

Raw Water Quality Not Textbook? Just Pilot! Iron Removal with High pH Raw Water

March 27, 2008

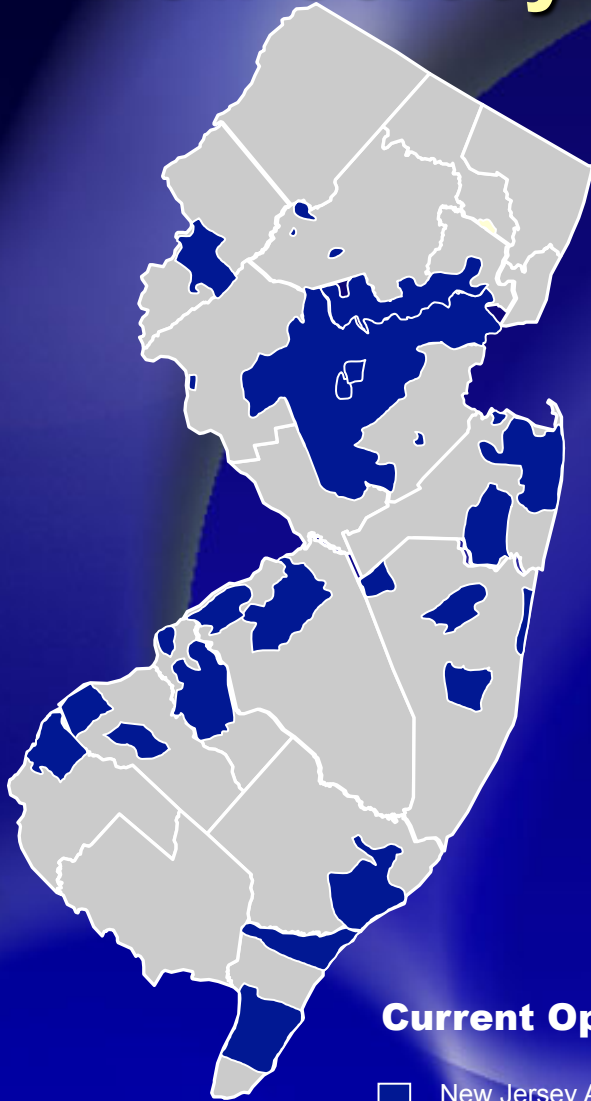
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Today's Presentation

- ◆ Background
- ◆ Treatment Alternatives
- ◆ Oxidation and Filtration
- ◆ Fe and Water Chemistry
- ◆ Pilot Test
- ◆ Design

New Jersey American Water



- ◆ Serves more than 2 million people in 180 communities
- ◆ 623,800 connections
- ◆ 8,100 miles (12 000 km) of main from 2" to 72" (5 to 183 cm) in size
- ◆ 170,000 valves, including hydrant branch valves

