

**CH2MHILL®**

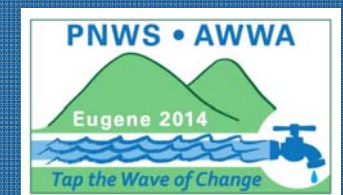


*Will Crandall Reservoir and Pump Station Construction Team  
Dedicated October 1, 2013*

## The Road to a Successful Project

*2014 PNWS-AWWA Conference  
Eugene, Oregon*

*Tyler Wubbena, P.E., City of Hillsboro  
Brad Phelps, P.E., CH2M HILL*



# This Successful Project Was Underlain By Complete Team Collaboration

## Actions to Success

- Adequate Project Funding
- Defined Roles/Responsibility's
- Open/Continuous Communications
- Personality's / Personal Behaviors
- Fair Negotiations
- Agreed Quality Parameters
- Trust



*Will Crandall Reservoir and Pump Station Construction Team*

*Dedicated October 1, 2013*

*82 Weeks Construction Duration*

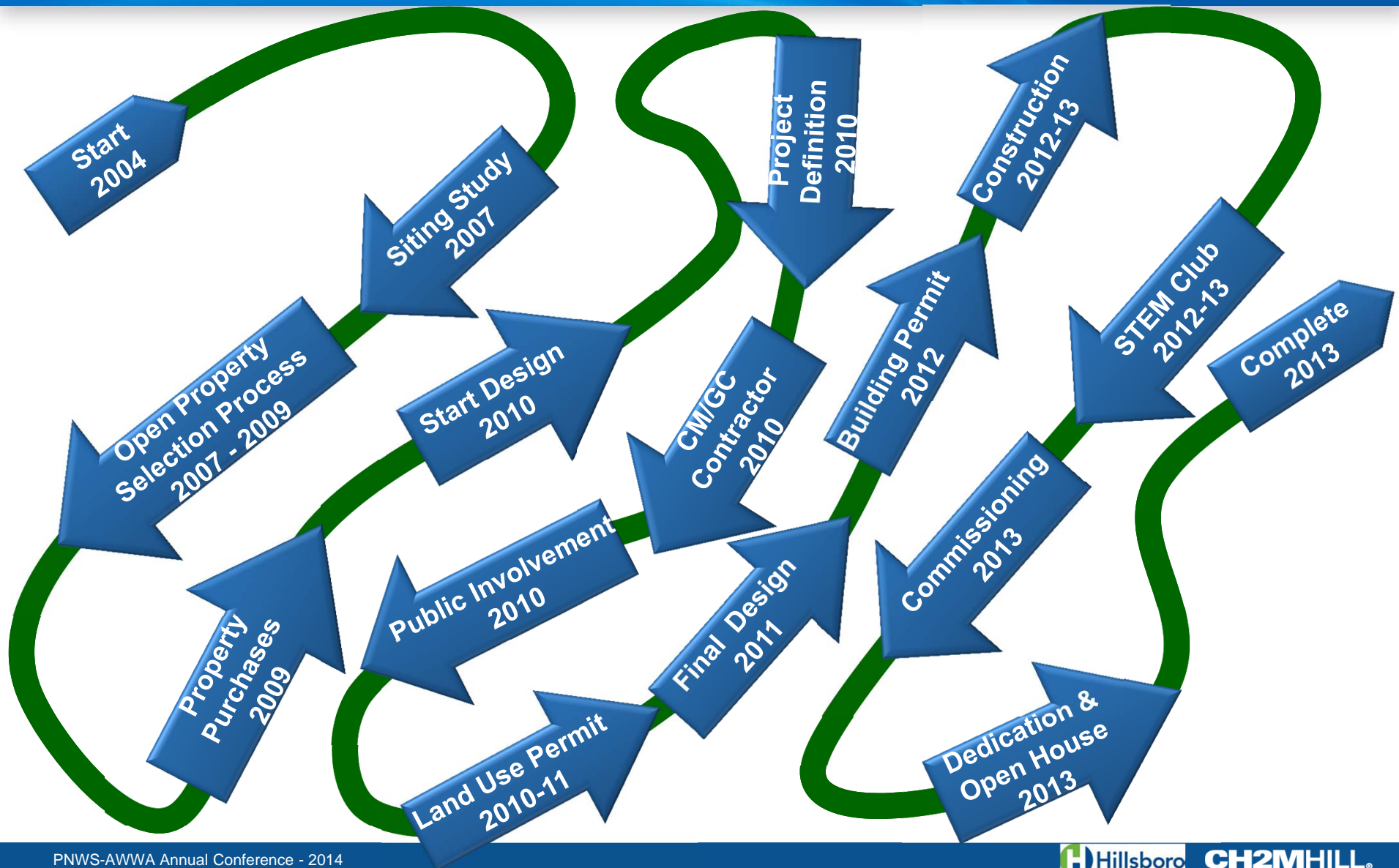


*Lands and Lands Construction  
Ratto, Inc.  
DN Tanks  
Cassidy Landscaping  
Willamette Fence Co., Inc.  
Kraft River Corp. Concrete  
Bar M Shed Commercial  
Canyon Hydro*

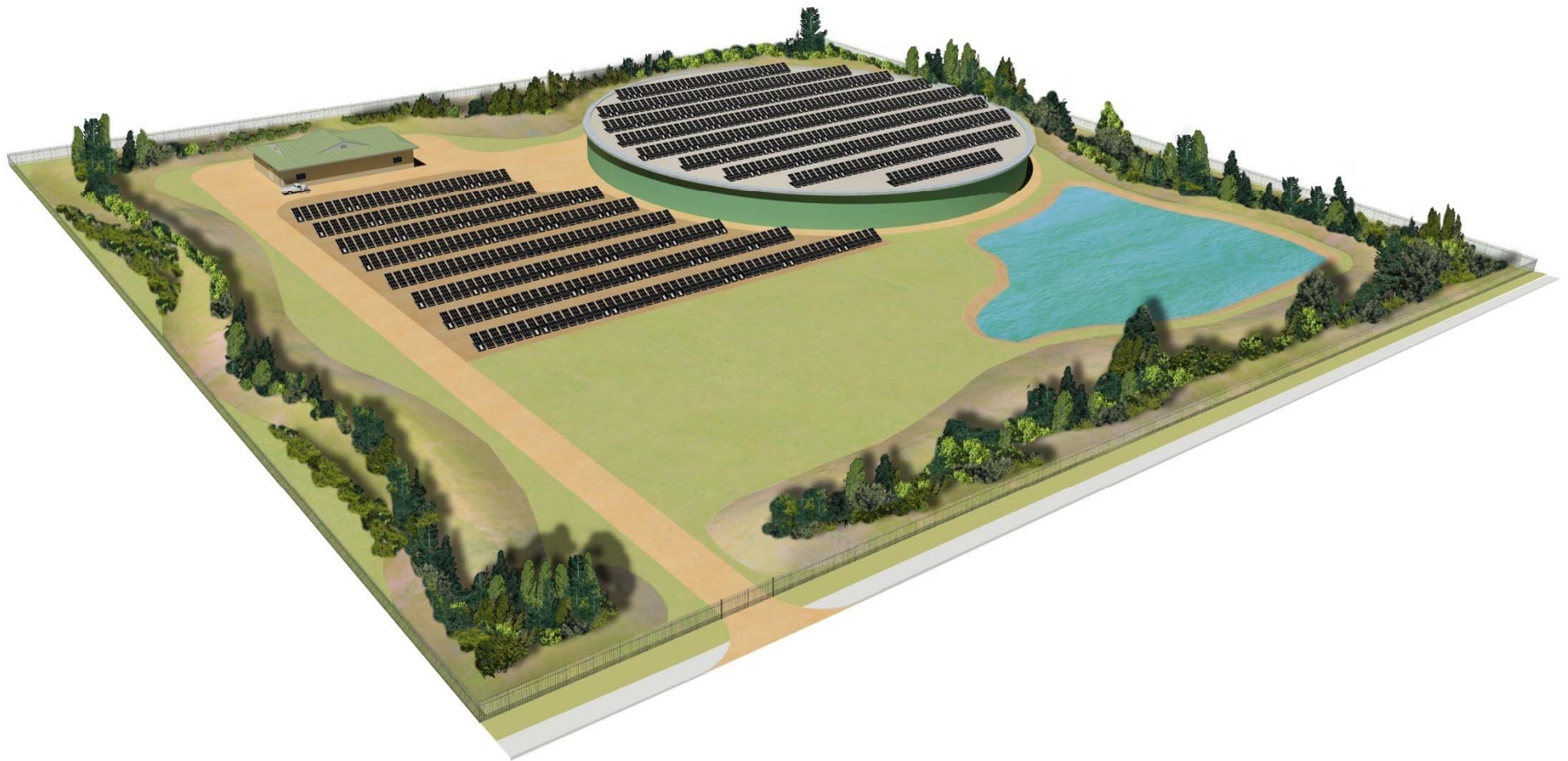
*Portland Sheet Metal Works  
Fine Painting, Inc.  
Roth Heating & Cooling  
Haskins Electric, Inc.  
Optimal Control Systems, Inc.  
Milne Masonry, Inc.  
Snyder Roofing*



