Washoe County Community Services Department

Cold Springs Wastewater System Facility Plan

WASHOE COUNTY, NEVADA
1861

June 2017

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EXECUTIVE SUMMARY

WASHOE COUNTY COMMUNITY SERVICES DEPARTMENT

COLD SPRINGS WASTEWATER SYSTEM FACILITY PLAN

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Reviewed By: Brent Farr, P.E.

Date: April 7, 2017

Subject: **Executive Summary**

The Washoe County Community Services Department (County) operates and maintains the wastewater collection system (collection system) and the water reclamation facility in Cold Springs, Nevada. The County currently provides sewer collection and treatment services for 2,090 connections representing a population of approximately 4,527 persons. On behalf of the County, Farr West Engineering (Farr West) and Ch2M have prepared this update to the previous Cold Springs Wastewater Facility Plan (Kennedy/Jenks, 2002). This Wastewater System Facility Plan (Facility Plan) provides the County with a condition and capacity assessment of existing facilities; an updated development schedule; facility capacity assessments at four future planning points (2021, 2026, 2036 and 2050); and a Capital Improvement Program (CIP) for infrastructure improvements needed over the next ten years. This Facility Plan is comprised of six Technical Memorandums (TM) and the ten-year CIP as presented in this executive summary.

TM 1 – COLD SPRINGS POPULATION AND SEWER FLOWS

With significant development anticipated over the next 30 years, this TM provides annual growth projections and future sewer flow estimates for capital planning purposes. This TM found that the collection system will expand to approximately 3 times its current size by 2026 with average flows increasing by approximately 5 times over this same period.

The recommended planning approach used in this facility plan update was a hybrid of the Truckee Meadows Regional Planning Agency's (TMRPA) housing study and the development plans of local developers. The recommended approach utilized annual growth rates between 1 and 12 percent over the next 30 years providing a reasonable development schedule which limits the County's vulnerability to constructing excessive idle capacity in response to development plans. Table ES-1 provides a summary of the projected growth at each planning period along with the average daily and peak hourly flows using a wastewater generation rate of 270 gpd/ERU and a peaking factor of 2.0.

Table ES-1 – Future Growth and Sewer Flow Estimates

Year	System Size (ERU)	Average Flow (MGD)	Peak Hour Flow (MGD)
2016	2,120	0.354	0.779
2021	3,421	0.705	1.482
2026	6,029	1.409	2.890
2036	11,359	2.848	5.768
2050	19,119	4.944	9.959

TM 2 – INFRASTRUCTURE CONDITION ASSESSMENT

This TM is an assessment of the condition of the existing infrastructure at the Cold Springs Water Reclamation Facility (CSWRF) and the two major lift stations in the Cold Springs basin, the Woodland Village lift station and the Diamond Peak lift station. The condition assessments of the facilities are based on observations from a team of four CH2M engineers comprised of mechanical, structural, electrical, and wastewater process disciplines during a site visit.

The TM concluded with the Table ES-2 list of recommendations to repair or replace items at CSWRF that were either non-functioning, in need of repair, or otherwise beyond the expected useful life of the equipment. In addition, a list of all the major equipment at CSWRF and the two lift stations was provided along with the anticipated remaining useful life for the installed equipment at each of the three sites.

Table ES-2 – Summary of Recommendations

Recommendation Number	Description
1	Remediation of influent pump station wet well
2	Test and verify performance of pumps and motors for the influent pumps.
3	Repaint grit chamber gearbox
4	Replace headworks thermal insulation
5	Replace grit classifier
6	Repair or replace influent sampler
7	Repair flow meter vault pipe flanges and repaint
8	Replace missing tines at oxidation ditch Brush Rotor ME-300
9	Repaint air piping near the digester blowers
10	Replace the original pump in the effluent pump station

Recommendation Number	Description
11	Review dewatering polymer and centrifuge operating parameters to achieve a drier cake.
12	Recalibrate or replace the flow meter to the centrifuge
13	Replace the polymer pump
14	Install new curtains or baffles to reduce sludge splatter in the disposal room
15	Replace the sodium hypochlorite tank
16	Replace corroded chemical electrical conduit
17	Replace the peristaltic chemical metering pumps
18	Replace the standby generator
19	Accurately document the size, number, and routing of major electrical distribution conductors
20	Complete Arc Flash Studies and apply appropriate warning labels to equipment
21	Recommend replacement of the standby engine generator once maintenance becomes impractical
22	Backflow preventer code update
23	Investigate cause of frequent water line leaks in paved area near the influent pump station.
24	Access provisions into the Woodland Village Lift Station dry well and meter vault should be modified to comply with IBC and OSHA standards.
25	Correct source of errors in the Woodland Village Lift Station flow meter
26	Complete Arc Flash labeling at Diamond Peak
27	Complete Arc Flash labeling @ Woodland Village
28	Repair metal manhole wall at corroded locations. Connect cathodic protection system.
29	Install guardrail around the Equalization Basins to meet IBC minimum height requirement.
30	Replace pumps and motors at the Diamond Peak Lift Station

TM 3 – HYDRAULIC MODEL DEVELOPMENT AND COLLECTION SYSTEM CAPACITY ASSESSMENT

The purpose of this TM was to assess excess capacity in the Cold Springs sewer collection system in 2016, 2021, 2026, 2036 and 2050. All capacity estimates were translated into values of equivalent residential units (ERUs) so that capacity triggers can be monitored as development actually unfolds in Cold Springs. The Cold Springs sewer collection system is comprised of two lift stations, one pump station, 11,506 linear feet (lf) of PVC force main pipe, 489 manholes and approximately 113,000 lf of PVC sewer interceptor pipes 8-inches in diameter or greater. The existing collection system was found to have adequate conveyance capacity through the 2026 planning period. Figure ES-1 provides a color-coded map of the remaining capacity in the system in the existing condition.

In 2036, there are two areas in the System which exceed the pipe surcharge capacity criteria and the existing Influent pump station is no longer capable of conveying peak hourly flows. Three improvement projects are recommended as shown in Table ES-3.

Table ES-3 – 2036 Collection System Improvement Projects

Name	Details
Glen Lakes Ct. Interceptor Replacement	Replace and regrade 1,650 lf of existing 8-inch pipe with 10-inch interceptor and 6 manholes.
Briar Dr. Interceptor Replacement	Replace 1,500 lf of 12 and 15-inch interceptor with 18-inch pipe and 9 manholes.
Influent Pump Station	Replace existing 800 gpm pump and 2,300 gallon wet well with a 2,700 gpm duplex pump station with a 6,600 gallon wet well.

In 2050, or the buildout condition, the conveyance capacity of the Influent pump station will again require improvement and additional segments of pipe will require upsizing as well. Because these collection system improvement projects are projected to be needed far in the future, it is not recommended for the County to include these projects in their current capital improvement program (CIP). Because these future assessments were made according to the development schedule presented in TM 1, it is important that the actual sequencing of new homes and businesses in and around Cold Springs be referenced against the remaining capacity of system assets presented in this TM. It is recommended that the County reference this report with all community development applications as they come in.

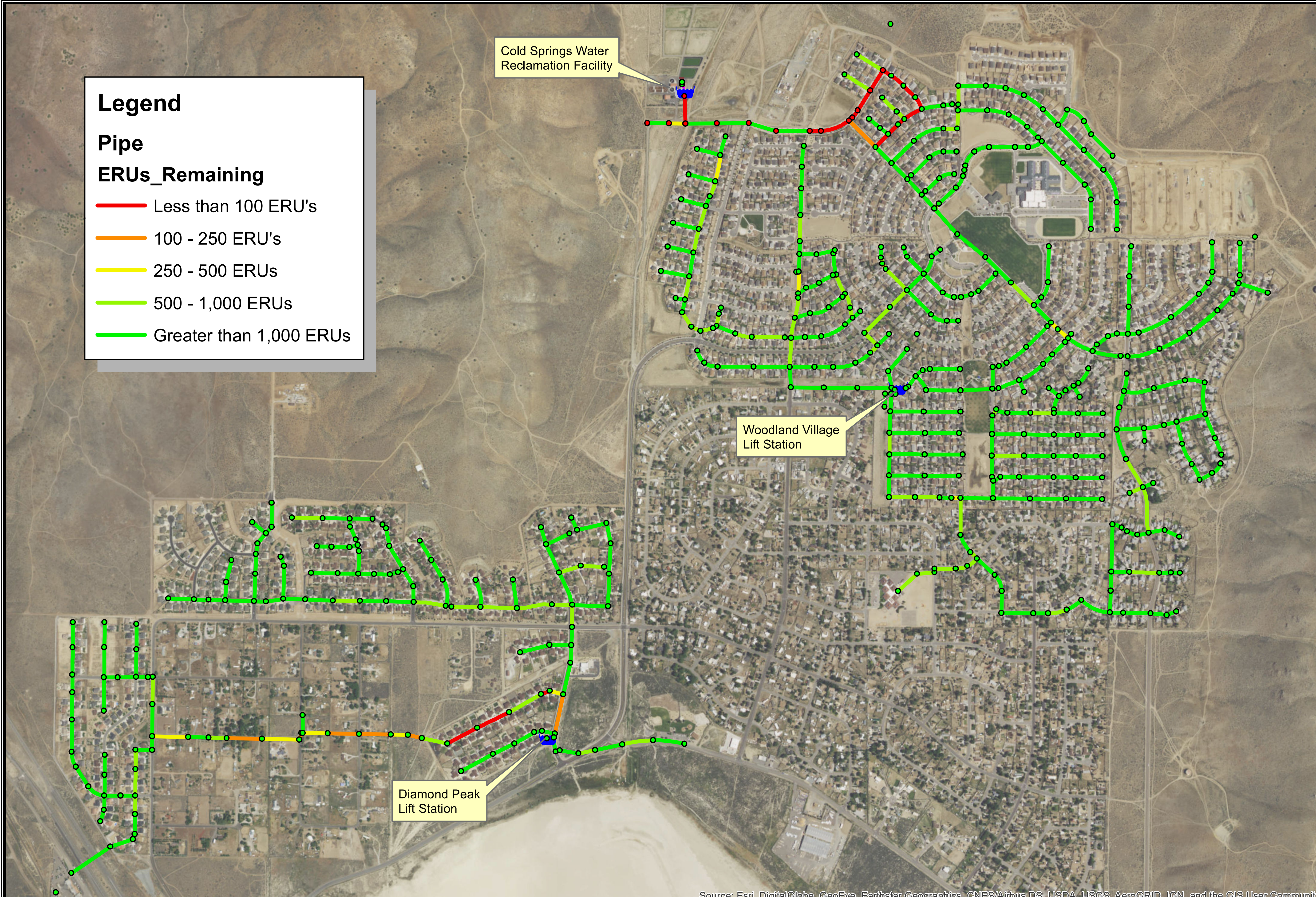

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Figure ES-1: Existing System ERU's Remaining

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1 " = 1,000 '

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

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TM 4 – TREATMENT PLANT CAPACITY ANALYSIS AND OPERATIONAL ASSESSMENT

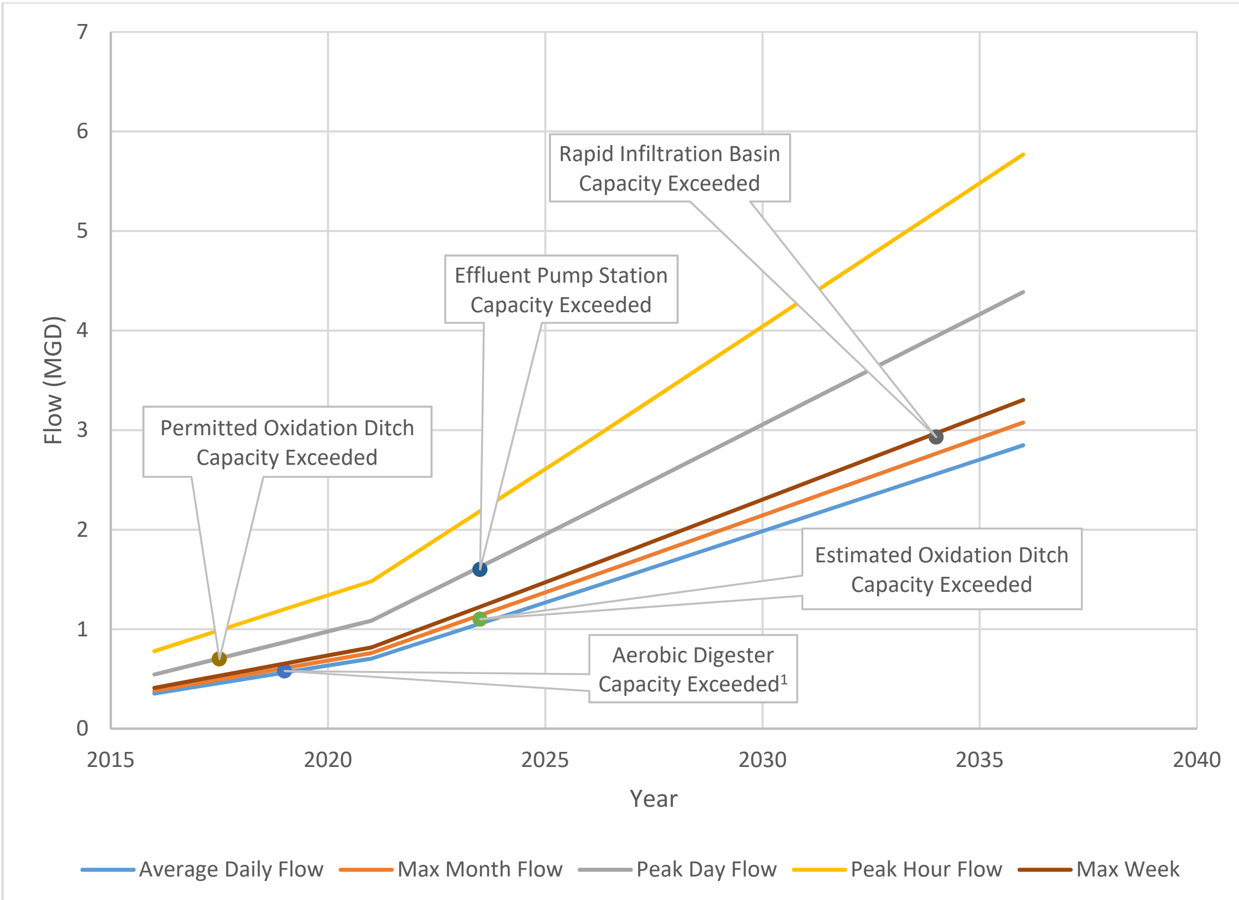
The primary objectives of this TM were to determine the capacity of CSWRF to convey, treat and dispose of wastewater generated in the Cold Springs Basin, and to evaluate the current operational practices of the facility to determine if there are any opportunities to reduce chemical or energy use or improve the treatment performance of the facility.

CSWRF has sufficient capacity in each unit process to meet both the present flows and the current permitted flows. However, the growth projections developed in TM #1 show that the flow to the plant is anticipated to grow rapidly. Accordingly, most of the major unit processes at the plant will be undersized by 2023. See Table ES-4 and Figure ES-2.

Table ES-4 – Unit Process Capacity Analysis Figure for Critical Processes

Unit Process	Current Capacity	Estimated Year Capacity Exceeded
Headworks	2.5 MGD peak instantaneous flow	Concurrent with any lift station addition
Oxidation Ditch (Permitted Capacity)	0.7 MGD peak day flow	2017
Oxidation Ditch (Estimated Capacity)	1.1 MGD maximum month flow	2023
Aerobic Digester	0.58 MGD maximum month flow	2019[1]
Effluent Pump Station	1.6 MGD peak day flow	2023
Rapid Infiltration Basins	2.93 MGD maximum week flow	2034

Notes: 1. Revising the current 60-day SRT design criteria will lengthen the time period before the aerobic digester capacity is exceeded.



Notes: 1. Revising the current 60-day SRT design criteria will lengthen the time period before the aerobic digester capacity is exceeded.

Figure ES-2 – Unit Process Capacity Analysis Figure for Critical Processes

TM 5 – TREATMENT PLANT EXPANSION ALTERNATIVES

The primary objectives of this TM were to determine water quality objectives for CSWRF through the end of the planning period and determine cost effective and beneficial expansion alternatives for CSWRF to maintain permit compliance as the influent flows and loads to CSWRF increase as described in TMs 1 and 4 of this Facility Plan.

Water quality goals for the expansion of the facility were defined as treating the 2036 planning period flows to the existing permit limits as well as a total nitrogen effluent of 5-7 mg/l and an effluent ammonia concentration below 2 mg/l. Solids treatment shall achieve 270 degree-days of sludge stabilization in the aerobic digester, and shall be acceptable for landfill disposal. Reuse treatment shall be to Nevada Class A standards designed for filtration and UV disinfection assuming an approximately 1 MGD seasonal reuse sidestream to a future development.

The expansion of CSWRF has been divided into six separate expansion projects. Individual projects have been developed to expand the headworks, secondary treatment, tertiary treatment for the reuse sidestream, digestion and thickening, dewatering and loadout, and emergency generator and plant water system. Three alternatives were developed for the secondary treatment expansion project that were compared on the basis of life-cycle cost and non-monetary factors. Each of the expansion projects has been designed to the capacity listed in Table ES-5.

Table ES-5 – CSWRF Design Criteria by Expansion Project

Expansion Project	Design Influent Flow (MGD)	Flow Type
Headworks	10	2036 Peak Pumped Flow
Secondary Treatment	3.08	2036 Max Month Flow
Reuse	1	Estimated Demand
Digestion and Thickening	3.08	2036 Max Month Flow
Dewatering and Loadout	3.08	2036 Max Month Flow
Emergency Generator and Plant Water System	N/A	Estimated Demand

The life cycle costs and non-cost evaluation scores for the secondary treatment system are summarized in Table ES-6 to determine the option with the lowest life cycle cost per rating point of non-cost benefit.

Table ES-6 – Secondary Treatment Lifecycle Cost and Non-Cost Rating

Option	Life Cycle Cost (NPV)	Non-Cost Rating
Option 1 - Four Oxidation Ditches	$29,000,000	3.81
Option 2 - A2O Process	$23,400,000	3.24
Option 3 - 5 Stage Bardenpho	$25,400,000	3.95

Option 3, 5 Stage Bardenpho, was the recommended option as it is the most stable process, provides the greatest ability to meet permit limits over a wide range of influent flows and loads, has the highest non-cost score, and is the second lowest life cycle and capital cost option.

CSRWF upgrades are broken down into six recommended projects, described in Table ES-7. The costs and timetable for these individual projects are summarized in the capital improvement program.

Table ES-7 – Summary of Expansion Projects

Unit Process	Description
Headworks	Two inclined fine screens, bypass channel with a manual bar screen, two screenings washer/compactors, mechanically induced grit vortex, grit washer/dewatering
Secondary Treatment	5-stage Bardenpho, blower building, 2 secondary clarifiers, RAS/WAS pumps station
Reuse	Continuously backwashed upflow sand filter, in-vessel UV disinfection
Digestion and Thickening	Design criteria revision, rotary drum thickener in existing dewatering building
Dewatering and Loadout	Centrifuge, dewatering and loadout facility
Emergency Generator and Plant Water System	New 750 kW emergency generator and new vertical turbine plant water pump station

TM 6 – EFFLUENT DISPOSAL ALTERNATIVES

As the Cold Springs area grows in the future, increased potable water use will result in larger volumes of treated effluent generated from CSWRF which could be put to use in a variety of ways. An important consideration will be the County's ability to dispose of treated effluent as system size increases. It was found that the existing CSWRF rapid infiltration basins (RIBs) contain adequate effluent disposal capacity to meet the demands of the system for the next twenty years, or until 2036. On the high side, up to 3,191 acre-feet of treated effluent could be available for reuse purposes in twenty years.

CAPITAL IMPROVEMENT PROGRAM

This section provides a planning assessment of capital improvements required at CSWRF and in the collection system for the planning period of 20 years, or the year 2036. Additionally, a 10-year program is presented with estimated impacts to user rates and connection fees. All costs shown are in 2016 dollars unless otherwise noted.

Per TMs 3 and 5, there are a total of nine improvement projects needed to increase the capacity of the collection system and CSWRF to convey and treat the increased sewer flows anticipated by 2036. Combined, these projects are estimated to cost $42.5 million dollars as presented in Table ES-8.

Table ES-8 – Cold Springs Infrastructure Needs Summary

Year	Description	Cost
2017	Headworks [10 MGD] – Screening + Grit Removal	$4.1M
2023	Secondary Treatment [3.08 MGD] – 5-stage Bardenpho, blowers, clarifiers, RAS/WAS pump station	$21.6M
2023	Emergency Generator and Plant Water System	$2.3M
2026	Solids Handling [3.08 MGD] – Centrifuge, new dewatering, and loadout facility	$5.8M
2036	Category "A" Reuse Treatment [1.0 MGD] – Upflow sand filter w/ UV disinfection	$4.6M
2036	Digestion and Thickening [3.08 MGD] – Digester Blowers and Diffusers	$1.7M
2036	Glen Lakes Ct. Interceptor Replacement [0.9 MGD] – 1,650 lf of 10-inch interceptor w/ 6 manholes	$0.6M
2036	Briar Dr. Interceptor Replacement [3.3 MGD] – 1,500 lf of 18-inch interceptor w/ 9 manholes	$0.8M
2036	Influent Pump Station [1.0 MGD] – 2,700 gpm Duplex Pump Station w/ 6,600 gallon wet well	$1.0M

By the year 2026, four improvement projects totaling approximately $34 million dollars will be needed to improve the CSWRF facility. Table ES-9 provides an additional breakdown of the capacity replaced and the capacity added for each improvement. Costs associated with added capacity should be covered by connection fee revenues while the costs of replacement capacity should be covered by user fee revenues.

Table ES-9 – 10-Yr Capital Improvement Program

Year	Improvement	Cost Estimate	User Fee		Connection Fee	
2017	Headworks	$ 4,100,000	25%	$ 1,025,000	75%	$ 3,075,000
2023	Secondary Treatment	$ 21,600,000	0%	$ 0	100%	$ 21,600,000
2023	Generator + Water System	$ 2,300,000	50%	$ 1,150,000	50%	$ 1,150,000
2026	Solids Handling	$ 5,800,000	0%	$ 0	100%	$ 5,800,000
	Totals	$ 33,800,000		$ 2,175,000		$ 30,475,000

User Fees

The headworks improvement project is needed in 2017 and will replace an existing capacity of 2.5 MGD at an approximate cost of $1.03M. The impact to user rates is dependent on the funding source the County selects for this improvement (i.e. cash vs. financed). If the County utilizes cash reserves for this project and the system size grows to 11,359 ERUs by 2036 as projected by TM 1, the County can expect to receive a full return on the $1.03M investment by 2036 after increasing user rates by approximately $0.64 per month. If no growth occurs, the County would need user rates to increase by $2.01 per month to generate $1.03M in additional revenues by 2036. If the County chooses to finance the project with a 20-year loan at 3 percent interest, the monthly impacts to user rates become $1.16 with the expected growth and $3.64 with zero growth over the next 20 years.

The emergency generator and plant water system improvement project is needed by 2023 at a total cost of $2.3M. Since this project does not have a specific capacity associated with it and will equally benefit the existing facility as well as the future CSWRF expansion, the cost of construction should be covered equally by user fees and connection fees. With $1.2M in 2016 costs attributable to user fees, the 2023 future value of these costs will be approximately $1.4M. The rate impacts presented below will use the same methodology as the headworks improvement project. Using cash, the impacts to user fees starting in 2017 will be $0.88 with growth and $2.78 without growth. If the project is financed, it is recommended that the County increase user rates by $1.30 per month assuming system growth or $4.08 if zero growth occurs by 2036.

In conclusion, the impact to user fees should range between $1.52 and $7.72 per user per month depending on the funding source used for project costs and on how the system grows over the next 20 years.

Connection Fees

The impact of approximately $31M in capital improvements to future connection fees is between $4,535 and $6,096 per ERU. In general, these values are found by dividing the future cost of construction for each improvement project by the number of future connections which will benefit from or will cause these improvements to occur. More specifically, these estimates account for inflation, the future value of money, and the costs associated with financing projects at a rate of 3 percent over a 20-year term.

For example, the Secondary Treatment improvement project is needed in the year 2023 at a cost of $26.6M. This cost estimate assumes a 3 percent growth in construction industry costs due to inflation from 2016 until 2023 (see Table ES-9 for 2016 cost estimate). The project will add treatment capacity up to 3 MGD or until the year 2036. If the capacity of the existing Secondary Treatment system is exceeded in 2023 (4,291 ERUs) and the improvement project adds sufficient capacity until 2036; then the cost of this improvement should be covered by the 7,086 ERUs which require this additional treatment capacity. If the County uses cash reserves to construct this improvement, the cost per connection is simply $26.6M divided by 7,086 ERUs or $3,758.53 per ERU. If the County wishes to fund the project with a 20-year loan at 3 percent interest, the annual debt service becomes $1.8M for a true project cost of $35.7M. This is equivalent to a cost of $5,052.64 per ERU.

Table ES-10 – Connection Fee Impacts

Year Needed	Improvement	Connection Fee Cost (year of construction dollars)	Capacity Added (ERUs)	Funded by Cash Cost ($/ERU)	Funded by Loan Cost ($/ERU)
2017	Headworks	$ 3,075,000	16,999	$ 186.32	$ 250.47
2023	Secondary Treatment	$ 26,565,275	7,068	$ 3,758.53	$ 5,052.64
2023	Generator + Water System	$ 1,414,355	14,828	$ 95.38	$ 128.23
2026	Solids Handling	$ 7,794,715	5,330	$ 1,462.42	$ 1,965.96
	Total =	**$ 38,849,345**		**$ 5,502.65**	**$ 7,397.30**

Table ES-10 provides an accounting of connection fee impacts for each improvement project at the expected year of construction. This analysis only presents the costs associated with system facility upgrades for Cold Springs only and does not consider the cost of existing capacity or capital improvement costs for other County owned systems. Farr West recommends that the County pursue a more thorough analysis of user and connection fees prior to making any modifications to the current fee schedule.

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TECHNICAL MEMORANDUM #1

WASHOE COUNTY COMMUNITY SERVICES DEPARTMENT

COLD SPRINGS WASTEWATER SYSTEM FACILITY PLAN

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Reviewed By: Brent Farr, P.E.

Date: September 21, 2016

Subject: **Technical Memorandum No. 1 – Cold Springs Population and Sewer Flows**

1.0 PURPOSE

The Washoe County Community Services Department (County) operates and maintains the wastewater collection system (collection system) and the water reclamation facility (CSWRF) in Cold Springs, Nevada. The County currently provides sewer collection and treatment services for 2,090 connections representing a population of approximately 4,527 persons. The Cold Springs service area is approximately 5 square miles and is a part of the North Valleys region of Northern Nevada.

Farr West Engineering (Farr West) prepared this Technical Memorandum (TM) to summarize current sewer flows; assess current regional planning data; and provide an estimate of future sewer flows as a result of development in the Cold Springs area. More specifically, this TM includes:

- A review of existing sewer flows in the collection system,
- Development of 5, 10, 20-yr and buildout planning periods with estimated ERU counts,
- Future development schedule for proposed large residential developments, and
- Sewer flow estimates for each planning period.

1.1 PREVIOUS STUDIES

The County assessed the wastewater facilities in Cold Springs in 2002 with the *Cold Springs Wastewater Facility Plan* by Kennedy/Jenks Consultants (2002 Facility Plan). The 2002 Facility Plan focused on a CSWRF capacity upgrade from 0.35 million gallons per day (MGD) to 1.3 MGD, and collection system improvements to connect approximately 1,000 existing septic systems to the sewer system.

In 2003, Kennedy/Jenks Consultants completed the *Preliminary Design Report – Cold Springs Water Reclamation Facility Expansion* (2003 Design Report) which updated existing system water consumption, future community sewer flow estimates and provided a comprehensive alternatives analysis of CSWRF upgrades to increase the plant capacity from 0.35 MGD to 0.7 MGD as part of Phase 1 and 0.7 MGD to 1.2 MGD upon completion of Phase 2.

The 2007 update to the *Washoe County 208 Washoe County Water Quality Management Plan* (208 Plan) provided updated population and wastewater flow forecasts for the collection system. And finally, the 2010 technical memorandum *Washoe County Department of Water Resources Financial Review Engineering Assessment* (2010 Service Area Growth Projections) prepared by CH2M reviewed historical growth patterns and offered growth projections until the year 2028.

2.0 HISTORIC AND CURRENT POPULATION AND COLLECTION SYSTEM SEWER FLOW INFORMATION

Documents containing historic and projected sewer flows for the Cold Springs Area were reviewed. The data of interest for the facility plan includes historic and projected values for population, number of services, average number of persons per service, average daily dry weather flow per service or equivalent residential unit (ERU), and peak hourly flow recorded in the collection system or at the treatment plant headworks. Analysis of this peak hour to average daily flow provides the peaking factor (PF) for the collection system.

According to the most recent census data from 2010, the current population of Cold Springs is 4,527 (Census Tracks 26.12 & 26.03). County billing data lists the current number of residential and commercial services at 2,082 and 8, respectively. There are also an additional 1,338 homes utilizing privately owned on-site septic systems for sewage disposal. The existing customer base equates to a current count of 2,120 ERUs. Population estimates, current ERU estimates and future connection assumptions for this TM and the documents referenced in Section 1.1 are listed in Table 1-1.

Table 1-1 – Cold Springs Population and Equivalent Residential Units

Source	Existing Population	Buildout Population	Existing Connections (ERU)	Buildout Connections (ERU)	Planning Period
2002 Facility Plan	2,342	8,519	669	4,107	2021
2003 Design Report	2,730	14,435	1,000	5,136	n/a
208 Plan	6,470	19,181	2,724	8,076	2030
2009 Service Area Growth Projections	n/a	n/a	1,987	4,172	2028
2016 TM #1	4,527	41,015[1]	2,120	19,119	2050

[1] Value derived by multiplying buildout residential units by a density of 2.5 persons per residence.

2.1 HISTORIC COLLECTION SYSTEM SEWER FLOWS

Prior to 2010, the only collection system sewer flow data available was from the previous planning studies referenced in Section 1.1. In Section 2.2.3.1 of the 2002 Facility Plan, Kennedy/Jenks provided a collection system average daily flow of 62,000 gallons per day (gpd) per meter records at CSWRF for the month of June, 2002. This report also estimated the 2002 ERU count to be 669 and stated an approximate collection system wastewater generation rate of 103 gpd/ERU.

The 2003 Design Report did not provide any updated collection system flow measurements or estimates. Rather, TM 004 provided a collection system consumptive use analysis that estimated an average flow of 130 gpd/ERU or 48 gpd/capita. The report stated that both of these values are unusually low, and recommended using 250 gpd/ERU for older residential areas, 225 gpd/ERU for new developments, and a collection system peaking factor of 2.5 for planning purposes.

The existing capacity assessment included in the 208 Plan referenced an existing collection system size of 2,724 ERUs as of January, 2015 and an average daily flow of 260,000 gpd. The document also estimated that an additional 130,000 gpd in flow could be added from converting 1,200 existing septic users to the County collection system.

The County provided daily historical influent flow totals at CSWRF from 2010 through 2016. Table 1-2 provides the average daily flow for each year between 2010 and 2015. 2016 data was omitted from this historic analysis since it was included in the current sewer flow analysis provided in Section 2.2.

Table 1-2 – Historic CSWRF Average Daily Flow (Influent)

Year	Average Daily Flow (MGD)
2010	0.277
2011	0.284
2012	0.292
2013	0.297
2014	0.300
2015	0.298

In summary, the historic flow data presented above has been included in this TM for reference purposes only. In many cases the previous studies lacked supporting data for the estimates presented in Table 1-1 and Table 1-2, or included multiple conflicting values. This data was not used for any of the current or future sewer flow estimates provided below.

2.2 CURRENT COLLECTION SYSTEM SEWER FLOWS

In order to estimate the performance and remaining capacity in the collection system infrastructure and at CSWRF, an evaluation of recent sewer flow data was performed. The results of this analysis are listed in Table 1-3.

Table 1-3 – Current Collection System Sewer Flows

	Average Flow (MGD)	Peak Hour Flow (MGD)	Peaking Factor
Existing	0.353	0.779	2.20

Three different sets of flow data were provided for analysis:

- Spring 2015 – Flow meters were installed at the four locations shown on Figure 1-2 for the period from February 19th through April 15th. Three locations measure wastewater flowing 100 percent via gravity (i.e. Briar, Diamond, and Woodland). The Diamond and Woodland meter locations were installed upstream of each lift stations vault and wet well. The fourth (CSWRF) measures a combination of flow from the Briar gravity system and the Diamond Peak force main. Analysis of the three gravity meters indicates a collection system average weekend daily flow of 0.353 MGD, a peak hourly flow of 0.779 MGD and a peaking factor of 2.20.
- CSWRF Flow Meter – This meter is permanently installed in the headworks channel at CSWRF and measures the combined influent flow from the Woodland Village lift station and the CSWRF influent lift station. Flow totalizer readings were reviewed from January, 2015 through April, 2016. These readings provided an average daily flow of 0.301 MGD. Peak hour flow readings were not included in this data set.
- Summer 2015 – From May 29th through June 22nd, three flow meters were installed at a manhole upstream of the Diamond Peak Lift Station. The recorded data suggest an average daily flow of 0.081 MGD, a peak flow of 0.189 MGD and a sub-basin peaking factor of 2.3. From June 27th through August 12th, sewer flow meters were installed at a manhole upstream of the Woodland Village Lift Station. The recorded data suggest an average daily flow of 0.155 MGD, a peak flow of 0.909 MGD and a sub-basin peaking factor of 5.87. These values indicate poor data quality and were not developed further to represent existing collection system sewer flows.

The Spring-2015 flow monitoring data was used as the basis of development for current collection system flow curves. The data was broken into weekday and weekend data sets, and the weekend data set was selected for collection system flow curve development since flow rates were higher than those taken on the weekdays. Figure 1-1 shows the weekend sewer flow of the collection system for the monitoring period of February 19th through April 15th, 2015.

The first curve, shown in green, is the average flow value for each 15-minute reporting interval and represents an average dry weather flow (ADWF) of 0.353 MGD. In other words, the 10:00am flow of 403 gpm represents the average of sixteen weekend values taken at 10:00am. The second curve is the maximum value for each reporting interval and represents a peak hourly dry weather flow (PHDF) of 0.779 MGD or 541 gpm. This PHDF was recorded at 10:30am on Sunday, March 29th and represents the maximum flow reading taken over the sixteen weekend days. Finally, the third curve was calculated by Farr West to represent daily average and peak hourly flows with a single curve or pattern. This same pattern will be utilized in the development of the existing collection system hydraulic model as part of TM 3. Evaluating the collection system ADWF against a current count of 2,120 ERUs results in an existing sewer flow of 166 gpd/ERU.

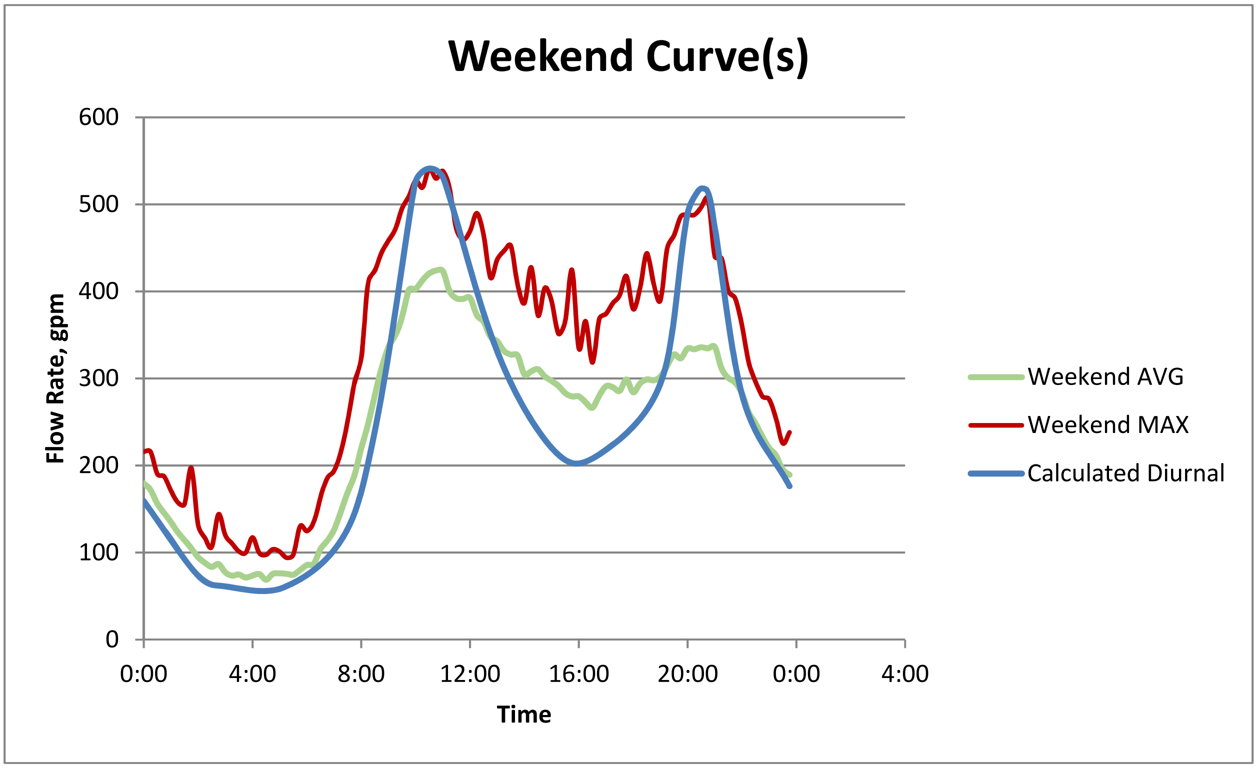

Figure 1-1 – Current Collection System Sewer Flow Curves

Even though the collection system generates a PHDF of 0.779 MGD, the CSWRF will experience much greater peak flows when the CSWRF influent lift station and the Woodland Village lift station are operating at the same time. The CSWRF influent lift station pumps water into the headworks at a rate of 800 gpm and the Woodland Village lift station provides pumped influent at a rate of 1,350 gpm. A combined flow rate of 2,150 gpm in the headworks channel is equivalent to a peak flow of 3.10 MGD.

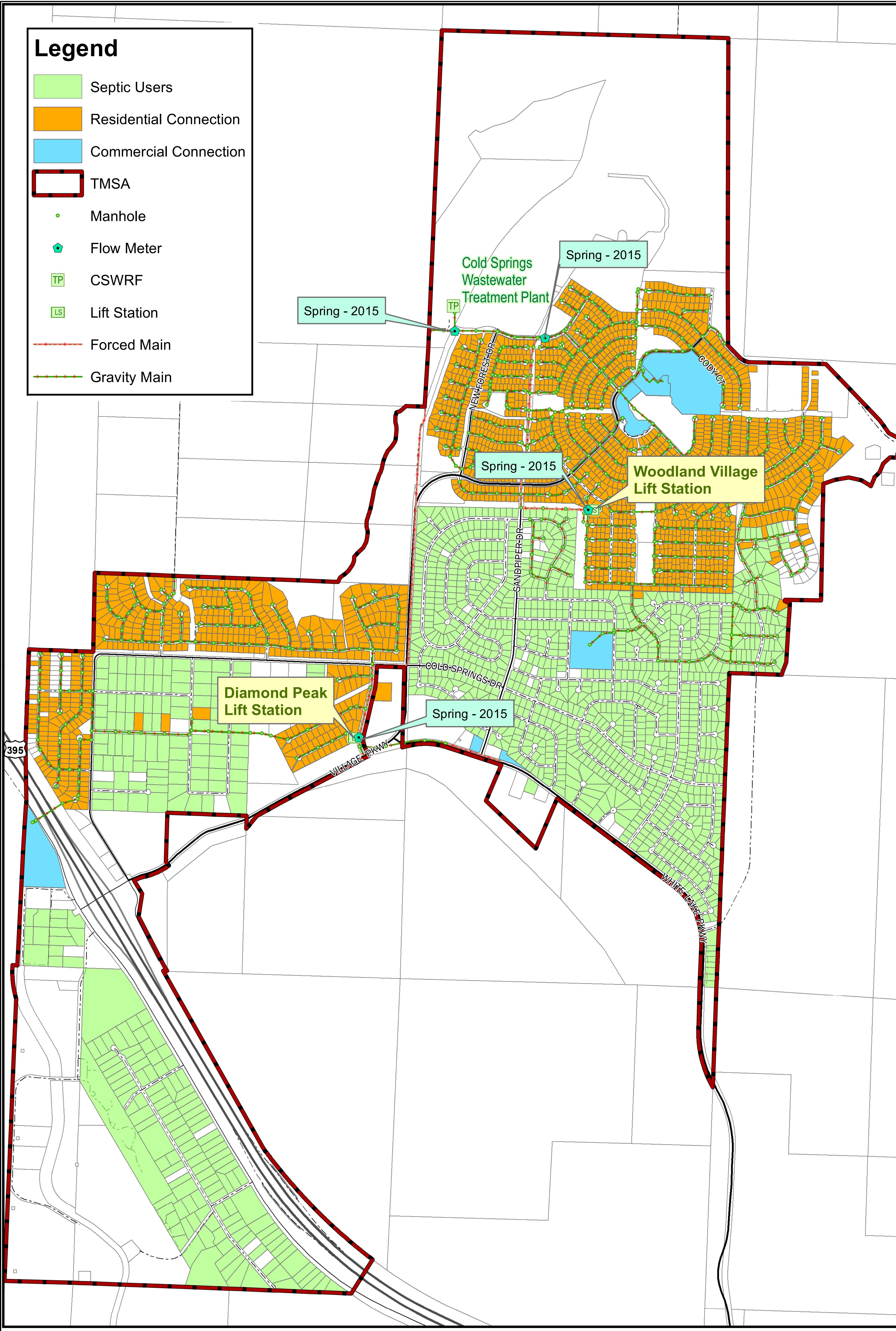

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Figure 1-2 - Existing System

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3.0 FUTURE GROWTH IN THE COLD SPRINGS AREA

3.1 FUTURE DEVELOPMENT PLANNING PERIOD

The Cold Springs area has evolved from rural roots into a bedroom community serving the North Valleys and the Truckee Meadows regions. The future development potential in the Cold Springs area is primarily comprised of residential units with a small commercial and industrial component. This Facility Plan includes four future planning periods to assess collection system infrastructure and CSWRF capacity: 5-years (2021), 10-years (2026), 20-years (2036) and buildout. Buildout represents the condition where all known developments are completed and all vacant land in the Cold Springs area has been improved. Per the development schedule, the year buildout will occur will be 2050.

3.2 CURRENT REGIONAL PLANNING

The Cold Springs Truckee Meadows Service Area (TMSA) is currently 2,935 acres as shown on Figure 1-3. The small amount of undeveloped land inside of the TMSA is primarily zoned low and medium density suburban with a small component of Industrial zoned land in the South West region. Figure 1-3 also displays that undeveloped areas adjacent to the TMSA are a mix of residential, commercial and unincorporated transition (UT-40) zoned properties.

The Truckee Meadows Regional Planning Agency (TMRPA) has conducted a regional housing study which evaluates current housing stock and identifies future housing needs for the next twenty years for the entire Truckee Meadows area. Parcel data supplied by TMRPA indicates that the future development potential of the Cold Springs area is approximately 7,700 ERUs. Of these 7,700 units, 770 of them are inside of the current Cold Springs TMSA. The remaining 7,000 units would require the County to expand their service territory to include areas currently under the City of Reno's jurisdiction. These undeveloped areas and unit counts are shown on Figure 1-4.

Using the TMRPA unit count as the basis for future development in Cold Springs presents three significant issues. First, the TMRPA data does not account for the StoneGate master planned community. The project is currently being reviewed by the City of Reno for a zoning map amendment from UT-40 to planned unit development (PUD). Since TMRPA does not model future zoning changes, the 1,300 acre site only has a 7 unit allocation per TMRPA's current parcel data. Second, TMRPA does not provide any unit counts for land zoned commercial or industrial. And third, there are additional developments (e.g. Train Town, Christman) which are either zoned commercial or have a high probability of a future zoning change. In total, these developments present an additional 9,900 ERUs which are not found in the TMRPA data.

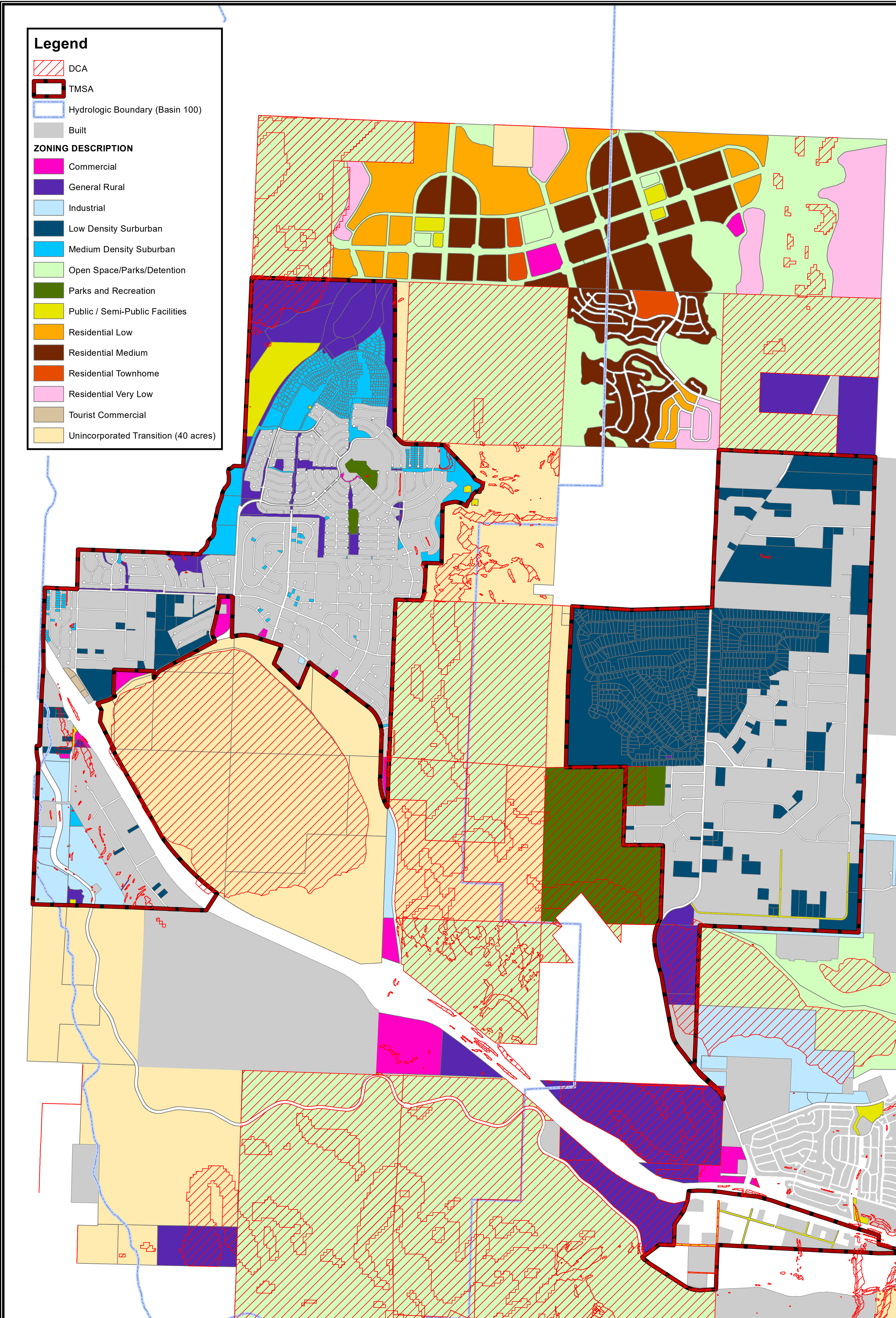

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Figure 1-3 - Existing Alt Zoning

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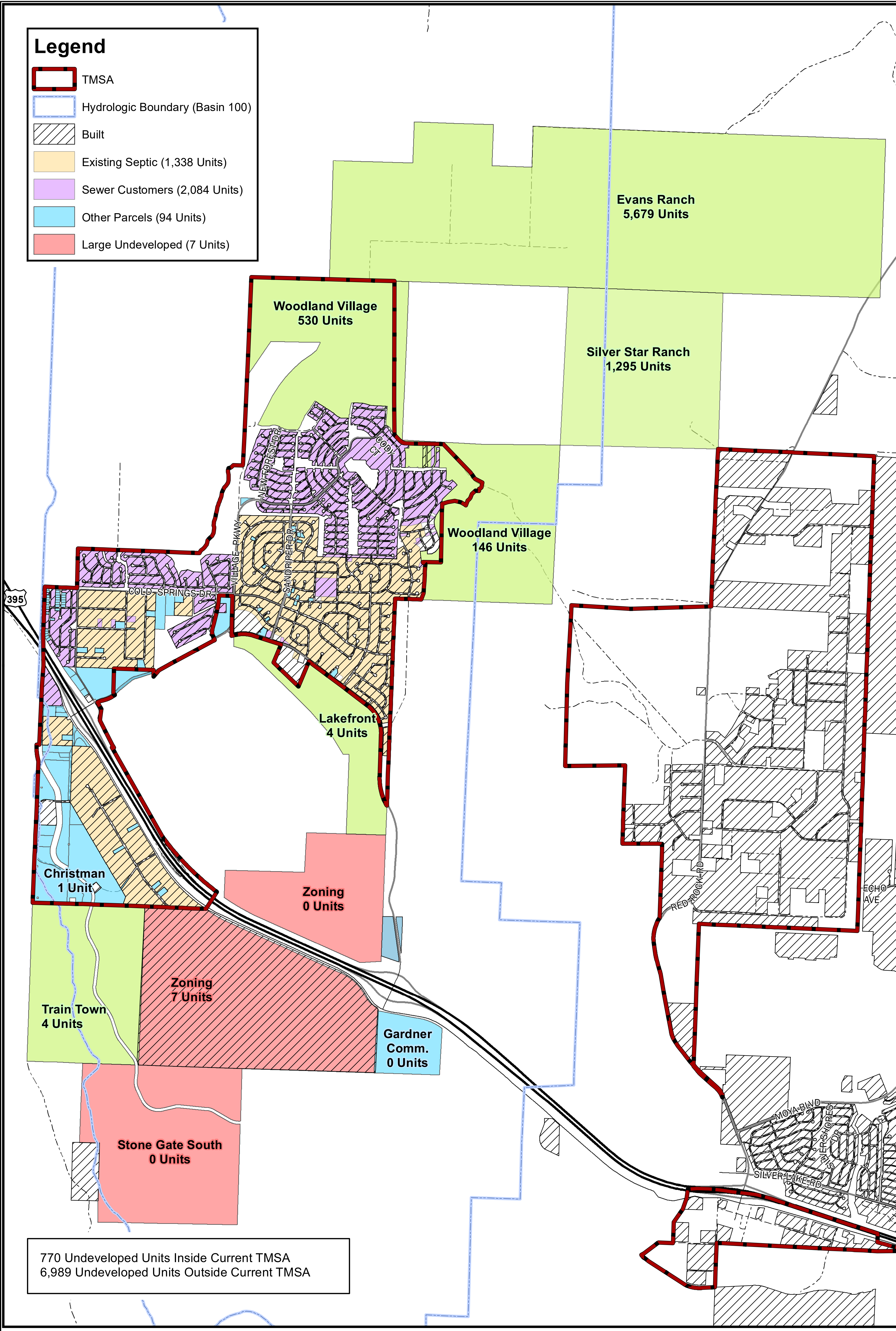

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Figure 1-4 - TMRPA Units

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3.3 DEVELOPER PROJECTIONS

As shown on Figure 1-5, the majority of future development in Cold Springs can be attributed to projects by two separate developers; StoneGate and Lifestyle Homes. Of the 7,271 acres of land which is currently undeveloped, only 390 acres is not controlled by either StoneGate or Lifestyle Homes. Three of these developments have an approved PUD handbook and another, StoneGate, submitted their handbook in July of 2016.

With the assistance of the County, Farr West met with the local developers to better understand their development plans. An annual schedule of units added to the collection system has been prepared for the remaining undeveloped land in the Cold Spring Basin per the testimony of the developers. In total, the future ERU estimates listed in Table 1-4 include the projections of the individual development groups and results in an average growth rate of 6.5%, with an extreme period of growth between 2019 and 2026 expected to grow at rates of 15 to 33 percent annually. A depiction of these estimates can also be found as the red line on Figure 1-7.

Table 1-4 – Developer Growth Estimates

Scenario	Residential	Commercial	Total	Running Total
Existing	2,082	38	2,120	2,120
2021	3,048	187	3,235	5,354
2026	5,410	707	6,118	11,472
2036	5,367	1,259	6,625	18,098
Buildout	770	251	1,021	**19,119**

While Farr West recognizes that the buildout unit count provided by the developers is a more accurate estimate of the buildout potential in Cold Springs; Farr West feels that the associated build rates are too optimistic. Utilization of an overly aggressive development schedule in capital planning applications sets the stage for the utility to overbuild improvement projects far sooner than they are needed. The impacts of overbuilding facilities at a premature date are an increased exposure to debt, since collection of connection fees can be significantly delayed from the time of capital investment. And, idle capacity which can reduce operational and maintenance efficiencies.

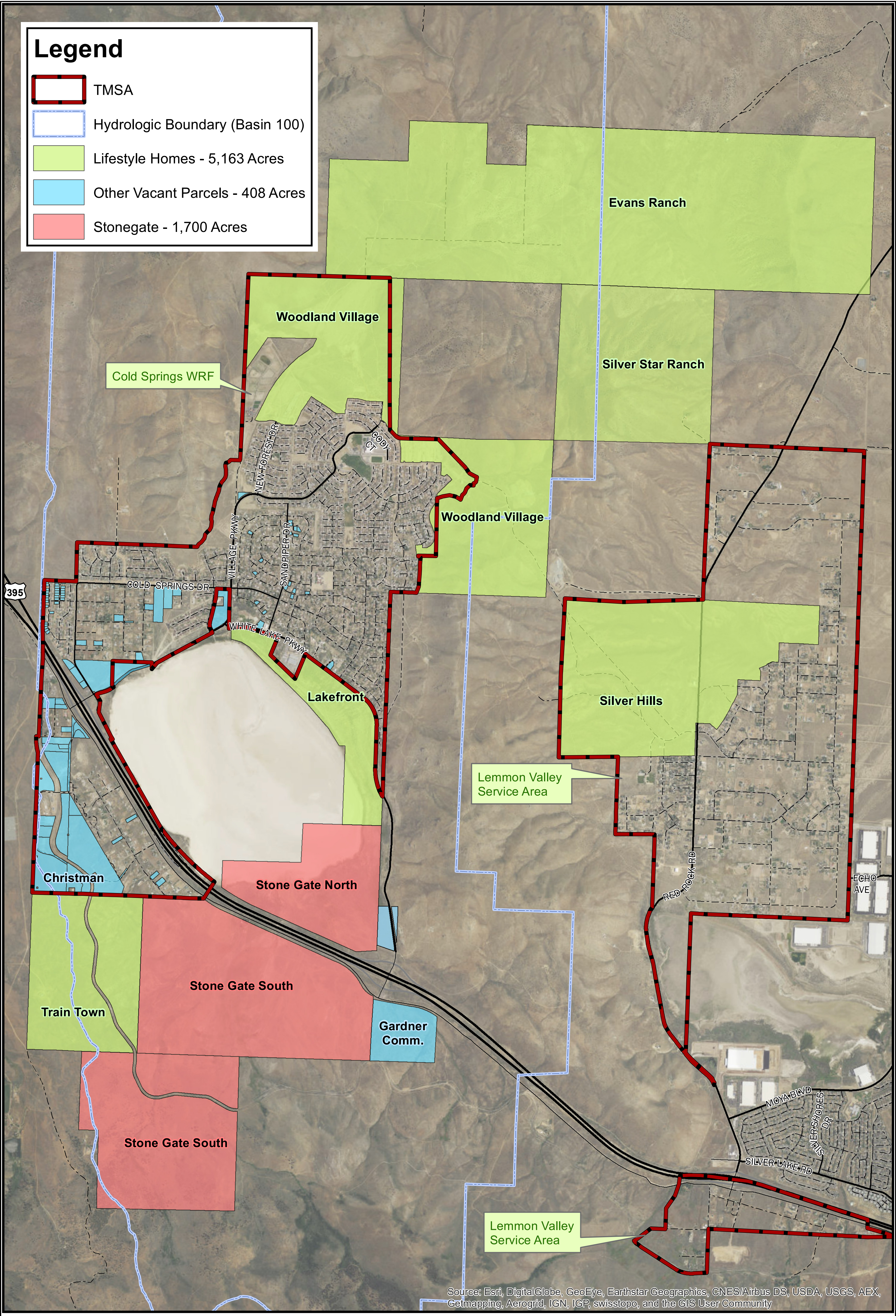

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Figure 1-5 - Future Development Areas

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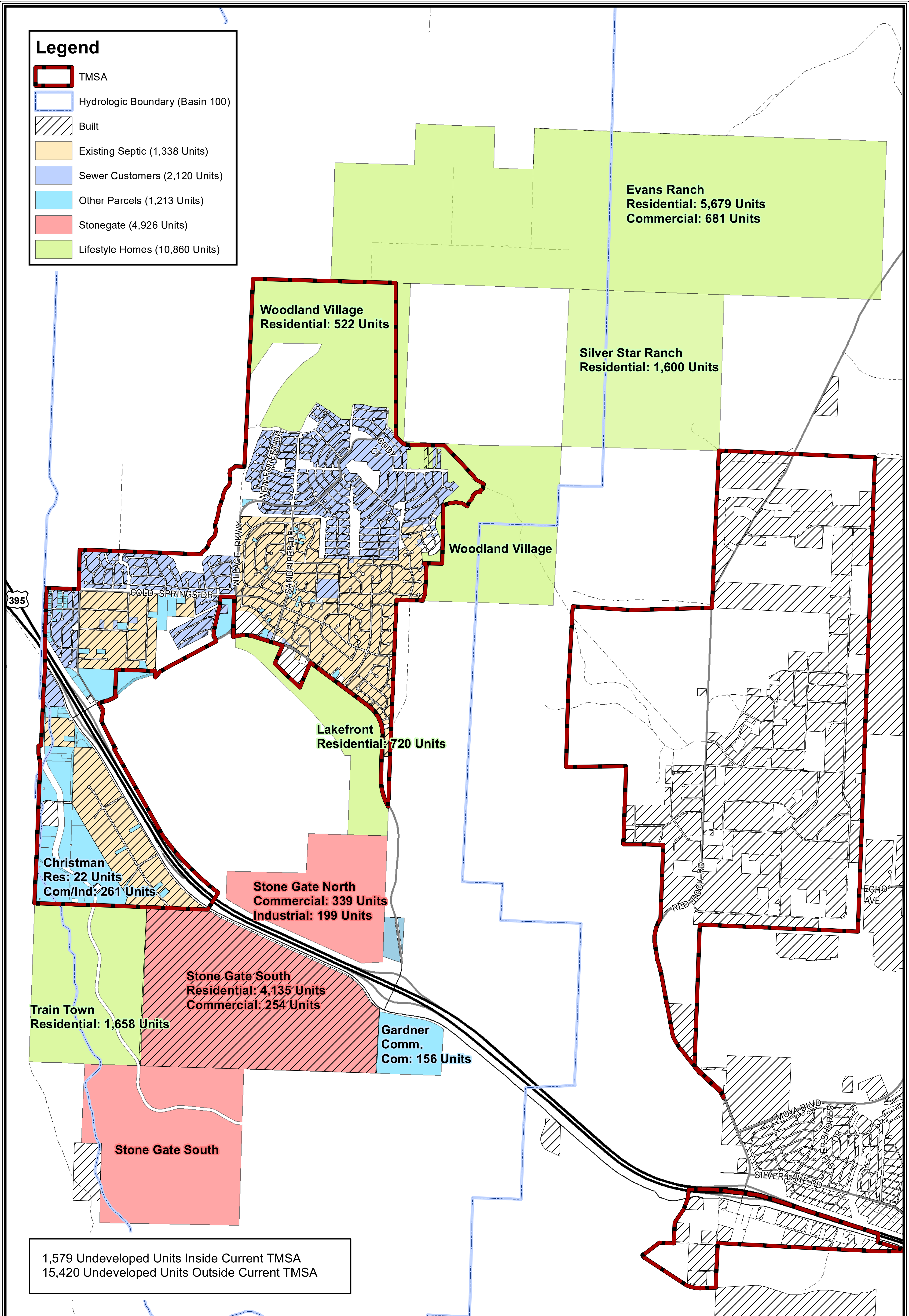

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Figure 1-6 - Future Developer Units

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3.4 RECOMENDED PLANNING APPROACH

Projecting population and subsequent housing unit growth in small areas is particularly difficult due to the small number of existing homes and the potential for extreme rates of growth to occur from the addition of only a small number of homes. Also, these small communities are typically not highlighted as part of larger regional studies. For instance, the 2014 Washoe County Consensus Forecast (2014 Consensus) provided 20 year projections in regards to population, employment, income and housing in all of Washoe County. The unincorporated areas of Washoe County were grouped together as the smallest population center assessed in the study.

The 2014 Consensus suggests that Washoe County will grow from 442,123 persons in 2014 to 563,779 in 2034 for an average annual growth rate of 1.2%. Also included in the study was an analysis of the jurisdictional distribution of population in Washoe County which found that the City of Reno, City of Sparks and Unincorporated Washoe County accounted for 50, 24 and 26 percent of the population totals, respectively. Review of the Unincorporated Washoe County population growth from 108,530 persons in 2013 to 134,164 persons in 2034 results in an average annual growth rate of 1.0%. Using a density of 2.5 persons per household this growth projection equates to 10,253 homes added in all of the unincorporated Washoe County areas by the year 2034.

While housing growth is heavily connected to population growth, the correlation is not always one to one. In the 2010 Service Area Growth Projections document, the number of homes in the North Valleys area grew at approximately 2.9 times the rate of Washoe County population growth from 2003 through 2008. This data also reveals that housing grew at a maximum rate of 19.3% in 2005 for the North Valleys region including Cold Springs.

Farr West recommends that the County utilize the buildout unit total supplied by the developers in place of the unit counts in the TMRPA data. The primary reasoning for this is that the StoneGate development is not included in the TMRPA data; the intended development potentials of the Lakefront, Train Town and Christman developments are significantly greater per developer testimony than that of existing zoning; and finally, the remaining undeveloped unit counts are very similar between regional planning and developer testimony.

Farr West will employ two methods to limit the County's vulnerability to constructing excessive idle capacity as a result of capital improvement projects. The first method is to develop a custom growth curve which reaches buildout by the year 2050, yet limits annual growth to reasonable rates of growth. This custom curve is shown in blue on Figure 1-7 and is defined by the annual growth rates shown in Table 1-5.

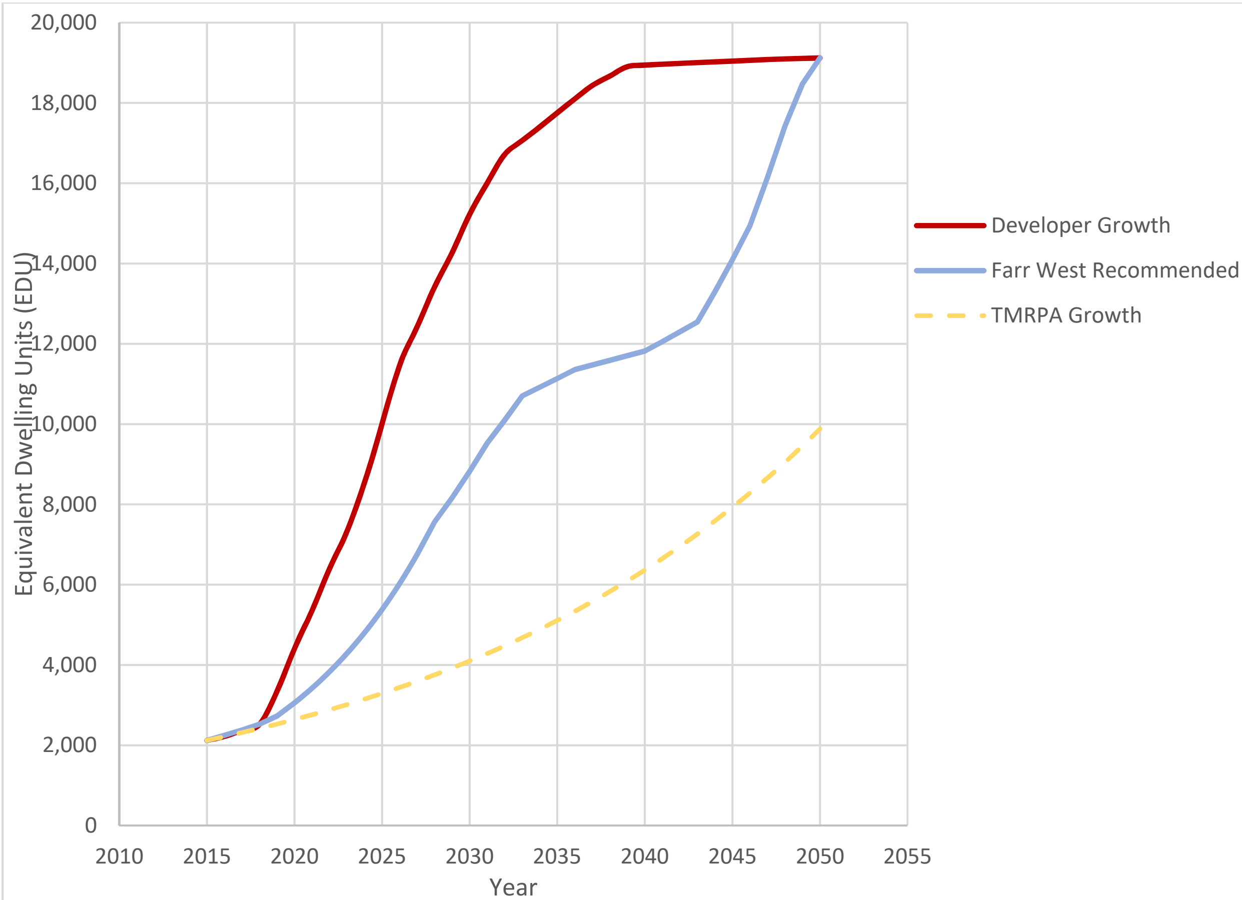

Figure 1-7 – Cold Springs Growth

Table 1-5 – Cold Springs Growth Data

Year	ERU Growth Rate (%)	Units Added	Running Total
Existing	0.0	-	2,120
2016 - 2018	6.0	405	2,525
2019	8.0	202	2,727
2020 - 2028	12.0	4,835	7,562
2029 - 2031	8.0	1,964	9,526
2032 – 2033	6.0	1,177	10,703
2034 – 2036	2.0	432	11,359
2037 - 2040	1.0	461	11,820
2041 - 2043	2.0	723	12,543
2044 - 2046	6.0	2,396	14,939
2047 - 2048	8.0	2,486	17,425
2049	6.0	1,046	18,471
2050	3.5	648	19,119

The annual ERU growth rates were developed upon the following principles:

- Principle 1 - Buildout ERU total must equal 19,119
- Principle 2 - The area shall grow at an extremely high rate of growth over the next 15 years to represent the intentions of regional developers
- Principle 3 - Periods of high growth shall be followed by periods of low growth

The resulting ERU growth estimates at each planning period interval can be found in Table 1-6.

Table 1-6 – Recommended Growth Schedule

Scenario	Residential	Commercial	Total	Running Total
Existing	2,082	38	2,120	2,120
2021	1,301	0	1,301	3,421
2026	2,462	146	2,608	6,029
2036	4,745	585	5,330	11,359
Buildout	6,087	1,673	7,760	**19,119**

The second method which will be used is to base the need for collection system improvement projects off of remaining capacity triggers instead of anticipated dates of capacity exceedance. Coupling this practice with improvement projects which provide modest increases in collection system capacity, the County will be provided the flexibility to adjust to the true growth seen in Cold Springs. This methodology and proposed improvement projects will be further detailed in TMs 3 and 4.

3.5 LIFESTYLE HOMES DEVELOPMENT SCHEDULE

There are six developments which are owned/controlled by Lifestyle Homes in the Cold Springs area. With the exception of the Silver Hills development, all of the future development will be connected to the Cold Springs Collection System in the future. For consistency, all of the future units listed in Table 1-7 are expressed in terms of ERUs, with 1 ERU = 270 gpd per Washoe County Design Standard 2.1.00.2. For instance, if a commercial building or parcel is projected to generate 4,000 gpd, then that connection would be equivalent to 15 ERUs.

Table 1-7 – Lifestyle Homes Development Schedule (ERUs)

Year	Woodland Village	Evans Ranch			Silver Star Ranch	Train Town		Lakefront	Sub Total
	Res	Res	MF	Com	Res	Res	MF	Res	
2015	0	0	0	0	0	0	0	0	0
2016	127	0	0	0	0	0	0	0	127
2017	135	0	0	0	0	0	0	0	135
2018	100	0	0	0	0	0	0	0	100
2019	102	0	0	0	0	0	0	0	100
2020	60	0	0	0	0	40	0	0	100
2021	0	0	0	0	0	22	0	0	22
2022	0	0	0	0	0	50	0	0	50
2023	0	0	0	0	0	75	0	0	75
2024	0	0	0	0	0	100	0	0	100
2025	0	0	0	0	0	325	0	0	325
2026	0	0	0	0	0	425	0	0	425
2027	0	0	0	0	0	263	150	0	413
2028	0	258	0	0	0	0	208	0	466
2029	0	175	0	0	0	0	0	0	175
2030	0	325	0	0	0	0	0	0	325
2031	0	130	0	0	0	0	0	0	375
2032	0	450	0	0	0	0	0	0	130
2033	0	450	0	0	0	0	0	0	450
2034	0	90	0	0	0	0	0	0	90
2035	0	90	0	0	0	0	0	0	90
2036	0	90	0	0	0	0	0	0	90
2037	0	0	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0	0	0
2039	0	50	0	0	0	0	0	0	50
2040	0	90	0	0	0	0	0	0	90
2041	0	200	0	0	0	0	0	0	200
2042	0	200	0	10	0	0	0	0	210
2043	0	225	0	10	0	0	0	0	235
2044	0	500	0	250	0	0	0	0	750
2045	0	500	0	275	0	0	0	0	775
2046	0	731	0	115	0	0	0	0	846
2047	0	750	14	21	400	0	0	0	1185
2048	0	0	290	0	1000	0	0	0	1290
2049	0	0	126	0	200	0	0	0	1046
2050	0	0	20	0	0	0	0	720	20
Totals	522	5,229	450	681	1,600	1,300	358	720	10,860

3.6 STONEGATE DEVELOPMENT SCHEDULE

There are four large parcels to the south of White Lake, which are part of the StoneGate master planned community. The PUD handbook has been submitted to the City of Reno as of July, 2016, and the first home is projected to be built in 2018. Approximately 4,000 homes will be built on the three parcels to the south of U.S. 395 over the next 15 years. The parcel to the north is likely to support a mix of commercial and industrial uses. Table 1-8 provides a development schedule for each phase of the plan according to information supplied by StoneGate and the annual ERU growth recommendation of this TM. As was discussed in Section 3.4, all commercial and industrial estimates were converted to an ERU basis for consistency.

