SSO 700 Integrated Watershed Action Plan: Development of a Water Quality Sampling Program

OWEA June 29, 2016





Presented by Kathleen A. Bollmer, P.E. CH2M



Agenda

- Project Overview/Goals
- Task Background
- Task Overview
- SAP and QAPP
- Sampling Logistics
- Implementation & Adaptation
- Final Thoughts

Project Overview

Problem

- SSO 700 is the largest SSO in MSDGC's service area (approx. 38 MG of overflow annually to Mill Creek)
- MSDGC's Consent Decree requires elimination of overflow.
- 2012 SSO 700 FRP identified Gray Solution = \$230 million

Goal

 Develop solution that will cost less and do more.



Taking an integrated approach



Taking an integrated approach

Address other upstream wet weather issues and achieve other benefits.

- 9 CSOs and 11 SSOs, including SSO 700
- Sewer backup complaints
- Sewage surfacing or manholes overflowing
- Water ponding in streets
- Flooding along Mill Creek
- Opportunities for aesthetic improvements and economic





Project goal

An Integrated Watershed Action Plan to meet MSDGC's Consent Decree obligations through an optimized and affordable suite of gray, green, and watershed controls. The plan will also:

- Maximize improvement to in-stream water quality,
- Obtain regulatory approval,
- Advance the economic development and quality of life for local watershed jurisdictions.

Water Quality Data Collection Program Background

Receiving Water – Use Attainment



Causes of Impairment

Waterbody	Bacteria	Sedimentation	Chlorides	Flow	Habitat Alteration	Nutrients	Dissolved Oxygen
Mill Creek	✓ []	✓ []	✓ []		✓ []	✓ []	
East Fork Mill Creek	✓ □	✓ □	✓ □			✓ []	✓ []
Beaver Creek	✓ □	✓ □	✓ □	✓ □			
Sharon Creek	✓ □	✓ □				✓ □	✓ □
Town Run	✓ 🗌	✓ □	✓ 🗌				
Cooper Creek	✓ □	✓ []				✓ □	
Small tributaries	✓ □	✓ □	✓ □		✓ []	✓ []	

Water Quality Assessment & Resulting Modeling Framework for SSO 700 IWAP



Water Quality Data Gaps

Data Inventory and Gap Analyses identified **three primary data gaps**:

- Dry and wet weather measurements of parameters of interest to characterize and calibrate watershed and surface water quality models
- **Observations from different land use types** for parameters of interest to characterize and calibrate watershed models
- Flow data for tributaries with which to calibrate watershed runoff model

Water Quality Data Collection Program developed to fill these requirements.

Water Quality Data Collection Program Task Overview

Sampling Components

- **Dry Weather Sampling:** water quality sampling in the Mill Creek and its tributaries
- Wet Weather Sampling: water quality sampling in the Mill Creek, its tributaries, and CSO, SSO and stormwater outfall locations
- Instream Flow Measurement: in tributary and upstream reaches to provide datasets for enhancing the hydrologic and hydraulic calibrations of the watershed and water quality models





Wet weather sampling at MC-001

Autosampler deployed at CSO-507 sampling manhole



Pressure transducer installation at TR-001

Dry Weather Event Sampling

- Collect water quality samples for 3 dry weather events, one of which will be during a low-flow period.
- Events are planned to be distributed across sampling season from May to October 2015.
- Collect samples at 17 locations:
 - 12 In-Stream Sampling Locations, on or near the main stem of Mill Creek
 - 5 Upstream Tributary Locations
- Install a Sonde at 3 locations in Mill Creek to monitor DO and temperature for 3 to 5 days.
- Collect grab samples at Sonde locations and in Sharon Creek daily during continuous sampling period.

