Navigating Regulations and Best Practices for Inspection and Maintenance of Stormwater Management Facilities

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AQUALIS

Objectives

1. Explain the Purpose, Scope, and Timing

Understand the **why, what, and when** of stormwater management inspection, maintenance, and regulatory reporting.

2. Showcase GIS Integration

Demonstrate how **AQUALIS leverages Geographic Information Systems (GIS)** to enhance the efficiency, accuracy, and traceability of stormwater inspection, maintenance, and reporting workflows.

3. Walk Through Key Inspection Phases

Provide a structured overview of the **pre-inspection, on-site (conducting), and post-inspection processes**, highlighting best practices and tools used.

4. Share Insights and Lessons Learned

Reflect on **key takeaways** gained through field experience.

Purpose, Scope, and Timing

Stormwater Management Inspection, Maintenance, and Reporting

Why is it required?

- National or State environmental agency with NPDES permitting authority issues **MS4**
- Permit requires Post-Construction Stormwater Management Ordinance
  - Model ordinance available from EPA/state agencies
- Ordinance requires maintenance agreement and inspection/reporting guidelines for eligible sites
- MS4 permittee implements and enforces ordinance

Stormwater Management Inspection, Maintenance, and Reporting

Why is it required?

- National or State environmental agency with NPDES permitting authority issues **general permit**
- Permit requires Stormwater Pollution Prevention Plan (SWPPP)
  - Available from EPA/state agencies
  - Requires inspection, monitoring, sampling, and record keeping
- Facility implements and agency enforces

Goal is to reduce discharge of pollutants from sewer system through long-term accountability

Landowners benefit in form of property value

Stormwater Management Inspection, Maintenance, and Reporting

What is the general process?

1. Document current condition of site, comparing with approved Stormwater Management Plan/Permit/Agreement
2. Verification that site's drainage facilities are functioning as designed
3. Perform maintenance, repair, and improvements as needed

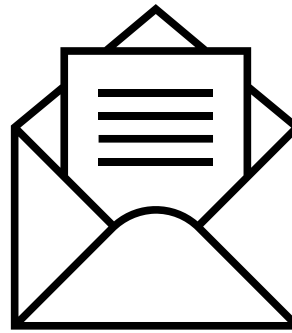
Communities have varying requirements:

- Storm Water Management Practice Maintenance Agreement (SWMPMA) Inspection
- Stormwater Management Plan (SWMP) Recertification
- Stormwater Management (SWM) Permit Annual Maintenance Certification

Stormwater Management Inspection, Maintenance, and Reporting

When to act?

- Most MS4 permittees required to inspect at least once per permit term
- General permits require more frequent inspection/monitoring/sampling
- Some municipalities require annual reporting of inspection/maintenance documents
  - EPA recommends annual inspections as a minimum frequency
- Notice is sent to landowner to alert them of the required action
- Municipality may keep public record of stormwater plans/permits/agreements and inspection/maintenance documents