# The Ten Year Winding Road to Success was not without Challenges



# First Task Find and Purchase a Site

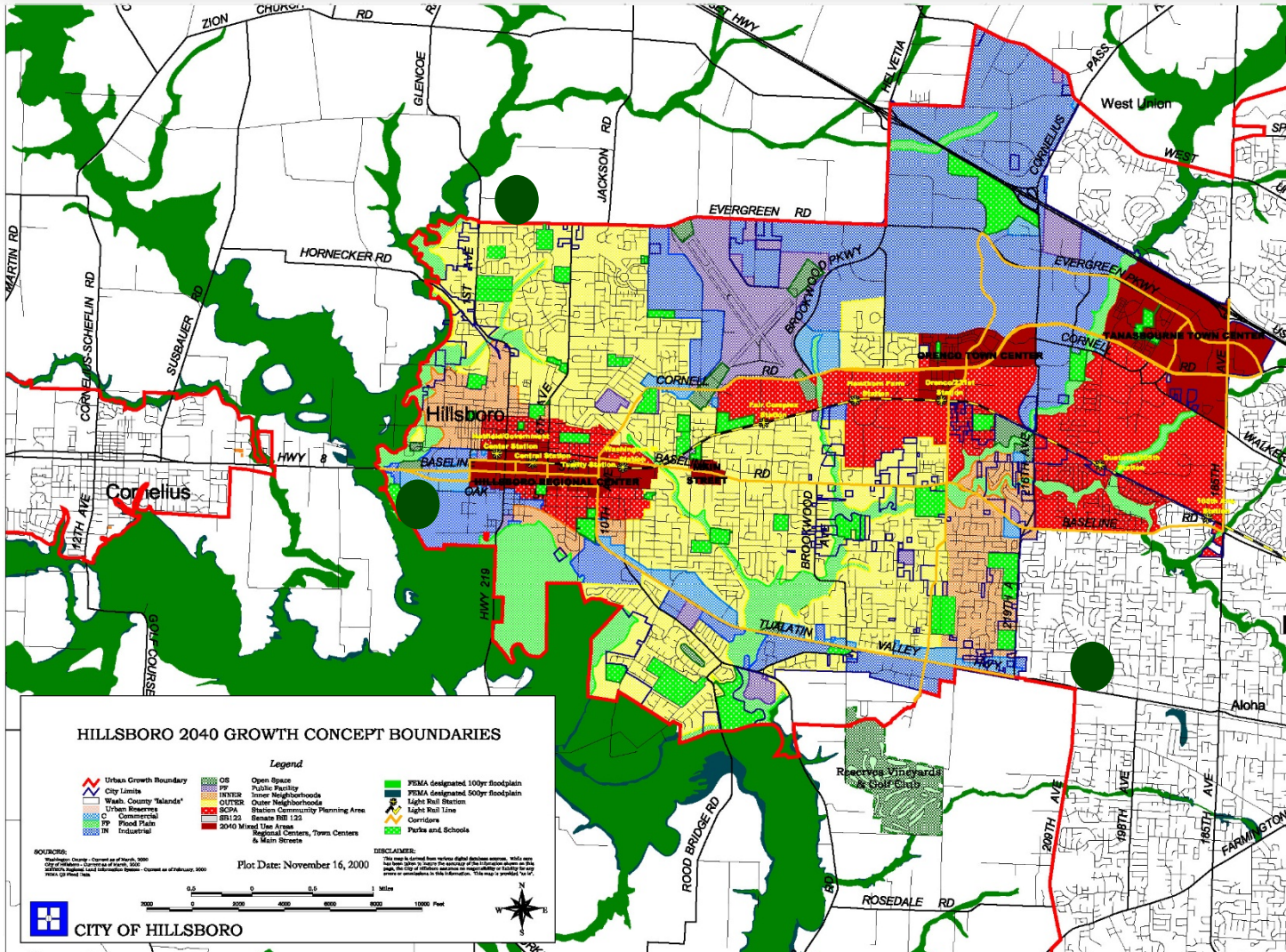




# Reservoir Site Selection and Property Purchase

- Find Three New Reservoir Sites
- Each Site Needs to be 6 to 10 Acres

# Location and Basic Supply System



Two Regional Pipelines Service Hillsboro

Nine Outlets provide water to Hillsboro

Two Existing In-Town Reservoirs

Three Additional Reservoirs Needed



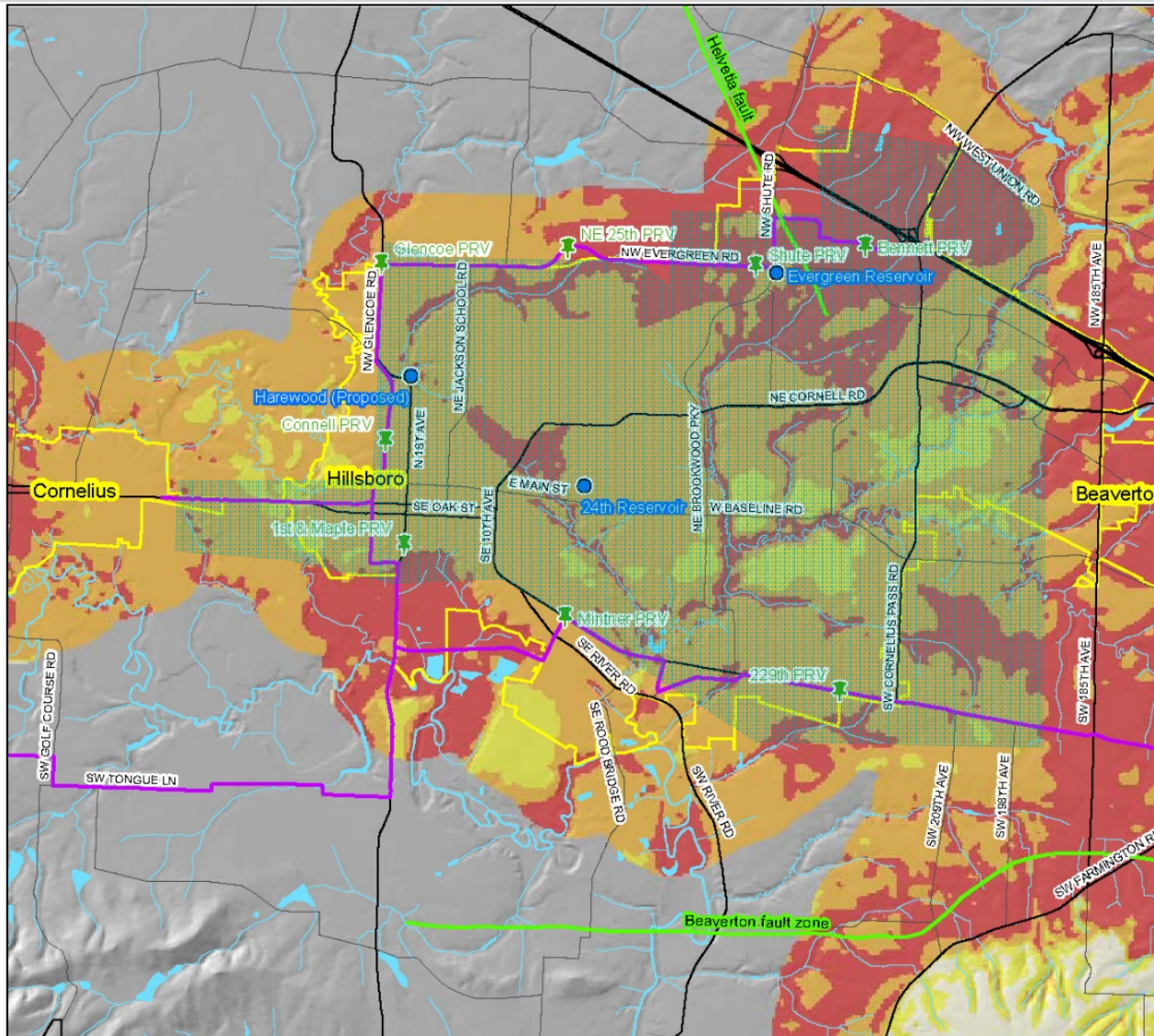
# Site Selection Criteria

- Geotechnical Considerations
- Serves Growth
- Distance to City's Distribution System and Transmission Supply
- Distance to Drainage Systems
- Environmental Impacts
- Independent of Cost
- Zoning / Planning Factors
- Utilization of Nuisance Sites

