City of Lorain, Ohio
Water Supply Master Plan

Findings & Recommendations

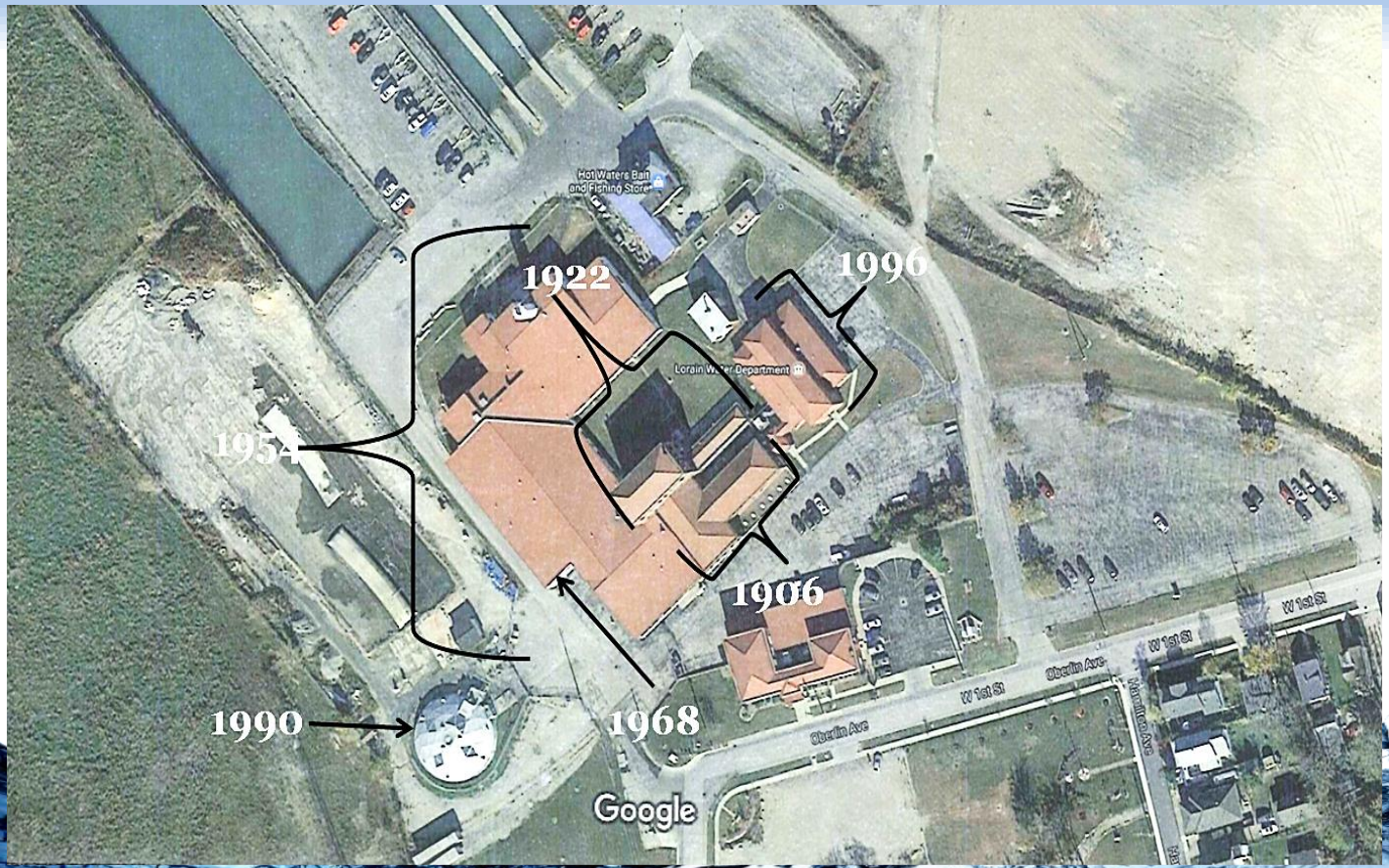
December 9, 2019

CORNWELL
ENGINEERING GROUP

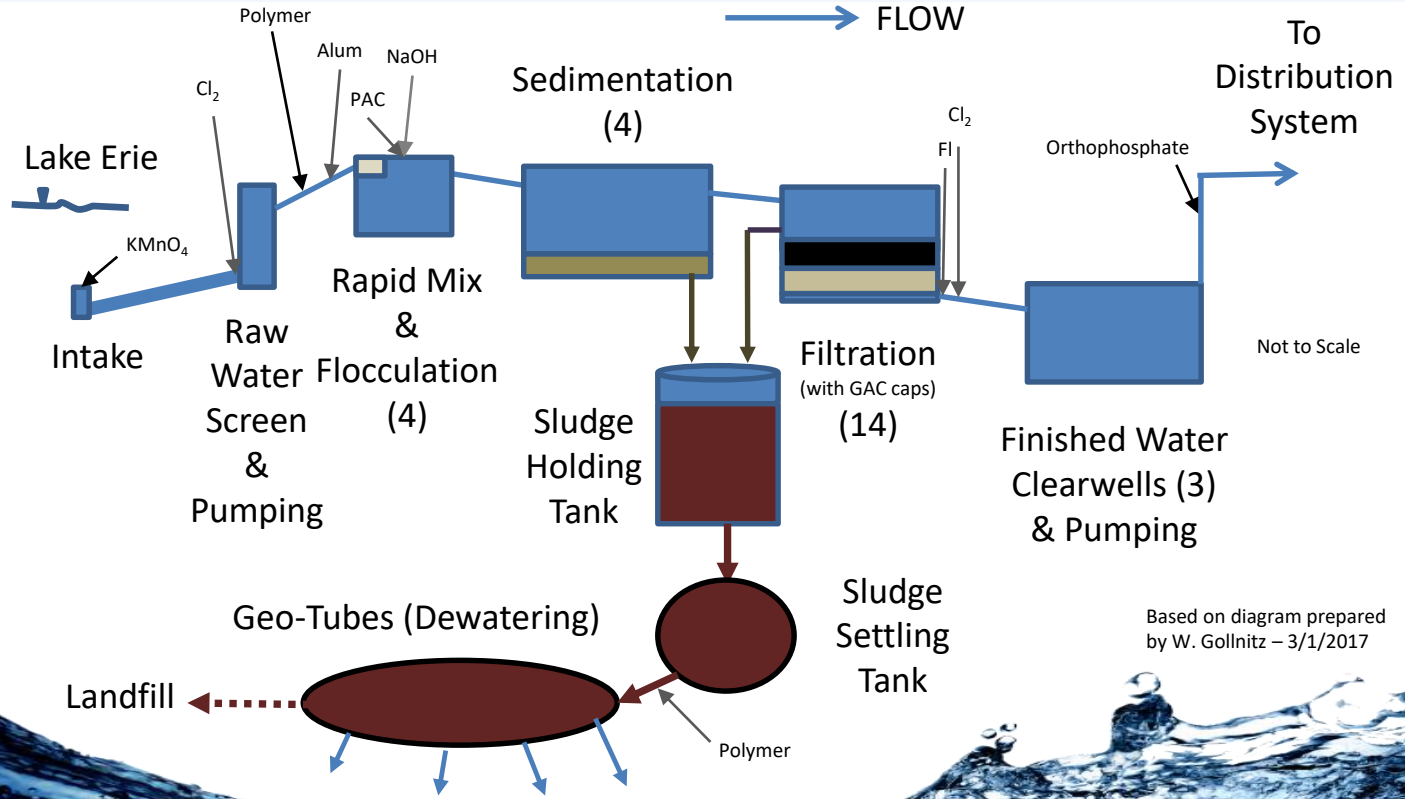
Major Objectives for Today

- Review findings of water supply facility master plan
- Rehab vs New: Begin the process of deciding to rehab the existing plant or build a new plant using as much of the existing facilities as possible to save funds
- Flow demand data and population analysis determined that a future plant capacity of 16 mgd is needed (same as today)

Lorain WTP: Site Plan Overview



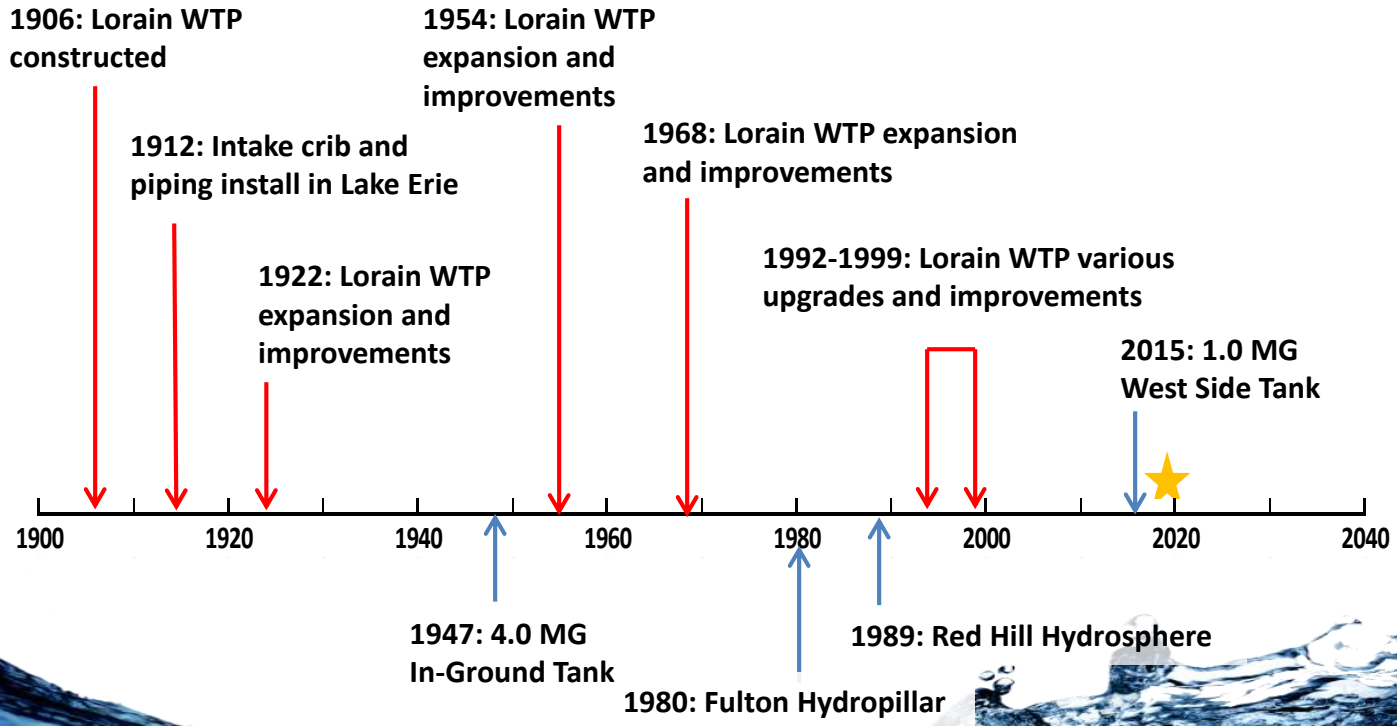
Lorain WTP:
Current Treatment Process Diagram



Water Treatment Plant Evaluations

- All the treatment processes must function to produce water meeting regulations.
- Reviewed the current water supply master plan and treatment strategies.
- We assessed each process for functionality and reliability.
