May 6, 2016

CASHMERE WASTEWATER TREATMENT FACILITY: START TO FINISH

Rick Ballard, PE and Tom Coleman, PE

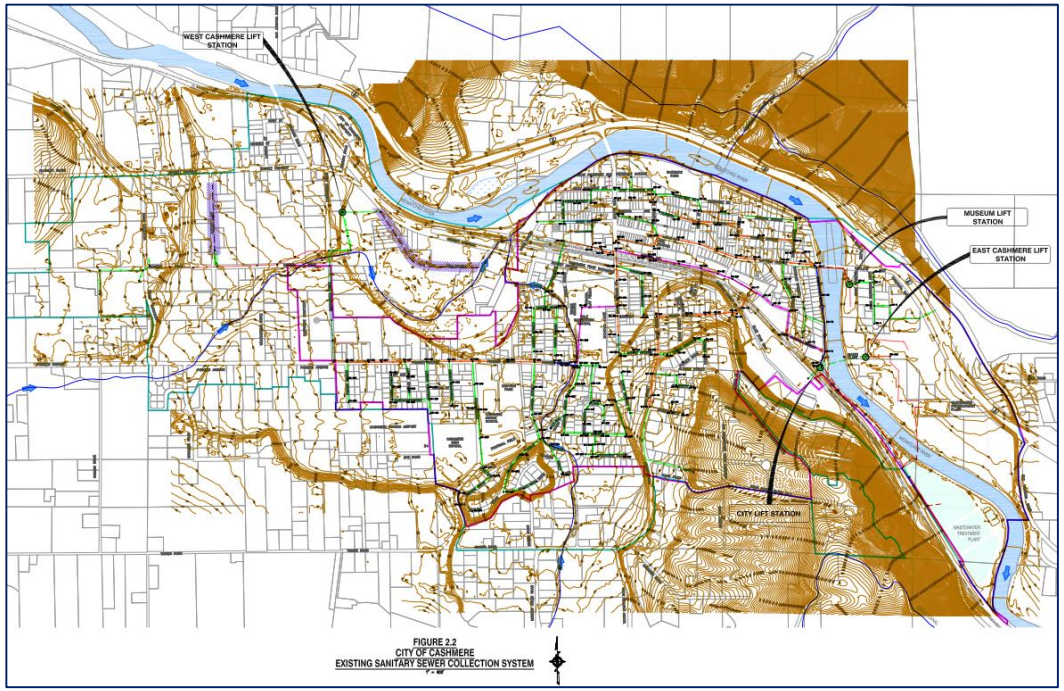
CITY OF CASHMERE WWTF UPGRADE

Project Chronology

- TMDL: April 2009
- Facility Plan: Nov. 2009
- Funding Procurement: 2009 to 2010
- Predesign/Design: 2010 to 2011
- Permitting: May 2012
- Construction: 2012 to 2014

EXISTING SYSTEM

- Population: 2,990
- Connections: 1,039
- Average Daily Flow: 0.36 mgd
- 3 cell aerated lagoon treatment system



PROJECT NEEDS

- Drivers for Upgrade to the WWTF
  - TMDL on the Wenatchee River
    - City was assigned a Wasteload Allocation for Phosphorus
  - Unlined Lagoons
    - Potential leakage into the river
- Existing Treatment System Capacity was sufficient

WENATCHEE RIVER TMDL IMPACT

Table 4. Updated critical-condition loads and loading capacity for inorganic-phosphorus in the lower Wenatchee River during critical low-flow conditions and 90th percentile WWTP effluent discharge. This table updates Table 22 in the 2006 Wenatchee DO and pH TMDL technical study (Carroll et al., 2006).

Location	Load (kg/day)		% of total load
Upstream Load		1.24	*2.5%*
NPDES Point Source Loads (90th percentile loads)		27.37	*54.9%*
Leavenworth POTW	9.535		
Peshastin POTW	2.046		
Cashmere POTW	14.956		
Cashmere POTW lagoon leak (estimated)	0.837		

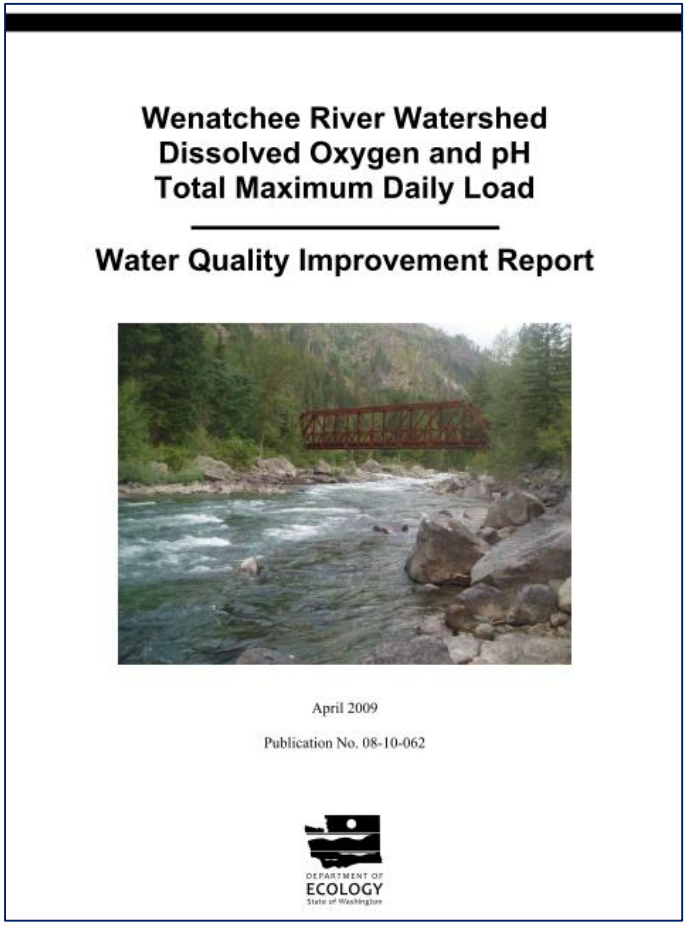
14.956
0.83711

Table 15. Wasteload allocation in concentration and kg/day for NPDES dischargers to the lower Wenatchee River (ug/L of phosphorus).

Wastewater treatment plant name and permit number	Wasteload allocation (micrograms/liter) of total phosphorus (daily maximum)	Load at TMDL: 90 ug/L TP daily maximum WLA concentration (kg/day) [a]	
		2002 Flow	Design Flow
Leavenworth WA0020974D	90	0.146	0.286
Peshastin WA0052175C	90	0.021	0.037
Cashmere WA0023183D	90	0.225	0.640

[a] kg/day for point sources = E

90 | 0.225 | 0.640



FLOW AND LOAD CHARACTERISTICS

- Primary Industrial Load
  - Crunch Pak – up to 100,000 gpd, at a maximum BOD of 4,000 mg/L

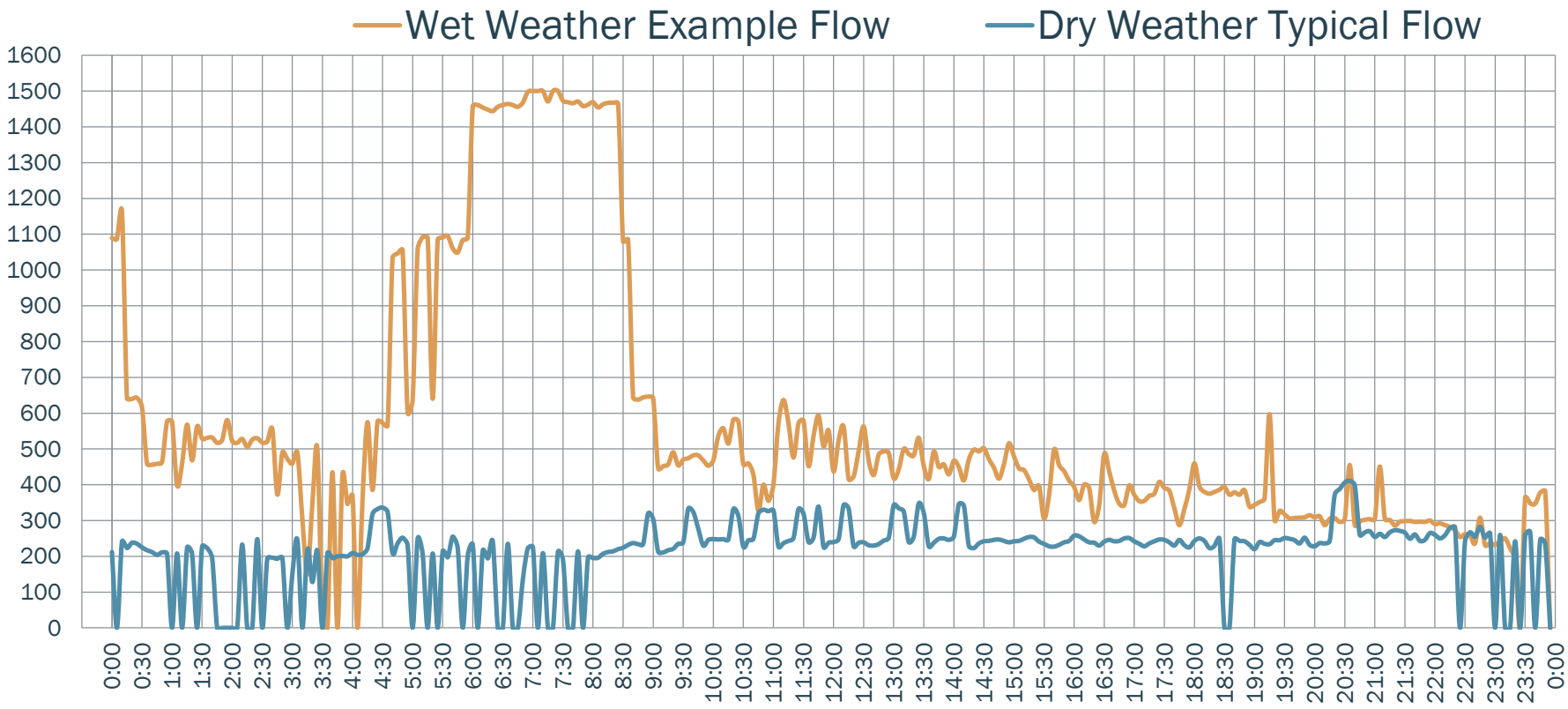
Table 4-4
Existing Average Annual Day Municipal and Residential Flow Rates at Treatment Facility

Name	2003-2006 Average Day Muncipal Flow (gpd)	2003-2006 Average Day Residential Flow (gpd)	2007 Average Day Municipal Flow (gpd)	2007 Average Day Residential Flow (gpd)	2008 Average Day Municipal Flow (gpd)	2008 Average Day Residential Flow (gpd)
Treatment Facility	330,000	302,000	370,418	333,818	357,380	290,780

Table 4-6
Existing Average Annual Day Municipal and Residential Effluent BOD_5

Name	2003-2006 Average Day Muncipal BOD_5 (ppd)	2003-2006 Average Day Residential BOD_5 (ppd)	2007 Average Day Municipal BOD_5 (ppd)	2007 Average Day Residential BOD_5 (ppd)	2008 Average Day Municipal BOD_5 (ppd)	2008 Average Day Residential BOD_5 (ppd)
Treatment Facility	1,282	723	1,271	416	1,594	739

TYPICAL DIURNAL FLOW CURVES

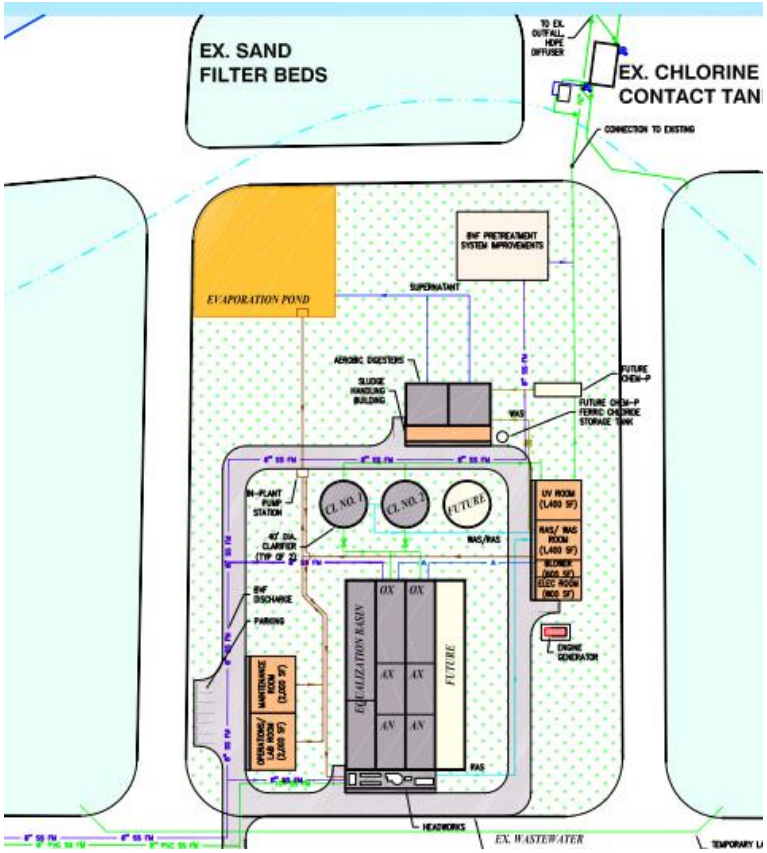


STRATEGIES FOR PROPOSED WWTF

- Reduce Phosphorus biologically to minimize chemical costs
- Attenuate high storm flows with equalizing to minimize treatment train size
- Design for high strength industrial wastewater and variable loads
- Maximize reliability and minimize operational complexity for existing City operations staff

RECOMMENDED ALTERNATIVE

- Modified Bardenpho Activated Sludge Plant
  - Headworks
  - Activated Sludge Basins
  - Equalizing Storage
  - Secondary Clarifiers
  - UV Disinfection
  - Solids Handling
- Sited within Existing Lagoon No. 2



COSTS AND FUNDING

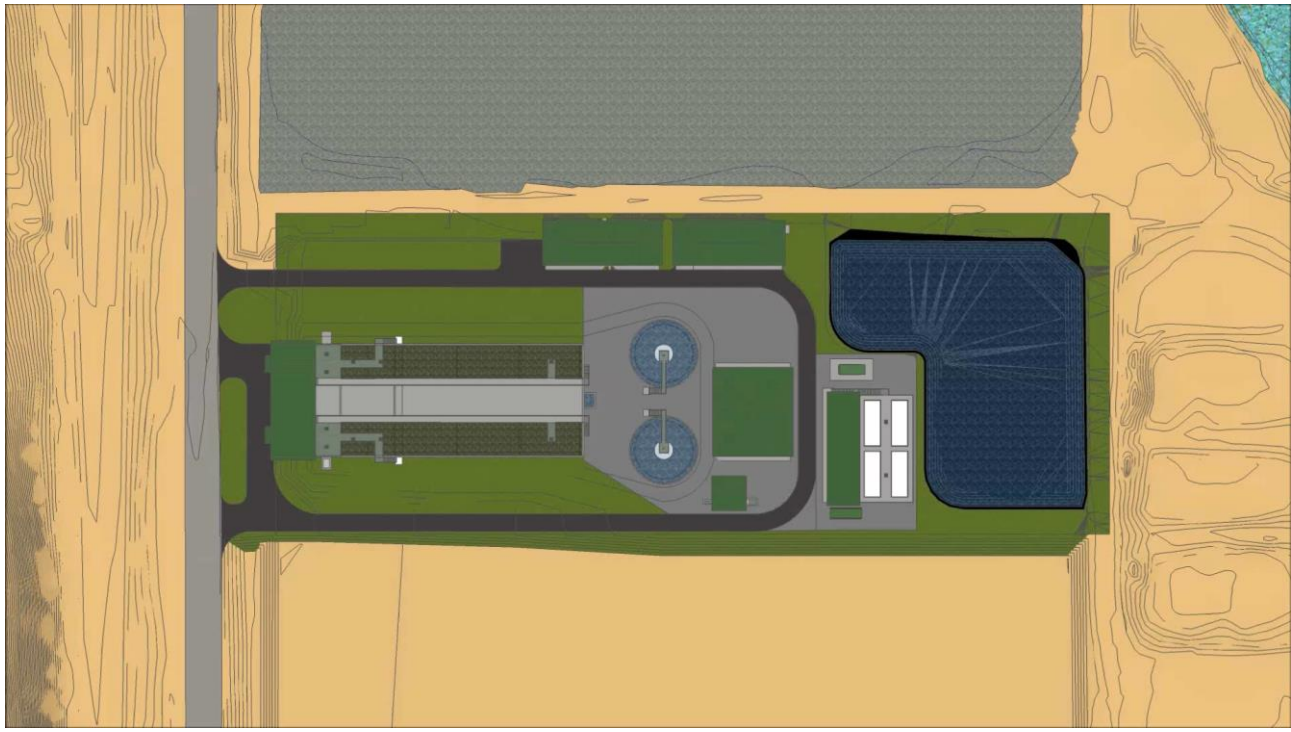
- Costs
  - Estimated $17.7 million total project costs to implement
- Impact on rates
  - Single Family Residential Sewer Rate - ~$200 per month, without funding
- USDA-RD Funding
  - City received $6 million grant from USDA-RD and low interest rate loan funding
  - Single Family Residential Sewer Rate - ~$85 per month, with funding

