

Tapping Into MBR - The Hamby WRF Indirect Potable Reuse Project

Joshua Berryhill, P.E., Associate Vice President and Technical Director
Enprotec / Hibbs & Todd, Inc. (eHT)



33rd Annual WaterReuse Symposium
September 9–12, 2018 | Austin, Texas

City of Abilene's Water Utilities

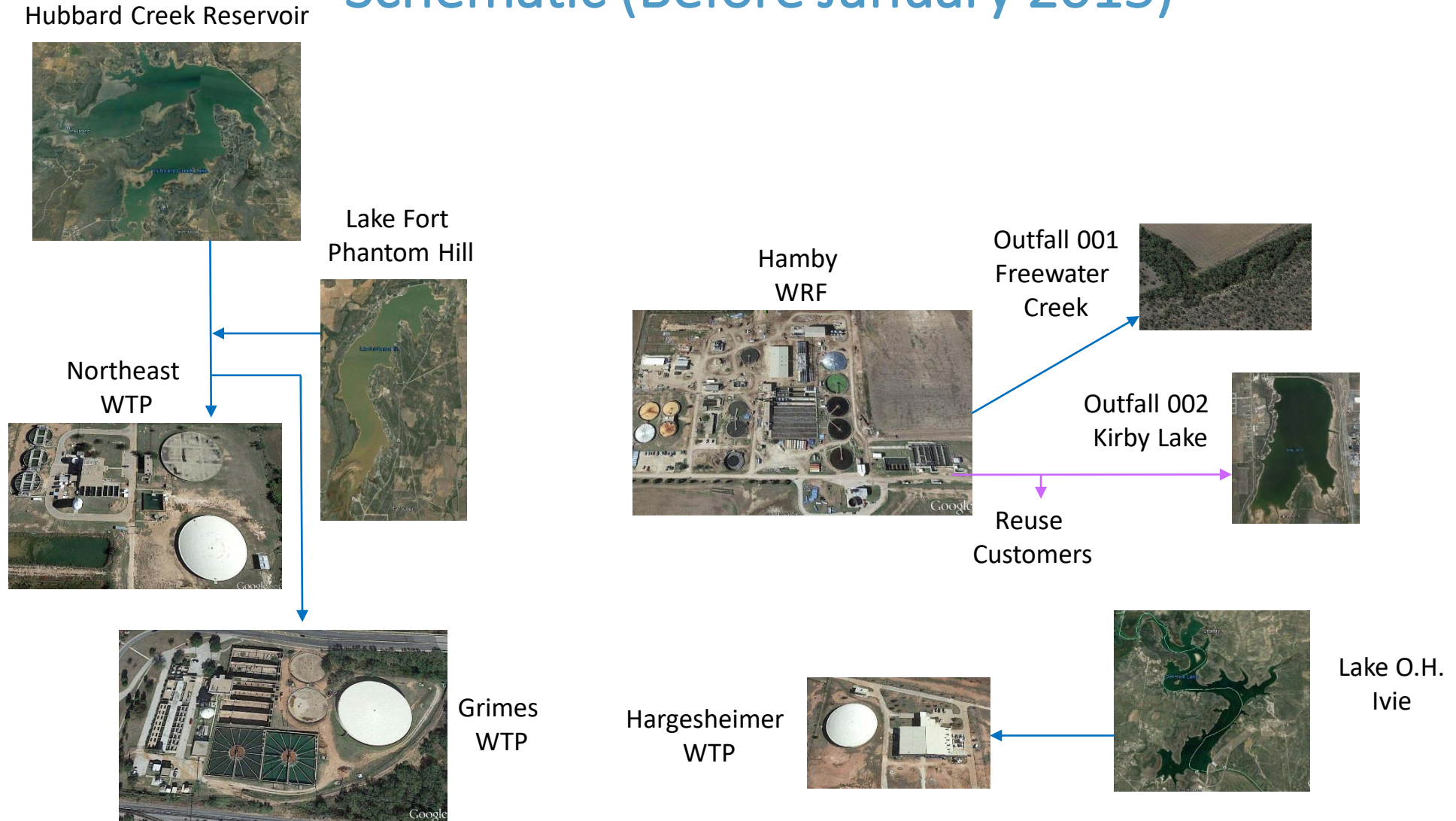
- Abilene serves treated potable water to approximately 125,000 retail users and an additional 32,000 wholesale users.
- Abilene has approximately 40,000 retail connections and connections with 14 wholesale water systems.
- Abilene supplies reclaimed water to 25 contracted reclaimed customers citywide and an additional 10 irrigators around the Hamby Water Reclamation Facility.

City of Abilene's Water Sources

- Abilene diverts approximately 24,500 ac-ft/yr of surface water from its three surface water sources (about 22 MGD)
 - Delivers 23,700 ac-ft/yr to its retail and wholesale customers (about 21 MGD)
- Abilene's retail customers use about 86% (about 18 MGD) of the total treated water that is produced from the water production system while its wholesale customers use about 14% (about 3 MGD)

City of Abilene

Water Production and Wastewater Reuse Schematic (Before January 2015)



City of Abilene's Water Sources

- The recent historic drought severely affected Abilene's raw water sources.

