per Liter (mg/L)	Effluent Gross	002	Once Per Permit Term [1]	DISCRT
Silver, total (as Ag)	Single Sample		M&R Milligrams per Liter (mg/L)	Effluent Gross	002	Once Per Permit Term [1]	DISCRT
Thallium, total (as Tl)	Single Sample		M&R Milligrams per Liter (mg/L)	Effluent Gross	002	Once Per Permit Term [1]	DISCRT
Zinc, total (as Zn)	Single Sample		M&R Milligrams per Liter (mg/L)	Effluent Gross	002	Once Per Permit Term [1]	DISCRT
Antimony, total (as Sb)	Single Sample		M&R Milligrams per Liter (mg/L)	Effluent Gross	002	Once Per Permit Term [1]	DISCRT
Arsenic, total (as As)	Single Sample		M&R Milligrams per Liter (mg/L)	Effluent Gross	002	Once Per Permit Term [1]	DISCRT
Beryllium, total (as Be)	Single Sample		M&R Milligrams per Liter (mg/L)	Effluent Gross	002	Once Per Permit Term [1]	DISCRT

WWTP Discharge Limitations Table for Sample Location 002 (Internal Outfall) To Be Reported Once During The Permit Term

	Discharge Limitations			Monitoring Requirements			
Parameter	**Base**	**Quantity**	**Concentration**	**Monitoring Loc**	**Sample Loc**	**Measurement Frequency**	**Sample Type**
Cadmium, total (as Cd)	Single Sample		M&R Milligrams per Liter (mg/L)	Effluent Gross	002	Once Per Permit Term [1]	DISCRT

Notes (WWTP Discharge Limitations Table):

1. Sampling shall be conducted in the 4th year of the permit and submitted with the 2017 4th quarter DMRs

Groundwater Monitoring Wells Table for Sample Location Mwa (Monitoring Well) To Be Reported Quarterly

	Discharge Limitations			Monitoring Requirements			
Parameter	**Base**	**Quantity**	**Concentration**	**Monitoring Loc**	**Sample Loc**	**Measurement Frequency**	**Sample Type**
Depth to water level ft below landsurface	Value	M&R Feet (ft)		Groundwater	MWA	Quarterly	DISCRT
Phosphorus, total (as P)	Single Sample		M&R Milligrams per Liter (mg/L)	Groundwater	MWA	Quarterly	DISCRT
Chloride (as Cl)	Single Sample		M&R Milligrams per Liter (mg/L)	Groundwater	MWA	Quarterly	DISCRT
Nitrogen, total	Single Sample		<= 10 Milligrams per Liter (mg/L)	Groundwater	MWA	Quarterly	DISCRT
Solids, total dissolved	Single Sample		M&R Milligrams per Liter (mg/L)	Groundwater	004	Quarterly	DISCRT

Groundwater Monitoring Wells Table for Sample Location Mwb (Monitoring Well) To Be Reported Quarterly

	Discharge Limitations			Monitoring Requirements			
Parameter	**Base**	**Quantity**	**Concentration**	**Monitoring Loc**	**Sample Loc**	**Measurement Frequency**	**Sample Type**
Depth to water level ft below landsurface	Value	M&R Feet (ft)		Groundwater	MWB	Quarterly	DISCRT
Phosphorus, total (as P)	Single Sample		M&R Milligrams per Liter (mg/L)	Groundwater	MWB	Quarterly	DISCRT
Chloride (as Cl)	Single Sample		M&R Milligrams per Liter (mg/L)	Groundwater	MWB	Quarterly	DISCRT
Nitrogen, total	Single Sample		<= 10 Milligrams per Liter (mg/L)	Groundwater	MWB	Quarterly	DISCRT
Solids, total dissolved	Single Sample		M&R Milligrams per Liter (mg/L)	Groundwater	005	Quarterly	DISCRT

Groundwater Monitoring Wells Table for Sample Location Mwc (Monitoring Well) To Be Reported Quarterly

	Discharge Limitations			Monitoring Requirements			
Parameter	**Base**	**Quantity**	**Concentration**	**Monitoring Loc**	**Sample Loc**	**Measurement Frequency**	**Sample Type**
Depth to water level ft below landsurface	Value	M&R Feet (ft)		Groundwater	MWC	Quarterly	DISCRT
Phosphorus, total (as P)	Single Sample		M&R Milligrams per Liter (mg/L)	Groundwater	MWC	Quarterly	DISCRT
Chloride (as Cl)	Single Sample		M&R Milligrams per Liter (mg/L)	Groundwater	MWC	Quarterly	DISCRT
Nitrogen, total	Single Sample		<= 10 Milligrams per Liter (mg/L)	Groundwater	MWC	Quarterly	DISCRT
Solids, total dissolved	Single Sample		M&R Milligrams per Liter (mg/L)	Groundwater	006	Quarterly	DISCRT

Proposed Technology Based Effluent Limitations:

Proposed Water Quality-Based Effluent Limitations:

Waste Load Allocation:

Rationale for Permit Requirements:

Effluent monitoring is required to assess the level of treatment being provided by the STMWRF, and to determine when design capacity is being approached.

Groundwater monitoring is required to ensure that the operations of the facility do not degrade the groundwater of the State.

Fecal Coliform:

WET Testing:

Special Conditions:

SA – Special Approvals / Conditions Table

There are no Special Approval / Condition items

Reasonable Potential Analysis and Antidegradation Review:

Flow:
The flow for STMWRF is limited to 4.10 MGD, 30-day average; 4.50 MGD, daily maximum.

Discharges From Future Outfalls:
Discharge to new reuse sites is contingent upon Division approvals and permits being obtained for the new reuse site(s) by the entity in responsible charge for that site.

Corrective Action Sites:
There are no Bureau of Corrective Actions sites within a one-mile radius of this facility.

Wellhead Protection Program:
The facility is not within 6000' of a public water supply. A Wellhead Protection Area (WHPA) has not been established for this area.

Schedule of Compliance:

SOC – Schedule of Compliance Table

Item #	Description	Due Date
1	The Permittee shall submit two (2) copies of an updated Operations and Maintenance (O&M) Manual for review and approval by the Division. The O&M Manual shall be prepared by a Nevada Registered Professional Engineer or a Division-approved qualified person. If prepared by a Nevada Registered Professional Engineer, the O&M Manual shall be wet stamped.. If no updates or revisions are required, the Permittee shall submit a letter indicating such.	7/1/2013

Deliverable Schedule:

DLV– Deliverable Schedule for Reports, Plans, and Other Submittals

Item #	Description	Interval	First Scheduled Due Date
1	Discharge Monitoring Reports	Quarterly	7/28/2013
2	Annual Report	Annually	1/28/2014

Procedures for Public Comment:
The Notice of the Division's intent to reissue a permit authorizing the facility to discharge to groundwater of the State of Nevada subject to the conditions contained within the permit, is being sent to the **Reno Gazette Journal** for publication. The notice is being mailed to interested persons on our mailing list. Anyone wishing to comment on the proposed permit can do so in writing until 5:00 P.M. **5/17/2013** , a period of 30 days following the date of the public notice. The comment period can be extended at the discretion of the Administrator.

A public hearing on the proposed determination can be requested by the applicant, any affected State, any affected interstate agency, the Regional Administrator of EPA Region IX or any interested agency, person or group of persons. The request must be filed within the comment period and must indicate the interest of the person filing the request and the reasons why a hearing is warranted. Any public hearing determined by the Administrator to be held must be conducted in the geographical area of the proposed discharge or any other area the Administrator determined to be appropriate. All public hearings must be conducted to accordance with NAC 445A.238.

The final determination of the Administrator may be appealed to the State Environmental Commission pursuant to NRS 445A.650.

Proposed Determination:
The Division has made the tentative determination to issue / re-issue the proposed 5-year permit.

Prepared by: **Michele Reid**
Date: **4/12/2013**
Title: **ES III**

7/7/2015

Washoe County Water Resources
4930 Energy Way
Reno, NV 89502
Attn: John Hulett

OrderID: *1506672*

Dear: John Hulett

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, online edition, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 6/24/2015. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Andy Smith
QA Manager

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fax (775) 355-0817
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fax (702) 622-2868
EPA LAB ID: NV00932

Western Environmental Testing Laboratory
Report Comments

Washoe County Water Resources - 1506672

Specific Report Comments

None

Report Legend

B	--	Blank contamination; Analyte detected above the method reporting limit in an associated blank.
D	--	Due to the sample matrix dilution was required in order to properly detect and report the analyte. The reporting limit has been adjusted accordingly.
HT	--	Sample analyzed beyond the accepted holding time.
J	--	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
M	--	The matrix spike/matrix spike duplicate (MS/MSD) values for the analysis of this parameter were outside acceptance criteria due to probable matrix interference.The reported result should be considered an estimate.
N	--	There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	--	Not calculated due to matrix interference or very high sample concentration.
QD	--	The sample duplicate or matrix spike duplicate analysis demonstrated sample imprecision. The reported result should be considered an estimate.
QL	--	The result for the laboratory control sample (LCS) was outside WETLAB acceptance criteria and reanalysis was not possible. The reported data should be considered an estimate.
S	--	Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits.
SC	--	Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered.
U	--	The analyte was analyzed for, but was not detected above the level of the reported sample reporting/quantitation limit.

General Lab Comments

Per method recommendation (section 4.4), Samples analyzed by methods EPA 300.0 and EPA 300.1 have been filtered prior to analysis.

The following is an interpretation of the results from EPA method 9223B:
A result of zero (0) indicates absence for both coliform and Escherichia coli meaning the water meets the microbiological requirements of the U.S. EPA Safe Drinking Water Act (SDWA). A result of one (1) for either test indicates presence and the water does not meet the SDWA requirements. Waters with positive tests should be disinfected by a certified water treatment operator and retested.

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Western Environmental Testing Laboratory
Analytical Report

Washoe County Water Resources
4930 Energy Way
Reno, NV 89502
Attn: John Hulett
Phone: (775) 954-4612 **Fax:**
PO\Project: *Reclaim Monitoring/45100*

Date Printed: 7/7/2015
OrderID: *1506672*

Customer Sample ID: Trademark PRV
WETLAB Sample ID: 1506672-001

Collect Date/Time: 6/24/2015 10:50
Receive Date: 6/24/2015 11:25

Analyte	Method	Results		Units	DF	RL	Analyzed	LabID
General Chemistry								
pH	SM 4500-H+ B	7.46	HT	pH Units	1		6/24/2015	NV00925
Temperature at pH	NA	24.2		°C	1		6/24/2015	NV00925
Total Phosphorous as P	SM 4500-P E	1.9		mg/L	10	0.10	7/1/2015	NV00925
Total Alkalinity	SM 2320B	190		mg/L as CaCO3	1	1.0	6/24/2015	NV00925
Bicarbonate (HCO3)	SM 2320B	190		mg/L as CaCO3	1	1.0	6/24/2015	NV00925
Carbonate (CO3)	SM 2320B	ND		mg/L as CaCO3	1	1.0	6/24/2015	NV00925
Hydroxide (OH)	SM 2320B	ND		mg/L as CaCO3	1	1.0	6/24/2015	NV00925
Total Nitrogen	Calc.	2.2		mg/L	1	0.45	7/2/2015	NV00925
Total Dissolved Solids (TDS)	SM 2540C	460		mg/L	1	10	6/26/2015	NV00925
Electrical Conductivity	SM 2510B	810		µmhos/cm	1	1	6/30/2015	NV00925
Anions by Ion Chromatography								
Chloride	EPA 300.0	110		mg/L	2	2.0	6/25/2015	NV00925
Nitrate Nitrogen	EPA 300.0	0.64		mg/L	2	0.20	6/25/2015	NV00925
Nitrite Nitrogen	EPA 300.0	ND	D	mg/L	2	0.050	6/25/2015	NV00925
Sulfate	EPA 300.0	26		mg/L	2	2.0	6/25/2015	NV00925
Flow Injection Analyses								
Total Kjeldahl Nitrogen	EPA 351.2	1.6	M	mg/L	1	0.20	7/2/2015	NV00925
Trace Metals by ICP-OES								
Aluminum	EPA 200.7	0.072		mg/L	1	0.045	6/30/2015	NV00925
Boron	EPA 200.7	2.2		mg/L	1	0.10	6/30/2015	NV00925
Calcium	EPA 200.7	27		mg/L	1	0.50	6/30/2015	NV00925
Magnesium	EPA 200.7	12		mg/L	1	0.50	6/30/2015	NV00925
Potassium	EPA 200.7	18		mg/L	1	0.50	6/30/2015	NV00925
Sodium	EPA 200.7	110		mg/L	1	0.50	6/30/2015	NV00925
Trace Metals by ICP-MS								
Arsenic	EPA 200.8	0.13		mg/L	1	0.0050	6/30/2015	NV00925
Sample Preparation								
Trace Metals Digestion	EPA 200.2	Complete			1		6/30/2015	NV00925

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

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Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC15061298	Blank 1	Chloride	EPA 300.0	ND	mg/L
QC15061302	Blank 1	Nitrite Nitrogen	EPA 300.0	ND	mg/L
QC15061305	Blank 1	Nitrate Nitrogen	EPA 300.0	ND	mg/L
QC15061309	Blank 1	Sulfate	EPA 300.0	ND	mg/L
QC15061449	Blank 1	Total Dissolved Solids (TDS)	SM 2540C	ND	mg/L
QC15070003	Blank 1	Aluminum	EPA 200.7	ND	mg/L
		Boron	EPA 200.7	ND	mg/L
		Calcium	EPA 200.7	ND	mg/L
		Magnesium	EPA 200.7	ND	mg/L
		Potassium	EPA 200.7	ND	mg/L
		Sodium	EPA 200.7	ND	mg/L
QC15070005	Blank 1	Arsenic	EPA 200.8	ND	mg/L
QC15070018	Blank 1	Electrical Conductivity	SM 2510B	ND	µmhos/cm
QC15070042	Blank 1	Total Phosphorous as P	SM 4500-P E	ND	mg/L
QC15070130	Blank 1	Total Kjeldahl Nitrogen	EPA 351.2	ND	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC15061259	LCS 1	pH	SM 4500-H+ B	6.96	7.00	99	pH Units
QC15061259	LCS 2	pH	SM 4500-H+ B	6.97	7.00	100	pH Units
QC15061259	LCS 3	pH	SM 4500-H+ B	6.98	7.00	100	pH Units
QC15061261	LCS 1	Total Alkalinity	SM 2320B	99.0	100	99	mg/L
QC15061261	LCS 2	Total Alkalinity	SM 2320B	98.9	100	99	mg/L
QC15061261	LCS 3	Total Alkalinity	SM 2320B	99.3	100	99	mg/L
QC15061261	LCS 4	Total Alkalinity	SM 2320B	99.5	100	100	mg/L
QC15061298	LCS 1	Chloride	EPA 300.0	10.1	10.0	101	mg/L
QC15061302	LCS 1	Nitrite Nitrogen	EPA 300.0	0.511	0.500	102	mg/L
QC15061305	LCS 1	Nitrate Nitrogen	EPA 300.0	2.15	2.00	108	mg/L
QC15061309	LCS 1	Sulfate	EPA 300.0	23.9	25.0	96	mg/L
QC15061449	LCS 1	Total Dissolved Solids (TDS)	SM 2540C	142	150	95	mg/L
QC15070003	LCS 1	Aluminum	EPA 200.7	0.954	1.00	95	mg/L
		Boron	EPA 200.7	0.966	1.00	97	mg/L
		Calcium	EPA 200.7	9.63	10.0	96	mg/L
		Magnesium	EPA 200.7	9.47	10.0	95	mg/L
		Potassium	EPA 200.7	9.61	10.0	96	mg/L
		Sodium	EPA 200.7	9.43	10.0	94	mg/L
QC15070005	LCS 1	Arsenic	EPA 200.8	0.0531	0.050	106	mg/L
QC15070018	LCS 1	Electrical Conductivity	SM 2510B	1409	1412	100	µmhos/cm
QC15070042	LCS 1	Total Phosphorous as P	SM 4500-P E	0.244	0.250	98	mg/L
QC15070130	LCS 1	Total Kjeldahl Nitrogen	EPA 351.2	0.983	1.00	98	mg/L

QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result		Units	RPD
QC15061259	Duplicate	pH	SM 4500-H+ B	1506664-001	7.52	7.50	HT	pH Units	<1%
QC15061259	Duplicate	pH	SM 4500-H+ B	1506665-001	7.42	7.43	HT	pH Units	<1%
QC15061259	Duplicate	pH	SM 4500-H+ B	1506668-031	6.79	6.84	HT	pH Units	1 %
QC15061259	Duplicate	pH	SM 4500-H+ B	1506668-018	7.59	7.55	HT	pH Units	1 %
QC15061259	Duplicate	pH	SM 4500-H+ B	1506694-001	8.03	8.06	HT	pH Units	<1%