DESIGN TEAM

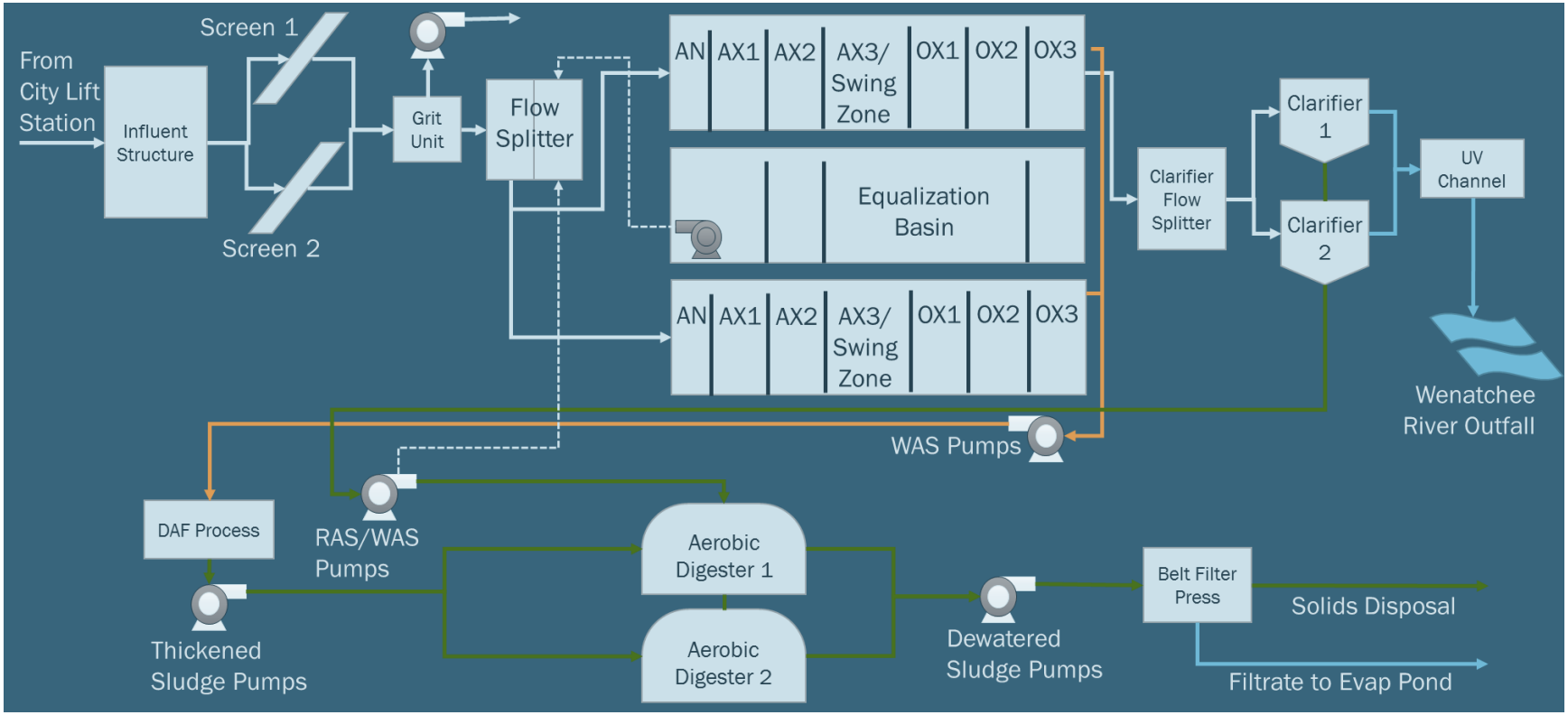
- Geotechnical: Shannon and Wilson
- Process Design: Thomas Coleman, P.E.
  - David Stensel, PhD, P.E.
  - James Barnard, PhD, P.E.
- Operations and Training: Donohue and Associates

DESIGN PHASE

- Design capacity:
  - 1.1 MGD AAF
  - 2.6 MGD MDF
  - 3.5 MGD PIDF
- Old plant 3-Pond Size: ~21 acres
- New facility: ~4 acres

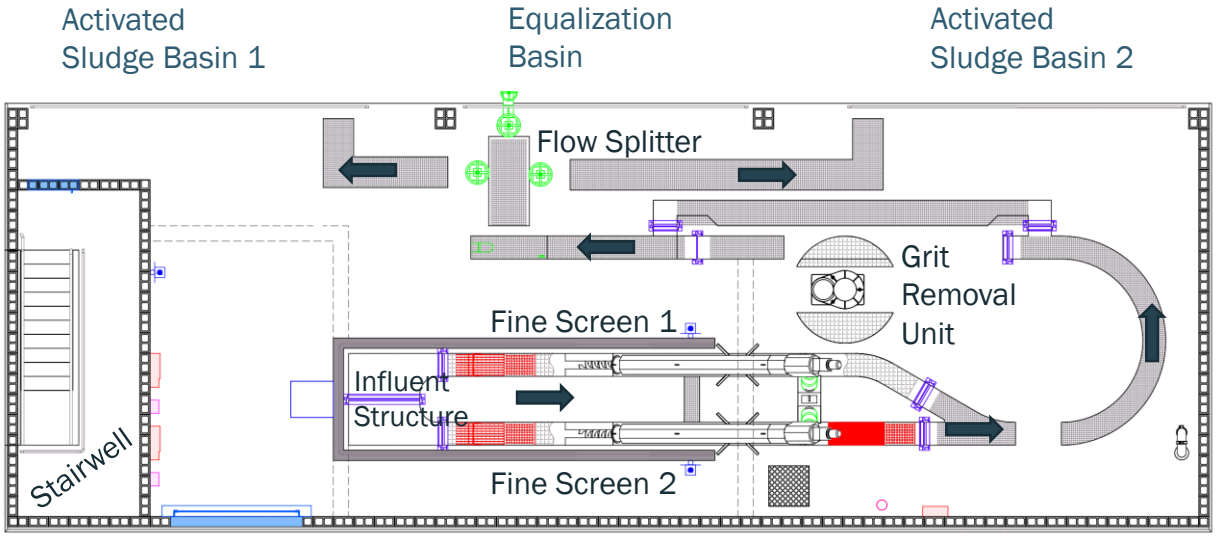


OVERALL PROCESS SCHEMATIC

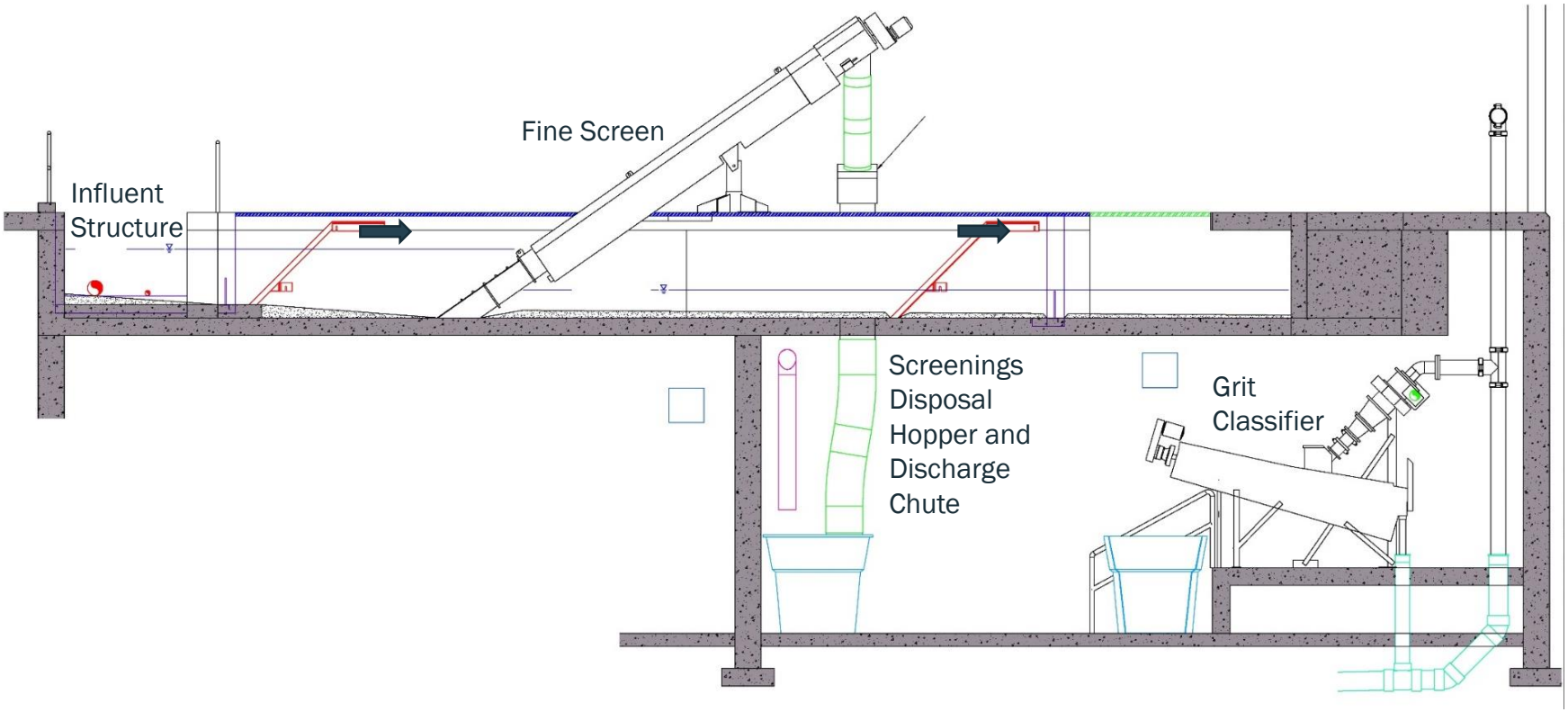


DESIGN – HEADWORKS: KEY ELEMENTS

- Headworks Capacity
  - Sized for peak hour flow of 3.46 MGD
- Fine Screening
  - 6 mm screening
- Grit Removal
- Control of Flow to 2 Activated Sludge Basins and/or Equalizing Basin

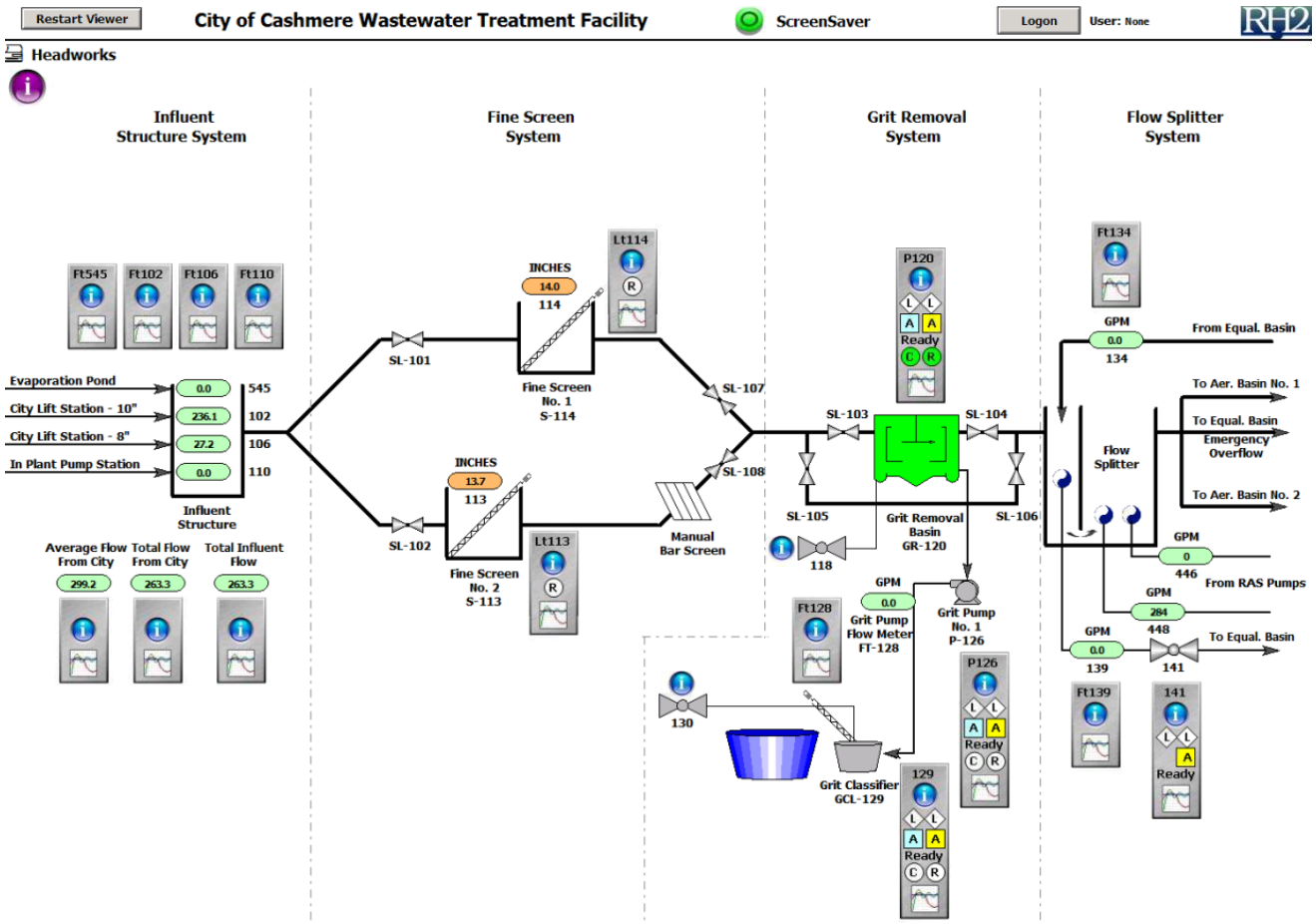


HEADWORKS PROFILE



DESIGN – HEADWORKS: CONTROL

- Monitor and record all incoming flows
- Flow split is hydraulically (gates) controlled to basins, and emergency overflow to EQ
- EQ disposal is also controlled via flow rate through an actuated valve
- EQ return flow is controlled

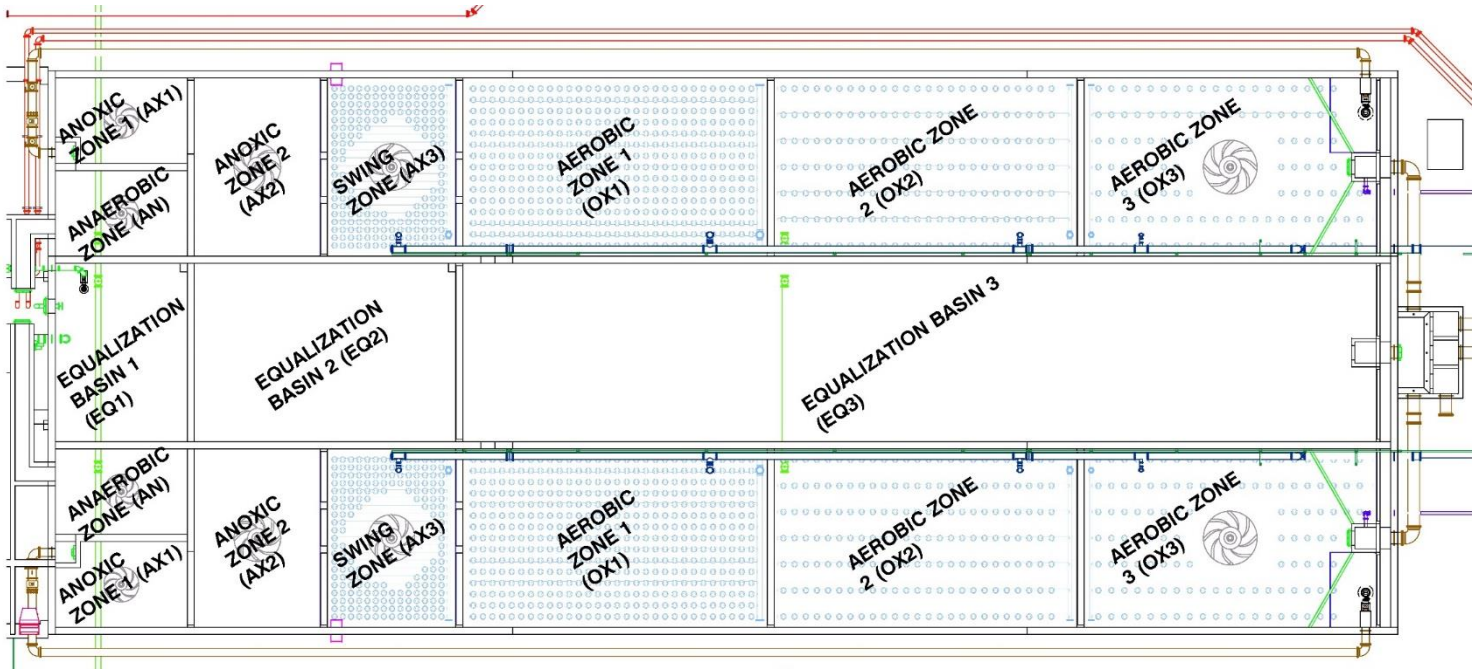


DESIGN – EQUALIZING: KEY ELEMENTS

- Equalizing Capacity
  - 550,000 gallons
  - Attenuates all flows above 2.6 MGD
  - Can also be used to attenuate peak loads
- Layout
  - Partitioned into 3 cells to minimize cleanup after smaller events
- Future Expansion
  - Designed identically to the ASB's for future conversion

