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

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Today's Presentation

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

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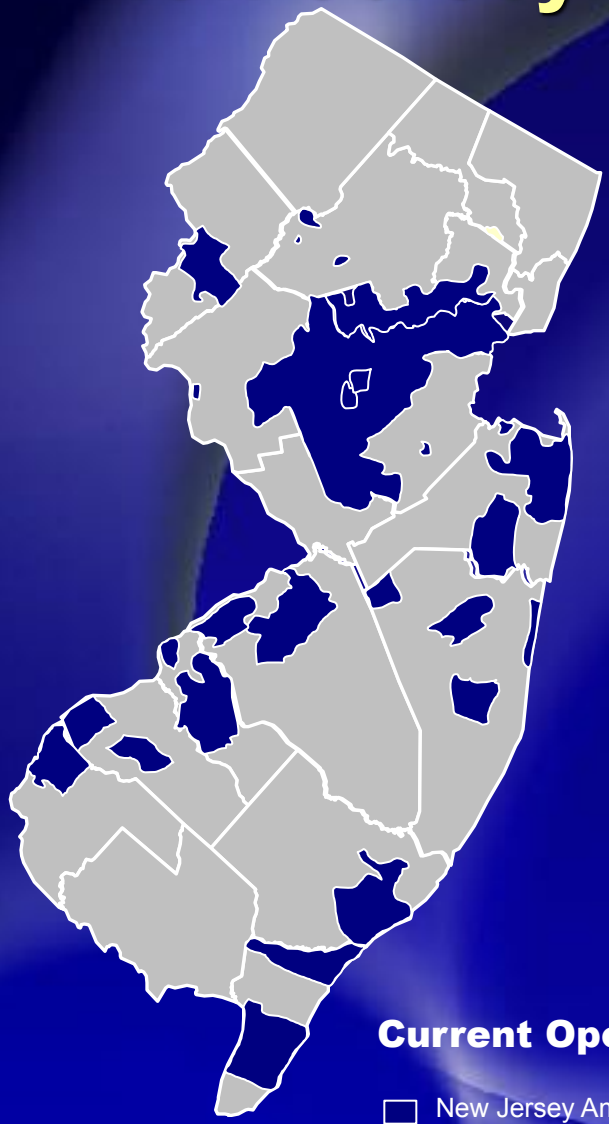
New Jersey American Water



- 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

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Background

Monterey Beach, NJ

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

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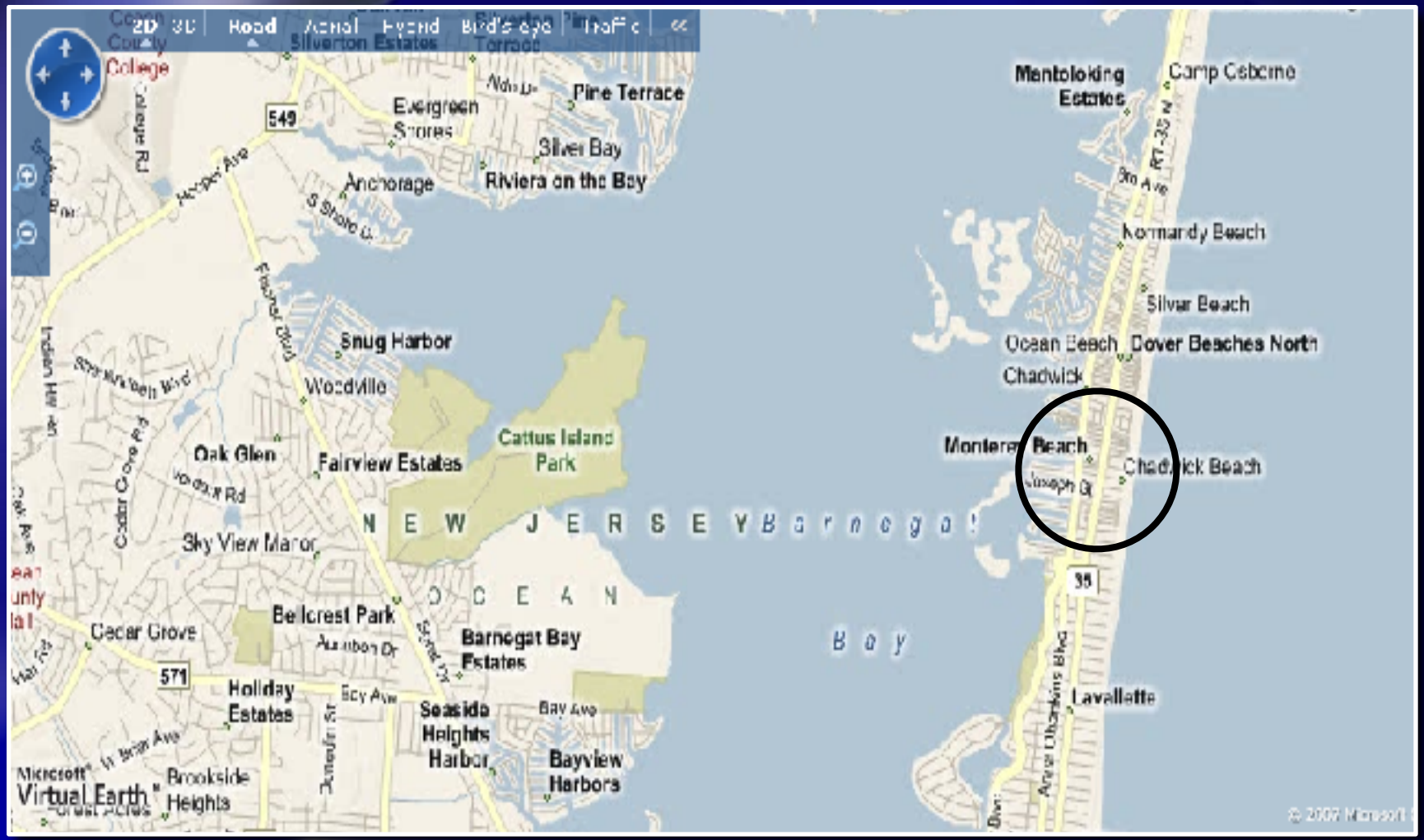
Project Location



