Nutrient Removal

History, Long-Term Planning, Operational Lessons Learned

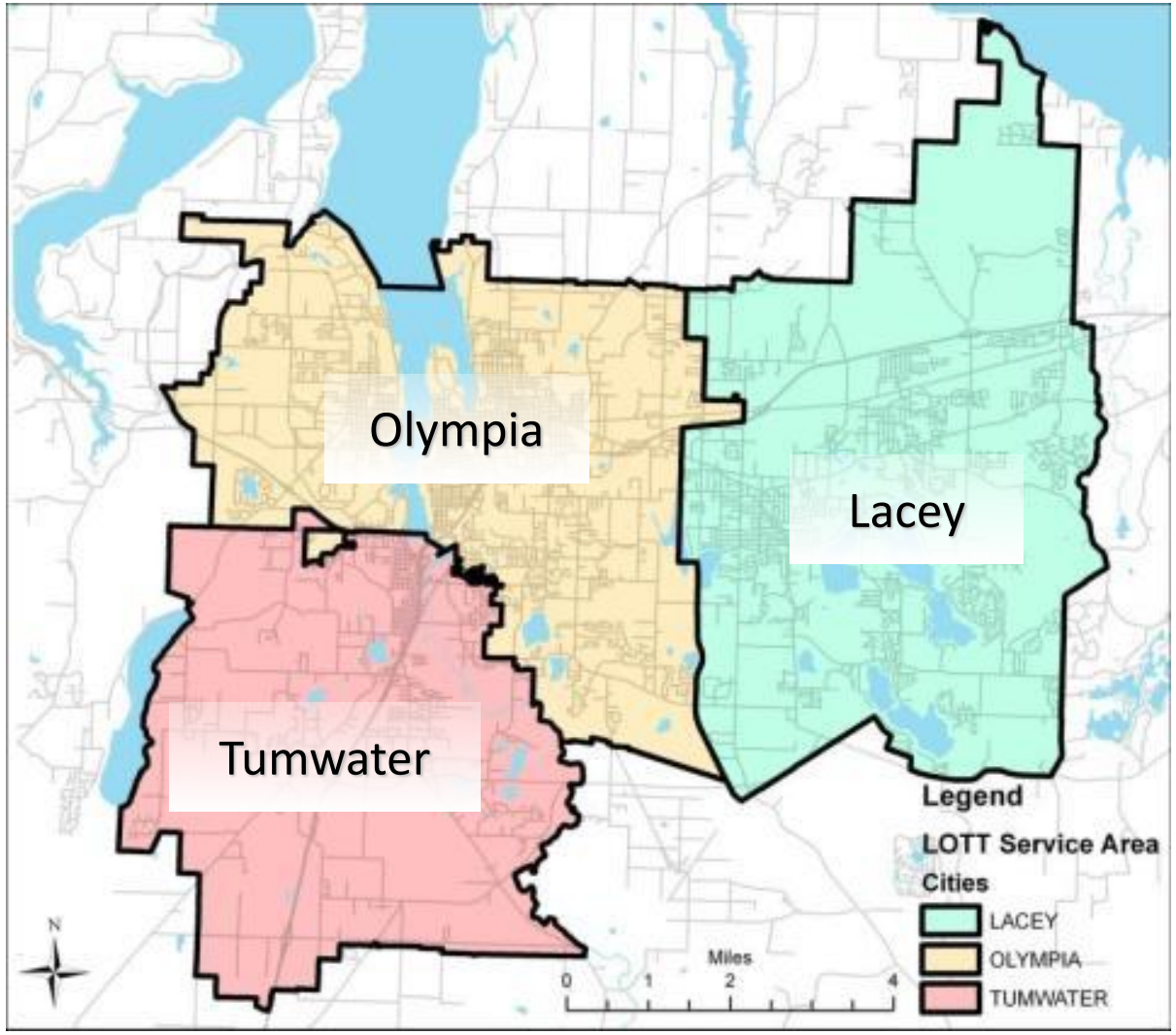
Nutrient Forum

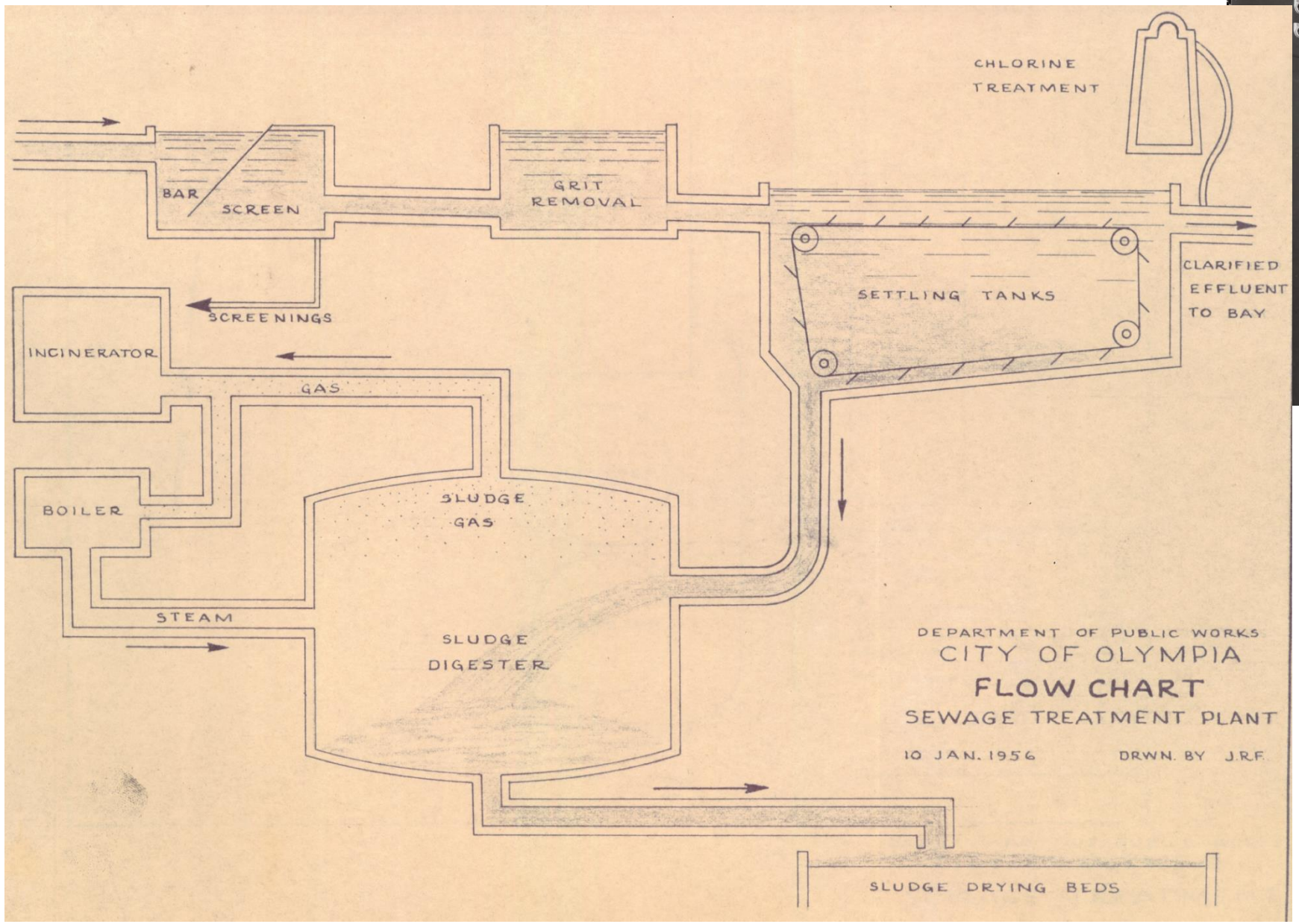
June 4, 2019

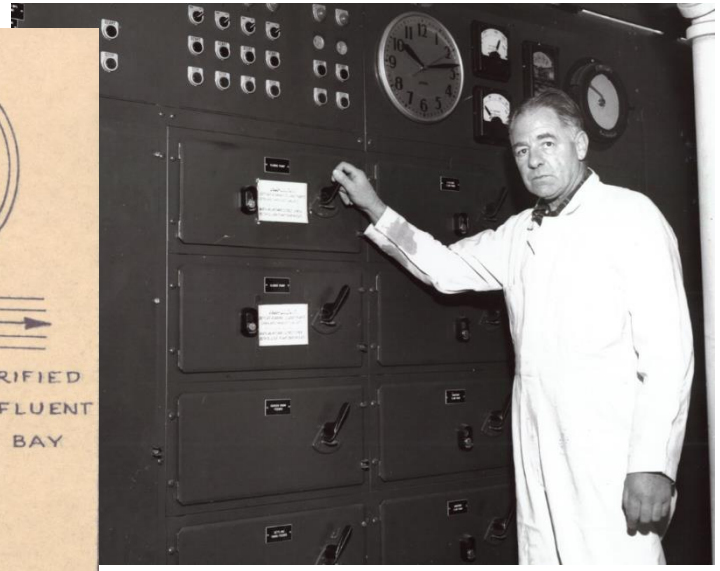
LOTT™ Clean Water Alliance

What is LOTT?