Table 1-8 – StoneGate Development Schedule (ERUs)

Year	Phase 1	Phase 2		Phase 3		Phase 4	Phase 5		North		Sub Total
	Res	Res	Com	Res	Com	Res	Res	MF	Com	Ind	
2015	0	0	0	0	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0	0	0	0
2018	43	0	0	0	0	0	0	0	0	0	43
2019	102	0	0	0	0	0	0	0	0	0	102
2020	227	0	0	0	0	0	0	0	0	0	227
2021	345	0	0	0	0	0	0	0	0	0	345
2022	163	187	0	0	0	0	0	0	0	0	350
2023	0	375	0	0	0	0	0	0	0	0	375
2024	0	405	0	0	0	0	0	0	0	0	405
2025	0	143	99	0	0	0	0	0	0	0	242
2026	0	0	47	164	0	0	0	185	0	0	211
2027	0	0	0	300	0	0	0	135	0	0	300
2028	0	0	0	226	108	0	0	0	0	0	334
2029	0	0	0	0	0	400	0	0	0	0	400
2030	0	0	0	0	0	200	0	100	0	0	300
2031	0	0	0	0	0	0	200	100	0	0	300
2032	0	0	0	0	0	0	300	120	0	0	420
2033	0	0	0	0	0	0	35	0	0	0	35
2034	0	0	0	0	0	0	0	0	50	50	100
2035	0	0	0	0	0	0	0	0	50	50	100
2036	0	0	0	0	0	0	0	0	50	50	100
2037	0	0	0	0	0	0	0	0	51	49	100
2038	0	0	0	0	0	0	0	0	100	0	100
2039	0	0	0	0	0	0	0	0	37	0	37
2040	0	0	0	0	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0	0	0	0	0
2042	0	0	0	0	0	0	0	0	0	0	0
2043	0	0	0	0	0	0	0	0	0	0	0
2044	0	0	0	0	0	0	0	0	0	0	0
2045	0	0	0	0	0	0	0	0	0	0	0
2046	0	0	0	0	0	0	0	0	0	0	0
2047	0	0	0	0	0	0	0	0	0	0	0
2048	0	0	0	0	0	0	0	0	0	0	0
2049	0	0	0	0	0	0	0	0	0	0	0
2050	0	0	0	0	0	0	0	0	0	0	0
Totals	880	1,110	146	690	108	600	535	320	338	199	4,926

3.7 INFILL DEVELOPMENT SCHEDULE

The remaining undeveloped property in Cold Springs can be broken into four groups:

- General Infill
- Bordertown
- Christman 135
- Gardner Commercial

The first group reflects undeveloped parcels spread throughout the existing collection system and is made up of approximately 60 percent zoned for residential use and 40 percent zoned for commercial or industrial uses. At approximately 150 acres, this group has been assigned an ERU count of 470 ERUs.

The second group is for the partially developed Bordertown Casino and RV Resort. In Section 3.3 of the 2002 Plan, the wastewater flow attributable to future Bordertown development plans was estimated. The plan referenced a future commercial estimate of 133 ERUs and a future residential estimate of 171 ERUs. Since the property has not been developed significantly since 2002, these values are still valid estimates of the development potential of the Bordertown property. It is projected that development at Bordertown will commence in 2024 and proceed until the year 2045.

The Christman 135 group refers to a group of parcels at the end of S. Reno Park Blvd which totals approximately 135 acres. The current land zoning is industrial, commercial and single family residential. The projected count for this group is 287 ERUs, with development starting in 2022 and ending in 2036.

The final group is a 90-acre parcel which lies southeast of the intersection of White Lake Parkway and North Virginia St, and an 18 acre parcel to the north of U.S. 395. Both parcels are owned by Gardner Properties, LLC and are currently zoned for commercial development. Due to existing topography on the south parcel, only 50 percent of the parcel will be able to be developed. Using a general commercial wastewater generation rate of 780 gpd/acre, this group has a future potential of 156 ERUs. Development of these parcels is highly unknown and is therefore expected to happen at buildout.

In total, these four groups represent a potential of 1,214 ERUs which can be added to the collection system in the future. The estimated annual development schedule for these undeveloped properties can be found in Table 1-9.

Table 1-9 – Infill Development Schedule (ERUs)

Year	Infill			Bordertown		Christman 135			Gardner Commercial	Sub Total
	Res	Com	Ind	Res	Com	Res	Com	Ind	Com	
2015	0	0	0	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	10	0	0	0	10
2023	0	0	0	0	0	10	0	0	0	10
2024	0	0	0	8	0	2	0	0	0	10
2025	0	0	0	10	0	0	0	0	0	10
2026	0	0	0	10	0	0	0	0	0	10
2027	0	0	0	10	0	0	0	0	0	10
2028	0	0	0	10	0	0	0	0	0	10
2029	0	0	0	10	10	0	10	0	0	30
2030	0	0	0	10	8	0	10	0	0	28
2031	10	0	0	10	1	0	10	0	0	31
2032	10	0	0	10	0	0	2	0	0	22
2033	10	0	49	10	10	0	40	2	0	121
2034	10	0	0	10	0	0	4	0	0	24
2035	10	0	0	10	0	0	8	0	0	28
2036	10	0	0	10	3	0	10	0	0	33
2037	4	0	0	10	0	0	0	0	0	14
2038	5	0	0	10	0	0	0	0	0	15
2039	10	0	0	10	9	0	0	0	0	29
2040	9	0	0	11	7	0	0	0	0	27
2041	0	0	0	2	34	0	0	0	0	36
2042	0	0	0	0	31	0	0	0	0	31
2043	0	0	0	0	11	0	0	0	0	11
2044	0	0	0	0	3	0	0	0	0	3
2045	0	0	0	0	6	0	0	0	0	23
2046	0	0	0	0	0	0	0	0	0	0
2047	0	0	0	0	0	0	0	0	0	10
2048	0	0	0	0	0	0	0	0	0	1
2049	0	0	0	0	0	0	0	0	0	0
2050	0	302	0	0	0	0	0	168	156	626
Totals	88	330	49	171	133	22	94	170	156	1,214

3.8 FUTURE COLLECTION SYSTEM SEWER FLOW ESTIMATES

The existing collection system flows detailed in Section 2.2 plus the recommended development estimates presented in Sections 3.4 through 3.7 provide the basis for estimating future collection system flows at each planning period (i.e. 5-yr, 10-yr, 20-yr, and buildout). Existing collection system flows are derived from the monitored results from the spring of 2015. Future flow estimates at each planning period were developed by multiplying each future interval ERU count (Table 1-6) by 270 gpd/ERU with a peaking factor of 2.0; and adding these values to existing collection system flows. Contributions to collection system flows as a result of future septic to sewer conversions were not included in this analysis. Table 1-10 provides a summary of the ADWF and PHDF estimate for each planning period.

Table 1-10 – Future Sewer Flow Estimates

Scenario	Average Flow (MGD)	Peak Hour Flow (MGD)	Peaking Factor
Existing	0.354	0.779	2.20
2021	0.705	1.482	2.10
2026	1.409	2.890	2.05
2036	2.848	5.768	2.02
Buildout	4.944	9.959	2.01

3.9 CONCLUSIONS

The growth projections presented in this TM indicate that the collection system will expand to approximately 3 times its current number of ERUs by 2026 with average daily flows growing by 5 times over this same period. These values were generated using current County design standards and a reasoned projection of future development in the Cold Springs area. The future ERU count, average day and peak hour flows will be used in subsequent TM's to evaluate capacity restrictions in the collection system and at CSWRF.

TECHNICAL MEMORANDUM #2

WASHOE COUNTY COMMUNITY SERVICES DEPARTMENT

COLD SPRINGS WASTEWATER SYSTEM FACILITY PLAN

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Date: October 4, 2016

Subject: **Technical Memorandum No. 2 – Infrastructure Condition Assessment**

1.0 PURPOSE

This memorandum is an assessment of the condition of the existing infrastructure at the Cold Springs Water Reclamation Facility (CSWRF) and the two major lift stations in the Cold Springs basin, the Woodland Village lift station and the Diamond Peak lift station. A team of four CH2M engineers comprised of mechanical, structural, electrical, and wastewater process disciplines visited CSWRF and the two lift stations on April 28, 2016. Findings from this site visit and an assessment on the general condition of facilities are included herein.

2.0 COLD SPRINGS WATER RECLAMATION FACILITY

2.1 FACILITY HISTORY

The CSWRF was originally constructed in 1996 as a sequencing batch reactor (SBR) facility with an average daily flow capacity of 0.35 million gallons per day (MGD). This original facility consisted of an influent pump station, two 175,000 gallon SBR tanks, a 120,000 gallon aerobic digester, a chlorine contact basin, a sodium hypochlorite feed system, effluent pump station, six rapid infiltration basins (RIBs), and two sludge lagoons. A major plant expansion was constructed in 2004 that increased the plant capacity to 0.7 MGD. This expansion converted the existing SBR into an aerobic digester and added a headworks with screenings and grit removal, an oxidation ditch, two secondary clarifiers, a solids processing building, an in-plant pump station, six additional rapid infiltration basins and an operations building. A process flow diagram and site layout of the facility are included in Appendix B.

2.2 INFLUENT PUMP STATION

The influent pump station receives flow from two different sub-basins in the collection area by way of gravity flow. These basins include the area of the system to the northeast of Rockland Drive and the area at the west end of the system which is pumped into manhole 260722090903 by the Diamond Peak lift station. The pump station is a wet well/drywell configuration containing two 800 gpm pumps in a duty/standby arrangement. The pump station lifts the gravity sewer flow into the headworks channel.

Structure

The uppermost (few) feet of the reinforced concrete wet well at the influent pump station is starting to show concrete deterioration due to hydrogen sulfide gas corrosion. There are no visible signs of reinforcing steel corrosion. Remediation is recommended to prevent corrosion of the reinforcing steel. The steel dry well appears to be in good structural condition.

Pumps and Equipment

The influent pump station contains two vertical centrifugal pumps installed in a 10-foot diameter prefabricated below-grade steel drywell with above-grade access hatch. Each pump is equipped with a 15 hp constant-speed motor, and has a nominal capacity of 800 gpm at 35 feet TDH. Pump suction is drawn from an adjacent 8-foot-diameter precast concrete wetwell. Resilient-seated gate valves, and a spring-and-lever check valve, serve each pump. Piping is ductile iron. Pumps are controlled via a bubbler-type level sensor and control panel. A small duplex air compressor and receiver unit serves the bubbler system. A simplex sump pump with integral float controller conveys nuisance drainage to the wetwell. The drywell is equipped with interior lighting, a blower for ventilation, a heater, and a dehumidifier. The lights and blower are automatically energized when the access hatch is opened.

All components appeared to be in good working order, except the dehumidifier was unplugged and reported to be no longer used. Paint coatings on the structure interior and on equipment were intact and appeared to be in good condition. The station appeared to be well-maintained. Given the age of the pumps, the performance of both the pump and the motor should be tested and verified. If the pump and motor are performing well and continue to be maintained, the pumps may provide service well beyond typical useful life estimates.

The floor of the drywell is approximately 25 feet below grade, with access via a hatch and ladder. Operator entry to the drywell requires confined-space-entry equipment and all associated safety protocol. Access to equipment within the drywell is relatively constrained, and removal or installation of any heavy equipment is by crane through the vertical manway access riser.

2.3 HEADWORKS

The headworks structure is an elevated open channel with an influent sampler, perforated basket spiral screen, vortex grit chamber and grit classifier. The entire system is exposed to the atmosphere and is equipped with freeze protection for the exposed equipment. Both the screens and the grit tank have a peak hydraulic capacity of 4.5 MGD.

Structure

Concrete corrosion due to hydrogen sulfide gas is present at the top of the influent channel upstream of the screens. The corrosion has been limited to the concrete surface and consists of loss of cement and exposed aggregate. There is no visible sign of rebar corrosion. Remediation is recommended to restore the concrete surfaces and protect the reinforcing steel. .

Screen

The perforated basket screen assembly is constructed of stainless steel and appears to be both free of corrosion, and functional. The 1.5 hp drive motor and gearbox were also free of corrosion and functional. The condition of the submerged screen agitator was not observable. Heat tracing and insulation over the spray water line serving the screen assembly appeared to be in a state of repair during the site visit, as portions of the heat tracing were exposed. The ultrasonic level transmitter located at the upstream side of the screen was installed in 2004 – some UV degradation of the housings is evident.

Grit Chamber

The grit chamber, inclusive of the motorized propeller, gearbox, motor, grit pump, and primer system was out of service and electrically disconnected at the time of the assessment, but was not reported to be damaged or otherwise faulty. The gearbox paint coating was in poor condition in several locations, and repainting is recommended. Thermal insulation over the priming lines was degraded and in need of replacement. Associated ductile iron piping appeared to be in good condition.

Grit Classifier

The classifier has minor corrosion, is exposed and subject to frequent freezing causing operational problems, and was out of service for repair at the time of assessment. The classifier was reportedly taken out of service entirely in mid-May 2016. Repair or replacement of the classifier with another functioning unit is recommended in the short term in order to avoid grit buildup in the oxidation ditch and digesters. Long term, it is recommended to add a greater level of freeze protection, either with additional heat tracing or by relocating grit classification into a heated indoor environment that would not be subject to freezing.

Influent Sampling

The automatic influent sampler was not functioning at the time of the site visit, and the operators were reportedly collecting composite samples by hand. This is a labor intensive process that potentially introduces error into the samples themselves. It is recommended that the sampler be repaired or replaced.

Flow Measurement

Influent flow rate is measured by a 16-inch magnetic flow meter located in a below-grade precast concrete vault adjacent to the headworks facility. The measured flow includes the pumped flow from the influent pump station and the flow pumped directly from the Woodland Village lift station. Peak flow measurements at this location reflect pumped flow rates and not system wastewater generation. The meter and piping are functional, but the pipe flanges have areas of heavy corrosion that should be repaired and the paint coating replaced.

2.4 OXIDATION DITCH

The oxidation ditch is a 390 foot long racetrack type channel 32 feet wide and 11 feet deep. The ditch is operated in a way to remove both carbonaceous biochemical oxygen demand (CBOD) and total nitrogen. Nitrogen is removed through the conversion of ammonia to nitrate under aerobic conditions, and conversion of nitrate to nitrogen gas during anoxic conditions. The brush aerators supply both oxygen and motive force for the process water during aerobic conditions. During anoxic conditions, channel velocity is maintained by two submersible mixers that supply the motive force without transferring oxygen to the process water.

Structure

The visible portions of the structure are in good condition.

Aerators

The aeration basin aerators are a horizontal rotary tine type driven by a 60 hp electric motor and belt-driven gearbox. Aerator shafts are supported by pillow block bearings with an automatic grease lubrication system. Hinged fiberglass covers are installed over the aerators to contain the spray that is generated during operation. Aerator function and condition is generally good, except as noted below:

- One gearbox is reported to have failed, but it was replaced and has been operating satisfactorily since.
- The automatic grease lubrication systems do not work well in very cold weather – operators must then manually grease the bearings.

- Three rows of tines are missing from the northernmost aerator shaft (Tag No. ME-300) Replacement of these tines is recommended.
- Many of the fiberglass cover segments have developed cracks that cause the cover to deflect when opened, making inspection difficult and unsafe.

Mixers

Oxidation basin mixers are a guiderail-mounted submersible propeller type, and are retrievable using installed davit cranes. Originally-provided composite propellers developed cracks, and propellers were subsequently replaced with stainless steel units. No ongoing problems with the mixers were reported.

Splitter Box

The oxidation ditch splitter box is a concrete box designed to distribute influent flow from the headworks, return activated sludge (RAS), and In-Plant Pump Station flows to the existing oxidation ditch, and to a future oxidation ditch. The splitter box contains two stainless steel slide gates, and a high-high level switch. No problems with the splitter box were observed or reported.

2.5 Secondary Clarifiers

The CSWRF has two 50-foot diameter center-feed circular secondary clarifiers to separate the biosolids from the plant effluent. The two clarifiers together have a design peak hour capacity of 3.1 MGD, which corresponds to a surface overflow rate of 789 GPD/SF.

Structure

The visible portions of the structures are in good condition.

2.6 RAS/Waste Activated Sludge (WAS) Pump Station

The RAS/WAS pump station contains five total pumps located inside the solids processing building. There are three RAS pumps, each with a capacity of 500 gpm, that convey return sludge from the bottom of the secondary clarifiers to the oxidation ditch splitter box and ultimately back into the biological process. The pump station also contains two 150 gpm WAS pumps that convey waste solids from the bottom of the clarifiers to the aerobic digesters.

2.7 Aerobic Digesters

The CSWRF's aerobic digesters are located in the original SBR constructed in 1996. In the 2004 plant expansion, all three cells of the SBR were converted for use as an aerobic digester, and utilize the original jet aeration system for the SBR. The digesters have a capacity greater than what is required to treat the facility's biosolids. The jet aeration system in particular is oversized, as the oxygen demand of WAS is far lower than raw influent. As a result, the plant operators have decided to forego the use of the jet mixing pumps, and currently operate only the blowers through the jet aerators. This practice uses less energy than operating both the pumps and blowers simultaneously would, but results in a less inefficient transfer of oxygen to the process water. The impacts of this alternative use of the jet aerators will be explored in more depth during the operational assessment in TM#4.

Structure

The visible portions of the structure are in good condition

Jet Mixing Pumps (SBR No. 1 Pump, SBR No. 2 Pump, Digester Pump)

Jet mixing pumps are a vertical centrifugal non-clog type, with integral motor stand. SBR No. 1 Pump and SBR No. 2 Pump have 20 hp motors, while the Digester Pump has a 15 hp motor. Motors are constant-speed. Pumps are located indoors, within the below-grade aerobic digester equipment gallery. Pumps appear to be in good condition and well-maintained, and no existing problems with their condition were observed or reported.

Digester Blowers

Digester blowers are a positive-displacement Roots-type, and are motor-driven via a belt and pulley drive. Blower No. 1 and No. 2 have 30 hp motors, while Blower No. 3 has a 15 hp motor. Motors are constant-speed. Blowers are located indoors, within a dedicated blower room integral to the digester facility. Blowers appear to be in good condition and well-maintained, and no existing problems with their condition were observed or reported. Air piping serving the blowers was observed to have localized areas of paint failure, but minimal corrosion. Repainting is recommended.

SBR Equipment

In addition to the pumps and blowers, the digester also contains equipment typical for an SBR, including floating decanters, jet aeration headers, influent piping, sludge collection manifolds and piping between the individual basins. The visible portions of the piping and the decanter appear to be in good condition. Items that are completely submerged, such and the sludge collector and jet manifold were not inspected. However, the operators did not indicate that any of the SBR equipment had been problematic, and all the equipment was in working order at the time of the site visit.

2.8 EQUALIZATION BASIN AND CHLORINE CONTACT CHAMBER

Downstream of the secondary clarifiers, the plant flow enters a tank that was originally a chlorine contact basin and post-equalization basin for the original SBR. This tank currently serves as a wide spot in the line upstream of the effluent pump station. The original function of the tank as an equalization basin is no longer required with the flow-through process of an oxidation ditch and secondary clarifiers that were installed in 2004. The tank also contains a small chlorine contact chamber and a submersible pump. The pump lifts the water to be reused throughout the plant into the chlorine contact chamber where it is disinfected. The main plant flow is not disinfected and is pumped directly from the equalization basin to the RIBs for disposal.

Structure

The visible portions of the structure are in good condition. The guardwall that is mounted to the top of the basin wall is a few inches short of meeting the code required 3’-6” height.

2.9 EFFLUENT PUMP STATION AND RIBS

The effluent pump station consists of a 6-foot-diameter precast concrete wetwell with two submersible, guiderail-mounted pumps, with 10 hp constant-speed motors. Pumps are configured as duty/standby, and sized to deliver 1,100 gpm of plant effluent to the RIBs. Pump discharge pipes are routed through a below-grade valve vault located immediately adjacent to the wetwell. The pumps were not visible for assessment, but one pump was reported to have been recently replaced, while the other was reported to be original. The pump station ultrasonic level transducer was reported to have been recently replaced. The interior of the wetwell and valve vault were not observed, but no ongoing problems were reported. Replacement is recommended for the original pump in the next few years as it is beyond its expected useful life.

There are twelve RIBs at the facility. The first six RIBs were added when the plant was originally constructed in 1996, and the remaining six were added during the plant expansion in 2004. RIBs 1 and 2 were noted to have slow infiltration rates prior to the 2004 expansion, and were successfully rehabilitated to increase the infiltration rates during the expansion project. The RIBs appear to be in good condition and have sufficient capacity for the disposal of CSWRF effluent. The only issue noted by the operators was that the infiltration rates of RIBs 3 and 4 were significantly lower than the other ten basins. The infiltration capacity of the basins will be investigated in this facility planning process, and results of the investigation will be presented in TM#4.

2.10 SOLIDS DEWATERING AND DISPOSAL

Solids dewatering is accomplished by a centrifuge located in the solids processing building. The centrifuge combines the digested solids pumped from cell #3 of the aerobic digester with a cationic polymer stored in drums inside the building. The centrifuge has a capacity of 125 gpm and dewaters the solids to a thickness of 15%-16%. The dewatered cake is conveyed to a dumpster through a screw conveyor. The 12 CY dumpster is hauled off to a landfill eight to nine times a month.

Centrifuge

The centrifuge has the capacity to dewater 625 lbs of dry solids per hour at a peak flow rate of 125 gpm. The main drive motor is 50 hp, while the backdrive motor is 20 hp. As stated above, the centrifuge dewaters the feed solids to achieve a solids concentration of 15% - 16%. This solids content is significantly lower than the 18% - 22% solids content for the solids cake noted in the specifications for the equipment. We recommend a review of the dewatering polymer and the operational parameters on the centrifuge with the goal of returning the cake solids up closer to the specified ranges.

The flow meter to the centrifuge does not display reliable sludge flow values, and runs continuously, even when no flow is in the pipes. Recalibration or replacement of the flow meter is recommended to correct the erroneous flow readings.

Polymer Pump

The polymer pump is a 120V LMI dosing pump with a maximum flow rate of 4.5 gallons per hour. The pump appears to be in satisfactory condition. The pump was added as part of the 2004 expansion project along with the centrifuge and polymer blend systems. The expected useful life for this type of pump is typically seven to ten years, and replacement is recommended.

Centrifuge Feed Pump

The centrifuge feed pump is a positive-displacement lobe pump equipped with a 7.5 hp variable-speed motor, and belt drive. The pump is located indoors, within the below-grade aerobic digester equipment gallery. The pump appears to be in good condition and well-maintained, and no existing problems with its condition were observed or reported.

Disposal Room

Dewatered biosolids are conveyed from the centrifuge through a screw conveyor into the dewatering room. The biosolids are transferred to a bi-directional conveyor that fills the disposal dumpster in three different points. There is a significant amount of splatter evident on the walls of the room, and was noted by the operators to be a problem. Installing curtains or baffles to reduce splatter is recommended. The conveyors themselves appear to be in good condition.

2.11 In-Plant Pump Station

The in-plant pump station is a submersible pump station with two guiderail-mounted, 5 hp, 545 gpm pumps in a duty/standby arrangement. The station conveys recycle flows from various processes, such as the centrate stream from the centrifuge, back to the oxidation ditch splitter structure. The pumps were not visible for assessment, but no existing problems were reported. The wetwell discharge piping had several areas where the coating had failed, and corrosion at these locations was observed. Guiderails and guiderail brackets appeared to be constructed of stainless steel, and were in good condition. The bracket restraining the PVC level stilling well had significant corrosion. The vertical face of the pump station precast lid opening was severely corroded. The access hatch and safety grating were in good condition.

Pump discharge pipes are routed through a below-grade valve vault located immediately adjacent to the wetwell. Valves and piping within the vault appeared to be in good condition and free of corrosion. The vault access hatch is rated for 300 psf, but appears to have been overloaded at some point, as the lid was deformed and welds holding reinforcing ribs to the lid were cracked and separated. The safety grating below the hatch was in good condition.

2.12 Scum Pump Station

Scum from the secondary clarifiers is routed to the scum pump station for conveyance to the digesters. The scum pump is a 125 gpm, 5 hp, vertical chopper type, with a recirculation system designed to self-clean the wetwell and entrain floatables for removal by the pump. Only the top portion of the pump and wetwell were observed. The interior of the adjacent valve vault was not observed. No existing problems were observed or reported.

2.13 Chemical Systems

The CSWRF uses a small liquid sodium hypochlorite storage and feed system for disinfection of utility water.

Chemical Tank

The sodium hypochlorite tank was originally installed in 1996 and was relocated as part of the 2004 expansion project to an outdoor location adjacent to the chemical pump enclosure. The tank appears to be constructed of polyethylene and is insulated with what appears to be a two-part spray-applied foam. Generally, exposed tanks used for such service should be replaced every 10 years to avoid failure caused by long-term degradation from the hypochlorite. Replacement of this tank is recommended.

Chemical Pumps

Two chemical metering pumps are housed within a prefabricated fiberglass enclosure. The pumps are a 120-volt fractional-horsepower peristaltic type with integral variable-speed controller, and are equipped with a hose failure/leak detection device. The pumps appear to be in good condition, and no existing problems were observed or reported. Not all feed piping was connected at the time of the visit. Corrosion was observed on several segments of electrical conduit, and on the east wall heater, and replacement is recommended for the corroded conduit. The overall condition of the facility is fair to good. Similar to the polymer pump, the useful life for the chemical pumps are seven to ten years. Replacement of the pumps is recommended to be done concurrent with the replacement of the chemical tank.

2.14 Electrical

Overall, the electrical systems at the treatment plant appear to be in good condition. Original construction was done in 1996, with a major upgrade in 2004. Plant staff report no major problems or deficiencies with the electrical distribution, motor controls, HVAC, and lighting systems.

Electrical power is supplied to the plant from Pacific Power Corp. via an overhead line, entering the plant near the main gate. The overhead line transitions to underground and runs to the service transformer located in the yard. Transformer size is not indicated on the exterior and should be verified with the utility. Until verified, the transformer is assumed to be 1000kVA, based on the 1200A service entrance rating.

The 1200A Main Switchboard was installed in 2004 and is in good working condition. This switchboard includes a 1200A main circuit breaker, a 1200A automatic transfer switch, and distribution circuit breakers. The switchboard distributes power to some equipment directly, and also feeds motor control centers MCC-A, MCC-B, and the original plant MCC. This equipment is well maintained and spare or replacement parts are available. The remaining life for this equipment is expected to be another 10 to 20 years.

The original plant MCC was installed in 1996 and houses motor starters for a number of pieces of equipment. This MCC, though a little older, is still well maintained. Replacement parts are available and no ‘problems’ have been reported. This MCC should continue to provide adequate service for another 10 years or more.

MCC-A and MCC-B are located in the Solids Processing Building. Both were installed during the 2004 expansion. These MCCs are in good shape, well maintained, and spare parts are readily available. The remaining life for this equipment is expected to be another 10 to 20 years.

Electrical systems in the Operations Building include a 45kVA low voltage transformer and two distribution panelboards. All systems in the Operations Building appear to be in good shape and should continue to give good service for many years.

General electrical construction around the plant appears to be of good quality and is holding up well. No corrosion problems were observed. Boxes and fittings are intact and secure. Lighting throughout seems adequate and functional. Only a few areas of concern were evident, as listed below.

- Standby Generator: The generator is old and nearing its end of life. The generator is also potentially underrated for anticipated future loads. Recommend continued use of the generator with attention to preventative maintenance. Recommend replacement of the generator if maintenance becomes impractical or when loads are added that exceed the practical capabilities of the unit.
- Headworks Grit equipment disconnected: This may just be ongoing maintenance.
- Freeze protection of the grit classifier. This issue is discussed under the Mechanical sections.
- Unknown/unverified connections between the generator, ATS, main switchboard, and original MCC. Recommend accurately documenting these conductors and routing. An accurate model will be necessary to facilitate the recommended Arc Flash Studies.
- NFPA 820: Existing construction in many areas of the plant does not meet current codes. No action required at this time, but current codes will apply to any significant modifications or upgrades in the future.

- Controls and SCADA: Installed systems are old and proprietary. Staff desires upgrades to a more open system.
- OSHA-compliant Arc Flash Labels do not exist. Current codes require arc flash warning labels for electrical equipment. Recommend performing Arc Flash Hazard studies and applying warning labels to appropriate electrical equipment in accordance with NFPA 70 and OSHA. According to Washoe County, Arc Flash Hazard studies are underway, and labels will be posted in fall 2016.
- Some flexible conduit shows discoloration and embrittlement in exterior areas. These should be dealt with as ongoing maintenance.

2.15 SITE ACCESS

The Cold Springs Water Reclamation Facility was evaluated to determine feasibility of in-plant vehicle access and circulation based on the plant's existing layout. Three vehicle types were evaluated to determine how much of the plant could be accessed.

The first vehicle analyzed was a large car (P) as defined by AASHTO. The dimensions of this vehicle are similar to a typical personal use vehicle such as an average sized pick-up truck or sedan. This vehicle could adequately access all areas of the plant. Figure 1 shows a schematic of this vehicle's path around the plant's facilities.

The second vehicle analyzed was a medium truck (SU-30) as defined by AASHTO. The dimensions of this vehicle are similar to an average sized delivery truck or a large service truck that may need to visit the plant. The medium truck can comfortably access the middle of the plant and travel around all sides of the clarifiers, but access to the western edge of the oxidation ditch and the eastern edge of the pre-treatment facility could be limited. Figure 2 shows a schematic of this vehicle's path through the plant.

The third and final vehicle analyzed was a semitrailer (WB-67) as defined by AASHTO. This is the largest semi-truck and trailer combination that AASHTO defines. A vehicle of this size would only be used for very large deliveries of materials or equipment. It is anticipated that a WB-67 would rarely, if ever, visit the plant. Access to the plant by a WB-67 would be limited to the central corridor between the clarifiers and the pre-treatment facilities. The large open space that has been reserved for the expansion of the biological treatment capacity of the plant can currently be utilized for a turn-around. If this area is utilized in a capacity expansion, a WB-67 will not be able to turn around at the facility without access improvements. Figure 3 shows a schematic of a WB-67 through the plant.

All turning movements analyzed were based on the use of AutoTurn Software developed by Transoft Solutions. Actual turning movements and site constraints will vary depending on vehicle type and driver skill level.

2.16 UTILITY SUPPORT SYSTEMS

Backflow-Protected Potable Water

An air-gap tank and pumping system is installed in the below-grade aerobic digester equipment gallery. The system serves digester mixing pump shaft seal water demand, and consists of a plastic tank with float-type level control, two constant-speed 1/2 hp end-suction booster pumps, a discharge hydropneumatic tank, and associated controls for pressure-based pump operation. The air-gap system is intended to provide the required protection against cross-connection (backflow) between the non-potable seal water system, and the potable water supply system. The system appears to be in fair to good condition. The manner in which the air-gap tank level control is arranged does not comply with current backflow prevention regulations. A section of the potable water system running through the paved area near the influent pump station frequently leaks and has been excavated multiple times for repairs. Additional investigation into the cause of the frequent leaks is recommended.

Plant Utility (Reuse) Water

Plant utility water is provided by a pumping system located in the below-grade aerobic digester equipment gallery. The system provides water for uses such as washdown, equipment spray water, and clarifier spray nozzles. The system draws chlorinated water from the chlorine contact chamber, and consists of a single variable-speed inline multi-stage centrifugal pump, discharge hydropneumatic tank, and associated controls for pressure-based pump operation. The system appears to be in excellent condition. No existing problems were observed or reported.

2.17 ODOR ISSUES AND COMPLAINTS

No odor complaints have been received at the facility in the last several years and no odor issues were observed at the facility during the site visit, nor were any recent issues reported by the operators. A few complaints were received soon after the completion of the 2004 plant expansion, which were related to lengthy air-off periods in the digesters as the operators were optimizing the new process. However, no odor complaints have been received while the digesters have been operating under the current practice of on-off aeration.

3.0 WOODLAND VILLAGE LIFT STATION

The pump station is a wet well/dry well configuration containing two nominal 1,350 gpm pumps in a duty/standby arrangement. The pump station lifts the gravity sewer flow into the CSWRF headworks channel.

3.1 STRUCTURE

No significant structural defects were observed.

3.2 PUMPS AND EQUIPMENT

The Woodland Village Lift Station contains two vertical centrifugal self-priming pumps installed in an 11-foot diameter prefabricated below-grade steel drywell with above-grade access hatch. Each pump is equipped with a 50 hp constant-speed motor (increased from 40 hp as part of 2004 CSWRF Expansion Project), and has a nominal capacity of 1,350 gpm at 83 feet TDH. Pump suction is drawn from an adjacent 10-foot-square precast concrete wetwell. A plug valve and spring-and-lever check valve serves each pump. Piping is ductile iron. Pumps are controlled via a bubbler-type level sensor and control panel. A small duplex air compressor and receiver unit serves the bubbler system. A simplex sump pump with integral float controller conveys nuisance drainage to the wetwell. The drywell is equipped with interior lighting, a blower for ventilation, a heater, and a dehumidifier. The lights and blower are automatically energized when the access hatch is opened.

All components appeared to be in good working order. Paint coatings on the structure interior and on equipment were intact and appeared to be in good condition. The station appeared to be well-maintained.

It was reported that settlement of the dry well caused leaks in the suction piping. The leaks were accessed and repaired from the dry well interior, and flexible rubber bellows were installed between the pump suction nozzles and the suction piping to prevent the shifting pipes from imposing damaging strain on the pumps.

The floor of the drywell is approximately 19 feet below grade, with access via a hatch and ladder. Operator entry to the drywell requires confined-space-entry equipment and all associated safety protocol. Access to equipment within the drywell is relatively constrained, and removal or installation of any heavy equipment is by crane through the vertical manway access riser. In addition, ladder rungs were installed after the original construction and the access hatch is not positioned to allow for safe access to the rungs. Modification of the access provisions to meet IBC and OSHA requirements is recommended.

3.3 Flow Measurement

Pumped flow rate is measured by a 12-inch magnetic flow meter that is adjacent to the lift station. The meter is installed within a 4-foot-diameter, 13-foot-deep, precast concrete vault. The meter and piping are functional, but have areas of light corrosion where the paint coating has failed. Access to the vault is made after removal of a cast iron traffic-rated lid. The opening through the manhole cover is not positioned to allow for safe access to the rungs. Modification of the access provisions to meet IBC and OSHA requirements is recommended.

3.4 Electrical

The lift station is supplied with electrical power from the utility through a pad-mounted transformer. Backup power is from a diesel engine generator, controlled with an automatic transfer switch.

Staff indicated the following concerns:

- The existing flowmeter is error prone, and should be investigated and corrected.
- There is a desire for more and better telemetry from this station.
- The engine generator is 12 or 13 years old, but still serviceable.

The electrical installation is in good shape. No major problems were observed or reported. Ongoing issues are similar to the treatment plant. NFPA code compliance and arc flash labeling need to be addressed.

4.0 DIAMOND PEAK LIFT STATION

The pump station is a wet well/dry well configuration containing two nominal 350 gpm pumps in a duty/standby arrangement. The pump station lifts the gravity sewer flow into manhole 260722090903, just south of CSWRF.

4.1 STRUCTURE

The fabricated steel walls of the entrance tube and dry well both have multiple holes from corrosion. Groundwater or evidence of past groundwater intrusion was observed at these locations. Some holes have been repaired by welding, while many others have not, and exhibit an inward projection from either swelling caused by products of corrosion, pressure from the exterior backfill material, or both. Markings from previous corrosion surveys are evident, indicating widespread thinning of the original steel shells that comprise the entrance tube and dry well. Patch plates should be welded over the existing corrosion locations to restore original steel section.

4.2 PUMPS AND EQUIPMENT

The Diamond Peak Lift Station contains two vertical centrifugal pumps installed in an 8-foot diameter prefabricated below-grade steel drywell with above-grade access hatch. Each pump is equipped with a 30 hp constant-speed motor, and has a nominal capacity of 350 gpm at 140 feet TDH. Pump suction is drawn from an adjacent 6-foot-diameter precast concrete wetwell. A knife gate valve and spring-and-lever check valve serves each pump. Piping is ductile iron. Pumps are controlled via a bubbler-type level sensor and control panel. A small duplex air compressor and receiver unit serves the bubbler system. A simplex sump pump with integral float controller conveys nuisance drainage to the wetwell. The drywell is equipped with interior lighting, a blower for ventilation, a heater, and a dehumidifier. The lights and blower are automatically energized when the access hatch is opened.

The station appeared to be well-maintained, and was functional. The original pumps, pump motors, gate-type isolation valves, and some interior piping were replaced in approximately 2005. One of the check valves was not original. The balance of dry well components appeared to be from the original 1996 construction. Electrical panels originally serving the pumps have been abandoned in place, as pumps are now powered from panels mounted above-grade.

Washoe County has reported that there is a significant amount of volute and impeller wear on the pumps at the Diamond Peak Lift Station. Furthermore, megger readings on the motors indicate that motor condition has deteriorated. As a result, pump and motor replacement is recommended for both pumps.

The floor of the drywell is approximately 24 feet below grade, with access via a hatch and ladder. Operator entry to the drywell requires confined-space-entry equipment and all associated safety protocol. Access to equipment within the drywell is very constrained, and removal or installation of any heavy equipment is by crane through the vertical manway access riser.

4.3 FLOW MEASUREMENT

Pumped flow rate is measured by a 6-inch magnetic flow meter that is within the lift station dry well. The meter and piping are functional, and no existing problems were observed or reported.

4.4 ELECTRICAL

The lift station is supplied with electrical power from the utility through a pad-mounted transformer. Backup power is from a diesel engine generator, controlled with an automatic transfer switch.

Staff indicated the following concerns:

- There is a desire for more and better telemetry from this station.

The electrical installation is in good shape. No major problems were observed or reported. Ongoing issues are similar to the treatment plant. NFPA code compliance and arc flash labeling need to be addressed.

5.0 REMAINING EQUIPMENT USEFUL LIFE

CH2M has estimated the useful life of various types of equipment at CSWRF in accordance with Table 5 - Equipment Life Expectancies in the 2010 *Financial Review Engineering Assessment* prepared for the County. This table has been reproduced in its entirety below.

Table 1-1 – Equipment Life Expectancies

Item	Life Expectancy
Sewage Pumps	15
Effluent/Water Pumps	15
Reinforced Concrete Structures	50
Headworks Screens	15
Collection Sewers-Gravity	50
Collection System Force Mains	35
Effluent Disposal Pipelines	40
Steel Tanks/Structures	40
Earthen Storage Reservoirs	60
Earthen Dams	50
Reinforced Concrete Dams	50
Chemical Pumps	7
Chemical Tanks	10
Blowers	15

Wells	30
Filtration Equipment	15
Power Generation Equipment	20
Electrical Equipment	15
Control System Equipment	10
Buildings	40

Major conclusions on CSWRF's useful life by discipline are included below.

Structural

CSWRF is a fairly new facility, having been originally constructed in 1996 and expanded in 2004. As a result, all of the structures on the site are either 12 or 20 years old, well within the service life expected for structural systems. Recommendations have been made were minor structural deficiencies were observed, but the overall useful life of the facility's structures should extend beyond the facility's planning period.

Electrical

The remaining useful life of the electrical equipment was observed and estimated on an item by item basis, with the estimated remaining life reported individually, above. The estimated life may differ from the expected life based on the table above due to the general condition of the equipment, maintenance practices and availability of spare parts.

Mechanical

The remaining useful life for the mechanical equipment at the facility has been reported in Appendix A. In general, most of the mechanical equipment is nearing or at the end of the useful life based on typical useful life tables. The majority of the mechanical equipment at CSWRF is 12 years old with a general expected life of 15 years. In our opinion, the service life of many classes of mechanical equipment can be extended beyond the anticipated useful life with proper maintenance as long as spare parts are available. For this reason, we have not recommended large scale near-term replacement of mechanical equipment, and have only made replacement recommendations on high wear or less expensive mechanical equipment like chemical and polymer metering pumps. See Appendix A for more information.

6.0 SUMMARY OF RECOMMENDATIONS

A summary of the recommendations made throughout this memo is included in the table below.

Table 1-2 – Summary of Recommendations

Recommendation Number	Description
1	Remediation of influent pump station wet well
2	Test and verify performance of pumps and motors for the influent pumps.
3	Repaint grit chamber gearbox
4	Replace headworks thermal insulation
5	Replace grit classifier
6	Repair or replace influent sampler
7	Repair flow meter vault pipe flanges and repaint
8	Replace missing tines at oxidation ditch Brush Rotor ME-300
9	Repaint air piping near the digester blowers
10	Replace the original pump in the effluent pump station
11	Review dewatering polymer and centrifuge operating parameters to achieve a drier cake.
12	Recalibrate or replace the flow meter to the centrifuge
13	Replace the polymer pump
14	Install new curtains or baffles to reduce sludge splatter in the disposal room
15	Replace the sodium hypochlorite tank
16	Replace corroded chemical electrical conduit
17	Replace the peristaltic chemical metering pumps
18	Replace the standby generator
19	Accurately document the size, number, and routing of major electrical distribution conductors
20	Complete Arc Flash Studies and apply appropriate warning labels to equipment
21	Recommend replacement of the standby engine generator once maintenance becomes impractical
22	Backflow preventer code update
23	Investigate cause of frequent water line leaks in paved area near the influent pump station.
24	Access provisions into the Woodland Village Lift Station dry well and meter vault should be modified to comply with IBC and OSHA standards.
25	Correct source of errors in the Woodland Village Lift Station flow meter
26	Complete Arc Flash labeling at Diamond Peak
27	Complete Arc Flash labeling @ Woodland Village
28	Repair metal manhole wall at corroded locations. Connect cathodic protection system.
29	Install guardrail around the Equalization Basins to meet IBC minimum height requirement.
30	Replace pumps and motors at the Diamond Peak Lift Station

Appendix A

Listing of Major Mechanical Equipment

Table A.1 – CSWRF Major Mechanical Equipment Summary

Equipment Name	Quantity	Capacity	HP	Age	Expected Useful Life	Estimated Remaining Useful Life	Recommended Action / Comments
Influent Pump Station							
Influent Pumps	2	800 gpm	15	20	15	0	Test and verify the performance of both the pump and motor.
Headworks							
Screen	1	4.5 mgd	1.5	12	15	3	
Grit Chamber & Vortex Inducer	1	2.5 mgd	0.75	12	15	3	
Grit Pump	1	250 gpm	0.75	12	15	3	
Grit Classifier	1	250 gpm	1	12	15	0	Unit has failed. Replacement Recommended.
Oxidation Ditch							
Aerators	3	210 lb/hr	60	12	15	3	Replace 3 tine rows at aerator ME-300.
Mixers	2	6.5 hp	6.5	1	15	14	
Secondary Clarifiers							
Clarifier Drive	2	12,100 ft-lbs	0.5	12	15	3	
RAS/WAS Pump Station							
RAS pumps	3	500 gpm	5	12	15	3	
WAS pumps	2	150 gpm	2	12	15	3	
Aerobic Digesters							
Cell 1&2 Blowers	2	784 cfm	30	20	15	0	See Note 1

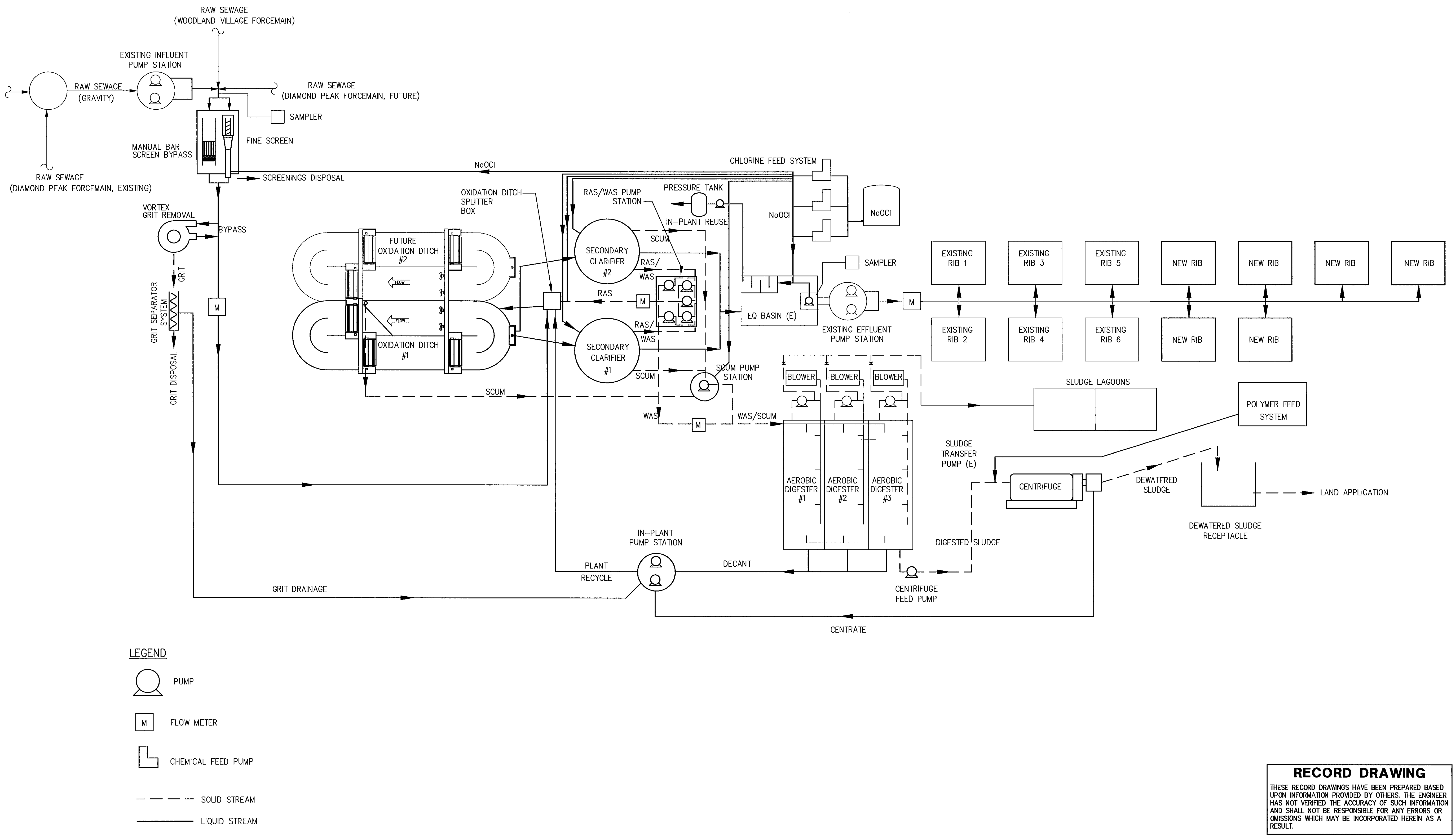
Equipment Name	Quantity	Capacity	HP	Age	Expected Useful Life	Estimated Remaining Useful Life	Recommended Action / Comments
Cell 3 Blower	1	360 cfm	15	20	15	0	See Note 1
Cell 1&2 Mixing Pumps	2	unknown	20	20	15	0	See Note 1
Cell 3 Mixing Pump	1	unknown	15	20	15	0	See Note 1
EQ Basin and Chlorine Contact Chamber							
Utility Water Fill Pump	1	125 gpm	1	12	15	3	
Effluent Pump Station and RIBs							
Effluent Pump	1	1,100 gpm	10	1	15	14	Recently Replaced
Effluent Pump	1	1,100 gpm	10	20	15	0	Replacement Recommended
Solids Dewatering and Disposal							
Centrifuge	1	625 lbs/hr	50	12	15	3	
Polymer Pump	1	4.5 gph	1.5 amps	12	7	0	Replacement recommended
Sludge Conveyors	2	100 ft^3/hr	2-3	12	15	3	
Centrifuge Feed Pump	1	157 gpm	7.5	12	15	3	
In-Plant Pump Station							
Submersible Pumps	2	545 gpm	5	12	15	3	
Scum Pump Station							
Submersible Pump	1	120 gpm	5	12	15	3	

Equipment Name	Quantity	Capacity	HP	Age	Expected Useful Life	Estimated Remaining Useful Life	Recommended Action / Comments
Chemical Systems							
Pump No. 1	1	15 gal/hr	Fractional	12	7	0	Replacement recommended
Pump No. 2	1	0.9 gal/hr	Fractional	12	7	0	Replacement recommended
Chemical Tank	1	unknown	N/A	20	10	0	Replacement recommended
Utility Support Systems							
Seal Water Booster Pumps	2	13 gpm	0.5	12	15	3	Modify suction tank to bring it into compliance with backflow prevention requirements
Utility Water Pump	1	50 gpm	7.5	12	15	3	
Woodland Village Lift Station							
Dry Pit Pumps	2	1350 gpm	50	12	15	3	
Diamond Peak Lift Station							
Dry Pit Pumps	2	350 gpm	30	12	15	3	Replacement recommended

Note 1: The digester mixing pumps and blowers are beyond their anticipated useful life, and should be inspected and verified if they are going to continue to be in service. However, these pieces of equipment were also designed to meet the much higher oxygen demands of an SBR basin receiving influent sludge. This equipment will be evaluated in the operational assessment in TM #4 to determine if there are benefits to retrofitting this equipment with VFDs, or to replacing the equipment with a different system.

Appendix B

Plant Process Schematic



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DRAWN DJR

CHECKED RAB

WASHOE COUNTY DEPARTMENT OF WATER RESOURCES

COLD SPRINGS VALLEY, NEVADA

COLD SPRINGS WRF EXPANSION

Kennedy/Jenks Consultants

5190 Neil Rd. Suite 210, Reno Nevada 89502 (775) 827-7900

SCHEMATIC
PROCESS FLOW DIAGRAM

FILE NAME 037012.10-G6-R

JOB NO. 037012.10

DATE JANUARY 2004

SHEET G6 OF XX

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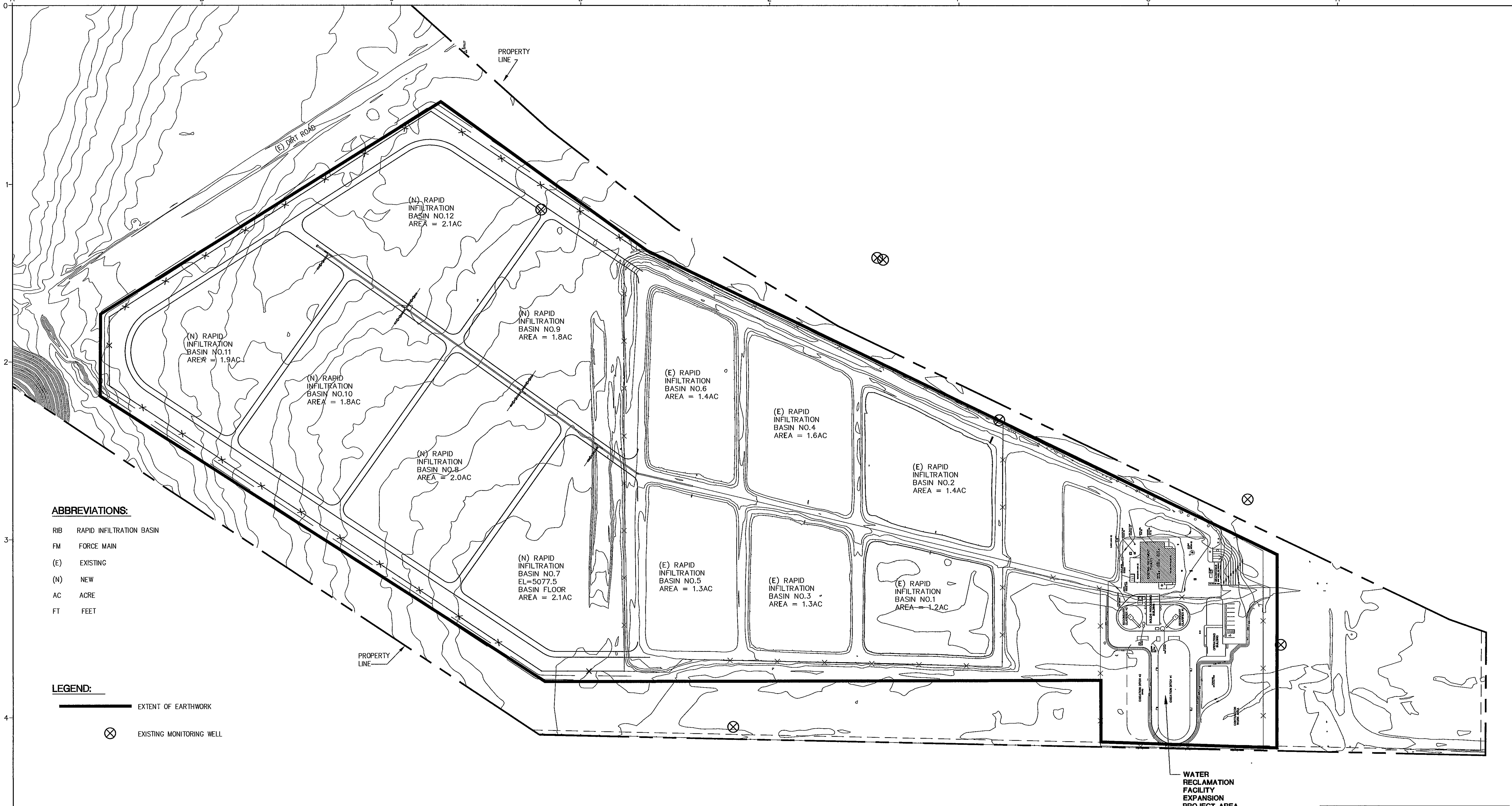

ABBREVIATIONS:

RIB	RAPID INFILTRATION BASIN
FM	FORCE MAIN
(E)	EXISTING
(N)	NEW
AC	ACRE
FT	FEET

LEGEND:

EXTENT OF EARTHWORK

EXISTING MONITORING WELL

NOTES:

1. TOTAL EXTENT OF EARTHWORK IS APPROX. 40 AC.
2. MONITOR WELLS NOT PART OF THIS CONTRACT.
3. EARTHWORK ASSOCIATED WITH RAPID INFILTRATION BASINS NOT PART OF THIS CONTRACT.

PLAN
SCALE: 1"=100'

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WASHOE COUNTY DEPARTMENT OF WATER RESOURCES
COLD SPRINGS VALLEY, NEVADA
COLD SPRINGS WRF EXPANSION

Kennedy/Jenks Consultants
5190 Neil Rd. Suite 210, Reno Nevada 89502 (775) 827-7900

OVERALL SITE PLAN

FILE NAME 037012.10-G8-R
JOB NO. 037012.10
DATE JANUARY 2004
SHEET G8 OF XX

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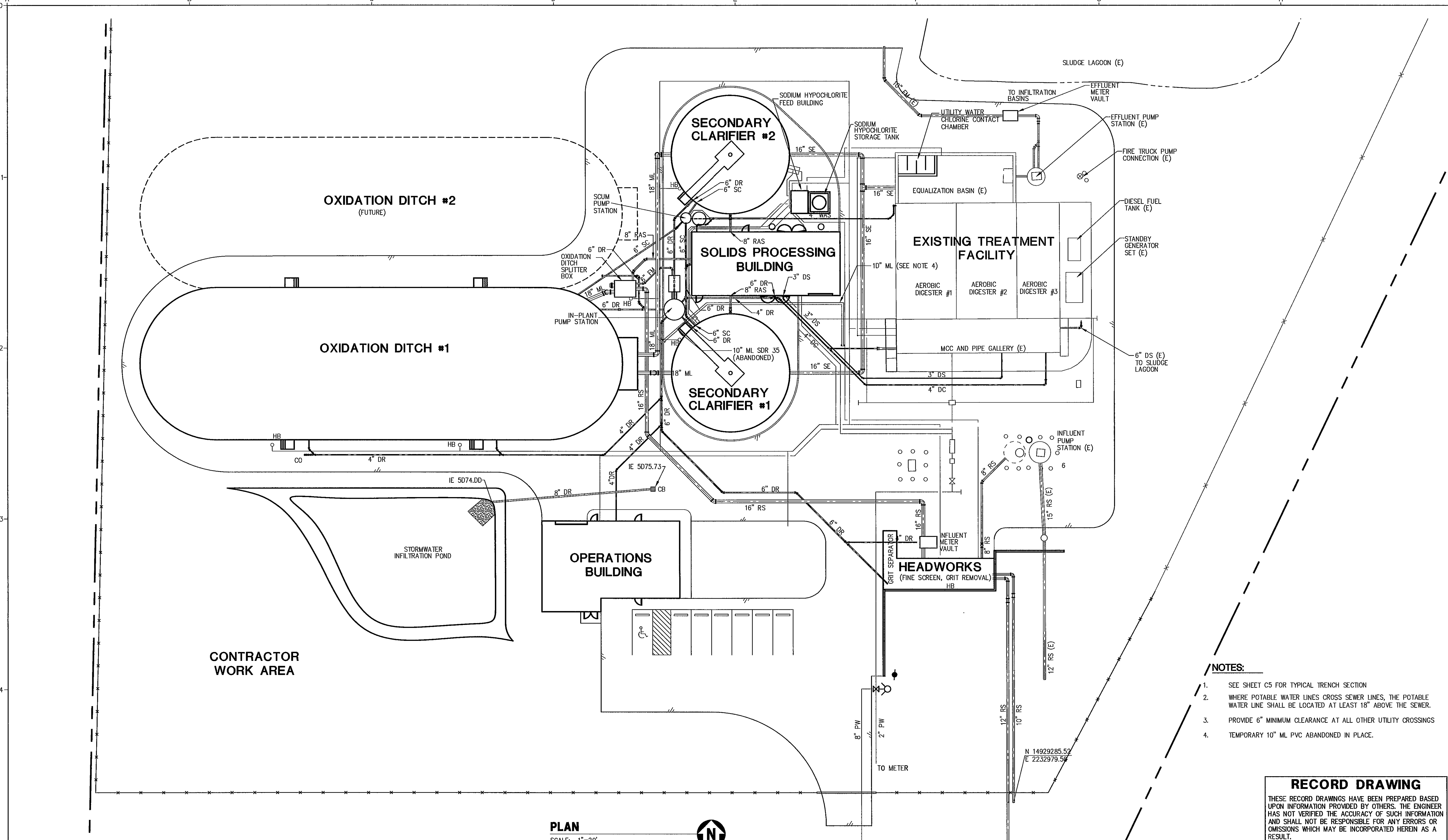

NOTES:

1. SEE SHEET C5 FOR TYPICAL TRENCH SECTION
2. WHERE POTABLE WATER LINES CROSS SEWER LINES, THE POTABLE WATER LINE SHALL BE LOCATED AT LEAST 18" ABOVE THE SEWER.
3. PROVIDE 6" MINIMUM CLEARANCE AT ALL OTHER UTILITY CROSSINGS
4. TEMPORARY 10" ML PVC ABANDONED IN PLACE.

RECORD DRAWING

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COLD SPRINGS VALLEY, NEVADA

COLD SPRINGS WRF EXPANSION

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5190 Neil Rd. Suite 210, Reno Nevada 89502 (775) 827-7900

YARD PROCESS PIPING PLAN

FILE NAME 037012.10-C4-R

JOB NO. D37012.10

DATE JANUARY 2004

SHEET C4 OF XX

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TECHNICAL MEMORANDUM #3

WASHOE COUNTY COMMUNITY SERVICES DEPARTMENT

COLD SPRINGS WASTEWATER SYSTEM FACILITY PLAN

Prepared For:	Alan Jones, P.E., Senior Licensed Engineer
Prepared By:	Lucas Tipton, P.E. Alex Stodtmeister, E.I.
Reviewed By:	Brent Farr, P.E.
Date:	February 17, 2017
Subject:	**Technical Memorandum No. 3 – Hydraulic Model Development and Collection System Capacity Assessment**

1.0 PURPOSE

Farr West Engineering (Farr West) has prepared this Technical Memorandum (TM) to summarize the excess capacity in the Cold Springs sewer collection system in 2016, 2021, 2026, 2036 and 2050. To quantify excess capacity in the System's gravity collection pipes and lift stations, Farr West built a hydraulic model of the collection system and evaluated the performance of the System to collect and convey sewer flows to the Cold Springs Water Reclamation Facility (CSWRF) at each planning period. These performance estimates were developed using 2009 Washoe County Design Criteria, State of Nevada guidance documents and engineering judgment to translate the remaining capacity in the System into a value of equivalent residential units (ERUs) which can be added upstream of each System asset.

2.0 HYDRAULIC MODEL DEVELOPMENT

Utilizing current GIS data provided by the County, Farr West constructed an existing condition hydraulic model using the software application InfoSWMM® by Innovyze®. The existing network of gravity pipes, force mains and lift stations were geospatially located on top of existing land use and customer data for existing sewer flow distribution. A sewer unit load and diurnal curve flow pattern was applied to each existing customer parcel and associated with the nearest existing manhole. Per Section 2.2 of TM #1, the residential unit diurnal curve was developed from flow monitoring data provided by the County. Once completed, the hydraulic model provided ready insight to flow velocity, depth, and rate for the current and future development scenarios.

2.1 SYSTEM ASSETS

The Cold Springs sewer collection system is comprised of two lift stations, one pump station, 11,506 linear feet (lf) of PVC force main pipe, 489 manholes and approximately 113,000 lf of PVC sewer interceptor pipes 8-inches in diameter or greater. Tables 3-1 through 3-4 provide additional detail for the sewer collection system assets.

Table 3-1 – Lift Stations

Woodland Village Lift Station	
Item	**Value**
Storage Type	Precast Concrete Wet Well
Storage Volume (Total)	26,743 Gallons
Storage Volume (Operating)	3,740 Gallons
Storage Dimensions	10’ Square by 35.75’ Deep
On/Off Set Points	On = 10.5’ | Off = 5.5’
Design Flow Rate	1,350 gpm
Design Total Dynamic Head	83 ft
Pump Size	50 Hp
Electrical Service	460V/60Hz/3-Phase
# of Pumps	2
Pump Manufacturer	Myers
Pump Model Number	MSPD8
Pump Type	Self-Priming Centrifugal Pump
Diamond Peak Lift Station	
Storage Type	Precast Concrete Wet Well
Storage Volume (Total)	5,023 Gallons
Storage Volume (Operating)	1,121 Gallons
Storage Dimensions	6’ Diameter by 23.75’ Deep
On/Off Set Points	On = 8.55’ | Off = 3.25’
Design Flow Rate	350 gpm
Design Total Dynamic Head	140 ft
Pump Size	30 Hp
Electrical Service	460V/60Hz/3-Phase
# of Pumps	2
Pump Manufacturer	Yeomans
Pump Model Number	4123C
Pump Type	Self-Priming Centrifugal Pump

Table 3-2 – Influent Pump Station

Item	Value
Storage Type	Precast Concrete Wet Well
Storage Volume (Total)	9,438 Gallons
Storage Volume (Operating)	2,324 Gallons
Storage Dimensions	8' Diameter by 25.1' Deep
On/Off Set Points	On = 9.9' | Off = 3.72'
Design Flow Rate	800 gpm
Design Total Dynamic Head	35 ft
Pump Size	15 Hp
Electrical Service	460V/60Hz/3-Phase
# of Pumps	2
Pump Manufacturer	Vaughan
Pump Model Number	VDP6U8
Pump Type	Self-Priming Centrifugal Pump

Table 3-3 – Manhole Summary

Manhole Depth	Number
< 10 feet deep	346
10 – 15 feet deep	114
15 – 20 feet deep	25
>20 feet deep	4
Total	489

Table 3-4 – Pipe Summary

Item	Quantity
8 Inch Pipe	100,967 lf
10 Inch Pipe	3,681 lf
12 Inch Pipe	6,896 lf
15 Inch Pipe	1,394 lf
Total	112,938 lf

2.2 MODEL CALIBRATION AND ASSUMPTIONS

Farr West used current customer GIS data to locate parcels of current residential and commercial users and applied a unit sewer load of 0.117 gallons per minute (gpm) to a point placed on the centroid for each of those parcels. These point sewer flows or loads were then allocated to the manhole with the nearest distance from the manhole to the centroid. These allocations were then visually verified and modified if a load was associated with an incorrect manhole. Once loads were allocated, a diurnal curve was associated with each load. Farr West used the average system diurnal curve developed in TM #1 (Figure 3-1) for all residential customers and a more generic flow pattern for commercial and industrial customers. Commercial and industrial diurnal curves can be found in Appendix A.

At this point, Farr West ran multiple 24-hour simulations with the hydraulic model and verified average and peak flow modeling results against field data at manholes 260722091054 (Briar gravity system), 260722052911 (Diamond Peak Lift Station), 260722063610 (Woodland Village Lift Station and 260722090901 (Influent Pump Station). Ultimately, Farr West found more than 91% agreement between the modeled values and the flow monitoring results at each location.

Because the flow metering data was derived from Isco area-velocity flow measurement devices, velocity and flow depth data was available for Farr West to calibrate existing system pipe roughness values. Unfortunately, Farr West found that the field recorded values for flow velocity and flow depth at the Diamond Peak, Woodland Village and Briar metering locations suggested inappropriate Manning’s n values for use in the model. However, data from the CSWRF influent manhole or Influent Pump Station confirmed that a Manning’s n value of 0.012 for PVC pipes in the collection system should be used.

Farr West was also able to identify some trouble areas with the hydraulic model and worked with the County to confirm some incorrect elevation data. After multiple iterations of data collection, Farr West and the County eliminated multiple conveyance capacity choke points caused by incorrect physical data. The existing condition hydraulic model is now an excellent representation of the Cold Springs sewer collection system.

3.0 EXISTING SEWER COLLECTION SYSTEM FLOWS

As discussed in Section 2.2, existing system sewer flows were developed from and calibrated against flow monitoring results. Table 3-5 lists the field measured versus hydraulically modeled average daily dry weather flow (ADWF) and Peak Hour Dry Flow (PHDF) for each of the four monitoring locations. Ultimately, there is a minimum agreement of 91% between the average day flow, indicating a model which is well calibrated from a hydraulic loading perspective.

Table 3-5 – Existing Flows vs. Model Results

Location	Measured ADWF (gpm)	Modeled ADWF (gpm)	Measured PHDF (gpm)	Modeled PHDF (gpm)
Woodland Village L.S.	117	129	279	280
Diamond Peak L.S.	58	58	110	127
Briar Gravity System	57	58	152	128
Influent P.S.	130	119	474	478

When comparing the peak hourly flow rates at each site it appears that the model results do not accurately reflect the flow rates measured in the field at some locations. The reason for this is that the diurnal curve was developed on the peak flow and average flow rates of the entire system and not for each sub-area of the System. Looking at Figure 3-1 below, the Weekend Max line, shown in purple, represents the sum of the maximum flow rates at each time interval, at each monitoring location. In other words, the peak hourly flow rate of 541 gpm is really a combination of 279 gpm at Woodland Village, 110 gpm at Diamond Peak, and 152 gpm at the Briar location which occurred at 10:30 am on March 29, 2015. The calculated diurnal curve, shown in blue, was created to accurately represent average daily flows while still meeting peak hourly flows. Since the calculated diurnal curve peaking factor of 2.21 is different from the individual sub area peaking factors, there will be some variation between modeled and measured peak hourly flows at these locations.

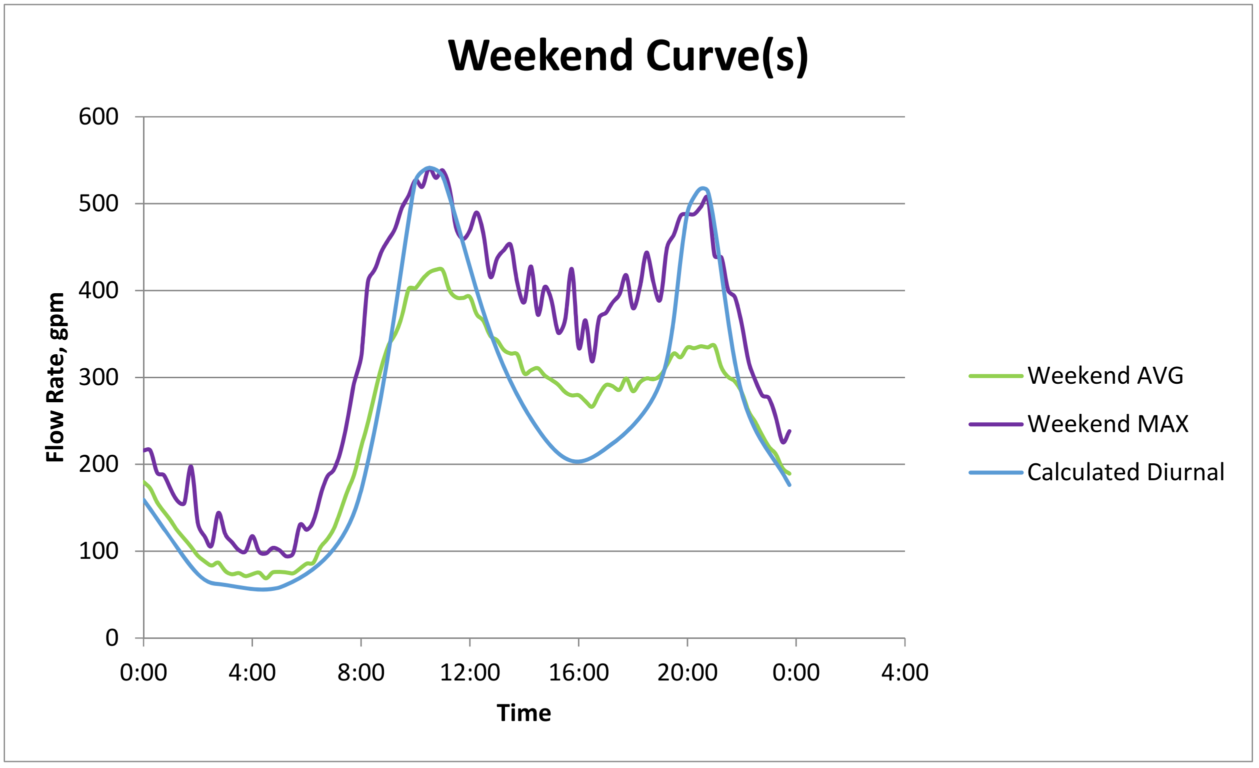


Figure 3-1 – Current Collection System Flow Curves

4.0 CAPACITY CRITERIA

The performance of the System was assessed against three discrete criteria:

1. The maximum depth of flow in System pipes or conduits was assessed against the overall diameter of the pipe. The depth to diameter ratio can be abbreviated as d/D, and the maximum allowable value was set at 0.8 or 80%. This value is equivalent to Washoe County Engineering Design Standard 2.1.02.04. Pipes with a d/D ratio exceeding 80% shall be considered to be "surcharged" pipes and in exceedance of their capacity.

2. Inside of manholes it is common for the surface elevation of the sewer flow to exceed the connected top of pipe elevations during events of high flow. Flow surface elevations which exceed a set distance from the ground surface or rim elevation of the manhole is a metric used to measure the "surcharging" of a manhole. The County has set the manhole

surcharging limit at 0.0’ or rather any manhole which does not “spill” sewer flows onto the ground surface is not considered to be surcharged.

3. The number of times a lift station pump turns on and off in an hour is an operational guidance set forth by the Nevada Division of Environmental Protection (NDEP) Technical Document WTS-14. The document recommends a minimum of 10 minutes between successive starts per hour, which is approximately equivalent to less than 6 starts per hour.

5.0 EXISTING SEWER COLLECTION SYSTEM CAPACITY ASSESSMENT

In the existing flow condition, there are not any pipes or manholes which exceed their capacity criteria as stated above. Further investigation of hydraulic profiles and maximum depths inside upstream and downstream manholes further supports this conclusion. The maximum number of pump starts per hour was determined to be 2, 3, and 3 at the Woodland Village Lift Station, the Diamond Peak Lift Station, and the Influent Pump Station, respectively. These values are well below the recommended limit.

