



Asset Management Guidance For Community Flood Infrastructure

Executive Summary

Flood infrastructure helps Texas communities store, convey, redirect, control, monitor, and reduce stormwater runoff. These systems include major structures, buried drainage networks, mechanical and electrical equipment, natural features, coastal defenses, and nature-based practices. Some operate passively, while others rely on gates, pumps, sensors, communications, power, operating procedures, or emergency coordination.

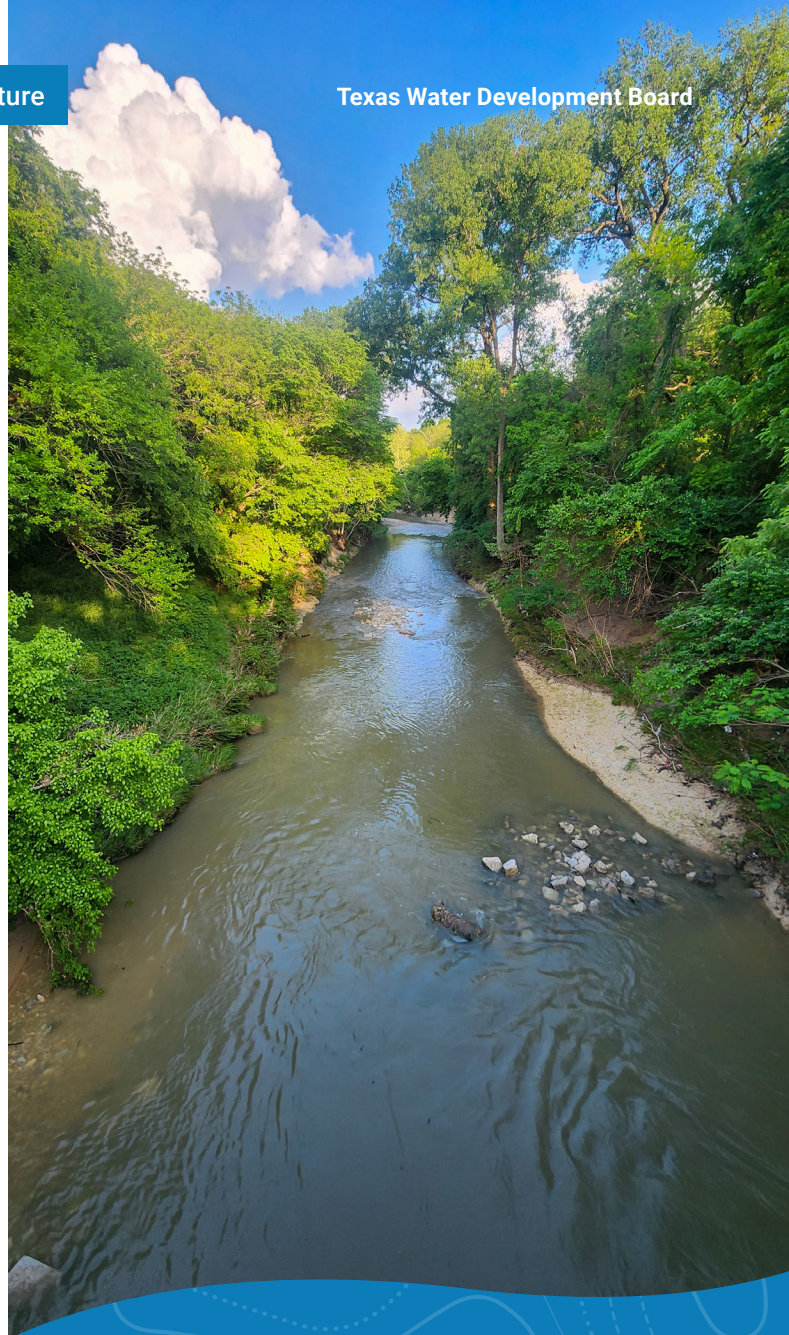
Flood infrastructure performs reliably only when owners understand their assets, monitor condition and function, address maintenance needs before deficiencies worsen, document work, and recognize when routine maintenance is no longer sufficient. Deferred care can reduce capacity, accelerate deterioration, increase emergency work, and raise consequences for people, roads, utilities, buildings, and critical facilities.

The Texas Water Development Board (TWDB) developed this Asset Management Guidance for Community Flood Infrastructure to give Texas communities a practical, repeatable starting point for managing 22 asset types. The guidance is intended for cities, counties, municipal utility districts, drainage and flood control districts, special districts, state agencies, and other owners or operators of flood infrastructure. It gives particular attention to entities with limited staff, equipment, data, or asset management resources.

The guidance builds on TWDB's Infrastructure Assessment Methodologies Classification Guidance and Toolkit, which supports asset inventories and planning-level descriptions of condition, functionality, and data confidence. The 22 asset packages extend that work into recurring field use by connecting observations to maintenance, follow-up, technical evaluation, emergency response, and long-term capital planning.

Each asset package combines a best management practice (BMP) reference sheet, an inspection checklist and five-level rating rubric, and a maintenance form.

Used together, the tools create a consistent process that can support a basic or established digital flood infrastructure asset management system.



AT A GLANCE

22

Asset Types

5

Condition Levels

3

Coordinated Tools

1

Repeatable Process

Reference sheets, inspection checklists and rubrics, and maintenance forms work together from field observation through follow-up and capital planning.

A Practical Framework for Action

The guidance follows a simple cycle: understand the asset and plan the work, observe and rate conditions, then act and document. Each completed record supports the next inspection, maintenance activity, repair, or capital decision.

UNDERSTAND AND PLAN BMP Reference Sheet Explains the asset, common warning signs, skill and equipment needs, maintenance goals, baseline timing, risk drivers, and repair or redesign considerations.	OBSERVE AND RATE Inspection Checklist and Rubric Records site and asset information, applies a safety stop, and uses asset-specific observable descriptions for ratings 1 through 5.	ACT AND DOCUMENT Maintenance Form Records why work occurred, what was performed, resources used, post-work condition, unresolved needs, photographs, and the next action date.
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Guidance for 22 Asset Types

The packages cover structural, conveyance, mechanical, electrical, natural, coastal, and nature-based flood infrastructure. Communities should use the packages that match their assets and review related packages where systems overlap.

Table ES-1: Asset Types Covered

No.	Asset Type
1	Dams
2	Levees
3	Rivers and Tributaries
4	Seawalls
5	Sea Barriers
6	Low Water Crossings/Roadway Stream Crossings
7	Flood Early Warning Systems
8	Stormwater Channels
9	Storm Drain Systems*
10	Pump Stations
11	Weirs
12	Reservoirs
13	Revetments
14	Ponds
15	Playas
16	Tidal Barriers
17	Tidal Gates
18	Wetlands
19	Dunes
20	Sinkholes
21	Bioswales
22	Rain Gardens

*The Storm Drain Systems package includes separate inspection checklists and maintenance forms for mains and culverts, manholes, catch basins/inlets, and outfalls.

Designed for Texas Communities

Texas communities vary in geography, flood hazards, asset portfolios, staffing, equipment, budgets, and data systems. The guidance can support a paper-based program built around asset IDs, photographs, and standard forms, or an established digital program that uses GIS, work orders, contracts, and capital planning.

Communities may perform routine work with in-house staff, shared services, or qualified contractors. Owner manuals, emergency plans, permits, regulations, maintenance agreements, and local procedures remain in effect and may require more specific actions.

Addressing Common Barriers

Common barriers include incomplete inventories, unclear ownership or access, inconsistent records, limited equipment or training, and maintenance needs that compete for funding. The guidance addresses these barriers by providing a common structure, simple forms, asset-specific rubrics, baseline schedules, risk drivers, service-delivery considerations, and clear points for escalating work.



How Communities Should Use the Tools

- 1. Confirm responsibility.** Identify ownership, maintenance responsibility, access rights, agreements, emergency contacts, and applicable requirements before field work.
- 2. Read the reference sheet.** Review the asset purpose, warning signs, skill needs, maintenance goals, baseline timing, risk drivers, decision logic, and repair or redesign considerations.
- 3. Complete the safety check first.** Stop and report when the form identifies an unsafe condition. Follow local procedures before returning to the site or entering the work area.
- 4. Observe and rate each applicable condition.** Use the full subcategory rubric. Record the exact location, extent, measurements, photographs, weather, and the context of the recent event where practical.
- 5. Act at the appropriate level.** Perform work within staff authority and training. Refer serious or recurring conditions, including those rated Major or Critical, as the asset-specific rubric directs.
- 6. Document and follow up.** Complete the maintenance form, retain supporting records, assign the next action and date, and keep unresolved items open until they are addressed or transferred to a project.

Building a Repeatable Local Program

- 1. Build the inventory and assign responsibility.** List each asset, location, unique ID, owner, maintainer, access requirement, agreement, and emergency contact. Map assets when practical.
- 2. Create a baseline condition record.** Complete the applicable checklist and photographs for priority assets. Record unknown information so staff can close data gaps over time.
- 3. Set priorities and inspection frequencies.** Use condition, consequences of failure, storm history, recurring problems, age, access, local experience, and owner or regulatory requirements.
- 4. Plan service delivery and support.** Identify work that staff can perform and work that requires outside support, such as a contractor, engineer, electrician, confined-space team, equipment vendor, or other specialist. Identify any required environmental permits before work begins.
- 5. Record work and close follow-up actions.** Keep inspections, maintenance records, photographs, disposal records, and supporting documents together.
- 6. Review trends and plan capital work.** At least annually, compare ratings, photographs, recurring failures, quantities of work, and costs. Move needs into budgets, procurement, and capital planning when routine maintenance is no longer sufficient.



From Observation to Action

How the Rating Scale Works

Every inspection checklist uses five levels: 1 Minor, 2 Mild, 3 Notable, 4 Major, and 5 Critical. The meaning of each level is specific to the subcategory. Staff should read the full asset-specific rating rubric before selecting a rating, as the label alone does not define the condition or the required response.

The rating supports screening, prioritization, and consistent records. It does not replace engineering analysis, a regulatory determination, or local authority. Consider consequences as well as physical conditions. A localized defect may need faster action when failure could affect occupied structures, roads, utilities, emergency access, public areas, or critical facilities.

Repair, Rehabilitation, or Redesign

Each BMP reference sheet includes asset-specific considerations for deciding whether maintenance or a targeted repair can restore function, or whether the condition warrants rehabilitation, replacement, reconstruction, or redesign. Escalation may be warranted when an asset has repeated failures, inadequate capacity despite being clean, widespread deterioration, changed hydrology or loading, obsolete components, poor access, or high consequences.

Use condition trends, maintenance history, consequences, owner and regulatory requirements, life cycle cost, and qualified professional judgment to determine how to proceed. Repeated work at the same location may indicate an underlying capacity, structural, watershed, access, or design problem rather than a maintenance problem alone.

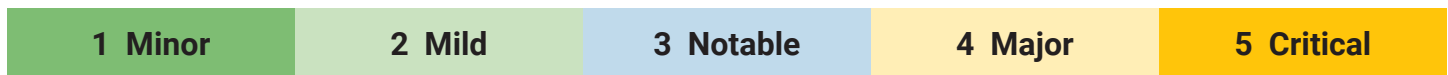
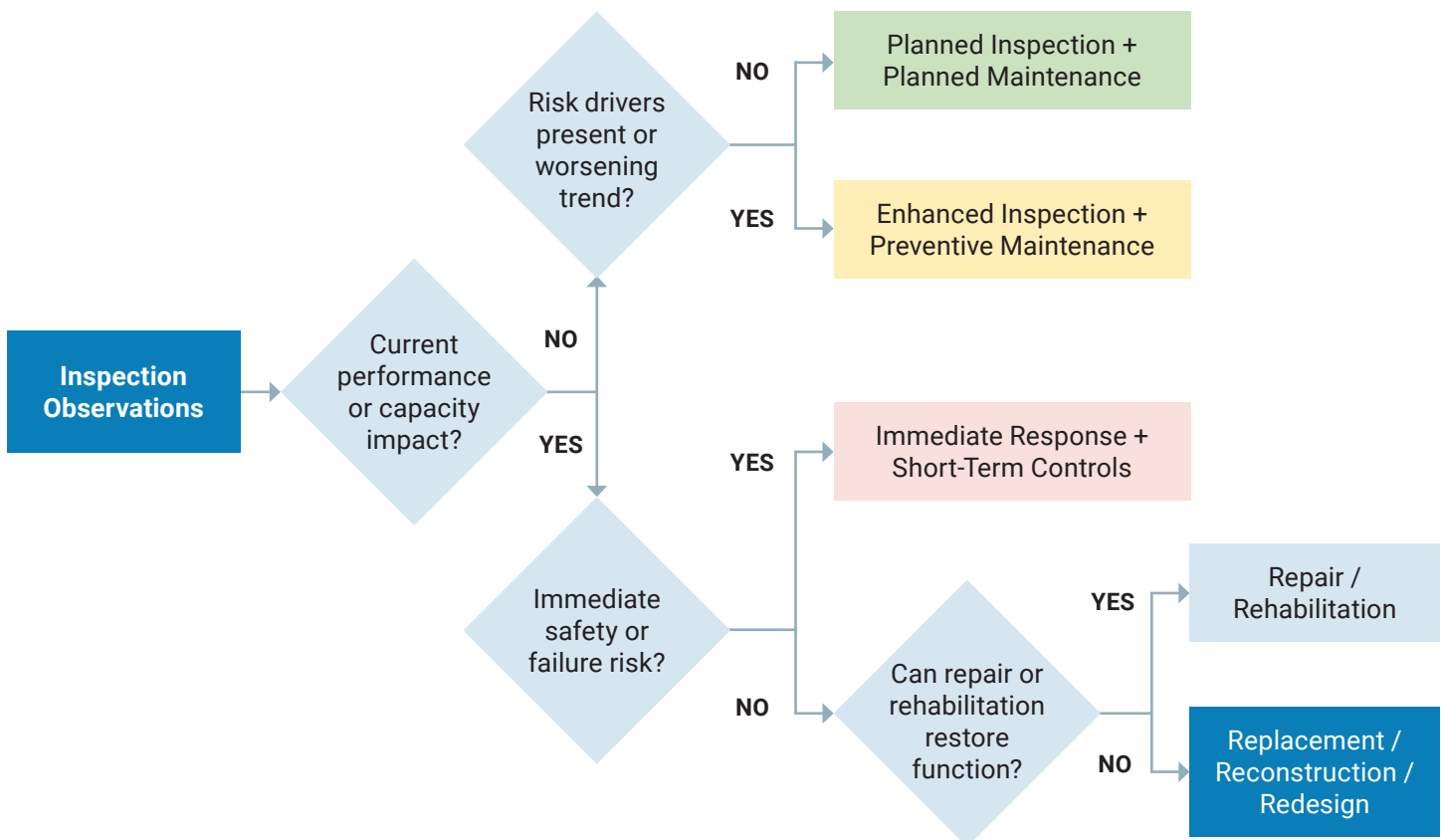


Figure ES-1: Inspection and Maintenance Decision Logic



Using Inspection and Maintenance Decision Logic

Begin with the inspection checklist and its asset-specific rubric. When performance or capacity is not currently affected, review the risk drivers and trend information in the reference sheet. Continue planned inspections and maintenance when no risk drivers are present; increase inspections and preventive maintenance as risk increases.

When current impacts are present, address immediate safety or failure risk first. Use emergency response and short-term controls when needed. If no immediate risk exists, determine whether repair or rehabilitation can restore function. If not, move the need into replacement, reconstruction, or redesign evaluation. Record interim controls, the selected action, unresolved needs, and the next review date on the maintenance form. Refer to Figure ES-1.

Limits, Safety, and Professional Support

These tools provide general statewide guidance. They are not a design standard, an ownership determination, a regulatory checklist, or a substitute for professional judgment. More specific owner manuals, emergency plans, permits, manufacturer instructions, regulations, and local safety procedures take precedence.

Stop field activity when fast water, severe weather, traffic, unstable ground, confined spaces, electrical hazards, structural hazards, hazardous materials, or other conditions make work unsafe. Some conditions cannot be evaluated through visual observation alone. Dams, levees, foundations, buried pipes, coastal structures, electrical systems, and other complex assets may require qualified engineering or other specialized support.

From Guidance to Local Action

The 22 asset-specific packages follow the order in **Table ES-1**. Use each BMP reference sheet, inspection checklist rating rubric, and maintenance form together. Communities may adapt fields and workflows to local systems but should retain asset identification, safety screening, condition documentation, consequence assessment, action tracking, follow-up, and recordkeeping. The objective is a repeatable local practice that converts field observations into timely maintenance and defensible planning.



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How to Maintain Your Dams



What is it?

A dam is any man-made barrier, including appurtenant works, that impounds or diverts water. Dams may be constructed of earth, rock, concrete, masonry, or combinations thereof. Key components typically include the foundation, earthen embankment, spillways (service and emergency/auxiliary), outlet works, abutments, and internal drainage and seepage control features.

Who maintains it?

Dams may be owned and maintained by federal, state, or local government agencies, drainage or water districts, utilities, private organizations, or individuals. Regardless of ownership, communities should confirm:

- Dam ownership and hazard classification (high, significant, low)
- Whether a current Emergency Action Plan (EAP) exists (if required) and is coordinated with local emergency management
- Inspection and maintenance responsibility
- Access to qualified engineering support for periodic technical inspections
- Regulatory compliance requirements with Texas Commission on Environmental Quality (TCEQ) Dam Safety Program

IMPORTANT NOTE:

The owner should take care to determine whether the dam is regulated by the TCEQ Dam Safety Program.

Best maintenance practices & strategies

Dams are engineered barriers that impound water. Over time, seepage, erosion, settlement, deterioration of concrete and mechanical components, vegetation encroachment, animal activity, and changes in hydrologic loading can compromise structural integrity, reduce spillway capacity, and increase the risk of failure. Routine inspection and routine maintenance protect public safety, preserve structural integrity, maintain hydraulic function, and extend service life.

The TCEQ Dam Safety Program is an excellent resource for best practices for dam ownership. Check the TCEQ Dam Safety Program website for regulations, technical guidelines, and resource manuals that address dam inspection and maintenance.

A. INSPECTION

Inspections confirm that the dam and its appurtenant structures remain structurally sound and operationally functional. Inspections should verify embankment stability, seepage control, spillway and outlet condition, and instrumentation performance. An inspection checklist for dams should cover the embankment (upstream slope, crest, downstream slope), abutments, spillways, outlet works, instrumentation, and downstream areas. Important aspects of a dam's functionality cannot be assessed by visual inspection and instead require engineering analyses such as hydrologic/hydraulic assessments, geotechnical investigations, and structural assessments. An inspection checklist for dams is included with this reference sheet.

Inspection skill needs:

- Familiarity with dam components: embankment zones, filters, drains, cutoff trenches, abutments, riprap, spillway structures, outlet conduits, gates, and valves
- Ability to recognize embankment distress indicators: seepage, cracking (longitudinal, transverse), slides, settlement, sinkholes, animal activity, and proper vs. undesirable vegetation
- Ability to identify spillway and outlet deficiencies: blockage, erosion, deterioration, gate malfunction, and indicators of insufficient hydraulic capacity
- Ability to recognize geotechnical issues: seepage paths, piping indicators, uplift, differential settlement, and erosion undermining

- Familiarity with instrumentation: piezometers, survey monuments, seepage weirs, inclinometers, and settlement monitoring devices
- Ability to document conditions clearly and recognize when professional engineering review is required
- Ability to safely observe without entering confined spaces, unstable slopes, fast water, or structurally compromised areas

What to look for:

- **Seepage and piping indicators.** Seepage is the most critical ongoing threat to embankment dams. Look for wet areas, springs, boils, or saturated zones on the downstream slope, at the toe, along abutment contacts, and around appurtenant structures. Turbid or sediment-laden seepage indicates internal erosion (piping), which can progress rapidly to failure. Monitor seepage quantity, clarity, and location relative to reservoir level. Seepage on the upper half of the downstream slope warrants immediate notification to the TCEQ Dam Safety Program or a dam engineer.
- **Embankment cracking, settlement, and displacement.** Longitudinal cracks along the crest may indicate slope instability or differential settlement. Transverse cracks across the crest suggest differential movement and pose a direct threat if they extend below the reservoir level, creating a seepage path. Sinkholes can indicate internal erosion or collapse. Distinguish desiccation (drying) cracks, which are typically shallow, intermittent, and narrow, from structural cracks, which are typically continuous, deep, and may show vertical offset. Earthen embankments should have proper grass vegetation coverage, and undesirable vegetation, i.e., deep-rooted vegetation that can undermine embankment integrity, should be kept clear.
- **Embankment instability and slides.** Look for bulging along embankment slopes, vertical displacement in the upper embankment, scarps, cracks at the crest, and slumping on either slope. Slides can indicate foundation weakness, excessive pore pressure, over-steepened slopes, or loss of material strength. Upstream slope instability may occur during rapid reservoir drawdown. Check along the water line for evidence of wave-induced erosion and benching.
- **Spillway condition and capacity.** Inspect for obstructions (debris, brush, trees, sediment, landslide deposits), erosion of the stilling basin or downstream channel, deterioration of concrete lining, headcutting erosion of earthen or rock spillways, open or displaced joints, cracking, undermining of the outlet, and scour downstream. A blocked or damaged spillway can lead to dam overtopping. For gated spillways, verify gate operability, structural condition, corrosion, hoist function, seal condition, and access to auxiliary power.
- **Outlet works and mechanical components.** Check outlet gates, valves, conduits, risers, and trash racks for corrosion, cavitation damage, blockages, leaks, misalignment, and operability. All gates should be exercised through their full range periodically, with precautions taken to install stoplogs or bulkheads in the event of gate malfunction. Check gate stems for alignment, gate seats for wear, and hoisting mechanisms for proper lubrication. Verify that the drawdown facility can lower the reservoir in an emergency. Note any noise, vibration, or excessive force during gate operation.
- **Concrete dam and structural element condition.** For concrete dams and concrete structures, inspect for structural cracking (irregular, angled, displaced), spalling, alkali-aggregate reaction indicators (random cracking pattern, gooe discharge, whitish deposits, chalky fracture), joint deterioration, and seepage. Check construction and expansion joints for sealant condition. Monitor cracks for changes in width, length, and offset.
- **Foundation and abutment stability.** Foundation and abutment deficiencies are a leading cause of concrete dam failure and a significant factor in embankment incidents. Look for embankment misalignment, seepage, erosion, movement, cracking in abutment rock, settlement, and undermining. Foundation problems may develop progressively over time after construction. Upstream abutment contacts, downstream groin areas, and areas around embedded structures require close attention.
- **Riprap and slope protection condition.** Check upstream slope protection for displaced or missing riprap, benching from wave erosion, loss of filter material beneath riprap, undesirable vegetation, and undermining. On the downstream slope, inspect for erosion gullies, bare areas, damaged vegetation cover, vehicle ruts, pedestrian or animal paths, and erosion at abutment contacts. Riprap deterioration from weathering, freeze-thaw, and abrasive wave action should be tracked over time.
- **Animal damage and vegetation encroachment.** Burrowing animals (beaver, nutria, muskrat, etc.) create tunnels that serve as seepage pathways and weaken the embankment. Ant colonies can reduce soil compaction and create subsurface galleries. Trees and brush on the embankment can obscure inspection, create root decay pathways, and damage structures

if uprooted. Identify signs of animal activity: gnawed vegetation, collapsed areas, unusual water level changes, and tunnel entrances at or below the water line. Cattle and wildlife trails can lead to erosion gullies forming on embankments.

