
METROPOLITAN
SEWER DISTRICT
OF GREATER CINCINNATI
ARCADIS
Reliable Preliminary Treatment for Little Miami WWTP
By: Nicholas Jones, P.E., MSDGC and
Brad Olson, P.E., Arcadis
2023
INDIANAPOLIS
FIVE CITIES PLUS

Outline

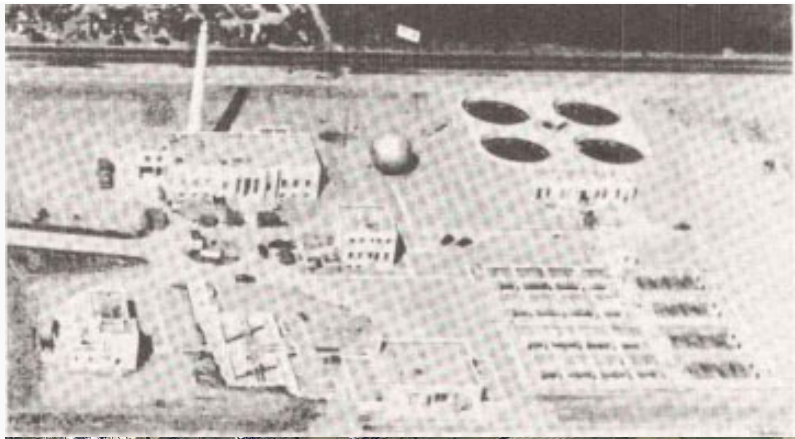
- Treatment Plant and Project Background
- Short Timeline
- Design Considerations
- Construction Challenge
- Project Takeaways
- Questions

Treatment Plant and Project Background

2023 INDIANAPOLIS FIVE CITIES PLUS

Little Miami WWTP

- Built in 1953 as Cincinnati's first WWTP
- Treats Eastside of Cincinnati and Hamilton County
- Combined and sanitary systems
- 55 MGD permitted treatment capacity
- Conventional Primary and Secondary Treatment
  - Stacked Secondary Treatment System
- Consent Decree calls for increase of plant capacity
- Two early work (Bridge) projects at Little Miami WWTP
  - Preliminary Treatment Improvements Phase A
  - Electrical Improvements Phase A



2023 INDIANAPOLIS FIVE CITIES PLUS

Recent Grit Projects Within MSD

- Mill Creek
  - Conical Propeller Vortex Grit Tanks
  - Six Total Tanks
  - Capacity of 360 MGD
- Muddy Creek
  - Eutek Grit Tray System
  - Two Total Tanks
  - Capacity of 35 MGD