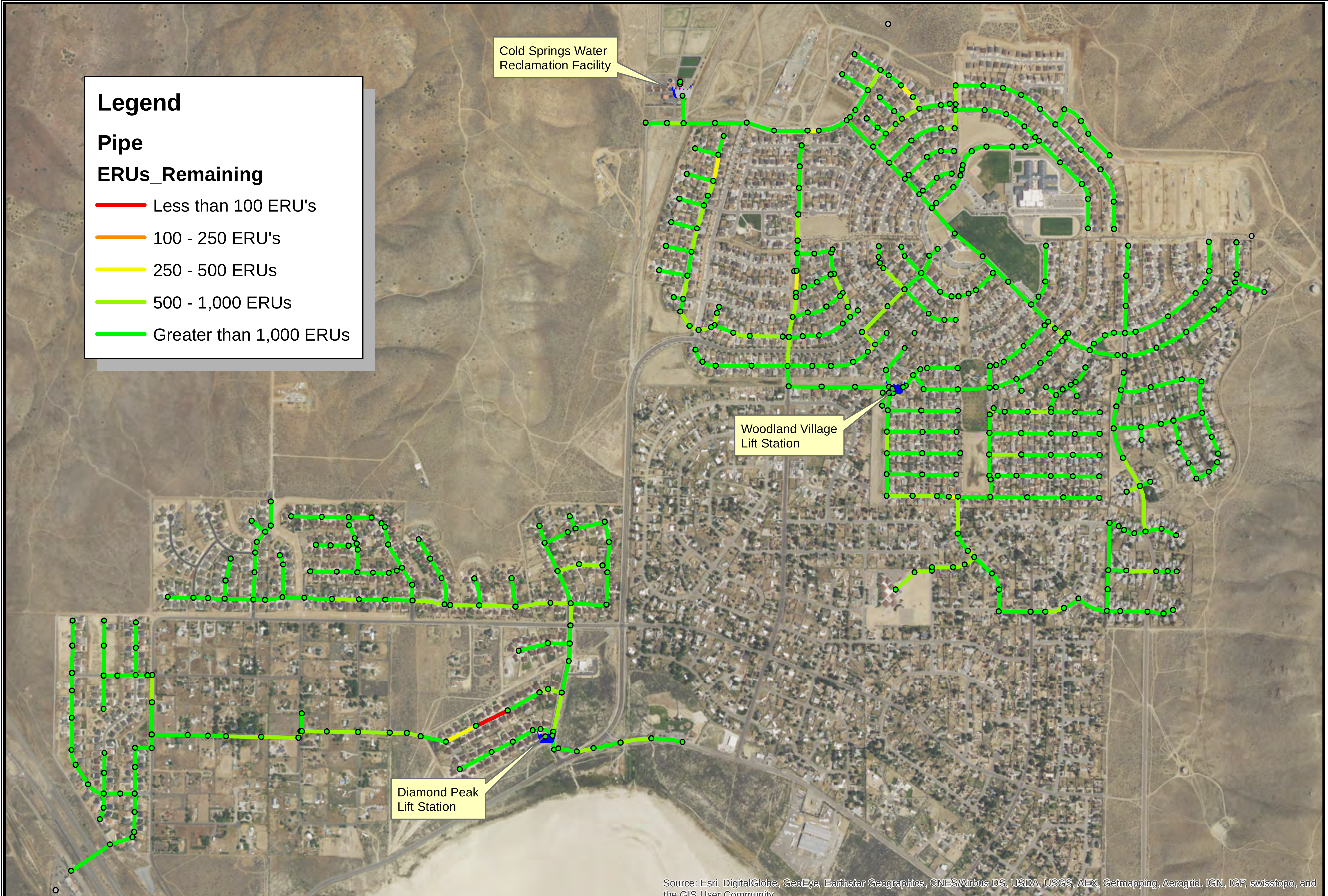
5.1 PIPE AND MANHOLE CAPACITY

The available capacity shown in Table 3-6 and Figure 3 are expressed in terms of ERUs to provide a normalized unit of wastewater generation. For instance, if a commercial building or parcel is found to generate 4,000 gpd then that connection would be equivalent to 15 ERUs. The remaining capacity value for each pipe was derived by taking the difference between the 80% full flow estimate and the maximum existing flow for each pipe, dividing the difference by a peaking factor of 2.0, and finally dividing the resultant by 270 gpd per ERU. Table 3-6 lists the ERUs remaining in 10 pipes with the lowest remaining capacity and Figure 3 provides a color-coded map of the remaining capacity in the system in the existing condition. Because the existing slopes for many of the pipes are extremely flat, much of the System appears to have minimal remaining capacity. This condition does not pose a major problem because little future development will be added to these segments of the System.

Table 3-6 – 10 Pipes with Lowest Remaining Capacity

Pipe ID	Remaining Capacity (ERUs)
262209037	0*
262205087	42
262205086	288
262205093	351
262209116	378
262206098	447
262209054	460
262210022	467
262206119	494
262210656	511

*There are two pipes in the System which had extremely flat slopes (<0.1%) which causes significant disagreement between the two calculation methods used to determine the ERUs remaining. Farr West feels that the flat slope is due to incorrect pipe invert elevation data and not actual field conditions. These pipes were given a remaining ERU capacity of zero until the data can be verified.



FARR WEST ENGINEERING
5510 Longley Lane
Reno, NV 89511
(775) 851-4788
www.farrwestengineering.com

Figure 3-2: Existing System ERU's Remaining

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

P:\Client Projects\Washoe County 086\0981 Cold Springs Wastewater Facility Plan\5.0 Design\5.13 GIS\Map\Cold Springs Capacity.mxd, Editor: alex, Printed: 2/15/2017

5.2 LIFT STATION CAPACITY

Lift station performance was evaluated using a series of engineering calculations in addition to hydraulic model results. Farr West took hourly pump run time reports and evaluated the hourly period with the maximum number of starts. Even though the pump run time graph may show 5 starts during the peak hour, the minimum rest time of each pump in the duplex lift station is greater than what the graph may first indicate. For example, if model results depict a pump running from 9:08 to 9:11 am, running again from 9:31 to 9:34, and another start at 9:50 until 9:53; the actual rest time of Pump #1 is 38 minutes and not 15 minutes. This is because Pump #2 is running during that second start from 9:31 to 9:34am, so Pump #1 is resting for that duration as well as the two rest periods during this time window. Figure 3-2 details the pump run times for the Woodland Village Lift Station during a peak flow period of the existing condition scenario. Table 3-7 also lists key pump statistics for the existing flow condition.

Table 3-7 – Existing Condition Lift/Pump Station Runtime Summary

Location	Max Starts per Pump during Peak Hour	Shortest Rest Period (min)	Longest Run Time (min)
Woodland Village L.S.	2	24	3
Diamond Peak L.S.	3	22	4
Influent P.S.	3	22	5

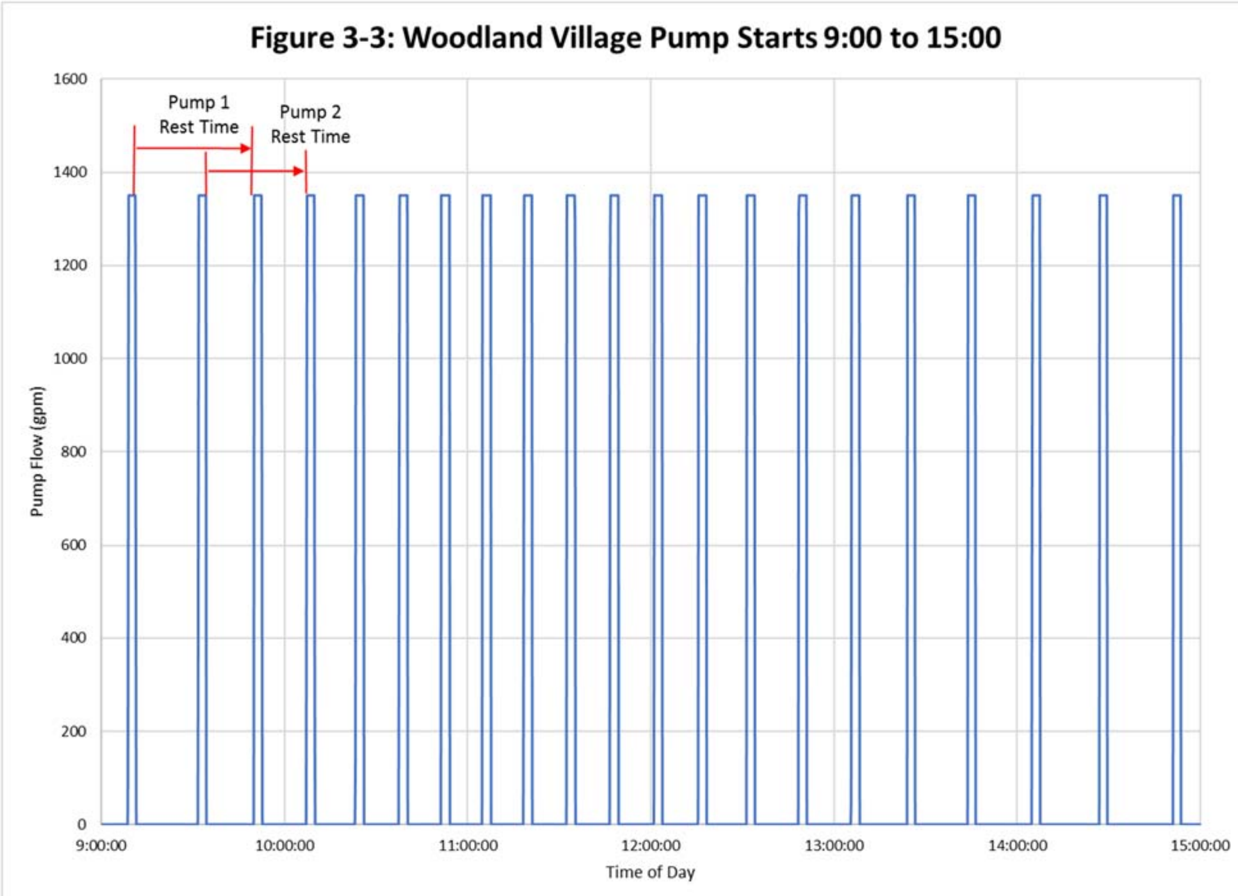


Figure 3-2 – Woodland Village Pump Starts

6.0 FUTURE SEWER COLLECTION SYSTEM FLOWS

To assess system capacity performance at future points in time when sewer flows have increased because of development, Farr West allocated the flow estimates per the development schedule proposed in TM #1 to specific existing manholes around the System. In general, significant development in the Cold Springs area is going to occur to the north and to the south of the existing collection system and a very small amount of these additional flows will be routed through the existing collection system. In fact, developments such as StoneGate, Train Town and others to the south and east of White Lake will require a dedicated lift station and force main which will terminate directly to the CSWRF headworks channel.

Table 3-8 provides a flow rate summary at each planning point for each of the flow monitoring locations highlighted previously. The StoneGate lift station has been added as an observation point and represents a single lift station serving all development in the area.

Table 3-8 – Future System Flows

Location	2021 ADWF* (gpm)	2021 PHDF* (gpm)	2026 ADWF (gpm)	2026 PHDF (gpm)	2036 ADWF (gpm)	2036 PHDF (gpm)	Buildout ADWF (gpm)	Buildout PHDF (gpm)
Woodland Village L.S.	129	280	129	280	129	280	138	296
Diamond Peak L.S.	58	127	63	134	109	219	174	360
Briar Gravity System	156	324	156	324	549	1,086	1,650	2,707
Influent P.S.	217	678	222	678	660	1,515	1,828	3,129
StoneGate L.S.	147	300	478	998	1,088	2,234	1,328	2,699

*ADWF = Average Daily Wastewater Flow

*PHDF = Peak Hour Dry Weather Flow

6.1 2021 SEWER COLLECTION SYSTEM CAPACITY ASSESSMENT

In the 2021 flow condition, there are not any pipes or manholes which exceed their capacity criteria as defined in Section 4.0. Further investigation of hydraulic profiles and maximum depths inside upstream and downstream manholes further supports this conclusion. The maximum number of pump starts per hour was determined to be 2, 3, and 3 at the Woodland Village Lift Station, the Diamond Peak Lift Station, and the Influent Pump Station, respectively. These values are well below the recommended limit.

6.1.1 PIPE AND MANHOLE CAPACITY

The available capacity shown in Table 3-9 and Figure 3-3 are expressed in terms of ERUs to provide a normalized unit of wastewater generation. Table 3-9 lists the ERUs remaining in the 10 pipes with the lowest remaining capacity and Figure 3-3 provides a color-coded map of the remaining capacity in the system at this planning point.

Table 3-9 – Remaining Capacity of Key Pipes in 2021

Pipe ID	Remaining Capacity (ERUs)
262209116	0*
262209037	0*
262205087	42
262205086	287
262205093	352
262206098	447
262209054	460
262210022	467
262206119	494
262210656	511

*There are two pipes in the System which had extremely flat slopes (<0.1%) which causes significant disagreement between the two calculation methods used to determine the ERUs remaining. Farr West feels that the flat slope is due to incorrect pipe invert elevation data and not actual field conditions. These pipes were given a remaining ERU capacity of zero until the data can be verified.

6.1.2 LIFT STATION CAPACITY

Lift station performance was evaluated using a series of engineering calculations in addition to hydraulic model results. In summary, existing lift station performance is adequate for this flow condition as shown in Table 3-10.

Table 3-10 – 2021 Lift/Pump Station Runtime Summary

Location	Max Starts per Pump during Peak Hour	Shortest Rest Period (min)	Longest Run Time (min)
Woodland Village L.S.	2	24	3
Diamond Peak L.S.	3	22	4
Influent P.S.	2	22	8

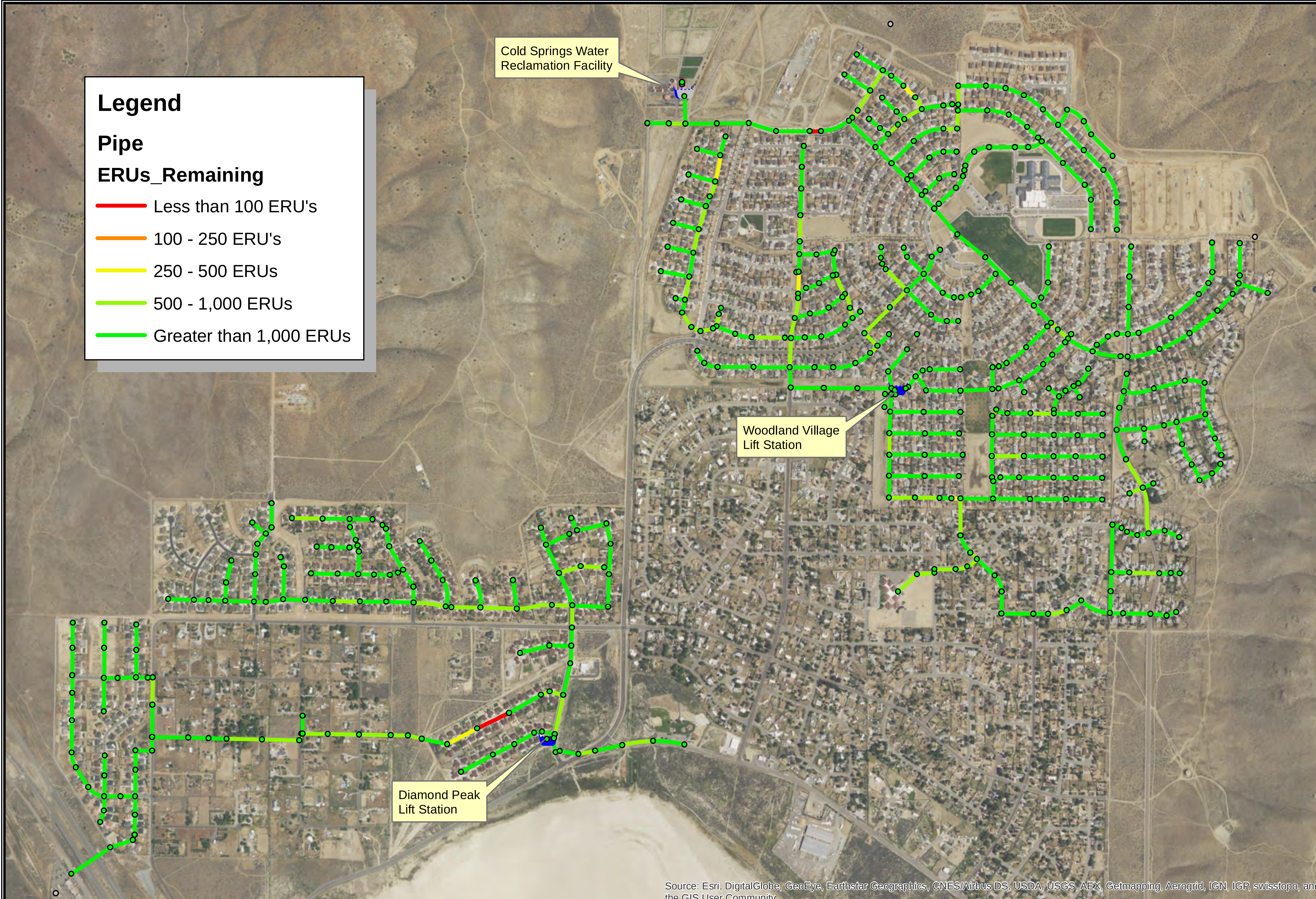


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Figure 3-4: 2021 System ERU's Remaining

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6.2 2026 SEWER COLLECTION SYSTEM CAPACITY ASSESSMENT

In the 2026 flow condition, there are not any pipes or manholes which exceed their capacity criteria as defined in Section 4.0. Further investigation of hydraulic profiles and maximum depths inside upstream and downstream manholes further supports this conclusion. The maximum number of pump starts per hour was determined to be 3, 3, and 3 at the Woodland Village Lift Station, the Diamond Peak Lift Station, and the Influent Pump Station, respectively. These values are well below the recommended limit.

6.2.1 PIPE AND MANHOLE CAPACITY

The available capacity shown in Table 3-11 and Figure 3-4 are expressed in terms of ERUs to provide a normalized unit of wastewater generation. Table 3-11 lists the ERUs remaining in 10 pipes with lowest remaining capacity and Figure 3-4 provides a color-coded map of the remaining capacity in the system at this planning point.

Table 3-11 – Remaining Capacity of Key Pipes in 2026

Pipe ID	Remaining Capacity (ERUs)
262209116	0*
262209037	0*
262205087	21
262205086	297
262205093	331
262210033	387
262206098	447
262209054	460
262210022	467
262210032	471

*There are two pipes in the System which had extremely flat slopes (<0.1%) which causes significant disagreement between the two calculation methods used to determine the ERUs remaining. Farr West feels that the flat slope is due to incorrect pipe invert elevation data and not actual field conditions. These pipes were given a remaining ERU capacity of zero until the data can be verified.

6.2.2 LIFT STATION CAPACITY

Lift station performance was evaluated using a series of engineering calculations in addition to hydraulic model results. In summary, existing lift station performance is adequate for this flow condition as shown in Table 3-12.

Table 3-12 – 2026 Lift/Pump Station Runtime Summary

Location	Max Starts per Pump during Peak Hour	Shortest Rest Period (min)	Longest Run Time (min)
Woodland Village L.S.	3	24	3
Diamond Peak L.S.	3	21	4
Influent P.S.	3	18	8

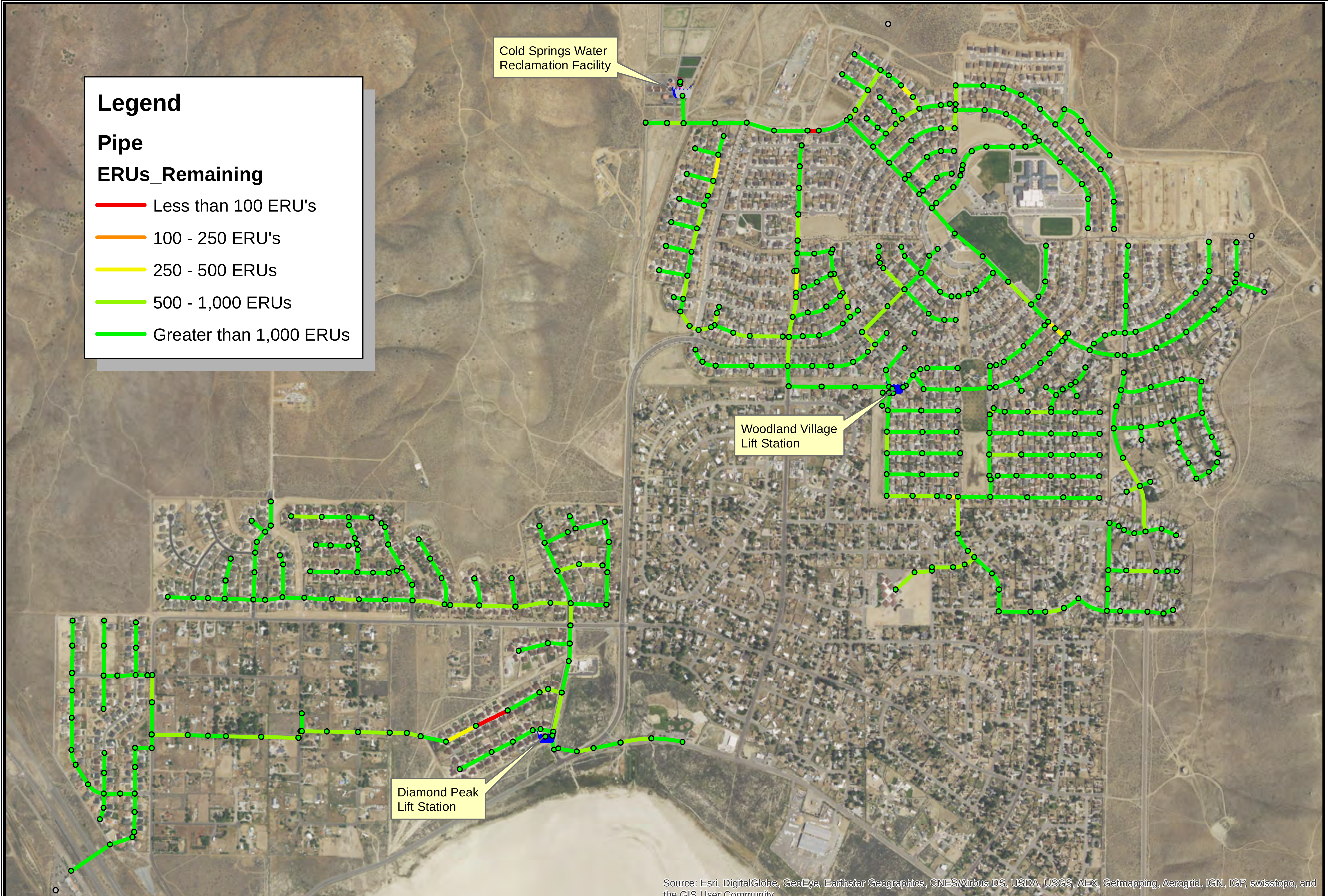

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Figure 3-5: 2026 System ERU's Remaining

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6.3 2036 SEWER COLLECTION SYSTEM CAPACITY ASSESSMENT

In the 2036 flow condition, there are two areas which exceed pipe capacity criteria and the Influent Pump Station is no longer capable of meeting the flow conveyance requirements of the 2036 peak hourly flows. Sections 6.3.1 and 6.3.2 will provide additional detail regarding these problem areas with Section 6.3.3 providing a capacity improvement recommendation for each exceedance. The maximum number of pump starts per hour was determined to be 2 and 3 at the Woodland Village Lift Station and the Diamond Peak Lift Station, respectively.

6.3.1 PIPE AND MANHOLE CAPACITY

There are two areas in the gravity collection system which exceed a d/D relationship of 0.8 during peak hourly flows. The first area is slightly upstream of the Diamond Peak Lift Station on Glen Lakes Ct. and is shown on Figure 3-5. Engineering analysis found that four existing 8-inch diameter pipes exceed a maximum flow depth of 6.5-inches during the peak hour. The primary development which can be attributed to this exceedance is the development at Bordertown, which adds more than 130 ERUs.

The other area which exceeds the pipe conveyance capacity criteria is near CSWRF on Briar Dr. Currently there is a mix of 8, 10, and 12-inch diameter pipe which collect flows from the north end of Woodland Village and convey flows to CSWRF via gravity. The number of pipes which need improvement are six pipes on Briar Dr. and the one pipe which flows into the Influent Pump Station at CSWRF. These system capacity problems can be directly associated with the Evans Ranch and Silver Star Ranch developments to the north.

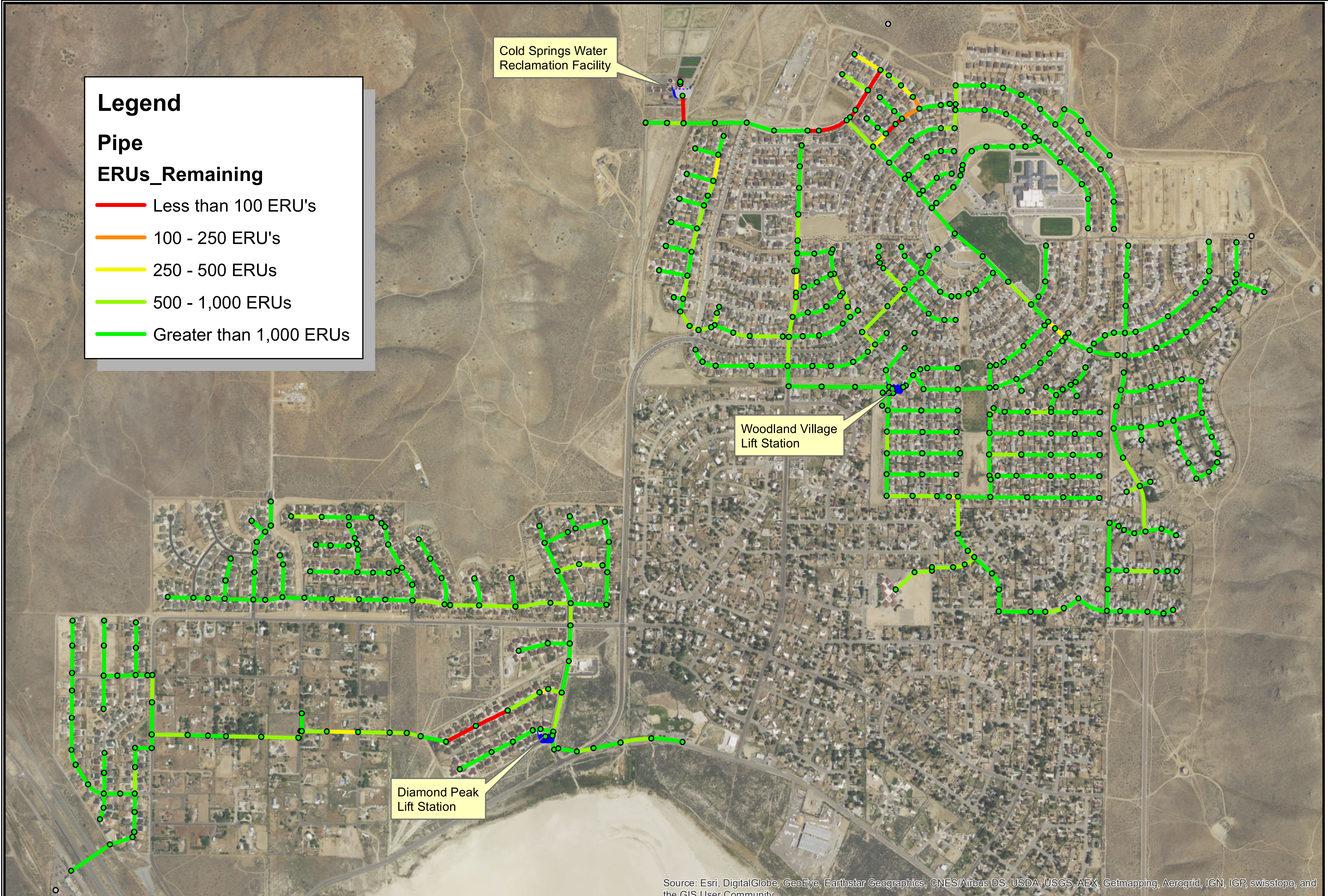

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Figure 3-6: 2036 System ERU's Remaining

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Figure 3-7: Glen Lakes Ct. Improvements

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Figure 3-8: Briar Dr. Improvements

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6.3.2 LIFT STATION CAPACITY

Lift station performance was evaluated using a series of engineering calculations in addition to hydraulic model results. While the Woodland Village and Diamond Peak Lift Stations performed in accordance with WTS-14, the Influent Pump Station and wet well were unable to meet the conveyance demands of the 2036 flow scenario. Table 3-13 provides some key performance statistics for each lift/pump station for this flow condition.

Table 3-13 – 2036 Lift/Pump Station Runtime Summary

Location	Max Starts per Pump during Peak Hour	Shortest Rest Period (min)	Longest Run Time (min)
Woodland Village L.S.	2	24	3
Diamond Peak L.S.	3	15	6
Influent P.S.	2	15	487

6.3.3 PROPOSED IMPROVEMENT PROJECTS

Glen Lakes Ct.

Engineering analysis has identified four existing 8-inch diameter pipes which exceed a d/D relationship of 0.8 at either the midpoint or end of the pipe during this 24-hour flow scenario because of extremely flat slopes. If the existing pipes are upsized to 10-inches in diameter, this capacity exceedance is eliminated. However, these pipes once again experience a capacity violation in the Buildout scenario even with the upsizing to 10-inch. Therefore, Farr West recommends that the five pipes and six manholes shown on Figure 3-5 be replaced and regraded to increase slopes for future conveyance. Once this section of the System is replaced with 10-inch pipe and regraded, the improvements will be adequately sized for the 2036 flow scenario and the Buildout flow scenario.

Briar Dr.

As discussed in Section 6.3.1, the flow conveyance capacity of the existing gravity pipes in Briar Dr. will be exceeded in the 2036 flow scenario. If the seven pipes highlighted on Figure 3-6 are replaced with new 18-inch diameter PVC pipe at the existing grade, the System will be appropriately sized to convey peak hour flows in 2036. If these areas are not upsized there are additional upstream portions of the collection system which will exceed the 0.8 d/D criteria. Once this section of the System is replaced with 18-inch pipe, the improvements will be adequately sized for the 2036 flow scenario and the Buildout flow scenario.

Influent Pump Station

With an existing wet well volume of 2,324 gallons and a duplex pump station capable of 800 gpm, the Influent Lift Station will operate for up to 8 hours continuously during peak flow periods. Preliminary calculations and model results indicate that the pump station should be equipped with two 2,700 gpm pumps and the wet well upsized to 6,600 gallons. An alternative improvement project would be to add a second duplex pump station adjacent to the existing one with a capacity of 1,800 gpm and a wet well volume of 4,400 gallons.

6.4 BUILDOUT SEWER COLLECTION SYSTEM CAPACITY ASSESSMENT

Finally, in the Buildout flow condition we evaluated the performance of the collection system at an average daily flow of 4.94 million gallons per day (mgd) and a peak hourly flow of 9.96 mgd. While no single portion of the System will be required to convey these flow rates, there are additional infrastructure improvements required to meet the set capacity criteria at these flow rates. These improvements are located in similar areas to those which were inadequate in the 2036 flow condition. Even though the Influent Pump Station will require an additional upgrade, the maximum number of pump starts per hour at the Woodland Village and Diamond Peak Lift Stations was determined to be acceptable at 3 and 3, respectively. Figure 3-8 provides a color-coded map of the remaining capacity in System pipes after Buildout.

6.4.1 PIPE AND MANHOLE CAPACITY

There are two areas in the gravity collection system which exceed a d/D relationship of 0.8 during peak hourly flows. The first area is directly upstream of the Diamond Peak Lift Station on Diamond Peak Dr. and is shown on Figure 3-9. Three pipes between the lift station and Glen Lakes Dr. will need to be increased from 8-inches in diameter to 10-inches in diameter. Like the 2036 Scenario, the primary development which can be attributed to this exceedance is Bordertown.

The other area which exceeds the pipe conveyance capacity criteria are the two 15-inch interceptors which gravity flow into CSWRF. If the pipes identified in the 2036 flow scenario are upsized to 18-inches in diameter there will only be another six pipes which will require improvement to 18-inches. These system capacity problems can be directly associated with Bordertown, Evans Ranch, Silver Star Ranch, and infill development.

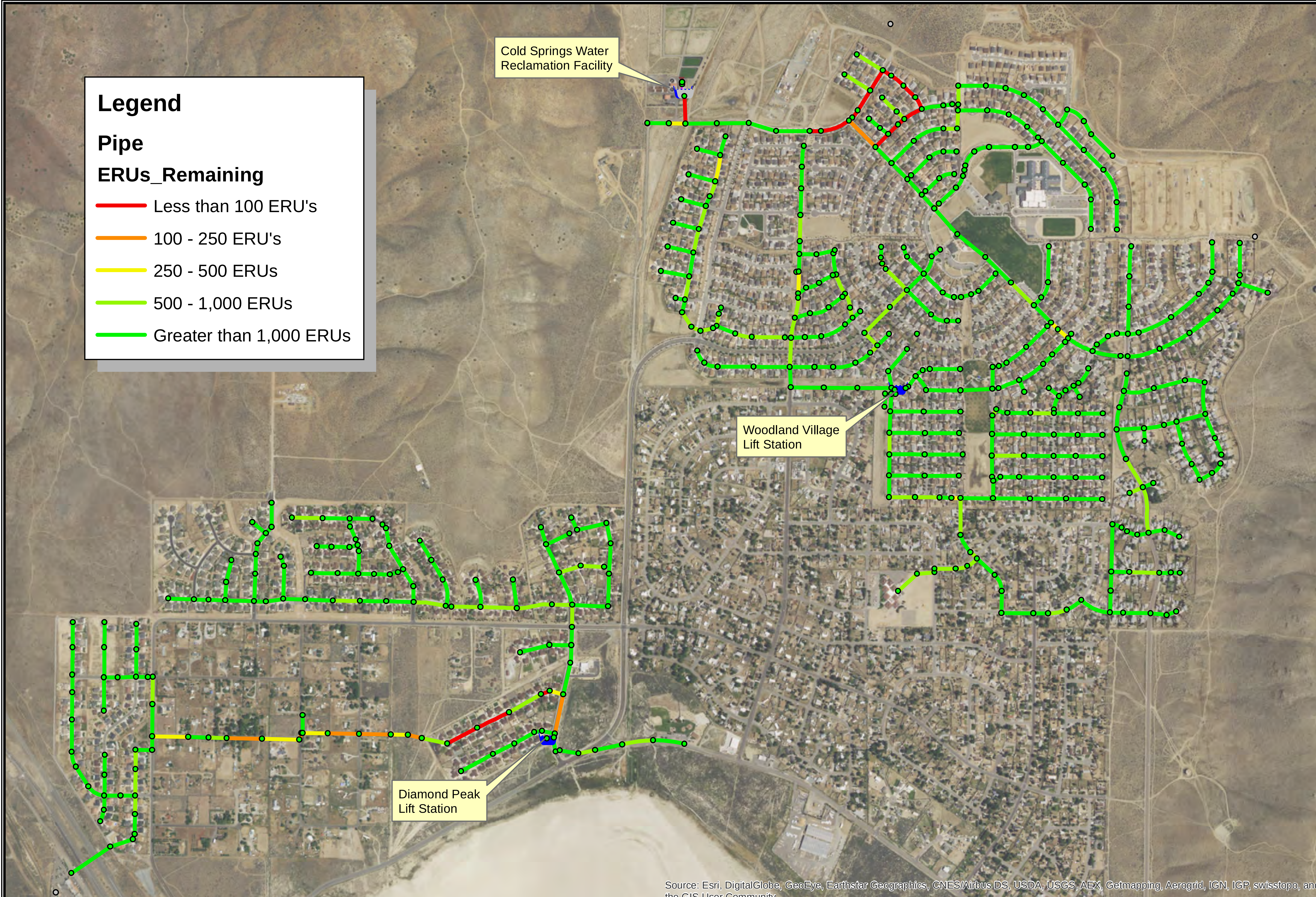

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Figure 3-9: 2050 System ERU's Remaining

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Figure 3-10: Diamond Peak Dr. Improvements

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Figure 3-11: Briar Dr. Buildout Improvements

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

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6.4.2 LIFT STATION CAPACITY

The Woodland Village and Diamond Peak Lift Stations performed in accordance with WTS-14, as shown in Table 3-14. The values associated with the Influent Pump Station are relative to the existing duplex lift station with a capacity of 800 gpm and not the improvement recommendations made under the 2036 flow scenario.

Table 3-14 – Buildout Lift/Pump Station Runtime Summary

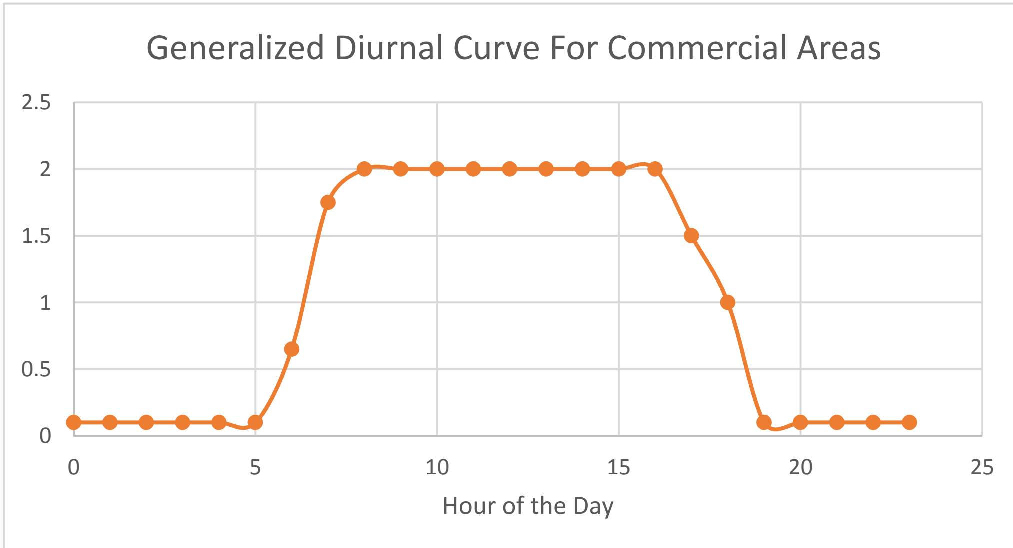
Location	Max Starts per Pump during Peak Hour	Shortest Rest Period (min)	Longest Run Time (min)
Woodland Village L.S.	3	23	3
Diamond Peak L.S.	3	15	19
Influent P.S.	2	19	1,050

The Influent Pump Station will require another upgrade project to accommodate an average influent flow rate of 1,829 gpm and peak flow rate of 3,658 gpm. These flow rates would require a single pump station capable of more than 7,300 gpm and a wet well volume of 18,500 gallons, or an additional duplex pump station with a capacity of 4,700 gpm and a wet well volume of 11,700 gallons to the improvements suggested in the 2036 flow condition assessment.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Future improvement projects are projected to be needed far in the future. It is not recommended for the County to include these projects in their current CIP. Therefore, detailed project quantity estimates or opinions of probable costs were not developed for these projects. It is recommended that the County revisit this facility plan within 7 years to re-assess the suggested time frames proposed in this document. More important than the remaining capacity assessments made at each future flow condition is the actual construction sequencing of new homes and businesses in and around Cold Springs. For instance, if the Evans Ranch PUD starts adding new connections before 2026, then the improvement projects driven by the 2036 and Buildout scenarios will be required much sooner than projected. It is recommended that the County reference this report with all community development applications as they come in.

Appendix A



Generalized Diurnal Curve For Commercial Areas
2.5
2
1.5
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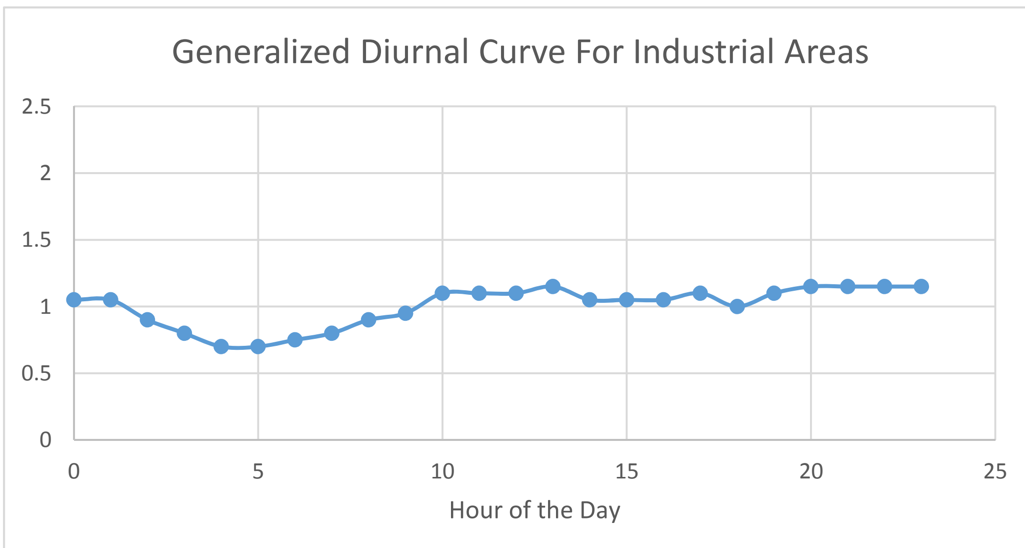
10
15
20
25
Hour of the Day



Generalized Diurnal Curve For Industrial Areas
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2
1.5
1
0.5
0
0
5
10
15
20
25
Hour of the Day

TECHNICAL MEMORANDUM #4

WASHOE COUNTY COMMUNITY SERVICES DEPARTMENT

COLD SPRINGS WASTEWATER SYSTEM FACILITY PLAN

Prepared For: Alan Jones, P.E., Senior Licensed Engineer

Prepared By: Paul Steele, P.E.
William Leaf
Nate Adams

Reviewed By: Jerry Dehn, P.E.
Brent Farr, P.E.

Date: February 1, 2017

Subject: **Final Technical Memorandum No. 4 – Treatment Plant Capacity Analysis and Operational Assessment**

1.0 PURPOSE

The primary objectives of this task are to determine the capacity of the Cold Springs Water Reclamation Facility (CSWRF) to convey, treat and dispose of wastewater generated in the Cold Springs Basin, and to evaluate the current operational practices of the facility to determine if there are any opportunities to reduce chemical or energy use or improve the treatment performance of the facility.

2.0 INTRODUCTION AND BACKGROUND

The CSWRF was originally constructed in 1996 as a sequencing batch reactor (SBR) facility with a design average daily flow capacity of 0.35 million gallons per day (MGD). This original facility consisted of an influent pump station, two 175,000-gallon SBR tanks, a 120,000-gallon aerobic digester, a chlorine contact basin, a sodium hypochlorite feed system, effluent pump station, six rapid infiltration basins (RIBs), and two sludge lagoons. A major plant expansion was constructed in 2004 that increased the design average daily flow capacity to 0.7 MGD. This expansion converted the existing SBR into an aerobic digester and added a headworks with screenings and grit removal, an oxidation ditch, two secondary clarifiers, a solids processing building, an in-plant pump station, six additional rapid infiltration basins and an operations building. A plant schematic from the record drawings of the 2004 plant expansion is shown in Figure 4-1.

CSWRF currently treats an average daily flow of approximately 0.3 MGD, which is less than half of the facility's permitted capacity of 0.7 MGD. In addition, the 2004 expansion project included provisions for a second oxidation ditch to bring the total capacity of the facility to 1.2 MGD. Based on growth projections outlined in TM #1, CSWRF is projected to exceed the permitted treatment capacity in 2021, with a projected build-out flow rate of 4.9 MGD.

3.0 HYDRAULIC CAPACITY ANALYSIS

Hydraulic models have been prepared for the gravity flow through the facility, as well as the influent, effluent and return activated sludge (RAS) pumping stations. The gravity flow stream from the headworks channel to the effluent pump station was evaluated with CH2M's WinHYDRO hydraulic modeling software for gravity flow. Hydraulics for the influent pump station, the effluent pump station to the rapid infiltration basins (RIBs) and the RAS pump station were modeled in AFT Fathom. Output from the individual hydraulic models are included in Appendix A.

3.1 CSWRF FLOW PROJECTIONS

CH2M reviewed daily influent flow records at the facility from 2010 to 2015 to develop peaking factors for the facility for max month and peak day flow. From this data set, the annual average, maximum month, maximum week and peak day flow was determined from the data for each year. The factors in the table below are the averages of the calculated factors for each of the years in the data set. The peaking factor relating peak hour flow to average annual flow was developed during the collection system modelling efforts. The peak hour factor decreases towards 2.0 as the system grows. The peaking factors are shown in Table 4-1. These factors will be utilized to assess both the hydraulic and treatment capacities of the plant as appropriate. Table 4-2 is an expansion of Table 1-8 from TM #1 that utilizes these peaking factors to generate projected flow conditions.

Table 4-1 – CSWRF Peaking Factors

Parameter	Peaking Factor
Maximum Month Flow	1.08
Maximum Week Flow	1.16
Peak Day Flow	1.54
Peak Hour Flow	~2.0

Figure 4-1 – Cold Springs WRF Plant Schematic

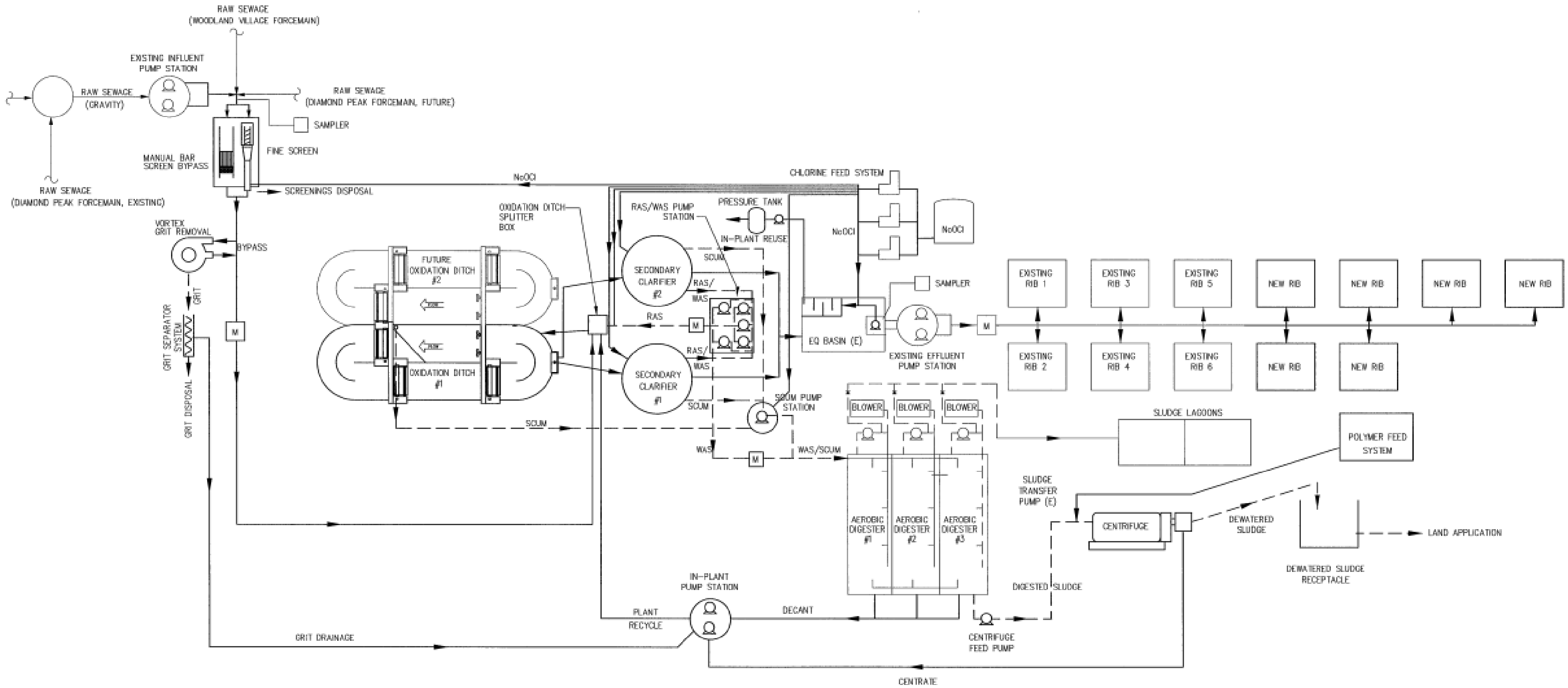


Table 4-2 – CSWRF Future System Flows (MGD)

Year	Average	Max Month	Max Week	Peak Day	Peak Hour	Peak Pumped
2016	0.35	0.38	0.41	0.55	0.78	3.1
2021	0.71	0.76	0.82	1.09	1.48	TBD
2026	1.41	1.52	1.63	2.17	2.89	TBD
2036	2.85	3.08	3.30	4.39	5.77	TBD
Buildout (2050)	4.94	5.34	5.74	7.61	9.96	TBD

Peak hour flow is assumed to be the controlling hydraulic flow rate for all systems except the headworks, which will have to treat the peak instantaneous flow. Secondary treatment and solids handling are controlled by maximum month flow, and the rapid infiltration basins are governed by maximum week flow due to the large amount of storage available within the basins.

3.2 INFLUENT PUMP STATION

Wastewater entering the plant by gravity and from the Diamond Peak lift station are conveyed to the influent pump station. The influent pump station conveys this wastewater to the headworks channel. Significantly, wastewater from the Woodland Village lift station does not pass through this Influent pump station, but is conveyed directly to the headworks channel.

The influent pump station contains two vertical centrifugal pumps installed in a 10-foot diameter prefabricated below-grade steel drywell with above-grade access hatch. Each pump is equipped with a 15-hp constant-speed motor, and has a nominal capacity of 800 gpm at 35-feet TDH. The hydraulic capacity of the influent pump station is more than sufficient at present. Future capacity expansions of this pump station are discussed in TM#3.

3.3 HEADWORKS

The headworks structure is an elevated open channel with an influent sampler, perforated basket spiral screen, vortex grit chamber and grit classifier. The entire system is exposed to the atmosphere and is equipped with freeze protection for the exposed equipment. The screens have a peak hydraulic capacity of 4.5 MGD, but the grit tank's peak hydraulic capacity is only 2.5 MGD.

The peak daily flow rate recorded in the six years ending in December 2015 was 0.55 MGD, which is only 12% of the rated peak flow rate of the headworks systems, indicating that the capacity of the headworks equipment is more than sufficient. However, all of the flow entering the headworks is pumped by either the Woodland Village lift station or the influent pump station. These stations have a capacity of 1,350 and 800 gpm, respectively. If the two stations are on simultaneously, the headworks channel can experience an instantaneous peak flow of 2,150 gpm, or 3.1 MGD. The headworks equipment can adequately process the flows at this rate given that 3.1 MGD does not greatly exceed the peak capacity of the grit tanks, the number of exceedances are small and the duration of the events are short. However, upgrades to the influent pump station and Woodland Village lift station recommended in TM #3, along with developer driven efforts to route a new lift station directly to the headworks channel will push the combined capacities of the stations beyond the capacity of the plant's headworks. The headworks should be upgraded concurrently with the construction of the lift station improvements.

3.4 GRAVITY FLOW THROUGH THE FACILITY

The open-channel hydraulic capacity of the plant was evaluated using CH2M's proprietary WinHYDRO modeling software. The flow path was modeled from the headworks through the effluent pump station wet well. Model results are summarized in Appendix A. It was found that the hydraulic profile presented in the construction drawing set from the 2004 plant expansion are based on conservative loss coefficients and, potentially, arbitrary head losses that may not be reflective of the physical system. Because of this, the results provided here are not consistent with what is shown on the hydraulic profile in the record documents.

Open-channel flow through the plant begins in the influent channel immediately upstream of the influent screen in the headworks. From the screen, flow passes through the grit chamber before entering the oxidation splitter box via a 16" pipe. After the splitter box, flow passes through an 18" pipe to the oxidation ditch. Oxidation ditch effluent flows over a weir and through two 18" pipes to the secondary clarifiers. Flow exits the secondary clarifiers over a v-notch weir before flowing through a launder and dropping over a weir and into a 16" pipe. Flow passes through this pipe into the equalization basin. Flow is then conveyed from the equalization basin to the effluent pump station wet well via a 14" pipe.

WinHYDRO model results demonstrate that the plant has sufficient hydraulic capacity to convey the permitted influent rate of 0.7 MGD by gravity through the facility. These results indicate that the gravity flow capacity is 2.5 MGD. At 2.5 MGD, freeboard in the oxidation ditch splitter box is reduced to 18 inches. A peak hour flow of 2.5 MGD corresponds to an average daily flow of approximately 1.25 MGD. There are no other significant hydraulic choke points in the gravity flow of the plant.

3.5 EFFLUENT PUMP STATION

The effluent pump station is a submersible pump station with two 1,100 GPM (1.6 MGD) pumps in a duty/standby arrangement. The pumps convey the plant effluent to the RIBs.The pump station utilizes a large equalization basin that provides several hours of detention as a wet well, allowing the station to be rated on the peak day flow, rather than peak hour. The effluent pump station is capable of pumping the peak day flow from the collection system through 2023, when the peak day flow is projected to rise to 1.5 MGD. Increasing the capacity of the effluent pump station is recommended in the near term, as the capacity of the effluent pump station is the current hydraulic bottleneck at CSWRF.

3.6 RAS/WAS PUMP STATION

The RAS/WAS pump station contains five total pumps located inside the solids processing building. There are three RAS pumps, each with a capacity of 700 GPM, that convey return sludge from the bottom of the secondary clarifiers to the oxidation ditch splitter box and ultimately back into the biological process. The pump station also contains two 135 GPM WAS pumps that convey waste solids from the bottom of the clarifiers to the aerobic digesters.

The RAS pumps are required to recycle an operator adjustable percentage of the daily flow through the plant, and are sufficient to convey 100% of the daily flow up to a peak day influent flow of 2.0 MGD with one pump out of service. This flow rate is sufficient to allow the RAS pump station to be utilized as is until a biological treatment expansion is necessary. The RAS pump station should be re-evaluated at that time to ensure that the recycle rates are appropriate for the ultimately selected biological treatment process.

Similarly, the WAS pumps have sufficient capacity to convey WAS to the digesters through a needed biological treatment expansion. WAS pumping should be revaluated along with the process needs of the selected biological treatment system.

3.7 HYDRAULIC CAPACITY SUMMARY

The hydraulic capacity of the unit processes at the facility are summarized in the table below.

Table 4-3 – Hydraulic Capacities (MGD)

Unit Process	Governing Criteria	Hydraulic Capacity
Influent Pump Station	Peak Hour Flow	1.15
Fine Screen	Peak Pumped Flow	4.5
Grit Removal	Peak Pumped Flow	2.5
Gravity Flow	Peak Pumped Flow / Peak Hour Flow[1]	2.5
Effluent Pump Station	Peak Day Flow	1.6
RAS/WAS Pump Station	Percentage of Peak Day Flow[2]	2.0

Notes: 1. Governing criteria is peak pumped flow upstream of the oxidation ditches, and peak hour flow downstream of the oxidation ditches.
2. The RAS/WAS Pump Station can convey 2.0 MGD back to the oxidation ditches. The pump station is not required to return 100% of the influent flow, and as a result, can support a peak day influent flow greater than 2.0 MGD.

4.0 TREATMENT CAPACITY ANALYSIS

4.1 SECONDARY TREATMENT

Summary of Plant Data

CSWRF's NPDES permit has not required frequent reporting of influent constituents to the NDEP. Composite influent samples for five-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) are required to be reported on a monthly basis. Furthermore, as noted in TM #2, the automatic influent sampler is non-functional. As a result, the composite samples for monthly reporting were hand-collected flow-weighted composite samples that reflect the influent conditions during daytime working hours of 7am-3pm. This historical data set does not provide the same level of confidence in the characterization of the long-term influent conditions present at the plant. Effluent data at the plant have been collected similarly on a monthly basis for BOD_5, TSS, total kjedahl nitrogen (TKN), nitrate, nitrite, and total nitrogen (TN).

To supplement the data required by permit, Washoe County commissioned Western Environmental Testing Laboratory (WET) to conduct quarterly sampling at the plant influent for chemical oxygen demand (COD), $CBOD_5$, TSS, volatile suspended solids (VSS), ammonia-nitrogen (NH_3-N), TKN, nitrate, and total phosphorous (TP). These results were used to supplement the regulatory influent data where data did not exist (NH_3-N, TKN, TP) and were also used as a check to verify the integrity of the existing BOD_5 and TSS data sets.

In addition, Washoe County commissioned WET to perform a 24-hour sampling event on December 22nd and 23rd, 2015. During this event, samples were collected every hour at the influent, inside the oxidation ditch and at the effluent of the secondary clarifiers. Influent data was analyzed for all the parameters discussed above for the quarterly sampling events. The oxidation ditch samples were evaluated for TSS and VSS. The secondary clarifier data was evaluated for COD, $CBOD_5$, TSS, VSS, TKN, NH_3-N, nitrate, nitrite, orthophosphate (OP), and TP.

It is notable that, according to plant staff, the monthly data collection at the facility performed by Sierra Environmental Monitoring (SEM) tested for BOD_5 in the influent wastewater, while the special sampling events performed by WET tested for $CBOD_5$ in the influent. The two tests are similar, though the $CBOD_5$ test involves the addition of a nitrification inhibitor to isolate carbonaceous oxygen demand from oxygen demand due to nitrogen. In influent wastewater, the $CBOD_5$ test has been shown to suppress the measured biochemical oxygen demand, even though nitrifying bacteria are not present in the influent wastewater to exert this demand. As a result, throughout this study, CH2M has assumed that the influent $CBOD_5$ values account for 85% of the actual $CBOD_5$ in the influent wastewater, and have adjusted accordingly.

Modeling Approach

CH2M modeled the Cold Springs WRF at two different influent conditions to reduce the uncertainty associated with the limited influent data available. The first influent condition utilized the historical data set based on the average influent flows for January 2015 – March 2016 and concentrations present for the monthly influent samples over the same period. Where data did not exist in the monthly samples, values were either used from the quarterly sampling events (influent NH_3-N, TKN, TP), related to a measured parameter (VSS as a percentage of TSS), or estimated based on typical wastewater where measured data was unavailable (calcium, magnesium, alkalinity, COD fractionation, etc.). Effluent data from this simulation was compared to the effluent data reported monthly to NDEP.

The plant was also evaluated for flows and loadings present in the December 22nd and 23rd, 2015 24-hour sampling event. Unlike the average condition, where the influent stream was reflected as a steady state average, the model developed from the December 22 dataset utilized a 24-hour diurnal influent simulated for a sufficient period of time to develop a steady-state response to repeated 24-hour periods of the same influent conditions. Effluent data from this scenario were compared to the reported effluent during the sampling period to calibrate the model.

Both of these models were modeled at ever increasing flow rates until the modeled effluent came close to exceeding permit limits. For all scenarios, the controlling effluent permit limit was the 10 mg/l limit for total nitrogen. As such, any scenario where the peak of the diurnal effluent total nitrogen curve exceeded 8 mg/l was deemed too close to the permit limit and above the capacity of the plant.

Average Loading Calibration

The CSWRF Biowin (Envirosim, Version 5.0) model is set up with an influent icon based on $CBOD_5$, 10 biological reactor zones corresponding to different stages in CSWRF's oxidation ditch, and an ideal secondary clarifier. The 10 biological reactor zones were further divided into three zones containing brush aerators and seven zones that are assumed to be unaerated, but well mixed. Nutrient loadings from the centrate stream of the aerobic digester were accounted for with a separate stream influent icon. Zones Brush 1- Brush 3 represent the three surface aerators, and Zones Bio-1 – Bio-7 represent the portions of the aerobic section of the oxidation ditch without a surface aerator. The secondary clarifier is modeled just downstream of Bio-4. The model layout is shown in Figure 4-2, and influent conditions are shown in Table 4-4.

Figure 4-2 – Cold Springs Average Loading Model Layout

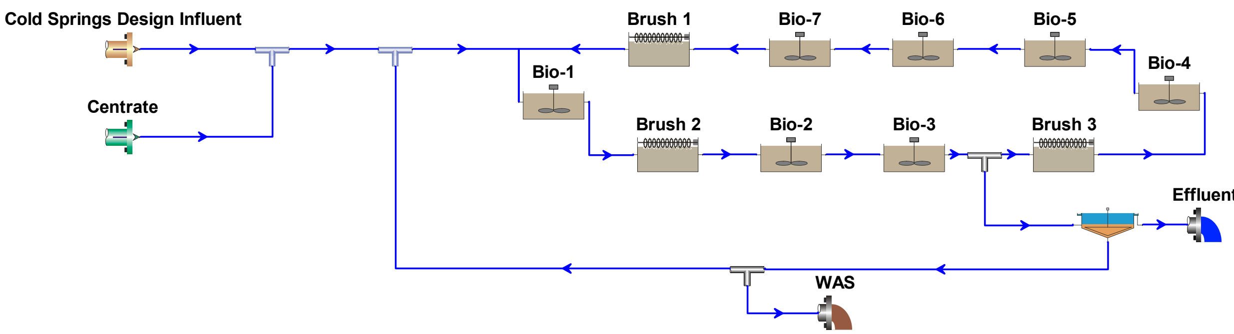


Table 4-4 – Average Loading Influent Conditions

Influent Parameter	Value
Flow	0.3 MGD
$CBOD_5$	261 mg/l
VSS	267 mg/l
TSS	287 mg/l
TKN	50 mg/l
TP	8 mg/l
pH	7.3
Alkalinity	6.0 mmol/l
Calcium	80 mg/l
Magnesium	15 mg/l
DO	0 mg/l

A full wastewater temperature data set was unavailable for Cold Springs, though County staff report that the CSWRF oxidation ditch can have a minimum temperature of 13-14 degrees C in the winter. In this simulation, the plant was modeled at 20-degrees C to reflect an average annual temperature. The SRT for the system was 69 days, with MLSS around 3,000 mg/L for the oxidation ditch. The brush aerators in the model were operated on an intermittent scheduled basis to match the current schedule set up in the SCADA system, which is shown in Table 4-5. Aeration is primarily accomplished using Brushes 1 and 2, while Brush 3 is only operated to achieve a quicker rise in the dissolved oxygen (DO) levels at the beginning of the aeration cycles and to prevent the settling of solids in the mixed liquor. The aeration horsepower actually applied to the wastewater from the nominally 60 hp brush aerators was assumed to be 40 hp, based on an assumed 83% motor loading and an 80% efficient motor. RAS return rate is modeled at 60% of the influent flow, and WAS rate is modeled at 6,100 gpd at a concentration of 8,500 mg/l for 430 lb/day.

Table 4-5 – Brush Aerator Operating Schedule

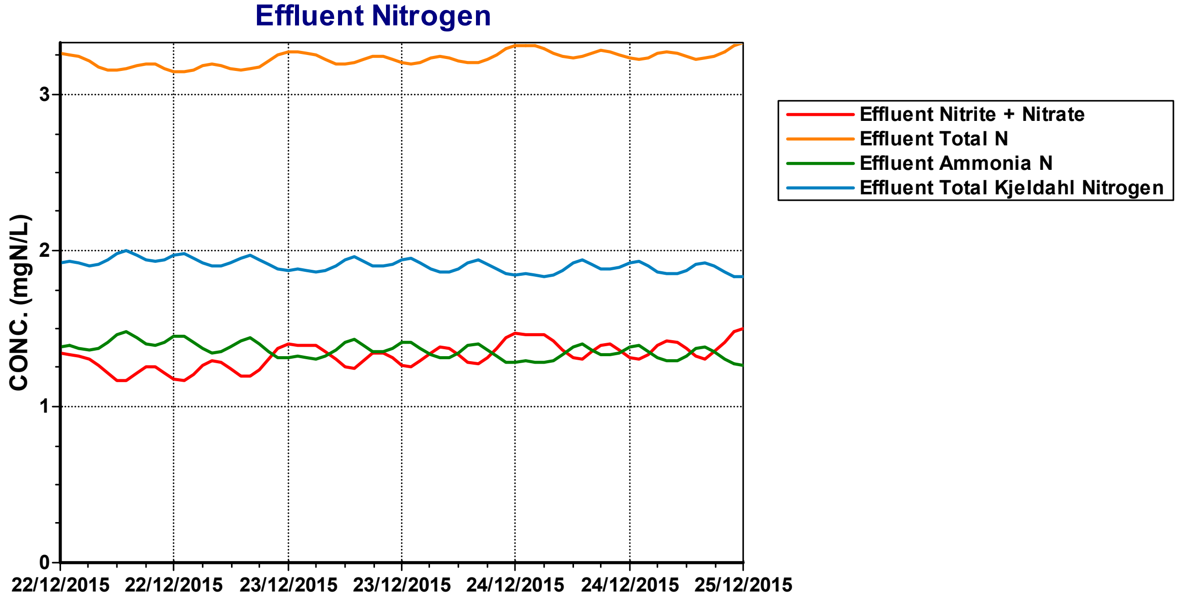
Time	Brush 1 and 2 Runtime	Brush 3 Runtime
1 am	45 minutes	20 minutes
6 am	2 hours	40 minutes
12 pm	2.5 hours	20 minutes
7pm	3 hours	20 minutes

Effluent projections from the BioWin model were compared with the reported effluent data, as shown in Table 4-6. The CSWRF data were very close to the BioWin predictions for effluent, especially for NH_3-N, nitrate and nitrite nitrogen. As shown in Figure 4-3, effluent TKN, nitrate, nitrite appear to be close to the average data of 1.02 mg-N/l for nitrite + nitrate, 1.91 mg-N/l for TKN, and total nitrogen of 2.85 mg-N/l.

Table 4-6 – Average Loading Effluent Data

Parameter	Value (mg/l)
BOD_5	3.33
TSS	4.17
TKN	1.91
Nitrate-N	0.83
Nitrite-N	0.19
TN	2.85

Figure 4-3 – Cold Springs Average Loading Effluent Nitrogen Plot



December 22nd Data Calibration

The model layout for the calibration based on the data from December 22nd was identical to the average layout with the exception of the influent. The influent for this calibration scenario utilized hourly data from December 22nd and varied the influent over the course of the day. The modeled 24-hr period was modeled for 20 or more days in succession until BioWin developed a steady 24-hour response to the loading conditions. The simulation was then modeled for two days so that the responses of the model to hourly changes could be better observed. The influent loading pattern is included in Appendix A.

Wastewater temperature data on December 22nd was unavailable. As such, temperature data from the STMWRF facility was reviewed, and a temperature of 15.5 degrees C was selected as reasonable for Cold Springs on this date. The SRT for the system was 71 days, with MLSS in the 3200 - 3300 mg/L range for the oxidation ditch. The brush aerators in the model were operated as shown in Table 4-7. RAS return rate is modeled at 60% of the influent flow, and WAS rate is modeled at an average mass rate of 400 lb/day.

Effluent projections from the BioWin model were compared with the reported effluent data, as shown in Figures 4-4 and 4-5. The CSWRF data for Dec 22nd were again close to the BioWin predictions for effluent. The primary deviations from the model appear in the first few hours of the effluent data, where the nitrogen species in the December 22nd data are lower than the model's predictions. This is not surprising, as the BioWin model does not have data on the influent prior to 5:00am on December 22nd. The effluent data for the early hours of the simulation reflect the plant treating wastewater that primarily arrived prior to the start of the influent dataset, and presumably had lower influent concentrations of NH_3-N and TKN. The simulation matches the effluent data for the second half of the sample period very closely, where the nitrogen in the plant effluent is primarily due to the influent recorded in the data set.