Score Definition: 5 = highly favorable; 4 = favorable; 3 = neutral; 2 = less desirable; 1 = undesirable

Map ID No.	Tax Lot No.	Parcel Size (ac.)	Geotech	Serves Growth Potential	Water Quality	Distance to Distribution Pipes	Distance to Drainage	Environmental Impacts	Total Capital Costs (Const. & Site)	Distance to Transmission Pipeline	Zoning / Planning Factors	Utilization of Non-Conforming/Nuisance Sites	Accessible Site	Short Term Impacts to Community/Neighbors	Partnerships	Multi-Use Potential	Price-Per-Acre	Site-Cost-Score	Total Score	Rank
262	1S2110001600	203.38	3	5	5	5	5	5	5	4.5	2	3	5	5	5				2277	1
302	1N6240D00300	17.00	3	5	5	5	3	4	5	5	2	3	5	5	3				2152	2
530 / 531	1N3240001809 / 1N3240001806	11.75	3	5	5	5	5	4	4	4	2	3	5	5	3				2037	3
216 / 216A	1S302A000100 / 1S302A000101	40.85	2	4	3	5	5	4	5	4.5	2	3	5	5	5				2018	4

# Initial Geotechnical Considerations



**Exhibit 3-1**  
**Relative Earthquake Hazards**  
 Reservoir Siting Study  
 City of Hillsboro  
 Hillsboro, Oregon

**LEGEND**

- Pipelines
- PRVs
- Reservoirs
- Cities
- Major Arterial Roads
- Minor Arterial Roads
- Rivers and Streams
- Lakes and Ponds
- Faults