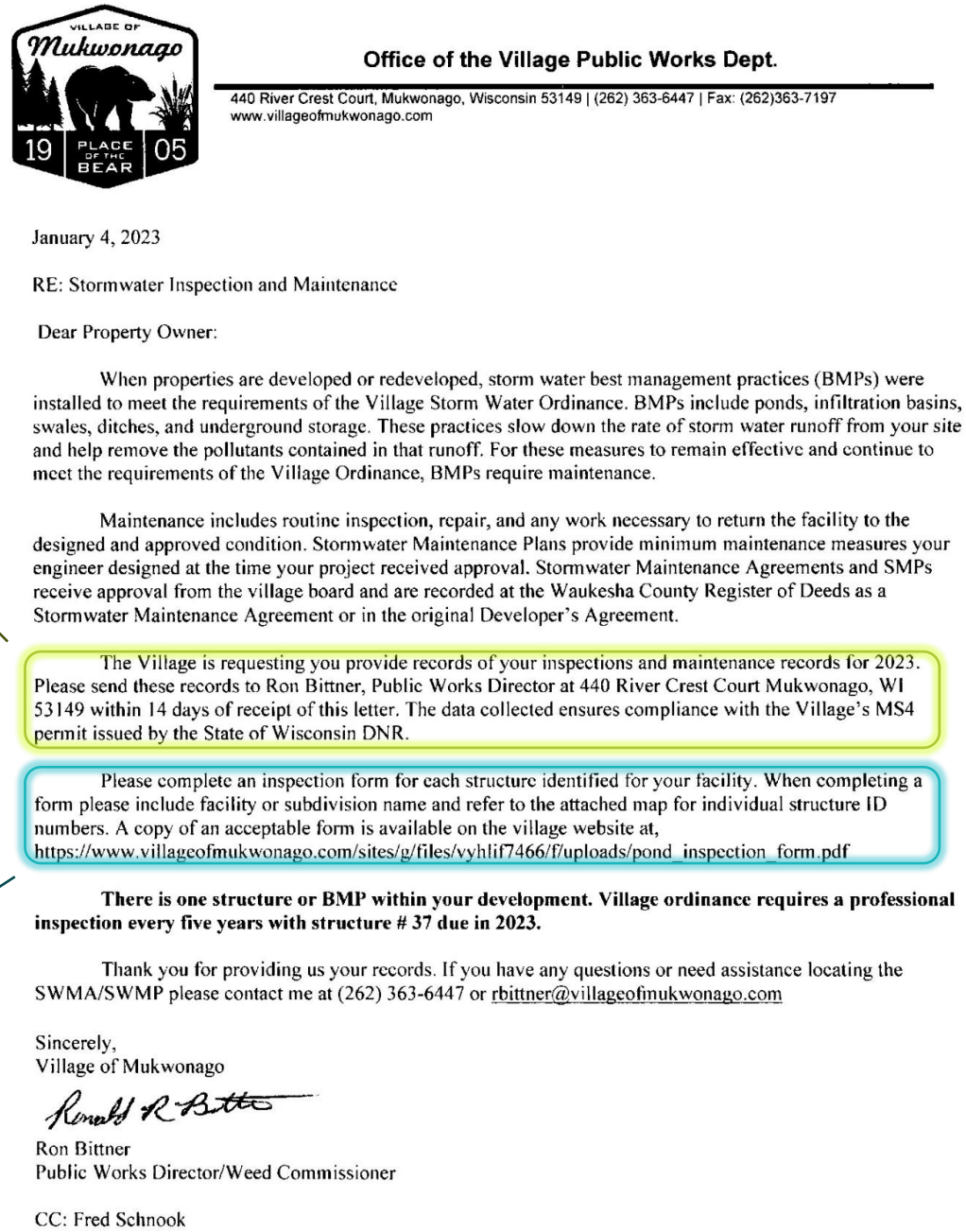


Landowner Point of View

- Notice received from municipality stating a BMP on site requires a professional inspection every five years

Landowner may be asked to send inspection and maintenance records from the previous year

Provide inspection form required and map of specific structure that required the inspection.



VILLAGE OF Mukwonago 19 PLACE OF THE BEAR 05

Office of the Village Public Works Dept.

440 River Crest Court, Mukwonago, Wisconsin 53149 | (262) 363-6447 | Fax: (262)363-7197
www.villageofmukwonago.com

January 4, 2023

RE: Stormwater Inspection and Maintenance

Dear Property Owner:

When properties are developed or redeveloped, storm water best management practices (BMPs) were installed to meet the requirements of the Village Storm Water Ordinance. BMPs include ponds, infiltration basins, swales, ditches, and underground storage. These practices slow down the rate of storm water runoff from your site and help remove the pollutants contained in that runoff. For these measures to remain effective and continue to meet the requirements of the Village Ordinance, BMPs require maintenance.

Maintenance includes routine inspection, repair, and any work necessary to return the facility to the designed and approved condition. Stormwater Maintenance Plans provide minimum maintenance measures your engineer designed at the time your project received approval. Stormwater Maintenance Agreements and SMPs receive approval from the village board and are recorded at the Waukesha County Register of Deeds as a Stormwater Maintenance Agreement or in the original Developer's Agreement.

The Village is requesting you provide records of your inspections and maintenance records for 2023. Please send these records to Ron Bittner, Public Works Director at 440 River Crest Court Mukwonago, WI 53149 within 14 days of receipt of this letter. The data collected ensures compliance with the Village's MS4 permit issued by the State of Wisconsin DNR.

Please complete an inspection form for each structure identified for your facility. When completing a form please include facility or subdivision name and refer to the attached map for individual structure ID numbers. A copy of an acceptable form is available on the village website at, https://www.villageofmukwonago.com/sites/g/files/vyhlif7466/f/uploads/pond_inspection_form.pdf

There is one structure or BMP within your development. Village ordinance requires a professional inspection every five years with structure # 37 due in 2023.

Thank you for providing us your records. If you have any questions or need assistance locating the SWMA/SWMP please contact me at (262) 363-6447 or rbittner@villageofmukwonago.com