- Regional wastewater utility
  - **L**acey
  - **O**lympia
  - **T**umwater
  - **T**hurston County
- Governmental, non-profit corporation
- Population served = 118,000

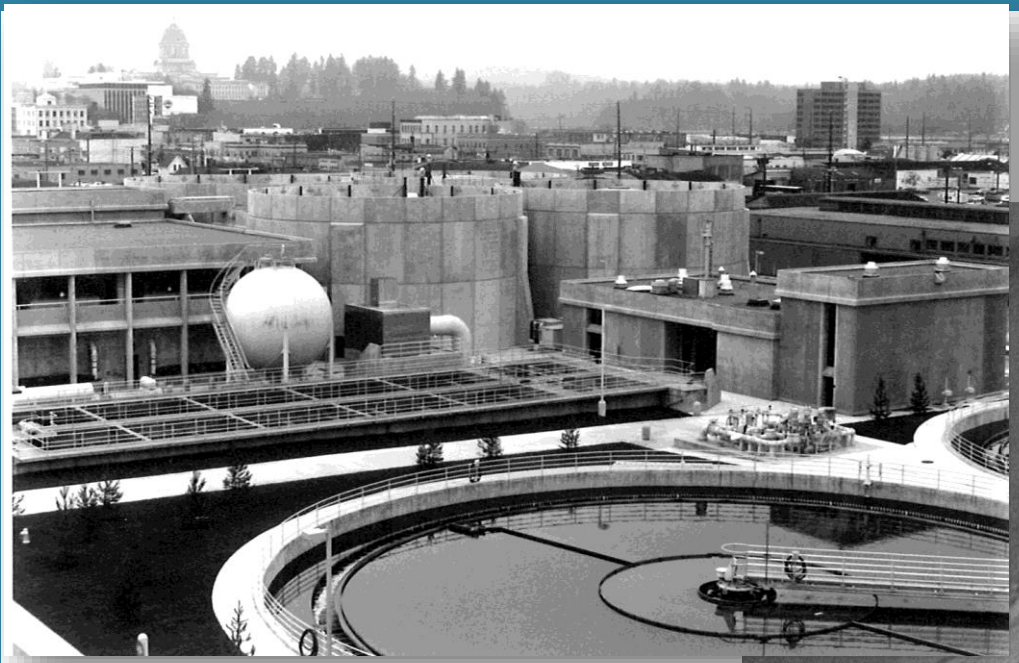






Original Plant: Primary Treatment

1951



Secondary Upgrades

1983

Nutrient Removal and Ultraviolet Disinfection

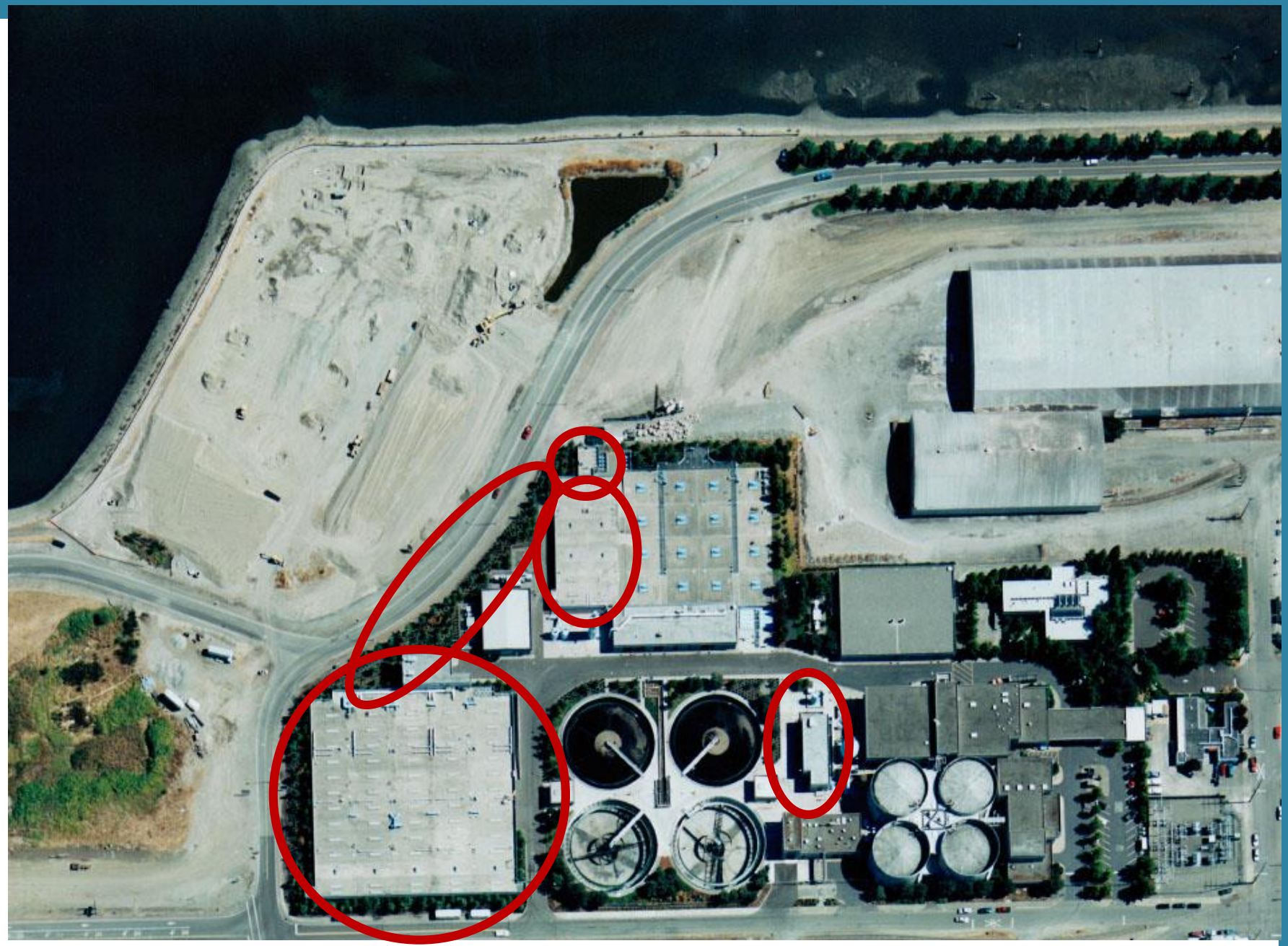
Capital cost =

$47.7 million

$3.2 million in grants

$35.5 million low interest loans

1994



Wastewater Resource Management Plan

Public values:

- Meet future wastewater needs
- Treat wastewater as a valuable resource
- Maximize benefits to the environment
- Provide multiple community benefits

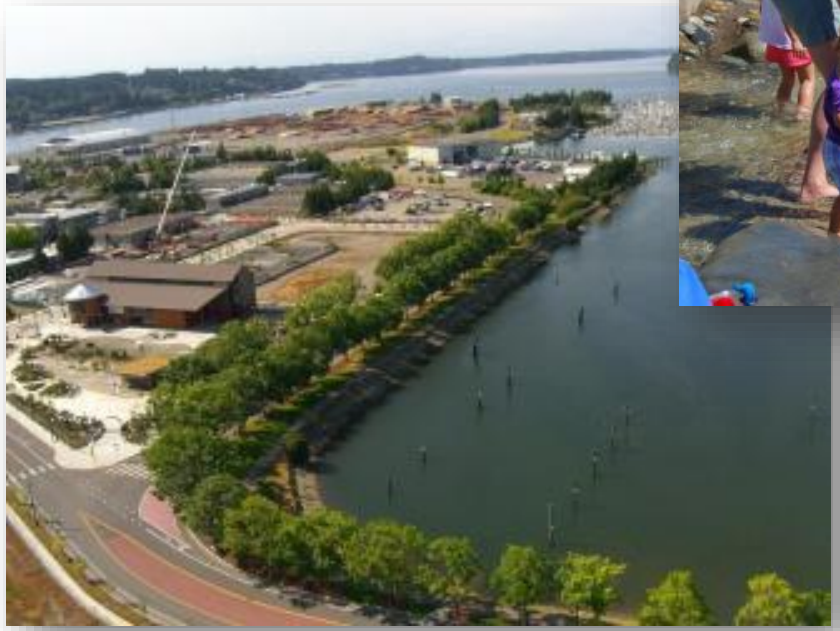
Long-term strategy:

- Continue discharge of treated effluent to Budd Inlet
- Expand production and use of reclaimed water
  - Multiple satellite plants in service area
  - Build capacity in increments, "just in time"
- Use reclaimed water to replenish groundwater

Budd Inlet Reclaimed Water Plant

Martin Way Reclaimed Water Plant


We're using
water wisely by
irrigating with
reclaimed water
LOTT




Recharge Basins

WELCOME TO WOODLAND CREEK
Groundwater Recharge Facility

This facility is jointly owned by the Cities of Lacey and Olympia.

1 Beneath this field is a state-of-the-art groundwater recharge facility that is using locally-produced Class A Reclaimed Water to replenish groundwater and streamflows in nearby Woodland Creek.

A Unique Facility

This recharge facility is the result of a joint effort by the Cities of Lacey and Olympia to ensure that stream flows in Woodland Creek are not diminished because of pumping drinking water from new wells constructed by the cities. This recharge facility consists of 4.7 miles of underground infiltration chambers underneath a four acre field. The chambers are located about three feet below ground and slowly discharge reclaimed water into the soil. Groundwater in and around the recharge facility is monitored remotely from a control center. The data collected is used to determine how much reclaimed water to release through the infiltration chambers. More water can be discharged during dry summer months, while less water is released during the wet months when groundwater levels are typically high. Depending on the month, 0.3 - 0.9 million gallons of reclaimed water are infiltrated per day.

Installation of the infiltration chambers prior to re-seeding the grassy field.

For more information, please visit www.ci.lacey.wa.us/reclaimed-water.