2023 INDIANAPOLIS FIVE CITIES PLUS

Issues with Screening and Grit

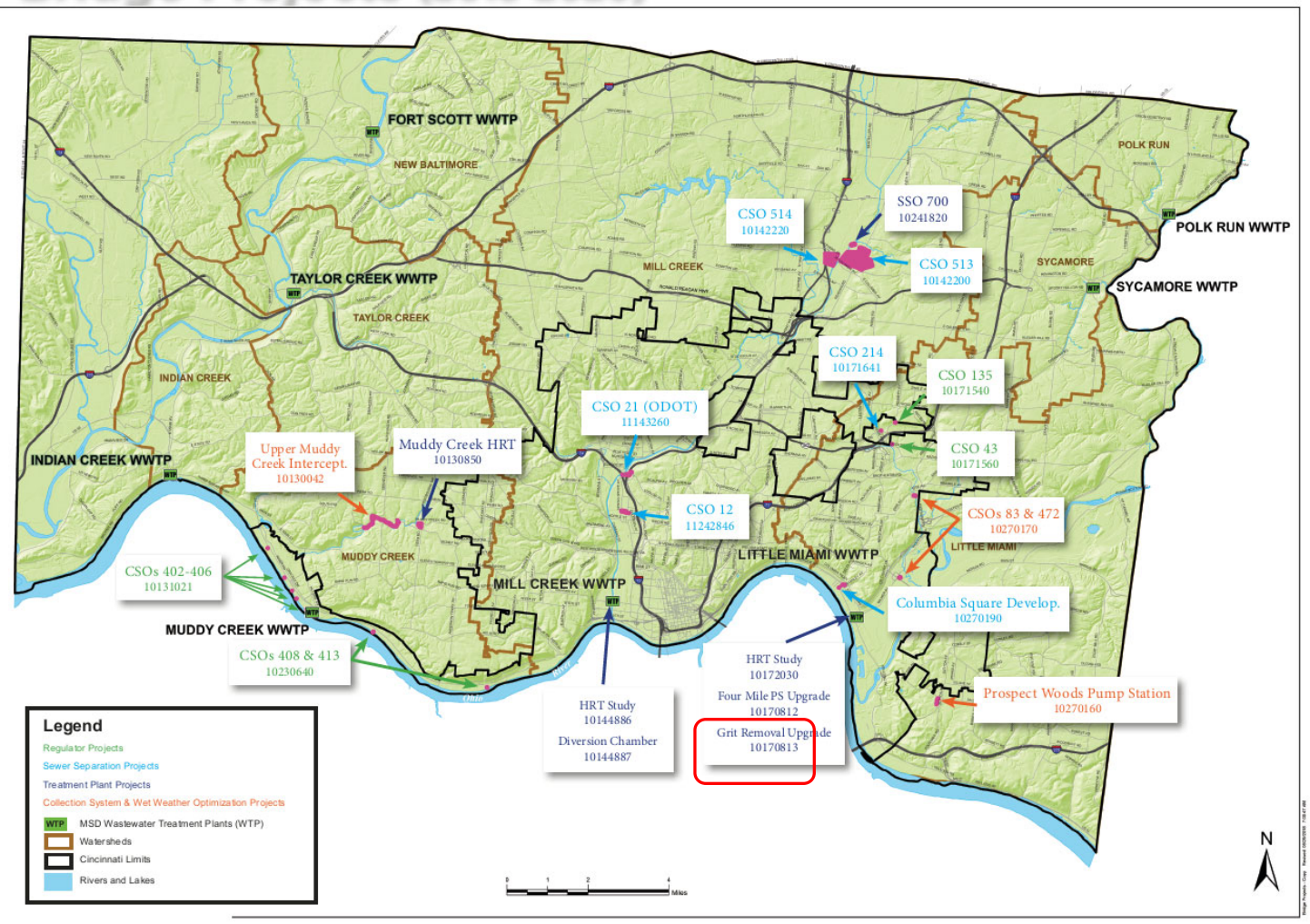
Screening System

- Issues with leaf loading in fall
- Poor performing screenings handling
- Equipment reached the end of useful life
- Fine screening needed for future improvements
- Desire to standardize screening equipment

Grit System

- Poor flow splitting during wet-weather
- Poor grit removal performance
- Replacement equipment is hard to obtain
- Poor performing grit handling system
- Grit influent channel had significant grit deposition

Bridge Projects (2018-2020)



