Pilot Study for the Removal of Iron and Manganese

For: Existing Wells No. 1 & 2

Rib Mountain Sanitary District

Rib Mountain, Wisconsin

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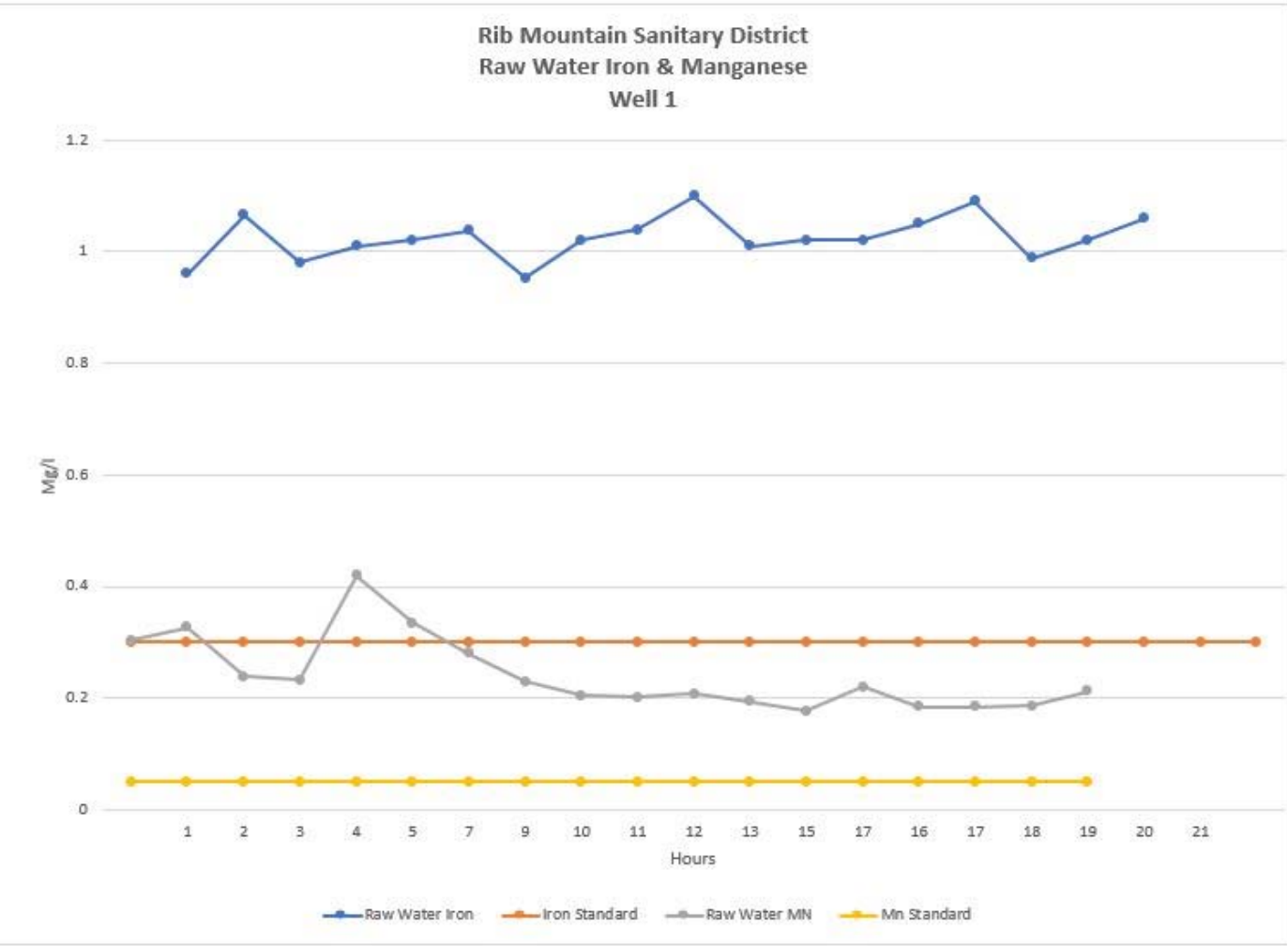
Presented By:
Randy Sanford, PE
John Thom, Operations Specialist
Jeff Nussbaum, PE

What is a Pilot Study

- Scaled model of a water treatment plant.
  - Proving the actual size and shape of proposed treatment required for your water.
- Purpose of the Rib Mountain Study?
  - Show the effectiveness of various treatment processes for the removal of dissolved iron and manganese from well water.
  - Consideration of best available treatment for two existing wells and for future wells.