- If necessary, improvements were recommended.
- Since many of the elements at the plant are quite old, structural integrity; old pumps, piping and valves; and treatment modernization were key considerations in the evaluation.

Lorain WTP: Brief History



Raw Water Intake & Pumping

Receive water from Lake Erie and pump through the treatment processes to become potable

Replace and Modernize Pumps, Valves, and Slide Gates for 20+ year life

Rapid Mix - Rehab

Mix chemicals and water to create reaction with particles as part of coagulation process

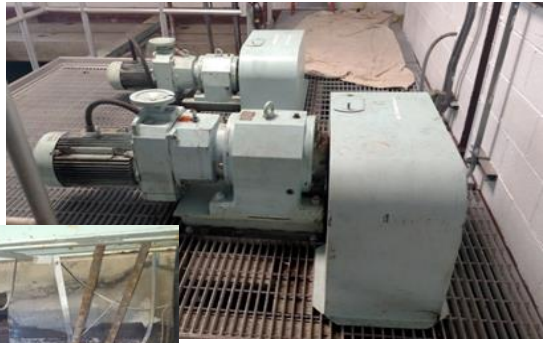
Recommendations

- Replace new rapid mixer systems, install with variable frequency drives (VFDs) for mixer motors
  - Systems are old, near end of expected service life, and more modern systems available
- Install electric motor actuators (modulating) with influent flow control butterfly valves
  - Automatically adjust to evenly split water between rapid mix/flocculation basins in service