Dry Weather Event Sampling Locations

- General Considerations: Accessibility and historical sampling
- In-Stream Sampling Locations:
 - Characterize loads entering project area from Butler County
 - Characterize load from the tributaries
 - Characterize upstream-downstream impacts in Mill Creek from tributaries and/or outfall loads.
 - Characterize loads leaving the project area
- Upstream Tributary Locations:
- Butler BC-002 Count ST-010 BC-001 MC-002 MC-001 SL-002 SS-1048 ST-009 •) SC-002 TR-00' (747) TR-002 MC-006 SC-00 ST-011 Water Quality Sample Locations/ GE-001 CSO SSO Storm Outfal In-Stream MC-004 In-Stream with DWF Sonde Up-Stream Trib Pressure Transducer Location SS700TRT County Boundary CS-513 SS-700 SSO 700 IWAP Study Area Stream ST-005 SS-704 River, Lake, Pond SS-603 CC-002 CS-507 ST-006 MC-003 ST-008
 - Purpose is to use data at these locations to calibrate SWMM runoff model.
 - Locations should not be significantly influenced by SSOs, CSOs, and WWTPs.

Wet Weather Event Sampling

- Collect water quality samples for 3 to 5 wet weather events.
- Events are planned to be distributed across a range of precipitation, flow, and seasonal conditions.
- Collect samples at 31 locations:
 - 12 In-Stream Sampling Locations, on or near the main stem of Mill Creek
 - 5 Upstream Tributary Locations
 - 14 Outfall Locations: CSO, SSO, and stormwater outfalls
 - Discharge of SSO 700 Storage & Treatment Facility
 - Final sampling locations determined based on accessibility and safety of locations.
- Scope assumed two false starts.

Wet Weather Event Sampling Locations

- In-Stream Sampling Locations: Same as Dry Weather Event Locations
- Upstream Tributary Locations: Same as Dry Weather Event Locations
- SSO and CSO Outfall Locations: Choose CSO and SSO Outfalls most likely to overflow during sampling period
- Stormwater Outfall Locations:
 - Purpose is to validate literature-based EMCs
 - Seek to quantify pollutant concentrations for 4-5 residential, commercial, and industrial areas
 - Seek outfalls with well-defined and uniform land use



Wet Weather Event Sampling Intervals

- In-Stream Sampling Locations:
 - Five sets of samples: approximately Hour 2-4, Hour 6-8, Hour 10-12, Hour 16-18, and Hour 24-26 from the start of rainfall
- Upstream Tributary Locations:
 - Four sets of samples: Pre-first flush, 1st flush, 30 minutes, and 60 minutes
- Outfall Locations:
 - Three sets of samples: 1st flush, 30 minutes, and 60 minutes
- Additional samples at each site for field quality control.



Analytical and Field Parameters

Parameter	Description	Sampling Program	Type of Measurement
E. coli	Escherichia coliform	Dry, Wet	Grab
TSS	Total suspended solids	Dry, Wet	Grab
Cl-	Chloride	Dry, Wet	Grab
Copper	Total recoverable copper	Dry, Wet	Grab
Lead	Total recoverable lead	Dry, Wet	Grab
Zinc	Total recoverable zinc	Dry, Wet	Grab
Hardness	Hardness	Dry, Wet	Grab
CBOD5	5-day Carbonaceous Oxygen Demand	Dry, Wet	Grab(s) ¹
NH3	Total ammonia (NH3)	Dry, Wet	Grab(s) ¹
NO3+NO2	Nitrate plus nitrite (NO3+NO2)	Dry, Wet	Grab(s) ¹
TKN	Total Kjeldahl nitrogen	Dry, Wet	Grab(s) ¹
ТР	Total Phosphorus	Dry, Wet	Grab(s) ¹
oPO4	ortho-Phosphate	Dry, Wet	Grab(s) ¹
Chl a	Chlorophyll a	Dry	Grab(s) ¹
ТОС	Total organic carbon	Dry, Wet	Grab(s) ¹
DO	Dissolved oxygen	Dry, Wet	In-situ
		Dry	Continuous 3-5 days ¹
wTemp	Water temperature	Dry, Wet	In-situ
		Dry	Continuous 3-5 days ¹
рН	рН	Dry, Wet	In-situ
		Dry	Continuous 3-5 days ¹
Cond	Conductivity	Dry, Wet	In-situ

¹ The continuous DO monitoring were conducted at three locations in Mill Creek (see Table 1-1). Additional grabs for nutrient and BOD parameters were collected once per day during the continuous DO monitoring period at these three Mill Creek locations and at the Sharon Creek at Reading Road location where the USGS gauge is located.

