Greenfield Water Reclamation Plant Phase III

EXPANSION

DESIGN REPORT

Volume 1 of 3

December 2017 (FINAL)

Engineers...Working Wonders With Water®

City of Mesa, Town of Gilbert, and Town of Queen Creek

GREENFIELD WATER RECLAMATION PLANT PHASE III EXPANSION

DESIGN REPORT VOLUME 1 OF 3

FINAL

DECEMBER 2017

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List of Abbreviations

% wt	percent weight
µg/L	micrograms per liter
5Q	500 percent
A.A.C.	Arizona Administrative Code
A.R.S.	Arizona Revised Statutes
AADF	annual average day flow
AADL	annual average day load
ADEQ	Arizona Department of Environmental Quality
AFY	acre-feet per year
AGAD	acid-gas anaerobic digestion
APP	Aquifer Protection Permit
avg	average
AzPDES	Arizona Pollutant Discharge Elimination System
BADCT	Best Available Demonstrated Control Technology
BNR	biological nutrient removal
BOD	biochemical oxygen demand
CAP	Central Arizona Project
CaRRB	centrate and RAS re-aeration basin
CBOD	carbonaceous biological oxygen demand
CCBs	chlorine contact basins
CEPT	chemically enhanced primary treatment
cf	cubic feet
cfd	cubic feet per day
cfu	colony forming units
cfu/100 mL	colony forming units per 100 milliliters
cm/sec	centimeters per second
CMAD	conventional mesophilic anaerobic digestion
CMAR	construction manager at risk
COD	chemical oxygen demand
CSI	Construction Specifications Institute
dB	decibel(s)
DCR	Design Concept Report
deg C	degrees Celsius
deg F	degrees Fahrenheit
DIA	Discharge Impact Area
DIMs	Design Information Memoranda
DO	dissolved oxygen
EMF	East Maricopa Floodway
EOMM	Electronic O&M Manual
EPS	effluent pump station
EQ	equalization
ERP	Emergency Response Plan
ESDs	egg-shaped anaerobic digesters
FEMA	Federal Emergency Management Agency
FRP	fiberglass reinforced plastic
ft	foot (feet)

gal	gallon
GMP	guaranteed maximum price
gpd	gallons per day
gpd/acre	gallons per day per acre
gpd/ft	gallons per day per foot
gpd/lf	gallons per day per linear foot
gpd/sf	gallons per day per square foot
gph	gallons per hour
gpm	gallons per minute
gpm/sf	gallons per minute per square foot
GRIC	Gila River Indian Community
GWRP	Greenfield Water Reclamation Plant
hp	horsepower
HRS	heat reservoir supply
hrs	hours
HRT	hydraulic retention time
HW	headworks
IGA	Intergovernmental Agreement
in	inch(es)
inches w.c.	inches water column
IPS	influent pump station
IWRMP	Integrated Water Resources Master Plan
lb VS/cf-d	pounds volatile solids per cubic foot-day
lbs/day	pounds per day
lbs/hr	pounds per hour
MAG	Maricopa Association of Governments
MCESD	Maricopa County Environmental Services Department
MCP	master control panel
MG	million gallon
mg/L	milligrams per liter
mgd	million gallons per day
min	minute(s)
mL	milliliter
MLE	Modified Ludzak-Ettinger
MLR	mixed liquor recycle
MLSS	mixed liquor suspended solids
mm	millimeter(s)
MMADF	maximum month average day flow
MMADL	maximum month average day load
MMBtu	million British thermal unit
MMBtu/hr	million British thermal units per hour
MPN	most probable number
MS	mixed sludge
N/A	not applicable
NH_4-N	ammonia
NPW	non-potable water
NTP	Notice to Proceed
NTU	nephelometric turbidity unit
NWRF	Neely Water Reclamation Facility
O&M	operations and maintenance

OCM	odor control media
OCSs	odor control systems
Owners	City of Mesa, Town of Gilbert, and Town of Queen Creek
PDF	peak day flow
PHF	peak hour flow
PLC	programmable logic controller
PMAs	pollutant management areas
POC	point of compliance
PS No. 1	Pump Station No. 1
PS	primary sludge
psi	pounds per square inch
psig	pounds per square inch gauge
PVC	polyvinyl chloride
RAS	return activated sludge
RWCD	Roosevelt Water Conservation District
SCADA	supervisory control and date acquisition
scfh	standard cubic feet per hour
scfm	standard cubic feet per minute
SEWRP	Southeast Water Reclamation Plant
sf	square feet
SHB	Solids Handling Building
SRP	Salt River Project
SSC	secondary scum
TAD	thermophilic anaerobic digestion
TBD	to be determined
TKN	total Kjeldahl nitrogen
TMs	Technical Memoranda
TN	total nitrogen
tons/hr	tons per hour
TSS	total suspended solids
TTHM	total trihalomethane
UV	ultraviolet
VFDs	variable frequency drives
VSR	volatile solids reduction
WAS	waste activated sludge
WWTP	wastewater treatment plant

Chapter 1 - Project Overview

1.1 Introduction

The Greenfield Water Reclamation Plant (GWRP), located in Gilbert, Arizona and serving the City of Mesa, Town of Gilbert, and Town of Queen Creek (Owners), is currently rated as a 16-million gallon per day (mgd) annual average day flow (AADF) facility. The plant is designed to consistently produce Class A+ reclaimed water while adequately handling the full range of variable flows and loads coming from each community's service areas. The plant is also a regional solids handling facility designed to produce Class B biosolids, with an additional 8 mgd equivalent of primary sludge and waste activated sludge (WAS) from Mesa's Southeast Water Reclamation Plant (SEWRP) pumped approximately 11 miles and blended with the GWRP primary sludge and WAS prior to stabilization.

As part of the GWRP Phase III Expansion project, the Owners seek to provide an additional 14 mgd AADF of liquids and solids treatment capacity to the existing facility to accommodate increased wastewater flows and loads and reclaimed water demand in the tributary service area. The Phase III Expansion will increase the plant capacity to accommodate 30 mgd AADF of liquids treatment and 38 mgd AADF equivalent of solids treatment (based on 8 mgd AADF equivalent transferred to GWRP from the SEWRP). The plant will continue to meet Arizona Department of Environmental Quality (ADEQ) Class A+ reclaimed water standards in accordance with the facility's Aquifer Protection Permit (APP), and Class B biosolids in accordance with near-term and long-term land application disposal strategies.

In this Design Phase of the project, the overall objective is to update and finalize the Phase III design criteria developed during the preceding Design Concept Report (DCR) Phase. As such, the final Phase III design criteria will be used as the basis for the preparation of the detailed design plans and specifications for the project.

1.2 Report Scope

The initial DCR Phase (May through October 2015) of the project involved extensive coordination with GWRP staff and other assigned Owner personnel to determine the overall plant infrastructure requirements to accommodate Phase III and buildout flows. Preliminary design criteria, conceptual layouts, and site development requirements were determined for the Phase III and buildout facilities, and documented in a series of Technical Memoranda (TMs) and later summarized in the Draft DCR, dated October 2015.

In the subsequent Preliminary (30%) Design Phase, additional detailed treatment process evaluations and selection of process components were completed, along with the development of design criteria necessary for the detailed design of the Phase III facilities, and documented in a series of (Draft and Revised Draft) Design Information Memoranda (DIMs). The culmination of the Preliminary Design Phase was the Draft Design Report, dated October 2016, which essentially summarized the DIMs and represented an update to the information established previously in the Draft DCR, with corresponding revisions resulting from additional detailed evaluations.

The final Phase III design criteria for the GWRP that have evolved throughout the duration of the Detailed Design Phase are summarized in this Design Report and are presented in detail in the supporting DIMs included with this report. **As such, this Design Report documents the final codes and standards, and final design criteria and strategies for the Phase III facilities, and will ultimately be utilized for regulatory permitting approval (i.e., Maricopa County Environmental Services Department [MCESD] and ADEQ).** In addition to documenting the Phase III design criteria for the GWRP, the report also includes various supporting documentation required by the permitting agencies, as described in the next section.

1.3 Report Content and Organization

This report includes five chapters plus appendices, as follows:

- **Chapter 1 – Project Overview**
  This Chapter defines the purpose for conducting this phase of the project, provides an overview of the tasks completed, summarizes the overall project as proposed, describes how the overall report is organized, and includes a description of existing facilities.
- **Chapter 2 – Project Description**
  This Chapter summarizes the overall proposed liquids and solids treatment strategies, describes the effluent [reclaimed water] management and solids management strategies, and includes the proposed site layouts.
- **Chapter 3 – Design Criteria**
  This Chapter summarizes the design criteria for the Phase III Expansion and the anticipated Buildout facilities. The design criteria serve as the framework for the detailed design of the Phase III facilities.
- **Chapter 4 – Project Schedule**
  This Chapter summarizes the overall project schedule for the design and construction phases of the project.
- **Chapter 5 - Agency Review Documentation**
  This Chapter summarizes the supporting documentation required for regulatory permitting approval for the project, with relevant attachments included in Appendix A.
- **Appendix A – Agency Review Documents**
  This Appendix includes the supporting documentation required for the regulatory permitting approval for the project.

- **Appendix B – Design Information Memoranda (DIMs)**

  This Appendix includes a series of 13 DIMs, updated during the Detailed Design Phase, which provide supplemental data and further detail on the information presented in this Design Report. The DIMs include the proposed recommendations to be implemented as part of the Phase III Expansion project for the various treatment processes.

  – DIM-01 Site and Support Facilities
  – DIM-02 Electrical, Instrumentation, and Controls
  – DIM-03 Headworks Facilities
  – DIM-04 Not Used
  – DIM-05 Primary Sedimentation Facilities
  – DIM-06 Secondary BNR Facilities
  – DIM-07 Not Used (included with DIM-06)
  – DIM-08 Tertiary Filtration Facilities
  – DIM-09 Disinfection Facilities
  – DIM-10 Effluent Pumping Facilities
  – DIM-11A Solids Handling Facilities
  – DIM-11B Sludge Screening Facilities
  – DIM-12 Digestion Facilities
  – DIM-13 Digester Gas and Boiler Facilities
  – DIM-14 Not Used
  – DIM-15 Centrate Equalization Facilities

- **Appendix C – Technical Memoranda (DCR Phase)**

  This Appendix includes a series of 18 TMs, completed during the DCR Phase, which include the initial design concepts and strategies for the Phase III and Buildout facilities.

  – TM-1 Wastewater Flow and Loading Characterization
  – TM-2 Reclaimed Water Management Strategies
  – TM-3 Solids and Digester Gas Strategies
  – TM-4 Process Modeling and Mass Balance
  – TM-5A Preliminary and Primary Treatment Process Evaluation
  – TM-5B Secondary Treatment Process Evaluation
  – TM-5C Tertiary Treatment Process Evaluation
  – TM-5D Reclaimed Water Pumping and Storage Process Evaluation
  – TM-6 Solids Stream Treatment Process Evaluation
  – TM-7A Plant-wide Odor Control Study
  – TM-7B Influent Flowmeter Evaluation
  – TM-7C Chemical Storage and Feed

- TM-7D Miscellaneous Improvements - Headworks, Effluent Emergency Bypass, and Aeration Basins
- TM-7E Miscellaneous Improvements - Solids Handling
- TM-7F Miscellaneous Improvements - VFD Replacement
- TM-8A Power System Assessment
- TM-8B Plant Control Systems and Site Communications
- TM-9 Codes and Standards Review

1.4 Plant Location

The GWRP facility is located west of Greenfield Road, between Germann and Queen Creek Roads, at 4400 South Greenfield Road, Gilbert, Arizona 85296, in Maricopa County. The legal description of the facility is: Township 2 S, Range 6 E, Section 9, N1/4, S1/4 of the Gila and Salt River Base Line and Meridian.

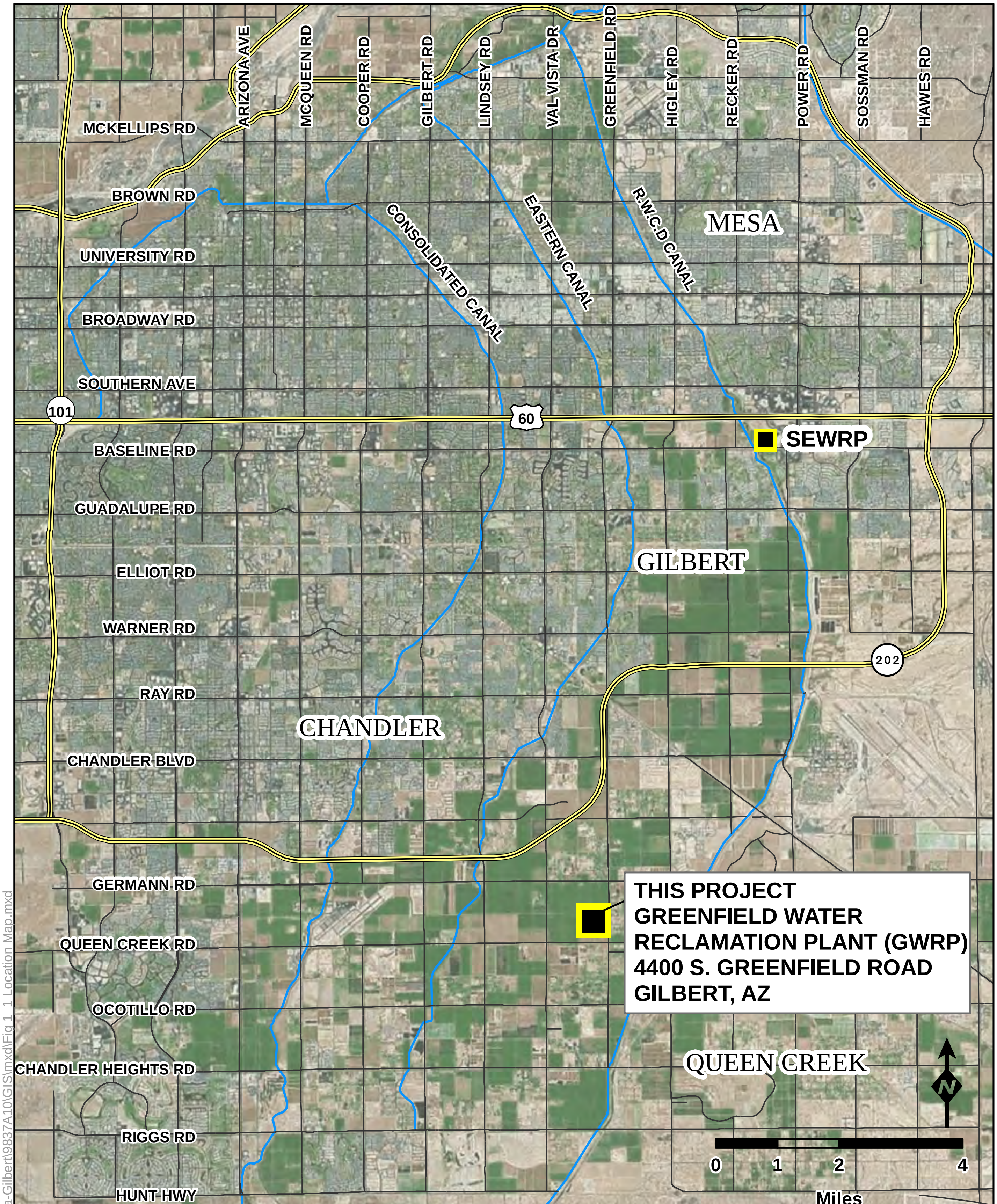
A location map for the facility is included in Figure 1.1.

1.5 Existing Facilities

The existing facility was constructed in two phases. Phase I was completed in 1999, and consisted primarily of the construction of the South Lift Station to transfer sewage to Mesa's SEWRP or to the Baseline Road Interceptor (for transfer to the Phoenix 91st Avenue Wastewater Treatment Plant [WWTP]). The second phase of the plant construction was completed in 2007, as part of the Phase II Expansion project, and consisted of the construction of treatment facilities with the capacity to treat 16 mgd AADF liquids and 24 mgd AADF solids equivalent. The South Lift Station and force mains, built originally in Phase I, were retained to maintain the capability of diverting (bypassing) up to 4.0 mgd to the SEWRP or Baseline Road Interceptor.

The existing GWRP employs the conventional activated sludge process with preliminary treatment (screening and grit removal), primary clarifiers, aeration basins with an integral centrate and return activated sludge (RAS) reaeration basin (CaRRB) zone, secondary clarifiers, cloth disk media tertiary filters, and ultraviolet (UV) disinfection, as shown in Figure 1.2. The solids produced at the facility and the additional solids received from the SEWRP are treated using sludge thickening centrifuges, egg-shaped anaerobic digesters, and dewatering centrifuges. Dewatered biosolids are land applied. The layout of the existing treatment components on the GWRP site is shown in Figure 1.3. Additional discussion on the liquids and solids treatment processes is included in Chapter 2. Specific design criteria are summarized in Chapter 3.

The reclaimed water [effluent] is currently distributed from the GWRP Effluent Pump Station (EPS) to several locations, including the Gila River Indian Community (GRIC) receiving canal, the Town of Gilbert South Recharge Area and Gilbert Reclaimed Water Reservoir, Roosevelt Water Conservation District (RWCD) Canal (Town of Queen Creek's discharge) and an emergency outlet at the East Maricopa Floodway (EMF). Additional discussion on the reclaimed water management strategies is included in Chapter 2.



GWRP LOCATION MAP

FIGURE 1.1

CITY OF MESA, TOWN OF GILBERT, AND TOWN OF QUEEN CREEK

GWRP PHASE III EXPANSION

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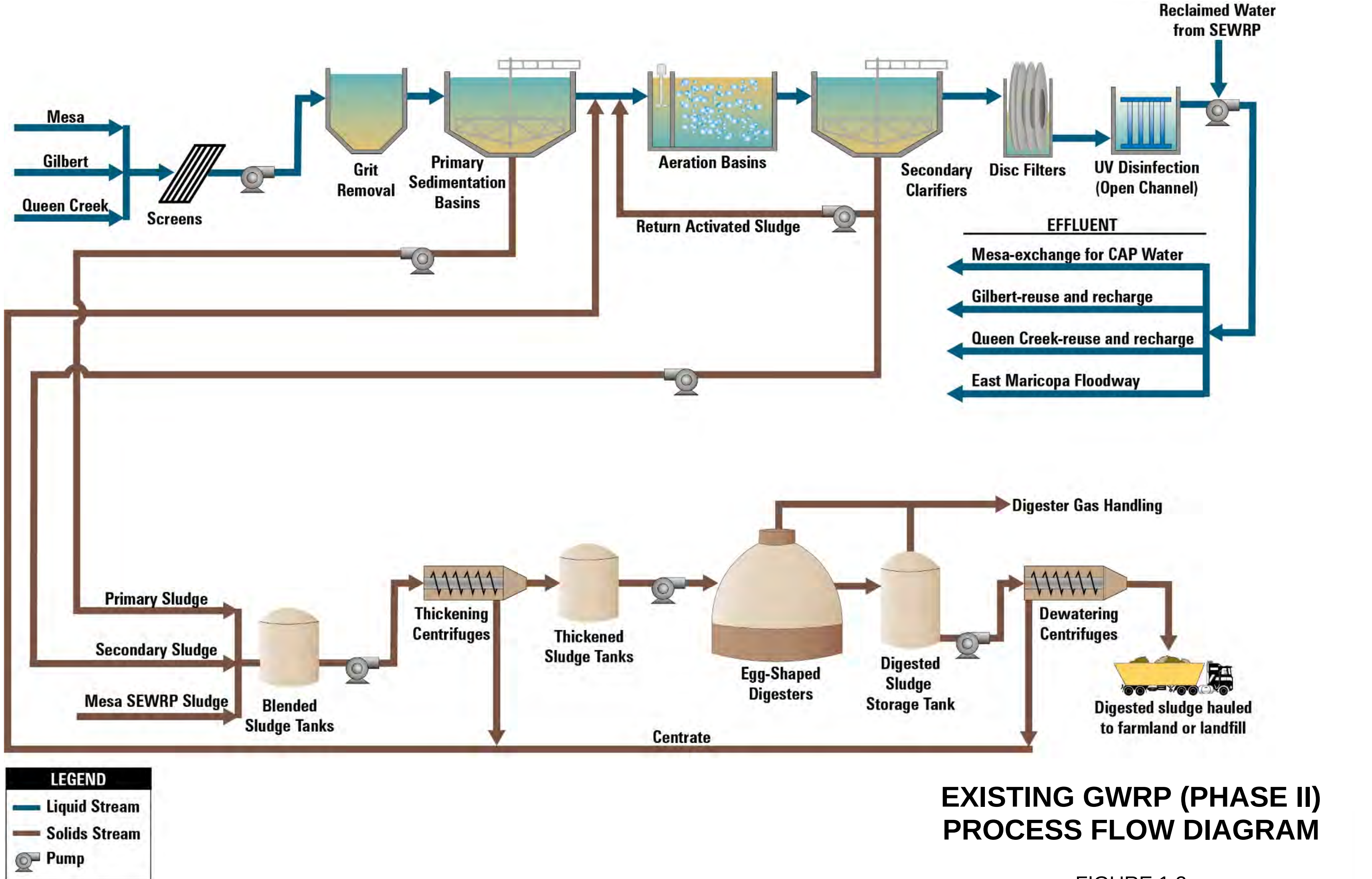
Date: October 04, 2016
File Path: M:\Client\Mesa-Gilbert\9837A10\GIS\mxd\Fig 1_1 Location Map.mxd



EXISTING GWRP (PHASE II) PROCESS FLOW DIAGRAM

FIGURE 1.2

CITY OF MESA, TOWN OF GILBERT, TOWN OF QUEEN CREEK
GWRP PHASE III EXPANSION

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EXISTING GWRP (PHASE II) SITE MAP

FIGURE 1.3

CITY OF MESA, TOWN OF GILBERT, TOWN OF QUEEN CREEK
GWRP PHASE III EXPANSION

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Chapter 2 - Project Description

The process flow diagrams for the liquids and solids treatment processes are presented in this Chapter, along with a summary of the key changes that are proposed to existing processes. The related effluent [reclaimed water] management strategies and solids management strategies for the GWRP are also discussed. Finally, site layouts showing the major treatment components proposed for the Phase III Expansion and Buildout are included.

2.1 Design Capacity

The current influent flow projections for the Owners are summarized in Table 2.1. The Owners provided the latest available planning information for the Phase III and Buildout (Phase IV) capacities. The proposed AADF capacity for the Phase III Expansion is 30 mgd. The total buildout wastewater flows are projected to be approximately 56 mgd AADF.

Table 2.1 Phase III and Buildout Influent Flow Projections

Owner	Phase II (1)	Phase III (2)	Buildout	Total
Town of Gilbert	8.0	4.0	4.4	16.4 (3)
City of Mesa	4.0	10.0	13.0	27.0 (3)
Town of Queen Creek	4.0	--	8.2	12.2 (3)
Total	16.0	14.0	25.6	55.6 (4)
Cumulative Total	**16.0**	**30.0**	**55.6 (4)**	**--**

Notes:

(1) Current capacity allocations.
(2) The additional overall Phase III expansion AADF capacity has been planned at 14 mgd, for a total capacity of 30 mgd.
(3) Updated projections provided in the DCR Phase.
(4) The GWRP site was initially master planned for 52 mgd AADF under the Phase II Expansion.

2.2 Phase III Expansion Treatment Processes

The GWRP Phase III Expansion will include expanded and new liquids and solids stream treatment processes, as described in the following sections.

2.2.1 Liquids Stream

The main processes that make up the Phase III liquids stream treatment process train at the GWRP are shown in Figure 2.1. The treatment train includes screening, influent pumping, vortex grit removal, primary sedimentation, activated sludge biological nutrient removal (BNR) with an integral CaRRB process, secondary clarification, tertiary cloth disk media filtration, chlorine disinfection, and reclaimed water [effluent] pumping. Ancillary facilities include flow metering, flow splitting structures, odor control systems, aeration blowers, sludge pumping, and chemical storage and feed systems. Of the ancillary facilities, the odor control systems and chemical storage and feed systems are not shown in the figure for clarity.

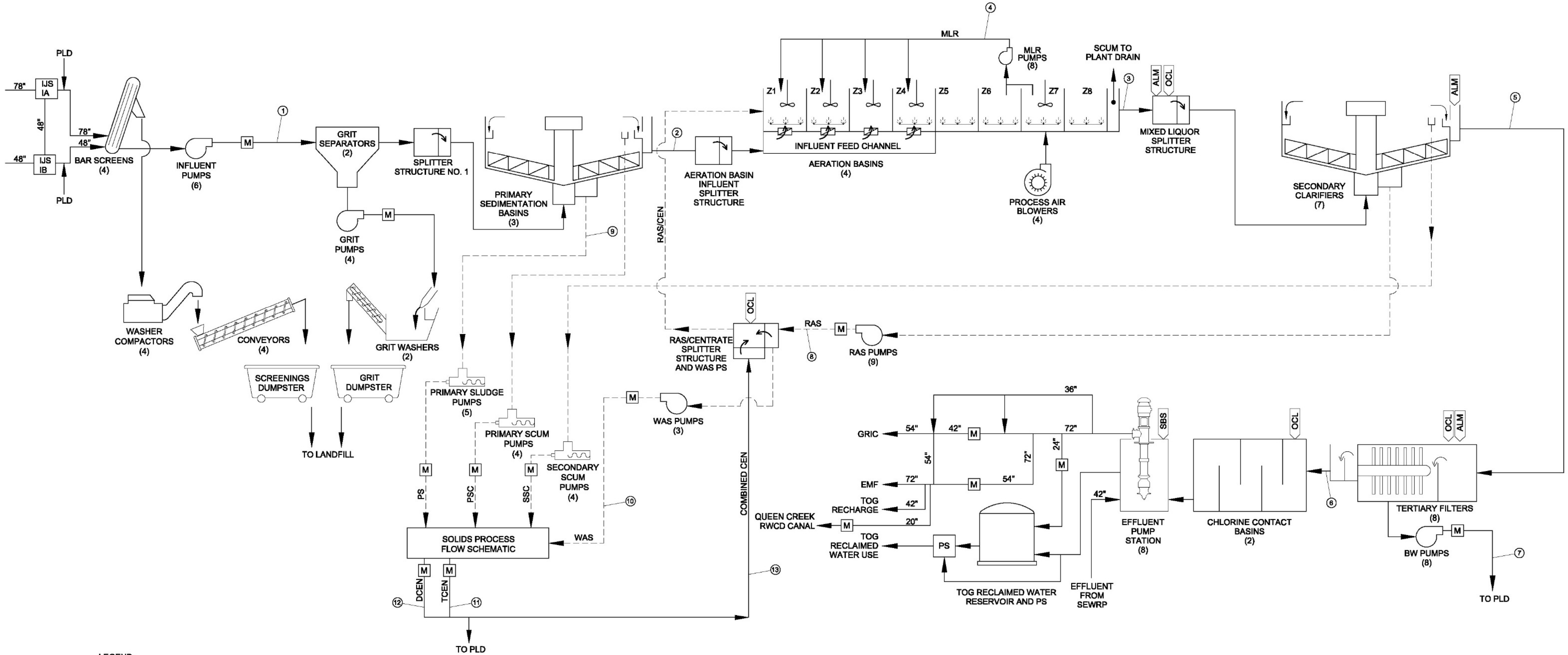
For the Phase III Expansion, some of the existing process units will be replaced with new, larger facilities; while some will be modified to increase capacity; and others will have parallel treatment trains added. The new parallel trains that will be added include a headworks facility, a primary sedimentation basin, two aeration basins, and three secondary clarifiers.

It is important to note that a few key changes are proposed to the existing process configuration for the Phase III Expansion, including the following:

- While no modifications are proposed to the existing 1/2-inch screens, the new screens will be designed with 1/4-inch screen spacing size, for increased screenings capture.
- Modification of the aeration basins operation from the Modified Ludzak-Ettinger (MLE) process to a 4-stage Bardenpho™ process for better process stability. Other modifications to the aeration basins configuration include a change in technology from coarse bubble diffusers to fine bubble diffusers, and an increase in the mixed liquor recycle (MLR) pumping capacity to up to 500 percent of the plant influent maximum month average day flow (MMADF).
- Change in tertiary filtration system, from an inside-out partially submerged cloth media filter to an outside-in fully submerged cloth media filter.
- Use of chlorine disinfection (with bulk sodium hypochlorite) in lieu of the existing UV disinfection technology.
- Addition of a new sodium bisulfite facility for dechlorination, as needed. The plant currently does not have a dechlorination facility.

2.2.2 Solids Stream

The main processes that make up the Phase III solids stream treatment process train at the GWRP are shown in Figure 2.2. The treatment train includes screening of primary sludge (PS) from the GWRP, blending of screened PS with mixed sludge (MS) from the SEWRP, WAS and secondary scum (SSC), blended sludge thickening with centrifuges, conventional mesophilic anaerobic digestion (CMAD) using egg-shaped digesters, sludge heating, biosolids storage, digested biosolids dewatering with centrifuges, biosolids transfer and cake storage using live-bottom hoppers, and truck loading facilities. Ancillary facilities include blended sludge and digested sludge pumped mixing, digester sludge heating, hot water boilers, digester waste gas flares, odor control system, and chemical storage and feed systems. Of the ancillary facilities, the odor control systems and chemical storage and feed systems are not shown in the figure for clarity.



LEGEND:

OCL SODIUM HYPOCHLORITE

ALM ALUM

SBS SODIUM BISULFITE

SOLIDS STREAM

LIQUIDS STREAM

(#) NUMBER OF UNITS/BASINS

ID	STREAM	Flow [mgd]	TOTAL COD [LB /D]	TOTAL CARBONACEOUS BOD [LB /D]	TOTAL SUSPENDED SOLIDS [LB TSS/D]	VOLATILE SUSPENDED SOLIDS [LB VSS/D]	TOTAL KJELDAHL NITROGEN [LB N/D]	AMMONIA N [LB N/D]	NITRATE N [LB N/D]	NITRITE N [LB N/D]	TOTAL INORGANIC N [LB N/D]	TOTAL N [LB N/D]	TOTAL P [LB P/D]	SOLUBLE PO4-P [LB P/D]
1	PLANT INFLUENT	33.00	276,778	118,765	138,455	110,753	18,562	12,993	0	0	12,993	18,562	4,035	1,066
2	PRIMARY EFFLUENT	33.28	158,484	75,855	54,501	43,567	16,473	12,848	18	2	12,868	16,493	2,272	1,105
3	AERATION BASIN EFFLUENT	50.46	1,697,369	384,821	1,508,762	1,118,257	78,807	92	1,397	157	1,645	80,361	33,121	3,947
4	INTERNAL MIXED LIQUOR RETURN	165.00	5,580,039	1,276,889	4,949,580	3,672,754	259,604	1,594	5,886	3,129	10,610	268,620	108,300	12,524
5	SECONDARY EFFLUENT	33.96	16,932	816	2,153	1,596	579	62	940	106	1,107	1,625	2,698	2,656
6	TERTIARY EFFLUENT	33.30	15,214	482	861	638	503	60	922	104	1,086	1,528	2,621	2,605
7	FILTER BACKWASH	0.66	1,717	334	1,292	958	76	1	18	2	22	96	77	52
8	RETURN ACTIVATED SLUDGE	15.78	1,607,110	367,248	1,440,866	1,067,935	74,815	29	437	49	515	75,301	29,096	1,234
9	PRIMARY SLUDGE	0.38	120,012	43,245	85,246	68,144	2,165	147	0	0	147	2,165	1,839	13
10	WASTE ACTIVATED SLUDGE	0.72	73,327	16,756	65,742	48,726	3,414	1	20	2	23	3,436	1,328	56
11	THICKENING CENTRATE	1.16	11,965	3,889	8,732	6,505	487	154	22	2	178	511	240	66
12	DEWATERING CENTRATE	0.24	5,683	581	5,525	3,442	1,958	1,784	0	0	1,784	1,958	1,513	1,437
13	COMBINED CENTRATE	1.40	17,648	4,470	14,257	9,947	2,444	1,938	22	2	1,961	2,468	1,753	1,502

LIQUIDS PROCESS FLOW SCHEMATIC AND MASS BALANCE

FIGURE 2.1

CITY OF MESA, TOWN OF GILBERT, TOWN OF QUEEN CREEK
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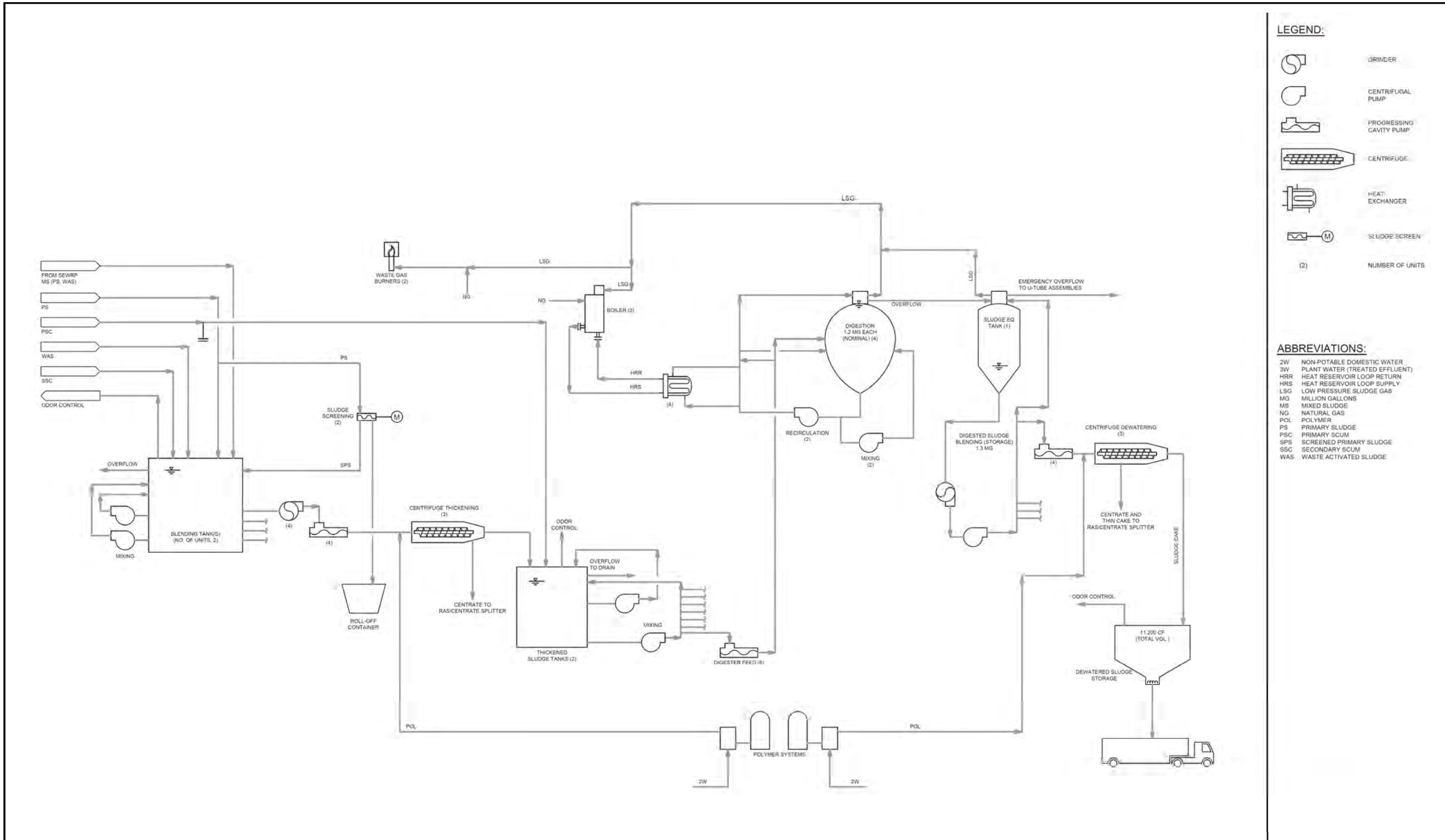

SOLIDS PROCESS FLOW SCHEMATIC

FIGURE 2.2

CITY OF MESA, TOWN OF GILBERT, TOWN OF QUEEN CREEK
GWRP PHASE III EXPANSION DESIGN REPORT

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For the Phase III Expansion, existing process units will have parallel treatment trains added as master-planned for the facility, while the operation of some of the process elements will be modified to increase throughput. The new parallel trains that will be added include two anaerobic digesters and a dewatering centrifuge.

It is important to note that a few key changes are proposed to the existing process configuration for the Phase III Expansion, including the following:

- Addition of sludge screening facilities for removal of fibrous material from the GWRP PS flow stream that currently impact the operation and maintenance of downstream equipment related to the thickened sludge tanks and digesters.
- Optimization of thickening centrifuge operation for maximum output and thickened sludge solids content of up to 6.5 percent (as compared to the current solids content of 5.75 to 6 percent) to meet digester hydraulic retention time (HRT) requirements and improve volatile solids reduction (VSR) performance for Phase III.
- Designing a CMAD process to potentially accommodate advanced digestion technologies such as thermophilic anaerobic digestion (TAD) or acid-gas anaerobic digestion (AGAD) in the future, which have the ability to reduce digester footprint at buildout and also allow for upgrades to Class A digestion.
- Replacing the two existing waste gas burners with two new units that have a newer design (the new units will have a higher gas handling capacity and more turndown capacity compared to the existing units).

2.3 Effluent Management Strategies

The existing and proposed effluent [reclaimed water] management strategies for the GWRP are described in TM-2 − Reclaimed Water Management Strategies. Highlights of these strategies are summarized herein.

In general, no major changes to the existing effluent management strategies are proposed for Phase III. The City of Mesa will reuse its reclaimed water through a water exchange via a 54-inch diameter pipeline to the GRIC canal located on the Gila River Indian Reservation. The Town of Gilbert's use of their reclaimed water will include discharge to its reuse system and the Gilbert South Recharge Site. The Town of Queen Creek is sending a portion of its allotment to the RWCD Canal. Additionally, if necessary, effluent may also be discharged to the EMF via a 72-inch pipeline, in case the above identified disposal options are not available.

The effluent discharging facilities for the GWRP include the GRIC canal, Gilbert's South Recharge Site, Gilbert's Reclaimed Water Reservoir, Town of Queen Creek's discharge to the RWCD canal, and the EMF, as shown in the Extended Site Map-1 included in Section 2.6 (Figure 2.4). In Phase III, all treated reclaimed water will continue to flow through the GWRP EPS wet well structure and be distributed to the permitted discharging facilities as described in the following sections.

2.3.1 City of Mesa

A significant portion of the City of Mesa's reclaimed water, including all of its current GWRP allotment, is being delivered to the GRIC as part of a Settlement Agreement providing for the exchange of Mesa reclaimed water for a portion of the GRIC Central Arizona Project (CAP) water. Early in 2002, a draft Intergovernmental Agreement (IGA) for Delivery of Reclaimed Water was developed between Mesa and the GRIC.

As part of the Phase II Expansion, a separate 42-inch reclaimed water pipeline from Mesa's SEWRP was constructed and connected to the GWRP EPS wet well as a redundant means of providing additional reclaimed water from Mesa to the GRIC as part of the aforementioned IGA. This additional reclaimed water source has been integral to how Mesa has met its delivery obligations.

According to City staff, Mesa is currently sending approximately 9 to 10 mgd of reclaimed water to GRIC, of which the split between GWRP and SEWRP is approximately 50/50. Furthermore, the City is projecting to continue to maintain delivery of approximately 9 to 10 mgd of reclaimed water to the GRIC in the near future, unless additional residential, commercial, or industrial growth results in an increase of available reclaimed water.

2.3.2 Town of Gilbert

In November of 2012, Carollo Engineers completed an Integrated Water Resources Master Plan (IWRMP) Update for the Town of Gilbert. The IWRMP Update summarizes the overall Town water resources management strategy that includes the management of Salt River Project (SRP) surface water, CAP water, RWCD water, groundwater, and reclaimed water from the Neely Water Reclamation Facility (NWRF) and GWRP.

The Town has three separate spreading basin type recharge facilities – the Neely Recharge Facility, the Riparian Preserve, and the South Recharge Site – to store renewable water supplies during periods of off-peak demand, which includes reclaimed water. Ultimately, the Town of Gilbert will produce and make use of approximately 27 mgd of reclaimed water, about half of which will be recharged in any given year. Groundwater recharge of reclaimed water from the GWRP is being performed at the 140-acre South Recharge Site, located at the northeast corner of Higley and Ocotillo Roads.

Reclaimed water that is not recharged into the aquifer is used by multiple customers for meeting demands that do not require potable water quality. Most of the reclaimed water use is for turf irrigation, water features, and ponds. Customers tend to be Homeowners Associations, golf courses, churches, businesses, and Town parks.

The Town of Gilbert stores reclaimed water produced by the GWRP at a 5-million gallon (MG) reservoir and booster pump station adjacent to the plant, then delivers the water either into the distribution system or to the South Recharge Site. The recharge rate for this site has been less than expected due to confining clay layers; the Phase 1 facility permitted maximum daily flow recharge rate is 9 mgd and permitted annual recharge volume of 3,285 acre-feet per year (AFY), although the historical maximum daily flow recharge rate has been 2.6 mgd.

To date, Gilbert has generally been able to take additional reclaimed water above their allotment capacity for short time periods when the other communities have not been able to take reclaimed water, although it has placed a significant strain on Gilbert's system capacity.

After the Phase III Expansion, the Town of Gilbert will continue to meet reclaimed water demand allocations to the established list of reuse customers, and will continue to recharge excess available reclaimed water into the aquifer.

2.3.3 Town of Queen Creek

The Town of Queen Creek's allotment of GWRP reclaimed water, i.e., 4 mgd, has historically been handled by the other two communities. However, the Town is currently receiving reclaimed water at their facility near the EMF and Queen Creek Road. This facility is not performing as expected from a process controls standpoint (manual control only is available), and the Town is currently working to modify this.

2.3.4 East Maricopa Floodway

The GWRP also has the capability of discharging effluent to the EMF, in case of plant upset reducing the reclaimed water quality below acceptable reuse or recharge thresholds, or in the case of a short-term shutdown to one of the end-user systems, or if the GRIC cannot accept reclaimed water from Mesa. Discharge of effluent to the EMF is in accordance with the plant's Arizona Pollutant Discharge Elimination System (AzPDES) discharge permit (No. AZ0025241).

The option of delivering effluent to the EMF will continue to remain in place as part of this Phase III Expansion project. At the completion of the detailed design phase, the existing AzPDES permit requirements (which are based on a design capacity of 16 mgd AADF) will be modified to reflect the Phase III design capacity of 30 mgd AADF.

2.3.5 Effluent Pump Station and Reclaimed Water Pipelines

The existing EPS provides pumping of both GWRP and SEWRP effluent via 36-inch and 72-inch reclaimed water pipelines to the various permitted discharging locations. In Phase III, modifications will be made to the effluent pumping system to accommodate the Phase III design flows, as described below.

- Add one new 12,000-gpm (gallons per minute) pump in the existing EPS in Open Slot No. 8 to accommodate the Phase III design peak hour flow under the condition where the SEWRP effluent flow is pumped separately from the GRIC effluent, without commingling the two waters.
- Create a tie-in from the existing 24-inch force main feeding the Gilbert 5-MG Reservoir to the existing 42-inch gravity pipeline, to provide the ability to feed the Gilbert reuse pumps directly, in the event that the reservoir needs to be taken offline.

2.3.6 References

The following documents were used as references in developing this section:

- TM-2 − Reclaimed Water Management Strategies (October 2015, Carollo Engineers)
- Town of Gilbert 2012 Integrated Water Resources Master Plan Update (November 2012, Carollo Engineers)

2.4 Solids Management Strategies

As shown in Figure 2.2, for Phase III, the solids treatment train will continue to consist of centrifuge thickening, anaerobic digestion, centrifuge dewatering, and truck hauling to land application, with landfilling as a backup. The only major change proposed is the addition of a sludge screening facility. The solids management strategies for the GWRP are described in detail in the various DIMs and TMs referenced in this Section and are summarized herein. The Phase III design criteria for the solids handling facilities are presented in Chapter 3 (see Section 3.6).

1. **Solids Quality:** For Phase III, the current practice of producing Class B biosolids will continue, with the biosolids being beneficially reused for agricultural purposes (in accordance with Arizona Administrative Code (A.A.C.) Title 18, Chapter 9, Article 10, or, if requisite quality is not attained, (or if weather conditions should prohibit application), landfilled. As such, there is no regulatory or other driver to deviate from the current practice; no technology changes for Class A or Class EQ biosolids will be included for Phase III.

2. **Solids Quantity:** Operational data indicates that the solids loadings to the plant have increased over time, both as a result of increasing flow and increasing concentrations associated with decreased water use. Table 2.2 illustrates this trend in increasing solids loadings and presents the revised Phase III design criteria as compared to original projections. Note that the characterization of the sludge (relative to % PS and % WAS) has changed from initial design assumptions, as well as blended solids percentages. Volatile solids percentages have also decreased from previous assumptions.

Table 2.2 Revised Phase III Solids Quantities

	Planned - Phase II	Current Operation (2013-2015)	Planned (per Original Projections - 2002) Phase III MMAD	Revised Phase III MMAD - Current	Projected Buildout MMAD - Current
Total pounds/day	70,521	45,862	126,428	174,646	306,468
Percent total (%)					
Primary	31	17	35	52	56.2
WAS	48	33	53	35	35.5
SEWRP MS (1)	21	50	12	13	8.3
Blended solids (% by weight)	0.89	1.41	1.14	1.43	1.46
Volatile solids (% by weight)	78.3	70.5	80.1	70.0	71.2

Note:

(1) Original Phase II planning (2002) assumed ultimate SEWRP MS from equivalent 12 mgd flow; current planning is for maximum equivalent 8 mgd flow.

3. **Sludge Screening:** The plant currently experiences accumulation of fibrous material in the thickened sludge tanks, which negatively impacts the operation and maintenance of the thickened sludge tanks and related solids handling equipment, particularly pumps. Testing conducted during the DCR Phase revealed that the predominant source of the fibers is the primary sludge flow stream. Some fibrous material is also suspected to be contributed from the SEWRP MS.

   Pilot testing of sludge screens ("strain presses") conducted in the Design Phase using GWRP PS indicated successful removal of fibers and positive impacts on the downstream processes. Based on the testing results, two new sludge screens (with interchangeable screen sizes of 3 mm/5 mm) will be installed in Phase III, to provide screening of GWRP PS, prior to routing this flow stream to the blend tanks for blending with the various other solids residual streams. Provisions will be made for the installation of a third screen in the future, which may be configured to either screen GWRP PS or SEWRP MS.

   The Phase III design criteria for the sludge screenings facilities are presented in Chapter 3 (see Section 3.6.1).

4. **Sludge Blending:** In Phase III, the sludge blending operation of the various plant residuals will continue to be provided using two blending tanks (one tank will be required, with the other tank serving as backup) to produce a relatively homogeneous feedstock to the thickening centrifuges. No major changes to the tanks and the related pumped mixing system are proposed. The Phase III design criteria for the sludge blending facilities are presented in Chapter 3 (see Section 3.6.1).

5. **Sludge Thickening:** The three existing centrifuges will continue to be used to thicken the blended sludge prior to feeding to the anaerobic digesters; no additional units are proposed for Phase III. For Phase III, 24/7 thickening operation is proposed, along with an increase in hydraulic and mass loading, 95 percent capture, and up to 6.5 percent thickened solids. Note that currently, with the typical feed concentration to the thickening centrifuges ranging from 1.2 to 2.4 percent, the thickened sludge concentration ranges from about 4.5 to 8 percent. The historical average range has been between 5.8 and 6 percent, with higher solids concentrations achievable with increased polymer dosage.

   Thickening centrate, along with dewatering centrate, will continue to be routed to the RAS/Centrate Splitter Structure to mix with RAS ahead of the CaRRB zones in the aeration basins (see Item No. 8 herein).

   The Phase III design criteria for the thickening facilities are presented in Chapter 3 (see Section 3.6.2).

6. **Digestion:** Two new 1.2-MG egg-shaped anaerobic digesters (ESDs) to be operated in CMAD mode (to match existing two ESDs) will be provided in Phase III. With the increase in the thickened sludge feed concentration to the digesters to up to 6.5 percent, the digested sludge concentration is expected to increase from the current range of 2.5 to 3.5 percent to about 4.3 percent.

   The existing digester gas management system will be expanded to collect and remove digester gas from the new digesters. Digester gas will continue to be used to power hot water boilers, which produce the heat energy required to maintain the digesters in the mesophilic range; excess gas will be flared to the atmosphere. For Phase III, an additional boiler will be included; and the two existing waste gas burners will be replaced with two new units.

   The Phase III design criteria for the digestion facilities are presented in Chapter 3 (see Section 3.6.3).

7. **Dewatering:** To provide flexibility in dewatering operations and to ensure a continuous, homogeneous feed of digested sludge to the dewatering centrifuges, digested sludge storage is provided upstream of the dewatering process. The sludge storage buffer allows for dewatering to occur daily, but not continuously; dewatering currently occurs daily for 8-10 hours per day, typically during the night and early morning hours. As flows increase, the length of the dewatering operation will need to be increased, until approximately three years after the Phase III construction is complete, when the plant will need to run the centrifuges on a 24/7 schedule. Ultimately, the continuous operation of the centrifuges should result in more stable operation of the units.

   There are two existing dewatering centrifuges which are operated in a duty/standby mode. For Phase III, a third centrifuge and related dewatering centrifuge feed pump and classifying conveyor will be added to accommodate the increased flows and loads. The dewatering equipment will be designed to accept approximately 4.3 percent digested sludge as feed, and produce 22 percent solids sludge cake, with a design solids capture rate of 95 percent.

No changes to the dewatered cake hoppers are proposed. The two existing live bottom hoppers are adequate to handle Phase III conditions; the available storage will be reduced from four days in Phase II to three days in Phase III.

Dewatering centrate, along with thickening centrate, will continue to be routed to the RAS/Centrate Splitter Structure to mix with RAS ahead of the CaRRB zones in the aeration basins (see Item No. 8 below).

The Phase III design criteria for the dewatering facilities are presented in Chapter 3 (see Section 3.6.4).

8. **Centrate Recycle Stream Management:** Process modeling during the DCR Phase indicated that return of the dewatering centrate to the liquid stream at the CaRRB zone is preferred to quickly provide the ammonia-laden centrate with air and carbon to facilitate its nitrification. Dewatering centrate return on a continuous basis would be preferable since starting and stopping flow can cause process instability. However, evaluation of providing centrate equalization indicated that it is not justifiable based on cost and limited need (increasing flows will widen the dewatering period until continuous dewatering is necessary, in any case). It is possible to return dewatering centrate at a near constant rate by decreasing the dewatering centrifuge feed rate, thereby extending the daily run time. This is an operational choice that can be made by staff as needed.

   The thickening centrate, which is present in a much higher quantity and with a relatively lower concentration of ammonia, may be returned at any convenient point in the process. Alternatives for returning thickening centrate to the RAS/Centrate Splitter Structure, the Grit Overflow Junction Structure, and the Basin Drain Pump Station have been proposed. For Phase III, the combined thickening and dewatering centrate will be directed to the RAS/Centrate Splitter Structure and mixed with RAS ahead of the CaRRB zones in the aeration basins.

   A pigging station will be added to the existing 10-inch centrate pipeline as part of Phase III.

9. **References:** The following documents were used as references in developing this section (included as Appendices to this Design Report).

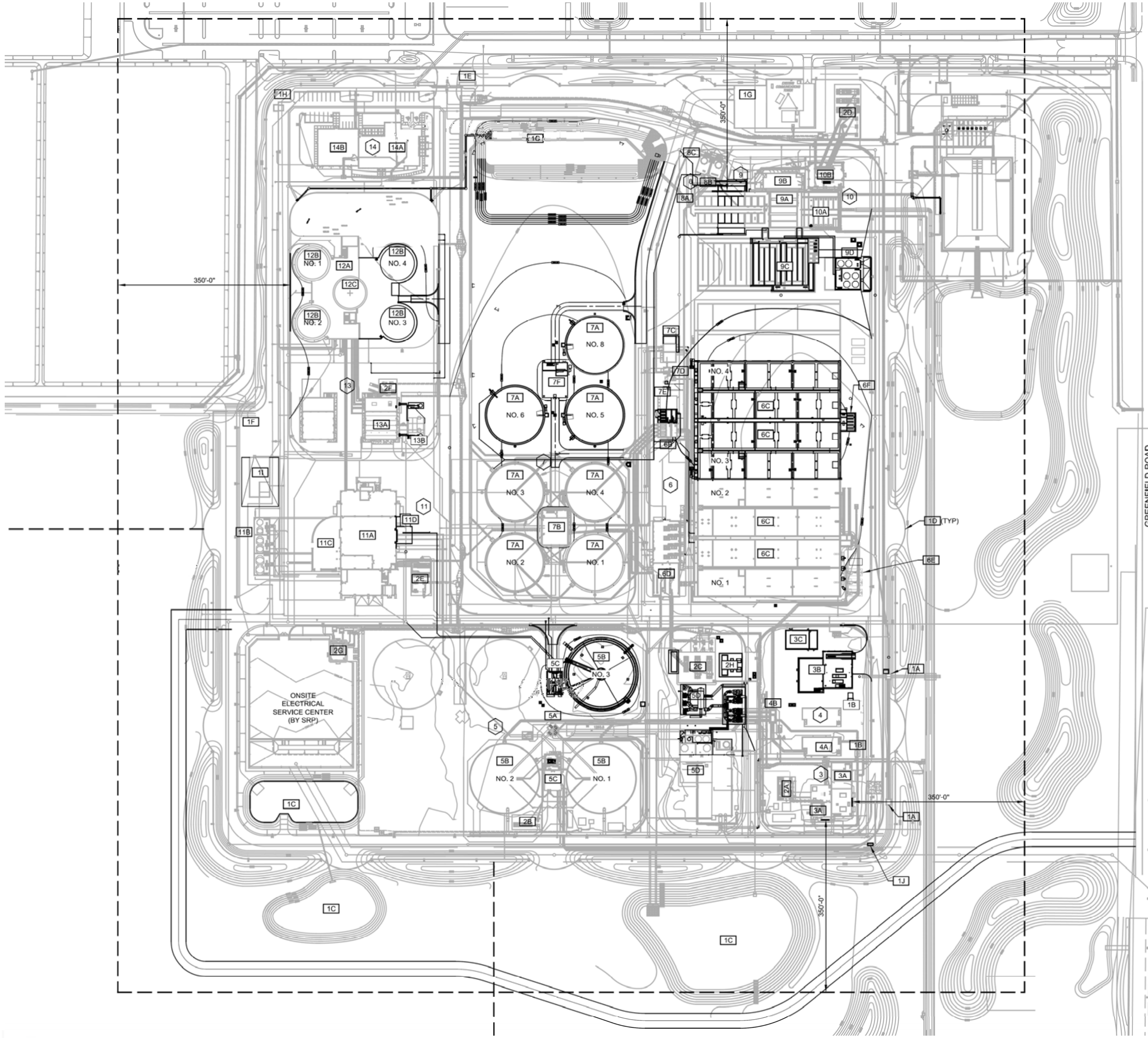
   - TM-3 – Solids and Digester Gas Management Strategies
   - TM-6 – Solids Stream Treatment Process Evaluation
   - DIM-11A – Solids Handling Facilities
   - DIM-11B – Sludge Screening Facilities
   - DIM-12 – Digestion Facilities
   - DIM-13 – Digester Gas and Boiler Facilities
   - DIM-15 – Centrate Equalization Facilities

2.5 GWRP Phase III Site Plan

The Phase II Expansion project included numerous provisions to allow for ease of future expansions, such as planning future diversion structures, starter walls and waterstop for expanding structures, dedicated yard piping and utility corridors, dedicated electrical ductbank and manhole corridors, planned footprints for all future treatment facilities, and adequately sized yard piping strategies to maintain minimum and maximum flow rates through all phases, all in an effort to help mitigate costly plant shutdowns or significant flow bypassing in subsequent plant expansions. As such, the elements of these master-planned provisions will be utilized as part of the proposed Phase III Expansion.

The key site layout elements for the Phase III Expansion are presented in Figure 2.3 and summarized below.

- A new Headworks Building No. 2, similar to the existing facility, will be constructed north of the existing Headworks Building No. 1. A new Headworks Electrical Building will be constructed north of Headworks Building No. 2.
- A new Primary Sedimentation Basin No. 3 and corresponding Primary Sludge Pump Station No. 2 will be located north of existing Primary Sedimentation Basin No. 1.
- New Aeration Basin Nos. 3 and 4 will be constructed adjacent to the existing aeration basins in a similar size and configuration.
- New Secondary Clarifier Nos. 5, 6, and 8, and corresponding RAS/Scum Pump Station No. 2, will be located north of the existing bank of secondary clarifiers. (NOTE: Secondary Clarifier No. 7 will be deferred to a future phase).
- New tertiary cloth media filter bays will be constructed along the existing influent channel, west of the existing filter bays.
- Two new chlorine contact basins (CCBs), and corresponding chlorination/dechlorination chemical storage and feed facilities, will be constructed south of the filters and existing UV channels. (NOTE: Since chlorine disinfection was not originally planned for the GWRP, the new and future CCBs will be located in the space originally allocated for future Aeration Basin No. 6.)
- New primary sludge screening facilities will be constructed on the east side of the Solids Handling Building.
- Two new ESDs and an expanded digester gallery will be constructed immediately east of the existing digesters and gallery complex.
- A new Primary Odor Control System No. 2 will be constructed north of the existing Primary Odor Control System No. 1.
- The existing Utility Pad will be expanded in size; additionally, changes will be made to the drainage pattern within the pad.
- The existing stormwater Retention Basin No. 4, located north of the secondary clarifiers, will be expanded to accommodate the required retention basin volume required for Phase III and the loss of retention volume of existing Retention Basin No. 3, which will be affected (and ultimately eliminated) by the construction of the new digesters and expanded gallery.



LEGEND:

EXISTING PHASE I AND II STRUCTURES

PHASE III STRUCTURES

MINIMUM SETBACK REQUIRED, 350 FT (THERE IS NO PRIVATELY OWNED PROPERTY WITHIN SETBACK)

GWRP - PLANT AREA DESIGNATIONS

TREATMENT AREA
#X STRUCTURE (EXISTING AND PROPOSED)

1 YARD/SITE FACILITIES
1A INFLUENT JUNCTION STRUCTURES
1B FLOW METERING VAULTS
1C STORM WATER RETENTION BASINS
1D PERIMETER WALL
1E PRIMARY ENTRANCE GATE
1F SECONDARY ENTRANCE GATE
1G BONEYARD STORAGE AREA
1H DUMPSTER ENCLOSURE
1I UTILITY PAD (SLUDGE DRYING BED)
1J PLANT DRAIN FLOW

2 POWER SERVICE/DISTRIBUTION FACILITIES
2A POWER CENTER NO.1
2B POWER CENTER NO.2
2C POWER CENTER NO.3
2D POWER CENTER NO.4
2E POWER CENTER NO.5
2F POWER CENTER NO.6
2G PRIMARY SWITCHGEAR BUILDING
2H POWER CENTER 1B

3 HEADWORKS FACILITIES
3A HEADWORKS BUILDING NO. 1
3B HEADWORKS BUILDING NO. 2
3C HEADWORKS ELECTRICAL BUILDING

4 GRIT HANDLING FACILITIES
4A GRIT REMOVAL TANKS
4B GRIT OVERFLOW JUNCTION STRUCTURE

5 PRIMARY SEDIMENTATION FACILITIES
5A SPLITTER STRUCTURE NO.1
5B PRIMARY SEDIMENTATION BASINS
5C PRIMARY SLUDGE/SCUM PUMP STATION NO. 1 & NO. 2
5D PRIMARY ODOR CONTROL SYSTEM AND BULK CHEMICAL STORAGE AREA NO. 1

6 SECONDARY BNR FACILITES
6A AERATION BASIN NO. 1 & NO. 2 INLET STRUCTURE
6B MIXED LIQUOR SPLITTER STRUCTURE
6C AERATION BASINS
6D BLOWER/ELECTRICAL BUILDING
6E SECONDARY ODOR CONTROL SYSTEM
6F AERATION BASIN INFLUENT SPLITTER STRUCTURE

7 SECONDARY CLARIFICATION FACILITIES
7A SECONDARY CLARIFIER BASINS
7B RAS/SCUM PUMP STATION NO. 1
7C RAS/CENTRATE SPLITTER STRUCTURE & WAS PUMP STATION
7D WAS PUMP STATION ELECTRICAL BUILDING
7E SECONDARY ODOR CONTROL SYSTEM NO. 1 AND NO. 2
7F RAS/SCUM PUMP STATION NO. 2

8 TERTIARY FILTRATION & CHEMICAL FEED FACILITIES
8A FILTER INFLUENT JUNCTION STRUCTURE
8B FILTERS
8C BULK CHEMICAL STORAGE AREA NO. 2

9 DISINFECTION FACILITIES
9A UV CHANNELS (DISCONNECTED IN PHASE III)
9B UV BALLAST BUILDING (DISCONNECTED IN PHASE III
9C CHLORINE CONTACT BASINS
9D BULK CHEMICAL STORAGE AREA NO. 4

10 EFFLUENT PUMPING/STORAGE FACILITIES
10A EFFLUENT PUMP STATION
10B EFFLUENT PUMPING ELECTRICAL BUILDING

11 SOLIDS HANDLING FACILITIES
11A SOLIDS HANDLING BUILDING
11B BULK CHEMICAL STORAGE AREA NO. 3
11C SOLIDS ODOR CONTROL SYSTEM
11D PRIMARY SLUDGE SCREENING

12 DIGESTION FACILITIES
12A DIGESTER COMPLEX
12B DIGESTER TANKS
12C DIGESTED SLUDGE STORAGE TANK

13 DIGESTER HEATING & WASTE GAS FACILITIES
13A BOILER BUILDING/CONGENERATION
13B WASTE GAS BURNERS

14 ADMINISTRATION/MAINTENANCE FACILITIES
14A ADMINISTRATION BUILDING
14B MAINTENANCE BUILDING

0 50' 100' 200'

GWRP PHASE III EXPANSION SITE PLAN

FIGURE 2.3

CITY OF MESA, TOWN OF GILBERT, TOWN OF QUEEN CREEK
GWRP PHASE III EXPANSION DESIGN REPORT

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pw:\\Carollo/Documents\Client/AZ/Mesa-Gilbert/9837A10/Deliverables/Design Report/Graphics\Fig 2.3

2.6 GWRP Extended Site Maps

An extended site map for the GWRP is shown in Figure 2.4, containing the following key information:

- Permitted discharging facilities
- Point of Compliance (POC) locations
- Effluent Pump Station (Sampling Point No. 1)
- Property boundary and setback requirements
- Groundwater flow direction (east-southeast direction)

Note that the plant remains outside of the 100-Year Floodplain (per Federal Emergency Management Agency [FEMA] Map 04013C2765M), which designates the area as Zone "X", which is assigned to areas with 0.2 percent chance of annual flood or protected by levees from 1 percent annual chance of flood.

2.6.1 Pollutant Management Areas and Corresponding Discharge Impact Areas

Two pollutant management areas (PMAs) have been designated for the GWRP. The first PMA is a line circumscribing all components of the plant; with the corresponding Discharge Impact Area (DIA) for this PMA being nearly identical to the PMA. The second PMA was defined by a Brown and Caldwell study (November 2003) and is the extent of surficial impact of the effluent discharged to the EMF. According to the study, the estimated maximum/steady-state length of effluent flow in the EMF for 16 mgd is approximately 6.5 miles. A discharge of 52 mgd would flow about 11.5 miles down the EMF by the end of the first day.

Figure 2.5 shows the two PMAs and corresponding DIAs designated for the GWRP.

2.6.2 Setback Requirements

Per the requirements of the A.A.C. R18-9-B201.I, the minimum setback distance required for the GWRP, with full noise, odor, and aesthetic controls, is 350 feet. The GWRP meets this setback requirement; as such, all property with the 350-foot setback is owned by the GWRP Owners.

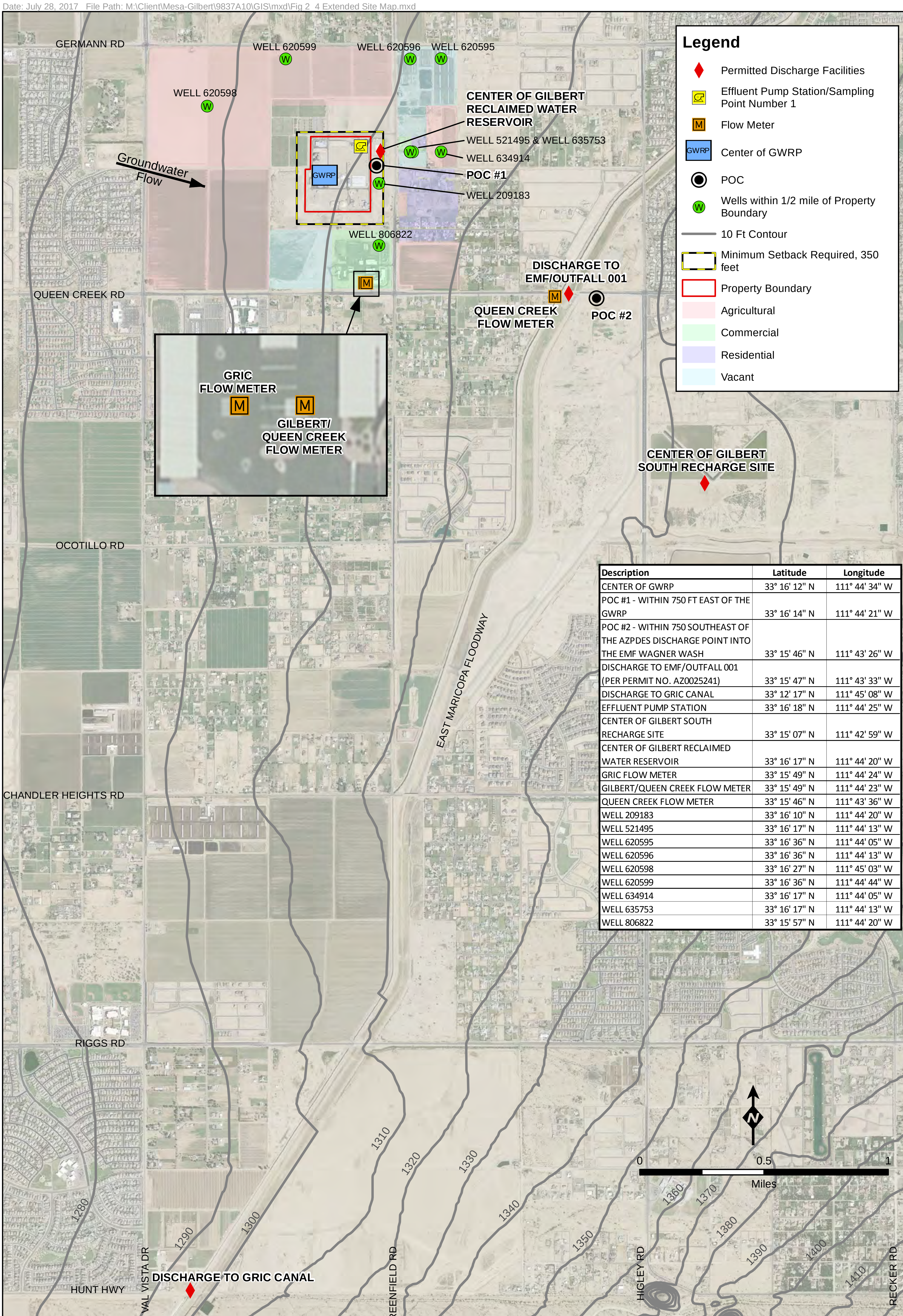
The Phase III Expansion project will incorporate full noise, odor, and aesthetic control features, similar to existing features, as described below.

Noise Attenuation Features

Noise attenuation features will be provided for the new Phase III facilities. The majority of processes and equipment components will either be below-grade, covered, or housed within buildings. Further, motor shrouds and/or insulation will be provided for the exposed equipment (including pumps and mixers). Table 2.3 summarizes the proposed noise control features for the new facilities.

Table 2.3 Phase III Facilities Noise Attenuation Features

Unit Process/Equipment	Noise Control Feature
Influent Screens and Pumps	• Enclosed in a building (Headworks Building No. 2) and/or located in below-grade structure
Primary Sedimentation Basin, Secondary Clarifiers	• Not required
Aeration Blowers	• Enclosed in building (existing; no changes)
Aeration Basin Diffusers and Mixers	• Covered basins • Motor shroud and/or increased level of insulation for exposed mixer drives
Primary Sludge, RAS, and WAS Pumps	• Enclosed in buildings and/or located in below-grade structure
Tertiary Filters	• Located in below-grade structure
Disinfection Facilities	• Not required
Effluent Pumps	• Motor shroud and/or increased level of insulation for pump motor
Primary Sludge Screens	• Enclosed in a building (extension to Solids Handling Building)
Sludge Thickening and Dewatering Centrifuges	• Enclosed in a building (Solids Handling Building) with interior acoustical treatment on walls • Separation of control and operator works areas from machine rooms • Motor shroud and/or increased level of motor insulation for centrifuge drives
Sludge Pumps	• Enclosed in a building (Solids Handling Building) with interior acoustical treatment on walls
Anaerobic Digesters	• Enclosed vessels for mixing • Below-grade structure for pumps
Variable Frequency Drives (VFDs)	• Enclosed in electrical building(s)



Description	Latitude	Longitude
CENTER OF GWRP	33° 16' 12" N	111° 44' 34" W
POC #1 - WITHIN 750 FT EAST OF THE GWRP	33° 16' 14" N	111° 44' 21" W
POC #2 - WITHIN 750 SOUTHEAST OF THE AZPDES DISCHARGE POINT INTO THE EMF WAGNER WASH	33° 15' 46" N	111° 43' 26" W
DISCHARGE TO EMF/OUTFALL 001 (PER PERMIT NO. AZ0025241)	33° 15' 47" N	111° 43' 33" W
DISCHARGE TO GRIC CANAL	33° 12' 17" N	111° 45' 08" W
EFFLUENT PUMP STATION	33° 16' 18" N	111° 44' 25" W
CENTER OF GILBERT SOUTH RECHARGE SITE	33° 15' 07" N	111° 42' 59" W
CENTER OF GILBERT RECLAIMED WATER RESERVOIR	33° 16' 17" N	111° 44' 20" W
GRIC FLOW METER	33° 15' 49" N	111° 44' 24" W
GILBERT/QUEEN CREEK FLOW METER	33° 15' 49" N	111° 44' 23" W
QUEEN CREEK FLOW METER	33° 15' 46" N	111° 43' 36" W
WELL 209183	33° 16' 10" N	111° 44' 20" W
WELL 521495	33° 16' 17" N	111° 44' 13" W
WELL 620595	33° 16' 36" N	111° 44' 05" W
WELL 620596	33° 16' 36" N	111° 44' 13" W
WELL 620598	33° 16' 27" N	111° 45' 03" W
WELL 620599	33° 16' 36" N	111° 44' 44" W
WELL 634914	33° 16' 17" N	111° 44' 05" W
WELL 635753	33° 16' 17" N	111° 44' 13" W
WELL 806822	33° 15' 57" N	111° 44' 20" W

GWRP PHASE III EXPANSION EXTENDED SITE MAP-1

FIGURE 2.4

CITY OF MESA, TOWN OF GILBERT, AND TOWN OF QUEEN CREEK

GWRP PHASE III EXPANSION

carollo

Brown AND Caldwell

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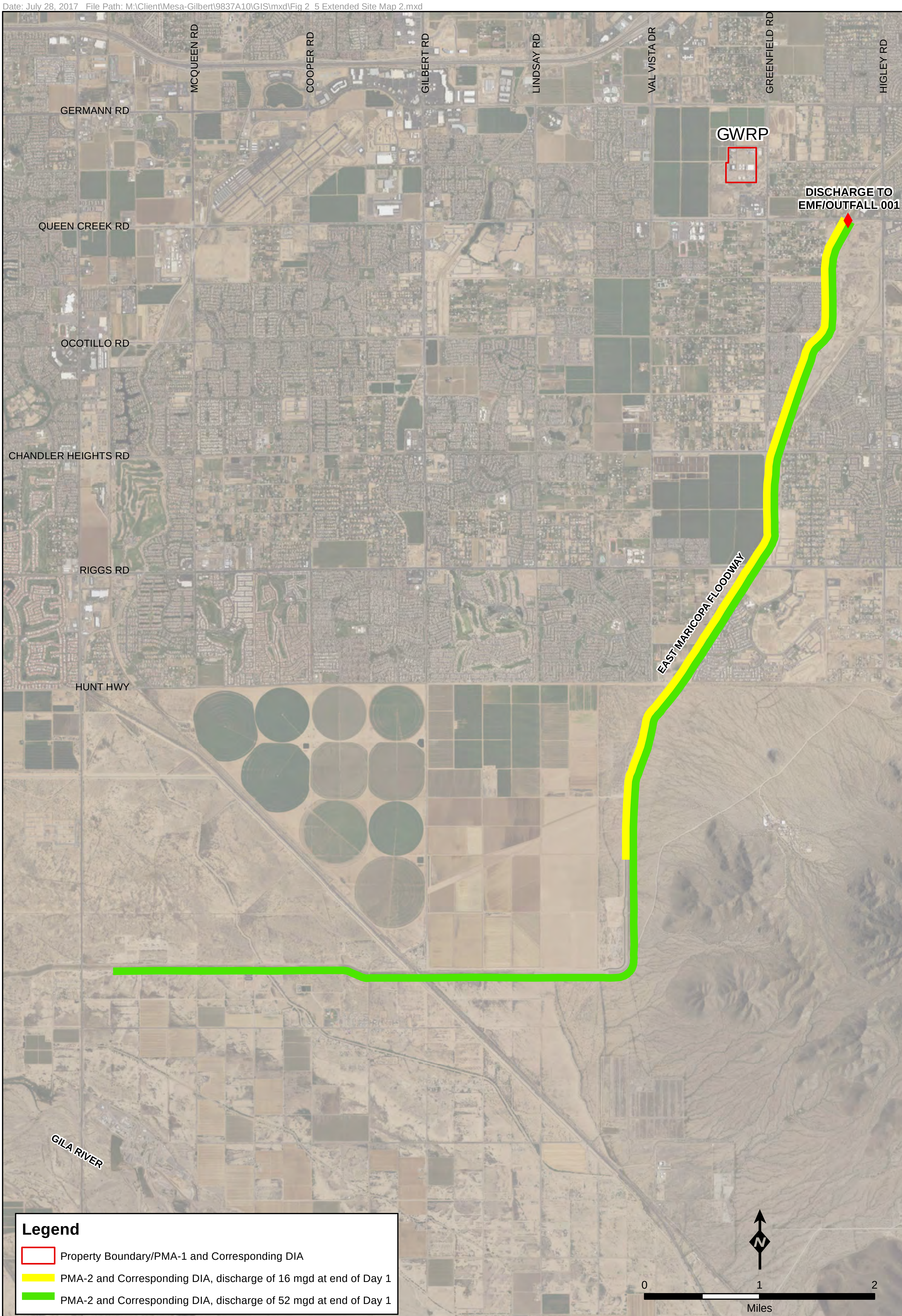

GWRP PHASE III EXPANSION EXTENDED SITE MAP-2

FIGURE 2.5

CITY OF MESA, TOWN OF GILBERT, AND TOWN OF QUEEN CREEK

GWRP PHASE III EXPANSION

Odor Control

The various odor-producing components at the plant, including preliminary and primary treatment facilities, aeration basins, and the Solids Handling Building will be provided with odor control treatment. A summary of the Phase III odor control systems (OCSs) is provided in Table 2.4.

