PNWS AWWA, Spokane, WA
May 10, 2013

Case Study: Reducing Electricity Costs with a New Reservoir

Will Crandall Reservoir and Pump Station Project

Tyler Wubbena, City of Hillsboro

Acknowledgements

- Kevin Hanway, City of Hillsboro
- Brad Phelps, CH2M HILL
- Jeff Stallard, CH2M HILL
- Ward-Henshaw Construction
- Raito Inc.
- City of Hillsboro Staff

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Outline

- Project Background
- Storage Requirements
- Water Quality
- Power Components
- Construction
- Extended Storage Validation
- Next Phases

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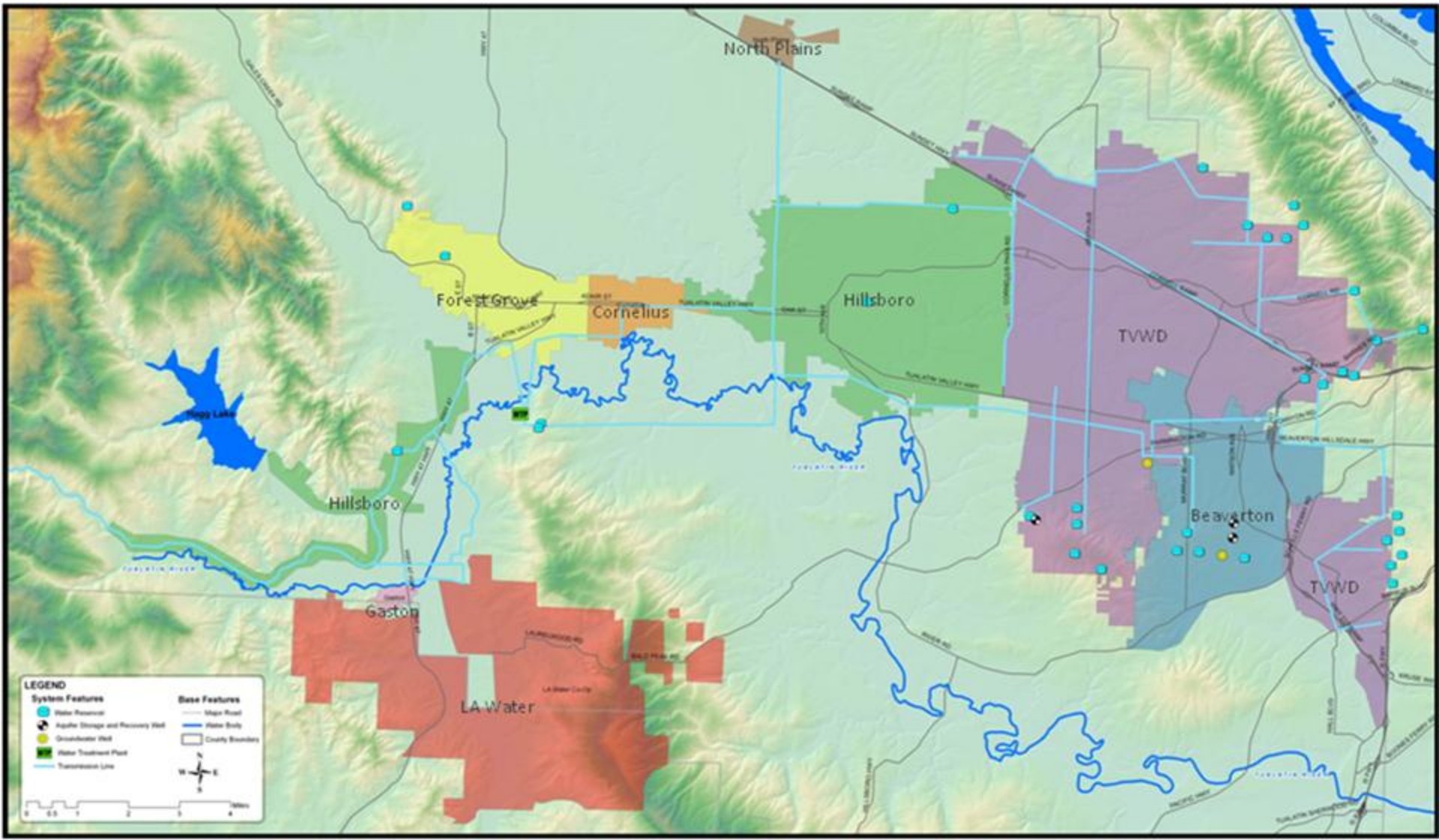
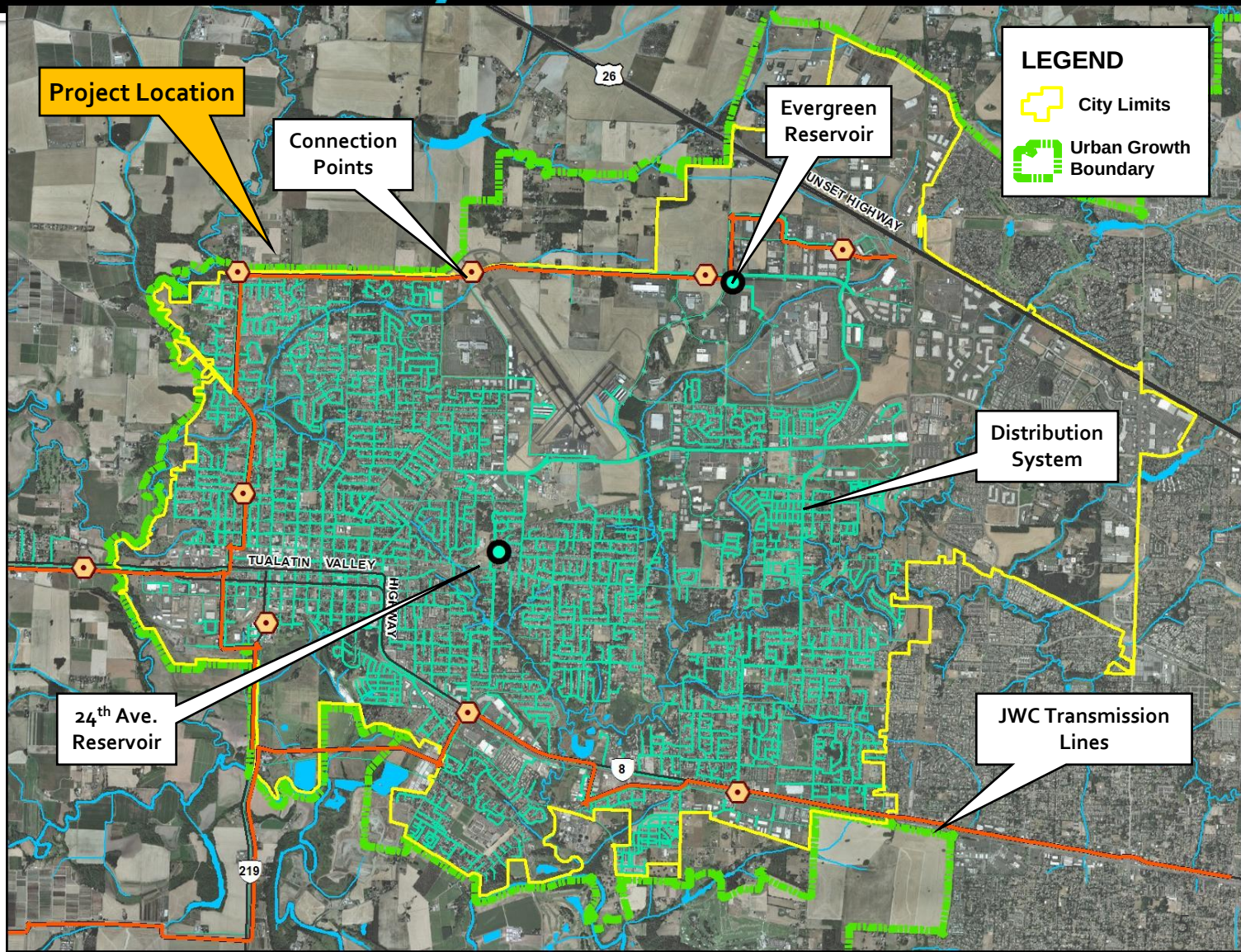
Project Background