Sincerely,
Village of Mukwonago

Ron Bittner
Public Works Director/Weed Commissioner

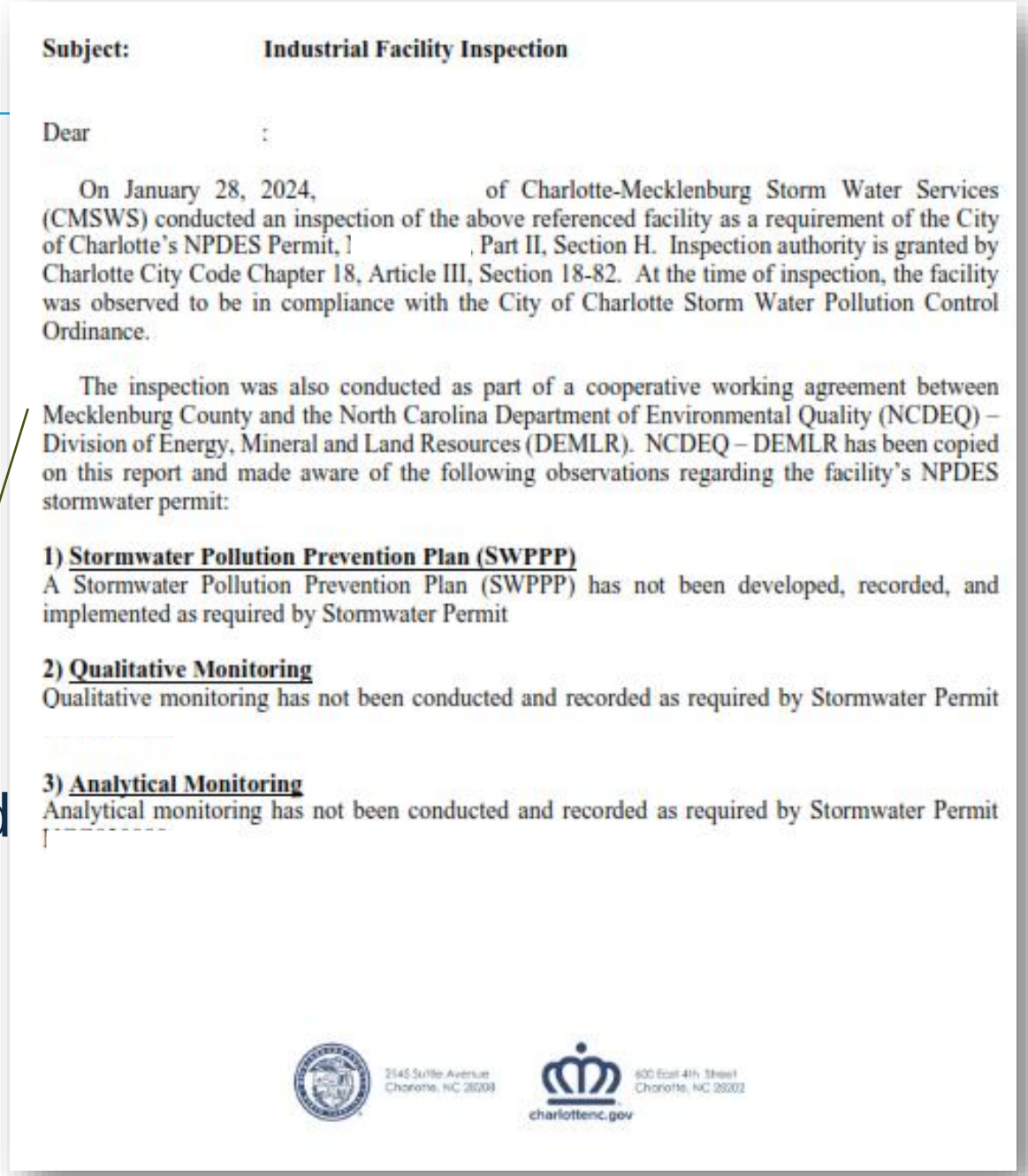
CC: Fred Schnook

Facility Manager Point of View

- Notice received from utility stating an inspection was performed and action is required to comply with NPDES permit

Describes authority for inspection and provides a list of unsatisfied permit requirements

- Following the receipt of a notice, the property owner will reach out to a licensed inspector or professional engineer of their choice (nmacdonald@aqualisco.com)



Subject: **Industrial Facility Inspection**

Dear :

On January 28, 2024, of Charlotte-Mecklenburg Storm Water Services (CMSWS) conducted an inspection of the above referenced facility as a requirement of the City of Charlotte's NPDES Permit, , Part II, Section H. Inspection authority is granted by Charlotte City Code Chapter 18, Article III, Section 18-82. At the time of inspection, the facility was observed to be in compliance with the City of Charlotte Storm Water Pollution Control Ordinance.

The inspection was also conducted as part of a cooperative working agreement between Mecklenburg County and the North Carolina Department of Environmental Quality (NCDEQ) – Division of Energy, Mineral and Land Resources (DEMLR). NCDEQ – DEMLR has been copied on this report and made aware of the following observations regarding the facility's NPDES stormwater permit:

1) Stormwater Pollution Prevention Plan (SWPPP)
A Stormwater Pollution Prevention Plan (SWPPP) has not been developed, recorded, and implemented as required by Stormwater Permit

2) Qualitative Monitoring
Qualitative monitoring has not been conducted and recorded as required by Stormwater Permit

3) Analytical Monitoring
Analytical monitoring has not been conducted and recorded as required by Stormwater Permit

2145 Suttle Avenue
Charlotte, NC 28208

600 East 4th Street
Charlotte, NC 28202

charlottenc.gov

GIS Integration

Water asset management and geographic information system (GIS)

Technology to capture, store, analyze, manage, and visualize geographic data.

Reduce operation and maintenance cost by staying on top of assets

Ensure water infrastructure are performing as designed.

Inspections and Geographic Information System (GIS)

Centralized digital recordkeeping	• Keeps inspection and maintenance records organized, accessible, and secure—no more paper files or scattered spreadsheets.
Streamlined desk review and reporting	• Simplify internal reviews and generate reports
Improved asset visibility and data-driven decision making	• Clear mapping of infrastructure, allowing teams to see what assets exist, where they are, and what condition they're in
Easier team collaboration	• GIS platforms allow multiple users to access and update records in real-time.