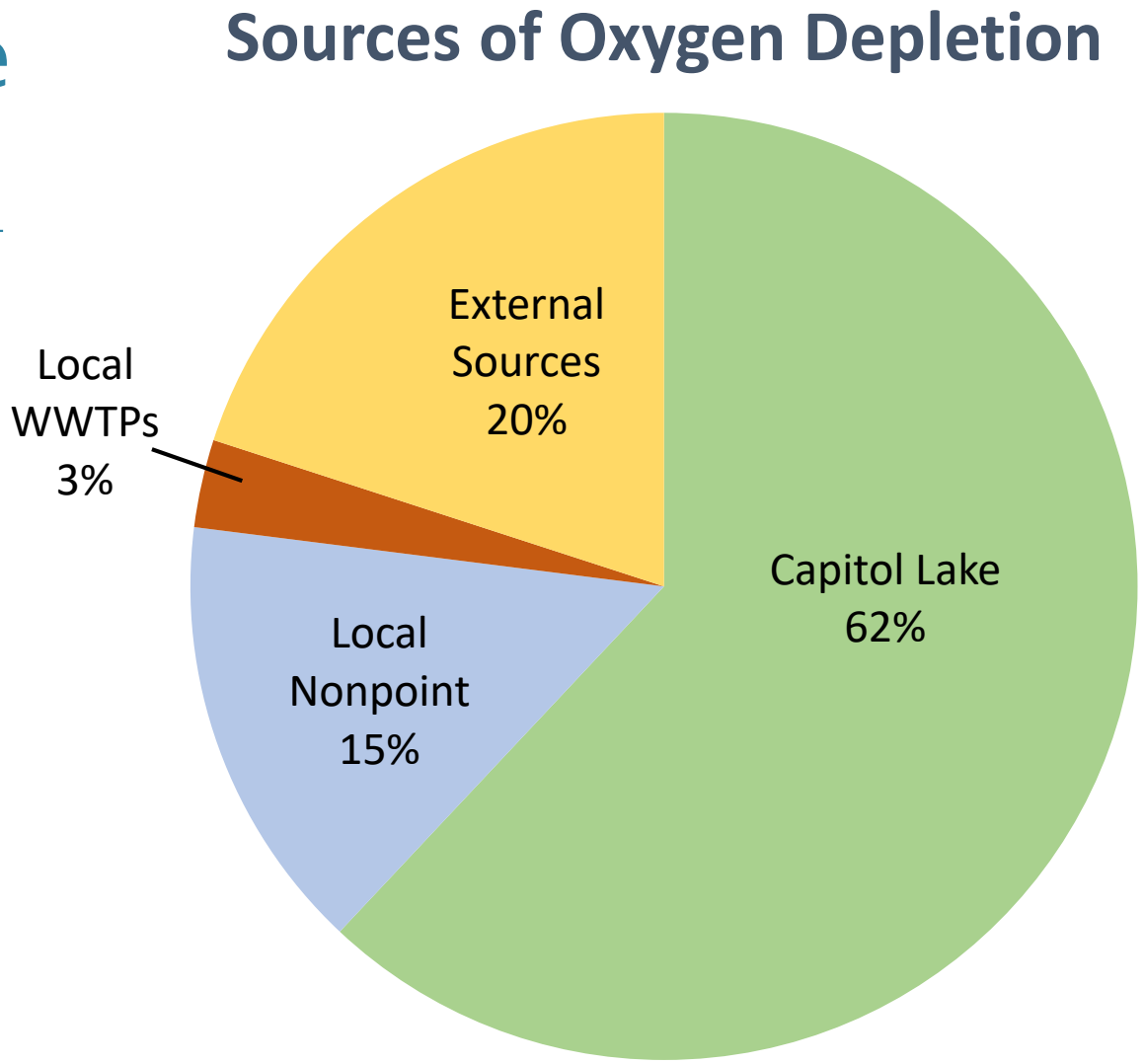
Planning Considerations

- Centralized facilities are more cost effective than multiple satellites
  - Can we expand production at existing facilities?
- Growth is slower than anticipated
  - Do not have adequate flow to expand reclaimed water production
  - Can we add equalization to capture diurnal peaks?
- Partners' demands are increasing – may become driver
  - Does the funding formula change?
- Sites purchased for future infiltration have limited capacity
  - Are other sites more viable?
  - Do other sites provide opportunity for multiple benefits?
- Residual chemical study underway – local regulatory decisions pending
- How will the local TMDL and PSNR process affect capacity?

Martin Way Reclaimed Water Plant

Budd Inlet and Capitol Lake TMDL

- Four main sources of nutrients
  - Local nonpoint: stormwater, septics, etc.
  - Local WWTPs: LOTT and other plants on Budd Inlet
  - External: WWTPs and nonpoint north of Budd Inlet
  - Capitol Lake
- Reductions are needed in all sources to meet the allowable depletion



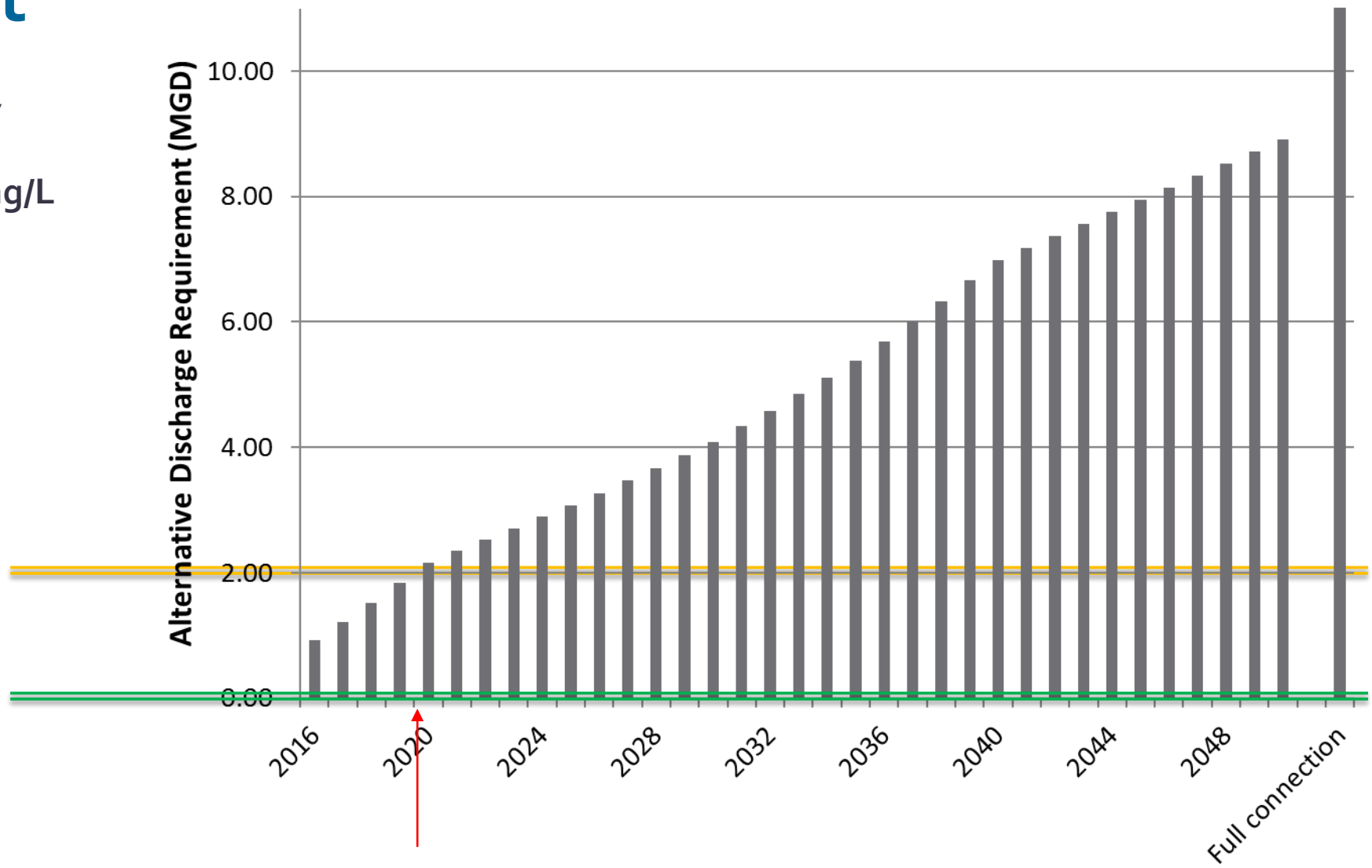
Existing Permit

Permit Limit TIN: 288 lbs/day

Performance Limit TIN: 3.0 mg/L

Discharge Capacity of
Martin Way/Hawks Prairie
Reclaimed Water System = **2 MGD**

Discharge Capacity of
Budd Inlet Treatment Plant = **11.5 MGD**



Current Performance

Permit Limit TIN: 288 lbs/day

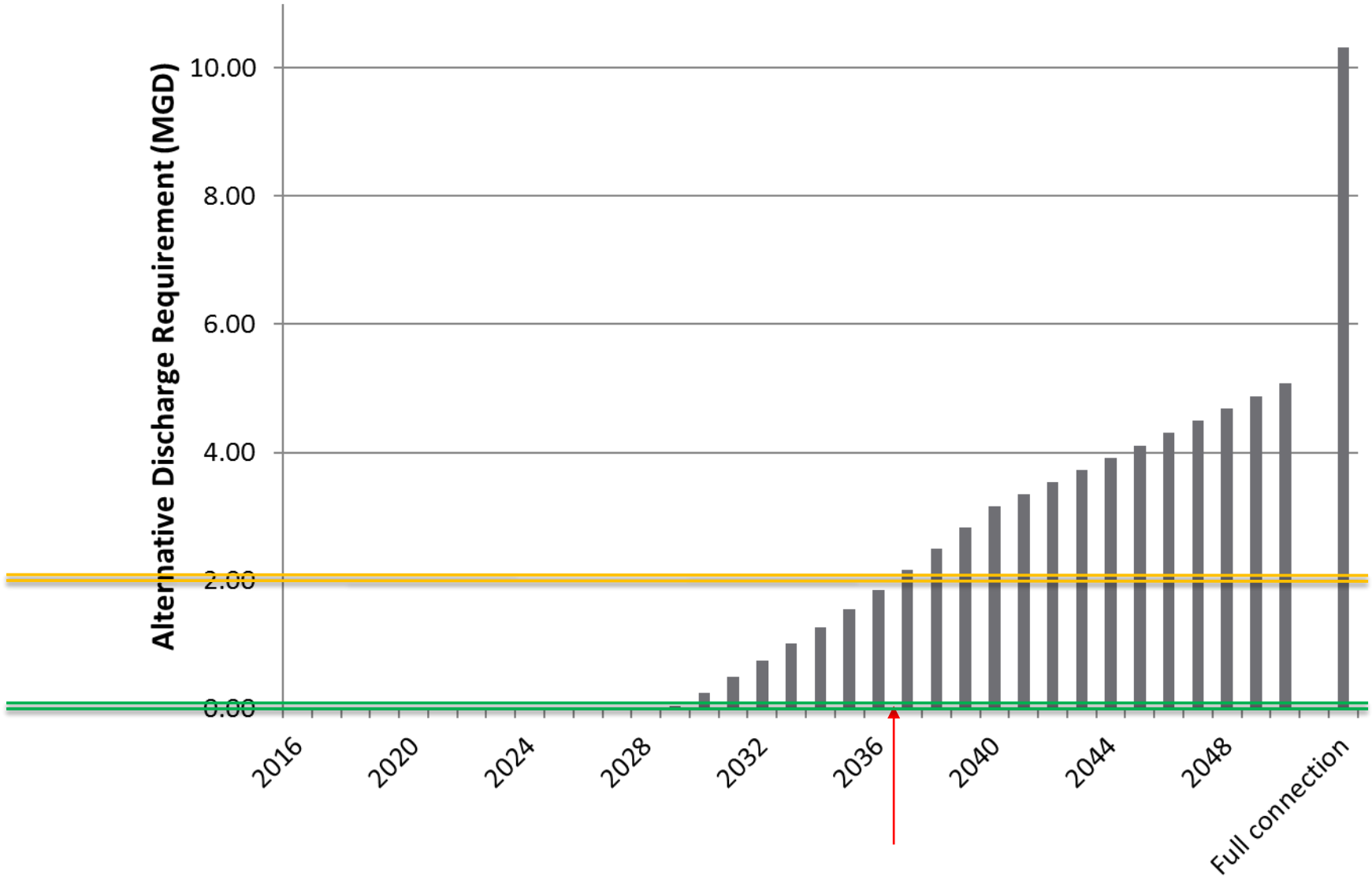
Current Performance: 216 lbs/day

Performance Limit TIN: 3.0 mg/L

Current Performance: 2.25mg/L

Discharge Capacity
of Martin Way/Hawks Prairie
Reclaimed Water System = **2 MGD**