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Problem / Water Quality

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

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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

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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

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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

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GreensandPlus Technology

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

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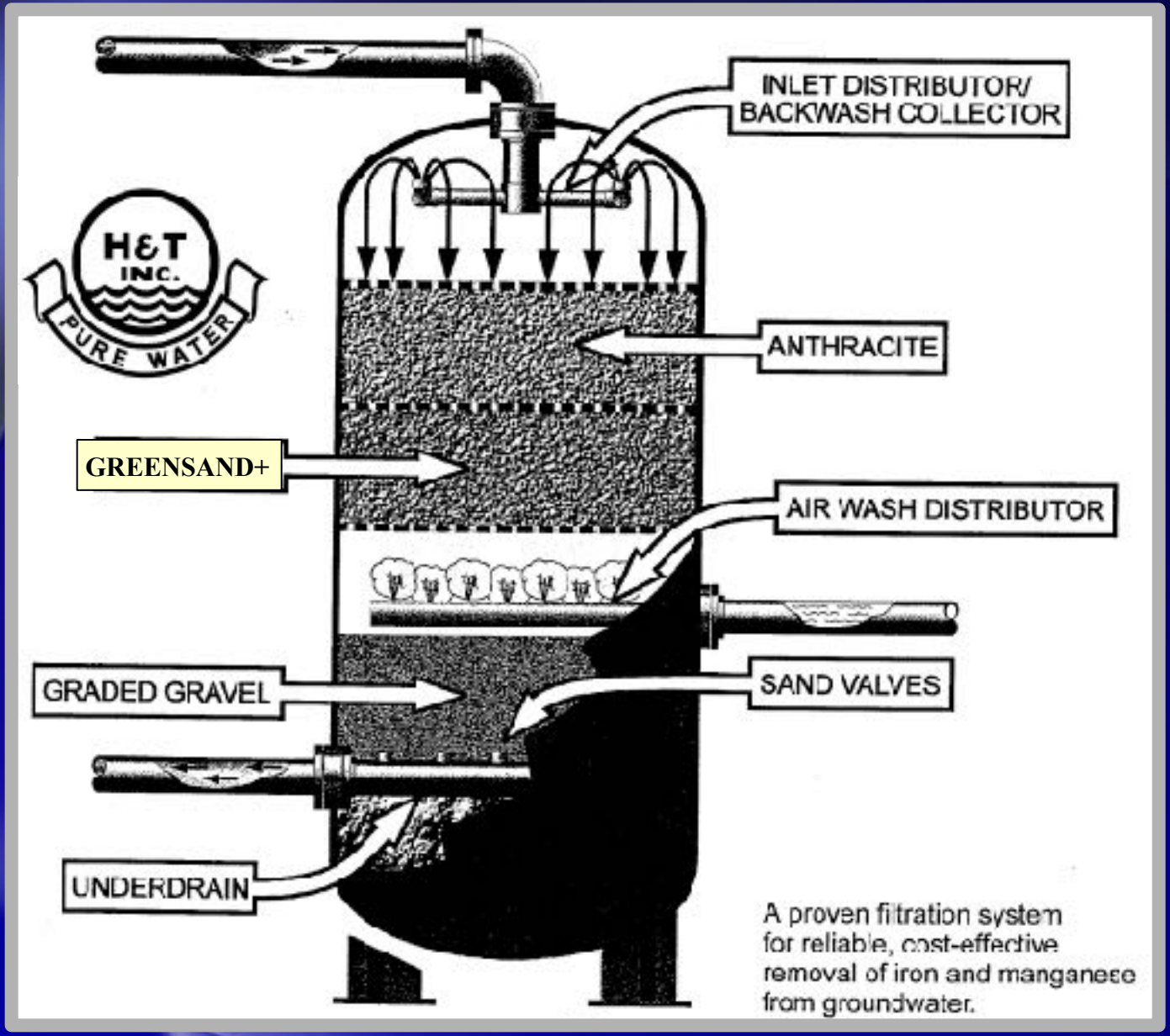