Project Background: Hillsboro Water System

- 2 Existing Reservoirs: 5.6 MG and 15 MG
- 9 PRV Connection Points
- MDD of 19 MGD

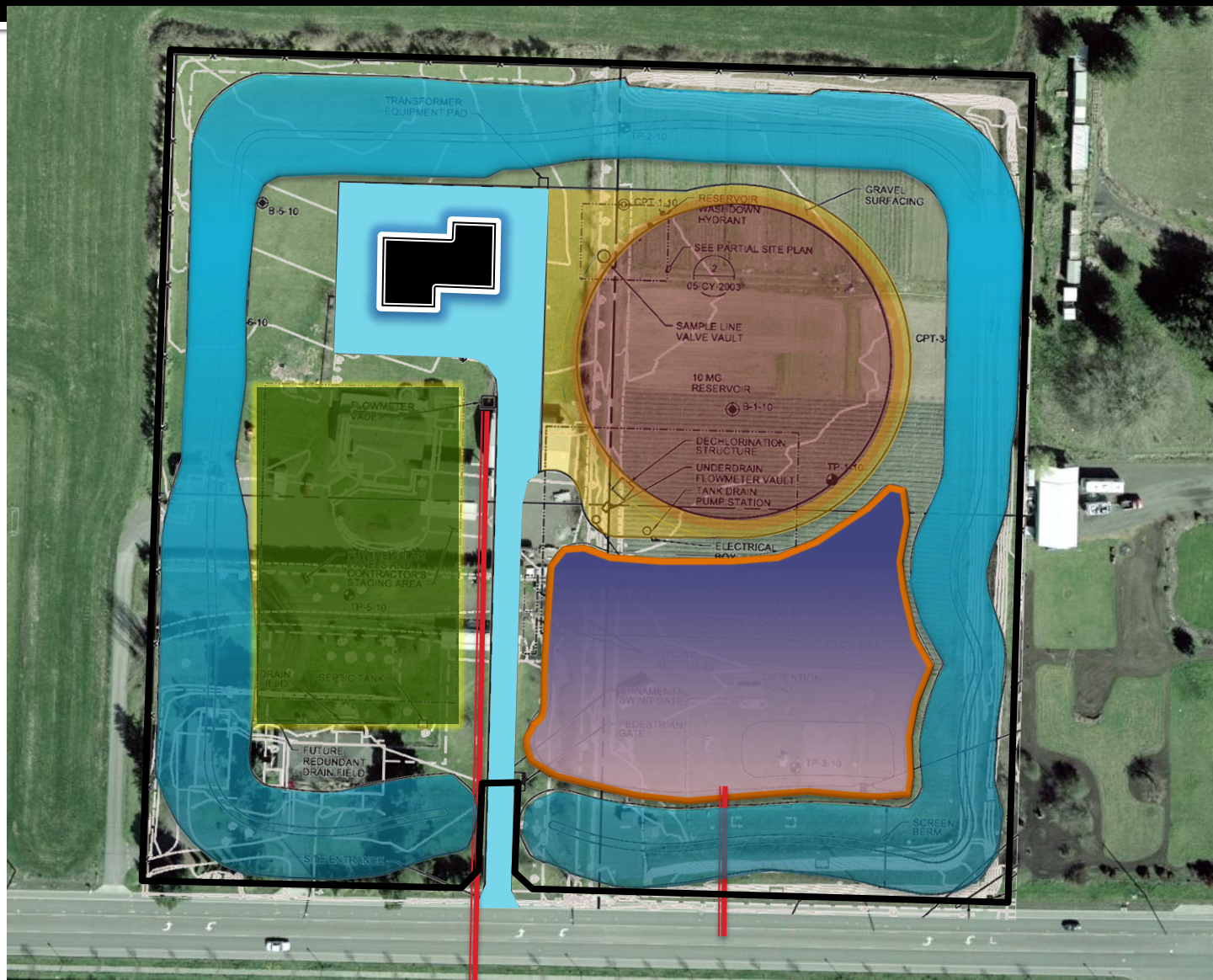


Project Background

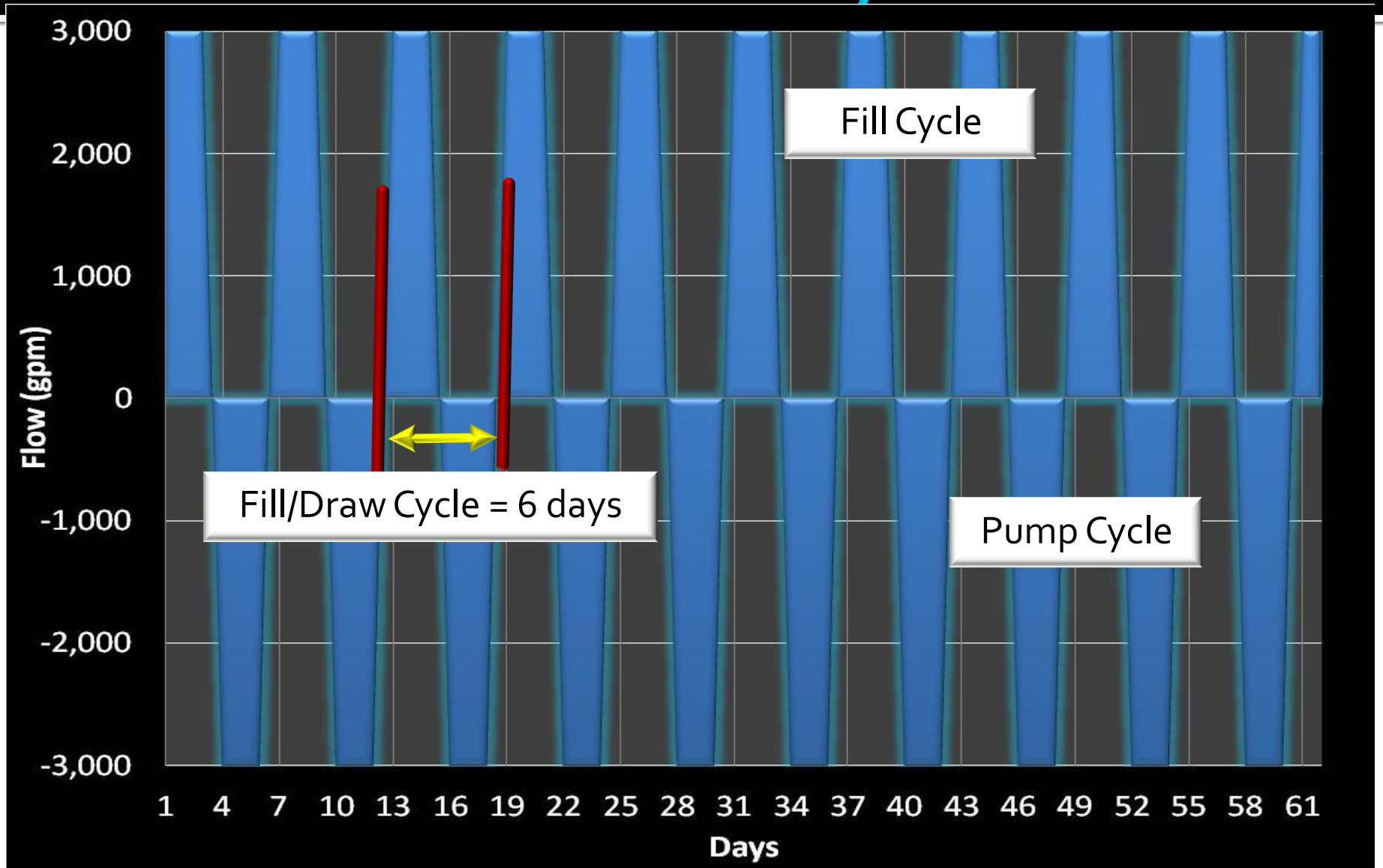
- CMGC Project Delivery
- 10 MG Partially-Buried Water Tank
- 15 MGD Booster Pump Station
- 800 kW Generator
- 88 kW Hydro Turbine
- Rechlorination
- Mixing System