Table 4-7 – Brush Aerator Operating Schedule – Dec. 22nd

Time	Brush 1 and 2 Runtime	Brush 3 Runtime
1 am	45 minutes	20 minutes
6 am	2 hours	40 minutes
12 pm	2.5 hours	20 minutes
7pm	3 hours	20 minutes

Figure 4-4 – December 22nd Hourly Effluent Nitrogen Data

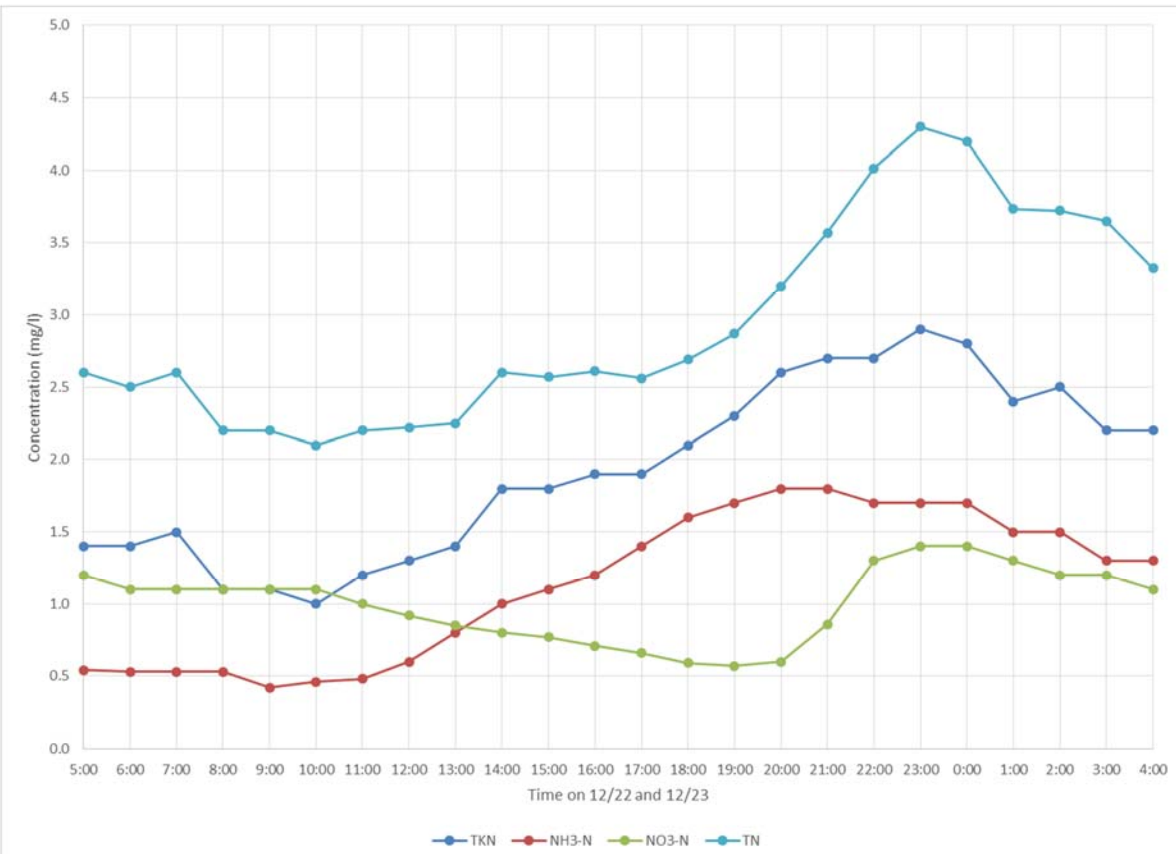
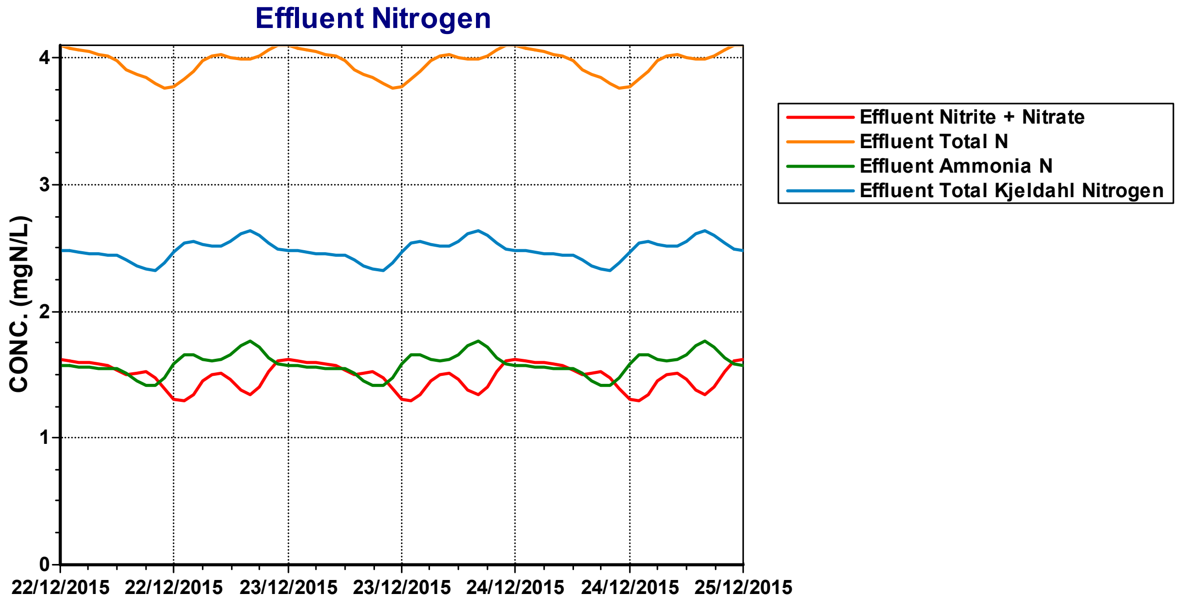


Figure 4-5 – Cold Springs Dec 22nd Calibration Effluent Nitrogen Plot



December 22nd Concentrations Capacity Analysis – Oxidation Ditch – Full Capacity

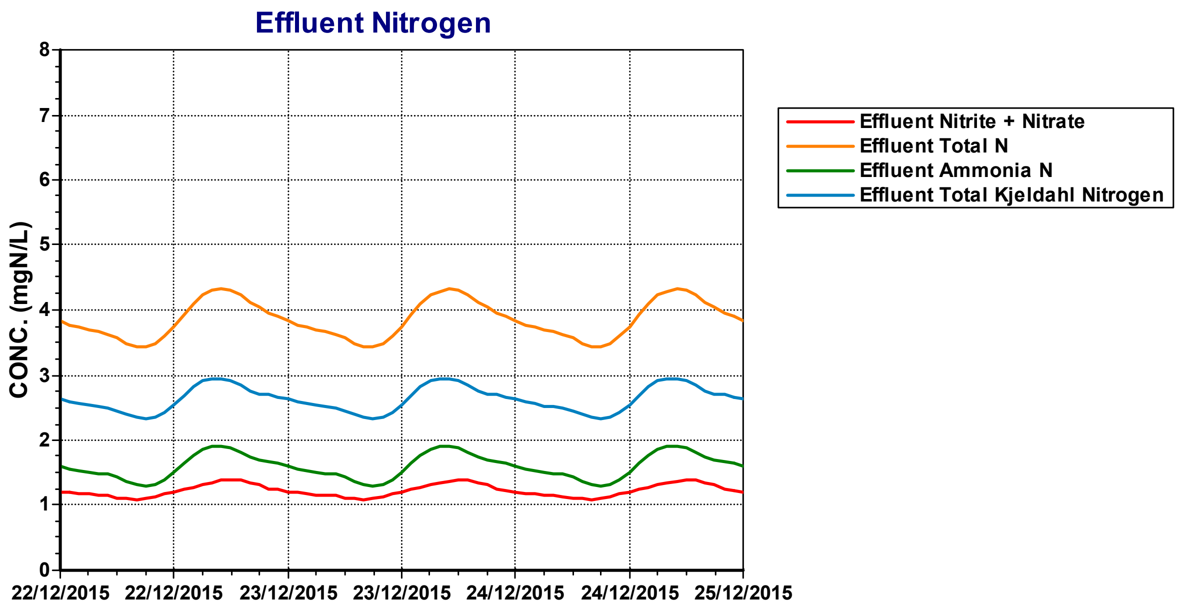
The December 22nd diurnal loading condition had a higher effluent total nitrogen value than the average condition. Since the 10 mg-N/l effluent total nitrogen permit limit is the controlling limit for the facility, the December 22nd flow condition was chosen as the more conservative case to evaluate plant capacity. Once permit compliance at an increased flow rate using the December 22nd influent concentrations was achieved, CH2M back-checked the results with the average loading concentrations at the same flow rate.

First, the December 22nd diurnal concentrations were modeled at the permitted capacity of 0.7 MGD flow. All three brushes in the oxidation ditch were utilized in an on-off pattern on a two-hour cycle with approximately one hour on, one hour off. The brush aerator schedule was optimized to produce approximately equal concentrations of NH_3-N and nitrite + nitrate, as this combination generally produced the lowest TN effluent.

The plant was modeled at 14-degrees C to reflect a worst-case winter temperature for nitrogen removal. The SRT for the system was approximately 42 days, with MLSS in the 3,100 to 3,200 mg/L range for the oxidation ditch. RAS return rate is modeled at 60% of the influent flow, and WAS rate is modeled at 2.6% of the RAS, or around 600 lb/day.

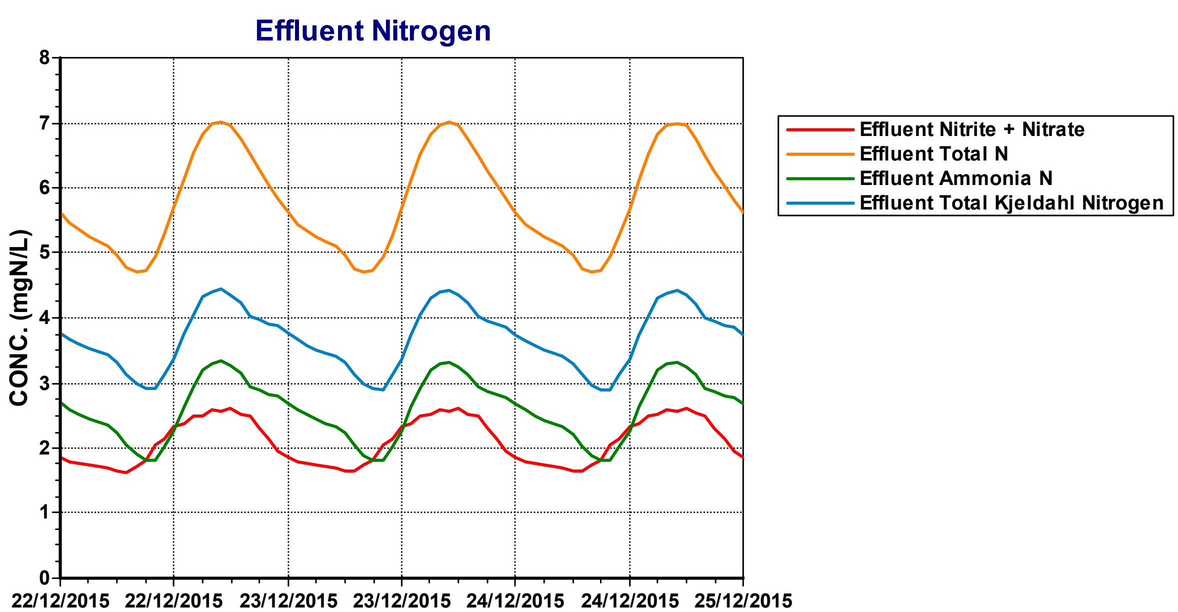
Effluent total nitrogen levels were maintained well below the permitted level of 10 mg/l, as seen in Figure 4-6 below.

Figure 4-6 – Effluent Nitrogen Plot - Dec 22nd Concentrations @ 0.7 MGD



The flow rate with the December 22nd diurnal influent concentrations was gradually increased up to 1.1 MGD. Similar to the 0.7 MGD simulation, the brushes were all operated in a two-hour cycle, this time with the brushes on for 78 minutes and off for 42 minutes.

Figure 4-7 – Effluent Nitrogen Plot - Dec 22nd Concentrations @ 1.1 MGD



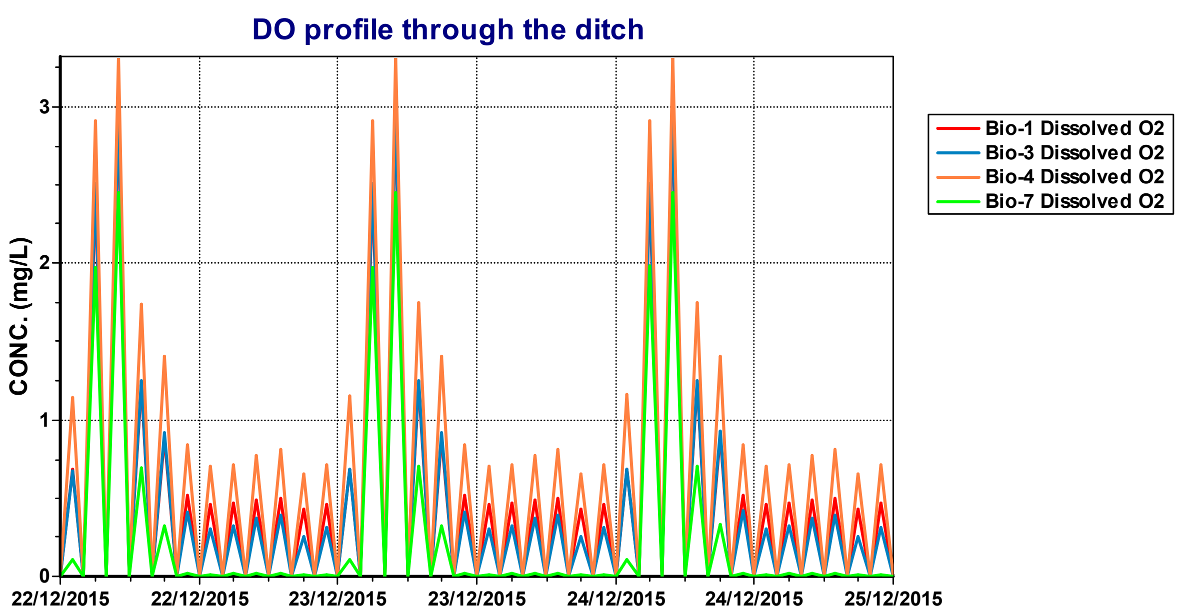
The plant was again modeled at 14-degrees C to reflect a worst-case winter temperature for nitrogen removal. The SRT for the system was approximately 21 days, with MLSS in the 2,900 to 3,000 mg/L range for the oxidation ditch. RAS return rate is modeled at 60% of the influent flow, and WAS rate is modeled at 2.6% of the RAS, or around 600 lb/day.

Effluent total nitrogen levels were kept below the permitted values, as shown in Figure 4-7.

The model predicted permit compliance with a substantial margin of safety even during the peak hour of a diurnal curve with influent flow rates over 55% greater than the permitted capacity. Several other plant parameters were checked to verify that this capacity was actually achievable.

Dissolved oxygen was maintained at reasonable levels during the air on periods as Figure 4-8 shows.

Figure 4-8 – DO Profile - Dec 22nd Concentrations @ 1.1 MGD



During peak hours, the DO was limited to around 0.7 mg/l near the aerators, and stayed near zero away from them. Overnight, the DO rose to close to 3.0 mg/l. It is possible that the aeration cycle could be optimized to achieve a more favorable result over the course of a given day.

December 22nd Concentrations Capacity Analysis – Secondary Clarifiers

As noted in Section 2.0 above, the 2004 expansion of CSWRF increased the capacity of the facility to a reported 0.7 MGD, expandable to 1.2 MGD with the addition of an additional oxidation ditch. The secondary clarifiers at CSWRF were designed at that time to support the full future flow of 1.2 MGD. As expected, the secondary clarifier surface overflow rate and solids loading rate at 1.1 MGD average daily flow is less than typical design guidance and regulatory standards for surface overflow rate and solids loading rate. Typical design guidance is shown in Table 4-8, and model results for the clarifiers are shown in Figures 4-9 and 4-10. The peak hour in the diurnal curve for this simulation is 1.95 MGD. Utilizing the Ten State Standards criteria, the secondary clarifiers are limited on the basis of solids loading rate, and have a peak hour flow capacity of approximately 3.8 MGD with both clarifiers operational.

Table 4-8 – Clarifier Design Guidance

Source	Surface Overflow Rate (gpd/ft^2)	Solids Loading Rate (lb/day/ft^2)
Ten State Standards	1,000	35
Metcalf and Eddy	600 - 800	33.6
WEF MOP 8	1000 - 1600	20 - 30

Figure 4-9 – Surface Overflow Rate - Dec 22nd Concentrations @ 1.1 MGD

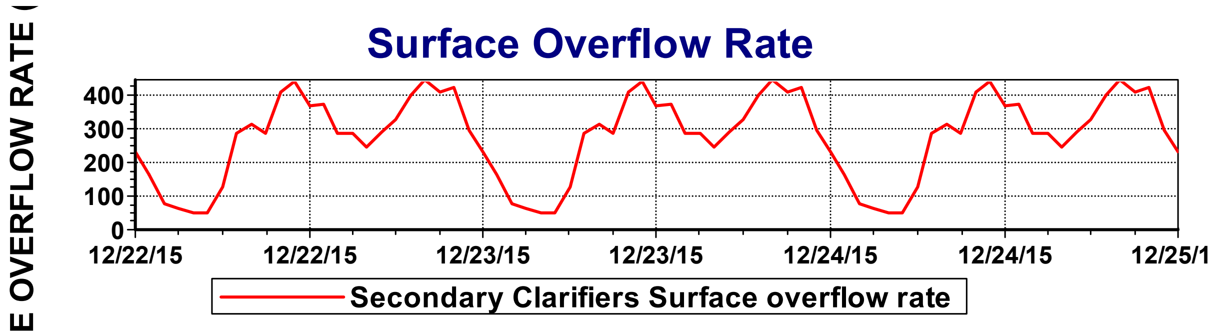
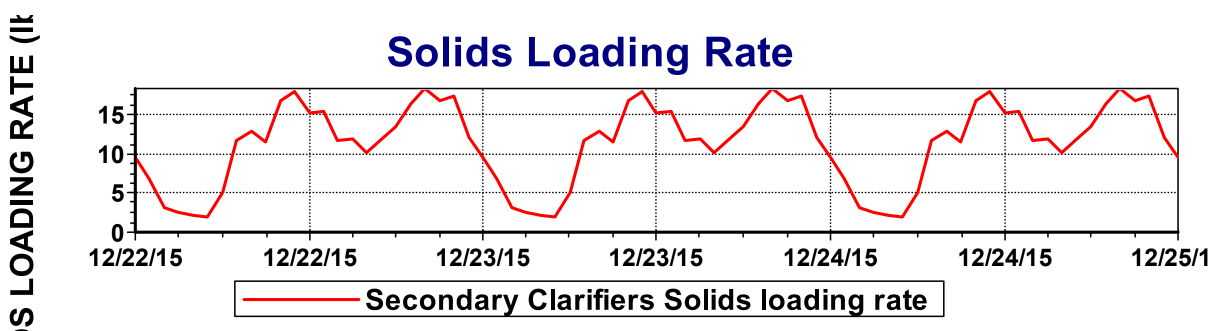


Figure 4-10 – Solids Loading Rate - Dec 22nd Concentrations @ 1.1 MGD



December 22nd Concentrations Capacity Analysis – Oxidation Ditch – Firm Capacity

Finally, the system was modeled again assuming one of the brushes at the oxidation ditch was out of service to prove an ability to meet permit with firm capacity aeration. For this model, the two remaining brushes were operated 24/7 with denitrification occurring in the longer runs of unaerated area in the oxidation ditch. Effluent nitrogen and a DO profile through the ditch are shown in Figures 4-11 and 4-12 below.

Figure 4-11 – Firm Capacity Effluent Nitrogen Plot - Dec 22nd Concentrations @ 1.1 MGD

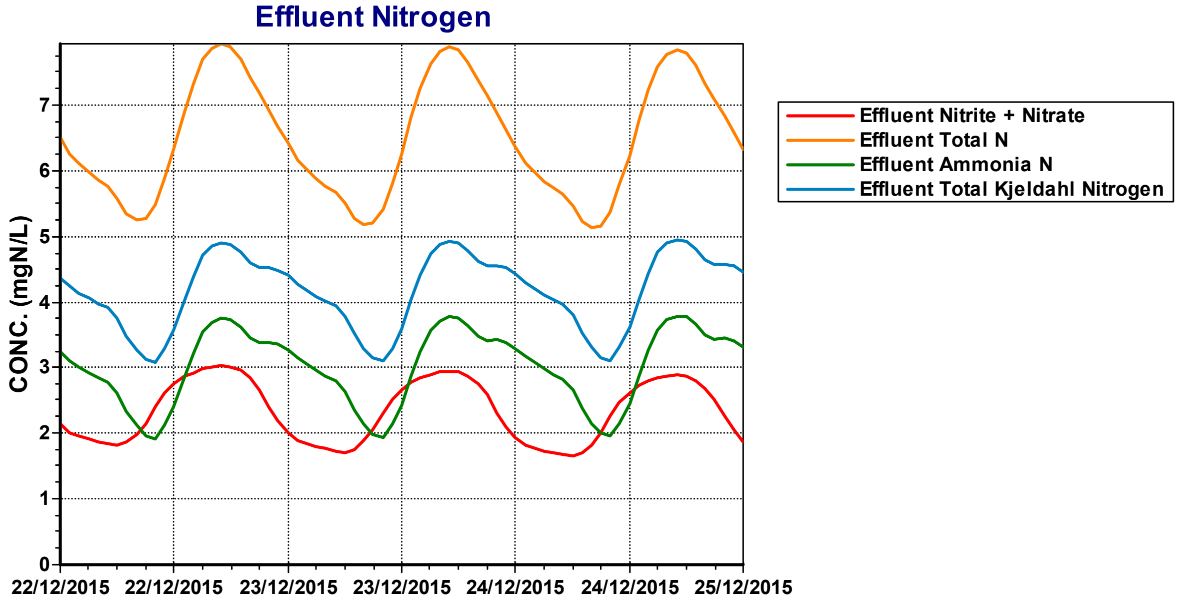
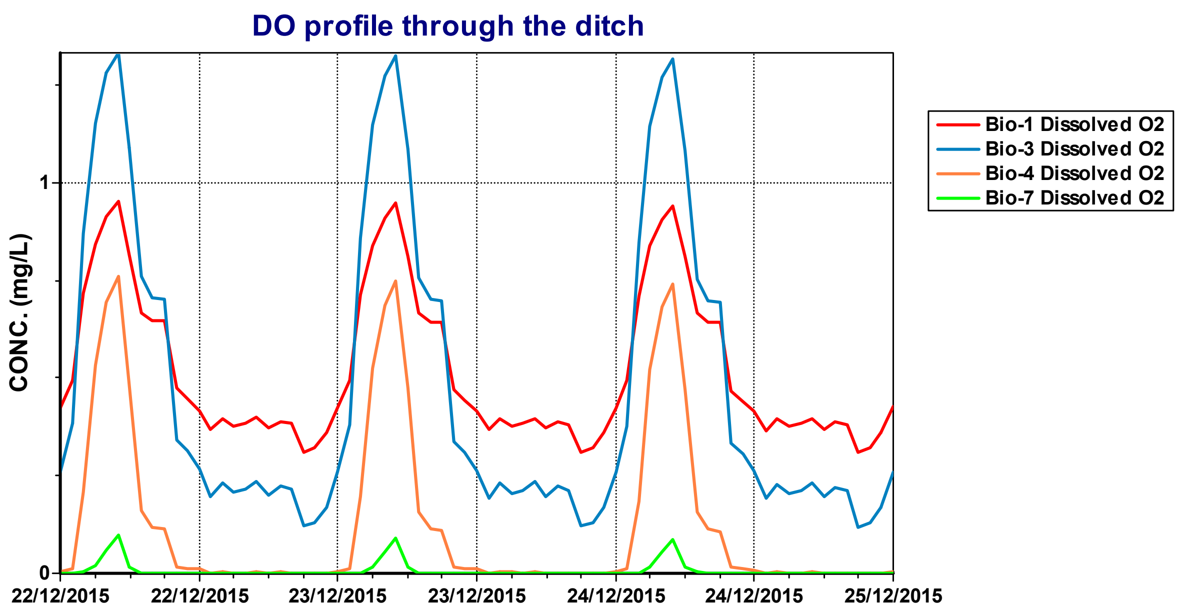


Figure 4-12 – Firm Capacity DO Profile - Dec 22nd Concentrations @ 1.1 MGD



The effluent total nitrogen for the firm capacity aeration condition is slightly higher than for the three brush, on-off aeration condition, though the overall results are similar. Dissolved oxygen varies considerably throughout the day, with most of the oxidation ditch having DO concentrations below 0.5 mg/L during peak hours, with the DO concentrations rising during the night hours.

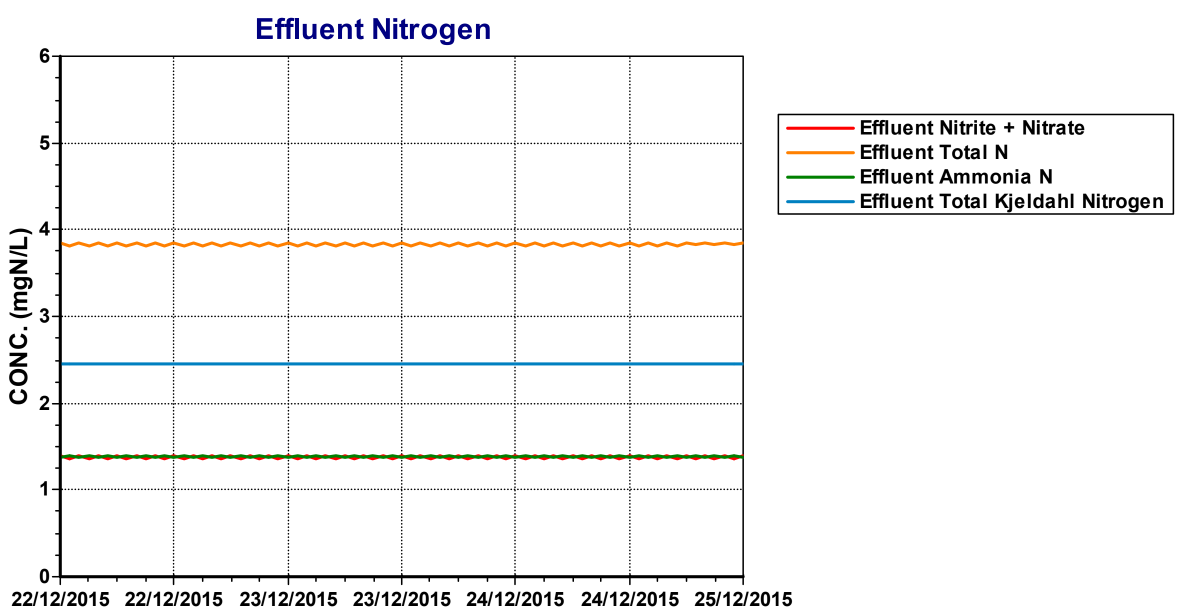
Average Concentrations Capacity Analysis

As expected, the performance under average conditions revealed more favorable results than under the December 22nd influent concentrations. The average concentrations were modeled at 1.1 MGD influent flow. All three brushes in the oxidation ditch were utilized in an on-off pattern with 72 minutes on and 48 minutes off. Similar to the December 22nd simulation, the brush aerator schedule was optimized to produce approximately equal concentrations of NH_3-N and nitrite + nitrate, as this combination generally produced the lowest TN effluent.

The plant was modeled at 14-degrees C to reflect an average annual temperature. The SRT for the system was 19 days, with MLSS in the 3,000 to 3,100 mg/L range for the oxidation ditch. RAS return rate is modeled at 60% of the influent flow, and WAS rate is approximately 1,400 lb/day.

Effluent total nitrogen levels were maintained below the permitted level of 10 mg/l, as seen in Figure 4-13 below.

Figure 4-13 –Effluent Nitrogen Plot - Average Concentrations @ 1.1 MGD



Re-rating Criteria

CH2M proposes that the plant rating be expressed as the flow that the plant can be projected to treat at 80% of the controlling permit limit at the design flow with one aerator out of service. In this case, the controlling permit limit is a total nitrogen limit of 10 mg/l at peak day on a composite daily average basis. Therefore, the flow rate where the plant can achieve a total nitrogen effluent of 8 mg/l daily average is the proposed rating. This criteria is slightly less conservative than the model results above showed, as the effluent total nitrogen was kept under 8 mg/l on a peak hour basis.

Summary

CSWRF appears to be able to effectively treat 1.1 MGD to the permitted effluent limitations even during a peak hour of a diurnal flow pattern in winter conditions. The influent data set is limited, and additional sampling should be obtained to verify the conclusions herein prior to taking action on the basis of these reported results. The capacity of the treatment system is still the permitted capacity of 0.7 MGD, however, this study shows that further modeling work with an expanded influent data set could provide enough support to re-rate the facility at a higher influent flow than the current permitted influent flow rate.

4.2 SOLIDS PROCESSING

The solids train at CSWRF consists of a three-cell aerobic digester, thickening with floating decanters and centrifuge dewatering. The aerobic digester was originally a two cell Jet-Tech™ sequencing batch reactor (SBR) with an integral aerobic digester that has been converted to a single, two-stage aerobic digester. The first two cells are 175,000 gallons each and operate in parallel, while the third, 120,000-gallon cell operates as the second digestion stage. Waste activated sludge (WAS) is transferred into one of the first two cells, and digested sludge is transferred from cells one and two to cell three. All three cells are equipped floating decanters to thicken the solids inside the digesters after approximately one day of settling time. According to plant staff, the digesters maintain a solids concentration from 1.0% to 1.3%. The digester has a total volume of 470,000 gallons.

Aerobic Digestion Design Basis Review

The design basis for the CSWRF aerobic digesters is presented in Technical Memorandum No. 11 in Kenedy-Jenks' October 2003 Preliminary Design Report for CSWRF. Major design parameters are summarized in Table 4-9 below.

The preliminary design report (Kennedy-Jenks, 2003) notes that the design actual oxygen required (AOR) was based on 2.3 lbs of O_2 per pound of VS destroyed, and that the standard oxygen required (SOR) was based on an assumed 0.44 AOR/SOR ratio provided by Jet-Tech. The anticipated 2.0% thickness was to be achieved by thickening with the decanters and using the centrifuges to thicken the digesting solids, if necessary.

Table 4-9 – CSWRF Aerobic Digester Design Criteria

Design Parameter	Phase 1	Phase 2
VSS to Digester	793 ppd	1,324 ppd
TSS to Digester	1,320 ppd	2,207 ppd
VSS Destruction	40%	40%
Digester Thickness	2.0%	2.0%
Design SRT	60 days	60 days
Design Temperature	15°C	15°C
SRT in existing tanks	59 days	26.6 days
AOR	727 ppd	1218 ppd
SOR	1,652 ppd	2,768 ppd
Existing SOTR available	3,120 ppd	3,120 ppd

There are a few items in the design's basis that need to be adjusted to account for insights from the plant data and operating experience with similar types of aerobic digesters. Those are:

- Operating data from the treatment plant indicates a VSS:TSS ratio in the WAS of 86.8% from the period of July – September 2016. The design assumed 60% VSS:TSS ratio. This discrepancy was likely the result of over-estimating the amount of inert solids in the plant influent, which was estimated at 30%, while the data shows less than 10%.

- The 0.44 AOR/SOR ratio assumed by Jet Tech is likely too high. This ratio corresponds to an alpha value of approximately 0.7. Recent experience at the South Truckee Meadows facility shows that alpha in a jet aerated aerobic digester operating between 1.0 – 1.2% thickness should not be assumed to be above 0.4.

- The digester thickness is higher than achievable by typical plant operation. The initial design report indicates that the thickness can be achieved by using the centrifuge to thicken the solids, but no conveyance was provided at the plant to allow dewatered solids from the centrifuge to return to the digesters. Based on plant staff experience, 1.3% is the highest achievable thickness in the third cell, and a design thickness of 1.0% going forward appears to be prudent.

Aerobic Digestion Performance

The aerobic digester is currently not performing up to the design parameters set out in the preliminary design report (Kennedy-Jenks, 2003). A comparison of the design parameters and current operating conditions is included in Table 4-10.

Table 4-10 – CSWRF Aerobic Digester Performance

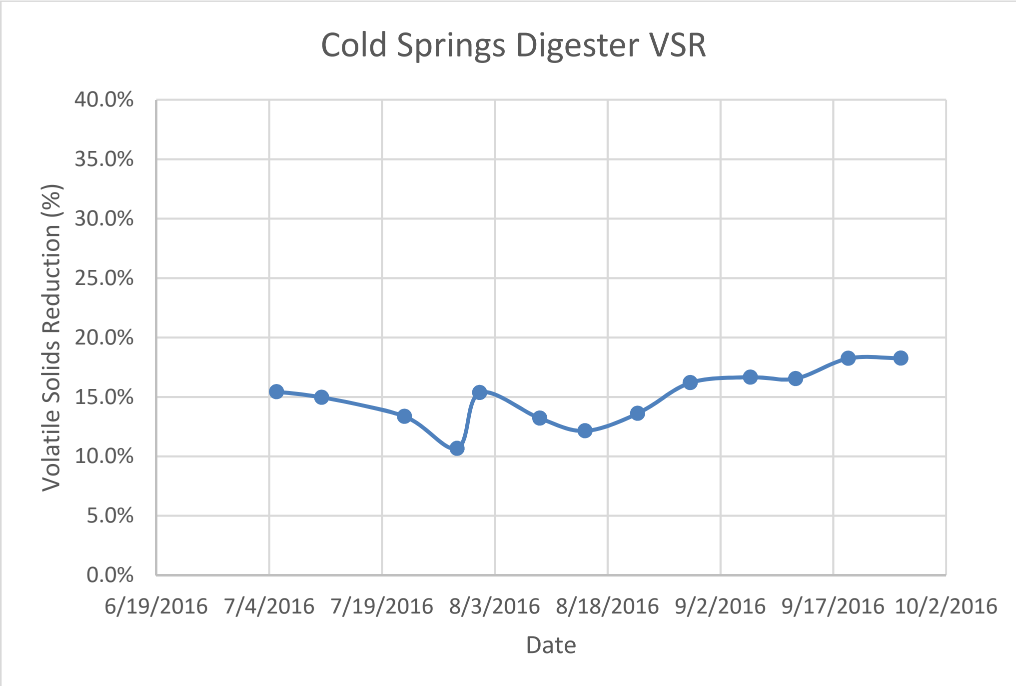
Parameter	Design	Current
VSS to Digester	793 ppd	480 ppd
TSS to Digester	1,320 ppd	555 ppd
VSS Destruction	40%	15%
Digester Thickness	2.0%	1.2%
SRT	60 days	56 days[1]
Temperature	15°C	Unknown[2]
AOR	727 ppd	143 ppd[3]
SOR	1,652 ppd	478 ppd[4]
AOR @ 40% VSR	NA	381 ppd[3]
SOR @ 40% VSR	NA	1,274 ppd[4]
Existing SOTR available	3,120 ppd	3,120 ppd

Notes: 1. Assumes digesters average 2/3 full
2. No temperature data available, however, 15°C is not unreasonable.
3. Value reflects actual oxygen consumed. Assumes 2 lb O_2 per lb VSS destroyed.
4. Value reflects standard oxygen consumed. Assumes Alpha = 0.4, DO residual = 0.5, Average water depth of 17 ft, Jet submergence of 13.7 ft, and Temp = 15°C

The aerobic digestion system at the CSWRF is not performing on the basis of volatile solids destruction, as seen in Figure 4-14. Reference texts suggest that aerobic digesters operating at this SRT and temperature should be able to achieve VSS destruction equal to or greater than 40%. This underperformance could be the result of many factors, and there is insufficient data available for the digesters to be certain of any conclusions.

During the course of this evaluation, Washoe County staff evaluated the effectiveness of the aeration equipment in the digesters. This evaluation revealed dissolved oxygen concentrations in excess of 6.5 mg/l using present aeration practices. It is therefore more likely that the low VS destruction is the result of the high SRT maintained in the oxidation ditch. Essentially, a large portion of the volatile solids destruction that would normally occur in the digesters is occurring inside the oxidation ditch itself, resulting in low oxygen demands and low volatile solids destruction inside the digesters. This assumption can be verified through specific oxygen uptake rate (SOUR) testing by the County if desired.

Figure 4-14 –Digester Volatile Solids Destruction



Aerobic Digestion Capacity Analysis

The aerobic digester has sufficient capacity at present to meet the design criteria, although it is unclear whether 40% VSS destruction in the digesters will be possible given the long operating solids retention time in the oxidation ditch. The Table 4-11 summarizes the available loading of the digester assuming that the design criteria are unchanged.

Table 4-11 – CSWRF Aerobic Digester Capacity Analysis

Parameter	Current Loading	Estimated Capacity
Digester Thickness	1.2%	1.2%
Volume	314,900[1]	423,000[2]
SRT	56 days[1]	60 days
VSS to Digester	480 ppd	940 ppd
TSS to Digester	560 ppd	1,100 ppd
VSS Destruction	15%	40%
Estimated Average Influent Flow	300,000 gpd	580,000 gpd

Notes: 1. Assumes digesters average 2/3 full
2. Assumes digester operational practices can be modified to achieve an average of 90% full.

The aerobic digester tanks at CSWRF have a total volume of 470,000 gallons. The tanks are operated by filling a tank, letting it settle, and decanting the free liquid off of the top. As a result of this practice, the tanks are frequently operated below full depth, at an estimated average of two-thirds full. Given that the tanks are thickened by settling and decanting, it is unlikely that the operators could maintain the tanks at full water depth. For the capacity analysis, it is assumed that the operators could maintain the tanks at 90% of full depth, on average. On this basis, a 60-day SRT can be maintained at CSWRF up to a WAS loading of approximately 1,100 ppd. This loading of 1,100 ppd corresponds to an average influent flow rate of approximately 580,000 gpd. Further, the firm capacity of the digesters is significantly lower, at 390,000 gpd should one of the basins be out of service. As the digesters each rely on a single blower for aeration, having an entire digester tank offline is a reasonable planning expectation, unless a backup air supply can be provided.

The average influent flow projected in TM #1 for 2021 is 0.7 MGD, or 700,000 gpd, indicating that the aerobic digesters will have insufficient volume prior to 2021. The 60-day SRT listed in the design criteria may not be necessary for landfill disposal of biosolids. Discussions with County staff have indicated that the present method of landfill disposal will likely be continued into the future and a 60-day SRT should not be required. These criteria should be re-evaluated in light of the solids disposal needs and requirements for the facility prior to any expansion project.

Dewatering

Sludge from the third digester cell is transferred directly to the existing Andritz centrifuge where the sludge is dewatered. The centrifuge can dewater 625 lbs of dry solids per hour, enabling it to dewater approximately 25,000 lbs of dry solids per week with 40 hours of operation. The digested solids flow, assuming 40% volatile reduction at the estimated capacity levels noted above, is 720 pounds per day, or approximately 5,000 pounds per week. This indicates that the dewatering equipment has a much larger capacity than the digesters, (approximately five times larger, corresponding to an influent flow rate of 2.9 MGD) and should not need to be expanded in the near term.

The facility has sufficient dewatering capacity, but does not have a redundant centrifuge should the duty unit fail. However, despite the lack of a redundant centrifuge, the plant has sufficient storage time in two on-site sludge lagoons to temporarily store sludge in the event of an equipment outage. The sludge lagoons have around 1.5 MG of usable volume assuming a freeboard of 1.5 feet. This volume can hold approximately seven months of the design sludge flow of 720 gpd at 1.2% thickness in the event of an equipment outage. This storage time should be sufficient to make any necessary repairs to the dewatering equipment.

Disposal and Hauling

The dewatering units at CSWRF currently load out biosolids to a 14 cubic yard dumpster that is able to hold a 12 yd load of dewatered biosolids. At the present sludge flow rates, the dumpster is hauled off approximately two times per work week. Assuming sludge flow rate increases at the same rate as the influent flow rate, the hauling frequency could be 14 loads per week at the 2.85 MGD average daily influent flow rate projected for 2036. This hauling frequency is only achievable with additional dumpsters available to allow the dewatering operation to continue uninterrupted while the dumpster is hauled off to the landfill. Constructing a facility with the ability to haul biosolids away in larger, less frequent loads should be considered concurrent with any digestion or dewatering expansion.

5.0 RAPID INFILTRATION BASIN CAPACITY ANALYSIS

5.1 BACKGROUND

The design loading rate of the original RIBs 1 through 6 was listed as 0.06 inches per hour (in/hr), and was derived from infiltrometer tests performed by Pezonella Associates in 1991 (Broadbent, 2003). Broadbent performed additional field infiltrometer tests is some of the RIBs and revised the design loading rate to a range of 0.07 to 0.3 in/hr or greater. The design loading rates were figured as a fraction of the measured field infiltration rates. Broadbent, 2003, stated that “The design rate was derived by taking 4.5% of the actual double ring test results, as suggested in the US EPA process design manual entitled Land Treatment of Municipal Wastewater (October, 1981).” It is misleading to use the EPA recommended reduction to 4.5 percent of the field test to estimate a real-time design infiltration rate. The reduction factors in the EPA guidance document are intended for obtaining an annual hydraulic loading rate, and include periods of non-loading, or drying periods. These non-loading periods improve treatment efficiency, maximize infiltration rates, and allow for maintenance of RIBs. Therefore, the original design loading rate for the Cold Springs RIBs in accordance with the EPA guidance document should have been portrayed as an annual design value. For example, 0.06 inches per hour should be converted to 44 feet per year. The derived design rates presented by Broadbent, 2003, were used by Kennedy/Jenks to estimate an average daily load capacity of 0.1 in/hr for the 12 existing and proposed RIBs. The resulting RIB design load capacities were underestimated because of the incorrect use of the EPA guideline.

The application rate during the loading period is dependent upon the number of cycles per year. Currently, each RIB goes through 1 cycle of loading per year, or an average period of approximately 1 month out of the year for each RIB. The design application rate could have therefore been 44 feet divided by 30 days of loading, or approximately 1.5 feet per day. For the smallest RIB size of 1.22 acres, the total design application volume would be approximately 600,000 gallons per day. Therefore, the current application rates of 300,000 gallons per day are below the design rates obtained using the EPA guidance document method with the infiltration test data from 1991 and 2003.

It should be noted that the bottom of RIBs #1 and #2 have been excavated subsequent to the field and operations infiltration data presented in Broadbent, 2003. RIBs #1 and #2 previously had the slowest infiltration rates, whereas now these RIBs have high infiltration rates compared with the other RIBs.

5.2 RECENT FIELD TESTING

Double-ring infiltrometer tests were performed in 2016 by NewFields at one location in each of the 12 RIBs. Tests were performed in accordance with ASTM D3385. Test locations were selected by NewFields near the center of each RIB, and the upper 7 to 9 inches of material was removed before performing the tests. The inner and outer rings were 12 inches and 21 inches in diameter, respectively. The tests were performed until the infiltration rate reached an apparent equilibrium, or was relatively constant. The representative infiltration rate for each test is summarized in Table 4-12. The test data is included in Appendix B.

The daily infiltration capacities for each RIB are summarized in Table 4-12 in accordance with the recent infiltrometer testing, using the EPA guideline for annual hydraulic loading capacity with 1 month of loading per year and 4.5 percent of the field test result. If only one RIB is loaded at a time, the allowable design rate would fluctuate depending upon which RIB is operating.

Up to a maximum of half, or six, of the RIBs could potentially be utilized at the same time, which would allow half of the RIBs to be drying while the other half are infiltrating. Using the EPA guideline for annual hydraulic loading capacity with 180 days of loading per year, and 4.5 percent of the field test result, the daily infiltration capacities for each RIB are summarized in Table 4-12. If we assume that one-half of all the RIBs (divided up by similar area) are loaded at the rates summarized in Table 4-10, then the allowable capacity of the total RIB array would be approximately 1.3 million gallons per day.

Table 4-12 – RIB Infiltration Rates Measured in the Double Ring Infiltrometer Test and Corresponding Loading Capacities

RIB#	Duration of Test (hrs)	Measured Infiltration Rate in Double-Ring Infiltrometer Test (in/hr)	Loading Capacity per EPA Guideline, With 30 Day Loading per Year (gal/day)	Loading Capacity per EPA Guideline, With 180 day Loading per Year (gal/day)
1	6.0	6.3	2,750,350	452,112
2	6.2	10.7	5,341,160	877,999
3	23.5	0.2	70,474	11,585
4	6.5	0.9	517,545	85,076
5	22.2	0.2	102,507	16,850
6	6.3	0.2	125,725	20,667
7	6.3	2.4	1,780,387	292,666
8	23.5	0.3	211,951	34,841
9	6.0	5.0	3,216,047	528,665
10	6.5	0.6	372,841	61,289
11	7.3	0.6	402,706	66,198
12	6.0	1.8	1,311,012	215,509

The allowable infiltration capacities for RIBs #3, #5, #6, and #8, figured using the EPA guideline with a factor of 4.5 percent, are below the current operating load rates that have been performing well. Therefore, the 4.5 percent value appears to be too conservative for the site conditions. The EPA guidance states that the annual loading rate should be selected between 4 to 10 percent. If a higher end factor of 10 percent is assumed, the allowable calculated infiltration capacities are below the observed operational infiltration in only two of the RIBs, assuming one month of loading per year. With a factor of 10 percent, and a loading period of 6 months per year, the allowable capacity of the total RIB array would add up to approximately 3.0 million gallons per day.

There are many factors that can have an effect on the infiltration capacity in each RIB. There is likely significant variability in hydraulic conductivity both laterally and vertically. Boring logs by Pezonella and Broadbent (1991 and 2003, respectively) show layers of silty sand or clay near the surface in some locations. Borings by Kleinfelder (2003) south of the RIB array show layers of silty sand interbedded in cleaner sand above and below. The borings are widely spaced, and it is likely that interbedded lenses of finer grained soil and slower conductivity are present in different areas around the RIB array.

5.3 Operational Infiltration Rates

The current RIB loading rate fluctuates around plus or minus 30% of 300,000 gallons per day. Records from January 2014 through April 2016 were available with estimated depth of water in the RIBs at the end of the loading period for each RIB. The observed infiltration rate was calculated from the total volume discharged into the RIB, minus the remaining estimated volume, divided by the number of loading days. Each RIB had at least two load cycles during the available period of record. Using the observed operational data, the daily apparent infiltration rates for each RIB are summarized in Table 4-13. The total gallons per day if all RIBs were loaded simultaneously at historical loadings rates is approximately 3.3 MGD. Assuming that a maximum of six RIBs, or one-half of the total RIB area, could potentially be utilized at the same time to allow continuous operation, the RIBs could handle approximately 1.7 MGD based solely on observations from historical loadings patterns.

The remaining estimated volume of water in the pond after each loading does not have a high level of accuracy, because it is derived from a visual depth of water in the pond at the end of loading. The depth of water is rather subjective, and it is likely to vary around the area of the pond. Also, the rate of infiltration will increase as the depth of water in the pond increases. Therefore, the apparent infiltration rates do not represent a maximum loading capacity, and it is estimated that many of the ponds can infiltrate much more than have been loaded up to the current time.

The potential effect of evaporation on the infiltration observations was evaluated based on potential evapotranspiration data from the National Weather Service Cooperative weather station at Stead, Nevada. Inclusion of evaporation in the analyses resulted in less than 5 percent change in the calculated infiltration rates during the summer months, and observed infiltration rates neglecting evaporation are valid for the purposes of this study.

The observed infiltration rates during operations at each RIB ranged between 0.2 to 0.35 in/hr. All of the RIBs have been able to support the current average loading rate of 300,000 gallons per day for at least three weeks of loading. There is a large difference between the average observed operational infiltration rate and infiltration rates measured with the double-ring infiltrometer. The operational infiltration rates appear to be outperforming the rates measured from field infiltrometer tests in RIBs #3, #5, and #6. The higher infiltration rate may be caused by higher secondary permeability through cracks and preferential pathways through the soil, which is not accounted for in the small diameter infiltrometer tests. The remaining RIBs appear to be able to accept a higher loading rate than the current loading rates based on the predicted rates from the field infiltrometer test results.

Table 4-13 – Infiltration Rates Derived from Operational Data

RIB#	Observed Average Infiltration Rate From Operations (in/hr)	Apparent Infiltration Rate (gal/day)
1	0.35	281,544
2	0.32	295,248
3	0.30	260,913
4	0.25	254,495
5	0.34	292,066
6	0.30	283,595
7	0.22	295,970
8	0.22	289,530
9	0.21	248,634
10	0.22	258,567
11	0.20	247,905
12	0.22	306,548

The observed infiltration is approximately twice as fast as the slowest double-ring measured infiltration rate in RIB #3. A difference of 200 percent may be a function of soil variability, or secondary permeability through sand seams or soil structure that does not affect the double-ring test. It should be noted that the field infiltrometer tests represent a small (less than 1 square foot) area within up to 2 acre sized RIBs. Multiple double-ring tests would be required with statistical analyses to increase the reliability of the double-ring test results.

RIBs #1 and #2 were previously listed as having the slowest infiltration rates in the 2003 reports. These RIBs were subsequently excavated down into coarser materials, and now have the fastest observed infiltration rates. The current loading rates are only around 5 percent of the measured infiltration rate for RIBs #1 and #2.

5.4 Discussion of Results and Recommended RIB Maximum Loading Rates

The current average application rate of 300,000 gallons per day is functioning for the RIBs. The maximum capacity of the RIBs do not appear to have been reached under current operations. The recommended design loading rates for each RIB are summarized in Table 4-14. Reasoning for the selected rates is discussed below. A maximum loading period of 180 days per year (e.g. six 1-month cycles) is assumed for all of the RIB evaluations below. The design values may be adjusted in the future if the RIBs are “proof tested” with increased loading rates.

According to the double-ring infiltrometer test results and size of the RIBs, the maximum application rates for RIB #1 is at least the design capacity obtained using the EPA guideline. Assuming a factor of 4.5 to 10 percent, the load capacity would be 450,000 to 1,000,000 gallons per day, respectively. RIB #1 had up to a foot of water at the current loading rate, and a design capacity on the conservative end of the range, or 500,000 gallons per day, is recommended.

Table 4-14 – Recommended RIB Load Capacities to Use in Planning

RIB#	Peak RIB Infiltration Rate from Double-Ring Infiltrometer Field Test Results (million gal/day)	Recommended Design RIB Load Capacity (gal/day)
1	5.0	500,000
2	9.8	1,000,000
3	0.1	300,000
4	0.9	400,000
5	0.2	400,000
6	0.2	400,000
7	3.3	500,000
8	0.4	450,000
9	5.9	500,000
10	0.7	450,000
11	0.7	450,000
12	2.4	500,000

According to the double-ring infiltrometer test results and size of the RIBs, the maximum application rates for RIB #2 is at least the design capacity obtained using the EPA guideline. Assuming a factor of 4.5 to 10 percent, the load capacity would be 880,000 to 1,950,000 gallons per day, respectively. RIB #2 had zero to 0.5 feet of water remaining after current operation loading, and a design capacity of 1,000,000 gallons per day, is recommended.

RIB #3 had the lowest design application rate as figured from the double-ring infiltrometer test results, at 0.15 inches per hour. This was supported by the operation data where RIB #3 had the highest measured water depth (2.5 feet) in the RIB following the loading period. The maximum loading rate reached in current operations, 300,000 gallons per day, is recommended as the design load rate.

RIB #4 had a double-ring test infiltration rate 6 times greater than RIB #3 in the double-ring infiltrometer test results. After 35 days of loading, there was 1 foot depth of water observed in the RIB in March, 2016. An increase of 30 percent above the current maximum loading rate is recommended as the design capacity, or 400,000 gallons per day.

RIB #5 had a double-ring test infiltration rate only slightly greater than #3. However, after more than a month of loading, RIB #5 only had 0.5 feet of water depth during the current average loading rate of 300,000 gallons per day. The double-ring infiltrometer test may not be representative of the full pond area. An increase of 30 percent above the current maximum loading rate is recommended as the design capacity, or 400,000 gallons per day.

RIB #6 had a double-ring test infiltration rate similar to RIB #5. The water depth after loading was also similar. An increase of 30 percent above the current maximum loading rate is recommended as the design capacity, or 400,000 gallons per day.

RIB #7 had a relatively high double-ring test infiltration rate, at 2.4 inches per hour. The water depth in current operation after almost 1 month of loading has been between 0.5 to 1 foot. The design capacity obtained using the EPA guideline with a factor of 4.5 to 10 percent would be 290,000 to 650,000 gallons per day, respectively. A design capacity of 500,000 gallons per day, is recommended.

RIB #8 had a relatively low double-ring test infiltration rate, at 0.3 inches per hour. However, this RIB has been operated three times for a period of at least 40 days, with a final water depth between 0.5 to 1 foot. A design capacity of 450,000 gallons per day, is recommended.

RIB #9 had a relatively high double-ring test infiltration rate, at 5.0 inches per hour. The water depth in current operations after approximately 1 month of loading has ranged from 1.0 to 1.5 foot. The design capacity obtained using the EPA guideline with a factor of 4.5 to 10 percent would be 530,000 to 1,170,000 gallons per day, respectively. The double-ring test may not be representative of the full pond area, and a design capacity of 500,000 gallons per day, is recommended.

RIBs #10 and #11 have similar double-ring test infiltration rates, at 0.5 inches per hour. The water depths in current operations after up to approximately 1 month of loading has been between 0.5 to 1 foot. A design capacity of 450,000 gallons per day, is recommended.

RIB #12 had a medium double-ring test infiltration rate, at 1.8 inches per hour. The RIB has been loaded up to 50 days continuous, with only 0.5 feet of water depth at the end of loading. A design capacity of 500,000 gallons per day, is recommended.

It should be noted that the infiltration rate can decrease over time due to clogging of the bottom of the RIBs. Periodic maintenance is required to either remove the clogged soil, or disturb it sufficiently to facilitate water entry.

The recommended maximum loading rate for all of the RIBs at the facility is 5.85 MGD. This rate assumes that the ponds are off 50% of the time, so the maximum flow projected to the facility at any one time is approximately 2.93 MGD. This loading rate to the RIBs assumes that the groundwater conditions in the Cold Springs basin remain somewhat similar to what they are at present. It is further recommended that Washoe County pursue developing a groundwater model to predict whether the increased infiltration from CSWRF will have a long term impact on groundwater levels and to establish long term water level recommendations for the basin.

6.0 OPERATIONAL ASSESSMENT

In general, the CSWRF is operated very effectively. The facility consistently operates well under the permit limits for BOD_5, TSS and total nitrogen. The effluent total nitrogen levels at the facility are extremely low, and point to excellent operational practices within the oxidation ditch.

In the digesters, dissolved oxygen should be monitored with a handheld DO probe on a periodic basis to determine if the existing operational practice of aerating with the jet pumps off is supplying sufficient oxygen. If the measured dissolved oxygen values are below 0.5 mg/l, the jet mixing pumps should be utilized again to improve the oxygen transfer of the system. This will likely result in a significant increase in VSS destruction within the digester, would should lead to reduced biosolids mass, improved dewaterability, and reduced biosolids hauling costs. Longer term, it would be advisable to install VFDs on both the pumps and blowers to the aeration system with a DO controller to avoid either over or under aerating the digester and saving energy.

The centrifuge is not producing a biosolids cake that is consistent with the design criteria of the centrifuge. The causes of this should be investigated with polymer vendors, potentially with the assistance of Andritz, the centrifuge manufacturer, to identify the cause of the underperformance.

7.0 CONCLUSIONS

CSWRF has sufficient capacity in each unit process to meet both the present flows and the current permitted flows, as summarized in Table 4-15. However, the growth projections performed in TM #1 show that the flow to the plant is anticipated to grow rapidly. Accordingly, most of the major unit processes at the plant will be undersized by 2023. See Table 4-16 and Figure 4-15. Some processes, such as the RAS/WAS pump station and the centrifuge, are not included in the table below as they will have to be redesigned prior to meeting their design capacity to support a new digestion or biological treatment process. Expansion alternatives for CSWRF will be explored in TM #5.

Table 4-15 – Unit Process Capacity Summary

Unit Process	Governing Criteria	Firm Capacity (MGD)	Full Capacity (MGD)
Fine Screen	Peak Pumped Flow	N/A[1]	4.5
Grit Removal	Peak Pumped Flow	N/A[1]	2.5
Oxidation Ditch (Permitted Capacity)	Peak Day Flow	0.7	0.7[2]
Oxidation Ditch (Estimated Capacity)	Max Month Flow	1.1	1.1[2]
Secondary Clarifiers	Peak Hour Flow	1.9	3.8
Effluent Pump Station	Peak Day Flow	1.6	3.2
RAS/WAS Pump Station	Percent of Peak Day Flow	2.0	3.0
Aerobic Digester	Max Month Flow	0.58	0.58
Centrifuges	Max Month Flow	N/A[3]	2.9
Rapid Infiltration Basins	Max Week Flow	2.93	2.93

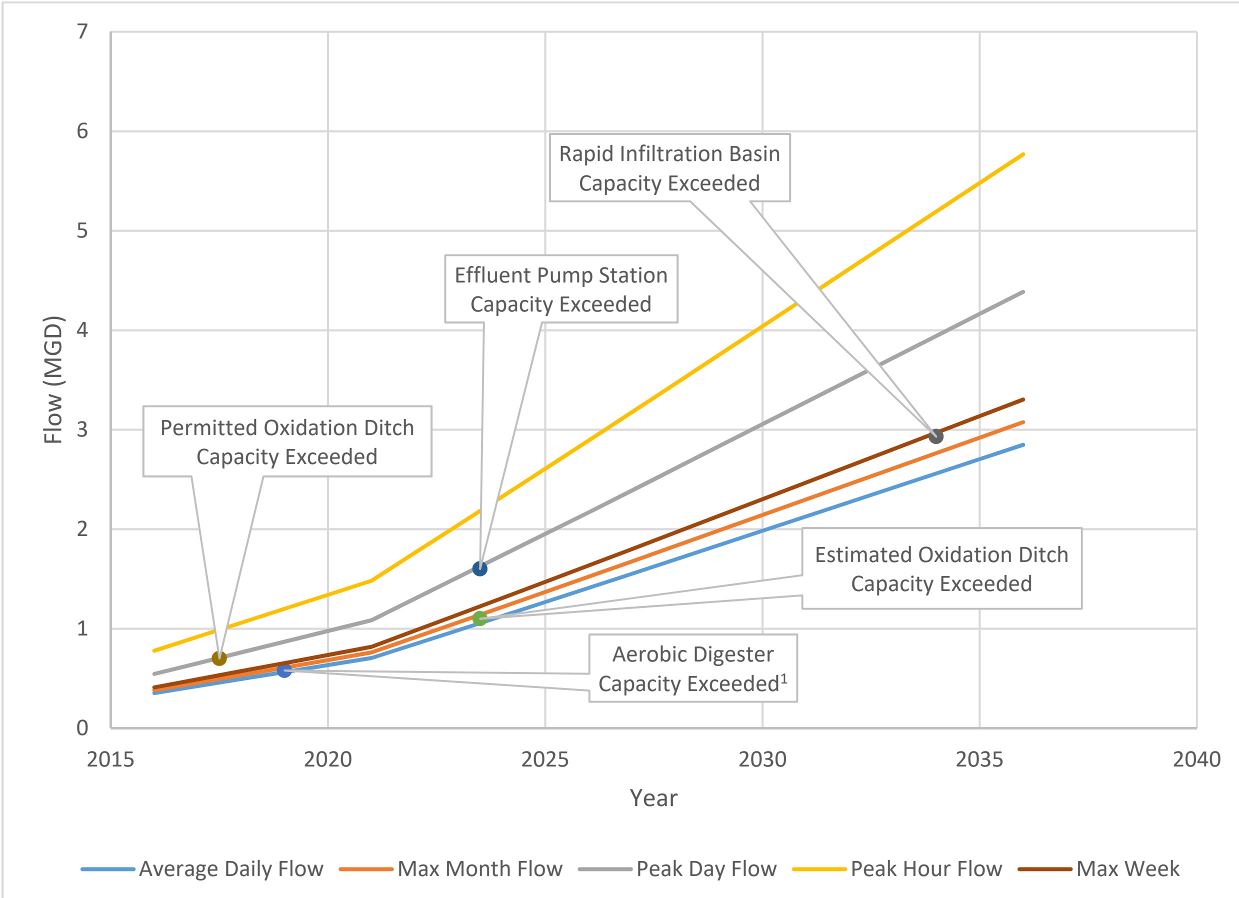
Notes: 1. Screen and grit chamber are bypassed in the event of failure.
2. Firm Capacity taken to be capacity with one aerator out of service.
3. Only one centrifuge is available. Process resiliency is provided by on-site sludge storage.

Table 4-16 – Unit Process Capacity Analysis Figure for Critical Processes

Unit Process	Current Capacity	Estimated Year Capacity Exceeded
Headworks	2.5 MGD peak instantaneous flow	Concurrent with any lift station addition
Oxidation Ditch (Permitted Capacity)	0.7 MGD peak day flow	2017
Oxidation Ditch (Estimated Capacity)	1.1 MGD maximum month flow	2023
Aerobic Digester	0.58 MGD maximum month flow	2019[1]
Effluent Pump Station	1.6 MGD peak day flow	2023
Rapid Infiltration Basins	2.93 MGD maximum week flow	2034

Notes: 1. Revising the current 60-day SRT design criteria as discussed in Section 4.2 will lengthen the time period before the aerobic digester capacity is exceeded.

Figure 4-15 – Unit Process Capacity Analysis Figure for Critical Processes



Notes: 1. Revising the current 60-day SRT design criteria as discussed in Section 4.2 will lengthen the time period before the aerobic digester capacity is exceeded.

8.0 REFERENCES

Design of Municipal Wastewater Treatment Plants. (WEF MOP 8) 5th ed. Alexandria, VA: WEF, 2010.

Recommended Standards for Wastewater Facilities (Ten State Standards) 2014 Edition, Albany, NY. Health Research, Inc. 2014

Tchobanoglous, George, Franklin L. Burton, and H. David. Stensel. (Metcalf and Eddy) Wastewater Engineering: Treatment and Reuse. Boston: McGraw-Hill, 2003.

Appendix A

Model Output

BioWin user and configuration data

Project details

Project name: Cold Springs Facility Plan **Project ref.: BW1**

Plant name: Cold Springs WRF **User name: psteele**

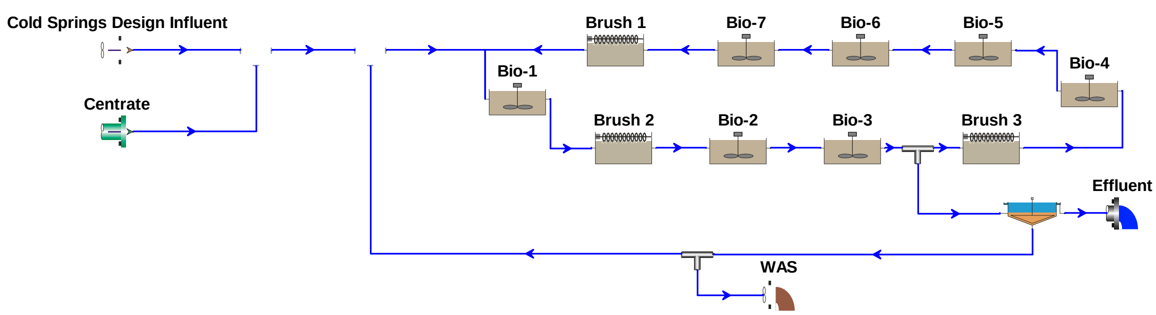
Created: 10/31/2014 **Saved: 11/4/2016**

Dynamic simulation on

SRT: 68.95* days

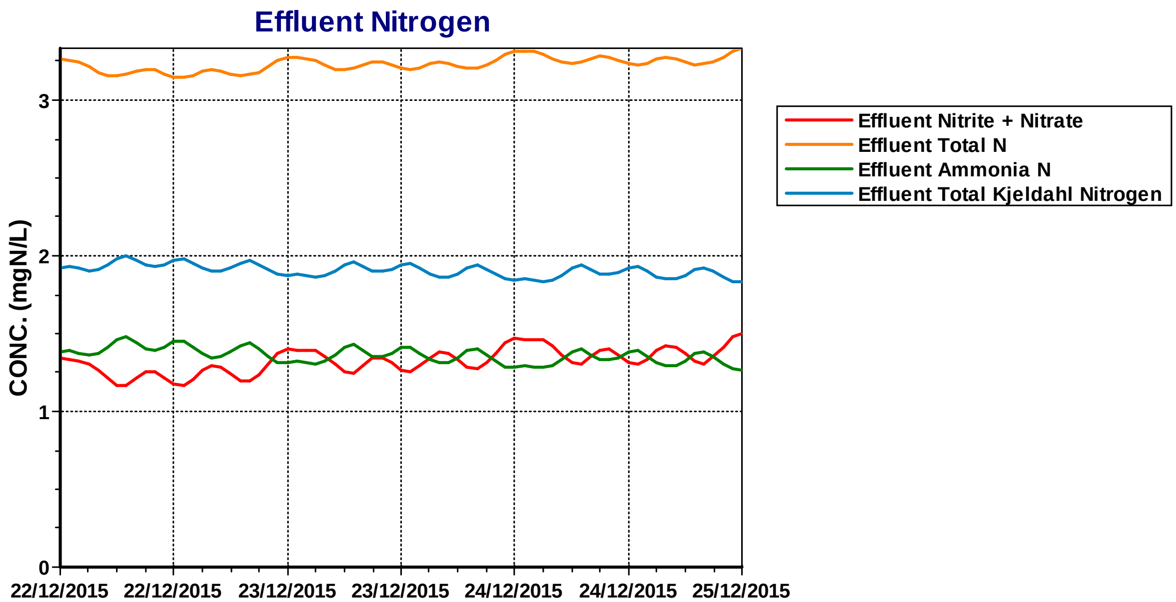
Temperature: 20.0°C

Flowsheet

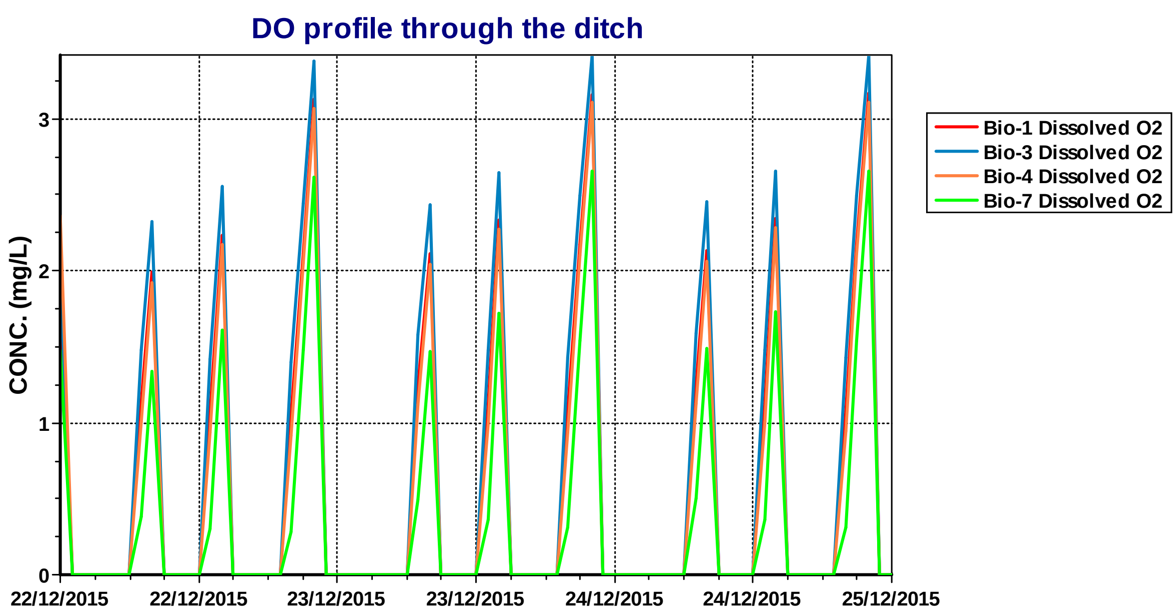


BioWin Album

Album page - Effluent Nitrogen



Album page - DO trends



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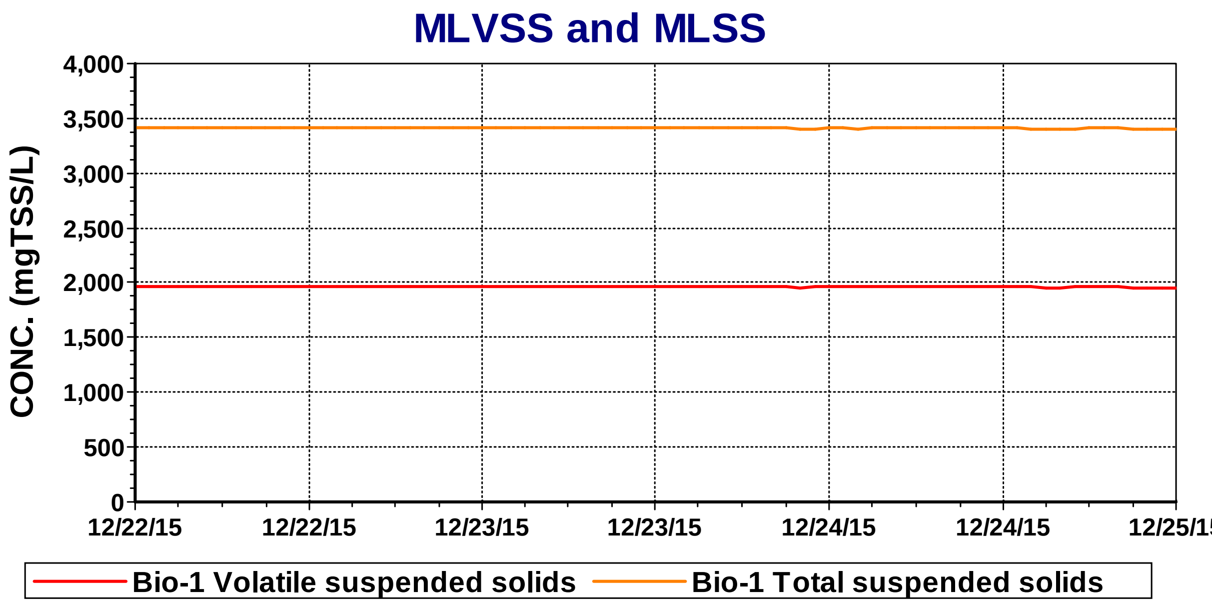

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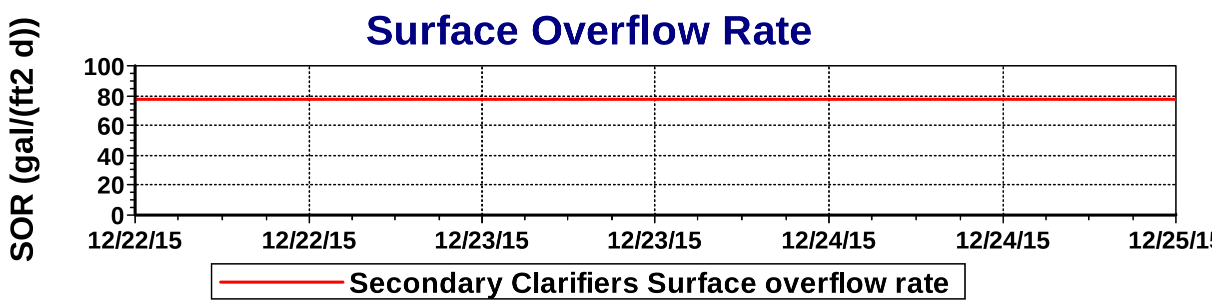

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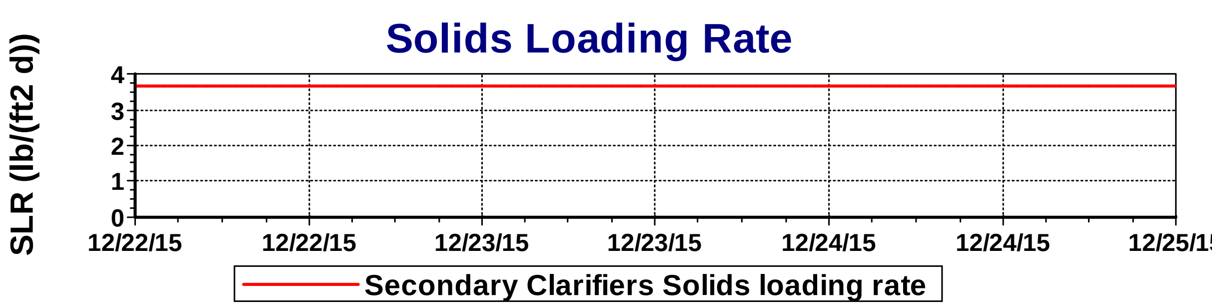


Global Parameters

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/(mgCOD d)]	0.0800	0.0800	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

AAO

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2000	0.2000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.0000	2.0000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.0000	1.0000	1.0000
Aerobic decay rate [1/d]	0.0190	0.0190	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0095	0.0095	1.0290
Ki Nitrite [mgN/L]	1000.0000	1000.0000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.0160	0.0160	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 [mol/L]	1.000E-7	1.000E-7	1.0000

Methylotrophs

Name	Default	Value	
Max. spec. growth rate [1/d]	1.3000	1.3000	1.0720
Methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.0400	0.0400	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0300	0.0300	1.0290
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

PAO

Name	Default	Value	

Max. spec. growth rate [1/d]	0.9500	0.9500	1.0000
Max. spec. growth rate, P-limited [1/d]	0.4200	0.4200	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.1000	0.1000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.0500	0.0500	1.0000
Magnesium half sat. [mgMg/L]	0.1000	0.1000	1.0000
Cation half sat. [mmol/L]	0.1000	0.1000	1.0000
Calcium half sat. [mgCa/L]	0.1000	0.1000	1.0000
Aerobic/anoxic decay rate [1/d]	0.1000	0.1000	1.0000
Aerobic/anoxic maintenance rate [1/d]	0	0	1.0000
Anaerobic decay rate [1/d]	0.0400	0.0400	1.0000
Anaerobic maintenance rate [1/d]	0	0	1.0000
Sequestration rate [1/d]	4.5000	4.5000	1.0000
Anoxic growth factor [-]	0.3300	0.3300	1.0000

Acetogens

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2500	0.2500	1.0290
Substrate half sat. [mgCOD/L]	10.0000	10.0000	1.0000
Acetate inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Anaerobic decay rate [1/d]	0.0500	0.0500	1.0290
Aerobic/anoxic decay rate [1/d]	0.5200	0.5200	1.0290