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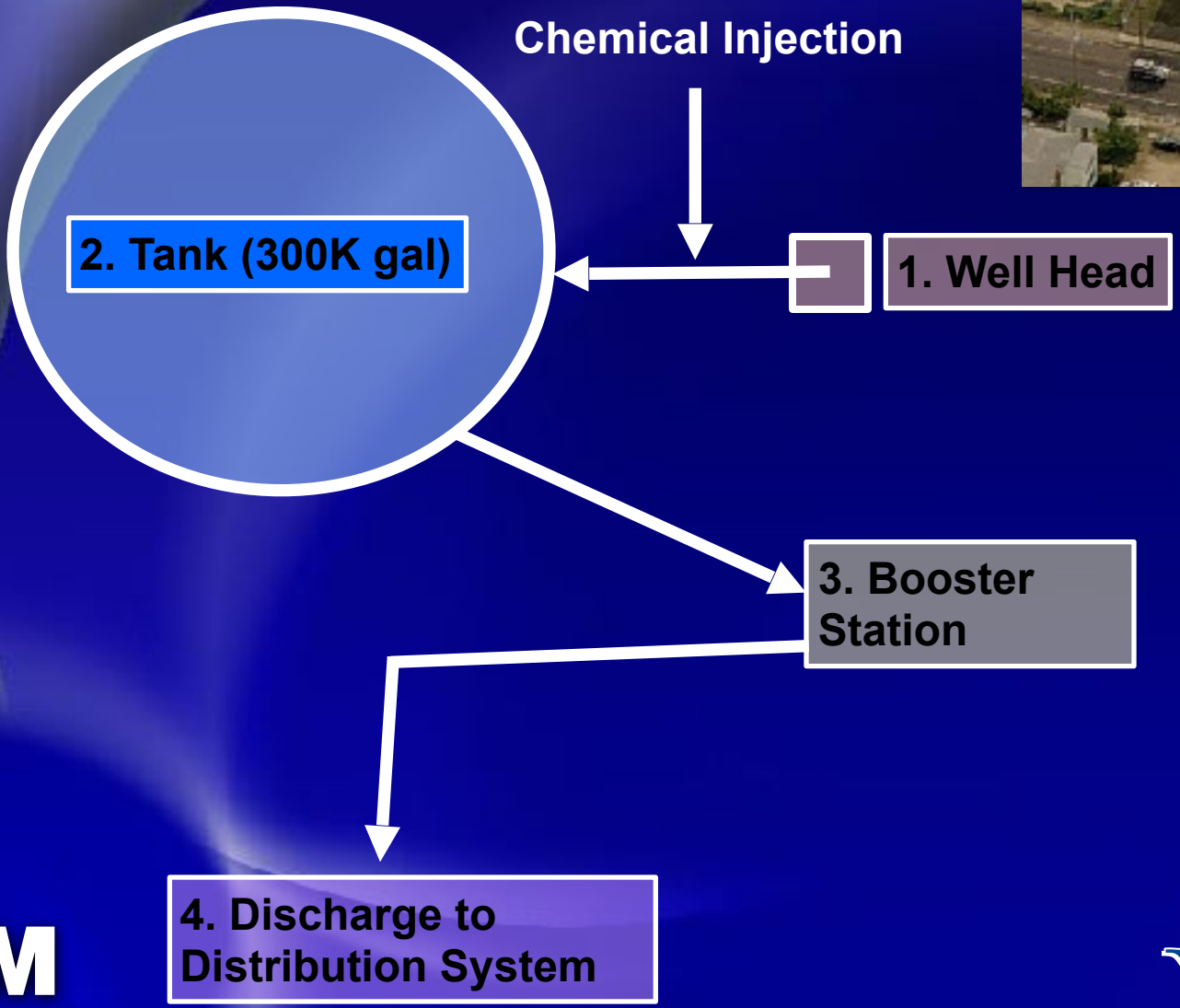
Existing Operations



