

A vertical photograph of a waterfall with multiple streams of water cascading over dark rocks, positioned on the left side of the slide.

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# Creative Engineering Solutions for a 5-MGD Groundwater Treatment Facility Serving 3 Pressure Zones

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Water and Sewer District



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Plateau  
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**MWH**

**BUILDING A BETTER WORLD**

# Wells 4 and 11 Treatment Facility



- **Project Objectives**

- Treat water produced from Wells 4, 11.1 and 11.2
  - *Hydrogen Sulfide* • *Manganese* • *Arsenic*
- House a new replacement well (well 4R)
- Replace the existing wood structure with a larger CMU facility



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**BUILDING A BETTER WORLD**

# Wells 4 and 11 Treatment Facility



- **District received two Washington State Public Works Trust Fund Loans (low-interest loan for critical public works projects)**
  - 2001 - \$573,750 for Pre-construction (Design)
  - 2003 - \$2,843,250 for Construction



# Wells 4 and 11 Treatment Facility



- **MWH**
  - 2005 MWH was hired to assist in the design of the new treatment facility
- **Project was to utilize similar equipment, technologies, and standards used at other District well houses**



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- **Located**

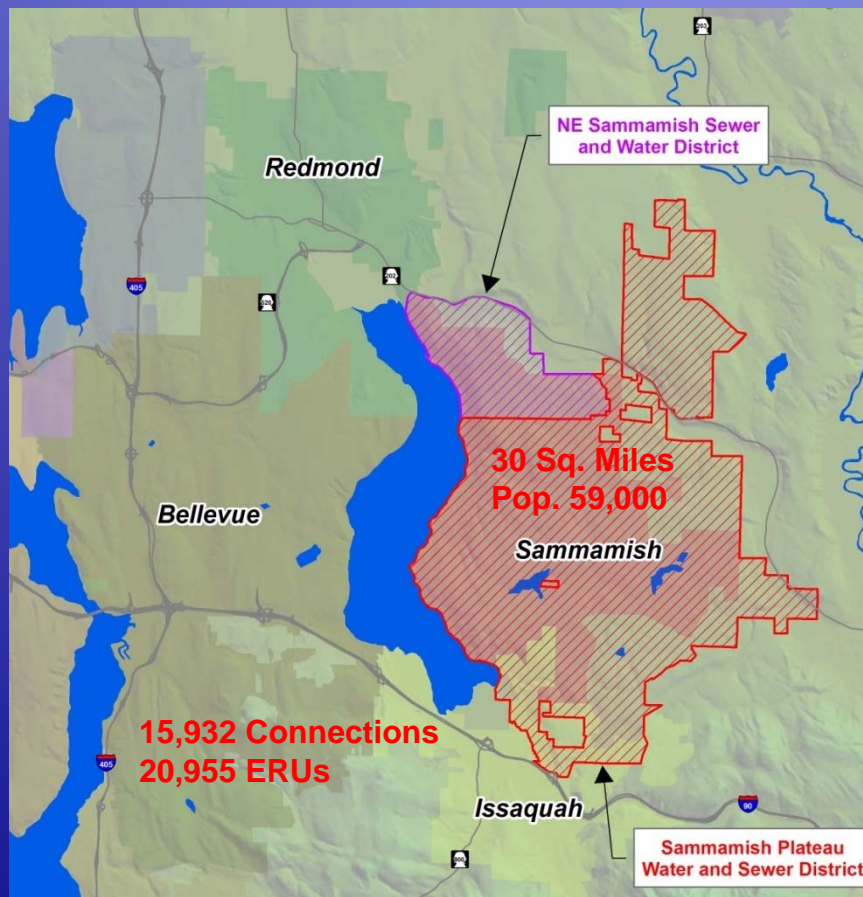
- East of Seattle & Bellevue

- Between

- *City of Redmond*
- *City of Issaquah*

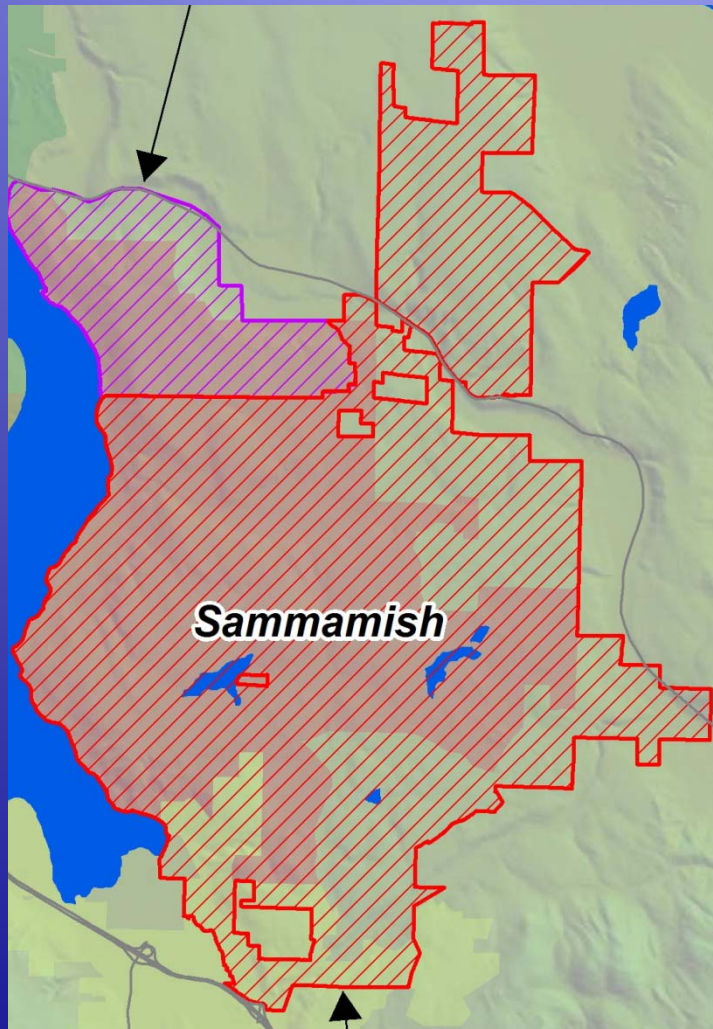
- One of two Districts supplying water within the City of Sammamish

- *Northeast Sammamish Sewer and Water District (NESSWD)*



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# SAMMAMISH PLATEAU Water and Sewer District



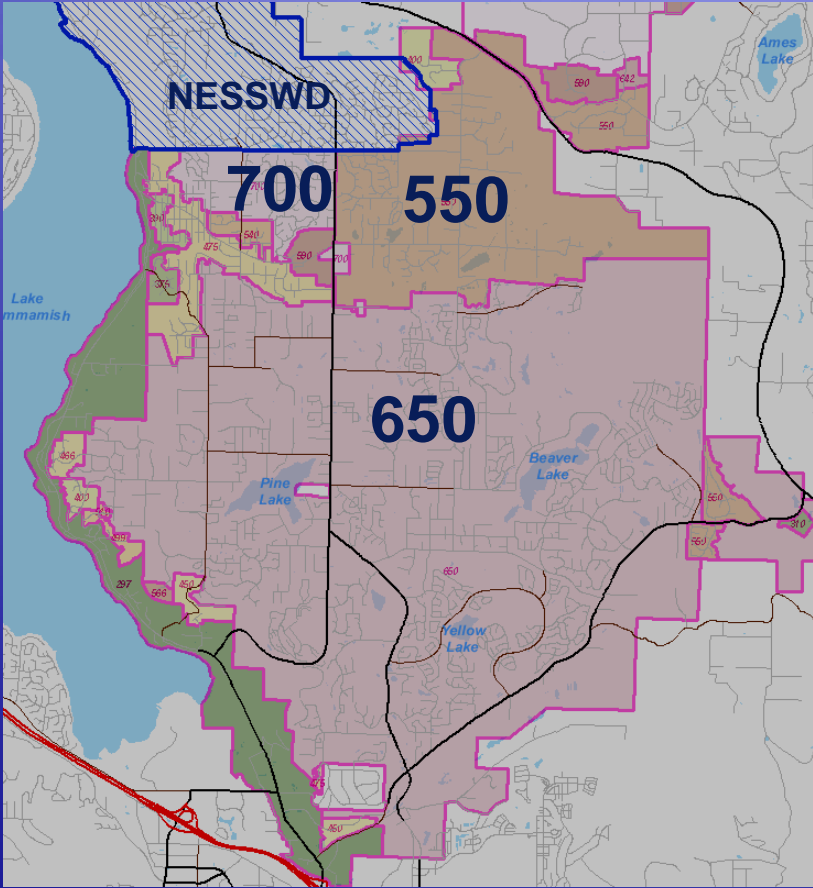
- **Ground water system**
  - 11 wells
  - 6 storage tanks
  - Two interties to the Regional Water System
    - *Currently use only during ASR*
  - Ave. Daily Demand of 5.1 MGD
  - Peak Day Demand of 12.5 MGD
  - 2006 Pumped 1.96 BG