- **Instrumentation and monitoring data.** Review piezometer readings for abnormal pore pressure trends, survey monument data for movement or settlement, seepage weir measurements for discharge changes, and inclinometer data for subsurface deformation. Compare current readings against baseline and historical trends. Anomalies or divergence from design assumptions require prompt evaluation by a qualified dam engineer. All instrumentation should have action levels that, if exceeded, trigger additional evaluation by a dam engineer.

How to record conditions:

- Use a standard inspection form. Consistent records enable comparison over time and support maintenance planning, budgeting, and regulatory compliance.
- Record location, date, weather, reservoir level, and recent storm or seismic activity. Context is essential for interpreting seepage, cracking, and erosion conditions.
- Describe the location of findings precisely: position along the dam (stationing or distance from a known location), elevation relative to the crest or toe, and relationship to known features. Accurate location enables meaningful comparison across inspections.
- Measure and record the extent of findings: length, width, depth, and area of cracks, seepage zones, eroded areas, and settlement. Quantify seepage flow rates where possible using a container and timer.
- Photograph key conditions with date stamps. Include overview and close-up images of seepage areas, cracks, erosion features, spillway conditions, and structural damage. Take photos from consistent vantage points for comparison.
- Flag urgent hazards immediately. Conditions threatening dam integrity, public safety, or that could worsen rapidly in the next storm event must be reported to the TCEQ Dam Safety Program authorities and the responsible dam engineer without delay.

B. MAINTENANCE

Maintenance protects a dam against deterioration, prolongs its service life, and prevents minor issues from escalating into emergency conditions or catastrophic failure. A good maintenance program is based on

systematic and frequent inspections. The cost of a proper maintenance program is small compared to the cost of major repairs, loss of life and property, and resultant litigation. A maintenance checklist for dams is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools for vegetation management, debris removal, and minor earthwork
- Mowing equipment appropriate for embankment slopes
- Erosion control materials: riprap, filter material, erosion control blankets, seed, and topsoil
- Compaction equipment for embankment repairs
- Tools for gate and valve exercising, lubrication, and minor mechanical repair
- Concrete repair materials and application tools for joint sealing and spall repair
- Survey equipment or access to survey services for settlement and alignment monitoring
- Confined space training and equipment where conduit or structure entry is required
- Boat or boatswain chair access for inspecting the upstream face and gates
- Specialized diving inspections may be required for submerged features
- Animal control supplies and coordination with wildlife damage management services
- Herbicide application equipment and approved products for brush and tree control on embankments (Refer to TCEQ Dam Safety Program guidelines for safe products to use near water)

Key maintenance goals:

- Maintain embankment integrity and surface protection. Keep slopes properly graded, well-vegetated with sturdy sod, free of brush and trees, and protected with functional riprap and filters. Repair erosion gullies, settlement, and ruts promptly.
- Control seepage and maintain drainage systems. Keep toe drains, relief wells, chimney drains, blanket drains, and foundation drains clear and functional. Monitor seepage quantity and quality. Clear drain outfalls of debris and sediment.
- Keep spillways clear and structurally sound. Remove obstructions, repair erosion and concrete deterioration, seal joints, maintain stilling basin protection, and ensure discharge channels convey flow safely away from the embankment. Earthen spillways should be

maintained with proper grass coverage, kept clear of trees, brush, and obstructions, and any erosion gullies/headcutting should be repaired.

- Maintain outlet works and mechanical systems. Exercise all gates and valves through their full range periodically, with precautions taken to install stoplogs or bulkheads in the event of gate malfunction. Lubricate operating mechanisms, check alignment, replace worn parts, test auxiliary power systems, and maintain trash racks.
- Control animal damage and invasive vegetation. Remove burrowing animals and fill burrows with compacted material. Clear trees and brush from the embankment. Treat root systems with an approved herbicide. Control ant colonies on and near the dam.
- Maintain concrete structures and metal components. Repair spalling, seal cracks and joints, paint or grease exposed metal to prevent corrosion, and maintain electrical systems for gate and lighting operation.

Key considerations while achieving maintenance goals:

- Never compromise dam safety for cost savings or schedule. Safety-related functions and features must not be sacrificed to reduce costs, improve project justification, or expedite time schedules.
- Do not draw down the reservoir too rapidly. Drawdown should generally not exceed about 1 foot per week for slopes composed of clay or silt materials, except in emergencies, to avoid triggering upstream slope instability.
- Coordinate with qualified engineers for non-routine work. Conditions such as embankment slides, structural cracking, sinkholes, foundation problems, and spillway capacity concerns require immediate professional engineering evaluation.
- Maintain the Emergency Action Plan (EAP). Keep the EAP current, update at least annually, coordinate regularly with local emergency management, and ensure all responsible parties understand notification procedures, inundation areas, and evacuation routes. A tabletop exercise of the EAP should be performed periodically to test the EAP.
- Prohibit unauthorized traffic and activities on the dam. Vehicle traffic (except maintenance) should be prohibited from embankment slopes. Restrict public access to sensitive areas. Prevent unauthorized excavation, grading, or construction on or near the dam.

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Perform a visual walk-through of the entire dam: upstream slope, crest, downstream slope, toe area, abutments, spillway, and outlet works
- Clear debris from spillway channels, inlet and outlet structures, trash racks, and drain outfalls
- Mow and maintain grass cover on embankment slopes and crest
- Record any seepage observations, comparing quantity and clarity with prior records
- Check instrumentation readings per established schedule
- Update inspection records and log recurring maintenance locations

2. Annual maintenance and comprehensive review

- Conduct a thorough inspection of all dam components and appurtenant structures
- Exercise gates and valves through their full range; test primary and auxiliary power systems. Gate and valve testing requires precautions in the event of gate or valve malfunction.
- Lubricate mechanical components per manufacturer specifications; check oil-filled stems for proper level
- Compare current conditions against prior inspection records to identify trends in seepage, settlement, erosion, and structural condition
- Review and update the EAP; coordinate with local emergency management agencies
- Review instrumentation data trends and assess whether installed instrumentation remains adequate
- Assess riprap condition and plan replacement where weathering, displacement, or filter loss has occurred
- All trees 2 inches in diameter or greater on the embankment, in riprap areas, or within clear zones must be cut, the root ball removed, the void filled with compacted material, and the area reseeded, if necessary
- Inspect and control animal burrows and ant colonies
- Review assets trending toward the end of life and plan rehabilitation proactively

3. Pre-, in-, and post-storm and seismic events

Pre-storm events

- Clear spillway channels, trash racks, and outlet areas of debris and obstructions

- Verify access routes to the dam are passable for emergency response
- Check that gates and valves are operable, and communications systems are functional
- Monitor weather forecasts

In-storm events (only when safe)

- Monitor reservoir level, spillway performance, and downstream conditions
- Document observed performance: surcharging, overtopping, erosion, debris accumulation
- Prioritize personal and public safety; avoid fast water, unstable slopes, and lightning exposure
- Monitor weather forecasts

Post-storm events or earthquakes

Inspect the entire dam as soon as conditions are safe; inspect immediately after significant earthquakes or storm events, and continue inspection frequency at TCEQ's or the dam engineer's direction. Remove storm-deposited debris from spillways, outlets, and drain systems.

- Check for new seepage, cracking, displacement, or erosion
- Document high water marks, debris lines, and any new problem areas
- Compare post-event conditions to pre-event records to identify changes

4. Factors that may influence the maintenance schedule

Use these to decide whether to stay at routine frequency or escalate to enhanced inspection and preventive maintenance:

- Storm intensity and frequency (increased rainfall intensity, consecutive storm events)
- Seepage changes (new seepage locations, increased quantity, turbid or sediment-laden flow, seepage on the downstream slope)
- Cracking and settlement (new cracks, widening or offset of existing cracks, progressive settlement, sinkholes)
- Spillway performance (evidence of overtopping, erosion progressing, gate operability concerns)
- Downstream hazard and consequence potential (high hazard classification, population at risk, critical facilities, roadways)
- Seismic activity in the region
- Age and condition of the dam (older dams with incomplete records require greater vigilance)
- Animal activity (beaver, nutria, muskrat colonies; ant infestation)

5. Repair vs. replacement considerations

Factors that indicate continued maintenance and repair

Choose repair/rehabilitation when:

- Issues are localized and do not affect overall dam stability or spillway adequacy
- Seepage can be controlled with improved drainage, grouting, or filter modifications
- Erosion can be stabilized with riprap, vegetation, or grade control without repeated failure
- Mechanical components can be rehabilitated or replaced without altering the dam function
- Concrete deterioration is surface-level and does not indicate structural compromise

Factors that indicate major rehabilitation or reconstruction

Consider major rehabilitation or replacement when:

- Repeated failures occur (recurring slides, progressive piping, repeated spillway erosion)
- The spillway is inadequate for the current design flood criteria
- Foundation or abutment deficiencies threaten structural integrity and cannot be corrected by standard treatment
- Widespread structural deterioration (severe corrosion, major concrete cracking, etc.) compromises load-bearing capacity
- The dam does not meet current design standards for seismic loading, hydrologic adequacy, or structural stability, and the cost and risk of continued repairs exceed the cost of a redesign to modern criteria
- Consequences of failure are severe: high hazard classification, population at risk, critical infrastructure downstream

Inspection Checklist

Asset Management Guidance for Community Flood Infrastructure

Dam Name/ID				
TCEQ Inventory No./Local ID				
County/Stream/Reservoir				
Location				
Dam Type	☐ Earth	☐ Floodwall	☐ Combined	☐ Other
Other/Details				
Date/Time				
Inspector				
Inspection Team				
Contractor				
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: °F			
Inspection Timing	☐ Routine	☐ Pre-Flood	☐ Post-Flood	☐ Annual
Size Classification				
Reservoir Level				
Regulatory Status	☐ Low Hazard	☐ Significant Hazard	☐ High Hazard	☐ Unregulated ☐ Other
Other/Details				
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____			

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Fast water/high flows	☐ Unstable slopes/sliding	☐ Structural collapse risk	☐ Severe weather /lightning
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Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Embankment and Slopes	Overall	☐	☐	☐	☐	☐
	Seepage on downstream slope or toe	☐	☐	☐	☐	☐
	Cracking (longitudinal, transverse, sinkholes)	☐	☐	☐	☐	☐
	Slope instability or slides	☐	☐	☐	☐	☐
Embankment and Slope	Erosion (surface, gullies, abutment contacts)	☐	☐	☐	☐	☐
	Riprap/slope protection condition	☐	☐	☐	☐	☐
	Animal burrows or undesirable vegetation encroachment	☐	☐	☐	☐	☐

Dam Name/ID: _____

Inspector Initials: _____

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Spillway	Overall	☐	☐	☐	☐	☐
	Obstructions (debris, brush, sediment)	☐	☐	☐	☐	☐
	Erosion or undermining at outlet	☐	☐	☐	☐	☐
	Concrete/lining deterioration	☐	☐	☐	☐	☐
	Vegetation condition for earthen spillways	☐	☐	☐	☐	☐
	Joint condition and sealant	☐	☐	☐	☐	☐
	Gate operability (if gated)	☐	☐	☐	☐	☐
Outlet Works	Overall	☐	☐	☐	☐	☐
	Gate or valve operability	☐	☐	☐	☐	☐
	Conduit or pipe condition	☐	☐	☐	☐	☐
	Trash rack and inlet condition	☐	☐	☐	☐	☐
	Corrosion or mechanical wear	☐	☐	☐	☐	☐
Seepage and Drainage	Overall	☐	☐	☐	☐	☐
	Seepage quantity and clarity	☐	☐	☐	☐	☐
	Drain and relief well function	☐	☐	☐	☐	☐
	Foundation or abutment seepage	☐	☐	☐	☐	☐
Concrete and Structural	Overall	☐	☐	☐	☐	☐
	Structural cracking or displacement	☐	☐	☐	☐	☐
	Spalling or surface deterioration	☐	☐	☐	☐	☐
	Leakage through the structure	☐	☐	☐	☐	☐
Impacts of Dam Conditions on People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to the downstream population	☐	☐	☐	☐	☐
	Threat to roads, utilities, or structures	☐	☐	☐	☐	☐

Inspection Checklist



Notes and Observations:

Dam Name/ID: _____

Inspector Initials: _____

Inspection Checklist



Notes and Observations:

Attach additional pages, if required.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Embankment and Slopes	Seepage on the downstream slope or toe	No seepage; dry slopes and toe.	Minor damp area; clear water; stable and small.	Persistent wet area; volume may be increasing; investigate the cause.	Significant seepage; turbid water or carrying soil fines; urgent evaluation.	Active piping; muddy, increasing flow; imminent failure risk; emergency response.
	Cracking (longitudinal, transverse, sinkholes)	Surface drying cracks only; shallow, intermittent, narrow.	Minor cracks; monitor with stakes for width and offset changes.	Continuous cracks >1 ft deep; possible settlement; schedule engineering review.	Transverse or offset cracks; structural movement suspected; urgent evaluation.	Active displacement, cracks extending toward the reservoir level, imminent breach risk, and emergency action.
	Slope instability or slides	Slopes stable; no cracks, bulging, or slumps.	Minor sloughing or localized bare areas; routine repair.	Cracks or slumps developing; slope becoming unsafe; schedule repair.	Significant slide, bulging at the toe, or vertical displacement; restrict access; delineate with flagging; prioritize repair.	Active slide or imminent failure; evacuate if warranted; emergency response.
	Erosion (surface, gullies, abutment contacts)	Good grass cover; minor rills only.	Small bare areas or shallow rills; reseed and repair.	Gullies forming or erosion at abutment contacts; schedule repair.	Active gully growth delivering sediment threatens the crest or toe; prioritize repair.	Severe erosion threatens embankment integrity or exposes internal zones; emergency stabilization.
	Riprap/slope protection condition	Riprap or soil cement intact; filter in place; no displacement.	Minor displacement or weathering; localized repair.	Sections missing or slumped; filter loss beginning; plan replacement.	Major displacement or benching; embankment exposed; urgent repair.	Slope protection failed; active wave erosion into embankment; emergency armoring.
	Animal burrows or vegetation encroachment	No burrows; dam clear of brush and trees.	Minor burrows or small brush; routine removal.	Active burrowing colony or trees on embankment; schedule removal and filling.	Extensive tunneling or large trees with root decay; seepage pathways possible; prioritize action.	Burrows extending through embankment or a large tree uprooted, leaving a void; emergency repair.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Spillway	Obstructions (debris, brush, sediment)	Spillway clear; no obstructions.	Minor debris or grass; routine cleanout.	Partial blockage reducing capacity; schedule removal.	Severe blockage; capacity significantly reduced; urgent removal.	Complete or near-complete blockage; overtopping risk; emergency removal.
	Erosion or undermining at outlet	No scour; stilling basin protected; outlet stable.	Minor scour; riprap in place; monitor.	Scour developing; protection borderline; plan repair.	Severe undermining; pipe displacement or slide risk at outlet; urgent repair.	Active failure at spillway outlet; uncontrolled erosion threatening embankment; emergency stabilization.
	Concrete/lining deterioration	Concrete sound; surfaces intact.	Minor spalling or surface wear; cosmetic.	Multiple spalls, exposed rebar, or delamination; schedule repair.	Widespread deterioration; structural section loss; urgent rehabilitation.	Structural failure of lining; flow eroding subgrade; emergency repair.
	Joint condition and sealant	Joints sealed; no displacement.	Minor sealant loss; joints aligned.	Open joints with water passing through; sediment loss is possible; seal soon.	Displaced joints; undermining or soil loss behind walls/slabs; urgent repair.	Joint failure with active undermining or slab displacement; emergency intervention.
	Gate operability (if gated)	Gates operate smoothly; seals intact; power available.	Stiff operation; minor corrosion; needs lubrication.	Gate is partially operable or leaking significantly; schedule repair.	Gate inoperable or cannot seal; cannot control flood releases; urgent repair.	Gate failure; no ability to regulate flow; emergency engineering response.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Outlet Works	Gate or valve operability	Operates smoothly through full range; no leaks.	Stiff operation; minor corrosion; lubrication needed.	Moderate corrosion or partial blockage; does not fully open or close; schedule repair.	Severe corrosion or damage; cannot seal or cannot open; urgent repair.	Outlet inoperable; no emergency drawdown capability; emergency response.
	Conduit or pipe condition	Sound; no defects visible at inlet or outlet.	Minor corrosion or wear, localized.	Moderate corrosion, cracking, or joint separation; schedule detailed inspection (CCTV if feasible).	Significant defects, deformation or holes, soil loss around the pipe is possible; urgent evaluation.	Conduit collapse or severe failure; uncontrolled flow path; emergency action.
	Trash rack and inlet condition	Trash rack clear and intact; inlet unobstructed.	Minor debris; easy removal; trash rack sound.	Partial blockage or trash rack damage; reduced intake capacity; schedule repair.	Severe blockage or trash rack failure; intake function impaired; urgent action.	Inlet completely blocked or trash rack gone; no controlled intake possible; emergency response.
	Corrosion or mechanical wear	Metal components in good condition; well-lubricated.	Surface corrosion; minor wear; paint or grease needed.	Active corrosion with section loss starting, worn seats or guides; plan replacement.	Severe corrosion; mechanical binding; parts failing; urgent repair.	Structural failure of metal components; gate or valve non-functional; emergency replacement.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Seepage and Drainage	Seepage quantity and clarity	No seepage observed; or minimal, clear, and stable.	Small clear seepage; quantity stable over time.	Seepage increasing or appearing at new locations; still clear; investigate and monitor closely.	Significant volume; water turbid or carrying soil; active internal erosion possible; urgent evaluation.	Heavy, turbid, or muddy flow increasing rapidly; piping failure likely; emergency response.
	Drain and relief well function	All drains are flowing or dry as expected; outfalls are clear.	Minor debris at outfalls; flow slightly reduced; routine cleanout.	Some drains are blocked or not producing as expected; schedule an investigation.	Multiple drains non-functional; pore pressures may be rising; urgent maintenance.	Drainage system failed; saturated conditions developing; emergency intervention.
	Foundation or abutment seepage	No seepage at abutments or foundation area.	Minor dampness at abutment contact; clear, stable.	Persistent seepage at foundation or abutment; volume or extent changing; investigate.	Significant seepage with soil loss or erosion at contacts; urgent engineering evaluation.	Active piping through foundation or abutment; uncontrolled flow; emergency response.
Concrete and Structural	Structural cracking or displacement	No structural cracks; joints intact.	Hairline cracks; no displacement; monitor.	Multiple cracks or minor displacement; possible foundation movement; schedule review.	Significant cracking with offset; structural load transfer affected; urgent evaluation.	Active structural failure; large displacement; imminent collapse risk; emergency action.
	Spalling or surface deterioration	Surfaces sound; no spalling.	Minor surface spalling; cosmetic only.	Multiple spalled areas or exposed rebar; possible alkali-aggregate reaction; plan repair.	Widespread deterioration; section loss; structural capacity reduced; urgent rehabilitation.	Severe deterioration compromising structural integrity; emergency repair or replacement.
	Leakage through the structure	No leakage; joints sealed.	Minor dampness or staining; stable.	Active leakage through joints or cracks; volume slowly increasing; investigate.	Significant leakage; material being leached or carried away; urgent repair.	Heavy uncontrolled leakage; structural dissolution or loss of support; emergency response.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Impacts of Dam Conditions on People and Infrastructure	Threat to the downstream population	No downstream population at risk.	Low consequence; issues contained at the dam site.	Moderate consequence; nearby residents or public areas could be affected; corrective work needed.	High consequence; population at risk from failure or uncontrolled release; prioritize action.	Immediate life-safety threat; failure imminent or occurring; emergency evacuation and response.
	Threat to roads, utilities, or structures	No downstream infrastructure at risk.	Minor nuisance impacts possible.	Roads or utilities could be disrupted during a failure event; schedule corrective work.	Damage to roads, bridges, or utilities is likely; closures are expected; urgent action is required.	Critical infrastructure threatened or damaged; immediate emergency response required.