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Location Details

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Proposed Site

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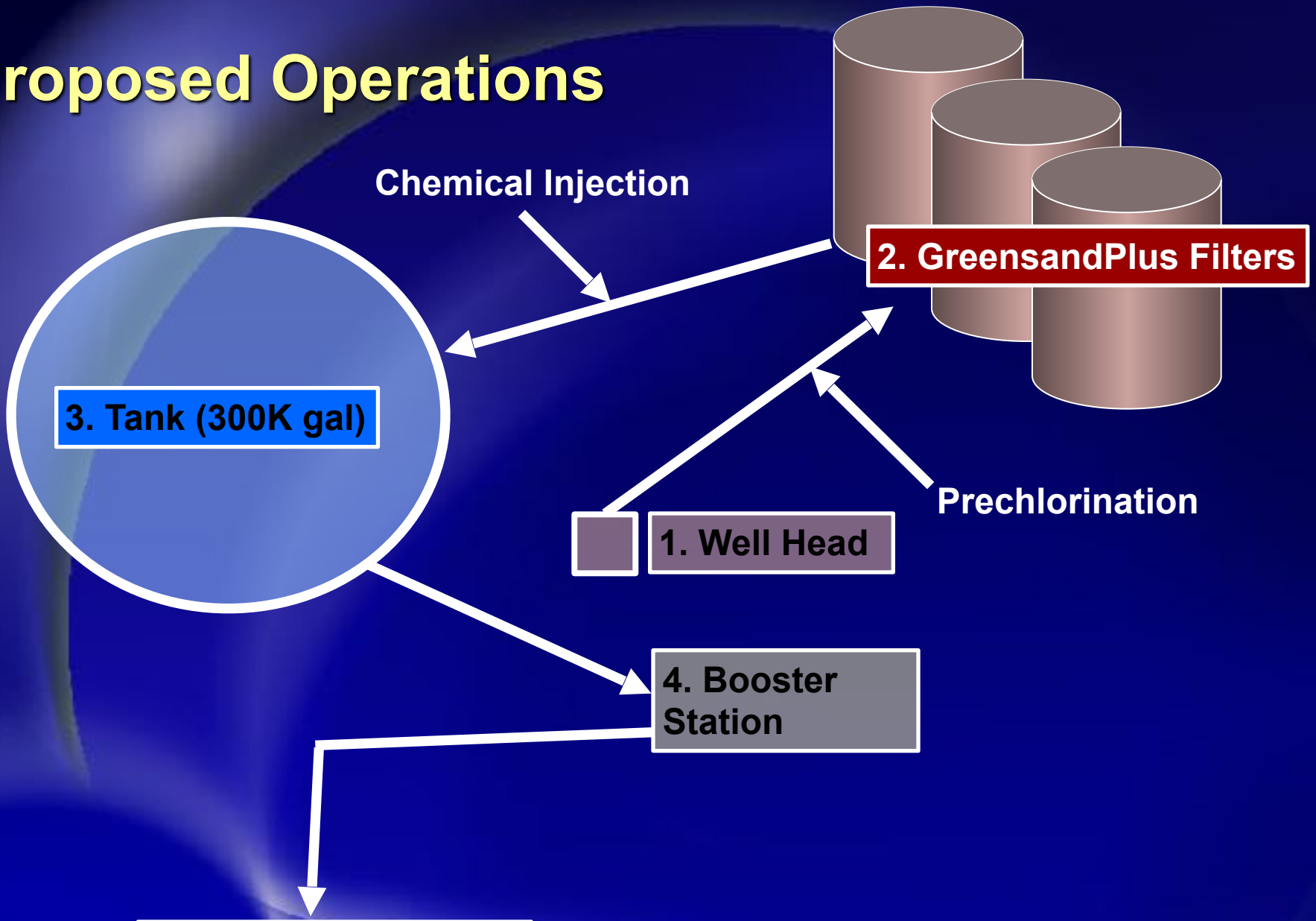
Proposed Operations



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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