Discharge Capacity of
Budd Inlet Treatment Plant = **15.3 MGD**



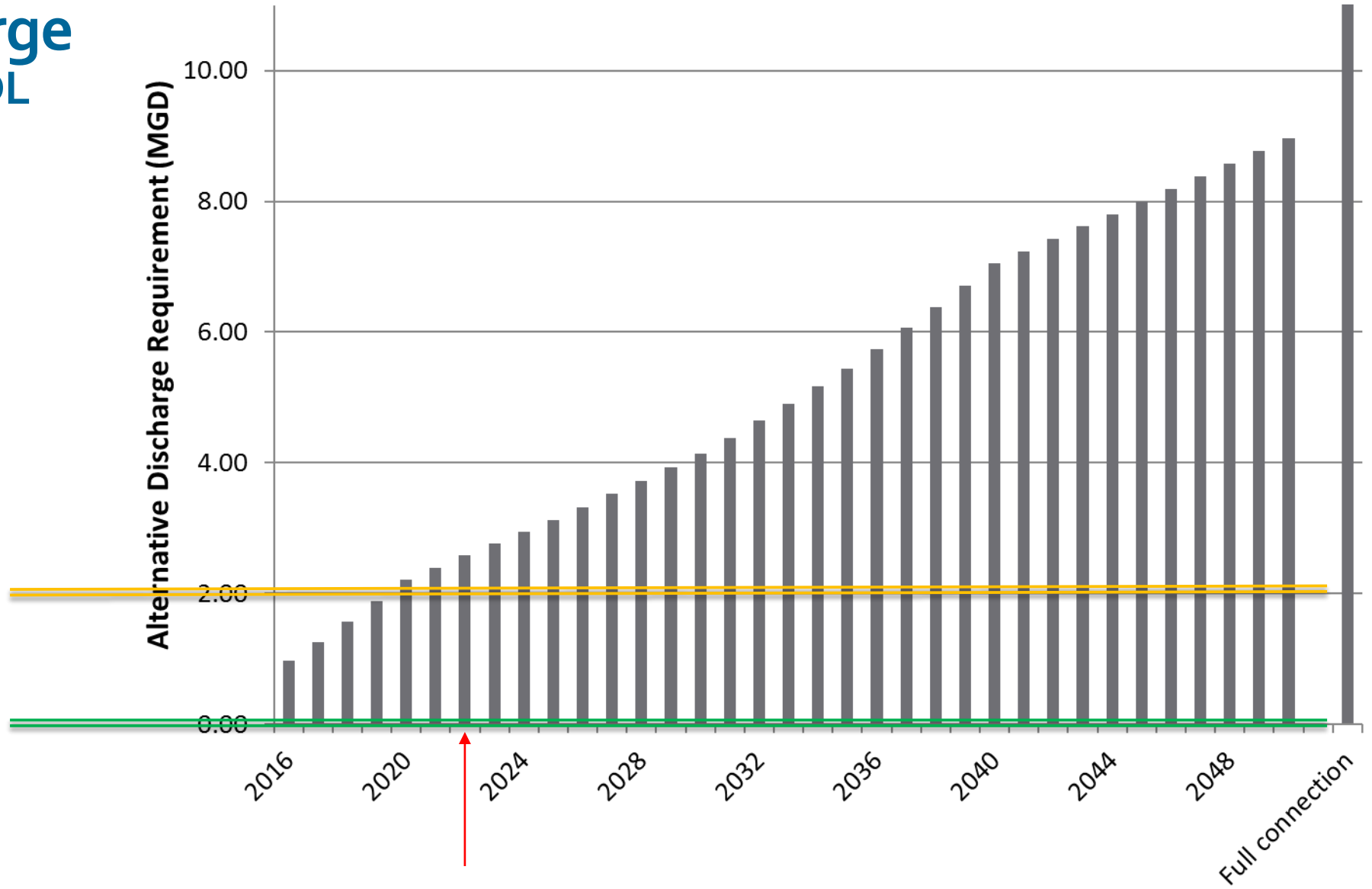
Reduced Discharge
due to pending TMDL

Permit Limit TIN: ~250 lbs/day

Discharge Capacity
of Martin Way/Hawks Prairie
Reclaimed Water System = **2 MGD**

Discharge Capacity of
Budd Inlet Treatment Plant = **12.5 MGD**

Lost Discharge Capacity = **3.2 MGD**



Permit Limits: Budd Inlet Treatment Plant

	1987	1996	2005	2011	2018	*changes to come with TMDL*
BOD average monthly mg/L	30	20	9	7	7	
BOD average monthly lbs/day	4,000	3,670	1,050	671	671	
TIN average monthly mg/L	no limit	3	3	3	3	
TIN average monthly lbs/day	no limit	no limit	350	288	288	

Phase 1 Master Planning

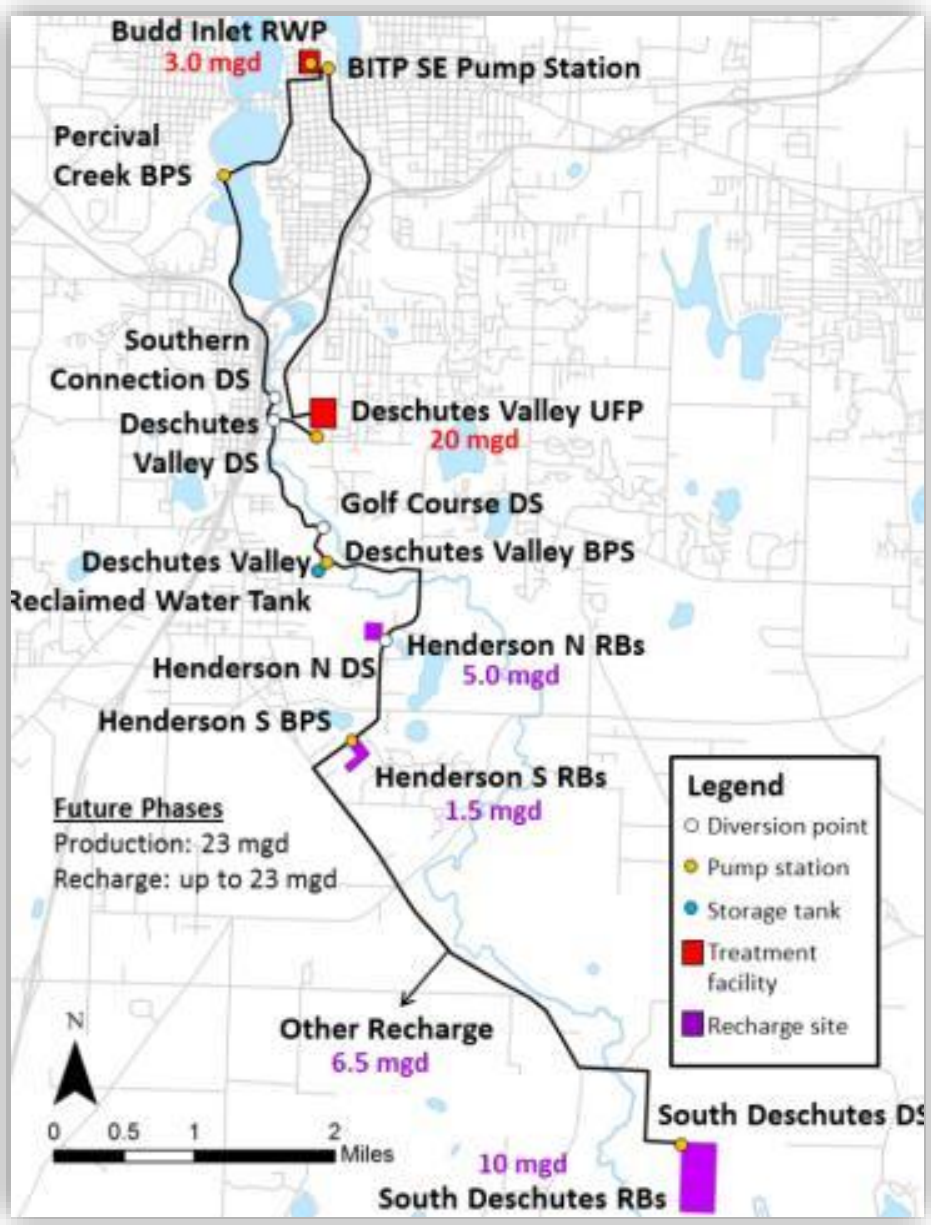
Budd Inlet Treatment Plant

- Determine process/facility needs
- Locate facilities within footprint
- Consider need for additional property
- Update site plan

Phase 2 Master Planning

Overall System Capacity

- Reclaimed water treatment, conveyance, disposition
  - When?
  - Where?
  - Quantity?
  - Quality?
  - Cost?
  - Mutual benefits?
- Initial update to strategy in 2020



Planning Lessons Learned

- Things change
  - Permit limits
  - Operational conditions
  - Community needs
- Need to stay nimble
- Have to be willing to revisit overarching strategy
- Centralize as much as practicable
- Look for opportunities for multiple community benefits