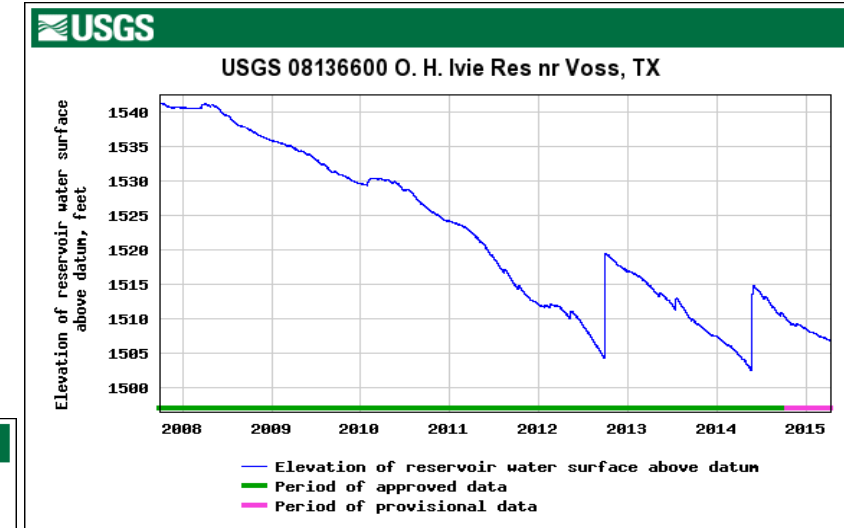
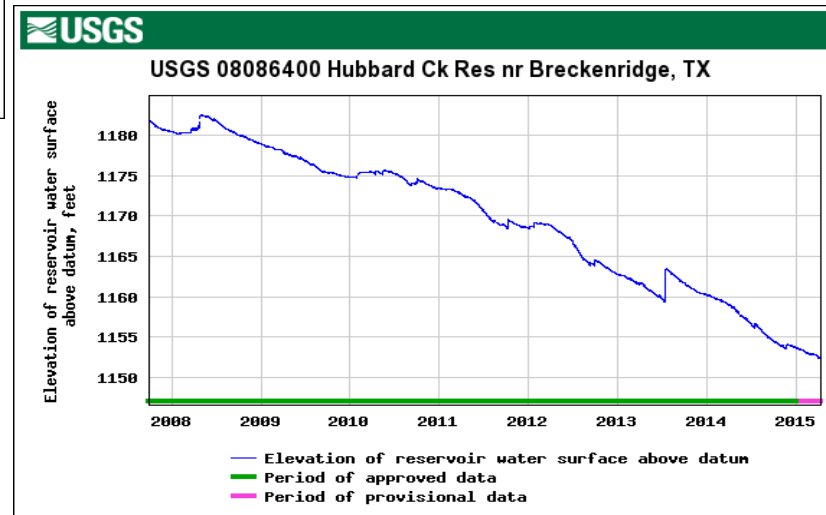


City of Abilene's Water Sources

Hubbard Creek Lake

Full pool: 1,183.0 ft msl

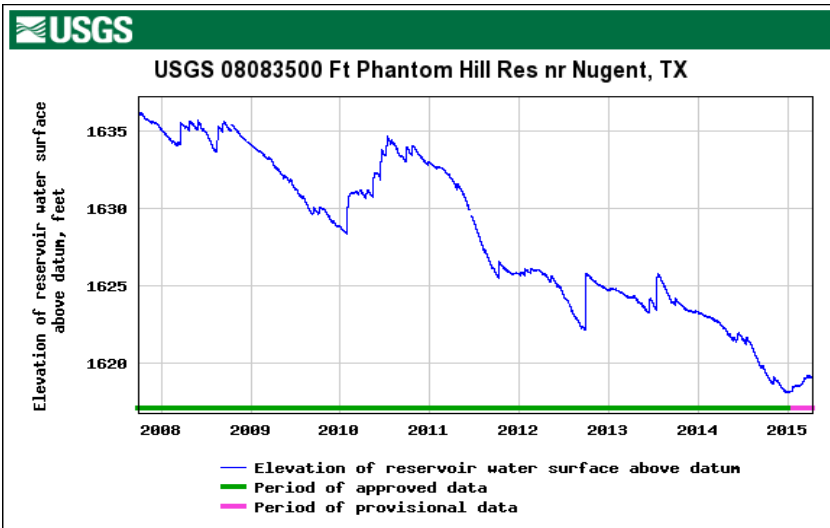
2015: - 30.73 ft



Lake O.H. Ivie

Full pool: 1,1551.5 ft msl

2015: - 44.81 ft



Lake Fort Phantom Hill

Full pool: 1,635.9 ft msl

2015: - 16.85 ft

City of Abilene

Water Production and Wastewater Reuse Schematic (After January 2015)