Key Inspection Phases

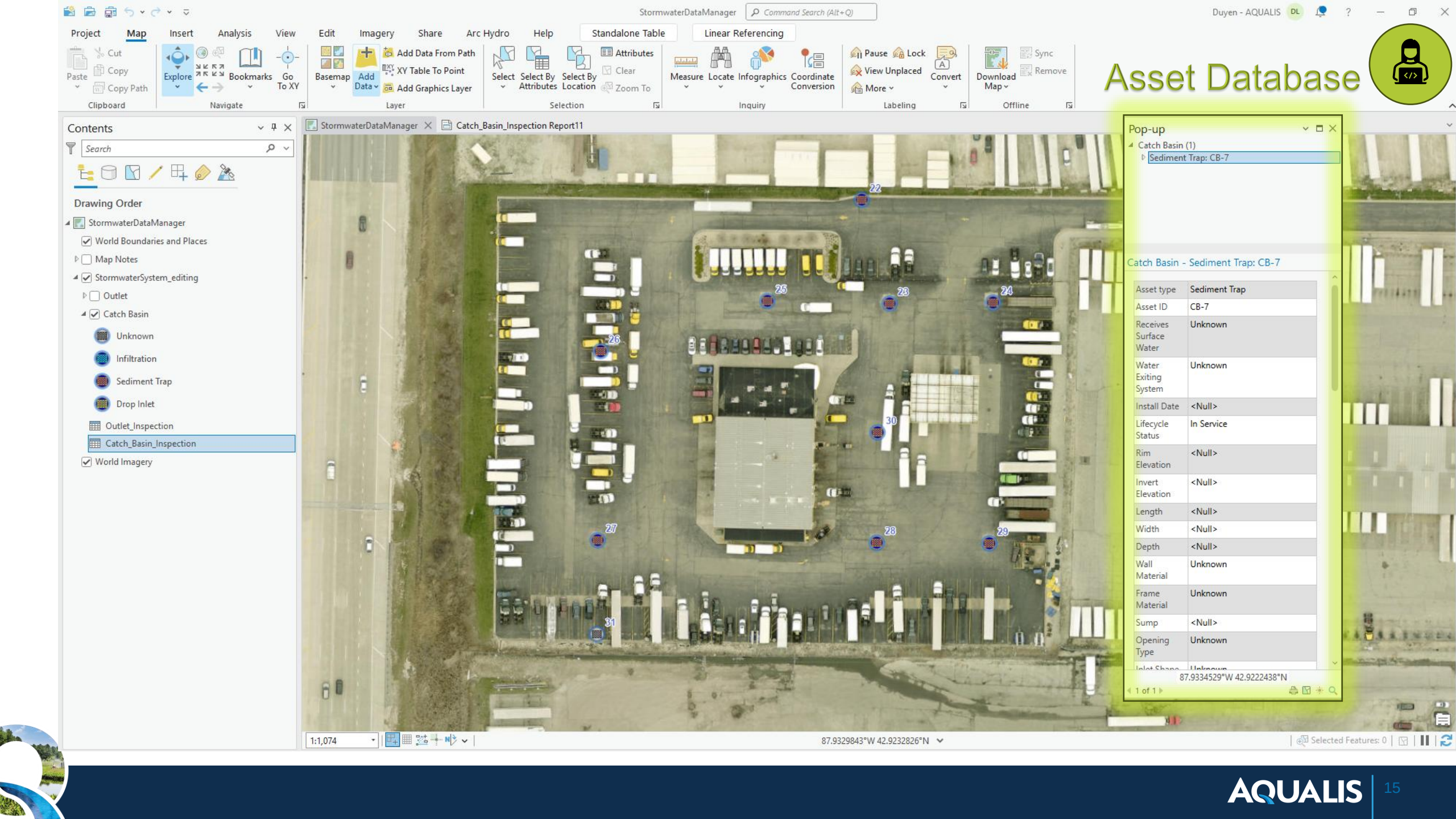
Phase 1: Pre-Inspection Preparation

1. Obtain site specific information from the client and/or the municipality
   - Plan set, copy of SWMP agreement, aerial imagery, topographic maps, past inspections

2. Perform a desk review of the documentation

3. Create an inspection plan
   - Determine equipment needed:
     - One site may only require you to remove and measure down in a few structures
     - A different site may require a kayak to measure the depth in a pond
   - Add asset into asset management database

Asset Database



Phase 1: Pre-Inspection Preparation

4. The inspector shares their inspection plan with someone from the office for safety!

5. Pack proper PPE Gloves, high-visibility clothing, and safety shoes (steel or composite toe)

- Don’t forget the pickaxe or measuring rod
- Protective eye wear, sunscreen, bug-spray
- Rain gear

Pre-Inspection Preparation: Importance & Benefits

1. Prepared to Collect All Required Data

Importance:

- Ensures no critical information is missed.
- Supports compliance with client and municipal requirements.

Benefits:

- Helps select the **right equipment** and tools for the job.
- **Reduces the need for repeat site visits**, saving time and resources.
- Enables efficient and complete **data collection** during the initial inspection.