Flocculation Basins - Rehab

- Recommendations
  - Reduce (eliminate) stages in each basin as too many stages and time in basins is too long
  - Construct intermediate baffle walls in each basin to improve staged flocculation
  - Replace mixing systems with more modern devices
  - Modify chemical feed points based on treatment study
  - Install new slide gate (post-flocculation)
  - Repair non-critical structural items / Conduct additional inspections as necessary for critical structural items to determine scope of work to repair and additional costs

Slow mixing allows particles to collide to create larger, heavier particles that will settle better

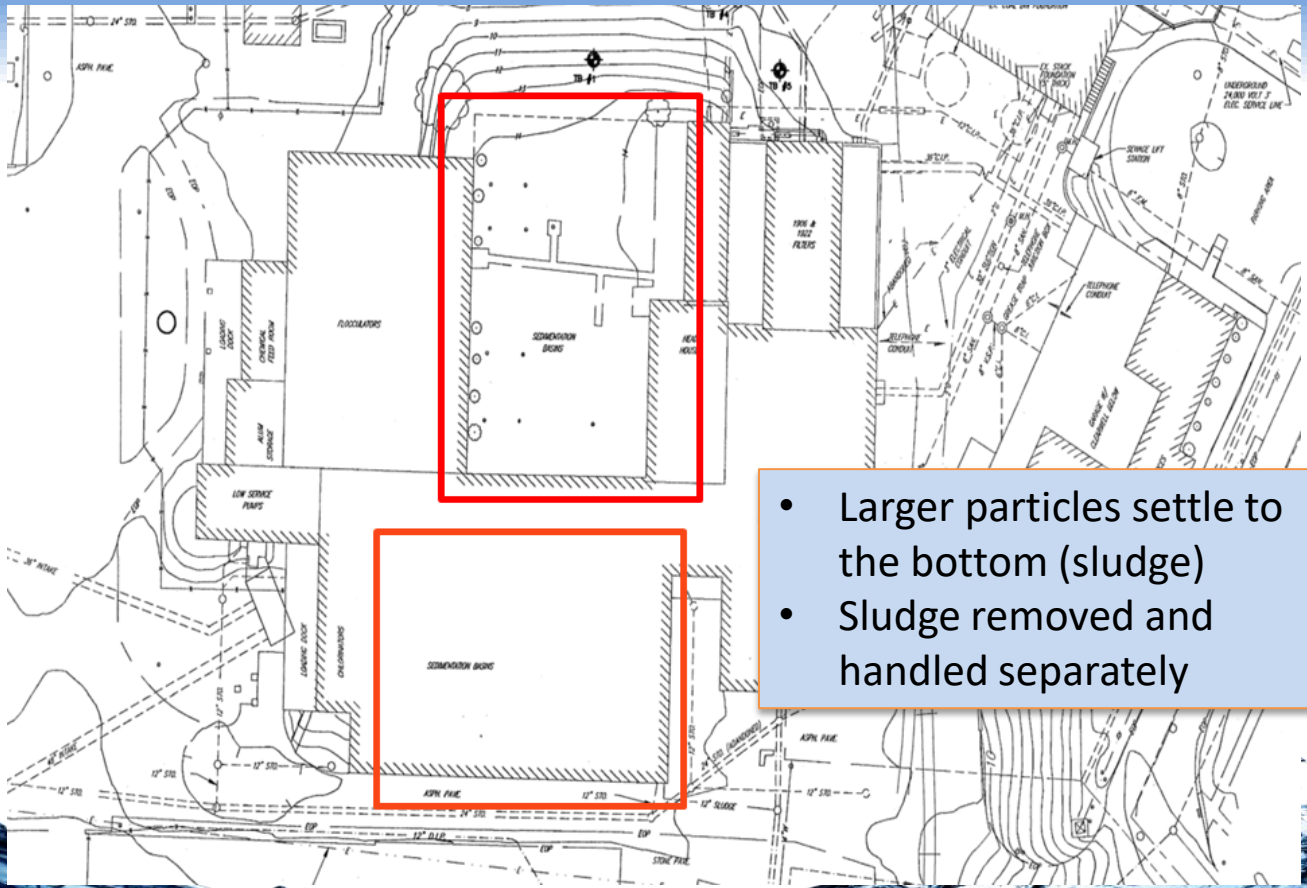


Structural Inspections – Flocculation Basins

From structural inspections, it is likely not possible that all observed deficiencies can be accessed for repair

Concrete structures – 1954
Walkway supports & flocculator systems - 1998

Sedimentation Basins - Rehab



- Larger particles settle to the bottom (sludge)
- Sludge removed and handled separately

Sedimentation Basins Rehab

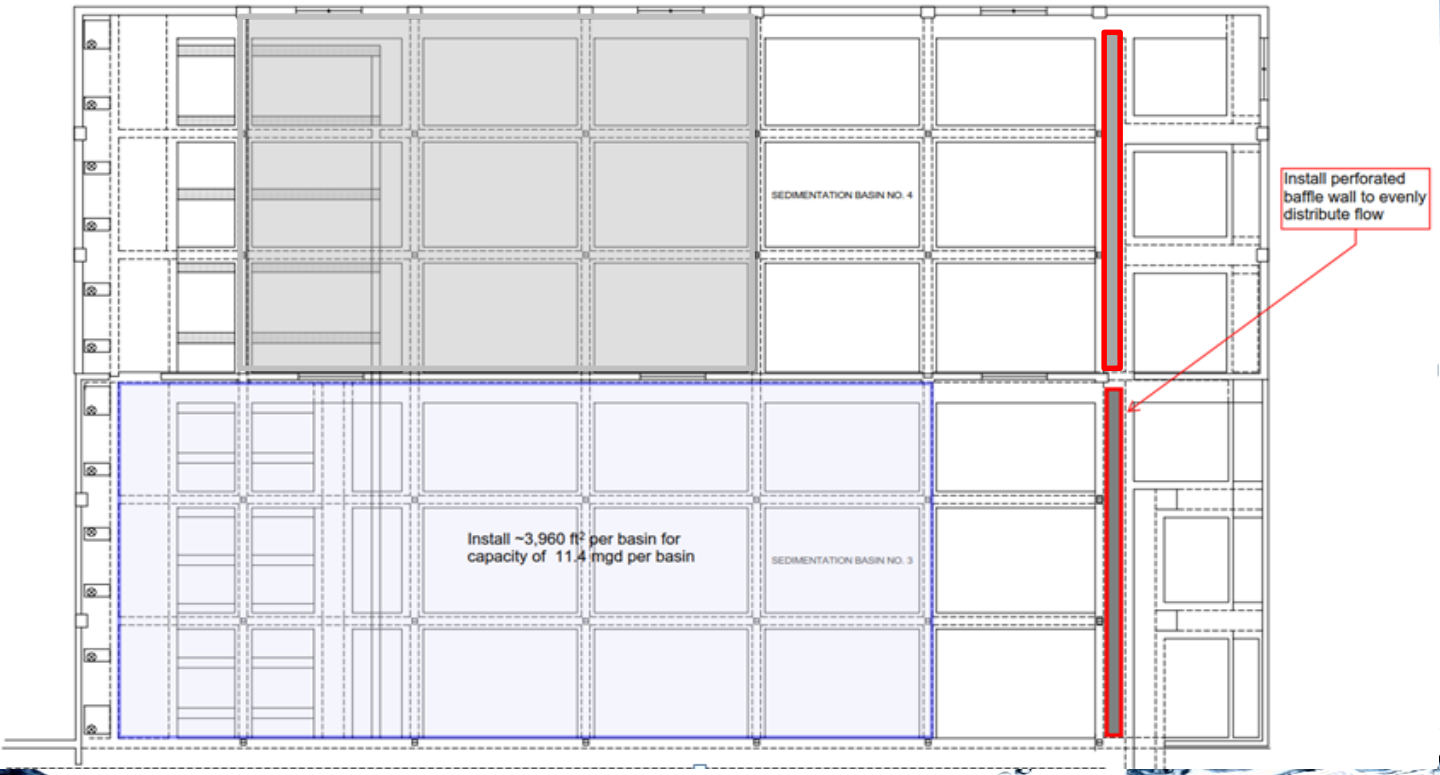
- Lorain WTP currently has 4 sed basins.
- Sed Basins 3 (1954) & 4 (1967) will be upgraded and modernized. These would be the normal operating basins.
- When 3 or 4 is out of service, Sed Basins 1 (1906) and/or 2 (1922) must be utilized. Major upgrades and improvements not practical, but basins still needed in support.
- Sed Basins 1 & 2 do not have mechanical systems to remove sludge. Installing mechanical system into the existing basins is not practical.
  - Potential health and safety issue, particularly during a HAB event when sludge removal is essential (i.e., toxins in sludge).

