The Westerly Storage Tunnel and Dewatering Pump Station:

*How to Hit a Moving Target*

June 28, 2017
NEORSD Introduction

- 355 square mile service area
- 61 member communities
Presentation Outline

• Walworth Run’s History

• Westerly Storage Tunnel & Dewatering Pump Station: project background and prior studies

• Design-phase flow monitoring

• H+H model recalibration

• Resulting adjustments to tunnel and pump station designs

Project History: Walworth Run
(main CSO location)

Industrialization along Walworth Run

While normally a small and slow-moving stream, Walworth Run would flood quickly in storms even during the 1850s.

Public outrage over the use of Walworth Run as an open sewer grew with the industrialization of the area, peaking during the 1870s and 1880s.
Construction of Walworth Run Sewer

Outlet of Walworth Run: 1905 (A.K.A. CSO-080)

Site Conditions at CSO-080: Present Day
Combined Sewer Overflows at CSO-080

- Approximately 300 MG of CSO enters the Cuyahoga River from CSO-080 in a Typical Year of Rainfall (TY)
- ~50 activations per TY
- Consent Decree requires reduction to 2 activations/TY
- The Westerly Storage Tunnel (WST) would provide an expected CSO volume reduction to 72 MG/TY in a 2010 estimate
Reducing CSO Volumes: Tunnel Alignment and Profile Overview

WST-1: Westerly Tunnel Dewatering Pump Station

WST-2 Diversion Structure

WST-3 Diversion Structure
The Westerly Storage Tunnel Alignment (in Orange) and Diversion Structure Locations

LAKE ERIE
Capture Areas (shown in green and pink)

- Westerly service area
- Catchments draining to CSO-080
- Catchments draining to CSO-074
- Flow meter locations
- Walworth Run Sewer West Branch
- Walworth Run Diversion Sewer
- Walworth Run Overflow Sewer

LAKE ERIE
Exclusion of Several Phase II Meters

Some of the reasons why certain sites were not considered verified were:

- Poor flow data (ragging, turbulence, flows too low to be recorded by probes, etc.)
- O&M problems, such as blockages
- Simplified representation of system in peripheral sewersheds
- Over prediction of flooding and spills in peripheral areas
- Unknown connections between sewer branches or storm and sanitary sewers
- Unknown flows contributing to system (highway drainage, additional inflows)
- Complex interaction between sewers in over/under sewer systems
- Complex nature of hydrological processes (non-linear rainfall-runoff relationship)

From Westerly Phase II Facilities Report, 1997
Original Hydraulic Model Calibration (Overlay):
Solid areas were accurately calibrated & verified in Phase II Facilities Plan

Calibrated Phase II CSO Facilities Plan subcatchment areas depicted as labeled in the solid areas below.
Flow Monitoring Locations (in red)

- WST flow meters
- Catchments draining to CSO-080
- Catchments draining to CSO-074
- Walworth Run Sewer West Branch
- Walworth Run Diversion sewer
- Walworth Run Overflow Sewer

Map showing flow monitoring locations with specific markers and labels indicating various sewer and drainage points.
Flow Meter Sub-basins

Areas calibrated during the WSI 30% model update are highlighted and labeled in the figure.
Recalibration of Hydraulic Model (Overlay):
Transparent areas (pink and green) recalibrated per 2016 flow monitoring

Catchments draining to CSO-080
Catchments draining to CSO-074

Calibrated Phase II CSO Facilities Plan
Subcatchment areas depicted as labeled in the solid areas below

WR27 A-D: dry weather only
3054RI
WWR-T1
WWR-1
WR-340
PS13-D
Rainfall Data from NEORSD Gages
Flow Monitoring Results

Early monitored events suggest that the model is overpredicting, but more data must be collected before recalibration can finally be accurately performed, during 60% design of WST/WTAPS
Original Model Calibration Results:
36 MG Tunnel Controls to 2 CSO Activations/TY

Tunnel volume set at 36 MG based on original model calibration.
Model Recalibration Results:
36 MG Tunnel is Oversized

Recalibrated model would have sized the tunnel at 25 MG

Recalibrated Event Overflow (MG)
Max Volume Stored in Tunnel at Any One Point (MG)
Maximum WST Storage = 36 MG (some additional volume in shafts)

Recalibrated model would have sized the tunnel at 25 MG

*data per 6/20/2017 calibration
Implications for Design Post-Recalibration

• During the 60% design stage, NEORSD and the Stantec/MM Joint Venture review the best available options to take advantage of the recalibration results.

• The Consent Decree requires a **36 MG tunnel** to be built, but the connecting structures can be resized as needed so long as the performance requirement (≤2 activations/TY) is achieved.

• So…
  – **EITHER** design features can be downsized
  – **OR** the tunnel’s connecting structures can be left oversized and thereby capable of exceeding the requirements of the Consent Decree.
Design Implications – Pump Station (WTDPS)

• WTDPS:
  – Surge risk mitigated by lower-than-expected flows
• Validation of an earlier proposal to remove the dedicated overflow conduit proposed in planning-stage design
• Elimination of 1,100 linear feet of 8’x20’ box culvert
Design Implications – WST-2

- WST-2:
  - Baffle drop structure shaft diameter is reduced from 18’ to 12’
  - Depth of diversion structure’s grit sump is reduced by 4 feet
  - Connecting sewer sizes reduced from 60” to 48”
Design Implications – WST-3

• WST-3:
  – *Baffle drop structure shaft diameter is reduced from 50’ to 40’*
  – Twin 7’x10’ hydraulic gates become twin 7’x6’ gates
  – Depth of diversion structure’s grit sump is reduced by 5 feet
Implications for Consent Decree Targets

- 0 overflows now predicted at WST-2 (3 allowed per CD)
- 1 overflows per year predicted at WST-3 (2 allowed per CD)

*data per 6/20/2017 calibration*
Implications for Consent Decree Targets, continued

Overflow volumes reduced relative to CD Targets

- 72 MG of CSO proposed in 2010 per original model
- 43 MG of CSO expected post-AFP (shown in grey)
- 11.3 MG CSO predicted per recalibrated model (shown in blue)

*data per 6/20/2017 calibration*
“Industry and Nature in Harmony”: Artist’s depiction of Walworth Run near the confluence with the Cuyahoga River, 1874