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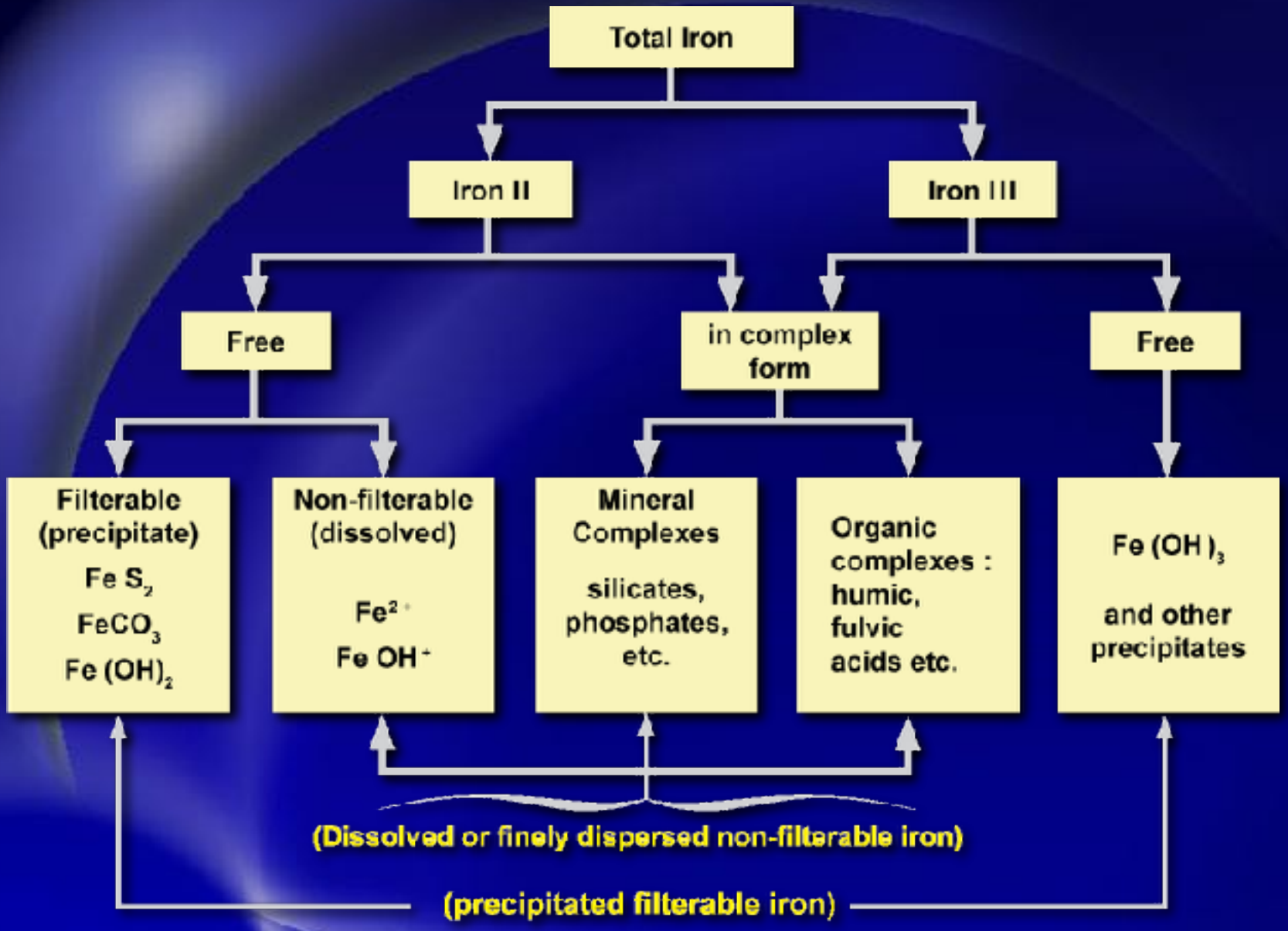

From "Water Treatment Handbook", Degremont, 1979

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

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Abnormal Water Quality and Filtration