As part of the odor control treatment systems, all odor-producing facilities will be enclosed, either using covers or inside buildings, and the air from these units scrubbed to remove odor producing elements. The aeration basins and splitter structures will be covered using flat aluminum covers while the primary sedimentation basin will be covered using low-profile aluminum dome covers. Additionally, the headworks and solids handling facilities will be enclosed inside buildings.

Table 2.4 Phase III Odor Control Systems

OCS Identification	Type of System	Number of Units	Plant Components Included
Primary OCS	LO/PRO Chemical Scrubbers	Seven (4 existing plus 3 new)	Influent Junction Boxes Influent Junction Structure 1A Influent Junction Structure 1B Headworks Building Nos. 1 and 2 Grit Handling Facilities Grit Overflow Junction Structure Primary Sedimentation Basins Splitter Structure No. 1
Secondary OCS	Carbon Adsorption Units	Three (3 existing)	Aeration Basins
	Packaged Carbon Adsorption Units	Two (1 existing plus 1 new)	Mixed Liquor Splitter Structure RAS/Centrate Splitter Structure
Solids OCS	Single-Stage Packed-Tower Wet Chemical Scrubbers	Two (existing)	Solids Handling Building, including new Sludge Screening Facility

Site Aesthetic Controls

An existing aesthetic perimeter wall (13-foot nominal height) constructed during the Phase II Expansion project surrounds the entire GWRP site, as well as extensive landscaping around the perimeter buffer area. No changes are proposed to the existing wall or landscaping under this project.

2.7 GWRP Buildout Site Plan

The anticipated site layout for the Buildout facilities is presented in Figure 2.6.

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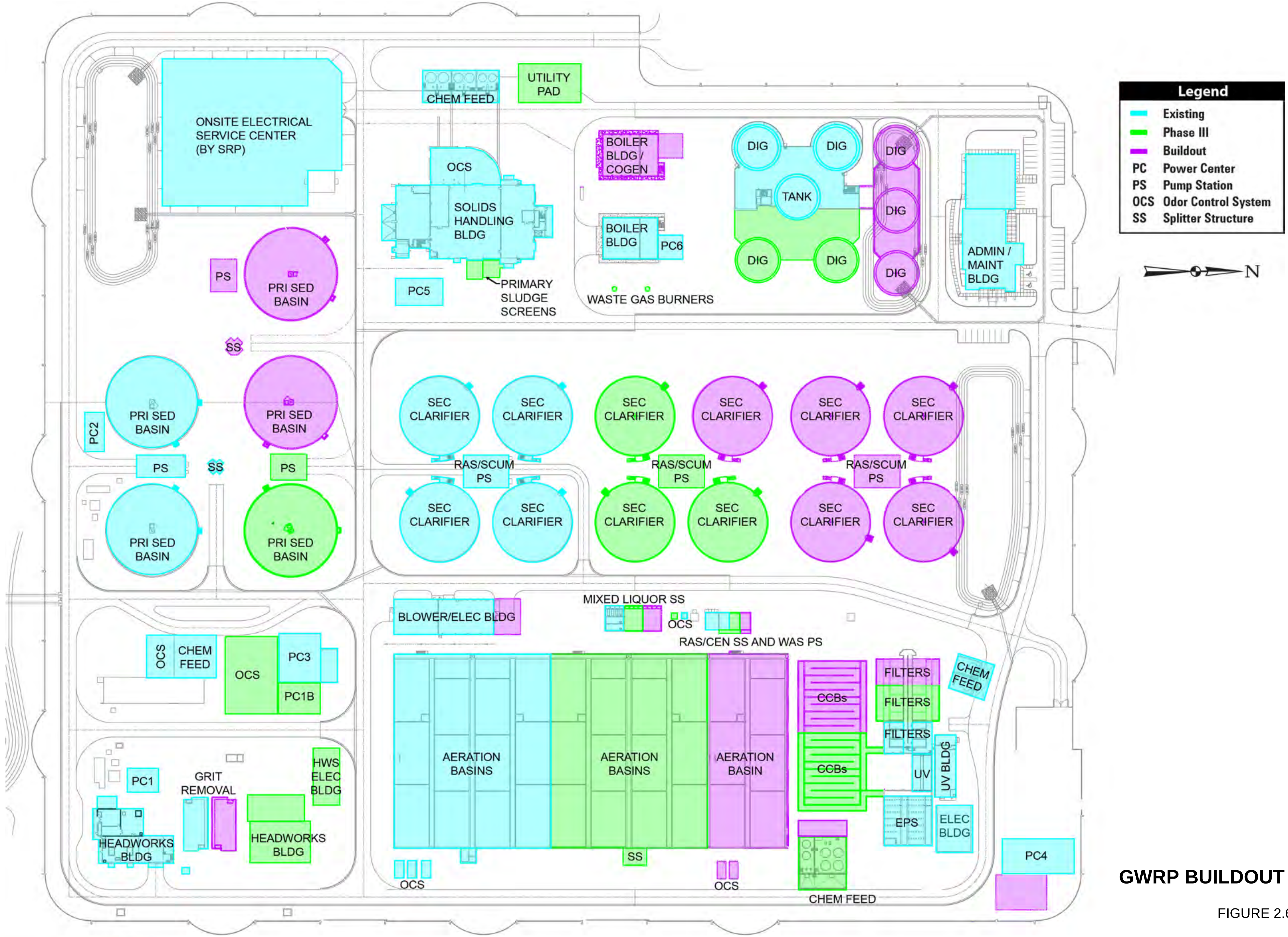

GWRP BUILDOUT SITE PLAN

FIGURE 2.6

CITY OF MESA, TOWN OF GILBERT, TOWN OF QUEEN CREEK
GWRP PHASE III EXPANSION

Chapter 3 - Design Criteria

In order to establish the design criteria for the new treatment facilities, a number of evaluations were completed on the GWRP in the preceding DCR Phase, including a review of historical influent wastewater flows and loadings, process modeling and mass balances, as well as individual unit process evaluations, and the resulting preliminary design criteria were established for the Phase III facilities. In this Design Phase, the design components were further detailed and reviewed with the Owners; a number of value engineering items were also evaluated in an effort to keep the project within budget. As such, the following revisions are proposed to the recommendations from the DCR Phase.

- The preliminary recommendation from the DCR Phase was to construct four new secondary clarifiers for Phase III. However, based on further process modeling analysis, and on re-evaluating the implications of the secondary clarification process on the effluent Total Nitrogen (TN) concentration, it was concluded that three new secondary clarifiers would be adequate to handle Phase III flows and loads. The design criteria and recommendations contained in this chapter are based on building only three additional secondary clarifiers (and associated RAS pumps) in Phase III (see Section 3.5.3).
- The preliminary recommendation from the DCR Phase was to provide a centrate equalization (EQ) tank and related appurtenances for improved management of the return of the centrate flows back to the CaRRB process for treatment. However, based on process modeling results (conducted in the DCR Phase) and the subsequent evaluation on centrate equalization volume requirements (based on 5-day, 7-day, and continuous centrifuge operation) and associated cost analyses, it was concluded that centrate equalization provides limited benefits to plant operation relative to the associated construction costs, having minimal impact on the effluent TN concentrations and permit limits. Additionally, it was noted that the benefits of centrate equalization will diminish over time, as the plant moves towards 24/7 dewatering operations. The revised recommendation for Phase III is to route the non-segregated thickening and dewatering centrate flows back to the liquids treatment stream without centrate equalization. The revised design recommendations for centrate flow management in Phase III are presented in Section 3.6.5.
- The preliminary recommendation from the DCR Phase was to provide a third waste gas burner, similar to the two existing units. However, based on detailed investigations, it was decided to replace the existing John Zink burners with two new Varec low emission, natural draft burners. The Varec units are relatively new technology; they have unlimited turndown and fewer maintenance points. The two new units are sufficient to handle the digester gas projected to be produced during Phase III and at Buildout (with one unit serving as duty and the other unit serving as stand-by). The revised design criteria for the waste gas burners are presented in Section 3.6.3.

- The preliminary recommendation from the DCR Phase was to provide a fourth, redundant carbon unit at the Secondary Odor Control System serving the aeration basins. However, based on further investigations and discussions with the Owners, it was decided that the addition of the fourth unit can be deferred to a future phase. The revised design criteria for the Secondary Odor Control System are presented in Section 3.7.

Based on the detailed design development conducted in this Design Phase, the proposed facilities for the Phase III Expansion of the GWRP have been defined, and the design criteria for the facilities have been developed. The design criteria for the Phase III (and buildout facilities) are presented in this chapter. Only the key information is contained in the following sections, with references in each section (as appropriate) to the supporting DIMs and TMs, which contain more detailed design information and considerations.

3.1 Wastewater Flows

The following standard definitions of flows are used in the data analysis for each of the system components:

- Annual average day flow (AADF): average of the daily flows for a calendar year.
- Maximum month average day flow (MMADF): the maximum 30-day average flow (based on daily flows) in a calendar year.
- Maximum month flow peaking factor: the ratio between the MMADF and AADF.
- Peak day flow (PDF): the highest average daily flow in a calendar year.
- Peak day flow peaking factor: the ratio between the PDF and AADF.
- Peak hour flow (PHF): the highest one-hour average flow in a calendar year.
- Peak hour flow peaking factor: the ratio between the PHF and the AADF.

Table 3.1 summarizes the hydraulic peaking factors established for the GWRP, and the corresponding influent wastewater flows, as established in TM-1 − Wastewater Flow and Loading Characteristics (see Appendix C) and TM-4 − Process Modeling and Mass Balance (see Appendix C).

Table 3.1 Design Influent Flows and Hydraulic Peaking Factors

Parameter	Units	Phase II	Phase III	Buildout
Influent Flow				
Annual Average Day Flow (AADF)	mgd	16	30	56
Maximum Month Average Day Flow (MMADF)	mgd	24	33	61.6
Peak Day Flow (PDF)	mgd	32	39	72.8
Peak Hour Flow (PHF)	mgd	48	60	112
Hydraulic Peaking Factors (1)				
Maximum Month Average Day	-	1.5	1.1	1.1
Peak Day	-	2.0	1.3	1.3
Peak Hour	-	3.0	2.0	2.0

Note:
(1) All peaking factors are relative to AADF conditions.

3.2 Influent Wastewater Characteristics

The following standard definitions of wastewater constituent concentrations and loading characteristics are used in the data analysis for each of the system components:

- Average concentration: average of the reported concentrations in a given time period.
- Load: the mass load (in pounds per day, or lbs/day) of a given constituent, which is a result of the product between flow (in mgd) and concentration (in milligrams per liter, or mg/L).
- Annual average daily load (AADL): average of the daily loads in a calendar year.
- Maximum month average day load (MMADL): the maximum 30-day average load in a calendar year.
- Maximum month load peaking factor: the ratio between the MMADL and the AADL.

The design wastewater characteristics, including loading peaking factors, concentrations, and loads were established in TM-1 − Wastewater Flow and Loading Characteristics (see Appendix C). Influent wastewater characteristics for the Phase III Expansion are summarized in Table 3.2 and Table 3.3.

Table 3.2 Design Influent Loading Peaking Factors

Parameter	Units	Value
Maximum Month Load Peaking Factors		
Biochemical Oxygen Demand (BOD)	-	1.3
Chemical Oxygen Demand (COD)	-	1.3
Total Suspended Solids (TSS)	-	1.3
Total Kjeldahl Nitrogen (TKN)	-	1.3

Table 3.3 Design Influent Wastewater Characteristics

Parameter	Annual Average	Maximum Month
Influent Wastewater Concentrations (1)		
BOD, mg/L	325	384
COD, mg/L	850	1,005
TSS, mg/L	425	502
TKN, mg/L (2)	57.0	67.4
Influent Wastewater Loads (3)		
BOD, lbs/day	81,315	105,710
COD, lbs/day	212,670	276,471
TSS, lbs/day	106,335	138,236

Notes:

(1) Average concentrations are based on historical data analysis. Maximum month concentrations are based on the maximum month load and flow.

(2) Based on assumed ammonia to TKN ratio of 0.7, typical for municipal wastewater in the area.

(3) Average loads are calculated from the average concentration and design flow. Maximum month loads are calculated from the average loads and the design maximum month load peaking factors.

3.3 Arizona BADCT Requirements

The Phase III GWRP will be designed to meet the Best Available Demonstrated Control Technology (BADCT) treatment performance criteria for new facilities as specified in Article 2 – Individual Aquifer Protection Permits of Chapter 9, Title 18 of the A.A.C. (R18-9-B204). A summary of the BADCT requirements are provided in Table 3.4.

Table 3.4 Arizona BADCT Requirements

BADCT Criteria	Treatment Requirement
Setbacks	350 ft (For facilities over 1 mgd, with full noise, odor and aesthetic controls) 150 ft with an ordinance or waiver
Treatment Requirement	Secondary Treatment Meeting BOD_5 < 30 mg/L (30-day avg) or $CBOD_5$ < 25 mg/L (30-day avg)
TSS	< 30 mg/L (30-day avg)
pH	Between 6.0 – 9.0
Removal Efficiency	85% of BOD_5, $CBOD_5$, and TSS
TN	< 10 mg/L 5-month rolling geometric mean
Fecal Coliform Limits	Non-detectable in 4 out of 7 daily samples 23 MPN or cfu/100 mL max
Disinfection	Use chlorination-dechlorination, UV light and/or ozone to achieve pathogen removal and minimize trihalomethane generation

Note:
Source: A.A.C. R18-9-Part B, September 30, 2005

3.4 Phase III Reclaimed Water Quality Goals and Limits

The Owners have indicated that they plan to continue the current strategies of reuse, recharge, and exchange. Therefore, the master plan for the Phase III Expansion will be responsive to current regulations and the Owners' present water reclamation and water resources strategies (as discussed previously in Chapter 2).

After a review of the applicable regulations and water quality trends, as well as the existing APP and AzPDES Permit requirements for the GWRP, the recommended reclaimed water quality goals for the treatment processes and technologies to be employed at the expanded GWRP are consistent with Class A+ Reclaimed Water standards (and consistent with the Phase II Expansion reclaimed water quality goals and criteria) and are summarized in Table 3.5.

Table 3.5 Phase III Reclaimed Water Quality Goals and Limits xxx

Parameter	Goal	Alert Level	Permit Limits
BOD_5	< 10 mg/L (30-day avg)	--	0 mg/L (30-day avg) 45 mg/L (7-day avg)
Turbidity	< 1.5 NTU (24-hr avg)	--	2 NTU (24-hr avg) 5 NTU (single reading max.)
TSS	< 10 mg/L (30-day avg)	--	30 mg/L (30-day avg) 45 mg/L (7-day avg)
TN	7 mg/L (monthly average)	8 mg/L (5-month rolling geometric mean)	10 mg/L (5-month rolling geometric mean)
E. coli (1)(2)	Non-detectable	--	15 cfu per 100 mL (single sample max) (1) Non-detectable in 4 out of 7 daily samples (1) 126 cfu per 100 mL (2) (monthly geometric mean)
Fecal Coliform (3)	Non-detectable	--	Non-detectable in 4 out of 7 daily samples 23 cfu or MPN per 100 mL (single sample max)
Total Residual Chlorine (2)	Varies depending on end use	--	9 µg/L (monthly avg) 18 µg/L (daily max)
Total Dissolved Solids	--	--	Not regulated

Notes:
(1) Based on Aquifer Protection Permit (APP No. P-105443, Section 4.2, Tables 1A and 1B).
(2) Based on AzPDES Permit No. AZ0025241 limits for discharge to EMF.
(3) The plant APP does not have requirements for fecal coliform. The limits listed in this table are per Class A+ and BADCT requirements.

3.5 Liquids Treatment Processes

The existing liquids treatment processes that will be expanded in Phase III by adding parallel treatment trains and/or units include influent screening and pumping, primary sedimentation and primary sludge and scum pumping, aeration basins, secondary clarifiers and associated RAS and scum pumping, and effluent pumping. The existing cloth media disk filters will be expanded with the addition of new cloth disk media filters of a different manufacturer. The existing UV disinfection system will be decommissioned and mothballed, and replaced with chlorine disinfection using bulk sodium hypochlorite.

The Phase III Expansion components and design criteria for the liquids treatment processes are presented in the following sections. The design criteria were established in the various DIMs and TMs listed in Table 3.6 (which are included as Appendices to this Design Report).

Table 3.6 Liquids Treatment Processes Design Criteria References

Treatment Process	Design Information Memoranda	Technical Memoranda
Headworks Facilities	• DIM-03 – Headworks Facilities	• TM-5A – Preliminary and Primary Treatment Facilities • TM-7D – Miscellaneous Improvements - Headworks, Effluent Emergency Bypass, and Aeration Basins
Primary Sedimentation Facilities and Primary Sludge/Scum Pumping Facilities	• DIM-05 – Primary Sedimentation Facilities	• TM-5A – Preliminary and Primary Treatment Process Evaluation • TM-6 – Solids Stream Treatment Process Evaluation
Secondary BNR Facilities, including Aeration Basins, Blowers, Diffused Aeration, Mixers and MLR Pumping Facilities	• DIM-06 – Secondary BNR Facilities	• TM-5B – Secondary Treatment Process Evaluation • TM-7D – Miscellaneous Improvements - Headworks, Effluent Emergency Bypass, and Aeration Basins
Secondary Clarification and Return Activated Sludge Pumping Facilities	• DIM-06 – Secondary BNR Facilities	• TM-5B – Secondary Treatment Process Evaluation
Tertiary Filtration Facilities	• DIM-08 – Tertiary Filtration Facilities	• TM-5C – Tertiary Treatment Process Evaluation
Disinfection/ Dechlorination Facilities	• DIM-09 – Disinfection Facilities	• TM-5C – Tertiary Treatment Process Evaluation
Effluent Pumping Facilities	• DIM-10 – Effluent Pumping Facilities	• TM-2 – Reclaimed Water Strategies • TM-5D – Reclaimed Water Pumping and Storage Process Evaluation

3.5.1 Headworks Facilities

The headworks facilities will be expanded to provide the additional screening and pumping capacities required to handle Phase III flows. New screens and pumps will be installed in new Headworks Building No. 2 (HW-2), located north of the existing Headworks Building No. 1 (HW-1), as described below.

- Provide two new 1/4-inch screens (with a nominal capacity of 32 mgd each) and two new 16 mgd pumps. One existing pump from HW-1 will be relocated to HW-2, for a total of three pumps in HW-2. This will provide firm (and matching) screening/pumping capacities of 32 mgd/32 mgd in HW-2.
- Equip each of the two new screens with a dedicated washer-compactor and screw conveyor, which matches the technology of the existing screenings handling equipment.
- Provide a glycol-based closed-loop cooling system for the two new pumps.
- Provide a new 42-inch inline ultrasonic flowmeter on the common discharge header from the HW-2 pumps.
- Construct the entire subgrade structure and building required to accommodate buildout flows; this consists of three screening channels, one bypass channel, and an influent pump station (IPS) (with dual wet wells/dry pit configuration) with space for up to five pumps.

No major changes are proposed to the equipment in HW-1, although some minor modifications are planned, as described below.

- Stay with the two existing 1/2-inch screens; however, operate the screens with an increased downstream water level, which will result in a nominal capacity of 32 mgd per screen. With one 16 mgd pump relocated to HW-2, firm (and matching) screening/pumping capacities of 32 mgd/32 mgd will be provided in HW-1.
- Install a new 48-inch sluice gate to provide the ability to isolate HW-1 by closing the 48-inch pipeline that conveys influent to the screening channels.
- Retrofit the four existing pumps with a non-potable water (NPW) cooling system (including the one pump that will be relocated to HW-2).

Note that no changes will be made to the existing grit removal system; the system has sufficient capacity to handle Phase III flows.

The design criteria for the headworks facilities are presented in Table 3.7.

Table 3.7 Headworks Facilities Design Criteria

Parameter	Units	Phase II	Phase III	Buildout
Influent Screening				
Number of Channels	--	4	8	8
Channel Dimensions				
Width, HW-1	ft	4.5	4.5	4.5
Depth, HW-1	ft	8.0	8.0	8.0
Width, HW-2	ft	N/A	4.5	4.5
Depth, HW-2	ft	N/A	13.0	13.0
Downstream Water Level, HW-1	ft	6 (design max)	3.7	3.7
Downstream Water Level, HW-2	ft	N/A	5.0	5.0
Type of Bar Screen	--	Catenary Chain Drive	Catenary Chain Drive	Catenary Chain Drive
Rake Orientation	--	Front-Clean	Front-Clean	Front-Clean
Number of Screen Units				
Duty	--	1	3	4
Standby	--	1	1	1
Total	--	2	4	5
Bar Spacing	in	1/2	1/4, 1/2	1/4, 1/2
Screen Design Capacity, each	mgd	--	32	32
Volume of Screenings/Bar Screen (at Design Capacity)				
Wet, 1/2-inch Screen	cfd	253 (1)	253 (1)	253 (1)
Wet, 1/4-inch Screen	cfd	--	493 - 640 (2)	493 - 640 (2)
Dewatered, 1/2-inch Screen (70% Reduction)	cfd	76	76	76
Dewatered, 1/4-inch Screen (70% Reduction)	cfd	--	148 - 192	148 - 192
Headloss through Screen (at Design Capacity)				
1/2-inch, 20% Blinded, HW-1	in	--	5.2	TBD
1/4-inch, 20% Blinded, HW-2	in	N/A	5.9	TBD
Screen Motor Horsepower	hp	0.5	0.5	0.5
Type of Washer-Compactor	--	Screw Press	Screw Press	Screw Press
Number of Washer-Compactors				
Duty	--	1	3	4
Standby	--	1	1	1
Total	--	2	4	5

Table 3.7 Headworks Facilities Design Criteria

Parameter	Units	Phase II	Phase III	Buildout
Washer-Compactor Motors, Horsepower	hp	5.0, 8.0	5.0, 8.0	5.0, 8.0
Type of Screenings Conveyor	--	Shaftless Screw	Shaftless Screw	Shaftless Screw
Number of Screenings Conveyors				
Duty	--	1	3	4
Standby	--	1	1	1
Total	--	2	4	5
Screenings Conveyor Motor Horsepower	hp	7.5	7.5	7.5
Influent Pumping				
Type of Pump	--	Submersible Dry-Pit Centrifugal	Submersible Dry-Pit Centrifugal	Submersible Dry-Pit Centrifugal
Number of Pumps				
Duty	--	3	5	7
Standby	--	1	1	1
Total	--	4	6	8
Pump Design Capacity, each	gpm	11,111	11,111	11,111
Total Dynamic Head	ft	65	65	65
Pump Controller Type	--	VFD	VFD (3)	VFD
Motor Horsepower	--	230	230	230
Influent Flow Metering				
Type of Meter	--	Ultrasonic	Ultrasonic	Ultrasonic
Number of Units	--	1	2	2
Diameter	in	36	36, 42	36, 42
Grit Traps (5)				
Type of System	--	Mechanically Induced Vortex	Mechanically Induced Vortex	Mechanically Induced Vortex
Tank Diameter	ft	18	18	18
Design Capacity, each	mgd	30	30	30
Design Headloss through Chamber	ft	0.25	0.25	0.25
Number of Units @ AADF				
Duty	--	1	1	3
Standby	--	1	1	1
Total	--	2	2	4

Table 3.7 Headworks Facilities Design Criteria

Parameter	Units	Phase II	Phase III	Buildout
Number of Units @ PHF				
Duty	--	2	2	4
Standby	--	0	0	0
Total	--	2	2	4
Grit Pumping (5)				
Type of Pump	--	Torque Flow Recessed Impeller	Torque Flow Recessed Impeller	Torque Flow Recessed Impeller
Number of Pumps				
Duty	--	1	1	3
Standby	--	1	1	1
Total	--	2	2	4
Pump Design Capacity, each	gpm	250	250	250
Total Dynamic Head	ft	43	43	TBD
Pump Controller Type	--	Constant	Constant	Constant
Grit Washing (Cyclone Separator and Grit Classifier) (4)				
Type of Separator	--	Hydrocyclone	Hydrocyclone	Hydrocyclone
Number of Grit Separators				
Duty	--	1	1	1
Standby	--	1	1	1
Total	--	2	2	2
Capacity Per Unit	gpm	250	250	250
Design Solids Content of Grit	%	5 - 15	5 - 15	5 - 15
Type of Grit Classifier	--	Inclined Screw	Inclined Screw	Inclined Screw
Number of Grit Classifiers				
Duty	--	1	1	1
Standby	--	1	1	1
Total	--	2	2	2

Notes:
(1) Estimated maximum screenings capture per MG is 7.9 cubic feet (cf) for 1/2 inch bar spacing, per WEF MOP 8, 2010.
(2) Estimated maximum screenings capture per MG is 15.4-20 cf for 1/4-inch bar spacing, per screen and washer compactor manufacturers (Duperon Corporation and Huber Technology respectively).
(3) A new VFD will be provided for the existing pump that is relocated from HW-1 to HW-2.
(4) No change anticipated for Phase III Expansion.

3.5.2 Primary Sedimentation Facilities

A new 140-foot diameter Primary Sedimentation Basin No. 3 will be constructed in Phase III, similar in size and configuration to the two existing basins. Some of the main features of the new basin include a collector mechanism with spiral collectors on each arm, a half-bridge to access the collector drive, and a scum arm, scum beach, and scum pit for removing floating solids. The new basin will be covered and provided with odor control measures, similar to the existing basins.

A new Primary Sludge Pump Station No. 2 will be constructed to house the primary sludge and scum pumps for Primary Sedimentation Basin No. 3 and future Primary Sedimentation Basin No. 4, and is described in Section 3.6.1. Additionally, the existing primary sludge pumps for the existing primary sedimentation basins will be modified to facilitate pumping to the new sludge screens; these modifications are also described in Section 3.6.1.

The design criteria for the primary sedimentation basins are presented in Table 3.8.

Table 3.8 Primary Sedimentation Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Type of Basin	--	Circular, with Cover	Circular, with Cover	Circular, with Cover
Clarifier Mechanism	--	Circular, Spiral Blades with Influent Well/Energy Dissipating	Circular, Spiral Blades with Influent Well/Energy Dissipating	Circular, Spiral Blades with Influent Well/Energy Dissipating
Drive Motor Horsepower	hp	3	3	3
Number of Basins				
Duty	--	1	2	4
Standby	--	1	1	1
Total	--	2	3	5
Basin Dimensions				
Interior Wall-to-Wall Diameter	ft	140	140	140
Inboard Launder Weir-to-Weir Diameter	ft	132	132	132
Side Water Depth	ft	14.5	14.5	14.5
Center Depth	ft	19.83	19.83	19.83
Freeboard	ft	3.5	3.5	3.5
Volume				
Each Basin	gal	1,875,000	1,875,000	1,875,000
All Basins	gal	3,750,000	5,625,000	9,375,000

Table 3.8 Primary Sedimentation Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Surface Area				
Each Basin	sf	15,400	15,400	15,400
All Basins	sf	30,800	46,200	77,000
Weir Type	--	Single Inboard	Single Inboard	Single Inboard
Weir Length				
Each Basin	ft	414.7	414.7	414.7
All Basins	ft	829.4	1,244.1	2,073.5
Hydraulic Retention Time (at AADF)				
All Basins in Service	hrs	5.6	4.5	4.0
One Basin Out-of-Service	hrs	2.8	3.0	3.2
Hydraulic Retention Time (at MMADF)				
All Basins in Service	hrs	3.8	4.1	3.7
One Basin Out-of-Service	hrs	1.9	2.7	2.9
Hydraulic Retention Time (at PDF)				
All Basins in Service	hrs	2.8	3.5	3.1
One Basin Out-of-Service	hrs	1.4	2.3	2.5
Hydraulic Retention Time (at PHF)				
All Basins in Service	hrs	1.9	2.3	2.0
One Basin Out-of-Service	hrs	0.9	1.5	1.6
Surface Overflow Rate (at AADF) (1)				
All Basins in Service	gpd/sf	520	650	728
One Basin Out-of-Service	gpd/sf	1,039	974	909
Surface Overflow Rate (at MMADF)				
All Basins in Service	gpd/sf	780	715	800
One Basin Out-of-Service	gpd/sf	1,559	1,072	1,000
Surface Overflow Rate (at PDF) (2)				
All Basins in Service	gpd/sf	1,039	844	946
One Basin Out-of-Service	gpd/sf	2,079	1,267	1,182
Surface Overflow Rate (at PHF) (3)				
All Basins in Service	gpd/sf	1,559	1,299	1,455
One Basin Out-of-Service	gpd/sf	3,118	1,949	1,819
Weir Loading (at AADF)				
All Basins in Service	gpd/ft	19,291	24,114	27,007
One Basin Out-of-Service	gpd/ft	38,582	36,171	33,759

Table 3.8 Primary Sedimentation Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Weir Loading (at MMADF)				
All Basins in Service	gpd/ft	28,937	26,525	29,708
One Basin Out-of-Service	gpd/ft	57,873	39,788	37,135
Weir Loading (at PDF)				
All Basins in Service	gpd/ft	38,582	31,348	35,110
One Basin Out-of-Service	gpd/ft	77,164	47,022	43,887
Weir Loading (at PHF) (4)				
All Basins in Service	gpd/ft	57,873	48,228	54,015
One Basin Out-of-Service	gpd/ft	115,746	72,341	67,519

Notes:
(1) ADEQ Bulletin No. 11: 800 gpd/sf. 10-State Standards: 1,000 gpd/sf, both at average day flow.
(2) ADEQ Bulletin No. 11: 700 to 1,000 gpd/sf at "peak loading." Peak interpreted as peak day.
(3) 10-States Standards: 1,500-2,000 gpd/sf at peak hour flow.
(4) ADEQ Bulletin No. 11: 15,000 gpd/lf. 10-States Standards: 30,000 gpd/lf.

3.5.3 Secondary BNR Facilities

The secondary BNR facilities include the aeration basins and secondary clarifiers (and related appurtenances, splitter structures and pumping systems). For Phase III, parallel treatment trains will be added to the existing facilities. The major additions and/or modifications to the secondary BNR facilities are summarized below.

Aeration Basin Influent Splitter Structure

Currently, there is no dedicated aeration basin influent flow splitter structure; the aeration basin influent (effluent from the primary sedimentation basins) is sent to a common influent channel serving Aeration Basins No. 1 and No. 2, from where it splits to the two basins. A new aeration basin influent splitter structure will be constructed in Phase III, as described below.

- Construct a new aeration basin influent splitter structure to divide primary sedimentation basin effluent flow equally between the four aeration basins in Phase III, and ultimately between five aeration basins at Buildout.
- Construct the new splitter structure integral with the two new aeration basins (No. 3 and No. 4). The structure shall be hydraulically connected to the existing aeration basins influent junction box.

Aeration Basins

The two existing aeration basins (No. 1 and No. 2) are designed to operate in a two-stage MLE configuration, with a CaRRB zone inside the basins. For Phase III, two new aeration basins (No. 3 and No. 4) will be constructed. Further, for Phase III, a change in the aeration basins process configuration is proposed from the existing MLE configuration to 4-stage Bardenpho™, for process stability, while maintaining the ability to operate under the MLE configuration. The CaRRB process implemented in Phase II, to provide centrate treatment and alleviate the nitrogen load from the centrate stream on the secondary treatment process will be maintained. Additional modifications proposed in Phase III include providing an increased total MLR pumping capacity of up to 500 percent (5Q) of the design MMADF and a change from coarse bubble to fine bubble diffuser technology.

For Phase III, the following modifications will be required to the two existing aeration basins to match the process configuration outlined above.

- Subdivide Zone 7 into two volumes, Zones 7 and 8 using a baffle wall, to implement 4-stage Bardenpho™. Equip Zone 7 as a swing zone with a new mechanical mixer and diffusers to allow operational flexibility between MLE and 4-stage Bardenpho™. Equip Zone 8 as a dedicated aeration zone with diffusers.
- Maintain the existing MLR pump configuration in the basins, which consists of pumping MLR from either Zone 6 or Zone 7 to any one of Zones 1 to 4; this arrangement allows operating in either 4-Stage Bardenpho™ or MLE process configurations. Upsize each of the MLR pumps to a capacity of 14,300 gpm (20.6 mgd); provide new VFDs for the upsized pumps.
- Change the existing coarse bubble diffusers to fine bubble diffusers.
- Stay with the existing deck-mounted, vertical-shaft propeller mixer type; alternative manufacturers of this same mixer type shall be considered for the design.

For Phase III, two new Aeration Basins No. 3 and No. 4 will be constructed with a layout based on a 4-stage Bardenpho™ configuration, and with the following design features.

- Install two new MLR pumps per basin, both equipped with VFD motors. Each pump shall have a capacity of 14,300 gpm (20.6 mgd).
- Install fine bubble diffusers.
- A total of five mixers are required in each of the two new aeration basins, in Zones 1, 2, 3, 4, and 7 of each basin.

As it relates to the aeration system, the existing single-stage centrifugal aeration blowers have sufficient capacity to cover the Phase III process air demands with no modifications, and as such, no changes to the existing blower infrastructure will be required. Minor programming adjustments will be needed to account for the slightly higher system pressure due to the higher headloss of the fine bubble diffusers. The Master Control Panel (MCP) for the aeration blowers will need to be expanded and upgraded to account for the additional airflow control valves, air flowmeters, and dissolved oxygen (DO) and ammonia (NH_4-N) probes in the new Aeration Basins No. 3 and No. 4.

The design criteria for the aeration basins are presented in Table 3.9.

Table 3.9 Aeration Basins Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Process Configuration	--	MLE Process	4-Stage Bardenpho™ Process	4-Stage Bardenpho™ Process
Number of Basins				
Duty	--	2	4	5 (1)
Standby	--	0	0	0
Total	--	2	4	5 (1)
Total CaRRB Volume (operating)	MG	0.55	1.11	1.38
Total 1st Stage Anoxic Volume (operating)	MG	4.87	9.73	12.17
Total 1st Stage Aerobic Volume (operating)	MG	5.44	7.25	9.06
Total 2nd Stage Anoxic Volume (operating)	MG	--	2.52	3.15
Total 2nd Stage Aerobic Volume (operating)	MG	--	1.11	1.38
Total Volume	MG	10.86	21.72	27.15
Fraction of Total Volume				
CaRRB Fraction	--	0.05	0.05	0.05
Anoxic Fraction (2)	--	0.45	0.56	0.56
Aerobic Fraction	--	0.50	0.39	0.39
Mixed Liquor Suspended Solids (MLSS) Concentration	mg/L	2,500	3,350-3,700	3,000-3,300
Hydraulic Retention Time (at Max. Month)	hrs	10.9	15.8	10.6
Solids Retention Time (at Max. Month)	days	7.2	9.7	7.1
Minimum Water Temperature	deg C	20	20	20
Aerobic Zones				
Number of Basins	--	2	4	5
Number of Zones per Basin	--	3	3	3
Total Operating Zones	--	6	12	15
Internal Zone Identification Number	--	5, 6 & 7	5, 6 & 8	5, 6 & 8
Total Aerobic Volume	MG	5.44	8.36	10.45

Table 3.9 Aeration Basins Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Anoxic Zones				
Number of Basins	--	2	4	5
Number of Zones per Basin	--	1	1	1
Total Operating Zones	--	2	4	5
Internal Zone Identification Number	--	3	3	3
Total Anoxic Volume	MG	1.62	3.24	4.06
Anoxic/Aerobic "Swing" Zones				
Number of Basins	--	2	4	5
Number of Zones per Basin	--	1	2	2
Total Operating Zones	--	2	8	10
Internal Zone Identification Number	--	4	4 & 7	4 & 7
Total Swing Zone Volume	MG	1.62	5.76	7.20
CaRRB/Anoxic "Swing" Zones				
Number of Basins	--	2	4	5
Number of Zones per Basin	--	2	2	2
Total Operating Zones	--	4	8	10
Internal Zone Identification Number	--	1 & 2	1 & 2	1 & 2
Total CaRRB Swing Zone Volume	MG	2.18	4.35	5.44
Mixers				
Mixer Type	--	Propeller	Propeller	Propeller
Mount Type	--	Deck	Deck	Deck
Number per Zone	--	1	1	1
Total Number of Mixers per Basin	--	4	5	5
Horsepower, Small Unit	hp	10	10	10
Horsepower, Large Unit	hp	30	30	30
Controller Type	--	Constant	Constant	Constant
Diffused Aeration				
Type of Diffuser	--	Coarse Bubble	Fine Bubble	Fine Bubble
Number of Units				
Number of Diffusers per Basin	--	1,512	5,360	5,360
Total Number of Diffusers	--	3,024	21,440	26,800
Total Process Air Requirements (at Max. Month)	scfm	38,437	36,000	TBD
Depth of Submergence	ft	22.8	21.8	TBD
Pressure at Blower Discharge	psig	10.4	10.6	TBD

Table 3.9 Aeration Basins Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Aeration Blowers				
Type of Blower	--	Single-Stage Centrifugal	Single-Stage Centrifugal	Single-Stage Centrifugal
Number of Blowers				
Duty	--	3	3	TBD
Standby	--	1	1	TBD
Total	--	4	4	TBD
Blower Design Capacity, each	scfm	38,437	38,437	TBD
Blower Discharge Pressure	psig	10.4	10.6	TBD
Controller Type	--	Constant	Constant	TBD
Motor Horsepower	hp	700	700	TBD
Mixed Liquor Recycle (MLR) Pumping				
Type of Pump	--	Axial	Axial	Axial
Number of Pumps				
Duty per Basin	--	2	2	2
Standby per Basin	--	0	0	0
Total per Basin	--	2	2	2
Total	--	4	8	10
Pump Design Capacity, each	gpm	7,000	14,300	14,300
Pump Controller Type	--	Constant	VFD	VFD
Motor Horsepower	hp	15	40	40

Notes:

(1) Based on implementing chemically enhanced primary treatment (CEPT) or other intensification processes at buildout to further reduce the loadings to the aeration basins, for buildout conditions.

(2) First and second stage anoxic volume is included.

Secondary Clarification and Return Activated Sludge

Three new secondary clarifiers and a new RAS/Scum Pump Station No. 2 are proposed for the Phase III Expansion. Additionally, the existing Mixed Liquor Splitter Structure and RAS/Centrate Splitter Structure will be expanded to accommodate the overall expansion to the secondary BNR facilities, as described below.

Mixed Liquor Splitter Structure

- Expand the existing Mixed Liquor Splitter Structure to the north to accept mixed liquor flow from the two new aeration basins, and provide capability to split to up to eight secondary clarifiers (seven total in Phase III and a future eighth). Provisions (including starter walls, waterstop and isolation gates) will also be included for future Aeration Basin No. 5 and Secondary Clarifier Nos. 9-12.
- The combined structure will have the ability to operate as one unit and split combined mixed liquor flow from the four aeration basins equally between up to eight secondary clarifiers. Isolation gates built in Phase II also provide the ability to operate as two parallel plants (Phase II and Phase III plants).

Secondary Clarifiers

- Add three new 120-foot diameter circular secondary clarifiers, i.e. Secondary Clarifier Nos. 5, 6, and 8, matching the dimensions and features of the existing clarifiers. NOTE: The fourth new clarifier (Secondary Clarifier No. 7) will be deferred to a future phase.
- Match the new secondary clarifier equipment and features with the existing secondary clarifiers (sludge and scum removal mechanisms, dome covers, etc.).

RAS/Scum Pump Station

- Construct new RAS/Scum Pump Station No. 2, with four new RAS pumps (three duty plus one standby) to serve the three new secondary clarifiers. Space and provisions for a fifth RAS pump shall be accommodated.
- The new RAS pumps shall have a larger capacity as compared to the existing RAS pump capacity (4.3 mgd versus 3.06 mgd).
- Add two new scum pumps (one duty plus one standby) in new RAS/Scum Pump Station No. 2.
- No modifications are proposed to the existing RAS/Scum Pump Station No. 1. Upsizing the existing five RAS pumps to match the new larger RAS pumps may be deferred as an interim project, as plant flows increase in the future.

RAS/Centrate Splitter Structure

- Expand the existing RAS/Centrate Splitter Structure to the north to accept the additional RAS flow and centrate flow for Phase III, and split to the four aeration basins (expansion for the two new aeration basins). Provisions (including starter walls and waterstop) will also be included for future Aeration Basin No. 5 and future RAS and centrate feeds.
- The structure shall split the combined RAS flow equally between the four aeration basins using fixed weirs. The structure shall be modified with an additional centrate splitter channel with fixed weirs, which will split combined thickening and dewatering centrate flow equally to the four aeration basins, as noted in Section 3.6.5.

The design criteria for the secondary clarifiers and RAS pumps are presented in Table 3.10. Note that the design criteria for the secondary scum pumps are presented in Section 3.6.1, as part of the solids treatment processes.

Table 3.10 Secondary Clarification and RAS Pumping Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Secondary Clarifiers				
Type of Basin	--	Circular	Circular	Circular
Number of Basins				
Duty	--	3	6	11
Standby	--	1	1	1
Total	--	4	7	12
Basin Dimensions				
Interior Wall-to-Wall Diameter	ft	120	120	120
Side Water Depth	ft	15	15	15
Freeboard	ft	2.5	2.5	2.5
Weir Type	--	Single Inboard	Single Inboard	Single Inboard
Volume				
Each Basin	MG	1.27	1.27	1.27
One Basin Out of Service	MG	3.81	7.62	13.97
All Basins	MG	5.08	8.89	15.24
Surface Area				
Each Basin	sf	11,300	11,300	11,300
One Basin Out of Service	sf	33,900	67,800	124,300
All Basins	sf	45,200	79,100	135,600
Weir Length				
Each Basin	ft	377	377	377
One Basin Out of Service	ft	1,131	2,262	4,147
All Basins	ft	1,508	2,639	4,524
Type of Sludge Removal	--	Hydraulic Suction	Hydraulic Suction	Hydraulic Suction
Type of Scum Removal	--	Scum Beach	Scum Beach	Scum Beach
Mechanism Drive Motor Horsepower	hp	2	2	2

Table 3.10 Secondary Clarification and RAS Pumping Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Hydraulic Retention Time				
At Average Day Flow				
All Basins	hrs	7.6	7.1	6.5
One Basin Out-of-Service	hrs	5.7	6.1	6.0
At Max. Month Flow				
All Basins	hrs	5.1	6.5	5.9
One Basin Out-of-Service	hrs	3.8	5.5	5.4
Surface Overflow Rate				
At Average Day Flow				
All Basins	gpd/sf	354	379	413
One Basin Out-of-Service	gpd/sf	472	442	451
At Max. Month Flow				
All Basins	gpd/sf	531	417	454
One Basin Out-of-Service	gpd/sf	708	487	496
Weir Loading				
At Average Day Flow				
All Basins	gpd/sf	10,610	11,368	12,378
One Basin Out-of-Service	gpd/sf	14,147	13,263	13,504
At Max. Month Flow				
All Basins	gpd/sf	15,915	12,505	13,616
One Basin Out-of-Service	gpd/sf	21,220	14,589	14,854
Return Activated Sludge (RAS) Pumping				
Type of Pump	--	Screw Centrifugal	Screw Centrifugal	Screw Centrifugal
Number of Pumps	--			
Duty	--	4	7	12
Standby	--	1	2	3
Total	--	5	9	15
Pump Design Capacity, each	gpm	2,125	2,125 (PS No. 1) [(1)]; 2,976 (PS No. 2)	3,240
Pump Controller Type	--	VFD	VFD	VFD
Motor Horsepower	hp	15	15 (PS No. 1) 30 (PS No. 2)	30

Note:

(1) RAS pumps in RAS/Scum Pump Station No. 1 to be replaced with 2,976 gpm pumps at the end of their useful life.

3.5.4 Tertiary Filtration and Chemical Feed Facilities

The existing tertiary filtration and chemical feed facilities consists of six inside-out Kruger Hydrotech Diskfilters and an aluminum sulfate (alum) storage and feed facility for standby filter aid. Due to the performance and operational issues with the existing filters experienced at the plant, the use of the existing filters will be discontinued in Phase III. AquaDisk® filters (manufactured by Aqua-Aerobic Systems), which are outside-in cloth media disk filters, will be installed for the Phase III Expansion. The existing filters will be kept installed but remain offline. The new AquaDisk® filters will service the entire plant upon the completion of the Phase III Expansion.

Some of the main design features related to the tertiary filters include the extension of the existing shade canopy over the existing filter/UV area further to the west, to cover the new filters and backwash pump gallery areas. Additionally, the existing bridge crane will be extended to the west, over the new filters and new monorails will be provided over the pump gallery areas.

The existing filter aid coagulant (aluminum sulfate) storage and feed system will remain in service. No modifications or additions to the system are required. To meet the increased feed pumping capacity that will be needed in Phase III, the two existing feed pumps, which currently operate in duty/standby mode, will both be operated as duty pumps, with no redundant pump. Additionally, the alum feed line will be extended and new alum dosing points will be provided at the Mixed Liquor Splitter Structure and secondary clarifier launder(s) (i.e., at Secondary Clarifier Nos. 3 and 6) to improve current coagulation results.

The design criteria for the new filters are presented in Table 3.11.

Table 3.11 Tertiary Filtration and Chemical Feed Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Tertiary Filters				
Type of Filter	--	Cloth Media Kruger	Cloth Media AquaDisk®	Cloth Media Kruger + AquaDisk®
Flow Mode	--	Inside-Out	Outside-In	--
Submergence	%	65	100	--
Design Hydraulic Loading				
Average	gpm/sf	3	3	3
Maximum	gpm/sf	6	6	6
No. of Filter Cells				
Duty	--	5	7 (1)	13 (1)
Standby	--	1	1	1
Total	--	6	8 (1)	14 (1)
Disks per Filter Cell	--	10	14	14
Disk Diameter	ft	--	6.9	6.9

Table 3.11 Tertiary Filtration and Chemical Feed Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Effective/Submerged Filtration Area				
per Disk	sf	62.9	53.8	53.8
per Filter Cell	sf	629	753	753
Total Installed	sf	3,775	6,026 (1)	10,545 (1)
Filter Cell Basin Dimensions, each				
Length x Width	ft x ft	20.25 x 12.5	20.25 x 12.5	20.25 x 12.5
Depth	ft	11	14.2	14.2
Design Hydraulic Loading Rate				
AADF, All In Service	gpm/sf	2.9	3.9 (2)	4.1 (2)
AADF, One Unit Out of Service	gpm/sf	3.5	4.4 (2)	4.4 (2)
PDF, All In Service	gpm/sf	5.9	4.9 (2)	5.2 (2)
PDF, One Unit Out of Service	gpm/sf	7.1	5.6 (2)	5.6 (2)
PHF, All In Service	gpm/sf	8.8	7.4 (2)	7.8 (2)
Maximum Allowed Headloss (3)	inches	--	16-18	16-18
Filter Coagulant Storage and Feed				
Coagulant	--	Aluminum Sulfate	Aluminum Sulfate	Aluminum Sulfate
Dosage	mg/L	15-50	15-50	15-50
Feed Rate	gph	4-52	8-100	16-200
System Control	--	Flow Paced	Flow Paced	Flow Paced
Application Point	--	Filter Influent Junction Structure	Filter Influent Junction Structure, Secondary Clarifier Effluent Launders, Mixed Liquor Splitter Structure	Filter Influent Junction Structure, Secondary Clarifier Effluent Launders, Mixed Liquor Splitter Structure
Feed Pumps				
Type	--	Diaphragm	Diaphragm	TBD
Number of Pumps, Duty/Standby Configuration	--	1+1	2+0	1+1
Pump Design Capacity, each	gph	60	60 (Existing)	240 (New)

Table 3.11 Tertiary Filtration and Chemical Feed Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Storage Tank				
Type	--	FRP	FRP	FRP
Number of Tanks	--	1	1 (Existing)	1 (Existing)
Volume	gal	12,500	12,500	12,500
Diameter	ft	12	12	12

Notes:
(1) Design for Aqua-Aerobic PES-13 cloth media not to exceed the 2007 CDPH approved loading rate 6 gpm/sf under peak day flow condition, including plant internal recycle flow.
(2) Values for new AquaDisk® filters only, existing filters are NOT in service. Assume the existing Hydrotech Discfilters remain available to be in service under peak flow conditions.
(3) Allowed headloss is controlled by backwash initiate level.

3.5.5 Disinfection Facilities

In Phase III, the use of the existing UV disinfection system will be discontinued, and disinfection of effluent will be through chlorination provided using bulk sodium hypochlorite. The existing UV system will be decommissioned and mothballed in place.

Chlorine Disinfection System

Two new CCBs will be constructed south of the existing UV/filter area to provide sufficient contact time for disinfection. The influent and effluent channels of the CCBs will be connected to the existing filter effluent channel and existing UV effluent channel, respectively, to allow filtered effluent to flow to the CCBs and then on to the existing EPS.

A new bulk sodium hypochlorite storage and feed facility, consisting of chemical storage tanks and a pressurized closed-loop chemical feed system, will be constructed for primary disinfection; and located in new Bulk Chemical Storage Area No. 4.

The existing bulk sodium hypochlorite storage and feed facility located next to the tertiary filters in Bulk Chemical Storage Area No. 2 will continue to be utilized for miscellaneous chlorine applications throughout the plant; note that the existing system will be modified to add a feed point to the aeration basins to aid in Nocardia control.

The design criteria for the new chlorine disinfection system are presented in Table 3.12.

Table 3.12 Disinfection Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Chlorine Contact Basins				
Number of Basins	--	--	2	4
Number of Passes per Basin	--	--	5	5
Pass Length	ft	--	85	85
Pass Width	ft	--	10	10
Water Depth	ft	--	11.5	11.5
Capacity (below freeboard)				
per Basin	MG	--	0.37	0.37
Common Effluent Channel	MG	--	0.10	0.18
Total	MG	--	0.84	1.64
Modal Contact Time				
AADF	min	--	33	35
MMADF	min	--	30	32
PDF	min	--	25	27
PHF	min	--	16	17
Chlorine Design Dose				
Minimum	mg/L	--	6	6
Average	mg/L	--	8	8
Maximum	mg/L	--	12	12
Disinfection Bulk Chemical Storage and Feed - Sodium Hypochlorite (1)				
Bulk Concentration				
Commercial	%	12.5	12.5	12.5
Design	%	--	10	10
Storage Tanks				
Type	--	FRP	FRP	FRP
Number of Tanks	--	1	4	8
Diameter	ft	12	12	12
Side Water Depth	ft	--	14.5	14.5
Straight Wall Height	ft	--	16	16
Volume, per Tank	gal	12,500	12,500	12,500
Total Tank Capacity	gal	12,500	50,000	100,000
Provided Storage Time				
AADF@ minimum dose	days	--	30	32
AADF@ average dose	days	--	23	24
MMADF@ average dose	days	--	21	22
MMADF@ maximum dose	days	--	14	15

Table 3.12 Disinfection Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Feed Pumps – Primary Disinfection (1)				
Application Point	--	Plant Water Reuse Water	CCBs	CCBs
Type	--	Diaphragm	Magnetic Drive Centrifugal	Magnetic Drive Centrifugal
Number of Pumps				
Duty	--	2	1	2
Standby	--	1	1	1
Total	--	3	2	3
Pump Design Capacity, each	gpm	0.33 (existing)	30	30
Flow Control	--	Flow Pace	Flow Pace Closed Loop (2)	Flow Pace Closed Loop (2)
Feed Pumps – Misc. Chlorination (1)				
Application Point	--	Mixed Liquor Splitter Structure, RAS/Centrate Splitter Structure, Filter Influent Junction Structure, Filters, Aeration Basins		
Type	--	Diaphragm	Diaphragm	TBD
Number of Pumps				
Duty	--	1	2	TBD
Standby	--	1	0	TBD
Total	--	2	2	TBD
Pump Design Capacity, each	gph	20 (existing)	20 (existing)	TBD
Flow Control	--	Manual	Manual	Manual

Notes:
(1) In Phase III, the existing sodium hypochlorite storage and feed system will no longer serve primary disinfection, but will remain in service for miscellaneous chlorination applications throughout the plant. The four new sodium hypochlorite tanks and two new pumps will serve primary disinfection for use in the CCBs.
(2) Closed pressure loop uses control valve and flowmeter for flow control.

Dechlorination

The plant does not currently have a dechlorination facility. A new sodium bisulfite storage and feed facility will be constructed in Phase III in Bulk Chemical Storage Area No. 4 to provide dechlorination of the plant effluent flow prior to intermittent discharge to the EMF (as necessary). The dechlorination will meet the total residual chlorine limits (9 µg/L monthly average, 18 µg/L daily maximum) required in the current AzPDES permit (No. AZ0025241). Dechlorination will be achieved (when necessary) by feeding sodium bisulfite at the EPS, downstream of the influent weir.

The design criteria for the dechlorination facilities are provided in Table 3.13.

Table 3.13 Dechlorination Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Dechlorination Chemical	--	--	Sodium Bisulfite	Sodium Bisulfite
Bulk Concentration	% wt		25	25
Sodium Bisulfite to Chlorine Ratio	--	--	1.46	1.46
Design Total Chlorine Residual				
Minimum	mg/L	--	2	2
Average	mg/L	--	4	4
Maximum	mg/L	--	8	8
Storage Tanks				
Type	--	--	FRP	FRP
Number of Tanks	--	--	1	2
Diameter	ft	--	12	12
Side Water Depth	ft	--	14.5	14.5
Straight Wall Height	ft	--	16	16
Volume, per Tank	gal	--	12,500	12,500
Total Tank Capacity	gal	--	12,500	25,000
Provided Storage Time				
AADF@ minimum dose	days	--	42	45
AADF@ average dose	days	--	21	22
MMADF@ average dose	days	--	19	20
MMADF@ maximum dose	days	--	10	10
Feed Pumps				
Application Point	--	--	Effluent Pump Station	
Type	--	--	Peristaltic	Peristaltic
Number of Pumps				
Duty	--	--	1	2
Standby	--	--	1	1
Total	--	--	2	3
Pump Design Capacity, each	gph	--	4 - 98	4 - 98
Flow Control	--	--	Flow Paced	Flow Paced

3.5.6 Effluent Pumping Facilities

The existing effluent pumping system provides pumping of both GWRP and SEWRP effluent [reclaimed water] and consists of an EPS equipped with seven vertical turbine pumps. Reclaimed water is pumped via 36-inch and 72-inch pipelines to several discharging locations including the GRIC receiving canal, the Gilbert South Recharge Area, the Gilbert 5-MG Reservoir and the EMF.

In Phase III, no major changes are proposed to the operation of the EPS. One new 12,000 gpm pump will be added in open slot No. 8 to accommodate the Phase III design peak hour flow under the condition where the SEWRP reclaimed water flow is pumped separately from the GWRP reclaimed water, without commingling the two waters. Note that the peak pumping requirement for the entire EPS including the 36-inch force main is 76 mgd; 60 mgd from the GWRP and an additional 16 mgd from the SEWRP. NOTE: Previous required peak flow capacity for SEWRP only was 24 mgd (established during Phase II Expansion).

In addition to the new pump, a few modifications will be made to the reclaimed water pipelines. There is an existing 42-inch gravity feed pipeline from the EPS wet well to the Gilbert 5-MG Reservoir which allows the reservoir to be partially filled and also has a branch line that can directly supply water to the Gilbert Reuse System pumps, if the reservoir is out of service. This gravity pipeline has been taken out of service due to leakage and settlement. Since that time, there is no way at present to directly feed the Gilbert Reuse System pumps. To restore direct reclaimed water feed to the reuse pumps, a new pipeline will be constructed from the existing 24-inch pressure line feeding the reservoir (off the 72-inch pipeline) that will tie in to the existing 42-inch pipeline, downstream of the damaged pipe.

The design criteria for the effluent pumps are presented in Table 3.14.

Table 3.14 Effluent Pumping Facilities Design Criteria

Parameter	Units	Phase II	Phase III	Buildout
Type of Pump	--	Vertical Turbine	Vertical Turbine	Vertical Turbine
Large Size Pumps				
Number of Pumps	--	3	4	TBD
Pump Design Capacity, each	gpm	12,000	12,000	TBD
Total Dynamic Head	ft	105	105	TBD
Pump Controller Type	--	VFD	VFD	VFD
Motor Horsepower	hp	400	400	TBD
Medium Size Pumps				
Number of Pumps	--	2	2	TBD
Pump Design Capacity, each	gpm	9,500	9,500	TBD
Total Dynamic Head	ft	105	105	TBD
Pump Controller Type	--	VFD	VFD	VFD
Motor Horsepower	hp	300	300	TBD

Table 3.14 Effluent Pumping Facilities Design Criteria

Parameter	Units	Phase II	Phase III	Buildout
Small Size Pumps				
Number of Pumps	--	2	2	TBD
Pump Design Capacity, each	gpm	6,000	6,000	TBD
Total Dynamic Head	ft	105	105	TBD
Pump Controller Type	--	VFD	VFD	VFD
Motor Horsepower	hp	200	200	TBD
Total Number of Pumps (all sizes)	--	7	8	TBD
Number of Empty Slots Available for Future Pumps	--	3	2	TBD

3.6 Solids Treatment Processes

The existing solids treatment processes, which include thickening, anaerobic digestion, and dewatering, will be expanded by adding parallel treatment trains and/or units. In general, no change in technology is proposed for these treatment processes; thickening and dewatering will be provided using centrifuges, while the digesters will continue to be operated in the CMAD mode, similar to existing facilities. In addition to expanding the existing processes to handle Phase III flows and loads, one new process will be added to the solids treatment train - screening of the primary sludge flow stream from GWRP, using sludge screens.

The Phase III Expansion components and design criteria for the solids treatment processes are presented in the following sections. The design criteria were established in the various TMs and DIMs listed in Table 3.15 (which are included as Appendices to this Design Report).

Table 3.15 Solids Treatment Processes Design Criteria References

Treatment Process	Design Information Memoranda	Technical Memoranda
Primary Sludge and Scum Pumping	• DIM-05 – Primary Sedimentation Facilities	• TM-3 – Solids and Digester Gas Management Strategies • TM-6 – Solids Stream Treatment Process Evaluation • TM-7E – Miscellaneous Improvements-Solids Handling
WAS and Secondary Scum Pumping	• DIM-06 – Secondary BNR Facilities	• TM-6 – Solids Stream Treatment Process Evaluation

Table 3.15 Solids Treatment Processes Design Criteria References

Treatment Process	Design Information Memoranda	Technical Memoranda
Sludge Blending and Mixing	--	• TM-6 – Solids Stream Treatment Process Evaluation • TM-7E – Miscellaneous Improvements-Solids Handling
Sludge Screening Facilities	• DIM-11B – Sludge Screening Facilities	• TM-3 – Solids and Digester Gas Management Strategies • TM-6 – Solids Stream Treatment Process Evaluation
Thickening Facilities	• DIM-11A – Solids Handling Facilities	• TM-3 – Solids and Digester Gas Management Strategies • TM-6 – Solids Stream Treatment Process Evaluation
Digestion Facilities	• DIM-11A – Solids Handling Facilities • DIM-12 – Digestion Facilities • DIM-13 – Digester Gas and Boiler Facilities	• TM-3 – Solids and Digester Gas Management Strategies • TM-6 – Solids Stream Treatment Process Evaluation • TM-7E – Miscellaneous Improvements-Solids Handling
Dewatering Facilities	• DIM-11A – Solids Handling Facilities	• TM-3 – Solids and Digester Gas Management Strategies • TM-6 – Solids Stream Treatment Process Evaluation

3.6.1 Sludge Pumping and Screening Facilities

The Phase III sludge pumping and screening facilities include new primary sludge and scum pumps for new Primary Sedimentation Basin No. 3, new WAS and secondary scum pumps for the new secondary clarifiers, and new primary sludge screens.

Primary Sludge and Scum Pumping

A new below-grade Primary Sludge Pump Station No. 2 will be constructed to house the new primary sludge and scum pumps for Primary Sedimentation Basin No. 3. The pump station will be sized to house three primary sludge pumps, with two pumps (one duty and one standby) installed in Phase III and space for a future third pump (for future Primary Sedimentation Basin No. 4). Two primary scum pumps (one duty and one standby) will also be installed, which is sufficient for Primary Sedimentation Basin No. 3 and future Primary Sedimentation Basin No. 4.

Additionally, in Phase III, the three existing primary sludge pumps that serve Primary Sedimentation Basins No. 1 and No. 2 will be de-rated to a lower capacity to facilitate pumping to the new sludge screens at a reduced flow rate but at more frequent intervals (to enhance screen performance), by making the following modifications.

- De-rate pumps from 300 gpm at 50 psi to 200 gpm at 30 psi.
- Provide the pumps with variable-speed capabilities by equipping them with new VFD drives.

The design criteria for the primary sludge and scum pumps are presented in Table 3.16.

Table 3.16 Primary Sludge and Scum Pumping Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Primary Sludge Pumps				
Type of Pump	--	Progressive Cavity	Progressive Cavity	Progressive Cavity
Number of Pumps				
Duty	--	2	3	5
Standby	--	1	2	3
Total	--	3	5	8
Pump Design Capacity, each (1)	gpm	300	200	200
Total Dynamic Head (1)	psi	50	30	30
Pump Controller Type	--	Constant	VFD	VFD
Motor Horsepower (1)	hp	30	30, 20	20
Primary Scum Pumps				
Type of Pump	--	Progressive Cavity	Progressive Cavity	Progressive Cavity
Number of Pumps				
Duty	--	1	2	3
Standby	--	1	2	3
Total	--	2	4	6
Pump Design Capacity, each	gpm	150	150	150
Total Dynamic Head	psi	50	50	50
Pump Controller Type	--	Constant	Constant	Constant
Motor Horsepower	hp	15	15	15

Note:

(1) Phase III design includes limiting the output of the existing primary sludge pumps to 200 gpm by adding VFDs. When the motors on the existing pumps reach the end of their useful life, they will be replaced with 20 HP inverter duty motors, as part of a future phase.

WAS and Secondary Scum Pumping

A third new WAS pump will be added in the existing space provided in the WAS pump station, similar in type and capacity to the existing WAS pumps. A new 10-inch WAS pipeline will be constructed in parallel to the existing 6-inch WAS pipeline from the discharge of the WAS pumps to the Solids Handling Building.

Two new secondary scum pumps (one duty and one standby) will be provided, similar in type and capacity to the existing secondary scum pumps, which will pump secondary scum from the new secondary clarifiers to the sludge blending tanks. The new pumps will be located in the new RAS/Scum Pump Station No. 2.

The design criteria for the WAS and secondary scum pumps are presented in Table 3.17.

Table 3.17 WAS and Secondary Scum Pumping Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
WAS Pumps				
Type of Pump	--	Screw Centrifugal	Screw Centrifugal	Screw Centrifugal
Number of Pumps				
Duty	--	1	2	2
Standby	--	1	1	1
Total	--	2	3	3
Pump Design Capacity, each	gpm	330	330	600
Total Dynamic Head	ft	32	32	TBD
Pump Controller Type	--	VFD	VFD	VFD
Motor Horsepower	hp	7.5	7.5	15
Secondary Scum Pumps				
Type of Pump	--	Progressive Cavity	Progressive Cavity	Progressive Cavity
Number of Pumps				
Duty	--	1	2	3
Standby	--	1	2	3
Total	--	2	4	6
Pump Design Capacity, each	gpm	150	150	150
Total Dynamic Head	psi	50	50	50
Pump Controller Type	--	Constant	Constant	Constant
Motor Horsepower	hp	15	15	15

Sludge Screening

New sludge screens will be added in Phase III, to provide screening of the PS flow stream from the GWRP. Sludge screening will aid in the removal of small, loose fibrous material (such as hair) and other inorganic material that currently passes through the headworks bar screens, impacting the operation and maintenance of pumps, tank mixing nozzles and other equipment related to the thickened sludge tanks and digesters.

Two new sludge screens are proposed for Phase III, as described below.

- Provide two sludge screens (with interchangeable screen sizes of 3 mm/5 mm) to screen GWRP PS. Both units will serve as duty units; there will be no standby unit.
- The sludge screens will be installed in a new three-level building, which will be constructed as an extension to the existing Solids Handling Building (SHB), on the east side.
- The new sludge screenings area will be sized to accommodate up to three sludge screens and one roll-off bay. It will be expanded in the future to accommodate up to six sludge screens and two roll-off bays (anticipated for buildout conditions).
- The sludge screens will be located on the third floor (and will be accessible from the existing SHB); the screenings will discharge to the first floor where a horizontal shaftless screw conveyor will distribute the screenings to a roll-off container below. The second floor will primarily be used for housing piping and instrument air system. The first floor will be scrubbed and air treated using the existing SHB scrubber, which has sufficient capacity to handle the additional foul air flow.

The design criteria for the sludge screens are presented in Table 3.18.

Table 3.18 Sludge Screening Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Sludge Screens				
Type	--	--	In-Line Sludge Screen	In-Line Sludge Screen
Number of Units				
Duty	--	--	2	5
Standby	--	--	0	1
Total	--	--	2	6
Capacity, each	gpm	--	150	TBD
Screenings Solids Content, min	%	--	45	45
Drive Type	--	--	Constant	Constant
Motor Horsepower	hp	--	5	5
Screenings Distribution Conveyor				
Type	--	--	Shaftless screw conveyor, reversing	Shaftless screw conveyor, reversing
Number of Units	--	--	1	2
Motor Horsepower	hp	--	1	1
Conveyor Discharge Gates, per Conveyor	--	--	3	3
Type of Conveyor Discharge Gates	--	--	Pneumatic	Pneumatic

Sludge Blending and Mixing

The following solids streams are currently blended and mixed in the two existing sludge blending tanks prior to being pumped to the thickening centrifuges - PS, WAS, and secondary scum generated at the GWRP, and MS generated at the SEWRP. Note that primary scum may be added to the sludge blending tanks, but is generally bypassed to the thickened sludge tank for conveyance directly to the digesters; this material typically has a significant quantity of grease and is best handled directly by the digesters. In Phase III, the sludge blending operation will continue, except that PS from the GWRP will be screened prior to being routed to the blend tanks.

No changes to the existing sludge blending and mixing system are required for the Phase III Expansion. The design criteria for the sludge blending and mixing system are presented in Table 3.19.

Table 3.19 Sludge Blending and Mixing Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Type of System	--	Tanks with Pumped Mixing	Tanks with Pumped Mixing	Tanks with Pumped Mixing
Number of Tanks	--	2	2	2
Type of Mixing Pump	--	Screw Centrifugal	Screw Centrifugal	Screw Centrifugal
Number of Pumps per Tank				
Duty	--	1	1	1
Standby	--	1	1	1
Total	--	2	2	2
Pump Design Capacity, each	gpm	1,700	1,700	1,700
Total Dynamic Head	ft	16	16	16
Pump Controller Type	--	Constant	Constant	Constant
Motor Horsepower	hp	20	20	20

Polymer System

In Phase III, thickening and dewatering polymer systems will continue to be emulsion polymer-based with no change in technology from the existing system. Similar to current practice, the same polymer will be used for both thickening and dewatering operations, as described below.

- The existing thickening and dewatering polymer make-up systems are adequately sized for the Phase III Expansion.
- The third post-dilution assembly, which currently serves as a swing spare for the two existing dewatering centrifuges, will be used as a dedicated unit to the third dewatering centrifuge, installed with Phase III.

- Additional flexibility will be provided in the selection of the aging/mixing tank in the operation of the polymer make-up systems. This will be achieved by adding a motorized valve in the polymer header pipe feeding each pair of aging tanks (thickening and dewatering) to increase the flexibility in selecting the polymer blender/aging tank combinations, and making associated programmable logic controller (PLC) programming updates to allow operator selection of the aging/mixing tank during polymer make-up.
- A new potable water line connection will be provided for polymer blending for the dewatering application. The existing non-potable water feed line will remain in place.

The design criteria for the polymer system are presented in Table 3.20.

Table 3.20 Thickening and Dewatering Polymer Feed System Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Type of System	--	Emulsion	Emulsion	Emulsion
Number of Bulk Storage Tanks, Thickening	--	2	2	2
Number of Bulk Storage tanks, Dewatering		2	2	2
Number of Aging Tanks, Thickening	--	2	2	2
Number of Aging Tanks, Dewatering		2	2	2
Number of Blenders, Thickening	--	2	2	2
Number of Blenders, Dewatering		2	2	2
Number of Post-Dilution Assemblies	--	7	7	7

3.6.2 Thickening Facilities

The operation of the three existing thickening centrifuges will be optimized for a thickened sludge solids content of 6.25 percent or higher (as compared to the current solids content of 5.75 percent) to meet the digester HRT requirements of 15 days for Phase III design loadings. Additionally, the centrifuges will also be operated at a higher liquids throughput rate. With these process modifications, the existing centrifuges will have adequate capacity to handle Phase III flows and loads, and as such, no additional thickening centrifuges will be required for Phase III.

No modifications are required to the thickening centrifuge feed pumps; the four existing pumps (one for each of the three existing centrifuges and a swing spare), that withdraw blended sludge from the blend tanks and deliver it to the thickening centrifuges are adequate for Phase III.

The thickening centrifuges discharge thickened sludge directly to the thickened sludge tanks. The existing screw centrifugal pumps that mix the thickened sludge tanks cannot successfully handle the thicker 6.25 percent sludge, and will be replaced with chopper pumps of the same capacity. NOTE: Pilot testing of the chopper pump mixing system conducted during the detailed design phase demonstrated that chopper pumps can effectively handle a thickened sludge solids content of 6.25 percent.

The design criteria for the thickening facilities are presented in Table 3.21.

Table 3.21 Thickening Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Thickening Centrifuge Feed Pumps				
Type of Pump	--	Progressive Cavity	Progressive Cavity	Progressive Cavity
Number of Pumps				
Duty	--	3	3	3
Standby	--	1	1	1
Total	--	4	4	4
Pump Design Capacity, each	gpm	500	500	TBD
Total Dynamic Head	psi	100	100	TBD
Pump Controller Type	--	VFD	VFD	VFD
Motor Horsepower	hp	60	60	TBD
Thickening Centrifuges				
Number of Centrifuges, Duty/Standby Configuration	--	1+2	2+1	3+1
Flow/Centrifuge	gpm	270	509	582
Mass Solids (per machine)	lbs/hr	1,900	3,639	4,257
Solids Capture	%	99	95	95
Solids Output	%	5.75-6.5	6.5	6.5
Polymer Dosage	lbs active/ton dry solids	2-5	2-5	2-5
Operation	hours per day/days per week	24/7	24/7	24/7
Thickened Sludge Tank and Mixing Pumps				
Type of Thickened Sludge Holding System	--	Tanks w/ Pumped Mixing	Tanks w/ Pumped Mixing	Tanks w/ Pumped Mixing
Number of Tanks	--	2	2	2
Type of Pump	--	Screw Centrifugal	Chopper	Chopper
Number of Pumps				
Duty	--	1	1	1
Standby	--	1	1	1
Total	--	2	2	2
Pump Design Capacity, each	gpm	1,100	1,100	1,100
Total Dynamic Head	ft	43	43	43
Pump Controller Type	--	Constant	Constant	Constant
Motor Horsepower	hp	20	20	20

3.6.3 Digestion Facilities

The existing digester system will be expanded to include two additional digesters, complete with associated digester feed pumps (located in the SHB), mixing pumps, recirculation pumps, bottom pumps, and digester heating and gas handling equipment, as described below.