Issue	Checked			Maintenance Needed			Comments
	Y	N	N/A	Y	N	N/A	
Embankment & Emergency Spillway							
1. Is the spillway level?	☐	☐	☐	☐	☐	☐	
2. Adequate Freeboard? (min 1' from top of bank to highest outlet)	☐	☐	☐	☐	☐	☐	
3. Embankment erosion evident?	☐	☐	☐	☐	☐	☐	
4. Cracking, bulging or sliding of embankment?	☐	☐	☐	☐	☐	☐	
5. Evidence of animal burrows?	☐	☐	☐	☐	☐	☐	
6. Seepage evident on exterior face of embankment?	☐	☐	☐	☐	☐	☐	
7. Vertical & horizontal alignment of top of dam as per plans?	☐	☐	☐	☐	☐	☐	
8. Emergency spillway clear of obstructions & debris?	☐	☐	☐	☐	☐	☐	
9. Maintenance access clear of obstruction?	☐	☐	☐	☐	☐	☐	
10. Other?	☐	☐	☐	☐	☐	☐	
Riser & Outfall Spillway							
1. Low flow orifice obstructed?	☐	☐	☐	☐	☐	☐	
2. Low flow trash rack debris/ corrosion?	☐	☐	☐	☐	☐	☐	
3. Weir trash rack debris/corrosion?	☐	☐	☐	☐	☐	☐	
4. Excessive sediment accumulation inside the riser?	☐	☐	☐	☐	☐	☐	
5. Sediment accumulation in outlet pipe?	☐	☐	☐	☐	☐	☐	
6. Outfall channels functioning?	☐	☐	☐	☐	☐	☐	
7. Under drain functioning?	☐	☐	☐	☐	☐	☐	
8. Slope protection or rip-rap failures?	☐	☐	☐	☐	☐	☐	
9. Other?	☐	☐	☐	☐	☐	☐	

Pre-Inspection Preparation: Importance & Benefits

2. Identify and Familiarize with the Site and Assets

Importance:

- Provides a better understanding of site layout and context.
- Aids in recognizing inspection priorities and constraints.

Benefits:

- **Streamlines asset identification** in the field.
- Helps **identify potential obstructions** (e.g., assets located in parking spaces needing temporary access arrangements).
- Reduces time spent searching for assets during inspection.

Conducting Inspection

What is Inspected?

- Various BMPs, including;
  - Dry/Wet Pond
  - Bioswales
  - Rain Gardens
  - Permeable/Porous Pavement
- Rip-rap channels
- Catch basins and other storm structures
- General site condition (litter/erosion)
- Illegal discharges
  - Illicit discharge detection and elimination (IDDE) form

Inspection Observations (Common)

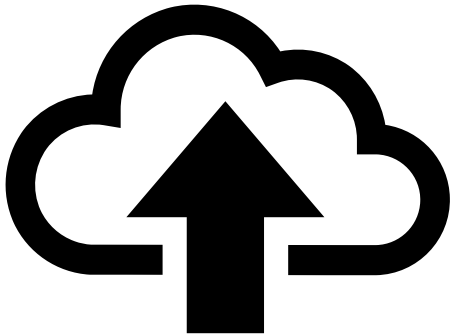
- Rip-rap channels are washed out
- Accumulated sediment in catch basins
- Site litter and erosion
- Sediment accumulation at pond bottom
- Lid stuck on structures due to paving
- Subgrade failure in paver area
- Wildlife (geese, raccoons, and beavers)
- Animal burrows/dens in pond side slopes
- Overgrown vegetation surrounding BMP
- Unlocked gates to BMP
- Trench drain full of debris

Inspection Observations (Extreme Cases)

- BMP has been demolished
- Pipe separation inside structures
- Paver areas not draining
- Sinkholes

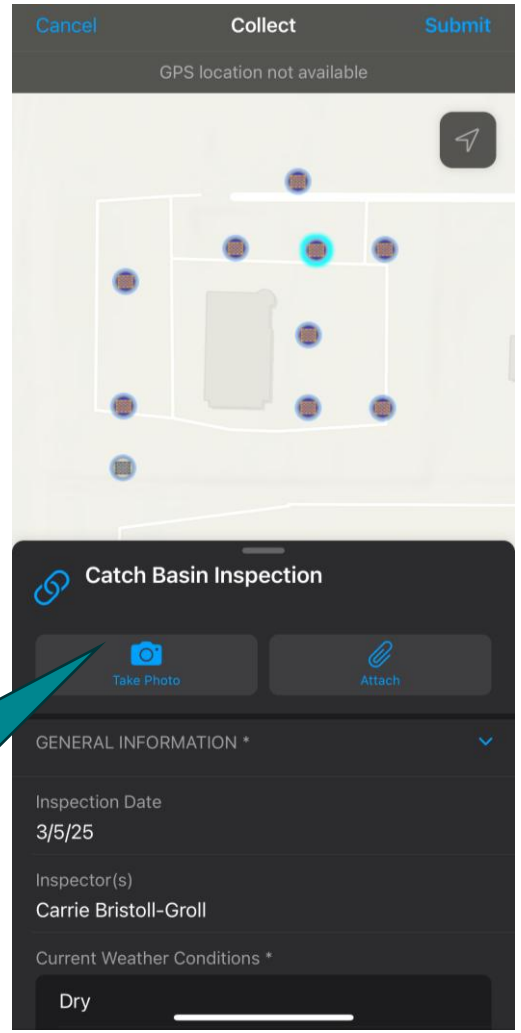
Streamline Inspection: Smart Phone Field Apps