DESIGN – ACTIVATED SLUDGE BASIN: KEY ELEMENTS

- Modified Bardenpho Process
  - 1 anaerobic zone, 3 anoxic zones, 3 aerobic zones
  - Recycle from 3rd aerobic zone to 1st anoxic zone



DESIGN – ACTIVATED SLUDGE BASIN: KEY ELEMENTS

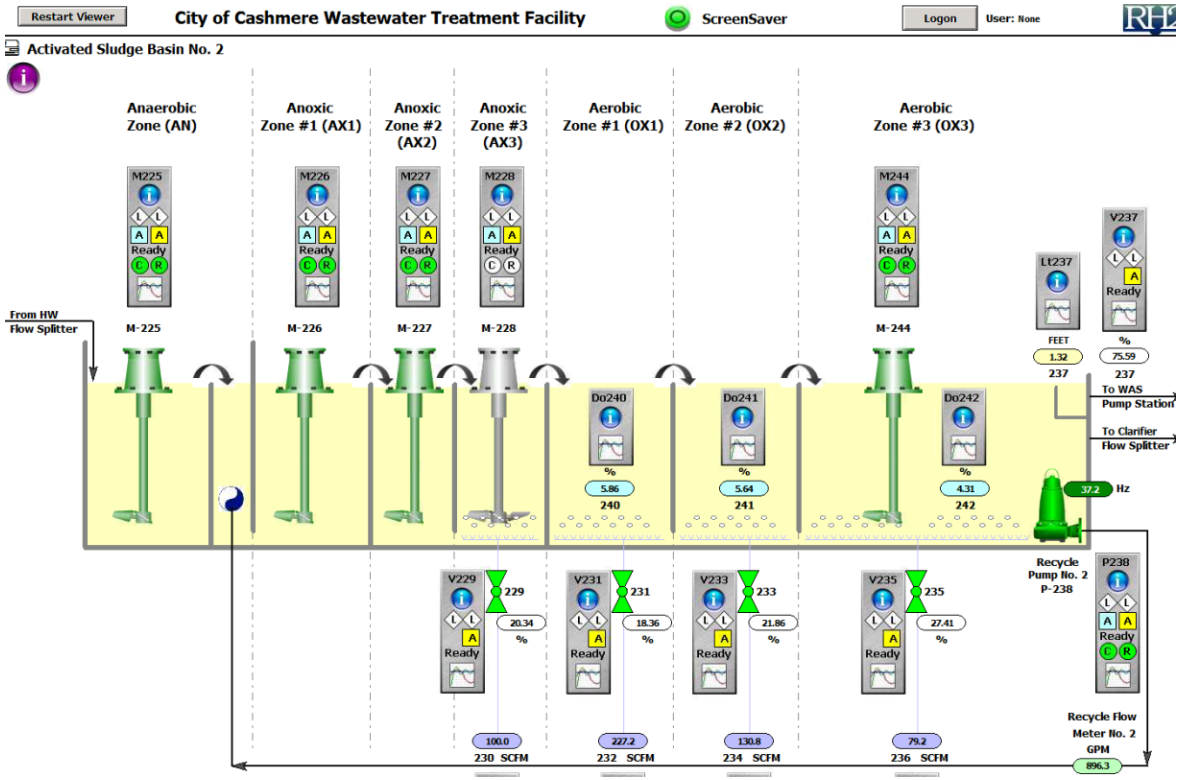
- Operational Flexibility for Varying Loads
  - 3rd anoxic zone is a “swing” zone – can either be anoxic or aerobic
- Swing zone can:
  - Operate as aerobic during periods of high loads
  - Operate as aerobic if low nutrients
  - Operate as anoxic if enough nitrogen

DESIGN – ACTIVATED SLUDGE BASIN: KEY ELEMENTS

3rd aerobic zone has a backup mixer for low demands to allow for greater turndown of air.

DESIGN – ACTIVATED SLUDGE BASIN: CONTROL

- One to three blowers can operate to meet overall air demands
- Each zone has an automatic valve and DO sensor
- Air flow control to maintain DO of 2.0 in OX1 and 2, and DO of 1.5 in OX3
- Recycle pumping runs at 300 to 600% of 2 hour running average of influent flow

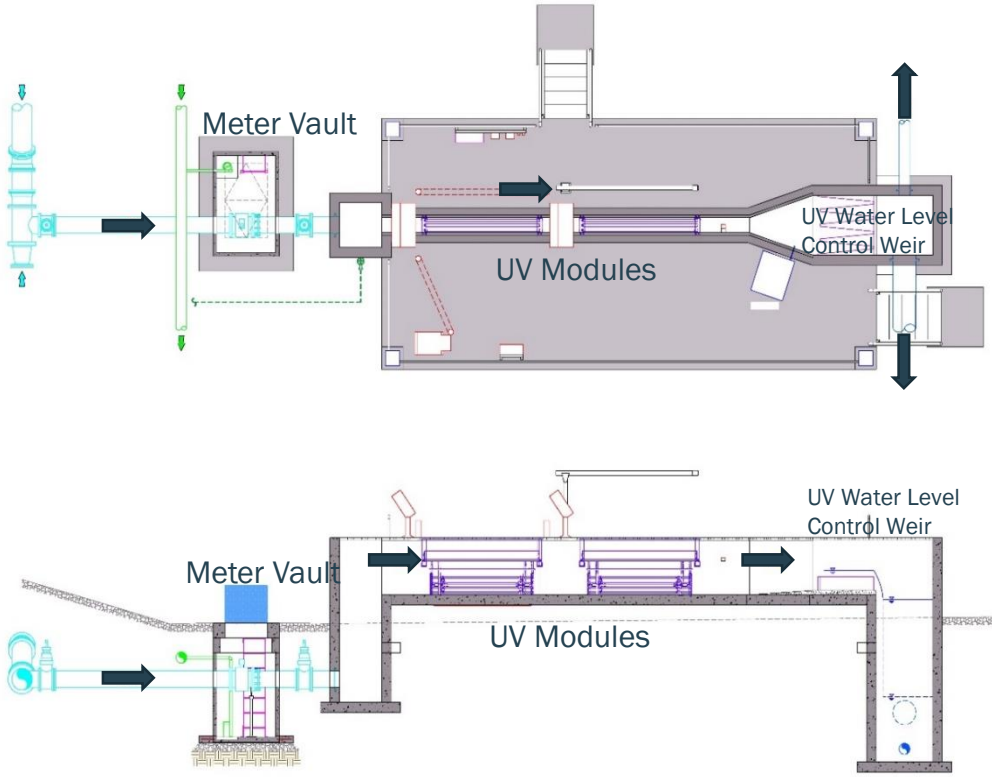


DESIGN – CLARIFIERS: KEY ELEMENTS

- Two Clarifiers, each with 1.3 MGD capacity
- Planning for 3rd clarifier in the future
- LA-EDI energy dissipating inlet
- Stamford current density baffle

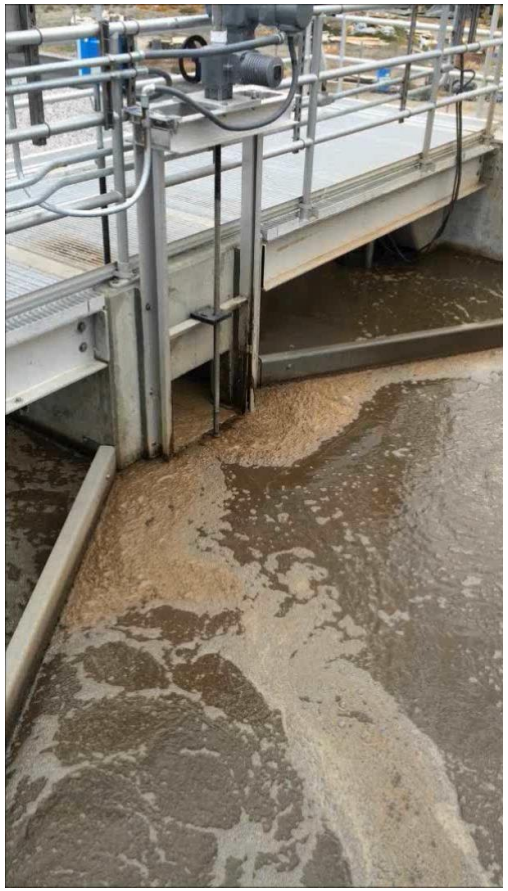
DESIGN – UV DISINFECTION: KEY ELEMENTS

- One channel with two modules
- Designed for 2.6 MGD at 65% transmittance
- At average flow of 0.4 MGD currently running one bank at 60 - 90% power



DESIGN – WASTE ACTIVATED SLUDGE REMOVAL SYSTEMS: KEY ELEMENTS

- Waste Activated Sludge Systems (WAS)
  - Primary system is a surface waste system
    - Removes waste activate sludge from surface of the activated sludge basins
    - Minimize Filamentous growth in ASB's
  - Secondary location removes it from the bottom of the clarifier
  - Current Operations uses both locations
  - SRT range of 9 – 15 days

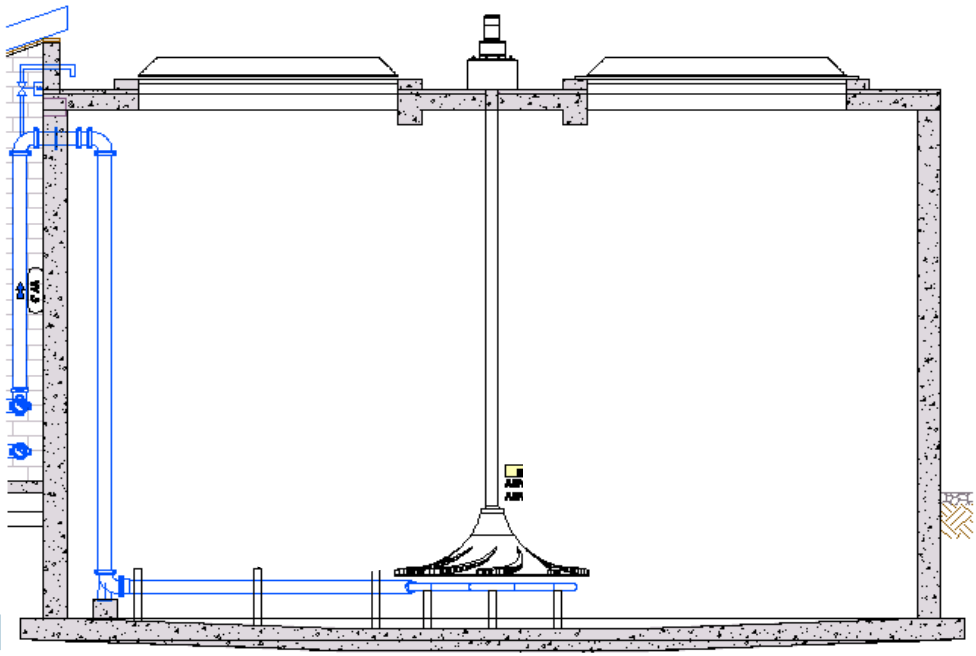


DESIGN – WAS THICKENING: KEY ELEMENTS

- Dissolved Air Flotation selected as thickening process
- Operates 24/7
- Thickens to approximately 3% prior to the digester

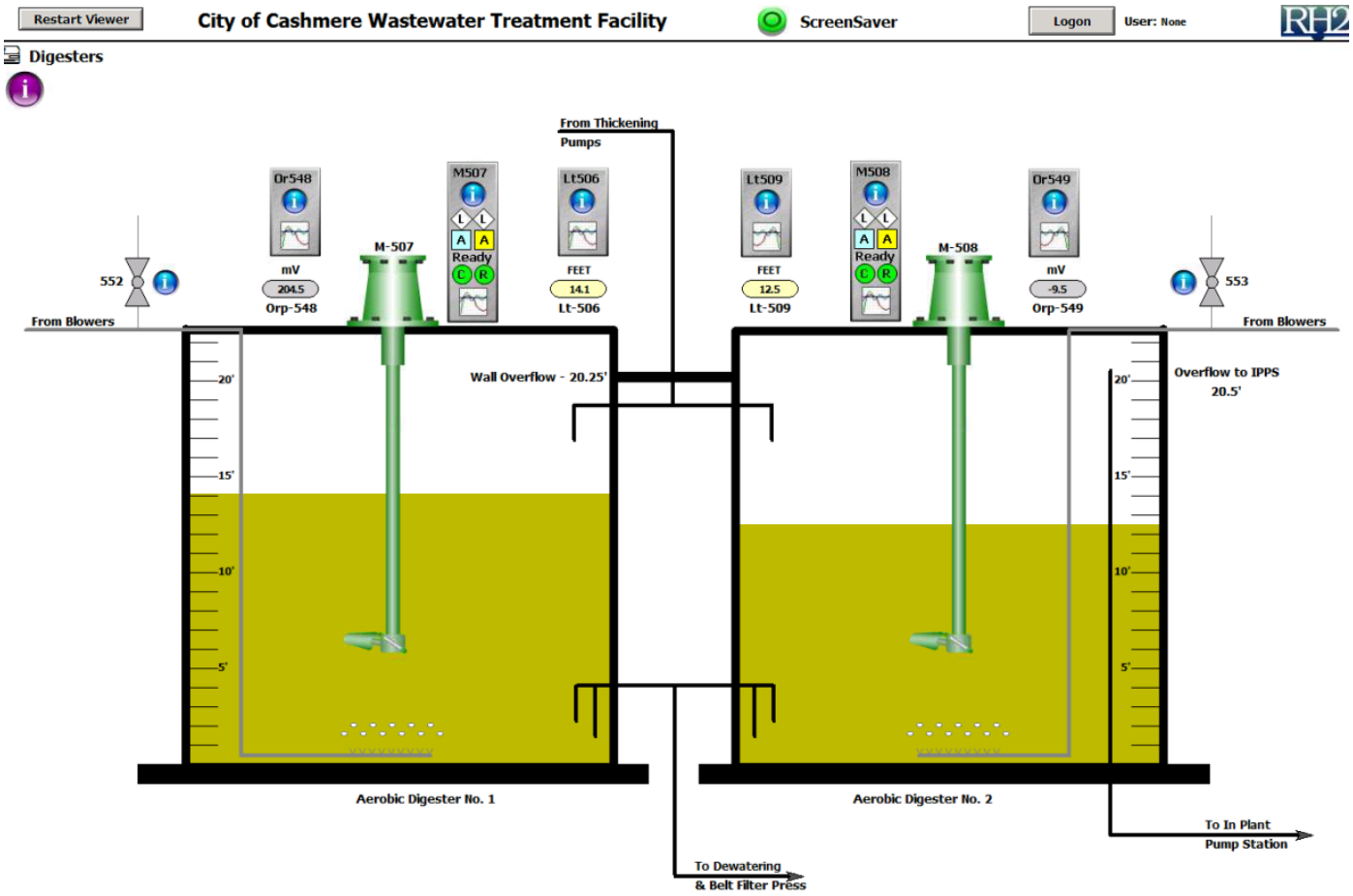
DESIGN – SOLIDS HANDLING: KEY ELEMENTS

- Digesters
  - Aerobic digesters for simple and efficient solids treatment
  - 2 digesters, each 180,000 gallon capacity
  - Using the Invent mixer with sparge ring for intermittent aeration
- Biosolids and Residuals
  - Belt filter press used to dewater
  - Filtrate sent to evaporation pond for storage and metered return to the plant



DESIGN – SOLIDS HANDLING: CONTROL

- Monitor ORP
- Control aeration cyclically based on time or ORP



DESIGN – RESIDUALS HANDLING: KEY ELEMENTS

- Storage Pond for Filtrate
- 640,000 gallons capacity
- Can store and evaporate filtrate or allow metered return

BID PHASE

10 bidders, Harbor Pacific was low at $13,063,885
Engineers Estimate: $13,962,000

City of Cashmere
Bid Tabulation - Wastewater Treatment Facility Upgrades
June 19, 2012 @ 2:00 pm