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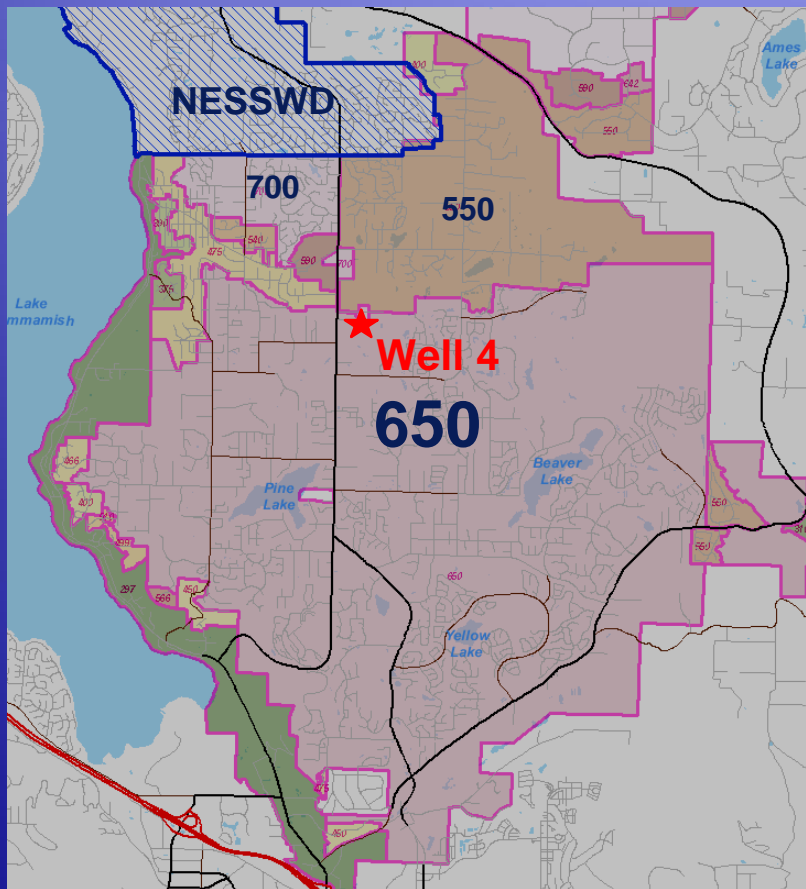
# Pressure Zones

- Of the District's 4 Primary Pressure Zones, our project is only concerned with these three



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# Pressure Zones



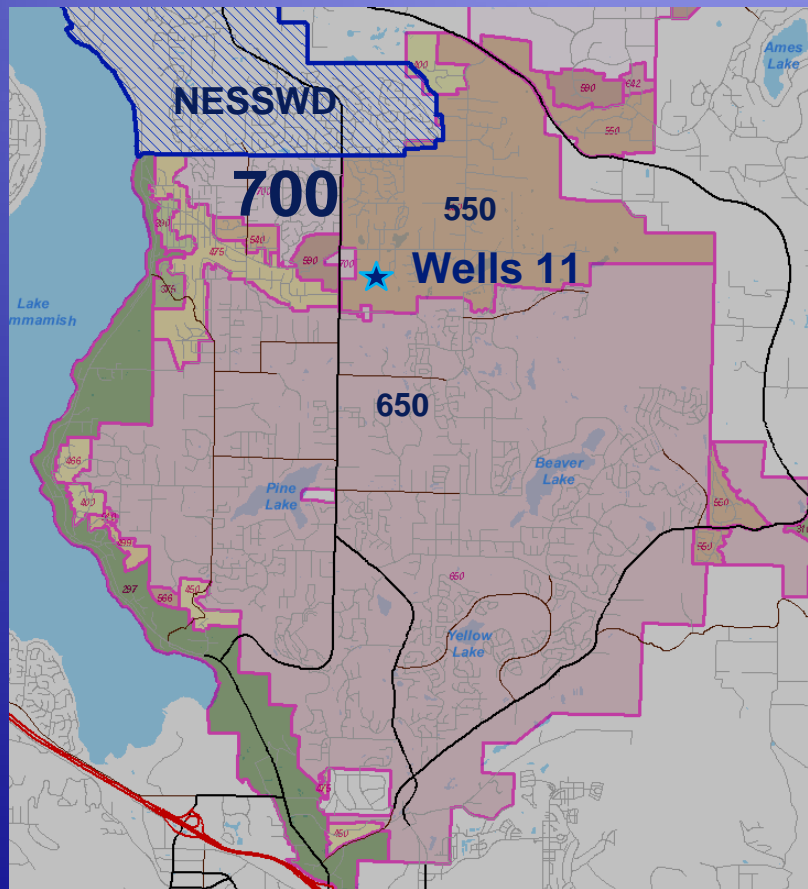
## • 650 Pressure Zone

- Largest in size and demand
  - 13,849 ERUs
- Two Storage Tanks
  - 2 and 7 MG
- Supplied by four wells and three booster facilities
  - *Well 4 is historically a primary source of supply*





