

Stormwater Monitoring Lessons Learned

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Preparation and Set-up

- **Budget**
 - Items to include in developing the budget
 - Planning (\approx 20% of budget)
 - Background research (e.g., previous, similar studies)
 - Develop site selection strategy
 - Field reconnaissance for final site selection
 - Develop project scope and sample design
 - Develop the monitoring QAPP
 - Implementation (\approx 80% of budget)
 - Equipment and supplies (purchase, installation, maintenance, and replacement)
 - Database development and implementation
 - Training
 - Logistics (e.g., pre-storm prep and post-storm sample transfer)
 - Sample collection (e.g., staff time, travel expenses, etc.)
 - Laboratory analysis
 - Verification and validation (data QA/QC)
 - Data management
 - Data analysis and report writing
 - Unexpected costs
 - Be prepared for unexpected costs
- **General**
 - Determine your research goals. Clear goals and boundaries on the research effort will improve the likelihood that the research effort will succeed in generating useful information as well as guard against unrealistic expectations.
 - Use the research goals to develop the study design and determine criteria.
 - Examples: Storm qualification, sample timing, type of sampling, sampling methods, analytical methods, priorities
 - Stormwater research and monitoring is complicated – start simple and add complexity later as needed.
- **Site selection in the Right-of-way**
 - Consider safety. Is the location easily accessed in the rain?; What are the driving conditions?; Do drivers have other escape options other than your monitoring site?
 - Is the site representative of the conditions being targeted?
 - How large is the contributing drainage area?; How much runoff do you anticipate from that drainage area?; Will the drainage area change over time?

- Research the site's background history and plans for the future use of the study area (and adjacent surroundings).
 - Augment office research with field evaluation of candidate sites.
 - Electrical power availability
 - Equipment security
 - Physical space needed for monitoring equipment
 - Avoid sites affected by backwater conditions, tidal influence, or high groundwater levels.
 - Verify that influent concentrations fall within an acceptable range
- **Monitoring Equipment and Site Preparation**
 - Start early
 - Determine best instrumentation to use for the application
 - Example: Flow meters
 - Research the materials you can use to construct the monitoring setup. Some materials may contaminate your sample
 - Example: PVC may contribute phthalates, if you are analyzing for phthalates PVC is not a good choice.
 - Site preparation requires coordination with Traffic Operations Office to make sure monitoring site preparation staff do not compromise roadway rules or the safety of staff and the driving public.
 - Example: Failing to coordinate a lane closure required for the installation can delay site preparation.
 - Specialized equipment take time to acquire and customizations take time to modify.
 - Equipment troubleshooting can be difficult as most equipment used for monitoring is not designed for stormwater monitoring.
 - Be prepared for unforeseen issues that spur the need to modify equipment and/or the site design.
 - Take safeguards to deter vandalism.
 - Example: When using job boxes re-identify them as monitoring sites to deter vandals looking for tools.
- **Experts**
 - Involve experienced experts as needed as they can assist in problem solving quicker than going at it on your own.
- **Start Sampling Early**
 - Site conditions may not be what you originally thought.
 - Allow time to learn about the site conditions, equipment, weather patterns, and staff ability/availability.
 - If dealing with multiple sites, it is a good idea to phase in the sites to verify operational soundness prior to moving on to the next.

Implementation

- **Adapting to conditions**
 - Mother nature may not cooperate with you.
 - Examples: rodent issues, erosion.
 - Be prepared to deal with common conditions encountered in roadside settings.
 - Example: Leaves and litter in your system, collisions and vehicles running off the road.
- **Weather**
 - The forecast may not be accurate.
 - Example: 100% chance of rain in the forecast mobilizes the monitoring team, but in reality it fails to rain at your site.
 - Example: Flow weighted samples paced based on the forecast may not be paced for the actual storm that occurs

Data

- **Working with the laboratories**
 - Establish a strong line of communication with any laboratories that you are using. This is especially true if you have parameters with holding times of 48 hours or less.
 - Expect frequent communication with the laboratory; insist that they contact you when issues arise so that decisions are made by you for the best interest of your project.
- **Data types**
 - The data collected for stormwater monitoring is complex due to the various types of data collected.
 - Examples: Hydrology, analytical chemistry, forecasts
 - Usually multiple databases are needed to manage data
 - Examples: Hydrology database, chemistry database, forecast database
- **Verification and Validation**
 - Make sure your data is usable. Verify (data is complete) and validate (data meets your criteria) your data to ensure it meets the goals of the project.
 - Validation can be expensive and time consuming.
 - 3rd party validation is best
- **Analysis and Reporting**
 - Bringing data together into a comprehensive picture is challenging due to: 1) having multiple databases and data types, and multiple audiences interested in the data and findings (and those audiences can be impatient too).