Large Scale CSO Storage Design and Construction

City of Toledo, OH

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ARCADIS-US

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Agenda

- Background
  - Consent decree
  - Long Term Control Plan
- Toledo CSO Program Overview
- Storage Tank Summaries
  - Maumee
  - Oakdale
  - Ottawa
- Lessons Learned
- Questions
Toledo Consent Decree History

- In 1991, EPA filed lawsuit for 50 Million Dollars
- NPDES Violations at the WWTP
- Focus shifted to raw bypassing in 1994
- Second shift to SSO and CSO-holistic approach
- Basic consent decree in place in 2001
- December 2002, judge entered the decree
Consent Decree Requirements

- Eliminate all SSO by 2006
- Develop LTCP by 12/2005
- Build wet weather facilities at WWTP
- Complete two SEP
- Pay $500,000 fine
Costs

• Estimated at $521 Million over 15 years
• SSO Improvements at $71 Million Dollars
• Plant improvements estimated at $135 Million Dollars
• CSO System improvements estimated at $315 Million Dollars
Program Phases

• Phase I - Wet Weather at WWTP
  ✓ Ballasted Flocculation-185 MGD
  ✓ Equalization Basin-25 MGD
  ✓ Grit Facility

• Phase II - Point Place upgrade
  ✓ SSO elimination

• Phase III - LTCP

• Phase IV - System Improvements
  ✓ SSES studies
  ✓ Construction of basins
LTCP – CSO Existing Conditions

- Currently 32 outfalls
- 17 square miles of CSO area
- Discharges 33 times per year
- Discharge volume-625 Million Gallons
LTCP: Recommended Plan

- Totally eliminates 9 overflow locations
- Reduces Untreated Frequency from 33 to 4
- Reduces overflow volume 89%
- Reduces pollutant and bacterial discharges 89%
- Includes 26 Major projects
- Estimated cost $315 Million
- Reduces Ottawa River, Maumee River and Swan Creek discharges to 2 - 4 times per year
Phases IV – System Improvements
Major Basins

- Maumee Basin
- Oakdale Basin
- Ottawa Basin
- Dearborn Storage Facility
- International Park Pipeline
- Jamie Farr Park Facility
- Galena Storage Facility
Maumee Storage Basin

Design Information
Sanitary Area: 388 acres
Storm Area: 376 acres
Population: 5,525
Homes: 2,184
Overflows: 33/year
Overflow Volume: 38 MG/yr

LTCP Requirements
• Discharge frequency of untreated overflow is a maximum of three a year
• Floatables control with a baffle and 2” upflow screens on the effluent/discharge from the basin
Maumee Storage Basin

Final Design
- Offline Storage Basin – Gravity In / Pump Out
- Max inflow of 90 MGD from 72” combined sewer
- Drain Pump Station Designed to drain tank in 48 hours at 1.8 MGD
- Two cells for a total volume of 2.7 MG
- 175’ x 100’ with a 30’ Storage Depth
- Flushing Gates for basin cleaning
Maumee Storage Basin
Maumee Storage Basin

Regulator 33:

- Receives flow from 60-inch combined sewer interceptor
- 18-inch normal flow outlet to MH 70 and the Westside Interceptor
  - Diversion based on a stationary weir
- During wet weather, 60-inch outlet to Diversion Chamber
- Flow up to 17.2 MGD can be delivered to Diversion Chamber
- No automated controls
Maumee Storage Basin

Diversion Chamber:

- Receives flow from Regulator 33 then diverts to storage basin via 72-inch sewer
- Excess flow after the basin is full is diverted to the river via the overflow weir and bar screen and on to the existing 60-inch outlet sewer
- Flows of 12 MGD rate can be diverted to CSO basin and 5.2 MGD is screened and sent to River
- Water levels are monitored by WWTP thru Ultrasonic sensors
- No automated controls
Maumee Storage Basin
Diversion Chamber
Maumee Storage Basin Operation

During Filling of Basin:

- As 72-inch is filling, the water pressure opens the inlet flap gate
- Cell 1 flushing reservoirs fill first
- Cell 1 flushing lanes 1A, 1B & 1C will begin to fill
- At 18 feet water overflows an opening into Cell 2 flushing reservoirs followed by filling the flushing lanes 2A, 2B & 2C
- WRP Control Room staff can monitor levels in chambers and basin and overflow to the river
Maumee Storage Basin - Dewatering Station

• Three dewatering Pumps
• 12” Dewatering line to MH 5
• Dewatering is manually started from the Plant by the Operator (or onsite from the Utility Building MCC)
• Conditions to dewater:
  ✓ Plant flow < 193 MGD
  ✓ Regulator 46 is not overflowing and interceptor tunnel under Hawley St. has capacity

<table>
<thead>
<tr>
<th>Dewatering Pump Design</th>
<th>Pump 1</th>
<th>1,388 GPM (2.0 MGD) @ 46' TDH w/ 25 HP Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pump 2</td>
<td>1,388 GPM (2.0 MGD) @ 65' TDH w/ 40 HP Motor</td>
</tr>
<tr>
<td></td>
<td>Pump 3</td>
<td>1,388 GPM (2.0 MGD) @ 65' TDH w/ 40 HP Motor</td>
</tr>
</tbody>
</table>
Maumee Storage Basin-Flush Gates

Normal Operation
Remote Auto:
• Flushing system PLC in REMOTE
• Plant Operator Initiates flush
• The onsite Flushing PLC sequences the operation starting with Lane 1A Gate.
• Once the first lane is flushed, PLC sends a signal for the next gate to open

Alternate Operation
Remote Manual:
• Flushing system PLC in REMOTE
• WRP Operator can operate each flushing gate manually via telemetry
Oakdale Storage Basin

Design Information
Sanitary Area: 614 acres
Storm Area: 563 acres
Population: 4,669
Homes: 1,903
Overflows: 25/year (4 outfalls)
Overflow Volume: 115 MG/yr

LTCP Requirements
- Discharge of 2.6 untreated overflows per year
- Floatables control with a baffle and 2” upflow screens on the effluent/discharge to the river.
Oakdale Storage Basin

Final Design

• Volume of 8 MG (321’ by 150’ by 28’ depth)
• City needed to acquire existing industrial land and easements
• Required careful sequencing to modify lagoon before construction
• Basin filled by 108” gravity sewer (200 MGD) and emptied via a pump station (5.34 MGD)
• Two 4MG cells in Basin
• Flushing Gates used for basin cleaning
Oakdale Storage Basin
Oakdale Storage Basin
Oakdale Storage Basin-Site
Oakdale Storage Basin
Oakdale Storage Basin - Pilkington Treatment Lagoons

- PNA storm and process water historically drained by gravity (higher elevation) to Lagoon 5D.

- The proposed basin will be constructed within Lagoon 5D.

- Prior to basin construction all water needed to be diverted to Lagoon 5C, which is at a much higher elevation.

- 4 Temporary pumps were installed, 1 electric and 3 diesel driven, having a combine pumping capacity of over 10,000 gpm to get to outfall structure off 5D
Oakdale Storage Basin - Sizing

- Basin was sized using a system wide hydraulic model, calibrated with flow monitoring data, to simulate storm events during the selected 5-year period (1997 through 2001).

- Basin was sized to minimize overflow events to 2.6 per year, or 13 in 5 years. The 14th largest event would be completely captured in the basin.

- 8.0 million gallons was determined to be the appropriate size

<table>
<thead>
<tr>
<th>Storage Basin</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet Pipe</td>
<td>108-inch</td>
</tr>
<tr>
<td>Cells 1 &amp; 2</td>
<td>4 flushing lanes each, each 293’ L x 17’ W</td>
</tr>
<tr>
<td>Inter Cell Flap Gate (FG-1)</td>
<td>48” x 48”</td>
</tr>
<tr>
<td>Slide Gate (SG-1)</td>
<td>48” x 48” w/ Actuator</td>
</tr>
<tr>
<td>Flushing Gates</td>
<td>8 Total 14’ 4” L x 26.5” W</td>
</tr>
</tbody>
</table>
Oakdale Storage Basin-Basin Layout

- 8.0 million gallon reinforced concrete storage basin.
- Divided into 2 each containing, 4 flushing lanes.
- Wall heights range from 25’ to 30’.
- Wall thicknesses up to 3’.
- Bottom slab thickness of 2’.
- Top of basin will be buried by up to 10’ of fill.
The existing 93” three-ring brick sewer was originally constructed in 1907.