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

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QCBatchID	QCType	Parameter	Method	Duplicate Sample	Sample Result	Duplicate Result	Units	RPD
QC15061261	Duplicate	Total Alkalinity	SM 2320B	1506664-001	146	146	mg/L as CaCO3	<1%
		Bicarbonate (HCO3)	SM 2320B	1506664-001	146	146	mg/L as CaCO3	<1%
		Carbonate (CO3)	SM 2320B	1506664-001	ND	ND	mg/L as CaCO3	<1%
		Hydroxide (OH)	SM 2320B	1506664-001	ND	ND	mg/L as CaCO3	<1%
QC15061261	Duplicate	Total Alkalinity	SM 2320B	1506665-001	192	192	mg/L as CaCO3	<1%
		Bicarbonate (HCO3)	SM 2320B	1506665-001	192	192	mg/L as CaCO3	<1%
		Carbonate (CO3)	SM 2320B	1506665-001	ND	ND	mg/L as CaCO3	<1%
		Hydroxide (OH)	SM 2320B	1506665-001	ND	ND	mg/L as CaCO3	<1%
QC15061261	Duplicate	Total Alkalinity	SM 2320B	1506668-031	6.75	6.50	mg/L as CaCO3	4 %
		Bicarbonate (HCO3)	SM 2320B	1506668-031	6.75	6.50	mg/L as CaCO3	4 %
		Carbonate (CO3)	SM 2320B	1506668-031	ND	ND	mg/L as CaCO3	<1%
		Hydroxide (OH)	SM 2320B	1506668-031	ND	ND	mg/L as CaCO3	<1%
QC15061261	Duplicate	Total Alkalinity	SM 2320B	1506668-018	15.5	14.9	mg/L as CaCO3	4 %
		Bicarbonate (HCO3)	SM 2320B	1506668-018	15.5	14.9	mg/L as CaCO3	4 %
		Carbonate (CO3)	SM 2320B	1506668-018	ND	ND	mg/L as CaCO3	<1%
		Hydroxide (OH)	SM 2320B	1506668-018	ND	ND	mg/L as CaCO3	<1%
QC15061261	Duplicate	Total Alkalinity	SM 2320B	1506694-001	88.9	89.0	mg/L as CaCO3	<1%
		Bicarbonate (HCO3)	SM 2320B	1506694-001	88.9	89.0	mg/L as CaCO3	<1%
		Carbonate (CO3)	SM 2320B	1506694-001	ND	ND	mg/L as CaCO3	<1%
		Hydroxide (OH)	SM 2320B	1506694-001	ND	ND	mg/L as CaCO3	<1%
QC15061449	Duplicate	Total Dissolved Solids (TDS)	SM 2540C	1506672-001	463	469	mg/L	1 %
QC15070018	Duplicate	Electrical Conductivity	SM 2510B	1506807-001	525	522	µmhos/cm	1 %
QC15070018	Duplicate	Electrical Conductivity	SM 2510B	1506672-001	814	811	µmhos/cm	<1%

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC15061298	MS 1	Chloride	EPA 300.0	1506694-001	12.1		17.4	17.7	5.00	mg/L	108	113	2%
QC15061298	MS 2	Chloride	EPA 300.0	1506731-001	6.89		12.2	12.5	5.00	mg/L	106	111	2%
QC15061302	MS 1	Nitrite Nitrogen	EPA 300.0	1506694-001	ND		0.459	0.482	0.500	mg/L	92	96	5%
QC15061305	MS 1	Nitrate Nitrogen	EPA 300.0	1506694-001	0.113	M	2.53	2.58	2.00	mg/L	NC	NC	NC
QC15061305	MS 2	Nitrate Nitrogen	EPA 300.0	1506731-001	0.175		2.57	2.64	2.00	mg/L	120	123	3%
QC15061309	MS 1	Sulfate	EPA 300.0	1506694-001	54.3		63.8	64.7	10.0	mg/L	96	104	1%
QC15061309	MS 2	Sulfate	EPA 300.0	1506731-001	3.96		14.1	14.4	10.0	mg/L	102	105	2%
QC15070003	MS 1	Aluminum	EPA 200.7	1506681-001	0.084		1.09	1.10	1.00	mg/L	101	102	1%
		Boron	EPA 200.7	1506681-001	0.125		1.11	1.12	1.00	mg/L	99	100	1%
		Calcium	EPA 200.7	1506681-001	19.8		28.5	29.0	10.0	mg/L	87	92	2%
		Magnesium	EPA 200.7	1506681-001	4.80		14.0	14.1	10.0	mg/L	92	93	1%
		Potassium	EPA 200.7	1506681-001	5.38		15.1	15.2	10.0	mg/L	97	98	1%
		Sodium	EPA 200.7	1506681-001	23.3		30.8	31.2	10.0	mg/L	75	79	1%
QC15070005	MS 1	Arsenic	EPA 200.8	1506681-001	ND		0.0549	0.0542	0.050	mg/L	105	104	1%
QC15070042	MS 1	Total Phosphorous as P	SM 4500-P E	1506655-001	0.132		0.377	0.389	0.250	mg/L	98	103	3%
QC15070130	MS 1	Total Kjeldahl Nitrogen	EPA 351.2	1506672-001	1.56	M	2.69	2.80	1.00	mg/L	NC	NC	NC
QC15070130	MS 2	Total Kjeldahl Nitrogen	EPA 351.2	1506677-001	45.5	SC	44.8	35.9	1.00	mg/L	NC	NC	NC

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Specializing in Soil, Hazardous Waste and Water Analysis

Lab Number	1506072
Report Due Date	7/9/15
Page	1 of 3

CLIENT REQUIREMENTS

Client	Washoe County Department of Water Resources
Address	4930 Energy Way
City, State & Zip	Reno, NV 89502
Contact	John Hulett
Phone	954-4612
Collector's Name	Adam Mancuso
Fax	954-4610
PWS/Project Name	Reclaim Monitoring
P.O. #	
PWS/Project Number	45100
Email	jhulett@washoecounty.us

Turnaround Time Requirements		Reporting Results Via	
Standard	X	Fax	
5 Day*		PDF	X
3-Day*		EDD	X
48 Hour*		Mail Only	
24 Hour*		Other:	

Compliance Monitoring		Samples Collected From Which State?				Standard Level QC Required?			
Yes		NV	X	CA		Yes	X	No	
No	X	Other:				*Level IV QC			

*Surcharges will apply

Billing Address (if different than Client Address)

Client	
Address	
City, State & Zip	
Contact	
Phone	
Fax	
Email	

ANALYSES REQUESTED

SAMPLE ID / LOCATION	DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Alkalinity	Bicarbonate	Carbonate	Hydroxide	Sulfate	Chloride	Aluminum	Calcium	Magnesium	Potassium	SAMPLE NUMBER (LAB USE ONLY)
Trademark PRV	6/24/15	10:50	WW		X	X	X	X	X	X	X	X	X	X	

1506 5
672 1

Instructions/Comments/Special Requirements:

Sample Matrix/Type Key** DW=Drinking water WW=Waste Water SW=Surfacewater MW=Monitoring Well SD=Solid/Sludge SO=Soil HW=Hazardous Waste OT=Other:

SAMPLE RECEIPT CONDITIONS	DATE	TIME	SAMPLES RELINQUISHED BY	SAMPLES RECEIVED BY
Temperature 17.2 C	6/24/15	1125	[signature]	Vanessa Geyer
Custody Seals Intact? Y N (None)				
Number of Containers				

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Specializing in Soil, Hazardous Waste and Water Analysis

Lab Number: 150672
Report Due Date: 7/9/15
Page 2 of 3

Client	Washoe County Department of Water Resources
Address	4930 Energy Way
City, State & Zip	Reno, NV 89502
Contact	John Hulett
Phone	954-4612
Collector's Name	Adam Mancuso
Fax	954-4610
PWS/Project Name	Reclaim Monitoring
P.O. #	
PWS/Project Number	45100
Email	jhulett@washoecounty.us

CLIENT REQUIREMENTS

Turnaround Time Requirements		Reporting Results Via	
Standard	X	Fax	
5 Day*		PDF	X
3-Day*		EDD	X
48 Hour*		Mail Only	
24 Hour*		Other:	

Compliance Monitoring		Samples Collected From Which State?				Standard Level QC Required?				
Yes		NV	X	CA		Yes	X	No		*Surcharges will apply
No	X	Other:				*Level IV QC				

Billing Address (if different than Client Address)

Client	
Address	
City, State & Zip	
Contact	
Phone	Fax
Email	

ANALYSES REQUESTED

SAMPLE ID / LOCATION	DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Sodium	TDS	EC	pH	Boron	T-N	Nitrate	Nitrite	TKN	T-P	SAMPLE NUMBER (LAB USE ONLY)
Trademark PRV	6/24/15	10:50	WW		X	X	X	X	X	X	X	X	X	X	

1506 672 5 1

Instructions/Comments/Special Requirements:

Sample Matrix/Type Key**: DW=Drinking water WW=Waste Water SW=Surfacewater MW=Monitoring Well SD=Solid/Sludge SO=Soil HW=Hazardous Waste OT=Other:

SAMPLE RECEIPT CONDITIONS	DATE	TIME	SAMPLES RELINQUISHED BY	SAMPLES RECEIVED BY
Temperature 17.2 C	6/24/15	1125	[signature]	Vanessa Geyer
Custody Seals Intact? Y N None				
Number of Containers				

WETLAB'S Standard Terms and Conditions apply unless written agreements specify otherwise. Payment terms are Net 30 for established customers. Pre-payment is required for clients without an account.

Client/Collector attests to the validity and authenticity of this (these) sample(s) and, is (are) aware that tampering with or intentionally mislabeling the sample(s) location or date/time of collection will be considered fraud and may be subject to legal action (NAC445.0636)

Samples are discarded 90 days after receipt unless other arrangements have been made with the laboratory.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compensation received, unless other arrangements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

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Lab Number 1506672
Report Due Date 7/9/15
Page 3 of 3

Client	Washoe County Department of Water Resources
Address	4930 Energy Way
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PWS/Project Name	Reclaim Monitoring
P.O. #	
PWS/Project Number	45100
Email	jhulett@washoecounty.us

CLIENT REQUIREMENTS

Turnaround Time Requirements		Reporting Results Via	
Standard	X	Fax	
5 Day*		PDF	X
3-Day*		EDD	X
48 Hour*		Mail Only	
24 Hour*		Other:	

Compliance Monitoring		Samples Collected From Which State?				Standard Level QC Required?				*Surcharges will apply
Yes		NV	X	CA		Yes	X	No		
No	X	Other:				*Level IV QC				

Billing Address (if different than Client Address)

Client	
Address	
City, State & Zip	
Contact	
Phone	Fax
Email	

SAMPLE ID / LOCATION	DATE	TIME	SAMPLE TYPE	NO. OF CONTAINERS	Arsenic	SAMPLE NUMBER (LAB USE ONLY)
Trademark PRV	6/24/15	10:50	WW		X	

Instructions/Comments/Special Requirements:

1506672 5 1

Sample Matrix/Type Key** DW=Drinking water WW=Waste Water SW=Surfacewater MW=Monitoring Well SD=Solid/Sludge SO=Soil HW=Hazardous Waste OT=Other:

SAMPLE RECEIPT CONDITIONS	DATE	TIME	SAMPLES RELINQUISHED BY	SAMPLES RECEIVED BY
Temperature 17.2 C	6/24/15	1125	[signature]	Vanessa Ayer
Custody Seals Intact? Y N None				
Number of Containers				

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Client/Collector attests to the validity and authenticity of this (these) sample(s) and, is (are) aware that tampering with or intentionally mislabeling the sample(s) location or date/time of collection will be considered fraud and may be subject to legal action (NAC445.0636)

Samples are discarded 90 days after receipt unless other arrangements have been made with the laboratory.

To the maximum extent permitted by law, the Client agrees to limit the liability of WETLAB for the Client's damages to the total compensation received, unless other arrangements are made in writing. This limitation shall apply regardless of the cause of action or legal theory pled or asserted.

Nevada Regulations for the Use a Treated Effluent

NAC 445A.276 Reuse categories: Requirements for bacteriological quality of effluent. (NRS 445A.425)

1. Treated effluent being used for an activity approved for a reuse category must meet the following requirements for bacteriological quality for that category:

	Total Coliform	Fecal Coliform			
	c.f.u. or mpn/100ml	c.f.u. or mpn/100ml			
Reuse Category	A	B	C	D	E
30-day geometric mean	2.2	2.2	23	200	No Limit
Maximum daily number	23	23	240	400	No Limit

2. As used in this section, "c.f.u. or mpn/100ml" means colony forming units or most probable number per 100 milliliters of the treated effluent.

(Added to NAC by Environmental Comm'n, eff. 9-13-91; A by R063-04, 10-6-2004)

NAC 445A.2762 Reuse category A: Approved uses. (NRS 445A.425) Treated effluent that meets the requirements for bacteriological quality set forth in NAC 445A.276 for reuse category A may be used for:

1. Spray irrigation of land used as a cemetery, commercial lawn, golf course, greenbelt or park even if:

(a) Public access to the area of use is not controlled; and

(b) Human contact with the treated effluent can reasonably be expected to occur.

2. An impoundment in which swimming is prohibited even if:

(a) Public access to the impoundment is not controlled; and

(b) Human contact with the treated effluent can reasonably be expected to occur.

3. Any activity approved for reuse category B, C, D or E.

4. Any other use that is approved by the Division.

(Added to NAC by Environmental Comm'n by R063-04, eff. 10-6-2004)

NAC 445A.2764 Reuse category B: Approved uses. (NRS 445A.425) Treated effluent that meets the requirements for bacteriological quality set forth in NAC 445A.276 for reuse category B may be used for:

1. Spray irrigation of land used as a cemetery, commercial lawn, golf course, greenbelt or park if:

(a) Public access to the area of use is controlled; and

(b) Human contact with the treated effluent cannot reasonably be expected to occur.

2. Subsurface irrigation of land used as a commercial lawn, greenbelt or park.

3. Cooling water in an industrial process.

4. Fire-fighting operations in an urban area if approved by the fire department, fire protection district or other fire-fighting agency in whose district the fire occurs.

5. Any activity approved for reuse category C, D or E.

6. Any other use that is approved by the Division.

(Added to NAC by Environmental Comm'n by R063-04, eff. 10-6-2004)

NAC 445A.2766 Reuse category C: Approved uses. (NRS 445A.425)

1. Treated effluent that meets the requirements for bacteriological quality set forth in NAC 445A.276 for reuse category C may be used for:

(a) Spray irrigation of land used as a cemetery, golf course or greenbelt if:

(1) Public access to the area of use is controlled;

(2) Human contact with the treated effluent does not occur; and

(3) A buffer zone of not less than 100 feet is maintained.

(b) Watering of nursery stock if public access to the area of use is controlled.

(c) Establishment, restoration or maintenance of a wetland if public access to the wetland is controlled.

(d) Washing of gravel used in concrete mixing.

(e) Feed water for a boiler.

(f) An impoundment if:

(1) Public access to the impoundment is controlled; and

(2) Human contact with the treated effluent cannot reasonably be expected to occur.

(g) Fire fighting of forest or other wildland fires if approved by the fire department, fire protection district or other fire-fighting agency in whose district the fire occurs.

(h) Any activity approved for reuse category D or E.

(i) Any other use that is approved by the Division.

2. As used in this section:

(a) "Nursery stock" has the meaning ascribed to it in NRS 555.23562.

(b) "Wetland" has the meaning ascribed to it in NRS 244.388.

(Added to NAC by Environmental Comm'n by R063-04, eff. 10-6-2004)

NAC 445A.2768 Reuse category D: Approved uses. (NRS 445A.425)

1. Treated effluent that meets the requirements for bacteriological quality set forth in NAC 445A.276 for reuse category D may be used for:

(a) Spray irrigation of land used for agricultural purposes if:

(1) Public access to the area of use is prohibited; and

(2) A buffer zone of not less than 400 feet is maintained.

(b) Surface irrigation of land used:

(1) As greenbelt if:

(I) Public access to the area of use is prohibited; and

(II) Human contact with the treated effluent does not occur.

(2) For agricultural purposes; and

(3) For the cultivation of fruit-bearing trees or nut-bearing trees.

(c) Subsurface irrigation of land used for agricultural purposes if public access is controlled.

(d) Dust control.

(e) Soil compaction.

(f) Flushing sewer lines.

(g) An impoundment if:

(1) Public access to the impoundment is prohibited;

(2) All human activities involving contact with the treated effluent are prohibited; and

(3) Human contact with the treated effluent does not occur.