In-Stream Flow Data Collection

Purpose: Measure flow within upstream tributary streams for use in calibration of the watershed model.

Approach:

- Deploy pressure transducers at 7 in-stream locations for 90 days to collect stream stage (depth) data.
- Manually collect velocity data at each location approximately 20 times throughout the 90 days.
- Use depth and velocity data to develop a rating curve for modeling purposes.





Sampling and Analysis Plan & Quality Assurance Project Plan

Sampling and Analysis Plan (SAP)

- Provides a road map for the Sampling Program
- Describes sampling and analysis for each program element
 - Roles and responsibilities
 - Key staff and contact info
 - Methods and procedures
- Sufficient for anyone to understand the details of the Sampling Program
 - who, what, where, when, why and how



Quality Assurance Project Plan (QAPP)

- Provides criteria for ensuring the Sampling Program meets Project objectives
- Follows EPA criteria for QAPPs (EPA/240/R-02/009)
 - EPA elements A D cross-referenced in QAPP
- Describes quality expectations and requirements for sampling and analysis
 - Sets criteria for field and laboratory
 - Accuracy
 - Precision
 - Completeness
 - Representativeness
 - Comparability
 - Required detection limits (lab)
- ²⁴ Equipment testing, inspection and maintenance



- Includes sections on the following:
 - Staff Training
 - Data Validation
 - Sampling Methods
 - Sample Handling and Custody
 - Analytical Methods
 - Quality Control
 - Instrument/Equipment Testing
 - Data Management

Sampling Logistics

Sampling Manpower

- Significant labor force required:
 - 31 sample locations requiring samples at or near first flush.
 - In-stream locations sampled for 24 hours.
- Two person crews required for grab samples:
 - Approx. 40 people required for mobilization if all samples collected as grab samples.
- Automatic samplers eliminate need for manual, real-time sample collection, but require:
 - Maintenance and battery charging
 - Icing of samples
 - Checking on activation
 - Troubleshooting and reconfiguration
- Mixture of grab samples and automatic sampling selected for project.





Laboratory Analysis

- 37 samples collected during dry weather events; 140 samples collected during wet weather events.
- Samples analyzed for 17 parameters.
- Significant commitment of lab resources required to perform work.
- Hold times for E coli limit travel distance.
- Mobile lab established to perform collect samples, perform E coli analysis on premises, and transfer samples for remainder of analyses to primary lab.





Water Quality Data Collection Training

- Large force of unskilled, on-call labor required to man wet weather events.
- Dry Weather Event #1 Used to train on-call staff team leaders on sampling SOPs
- Wet Weather Event Test Run Used to train all other on-call staff on SOPs
- Training of additional on-call staff performed as necessary to ensure necessary labor force available.





Health & Safety

Primary Concerns:

- Driving safety
- Falls into streams
- Lifting heavy objects (i.e., autosamplers and manhole lids)
- Contact with pathogens
- Exposure to traffic
- Walking in water
- Outdoor exposures: Insects and other pests, poison Ivy, dogs, snakes, etc.
- Heat Exposure

Protocols developed to address these risks.

- Job hazard analysis documents developed for each risk to identify hazards and outline controls & protocols.
- Training and personal protective equipment provided to all field workers.





Final Revisions to Sample Locations

Draft sample locations identified based on modeling needs, site access, and historic sampling locations.

Sample locations finalized based on achievement of **site access approval** and assessment of **safety** of access.