Methanogens

Name	Default	Value	
Acetoclastic max. spec. growth rate [1/d]	0.3000	0.3000	1.0290
H2-utilizing max. spec. growth rate [1/d]	1.4000	1.4000	1.0290
Acetoclastic substrate half sat. [mgCOD/L]	100.0000	100.0000	1.0000
Acetoclastic methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.1000	0.1000	1.0000
H2-utilizing substrate half sat. [mgCOD/L]	1.0000	1.0000	1.0000
H2-utilizing methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Acetoclastic anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
Acetoclastic aerobic/anoxic decay rate [1/d]	0.6000	0.6000	1.0290
H2-utilizing anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
H2-utilizing aerobic/anoxic decay rate [1/d]	2.8000	2.8000	1.0290

pH

Name	Default	Value
OHO low pH limit [-]	4.0000	4.0000
OHO high pH limit [-]	10.0000	10.0000
Methylotrophs low pH limit [-]	4.0000	4.0000
Methylotrophs high pH limit [-]	10.0000	10.0000
Autotrophs low pH limit [-]	5.5000	5.5000
Autotrophs high pH limit [-]	9.5000	9.5000
PAO low pH limit [-]	4.0000	4.0000
PAO high pH limit [-]	10.0000	10.0000
OHO low pH limit (anaerobic) [-]	5.5000	5.5000
OHO high pH limit (anaerobic) [-]	8.5000	8.5000
Propionic acetogens low pH limit [-]	4.0000	4.0000
Propionic acetogens high pH limit [-]	10.0000	10.0000
Acetoclastic methanogens low pH limit [-]	5.0000	5.0000
Acetoclastic methanogens high pH limit [-]	9.0000	9.0000
H2-utilizing methanogens low pH limit [-]	5.0000	5.0000
H2-utilizing methanogens high pH limit [-]	9.0000	9.0000

Switches

Name	Default	Value
OHO DO half sat. [mgO2/L]	0.0500	0.0500
PAO 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
AAO DO half sat. [mgO2/L]	0.0100	0.0100
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
PolyP half sat. [mgP/mgCOD]	0.0100	0.0100
VFA sequestration half sat. [mgCOD/L]	5.0000	5.0000
P uptake half sat. [mgP/L]	0.1500	0.1500
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
Propionic acetogens H2 inhibition [mgCOD/L]	5.0000	5.0000

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	1.3000
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.3000
Molecular weight of other anions [mg/mmol]	35.5000	35.5000
Molecular weight of other cations [mg/mmol]	39.1000	39.1000

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

AAO

Name	Default	Value
Yield [mgCOD/mgN]	0.1140	0.1140
Nitrate production [mgN/mgBiomassCOD]	2.2800	2.2800
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

Methylotrophs

Name	Default	Value
Yield (anoxic) [-]	0.4000	0.4000
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
Max fraction to N2O at high FNA over nitrate [-]	0.1000	0.1000
Max fraction to N2O at high FNA over nitrite [-]	0.1500	0.1500

PAO

Name	Default	Value
Yield (aerobic) [-]	0.6390	0.6390
Yield (anoxic) [-]	0.5200	0.5200
Aerobic P/PHA uptake [mgP/mgCOD]	0.9300	0.9300
Anoxic P/PHA uptake [mgP/mgCOD]	0.3500	0.3500
Yield of PHA on sequestration [-]	0.8890	0.8890
N in biomass [mgN/mgCOD]	0.0700	0.0700
N in sol. inert [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous part. [-]	0.2500	0.2500
Inert fraction of endogenous sol. [-]	0.2000	0.2000
P/Ac release ratio [mgP/mgCOD]	0.5100	0.5100
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield of low PP [-]	0.9400	0.9400
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

Acetogens

Name	Default	Value
Yield [-]	0.1000	0.1000
H2 yield [-]	0.4000	0.4000
CO2 yield [-]	1.0000	1.0000
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

Methanogens

Name	Default	Value
Acetoclastic yield [-]	0.1000	0.1000
Methanol acetoclastic yield [-]	0.1000	0.1000
H2-utilizing yield [-]	0.1000	0.1000
Methanol H2-utilizing yield [-]	0.1000	0.1000
N in acetoclastic biomass [mgN/mgCOD]	0.0700	0.0700
N in H2-utilizing biomass [mgN/mgCOD]	0.0700	0.0700
P in acetoclastic biomass [mgP/mgCOD]	0.0220	0.0220
P in H2-utilizing biomass [mgP/mgCOD]	0.0220	0.0220
Acetoclastic fraction to endog. residue [-]	0.0800	0.0800
H2-utilizing fraction to endog. residue [-]	0.0800	0.0800
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

General

Name	Default	Value
Tank head loss per metre of length (from flow) [m/m]	0.0025	0.0025

Chemical Costs

Name	Default	Value
Methanol cost [$/gal]	1.6656	1.6656
Ferric cost [$/gal]	0.3785	0.3785
Aluminium cost [$/gal]	0.3028	0.3028

Anaerobic digester

Name	Default	Value
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

Combined Heat and Power (CHP) engine

Name	Default	Value
Methane heat of combustion [kJ/mole]	800.0000	800.0000
Hydrogen heat of combustion [kJ/mole]	240.0000	240.0000
CHP engine heat price [$/kWh]	0	0
CHP engine power price [$/kWh]	0.1500	0.1500

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	2400.0000
O2 [M/atm]	1.3000E-3	1.3000E-3	1500.0000
N2 [M/atm]	6.5000E-4	6.5000E-4	1300.0000
N2O [M/atm]	2.5000E-2	2.5000E-2	2600.0000
NH3 [M/atm]	5.8000E+1	5.8000E+1	4100.0000
CH4 [M/atm]	1.4000E-3	1.4000E-3	1600.0000
H2 [M/atm]	7.8000E-4	7.8000E-4	500.0000

Properties constants

Name	Default	Value

K in Viscosity = K e ^(Ea/RT) [Pa s]	6.849E-7	6.849E-7
Ea in Viscosity = K e ^(Ea/RT) [j/mol]	1.780E+4	1.780E+4
Y in ML Viscosity = H2O viscosity * (1+A*MLSS^Y) [-]	1.0000	1.0000
A in ML Viscosity = H2O viscosity * (1+A*MLSS^Y) [m3/g]	1.000E-7	1.000E-7
A in ML Density = H2O density + A*MLSS [m3/g]	0.0032	0.0032
A in Antoine equn. [T in K, P in Bar {NIST}]	5.2039	5.2039
B in Antoine equn. [T in K, P in Bar {NIST}]	1733.9260	1733.9260
C in Antoine equn. [T in K, P in Bar {NIST}]	-39.5	-39.5

Chemical precipitation 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

Chemical precipitation 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

Pipe and pump parameters

Name	Default	Value

Static head [ft]	0.8202	0.8202
Pipe length (headloss calc.s) [ft]	164.0420	164.0420
Pipe inside diameter [in]	19.68504	19.68504
K(fittings) - Total minor losses K	5.0000	5.0000
Pipe roughness [in]	0.00787	0.00787
'A' in overall pump efficiency = A + B*Q + C*(Q^2)[-]	0.8500	0.8500
'B' in overall pump efficiency = A + B*Q + C*(Q^2)[[-]/(mgd)]	0	0
'C' in overall pump efficiency = A + B*Q + C*(Q^2)[[-]/(mgd)^2]	0	0

Fittings and loss coefficients ('K' values)

Name	Default	Value	
Pipe entrance (bellmouth)	1.0000	1.0000	0.0500
90° bend	5.0000	5.0000	0.7500
45° bend	2.0000	2.0000	0.3000
Butterfly value (open)	1.0000	1.0000	0.3000
Non-return value	0	0	1.0000
Outlet (bellmouth)	1.0000	1.0000	0.2000

Aeration

Name	Default	Value
Surface pressure [kPa]	101.3250	84.3000
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	20.9500
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Off-gas N2O [vol. %]	0	0
Surface turbulence factor [-]	2.0000	2.0000
Set point controller gain []	1.0000	1.0000

Blower

Name	Default	Value
Intake filter pressure drop [psi]	0.5076	0.5076
Pressure drop through distribution system (piping/valves) [psi]	0.4351	0.4351
Adiabatic/polytropic compression exponent (1.4 for adiabatic)	1.4000	1.4000
'A' in blower efficiency = A + B*Qa + C*(Qa^2)[-]	0.7500	0.7500
'B' in blower efficiency = A + B*Qa + C*(Qa^2)[[-]/(ft3/min (20C, 1 atm))]	0	0
'C' in blower efficiency = A + B*Qa + C*(Qa^2)[[-]/(ft3/min (20C, 1 atm))^2]	0	0

Diffuser

Name	Default	Value
k1 in C = k1(PC)^0.25 + k2	1.2400	1.2400
k2 in C = k1(PC)^0.25 + k2	0.8960	0.8960
Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	0.8880	0.8880
Area of one diffuser [ft2]	0.4413	0.4413
Diffuser mounting height [ft]	0.8202	0.8202
Min. air flow rate per diffuser ft3/min (20C, 1 atm)	0.2943	0.2943
Max. air flow rate per diffuser ft3/min (20C, 1 atm)	5.8858	5.8858
'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2 [psi]	0.4351	0.4351
'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[psi/(ft3/min (20C, 1 atm))]	0	0
'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[psi/(ft3/min (20C, 1 atm))^2]	0	0

Surface aerators

Name	Default	Value
Surface aerator Std. oxygen transfer rate [lb O /(hp hr)]	2.46697	3.00000
Maximum power per rotor [hp]	26.80965	60.00000

Modified Vesilind

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.387	0.387
Vesilind hindered zone settling parameter (K) [L/g]	0.370	0.370
Clarification switching function [mg/L]	100.000	100.000
Specified TSS conc.for height calc. [mg/L]	2500.000	2500.000
Maximum compactability constant [mg/L]	15000.000	15000.000

Double exponential

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.934	0.934
Maximum (practical) settling velocity (Vo') [ft/min]	0.615	0.615
Hindered zone settling parameter (Kh) [L/g]	0.400	0.400
Flocculent zone settling parameter (Kf) [L/g]	2.500	2.500
Maximum non-settleable TSS [mg/L]	20.0000	20.0000
Non-settleable fraction [-]	0.0010	0.0010
Specified TSS conc. for height calc. [mg/L]	2500.0000	2500.0000

Emission factors

Name	Default	Value
Carbon dioxide equivalence of nitrous oxide	296.0000	296.0000
Carbon dioxide equivalence of methane	23.0000	23.0000

Biofilm general

Name	Default	Value	
Attachment rate [g / (m2 d)]	80.0000	80.0000	1.0000
Attachment TSS half sat. [mg/L]	100.0000	100.0000	1.0000
Detachment rate [g/(m3 d)]	8.000E+4	8.000E+4	1.0000
Solids movement factor []	10.0000	10.0000	1.0000
Diffusion neta []	0.8000	0.8000	1.0000
Thin film limit [mm]	0.5000	0.5000	1.0000
Thick film limit [mm]	3.0000	3.0000	1.0000
Assumed Film thickness for tank volume correction (temp independent) [mm]	0.7500	0.7500	1.0000
Film surface area to media area ratio - Max.[ ]	1.0000	1.0000	1.0000
Minimum biofilm conc. for streamer formation [gTSS/m2]	4.0000	4.0000	1.0000

Maximum biofilm concentrations [mg/L]

Name	Default	Value	
Ordinary heterotrophic organisms (OHO)	5.000E+4	5.000E+4	1.0000

Methylotrophs	5.000E+4	5.000E+4	1.0000
Ammonia oxidizing biomass (AOB)	1.000E+5	1.000E+5	1.0000
Nitrite oxidizing biomass (NOB)	1.000E+5	1.000E+5	1.0000
Anaerobic ammonia oxidizers (AAO)	5.000E+4	5.000E+4	1.0000
Polyphosphate accumulating organisms (PAO)	5.000E+4	5.000E+4	1.0000
Propionic acetogens	5.000E+4	5.000E+4	1.0000
Methanogens - acetoclastic	5.000E+4	5.000E+4	1.0000
Methanogens - hydrogenotrophic	5.000E+4	5.000E+4	1.0000
Endogenous products	3.000E+4	3.000E+4	1.0000
Slowly bio. COD (part.)	5000.0000	5000.0000	1.0000
Slowly bio. COD (colloid.)	4000.0000	4000.0000	1.0000
Part. inert. COD	5000.0000	5000.0000	1.0000
Part. bio. org. N	0	0	1.0000
Part. bio. org. P	0	0	1.0000
Part. inert N	0	0	1.0000
Part. inert P	0	0	1.0000
Stored PHA	5000.0000	5000.0000	1.0000
Releasable stored polyP	1.150E+6	1.150E+6	1.0000
Fixed stored polyP	1.150E+6	1.150E+6	1.0000
Readily bio. COD (complex)	0	0	1.0000
Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved CH4	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrous Oxide N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved N2	0	0	1.0000
PO4-P (Sol. & Me Complexed)	1.000E+10	1.000E+10	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
ISS Influent	1.300E+6	1.300E+6	1.0000
Struvite	8.500E+5	8.500E+5	1.0000
Hydroxy-dicalcium-phosphate	1.150E+6	1.150E+6	1.0000
Hydroxy-apatite	1.600E+6	1.600E+6	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.000E+10	1.000E+10	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000

User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	5.000E+4	5.000E+4	1.0000
User defined 4	5.000E+4	5.000E+4	1.0000
Dissolved O2	0	0	1.0000

Effective diffusivities [m2/s]

Name	Default	Value	
Ordinary heterotrophic organisms (OHO)	5.000E-14	5.000E-14	1.0290
Methylotrophs	5.000E-14	5.000E-14	1.0290
Ammonia oxidizing biomass (AOB)	5.000E-14	5.000E-14	1.0290
Nitrite oxidizing biomass (NOB)	5.000E-14	5.000E-14	1.0290
Anaerobic ammonia oxidizers (AAO)	5.000E-14	5.000E-14	1.0290
Polyphosphate accumulating organisms (PAO)	5.000E-14	5.000E-14	1.0290
Propionic acetogens	5.000E-14	5.000E-14	1.0290
Methanogens - acetoclastic	5.000E-14	5.000E-14	1.0290
Methanogens - hydrogenotrophic	5.000E-14	5.000E-14	1.0290
Endogenous products	5.000E-14	5.000E-14	1.0290
Slowly bio. COD (part.)	5.000E-14	5.000E-14	1.0290
Slowly bio. COD (colloid.)	5.000E-12	5.000E-12	1.0290
Part. inert. COD	5.000E-14	5.000E-14	1.0290
Part. bio. org. N	5.000E-14	5.000E-14	1.0290
Part. bio. org. P	5.000E-14	5.000E-14	1.0290
Part. inert N	5.000E-14	5.000E-14	1.0290
Part. inert P	5.000E-14	5.000E-14	1.0290
Stored PHA	5.000E-14	5.000E-14	1.0290
Releasable stored polyP	5.000E-14	5.000E-14	1.0290
Fixed stored polyP	5.000E-14	5.000E-14	1.0290
Readily bio. COD (complex)	6.900E-10	6.900E-10	1.0290
Acetate	1.240E-9	1.240E-9	1.0290
Propionate	8.300E-10	8.300E-10	1.0290
Methanol	1.600E-9	1.600E-9	1.0290
Dissolved H2	5.850E-9	5.850E-9	1.0290
Dissolved CH4	1.963E-9	1.963E-9	1.0290
Ammonia N	2.000E-9	2.000E-9	1.0290
Sol. bio. org. N	1.370E-9	1.370E-9	1.0290
Nitrous Oxide N	1.607E-9	1.607E-9	1.0290
Nitrite N	2.980E-9	2.980E-9	1.0290
Nitrate N	2.980E-9	2.980E-9	1.0290
Dissolved N2	1.900E-9	1.900E-9	1.0290
PO4-P (Sol. & Me Complexed)	2.000E-9	2.000E-9	1.0290

Sol. inert COD	6.900E-10	6.900E-10	1.0290
Sol. inert TKN	6.850E-10	6.850E-10	1.0290
ISS Influent	5.000E-14	5.000E-14	1.0290
Struvite	5.000E-14	5.000E-14	1.0290
Hydroxy-dicalcium-phosphate	5.000E-14	5.000E-14	1.0290
Hydroxy-apatite	5.000E-14	5.000E-14	1.0290
Magnesium	7.200E-10	7.200E-10	1.0290
Calcium	7.200E-10	7.200E-10	1.0290
Metal	4.800E-10	4.800E-10	1.0290
Other Cations (strong bases)	1.440E-9	1.440E-9	1.0290
Other Anions (strong acids)	1.440E-9	1.440E-9	1.0290
Total CO2	1.960E-9	1.960E-9	1.0290
User defined 1	6.900E-10	6.900E-10	1.0290
User defined 2	6.900E-10	6.900E-10	1.0290
User defined 3	5.000E-14	5.000E-14	1.0290
User defined 4	5.000E-14	5.000E-14	1.0290
Dissolved O2	2.500E-9	2.500E-9	1.0290

EPS Strength coefficients [ ]

Name	Default	Value	
Ordinary heterotrophic organisms (OHO)	1.0000	1.0000	1.0000
Methylotrophs	1.0000	1.0000	1.0000
Ammonia oxidizing biomass (AOB)	5.0000	5.0000	1.0000
Nitrite oxidizing biomass (NOB)	25.0000	25.0000	1.0000
Anaerobic ammonia oxidizers (AAO)	10.0000	10.0000	1.0000
Polyphosphate accumulating organisms (PAO)	1.0000	1.0000	1.0000
Propionic acetogens	1.0000	1.0000	1.0000
Methanogens - acetoclastic	1.0000	1.0000	1.0000
Methanogens - hydrogenotrophic	1.0000	1.0000	1.0000
Endogenous products	1.0000	1.0000	1.0000
Slowly bio. COD (part.)	1.0000	1.0000	1.0000
Slowly bio. COD (colloid.)	1.0000	1.0000	1.0000
Part. inert. COD	1.0000	1.0000	1.0000
Part. bio. org. N	1.0000	1.0000	1.0000
Part. bio. org. P	1.0000	1.0000	1.0000
Part. inert N	1.0000	1.0000	1.0000
Part. inert P	1.0000	1.0000	1.0000
Stored PHA	1.0000	1.0000	1.0000
Releasable stored polyP	1.0000	1.0000	1.0000
Fixed stored polyP	1.0000	1.0000	1.0000
Readily bio. COD (complex)	0	0	1.0000

Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved CH4	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrous Oxide N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved N2	0	0	1.0000
PO4-P (Sol. & Me Complexed)	1.0000	1.0000	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
ISS Influent	0.3300	0.3300	1.0000
Struvite	1.0000	1.0000	1.0000
Hydroxy-dicalcium-phosphate	1.0000	1.0000	1.0000
Hydroxy-apatite	1.0000	1.0000	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.0000	1.0000	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000
User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	1.0000	1.0000	1.0000
User defined 4	1.0000	1.0000	1.0000
Dissolved O2	0	0	1.0000

The simulation is constructed based upon the loadings recorded monthly from 1/1/15 - 3/1/16. The loadings were assumed to come on a constant basis. The average flow over the time period was 0.3 MGD. The simulation is performed dynamically with constant loadings to reflect the actual on/off rotor schedule at the plant. The rotors have a nameplate capacity of 60 HP. I assumed the motors were 75% efficient and operating at 80% of capacity to reach the applied power to the water for Biowin.

Clarifier removal efficiency was set to approximately reflect the TSS effluent data.

WAS split as set to acheive a balance between actual MLSS and actual MLVSS. The ratio between the two shoud be around 0.8, but is 0.57 in the model.

BioWin user and configuration data

Project details

Project name: Cold Springs Facility Plan **Project ref.: BW1**

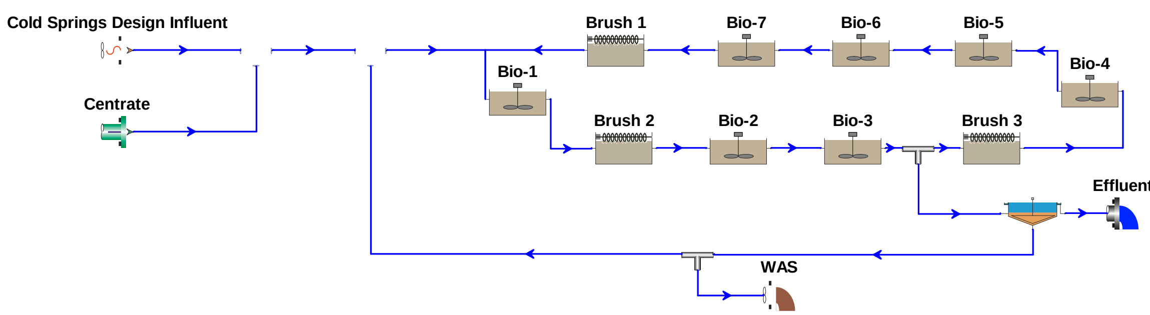
Plant name: Cold Springs WRF **User name: psteele**

Created: 10/31/2014 **Saved: 11/4/2016**

SRT: ** days**

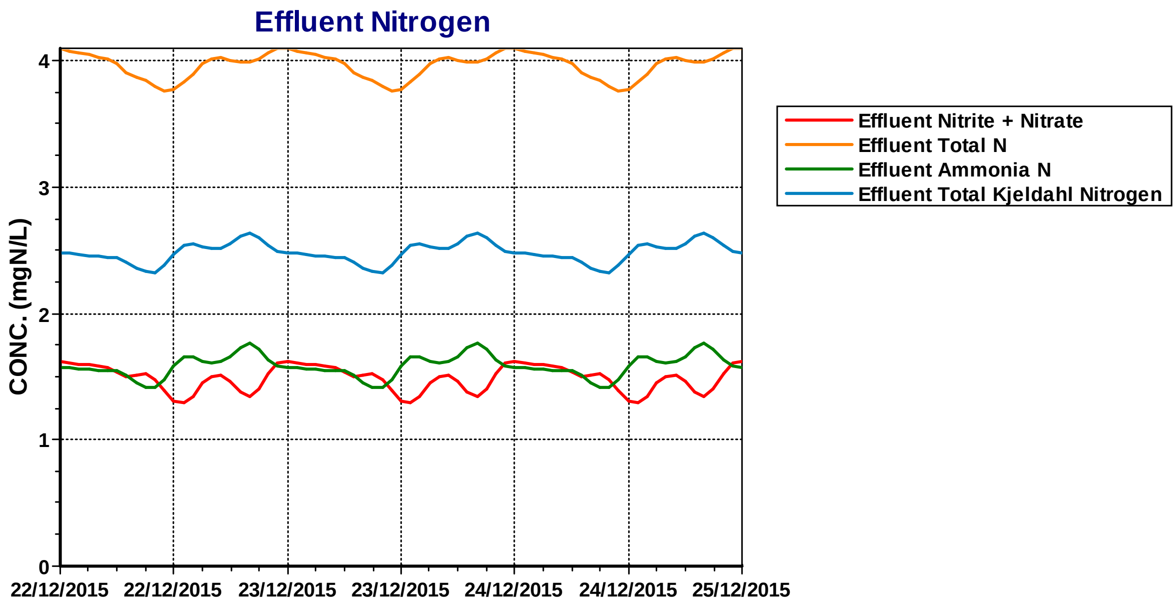
Temperature: 15.5°C

Flowsheet

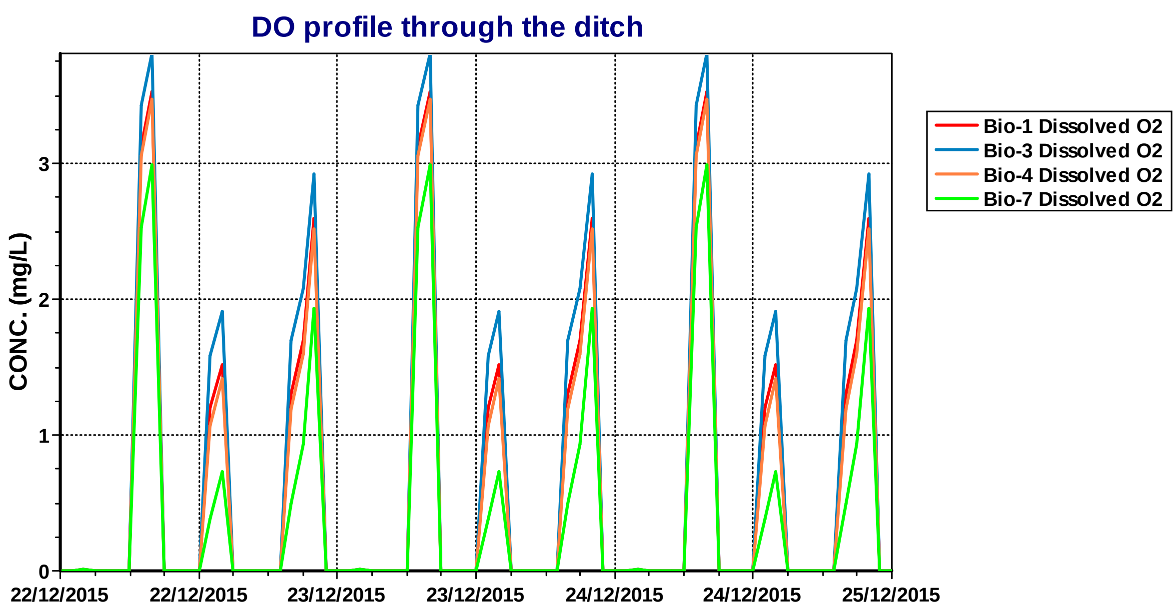


BioWin Album

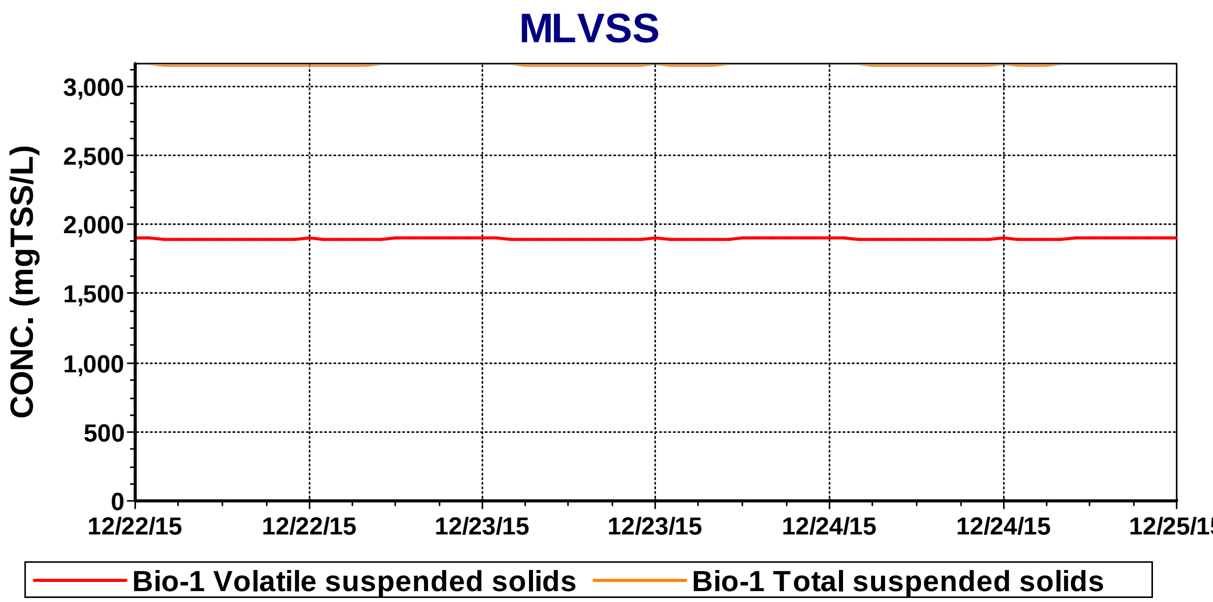
Album page - Effluent Nitrogen



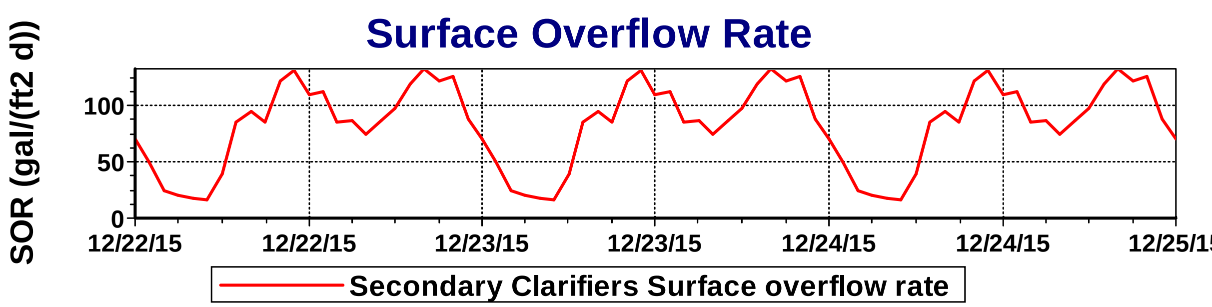
Album page - DO trends



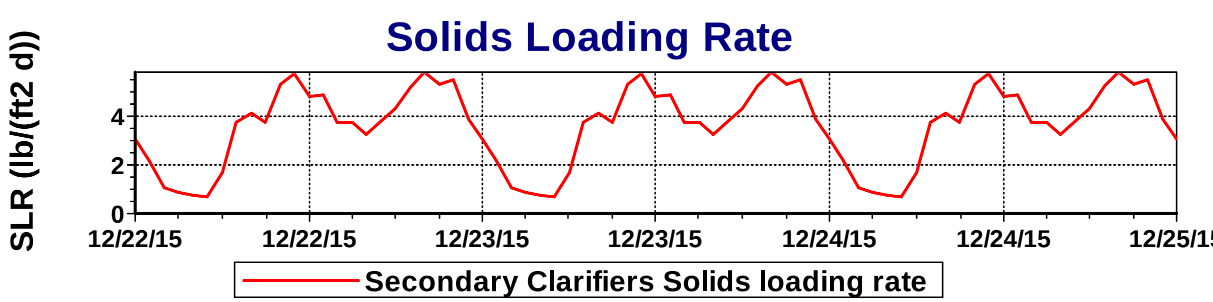
Album page - MLVSS



Album page - Clarifier Data



Album page - Clarifier Data



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/(mgCOD d)]	0.0800	0.0800	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

AAO

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2000	0.2000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.0000	2.0000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.0000	1.0000	1.0000
Aerobic decay rate [1/d]	0.0190	0.0190	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0095	0.0095	1.0290
Ki Nitrite [mgN/L]	1000.0000	1000.0000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.0160	0.0160	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 [mol/L]	1.000E-7	1.000E-7	1.0000

Methylotrophs

Name	Default	Value	
Max. spec. growth rate [1/d]	1.3000	1.3000	1.0720
Methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.0400	0.0400	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0300	0.0300	1.0290
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

PAO

Name	Default	Value

Max. spec. growth rate [1/d]	0.9500	0.9500	1.0000
Max. spec. growth rate, P-limited [1/d]	0.4200	0.4200	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.1000	0.1000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.0500	0.0500	1.0000
Magnesium half sat. [mgMg/L]	0.1000	0.1000	1.0000
Cation half sat. [mmol/L]	0.1000	0.1000	1.0000
Calcium half sat. [mgCa/L]	0.1000	0.1000	1.0000
Aerobic/anoxic decay rate [1/d]	0.1000	0.1000	1.0000
Aerobic/anoxic maintenance rate [1/d]	0	0	1.0000
Anaerobic decay rate [1/d]	0.0400	0.0400	1.0000
Anaerobic maintenance rate [1/d]	0	0	1.0000
Sequestration rate [1/d]	4.5000	4.5000	1.0000
Anoxic growth factor [-]	0.3300	0.3300	1.0000

Acetogens

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2500	0.2500	1.0290
Substrate half sat. [mgCOD/L]	10.0000	10.0000	1.0000
Acetate inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Anaerobic decay rate [1/d]	0.0500	0.0500	1.0290
Aerobic/anoxic decay rate [1/d]	0.5200	0.5200	1.0290

Methanogens

Name	Default	Value	
Acetoclastic max. spec. growth rate [1/d]	0.3000	0.3000	1.0290
H2-utilizing max. spec. growth rate [1/d]	1.4000	1.4000	1.0290
Acetoclastic substrate half sat. [mgCOD/L]	100.0000	100.0000	1.0000
Acetoclastic methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.1000	0.1000	1.0000
H2-utilizing substrate half sat. [mgCOD/L]	1.0000	1.0000	1.0000
H2-utilizing methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Acetoclastic anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
Acetoclastic aerobic/anoxic decay rate [1/d]	0.6000	0.6000	1.0290
H2-utilizing anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
H2-utilizing aerobic/anoxic decay rate [1/d]	2.8000	2.8000	1.0290

pH

Name	Default	Value
OHO low pH limit [-]	4.0000	4.0000
OHO high pH limit [-]	10.0000	10.0000
Methylotrophs low pH limit [-]	4.0000	4.0000
Methylotrophs high pH limit [-]	10.0000	10.0000
Autotrophs low pH limit [-]	5.5000	5.5000
Autotrophs high pH limit [-]	9.5000	9.5000
PAO low pH limit [-]	4.0000	4.0000
PAO high pH limit [-]	10.0000	10.0000
OHO low pH limit (anaerobic) [-]	5.5000	5.5000
OHO high pH limit (anaerobic) [-]	8.5000	8.5000
Propionic acetogens low pH limit [-]	4.0000	4.0000
Propionic acetogens high pH limit [-]	10.0000	10.0000
Acetoclastic methanogens low pH limit [-]	5.0000	5.0000
Acetoclastic methanogens high pH limit [-]	9.0000	9.0000
H2-utilizing methanogens low pH limit [-]	5.0000	5.0000
H2-utilizing methanogens high pH limit [-]	9.0000	9.0000

Switches

Name	Default	Value
OHO DO half sat. [mgO2/L]	0.0500	0.0500
PAO 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
AAO DO half sat. [mgO2/L]	0.0100	0.0100
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
PolyP half sat. [mgP/mgCOD]	0.0100	0.0100
VFA sequestration half sat. [mgCOD/L]	5.0000	5.0000
P uptake half sat. [mgP/L]	0.1500	0.1500
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
Propionic acetogens H2 inhibition [mgCOD/L]	5.0000	5.0000

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	1.3000
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.3000
Molecular weight of other anions [mg/mmol]	35.5000	35.5000
Molecular weight of other cations [mg/mmol]	39.1000	39.1000

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

AAO

Name	Default	Value
Yield [mgCOD/mgN]	0.1140	0.1140
Nitrate production [mgN/mgBiomassCOD]	2.2800	2.2800
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

Methylotrophs

Name	Default	Value
Yield (anoxic) [-]	0.4000	0.4000
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
Max fraction to N2O at high FNA over nitrate [-]	0.1000	0.1000
Max fraction to N2O at high FNA over nitrite [-]	0.1500	0.1500

PAO

Name	Default	Value
Yield (aerobic) [-]	0.6390	0.6390
Yield (anoxic) [-]	0.5200	0.5200
Aerobic P/PHA uptake [mgP/mgCOD]	0.9300	0.9300
Anoxic P/PHA uptake [mgP/mgCOD]	0.3500	0.3500
Yield of PHA on sequestration [-]	0.8890	0.8890
N in biomass [mgN/mgCOD]	0.0700	0.0700
N in sol. inert [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous part. [-]	0.2500	0.2500
Inert fraction of endogenous sol. [-]	0.2000	0.2000
P/Ac release ratio [mgP/mgCOD]	0.5100	0.5100
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield of low PP [-]	0.9400	0.9400
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

Acetogens

Name	Default	Value
Yield [-]	0.1000	0.1000
H2 yield [-]	0.4000	0.4000
CO2 yield [-]	1.0000	1.0000
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

Methanogens

Name	Default	Value
Acetoclastic yield [-]	0.1000	0.1000
Methanol acetoclastic yield [-]	0.1000	0.1000
H2-utilizing yield [-]	0.1000	0.1000
Methanol H2-utilizing yield [-]	0.1000	0.1000
N in acetoclastic biomass [mgN/mgCOD]	0.0700	0.0700
N in H2-utilizing biomass [mgN/mgCOD]	0.0700	0.0700
P in acetoclastic biomass [mgP/mgCOD]	0.0220	0.0220
P in H2-utilizing biomass [mgP/mgCOD]	0.0220	0.0220
Acetoclastic fraction to endog. residue [-]	0.0800	0.0800
H2-utilizing fraction to endog. residue [-]	0.0800	0.0800
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

General

Name	Default	Value
Tank head loss per metre of length (from flow) [m/m]	0.0025	0.0025

Chemical Costs

Name	Default	Value
Methanol cost [$/gal]	1.6656	1.6656
Ferric cost [$/gal]	0.3785	0.3785
Aluminium cost [$/gal]	0.3028	0.3028

Anaerobic digester

Name	Default	Value
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

Combined Heat and Power (CHP) engine

Name	Default	Value
Methane heat of combustion [kJ/mole]	800.0000	800.0000
Hydrogen heat of combustion [kJ/mole]	240.0000	240.0000
CHP engine heat price [$/kWh]	0	0
CHP engine power price [$/kWh]	0.1500	0.1500

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	2400.0000
O2 [M/atm]	1.3000E-3	1.3000E-3	1500.0000
N2 [M/atm]	6.5000E-4	6.5000E-4	1300.0000
N2O [M/atm]	2.5000E-2	2.5000E-2	2600.0000
NH3 [M/atm]	5.8000E+1	5.8000E+1	4100.0000
CH4 [M/atm]	1.4000E-3	1.4000E-3	1600.0000
H2 [M/atm]	7.8000E-4	7.8000E-4	500.0000

Properties constants

Name	Default	Value

K in Viscosity = K e ^(Ea/RT) [Pa s]	6.849E-7	6.849E-7
Ea in Viscosity = K e ^(Ea/RT) [j/mol]	1.780E+4	1.780E+4
Y in ML Viscosity = H2O viscosity * (1+A*MLSS^Y) [-]	1.0000	1.0000
A in ML Viscosity = H2O viscosity * (1+A*MLSS^Y) [m3/g]	1.000E-7	1.000E-7
A in ML Density = H2O density + A*MLSS [m3/g]	0.0032	0.0032
A in Antoine equn. [T in K, P in Bar {NIST}]	5.2039	5.2039
B in Antoine equn. [T in K, P in Bar {NIST}]	1733.9260	1733.9260
C in Antoine equn. [T in K, P in Bar {NIST}]	-39.5	-39.5

Chemical precipitation 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

Chemical precipitation 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

Pipe and pump parameters

Name	Default	Value

Static head [ft]	0.8202	0.8202
Pipe length (headloss calc.s) [ft]	164.0420	164.0420
Pipe inside diameter [in]	19.68504	19.68504
K(fittings) - Total minor losses K	5.0000	5.0000
Pipe roughness [in]	0.00787	0.00787
'A' in overall pump efficiency = A + B*Q + C*(Q^2)[-]	0.8500	0.8500
'B' in overall pump efficiency = A + B*Q + C*(Q^2)[[-]/(mgd)]	0	0
'C' in overall pump efficiency = A + B*Q + C*(Q^2)[[-]/(mgd)^2]	0	0

Fittings and loss coefficients ('K' values)

Name	Default	Value	
Pipe entrance (bellmouth)	1.0000	1.0000	0.0500
90° bend	5.0000	5.0000	0.7500
45° bend	2.0000	2.0000	0.3000
Butterfly value (open)	1.0000	1.0000	0.3000
Non-return value	0	0	1.0000
Outlet (bellmouth)	1.0000	1.0000	0.2000

Aeration

Name	Default	Value
Surface pressure [kPa]	101.3250	84.3000
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	20.9500
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Off-gas N2O [vol. %]	0	0
Surface turbulence factor [-]	2.0000	2.0000
Set point controller gain []	1.0000	1.0000

Blower

Name	Default	Value
Intake filter pressure drop [psi]	0.5076	0.5076
Pressure drop through distribution system (piping/valves) [psi]	0.4351	0.4351
Adiabatic/polytropic compression exponent (1.4 for adiabatic)	1.4000	1.4000
'A' in blower efficiency = A + B*Qa + C*(Qa^2)[-]	0.7500	0.7500
'B' in blower efficiency = A + B*Qa + C*(Qa^2)[[-]/(ft3/min (20C, 1 atm))]	0	0
'C' in blower efficiency = A + B*Qa + C*(Qa^2)[[-]/(ft3/min (20C, 1 atm))^2]	0	0

Diffuser

Name	Default	Value
k1 in C = k1(PC)^0.25 + k2	1.2400	1.2400
k2 in C = k1(PC)^0.25 + k2	0.8960	0.8960
Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	0.8880	0.8880
Area of one diffuser [ft2]	0.4413	0.4413
Diffuser mounting height [ft]	0.8202	0.8202
Min. air flow rate per diffuser ft3/min (20C, 1 atm)	0.2943	0.2943
Max. air flow rate per diffuser ft3/min (20C, 1 atm)	5.8858	5.8858
'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2 [psi]	0.4351	0.4351
'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[psi/(ft3/min (20C, 1 atm))]	0	0
'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[psi/(ft3/min (20C, 1 atm))^2]	0	0

Surface aerators

Name	Default	Value
Surface aerator Std. oxygen transfer rate [lb O /(hp hr)]	2.46697	3.00000
Maximum power per rotor [hp]	26.80965	60.00000

Modified Vesilind

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.387	0.387
Vesilind hindered zone settling parameter (K) [L/g]	0.370	0.370
Clarification switching function [mg/L]	100.000	100.000
Specified TSS conc.for height calc. [mg/L]	2500.000	2500.000
Maximum compactability constant [mg/L]	15000.000	15000.000

Double exponential

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.934	0.934
Maximum (practical) settling velocity (Vo') [ft/min]	0.615	0.615
Hindered zone settling parameter (Kh) [L/g]	0.400	0.400
Flocculent zone settling parameter (Kf) [L/g]	2.500	2.500
Maximum non-settleable TSS [mg/L]	20.0000	20.0000
Non-settleable fraction [-]	0.0010	0.0010
Specified TSS conc. for height calc. [mg/L]	2500.0000	2500.0000

Emission factors

Name	Default	Value
Carbon dioxide equivalence of nitrous oxide	296.0000	296.0000
Carbon dioxide equivalence of methane	23.0000	23.0000

Biofilm general

Name	Default	Value	
Attachment rate [g / (m2 d)]	80.0000	80.0000	1.0000
Attachment TSS half sat. [mg/L]	100.0000	100.0000	1.0000
Detachment rate [g/(m3 d)]	8.000E+4	8.000E+4	1.0000
Solids movement factor []	10.0000	10.0000	1.0000
Diffusion neta []	0.8000	0.8000	1.0000
Thin film limit [mm]	0.5000	0.5000	1.0000
Thick film limit [mm]	3.0000	3.0000	1.0000
Assumed Film thickness for tank volume correction (temp independent) [mm]	0.7500	0.7500	1.0000
Film surface area to media area ratio - Max.[ ]	1.0000	1.0000	1.0000
Minimum biofilm conc. for streamer formation [gTSS/m2]	4.0000	4.0000	1.0000

Maximum biofilm concentrations [mg/L]

Name	Default	Value	
Ordinary heterotrophic organisms (OHO)	5.000E+4	5.000E+4	1.0000

Methylotrophs	5.000E+4	5.000E+4	1.0000
Ammonia oxidizing biomass (AOB)	1.000E+5	1.000E+5	1.0000
Nitrite oxidizing biomass (NOB)	1.000E+5	1.000E+5	1.0000
Anaerobic ammonia oxidizers (AAO)	5.000E+4	5.000E+4	1.0000
Polyphosphate accumulating organisms (PAO)	5.000E+4	5.000E+4	1.0000
Propionic acetogens	5.000E+4	5.000E+4	1.0000
Methanogens - acetoclastic	5.000E+4	5.000E+4	1.0000
Methanogens - hydrogenotrophic	5.000E+4	5.000E+4	1.0000
Endogenous products	3.000E+4	3.000E+4	1.0000
Slowly bio. COD (part.)	5000.0000	5000.0000	1.0000
Slowly bio. COD (colloid.)	4000.0000	4000.0000	1.0000
Part. inert. COD	5000.0000	5000.0000	1.0000
Part. bio. org. N	0	0	1.0000
Part. bio. org. P	0	0	1.0000
Part. inert N	0	0	1.0000
Part. inert P	0	0	1.0000
Stored PHA	5000.0000	5000.0000	1.0000
Releasable stored polyP	1.150E+6	1.150E+6	1.0000
Fixed stored polyP	1.150E+6	1.150E+6	1.0000
Readily bio. COD (complex)	0	0	1.0000
Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved CH4	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrous Oxide N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved N2	0	0	1.0000
PO4-P (Sol. & Me Complexed)	1.000E+10	1.000E+10	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
ISS Influent	1.300E+6	1.300E+6	1.0000
Struvite	8.500E+5	8.500E+5	1.0000
Hydroxy-dicalcium-phosphate	1.150E+6	1.150E+6	1.0000
Hydroxy-apatite	1.600E+6	1.600E+6	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.000E+10	1.000E+10	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000

User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	5.000E+4	5.000E+4	1.0000
User defined 4	5.000E+4	5.000E+4	1.0000
Dissolved O2	0	0	1.0000

Effective diffusivities [m2/s]

Name	Default	Value	
Ordinary heterotrophic organisms (OHO)	5.000E-14	5.000E-14	1.0290
Methylotrophs	5.000E-14	5.000E-14	1.0290
Ammonia oxidizing biomass (AOB)	5.000E-14	5.000E-14	1.0290
Nitrite oxidizing biomass (NOB)	5.000E-14	5.000E-14	1.0290
Anaerobic ammonia oxidizers (AAO)	5.000E-14	5.000E-14	1.0290
Polyphosphate accumulating organisms (PAO)	5.000E-14	5.000E-14	1.0290
Propionic acetogens	5.000E-14	5.000E-14	1.0290
Methanogens - acetoclastic	5.000E-14	5.000E-14	1.0290
Methanogens - hydrogenotrophic	5.000E-14	5.000E-14	1.0290
Endogenous products	5.000E-14	5.000E-14	1.0290
Slowly bio. COD (part.)	5.000E-14	5.000E-14	1.0290
Slowly bio. COD (colloid.)	5.000E-12	5.000E-12	1.0290
Part. inert. COD	5.000E-14	5.000E-14	1.0290
Part. bio. org. N	5.000E-14	5.000E-14	1.0290
Part. bio. org. P	5.000E-14	5.000E-14	1.0290
Part. inert N	5.000E-14	5.000E-14	1.0290
Part. inert P	5.000E-14	5.000E-14	1.0290
Stored PHA	5.000E-14	5.000E-14	1.0290
Releasable stored polyP	5.000E-14	5.000E-14	1.0290
Fixed stored polyP	5.000E-14	5.000E-14	1.0290
Readily bio. COD (complex)	6.900E-10	6.900E-10	1.0290
Acetate	1.240E-9	1.240E-9	1.0290
Propionate	8.300E-10	8.300E-10	1.0290
Methanol	1.600E-9	1.600E-9	1.0290
Dissolved H2	5.850E-9	5.850E-9	1.0290
Dissolved CH4	1.963E-9	1.963E-9	1.0290
Ammonia N	2.000E-9	2.000E-9	1.0290
Sol. bio. org. N	1.370E-9	1.370E-9	1.0290
Nitrous Oxide N	1.607E-9	1.607E-9	1.0290
Nitrite N	2.980E-9	2.980E-9	1.0290
Nitrate N	2.980E-9	2.980E-9	1.0290
Dissolved N2	1.900E-9	1.900E-9	1.0290
PO4-P (Sol. & Me Complexed)	2.000E-9	2.000E-9	1.0290

Sol. inert COD	6.900E-10	6.900E-10	1.0290
Sol. inert TKN	6.850E-10	6.850E-10	1.0290
ISS Influent	5.000E-14	5.000E-14	1.0290
Struvite	5.000E-14	5.000E-14	1.0290
Hydroxy-dicalcium-phosphate	5.000E-14	5.000E-14	1.0290
Hydroxy-apatite	5.000E-14	5.000E-14	1.0290
Magnesium	7.200E-10	7.200E-10	1.0290
Calcium	7.200E-10	7.200E-10	1.0290
Metal	4.800E-10	4.800E-10	1.0290
Other Cations (strong bases)	1.440E-9	1.440E-9	1.0290
Other Anions (strong acids)	1.440E-9	1.440E-9	1.0290
Total CO2	1.960E-9	1.960E-9	1.0290
User defined 1	6.900E-10	6.900E-10	1.0290
User defined 2	6.900E-10	6.900E-10	1.0290
User defined 3	5.000E-14	5.000E-14	1.0290
User defined 4	5.000E-14	5.000E-14	1.0290
Dissolved O2	2.500E-9	2.500E-9	1.0290

EPS Strength coefficients [ ]

Name	Default	Value	
Ordinary heterotrophic organisms (OHO)	1.0000	1.0000	1.0000
Methylotrophs	1.0000	1.0000	1.0000
Ammonia oxidizing biomass (AOB)	5.0000	5.0000	1.0000
Nitrite oxidizing biomass (NOB)	25.0000	25.0000	1.0000
Anaerobic ammonia oxidizers (AAO)	10.0000	10.0000	1.0000
Polyphosphate accumulating organisms (PAO)	1.0000	1.0000	1.0000
Propionic acetogens	1.0000	1.0000	1.0000
Methanogens - acetoclastic	1.0000	1.0000	1.0000
Methanogens - hydrogenotrophic	1.0000	1.0000	1.0000
Endogenous products	1.0000	1.0000	1.0000
Slowly bio. COD (part.)	1.0000	1.0000	1.0000
Slowly bio. COD (colloid.)	1.0000	1.0000	1.0000
Part. inert. COD	1.0000	1.0000	1.0000
Part. bio. org. N	1.0000	1.0000	1.0000
Part. bio. org. P	1.0000	1.0000	1.0000
Part. inert N	1.0000	1.0000	1.0000
Part. inert P	1.0000	1.0000	1.0000
Stored PHA	1.0000	1.0000	1.0000
Releasable stored polyP	1.0000	1.0000	1.0000
Fixed stored polyP	1.0000	1.0000	1.0000
Readily bio. COD (complex)	0	0	1.0000

Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved CH4	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrous Oxide N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved N2	0	0	1.0000
PO4-P (Sol. & Me Complexed)	1.0000	1.0000	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
ISS Influent	0.3300	0.3300	1.0000
Struvite	1.0000	1.0000	1.0000
Hydroxy-dicalcium-phosphate	1.0000	1.0000	1.0000
Hydroxy-apatite	1.0000	1.0000	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.0000	1.0000	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000
User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	1.0000	1.0000	1.0000
User defined 4	1.0000	1.0000	1.0000
Dissolved O2	0	0	1.0000

The simulation is constructed based upon the loadings recorded on 12/22 and 12/23 2015. These loadings constitute the only diurnal curve available for the plant. The flow on that day was approximately 0.325 MGD.

The simulation is performed dynamically with hourly loadings to reflect the actual on/off rotor schedule at the plant. The rotors have a nameplate capacity of 60 HP. I assumed the motors were 80% efficient and operating at ~85% of capacity to reach the applied power to the water for Biowin.

Temperature of 15.5 degrees C was used from a different year at another Washoe County facility. This isn't perfect, but is more reasonable than looking at the temperature in the data set. The samples likely changed temperatures.

In the influent, Fbs was raised to 0.2 and Fup was dropped to 0.08 to note that the influent WW is more volatile and more biodegradable than is typical. Fnus was dropped to zero to better reflect the amount on non-ammonia TKN in the effluent. The OHO COD fraction was increased to 0.08 to reflect data collected by Biowin in the past. Fna was set to match the data.

The COD:VSS ratios in the stoiciometry were changed to produce a more biodegradable influent.

Aeration parameters were adjusted to account for the 5000 ft elevation of the site and to make sure that Biowin properly

Clarifier removal efficiency was set to approximately reflect the TSS effluent data.

WAS split is set to acheive actual MLSS. The ratio between the two shoud be around 0.8, but is 0.6 in the model, resulting in a lower MLVSS than what show up in the data.

Appendix B

RIB Infiltration Test Results

NewFields
Perspective. Vision. Solutions.

1301 N. McCarran Blvd., Suite 101
Sparks, NV 89431

T: 775.525.2575
F: 775.525.2577

TECHNICAL MEMORANDUM

To: **Mr. Brent Farr, P.E.**
President
Farr West Engineering

From: **Ashley Thibedeau, P.E.**

Reviewed: **Paul Kaplan, P.E.**

Project: **Cold Springs Infiltration Basins**

Project No: **475.0251**

Subject: **Summary Report**
Cold Springs Infiltration Testing

Date: **17 June 2016**

1.0 INTRODUCTION

This draft technical memorandum presents a summary of the results of the infiltration testing completed at the Cold Springs Water Reclamation Facility (WRF). Testing activities were initiated on May 19, 2016 and completed on June 6, 2016. The program involved the performance of a double ring infiltration test in each of the twelve infiltration basins at the Cold Springs WRF. The infiltration testing was completed in accordance with ASTM D3385 with NewFields providing full-time observation during infiltration testing and visual classification of soils encountered at the test location. Potable water from the Cold Springs WRF was used for the testing.

The Cold Springs WRF is located in Cold Springs in Washoe County, Nevada. The WRF consists of twelve rapid infiltration basins varying in size from 1.2 to 2.0 acres.

2.0 FIELD PROGRAM

NewFields performed one double ring infiltrometer test in the approximate center of the bottom of each of the twelve rapid infiltration basins. Each test was performed for a minimum of 6 hours at a depth of 7 to 9 inches below the existing ground surface. At regular intervals throughout the testing period readings were taken to determine the incremental infiltration rate in the inner ring and the annulus. Readings were taken for a minimum of 6 hours with testing continuing until relatively consistent readings were obtained. A summary of the final incremental infiltration rate for both the inner ring and annulus is presented in Table 1. In addition, ground and water temperatures were measured throughout the testing and are available on request. A photograph of the typical testing apparatus and setup is presented in Photograph 1. Upon completion of each test the excavation was backfilled to the original ground surface.

Photograph 1 - Double ring infiltrometer test in Rapid Infiltration Basin 10.

Visual soil classification of the material at the bottom of each excavation is also presented in Table 1. Soils encountered were typically fine to coarse grained sands with varying amounts of nonplastic to low plasticity silts and were slightly moist to moist. Finer grained soils were encountered in two test locations: in Basin 3 the soil was low plasticity silt with sand; and the soil encountered in Basin 6 was low to medium plasticity fine and medium sand with some clay. The test location in Basin 9 had fine to coarse sand with fine and coarse subangular gravel and trace subangular cobbles to 3" in diameter.

TABLE 1 – SUMMARY OF DOUBLE RING INFILTRATION TESTING

Rapid Infiltration Basin	Final Incremental Infiltration Rate		Approximate Excavation Depth (in)	Unified Soil Classification
	Inner (in/hr)	Annular (in/hr)		
1	6.3	6.2 [1]	9	SP
2	10.7	7.4 [1]	8	SP-SM
3	0.15	0.17	7	ML
4	0.9	2.2	8	SP
5	0.3	0.5	8	SP-SM
6	0.2	0.4	7	SC
7	2.4	2.7	8	SM
8	0.3	0.4	7	SP-SM
9	5.4	3.9	8	SP
10	0.6	0.7	8	SM
11	0.6	0.8	8	SP-SM
12	1.7	3.5	8	SP

Note: 1) Unable to maintain constant head in annulus. A drop of 1/2 inch was measured over the testing interval.

If you have any questions or require additional information, please contact the undersigned.

Sincerely,

NewFields Mining Design & Technical Services **Reviewed by:**

Ashley Thibedeau
Staff Engineer

Paul Kaplan, P.E.
Principal Engineer

AT/PK/ng

Addressee: (via e-mail)

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NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 1, approximately in the center, bottom of pond
Soil: SP, fine sand, trace silt, nonplastic, slightly moist, brown with orange mottling

Date: June 3, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 9 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings		Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate		Remarks: Weather, etc.
				Inner Reading Volume (mL)	Annular Space Volume (mL)			Inner (cm/h)	Annular (cm/h)	
1	S	11:44		2300	6875	76.2	75.5	18.93	18.84	Sunny & windy. 1/2" drop in outer ring.
	E	11:54	0:10							
2	S	12:07		2250	6500	76.6	75.8	18.52	17.82	1/2" drop in outer ring throughout test
	E	12:17	0:10							
3	S	12:26		2150	6000	76.7	76.3	17.70	16.45	
	E	12:36	0:10							
4	S	12:49		2075	5688	76.4	77.0	17.08	15.59	Sunny & still
	E	12:59	0:10							
5	S	13:23		2050	5750	76.7	77.9	16.87	15.76	
	E	13:33	0:10							
6	S	13:43		2025	5875	76.9	78.4	16.67	16.10	
	E	13:53	0:10							
7	S	14:05		2000	5875	77.0	78.5	16.46	16.10	
	E	14:15	0:10							
8	S	14:31		1950	5750	77.2	78.7	16.05	15.76	
	E	14:41	0:10							
9	S	14:52		1925	5875	76.9	79.1	15.84	16.10	
	E	15:02	0:10							

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 1, approximately in the center, bottom of pond
Soil: SP, fine sand, trace silt, nonplastic, slightly moist, brown with orange mottling

Date: June 3, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 9 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings: Inner Reading Volume (mL)	Flow Readings: Annular Space Volume (mL)	Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate: Inner (cm/h)	Incremental Infiltration Rate: Annular (cm/h)	Remarks: Weather, etc.
10	S	15:12		1950	6000	76.6	79.8	16.05	16.45	
	E	15:22	0:10							
11	S	15:41		1850	5500	76.8	79.2	15.23	15.08	
	E	15:51	0:10							
12	S	16:27		2000	5750	76.3	78.8	16.46	15.76	
	E	16:37	0:10							
13	S	16:48		1850	5750	75.9	78.2	15.23	15.76	
	E	16:58	0:10							
14	S	17:06		1975	6000	75.8	77.9	16.26	16.45	
	E	17:16	0:10							
15	S	17:36		1950	5750	75.6	77.2	16.05	15.76	
	E	17:46	0:10							

Constants	Area (cm^2)
Inner Ring	729
Outer Ring	2,189

To convert Infiltration Rate to in/hr divide the results above by 2.54.

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 2, approximately in the center, bottom of pond
Soil: SP-SM, fine and medium sand with some silt, nonplastic, moist at 4" depth, brown

Date: May 27, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings: Inner Reading Volume (mL)	Flow Readings: Annular Space Volume (mL)	Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate: Inner (cm/h)	Incremental Infiltration Rate: Annular (cm/h)	Remarks: Weather, etc.
1	S	11:12		1900	4000			31.28	21.93	Sunny. 1" drop in outer ring
	E	11:17	0:05							
2	S	11:43		1700	3500	66.0	63.7	27.98	19.19	1" drop in outer ring.
	E	11:48	0:05							
3	S	12:15		1650	3125			27.16	17.13	3/4" drop in outer ring.
	E	12:20	0:05							
4	S	12:38		1600	3250			26.34	17.82	3/4" drop in outer ring.
	E	12:43	0:05							
5	S	12:53		1650	300	66.4	64.7	27.16	1.64	1/2" drop in outer ring.
	E	12:58	0:05							
6	S	13:06		1650	3188			27.16	17.47	1/2" drop in outer ring.
	E	13:11	0:05							
7	S	13:18		1625	2938			26.75	16.10	1/2" drop in outer ring.
	E	13:23	0:05							
8	S	13:41		1625	3250			26.75	17.82	1/2" drop in outer ring.
	E	13:46	0:05							
9	S	13:54		1700	3625	66.3	66.7	27.98	19.87	1/2" drop in outer ring.
	E	13:59	0:05							

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 2, approximately in the center, bottom of pond
Soil: SP-SM, fine and medium sand with some silt, nonplastic, moist at 4" depth, brown

Date: May 27, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings: Inner Reading Volume (mL)	Flow Readings: Annular Space Volume (mL)	Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate: Inner (cm/h)	Incremental Infiltration Rate: Annular (cm/h)	Remarks: Weather, etc.
10	S	14:08		150	3500			2.47	19.19	1/2" drop in outer ring.
	E	14:13	0:05							
11	S	14:21		1725	3750	65.6	66.0	28.40	20.56	1/2" drop in outer ring.
	E	14:26	0:05							
12	S	15:14		1700	3563			27.98	19.53	1/2" drop in outer ring.
	E	15:19	0:05							
13	S	15:26		1650	3125	65.7	65.4	27.16	17.13	1/2" drop in outer ring.
	E	15:31	0:05							
14	S	15:39		1620	3375			26.67	18.50	1/2" drop in outer ring.
	E	15:44	0:05							
15	S	16:02		1650	3125			27.16	17.13	1/2" drop in outer ring.
	E	16:07	0:05							
16	S	16:15		1575	3125	65.8	65.4	25.93	17.13	1/2" drop in outer ring.
	E	16:20	0:05							
17	S	16:28		1600	3250			26.34	17.82	1/2" drop in outer ring.
	E	16:33	0:05							
18	S	16:42		1650	3250			27.16	17.82	1/2" drop in outer ring.
	E	16:47	0:05							
19	S	17:05		1650	3438	65.8	65.3	27.16	18.84	1/2" drop in outer ring.
	E	17:10	0:05							

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 2, approximately in the center, bottom of pond
Soil: SP-SM, fine and medium sand with some silt, nonplastic, moist at 4" depth, brown

Date: May 27, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings		Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate		Remarks: Weather, etc.
				Inner Reading	Annular Space					
				Volume (mL)	Volume (mL)			Inner (cm/h)	Annular (cm/h)	
20	S	17:19		1650	3438			27.16	18.84	1/2" drop in outer ring.
	E	17:24	0:05							

Constants	Area (cm²)
Inner Ring	729
Outer Ring	2,189

To convert Infiltration Rate to in/hr divide the results above by 2.54.

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 3, approximately in the center, bottom of pond
Soil: ML, silt with sand, fine sand, low plasticity, moist, pockets of med. plasticity CL, dark brown

Date: May 26, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 7 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings: Inner Reading Volume (mL)	Flow Readings: Annular Space Volume (mL)	Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate: Inner (cm/h)	Incremental Infiltration Rate: Annular (cm/h)	Remarks: Weather, etc.
1	S	10:28		175	1125			0.96	2.06	Overcast
	E	10:43	0:15							
2	S	10:43		175	938			0.96	1.71	
	E	10:58	0:15							
3	S	10:58		125	688			0.69	1.26	Partly cloudy
	E	11:13	0:15							
4	S	11:13		150	1375			0.82	2.51	
	E	11:28	0:15							
5	S	11:35		250	938			0.69	0.86	
	E	12:05	0:30							
6	S	12:05		300	1750			0.82	1.60	Scattered clouds
	E	12:35	0:30							
7	S	12:46		375	1375			0.51	0.63	
	E	13:46	1:00							
8	S	13:46		275	1125			0.38	0.51	
	E	14:46	1:00							
9	S	14:46		250	1063			0.34	0.49	
	E	15:46	1:00							

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 3, approximately in the center, bottom of pond
Soil: ML, silt with sand, fine sand, low plasticity, moist, pockets of med. plasticity CL, dark brown

Date: May 26, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 7 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings		Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate		Remarks: Weather, etc.
				Inner Reading Volume (mL)	Annular Space Volume (mL)			Inner (cm/h)	Annular (cm/h)	
10	S	15:46		300	1063			0.41	0.49	
	E	16:46	1:00							
11	S	8:56		275	938			0.38	0.43	6/27 - Saturated overnight.
	E	9:56	1:00							

Constants	Area (cm²)
Inner Ring	729
Outer Ring	2,189

To convert Infiltration Rate to in/hr divide the results above by 2.54.

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 4, approximately in the center, bottom of pond
Soil: SP, fine and medium sand, trace silt, nonplastic, moist, brown

Date: May 24, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings: Inner Reading Volume (mL)	Flow Readings: Annular Space Volume (mL)	Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate: Inner (cm/h)	Incremental Infiltration Rate: Annular (cm/h)	Remarks: Weather, etc.
1	S	10:08		900	4875	62.3	55.9	4.94	8.91	Drained in < 10 min
	E	10:23	0:15							
2	S	10:29		850	5562	61.5	55.5	4.66	10.16	Scattered clouds
	E	10:44	0:15							
3	S	10:54		600	4875	61.7	55.8	3.29	8.91	
	E	11:09	0:15							
4	S	11:18		600	4188	61.6	56.1	3.53	8.20	Cloudy & windy
	E	11:32	0:14							
5	S	11:14		1050	6750	61.3	56.8	1.54	3.30	
	E	12:10	0:56							
6	S	12:20		900	6375	61.5	56.3	2.47	5.82	
	E	12:50	0:30							
7	S	12:58		850	6250	61.4	55.5	2.33	5.71	Partly cloudy & windy
	E	13:28	0:30							
8	S	13:35		850	6125	60.5	56.5	2.33	5.60	
	E	14:05	0:30							
9	S	14:12		900	6125	60.3	57.4	2.47	5.60	
	E	14:42	0:30							

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client:	Farr West Engineering	**Date:**	May 24, 2016	
Project Number:	475.0249.000	**Liquid Used:**	Site Potable Water	
Project Location:	Cold Springs Infiltration Basins	**Ring Pen.:**	9 cm	
Test Location:	Pond 4, approximately in the center, bottom of pond	**Tested By:**	AT	
Soil:	SP, fine and medium sand, trace silt, nonplastic, moist, brown		**Ex. Depth:**	8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings		Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate		Remarks: Weather, etc.
				Inner Reading	Annular Space					
				Volume (mL)	Volume (mL)			Inner (cm/h)	Annular (cm/h)	
10	S	14:49		900	6188	60.5	57.5	2.47	5.65	
	E	15:19	0:30							
11	S	15:30		850	5875	60.8	57.4	2.33	5.37	Cloudy & windy
	E	16:00	0:30							
12	S	16:09		850	6000	61.7	57.8+	2.33	5.48	Cloudy & windy
	E	16:39	0:30							

Constants	Area (cm²)
Inner Ring	729
Outer Ring	2,189

To convert Infiltration Rate to in/hr divide the results above by 2.54.

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 5, approximately in the center, bottom of pond
Soil: SP-SM, fine sand with silt, nonplastic, moist, red gray

Date: May 21, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: IGS
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings		Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate		Remarks: Weather, etc.
				Inner Reading	Annular Space					
				Volume (mL)	Volume (mL)			Inner (cm/h)	Annular (cm/h)	
1	S	13:26		400	2250			2.19	4.11	Sunny
	E	13:41	0:15							
2	S	13:43		350	2125			1.92	3.88	
	E	13:58	0:15							
3	S	13:59		300	1875			1.65	3.43	
	E	14:14	0:15							
4	S	14:20		250	1625			1.37	2.97	
	E	14:35	0:15							
5	S	14:36		500	3000			1.37	2.74	
	E	15:06	0:30							
6	S	15:16		550	2563			1.51	2.34	
	E	15:46	0:30							
7	S	16:00		800	4188			1.10	1.91	
	E	17:00	1:00							
8	S	17:20		775	3500			1.06	1.60	
	E	18:20	1:00							
9	S	18:49		700	3000			0.96	1.37	
	E	19:49	1:00							

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 5, approximately in the center, bottom of pond
Soil: SP-SM, fine sand with silt, nonplastic, moist, red gray

Date: May 21, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: IGS
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings: Inner Reading Volume (mL)	Flow Readings: Annular Space Volume (mL)	Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate: Inner (cm/h)	Incremental Infiltration Rate: Annular (cm/h)	Remarks: Weather, etc.
10	S	20:03		650	2750	58.2	54.5	0.89	1.26	
	E	21:03	1:00							
11	S	11:09		200	875			0.55	0.80	
	E	11:39	0:30							

Constants	Area (cm^2)
Inner Ring	729
Outer Ring	2,189

To convert Infiltration Rate to in/hr divide the results above by 2.54.

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 6, approximately in the center, bottom of pond
Soil: SC, fine and medium sand, some clay, low to medium plasticity, slightly moist, brown. Hard digging.

Date: June 1, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 7 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings		Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate		Remarks: Weather, etc.
				Inner Reading Volume (mL)	Annular Space Volume (mL)			Inner (cm/h)	Annular (cm/h)	
1	S	11:27		150	1063	76.1	74.9	0.82	1.94	Sunny & windy
	E	11:42	0:15							
2	S	11:42		100	875	77.8	76.3	0.55	1.60	Partly cloudy
	E	11:57	0:15							
3	S	11:57		125	875	77.8	76.5	0.69	1.60	
	E	12:12	0:15							
4	S	12:12		125	688	79.0	77.6	0.69	1.26	
	E	12:27	0:15							
5	S	12:27		225	1250	80.4	79.7	0.62	1.14	Sunny
	E	12:57	0:30							
6	S	12:57		250	1375	81.6	80.6	0.69	1.26	
	E	13:27	0:30							
7	S	13:27		400	2125	81.9	80.9	0.55	0.97	
	E	14:27	1:00							
8	S	14:42		450	2500	82.1	81.6	0.62	1.14	
	E	15:42	1:00							
9	S	15:42		425	2063	81.7	81.5	0.58	0.94	
	E	16:42	1:00							

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 6, approximately in the center, bottom of pond
Soil: SC, fine and medium sand, some clay, low to medium plasticity, slightly moist, brown. Hard digging.

Date: June 1, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 7 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings		Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate		Remarks: Weather, etc.
				Inner Reading	Annular Space					
				Volume (mL)	Volume (mL)			Inner (cm/h)	Annular (cm/h)	
10	S	16:42		450	2063	79.7	79.1	0.62	0.94	
	E	17:42	1:00							

Constants	Area (cm²)
Inner Ring	729
Outer Ring	2,189

To convert Infiltration Rate to in/hr divide the results above by 2.54.

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 7, approximately in the center, bottom of pond
Soil: SM; fine sand, silt, nonplastic to low plasticity, moist, brown

Date: May 31, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings		Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate		Remarks: Weather, etc.
				Inner Reading	Annular Space					
				Volume (mL)	Volume (mL)			Inner (cm/h)	Annular (cm/h)	
1	S	10:45		1100	4188	70.2	64.3	6.04	7.65	Sunny & breezy
	E	11:00	0:15							
2	S	11:00		950	3625			5.21	6.62	
	E	11:15	0:15							
3	S	11:23		950	3625	71.9	64.3	5.21	6.62	
	E	11:38	0:15							
4	S	11:38		900	3563	72.7	64.6	4.94	6.51	
	E	11:53	0:15							
5	S	12:03		1850	7186	75.7	65.6	5.08	6.57	
	E	12:33	0:30							
6	S	12:42		1950	7125	77.9	68.6	5.35	6.51	
	E	13:12	0:30							
7	S	13:21		2050	7250	78.4	70.9	5.62	6.62	Sunny, no wind
	E	13:51	0:30							
8	S	13:58		2100	7375	79.7	72.5	5.76	6.74	
	E	14:28	0:30							
9	S	14:36		2100	7688	79.8	76.4	5.76	7.02	
	E	15:06	0:30							

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 7, approximately in the center, bottom of pond
Soil: SM; fine sand, silt, nonplastic to low plasticity, moist, brown

Date: May 31, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings: Inner Reading Volume (mL)	Flow Readings: Annular Space Volume (mL)	Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate: Inner (cm/h)	Incremental Infiltration Rate: Annular (cm/h)	Remarks: Weather, etc.
10	S	15:15		2200	7500	80.4	75.2	6.04	6.85	
	E	15:45	0:30							
11	S	15:54		2200	7500	80.6	75.1	6.04	6.85	
	E	16:24	0:30							
12	S	16:33		2200	7625	80.5	75.4	6.04	6.97	
	E	17:03	0:30							

Constants	Area (cm²)
Inner Ring	729
Outer Ring	2,189

To convert Infiltration Rate to in/hr divide the results above by 2.54.