Current Operations

□ New Jersey American Water



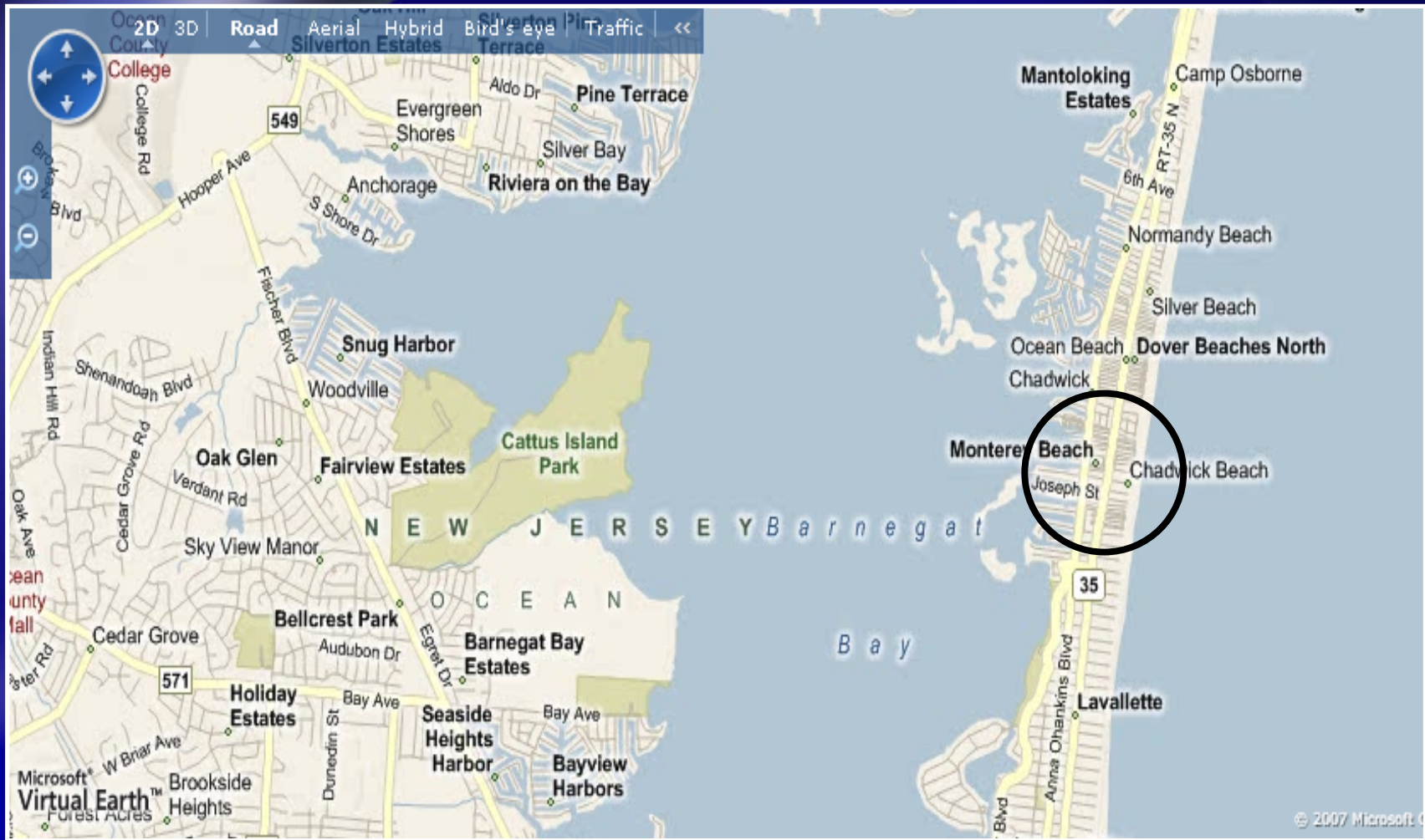
Background

Monterey Beach, NJ

- ◆ Existing well – PRM
- ◆ Allocation limit of 900 GPM
- ◆ SOS is limited on Barrier Island
 - ◆ Location
 - ◆ Large seasonal demand fluctuation



Project Location



Problem / Water Quality

- ◆ Current Treatment
 - ◆ Sequestration
- ◆ Customer Issues
 - ◆ Discoloration of laundry
 - ◆ Staining of sink
 - ◆ Taste and Odor



Iron Levels

◆ Iron Requirement

- ◆ NJDEP Secondary Contaminant – Recommended Upper Limit = 0.3 (mg/L)