Hubbard Creek Reservoir



Northeast WTP



Grimes WTP

Hargesheimer WTP



Hamby WRF



Outfall 003
Lake Fort
Phantom Hill

Outfall 001
Freewater
Creek

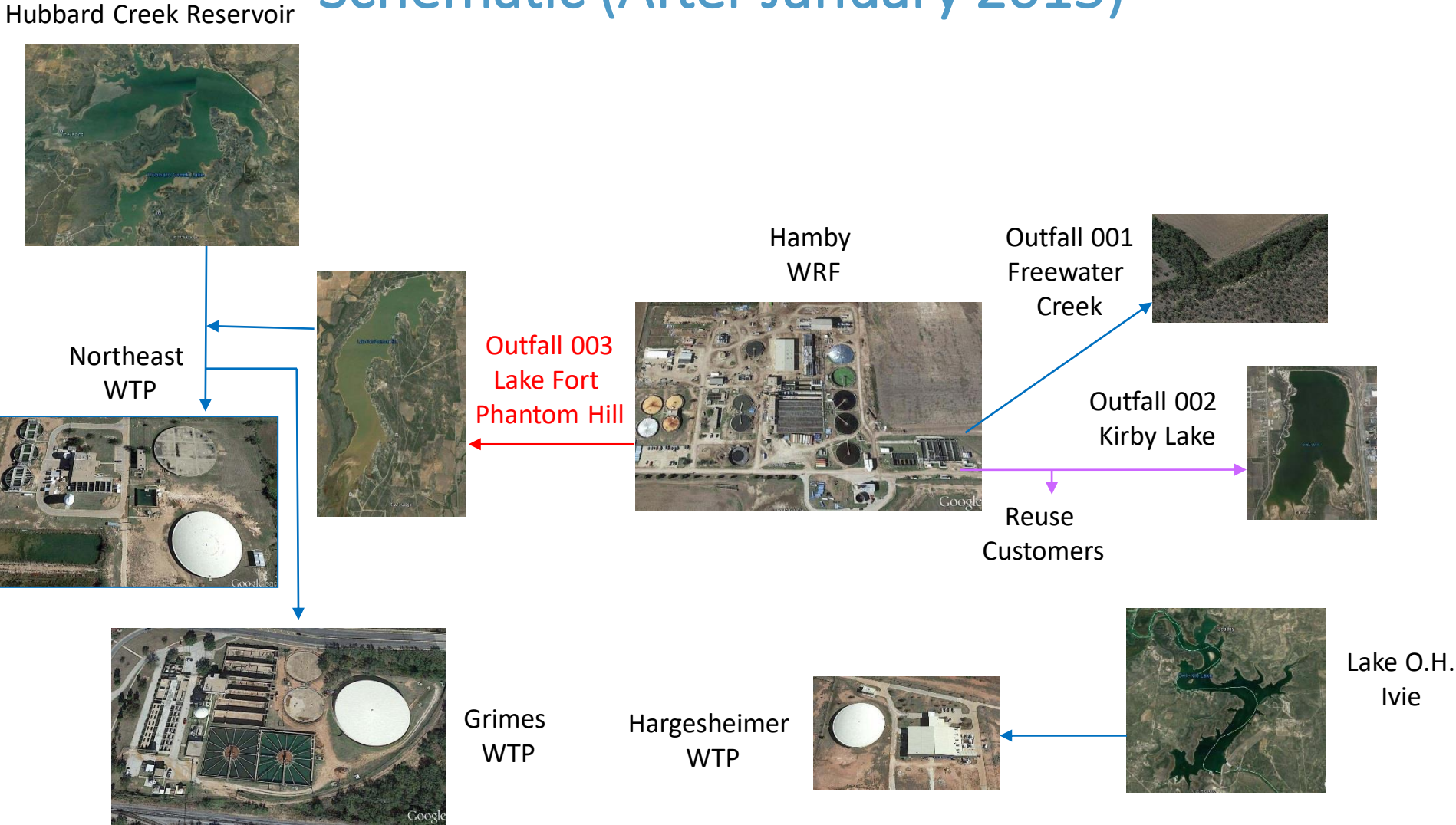


Outfall 002
Kirby Lake



Reuse
Customers

Lake O.H.
Ivie



Hamby WRF

- The Hamby WRF was constructed in the 1950s and underwent some modifications over the years but represented a first generation activated sludge facility (1970s technology).
- Effluent from the Hamby WRF was usually suitable for discharge to Freewater Creek, and for irrigation reuse, but unsuited for indirect potable reuse.



Hamby WRF (Pre-2015)



Indirect Potable Reuse

- The City of Abilene undertook a study to evaluate treatment options to address needs to:
 - Meet current and future TPDES permits (CBOD₅, TSS, ammonia, pH, DO), and to reduce phosphorus.
 - Preserve reuse water quality
 - Supplement raw water source without negatively impacting surface water quality standards
 - Remove salinity and other constituents that didn't belong in a drinking water source.

Indirect Potable Reuse

- Constituents of concern in the Hamby WRF effluent, were it to be used for indirect potable reuse included:
 - Nitrogen/Phosphorus-algae growth leads to taste and odor
 - Salinity levels and other secondary parameters
 - DBPs - TTHMs, HAA₅, Bromate, others?
 - Contaminants of Emerging Concern (CECs)

WRF Improvements

- The City of Abilene determined through its study that a viable treatment system to meet all treatment objectives would utilize:
 - BNR/MBR to meet current and future TPDES permits, to reduce phosphorus, and to provide filtration for Type I/II reuse supply
 - Reverse osmosis to remove salinity and other secondary constituents
 - Use of hollow fiber MBR to produce low SDI feedwater to the proposed RO system
 - Ozone followed by biologically active filters to break apart and remove CECs

Average and Design WRF Influent Quality for the Reuse Project

Parameter	Average Condition	Design Condition
BOD ₅ (mg/L)	199	232.8
Total Suspended Solids (TSS) (mg/L)	190	226.1
Ammonia (mg/L as N)	22.0	24.0
Total Phosphorus (TP) (mg/L as P)	5.7	7.3
Volatile Suspended Solids (VSS): TSS	0.70	0.70
Ammonia: Total Kjeldahl Nitrogen (TKN)	0.69	0.69
Ortho-Phosphate: TP	0.5	0.5

Anticipated TPDES Permit Limits and Reuse Quality Standards

Parameter	Anticipated Outfall No. 001/002 TPDES Permit Limits	Anticipated Outfall 003 TPDES Permit Limits	Current Type I Reuse Quality Standards per Reclaimed Water Rules
5-day Carbonaceous Biochemical Oxygen Demand (CBOD ₅), milligrams per liter (mg/L)	April-Sept.: 7 Oct.-March: 10	5	5
Total Suspended Solids (TSS), mg/L	15	15	None
Ammonia-Nitrogen, (NH ₃ -N), mg/L	April-Sept.: 2 Oct.-March: 3	2	None
Total Phosphorus (TP), mg/L	0.5	0.5	None
<i>Escherichia coli</i> (<i>E. coli</i>) or Fecal Coliform (Fecal) Colony Forming Units per 100 milliliters (CFU/100 mL)	<i>E. coli</i> : 126	<i>E. coli</i> : 126	Fecal: 20 (30-day geometric mean) 75 (single grab max)
Turbidity, Nephelometric Turbidity Units (NTU)	None	None	3