Dam Name/ID	
TCEQ Inventory No./Local ID	
County/Stream/Reservoir	
Location	
Dam Type	☐ Earth ☐ Floodwall ☐ Combined ☐ Other
Other/Details	
Date/Time	START: __ / __ / ____ END: __ / __ / ____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Inspection Timing	☐ Routine ☐ Pre-Flood ☐ Post-Flood ☐ Annual
Size Classification	
Reservoir Level	
Regulatory Status	☐ Low Hazard ☐ Significant Hazard ☐ High Hazard ☐ Unregulated ☐ Other
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE		
☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up
☐ Complaint/observation	☐ Emergency/safety issue	☐ Spillway repair/cleanout
☐ Seepage control/drainage issue	☐ Embankment repair (erosion, cracks)	☐ Vegetation/brush removal
☐ Outlet works/gate maintenance	☐ Animal damage repair	☐ Instrumentation maintenance

Dams

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

REASON FOR MAINTENANCE

☐ Riprap repair/replacement	☐ Concrete repair/joint sealing	☐ Security/access control issue
☐ Mechanical/electrical maintenance	☐ EAP update/coordination	☐ Other (describe below)

Other/Details:

IMMEDIATE DAM-SAFETY TRIGGER OBSERVED

☐ None observed	☐ Excessive or increasing seepage	☐ Structural cracking/displacement
☐ Overtopping occurring or imminent	☐ Saturated downstream slope/toe	☐ Foundation/abutment instability
☐ Progressive erosion/breach risk	☐ Blocked or inoperable spillway	☐ Other (describe below)
☐ Muddy/cloudy seepage or suspected piping	☐ Inoperable outlet gate/valve affecting drawdown	

Other/Details:

Dam Name/ID: _____ Foreman Initials: _____

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Mowing/vegetation management	☐ Brush and tree removal
☐ Herbicide treatment	☐ Animal burrow filling/repair	☐ Ant control treatment
☐ Erosion repair/regrading	☐ Rill/gully repair	☐ Riprap placement/repair
☐ Filter material replacement	☐ Crack filling or joint repair	☐ Sinkhole repair/void filling
☐ Spillway debris removal	☐ Spillway concrete repair	☐ Spillway joint sealing
☐ Stilling basin repair/armoring	☐ Outlet gate exercise/lubrication	☐ Outlet gate repair/replacement
☐ Trash rack cleanout/repair	☐ Conduit/pipe repair	☐ Valve maintenance/replacement
☐ Drain/relief well cleanout	☐ Concrete spall repair/patching	☐ Metal painting/corrosion protection
☐ Electrical system maintenance	☐ Auxiliary power system test/maintenance	☐ Instrumentation repair/calibration
☐ Survey/settlement monitoring	☐ Seepage measurement/weir maintenance	☐ Other (describe below)

Other maintenance actions performed:

AREAS ADDRESSED

☐ Upstream slope	☐ Crest	☐ Downstream slope
☐ Downstream toe area	☐ Left abutment/groin	☐ Right abutment/groin
☐ Foundation area	☐ Service spillway	☐ Emergency spillway
☐ Stilling basin	☐ Outlet works/conduit	☐ Gates/valves
☐ Trash rack/inlet structure	☐ Drainage system	☐ Instrumentation
☐ Reservoir rim/shoreline	☐ Downstream channel	☐ Other (describe below)

Other areas addressed:

MATERIALS, EQUIPMENT, AND QUANTITIES

Equipment used (e.g., mower, backhoe, vacuum truck, survey equipment, gate wrench):

Maintenance hours/staff:

Materials used (e.g., riprap, filter gravel, topsoil, seed, concrete, grout, sealant, paint, lubricant, herbicide):

Quantity of materials (volume, weight, area):

Spoil/sediment removed (estimate volume and disposal location):

SAFETY, ENVIRONMENTAL AND REGULATORY CONTROLS

☐ Site access controlled and safe

☐ No fuel, oil, or material spills

☐ Traffic control in place (if needed)

☐ Herbicide applied per label requirements

☐ Confined space procedures followed (if needed)

☐ Reservoir level managed appropriately for work being performed

☐ Erosion and sediment controls in place during earthwork

☐ Area left clean and stable

CONDITION AFTER MAINTENANCE

Function/structural condition after work:	Embankment/slope condition after work:
☐ Restored/Acceptable	☐ Stable
☐ Improved	☐ Improved
☐ Still deficient	☐ Needs follow-up

DOCUMENTATION

Before photos attached:	☐ Yes	☐ No	☐ N/A
Photo locations/direction recorded?	☐ Yes	☐ No	☐ N/A
Sketch/map/GPS points attached?	☐ Yes	☐ No	☐ N/A
Inspection checklist attached?	☐ Yes	☐ No	☐ N/A
Work order attached?	☐ Yes	☐ No	☐ N/A
Instrumentation readings recorded?	☐ Yes	☐ No	☐ N/A
Seepage measurements recorded?	☐ Yes	☐ No	☐ N/A
Seepage clarity/color recorded?	☐ Yes	☐ No	☐ N/A
Rainfall and reservoir level log updated?	☐ Yes	☐ No	☐ N/A
Drawdown/release record updated?	☐ Yes	☐ No	☐ N/A
Gate/valve exercise log updated?	☐ Yes	☐ No	☐ N/A
Maintenance logbook updated?	☐ Yes	☐ No	☐ N/A
Disposal tickets/manifests attached?	☐ Yes	☐ No	☐ N/A
Permits/environmental coordination attached?	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED?

☐ Yes

☐ No

☐ N/A

(If yes, describe trigger)

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Maintenance Form



Dam Name/ID: _____ Foreman Initials: _____

How to Maintain Your Levees



What is it?

A levee is an engineered earthen embankment, floodwall, or combination of both, designed to prevent flooding of adjacent land. Levee systems may include embankments, floodwalls, closure structures, interior drainage features, relief wells, seepage berms, pump stations, and associated channels and ponding areas.

Who maintains it?

Levees may be owned and maintained by local levee districts, cities, counties, drainage districts, state agencies, or the federal government. The public sponsor is solely responsible for ensuring proper maintenance. Communities should confirm:

- Levee ownership, public sponsor, and hazard classification
- Eligibility status in the USACE Rehabilitation and Inspection Program
- Whether a current flood response plan exists and is coordinated with local and state emergency management
- Inspection and maintenance responsibility, including sub-agreements with adjacent landowners
- Access to qualified engineering support for technical inspections and repairs
- Regulatory compliance with Federal Emergency Management Agency and U.S. Army Corps of Engineers

Best maintenance practices & strategies

Levees are engineered earthen embankments or floodwalls designed to contain floodwaters and protect communities, infrastructure, and agricultural land. Over time, erosion, seepage, settlement, animal burrowing, vegetation encroachment, encroachments, deterioration of closure structures, and aging of internal drainage components can compromise structural integrity and reduce the level of flood protection. Routine inspection and targeted maintenance protect public safety, preserve structural integrity, maintain flood-fight readiness, and extend service life.

A. INSPECTION

Inspections confirm that the levee system contains flood waters, interior drainage systems function during flood events, and that all components are structurally sound and operationally ready. Inspections should verify embankment integrity, seepage control, slope stability, closure structure readiness, interior drainage function, and pump station operability. An inspection checklist for levees should cover the embankment (riverside slope, crown, landside slope, and toe), seepage and under-seepage features, closure structures, interior drainage, pump stations, and adjacent channel conditions. An inspection checklist for levees is included with this reference sheet.

Inspection skill needs:

- Familiarity with levee components: embankment, floodwalls, seepage berms, relief wells, toe drains, closure structures, interior drainage systems, flap and slide gates, and pump stations
- Ability to recognize embankment distress: seepage, sand boils, cracking, slides, settlement, sinkholes, and animal burrows
- Ability to identify encroachments, unauthorized excavations, and obstructions within the levee easement
- Ability to recognize slope instability indicators: cracks paralleling the crest, vertical displacement, toe bulging, and saturated slopes
- Ability to identify riprap and bank protection deficiencies: displacement, undermining, missing riprap, and vegetation encroachment in protected areas

- Ability to recognize interior drainage problems: blocked or failed conduits, non-functioning gates, and reduced channel capacity
- Ability to assess pump station operability, including electrical supply and back-up supply, mechanical components, controls, and discharge points
- Ability to document conditions clearly (photos, location, measurements) and recognize when professional engineering review is required
- Ability to observe safely without entering confined spaces, fast water, unstable slopes, or failing culverts

What to look for:

- **Seepage, sand boils, and under-seepage indicators.** Seepage is the most critical threat during high water. Look for wet areas, springs, boils, or saturated zones on the landside slope, at the landside toe, and in the area beyond the toe. Sand boils appear as cone-shaped mounds of sand deposited by water emerging under pressure through the foundation. Turbid or sediment-laden seepage indicates piping, which can progress rapidly to failure. Continuously saturated soils on the landside, even under low-water conditions, suggest a chronic under-seepage problem that will become serious during floods.
- **Embankment cracking, settlement, and sinkholes.** Longitudinal cracks along the crown or extending down slopes may indicate slope instability or differential settlement. Transverse cracks across the crown suggest movement between adjacent levee sections. Sinkholes indicate internal erosion, pipe failure, or the collapse of animal burrows. Shrinkage cracks in clay soils are common during drought and are typically shallow and intermittent, but all cracking must be monitored and evaluated. Cracks extending more than a few inches deep or showing vertical offset require engineering review. Evaluate utility structures that cross the floodwall, such as fiber-optic cables or gas pipelines, for signs of internal erosion
- **Floodwalls.** Check concrete surfaces for cracking, spalling (chipping or flaking), or scour (erosion of soil at the base). Inspect the sealant or water stops between concrete wall sections to ensure they are fully sealed. Check for signs that the wall is tilting, toppling, or sliding. A floodwall's stability depends on its deep, often underground foundation.
- **Slope instability and slides.** Look for deep cracks paralleling the riverside bank or levee crest, vertical displacement along the crack, bulging at the toe, and slumping on either slope. Slope failures can occur on both riverside and landside slopes, particularly after prolonged high water or heavy rainfall, or during rapid drawdown. Trees growing on or near levee slopes are a major cause of slope failure, because decaying root systems leave voids that allow water to saturate the slope.
- **Erosion (surface, wave erosion, and bank erosion).** Inspect for rain runoff erosion on slopes (rills, gullies), wave erosion on the riverside slope during high water, and stream bank erosion that may be migrating toward the levee. Bank caving, moving toward a levee or floodwall, is an immediate threat. Repair all erosion gullies by scarifying the surface, backfilling with matching levee material in compacted layers, and reseeding.
- **Encroachments and unauthorized activities.** Structures, excavations, fencing, stockpiled materials, gardens, utilities, and tillage within the levee easement are generally prohibited. Encroachments can compromise structural integrity, obstruct inspection and flood-fight access, and alter seepage and stability conditions. Fencing that blocks access along the crown is prohibited; where access control is needed, install gates.
- **Vegetation condition.** The entire levee must be consistently mowed and kept clear of brush, saplings, and trees. Tall grass makes visual inspection difficult and hides animal activity, slides, and cracking. All trees 2 inches in diameter or greater on the levee, in riprap areas, or within clear zones must be cut, the root ball removed, the void filled with compacted material, and the area reseeded. A clear zone extending approximately equal to the embankment height beyond each toe must be kept clear of woody growth.
- **Animal burrows and burrowing damage.** Burrowing animals (gophers, muskrats, badgers, beaver, nutria) create tunnels that become rapid failure paths during floods. Inspect immediately after mowing when burrows are most visible. All burrows must be thoroughly excavated, inspected for extent, backfilled with compacted material, and reseeded. Beaver dams in adjacent channels must be removed promptly to prevent bank erosion and blockage.
- **Riprap and bank protection condition.** Look for settled or displaced areas indicating undermining by the river, ice, or debris. When the rock is uneven, flow turbulence increases and causes additional erosion.

Keep protected areas free of brush, saplings, and trees. Replace missing or displaced stone with hard, durable, block-shaped rock over a filter layer (sand and gravel or geotextile fabric).

- **Closure structures, gates, and stoplogs.** Verify that all closure structure components (stoplogs, support equipment, sandbags, hardware) are readily available, clearly marked, and stored nearby on the protected side. Regularly check your inventory. Inspect, lubricate, and operate all flap gates, slide gates, and sluice gates at least annually before flood season. Check gate seats and frames for proper seating.
- **Interior drainage and conduits.** Inspect all drainage ditches, concrete culverts, conduits, gated structures, gate wells, and pump stations. Corrugated metal pipes (CMPs) have a limited design life and must be inspected frequently and replaced as needed. Even a CMP that looks acceptable inside may be severely corroded on the outside.
- **Pump stations.** Check and clean trash racks and intake screens to prevent clogs. Listen for unusual noises when pumps are operating. Ensure all moving parts are lubricated. Inspect floats for damage, tangling, or grease buildup so the pumps turn on at the right water levels. Review control room panels and test different water levels. Cycle emergency generators and test main disconnects to guarantee pumps work during power outages. Inspect pipes, valve vaults, and structural concrete for leaks, cracks, or rust. Inspect pipes, valve vaults, and structural concrete for leaks, cracks, or rust.

How to record conditions:

- Use a standard inspection form. Consistent records enable comparison over time and support maintenance planning, budgeting, and regulatory compliance.
- Record location, date, weather, river stage, and recent storm history. Context is essential for interpreting seepage, cracking, and erosion conditions.
- Describe the location of findings precisely: levee station or distance from a known feature, position on the cross-section (riverside slope, crown, landside slope, toe, berm), and relationship to drainage structures or closures.
- Document structural, mechanical, electrical, and hydraulic conditions of pump stations to ensure operability.
- Measure and record the extent: length, width, depth of cracks, erosion areas, settled areas, and seepage zones. Quantify seepage and relief well flows where possible.

- Photograph key conditions with date stamps. Include overview and close-up images from consistent vantage points for comparison over time.
- Flag urgent hazards immediately. Active sand boils, piping, slope failures, bank erosion migrating toward the levee, or failed drainage structures require immediate notification to the USACE and responsible engineers.

B. MAINTENANCE

Maintenance protects the levee system against deterioration, preserves flood-fight readiness, and prevents minor issues from escalating into catastrophic failures or regulatory compliance. Budget for both routine annual maintenance and the eventual replacement of expensive components such as pumps, motors, gates, and corrugated metal pipes as they reach the end of design life. A maintenance form for levees is included with this sheet.

Maintenance equipment and skill needs:

- Mowing equipment appropriate for levee slopes, crown, and clear zones
- Hand tools for vegetation management, debris removal, gate operation, and minor earthwork
- Compaction equipment for embankment repairs
- Erosion control materials: rock riprap, filter fabric, seed, mulch, topsoil
- Gate and valve maintenance tools, lubricants, and paint for metal components
- Concrete repair materials for floodwall and structure maintenance
- Pump station equipment may include mechanical tools, electrical testing devices, and heavy machinery. Essential skills include pump diagnostics, electrical troubleshooting, and confined space safety.
- Confined space training and equipment where culvert conduit or structure entry is required
- Animal control supplies and coordination with state wildlife agency
- Herbicide application equipment and approved products for vegetation control in riprap and difficult areas
- Sandbags, plastic sheeting, lumber, and other flood-fight supplies maintained in ready inventory

Key maintenance goals:

- Maintain embankment integrity and surface protection. Keep slopes properly graded, well-vegetated, free of brush and trees, and clear of encroachments. Repair

erosion, ruts, settlement, and depressions promptly with compacted fill matching levee material.

- Control seepage and maintain under seepage defenses. Keep relief wells functional through periodic surge testing and pump testing by qualified well drillers. Maintain seepage berms. Monitor sand boil history locations. Keep toe drains clear.
- Control animal damage aggressively. Implement an active animal abatement program. Excavate and backfill all burrows with compacted material. Remove beaver dams and blockages from channels. Inspect for burrows immediately after each mowing.
- Maintain all closure structures and gates. Inspect, lubricate, and manually operate all gates at least annually before flood season. Maintain complete stoplog and closure component inventory, stored nearby and clearly marked. Replace cracked or damaged gates immediately.
- Maintain interior drainage systems. Keep ditches clear of sediment and vegetation, restore original channel grade and cross-section at scheduled intervals. Inspect and maintain all culverts, flap gates, slide gates, and gate wells.
- Maintain pump stations. Follow manufacturer maintenance schedules. Remove debris and trash from the intake screens (trash racks) so water flows freely. Test the backup generator under load and check fuel, oil, and coolant levels. Check battery chargers. Track the operating hours of each pump. If usage varies widely, rotate the lead/lag duties. Inspect floats for debris or grease buildup so the pumps turn on at the correct water levels. Check the condition of impellers, seals, and bearings. Lubricate all moving parts as recommended by the manufacturer. Test voltage, inspect for wire corrosion, and verify all circuit breakers function properly. Maintain logbooks. Ensure fire protection measures are adequate. Test automatic and remote stations on schedule.
- Maintain riprap and bank protection. Replace displaced or settled stone. Remove vegetation from protected areas. Use durable, block-shaped stone over proper filter layers. Contact the USACE before placing any material in a river channel (a Section 404 permit may be required).
- Maintain concrete structures. Seal cracks with flexible sealant, repair spalling promptly (especially where rebar is exposed), apply protective coatings to weathered surfaces, and repair freeze-thaw damage before it worsens. Monitor floodwall joints and monolith movement. Replace eroded areas along base of floodwalls.

SCHEDULING MAINTENANCE:

1. Routine and seasonal maintenance

- Mow the entire levee profile regularly; maintain clear zones beyond each toe
- Remove debris, drift, and grass clippings from slopes, crown, channels, and drainage structures
- Inspect for and fill animal burrows after each mowing
- Test pump station mechanical, electrical, structural, and hydraulic systems per manufacturer recommendations
- Clear drainage ditch vegetation and sediment at scheduled intervals
- Inspect riprap for displacement, undermining, and vegetation encroachment
- Remove encroachments and report unauthorized activities within the levee easement

2. Annual maintenance and comprehensive review

- Conduct a thorough inspection of the entire levee system and all appurtenant structures
- Inspect, lubricate, and manually operate all flap gates, slide gates, sluice gates, and closure structures
- Verify stoplog and closure component inventory; confirm placement equipment is available and functional
- Test pump station mechanical, electrical, structural, and hydraulic systems per manufacturer recommendations
- Surge and pump test relief wells; compare results to baseline installation data
- Inspect all CMPs and culverts; budget for replacement of aging pipes approaching the end of design life
- Review and update the flood response plan; coordinate with local and state emergency management
- Compare current conditions against prior inspection records to identify trends
- Remove all trees 2 inches or greater in diameter on the levee, in riprap, or within 15 feet of the toe; remove root balls and backfill

3. Pre-, in-, and post-high-water events

Pre-high-water events

- Complete all pressing maintenance before the river rises; clear drainage structures and pump station trash racks, fill ruts and depressions, check all gates
- Distribute flood-fight supplies (e.g., sandbags, lumber, plastic sheeting, lights) to anticipated problem locations

- Verify access roads and ramps along the levee are usable; verify communications
- Manually check all flap gates on structures that will be submerged first
- Check pump station back-up power systems
- Alert community and coordinate with upstream and downstream jurisdictions

In-high-water events (patrol continuously)

- Patrol the entire system at least daily and continuously; use patrol teams, not individuals
- Look for sand boils, wet areas at the landside toe, slides, wave wash, low areas, and gate closure problems
- Monitor relief wells (flowing/non-flowing), pump stations, and closure structures
- Monitor pump station operations and fuel supplies for generators
- Document and report significant conditions to the USACE and local emergency management

Post-high-water events

- Inspect the entire system as soon as safe; compare post-event conditions to pre-event records
- Document high-water marks, debris lines, sand boil locations, erosion, and new problem areas
- Remove storm-deposited debris from channels, drainage structures, and levee slopes
- Report damage to the USACE and request technical or rehabilitation assistance if needed

4. Factors that may influence the maintenance schedule

- Storm intensity and river stage trends (increasing frequency of high-water events)
- Seepage and sand boil history (known problem locations, increasing frequency or severity)
- Conduit and drainage structure age and condition
- Bank erosion migrating toward the levee or floodwall
- Encroachment pressure from adjacent landowners or development
- Closure structure and pump station condition and reliability
- Animal activity (active burrowing colonies, beaver dams in channels)
- USACE Rehabilitation and Inspection Program eligibility status and upcoming USACE inspection findings

5. Repair vs. replacement considerations

Factors that indicate continued maintenance and repair

Choose repair/rehabilitation when:

- Issues are localized and do not affect overall levee stability or flood protection level
- Erosion can be stabilized with riprap, vegetation, or drainage improvements without repeated failure
- Conduit or culvert condition is still structurally adequate
- Closure structures and pump stations function properly after routine maintenance
- Relief wells respond to maintenance, and testing confirms adequate performance

Factors that indicate major rehabilitation or replacement

Consider replacement or major reconstruction when:

- Repeated failures occur (recurring slope failures, floodwall instability, progressive bank erosion, chronic sand boils)
- Conduits are at or past design life; interior corrosion or joint separation detected; Pump stations require a complete overhaul, or the capacity no longer matches the interior drainage needs
- Bank erosion threatens the levee alignment and cannot be economically stabilized in place; levee setback may be the only solution
- Deep-seated slope failures require removal and replacement of levee sections with stabilization berms
- The levee does not meet current design standards, and the cost of repeated repairs exceeds rehabilitation to modern criteria
- Consequences of failure are severe: populated areas, critical infrastructure, or loss of USACE Rehabilitation and Inspection Program eligibility

6. Repair and replacement scheduling questions

- Does the levee protect a populated area? What is the consequence of failure or overtopping?
- Does the current condition threaten levee integrity? Active sand boils, progressive bank erosion, failing conduits, slope instability?
- Are failures repeated or worsening? Same problem area reappears after repair?
- Is the project eligible for the USACE Rehabilitation and Inspection Program? Would deferred maintenance jeopardize that eligibility?
- Is replacement more cost-effective than continued repairs? Compare life-cycle costs, emergency repair costs, and risk reduction.
- Will future flood conditions exceed current levee capacity? Changed hydrology, upstream development, increased runoff?