Nutrient Removal

Operational Lessons Learned

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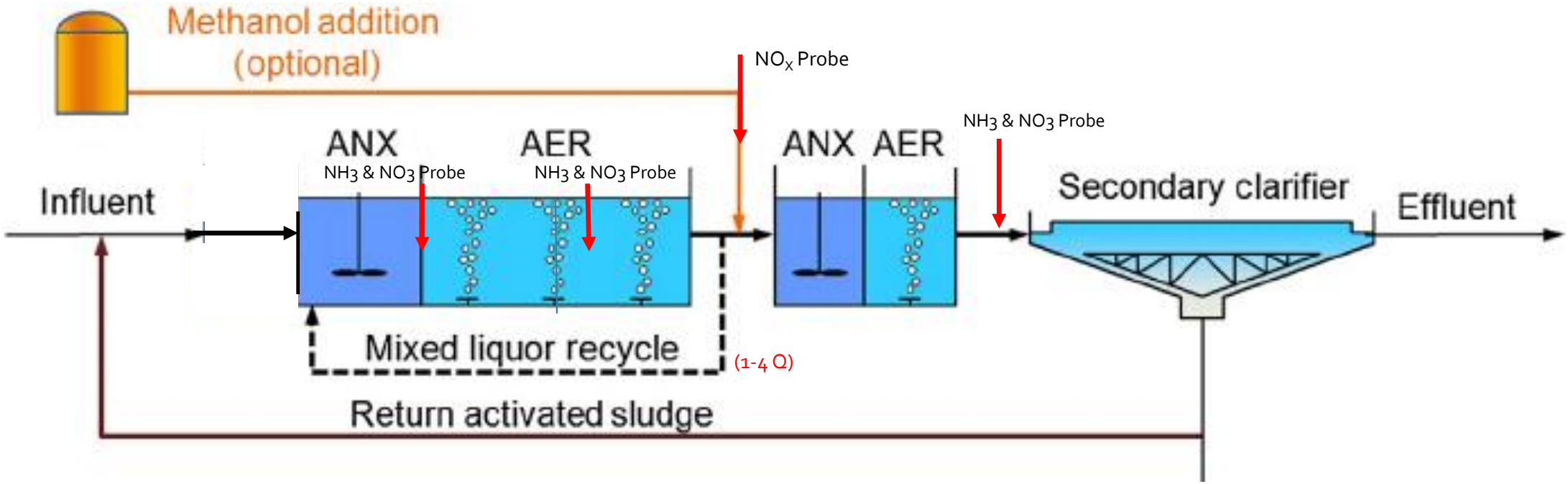
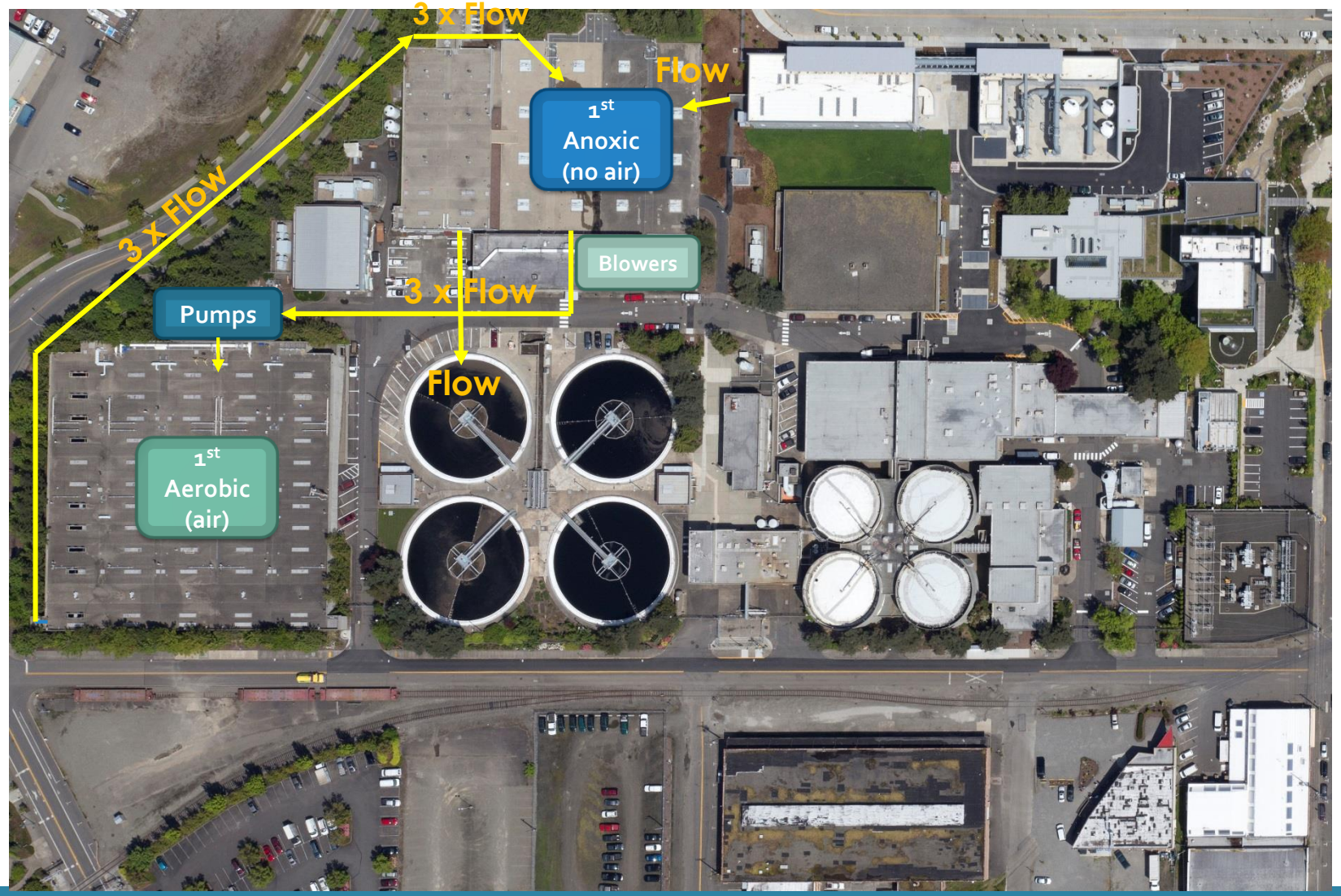
LOTT™ Clean Water Alliance

Nitrogen Removal: Modified 4-Stage Bardenpho



Current Biological Process



Permit Limits: Budd Inlet Treatment Plant

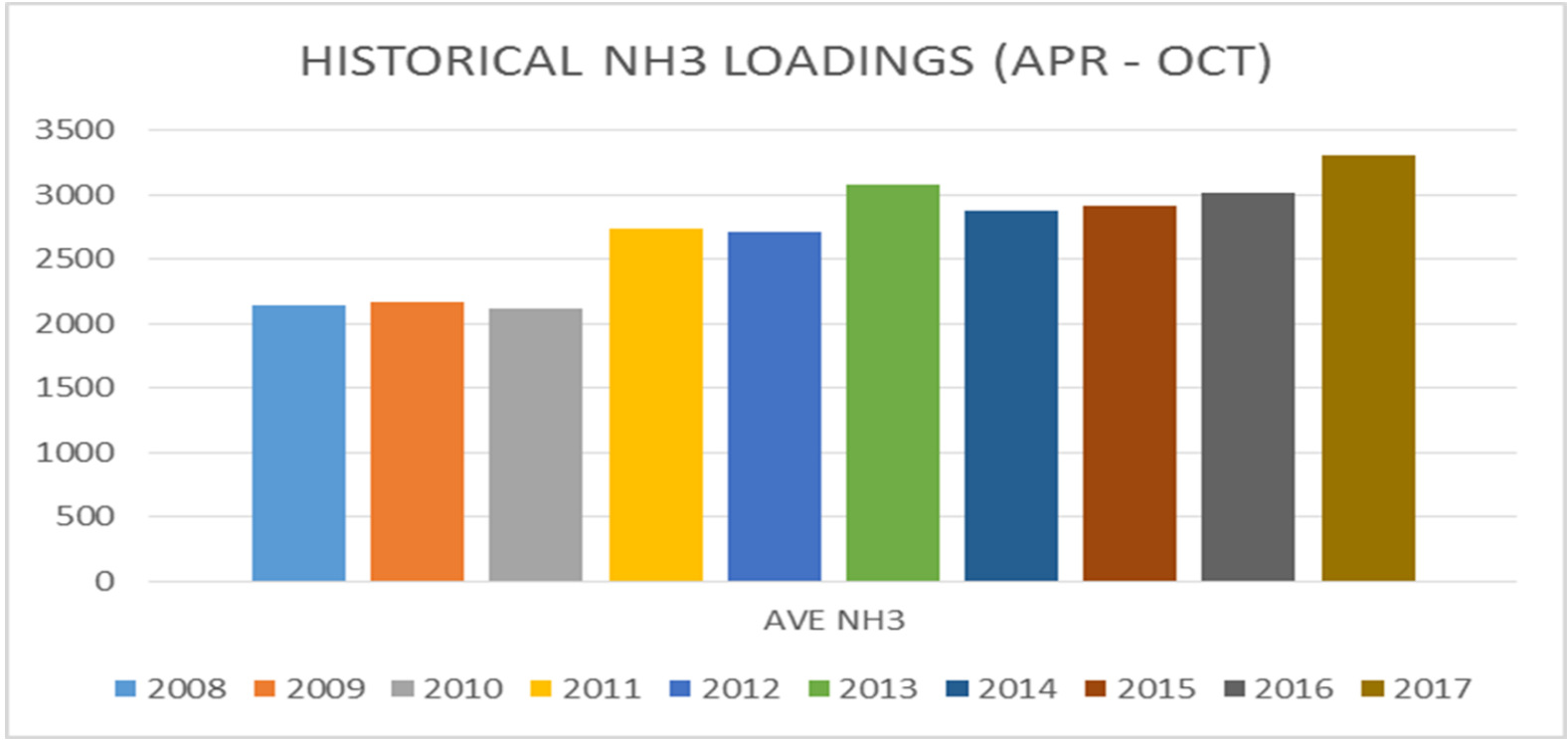
	BOD average monthly mg/L	TIN average monthly mg/L	TIN average monthly lbs/day
June - Sep	7	3	288
Apr, May, Oct	8	3	338
Nov - Mar	30	NH_3 26 mg/L	N < 10 mg/L (CLA)

Lessons Learned: Carbon Source

- 1994 upgrades designed assuming carbon inputs from Olympia brewery
  - Brewery closed in 2003
- Need to supplement carbon sources
  - Pepsi & Fishtale Brewery discharges can provide additional carbon to benefit LOTT
    - High strength waste charges waived for these carbon sources
  - Methanol used as a supplemental carbon source to support denitrification in 2nd Anoxic