- 24th Street Reservoir – Rechlorination and Mixing System

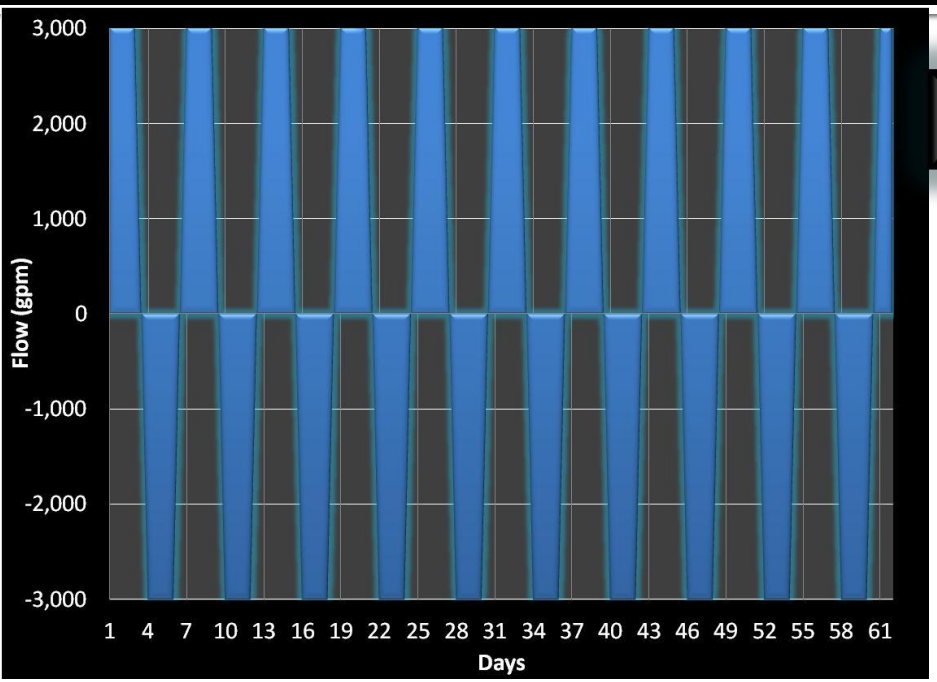
Site Features

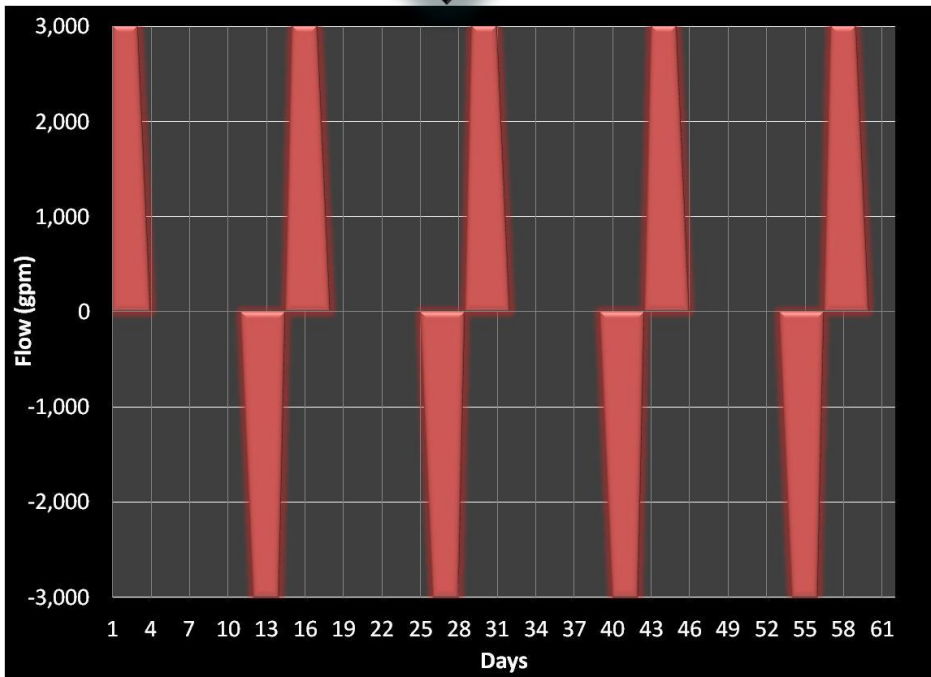


Tank Operation: Current Fill and Draw Cycles



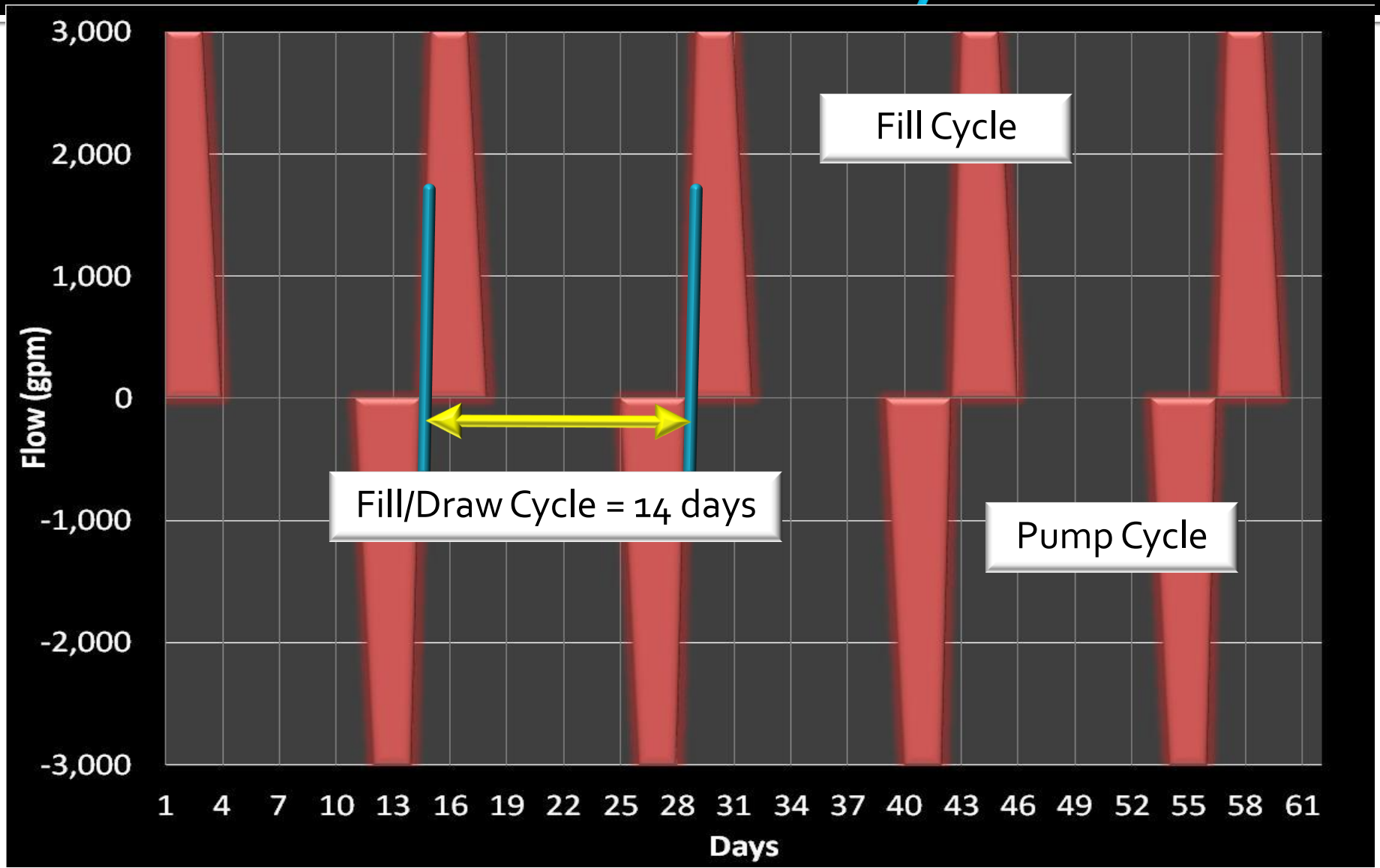
Storage Requirements: Fill and Draw Concepts





Desire to modify current operation and operate fill/draw cycles less frequently

Tank Operation: Modified Fill and Draw Cycle



Water Quality

Water Quality

- Additional storage ⇒ Longer residence time
- Maintaining chlorine residual with long residence times in reservoirs
  - Field tests to evaluate rechlorination
- CFD to evaluate mixing & sampling
- Incorporation of tablet chlorinator into the reservoir and pump station design

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Water Quality: Field Tests

- Laboratory SDS tests
  - Existing reservoirs
  - One PRV supply point
- Screening evaluation
  - Rechlorination
  - DBP production