(h) Any activity approved for reuse category E.

(i) Any other use approved by the Division.

2. As used in this section, "dust control" means the program required pursuant to NAC 445B.22037 to prevent controllable particulate matter from becoming airborne.

(Added to NAC by Environmental Comm'n by R063-04, eff. 10-6-2004)

NAC 445A.2771 Reuse category E: Approved uses. (NRS 445A.425) Treated effluent that meets the requirements for bacteriological quality set forth in NAC 445A.276 for reuse category E may be used for:

1. Spray irrigation of land used for agricultural purposes if:

(a) Public access to the area of use is prohibited; and

(b) A buffer zone of not less than 800 feet is maintained.

2. Any other use that is approved by the Division.

(Added to NAC by Environmental Comm'n by R063-04, eff. 10-6-2004)

4.0 WASTEWATER LOADS

The STM collection system conveys wastewater from three sources to the South Truckee Meadows Water Reclamation Facility (STMWRF) for treatment. These flows are:

- Wastewater flows from customers.
- Infiltration from the groundwater in areas where the water table is high and groundwater can infiltrate through joints and cracks.
- County wells that can be pumped into the collection system to augment reclaimed water supplies, particularly during low flow times in the collection system. Flows from these wells are not included in the capacity evaluation in this study because the wells are not needed during peak flow times.

4.1 Dry Weather Wastewater Flows

Dry weather wastewater flows have been estimated using the growth projections and land use information provided by the County and documented in TM 2. The wastewater flows are also expressed in terms of Equivalent Residential Units (ERU) for convenience in allocating development flows to pipe capacity. Table 3.2 summarizes the projected wastewater flows and peaking factors.

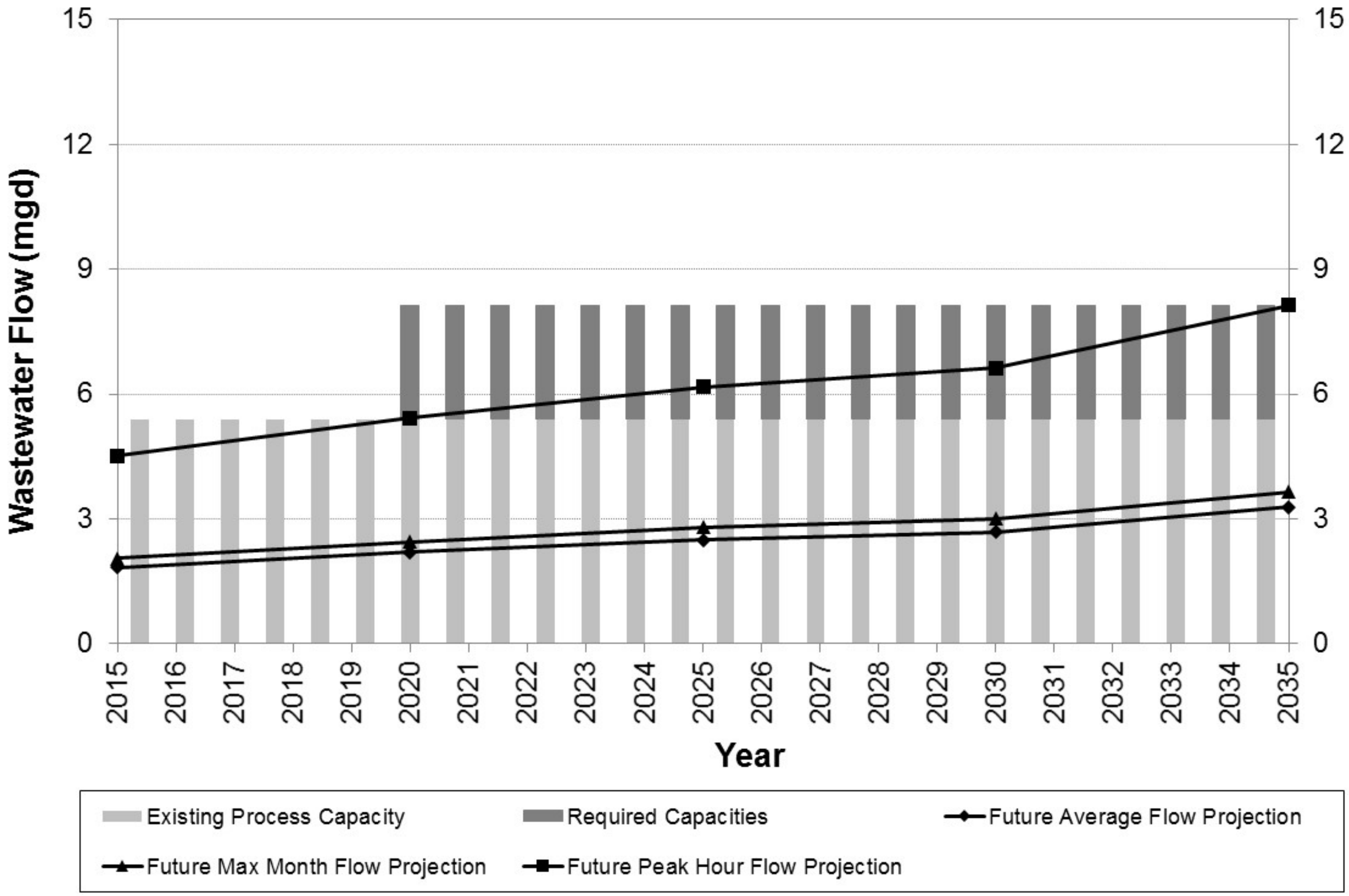
Table 3.2 Projected Wastewater Minimum, Average, and Maximum Flows
STMWRF Facility Plan Update
Washoe County

Year	Ave Flow, mgd	Max Month Flow, mgd	WW Peak Hour Flow, mgd	Total ERUs
2015	3.0	3.4	7.4	14,290
2020	3.6	4.0	8.9	17,150
2025	4.1	4.6	10.1	19,380
2030	4.4	4.9	10.8	20,730
2035	4.5	5.0	11.1	21,360
Buildout	11.6	13.0	28.7	42,963

4.2 Diurnal Patterns

Diurnal patterns are used to adjust average daily flows to represent the flows that would occur at each hour of the day in the model. The diurnal patterns in the County's hydraulic model were developed from flow monitoring data documented in "South Truckee Meadows Sewer Collection System Flow Monitoring - 2011" by CH2M. Loads that were added to future scenarios in the model were assigned diurnal patterns based on the 2011 flow monitoring basin location. Weekend flows typically have higher peak flows so the weekend

APPENDIX C – PHASED IMPLEMENTATION SCHEDULES FOR STMWRF

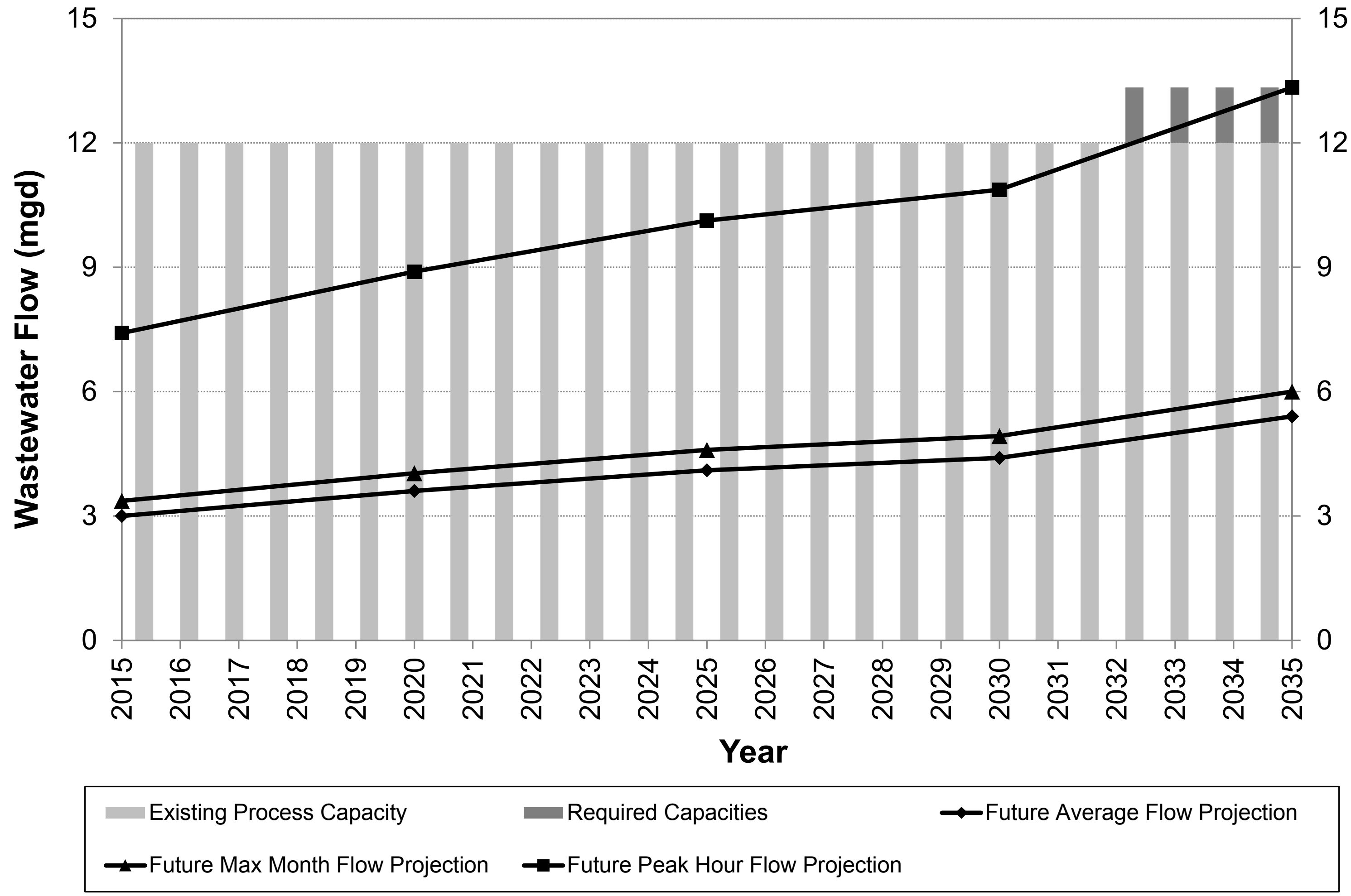


PHASED IMPLEMENTATION OF PROPOSED INFLUENT RAW WASTEWATER CONVEYANCE

FIGURE C.1

WASHOE COUNTY

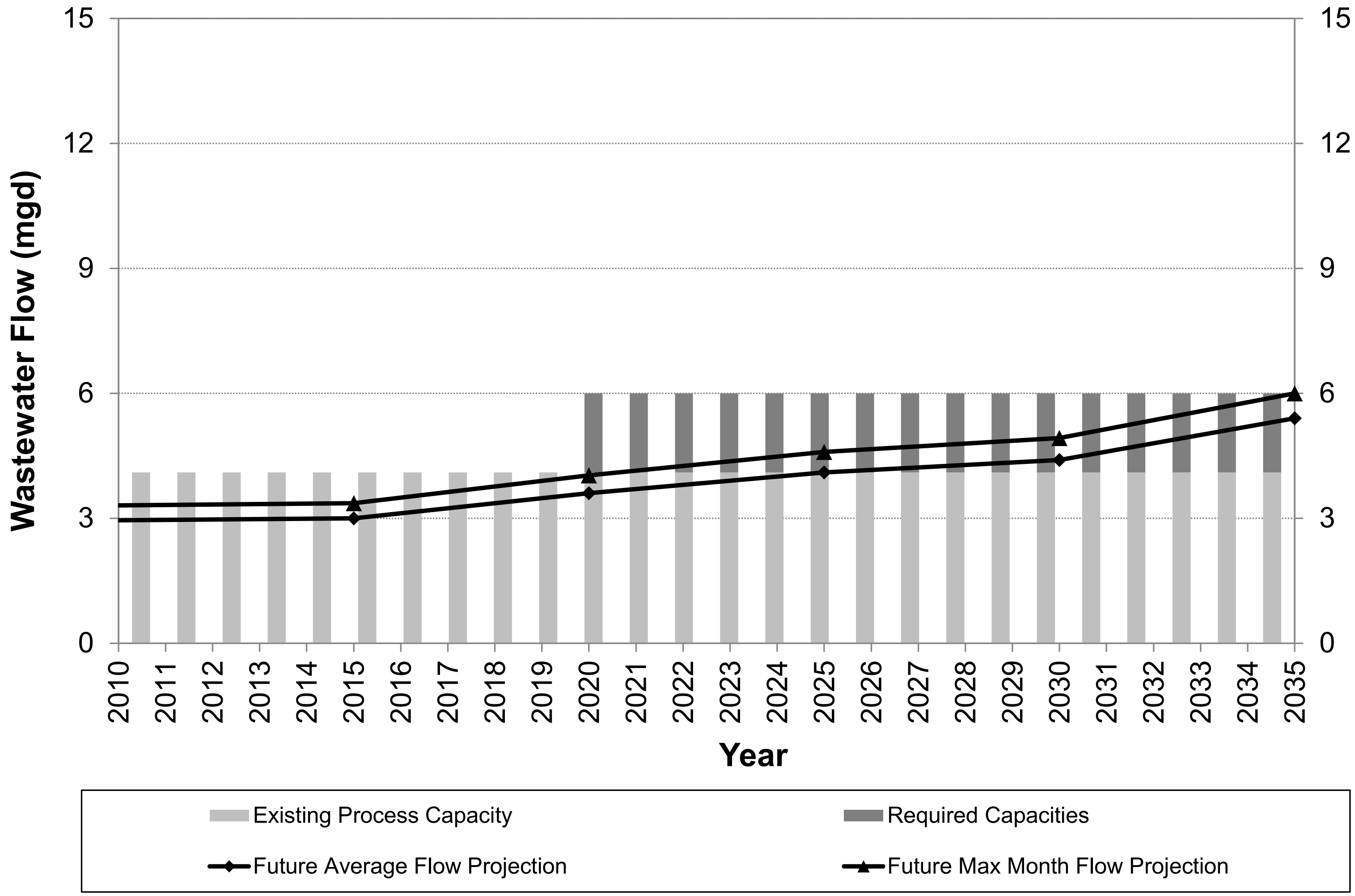
STWMRF FACILITY PLAN UPDATE



PHASED IMPLEMENTATION OF PROPOSED PRELIMINARY TREATMENT FACILITIES

FIGURE C.2

WASHOE COUNTY
STWMRF FACILITY PLAN UPDATE



PHASED IMPLEMENTATION OF PROPOSED SECONDARY TREATMENT FACILITIES

FIGURE C.3

WASHOE COUNTY
STWMRF FACILITY PLAN UPDATE

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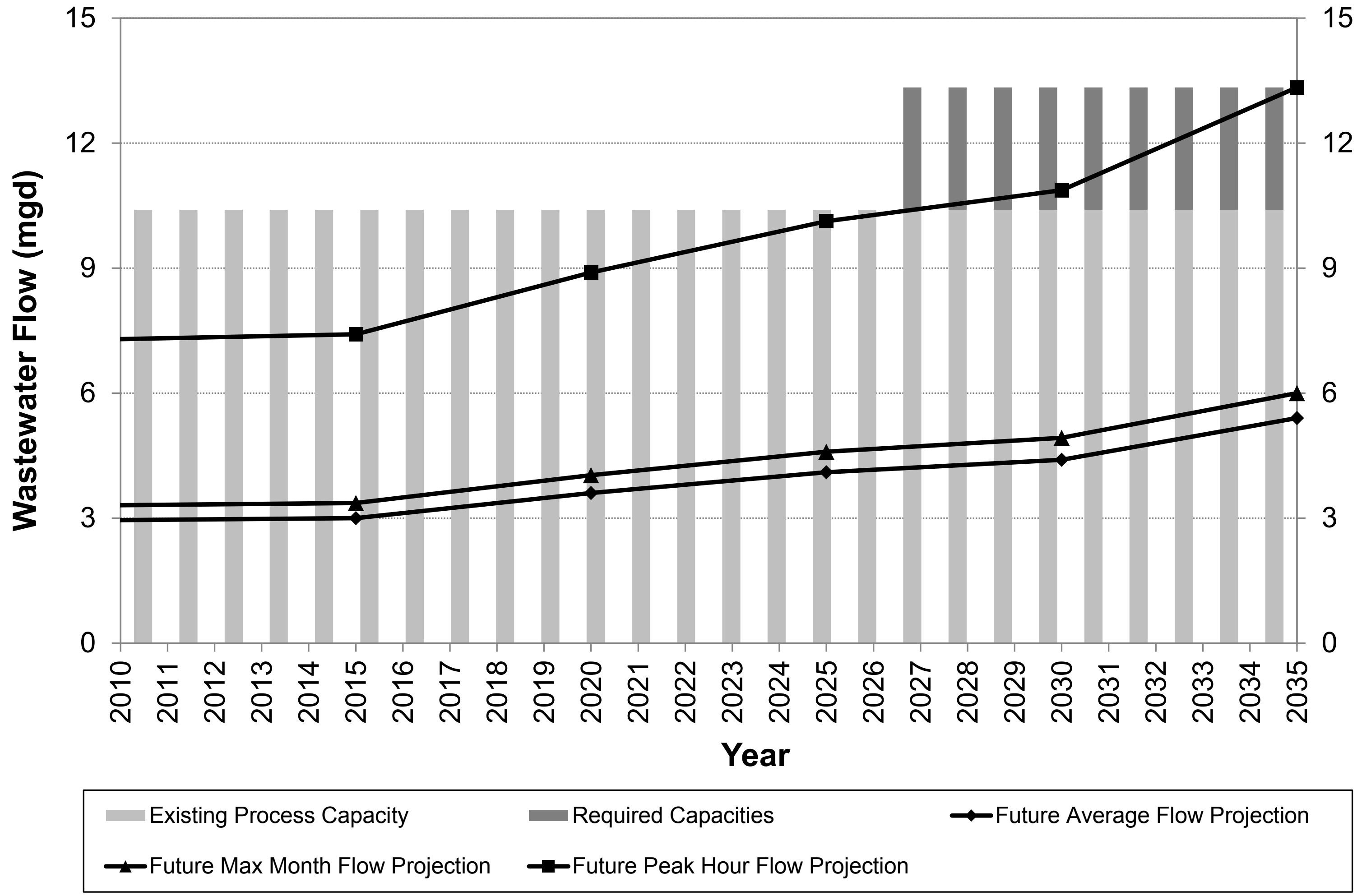