- ◆ With Sequestration Treatment – Recommended Upper Limit = 0.6 (mg/L)
- ◆ When Upper limit is exceeded, Treatment must be added to reduce levels below 0.3 mg/L

Monterey Well Iron Levels						
Year	2002	2003	2004	2005	2006	2007
Iron Levels (mg/L)	0.9	0.7	0.7	1.0	0.8	0.8

Treatment Alternatives

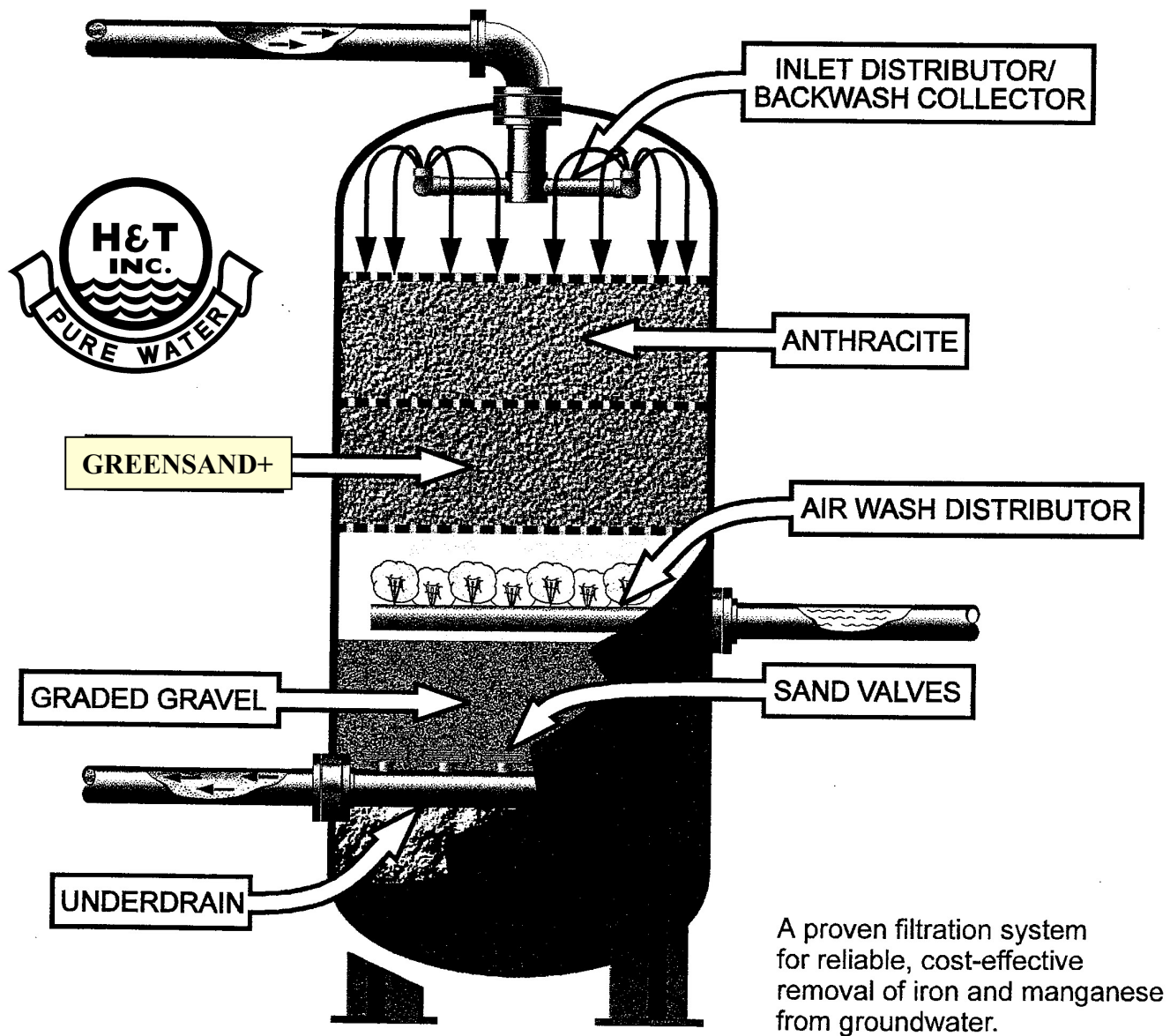
- ◆ Evaluated treatment methods
 - ◆ Membranes – eliminated due to space limitations and cost
 - ◆ Biological removal – eliminated due to increase in O&M
 - ◆ Oxidation with filtration – treatment method of choice