- Instant notification
- In field staff capabilities:

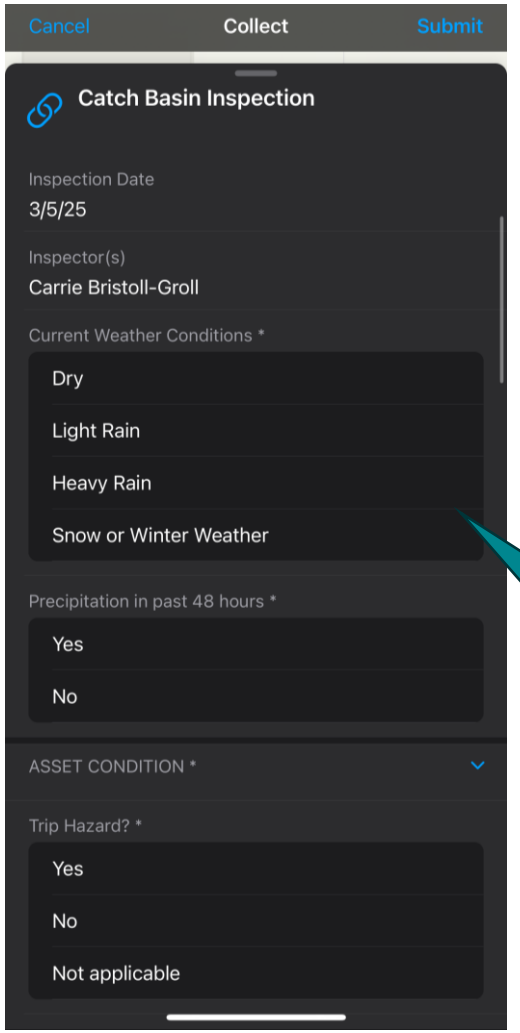


Organized photo log associated with each asset

Locate



Perform

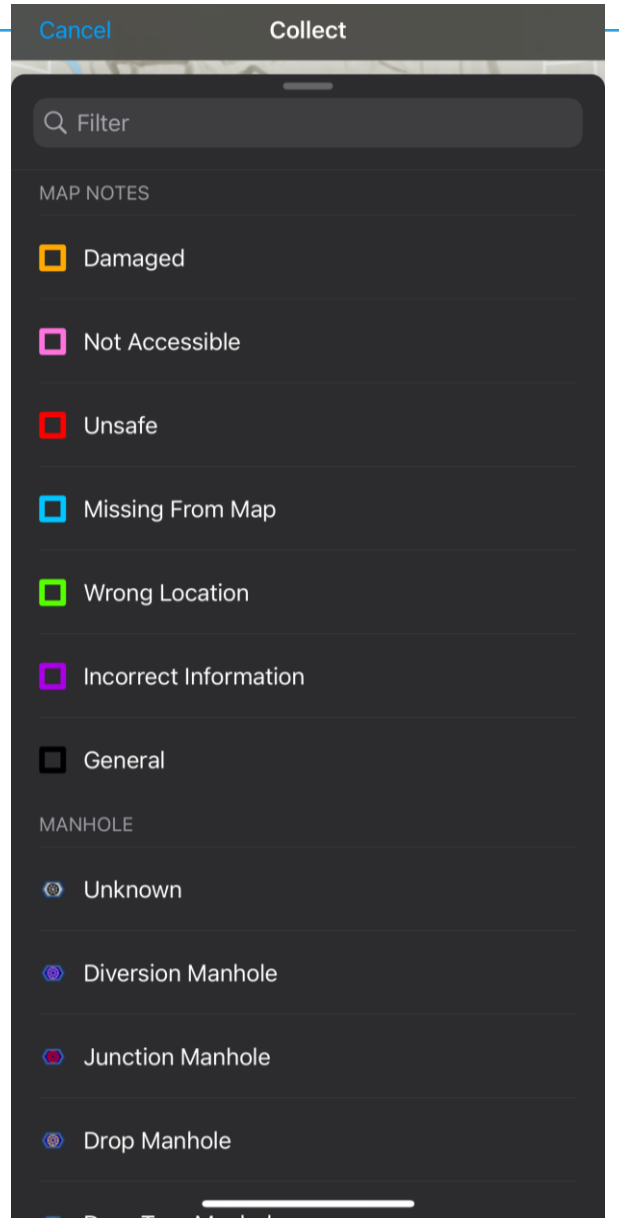


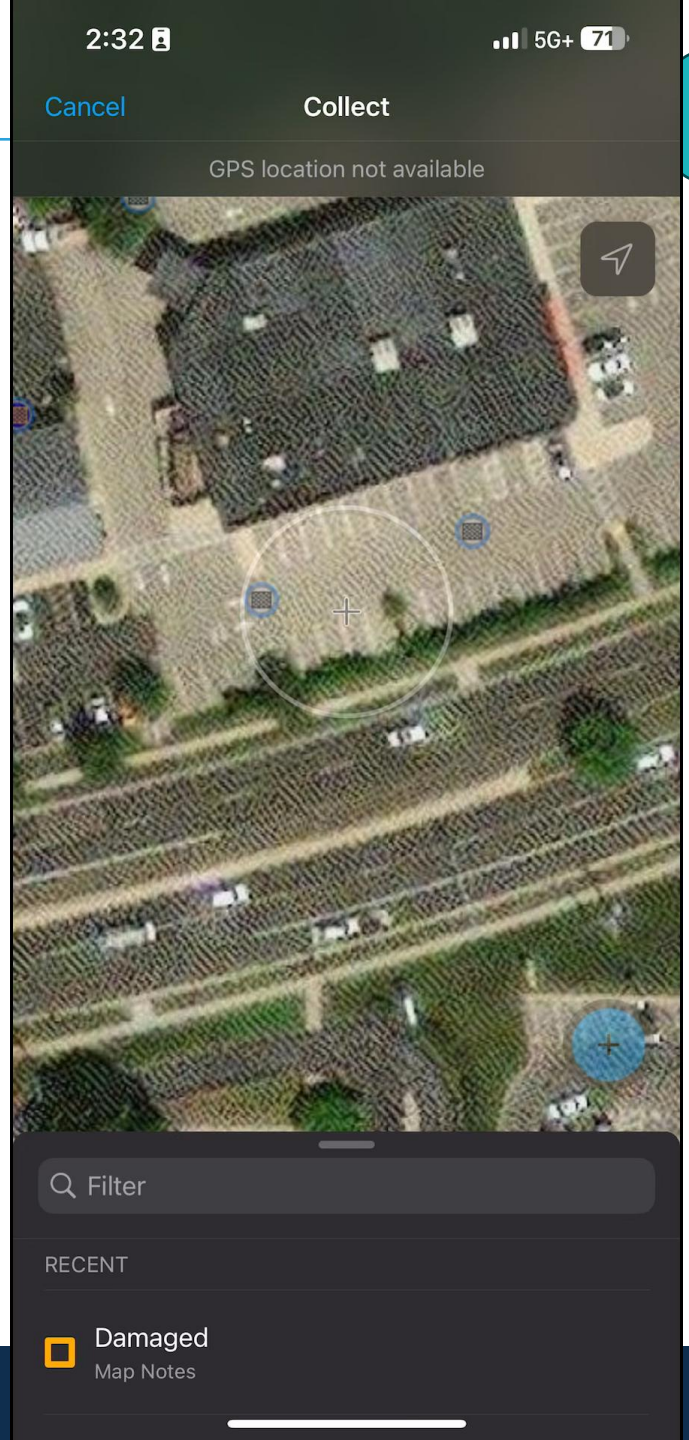
In field access to past inspections

Uniform and repeatable inspections

Adding information

- Add asset in field
- Map notes to communicate with other staff and maintenance crew:
  - Reminder to update the rest of the asset information
  - Mark an asset as unsafe or damaged, etc.





Technology Use in Inspection: Importance & Benefits

1. Use for Photo Log Organization

Importance:

- Ensures systematic and traceable documentation of field conditions.

Benefits:

- **Saves time** during report preparation and review.
- **Links photos directly** to specific assets or inspection points for easy reference.
- Reduces risk of misplaced or misidentified photos.

Technology Use in Inspection: Importance & Benefits

2. Use in Inclement Weather

Importance:

- Maintains continuity of inspection work regardless of weather conditions.

Benefits:

- **Enables ongoing inspections** even in rain, snow, or high humidity.
- **Increases efficiency and flexibility** in scheduling site visits.
- **Protects records** from physical damage or loss.
- Enhances inspector **comfort and safety** by reducing reliance on paper in the field.