Methanol Spending

Year	$USD
2008	95,927
2009	75,611
2010	78,866
2011	46,031
2012	66,392
2013	33,393
2014	45,155
2015	53,461
2016	42,783
2017	32,938

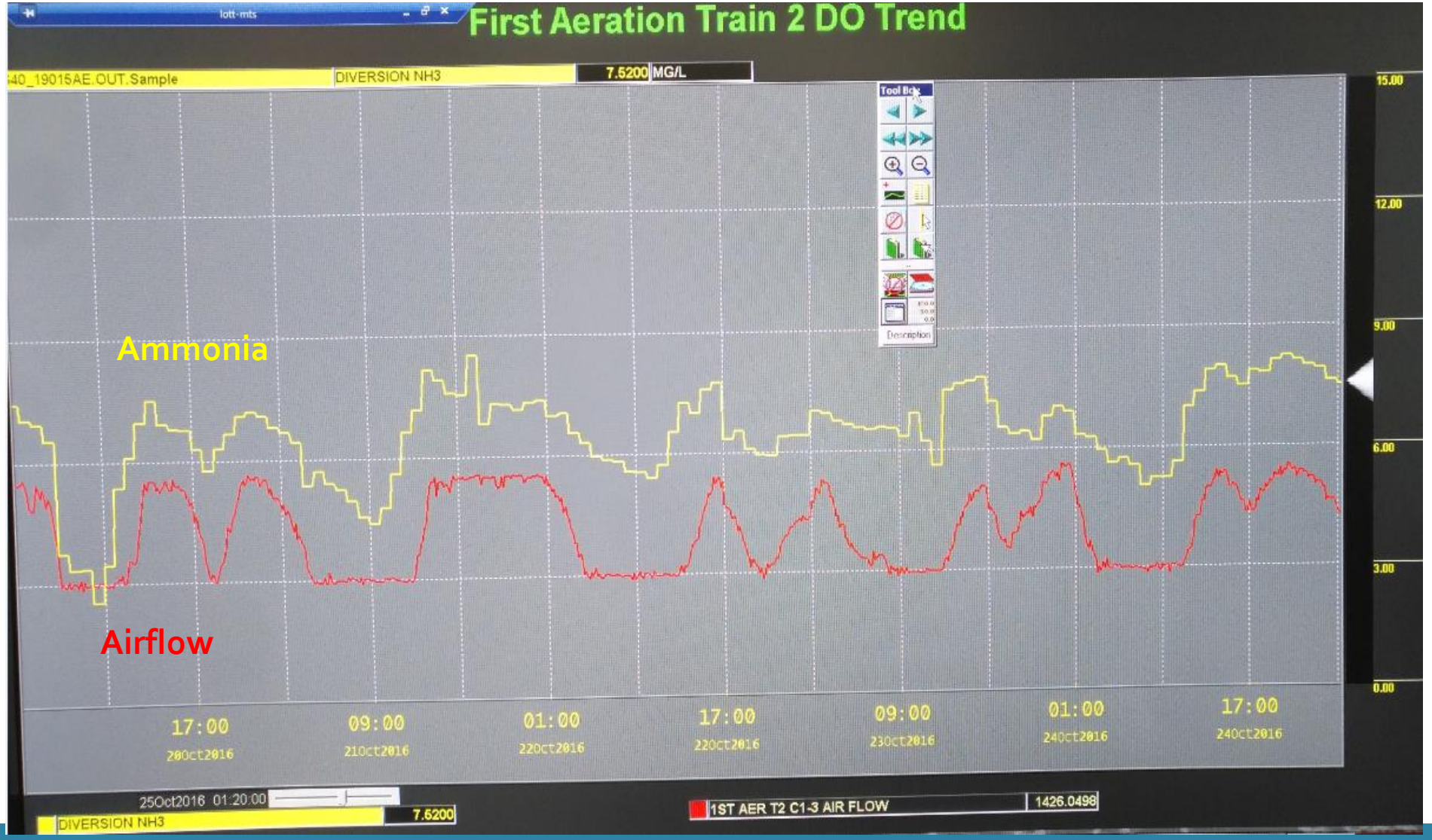


Lessons Learned: Oxygen Control

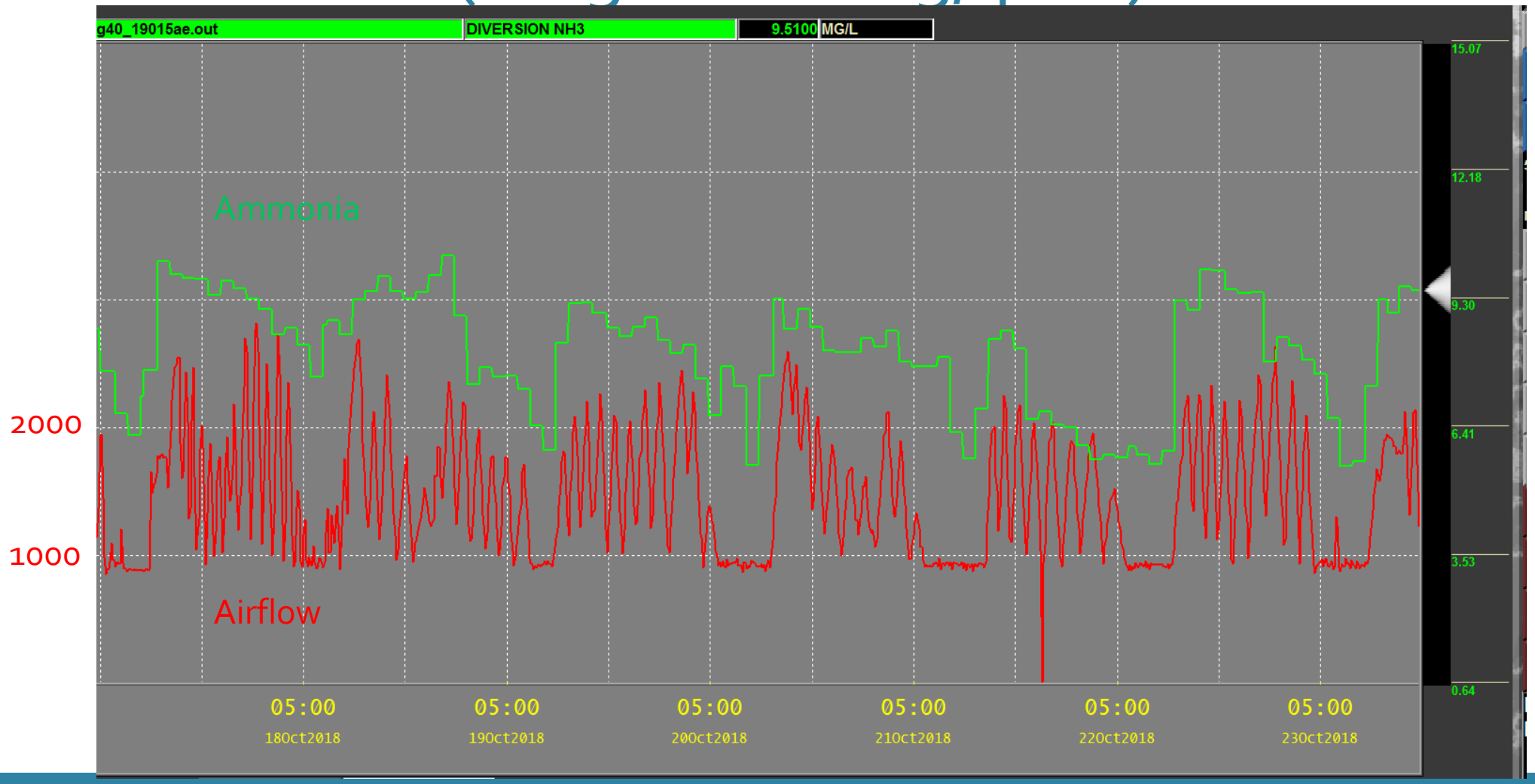
- Ecology Orange Book specifies 2.0 mg/L DO setpoint to treat ammonia
- Blowers
- Probes
- Ammonia Based Aeration Control (ABAC)

Simple DO Control

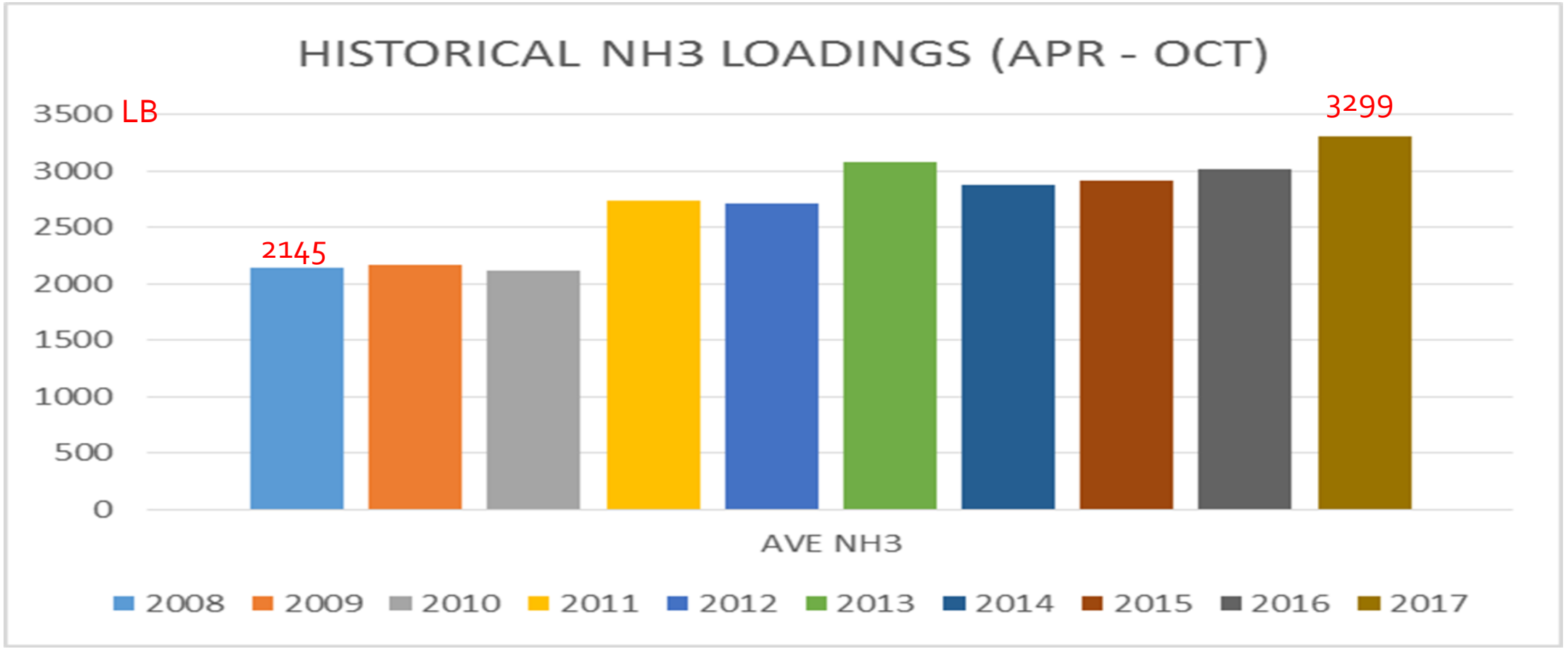
Centrate Management + ABAC (3 mg/L SP in Cell 2)