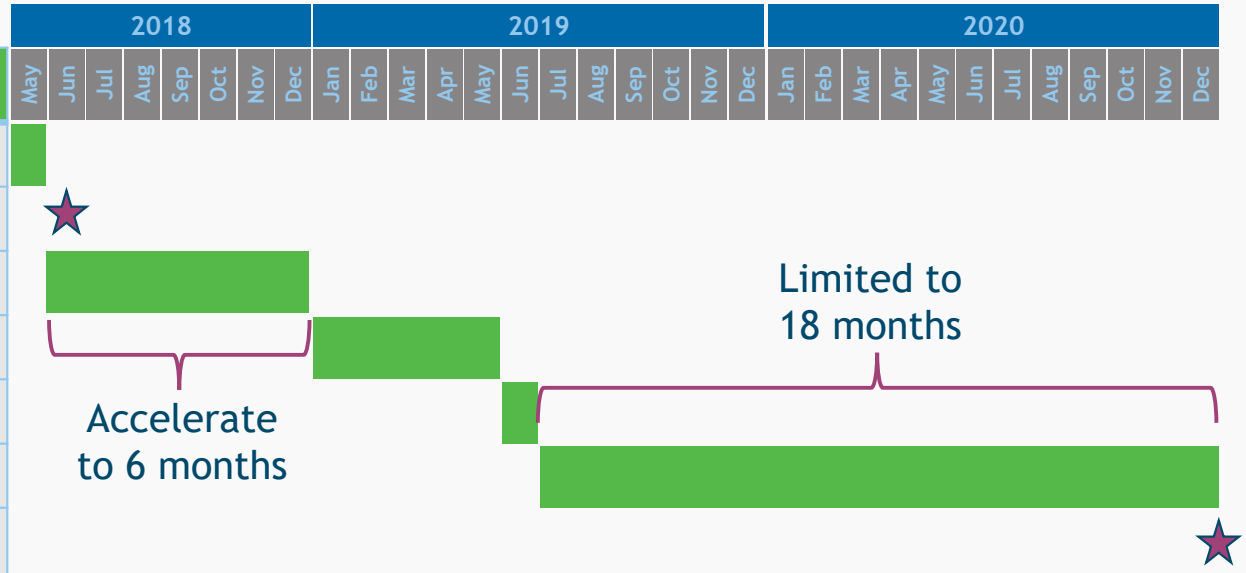
Short Timeline

- 26 projects totaling $61 million (2006$)
- Fills the gap between Phase 1 completion and negotiation of Phase 2A

2023 INDIANAPOLIS FIVE CITIES PLUS

Preliminary Treatment Improvements accelerated schedule

Description
Notice to Proceed for Design
Regulatory Agencies approved Bridge Projects
Design
Legislation, Bidding and Award Period
Notice to Proceed for Construction
Construction
Bridge Construction Milestone Date for Substantial Completion



Met the Consent Decree deadline while maintaining plant operations at permitted 55 MGD - 2 tanks in service at all times

2023 INDIANAPOLIS FIVE CITIES PLUS

How was it possible to design and construct facility in 2.5 years?

- Design:
  - Replaced 30/60/90 submittals with 50/90 submittals
  - At 50% submittal - commitment from MSD that process and key decisions would be locked in
  - Timely MSD reviews from Engineering and Treatment

- Construction:
  - Phased shutdowns to utilize existing space
  - Electrical building and 2 grit tanks had Partial Substantial Completion deadline
  - Liquidated damages based on consent decree penalties

2023 INDIANAPOLIS FIVE CITIES PLUS

2019

- Three grit Detritor tanks
  - Capacity of 40 MGD
  - 40’ x 40’ x 3’
  - Two original to plant
  - One additional tanks installed in 1996
- Five medium climber screens
  - Installed in 1996
  - 1/2 in. openings
  - Conveyor to dumpster in building

2023 INDIANAPOLIS FIVE CITIES PLUS

2020

- First grit Detritor tank demolished
- Under construction
  - Three grit tanks
  - Grit Handling Building
  - Electrical Building

2023 INDIANAPOLIS FIVE CITIES PLUS

2021

- Three tray style grit removal units
  - Hydro Eutek Headcell (vortex tray type) grit concentrators
  - Standardized equipment with Muddy Creek
- New Solids Handling building
- New LMPS Electrical building
- Five Chain and Rake Fine Screens replaced in existing building