Oxidation with Filtration

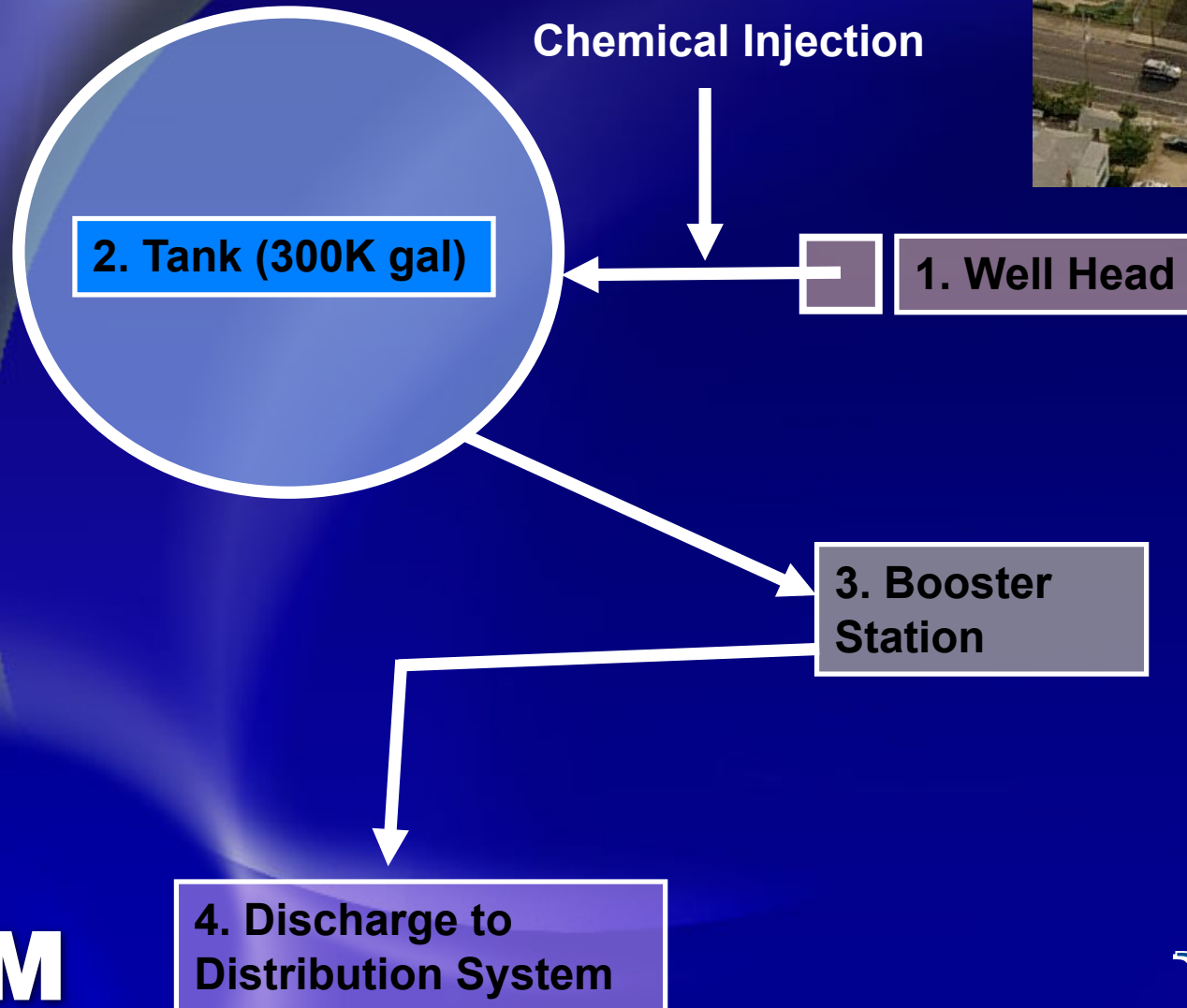
- ◆ **Basics of treatment process**
 - ◆ **Oxidation of iron and manganese with the addition of chlorine**
 - ◆ **Dual media filtration of precipitates**
 - ◆ **Manganese dioxide coating on sand acts as catalyst for oxidation and reduction of iron and manganese**