- Install two new 1.2-MG egg-shaped digesters (Digesters No. 3 and No. 4) configured for the CMAD process. The process will be designed to accommodate either TAD or AGAD in the future, which may have the ability to reduce digester footprint at buildout and also allow for upgrades to produce Class A biosolids.
- Provide three new progressive cavity type digester feed pumps (two duty and one designated standby) for the new digesters that match the technology and capacity of the existing pumps.
- Provide external pumped mixing using screw centrifugal pumps for the new digesters, similar to the mixing system for the existing digesters. Two new mixing pumps, operating in duty-standby mode, will be provided per digester.
- Provide a digester recirculation system for the new digesters, consisting of two new chopper pumps per digester, operating in duty-standby mode. The pumps will be used for circulating sludge through the digester heat exchanger and returning the heated sludge back to the digester. A spool piece will be provided on the suction side of the pumps, so that grinders may be installed in the future, if required. Pilot testing conducted during the detailed design phase, using the chopper style pumps, indicated that these type of pumps will work well for the digester recirculation system without the need for grinders. NOTE: The existing digester recirculation pumps for the existing digesters are screw centrifugal pumps; these pumps may be replaced with chopper pumps in the future, when they wear out and are in need of replacement.
- Provide one new common bottom pump for the two new digesters, similar to the bottom pump configuration for the two existing digesters. The bottom pump will be a constant-speed, progressive cavity type pump, with a similar capacity as the existing bottom pump.
- Provide two new concentric-tube heat exchangers and centrifugal hot water pumps for the two new digesters, functioning in the same manner as the heating system for the existing digesters.
- Add a third boiler and ancillary equipment in the Boiler Building, for redundancy.
- Replace existing Heat Reservoir Loop Recirculation Pumps No. 1 and No. 2, and add a new Heat Reservoir Recirculation Pump No. 3, in the Boiler Building.
- Replace the two existing waste gas burners with two new burners that are of a newer technology.

The design criteria for the digestion facilities are presented in Table 3.22.

Table 3.22 Digestion Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Anaerobic Digesters				
Type of System	--	Conventional Mesophilic Anaerobic Digestion	Conventional Mesophilic Anaerobic Digestion	Conventional Mesophilic Anaerobic Digestion
Type of Digesters	--	Egg-Shaped	Egg-Shaped	Egg-Shaped
Number of Digesters	--	2	4	7
Volume of Digesters, each, nominal	MG	1.2	1.2	1.2
Total Solids to Digesters				
Annual Average	lbs/day	--	130,600	227,800
Maximum Month	lbs/day	63,219	165,900	291,100
Total Solids % Digester Feed	%	5.75	6.5	6.5
Volatile Solids Fraction				
Annual Average	%	75-80	73.3	73
Maximum Month	%	75-80	74.5	71
Digester Feed Rate				
Annual Average	gpd	--	241,000	428,800
Maximum Month	gpd	66,200	306,100	537,100
Solids Retention Time				
Average Annual, Service Condition (Largest Unit out of Service)	days	--	14.9	17.0
Maximum Month, Peak Condition (All Units in Service)	days	19.6	15.7	15.6
Organic Loading Rate				
Average Annual, Service Condition (Largest Unit out of Service)	lb VS/cf-d	--	0.20	0.17
Maximum Month, Peak Condition (All Units in Service)	lb VS/cf-d	0.16	0.19	0.185
Digester Feed Pumps				
Type of Pump	--	Progressive Cavity	Progressive Cavity	Progressive Cavity
Number of Pumps	--	2	4	7
Pump Design Capacity, each	gpm	106	106	106
Total Dynamic Head	psi	100	100	100
Pump Controller Type	--	VFD	VFD	VFD
Motor Horsepower	hp	20	20	20

Table 3.22 Digestion Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Standby Digester Feed Pumps				
Type of Pump	--	Progressive Cavity	Progressive Cavity	Progressive Cavity
Number of Pumps	--	1	2	2
Pump Design Capacity, each	gpm	106	106	106
Total Dynamic Head	psi	150	150	150
Pump Controller Type	--	VFD	VFD	VFD
Motor Horsepower	hp	30	30	30
Digester Mixing				
Type of Mixing System	--	External Recirculation Pumps	External Recirculation Pumps	External Recirculation Pumps
Type of Mixing Pump	--	Screw Centrifugal	Screw Centrifugal	Screw Centrifugal
Total Number of Pumps	--	4	8	14
Number of Pumps per Digester, Duty/Standby Configuration	--	1+1	1+1	1+1
Pump Design Capacity, each	gpm	2,500	2,500	2,500
Total Dynamic Head	ft	38	38	38
Pump Controller Type	--	Constant	Constant	Constant
Motor Horsepower	hp	40	40	40
Digester Recirculation Pumps				
Type of Pump	--	Screw Centrifugal	Screw Centrifugal, Chopper	Screw Centrifugal, Chopper
Total Number of Pumps	--	4	4, 4	4, 10
Number of Pumps per Digester, Duty/Standby Configuration	--	1+1	1+1	1+1
Pump Design Capacity, each	gpm	500	500	500
Total Dynamic Head	ft	42	42	42
Pump Controller Type	--	Constant	Constant	Constant
Motor Horsepower	hp	10	10, 15	10, 15

Table 3.22 Digestion Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Digester Bottom Pumps				
Type of Pump	--	Progressive Cavity	Progressive Cavity	Progressive Cavity
Total Number of Pumps	--	1	2	TBD
Number of Pumps	--	One duty per pair of digesters	One duty per pair of digesters	TBD
Pump Design Capacity, each	gpm	60	60	TBD
Total Dynamic Head	psi	100	100	TBD
Pump Controller Type	--	Constant	Constant	TBD
Motor Horsepower	hp	20	10	TBD
Digester Gas Handling - Waste Gas Burners				
Type	--	Low Emission, Enclosed 304 SS Stack with Forced Air Induction	Low Emission, Enclosed 304 SS Stack with Natural Air Induction	Low Emission, Enclosed 304 SS Stack with Natural Air Induction
Number of Units				
Duty	--	1	1	1
Standby	--	1	1	1
Total	--	2	2	2
Approximate Diameter	feet	4, 5	7	7
Height	feet	50	29	29
Waste Gas Burner Capacity, each	scfm	150, 425	945	945
Low Pressure Digester Gas Manifold Diameter	inches	16	16	16
Lateral Pipe Diameter	inches	8	8	8
Natural Gas Supplemental Flow, total	scfh	90	100	100
Digester Heating				
Type of Heating System	--	Heat Exchangers, Recirculation Pumps, and Hot Water Boilers	Heat Exchangers, Recirculation Pumps, and Hot Water Boilers	Heat Exchangers, Recirculation Pumps, and Hot Water Boilers

Table 3.22 Digestion Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Heat Exchangers				
Heat Exchanger Type	--	Concentric Tube	Concentric Tube	Concentric Tube
Number of Heat Exchangers	--	2	4	7
Heat Exchanger Capacity, each	MMBtu/hr	1.5	1.5	1.5
Digester Heat Reservoir Supply (HRS) Recirculation Pumps				
Type of Pump	--	Centrifugal	Centrifugal	Centrifugal
Total Number of Pumps	--	2	4	7
Number of Pumps per Digester, Duty/Standby Configuration	--	1 (duty only)	1 (duty only)	1 (duty only)
Pump Design Capacity, each	gpm	250	250	250
Total Dynamic Head	ft	23	23	23
Pump Controller Type	--	Constant	Constant	Constant
Motor Horsepower	hp	3	3	3
Heat Reservoir Loop Recirculation Pumps				
Type of Pump	--	Centrifugal	Centrifugal	Centrifugal
Number of Pumps				
Duty	--	1	2	2
Standby	--	1	1	1
Total	--	2	3	3
Pump Design Capacity, each	gpm	212	212	TBD
Total Dynamic Head	ft	28	28	TBD
Pump Controller Type	--	Constant	Constant	Constant
Motor Horsepower	hp	3	3	TBD
Boilers				
Boiler Type	--	Fire Tube	Fire Tube	Fire Tube
Number of Boilers, Duty/Standby Configuration	--	1+1	2+1	TBD
Boiler Capacity, each	MMBtu/hr	2	2	TBD
Boiler Horsepower, each	hp	60	60	TBD
Natural Gas Flow Rate, each	scfh	2,510	2,510	TBD
Digester Gas Flow Rate, each	scfh	4,185	4,185	TBD
Digester Gas Operating Pressure (minimum)	inches w.c.	10	10	TBD
Hot Water Flow Rate, each	gpm	100	100	TBD

Table 3.22 Digestion Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
How Water Discharge Temperature, each	deg F	210	210	TBD
Design Pressure	psi	30	30	TBD
How Water Operating Pressure	psi	20	20	TBD
Burner Turndown	--	4:1	4:1	TBD
Blower Motor, each	hp	3	3	TBD
Noise Level at 3 Feet	dB	80	80	80
Digested Sludge Storage Tank				
Number of Storage Tanks	--	1	1	1
Tank Capacity, maximum	MG	1.3	1.3	1.3
Digested Sludge Storage Tank Recirculation Pumps				
Type of Pump	--	Screw Centrifugal	Screw Centrifugal	Screw Centrifugal
Total Number of Pumps, Duty/Standby Configuration	--	1+1	1+1	1+1
Pump Design Capacity, each	gpm	1,200	1,200	1,200
Total Dynamic Head	ft	72	72	72
Pump Controller Type	--	Constant	Constant	Constant
Motor Horsepower	hp	40	40	40

3.6.4 Dewatering Facilities

One new dewatering centrifuge and corresponding dewatering centrifuge feed pump and classifying conveyor will be added in Phase III. Additionally, the two existing classifying conveyors serving the two existing dewatering centrifuges will be replaced with new units in Phase III, for a total of three new conveyors. The design criteria for the dewatering facilities are presented in Table 3.23.

Table 3.23 Dewatering Facilities Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
Dewatering Centrifuge Feed Pumps				
Type of Pump	--	Progressive Cavity	Progressive Cavity	Progressive Cavity
Number of Pumps				
Duty	--	2	3	3
Standby	--	1	1	1
Total	--	3	4	4
Pump Design Capacity, each	gpm	500	500	500
Total Dynamic Head	psi	100	100	100
Pump Controller Type	--	VFD	VFD	VFD
Motor Horsepower	hp	60	60	60
Dewatering Centrifuges				
Number of Centrifuges, Duty/Standby Configuration	--	1+1	2+1	2+1
Flow/Centrifuge	gpm	200	106	188
Mass Solids (per machine)	lbs/hr	3,300	2,302	3,921
% Solids Capture	%	99	95	95
% Solids Output	%	20-22	20-22	20-22
Polymer Dosage	lbs active/ ton dry solids	18-20	18-25	18-25
Operation	hours per day/days per week	12/7	24/7	24/7
Dewatered Cake Storage				
Type of System	--	Live-Bottom Hopper	Live-Bottom Hopper	TBD
Number of Units	--	2	2	TBD
Useful Capacity per Unit	cf	3,000	3,000	TBD
Dewatered Cake Classifying Conveyors				
Type of System	--	Inclined	Inclined	Inclined
Number of Units	--	2	3 (1)	3
Flight Diameter	inches	16	16	16
Flight ID	inches	4.03	6.6	6.6
Shaft Type	--	Shafted	Shafted	Shafted
Capacity (at 25% solids), each	tons/hr	10	10	10
Maximum Horsepower	hp	15	15	15

Note:
(1) The two existing dewatering cake classifying conveyors will be replaced with new units in Phase III.

3.6.5 Centrate Flow Management

In Phase III, the combined thickening and dewatering centrate flow will be routed using the existing 10-inch pipeline, to the new centrate flow splitting weir structure that will be constructed integral to the existing RAS/Centrate Splitter Structure. Although evaluated in the preliminary design phase, centrate segregation and equalization of the dewatering centrate will not be provided (refer to DIM-15 − Centrate Equalization Facilities for further discussion). The combined RAS/centrate flow streams from the RAS/Centrate Splitter Structure will be returned to the CaRRB zones of the aeration basins. A new pigging station will be added to serve the existing centrate pipeline.

3.7 Support Facilities

The various support facilities for the liquids and solids treatment processes include OCSs and supporting chemical facilities, and various miscellaneous utilities (i.e., potable water, NPW, compressed air, natural gas, electrical power, and supervisory control and data acquisition [SCADA] Ethernet, etc.). Detailed evaluations and design information related to the support facilities are included in DIM-01 − Site and Support Facilities, DIM-02 − Electrical, Instrumentation and Controls, TM-7A − Plant-wide Odor Control Study, and TM-7C − Chemical Storage and Feed.

The existing odor control facilities at the GWRP include: (1) Primary OCS No. 1 (serving the influent junction box and junction structures, Headworks Building No. 1, grit removal, primary sedimentation basins, and Splitter Structure No. 1) and its associated chemicals located in Bulk Chemical Storage Area No. 1; (2) Secondary OCS, serving the aeration basins, with smaller, separate ancillary systems serving the Mixed Liquor Splitter Structure and RAS/Centrate Splitter Structure, and (3) Solids OCS (serving the Solids Handling Building) and its associated chemicals located in Bulk Chemical Storage Area No. 3.

Modifications will be made to the existing odor control systems to handle the additional foul air from the new Phase III facilities, as described below. The design criteria for the odor control systems and supporting chemical facilities are presented in Table 3.24.

- Construct a new Primary OCS No. 2, similar to existing Primary OCS No. 1, to serve new Headworks Building No. 2 and Primary Sedimentation Basin No. 3. The system will consist of three new LO/PRO wet chemical scrubbers. Additionally, provide a new chemical feed loop system to the existing chemical feed loop for both sodium hypochlorite and sodium hydroxide. The existing Bulk Chemical Storage Area No. 1 is equipped with chemical storage tanks that are adequate in size to serve the existing Primary OCS No. 1 and new Primary OCS No. 2.
- The three existing carbon units at the Secondary OCS located by the existing aeration basins have sufficient capacity to handle foul air from the existing and new aeration basins, and no major additions to this system are proposed in Phase III. The existing activated carbon media will be replaced with a 75%/25% mixture of high capacity carbon/potassium permanganate in Phase III. Additionally, mist eliminators will be added upstream of each of

the existing units, to extend the life of the media. Provisions will be made for the addition of a fourth, redundant, future carbon unit.

- Add one new packaged carbon odor control unit to treat foul air from the new additions to the Mixed Liquor Splitter Structure and RAS/Centrate Splitter Structure.
- The existing Solids OCS, which consists of two wet chemical scrubbers, has adequate capacity to treat foul air from the Solids Handling Building, including the additional sludge screenings area, and no major changes are required to this system. Minor valving and piping modifications will be made to provide the ability to run either of the two units, both units in parallel or both units in series. Additionally, the Solids OCS control system will be updated to improve overall reliability.

Table 3.24 Odor Control Systems and Supporting Chemical Storage and Feed Facilities Design Criteria

Parameter	Units	Phase II	Phase III	Buildout
PRIMARY ODOR CONTROL SYSTEM AND CHEMICAL FACILITIES				
Primary Odor Control System No. 1				
Type	--	LoPro-Type Packaged Wet Chemical Scrubber	LoPro-Type Packaged Wet Chemical Scrubber	LoPro-Type Packaged Wet Chemical Scrubber
Treating Chemicals	--	12.5% NaOCl 25% NaOH	12.5% NaOCl 25% NaOH	12.5% NaOCl 25% NaOH
Number of Units				
Total	--	4	4	4
Duty/Standby Configuration	--	3+1	3+1	3+1
Capacity/Unit	cfm	24,500	24,500	24,500
Stage 1 Recirculation Pump Capacity, each	gpm	400 (units 1-3); 430 (unit 4)	400 (units 1-3); 430 (unit 4)	400 (units 1-3); 430 (unit 4)
Stage 1 Recirculation Pump Horsepower	hp	10 (units 1-3); 15 (unit 4)	10 (units 1-3); 15 (unit 4)	10 (units 1-3); 15 (unit 4)
Stage 2 Recirculation Pump Capacity, each	gpm	600 (units 1-3) (1); 430 (unit 4)	600 (units 1-3) (1); 430 (unit 4)	600 (units 1-3) (1); 430 (unit 4)
Stage 2 Recirculation Pump Horsepower	hp	20 (units 1-3); 15 (unit 4)	20 (units 1-3); 15 (unit 4)	20 (units 1-3); 15 (unit 4)

Table 3.24 Odor Control Systems and Supporting Chemical Storage and Feed Facilities Design Criteria

Parameter	Units	Phase II	Phase III	Buildout
Fan				
Type	--	FRP Centrifugal	FRP Centrifugal	FRP Centrifugal
Number of Units	--	4	4	4
Capacity, each	cfm	24,500 (2)	24,500	24,500
Pressure	inches w.c.	16	16	16
Horsepower	hp	125 (units 1-3); 100 (unit 4)	125 (units 1-3); 100 (unit 4)	125 (units 1-3); 100 (unit 4)
Primary Odor Control System No. 2				
Type	--	LoPro-Type Packaged Wet Chemical Scrubber	LoPro-Type Packaged Wet Chemical Scrubber	LoPro-Type Packaged Wet Chemical Scrubber
Treating Chemicals	--	12.5% NaOCl 25% NaOH	12.5% NaOCl 25% NaOH	12.5% NaOCl 25% NaOH
Number of Units				
Total	--	N/A	3	4
Duty/Standby Configuration	--	N/A	2+1	3+1
Capacity/Unit	cfm	24,500	24,500	24,500
Stage 1 Recirculation Pump Capacity, each	gpm	N/A	430	430
Stage 1 Recirculation Pump Horsepower	hp	N/A	15	15
Stage 2 Recirculation Pump Capacity, each	gpm	N/A	430	430
Stage 2 Recirculation Pump Horsepower	hp	N/A	15	15
Fan				
Type	--	N/A	FRP Centrifugal	FRP Centrifugal
Number of Units	--	N/A	3	4
Capacity, each	cfm	N/A	24,500	24,500
Pressure	inches w.c.	N/A	16	16
Horsepower	hp	N/A	100	100

Table 3.24 Odor Control Systems and Supporting Chemical Storage and Feed Facilities Design Criteria

Parameter	Units	Phase II	Phase III	Buildout
Bulk Chemical Storage Area No. 1				
Sodium Hydroxide System				
Bulk Concentration	%	20	20	20
Number of Tanks	--	1	1	TBD
Tank Volume	gal	12,500 (3)	12,500	TBD
Chemical Feed Pump				
Number of Pumps	--	2	2	TBD
Pump Design Capacity, each	gpm	5	8.7	TBD
Total Dynamic Head	ft	21	20.5	TBD
Sodium Hydroxide Loop Peak Demand Total	gpm	1.28	2.24	TBD
Sodium Hypochlorite System				
Bulk Concentration	%	12.5	12.5	12.5
Number of Tanks	--	1	1	TBD
Tank Volume	gal	12,500	12,500	TBD
Chemical Feed Pump				
Number of Pumps	--	2	2	TBD
Pump Design Capacity, each	gpm	5	10.1	TBD
Total Dynamic Head	ft	21	17.4	TBD
Sodium Hypochlorite Loop Peak Demand Total	gpm	6.0	10.5	TBD
SECONDARY ODOR CONTROL SYSTEM				
Aeration Basins Odor Control System				
Type	--	Activated Carbon	Activated Carbon	Activated Carbon
Number of Units	--	3	3	TBD
Capacity/Unit	cfm	17,000	17,000	TBD
Media Type	--	Activated Carbon	75% High Capacity Carbon/25% Potassium Permanganate Carbon	75% High Capacity Carbon/25% Potassium Permanganate Carbon

Table 3.24 Odor Control Systems and Supporting Chemical Storage and Feed Facilities Design Criteria

Parameter	Units	Phase II	Phase III	Buildout
Fan				
Type	--	FRP Pressure Blowers	FRP Pressure Blowers	FRP Pressure Blowers
Number of Units	--	3	3	TBD
Capacity, each	cfm	17,000	17,000	TBD
Pressure	inches w.c.	8	8	8
Horsepower	hp	30	30	TBD
Mixed Liquor and RAS/Centrate Splitter Structures Odor Control System				
Type	--	Activated Carbon	Activated Carbon	Activated Carbon
Number of Units	--	1	2	TBD
Capacity, each	cfm	700	700	TBD
Media Type	--	Midas OCM	High Capacity Carbon, Pelletized	High Capacity Carbon, Pelletized
Fan				
Type	--	FRP Centrifugal	FRP Centrifugal	FRP Centrifugal
Number of Units	--	1	2	TBD
Capacity, each	cfm	700	700	TBD
Pressure	inches w.c.	7	7	7
Horsepower	hp	5	5	5
SOLIDS ODOR CONTROL SYSTEM				
Odor Control System				
Type	--	Wet Chemical Scrubber	Wet Chemical Scrubber	Wet Chemical Scrubber
Number of Units	--	2	2	2
Rated Capacity, each	cfm	40,000	40,000	40,000
Bulk Chemical Storage Area No. 3				
Sodium Hypochlorite System				
Bulk Concentration	%	12.5	12.5	12.5
Number of Tanks	--	2	2	2
Tank Volume, each	gal	8,000	8,000	8,000

Table 3.24 Odor Control Systems and Supporting Chemical Storage and Feed Facilities Design Criteria

Parameter	Units	Phase II	Phase III	Buildout
Sodium Hydroxide System				
Bulk Concentration	%	20	20	20
Number of Tanks	--	2	2	2
Tank Volume, each	gal	6,000	6,000	6,000
Ferrous Chloride System (4)				
Number of Tanks	--	1	1	TBD
Tank Volume, each	gal	4,000	4,000	TBD

Notes:

(1) Existing Scrubbers 1-3 are 3 stage units. Stage 2 recirculation pumps are shared between Stages 2 and 3.

(2) Capacity of existing fans is based on SWRP Lift Station project as-builts dated 2000 and Phase II Expansion as-builts dated 2004.

(3) The 8,000-gallon tank that was installed in Phase II, has subsequently been replaced with a 12,500-gallon tank that has adequate capacity to handle Phase III conditions.

(4) The ferrous chloride storage and pumping system serves the digesters.

Various modifications will be required to the miscellaneous site utilities, as described below.

- Extend existing potable water pipelines to accommodate all facilities that require potable water in the Phase III Expansion. In total, the plant will require an estimated maximum of 333 gpm of potable water for brief periods of time.

- Extend existing NPW pumping system and distribution pipelines to accommodate all the new facilities that require NPW in the Phase III Expansion. Construct a new NPW pump station east of the new CCBs that is equipped with two new 900 gpm vertical turbine pumps, for a firm NPW pumping system capacity of 1,800 gpm. Two manual duplex strainers will be provided on the discharge of the new NPW system. The new pumps will be the primary pumping (duty) pumps with the two existing 600 gpm pumps remaining in service as backup to the new pumps. The design criteria for the NPW pump system are presented in Table 3.25.

Table 3.25 NPW Pump System Design Criteria

Design Criteria	Units	Phase II	Phase III	Buildout
NPW Pumps				
Type of Pump	--	Vertical Turbine	Vertical Turbine	Vertical Turbine
Number of Pumps				
Duty	--	1	2 (new)	3
Standby	--	1	2 (exist.)	1
Total	--	2	4 (1)	4 (2)
New NPW Pump				
Pump Design Capacity, each	gpm	--	900	900
Total Dynamic Head	ft	--	237	237
Pump Controller Type	--	--	VFD	VFD
Motor Horsepower	hp	--	75	75
Existing NPW Pump				
Pump Design Capacity, each	gpm	600	600	-- (2)
Total Dynamic Head	ft	225	225	--
Pump Controller Type	--	Constant	Constant	--
Motor Horsepower	hp	60	60	--
Strainers				
Type of Strainer	--	--	Duplex Basket	Duplex Basket
Number of Strainers				
Duty	--	--	2	3
Standby	--	--	0	0
Total	--	--	2	3
Capacity, each	gpm	--	900	900
Design differential Pressure, Clean	psig	--	2.6	2.6
Design differential Pressure, Dirty	psig	--	5.3	5.3
Basket Screen Size	inches	--	1/32	1/32

Notes:
(1) The two existing pumps shall serve as standby pumps to the two new duty pumps in Phase III.
(2) For buildout conditions, it is assumed that the two existing small pumps and hydro-pneumatic system will no longer be in service, and that two additional 900 gpm pumps will be installed.

3.8 Hydraulic Profile

A hydraulic profile has been developed for the Phase III Expansion facilities and is shown in Figure 3.1.

3.9 Applicable Codes and Standards

A codes and standards classification table for the GWRP has been developed, to summarize the building code, fire protection, ventilation, and electrical code requirements for the various structures, rooms, and areas, and is presented in Table 3.26. The codes and standards applicable to this project are listed in the table.

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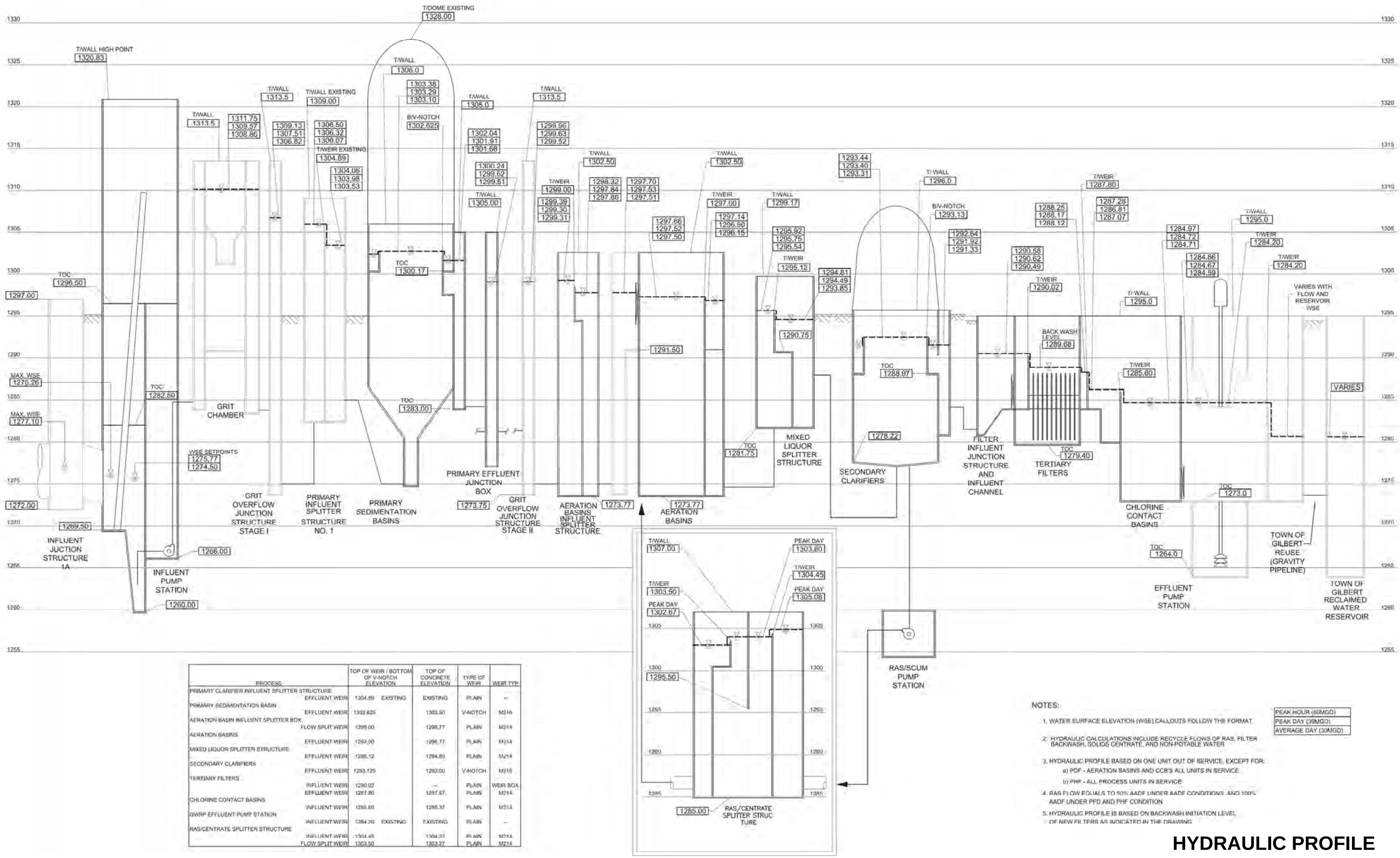

PROCESS	TOP OF WEIR / BOTTOM OF V-NOTCH ELEVATION		TOP OF CONCRETE ELEVATION	TYPE OF WEIR	WEIR TYP
PRIMARY CLARIFIER INFLUENT SPLITTER STRUCTURE					
EFFLUENT WEIR	1304.89	EXISTING	EXISTING	PLAIN	–
PRIMARY SEDIMENTATION BASIN					
EFFLUENT WEIR	1302.625		1302.50	V-NOTCH	M216
AERATION BASIN INFLUENT SPLITTER BOX					
FLOW SPLIT WEIR	1299.00		1298.77	PLAIN	M214
AERATION BASINS					
EFFLUENT WEIR	1297.00		1296.77	PLAIN	M214
MIXED LIQUOR SPLITTER STRUCTURE					
EFFLUENT WEIR	1295.12		1294.89	PLAIN	M214
SECONDARY CLARIFIERS					
EFFLUENT WEIR	1293.125		1293.00	V-NOTCH	M216
TERTIARY FILTERS					
INFLUENT WEIR	1290.02		–	PLAIN	WEIR BOX
EFFLUENT WEIR	1287.80		1287.57	PLAIN	M214
CHLORINE CONTACT BASINS					
INFLUENT WEIR	1285.60		1285.37	PLAIN	M214
GWRP EFFLUENT PUMP STATION					
INFLUENT WEIR	1284.20	EXISTING	EXISTING	PLAIN	–
RAS/CENTRATE SPLITTER STRUCTURE					
INFLUENT WEIR	1304.45		1304.22	PLAIN	M214
FLOW SPLIT WEIR	1303.50		1303.27	PLAIN	M214

NOTES:

1. WATER SURFACE ELEVATION (WSE) CALLOUTS FOLLOW THE FORMAT
2. HYDRAULIC CALCULATIONS INCLUDE RECYCLE FLOWS OF RAS, FILTER BACKWASH, SOLIDS CENTRATE, AND NON-POTABLE WATER
3. HYDRAULIC PROFILE BASED ON ONE UNIT OUT OF SERVICE, EXCEPT FOR:
   a) PDF - AERATION BASINS AND CCB'S ALL UNITS IN SERVICE
   b) PHF - ALL PROCESS UNITS IN SERVICE
4. RAS FLOW EQUALS TO 50% AADF UNDER AADF CONDITIONS, AND 100% AADF UNDER PFD AND PHF CONDITION
5. HYDRAULIC PROFILE IS BASED ON BACKWASH INITIATION LEVEL OF NEW FILTERS AS INDICATED IN THE DRAWING

PEAK HOUR (60MGD)
PEAK DAY (39MGD)
AVERAGE DAY (30MGD)

HYDRAULIC PROFILE

FIGURE 3.1

CITY OF MESA, TOWN OF GILBERT, TOWN OF QUEEN CREEK
GWRP PHASE III EXPANSION

carollo | Brown AND Caldwell

Table 3.26 GWRP Phase III Code Classification Table

Project Name: Greenfield Water Reclamation Plant - Phase III Expansion
Project Owner(s): City of Mesa, Town of Gilbert, Town of Queen Creek
Project Location: 4400 S. Greenfield Road, Gilbert, AZ 85296
CM@Risk: McCarthy Building Companies, Inc.
City of Mesa Project No: CP0067
Carollo Job No: 9837A.10
Project Schedule: May 2016 through February 2018 (Design)
November 2017 through October 2020 (Construction)

Building Code: 2012 International Building Code (IBC), with Town of Gilbert Amendments
Mechanical Code: 2012 International Mechanical Code (IMC), with Town of Gilbert Amendments
Plumbing Code: 2012 International Plumbing Code (IPC), with Town of Gilbert Amendments
Fire Code: 2012 International Fire Code (IFC), with Town of Gilbert Amendments
Electric Code: 2011 National Electric Code (NEC)
Other Codes: National Fire Protection Association (NFPA) - 2012 NFPA 820, 2010 NFPA 13, 2000 NFPA 45, 2011 NFPA 58, 2010 NFPA 72
2006 International Energy Conservation Code (IECC) with Town of Gilbert Amendments
2012 International Fuel Gas Code (IFGC)
2010 Americans with Disabilities Act (ADA)
The Arizonans with Disabilities Act and Implementing Rules
2013 Building and Construction Regulations Code of the Town of Gilbert, Arizona
2015 Town of Gilbert Land Development Code
2006 Energy Conservation Code, with Town of Gilbert Amendments
Notes: See General Note 1 for the application of updated code/classification standards in Phase III construction

PLANT AREA	STRUCTURE, ROOM, AREA	BUILDING CODE			NFPA 820	FIRE PROTECTION							VENTILATION				HAZARD CLASSIFICATION			
		Occupancy Class	ADA Access	Grade Location	Table	Comb. Gas Detect.	Heat Detect.	Smoke Detect.	Portable FE	Hydrant Protection	Fire Alarm System	Fire Suppr. Type	Odor Control	Air Conditioning	Rate (ACH)	Remarks	Class	Group	Division	Remarks
01	***Yard / Site Facilities***																			
	Site walkways at ADA buildings (Existing)	n/a	yes	outside	n/a	--	--	--	--	--	--	--	--	--	--		--	--	--	
	Site walkways at Non-ADA buildings (Existing)	n/a	no	outside	n/a	--	--	--	--	--	--	--	--	--	--		--	--	--	
	Site Canopies	n/a	no	outside	n/a	--	--	--	--	X	--	--	--	--	--		--	--	--	
02	***Standby Generators***																			
	Diesel Generators	n/a	no	outside	n/a	--	--	--	X	X	--	--	--	--	--		--	--	--	
03	***Headworks Building No. 2***																			
	Wetwells	F-2	no	below	4.2, 16b	--	--	--	--	X	--	--	yes	--	12	Air Flow Sensor/Alarm	I	D	2	Potential for submergence
	Pump Pit	F-2	no	below/ open top	4.2, 17a	--	--	--	X	X	--	WSP	--	--	6	Air Flow Sensor/Alarm	UNCL	--	--	Potential for submergence
	Screenings Room	F-2	no	above	5.2, 1b	X	--	--	X	X	X	WP	yes	--	12	Air Flow Sensor/Alarm	I	D	2	
	Screenings Area Lower Level	F-2	no	below	5.2, 1b	X	X	X	X	X	--	WSP	yes	--	12	Air Flow Sensor/Alarm	I	D	2	
03	***Headworks Electrical Building***																			
	Electrical Room	F-2	no	above	n/a	--	--	--	X	X	X	PA	--	yes	note (6)		UNCL	--	--	
	Control Room	F-2	no	above	n/a	--	--	--	X	X	X	PA	--	yes	note (6)		UNCL	--	--	
05	***Primary Odor Control System No. 2***																			
	Odor Control System Area	n/a	no	outside	5.2, 26b,c	--	--	--	X	--	--	--	--	--	--	Outside - No canopy	I	D	2	3'-0" envelope
	Bulk Chemical Storage Area No. 1 (Existing)	n/a	no	outside	n/a	--	--	--	--	X	--	--	--	--	--		--	--	--	
05	***Primary Sedimentation Basins***																			
	Basin Cover Headspace	n/a	no	above	5.2,6a	X	--	--	--	X	--	--	yes	--	--	Maintain - 0.10" WC	I	D	1	
	Basin Cover Tunnels	n/a	no	outside	5.2,6c	--	--	--	X	X	--	--	--	--	--		I	D	2	
	Scum Wetwells	n/a	no	above / below	6.2 (a),4a	X	--	--	--	X	--	--	yes	--	--	Maintain - 0.10" WC	I	D	1	
05	***Primary Sludge/Scum Pump Station No. 1***																			
	Gallery (Existing)	F-2	no	below	6.2 (a), 9b	--	--	--	X	X	--	WSP	no	--	6		UNCL	--	--	
	Electrical Room (Existing)	F-2	note (1)	above	n/a	--	X	X	X	X	X	WP	no	yes	note (6)		UNCL	--	--	
05	***Primary Sludge/Scum Pump Station No. 2***																			
	Gallery	F-2	no	below	6.2 (a), 9b	--	--	--	X	X	--	WP	no	--	6		UNCL	--	--	
	Electrical Room	F-2	note (1)	above	n/a	--	X	--	X	X	X	PA	no	yes	note (6)		UNCL	--	--	
	Equipment Room	F-2	note (1)	above	n/a	--	X	--	X	X	X	PA	no	yes	note (6)		UNCL	--	--	
06	***Aeration Basins Complex***																			
	Aeration Basins Influent Splitter Structure	n/a	no	outside	5.2, 9	--	--	--	--	--	--	--	yes	--	--	Maintain - 0.10" WC	UNCL	--	--	
	Aeration Basins / Channels	n/a	no	outside	5.2, 9	--	--	--	--	--	--	--	yes	--	--	Maintain - 0.10" WC	UNCL	--	--	
06	***Blower / Electrical Building***																			
	Equipment Room (Existing)	F-2	no	above	n/a	--	--	--	X	X	X	WP	--	EVAP	IBC		UNCL	--	--	
	Electrical Room (Existing)	F-2	note (1)	above	n/a	--	--	--	X	X	X	WP	--	yes	IBC		UNCL	--	--	
06	***Mixed Liquor Splitter Structure***																			
	Mixed Liquor Splitter Structure	n/a	no	outside	5.2, 9	--	--	--	--	--	--	--	yes	--	--	Maintain - 0.10" WC	UNCL	--	--	

Table 3.27 GWRP Phase III Code Classification Table

Project Name: Greenfield Water Reclamation Plant - Phase III Expansion
Project Owner(s): City of Mesa, Town of Gilbert, Town of Queen Creek
Project Location: 4400 S. Greenfield Road, Gilbert, AZ 85296
CM@Risk: McCarthy Building Companies, Inc.
City of Mesa Project No: CP0067
Carollo Job No: 9837A.10
Project Schedule: May 2016 through February 2018 (Design)
November 2017 through October 2020 (Construction)

Building Code: 2012 International Building Code (IBC), with Town of Gilbert Amendments
Mechanical Code: 2012 International Mechanical Code (IMC), with Town of Gilbert Amendments
Plumbing Code: 2012 International Plumbing Code (IPC), with Town of Gilbert Amendments
Fire Code: 2012 International Fire Code (IFC), with Town of Gilbert Amendments
Electric Code: 2011 National Electric Code (NEC)
Other Codes: National Fire Protection Association (NFPA) - 2012 NFPA 820, 2010 NFPA 13, 2000 NFPA 45, 2011 NFPA 58, 2010 NFPA 72
2006 International Energy Conservation Code (IECC) with Town of Gilbert Amendments
2012 International Fuel Gas Code (IFGC)
2010 Americans with Disabilities Act (ADA)
The Arizonans with Disabilities Act and Implementing Rules
2013 Building and Construction Regulations Code of the Town of Gilbert, Arizona
2015 Town of Gilbert Land Development Code
2006 Energy Conservation Code, with Town of Gilbert Amendments
Notes: See General Note 1 for the application of updated code/classification standards in Phase III construction

PLANT AREA	STRUCTURE, ROOM, AREA	BUILDING CODE				FIRE PROTECTION							VENTILATION				HAZARD CLASSIFICATION			
		Occupancy Class	ADA Access	Grade Location	NFPA 820 Table	Comb. Gas Detect.	Heat Detect.	Smoke Detect.	Portable FE	Hydrant Protection	Fire Alarm System	Fire Suppr. Type	Odor Control	Air Conditioning	Rate (ACH)	Remarks	Class	Group	Division	Remarks
07	***Secondary Odor Control System***																			
	Odor Control System Area	n/a	no	outside	5.2, 26b,c	--	--	--	--	X	--	--	--	--	--		I	D	2	3'-0" envelope
07	***Secondary Clarifiers***																			
	Basin Cover Headspace	n/a	no	above	5.2, 14	--	--	--	--	X	--	--	--	--	--	--	UNCL	--	--	
	Basin Cover Tunnels	n/a	no	outside	5.2, 14	--	--	--	X	X	--	--	--	--	--		UNCL	--	--	
	Scum Wetwells	n/a	no	above / below	6.2 (a),4a	--	--	--	--	X	--	--	--	--	--	--	I	D	1	
07	***RAS/Scum Pump Station No. 1***																			
	Basement (Existing)	F-2	no	below	6.2 (a),9b	--	--	--	X	X	--	WSP	--	--	6		UNCL	--	--	
	Sampler/Access Room (Existing)	F-2	no	above	6.2 (a),9b	--	--	X	--	--	--	WP	--	--	6		UNCL	--	--	
	Electrical Room (Existing)	F-2	note (1)	above	n/a	--	--	--	X	X	X	WP	--	yes	note (6)		UNCL	--	--	
07	***RAS/Scum Pump Station No. 2***																			
	Pump Room	F-2	no	below	6.2 (a),9b	--	--	--	X	X	--	WSP	--	--	6		UNCL	--	--	
	Sampler/Access Room	F-2	no	above	6.2 (a),9b	--	X	--	X	--	--	PA	--	--	6		UNCL	--	--	
	Electrical Room	F-2	note (1)	above	n/a	--	X	--	X	X	X	PA	--	yes	note (6)		UNCL	--	--	
	Control Room	F-2	note (1)	above	n/a	--	X	--	X	X	X	PA	--	yes	note (6)		UNCL	--	--	
07	***RAS Centrate Splitter Structure***																			
	RAS/Centrate Splitter Structure	n/a	no	outside	5.2, 9	--	--	--	--	--	--	--	yes	--	--	Maintain - 0.10" WC	UNCL	--	--	
08	***Filters***																			
	Filter Area	n/a	no	outside	5.2, 20	--	--	--	X	X	--	--	--	--	--		UNCL	--	--	
	Bulk Chemical Storage Area No. 2 (Existing)	n/a	no	outside	5.2, 17	--	--	--	--	X	--	--	--	--	--		UNCL	--	--	
09	***Disinfection System***																			
	Chlorine Contact Basins	n/a	no	outside	5.2, 17	--	--	--	--	X	--	--	--	--	--		UNCL	--	--	
	Bulk Chemical Storage Area No. 4	H-4	no	outside	5.2, 17	--	--	--	X	X	--	--	--	--	--		UNCL	--	--	Corrosive
10	***Effluent Pump Station***																			
	Pump Area (Existing)	n/a	no	outside	5.2, 19	--	--	--	--	X	--	--	--	--	--		UNCL	--	--	
11	***Solids Handling Building***																			
	Roll-off Room	F-2	no	above	6.2 (a), 13a	X	--	--	X	X	X	WP	yes	EVAP	--		I	D	2	
	Piping Room	F-2	no	above	6.2 (a), 1	--	--	--	X	X	X	WP		--	--		UNCL	--	--	
	Equipment Room	F-2	no	above	6.2 (a), 1	--	--	--	X	X	X	WP		--	--		UNCL	--	--	
	Polymer Room (Existing)	H-4	no	above	n/a	--	--	--	X	X	X	WP	--	--	--		UNCL	--	--	
	Blending/Centrate/Thickening Tanks (Existing)	F-2	no	above	6.2 (a), 10a	--	--	--	X	X	--	WP	yes	EVAP	6		I	D	1	Odor control, interior only
	Pump Area (Existing)	F-2	no	above	6.2 (a), 9b	--	--	--	X	X	--	WP		EVAP	6		UNCL	--	--	
	Centrifuge Area (Existing)	F-2	no	above	6.2 (a), 12	--	--	--	X	X	X	WP	yes	EVAP	IBC		UNCL	--	--	Odor control, chutes and duct
	Sludge Loading Area (Existing)	F-2	no	above	6.2 (a), 13	--	--	--	X	X	X	WP	yes	EVAP	IBC		UNCL	--	--	
	Air Compressor Room (Existing)	F-2	no	above	n/a	--	--	--	X	X	X	WP	--	EVAP	IBC		UNCL	--	--	
	Electrical Rooms (Existing)	F-2	no	above	n/a	--	--	--	X	X	X	WP	--	yes	note (6)		UNCL	--	--	
	Control Room/Process Lab (Existing)	F-2	yes	above	n/a	--	--	--	X	X	X	DI	--	yes	IBC		UNCL	--	--	
	Restrooms (Existing)	F-2	yes	above	n/a	--	--	X	--	X	X	WP	--	yes	--		UNCL	--	--	
	Elevator Area (Existing)	F-2	yes	above	n/a	--	--	--	--	X	X	WP	--	See Remarks	--		UNCL	--	--	A/C - Equipment Room
	Stairwells (Existing)	F-2	note (2)	above	n/a	--	--	--	--	X	X	WP / SP	--	--	--		UNCL	--	--	

Table 3.28 GWRP Phase III Code Classification Table

Project Name:	Greenfield Water Reclamation Plant - Phase III Expansion
Project Owner(s):	City of Mesa, Town of Gilbert, Town of Queen Creek
Project Location:	4400 S. Greenfield Road, Gilbert, AZ 85296
CM@Risk:	McCarthy Building Companies, Inc.
City of Mesa Project No:	CP0067
Carollo Job No:	9837A.10
Project Schedule:	May 2016 through February 2018 (Design) November 2017 through October 2020 (Construction)

Building Code:	2012 International Building Code (IBC), with Town of Gilbert Amendments
Mechanical Code:	2012 International Mechanical Code (IMC), with Town of Gilbert Amendments
Plumbing Code:	2012 International Plumbing Code (IPC), with Town of Gilbert Amendments
Fire Code:	2012 International Fire Code (IFC), with Town of Gilbert Amendments
Electric Code:	2011 National Electric Code (NEC)
Other Codes:	National Fire Protection Association (NFPA) - 2012 NFPA 820, 2010 NFPA 13, 2000 NFPA 45, 2011 NFPA 58, 2010 NFPA 72 2006 International Energy Conservation Code (IECC) with Town of Gilbert Amendments 2012 International Fuel Gas Code (IFGC) 2010 Americans with Disabilities Act (ADA) The Arizonans with Disabilities Act and Implementing Rules 2013 Building and Construction Regulations Code of the Town of Gilbert, Arizona 2015 Town of Gilbert Land Development Code 2006 Energy Conservation Code, with Town of Gilbert Amendments
Notes:	See General Note 1 for the application of updated code/classification standards in Phase III construction

PLANT AREA	STRUCTURE, ROOM, AREA	BUILDING CODE				FIRE PROTECTION							VENTILATION				HAZARD CLASSIFICATION			
		Occupancy Class	ADA Access	Grade Location	NFPA 820 Table	Comb. Gas Detect.	Heat Detect.	Smoke Detect.	Portable FE	Hydrant Protection	Fire Alarm System	Fire Suppr. Type	Odor Control	Air Conditioning	Rate (ACH)	Remarks	Class	Group	Division	Remarks
11	***Solids Odor Control System***																			
	Odor Control System Area (Existing)	n/a	no	outside	6.2 (a), 26b		--	--		X	--	--	--	--	--		I	D	2	3'-0" Envelope, FE
	Bulk Chemical Storage Area No. 3 (Existing)	n/a	no	outside	6.2 (a), 26b		--	--		X	--	--	--	--	--		UNCL			
12	***Anaerobic Digestion Complex***																			
	Digesters/Sludge Storage Tank (Existing and new)	F-2	no	outside	6.2 (a), 16a	X	--	--	X	X	--	--	--	--	--		I	D	1	10' envelope above, 5' from sides above deck
																	I	D	2	Area 5' to 10' from sides above deck
	Digester Gallery (No Gas) (Existing and new)	F-2	no	below	6.2 (a), 23	--	--	--	X	--	--	WP (egress corridors only)	--	--	--		UNCL	--	--	Potential for submergence
	Access Tower Stairwell (Existing)	F-2	no	above / below	n/a	--	--	--	--	X	X	WP	--	--	--		UNCL	--	--	
	Pipe Chase (Gas Piping)	H-2	no	above / below	6.2 (a), 22a	X	--	--	X	--	--	--	--	--	--		I	D	1	
	Upper Platform and Catwalks (Existing and new)	H-2	no	outside	6.2 (a), 16a	--	--	--	X	X	--	--	--	--	--		I	D	1	
	Elevator Area (Existing)	F-2	no	above / below	n/a	--	X	--	--	X		WP	--	See Remarks	--		UNCL	--	--	A/C - Equipment Room Only
13	***Waste Gas Burners***																			
	Gas Burner Area	n/a	no	outside	6.2 (a), 20a	--	--	--	X	X	--	--	--	--	--		I	D	1	10'-0" Envelope, tanks valves, appurtenances
																	I	D	2	5'-0" Envelope, beyond 10' Envelope
13	***Boiler Building / Cogeneration***																			
	Boiler Room (Existing)	F-2	no	above	n/a	X	--	--	X	X	--	WP	--	EVAP	6/ IMC		UNCL	--	--	
	Electrical Room (Existing)	F-2	no	above	n/a	--		--	X	X	X	WP	--	yes	note (6)		UNCL	--	--	

General Note
1. Updated code/classification standards apply to the new buildings/structures constructed in Phase III Expansion. The existing buildings/structures constructed in the previous phases will not be upgraded to the current codes/classification standards during Phase III construction. Refer to Phase II as-built drawings for existing buildings/structures code and classification.

Building Code Notes
1. Ramp and door per ADA only.
2. Handrailing per ADA only.

Fire Protection Notes
1. WP = Wet Pipe (NFPA 13)
2. WSP = Wet Stand Pipe
3. SP = Dry Stand Pipe (NFPA 14)
4. PA = Pre-action Fire Extinguishing System

Ventilation Notes
1. IBC = Ventilation rate per IBC 2012
2. EVAP = Evaporative Cooler
3. ACH = Air changes per hour
4. NNV = Normally non-ventilated
5. WC = Water Column
6. 0.06 cfm/sf

Electrical Code Note
1. UNCL = Unclassified

Chapter 4 - Project Schedule

This chapter presents a discussion on the project schedule for the design and construction phases of the GWRP Phase III Expansion project.

The overall project schedule is presented in Figure 4.1, which shows the sequencing for the three main phases of the project - the preceding DCR phase (May through October 2015), the current design phase, and the subsequent construction phase.

For this project, the Owners have chosen the construction management at risk (CMAR) alternate project delivery method, in which the construction manager (CMAR) acts as a consultant during design and as a general contractor during construction. Through designer-contractor collaboration, the CMAR method helps expedite the project schedule and offers a number of benefits to the project, including early initiation of site work contracts, pre-selection and/or pre-purchase of certain equipment, ability to choose preferred equipment without sole-sourcing through competitive early procurement strategies, and contractor input to design, constructability and construction sequencing.

4.1 Design Phase Schedule

The Notice-to-Proceed (NTP) to commence the design phase was in May 2016, with completion planned in January 2018 (approximately 20 months total duration). In the preceding Preliminary Design Phase, preliminary design criteria were established for the Phase III facilities, in close consultation with the Owners. Throughout this Detailed Design Phase (30%, 60%, and 90% design phases), the design criteria, process layouts, and control strategies have been further developed and finalized in coordination with the Owners and the CMAR. Some of the other major tasks completed in this phase include permitting assistance and cost model review and validation.

Note that subsequent to the 60% Design submittal, the 90% Design submittal was packaged to support two separate GMPs for ease of permitting and construction - GMP-1 and GMP-2. GMP-1 essentially serves as a precursor to GMP-2 and includes site mobilization and mass excavation around the new headworks, aeration basins, and digester facilities, construction of the digester concrete support structure and foundation, and pre-procurement of long-lead equipment items. GMP-2 encompasses the balance of the work.

The GMP-1 90% Design submittal and the subsequent GMP-1 95% Agency Review submittal were completed in June-July 2017. The GMP-1 Final (100%) Design submittal was completed in September 2017.

The issuance of this Final Report as part of the overall GMP-2 (95%) Agency Review submittal essentially marks the conclusion of the GMP-2 95% Design Phase, in which the "final" treatment processes and design criteria for the Phase III expansion of the GWRP have been established, and detailed drawings and specifications have been developed. As such, this Final Report, together with the GMP-2 95% Agency Review drawings and specifications will be used for review of the GMP-2 work by the regulatory and permitting agencies. The GMP-2 Final (100%) Design submittal is planned for completion in January 2018.

4.2 Construction Phase Schedule

The CMAR will be responsible for developing a detailed construction phase schedule. A project schedule developed by the design team is included for reference. The GMP-1 NTP was in November 2017. The GMP-2 NTP is planned in the first quarter of 2018. Commissioning, testing, training and startup activities are anticipated to take place from October 2019 through April 2020. Final completion is anticipated in the third quarter of 2020.

MESA | GILBERT | QUEEN CREEK

GREENFIELD WATER RECLAMATION PLANT (GWRP) PHASE III EXPANSION

PROJECT SCHEDULE

(September 25, 2017 Update)

ID	Task Name	Duration	Start	Finish
1	**DCR PHASE**	129 days	Tue 5/5/15	Fri 10/30/15
154				
155	**DESIGN PHASE**	407 days	Tue 5/31/16	Wed 12/20/17
156	Design Phase Notice to Proceed (NTP)	0 days	Tue 5/31/16	Tue 5/31/16
157	Task 1 - Project Management	407 days	Tue 5/31/16	Wed 12/20/17
209	Task 3 - Design and Construction Documents	395 days	Thu 6/16/16	Wed 12/20/17
210	Preliminary Design Phase	360 days	Thu 6/16/16	Wed 11/1/17
271	Detailed Design Phase	395 days	Thu 6/16/16	Wed 12/20/17
272	3.7 - Interim (30%) Design Submittal	110 days	Thu 6/16/16	Wed 11/16/16
278	3.8 - Interim (60%) Design Submittal	143 days	Thu 10/20/16	Mon 5/8/17
284	3.9 - Interim (90%) Design Submittal (GMP-1)	55 days	Tue 4/11/17	Mon 6/26/17
290	3.9 - Interim (90%) Design Submittal (GMP-2)	127 days	Tue 4/11/17	Wed 10/4/17
296	3.10 - Agency Review (95%) Design Submittal (GMP-1)	85 days	Tue 6/6/17	Mon 10/2/17
301	3.10 - Agency Review (95%) Design Submittal (GMP-2)	60 days	Thu 9/7/17	Wed 11/29/17
306	3.11 - Final (100%) Design Submittal	15 days	Thu 11/30/17	Wed 12/20/17
309	Task 4 - Coordination with CMAR	402 days	Tue 5/31/16	Wed 12/13/17
334	Task 7 - Quality Management	357 days	Tue 5/31/16	Wed 10/11/17
345	Task 8 - Permitting Assistance	407 days	Tue 5/31/16	Wed 12/20/17
357	Task 9 - Public Outreach Assistance	270 days	Wed 10/19/16	Wed 11/1/17
359				
360	**CONSTRUCTION PHASE**	746 days	Mon 9/18/17	Mon 7/27/20
361	Task 5 - Construction and Testing Phase Services	746 days	Mon 9/18/17	Mon 7/27/20
362	GMP-1 Notice-to-Proceed	8 days	Mon 9/18/17	Wed 9/27/17
363	CoM Council Mtg (GMP-1 Approval)	0 days	Mon 9/18/17	Mon 9/18/17
364	ToQC Council Mtg (GMP-1 Approval)	0 days	Wed 9/20/17	Wed 9/20/17
365	ToG Council Mtg (GMP-1 Approval)	0 days	Thu 9/21/17	Thu 9/21/17
366	CoM NTP Preparation	1 wk	Thu 9/21/17	Wed 9/27/17
367	*GMP-1 Notice-to-Proceed*	0 days	Wed 9/27/17	Wed 9/27/17
368	GMP-2 Notice-to-Proceed	8 days	Mon 1/15/18	Wed 1/24/18
369	CoM Council Mtg (GMP-2 Approval)	0 days	Mon 1/15/18	Mon 1/15/18
370	ToQC Council Mtg (GMP-2 Approval)	0 days	Wed 1/17/18	Wed 1/17/18
371	ToG Council Mtg (GMP-2 Approval)	0 days	Thu 1/18/18	Thu 1/18/18
372	CoM NTP Preparation	1 wk	Thu 1/18/18	Wed 1/24/18
373	*GMP-2 Notice-to-Proceed*	0 days	Wed 1/24/18	Wed 1/24/18
374	General Construction (Months 1-33)	737 days	Fri 9/29/17	Mon 7/27/20
375	GMP-1 Procurement	279 days	Fri 9/29/17	Wed 10/24/18
376	GMP-1 Site Prep	30 days	Wed 11/22/17	Tue 1/2/18
377	GMP-1 Mass Excavation	123 days	Mon 11/27/17	Wed 5/16/18
378	GMP-1 Digester Foundations	156 days	Mon 11/27/17	Mon 7/2/18
379	GMP-2 Construction Work	587 days	Fri 1/26/18	Mon 4/27/20
380	Rehab Work (Months 29-32)	65 days	Tue 4/28/20	Mon 7/27/20
381	Startup/Testing/Training (Months 25-30)	26 wks	Tue 10/29/19	Mon 4/27/20
382	*Substantial Completion*	0 days	Mon 4/27/20	Mon 4/27/20
383	Final Completion (Months 32-33)	13 wks	Tue 4/28/20	Mon 7/27/20
384	*Final Completion*	0 days	Mon 7/27/20	Mon 7/27/20

Filename: **GWRP Phase 3 Exp Schedule ver14.mpp**
Date: **Mon 9/25/17**

NOTE: This schedule is preliminary and subject to change, and will be updated as the project evolves.

PROJECT SCHEDULE

FIGURE 4.1

CITY OF MESA, TOWN OF GILBERT, TOWN OF QUEEN CREEK
GWRP PHASE III EXPANSION

carollo | Brown and Caldwell

pw:\\Carollo/Documents\Client/AZ/Mesa-Gilbert/9837A10/Deliverables/Design Report/Graphics\Fig 4.1

Chapter 5 - Agency Review Documentation

For the Phase III Expansion project, multiple agencies will be involved in the review of project design and in issuing the administrative and regulatory permits for the GWRP. The agencies include the GWRP Owners (City of Mesa, Town of Gilbert, and Town of Queen Creek), ADEQ, Maricopa Association of Governments (MAG), and MCESD.

Specific supporting documentation that is required by the various agencies for the permitting process, and that is not included in Chapters 1 through 4 or the various DIMs or TMs, is defined in this chapter, with the corresponding documents provided in Appendix A. As such, the following checklists developed by ADEQ were used as the basis to prepare the supporting documentation - Individual APP Administrative Completeness Review Checklist, Wastewater Treatment Plant Aquifer Protection Permit Engineering Substantive Checklist, and Individual APP Closure and Post-Closure Plan/Strategy and Cost Estimate Checklist.

A discussion on the following items is included in this chapter, with supporting documents provided in Appendix A, as applicable:

- Financial Demonstration
- Technical Capability Demonstration
- Facility Compliance History
- Operations and Maintenance (O&M) Manual Update
- Contingency Plan Update
- Emergency Response Plan Update
- Construction Management Controls
- System Start-Up Plan
- Closure Plan Update
- Maximum Seepage Rate for Concrete Structures
- Environmental Impacts of Project During and After Construction
- Process Modeling Calculations

5.1 Financial Demonstration

A Letter of Financial Capability certifying that the applicant has the financial resources to operate the facilities in accordance with the terms of the APP is included in Appendix A (see Attachment A.1).

5.2 Technical Capability Demonstration

Design

Carollo Engineers, Inc. is the Design Engineer-of-Record for the GWRP Phase III Expansion project. Russell Wachter, P.E. is the Project Manager for design and is a registered Civil Engineer in the State of Arizona (AZ 35483). Chad Meyer, P.E. is the Project Engineer and is a registered Civil Engineer in the State of Arizona (AZ 41950). Judd Hunemuller is the Design Manager and is a registered Civil Engineer in the State of Arizona (AZ 25317). Resumes for Mr. Wachter, Mr. Meyer, and Mr. Hunemuller are included in Appendix A (see Attachment A.2).

Construction

McCarthy is the General Contractor for this CMAR project and is registered with the Registrar of Contractors for the state of Arizona. Copies of the licenses held by the CMAR in the state of Arizona are included in Appendix A (see Attachment A.2).

Operations

The facility is operated by the City of Mesa. Raymond Aguallo is the Water Reclamation Superintendent, and Michael Davis is the Water Reclamation Supervisor. Copies of Mr. Aguallo's and Mr. Davis' operator licenses are included in Appendix A (see Attachment A.2).

5.3 Facility Compliance History

The Compliance History for the GWRP is included in Appendix A (see Attachment A.3).

5.4 Operation and Maintenance Manual Update

The O&M Manual developed by Carollo Engineers in June 2008 for the GWRP Phase II Expansion project (under City Project No. 02-46), will be updated for this project during the construction phase, to include the expansion to existing components and the addition of new components. Note that the updated manual that will be developed as part of the Phase III project will be a web-based Electronic O&M Manual (EOMM). The updates will be based on the O&M data collected by the CMAR for each piece of equipment or system prior to field quality control testing of equipment, per the requirements of *Specification 01_78_23 - Operation and Maintenance Data,* a copy of which is included in Appendix A (see Attachment A.4).

The EOMM will include the following information for each of the major liquids and solids treatment processes. Additional reference information (i.e., permits, CAD drawings, 3D models, photos, manufacturer O&M manuals) will also be included in the EOMM, as available.

- General Operational Description
- Component Description
- Design Criteria

- Process Control
- Equipment Controls
- Normal Operation
- Alternate Operation
- Emergency Operation
- Fail Safe Shutdown
- Troubleshooting
- Safety Considerations
- Maintenance

If necessary, hard copies of the relevant pages of the completed GWRP Phase III Expansion EOMM will be submitted to the agencies for review.

5.5 Contingency Plan Update

Pursuant to A.A.C. R18-9-A204, a Contingency Plan is required for the GWRP, which describes the actions to be taken if a discharge results in any of the following: a violation of an Aquifer Water Quality Standard, a violation of a discharge limitation, a violation of any other permit condition, an alert level is exceeded, or an imminent and substantial endangerment to public health or the environment. A copy of the current Contingency Plan is included in Appendix A (see Attachment A.5).

5.6 Emergency Response Plan Update

Pursuant to A.A.C. R18-9-A204, an Emergency Response Plan (ERP) is required for the GWRP, which describes the 24-hour emergency response measures to be undertaken to address an imminent and substantial endangerment to public health or the environment. The ERP includes a list of personnel to be contacted in the event of an emergency. A copy of the current ERP is included in Appendix A (see Attachment A.6).

5.7 Construction Management Controls

Pursuant to A.A.C. R18-9-B202.A.6, a description of the construction management controls is required for the GWRP. The approach to providing construction management controls for the Phase III Expansion is to incorporate the provisions of the Division 1 - General Requirements of the Construction Specifications Institute (CSI) specifications in the construction contract documents.

The Division 1 specifications cover all of the major elements required for good construction management controls, including equipment and materials information submittal procedures, special procedures such as maintenance of plant operations during construction, quality control procedures, special tests and inspections, and closeout procedures. Specifically, *Specification 01_14_00 - Work Restrictions*, describes work scheduling, continuous operation of the existing treatment components, compliance with all water quality permits, and shutdown constraints; a copy of this specification is included in Appendix A (see Attachment A.7).

5.8 System Start-Up Plan

Pursuant to A.A.C. R18-9-B202.A.7, a description of the facility Start-Up Plan is required for the GWRP. As such, under the construction contract, the CMAR will be responsible for developing and implementing a Start-Up Plan, including pre-operational testing, expected treated wastewater characteristics and monitoring requirements during startup, expected time-frame for meeting performance requirements, and any other special startup condition that may merit consideration in the individual permit. The specific requirements and responsibilities of the CMAR in developing the Start-Up Plan is included in *Specification 01_75_17 - Commissioning*; a copy of this specification is included in Appendix A (see Attachment A.8).

During start-up and commissioning of the plant, testing for water leakage from new concrete structures will be completed in accordance with *Specification 01_75_19 - Water Leakage Test for Concrete Structures*; a copy of this specification is included in Appendix A (see Attachment A.9).

5.9 Closure Plan Update

In the unlikely event of the closure of the GWRP, the City of Mesa would need to provide a written notice of closure to ADEQ, stating the intent to cease operation of the facility. Following this notice, a detailed Closure Plan would need to be submitted to ADEQ for approval, within 90 calendar days of the notification of closure. The detailed Closure Plan would include the following key information per the requirements of the Arizona Revised Statutes Title 49, Chapter 2, Article 3, Section 252 (A.R.S. 49-252), A.A.C. R18-9-A209, and the plant's APP (No. P-105443): the materials to be removed from the facility; the method used, if any, to treat any material remaining at the facility; the method used to control the discharge of pollutants from the facility; any limitation on future land or water uses; and an estimate of the cost of closure.

A summary of the key closure activities that would be required for the GWRP is presented below.

1. *Materials to be removed from the facility and their destination.*
    - After the closure of the facility (and when influent flow is no longer received into the facility), the volume of wastewater remaining in the plant systems would be treated to the maximum extent feasible, to produce Class A+ reclaimed water, which would then be sent to the various permitted discharging facilities. Note that temporary pumping facilities would be needed to transfer the content from the various process basin(s) to the next downstream treatment process.
    - The sludge in the system would similarly be processed to produce dewatered cake, which would be hauled away to a landfill. There may be some remaining volume of wastewater/solids (biosolids) in the treatment structures that cannot be entirely

processed; this volume would be pumped to the gravity sewer system outside the plant and delivered to the active regional plant. The physical facilities of the GWRP, including concrete tanks (and structural reinforcement bar), equipment, and pipe would be properly demolished and removed from the site. Metal and equipment items may be salvaged and used for the Owners' benefit. All demolition debris would be properly disposed of at a landfill.

- The chemicals used in the treatment processes include bulk sodium hypochlorite (used for disinfection), sodium bisulfite (used for dechlorination), and polymer (used in the solids thickening and dewatering processes). All remaining chemicals would be drained from the chemical storage tanks and used at the Owners' other facilities.
- Diesel fuel is stored on site for use by the power standby generators at the facility. Note that there are no buried fuel tanks; the existing fuel tanks are integral to the generators and will be removed with the generators.

2. *The approximate quantities and the chemical, biological, and physical characteristics of the materials that will remain at the facility.*
    - The proposed closure would eliminate all existing quantities of materials used for the treatment of wastewater at the plant. Certain concrete structures (including the filters and CCBs) may remain on site at the option of the Owners. The Administration Building would likely stay and be re-purposed for the Owners' use.
3. *The methods to be used to treat any materials remaining at the facility.*
    - No wastewater materials or chemicals would remain at the closed GWRP site.
4. *The methods to be used to control the discharge of pollutants from the facility.*
    - All potential pollutants would be removed from the site. No pollutants would remain at the facility. There has never been buried disposal of waste materials or sludge at the GWRP site.
5. *Any limitations on future land or water uses created as a result of the facility's operations or closure activities.*
    - There has been no underground storage or burial of any sludge or waste material at the plant; all the sludge and chemicals have been contained for the life of the facility. The entire facility has been designed, built, and operated in compliance with all the underground aquifer protection rules. It is therefore anticipated that no limitations for land use will result from any closure activities.
6. *The methods to be used to secure the facility.*
    - Security at the facility would be maintained with the existing site wall (13-foot nominal height) around the site, which has lockable gates for entry/exit. The site wall surrounds the entire site, and would remain in place until demolition of the treatment plant unit is complete.

7. *An estimate of the cost of closure.*
   - The total estimated cost of closure is approximately $1.9M, as shown in Table 5.1. Note that the estimated closure cost is based on today's dollars and existing plant conditions. The cost would need to be scaled to reflect costs and plant conditions when closure is planned.

Table 5.1 Closure Cost

Parameter	Cost
Divert Flows Around Plant	$ 345,000
Treat Remaining Flow in Plant	$ 235,000
Pump Remaining Residuals to Sewer	$ 235,000
Haul Remaining Chemicals to Other Facilities	$ 80,000
Flush, Clean and Disinfect Basins	$ 60,000
Remove and Salvage Select Equipment	$ 170,000
Render Basins Inoperable	$ 100,000
Final Lockout / Safety Improvements	$ 25,000
Miscellaneous Costs	$ 150,000
Subtotal Estimated Cost	$ 1,400,000
Contingencies (35%)	$ 490,000
Total Estimated Cost	**$ 1,890,000**

8. *A schedule for implementation of the closure plan and the submission of a post-closure plan.*
   - A schedule for the implementation of the closure plan would be established, if and when the closure of the facility is finalized. A post-closure plan would be prepared and submitted to the ADEQ, in the event that clean closure cannot be achieved pursuant to A.R.S. 49-252. At this time, the GWRP is anticipated to be operational in perpetuity.

5.10 Maximum Seepage Rate for Containment Structures

All new Phase III containment structures will be constructed of concrete; the new containment structures include the following:

- Primary Effluent Junction Box
- Headworks Building No. 2 Screenings Channels and Wetwell Nos. 3 and 4
- Primary Sedimentation Basin No. 3
- Aeration Basin Influent Splitter Structure
- Aeration Basin Nos. 3 and 4
- Mixed Liquor Splitter Structure (expansion of an existing structure)

- Secondary Clarifier Nos. 5, 6, and 8
- RAS/Centrate Splitter Structure (expansion of an existing structure)
- Tertiary Filter Nos. 7-14
- Chlorine Contact Basins

The permeability of mature, good-quality concrete is about $1x10^{-10}$ centimeters per second (cm/sec) (Reference: *Design and Control of Concrete Mixtures*, EB001T, Portland Cement Association). This value translates to a permeability (or seepage rate) of approximately 0.09 gpd/acre, for all the containment structures, which is below the maximum seepage rate of 550 gpd/acre specified in the A.A.C., Title 18, Chapter 9 [R18-9-B204(B)(7)].

5.11 Environmental Impacts of Project During and After Construction

The Phase III Expansion is not expected to have any environmental impacts to the GWRP site and the off-site Contractor's staging yard. The entire site was studied in 2002 for Archaeological impacts by the Mesa-Southwest Museum. The study included a "Class 1 Literature Search and a Class III Archaeological Survey" of the plant site. The study failed to find any previously recorded archaeological sites. Two surface sherd and lithic scatters of poor integrity were noted but did not extend into the project site. The integrity of these scatters was considered low because the scatters did not extend below the soil surface and may likely have been deposited by movement of soil and water (fluvial deposition). No evidence of occupation of the area was found; likewise, no prehistoric or historic features were located at the site.

Environmental impacts to the site and vicinity are not anticipated due to the following measures designed into the plant.

- The risk of chemical contamination will be reduced by constructing secondary concrete containment structures around all chemical storage tanks. There will be no below-ground chemical storage.
- Chemical piping between structures will be installed in lined concrete trenches providing secondary containment.
- Concrete basins will be constructed for all liquids process vessels. These basins will include PVC waterstops embedded in the concrete at constructions joints.
- The tops of all liquids process vessels will be fitted with aluminum covers to suppress the escape of foul air. Odor control systems will be provided for the following liquids processes: Preliminary Treatment (Headworks), Grit Removal, Primary Sedimentation Basins, Secondary Treatment/Aeration Basins, Mixed Liquor Splitter Structure, and RAS/Centrate Splitter Structure.
- Solids treatment will be done inside enclosed buildings and digesters. The Solids Handing Building is also equipped with an odor control system.

There are no anticipated impacts to foliage as the site has previously been cleared and grubbed.

Long term dust control will be managed by re-application of decomposed-granite surfacing material in plant areas disturbed by construction activities. During construction, fugitive dust will be controlled by the Contractor in accordance with the local air quality regulations.

5.12 Process Modeling Calculations

The process modeling calculations for the Phase III Expansion are included in Appendix A (see Attachments A.10 and A.11).

APPENDIX A – AGENCY REVIEW DOCUMENTS

ATTACHMENT A.1 – LETTER OF FINANCIAL CAPABILITY

mesa·az
ENGINEERING
REAL ESTATE SERVICES

mesaaz.gov

20 E Main St Suite 500
PO Box 1466
Mesa, Arizona 85211-1466

August 15, 2017

Monica Phillips
Arizona Department of Environmental Quality
Water Quality Division Groundwater Section
Aquifer Protection Permit Unit
1110 West Washington Street
Phoenix, AZ 85007

Re: Greenfield Water Reclamation Plant (GWRP) Phase III Expansion Project
Aquifer Protection Permit Significant Amendment Application
City of Mesa Project No. CP0067
Letter of Financial Capability

Dear Ms. Phillips,

The City of Mesa is financially capable of operating, closing, and providing post-closure care of the Greenfield Water Reclamation Facility.