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 8, approximately in the center, bottom of pond
Soil: SP-SM, fine sand with silt, nonplastic, moist, red gray

Date: May 22, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: IGS
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings		Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate		Remarks: Weather, etc.
				Inner Reading	Annular Space					
				Volume (mL)	Volume (mL)			Inner (cm/h)	Annular (cm/h)	
1	S	13:31		700	1500			3.84	2.74	
	E	13:46	0:15							
2	S	13:47		700	1625	61.2	64.4	3.03	2.34	
	E	14:06	0:19							
3	S	14:14		500	1000			2.74	1.83	Water Fill
	E	14:29	0:15							
4	S	14:30		450	1000			2.47	1.83	
	E	14:45	0:15							
5	S	14:54		650	1625			1.78	1.48	Water Fill
	E	15:24	0:30							
6	S	15:25		550	1375	60.8	57.6	1.51	1.26	
	E	15:55	0:30							
7	S	16:06		950	2676	59.8	57.5	1.30	1.22	Water Fill
	E	17:06	1:00							
8	S	17:15		725	2375			0.99	1.08	Water Fill
	E	18:15	1:00							
9	S	10:39		550	2125	58.5	51.8	0.75	0.97	Water Fill
	E	11:39	1:00							

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 8, approximately in the center, bottom of pond
Soil: SP-SM, fine sand with silt, nonplastic, moist, red gray

Date: May 22, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: IGS
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings: Inner Reading Volume (mL)	Flow Readings: Annular Space Volume (mL)	Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate: Inner (cm/h)	Incremental Infiltration Rate: Annular (cm/h)	Remarks: Weather, etc.
10	S	12:01		550	2068	61.0	58.1	0.75	0.94	
	E	13:01	1:00							

Constants	Area (cm²)
Inner Ring	729
Outer Ring	2,189

To convert Infiltration Rate to in/hr divide the results above by 2.54.

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 9, approximately in the center, bottom of pond
Soil: SP, fine - coarse sand, fine and coarse gravel, cobbles to 3", nonplastic, moist, brown

Date: May 25, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings: Inner Reading Volume (mL)	Flow Readings: Annular Space Volume (mL)	Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate: Inner (cm/h)	Incremental Infiltration Rate: Annular (cm/h)	Remarks: Weather, etc.
1	S	10:37						0.00	0.00	Drained in < 10 min
	E		##############							
2	S	10:53		1800	3375	64.2	60.1	24.69	15.42	Scattered clouds
	E	10:59	0:06							
3	S	11:08		1900	3500			26.06	15.99	
	E	11:14	0:06							
4	S	11:44		2300	3750	64.0	58.8	17.21	9.34	Cloudy & windy
	E	11:55	0:11							
5	S	12:11		1850	3750			13.84	9.34	
	E	12:22	0:11							
6	S	12:28		1950	3500			14.59	8.72	
	E	12:39	0:11							
7	S	13:04		2200	3875	64.6	60.2	16.46	9.66	Partly cloudy & windy
	E	13:15	0:11							
8	S	13:24		1950	3688			14.59	9.19	
	E	13:35	0:11							
9	S	13:40		1900	3825	65.3	62.2	14.22	9.53	
	E	13:51	0:11							

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 9, approximately in the center, bottom of pond
Soil: SP, fine - coarse sand, fine and coarse gravel, cobbles to 3", nonplastic, moist, brown

Date: May 25, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings: Inner Reading Volume (mL)	Flow Readings: Annular Space Volume (mL)	Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate: Inner (cm/h)	Incremental Infiltration Rate: Annular (cm/h)	Remarks: Weather, etc.
10	S	14:16		2100	3750			15.71	9.34	
	E	14:27	0:11							
11	S	14:34		1925	3813			14.40	9.50	Cloudy & windy
	E	14:45	0:11							
12	S	14:53		1850	3750			13.84	9.34	
	E	15:04	0:11							
13	S	15:20		1725	3750	64.0	57.5	12.91	9.34	Mostly cloudy
	E	15:31	0:11							
14	S	15:36		1700	3750			12.72	9.34	
	E	15:47	0:11							
15	S	15:53		1700	3750	64.6	60.4	12.72	9.34	
	E	16:04	0:11							
16	S	16:13		1700	3750			12.72	9.34	
	E	16:24	0:11							
17	S	16:28		1850	4000	64.9	62.2	13.84	9.97	Sunny & very windy
	E	16:39	0:11							

Constants	Area (cm^2)
Inner Ring	729
Outer Ring	2,189

To convert Infiltration Rate to in/hr divide the results above by 2.54.

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 10, approximately in the center, bottom of pond
Soil: SM, fine sand with silt, no to low plasticity, moist, dark brown

Date: June 6, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings		Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate		Remarks: Weather, etc.
				Inner Reading	Annular Space					
				Volume (mL)	Volume (mL)			Inner (cm/h)	Annular (cm/h)	
1	S	10:33		350	1500	73.7	66.5	1.92	2.74	Sunny
	E	10:48	0:15							
2	S	10:48		425	1313	74.2	66.4	2.33	2.40	
	E	11:03	0:15							
3	S	11:03		300	1125	75.0	66.2	1.65	2.06	
	E	11:18	0:15							
4	S	11:18		300	1000	76.7	66.8	1.65	1.83	Sunny and breezy
	E	11:33	0:15							
5	S	11:33		550	1938	78.5	67.8	1.51	1.77	Sunny and still
	E	12:03	0:30							
6	S	12:11		500	1875	80.6	68.6	1.37	1.71	
	E	12:41	0:30							
7	S	12:41		1000	3500	82.2	70.4	1.37	1.60	Windy, scattered clouds
	E	13:41	1:00							
8	S	13:52		400	3688	84.4	41.6	0.55	1.68	Checked equip; no blockages/air bubbles to explain low inner reading.
	E	14:52	1:00							
9	S	14:52		1050	3625	84.5	72.3	1.44	1.66	
	E	15:52	1:00							

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 10, approximately in the center, bottom of pond
Soil: SM, fine sand with silt, no to low plasticity, moist, dark brown

Date: June 6, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings: Inner Reading Volume (mL)	Flow Readings: Annular Space Volume (mL)	Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate: Inner (cm/h)	Incremental Infiltration Rate: Annular (cm/h)	Remarks: Weather, etc.
10	S	16:05		1075	3625	84.1	72.4	1.47	1.66	Still
	E	17:05	1:00							

Constants	Area (cm²)
Inner Ring	729
Outer Ring	2,189

To convert Infiltration Rate to in/hr divide the results above by 2.54.

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 11, approximately in the center, bottom of pond
Soil: SP-SM, fine sand with silt, nonplastic, moist, red gray

Date: May 23, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: IGS
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings: Inner Reading Volume (mL)	Flow Readings: Annular Space Volume (mL)	Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate: Inner (cm/h)	Incremental Infiltration Rate: Annular (cm/h)	Remarks: Weather, etc.
1	S	14:42		325	1750			1.78	3.20	
	E	14:57	0:15							
2	S	14:58		400	1750	64.6	60.7	2.19	3.20	
	E	15:13	0:15							
3	S	15:17		350	1500			1.92	2.74	Water Fill
	E	15:32	0:15							
4	S	15:33		350	1500	64.5	59.5	1.92	2.74	
	E	15:48	0:15							
5	S	15:57		600	2625			1.65	2.40	Water Fill
	E	16:27	0:30							
6	S	16:28		600	2625			1.65	2.40	
	E	16:58	0:30							
7	S	17:12		1150	4875			1.58	2.23	Water Fill
	E	18:12	1:00							
8	S	18:30		1125	4625			1.54	2.11	Water Fill
	E	19:30	1:00							
9	S	19:46		1100	4375	58.0	53.3	1.51	2.00	Water Fill
	E	20:46	1:00							

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 11, approximately in the center, bottom of pond
Soil: SP-SM, fine sand with silt, nonplastic, moist, red gray

Date: May 23, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: IGS
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings: Inner Reading Volume (mL)	Flow Readings: Annular Space Volume (mL)	Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate: Inner (cm/h)	Incremental Infiltration Rate: Annular (cm/h)	Remarks: Weather, etc.
10	S	21:00		1100	4500			1.51	2.06	
	E	22:00	1:00							

Constants	Area (cm²)
Inner Ring	729
Outer Ring	2,189

To convert Infiltration Rate to in/hr divide the results above by 2.54.

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 12, approximately in the center, bottom of pond
Soil: SP, fine - coarse sand, trace fine gravel, trace silt, nonplastic, slightly moist, brown. Hard digging.

Date: June 2, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings		Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate		Remarks: Weather, etc.
				Inner Reading Volume (mL)	Annular Space Volume (mL)			Inner (cm/h)	Annular (cm/h)	
1	S	10:40		1125	5875	71.1	73.5	6.17	10.74	Sunny & breezy
	E	10:55	0:15							
2	S	11:04		900	49375	71.4	74.5	4.94	90.22	
	E	11:19	0:15							
3	S	11:25		825	4813	74.0	74.8	4.53	8.79	
	E	11:40	0:15							
4	S	11:48		850	8475	75.3	76.2	4.66	15.49	
	E	12:03	0:15							
5	S	12:12		1350	7750	77.2	78.6	4.44	8.50	
	E	12:37	0:25							
6	S	12:47		1350	7750	78.6	80.1	4.44	8.50	
	E	13:12	0:25							
7	S	13:20		1350	7875	78.8	80.3	4.44	8.63	
	E	13:45	0:25							
8	S	13:55		1375	7878	80.4	79.9	4.53	8.64	
	E	14:20	0:25							
9	S	14:30		1325	8125	81.5	77.2	4.36	8.91	
	E	14:55	0:25							

NewFields

Double-Ring Infitrometer Test (ASTM D3385)

Client: Farr West Engineering
Project Number: 475.0249.000
Project Location: Cold Springs Infiltration Basins
Test Location: Pond 12, approximately in the center, bottom of pond
Soil: SP, fine - coarse sand, trace fine gravel, trace silt, nonplastic, slightly moist, brown. Hard digging.

Date: June 2, 2016
Liquid Used: Site Potable Water
Ring Pen.: 9 cm
Tested By: AT
Ex. Depth: 8 inches

Trial Number	Start End	Time (hr:min)	Incremental Elapsed Time (hr:min)	Flow Readings: Inner Reading Volume (mL)	Flow Readings: Annular Space Volume (mL)	Liquid Temp (°F)	Ground Temp (°F)	Incremental Infiltration Rate: Inner (cm/h)	Incremental Infiltration Rate: Annular (cm/h)	Remarks: Weather, etc.
10	S	15:04		1350	8000	82.8	76.0	4.44	8.77	
	E	15:29	0:25							
11	S	15:43		1350	8125	82.8	74.9	4.44	8.91	
	E	16:08	0:25							
12	S	16:17		1350	8125	82.2	74.5	4.44	8.91	
	E	16:42	0:25							

Constants	Area (cm²)
Inner Ring	729
Outer Ring	2,189

To convert Infiltration Rate to in/hr divide the results above by 2.54.

TECHNICAL MEMORANDUM #5

WASHOE COUNTY COMMUNITY SERVICES DEPARTMENT – WATER RESOURCES

COLD SPRINGS WASTEWATER SYSTEM FACILITY PLAN

Prepared For:	Alan Jones, P.E., Senior Licensed Engineer
Prepared By:	Paul Steele, P.E. William Leaf Ted Couch
Reviewed By:	Jerry Dehn, P.E. Brent Farr, P.E.
Date:	April 19, 2017
Subject:	**Final Technical Memorandum No. 5 – Treatment Plant Expansion Alternatives**

1.0 PURPOSE

The primary objectives of this task are to determine water quality objectives for the Cold Springs Water Reclamation Facility (CSWRF) through the end of the planning period and determine cost effective and beneficial expansion alternatives for CSWRF to maintain permit compliance as the influent flows and loads to CSWRF increase as described in TMs 1 and 4 of this facility plan.

2.0 PLANNING CRITERIA

Water quality goals for the expansion for the facility were set following a review of the existing effluent and permit and through discussions with Washoe County staff. The treatment plant needs to be capable of treating the 2036 planning period flows described in Table 4-2 in TM #4 to the existing permit limits: a total nitrogen effluent of 5- 7 mg/l and an effluent ammonia concentration below 2 mg/l. Solids treatment shall be designed to a criteria similar to the criteria used for the South Truckee Meadows WRF. Solids shall be held for approximately 270 degree-days, and shall be acceptable for landfill disposal. Reuse treatment shall be to Nevada Class A standards designed for filtration and UV disinfection assuming an approximately 1 MGD seasonal reuse sidestream to a future development.

The expansion of CSWRF has been divided into six separate expansion projects. Individual projects have been developed to expand the headworks, secondary treatment, tertiary treatment for the reuse sidestream, digestion and thickening, and dewatering and loadout. Three alternatives were developed for the secondary treatment expansion project that were compared on the basis of life-cycle cost and non-monetary factors.

Each of the expansion projects has been designed to the capacity listed in Table 5-1. Each project was estimated using the proprietary CH2MHILL Parametric Cost Estimating System (CPES) software to generate scalable cost estimates for the expansion projects. The secondary treatment alternatives were also modeled in the Biowin^{TM} wastewater process modeling software by Envirosim, Inc.

Table 5-1 – CSWRF Design Criteria by Expansion Project

Expansion Project	Design Influent Flow (MGD)	Flow Type
Headworks	10	2036 Peak Pumped Flow
Secondary Treatment	3.08	2036 Max Month Flow
Reuse	1	Estimated Demand
Digestion and Thickening	3.08	2036 Max Month Flow
Dewatering and Loadout	3.08	2036 Max Month Flow
Emergency Generator and Plant Water System	N/A	Estimated Demand

3.0 HEADWORKS

The future pump stations conveying raw influent to the headworks will have a combined capacity of 10 MGD in 2036. The current headworks screens have sufficient capacity to accommodate current peak pumped flow (3.1 MGD), however the current grit removal system does not. Immediate improvements are required to bring the grit system up to this capacity. The construction requirements for these grit system improvements will require removal of the existing screening system. So, the required screening improvements should be installed concurrent with the grit removal improvements. In addition, while the expansion to 10 MGD will come in phases, there is not a cost effective method to expand the recommended headworks improvements to match the corresponding pumping phases. Therefore, there will only be one, immediate phase for headworks improvements, which will bring the system up to the required 2036 capacity.

The recommended alternative for headworks expansion requires demolition of the existing components, and installation of two, in-channel, 6mm perforated plate fine screens with screenings washer/compactors, one bypass channel with a manually cleaned bar screen, grit removal with a vortex separator, followed by a grit washer, and grit dewatering unit.

The new components will be housed in an enclosed building in the southwest portion of the facility. This will prevent wear from exposure to the elements, and allow for better storage and access. The suggested screen type has proven effective at the STMWRF facility, and should achieve similar performance at CSWRF. County staff will also have familiarity with this type of unit, and can share spare parts and tools across facilities if feasible.

Grit removal in the recommended alternative is based on the Pista Grit mechanically induced vortex system manufactured by Smith and Loveless, which is the same system currently installed at CSWRF. A second grit removal option, the HeadCell process manufactured by Hydro International has greater overall grit removal at design flow rates, however its turndown capability is not as great as that of the Pista Grit. The Pista Grit will have a cheaper capital cost when compared with a HeadCell, but will also require more O&M costs over the life of the equipment due to the energy required for the mechanical vortex, the potential wear on downstream equipment due to reduced grit removal efficiency, and potential cleaning costs to remove grit from the aeration basins or digesters. The selection of the exact grit removal system and configuration will occur during the preliminary design phase. The preliminary construction cost for the headworks facility employing a Pista Grit system is **$4.3M**, with a total project cost of **$5.5M**.

4.0 SECONDARY TREATMENT

Per TM #4, the permitted capacity of the existing secondary treatment system is 0.7 MGD. Based on the projected growth flow growth rates noted in TM #1, CSWRF is projected to meet this flow rate by the end of 2017. TM #4 also noted that a process model of the existing oxidation ditch can achieve effluent total nitrogen levels under 8 mg/l at flows up to 1.1 MGD which will satisfy the existing 10 mg/l effluent permit limit. This change could allow the existing secondary treatment system to treat the influent flow through year 2023. This memo presents expansion options to allow the secondary treatment system to treat the 2036 maximum month flow of 3.08 MGD to the water quality objectives of 5 – 7 mg/l total nitrogen and less than 2 mg/l ammonia.

Three options were considered for evaluation. On the basis of previous work done at the STMWRF facility, all three options utilized an anaerobic selector for sludge settleability improvements along with potential biological phosphorous removal. Downstream of the anaerobic selector, the first option replicated the existing on/off aeration strategy in oxidation ditches as required to meet the 2036 flow rate. The second option utilized a nitrified recycle in a modified Ludzack-Ettinger arrangement to achieve the denitrification required to meet the total nitrogen limit. When coupled with the selector, this process is an A2O process. The third option is a five stage Bardenpho process that utilizes the same tank volumes as the A2O process with a lower recycle rate, but adds post-anoxic and reaeration zones to remove additional nitrogen.

All three options will replace the brush aerators in the existing oxidation ditch with fine pore diffusers and will add fine pore diffusers to the new oxidation ditches. Similarly, each of the options include two new secondary clarifiers and new blower building with the blowers sized as required per process. All of the options will use small mixers in the un-aerated zones and large-bladed flow boosting mixers to provide circulation in the oxidation ditches.

4.1 OPTION 1 – FOUR OXIDATION DITCHES

Option 1 will have two new 150,000 gal anaerobic selectors at the front end of the process, which will allow either of the selectors to be taken offline for maintenance. Each selector will be equipped with a suitable mixer to maintain complete mix conditions. The mixers are assumed to be submersible small propeller mixers at this point, though a cost/benefit evaluation between submersible, floating and hyperbolic mixers should be conducted during preliminary engineering prior to entering into design.

Following the selectors, four oxidation ditches, one existing and three new, will accomplish nitrification and denitrification. The new basins are each 1.03 MG with the same dimensions as the existing basin. Of particular note is the side water depth of 11.5 feet, which is below the typical depth for diffused air systems, which are typically 14 – 18 feet deep. Increased depth in the aeration basins will lead to greater oxygen transfer efficiency. Increasing the depth in both the existing and new basins should be investigated during preliminary design, independent of which option is selected for secondary treatment.

Treatment in the basin will be accomplished through anoxic/aerobic cycling. The system was modeled having a two hour on/off cycle throughout the day, with approximately 66 minutes on and 54 minutes off to produce optimum denitrification. The oxygen will be supplied to the tanks through fine pore diffusers fed by five blowers, each capable of producing 4,225 scfm of air, for a total firm capacity air rate of 16,900 scfm. The blowers are assumed to be single stage centrifugal units housed in a separate blower building. The diffusers are assumed to be low profile panel type diffusers, such as the Aerostrip diffusers manufactured by Ovivo, as these diffusers will make the best use of the low water depth in the oxidation ditches. Circulation will be provided by large, low speed, flow boosting submersible mixers similar to the type currently in place in the existing oxidation ditch.

Nitrogen effluent results at 3.08 MGD for the system utilizing the diurnal flow and concentration data established in TM #4 are shown in Figure 5-1.

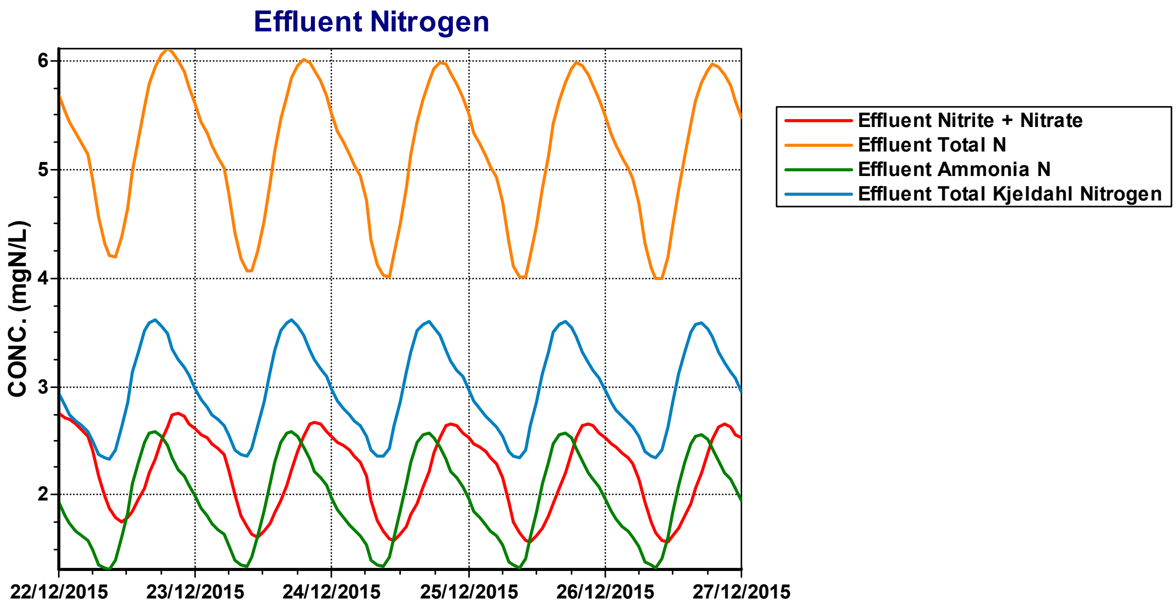

Figure 5-1 –Option 1: Four Oxidation Ditches – Nitrogen Effluent

The results in the figure assume equal flow splitting between trains throughout the day. However, additional denitrification performance is possible by operating the influent feed to the oxidation ditches in a time cyclic manner to ensure that influent flow only enters the oxidation ditch during an air off cycle. This may result in a slightly lower total nitrogen effluent and may also raise the alpha value of the aeration equipment, leading to improved aeration efficiency relative to splitting flow equally.

This option also requires the addition of two secondary clarifiers identical to the two existing units and new RAS pumps to continue to recirculate 60% of the influent flow. A site layout and process flow diagram of this option are shown in Figures 5-2 and 5-3.

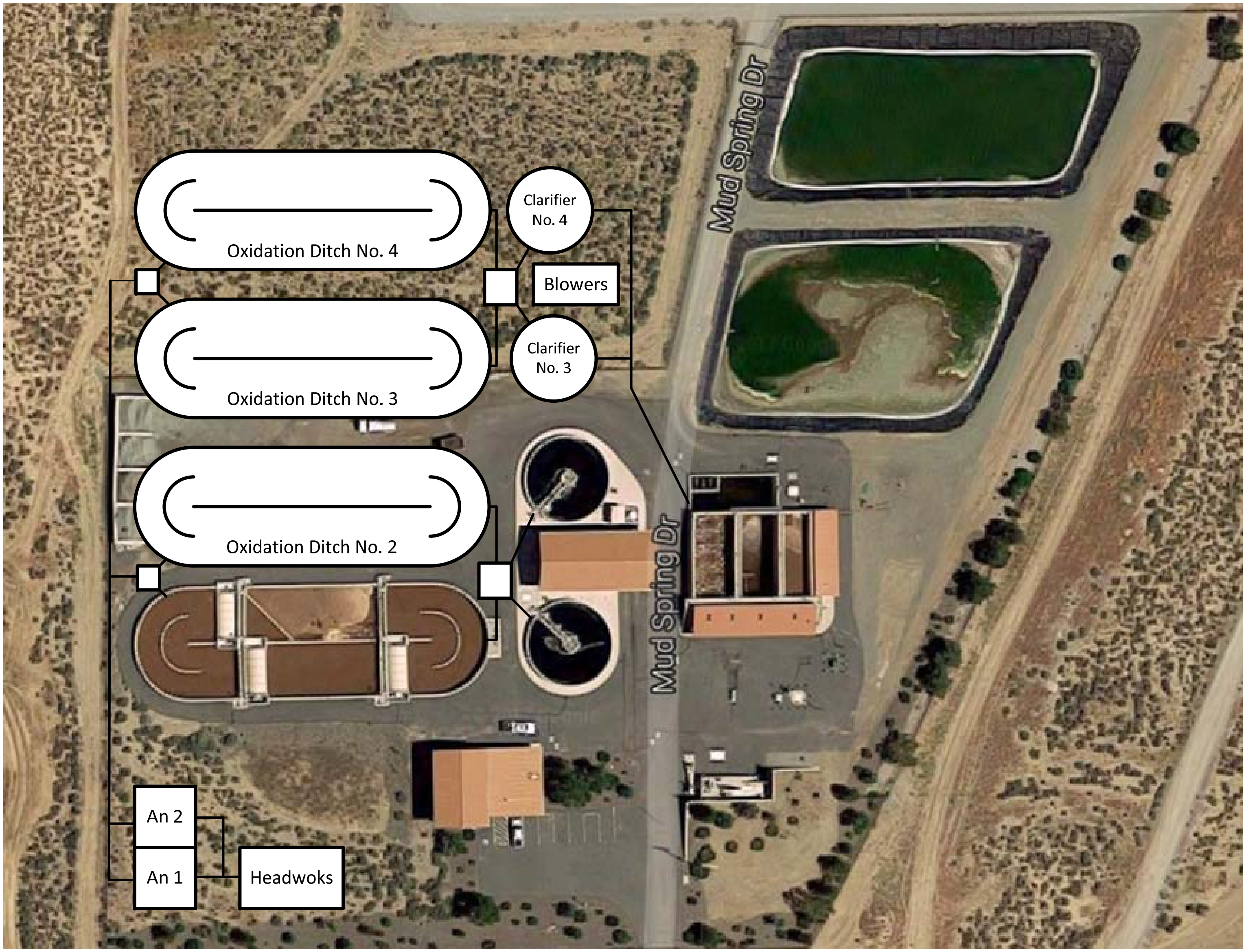

Figure 5-2 –Option 1 – Four Oxidation Ditches – Site Layout with Headworks

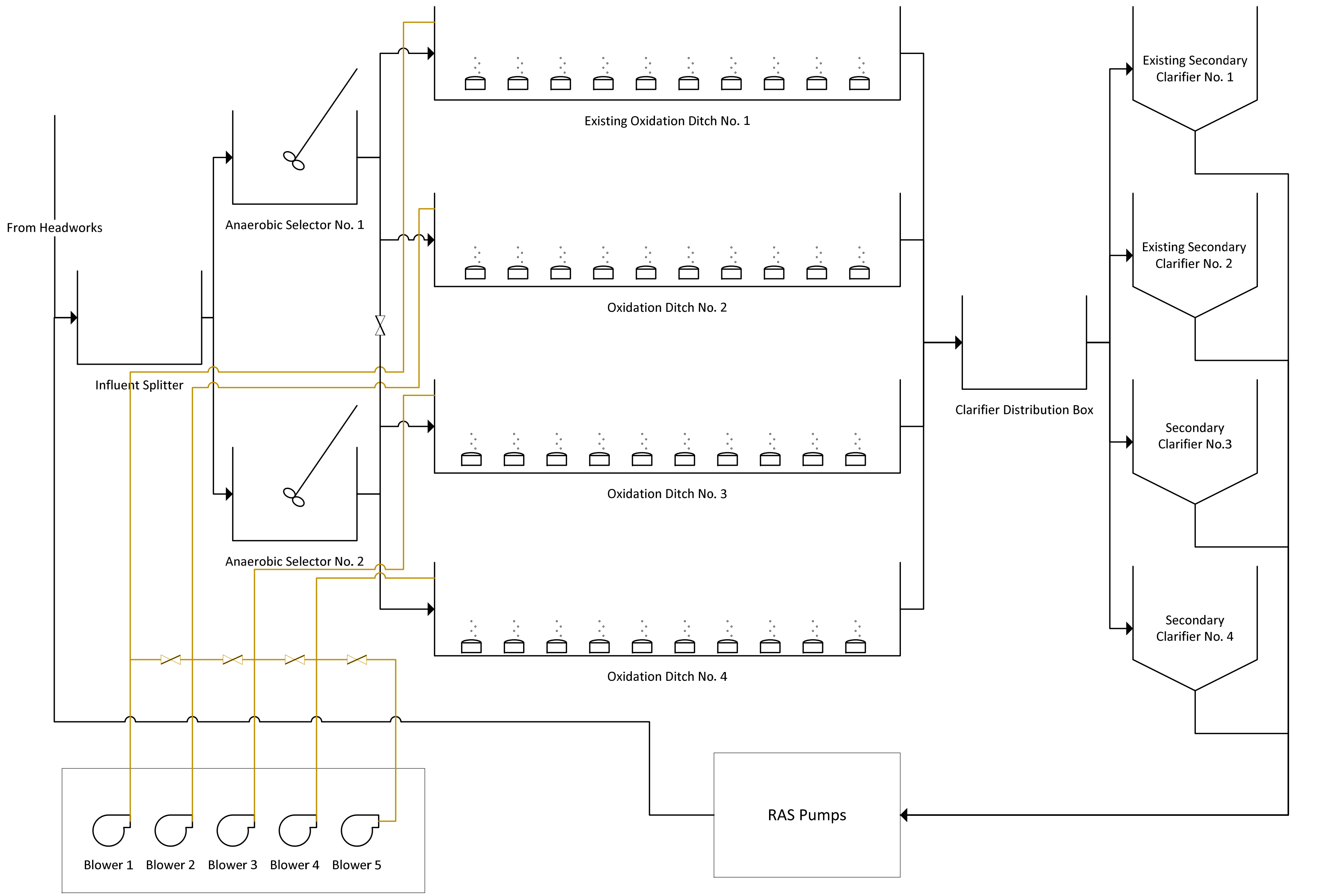

Figure 5-3 –Option 1 – Four Oxidation Ditches – Process Flow Diagram

4.2 OPTION 2 – A2O PROCESS

Option 2 will similarly have two new 150,000 gal anaerobic selectors at the front end of the process with a dedicated mixer for each basin. Each of these selectors will be followed by three 200,000 gallon anoxic zones with dedicated mixers. The first anoxic zone will receive a variable nitrified recycle from the downstream oxidation ditches with a flow rate up to 10 MGD for each train. The anoxic volume along with the high recycle rate will accomplish the required denitrification for the process.

Following the anoxic zones, two oxidation ditches, one existing and one new, will accomplish nitrification. The new basin is 1.03 MG with the same dimensions as the existing basin. Treatment in the basin will be accomplished through constant aeration at an assumed dissolved oxygen setpoint of 2 mg/l. The oxygen will be supplied to the tanks through fine pore diffusers fed by four blowers, each capable of producing 3,200 scfm of air, for a total firm capacity air rate of 9,600 scfm. Similar to Option 1, the blowers are assumed to be single stage centrifugal units housed in a separate blower building, the diffusers are assumed to be low profile panel type diffusers, and circulation will be provided by large, low speed, flow boosting submersible mixers similar to the type currently in place in the existing oxidation ditch.

Nitrogen effluent results at 3.07 MGD for the system utilizing the diurnal flow and concentration data established in TM #4 are shown in Figure 5-4.

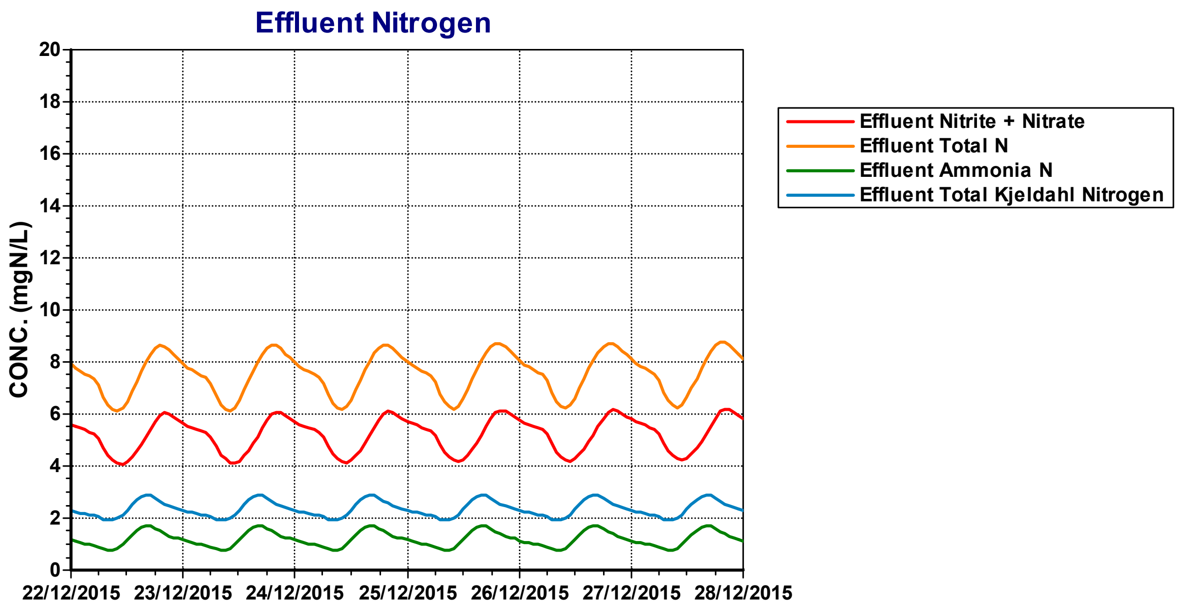

Figure 5-4 –Option 2 – A2O Process –Nitrogen Effluent

This option also requires the addition of two secondary clarifiers identical to the two existing units and new RAS pumps to continue to recirculate 60% of the influent flow. A site layout and process flow diagram of this option are shown in in Figures 5-5 and 5-6.

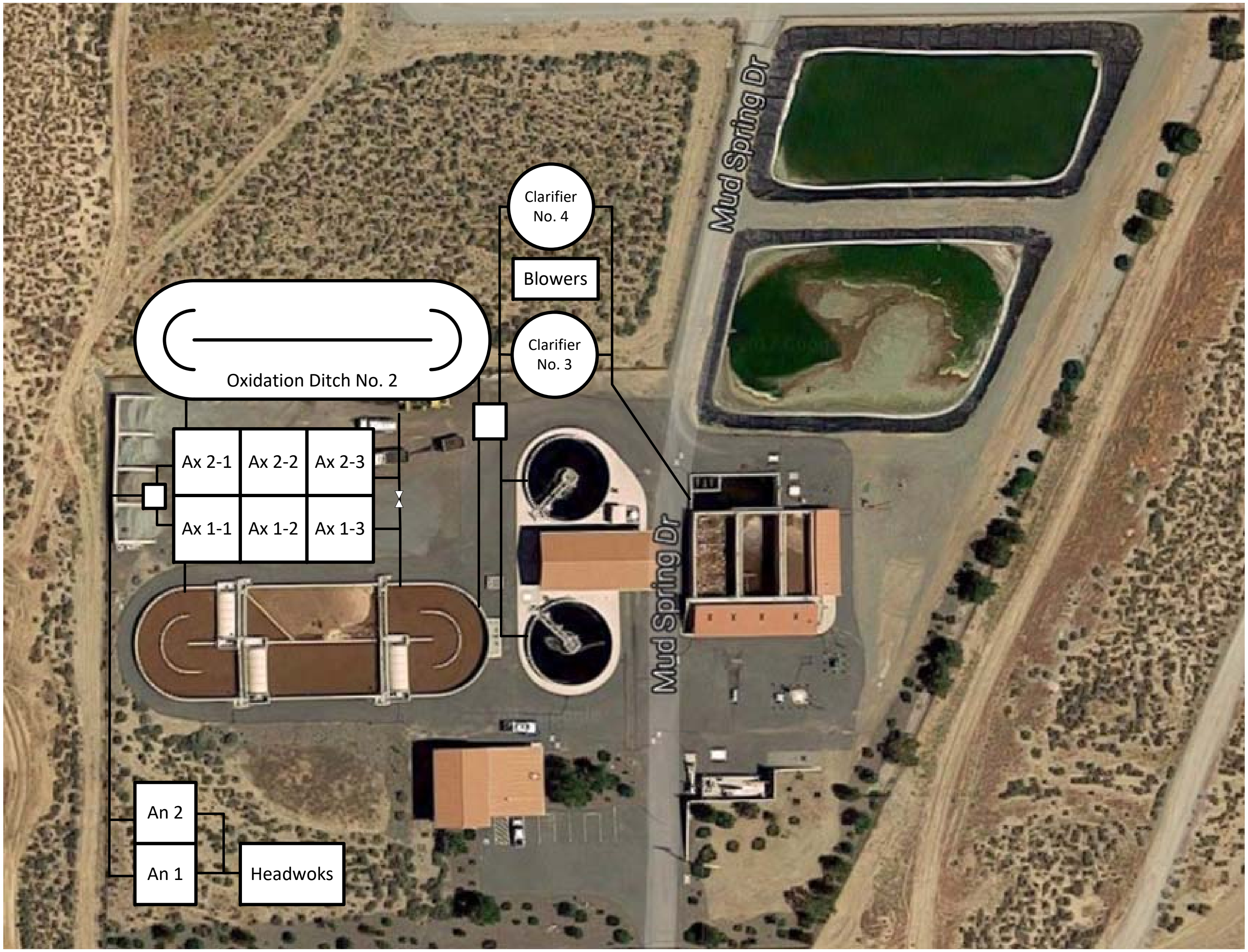

Figure 5-5 –Option 2 – A2O Process – Site Layout with Headworks

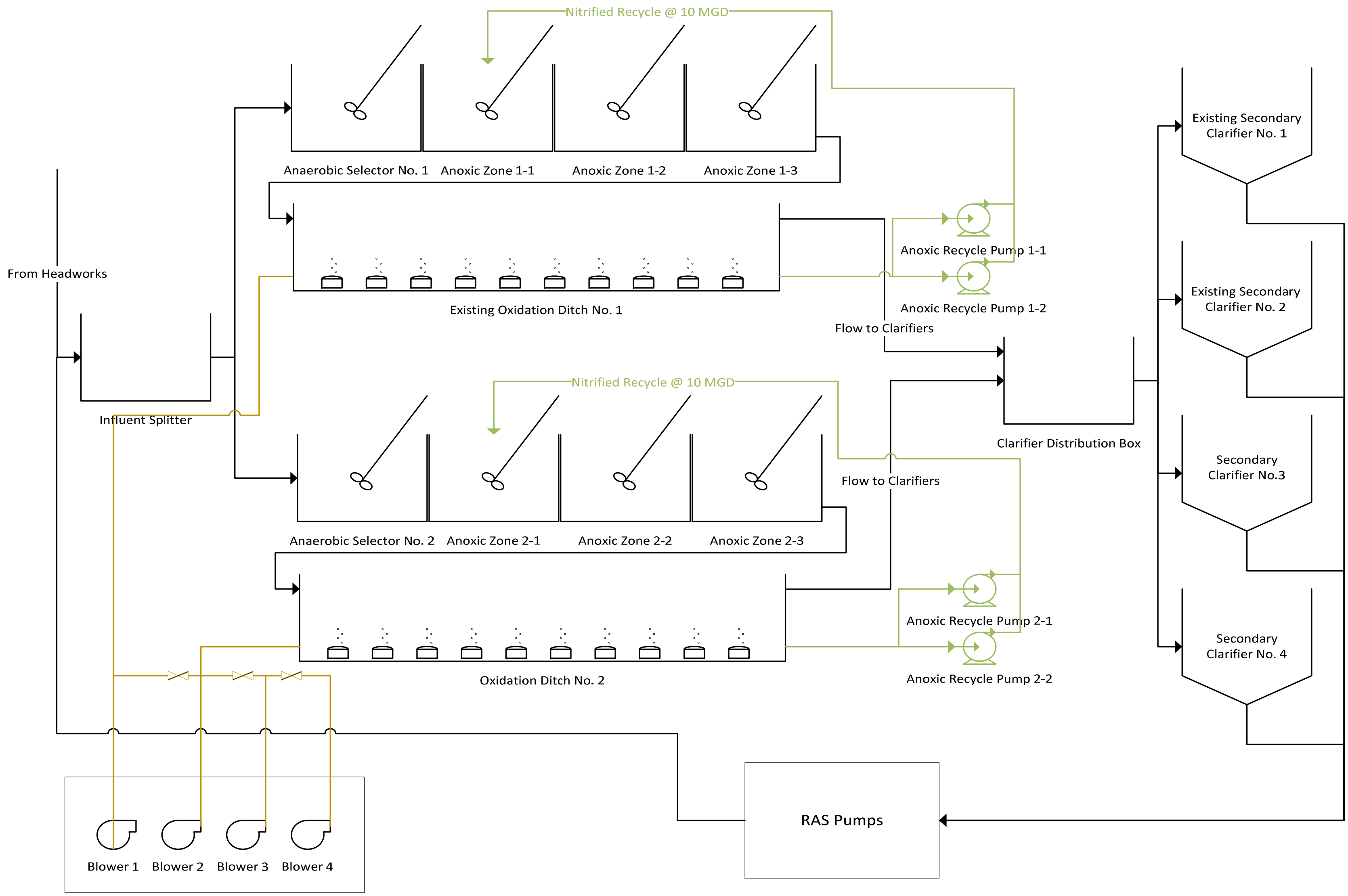

Figure 5-6 –Option 2 – A2O Process – Process Flow Diagram

4.3 OPTION 3 – FIVE STAGE BARDENPHO

Option 3 will similarly have two new 150,000 gal anaerobic selectors at the front end of the process with a dedicated mixer for each basin. Each of these selectors will be followed by three 200,000 gallon anoxic zones with dedicated mixers. The first anoxic zone will receive a variable nitrified recycle from the downstream oxidation ditches with a flow rate up to 6 MGD for each train. The anoxic volume along with the high recycle rate will accomplish the required denitrification for the process.

Following the anoxic zones, two oxidation ditches, one existing and one new, will accomplish nitrification. The new basin is 1.03 MG with the same dimensions as the existing basin. Treatment in the basin will be accomplished through constant aeration at an assumed dissolved oxygen setpoint of 2 mg/l. The oxygen will be supplied to the tanks through fine pore diffusers fed by four blowers, each capable of producing 3,100 scfm of air, for a total firm capacity air rate of 9,300 scfm. Similar to Options 1 and 2, the blowers are assumed to be single stage centrifugal units housed in a separate blower building, the diffusers are assumed to be low profile panel type diffusers, and circulation will be provided by large, low speed, flow boosting submersible mixers similar to the type currently in place in the existing oxidation ditch.

Downstream of the oxidation ditches on each train will be a 250,000 gallon post-anoxic zone followed by a 50,000 gallon reaeration zone. These downstream zones supply additional nitrification and denitrification in the process allowing a lower anoxic recycle rate and lower overall total nitrogen effluent than either of the first two options.

Nitrogen effluent results at 3.07 MGD for the system utilizing the diurnal flow and concentration data established in TM #4 are shown in Figure 5-7.

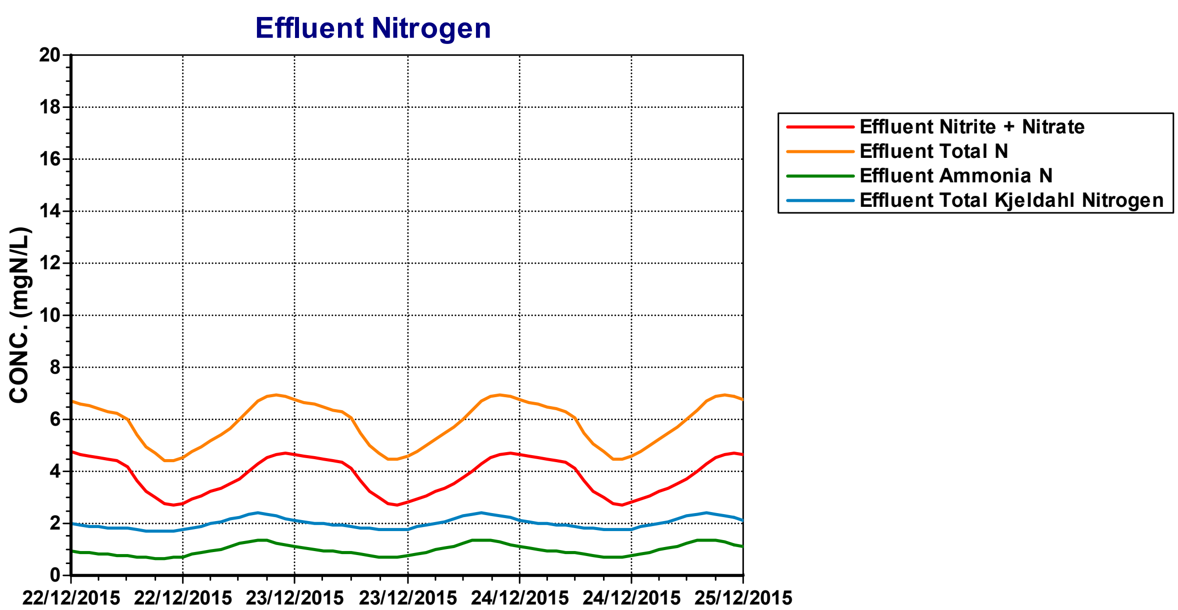

Figure 5-7 –Option 3 – Five Stage Bardenpho –Nitrogen Effluent

This option also requires the addition of two secondary clarifiers identical to the two existing units and new RAS pumps to continue to recirculate 60% of the influent flow. A site layout and process flow diagram of this option are shown in Figures 5-8 and 5-9.

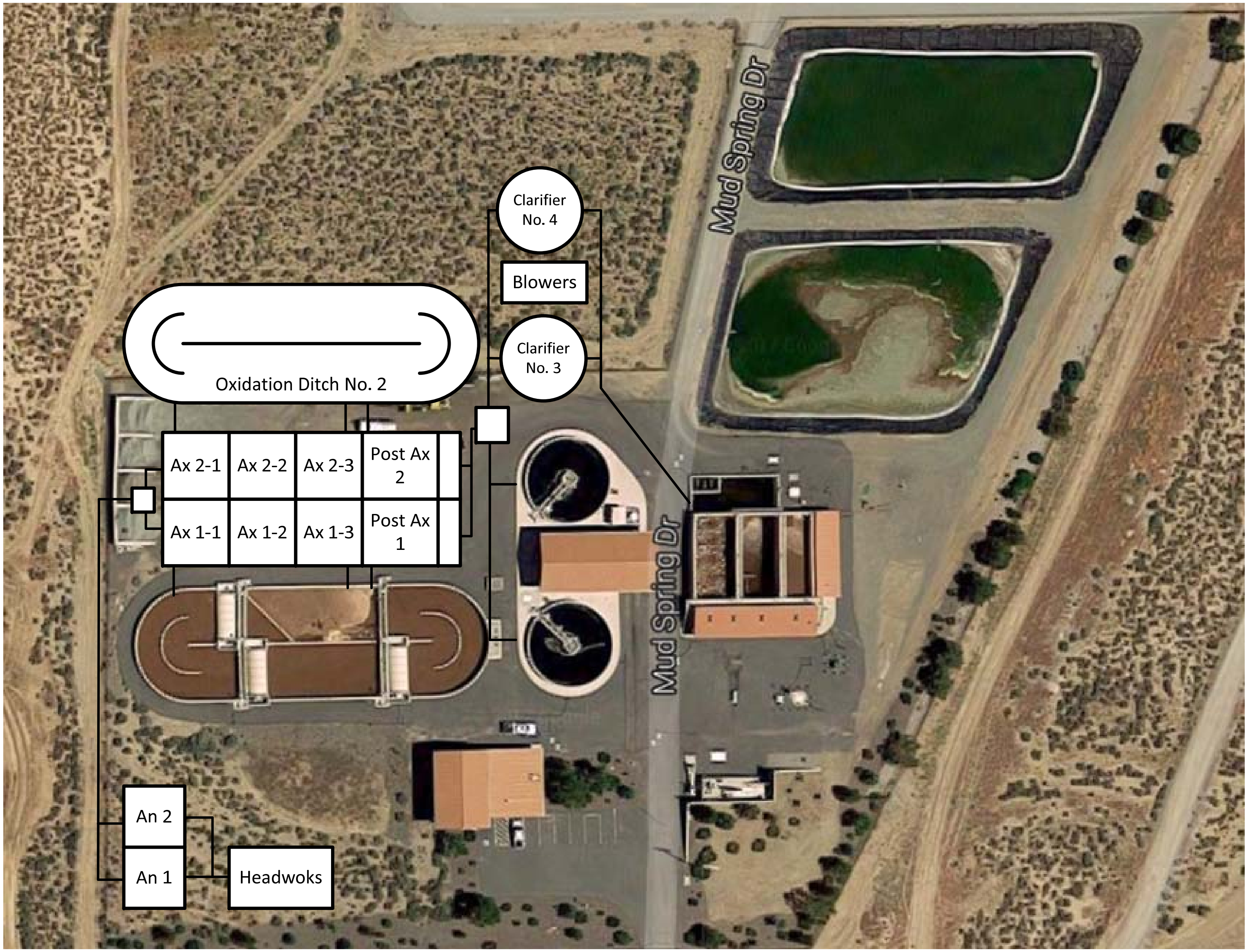

Figure 5-8 –Option 3 – Five Stage Bardenpho - Site Layout with Headworks

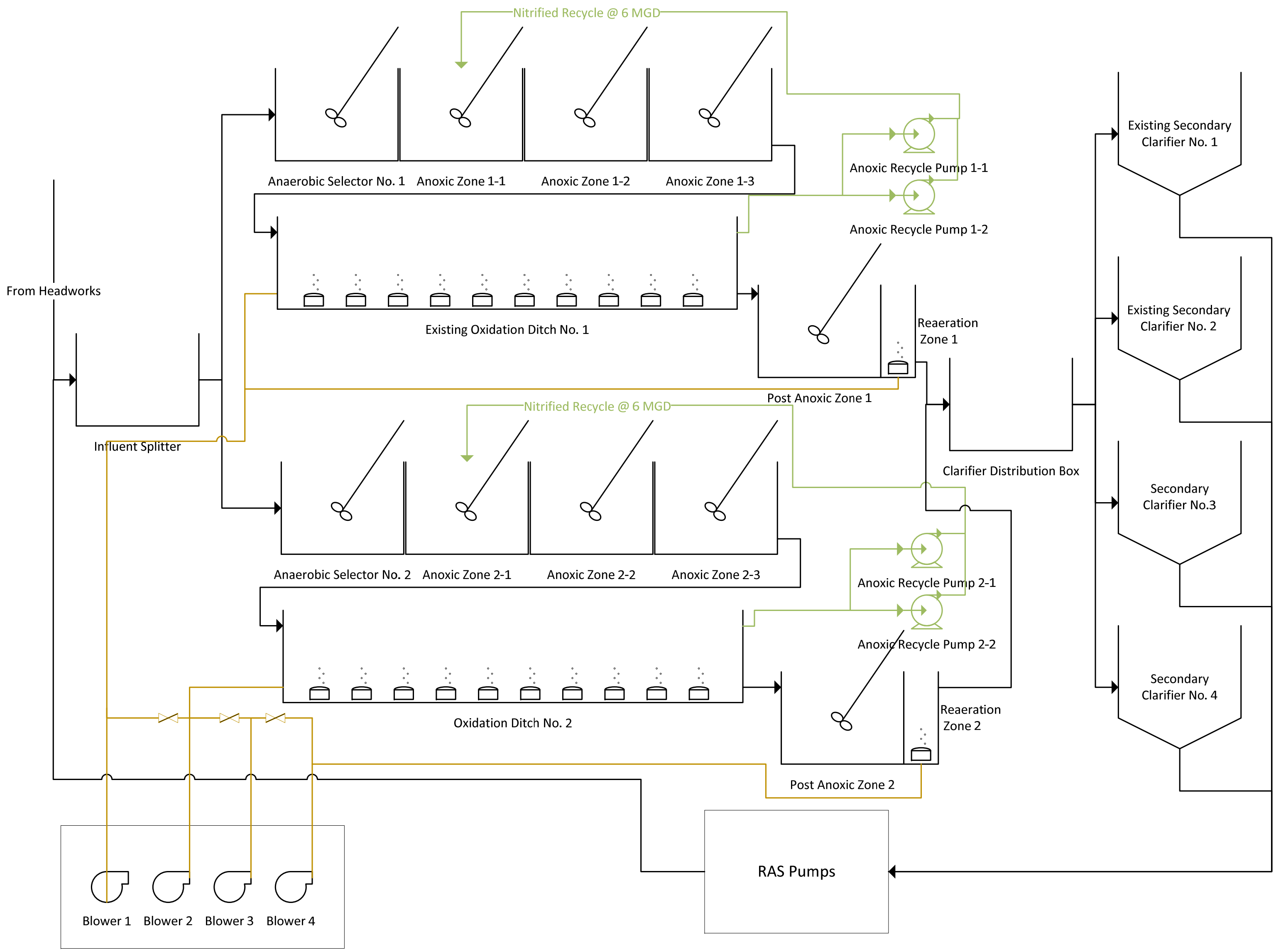

Figure 5-9 –Option 3 – Five Stage Bardenpho – Process Flow Diagram

4.4 SECONDARY TREATMENT COST EVALUATION

The total costs of the three secondary treatment options are summarized in Table 5-2.

Table 5-2 – Secondary Treatment Options Construction Cost Analysis

Option	Construction Cost	Total Project Costs
Option 1 – Four Oxidation Ditches	$18,500,000	$23,800,000
Option 2 – A2O Process	$15,000,000	$19,300,000
Option 3 – 5 Stage Bardenpho	$16,800,000	$21,600,000

Option 2 – A2O Process has the lowest construction cost. The total project cost of each item includes additional cost allowances for permitting, engineering, services during construction and commissioning.

Life cycle costs for each option have been calculated on the basis of the construction cost plus the net present value of twenty years of operating costs for the system. The results are shown in Table 5-3.

Table 5-3 – Secondary Treatment Options Life Cycle Cost Analysis

Option	Construction Cost	Annual O&M Cost (Year 1)	Life Cycle Cost (NPV)
Option 1 - Four Oxidation Ditches	$18,500,000	$556,000	$29,000,000
Option 2 - A2O Process	$15,000,000	$444,000	$23,400,000
Option 3 - 5 Stage Bardenpho	$16,800,000	$453,000	$25,400,000

Options 2 and 3 have similar annual O&M costs, while the O&M cost for Option 1 is significantly higher due to increased power requirements for aeration.

4.5 NON-COST EVALUATION

The three secondary treatment options were evaluated on six non-cost factors: Permit Compliance, System Reliability, Ease of Operation and Maintenance, Adaptability/Phasing Opportunity, Social Impacts, and Environmental Sustainability. A detailed description of the non-cost factors is provided in Appendix A.

These six factors were weighted through a pairwise comparison to select the most and least important factors and then weighted based on those results. The results of the pairwise comparison are shown below.

Different weighting methods for the non-cost factors were considered. The weighting that added one vote to the votes generated in the pairwise comparison, the V+1 weighting, was used. The V+1 weighting was chosen because it places more emphasis on the top three scoring factors: System Reliability, Permit Compliance, and Adaptability / Phasing Opportunity.

	A	B	C	D	E	F	V+1	W	V+2	W	V+3	W
A	X	B	A	A	A	A	**5**	24%	**6**	22%	**7**	**21%**
B	X	X	B	B	B	B	**6**	29%	**7**	26%	**8**	**24%**
C	X	X	X	D	C	C	**3**	14%	**4**	15%	**5**	**15%**
D	X	X	X	X	D	D	**4**	19%	**5**	19%	**6**	**18%**
E	X	X	X	X	X	E	**2**	10%	**3**	11%	**4**	**12%**
F	X	X	X	X	X	X	**1**	5%	**2**	7%	**3**	**9%**
							21	100%	27	100%	33	100%

Legend

A Permit Compliance - System's ability to stay within permit limits during an abnormal event.
B System Reliability - Ability to maintain operation in the event of equipment failures and/or unit process downtime.
C Ease of Operations and Maintenance - User friendliness of Operations.
D Adaptability / Phasing Opportunity - Ability to build only what is needed today and then expand in the future.
E Social Impacts - Minimize impacts to the local community (odors, noise, traffic, etc.)
F Environmental Sustainability - An alternative that exceeds permit requirements and/or minimizes carbon footprint.

V Votes
W Weight

Figure 5-10 –Non-Cost Factor Weighting Table

Each option was rated for each of the non-cost factors. The weightings assigned to each option are shown in Table 5-4.

Table 5-4 – Secondary Treatment Non-Cost Evaluation Results

Criteria	Weight	Option 1	Option 2	Option 3
Permit Compliance	24%	3.00	2.00	5.00
System Reliability	29%	5.00	4.00	4.00
Ease of Operations and Maintenance	14%	4.00	3.00	3.00
Adaptability / Phasing Opportunity	19%	3.00	3.00	3.00
Social Impacts	10%	4.00	4.00	4.00
Environmental Sustainability	5%	3.00	5.00	5.00
Weighted Score	**100%**	**3.81**	**3.24**	**3.95**
Final Rankings		**2nd**	**3rd**	**1st**

Note: Ratings: 1- Poor, 2-Average, 3-Good, 4-Very Good, 5-Excellent

The ratings show that secondary treatment Options 1 and 3 are more attractive in the non-cost evaluation. The following is a discussion of the ratings.

Permit Compliance

This factor has the widest variance among all the options. All of the options are able to meet the permit effluent limits and water quality objectives under design conditions. However, both Option 1 – Four Oxidation Ditches and Option 2 – A2O process have limitations in maintaining the site's water quality objectives outside of the design flow range for the facility.

Option 1 does not have the aerobic capacity to achieve low levels of ammonia at nitrogen levels significantly above the design flow and loading. The peak of the diurnal curve for effluent ammonia concentration at the design conditions is approximately 2.5 mg/l, and this will quickly rise above the water quality objective of less than 2 mg/l ammonia on a daily average basis with an increased influent nitrogen load.

Option 2 depends on a large nitrified recycle rate, approximately 650% of the influent flow, to achieve the required denitrification. If the anticipated amount of soluble COD is significantly less than the design assumptions, the process will fail to achieve the water quality goal of 5-7 mg/l total nitrogen due to a lack of substrate to drive denitrification.

Option 3 does not have similar concerns and can comfortably meet the water quality objectives for loadings significantly in excess of the design assumptions. Further, Option 3 allows for the conversion of one of the upstream anoxic zones to a swing aerobic zone in the future if additional aerobic volume for nitrification becomes necessary. Additional denitrification can be achieved through the addition of a supplemental carbon source into the post-anoxic zone to achieve low levels of total nitrogen, even with the loss of the upstream anoxic volume. A similar swing zone cannot be added to Option 2 without a very significant drop in overall denitrification rates. This flexibility makes Option 3 the most robust option for meeting the effluent permit limits by a significant margin.

System Reliability

The three options are similar in terms of reliability after equipment failure. Option 1 has slightly more redundancy due to having five blowers rather than four and four independent aerobic trains rather than two. If an aerobic train is taken out of service, Option 1 will only lose 25% of the available treatment volume while Options 2 and 3 will lose approximately 50% of the available aerobic volume.

Ease of Operations and Maintenance

Options 2 and 3 require the monitoring of the nitrate content and flow rate in an anoxic recycle stream to ensure that adequate denitrification is occurring. Option 1 accomplishes the same function through blower cycling, which is the method currently employed at the plant.

Adaptability / Phasing Opportunity

All three options can be expanded in two phases. The first phase for all options is essentially the same: construct a second oxidation ditch with diffused aeration, the anaerobic selectors, and a new blower facility. All of the options would continue to be operated with on/off air after this first phase. The second phase for Option 1 would involve constructing two additional oxidation ditches and two additional clarifiers, while the second phase of Options 2 and 3 would involve constructing the two additional clarifiers, the anoxic selectors, and for Option 3, the post-anoxic and reaeration zones.

However, none of the evaluated options scored highly for adaptability and phasing. Greater adaptability can be achieved through adding smaller volume attached growth type processes as flow grows. Greater adaptability is also possible in suspended growth processes that do not utilize the oxidation ditch configuration, but this is not practical without abandoning the existing oxidation ditch.

Social Impacts

The options all scored similarly for social impacts. None are likely to have increased truck traffic, odors or noise relative to any of the other options.

Environmental Sustainability

Options 2 and 3 will both utilize significantly less energy to treat the flow than Option 1, and as such have a reduced carbon footprint.

4.6 SECONDARY TREATMENT SUMMARY AND RECOMMENDATION

The life cycle costs and non-cost evaluation scores have been summarized in Table 5-5 to determine the option with the lowest life cycle cost per rating point of non-cost benefit.

Table 5-5 – Secondary Treatment Lifecycle Cost and Non-Cost Rating

Option	Life Cycle Cost (NPV)	Non-Cost Rating
Option 1 - Four Oxidation Ditches	$29,000,000	3.81
Option 2 - A2O Process	$23,400,000	3.24
Option 3 - 5 Stage Bardenpho	$25,400,000	3.95

Option 3, 5 Stage Bardenpho, is the recommended option as it is the most stable process, provides the greatest ability to meet permit limits over a wide range of influent flows and loads, has the highest non-cost score, and is the second lowest life cycle and capital cost option.

5.0 REUSE

CSWRF will supply reclaimed water to Stonegate development for landscape irrigation and other non-potable uses. For the basis of this facility plan, the reclaimed water system demands are projected to increase in phases up to a maximum of 1.0 MGD. Secondary effluent will undergo treatment to achieve Nevada reuse category A quality. This requires tertiary treatment (filtration) and disinfection to achieve the required pathogen inactivation and water quality. There are multiple possible configurations of filtration and disinfection processes that can achieve reuse category A quality, including cloth media filtration, multi-media gravity filtration or upflow sand filtration combined with chlorine, ozone, or UV disinfection.

Upflow sand filtration followed by UV disinfection is the configuration selected for development in this facility plan, although an alternate configuration may be selected during preliminary design. The selected filters produce reliable reclaimed water quality at STMWRF, have low O&M requirements when compared with other alternatives, and provide an alternative to chlorine-only disinfection.

A new tertiary treatment facility will house both the upflow sand filtration system and the UV disinfection system. The filtration system is continuously backwashed and requires no additional backwash conveyance equipment. The system will require a total of 4 filters, and 4 UV lamps (3 + 1 redundancy). The UV lamps will be installed inside the conveying pipe vessel, downstream of the filters. The proposed reuse facility will be located at the southeastern portion of the facility, in the area generally occupied by the current headworks. The preliminary construction cost for the reuse facility is **$3.5M**, with a total project cost of **$4.6M**.

6.0 DIGESTION AND THICKENING

6.1 DESIGN CRITERIA REVISION

The primary expansion alternative for the aerobic digestion system at CSWRF is a revision in the design criteria for the system. Currently, the assumed solids retention time (SRT) and temperature in the digesters are 60-days, and 15°C, respectively. Conservatively, these parameters correspond to a 40% volatile suspended solids (VSS) destruction in the digesters. By lowering the SRT, the same digester volume can process a higher influent WAS flow rate. A lower SRT will decrease the VSS destruction in the digesters, however as the digested sludge produced at CSWRF does not need to meet Class B biosolids standards, maintaining this SRT is not critical to facility operation.

At Washoe County's STMWRF facility, 270 degree days was chosen to achieve a significant amount of biosolids stabilization without building out unnecessary infrastructure. This criteria has been utilized for CSWRF to re-rate the digesters. From County sampling, the typical temperature in the digesters is 13°C. This corresponds to an SRT of 21 days, with a VSS destruction of 32%. With the current storage volume of the digesters at 423,000 gallons (at 90% full), the digesters will be able to process WAS flows corresponding to 1.48 MGD average influent flow rate. At a firm digester storage volume of 265,000 gallons (at 90% full), the digesters will be able to process WAS flows corresponding to 0.93 MGD average influent flow rate. Table 5-6 presents current and future capacities digestion system, assuming all three digesters are operating in parallel, and the SRT and temperature criteria revision.

With the revised criteria, the digesters will have sufficient capacity to process solids generated by an influent flow of approximately 1.48 MGD. This influent flow is nearly identical to the projected 2026 max month influent flow of 1.52 MGD. Therefore for this analysis, revised design criteria is assumed to provide adequate digestion capacity through 2026. The existing aeration system also has sufficient capacity to stabilize the sludge at the projected 2026 conditions. Therefore, there is no added cost for capacity expansion with digester design criteria revision, as no capital or O&M cost modifications are required through 2026.

Table 5-6 – Digestion Capacity with Criteria Revision

Parameter	Current Capacity	Current Firm Capacity	Revised Criteria Capacity	Revised Criteria Firm Capacity
Digester Thickness (%)	1.2%	1.2%	1.2%	1.2%
Volume (gallons)	423,000	265,500	423,000	265,500
SRT (days)	60	60	21	21
VSS to Digester (ppd)	920	625	2,354	1,477
TSS to Digester (ppd)	1,082	735	2,769	1,738
Design VSS Destruction (%)	40%	40%	20 - 35%	20 - 35%
Digested Sludge Load to Centrifuges (ppd)	714	485	2016	1265
Estimated Average Influent Flow (gpd)	580,000	360,000	1,480,000	930,000

gpd – gallons per day

ppd – pounds per day

6.2 THICKENING AND AERATION EXPANSION

While revised design criteria creates adequate capacity through 2026, the digesters will require additional capacity to meet the 2036 max month influent flow of 3.08 MGD. The most efficient method for further expansion of the digester capacity is to thicken in the influent WAS flow. By thickening the feed to the digesters, the flow rate to the digesters is decreased, while the solids flow rate remains constant. The excess water removed from the WAS is returned to upstream treatment processes. This analysis assumes the addition of a single 150 gpm capacity rotary drum thickener (RDT) to achieve the needed increase in digester capacity.

Calculations for the CSWRF solids train used an estimated solids load of 4,000 pounds per day, which was based on the sludge production rates predicted by the Biowin model. The VSS destruction in 2036 has been estimated at the minimum range expected for sludge digested at approximately 270 degree days, or 20% VSS destruction at a 21 day SRT in 2036. It is also assumed that in 2036, 100% of the digester volume will be accessible, as the digester contents will not be drawn down regularly for decanting.

Table 5-7 – 2036 Digestion Capacity

Parameter	Capacity
Full Volume (gallons)	470,000
Firm Volume (gallons)	295,5000
SRT (days)	21
WAS Flow Rate (gpd)	56,425
Assumed WAS Thickness	0.85%
TSS to Digestion (ppd)	4,000
VSS Destruction (%)	20%
Digested Sludge Load to Centrifuges (ppd)	3,320
Estimated Average Influent Flow (gpd)	3,080,000

The RDT will produce total solids (TS) of 5% in thickened sludge under normal operating conditions. The RDT operating time will vary depending upon the WAS flow rate and concentration as well as the number of operating digesters. Assuming thickened WAS at 5% TS, at 2036 max month with full digestion capacity, 31% of all WAS flow to the digesters would require thickening. This corresponds to approximately 17,500 gpd of WAS flow that requires thickening, or approximately two hours of RDT runtime at 150 gpm per day. At 2036 max month with firm digestion capacity, 62% of all WAS flow to the digesters would require thickening. This corresponds to approximately 4 hours per day of RDT runtime at 150 gpm.

Table 5-8 – 2036 Digestion RDT Operation

Parameter	Capacity	Firm Capacity
Full Volume (gallons)	470,000	295,5000
TS in Digesters	1.8%	2.9%
Average Digestion Influent TS	2.1%	3.4%
Thickened WAS Flow Rate Required (gpd)	17,500	35,000
RDT Daily Runtime (hours)	2	4

The system will also require an expanded aeration system to achieve the levels of VS destruction required in the 2036 condition. It is recommended that the improvements be installed concurrently with the addition of the RDT. The planned improvements include three 1,210 scfm positive displacement blowers with VFDs in the existing blower building to replace the existing blowers and a new coarse bubble diffuser system in the digester to replace the existing jet aeration manifold. The new aeration system is summarized in Table 5-9.

Table 5-9 – 2036 Digestion Aeration Design

Parameter	Capacity
Max Temp in Digesters (°C)	23
Maximum Degree Day SRT	480
Design Max VSR	40%
Max TS in Digesters (firm capacity only)	2.9%
Volatile Solids Reduced (ppd)	1,280
Oxygen Requirement (lb O_2 / lb VSR)	2
Assumed Air On Percentage	80%
Actual Oxygen Requirement (lb/hr)	133
Alpha	0.5
Standard Oxygen Requirement (lb/hr)	373
Clean Water SOTE	14.5%
Required Total Airflow (scfm)	2,420

6.3 DIGESTION IMPROVEMENTS COST ESTIMATE AND ALTERNATIVES ANALYSIS

As no capital or O&M cost modifications are required to revise the digestion design criteria, there is no added cost to create full digestion capacity through 2026.

The options for RDT installation and aeration system improvements accompany the options for dewatering and loadout improvements, and are discussed in detail in Section 7.2. These costs are intertwined as the RDT will be located in the existing dewatering room, while the existing centrifuges will be relocated. As such, these projects have been estimated together.

7.0 DEWATERING AND LOADOUT

7.1 ADDITIONAL CENTRIFUGE

The current dewatering system consists of one Andritz centrifuge, and a conveyor discharging dewatered cake to a dumpster with a capacity of 12 cubic yards. The centrifuge has a loading capacity of 625 pounds per hour at 65 gpm. At 2036 max month influent flow rate, the centrifuge will receive approximately 581 pounds per hour at 59 gpm of aerobically digested WAS, assuming 8 hours per day, 5 days per week operation. Therefore, the current centrifuge is sufficient to meet 2036 max month loading criteria. However, there is currently no redundancy in the system, so an additional, identical centrifuge is recommended to provide redundancy, and to allow for faster and more efficient solids removal from the system. A new centrifuge could be installed in the existing dewatering building, or could be installed in a new building along with the existing centrifuge.

While the centrifuge was designed to produce a minimum of 18% TS dewatered cake, recent data shows average cake TS between 15-16%. Assuming a 15% TS cake at 2036 max month, the dewatering system will produce approximately 92 cubic yards of cake per week, requiring disposal of 8, 12-cubic yard bins per week. This disposal frequency will produce operational and staffing challenges, therefore construction of a new facility with greater storage capacity is recommended.

A new facility could accommodate trucks with a live storage capacity of 18.75 cubic yards, (75% of a full volume of 25 cubic yards). Disposal will only be required 5 times per week with these bins. This facility will also have two truck bays, with the potential to park two trailers, for a total storage capacity of 37.5 cubic yards.

7.2 DEWATERING COST ESTIMATE AND ALTERNATIVES ANALYSIS

Two options were evaluated for digestion and dewatering facility improvements:

1) Install 1 additional centrifuge in the existing dewatering building, construct a new RDT facility, install three new 1210 scfm positive displacement blowers in the existing blower room, and install a coarse bubble diffuser system. This option with meet the system design criteria with redundancy, but would require very frequent disposal of dewatered cake, estimated at 14 dumpster loads per week. This frequent loadout is insufficient for future solids loads and the loadout facility cannot be readily expanded due to its central location on the CSWRF site, as shown in Figure 5-11.

2) Construct a new dewatering and loadout facility with two centrifuges, (one new and one existing), install the RDT in the existing dewatering facility, install three new 1210 scfm positive displacement blowers in the existing blower room, and install a coarse bubble diffuser system. Option 2 meets the demand criteria while providing appropriate redundancy, improved operational flexibility and decreased O&M costs associated with cake disposal. Figure 5-11 presents Option 1, and Figure 5-12 presents Option 2. Total construction cost of **$6.7M**, with a total project cost of **$8.7M**. A large portion of the costs for this option is the construction of a new, two-bay covered loadout facility. Constructing a single bay, rather than a two-bay loadout facility will result in cost savings of approximately $1 million.