GreensandPlus Technology

- ◆ Selected in previous study
- ◆ GreensandPlus media
 - ◆ Silica sand
 - ◆ Manganese dioxide coating
- ◆ Ordinary Manganese Greensand versus GreensandPlus



Existing Operations



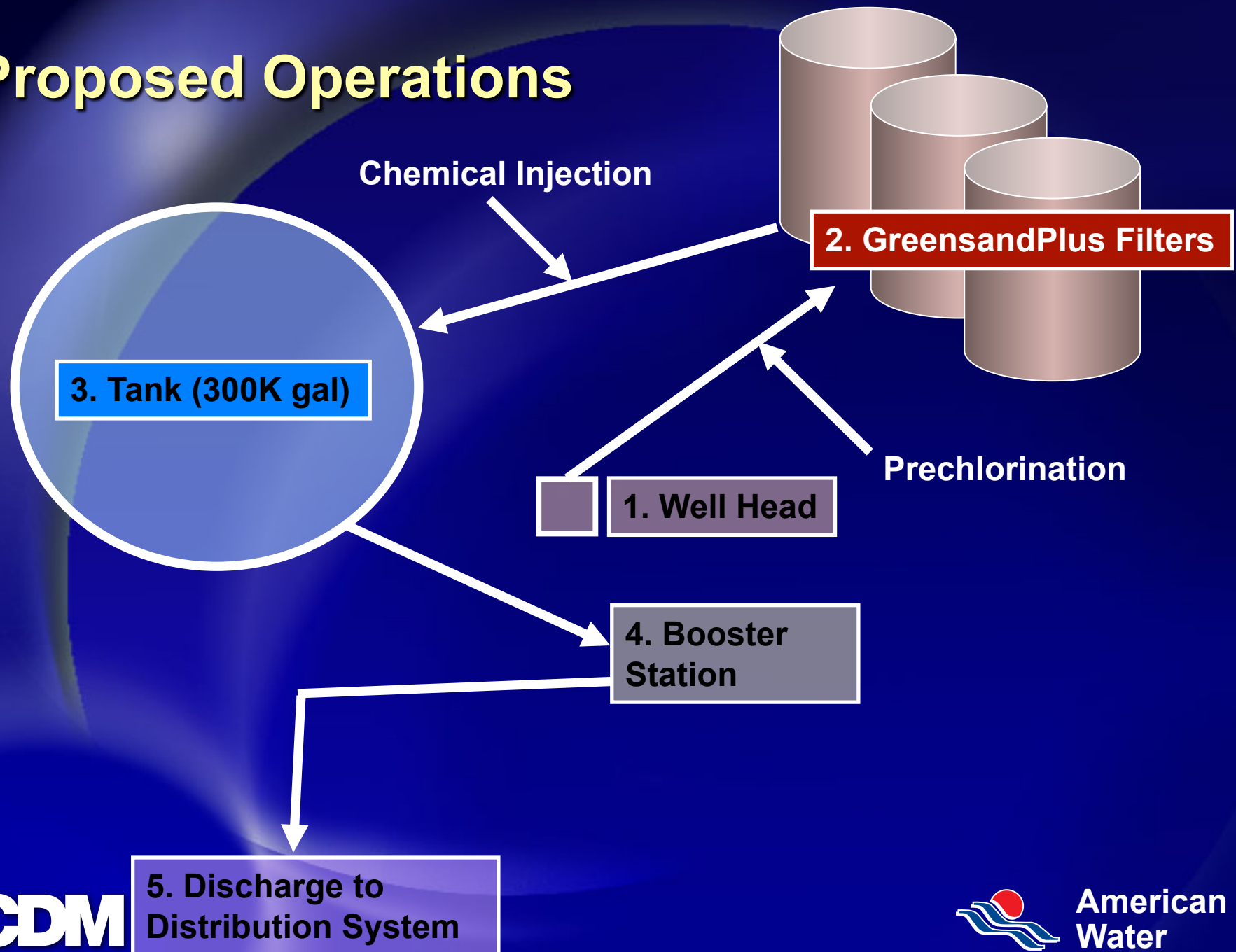
Location Details



Proposed Site

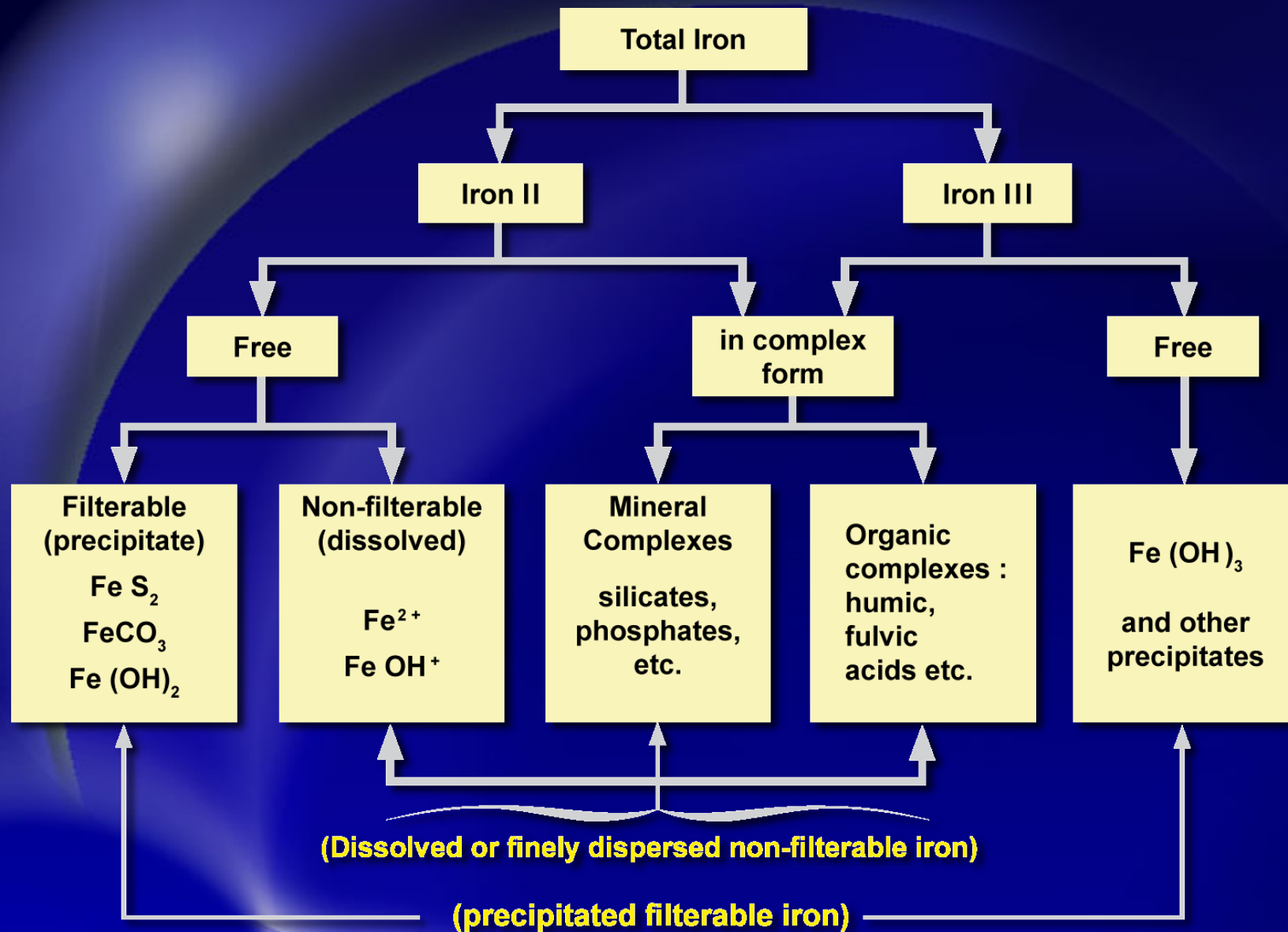


Proposed Operations



Iron and Water Chemistry

- ◆ **Surface Water Iron**
 - ◆ Oxidized form as precipitate
 - ◆ Typically removed by conventional clarification
- ◆ **Groundwater Iron**
 - ◆ Deprived of Oxygen
 - ◆ Reduced Form (2+) and in solution