If you have any questions or comments, please feel free to contact me at 480-644-3285.

Sincerely,

Joseph L. Schroeder, P.E.
Supervising Engineer
City of Mesa

Cf. Lance Webb, Deputy Engineer
Hebi Li, Senior Civil Engineer, Water Resources

480.644.2251 (tel)
480.644.2577 (tel)
480.644.3392 (fax)

ATTACHMENT A.2 – TECHNICAL CAPABILITY DEMONSTRATION

Russell A. Wachter

Education

MS Environmental Engineering, University of Kansas, 2000

BS Civil Engineering, University of Nebraska-Lincoln, 1991

Licenses

Civil Engineer, Arizona, Nebraska, Nevada

Professional Engineer, Kansas, Colorado, Iowa, Illinois, Oklahoma, Michigan, Missouri, New Mexico, South Dakota, Texas

Professional Affiliations

American Academy of Environmental Engineers, Board Certified Environmental Engineer, Diplomat

American Water Works Association

AZ Water Association

Water Environment Federation

Mr. Wachter, an executive vice president with Carollo Engineers, has over 23 years of experience in the planning, design, and construction of municipal wastewater collection and treatment facilities, water distribution and treatment facilities, and related infrastructure, as well as various odor control systems and environmental permitting processes. He is experienced in alternative project delivery, including construction management at risk (CMAR), progressive design-build (PDB), prescriptive design-build (DB), and job order contracting (JOC). He has also participated in a number of competitive assessments for municipal water and wastewater facilities and has served as principal and project manager for several integrated master planning and modeling projects.

Executive Management

Mr. Wachter has served, and is currently serving, in a number of corporate management roles with the Carollo Engineers organization, providing both operational and strategic oversight and management including:

- *Carollo Board of Directors (2012-2017).* Mr. Wachter was recently elected to his second three-year term on Carollo's Board of Directors. This seven-member Board meets monthly to provide oversight and strategic direction on the company's business growth and operations.

- *Managing Director of Client Services (2015-2017).* Mr. Wachter transitioned from his Client Services Director (CSD) role into the Managing Director (MD) of Client Services, which oversees seven separate CSDs companywide. The MDs for Client Services, Technical Practices, Internal Operations, and Marketing make up the Operations Committee for the company.

- *Client Services Director – Midwest/Southwest Region (2011-2014).* As the Client Service Director (CSD) for the Midwest/Southwest Region, Mr. Wachter provided oversight for Carollo's operations in 10 states (AZ, CO, IL, KS, MO, NE, NM, NV, OK, and TX).

- *Southwest Regional Manager (2008-2010).* Mr. Wachter served as the Southwest Regional Manager, overseeing the business operations in AZ, NV, and UT. A companywide Operations Committee consisting of six Regional Managers and the Chief Operating Officer met on a regular basis to provide oversight and direction on company growth and marketing, project and fiscal management, and resource management and staff development.

- *Business Solutions Practice (2009-2010).* Mr. Wachter served in a senior management oversight role for the newly-formed Business Solutions Practice (BSP), which focused on the delivery of non-traditional engineering consulting services such as financial and economic services, asset management, information technology, business case evaluations, and strategic decision support services.

- *Fiscal Committee (2006-2010).* Mr. Wachter served as the company's internal Fiscal Committee, providing review and oversight on the fiscal management policies and procedures, and review of monthly business barometers and financial statements.

Alternative Project Deliery

- Treatment plant design team leader for the estimated $475-million Metro Wastewater Reclamation District (MWRD) PAR 1088 Northern Treatment Plant (NTP) Program, Denver, Colorado. Carollo and Jacobs Engineering Group (Jacobs) are jointly serving as the Owner's Advisor (OA) for the NTP Program. The objective of NTP Program is to implement wastewater facilities for the treatment and conveyance of wastewater flows for the northern portion of the Denver metropolitan area. The service areas will include portions of the City of Thornton, City of Aurora, and a potential small area in the City and County of Denver in the Lower South Platte and Sandy Creek Basins, as well as two new District members, South Adams County Water and Sanitation District and the City of Brighton. Phase 1 of the NTP is assumed to be online in 2015 and will include design and construction of a 20 to 24 million gallons per day (mgd) plant. Phase 2 will upgrade the plant to 36 mgd by 2025. It is expected that Phase 3 will be complete by 2035 and will have a capacity of 48 mgd, and final build-out capacity is expected to be 52 to 60 mgd. Project includes full liquids and solids treatment trains for the ‘greenfield’ water reclamation facility, expandable to ultimate 64-mgd capacity. Preliminary, secondary BNR, and tertiary treatment is required to meet stringent effluent ammonia and phosphorus limits prior to discharge to the South Platte River. Project responsibilities include lead for the Alternate Delivery Analysis and subsequent Design Definition/Design Refinement phases. A Progressive Design-Build alternate delivery method was selected by MWRD for procurement of the treatment plant facilities.

- Principal-in-charge for the planning, preliminary and detailed design, and construction administration services for the Greenfield Water Reclamation Plant Phase III Expansion in Gilbert, Arizona. The City of Mesa, Town of Gilbert, and Town of Queen Creek wished to provide an additional 16 mgd annual average day flow (AADF) of liquids and solids treatment capacity at the existing plant, complete with the required infrastructure, technology, and environmental features to provide a reliable, efficient, expanded plant to meet the current and future demands of the three Owners. The initial Plant System Evaluation phase will involve extensive coordination with assigned city personnel to determine the overall plant infrastructure requirements to expand the existing plant to reliably treat 32 mgd AADF for liquids and 40 mgd AADF solids equivalent. This includes the evaluation and replacement of some existing equipment and facilities. Design focused on "best value" solutions; improving facilities through life cycle optimization, new technologies, and digester gas management / cogeneration opportunities. Estimated construction cost is $120-$140 million, and targeted plant start-up is by 2019. As part of the detailed design and construction, the Owners selected the construction management at risk (CMAR) alternative project delivery method.

- Project manager for the planning, preliminary and detailed design, and construction administration services associated with the $146-million Greenfield Water Reclamation Plant Phase II expansion in Gilbert, Arizona, jointly owned by the City of Mesa, Town of Gilbert, and Town of Queen Creek. The phase II expansion design project included 16-mgd liquids water reclamation facility, 24 mgd equivalent of solids treatment, and modifications to Mesa's Southeast Water Reclamation Plant to allow transfer of primary and waste activated solids from the Greenfield WRP to the Southeast WRP. The plant is designed to meet Arizona Department of Environmental Quality Class A+ reclaimed water quality standards and Class B solids for land application or disposal. The liquids treatment train includes screening, grit removal, primary clarification, biological nutrient removal (anoxic and aerobic), secondary clarification, tertiary filtration, UV disinfection, and effluent pumping. Solids handling and treatment includes blending, thickening, anaerobic digestion, dewatering, and gas handling. Other site improvements include comprehensive odor control and noise abatement measures, and extensive site screening with berming and landscaping.

Preliminary design efforts included wastewater characterization and particle size distribution testing, computerized process model simulations, and development of a series of technical memoranda. Detailed design efforts included overall coordination and oversight of multiple design engineers, CADD and support staff, and 10 subconsultants under a multi-phased design document deliverables approach. As part of the detailed design and construction, the Owners selected the construction management at risk (CMAR) alternative project delivery method. In addition to continuous interaction with the CMAR consisting of review of cost model development, phased scheduling, and development of early procurement documents, Mr. Wachter also oversaw the implementation of a collaborative project website, comprehensive public involvement program, and multiple administrative and regulatory permitting requirements.

- Technical advisor for the City of Chandler, Arizona Ocotillo Brine Reduction Facility Design-Build, a $73 million advanced water treatment facility to handle an industrial waste stream for Confidential Client.

- Technical Advisor for the City of Chandler, Arizona Ocotillo Water Reclamation Facility Expansion Design. Project involves permitting, public outreach, and preliminary and detailed design for the initial 5-mgd plant expansion. Work efforts also include modifications to the new Airport Lift Station to serve as a joint influent pump station, new joint headworks, membrane bioreactor treatment, disinfection, basin/tank covers, foul air ductwork and associated odor control systems, solids handling facilities, as well as effluent water storage and pumping facilities. Design also includes a new administration building, process laboratory, extensive perimeter landscaping, and coordination with the construction manager at risk (CMAR) contractor.

- Technical advisor for preliminary and detailed design, and the construction administration services associated with the $43-million Unified Plant 2005 (UP05) Expansion, Project A, at the 91st Avenue Wastewater Treatment Plant, Phoenix, Arizona. A Construction Manager at Risk (CMAR) alternative project delivery method was selected for this project. The 91st Avenue WWTP is located on a 560-acre site and is owned by the Sub-regional Operating Group (SROG) consisting of the cities of Glendale, Mesa, Scottsdale, Tempe, and Phoenix. The facility is operated by the City of Phoenix. Originally constructed in 1957, the plant has been upgraded and expanded to the current capacity of 180 mgd, the largest operating WWTP in Arizona. The unit processes consist of screening, grit removal, primary sedimentation, activated sludge with nitrification-denitrification, disinfection, and dechlorination. Solids are digested in anaerobic digesters and then dewatered in centrifuges. The UP05 Expansion is the second unified plant expansion (following the ongoing UP01 Project), and will provide additional flow, biochemical oxygen demand (BOD), and total suspended solids (TSS) capacity needed by the SROG cities. The Project A UP05 Facilities specifically being designed by Carollo under this scope of work include the following: new 96-inch effluent conveyance pipelines; Plants 1-3 chlorine disinfection improvements; Unified Plant chlorine disinfection improvements; a new sludge thickening centrifuge and polymer feed modifications; and, a new Unified Pump Station having an initial firm pumping capacity of 150 mgd, and an ultimate firm pumping capacity of 300 mgd with the addition of future pumps.

- Technical advisor for the Ak-Chin Indian Community Wastewater Reclamation Facility (WRF) planning and design project that involved development of infrastructure including water production, storage, and transmission facilities, wastewater collection system upgrades, and expansion of the existing reclaimed water system. The project also included construction of a new 0.6 mgd initial phase WRF, with the ability to expand to 1.2 mgd capacity. Carollo evaluated potential wastewater treatment process options including conventional activated sludge, SBR, MBR, and various package/proprietary facilities. Based on that evaluation, the Community selected MBR technology for the new WRF facility. GE (Zenon Environmental) was ultimately selected as the membrane supplier, and as part of the design, Carollo is building upon our existing relationships with Zenon to maximize the design efficiency, promote operational flexibility, minimize costs, and add overall value to the project and the Community. The ultimate treatment process for the new WRF will include influent pumping, fine rotary drum screens, zoned activated sludge basins, built-in flow equalization, membrane facilities, and in-vessel, low-pressure ultraviolet disinfection modules. The project initially was intended to be delivered under the Construction Manager at Risk (CMAR) alternate project delivery method, but after failing to reach an acceptable Guaranteed Maximum Price (GMP) with the pre-selected CMAR, the Community ultimately elected to bid the project competitively through a traditional design-bid-build methodology.

- Principal-in-charge for the conceptual, preliminary, and detailed design services associated with the proposed $67-million expansion of the Airport Water Reclamation Facility from 10 mgd to

15 mgd for the City of Chandler, Arizona. This project was delivered using a Construction Manager at Risk (CMAR) alternate project delivery method. As part of the conceptual study phase, Carollo was a subconsultant to Wilson Engineers, focusing specifically on the sludge thickening and odor control systems. Thickening alternatives evaluated included gravity belt, rotary drum, and centrifuges. Odor control alternatives evaluated included wet chemical scrubbers, carbon adsorption, and biofiltration. For the preliminary and detailed design phases, Carollo provided electrical and instrumentation design for the entire expansion to 15 mgd.

- Technical advisor for the City of Surprise SPA - 2.0-mgd Membrane Water Reclamation Facility (WRF) Design and Construction, Surprise, Arizona. The challenge of this project was to design a WRF for SPA 2 that could produce Class A+ reclaimed water—the highest quality reclaimed water in Arizona—within a well-defined budget for design and construction. Assisted in the development of a conceptual design for a 2.0-mgd WRF that utilized common wall construction and a membrane bioreactor. Reclaimed water disposal is accomplished through a combination of recharge basins and on-site vadose zone recharge wells. Also assisted in the preparation of an Aquifer Protection Permit (APP) and an Underground Storage Facility Permit. The SPA 2 - 2.0 mgd Membrane WRF was constructed using the Construction Manager at Risk (CMAR) project delivery method.

- Technical advisor for the City of Prescott, Arizona Airport Water Reclamation Facility Phase 1 Expansion. Assisting in approximately 65% of the design. Phase 1 will be 3.75 mgd capacity, with the phased expansion of the facility planned for an ultimate capacity of 9 mgd. Because this Phase 1 expansion includes a process change (from the existing oxidation ditches to activated sludge BNR) this project is essentially designing the first phase of a new treatment facility. This project was delivered using a Construction Manager at Risk (CMAR) alternate project delivery method.

- Technical advisor for the City of Prescott, Arizona Sundog Wastewater Treatment Plant Generator Electrical Design project. Assisted with design work and plans for the generator installation at the facility. Design included plan sheets and specifications for additional buss installation, conduit duct banks, and connection of the automatic transfer switch to the generator. This project was delivered using a Construction Manager at Risk (CMAR) alternate project delivery method.

- Project manager for the design-build efforts associated with the South Area Service Center for the Town of Gilbert, Arizona. Carollo performed the civil design services for the site as a subconsultant to HDA Architects. The South Area Service Center consists of municipal service buildings, truck storage and maintenance yards, fueling facility, public works offices, and a police facility. Specific civil design efforts included paving and grading, storm water retention, water and sewer utilities, and approximately two miles of roadway widening improvements for Greenfield and Queen Creek Roads.

- Project manager for the design-build rehabilitation, along with Hunter Contracting Company, for the East Warner Road Lift Station in Mesa, Arizona. Due to significant settling of structures at the lift station site, Carollo and Hunter were contracted to perform emergency investigation and construction repair services. Phase I efforts included a geotechnical investigation; testing of the influent sewer line for leakage; leak repair of the wet well and influent sewer line; repair, replacement and removal of supporting facilities, and general site level to reduce further off-site drainage issues. Carollo provided engineering services and general oversight of the construction activities.

Water Supply and Treatment

- Principal-in-charge for a Central Arizona Project Water Treatment Plant (CAP WTP) Utilization Plan and Conceptual Design for Arizona Water Company (AWC). The initial phase of the project focused on developing a 10-mgd surface WTP, the first in Pinal County, along with a feasibility evaluation of transmission and distribution infrastructure to deliver the treated water to the Town of Coolidge and City of Casa Grande. Efforts included a water quality review and goals development, alternative process evaluation, WTP process selection, and conceptual design criteria, costs and schedule development.

- Principal-in-charge of a Water Quality Investigation for The Ranch at White Hills development near Kingman, Arizona, to assist with an evaluation of the lower aquifer water quality as part of an overall assured water supply. Investigation included a comparison of well water quality data and development of three conceptual process options for treating the poor water quality parameters to meet the AWQS.

- Principal-in-charge for the Main St. WTP Security System Design Improvements Phase 1 project, City of Yuma, Arizona. Project included replacing the existing perimeter chain fence and gates with a block wall and metal rolling gates, adding power/signal wiring conduits for future security improvements, and incorporating Phase 1 security components to the existing security system associated with the raw water pump station.

- Project engineer for an integrated membrane system design for the Lake Granbury Surface Water Advanced Treatment System (SWATS) 10-mgd plant expansion, Brazos River Authority, Granbury, Texas. For this project, Mr. Wachter was responsible for reviewing the results of Carollo's microfiltration/ultrafiltration (MF/UF) and reverse osmosis (RO) pilot plant study and completing the preliminary and detailed design of the recommended facility. Final design included pre-selection of a microfiltration/ultrafiltration membrane system capable of producing 7.3-mgd of filtered permeate, and a reverse osmosis membrane system capable of producing 6.0-mgd of RO permeate. Two separate suppliers were selected for the two membrane systems. Following pre-selection of the membrane systems and appurtenances, including the necessary feed and backwash pumps, automatic self-cleaning strainers and cartridge filters, clean-in-place and chemical feed systems, and other supporting equipment, Mr. Wachter coordinated the design of a Membrane Building to house all of the installed equipment, process piping, and supporting systems. This responsibility included development of detailed pre-selection specifications, installation specifications and contract drawings relative to the two separate membrane systems; coordination with in-house structural, mechanical and instrumentation designers; coordination with architectural and electrical design sub-consultants; and continuous interaction with the Owner and prime consultant throughout the fast-track 4-month design duration.

- Project engineer for the Lake Pleasant WTP Water Quality Testing Study for the City of Phoenix Water Services Division, a bench-scale and pilot-scale evaluation of several water sources for a proposed new water treatment facility in northern Phoenix. As part of the bench-scale efforts, Mr. Wachter assisted with the coordination of schedule and protocol development, procurement of laboratory supplies and equipment, and construction of a bench-scale laboratory located at the City's Union Hills WTP. As part of the pilot-scale efforts, he also assisted with the coordination of schedule and protocol development, as well as the procurement and construction of pilot facilities and equipment. Pilot equipment consisted of four separate 3- to 5-gpm conventional treatment (rapid mix, coagulation, and sedimentation) trains, filters (mono-media, dual-media and biologically activated carbon), pre-oxidation systems (ozone and chlorine dioxide), and MF/UF and NF/RO membrane skids. Coordinated lease agreements for dissolved air flotation (DAF) and ballasted flocculation pretreatment pilot trailers, and ultraviolet (UV) disinfection system, from several manufacturers. Pilot facilities were located at the City's Union Hills WTP as well as a remote site located near the Waddell Canal, the proposed location of the proposed new treatment plant pump station intake. Production of the remote pilot facility at the Waddell Canal site included completion of all necessary permit and site requirements with the Central Arizona Water Conservation District, City of Peoria, Arizona Department of Environmental Quality, and Arizona Public Service (for temporary electrical service on site).

- Principal-in-charge for the City of Yuma Main St. WTP Permitting Assistance and Local Limits Development Study. Tasks included working with ADEQ to request additional modified water quality standards associated with implementation of Net Ecological Benefit at the East Mesa Wetlands, additional MSWTP AZPDES Permit Development, and assistance in the generation of a General APP and/or closure plan for the new MSWTP Drying Beds.

Water Reclamation and Wastewater Treatment

- Technical advisor / Quality management for the City of Mesa Northwest Water Reclamation Plant

(NWRWP) Phosphorus Scaling Study, Mesa, Arizona. The NWWRP was experiencing scaling in the digester piping and heat exchanger that has severely impacted operation. The goal of this study was to determine scaling magnitude and extent, and develop a plan for removing the existing scaling and eliminating or controlling future scaling within the solids handling system.

- Principal-in-charge for the SROG Salinity Research on Concentrate Management Pilot Demonstration Study, City of Phoenix, Arizona. Project involves executing pilot-scale demonstration testing on cost-effective concentrate management technologies that are alternatives to the costly and energy intensive solution of employing a brine concentrator. Key objectives include establishing a centralized SROG reclaimed water quality database; describing and documenting reclamation plant-specific water quality treatment goals, where possible; selecting the appropriate technology alternatives for pilot testing that represent responsive solutions for all SROG participants; conducting necessary bench-scale testing and modeling to gather critical information for pilot design; delivering a customized decision support model called the Central Arizona Salinity Management Assessment Toolbox (CASMAT) for SROG facilities; conducting pilot-scale demonstration testing of selected concentrate management technologies; determining chemical, energy, and other O&M costs for life cycle costing; and establishing full-scale implementation guidelines for demonstrated technologies.

- Peer reviewer and Value Engineering (VE) team member for the $321-million Metro Wastewater Reclamation District (MWRD) PAR 1085 South Secondary Treatment Improvements Project, Denver, Colorado. Project includes preliminary and final design of a new 100-mgd secondary treatment complex, including primary effluent pump station, aeration basins, centrate reaeration basins, blower building, mixed liquor return, and RAS/WAS pump stations and associated utility galleries. Additional project responsibilities included assistance with cost acceleration evaluation and supplemental ammonia feed facilities design efforts.

- Peer reviewer for the $48-million Metro Wastewater Reclamation District (MWRD) PAR 942 North Secondary Treatment Improvements Project, Denver, Colorado. This work involves extensive modifications to plant while maintaining plant operations. Secondary improvements included modification to the aeration basin layout, secondary clarifiers, mixed liquor pumping, RAS/WAS systems, and centrate treatment to meet more stringent effluent nitrate and ammonia requirements while providing increased secondary treatment capacity.

- Peer reviewer for the $30-million Metro Wastewater Reclamation District (MWRD) PAR 1225 South Headworks and Grease Processing Facility Improvements Project, Denver, Colorado. This work involves extensive modifications to the existing screening, grit removal and grease processing facilities for the 100-mgd South plant.

- Principal-in-charge for the $66 million Victor Valley Wastewater Reclamation Authority (VVWRA) Hesperia / Apple Valley WRP project, Hesperia, California. Provided planning, preliminary and detailed design services associated with the City of Hesperia and the Town of Apple Valley 2-mgd membrane bioreactor (MBR) scalping WRPs. Project includes two greenfield WRPs, each sized initially at 1 mgd expandable to 2 mgd, with ultimate capacity to 4 mgd., plus a dedicated off-site Hesperia raw sewage pump station and force main. Plant components include fine screening, modified 4-stage Bardenpho activated sludge, MBRs, closed-vessel UV disinfection, effluent pumping, biofiltraton odor control, and supporting appurtenences. Treatment system and support facilities were developed into a common structure with a compact footprint to fit into limited public right-of-ways. GE (Zenon Environmental) was selected by VVWRA as the immersed membrane system supplier.

- Technical advisor and reviewer for the Desert Dunes Water Reclamation Facility Expansion Project, Phase II, City of Yuma, Arizona. Once constructed, the facility’s capacity will increase from 3.0 mgd to 6.0 mgd. The project liquid stream elements include a second grit chamber, second aeration basin, third secondary clarifier, expanded RAS pumping, second module of tertiary filters, second train of UV disinfection, expanded effluent metering facilities, and on-site treated effluent storage and reclaimed water pumping. The project solids stream elements include a new aerobic digester and solids handling control building. Effluent will be disposed of on-site utilizing percolation ponds for groundwater recharge.

- Principal-in-charge for the preliminary and detailed design and construction management services associated with the $48 million Casa Grande Water Reclamation Facility Phase 3 Expansion project, City of Casa Grande, Arizona. Expansion of the existing facility increases the annual average day flow (AADF) design capacity of 12 mgd from its current rating of 6 mgd. Project elements include replacement of free vortex grit removal system to a mechanical system, addition of a fourth anoxic/aeration basin, process optimization of the BNR system, four new secondary clarifiers, a new liquid sodium bisulfite dechlorination system, four new aerobic digesters, and new biosolids handling building. This is the third phase and the final step towards the original master-planned (previous phases designed by Carollo) ultimate plant capacity for this site.

- Principal-in-charge for the design and construction assistance services associated with the $4 million Headworks Replacement project for the City of Eloy, Arizona. Project consisted of a replacement headworks facility for the 2.0-mgd AADF Eloy Wastewater Treatment Plant, including a new influent pump station wet well structure with submersible pumps; a new influent screening structure with automatic step screen; a new in-ground biofiltration odor control system; a new electrical enclosure with MCC, VFDs, and other equipment; and miscellaneous site improvements.

- Project manager for the preliminary and detailed design and construction management services associated with the $10-million Casa Grande Water Reclamation Facility Phase II Expansion, City of Casa Grande, Arizona. This project included a 2.0-mgd expansion of the existing 4.0-mgd facility. The upgrade primarily consists of one additional treatment train, including preliminary screening using step screens, vortex grit removal, nitrification/denitrification in a Carrousel™ basin, secondary clarification, tertiary filtration and aerobic digestion. New facilities include a 9,000 cfm biofiltration system for primary odor control, additional gravity belt thickening, and other supporting solids handling facility modifications. An instrumentation and control system upgrade, miscellaneous electrical system modifications, yard piping and other site improvements were included.

- Principal-in-charge for the study, design, and construction management of the $10 million Aeration Basin Rehabilitation project at the 12-mgd Figueroa Avenue Water Pollution Control Facility (FAWPCF) in Yuma, Arizona. Phase 1 of the project involved an evaluation of the facility basin requirements to meet current seismic code requirements, as well as identifying the necessary modifications to convert to a nitrification-denitrification process. Phase 2 involved the design of the aeration basin rehabilitation with seismic strengthening and baffle walls for process compartmentalization, plus replacement of process aeration blowers and diffusers, electrical system upgrade, and miscellaneous structural modifications.

- Principal-in-charge for an Interim Diversion Pump Station design and construction at the Jack Rabbit Mesa Water Pollution Control Facility (JRMWPCF) in Yuma, Arizona. Project efforts included the addition of a 0.5-mgd submersible duplex pump station and supporting appurtenances required to divert excess flow from the 0.26-mgd rated sequencing batch reactor facility to the City's Desert Dunes WPCF located several miles away.

- Principal-in-charge for the Liberty Water Company and operated by the Litchfield Park Service Company (LPSCO) Palm Valley Water Reclamation Facility Odor Control Improvements study and design. Preliminary design included data collection, process modeling, vendor coordination and regulatory coordination. The study also included generation of a technical memorandum that outlined recommendations for short-term and long-term odor control system solutions. Detailed design services included coordination of the pre-selected system supplier and contractor for the installation of the unit and related appurtenances, including a 14-foot diameter FRP carbon vessel, blower, foul air ductwork, dampers, controls and supports. Carollo also provided coordination with the Maricopa County Environmental Services Department (MCESD) for permit approval of this fast-track "turn-key" procurement and installation project.

- Project manager for the preliminary design phase of an upgrade and expansion project for the

Nogales International Wastewater Treatment Plant (NIWTP), a 17-mgd average flow treatment facility located in Nogales, Arizona and co-owned by the City of Nogales and the U.S. Section - International Boundary and Water Commission (IBWC). Treatability and capacity modifications to the facility were required based on a draft NPDES permit from the EPA Region IX and Arizona Department of Environmental Quality (ADEQ) authorizing the discharge of treated effluent from the NIWTP to the Santa Cruz River. As part of the preliminary design efforts, Mr. Wachter oversaw a number of evaluations regarding the various liquid and solids stream treatment processes for the proposed plant improvements. Mr. Wachter coordinated the preliminary evaluations and development of design criteria, preliminary sizing requirements, site layouts, hydraulic profiles, process flow and instrumentation diagrams, and estimates of probable costs for improvements to the headworks, secondary treatment, disinfection and solids handling facilities. Recommended improvements included influent and effluent flow monitoring and sampling, peak flow equalization using existing lagoons, modifications to existing grit handling and screening equipment, secondary treatment using oxidation ditches for nitrification/denitrification and secondary clarifiers, ultraviolet disinfection facilities, and aerobic digestion and storage using facultative sludge storage lagoons. Additional improvements included new septage receiving, administration/maintenance, and RAS chlorination facilities. Total budgetary costs for the plant expansion were estimated at $37.5 million, with an additional $4 to 5 million in miscellaneous upgrades requested by the client. Mr. Wachter also provided coordination with geotechnical and surveying subconsultants, as well as several value-engineering workshops with a multitude of project stakeholders.

Planning

- Project director for the Water Demand Study Update, City of Chandler, Arizona. Assisted the City in updating their water demand estimates based on the land use plan and classifications from the 2008 Master Plan and supplementing it with updated data and strategies for 2012 and beyond.

- Project director for the Mesa/Gilbert Greenfield WRP Re-rating Desktop Analysis, Mesa, Arizona. Performing a study to evaluate the "true" capacity of the existing facilities based on actual conditions and determine if a potential re-rating of capacity is feasible.

- Project manager / Technical advisor for a Water/Wastewater Service Rate Study for the City of Scottsdale, Arizona. Serving in an advisory role with FCS Group for a Water/Wastewater Service Rate Study to review the current methodology used for determining water and wastewater rates and enhancing such methodology to conform to the results of a water and wastewater cost of service rate study.

- Principal-in-charge for the City of Chandler 2008 Integrated Water, Wastewater, and Reclaimed Water Master Plans, which previously were prepared by Carollo in 2004. The scope of work for the update includes the following project elements: verifying the reliability and redundancy of the existing systems; calibrating and updating the City’s hydraulic computer models; assessing impacts of future high-density areas identified in the General Plan Update, and developing alternative infrastructure scenarios that meet water, wastewater, and reclaimed water system needs.

- Principal-in-charge for the City of Chandler Water, Wastewater, and Reclaimed Water Master Plan Update Addendum study. This master plan update addendum was completed to address changes to the configuration and operation of the City's water system that were proposed after the completion of the Master Plan Update and applied only to the City's water system. This study was performed to evaluate the impacts of re-aligning the City's proposed pressure zones 1 and 2. Several infrastructure improvements were identified through hydraulic analyses that were needed based on the revised pressure zone boundary and distribution system configuration, and were therefore not included in the Master Plan Update.
- Principal-in-charge for the Facilities Master Plan project associated with the Greenfield Water Reclamation Plant (WRP) located in Gilbert, Arizona. The facility, jointly owned by the City of Mesa, Town of Gilbert, and Town of Queen Creek, was designed for 16-mgd liquids treatment and 24-mgd equivalent of solids treatment. A series of technical memoranda were developed for this

project in the areas of flow and loading projections, biological nutrient removal system modeling and capacity analysis, supplemental effluent pumping facilities, carbon addition facilities, disinfection facilities, and interim solids handling facilities.

- Principal-in-charge for the City of Mesa 2009 Wastewater Master Plan Update. Project included evaluation of the City's wastewater collection and treatment system, as well as the reclaimed water system. The City of Mesa is the third largest city in the State of Arizona, with a planning area of 182 square miles and a current population of approximately 464,000. Although many areas of the City are fully developed, build-out is on the not-too-distant horizon. The City expects to have a population of approximately 585,000 by 2030. Additional development opportunities include the Mesa Gateway Airport area, the former General Motors proving grounds, development along freeways, and revitalization along light rail corridors. The City currently owns and operates three separate WRPs, as well as sending a portion of flow to the regional 91st Avenue Wastewater Treatment plant (WWTP) as a member agency of the Sub Regional Operating Group (SROG). In developing this master plan update, the flows that could be delivered to each WRP were quantified to determine which plants could receive increased flows based on necessary infrastructure improvements. Both the capital and annual O&M costs of treating wastewater at each plant were then calculated, and a recommendation was developed based on the optimum (least cost) method of expanding the plants and associated infrastructure. Effluent disposal alternatives were also considered, so that the WRP expansions would produce effluent where it could be disposed of most economically. Biosolids management strategies were evaluated based on current land application practices and trends, and alternatives for future potential conversion to EQ or Class A biosolids, as well as cogeneration using biogas, were discussed. A hydraulic analysis of the collection system was evaluated to identify the infrastructure that will be needed to serve the City in the future, including the impacts of wet weather-related infiltration and inflow. Finally, a comprehensive capital improvement program (CIP) for the various wastewater-related projects was developed in terms of overall project costs and phasing.

- Principal-in-charge for the Regional Capacity Management Facilities (RCMF) project for the Sub-Regional Operation Group (SROG) consisting of the Cities of Glendale, Mesa, Phoenix, Scottsdale, and Tempe. The project focus centered on the anticipated capacity limitations of the regional SROG interceptors under both dry and wet weather flow conditions, and to solve the SROG member community's backbone interceptor capacity issues while working to integrate that solution with the local SROG wastewater programs. Mr. Wachter coordinated the planning and evaluation efforts for the Cities of Mesa, Scottsdale, and Tempe, as well as Northeast Phoenix, to develop an integrated solution set for the eastern portion of the Salt River Outfall (SRO) and Southern Avenue Interceptor (SAI), sufficient to handle the wet weather impacts from a 10-year, 24-hour storm event under current CMOM guidelines.

- Principal-in-charge for the City of Yuma 2008 Integrated Water and Wastewater Master Plan. Mr. Wachter oversaw the development of an integrated planning framework used for evaluating and developing the master planning documents. The water planning effort focused on water demands and resources, water quality issues, water system evaluation, and overall capital planning. The wastewater planning effort focused on the treatment and effluent recharge needs, optimization of plant operations between the City's different facilities, collection system evaluation, and overall capital planning. A supplemental Effluent Management Plan and Biosolids Master Plan were also developed in conjunction with the Integrated Master Plan.

- Principal-in-charge for the City of Scottsdale, Arizona Water Reuse Master Plan Update (as a subconsultant) that included an evaluation of wastewater flow trends, development of wastewater collection and treatment system strategies to meet existing and future needs, and determination of how best to use the reclaimed water.

- Principal-in-charge and project manager for the City of Scottsdale 2008 Integrated Water Master Plan and 2008 Integrated Wastewater Master Plan. As the City approaches build-out and is transitioning from a growth-oriented community to a mature City environment emphasizing economic development, revitalization, and sustainability, the need to update the Water and Wastewater Master

Plans was also recognized. The capacity management program included an overall integrated planning framework for developing Integrated Water and Wastewater Master Plans. The Integrated Water Master Plan focused on water demands and resources, water quality issues, water system evaluation, and overall capital planning. The Integrated Wastewater Master Plan focused on the treatment and effluent recharge needs, optimization of plant operations between the City and SROG, collection system evaluation, and overall capital planning. The capacity management program summarizes and addresses the City's overall water and wastewater needs through planning year 2035.

- Principal-in-charge for the City of Casa Grande 2006 Wastewater Master Plan Update. In order to accommodate the rapid growth expected in the City's build-out service area, the City embarked on a multi-phased approach to assist in the planning, construction, and operation of future facilities and infrastructure. Phase I of this planning effort defined the revised City planning area; developed a conceptual land use plan for the revised City planning area at build-out; utilized the land use criteria to develop estimated future wastewater flows; purchased and verified a hydraulic wastewater model (H2OMap Sewer) for use in planning future wastewater systems; developed three conceptual wastewater collection and treatment options for the revised planning area, developed a conceptual plan for a future reclaimed water distribution system; developed procedures for City review and approval of interim (developer-based) wastewater collection and treatment facilities; and prepared a CAAG 208 Plan Amendment encompassing the revised City planning area.

- Principal-in-charge for the Sewer Service Area Study for the City of Eloy, Arizona. The City is experiencing rapid growth of their planning area in the form of residential and commercial developments. In order to accomplish the administrative and fiscal requirements of the multi-phased planning effort, the City organized a collaborative effort with a consortium of private developers and landowners. Phase I of the study included information gathering, initial development of the consortium, base map preparation of the study area, and preparation for and conducting an initial consortium workshop. Phase II services included further preparation for the initial developer consortium workshop, including preliminary flow calculations and conceptual treatment facility locations for the study area. Phase III services include obtaining and reviewing information on specific planned developments for inclusion in the land use plan; developing performance criteria and design standards for future facilities and infrastructure; purchasing a hydraulic wastewater model and evaluating the existing collection system capacity; evaluating the existing wastewater treatment plan and developing a conceptual expansion plan; developing a conceptual plan for effluent management within the City, developing procedures for City review and approval of interim wastewater collection and treatment facilities; preparing a CAAG 208 Plan Amendment encompassing the City planning area; and developing a conceptual master plan for the City's wastewater system.

Asset Management

- Project manager for the EPA Water System Treatment Improvements Study, City of Surprise, Arizona. Providing an asset management program, sanitary survey, and SCADA upgrades for the City of Surprise that will be completed in two distinct phases. The City will use the results of this study to manage and maintain an inventory of the water system infrastructure assets with the necessary attributes to support maintenance and operations planning, improve decision-making regarding capital investment, and provide reliable service to the City's citizens.

- Principal-in-charge for the Paradise Valley Water System Study for City of Scottsdale, Arizona. Carollo, in conjunction with FCS Group, was contracted to provide assistance in the preparation of a confidential engineering analysis, potential range of values using three standard valuation methods (market, income and cost approaches), and an overall feasibility study for the potential acquisition of the Arizona-American Water Company (AAWC) Paradise Valley Water District (PVWD) system. The intent of the study was to provide the City with an initial level of due diligence with five separate potential system acquisition scenarios and allow the City to decide if advancement of acquisition efforts are warranted. Components of the analysis included water supply rights, treatment facilities, storage and pumping facilities, distribution system piping, valves, meters and fire hydrant for the 7.3-square mile service area.

• Principal-in-charge and project manager for the Water and Wastewater Asset Management Program for City of Scottsdale Water Resources Department, Scottsdale, Arizona. Phase 1 of the comprehensive asset management program (AMP) defined the vision of the project, established best practices for cost-oriented elements required, and defined the "performance metrics" to track and measure progress in attaining specific objectives. Phase 2 of the AMP focused on the inventory of assets and their association condition assessments through desktop analyses, computer modeling and field assessments. Phase 3 focuses on project prioritization and financial analysis. Specific components of the City's water and wastewater facilities enveloped in the AMP include 50-mgd and 27-mgd surface water treatment plants, 12-mgd groundwater treatment plant, 36 active production wells and 3 arsenic treatment facilties; 2,058 miles of water pipe, over 47,000 valves, 10,000 fire hydrants, 302 pressure-reducing stations, 57 booster pump stations, and 37 potable water storage reservoirs; 20-mgd and 1.7-mgd water reclamation facilities, 1,370 miles of sewer pipe, 32,000 manholes, 35 remote lift stations and 5 pumpback stations; and 55 reclaimed water vadose zone recharge wells; all with a calculated replacement value in excess of $6 billion. Assessment included development of a tactical (5-year) and strategic (20-year) asset renewal capital improvement plans, plus development of a program performance measurement and CIP decision flow plans.

• Principal-in-charge for the Surface Water Treatment Plant (SWTP) Asset Management Program (AMP), City of Chandler, Arizona. The AMP is a logical process for developing an Asset Renewal Capital Improvement Program (CIP) reflecting the estimated capital needs and reinvestment timing for the City to maintain its existing asset SWTP infrastructure at a desired level of service. Principal tasks include: asset inventorying, condition assessments, estimation of asset remaining useful life, risk determination and asset prioritization, estimation of replacement costs, and asset renewal (or reinvestment) timing. Current value of the SWTP assets is approximately $105 million with an estimated replacement value of $112 million. Assessment included development of a tactical (5-year) and strategic (20-year) asset renewal capital improvement plans.

• Principal-in-charge for the Standby Generator Assessment Study, City of Chandler, Arizona. This project involved conducting an assessment of the power needs of the City's Municipal Utilities Department complex and sizing of a standby generator. Two existing generators for their possible use in this capacity were also evaluated.

Infrastructure

• Project Director for the City of Chandler, Arizona West Chandler-Santan Freeway Lift Station Design. Project involves analyzing the existing Kyrene Lift Station for possible modification and the rehabilitation and for the design of a new junction structure to an existing 66-inch sewer line. Work also includes design and ADOT encroachment permitting acquisition for the 24-inch diameter wastewater force main to be constructed within an existing utility corridor along the south side of the San Tan 202 Freeway.

• Project director for an upgrade to the City of Chandler, Arizona Pecos Surface WTP existing horizontal paddle-type flocculators in Flocculation/Sedimentation Basins 1-3. Project involves upgrading the existing in-line flash mix and chemical injection system and the current temporary alum drip system installed by plant staff at the Ballasted Flocculation Basins. Project also includes structural inspection of the basins, particularly the coatings on the sludge collectors in the sedimentation basins. This inspection will also provide an opportunity to evaluate concrete integrity, and general condition of the existing flocculators.

• Principal-in-charge for the City of Eloy Auto Read Water Meters Bidding Assistance project. The City of Eloy has applied for stimulus money to replace approximately 2,500 water meters. The new meters will be equipped for automatic reading via fixed base and/or mobile receivers. Mr. Wachter is assisting the City to expedite a bidding and contract award.

• Principal-in-charge for the Southern Arizona Avenue Entry Corridor Water and Wastewater Supply and Capacity Study, Chandler, Arizona.

This project includes the design of replacements and upgrades to approximately 9,400 linear feet of undersized water and wastewater mains and replacements for new storm drain utilities that will serve future planned downtown area needs.

• Project director for the Sewer Assessment and Rehabilitation Study Phase 6, City of Chandler, Arizona. The project involves conducting field inspection of Chandler's collection system as needed, with emphasis on those areas known from the Phase 5 work to be deteriorated. Specific objectives will be to develop an assessment of the City's 66-inch interceptor, develop one manholes rehabilitation project for construction, and one interceptor sewer rehabilitation project for construction.

• Principal-in-charge for the Sewer Assessment and Rehabilitation Study Phases 1 through 5, City of Chandler, Arizona. This project was a multi-year sewer assessment program that began in January 2004. The program was set up to investigate sewer pipelines 15 inches and larger and their associated manholes, with the goal of evaluating the structural condition of the infrastructure. This program serves as a significant component of the City's Capacity, Management, Operations, and Maintenance (CMOM) plan implementation to prevent sanitary sewer overflows by addressing the capacity, condition, and structural integrity of the sewer collection system. Based on this investigation, a prioritized program of rehabilitation, repair, and replacement of critical facilities can be identified to mitigate potential severe maintenance problems and structural failures. This investigation was accomplished through physical inspections of manholes and closed circuit television (CCTV) inspections of sewer pipelines.

• Principal-in-charge for the Sewer Rehabilitation Design and Construction Management Phase Services, City of Chandler, Arizona. Project efforts included rehabilitation of the existing 16-inch sewer interceptor pipelines and numerous sewer manholes in the City's collection system. The design called for CIPP to be installed in the pipelines and manholes to be rehabilitated using epoxy coating systems. Office engineering services were provided during the construction phase.

• Principal-in-charge for the Improvements Project to five sewer lift stations serving the City of Chandler's collection system, City of Chandler, Arizona.

• Principal-in-charge for the City of Chandler Municipal Utilities Department Standby Generator Assessment, Chandler, AZ. Provided engineering services related to an electrical distribution system standby generator for the City of Chandler's Municipal Utilities Department (MUD) Complex. An assessment of the power needs and sizing of a standby generator was conducted, and two existing generators were also evaluated for their possible use in this capacity. Services provided under this contract included project management, data collection and preliminary design, detailed design, and bid-ready documents.

• Project engineer for a sewer diversion structure rehabilitation study for the City of Mesa, Arizona. Preliminary study included the evaluation of ten existing diversion structures for identification and development of alternatives regarding materials of construction and rehabilitation requirements for the structures, linings, and various equipment (including sluice and slide gates, access hatches, ladders, hand railing, grating and rebates, and stop plates and grooves). Recommended improvements, estimates of probable costs and proposed phasing of the various rehabilitation work were included in the evaluation report.

• Principal-in-charge for the City of Chandler Alamosa Wells Equipping Construction Management project, Chandler, Arizona. Services include: project administration, engineering services, field inspection, and special inspection services during the 12-month guarantee / warranty period for equipping two potable drinking water wells. Alamosa Well No. 2 includes a 1,200 gpm vertical turbine well pump (motor equipped VFD), discharge piping and appurtenances, motor control center (MCC), SRP transformer and other electrical components, site lighting, and a SCADA system. Alamosa Well No. 3 includes a 1,400 gpm vertical turbine well pump, discharge piping and appurtenances, MCC, SRP transformer and other electrical components, site lighting, a SCADA system, and CMU perimeter wall and gates.

Permitting

• Principal-in-charge for the City of Chandler, Arizona Comprehensive Permit Upgrades project.

This three-phase study was established to provide services related to updating Chandler's permits. The goal is to allow flexible operations of the City's water reclamation facilities. During the first phase, existing permits were compiled and assessed, current and future operations were analyzed and compared to existing permits, and an action plan for updating the permits was prepared.

- Principal-in-charge for the City of Mesa Northwest Water Reclamation Plant Underground Storage Facility Permit, Mesa, Arizona. The existing Underground Storage Facility (USF) permit that allows surface percolation recharge of the effluent from the City of Mesa's 18-mgd AADF Northwest Water Reclamation Plant (NWWRP) expired in March 2008. Mr. Wachter assisted in conducting studies to support the USF permit renewal application. Before the actual permit application could be prepared, some basic analysis had to be completed on the water balance and ponding in the area of the Salt River upstream and downstream of the NWWRP. This preliminary analysis was intended to determine the relative impact of the inflows into the area from the numerous water sources on the available mounding capacity in the area to allow recharge from the NWWRP. As a result of the need for this preliminary analysis, the project was completed in three separate phases - preliminary evaluation, permit application preparation, and permit application support.

- Principal-in-charge for the Northwest Water Reclamation Facility (NWWRF) Underground Storage Facility (USF) Permit Renewal Assistance project, City of Mesa, AZ. Project efforts included conducting studies to support the USF permit renewal application. Before the actual permit application could be prepared, some basic analysis had to be completed on the water balance and ponding in the area of the Salt River upstream and downstream of the NWWRP. This preliminary analysis was intended to determine the relative impact of the inflows into the area from the numerous water sources on the available mounding capacity in the area to allow recharge from the NWWRP. As a result of the need for this preliminary analysis, the project is being completed in three separate phases - preliminary evaluation, permit application preparation, and permit application support.

Previous ExperienceMunicipal Wastewater

- Project engineer for the feasibility study and preliminary design of various improvements to Sewage Treatment Plant No. 2, City of Wichita, Kansas. As part of the predesign efforts, Mr. Wachter coordinated the preliminary evaluation and development of design criteria, preliminary sizing requirements, and estimates of probable costs for improvements to the headworks facilities, odor control facilities, effluent disinfection facilities, and other miscellaneous facilities throughout the plant. Recommended improvements included a new septage receiving station, odor control biofilter, mechanical screening, vortex grit removal, replacement of influent pumps, clarifier modifications, ultraviolet (UV) disinfection, and other piping modifications throughout the A2-MAD facility. Total project costs were estimated at $11.5 million for the various improvements.

- Project engineer and lead process design engineer for the design of a biosolids handling system upgrade of two wastewater treatment plants, City of Springfield, Missouri. The project involved the centralization of all biosolids handling and treatment from the Southwest Wastewater Treatment Plant (SWP) and Northwest Wastewater Treatment Plant (NWP) by providing for thickened sludge from the NWP to be hauled to an expanded digestion facility at the SWP. The major new additions to the biosolids processing facilities included a sludge wasting force main, gravity belt thickeners and feed pumps, 1.2-MG primary anaerobic digester, sludge/grease/septage unloading facility, truck loading facility, 1.5-MG thickened biosolids storage basin, and odor control biofilter. The major modifications to the existing systems included the conversion of existing secondary digester to primary digester with draft-tube mixers and fixed steel roof, replacement of existing sludge heaters and boiler system, modifications to sludge feed, recirculation and withdrawal piping and equipment, rehabilitation of digester gas handling system, modifications to existing centrifuges for conversion from dewatering to thickening mode, and installation of new variable frequency drives to waste and thickened sludge pumps. The project was split into four separate phases with complete bidding documents developed for each phase, with a total estimated construction cost for all four phases of $7.5 million. Mr. Wachter also provided bidding and award and construction phase services for the various design contracts.

- Project engineer and lead process design engineer on the design of a 7.28-mgd (peak flow) wastewater treatment plant upgrade, City of Great Bend, Kansas. Design work to the existing treatment facility included the design of two new activated sludge aeration basins, flow and sludge control structures, post-aeration and UV disinfection systems, and a sludge handling facility, including gravity belt thickener, double-disc pumps and polymer feed system. Design also included modifications to existing primary clarifier and trickling filter splitter structures, influent screw pump, secondary clarifiers, and installation of new draft-tube mixers and fixed steel covers on existing primary and secondary digesters.

- Process engineering services for a digester improvements project for the Glenbard Regional Wastewater Treatment Plant, Glen Ellen, Illinois, a suburb in eastern Chicago. Mr. Wachter completed a review of existing drawings and documents and made an on-site inspection of the facilities in order to evaluate existing conditions and determine preliminary design improvements for the existing anaerobic digestion system at the plant. The Glenbard WWTP currently utilizes two anaerobic digesters to stabilize primary and waste activated sludge prior to belt filter press dewatering and contract land application. The digesters currently operate as a two-stage system, with a 525,000-gallon high-rate primary digester and a 462,000-gallon secondary digester. As part of the evaluation, Mr. Wachter reviewed the operation of the system and evaluated the digesters covers, mixing systems, recirculation pumps, heat exchangers, gas compressors, and other miscellaneous equipment such as piping, fittings, instrumentation, heaters, fans and gas system appurtenances. A review of the various applicable regulations and codes was also completed. Based on the evaluation, recommendations were made for the future mode of operation of the digestion system, and preliminary design criteria was developed for modifications to the covers, mixing systems, pumping systems, heating systems and gas handling system.

- Project engineer and lead process design engineer on the design of a sanitary interceptor, pump station and force main, Brenner Heights district, City of Kansas City, Kansas. The project involved the design of a 42-inch reinforced concrete pipe (RCP) gravity interceptor, installation of a three 1,600-gpm submersible pump station and valve vault, and approximately 2000 feet of 18-inch ductile iron pipe force main which tied into an existing 30-inch force main. Installation of the force main included crossing the nearby Brenner Heights Creek, interstate highway 70, state highway 32 and railroad, as well as attaining the various permits from the local, state and federal agencies involved. Microtunnelling techniques were used for the various traffic lateral crossings.

- Project engineer for the upgrade of a sanitary packaged submersible lift station at an Egyptian Air Force Base in Sakara, Egypt. The station's proximity to an airport runway required modification to eliminate all aboveground structures. A dual submersible pump package with a rail system was retrofitted into the existing 4-foot diameter manhole/wet well structure. A new below-grade valve vault, which also housed the control panel, was also designed.

- Project engineer for a feasibility study on expansion of an existing wastewater treatment plant, Carthage, Missouri. The 2.7-mgd deep ditch-extended aeration plant was evaluated for alternatives to increase the hydraulic capacity of the system. Four different alternatives were developed which incorporated both short-term and long-term modifications, with hydraulic increases from 25 to 30 percent at approximate costs from $0.05 to $1.05 per gallon of increased capacity.

Previous Experience Municipal Water

- Project engineer and lead process design engineer for the upgrade of a chlorine dioxide chemical feed system at the Quindaro Water Treatment Plant for the Board of Public Utilities of Kansas City, Kansas. This upgrade included the design and procurement of bulk and day chemical storage tanks along with loading and unloading systems, an electric-operated double diaphragm chemical transfer pump, and various site work, piping, containment, and electrical requirements.

Previous Experience Industrial Wastewater

- Project engineer for the development of a work plan for the investigation and remediation of a large petrochemical complex operated by Petroquímica de Venezuela, S.A., located in Los Puertos de Altagracia, Municipio Miranda in the State of Zulia, Venezuela. The work plan was for a site characterization program of the 100-hectare northern portion (Area Norte) of the El Tablazo Complex, including the installation of new monitoring wells as well as groundwater soil and surface water sampling and evaluation, where industrial solid waste from the various production processes was stored. The purpose of the investigation was to collect data necessary for the characterization of the site and identify potential areas of contamination through a multi-phased approach.

- Project engineer for a feasibility study on chemical process sewer rehabilitation and segregation for Abbott Laboratories pharmaceutical facility, North Chicago, Illinois. This fast-track study on the feasibility of converting a gravity chemical drain system to a "non-conventional" system of double-contained piping, lift stations and force mains included evaluation, preliminary layouts, conceptual sizing and routing, and cost estimates upwards of $46 million, as well as various alternatives and recommendations, all completed within a 6-week time frame.

- Project engineer for the development of a response to an EPA chemical safety pre-audit questionnaire for the Fairfax Assembly Plant of the General Motors Corporation in Kansas City, Kansas.

- Project engineer for the development of a work plan for an industrial wastewater treatment system, City of Liberal, Kansas. The 2.5-mgd system consists of a series of anaerobic and aerobic lagoons, which accepts flow from the National Beef Packing production plant. The work plan was developed to meet several Supplemental Conditions to a Discharge Permit required by the State of Kansas Department of Health and Environment. This work plan included the necessary provisions for field testing, sampling and evaluating the loadings, capacities and efficiencies of the various lagoons, as well as evaluating the potential groundwater contamination issues caused by leakage through synthetic liners and earthen lagoon seals. Detailed cost estimates for completing all field and engineering activities detailed in the Work Plan were also developed.

- Provided engineering services for the design of an industrial wastewater pretreatment facility at Cape Canaveral Air Force Station, Florida. His work included the hydraulic analyses needed for over 70,000 linear feet of force main and 18 accompanying dual pump stations. In addition, he was involved with the completion of the various environmental and construction-related permits required for the project. This permit work included close involvement with the Florida Department of Environmental Protection, District Corps of Engineers and the St. John River Water Management District.

- Project engineer for a wastewater treatment study for Granite City Division of National Steel Corporation, Granite City, Illinois. This study included the development and evaluation of treatment alternatives for the removal of zinc and fluoride from the plant's 57-mgd waste stream. Water quality sampling matrix, mass and water balance diagrams were developed in order to facilitate the evaluation of the industrial process waste streams. Also included were sampling and testing of various alternatives, as well as bench and pilot testing for polymer-enhanced filtration at the existing treatment plant.

- Project engineer for a groundwater treatment plant operating under a Consent Decree for the remediation of a CERCLA-identified site in Kansas City, Kansas, over a 7-year period. Responsible for assisting in the management of the day-to-day "pump-and-treat" operations, developing various regulatory reports on a monthly and quarterly basis, overseeing all analytical data and sampling issues regarding the groundwater and processed sludge, and reviewing various regulations to maintain up-to-date regulatory compliance.

Previous Experience Competitive Utility Operations

- Project manager for a competitive assessment of the City of Omaha, Nebraska, Environmental

Services. This study includes the review of the overall organizational, financial and technical structure of the 240-employee group, which consists of two wastewater treatment facilities (including operations and maintenance), sewer maintenance, pump station maintenance, and a quality control group. As part of the Phase I study, Mr. Wachter assisted with the project management duties as well as oversaw the preparation of an organizational needs assessment and technical evaluation, development of a typical private contract operator approach and cost, comparison of performance indicator benchmarks to other public utilities and private companies, and development of an overall Findings and Recommendations report for presentation to the entire staff and management organization.

- Project manager for a competitive assessment baseline evaluation of the Sanitary Services Division, City of Springfield, Missouri. The study included a review of the organizational, financial and technical structure of the Southwest Wastewater Treatment Plant (SWP) operations and maintenance, Northwest Wastewater Treatment Plant (NWP) operations and maintenance, and the laboratory located at the SWP. As part of the baseline evaluation, Mr. Wachter assisted the technical evaluation, development of a typical private contract operator approach and cost, comparison of performance indicating benchmarks to other public utilities and private companies, and development of an overall Findings and Recommendations report.

- Project manager for a competitive maintenance assessment for Johnson County Wastewater (JCW), Johnson County, Kansas. This assessment focused on the various maintenance activities at the larger wastewater treatment facilities owned and operated by JCW. Recommendations for maintenance-related optimization, including criteria selection for a new computerized maintenance management system (CMMS) for the wastewater treatment facilities, were summarized in an Findings and Recommendations memorandum.

- Project manager for a comprehensive competitive utility optimization study for the City of Topeka, Kansas, Water Division. This study included a review of the overall organizational structure of the 138-employee division, including the water treatment plant, distribution, meter shop, customer service, administration and management staff, as well as the preparation of a competitive analysis and improvement plan. As part of the study, Mr. Wachter oversaw the preparation of an organization needs assessment and technical evaluation, development of a typical private contract operator approach and cost, comparison of performance indicator benchmarks to other public utilities and private companies, and a formal collaboration effort between key management and labor personnel to develop an overall action plan for future implementation.

Previous Experience Hydraulic Computer Modeling

- Project engineer for a combined sewer overflow (CSO) study for the City of Kansas City, Missouri. This study included an evaluation of current and background water quality and quantity parameters, followed by an evaluation of the impacts of the CSOs on the various receiving streams throughout the watershed. The evaluation included the use of a computer-generated hydraulic model for simulating the major trunk portions of the existing collection system. EPA's Storm Water Management Model (SWMM) was utilized to assess the impact of various storm events on the existing combined sewer system.

- Project engineer for a major study for the Metropolitan St. Louis Sewer District (MSD), City of St. Louis, Missouri. This study investigated wet weather overflows in three major watersheds within MSD. Overflow locations were logged, quantified and evaluated. An extensive hydraulic analysis using a computerized model was performed within each of the watersheds on various elimination strategies. The HYDRA software and accompanying GIS module was utilized to quantify the flows in the existing and future collection system, and also to assess potential impacts from overflows for various storm events. Overflow elimination techniques were developed, cost estimates established and alternatives evaluated for the elimination of all wet weather overflows in the sewer system.

- Provided modeling assistance with the evaluation of a new collection system for a Wastewater Master Plan for Platte County, Missouri. The HYDRA and GIS Master software were utilized to quantify potential flow rates from non-developed sewer areas in the County. The software also modeled and sized the collection system as needed.

• Project engineer for a Wastewater Facilities Plan, City of Springdale, Arkansas. This study also included the use of a computer-generated hydraulic model to evaluate the existing collection system for future flow extrapolations.

Previous Experience Storm Water Collection and Management

• Project manager on the preliminary and final design services for a flood pump station remediation project for the Unified Government of Wyandotte County/Kansas City, Kansas. The project consisted of an evaluation of various process, structural, mechanical, electrical and code issues for the 32,000-gpm Ohio Avenue Flood Pump Station No. 1 and the 3,000-gpm Central Avenue Flood Pump Station No. 8, both located in Kansas City, Kansas. As part of the project, modifications to both stations were designed and incorporated in bidding documents for construction.

• Project engineer for the design of a 24-inch storm sewer at the Quindaro Water Treatment Plant for the Board of Public Utilities of Kansas City, Kansas. The design included several hundred feet of 24-inch RCP and several storm inlets though an existing parking lot and driveway area heavily congested with existing piping and underground abandoned structures.

Previous Experience Odor Control and Treatment

• Project engineer and lead process design engineer for the design of two odor control biofilters, City of Topeka, Kansas. The existing activated carbon odor abatement system for the 2.3-mgd average flow Shunga Pump Station was abandoned and replaced with two new biofiltration systems, one sized for a 2,500-cfm air flow rate and the second sized for a 800-cfm air flow rate. The design also included upgrades to existing exhaust fans, new ductwork and in-line humidification systems. The project also included major rehabilitation and lining of the influent channel and wet well structure for corrosion control, including the design of a temporary bypass pumping system for use during shutdown of the pump station.

• Project engineer for the development of a Technical Memorandum for odor control alternatives at the 9-mgd average flow Ash Street Pump Station, City of Topeka, Kansas. Alternatives such as activated carbon, wet chemical scrubber, and biofiltration were all evaluated based on technical merit and cost for an exhaust air system with a 2,500-cfm design airflow rate.

• Design engineer of a new 11,500-cfm biofiltration system designed to treat odorous air from existing dewatering centrifuges and a new 1.5-MG thickened biosolids storage basin, as part of the Wastewater Biosolids System Improvements, City of Springfield, Missouri. Design of the biofilter system included above and below-grade ductwork, exhaust fan and an in-line humidification system housed in a precast below-grade structure.

Previous Experience Wastewater Characterization and Sampling

• Worked on a variety of projects where wastewater characterization of various industrial process or municipal waste streams were required. He has been directly involved with the matrix development, actual sampling and flow monitoring activities, as well as the data evaluation and characterization for a host of clients including the following:

- Granite City Steel - Granite City, Illinois

- T.J. Lipton Co. - Independence, Missouri

- Excel Corporation - Dodge City, Kansas

- Marion Labs - Kansas City, Missouri

- FSRAC GWTP - Kansas City, Missouri

- General Motors - Kansas City, Kansas

- Whiteman AFB - Knob Knoster, Missouri

Previous Experience Environmental Permitting

- Worked on the development and completion of a $4 million State Revolving Fund (SRF) loan application through the State of Kansas Department of Health and Environment for a new effluent disinfection and pumping facility at the Oakland Wastewater Treatment Plant in the City of Topeka, Kansas.

- Worked on a variety of projects involving various environmental permits. He recently completed a State of Missouri Department of Natural Resources NPDES permit renewal for a local industrial groundwater treatment plant. This permitting process involved the compilation of over five years of wastewater flow and analytical data. Prior to that, he was solely responsible for the various environmental and construction permits for two major industrial facilities at the Cape Canaveral Air Force Station in Florida. The construction of a new Industrial Wastewater Pretreatment Facility and a new Sludge Dewatering Facility involved permitting for the management and storage of surface water and storm water, potable and nonpotable water distribution system, industrial and domestic wastewater force main and gravity transmission system, and dredge and fill activities in state-designated wetland areas. This permit work included close involvement with the Florida Department of Environmental Protection, the St. John's River Water Management District, and the District Corps of Engineers.

Previous Experience Storm Water Pollution Prevention

- Project engineer for the development of a Storm Water Pollution Prevention Plan (SWP3) for Whiteman AFB, Missouri, and the Corps of Engineers - Kansas City District. The plan incorporated the identification and assessment of existing pollution prevention practices and identified various Best Management Practices (BMPs) for reducing or eliminating storm water pollution as required by state and federal regulatory requirements.

Previous Experience Air Emissions Inventory

- Project engineer in the development of an air emissions inventory for the Fairfax Assembly Plant of the General Motors Corporation in Kansas City, Kansas. The inventory included a tabulation of the physical and operational characteristics of over 600 point-source and fugitive emissions. The extensive data acquisition and compilation process included a review of plant records, personnel interviews and visual observations. A spreadsheet-based format was utilized for the data management.

- Project engineer for updating and expanding an air emissions inventory for the Arlington Assembly Plant of the General Motors Corporation, City of Arlington, Texas. This inventory included a tabulation of the physical and operational characteristics of the point-source and fugitive emissions, with special consideration given to the sources directly affected by air permits with the Texas Air Control Board.

Publications/Presentations

Dillon, L., Wachter, R.A., Vanier, S.M., and Overacre, R. "From Infrastructure Boom to Maintenance: A Case Study for the Development of the City of Scottsdale's Integrated Asset Management Program." Paper presented at the Arizona Water Association 82nd Annual Conference, Glendale, AZ, May 6-8, 2009.

Lopez, C., Wachter, R.A., Meyer, C., Narayanan, B., and Baer, C. "Optimization of Biological Nutrient Removal Systems in Response to Increased Loadings." Proceeding of the 81st Annual Water Environment Federation Technical Exhibition and Conference, Chicago, IL, October 18-22, 2008.

Wachter, R.A., Hunemuller, J., Narayanan, B., Lopez, R., Baer, C., Aguallo, R. “Design Flexibility Key to Addressing BNR Operational Challenges at a Regional Water Reclamation Facility.” Proceedings of the 80th Annual WEFTEC Technical Exhibition and Conference, San Diego, CA. October 13-17, 2007.

Wachter, R.A., Hunemuller, J., and Baer, C. “Learning to ‘Go With the Flow’ - Startup Challenges at the New 16-mgd Greenfield WRP.”

Paper presented at the Arizona Water & Pollution Control Association 80th Annual Conference, Mesa, AZ, May 2-4, 2007.

Narayanan, B., and Wachter, R.A. "Tertiary Filtration Background." Paper presented at the Carollo Engineers Technology Transfer Seminar: Cloth Media Disk Tertiary Filtration and Asset Management Seminar, Mesa, AZ, November 5, 2004.

Bourgeous, K.N., and Wachter, R.A. "Presentation of Testing Results from Selected Plants." Paper presented at the Carollo Engineers Technology Transfer Seminar: Cloth Media Disk Tertiary Filtration and Asset Management Seminar, Mesa, AZ, November 5, 2004.

Bourgeous, K.N., Wachter, R.A., Vanier, S.M., and Berlin, J.S. "Discussion of Existing Depth Filtration Technologies." Paper presented at the Carollo Engineers Technology Transfer Seminar: Cloth Media Disk Tertiary Filtration and Asset Management Seminar, Mesa, AZ, November 5, 2004.

Wachter, R.A., Vanier, S.M., and Bourgeous, K.N. "Discussion of Cloth Media Disk Surface Filtration Technologies." Paper presented at the Carollo Engineers Technology Transfer Seminar: Cloth Media Disk Tertiary Filtration and Asset Management Seminar, Mesa, AZ, November 5, 2004.

Narayanan, B., Wachter, R.A., Vanier, S.M., and Berlin, J.S. "Discussion of ADEQ Class A+ and CDHS Title 22 Requirements." Paper presented at the Carollo Engineers Technology Transfer Seminar: Cloth Media Disk Tertiary Filtration and Asset Management Seminar, Mesa, AZ, November 5, 2004.

Wachter, R.A., Vanier, S.M., and Bourgeous, K.N. "Comparison of Aqua-Aerobics AquaDisk vs. Kruger Hydrotech." Paper presented at the Carollo Engineers Technology Transfer Seminar: Cloth Media Disk Tertiary Filtration and Asset Management Seminar, Mesa, AZ, November 5, 2004.

Wachter, R.A., Vanier, S.M., and Berlin, J.S. "Current Filtration and Disinfection Approaches at Large-Scale Treatment Facilities for Water Reuse." Paper presented at the Rocky Mountain Section of the American Water Works Association/Rocky Mountain Water Environment Association 2004 Annual Conference, Grand Junction, CO, September 11-15, 2004.

Wachter, R.A., Farmer, W.F., and Lopez, R. "Addressing Impacts of Recycle Nutrient Loads on BNR Performance at a New Regional WRF." Paper presented at the Arizona Water & Pollution Control Association 77th Annual Conference, Mesa, AZ, May 5-7, 2004.

Wachter, R.A. "The Use of Biofiltration for Odor Control of Wastewater Conveyance and Treatment Facilities." Masters Thesis, University of Kansas, May 2000.

Wachter, R.A. "Odor Control Alternatives for Large Pumping Stations in Topeka, Kansas." Paper presented at the Water Environment Federation Association Annual Conference. April 1998.

Wachter, R.A. "Does Your Industrial Sewer System Today Meet the Requirements of Tomorrow? The Use of Non-Conventional Sewer Systems." Paper presented at the Missouri Water Environment Association Annual Conference. March 1996.

Wachter, R.A. "Development of Best Management Practices and Storm Water Pollution Prevention Plans for Multi-Activity Industrial Facilities." Paper presented at the Missouri Water Environment Association Annual Conference. April 1995.

Chad D. Meyer

Education

MS Civil and Environmental Engineering, South Dakota State University, 1999

BS Civil Engineering, South Dakota State University, 1999

BS Computer Science, Southwest Minnesota State University, 1993

Licenses

Civil Engineer, Arizona

Professional Engineer, New Mexico

Water Treatment Plant Operator, Grade 3, New Mexico

Wastewater Treatment Plant Operator, Grade 3, New Mexico, Grade 4, Arizona

Water Treatment Plant Operator, Grade 4, Arizona

Professional Affiliations

American Society of Civil Engineers

American Water Works Association

Water Environment Federation

AZ Water Association

Construction Management Association of America

Mr. Meyer, an associate with Carollo, has more than 23 years of combined experience in planning, design, construction, commissioning, and operation of water and wastewater treatment facilities, wastewater collection systems, water distribution systems, related infrastructure, as well as associated permitting. His general qualifications include knowledge of a broad range of civil engineering and environmental theory and construction practices and their application to a wide variety of civil and environmental engineering programs and projects. He also possesses an in-depth knowledge of water and wastewater treatment processes, methods, and equipment.

Water

- Project engineer for the City of Peoria, Arizona Greenway Water Treatment Plant Chemical Feed Tank Additions Design-Build and Job Order Contract. This project included the design and installation of a 9.950-gallon sodium hydroxide storage tank, a 6,000-gallon coagulant aid polymer tank, and replacement of an existing fluoride tank with a larger 6,000-gallon storage tank. Mr. Meyer also provided construction management and inspection services.

- Project engineer for the City of Phoenix, Arizona Val Vista Water Treatment Plant East and West Plant Filter Process Controls Upgrade Project. This phased $2.5 million, one-year design-build / job order contract project included the upgrade of existing filter controls software and hardware and chemical feed system upgrades. It also involved implementation of automatic backwash sequence logic, along with hardware components associated with the distributed control system.

- Assistant project manager for the City of Phoenix, Arizona Val Vista Water Treatment Plant Job Order Contracting Project. Mr. Meyer coordinated various projects from design through construction that City staff identified as needed improvements. The project included identifying the problem, investigating alternative solutions, reporting the recommendation, estimating the construction cost and construction drawing development.

- Project engineer and technical support for the Southern Nevada Water Authority, Las Vegas, Nevada Alfred Merritt Smith Water Treatment Facility Process Improvements Project. This project consisted of the addition and expansion of various chemical delivery systems including gaseous chlorine, sulfuric acid, calcium thiosulfate, sodium hydroxide, liquid ammonia, and polymer.

- Project engineer and resident project representative for the City of Phoenix, Arizona Union Hills Water Treatment Plant Phase I Miscellaneous Modifications and Improvements. The project scope consisted of the modifications to various chemical feed and containment areas including ferric chloride, fluorosilicic acid, polymer, sodium hydroxide, sulfuric acid, and chlorine gas scrubber systems. The scope of work also included electrical, instrumentation and control system modifications, and installation, along with other appurtenant and related work required to complete the project. Responsibilities included all field inspection activity; review of shop drawings, progress schedule, and payment applications; and processing of submittals, requests for information, and issuance of clarifications. In addition, responsibilities also included design, preparation, and issue of change orders required for the completion of the work. All work performed under this contract required that the plant be able to perform normal daily operations with minimal contractor interference.

- Project engineer and resident project representative for the City of Phoenix, Arizona Union Hills Water Treatment Plant Landscape Planting and Irrigation Project. The scope of work included the complete rework of all on-site landscaping and associated irrigation systems. Responsibilities included all field inspection activity; review of shop drawings, progress schedule, and payment applications; and processing of submittals, requests for information, and issuance of clarifications. In addition, responsibilities also included design, preparation, and the issue of any change orders required for the completion of the work. All work performed under this contract required that the plant be able to perform normal daily operations with minimal contractor interference.

- Project engineer and resident project representative for the City of Phoenix, Arizona Union Hills Water Treatment Plant Storm Drain Modifications Project. The project scope involved rerouting of all on-site storm water flow to appropriate retention areas. Responsibilities included all field inspection activity; review of shop drawings, progress schedule, and payment applications; and processing of submittals, requests for information, and issuance of clarifications. In addition, responsibilities also included design, preparation, and the issue of any change orders required for the completion of the work. All work performed under this contract required that the plant be able to perform normal daily operations with minimal contractor interference.

Wastewater Treatment

- Civil engineer for the City of Chandler, Arizona Ocotillo Water Reclamation Facility Process Facility Assessment.

- Project manager for the Mesa / Gilbert Greenfield Water Reclamation Plant Re-rating Desktop Analysis, jointly owned by the City of Mesa, Arizona. Performed a study to evaluate the "true" capacity of the existing facilities based on actual conditions and determine if a potential re-rating of capacity was feasible.

- Project manager for the City of Mesa, Arizona Northwest Water Reclamation Plant Phosphorus Scaling Study. The facility was experiencing scaling in the digester piping and heat exchanger that severely affected operation. The goal of this study was to determine scaling magnitude and extent, and develop a plan for removing the existing scaling and eliminating or controlling future scaling within the solids handling system.

- Project manager for the City of Prescott, Arizona Prescott Airport Water Reclamation Facility Phase 1 Expansion. Mr. Meyer is assisting in approximately 65% of the design portion of this project. This Phase 1 project has an initial 3.75 mgd capacity, with the phased expansion of the facility planned for an ultimate capacity of 9 mgd. Because this Phase 1 expansion includes a process change from the existing oxidation ditches to activated sludge biological nutrient removal (BNR), this project is essentially designing the first phase of a new treatment facility.

- Process engineer for the City of Surprise, Arizona Special Planning Area 2 (SPA2) 2.0 mgd Water Reclamation Facility Construction Administration and Start-Up Services. This membrane bioreactor (MBR) facility was designed to produces Class A+ reclaimed water within a well-defined budget for design and construction. Conceptual design used a common wall construction and MBR that eliminated the need for conventional sedimentation, filtration, and disinfection facilities, thus minimizing excavation, concrete, and electrical construction costs. Construction of this project utilized the Construction Manager at Risk (CMAR) project delivery method.

- Project engineer for the City of Phoenix, Arizona 91st Avenue Wastewater Treatment Plant Primary Sludge Booster Pump Design and Construction Administration and Inspection Project. Work efforts included design and installation of three primary sludge booster pumps to convey unthickened primary sludge to the centrifuges, and construction within the plant’s Solids Thickening Facility. Design of the flow modulating valves and portions of the new primary sludge pipelines convey primary sludge from Plants No. 1, No. 2, and No. 3, UP01, and UP05 to the existing centrifuges. The project efforts include coordination with the 91st Avenue Wastewater Treatment Plant Three-Phase Digestion and Solids Handling Facility Centrifuge Expansion projects.