Inspection Checklist

Asset Management Guidance for Community Flood Infrastructure

Levee Name/ID	
River/Stream	
River Stage	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Inspection Timing	☐ Routine ☐ Pre-Flood ☐ Post-Flood ☐ Annual
Levee Type	☐ Earth ☐ Floodwall ☐ Combined ☐ Other
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK - STOP IF UNSAFE

If checked, report and do not enter.

☐ Fast water/high flows	☐ Unstable slopes/sliding	☐ Failing culvert/confined space	☐ Severe weather/lightning
--	--	---	---

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Embankment and Slopes	Overall	☐	☐	☐	☐	☐
	Seepage, sand boils, or wet areas (landside)	☐	☐	☐	☐	☐
	Cracking (longitudinal, transverse, sinkholes)	☐	☐	☐	☐	☐
	Slope instability or slides	☐	☐	☐	☐	☐
	Erosion (surface, wave wash, bank caving)	☐	☐	☐	☐	☐
	Animal burrows or burrowing damage	☐	☐	☐	☐	☐
	Vegetation condition (mowing, trees, brush)	☐	☐	☐	☐	☐
	Encroachments within levee easement	☐	☐	☐	☐	☐
Riprap and Bank Protection	Overall	☐	☐	☐	☐	☐
	Stone displacement or undermining	☐	☐	☐	☐	☐
	Vegetation in riprap areas	☐	☐	☐	☐	☐
	Channel bank erosion near the levee	☐	☐	☐	☐	☐

Levee Name/ID: _____ Inspector Initials: _____

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Closure Structures and Gates	Overall	☐	☐	☐	☐	☐
	Closure component inventory and readiness	☐	☐	☐	☐	☐
	Flap/slide gate condition and operability	☐	☐	☐	☐	☐
	Metal condition (corrosion, painting, lubrication)	☐	☐	☐	☐	☐
Interior Drainage and Pump Stations	Overall	☐	☐	☐	☐	☐
	Culvert/conduit condition	☐	☐	☐	☐	☐
	Drainage ditch capacity and condition	☐	☐	☐	☐	☐
	Pump station function and maintenance	☐	☐	☐	☐	☐
	Relief well function	☐	☐	☐	☐	☐
Concrete and Structural (Floodwalls)	Overall	☐	☐	☐	☐	☐
	Cracking, spalling, or scaling	☐	☐	☐	☐	☐
	Joint condition and sealant	☐	☐	☐	☐	☐
	Tilting, sliding, or settlement	☐	☐	☐	☐	☐
Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to the protected population	☐	☐	☐	☐	☐
	Threat to roads, utilities, or structures	☐	☐	☐	☐	☐

Follow-Up Actions	Goal Resolution Date	Responsible Person

Inspection Checklist



Notes and Observations:

Attach additional pages, if required.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Embankment and Slopes	Seepage, sand boils, or wet areas (landside)	No seepage; landside dry.	Minor damp area; clear water; small and stable.	Persistent wet area or new seepage location; investigate the cause and monitor.	Significant seepage; turbid water or sand boils depositing material; urgent evaluation.	Active piping or large sand boils with increasing flow; imminent failure risk; emergency response.
	Cracking (longitudinal, transverse, sinkholes)	Surface shrinkage cracks only; shallow, narrow, intermittent.	Minor cracks; stake and monitor for changes in width and offset.	Continuous cracks extending several inches deep; possible settlement; schedule engineering review.	Transverse or offset cracks; structural movement suspected; urgent evaluation and USACE notification.	Active displacement or cracks extending to depth or growing rapidly; imminent breach risk; emergency action.
	Slope instability or slides	Slopes stable; no cracks, bulging, or slumps.	Minor sloughing or localized soft area; routine repair.	Cracks paralleling crest or slope, early bulging at toe; schedule stabilization and engineering review.	Significant slide, vertical displacement, or toe bulging; restrict access; prioritize repair; notify USACE.	Active slope failure or levee section displaced; imminent flood protection loss; emergency response.
	Erosion (surface, wave wash, bank caving)	Good grass cover; no rills or gullies.	Small bare areas or shallow rills; reseed and repair.	Gullies forming, wave wash benching, or bank erosion approaching the levee; schedule repair.	Active gully growth, severe wave damage, or bank caving migrating toward the levee; urgent stabilization.	Severe erosion threatens the levee cross-section, or bank caving is imminent at the levee toe; emergency action is required.
	Animal burrows or burrowing damage	No burrows; no animal activity.	Minor burrows; shallow; routine excavation and fill.	Active burrowing colony or multiple burrows; schedule abatement, excavation, and compacted backfill.	Extensive tunneling systems or large beaver dens; seepage paths possible; prioritize action and USACE review.	Burrows extending through the levee or collapse observed; emergency excavation, repair, and abatement.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Embankment and Slopes (Cont' d.)	Vegetation condition	Grass mowed to standard; no woody growth; 15-foot zones clear.	Grass slightly long; minor weeds; mow promptly.	Grass over 12 inches, hiding conditions; saplings present; schedule mowing and brush removal.	Trees 2 inches or greater on levee or within 15 feet of toe; inspection impossible; urgent removal required.	Dense tree and brush cover; root decay creating voids; levee integrity compromised; emergency clearing.
	Encroachments within levee easement	No encroachments; easement clear.	Minor encroachment (small garden, light debris); notify and request removal.	Structure, fencing, or stockpile in easement restricting access; schedule removal and enforcement.	Excavation, utility penetration, or tillage into the levee slope without approval; urgent correction and USACE notification.	Encroachment compromises structural integrity or blocks flood-fight access; emergency removal is required.
Riprap and Bank Protection	Stone displacement or undermining	Riprap intact; even slope; filter in place.	Minor displacement; localized stone replacement needed.	Sections settled or missing; undermining starting; plan replacement with a proper filter.	Major displacement; embankment exposed; flow turbulence increasing erosion; urgent repair.	Riprap failed; bank eroding rapidly; levee threatened; emergency armoring required.
	Vegetation in riprap areas	Riprap free of brush and trees.	Minor grass or weeds; routine spraying.	Saplings established in riprap; schedule removal and herbicide treatment.	Trees rooted in riprap; displacement risk during floods; urgent removal.	Dense growth displacing stone; riprap is non-functional; emergency clearing and stone replacement.
	Channel bank erosion near the levee	Banks are stable; no erosion migrating toward the levee.	Minor bank erosion; distant from levee; monitor.	Bank erosion progressing toward the levee; plan stabilization.	Bank caving approaching levee toe; urgent stabilization or levee setback evaluation.	Active bank failure at or near levee; imminent threat to flood protection; emergency response.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Closure Structures and Gates	Closure component inventory and readiness	All components present, marked, and stored nearby; placement equipment ready.	Minor inventory issue; components present but need organizing.	Some components are missing, or the placement equipment needs repair; schedule correction before the flood season.	Critical components missing or inaccessible; closure cannot be made in time; urgent procurement.	Closure structure non-functional; gap in flood protection; emergency action required.
	Flap/slide gate condition and operability	Gates operate smoothly; seats properly; no leaks.	Stiff operation; minor debris; lubrication needed.	The gate does not fully seat and shows moderate corrosion; schedule repair before the flood season.	Gate inoperable or cracked; water would flow back through the structure during high water; urgent replacement.	Gate failure; uncontrolled opening in flood protection; emergency repair or temporary closure.
	Metal condition (corrosion, painting, lubrication)	Metal components are painted, greased, and sound.	Surface rust; painting overdue; schedule maintenance.	Active corrosion with section loss starting; lubrication dried; repair and paint before flood season.	Severe corrosion; structural weakness; bolt/hinge failure possible; urgent repair.	Metal component failure; gate or structure non-functional; emergency replacement.
Impacts to People and Infrastructure	Threat to the protected population	No population at significant risk.	Low consequence; issues contained at the levee.	Moderate consequence; nearby residents could be affected if conditions worsen; corrective work is needed.	High consequence; populated area at risk from failure or overtopping; prioritize action.	Immediate life-safety threat; failure imminent or occurring; emergency evacuation and response.
	Threat to roads, utilities, or structures	No infrastructure at risk.	Minor nuisance impacts possible.	Roads or utilities could be disrupted during a failure event; schedule corrective work.	Damage to roads, bridges, or utilities is likely; closures are expected; urgent action is required.	Critical infrastructure threatened or damaged; immediate emergency response required.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Interior Drainage and Pump Stations	Culvert/conduit condition	Culverts clear; structurally sound; no settlement.	Minor sediment or debris; routine cleanout.	Moderate corrosion, joint separation, or settlement in CMP; schedule detailed inspection and plan replacement.	Severe corrosion, holes, or CMP separation; levee material at risk of collapse into a void; urgent replacement.	CMP failed or is collapsing; levee breach risk during flood; emergency replacement and levee repair.
	Drainage ditch capacity and condition	Ditches clear; original grade and cross-section maintained.	Minor vegetation or sediment; routine clearing.	Capacity reduced by vegetation or sediment; cross-section narrowed; schedule restoration.	Severely blocked; ponding on the protected side during rain; urgent clearing.	Ditch non-functional; interior flooding occurring; emergency restoration required.
	Pump station function and maintenance	Pumps operational; tested; logbook current; electrical sound.	Minor maintenance overdue; schedule service.	Pump issues identified; megger test overdue; reduced reliability; schedule repair.	Pump inoperable or electrical failure; cannot pump during flood; urgent repair.	Pump station is non-functional; protected area will flood from interior drainage; emergency action.
	Relief well function	Wells are flowing as designed; test results match baseline.	Minor reduced flow; schedule surge testing.	Significant performance decline; clogging or bio-fouling suspected; schedule well maintenance.	Wells are non-functional; under seepage pressures are rising; urgent well rehabilitation is required.	Relief system failed; sand boil risk elevated; emergency intervention and USACE notification.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Concrete and Structural (Floodwalls)	Cracking, spalling, or scaling	Concrete sound; minimal weathering.	Minor hairline cracks or surface scaling; seal and coat.	Multiple cracks, spalls, or exposed rebar; freeze-thaw damage is accelerating; schedule repair.	Significant structural cracking or deep spalling; section loss; urgent rehabilitation.	Structural failure of concrete; monolith integrity compromised; emergency repair.
	Joint condition and sealant	Joints sealed; no separation.	Minor sealant loss; joints aligned; reseal.	Open joints or gaps; water passing through during high water is possible; schedule repair.	Significant joint separation; monoliths are displacing; water passage is likely; urgent repair.	Joint failure with active water passage or structural displacement; emergency response.
	Tilting, sliding, or settlement	No movement; monoliths aligned.	Minor settlement; no tilting; monitor.	Measurable tilt or settlement; cracking developing; schedule engineering review.	Significant tilting (>2 inches) or sliding; spalling at joints; urgent evaluation by a licensed engineer.	Active structural failure; monolith displaced; flood protection compromised; emergency action.

Levees

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Levee Name/ID	
River/Stream	
River Stage	
Location	
Date/Time	START: __ / __ / ____ END: __ / __ / ____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Inspection Timing	☐ Routine ☐ Pre-Flood ☐ Post-Flood ☐ Annual
Levee Type	☐ Earth ☐ Floodwall ☐ Combined ☐ Other
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-flood response	☐ Pre-flood season preparation
☐ Complaint/observation	☐ Emergency/safety issue	☐ Inspection follow-up
☐ Erosion repair needed	☐ Animal burrow abatement/repair	☐ Vegetation/brush/tree removal
☐ Riprap repair/replacement	☐ Closure structure/gate maintenance	☐ Interior drainage/culvert issue
☐ Pump station maintenance	☐ Relief well maintenance	☐ Concrete/floodwall repair
☐ Encroachment removal	☐ Rut/depression/settlement repair	☐ Other (describe below)

Levee Name/ID: _____ Foreman Initials: _____

Other/Details:

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Mowing/vegetation management	☐ Brush and tree removal/root ball extraction
☐ Herbicide application	☐ Animal burrow excavation and backfill	☐ Beaver dam/blockage removal
☐ Erosion repair/regrading/compaction	☐ Rill/gully repair	☐ Riprap placement/repair
☐ Filter fabric/bedding placement	☐ Crack repair/monitoring stake install	☐ Sinkhole/void repair
☐ Rut/depression fill and compaction	☐ Seepage berm repair	☐ Encroachment removal
☐ Gate inspection/lubrication/exercise	☐ Stoplog inventory/placement test	☐ Flap gate/slide gate repair
☐ Culvert/conduit cleanout or repair	☐ Conduit replacement	☐ Drainage ditch clearing/grading
☐ Pump station service/test	☐ Relief well surge/pump test	☐ Electrical components testing
☐ Concrete crack sealing/coating	☐ Spall repair/rebar protection	☐ Floodwall joint resealing
☐ Metal painting/greasing	☐ Sandbag/supply restocking	☐ Other (describe below)

Other maintenance actions performed:

Levees

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

AREAS ADDRESSED

☐ Riverside slope	☐ Crown/crest	☐ Landside slope
☐ Landside toe/berm area	☐ Seepage berm	☐ Relief wells/toe drains
☐ Riprap/bank protection	☐ Channel/riverbank	☐ Closure structure/gate
☐ Interior drainage ditch	☐ Culvert/conduit	☐ Gate well/inlet-outlet structure
☐ Pump station	☐ Floodwall section	☐ Other (describe below)

Other areas addressed:

MATERIALS, EQUIPMENT, AND QUANTITIES

Equipment used (e.g., mower, backhoe, vacuum truck, survey equipment, gate wrench):

Maintenance hours/staff:

Materials used (e.g., riprap, filter gravel, topsoil, seed, concrete, grout, sealant, paint, lubricant, herbicide):

Quantity of materials (volume, weight, area):

Spoil/sediment removed (estimate volume and disposal location):

Levee Name/ID: _____ Foreman Initials: _____

Levees

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

SAFETY AND ENVIRONMENTAL CONTROLS

☐ Site access controlled and safe	☐ No fuel, oil, or material spills; herbicide applied per label
☐ Traffic control in place (if needed)	☐ Spoil material disposed outside floodway
☐ Confined space procedures followed (if needed)	☐ Section 404 permit obtained if placing material in channel (coordinated with USACE)
☐ Work performed outside periods of active high water and under safe conditions	☐ Area left clean and stable
☐ Erosion and sediment controls in place during earthwork	☐ Reseeded where disturbed

CONDITION AFTER MAINTENANCE

Function/structural condition after work:	Embankment/slope condition after work:
☐ Restored/Acceptable	☐ Stable
☐ Improved	☐ Improved
☐ Still deficient	☐ Needs follow-up

DOCUMENTATION

Before photos attached:	☐ Yes	☐ No	☐ N/A
Relief well test results recorded:	☐ Yes	☐ No	☐ N/A
Pump station logbook updated:	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED?

☐ Yes

☐ No

☐ N/A

(If yes, describe trigger)

Levee Name/ID: _____ Foreman Initials: _____

Levees

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Follow-Up Actions	Goal Resolution Date	Responsible Person

Notes and Observations:

Attach additional pages, if required.

How to Maintain Your Rivers and Tributaries



What is it?

A river or tributary is a natural or modified waterway that collects and conveys stormwater runoff through a watershed. These waterways range from small urban creeks and drainage channels to major rivers. Key features include the channel bed, channel banks, floodplain, riparian buffer, bank protection (riprap, gabions, bioengineered treatments), grade control structures, bridge and culvert crossings, and outfall discharge points.

Who maintains it?

Rivers and tributaries may be maintained by cities, counties, flood control districts, drainage districts, state agencies, or federal agencies (e.g., USACE). Private landowners may have responsibility for bank maintenance on their property. Regardless of ownership, communities should confirm:

- Channel ownership, easement boundaries (public vs. private), and maintenance responsibility
- Whether access easements and maintenance access points exist at adequate intervals
- Coordination with regulatory agencies for in-channel work (Section 404 permits, TPDES, state environmental requirements)
- Emergency response coordination for flood events and debris blockages

Best maintenance practices & strategies

Rivers, creeks, and tributaries are the natural and modified waterways that convey stormwater runoff through watersheds to downstream receiving waters. Over time, bank erosion, channel migration, sedimentation, debris accumulation, log jams, invasive vegetation, illegal dumping, and degradation of engineered bank protection can reduce conveyance capacity, increase flood risk, damage adjacent infrastructure, degrade water quality, and threaten public safety. Routine inspection and targeted maintenance protect flood conveyance, preserve bank stability, reduce sediment and pollutant loading, and extend the functional stability of engineered and natural channel features.

A. INSPECTION

Inspections confirm that rivers, creeks, and tributaries can still convey stormwater safely, that channel banks are stable, that engineered features such as riprap, grade control structures, and bridge crossings remain functional, and that obstructions are not reducing capacity or redirecting flows into vulnerable banks. An inspection checklist for rivers and tributaries should include the channel bed, channel banks, riparian corridor, engineered bank protection, crossings and structures, water quality indicators, and adjacent infrastructure exposure. An inspection checklist for rivers is included with this reference sheet.

Inspection skill needs:

- Ability to recognize active bank erosion patterns: undercutting, slumping, tension cracks along the bank crest, toe scour, and head-cutting at tributary confluences
- Ability to identify channel capacity problems: sedimentation, shoaling, debris jams, log jams, and vegetation encroachment that narrows the effective flow area
- Familiarity with channel features: channel bed, bank toe, bank crest, floodplain bench, riparian buffer, grade control structures, drop structures, outfalls, and bridge/culvert crossings
- Ability to identify engineered bank protection deficiencies: displaced or undermined riprap, failed gabions, eroded bioengineered treatments, and scour at the upstream and downstream ends of armored reaches

- Ability to recognize water quality indicators: illicit discharges, oil sheen, unusual color or odor, dry-weather flow from outfalls, fish kills, and algal blooms
- Ability to document conditions clearly (photos, GPS location, measurements) and recognize when engineering review is required
- Ability to observe safely: avoid fast water, unstable banks, confined spaces in culverts, and steep slopes

What to look for:

- **Bank erosion and instability.** The single greatest maintenance drivers for rivers and tributaries are bank erosion and instability. Look for actively eroding banks (vertical or undercut faces), tension cracks along the bank crest, slumping or mass failure, exposed tree roots, fallen trees pulling bank material into the channel, toe scour at the base of banks, and head-cutting at tributary confluences or outfall discharge points. Bank erosion delivers sediment downstream, reduces channel capacity, threatens adjacent roads, utilities, and structures, and can undermine bridge foundations and levees.
- **Sedimentation and shoaling.** Sediment deposited in the channel bed reduces conveyance capacity and redirects flow into erodible banks. Look for point bars growing into the flow area, mid-channel shoals supporting vegetation, raised bed elevations that reduce freeboard at crossings, and sediment accumulation at bridge piers, culvert entrances, and confluence points. Sedimentation sources include upstream construction, field erosion, bank failures, and inadequate erosion controls.
- **Debris, log jams, and obstructions.** Fallen trees, log jams, construction debris, illegal dumping, and accumulated drift can deflect flows into channel banks, cause severe erosion, trap additional debris, create progressive blockages, raise upstream water levels, and endanger bridge crossings and downstream infrastructure. Log jams and beaver dams that are not promptly removed have historically caused levee-threatening bank erosion and bridge damage. Note that if the river was designed to consider woody debris, it should not be removed. Natural woody debris can help stabilize banks. Similarly, debris jams may have a role in aquatic ecosystems.
- **Vegetation encroachment and invasive species.** Dense vegetation in the channel flow area (cattails, reeds, willows, saltcedar) reduces conveyance capacity, traps sediment, and can redirect flow. Invasive species may outcompete native riparian vegetation and reduce bank stability. However, healthy riparian vegetation on the banks and floodplain bench provides essential bank stabilization, shade, habitat, and water quality benefits — indiscriminate clearing harms more than it helps. Focus vegetation management on maintaining conveyance within the active channel while preserving healthy riparian buffers on banks.
- **Engineered bank protection condition.** Inspect riprap revetments, gabion walls, concrete channel linings, bioengineered bank treatments, and grade control structures for displacement, undermining, settlement, flanking (erosion around the ends), vegetation disruption, and structural deterioration. Eddy currents at the upstream and downstream ends of armored reaches commonly cause accelerated erosion of unprotected banks. Grouted riprap can fail suddenly if undermined.
- **Bridge and culvert crossings.** Inspect for scour at bridge piers and abutments, debris accumulation against piers and decks, sediment deposition reducing waterway opening, undermining of headwalls and wingwalls, and structural deterioration. Culvert entrances and outlets are especially vulnerable to blockage, scour, and erosion. Undersized crossings cause upstream backwater and overtopping of roadways.
- **Outfall discharge points.** Storm drain outfalls discharging into the channel can cause localized erosion, head-cutting, and bank failure at the discharge point. Look for scour holes, undermining, exposed pipe, displaced energy dissipation features, and erosion migrating upstream from the outfall. Also check for illicit discharge indicators: dry-weather flow, unusual color, sheen, odor, or staining.
- **Water quality indicators.** Document oil sheen, unusual color or turbidity, persistent foam, strong odors, fish kills, excessive algal growth, and evidence of illicit discharges or spills. Dry-weather flow from outfalls may indicate illicit connections. Report all suspected illicit discharges to the appropriate enforcement or utility agency promptly.
- **Floodplain encroachments and adjacent infrastructure.** Structures, fill, fencing, or other obstructions in the floodplain reduce flood conveyance and increase flood risk. Note any new construction, grading, or fill placement within the floodway. Identify infrastructure (roads, bridges, utilities, buildings) at risk from progressive bank erosion, undermining, or flood exposure.