Relative Earthquake Hazard Zone

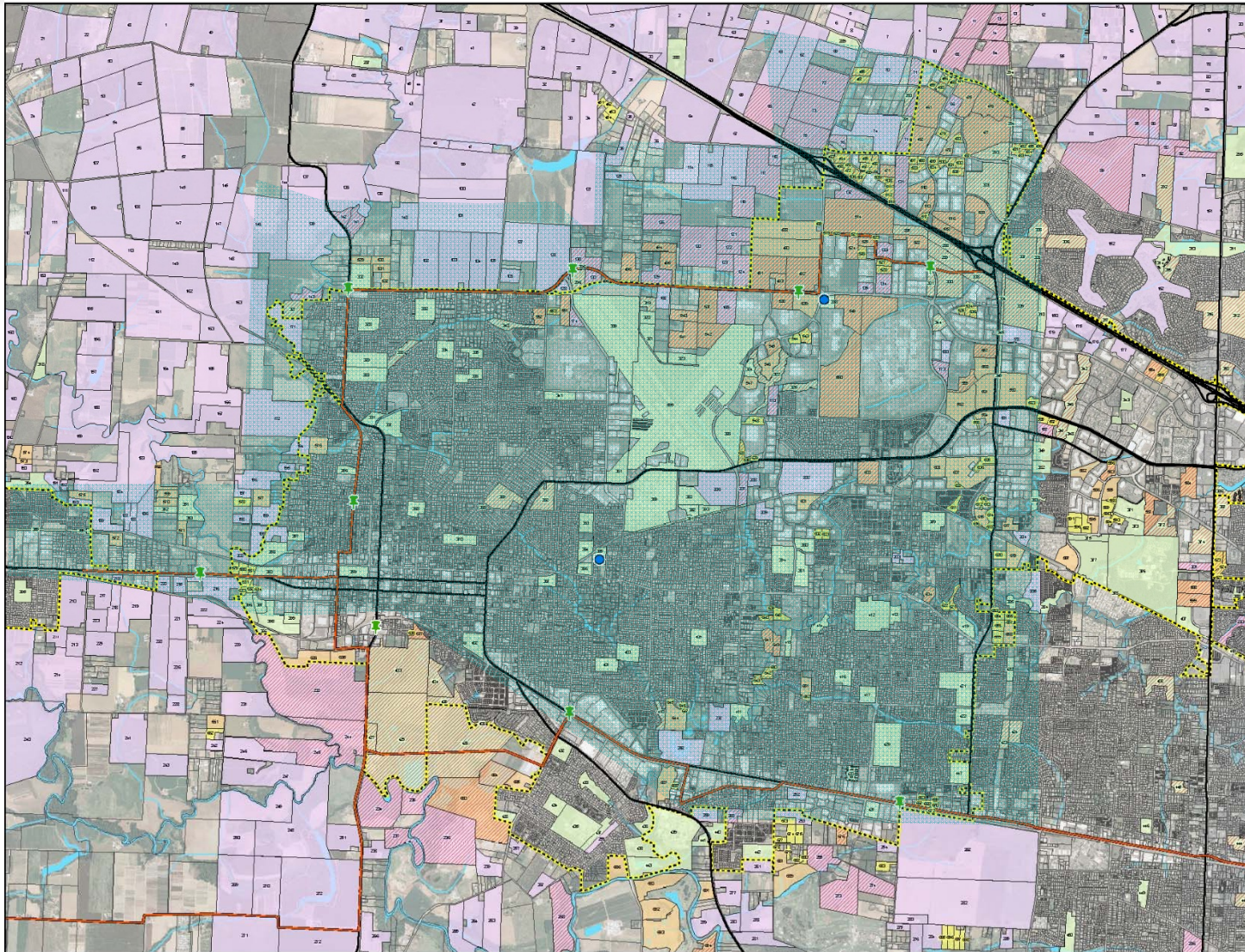
- Zone A
- Zone B
- Zone C
- Zone D

N

0 0.5 1  
 Miles



# Initial Parcel Identification Over 900 Sites

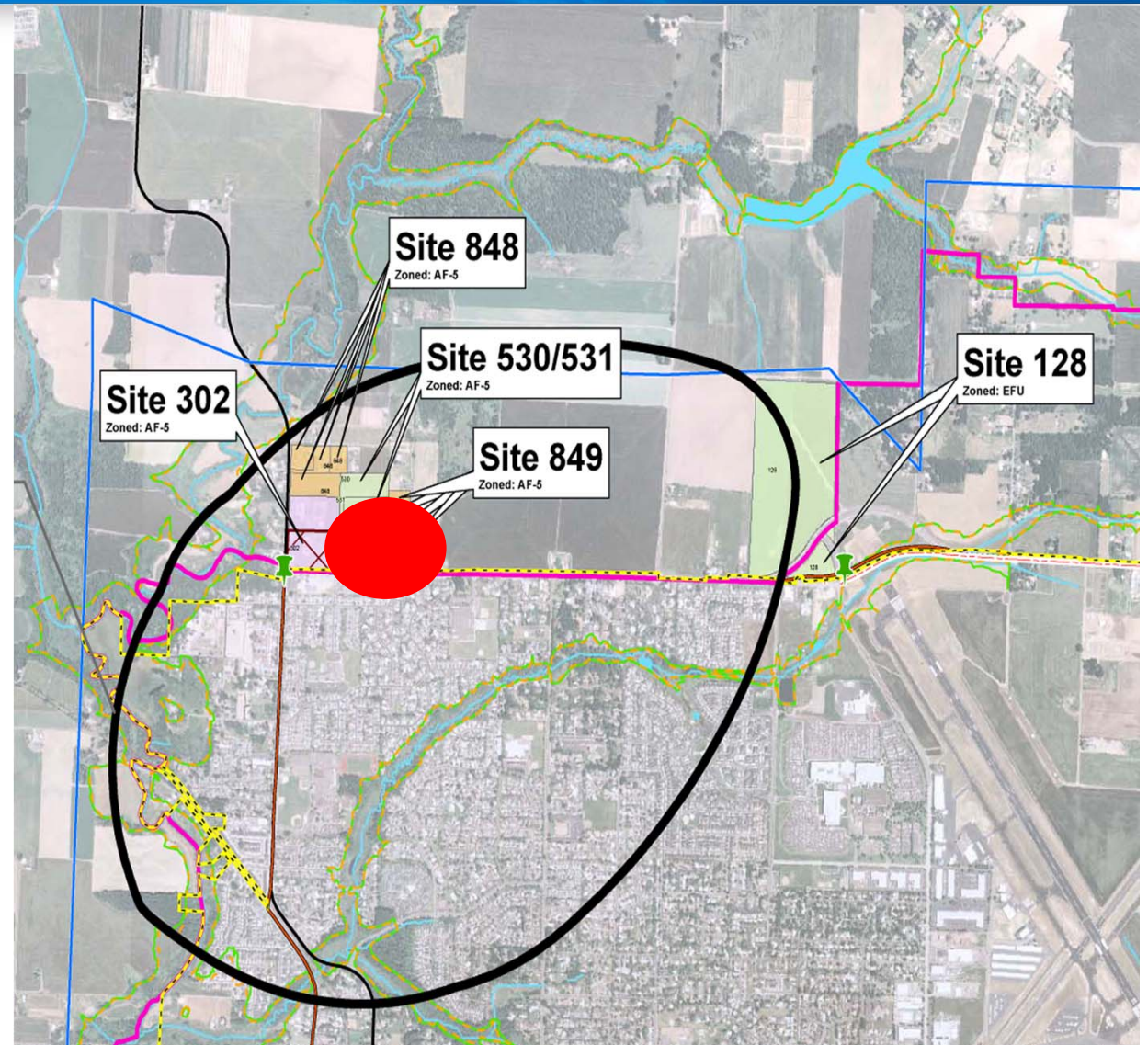




# Northwest Sector Top 5 Sites

## 5 Sites in Top 20

- 0 inside City Limits
- 5 outside City Limit
  - 4 sites AF-5
  - 1 site EFU



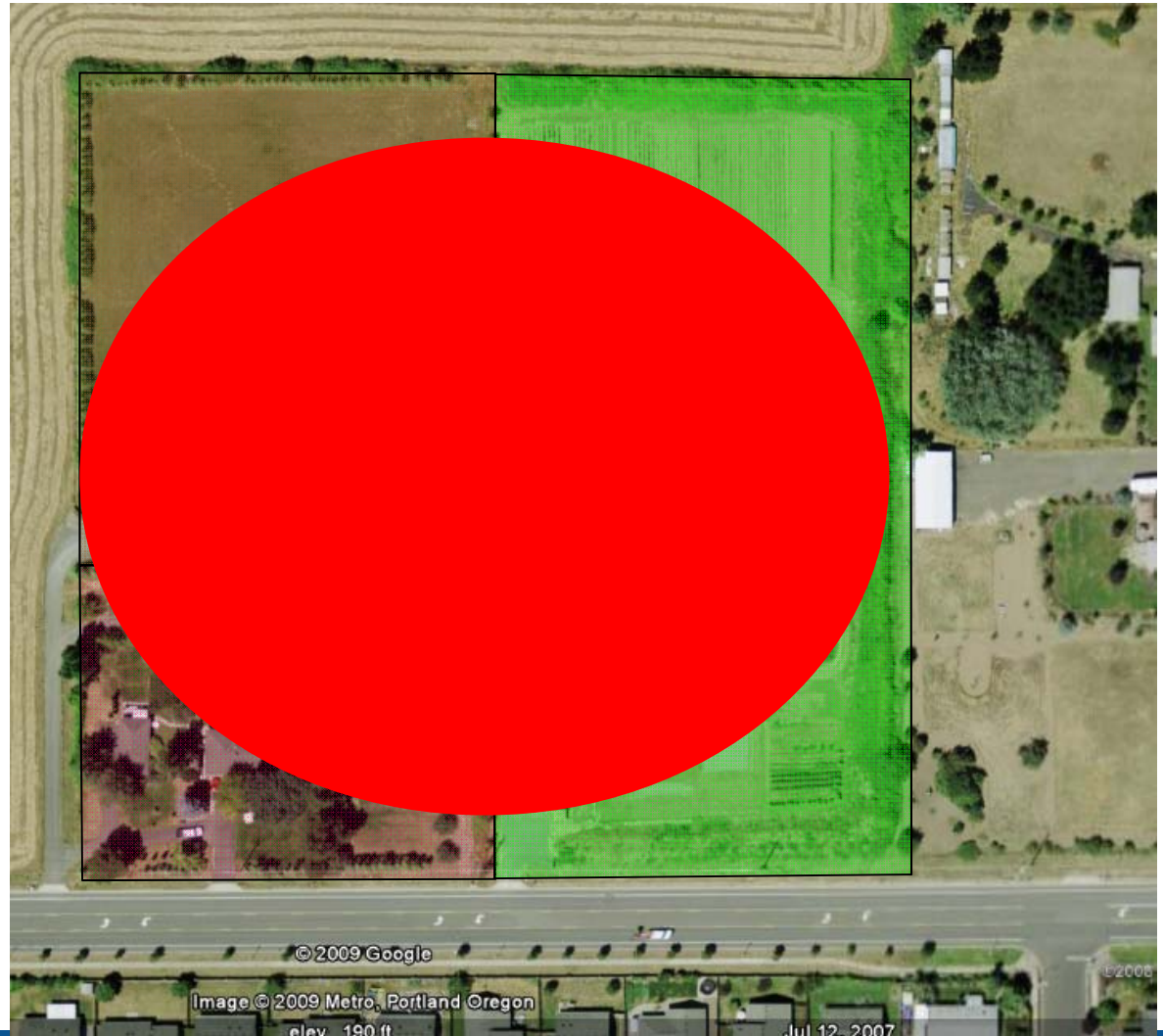


# NW Reservoir Site

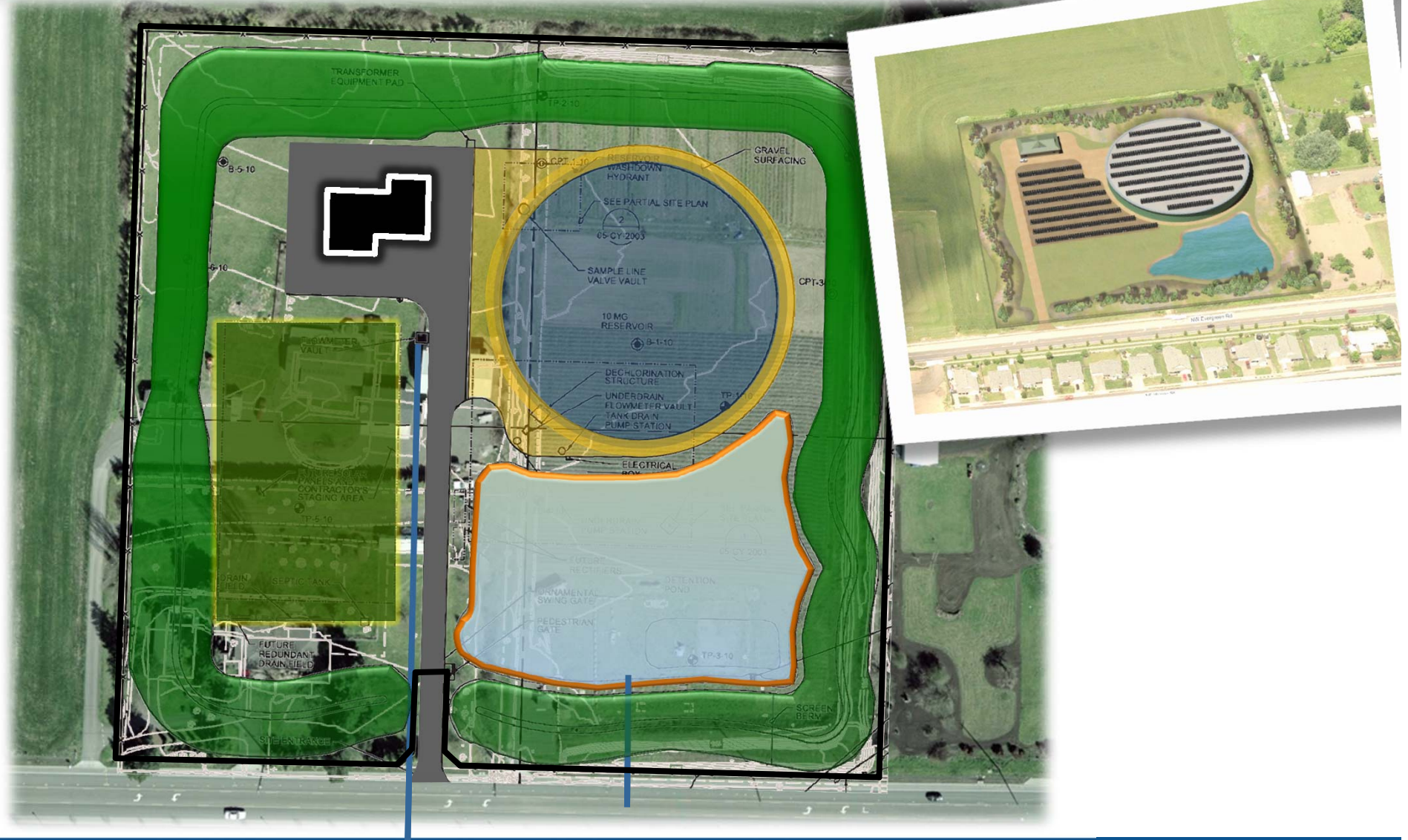