PHASED IMPLEMENTATION OF PROPOSED TERTIARY TREATMENT FACILITIES

FIGURE C.4

WASHOE COUNTY
STWMRF FACILITY PLAN UPDATE

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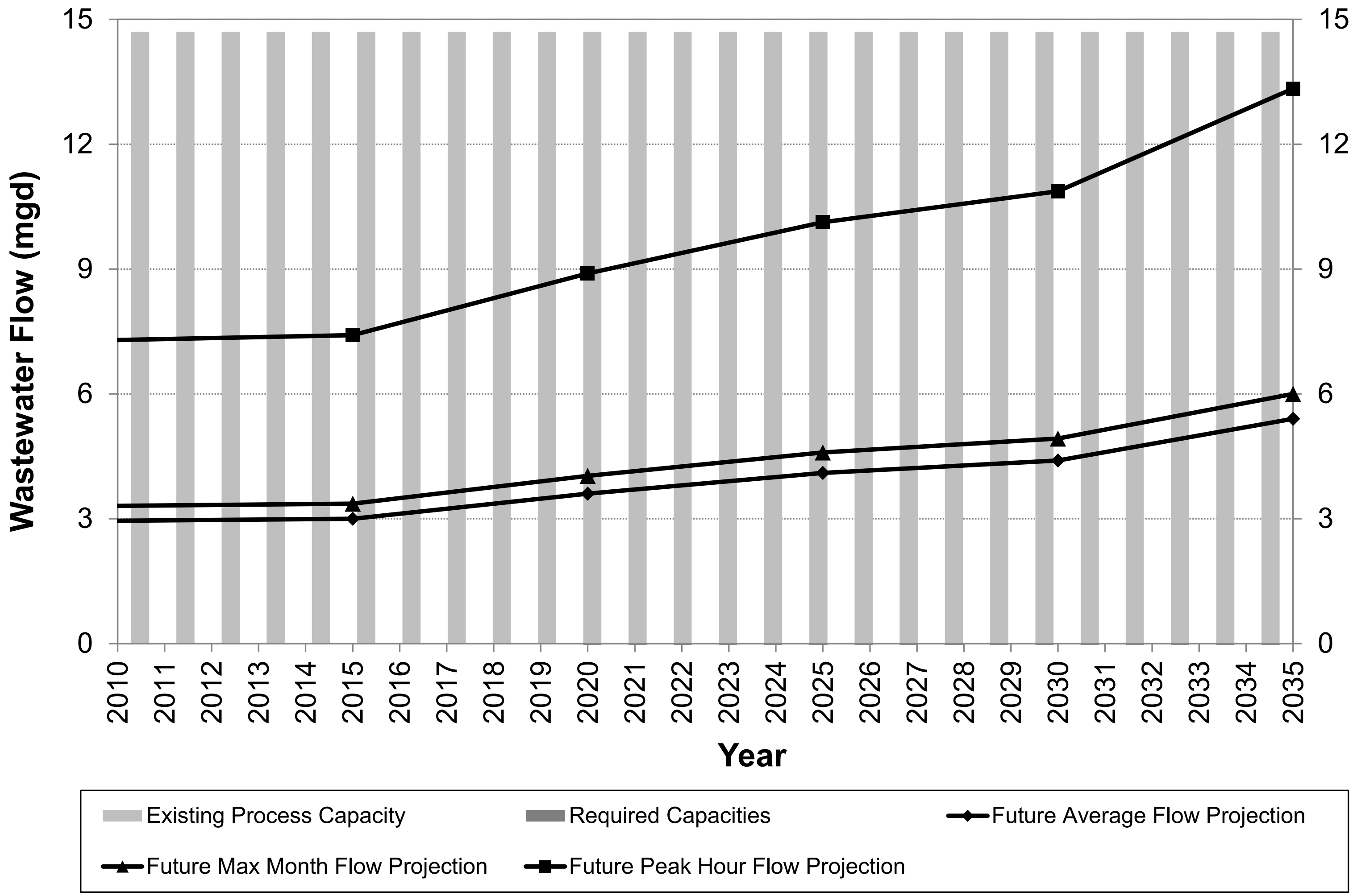

PHASED IMPLEMENTATION OF DISINFECTION TREATMENT FACILITIES

FIGURE C.5

WASHOE COUNTY
STWMRF FACILITY PLAN UPDATE

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APPENDIX D - FACILITY COST ESTIMATES

Table D.1 Cost Estimate for Influent Raw Wastewater Conveyance Facilities
STMWRF Facility Plan Update
Washoe County

Description	Cost ($,millions)
Influent Screw Pump	0.85
Subtotal	**0.85**
Miscellaneous Yard Piping and Utilities (20%)	0.17
Site Work (10%)	0.10
Electrical/Instrumentation (20%)	0.23
Subtotal	**1.35**
Contingency (20%)	0.27
Total Direct Costs	**1.62**
General Conditions (10%)	0.16
Nevada Sales and Use Tax (7.725%)(2)	0.03
Contractor Overhead and Profit (10%)	0.18
Total Construction Costs	**1.99**
Engineering, Legal & Administrative (20%)	0.40
Total Project Cost	**2.39**

Notes:

(1) Cost based on December 2015 dollars.
(2) Assume Sales Tax and Use Tax applies to 50% of Total Direct Costs.

Table D.2 Cost Estimate for Future Preliminary Treatment Facilities
STMWRF Facility Plan Update
Washoe County

Description	Cost ($,millions)
Perforated Plate Screen	0.54
Subtotal	**0.54**
Miscellaneous Yard Piping and Utilities (20%)	0.11
Site Work (10%)	0.07
Electrical/Instrumentation (20%)	0.14
Subtotal	**0.86**
Contingency (20%)	0.17
Total Direct Costs	**1.03**
General Conditions (10%)	0.10
Nevada Sales and Use Tax (7.725%)(2)	0.02
Contractor Overhead and Profit (10%)	0.12
Total Construction Costs	**1.27**
Engineering, Legal & Administrative (20%)	0.25
Total Project Cost	**1.52**

Notes:
(1) Cost based on December 2015 dollars.
(2) Assume Sales Tax and Use Tax applies to 50% of Total Direct Costs.

Table D.3 Cost Estimate for Future Secondary Treatment Facilities
STMWRF Facility Plan Update
Washoe County

Facility	Cost ($, millions)
Selector Zone	0.43
Oxidation Ditches	5.0
Mixers	0.18
Blowers / Blower Building(1)	1.15
RAS/WAS Pump Station	0.08
Equipment Installation	1.19
Subtotal	**8.0**
Miscellaneous Yard Piping and Utilities (20%)	1.6
Site Work (10%)	0.95
Electrical/Instrumentation (20%)	2.0
Subtotal	**12.6**
Contingency (20%)	2.6
Total Direct Costs	**15.2**
General Conditions (10%)	1.5
Nevada Sales and Use Tax (7.725%)(2)	0.31
Contractor Overhead and Profit (10%)	1.7
Total Construction Costs	**18.7**
Engineering, Legal and Administrative (20%)	3.7
Total Project Cost	**22.4**

Notes:
Cost based on December 2015 dollars
(1) Cost to be determined during IPS replacement study.
(2) Assume Sales Tax and Use Tax applies to 50 percent of total direct costs.

Table D.4 Cost Estimate for Tertiary Treatment Pre-Conditioning
STMWRF Facility Plan Update
Washoe County

Facility	Cost ($, millions)
DAF System	3.8
Subtotal	**3.8**
Miscellaneous Yard Piping & Utilities (15%)	0.57
Site Work (10%)	0.43
Electrical/ Instrumentation (15%)	0.72
Subtotal	**5.5**
Contingency (15%)	0.82
Total Direct Cost	**6.3**
General Conditions (10%)	0.63
Nevada Sales and Use Tax (7.725%)(2)	0.15
Contractor Overhead and Profit (10%)	0.71
Total Construction Costs	**7.8**
Engineering, Legal, & Administrative Costs (20%)	1.6
Total Project Cost	**9.4**

Notes:
(1) Costs based on December 2015 dollars.
(2) Assume Sales and Use Tax applies to 50 percent of Total Direct Costs.

Table D.5	Cost Estimate for Future Tertiary Filtration Facilities STMWRF Facility Plan Update Washoe County
Facility	**Cost ($, millions)**
Filters	2.2
Subtotal	**2.2**
Miscellaneous Yard Piping & Utilities (20%)	0.43
Site Work (10%)	0.26
Electrical/ Instrumentation (20%)	0.57
Subtotal	**3.5**
Contingency (20%)	0.69
Total Direct Cost	**4.2**
General Conditions (10%)	0.41
Nevada Sales and Use Tax (7.725%)(2)	0.08
Contractor Overhead and Profit (10%)	0.46
Total Construction Costs	**5.2**
Engineering, Legal, & Administrative Costs (20%)	1.0
Total Project Cost	**6.2**

Notes:

(1) Costs based on December 2015 dollars.
(2) Assume Sales and Use Tax applies to 50 percent of Total Direct Costs.

WASHOE COUNTY

SOUTH TRUCKEE MEADOWS
WATER RECLAMATION FACILITY
FACILITY PLAN UPDATE

TECHNICAL MEMORANDUM NO. 7
OVERALL CIP AND IMPLEMENTATION PLAN

FINAL
January 2016

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WASHOE COUNTY

**SOUTH TRUCKEE MEADOWS WATER RECLAMATION FACILITY
FACILITY PLAN UPDATE**

**TECHNICAL MEMORANDUM
NO. 7**

OVERALL CIP AND IMPLEMENTATION PLAN

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OVERALL CIP AND IMPLEMENTATION PLAN

1.0 INTRODUCTION

The purpose of this Technical Memorandum (TM) *Overall CIP and Implementation Plan* is to summarize the recommended improvements, implementation schedule, cost estimates, and capital funding requirements for the proposed new wastewater facilities identified through the year 2035 at the South Truckee Meadows Water Reclamation Facility. The recommended improvements provide for increased conveyance and treatment capacity to keep pace with changing demands in the service area and to replace aging facilities.

Washoe County's (County) South Truckee Meadows Water Reclamation Facility (STMWRF) was originally constructed in 1991. The last major expansion project at the facility was completed in 2002 when STMWRF was expanded to an average day maximum month flow (ADMMF) capacity of 4.1 million gallons per day (mgd).

The last facility plan, titled *Draft Facility Plan Update South Truckee Meadows Water Reclamation Facility 6-mgd Expansion Project* (CH2M, April 2008), began in a period of significant economic and population growth, and was published at a time shortly thereafter where changes had taken place in economic growth, regulatory climate, wastewater quality, and treatment technologies. The County has commissioned this STMWRF Facility Master Plan Update to evaluate the current design criteria, establish new criteria as appropriate, and make recommendations for the Capital Improvements Program (CIP). The planning period for this master plan report will be 20 years, running from 2015 through 2035.

2.0 PLANNING CONCEPTS

There are several basic planning concepts that were followed in this Facility Plan Update for the proposed collection and treatment facilities. These include:

1. Provide facilities that are compatible with processes already constructed.
2. Recommend treatment processes which are the same or similar to existing facilities, where possible, to minimize and simplify the number of different unit operations.
3. Adopt new technology when the potential cost savings and/or performance enhancements outweigh the drawbacks associated with implementing new processes in parallel with or in place of existing proven processes.
4. Size recommended process units to match existing units, when possible, for uniformity and symmetry of layout.
5. Provide for incremental expansion to minimize idle capacity.

6. Establish project timing to minimize the inconvenience and effort in managing a series of construction projects.

7. Provide a flexible layout to accommodate changes in treatment technology and to reserve space for future facilities.

3.0 PROPOSED FACILITIES

At STMWRF, the projected average day maximum month flows (ADMMF) and peak hour flows (PHF) for the year 2035 are 6.0 million gallons per day (mgd) and 13.3 mgd, respectively. The major facility improvements needed to handle a 6.0 mgd ADMMF and 13.3 mgd PHF include expansion of preliminary, secondary, and tertiary treatment unit processes.

TM No. 3: Wastewater Collection System Evaluation and TM No. 6: Facility Plan includes detailed analyses and descriptions of the new collection and treatment facilities needed within the service area and at STMWRF by 2035. The recommended collection system and plant improvements are summarized below.

3.1 Wastewater Collection System

3.1.1 Capacity Improvements for Existing Sewers

The existing wastewater collection system has adequate capacity for conveying current flows to STMWRF. There were no bottlenecks or capacity restrictions identified.

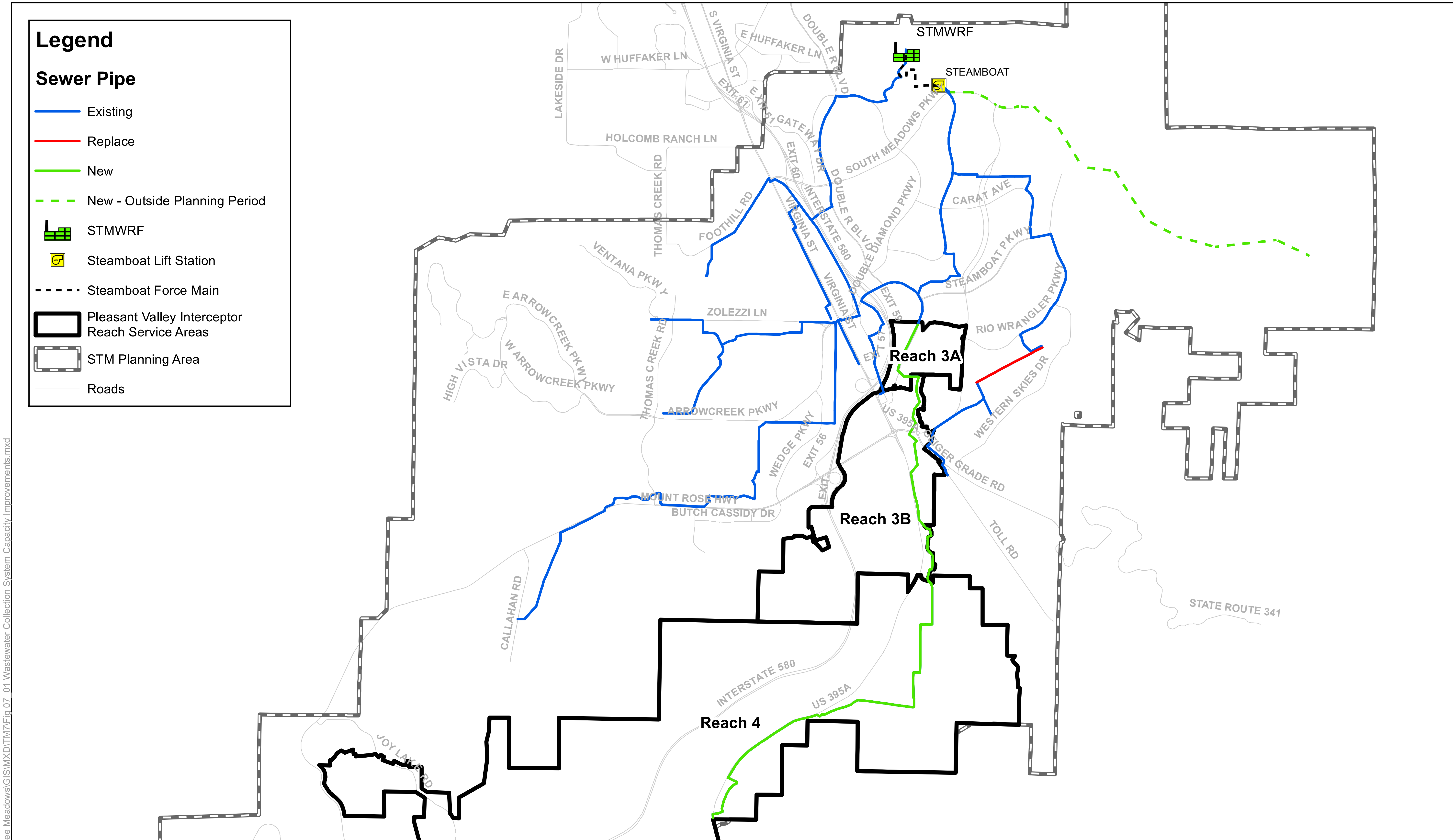
By 2035, however, 3,520 feet of sewer main near Whitecliff Drive and Parma Way will need to be replaced with a 15-inch pipe.