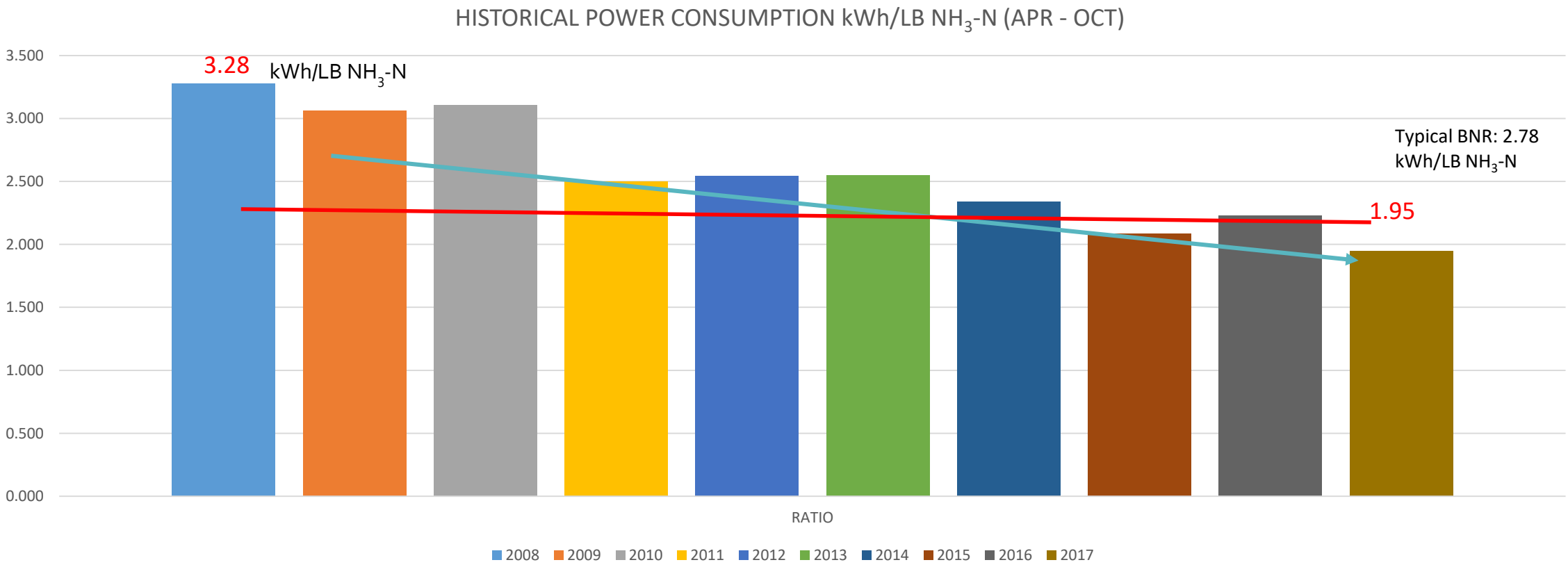
Moving NH_3 Set-Point Based On NO_3 Probe (NH_3 SP = $NO_3/4 + 1$)