# Pressure Zones

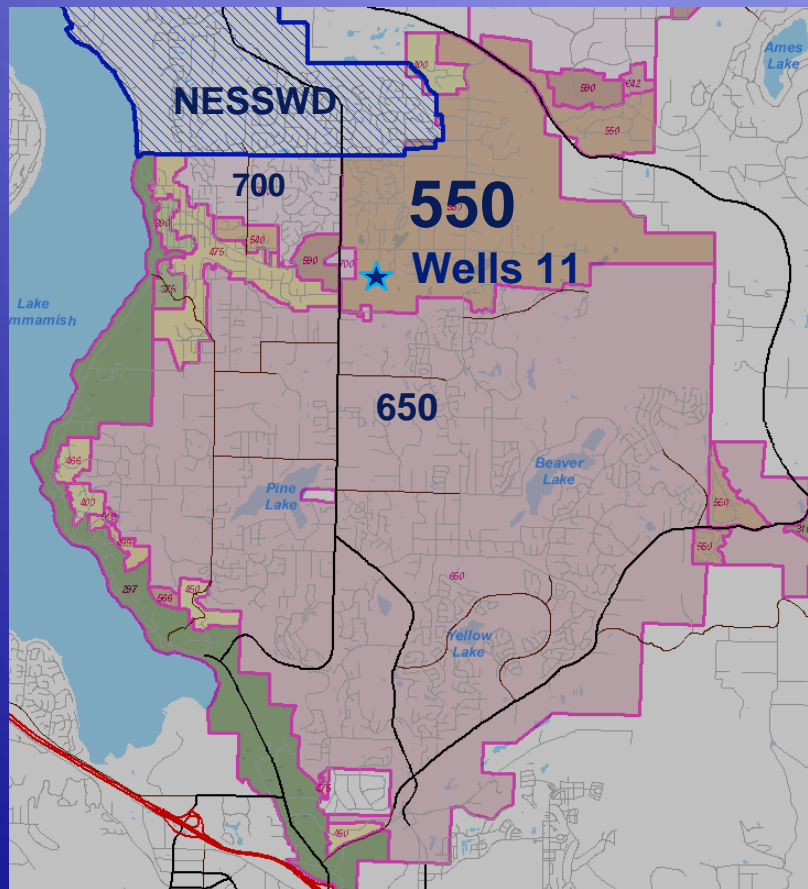


- **700 Pressure Zone**

- 1,892 ERUs
- Supplied water by Wells 11.1 and 11.2
- 3 MG Storage Tank
  - *Shared Storage with NESSWD*
- Intertie with NESSWD limits the treatment allowed
  - *Sodium Hypochlorite is necessary for treatment of Hydrogen Sulfide and Manganese*
  - *Fluoride can not be added*



# Pressure Zones



- **550 Pressure Zone**

- 1,402 ERUs
- Prior to 2001, served from the 700 PZ through 4 PRVs
- 2001
  - 8 MG of storage built
  - Allowing separate storage for the 550 PZ
  - Also supplied water by Wells 11.1 and 11.2
  - Still connected to the 3MG tank in the 700 PZ
  - Limited chemical addition



# Water Supply



- **Wells 11.1 and 11.2**
  - Well House 11 was constructed in 2001
  - Wells 11.1 & 11.2
    - *Well 11.1*
      - Depth of 500' BGS
      - Capacity 400 GPM
    - *Well 11.2*
      - Depth of 884' BGS
      - Capacity 1,800 GPM
  - *Supplies the 700 and 550 pressure zones*



# Water Supply



- **Wells 11.1 and 11.2**
  - Water Quality
    - *Hydrogen Sulfide*
    - *Manganese*
    - *Arsenic - only Well 11.1 exceeds the MCL*
  - Limited Treatment
    - *Sodium Hypochlorite for Hydrogen Sulfide*
    - *In 2003 limited use of 11.1 due to Arsenic*
    - *When 11.1 was used, the water was blended with 11.2 to reduce Arsenic levels*



# Water Supply



- **Limited Treatment Options**
  - Located within a local High School
  - Limited area for expansion
  - No room for manganese treatment
  - No direct access to the gravity sewer system
- **District looked to Well 4 for expansion and treatment of Well 11 water**



# Water Supply

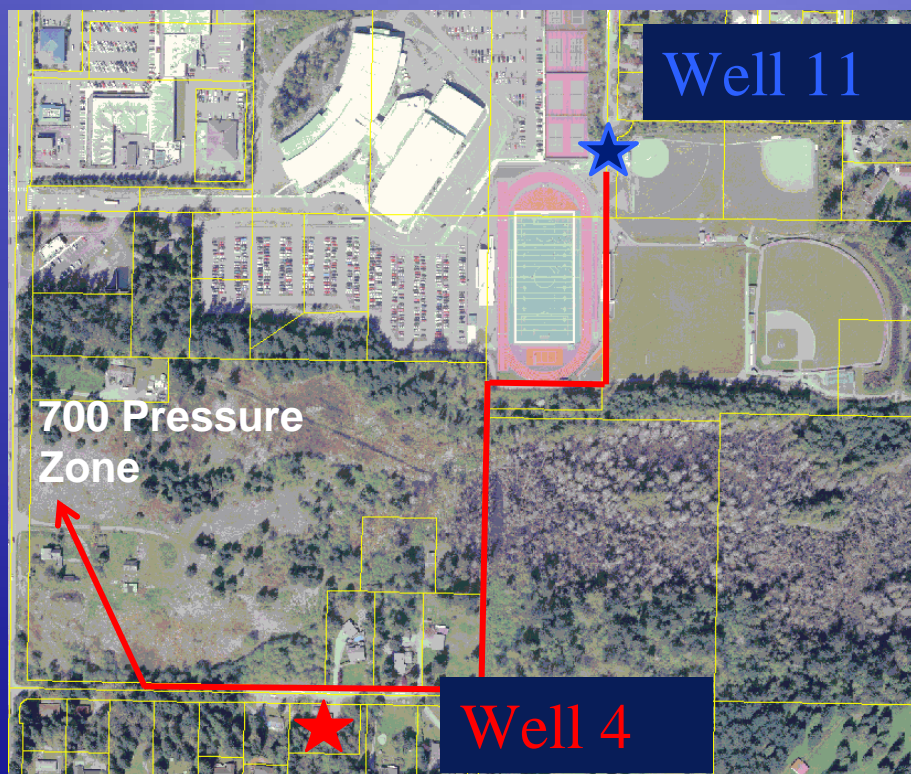


- **Well 4**
  - Drilled in 1970
    - *Depth of 717-feet*
    - *Capacity of approx. 750-GPM*
  - Constructed to supply the 650 pressure zone
- **Over time the simple well house was remodeled**
  - Sodium hypochlorite, booster station and a generator were added



# Water Supply

- Well 4 located approximately 1,800-feet to the south of Wells 11



- Perfect site for a Treatment Facility
  - The transmission main from Well 11 to the 700 pressure zone runs past the existing Well 4 facility
  - Well 4 is a hub for all three pressure zones
  - Some space for expansion



# Water Supply



- In 2003, operation of Well 11.2 impacted the operation of Well 4
  - Well 4 was only drilled into the top portion of the aquifer
  - Continuous summer operation of Well 11.2 impacted the water levels at Well 4
  - 2003 a replacement well (Well 4R) was drilled behind the existing structure





# Water Supply



- **Well 4R**
  - Penetrating the complete aquifer
    - *Depth – 855-feet BGS*
  - Increased yield – 2,000-GPM
  - Water Quality
    - *Similar to original well 4 and Wells 11.1 and 11.2*
    - *Hydrogen Sulfide*
    - *Manganese*
    - *Arsenic levels less than the MCL*



# Wells 4 and 11 Treatment Facility

- **MWH left to address a number of design issues as part of the treatment facility**
  - Site Constraints
  - Residential neighborhood
  - Using similar technology and equipment used in other District's facilities, the size of the treatment facility:
    - *Increased labor*
    - *Increased costs*
    - *Increased O&M*
    - *Increased health and safety risks*