Post Inspection

Post Inspection

1. In office inspection review and edit
2. Prepare photographic log and fill out required inspection form
3. Quality control meeting with senior engineer

Village of Menomonee Falls
W156 N8480 Pilgrim Road
Menomonee Falls, WI 53051-3140
Telephone: (262) 532-4200

STORMWATER MANAGEMENT FACILITIES OPERATION AND INSPECTION REPORT

Quarter Section _____ Name of Business/Subdivision C
Property Tax ID Number M ddress of Property W
4

Date: 05/28/2025

Dry Pond	
Wet Pond	X
Other	

Pond ID: _____

Year Pond Constructed 2004

Year of Last Certification 2019

Plan set and/or previous inspections

Survey and inspection

Compliance Verification	Design	Actual	Compliant Yes	Compliant No	Comments (Condition of Structure)
Primary Outlet Pipe					Outlet Pipe Material
Opening Diameter (inches)	12"	12"			Concrete
Upstream Invert	788.00	788.00	x		Vegetation surrounding.
Downstream Invert	787.00	787.09	x		
Length (feet)	150.0'	117.03'	x		
Slope (%)	0.67%	0.78%	x		
Secondary Outlet Pipe	(If Applicable)				Outlet Pipe Material
Opening Diameter (inches)					
Upstream Invert					
Downstream Invert					
Length (feet)					
Slope (%)					
Riser	(If Applicable)				Riser Material
Opening Diameter (inches)					
Elevation					
Upper Discharge Control	(If Applicable)				
Opening Diameter (inches)					
Elevation					