- Project engineer for the City of Phoenix, Arizona 91st Avenue and 23rd Avenue Wastewater Treatment Plants Biosolids Disposal Study. The goal of this study was to establish an overall strategic biosolids management plan for both the 91st Avenue Wastewater Treatment Plant and the 23rd Avenue Wastewater Treatment Plant and to recommend strategies to establish diversity, flexibility, cost-effectiveness, and environmental stewardship.

• Project engineer for the City of Prescott, Arizona Airport Water Reclamation Facility and Sundog Wastewater Treatment Plant Technology Assessment Master Plan Studies. The project included a treatment technology assessment, facility master plans, existing facility evaluations, and a biosolids master plan. Responsible for evaluating the existing Airport Water Reclamation Facility and developing the facility master plan, which has a current design capacity of 2.2 mgd (oxidation ditches), with a master planned build-out capacity to either 9.6 mgd or 15 mgd. The evaluation and master plan included an evaluation of alternative treatment processes, and the phased expansion included a major process change and biosolids treatment for beneficial use. Effluent is reclaimed via recharge and golf course irrigation. Mr. Meyer is also assisting with the Sundog Wastewater Treatment Plant evaluation (5.3- mgd oxidation ditches), master plan, and biosolids master plan. The project expansion included a technical and economic feasibility evaluation for diverting raw wastewater from the Sundog Wastewater Treatment Plant to the Airport Water Reclamation Facility. During the analysis, the team used the City's collection system master plan and model that was prepared for the City during a previous project.

• Project manager for the City of Phoenix / Sub-Regional Operating Group (SROG), Arizona $46-million 91st Avenue Wastewater Treatment Plant Unified Plant 2005 (UP05) Expansion Project A preliminary design, detailed design and construction administration services. The unit processes consist of screening, grit removal, primary sedimentation, activated sludge with nitrification-denitrification, disinfection, and dechlorination. Solids handling processes include centrifuge thickening, anaerobic digestion, and dewatering via centrifuges and drying beds. The UP05 Expansion is the second unified plant expansion (following the UP01 Project) and provides additional flow, biochemical oxygen demand (BOD), and total suspended solids (TSS) capacity needed by the SROG cities. The Project A UP05 Facilities under this scope of work included: new 96-inch effluent conveyance pipelines; Plants 1-3 chlorine disinfection improvements; Unified Plant chlorine disinfection improvements; a new sludge thickening centrifuge and polymer feed modifications; and a new Unified Pump Station with an initial pumping capacity of 150 mgd (ultimate pumping capacity of 300 mgd).

• Project manager (as a subconsultant) for the City of Chandler, Arizona $67-million Airport Water Reclamation Facility Phase II Expansion preliminary design, detailed design, and construction administration services. The design will allow the plant the capability of handling 15 mgd of influent flow, an increase of 5 mgd from the existing capacity of 10 mgd. The liquids stream unit processes include influent pumping, fine screening, a selector basin, biological nutrient removal facilities, secondary clarification, tertiary filtration, and disinfection system. Solids stream processes include the design of a new thickening building, expansion of existing anaerobic digesters, and modifications to the dewatering facility. As part of the overall expansion project, the scope of work focused specifically on the facilities electrical, instrumentation, and control design.

• Process engineer for the City of Mesa, Arizona Wastewater Master Plan Update. Updated the wastewater model, conducted flow monitoring, and calibrated the model. Developed alternatives to deliver wastewater to four different water reclamation plants, identified the optimal water reclamation plan, and evaluated the impact of storm inflows on the collection system capacity. Developed reclaimed water strategies to dispose of reclaimed water in the most beneficial ways to the City. The project also included recommendations for biosolids removal, disinfection, and phosphorus removal at the water reclamation facilities, and development of a phased Capital Improvement Program (CIP).

• Project manager for the Greenfield Water Reclamation Plant Facilities Master Plan, jointly owned by the City of Mesa, Town of Gilbert, and Town of Queen Creek, Arizona. The project involved conducting a detailed evaluation of the biological process performance of the existing facilities to evaluate the effect of increased wastewater strength. The evaluation included collection and analysis of plant operational data, as well as developing process models using BioWin™ and Biotran software to evaluate the capacity of the existing secondary process using alternative modes of operation. The evaluation involved a supplemental carbon addition alternatives assessment that included in-basin fermentation and external carbon addition, to improve the biological denitrification process.

- Project manager for the City of Phoenix, Arizona Cave Creek Water Reclamation Plant Disinfection System Enhancements and Archaea Bio-System Pathogen Management Pilot Project. Project scope included the identification and design of recommended improvements to the existing hypochlorite system, which serves as a backup to the UV system, and an investigation of the feasibility of alternative disinfection processes to increase the reliability of the facility's disinfection system. These services included assistance with permitting issues and documentation. Further scope objectives included determining the effectiveness of Archaea Solutions, Inc., technology for controlling the levels of pathogenic organisms in the plant under actual operating conditions as measured upstream, within, and downstream of the existing Trojan UV 4000 disinfection system.

- Project engineer for the City of Glendale, Arizona $12-million Arrowhead Ranch Water Reclamation Facility Miscellaneous Improvements Project planning, preliminary, and detailed design services. The liquids stream unit processes include grinding, influent pumping, fine screening, biological nutrient removal (BNR) facilities, secondary clarification, tertiary filtration, and UV disinfection. The primary focus of the project was to increase the overall efficiency of the plant's continuous backwash tertiary filters and medium pressure UV disinfection system. The secondary project focus pertained to the minor modifications required on a plant-wide basis.

- Project engineer for the City of Phoenix, Arizona Cave Creek Water Reclamation Plant Process Control Optimization Study. Project scope included the examination of the entire plant process and infrastructure for potential improvements. This included the pumping systems, process basins, chemical feed systems, solids handling, and electrical systems. The project encompassed an investigation of key issues, suggested improvements, and a summarized technical report that detailed conceptual engineering recommendations, constructability issues, and construction and engineering costs.

- Project engineer for planning, preliminary and detailed design, and construction administration services for the Greenfield Water Reclamation Plant Phase III Expansion in Gilbert, Arizona. The City of Mesa, Town of Gilbert, and Town of Queen Creek wished to provide an additional 16 mgd annual average day flow (AADF) of liquids and solids treatment capacity at the existing plant, complete with the required infrastructure, technology, and environmental features to provide a reliable, efficient, expanded plant to meet the current and future demands of the three Owners. The initial Plant System Evaluation phase will involve extensive coordination with assigned city personnel to determine the overall plant infrastructure requirements to expand the existing plant to reliably treat 32 mgd AADF for liquids and 40 mgd AADF solids equivalent. This includes the evaluation and replacement of some existing equipment and facilities. Design focused on "best value" solutions; improving facilities through life cycle optimization, new technologies, and digester gas management / cogeneration opportunities. Estimated construction cost is $120-$140 million, and targeted plant start-up is by 2019. As part of the detailed design and construction, the Owners selected the construction management at risk (CMAR) alternative project delivery method.

- Project engineer for the $156-million Greenfield Water Reclamation Plant Phase II Expansion, jointly owned by the City of Mesa, Town of Gilbert, and Town of Queen Creek, Arizona planning, preliminary and detailed design, and construction administration services project. During the preliminary design phase of the project, Mr. Meyer assisted with wastewater treatment process alternatives analysis, process unit sizing, plant hydraulics, site layout planning, and cost estimation, and development of a series of technical memoranda. The Owners' selected the Construction Management at Risk (CMAR) project delivery method, along with self-performance of the resident inspection services, and a portion of the "traditional" construction administration services.

Responsibilities during the detailed design phase of the project involved further definition of the cost model, coordination with owners and operators, development of early procurement documents, and the development of plans and specifications. During the construction phase of the project, Mr. Meyer responded to requests for information, change orders, and requests for alternates; submittal reviews; developed the facility Operation and Maintenance (O&M) Manual; performed general, electrical, and mechanical inspection; and, assisted with project management and monitoring activities throughout the construction administration phase.

- Project engineer for the Craig Realty Group Outlets in Anthem, Arizona Wastewater Treatment Plant Closure and Decommissioning Project. Responsibilities included preparation of a closure plan to meet the requirements of the Arizona Department of Environmental Quality (ADEQ), design of a new sewer line connection to the City of Phoenix collection system, demolition and removal of the existing 50,000-gpd packaged wastewater treatment plant, and the subsequent restoration of the site for future use and improvement. During the construction phase of the project, Mr. Meyer was responsible for all field inspection activity; review of shop drawings, progress schedule, and payment applications; and processing of submittals, requests for information, and issuance of clarifications. Other work efforts included design, preparation, and issue of change order requests.

- Project engineer for the City of Mesa, Arizona East Warner Road Lift Station Rehabilitation Design-Build Project. Due to significant settling of structures at the lift station site, the scope of work required an emergency investigation and construction repair services. Phase I efforts included a geotechnical investigation; testing of the influent sewer line for leakage; leak repair of the wet well and influent sewer line; repair, replacement, and removal of supporting facilities; and general site level to reduce further off-site drainage issues. Mr. Meyer provided engineering services and general oversight of the construction activities.

- Project engineer for the City of Peoria, Arizona Beardsley Road Water Reclamation Facility Phase II Expansion. Responsible for preliminary design of tertiary filters including treatment process analysis, cost estimating, site layout planning, process unit sizing, and the development of technical memorandum evaluating tertiary filtration alternatives.

- Project engineer for the City of Chandler, Arizona $15-million Chandler Heights Recharge Facility. The overall 113-acre property dedicates five acres to police department use, and 108 acres for wetlands/recharge development, in which the reclaimed water management component of the project could include surface spreading basins for recharge, as well as surface storage capacity to promote efficient reclaimed water utilization. The primary goal of the project was to develop a recharge site, with an important secondary goal of developing an integrated, multi-use park facility, including education, passive recreation, habitat, and trails.

- Project engineer for the City of Phoenix, Arizona $42-million Cave Creek Water Reclamation Plant. Project scope included the design, construction, and commissioning of a new award-winning 8-mgd water reclamation facility. The plant is master planned for an ultimate capacity of 32-mgd. Processes include influent pumping, preliminary treatment, primary sedimentation, biological nutrient removal, secondary clarification, deep-bed continuous backwash filtration, medium pressure UV disinfection, and effluent pumping. Other site developments included comprehensive odor, noise, and visibility control measures to ensure acceptance within the community. The facility is capable of achieving an effluent meeting Arizona Department of Environmental Quality (ADEQ) Class A+ reclaimed water quality standards.

Responsibilities during commissioning included assuming a supervisory role in the operation and maintenance of the plant during the start-up period, overseeing a staff of operators, conducting on-site and coordinating off-site laboratory process control analyses, coordinating necessary and preventative plant maintenance, and tracking contractor warranty items. Also assisted with development of the facility start-up plan, and provided assistance with the testing and check out of major unit processes along with associated instrumentation and control systems.

Responsibilities during construction included assisting the resident engineer with field inspection activity; the review of shop drawings, progress schedule, and payment applications; the processing of submittals, requests for information, and issuance of clarifications. Responsibilities also included assistance in the design, preparation, and the issue of any change orders required for the completion of the work.

Miscellaneous project responsibilities included assistance with preparation of the facility operation and maintenance manual; and preparation, application, and approval for various permits required by the Environmental Protection Agency, Arizona Department of Environmental Quality (ADEQ), Maricopa County, and the City of Phoenix. Permitting included, but was not limited to, air quality, approval of construction, drywell installation, hazardous materials management, and storm water pollution prevention.

Previous Experience - General

- Certified wastewater treatment plant operator and graduate laboratory analyst at the Municipal Wastewater Treatment Facility, Bookings, South Dakota. Responsibilities included the sole monitoring, operation, and maintenance of various treatment plant processes during evening and weekends. In addition, numerous laboratory techniques were employed in wastewater analysis to maintain efficient plant operation, and to ensure facility met both state and federal effluent guidelines.

- Graduate laboratory assistant, Northern Great Plains Water Research Center, South Dakota State University, Brookings, South Dakota. Responsibilities included the implementation of standard methods in the analysis of diverse samples of industrial and municipal water and wastewater. Common parameters tested for included BOD, COD, TSS, TDS, ammonia, chlorine, and various others. Experience also includes the use of atomic absorption spectrometry, gas & liquid chromatography, and mass spectrometry in analysis of organics, nitrates, Ca, Mg, Na, etc.

- Certified equipment operator / construction laborer for the Robert L. Carr Construction Company, Marshall, Minnesota. Project scope included a $10-million, 3-mgd expansion to the Municipal Wastewater Treatment Plant in Windom, Minnesota. Processes included influent pumping, pretreatment with screening and cyclone grit removal, extended aeration, secondary clarification, gravity filtration, chlorine contact disinfection, and heated aerobic digestion. Responsibilities included the interpretation of engineering plans and specifications to actively participate in all phases of structural and mechanical construction. Experience with installation of cast-in-place and precast concrete, reinforcing bar, yard pipe; mechanical equipment, pumps, piping, and valves; clarifier equipment, weirs, and baffles; centrifugal blowers, fine and coarse bubble aeration diffusers; filter media, underdrain, and backwash systems; various electrical and instrumentation equipment.

Publications/Presentations

Lopez, C., Meyer C.D., Buhrmaster, D.F., and Lowe, J. “The Effects of Increased Wastewater Strength in Northern Arizona.” Paper presented at the Arizona Water Association 83rd Annual Conference, Glendale, AZ, May 5-7, 2010.

Meyer, C.D., and Mally, A.J. “The Commissioning of a Large Pump Station – Lessons Learned.” Paper presented at the AZ Water Association (formerly AWPCA) 83rd Annual Conference, Glendale, AZ, May 5-7, 2010.

Bernard, B., King, K., and Meyer, C.D. “Bryozoans - The Unrecognized Treatment Plant Menace.” Paper presented at the Arizona Water Association 82nd Annual Conference, Glendale, AZ, May 6-8, 2009.

Lopez, C., Wachter, R.A., Meyer, C.D., Narayanan, B., and Baer, C. “Optimization of Biological Nutrient Removal Systems in Response to Increased Influent Loadings.” Paper prepared for at the 81st Annual Water Environment Federation Technical Exhibition and Conference, Chicago, IL, October 19-22, 2008.

Meyer, C.D., Doller, J.D., Childs, E., Bondegard, J., Fathali, B., and Robinson, G. “Archaea Augmentation and Coliform Reduction at an Arizona Water Reclamation Facility.” Paper presented at the 81st Annual Water Environment Federation Technical Exhibition and Conference, Chicago, IL, October 19-22, 2008.

Meyer, C.D., Doller, J.D., Childs, E., Bondegard, J., Fathali, B., and Robinson, G. “Archaea Augmentation and Coliform Reduction at an Arizona Water Reclamation Facility.” Paper presented at the Arizona Water and Pollution Control Association 81st Annual Conference, Mesa, AZ, May 2-4, 2008.

Meyer, C.D., and Briggeman, T. "The Physical Hydraulic Modeling of a Large Pump Station - Lessons Learned." Paper presented at the Arizona Water and Pollution Control Association 80th Annual Conference, Mesa, AZ, May 2-4, 2007.

Meyer, C.D., and Shirley, G.E. "The Clean Closure of a Wastewater Treatment Plant - Lessons Learned." Paper presented at the Arizona Water and Pollution Control Association 79th Annual Conference, Mesa, AZ, May 3-5, 2006.

Judd L. Hunemuller

Education

BS Construction Engineering, Iowa State University, 1977

Licenses

Civil Engineer, Arizona

Professional Affiliations

American Society of Civil Engineers

Construction Management Association of America

Mr. Hunemuller, an associate vice president with Carollo, has more than 28 years of experience in the management, planning, design, and construction of water, wastewater, storm water, and solid waste facilities. He has extensive experience working with the Arizona Department of Environmental Quality (ADEQ) and other local government agencies. Mr. Hunemuller has worked as project manager and project engineer on municipal master planning projects, pipelines, pump stations, wastewater treatment plants, solid waste handling facilities and landfills, storm water collection and disposal facilities. He also has extensive construction management experience.

Construction Management

- Construction manager for the City of Chandler and Town of Gilbert, Arizona Santan Vista Water Treatment Plant Construction Management project. The new 24-mgd water treatment plant includes a raw water control area, an ozone pipeline contactor; a treatment complex consisting of ballasted flocculation, ozone basin contactor, and deep bed monomedia filters; 6 MG finished water reservoir; finished water pump station; recovered water treatment units; drying beds; admin. facility; electrical building and chemical complex. Carollo served as construction manager, utilizing a Construction Manager at Risk (CMAR) project delivery contract. Work efforts included construction quality control, materials testing, inspection and communications coordination, and 8-hour and 7-day equipment start-up testing oversight.

- Construction manager / design manager for the planning, preliminary and detailed design, and construction administration services for the Greenfield Water Reclamation Plant Phase III Expansion in Gilbert, Arizona. The City of Mesa, Town of Gilbert, and Town of Queen Creek wished to provide an additional 16 mgd annual average day flow (AADF) of liquids and solids treatment capacity at the existing plant, complete with the required infrastructure, technology, and environmental features to provide a reliable, efficient, expanded plant to meet the current and future demands of the three Owners. The initial Plant System Evaluation phase will involve extensive coordination with assigned city personnel to determine the overall plant infrastructure requirements to expand the existing plant to reliably treat 32 mgd AADF for liquids and 40 mgd AADF solids equivalent. This includes the evaluation and replacement of some existing equipment and facilities. Design focused on "best value" solutions; improving facilities through life cycle optimization, new technologies, and digester gas management / cogeneration opportunities. Estimated construction cost is $120-$140 million, and targeted plant start-up is by 2019. As part of the detailed design and construction, the Owners selected the construction management at risk (CMAR) alternative project delivery method.

- Project engineer and resident engineer for the design and construction of the $146-million Greenfield Water Reclamation Plant Phase II Expansion located in Gilbert, Arizona, and jointly owned by the City of Mesa, Town of Gilbert, and Town of Queen Creek. This project included a 16 mgd liquids water reclamation facility, 24 mgd equivalent of solids treatment, and modifications to Mesa's Southeast Water Reclamation Plant to allow transfer of primary and waste activated solids from the Greenfield Water Reclamation Plant to the Southeast Water Reclamation Plant. The plant is designed to meet Arizona Department of Environmental Quality (ADEQ) Class A+ standards and Class B solids for land application or disposal. The liquids treatment processes include preliminary treatment via screening and grit removal, primary sedimentation, biological nutrient removal, secondary clarification, tertiary disk filtration, low-pressure UV disinfection, chemical feed systems, and effluent pumping. Solids handling and treatment includes blending, thickening, anaerobic digestion, dewatering, and gas handling. Other site improvements include comprehensive odor control and noise abatement measures to assist with the acceptance by the community, and extensive site screening with berming and landscaping.

Responsibilities included overall civil facilities design, as well as mechanical process design. Civil facilities included roadway drainage and utility design and coordination. Mechanical process design included headworks screening and pumping, primary sedimentation, primary sludge and scum pumping, grit removal, and effluent pumping. The project was delivered under a Construction Manager at Risk (CMAR) contract.

Infrastructure

- Project manager for the Town of Gilbert, Arizona South Area Service Center Design-Build Project. Civil and site work design included a combined public works storage yard, police facilities, and a school district vehicle storage and service facility. Design and construction of the 20-acre site was performed under a design-build arrangement. Other work efforts included paving, grading, access roadway, parking, and utilities, and roadway improvements to Greenfield and Queen Creek roads adjacent to the site.

- Project manager for the Town of Queen Creek, Arizona Queen Creek Water Company Engineering Evaluation Phase 2. This project was a follow-up to the Phase 1 analysis for the Town to purchase the Queen Creek Water Company. The primary goal of the Phase 2 assessment was to determine the presence of any major engineering problems within the Queen Creek Water Company system that would deter the Town from purchasing the system. The facilities and operations of the privately held Queen Creek Water Company system were compared with accepted design and operation standards for publicly owned and operated municipal water systems.

Water

- Project manager for the City of Chandler, Arizona Pecos 60 mgd Surface Water Treatment Plant Asset Management project.

- Civil designer for the City of Austin, Texas Travis Water Treatment Plant 4 Final Design engineering design for a new 50 mgd (ultimate capacity of 300 mgd) water treatment plant. Responsibilities included drainage, paving, wet utilities, yard piping, and site perimeter security in the environmentally sensitive Hill Country in Austin. Highlights of the new plant include design of several miles of new tunnels including a raw water tunnel more than 350 feet deep, use of lime softening, creating buildings using “green” technology to achieve a LEED rating of Silver, and harvesting rainwater to reduce runoff and maximize efficient water use.

Wastewater

- Field inspector for the City of Mesa, Arizona Northwest Water Reclamation Plant Phosphorus Scaling Study. The facility was experiencing scaling in the digester piping and heat exchanger that had severely affected operation. The goal of this study was to determine scaling magnitude and extent, and develop a plan to remove the existing scaling and eliminate or control future scaling within the solids handling system.

- Civil engineer for the preliminary design of Metro Wastewater Reclamation District, Denver, Colorado Northern Treatment Plant, a new 24-mgd (60-mgd ultimate capacity) regional facility. Responsibilities include design definition (up to 30 percent) for civil site design including wet utilities, grading, flood plain modification, and some U.S. Army Corps of Engineers 404 permitting and FEMA map revisions (C.L.O.M.R.). Follow-up work included coordination with the design-build team throughout detailed design and construction.

- Civil engineer for the City of Eloy, Arizona Phase 1A Expansion Headworks Replacement Project. Work efforts included a minor APP amendment and an Air Quality Permit through the Pinal County Air Quality Board. Mr. Hunemuller played a key role in the start-up activities for the project.

- Project engineer for Robson Communities, Arizona SaddleBrooke Ranch Water Reclamation Plant located near Oracle Junction, Arizona. This package plant serves a retirement community of approximately 6,300 homes built over a 20-year period. The initial phase of the .8-mgd plant (ultimate 1.2 mgd) provides sufficient capacity for the first 13 years of development.

Planning

- Civil and process engineer for the City of Scottsdale, Arizona Water and Wastewater Asset Management Program. This project was driven by the need to prioritize CIP projects and to shift from an expansion-oriented organization to one that focuses on maintaining and preserving existing assets and making the best use of monetary and personnel resources. The Asset Management Program provided the City with a "roadmap" for the maintenance and replacement of system assets, while balancing the level of service objectives with financial optimization and risk management. The project involved strategic visioning, asset guidelines, data needs assessment, asset inventory, condition assessments, asset replacement costs, project prioritizing all of the City's water, wastewater, and reclaimed water assets—both above-ground and below-ground—and systematically categorizing them into a detailed customizable database for ongoing implementation by the City. With a total asset replacement value of over $6 billion, the City is now primed to include the necessary asset reinvestments in the planning of required revenues and reserves.

- Civil and process engineer for the City of Chandler, Arizona Surface Water Treatment Plant Asset Management Program. The Asset Management Program is a logical process for developing an Asset Renewal Capital Improvement Program (CIP), reflecting the estimated capital needs and reinvestment timing for the City to maintain its existing asset facility infrastructure at a desired level of service. Principal tasks included asset inventory, condition assessments, estimation of asset remaining useful life, risk determination and asset prioritization, estimation of replacement costs, and asset renewal or reinvestment timing. Current value of the facility assets is approximately $105 million with an estimated replacement value of $112 million. The assessment included development of a tactical (5-year) and strategic (20-year) asset renewal COP.

Previous Experience - Construction Management

- Resident engineer for chlorine reduction facilities at the Pima County, Arizona Ina Road Wastewater Treatment Plant. Facilities include bulk storage and chemical feed and facilities for sulfur dioxide and emergency vapor scrubbers.

- Project superintendent on the City of Phoenix, Arizona Estrella Wastewater Treatment Plant, with a $1.5 million construction cost, and an estimator on various water projects.

- Project superintendent for the expansion of the Colorado Springs, Colorado Sand Creek Wastewater Pump Station. The project consisted of upgrading the pump station capacity from 3.0 mgd to 4.0 mgd through the addition of piping, valves, pumps, and a stand-by generator.

- Project superintendent for the Denver Metro Sewage Disposal District, Colorado Brantner Gulch Pump Station Construction Project. The project consisted of a deep concrete pump station with a pumping capacity of 3 mgd utilizing vertical shaft centrifugal pumps powered by variable frequency drives.

- Resident engineer for the Tucson Water, Arizona Avra Valley Emergency Transmission repair project, which provided emergency repairs to 5 miles of 42-inch diameter force main for Tucson Water, Arizona. His duties included on-site inspection of corroded pipeline and determination of appropriate methods of repair.

- Resident engineer for the Tucson Water, Arizona Central Arizona Project (CAP) Pressure Regulating Stations during Phase I, and project engineer for the hydroelectric facilities during Phase I and Phase II.

- Construction manager and inspector for the City of Flagstaff, Arizona Christmas Tree and Paradise Road Water Storage Reservoirs Project, which consisted of the construction of two circular, buried reservoirs (2.5 MG and 5 MG). One reservoir is pre-stressed concrete and one is cast-in-place concrete. The associated transmission main consists of nearly two miles of 18- and 24-inch pipeline. The environmental sensitivity of the project was a key factor, as the project was being constructed on

Forest Service property, and great lengths were taken to leave the site as undisturbed as possible.

- Construction manager and engineer for the City of Prescott, Arizona 5.0-MG Storage Reservoir and Transmission Line Construction.

- Resident engineer and inspector for the new entry and exit roadways and bridges at the Tucson International Airport, Arizona. The project consisted of two concrete bridge structures supported on drilled piers, plus new asphaltic concrete roadways, lighting, and signage.

Previous Experience - Water

- Project engineer for a City of Page, Arizona Water Master Plan. Mr. Hunemuller assessed the water system hydraulics for the master plan.

- Project engineer for City of Phoenix, Arizona Transmission Pipelines. Project consisted of 16-inch water lines in Van Buren and 52nd Street. The project included design of 1 mile of ductile iron pipe waterline.

Previous Experience - Water Reclamation

- Project engineer for Greenfield South Water Reclamation Plant Equalization Basin and Lift Station Design, jointly owned by the City of Mesa, Town of Gilbert, and Town of Queen Creek, Arizona. Responsible for the design of equalization basins and 4.3 mgd wastewater lift station. This project consisted of two pumping stations, one pumps to a pair of 140-foot diameter equalization basins and the second pumps from the basins through an 11-mile force main. The lift station consisted of two individual pump stations, 2 flow equalization tanks, and 11 miles of dual 16- and 10-inch diameter force mains.

- Project engineer for the City of Phoenix, Arizona for the Foothills Water Reclamation Plant Upgrade that included design of a water reclamation lift station and pipeline.

Previous Experience - Pump Stations

- Project manager and project engineer for the Tucson Water, Arizona Northeast "E" Zone (Sabino Canyon) Reservoir Potable Water Booster Station Design. Project included design of booster and fire flow pumps with hydro-pneumatic surge control tanks, on-site disinfection facilities, and flow metering and controls.

- Project manager and project engineer for the Tucson Water, Arizona Wilmot (Southeast "D" Zone) 4,500-gpm Booster Station Design. This booster station was designed for future expansion to a 12,000-gpm booster station and includes vertical turbine pumps, a tablet chlorination system, recirculation system for the on-site 5 MG reservoir, inflow and outflow metering, and reservoir wash down piping. A significant project feature is the deep valve vault located at the same elevation as the bottom of the buried 5-MG reservoir, which is fitted with a sump pump system to remove groundwater from underneath the reservoir.

Previous Experience - Sewer System

- Project manager for the Town of Gilbert, Arizona Sewer System Evaluation and Design. Mr. Hunemuller managed the study of the Gilbert's Downtown Heritage District sewer system. The study determined existing and future land uses, developed unit flows for the various land types, determined cumulative existing and projected future flows for the system, evaluated the system's current physical condition, and recommended various rehabilitation methods. A 3-year phased program for replacing the sewer system was prepared and implemented for the replacement of over 24,000 feet of existing sewer in downtown Gilbert. The scope of work also included developing a preliminary design report, sizing the system, drafting legal descriptions to obtain easements, obtaining construction and railroad crossing permits, and identifying utility conflicts.

Previous Experience - Storm Water Infrastructure

- Project manager and project engineer for the City of Chandler, Arizona Erie-Hartford storm drain, the Arrowhead Basin Storm Water Pump Station, and 1.5 miles of 36-inch storm water force main. The pump station consists of a 25-foot deep pump station structure with three 30 cfs submersible pumps powered by an on-site natural gas fueled generator housed in a separate new generator building. These projects were identified in the City's 1999 Storm Water Management Master Plan Update and will complete a large portion of the City's storm water projects for the downtown area. Mr. Hunemuller also assisted in preparation of Chandler's 1999 Storm Water Management Master Plan, Storm Water Pipe Guidelines, and updating of the Chandler's Technical Design Manual for Storm Water Facilities.

- Project manager and project engineer for the Erie and Galveston Streets storm water pipeline design. Mr. Hunemuller served as project manager for the design of 3 miles of storm water drainage pipeline system located in urban-residential Chandler, Arizona. Pipelines ranged in size from 30" to 60" diameter. The work included site improvements at the City's regional storm water retention basin at Galveston Street and Chippewa Street for which upgrades to access, lighting, landscaping, and drainage were designed.

- Environmental engineer for the Flood Control District of Maricopa County, Arizona Drainage Erosion Control and Design Manual. Assisted in developing a manual to guide agencies, engineers, and contractors in complying with the EPA requirements and procedures for the NPDES General Permit for storm water discharges from construction sites. Contained in the manual are descriptions of control measures and management practices to reduce erosion, minimize sedimentation, and control non-storm water discharges. The manual also contained a five-step process and fact sheet for identifying, selecting, designing, and implementing Best Management Practices for erosion control on construction sites.

Previous Experience - Other Experience

- Project engineer for the City of Scottsdale, Arizona, 400 ton per day Solid Waste Transfer Station, a twin tunnel facility with stationary grappler, vehicle scale equipment and dust and odor control systems.

- Mr. Hunemuller also worked on the City of Mesa, Arizona Transfer Station Feasibility Study where he was responsible for preliminary site layouts, site evaluation, preliminary transfer station layouts and cost estimates.

- On the City of Scottsdale, Arizona Visitor and Education Center Feasibility Study, Mr. Hunemuller was responsible for analyzing the site impacts of the proposed center and its interface with the existing Transfer Station.

- For the Town of Gilbert, Arizona Mr. Hunemuller analyzed the feasibility of a solid waste transfer station to reduce haul costs to a number of regional landfills and prepared design and construction costs for various sizes of transfer stations.

- For the City of Albuquerque, New Mexico Mr. Hunemuller designed leachate collection systems and liner for Cell 5 at the Cerro Colorado Landfill.

IMPORTANT NOTICE
YOU MUST:

1.) REPORT DISASSOCIATION OF QUALIFYING PARTY **IN WRITING** WITHIN 15 DAYS. [SEE A.R.S. § 32-1154(A)(18)]
2.) REPORT A CHANGE OF ADDRESS **IN WRITING** WITHIN 30 DAYS. [SEE A.R.S. § 32-1122(B)(1)]
3.) REPORT ANY TRANSFER OF OWNERSHIP OF 50% OR MORE IMMEDIATELY [SEE A.R.S. § 32-1151.01]
4.) REPORT ANY CHANGE IN LEGAL ENTITY, SUCH AS ANY CHANGE OF THE OWNERSHIP IN A SOLE PROPRIETORSHIP OR CHANGE OF A PARTNER IN A PARTNERSHIP OR THE CREATION OF A NEW CORPORATE ENTITY. [SEE A.R.S. § 32-1124(B)(F) § RULE R-4-9-110]

Mc Carthy Building Companies Inc

1341 N Rock Hill Rd
Saint Louis, MO 63124-1441

THIS IS YOUR IDENTIFICATION CARD
DO NOT DESTROY

LICENSE EFFECTIVE THROUGH: 10/31/2019
STATE OF ARIZONA
Registrar of Contractors CERTIFIES THAT
Mc Carthy Building Companies Inc

CONTRACTORS LICENSE NO. 80911 CLASS B-1

General Commercial Contractor

THIS CARD MUST BE PRESENTED UPON DEMAND

JEFF FLEETHAM, DIRECTOR

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CONTRACTORS LICENSE NO. 80910 CLASS A

General Engineering

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General Engineering

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JEFF FLEETHAM, DIRECTOR

ADEQ Water and Wastewater Certified Operators Database Search Results

This table was generated from ADEQ's AZURITE database.

Date Generated: June 08, 2017

Operator ID	OP004828
City	QUEEN CREEK
Name	RAYMOND D AGUALLO
E-mail	raymond.aguallo@mesaaz.gov
Work Phone	(480) 644-2358

Certification	Grade	Effective Date	Expiration Date
Grade 4 Wastewater Collection System Operator	4C	27-Jun-1991	30-Jun-2019
Grade 3 Water Distribution System Operator	3D	27-Jun-1991	30-Jun-2019
Grade 4 Water Treatment Plant Operator	4T	31-Jul-1993	30-Jun-2019
Grade 4 Wastewater Treatment Plant Operator	4W	11-Jul-1990	30-Jun-2019

Results 1 - 1 of 1

Go to Page: **1**

Search Again

ADEQ Water and Wastewater Certified Operators Database Search Results

This table was generated from ADEQ's AZURITE database.

Date Generated: August 16, 2017

Operator ID	OP009236
City	MESA
Name	MICHAEL D DAVIS
E-mail	Mike.Davis@mesaaz.gov
Work Phone	(480) 644-6012

Certification	Grade	Effective Date	Expiration Date
Grade 2 Water Treatment Plant Operator	2T	02-Oct-1999	30-Jun-2019
Grade 4 Wastewater Treatment Plant Operator	4W	14-May-2009	30-Jun-2019

Results 1 - 1 of 1

Go to Page: **1**

Search Again

ATTACHMENT A.3 – FACILITY COMPLIANCE HISTORY

FACILITY COMPLIANCE HISTORY

The Greenfield Water Reclamation Plant (GWRP) located in the Town of Gilbert has not received any Notices of Violation, Consent Orders, or Compliance Orders in the period beginning January 2012 until the present time. During this timeframe, the GWRP has experienced the following discharge exceedances and has received two (2) Temporary Emergency Waivers (TEWs).

- 12/15/13 Turbidity Average 2.23 NTU

Note: The plant applied and received for a Temporary Emergency Waiver for Turbidity due to an unforeseen plant upset, therefore the City of Mesa did not receive a NOV for the following exceedances.

- 10/8/16 Turbidity Average 3.96 NTU
  Turbidity Max 20.0 NTU

- 10/9/16 Turbidity Average 4.55 NTU
  Turbidity Max 20.0 NTU

- 10/10/16 Turbidity Average 5.34 NTU
  Turbidity Max 16.7 NTU

- 10/11/16 Turbidity Average 8.33 NTU
  Turbidity Max 12.6 NTU

- 10/12/16 Turbidity Average 6.48 NTU
  Turbidity Max 11.38 NTU

- 10/13/16 Turbidity Average 3.34 NTU
  Turbidity Max 5.16 NTU

- 1/6/17 Turbidity Maximum 17.0 NTU - Note: The plant was under a Temporary Emergency Waiver for Turbidity at this time.

ATTACHMENT A.4 – SPECIFICATION 01_78_23 - OPERATION AND MAINTENANCE DATA

SECTION 01_78_23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Preparation and submittal of Operation and Maintenance Manuals.

1.02 GENERAL

A. Submit Operation and Maintenance Manuals as specified in technical sections.

B. Make approved manuals available at project site for use by construction personnel and Owner.

1.03 SUBMITTALS

A. Draft Operation and Maintenance Manuals:
   1. Submit prior to shipment of equipment or system to site.
   2. Shipment will be considered incomplete without the draft Operation and Maintenance Manuals.
   3. Quantity:
      a. Hard copy: 4 sets.
      b. Electronic: 2 USB Flash Drives.

B. Final Operation and Maintenance Manuals:
   1. Make additions and revisions in accordance with Owner's and Engineer's review comments on draft manuals.
   2. Submit approved Operation and Maintenance Manuals at least 30 days prior to Functional Testing and at least 60 days prior to Owner Training.
   3. Quantity:
      a. Hard copy: 4 sets.
      b. Electronic: 2 USB Flash Drives.

1.04 PREPARATION

A. General requirements:
   1. Provide dimensions in English units.
   2. Assemble material, where possible, in the same order within each volume.
   3. Reduce drawings and diagrams to 8-1/2 by 11-inch size, if possible unless otherwise specified.
   4. Complete forms on computer, handwriting not acceptable.
   5. Delete items or options not provided in the supplied equipment or system.
   6. Provide package control system annotated logic for PLC, if applicable.

B. Hard copy requirements:
   1. Binders: 3-ring with rigid covers.
      a. Break into separate binders as needed to accommodate large size.
   2. Utilize numbered tab sheets to organize information.

3. Provide original and clear text on reproducible non-colored paper, 8-1/2 by 11-inch size, 24-pound paper.
4. Drawings larger than 8-1/2 by 11 inch:
    a. Fold drawings separately and place in envelope bound into the manual.
    b. Label each drawing envelope on the outside regarding contents.

C. Electronic requirements:
    1. File format:
        a. Entire manual in PDF format.
            1) Include text and drawing information.
            2) Provide a single PDF file even if the hard copy version is broken into separate binders due to being large.
            3) Create PDF from the native format of the document (Microsoft Word, graphics programs, drawing programs, etc.).
                a) If material is not available in native format and only available in paper format, remove smudges, fingerprints, and other extraneous marks before scanning to PDF format.
                b) Hard copy record drawing requirements:
                    (1) Provide a single multipage PDF file of each set of the scanned drawings.
                    (2) Page 1 shall be the cover of the Drawing set.
                c) At file opening, display the entire cover.
                    (1) Scan drawings at 200 to 300 dots per inch (DPI), black and white, Group IV Compression, unless otherwise specified.
                    (2) Scan drawings with photos in the background at 400 dots per inch (DPI), black and white, Group IV Compression.
            4) Pagination and appearance to match hard copy.
            5) Searchable.
            6) Scanned images are not acceptable.
            7) Bookmarks:
                a) Bookmarks shall match the table of contents.
                b) Bookmark each section (tab) and heading.
                c) Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
                d) At file opening, display all levels of bookmarks as expanded.
            8) Thumbnails optimized for fast web viewing.
        b. Drawing requirements:
            1) Provide additional copy of drawings in most current version of AutoCAD format.
            2) Drawings shall have a white background.
            3) Drawing shapes shall not degrade when closely zoomed.
            4) Screening effects intended to de-emphasize detail in a drawing must be preserved.
            5) Delete items or options not provided in the supplied equipment or system.
    2. Media:
        a. CD-ROM or DVD-ROM compatible with Microsoft Windows.
        b. Flash drive.
    3. Label media with the following information:
        a. Operation and Maintenance Manual.
        b. Equipment name.
        c. Specification Section Number.

d. Equipment tag number.
e. Owner's name.
f. Project number and name.
g. Date.

4. If multiple submittals are made together, each submittal must have its own subdirectory that is named and numbered based on the submittal number.

1.05 CONTENTS

A. Label the spines:
1. Equipment name.
2. Tag number.
3. Project name.
4. Owner name.

B. Cover page:
1. Operation and Maintenance Manual.
2. Equipment name.
3. Specification Section Number.
4. Equipment tag number.
5. Owner's name.
6. Project number and name.
7. Date.

C. Table of Contents: General description of information provided within each tab section.

D. Equipment Summary Form: Completed form as specified in Appendix A of this Section.

E. Equipment Maintenance Summary Form: Completed form as specified in Appendix B of this Section.

F. Electric Motor Technical Data Form: Completed form as specified in Appendix C of this Section.

G. Description of equipment function, normal operating characteristics, and limiting conditions.

H. Manufacturer's product data sheets:
1. Where printed material covers more than 1 specific model, indicate the model number, calibrated range, and other special features.

I. Assembly, installation, alignment, adjustment, and checking instructions.

J. Storage instructions: Control diagrams:
1. Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, logic for computer based systems, and connections between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings.
2. Complete set of 11-inch by 17-inch drawings of the control system.
3. Complete set of control schematics.

K. Programming: Copies of Contractor furnished programming.

L. Start-up procedures: Recommendations for installation, adjustment, calibration, and troubleshooting.

M. Operating procedures:
   1. Step-by-step instructions including but not limited to the following:
      a. Safety precautions.
      b. Guidelines.
      c. Manual keyboard entries.
      d. Entry codes.
      e. System responses.
      f. Other information as needed for safe system operation and maintenance.
   2. Modes:
      a. Startup.
      b. Routine and normal operation.
      c. Regulation and control.
      d. Shutdown under specified modes of operation.
      e. Emergency operating shutdown.

N. Preventative maintenance procedures:
   1. Recommended steps and schedules for maintaining equipment.
   2. Troubleshooting.

O. Lubrication information: Required lubricants and lubrication schedules.

P. Overhaul instructions: Directions for disassembly, inspection, repair, and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.

Q. Parts list:
   1. Complete parts list for equipment including but not limited to the following information.
   2. Catalog data: Generic title and identification number of each component part of equipment.
   3. Include bearing manufacturer, model and ball or roller pass frequencies for every bearing.
   4. Availability.
   5. Service locations.

R. Spare parts list: Recommended number of parts to be stored at the site and special storage precautions.

S. Engineering data:
   1. Drawings: Complete set of 11-inch by 17-inch equipment drawings.
   2. Exploded view or plan and section views with detailed callouts.
   3. Outline, cross-section, and assembly drawings.
   4. System drawings: Provide interconnection and wiring diagrams, plan views, panel layouts, bill of materials, etc.
   5. Packaged equipment system drawings: Provide instrumentation loop drawing, control schematic diagrams, interconnection and wiring diagrams, plan views, panel layouts, bill of materials, etc.

6. System drawings and data sheets: Include drawings and data furnished by the Engineer and the Supplier; provide "as installed" version.
7. Provide electrical and instrumentation schematic record drawings.

T. Test data and performance curves, when applicable.

U. Manufacturer's technical reference manuals.

V. Source (factory) Test results: Provide copies of Source Tests reports as specified in technical sections.

W. Functional Test results: After Functional Tests are completed, insert Functional Test reports as specified in technical sections.

1.06 ARCHIVAL DOCUMENTATION

A. Typically does not require updating to remain valid and should be stored in a format that preserves the document and limits one's ability to make changes.

B. Types of archival documents include the following:
1. Record drawings.
2. Reports.
3. Specifications.
4. Shop drawings.
5. Vendor Equipment O & M Manuals.
6. Photos.
7. Demonstration and training videos.
8. Other.

1.07 LIVING DOCUMENTATION

A. Requires periodic updates to remain valid and should be stored in formats that are easy to update.

B. Types of living documents include the following:
1. Facility O&M Manuals.
2. Standard Operating Procedures.
3. Other.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

APPENDIX A
EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM____

2. MANUFACTURER ____

3. EQUIPMENT IDENTIFICATION NUMBER(S)__________________________
(maps equipment number)

4. LOCATION OF EQUIPMENT____________________________________

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS)_____________

6. NAMEPLATE DATA -
   Horsepower____
   Amperage____
   Voltage____
   Service Factor (S.F.)__________________________________
   Speed____
   ENC Type____
   Capacity____
   Other____

7. MANUFACTURER'S LOCAL REPRESENTATIVE

   Name____

   Address____

   Telephone Number_____________________________________

8. MAINTENANCE REQUIREMENTS________________________________

9. LUBRICANT LIST____

10. SPARE PARTS (recommendations)_____________________________

11. COMMENTS____

APPENDIX B
EQUIPMENT MAINTENANCE SUMMARY

1. Equipment Item: ______________________________
2. Manufacturer: ______________________________
3. Serial No. (if applicable): ______________________________
4. Manufacturer's Order No. (if applicable): ______________________________
5. Nameplate Data (horsepower, voltage, speed, etc.): ______________________________

   ____
6. Manufacturer's Local Representative:

   Name: ______________________________

   Address: ______________________________

   Telephone: ______________________________
7. Maintenance Requirements:

Maintenance Operation	Frequency	Lubricant (if applicable)	Comments
(List each operation required. Refer to specific information in Manufacturer's Manual, if applicable)	(List required frequency of each maintenance operation)	(Refer by symbol to lubricant list as required)	

8. Lubricant List:

Reference Symbol	Conoco Phillips	Exxon/Mobil	BP/Amoco	Other (List)
(Symbols used in Item 7 above)	(List equivalent lubricants, as distributed by each manufacturer for the specific use recommended)			

9. Spare Parts: (Include recommendation on what spare parts should be kept on the job):

____

____

APPENDIX C
ELECTRIC MOTOR TECHNICAL DATA

Technical Data for Each Motor:

Application: ____________________

Manufacturer: ____________________

Frame No.: ____________________ Type: ____________________

Code Letter: ____________________ Design Letter: ____________________

Rating:

Horsepower: ____________________ Voltage: ________________ Phase: _____________

Cycles: ____________________ Full Load rpm: ____________________

(wound rotor secondary)

Volts: ____________________ Amperes: ________________

Full Load Current: ____________________ amperes

Locked Rotor Current: ____________________ amperes

Locked Rotor or Starting Torque (percent of full load): ________ percent

Full Load Torque: ____________________ ft-lb

Breakdown Torque: ____________________ percent

Efficiency:

Full Load: ________ percent

3/4 Load: ________ percent

1/2 Load: ________ percent

Power Factor:

Full Load ______ percent

3/4 Load: ______ percent

1/2 Load: ______ percent

Insulation:

Type: ____________________

Class: ____________________

Temperature Rise: ____________________ Above Ambient: ________________

Enclosure: ____________________

Net Weight: ____________________ lbs

Wk^2: ____________________ lbs/sq ft

Type of Bearings: ____________________

Service Factor: ____________________

Noise Level in Decibels: ________________

Heaters: ____________________ kW, ________ Phase, ________ volts

Altitude: ____________________

ATTACHMENT A.5 – CONTINGENCY PLAN

mesa·az

Greenfield Water Reclamation Plant

Contingency Plan
Aquifer Protection
Permit Number 105443

June 2014

CONTINGENCY PLAN

TABLE OF CONTENTS

Page

CONTINGENCY PLAN

Pursuant to Arizona Administrative Code R18-9-A204, the following Contingency Plan has been developed for the Greenfield Water Reclamation Plant (GWRP as part of the Aquifer Protection Permit (APP) process. The City of Mesa will secure the equipment, personnel, tools, and subcontract vendors necessary to mitigate unauthorized discharges. At least one copy of this Contingency Plan will be located in a location where day-to-day decisions are made regarding the operation of facility. All employees responsible for the operation of the facility shall be advised of the location of this Contingency Plan. The Owners shall revise this Contingency Plan upon any change to the information contained herein.

1.0 DISCHARGE RESULTS

This section defines the actions to be taken if any of the following occur :

1. A discharge results in a violation of a permit condition within the Contingency Plan. (Follow the Contingency Plan)
2. A discharge results in a violation of an Aquifer Water Quality Standard. (Follow the Contingency Plan)
3. A discharge results in an alert level is exceeded. (Follow the Contingency Plan)
4. A discharge results in a discharge limit is exceeded. (Follow the Contingency Plan)
5. A discharge cannot be made due to mechanical problems within or outside of the plant. (Follow the Contingency Plan)
6. A discharge will be made to the East Maricopa Floodway (EMF). (Follow the Contingency Plan)
7. An imminent and substantial endangerment to the public health or the environment. **(Follow the Emergency Response Plan)**

2.0 DISCHARGE RESULTS

The following is the contact information and the related discharge specific to them. Notifications for Section 1.0 may relate to one or all of the discharges from the GWRP. **All notifications shall be made to:**

City of Mesa
Greenfield Water Reclamation Plant
4400 South Greenfield Road
Gilbert, AZ 85296
(480) 644-6000
Mike Davis, Plant Supervisor (480) 209-0348 cell
Bill Daskam, Plant Maintenance Supervisor (480) 209-0462
Liquids Side Operator (480) 276-0982
Solids Side Operator (480) 510-4627
Jen Hetherington, Regulatory Compliance Program Manager (480) 577-8902

Arizona Department of
Environmental Quality (ADEQ)
Water Quality Compliance Section
1110 W. Washington
Phoenix, AZ 85007
(602) 771-4612

Town of Gilbert (TOG)
Mark Horn, Wastewater Manager 480-503-6420
Patricia Jordon, O/M Supervisor, Recharge 480-503-6439
In the event of total shut down of recharge facility:
Bob Lawrence, Reuse Quality Tech 480-503-6422 or
Todd Gregorski, Reuse Quality Tech 480-503-6465
Weekends, Nights, Holiday- try Patricia Jordon/Brian Quill or
Police Dispatch 480-503-6500 for Reuse on-call person.

Flood Control District of Maricopa County – EMF Discharge
Charlie Klenner, Division Manager Operations (602) 980-6026
Matthew Oller, Water Quality Manager 602-506-4663
Timothy Phillips, Chief Engineer& General Manager 602-506-4701

Gila River Indian Community- If Discharge to Effluent Line to GWRP
Gary Parker, General Manager, Gila River Indian Irrigation and Drainage District (GRIIDD)
Office:(520) 562-6722
Cell:(602) 376-4106

3.0 DISCHARGE RESPONSE

The City of Mesa response may also include one or more of the following actions if any of the conditions described in Section 1.0 occur.

3.1 Reporting Requirements

Specific reporting requirements are defined in the Aquifer Protection Permit for the GWRP. These ADEQ reporting requirements are included in this document as Section 5.

3.2 Verification Sampling

Perform Verification sampling after becoming aware of an occurrence of any condition listed in Section 1.0

3.2.1 If the results of verification sampling do not reveal an occurrence, the original sample result will be considered invalid and an occurrence has not taken place. Unless instructed by ADEQ, no action will be taken. Prepare a written report that demonstrates that the invalid occurrence was a result of sampling, analysis, or statistical evaluation errors, and establishes a plan of action to avoid future errors.

3.2.2 If the results of verification sampling do reveal that an occurrence has taken place, submit a written report to ADEQ and interested parties depending on the discharge after receiving the laboratory report. In this event, prepare a written report that includes:

1. A description and explanation of the cause of the occurrence
2. The exact time(s) and exact date(s) of the occurrence
3. Expected length of time occurrence will continue (if applicable)
4. Action taken to correct the effects of the occurrence
5. Plan for preventing future occurrences
6. Description / explanation of the malfunction or failure of pollution control devices, equipment or processes
7. Monitoring activity and / or other information

3.3 Other Action

Other actions may be required as determined by the City of Mesa and ADEQ. These actions include but are not limited to:

1. Verification sampling;

2. Notification to downstream or down gradient users who may be directly affected by the discharge;
3. Further monitoring that may include temporary increased frequency, additional constituents, or additional monitoring locations as described within the aquifer protection permit;
4. Inspection, testing, or maintenance of discharge control features of the facility;
5. Pretreatment evaluation (if applicable);
6. Preparation of a hydrogeologic study to assess the extent of soil, surface water, or aquifer impact and/or;
7. Corrective actions, as determined by ADEQ and City of Mesa.

3.4 Specific Notifications for situations listed in 1.0.

1. A discharge results in a violation of a permit condition within the Contingency Plan.

   Notify:

   ADEQ
   GRIIDD- if Discharging
   TOG – if Discharging
   Flood Control – if Discharging

2. A discharge results in a violation of an Aquifer Water Quality Standard.

   Notify:

   ADEQ
   GRIIDD- if Discharging
   TOG – if Discharging
   Flood Control – if Discharging

3. A discharge results in an alert level is exceeded.

   Notify:

   ADEQ
   GRIIDD- if Discharging
   TOG – if Discharging
   Flood Control – if Discharging

4. A discharge results in a discharge limit is exceeded.

   Notify:

   ADEQ

GRIIDD- if Discharging
TOG – if Discharging
Flood Control – if Discharging

5. A discharge cannot be made due to mechanical problems within or outside of the plant.

   Notify:

   GRIIDD- if Discharging
   TOG – if Discharging
   Flood Control – if Discharging

6. A discharge will be made to the East Maricopa Floodway (EMF).
   Notify:

   Flood Control
   Jen Hetherington

7. An imminent and substantial endangerment to the public health or the environment.
   Notify:

   COM Management
   ADEQ
   GRIIDD- if Discharging
   TOG – if Discharging
   Flood Control – if Discharging

4.0 REPORTING ACTIONS

The City of Mesa will notify the ADEQ and interested parties that a discharge has resulted in any one of the conditions listed in Section 1.0 within the specified times as indicated in the APP and that this Contingency Plan has been implemented.

The City of Mesa will submit a written report to ADEQ and interested parties after becoming aware of the discharge results listed in Section 1.0. The report may contain the following, as applicable and appropriate to the discharge condition:

1. A description of the violation and its cause;
2. The period of violation, including exact date and time, if known, and the anticipated time period the violation is expected to continue;
3. Any action taken or planned to mitigate the effects of the violation or to eliminate or prevent recurrence of the violation;

4. Any monitoring activity or other information that indicates that a pollutant is expected to cause a violation of an Aquifer Water Quality Standard; and
5. Any malfunction or failure of a pollution control device or other equipment or process.

In the case of an emergency response, GWRP personnel will notify ADEQ as soon as reasonably possible, but in no case before doing so would compromise the ability to gain understanding and control of the emergency.

5.0 SPECIFIC ADEQ REPORTING REQUIREMENTS

The following sections outline reporting requirements typical of Aquifer Protection Permits issued by ADEQ.

5.1 Exceeding of Alert Levels (AL) or Performance Levels (PL)

Notify ADEQ Water Quality Compliance Section within five (5) days of becoming aware of a violation of a PL.

Submit a written report within 30 days after becoming aware of the violation of a PL. The report shall document all of the following:

1. A description of the violation and its cause;
2. The period of violation, including exact date(s) and time(s), if known, and the anticipated time period during which the violation is expected to continue;
3. Any action taken or planned to mitigate the effects of the violation, or to eliminate or prevent recurrence of the violation;
4. Any monitoring activity or other information, which indicates that any pollutants would be reasonably expected to cause a violation of an Aquifer Water Quality Standard.
5. Any malfunction or failure of pollution control devices or other equipment or process.

5.2 Exceeding of Alert Levels Set for Discharge Monitoring

Conduct verification sampling within 24 hours of becoming aware of the alert status.

Within thirty days after confirmation of an AL being exceeded, the permittee shall submit the laboratory results to the ADEQ Water Quality Compliance Section, Data Unit, along with a summary of the findings of the investigation, the cause of the AL being exceeded, and actions taken to resolve the problem.

5.3 Alert Levels for Pollutants with Numeric Aquifer Water Quality Standards

1. If an AL has been exceeded, conduct verification sampling within 5 days of becoming aware of an AL being exceeded.

2. If verification sampling confirms the AL being exceeded, the permittee shall increase the frequency of monitoring to weekly. Any parameter that has daily monitoring shall remain as daily. In addition, the permittee shall immediately initiate an investigation of the cause of the AL being exceeded, including inspection of all discharging units and all related pollution control devices, review of any operational and maintenance practices that might have resulted in an unexpected discharge, and hydrologic review of groundwater conditions including up gradient water quality.
3. Within thirty days after confirmation of an AL being exceeded, the permittee shall submit the laboratory results to the Water Quality Compliance Section, Data Unit along with a summary of the findings of the investigation, the cause of the AL being exceeded, and actions taken to resolve the problem.
4. The increased monitoring required as a result of an AL being exceeded may be reduced, if the results of four sequential sampling events demonstrate that no parameters exceed the AL.

5.4 Discharge Limitations (DL) Violations

Conduct verification sampling within 24 hours of becoming aware of a DL being exceeded.

If verification sampling confirms that the DL has been violated, the permittee shall immediately investigate to determine the cause of the violation. The investigation shall include the following:

1. Inspection, testing, and assessment of the current condition of all treatment or pollutant discharge control systems that may have contributed to the violation;
2. Review of recent process logs, reports, and other operational control information to identify any unusual occurrences;

5.5 Aquifer Quality Limit (AQL) Violation

Conduct verification sampling within 5 days of becoming aware of an AQL violation.

1. If verification sampling confirms that the AQL is violated for any parameter, the permittee shall increase the frequency of monitoring to weekly. In addition, the permittee shall immediately initiate an evaluation for the cause of the violation, including inspection of all discharging units and all related pollution control devices, and review of any operational and maintenance practices that might have resulted in unexpected discharge.
2. The permittee also shall submit a report according to Section 5.1, which includes a summary of the findings of the investigation, the cause of the violation, and actions taken to resolve the problem. The permittee shall consider corrective action that may include control of the source of discharge, cleanup of affected soil, surface water or groundwater, and mitigation of the impact of pollutants on existing uses of the aquifer.

5.6 Emergency Response and Contingency Requirements for Spills and Unauthorized Discharges

The permittee shall act immediately to correct any condition that could pose an endangerment to public health or the environment.

5.7 Spills of Hazardous Substances or Toxic Pollutants

In the event of any accidental spill or unauthorized discharge (A.R.S. § 49-201(12)) of suspected hazardous substances (A.R.S. § 49-201(18)) or toxic pollutants (A.R.S. § 49-243(I)) on the facility site, the permittee shall promptly isolate the area and attempt to identify the spilled material. The permittee shall record information, including name, nature of exposure and follow-up medical treatment, if necessary, on persons who may have been exposed during the incident. Spilled materials, absorbents, and contaminated media generated during emergency response shall be removed and disposed of according to applicable federal, state and local regulations. The emergency response coordinator shall notify the ADEQ Emergency Response Unit at (602) 771-2300 immediately upon discovering a release of a hazardous substance in excess of a reportable quantity in accordance with 40 CFR Part 302, et seq.

6.0 FURTHER INFORMATION

Refer to APP Number 105443 for further information.

ATTACHMENT A.6 – EMERGENCY RESPONSE PLAN

mesa·az

Greenfield Water Reclamation Plant

Emergency Response Plan
Aquifer Protection
Permit Number 105443

June 2014

EMERGENCY RESPONSE PLAN

The City of Mesa is required to provide 24-hour emergency response at the Greenfield Water Reclamation Plant (the plant) to situations that may cause imminent and substantial endangerment to public health or the environment. As specified in Part II.C.3 of Aquifer Protection Permit #105443 (the permit).

PART I

The emergency response plan consists of this document, along with appropriate operation and maintenance manuals, all which will be kept at the location where day-to-day decisions are made regarding the Greenfield Water Reclamation Plant (GWRP).

- The emergency response plan requires:
  - A designated Emergency Response Coordinator (ERC) identified in PART II of this plan; that is responsible for the initiation and maintenance of emergency response actions.
  - Operations personnel to acquire professional training in emergency response for situations that may cause imminent and substantial endangerment of public health and/or the environment.
  - Immediate notification of the Assistant Water Director, Water Reclamation Superintendent and the Water Reclamation Plant Supervisor.
  - The ERC as defined in PART II of this plan will notify ADEQ Water Permits Compliance Section via telephone immediately in the event that emergency response measures are taken or those portions of the contingency plan that address imminent and substantial endangerment are activated.

PART II

The following personnel shall be contacted immediately if an emergency should occur:

Carlos Padilla
Assistant Water Director
(480) 644-4109 (Office)
(602) 220-5357 (Cell)

Ray Aguallo
Water Reclamation Superintendent
(480) 644-6014 (Office)
(480) 294-4373 (Cell)

Mike Davis
Water Reclamation Plant Supervisor
(480) 209-0348 (Cell)
(480) 644-6000 (office)

Bill Daskum
Water Reclamation Maintenance Supervisor
(480) 209-0462 (cell)
(480) 644-6000 (office)

PART III

The following procedures will be activated in the event that emergency response is initiated at the plant:

- Implement measures to minimize adverse effects related to the emergency. Including containment, identification, and evacuation of chemical hazards.

- Use of available resources to ensure the safety of the public health and/or the environment. Including personnel, equipment, and contracted personnel.

- Physical verification of standard operation of facility equipment and all components.

- Written notification to the ADEQ Water Compliance Section should include a narration of the nature of the emergency, a detailed description of the actions taken including facility inspection and a completed strategy to prevent future emergency situations of the same nature. (see Part V for "Spill Response Information Form")

- If the emergency involves wastewater spillage onto ground, reuse sites or the East Maricopa Floodway, then implement PART IV of this plan.

PART IV

◆ **Description of Spill**

- A spill is defined as a discharge of untreated wastewater onto the ground, reuse sites or the East Maricopa Floodway.

◆ **Typical Spill Sources:**

- Plant Upset caused by a change in the raw influent quality which may lead to a violation in one of the discharge permits; or

- Operational errors or equipment failure that may lead to a violation of a discharge permit.

◆ **Actions**

When an emergency situation is detected, standard operational and safety procedures to stop the progress of and correct the situation should be followed. This includes:

- Diversion of as much influent as possible to 91st Avenue and the Southeast Water Reclamation Plant.

- If an actual "spill" (overflow) occurs, an attempt should be made to contain it within City of Mesa property and kept away from the designated sample locations. This can be done through channelization, temporary berming, or pumping to a sewered area. Every available endeavor should be made to prevent the spill from going beyond City of Mesa property boundaries.

- Request assistance from available resources. Follow standard operating procedures of order of call out. Also, emergency assistance may be requested from the Utility Operations Wastewater Collection Crew 24-hours a day by contacting the Utility Operation Control Center at (480) 622-2262.

- Notify the Utility Operations Wastewater Compliance Section within one business day of the event.

- Notify Maricopa County Flood Control or Town of Gilbert if spill is on those properties.

Maricopa County Flood Control
Matthew Oller (602) 506-4663

Town of Gilbert
Mark Horn, Wastewater Manager 480-503-6420
Patricia Jordon, O/M Supervisor, Recharge 480-503-6439

◆ **<u>Sampling</u>**

Samples should ***only*** be collected when there is an actual spillage of wastewater onto the ground, reuse sites or the East Maricopa Floodway. Procedures for collection required samples should be sought from the Utility Operations Wastewater Compliance Section. At a minimum, samples should include four one-liter unpreserved polyethylene bottles and four pre-preserved, sterilized, e. coli sample containers, to be collected at the designated sample location(s) as per the permit.
Designated sample locations are identified in the permit as:

- Outfall 001
- Outfall 002
- TOG Reservoir
- GRIIDD

◆ **<u>Spill Information</u>**

When the situation is stabilized, the "Spill Response Information Form" should be completed and sent to the Utility Operations Wastewater Compliance Section. (See part V for "Spill Response Information Form")

PART V

- **SPILL RESPONSE INFORMATION FORM**

Start Date: ______________________ Start Time: ______________________

End Date: ______________________ End Time: ______________________

Location(s): ____

____

Approximate volume of spill (#gallons): ______________________

What caused the spill?____

____

____

The cause of the spill was determined by:

NAME: ______________________ TITLE: ______________________

ADDRESS: ______________________ PHONE NUMBER: (____) ____ - ________

Remedial/Mitigative/Corrective Actions: ______________________

____

____

Information on person(s) exposed to the spill/discharge: ______________________

____

____

ADEQ Contact Name: ____

Title: ______________________ Phone Number: ______________________

Contact Date: ______________________ Contact Time: ______________________

ATTACHMENT A.7 – SPECIFICATION 01_14_00 - WORK RESTRICTIONS

SECTION 01_14_00

WORK RESTRICTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for sequencing and scheduling the Work affected by existing site and facility, work restrictions, and coordination between construction operations and plant operations.

B. Related sections:
   1. Section 01_11_00 - Summary of Work.
   2. Section 01_32_16 - Progress Schedules and Reports.
   3. Section 01_35_21 - Selective Alterations and Demolition.
   4. Section 01_50_00 - Temporary Facilities and Controls.
   5. Section 01_75_17 - Commissioning.

1.02 SUBMITTALS

A. Baseline Schedule with MOP tasks.

B. Method of Procedure (MOP) Form.

C. Method of Procedure (MOP) Log.

D. Progress Schedule with MOP tasks.

1.03 GENERAL CONSTRAINTS ON SEQUENCE AND SCHEDULING OF WORK

A. Wastewater projects:
   1. The Greenfield Water Reclamation Plant is the Owners' only means of treating domestic, commercial, and industrial wastewater in this region. Impairing the operational capabilities of this treatment plant will result in serious environmental damage and monetary fines.
   2. Conduct Work in a manner that will not impair the operational capabilities of essential elements of the treatment process or reduce the capacity of the entire treatment plant below levels sufficient to treat the quality of raw wastewater to the water quality limitations specified in the discharge permit.
   3. Conduct commissioning and process start-up activities as specified in Section 01_75_17 in a manner that will not impair the operational capabilities of essential elements of the treatment process or reduce the capacity of the entire treatment plant below levels sufficient to treat the quality of raw wastewater to the water quality limitations specified in the discharge permit.
   4. The status of the treatment plant shall be defined as "operational" when it is capable of treating the entire quantity of wastewater received to the water quality limits specified in the discharge permit.
   5. An Approval to Construct (ATC) permit from the Maricopa County Environmental Services Department (MCESD) must be in place before any on-

site construction activities can begin. The MCESD ATC permit will be secured by Others.

B. Work sequence and constraints:
   1. Utilize description of critical events in work sequence in this Section as a guideline for scheduling and undertaking the Work.
   2. Work sequence and constraints presented do not include all items affecting completion of the Work, but are intended to describe critical events necessary to minimize disruption of the existing facilities and to ensure compliance with water quality permit requirements.

C. Instrumentation and controls process performance testing:
   1. After the Process Operational Period, test PCIS system as specified in Section 01_75_17.

1.04 SHUTDOWN AND CONSTRUCTION CONSTRAINTS

A. General shutdown constraints:
   1. Execute the Work while the existing facility is in operation.
   2. Some activities may be accomplished without a shutdown.
   3. Apply to activities of construction regardless of process or work area.
   4. Activities that disrupt plant or utilities operations must comply with these shutdown constraints.
   5. Organize work to be completed in a minimum number of shutdowns.
   6. Provide thorough advanced planning, including having required equipment, materials, and labor on hand at time of shutdown.
   7. Where required to minimize treatment process interruptions while complying with specified sequencing constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.
   8. Final determination of the permitting of shutdowns will be the sole judgment of the Owner.
   9. Owner maintains the ability to abort on the day of the scheduled shutdown.

B. General maximum plant flow work limitations:
   1. Activities that disrupt plant operations are prohibited during the following flow conditions, unless otherwise approved in writing by the Engineer.
      a. Flow condition: Average day flow of 16 mgd or greater.

C. Shutdown activities:
   1. Scheduling:
      a. Perform between the hours of 6 a.m. and 10 a.m. or as approved by Owner.
   2. Unplanned shutdowns due to emergencies are not defined in this Section.

D. Process area shutdown and construction constraints:
   1. Comply with shutdown constraints described in general terms as follows:
      a. Influent Pump Station: Shutdowns restricted to one influent pump at a time, unless alternate bypass pumping is provided.
      b. Primary Sludge and Scum Pump Station: Shutdowns restricted to one pump at a time, unless alternate bypass pumping is provided.
      c. RAS and Scum Pump Station: Shutdowns restricted to one pump at a time, unless alternate bypass pumping is provided.

d. WAS Pump Station: Shutdowns restricted to one pump at a time, unless alternate bypass pumping is provided.
e. Effluent Pump Station: Shutdowns restricted to one effluent pump at a time, unless alternate bypass pumping is provided.
f. NPW Pump Station: Shutdowns restricted to one pump at a time, unless alternate bypass pumping is provided.
g. Aeration Basins: Shutdowns restricted. Two aeration basins must be operating at all times. New Aeration Basin Nos. 3 and 4 must be fully operational before any work on the existing Aeration Basin Nos. 1 and 2 (and corresponding influent channel) can begin.
h. Thickened Sludge Mixing Pumps: Shutdowns restricted to one pump at a time.
i. Digester Feed Pumps: Shutdown restricted to one pump at a time. If a digester feed pump is out of service a designated standby digester feed pump must be available to substitute.
j. Digesters and associated heat exchangers and mixing pumps: Shutdown of existing digesters cannot occur until new digesters are completed and in service.
k. Digester Recirculation Pumps and Grinders: Shutdown restricted to one pump at a time.
l. Digester Heating Boiler: No shutdown permitted, except in summer months (May through September).
m. Hot Water Circulating Pumps: Shutdown restricted to one pump at a time.
n. Dewatering Centrifuge Feed Pumps: Shutdown restricted to one pump at a time, and availability of swing spare pump
o. Classifying Conveyors: Replacement requires shut down of the associated dewatering centrifuge. Centrifuge shut down restricted to one at a time.
p. Waste Gas Burners: Both existing waste gas burners shall be replaced by new waste gas burners. Existing Waste Gas Burner 1 and 2 shall remain in service until Waste Gas Burner 3 is installed and successfully commissioned and placed into service. Waste Gas Burner 3 shall serve as duty waste gas burner with Waste Gas Burner 2 as standby unit while Waste Gas Burner 1 is demolished and Waste Gas Burner 4 is installed. After Waste Gas Burner 4 is successfully commissioned and placed into service, Waste Gas Burner 2 shall be demolished. Isolation during construction shall be provided by temporary blind flanges at expansion joints as shown on the Drawings. Shutdowns for expansion joint and blind flange installation or removal shall not exceed 6 hours.

1.05 METHOD OF PROCEDURE (MOP)

A. MOP Instructions: See Appendix A. Note: MOP also referred to as MOPO (Maintenance of Plant Operations).

B. Prepare MOP for the following conditions:
1. Shutdowns, diversions, and tie-ins to the existing facility.
2. Process start-up activities.
3. Power interruption and tie-ins.
4. Switch over between temporary and permanent facilities, equipment, piping, and electrical and instrumentation systems.
5. Process constraints requiring interruption of operating processes or utilities.

C. Other Work not specifically listed may require MOPs as determined necessary by the Contractor, Owner, or Engineer.

D. Submit Baseline Schedule, as specified in Section 01_32_16, with proposed MOPs.

E. Submit MOP Log at construction progress meetings.

F. No consideration will be given to claims of additional time and cost associated to preparing MOPs required by the Owner and Engineer to complete this work in a manner that facilitates proper operation of the facility and compliance with effluent discharge criteria.

G. Where required to minimize treatment process interruptions while complying with specified sequencing constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.

1.06 COMPLIANCE WITH WATER QUALITY PERMIT

A. The existing facility is operating under the terms of an Aquifer Protection Permit (APP) and Arizona Pollutant Discharge Elimination System (AZPDES) permit, both issued by the Arizona Department of Environmental Quality (ADEQ). These permits specify the water quality limits that the plant must meet prior to discharge and/or reuse of the effluent. Copies of the existing permits are on file for review at the GWRP Administration Building.

B. Perform work in a manner that will not prevent the existing facility from achieving the finished water quality requirements established by regulations.

C. Bear the cost of penalties imposed on the Owner for water quality violations caused by actions of the Contractor.

1.07 REQUIREMENTS FOR OPERATION OF PLANT AND MAINTAINING CONTINUOUS OPERATION OF EXISTING FACILITIES

A. Facilities or conditions required to keep the existing plant operational include, but are not limited to, the following:
   1. Electrical power including transformers, distribution duct banks, conduit and wiring, switchgear, motor control centers and standby generators.
   2. Piping for conveyance of raw wastewater to the Headworks facilities, through the existing grit removal system, through the existing primary sedimentation facilities, through the existing aeration basin and secondary clarifier facilities, through the existing tertiary filter facilities, through the existing UV disinfection facilities, through the existing effluent pump station facilities, and on to the respective reclaimed water distribution and discharge locations.
   3. A means of measuring the raw wastewater, which is accomplished by existing metering facilities.
   4. Basins, structures, tanks, mechanical equipment, process piping and valves, and other necessary appurtenances associated with the liquids treatment train, including existing influent screening, influent pumping, grit removal, primary sedimentation, primary scum and sludge removal, aeration basins, secondary clarification, secondary scum and RAS/WAS removal, tertiary filtration, UV disinfection, and effluent pumping facilities.

5. Basins and structures, as well as weirs and gates, associated with the various flow splitting and flow distribution structures located upstream of the primary sedimentation basins, aeration basins, and secondary clarifiers accordingly.
6. Piping for conveyance of primary and waste activated sludge and scum to and from the Solids Handling Building, including from the primary sludge and scum pump station, RAS and scum pump station, digester complex, and associated mixed sludge pipeline from the Mesa SEWRP.
7. Buildings, structures, tanks, mechanical equipment, process piping and valves, and other necessary appurtenances associated with the solids treatment train, including existing sludge blending, sludge thickening, centrate tanks and pumps, anaerobic digesters, biosolids storage/equalization, biosolids dewatering, cake storage and loading, and chemical feed facilities (polymer).
8. Primary, secondary and solids odor control facilities, including fans, ductwork, scrubbers and media vessels, and related chemical facilities.
9. Chemical delivery, storage, metering, conveyance and control facilities, including existing systems for ferrous chloride, hypochlorite, caustic, muriatic acid, brine, and polymer.
10. Potable and non-potable (plant) water supplies. Water for flushing pump cooling jackets, chemical make-up, fire sprinkler, and general use throughout the plant is provided by both potable water supplied by the Town of Gilbert water distribution system and non-potable water sourced from the on-site effluent pump station.
11. Administration and maintenance facilities, including plant monitoring and control systems, sampling facilities and other appurtenances.
12. Perimeter fencing and access gates.
13. Plant-wide and facility lighting systems.
14. Heating, ventilation and air conditioning systems.
15. Safety equipment and features.
16. Parking for City employees and vehicles required for operation and maintenance of the Greenfield WRP.
17. Telephone and plant communication systems.
18. Fire protection and alarm system.
19. Stormwater conveyance and retention system.