# Site Layout Issues

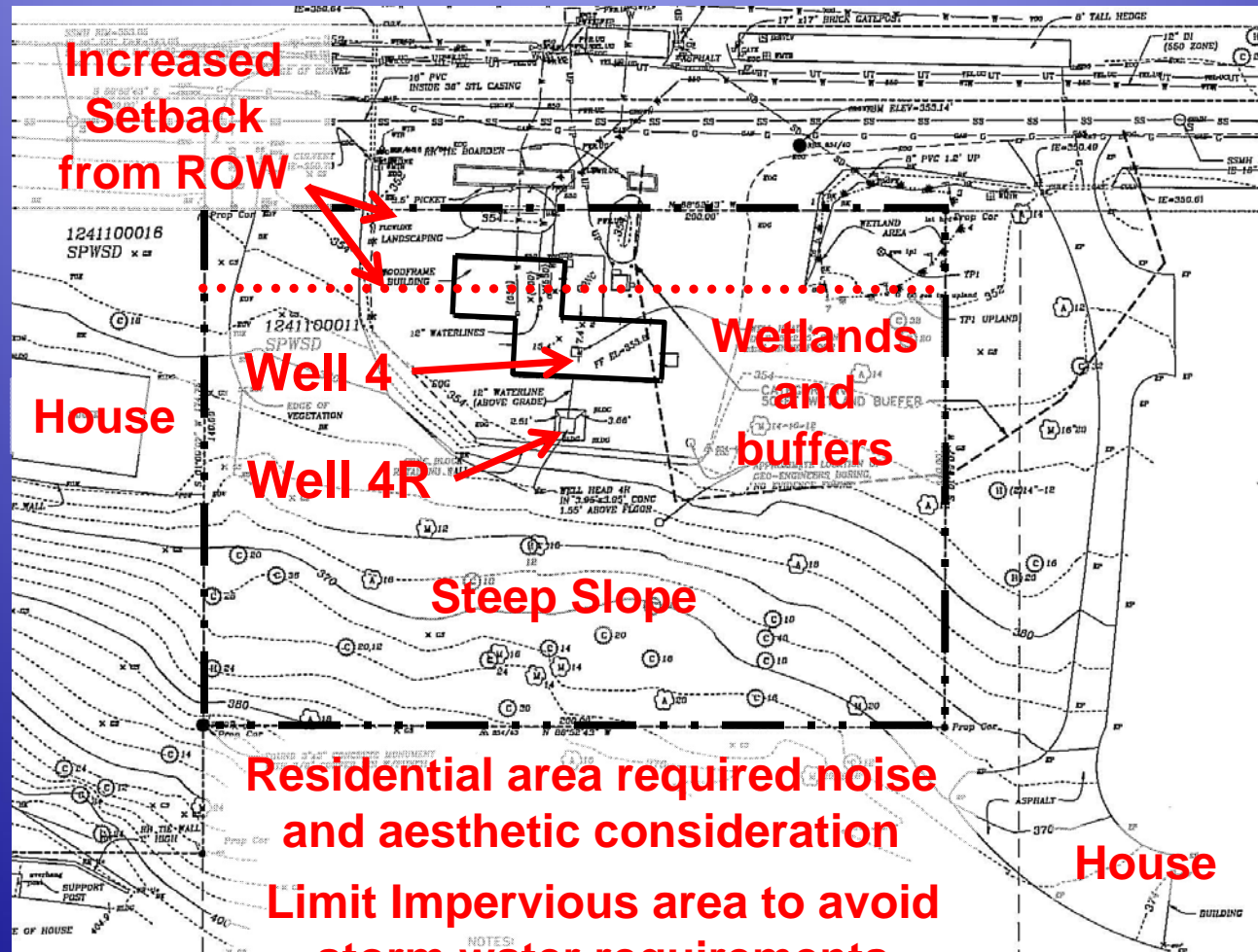
- **Well 4**



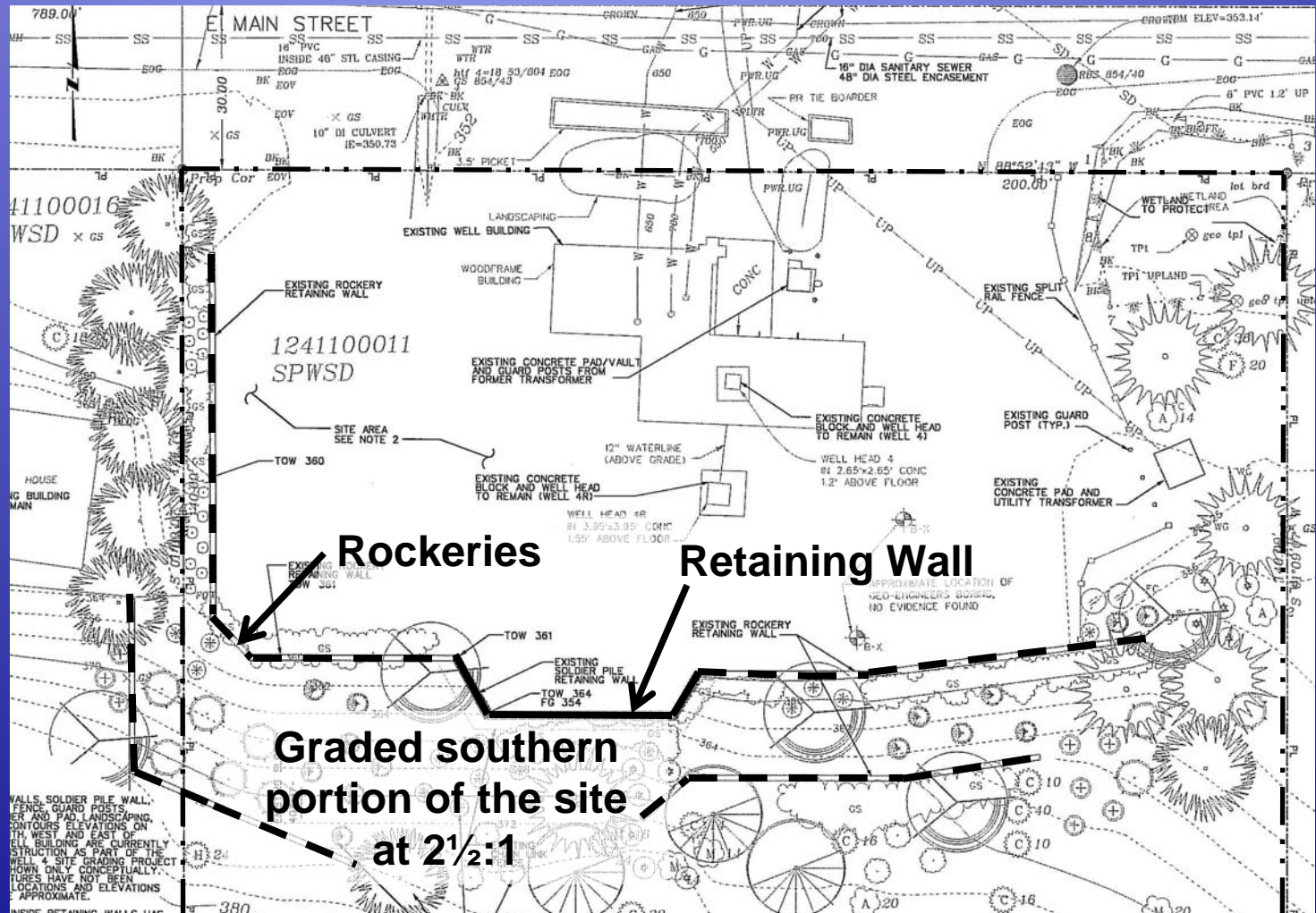
- Located within a residential neighborhood
- Some space for development
- **During design the neighboring property goes up for sale**
  - *District purchases property*
  - *Construction Staging*
  - *Future Expansion*