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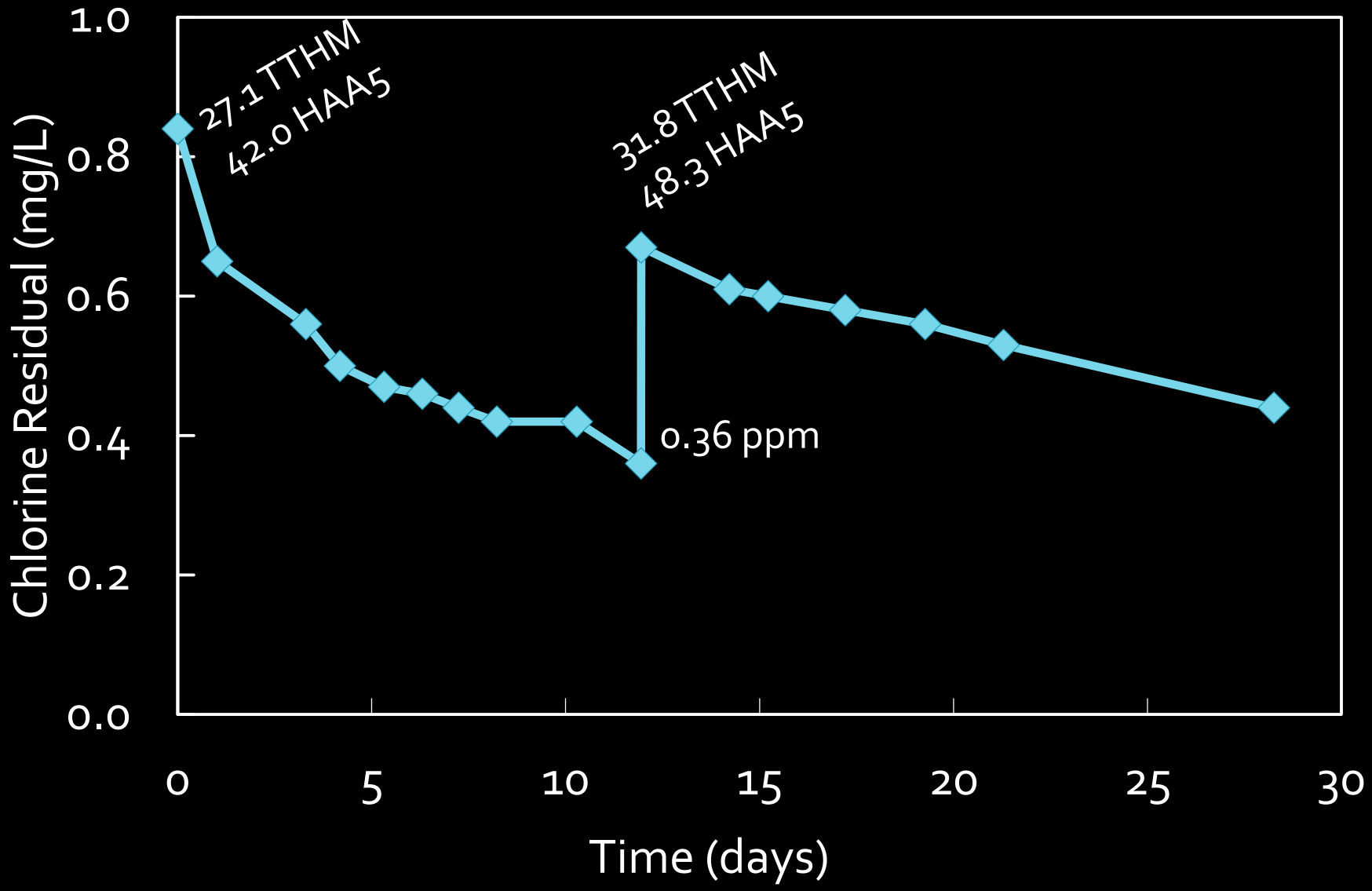
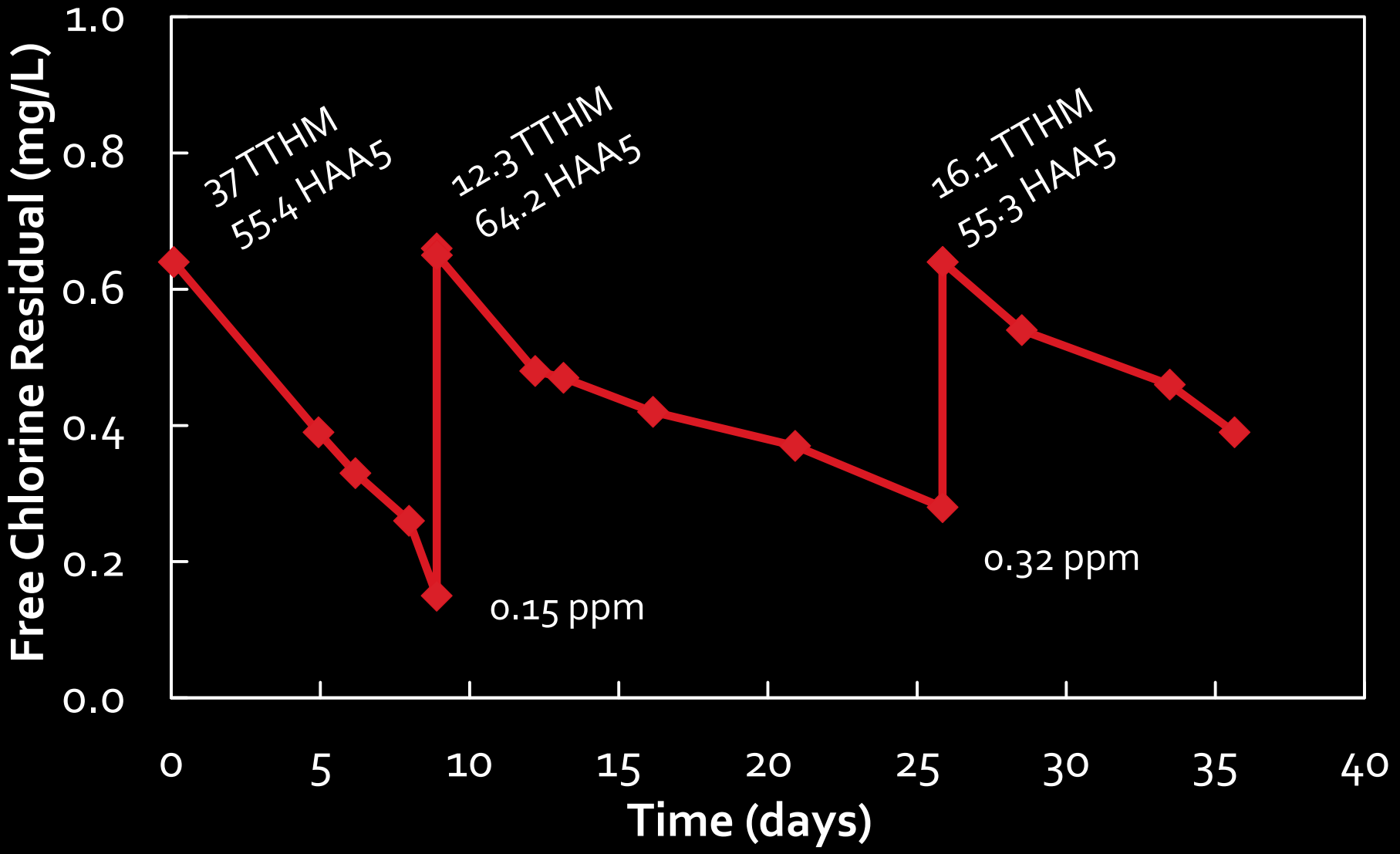
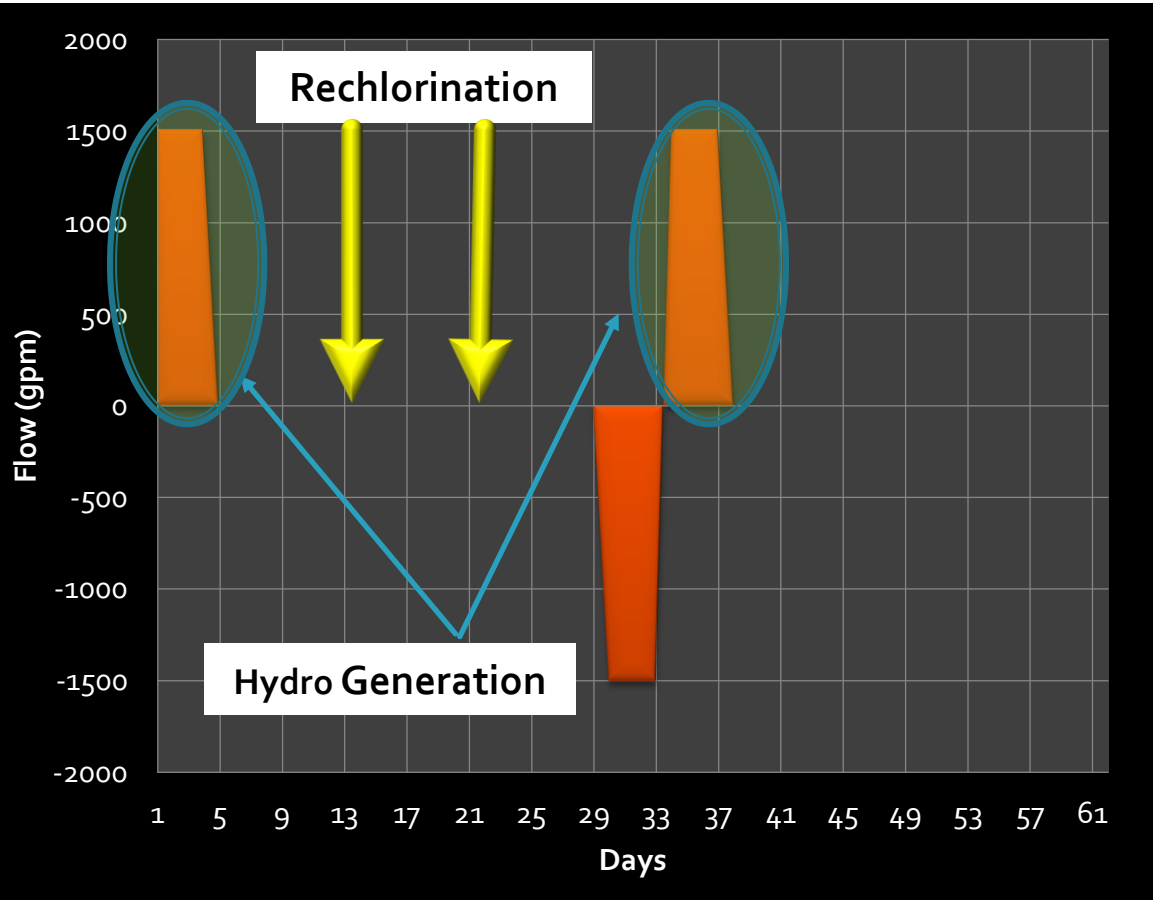
Water Quality:
1st Street PRV Lab Testing



Water Quality:
Evergreen Reservoir Lab Testing



Rechlorination: Promotes Longer Holding Times



- Operation Scenario – 32 day Cycle
  - 4 days fill
  - 8 days hold
  - 1 day rechlorination
  - 8 days hold
  - 4 Days Pump
  - Repeat