Compliance Verification	Design	Actual	Compliant Yes	Compliant No	Comments
Lower Discharge Control	(If Applicable)				
Opening Diameter (inches)					
Elevation					
Other (Description)					
Opening Type and Size (inches)	6"	6"	X		Vertical orifice
Elevation	788.0	788.0	X		
Emergency Spillway					
Elevation	793.50	794.58	X		
Length of spillway (feet)	20.0'	24.0'	X		

Embankment	Present Yes	Present no	Comments/Maintenance Requirements
Unauthorized Plantings, trees, or woody vegetation		X	Minor slope erosion
Animal burrows or slope erosion	X		

Storm Sewer Outfalls	Type & Size	Location	Comments
Outfall 1	12" RCP	NE corner of pond on W Appleton Ave.	
Outfall 2			
Outfall 3			

Storage Properties	Design	Actual	Compliant Yes	Compliant No	Not Applicable	Equipment Used
Normal Water Elevation *(Wet Ponds)*	788.0	788.20	X			Trimble R980 GPS Trimble S6 Instrument
Design High Water Elevation	791.53	791.53	X			
Area at Normal Water Elevation (Ac) (Wet Ponds)	0.698	0.592	X			
Area at Design High Water Elevation (Ac)	1.04	0.93	X			
Active Storage Available (Ac-Ft)*	5.993	4.284	X			
Lowest Elevation at Top of Embankment (If Applicable)	793.50	795.01	X			
Average Elevation at Top of Embankment (If Applicable)	794.50	797.67	X			
Maximum Bottom Elevation	783.00	783.81	X			
Average Pond Bottom Elevation	783.00	782.77	X			
Pond Bottom Area (Ac)	0.28	0.14	X			
Maximum Pond Depth	5.0'	6.03'	X			
Average Pond Depth	5.0'	5.43'	X			
Average Permanent Pool Depth *(Wet Ponds)*	5.0'	5.43'	X			

*To Determine Active Storage V=(H/3)(A1+A2+(√(A1+A2)))
Wet Ponds Use *H = Height of Section , A1= area at normal water elevation, A2=area at top section*
Dry Ponds Use *H= Height of Section, A1= pond bottom area, A2=area at top section*

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Photographic Log: Pond

Object ID	Overall Condition	Require Action	Action Notes	Inspection Notes
OS-1	Fair	Yes	Remove all veg within 50 ft of outlet structure.	



SPILLWAY	Excellent	No		



AQUALIS

Photographic Log: Catch Basins

Object ID	Overall Condition	Require Action	Action Notes	Inspection Notes
CB1	Good	Yes	Fill back of curb	Some erosion on back of curb



CB2	Fair	Yes	Remove block of concrete from bottom of inlet. Blocking the inlet	Source of concrete unknown.



Memorandum

This document serves as AQUALIS's Inspection Summary of the Stormwater Management Facilities Operation and Inspection Report in use at XXX (located at XX). The inspection performed by AQUALIS took place on Wednesday, May 21, 2025. The weather was rainy (approximately 46 deg F) with a measurable rainfall depth of 0.6 inches.

All items listed below in the Requirements section must be completed to recertify the SWMP. Once complete, please email photos of the areas in question and proof of maintenance. If you cannot send photos of the maintenance, AQUALIS can perform a follow-up visit as described in the original contract. Following proof of maintenance, we will stamp and certify the Stormwater Management Facilities Operation and Inspection Report and submit copies to you and the Village of Menomonee Falls at that time.

Additional Recommendations are also provided below to ease future maintenance and potential BMP failure.

Inspection Observations:

- Overall, the pond and associated catch basins are in good shape.
- Vegetation was noticed around outlet structure and debris in some catch basins.

Requirements (see Attachment for the site map and photo log):

- Remove all vegetation and debris within 50 ft of outlet structure (OS-1), located on the northwest corner of the pond.
- Place topsoil fill behind curb of CB1. Seed & mulch disturbed area
- Remove the block of concrete at the bottom of CB2.

Recommendations:

- General upkeep, including street sweeping, cleaning of all steel curb boxes, and minimizing debris and vegetation litter in the pond.

Attachments:

- Attachment 1: Stormwater Management Facilities Operation and Inspection Report (Draft)

If Maintenance is Required

1. Use inspection report and approved permit/plan for scope of work
2. Maintenance is performed, and verified via:
    - Completion photos, or
    - Follow-up site inspection.

After confirming completion, a qualified professional will certify and submit reports to the municipality and client.

Why use AQUALIS Team for Maintenance

1. Specialized Knowledge Required

- Not all traditional landscaping or general maintenance crews are trained in the specific needs of GSI systems.
- GSI features have **unique functional and ecological roles**—improper maintenance (e.g., over-mulching, removal of key vegetation) can compromise system performance.

2. Quality Control

- Our team ensures **consistent standards and procedures** are followed across all sites.
- Easier to **track performance history** and adapt practices based on site-specific experience.

Mich. | Detention Pond Failure

Key Takeaways

- Inspections are important to help prevent stormwater related disasters
- Municipalities and other agencies are generally cooperative to work with
- Record keeping is key
- Desk review = smoother inspections
- Grates are heavy! Work with caution
- Clients like to understand what is happening on their site
- Design with maintenance in mind

Thanks for Attending!!

Navigating Regulations and Best Practices for Inspection and Maintenance of Stormwater Management Facilities

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Questions?