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

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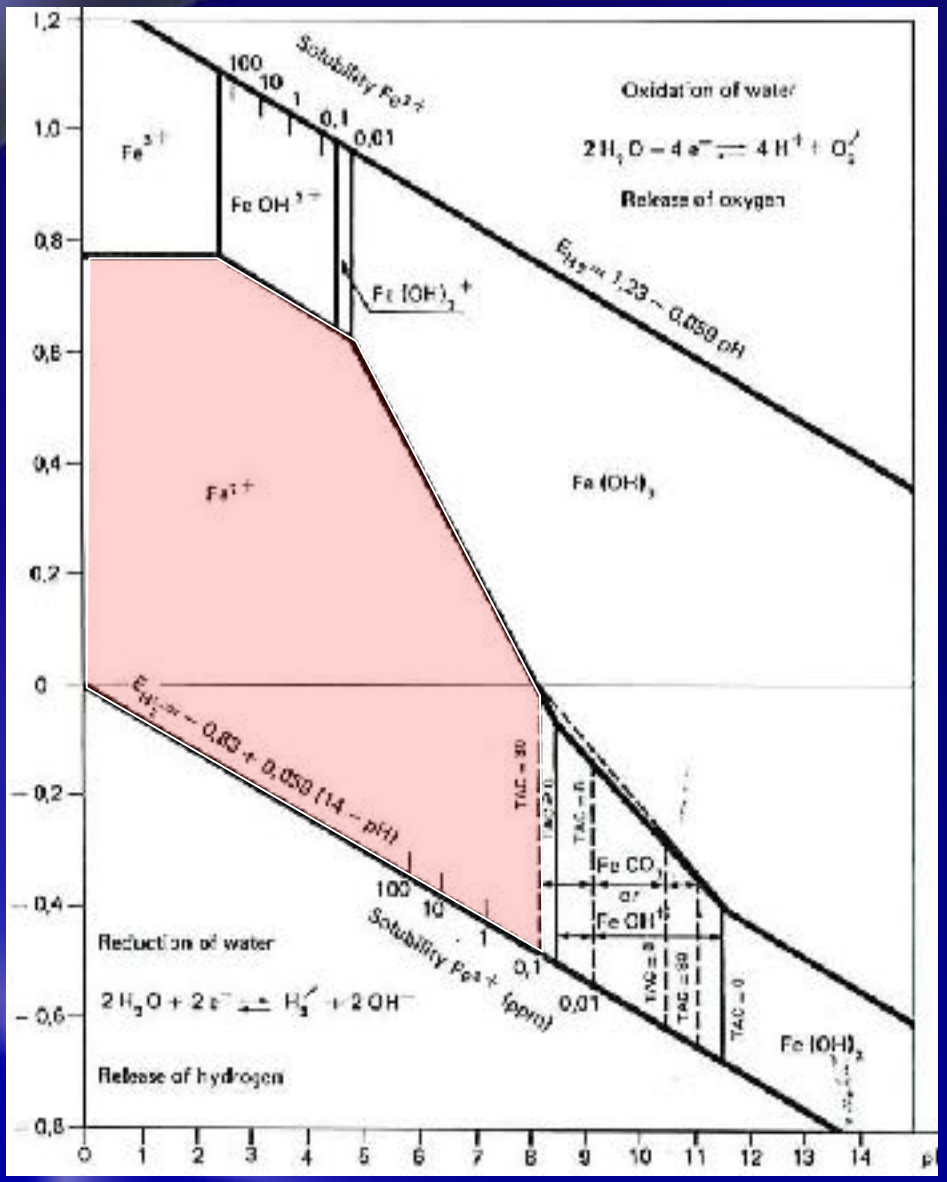
Iron: pH and Oxidation-Reduction Potential



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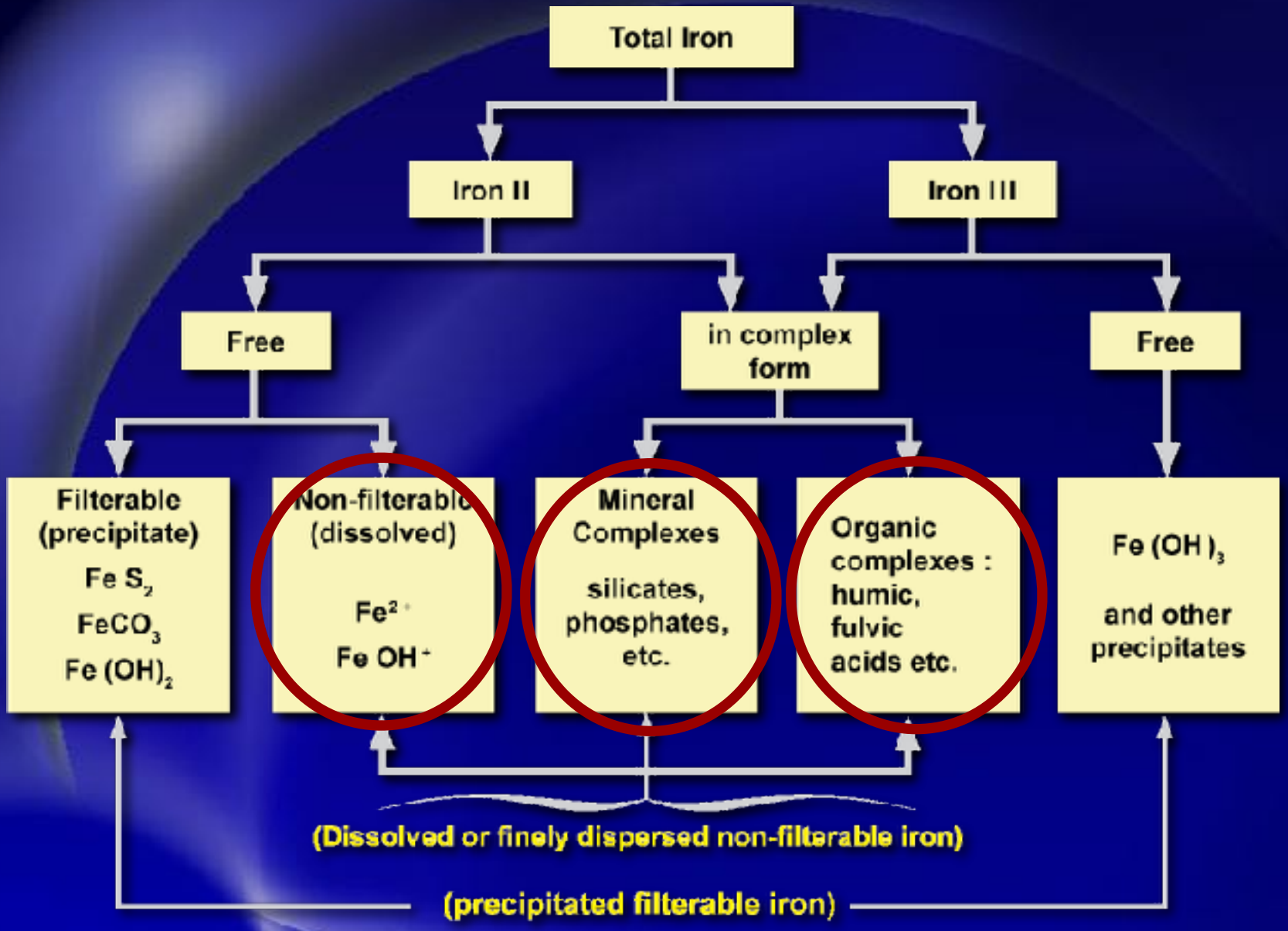