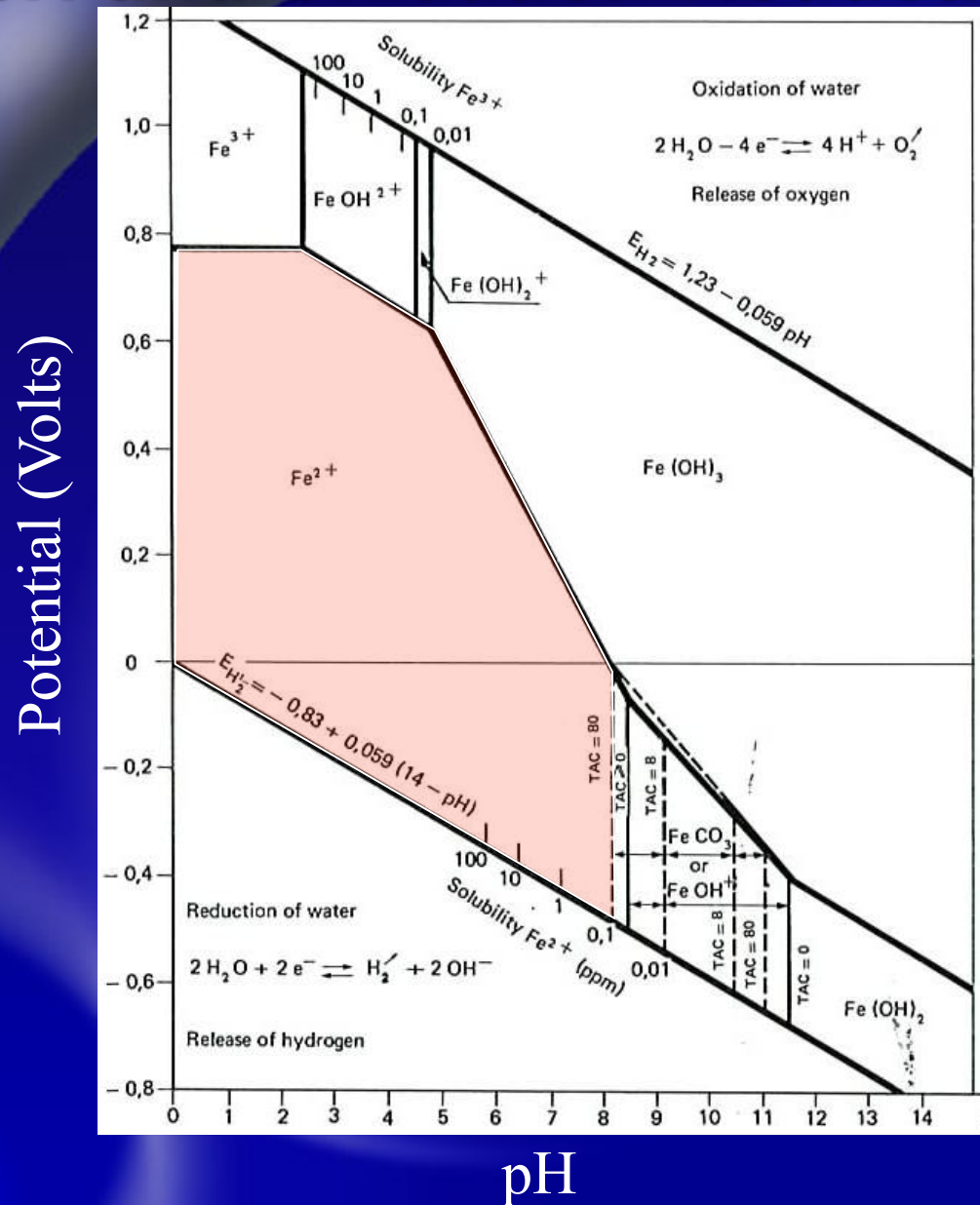
Oxidation and Filtration

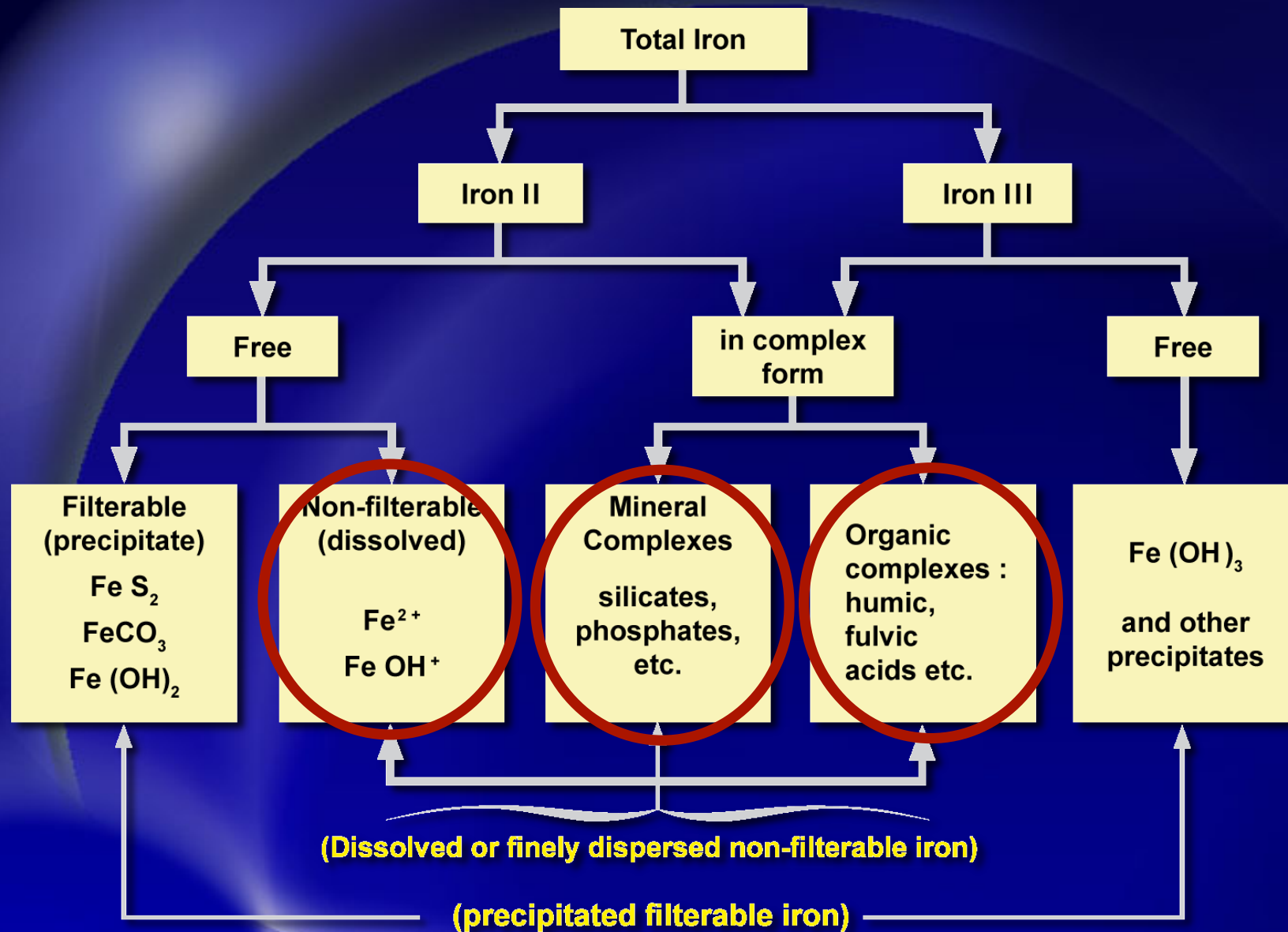
- ◆ Most widely used treatment
- ◆ Manganese Dioxide (MnO_2) or green sand
 - ◆ Oxidizes iron (II) and Manganese
 - ◆ Precipitated and retained by the filter media
- ◆ Prechlorination oxidizes iron at Monterey Beach