Treatment Goals for Advanced Treated Effluent Discharged Via Outfall No. 003

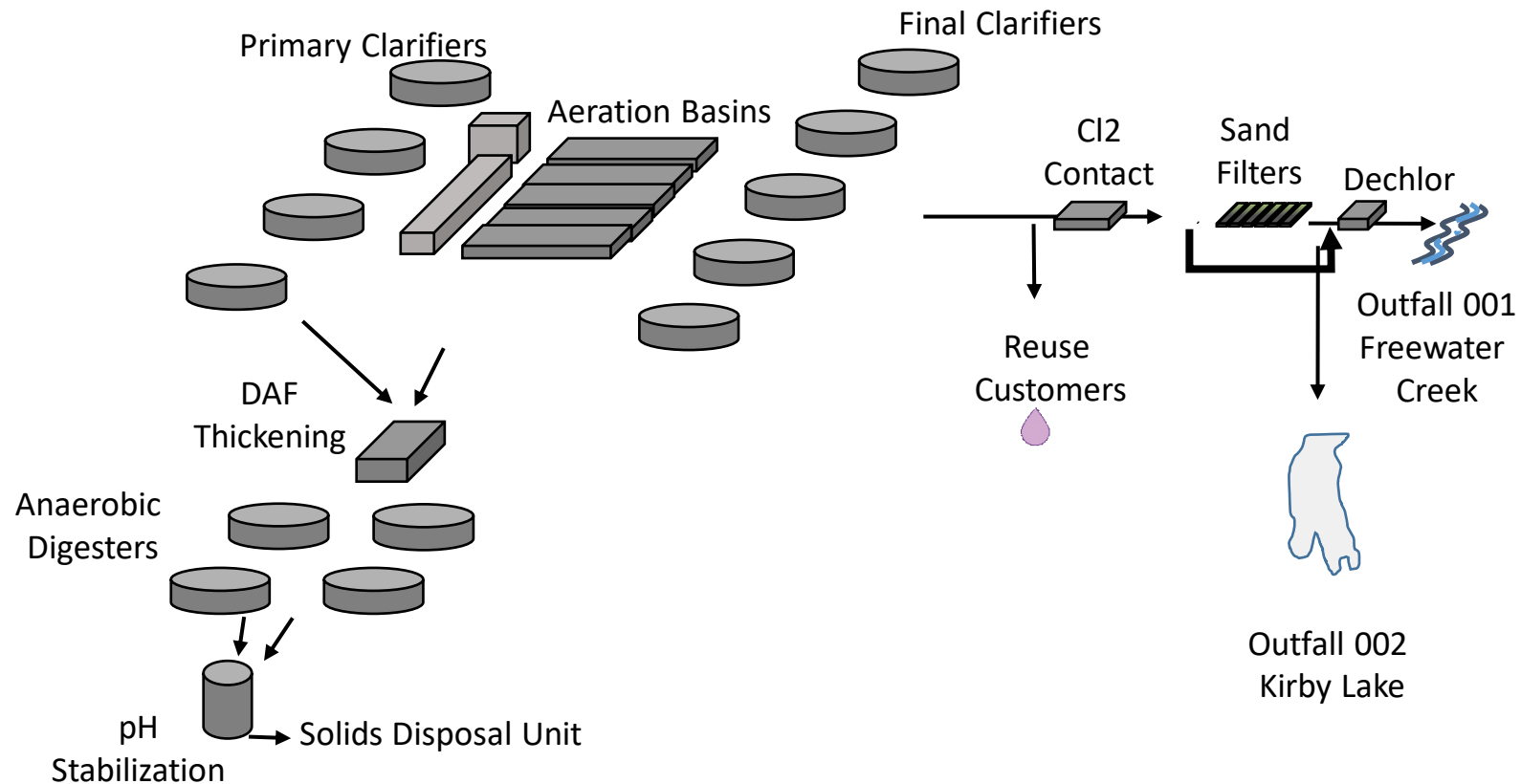
Parameter	Goal
Annual Average Flow Rate to Lake Fort Phantom Hill	7 MGD
Total Phosphorus	0.5 mg/L
TDS	375 mg/L
Chloride (as Cl ⁻)	100 mg/L
Sulfate (as SO ₄ ²⁻)	95 mg/L
Pathogen Removal/Inactivation ^b	
<i>Cryptosporidium parvum</i>	4-log
<i>Giardia lamblia</i>	4-log
Viruses	0.5-log
Contaminants of Emerging Concern (CECs)	50 - 90% Reduction

Hamby Water Reclamation Facility (During Construction)



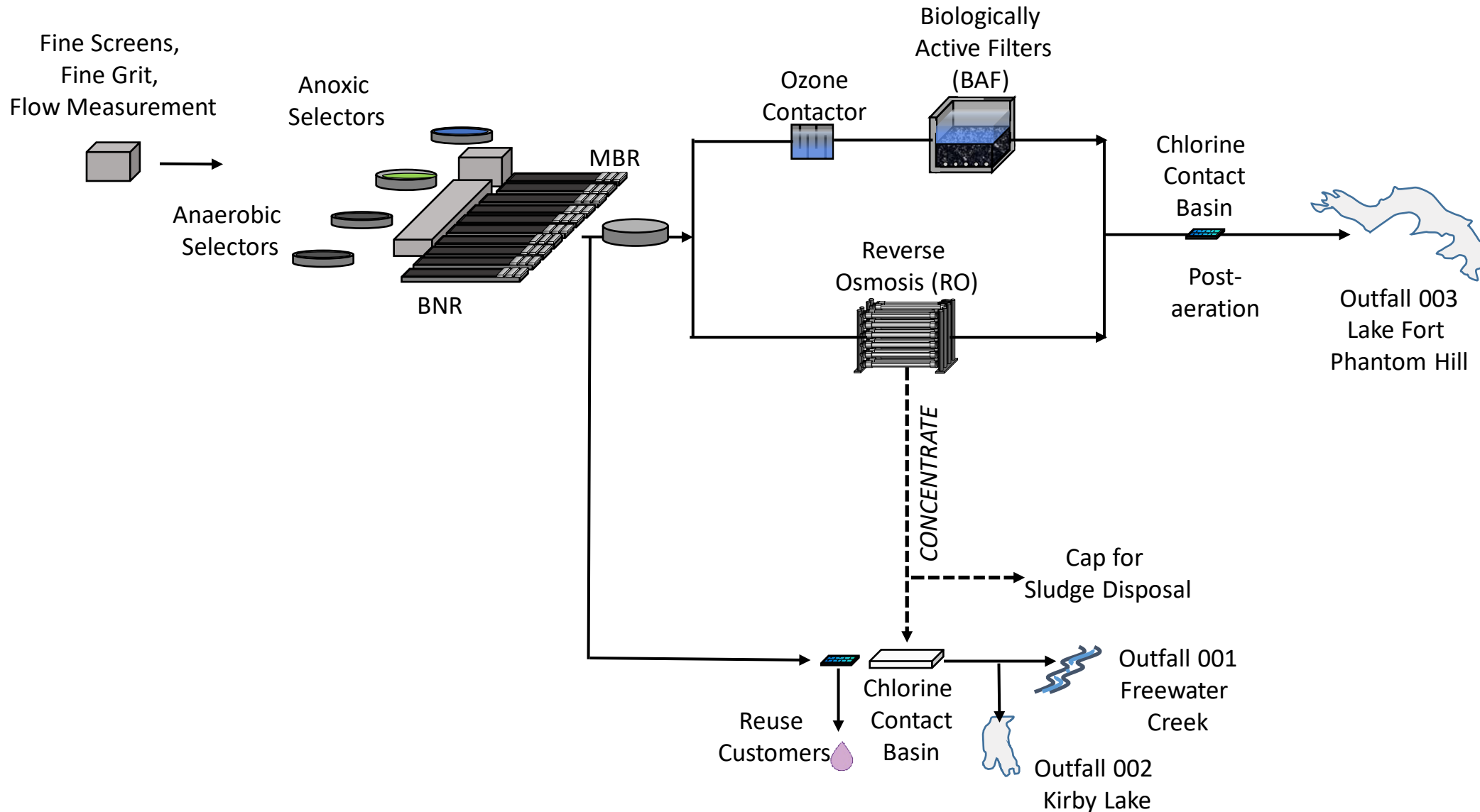
Hamby WRF

Plant Process Schematic (Prior to 2015)



Hamby WRF Improvements

Process Schematic (After January 2015)