- 1/4 Pumping Cycles = 1/4th Pumping Cost
- ½ the Pumping Rate
- 1/4th the Pumping Power Consumption Offset by Hydroplant
- Increased Cost of Rechlorination (about $10k per year)

Water Quality: Benefits for Rechlorination

- Review of Fill/Draw Operation
  - Lab analysis indicated possibility to hold stored water for extended time periods
- Benefits
  - Reduced Operational Pumping Costs
    - Less Pumping
    - Pumping Costs at Evergreen - $58k/year (2009)
  - Able to pump water from tanks when needed
  - Control over detention time in 24th Ave Reservoir
- *Note: This is not a common operational scenario or practice*

Water Quality: Recommendations

- Recommend City implement the operational scenario of rechlorination which would include
  - Additional testing during the first year of rechlorination operations
    - Seasonal variations/field influences may require adjustment to operation
- Extensive sampling and analysis system developed for Crandall Reservoir
  - Reagent-less chlorine analyzer

Power Components

Power Components

- Utility Power Connection
- Backup Generator
  - Power for pump station
  - PGE DSG participation
- Micro Hydro
  - Converting head on inlet to reservoir
- Solar Panels (future)
- LED lights
  - Power saving

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Power Components: Backup Generator

- 800 kW generator
  - Oversized for needs at pump station
- Supply power to pump station **AND** backfeed the power utility (PGE)
  - Parallel switching device
- PGE can operate generator remotely
  - PGE can meet peak power requirements for FERC
  - PGE can defer construction of another peak power supply

Power Components: PGE

- City has first right of refusal for generator use during an emergency
- Generator is exercised under full load during monthly testing
- Win-Win for City
  - PGE pays all maintenance
  - PGE pays all fuel
  - Monitored 24 hours/day

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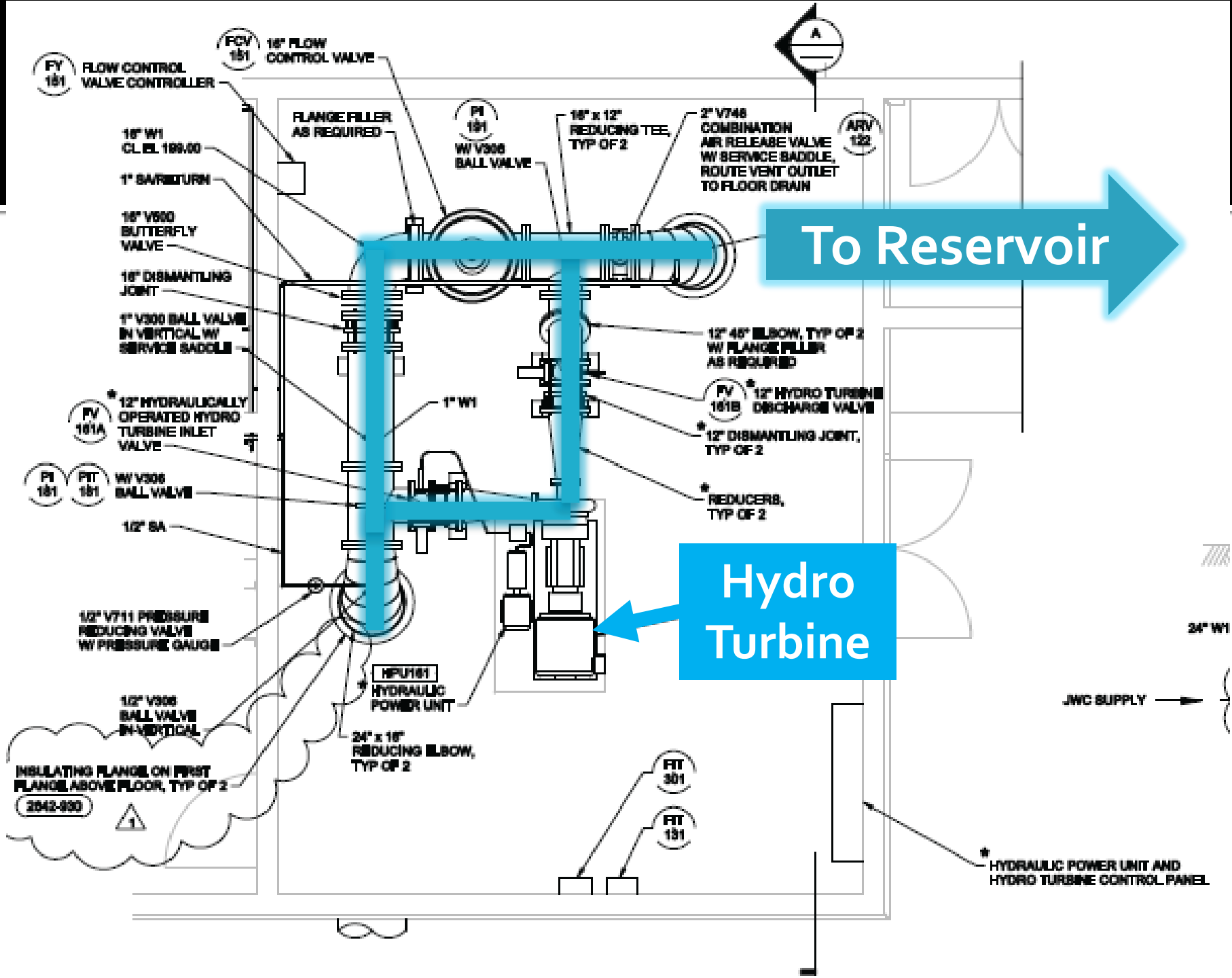
Power Components: MicroHydro

- Turbine that converts excess available head to power
- Supply pressure from JWC at delivery point: 125 psi – 130 psi
  - System pressure reduced to 60 – 80 psi at PRV connection points
  - Only 20 psi needed to fill reservoir
- Use MicroHydro when reservoir is filled
- Power generated is supplied to the grid
  - Net metering agreement with PGE