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Bench Scale Test

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

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Pilot Test

- Higher Loading Rates
  - 5 to 7 gpm/ft^2
- Confirm Iron and Manganese Removal
  - Prechlorinate
  - Impact of MnO_2 coated green sands

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Pilot Study

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Pilot Study Results

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

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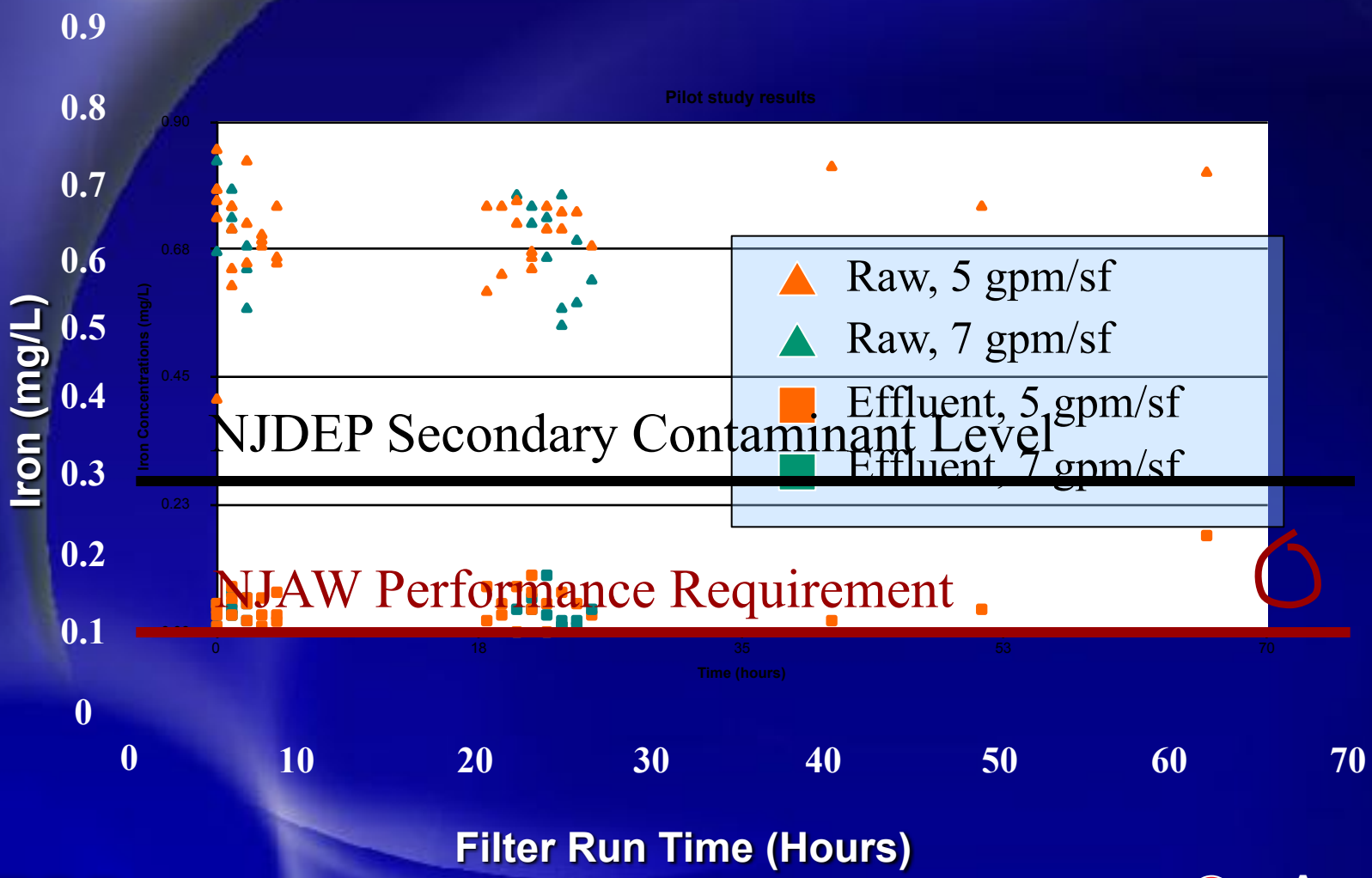
Pilot Study Results