2023 INDIANAPOLIS FIVE CITIES PLUS

Design Considerations

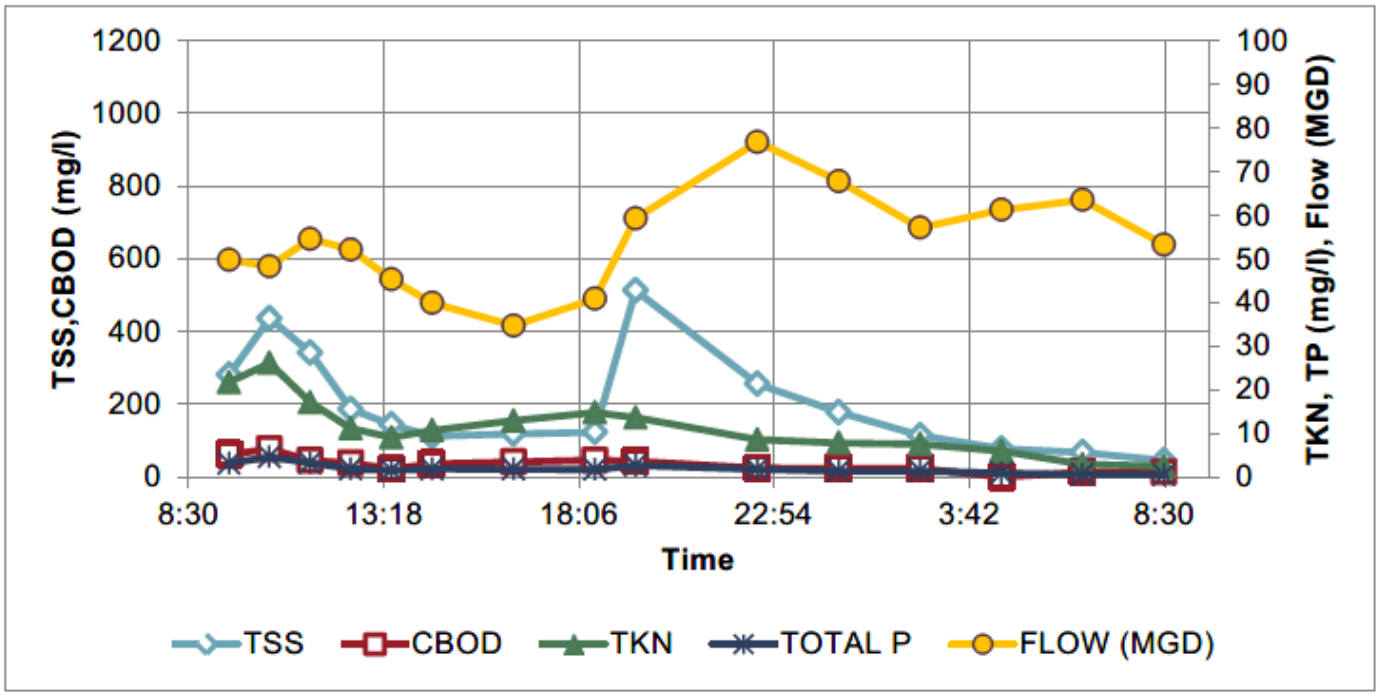
2023 INDIANAPOLIS FIVE CITIES PLUS

Design Considerations - Sizing

- Understand the application
  - Combined versus separate systems
  - Influent flow versus grit loading
- Optimized/adjust the recognized capacity to fit the application
  - Work within existing hydraulic profile
  - CFD modeling documents flow imbalance
- Ultimately, units derated to account for peak grit load and flow imbalance

Wet Weather Characterizations

Figure 2-6 Wet Weather Influent Pollutant Concentrations, April 11, 2013 Wet Weather Sampling Event