The design flow rate that the 93” sewer conveys is 200 mgd which makes bypass pumping impractical.

The proposed Diversion Chamber was to be constructed around the 93” sewer while it is still in service.
Oakdale Storage Basin-Design Filling Criteria

• The 10-yr, 24-hour storm event was used to determine design flow rates.

• The basin is designed to fill by gravity at a flow rate of up to 309 cfs (200 mgd) without overflowing to the river.

• Once the basin is at full capacity (8.0 mgd), any additional combined sewage will overflow the Diversion Chamber weir.
Oakdale Storage Basin - Dewatering

- Dewater basin in 48 hours with the firm capacity of the station.

- Install three submersible pumps, two duty, one stand-by.

- Three, 4,200 gpm, 50 HP pumps were selected.

- One pump operates at higher wet well elevations with a second pump kicking on as the wet well level drops below half full.
Oakdale Storage Basin-Flushing System

- Each cell has a 13’-4” by 16” flap gate that holds back approximately 10,000 gallons of water in the FWSA.

- When flushing is desired, a hydraulic cylinder is activated and it “unlocks” the gate allowing it to open.

- The head pressure of the stored water opens the gate and flushes the basin floor, washing debris to the pumping station.
Ottawa Storage Basin

Design Information
Sanitary Area: 1,970 acres
Storm Area: 1,502 acres
Population: 25,565
Homes: 10,932
Overflows: 24/yr
Overflow Volume: 84 MG/yr

LTCP Requirements
- Discharge of 2 untreated overflows per year
Ottawa Storage Basin

Final Design

• Sized at 36MG during design to provide interceptor relief
  (710’ by 300’ by 28’ depth)
• Basin filled by three 84” sewers through pump station and two 72” sewers by gravity.
• Total Inflow of 375 MGD possible, pump station has a 212 MGD firm capacity and 252 MGD installed capacity
• 6 Bosker Screens in pump station
• Pump Station can pump into basin or recirculate via influent channel
• Free Discharge of pumps avoids check valves and flap gates
• Vents in basin to let air out during fill
• Future odor control designed
Ottawa Storage Basin
Ottawa Storage Basin
Ottawa Storage Basin

Dry Weather Flow

<table>
<thead>
<tr>
<th>Location</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-75 Channel</td>
<td>0 MGD</td>
</tr>
<tr>
<td>8x12 Box</td>
<td>0 MGD</td>
</tr>
<tr>
<td>Lagrange Screening Chamber</td>
<td>0 MGD</td>
</tr>
<tr>
<td>Reg 62A</td>
<td>0 MGD</td>
</tr>
<tr>
<td>Reg 61</td>
<td>1.2 MGD</td>
</tr>
<tr>
<td>TMCI Sanitary Chamber</td>
<td>1.6 MGD</td>
</tr>
<tr>
<td>TMCI</td>
<td>37 MGD</td>
</tr>
<tr>
<td>TMCI CSQ Chamber</td>
<td>2.3 MGD</td>
</tr>
<tr>
<td>24&quot;</td>
<td>0 MGD</td>
</tr>
<tr>
<td>96&quot;</td>
<td>0 MGD</td>
</tr>
<tr>
<td>57&quot;</td>
<td>0 MGD</td>
</tr>
<tr>
<td>96&quot;</td>
<td>0 MGD</td>
</tr>
<tr>
<td>57&quot;</td>
<td>0 MGD</td>
</tr>
<tr>
<td>72&quot;</td>
<td>72&quot; to Windermere PS</td>
</tr>
<tr>
<td>78&quot;</td>
<td>0 MGD</td>
</tr>
<tr>
<td>Channel</td>
<td>0 MGD</td>
</tr>
<tr>
<td>0 MGD</td>
<td>0 MGD</td>
</tr>
</tbody>
</table>
Ottawa Storage Basin