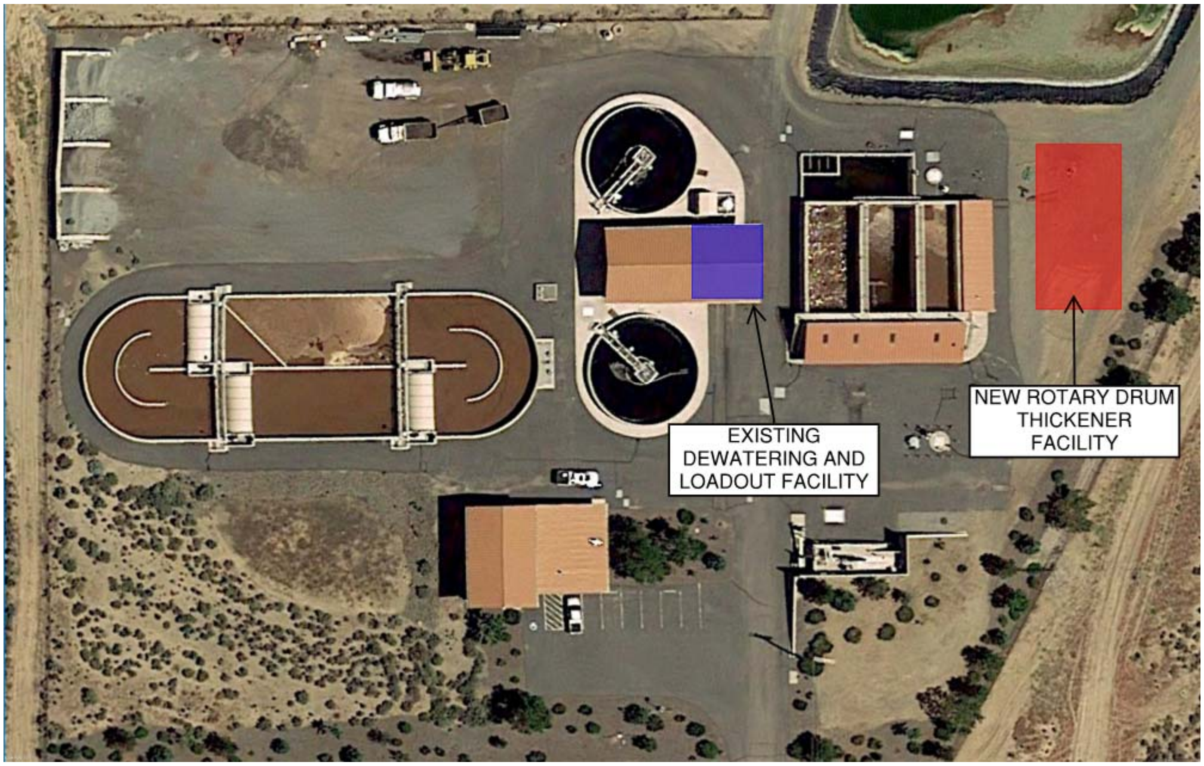

Figure 5-11: Option 1 Digestion and Dewatering Improvements

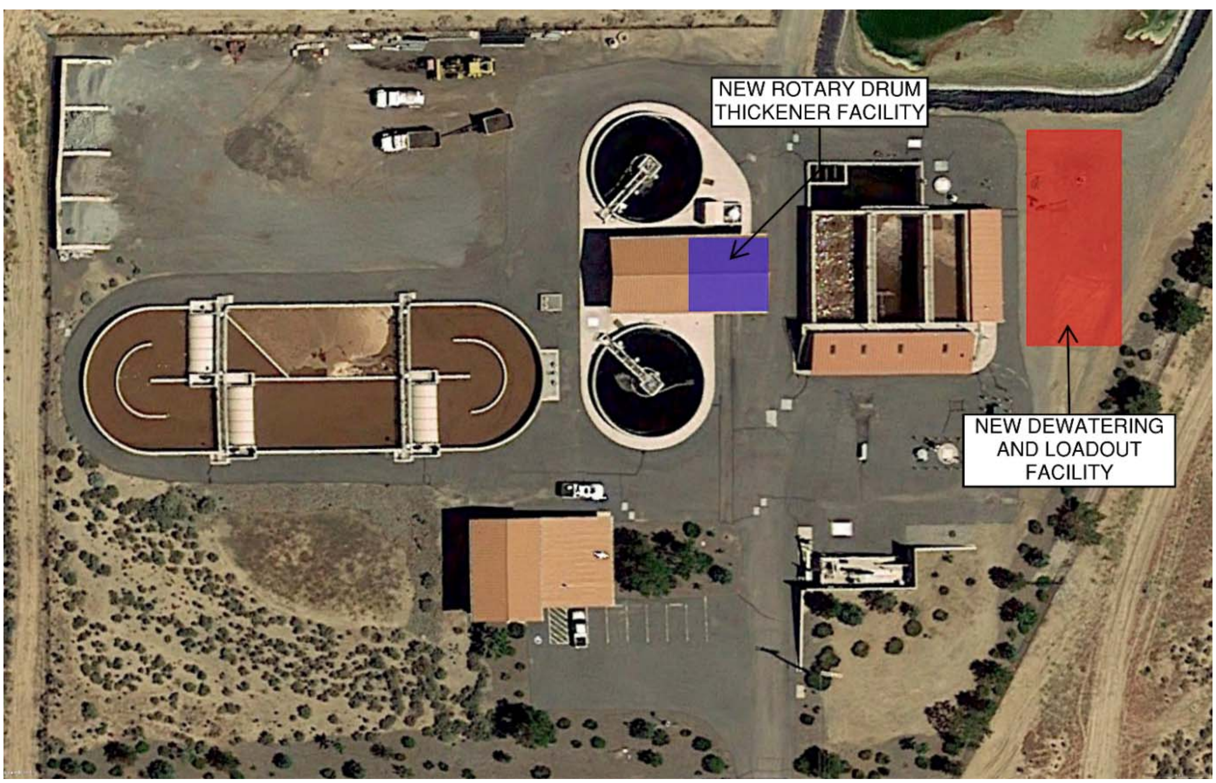

Figure 5-12: Option 2 Digestion and Dewatering Improvements

Option 2 is the recommended alternative, as the long-term operational difficulties and increased costs in operating an undersized loadout facility make Option 1 unfeasible.

8.0 EMERGENCY GENERATION AND PLANT WATER SYSTEM

The expansion of CSWRF as outlined in the various expansion projects will result in the system exceeding the capacity of both the emergency generator and the plant water system. The costs for expanding these two items were not included in any of the other individual projects. The future plant will consist of a 750 kW pad mounted generator located near the covered area that houses the current generator. The plant water system upgrades include a new plant water pump station constructed with two new vertical turbine pumps and a new pressure tank. The pumps would be located in a dedicated portion of the existing effluent equalization basin. The costs for running new plant water piping, as well as piping for other support utilities, have been reflected in yard piping allowances for the individual expansion projects. Construction costs for the generator and pump station are **$1.8M** with total project costs of **$2.3M**.

9.0 SUMMARY OF EXPANSION PROJECTS

CSRWF requires several upgrades in order to treat 2036 flow rates to the desired quality as described in Section 2. These upgrades are broken down into six recommended projects, described in Table 5-9 below. The costs and timetable for these individual projects will be summarized in the capital improvement plan.

Table 5-9 – Summary of Expansion Projects

Unit Process	Description
Headworks	Two inclined fine screens, bypass channel with a manual bar screen, two screenings washer/compactors, mechanically induced grit vortex, grit washer/dewatering
Secondary Treatment	5-stage Bardenpho, blower building, 2 secondary clarifiers, RAS/WAS pumps station
Reuse	Continuously backwashed upflow sand filter, in-vessel UV disinfection
Digestion and Thickening	Design criteria revision, rotary drum thickener in existing dewatering building
Dewatering and Loadout	Centrifuge, dewatering and loadout facility
Emergency Generator and Plant Water System	New 750 kW emergency generator and new vertical turbine plant water pump station

Appendix A

Cost Estimate Summaries

CH2M Parametric Cost Estimating System (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

File Version: 1/25/2017

Project Capacity: >>>		Project Unit: >>>		(For example: MGD, HP, GPM...)

Project Name:	Cold Springs
Project Number:	678250
Project Manager:	Paul Steele
Estimator:	Kevin Butcher
Project Description:	WRF
Project Location (City):	Reno
Project Location (State):	NEVADA
Project Location (Country):	USA
Cost Basis (Month/Year):	February/2017

Roundup to the nearest: $10,000

Item	Include? (Yes or No)	SCOPE OF PROJECT	Cost
	Yes	Screening and Grit: Headworks	$2,370,000
	No	U.D. Facility: Misc	$0

SUBTOTAL - PROJECT COST		$2,370,000
ADDITIONAL PROJECT COSTS:		
Demolition:	5.00%	$120,000
Overall Sitework:	3.10%	$80,000
Plant Computer System:	1.40%	$40,000
Yard Electrical:	4.30%	$110,000
Yard Piping:	5.50%	$140,000
UD #1 Default Description	0.00%	$0
UD #2 Default Description	0.00%	$0
UD #3 Default Description	0.00%	$0
SUBTOTAL with Additional Project Costs		$2,860,000

RED FLAGS:

1	Rock Excavation	
2	Pile Foundations	
3	Seismic Foundations	
4	Dewatering Conditions	
5	Wetlands Mitigation	
6	Weather Impacts	
7	Depth of Structures	
8	Local Building Code Restrictions	
9	Coatings or Finishes	
10	Building or Architectural Considerations	
11	Client Material Preferences	
12	Client Equipment Preferences	

13	Piping Galleries, Piping Trenches, Piping Racks		
14	Yard Piping Complexity		
15	Existing Site Utilities (New, Retrofit, and Complexity)		
16	I & C Automation (New or Retrofit)		
17	Electrical Feed (New or Retrofit)		
18	Electrical Distribution		
19	Shoring		
20	Contamination		
21	User Defined Red Flag 1		
22	User Defined Red Flag 2		
23	User Defined Red Flag 3		
24	User Defined Red Flag 4		
25	User Defined Red Flag 5		
26	User Defined Red Flag 6		
27	User Defined Red Flag 7		
TOTAL - RED FLAGS			$0

SUBTOTAL - PROJECT COST with Additional Project Costs and Red Flag Costs			$2,860,000
TAX:	0.00%	$0	$0
SUBTOTAL with Tax			$2,860,000
CONTRACTOR MARKUPS:			
Overhead	10.00%	$2,860,000	$290,000
Subtotal			$3,150,000
Profit	5.00%	$3,150,000	$160,000
Subtotal			$3,310,000
Mob/Bonds/Insurance	5.00%	$3,310,000	$170,000
Subtotal			$3,480,000
Contingency	30.00%	$3,480,000	$1,050,000
SUBTOTAL with Markups			$4,530,000
LOCATION ADJUSTMENT FACTOR	93.7	$4,530,000	$4,250,000
SUBTOTAL - with Local Adjustment Factor			$4,250,000
MARKET ADJUSTMENT FACTOR		$4,250,000	$0
SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor			$4,250,000
Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:			
Name of Process Reviewer		Leaf, Bill	
Name of Estimator Reviewer		Bredehoeft, Pete	
MAXIMUM CONSTRUCTION COST			$4,250,000
NON-CONSTRUCTION COSTS:			
Permitting:	2.00%	$4,250,000	$90,000
Engineering:	12.00%	$4,250,000	$510,000
Services During Construction:	12.00%	$4,250,000	$510,000
Commissioning & Startup:	3.00%	$4,250,000	$130,000
Land / ROW:	0.00%	$4,250,000	$0
Legal / Admin:	0.00%	$4,250,000	$0
Other Default Description	0.00%	$4,250,000	$0
SUBTOTAL - Non-Construction Costs			$1,240,000
TOTAL - CAPITAL COST			$5,490,000

Currency Conversion of TOTAL CAPITAL COST:

Currency	*Unit of Measure*	*Conversion Rate*	*Converted Amount*
None	**U.S. Dollar**	**1**	**5,490,000**

CH2M Parametric Cost Estimating System (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

Cold Springs Secondary Treatment Option 1

File Version: 1/25/2017

Project Capacity: >>>	3.07	*Project Unit: >>>*	MGD	*(For example: MGD, HP, GPM…)*

Project Name:	Cold Springs WRF	
Project Number:	678250	
Project Manager:	Paul Steele	
Estimator:	Kevin Butcher	
Project Description:	WRF Facility Plan for expansion	Roundup to the nearest:
Project Location (City):	Reno	$1,000
Project Location (State):	NEVADA	
Project Location (Country):	USA	
Cost Basis (Month/Year):	February/2017	

Item	Include? (Yes or No)	SCOPE OF PROJECT	Cost
	Yes	Aeration Basin: Main	$6,093,000
	Yes	Blowers: Main	$2,291,000
	Yes	Round SC: Main	$1,231,000
	Yes	RAS WAS PS: Main	$856,000

SUBTOTAL - PROJECT COST			$10,471,000
ADDITIONAL PROJECT COSTS:			
Demolition:	5.00%		$524,000
Overall Sitework:	3.10%		$325,000
Plant Computer System:	1.40%		$147,000
Yard Electrical:	4.30%		$451,000
Yard Piping:	5.50%		$576,000
UD #1 Default Description	0.00%	$5,356,000	$0
UD #2 Default Description	0.00%		$0
UD #3 Default Description	0.00%		$0
SUBTOTAL with Additional Project Costs			$12,494,000

RED FLAGS:

1	Rock Excavation	
2	Pile Foundations	
3	Seismic Foundations	
4	Dewatering Conditions	
5	Wetlands Mitigation	
6	Weather Impacts	
7	Depth of Structures	
8	Local Building Code Restrictions	
9	Coatings or Finishes	
10	Building or Architectural Considerations	

11	*Client Material Preferences*			
12	*Client Equipment Preferences*			
13	*Piping Galleries, Piping Trenches, Piping Racks*			
14	*Yard Piping Complexity*			
15	*Existing Site Utilities (New, Retrofit, and Complexity)*			
16	*I & C Automation (New or Retrofit)*			
17	*Electrical Feed (New or Retrofit)*			
18	*Electrical Distribution*			
19	*Shoring*			
20	*Contamination*			
21	*User Defined Red Flag 1*			
22	*User Defined Red Flag 2*			
23	*User Defined Red Flag 3*			
24	*User Defined Red Flag 4*			
25	*User Defined Red Flag 5*			
26	*User Defined Red Flag 6*			
27	*User Defined Red Flag 7*			
TOTAL - RED FLAGS				$0
SUBTOTAL - PROJECT COST with Additional Project Costs and Red Flag Costs				$12,494,000
TAX:		0.00%	$0	$0
SUBTOTAL with Tax				$12,494,000
CONTRACTOR MARKUPS:				
	Overhead	10.00%	$12,494,000	$1,250,000
	Subtotal			$13,744,000
	Profit	5.00%	$13,744,000	$688,000
	Subtotal			$14,432,000
	Mob/Bonds/Insurance	5.00%	$14,432,000	$722,000
	Subtotal			$15,154,000
	Contingency	30.00%	$15,154,000	$4,547,000
SUBTOTAL with Markups				$19,701,000
LOCATION ADJUSTMENT FACTOR		93.7	$19,701,000	$18,460,000
SUBTOTAL - with Local Adjustment Factor				$18,460,000
MARKET ADJUSTMENT FACTOR			$18,460,000	$0
SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor				$18,460,000
Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:				
Name of Process Reviewer			Leaf, Bill	
Name of Estimator Reviewer			Bredehoeft, Pete	
MAXIMUM CONSTRUCTION COST				$18,460,000
NON-CONSTRUCTION COSTS:				
	Permitting:	2.00%	$18,460,000	$370,000
	Engineering:	12.00%	$18,460,000	$2,216,000
	Services During Construction:	12.00%	$18,460,000	$2,216,000
	Commissioning & Startup:	3.00%	$18,460,000	$554,000
	Land / ROW:	0.00%	$18,460,000	$0
	Legal / Admin:	0.00%	$18,460,000	$0
	Other Default Description	0.00%	$18,460,000	$0
SUBTOTAL - Non-Construction Costs				$5,356,000

TOTAL - CAPITAL COST	**$23,816,000**

Currency Conversion of TOTAL CAPITAL COST:

Currency	*Unit of Measure*	*Conversion Rate*	*Converted Amount*
None	**U.S. Dollar**	**1**	**23,816,000**

CH2M Parametric Cost Estimating System (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

Cold Springs Secondary Treatment Option 2

File Version: 1/25/2017

Project Capacity: >>>	3.07	Project Unit: >>>	MGD	(For example: MGD, HP, GPM…)

Project Name:	Cold Springs WRF	
Project Number:	678250	
Project Manager:	Paul Steele	
Estimator:	Kevin Butcher	
Project Description:	WRF Facility Plan for expansion	Roundup to the nearest:
Project Location (City):	Reno	$1,000
Project Location (State):	NEVADA	
Project Location (Country):	USA	
Cost Basis (Month/Year):	February/2017	

Item	Include? (Yes or No)	SCOPE OF PROJECT	Cost
	Yes	Aeration Basin: Main	$4,801,000
	Yes	Blowers: Main	$1,604,000
	Yes	Round SC: Main	$1,231,000
	Yes	RAS WAS PS: Main	$854,000

SUBTOTAL - PROJECT COST			$8,490,000
ADDITIONAL PROJECT COSTS:			
Demolition:	5.00%		$425,000
Overall Sitework:	3.10%		$264,000
Plant Computer System:	1.40%		$119,000
Yard Electrical:	4.30%		$366,000
Yard Piping:	5.50%		$467,000
UD #1 Default Description	0.00%	$4,344,000	$0
UD #2 Default Description	0.00%		$0
UD #3 Default Description	0.00%		$0
SUBTOTAL with Additional Project Costs			$10,131,000

RED FLAGS:

1	Rock Excavation	
2	Pile Foundations	
3	Seismic Foundations	
4	Dewatering Conditions	
5	Wetlands Mitigation	
6	Weather Impacts	
7	Depth of Structures	
8	Local Building Code Restrictions	
9	Coatings or Finishes	
10	Building or Architectural Considerations	

11	Client Material Preferences			
12	Client Equipment Preferences			
13	Piping Galleries, Piping Trenches, Piping Racks			
14	Yard Piping Complexity			
15	Existing Site Utilities (New, Retrofit, and Complexity)			
16	I & C Automation (New or Retrofit)			
17	Electrical Feed (New or Retrofit)			
18	Electrical Distribution			
19	Shoring			
20	Contamination			
21	User Defined Red Flag 1			
22	User Defined Red Flag 2			
23	User Defined Red Flag 3			
24	User Defined Red Flag 4			
25	User Defined Red Flag 5			
26	User Defined Red Flag 6			
27	User Defined Red Flag 7			
TOTAL - RED FLAGS				$0
SUBTOTAL - PROJECT COST with Additional Project Costs and Red Flag Costs				$10,131,000
TAX:		0.00%	$0	$0
SUBTOTAL with Tax				$10,131,000
CONTRACTOR MARKUPS:				
Overhead		10.00%	$10,131,000	$1,014,000
Subtotal				$11,145,000
Profit		5.00%	$11,145,000	$558,000
Subtotal				$11,703,000
Mob/Bonds/Insurance		5.00%	$11,703,000	$586,000
Subtotal				$12,289,000
Contingency		30.00%	$12,289,000	$3,687,000
SUBTOTAL with Markups				$15,976,000
LOCATION ADJUSTMENT FACTOR		93.7	$15,976,000	$14,970,000
SUBTOTAL - with Local Adjustment Factor				$14,970,000
MARKET ADJUSTMENT FACTOR			$14,970,000	$0
SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor				$14,970,000
Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:				
Name of Process Reviewer			Leaf, Bill	
Name of Estimator Reviewer			Bredehoeft, Pete	
MAXIMUM CONSTRUCTION COST				$14,970,000
NON-CONSTRUCTION COSTS:				
Permitting:		2.00%	$14,970,000	$300,000
Engineering:		12.00%	$14,970,000	$1,797,000
Services During Construction:		12.00%	$14,970,000	$1,797,000
Commissioning & Startup:		3.00%	$14,970,000	$450,000
Land / ROW:		0.00%	$14,970,000	$0
Legal / Admin:		0.00%	$14,970,000	$0
Other Default Description		0.00%	$14,970,000	$0
SUBTOTAL - Non-Construction Costs				$4,344,000

TOTAL - CAPITAL COST	**$19,314,000**

Currency Conversion of TOTAL CAPITAL COST:

Currency	*Unit of Measure*	*Conversion Rate*	*Converted Amount*
None	**U.S. Dollar**	**1**	**19,314,000**

CH2M Parametric Cost Estimating System (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

Cold Springs Secondary Treatment Option 3

File Version: 1/25/2017

Project Capacity: >>>	3.07	Project Unit: >>>	MGD	(For example: MGD, HP, GPM…)

Project Name:	Cold Springs WRF
Project Number:	678250
Project Manager:	Paul Steele
Estimator:	Kevin Butcher
Project Description:	WRF Facility Plan for expansion
Project Location (City):	Reno
Project Location (State):	NEVADA
Project Location (Country):	USA
Cost Basis (Month/Year):	February/2017

Roundup to the nearest: $1,000

Item	Include? (Yes or No)	SCOPE OF PROJECT	Cost
	Yes	Aeration Basin: Main	$5,793,000
	Yes	Blowers: Main	$1,640,000
	Yes	Round SC: Main	$1,231,000
	Yes	RAS WAS PS: Main	$854,000

SUBTOTAL - PROJECT COST			$9,518,000
ADDITIONAL PROJECT COSTS:			
Demolition:	5.00%		$476,000
Overall Sitework:	3.10%		$296,000
Plant Computer System:	1.40%		$134,000
Yard Electrical:	4.30%		$410,000
Yard Piping:	5.50%		$524,000
UD #1 Default Description	0.00%	$4,868,000	$0
UD #2 Default Description	0.00%		$0
UD #3 Default Description	0.00%		$0
SUBTOTAL with Additional Project Costs			$11,358,000

RED FLAGS:

1	Rock Excavation	
2	Pile Foundations	
3	Seismic Foundations	
4	Dewatering Conditions	
5	Wetlands Mitigation	
6	Weather Impacts	
7	Depth of Structures	
8	Local Building Code Restrictions	
9	Coatings or Finishes	
10	Building or Architectural Considerations	

11	Client Material Preferences			
12	Client Equipment Preferences			
13	Piping Galleries, Piping Trenches, Piping Racks			
14	Yard Piping Complexity			
15	Existing Site Utilities (New, Retrofit, and Complexity)			
16	I & C Automation (New or Retrofit)			
17	Electrical Feed (New or Retrofit)			
18	Electrical Distribution			
19	Shoring			
20	Contamination			
21	User Defined Red Flag 1			
22	User Defined Red Flag 2			
23	User Defined Red Flag 3			
24	User Defined Red Flag 4			
25	User Defined Red Flag 5			
26	User Defined Red Flag 6			
27	User Defined Red Flag 7			
TOTAL - RED FLAGS				$0
SUBTOTAL - PROJECT COST with Additional Project Costs and Red Flag Costs				$11,358,000
TAX:		0.00%	$0	$0
SUBTOTAL with Tax				$11,358,000
CONTRACTOR MARKUPS:				
Overhead		10.00%	$11,358,000	$1,136,000
Subtotal				$12,494,000
Profit		5.00%	$12,494,000	$625,000
Subtotal				$13,119,000
Mob/Bonds/Insurance		5.00%	$13,119,000	$656,000
Subtotal				$13,775,000
Contingency		30.00%	$13,775,000	$4,133,000
SUBTOTAL with Markups				$17,908,000
LOCATION ADJUSTMENT FACTOR		93.7	$17,908,000	$16,780,000
SUBTOTAL - with Local Adjustment Factor				$16,780,000
MARKET ADJUSTMENT FACTOR			$16,780,000	$0
SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor				$16,780,000
Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:				
Name of Process Reviewer			Leaf, Bill	
Name of Estimator Reviewer			Bredehoeft, Pete	
MAXIMUM CONSTRUCTION COST				$16,780,000
NON-CONSTRUCTION COSTS:				
Permitting:		2.00%	$16,780,000	$336,000
Engineering:		12.00%	$16,780,000	$2,014,000
Services During Construction:		12.00%	$16,780,000	$2,014,000
Commissioning & Startup:		3.00%	$16,780,000	$504,000
Land / ROW:		0.00%	$16,780,000	$0
Legal / Admin:		0.00%	$16,780,000	$0
Other Default Description		0.00%	$16,780,000	$0
SUBTOTAL - Non-Construction Costs				$4,868,000

TOTAL - CAPITAL COST	$21,648,000

Currency Conversion of TOTAL CAPITAL COST:

Currency	*Unit of Measure*	*Conversion Rate*	*Converted Amount*
None	**U.S. Dollar**	**1**	**21,648,000**

CH2M Parametric Cost Estimating System (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

Cold Springs Reuse

File Version: 1/25/2017

Project Capacity: >>>		Project Unit: >>>		(For example: MGD, HP, GPM…)

Project Name:	Cold Springs	
Project Number:	678250	
Project Manager:	Paul Steele	
Estimator:	Kevin Butcher	
Project Description:	WRF	Roundup to the nearest:
Project Location (City):	Reno	$10,000
Project Location (State):	NEVADA	
Project Location (Country):	USA	
Cost Basis (Month/Year):	February/2017	

Item	Include? (Yes or No)	SCOPE OF PROJECT	Cost
	Yes	UV Disinfection: New	$730,000
	No	U.D. Facility: Misc	$0
	Yes	Cloth Disk Filter: New	$1,240,000

SUBTOTAL - PROJECT COST		$1,970,000
ADDITIONAL PROJECT COSTS:		
Demolition:	5.00%	$100,000
Overall Sitework:	3.10%	$70,000
Plant Computer System:	1.40%	$30,000
Yard Electrical:	4.30%	$90,000
Yard Piping:	5.50%	$110,000
UD #1 Default Description	0.00%	$0
UD #2 Default Description	0.00%	$0
UD #3 Default Description	0.00%	$0
SUBTOTAL with Additional Project Costs		$2,370,000

RED FLAGS:

1	Rock Excavation	
2	Pile Foundations	
3	Seismic Foundations	
4	Dewatering Conditions	
5	Wetlands Mitigation	
6	Weather Impacts	
7	Depth of Structures	
8	Local Building Code Restrictions	
9	Coatings or Finishes	
10	Building or Architectural Considerations	
11	Client Material Preferences	

12	*Client Equipment Preferences*			
13	*Piping Galleries, Piping Trenches, Piping Racks*			
14	*Yard Piping Complexity*			
15	*Existing Site Utilities (New, Retrofit, and Complexity)*			
16	*I & C Automation (New or Retrofit)*			
17	*Electrical Feed (New or Retrofit)*			
18	*Electrical Distribution*			
19	*Shoring*			
20	*Contamination*			
21	*User Defined Red Flag 1*			
22	*User Defined Red Flag 2*			
23	*User Defined Red Flag 3*			
24	*User Defined Red Flag 4*			
25	*User Defined Red Flag 5*			
26	*User Defined Red Flag 6*			
27	*User Defined Red Flag 7*			
TOTAL - RED FLAGS				$0

SUBTOTAL - PROJECT COST with Additional Project Costs and Red Flag Costs			$2,370,000
TAX:	0.00%	$0	$0
SUBTOTAL with Tax			$2,370,000
CONTRACTOR MARKUPS:			
Overhead	10.00%	$2,370,000	$240,000
Subtotal			$2,610,000
Profit	5.00%	$2,610,000	$140,000
Subtotal			$2,750,000
Mob/Bonds/Insurance	5.00%	$2,750,000	$140,000
Subtotal			$2,890,000
Contingency	30.00%	$2,890,000	$870,000
SUBTOTAL with Markups			$3,760,000
LOCATION ADJUSTMENT FACTOR	93.7	$3,760,000	$3,530,000
SUBTOTAL - with Local Adjustment Factor			$3,530,000
MARKET ADJUSTMENT FACTOR		$3,530,000	$0
SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor			$3,530,000
Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:			
Name of Process Reviewer		Leaf, Bill	
Name of Estimator Reviewer		Bredehoeft, Pete	
MAXIMUM CONSTRUCTION COST			$3,530,000
NON-CONSTRUCTION COSTS:			
Permitting:	2.00%	$3,530,000	$80,000
Engineering:	12.00%	$3,530,000	$430,000
Services During Construction:	12.00%	$3,530,000	$430,000
Commissioning & Startup:	3.00%	$3,530,000	$110,000
Land / ROW:	0.00%	$3,530,000	$0
Legal / Admin:	0.00%	$3,530,000	$0
Other Default Description	0.00%	$3,530,000	$0
SUBTOTAL - Non-Construction Costs			$1,050,000

TOTAL - CAPITAL COST	**$4,580,000**

Currency Conversion of TOTAL CAPITAL COST:

Currency	*Unit of Measure*	*Conversion Rate*	*Converted Amount*
None	**U.S. Dollar**	**1**	**4,580,000**

CH2M Parametric Cost Estimating System (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

Cold Springs Digester Blowers and Diffusers

File Version: 1/25/2017

Project Capacity: >>>	3.07	Project Unit: >>>	MGD	(For example: MGD, HP, GPM…)

Project Name:	Cold Springs WRF
Project Number:	678250
Project Manager:	Paul Steele
Estimator:	Kevin Butcher
Project Description:	WRF Facility Plan for expansion
Project Location (City):	Reno
Project Location (State):	NEVADA
Project Location (Country):	USA
Cost Basis (Month/Year):	February/2017

Roundup to the nearest: $1,000

Item	Include? (Yes or No)	SCOPE OF PROJECT	Cost
	Yes	Blowers: Main	$729,000

SUBTOTAL - PROJECT COST			$729,000
ADDITIONAL PROJECT COSTS:			
Demolition:	5.00%		$37,000
Overall Sitework:	3.10%		$23,000
Plant Computer System:	1.40%		$11,000
Yard Electrical:	4.30%		$32,000
Yard Piping:	5.50%		$41,000
UD #1 Default Description	0.00%	$377,000	$0
UD #2 Default Description	0.00%		$0
UD #3 Default Description	0.00%		$0
SUBTOTAL with Additional Project Costs			$873,000

RED FLAGS:

1	Rock Excavation	
2	Pile Foundations	
3	Seismic Foundations	
4	Dewatering Conditions	
5	Wetlands Mitigation	
6	Weather Impacts	
7	Depth of Structures	
8	Local Building Code Restrictions	
9	Coatings or Finishes	
10	Building or Architectural Considerations	
11	Client Material Preferences	
12	Client Equipment Preferences	
13	Piping Galleries, Piping Trenches, Piping Racks	

14 Yard Piping Complexity			
15 Existing Site Utilities (New, Retrofit, and Complexity)			
16 I & C Automation (New or Retrofit)			
17 Electrical Feed (New or Retrofit)			
18 Electrical Distribution			
19 Shoring			
20 Contamination			
21 User Defined Red Flag 1			
22 User Defined Red Flag 2			
23 User Defined Red Flag 3			
24 User Defined Red Flag 4			
25 User Defined Red Flag 5			
26 User Defined Red Flag 6			
27 User Defined Red Flag 7			
TOTAL - RED FLAGS			$0
SUBTOTAL - PROJECT COST with Additional Project Costs and Red Flag Costs			$873,000
TAX:	0.00%	$0	$0
SUBTOTAL with Tax			$873,000
CONTRACTOR MARKUPS:			
Overhead	10.00%	$873,000	$88,000
Subtotal			$961,000
Profit	5.00%	$961,000	$49,000
Subtotal			$1,010,000
Mob/Bonds/Insurance	5.00%	$1,010,000	$51,000
Subtotal			$1,061,000
Contingency	30.00%	$1,061,000	$319,000
SUBTOTAL with Markups			$1,380,000
LOCATION ADJUSTMENT FACTOR	93.7	$1,380,000	$1,294,000
SUBTOTAL - with Local Adjustment Factor			$1,294,000
MARKET ADJUSTMENT FACTOR		$1,294,000	$0
SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor			$1,294,000
Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:			
Name of Process Reviewer		Leaf, Bill	
Name of Estimator Reviewer		Bredehoeft, Pete	
MAXIMUM CONSTRUCTION COST			$1,294,000
NON-CONSTRUCTION COSTS:			
Permitting:	2.00%	$1,294,000	$26,000
Engineering:	12.00%	$1,294,000	$156,000
Services During Construction:	12.00%	$1,294,000	$156,000
Commissioning & Startup:	3.00%	$1,294,000	$39,000
Land / ROW:	0.00%	$1,294,000	$0
Legal / Admin:	0.00%	$1,294,000	$0
Other Default Description	0.00%	$1,294,000	$0
SUBTOTAL - Non-Construction Costs			$377,000
TOTAL - CAPITAL COST			$1,671,000

Currency Conversion of TOTAL CAPITAL COST:

Currency	*Unit of Measure*	*Conversion Rate*	*Converted Amount*
None	**U.S. Dollar**	**1**	**1,671,000**

CH2M Parametric Cost Estimating System (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

Cold Springs RDT In Existing Dewatering Room

File Version: 1/25/2017

Project Capacity: >>>		Project Unit: >>>		(For example: MGD, HP, GPM…)

Project Name:	Cold Springs	
Project Number:	678250	
Project Manager:	Paul Steele	
Estimator:	Kevin Butcher	
Project Description:	WRF	Roundup to the nearest:
Project Location (City):	Reno	$10,000
Project Location (State):	NEVADA	
Project Location (Country):	USA	
Cost Basis (Month/Year):	February/2017	

Item	Include? (Yes or No)	SCOPE OF PROJECT	Cost
	Yes	GBT: RDT	$500,000
	No	U.D. Facility: Misc	$0

SUBTOTAL - PROJECT COST			$500,000
ADDITIONAL PROJECT COSTS:			
Demolition:	5.00%		$30,000
Overall Sitework:	3.10%		$20,000
Plant Computer System:	1.40%		$10,000
Yard Electrical:	4.30%		$30,000
Yard Piping:	5.50%		$30,000
UD #1 Default Description	0.00%	$290,000	$0
UD #2 Default Description	0.00%		$0
UD #3 Default Description	0.00%		$0
SUBTOTAL with Additional Project Costs			$620,000

RED FLAGS:

1	Rock Excavation	
2	Pile Foundations	
3	Seismic Foundations	
4	Dewatering Conditions	
5	Wetlands Mitigation	
6	Weather Impacts	
7	Depth of Structures	
8	Local Building Code Restrictions	
9	Coatings or Finishes	
10	Building or Architectural Considerations	
11	Client Material Preferences	
12	Client Equipment Preferences	

13	Piping Galleries, Piping Trenches, Piping Racks		
14	Yard Piping Complexity		
15	Existing Site Utilities (New, Retrofit, and Complexity)		
16	I & C Automation (New or Retrofit)		
17	Electrical Feed (New or Retrofit)		
18	Electrical Distribution		
19	Shoring		
20	Contamination		
21	User Defined Red Flag 1		
22	User Defined Red Flag 2		
23	User Defined Red Flag 3		
24	User Defined Red Flag 4		
25	User Defined Red Flag 5		
26	User Defined Red Flag 6		
27	User Defined Red Flag 7		
TOTAL - RED FLAGS			$0

SUBTOTAL - PROJECT COST with Additional Project Costs and Red Flag Costs			$620,000
TAX:	0.00%	$0	$0
SUBTOTAL with Tax			$620,000
CONTRACTOR MARKUPS:			
Overhead	10.00%	$620,000	$70,000
Subtotal			$690,000
Profit	5.00%	$690,000	$40,000
Subtotal			$730,000
Mob/Bonds/Insurance	5.00%	$730,000	$40,000
Subtotal			$770,000
Contingency	30.00%	$770,000	$240,000
SUBTOTAL with Markups			$1,010,000
LOCATION ADJUSTMENT FACTOR	93.7	$1,010,000	$950,000
SUBTOTAL - with Local Adjustment Factor			$950,000
MARKET ADJUSTMENT FACTOR		$950,000	$0
SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor			$950,000

Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:

Name of Process Reviewer	Leaf, Bill
Name of Estimator Reviewer	Bredehoeft, Pete

MAXIMUM CONSTRUCTION COST	$950,000

NON-CONSTRUCTION COSTS:			
Permitting:	2.00%	$950,000	$20,000
Engineering:	12.00%	$950,000	$120,000
Services During Construction:	12.00%	$950,000	$120,000
Commissioning & Startup:	3.00%	$950,000	$30,000
Land / ROW:	0.00%	$950,000	$0
Legal / Admin:	0.00%	$950,000	$0
Other Default Description	0.00%	$950,000	$0
SUBTOTAL - Non-Construction Costs			$290,000

TOTAL - CAPITAL COST	$1,240,000

Currency Conversion of TOTAL CAPITAL COST:

Currency	*Unit of Measure*	*Conversion Rate*	*Converted Amount*
None	**U.S. Dollar**	**1**	**1,240,000**

CH2M Parametric Cost Estimating System (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

Cold Springs New Dewatering and Loadout Facility

File Version: 1/25/2017

Project Capacity: >>>		Project Unit: >>>		(For example: MGD, HP, GPM…)

Project Name:	Cold Springs	
Project Number:	678250	
Project Manager:	Paul Steele	
Estimator:	Kevin Butcher	
Project Description:	WRF	Roundup to the nearest:
Project Location (City):	Reno	$10,000
Project Location (State):	NEVADA	
Project Location (Country):	USA	
Cost Basis (Month/Year):	February/2017	

Item	Include? (Yes or No)	SCOPE OF PROJECT	Cost
	Yes	Centrifuge Dew: New	$2,520,000
	No	U.D. Facility: Misc	$0

SUBTOTAL - PROJECT COST		$2,520,000
ADDITIONAL PROJECT COSTS:		
Demolition:	5.00%	$130,000
Overall Sitework:	3.10%	$80,000
Plant Computer System:	1.40%	$40,000
Yard Electrical:	4.30%	$110,000
Yard Piping:	5.50%	$140,000
UD #1 Default Description	0.00%	$0
UD #2 Default Description	0.00%	$0
UD #3 Default Description	0.00%	$0
SUBTOTAL with Additional Project Costs		$3,020,000

RED FLAGS:

1	Rock Excavation	
2	Pile Foundations	
3	Seismic Foundations	
4	Dewatering Conditions	
5	Wetlands Mitigation	
6	Weather Impacts	
7	Depth of Structures	
8	Local Building Code Restrictions	
9	Coatings or Finishes	
10	Building or Architectural Considerations	
11	Client Material Preferences	
12	Client Equipment Preferences	

13	*Piping Galleries, Piping Trenches, Piping Racks*			
14	*Yard Piping Complexity*			
15	*Existing Site Utilities (New, Retrofit, and Complexity)*			
16	*I & C Automation (New or Retrofit)*			
17	*Electrical Feed (New or Retrofit)*			
18	*Electrical Distribution*			
19	*Shoring*			
20	*Contamination*			
21	*User Defined Red Flag 1*			
22	*User Defined Red Flag 2*			
23	*User Defined Red Flag 3*			
24	*User Defined Red Flag 4*			
25	*User Defined Red Flag 5*			
26	*User Defined Red Flag 6*			
27	*User Defined Red Flag 7*			
TOTAL - RED FLAGS				$0

SUBTOTAL - PROJECT COST with Additional Project Costs and Red Flag Costs			$3,020,000
TAX:	0.00%	$0	$0
SUBTOTAL with Tax			$3,020,000
CONTRACTOR MARKUPS:			
Overhead	10.00%	$3,020,000	$310,000
Subtotal			$3,330,000
Profit	5.00%	$3,330,000	$170,000
Subtotal			$3,500,000
Mob/Bonds/Insurance	5.00%	$3,500,000	$180,000
Subtotal			$3,680,000
Contingency	30.00%	$3,680,000	$1,110,000
SUBTOTAL with Markups			$4,790,000
LOCATION ADJUSTMENT FACTOR	93.7	$4,790,000	$4,490,000
SUBTOTAL - with Local Adjustment Factor			$4,490,000
MARKET ADJUSTMENT FACTOR		$4,490,000	$0
SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor			$4,490,000

Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:

Name of Process Reviewer	Leaf, Bill
Name of Estimator Reviewer	Bredehoeft, Pete

MAXIMUM CONSTRUCTION COST	$4,490,000

NON-CONSTRUCTION COSTS:			
Permitting:	2.00%	$4,490,000	$90,000
Engineering:	12.00%	$4,490,000	$540,000
Services During Construction:	12.00%	$4,490,000	$540,000
Commissioning & Startup:	3.00%	$4,490,000	$140,000
Land / ROW:	0.00%	$4,490,000	$0
Legal / Admin:	0.00%	$4,490,000	$0
Other Default Description	0.00%	$4,490,000	$0
SUBTOTAL - Non-Construction Costs			$1,310,000

TOTAL - CAPITAL COST	$5,800,000

Currency Conversion of TOTAL CAPITAL COST:

Currency	*Unit of Measure*	*Conversion Rate*	*Converted Amount*
None	**U.S. Dollar**	**1**	**5,800,000**

CH2M Parametric Cost Estimating System (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

File Version: 1/25/2017

Project Capacity: >>>		Project Unit: >>>		(For example: MGD, HP, GPM...)

Project Name:	Cold Springs WRF	
Project Number:	678250	
Project Manager:	Paul Steele	
Estimator:	Kevin Butcher	
Project Description:	WRF Facility Plan for expansion	Roundup to the nearest:
Project Location (City):	Reno	$1,000
Project Location (State):	NEVADA	
Project Location (Country):	USA	
Cost Basis (Month/Year):	January/2017	

Item	Include? (Yes or No)	SCOPE OF PROJECT	Cost
	Yes	In-Plant PS: 3Water	$435,000
	Yes	Emergency Generator: Generator	$550,000

SUBTOTAL - PROJECT COST		$985,000
ADDITIONAL PROJECT COSTS:		
Demolition:	5.00%	$50,000
Overall Sitework:	3.10%	$31,000
Plant Computer System:	1.40%	$14,000
Yard Electrical:	4.30%	$43,000
Yard Piping:	5.50%	$55,000
UD #1 Default Description	0.00%	$0
UD #2 Default Description	0.00%	$0
UD #3 Default Description	0.00%	$0
SUBTOTAL with Additional Project Costs		$1,178,000

RED FLAGS:

1	Rock Excavation	
2	Pile Foundations	
3	Seismic Foundations	
4	Dewatering Conditions	
5	Wetlands Mitigation	
6	Weather Impacts	
7	Depth of Structures	
8	Local Building Code Restrictions	
9	Coatings or Finishes	
10	Building or Architectural Considerations	
11	Client Material Preferences	
12	Client Equipment Preferences	

13	Piping Galleries, Piping Trenches, Piping Racks			
14	Yard Piping Complexity			
15	Existing Site Utilities (New, Retrofit, and Complexity)			
16	I & C Automation (New or Retrofit)			
17	Electrical Feed (New or Retrofit)			
18	Electrical Distribution			
19	Shoring			
20	Contamination			
21	User Defined Red Flag 1			
22	User Defined Red Flag 2			
23	User Defined Red Flag 3			
24	User Defined Red Flag 4			
25	User Defined Red Flag 5			
26	User Defined Red Flag 6			
27	User Defined Red Flag 7			
TOTAL - RED FLAGS				$0
SUBTOTAL - PROJECT COST with Additional Project Costs and Red Flag Costs				$1,178,000
TAX:		0.00%	$0	$0
SUBTOTAL with Tax				$1,178,000
CONTRACTOR MARKUPS:				
Overhead		10.00%	$1,178,000	$118,000
Subtotal				$1,296,000
Profit		5.00%	$1,296,000	$65,000
Subtotal				$1,361,000
Mob/Bonds/Insurance		5.00%	$1,361,000	$69,000
Subtotal				$1,430,000
Contingency		30.00%	$1,430,000	$429,000
SUBTOTAL with Markups				$1,859,000
LOCATION ADJUSTMENT FACTOR		93.7	$1,859,000	$1,742,000
SUBTOTAL - with Local Adjustment Factor				$1,742,000
MARKET ADJUSTMENT FACTOR			$1,742,000	$0
SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor				$1,742,000
Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:				
Name of Process Reviewer			Leaf, Bill	
Name of Estimator Reviewer			Bredehoeft, Pete	
MAXIMUM CONSTRUCTION COST				$1,742,000
NON-CONSTRUCTION COSTS:				
Permitting:		2.00%	$1,742,000	$35,000
Engineering:		12.00%	$1,742,000	$210,000
Services During Construction:		12.00%	$1,742,000	$210,000
Commissioning & Startup:		3.00%	$1,742,000	$53,000
Land / ROW:		0.00%	$1,742,000	$0
Legal / Admin:		0.00%	$1,742,000	$0
Other Default Description		0.00%	$1,742,000	$0
SUBTOTAL - Non-Construction Costs				$508,000
TOTAL - CAPITAL COST				$2,250,000

Currency Conversion of TOTAL CAPITAL COST:

Currency	Unit of Measure	Conversion Rate	Converted Amount
None	U.S. Dollar	1	2,250,000

CH2M Parametric Cost Estimating System (CPES)

FACILITIES LIFE CYCLE COST ANALYSIS MODULE

File Version: 1/25/2017

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Project Name:	***Cold Springs WRF***
Project Number:	***678250***
Project Manager:	***Paul Steele***
Estimator:	***Kevin Butcher***
Project Description:	***WRF Facility Plan for expansion***
Project Location (City):	***Reno***
Project Location (State):	***NEVADA***
Project Location (Country):	***USA***
Cost Basis (Month/Year):	***February/2017***

Life Cycle Analysis:

i =	***5.00%***
n =	***25 years***
Annual Inflation:	***3.00%***

Item	***Include? (Yes or No)***	***SCOPE OF PROJECT***	***Construction Cost***	***Annual O&M Cost (Year 1)***	***Life Cycle Cost (NPV)***
	Yes	**Aeration Basin: Main**	**$9,002,000**	**$81,000**	**$10,529,000**
	Yes	**Blowers: Main**	**$3,385,000**	**$348,000**	**$10,023,000**
	Yes	**Round SC: Main**	**$1,819,000**	**$25,000**	**$2,285,000**
	Yes	**RAS WAS PS: Main**	**$1,265,000**	**$24,000**	**$1,705,000**

Additional Project Costs:

	Construction Cost	Annual O&M Cost (Year 1)	Life Cycle Cost (NPV)
Standard Items	**$2,990,000**	**$78,000**	**$4,463,000**
User Defined Items	**$0**	**$0**	**$0**

Plant O&M Labor	**$0**	**$0**

TOTAL - Life Cycle Analysis ***(Red Flag Items and Market Adjustment Factor are EXCLUDED)***	**$18,461,000**	**$556,000**	**$29,005,000**
Construction Cost per GPD (based on Maximum Daily Flow Rate)	**$0.26 / GPD**		
Annual O&M Cost per 1,000 Gallons (based on Average Annual Daily Flow Rate)		**$ 0.038**	**/ Thousand Gallons**

CH2M Parametric Cost Estimating System (CPES)

FACILITIES LIFE CYCLE COST ANALYSIS MODULE

File Version: 1/25/2017

\\odin\Proj\WashoeCountyDWR\Cold_Springs_WRF\CPES estimates\CPES_A2O_PS_030817.xlsm

Project Name:	Cold Springs WRF
Project Number:	678250
Project Manager:	Paul Steele
Estimator:	Kevin Butcher
Project Description:	WRF Facility Plan for expansion
Project Location (City):	Reno
Project Location (State):	NEVADA
Project Location (Country):	USA
Cost Basis (Month/Year):	February/2017

Life Cycle Analysis:

i =	5.00%
n =	25 years
Annual Inflation:	3.00%

Item	Include? (Yes or No)	SCOPE OF PROJECT	Construction Cost	Annual O&M Cost (Year 1)	Life Cycle Cost (NPV)
	Yes	Aeration Basin: Main	$7,094,000	$76,000	$8,538,000
	Yes	Blowers: Main	$2,370,000	$256,000	$7,242,000
	Yes	Round SC: Main	$1,819,000	$25,000	$2,285,000
	Yes	RAS WAS PS: Main	$1,262,000	$24,000	$1,702,000
		Additional Project Costs:			
		Standard Items	$2,425,000	$63,000	$3,620,000
		User Defined Items	$0	$0	$0
		Plant O&M Labor		$0	$0
TOTAL - Life Cycle Analysis (Red Flag Items and Market Adjustment Factor are EXCLUDED)			$14,970,000	$444,000	$23,387,000

Construction Cost per GPD (based on Maximum Daily Flow Rate)	**$0.21 / GPD**
Annual O&M Cost per 1,000 Gallons (based on Average Annual Daily Flow Rate)	**$ 0.030 / Thousand Gallons**

CH2M Parametric Cost Estimating System (CPES)

FACILITIES LIFE CYCLE COST ANALYSIS MODULE

File Version: 1/25/2017

\\odin\Proj\WashoeCountyDWR\Cold_Springs_WRF\CPES estimates\CPES_5 stage_PS_030817.xlsm

Project Name:	**Cold Springs WRF**	**Life Cycle Analysis:**	
Project Number:	**678250**	**i =**	**5.00%**
Project Manager:	**Paul Steele**	**n =**	**25 years**
Estimator:	**Kevin Butcher**	**Annual Inflation:**	**3.00%**
Project Description:	**WRF Facility Plan for expansion**		
Project Location (City):	**Reno**		
Project Location (State):	**NEVADA**		
Project Location (Country):	**USA**		
Cost Basis (Month/Year):	**February/2017**		

Item	Include? (Yes or No)	SCOPE OF PROJECT	Construction Cost	Annual O&M Cost (Year 1)	Life Cycle Cost (NPV)
	Yes	Aeration Basin: Main	$8,558,000	$92,000	$10,301,000
	Yes	Blowers: Main	$2,423,000	$241,000	$7,010,000
	Yes	Round SC: Main	$1,819,000	$25,000	$2,285,000
	Yes	RAS WAS PS: Main	$1,262,000	$24,000	$1,702,000

Additional Project Costs:

	Construction Cost	Annual O&M Cost (Year 1)	Life Cycle Cost (NPV)
Standard Items	$2,719,000	$71,000	$4,059,000
User Defined Items	$0	$0	$0
Plant O&M Labor		$0	$0

TOTAL - Life Cycle Analysis ***(Red Flag Items and Market Adjustment Factor are EXCLUDED)***	**$16,781,000**	**$453,000**	**$25,357,000**
Construction Cost per GPD (based on Maximum Daily Flow Rate)	**$0.24 / GPD**		
Annual O&M Cost per 1,000 Gallons (based on Average Annual Daily Flow Rate)		**$ 0.031**	**/ Thousand Gallons**

Appendix B

Biowin Output

Option 1 – Four Oxidation Ditches Biowin Report

Project details

Project name: Cold Springs Facility Plan **Project ref.: BW1**

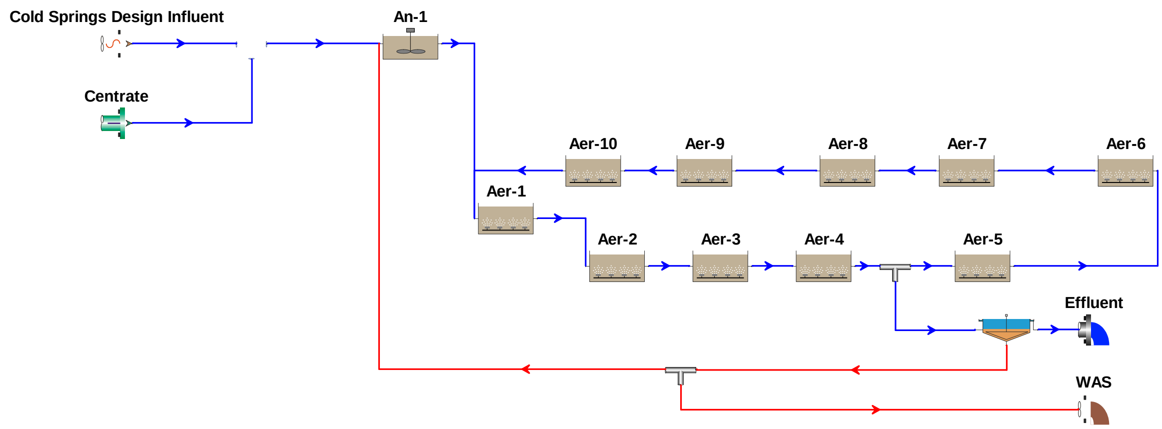
Plant name: Cold Springs WRF **User name: psteele**

Created: 10/31/2014 **Saved: 2/24/2017**

SRT: ** days**

Temperature: 14.0°C

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Aer-1	0.4120	4789.2515	11.500	1085
An-1	0.3000	2716.3485	14.764	Un-aerated
Aer-2	0.4120	4789.2515	11.500	1085
Aer-3	0.4120	5006.9447	11.000	1135
Aer-4	0.4120	5006.9447	11.000	1135

Aer-5	0.4120	4789.2515	11.500	1085
Aer-6	0.4120	4789.2515	11.500	1085
Aer-7	0.4120	4789.2515	11.500	1085
Aer-8	0.4120	4789.2515	11.500	1085
Aer-9	0.4120	4789.2515	11.500	1085
Aer-10	0.4120	5006.9447	11.000	1135

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Aer-1	1.0
An-1	0
Aer-2	1.0
Aer-3	1.0
Aer-4	1.0
Aer-5	1.0
Aer-6	1.0
Aer-7	1.0
Aer-8	1.0
Aer-9	1.0
Aer-10	1.0

Configuration information for all BOD Influent units

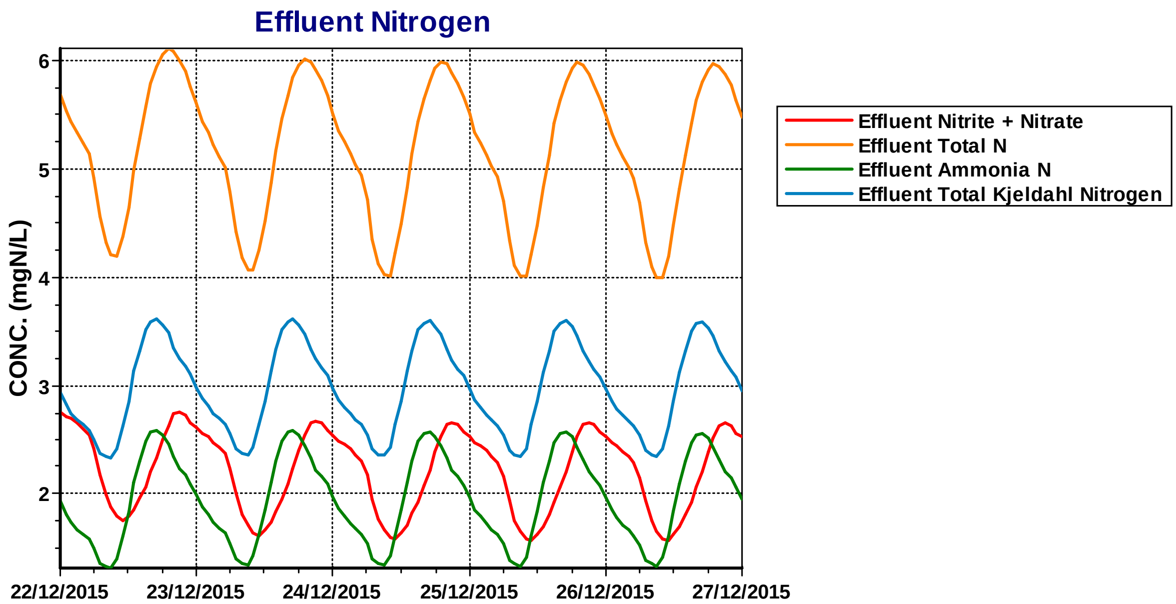
Operating data Average (flow/time weighted as required)

Element name	Cold Springs Design Influent
Flow	3.07000002177159
Total Carbonaceous BOD mgBOD/L	279.22
Volatile suspended solids mgVSS/L	190.70
Total suspended solids mgTSS/L	202.87
Total Kjeldahl Nitrogen mgN/L	48.86
Total P mgP/L	6.32
Nitrate N mgN/L	0
pH	7.28
Alkalinity mmol/L	5.56
Calcium mg/L	80.00
Magnesium mg/L	15.00
Dissolved O2 mg/L	0

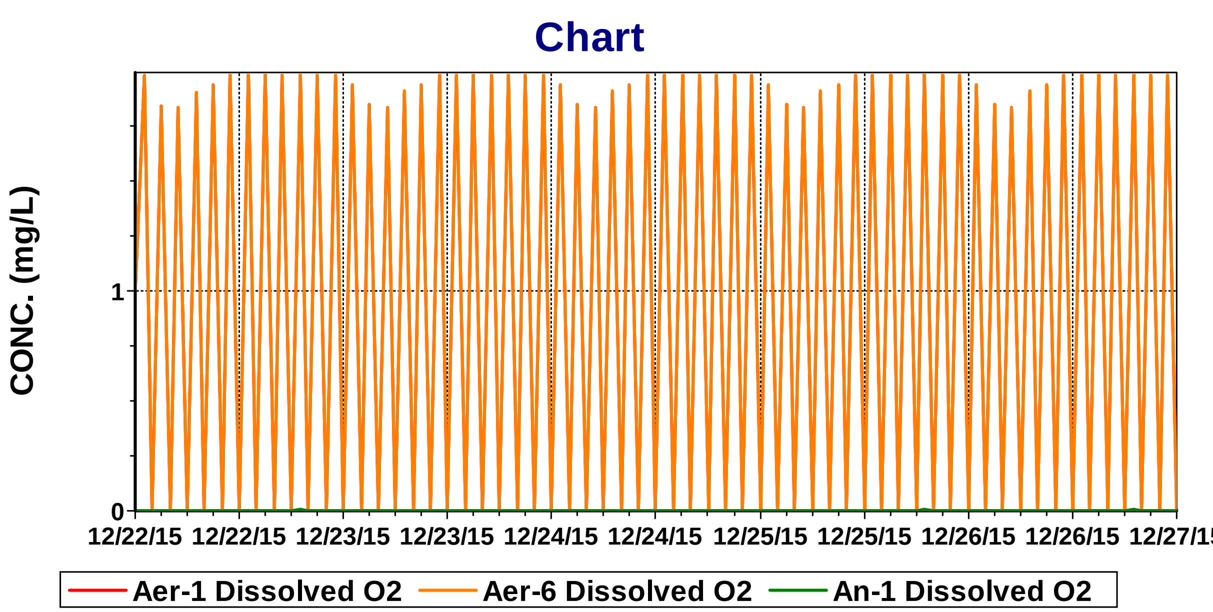
Element name	Cold Springs Design Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.2000
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.5597
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.0800
Fna - Ammonia [gNH3-N/gTKN]	0.7600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0
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]	0.0800
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

BioWin Album

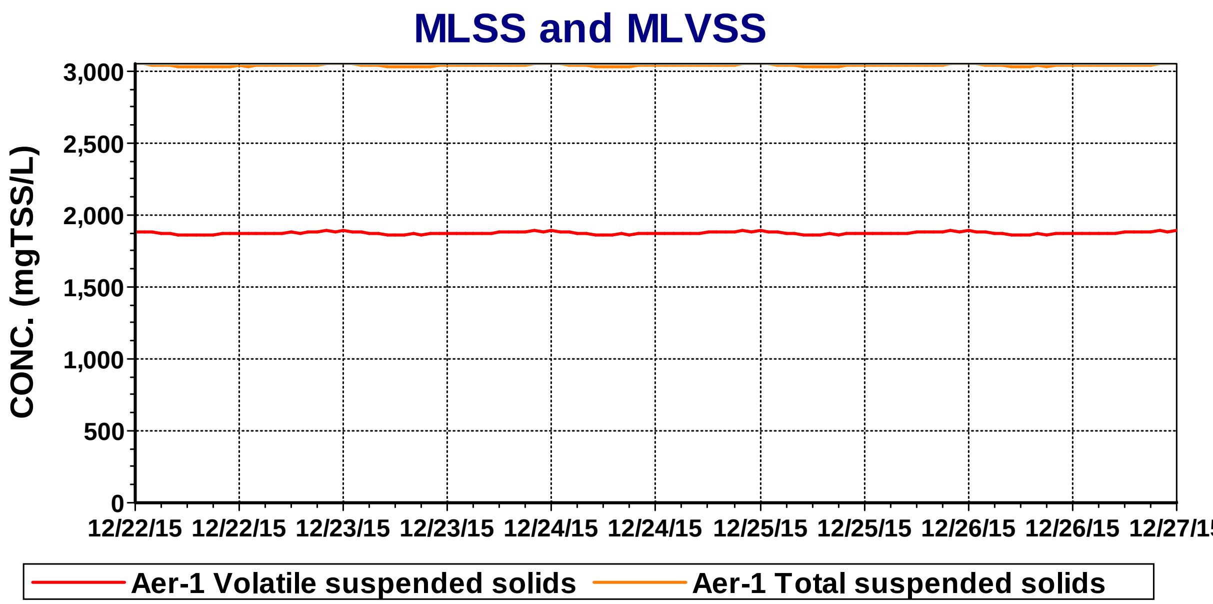
Album page - Effluent Nitrogen



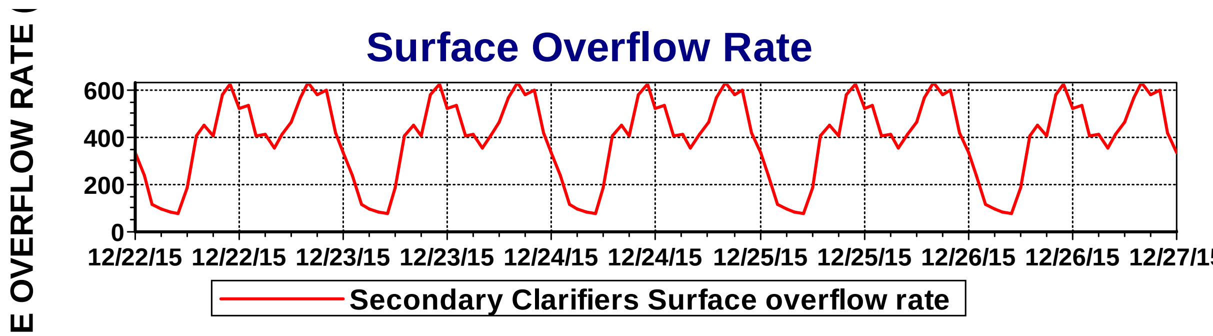
Album page - DO trends



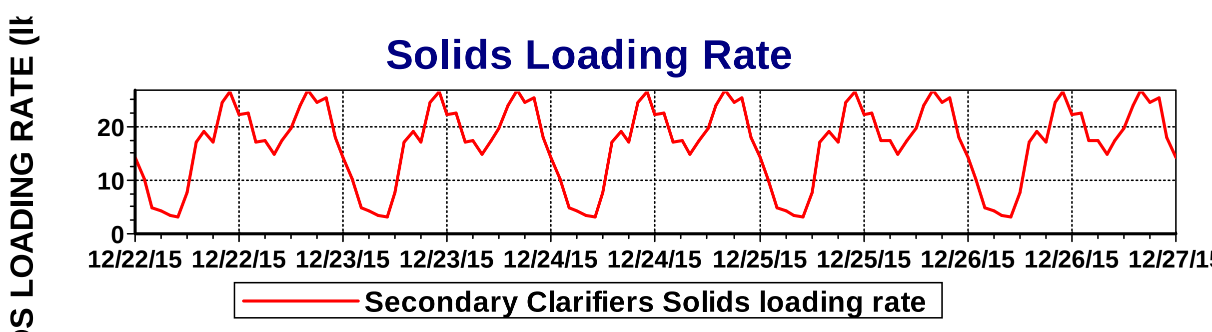
Album page - MLVSS



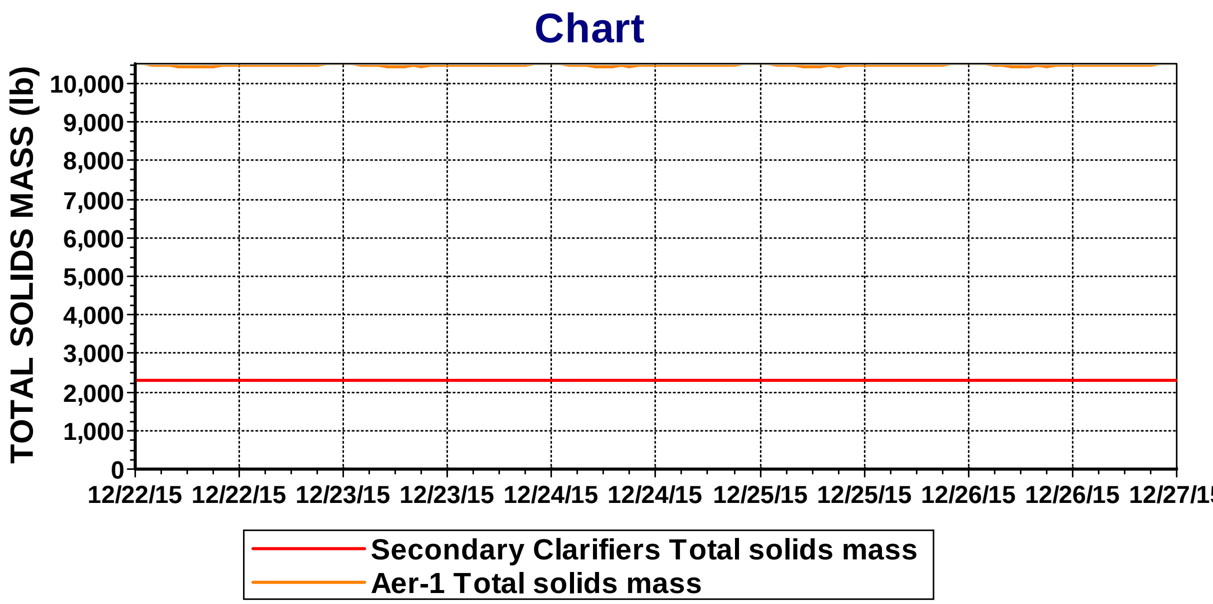
Album page - Clarifier



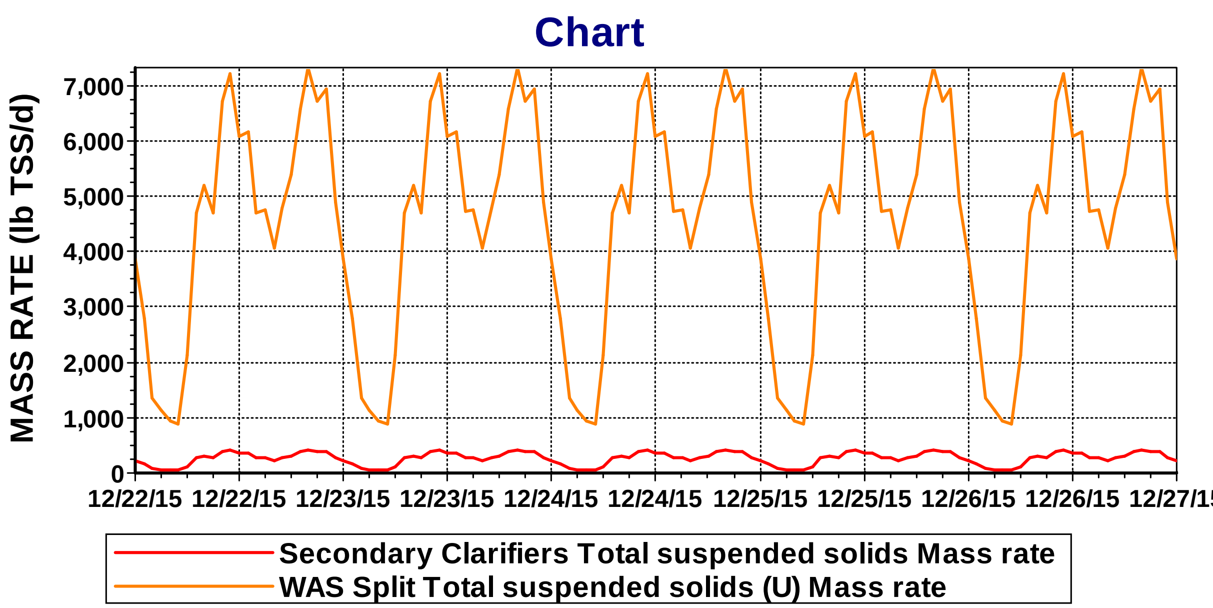
Album page - Clarifier



Album page - Solids Mass



Album page - Wasteage



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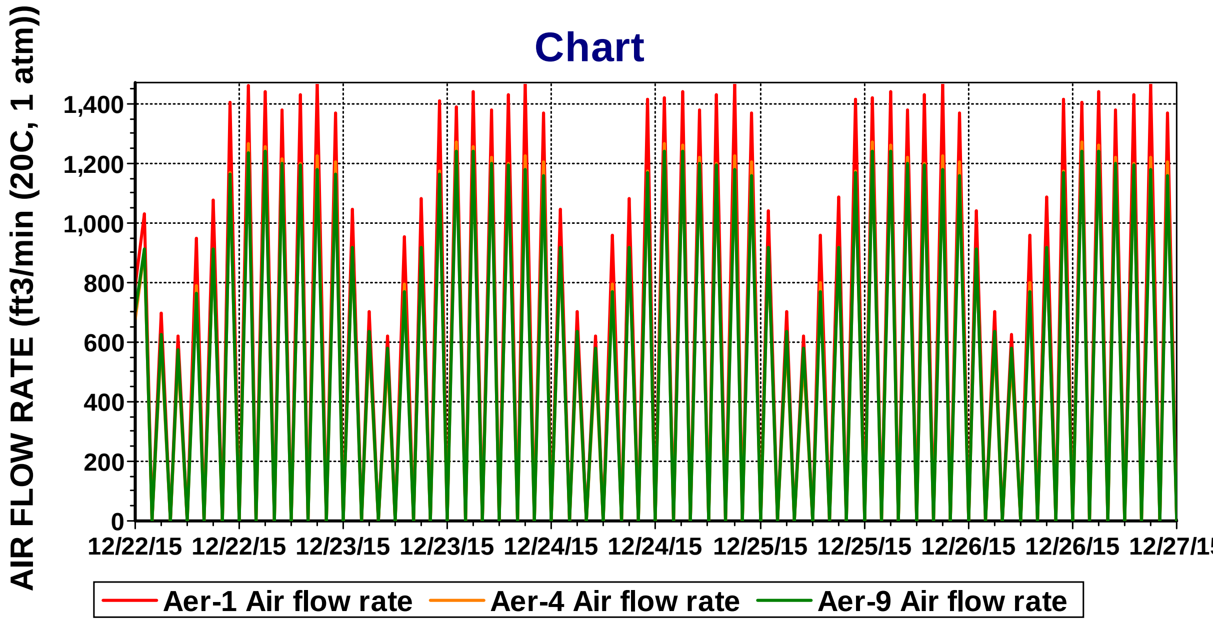
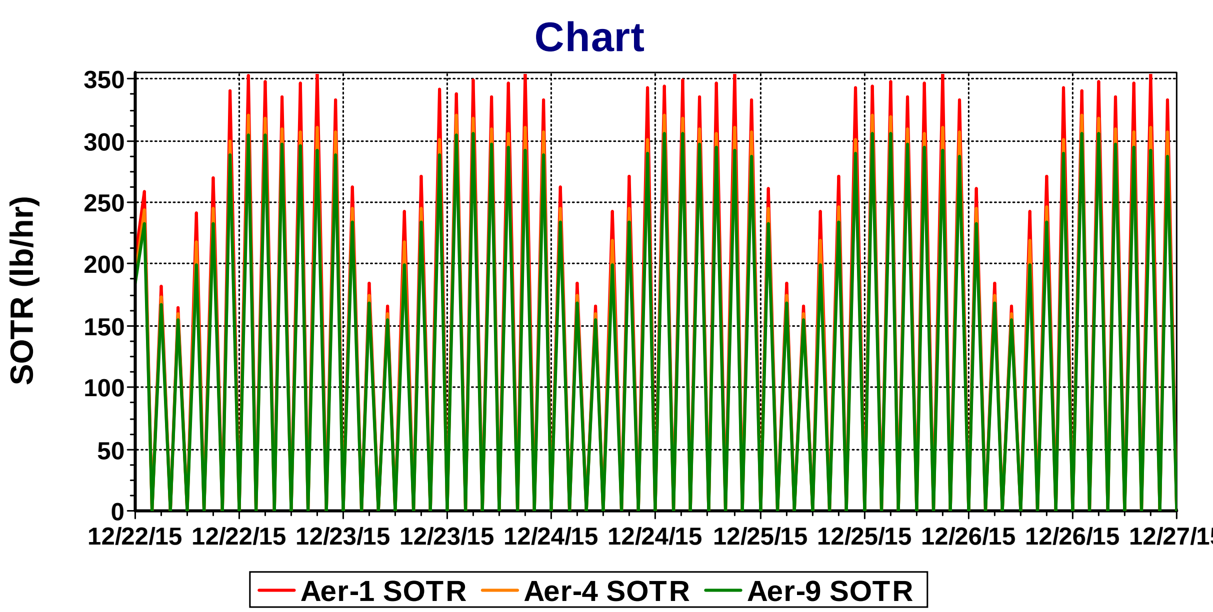


Album page - SOTR



Global Parameters

Aeration

Name	Default	Value

Surface pressure [kPa]	101.3250	84.3000
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
Off-gas N2O [vol. %]	0	0
Surface turbulence factor [-]	2.0000	2.0000
Set point controller gain []	1.0000	1.0000

Blower

Name	Default	Value
Intake filter pressure drop [psi]	0.5076	0.5076
Pressure drop through distribution system (piping/valves) [psi]	0.4351	0.4351
Adiabatic/polytropic compression exponent (1.4 for adiabatic)	1.4000	1.4000
'A' in blower efficiency = A + B*Qa + C*(Qa^2)[-]	0.7500	0.7500
'B' in blower efficiency = A + B*Qa + C*(Qa^2)[[-]/(ft3/min (20C, 1 atm))]	0	0
'C' in blower efficiency = A + B*Qa + C*(Qa^2)[[-]/(ft3/min (20C, 1 atm))^2]	0	0

Diffuser

Name	Default	Value
k1 in C = k1(PC)^0.25 + k2	1.2400	1.2400
k2 in C = k1(PC)^0.25 + k2	0.8960	0.8960
Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	0.8880	0.8880
Area of one diffuser [ft2]	0.4413	0.4413
Diffuser mounting height [ft]	0.8202	0.5000
Min. air flow rate per diffuser ft3/min (20C, 1 atm)	0.2943	0.2943
Max. air flow rate per diffuser ft3/min (20C, 1 atm)	5.8858	5.8858
'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2 [psi]	0.4351	0.4351
'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[psi/(ft3/min (20C, 1 atm))]	0	0
'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[psi/(ft3/min (20C, 1 atm))^2]	0	0

This scenario models 4 oxidation ditches operating in parallel to achieve the water quality goals set out for the CSWRF.