B. Conduct the Work and provide temporary facilities required to keep the existing plant continuously operational.

C. Do not remove or demolish existing facilities required to keep the existing plant operational at the capacities specified until the existing facilities are replaced by temporary, new, or upgraded facilities or equipment.
   1. Test replacement facilities to demonstrate operational success prior to removing or demolishing existing facilities.

1.08 OPERATIONS AND MAINTENANCE ACCESS

A. Provide safe, continuous access to process control equipment for plant operations personnel.

B. Contractor shall provide a traffic plan defining routes and separation for construction traffic, plant operations traffic, and visitor traffic. Provide hard-surfaced all-weather roadways for plant operations traffic where existing roadways are unavailable due to construction operations.

C. Provide access on 1-hour advance notice to process control equipment for plant maintenance personnel and associated maintenance equipment.

1.09 UTILITIES

A. Provide advance notice to and utilize services of Blue Stake for location and marking of underground utilities operated by utility agencies other than the Owner.

B. Maintain electrical, telephone, water, gas, sanitary facilities, and other utilities within existing facilities in service. Provide temporary utilities when necessary.

C. New yard utilities were designed using existing facility drawings.
   1. Field verification of utilities locations was not performed during design.
   2. Services crossed or located nearby by new yard utilities may require relocation and possible shutdowns.
   3. Pipe alignments as indicated on the Drawings.

1.10 WORK SEQUENCE

A. Contractor shall submit a detailed outline of proposed work sequence as part of the MOP for review and approval by Owners and Engineer prior to construction.

B. Construction of New Headworks No. 2 (HW-2) shall be complete and fully functional, including installation of the two new influent pumps, prior to relocation of the existing influent pump from HW-1 to HW-2.

C. Construction of Aeration Basin No. 3 and No. 4, as well as Aeration Basin Influent Junction Structure, shall be complete and fully functional prior to modifications to existing Aeration Basin No. 1 and No. 2, as well as existing AB Influent Channel. Modifications to Aeration Basin No. 1 and No. 2, as well as existing AB Influent Channel, shall then be completed concurrently.

D. Construction of new tertiary filter basins and appurtenances shall be complete and fully functional prior to taking existing filter units offline.

E. Construction of new chlorine contact basin and appurtenances, including chlorination and dechlorination chemical storage and feed facilities, shall be complete and fully functional prior to modifications to existing UV disinfection inlet and outlet channels and decommissioning of the UV disinfection system.

F. Construction of Digester No. 3 and No. 4, and supporting sludge feed and transfer pumps, piping and appurtenances, are complete and fully functional prior to inspection and modifications to existing Digester No. 1 and No. 2. Inspection and subsequent improvements to each existing digester shall be completed sequentially and not concurrently.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

APPENDIX A
"Method of Procedure" (MOP)
Instructions and Forms

Definition and Purpose

"Method of Procedure" (MOP) is a detailed document submitted by the Contractor to request process shutdown(s), utility tie-in(s), work in areas that may risk unanticipated outages, or flow diversions to accommodate site construction activities during a project. Such activities may include (but are not limited to) new tie-ins to utilities or structures, mechanical modifications to process piping or equipment, demolition, bulkhead installation, and cleaning processes.

The MOP provides a detailed plan to the Owner and Engineer that describes specific aspects of the work including purpose, time of execution, and anticipated impacts on treatment processes. The MOP also includes contingency measures and provisions for rapid closure in the event that shutdown or work progress difficulties are encountered. Information from relevant trades associated with the requested shutdown, diversion, or tie-in is also included.

The Owner should use the information within the MOP to define operational procedures and methods to safely and successfully assist the Contractor.

MOP Process Summary

WHO	STEP	TIMING
Contractor	1. Identify MOPs needed on MOP Log and Baseline Schedule.	7 days prior to Preconstruction Scheduling Meeting
Contractor, Owner, Engineer	2. Pre-MOP Meeting.	More than 28 days prior to work
Contractor	3. Submits MOP.	No later than 28 days prior to work
Owner	4. Reviews MOP.	
Owner	5. MOP finalized.	7 days prior to work
Contractor	6. Complete Readiness Checklist.	5 days prior to work. Verify that all tools equipment and parts are on hand and that any contingency supplies needed are on hand.
Contractor	7. Complete Safety Checklist.	Just prior to commencing work
Contractor	8. Complete Work.	
Contractor	9. Update MOP Log and Progress Schedules.	Monthly

MOP Process Detail

STEP 1. Identifies MOPs needed on MOP Log and Baseline Schedule.

Contractor submits a preliminary list of anticipated project MOPs on MOP Log. MOPs identified but not limited to those shutdowns, diversions, or tie-ins described in the Contract Documents. Incorporate MOPs as tasks in Baseline Schedule. Date scheduled MOPs to coincide with the appropriate construction activities.

STEP 2. Pre-MOP Meeting.

Contractor requests a Pre-MOP Meeting with the Owner and Engineer to discuss the nature of the shutdown, diversion, or tie-in, and to gather the information necessary to complete the MOP Form. The pre-MOP meeting may be waived by the Owner or Engineer if the work is deemed to be minor.

STEP 3. Submits MOP.

Contractor completes the MOP Form and submit 3 copies for approval to the Owner's Project Manager (OPM).

STEP 4. Reviews MOP.

OPM distributes MOP Form for review by the Owner's Construction Coordinator, O&M Representative, and Engineer's Project Representative. Review MOP Form for completeness, accuracy, compliance with both the construction schedule, constraints defined in contract documents, and to ensure that the requested work does not negatively impact plant operations or other concurrent project activities. Additional information may be requested to better understand the nature of and method for completing the Work.

STEP 5. MOP finalized.

Once the MOP is agreed to by all parties, the MOP will be finalized by signature. Copies are distributed to the Owner, Engineer, and Contractor.

STEP 6. Complete Readiness Checklist.

Contractor verifies everything is ready for the work. One day prior to commencement of MOPO work verify that all parts, equipment, and tools are on site and contingency plans are in place.

STEP 7. Complete Safety Checklist.

Contractor ensures safety.

STEP 8. Complete work.

Contractor complete work.

STEP 9. Update MOP Log and Progress Schedules.

Contractor updates MOP Log weekly and distributes at the regularly scheduled construction progress meetings.

MAINTANENCE OF PLANT OPERATIONS

MOPO NUMBER:
TITLE:

EST. START DATE
STATUS:

<u>SUBCONTRACTORS</u>

TABLE OF CONTENTS

NARRATIVE

Insert a descriptionof the task.

MOPO Number: 0
Title: 0
Est Start Date: 0

STATUS: 0

SUMMARY OF ACTIVITIES

Pre-MOPO Activities

1 SRP to develop a written MOPO
2 MOPO review with the City of Mesa and Sub-contractors
3 SRP to modify plan based on comments
4 Review final work plan work with Mesa and Sub-contractors
5 SRP and Mesa to verify that materials, tools and safety equipment have been ordered
6 SRP to develop task hazard analysis
7 SRP to review task hazard analysis with city and sub-contractors
8
9
10
11
12
13
14

MOPO Activities

1
2
3
4
5
6
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9
10
11
12
13
14

City of Mesa

MOPO Number: 0

Title: 0

Est Start Date: 0

TIMELINE

	PRE-MOPO ACTIVITIES				DATE	TIME
1	SRP to develop a written MOPO					
2	MOPO review with the City of Mesa and Sub-contractors					
3	SRP to modify plan based on comments					
4	Review final work plan work with Mesa and Sub-contractors					
5	SRP and Mesa to verify that materials, tools and safety equipment have been ordered					
6	SRP to develop task hazard analysis					
7	SRP to review task hazard analysis with city and sub-contractors					
8	0					
9	0					
10	0					

	MOPO ACTIVITIES				HR 1	HR 2	HR 3	HR 4	HR 5	HR 6	HR 7	HR 8	HR 9	HR 10
1	0													
2	Review Work Plan													
3	0													
4	0													
5	0													
6	0													
7	0													
8	0													
9	0													
10	0													
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32														
33														

MOPO Number: 0
Title: 0
Est Start Date: 0

Tool and Equipment Requirements

Item	Qty	Resp	Description
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			

Material Requirements

Item	Qty	Resp	Description
1			
2			
3			
4			
5			
6			
7			
8			

Safety Requirements

Item	Resp	Description
1		PPE
2		
3		
4		
5		
6		
7		
8		

MOPO Number:	**0**
Title:	**0**
Est Start Date:	####

Emergency Contact List for this MOPO

SRP	Office Number	Cell Number	Emergency

City of Mesa	Office Number	Cell Number	Emergency

	Office Number	Cell Number	Emergency
		0	

	Office Number	Cell Number	Emergency
		0	

City of Mesa

Maintenance Of Plant Operations

MOPO Number:

Title:

Est Start Date:

MOPO Completion Sign Off Sheet

Owner Lead Contact: ______________________________ Date:______________Time:___________

Engineer Lead Contact: ______________________________ Date:______________Time:___________

Archer Western Lead Contact: ______________________________ Date:______________Time:___________

Contractor	Title	Name	Completed	Date	Time

NOTES:

ATTACHMENT A.8 – SPECIFICATION 01_75_17 - COMMISSIONING

SECTION 01_75_17

COMMISSIONING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for each Commissioning phase of, the Project equipment/system and/or facility.

B. Related sections:
1. Section 01_14_00 - Work Restrictions.
2. Section 01_78_23 - Operation and Maintenance Data.
3. Section 09_96_01 - High-Performance Coatings.
4. Section 23_05_93 - HVAC Systems Testing, Adjusting, and Balancing.
5. Section 26_08_50 - Field Electrical Acceptance Tests.
6. Section 40_05_00.09 - Piping Systems Testing.
7. Section 40_94_44 - Facility Monitoring and Control System Start Up Commissioning and Field Testing.
8. Section 40_95_15 - Integrated System Field Testing.
9. Section 46_05_10 - Common Work Results for Mechanical Equipment.
10. Section 46_05_94 - Mechanical Equipment Testing.

1.02 DEFINITIONS

A. Clean Water Facility Testing - Testing of complete facility utilizing clean water for purposes of confirming extended equipment/system operation prior to Process Start-up Phase.

B. Commissioning - The process of planning, testing, and process start-up of the installation for compliance with contract requirements and demonstrating, through documented verification, that the project has successfully met the Contractual requirements. It includes training the Owner's staff to operate the facility.

C. Commissioning Phases - The work activities of facility commissioning are grouped into the phases defined in the table below.

Commissioning		
Planning Phase	**Testing and Training Phase**	**Process Start-Up Phase**
Owner Training Plan and Schedule	Source Testing	Process Start-up
Commissioning Schedule	Owner Training	Process Operational Period
Subsystem Testing Plan	Installation Testing	Instrumentation and Controls Fine-Tuning

Commissioning		
Planning Phase	**Testing and Training Phase**	**Process Start-Up Phase**
Clean Water Facility Testing Plan	Functional Testing	
	Clean Water Facility Testing	
	Closeout Documentation	

D. Component - A basic building block of equipment, subsystems, and systems that requires installation or functional testing but does not have an electrical connection or internal electronics. (Examples: filter effluent piping and manual isolation valves).

E. Device - A basic building block of equipment, subsystems, and systems that requires installation or functional testing and does have an electrical connection or internal electronics. (Examples: filter level transmitter or water pump pressure transmitter).

F. Equipment - An assembly of component(s) and devices(s) that requires installation or functional testing. (Examples: Pump, motor, VFD, Ozone Generator, UV Disinfection System, etc.).

G. Facility - A grouping of process areas, systems, subsystems, equipment, components, and devices (Examples: treatment plant, pump station, etc.).

H. Functional Testing - Testing performed on a completed subsystem to demonstrate that equipment/system meets manufacturers' calibration and adjustment requirements and other requirements as specified. Functional testing includes operating equipment/system manually in local, manually in remote (or remote manual), and automatically in remote (in remote auto).

I. Installation Testing - Testing to demonstrate that subsystem component (piping, power, networks, devices, etc.) is ready and meets the project requirements in advance of functional testing. Installation testing also includes manufacturers' certification of installation and other requirements as specified to prepare equipment/system for Functional Testing. Also referred to as Field Acceptance Testing.

J. Manufacturer's Certificate of Source Testing - When applicable, the form is used during Source Testing for the manufacturer to confirm that the applicable source tests have been performed and results conform to the Contract Documents. The form is provided at the end of this Section.

K. Manufacturer's Certificate of Installation and Functionality Compliance - The form is used during Installation Testing and Functional Testing. It is submitted at the end of Functional Testing to confirm that the equipment/system is installed in conformance with the Contract Documents and that it meets the Functional Testing requirements defined in the Contract Documents. The form is provided at the end of this Section.

L. Process Area - A grouping of systems, subsystems, equipment, components, and devices that divide a facility into functional areas. (Examples: Filter Process Area or Chemical Area).

M. Process Operational Period - A period of time after completion of the process start-up set aside for final Operational Testing to verify facility performance meets the Contract Document requirements. This period may specifically limit other construction activities.

N. Process Start-up Phase - Operating the facility to verify performance meets the Contract Document requirements.

O. Process Start-Up - Activities conducted after the testing and training phase that are necessary to place systems or process areas into operational service.

P. Product - A system, subsystem, or component.

Q. Subsystem - A building block of systems made up from a grouping of components, devices, and equipment that perform a definable function. (Examples: Filter No. 1 Backwash Subsystem, Sedimentation Basin No. 1 Sludge Removal Subsystem).

R. System - A grouping of subsystems, equipment, components, and devices that perform a definable function. (Examples: Filter No. 1, Sedimentation Basin).

1.03 COMMISSIONING COORDINATOR (CC)

A. Designate and provide a CC for this project.

B. Submit summary of the CC's qualifications within 30 days of NTP:
   1. Include description of previous experience as a CC on similar projects for the designated CC with a list of references including phone numbers for review and Owner approval.

C. CC responsibilities include the following:
   1. Lead efforts relating to Commissioning.
   2. Be thoroughly familiar with commissioning requirements in the Contract Documents.
   3. Be regularly engaged and experienced in all aspects of commissioning.
   4. Provide technical instruction for commissioning.
   5. Provide primary interface with Engineer and Owner for efforts relating to Commissioning of Project facilities.
   6. Coordinate training efforts.

D. CC on-site:
   1. NTP to 30 percent milestone: 2 hours per week.
   2. 30 percent milestone to 70 percent milestone: 1 day per week.
   3. Testing and Training Phase: Full-time.
   4. Process Start-up Phase: Full-time.

E. Designate and provide CC assistants, as needed.

1.04 SERVICES OF MANUFACTURER'S REPRESENTATIVES

A. Qualification of manufacturer's representative as specified in the Contract Documents technical Sections include the following:
   1. Authorized representative of the manufacturer, factory trained and experienced in the technical applications, installation, operation, and maintenance of respective equipment/system with full authority by the equipment/system manufacturer to issue the certifications required of the manufacturer.
   2. Competent, experienced technical representative of equipment/system manufacturer for assembly, installation, testing guidance, and training.
   3. Additional qualifications may be specified in the individual Sections.
   4. Submit qualifications of the manufacturer's representative no later than 30 days in advance of required observations.
   5. Representative subject to approval by Owner and Engineer.
   6. No substitute representatives will be allowed until written approval by Owner and Engineer has been obtained.

B. Completion of manufacturer on-site services: Engineer approval required.

C. Manufacturer is responsible for determining the time required to perform the specified services.
   1. Minimum times specified in the Contract Documents are estimates.
   2. No additional costs associated with performing the required services will be approved.
   3. Manufacturer required to schedule services in accordance with the Contractor's project schedule up to and including making multiple trips to project site when there are separate milestones associated with installation of each occurrence of manufacturer's equipment.

D. Manufacturer's on-site services as specified in the Contract Documents include the following:
   1. Assistance during Commissioning Phase and Process Start-Up Phase.
   2. Provide daily copies of manufacturer's representatives field notes and data to Engineer.
   3. Other requirements as specified in the Contract Documents.

1.05 PLANNING PHASE

A. Overview of Planning Phase:
   1. Define approach and timing for Commissioning.

B. Owner training plan and schedule:
   1. Training outcomes:
      a. Owner's operations, maintenance, and engineering staff have the information needed to safely operate, maintain, and repair the equipment/systems provided in the Contract Documents.
   2. Training objectives:
      a. To instruct personnel in the operation and maintenance of the equipment/system. Instruction shall include step-by-step troubleshooting procedures with all necessary test equipment/system.
      b. To instruct personnel in the removal, inspection, and cleaning of equipment/system as needed.

c. Training tailored to the skills and job classifications of the staff attending the classes (e.g., plant superintendent, treatment plant operator, maintenance technician, electrician, etc.).
d. Provide supporting documentation, such as vendor operation and maintenance manuals.

3. Training schedule:
   a. Schedule Owner's staff training within the constraints of their workloads. Those who will participate in this training have existing full-time work assignments, and training is an additional assigned work task, therefore, scheduling is imperative. Owner staff work schedules regularly shift, as treatment facilities are typically operated on an around-the-clock basis.
4. Training plan:
   a. Coordinate and arrange for manufacturer's representatives to provide both classroom-based learning and field (hands-on) training, based on training module content and stated learning objectives.
   b. Conduct classroom training at location designated by Owner.
   c. Scope and sequence:
      1) Plan and schedule training in the correct sequence to provide prerequisite knowledge and skills to trainees.
         a) Describe recommended procedures to check/test equipment/system following a corrective maintenance repair.
5. Training scheduling coordination:
   a. CC is responsible for the following:
      1) Coordinate schedule for training periods with the Owner's personnel and manufacturer's representatives (instructors).
   b. Complete Owner training no sooner than 15 calendar days prior to start of process start-up of each system.
6. Meetings:
   a. CC is responsible for setting commissioning coordination meeting dates and times, as well as preparing the agendas and meeting minutes.
   b. CC shall meet with Engineer and Owner's designated training coordinator to develop list of personnel to be trained and to establish expected training outcomes and objectives at least 90 calendar days prior to commissioning of equipment/system.
   c. CC shall conduct commissioning progress meetings throughout construction, to plan, scope, coordinate, and schedule future activities, resolve problems, etc.
      1) Frequency: Monthly minimum. Increase frequency as needed based on complexity and quantity of commissioning activities.
7. Submittals:
   a. Submit Training Plan Schedule 90 calendar days before the first scheduled training session, including but not limited to lesson plans, participant materials, instructor's resumes, and training delivery schedules.
   b. Submit training documentation including the following:
      1) Training plan:
         a) Training modules.
         b) Scope and sequence statement.
         c) Contact information for manufacturer's instructors including name, phone, and e-mail address.
         d) Instructor qualifications.

2) Training program schedule:
a) Format: Bar chart.
(1) Additionally include in the Project Progress Schedule.
b) Contents:
(1) Training modules and classes.

8. Training sessions:
a. Provide training sessions for equipment/system as specified in the individual equipment/system Section.

C. Commissioning Schedule:
1. Commissioning overview:
a. Comply with Commissioning Roles and Responsibilities Matrix specified at the end of this Section.
2. Submittal due date:
a. Submit Commissioning Schedule not less than 90 calendar days prior to planned initial commissioning of each subsystem or system.
3. Schedule requirements:
a. Schedule durations and float for commissioning activities to ensure Work does not fall behind schedule due to complications or delays during commissioning.
b. Time-scaled network diagram detailing the work to take place in the period between 90 calendar days prior to planned initial commissioning of equipment and systems, and prior to the date of Substantial Completion, together with supporting narrative.
c. Provide detailed schedule of commissioning activities including durations and sequencing requirements.
1) Identify the following activities:
a) Testing and Training Phase:
(1) Source Testing.
(2) Owner Training.
(3) Installation Testing.
(4) Functional Testing.
(5) Clean Water Facility Testing.
(6) Closeout Documentation.
b) Process Start-Up Phase:
(1) Process Start-Up.
(2) Process Operational Period.
(3) Instrumentation and Controls Fine-Tuning.
d. Schedule manufacturer's services to avoid conflict with other on-site testing or other manufacturers' on-site services.
e. Verify that conditions necessary to allow successful testing have been met before scheduling services.

D. Subsystem testing plans:
1. Provide separate testing plans for each individual subsystem and system that include the following:
a. Approach to testing including procedures, schedule, and recirculation requirements.
b. Test objective: Demonstrate subsystem meets the design requirements as specified in the technical Sections.
c. Test descriptions, forms, temporary systems (pumps, piping, etc.), shutdown requirements for existing systems, test forms, test logs, witness

forms, and checklists to be used to control and document the required tests.

d. Test forms: Include, but not limited to, the following information:
    1) Tag and name of equipment/system to be tested.
    2) Test date.
    3) Names of persons conducting the test.
    4) Names of persons witnessing the test, where applicable.
    5) Test data.
    6) Applicable project requirements.
    7) Check offs for each completed test or test step.
    8) Place for signature of person conducting tests and for the witnessing person, as applicable.
e. Define start-up sequencing of unit processes:
    1) Include testing of alarms, interlocks, permissives, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.
    2) Provide detailed test procedures setting forth step-by-step descriptions of the procedures for systematic testing of equipment/system.
    3) Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration.
        a) Perform initial checks in the presence of and with the assistance of the manufacturer's representative.
    4) Demonstrate proper operation of each control loop function including mechanical, electrical, alarms, local and remote controls, instrumentation, and other equipment/system functions.
        a) Generate signals with test equipment/system to simulate operating conditions in each control mode.

2. Engineer approval of test plan is required prior to performing test.
    a. Revise and update test plans based on review comments, actual progress, or to accommodate changes in the sequence of activities.
    b. Submit test reports for each phase of testing for each equipment/system.
    c. Engineer approval of preceding test reports is required prior to start of next test.
    d. Tests will be rescheduled if test plan is not approved by the required deadline.
        1) Contractor is responsible for any resulting delay.
3. Contractor is responsible to reproduce and distribute final test procedures.
    a. Provide 3 copies for Engineer.
4. Tests may commence only after Engineer has received approved test plan copies.
5. Submittals:
    a. Submit test plans not less than 45 calendar days prior to planned installation testing of subsystem or system.
    b. Completed Manufacturer's Certificate of Installation and Functionality Compliance.
    c. Test procedures and forms: Provide signed-off copy of test forms and test reports upon completion of the test.
    d. Test reports:
        1) Submit preliminary copies within 1 day after testing completion.
        2) Submit final copies and report within 14 days after testing completion.

E. Clean Water Facility Testing Plan:
   1. Submit a Clean Water Facility Testing Plan equivalent to the requirements of the subsystem test plans a minimum of 60 calendar days prior to Clean Water Facility Testing.

1.06 TESTING AND TRAINING PHASE

A. Overview of Testing and Training Phase:
   1. General:
      a. Include specified Source Testing, Owner Training, Installation Testing, Functional Testing, Clean Water Facility Testing, and Closeout Documentation required by this Section and the technical Sections.
   2. Contractor responsibilities:
      a. Furnish labor, tools, equipment, instruments, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.
      b. Prior to testing, verify equipment protective devices and safety devices have been installed, calibrated, and tested.
      c. Acceptable tests: Demonstrate the equipment/system performance meets the requirements stated in the Contract Documents.
         1) When the equipment/system fails to meet the specified requirements, perform additional, more detailed, testing to determine the cause, correct, repair, or replace the causative components and repeat the testing that revealed the deficiency.

B. Source testing:
   1. Also referred to as factory testing or factory acceptance testing (FAT).
   2. Test components, devices, and equipment/system for proper performance at point of manufacture or assembly as specified in the technical Sections.
   3. Notify the Engineer in writing when the equipment/system is ready for source inspection and testing.
   4. Source Test Plan:
      a. As specified in this Section and other technical Sections.
      b. Source testing requirements as specified in technical Sections.
         1) Non-witnessed: Provide Manufacturer's Certificate of Source Testing.
         2) Witnessed: 1 Owner's representative and 1 Engineer's representative present during testing, unless otherwise specified, and provide Manufacturer's Certificate of Source Testing.
      c. Prepared by Contractor as a result of discussions and planning emerging from regularly conducted commissioning meetings for source tests as specified in the Contract Documents.
      d. Provide the following items for each Source Test:
         1) Purpose and goals of the test.
         2) Identification of each item of equipment/system, including system designation, location, tag number, control loop identifier, etc.
         3) Description of the pass/fail criteria that will be used.
         4) Listing of pertinent reference documents (Contract Documents and industry standards or Sections applicable to the testing).
         5) Complete description, including drawings or photographs, of test stands and/or test apparatus.
         6) Credentials of test personnel.

7) Descriptions of test equipment to be used, product information, and all appropriate calibration records for the test equipment.
8) Test set-up procedures.
9) Detailed step-by-step test procedures.
    a) The level of detail shall be sufficient for any witness with a rudimentary technical aptitude to be able to follow the steps and develop confidence that the tests were being performed as planned.
    b) All steps are significant, and all steps shall be included in the procedures.
10) Sample data logs and data recording forms.
11) Sample computations or analyses with the results in the same format as the final report to demonstrate how data collected will be used to generate final results.
    a) Complete disclosure of the calculation methodologies.
    b) Include a sample for each type of computation required for the test and analysis of the results.
12) Detailed outline of the Source Test report.
13) Sample test reports.

e. Submit Source Test Plan and forms as specified in the technical Sections.
    1) Submit a copy of the Source Test Plan at least 21 days before any scheduled test date.
    2) Engineer approval of Source Test Plan required prior to beginning source testing.
    3) Schedule the testing after approval of the test procedures submittal.

f. Indicate the desired dates for source inspection and testing.
    1) Notify the Engineer of the scheduled tests a minimum of 15 days before the date of the test.

5. Test results:
    a. Prepare and submit test results with collected data attached.
6. Contractor is responsible for costs associated with Owner's representatives and Engineer's representative witnessing Source Tests.
    a. Include costs for at least the following:
        1) Transportation:
            a) Travel 1 day on commercial airline to site including air flight costs and $1,600 allowance per person per day.
            b) Rental car from hotel to and from the test site.
        2) Hotel costs at a facility with an American Automobile Association 4 star rating or equivalent for single occupancy room per person per day.
        3) Meal allowance of $60 per person per day.
        4) On-site time: 1 day at the site, unless specified otherwise, including $1,600 allowance per person per day.
    b. If Source Test is not ready when the witnesses arrive or if the Source Test fails, the witnesses will return home with Contractor responsible for costs associated with the trip including costs described above. Contractor is responsible for rescheduling the Source Test and witnesses' costs associated with the second trip including costs described above.
    c. Contractor is responsible for witnesses' costs associated with retests including costs described above.
7. Contractor is responsible for providing fuel, chemicals, and other consumables needed for Source Testing.

C. Owner training:
1. Training instruction format:
   a. The training for operations personnel shall be provided separately from the maintenance personnel.
      1) The training for maintenance personnel shall be further subdivided into 2 trade groups:
         a) Mechanical maintenance.
         b) Electrical, Instrumentation and Controls maintenance.
   b. Instructors shall apply adult education best practices, emphasizing learner participation and activity.
   c. Training delivery may include problem-solving, question/answer, hands-on instruction, practice, evaluation/feedback tools, and lecture.
   d. Visual aids and hands-on practice sessions must support training objectives.
   e. Lecturing should be less than 30 percent of class time.
   f. Conduct hands-on instruction according to the following descriptions:
      1) Present hands-on demonstrations of at least the following tasks:
         a) Proper start-up, shutdown, and normal and alternative operating strategies.
         b) Common corrective maintenance repairs for each group.
         c) Describe recommended procedures to check/test equipment/system following a corrective maintenance repair.
      2) Use tools and equipment provided by manufacturer to conduct the demonstrations.
         a) Submit requests for supplemental assistance and facilities with the Contractor's proposed lesson plans.
      3) Contractor remains responsible for equipment disassembly or assembly during hands-on training situations involving equipment disassembly or assembly by Owner's personnel.
         a) Provide written certification of proper equipment/system operation to Engineer after completion of hands-on training.
2. Class agenda:
   a. Include the following information in the agenda:
      1) Instructor name.
      2) Listing of subjects to be discussed.
      3) Time estimated for each subject.
      4) Allocation of time for Owner staff to ask questions and discuss the subject matter.
      5) List of documentation to be used or provided to support training.
   b. Owner may request that particular subjects be emphasized and the agenda be adjusted to accommodate these requests.
   c. Distribute copies of the agenda to each student at the beginning of each training class.
3. Number of students:
   a. Estimated maximum class size: 5 to 10 persons.
      1) Owner will determine the actual number of students.
      2) Engineer will provide an estimated headcount 1 week prior to the class, so that the instructor can provide the correct number of training aids for students.

4. Instructor qualifications:
   a. Provide instructors completely knowledgeable in the equipment/system for which they are training.
   b. Provide instructors experienced in conducting classes.
   c. Provide instructor's technical preparation and instructional technology skills and experience.
   d. Sales representatives are not qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper class instruction.
   e. If, in the opinion of the Owner, an appropriately knowledgeable person did not provide the scheduled training, such training shall be rescheduled and repeated with a suitable instructor.
5. Training aids:
   a. Instructors are encouraged to use audio-visual devices, P&IDs, models, charts, etc. to increase the transfer of knowledge.
   b. Instructors shall provide such equipment (televisions, video recorder/player, computer, projectors, screens, easels, etc.), models, charts, etc. for each class.
   c. Instructor is responsible for confirming with Engineer and Owner in advance of each class that the classroom will be appropriate for the types of audiovisual equipment to be employed.
6. Classroom documentation:
   a. Trainees will keep training materials and documentation after the session.
   b. Operations and maintenance manuals, as specified in technical Sections:
      1) Provide a minimum of 2 copies of final Engineer-approved operations and maintenance manuals as specified in Section 01_78_23 for use during the classroom instruction.
      2) Owner reserves the right to delay training for a particular equipment item if the operations and maintenance manuals for that equipment are incomplete, inaccurate, or otherwise unsuitable for use by the Owner's staff.
      3) No contract extensions or extra costs will be allowed for training delays due to operations and maintenance manual submittal delays.
   c. Provide supplemental documentation handouts to support instruction.
   d. Digitally record audio and video of each training session.
      1) Include classroom and field instruction with question and answering periods.
      2) Engineer approval required for producer of video materials from one of the following options:
         a) Qualified, professional video production company.
         b) Contractor demonstrates satisfactory skill.
      3) Record in digital format and recording shall become property of the Owner.
         a) Provide audio quality that is not degraded during the recording of the field sessions due to background noise, space, distance or other factors.
      4) Video files shall be file format and delivery medium as directed and approved by Owner.
      5) Provide 2 complete sets of video materials fully indexed and cataloged with printed labels stating session content and dates recorded.
      6) The Contractor shall provide a written release from all claims to the recorded training material produced, if required.

e. Training modules:
   1) Provide a training module for each equipment category.
   2) Divide each training module's instructional content into discrete lesson plans.
f. Lesson plans:
   1) Provide performance-based learning objectives.
   2) State learning objectives in terms of what the trainees will be able to do at the end of the lesson.
   3) Define student conditions of performance and criteria for evaluating instructional success.
      a) Provide the following information:
   4) Instruction lesson plan outlines for each trade.
      a) Provide specific components and procedures.
   5) Minimum requirements:
      a) Hands-on demonstrations planned for the instructions.
      b) Cross-reference training aids.
      c) Planned training strategies such as whiteboard work, instructor questions, and discussion points or other planned classroom or field strategies.
      d) Attach handouts cross-referenced by section or topic in the lesson plan.
      e) Indicate duration of outlined training segments.
   6) Provide maintenance instruction lesson plans including mechanical, HVAC, instrumentation, and electrical aspects:
      a) Equipment operation:
         (1) Describe equipment's operating (process) function and system theory.
         (2) Describe equipment's fundamental operating principles and dynamics.
         (3) Identify equipment's mechanical, electrical, and electronic components and features.
         (4) Identify support equipment associated with the operation of subject equipment.
         (5) Detail the relationship of each piece of equipment or component to the subsystems, systems, and process.
         (6) Cite hazards associated with the operations, exposure to chemicals associated with the component, or the waste stream handled by the component.
         (7) Specify appropriate safety precautions, equipment, and procedures to eliminate, reduce, or overcome hazards.
      b) Detailed component description:
         (1) Define Preventative Maintenance (PM) inspection procedures required on equipment in operation, spot potential trouble symptoms (anticipate breakdowns), and forecast maintenance requirements (predictive maintenance).
            (a) Review preventive maintenance frequency and task analysis table.
         (2) Identify each component function and describe in detail.
         (3) Where applicable, group relative components into subsystems.
         (4) Identify and describe in detail equipment safety features, permissive and controls interlocks.

7) Provide the following information in equipment troubleshooting lesson plans:
    a) Define recommended systematic troubleshooting procedures as they relate to specific craft problems.
    b) Provide component specific troubleshooting checklists as they relate to specific craft problems.
8) Provide the following information in equipment Corrective Maintenance (CM) troubleshooting lesson:
    a) Describe recommended equipment preparation requirements as they relate to specific craft problems.
    b) Identify and describe the use of any special tools required for maintenance of the equipment as they relate to specific craft problems.
    c) Describe component removal/installation and disassembly/assembly procedures for specific craft repairs.
    d) Perform at least 2 hands-on demonstrations of common corrective maintenance repairs.
        (1) Additional demonstrations may be required by the Owner.
    e) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.

7. Class logistics:
    a. Delivery time minimum: 2 hours.
    b. Delivery time maximum: 4 hours.
        1) Longer time requires Engineer approval.
    c. Class agenda:
        1) Refreshment break: One 10-minute break.
        2) Meal break: One 45-minute break, unless otherwise specified.
        3) Schedule refreshment breaks and meal breaks to meet the class needs and Owner work rules.
    d. Schedule specific sessions:
        1) Minimum of 30 days in advance to allow Owner staffing arrangements to take place.
        2) At the times requested by the Owner, within the period 7 a.m. to 3 p.m. Monday through Friday.
            a) Times scheduled will be at Owner's discretion.
        3) Owner approval and confirmation required for session schedules.
        4) Provide minimum of 2 sessions for each class unless otherwise noted.
            a) The purpose of having multiple sessions on each class is to accommodate the attendance of as many Owner personnel working different shifts as possible.
            b) A maximum of 1 session per day for each class.
8. Distribute Training Evaluation Form following each training session.
    a. Training Evaluation Form is included in this Section.
    b. Return completed Training Evaluation Forms to Owner's designated training coordinator immediately after session is completed.
    c. Revise training sessions judged "Unsatisfactory" by a majority of attendees.
        1) Conduct training sessions again until a satisfactory rating is achieved at no additional cost to Owner.

9. Submittals:
   a. Prior to the training session:
      1) Instructor qualifications: Due 30 calendar days prior to initial training session.
      2) Training course materials: Due 14 calendar days prior to initial training session.
         a) Training agenda, lesson plan, presentation, and handouts.
         b) Other audio-visual aids utilized during each training course.
         c) Format: 2 electronic copies and 3 hard copies organized in notebooks.
   b. Post training session:
      1) Training course materials: Due 14 calendar days after class completion.
         a) Video recordings.
         b) Class attendance sheet.
         c) Training agenda, final lesson plan, presentation, and handouts.
         d) Other audio-visual aids utilized during each training course.
         e) Provide materials for all sessions of the class in a single transmittal.
         f) Format: 2 electronic copies and 3 hard copies organized in notebooks.

D. Installation Testing:
   1. Perform subsystem testing according to approved Subsystem Testing Plans.
   2. Initiate the Manufacturer's Certificate of Installation and Functionality Compliance for all equipment.
      a. Manufacturer's Certificate of Installation and Functionality Compliance form is included in this Section.
      b. Manufacturer's Certificate of Installation and Functionality Compliance certifies the equipment meets the following requirements:
         1) Has been properly installed, adjusted, aligned, and lubricated.
         2) Is free of any stresses imposed by connecting piping or anchor bolts.
         3) Is able to be operated as necessary for Functional Testing.
      c. Form shall be submitted after completion of Functional Testing, as specified in this Section.
   3. Coordinate Installation Testing with restrictions and requirements as specified in Section 01_14_00.
   4. Perform coating holiday testing as specified in Section 09_96_01.
   5. Perform pressure and leakage testing as specified in individual component Sections and Section 40_05_00.09.
   6. Perform mechanical equipment Installation Testing: As specified below and in individual equipment Sections, such as Sections 23_05_93, 46_05_10, and 46_05_94:
      a. Remove rust preventatives and oils applied to protect equipment during construction.
      b. Flush lubrication systems and dispose of flushing oils.
         1) Recharge lubrication system with lubricant recommended by manufacturer.
      c. Flush fuel system and provide fuel for testing and start-up.
      d. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.

e. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.
f. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
g. Perform cold alignment and hot alignment to manufacturer's tolerances.
h. Adjust V-belt tension and variable pitch sheaves.
i. Inspect hand and motorized valves for proper adjustment.
    1) Tighten packing glands to ensure no leakage, but permit valve stems to rotate without galling.
    2) Verify valve seats are positioned for proper flow direction.
j. Tighten leaking flanges or replace flange gasket.
    1) Inspect screwed joints for leakage.
k. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.

7. Electrical devices and subsystems Installation Testing: As specified below, in Section 26_08_50, and the technical Sections.
    a. Perform insulation resistance tests on all wiring except wiring and control wiring inside electrical panels.
    b. Perform grounding resistance tests on grounding systems.
    c. Test and set relays and circuit breaker trip units for proper operation.
    d. Perform direct-current high-potential tests on all cables that will operate at more than 2,000 volts.
    e. Motors:
        1) Windings energized to 1,000 volts DC for 1 minute.
            a) Motor resistance measured at the end of the test and recorded.
        2) Check motors for actual full-load amperage draw and proper rotation.
8. Instrumentation devices and subsystems Installation Testing: As specified below, in Sections 40_94_44 and 40_95_15, and technical Sections.
9. Heating, ventilating, and air-conditioning systems Installation Testing: As specified below, in Section 23_05_93, and technical Sections.
    a. Perform testing of heating, ventilating, and air conditioning equipment, balancing of distribution systems, and adjusting of ductwork accessories.
    b. Test hydronic systems, if required by technical Sections.

E. Functional Testing:
1. Perform subsystem testing according to approved Subsystem Testing Plan.
2. Notify the Engineer 5 days prior to when the Work is ready for Functional Testing.
    a. Perform testing in the presence of the Engineer.
3. Determine Functional Testing durations with Owner's input.
    a. Durations will vary depending on the availability of water for testing.
    b. Target minimum Functional Test duration: 8 hours.
        1) Identify equipment/system that cannot be tested for a minimum of 8 hours as specified in technical Sections.
4. Perform Functional Testing as specified in technical Sections.
    a. Perform Functional Testing in addition to the other tests specified in the technical Sections.
    b. Perform Functional Testing to demonstrate that the component equipment functions as an entire system in accordance with the design requirements.
    c. Perform Functional Testing to demonstrate that the unit process has operated in a manner necessary to demonstrate equipment/system

functions manually in local, manually in remote (or remote manual), and automatically in remote (in remote auto).

d. Perform testing with Contractor-provided water.

e. Repair or replace parts that operate improperly and retest.

f. Submit testing results as specified in the technical Sections to the Owner and Engineer for approval of Functional Testing results.

5. Provide completed Manufacturer's Certificate of Installation and Functionality Compliance forms for all equipment.

   a. Manufacturer's Certificate of Installation and Functionality Compliance form is included in this Section.

   b. Manufacturer's Certificate of Installation and Functionality Compliance certifies the equipment/system meets the following requirements:

      1) Is suitable for satisfactory full-time operation under full-load conditions.

      2) Operates within the allowable limits for vibration and noise.

      3) Electrical and instrumentation requirements:

         a) Electrical equipment, instrumentation, and control panels are properly installed, calibrated, and functioning.

         b) Electrical Installation Testing is complete, and test results have been approved by the Engineer.

            (1) Noted deficiencies have been corrected.

            (2) Relays, circuit breakers, and other protective devices are set.

         c) Control logic for start-up, shutdown, sequencing, interlocks, control, and emergency shutdown has been tested and is properly functioning.

         d) Motor control is calibrated and tested.

F. Clean Water Facility Testing:

1. Utilize plant water.

2. Do not begin Clean Water Facility Testing until Engineer has approved submittals for Functional Testing requirements.

3. Test facility to the fullest extent practical with recirculating water supply at the design flow for the largest single process or system train to ensure proper complete facility (equipment/system) hydraulic performance.

   a. As this is a functioning treatment facility, it will not be possible to test the entire facility with clean water.

   b. Contractor shall Clean Water Test individual systems (e.g. Headworks alone), or multiple systems (e.g. Aeration Basins and Secondary Clarifiers) as practical, until each of the systems (unit processes) are deemed acceptable by the Engineer.

4. Perform testing in the presence of the Engineer unless such presence is expressly waived in writing.

5. The purpose of Clean Water Facility Testing is to confirm extended equipment/system operation prior to process start-up.

   a. Testing shall occur for a minimum of 7 days with all systems operational to the extent possible.

G. Closeout documentation:
1. Submittals:
a. Provide records generated during Commissioning Phase of Project.
1) Required documents include but are not limited to:
a) Training documentation.
b) Manufacturer's Certificate of Source Testing.
c) Manufacturer's Certificate of Installation and Functionality Compliance.
d) Daily logs of equipment/system testing identifying tests conducted and outcome.
e) Test forms and documentation.
f) Functional Testing results.
g) Logs of time spent by manufacturer's representatives performing services on the job site.
h) Equipment lubrication records.
i) Electrical phase, voltage, and amperage measurements.
j) Insulation resistance measurements.
k) Bearing temperature measurements.
2) Data sheets of control loop testing including testing and calibration of instrumentation devices and setpoints. Format: 2 electronic copies and 3 hard copies organized in notebooks.
3) Due date: Within 14 calendar days of Substantial Completion.

1.07 PROCESS START-UP PHASE

A. Overview of Process Start-Up Phase:
1. Operating the facility to verify performance meets the Contract Document requirements.

B. Process Start-Up:
1. Perform process start-up in the presence of the Engineer.
2. Pre-start-up activities:
a. Commissioning Documentation and Data Review.
b. Start-Up Go/No-Go Decision Criteria.
c. Building and Fire Inspection Compliance Check.
d. Process Start-Up Sequence Review.
1) Submit a Process Start-Up plan for review by Engineer not less than 90 calendar days prior to planned commencement of process start-up activities.
2) Include the following:
a) Pre-start-up activities.
b) Process Start-Up.
c) Process Operational Period.
e. Description of Temporary Testing Arrangement, if applicable.
f. Final Process Start-Up Forms and Documentations.
g. Final Operational Testing Plan.
3. Control loop tuning.
a. Perform control loop tuning during system testing with water to the extent possible.

4. Process area start-ups.
    a. Process start-up individual process areas comprised of multiple interdependent systems where possible and beneficial to reduce complexity and risk of complete facility testing.
    b. Process area test flows may be limited by upstream and downstream process constraints (i.e., tank and basin volumes) and/or localized recirculation capabilities.
5. Facility-wide process start-up.
    a. Upon approved completion of pre-start-up activities, perform entire facility process start-up.
        1) Complete control loop tuning during this phase of process start-up.
        2) Continue process start-up operations until facility meets or exceeds the Contract requirements.
    b. Process control systems testing.
        1) Test complete system instrumentation, controls and PLC, HMI, and LOI programming for the facility.
    c. HVAC systems start-up and testing.
        1) Test complete HVAC system for the facility.
    d. Ancillary systems start-up and testing.
        1) Test complete security system, phone system, fire alarm system, etc. for the facility.
    e. Remaining equipment/system tests:
        1) Conduct remaining specified equipment/system performance tests that could not be performed during the Testing and Training Phase due to inter-system and/or treatment process dependencies.

C. Process Operational Period:
1. Prior to beginning the Process Operational Period:
    a. Conformance with treatment standards is required prior to Operational Testing, if applicable.
        1) Biological processes require time to build up the necessary population of organisms to meet treatment standards, as specified in Section 01_14_00.
    b. Correct any outstanding punchlist items prior to the Operational Testing.
2. Duration: 30 calendar days.
3. Engineer will be present for process operational period unless such presence is expressly waived in writing.
4. Prove facility conformance with Contract Document requirements.
5. Contractor to provide:
    a. Specified start-up materials and operating supplies.
    b. Necessary craft of labor assistance, in the event of an emergency equipment failure requiring immediate attention (emergency is defined as a failure of function which precludes the further operation of a critical segment of or the whole of the Work) with a response time of not more than 4 hours from the time of notification.
    c. Manufacturer's authorized representative to supervise placing equipment/systems in operation and provide guidance during Operational Testing per applicable Section.
    d. Necessary manufacturer's representatives and operating supplies for retesting systems that fail to pass the initial Operational Testing due to deficiencies in products of workmanship at no additional cost to the Owner.

e. List of 24-hour "on-call" representative supervisory persons who will monitor the Operational Testing and serve as liaison for the Engineer and Owner.

6. Owner will provide:
   a. Operations personnel for duration of test.
7. Prior to date of Substantial Completion of Installation, the Contractor's CC shall oversee Process Operational Period.
   a. Owner staff will operate the completed Project construction.
   b. Entire system shall continuously meet performance requirements and shall operate without fault, failure, or defect for a continuous period.
   c. Individual equipment/system failures that are corrected within 24 hours and do not prevent the entire project from continuously satisfying the established operational requirements shall not require the consecutive day test to be restarted unless the failure recurs.
   d. Restart the consecutive test period for any of the following conditions:
      1) Any failure of the complete Project construction to meet operational requirements.
      2) When malfunctions or deficiencies cause shutdown or partial operation of the facility, or results in failure of the complete Project construction to meet operational requirements.
      3) Any individual equipment/system failure that meets any of the following conditions:
         a) Requires more than 24 hours to correct, unless otherwise specified in Sections 40_94_44 and 40_95_15.
         b) Recurs within the 24-hour correction period requiring further correction.
      4) Immediately correct defects in material, workmanship, or equipment/system which became evident during Operational Testing.

1.08 INSTRUMENTATION AND CONTROLS FINE-TUNING:

A. After the Process Operational Period, test PCIS system for additional 60 days as specified in Sections 40_94_44 and 40_95_15 to identify issues and make corrections, as needed.

B. Extended PCIS system testing may occur after Substantial Completion, at the discretion of the City and Engineer.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

OWNER ______________________________ EQPT/SYSTEM __________________________

PROJECT NAME _______________________ EQPT TAG NO. __________________________

PROJECT NO. ________________________ EQPT SERIAL NO. _______________________

SPECIFICATION NO. ___________________

SPECIFICATION TITLE ____

Comments: ____

____

____

____

____

I hereby certify Source Testing has been performed on the above-referenced equipment/system as defined in the Contract Documents, and results conform to the Contract Document requirements. Testing data is attached.

Date of Execution: ________________________, 20____

Manufacturer: ____

Manufacturer's Authorized Representative Name *(print)*: ________________________

____

(Authorized Signature)

If applicable, Witness Name *(print)*: ______________________________________

____

(Witness Signature)

MANUFACTURER'S CERTIFICATE OF INSTALLATION AND FUNCTIONALITY COMPLIANCE

OWNER ______________________________ EQPT/SYSTEM ___________________________
PROJECT NAME ______________________ EQPT TAG NO. ___________________________
PROJECT NO. _______________________ EQPT SERIAL NO. _________________________
SPECIFICATION NO. __________________
SPECIFICATION TITLE ____

I hereby certify that the above-referenced equipment/system has been: (Check Applicable)

- ☐ Installed in accordance with manufacturer's recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants.
- ☐ Electrical/instrumentation and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ Functionally tested.
- ☐ System has been performance tested, and meets or exceeds specified performance requirements.

NOTES:
Attach test results with collected data and test report.

Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: ____

____

I, the undersigned manufacturer's representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: ___________________________________, 20 ____

Manufacturer: ____

Manufacturer's Authorized Representative Name *(print)*: ___________________________

By Manufacturer's Authorized Representative: ___________________________________
(Authorized Signature)

COMMISSIONING

TRAINING EVALUATION FORM

EQUIPMENT/SYSTEM ITEM: ____________________

VENDOR/MANUFACTURER: ____________________

DATE: ____________ NAME OF REPRESENTATIVE: ____________

1.	Was representative prepared?	Acceptable	Unacceptable	or	N/A
2.	Was an overview description presented?	Acceptable	Unacceptable	or	N/A
3.	Were specific details presented for system components?	Acceptable	Unacceptable	or	N/A
4.	Were alarm and shutdown conditions clearly presented?	Acceptable	Unacceptable	or	N/A
5.	Were step-by-step procedures for starting, stopping, and troubleshooting presented?	Acceptable	Unacceptable	or	N/A
6.	Were routine/preventative maintenance items clearly identified?	Acceptable	Unacceptable	or	N/A
7.	Was the lubrication schedule (if any) discussed?	Acceptable	Unacceptable	or	N/A
8.	Was the representative able to answer all questions?	Acceptable	Unacceptable	or	N/A
9.	Did the representative agree to research and answer unanswered questions?	Acceptable	Unacceptable	or	N/A

10. Comments: ____________________

____

____

____

11. Overall Rating: Satisfactory Unsatisfactory

Note:

Sessions judged "Unsatisfactory" by a majority of attendees shall be revised and conducted again until a satisfactory rating is achieved.

COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

NO.	TASK	OWNER	CONTRACTOR	ENGINEER
Testing and Training Phase				
Source Testing				
1	Source Testing	Witness	Lead	Witness, Review
Installation Testing				
2	Electrical Conductor Testing	No Action	Lead	Witness
3	Electrical Field Acceptance Tests	No Action	Lead	Witness
4	Instrument Field Calibration	No Action	Lead	Witness
5	Network Installation Testing	Witness	Lead	Witness
6	Loop Testing	Witness	Lead	Witness
7	Pressure Testing	No Action	Lead	Witness
8	Leak Testing	No Action	Lead	Witness
9	Holiday Testing	No Action	Lead	Witness
10	HVAC Testing	No Action	Lead	Witness
11	Motor Electrical Testing	No Action	Lead	Witness
Functional Testing				
12	Network Operational Testing	Witness	Lead	Review
13	Preliminary Run Testing Local/Manual Control	Witness	Lead	Review
14	PCIS Functional Demonstration Testing - Local/Auto Control Testing - Remote/Manual Contact Testing - Alarm Testing - Control Loop Testing	No Action	Lead	Review
15	Subsystem Start-Up and Testing	Witness	Lead	Review
16	Equipment/System Start-Up and Testing	Witness	Lead	Review
17	HVAC Start-Up and Testing	Witness	Lead	Review
18	Corrosion Control Start-Up and Testing	Witness	Lead	Review
19	Wide Area Network Communications Testing	Support	Lead	Witness
20	Manufacturer's Certificate of Installation and Functionality Compliance	No Action	Lead	Witness, Review
Clean Water Facility Testing				
21	Test Water Management Plan Finalization	Support	Lead	Review
22	Clean Water Facility Testing	Witness	Lead	Witness, Review

NO.	TASK	OWNER	CONTRACTOR	ENGINEER
Process Start-Up Phase				
Process Start-Up				
23	Commissioning Documentation and Data Review	Review	Support	Lead
24	Start-Up Go/No-Go Decision Criteria	Lead	Support	Review
25	Building and Fire Inspection Compliance Check	No Action	Lead	Witness
26	HVAC Functionality Check	No Action	Lead	Witness
27	Start-Up Sequence Review	Support	Lead	Review
28	Temporary Testing Arrangement Finalization	Support	Lead	Support
29	Start-Up Forms Finalization	Support	Lead	Support
30	Operation Testing Plan Finalization	Review	Support	Lead
31	Test Water Management Plan Finalization	Support	Lead	Review
32	System Testing	Support	Lead	Witness
33	Control Loop Tuning	Support	Lead	Witness
34	Process Area Start-Ups	Support	Lead	Witness
35	Facility-Wide Start-Up	Support	Lead	Witness
36	Process Control Systems Testing	Support	Lead	Witness
37	HVAC Final Testing, Adjust, and Balancing	Witness	Lead	Witness, Review
Process Operational Period				
38	Operational Testing	Support	Lead	Witness, Review
39	Final Testing Reports	Support	Lead	Review
40	Water Quality Testing and Documentation	Support	Lead	Review
Instrumentation and Controls Reliability Phase				
Instrumentation and Controls Reliability Period				
41	As specified in Section 40_94_44 and Section 40_95_15			

Legend:
Lead: Primarily responsible for organization, coordination, and execution of task work product or result.
Support: Assist the lead with organization, coordination, and execution of task work product or result.
Witness: Observe and document completion of task work product or result.
Review: As necessary to accept task work product result.
No Action: Limited or no involvement.

ATTACHMENT A.9 – SPECIFICATION 01_75_19 - WATER LEAKAGE TEST FOR CONCRETE STRUCTURES

SECTION 01_75_19

WATER LEAKAGE TEST FOR CONCRETE STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Hydrostatic leakage test for concrete water-holding structures.

B. Related sections:
   1. Section 01_75_18 - Disinfection.
   2. Section 03_30_00 - Cast-in-Place Concrete.
   3. Section 31_00_00 - Earthwork.

1.02 REFERENCES

A. Abbreviations and acronyms.

B. Definitions:
   1. Damp spots: Surfaces where visible moisture can be picked up by a dry hand.
   2. Containment structure, lined: Liquid-containing structure with barrier coating or membrane applied to the inside surfaces to prevent leaking of contents to the outside.
   3. Containment structure, unlined: Liquid containing structure where only the concrete structure itself is used to prevent leaking of contents to the outside.

C. Reference standards.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination.

B. Pre-installation meetings.

C. Sequencing.

D. Scheduling.

1.04 SUBMITTALS

A. Product data.

B. Shop drawings:
   1. Description and details of each evaporation/precipitation-measuring device anticipated for use during the test.

C. Samples.

D. Certificates.

E. Delegated design submittals.

F. Tests and evaluation reports:
   1. Results of water leakage test for each structure and for each portion of a structure designated for testing.

G. Manufacturer instructions.

H. Source quality control submittals.

I. Field/site quality control submittals.

J. Manufacturer reports.

K. Sustainable design submittals.

L. Special procedure submittals:
   1. Testing plan for each structure, or portion thereof, required to be tested.
      a. Describe methods of obtaining water for testing and of releasing water for disposal, including provisions for dechlorination if required.
      b. Include plans showing locations where measurements will be made and locations of evaporation/precipitation-measuring device.
      c. Indicate plans for filling and draining structure(s).
      d. Include schedule showing duration of test for each structure or cell to be tested, date and time for start of each test, dates and times of observations and measurements during the test, dates and times for closeout of testing procedures, and date for submittal of final results.
   2. Proposed procedures and products for repair of leaks.

M. Qualifications statements.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 GENERAL

A. Test structures and portions of structures listed in the following paragraphs for water leakage.
   1. Unless otherwise specified, the Contractor shall:
      a. Obtain all required permits for discharging testing water.
      b. Provide dechlorination of such water if required by the permits.
      c. Prepare and fill the structures.
      d. Provide access and equipment required for testing and for recording test results.
      e. Take measurements and make observations required for testing.
   2. At all times during testing, the Engineer shall have access to observe measurements by others or to make independent measurements.

B. Test the following concrete structures for water leakage (Area):
   1. Primary Effluent Junction Box (01).
   2. Headworks No. 2 Screenings Channels and Wet Wells No. 3-4 (03).
   3. Primary Sedimentation Basin No. 3 (05).
   4. Aeration Basins No. 1-4 (06).
   5. Mixed Liquor Splitter Structure (06).
   6. Secondary Clarifiers No. 5-8 (07).
   7. RAS/Centrate Splitter Structure (07).
   8. Tertiary Filters 7-14 (08).
   9. Common Channels of Existing Tertiary Filters (08).
   10. Isolation Walls within UV Channels (09).
   11. Chlorine Contact Basins (09).
   12. Effluent Pump Station (10).

C. Required preparation for testing is designated in this Section. Waiver of, or failure to complete preparations shall not change the testing criteria or approval criteria for the areas tested.

D. Retest structures and portions of structures until the evaluation criteria are satisfied.

3.02 TEST WATER SOURCE AND DISPOSAL

A. Water used for leak testing will be furnished by Owner.

B. After leakage testing is complete, Contractor shall dispose of water by discharging into the facility Plant Drain system, at a controlled rate acceptable to the Engineer.

3.03 PREPARATION

A. For each structure to be tested, prepare and submit a plan showing schedule and sequence of activities, method of filling, and methods of disposing of test water.

B. Sequencing requirements:
   1. Complete construction of concrete structure and cure concrete to obtain minimum specified 28-day compressive strength as specified in Section 03_30_00.
      a. Do not begin tests until all portions of structure are complete and have reached their minimum specified 28-day compressive strength.
      b. Do not begin tests until at least 14 days have passed since completion of the last concrete placement.
   2. Complete tests before:
      a. Covering any surface of the structure with materials that might mask the location of leaks or obscure damp concrete surfaces. Such coverings include, but are not limited to basin bottom grout, masonry veneer, stucco, plaster, and other coatings.
      b. Installation of equipment, unless otherwise approved by the Engineer.
      c. Backfill structures to elevations approved by the Engineer. Where backfilling is allowed, a 12-inch minimum diameter PVC "half-pipe" shall be located over vertical joints to observe the entire joint for leaks. After successful completion of test, pipe shall be filled with drain rock or pea gravel. Pipe shall extend to finished grade, but not above finished grade.
   3. Coatings:
      a. Unless otherwise specified, do not install surface-applied protective or decorative coatings and linings until leakage tests have been completed.

C. Weather requirements:
   1. Tests on structures with tops open to the atmosphere shall not be scheduled for periods when the 10-day weather forecast indicates a substantial change in weather patterns.
   2. Measurements of water surface levels in the structure shall not be scheduled for periods when the weather forecast indicates a difference of more than 35 degrees Fahrenheit between the ambient temperature readings at the times of initial and final measurements.
   3. Tests shall not be scheduled for periods when the 10-day weather forecast indicates that the water surface may freeze before the test is complete.

D. Clean interior of structure:
   1. Remove dirt, contaminants, and construction debris.
   2. Flush floors and sumps to provide clean surfaces.
   3. Remove standing water that would interfere with examination of surfaces, cracks, or joints.

E. Observe the structure, or portions of the structure being tested, for potential leak locations:
   1. Give particular attention to cracks, open joints, voids, and honeycombed and repaired surfaces.
   2. Visually observe openings, fitting, and pipe penetrations in the structure at both faces, if possible.
   3. Repair potential leak locations in accordance with these Specifications and as approved by the Engineer.
   4. Backfill excavations to the top of the structure foundation. Do not place backfill against water-bearing walls or over footings unless approved in advance by the Engineer.
      a. If requesting backfilling of walls before testing, include a description of methods that will be used to detect leakage in the backfilled areas. Methods shall include half-pipes at joint locations to observe joints for signs of leaks.
      b. Engineer's approval of backfilling before testing shall not relieve Contractor of the responsibility to conduct leakage tests, to satisfy the leakage acceptance criteria for the structure, or to repair leaking portions of the structure, including those portions below or behind the backfill.
   5. See Drawings and Section 31_00_00 for requirements to provide wall stability before backfilling.

F. Inlets to/outlets from the structure:
   1. Make inlets to and outlets from the structure watertight.
      a. Include valves; stop, sluice, and slide gates; and temporary bulkheads as required.
      b. Inlets and outlets not required to be operable may be temporarily sealed before testing of the compartments to which they open.
      c. Secure inlets used to fill the structure for testing to ensure that no water is entering or leaving the structure once it has been filled to the test level.
   2. Adjustments to measured leakage at inlets and outlets based on manufacturer's or Contractor's estimates will not be allowed.
      a. Adjustments to measured leakage may be permitted by the Engineer, and, at his/her discretion, only when the Contractor makes specific

measurements of leakage at each individual inlet and outlet using methods approved by the Engineer.

3.04 HYDROSTATIC LEAKAGE TEST FOR OPEN OR COVERED CONTAINMENT STRUCTURES ("HST-100")

A. Isolate sections of water-holding structures that can be isolated in actual operation. Fill and test sections for leakage separately.
   1. Fill structures and sections of structures scheduled for testing to the normal operating water level indicated on the Hydraulic Profile indicated on the Drawings.

B. Initial rate for filling of structures shall not exceed 4 feet per hour.

C. HST-100 testing includes 2 parts, "Qualitative Testing," and "Quantitative Testing," as described in the following paragraphs:
   1. HST-100, Part 1 - Qualitative Testing:
      a. During the first 24 hours after structures are filled, examine exposed concrete surfaces for damp spots or flowing water.
         1) Make observations in early morning, at midday, and in late afternoon.
         2) Continue observations through the duration of the Quantitative Testing period.
         3) Pay particular attention to conditions at joints, honeycombed areas, cracks, and repaired portions of the structure.
      b. Evaluation criteria:
         1) The structure shall be considered to have failed these Qualitative Testing requirements if any of the following conditions are observed.
            a) Water droplets or moist areas on an outside surface that could only have originated inside the structure.
            b) Water is flowing or seeping from joints, cracks, or surfaces.
               (1) Exception: Dampness or wetness on top of a footing, in the absence of flowing water, shall not be considered as failure to meet this criterion.
            c) Moisture can be transferred to a dry hand from the outside surfaces of the filled area.
      c. Repairs and retesting:
         1) Where damp spots or flowing water as described in the preceding paragraphs are observed, mark locations, provide repairs, and retest the structure as specified in subsequent paragraphs.
   2. HST-100 - Part 2: Quantitative Testing:
      a. If approved by the Engineer, Quantitative Testing may begin before repairs are made to areas failing Part 1 of this test; however:
         1) Adjustments to volume loss calculations of Quantitative Testing based on observed leakage will not be permitted.
         2) All defects identified for repair during Qualitative Testing shall be repaired to the satisfaction of the Engineer before approval of the structure.
      b. Report the results of Quantitative Testing on "Leakage Test Report" included as Figure A at the end of this Section, or similar form prepared by the Contractor and containing at least the information included in Figure A.

c. Unlined concrete structures:
   1) Fill to the designated water surface elevation. Maintain that level for at least 72 hours before recording initial water levels for leakage test.
   2) Duration of test:
      a) Theoretical time required to lower the water surface in the structure by 3/8 inch when leakage is occurring at the maximum allowable rate specified in subsequent paragraphs of this Section.
      b) The duration ("D") of the test in days is determined by the following equation:

$$D = \frac{0.375 \text{ inch}}{(0.005 \text{ in/in/day} \times H \text{ ft} \times 12 \text{ in/ft})}$$

Where: H = maximum liquid depth

         (1) Round results upward to the next full 24-hour period (day).
         (2) Minimum duration of test: 24 hours (1 day).
         (3) Maximum duration of test: 120 hours (5 days).

d. Lined concrete structures and secondary containment areas:
   1) Fill to the designated water surface elevation. Recording of water levels for leakage tests may begin as soon as the designated water surface level is reached and the water surface is calm.
   2) Duration of test: 72 hours (3 days).

e. Measurements: Water level:
   1) Record water levels at 24-hour intervals for the full duration of the test period.
   2) Measure water levels at not less than 2 locations on opposite ends of the structure, and preferably at 4 locations spaced equally around the structure. Mark locations on the structure and take measurements at the same locations throughout the duration of the test.
   3) Measure, to an accuracy of 1/16 inch, the vertical distance to the water surface from a fixed point on the structure above.

f. Measurements: Temperatures:
   1) As part of the first and last sets of level measurements, record water temperature at a depth of 18 inches below the water surface. Measure temperature at the same locations where level measurements are taken.
   2) Record ambient temperature at the time of each water level measurement.

g. Measurements: Evaporation and precipitation:
   1) Measure evaporation and precipitation by floating pans inside the structures during testing.
      a) For uncovered structures, measure both evaporation and precipitation.
      b) For covered structures that are well ventilated, measure evaporation.
   2) Measure using specially constructed clear containers:
      a) Provide clear plastic, calibrated, open-top containers not less than 18 inches in diameter and 18 inches deep.
      b) Partially fill containers with water and float inside the structure. Make provisions to hold containers in place at each

measurement location, but away from structure walls and items passing overhead, such as beams or pipes.

c) Measure initial depth of water in each device. Measure changes in water level in each device at the same time measurements of the water level inside the structure are taken.

h. Restart of test:

1) The Engineer may order a restart of the test when, in the Engineer's opinion, measurements have become unreliable due to unusual precipitation or other factors.

2) If measurements or observed leakage during the testing period indicate that the allowable leakage requirements will be exceeded, the test may be terminated before completion of the full test period. Take appropriate actions to correct problems before restarting the test.

i. Calculations of leakage test results:

1) For each section of the structure tested, use water surface level records to calculate average loss of volume per 24-hour interval.

a) For each 24-hour interval during the test, calculate the average of all measured drops in water level around the structure.

b) Use the average drop thus determined to calculate an average loss of volume for each 24-hour interval.

2) Adjustments to leakage calculations:

a) For uncovered basins, calculations shall be corrected for precipitation added to the structure.

b) Calculations may be corrected for evaporation and water temperature.

j. Evaluation criteria:

1) Unless otherwise specified, the average loss of volume during any 24-hour interval shall not exceed the limits shown in Table A.

Table A - Loss of Volume Criteria for Leakage Tests

Structure Type	Maximum Loss of Water Volume
Concrete paved canals, drying beds, lagoons, and similar structures.	0.100 percent of volume per 24-hour period.

k. Repairs and retesting:

1) Structures and portions of structures that have satisfied the qualitative requirements of HST-100, but have failed to satisfy the quantitative requirements of HST-100 may be immediately retested for volume loss.

a) If the structure fails the second test for volume loss, the structure shall be drained, and the Contractor shall observe the interior for probable areas of leakage.

b) The structure shall not be retested until repairs to the probable areas of leakage are complete.

3.05 REPAIRS FOR RETESTING

A. Locations showing damp spots or flowing water:
   1. Mark locations of visible leaks and damp spots.
   2. Drain structures for repair.
   3. Repair defects causing damp spots and flowing water using methods specified in Section 03_30_00 and approved by the Engineer.
      a. Repair both interior and exterior surfaces and make structures watertight.
      b. Submit proposed repair products and procedures for Engineer's review.
      c. Refill structures for retesting.
   4. Repeat filling, observations, and repairs until no leaks or damp spots appear.

B. Structures for which loss of water volume loss exceeds the limits specified after adjustments for evaporation, and precipitation:
   1. Determine cause of volume loss.
   2. Drain structures of water.
   3. Repair defects causing loss of water volume using methods specified in Section 03_30_00 and approved by the Engineer.
      a. Submit proposed repair products and procedures for Engineer's review.
   4. Refill water-holding structures.
   5. Repeat testing and repairs until volume loss does not exceed specified limits.