How to record conditions:

- Use a standard inspection form or digital tool. Consistent records enable comparison over time, support maintenance planning, and document regulatory compliance.
- Record location (GPS coordinates or stationing), date, weather, approximate flow conditions, and recent storm history.
- Describe bank erosion by position (left bank or right bank looking downstream), height and length of eroded face, presence of undercutting or tension cracks, proximity to infrastructure, and estimated rate of migration if observable.
- Quantify obstructions and sediment: estimate dimensions of debris jams, sediment bar area and depth, and percentage of channel capacity affected.
- Photograph key conditions with date stamps from consistent vantage points. Include overview and close-up images of erosion, debris jams, bank protection damage, outfall conditions, and water quality concerns.
- Flag urgent hazards immediately: bank erosion threatening roads, utilities, or structures; debris jams threatening bridges; active head-cutting; illicit discharges or spills; and public safety hazards such as undercut banks near trails or parks.

B. MAINTENANCE

Maintenance protects channel conveyance capacity, stabilizes banks, removes obstructions, and prevents minor problems from escalating into major infrastructure damage or flood risk. Maintenance of rivers and tributaries requires coordination with regulatory agencies, because in-channel work (placing rock, grading banks, removing sediment) may require Section 404 permits, Texas Pollutant Discharge Elimination System (TPDES) compliance, and coordination with state environmental agencies. Plan maintenance activities in advance and obtain necessary permits before mobilizing. A maintenance checklist for rivers is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools for debris removal, vegetation management, and minor bank work
- Mowing equipment for channel buffer and access road maintenance
- Heavy equipment (excavator, loader, dump truck) for sediment removal, bank stabilization, and riprap placement
- Erosion control materials (riprap, filter fabric, erosion control blankets, seed, mulch, and live stakes for bioengineered treatments)
- Chainsaws and log removal equipment for debris jams and fallen trees
- Litter boom equipment for floatable management at key collection points
- CCTV or remote inspection capability for culvert crossings where feasible
- Water quality monitoring equipment (basic field kit) for illicit discharge screening
- Traffic control capability for work near roadway crossings
- Confined space training and equipment where culvert entry is required
- Boat access for large waterway inspection and maintenance

Key maintenance goals:

- Remove obstructions and maintain conveyance capacity. Remove debris jams, log jams, fallen trees, illegal dumping, and accumulated drift that reduce capacity or redirect flow into erodible banks. Remove sediment from critical locations (bridge waterway openings, culvert entrances, upstream of grade control structures) when the accumulation measurably reduces capacity. Dispose of removed material outside the floodway.
- Stabilize actively eroding banks. Prioritize bank stabilization where erosion threatens infrastructure (roads, bridges, utilities, buildings, levees), where sediment delivery degrades downstream capacity, and where public safety is at risk. Use appropriate bank protection: riprap with filter underlayment, bioengineered treatments (live stakes, brush layering, coir logs), or combinations. Extend protection far enough upstream and downstream to prevent flanking.
- Maintain engineered bank protection and grade control structures. Replace displaced or settled stone, repair undermined gabions, maintain grade control structures, and address scour at structure ends. Keep armored areas free of woody vegetation that could displace rock during floods. Contact the U.S. Army Corps of Engineers (USACE) or local authority before placing material in the channel.
- Manage vegetation for conveyance and bank stability. Remove vegetation encroaching into the active channel that reduces conveyance (dense cattails, reed stands, in-channel willows). Preserve and enhance riparian buffer vegetation on banks and the floodplain bench —

healthy riparian trees and grasses stabilize banks, filter sediment, shade the stream, and support habitat. Mow access corridors and easement areas per maintenance schedule.

- Maintain bridge and culvert crossings. Remove debris accumulation at bridge piers and culvert entrances. Monitor and address scour at bridge foundations and abutments. Keep headwalls, wingwalls, and energy dissipation features in good repair. Report structural concerns to the responsible bridge owner.
- Manage outfall discharge impacts. Stabilize erosion at outfall discharge points. Maintain or restore energy dissipation features. Monitor for head-cutting migrating upstream from outfalls. Investigate and report dry-weather flows and illicit discharge indicators.
- Collect and remove floatables and trash. Maintain litter booms at designated collection points. Remove accumulated litter and debris from channel banks and accessible shorelines, especially after storm events. Coordinate with parks, public works, and volunteer cleanup programs.

Key considerations:

- Obtain permits before in-channel work. Placing material (rock, soil) in the channel, removing sediment, grading banks, or altering channel geometry may require Section 404 permits (USACE), TPDES compliance (TCEQ), and coordination with state fish and wildlife agencies. Contact your USACE district and state agencies before starting work.
- Preserve healthy riparian vegetation. Do not clear-cut riparian corridors. Riparian buffers provide bank stability, sediment filtration, shade, habitat, and water quality benefits. Focus on in-channel vegetation that reduces conveyance, dead or hazardous trees, and invasive species.
- Dispose of removed material properly. Sediment, debris, and vegetation removed from the channel must be disposed of outside the floodway where floodwaters cannot carry it back into the stream.
- Address erosion sources, not just symptoms. Upstream development, increased impervious cover, undersized crossings, and uncontrolled stormwater discharges often drive channel erosion. Coordinate with planning, development services, and stormwater programs to address root causes.

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Conduct drive-by and walk-through checks of known problem areas: active erosion zones, debris-prone crossings, outfall discharge points, and litter boom sites
- Remove visible debris from bridge piers, culvert entrances, and channel restrictions
- Mow and maintain access corridors, buffer areas, and easement zones per schedule (2–6 times per year, depending on site)
- Inspect and clean litter booms; remove collected floatables
- Remove illegal dumping from the channel and floodway

2. Annual maintenance and comprehensive review

- Conduct a full inspection of the entire reach: channel bed, both banks, all crossings, outfalls, and engineered features
- Compare current conditions against prior inspection records to identify erosion migration, sediment trends, and capacity changes
- Plan and schedule bank stabilization projects for reaches where erosion threatens infrastructure.
- Remove sediment from critical locations where accumulation measurably reduces conveyance capacity
- Inspect and maintain engineered bank protection: replace displaced riprap, repair grade control structures, and address flanking erosion
- Review culvert and bridge crossing conditions; schedule scour repair and debris clearance
- Coordinate with regulatory agencies on planned in-channel work; obtain necessary permits
- Review assets trending toward the end of life (corroded culverts, failing gabions, deteriorating concrete lining) and plan rehabilitation

3. Pre-, in-, and post-storm events

Pre-storm events

- Clear debris from bridge piers, culvert entrances, and known restriction points
- Verify access routes for emergency response
- Pre-stage barricades at chronic road overtopping locations

In-storm events (only when safe)

- Monitor known trouble locations for debris accumulation, overtopping, and rapid bank erosion
- Deploy road barricades where hazardous overtopping is occurring or imminent
- Prioritize personal and public safety; avoid fast water, unstable banks, and lightning

Post-storm events

- Inspect the entire reach as soon as conditions are safe; remove storm-deposited debris from crossings and restrictions
- Document high-water marks, new erosion, debris lines, and scour at crossings
- Identify new problem areas and update priority maintenance lists
- Respond to and investigate fish kills, illicit discharges, and water quality complaints

4. Factors that may influence the maintenance schedule

- Storm intensity and frequency (increasing peak flows, consecutive events)
- Active bank erosion approaching roads, bridges, utilities, or structures
- Debris accumulation at bridges or culverts creates backwater and overtopping risk
- Upstream development is increasing runoff volumes and peak flows
- Sedimentation reducing capacity at critical conveyance points
- Fish kills or illicit discharge complaints indicating water quality problems
- Age and condition of engineered features (culverts at or past design life, failing bank protection)

5. Repair vs. replacement considerations

Factors that indicate continued maintenance and repair

Choose repair/rehabilitation when:

- Bank erosion is localized and can be stabilized with riprap or bioengineered treatment without repeated failure
- Sediment removal restores capacity, and sediment return rates are manageable with upstream controls
- Crossings remain structurally sound, and scour can be controlled with armoring
- Engineered bank protection is repairable (stone replacement, gabion repair, grade control maintenance)

Factors that indicate major rehabilitation or redesign

Consider replacement or major reconstruction when:

- Repeated failures occur (bank stabilization repeatedly fails, sediment returns rapidly, debris jams recur despite removal)
- Channel capacity is inadequate for current hydrologic conditions due to watershed development
- Crossings are undersized and cause chronic upstream flooding even when clean
- Bank erosion is systemic along long reaches, driven by altered hydrology, and cannot be economically stabilized in place
- Stream restoration or channel rehabilitation is more cost-effective and sustainable than continued point repairs
- Consequences of failure are severe: road closures, bridge loss, structural flooding, utility damage, or risk to critical facilities

Rivers and Tributaries

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

River/Tributary Name/ID	
Reach/Station	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Flow Conditions	☐ Dry ☐ Low ☐ Normal ☐ High
Channel Type	☐ Natural ☐ Modified ☐ Concrete
Inspection Timing	☐ Routine ☐ Pre-Storm ☐ Post-Storm ☐ Annual
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Fast water/high flows	☐ Unstable/undercut banks	☐ Confined space (culvert)	☐ Severe weather/lightning
--	--	---	---

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Bank Erosion and Stability	Overall	☐	☐	☐	☐	☐
	Active bank erosion or undercutting	☐	☐	☐	☐	☐
	Bank slumping, slides, or tension cracks	☐	☐	☐	☐	☐
	Scour at outfalls or tributary confluences	☐	☐	☐	☐	☐
Channel Capacity and Obstructions	Overall	☐	☐	☐	☐	☐
	Sedimentation and shoaling	☐	☐	☐	☐	☐
	Debris jams, log jams, or blockages	☐	☐	☐	☐	☐
	Vegetation encroachment in the flow area	☐	☐	☐	☐	☐
Engineered Features and Crossings	Overall	☐	☐	☐	☐	☐
	Riprap/bank protection condition	☐	☐	☐	☐	☐
	Grade control structure condition	☐	☐	☐	☐	☐
	Bridge/culvert scour and blockage	☐	☐	☐	☐	☐

River/Tributary Name/ID: _____ Inspector Initials: _____

Rivers and Tributaries

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Water Quality and Illicit Discharge	Overall	☐	☐	☐	☐	☐
	Illicit discharge indicators (sheen, odor, dry-weather flow)	☐	☐	☐	☐	☐
	Trash, dumping, and floatables	☐	☐	☐	☐	☐
Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to roads, bridges, or utilities	☐	☐	☐	☐	☐
	Threat to buildings or public safety	☐	☐	☐	☐	☐

Follow-Up Actions	Goal Resolution Date	Responsible Person

Notes and Observations:

Inspection Checklist



River/Tributary Name/ID: _____ Inspector Initials: _____

Rivers and Tributaries

Rubrics and Guidelines



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Bank Erosion and Stability	Active bank erosion or undercutting	Banks stable; minor surface weathering.	Localized erosion; small bare areas; not threatening infrastructure.	Active erosion on one or both banks; undercutting developing; plan stabilization.	Severe erosion approaching road, utility, or structure; bank retreat accelerating; urgent stabilization.	Active bank failure threatening infrastructure; imminent road loss or utility exposure; emergency response.
	Bank slumping, slides, or tension cracks	No cracks, slumps, or mass failure.	Minor sloughing; localized; self-healing likely.	Tension cracks along bank crest or developing slump blocks; schedule repair.	Significant slide or mass failure; material entering channel; urgent repair.	Active large-scale bank failure; channel blockage or infrastructure collapse risk; emergency action.
	Scour at outfalls or tributary confluences	No scour; energy dissipation intact.	Minor scour; shallow; dissipation features functional.	Scour hole expanding; outfall pipe or headwall undermining starting; plan repair.	Severe scour; pipe exposed or headwall displaced; head-cutting migrating; urgent stabilization.	Outfall failure; uncontrolled head-cutting threatening upstream infrastructure; emergency intervention.
Channel Capacity and Obstructions	Sedimentation and shoaling	Channel clear; bed at design grade.	Minor point bars; no measurable capacity loss.	Noticeable deposition; capacity partially reduced at crossings or restrictions; plan removal.	Severe shoaling; flow redirected into erodible banks; overtopping risk at crossings; urgent removal.	Channel largely blocked; chronic flooding or road overtopping; emergency excavation and engineering review.
	Debris jams, log jams, or blockages	Channel clear of obstructions.	Minor debris; easily removed; no flow impact.	Debris accumulation at crossing or restriction; partial blockage; schedule removal.	Major jam deflecting flows into banks; backup upstream; bridge or levee at risk; urgent removal.	Complete blockage; active flooding, bank failure, or bridge damage; emergency clearance.
	Vegetation encroachment in flow area	Flow area clear; vegetation on banks only.	Minor in-channel vegetation; seasonal; routine mowing.	Dense vegetation reducing conveyance; sediment trapping; schedule clearing within the active channel.	Severe encroachment; channel narrowed significantly; flood risk elevated; urgent clearing.	Channel impassable; vegetation and sediment have eliminated effective conveyance; emergency restoration.

Rivers and Tributaries

Rubrics and Guidelines



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Engineered Features and Crossings	Riprap/bank protection condition	Riprap intact; no displacement; filter sound.	Minor displacement; localized stone repair needed.	Sections missing or settled; flanking erosion developing; plan replacement with filter.	Major displacement; bank exposed; accelerated erosion; urgent repair.	Bank protection failed; rapid erosion of unprotected bank; emergency armoring.
	Grade control structure condition	Structure intact; no scour or undermining.	Minor wear; stable; monitor.	Scour developing at base or ends; plan repair.	Significant undermining or flanking; structure at risk of failure; urgent repair.	Structure failed or bypassed; uncontrolled head-cutting downstream; emergency response.
	Bridge/culvert scour and blockage	No scour; waterway opening clear.	Minor debris; minor scour; routine clearance.	Scour developing at piers or abutments; partial debris blockage; schedule repair.	Severe scour undermining foundation; major blockage with backwater; urgent action.	Foundation failure imminent; complete blockage with road overtopping; emergency response.
Water Quality and Illicit Discharge	Illicit discharge indicators	No sheen, odor, or dry-weather flow.	Minor staining or faint odor; document and monitor.	Persistent dry-weather flow or sheen from outfall; initiate investigation.	Strong evidence of illicit discharge; ongoing pollution; escalate to enforcement.	Active spill, strong odors, or fish kill; emergency response and agency notification.
	Trash, dumping, and floatables	Minimal litter; no dumping.	Localized trash; routine cleanup.	Recurring debris or dumping piles; schedule removal and deterrents.	Large dumping or hazardous debris; restrict access; coordinate removal.	Hazardous materials or massive dumping blocking channel; emergency response.

Rivers and Tributaries

Rubrics and Guidelines



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Impacts to People and Infrastructure	Threat to roads, bridges, or utilities	No infrastructure at risk.	Minor nuisance; erosion distant from assets.	Erosion or scour approaching infrastructure; corrective work needed before next major storm.	Active threat to road, bridge, or utility; damage likely during next event; urgent action.	Infrastructure damage occurring or imminent; road closure, utility failure, or bridge loss; emergency response.
	Threat to buildings or public safety	No buildings or public areas at risk.	Low exposure; erosion distant from structures.	Bank erosion approaching buildings, trails, or park areas; schedule correction.	Active threat to occupied structures or high-use public areas; restrict access; prioritize repair.	Immediate life-safety hazard; building undermining or public area collapse; emergency action.

Rivers and Tributaries



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

River/Tributary Name/ID			
Reach/Station			
Location			
Date/Time	START: ____ / ____ / ____	END: ____ / ____ / ____	
Foreman			
Maintenance Crew			
Contractor			
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F		
Flow Conditions	☐ Dry	☐ Low	☐ Normal ☐ High
Channel Type	☐ Natural	☐ Modified	☐ Concrete
Inspection Timing	☐ Routine	☐ Pre-Flood	☐ Post-Flood ☐ Annual
Other/Details			
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____		

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Complaint/service request
☐ Emergency/safety issue	☐ Inspection follow-up	☐ Bank erosion/stabilization needed
☐ Debris jam/log jam removal	☐ Sediment removal needed	☐ Vegetation management
☐ Trash/illegal dumping removal	☐ Outfall erosion repair	☐ Bridge/culvert scour repair
☐ Riprap/bank protection repair	☐ Grade control structure repair	☐ Litter boom maintenance
☐ Water quality/illicit discharge issue	☐ Floodplain encroachment	☐ Other (describe below)

River/Tributary Name/ID: _____ Foreman Initials: _____

Rivers and Tributaries

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Other/Details:

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Debris jam/log jam removal	☐ Fallen tree removal
☐ Trash and illegal dumping removal	☐ Litter boom inspection/cleaning	☐ Floatables collection
☐ Sediment removal/excavation	☐ Channel bed grading/restoration	☐ Bank grading/reshaping
☐ Riprap placement/repair	☐ Filter fabric/bedding placement	☐ Gabion repair/replacement
☐ Bioengineered bank treatment	☐ Grade control structure repair	☐ Drop structure maintenance
☐ Vegetation clearing (in-channel)	☐ Riparian buffer management	☐ Invasive species removal
☐ Mowing/access corridor maintenance	☐ Erosion control blanket/seeding	☐ Outfall scour repair
☐ Bridge/culvert debris clearance	☐ Headwall/wingwall repair	☐ Culvert cleanout or repair
☐ Concrete lining repair/joint seal	☐ Illicit discharge investigation	☐ Water quality sampling
☐ Encroachment removal	☐ Floodplain restoration	☐ Other (describe below)

Other maintenance actions performed:

River/Tributary Name/ID: _____ Foreman Initials: _____

Page 2 of 5

Rivers and Tributaries



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

AREAS ADDRESSED

☐ Left bank (looking downstream)	☐ Right bank (looking downstream)	☐ Channel bed/thalweg
☐ Riparian buffer/floodplain	☐ Riprap/bank protection reach	☐ Grade control structure
☐ Bridge/culvert crossing	☐ Outfall discharge point	☐ Confluence/tributary junction
☐ Litter boom site	☐ Concrete channel section	☐ Other (describe below)

Other areas addressed:

MATERIALS, EQUIPMENT, AND QUANTITIES

Equipment used (e.g., excavator, loader, dump truck, chainsaw, mower, CCTV, boat):

Maintenance hours/staff:

Materials used (e.g., riprap, filter fabric, gabion baskets, erosion blanket, seed, live stakes, concrete):

Quantities and disposal (sediment CY removed, debris CY removed, disposal location):

SAFETY, ENVIRONMENTAL, AND REGULATORY CONTROLS

☐ Site access controlled and safe	☐ No fuel, oil, or material spills; equipment operated from stable ground
☐ Traffic control in place (if needed)	☐ Work performed outside active high flow/safe water conditions
☐ Confined space procedures followed (if needed)	☐ Area left clean and stable
☐ Section 404 permit obtained/not required for this work (coordinated with USACE)	☐ State environmental permits and coordination completed (TCEQ, TPWD as applicable)
☐ Removed material disposed outside the floodway at the approved location	☐ Disturbed areas stabilized (seeded, blanketed, or armored) before demobilization
☐ Erosion and sediment controls in place during earthwork	

River/Tributary Name/ID: _____ Foreman Initials: _____

Rivers and Tributaries



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

CONDITION AFTER MAINTENANCE

Channel/Flow Condition:	Bank/Bed Condition:
☐ Clear/Restored	☐ Stable
☐ Improved	☐ Improved
☐ Still Restricted	☐ Needs Follow-Up

DOCUMENTATION

Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A
GPS coordinates recorded:	☐ Yes	☐ No	☐ N/A
Water quality samples collected:	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED?

☐ Yes

☐ No

☐ N/A

(If yes, describe trigger)

Follow-Up Actions	Goal Resolution Date	Responsible Person

River/Tributary Name/ID: _____ Foreman Initials: _____

Rivers and Tributaries



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Follow-Up Actions	Goal Resolution Date	Responsible Person

Notes and Observations:This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

Attach additional pages, if required.

How to Maintain Your Seawalls

What is it?

A seawall is a hard shoreline protection structure built generally parallel to the coast to resist waves, storm surge, overtopping, and erosion that would otherwise damage land and structures behind it. Seawalls can be vertical, curved, stepped, sloped, gravity-supported, pile-supported, sheet pile-supported, or combined with a rock toe or fronting revetment. Their main purpose is to protect upland development, roads, utilities, public spaces, or critical facilities from coastal flooding and wave attack.

Common forms include:

- Cast-in-place or precast concrete seawalls with vertical, stepped, curved, or recurved faces
- Sheet pile or soldier pile walls with concrete caps, tiebacks, and drainage features
- Rubble-mound seawalls or gravity walls with rock toe protection
- Hybrid systems with a concrete wall, fronting riprap, beach nourishment, or drainage improvements

Who maintains it?

Seawalls may be maintained by cities, counties, port authorities, flood control districts, navigation districts, parks departments, private owners, transportation agencies, or special districts. Maintenance responsibility should be confirmed, as the wall face, wall cap, tiebacks, fronting beach, drainage outlets, and public walkway may be maintained by different parties. Communities should document who owns the wall, who can authorize repairs, who monitors overtopping, and who is responsible for public safety in the event of damage.

Regardless of ownership, it is important to understand:

- Which properties, roads, utilities, public facilities, or neighborhoods the seawall protects
- Whether the wall is concrete, sheet pile, gravity block, timber, stone, rubble-mound, or a hybrid system
- Whether the wall has tiebacks, anchors, drainage weeps, toe protection, a cutoff wall, cap, railings, stairs, or outfalls
- Whether the site has known toe scour, beach lowering, overtopping, wall movement, settlement, or corrosion history



Best maintenance practices & strategies

Seawalls can provide a high level of risk reduction, but they also concentrate wave forces and can increase scour at the toe. Maintenance must focus on structural integrity, foundation support, drainage, and public safety. Cracks, joint openings, blocked weeps, or toe scour can become serious because seawalls are less forgiving than flexible rock slopes. Routine inspections help identify defects before they result in wall movement, undermining, or tieback failure.