3.1.2 Capacity Improvements for New Service

The Pleasant Valley Interceptor can be constructed using smaller pipe diameters than the original design. Construction of new homes in the Reach 4 service area beginning in 2018 will require that the interceptor be in place by 2018, along with Reaches 3A and 3B which are tributary to the existing Reach 2.

3.1.3 Wastewater Collection System Capacity Improvement Projects

Figure 7.1 identifies the capacity improvement projects within the collection system throughout the planning period.



WASTEWATER COLLECTION SYSTEM CAPACITY IMPROVEMENTS

FIGURE 7.1

WASHOE COUNTY

STMWRF FACILITY PLAN UPDATE

Date: December 23, 2015
File Path: M:\Client\Truckee Meadows\GIS\MXD\TM7\Fig 07_01 Wastewater Collection System Capacity Improvements.mxd

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3.2 STMWRF Rehabilitation and Renewal Projects

The team performed a visual condition assessment of existing STMWRF facilities in April 2015. Findings and recommendations were presented in TM 4: Condition Assessment. Since the time of the site visit, operations staff have repaired the air leaks in the air piping and installed sunshades for various local panels at the oxidation ditches. Additionally, the County is implementing an electrical equipment upgrade project that is intended to address obsolete VFD's and instrumentation, as well as a CIP project for upgrading the existing plant water booster station at the Effluent Pump Station. For the purposes of CIP planning, these projects will not be included in the recommended rehabilitation and renewal projects. Table 7.1 presents the recommended projects identified through the condition assessment effort.

Table 7.1 Summary of Facilities Needed within the Planning Period
STMWRF Facility Plan Update
Washoe County

Facility/Process	Equipment(1)	Condition(2)	Recommendation(2)
Steamboat Creek Lift Station	I	I&C equipment obsolete.	Phased replacement and upgrade.
Influent Pump Station	M	Splashing occurs at the top of screw pumps.	Design and add splash protection.
Influent Pump Station	E	Emergency stop button damaged on the west screw pump panel.	Replace
Manual Bar Screen	S	Coating failure in inlet and outlet channel.	Dewater, inspect, repair concrete damage, recoat.
Oxidation Ditch	S	Coating failure.	Dewater, inspect, repair concrete damage, recoat.
Oxidation Ditch	S	Cracking of concrete structure.	Repair cracks.
Oxidation Ditch	I	Probes and meters will reach end of life within 5-10 years.	Phased replacement.
Secondary Clarifier	S	Coating failure on units 2 and 3.	Dewater, inspect, repair concrete damage, recoat.

Table 7.1 Summary of Facilities Needed within the Planning Period STMWRF Facility Plan Update Washoe County			
Facility/Process	**Equipment[1]**	**Condition[2]**	**Recommendation[2]**
Secondary Clarifier	M	Algae buildup on launder weirs.	Evaluate brushes or covers for implementation.
Tertiary Filters	S	Cracking of concrete structure.	Repair cracks.
Tertiary Filters	I	Inlet channel level float inoperable.	Replace or repair.
Chlorine Contact Basin	S	Cracking of concrete structure.	Dewater, inspect, repair concrete damage.
Export Pump Station	M	Pump and piping drains supported by rope; Air release valves have garden hose vice hard piping to floor drains.	Design and replace piping.
Effluent Pump Station	S	Roof leak.	Conduct roof inspection and repair.
Effluent Pump Station	S	Joist above Pump 1 is twisted at electrical conduit attachment.	Reinforce joist and repair deformation.
Effluent Pump Station Electrical Room	M	AC unit freezes evaporative coil in air handler.	Replace AC unit.
Sand Drying and Sludge Dewatering Beds	--	Degraded.	Minimum refurbishment.

Notes:
(1) Type of Equipment: E = Electrical, I = Instrumentation, M = Mechanical, S = Structural.
(2) See TM No. 4 for additional detail on condition observations and recommendations for mitigation.

3.3 STMWRF Treatment Facilities

3.3.1 Influent Raw Wastewater Conveyance

As developed in TM 2: Planning Framework, the estimated flow within the service area by 2035 is 11.1 mgd. As presented in TM 3: Wastewater Collection System Evaluation, the

2035 PHF from the Steamboat Creek Lift Station is estimated at 2.9 mgd, and the existing pumps have adequate capacity to convey the estimated 2035 PHF. The remainder of the influent flow to STMWRF is conveyed by gravity. The projected gravity influent flow is estimated at 8.2 mgd, which is tributary to the influent screw pumps located at the STMWRF Headworks Building.

There are two influent screw pumps rated at 3,750 gpm (5.4 mgd) each. During peak flow conditions, a future upgrade to the screw pumps is recommended to adequately convey 8.2 mgd. A third screw pump at 2,000 gpm should be added, to provide a firm capacity of 8.2 mgd, with one pump out of service. Provisions have been made at the Headworks Building for a third screw pump to be added in the future. To match existing screw pump equipment, the County may decide to implement a third screw pump at 3,750 gpm.

3.3.2 Influent Screening

Under the 2012 Rehabilitation and Enhancement Project, PWP No. WA-2013-3, two new perforated-plate style bar screens, and two new washer compactors were installed with provisions for a future screen when expansion to 6.0 mgd ADMMF is required. Based on the planning framework presented in *TM 2*, and to maintain redundancy with one unit out of service, the additional screen will be needed by year 2035.

3.3.3 Secondary Treatment

The Secondary Treatment facilities consist of two oxidation ditches and four secondary clarifiers. The total design capacity of the Secondary Treatment process is 4.1 mgd ADMMF, with all units in service. A new anaerobic zone upstream of the oxidation ditches and two additional oxidation ditches will be required to treat the ADMMF projected flow of 6.0 mgd. The proposed facilities include:

1. One anaerobic tank to promote settleability and enhance secondary treatment capacity.
2. Two oxidation ditches.
3. Associated upgrades/modifications to existing infrastructure:
    a. Headworks distribution box.
    b. Mixed liquor distribution structure.
    c. RAS and WAS pumping.
    d. Blowers and Blower Building.

3.3.4 Tertiary Filtration

The existing tertiary filters at STMWRF are rated at 11.5 mgd peak flow. An additional 1.8 mgd of peak flow capacity is required to meet the projected peak flow of 13.3 mgd. It is expected that the existing eight tertiary filters will be operational through the planning period, with rehabilitation as recommended in TM 6. To match existing equipment and footprint, new tertiary filters should be constructed in phases to provide an additional PHF capacity. A bank of four new filters is recommended for implementation to meet 2035 flow conditions. This phased expansion will allow STMWRF to be able to treat influent flow within the planning period, then expand as needed beyond the planning period. In addition, a DAF system is recommended for implementation upstream of the tertiary filters to provide pre-conditioning and removal of algae and other solids prior to filtration.

3.3.5 Disinfection

Based on discussions with County staff, anticipated regulations for Class A+ reclaimed water are currently being drafted by the State. It is anticipated that the regulations will include some requirements similar to California Title 22 (i.e. turbidity, CT). The Title 22 CT requirements are not likely to be implemented in this planning period, therefore based on County staff direction, new turbidity requirements, as previously discussed, are considered for this plan.

The County is currently undergoing design for the sodium hypochlorite system modifications, which will include work at the existing chlorine contact basins. The modifications made under the Chemical Storage Building Rehabilitation project, combined with the recommended capital improvements for the tertiary filtration system will provide adequate disinfection during the planning period with the ability to meet proposed turbidity requirements.

Should CT requirements be implemented in the future, STMWRF should consider alternative disinfection technology like UV disinfection to meet both turbidity and CT requirements, and an alternatives analysis be performed at that time. Another option would be to expand the existing chlorine contact basins to provide additional treatment volume and contact time.

3.3.6 Solids Treatment Facilities

As noted previously, a project is currently being constructed to add solids treatment and handling facilities at STMWRF. The design calls for new aerobic digesters with jet aeration, WAS thickening via rotary drums, and dewatering via screw presses. This facility is expected to be online in the third quarter of 2016. This facility has been designed for solids processing associated with an ADMMF of 6.0 mgd. Therefore, expansion of the facility, once constructed, will not be required during the planning period.

3.3.7 Recycle Stream Management

The existing tertiary filters generate backwash waste, which along with plant drain are recycled back through the plant. Treatment capacity, chemicals, and energy are expended to treat these side streams, which contain constituents and suspended solids. As flows to the plant continue to increase along with a new recycle stream from the solids handling facility, recycle stream management becomes important to improve performance, reduce costs, and continue permit compliance.

As presented in TM 6, the estimated existing and design recycle flows and ammonia loadings are not significant compare to influent loading. However, solids loading in the influent will increase due to the new recycle stream from the solids handling facility. Estimated recycle stream loads may not have significant impact on plant treatment capacity, however, may increase MLSS concentration. At this time, additional treatment processes to address recycle streams are not required. However, to minimize nutrients and solids loading within the recycle stream generated at the new solids handling facility, the sludge handling process should be operated as recommended in this facility plan.

3.3.8 Effluent Reuse

As developed in TM 6, treatment and expansion recommendations in this facility plan consider the potential requirements for producing Class A+ reclaimed water. The improved quality of reclaimed water will expand uses for potable purposes in the State.

There are several states that have indirect potable reuse (IPR) regulations, with Nevada to soon be one of them. The states that have IPR regulations have successfully permitted reuse facilities that augment their water supplies. With the advancement of technology, IPR is a cost effective, safe, and reliable solutions to water shortage issues.

Other than the anticipated reuse regulations for Class A+ reclaimed water, the effluent planning performed for STMWRF in 2008 is still applicable. This is due to the fact that water reuse demands are similar to what they were in 2008 (2,600 ac-ft/year). Based on direction from County staff, and because at the time of this report water reuse demands have been maintained around 2008 demands (2,600 ac-ft/year), the previous effluent planning effort conducted in 2008 is applicable.

3.3.9 Plant Utilities and Support Facilities

TM 6: Facility Plan described the upgrades and improvements to the various existing plant utility systems needed to accommodate future plant expansions. These utility systems include potable water, plant drain systems, storm drainage, HVAC system, hot water, and the communication system.

3.3.10 Summary of Proposed Facilities

New facilities will be required for STMWRF treatment processes in the planning period. Table 7.2 summarizes the existing and future facilities required at STMWRF.

Table 7.2 Summary of Facilities Needed within the Planning Period STMWRF Facility Plan Update Washoe County			
Facility/Process	**No. Existing[(1)]**	**No. Future Required[(2)]**	**Total Required[(3)]**
Headworks Screw Pumps	2	1	3
Anaerobic Basin	-	1	1
Oxidation Ditches	2	2	4
Secondary Clarifiers	4	0	4
Tertiary Filters	8	4	12
Chlorine Contact Basins	4	0	4
Effluent Pumps[(4)]	5	1	6
Export Pumps[(4)]	5	1	6

Notes:
(1) Existing facilities are operational, under design, or under construction as of January 2015.
(2) Future facilities are required to treat average day maximum month flows of 6 mgd.
(3) Total number of each type of facility for treating 6 mgd ADMMF and 13.3 mgd peak.
(4) Expansion of existing with larger pumps.

3.3.11 Layout of Proposed STMWRF Facilities

Figure 7.2 depicts the locations of the new facilities. In addition, the figure identifies areas to be reserved for facilities beyond the planning period.

4.0 PROJECT PHASING AND IMPLEMENTATION

This section discusses project phasing and triggers that define when the design of project improvements should be started, so that future expansions can be operational in time to provide capacity for treatment. The use of these triggers should prevent both overloading the treatment processes as well as overbuilding, yet provide time for design and construction of the recommended projects.

4.1 Influent Flow Projections

The population projections and flow projections presented in *TM 2: Planning Framework* predict that the average wastewater flow from the STMWRF service area will be 4.5 mgd by the year 2035. Based on County staff direction, this Facility Plan Update for the treatment facilities at STMWRF is based on an average influent flow of 5.4 mgd through the planning period. Table 7.3 shows the wastewater flow projections for STMWRF Facilities.

STMWRF - EXPANSION PLAN

FIGURE 7.2

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

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Table 7.3	STMWRF Influent Flow Projections STMWRF Facility Plan Update Washoe County		
Year	**Average Day Flow, mgd**	**Max Month Flow, mgd**	**Peak Hour Flow, mgd**
2015	3.0	3.4	7.4
2020	3.6	4.0	8.9
2025	4.1	4.6	10.1
2030	4.4	4.9	10.8
2035	4.5	5.0	11.1
2035 STMWRF(1)	5.4	6.0	13.3

Note:
(1) To match existing unit processes, facility planning based on 6.0 mgd ADMMF.

Table 7.4 summarizes the various peaking factors used in this Facility Plan Update. Refer to *TM 2: Planning Framework* for the derivation of these factors.

Table 7.4	Summary of STMWRF Flow Parameters STMWRF Facility Plan Update Washoe County	
	2015 Facility Plan Update Planning Value	
Parameter	**Peaking Factor**	**Flow (mgd)**
Influent Flow Planning Capacities		
Annual Average Flow (AAF)	--	5.4
Average Day Max Month Flow (ADMMF)	1.12	6.0
Peak Day Flow (PDF)	1.33	7.2
Peak Hour Dry Weather Flow (PHDWF)	2.10	11.3
Peak Hour Wet Weather Flow (PHWWF)	2.47	13.3

4.2 Influent Load Projections

TM 2: Planning Framework presents extensive information on the influent wastewater characteristics, including the five-day carbonaceous biochemical oxygen demand ($cBOD_5$), total suspended solids (TSS), ammonia, total Kjeldahl nitrogen and total phosphorus. The water quality data is based on samples collected from the influent. Table 7.5 summarizes the wastewater characteristic parameters adopted for this facility plan.

Table 7.5 STMWRF Influent Constituent Summary STMWRF Facility Plan Update Washoe County		
Parameter	**Average Influent Concentration (mg/L)**	**Load Peaking Factors**
Carbonaceous Biochemical Oxygen Demand (BOD_5)	327.0	1.45
Total Suspended Solids (TSS)	276.0	1.54
Ammonia-nitrogen (NH_4-N)	33.0	--
Total Kjeldahl Nitrogen (TKN)	56.0	--
Total Phosphorus (TP)	6.4	--

4.3 Implementation Triggers

For the purposes of this Facility Plan Update, phased implementation for expansion is developed assuming the future flows and loads match the projected values. However, as has occurred in the past, future conditions could affect the actual wastewater flows and loads. Therefore, actual flows and loads should be compared to the projections regularly so that facilities are constructed as needed in accordance with the actual increases in wastewater flow. Using this approach, planning and facility construction can be adjusted to respond to actual growth.

Initiating the design and construction of new facilities using actual growth conditions means that new facilities should be implemented based on flow and load "triggers." These flow and load triggers are established by considering the lead-time required for design and construction of new facilities. Using the required lead-time and the projected rate of growth, a trigger flow value can be established, which when reached "triggers" the design of new facilities. The triggers established for a treatment expansion will provide the required lead-time only if the rate of growth is equal to the assumed rate of growth. If the growth rate is slower than projected, the construction of an increment of treatment capacity can be delayed until it is required. Conversely, if the growth rate is faster than projected, the increment of treatment capacity needs to be constructed earlier than anticipated.