END OF SECTION

FIGURE A

WATERTIGHTNESS TEST REPORT

PROJECT:		SUBMITTED BY:	
STRUCTURE:		WITNESSED BY:	
AREA:		TEST DATES:	
TEST DURATION:		TEST DURATION:	

Surface area of structure tested:		(square feet)
Volume of structure tested:		(cubic feet)
Volume of structure tested:		(gallons)
Measured loss through gates, etc.:		(gallons / day)
Allowable loss of water volume:		(per day)
Allowable loss of water volume:		(% in 24 hours)
Allowable measured loss over test duration (inches):		
Measured loss of water:		(gallons / day - From E below)
Measured loss of water volume (%):		(in 24 hours - From E below)

Water Temperature: Start of test: °F End of test: °F

			Water Surface Elevation (top of structure to top of water)				
			Location #1	Location #2	Location #3	Location #4	Initials**
Day	Date	Time	(inches)	(inches)	(inches)	(inches)	
1							
2							
3							
4							
5							
Changes in Level:							

A.	Average change in level (feet):		(Average of total charges for all locations)
B.	Correction for precipitation:		(Measured from pan)
C.	Correction for evaporation:		(Measured from pan)
D.	Corrected change in level (CL):		
E.	Total days tested:		
F.	Average measured % water loss in 24 hours:		= (CL) x (surface area) x 100 / (initial water volume) x (number of test days)

Notes and field observations**

** Place date and initials at the beginning of each entry

ATTACHMENT A.10 – PROCESS MODELING RESULTS FOR ANNUAL AVERAGE DAY LOADING CONDITIONS

PROCESS MODEL RESULTS SUMMARY

ANNUAL AVERAGE DAY LOADING CONDITIONS

Greenfield Water Reclamation Plant
GWRP Process Modeling Loading Condition: **Annual Average Day Loading**

GWRP Flow	**30.0**	mgd
SEWRP Flow	**8.0**	mgd (sludge equivalent sent to GWRP)

Liquids Train Summary

No. of Primary Clarifiers in Service	**2**	of 3
Primary Clarifier Surface Area	30,788	sf
Primary Treatment TSS Removal	61%	
No. of Aeration Basins in Service	**3**	of 4
Total A.B. Volume	16.2	MG
MLSS	3,702	mg/L
Aerobic SRT	4.7	days
Total SRT	10.0	days
RAS Flow Ratio	78%	
MLR Flow Ratio	410%	
Oxygen Demand	85,986	lb/d
No. of Sec. Clarifiers in Service	**7**	of 7
Secondary Clarifier Surface Area	79,168	sf

Plant Effluent Nitrogen Summary

Ammonia	0.2	mg/L
Nitrate	3.9	mg/L
Nitrite	0.3	mg/L
Organic N	1.5	mg/L
Total N	**5.9**	mg/L

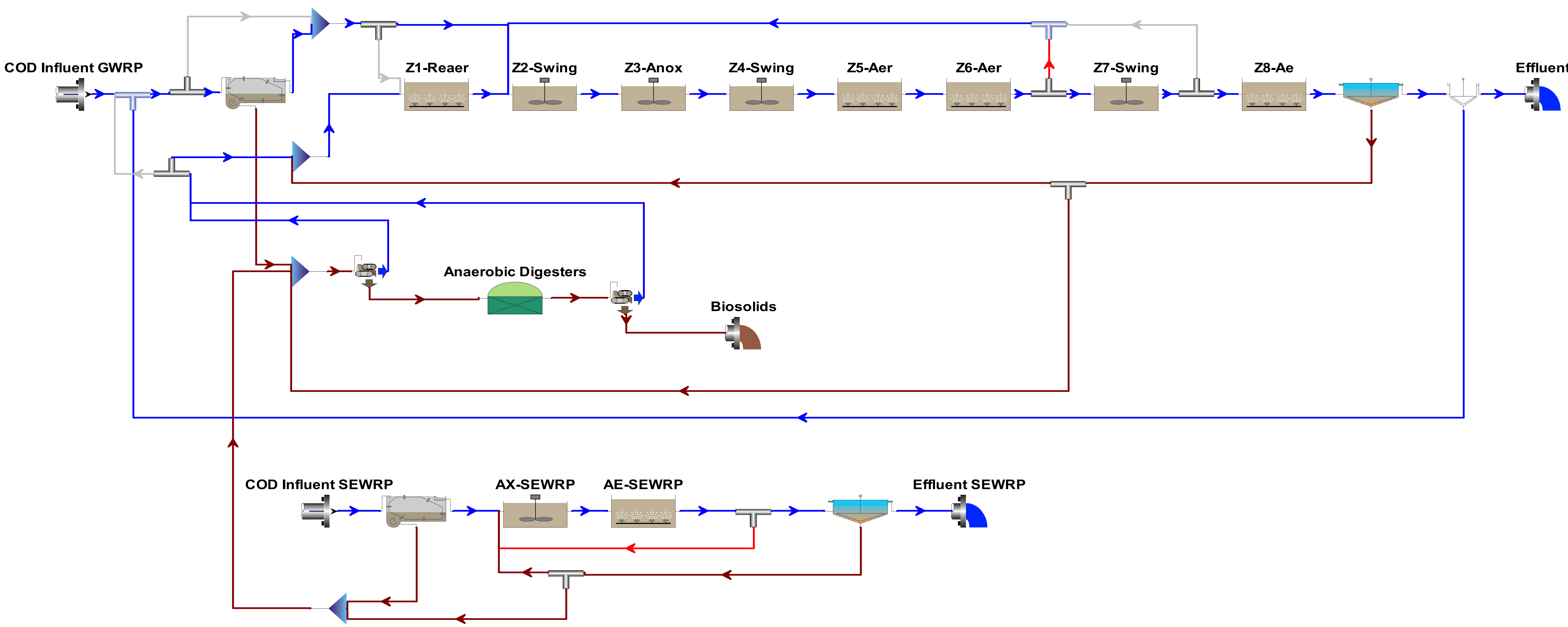
Solids Train Summary

Primary Sludge Solids Concentration	2.3	% TS	
Blended Sludge Solids Concentration	1.2	% TS	
Thickening Solids Capture Efficiency	95%		
Thickened Sludge Solids Concentration	6.0	% TS	
No. of Anaerobic Digesters in Service	4	of 4	
Active Volume per Digester	1.2	MG/digester	
Anaerobic Digestion HRT	18.0	days	18.0
Anaerobic Digestion VS Destruction	45%		
Digested Sludge Solids Concentration	4.0	% TS	
Dewatering Solids Capture Efficiency	95%		
Cake Solids Concentration	20.0	% TS	

Flows and Concentrations	Flow	COD	BOD	TSS	VSS	TN	NH_3-N	TP	PO_4-P
	mgd	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Plant Influent	30.0	850	364	425	340	57.0	39.9	13.2	4.1
Aeration Basin Influent	30.3	483	231	166	133	50.3	39.1	7.7	4.1
Secondary Effluent	30.9	52	3	7	5	6.1	0.2	9.1	9.0
Plant Effluent	30.3	47	2	3	2	5.9	0.2	9.1	9.0
GWRP Primary Sludge	0.345	32,070	11,555	22,783	18,212	579	39	492	4
GWRP WAS	0.728	9,433	2,201	8,463	6,266	445	0	172	9
SEWRP (PS+WAS)	0.365	7,354	2,220	7,771	4,348	197	15	134	5
Blended Sludge to Thickening	1.439	14,337	4,450	11,723	8,646	414	13	239	7
Thickened Sludge to Digestion	0.267	72,966	22,580	60,039	44,277	2,040	13	1,198	7
Digested Sludge to Dewatering	0.267	37,742	2,526	39,851	24,352	2,037	833	1,198	661
Biosolids disposal	0.050	189,027	12,312	200,308	122,402	6,883	833	3,361	661

Mass Loads	COD	BOD	TSS	VSS	TN	NH_3-N	TP	PO_4-P
	lb/d	lb/d	lb/d	lb/d	lb/d	lb/d	lb/d	lb/d
Plant Influent	212,803	91,191	106,458	85,159	14,270	9,989	3,295	1,013
Aeration Basin Influent	121,886	58,209	41,938	33,523	12,689	9,878	1,944	1,046
Secondary Effluent	13,421	717	1,793	1,328	1,585	56	2,355	2,321
Plant Effluent	12,006	432	717	531	1,500	55	2,290	2,276
GWRP Primary Sludge	92,333	33,267	65,595	52,433	1,667	113	1,417	12
GWRP WAS	57,309	13,374	51,414	38,069	2,703	1	1,048	55
SEWRP (PS+WAS)	22,389	6,758	23,659	13,237	599	47	409	14
Blended Sludge to Thickening	172,030	53,399	140,668	103,739	4,969	160	2,873	81
Thickened Sludge to Digestion	162,408	50,259	133,635	98,552	4,541	30	2,668	15
Digested Sludge to Dewatering	84,007	5,622	88,700	54,202	4,535	1,854	2,668	1,472
Biosolids disposal	79,519	5,179	84,265	51,492	2,896	350	1,414	278

BioWin Process Model Flowsheet



BioWin Process Model Results - Concentration Table

Elements	Flow [mgd]	Total COD [mg/L]	Filtered COD [mg/L]	Total Carbonaceous BOD [mg/L]	Filtered Carbonaceous BOD [mg/L]	Total suspended solids [mgTSS/L]	Volatile suspended solids [mgVSS/L]	Total Kjeldahl Nitrogen [mgN/L]	Filtered TKN [mgN/L]	Nitrite + Nitrate [mgN/L]	pH []	Dissolved oxygen [mg/L]	Alkalinity [mmol/L]	Ammonia N [mgN/L]	Nitrate N [mgN/L]	Nitrite N [mgN/L]	Total inorganic N [mgN/L]	Total N [mgN/L]	Total P [mgP/L]	Soluble PO4-P [mgP/L]
COD Influent GWRP	30.000	850	255	364	150	425	340	57.00	47.18	0.00	7.30	0.00	7.00	39.90	0.00	0.00	39.90	57.00	13.16	4.05
PE Spllitter	30.600	839	251	358	147	421	337	56.13	46.29	0.08	7.28	0.04	6.94	39.12	0.08	0.01	39.20	56.21	13.16	4.14
PE Spllitter (U)	0.000	839	251	358	147	421	337	56.13	46.29	0.08	7.28	0.04	6.94	39.12	0.08	0.01	39.20	56.21	13.16	4.14
Primary clarifiers	30.250	483	251	231	147	166	133	50.17	46.29	0.08	7.28	0.04	6.94	39.12	0.08	0.01	39.20	50.25	7.70	4.14
Primary clarifiers (U)	0.340	32,070	251	11,555	147	22,783	18,212	578.79	46.29	0.08	7.28	0.04	6.94	39.12	0.08	0.01	39.20	578.87	492.02	4.14
RAS+Cen	24.660	8,971	49	2,095	4	8,042	5,952	425.81	9.57	4.13	6.84	1.95	4.16	8.15	3.81	0.31	12.27	429.94	169.82	14.61
Z1-Reaer	24.660	8,935	44	2,073	1	8,028	5,937	417.97	2.08	11.45	6.72	1.00	3.09	0.48	11.13	0.32	11.93	429.42	169.82	15.01
Z2-Swing	177.910	4,189	50	987	4	3,718	2,757	201.12	9.05	1.16	6.91	0.00	4.53	7.40	0.78	0.38	8.56	202.28	80.50	8.66
Z3-Swing	177.910	4,186	45	984	1	3,719	2,758	201.12	8.96	0.06	6.94	0.00	4.64	7.81	0.04	0.01	7.87	201.18	80.50	8.65
Z4-Swing	177.910	4,186	46	983	1	3,718	2,758	201.12	8.98	0.00	6.95	0.00	4.66	8.15	0.00	0.00	8.15	201.12	80.50	8.67
Z5-Aer	177.910	4,176	45	978	1	3,714	2,754	197.27	4.97	3.79	6.87	2.00	4.08	3.75	2.38	1.41	7.54	201.05	80.50	8.73
Z6-Aer	177.910	4,168	44	974	1	3,711	2,750	194.83	2.46	6.10	6.81	1.00	3.72	1.04	4.33	1.78	7.14	200.93	80.50	8.79
Z7a-Ax	54.910	4,160	44	968	1	3,706	2,745	194.73	2.51	3.23	6.84	0.00	3.95	1.50	2.01	1.22	4.73	197.97	80.50	8.90
Z7b-Ae	54.910	4,152	44	964	1	3,702	2,741	193.68	1.55	4.23	6.84	2.00	3.79	0.22	3.91	0.32	4.45	197.91	80.50	9.00
IMLR Splitter Z6	54.910	4,168	44	974	1	3,711	2,750	194.83	2.46	6.10	6.81	1.00	3.72	1.04	4.33	1.78	7.14	200.93	80.50	8.79
IMLR Splitter Z6 (U)	123.000	4,168	44	974	1	3,711	2,750	194.83	2.46	6.10	6.81	1.00	3.72	1.04	4.33	1.78	7.14	200.93	80.50	8.79
IMLR Splitter Z7	54.910	4,152	44	964	1	3,702	2,741	193.68	1.55	4.23	6.84	2.00	3.79	0.22	3.91	0.32	4.45	197.91	80.50	9.00
IMLR Splitter Z7 (U)	0.000	4,152	44	964	1	3,702	2,741	193.68	1.55	4.23	6.84	2.00	3.79	0.22	3.91	0.32	4.45	197.91	80.50	9.00
Secondary clarifier	30.910	52	44	3	1	7	5	1.91	1.55	4.23	6.84	2.00	3.79	0.22	3.91	0.32	4.45	6.14	9.13	9.00
Secondary clarifier (U)	24.000	9,433	44	2,201	1	8,463	6,266	440.70	1.55	4.23	6.84	2.00	3.79	0.22	3.91	0.32	4.45	444.93	172.43	9.00
Filters	30.310	47	44	2	1	3	2	1.70	1.55	4.23	6.84	2.00	3.79	0.22	3.91	0.32	4.45	5.93	9.05	9.00
Filters (U)	0.600	283	44	57	1	215	159	12.70	1.55	4.23	6.84	2.00	3.79	0.22	3.91	0.32	4.45	16.93	13.15	9.00
Effluent	30.310	47	44	2	1	3	2	1.70	1.55	4.23	6.84	2.00	3.79	0.22	3.91	0.32	4.45	5.93	9.05	9.00
RAS/WAS Splitter	23.270	9,433	44	2,201	1	8,463	6,266	440.70	1.55	4.23	6.84	2.00	3.79	0.22	3.91	0.32	4.45	444.93	172.43	9.00
RAS/WAS Splitter (U)	0.730	9,433	44	2,201	1	8,463	6,266	440.70	1.55	4.23	6.84	2.00	3.79	0.22	3.91	0.32	4.45	444.93	172.43	9.00
Sludge SEWRP (PS+WAS)	0.360	7,354	113	2,220	61	7,771	4,348	194.12	18.82	2.57	7.07	0.76	4.17	15.28	2.54	0.03	17.85	196.69	134.25	4.64
Blended PS+WAS	1.440	14,337	111	4,450	51	11,723	8,646	411.27	16.67	2.81	7.00	1.22	4.64	13.37	2.64	0.17	16.19	414.08	239.43	6.73
Thickening	1.170	985	111	321	51	720	531	40.89	16.67	2.81	7.00	1.22	4.64	13.37	2.64	0.17	16.19	43.71	21.01	6.73
Thickening (U)	0.270	72,966	111	22,580	51	60,039	44,277	2037.54	16.67	2.81	7.00	1.22	4.64	13.37	2.64	0.17	16.19	2040.35	1198.45	6.73
Anaerobic Digesters	0.270	37,742	170	2,526	95	39,851	24,352	2037.49	834.03	0.00	6.68	0.00	42.67	833.08	0.00	0.00	833.08	2037.49	1198.45	661.44
Dewatering	0.220	2,486	170	245	95	2,457	1,501	908.23	834.03	0.00	6.74	0.00	42.57	833.08	0.00	0.00	833.08	908.23	694.54	661.44
Dewatering (U)	0.050	189,027	170	12,312	95	200,308	122,402	6883.19	834.03	0.00	6.74	0.00	42.57	833.08	0.00	0.00	833.08	6883.19	3360.70	661.44
Biosolids	0.050	189,027	170	12,312	95	200,308	122,402	6883.19	834.03	0.00	6.74	0.00	42.57	833.08	0.00	0.00	833.08	6883.19	3360.70	661.44

BioWin Process Model Results - Mass Flow Table

Elements	Flow [mgd]	Total COD [lb /d]	Filtered COD [lb /d]	Total Carbonaceous BOD [lb /d]	Filtered Carbonaceous BOD [lb /d]	Total suspended solids [lb TSS/d]	Volatile suspended solids [lb VSS/d]	Total Kjeldahl Nitrogen [lb N/d]	Filtered TKN [lb N/d]	Nitrite + Nitrate [lb N/d]	pH []	Dissolved oxygen [lb /d]	Alkalinity [kmol/d]	Ammonia N [lb N/d]	Nitrate N [lb N/d]	Nitrite N [lb N/d]	Total inorganic N [lb N/d]	Total N [lb N/d]	Total P [lb P/d]	Soluble PO4-P [lb P/d]
COD Influent GWRP	-----	212,803	63,815	91,191	37,630	106,458	85,159	14,270	11,813	0	7.30	0	795	9,989	0	0	9,989	14,270	3,295	1,013
PE Spllitter (U)	-----	0	0	0	0	0	0	0	0	0	7.28	0	0	0	0	0	0	0	0	0
PE Spllitter	-----	214,219	64,037	91,476	37,635	107,533	85,956	14,334	11,821	21	7.28	10	803	9,990	20	2	10,012	14,355	3,361	1,058
Primary clarifiers	-----	121,886	63,315	58,209	37,211	41,938	33,523	12,668	11,687	21	7.28	10	794	9,878	19	2	9,899	12,689	1,944	1,046
Primary clarifiers (U)	-----	92,333	722	33,267	424	65,595	52,433	1,666	133	0	7.28	0	9	113	0	0	113	1,667	1,417	12
RAS+Cen	-----	1,846,054	9,999	431,112	861	1,654,991	1,224,811	87,627	1,970	849	6.84	400	389	1,677	784	65	2,526	88,476	34,947	3,007
Z1-Reaer	-----	1,838,795	9,056	426,547	197	1,652,049	1,221,718	86,013	428	2,356	6.72	206	288	99	2,290	66	2,455	88,369	34,947	3,089
Z2-Swing	-----	6,219,584	73,899	1,465,197	6,469	5,520,122	4,094,033	298,607	13,443	1,722	6.91	3	3,049	10,983	1,162	559	12,705	300,328	119,520	12,864
Z3-Swing	-----	6,215,431	67,468	1,460,822	1,316	5,521,347	4,095,276	298,607	13,302	87	6.94	0	3,123	11,602	66	21	11,689	298,694	119,520	12,845
Z4-Swing	-----	6,215,094	68,011	1,460,117	1,595	5,520,151	4,094,308	298,607	13,339	2	6.95	0	3,140	12,105	1	0	12,107	298,609	119,520	12,877
Z5-Aer	-----	6,200,827	66,425	1,452,805	1,706	5,515,030	4,088,657	292,889	7,385	5,621	6.87	2,969	2,748	5,572	3,527	2,094	11,193	298,510	119,520	12,961
Z6-Aer	-----	6,188,427	66,006	1,445,619	1,611	5,509,953	4,083,146	289,266	3,649	9,061	6.81	1,485	2,505	1,540	6,424	2,637	10,602	298,327	119,520	13,058
Z7a-Ax	-----	1,906,235	20,115	443,655	234	1,698,529	1,258,186	89,241	1,149	1,482	6.84	1	822	687	923	559	2,169	90,723	36,891	4,078
Z7b-Ae	-----	1,902,674	20,307	441,621	445	1,696,730	1,256,310	88,759	712	1,938	6.84	917	787	100	1,790	149	2,039	90,698	36,891	4,123
IMLR Splitter Z6	-----	1,910,097	20,373	446,200	497	1,700,682	1,260,289	89,284	1,126	2,797	6.81	458	773	475	1,983	814	3,272	92,080	36,891	4,030
IMLR Splitter Z6 (U)	-----	4,278,330	45,633	999,420	1,114	3,809,271	2,822,857	199,982	2,523	6,264	6.81	1,026	1,732	1,065	4,441	1,823	7,329	206,246	82,630	9,028
IMLR Splitter Z7	-----	1,902,674	20,307	441,621	445	1,696,730	1,256,310	88,759	712	1,938	6.84	917	787	100	1,790	149	2,039	90,698	36,891	4,123
IMLR Splitter Z7 (U)	-----	0	0	0	0	0	0	0	0	0	6.84	0	0	0	0	0	0	0	0	0
Secondary clarifier	-----	13,421	11,432	717	250	1,793	1,328	494	401	1,091	6.84	516	443	56	1,008	84	1,148	1,585	2,355	2,321
Secondary clarifier (U)	-----	1,889,253	8,875	440,904	194	1,694,937	1,254,983	88,265	311	847	6.84	401	344	44	782	65	891	89,112	34,535	1,802
Filters	-----	12,006	11,210	432	246	717	531	430	393	1,070	6.84	506	435	55	988	82	1,125	1,500	2,290	2,276
Filters (U)	-----	1,415	222	285	5	1,076	797	64	8	21	6.84	10	9	1	20	2	22	85	66	45
Effluent	-----	12,006	11,210	432	246	717	531	430	393	1,070	6.84	506	435	55	988	82	1,125	1,500	2,290	2,276
RAS/WAS Splitter	-----	1,831,945	8,606	427,530	188	1,643,522	1,216,914	85,588	302	821	6.84	388	334	42	758	63	864	86,409	33,488	1,747
RAS/WAS Splitter (U)	-----	57,309	269	13,374	6	51,414	38,069	2,677	9	26	6.84	12	10	1	24	2	27	2,703	1,048	55
Sludge SEWRP (PS+WAS)	-----	22,389	344	6,758	185	23,659	13,237	591	57	8	7.07	2	6	47	8	0	54	599	409	14
Blended PS+WAS	-----	172,030	1,335	53,399	615	140,668	103,739	4,935	200	34	7.00	15	25	160	32	2	194	4,969	2,873	81
Thickening	-----	9,622	1,087	3,140	501	7,033	5,187	400	163	27	7.00	12	21	131	26	2	158	427	205	66
Thickening (U)	-----	162,408	248	50,259	114	133,635	98,552	4,535	37	6	7.00	3	5	30	6	0	36	4,541	2,668	15
Anaerobic Digesters	-----	84,007	377	5,622	212	88,700	54,202	4,535	1,856	0	6.68	0	43	1,854	0	0	1,854	4,535	2,668	1,472
Dewatering	-----	4,488	306	442	172	4,435	2,710	1,639	1,506	0	6.74	0	35	1,504	0	0	1,504	1,639	1,254	1,194
Dewatering (U)	-----	79,519	71	5,179	40	84,265	51,492	2,896	351	0	6.74	0	8	350	0	0	350	2,896	1,414	278
Biosolids	-----	79,519	71	5,179	40	84,265	51,492	2,896	351	0	6.74	0	8	350	0	0	350	2,896	1,414	278

SECONDARY CLARIFIERS STATE POINT ANALYSIS

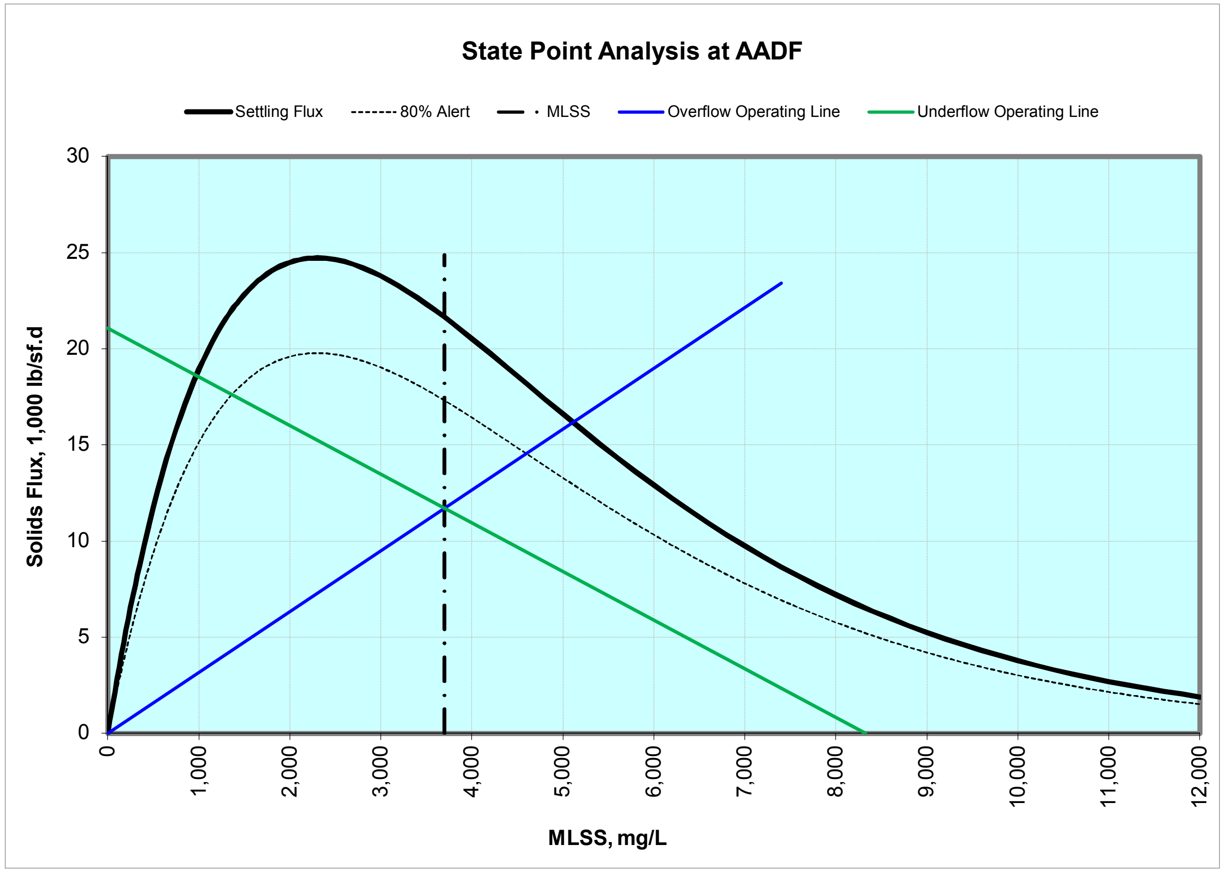
ANNUAL AVERAGE DAY LOADING CONDITIONS

State Point Analysis Diagram

Scenario: AADF, one SC out of service

CSF:	1.85
Max. MLSS:	3,700 mg/L
RAS ratio:	0.80
Max. SLR:	21.0 ppd/sf
SOR:	379 gpd/sf

		Values for Analysis (**BLUE**) Inputs
o Flow Rates, mgd		
- Sec.Effluent from Clars, mgd		
-- AADF		**30.00**
-- PF		**1.00**
-- AADF		30.00
-- Peaking Factor	*	**1.00**
-- Clarifier Effluent, mgd		30.00
- Qunderflow/Q, fraction	*	**0.80**
- Effluent Rise Rate, qF, ft/h		2.11
- Underflow velocity, qR, ft/h		1.69
o Clarifiers		
- Number		**7**
- Number in Service		**7**
- Diameter, ft		**120**
- Surface area, each, sf		11,310
- Total Clarifier Area in Service, sf	*	79,168
- L-P MLSS conc, XF, mg/L	*	**3,700**
o Settling Curve		
- V_0, ft/hr	*	19.5
- X_M, mg/L	*	2,300
ISV = V_0 exp(- MLSS/X_M), ft/h		
o Clarification Safety Factor, CSF		**1.85** OK



Design SVI, mL/g	**150**
Pitman (modified): V_0*X_M	44,758
V_0, ft/hr	19.5
X_M, mg/L	2,300

Peak 4-hr Diurnal Flow:	48.00
AADF:	30.00
CSF:	**1.84** target at AADF

$$\text{Target } CSF = \frac{PeakFlow}{AADF} * 1.15$$

BIOWIN PROCESS MODEL CONFIGURATION DATA

ANNUAL AVERAGE DAY LOADING CONDITIONS

ANNUAL AVERAGE DAY LOADING CONDITIONS

BioWin user and configuration data

Project details

Project name: Greenfield WRP Phase III Expansion **Project ref.: 9837a.10**

Plant name: Greenfield WRP **User name: CLopez**

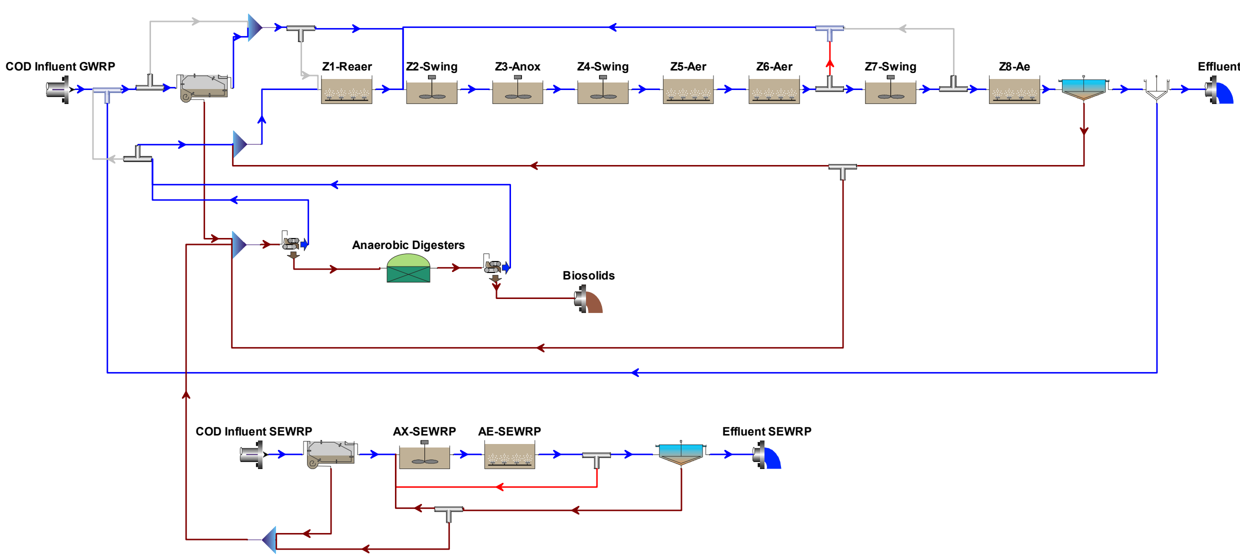
Created: 8/18/2011 **Saved: 11/14/2017**

Steady state solution

Total SRT: 9.97 days

Temperature: 20.0°C

Flowsheet



Configuration information for all Anaerobic Digester units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	Head space volume
Anaerobic Digesters	4.8000	2.139E+4	30.000	0.5

Operating data Average (flow/time weighted as required)

Element name	Pressure [psi]	pH
Anaerobic Digesters	14.9	-

Element name	Average Temperature
Anaerobic Digesters	35.0

Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Z1-Reaer	0.8240	4871.8613	22.610	2550
Z2-Swing	2.4150	1.428E+4	22.610	Un-aerated
Z3-Anox	2.4150	1.428E+4	22.610	Un-aerated
Z4-Swing	2.4150	1.428E+4	22.610	Un-aerated
Z6-Aer	2.6990	1.596E+4	22.610	3000
Z5-Aer	2.6990	1.596E+4	22.610	4800
Z7-Swing	1.8750	1.109E+4	22.610	Un-aerated
AX-SEWRP	1.0000	6684.0282	20.000	Un-aerated
AE-SEWRP	4.0000	2.674E+4	20.000	6058
Z8-Ae	0.8240	4871.8613	22.610	690

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Z1-Reaer	1.0
Z2-Swing	0
Z3-Anox	0
Z4-Swing	0
Z5-Aer	2.0
Z6-Aer	1.0
Z7-Swing	0
Z8-Ae	2.0
AX-SEWRP	0
AE-SEWRP	2.0

Configuration information for all Model clarifier units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]	Number of layers	Top feed layer	Feed Layers
Secondary clarifier	8.8835	7.917E+4	15.000	10	6	1
Secondary clarifier SEWRP	2.5380	2.262E+4	15.000	5	4	1

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Secondary clarifier	Flow paced	80.00 %
Secondary clarifier SEWRP	Flow paced	100.00 %

Element name	Average Temperature	Reactive
Secondary clarifier	Uses global setting	No
Secondary clarifier SEWRP	Uses global setting	No

Configuration information for all COD Influent units

Operating data Average (flow/time weighted as required)

Element name	COD Influent GWRP	COD Influent SEWRP
Flow	29.9993765500001	7.99992180507696
Total COD mgCOD/L	850.00	550.00
Total Kjeldahl Nitrogen mgN/L	57.00	35.00
Total P mgP/L	13.16	11.33
Nitrate N mgN/L	0	0
pH	7.30	7.30
Alkalinity mmol/L	7.00	5.00
ISS Influent mgISS/L	85.00	159.00
Calcium mg/L	80.00	80.00
Magnesium mg/L	15.00	15.00
Dissolved O2 mg/L	0	0

Element name	COD Influent GWRP	COD Influent SEWRP
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1746	0.1751
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.8642	0.8610
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0506	0.0498
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.2240	0.2351
Fna - Ammonia [gNH3-N/gTKN]	0.7000	0.7000
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.4959	0.4751
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0070	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0157	0.0177
Fpo4 - Phosphate [gPO4-P/gTP]	0.3074	0.3756
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0110	0.0110
FZbh - OHO COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZbm - Methylotroph COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZaob - AOB COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZnob - NOB COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4

FZaao - AAO COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZbp - PAO COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZbpa - Propionic acetogens COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZbam - Acetoclastic methanogens COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZbhm - H2-utilizing methanogens COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZe - Endogenous products COD fraction [gCOD/g of total COD]	0	0

Configuration information for all Sidestream Mixer units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]
IMLR Header	0	N/A	N/A
Inf+FBW	0	N/A	N/A

Configuration information for all General Mixer units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]
RAS+Cen	0	N/A	N/A
Blended PS+WAS	0	N/A	N/A
PE+MLR	0	N/A	N/A
Sludge SEWRP (PS+WAS)	0	N/A	N/A

Configuration information for all Ideal primary settling tank units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Primary clarifiers	3.3397	3.079E+4	14.500
Primaries SEWRP	0.7485	7697.0000	13.000

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Primary clarifiers	Flow paced	1.15 %
Primaries SEWRP	Flow paced	2.82 %

Element name	Percent removal	Blanket fraction
Primary clarifiers	61.00	0.10
Primaries SEWRP	60.00	0.10

Configuration information for all Dewatering unit units

Physical data

Element name	No Volume
Dewatering	0
Thickening	0

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Dewatering	Fraction	0.19
Thickening	Fraction	0.19

Element name	Percent removal
Dewatering	95.00
Thickening	95.00

Configuration information for all Point clarifier units

Physical data

Element name	No Volume
Filters	0

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Filters	Flow paced	2.00 %

Element name	Percent removal
Filters	60.00

Configuration information for all Splitter units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]
IMLR Splitter Z6	0	N/A	N/A
RAS/WAS Splitter	0	N/A	N/A
IMLR Splitter Z7	0	N/A	N/A
PE Spllitter	0	N/A	N/A
IMLR Splitter SEWRP	0	N/A	N/A
RAS/WAS Splitter SEWRP	0	N/A	N/A
Centrate Splitter to HW	0	N/A	N/A
ABinf Splitter to Zn1	0	N/A	N/A

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
IMLR Splitter Z6	Flow paced	410.00 %
RAS/WAS Splitter	Flowrate [Side]	0.728
IMLR Splitter Z7	Flowrate [Side]	0
PE Spllitter	Fraction	0.00
IMLR Splitter SEWRP	Flow paced	400.00 %
RAS/WAS Splitter SEWRP	Flow paced	1.74 %
Splitter78	Fraction	1.00
Splitter81	Fraction	0.00

BioWin Album

Album page - Inf-Eff

COD Influent GWRP			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	340.15	85159.02	
Total suspended solids	425.22	106457.61	
Particulate COD	595.11	148988.67	
Filtered COD	254.89	63814.72	
Total COD	850.00	212803.39	
Soluble PO4-P	4.05	1012.79	
Total P	13.16	3294.70	
Filtered TKN	47.18	11812.86	
Particulate TKN	9.82	2457.48	
Total Kjeldahl Nitrogen	57.00	14270.34	
Filtered Carbonaceous BOD	150.31	37630.46	
Total Carbonaceous BOD	364.24	91191.11	
Nitrite + Nitrate	0	0.00	
Total N	57.00	14270.34	
Total inorganic N	39.90	9989.24	
Alkalinity	7.00	794.91	mmol/L and kmol/d
pH	7.30		

Volatile fatty acids	22.26	5573.32	
ISS precipitate	0	0	
ISS cellular	0.07	18.25	
ISS Total	85.07	21298.59	
Ammonia N	39.90	9989.24	
Nitrate N	0	0.00	

Album page - Inf-Eff

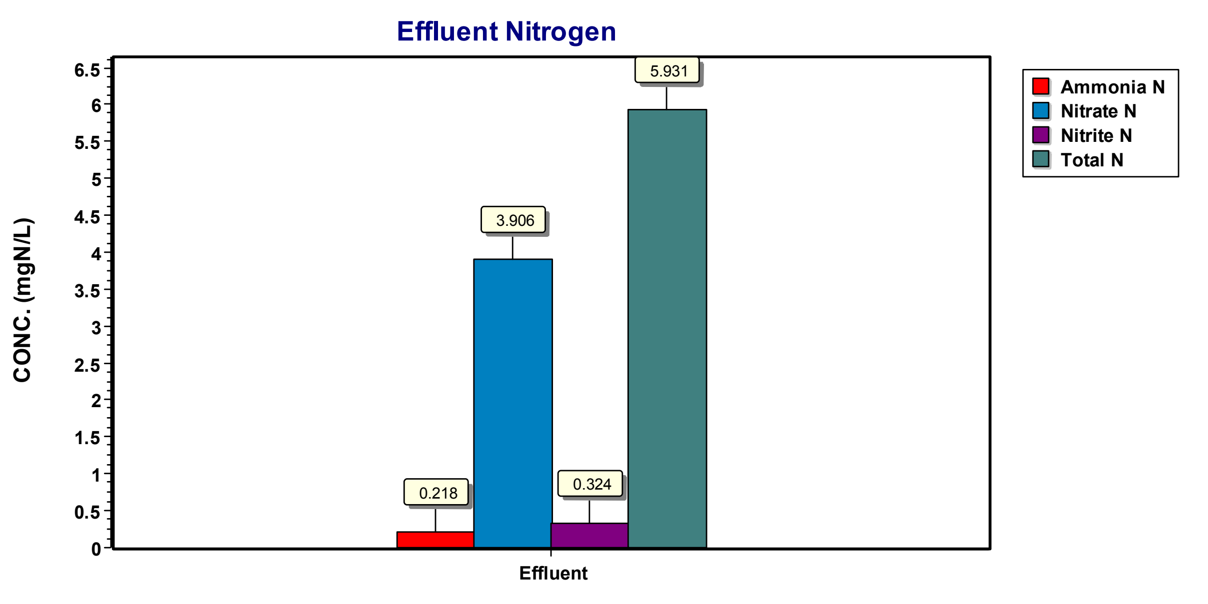
RAS+Cen

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	5951.80	1224811.27	
Total suspended solids	8042.20	1654990.76	
Particulate COD	8922.06	1836055.09	
Filtered COD	48.59	9999.18	
Total COD	8970.65	1846054.27	
Soluble PO4-P	14.61	3006.81	
Total P	169.82	34946.78	
Filtered TKN	9.57	1970.28	
Particulate TKN	416.24	85656.69	
Total Kjeldahl Nitrogen	425.81	87626.97	
Filtered Carbonaceous BOD	4.18	861.14	
Total Carbonaceous BOD	2094.93	431112.08	
Nitrite + Nitrate	4.13	848.97	
Total N	429.94	88475.94	
Total inorganic N	12.27	2525.91	
Alkalinity	4.16	388.70	mmol/L and kmol/d
pH	6.84		
Volatile fatty acids	1.49	307.33	
ISS precipitate	0.00	0.00	
ISS cellular	306.19	63009.87	
ISS Total	2090.40	430179.49	
Ammonia N	8.15	1676.94	
Nitrate N	3.81	784.28	

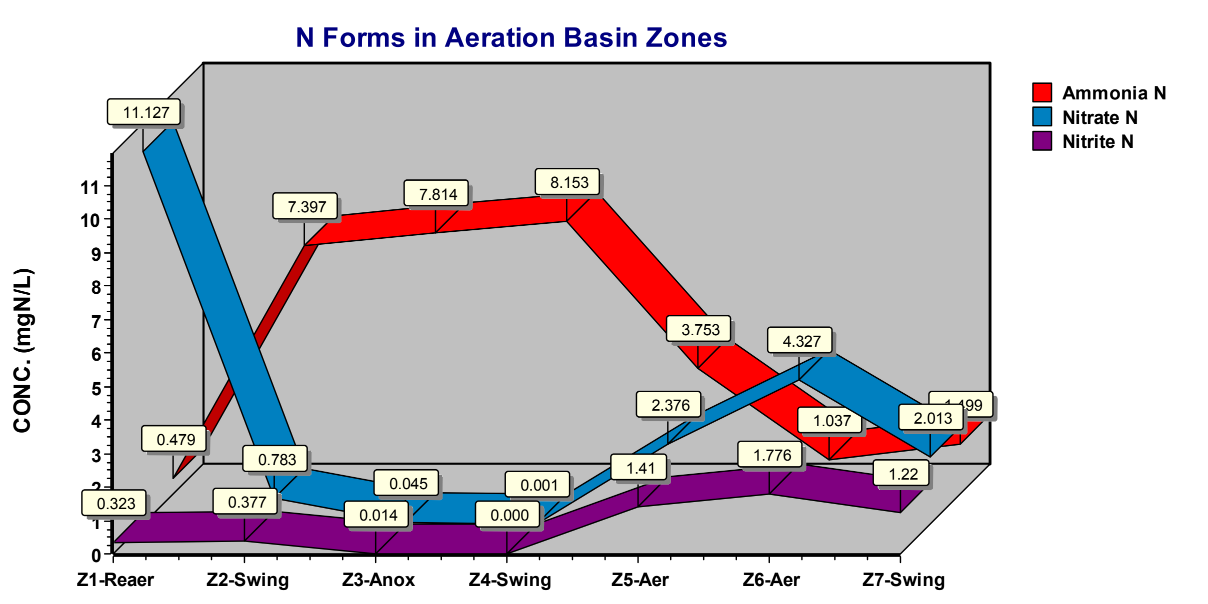
Album page - Inf-Eff

Effluent			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	2.10	531.05	
Total suspended solids	2.84	717.21	
Particulate COD	3.15	795.68	
Filtered COD	44.31	11210.04	
Total COD	47.46	12005.73	
Soluble PO4-P	9.00	2275.78	
Total P	9.05	2289.63	
Filtered TKN	1.55	393.18	
Particulate TKN	0.15	37.22	
Total Kjeldahl Nitrogen	1.70	430.40	
Filtered Carbonaceous BOD	0.97	245.51	
Total Carbonaceous BOD	1.71	432.00	
Nitrite + Nitrate	4.23	1070.07	
Total N	5.93	1500.46	
Total inorganic N	4.45	1125.32	
Alkalinity	3.79	434.66	mmol/L and kmol/d
pH	6.84		
Volatile fatty acids	0.00	0.40	
ISS precipitate	0.00	0.00	
ISS cellular	0.11	27.42	
ISS Total	0.74	186.17	
Ammonia N	0.22	55.25	
Nitrate N	3.91	988.02	

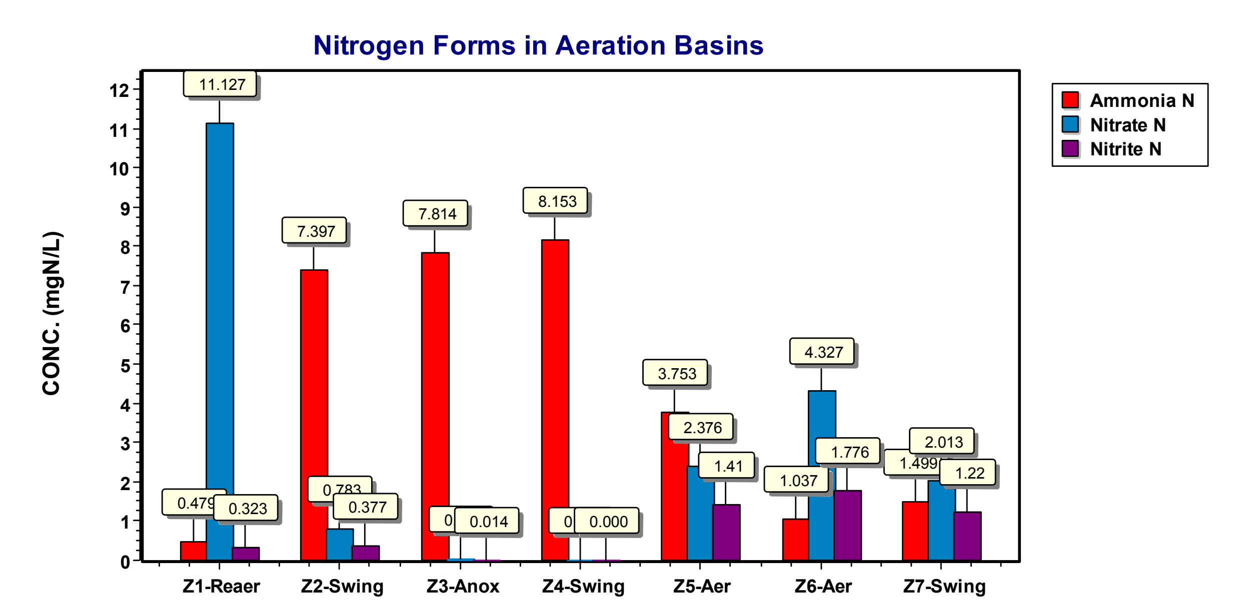
Album page - Eff N



Album page - N forms in ABs (3D)



Album page - N forms in ABs



Album page - SC

Secondary clarifier			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	5.15	1327.62	
Total suspended solids	6.95	1793.04	
Particulate COD	7.71	1989.21	
Filtered COD	44.31	11431.92	
Total COD	52.02	13421.13	
Soluble PO4-P	9.00	2320.83	
Total P	9.13	2355.45	
Filtered TKN	1.55	400.96	
Particulate TKN	0.36	93.04	
Total Kjeldahl Nitrogen	1.91	494.01	
Filtered Carbonaceous BOD	0.97	250.37	
Total Carbonaceous BOD	2.78	716.59	
Nitrite + Nitrate	4.23	1091.25	
Total N	6.14	1585.25	
Total inorganic N	4.45	1147.59	

Alkalinity	3.79	443.26	mmol/L and kmol/d
pH	6.84		
Volatile fatty acids	0.00	0.41	
ISS precipitate	0.00	0.00	
ISS cellular	0.27	68.54	
ISS Total	1.80	465.42	
Ammonia N	0.22	56.34	
Nitrate N	3.91	1007.57	

Parameters	Value	Units
Element HRT	3.88	hours
Percent TSS removal	99.89	%
Percent COD removal	99.29	%
Percent BOD removal	99.84	%
Percent TKN removal	99.44	%
Percent Tot. P removal	93.62	%
Height of specified concentration	1.80	ft
Total solids mass	89486.93	lb
Surface overflow rate	390.47	gal/(ft2 d)
Solids loading rate	21.43	lb/(ft2 d)
Power	1.50	kW
Power cost (Excl. heating)	0.23	$/hour

Album page - Centrifuge

Dewatering

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	122402.16	51491.72	
Total suspended solids	200307.94	84264.86	
Particulate COD	188857.41	79447.89	
Filtered COD	169.53	71.32	
Total COD	189026.94	79519.21	
Soluble PO4-P	661.44	278.25	

Total P	3360.70	1413.77	
Filtered TKN	834.03	350.86	
Particulate TKN	6049.16	2544.74	
Total Kjeldahl Nitrogen	6883.19	2895.60	
Filtered Carbonaceous BOD	95.19	40.04	
Total Carbonaceous BOD	12312.09	5179.41	
Nitrite + Nitrate	0.00	0.00	
Total N	6883.19	2895.60	
Total inorganic N	833.08	350.46	
Alkalinity	42.57	8.12	mmol/L and kmol/d
pH	6.74		
Volatile fatty acids	129.45	54.46	
ISS precipitate	0.00	0.00	
ISS cellular	3425.36	1440.97	
ISS Total	77905.78	32773.14	
Ammonia N	833.08	350.46	
Nitrate N	0.00	0.00	

Parameters	Value	Units
Percent TSS removal	95.00	%
Power	0	kW
Power cost (Excl. heating)	0	$/hour
Cost (Chemicals)	0	$/hour

Album page - Centrifuge

Dewatering

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	1501.33	2710.09	
Total suspended solids	2456.89	4434.99	
Particulate COD	2316.44	4181.47	
Filtered COD	169.53	306.03	
Total COD	2485.97	4487.50	

Soluble PO4-P	661.44	1193.98	
Total P	694.54	1253.74	
Filtered TKN	834.03	1505.53	
Particulate TKN	74.20	133.93	
Total Kjeldahl Nitrogen	908.23	1639.46	
Filtered Carbonaceous BOD	95.19	171.83	
Total Carbonaceous BOD	245.04	442.32	
Nitrite + Nitrate	0.00	0.00	
Total N	908.23	1639.46	
Total inorganic N	833.08	1503.81	
Alkalinity	42.57	34.86	mmol/L and kmol/d
pH	6.74		
Volatile fatty acids	129.45	233.68	
ISS precipitate	0.00	0.00	
ISS cellular	42.01	75.84	
ISS Total	955.56	1724.90	
Ammonia N	833.08	1503.81	
Nitrate N	0.00	0.00	

Parameters	Value	Units
Percent TSS removal	95.00	%
Power	0	kW
Power cost (Excl. heating)	0	$/hour
Cost (Chemicals)	0	$/hour

Album page - Digesters

Anaerobic Digesters

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	24351.59	54201.81	
Total suspended solids	39850.74	88699.85	
Particulate COD	37572.68	83629.36	
Filtered COD	169.53	377.35	

Total COD	37742.22	84006.70	
Soluble PO4-P	661.44	1472.23	
Total P	1198.45	2667.51	
Filtered TKN	834.03	1856.39	
Particulate TKN	1203.46	2678.67	
Total Kjeldahl Nitrogen	2037.49	4535.06	
Filtered Carbonaceous BOD	95.19	211.87	
Total Carbonaceous BOD	2525.71	5621.73	
Nitrite + Nitrate	0.00	0.00	
Total N	2037.49	4535.06	
Total inorganic N	833.08	1854.27	
Alkalinity	42.67	43.08	mmol/L and kmol/d
pH	6.68		
Volatile fatty acids	129.45	288.14	
ISS precipitate	0.00	0.00	
ISS cellular	681.47	1516.81	
ISS Total	15499.15	34498.04	
Ammonia N	833.08	1854.27	
Nitrate N	0.00	0.00	

Parameters	Value	Units
Element HRT	431.93	hours
Velocity gradient	6.60	1/s
VSS destruction	45.00	%
Total solids mass	1596338.52	lb
Total readily biodegradable COD	129.54	mg/L
Off gas flow rate (dry)	537.00	ft3/min (field)
Off gas Oxygen	0	%
Off gas Carbon dioxide	37.04	%
Off gas Ammonia	0	%
Off gas Hydrogen	0.05	%
Off gas Methane	62.84	%
Off gas Nitrous oxide	0	%

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	0.5500	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.1500	0.3000	1.0290
Ammonification rate [L/(mgCOD d)]	0.0800	0.0400	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.5000	0.5000	1.0000
Endogenous products decay rate [1/d]	0	0	1.0000

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9000	0.9000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.7000	0.7000	1.0000
Byproduct NH4 logistic slope [-]	50.0000	50.0000	1.0000
Byproduct NH4 inflection point [mgN/L]	1.4000	1.4000	1.0000
AOB denite DO half sat. [mg/L]	0.1000	0.1000	1.0000
AOB denite HNO2 half sat. [mgN/L]	5.000E-6	5.000E-6	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiHNO2 [mmol/L]	0.0050	0.0050	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.7000	0.7000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.1000	0.1000	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiNH3 [mmol/L]	0.0750	0.0750	1.0000

AAO

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2000	0.1000	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	3.2000	1.0290
Fermentation half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Fermentation growth factor (AS) [-]	0.2500	0.1250	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	0.1000	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	1.8310
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000
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	0.3000
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

Heating fuel/Chemical Costs

Name	Default	Value
Methanol [$/gal]	1.6656	1.6656
Ferric [$/gal]	0.3785	0.3785
Aluminium [$/gal]	0.3028	0.3028
Natural gas [$/MMBTU]	3.1652	3.1652
Heating oil [$/gal]	1.8927	1.8927
Diesel [$/gal]	2.6498	2.6498
Custom fuel [$/gal]	3.7854	3.7854
Biogas sale price [$/MMBTU]	2.1101	2.1101

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

Calorific values of heating fuels

Name	Default	Value
Calorific value of natural gas [BTU/lb]	20636	20636
Calorific value of heating fuel oil [BTU/lb]	18057	18057

Calorific value of diesel [BTU/lb]	19776	19776
Calorific value of custom fuel [BTU/lb]	13758	13758

Density of liquid heating fuels

Name	Default	Value
Density of heating fuel oil [lb/ft3]	56	56
Density of diesel [lb/ft3]	55	55
Density of custom fuel [lb/ft3]	49	49

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	101.3250
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	1.0000
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	2.46697
Maximum power per rotor [hp]	26.80965	26.80965

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-10	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	1.0000	1.0000
Nitrite oxidizing biomass (NOB)	25.0000	1.0000	1.0000
Anaerobic ammonia oxidizers (AAO)	10.0000	1.0000	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

DIFFUSER DESIGN CALCULATIONS

CAROLLO ENGINEERS == DIFFUSER DESIGN CALCULATIONS

W.O./CLIENT:	9837A.10/CITY OF MESA
PROJECT:	GREENFIELD WRP PHASE III EXPANSION DESIGN
SUBJECT:	**DIFFUSER SYSTEM DESIGN - System Configuration**

v67	Calc By	Date	Time	Chk by	Filename
	CL	9/16/2016	17:08		Diffuser System Design67 4-Stage GWRP PH III DESIGN 24in.xls

Diffuser System Data Sheet

OPERATING CONDITIONS (Daily Average):		Annual Average	Max-Month	Min Startup	
Operating Solids Retention Time (SRT)	=	13.4	10.1	21.5	days
Design WW Temperature	=	20.0	28.0	20.0	deg. C
Total Oxygen Demand (all Basins combined)	=	90,896	113,179	42,418	lb/d
Number of Basins in Operation	=	4.00	4.00	3.00	
Total Oxygen Demand per Basin	=	22,724	28,295	14,139	lb/d
Side Water Depth in Aeration Basin	=	23.80	23.80	23.80	ft
Aeration Basin Water Surface Elevation	=	1,296	1,296	1,296	ft above Sea Level

All data shown are PER BASIN

Nominal Dimensions for AERATED ZONES ONLY:											
Diffuser Grid Number		**Grid 1**	**Grid 2**	**Grid 3**	**Grid 4**	**Grid 5**	**Grid 6**	**Grid 7**	**Grid 8**	**Total**	
Zone Length	=	29.0	85.0	85.0	85.0	95.0	95.0	66.0	29.0	569	ft
Zone Width	=	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0		ft
Floor Area	=	1,624	4,760	4,760	4,760	5,320	5,320	3,696	1,624	**31,864**	sf
% of Aerated Basin Volume		5.1	14.9	14.9	14.9	16.7	16.7	11.6	5.1		

OXYGEN DEMAND DISTRIBUTION:

	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Total	
Average Conditions										
Design Peaking Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**		
Design lb/d Oxygen Demand exerted in this Zone (*1)	4,034	0	0	0	10,410	6,816	0	1,463	**22,724**	lb/d
Site Conditions Adjustment Factor, F (*3)	0.23	0.53	0.57	0.60	0.51	0.56	0.66	0.00		
Peak Conditions										
Design Peaking Factor	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**		
Design lb/d Oxygen Demand exerted in this Zone (*1)	6,134	0	0	0	14,832	10,724	0	2,264	**33,954**	
Site Conditions Adjustment Factor, F (*3)	0.21	0.50	0.53	0.56	0.48	0.50	0.61	0.00		
Minimum Conditions										
Design Peaking Factor	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**		
Design lb/d Oxygen Demand exerted in this Zone	1,883	0	0	0	4,858	3,181	0	683	**10,605**	lb/d
Site Conditions Adjustment Factor, F	0.26	0.65	0.69	0.69	0.56	0.59	0.69	0.00		

OXYGEN DEMAND DISTRIBUTION (Oxygen Demand Exerted in Each Zone)

Select the manner in which the Oxygen Demand Distribution is to be calculated -

Select Calculation Option: 3 = DIRECT Correspondence with BioWin (or direct Entry of lb/d)
Now proceed to specify correspondence between each Grid and Biotran Zone in the Table below,
(or enter lb/d Demand directly); then enter Peaking Factors in Diffuser System Data Sheet

Grid/Zone Correspondence Table for Option 3

Diffuser Grid	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8
Corresponding Biotran Zone Number	1	2	3	4	5	6	7	8

- If you want to enter your own selected distribution of lb/d Oxygen Demand (e.g., if you wanted to check extreme operating alternatives), select OPTION 3 and enter your data directly into the "lb/d Oxygen Demand Distribution" Table, below.

lb/d Oxygen Demand Distribution for Option 3

Average Oxygen Demand exerted in this Zone, lb/d	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8
Annual Average Conditions	16,137	0	0	0	41,640	27,265	0	5,854
Max-Month (Peak) Conditions	20,445	0	0	0	49,439	35,747	0	7,548
Minimum Startup Conditions	7,530	0	0	0	19,432	12,724	0	2,732

CAROLLO ENGINEERS == DIFFUSER DESIGN CALCULATIONS

W.O./CLIENT:	9837A.10/CITY OF MESA
PROJECT:	GREENFIELD WRP PHASE III EXPANSION DESIGN
SUBJECT:	**DIFFUSER SYSTEM DESIGN - Values for Specification**

v67	Calc By	Date	Time	Chk By	Filename
	CL	9/16/2016	17:08		Diffuser System Design67 4-Stage GWRP PH III DESIGN 24in.xls

Diffuser Data for Specification Section

Sanitaire 9" Membrane Disk Diffusers:

This section helps to prepare the data table as used in the latest recommended version of the diffuser Spec, once it has been decided what SOTE is to be asked for in the Spec. For the BLUE values, change the entries to use the appropriate diffuser type

All values are PER BASIN, for a total of (number) basins.										
Zone Number	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Total per basin	Total
Nominal floor dimensions:										
Length (ft)	29	85	85.0	85.0	95.0	95	66	29		
Width (ft)	56	56	56	56	56	56	56	56		
Side water depth (ft)	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.8		
Standard Oxygen Transfer Rate,										
SOTR (lb/day)	**17,834**	0	0	0	**20,464**	**12,234**	0	**2,713**		
Standard Oxygen Transfer Efficiency,										
SOTE, minimum (percent)	**39.2**	0.0	0.0	0.0	**41.5**	**39.4**	0.0	**37.6**		
Average Air Flow Rate (scfm)	**1,804**	**0**	**0**	**0**	**1,954**	**1,230**	**0**	**286**	5,274	**21,095**
= 3.96 x SOTR / SOTE										
Peak Air Flow Rate (scfm)	**3,090**	**0**	**0**	**0**	**3,082**	**2,331**	**0**	**498**	9,001	**36,003**
Minimum Process Air Flow Rate (scfm)	661	0	0	0	751	489	0	115	2,016	6,048
Minimum Mixing Air Flow Rate (scfm)	195	571	571	571	638	638	444	195		
Minimum Air Flow Rate (scfm)	**661**	**0**	**0**	**0**	**751**	**638**	**0**	**195**	2,245	**6,736**
Number of diffusers	**850**	850	0	1600	**1600**	**1000**	400	**230**		
Active Diffuser Area (sq ft),										
minimum (Note 1)	349	349	0	656	656	410	164	94		
Number of blanks (percent)	0	0	0	10	10	10	10	10		

(Note 1): The Contractor is cautioned that the active diffuser areas shown are a minimum, and may have to be increased to achieve the specified SOTE. Actual numbers of diffusers required should be reviewed with the proposed supplier of the diffuser system.

Calculation Section

Factor for Peak/Aver Air Flow Rate 1.71 [See estimate below]

Value used to convert scfm to Diffuser Area (scfm/sf)
Use 3 - 4

Resulting Air Rate per diffuser:	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8
Diffuser active area, sf	0.41	0.41	0.00	0.41	0.41	0.41	0.41	0.41
Average Loading, scfm/dfr	2.12	0.00	0.00	0.00	1.22	1.23	0.00	1.24
Peak Loading, scfm/dfr	3.64	0.00	0.00	0.00	1.93	2.33	0.00	2.16

Evaluation Of Standard Oxygen Transfer Rate

Enter the following values from the spreadsheet for the selected diffuser:

		Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Total
Average Conditions:										
Oxygen Transfer Rate, OTR	=	4,034	0	0	0	10,410	6,816	0	1,463	**22,724** lb/day
Site Adjustment Factor, F	=	0.23	0.53	0.57	0.60	0.51	0.56	0.66	0.54	
[includes effects of operating D.O. concentration, site elevation, temperature and alpha factor]										
Standard Oxygen Transfer Rate, SOTR	=	17,834	0	0	0	20,464	12,234	0	2,713	**53,244** lb/day
[SOTR = OTR / F]										
Peak Conditions:										
Oxygen Transfer Rate, OTR	=	6,134	0	0	0	14,832	10,724	0	2,264	**33,954** lb/day
Site Adjustment Factor, F	=	0.21	0.50	0.53	0.56	0.48	0.50	0.61	0.51	
[includes effects of operating D.O. concentration, site elevation, temperature and alpha factor]										
Standard Oxygen Transfer Rate, SOTR	=	28,856	0	0	0	30,749	21,591	0	4,423	**85,618** lb/day
[SOTR = OTR / F]										
Peak/Average Air Flow Rate		1.71	0.00	0.00	0.00	1.58	1.90	0.00	1.74	1.71
[Select an appropriate average for Spec)										
Minimum Conditions:										
Oxygen Transfer Rate, OTR	=	1,883	0	0	0	4,858	3,181	0	683	**10,605** lb/day
Site Adjustment Factor, F	=	0.26	0.65	0.69	0.69	0.56	0.59	0.69	0.56	
[includes effects of operating D.O. concentration, site elevation, temperature and alpha factor]										
Standard Oxygen Transfer Rate, SOTR	=	7,268	0	0	0	8,707	5,386	0	1,217	**22,577** lb/day
[SOTR = OTR / F]										

Note: Average air flow rate per Zone = 3.96 x SOTR / SOTE

CAROLLO ENGINEERS == DIFFUSER DESIGN CALCULATIONS

W.O./CLIENT:	9837A.10/CITY OF MESA
PROJECT:	GREENFIELD WRP PHASE III EXPANSION DESIGN
SUBJECT:	**DIFFUSER SYSTEM DESIGN - Average Conditions**
Treatment Conditions:	**Annual Average**
Type of Diffuser	Sanitaire 9" Membrane Disk Diffusers:

v67	Calc By	Date	Time	Chk By	Filename
	CL	9/16/2016	17:08		Diffuser System Design67 4-Stage GWRP PH III DESIGN 24in.xls

Grid 1 **Grid 2** **Grid 3** **Grid 4** **Grid 5** **Grid 6** **Grid 7** **Grid 8** **Total**

Part B: This section is set up to calculate air requirements, zone by zone along the aeration basin FOR ANNUAL AVERAGE CONDITIONS
The calculations use estimated SOTE's. Proposed layout should be checked with Diffuser Vendor
Enter the data required below - either from Sheet O2_Demand, or your own values:
General Procedure:
Manipulate number of diffusers and Oxygen Transferred per zone, to attain air loading per diffuser in the required ranges, for average as well as peak conditions. Do not exceed the max number of diffusers that can reasonably fit into a zone.
[Note: Entries for Oxygen Transferred per Zone will transfer proportionately to the Peak calc. sheet]

Operating Solids Retention Time (SRT)	(Rs)	=	13.4 days								
WW Temperature		=	20 deg. C								
Design Air Temperature		=	25 deg. C								
Side Water Depth in Aeration Basin		=	23.80 ft								
Total Oxygen Transfer Required (all basins, daily average)		=	90,896 lb/d								
Number of Basins in Service		=	4								
Total Oxygen Transfer per Basin		=	22,724 lb/d								
Normal D.O. Set Point		=	**1.5**	**0.0**	**0.0**	**0.0**	**2.0**	**1.5**	**0.0**	**2.0**	mg/L

All data shown are PER BASIN

COMPARTMENT SIZES (per Basin) - from Data Sheet			**Grid 1**	**Grid 2**	**Grid 3**	**Grid 4**	**Grid 5**	**Grid 6**	**Grid 7**	**Grid 8**	**Total**	
Length			29.0	85.0	85.0	85.0	95.0	95.0	66.0	29.0		ft
Width			56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0		ft
Floor Area		=	1,624	4,760	4,760	4,760	5,320	5,320	3,696	1,624	31,864	sf
This area is used to specify the parameters required to evaluate SOTE for the specific diffuser selected												
NUMBER OF DIFFUSERS PER ZONE [Enter Data where indicated, below!]			850	850	0	1600	1600	1000	400	230	6,530	
Active Area per diffuser, sf (average if using different panels)			0.41	0.41	0	0.41	0.41	0.41	0.41	0.41		
Total Active Area, sf			348.5	348.5	0	656	656	410	164	94.3		
Floor Coverage, sf/sf	(At/Ad)	=	4.7	13.7	0.0	7.3	8.1	13.0	22.5	17.2		
Diffuser coverage			21.5%	7.3%	0.0%	13.8%	12.3%	7.7%	4.4%	5.8%		
OXYGEN DEMAND DISTRIBUTION:												
Oxygen Demand in this Zone (per Basin)			4,034	0	0	0	10,410	6,816	0	1,463		lb/d
Carryover from previous zone			-	-	-	-	-	-	-	-		lb/d
Total Oxygen Demand in this zone			4,034	0	0	0	10,410	6,816	0	1,463		lb/d
Design Oxygen Transfer for this zone	(OTR)	=	4,034	0	0	0	10,410	6,816	0	1,463		lb/d
Carryover to next zone			0	0	0	0	0	0	0	0		lb/d
OPERATING CONDITIONS												
Site Conditions Adjustment Factor, F, to be used in System Sizing calculations:	(F)	=	0.23	0.53	0.57	0.60	0.51	0.56	0.66	0.54		
where F = Alpha x [Theta ^(T-20)] x (Tau Beta Omega C*20 - C)/C*20												
Omega = Barometric pressure correction factor; other terms are standard terminiology												
OXYGEN TRANSFER EFFICIENCY												
Estimated SOTE (cw)	(SOTE)	=	39.2	0.0	0.0	0.0	41.5	39.4	0.0	37.6		%
Actual OTE = F x SOTE, percent	(OTE)	=	8.86	0.01	0.01	0.01	21.09	21.95	0.01	20.26		%
Process Air Rate = OTR / OTE * 3.96		=	1,804	0	0	0	1,954	1,230	0	286		scfm
Air Loading per Diffuser		=	**2.12**	**0.00**	**0.00**	**0.00**	**1.22**	**1.23**	**0.00**	**1.24**		scfm/sf
check: Air Loading for Peak Conditions		=	3.64	0.00	0.00	0.00	1.93	2.33	0.00	2.16		
Total Air for One Basin		=	5,274									scfm
TOTAL AIR FOR ALL BASINS		=	21,095									scfm

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CAROLLO ENGINEERS == DIFFUSER DESIGN CALCULATIONS

W.O./CLIENT:	9837A.10/CITY OF MESA
PROJECT:	GREENFIELD WRP PHASE III EXPANSION DESIGN
SUBJECT:	**DIFFUSER SYSTEM DESIGN - Peak Conditions**
Treatment Conditions:	**Peak Conditions (diurnal peaks at max. month loadings)**
Type of Diffuser	Sanitaire 9" Membrane Disk Diffusers:

v67	Calc By	Date	Time	Chk By	Filename
	CL	9/16/2016	17:08		Diffuser System Design67 4-Stage GWRP PH III DESIGN 24in.xls

This section is set up to calculate air requirements, zone by zone along the aeration basin FOR PEAK CONDITIONS
The calculations use estimated SOTE's. Proposed layout should be checked with Diffuser Vendor
Enter the data required below - either from Sheet O2_Demand, or your own values:
The Oxygen Demand values are transferred proportionately from the Average spreadsheet. Enter your own selections if necessary.

Operating Solids Retention Time (SRT)	(Rs)	=	10.1	days								
WW Temperature		=	28.0	deg. C								
Design Air Temperature		=	33.0	deg. C								
Side Water Depth in Aeration Basin		=	23.80	ft								
Total Oxygen Transfer Required (all basins, daily average)		=	113,179	lb/d								
Number of Basins in Service		=	4.00									
Total Oxygen Transfer per Basin		=	28,295	lb/d								
Normal D.O. Set Point		=	1.5	0.0	0.0	0.0	1.5	1.5	0.0	1.5	mg/L	

All data shown are PER BASIN

			Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Total	
COMPARTMENT SIZES (per Basin) - from Data Sheet												
Length			29	85	85.0	85.0	95.0	95	66	29		ft
Width			56	56	56	56	56	56	56	56		ft
Floor Area		=	1,624	4,760	4,760	4,760	5,320	5,320	3,696	1,624	31,864	sf
NUMBER OF DIFFUSERS PER ZONE [Data taken from "Average" Sheet]			850	850	0	1600	1600	1000	400	230	6,530	
Active Area per diffuser, sf			0.41	0.41	0	0.41	0.41	0.41	0.41	0.41		
Total Active Area, sf			348.5	348.5	0	656	656	410	164	94.3		
Floor Coverage, sf/sf	(At/Ad)	=	4.7	13.7	0.0	7.3	8.1	13.0	22.5	17.2		
Diffuser coverage			21.5%	7.3%	0.0%	13.8%	12.3%	7.7%	4.4%	5.8%		
OXYGEN DEMAND DISTRIBUTION:												
Oxygen Demand in this Zone			6,134	0	0	0	14,832	10,724	0	2,264		lb/d
Carryover from previous zone			-	-	-	-	-	-	-	-		lb/d
Total Oxygen Demand in this zone			6,134	0	0	0	14,832	10,724	0	2,264		lb/d
Design Oxygen Transfer for this zone	(OTR)	=	6,134	0	0	0	14,832	10,724	0	2,264		lb/d
Carryover to next zone			0	0	0	0	0	0	0	0		lb/d
OPERATING CONDITIONS												
Site Conditions Adjustment Factor, F, to be used in System Sizing calculations:	(F)	=	0.21	0.50	0.53	0.56	0.48	0.50	0.61	0.51		
where F = Alpha x [Theta ^(T-20)] x (Tau Beta Omega C*20 - C)/C*20												
Omega = Barometric pressure correction factor; other terms are standard terminiology												
OXYGEN TRANSFER EFFICIENCY												
Estimated SOTE (cw)	(SOTE)	=	37.0	0.0	0.0	0.0	39.5	36.7	0.0	35.2		%
Actual OTE = F x SOTE, percent	(OTE)	=	7.86	0.01	0.01	0.01	19.06	18.22	0.01	18.02		%
Process Air Rate = OTR / OTE * 3.96		=	3,090	0	0	0	3,082	2,331	0	498		scfm
Air Loading per Diffuser		**=**	**3.64**	**0.00**	**0.00**	**0.00**	**1.93**	**2.33**	**0.00**	**2.16**		scfm/sf
[This line is intentionally blank]												
Total Air for One Basin		=	9,001									scfm
TOTAL AIR FOR ALL BASINS		=	36,003									scfm

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CAROLLO ENGINEERS == DIFFUSER DESIGN CALCULATIONS

W.O./CLIENT:	9837A.10/CITY OF MESA
PROJECT:	GREENFIELD WRP PHASE III EXPANSION DESIGN
SUBJECT:	**DIFFUSER SYSTEM DESIGN - Minimum Load Conditions**
Treatment Conditions:	**Minimum Loading Conditions**
Type of Diffuser	Sanitaire 9" Membrane Disk Diffusers:

v67 Calc By	Date	Time	Chk By	Filename
CL	9/16/2016	17:08		Diffuser System Design67 4-Stage GWRP PH III DESIGN 24in.xls

Grid 1 **Grid 2** **Grid 3** **Grid 4** **Grid 5** **Grid 6** **Grid 7** **Grid 8** **Total**

This section is set up to calculate air requirements, zone by zone along the aeration basin
The calculations use estimated SOTE's. Proposed layout should be checked with Diffuser Vendor
Enter the data required below - either from Sheet O2_Demand, or your own values:
The Oxygen Demand values are transferred proportionately from the Average spreadsheet. Enter your own selections if necessary.