# Site Layout Issues

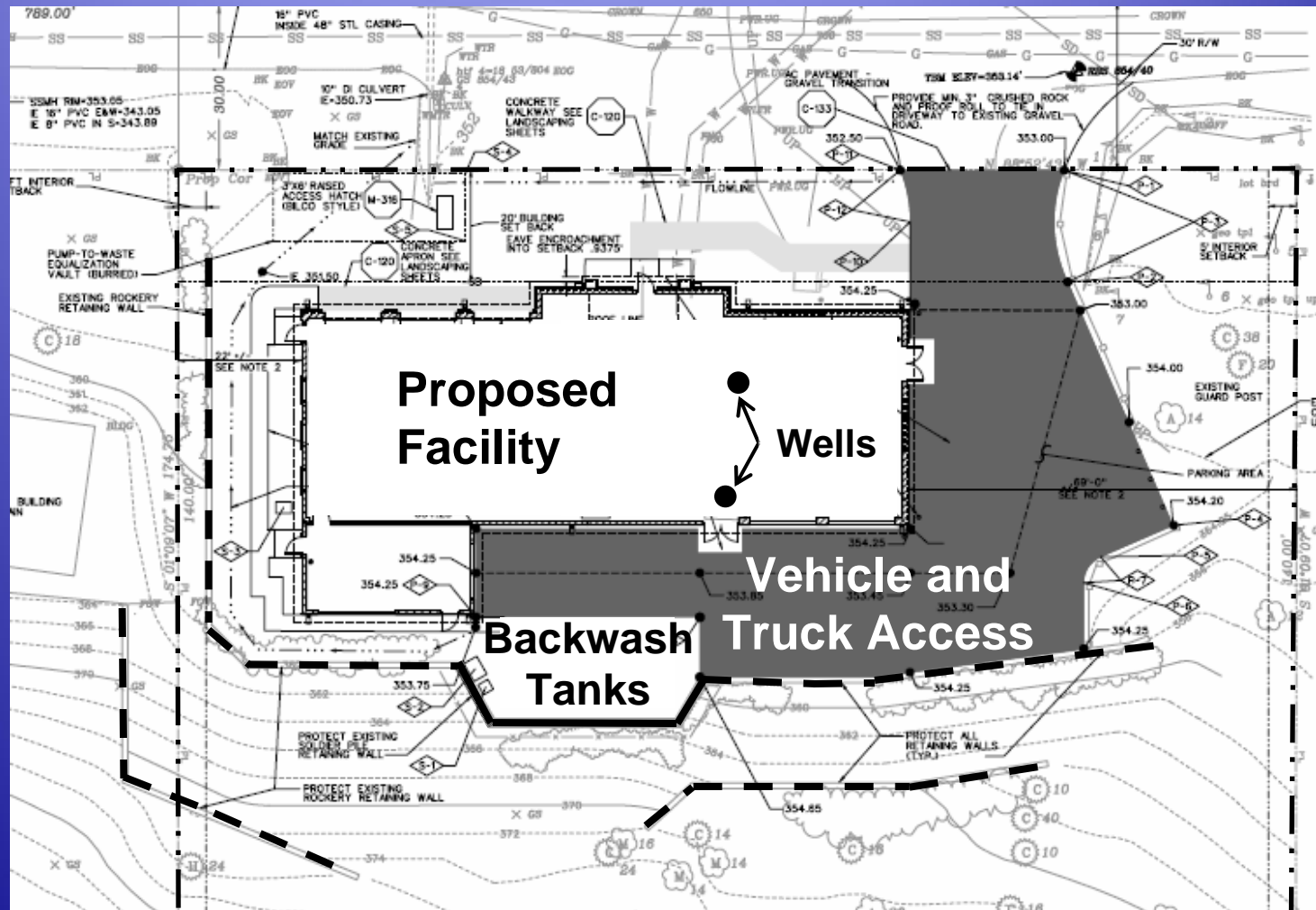


# Phase 1 – Site Grading Project



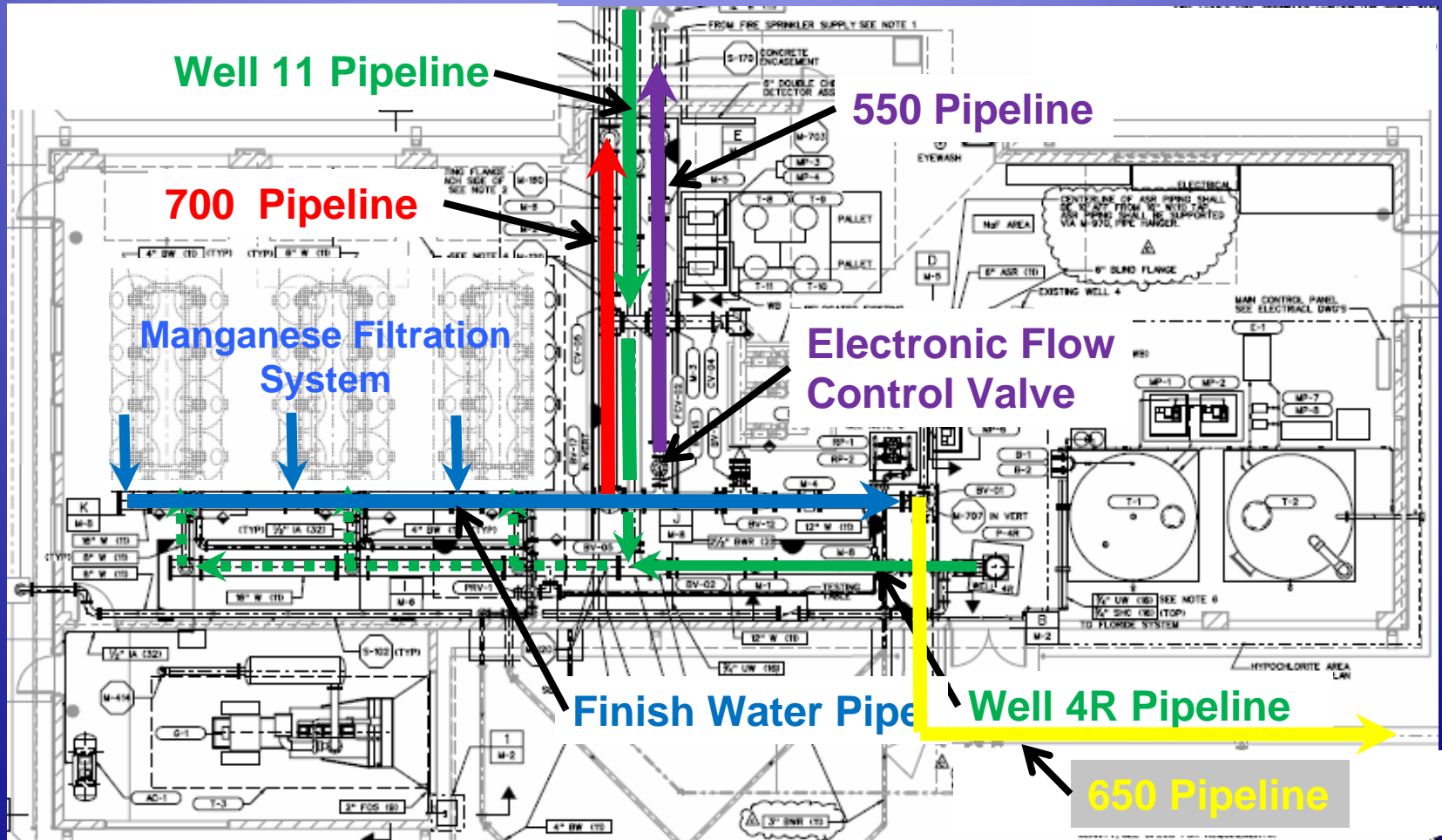
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# Phase 2 – Treatment Facility