Generally, facility expansions should be phased in five- to ten-year increments over the planning period. These increments are large enough to provide a reasonable economy of scale and yet small enough to minimize the investment in potentially idle facilities. The phased implementation of proposed facilities presented in this chapter is for the purpose of developing the capital improvement plan (CIP) and funding requirements. Based on County staff direction, a five-year lead-time is used for planning purposes.

4.4 Trigger Curves

Trigger curves for the individual treatment processes at STMWRF are presented in Appendix A. These curves show the projected flow, the estimated and projected treatment capacity of STMWRF, and the phasing of process expansions.

The indicated project phasing shows the recommended sizing and timing of the treatment process expansions. The timing represents the year in which the process expansion becomes operational, so the trigger point for start of design precedes the year indicated by the estimated time needed for design, bidding, construction, and start-up.

5.0 COST ESTIMATES AND FUNDING REQUIREMENTS

The costs presented in this *Facility Plan Update* are based on preliminary layouts and preliminary unit sizes as developed in the various TMs within this report. Construction costs are estimated from past STMWRF construction contracts, construction costs for similar facilities at other locations, and estimating guidelines.

5.1 Accuracy of Cost Estimates

Construction costs at any given time are subject to multiple factors, including the state of the economy and the amount of construction activity at a given location at a given time (bidding climate). Further, the size and features of the facilities may be refined during preliminary and final design based on the most current operational information. For these reasons, it is possible that actual construction cost may vary from earlier estimates.

The Association for the Advancement of Cost Engineering (AACE) International has suggested a level of accuracy for three construction cost estimating categories. These three major cost categories are summarized in Table 7.6.

The accuracy of a cost estimate depends on the quantity and quality of the information available to prepare that estimate. Typically, as a project progresses from the conceptual phase to the study phase and from preliminary design to final design, the quantity and quality of information increases, thereby providing information for development of progressively more accurate estimates. Contingencies are used to compensate for lack of detailed information, unanticipated changes during design and construction, and imperfection in the estimating methods used. As the quantity and quality of information becomes better, smaller contingency allowances may be applied. For this Facility Plan Update, the cost estimates presented should be considered Class 5 estimates.

Table 7.6	AACE International Cost Estimate Classification Summary STMWRF Facility Plan Update Washoe County			
Estimate Class	**Maturity Level of Project Definition Deliverables – (Level of Engineering Design)**	**End Use**	**Typical Cost Estimating Methodology Used**	**Expected Accuracy Range (Low/High)**
Class 5	0% to 2%	Conceptual screening	Capacity factored, parametric models, judgment or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -10% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

5.2 Contingency and Markups

Cost estimates were developed using cost information for the major components in each area. The costs include both materials and labor/installation. For major equipment items, budget level quotes were obtained from the vendor. To account for lack of detailed design information, allowances for miscellaneous piping and utilities, site work, and electrical/instrumentation was applied (where applicable) as follows:

- Miscellaneous Piping & Utilities 20%
- Site work 10%
- Electrical/Instrumentation 20%

Markups, applied in a compounding manner, were applied to the subtotal calculated for the major equipment components and allowances above, as follows:

- Contingency 20%

- General Conditions 10%
- Nevada Sales Tax & Use Tax(1) 7.725%
- Contractor Overhead and Profit (OH&P) 10%
- Engineering, Legal & Administrative 20%

(1)Assume Sales tax and Use Tax applies to 50 percent of Total Direct Costs.

5.3 Operations and Maintenance Costs

Where applicable, O&M costs were factored into evaluation of alternatives. O&M costs were developed based on projected energy consumption, chemical usage, and estimated labor costs. These were developed from a review of existing O&M costs, estimates of future costs, input from County staff, and operating information from similar wastewater treatment facilities. Table 7.7 summarizes the O&M cost components used in this Facility Plan Update.

**Table 7.7 Operations and Maintenance Cost Components
STMWRF Facility Plan Update
Washoe County**

Category	Cost per Million Gallons Treated ($, hundreds)
Electrical Energy	$0.087 / kWhr
O & M Labor	$50 / hr
Chemicals – Sodium Hypochlorite	$0.85 / gallon

5.4 Project Cost Distribution

The estimated projects costs were allocated over the duration of the design and construction phases according to the distribution shown in Table 7.8.

**Table 7.8 Allocation of Project Costs Based on Project Duration
STMWRF Facility Plan Update
Washoe County**

	Portion of Project Cost Incurred Each Year				
Project Duration (years)	1	2	3	4	5
1	100%				
2	30%	70%			
3	10%	45%	45%		
4	10%	35%	35%	20%	
5	1%	9%	35%	35%	20%

5.5 Capital Improvement Plan

Cost estimates for the facilities recommended in this Facility Plan Update are included in Table B.1 through Table B.7 in Appendix B. These costs were developed and presented in the various TMs within this report. Refer to the specific TMs for a detailed discussion of the recommended facilities.

Note that in some cases where costs were developed for comparison of alternatives, not all of the common facilities associated with the alternatives were included. Consequently, differences may exist between such cost estimates used for comparison of alternatives and those included here. The costs presented here and the final cost estimate presented at the end of each TM account for all project components including major process piping, utility tunnels, electrical substations, and odor control facilities, among others.

Table 7.9 summarizes the costs for wastewater collection system improvements within the study area. Table 7.10 recaps the costs for the rehabilitation and renewal projects at STMWRF. In an effort to spread the capital cost of the recommended projects over the near term, the projects are grouped according to the type of work to be done, Structural and Other, which includes the remainder of the recommended projects (i.e. mechanical, electrical, and instrumentation). Table 7.11 presents the proposed expansion projects at STMWRF. Table 7.12 presents the CIP with costs for future capital projects for both the collection system and treatment facilities.

Table 7.9 Cost Estimates for Wastewater Collection System Projects
STMWRF Facility Plan Update
Washoe County

Facility	Year Needed	Cost(1) ($, millions)
Pleasant Valley Interceptor Reach 3A(2)	2018	1.3
Pleasant Valley Interceptor Reach 3B(2)	2018	4.3
Pleasant Valley Interceptor Reach 4(2)	2018	5.3
3,520 feet of 15-in Sewer Main Near Whitecliff Drive and Parma Way	2035	1.0
Total Project Cost		**11.9**

Note:
(1) Cost based on December 2015 dollars, includes engineering design, inspection, and project management.
(2) See TM 3 for additional detail.
(3) See Appendix B for detailed cost estimate.

Table 7.10 Cost Estimates for STMWRF Rehabilitation and Renewal Projects
STMWRF Facility Plan Update
Washoe County

Project Identification	Year Needed	Cost(1) ($, M)
Structural Rehabilitation and Renewal Projects	2019	2.7
Other Rehabilitation and Renewal Projects	2017	0.5
Total Project Cost		**3.2**

Note:
(1) Cost based on December 2015 dollars. See Appendix B for detailed cost estimate.

Table 7.11 Cost Estimates for STMWRF Expansion Projects
STMWRF Facility Plan Update
Washoe County

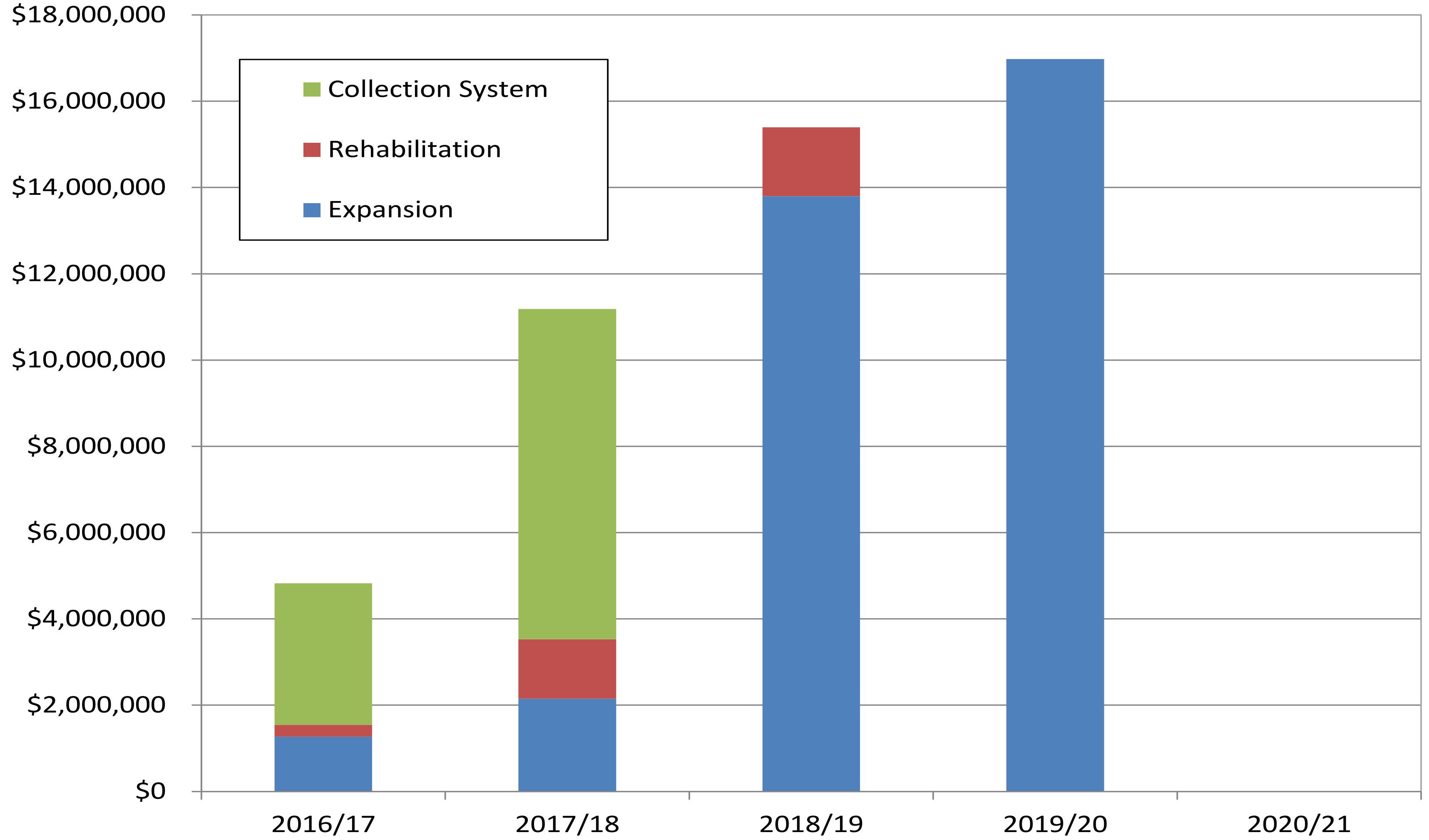
Facility	Year Needed	Cost(1) ($, millions)
Influent Raw Wastewater Conveyance – Screw Pumps	2020	2.4
Preliminary Treatment Facilities – Screen No. 3	2032	1.5
Secondary Treatment Facilities – Anaerobic Zone and Two Oxidation Ditches	2020	22.4
Tertiary Filtration Pre-conditioning – DAF(2)	2018	9.4
Tertiary Filtration Facilities – Four Tertiary Filters	2027	6.2
Total Project Cost		**41.9**

Note:
(1) Cost based on December 2015 dollars. See Appendix B for detailed cost estimate.

Figure 7.3 shows the 5 year projected capital expenditure by year for STMWRF. Figure 7.4 shows the 20 year projected capital expenditure (in 2015 dollars) for STMWRF. There is a heavy expenditure in the next five years, primarily associated with the new secondary treatment facilities and the new DAF Process. Figure 7.5 shows the cumulative costs (2015 dollars) for the same 20 year period.

Table 7.12 Capital Improvement Plan
STMWRF Facility Plan Update
Washoe County

Project ID	Project Title (Descriptive)	Primary Trigger	Project Start Year	Planning Design	Construction	Project Duration	Year In Service	Total Project Cost	FY 2016/17	FY 2017/18	FY 2018/19	FY 2019/20	FY 2020/21	FY 2021/22	FY 2022/23	FY 2023/24	FY 2024/25	FY 2025/26	FY 2026/27	FY 2027/28	FY 2028/29	FY 2029/30	FY 2030/31	FY 2031/32	FY 2032/33	FY 2033/34	FY 2034/35	FY 2035/36	Total
	STMWRF Expansion - Treatment																												
1	Influent Raw Wastewater Conveyance – Screw Pumps	Capacity	2017	1.5	1.5	3	2020	$2,400,000	$0	$240,000	$1,080,000	$1,080,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$ 2,400,000
2	Preliminary Treatment Facilities – Screen No. 3	Capacity	2029	1.5	1.5	3	2032	$1,500,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$150,000	$675,000	$675,000	$0	$0	$0	$0	$ 1,500,000
3	Secondary Treatment Facilities – Anaerobic Zone and Oxidation Ditches	Capacity	2016	1.5	2.5	4	2020	$22,400,000	$896,000	$1,344,000	$8,960,000	$11,200,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$ 22,400,000
4	Tertiary Filtration Facilities – XX mgd DAF	Capacity	2016	1.5	2.5	4	2020	$9,400,000	$376,000	$564,000	$3,760,000	$4,700,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$ 9,400,000
5	Tertiary Filtration Facilities – XX mgd Tertiary Filters	Capacity	2023	1.5	2.5	4	2027	$6,100,000	$0	$0	$0	$0	$0	$0	$0	$244,000	$366,000	$2,440,000	$3,050,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$ 6,100,000
	STMWRF Rehabilitation - Treatment																												
6	Rehabilitation and Renewal Projects - Structural	Condition Assessment	2016	2	1	3	2019	$2,700,000	$270,000	$1,215,000	$1,215,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$ 2,700,000
7	Rehabilitation and Renewal Projects - Other	Condition Assessment	2017	1	1	2	2019	$547,000	$0	$164,100	$382,900	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$ 547,000
	STMWRF Service Area - Wastewater Collection System																												
8	Pleasant Valley Interceptor Reach 3A	Development	2016	0.5	1.5	2	2018	$1,320,000	$396,000	$924,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$ 1,320,000
9	Pleasant Valley Interceptor Reach 3B	Development	2016	0.5	1.5	2	2018	$4,330,000	$1,299,000	$3,031,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$ 4,330,000
10	Pleasant Valley Interceptor Reach 4	Development	2016	0.5	1.5	2	2018	$5,290,000	$1,587,000	$3,703,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$ 5,290,000
11	Whitecliff Drive and Parma Way	Development	2033	1	1	2	2035	$930,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$279,000	$651,000	$0	$ 930,000
									$4,824,000	**$11,185,100**	**$15,397,900**	**$16,980,000**	**$0**	**$0**	**$0**	**$244,000**	**$366,000**	**$2,440,000**	**$3,050,000**	**$0**	**$0**	**$150,000**	**$675,000**	**$675,000**	**$0**	**$279,000**	**$651,000**	**$0**	**$ 56,917,000**