- Instream sample locations required access through private property to reach stream.
- Autosampler installation required authorization from owner of infrastructure in which they were installed.
- Pressure transducer installation required authorization from property owners.
- Safety of access to each location during wet weather was final consideration (e.g., avoided steep slopes and other fall or slipping hazards; avoided placement of autosamplers in highly trafficked areas)



Public Notifications

- Sampling performed at all times of day or night, in residential, commercial, and industrial areas.
- Wet weather events often require waiting for long periods for the rainfall to begin.
- Unusual behavior has potential to concern local residents (e.g., sampling from bridge overpasses and stream banks, retrieval of samples from manholes)
- Public Notification Approach:
 - Notices were delivered to property owners adjacent to high profile sample locations.
 - In some cases, impacted property owners were contacted before each event.
 - Police departments in each municipality were contacted to inform them of the work.
 - Each team leader carried an MSDGC badge and a field activity notice.



02/28/2014

WER DISTRICT

Wet Weather Event Logistics

- Organization of staff into teams.
- Assignment of sampling locations and roles:
 - Maintenance and start-up of autosamplers
 - First flush sample locations
 - In-stream sample locations
 - Collection of samples and transport to lab within hold times
 - Monitoring of autosamplers
- Development of itinerary for each team.



Implementation & Adaptation

Selecting Sampling Events





- Dry Weather Events:
 - 48 hours of dry weather followed by 3 to 5 days of dry weather
- Wet Weather Events:
 - 48 hours of dry weather preceding event
 - Minimum of 0.5" rainfall



Communication

- Team communicated weekly, then daily in lead up to selected event.
- Decision to pursue event made 24 hours in advance of event.
- Final authorization to mobilize made 3 hours before event.
- Continuous communication by phone and text message with entire team up to and through event.



••••• \	Verizon LTE 2:24 PM 7 🖇	60% 🔳 🕨
< Me	essages Group MMS	Details
To: F	rank, Carrie, Don, Cathy, Kevin & 5 mor	re
	have any questions. Thx.	
	Carrie Turner	
СТ	Got it. Our crews are planning to check the SSOS when they go around and retrieve the storm and CSO autosampler samples.	
	Brandon Ellefson	
BE	We are all ready go to set up the iscos now and will check the sso stations to see if any more activated.	
	Carrie Turner	
СТ	Are you checking the SSOs now or when you retrieve the samples after Round 3?	
	Brandon Ellefson	
BE	We will try to check them now.	
	Wed, Oct 28, 1:04 AM	
	Don Cuthbert	
	Lost remote monitoring of	
O'	Text Message	Send

Adaptation

- During event:
 - Modifications in response to changing weather conditions
 - Flexibility in team roles to fill in where needed.



- After event:
 - Post-mortem discussions after each sampling event.
 - Any issues or deviations from protocol identified and discussed.
 - Modifications to approach and/or field modifications to equipment made for following sampling event.

Final Thoughts

Mission Accomplished

- Objectives of the QAPP and SAP were met.
- Data collected for a variety of wet weather and dry weather conditions.
- Data collected meets needs for model calibration.
- No Health and Safety Issues.
- Project came in on budget.





.imnoTech 501 Avis Drive Ann Arbor, MI 48108

Program Team

MSDGC – Provided use of Galbraith Facility & access to Telog alerts

Political Jurisdictions – Assistance in identifying sample locations; Use of storm sewer.

CH2M – Project Management, Sampling Coordination, Technical Oversight

LimnoTech – Technical Oversight, Field Sampling Support

Browne E & C Services - Field Sampling

Alloway Laboratories – Sample Analysis



Radar at Hour 0 of Wet Weather Event 4

Lessons Learned

- Leave room in schedule for public outreach and right-of-entry access coordination.
- Forecasting the weather is challenging. Anticipate long waits and/or false starts.
- Plan for staggered deployments and additional shifts for samplers and task managers.
- Account for the human elements in task planning: build in room for sleep and food; provide appropriate rain gear and waterproof materials.
- Expect to be flexible.
- Use best judgment: water quality sampling is not an exact science.
- Work with people you don't mind talking to at 3 am.

Questions?

Thank You

Ch2nn-