Design flow at overflow
Ottawa Storage Basin

Imagine the result
Ottawa Storage Basin

(Hour 1) Gravity Flow to Cell 4B, Wet well filling
Ottawa Storage Basin

(Hour 8) Cell 2 overflows to Cell 3
Ottawa Storage Basin

(Hour 11) Basin Full

0 MGD #34

0 MGD #999

0 MGD

PS

TMCI
Ottawa Storage Basin

Current Status
Notice to Proceed – November 2014
Substantial Completion – July 2017
Final Completion – September 2017
Lessons Learned Property Acquisition

- Industrial Site
  - Private ownership
- Reservoir
  - Changing the intended use
- City Park
  - Restoring public use
- Zoning of Property
- Right of Way Issues
  - RR
  - Easement
Land-Prior Use

- Phase I Environmental Study
- Phase II Environmental Study
- Previous records
- Geotechnical Investigations
  - Borings
    - Number and spacing
    - Adequately characterize site
  - Soil/fill characterization
    - Disposal options
    - Reuse possibilities
System Hydraulics

• Hydraulic model was develop using US-EPA SWMM 4.4 h
• Purpose- to evaluate alternatives for CSO overflow control
• Model included Sanitary sewers ≥18” and combined ≥ 36”
• Improvements have been included as they were completed
• typical LTCP 5 year simulation to access capacity
• Model took into account overflow events per year per individual basin

Issues to define

• Basin sizing which is dependent upon Model and assumptions
• Regulatory control i.e. overflow events targets are critical
• Representative years of precipitation
• Seasonal flow variations
• Must take into account changes to system as upgrades/ repairs take place
• Determination of HGL is critical for weir functioning
• Accurately depict alternatives and scenarios
Regulatory Requirements

- Timeframe and deadlines
- Understanding of Consent Decree or regulatory mandate
- Communication with oversight regulators
- Particular provisions
  - Number of overflows (CSO’s) per year per site
  - Acceptable alternatives/technologies
  - Accurate cost of alternatives
  - Be aware of rate impacts to customers
  - Know your system flows and piping !!!
  - Look for help
System Parts

- **Flushing system**: How are we going to clean the basin
- **Outfalls**: Relocate - Permitting and time
- **Screens**: Control of floatables
- **System controls**: Remote or local controls, software
- **Security**: How best to protect station
- **Equipment**: Selection and use
Site Safety

- Tight working areas
- Excavation security
- Heavy equipment moving around the site
- Transportation equipment on and off the property
- Overall safety plan for project
- Daily safety meetings

To keep health & safety on TRACK, before every task, STOP and...

- T - Think through the task
- R - Recognize the hazards
- A - Assess the risks
- C - Control the hazards
- K - Keep health & safety first in all things
Site Issues

- Soil disposal or maintained on site
- Discharge pipe stabilization
- Site dewatering plan
- Influence of River on sites
- Site restoration
  - Community use
  - Public impute
Maumee Storage Basin Challenges

- Remote location; access is difficult
- Easements from Railroad and Industrial concerns
- Vandalism
- Soil borings near or on the site are limited
  - Needed to be expanded before final design
- Suspected construction material fill at site
  - Concrete
  - Gravel
  - Railroad ties
  - Steel
Oakdale Storage Basin Challenges

- Land Acquisitions – City needed property to build the basin

- Pilkington North America (PNA) Treatment Lagoons
  - Maintaining a discharge location for PNA storm and process discharges
  - Stability of berm between Lagoon 5C and Lagoon 5D

- Regulator 09 must remain active during construction
Ottawa Storage Basin - Challenges

- Site is currently an active City park
- Local high school use the baseball diamond as their home field
- Highly residential area
- Nexus of large collection piping in the area, high flow area
- Large lift station near-by
- Complicated system hydraulics
- Massive amount of fill material to handle
- Recreational rehabilitation needed post construction
- Public opinion vital to project success
Thank You

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