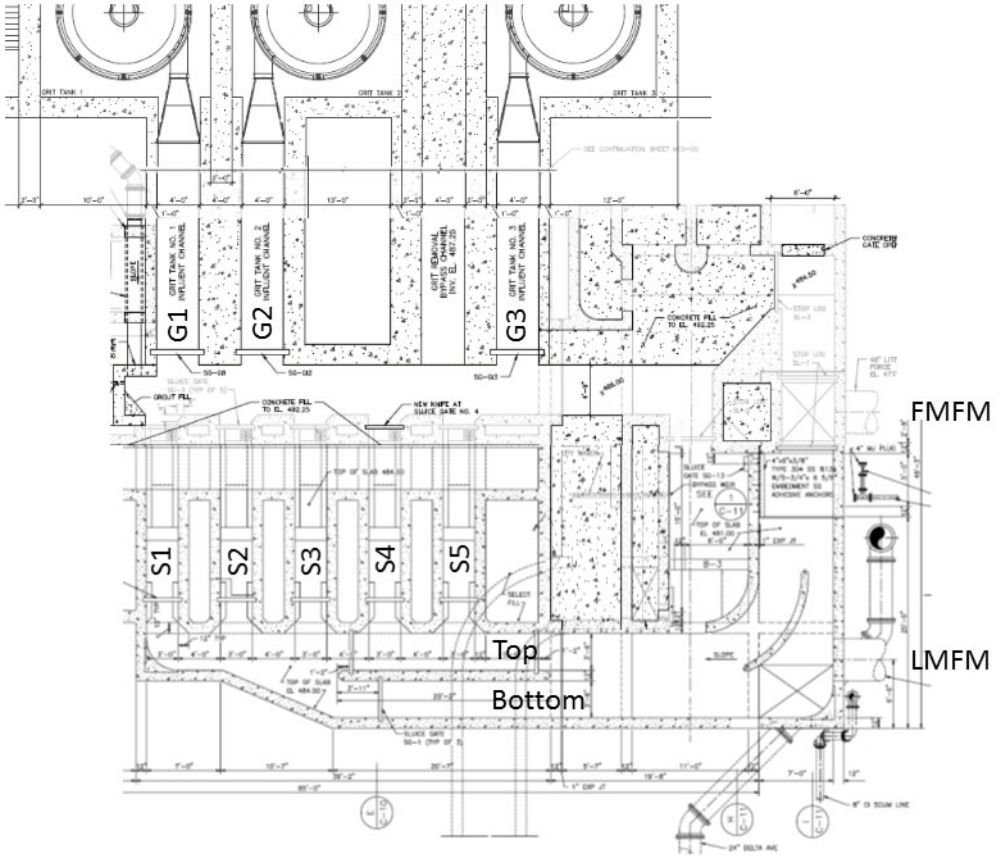


- First flush response after 5 to 6 hours with flows of 50 MGD
- Second peak of TSS due to a second flow surge above 70 MGD further scours solids in collection system

2023 INDIANAPOLIS FIVE CITIES PLUS

CFD Modeling

- Geometry optimization
  - 4 case studies to identify mitigation during design
- Operations analysis – 3 scenarios for each flow rate