A. INSPECTION

Inspections confirm that the wall face, foundation, toe protection, cap, joints, drainage, tie-ins, overtopping scour apron, and landward surface remain functional and safe. Inspect at low water when possible to see the toe and fronting beach. Inspect after high tide or storm events to identify overtopping, seepage, debris lines, displaced toe rock, back scour, and damage to the landward side. Public access areas should receive special attention because wall damage can create trip, fall, and collapse hazards. An inspection checklist for seawalls is included with this reference sheet.

Inspection skill needs:

- Ability to recognize structural cracking, spalling, corrosion, tilting, settlement, joint movement, and exposed reinforcement
- Familiarity with seawall components such as wall face, cap, joints, toe protection, tiebacks, weep holes, cutoff walls, stairs, railings, and outfalls

- Ability to identify toe scour, beach lowering, undermining, overtopping damage/scour, and landward erosion
- Awareness of how wave reflection, tide range, and storm surge affect seawall performance
- Ability to safely observe near wave runup, slippery surfaces, steep drops, and public access areas
- Ability to document conditions with photos, stationing, tide stage, measurements, and simple condition ratings

What to look for:

- **Wall face cracking, spalling, and corrosion.** Inspect the exposed face for cracks, spalls, rust staining, exposed reinforcing steel, corrosion holes, timber decay, or sheet pile loss. Minor surface defects may be cosmetic, but widening cracks, corrosion with section loss, or exposed reinforcement can indicate reduced structural capacity.
- **Wall movement, tilt, bulging, or settlement.** Look along the wall alignment for leaning, bulging, offset panels, open joints, low spots, or uneven cap elevations. Movement may indicate toe scour, tieback distress, foundation settlement, or excessive earth pressure. Compare with prior photographs or survey points where available.
- **Toe scour and seaward or landward settlement.** The toe supports the wall and prevents undermining. Inspect at low water for scour holes, exposed foundation elements, missing toe rock, displaced aprons, or seaward or landward soils that have lowered since prior inspections. Toe scour is a common trigger for serious seawall failure.
- **Joints, seals, and panel connections.** Open joints can allow backfill to wash out, creating voids behind the wall. Inspect expansion joints, construction joints, panel seams, and connections for separation, missing sealant, rust, leakage, or soil staining. Soil loss through joints should be treated as a high-priority condition.
- **Drainage and hydrostatic pressure relief.** Check weep holes, drains, outfalls, scuppers, and landward drainage paths. Blocked drainage can trap water behind the wall and increase pressure. Persistent seepage with soil particles, sinkholes behind the wall, or wet spots after dry weather may indicate piping or backfill loss.
- **Overtopping and landward erosion.** Inspect for debris lines, salt staining, damaged pavement, eroded soil, undermined sidewalks, damaged utilities, or washouts behind the wall. Overtopping may not damage the wall

face but can erode the landward side and create public hazards or structural instability.

- **Cap, railing, stairs, and appurtenances.** Wall caps, railings, ladders, stairs, access platforms, and utility penetrations should be secure and functional. Damage to these features can expose the public to fall hazards and can allow water or debris to enter the wall system.
- **Flanks and transitions.** The ends of the seawall and transitions to revetments, dunes, bulkheads, natural banks, or high ground are common weak points. Look for erosion around the ends, settlement at transitions, gaps at outfalls, and flow paths that bypass the wall.
- **Fronting beach or protective apron condition.** Where a seawall relies on a fronting beach/soil berm, rubble mound, or riprap apron, inspect for loss of material, displaced armor, or narrowing beach width. A lowered beach or seaward berm allows larger waves to reach the wall and increases wave impact and overtopping.
- **Public safety and access conditions.** Seawalls often occur in public areas. Inspect for falling concrete, unstable railing, open voids, uneven walking surfaces, exposed rebar, slippery algae, or undermined pavement. Serious hazards should be isolated until repairs are made.

How to record conditions:

- Use a standard inspection form or digital tool and record wall segment, stationing, tide condition, recent storm history, and whether the inspection occurred at low or high water
- Describe conditions by location: face, cap, toe, landward side, joints, drains, flanks, and appurtenances
- Record crack widths, displaced panel lengths, scour dimensions, settlement indicators, and distance from defects to roads, utilities, or structures where practical
- Photograph the wall face, toe, cap, joints, drainage outlets, overtopping evidence, landward erosion, and public safety hazards from repeatable locations
- Flag urgent hazards such as active wall movement, exposed foundation, soil loss through joints, sinkholes behind the wall, or public fall hazards
- Track recurring locations because repeated small repairs may indicate a deeper foundation, drainage, or design problem

B. MAINTENANCE

Seawall maintenance protects the structure from undermining, deterioration, excessive back pressure, and damage from overtopping. Work usually includes concrete repair, joint sealing, corrosion protection, drainage clearing, toe/overtopping protection repair, backfill stabilization, and safety repairs. Because wall failure can be sudden and high consequence, communities should escalate progressive movement, toe scour, or sinkholes to engineering review rather than treating them as routine patching. A maintenance checklist for seawalls is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools, pressure washing, and small equipment for drain cleaning and minor debris removal
- Concrete repair materials, grout, joint sealant, corrosion protection, patching mortar, and compatible replacement components
- Excavation equipment, riprap, bedding stone, filter fabric, and concrete for toe and apron repairs
- Survey equipment or simple monitoring points for tracking movement, settlement, and crack growth
- Traffic control, barricades, fall protection, and public access control equipment
- Pump or drainage cleaning equipment for weep holes, back drains, and outfalls
- Engineering and contractor support for structural movement, tieback concerns, or foundation repair

Key maintenance goals:

- Maintain wall structural integrity. Repair concrete spalls, corrosion, joint failures, and damaged caps before deterioration reaches reinforcement, anchors, or structural connections.
- Protect the toe and foundation. Replace missing toe protection, repair scour holes, and stabilize exposed foundations. Toe protection is critical because undermining can trigger wall movement or collapse.
- Keep drainage functioning. Clear weep holes and drainage outlets, and repair back drains where needed. Reducing hydrostatic pressure behind the wall helps limit cracking, movement, and soil loss.
- Seal joints and stop soil loss. Repair open joints or cracks that allow backfill to wash out. Soil loss behind the wall can create sinkholes and reduce support for sidewalks, roads, and utilities.
- Repair overtopping damage on the landward side. Fill washouts, repair damaged pavement, stabilize

eroded areas, and restore drainage paths to prevent overtopping from undermining the wall from behind.

- Maintain flanks and transitions. Stabilize erosion around the wall ends and at transitions to other protection systems. End effects can bypass the wall and threaten adjacent properties.
- Maintain public safety features. Repair railings, stairs, access covers, warning signs, and walking surfaces. Restrict access promptly where collapse or fall hazards are present.
- Document movement and recurring distress. Install simple monitoring markers or use repeated photographs where movement is suspected. Progressive movement should trigger an engineering review.

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Conduct walk-through inspections of accessible wall segments, public access areas, drains, and known weak spots
- Remove debris and vegetation that blocks drains, hides joints, or creates safety hazards
- Patch small concrete defects, seal minor joints, and clear weep holes where safe and appropriate
- Maintain barricades, railings, and warning signs in public areas

2. Annual maintenance and comprehensive review

- Perform a full inspection of the wall face, cap, toe, landward side, joints, drains, flanks, and fronting beach or apron
- Compare current conditions to prior inspection photos and survey data to identify movement, settlement, or increasing scour
- Prioritize structural repairs, toe repairs, and drainage improvements before storm season
- Review whether sea level, subsidence, beach loss, or landward development has changed the wall risk profile

3. Pre-, in-, and post-storm events

Pre-storm events

- Before major coastal storms, inspect known problem areas, clear drains, secure public access, and check temporary barriers if used

In-storm events (only when safe)

- Avoid wave runup and overtopping zones
- Observe only from safe locations

Post-storm events

- Inspect for toe scour, displaced apron materials, wall movement, overtopping washouts/scour, sinkholes, falling concrete, and public safety hazards before reopening access

4. Maintenance decision logic

- Continue planned maintenance when defects are minor, wall alignment is stable, toe protection is intact, and drainage remains functional.
- Increase preventive maintenance when cracks, joint openings, corrosion, blocked drains, or toe scour are increasing but localized
- Plan rehabilitation when toe protection is failing, soil loss is occurring, structural repairs are recurring, or public safety features need substantial replacement
- Consider replacement or redesign when the wall is moving, undermined, repeatedly overtopped, structurally deteriorated, or no longer provides the required protection level

5. Factors that may influence the maintenance schedule

- Wave exposure, storm surge, tide range, and frequency of overtopping
- Condition of fronting beach/soil berm, toe protection, and seabed elevation
- Wall material, age, corrosion environment, and concrete quality
- Drainage behind the wall, groundwater pressure, and backfill condition
- Public access intensity, fall hazards, and proximity to roads, utilities, and critical facilities
- Adjacent shoreline erosion and transition conditions at wall ends
- Observed movement, repeated repairs, and rate of deterioration over time

6. Repair vs. replacement considerations

Factors that indicate continued maintenance and repair

Choose repair/rehabilitation when:

- Cracking, spalling, corrosion, or joint deterioration is localized, and the wall remains aligned
- Toe scour can be repaired with compatible rock, bedding, or concrete protection
- Drainage defects can be cleared or repaired without major excavation
- Public safety features can be restored without modifying the wall structure

Factors that indicate asset replacement or major repair

Consider replacement or major reconstruction when:

- Wall movement, tilting, sliding, settlement, or rotation is progressive
- Foundation support is lost, or toe scour is severe and recurring
- Tiebacks, sheet piles, or structural elements have significant section loss or failure
- The wall is repeatedly overtopped or too low for current coastal flood conditions, and the consequences are high

Seawall Segment Name/ID	
Location	
Date/Time	START: __/__/____ END: __/__/____
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Inspection Timing	☐ Routine ☐ Pre-Storm ☐ Post-Storm ☐ Annual
Tide/Water Level Condition	☐ Low ☐ Rising ☐ High ☐ Falling ☐ Storm ☐ Surge ☐ N/A
Other/details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK - STOP IF UNSAFE

If checked, report and do not enter.

☐ Wave overtopping	☐ Falling concrete/collapse risk	☐ Open void or fall hazard	☐ Severe weather/lightning
---	---	---	---

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Wall Structure and Face Condition	Overall	☐	☐	☐	☐	☐
	Cracking, spalling, corrosion, or exposed reinforcement	☐	☐	☐	☐	☐
	Wall movement, tilt, bulging, or settlement	☐	☐	☐	☐	☐
	Joint separation or panel displacement	☐	☐	☐	☐	☐
Toe, Foundation, and Scour	Overall	☐	☐	☐	☐	☐
	Toe scour or beach/bed lowering	☐	☐	☐	☐	☐
	Toe protection or apron condition	☐	☐	☐	☐	☐
	Exposed foundation, cutoff, or sheet pile	☐	☐	☐	☐	☐
Overtopping and Backside Drainage	Overall	☐	☐	☐	☐	☐
	Overtopping evidence or debris lines	☐	☐	☐	☐	☐
	Landward erosion or washout	☐	☐	☐	☐	☐
	Weep holes, drains, or seepage	☐	☐	☐	☐	☐

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Anchors, Caps, and Appurtenances	Overall	☐	☐	☐	☐	☐
	Wall cap or coping condition	☐	☐	☐	☐	☐
	Tieback or anchor distress indicators	☐	☐	☐	☐	☐
	Railings, stairs, ladders, or access features	☐	☐	☐	☐	☐
Flanks and Adjacent Shoreline	Overall	☐	☐	☐	☐	☐
	End effects or flanking erosion	☐	☐	☐	☐	☐
	Transition to adjacent protection	☐	☐	☐	☐	☐
	Outfalls or utility penetrations through the wall	☐	☐	☐	☐	☐
Debris, Vegetation, and Public Safety	Overall	☐	☐	☐	☐	☐
	Debris or drift accumulation	☐	☐	☐	☐	☐
	Vegetation affecting the inspection or the structure	☐	☐	☐	☐	☐
	Trip, fall, or falling material hazards	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to roads, utilities, or structures	☐	☐	☐	☐	☐
	Threat to the flood protection function	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐

Follow-Up Actions	Goal Resolution Date	Responsible Person

Attach additional pages, if required.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Wall Structure and Face Condition	Cracking, spalling, corrosion, or exposed reinforcement	None or hairline.	Minor localized defects.	Moderate defects; repair needed.	Severe deterioration or exposed steel.	Structural failure or falling material.
	Wall movement, tilt, bulging, or settlement	No movement.	Minor unevenness.	Movement suspected.	Movement visible and progressing.	Active instability.
	Joint separation or panel displacement	Joints tight.	Minor opening.	Open joints with leakage.	Large separation or offset more than 1 inch.	Panel failure or soil loss through joint.
Toe, Foundation, and Scour	Toe scour or beach/bed lowering	No scour.	Minor lowering.	Scour reaches toe protection.	Severe lowering exposes foundation.	Foundation undermined.
	Toe protection or apron condition	Intact.	Minor displacement.	Gaps forming.	Protection ineffective.	Protection failed.
	Exposed foundation, cutoff, or sheet pile	Not exposed.	Minor exposure.	Exposure requires monitoring.	Major exposure; urgent repair.	Failure likely or occurring.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Overtopping and Backside Drainage	Overtopping evidence or debris lines	None.	Minor splash staining.	Debris lines; monitor.	Repeated overtopping damage.	Severe overtopping; emergency risk.
	Landward erosion or washout	None.	Minor rills.	Gullies or pavement damage.	Undermining behind wall.	Sinkhole or collapse behind wall.
	Weep holes, drains, or seepage	Clear; no issue.	Minor blockage or dampness.	Blocked drains or persistent seepage.	Seepage with soil staining.	Piping or active soil loss.
Anchors, Caps, and Appurtenances	Wall cap or coping condition	Intact.	Minor cracking.	Cracked or displaced sections.	Major cap failure.	Cap collapse or falling hazard.
	Tieback or anchor distress indicators	No signs.	Minor surface signs.	Bulging/cracking suggests distress.	Anchor distress likely.	Tieback failure suspected.
	Railings, stairs, ladders, or access features	Safe.	Minor wear.	Repair needed.	Unsafe without controls.	Immediate hazard.
Flanks and Adjacent Shoreline	End effects or flanking erosion	None.	Minor end erosion.	Erosion nearing wall end.	Bypass likely.	Active bypass around wall.
	Transition to adjacent protection	Stable tie-in.	Minor gap.	Gap/settlement developing.	Transition undermined.	Transition failed.
	Outfalls or utility penetrations through the wall	Sound.	Minor wear.	Leakage or erosion developing.	Major leakage or undermining.	Penetration failure or sinkhole.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Debris, Vegetation, and Public Safety	Debris or drift accumulation	Minimal.	Light debris.	Debris affects drainage/access.	Heavy debris creates hazard.	Immediate blockage or hazard.
	Vegetation affecting the inspection or structure	No issue.	Minor trimming.	Visibility reduced.	Roots or growth damaging wall.	Unsafe access or structural impact.
	Trip, fall, or falling material hazards	None.	Minor hazard.	Controls needed.	Restrict access.	Close area immediately.
Overall Rating Based on Impacts to People and Infrastructure	Threat to roads, utilities, or structures	No threat.	Minor risk.	Threat developing.	Damage likely.	Damage occurring or imminent.
	Threat to the flood protection function	Full function.	Minor reduction.	Reliability reduced.	Protection likely inadequate.	Protection failed.
	Public safety hazards	None.	Minor hazard.	Controls needed.	Serious hazard.	Immediate danger.

Seawalls

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Seawall Segment Name/ID	
Location	
Date/Time	START: ____ / ____ / ____ END: ____ / ____ / ____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Inspection Timing	☐ Routine ☐ Pre-Storm ☐ Post-Storm ☐ Annual
Tide/Water Level Condition	☐ Low ☐ Rising ☐ High ☐ Falling ☐ Storm ☐ Surge ☐ N/A
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up
☐ Complaint/service request	☐ Emergency/safety issue	☐ Concrete/structural repair
☐ Toe scour/apron repair	☐ Joint/seal repair	☐ Drainage/weep cleaning
☐ Backside washout repair	☐ Public safety repair	☐ Other (describe below)

Other/Details:

Seawall Name/ID: _____ Foreman Initials: _____

Seawalls

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Debris removal	☐ Concrete spall/crack repair
☐ Joint sealing/panel repair	☐ Corrosion treatment	☐ Clear weep holes/drains
☐ Repair toe/landward protection/apron	☐ Backfill voids/repair sinkholes	☐ Repair cap/coping
☐ Repair railing/stairs/access feature	☐ Stabilize flanks or transitions	☐ Survey/monitor movement
☐ Other (describe below)		

Other maintenance actions performed:

AREAS ADDRESSED

☐ Wall face	☐ Wall cap/coping	☐ Joints/panels
☐ Toe/foundation	☐ Fronting beach/apron	☐ Landward side/backfill
☐ Weep holes/drains	☐ Flanks/transitions	☐ Railings/stairs/access
☐ Outfalls/penetrations	☐ Other (describe below)	

Other maintenance actions performed:

Seawall Name/ID: _____ Foreman Initials: _____

Seawalls

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

MATERIALS, EQUIPMENT, AND QUANTITIES

Equipment used (e.g., excavator, loader, vactor, crane, hand tools, survey instrument):

Maintenance hours/staff:

Materials used (e.g., riprap, filter fabric, concrete, sealant, hardware, grout, topsoil, seed):

Quantities and disposal (e.g., sediment CY, debris CY, rock tons, LF repaired, disposal location):

SAFETY, ENVIRONMENTAL, AND REGULATORY CONTROLS

☐ Site access controlled and safe	☐ Traffic control in place (if near roadway or public access)
☐ Work performed outside unsafe flow, wave runup, or high tide conditions	☐ Erosion and sediment controls in place during earthwork
☐ No fuel, oil, or material spills; equipment operated from stable ground	☐ Regulatory permit requirements reviewed (USACE, TCEQ, TPWD, GLO, local floodplain permits as applicable)
☐ Confined space procedures followed if culvert, gate chamber, or structure entry was required	☐ Removed material disposed at approved location
☐ Area left clean and stable after work	

CONDITION AFTER MAINTENANCE

Wall condition after work:	☐ Restored/acceptable	☐ Improved	☐ Still deficient
Toe, seaward and landward foundations condition after work:	☐ Stable	☐ Improved	☐ Needs follow-up
Public access condition after work:	☐ Safe/open	☐ Restricted	☐ Closed/unsafe

Seawall Name/ID: _____ Foreman Initials: _____

DOCUMENTATION

☐ Before photos attached:	☐ Yes	☐ No	☐ N/A
☐ GPS coordinates or stationing recorded:	☐ Yes	☐ No	☐ N/A
☐ Measurements or survey data recorded:	☐ Yes	☐ No	☐ N/A
☐ After photos attached:	☐ Yes	☐ No	☐ N/A
☐ Tide/water level notes recorded:	☐ Yes	☐ No	☐ N/A
☐ Maintenance entered into asset database:	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED?

☐ Yes

☐ No

☐ N/A

(If yes, describe trigger)

Follow-Up Actions	Goal Resolution Date	Responsible Person

Maintenance Form



Seawall Name/ID: _____ Foreman Initials: _____

How to Maintain Your Sea Barriers

What is it?

A sea barrier is a coastal flood defense that separates the sea from low-lying land. In community flood infrastructure, this term commonly includes sea dikes, coastal levees, floodbanks, armored coastal embankments, and fixed shoreline barriers that prevent or reduce inundation during high tides, storm surge, and wave runup. Sea barriers are usually broad earth or sand-core structures with clay, grass, rock, asphalt, concrete, or other slope protection, plus toe protection, crest access, drainage, and tie-ins to high ground or other defenses.

Common forms include:

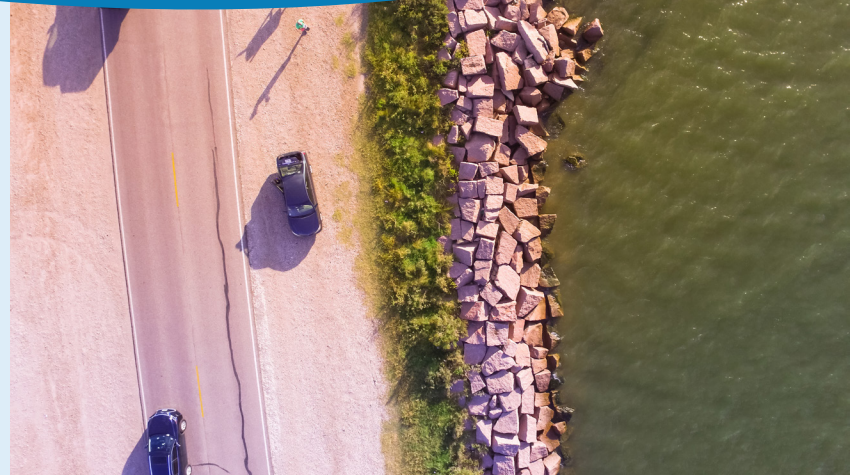
- Coastal levees or sea dikes with grass, clay, asphalt, rock, or concrete slope protection
- Armored floodbanks protecting low-lying coastal neighborhoods, roads, utilities, or pump station service areas
- Fixed coastal barriers or closure embankments with drainage structures, pipes, gates, or pump stations
- Hybrid barrier systems tied into seawalls, tidal barriers, revetments, dunes, or natural high ground

Who maintains it?

Sea barriers may be maintained by cities, counties, levee improvement districts, drainage districts, flood control districts, ports, state agencies, private owners, or special purpose districts. Because barriers often cross property boundaries and protect large areas, communities should document ownership, easements, inspection access, mowing responsibility, drainage structure responsibility, emergency closure responsibility, and regulatory requirements. A barrier should be treated as a continuous system, not as isolated segments.