Power Components: MicroHydro

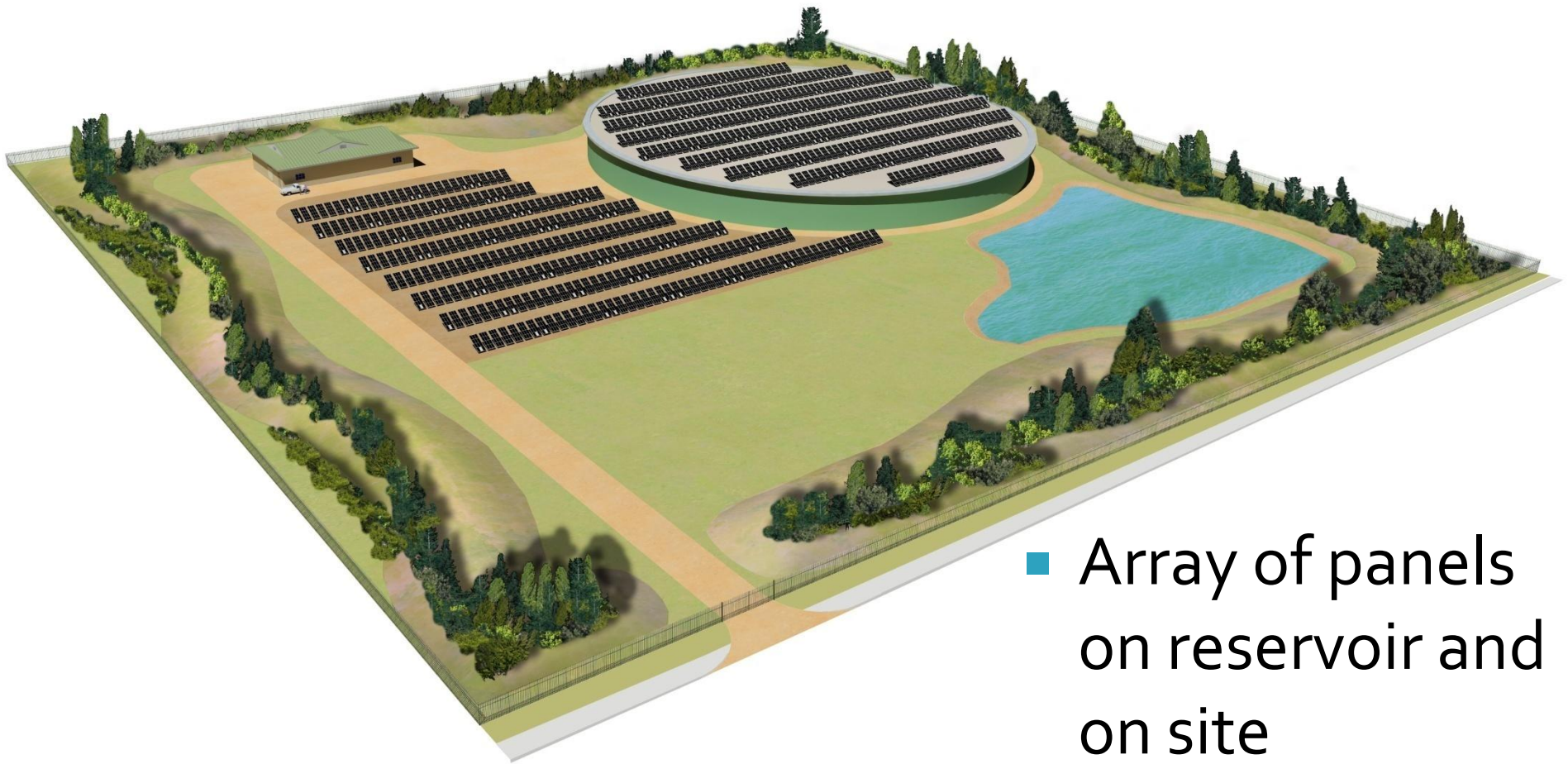
- Driver
  - Strong renewable energy goals
  - Sustainability goals
- Off-the-shelf pump technology
- Single 88 kW horizontal Francis unit


FCV 181
16" FLOW CONTROL VALVE
FY 181
FLOW CONTROL VALVE CONTROLLER
FLANGE FILLER AS REQUIRED
PI 181
W/ V306 BALL VALVE
16" x 12" REDUCING TEE, TYP OF 2
2" V748 COMBINATION AIR RELEASE VALVE W/ SERVICE SADDLE, ROUTE VENT OUTLET TO FLOOR DRAIN
ARV 122
16" W1 CL EL 199.00
1" SA/RETURN
16" V500 BUTTERFLY VALVE
16" DISMANTLING JOINT
1" V300 BALL VALVE IN VERTICAL W/ SERVICE SADDLE
12" 45° ELBOW, TYP OF 2 W/ FLANGE FILLER AS REQUIRED
PV 181B
* 12" HYDRO TURBINE DISCHARGE VALVE
* 12" DISMANTLING JOINT, TYP OF 2
1" W1
PV 181A
* 12" HYDRAULICALLY OPERATED HYDRO TURBINE INLET VALVE
PI 181
PIT 181
W/ V306 BALL VALVE
* REDUCERS, TYP OF 2
1/2" SA
1/2" V711 PRESSURE REDUCING VALVE W/ PRESSURE GAUGE
HPU181
* HYDRAULIC POWER UNIT
1/2" V306 BALL VALVE IN VERTICAL
24" x 16" REDUCING ELBOW, TYP OF 2
INSULATING FLANGE ON FIRST FLANGE ABOVE FLOOR, TYP OF 2
2042-930
1
FIT 301
FIT 131
* HYDRAULIC POWER UNIT AND HYDRO TURBINE CONTROL PANEL
24" W1
JWC SUPPLY
A
To Reservoir
Hydro Turbine

Power Components: Solar Panels

- Planned as part of future activities at the site
- City has experience with solar panels at Evergreen Reservoir site (100 kW) and multiple other locations
- Note: Solarworld is 3 miles from the project site and a water customer of the City

Power Components: Solar Panels



- Array of panels on reservoir and on site

Power Components

- City has the opportunity to generate power 3 different ways at their Crandall reservoir site
  - Diesel backup power generation partnership with PGE DSG program
  - Microhydro offsets pumping costs at Crandall
  - Future solar panels provide a passive power generation opportunity

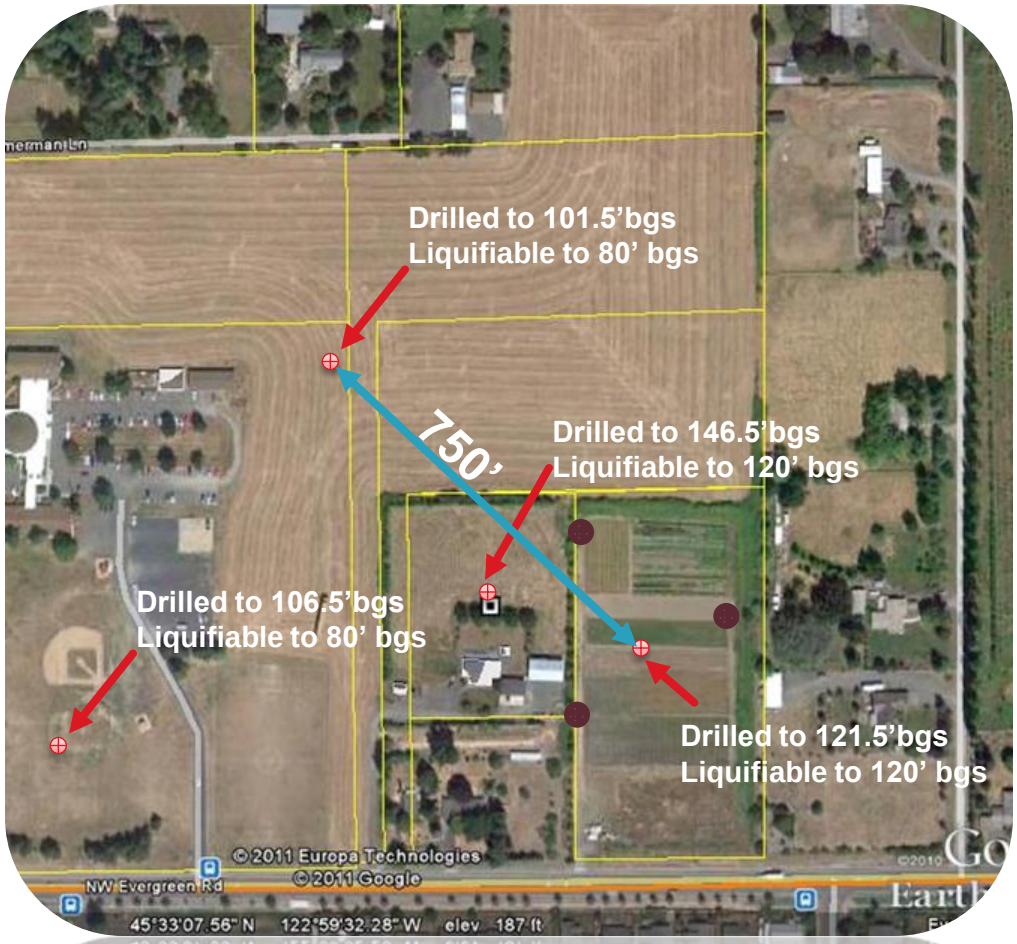
Design & Construction

Construction:
Evergreen Reservoir Subsurface Conditions

- Evergreen Reservoir project found liquifiable soils to 32’ below ground surface (bgs)
  - Mitigation was additional excavation to 27’ bgs, and import fill