Existing Filter Water Quality

- Water quality with Vyredox system off line
  - Fe
  - Mn
- EPA Standards



Existing Water Quality

- Well No. 1
  - 500gpm or about 0.720 MGD
  - Raw Water Quality
    - Iron
      - Min 0.952 mg/l
      - Max 1.1 mg/l
      - Ave. 1.025 mg/l
      - EPA Limit 0.30mg/l
    - Manganese
      - Min 0.177 mg/l
      - Max 0.420 mg/l
      - Ave. 0.241 mg/l
      - EPA Secondary Maximum Contaminant Level 0.050 mg/l

Almost 3.5times the recommended maximum level

Almost 4.5 times the recommended maximum level

Existing Water Quality

- Well No. 2
  - 500gpm or about 0.720 MGD
  - Raw Water Quality
    - Iron
      - Min 0.889 mg/l
      - Max 1.30 mg/l
      - Ave. 1.132 mg/l
      - EPA Limit 0.30mg/l
    - Manganese
      - Min 0.126 mg/l
      - Max 0.393 mg/l
      - Ave. 0.223 mg/l
      - EPA Secondary Maximum Contaminant Level 0.050 mg/l

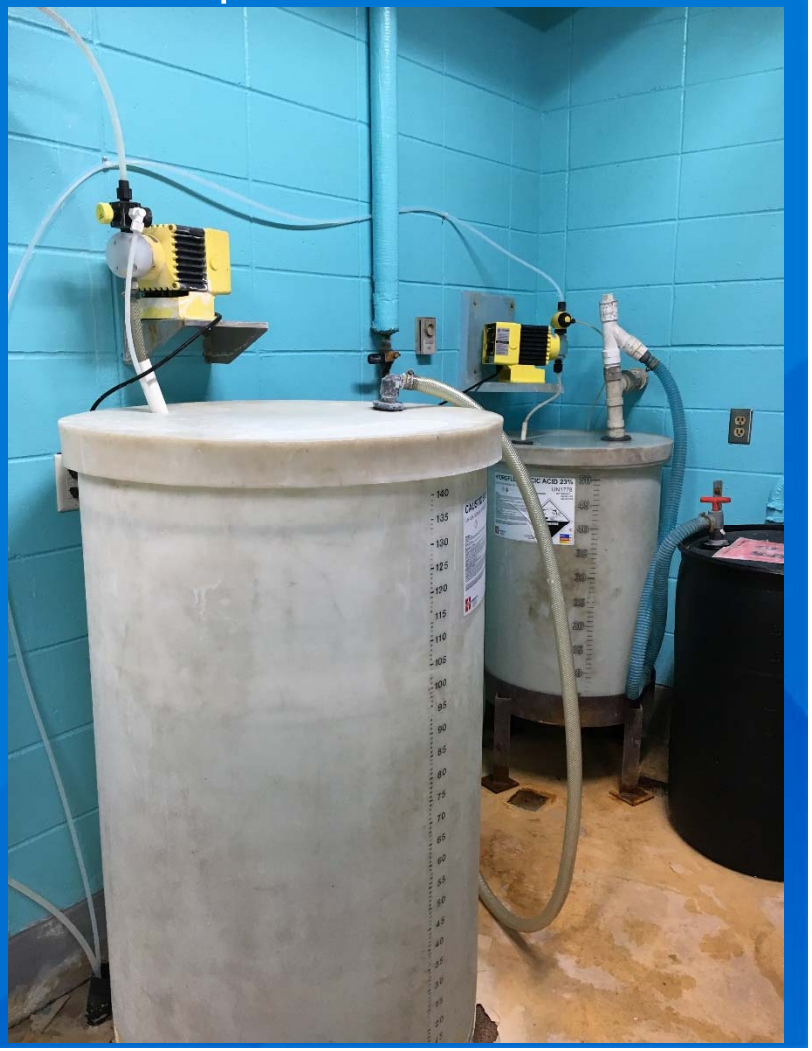
More than 3.5 times the recommended maximum level