Structural Inspections

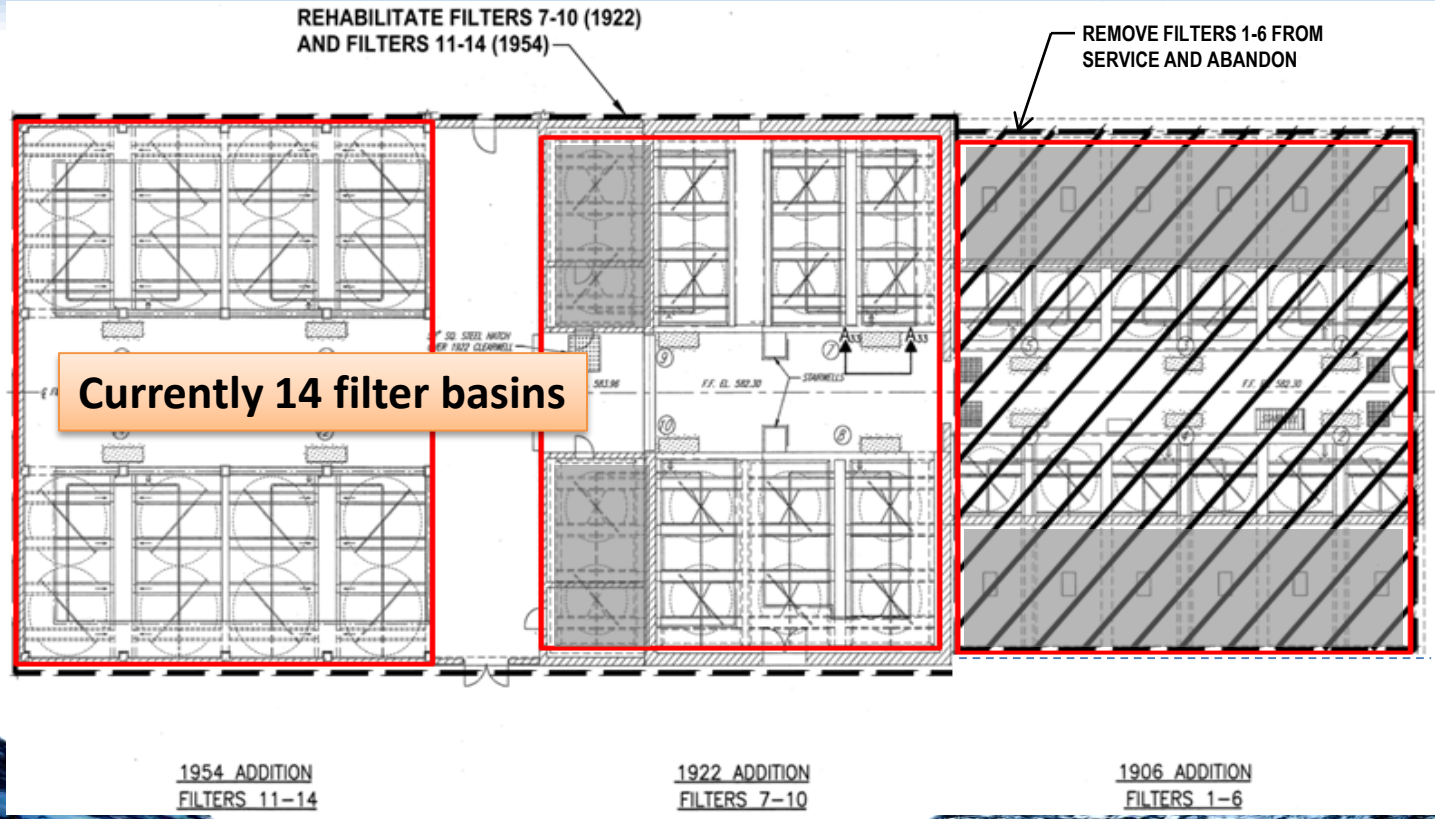
- Sedimentation Basins

Sedimentation Basins - Rehab

Sedimentation Basins - Rehab

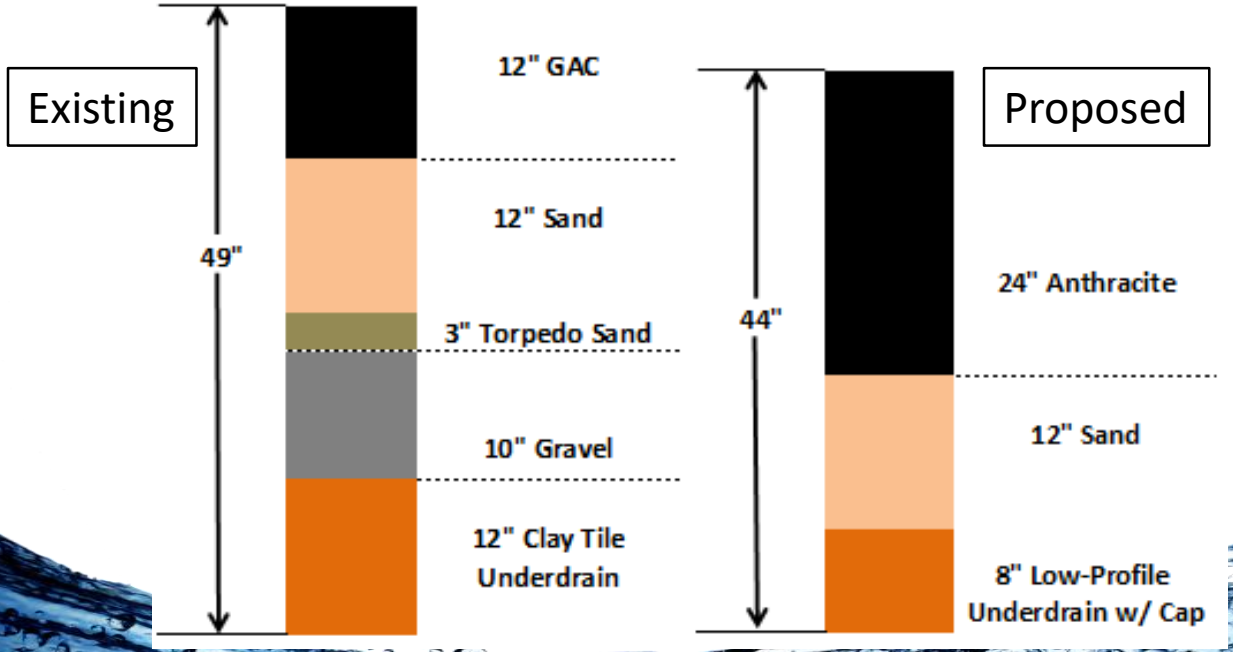


Filtration Basins – Rehab



Filtration Basins – Rehab

- Sand and carbon filter out remaining particles from water
- Typically, most significant treatment process at a water plant (some may say the “heart” of the WTP)



Filtration Basins – Rehab (1906)

Filtration Basins – Rehab (1922)

Filtration Basins – Rehab: But there May be a Problem

- Recommendations
  - Replace, rehab piping
  - Conduct further investigation to determine extent of structural repairs
  - Conduct piloting for filters
    - Abandon Filters 1 – 6 (1905)
    - Rebuild Filters 7 – 14 with Ohio EPA-approved dual-media configuration that we developed and have used for Lake Erie facilities