## 3 Parcels to Comprise a Single Site

- Parcel A - 2.64 Ac
- Parcel B - 1.66 Ac
- Parcel C - 5.03 Ac

TOTAL 9.33 Ac



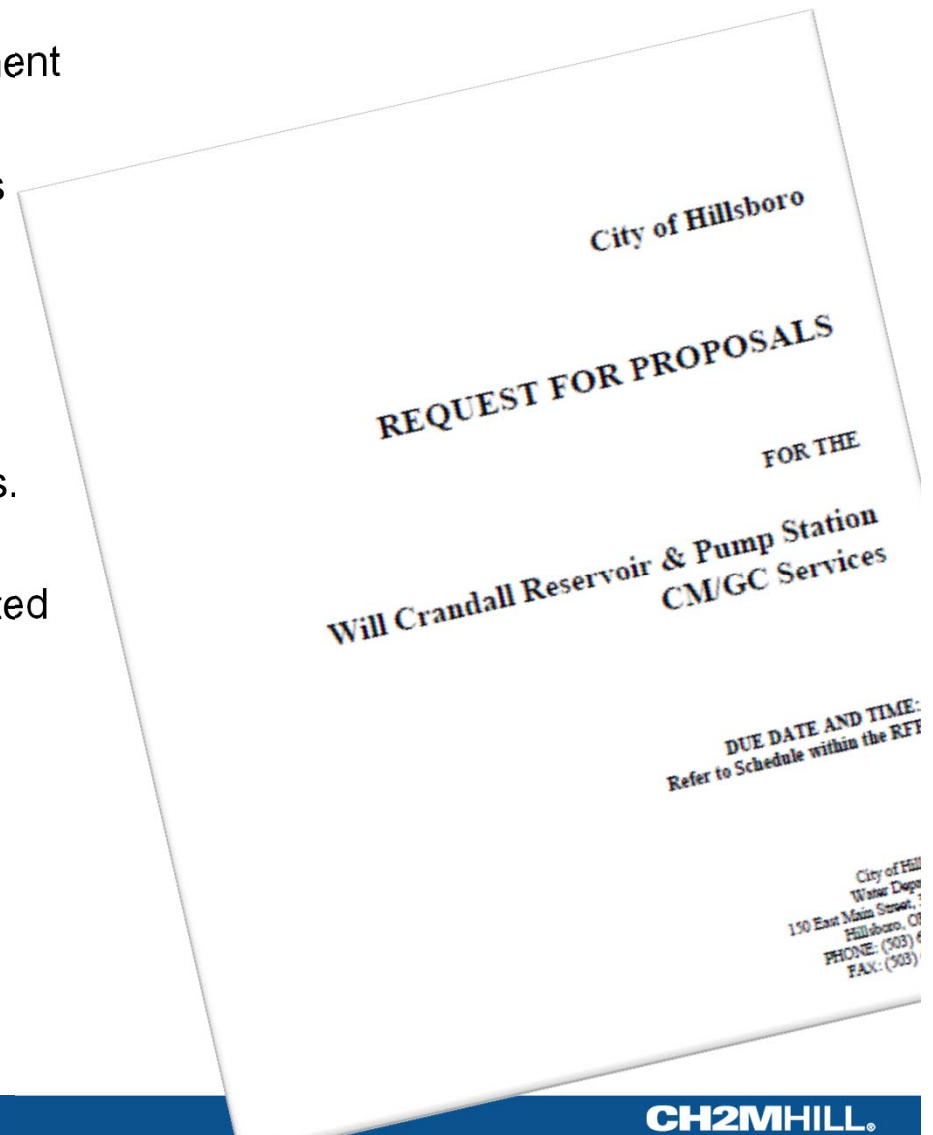
# Project Design Elements



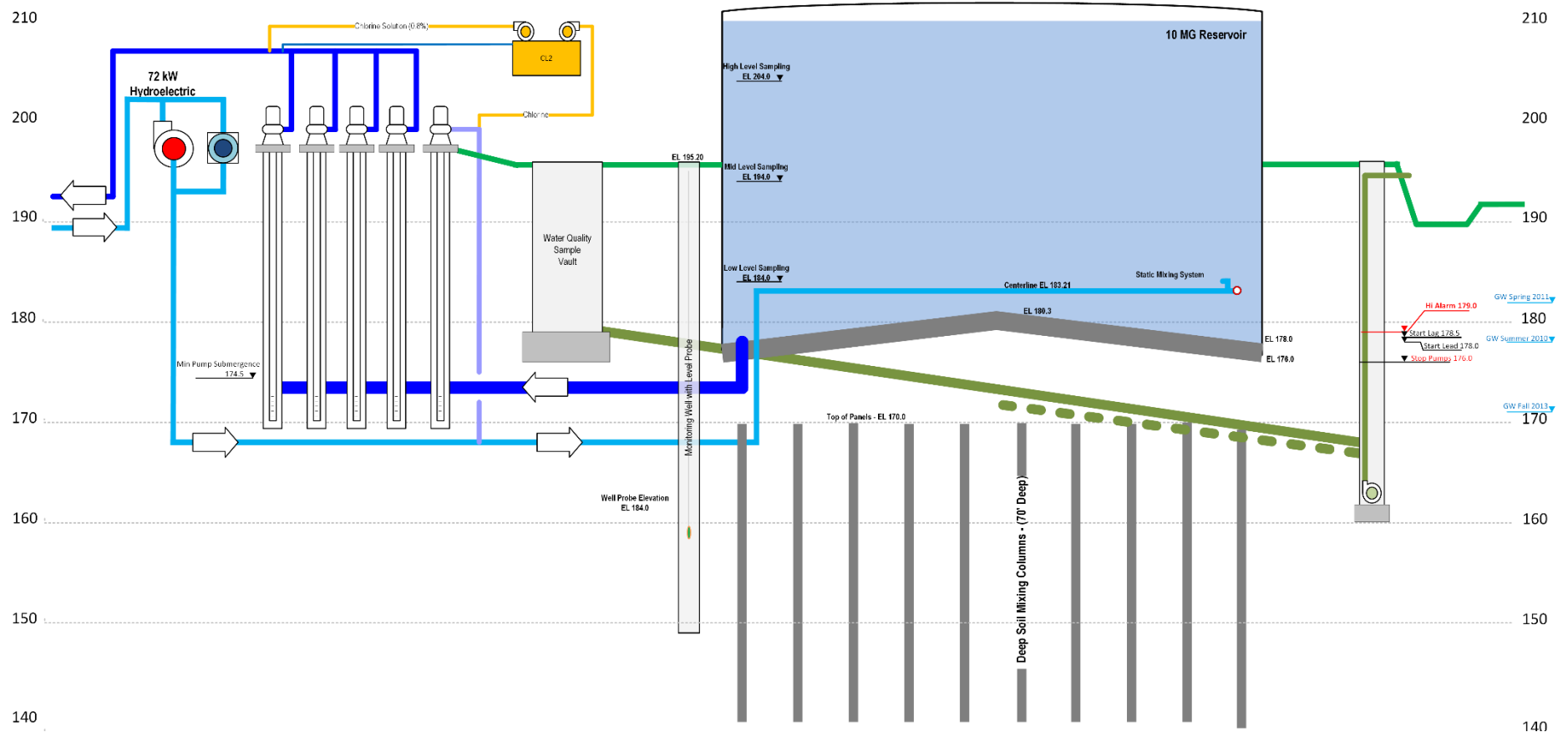


# CM/GC Construction Contractor Selected

- Contractor Selected at 10% Design Development
- Selection performed primarily on qualifications process
- Four Contractor's provide proposals
- Two Contractors selected for verbal interviews.
- Ward-Henshaw Construction Company Selected