Almost 4.5 times the recommended maximum level

Existing Water Treatment Plant

Existing Water Treatment Process

- Vyredox® iron and manganese removal treatment process was installed in 1985 for Well No. 1 and Well No. 2.
- Current Chemicals Added:
  - Chlorine for disinfection
  - Caustic Soda for corrosion control
  - Fluoride for dental health



Current Maintenance Required

- Vyredox® treatment system oxidizes the iron and manganese in the soil, leaving the iron and manganese in the water source, except their non-soluble form
- Well 1 & 2 well rehabilitation
- Hydrant flushing to remove deposits within distribution system

PILOT STUDY

- Four Different Columns of Media
  - Sand & Anthracite(1)
  - Green Sand Plus (1)
  - Pyrolucite (2)
- Detention
- Aeration
- Filtration 3 gpm/ft^2
- Filtration 5-6 gpm/ft^2
- Chemical Oxidation
- Scaled Model of New Process

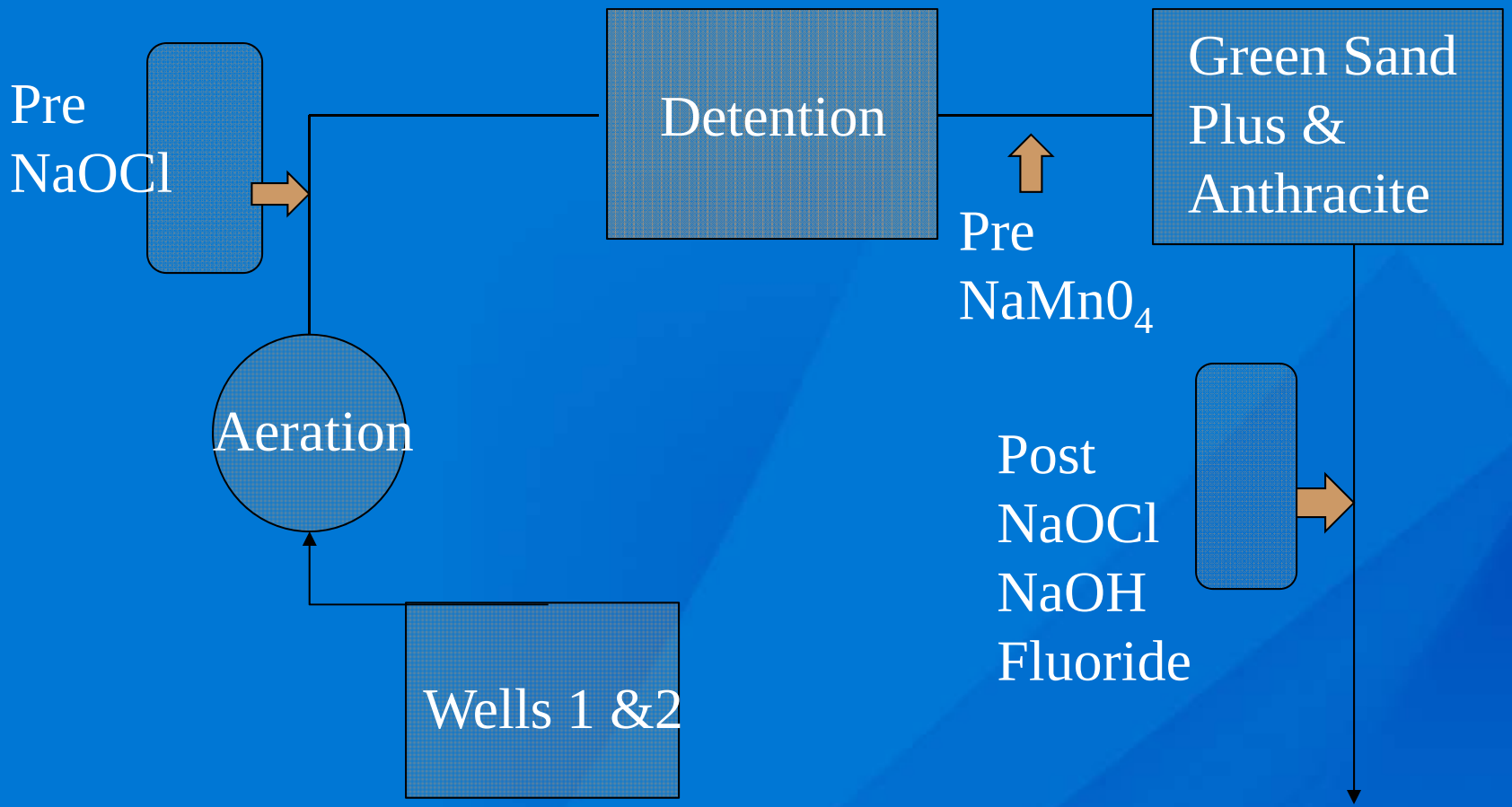
Pilot Study Results

- Filter Media – Two of the columns provided recommendable results and are summarized here:
- Column No. 2 - Filtration (3gpm/sf)
  - Greensand Plus with Anthracite (with aeration & detention)
    - Fe reduced to an average of 0.05 mg/l
    - Mn reduced to an average of 0.01 mg/l or less
    - Head loss difference = 1.97 psi (55 inches)
    - Run time approx. 20 hrs
- Column No. 4 - Filtration (6gpm/sf)
  - Pyrolucite
    - Fe reduced to an average of 0.05 mg/l
    - Mn reduced to an average of 0.01 mg/l or less
    - Head loss difference = 3.62 psi (101 inches)
    - Run time approx. 20 hrs