5-YEAR PROJECTED CAPITAL EXPENDITURE FOR STMWRF

FIGURE 7.3

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

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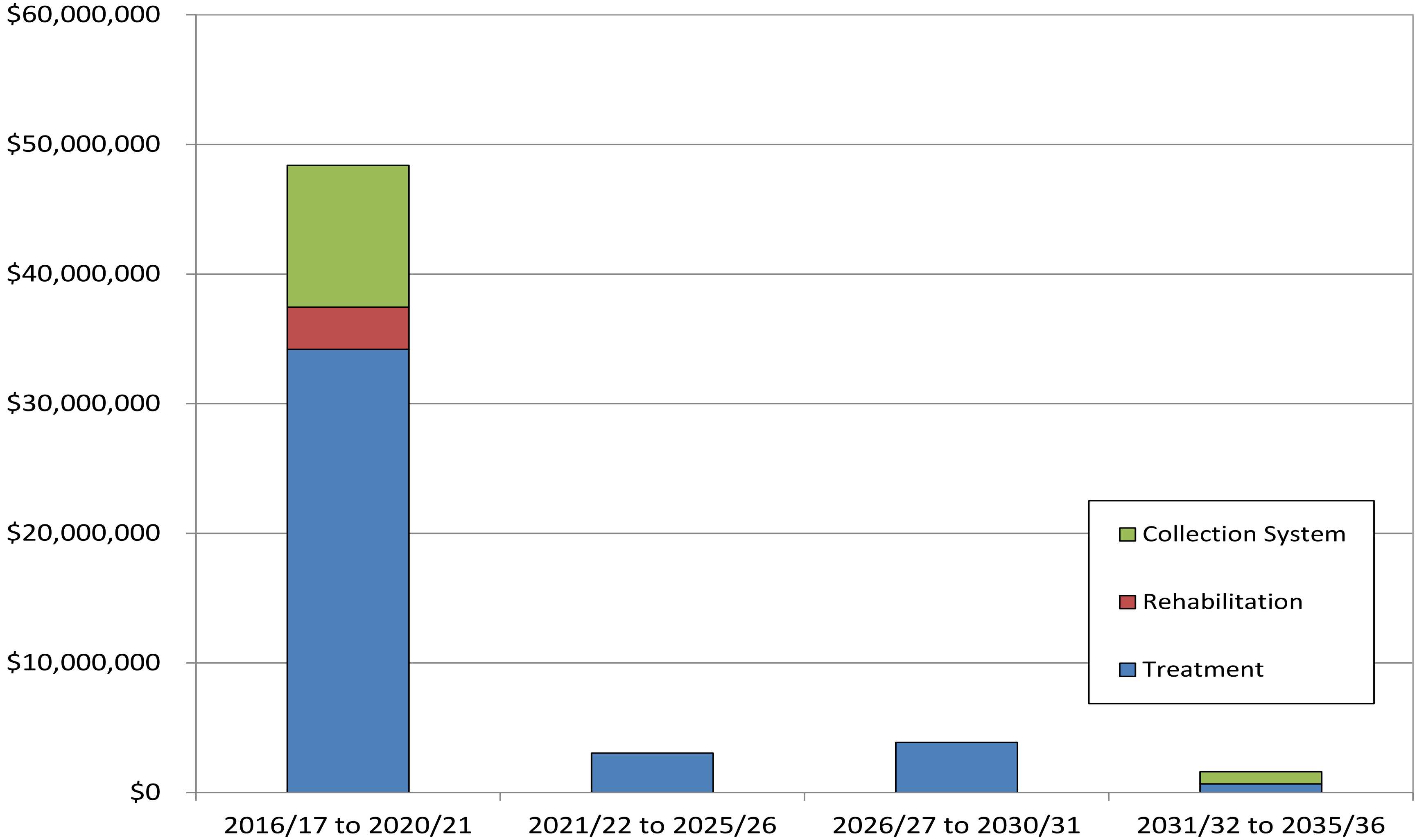
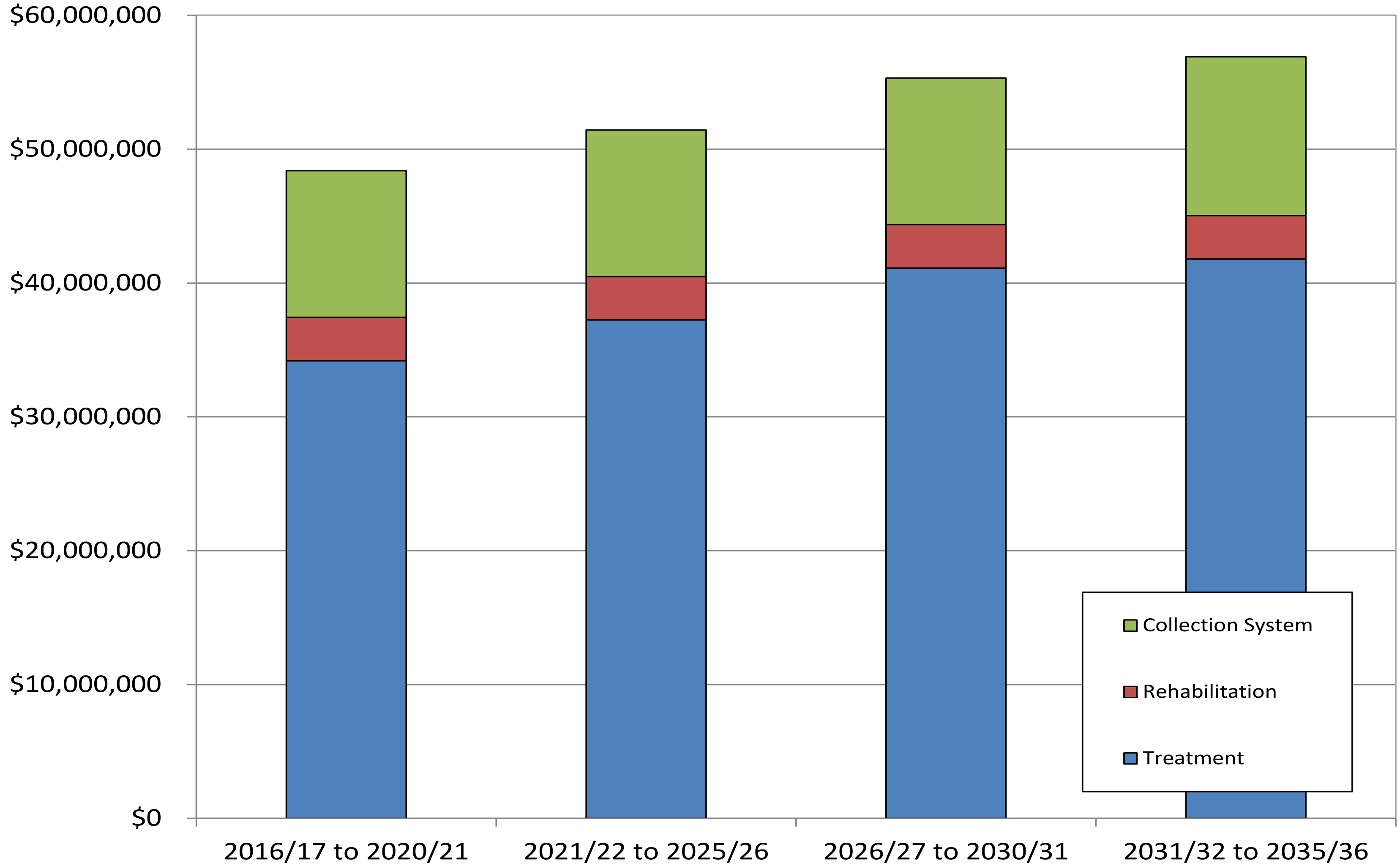


20-YEAR PROJECTED CAPITAL EXPENDITURE FOR STMWRF

FIGURE 7.4

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE



20-YEAR CUMULATIVE COSTS FOR STMWRF

FIGURE 7.5

WASHOE COUNTY
STMWRF FACILITY PLAN UPDATE

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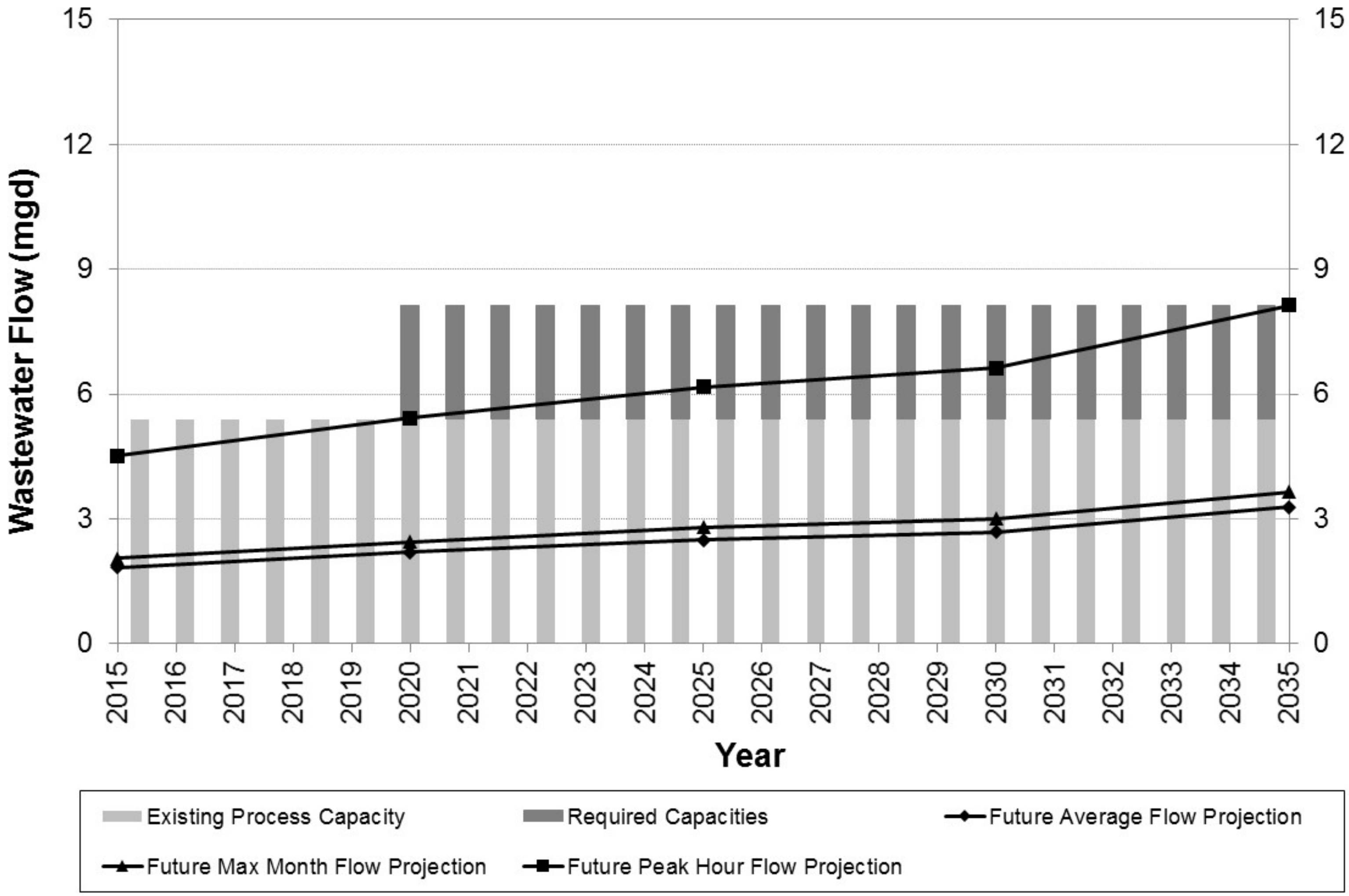
APPENDIX A - PHASED IMPLEMENTATION SCHEDULES FOR STMWRF



PHASED IMPLEMENTATION OF PROPOSED INFLUENT RAW WASTEWATER CONVEYANCE

FIGURE A.1

WASHOE COUNTY

STWMRF FACILITY PLAN UPDATE

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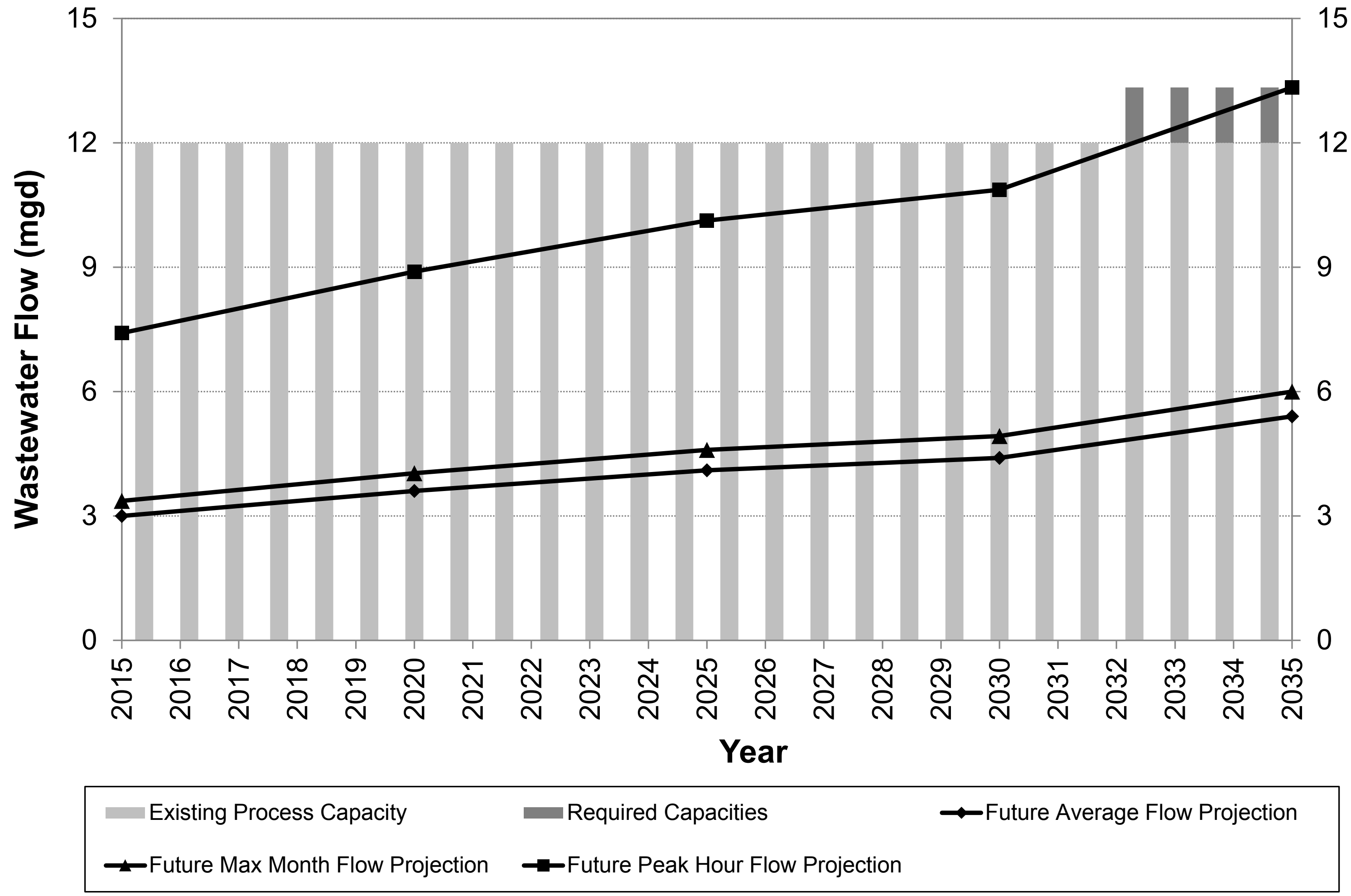

PHASED IMPLEMENTATION OF PROPOSED PRELIMINARY TREATMENT FACILITIES

FIGURE A.2

WASHOE COUNTY
STWMRF FACILITY PLAN UPDATE

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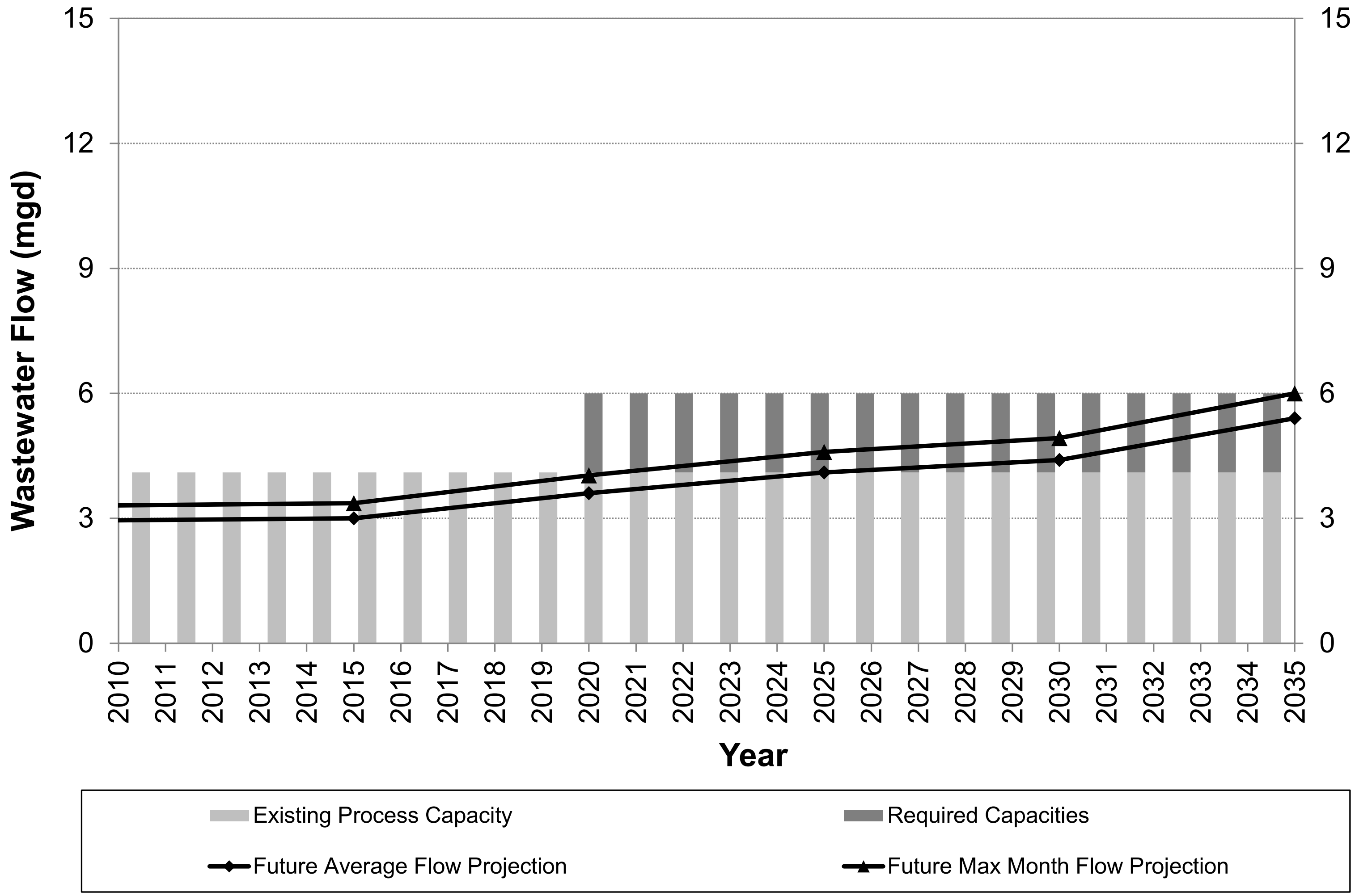