  - 100 MGD High
    - 4 screens and 3 grit tanks
  - 35 MGD Average
    - 3 screens and 2 grit tanks
  - 12 MGD Low
    - 2 screens and 1 grit tank



2023 INDIANAPOLIS FIVE CITIES PLUS

CFD Modeling – 100 MGD

Demonstrates flow imbalance through the existing 5 screening channels (4 in service) and proposed 3 grit tanks.

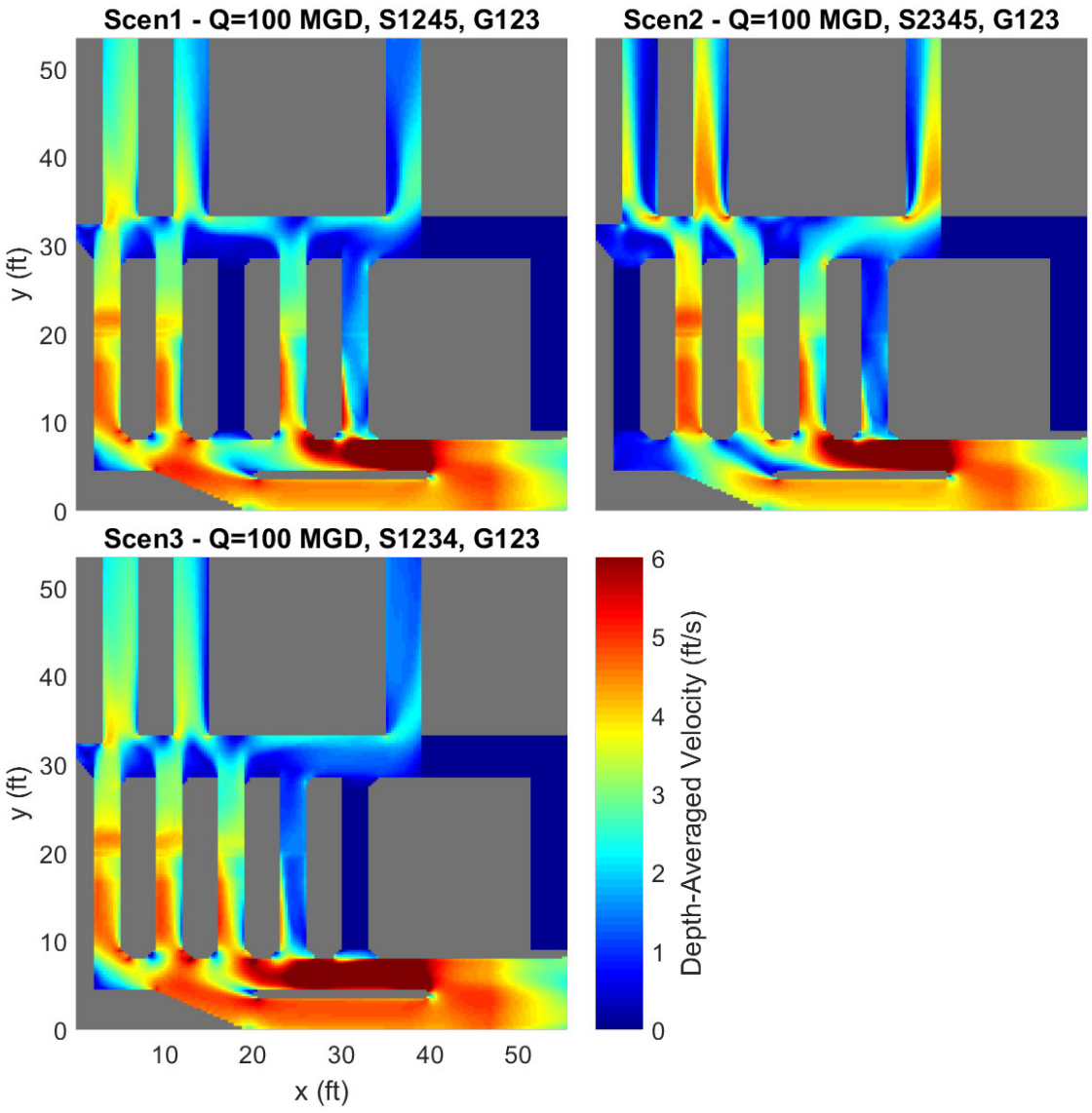
Screening (100/4 = 25 MGD)