With **4 gpm/ft²** filtration rate allowed by the state

Filter No.	No. of Filters in Service	Cumulative Area (ft^2)	Cumulative Capacity (mgd)
1 – 6	0	--	--
7 – 10	4	1,744	10.0
11 – 14	3	1,562	9.0
Total		3,306	19.0

Filters 9 and 10 would be needed, but are partially covered, making it difficult to fully observe filter operations, especially backwash.

Filtration Basins – Rehab (Backwash)

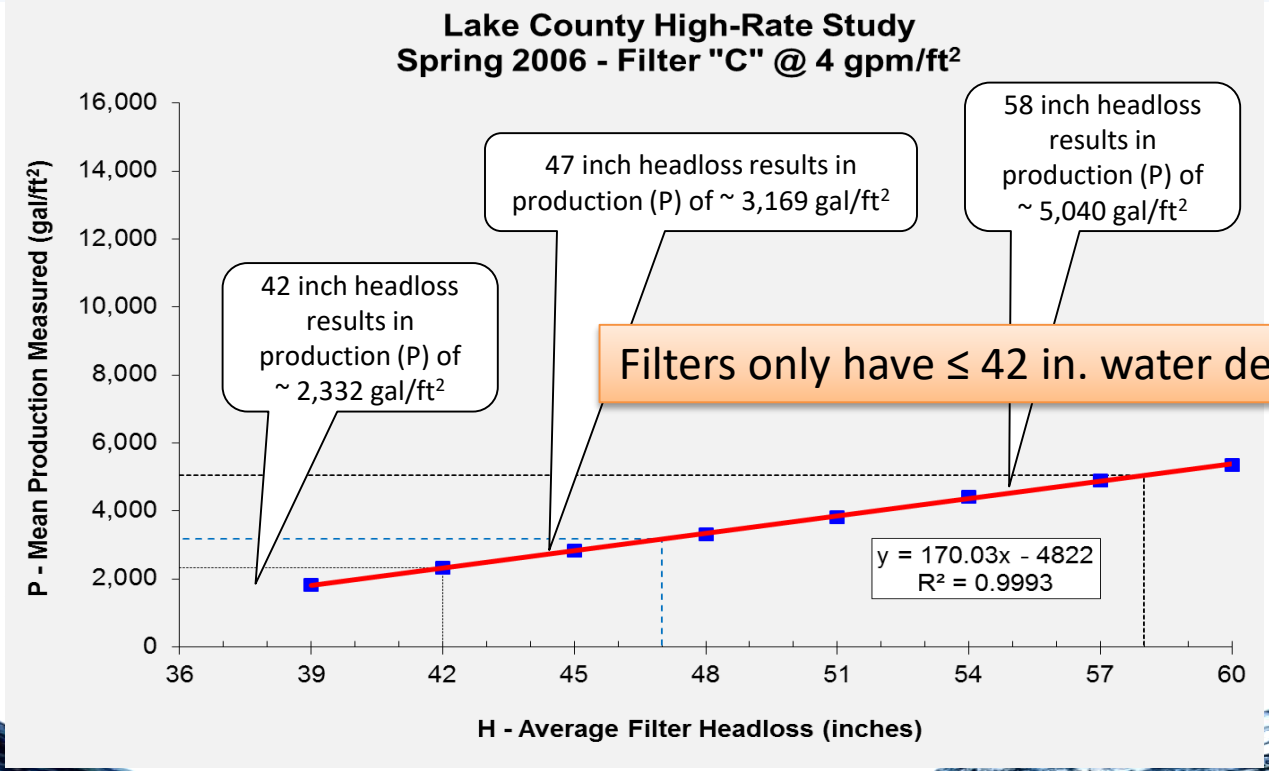
- Backwash pump system installed as part of 1998 improvements
- Pre-1998, elevated tanks provided backwash to filters
- Several leaks occurred and some piping sections separated shortly after startup of pump, so back to using elevated tanks and pump used to fill the tanks

➢ No means of backup for backwashing filters (required).