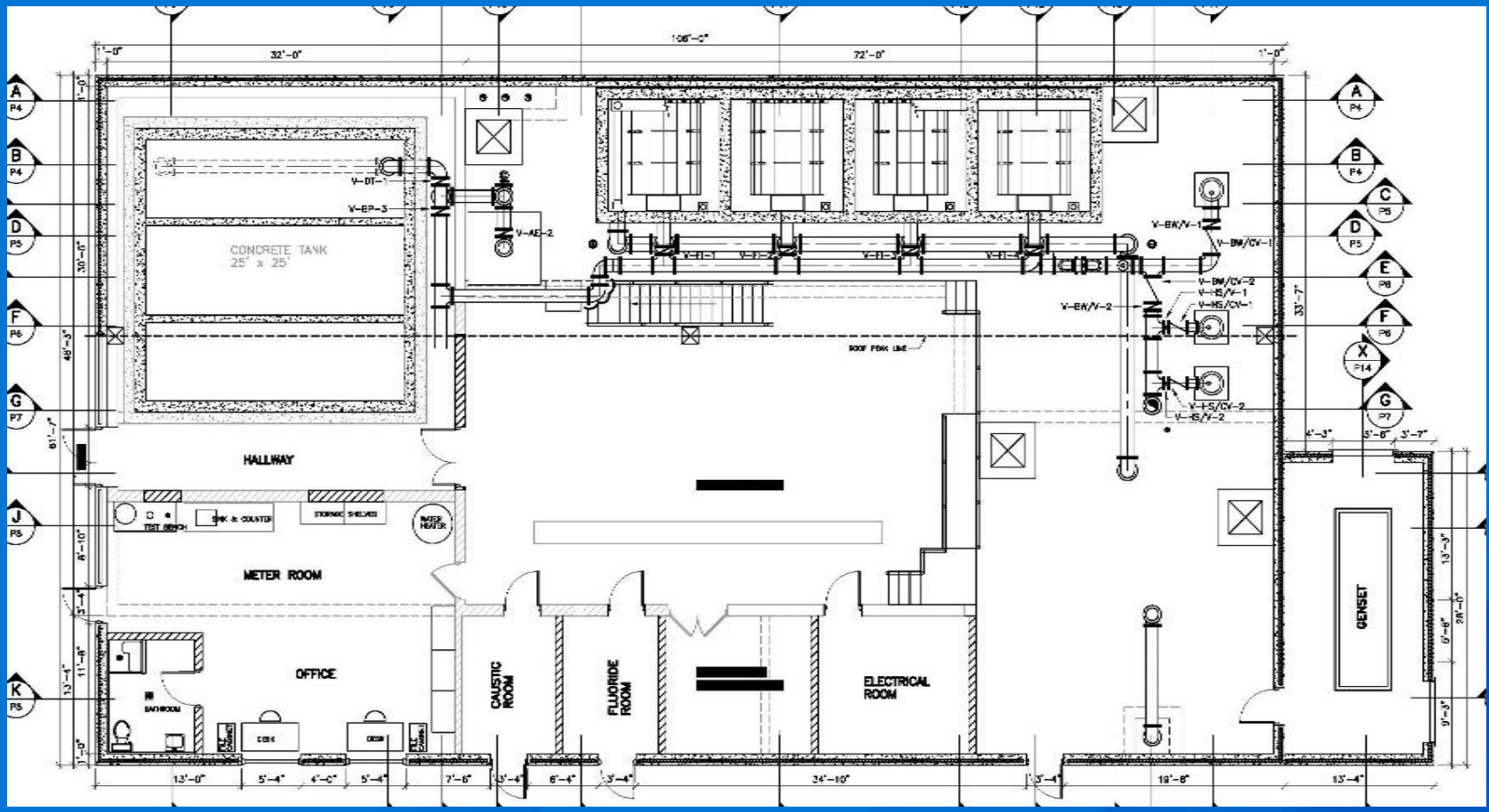
Pilot Study Results

- Column 2 - Detention time & Aeration Required
  - Pretreatment of raw water with chemicals
    - Chlorine
    - Sodium Permanganate
- Column 4 – Chemical Oxidation Only
  - Pretreatment of raw water with chemicals
    - Chlorine only
- Post treatment of filtered water was not tested but would include:
  - Caustic Soda
  - Chlorine
  - Fluoride