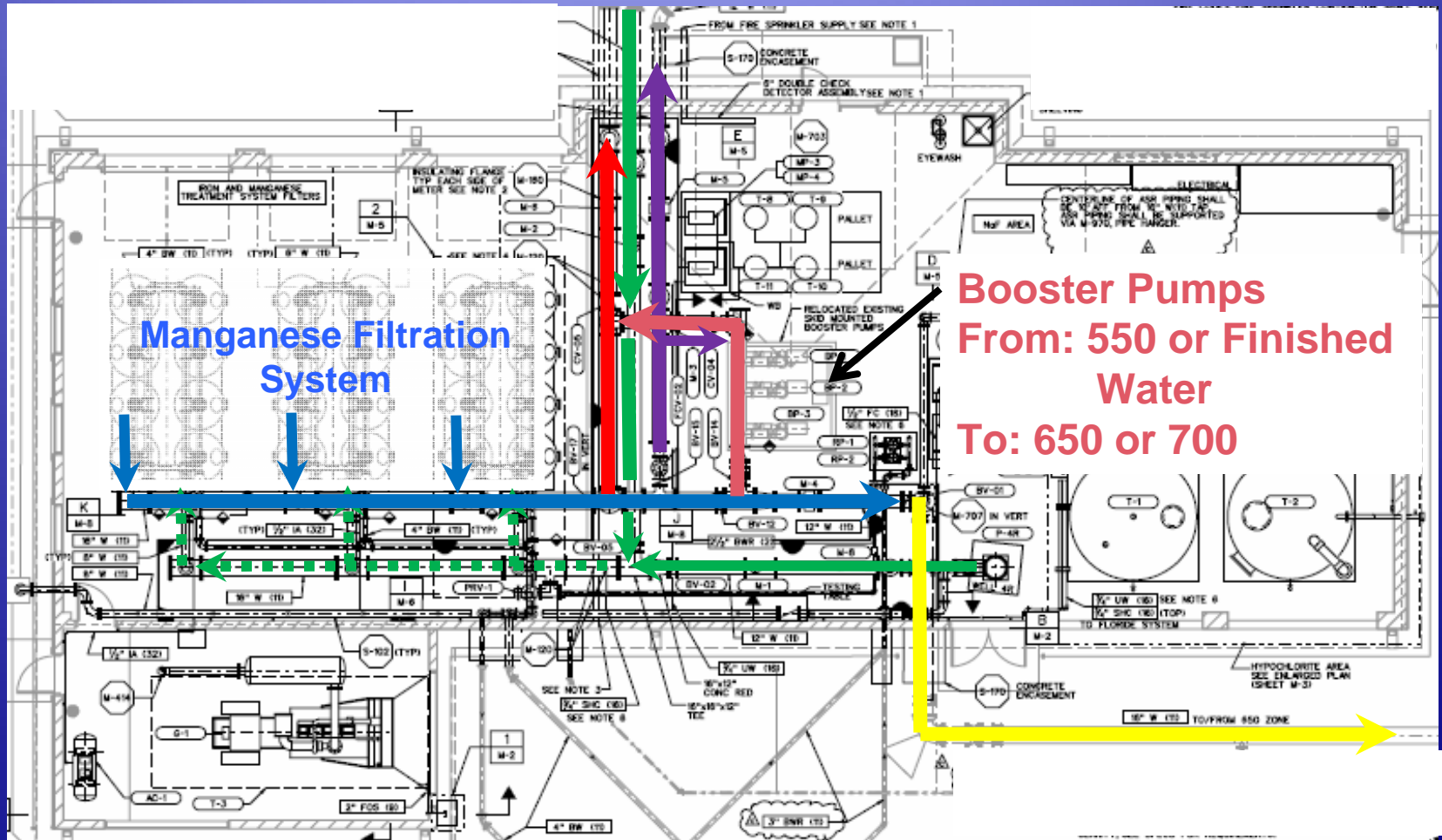


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# Facility Mechanical Piping

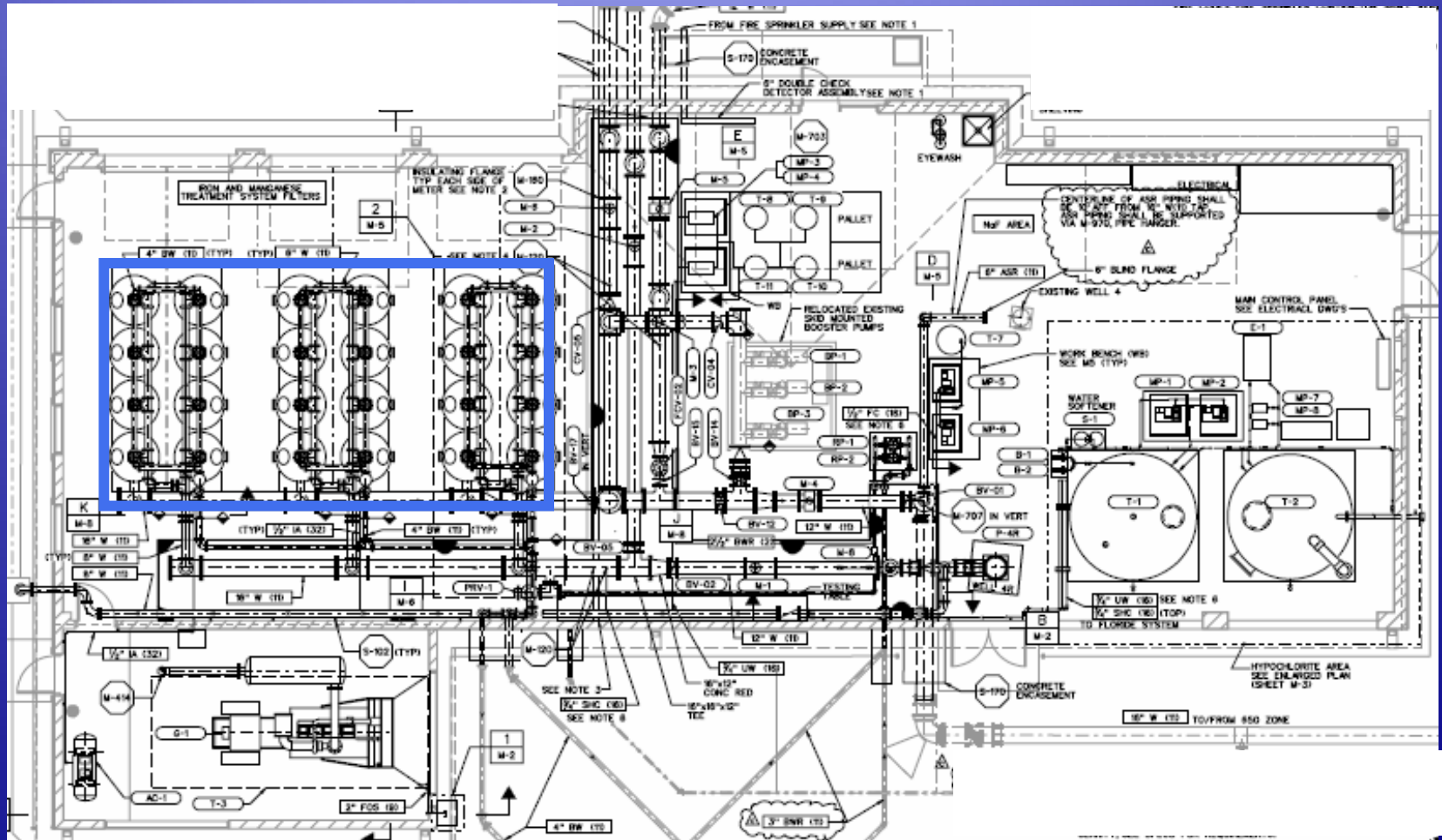


# Facility Mechanical Piping





# Manganese Treatment



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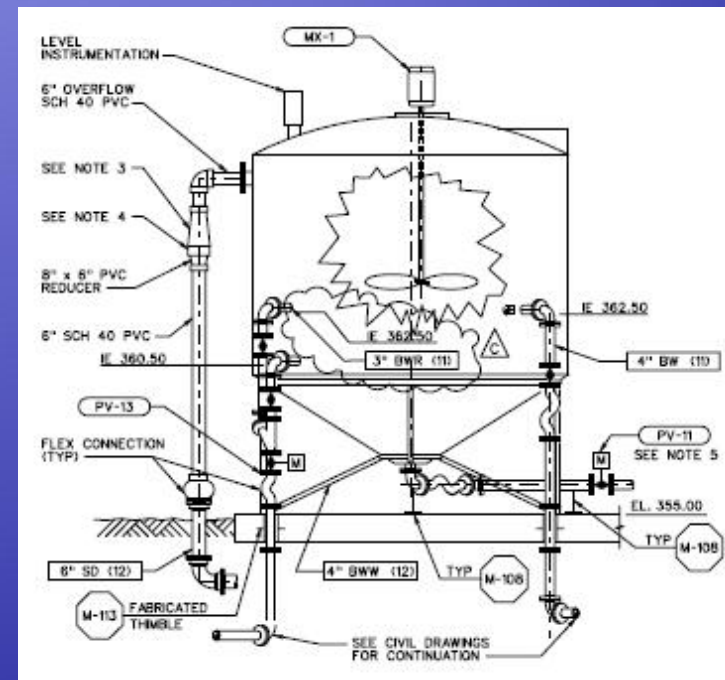
# Manganese Treatment