➢ Nov 12, 2019: Ohio EPA issues NOV to City to have backwash system comply with regulations.

Filter Pilot Study

A Filter Pilot Study is needed to confirm operation at needed flow rate
Approval at less than 4 gpm/ft^2 will limit rehab options (# of filters required).



Structural Inspections - Notable Critical Repairs

- Filter Basins & Backwash Tanks

Structural Inspections - Notable Critical Repairs

- Filter Basins (Pipe Gallery)

Post-Filtration Storage - Current

1 – 1922 Clearwell
(1906 & 1922 Filters)

2 – 1954 Clearwell

3 – 1998 Clearwell
(Finished Water Pump Station)

4 – 1954 Filters

Store treated water in preparation for sending into the distribution system and to customers

Post-Filtration Storage - Current

1954 Clearwell

1998 Clearwell

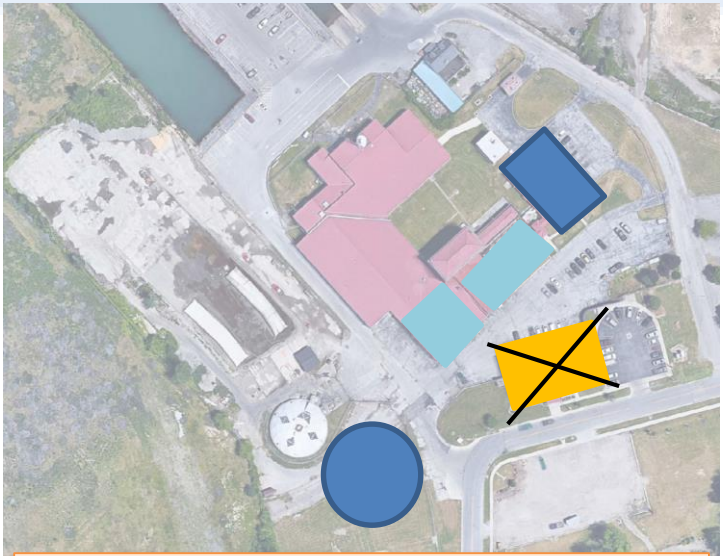
Post-Filtration Storage - Current

1954 Clearwell

Post-Filtration Storage - Recommendations

Recommendations

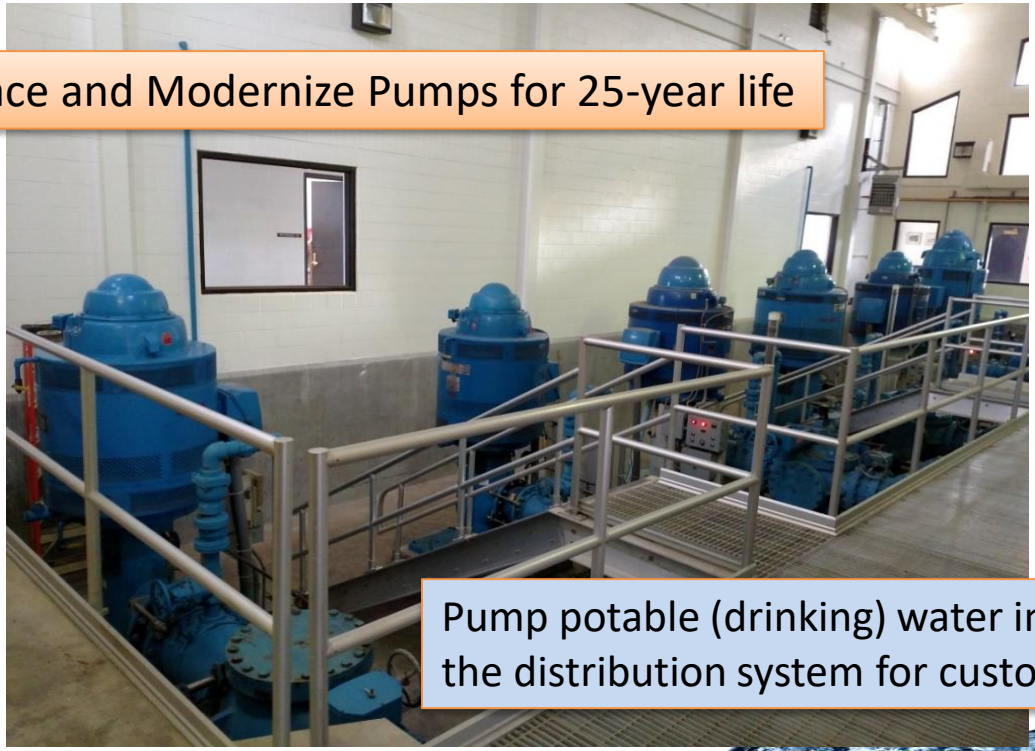
- Maintain/rehab 1998 clearwell
- Abandon 1922 and 1954 clearwells
- Construct new chlorine contact tank/clearwell
  - sited on west side of plant
  - Est vol ~750,000 gal



- Confirming CT, or disinfection time, difficult to calculate
- Different construction and operating levels in tanks
- Finished water stored under a garage/maintenance shop (1954)

Finished Water Pumping

Replace and Modernize Pumps for 25-year life



Pump potable (drinking) water into the distribution system for customers

Chemical Storage and Feed (Alum)

Aged Equipment & Materials
Inadequate Spill Containment

Aluminum sulfate, or alum, bulk storage tanks area

Various chemicals, carefully selected, are used in to make potable water

Chemical Storage and Feed (Caustic)

Sodium hydroxide, or caustic soda, bulk storage (totes)

Aged Equipment & Materials
Tote Storage Adjacent to Sed Basin 3

Chemical Storage and Feed (Carbon)

Carbon storage and feed equipment

Aged Equipment & Materials
Equipment capable of responding to HAB event?