				Engineer's Estimate		(1) Harbor Pacific		Average Bid	
Item	Quantity	Units	Description	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
1	1	LS	Mobilization, Demobilization, Site Prep & Clean-up	$ 597,000.00	$ 597,000.00	$ 250,000.00	$ 250,000.00	$ 622,000.00	$ 622,000.00
2	1	LS	Trench Safety and Shoring	$ 15,000.00	$ 15,000.00	$ 12,500.00	$ 12,500.00	$ 15,450.10	$ 15,450.10
3	7400	CY	Lagoon Cell No. 2 Biosolids Removal and Hauling	$ 70.00	$ 518,000.00	$ 32.00	$ 236,800.00	$ 37.66	$ 278,706.20
4	800	CY	Unscheduled Excavation	$ 12.00	$ 10,000.00	$ 22.00	$ 17,600.00	$ 18.10	$ 14,480.00
5	68	TONS	Unscheduled Backfill	$ 12.00	$ 1,000.00	$ 33.50	$ 2,278.00	$ 38.45	$ 2,614.26
6	1	LS	Wastewater Treatment Facility	$ 10,895,000.00	$ 10,895,000.00	$ 10,699,339.00	$ 10,699,339.00	$ 11,774,697.80	$ 11,774,697.80
7	1	LS	UV Disinfection Equipment	$ 98,500.00	$ 98,500.00	$ 98,500.00	$ 98,500.00	$ 98,500.00	$ 98,500.00
8	1	LS	Mixers	$ 180,500.00	$ 180,500.00	$ 180,500.00	$ 180,500.00	$ 180,500.00	$ 180,500.00
9	1	LS	Belt Filter Press	$ 210,000.00	$ 210,000.00	$ 210,000.00	$ 210,000.00	$ 210,000.00	$ 210,000.00
10	1	LS	Fine Screens	$ 99,483.00	$ 99,483.00	$ 99,483.00	$ 99,483.00	$ 99,483.00	$ 99,483.00
11	1000	TONS	HMA Cl. 3/8" for 2" Overlay on Riverfront Drive	$ 90.00	$ 90,000.00	$ 78.00	$ 78,000.00	$ 81.66	$ 81,661.00
12	1	FA	Minor Change	$ 200,000.00	$ 200,000.00	$ 200,000.00	$ 200,000.00	$ 200,000.00	$ 200,000.00
				Subtotal	$ 12,915,000.00	Subtotal	$ 12,085,000.00	Subtotal	$ 13,578,092.36
				Sales Tax (8.1%)	$ 1,047,000.00	Sales Tax (8.1%)	$ 978,885.00	Sales Tax (8.1%)	$ 1,099,825.48
				TOTAL	$ 13,962,000.00	**TOTAL**	$ 13,063,885.00	**TOTAL**	$ 14,677,917.84

CONSTRUCTION

- Stayed on schedule and budget with minimum change orders
- Utilized time lapse videos to film construction efforts
- Extreme weather conditions
  - Winter construction in snow – utilized heaters to heat ground for subgrade work
  - Wildfires in the summer months
- Construction
  - Currently ~$38,000 in change orders (0.3%)
  - Overall Construction cost : $13,116,841

City of Cashmere
Wastewater Treatment Facility Upgrades
Construction Progress Report

UPDATED ON 2.22.13 http://bothell.rh2.com/documents/ca/CAWWTF - Construction Progress Report.pdf

HARBOR PACIFIC CONTRACT	CHANGE ORDERS TO DATE	RH2 ENGINEERING CONTRACT
THROUGH 6th PAY ESTIMATE	PERCENT CHANGES OF CONTRACT	CONSTRUCTION ADMINISTRATION
12.2%	0%	27.2%
CONTRACT AT AWARD: $13,063,885 PAID TO DATE: $1,599,703	PAID TO DATE: $0	

HEADWORKS BUILDING

PERCENT COMPLETE: <5%

KLEINFELDER REVIEWED THE HEADWORKS SUBGRADE AND DETERMINED THAT OVER-EXCAVATION OF UNSUITABLE SOILS WILL BE NECESSARY PRIOR TO FOOTING PLACEMENT.

BASINS

PERCENT COMPLETE: 25%

FOUR WALL POURS HAVE BEEN COMPLETED TOTALING APPROX. 400 YARDS OF CONCRETE. WALL POUR #5 WILL COMPLETE THE WEST WALL THAT ADJOINS THE HEADWORKS.

CLARIFIERS

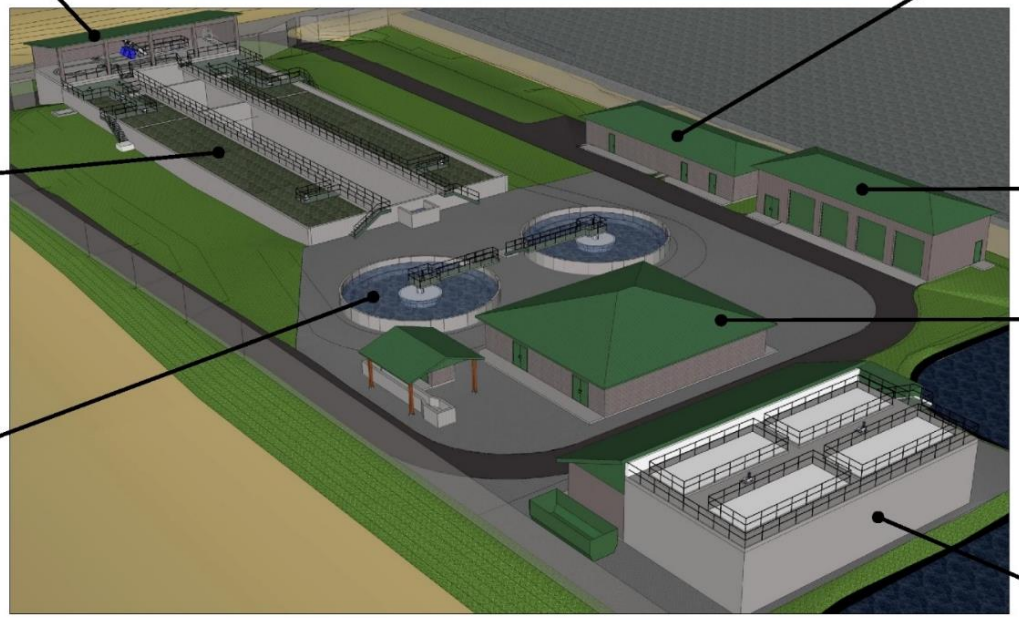
PERCENT COMPLETE: 15%

WALL REBAR AND FORMSAVER PLACEMENT IS CURRENTLY NEAR COMPLETION FOR CLARIFIER #2. A SINGLE WALL POUR WILL COMPLETE THE FULL CLARIFIER WALL.

EVAPORATION POND (NOT SHOWN)

PERCENT COMPLETE: <5%

NO FURTHER WORK HAS BEEN COMPLETED.



ADMINISTRATION BUILDING

PERCENT COMPLETE: <5%

NO FURTHER WORK HAS BEEN COMPLETED.

MAINTENANCE BUILDING

PERCENT COMPLETE: 0%

STARTING DATE: APPROXIMATELY SPRING OF 2013

EQUIPMENT AND UV TREATMENT BUILDINGS

PERCENT COMPLETE: <5%

EXCAVATION OF THE NPW PUMP STATION SUMP AND RAS PUMP ROOM HAS BEEN COMPLETED. KLEINFELDER WILL REVIEW SUBGRADE PRIOR TO BASE ROCK PLACEMENT.

SOLIDS HANDLING AND AEROBIC DIGESTER

PERCENT COMPLETE: <15%

THE DIGESTER SLAB HAS BEEN POURED. WORK ON THE DIGESTER WALLS WILL LIKELY OCCUR AFTER THE BASIN WALLS HAVE BEEN COMPLETED.

UPCOMING WORK SCHEDULE / GENERAL NOTES

WORK FOR WEEKS OF FEBRUARY 25th AND MARCH 4th, 2013

- HARBOR PACIFIC WILL COMPLETE THE 5th WALL POUR FOR THE BASINS WHICH WILL CONSIST OF PORTIONS OF THE WEST EXTERIOR WALL.
- THE FULL CIRCUMFERENCE WALL OF CLARIFIER #2 WILL BE POURED.
- HPC WILL PLACE ROCK, FORM AND POUR THE SUMP SLAB FOR THE EQUIPMENT BUILDING NPW PUMP STATION SUMP.
- THE CONTRACTOR WILL LAY THE REMAINING 18" TE LINE TO OUTSIDE OF THE UV STRUCTURE.
- COMMON FILL WORK WILL CONTINUE ON THE NORTH SIDE OF THE PROJECT IN ORDER TO FACILITATE PREPARING THE ADMINISTRATION AND MAINTENANCE BUILDING FOOTPRINTS AND ALLOW FOR INSTALLATION OF THE 12" FIRE PROTECTION LINE.

PHOTOS OF RECENT WORK

MH-2 SET ON TE LINE TO OUTFALL

COMMON FILL BROUGHT TO SITE

City of Cashmere
Wastewater Treatment Facility Upgrades
Construction Progress Report

UPDATED ON 4.19.13 http://bothell.rh2.com/documents/ca/CAWWTF - Construction Progress Report.pdf

HARBOR PACIFIC CONTRACT THROUGH 7th PAY ESTIMATE	CHANGE ORDERS TO DATE PERCENT CHANGES OF CONTRACT	RH2 ENGINEERING CONTRACT CONSTRUCTION ADMINISTRATION
16.2%	0%	38.5%
CONTRACT AT AWARD: $13,063,885 PAID TO DATE: $2,122,233	PAID TO DATE: $0	

HEADWORKS BUILDING

PERCENT COMPLETE: 10%

BELOW-GRADE ELECTRICAL AT THE HEADWORKS IS LARGELY COMPLETED. THE FOOTING SLAB POUR WILL FOLLOW NEXT.

BASINS

PERCENT COMPLETE: 40%

BASIN WALL POUR #7 WAS COMPLETED ON 4/18/13, CONSISTING OF 4 SECTIONS OF NORTH-SOUTH INTERIOR WALLS. HPC WILL BEGIN WORK ON THE EAST EXTERIOR WALL.

CLARIFIERS

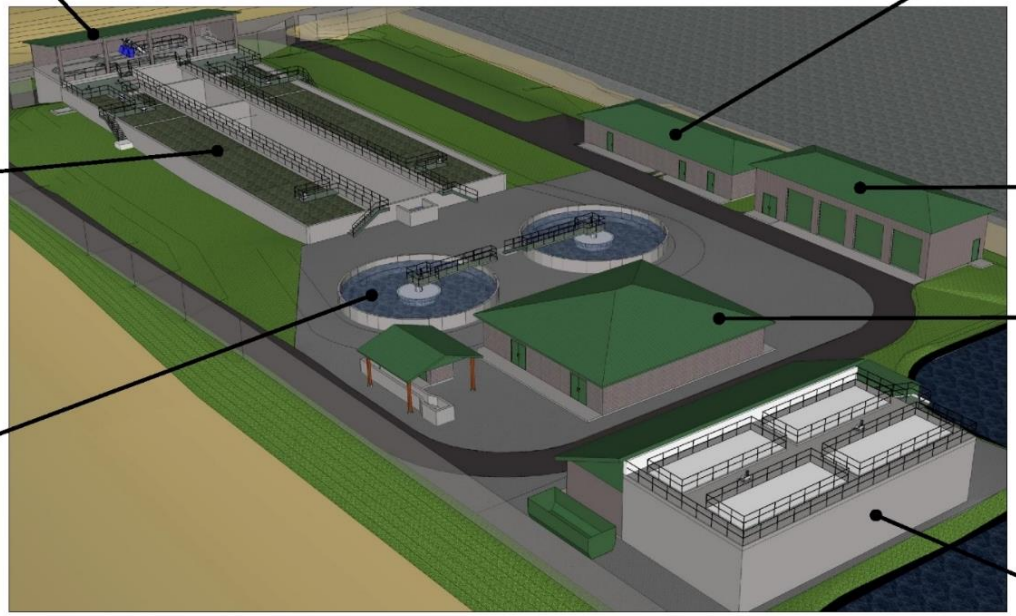
PERCENT COMPLETE: 35%

THE SCUM BOX WALLS FOR BOTH CLARIFIERS HAVE BEEN POURED. THE SE BOX WALLS WILL BE POURED NEXT AND BACKFILL WILL BE BROUGHT UP ALONGSIDE THE CLARIFIERS.

EVAPORATION POND (NOT SHOWN)

PERCENT COMPLETE: 15%

NO FURTHER WORK HAS BEEN COMPLETED SINCE LAST REPORT.



UPCOMING WORK SCHEDULE / GENERAL NOTES

WORK FOR WEEKS OF APRIL 22th AND APRIL 29th, 2013

- THE ELECTRICIANS WILL COMPLETE THE BELOW-GRADE WORK AT THE HEADWORKS AND HPC WILL POUR THE FOOTING SLABS.
- HPC WILL CONTINUE TO WORK ON THE NORTH-SOUTH INTERIOR WALLS OF THE BASINS AND WILL BEGIN FORMWORK ON THE EAST EXTERIOR WALL.
- THE SE SUMP WALLS WILL BE POURED FOR BOTH CLARIFIERS AND FILL WILL CONTINUE TO BE BROUGHT UP BETWEEN THE CLARIFIERS AND ALONG THE BASINS TO FACILITATE BELOW-GRADE PIPING EFFORTS.
- BELOW-GRADE PIPING AND ELECTRICAL WORK WILL BEGIN FOR THE UPPER ROOMS IN THE EQUIPMENT BUILDING. THE PUMP ROOM SLAB WILL BE POURED ALONG WITH THE ADMINISTRATION BUILDING SLAB.
- BELOW-GRADE PLUMBING AT THE MAINTENANCE BUILDING WILL BE COMPLETED AND THE FINISHED SLAB GRADE WILL BE REACHED.

PHOTOS OF RECENT WORK

CLARIFIER 16" SE PIPING AND SUMP

18" ML PIPING INSTALLATION

ADMINISTRATION BUILDING

PERCENT COMPLETE: 10%

ALL PLUMBING AND BELOW-GRADE ELECTRICAL LINES ARE IN. FINISHED GRADE FOR THE SLAB HAS BEEN REACHED. REBAR WILL BE PLACED FOR THE SLAB NEXT.

MAINTENANCE BUILDING

PERCENT COMPLETE: 10%

THE FOOTING STEM WALLS WERE POURED ON 4/18/13. BACKFILL OF THE STEM WALLS AND BELOW-GRADE PLUMBING WORK WILL TAKE PLACE NEXT.

EQUIPMENT AND UV TREATMENT BUILDINGS

PERCENT COMPLETE: 10%

THE RAS PUMP ROOM FLOOR SLAB IS NEARLY COMPLETE AND READY FOR POURING. THE CONTRACTOR WILL ALSO FORM AND POUR THE UV INLET SUMP WALLS NEXT.

SOLIDS HANDLING AND AEROBIC DIGESTER

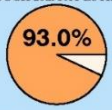
PERCENT COMPLETE: 15%

NO FURTHER WORK HAS BEEN COMPLETED SINCE LAST REPORT.

ALL COMPLETION PERCENTAGES ARE BASED ON THE LATEST PAY ESTIMATE AND ARE APPROXIMATE

City of Cashmere
Wastewater Treatment Facility Upgrades
Facility Guideline and Overview

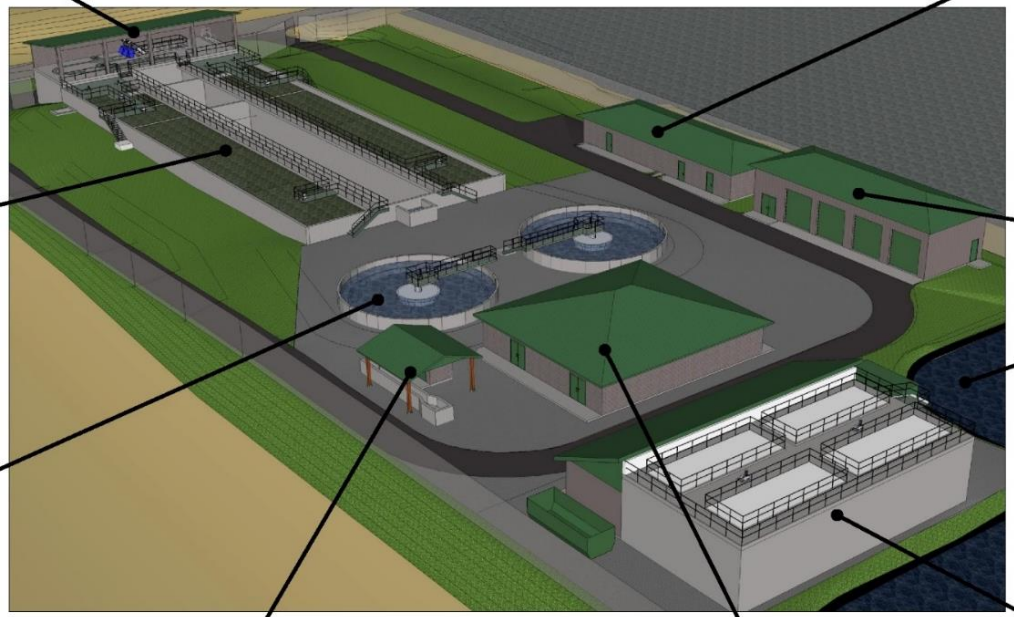
HARBOR PACIFIC CONTRACT
THROUGH 26th PAY ESTIMATE



CONTRACT W/ CHANGES: $13,116,841
PAID TO DATE: $12,189,573

CHANGE ORDERS TO DATE
PERCENT CHANGES OF CONTRACT

CHANGE ORDER AMOUNT TO DATE: $37,774



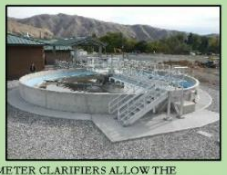
HEADWORKS BUILDING
PERCENT COMPLETE: 100%

THE HEADWORKS BUILDING HOUSES THE INFLUENT STRUCTURE, SCREENING AND DEGRITTING EQUIPMENT AND SPLITS FLOW BETWEEN THE BASINS.