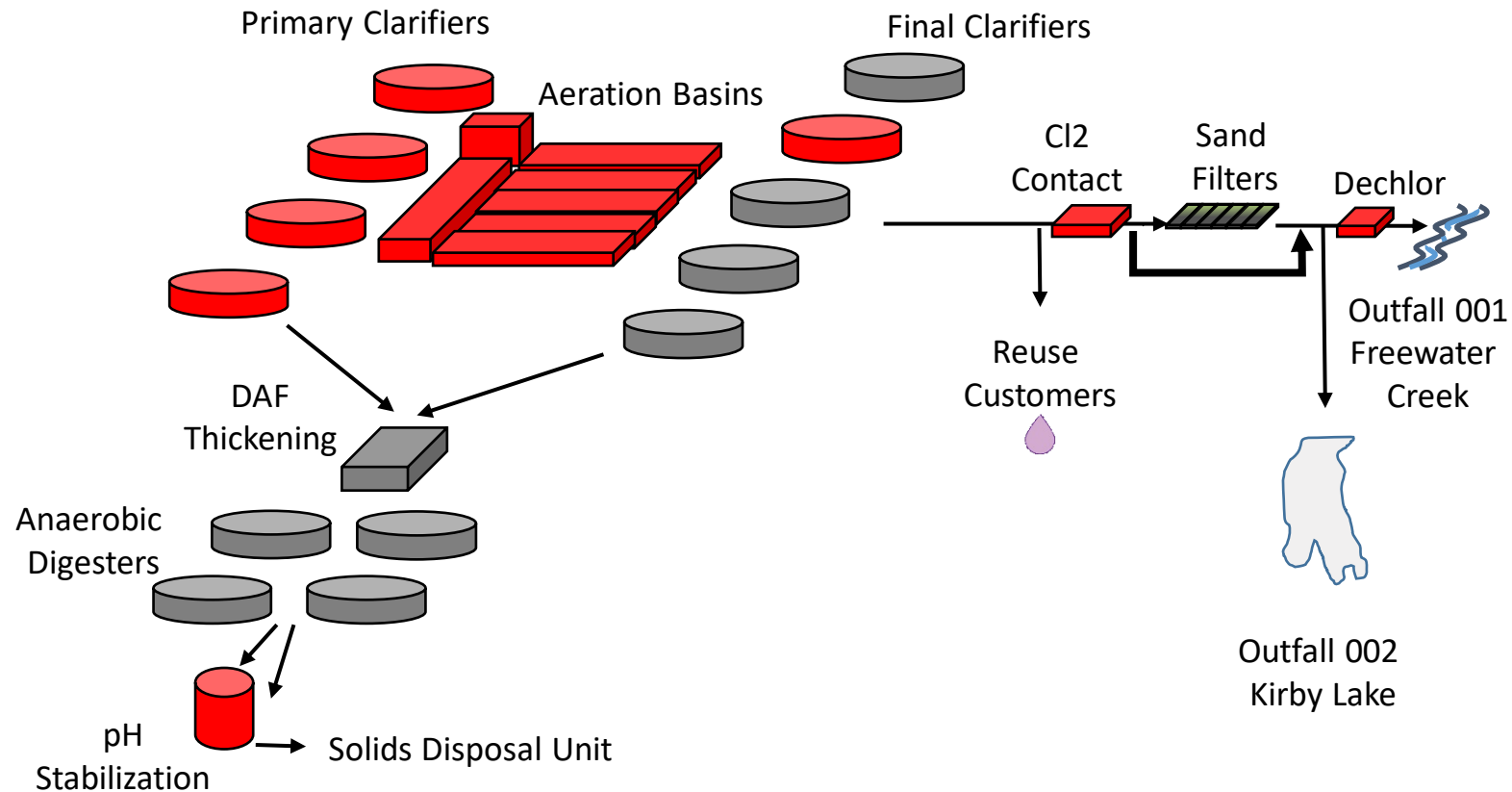


Hamby WRF

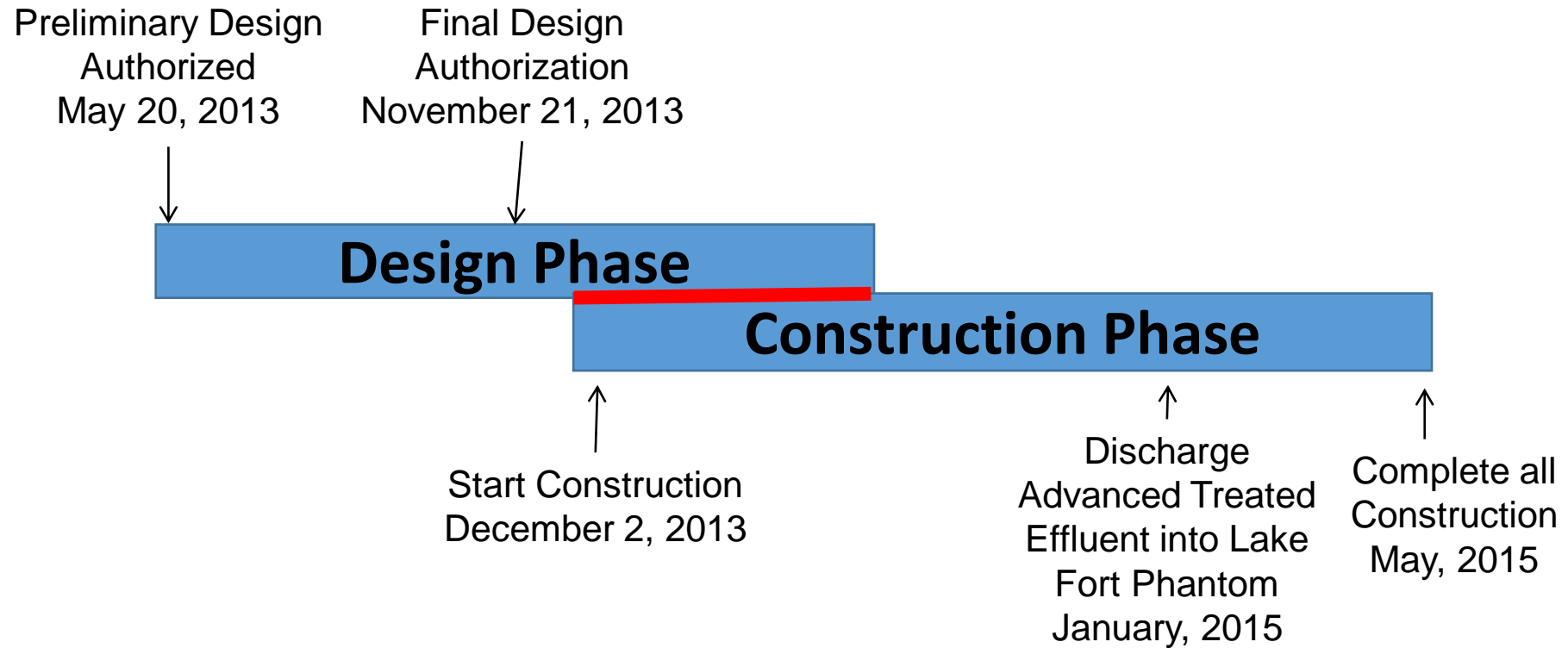
Existing Plant Process Schematic



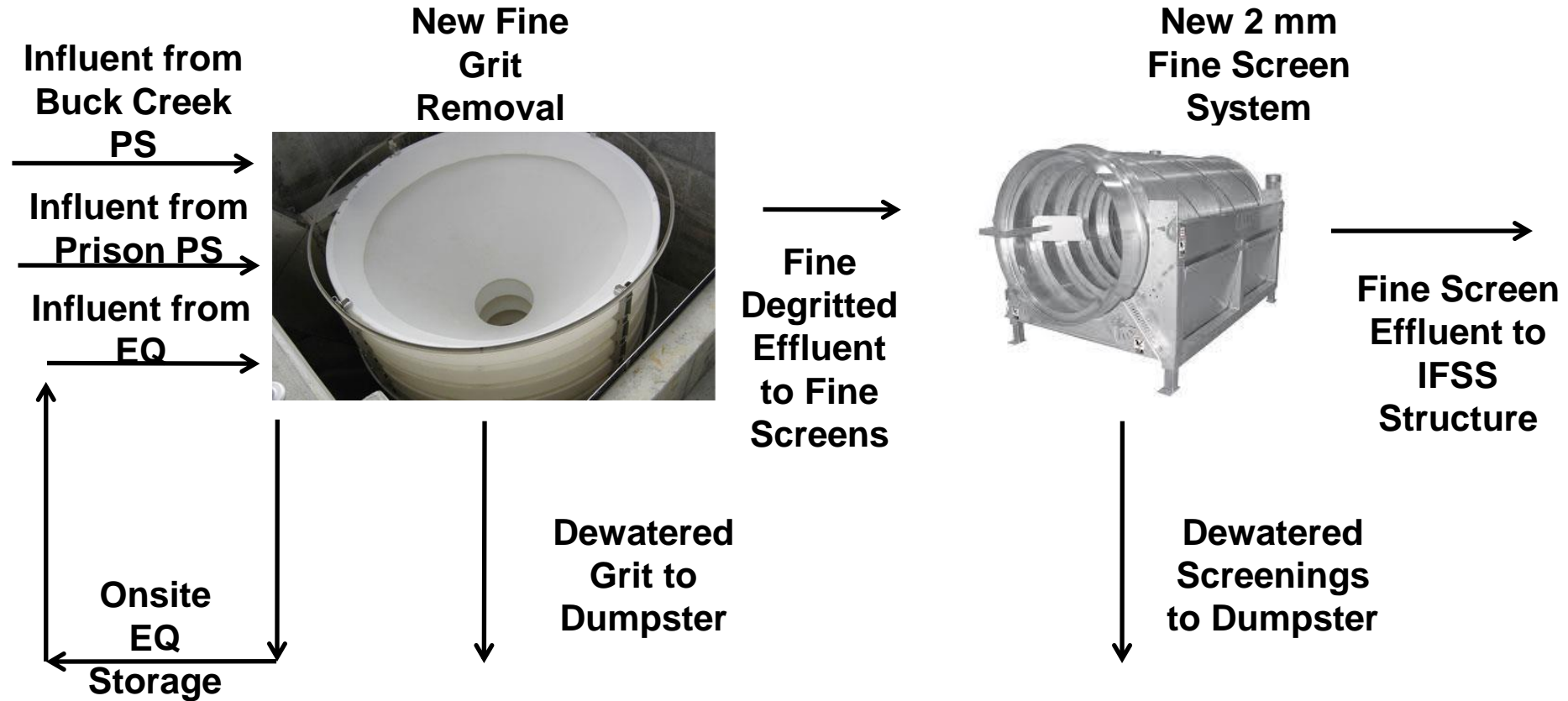
-Red indicates repurposed structures



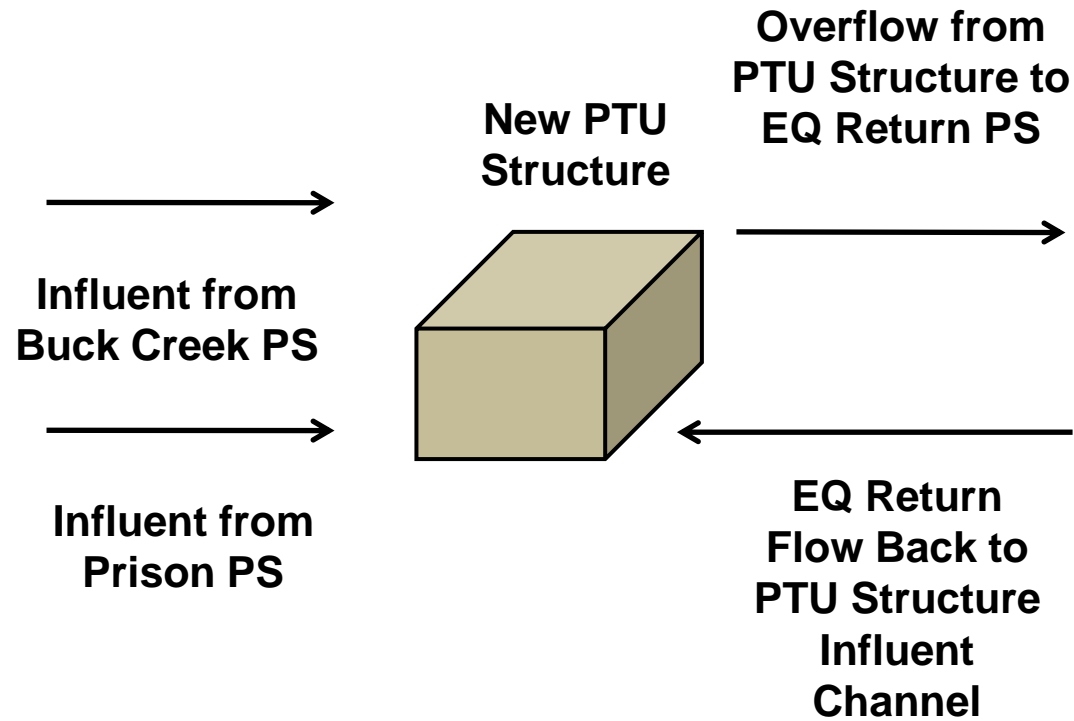
Project Timeline



Pretreatment System