- **ATEC pressure filtration system chosen**
  - Benefits:
    - *District familiarity with technology*
    - *Pilot study proved suitable for Mn removal needs*
  - Challenges:
    - *24 filters required*
    - *Backwash: >32,000 gpd waste resulting in high sewer disposal fees*



# Manganese Treatment

- **Solution: Backwash Collection, treatment and recycle system designed**
  - Two 7,000-gal cone-bottom tanks
  - Vertical shaft flocculators
  - Ferric chloride coagulant
  - Treat and recycle backwash from 4 filters at once

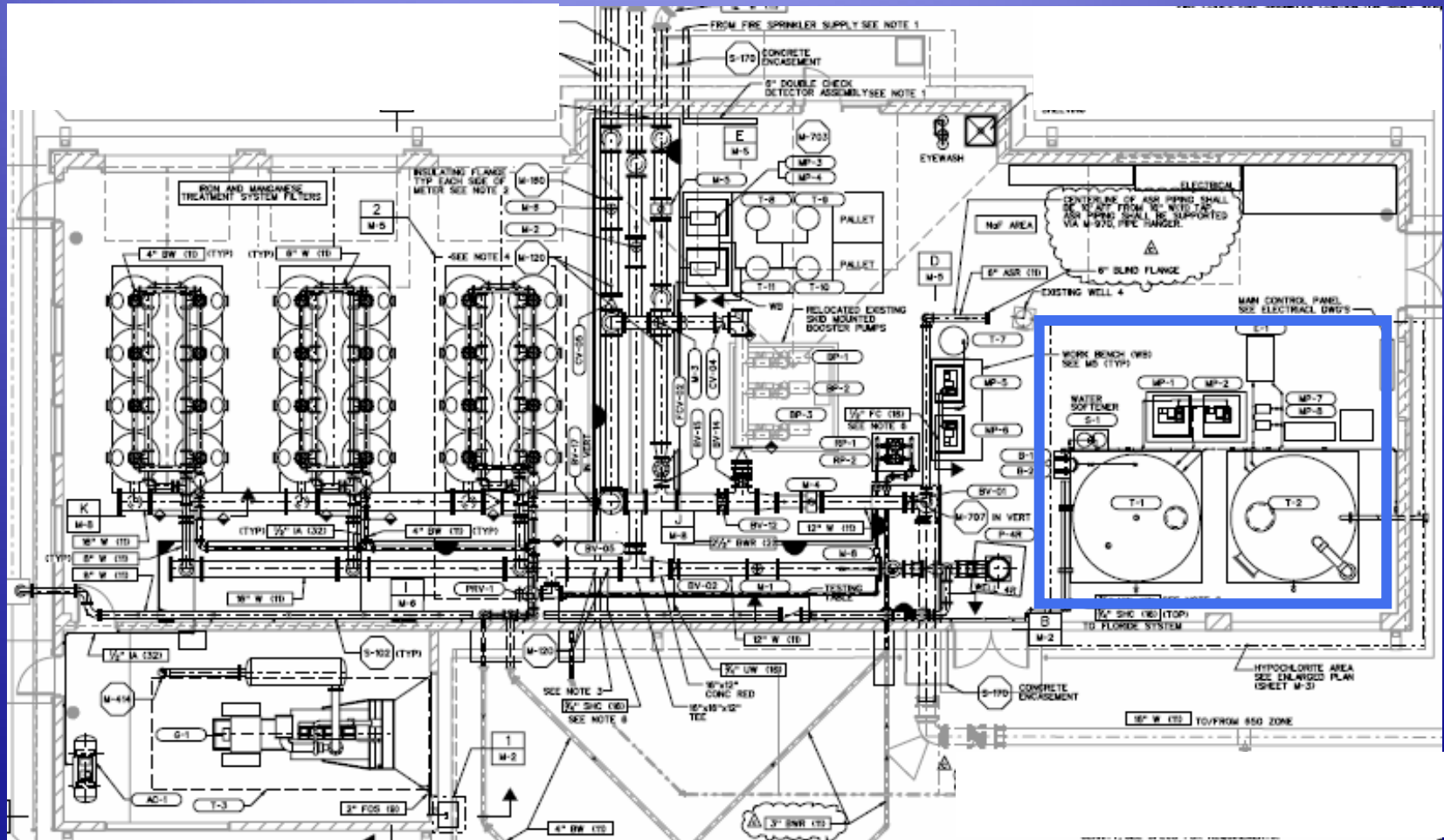


# Manganese Treatment



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# Sodium Hypochlorite for Manganese Oxidation



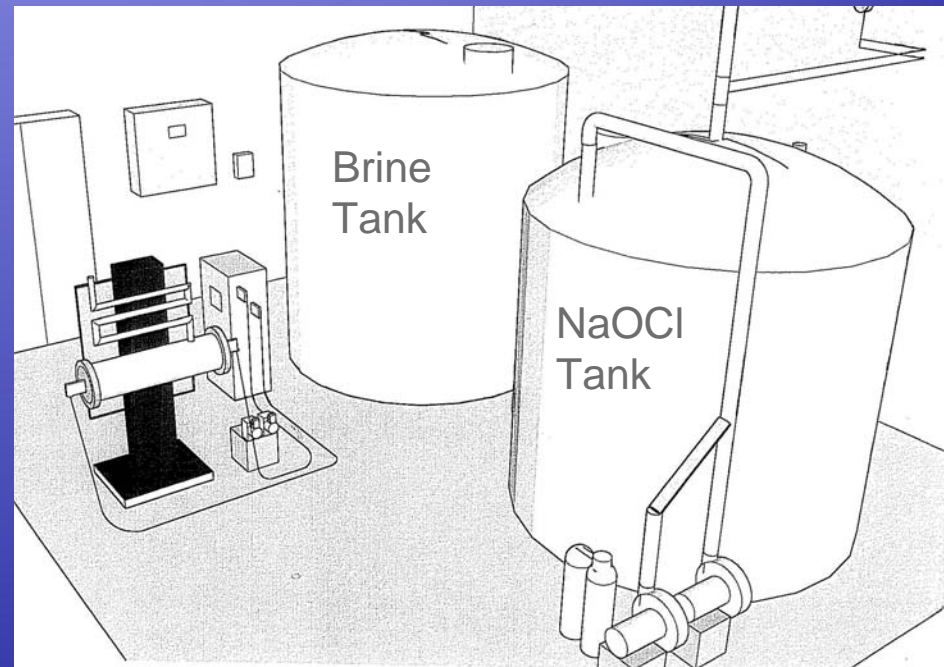
# Sodium Hypochlorite for Manganese Oxidation

- **On-Site Hypochlorite Generation selected**
  - Benefits:
    - *District familiarity with technology*
    - *Safe and low health hazard*
  - Challenges:
    - *Large volume of salt required for brine solution*
    - *Delivery & handling of 50-lb salt bags*
    - *Labor intensive & risk of injury*