# Defining/Designing the Project

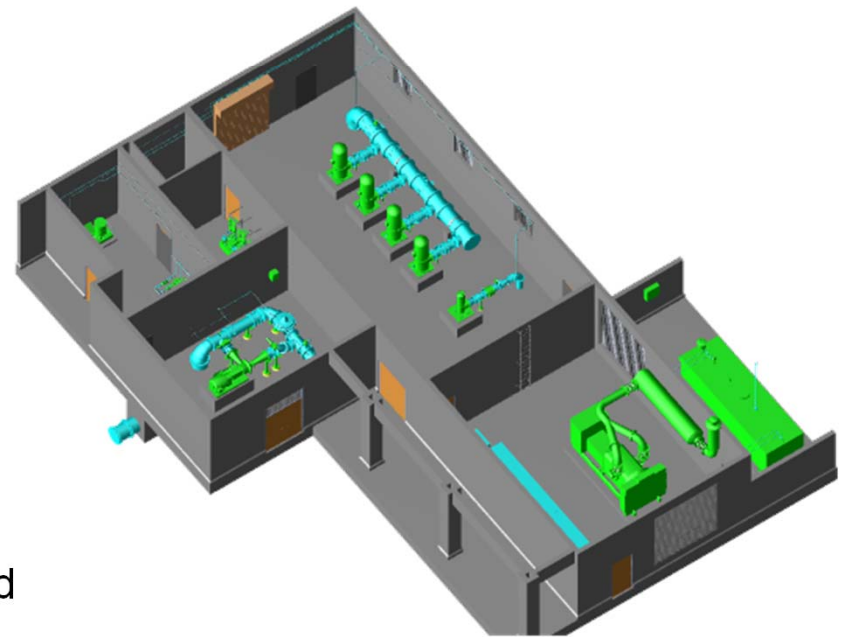


Team Collaboration throughout design  
Involved all stakeholders in each system and process



# Design Process and Project Evolution

- City wanted a “Full-Featured” Community Asset that is seismically resilient and would provide emergency service
- Team remained flexible in developing project elements
- The Project entailed more than “just” a Reservoir and Pump Station
- Provide a facility with high flexibility in operations
- Incorporated Contractor and Operations Staff input/advice throughout Design
- Utilized 3D Models to assist with project understanding
- Weekly Design Communications kept team informed



# Design Evolution and Informed Decision Process

Siting Study	
Ward Henshaw Est	N/A
CH2M HILL Estimate	\$21.6 M
Reservoir Size	15 MG
Peak Pumping	10 MGD (4 - 125Hp)
Firm Pumping	7.5 MGD
# of Pumps	4
P.S. Discharge	Single Zone
Building Size	1550 sq ft (Evergreen)
Generator	350 kW
Hydro Generator	No
Rechlorination	No
Solar	No
ASR (Future)	No

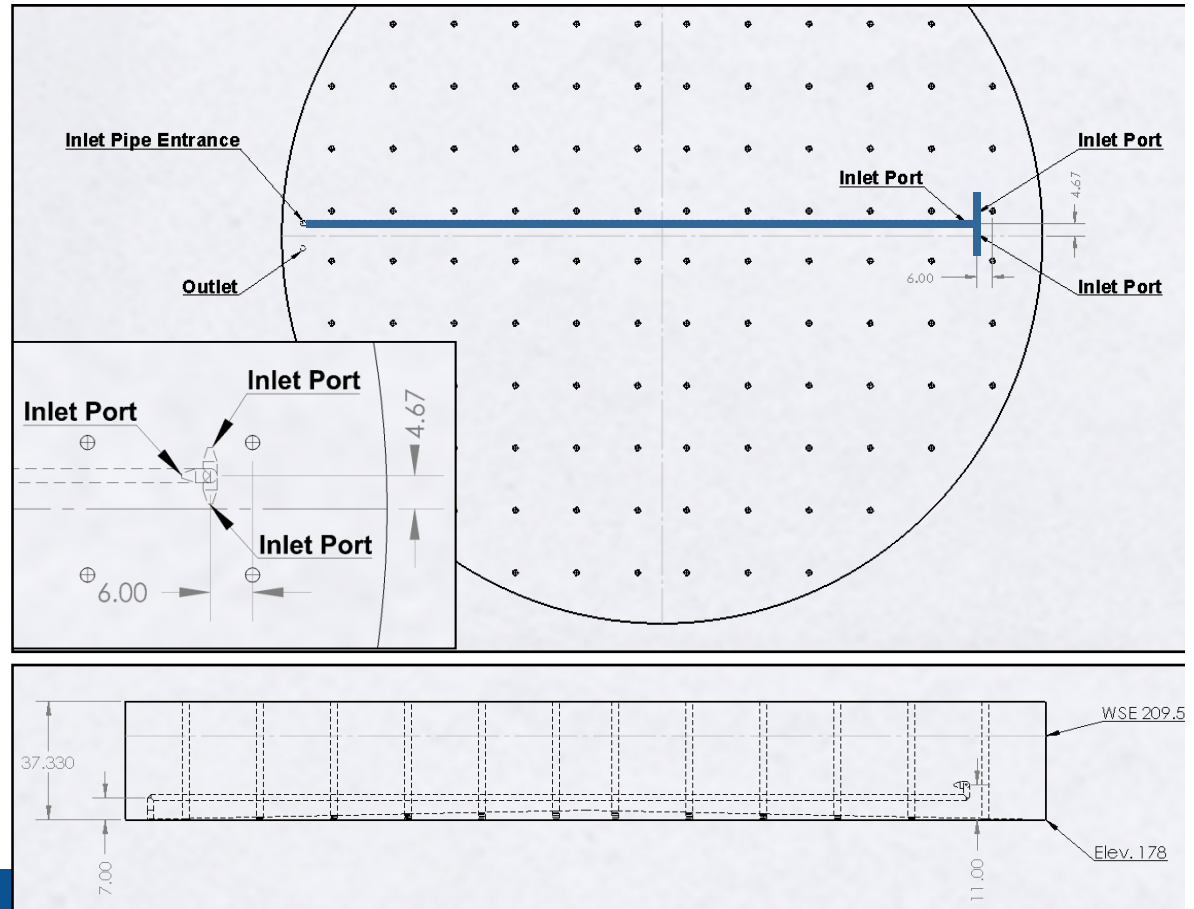


# Permits and Status Log

Permit	Remaining	Application Delivered	Approved Application
PGE Service Application		X	
PGE Netmetering Application	X – Needs Meeting		
FERC Waiver (hydro)	X – Planned Meeting		
OHA (plan rvw)		X – This Week (LUCS)	(expected in 30 days)
DEQ 1200C ESC		X – This Week (LUCS)	(expected in 30 days)
DEQ Air Quality Permit	X – Eqpt Specific Needed		
Wa Co Land Use	Need to update Dwgs, and perform Lot Line Adjustment	X	X - Conditioned
Wa Co Road Opening / Entrance		X – This Week	(expected in 30 days)
Wa Co Building Permit (Grading/Bldg/Plumb/Elec/Mech)		X - Today	(expected in 30 days)
Wa Co Septic	X – Needs to have installer identified		
Wa Co Noise Variance	Contractor to Request		