Chemical Storage and Feed (Chlorine)

- Chlorine gas presents health & safety risks and concerns
- Aged equipment and materials, hard to maintain parts and components

** Replace with liquid storage and feed systems (note, most plants have gotten away from gas and converted to liquid chlorine storage and feed systems)*

Chemical Storage and Feed

- Recommendations
  - Construct new chemical building to consolidate all chemical storage
  - Co-location of chemical storage and dedicated maintenance space within same building

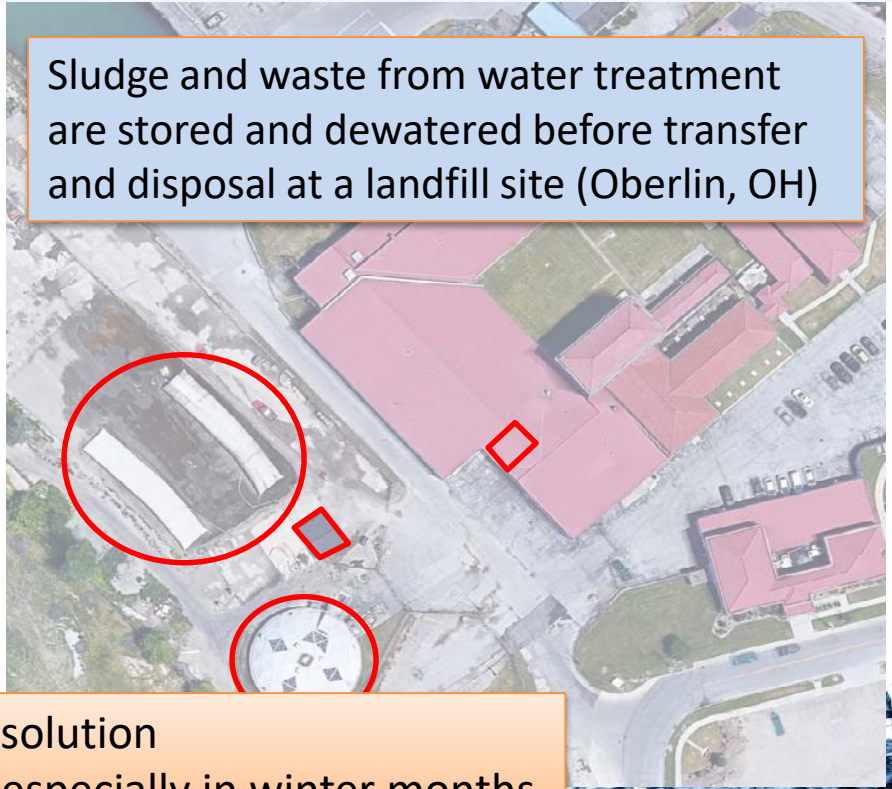
Chemical Storage and Feed

Rehab Only Option:

- Locate new bldg on current WTP site
- **Enable trucks to pull into enclosed area for deliveries/transfers**
- **Consider additional space/layout in bldg for maintenance and storage**

Residuals Storage & Handling - Current

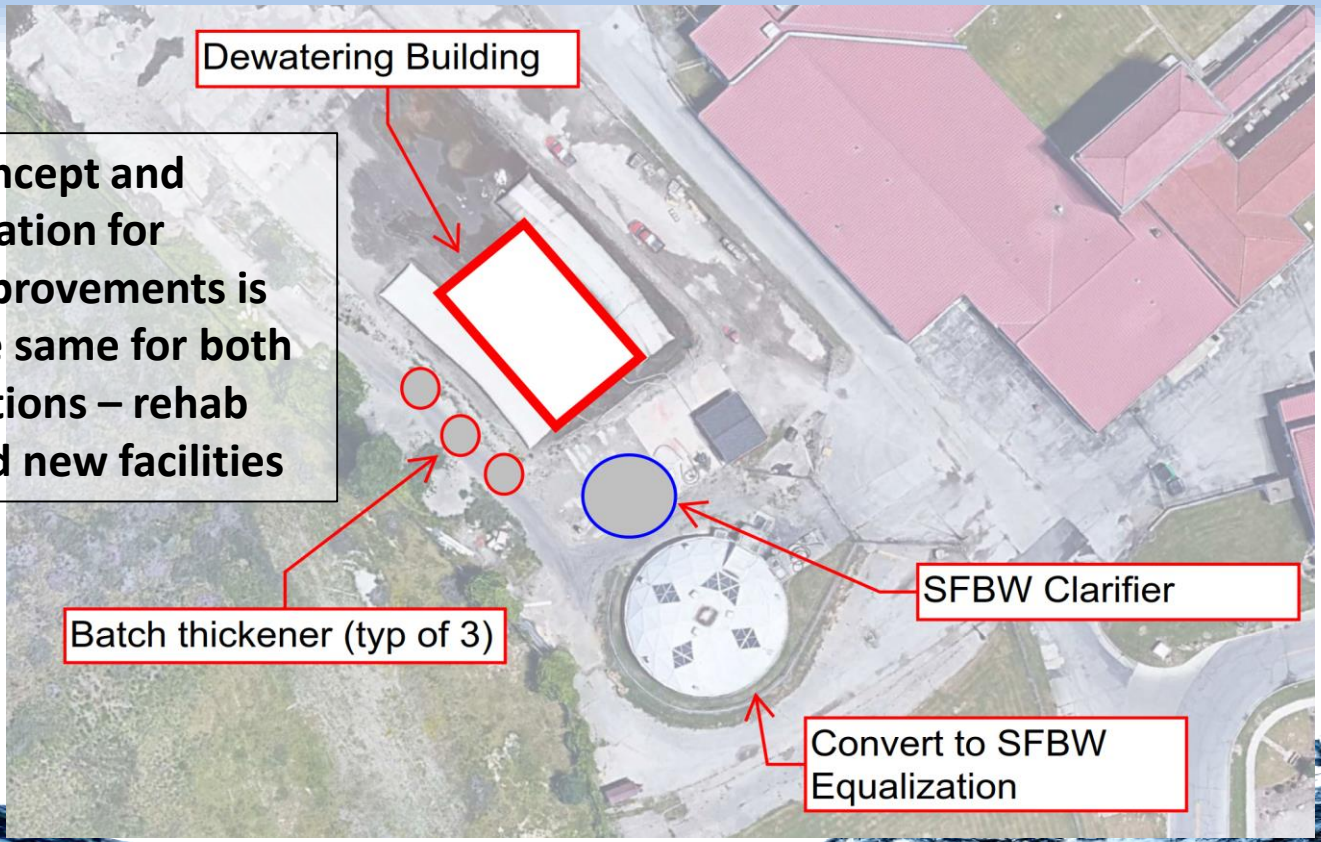
- Sludge holding tank
- Sludge settling tank
- Shed
  - Polymer feed
  - Transfer pump (settling tank to geotubes)
- Geotubes
  - When full, contents are manually loaded into dump trucks and transported for landfill disposal



Meant to be a temporary solution
Time and labor intensive, especially in winter months

Residuals Storage & Handling - Future

Concept and location for improvements is the same for both options – rehab and new facilities