BASINS
PERCENT COMPLETE: 100%

THE BASINS CONTAIN TWO 1.3 MGD PROCESS TRAINS AND AN EQUALIZATION BASIN. THE PROCESS TRAINS CONTAIN MIXERS, AERATION AND RECYCLE PUMPING EQUIPMENT.

CLARIFIERS
PERCENT COMPLETE: 100%



THE TWO 40-FOOT DIAMETER CLARIFIERS ALLOW THE CLARIFIED SECONDARY EFFLUENT TO OUTFALL TO THE UV DISINFECTION SYSTEM. SLUDGE IS RETURNED FROM THE BOTTOM OF THE CLARIFIERS TO THE HEAD OF THE BASINS.

EVAPORATION POND (NOT SHOWN)
PERCENT COMPLETE: 100%

THE EVAPORATION POND RECEIVES FILTRATE WATER FROM THE BELT FILTER PRESS AND STORES IT PRIOR TO IT SLOWLY BEING RELEASED BACK INTO THE PROCESS TRAINS VIA THE EVAPORATION POND PUMP STATION.

UV DISINFECTION SHELTER
PERCENT COMPLETE: 100%

THE ULTRAVIOLET LIGHT DISINFECTION SHELTER HOUSES UV BULBS WITHIN THE EFFLUENT CHANNEL. THE UV LIGHT NEUTRALIZES PATHOGENS PRIOR TO THE EFFLUENT OUTFALL TO THE WENATCHEE RIVER.

EQUIPMENT BUILDING
PERCENT COMPLETE: 100%

THE EQUIPMENT BUILDING HOUSES SLUDGE PUMPING AND THICKENING EQUIPMENT AS WELL AS THE AERATION BLOWERS FOR THE BASINS AND THE NON-POTABLE WATER PUMP STATION.

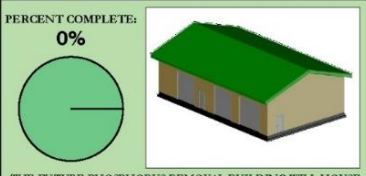
ADMINISTRATION BUILDING
PERCENT COMPLETE: 100%

THE ADMINISTRATION BUILDING HOUSES THE OPERATORS OFFICES, CONFERENCE ROOM, NETWORK AND SCADA CONTROL SYSTEM INTERFACE AND LABORATORY.

MAINTENANCE BUILDING
PERCENT COMPLETE: 100%

THE MAINTENANCE BUILDING CONTAINS THREE GARAGE BAYS, A SHOP ROOM AND A STORAGE ROOM.

FUTURE PHOSPHORUS REMOVAL BUILDING LOCATION
PERCENT COMPLETE: 0%



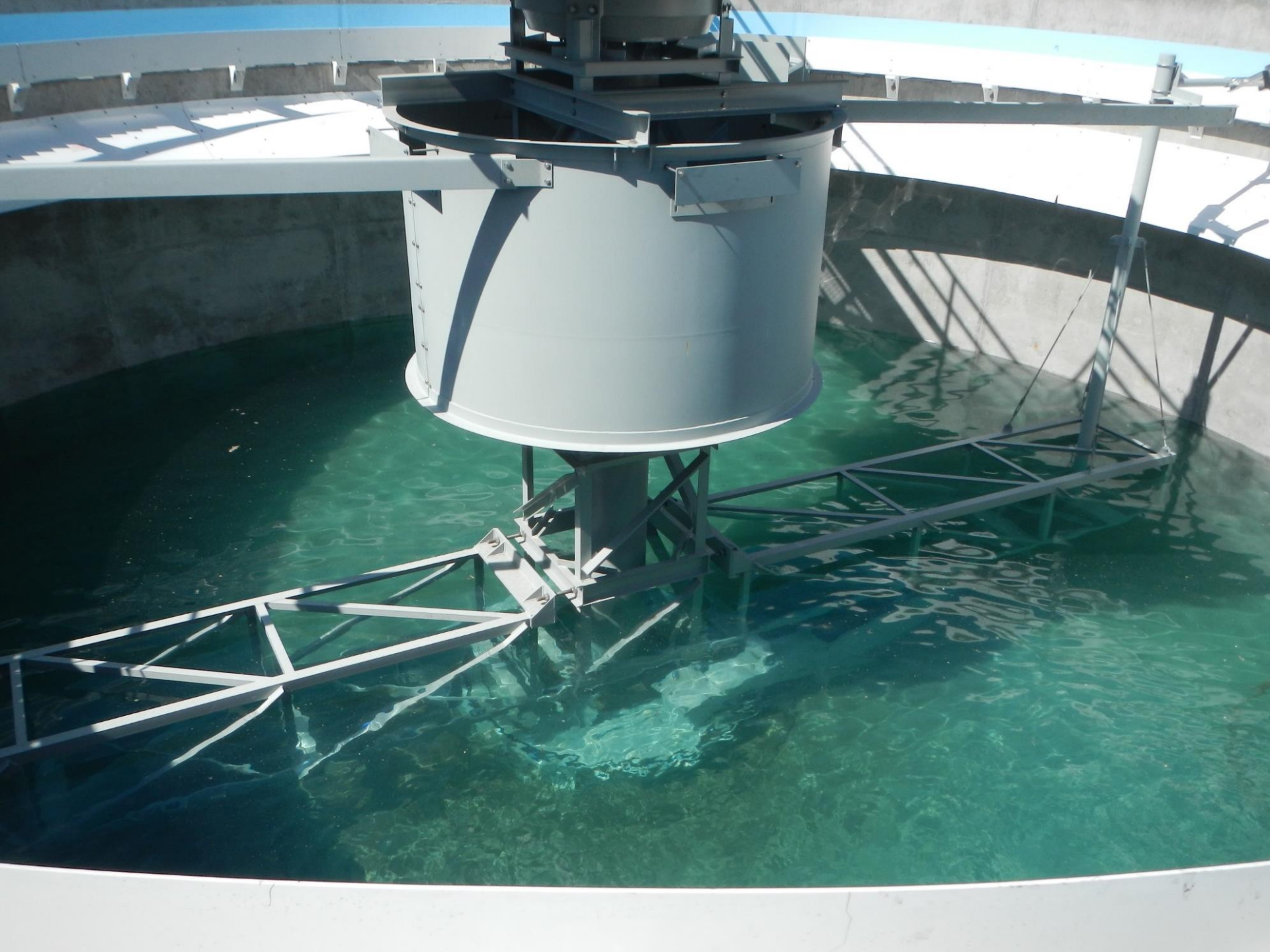
THE FUTURE PHOSPHORUS REMOVAL BUILDING WILL HOUSE A CLOTH FILTER UNIT THAT WILL POLISH SECONDARY EFFLUENT OF PARTICULATE PHOSPHORUS PRIOR TO DISCHARGE TO THE UV DISINFECTION SYSTEM.

SOLIDS HANDLING AND AEROBIC DIGESTER
PERCENT COMPLETE: 100%

THE SOLIDS HANDLING BUILDING HOUSES THE BELT FILTER PRESS FOR FINAL CAKE PRODUCTION AS WELL AS THE AERATION BLOWERS FOR THE DIGESTERS. THE TWO AEROBIC DIGESTERS DIGEST SLUDGE TO PRODUCE CLASS B BIOSOLIDS.

ALL COMPLETION PERCENTAGES ARE BASED ON THE LATEST PAY ESTIMATE AND ARE APPROXIMATE


GROVE



AERIAL VIEW OF FACILITY


EST. CASHMERE 1904
CITY OF CASHMERE
WASTE WATER TREATMENT FACILITY
2 RIVERFRONT DRIVE

OPTIONS FOR P REMOVAL

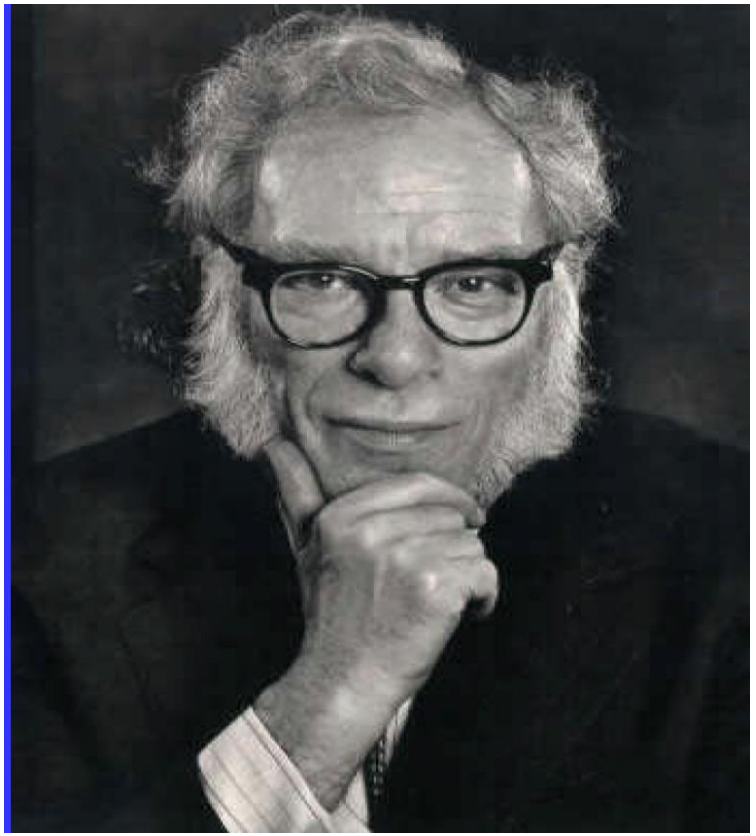
- Chemical precipitation with metal salts
- Enhanced biological phosphorus removal (EBPR) process
- EBPR + Chemical precipitation with metal salts

BENEFITS OF EBPR VS. CHEMICAL USE

- EBPR is a more sustainable process with reduced energy consumption and reduced greenhouse gas production (both on-site and off-site)
- The use of EBPR makes P recovery possible while P removed by chemical precipitation is for all practical purposes not recoverable.

PHOSPHORUS USE AND RECOVERY

"We may be able to substitute nuclear power for coal power, and plastics for wood, and yeast for meat, and friendliness for isolation, but for phosphorus there is neither substitute nor replacement."



Isaac Asimov

DESIGN OBJECTIVES

- Maximize the use of EBPR to minimize the use of chemicals for P removal
- Design to take advantage of high COD industrial wastewater to improve biological P removal and to accommodate variable loads using flow equalization
- Attenuate high storm flows with equalizing to minimize treatment train size
- Maximize reliability and minimize operational complexity for existing City operations staff

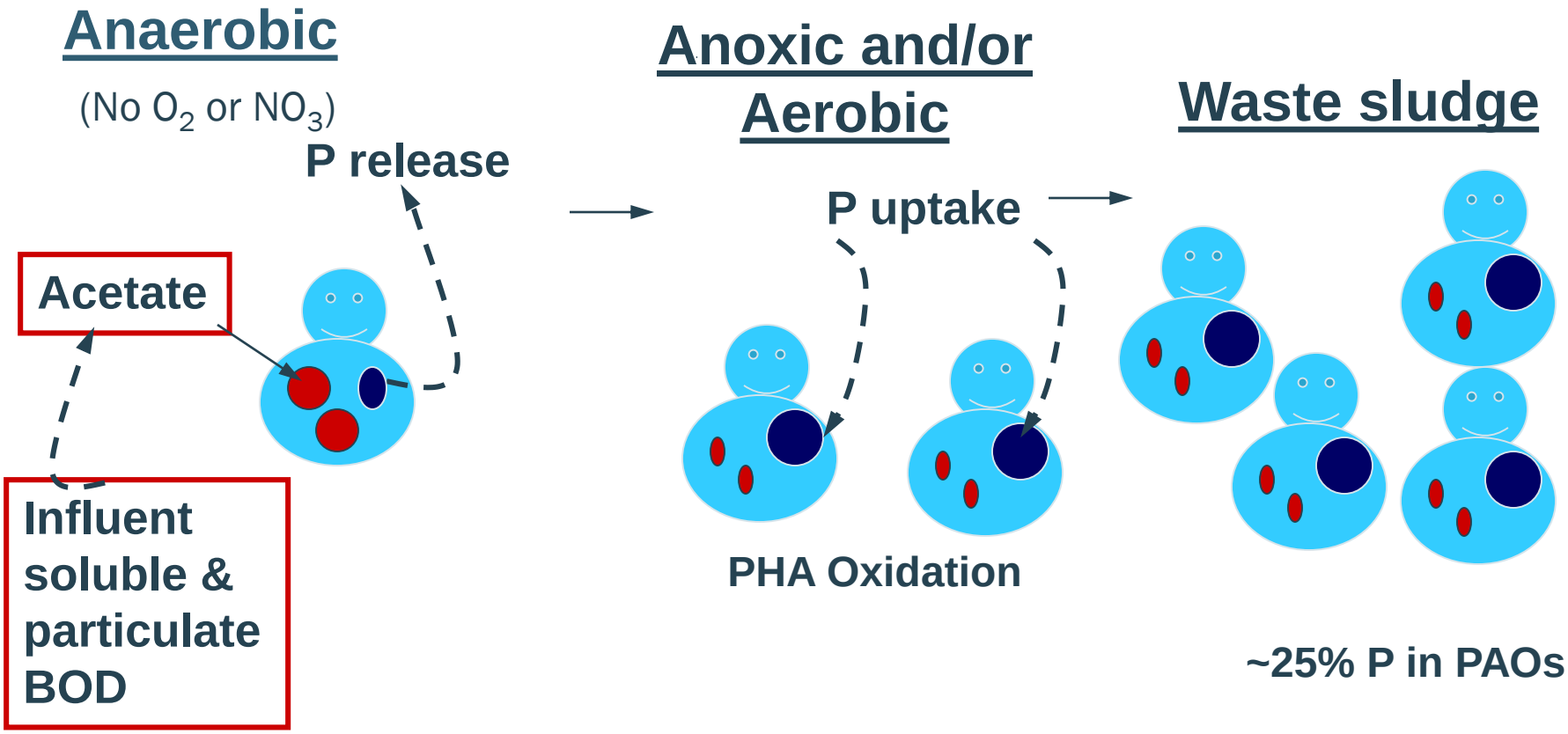
KEY ELEMENT OF THE EBPR PROCESS

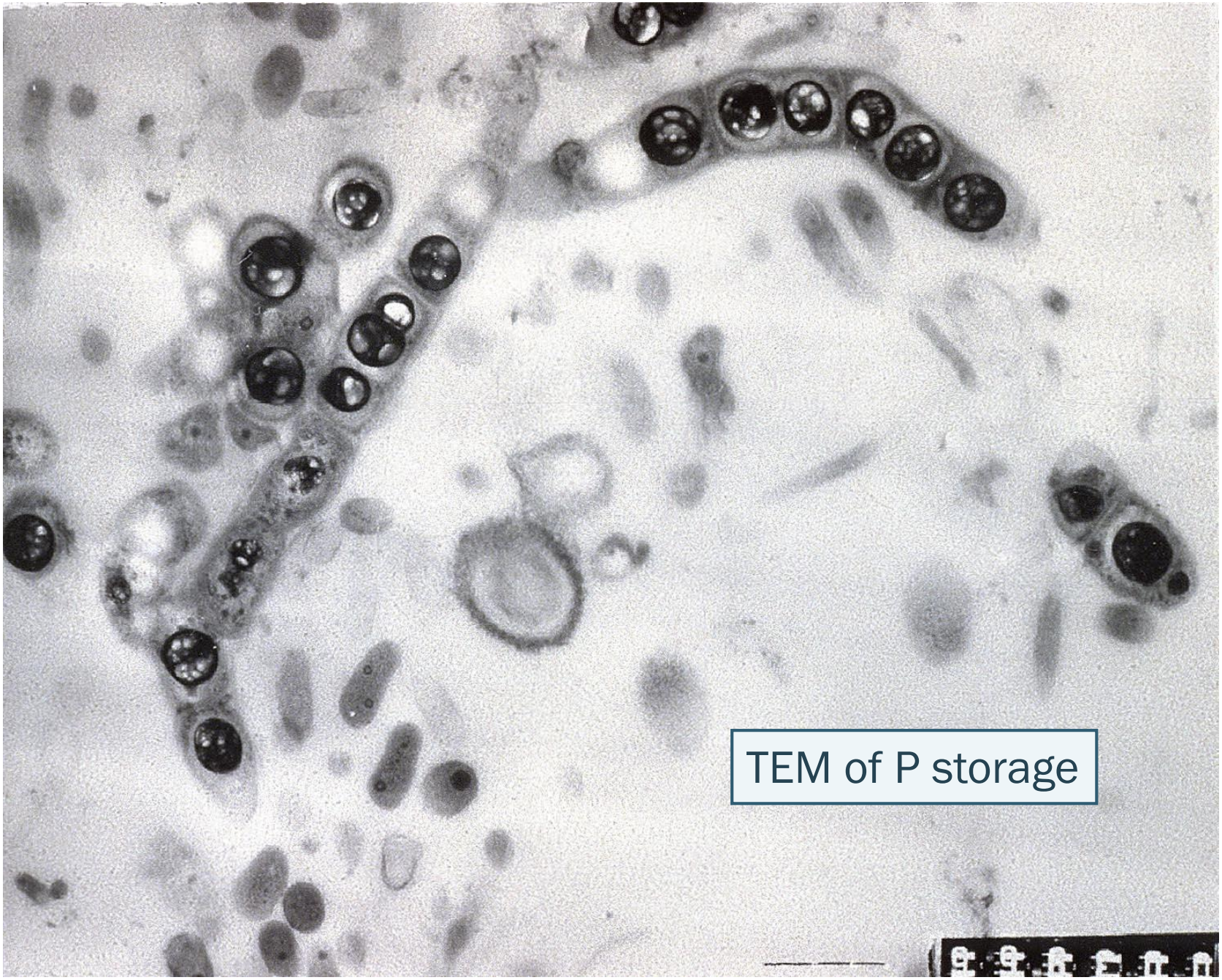
- P release in anaerobic zone
  - 20 – 30 mg/L P is common
  - Soluble COD removed in anaerobic zone but no oxidation is occurring
- P uptake in aerobic zone
- Nitrate to anaerobic zone decreases P removal performance
- A group of bacteria called phosphorus accumulating organisms (PAOs) make EBPR possible