The influent constructed based upon the loadings to the wastewater plant recorded on 12/22 - 12/23 2015. These loadings constitute the only diurnal curve available for the plant. The flow on that day was approximately 0.325 MGD. The concentrations for that diurnal have been utilized with augmented flow values to approximate the 2036 MM flow condition of 3.07 MGD.

Option 2 – A2O Process Biowin Report

Project details

Project name: Cold Springs Facility Plan **Project ref.: BW1**

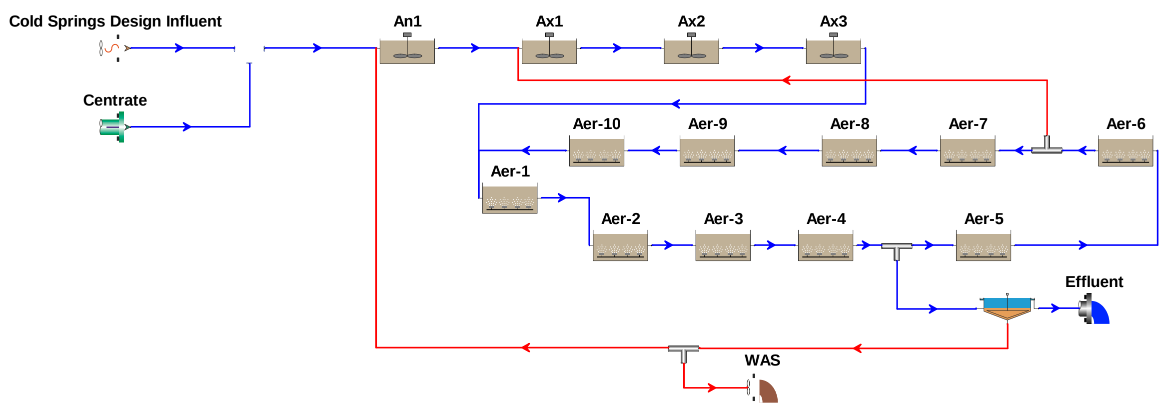
Plant name: Cold Springs WRF **User name: psteele**

Created: 10/31/2014 **Saved: 2/24/2017**

SRT: ** days**

Temperature: 14.0°C

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Aer-1	0.2060	2394.6257	11.500	543
An1	0.3000	2716.3485	14.764	Un-aerated
Ax1	0.4000	3621.7980	14.764	Un-aerated
Ax2	0.4000	3621.7980	14.764	Un-aerated
Ax3	0.4000	3621.7980	14.764	Un-aerated
Aer-2	0.2060	2394.6257	11.500	543

Aer-3	0.2060	2394.6257	11.500	543
Aer-4	0.2060	2394.6257	11.500	543
Aer-5	0.2060	2394.6257	11.500	543
Aer-6	0.2060	2394.6257	11.500	543
Aer-7	0.2060	2394.6257	11.500	543
Aer-8	0.2060	2394.6257	11.500	543
Aer-9	0.2060	2394.6257	11.500	543
Aer-10	0.2060	2394.6257	11.500	543

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Aer-1	2.0
An1	0
Ax1	0
Ax2	0
Ax3	0
Aer-2	2.0
Aer-3	2.0
Aer-4	2.0
Aer-5	2.0
Aer-6	2.0
Aer-7	2.0
Aer-8	2.0
Aer-9	2.0
Aer-10	2.0

Configuration information for all BOD Influent units

Operating data Average (flow/time weighted as required)

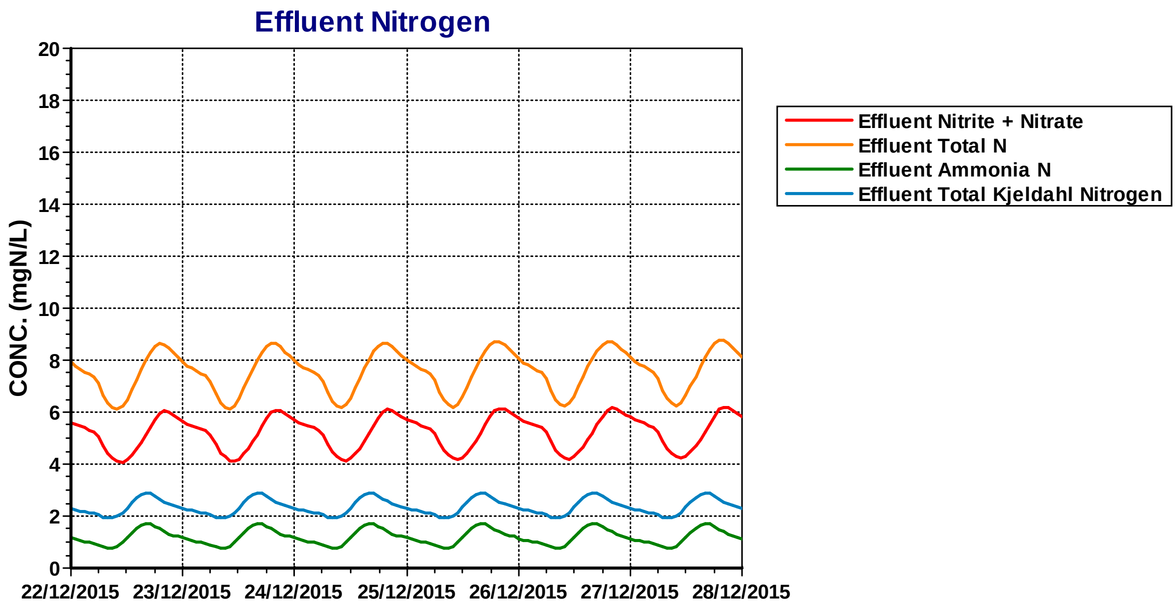
Element name	Cold Springs Design Influent
Flow	3.07000002177159
Total Carbonaceous BOD mgBOD/L	279.22
Volatile suspended solids mgVSS/L	190.70
Total suspended solids mgTSS/L	202.87
Total Kjeldahl Nitrogen mgN/L	48.86
Total P mgP/L	6.32
Nitrate N mgN/L	0

pH	7.28
Alkalinity mmol/L	5.56
Calcium mg/L	80.00
Magnesium mg/L	15.00
Dissolved O2 mg/L	0

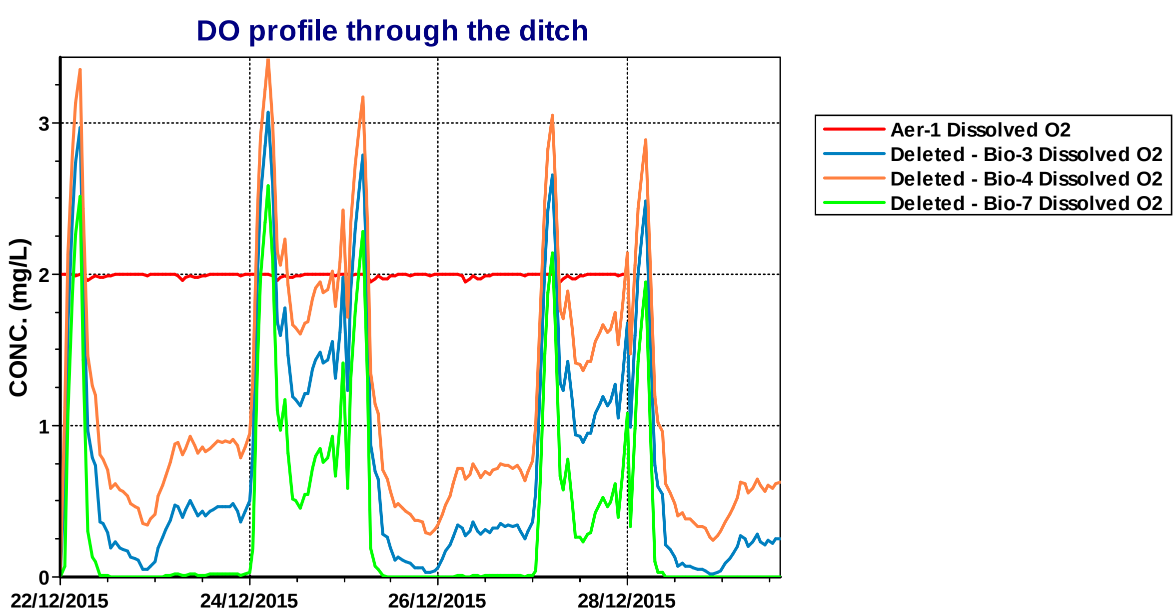
Element name	Cold Springs Design Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.2000
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.5597
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.0800
Fna - Ammonia [gNH3-N/gTKN]	0.7600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0
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]	0.0800
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

BioWin Album

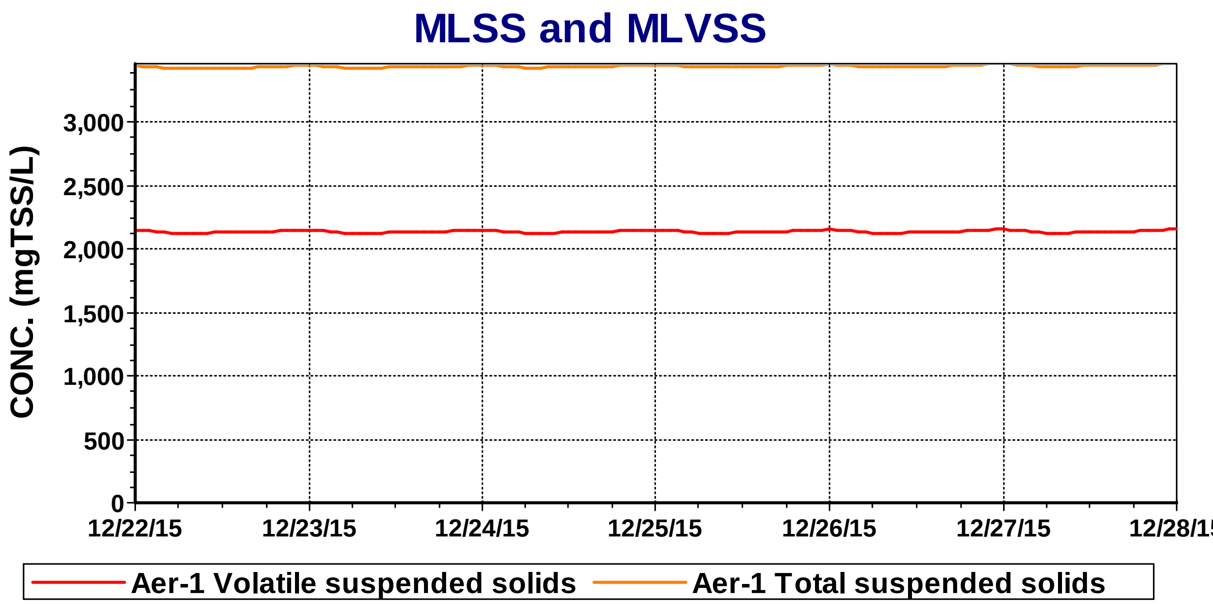
Album page - Effluent Nitrogen



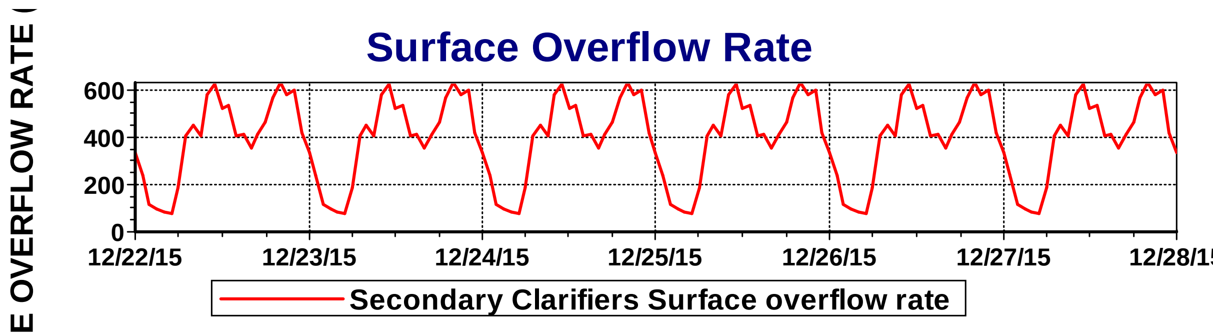
Album page - DO trends



Album page - MLVSS



Album page - Clarifier



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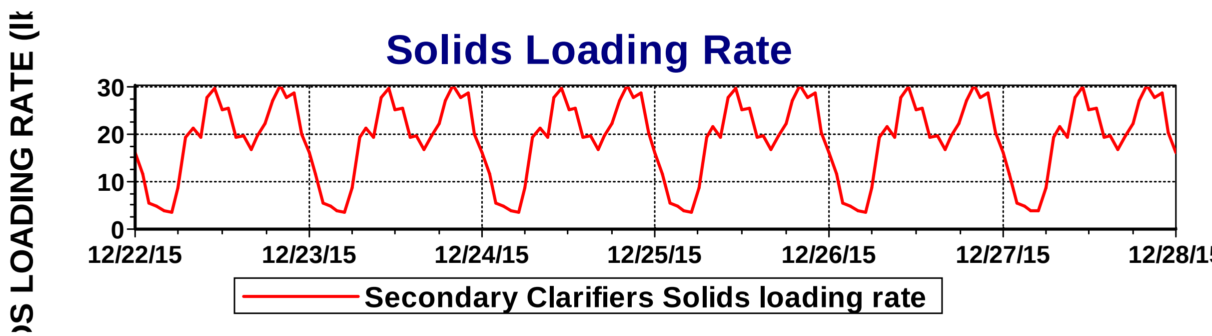
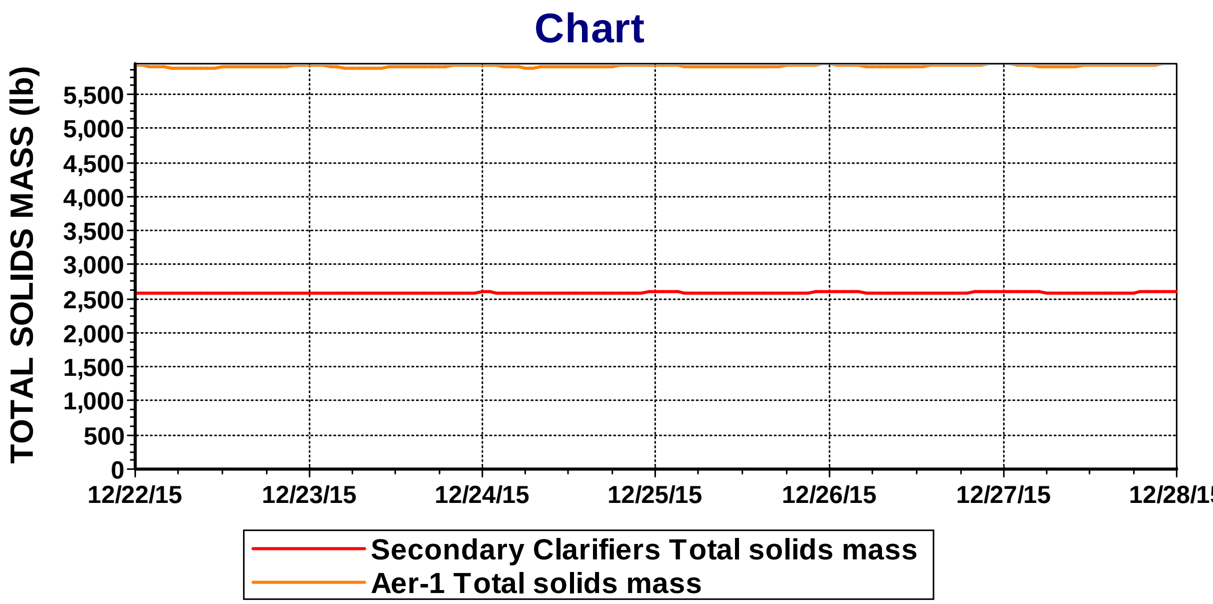
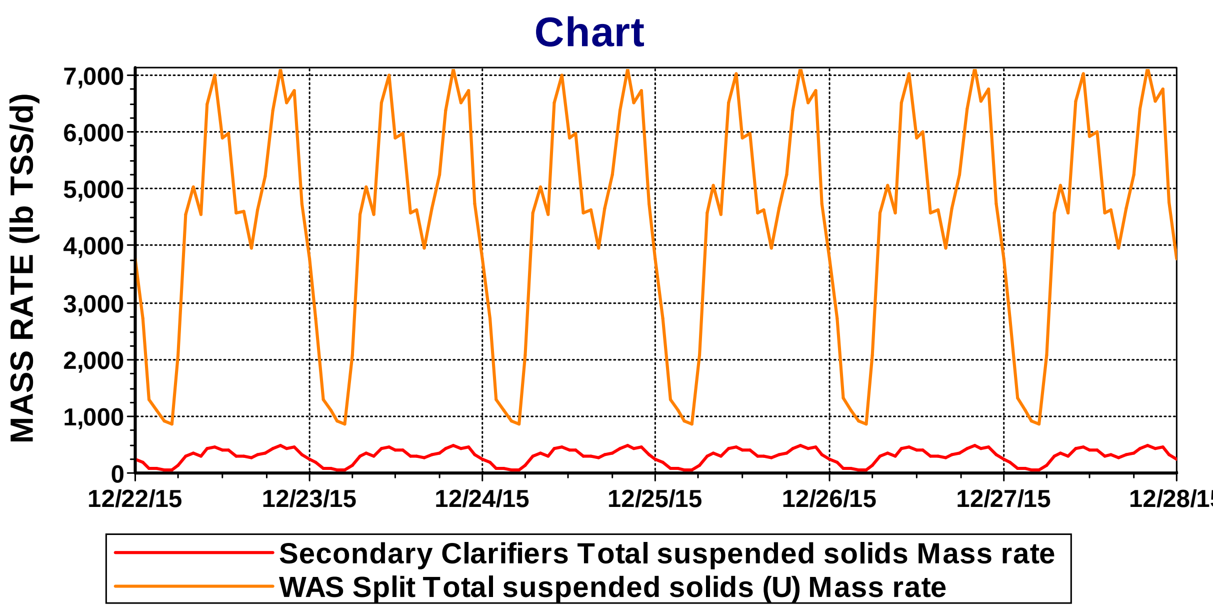


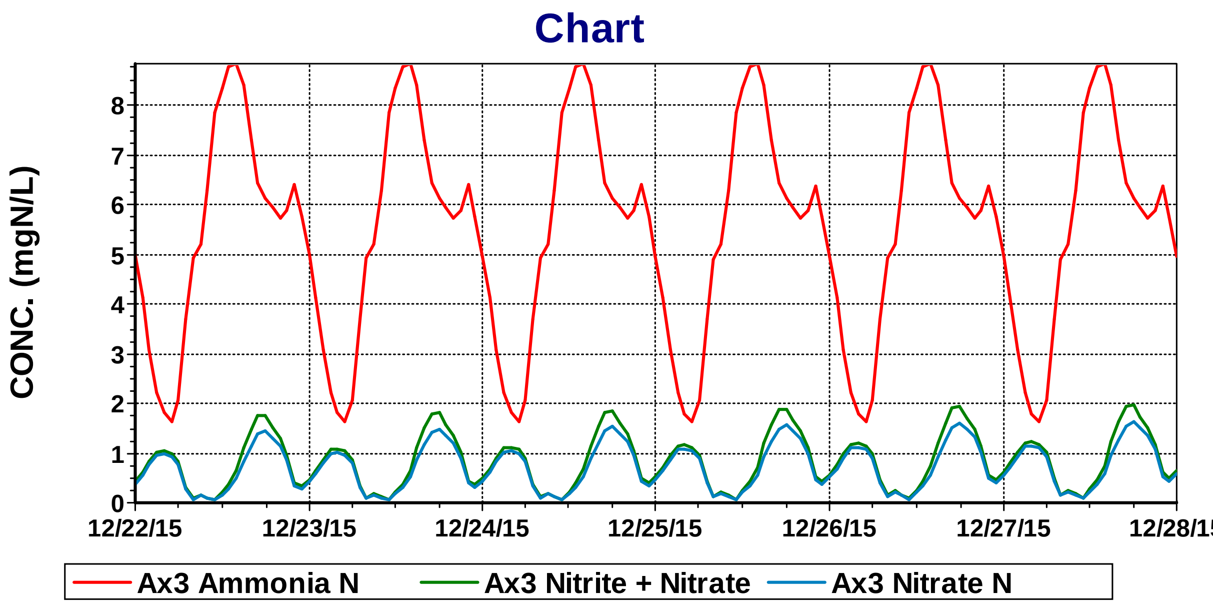
Album page - Solids Mass



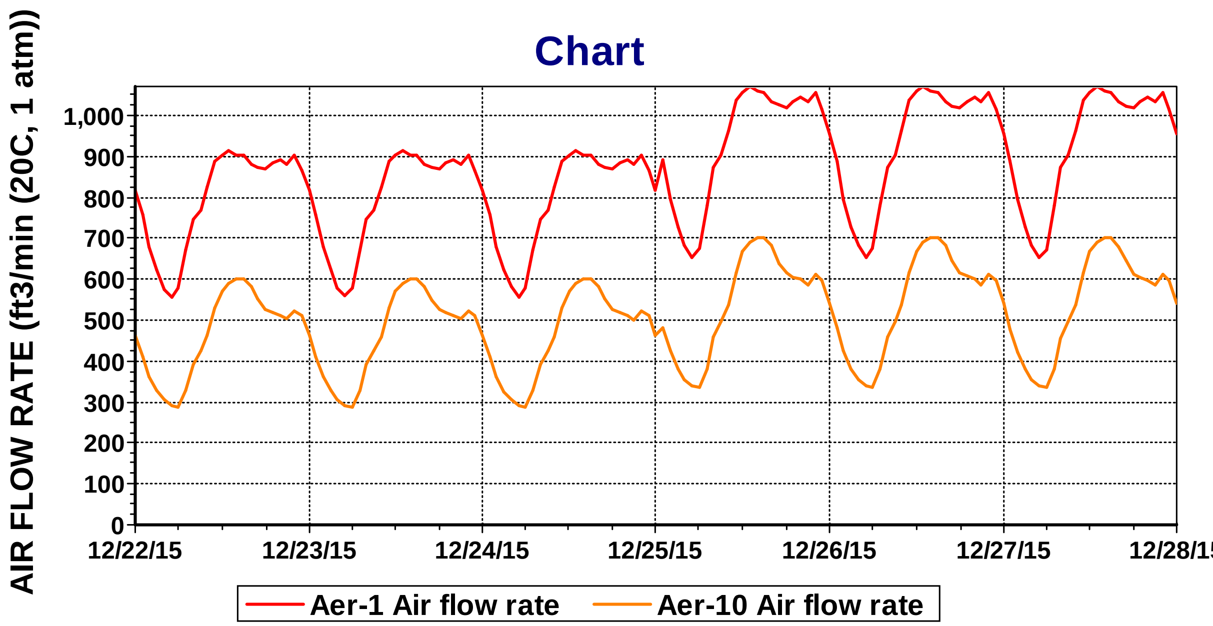
Album page - Wasteage



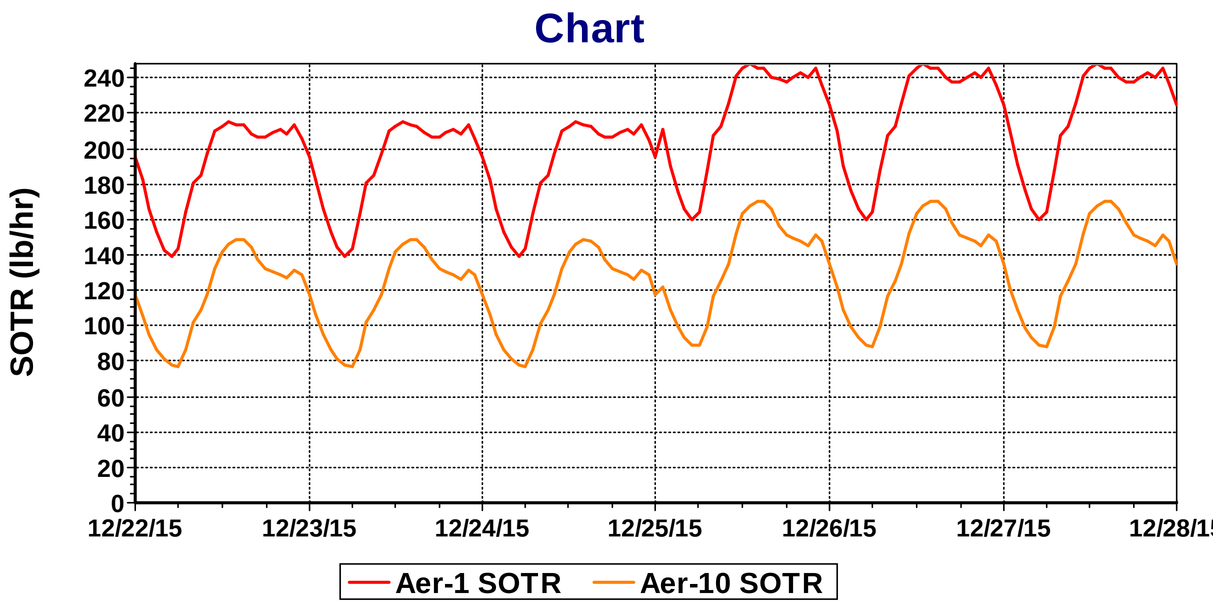
Album page - Ax4 Nitrate



Album page - Air flow rate



Album page - SOTR



Global Parameters

Aeration

Name	Default	Value
Surface pressure [kPa]	101.3250	84.3000
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
Off-gas N2O [vol. %]	0	0
Surface turbulence factor [-]	2.0000	2.0000
Set point controller gain []	1.0000	1.0000

Blower

Name	Default	Value
Intake filter pressure drop [psi]	0.5076	0.5076
Pressure drop through distribution system (piping/valves) [psi]	0.4351	0.4351

Adiabatic/polytropic compression exponent (1.4 for adiabatic)	1.4000	1.4000
'A' in blower efficiency = A + B*Qa + C*(Qa^2)[-]	0.7500	0.7500
'B' in blower efficiency = A + B*Qa + C*(Qa^2)[[-]/(ft3/min (20C, 1 atm))]	0	0
'C' in blower efficiency = A + B*Qa + C*(Qa^2)[[-]/(ft3/min (20C, 1 atm))^2]	0	0

Diffuser

Name	Default	Value
k1 in C = k1(PC)^0.25 + k2	1.2400	1.2400
k2 in C = k1(PC)^0.25 + k2	0.8960	0.8960
Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	0.8880	0.8880
Area of one diffuser [ft2]	0.4413	0.4413
Diffuser mounting height [ft]	0.8202	0.5000
Min. air flow rate per diffuser ft3/min (20C, 1 atm)	0.2943	0.2943
Max. air flow rate per diffuser ft3/min (20C, 1 atm)	5.8858	5.8858
'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2 [psi]	0.4351	0.4351
'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[psi/(ft3/min (20C, 1 atm))]	0	0
'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[psi/(ft3/min (20C, 1 atm))^2]	0	0

This is a setup in the A2O arrangement to reduce nitrogen.

The simulation is constructed based upon the loadings to th ewastewater plant recorded on 12/22 - 12/23 2015. These loadings constitute the only diurnal curve available for the plant. The flow on that day was approximately 0.325 MGD. These simulations utilize increased rotor on-time to attempt to meet the permitted 10 mg/l total nitrogen effluent at higher flows and loads.

Option 3 – 5 Stage Bardenpho Biowin Report

Project details

Project name: Cold Springs Facility Plan **Project ref.: BW1**

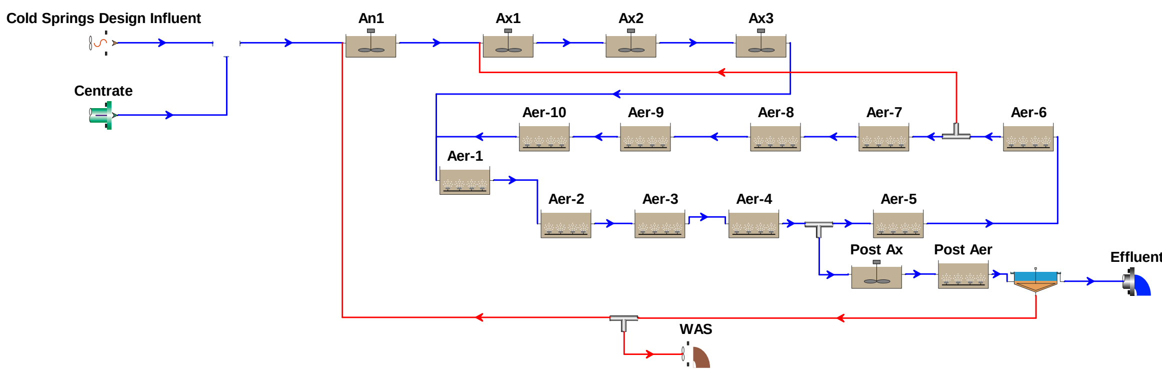
Plant name: Cold Springs WRF **User name: psteele**

Created: 10/31/2014 **Saved: 3/8/2017**

SRT: ** days**

Temperature: 14.0°C

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Aer-1	0.2060	2394.6257	11.500	543
An1	0.3000	2716.3485	14.764	Un-aerated
Ax1	0.4000	3621.7980	14.764	Un-aerated
Ax2	0.4000	3621.7980	14.764	Un-aerated
Ax3	0.4000	3621.7980	14.764	Un-aerated
Aer-2	0.2060	2394.6257	11.500	543
Aer-3	0.2060	2394.6257	11.500	543

Aer-4	0.2060	2394.6257	11.500	543
Aer-5	0.2060	2394.6257	11.500	543
Aer-6	0.2060	2394.6257	11.500	543
Aer-7	0.2060	2394.6257	11.500	543
Aer-8	0.2060	2394.6257	11.500	543
Aer-9	0.2060	2394.6257	11.500	543
Aer-10	0.2060	2394.6257	11.500	543
Post Ax	0.5000	4177.5176	16.000	Un-aerated
Post Aer	0.1000	1162.4397	11.500	263

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Aer-1	2.0
An1	0
Ax1	0
Ax2	0
Ax3	0
Aer-2	2.0
Aer-3	2.0
Aer-4	2.0
Aer-5	2.0
Aer-6	2.0
Aer-7	2.0
Aer-8	2.0
Aer-9	2.0
Aer-10	2.0
Post Ax	0
Post Aer	2.0

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	Diffuser mounting height	Min. air flow rate per diffuser	Max. air flow rate per diffuser	'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2
Aer-1	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0

An1	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0
Ax1	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0
Ax2	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0
Ax3	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0
Aer-2	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0
Aer-3	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0
Aer-4	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0
Aer-5	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0
Aer-6	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0
Aer-7	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0
Aer-8	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0
Aer-9	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0
Aer-10	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0
Post Ax	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0
Post Aer	1.2400	0.8960	0.8880	0.4413	0.1524	12.0005	240.0009	2.9999	0	0

Configuration information for all BOD Influent units

Operating data Average (flow/time weighted as required)

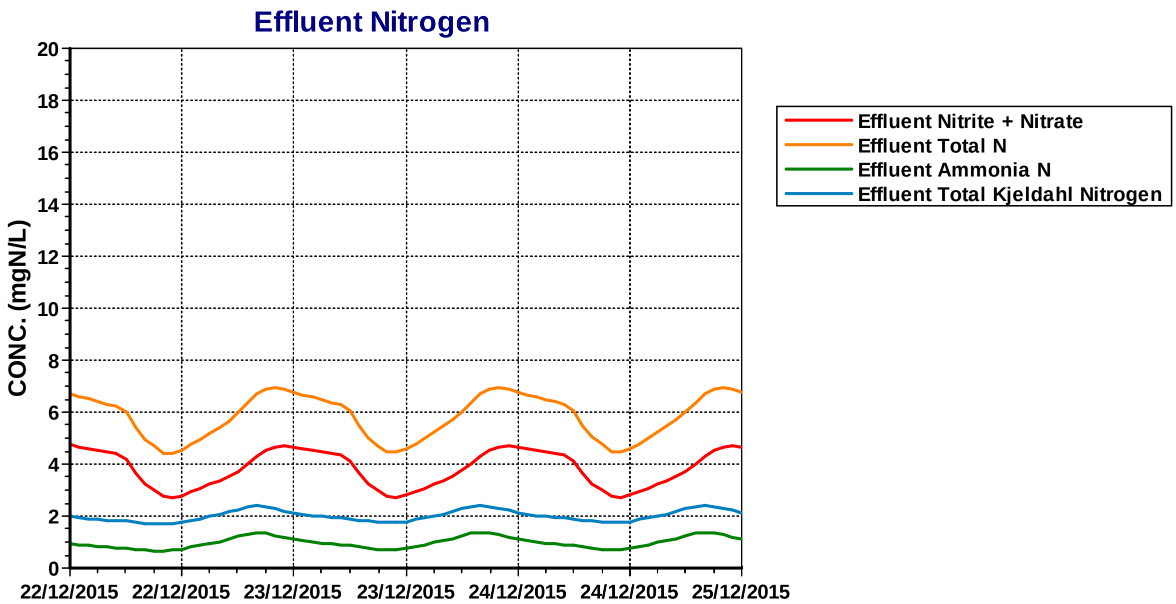
Element name	Cold Springs Design Influent
Flow	3.07000002177159
Total Carbonaceous BOD mgBOD/L	279.22
Volatile suspended solids mgVSS/L	190.70
Total suspended solids mgTSS/L	202.87
Total Kjeldahl Nitrogen mgN/L	48.86
Total P mgP/L	6.32
Nitrate N mgN/L	0
pH	7.28
Alkalinity mmol/L	5.56
Calcium mg/L	80.00
Magnesium mg/L	15.00

Dissolved O2 mg/L	0

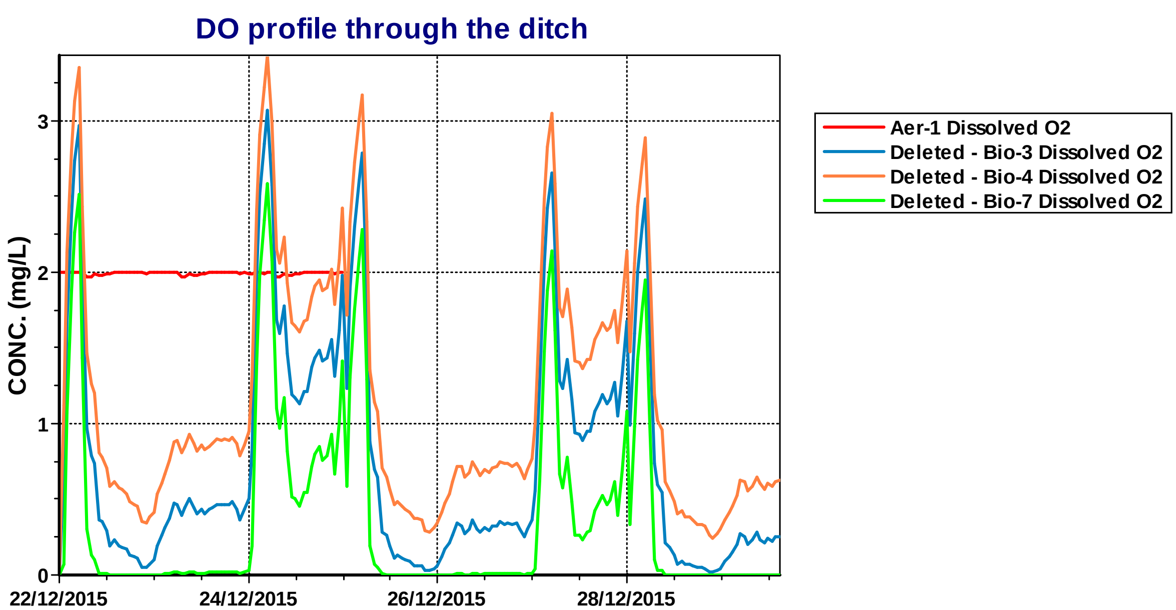
Element name	Cold Springs Design Influent
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.2000
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.5597
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.0800
Fna - Ammonia [gNH3-N/gTKN]	0.7600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0
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]	0.0800
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

BioWin Album

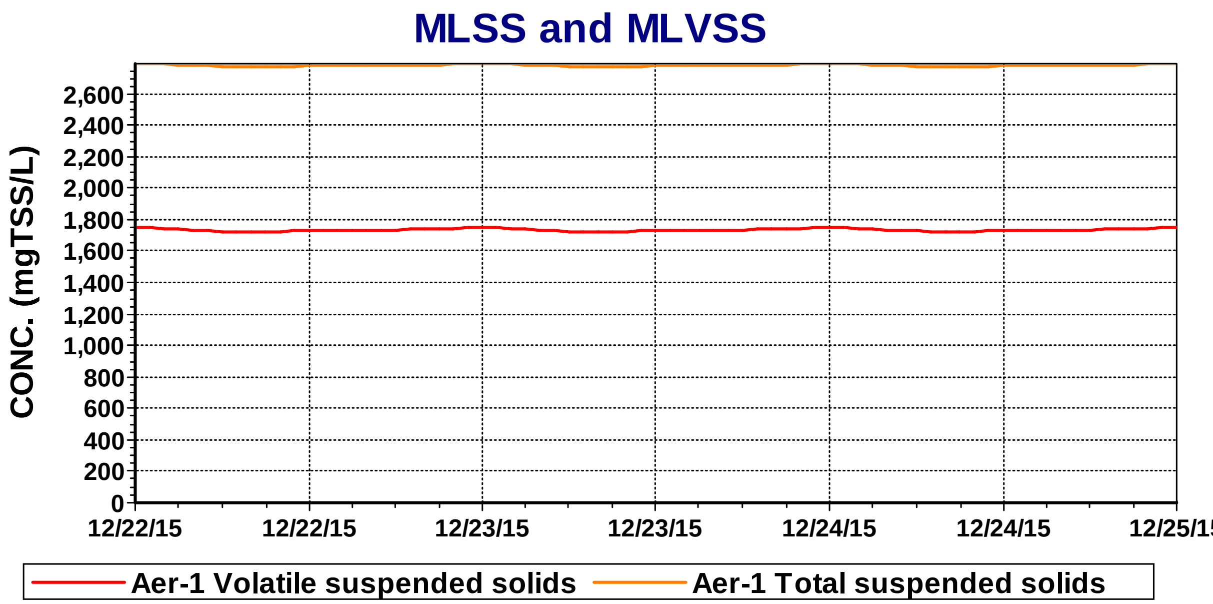
Album page - Effluent Nitrogen



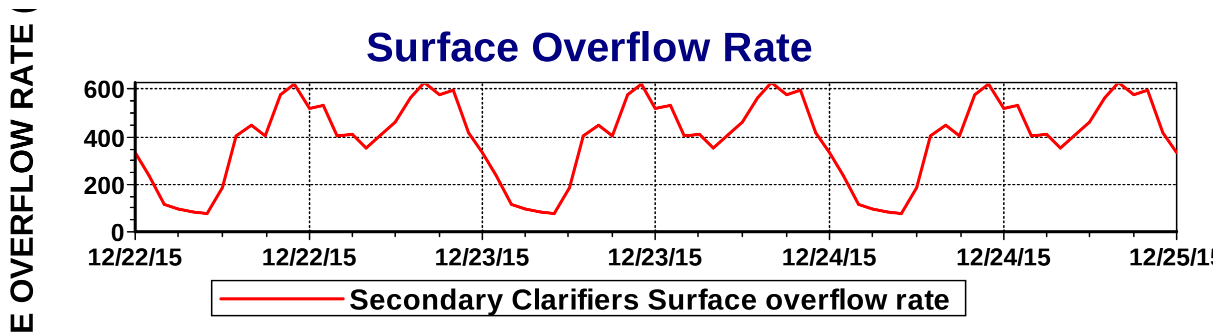
Album page - DO trends



Album page - MLVSS



Album page - Clarifier



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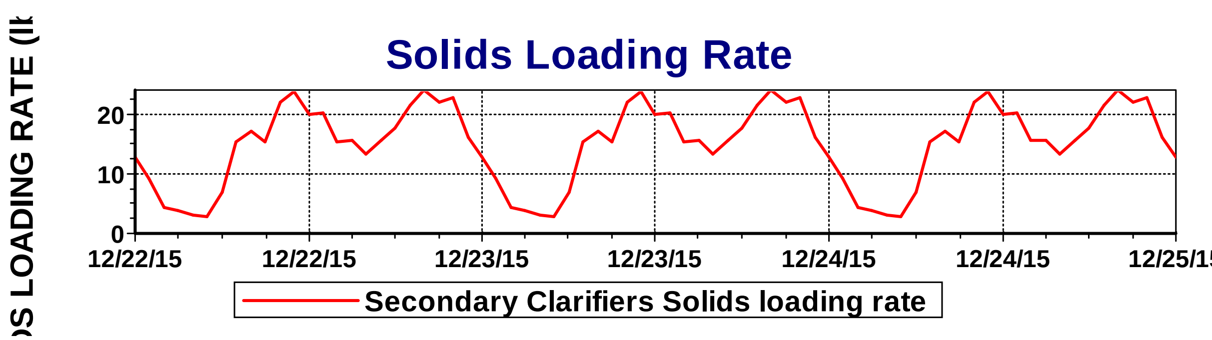
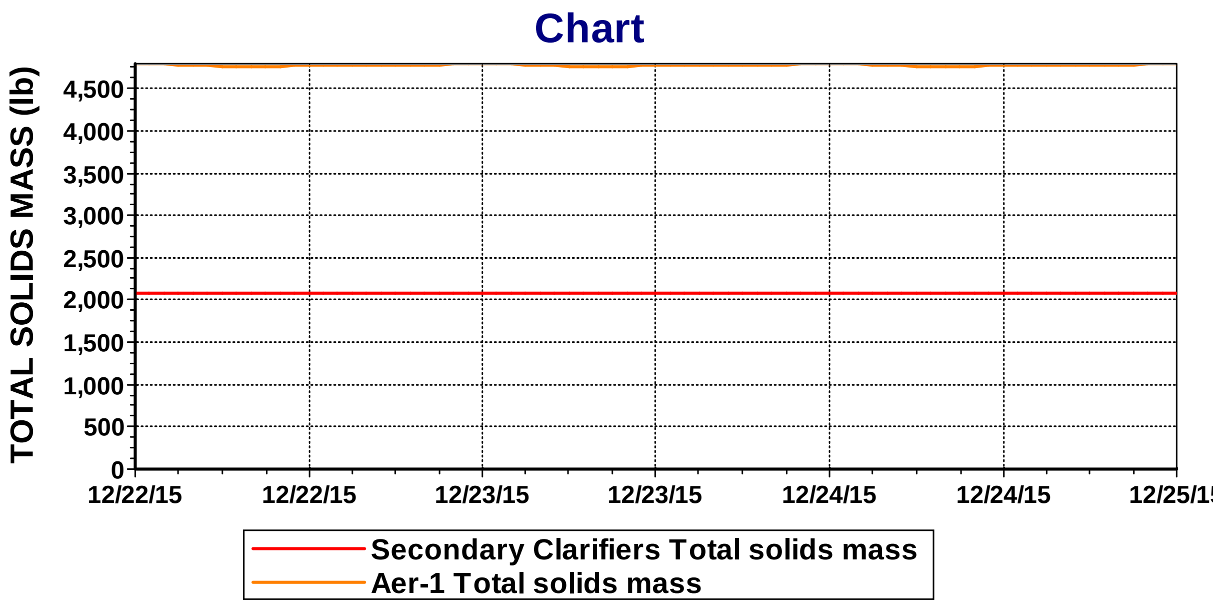
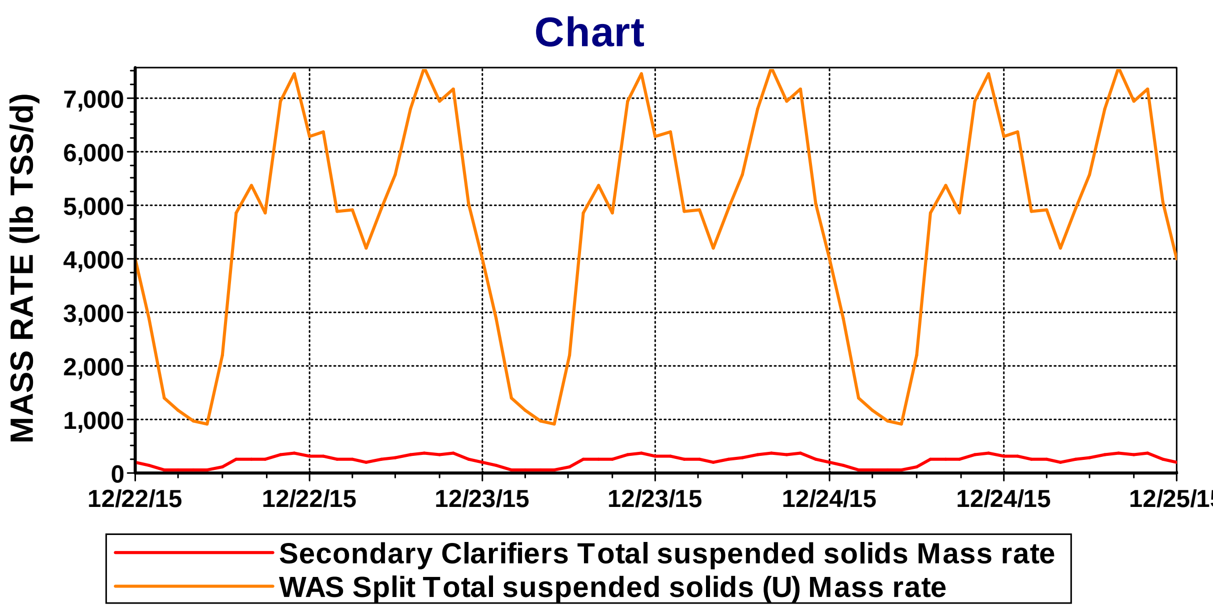


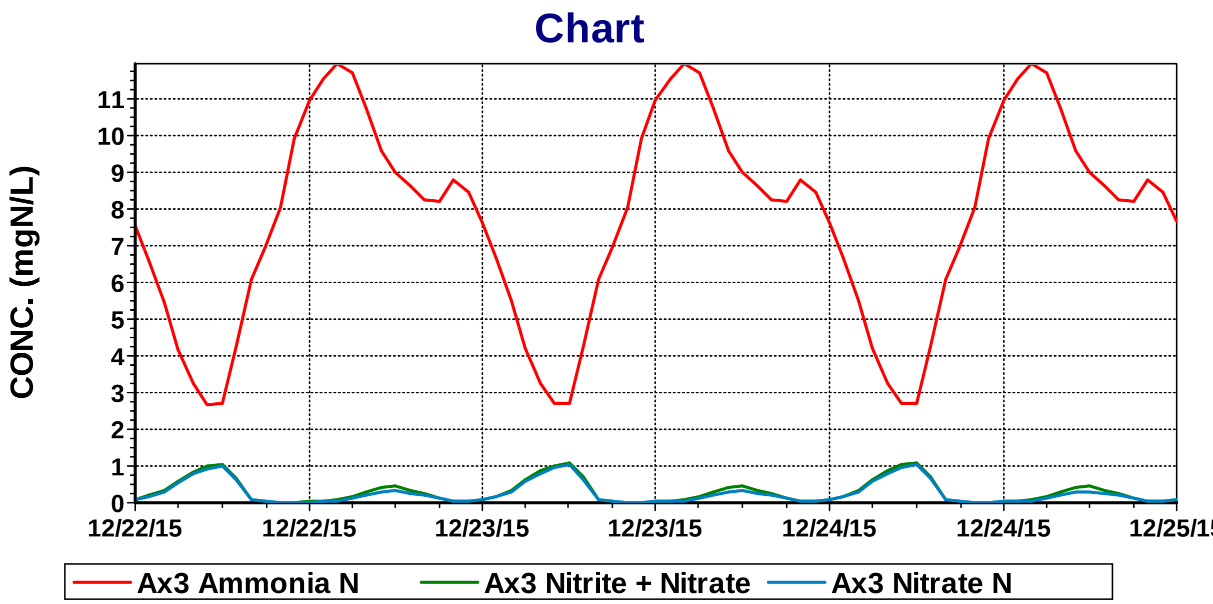
Album page - Solids Mass



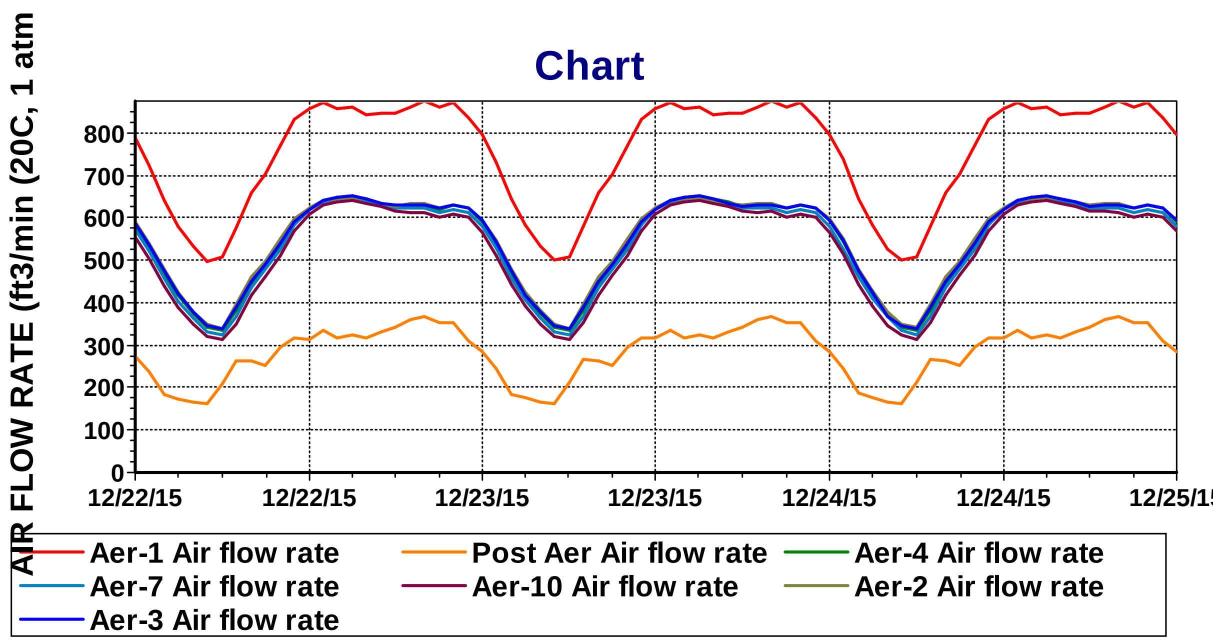
Album page - Wasteage



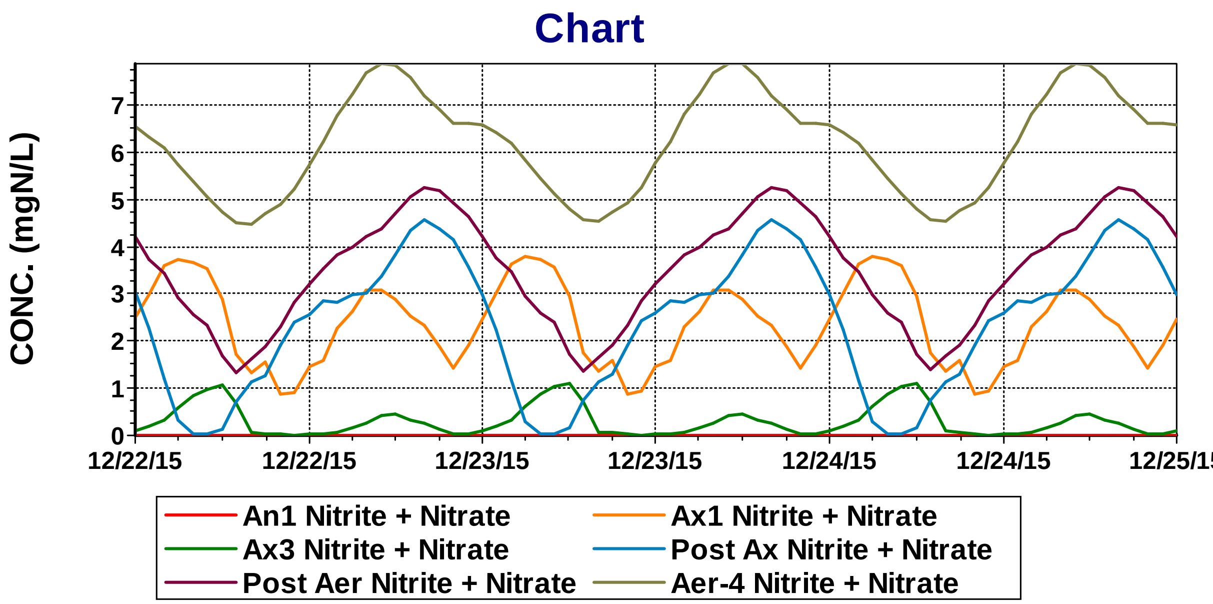
Album page - Ax3 Nitrate



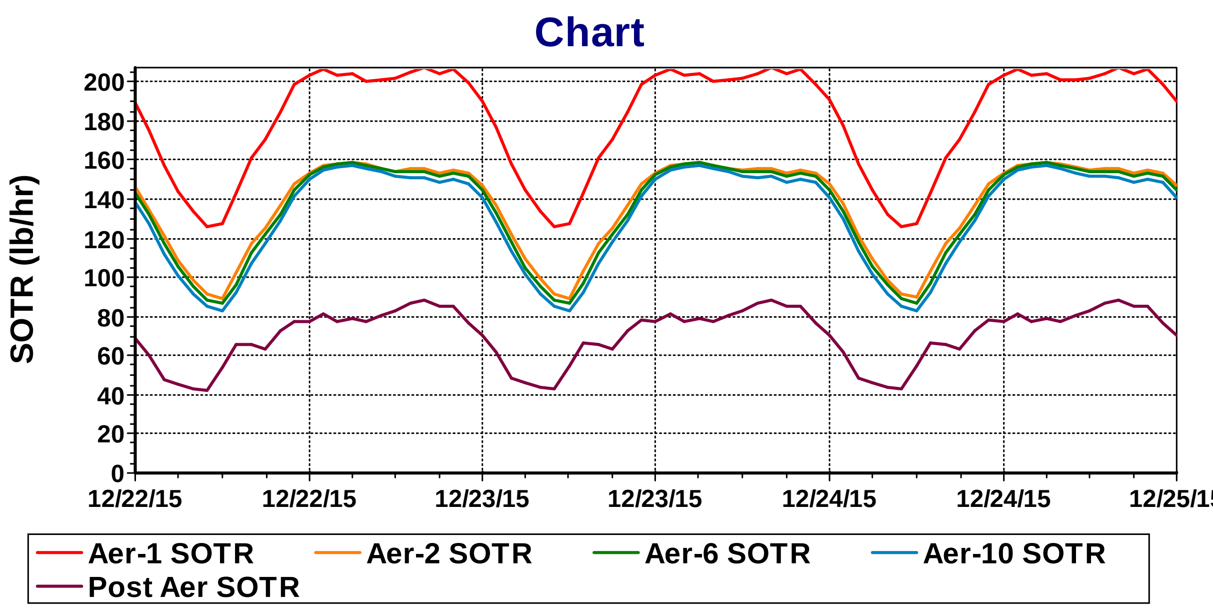
Album page - Air flow rate



Album page - Nitrate Profile



Album page - SOTR



Aeration

Name	Default	Value
Surface pressure [kPa]	101.3250	84.3000

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
Off-gas N2O [vol. %]	0	0
Surface turbulence factor [-]	2.0000	2.0000
Set point controller gain []	1.0000	1.0000

Blower

Name	Default	Value
Intake filter pressure drop [psi]	0.5076	0.5076
Pressure drop through distribution system (piping/valves) [psi]	0.4351	0.4351
Adiabatic/polytropic compression exponent (1.4 for adiabatic)	1.4000	1.4000
'A' in blower efficiency = A + B*Qa + C*(Qa^2)[-]	0.7500	0.7500
'B' in blower efficiency = A + B*Qa + C*(Qa^2)[[-]/(ft3/min (20C, 1 atm))]	0	0
'C' in blower efficiency = A + B*Qa + C*(Qa^2)[[-]/(ft3/min (20C, 1 atm))^2]	0	0

Diffuser

Name	Default	Value
k1 in C = k1(PC)^0.25 + k2	1.2400	1.2400
k2 in C = k1(PC)^0.25 + k2	0.8960	0.8960
Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	0.8880	0.8880
Area of one diffuser [ft2]	0.4413	0.4413
Diffuser mounting height [ft]	0.8202	0.5000
Min. air flow rate per diffuser ft3/min (20C, 1 atm)	0.2943	0.2943
Max. air flow rate per diffuser ft3/min (20C, 1 atm)	5.8858	5.8858
'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2 [psi]	0.4351	0.4351
'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[psi/(ft3/min (20C, 1 atm))]	0	0
'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[psi/(ft3/min (20C, 1 atm))^2]	0	0

This is a setup in the five stage Bardenpho arrangement to reduce nitrogen.

The simulation is constructed based upon the loadings to the wastewater plant recorded on 12/22 - 12/23 2015. These loadings constitute the only diurnal curve available for the plant. The flow on that day was approximately 0.325 MGD. These simulations utilize increased rotor on-time to attempt to meet the permitted 10 mg/l total nitrogen effluent at higher flows and loads.

TECHNICAL MEMORANDUM #6

WASHOE COUNTY COMMUNITY SERVICES DEPARTMENT

COLD SPRINGS WASTEWATER SYSTEM FACILITY PLAN

Prepared For: Alan Jones, P.E., Senior Licensed Engineer

Prepared By: Lucas Tipton, P.E.

Reviewed By: Brent Farr, P.E.

Date: April 10, 2017

Subject: **Technical Memorandum No. 6 – Effluent Disposal Alternatives**

1.0 PURPOSE

This Technical Memorandum (TM) includes an evaluation of current and future water use in the Cold Springs Valley and provides estimates of treated effluent volumes requiring disposal or reuse in 2036 and 2050. Since future development plans will exceed the capacity of the existing groundwater supply, future growth will rely heavily on an imported water supply. The increase in potable water use will also increase the volume of wastewater treated at the Cold Springs Wastewater Reclamation Facility (CSWRF), creating a substantial water resource which could be put to use in a variety of ways. This memo will provide a planning level assessment of the disposal and reuse options for the treated effluent in Cold Springs between 2016 and 2050.

2.0 EXISTING FACILITIES

CSWRF currently treats an average of 0.354 million gallons per day (MGD) of wastewater to secondary effluent standards set forth in the existing groundwater discharge permit. Treated effluent is discharged to a series of twelve Rapid Infiltration Basins (RIBs) which have an estimated maximum capacity of 3.0 MGD. A daily flow of 0.354 MGD equates to approximately 400 acre-feet annually (afa) of effluent reentering the basin. This TM assumes that the existing RIBs provide instantaneous permeability and will infiltrate treated effluent without losses due to evapotranspiration. The existing RIBs have adequate capacity to provide effluent disposal for 100 percent of the anticipated wastewater flows in 2036, which is the end of the planning period of this facility plan.

3.0 FUTURE EFFLUENT DISPOSAL

This TM provides a low and high range of the volume of water which may be available for reuse in the future. The smallest volume of water which may be available for reuse is found by placing the maximum amount of treated effluent in the RIBs and supplying an irrigation reuse system (i.e. purple pipe) with the full demand created by development in and around Cold Springs. Subtracting this volume from the annual treated effluent total leaves an estimated 1,678 afa of effluent which needs to be disposed of in a different manner than the RIBs or via an irrigation reuse system by the year 2050.

Table 6-1 – Low Estimate

Year	Treated Effluent (AFA)	Returned via RIBs (AFA)(1)	Volume used for Irrigation Reuse (AFA)	Volume Available for Other Uses (AFA)
2016	397	397	-	(476)
2026	1,579	1,579	-	-
2036	3,191	2,691	500	-
2050	5,538	3,360	500	1,678

Note: (1) The maximum capacity of RIBs is 3,360 afa.

The largest volume of water which may be available for reuse in the future is simply the volume of treated effluent at each planning point. This calculation estimates 3,191 afa and 5,538 afa of treated effluent which could be available for reuse in 2036 and 2050, respectively. Figure 6-1 provides a summary of the Cold Springs basin in 2050.

Table 6-2 – High Estimate

Year	Treated Effluent (AFA)	Returned via RIBs (AFA)	Volume used for Irrigation Reuse (AFA)	Volume Available for Other Uses (AFA)
2016	397	-	-	397
2026	1,579	-	-	1,579
2036	3,191	-	-	3,191
2050	5,538	-	-	5,538

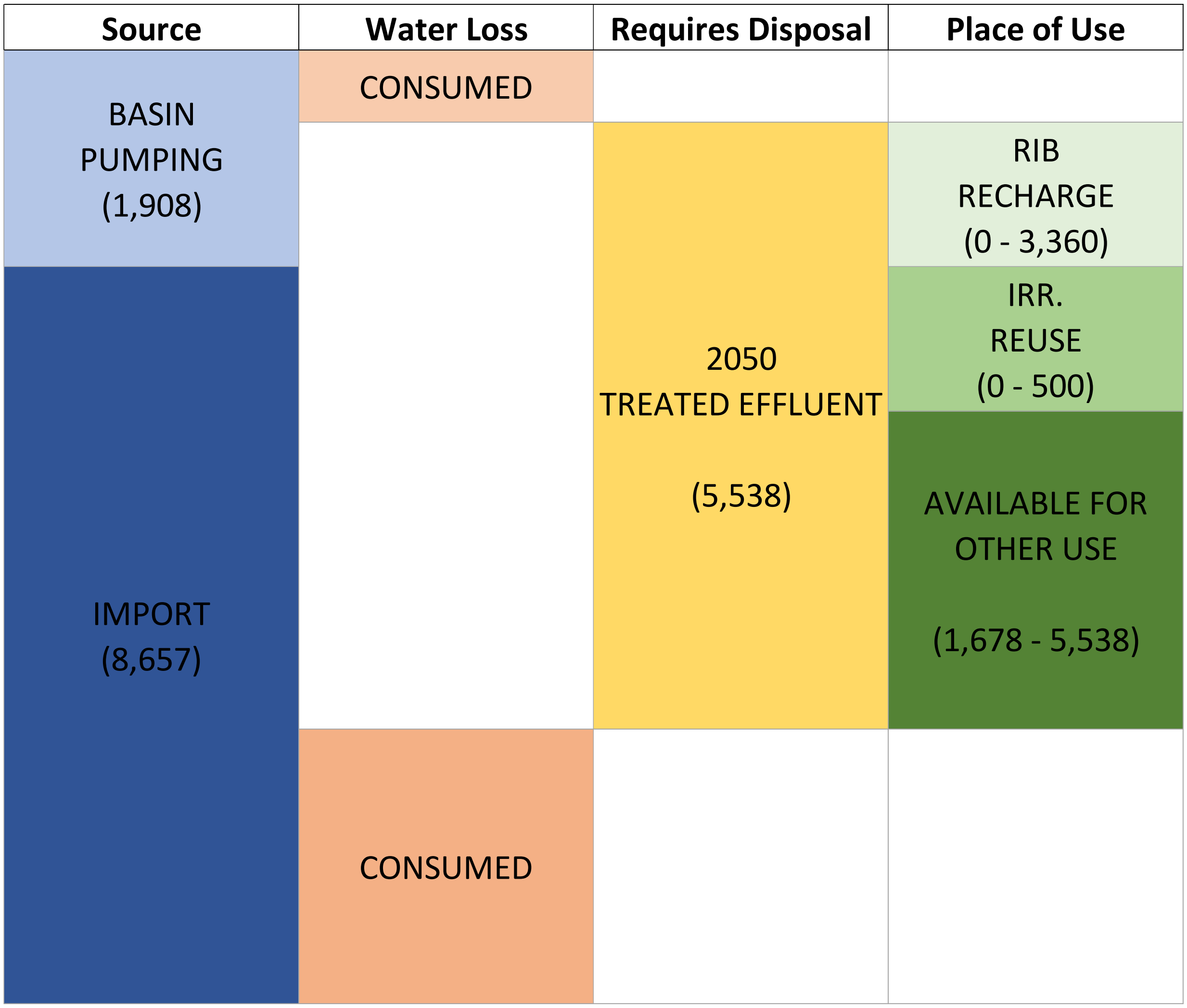


Figure 6-1 – Basin Water Use Summary

3.1 NONPOTABLE REUSE

Nonpotable reuse of treated effluent from a treatment facility for land or surface application is the most common type of reuse employed today in Northern Nevada. This nonpotable water can be used for the following activities:

- irrigating parks, common areas or for agricultural uses,
- dust control and fire suppression activities,
- wildlife habitat enhancement,
- or industrial processes in the area.

In order to supply water for these uses without restriction, significant treatment processes would need to be added at CSWRF to treat effluent to reuse category "A" quality. "On-site" capital costs associated with these improvements are estimated to be approximately $4.5 million per TM #5. A purple pipe effluent distribution system including multiple booster pump stations and more than 10 miles of transmission main piping would also need to be constructed to convey treated effluent from CSWRF to developments around Cold Springs.

3.1.1 POTENTIAL NONPOTABLE REUSE DEMANDS

Future development in and around Cold Springs is primarily attributable to the StoneGate development to the south of US 395 and to the Evans/Silver Star Ranch developments to the north by Lifestyle Homes. These developments also present the largest potential for future treated effluent reuse for irrigation purposes. The values listed in Table 6-3 are estimates provided by both development groups pertaining to the size of future public turf areas as part of the planned unit development.

Table 6-3 – Future Irrigation Water Demands

Development	Application Type	Land Area (Acre) (1)	NIWR (AFA) (2)
Lifestyle Homes	Turf Grass	60 - 100	186 – 310
StoneGate	Turf Grass	n/a	138
Existing Areas	Turf Grass	23	71
		Total =	395 - 519

Notes: (1) StoneGate provided an average day irrigation demand (ADD) in place of a turfed area estimate.
(2) Net irrigation water use estimate was derived by multiplying the ADD estimate by 365 days and converting the units from gallons to acre-feet

3.2 INDIRECT POTABLE REUSE

Utilizing treated effluent to enhance the potable water supply is an alternative for water systems with limited or dwindling water resources. Local agencies have been active in developing regulations which allow for indirect potable reuse (IPR) in Nevada. IPR is defined as being the release of treated wastewater into groundwater or surface water sources with the intent of future extraction and treatment prior to being placed into the public potable water system. As of June, 2016, a draft regulation for IPR has been proposed for amendment to Nevada Administrative Code (NAC) 445A. This amendment would approve wastewater treated to category “A+” for use in IPR through injection wells or spreading basins.

With a history of success across the United States, an IPR project in the Cold Springs basin could significantly expand the ability to manage basin water resources. The project is likely to be a joint venture between local agencies and will require substantial public outreach and pilot testing programs prior to its approval. The IPR project would provide the ability to increase groundwater storage and uses, potentially reducing dependence on water imported from another basin. As shown in Table 6-1, Table 6-2, and Figure 6-1, there is a potential for up to 3,191 afa of treated effluent in 2036 which could be available for an IPR project. By buildout this total could reach a volume of 5,538 afa.

3.3 REGIONAL WATER PROJECT

Another effluent reuse alternative to consider is a regional project which collects effluent from multiple treatment facilities and places the effluent into the best uses for the North Valleys, Truckee Meadows region, or outside of the Truckee Meadows (e.g. Long Valley discharge, Tahoe Reno Industrial Center, etc.). The value of this alternative could be a reduction in future capital costs related to sidestream treatment at CSWRF; storage, pumping, and distribution facilities across the Cold Springs system; and deep-water wells or spreading basins related to local IPR. The volume of effluent which may be available for a regional project would be the same as for the IPR alternative at 3,191 afa in 2036, and 5,538 by 2050. Similar to the IPR alternative would be the requirement for this project to be coordinated and operated as a joint venture by multiple agencies such as Washoe County, TMWA, the City of Reno and the City of Sparks.

4.0 SUMMARY

The existing Cold Springs Water Reclamation Facility contains adequate effluent disposal capacity to meet the demands of the system in twenty years or 2036. Even though the existing RIBs have suitable disposal capacity, it is very probable that a purple pipe system may be in place by 2036. Finally, future geologic or hydrogeologic studies will be required to evaluate the impacts to the basin groundwater supply due to future water resource management in the Cold Springs basin.