New Process Diagram For Column 2 – Filtration 3 gpm/sf

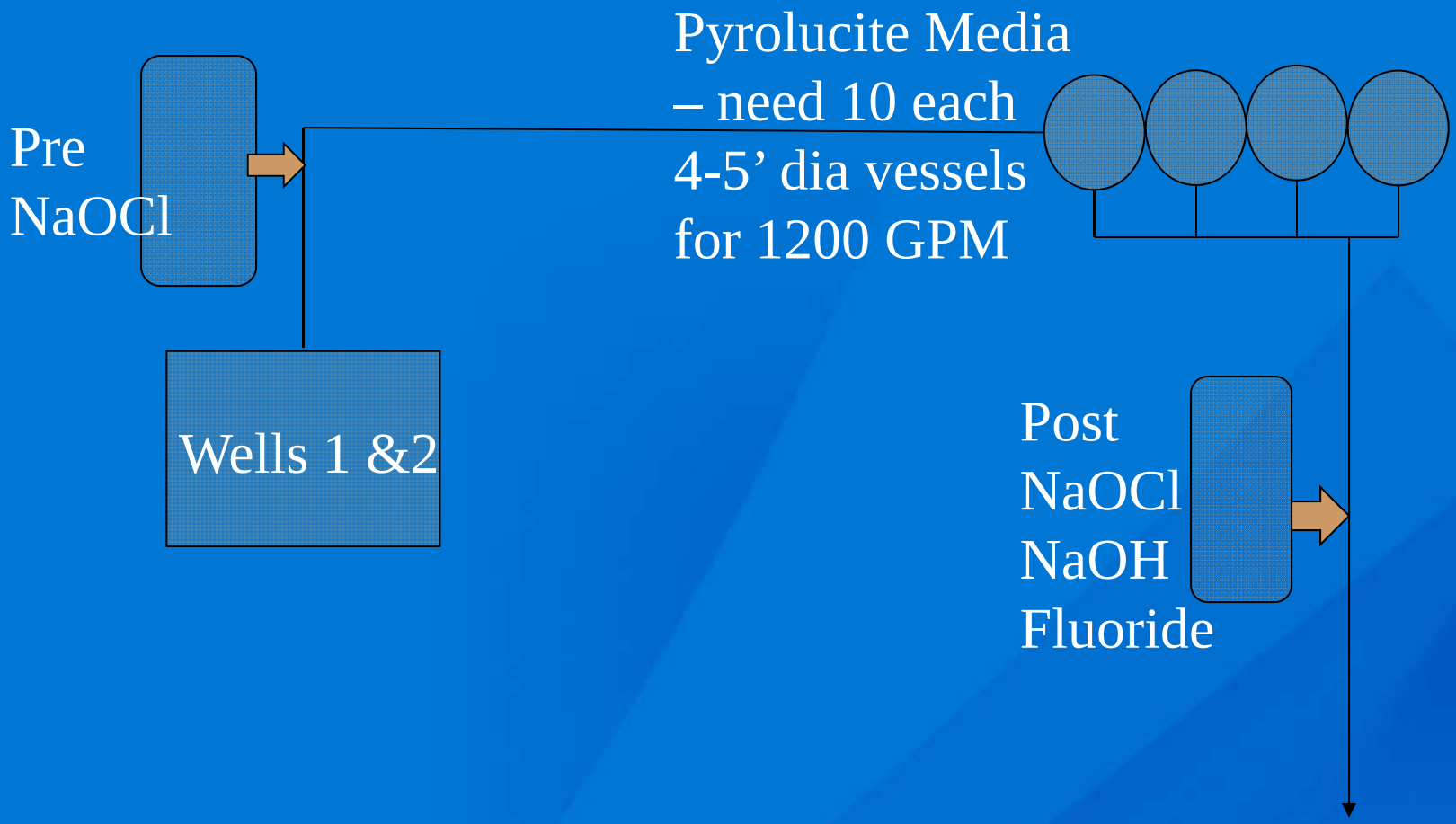


Preliminary Sizing Gravity Filter @ 3 gpm/ft^2