PHOSPHORUS ACCUMULATING ORGANISMS

- P content of "average" bug
  - 1.5 to 2.0 percent
- P content of PAOs
  - 20 to 30 percent
- Phosphorus content of waste sludge
  - Without PAOs 1.0 to 1.5 %
  - With PAOs 4.0 to 6.0 %

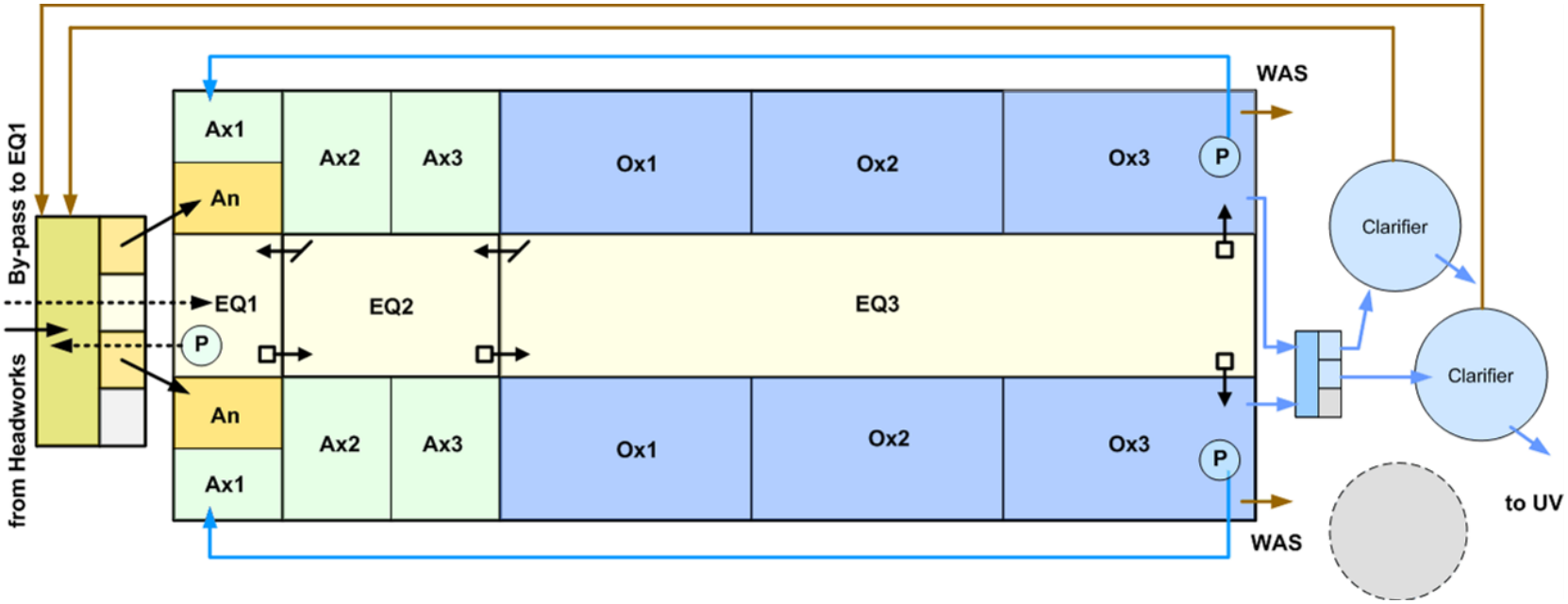
THE BASICS OF EBPR




TEM of P storage

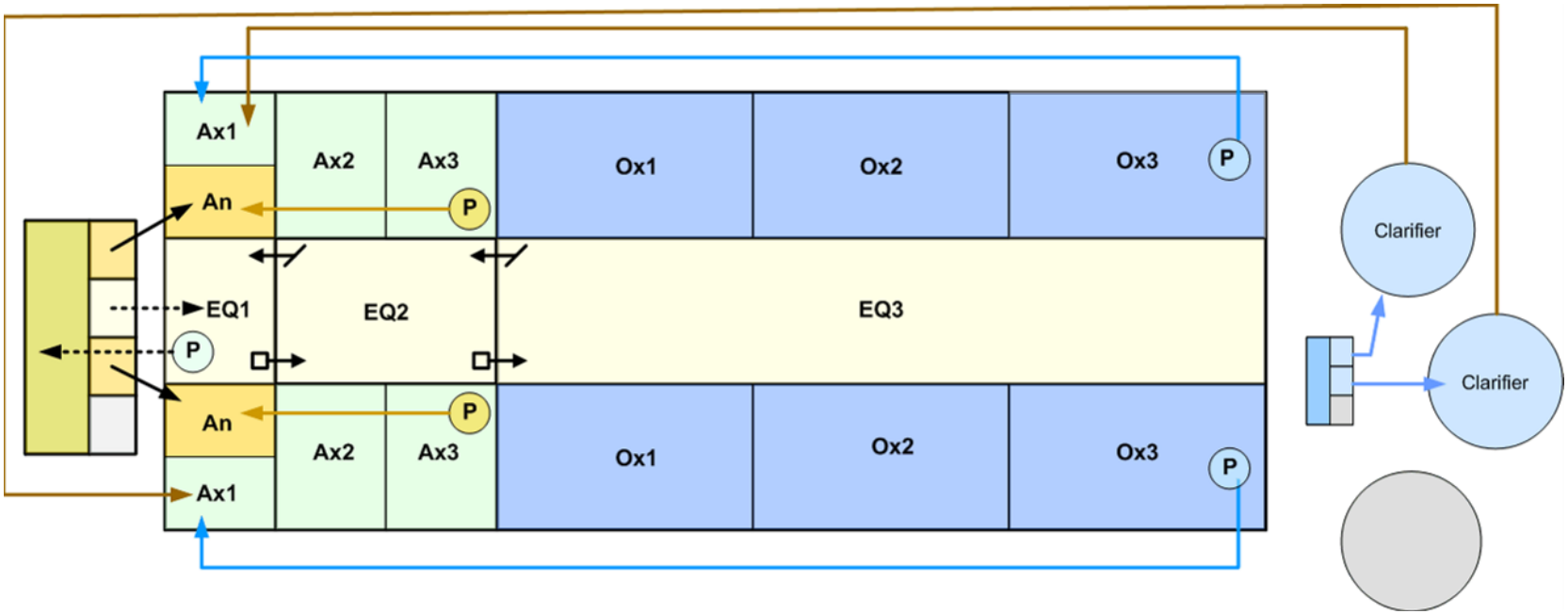
CASHMERE WWTF – EBPR PROCESS LAYOUT

A conventional continuous flow EBPR using a modified form of the Bardenpho process.

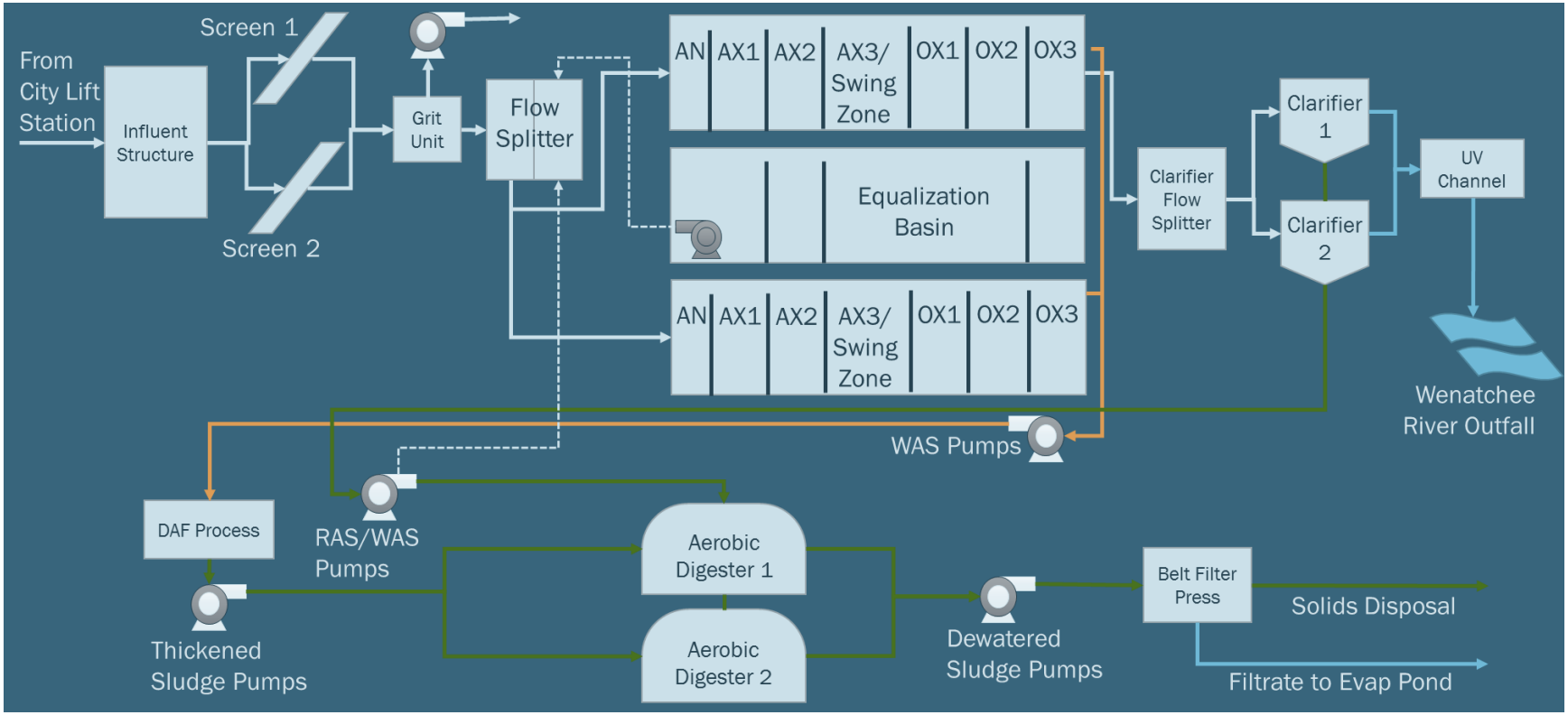


CASHMERE WWTF – ALTERNATIVE EBPR PROCESS LAYOUT

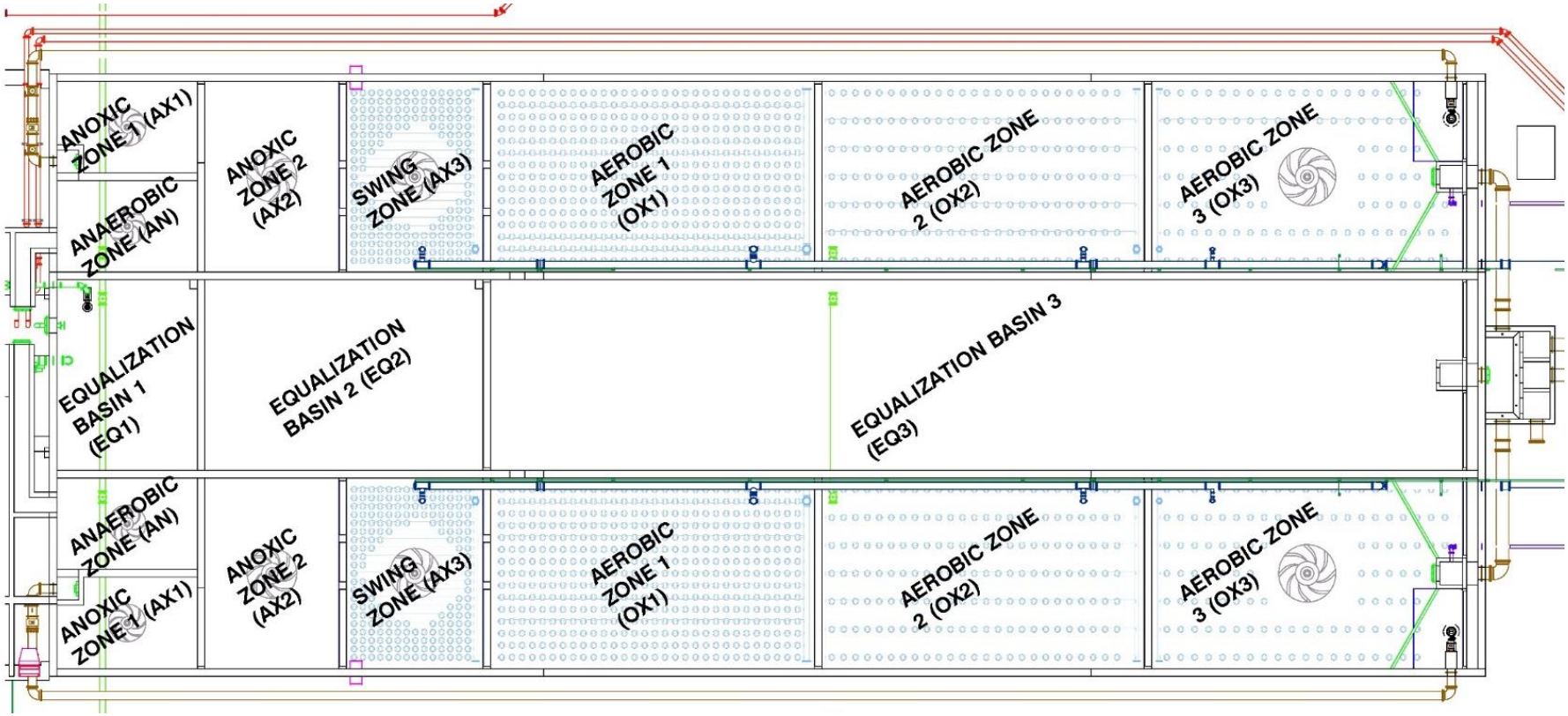
A conventional continuous flow EBPR using the UCT process configuration.