PHASED IMPLEMENTATION OF PROPOSED SECONDARY TREATMENT FACILITIES

FIGURE A.3

WASHOE COUNTY
STWMRF FACILITY PLAN UPDATE

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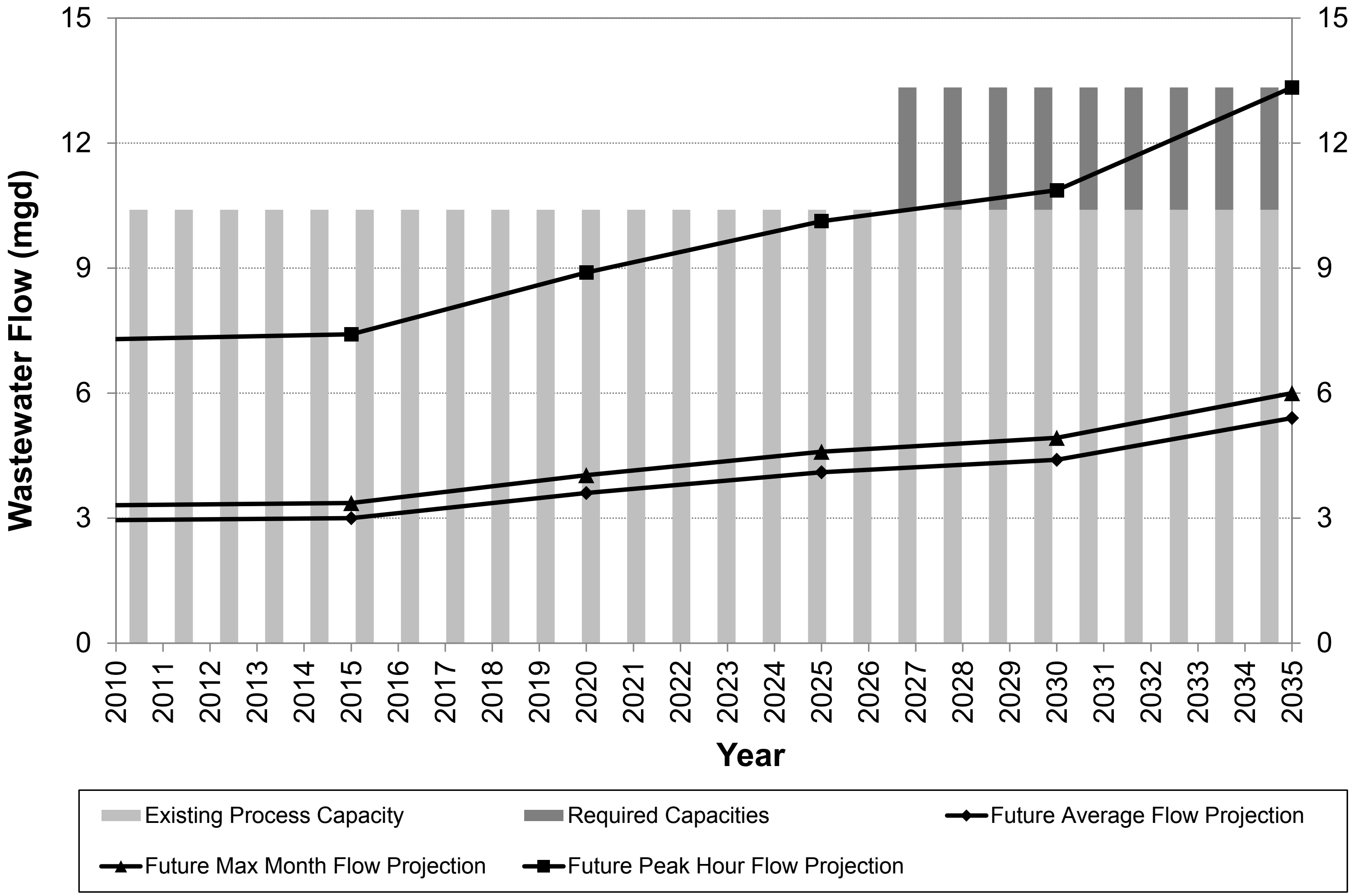

PHASED IMPLEMENTATION OF PROPOSED TERTIARY TREATMENT FACILITIES

FIGURE A.4

WASHOE COUNTY
STWMRF FACILITY PLAN UPDATE

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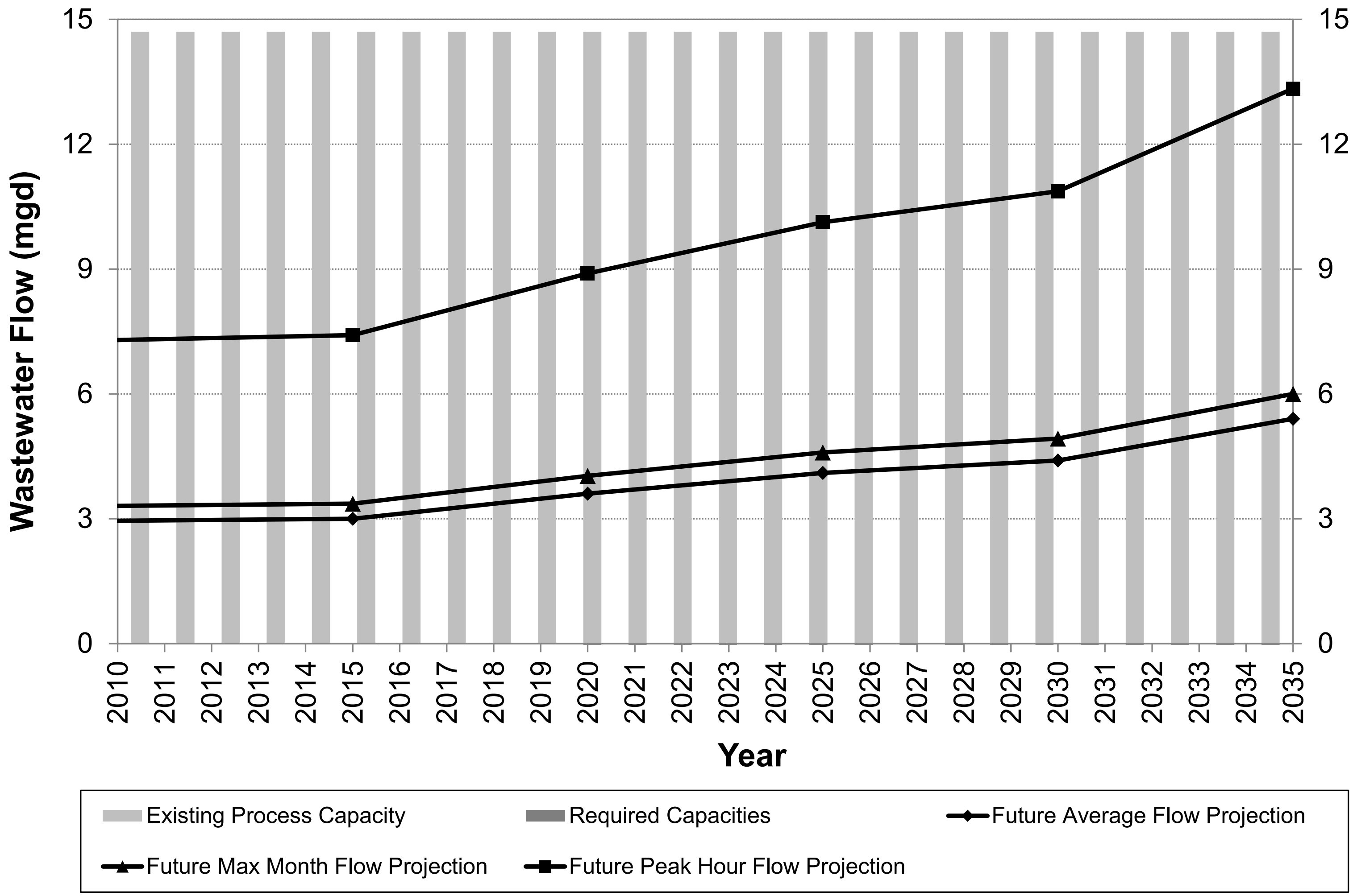

PHASED IMPLEMENTATION OF DISINFECTION TREATMENT FACILITIES

FIGURE A.5

WASHOE COUNTY
STWMRF FACILITY PLAN UPDATE

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APPENDIX B - FACILITY COST ESTIMATES

Table B.1 Cost Estimate for Collection System Improvements
STMWRF Facility Plan Update
Washoe County

Component	Construction Cost	Project Cost(1)	Planning Year
Pleasant Valley Interceptor Reach 3A(2)	$940,00	$1,320,000	2018
Pleasant Valley Interceptor Reach 3B(2)	$3,100,000	$4,330,000	2018
Pleasant Valley Interceptor Reach 4(2)	$3,780,000	$5,290,000	2018
3,520 feet of 15-in Sewer Main Near Whitecliff Drive and Parma Way	$660,000	$930,000	2035
South Meadows Pkwy East Interceptor	-	-	Buildout
2020 Planning Period Total	**$7,820,000**	**$10,940,000**	
2025 Planning Period Total	**-**	**-**	
2035 Planning Period Total	**$660,000**	**$930,000**	

Notes:

(1) Construction Cost x 1.4 (engineering design, inspection, and project management).
(2) These costs are for the reduced pipe diameters. For the original design, use project costs from the pipeline design projects.
(3) Cost based on December 2015 dollars.

Table B.2	Cost Estimate for Structural Rehabilitation and Renewal Projects STMWRF Facility Plan Update Washoe County
Description	**Cost ($,K)**
Manual Bar Screen	15
Oxidation Ditch (Cracks)	20
Oxidation Ditch (Coating)	1,000
Secondary Clarifier	400
Tertiary Filters	10
Chlorine Contact Basins	10
Effluent Pump Station (Roof)	5
Effluent Pump Station (Joist)	5
Sand Drying and Sludge Dewatering Beds	25
Subtotal	**1,500**
Contingency (20%)	298
Total Direct Costs	**1,798**
General Conditions (10%)	179
Nevada Sales and Use Tax (7.725%)(2)	76
Contractor Overhead and Profit (15%)	204
Total Construction Costs	**2,257**
Engineering, Legal & Administrative (35%)	449
Total Project Cost	**2,706**

Notes:
(1) Cost based on December 2015 dollars.
(2) Assume Sales Tax and Use Tax applies to 50% of Total Direct Costs.

Table B.3 Cost Estimate for Other Rehabilitation and Renewal Projects
STMWRF Facility Plan Update
Washoe County

Description	**Cost ($,K)**
Steamboat Creek Lift Station (I&C Equipment)	150
Influent Pump Station (Splash protection and E-stop button)	3
Oxidation Ditch (Probes and Meters)	75
Secondary Clarifier (Launder covers or brushes)	50
Tertiary Filters (Level float)	0.5
Export Pump Station (Drain piping)	15
Effluent Pump Station Electrical Room (AC Unit)	9
Subtotal	**303**
Contingency (20%)	60
Total Direct Costs	**363**
General Conditions (10%)	36
Nevada Sales and Use Tax (7.725%)[(2)]	15
Contractor Overhead and Profit (10%)	42
Total Construction Costs	**456**
Engineering, Legal & Administrative (20%)	91
Total Project Cost	**547**

Notes:
(1) Cost based on December 2015 dollars.
(2) Assume Sales Tax and Use Tax applies to 50 percent of Total Direct Costs.

Table B.4 Cost Estimate for Influent Raw Wastewater Conveyance Facilities
STMWRF Facility Plan Update
Washoe County

Description	Cost ($,millions)
Influent Screw Pump	0.85
Subtotal	**0.85**
Miscellaneous Yard Piping and Utilities (20%)	0.17
Site Work (10%)	0.10
Electrical/Instrumentation (20%)	0.23
Subtotal	**1.35**
Contingency (20%)	0.27
Total Direct Costs	**1.62**
General Conditions (10%)	0.16
Nevada Sales and Use Tax (7.725%)(2)	0.03
Contractor Overhead and Profit (10%)	0.18
Total Construction Costs	**1.99**
Engineering, Legal & Administrative (20%)	0.40
Total Project Cost	**2.39**

Notes:
(1) Cost based on December 2015 dollars.
(2) Assume Sales Tax and Use Tax applies to 50% of Total Direct Costs.

Table B.5	Cost Estimate for Future Preliminary Treatment Facilities STMWRF Facility Plan Update Washoe County
Description	**Cost ($,millions)**
Perforated Plate Screen	0.54
Subtotal	**0.54**
Miscellaneous Yard Piping and Utilities (20%)	0.11
Site Work (10%)	0.07
Electrical/Instrumentation (20%)	0.14
Subtotal	**0.86**
Contingency (20%)	0.17
Total Direct Costs	**1.03**
General Conditions (10%)	0.10
Nevada Sales and Use Tax (7.725%)[(2)]	0.02
Contractor Overhead and Profit (10%)	0.12
Total Construction Costs	**1.27**
Engineering, Legal & Administrative (20%)	0.25
Total Project Cost	**1.52**

Notes:
(1) Cost based on December 2015 dollars.
(2) Assume Sales Tax and Use Tax applies to 50% of Total Direct Costs.

Table B.6	Cost Estimate for Future Secondary Treatment Facilities STMWRF Facility Plan Update Washoe County
Facility	**Cost ($, millions)**
Selector Zone	0.43
Oxidation Ditches	5.0
Mixers	0.18
Blowers / Blower Building[1]	1.15
RAS/WAS Pump Station	0.08
Equipment Installation	1.19
Subtotal	**8.0**
Miscellaneous Yard Piping and Utilities (20%)	1.6
Site Work (10%)	0.95
Electrical/Instrumentation (20%)	2.0
Subtotal	**12.6**
Contingency (20%)	2.6
Total Direct Costs	**15.2**
General Conditions (10%)	1.5
Nevada Sales and Use Tax (7.725%)[2]	0.31
Contractor Overhead and Profit (10%)	1.7
Total Construction Costs	**18.7**
Engineering, Legal and Administrative (20%)	3.7
Total Project Cost	**22.4**

Notes:

(1) Cost based on December 2015 dollars.
(2) Assume Sales Tax and Use Tax applies to 50% of total direct costs.

Table B.7 Cost Estimate for Future Tertiary Filtration Facilities
STMWRF Facility Plan Update
Washoe County

Facility	Cost ($, millions)
Filters	2.2
Subtotal	**2.2**
Miscellaneous Yard Piping & Utilities (20%)	0.43
Site Work (10%)	0.26
Electrical/ Instrumentation (20%)	0.57
Subtotal	**3.5**
Contingency (20%)	0.69
Total Direct Cost	**4.2**
General Conditions (10%)	0.41
Nevada Sales and Use Tax (7.725%)(2)	0.08
Contractor Overhead and Profit (10%)	0.46
Total Construction Costs	**5.2**
Engineering, Legal, & Administrative Costs (20%)	1.0
Total Project Cost	**6.2**

Notes:
(1) Costs based on December 2015 dollars.
(2) Assume Sales and Use Tax applies to 50% of Total Direct Costs.

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