Construction: Crandall Reservoir Subsurface Changes

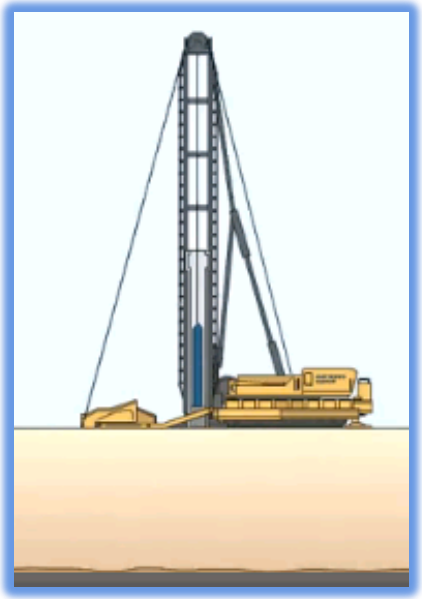
- Siting study (2007) found liquifiable soils at 80’ bgs.
  - An increase in **48’** of liquifiable soils from Evergreen Reservoir located 16,000’ feet away.
- Final Design (2010) at Crandall Reservoir site found liquifiable soils at 120’ bgs.
  - A **40’** increase in depth of liquifiable soils – 750’ away.



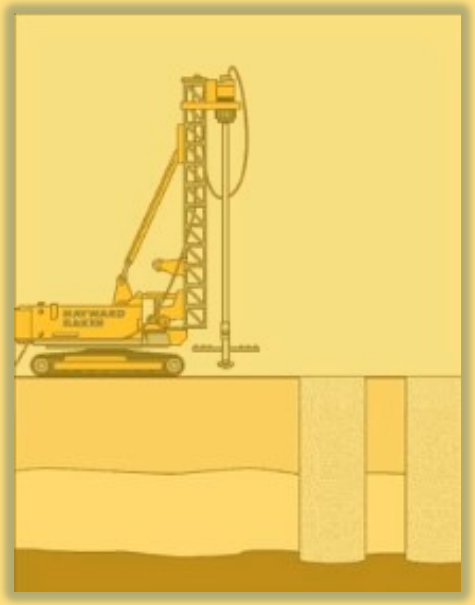
Demonstration of Liquifiable Soils

Foundation Improvement Alternatives

- Foundation Improvement Options Investigated were:



Piles



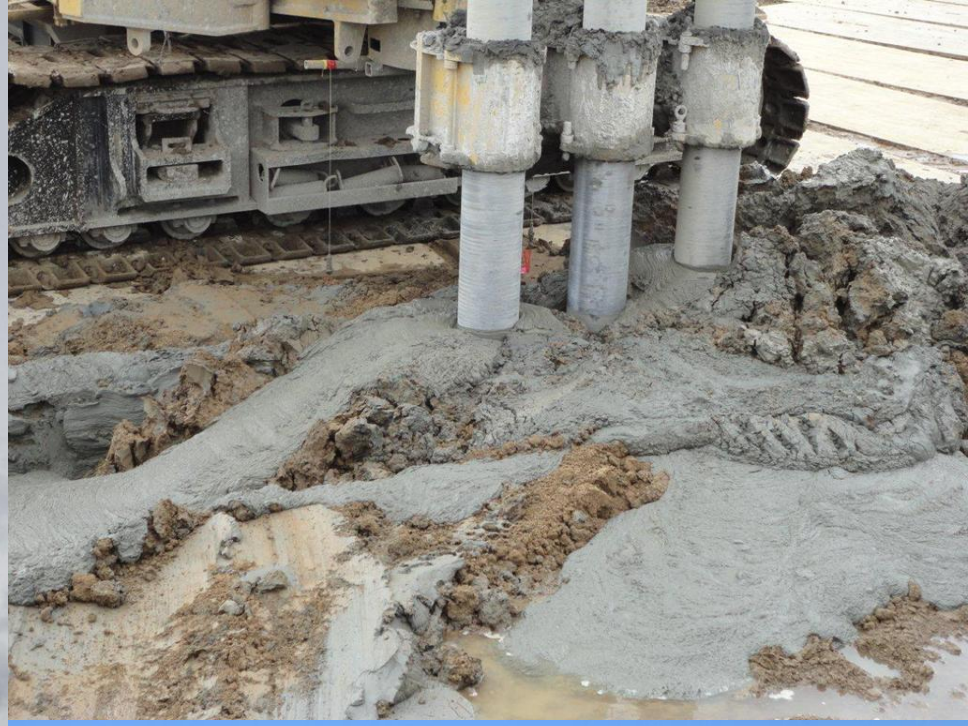
Deep Soil Mixing

Jet Grouting

Advantages of CDSM

- Lowest Cost
- Least impact (vibratory and acoustically) to surrounding neighbors
- More "green" method of construction as compared to piles


DEERE




DEERE
08/28/2012

Weather:
2012 Record Wet Spring

CH2M Asst PM, Jeff Stallard:
Project Weather Expert

Construction: Current Progress

Date: April 24, 2013

Construction: 1 Year Previous

Date: April 2012

Construction: Family Visit

Construction: Current Progress

Construction: Current Progress

Extended Reservoir Storage Validation

Extended Storage: 24th Street Reservoir

- Extended storage testing at 24th Street Reservoir
- Extended Storage Test Periods 2, 3, and 4 weeks
- Test periods repeated for seasonal WQ variations
- SCADA monitoring of Cl2, UV 254, and pH
- Periodic sampling of THM and HAA5

Extended Storage: 24th Street Reservoir

- Trial 1 (March 19 to April 1)
- No rechlorination

	3/19/2013	3/25/2013	4/1/2013	**MCL**
HAA5	0.0420	0.0408	0.0370	**0.0600**
TTHMs	0.0432	0.0412	0.0470	**0.0800**
TOC (by lab)	0.89	0.63	0.57	
Cl2 (by colorimeter)	0.69	0.6	0.52	

Extended Storage: 24th Street Reservoir

- Initial extended storage results appear promising
- Correlate UV254 monitoring with DBP formation potential
- Document seasonal raw WQ influences on test results
- Keep below MCLs for TTHM and HAA5

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Next Phases

- Construction Continues
- Wrapping of reservoir (May)
- Leak testing June
- Pump Station finishing (July)
- Startup (Sept)
- Landscaping (Sep-Oct)
- Commissioning (Late Fall)
- Extended storage validation (2014)

Questions?

Thank you

Tyler Wubbena
City of Hillsboro

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