Estimated size of building 7,000 sf

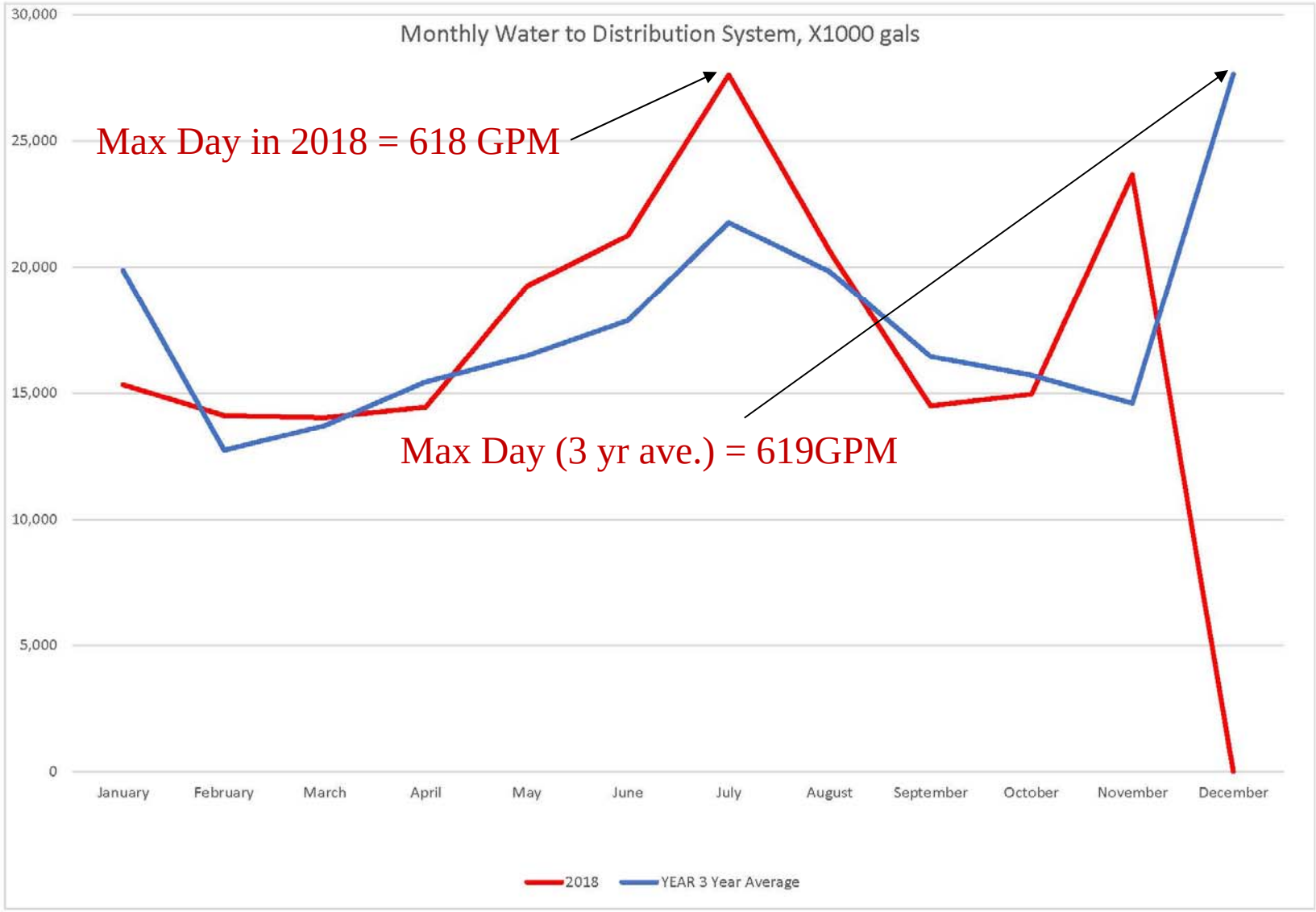
New Process Diagram For Column 4 – Filtrations 6 gpm/sf