# Computational Fluid Analysis Provided Reservoir Mixing Analysis and Design Parameters

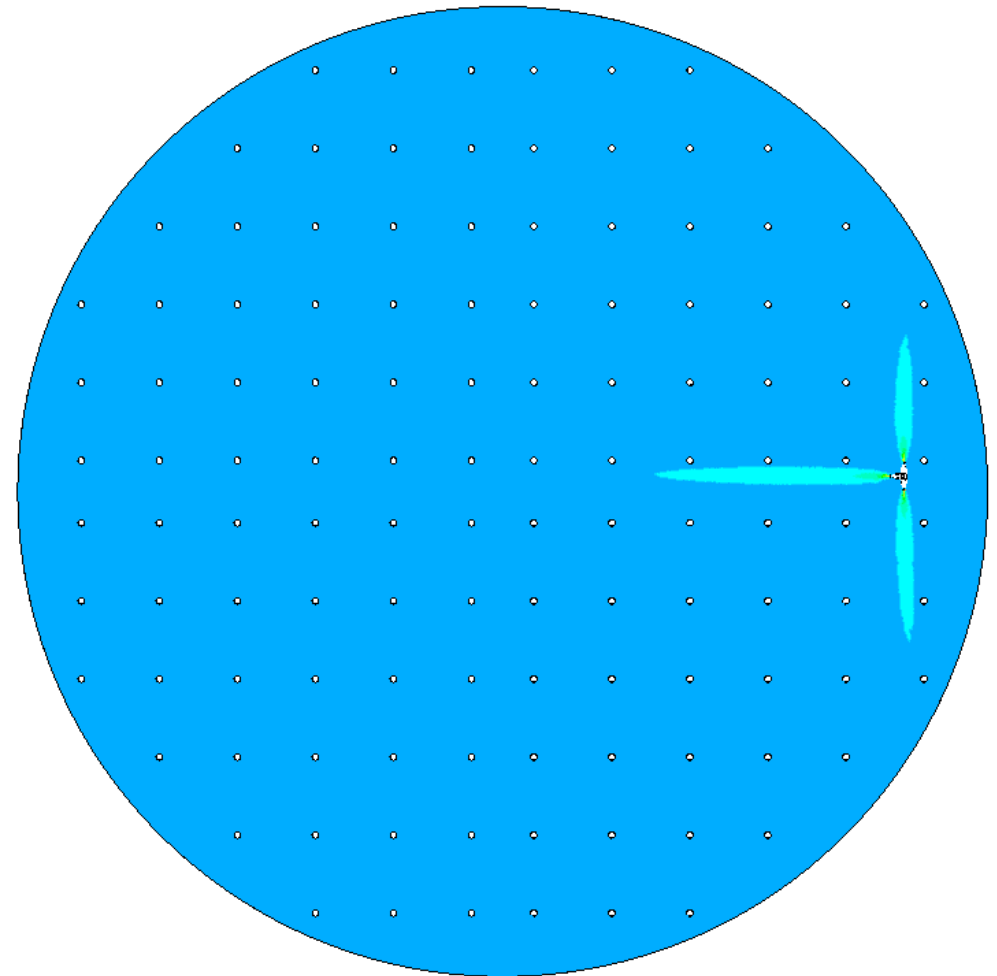
- Many Options Investigated
- Selected “T” Style Outlet System
  - 3 ea, 8” Ports
- Required Flowrate 2MGD





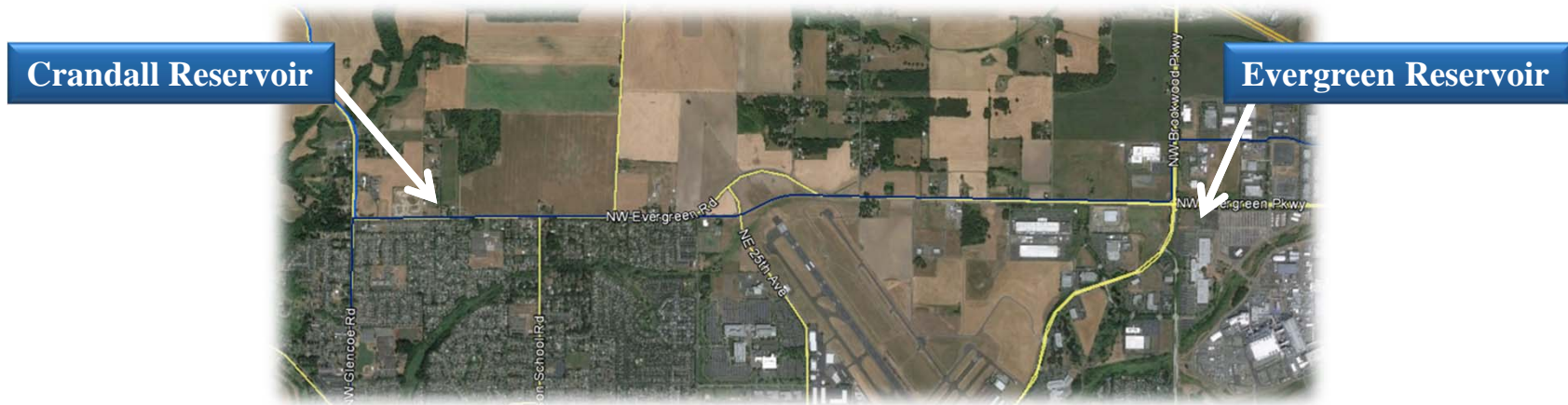
# Crandall Mixing Analysis

- 29 hour Mixing Time at 2MGD provides 10% Coefficient of Variation



# Evergreen Reservoir Subsurface Conditions

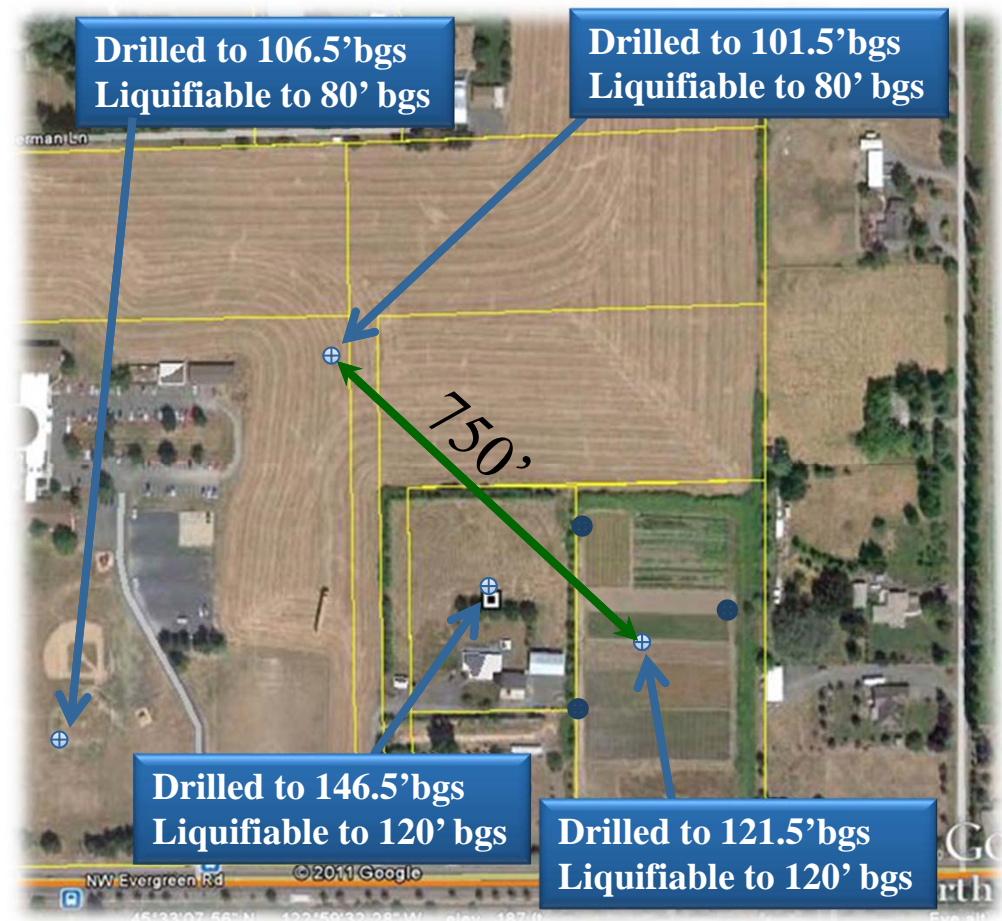
- 2001 Evergreen Reservoir project found liquifiable soils to 32' bgs.
  - Mitigation was excavation to 27' bgs, and import 7' of structural fill.