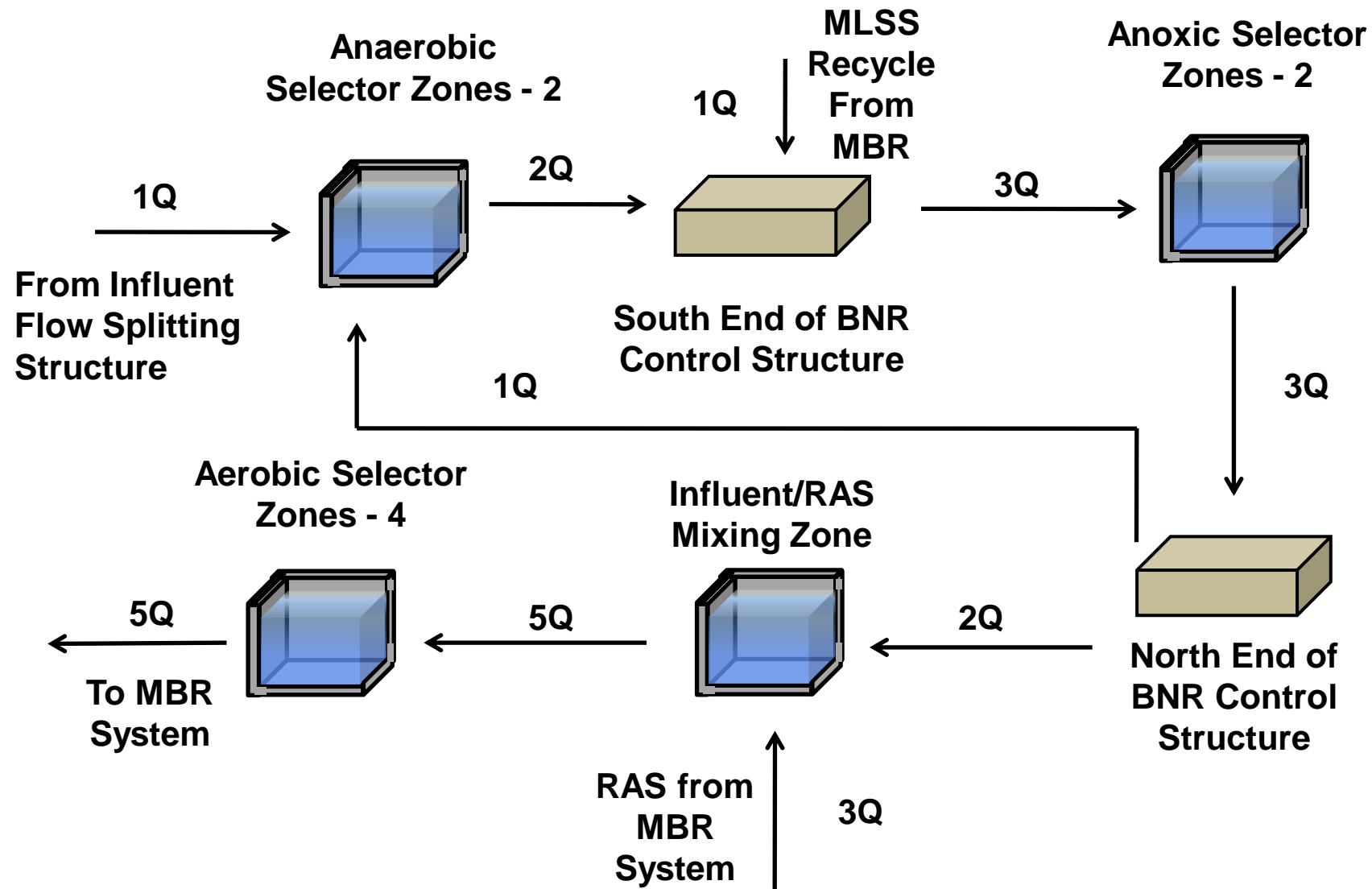


Flow Equalization System

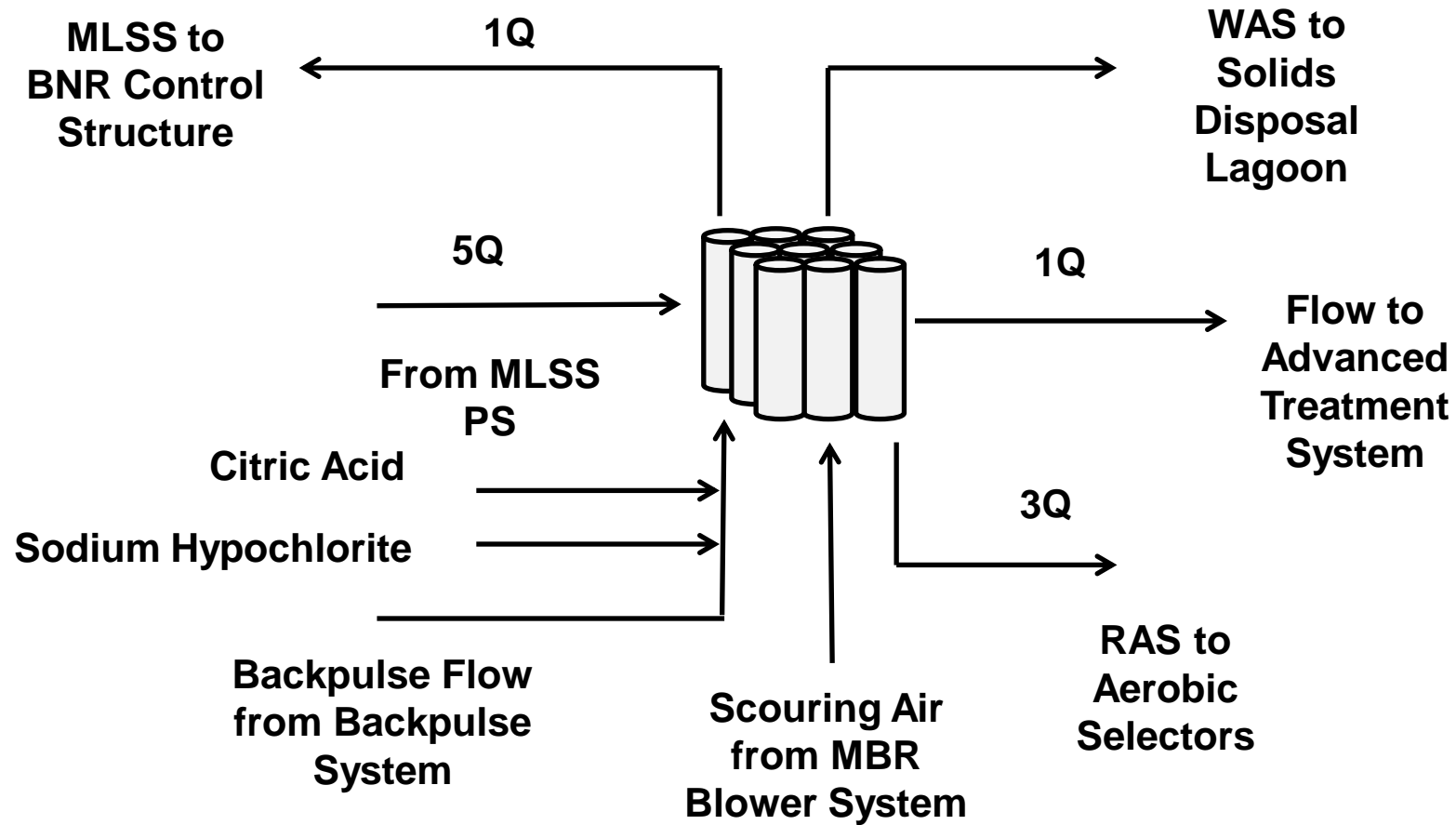


Earthen EQ Basin

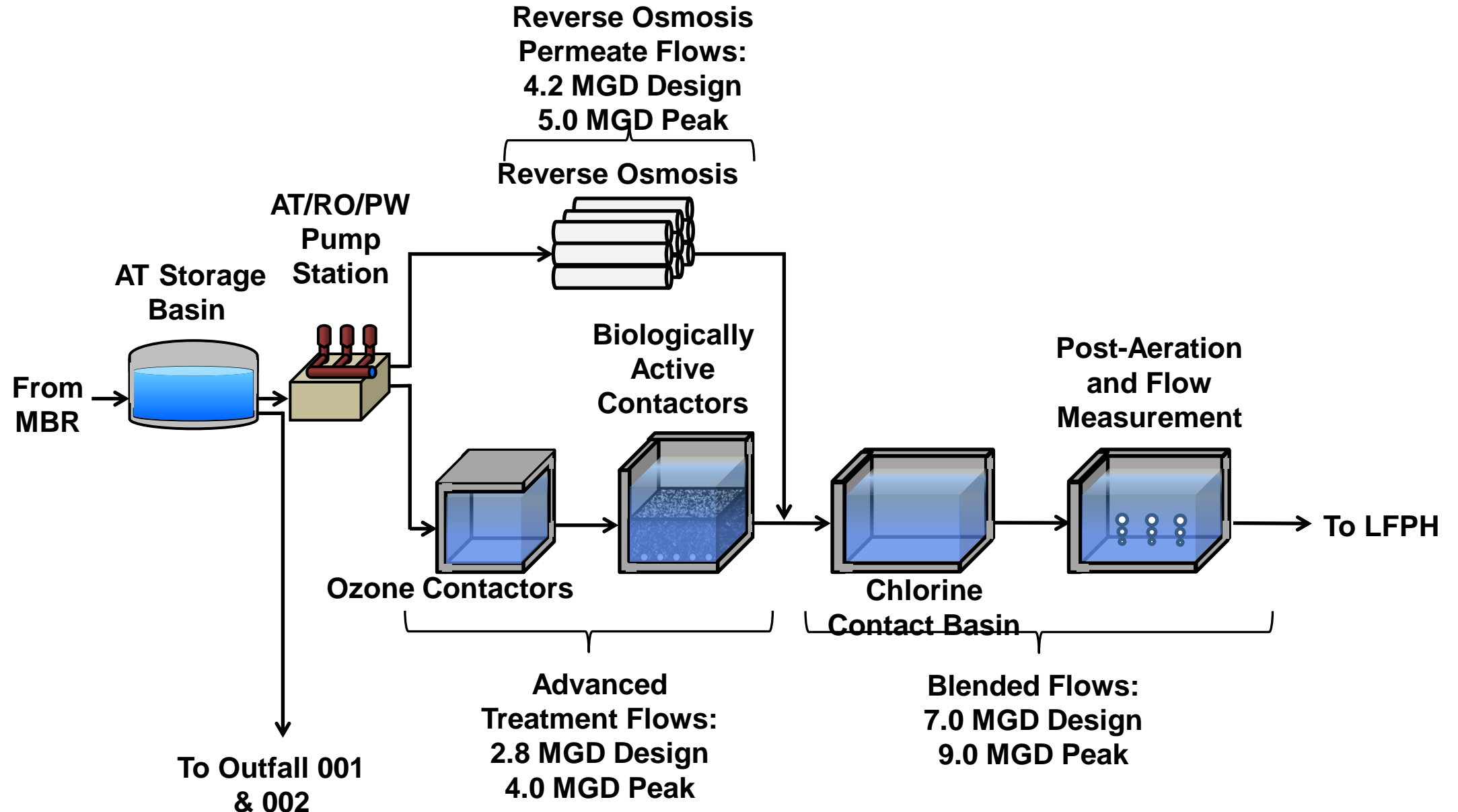
Biological Nutrient Removal System



Membrane Bioreactor System



Advanced Treatment System



Comparison of Advanced Treated Effluent Treatment Goals and Actual Performance

Parameter	Goal	Actual Performance
Annual Average Flow Rate to Lake Fort Phantom Hill	7 MGD	6-7 MGD
Total Phosphorus	0.5 mg/L	0.03 mg/L
TDS	375 mg/L	325 mg/L
Chloride (as Cl ⁻)	100 mg/L	80 mg/L
Sulfate (as SO ₄ ²⁻)	95 mg/L	70 mg/L
Pathogen Removal/Inactivation ^b		
<i>Cryptosporidium parvum</i>	4-log	4-log+
<i>Giardia lamblia</i>	4-log	4-log+
Viruses	0.5-log	0.5-log+
Contaminants of Emerging Concern (CECs)	50 - 90% Reduction	80% Reduction

For More Questions, Please Contact:

Joshua Berryhill, P.E.
Enprotec / Hibbs & Todd, Inc.