Regardless of ownership, it is important to understand:

- Which protected area, drainage basin, evacuation route, utility corridor, or critical facility depends on the barrier
- Where the crest, seaward slope, landward slope, toe, drainage channel, crossings, closures, and tie-ins are located
- Whether the barrier includes culverts, tidal gates, pump stations, flap valves, road closures, or utility penetrations
- Whether the barrier has known low spots, settlement, animal burrows, seepage, overtopping, erosion, or slope instability



Best maintenance practices & strategies

Sea barriers depend on crest height, slope stability, surface protection, seepage control, toe protection, and continuity. A small low spot, animal burrow, eroded toe, blocked drainage channel, or weak tie-in can reduce the protection level of the entire barrier. Routine inspection and maintenance protect the barrier before the storm season, identify sections that need repair, preserve access for emergency response, and reduce the chance of breach during high water conditions.

A. INSPECTION

Inspections confirm that the barrier crest is continuous, the slopes are stable, the surface protection is intact, the toe is not being undermined, drainage features are working, and tie-ins or closures do not create bypass paths. Inspections should cover the full alignment, including seaward and landward toes, crest roads or paths, gates, culverts, outfalls, pump station connections, animal damage areas, and transitions to adjacent defenses. An inspection checklist for sea barriers is included with this reference sheet.

Inspection skill needs:

- Ability to identify low spots, settlement, erosion, slope slides, burrows, seepage, and overtopping evidence
- Familiarity with barrier components such as crest, seaward slope, landward slope, toe, drainage channel, slope armor, filters, and penetrations
- Ability to recognize damaged grass cover, rock armor, concrete panels, asphalt surfaces, or clay cover layers

- Awareness of how tide, surge, wave runup, rainfall, and interior drainage affect barrier performance
- Ability to safely observe on steep slopes, wet ground, access roads, and near tidal water without entering hazardous areas
- Ability to document conditions by stationing, GPS, photographs, measurements, and simple condition ratings

What to look for:

- **Crest elevation, settlement, and continuity.** Inspect the crest for low spots, depressions, rutting, cracking, settlement, unauthorized excavation, or damage from vehicles. The lowest point controls performance. Even if most of the barrier appears high and stable, a short, low section can overtop first, initiating erosion.
- **Seaward slope armor and surface protection.** Check rock, concrete, asphalt, grass, clay cover, or other slope protection for missing material, cracks, displaced panels, erosion, slumps, or wave damage. The seaward face receives the highest wave and surge loading and must remain continuous.
- **Toe protection and foreshore condition.** Inspect the seaward toe for scour, exposed geotextile, displaced toe rock, soft ground, or undermining. Toe erosion can lead to slope instability and breach. Where the foreshore is eroding, the toe may need more frequent inspection and engineering review.
- **Landward slope and overtopping damage.** Look for erosion on the landward slope, debris lines across the crest, washed-out soil, rills, gullies, or scour at the landward toe. Overtopping may damage the back side of the barrier even when the seaward slope appears intact.
- **Seepage, piping, and wet areas.** Wet spots, boils, muddy seepage, sinkholes, or flowing water on the landward side during high tide or surge can indicate seepage problems. Clear seepage should be monitored; turbid seepage or soil movement is urgent because it may indicate internal erosion.
- **Animal burrows, roots, and vegetation condition.** Burrowing animals, large tree roots, dead root channels, and woody vegetation can create seepage paths or weaken the embankment. Grass or low vegetation may protect the surface from erosion, but vegetation should not prevent inspection or compromise the barrier.

- **Drainage features and penetrations.** Culverts, pipes, valves, tide gates, pump station connections, utility crossings, and drainage channels should be clear, stable, and protected against leakage or erosion. Penetrations are common weak points because water can flow along the outside of pipes or through poorly compacted backfill.
- **Flanks, tie-ins, and adjacent defenses.** Inspect where the barrier connects to high ground, seawalls, tidal barriers, dunes, roads, or other levees. Gaps, low transitions, erosion around ends, and unauthorized grading can create bypass paths.
- **Access routes and emergency readiness.** Confirm the crest or access road can support inspection, mowing, emergency repair, and material delivery where required. Rutting, soft ground, locked gates, or blocked access can delay response during a high-water event.
- **Encroachments and unauthorized changes.** Record fences, sheds, excavations, utilities, landscaping, vehicle crossings, dumping, or other encroachments on or near the barrier. Small, unauthorized changes can reduce crest height, damage armor, block access, or create seepage paths.

How to record conditions:

- Use a standard inspection form or digital tool and record stationing or GPS location, tide condition, recent storm history, and water levels if known
- Record whether each issue is on the crest, seaward slope, landward slope, toe, drainage feature, penetration, or tie-in
- Describe severity using consistent terms such as minor rutting, active erosion, settlement, seepage clear, seepage turbid, slope slide, or immediate breach risk
- Photograph conditions from repeatable locations and include a scale item when documenting cracks, burrows, erosion, and low spots
- Flag urgent issues, including turbid seepage, active slope movement, crest breach, severe overtopping erosion, blocked closure structures, or threats to roads and utilities
- Update the barrier inventory when new penetrations, repairs, closures, or access limitations are observed

B. MAINTENANCE

Sea barrier maintenance preserves the line of protection. The most important tasks are to maintain crest elevation and access, protect slopes from erosion, repair animal burrows and rutting, maintain toe protection, control seepage pathways, keep drainage structures functional, and preserve tie-ins. Maintenance should be scheduled before storm season, after high-water events, and whenever inspections show progressive deterioration. A maintenance checklist for sea barriers is included with this reference sheet.

Maintenance equipment and skill needs:

- Mowing and vegetation management equipment suitable for embankment slopes
- Hand tools, compaction equipment, topsoil, clay, seed, mulch, erosion control blanket, and turf reinforcement materials
- Excavator, loader, dump truck, riprap, bedding stone, filter fabric, and clay fill for slope and toe repair
- Grout or approved fill materials for animal burrow repair when allowed by local practice and environmental requirements
- Survey equipment or simple elevation checks for crest settlement and low spots
- Traffic control, access control, and emergency repair materials such as sandbags, rock, plastic sheeting, and pumps
- Engineering support for seepage, piping, slope stability, repeated settlement, or major overtopping damage

Key maintenance goals:

- Maintain crest height and continuity. Repair low spots, rutting, cracks, and unauthorized cuts. The crest should remain continuous and accessible where it serves inspection or emergency repair functions.
- Maintain seaward slope protection. Repair displaced rock, eroded grass, cracked asphalt, damaged concrete, or exposed clay before waves can erode the core material.
- Maintain toe and foreshore protection. Reset toe rock and repair scour. Toe failure can lead to slope failure and should be addressed early.
- Repair landward overtopping damage. Fill and stabilize rills, gullies, and washouts caused by overtopping or rainfall. Landward slope erosion can progress rapidly if another event occurs.
- Control seepage and animal damage. Fill and compact burrows, remove inappropriate woody vegetation, monitor wet areas, and escalate turbid seepage or boils

for engineering review.

- Maintain drainage structures and closures. Keep culverts, tide gates, flap valves, pump station connections, and closure devices functional. A barrier can fail hydraulically through a blocked or leaking penetration.
- Protect tie-ins and flanks. Stabilize transitions and prevent bypass around the ends. The barrier must work as a continuous system.
- Maintain records and readiness. Update maintenance logs, inspection photos, emergency contacts, material stockpiles, and access routes so response is not delayed during a coastal flood event.

SCHEDULING MAINTENANCE:

1. Routine and seasonal maintenance

- Mow or trim vegetation to allow inspection of the crest, slopes, toe, and drainage structures while preserving erosion-resistant ground cover
- Repair small rills, bare spots, animal burrows, rutting, and access road damage before storm season
- Remove trash, dumped material, and obstructions from drainage channels, culverts, and access routes
- Check closures, tide gates, and flap valves associated with the barrier

2. Annual maintenance and comprehensive review

- Walk or drive the full barrier alignment and document crest, seaward slope, landward slope, toe, drainage features, and tie-ins
- Compare current conditions to prior records to identify settlement, recurring burrows, expanding erosion, or toe loss
- Review whether crest elevations and slope protection remain appropriate for current tide, surge, rainfall, and sea level conditions
- Plan capital repairs for sections with repeated damage, seepage, or slope instability

3. Pre-, in-, and post-storm events

Pre-storm events

- Before coastal flooding, inspect low spots, closures, gates, pump connections, and known seepage or erosion areas
- Stage repair materials, as appropriate

In-storm events (only when safe)

- Monitor only from safe locations and avoid wave runup, overtopping, and unstable slopes

Post-storm events

- Inspect for overtopping erosion, crest damage, slope slides, toe scour, seepage, debris, and damage to penetrations before returning to normal operations

4. Maintenance decision logic

- Continue planned maintenance when the crest is continuous, slopes are stable, seepage is absent or stable, and minor vegetation or surface repairs are sufficient
- Increase preventive maintenance when low spots, rutting, burrows, minor erosion, or toe scour are recurring but localized
- Plan rehabilitation when slope armor, toe protection, drainage structures, or crest elevations require substantial repair to restore the intended level of protection
- Consider replacement, raising, or redesign when the barrier is too low, repeatedly overtopped, unstable, affected by progressive seepage, or unable to protect current development and critical infrastructure

5. Factors that may influence the maintenance schedule

- Storm surge frequency, tide range, wave runup, and observed overtopping history
- Relative sea level rise, subsidence, and settlement of the barrier or underlying soils
- Slope armor type, grass cover, clay cover, toe configuration, and drainage system condition
- Animal activity, woody vegetation, unauthorized excavations, and encroachments
- Interior drainage conditions and performance of gates, culverts, and pump stations
- Criticality of protected roads, utilities, homes, emergency routes, and public facilities
- Availability of emergency materials, access routes, and trained maintenance crews

6. Repair vs. replacement considerations

Factors that indicate continued maintenance and repair

Choose repair/rehabilitation when:

- Damage is localized, and the barrier geometry remains stable
- Crest low spots, surface erosion, or burrows can be repaired with proper fill and compaction
- Toe erosion is limited and can be stabilized with compatible armor and filter material
- Drainage structures and gates remain functional after maintenance

Factors that indicate asset replacement or major repair

Consider replacement or major reconstruction when:

- Crest elevation is broadly inadequate for current or expected water levels
- Slope instability, settlement, or seepage is progressive and not corrected by routine repair
- Toe loss or foreshore erosion repeatedly undermines the barrier
- Major drainage or closure components fail, and the protected area has high consequences of flooding

Sea Barriers

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Sea Barrier Segment Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Inspection Timing	☐ Routine ☐ Pre-Storm ☐ Post-Storm ☐ Annual
Tide/Water Level Condition	☐ Low ☐ Rising ☐ High ☐ Falling ☐ Storm ☐ Surge ☐ N/A
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK - STOP IF UNSAFE

If checked, report and do not enter.

☐ Wave overtopping	☐ Slope failure/seepage	☐ Unsafe access road	☐ Severe weather/lightning
---	--	---	---

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Crest and Freeboard	Overall	☐	☐	☐	☐	☐
	Crest elevation or low spots	☐	☐	☐	☐	☐
	Crest surface, access road, or path condition	☐	☐	☐	☐	☐
	Overtopping evidence	☐	☐	☐	☐	☐
Seaward Armor and Slope Protection	Overall	☐	☐	☐	☐	☐
	Armor, grass, clay, asphalt, or concrete condition	☐	☐	☐	☐	☐
	Wave runup erosion or surface lifting	☐	☐	☐	☐	☐
	Slope rills, gullies, or slumps	☐	☐	☐	☐	☐
Toe, Foreshore, and Scour Protection	Overall	☐	☐	☐	☐	☐
	Toe scour or foreshore lowering	☐	☐	☐	☐	☐
	Toe rock, geotextile, or apron condition	☐	☐	☐	☐	☐
	Seaward drainage or channel erosion	☐	☐	☐	☐	☐
Landward Slope and Drainage	Overall	☐	☐	☐	☐	☐
	Landward erosion or overtopping scour	☐	☐	☐	☐	☐
	Seepage, boils, or piping indicators	☐	☐	☐	☐	☐
	Drainage channel, outlet, or flap gate condition	☐	☐	☐	☐	☐

Sea Barrier Segment Name/ID: _____

Inspector Initials: _____

Page 1 of 3

Sea Barriers

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Settlement, Stability, and Animal Damage	Overall	☐	☐	☐	☐	☐
	Settlement, depressions, or cracks	☐	☐	☐	☐	☐
	Slope slides or tension cracks	☐	☐	☐	☐	☐
	Animal burrows or damaging vegetation	☐	☐	☐	☐	☐
Transitions, Closures, and Appurtenances	Overall	☐	☐	☐	☐	☐
	Tie-ins to high ground or adjacent defenses	☐	☐	☐	☐	☐
	Closures, crossings, pipes, or penetrations	☐	☐	☐	☐	☐
	Signage, gates, and access control	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to a protected area	☐	☐	☐	☐	☐
	Threat to roads, utilities, or critical facilities	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐

Follow-Up Actions	Goal Resolution Date	Responsible Person

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Notes and Observations:

Attach additional pages, if required.

Sea Barriers

Rubrics and Guidelines

Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Crest and Freeboard	Crest elevation or low spots	No low spots.	Minor rutting.	Localized low area.	Low area likely to overtop.	Crest breached or too low.
	Crest surface, access road, or path condition	Stable and passable.	Minor wear.	Rutting or cracking.	Access impaired or erosion active.	Impassable or failed.
	Overtopping evidence	None.	Minor splash.	Debris line or small rills.	Repeated overtopping erosion.	Severe overtopping or breach.
Seaward Armor and Slope Protection	Armor, grass, clay, asphalt, or concrete condition	Intact.	Minor damage.	Localized loss or cracks.	Large damaged area.	Core exposed or failure occurring.
	Wave runup erosion or surface lifting	None.	Minor erosion.	Erosion/lifting developing.	Major erosion or panel displacement.	Severe erosion exposing core.
	Slope rills, gullies, or slumps	None.	Minor rills.	Gullies/slumps forming.	Major slope instability.	Active slide or breach risk.

Sea Barriers

Rubrics and Guidelines

Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Toe, Foreshore, and Scour Protection	Toe scour or foreshore lowering	No scour.	Minor lowering.	Scour reaches toe.	Severe lowering undermines slope.	Toe failure or breach likely.
	Toe rock, geotextile, or apron condition	Intact.	Minor displacement.	Gaps or exposure.	Protection ineffective.	Protection failed.
	Seaward drainage or channel erosion	Stable.	Minor erosion.	Erosion developing.	Erosion threatens toe.	Active failure path.
Landward Slope and Drainage	Landward erosion or overtopping scour	None.	Minor rills.	Gullies forming.	Severe washout.	Landward slope failing.
	Seepage, boils, or piping indicators	None.	Minor damp area clear.	Persistent seepage.	Turbid seepage or boil.	Active piping or emergency.
	Drainage channel, outlet, or flap gate condition	Clear and functional.	Minor maintenance.	Partial blockage or wear.	Function impaired.	Failed or causing flooding.

Sea Barriers

Rubrics and Guidelines

Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Settlement, Stability, and Animal Damage	Settlement, depressions, or cracks	None.	Minor cracking.	Settlement developing.	Major settlement or cracks.	Rapid settlement/collapse.
	Slope slides or tension cracks	None.	Minor sloughing.	Tension cracks or small slump.	Significant slide.	Active slide or breach risk.
	Animal burrows or damaging vegetation	None.	Minor burrows/growth.	Multiple burrows or woody growth.	Extensive burrowing/root damage.	Through-burrow or void with seepage.
Transitions, Closures, and Appurtenances	Tie-ins to high ground or adjacent defenses	Secure.	Minor erosion.	Gap or settlement developing.	Bypass likely.	Active bypass.
	Closures, crossings, pipes, or penetrations	Functional.	Minor wear.	Leakage/blockage developing.	Function impaired.	Failed or high-risk penetration.
	Signage, gates, and access control	Adequate.	Minor wear.	Incomplete controls.	Access/control unreliable.	Immediate safety/security issue.

Sea Barriers

Rubrics and Guidelines

Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Overall Rating Based on Impacts to People and Infrastructure	Threat to a protected area	No threat.	Minor risk.	Reliability reduced.	Flooding likely during design event.	Flooding occurring or imminent.
	Threat to roads, utilities, or critical facilities	No threat.	Minor risk.	Threat developing.	Damage likely.	Damage occurring or imminent.
	Public safety hazards	None.	Minor hazard.	Controls needed.	Serious hazard.	Immediate danger.

Sea Barriers



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Sea Barrier Segment Name/ID	
Location	
Date/Time	START: _ / _ / _ END: _ / _ / _
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Inspection Timing	☐ Routine ☐ Pre-Storm ☐ Post-Storm ☐ Annual
Tide/Water Level Condition	☐ Low ☐ Rising ☐ High ☐ Falling ☐ Storm ☐ Surge ☐ N/A
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up
☐ Complaint/service request	☐ Emergency/safety issue	☐ Crest low spot/rutting repair
☐ Seaward slope erosion repair	☐ Toe scour repair	☐ Seepage/burrow repair
☐ Drainage structure repair	☐ Closure/penetration issue	☐ Other (describe below)

Other/Details:

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Mowing/vegetation management	☐ Fill and compact crest low spot(s)
---	---	---

Sea Barrier Name/ID: _____ Foreman Initials: _____

Sea Barriers



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

MAINTENANCE ACTIVITIES PERFORMED

☐ Repair rutting on access road	☐ Repair seaward slope armor	☐ Repair landward overtopping erosion
☐ Place riprap/toe protection	☐ Fill animal burrows/voids	☐ Repair drainage channel or outlet
☐ Clean/repair flap gate or pipe penetration	☐ Stabilize tie-ins/flanks	☐ Survey crest or settlement
☐ Other (describe below)		

Other/Details:

AREAS ADDRESSED

☐ Crest/access road	☐ Seaward slope	☐ Landward slope
☐ Seaward toe/foreshore	☐ Landward toe/drainage channel	☐ Tie-ins/flanks
☐ Culvert/pipe/penetration	☐ Gate/closure structure	☐ Vegetation/animal damage area
☐ Access route	☐ Other (describe below)	

Other areas addressed:

MATERIALS, EQUIPMENT, AND QUANTITIES

Equipment used (e.g., excavator, loader, vactor, crane, hand tools, survey equipment):

Maintenance hours/staff:

Sea Barrier Name/ID: _____ Foreman Initials: _____

Sea Barriers

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Materials used (e.g., riprap, filter fabric, concrete, sealant, hardware, grout, topsoil, seed):

Quantities and disposal (e.g., sediment CY, debris CY, rock tons, LF repaired, disposal location):

SAFETY, ENVIRONMENTAL, AND REGULATORY CONTROLS

☐ Site access controlled and safe	☐ Traffic control in place (if near roadway or public access)
☐ Work performed outside unsafe flow, wave runup, or high tide conditions	☐ Erosion and sediment controls in place during earthwork
☐ No fuel, oil, or material spills; equipment operated from stable ground	☐ Regulatory permit requirements reviewed (USACE, TCEQ, TPWD, GLO, local floodplain permits as applicable)
☐ Confined space procedures followed if culvert, gate chamber, or structure entry was required	☐ Removed material disposed at approved location
☐ Area left clean and stable after work	

CONDITION AFTER MAINTENANCE

Barrier condition after work:	☐ Restored/acceptable	☐ Improved	☐ Still deficient
Slope and toe condition after work:	☐ Stable	☐ Improved	☐ Needs follow-up
Drainage/closure condition after work:	☐ Functional	☐ Improved	☐ Needs follow-up

DOCUMENTATION

☐ Before photos attached:	☐ Yes	☐ No	☐ N/A
☐ GPS coordinates or stationing recorded:	☐ Yes	☐ No	☐ N/A
☐ Measurements or survey data recorded:	☐ Yes	☐ No	☐ N/A
☐ After photos attached:	☐ Yes	☐ No	☐ N/A
☐ Tide/water level notes recorded:	☐ Yes	☐ No	☐ N/A
☐ Maintenance entered into asset database:	☐ Yes	☐ No	☐ N/A

Sea Barrier Name/ID: _____ Foreman Initials: _____

ENGINEERING REVIEW REQUIRED?

(If yes, describe trigger)

☐ Yes

☐ No

☐ N/A

Follow-Up Actions	Goal Resolution Date	Responsible Person

Notes and Observations:

Maintenance Form



Sea Barrier Name/ID: _____ Foreman Initials: _____

How to Maintain Your Low Water Crossings/Roadway Stream Crossings



What is it?

A low water crossing (also called a roadway stream crossing) is a road structure that allows vehicles to cross a stream, creek, or drainage channel at or near the water surface. These crossings are typically paved or concrete-surfaced and designed to be overtopped by floodwaters, resuming normal use when flows recede. Common forms include:

- Concrete or paved fords with or without culverts
- Vented fords combining a culvert with an overtopping surface
- Slab or dip crossings with hardened surfaces
- Unimproved fords on low-volume or ranch roads

Who maintains it?

Ownership and maintenance vary. They may be owned or maintained by:

- County road departments or municipal public works
- TxDOT or regional transportation authorities
- Private landowners on private access roads
- Drainage districts or flood control entities

Regardless of ownership, it is important to understand:

- Which roadway and drainage system the crossing serves
- Whether the crossing has culverts, vents, or is a surface-only ford
- Whether the jurisdiction has authority to inspect and maintain the crossing
- Whether any regulatory permits govern work in or adjacent to the stream

Best maintenance practices & strategies

Low water crossings interact directly with live stream channels and are subject to scour, debris accumulation, and overtopping. Routine inspection and targeted maintenance protect road users, preserve crossing function, and reduce the risk of structural failure.

A. INSPECTION

Inspections confirm the crossing is structurally sound, free of significant scour or blockage, and safe for vehicle use. An inspection checklist for low water crossings is included with this reference sheet.