Abnormal Water Quality and Filtration

- ◆ Effectiveness varies with pH and oxidation-reduction potential (E_{H_2})
- ◆ Monterey, NJ Well
 - ◆ Possibly colloidal or complex iron
 - ◆ High pH (above 7.5)
 - Iron Fe^{2+} (dissolved) most likely but not a guarantee

Iron: pH and Oxidation-Reduction Potential





Bench Scale Test

- ◆ Prechlorinate to oxidize iron
- ◆ Filter
- ◆ Test for removal of Iron
- ◆ Confirm: Iron form likely Fe^{2+}



Pilot Test

- ◆ Higher Loading Rates
 - ◆ 5 to 7 gpm/ft²
- ◆ Confirm Iron and Manganese Removal
 - ◆ Prechlorinate
 - ◆ Impact of MnO₂ coated green sands

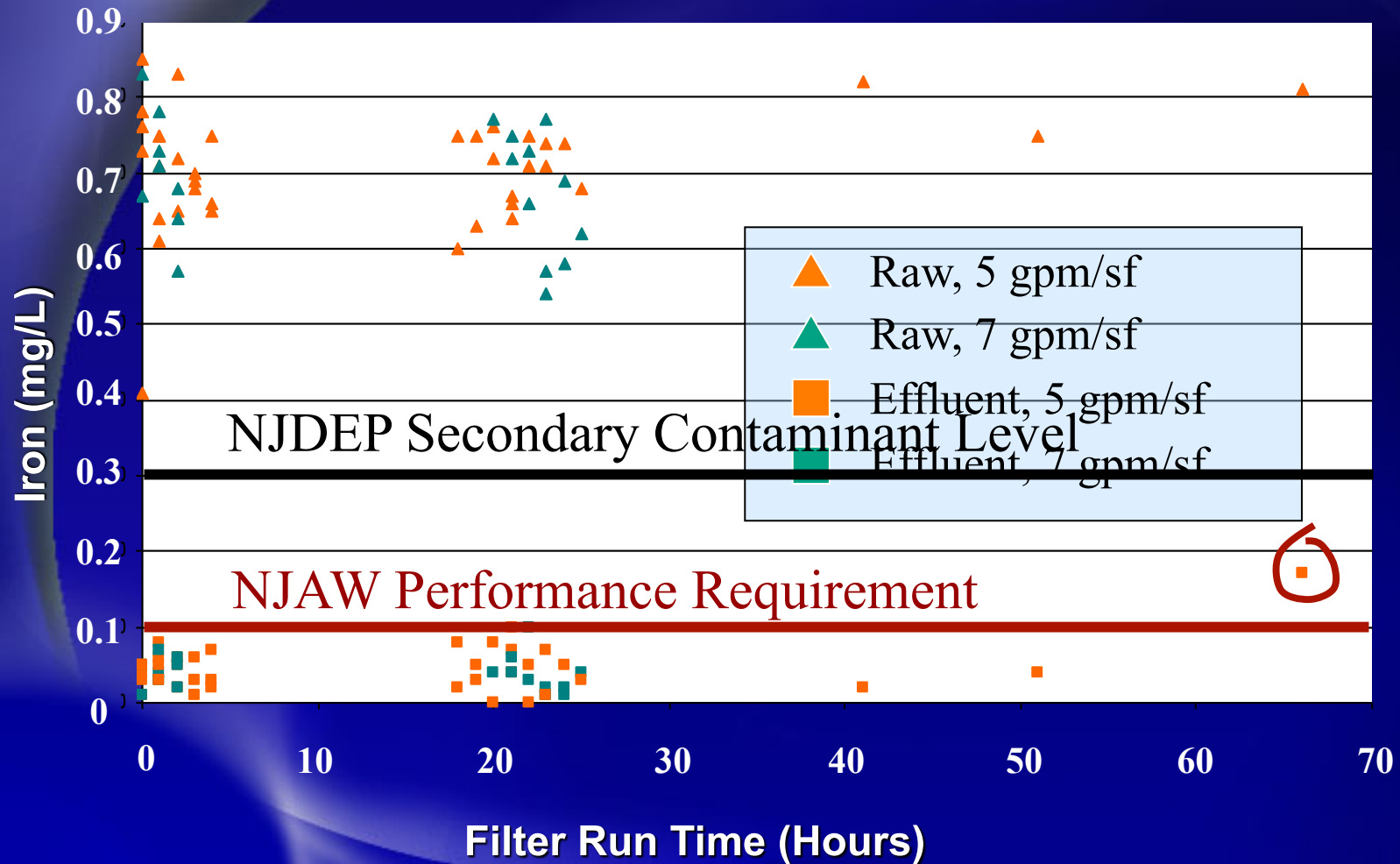
Pilot Study



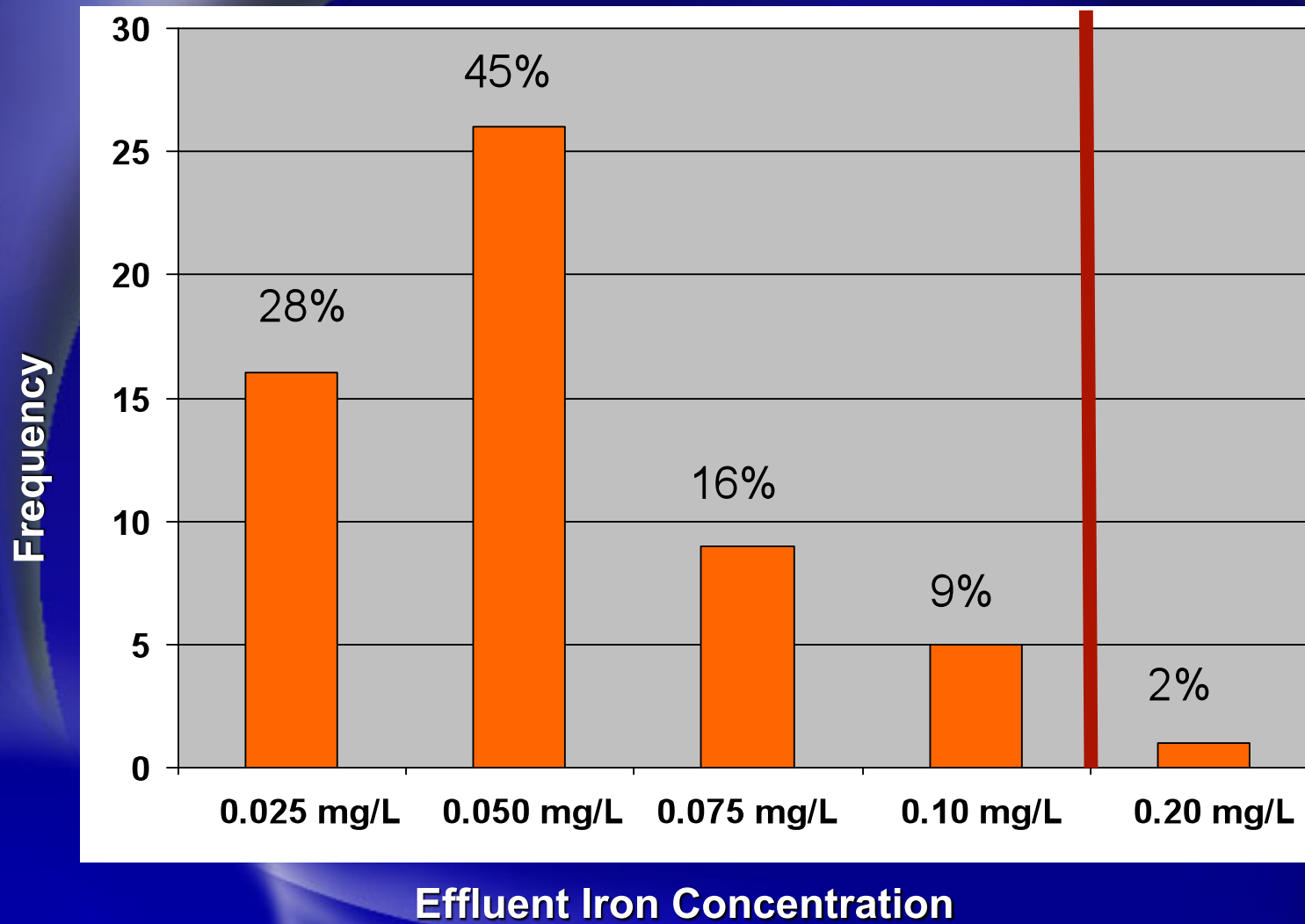
Pilot Study Results

- ◆ Effluent Iron concentrations
 - ◆ 0.05 mg/L
- ◆ Effluent Manganese concentrations
 - ◆ 0.02 mg/L
- ◆ Headloss

Pilot Study Results



Pilot Study



Design

- ◆ GreensandPlus filters
- ◆ Regular operation
- ◆ Backwash operation (one filter backwashing)
- ◆ Benefits of higher loading rate
- ◆ Recycle 85% backwash flow

Recap

- ◆ Background
- ◆ Treatment Alternatives
- ◆ Oxidation and Filtration
- ◆ Fe and Water Chemistry
- ◆ Bench Scale & Pilot Tests
- ◆ Design

Questions?