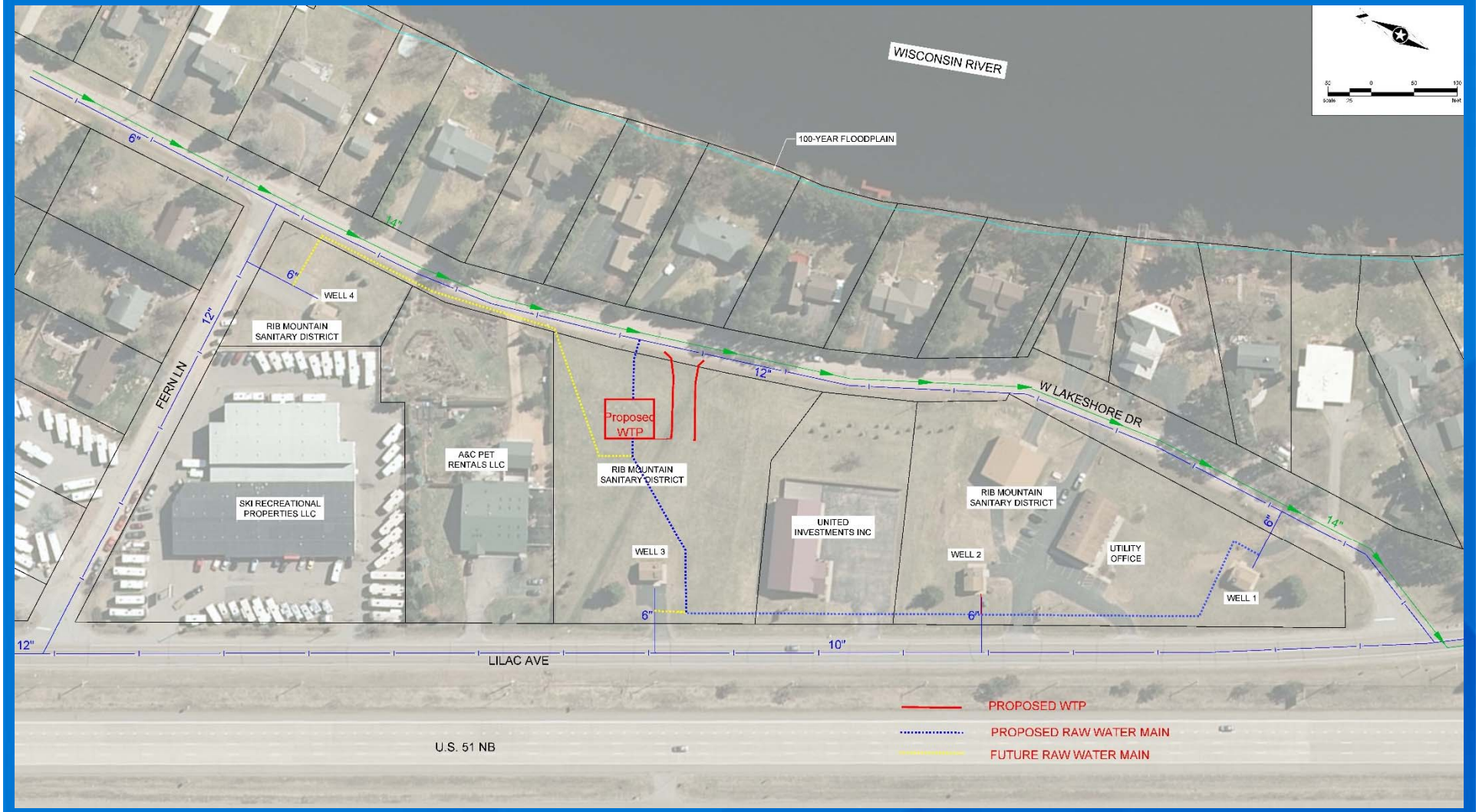
Preliminary Sizing Pressure Filter @ 6 gpm/ft^2