- Lowest – 8.4 MGD
- Highest – 36.2 MGD

Grit Tanks (100/3 = 33 MGD)

- Lowest – 19.5 MGD
- Highest – 44.4 MGD

All scenarios show unbalanced flows



Design Consideration: Grit Unit Sizing

- Grit equipment typically rated with clean sand particle
- Actual grit can have grease and oil attached or variable shapes and sizes
  - Changes specific gravity and settling characteristics
- Grit distribution within the flow is not uniform
- Grit units at Little Miami purposefully oversized
  - Previous experience on other MSD projects
  - Designer successfully used this tactic on previous projects
  - Rating factor of 1.5
  - Hydraulic capacity of 150 MGD but rated capacity of 100 MGD

Overall Design Considerations

- Don’t be afraid to oversize grit equipment
  - Grit characterization study
  - Pilot grit removal systems
  - Consider sensitivity of downstream processes to grit
  - Cost
  - Flow splitting
- Model your system
  - CFD
  - Physical model if possible
- More NPW
  - Flushing connections
  - Fluidizing water
- Equipment redundancy
- Cleaning considerations
- Get creative with existing space

2023 INDIANAPOLIS FIVE CITIES PLUS

Construction Collaboration

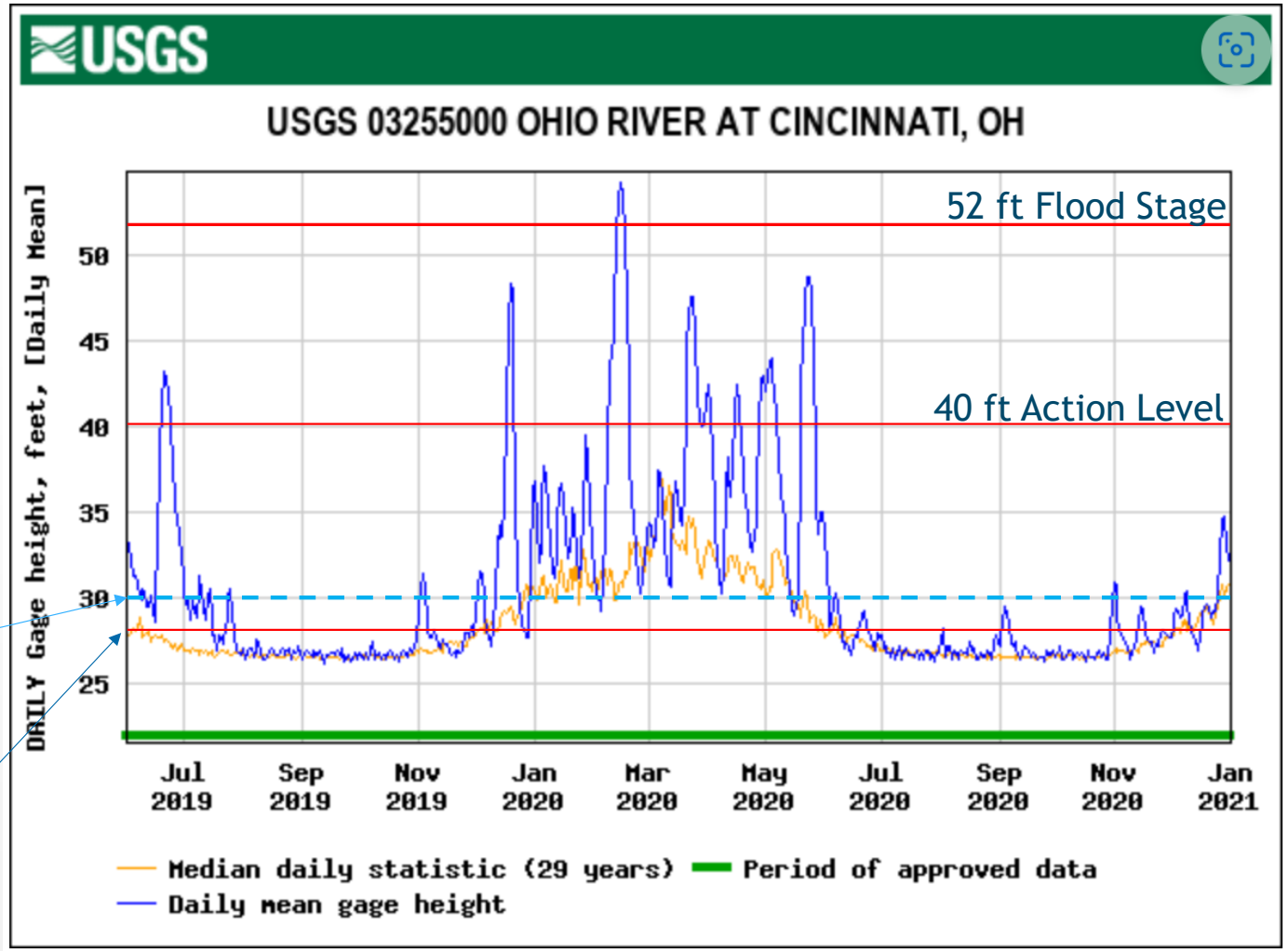
2023 INDIANAPOLIS FIVE CITIES PLUS

Ohio River Flood Stage

- Heavy rainfall during winter 2019-2020
- Location of the Ohio River to the plant
- Flooding due to groundwater infiltration

Foundation depth of 459.5 ft equates to River Stage of 30 ft

28 ft Normal Pool Stage (Average)



Means and Methods

- Underground seam allowed ground water to infiltrate grit tank excavation site
- Overwhelmed groundwater pumping system
- Caused damage to Influent Screen Building as a result of settling
- Mitigation:
  - Grouted area around Screen Building
  - Installed a more robust temporary wall to allow for construction within the Grit Pumping Room

2023 INDIANAPOLIS FIVE CITIES PLUS

2023 INDIANAPOLIS FIVE CITIES PLUS

2023 INDIANAPOLIS FIVE CITIES PLUS

Project Takeaways

- Collaboration is key for accelerated projects
- Understand the application
- Oversize your grit system
- Redundancy
- Means and methods versus risk management

Questions

Nicholas Jones, P.E.

513-244-1365

nicholas.jones@cincinnati-oh.gov

Brad Olson, P.E.

513-543-4003

bradley.olson@arcadis.com