OVERALL PROCESS SCHEMATIC



EBPR AERATION BASIN DESIGN ELEMENTS



SWING ZONE

Operational Flexibility for Varying Loads

- 3rd anoxic zone is a “swing” zone – can either be anoxic or aerobic

Swing zone can:

- Operate as aerobic during periods of high loads
- Operate as aerobic if low nutrients
- Operate as anoxic if enough nitrogen

3-STAGE ANOXIC AND AEROBIC ZONES

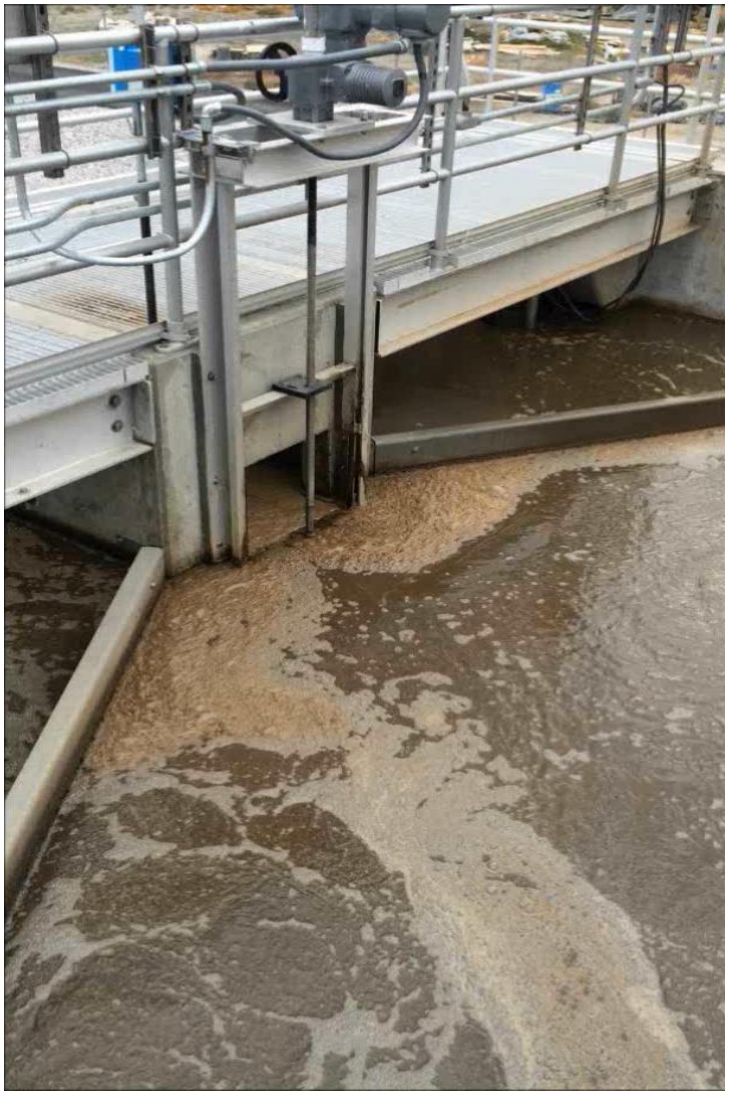
3RD AEROBIC ZONE

3rd aerobic zone has a mixer to allow for greater turndown of air during low demand period (energy savings and reduce O2 in recycle)

SURFACE WASTING FROM 3RD OXIC ZONE

Waste Activated Sludge Systems (WAS)

- Primary system is a surface waste system
  - Removes waste activate sludge from surface of the activated sludge basins
  - Minimize Filamentous growth in ASB's
- Secondary location removes it from the bottom of the clarifier
- Current Operations uses both locations
- SRT range of 9 – 15 days

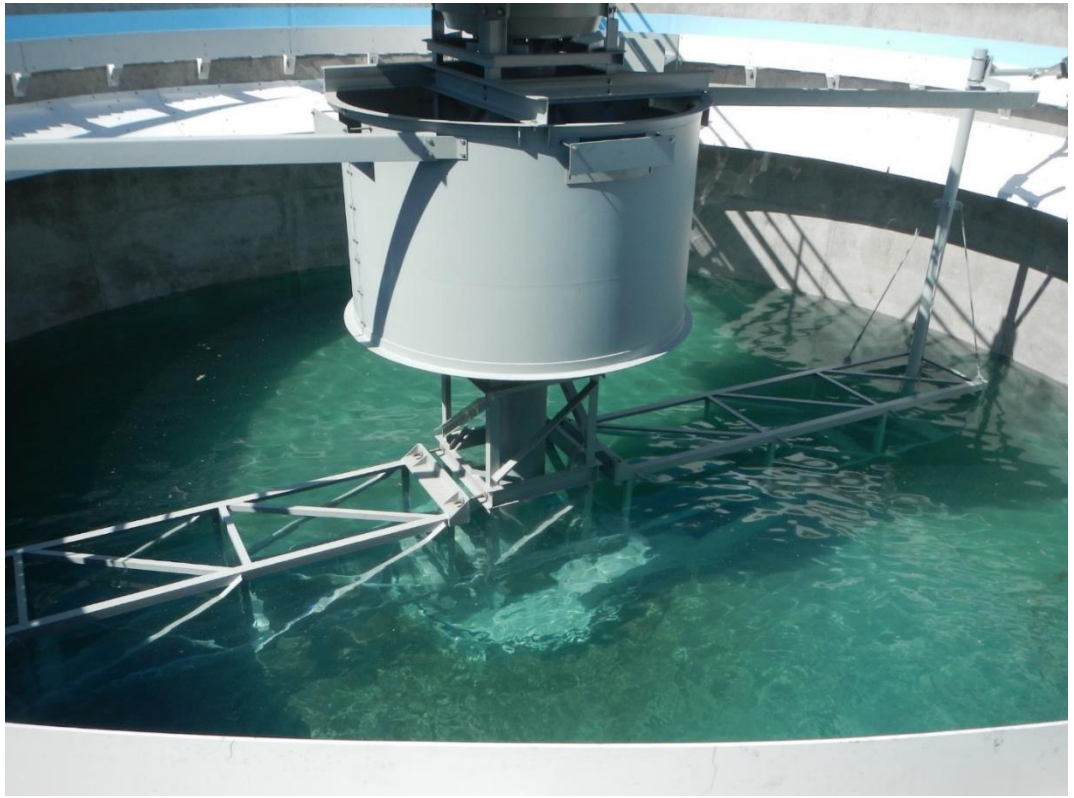


DISSOLVE AIR FLOTATION THICKENER

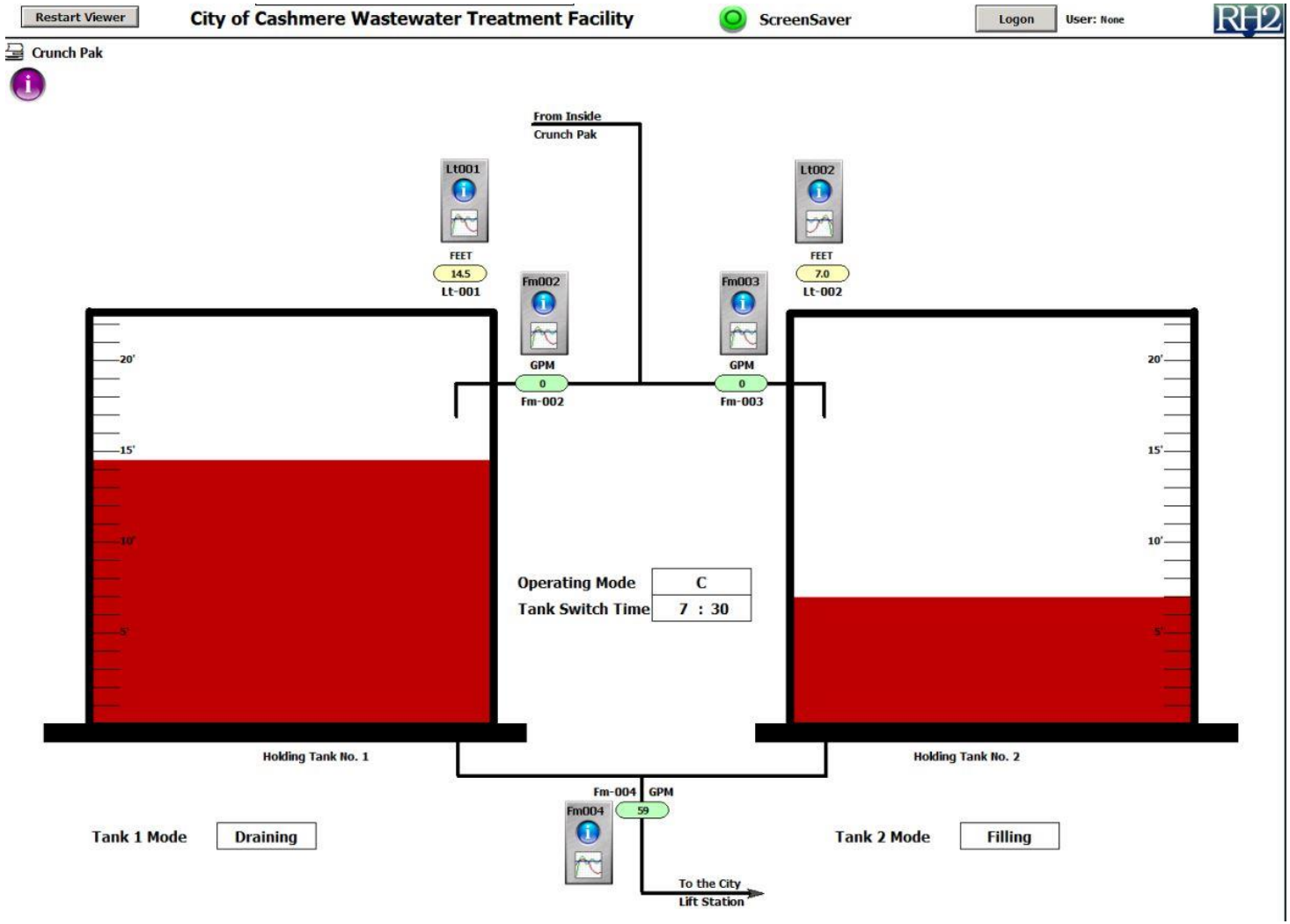
- Operates 24/7
- Thickens WAS prior to the digester

FINAL CLARIFIERS

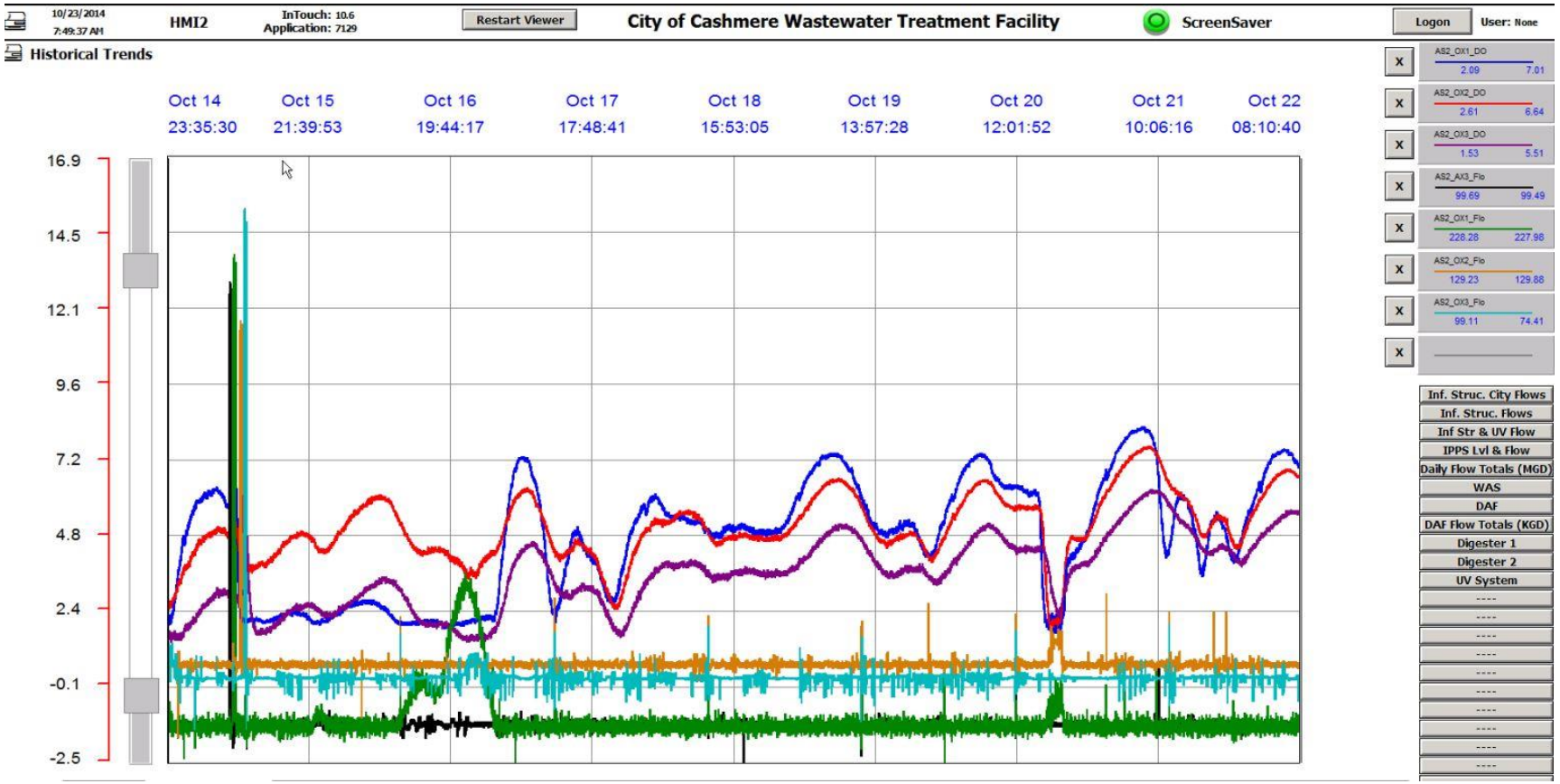
- Two Clarifiers, each with 1.3 MGD capacity
- Planning for 3rd clarifier in the future
- LA-EDI energy dissipating inlet
- Stamford current density baffle
- Underflow to RAS or WAS