New Water Treatment Facilities – General Concept

Good news

- Continue using existing infrastructure for raw water intake and raw water pump systems (rehab as previously discussed) Note: very difficult and time consuming to obtain approvals for new intake construction, plus the construction itself and costs ($7.5M+, not including potential land acquisition)
- Continue using existing infrastructure for high service pump systems and clearwell (rehab as previously discussed) Note: constructed/installed in 1998
- Construct new residuals storage and handling facilities (same for both rehab and new options) Reason: Current method was intended to be temporary, time/labor intensive process, especially in winter months

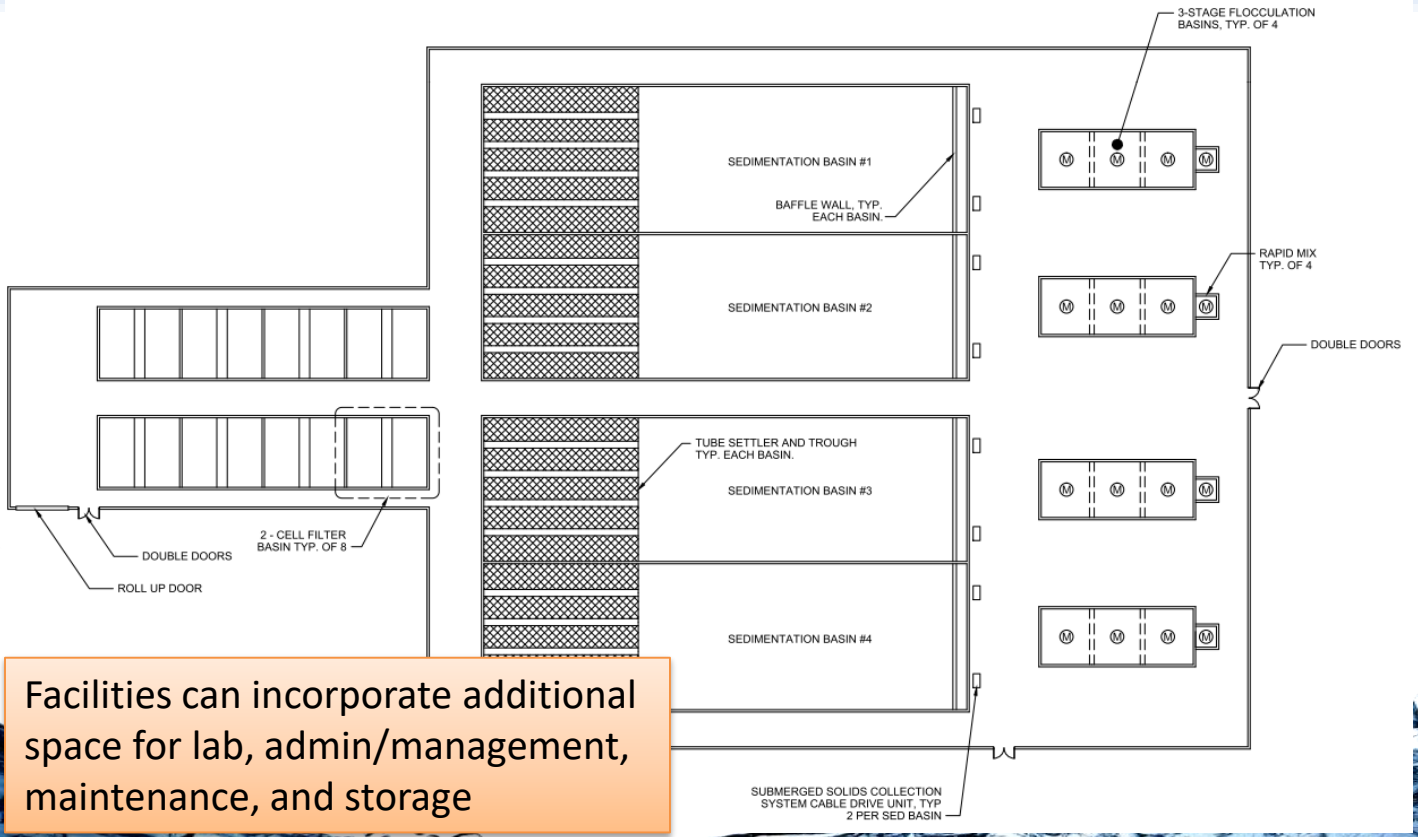
New Water Treatment Facilities – General Concept

More good news

- We construct new facilities for:
  - Rapid mix / flocculation Reason: With rehab, some elements will remain non-compliant with Ohio EPA standards and hydraulically limited, and need to address critical structural repairs
  - Sedimentation / clarification Reason: With rehab, some elements will remain non-compliant with Ohio EPA standards, and need to address critical structural repairs
  - Filtration Reason: Most related infrastructure is very old; with rehab, some elements will remain non-compliant with Ohio EPA standards, and need to address critical structural repairs
  - Chemical storage and feed Reason: Consolidate chemicals, address dangers/risks with chlorine gas, construct facilities and infrastructure in compliance with Ohio EPA standards
  - Chlorine contact tank / clearwell Reason: Very old infrastructure, critical to ensuring sufficient disinfection prior to sending potable water to customers

New Water Treatment Facilities – Conceptual Site Layout

New Water Treatment Facilities – Conceptual Layout



Facilities can incorporate additional space for lab, admin/management, maintenance, and storage

Budgetary Cost Estimates

Lorain WTP Upgrades/Improvements:

Treatment Process Area	Rehabilitate Existing	New Facilities
Intake and Raw Water PS	$ 2,800,000	$ 2,800,000
Rapid Mix and Flocculation	$ 4,700,000	$ 5,200,000
Sedimentation Basins	$ 4,000,000	$ 5,800,000
Filtration Systems	$ 4,000,000	$ 4,000,000
Chemical Storage and Feed	$ 3,600,000	$ 3,500,000
High Service PS	$ 5,400,000	$ 5,400,000
Residuals Storage and Handling	$ 15,000,000	$ 15,000,000
Miscellaneous	$ 4,900,000	$ 6,000,000
Total	**$ 44,400,000 ***	**$ 47,700,000**

**** Costs for additional structural investigations and repairs not available at this time, but would very likely result in the rehab existing option exceed the new facilities cost***

Recommendations

- Within budget estimating – the costs are essentially the same
- The rehab option still leaves many old pipes and structures, much of which still requires further investigation to determine repair options, as well as the need to conduct a filter pilot study
- The new plant option using the existing site and facilities where possible is recommended

Next Steps

- Explore and finalize land availability
- Finalize the concept design and transition into a preliminary design for state review and refine costing
- Develop a phased plan, if desired
- Develop schedule and CIP based on the refinements, assist in researching funding sources and options

Questions?

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