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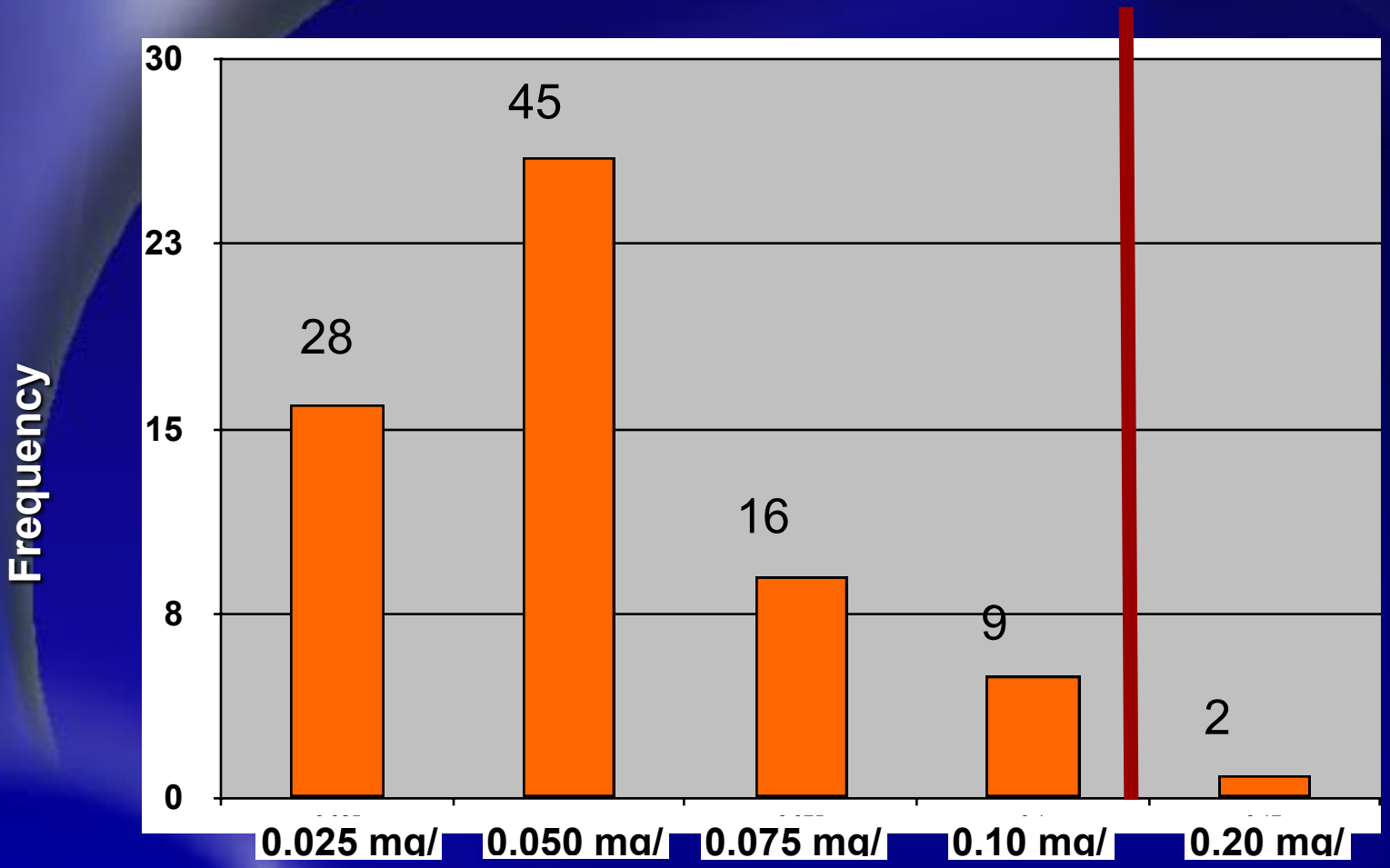
Pilot Study



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Design

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

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Recap

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

Questions?

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