Estimated size of building = 3,500 sf

Water Demand Considerations



Overview of Proposed WTP Improvements



Recommendations

Add Water Treatment Plant Improvements Based on Pilot Objectives and Water Quality Results

- Long Term Improvements
  - Improves Water Quality To All Customers
  - 800 GPM treatment – approx. intermediate need
  - 1,200 GPM treatment – approx. long term need
  - Addresses Energy Efficiency
  - Meets EPA Secondary Maximum Contaminant Levels
  - Improves Well Operation Efficiency
  - 50 plus Year Life

Recommendations

Option 1

- Gravity Filtration (3 gpm/sf)

  Advantages

  - Reliability
  - Operation & Maintenance Flexibility
  - Flexible to Water Quality Changes in the aquifer
    - Fe, Mn, bacteria, turbidity etc.
  - Long Run Times
  - High Water Quality

  Disadvantages

  - Higher Capital Costs
  - Larger Footprint
  - Additional Chemicals
  - Additional pumping necessary

Recommendations

Option 2

- Pressure Filtration (6 gpm/sf)

  <u>Advantages</u>

  - Reliable
  - Less capital costs
  - Smaller footprint
  - Flexible to water quality changes in the aquifer
    - Fe, Mn, bacteria, turbidity etc.
  - Long run times
  - High water quality
  - Uses same well pump and chlorine feed

  <u>Disadvantages</u>

  - Flexible to water quality changes in the aquifer
  - Less flexible for operations & maintenance

Utilize Existing Building For Improvements to WTP?

Preliminary Cost Estimate

WTP for up to 1,200 gallons per minute:

Option 1 - $4.7 Million
Option 2 - $3.0 Million

Phased construction discussion….

Financing Discussion

- Utility Bonding
- TIF/TID District Income (probably not available for a sanitary district)
- Safe Drinking Water Loan Program; WDNR
  - ITA/PERF submitted October 2018
  - Application due end of June 2019
- USDA Rural Water Loan

Major Next Steps

- Sanitary District Board direction
- WDNR final pilot study report approval
- Preliminary engineering
  - WDNR engineering report
- PSC rate review and utility financial analysis.
- Safe Drinking Water Loan Program application (SDWLP)
- Final design
  - PSC construction authorization
  - WDNR plan submittal
- Bidding
- Construction
- Startup

Schedule For Next Steps

Description	Milestones (2019)
Sanitary District Board direction	January
WDNR final pilot report submittal	January
Preliminary engineering	Feb - April
PSC rate review and utility financial analysis	Feb - April
SDWLP Application/Design plans & specs	June (to DNR)
Prepare final bidding documents	June - December

Description	Milestones (2020-2021)
Bidding	January
Construction Start	April
Startup	2021

Questions and Answers