BITP Loadings



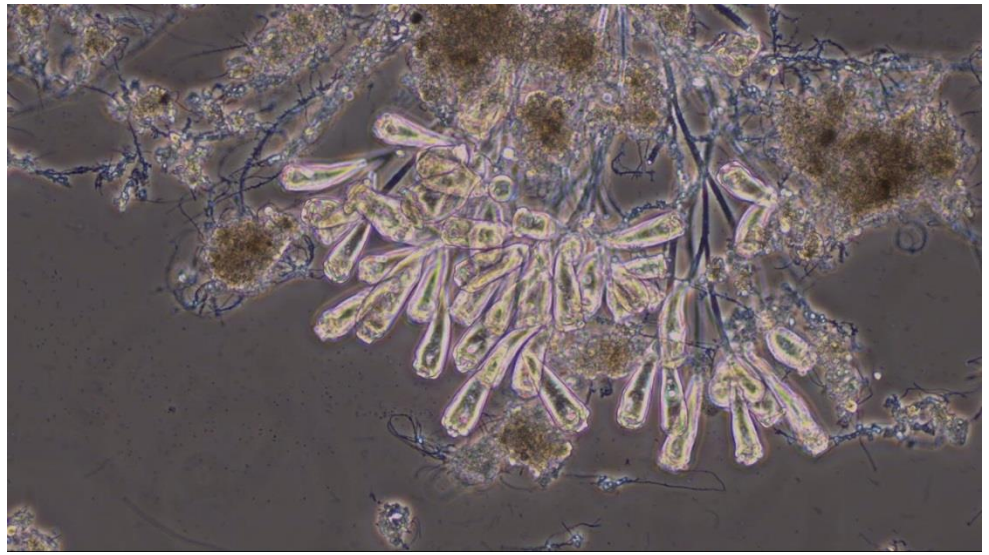
Aeration Cost During BNR Season

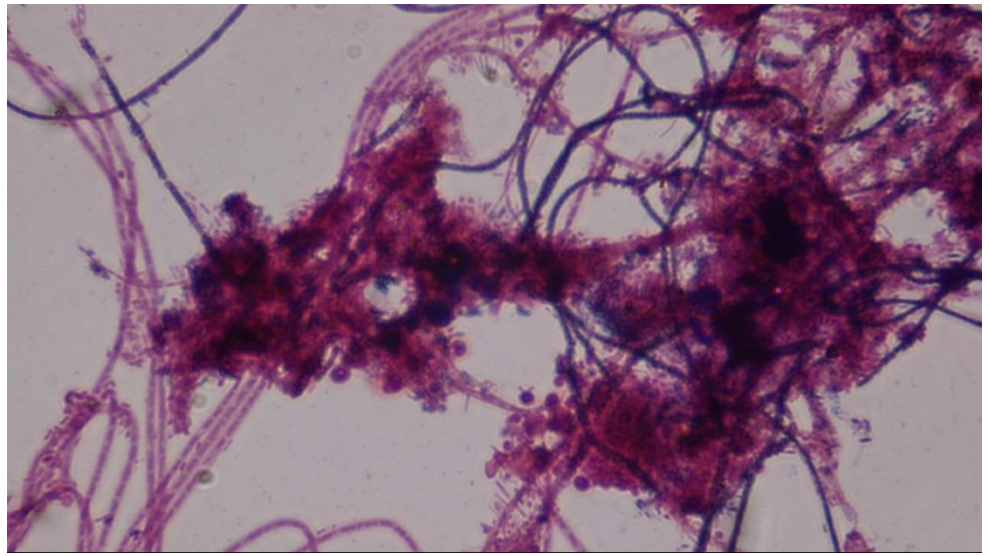


$64,520 annual savings from 2008 to 2017

Foam Control

- Remove Foam Trapping Structures
- Microbiology monitoring
- PAX – 14
- SRT

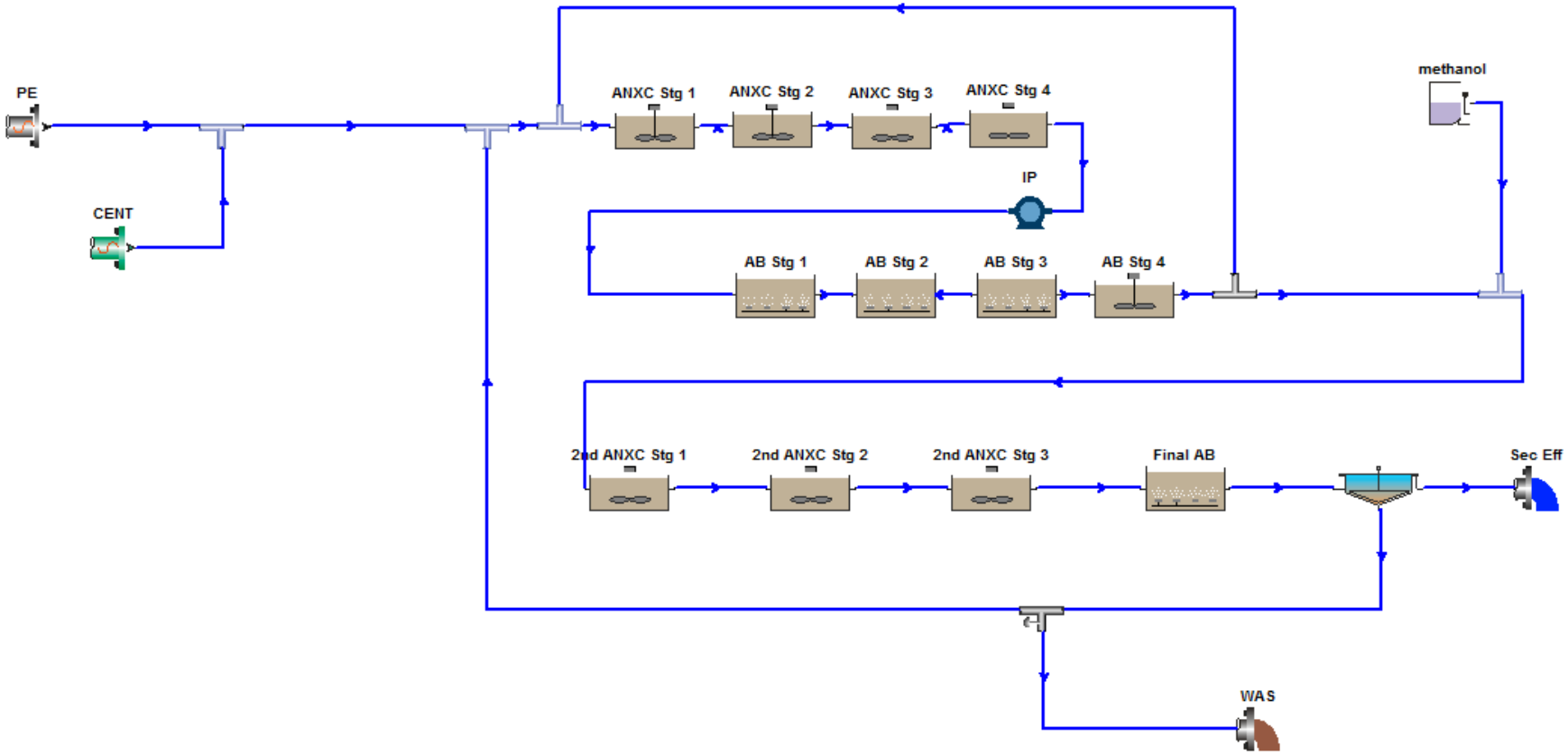




Lessons Learned: Improving Treatment Efficiency

- Probes are helpful – TSS/DO/AN-ISE/NH_3/NO_X/ORP/pH
  - Constant SRT
  - Ammonia based aeration control (ABAC)
  - Methanol control
- Computer simulation software – BIOWIN
- Training and teamwork

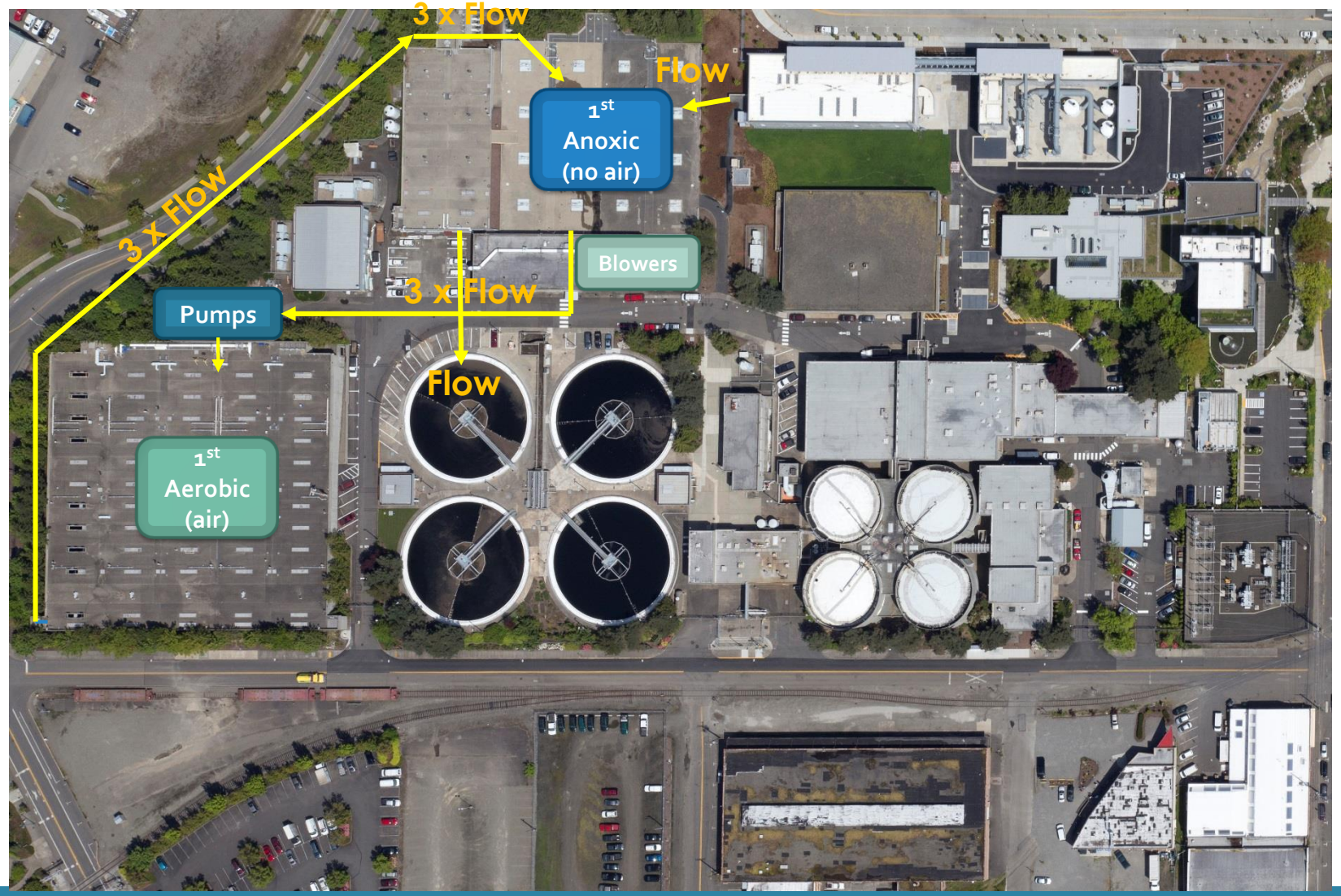
Simulation Software (BioWin)



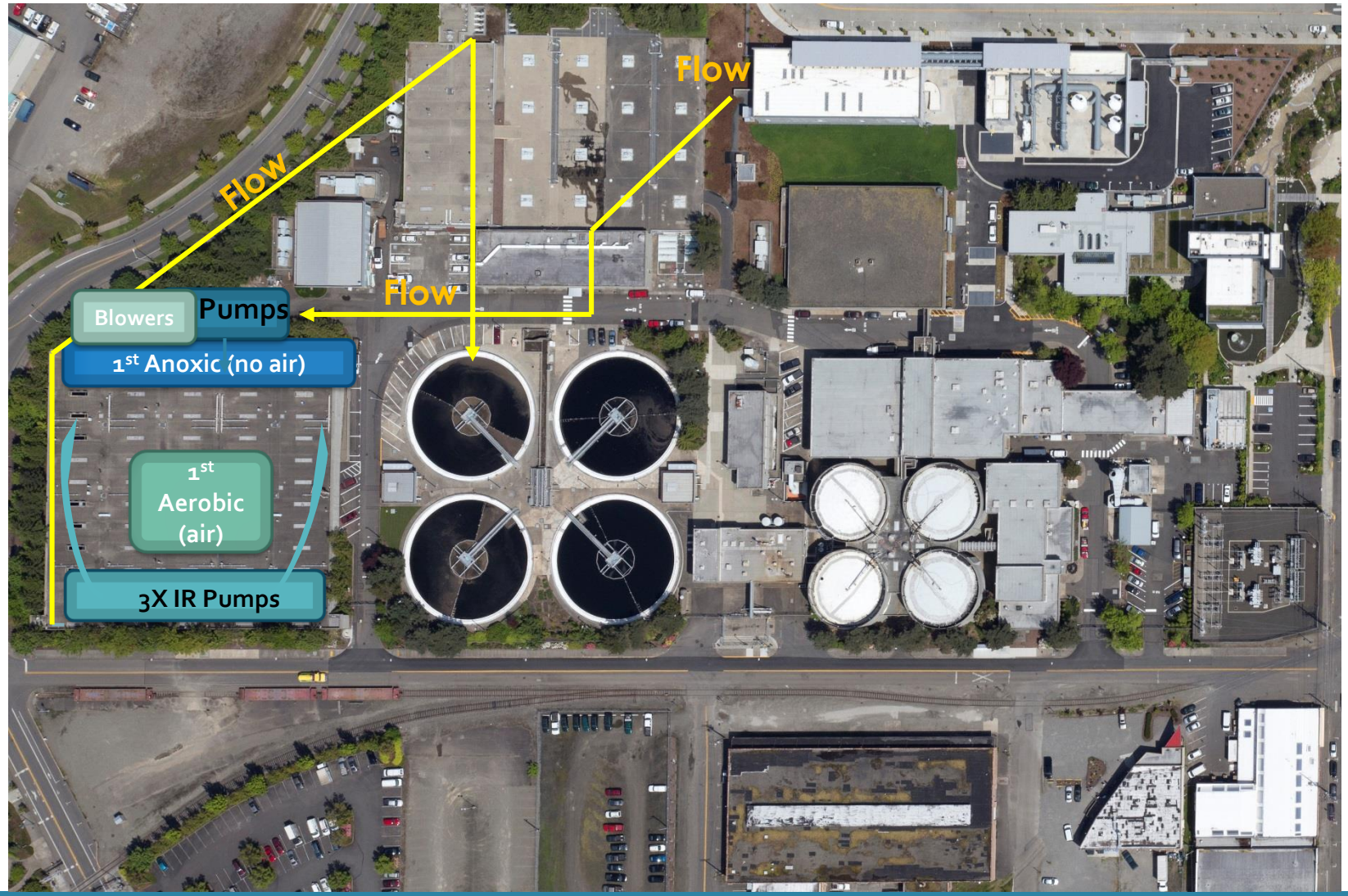
Biological Process Improvements Project

- Treatment Process
  - Improves control
  - Upgrades instrumentation
  - Reduces permit risk
- Plant Space
  - Consolidates biological treatment components
  - Frees up premium plant space
  - Unused basins can be used for equalization
- Energy
  - Over 20% estimated total plant energy savings
  - Improves safety by eliminating medium voltage (4160V)

Current Biological Process



Biological Process Improvements



Capital cost estimate =

$22 million

Keys to Managing Nutrient Removal Process

- Process control team
  - Probes to monitor process
  - Microbes monitored daily
  - Constant adjustments to process
- Hauled waste moratorium
- Continual capital projects/upgrades
  - Improvements to address hydraulic choke points & process controls
    - Master planning
    - Biological Process Improvements project
- Centrate management as a separate process
  - Carefully metered to avoid overloading the process with nutrients
  - Future project anticipated to pre-treat centrate to reduce NH_3 loadings – we're working on it!

Questions?

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