# Sodium Hypochlorite for Manganese Oxidation

- **Solution: Brine Tank for Bulk Salt Delivery**
  - 5,800-Gal Bulk Brine Tank for 20 tons of salt
  - One delivery can last several months
  - Salt is blown directly into tank requiring no manual lifting of bags
  - 3,850-Gal Sodium Hypochlorite Storage Tank



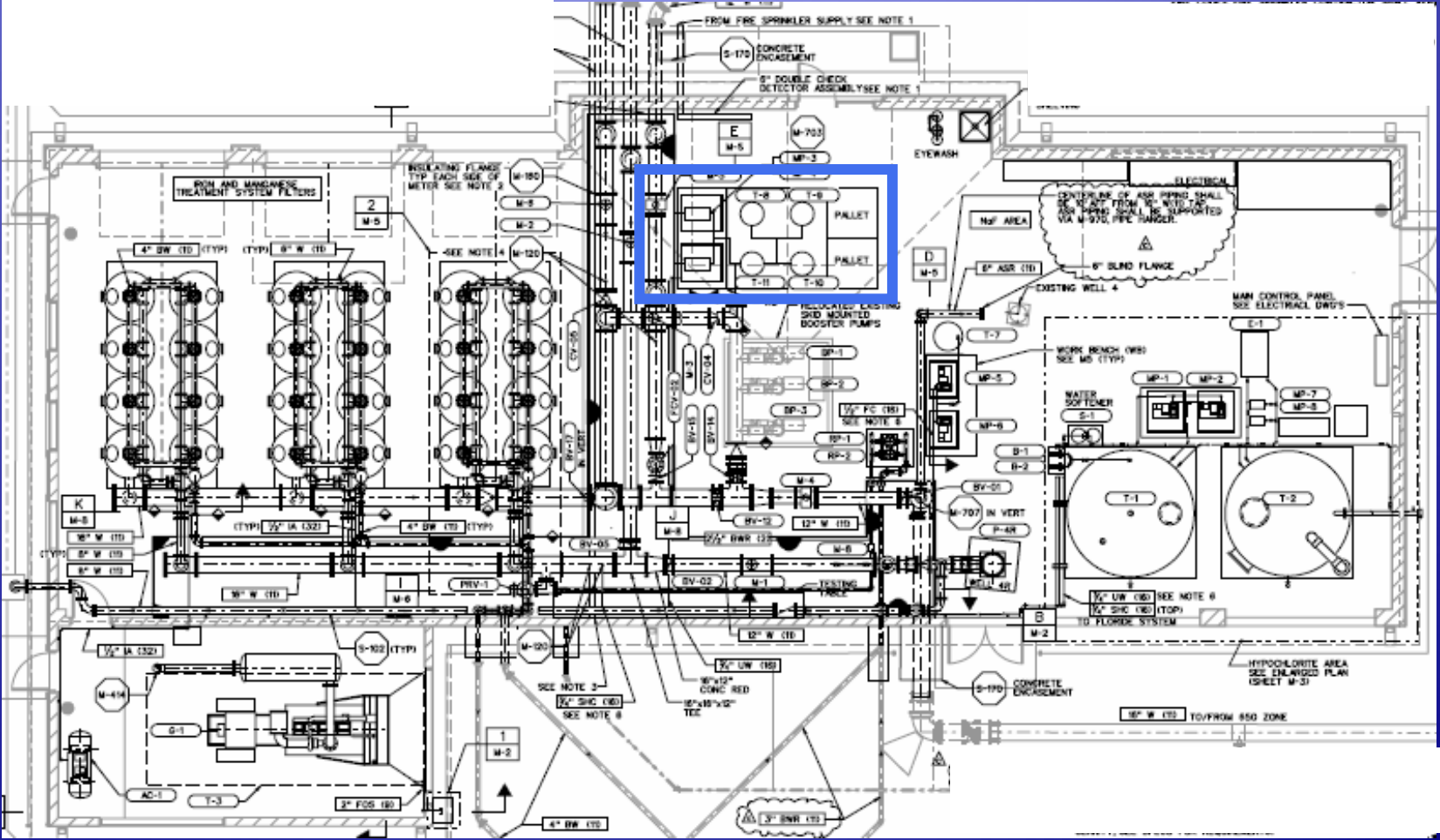
# Sodium Hypochlorite for Manganese Oxidation



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# Fluoridation



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A vertical photograph of a waterfall with multiple streams of water cascading down dark rocks.

# Fluoridation

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- **Dry Sodium Fluoride (NaF) saturation system**
- **Benefits:**
  - District familiarity with technology
  - Public sensitivity to other technologies
- **Challenges:**
  - Saturation tank required to remain unattended for up to 5 days
  - Loading of 50-lb bags is labor intensive – risk of injury
  - Only the 650 Zone can be fluoridated





# Fluoridation

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- **Solutions:**

- System includes 3 saturation tanks and 1 day tank hydraulically connected
- Tanks are set in a trench below finished floor to minimize bag handling
- Injection system designed to fluoridate only water provided to the 650 pressure zone
- Future capacity provided to allow fluoridation of other pressure zones if needed



# Arsenic Treatment

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- **Only Well 11.1's Arsenic level exceeds the MCL**
- **Treatment**
  - Well 11.1 has a water right of 400-GPM
  - Well 4R has additional yield
  - District applied to the State of Washington for a second point of withdrawal of the Well 11.1 from Well 4R thereby avoiding additional treatment
  - However, when Well 11.1 is needed, the water will be blended with Well 4R or 11.2 to maintain an Arsenic level below 10-ppb
- **Blending is not the District's preferred method of treatment, however, other options were cost prohibitive**



# Well 4R Pump Selection

- **Proposed a Vertical Shaft Turbine Pump**
- **Existing pump and motor not suitable**
  - Increased yield
  - Increased depth
  - New pump needed to be set approximately 100-feet lower (500-bgs)
    - *To avoid influences from Well 11.2*
    - *Provide for future decline in the aquifer level during the peak summer usage*



# Well 4R Pump Selection

- To maximize annual water rights the pump would need to run close to 24 hours, 7 days a week
- Pumping rate of 1,150 to 1,650 GPM
  - *750 GPM original water rights (includes supplemental rights)*
  - *400 GPM from Well 11.1 (secondary point of withdrawal)*
  - *500 GPM for ASR withdrawal*
  - *Possible 500 GPM from 11.2 (secondary point of withdrawal)*



# Well 4R Pump Selection

- **Well 4R pump selection**
  - Variable Frequency Drive
    - *First VFD well pump in the District*
    - *Pumping to the 650 pressure zone for economy*
    - *Capable of pumping to the 700 pressure zone at reduced capacity when needed*
  - 450 HP VFD motor with a head of 810-feet



# Power Generation

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- **Facility became a critical link in the system**
  - Provides water to three major zones
  - Could produce up to 1,650-gpm from Well 4 only
- **Need for emergency standby power was required**
  - Required a 600 kW Generator
  - Needed 4 days of fuel storage requiring a 2,500 gallon diesel fuel tank
  - To reduce height of the gen set, a submerged floor was installed to keep the fuel tank below finished grade.





# Power Generation



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# Aesthetics and Architectural Aspects

- District strives to make facilities match the surrounding neighborhood



# Aesthetics and Architectural Aspects



- **District wanted a residential look**
  - Projected a portion of the building and added a small porch to give some relief
  - Added dormers and hip trusses to the roof line
  - Dormers and skylights provide natural light into the building



# Aesthetics and Architectural Aspects



- **Facility was built using CMU construction for low maintenance**
- **To maintain a residential look**
  - Manufactured stone facing was added
  - Vinyl siding used to keep the residential look while reducing the maintenance



# Questions



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