Operating Solids Retention Time (SRT)	(Rs)	=	21.5 days									
WW Temperature		=	20.0 deg. C									
Design Air Temperature		=	25.0 deg. C									
Side Water Depth in Aeration Basin		=	23.80 ft									
Total Oxygen Transfer Required (all basins, daily average)		=	42,418 lb/d									
Number of Basins in Service		=	3.00									
Total Oxygen Transfer per Basin		=	14,139 lb/d									
Normal D.O. Set Point		=	1.5	0.0	0.0	0.0	2.0	1.5	0.0	2.0 mg/L		

All data shown are PER BASIN

COMPARTMENT SIZES (per Basin) - from Data Sheet			**Grid 1**	**Grid 2**	**Grid 3**	**Grid 4**	**Grid 5**	**Grid 6**	**Grid 7**	**Grid 8**	**Total**	
Length			29	85	85.0	85.0	95.0	95	66	29		ft
Width			56	56	56	56	56	56	56	56		ft
Floor Area		=	1,624	4,760	4,760	4,760	5,320	5,320	3,696	1,624	31,864	sf
NUMBER OF DIFFUSERS PER ZONE [Data taken from "Average" Sheet]			850	850	0	1600	1600	1000	400	230	6,530	
Active Area per diffuser, sf			0.41	0.41	0	0.41	0.41	0.41	0.41	0.41		
Total Active Area, sf			348.5	348.5	0	656	656	410	164	94.3		
Floor Coverage, sf/sf	(At/Ad)	=	4.7	13.7	0.0	7.3	8.1	13.0	22.5	17.2		
Diffuser coverage			21.5%	7.3%	0.0%	13.8%	12.3%	7.7%	4.4%	5.8%		
OXYGEN DEMAND DISTRIBUTION:												
Oxygen Demand in this Zone			1,883	0	0	0	4,858	3,181	0	683		lb/d
Carryover from previous zone			-	-	-	-	-	-	-	-		lb/d
Total Oxygen Demand in this zone			1,883	0	0	0	4,858	3,181	0	683		lb/d
Design Oxygen Transfer for this zone	(OTR)	=	1,883	0	0	0	4,858	3,181	0	683		lb/d
Carryover to next zone			0	0	0	0	0	0	0	0		lb/d
OPERATING CONDITIONS												
Site Conditions Adjustment Factor, F, to be used in System Sizing calculations:	(F)	=	0.26	0.65	0.69	0.69	0.56	0.59	0.69	0.56		

where F = Alpha x [Theta ^(T-20)] x (Tau Beta Omega C*20 - C)/C*20

Omega = Barometric pressure correction factor; other terms are standard terminiology

OXYGEN TRANSFER EFFICIENCY			Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	
Estimated SOTE (cw)	(SOTE)	=	43.5	0.0	0.0	0.0	45.9	43.7	0.0	41.7	%
Actual OTE = F x SOTE, percent	(OTE)	=	11.28	0.01	0.01	0.01	25.61	25.79	0.01	23.43	%
Process Air Rate = OTR / OTE * 3.96		=	661	0	0	0	751	489	0	115	scfm
Air Loading per Diffuser		=	**0.78**	**0.00**	**0.00**	**0.00**	**0.47**	**0.49**	**0.00**	**0.50**	scfm/sf
[This line is intentionally blank]											
Total Air for One Basin		=	2,016								scfm
TOTAL AIR FOR ALL BASINS		=	6,048								scfm

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ATTACHMENT A.11 – PROCESS MODELING RESULTS FOR MAXIMUM MONTH AVERAGE DAY LOADING CONDITIONS

PROCESS MODEL RESULTS SUMMARY

MAXIMUM MONTH AVERAGE DAY
LOADING CONDITIONS

Greenfield Water Reclamation Plant

GWRP Process Modeling Loading Condition: **Maximum Month Average Day Loading**

GWRP Flow **33.0** mgd

SEWRP Flow **8.0** mgd (sludge equivalent sent to GWRP)

Liquids Train Summary

No. of Primary Clarifiers in Service	**2**	of 3
Primary Clarifier Surface Area	30,788	sf
Primary Treatment TSS Removal	61%	
No. of Aeration Basins in Service	**4**	of 4
Total A.B. Volume	21.6	MG
MLSS	3,356	mg/L
Aerobic SRT	4.3	days
Total SRT	9.3	days
RAS Flow Ratio	72%	
MLR Flow Ratio	500%	
Oxygen Demand	110,463	lb/d
No. of Sec. Clarifiers in Service	**6**	of 7
Secondary Clarifier Surface Area	67,858	sf

Plant Effluent Nitrogen Summary

Ammonia	0.2	mg/L
Nitrate	3.8	mg/L
Nitrite	0.3	mg/L
Organic N	1.6	mg/L
Total N	**6.0**	mg/L

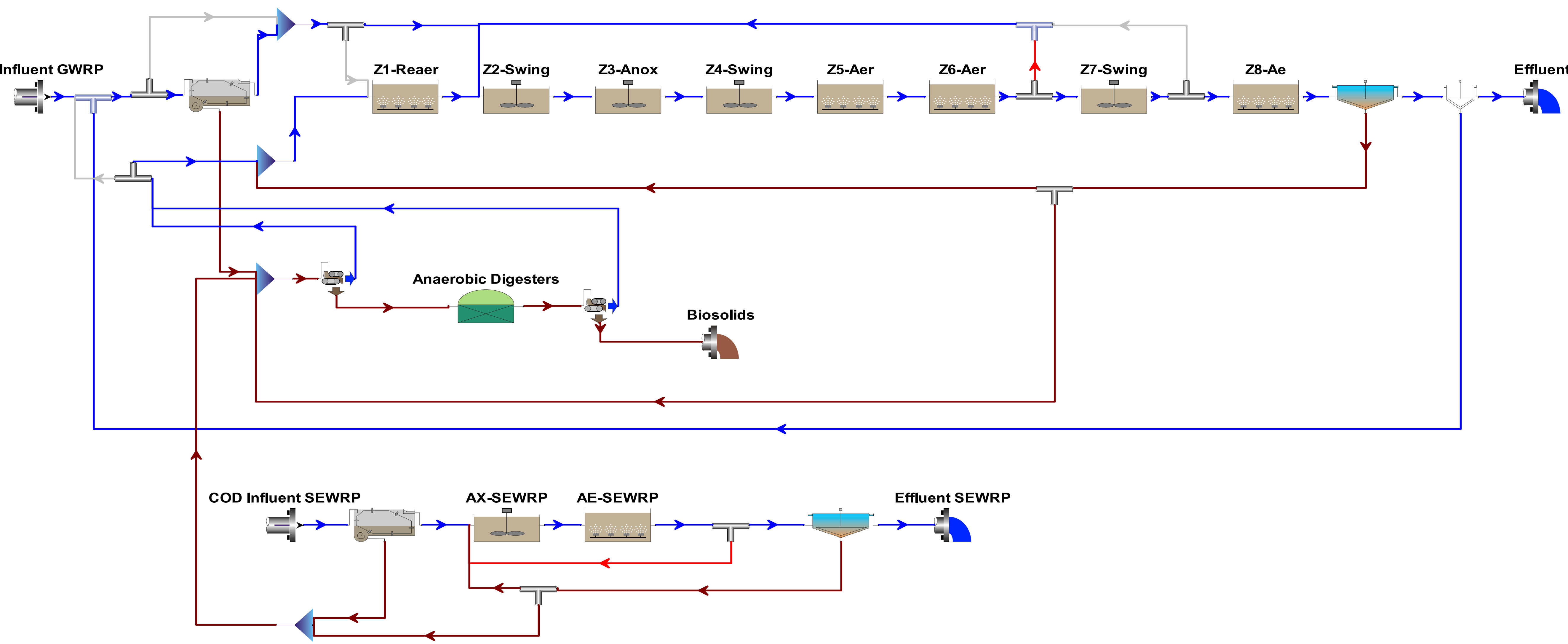
Solids Train Summary

Primary Sludge Solids Concentration	2.7	% TS	
Blended Sludge Solids Concentration	1.2	% TS	
Thickening Solids Capture Efficiency	95%		
Thickened Sludge Solids Concentration	6.2	% TS	
No. of Anaerobic Digesters in Service	4	of 4	
Active Volume per Digester	1.2	MG/digester	
Anaerobic Digestion HRT	15.0	days	15.0
Anaerobic Digestion VS Destruction	44%		
Digested Sludge Solids Concentration	4.2	% TS	
Dewatering Solids Capture Efficiency	95%		
Cake Solids Concentration	20.0	% TS	

Flows and Concentrations	Flow	COD	BOD	TSS	VSS	TN	NH_3-N	TP	PO_4-P
	mgd	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Plant Influent	33.0	1,005	431	503	402	67.4	47.2	14.7	3.9
Aeration Basin Influent	33.3	571	273	197	157	59.4	46.3	8.2	4.0
Secondary Effluent	34.0	62	3	9	7	6.3	0.2	9.5	9.4
Plant Effluent	33.3	56	2	4	3	6.0	0.2	9.4	9.4
GWRP Primary Sludge	0.380	37,959	13,673	26,974	21,560	687	46	582	4
GWRP WAS	1.006	8,916	2,138	7,948	5,921	423	0	164	9
SEWRP (PS+WAS)	0.365	7,354	2,220	7,771	4,348	197	15	134	5
Blended Sludge to Thickening	1.750	14,891	4,658	12,039	8,986	433	13	248	7
Thickened Sludge to Digestion	0.320	76,812	23,964	62,496	46,647	2,167	13	1,259	7
Digested Sludge to Dewatering	0.320	40,134	3,102	41,511	25,922	2,164	861	1,259	683
Biosolids disposal	0.063	193,013	14,571	200,382	125,130	7,147	861	3,463	683

Mass Loads	COD	BOD	TSS	VSS	TN	NH_3-N	TP	PO_4-P
	lb/d	lb/d	lb/d	lb/d	lb/d	lb/d	lb/d	lb/d
Plant Influent	276,778	118,765	138,455	110,753	18,562	12,993	4,035	1,066
Aeration Basin Influent	158,617	75,894	54,618	43,656	16,502	12,848	2,275	1,105
Secondary Effluent	17,493	985	2,654	1,977	1,771	60	2,705	2,654
Plant Effluent	15,434	552	1,062	791	1,655	59	2,623	2,602
GWRP Primary Sludge	120,220	43,305	85,429	68,283	2,175	147	1,843	13
GWRP WAS	74,781	17,931	66,661	49,659	3,551	2	1,375	79
SEWRP (PS+WAS)	22,389	6,758	23,659	13,237	599	47	409	14
Blended Sludge to Thickening	217,390	67,993	175,748	131,179	6,325	195	3,626	105
Thickened Sludge to Digestion	205,207	64,021	166,961	124,620	5,789	36	3,364	19
Digested Sludge to Dewatering	107,220	8,287	110,898	69,251	5,781	2,300	3,364	1,826
Biosolids disposal	101,478	7,661	105,353	65,789	3,758	453	1,821	359

BioWin Process Model Flowsheet



BioWin Process Model Results - Concentration Table

Elements	Flow [mgd]	Total COD [mg/L]	Filtered COD [mg/L]	Total Carbonaceous BOD [mg/L]	Filtered Carbonaceous BOD [mg/L]	Total suspended solids [mgTSS/L]	Volatile suspended solids [mgVSS/L]	Total Kjeldahl Nitrogen [mgN/L]	Filtered TKN [mgN/L]	Nitrite + Nitrate [mgN/L]	pH []	Dissolved oxygen [mg/L]	Alkalinity [mmol/L]	Ammonia N [mgN/L]	Nitrate N [mgN/L]	Nitrite N [mgN/L]	Total inorganic N [mgN/L]	Total N [mgN/L]	Total P [mgP/L]	Soluble PO4-P [mgP/L]
COD Influent GWRP	33.000	1,005	301	431	178	503	402	67.40	55.79	0.00	7.30	0.00	7.00	47.18	0.00	0.00	47.18	67.40	14.65	3.87
PE Spllitter	33.660	993	297	424	175	499	398	66.41	54.73	0.08	7.28	0.04	6.93	46.26	0.08	0.01	46.34	66.49	14.66	3.98
PE Spllitter (U)	0.000	993	297	424	175	499	398	66.41	54.73	0.08	7.28	0.04	6.93	46.26	0.08	0.01	46.34	66.49	14.66	3.98
Primary clarifiers	33.280	571	297	273	175	197	157	59.33	54.73	0.08	7.28	0.04	6.93	46.26	0.08	0.01	46.34	59.42	8.19	3.98
Primary clarifiers (U)	0.380	37,959	297	13,673	175	26,974	21,560	686.76	54.73	0.08	7.28	0.04	6.93	46.26	0.08	0.01	46.34	686.84	581.80	3.98
RAS+Cen	25.430	8,409	56	2,018	5	7,488	5,575	403.41	11.19	4.00	6.79	1.94	3.74	9.65	3.73	0.27	13.66	407.41	161.54	16.06
Z1-Reaer	25.430	8,367	51	1,991	1	7,471	5,557	393.78	2.12	13.21	6.61	1.50	2.41	0.44	12.97	0.24	13.64	406.99	161.54	16.58
Z2-Swing	223.710	3,835	57	929	5	3,373	2,518	185.79	9.47	1.49	6.86	0.00	4.01	7.70	0.97	0.51	9.18	187.28	74.61	8.99
Z3-Swing	223.710	3,832	52	925	1	3,374	2,518	185.79	9.36	0.12	6.88	0.00	4.14	8.10	0.08	0.04	8.22	185.91	74.61	8.97
Z4-Swing	223.710	3,831	52	925	1	3,373	2,518	185.79	9.38	0.00	6.90	0.00	4.17	8.45	0.00	0.00	8.45	185.80	74.61	8.99
Z5-Aer	223.710	3,822	52	920	1	3,370	2,514	181.98	5.40	3.75	6.81	2.00	3.60	4.10	2.28	1.47	7.85	185.73	74.61	9.05
Z6-Aer	223.710	3,813	51	915	1	3,366	2,510	179.32	2.65	6.33	6.75	1.50	3.20	1.15	4.42	1.90	7.48	185.65	74.61	9.12
Z7a-Ax	58.710	3,803	51	908	1	3,360	2,505	179.18	2.69	3.00	6.79	0.00	3.47	1.62	1.78	1.22	4.61	182.17	74.61	9.25
Z7b-Ae	58.710	3,794	51	903	1	3,356	2,500	178.00	1.64	4.11	6.78	2.00	3.28	0.21	3.83	0.28	4.32	182.11	74.61	9.36
IMLR Splitter Z6	58.710	3,813	51	915	1	3,366	2,510	179.32	2.65	6.33	6.75	1.50	3.20	1.15	4.42	1.90	7.48	185.65	74.61	9.12
IMLR Splitter Z6 (U)	165.000	3,813	51	915	1	3,366	2,510	179.32	2.65	6.33	6.75	1.50	3.20	1.15	4.42	1.90	7.48	185.65	74.61	9.12
IMLR Splitter Z7	58.710	3,794	51	903	1	3,356	2,500	178.00	1.64	4.11	6.78	2.00	3.28	0.21	3.83	0.28	4.32	182.11	74.61	9.36
IMLR Splitter Z7 (U)	0.000	3,794	51	903	1	3,356	2,500	178.00	1.64	4.11	6.78	2.00	3.28	0.21	3.83	0.28	4.32	182.11	74.61	9.36
Secondary clarifier	33.960	62	51	3	1	9	7	2.14	1.64	4.11	6.78	2.00	3.28	0.21	3.83	0.28	4.32	6.25	9.54	9.36
Secondary clarifier (U)	24.750	8,916	51	2,138	1	7,948	5,921	419.31	1.64	4.11	6.78	2.00	3.28	0.21	3.83	0.28	4.32	423.43	163.90	9.36
Filters	33.300	56	51	2	1	4	3	1.84	1.64	4.11	6.78	2.00	3.28	0.21	3.83	0.28	4.32	5.96	9.44	9.36
Filters (U)	0.660	374	51	79	1	289	215	16.84	1.64	4.11	6.78	2.00	3.28	0.21	3.83	0.28	4.32	20.95	14.98	9.36
Effluent	33.300	56	51	2	1	4	3	1.84	1.64	4.11	6.78	2.00	3.28	0.21	3.83	0.28	4.32	5.96	9.44	9.36
RAS/WAS Splitter	23.750	8,916	51	2,138	1	7,948	5,921	419.31	1.64	4.11	6.78	2.00	3.28	0.21	3.83	0.28	4.32	423.43	163.90	9.36
RAS/WAS Splitter (U)	1.000	8,916	51	2,138	1	7,948	5,921	419.31	1.64	4.11	6.78	2.00	3.28	0.21	3.83	0.28	4.32	423.43	163.90	9.36
Sludge SEWRP (PS+WAS)	0.360	7,354	113	2,220	61	7,771	4,348	194.12	18.82	2.57	7.07	0.76	4.17	15.28	2.54	0.03	17.85	196.69	134.25	4.64
Blended PS+WAS	1.750	14,891	117	4,658	51	12,039	8,986	430.38	16.74	2.92	6.95	1.32	4.26	13.34	2.74	0.17	16.26	433.29	248.38	7.21
Thickening	1.430	1,021	117	333	51	737	550	42.06	16.74	2.92	6.95	1.32	4.26	13.34	2.74	0.17	16.26	44.97	21.97	7.21
Thickening (U)	0.320	76,812	117	23,964	51	62,496	46,647	2164.02	16.74	2.92	6.95	1.32	4.26	13.34	2.74	0.17	16.26	2166.93	1259.18	7.21
Anaerobic Digesters	0.320	40,134	189	3,102	105	41,511	25,922	2163.97	862.03	0.00	6.67	0.00	43.57	861.05	0.00	0.00	861.05	2163.97	1259.18	683.36
Dewatering	0.260	2,676	189	292	105	2,584	1,614	943.07	862.03	0.00	6.73	0.00	43.47	861.05	0.00	0.00	861.05	943.07	719.20	683.36
Dewatering (U)	0.060	193,013	189	14,571	105	200,382	125,130	7146.82	862.03	0.00	6.73	0.00	43.47	861.05	0.00	0.00	861.05	7146.82	3462.98	683.36
Biosolids	0.060	193,013	189	14,571	105	200,382	125,130	7146.82	862.03	0.00	6.73	0.00	43.47	861.05	0.00	0.00	861.05	7146.82	3462.98	683.36

BioWin Process Model Results - Mass Flow Table

Elements	Flow [mgd]	Total COD [lb /d]	Filtered COD [lb /d]	Total Carbonaceous BOD [lb /d]	Filtered Carbonaceous BOD [lb /d]	Total suspended solids [lb TSS/d]	Volatile suspended solids [lb VSS/d]	Total Kjeldahl Nitrogen [lb N/d]	Filtered TKN [lb N/d]	Nitrite + Nitrate [lb N/d]	pH []	Dissolved oxygen [lb /d]	Alkalinity [kmol/d]	Ammonia N [lb N/d]	Nitrate N [lb N/d]	Nitrite N [lb N/d]	Total inorganic N [lb N/d]	Total N [lb N/d]	Total P [lb P/d]	Soluble PO4-P [lb P/d]
COD Influent GWRP	-----	276,778	83,012	118,765	49,110	138,455	110,753	18,562	15,364	0	7.30	0	874	12,993	0	0	12,993	18,562	4,035	1,066
PE Spllitter (U)	-----	0	0	0	0	0	0	0	0	0	7.28	0	0	0	0	0	0	0	0	0
PE Spllitter	-----	278,837	83,295	119,199	49,115	140,047	111,940	18,655	15,373	23	7.28	11	882	12,995	21	2	13,017	18,677	4,117	1,117
Primary clarifiers	-----	158,617	82,356	75,894	48,561	54,618	43,656	16,480	15,200	22	7.28	11	872	12,848	21	2	12,870	16,502	2,275	1,105
Primary clarifiers (U)	-----	120,220	939	43,305	554	85,429	68,283	2,175	173	0	7.28	0	10	147	0	0	147	2,175	1,843	13
RAS+Cen	-----	1,784,796	11,966	428,252	1,025	1,589,332	1,183,311	85,618	2,375	850	6.79	412	360	2,049	791	58	2,898	86,468	34,285	3,408
Z1-Reaer	-----	1,775,691	10,792	422,485	197	1,585,524	1,179,352	83,575	450	2,803	6.61	318	232	93	2,752	51	2,896	86,378	34,285	3,519
Z2-Swing	-----	7,160,050	106,490	1,733,815	8,649	6,297,396	4,700,434	346,873	17,684	2,775	6.86	6	3,399	14,369	1,814	961	17,144	349,648	139,303	16,780
Z3-Swing	-----	7,153,655	97,686	1,727,564	1,636	6,298,859	4,701,863	346,873	17,481	222	6.88	0	3,508	15,122	150	72	15,344	347,095	139,303	16,754
Z4-Swing	-----	7,152,967	97,976	1,726,444	1,676	6,297,498	4,700,752	346,874	17,514	5	6.90	0	3,534	15,778	4	1	15,783	346,878	139,303	16,782
Z5-Aer	-----	7,135,198	96,533	1,717,378	2,144	6,290,815	4,693,427	339,751	10,090	7,003	6.81	3,734	3,045	7,656	4,252	2,752	14,660	346,755	139,303	16,897
Z6-Aer	-----	7,119,553	96,038	1,708,327	2,048	6,284,446	4,686,509	334,786	4,956	11,812	6.75	2,800	2,710	2,151	8,259	3,553	13,963	346,598	139,303	17,022
Z7a-Ax	-----	1,863,571	24,952	445,117	255	1,646,541	1,227,235	87,793	1,319	1,468	6.79	2	770	793	871	596	2,261	89,261	36,559	4,530
Z7b-Ae	-----	1,859,145	25,123	442,570	469	1,644,314	1,224,925	87,215	805	2,015	6.78	980	730	104	1,876	139	2,118	89,230	36,559	4,587
IMLR Splitter Z6	-----	1,868,483	25,205	448,340	538	1,649,314	1,229,946	87,863	1,301	3,100	6.75	735	711	565	2,168	932	3,665	90,962	36,559	4,467
IMLR Splitter Z6 (U)	-----	5,251,070	70,834	1,259,987	1,511	4,635,131	3,456,564	246,923	3,655	8,712	6.75	2,066	1,999	1,587	6,092	2,620	10,299	255,635	102,744	12,554
IMLR Splitter Z7	-----	1,859,145	25,123	442,570	469	1,644,314	1,224,925	87,215	805	2,015	6.78	980	730	104	1,876	139	2,118	89,230	36,559	4,587
IMLR Splitter Z7 (U)	-----	0	0	0	0	0	0	0	0	0	6.78	0	0	0	0	0	0	0	0	0
Secondary clarifier	-----	17,493	14,532	985	272	2,654	1,977	605	466	1,165	6.78	567	422	60	1,085	80	1,225	1,771	2,705	2,654
Secondary clarifier (U)	-----	1,841,652	10,591	441,585	198	1,641,660	1,222,948	86,610	339	849	6.78	413	308	44	791	58	893	87,459	33,854	1,934
Filters	-----	15,434	14,250	552	266	1,062	791	513	457	1,143	6.78	556	414	59	1,064	79	1,202	1,655	2,623	2,602
Filters (U)	-----	2,059	282	433	5	1,593	1,186	93	9	23	6.78	11	8	1	21	2	24	115	83	52
Effluent	-----	15,434	14,250	552	266	1,062	791	513	457	1,143	6.78	556	414	59	1,064	79	1,202	1,655	2,623	2,602
RAS/WAS Splitter	-----	1,766,871	10,161	423,654	190	1,574,999	1,173,289	83,093	326	815	6.78	396	295	42	759	56	857	83,908	32,479	1,855
RAS/WAS Splitter (U)	-----	74,781	430	17,931	8	66,661	49,659	3,517	14	34	6.78	17	12	2	32	2	36	3,551	1,375	79
Sludge SEWRP (PS+WAS)	-----	22,389	344	6,758	185	23,659	13,237	591	57	8	7.07	2	6	47	8	0	54	599	409	14
Blended PS+WAS	-----	217,390	1,713	67,993	746	175,748	131,179	6,283	244	43	6.95	19	28	195	40	2	237	6,325	3,626	105
Thickening	-----	12,183	1,399	3,972	610	8,787	6,559	502	200	35	6.95	16	23	159	33	2	194	536	262	86
Thickening (U)	-----	205,207	313	64,021	137	166,961	124,620	5,781	45	8	6.95	4	5	36	7	0	43	5,789	3,364	19
Anaerobic Digesters	-----	107,220	505	8,287	281	110,898	69,251	5,781	2,303	0	6.67	0	53	2,300	0	0	2,300	5,781	3,364	1,826
Dewatering	-----	5,741	406	626	226	5,545	3,463	2,024	1,850	0	6.73	0	42	1,848	0	0	1,848	2,024	1,543	1,466
Dewatering (U)	-----	101,478	99	7,661	55	105,353	65,789	3,758	453	0	6.73	0	10	453	0	0	453	3,758	1,821	359
Biosolids	-----	101,478	99	7,661	55	105,353	65,789	3,758	453	0	6.73	0	10	453	0	0	453	3,758	1,821	359

SECONDARY CLARIFIERS STATE POINT ANALYSIS

MAXIMUM MONTH AVERAGE DAY

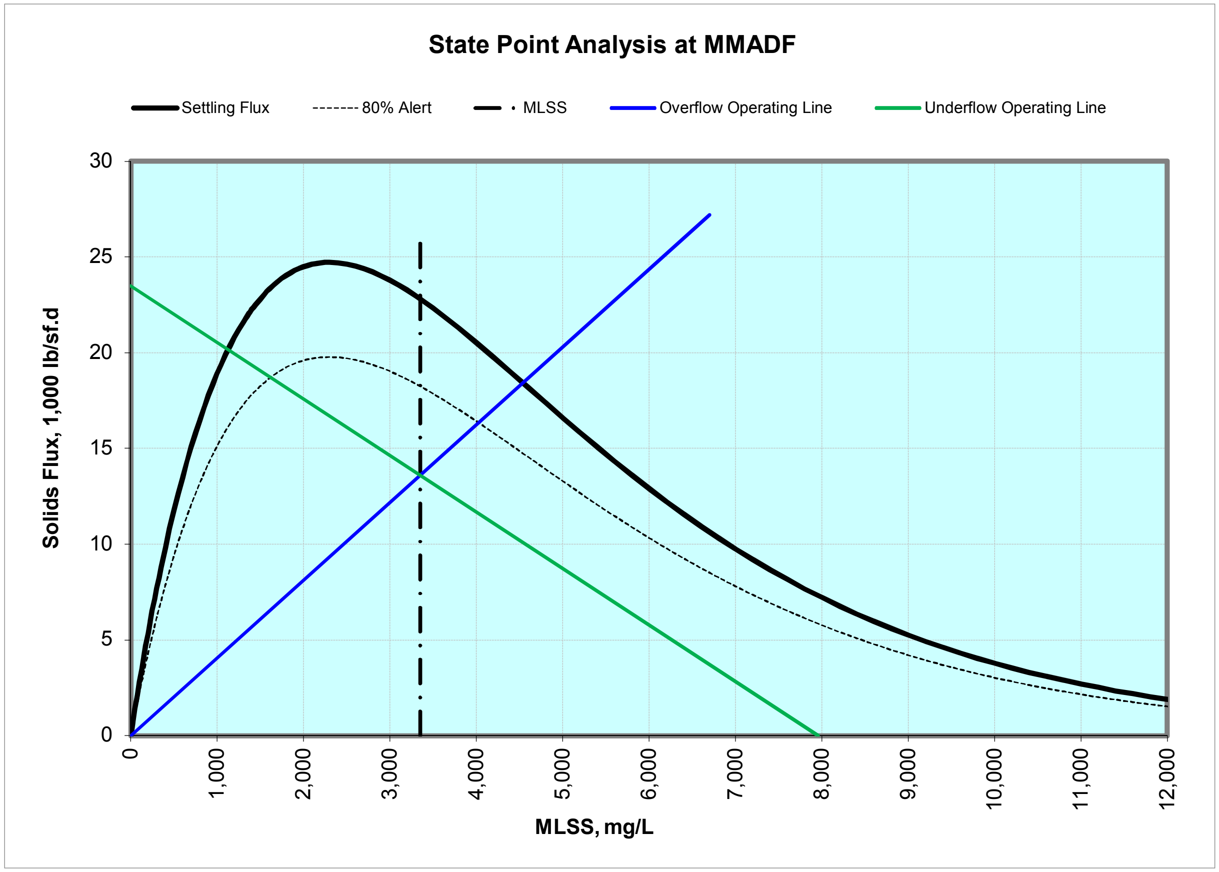
LOADING CONDITIONS

State Point Analysis Diagram

Scenario: MMADF, all SC in service

CSF:	1.68
Max. MLSS:	3,350 mg/L
RAS ratio:	0.73
Max. SLR:	23.5 ppd/sf
SOR:	486 gpd/sf

		Values for Analysis (BLUE) Inputs
o Flow Rates, mgd		
- Sec.Effluent from Clars, mgd		
-- AADF		30.00
-- PF		1.10
-- MMADF		33.00
-- Peaking Factor	*	1.00
-- Clarifier Effluent, mgd		33.00
- Qunderflow/Q, fraction	*	0.73
- Effluent Rise Rate, qF, ft/h		2.71
- Underflow velocity, qR, ft/h		1.97
o Clarifiers		
- Number		7
- Number in Service		6
- Diameter, ft		120
- Surface area, each, sf		11,310
- Total Clarifier Area in Service, sf	*	67,858
- L-P MLSS conc, XF, mg/L	*	3,350
o Settling Curve		
- V_0, ft/hr	*	19.5
- X_M, mg/L	*	2,300
ISV = V_0 exp(- MLSS/X_M), ft/h		
o Clarification Safety Factor, CSF		1.68 OK



Design SVI, mL/g	**150**
Pitman (modified): V_0*X_M	44,758
V_0, ft/hr	19.5
X_M, mg/L	2,300

Peak 4-hr Diurnal Flow:	48.00
AADF:	30.00
MMADF:	33.00
CSF:	**1.67** target at MMADF

$$\text{Target } CSF = \frac{PeakFlow}{MMADF} * 1.15$$

BIOWIN PROCESS MODEL CONFIGURATION DATA

MAXIMUM MONTH AVERAGE DAY
LOADING CONDITIONS

MAX. MONTH AVERAGE DAY LOADING CONDITIONS

BioWin user and configuration data

Project details

Project name: Greenfield WRP Phase III Expansion **Project ref.: 9837a.10**

Plant name: Greenfield WRP **User name: CLopez**

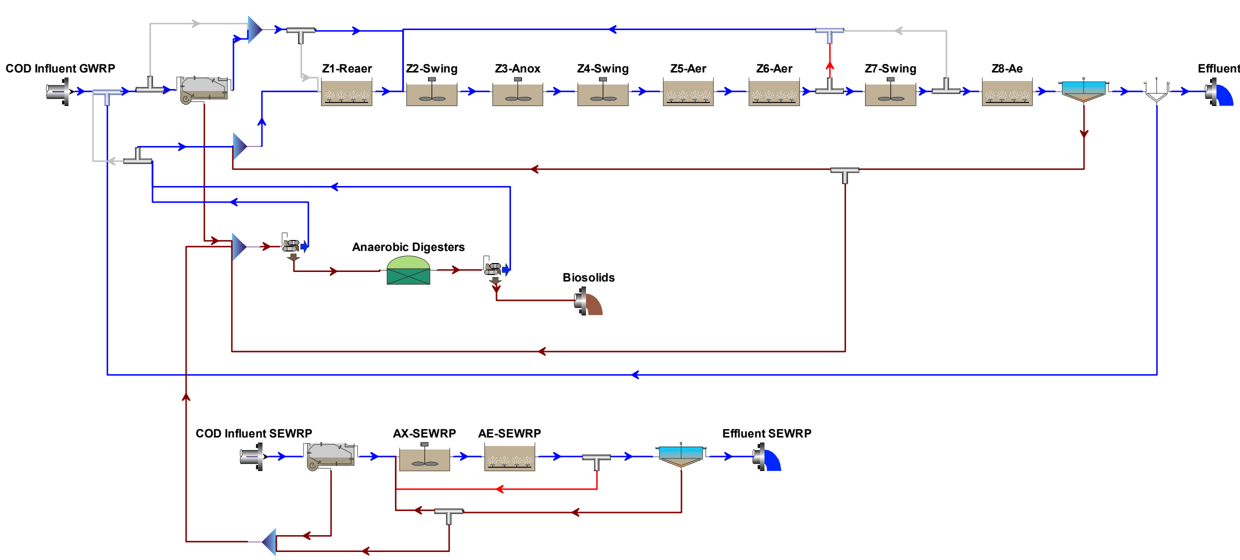
Created: 8/18/2011 **Saved: 11/14/2017**

Steady state solution

Total SRT: 9.29 days

Temperature: 20.0°C

Flowsheet



Configuration information for all Anaerobic Digester units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	Head space volume
Anaerobic Digesters	4.8000	2.139E+4	30.000	0.5

Operating data Average (flow/time weighted as required)

Element name	Pressure [psi]	pH
Anaerobic Digesters	14.9	-

Element name	Average Temperature
Anaerobic Digesters	35.0

Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Z1-Reaer	1.0990	6497.7859	22.610	3400
Z2-Swing	3.2200	1.904E+4	22.610	Un-aerated
Z3-Anox	3.2200	1.904E+4	22.610	Un-aerated
Z4-Swing	3.2200	1.904E+4	22.610	Un-aerated
Z5-Aer	3.5990	2.128E+4	22.610	6400
Z6-Aer	3.5990	2.128E+4	22.610	4000
Z7-Swing	2.5000	1.478E+4	22.610	Un-aerated
Z8-Ae	1.0990	6497.7859	22.610	920
AX-SEWRP	1.0000	6684.0282	20.000	Un-aerated
AE-SEWRP	4.0000	2.674E+4	20.000	6058

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Z1-Reaer	1.5
Z2-Swing	0
Z3-Anox	0
Z4-Swing	0
Z5-Aer	2.0
Z6-Aer	1.5
Z7-Swing	0
Z8-Ae	2.0
AX-SEWRP	0
AE-SEWRP	2.0

Configuration information for all Model clarifier units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]	Number of layers	Top feed layer	Feed Layers
Secondary clarifier	7.6144	6.786E+4	15.000	10	6	1
Secondary clarifier SEWRP	2.5380	2.262E+4	15.000	5	4	1

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Secondary clarifier	Flow paced	75.00 %
Secondary clarifier SEWRP	Flow paced	100.00 %

Element name	Average Temperature	Reactive
Secondary clarifier	Uses global setting	No
Secondary clarifier SEWRP	Uses global setting	No

Configuration information for all COD Influent units

Operating data Average (flow/time weighted as required)

Element name	COD Influent GWRP	COD Influent SEWRP
Flow	33.0003708975403	7.99992180507696
Total COD mgCOD/L	1005.00	550.00
Total Kjeldahl Nitrogen mgN/L	67.40	35.00
Total P mgP/L	14.65	11.33
Nitrate N mgN/L	0	0
pH	7.30	7.30
Alkalinity mmol/L	7.00	5.00
ISS Influent mgISS/L	100.50	159.00
Calcium mg/L	80.00	80.00
Magnesium mg/L	15.00	15.00
Dissolved O2 mg/L	0	0

Element name	COD Influent GWRP	COD Influent SEWRP
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1752	0.1751
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.8638	0.8610
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0498	0.0498
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.2240	0.2351
Fna - Ammonia [gNH3-N/gTKN]	0.7000	0.7000
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.4962	0.4751
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0070	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0157	0.0177
Fpo4 - Phosphate [gPO4-P/gTP]	0.2641	0.3756
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0110	0.0110
FZbh - OHO COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZbm - Methylotroph COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZaob - AOB COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZnob - NOB COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4

FZaao - AAO COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZbp - PAO COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZbpa - Propionic acetogens COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZbam - Acetoclastic methanogens COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZbhm - H2-utilizing methanogens COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZe - Endogenous products COD fraction [gCOD/g of total COD]	0	0

Configuration information for all Sidestream Mixer units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]
IMLR Header	0	N/A	N/A
Inf+FBW	0	N/A	N/A

Configuration information for all General Mixer units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]
RAS+Cen	0	N/A	N/A
Blended PS+WAS	0	N/A	N/A
PE+MLR	0	N/A	N/A
Sludge SEWRP (PS+WAS)	0	N/A	N/A

Configuration information for all Ideal primary settling tank units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Primary clarifiers	3.3395	3.079E+4	14.500
Primaries SEWRP	0.7485	7697.0000	13.000

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Primary clarifiers	Flow paced	1.15 %
Primaries SEWRP	Flow paced	2.82 %

Element name	Percent removal	Blanket fraction
Primary clarifiers	61.00	0.10
Primaries SEWRP	60.00	0.10

Configuration information for all Dewatering unit units

Physical data

Element name	No Volume
Dewatering	0
Thickening	0

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Dewatering	Fraction	0.20
Thickening	Fraction	0.18

Element name	Percent removal
Dewatering	95.00
Thickening	95.00

Configuration information for all Point clarifier units

Physical data

Element name	No Volume
Filters	0

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Filters	Flow paced	2.00 %

Element name	Percent removal
Filters	60.00

Configuration information for all Splitter units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]
IMLR Splitter Z6	0	N/A	N/A
RAS/WAS Splitter	0	N/A	N/A
IMLR Splitter Z7	0	N/A	N/A
PE Spllitter	0	N/A	N/A
IMLR Splitter SEWRP	0	N/A	N/A
RAS/WAS Splitter SEWRP	0	N/A	N/A
Centrate Splitter to HW	0	N/A	N/A
ABinf Splitter to Zn1	0	N/A	N/A

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
IMLR Splitter Z6	Flow paced	500.00 %
RAS/WAS Splitter	Flowrate [Side]	1.005
IMLR Splitter Z7	Flowrate [Side]	0
PE Spllitter	Fraction	0.00
IMLR Splitter SEWRP	Flow paced	400.00 %
RAS/WAS Splitter SEWRP	Flow paced	1.74 %
Centrate Splitter to HW	Fraction	1.00
ABinf Splitter to Zn1	Fraction	0.00

BioWin Album

Album page - Inf-Eff

COD Influent GWRP

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	402.15	110753.23	
Total suspended solids	502.74	138454.81	
Particulate COD	703.58	193766.05	
Filtered COD	301.42	83012.39	
Total COD	1005.00	276778.45	
Soluble PO4-P	3.87	1065.55	
Total P	14.65	4034.63	
Filtered TKN	55.79	15364.21	
Particulate TKN	11.61	3197.85	
Total Kjeldahl Nitrogen	67.40	18562.06	
Filtered Carbonaceous BOD	178.32	49109.65	
Total Carbonaceous BOD	431.24	118765.33	
Nitrite + Nitrate	0	0.00	
Total N	67.40	18562.06	
Total inorganic N	47.18	12993.44	
Alkalinity	7.00	874.44	mmol/L and kmol/d
pH	7.30		

Volatile fatty acids	26.41	7273.74	
ISS precipitate	0	0	
ISS cellular	0.09	23.74	
ISS Total	100.59	27701.58	
Ammonia N	47.18	12993.44	
Nitrate N	0	0.00	

Album page - Inf-Eff

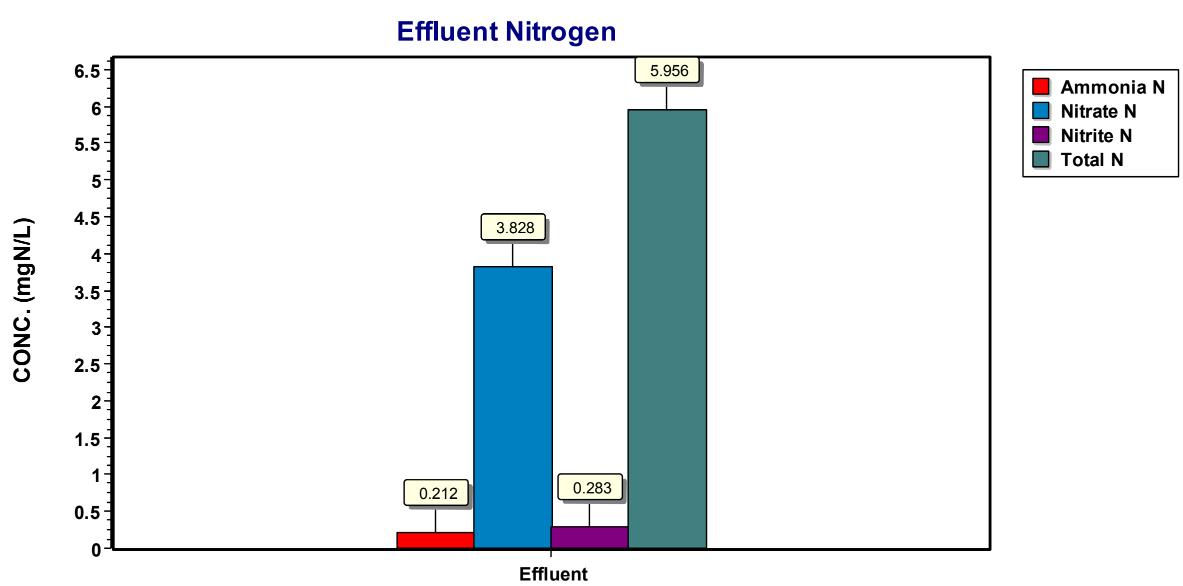
RAS+Cen

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	5575.43	1183310.96	
Total suspended solids	7488.48	1589331.54	
Particulate COD	8353.07	1772829.83	
Filtered COD	56.38	11965.73	
Total COD	8409.45	1784795.56	
Soluble PO4-P	16.06	3407.62	
Total P	161.54	34284.61	
Filtered TKN	11.19	2375.07	
Particulate TKN	392.22	83243.17	
Total Kjeldahl Nitrogen	403.41	85618.24	
Filtered Carbonaceous BOD	4.83	1025.27	
Total Carbonaceous BOD	2017.80	428252.21	
Nitrite + Nitrate	4.00	849.51	
Total N	407.41	86467.75	
Total inorganic N	13.66	2898.30	
Alkalinity	3.74	359.86	mmol/L and kmol/d
pH	6.79		
Volatile fatty acids	1.87	396.31	
ISS precipitate	0.00	0.00	
ISS cellular	288.27	61181.11	
ISS Total	1913.05	406020.59	
Ammonia N	9.65	2048.79	
Nitrate N	3.73	791.39	

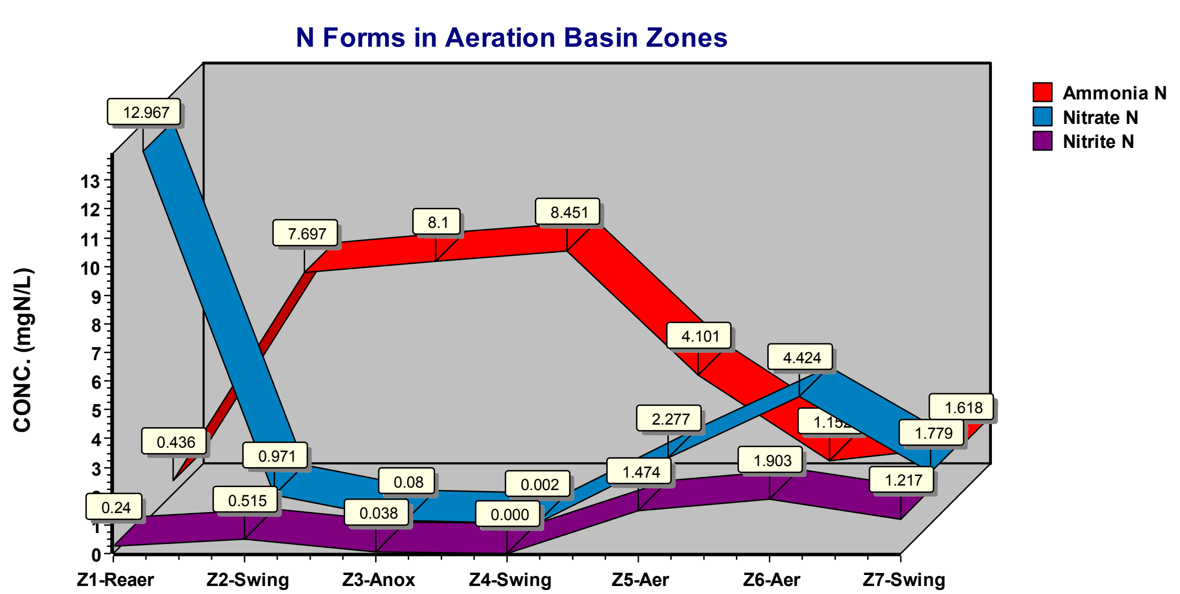
Album page - Inf-Eff

Effluent			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	2.85	790.89	
Total suspended solids	3.82	1061.68	
Particulate COD	4.26	1184.16	
Filtered COD	51.27	14250.07	
Total COD	55.53	15434.23	
Soluble PO4-P	9.36	2601.99	
Total P	9.44	2622.63	
Filtered TKN	1.64	456.73	
Particulate TKN	0.20	55.79	
Total Kjeldahl Nitrogen	1.84	512.52	
Filtered Carbonaceous BOD	0.96	266.26	
Total Carbonaceous BOD	1.99	551.71	
Nitrite + Nitrate	4.11	1142.65	
Total N	5.96	1655.17	
Total inorganic N	4.32	1201.57	
Alkalinity	3.28	413.83	mmol/L and kmol/d
pH	6.78		
Volatile fatty acids	0.00	0.42	
ISS precipitate	0.00	0.00	
ISS cellular	0.15	41.08	
ISS Total	0.97	270.78	
Ammonia N	0.21	58.92	
Nitrate N	3.83	1064.00	

Album page - Eff N

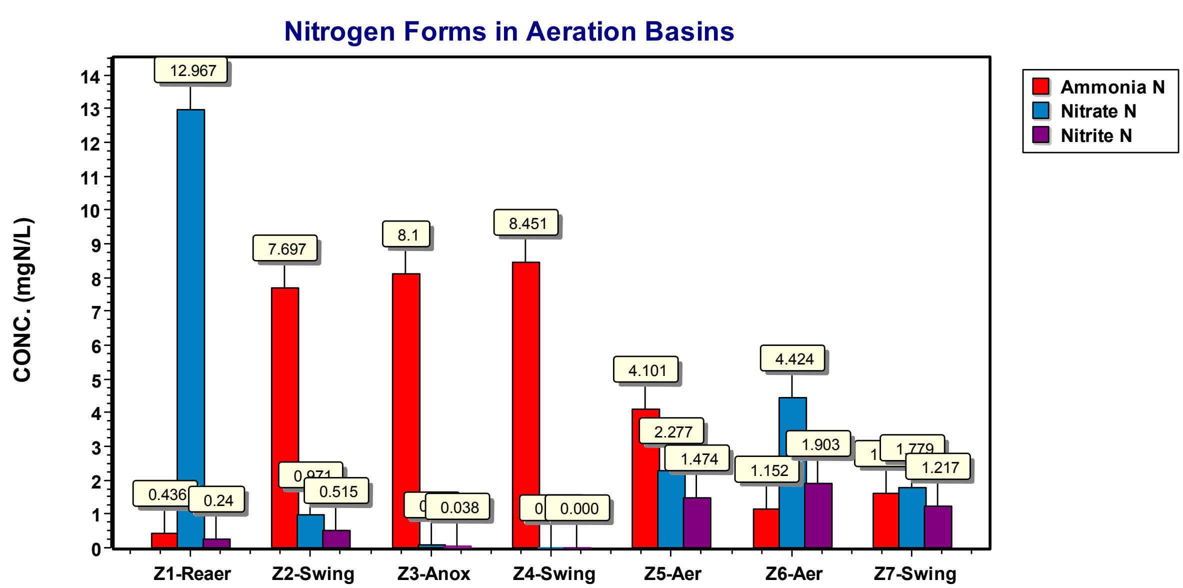


Album page - N forms in ABs (3D)



MAX. MONTH AVERAGE DAY LOADING CONDITIONS

Album page - N forms in ABs



Album page - SC

Secondary clarifier			
Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	6.98	1977.23	
Total suspended solids	9.36	2654.19	
Particulate COD	10.45	2960.41	
Filtered COD	51.27	14532.49	
Total COD	61.72	17492.90	
Soluble PO4-P	9.36	2653.56	
Total P	9.54	2705.16	
Filtered TKN	1.64	465.78	
Particulate TKN	0.49	139.48	
Total Kjeldahl Nitrogen	2.14	605.26	
Filtered Carbonaceous BOD	0.96	271.54	
Total Carbonaceous BOD	3.48	985.16	
Nitrite + Nitrate	4.11	1165.30	
Total N	6.25	1770.56	
Total inorganic N	4.32	1225.38	

Alkalinity	3.28	422.03	mmol/L and kmol/d
pH	6.78		
Volatile fatty acids	0.00	0.43	
ISS precipitate	0.00	0.00	
ISS cellular	0.36	102.69	
ISS Total	2.39	676.96	
Ammonia N	0.21	60.08	
Nitrate N	3.83	1085.08	

Parameters	Value	Units
Element HRT	3.11	hours
Percent TSS removal	99.84	%
Percent COD removal	99.06	%
Percent BOD removal	99.78	%
Percent TKN removal	99.31	%
Percent Tot. P removal	92.60	%
Height of specified concentration	1.80	ft
Total solids mass	76875.38	lb
Surface overflow rate	500.47	gal/(ft2 d)
Solids loading rate	24.23	lb/(ft2 d)
Power	1.50	kW
Power cost (Excl. heating)	0.23	$/hour

Album page - Centrifuge

Dewatering

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	125130.33	65788.60	
Total suspended solids	200382.48	105353.21	
Particulate COD	192823.47	101378.98	
Filtered COD	189.02	99.38	
Total COD	193012.50	101478.37	
Soluble PO4-P	683.36	359.28	

Total P	3462.98	1820.70	
Filtered TKN	862.03	453.22	
Particulate TKN	6284.80	3304.30	
Total Kjeldahl Nitrogen	7146.82	3757.52	
Filtered Carbonaceous BOD	105.12	55.27	
Total Carbonaceous BOD	14570.65	7660.68	
Nitrite + Nitrate	0.00	0.00	
Total N	7146.82	3757.52	
Total inorganic N	861.05	452.70	
Alkalinity	43.47	10.37	mmol/L and kmol/d
pH	6.73		
Volatile fatty acids	142.97	75.17	
ISS precipitate	0.00	0.00	
ISS cellular	3625.03	1905.90	
ISS Total	75252.15	39564.62	
Ammonia N	861.05	452.70	
Nitrate N	0.00	0.00	

Parameters	Value	Units
Percent TSS removal	95.00	%
Power	0	kW
Power cost (Excl. heating)	0	$/hour
Cost (Chemicals)	0	$/hour

Album page - Centrifuge

Dewatering

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	1613.65	3462.56	
Total suspended solids	2584.09	5544.91	
Particulate COD	2486.61	5335.74	
Filtered COD	189.02	405.61	
Total COD	2675.64	5741.34	

Soluble PO4-P	683.36	1466.34	
Total P	719.20	1543.26	
Filtered TKN	862.03	1849.73	
Particulate TKN	81.05	173.91	
Total Kjeldahl Nitrogen	943.07	2023.64	
Filtered Carbonaceous BOD	105.12	225.55	
Total Carbonaceous BOD	291.66	625.84	
Nitrite + Nitrate	0.00	0.00	
Total N	943.07	2023.64	
Total inorganic N	861.05	1847.62	
Alkalinity	43.47	42.31	mmol/L and kmol/d
pH	6.73		
Volatile fatty acids	142.97	306.77	
ISS precipitate	0.00	0.00	
ISS cellular	46.75	100.31	
ISS Total	970.44	2082.35	
Ammonia N	861.05	1847.62	
Nitrate N	0.00	0.00	

Parameters	Value	Units
Percent TSS removal	95.00	%
Power	0	kW
Power cost (Excl. heating)	0	$/hour
Cost (Chemicals)	0	$/hour

Album page - Digesters

Anaerobic Digesters

Parameters	Conc. (mg/L)	Mass rate (lb/d)	Notes
Volatile suspended solids	25921.74	69251.15	
Total suspended solids	41510.81	110898.12	
Particulate COD	39944.90	106714.72	
Filtered COD	189.02	504.99	

Total COD	40133.93	107219.71	
Soluble PO4-P	683.36	1825.62	
Total P	1259.18	3363.96	
Filtered TKN	862.03	2302.95	
Particulate TKN	1301.95	3478.21	
Total Kjeldahl Nitrogen	2163.97	5781.16	
Filtered Carbonaceous BOD	105.12	280.82	
Total Carbonaceous BOD	3101.77	8286.51	
Nitrite + Nitrate	0.00	0.00	
Total N	2163.97	5781.16	
Total inorganic N	861.05	2300.33	
Alkalinity	43.57	52.80	mmol/L and kmol/d
pH	6.67		
Volatile fatty acids	142.97	381.94	
ISS precipitate	0.00	0.00	
ISS cellular	750.95	2006.21	
ISS Total	15589.08	41646.96	
Ammonia N	861.05	2300.33	
Nitrate N	0.00	0.00	

Parameters	Value	Units
Element HRT	359.86	hours
Velocity gradient	7.23	1/s
VSS destruction	44.43	%
Total solids mass	1662837.68	lb
Total readily biodegradable COD	143.05	mg/L
Off gas flow rate (dry)	671.34	ft3/min (field)
Off gas Oxygen	0	%
Off gas Carbon dioxide	37.09	%
Off gas Ammonia	0	%
Off gas Hydrogen	0.04	%
Off gas Methane	62.79	%
Off gas Nitrous oxide	0	%

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	0.5500	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.1500	0.3000	1.0290
Ammonification rate [L/(mgCOD d)]	0.0800	0.0400	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.5000	0.5000	1.0000
Endogenous products decay rate [1/d]	0	0	1.0000

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9000	0.9000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.7000	0.7000	1.0000
Byproduct NH4 logistic slope [-]	50.0000	50.0000	1.0000
Byproduct NH4 inflection point [mgN/L]	1.4000	1.4000	1.0000
AOB denite DO half sat. [mg/L]	0.1000	0.1000	1.0000
AOB denite HNO2 half sat. [mgN/L]	5.000E-6	5.000E-6	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiHNO2 [mmol/L]	0.0050	0.0050	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.7000	0.7000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.1000	0.1000	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiNH3 [mmol/L]	0.0750	0.0750	1.0000

AAO

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2000	0.1000	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	3.2000	1.0290
Fermentation half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Fermentation growth factor (AS) [-]	0.2500	0.1250	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	0.1000	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	1.8310
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000
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	0.3000
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

Heating fuel/Chemical Costs

Name	Default	Value
Methanol [$/gal]	1.6656	1.6656
Ferric [$/gal]	0.3785	0.3785
Aluminium [$/gal]	0.3028	0.3028
Natural gas [$/MMBTU]	3.1652	3.1652
Heating oil [$/gal]	1.8927	1.8927
Diesel [$/gal]	2.6498	2.6498
Custom fuel [$/gal]	3.7854	3.7854
Biogas sale price [$/MMBTU]	2.1101	2.1101

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

Calorific values of heating fuels

Name	Default	Value
Calorific value of natural gas [BTU/lb]	20636	20636
Calorific value of heating fuel oil [BTU/lb]	18057	18057

Calorific value of diesel [BTU/lb]	19776	19776
Calorific value of custom fuel [BTU/lb]	13758	13758

Density of liquid heating fuels

Name	Default	Value
Density of heating fuel oil [lb/ft3]	56	56
Density of diesel [lb/ft3]	55	55
Density of custom fuel [lb/ft3]	49	49

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	101.3250
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	0.8202
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	2.46697
Maximum power per rotor [hp]	26.80965	26.80965

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-10	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	1.0000	1.0000
Nitrite oxidizing biomass (NOB)	25.0000	1.0000	1.0000
Anaerobic ammonia oxidizers (AAO)	10.0000	1.0000	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

DIFFUSER DESIGN CALCULATIONS

CAROLLO ENGINEERS == DIFFUSER DESIGN CALCULATIONS

W.O./CLIENT:	9837A.10/CITY OF MESA
PROJECT:	GREENFIELD WRP PHASE III EXPANSION DESIGN
SUBJECT:	**DIFFUSER SYSTEM DESIGN - System Configuration**

v67	Calc By	Date	Time	Chk by	Filename
	CL	9/16/2016	17:08		Diffuser System Design67 4-Stage GWRP PH III DESIGN 24in.xls

Diffuser System Data Sheet

OPERATING CONDITIONS (Daily Average):		Annual Average	Max-Month	Min Startup	
Operating Solids Retention Time (SRT)	=	13.4	10.1	21.5	days
Design WW Temperature	=	20.0	28.0	20.0	deg. C
Total Oxygen Demand (all Basins combined)	=	90,896	113,179	42,418	lb/d
Number of Basins in Operation	=	4.00	4.00	3.00	
Total Oxygen Demand per Basin	=	22,724	28,295	14,139	lb/d
Side Water Depth in Aeration Basin	=	23.80	23.80	23.80	ft
Aeration Basin Water Surface Elevation	=	1,296	1,296	1,296	ft above Sea Level

All data shown are PER BASIN

Nominal Dimensions for AERATED ZONES ONLY:											
Diffuser Grid Number		**Grid 1**	**Grid 2**	**Grid 3**	**Grid 4**	**Grid 5**	**Grid 6**	**Grid 7**	**Grid 8**	**Total**	
Zone Length	=	29.0	85.0	85.0	85.0	95.0	95.0	66.0	29.0	569	ft
Zone Width	=	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0		ft
Floor Area	=	1,624	4,760	4,760	4,760	5,320	5,320	3,696	1,624	**31,864**	sf
% of Aerated Basin Volume		5.1	14.9	14.9	14.9	16.7	16.7	11.6	5.1		

OXYGEN DEMAND DISTRIBUTION:

	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Total	
Average Conditions										
Design Peaking Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**		
Design lb/d Oxygen Demand exerted in this Zone (*1)	4,034	0	0	0	10,410	6,816	0	1,463	**22,724**	lb/d
Site Conditions Adjustment Factor, F (*3)	0.23	0.53	0.57	0.60	0.51	0.56	0.66	0.00		
Peak Conditions										
Design Peaking Factor	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**		
Design lb/d Oxygen Demand exerted in this Zone (*1)	6,134	0	0	0	14,832	10,724	0	2,264	**33,954**	
Site Conditions Adjustment Factor, F (*3)	0.21	0.50	0.53	0.56	0.48	0.50	0.61	0.00		
Minimum Conditions										
Design Peaking Factor	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**	**0.75**		
Design lb/d Oxygen Demand exerted in this Zone	1,883	0	0	0	4,858	3,181	0	683	**10,605**	lb/d
Site Conditions Adjustment Factor, F	0.26	0.65	0.69	0.69	0.56	0.59	0.69	0.00		

OXYGEN DEMAND DISTRIBUTION (Oxygen Demand Exerted in Each Zone)

Select the manner in which the Oxygen Demand Distribution is to be calculated -

Select Calculation Option: **3**

= DIRECT Correspondence with BioWin (or direct Entry of lb/d)
Now proceed to specify correspondence between each Grid and Biotran Zone in the Table below,
(or enter lb/d Demand directly); then enter Peaking Factors in Diffuser System Data Sheet

Grid/Zone Correspondence Table for Option 3

Diffuser Grid	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8
Corresponding Biotran Zone Number	1	2	3	4	5	6	7	8

- If you want to enter your own selected distribution of lb/d Oxygen Demand (e.g., if you wanted to check extreme operating alternatives), select OPTION 3 and enter your data directly into the "lb/d Oxygen Demand Distribution" Table, below.

lb/d Oxygen Demand Distribution for Option 3

Average Oxygen Demand exerted in this Zone, lb/d	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8
Annual Average Conditions	16,137	0	0	0	41,640	27,265	0	5,854
Max-Month (Peak) Conditions	20,445	0	0	0	49,439	35,747	0	7,548
Minimum Startup Conditions	7,530	0	0	0	19,432	12,724	0	2,732

CAROLLO ENGINEERS == DIFFUSER DESIGN CALCULATIONS

W.O./CLIENT:	9837A.10/CITY OF MESA
PROJECT:	GREENFIELD WRP PHASE III EXPANSION DESIGN
SUBJECT:	**DIFFUSER SYSTEM DESIGN - Values for Specification**

v67	Calc By	Date	Time	Chk By	Filename
	CL	9/16/2016	17:08		Diffuser System Design67 4-Stage GWRP PH III DESIGN 24in.xls

Diffuser Data for Specification Section

Sanitaire 9" Membrane Disk Diffusers:

This section helps to prepare the data table as used in the latest recommended version of the diffuser Spec, once it has been decided what SOTE is to be asked for in the Spec. For the BLUE values, change the entries to use the appropriate diffuser type

All values are PER BASIN, for a total of (number) basins. Zone Number	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Total per basin	Total
Nominal floor dimensions:										
Length (ft)	29	85	85.0	85.0	95.0	95	66	29		
Width (ft)	56	56	56	56	56	56	56	56		
Side water depth (ft)	23.8	23.8	23.8	23.8	23.8	23.8	23.8	23.8		
Standard Oxygen Transfer Rate, SOTR (lb/day)	**17,834**	0	0	0	**20,464**	**12,234**	0	**2,713**		
Standard Oxygen Transfer Efficiency, SOTE, minimum (percent)	**39.2**	0.0	0.0	0.0	**41.5**	**39.4**	0.0	**37.6**		
Average Air Flow Rate (scfm) = 3.96 x SOTR / SOTE	**1,804**	**0**	**0**	**0**	**1,954**	**1,230**	**0**	**286**	5,274	**21,095**
Peak Air Flow Rate (scfm)	**3,090**	**0**	**0**	**0**	**3,082**	**2,331**	**0**	**498**	9,001	**36,003**
Minimum Process Air Flow Rate (scfm)	661	0	0	0	751	489	0	115	2,016	6,048
Minimum Mixing Air Flow Rate (scfm)	195	571	571	571	638	638	444	195		
Minimum Air Flow Rate (scfm)	**661**	**0**	**0**	**0**	**751**	**638**	**0**	**195**	2,245	**6,736**
Number of diffusers	**850**	850	0	1600	**1600**	**1000**	400	**230**		
Active Diffuser Area (sq ft), minimum (Note 1)	349	349	0	656	656	410	164	94		
Number of blanks (percent)	0	0	0	10	10	10	10	10		

(Note 1): The Contractor is cautioned that the active diffuser areas shown are a minimum, and may have to be increased to achieve the specified SOTE. Actual numbers of diffusers required should be reviewed with the proposed supplier of the diffuser system.

Calculation Section

Factor for Peak/Aver Air Flow Rate 1.71 [See estimate below]

Value used to convert scfm to Diffuser Area (scfm/sf)
Use 3 - 4

Resulting Air Rate per diffuser:								
Diffuser active area, sf	0.41	0.41	0.00	0.41	0.41	0.41	0.41	0.41
Average Loading, scfm/dfr	2.12	0.00	0.00	0.00	1.22	1.23	0.00	1.24
Peak Loading, scfm/dfr	3.64	0.00	0.00	0.00	1.93	2.33	0.00	2.16

Evaluation Of Standard Oxygen Transfer Rate

Enter the following values from the spreadsheet for the selected diffuser:

Average Conditions:											
Oxygen Transfer Rate, OTR	=	4,034	0	0	0	10,410	6,816	0	1,463	**22,724**	lb/day
Site Adjustment Factor, F	=	0.23	0.53	0.57	0.60	0.51	0.56	0.66	0.54		
[includes effects of operating D.O. concentration, site elevation, temperature and alpha factor]											
Standard Oxygen Transfer Rate, SOTR [SOTR = OTR / F]	=	17,834	0	0	0	20,464	12,234	0	2,713	**53,244**	lb/day
Peak Conditions:											
Oxygen Transfer Rate, OTR	=	6,134	0	0	0	14,832	10,724	0	2,264	**33,954**	lb/day
Site Adjustment Factor, F	=	0.21	0.50	0.53	0.56	0.48	0.50	0.61	0.51		
[includes effects of operating D.O. concentration, site elevation, temperature and alpha factor]											
Standard Oxygen Transfer Rate, SOTR [SOTR = OTR / F]	=	28,856	0	0	0	30,749	21,591	0	4,423	**85,618**	lb/day
Peak/Average Air Flow Rate [Select an appropriate average for Spec]		1.71	0.00	0.00	0.00	1.58	1.90	0.00	1.74	1.71	
Minimum Conditions:											
Oxygen Transfer Rate, OTR	=	1,883	0	0	0	4,858	3,181	0	683	**10,605**	lb/day
Site Adjustment Factor, F	=	0.26	0.65	0.69	0.69	0.56	0.59	0.69	0.56		
[includes effects of operating D.O. concentration, site elevation, temperature and alpha factor]											
Standard Oxygen Transfer Rate, SOTR [SOTR = OTR / F]	=	7,268	0	0	0	8,707	5,386	0	1,217	**22,577**	lb/day

Note: Average air flow rate per Zone = 3.96 x SOTR / SOTE

CAROLLO ENGINEERS == DIFFUSER DESIGN CALCULATIONS

W.O./CLIENT:	9837A.10/CITY OF MESA
PROJECT:	GREENFIELD WRP PHASE III EXPANSION DESIGN
SUBJECT:	**DIFFUSER SYSTEM DESIGN - Average Conditions**
Treatment Conditions:	**Annual Average**
Type of Diffuser	Sanitaire 9" Membrane Disk Diffusers:

v67 Calc By	Date	Time	Chk By	Filename
CL	9/16/2016	17:08		Diffuser System Design67 4-Stage GWRP PH III DESIGN 24in.xls

Grid 1 Grid 2 Grid 3 Grid 4 Grid 5 Grid 6 Grid 7 Grid 8 Total

Part B: This section is set up to calculate air requirements, zone by zone along the aeration basin FOR ANNUAL AVERAGE CONDITIONS
The calculations use estimated SOTE's. Proposed layout should be checked with Diffuser Vendor
Enter the data required below - either from Sheet O2_Demand, or your own values:
General Procedure:
Manipulate number of diffusers and Oxygen Transferred per zone, to attain air loading per diffuser in the required ranges, for average as well as peak conditions. Do not exceed the max number of diffusers that can reasonably fit into a zone.
[Note: Entries for Oxygen Transferred per Zone will transfer proportionately to the Peak calc. sheet]

Operating Solids Retention Time (SRT)	(Rs)	=	13.4	days								
WW Temperature		=	20	deg. C								
Design Air Temperature		=	25	deg. C								
Side Water Depth in Aeration Basin		=	23.80	ft								
Total Oxygen Transfer Required (all basins, daily average)		=	90,896	lb/d								
Number of Basins in Service		=	4									
Total Oxygen Transfer per Basin		=	22,724	lb/d								
Normal D.O. Set Point		=	**1.5**		**0.0**	**0.0**	**0.0**	**2.0**	**1.5**	**0.0**	**2.0**	mg/L

All data shown are PER BASIN

COMPARTMENT SIZES (per Basin) - from Data Sheet			Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Total	
Length			29.0	85.0	85.0	85.0	95.0	95.0	66.0	29.0		ft
Width			56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0		ft
Floor Area		=	1,624	4,760	4,760	4,760	5,320	5,320	3,696	1,624	31,864	sf
This area is used to specify the parameters required to evaluate SOTE for the specific diffuser selected												
NUMBER OF DIFFUSERS PER ZONE [Enter Data where indicated, below!]			850	850	0	1600	1600	1000	400	230	6,530	
Active Area per diffuser, sf (average if using different panels)			0.41	0.41	0	0.41	0.41	0.41	0.41	0.41		
Total Active Area, sf			348.5	348.5	0	656	656	410	164	94.3		
Floor Coverage, sf/sf	(At/Ad)	=	4.7	13.7	0.0	7.3	8.1	13.0	22.5	17.2		
Diffuser coverage			21.5%	7.3%	0.0%	13.8%	12.3%	7.7%	4.4%	5.8%		
OXYGEN DEMAND DISTRIBUTION:												
Oxygen Demand in this Zone (per Basin)			4,034	0	0	0	10,410	6,816	0	1,463		lb/d
Carryover from previous zone			-	-	-	-	-	-	-	-		lb/d
Total Oxygen Demand in this zone			4,034	0	0	0	10,410	6,816	0	1,463		lb/d
Design Oxygen Transfer for this zone	(OTR)	=	4,034	0	0	0	10,410	6,816	0	1,463		lb/d
Carryover to next zone			0	0	0	0	0	0	0	0		lb/d
OPERATING CONDITIONS												
Site Conditions Adjustment Factor, F, to be used in System Sizing calculations:	(F)	=	0.23	0.53	0.57	0.60	0.51	0.56	0.66	0.54		
where F = Alpha x [Theta ^(T-20)] x (Tau Beta Omega C*20 - C)/C*20												
Omega = Barometric pressure correction factor; other terms are standard terminiology												
OXYGEN TRANSFER EFFICIENCY												
Estimated SOTE (cw)	(SOTE)	=	39.2	0.0	0.0	0.0	41.5	39.4	0.0	37.6		%
Actual OTE = F x SOTE, percent	(OTE)	=	8.86	0.01	0.01	0.01	21.09	21.95	0.01	20.26		%
Process Air Rate = OTR / OTE * 3.96		=	1,804	0	0	0	1,954	1,230	0	286		scfm
Air Loading per Diffuser		=	**2.12**	**0.00**	**0.00**	**0.00**	**1.22**	**1.23**	**0.00**	**1.24**		scfm/sf
check: Air Loading for Peak Conditions		=	3.64	0.00	0.00	0.00	1.93	2.33	0.00	2.16		
Total Air for One Basin		=	5,274									scfm
TOTAL AIR FOR ALL BASINS		=	21,095									scfm

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CAROLLO ENGINEERS == DIFFUSER DESIGN CALCULATIONS

W.O./CLIENT:	9837A.10/CITY OF MESA
PROJECT:	GREENFIELD WRP PHASE III EXPANSION DESIGN
SUBJECT:	**DIFFUSER SYSTEM DESIGN - Peak Conditions**
Treatment Conditions:	**Peak Conditions (diurnal peaks at max. month loadings)**
Type of Diffuser	Sanitaire 9" Membrane Disk Diffusers:

v67	Calc By	Date	Time	Chk By	Filename
	CL	9/16/2016	17:08		Diffuser System Design67 4-Stage GWRP PH III DESIGN 24in.xls

Grid 1 **Grid 2** **Grid 3** **Grid 4** **Grid 5** **Grid 6** **Grid 7** **Grid 8** **Total**

This section is set up to calculate air requirements, zone by zone along the aeration basin FOR PEAK CONDITIONS
The calculations use estimated SOTE's. Proposed layout should be checked with Diffuser Vendor
Enter the data required below - either from Sheet O2_Demand, or your own values:
The Oxygen Demand values are transferred proportionately from the Average spreadsheet. Enter your own selections if necessary.

Operating Solids Retention Time (SRT)	(Rs)	=	10.1	days								
WW Temperature		=	28.0	deg. C								
Design Air Temperature		=	33.0	deg. C								
Side Water Depth in Aeration Basin		=	23.80	ft								
Total Oxygen Transfer Required (all basins, daily average)		=	113,179	lb/d								
Number of Basins in Service		=	4.00									
Total Oxygen Transfer per Basin		=	28,295	lb/d								
Normal D.O. Set Point		=	1.5	0.0	0.0	0.0	1.5	1.5	0.0	1.5	mg/L	

All data shown are PER BASIN

COMPARTMENT SIZES (per Basin) - from Data Sheet			**Grid 1**	**Grid 2**	**Grid 3**	**Grid 4**	**Grid 5**	**Grid 6**	**Grid 7**	**Grid 8**	**Total**	
Length			29	85	85.0	85.0	95.0	95	66	29		ft
Width			56	56	56	56	56	56	56	56		ft
Floor Area		=	1,624	4,760	4,760	4,760	5,320	5,320	3,696	1,624	31,864	sf
NUMBER OF DIFFUSERS PER ZONE [Data taken from "Average" Sheet]			850	850	0	1600	1600	1000	400	230	6,530	
Active Area per diffuser, sf			0.41	0.41	0	0.41	0.41	0.41	0.41	0.41		
Total Active Area, sf			348.5	348.5	0	656	656	410	164	94.3		
Floor Coverage, sf/sf	(At/Ad)	=	4.7	13.7	0.0	7.3	8.1	13.0	22.5	17.2		
Diffuser coverage			21.5%	7.3%	0.0%	13.8%	12.3%	7.7%	4.4%	5.8%		
OXYGEN DEMAND DISTRIBUTION:												
Oxygen Demand in this Zone			6,134	0	0	0	14,832	10,724	0	2,264		lb/d
Carryover from previous zone			-	-	-	-	-	-	-	-		lb/d
Total Oxygen Demand in this zone			6,134	0	0	0	14,832	10,724	0	2,264		lb/d
Design Oxygen Transfer for this zone	(OTR)	=	6,134	0	0	0	14,832	10,724	0	2,264		lb/d
Carryover to next zone			0	0	0	0	0	0	0	0		lb/d
OPERATING CONDITIONS												
Site Conditions Adjustment Factor, F, to be used in System Sizing calculations:	(F)	=	0.21	0.50	0.53	0.56	0.48	0.50	0.61	0.51		

where F = Alpha x [Theta ^(T-20)] x (Tau Beta Omega C*20 - C)/C*20

Omega = Barometric pressure correction factor; other terms are standard terminiology

OXYGEN TRANSFER EFFICIENCY												
Estimated SOTE (cw)	(SOTE)	=	37.0	0.0	0.0	0.0	39.5	36.7	0.0	35.2		%
Actual OTE = F x SOTE, percent	(OTE)	=	7.86	0.01	0.01	0.01	19.06	18.22	0.01	18.02		%
Process Air Rate = OTR / OTE * 3.96		=	3,090	0	0	0	3,082	2,331	0	498		scfm
Air Loading per Diffuser		**=**	**3.64**	**0.00**	**0.00**	**0.00**	**1.93**	**2.33**	**0.00**	**2.16**		scfm/sf
[This line is intentionally blank]												
Total Air for One Basin		=	9,001									scfm
TOTAL AIR FOR ALL BASINS		=	36,003									scfm

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CAROLLO ENGINEERS == DIFFUSER DESIGN CALCULATIONS

W.O./CLIENT:	9837A.10/CITY OF MESA
PROJECT:	GREENFIELD WRP PHASE III EXPANSION DESIGN
SUBJECT:	**DIFFUSER SYSTEM DESIGN - Minimum Load Conditions**
Treatment Conditions:	**Minimum Loading Conditions**
Type of Diffuser	Sanitaire 9" Membrane Disk Diffusers:

v67	Calc By	Date	Time	Chk By	Filename
	CL	9/16/2016	17:08		Diffuser System Design67 4-Stage GWRP PH III DESIGN 24in.xls

Grid 1 **Grid 2** **Grid 3** **Grid 4** **Grid 5** **Grid 6** **Grid 7** **Grid 8** **Total**

This section is set up to calculate air requirements, zone by zone along the aeration basin
The calculations use estimated SOTE's. Proposed layout should be checked with Diffuser Vendor
Enter the data required below - either from Sheet O2_Demand, or your own values:
The Oxygen Demand values are transferred proportionately from the Average spreadsheet. Enter your own selections if necessary.

Operating Solids Retention Time (SRT)	(Rs)	=	21.5 days									
WW Temperature		=	20.0 deg. C									
Design Air Temperature		=	25.0 deg. C									
Side Water Depth in Aeration Basin		=	23.80 ft									
Total Oxygen Transfer Required (all basins, daily average)		=	42,418 lb/d									
Number of Basins in Service		=	3.00									
Total Oxygen Transfer per Basin		=	14,139 lb/d									
Normal D.O. Set Point		=	1.5	0.0	0.0	0.0	2.0	1.5	0.0	2.0	mg/L	

All data shown are PER BASIN

COMPARTMENT SIZES (per Basin) - from Data Sheet			**Grid 1**	**Grid 2**	**Grid 3**	**Grid 4**	**Grid 5**	**Grid 6**	**Grid 7**	**Grid 8**	**Total**	
Length			29	85	85.0	85.0	95.0	95	66	29		ft
Width			56	56	56	56	56	56	56	56		ft
Floor Area		=	1,624	4,760	4,760	4,760	5,320	5,320	3,696	1,624	31,864	sf
NUMBER OF DIFFUSERS PER ZONE [Data taken from "Average" Sheet]			850	850	0	1600	1600	1000	400	230	6,530	
Active Area per diffuser, sf			0.41	0.41	0	0.41	0.41	0.41	0.41	0.41		
Total Active Area, sf			348.5	348.5	0	656	656	410	164	94.3		
Floor Coverage, sf/sf	(At/Ad)	=	4.7	13.7	0.0	7.3	8.1	13.0	22.5	17.2		
Diffuser coverage			21.5%	7.3%	0.0%	13.8%	12.3%	7.7%	4.4%	5.8%		
OXYGEN DEMAND DISTRIBUTION:												
Oxygen Demand in this Zone			1,883	0	0	0	4,858	3,181	0	683		lb/d
Carryover from previous zone			-	-	-	-	-	-	-	-		lb/d
Total Oxygen Demand in this zone			1,883	0	0	0	4,858	3,181	0	683		lb/d
Design Oxygen Transfer for this zone	(OTR)	=	1,883	0	0	0	4,858	3,181	0	683		lb/d
Carryover to next zone			0	0	0	0	0	0	0	0		lb/d
OPERATING CONDITIONS												
Site Conditions Adjustment Factor, F, to be used in System Sizing calculations:	(F)	=	0.26	0.65	0.69	0.69	0.56	0.59	0.69	0.56		

where F = Alpha x [Theta ^(T-20)] x (Tau Beta Omega C*20 - C)/C*20
Omega = Barometric pressure correction factor; other terms are standard terminiology

OXYGEN TRANSFER EFFICIENCY											
Estimated SOTE (cw)	(SOTE)	=	43.5	0.0	0.0	0.0	45.9	43.7	0.0	41.7	%
Actual OTE = F x SOTE, percent	(OTE)	=	11.28	0.01	0.01	0.01	25.61	25.79	0.01	23.43	%
Process Air Rate = OTR / OTE * 3.96		=	661	0	0	0	751	489	0	115	scfm
Air Loading per Diffuser		=	**0.78**	**0.00**	**0.00**	**0.00**	**0.47**	**0.49**	**0.00**	**0.50**	scfm/sf
[This line is intentionally blank]											
Total Air for One Basin		=	2,016								scfm
TOTAL AIR FOR ALL BASINS		=	6,048								scfm

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