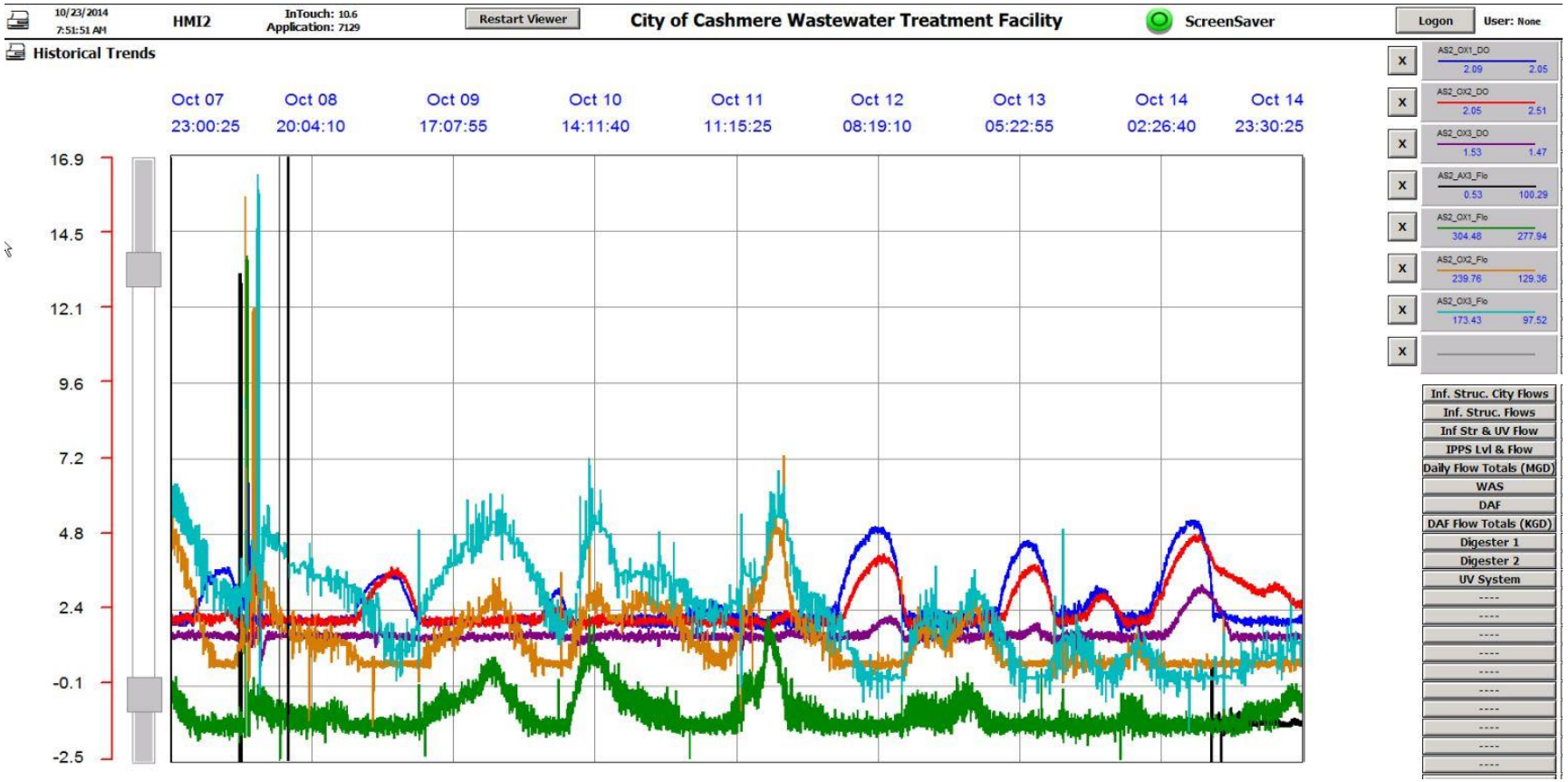
INDUSTRIAL LOADS – CRUNCH PAK EQUALIZATION



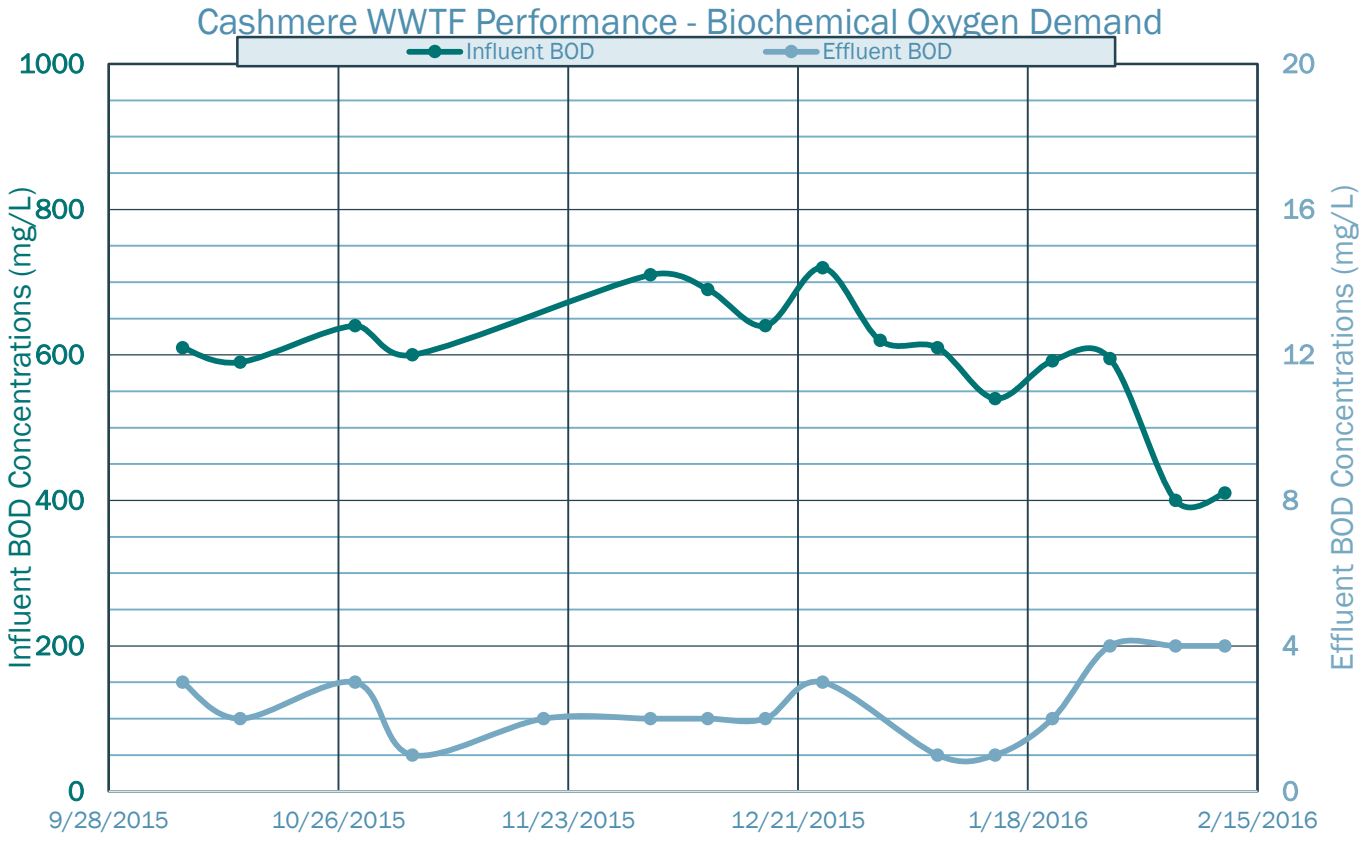
OPERATIONS DATA – DO AND AIRFLOW



OPERATIONS DATA – DO AND AIRFLOW



HOW ARE WE DOING - BOD?



BOD

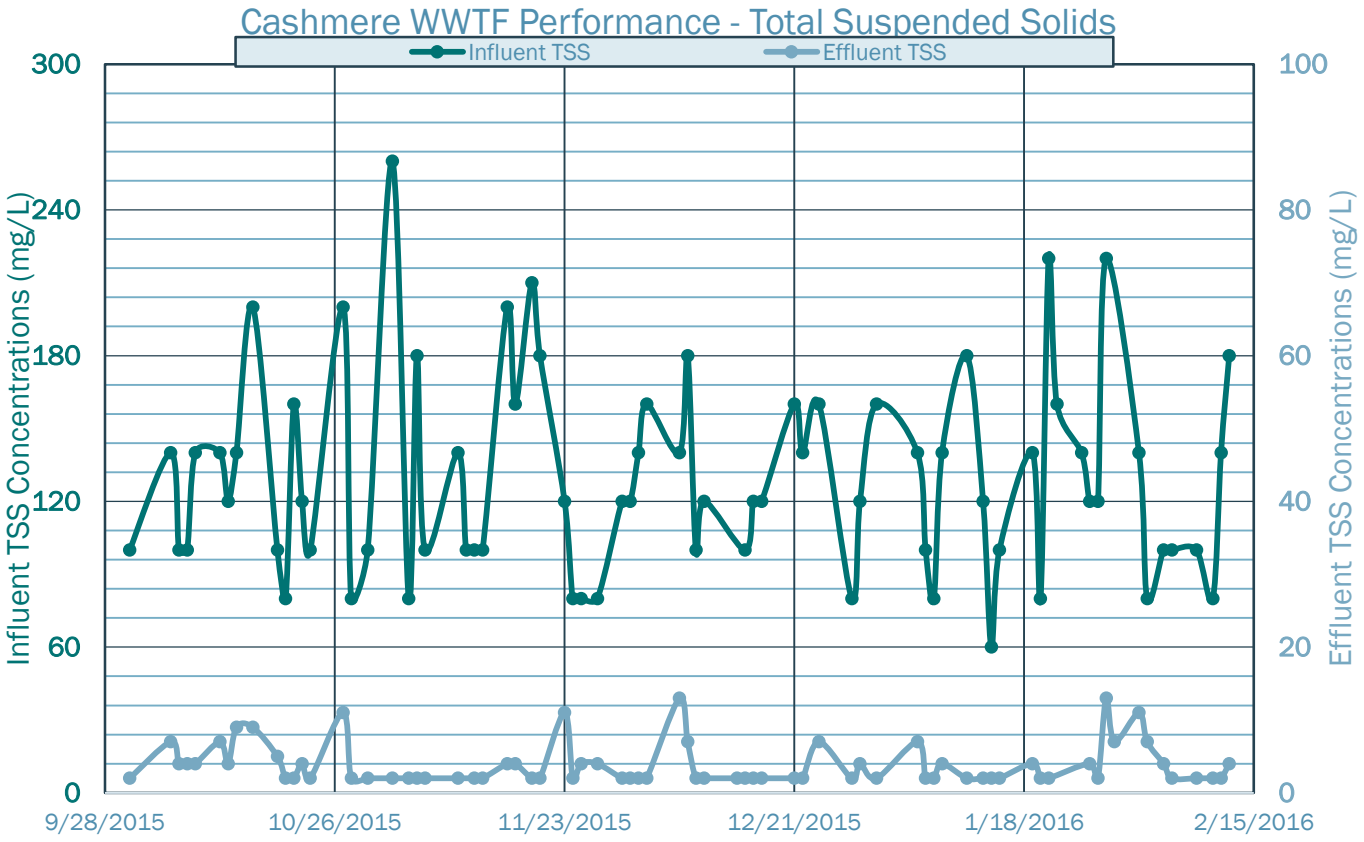
(10/1/15 through 2/10/15)

Influent BOD
- Avg: 611 mg/L

Effluent BOD
- Avg: 2.3 mg/L

CrunchPak BOD:
- Avg: 1745 mg/L

HOW ARE WE DOING - TSS?



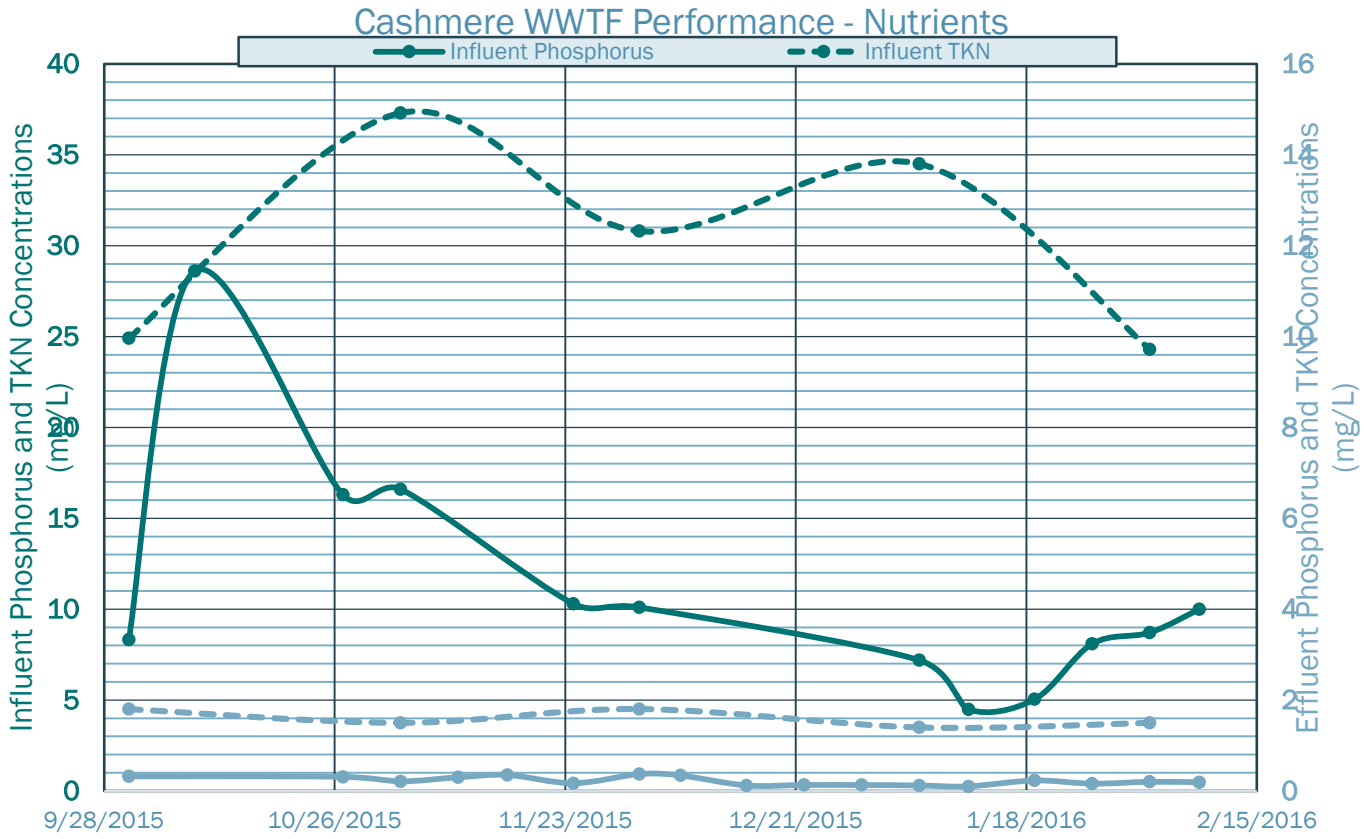
Total Suspended Solids

(10/1/15 through 2/10/15)

Influent
- Avg: 128 mg/L
- Min: 60 mg/L
- Max: 260 mg/L

Effluent
- Avg: 3.8 mg/L
- Min: 2.0 mg/L
- Max: 13.0 mg/L

HOW ARE WE DOING - NUTRIENTS?



Nutrients

(10/1/15 through 2/10/15)

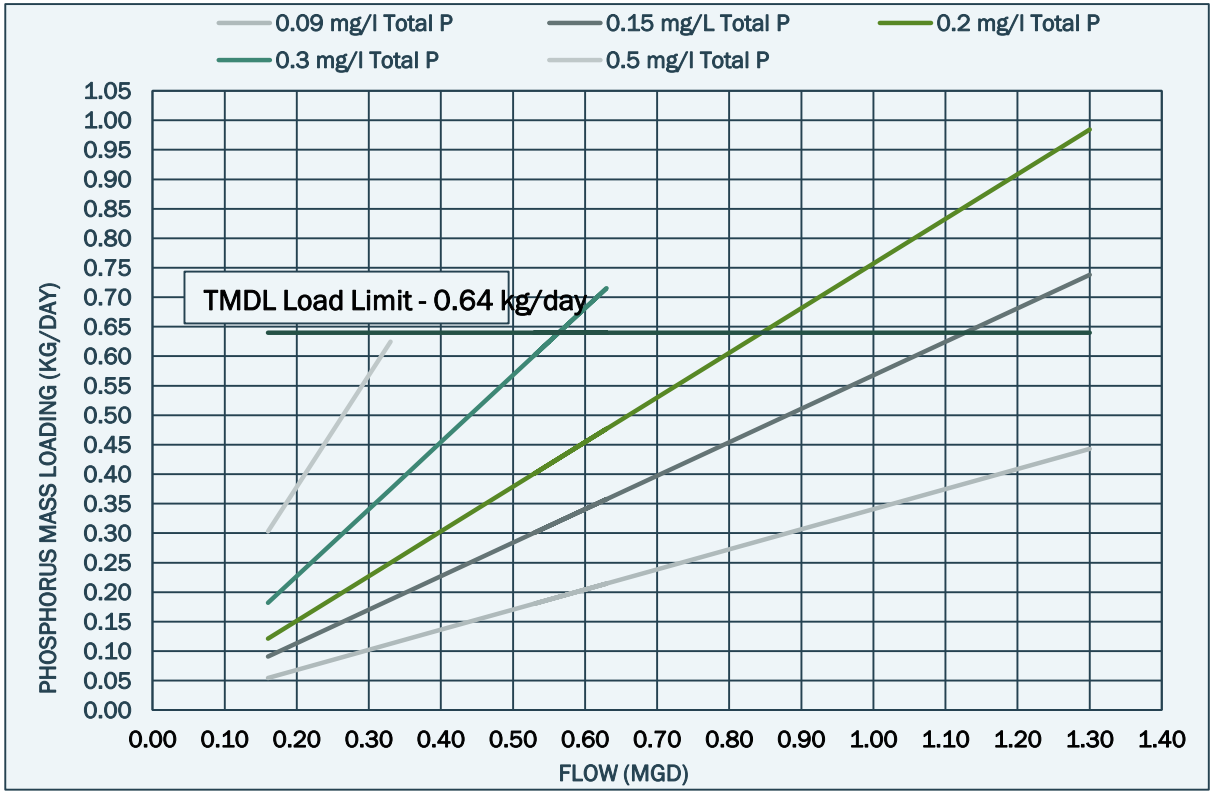
Influent

- Avg. Total P: 11 mg/L
- Avg. TKN: 30 mg/L

Effluent

- Avg. Total P: 0.2 mg/L
- Avg. TKN: 1.6 mg/L

HOW ARE WE DOING - TMDL?



Phosphorus TMDL

(10/1/15 through 2/10/15)

Avg. Daily Flow 0.37 MGD

Avg. Effluent Total P: 0.20 mg/L

Avg. Daily Total P: 0.28 kg/day

TMDL Load Limit: 0.64 kg/day

FINAL STEP – TERTIARY TREATMENT FOR PHOSPHORUS REMOVAL

- At conclusion of construction, change orders were only $38k
- Approximately $800,000 remaining in funds
- City decided to accelerate the tertiary treatment step

TERTIARY TREATMENT

- RH2 evaluated several tertiary treatment processes
- Cloth Media Filtration was selected as the preferred alternative

Table 5
Equipment and Total Constructed Cost for the Phase I Phosphorus Removal Alternatives

	Process	Manufacturer/ Equipment	Equipment Proposal	Total Constructed Cost
1	High Rate Ballasted Clarification	Parkson CoMag	$743,000	$3,400,000
2	Cloth Media Filtration	Aqua-Aerobic AquaDisk	$190,000	$2,100,000
3a	Continuous Backwash Granular Media Filter	Blue Water Technologies	$375,000	$2,000,000
3b	Continuous Backwash Granular Media Filter	Parkson Dynasand	$1,067,000	$4,100,000
4	Conventional Granular Media Filtration	IDI Aquazur	$440,000	$3,000,000
5	Immersed Membranes	GE Z-pak	$1,390,000	$6,500,000

CLOTH MEDIA FILTRATION PILOT STUDY

- Pilot trailer was onsite in February and March of 2015
- The pilot demonstrated scalable filtration of Cashmere's WWTP effluent
- Pilot runs included: no chemical, alum at several dosage points, and ferric chloride.

CLOSING – QUESTIONS?

RECENT PERFORMANCE DATA

Date	TKN	Total Ammonia	Total Phos	soluble Phos
	mg/L	*mg/L*	*mg/L*	*mg/L*
	End UV	End UV	End UV	End UV
Aug 4	2.9	1.1	0.23	0.13
Aug 5	6.0	3.91	1.03	0.82
Aug 6	2.5	0.42	0.90	0.71
Aug 10	1.8	0.156	0.17	<0.07
Aug 12	4.3	2.77	0.22	0.13
Aug 17	1.4	<0.07	0.19	0.09
Aug 25	1.4	0.14	0.13	<0.07
Aug 26	1.8	0.28	0.16	<0.07