# Crandall Reservoir Subsurface Changes

- Siting study (2007) found liquifiable soils at 80' bgs on neighboring property.
  - A **150%** increase in depth of liquifiable soils from Evergreen Reservoir located **3 miles** away.
- Final Design (2010) at Crandall Reservoir site found liquifiable soils at 120' bgs.
  - A **50%** increase in depth of liquifiable soils – **750'** away.
  - A **375%** increase (**88' additional liquifiable soils**) from **Evergreen to Crandall**.



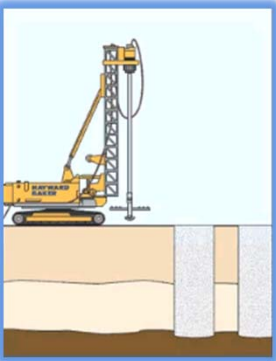
# Ground Improvements Considered



Piles



Jet  
Grouting



Deep Soil  
Mixing





# Ground Conditions Required Subsurface Improvements



# Project Construction



A project with more than just a  
Pump Station and Reservoir





# The Onsite Weather Predictor 2012 Record Wet Weather



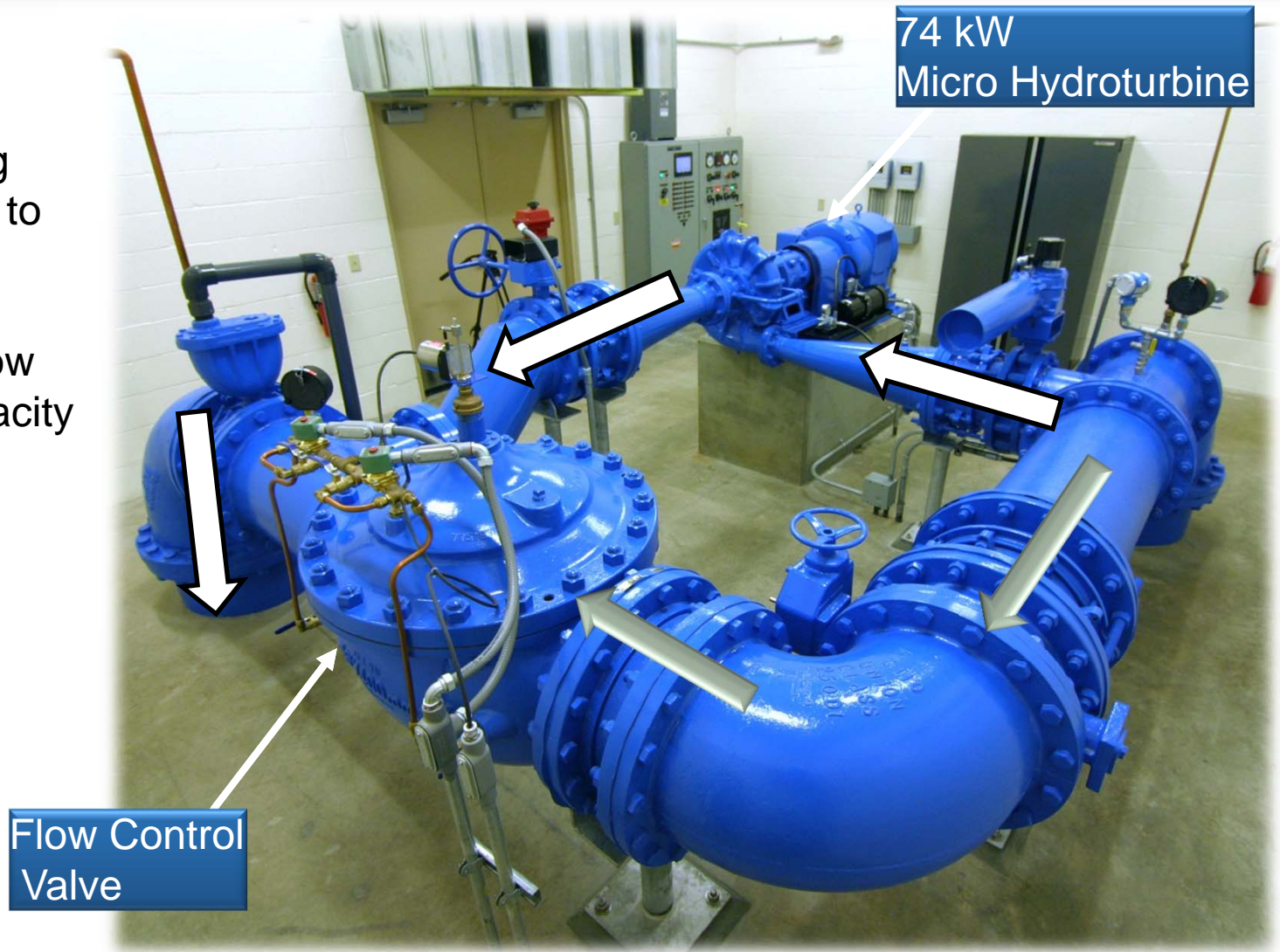
CH2M Asst PM, Jeff Stallard:  
Project Weather Expert



# Micro-Hydro Designed to 2MGD Capacity Provides Netmetering Power during Fill Cycle

Excess Inlet pressure for filling tank is converted to electrical energy

Supplemental Flow with 10MGD capacity Provided by Flow Control Valve





# Continuously Monitored Water Quality

## Monitored Points

- Inlet
- Post Chlorine Outlet
- Reservoir Water
- PreChlorine Injection



Reservoir Water Quality Sample  
Remotely selectable from 12  
locations inside the tank

Had Commissioning Issue with  
Samplers



# Backup Generation tied with PGE Electrical Utility



800 kW Diesel Generator can be controlled remotely by PGE to provide power to the Electrical Grid System



# Operators were engaged in the Design and Construction



## Davis Dump Valve

- Added during construction





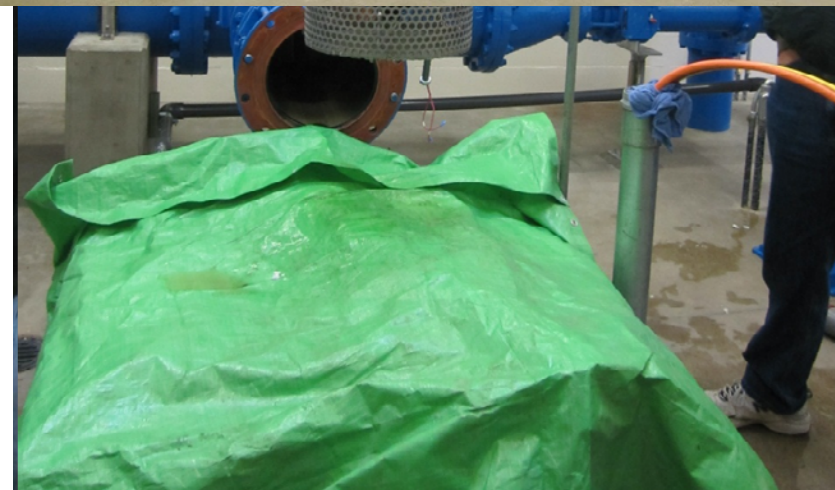
# Rechlorination Allows Extended Reservoir Residence Holding Times

- Rechlorination provides ability to hold water in Reservoir up to six weeks.
- Reduction in electrical operation costs from extended water storage could be \$74,000/yr



# Pump Vortexing is Vexing

- 1 of 4 identical canned turbine pumps exhibit cyclical noise when running at startup.
- Flow/Head and Hp Characteristics didn't exhibit abnormal operation
- Pump Manufacturer recommends Vortex Suppressor be installed – No engineering basis.
- Installation solves noise issue.





# Project Completion

## Project Results

- Completed as desired with additional benefits
- Highly satisfying team and personal experience
- Completed with a net-positive change order to the City
- Community Asset which truly engaged the community
- Flexible Operations have already been utilized
- Hope not to observe the built-in seismic resiliency benefit !



# Teamwork Accomplishes \$20M in 82 weeks



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*82 Week Construction Duration*



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DN Tanks  
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