Inspection skill needs:

- Ability to recognize scour, undermining, and slab displacement
- Familiarity with crossing components: culverts, headwalls, wing walls, aprons, approach embankments, and safety signage
- Ability to identify blockage, debris accumulation, and structural defects in culverts
- Awareness of stream channel indicators: bed scour, bank erosion, and debris jams
- Ability to assess safety features: warning signs, depth gauges, barricades
- Ability to safely observe conditions near flowing water and on road surfaces
- Ability to document conditions clearly with photos, location, and simple condition ratings

What to look for:

- **Crossing surface and pavement condition.** Check for cracking, spalling, potholing, displacement, or washout damage. Surface deterioration worsens rapidly under repeated flood overtopping and vehicle loading.
- **Scour, undermining, and erosion.** Scour is the primary cause of low water crossing failure. Look for voids beneath slabs, undermining at edges, bank erosion adjacent to the crossing, and loss of riprap or protective materials.
- **Culvert or vent condition (if present).** Inspect culverts for blockage, sediment fill, structural damage (cracks, deformation, corrosion, joint separation), and debris at inlets or outlets. Blocked culverts concentrate scour and force damaging flows over unprotected surfaces.

- **Headwalls, wing walls, and traffic features.** Inspect concrete or masonry wing walls and headwalls for cracking, spalling, undermining, or displacement. Check traffic barriers and railings for damage or missing sections.
- **Approach embankment and roadway transitions.** Check approaches for erosion, rutting, undermining, or settlement. Embankment fill at the transition between roadway and crossing is vulnerable to scour and seepage.
- **Debris accumulation and blockage.** Debris lodged against the crossing surface, culvert inlets, or railing features raises effective water surface elevations, worsens scour, and increases overtopping risk.
- **Safety features and signage.** Verify that warning signs, barricades, and traffic control devices are present, legible, and properly positioned, and that depth gauges, if present, are legible and properly positioned. Crossings subject to sudden flooding must always have clear, visible warnings.
- **Channel and streambed condition.** Observe the stream channel upstream and downstream for aggradation, incision, bank migration, and debris. Channel changes can increase scour or redirect flow against unprotected embankments.
- **Riprap, energy dissipation, and channel protection.** Inspect downstream riprap aprons, energy dissipators, and armored channel sections for displacement, loss of material, undercutting, or sediment burial.
- **Water quality and illicit discharges.** Note unusual staining, oily sheens, odors, or discoloration that may indicate illicit discharges. Report observations to the appropriate environmental authorities.

How to record conditions:

- Use a standard inspection form or digital tool. Consistent records make inspections comparable over time and help prioritize maintenance.
- Record location, date, weather, recent storm history, and current flow level.
- Describe surface condition, scour, and culvert status using simple categories: intact surface, minor cracking, damaged surface, and displaced or undermined slab.
- Document upstream and downstream channel conditions. Note debris accumulation, bank erosion, and flow bypassing or damaging the crossing.
- Photograph key conditions. Include crossing surface from both directions, culvert inlets and outlets, scour zones, riprap condition, signage, and any observed damage.
- Flag urgent hazards. Mark issues that threaten user safety, crossing integrity, or downstream infrastructure, or that could worsen rapidly in the next storm.

B. MAINTENANCE

Maintenance preserves structural integrity and operational safety, keeps culverts functional, and protects the roadway embankment and adjacent channel from scour and erosion. A maintenance checklist for low water crossings is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools for debris removal, minor concrete repair, and light maintenance
- Vacuum truck or high-pressure jetting for culvert and vent cleaning
- Excavation equipment for riprap placement, scour repair, and embankment work
- Concrete repair materials: patching compounds, bonding agents, joint sealants
- Riprap, bedding stone, filter fabric, and channel protection materials
- Traffic control equipment and qualified flagger or lane closure support
- Safety equipment for working near active stream channels
- Training for working around water, near moving traffic, and in confined culvert entries

Key maintenance goals:

- **Maintain a safe and functional travel surface.** Repair cracking, spalling, potholing, and displacement promptly. Surface deterioration that exposes voids or structural gaps is a safety hazard.
- **Keep culverts and vents clear and structurally sound.** Remove debris and sediment. Repair cracks, joint separations, and corrosion. Blocked culverts concentrate scour and force flow onto unprotected surfaces.
- **Repair scour and undermining early.** Scour voids beneath slabs or at foundations must be filled and stabilized before traffic is restored. Small scour pockets expand rapidly under repeated flow.
- **Maintain energy dissipation and downstream channel protection.** Restore displaced or missing riprap at outlets and aprons. Energy dissipators protect the channel from culvert discharge.
- **Protect and restore approach embankments.** Repair erosion at the transition between roadway and crossing. Approach failures can isolate the crossing and lead to larger structural damage.
- **Keep debris clear from the crossing and culvert inlets.** Conduct post-storm debris removal as a priority. Accumulated debris reduces hydraulic capacity and increases overtopping risk.

- **Ensure safety features are present and functional.** Maintain depth gauges, warning signs, barricades, and roadway markings. Crossings subject to overtopping must have clear, visible warnings at all times.
- **Monitor for channel migration and bed changes.** Periodically assess upstream and downstream channel conditions. Shifts in the thalweg, new bank erosion, and sediment bars are early indicators of changing scour conditions.

SCHEDULING MAINTENANCE:

1. Routine and seasonal maintenance

- Conduct periodic drive-through and walk-through inspections of the crossing surface, culvert inlets and outlets, and approach embankments
- Remove minor debris accumulation at culvert inlets, on the crossing surface, and from upstream debris traps if present
- Inspect and clean safety signage, depth gauges, and barricades
- Mow or manage vegetation on approach embankments to prevent encroachment and facilitate inspection

2. Annual maintenance and comprehensive review

- Perform a full inspection of the crossing surface, edges, headwalls, wing walls, culverts or vents, riprap, approach embankments, and adjacent channel
- Compare scour indicators, surface condition, and channel geometry to past records to identify worsening trends
- Identify crossings where scour, undermining, or surface deterioration is advancing and plan repairs before the next storm season
- Review safety features and signage inventory for completeness and legibility

3. Pre-, in-, and post-storm events

Pre-storm events

- Inspect culvert inlets for debris that could block flow and cause overtopping or scour
- Confirm barricades and warning devices are accessible and operational

In-storm events (only when safe)

- Do not enter or drive on an overtopped crossing. Even shallow, fast-moving water can displace vehicles.
- Deploy barricades and signage if overtopping is occurring or imminent

Post-storm events

- Inspect the crossing before reopening to traffic. Check for new scour, surface damage, debris, and displaced components.
- Document high water marks and debris lines to evaluate past flow levels
- Remove deposited debris and sediment from the travel surface and culvert inlets as soon as conditions allow

4. Maintenance decision logic

- Continue planned maintenance when surface is intact, scour is stable, culverts are functional, and issues can be resolved through routine tasks
- Increase frequency of preventive maintenance when scour indicators are trending, debris accumulation is increasing, surface cracking is advancing, or approach embankments show early erosion
- Plan rehabilitation or repair when slab undermining is confirmed, culvert structural damage is observed, riprap protection has significantly degraded, or recurring scour is reshaping the channel
- Consider replacement or closure when the crossing cannot be safely reopened after storm damage, repeated repairs are failing, or the risk to users cannot be adequately managed

5. Factors that may influence the maintenance schedule

- Storm intensity and frequency. More intense and frequent storms accelerate scour, debris accumulation, and surface damage. Post-storm inspections are mandatory after significant events.
- Upstream watershed changes. Land clearing, new development, or channel modification upstream increases runoff peaks, debris load, and sediment transport, accelerating scour and debris blockage.
- Known scour history. Crossings with documented scour problems require more frequent monitoring and targeted post-storm assessment.
- Traffic volume and road classification. Higher-volume and emergency access routes require faster post-storm response and higher condition standards.
- Culvert age and material type. Older corrugated metal pipe culverts are prone to corrosion and joint failure. Increase inspection frequency as culverts age.
- Nearby critical facilities. Hospitals, fire stations, schools, and emergency response routes increase the consequence of closure or failure.
- Channel migration or incision. Active channel adjustment near the crossing accelerates scour risk and may require engineering evaluation.

6. Repair vs. replacement considerations

Factors that indicate continued maintenance and repair

Choose repair/rehabilitation when:

- Surface damage is localized and does not expose structural voids or undermine slab support
- Scour is limited and can be backfilled and stabilized without repeated failure
- Culverts retain structural integrity and can be maintained adequately
- Riprap and channel protection features can be restored and remain effective

Factors that indicate asset replacement or major repair

Consider replacing or undertaking major reconstruction when:

- Slab undermining is widespread or repeated, and backfill repairs do not hold
- Culverts are structurally compromised or undersized for current flow conditions
- The crossing repeatedly fails after storms, indicating design no longer matches site conditions
- Approach embankments are chronically eroding and cannot be sustainably stabilized
- The consequences of failure are severe, such as serious risk to motorists, loss of isolated community access, or loss of an emergency route.
- Engineering review indicates the existing crossing does not meet current standards

Low Water Crossings/ Roadway Stream Crossings

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Crossing Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Recent high water?	☐ Yes ☐ No
Recent storm event?	☐ Yes ☐ No
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK - STOP IF UNSAFE

If checked, report and do not enter.

☐ Active flow/overtopping	☐ Severe weather/flooding	☐ Slab displacement or void	☐ Unstable approach/embankment
--	--	--	---

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Crossing Surface Condition	Overall	☐	☐	☐	☐	☐
	Surface cracking or spalling	☐	☐	☐	☐	☐
	Potholing or surface washout	☐	☐	☐	☐	☐
	Surface displacement or settlement	☐	☐	☐	☐	☐
Scour, Undermining, and Erosion	Overall	☐	☐	☐	☐	☐
	Scour at crossing edges or embankment	☐	☐	☐	☐	☐
	Approach embankment erosion	☐	☐	☐	☐	☐
	Downstream channel scour and bank erosion	☐	☐	☐	☐	☐
Culvert or Vent Condition (if present)	Overall	☐	☐	☐	☐	☐
	Blockage or debris at inlet/outlet	☐	☐	☐	☐	☐
	Structural integrity	☐	☐	☐	☐	☐
	Sediment fill in culvert	☐	☐	☐	☐	☐
Headwalls, Wing Walls, and Traffic Features	Overall	☐	☐	☐	☐	☐
	Headwall or wing wall condition	☐	☐	☐	☐	☐
	Traffic barriers and railings condition	☐	☐	☐	☐	☐
	Approach transitions and edge treatment condition	☐	☐	☐	☐	☐

Crossing Name/ID: _____

Inspector Initials: _____

Low Water Crossings/ Roadway Stream Crossings

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Safety Features and Signage	Overall	☐	☐	☐	☐	☐
	Warning signs and roadway markings condition	☐	☐	☐	☐	☐
	Water depth gauge condition (if present)	☐	☐	☐	☐	☐
	Barricades and flood closure equipment condition	☐	☐	☐	☐	☐
Channel and Stream Condition	Overall	☐	☐	☐	☐	☐
	Upstream channel and debris accumulation	☐	☐	☐	☐	☐
	Downstream channel and riprap condition	☐	☐	☐	☐	☐
	Bed aggradation or incision near crossing	☐	☐	☐	☐	☐
Trash, Dumping, and Water Quality	Overall	☐	☐	☐	☐	☐
	Debris and trash on crossing surface	☐	☐	☐	☐	☐
	Illegal dumping near crossing	☐	☐	☐	☐	☐
	Staining, sheen, or unusual discharge	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to roads, structures, or critical facilities	☐	☐	☐	☐	☐
	Public safety hazards at or near crossing	☐	☐	☐	☐	☐
	Loss of access or emergency route continuity	☐	☐	☐	☐	☐

Follow-Up Actions	Goal Resolution Date	Responsible Person

Crossing Name/ID: _____

Inspector Initials: _____

Page 2 of 3

Inspection Checklist



Crossing Name/ID: _____

Inspector Initials: _____

Low Water Crossings/ Roadway Stream Crossings

Rubrics and Guidelines



Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Crossing Surface Condition	Surface cracking or spalling	Hairline cracks; surface intact.	Minor cracking or surface wear; no open gaps.	Moderate cracking; localized spalling; no void.	Significant spalling or cracking; possible void.	Surface collapsed, open void, or slab displaced.
	Potholing or surface washout	Minor texture loss; no potholes.	Small potholes; drivable but rough.	Multiple potholes reducing usable width.	Deep potholes or washout cuts into structure.	Major washout; surface impassable.
	Surface displacement or settlement	Slight unevenness; no offset.	Minor offset or settlement; acceptable.	Noticeable offset at joints or slab edges.	Slab heaved, tilted, or settled; traffic hazard.	Slabs shifted, overturned, or missing; impassable.
Scour, Undermining, and Erosion	Scour at crossing edges or embankment	Minor scour; riprap intact and stable.	Small scour pockets; riprap displaced locally.	Scour reaching slab edge or headwall base.	Scour undercutting slab or foundation; active.	Void beneath slab or foundation failure; immediate failure; already failed.
	Approach embankment erosion	Very minor rilling on slopes.	Small erosion cuts developing; stable overall.	Gully formation threatening embankment fill.	Erosion cutting toward roadway subgrade.	Embankment breached or imminently failing.
	Downstream channel scour and bank erosion	Channel stable; no visible scour.	Minor scour at outlet; riprap apron shifting.	Scour hole forming; bank erosion at limit.	Scour threatening riprap or channel protection.	Rapid scour or bank failure; foundation at risk.

Low Water Crossings/ Roadway Stream Crossings

Rubrics and Guidelines



Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Culvert or Vent Condition (if present)	Blockage or debris at inlet/outlet	Minimal debris; flow unobstructed.	Minor debris; slight restriction.	Debris restricting flow; partial blockage.	Substantial blockage; significant flow reduction.	Culvert fully blocked; flow bypassing entirely.
	Structural integrity	No visible defects.	Minor corrosion or surface cracking.	Cracking, joint separation, or moderate corrosion.	Deformation, significant joint failure or compromise.	Collapse or imminent structural failure.
	Sediment fill in culvert	Trace sediment; no capacity loss.	Sediment along invert; minor restriction.	Noticeable sediment; capacity reduced.	Heavy fill; capacity significantly reduced.	Culvert buried or nearly filled; non-functional.
Headwalls, Wing Walls, and Traffic Features	Headwall or wing wall	No defects; intact.	Minor surface spalling or hairline cracks.	Moderate cracking; localized undermining.	Significant cracking, displacement, or undermining.	Headwall or wing wall failed or collapsing.
	Traffic barriers and railings	Intact; no damage.	Minor dent or surface damage; functional.	Sections bent, loose, or misaligned.	Multiple sections compromised; barriers unreliable.	Barriers absent, collapsed, or ineffective.
	Approach transitions and edge treatment	Smooth transition; no edge drop-offs.	Minor lip or unevenness at transition.	Noticeable edge drop or transition hazard.	Abrupt drop or damaged edge; rollover risk.	Transition failed; dangerous edge; crossing unusable.

Low Water Crossings/ Roadway Stream Crossings

Rubrics and Guidelines



Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Safety Features and Signage	Warning signs and roadway markings	All signs present, legible, correctly placed.	Minor fading or displacement; acceptable.	Signs faded, damaged, or poorly positioned.	Signs missing at key locations or unreadable.	No warning signage present; safety hazard.
	Water depth gauge (if present)	Gauge intact and readable.	Minor damage; still functional.	Gauge damaged but partially readable.	Gauge not readable or missing markings.	Gauge absent or completely non-functional.
	Barricades and flood closure equipment	All equipment present and functional.	Equipment present; minor wear.	Equipment degraded; may not deploy reliably.	Key equipment missing or non-functional.	No closure equipment available.
Channel and Stream Condition	Upstream channel and debris accumulation	Channel clear; no debris concern.	Minor debris; no blockage risk.	Debris accumulating; approaching crossing.	Heavy debris lodged against crossing.	Debris jam causing backwater or diverting flow.
	Downstream channel and riprap condition	Riprap intact; channel stable.	Minor riprap displacement; channel stable.	Riprap shifting; minor scour initiating.	Riprap significantly displaced; scour expanding.	Riprap absent; channel protection failed.
	Bed aggradation or incision near crossing	Bed stable; no elevation change.	Minor aggradation or incision; monitor.	Noticeable bed change affecting flow.	Significant change altering scour exposure.	Severe change threatening foundation.

Low Water Crossings/ Roadway Stream Crossings

Rubrics and Guidelines



Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Trash, Dumping, and Water Quality	Debris and trash on crossing surface	Clean.	Light litter; no obstruction.	Trash accumulation affecting travel surface.	Heavy debris; travel hazard.	Impassable debris blocking crossing.
	Illegal dumping near crossing	None present.	Small household waste; not near channel.	Dumped materials present; not blocking flow.	Dumping affecting channel access or flow.	Hazardous material or major blockage from dumping.
	Staining, sheen, or unusual discharge	No staining or sheen.	Faint staining; likely non-hazardous.	Oily sheen or staining; source unclear.	Active discharge with sheen or unusual odor.	Active hazardous discharge confirmed.
Overall Rating Based on Impacts to People and Infrastructure	Threat to roads, structures, or critical facilities	No threat identified.	Minor risk; unlikely to affect operations.	Notable risk; conditions warrant close monitoring.	Significant risk; maintenance or closure considered.	Immediate threat to safety. Closure or emergency action required.
	Public safety hazards at or near crossing	No safety concerns.	Minor hazard; manageable with standard controls.	Hazard present; traffic control or signage needed.	Serious hazard; access should be restricted.	Imminent danger. Crossing must close immediately.
	Loss of access or emergency route continuity	No access impact.	Minor inconvenience; alternates available.	Partial restriction affecting some users.	Significant access loss; emergency route impacted.	Complete isolation; emergency response at risk.

Low Water Crossings/ Roadway Stream Crossings



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Crossing Name/ID			
Location			
Date/Time	START: __/__/____	END: __/__/____	
Foreman			
Maintenance Crew			
Contractor			
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F		
Recent high water?	☐ Yes ☐ No		
Recent storm event?	☐ Yes ☐ No		
Other/Details			
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____		

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up
☐ Complaint/service request	☐ Emergency/safety issue	☐ Scour repair
☐ Surface repair	☐ Culvert/vent cleaning or repair	☐ Riprap or channel protection repair
☐ Approach embankment repair	☐ Safety signage/barricade maintenance	☐ Other (describe below)

Other/Details:

Crossing Name/ID: _____ Foreman Initials: _____

Low Water Crossings/ Roadway Stream Crossings



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Debris removal — crossing surface	☐ Debris removal — culvert inlet/outlet
☐ Culvert/vent cleaning (jetting or manual)	☐ Culvert structural repair	☐ Surface crack repair/patching
☐ Pothole or spall repair	☐ Slab replacement or stabilization	☐ Scour void filling/grouting
☐ Riprap placement or repair	☐ Filter fabric/bedding installation	☐ Headwall/wing wall repair
☐ Traffic barrier or railing repair	☐ Approach embankment repair	☐ Energy dissipator repair or restoration
☐ Channel armoring or bank stabilization	☐ Safety signage replacement/installation	☐ Depth gauge repair or replacement
☐ Barricade maintenance/deployment	☐ Vegetation management on embankment	☐ Other (describe below)

Other maintenance actions performed:

AREAS ADDRESSED

☐ Crossing travel surface	☐ Crossing edges/headwalls	☐ Wing walls or abutments
☐ Traffic barriers/railings	☐ Culvert inlet(s)	☐ Culvert barrel
☐ Culvert outlet(s)	☐ Upstream approach	☐ Downstream approach
☐ Downstream riprap/apron	☐ Left bank (facing downstream)	☐ Right bank (facing downstream)
☐ Stream channel upstream	☐ Stream channel downstream	☐ Other (describe below)

Crossing Name/ID: _____ Foreman Initials: _____

Low Water Crossings/ Roadway Stream Crossings



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Other areas addressed:

MATERIALS AND EQUIPMENT USED

Equipment used (e.g., excavator, jetter, compactor, concrete mixer, dump truck):

Maintenance hours/staff:

Materials used (e.g., concrete patch, riprap, filter fabric, joint sealant, seed/mulch):

Quantity of materials (e.g., volume, tonnage, LF):

SAFETY, ENVIRONMENTAL AND REGULATORY CONTROLS

☐ Site access controlled and safe	☐ Traffic control in place (if needed)
☐ Work performed outside active flow/safe water conditions	☐ Erosion and sediment controls in place during earthwork
☐ No fuel, oil, or material spills near stream	☐ Regulatory permit requirements reviewed (Section 404, TCEQ)
☐ Confined space procedures followed (if culvert entry required)	☐ Area left clean and stable after work

Crossing Name/ID: _____ Foreman Initials: _____

Low Water Crossings/ Roadway Stream Crossings



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

CONDITION AFTER MAINTENANCE	
Crossing surface condition after work:	Scour and channel protection after work:
☐ Restored/acceptable	☐ Stable
☐ Improved	☐ Improved
☐ Still deficient	☐ Needs follow-up
Culvert/vent condition after work:	Crossing open to traffic after maintenance:
☐ Clear and functional	☐ Yes — open to traffic
☐ Improved	☐ No — crossing remains closed
☐ Needs follow-up	☐ Restricted use only (describe below)
☐ N/A	

DOCUMENTATION			
Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A

Follow-Up Actions	Goal Resolution Date	Responsible Person

Asset Management Guidance for Community Flood Infrastructure

Crossing Name/ID: _____ Foreman Initials: _____

How to Maintain Your Flood Early Warning Systems

What is it?

A Flood Early Warning System (FEWS) is a coordinated set of field equipment, communications, data tools, operating procedures, and public notification methods used to detect rising flood risk and communicate timely information before or during a flood event. These systems may include rain gauges, stream gauges, water-level sensors, road-stage sensors, cameras, telemetry equipment, data loggers, dashboards, models, warning thresholds, sirens, flashing beacons, public alert platforms, and emergency contact procedures.

The purpose of a FEWS is not only to collect data. The system must turn field observations into actionable information that helps local staff, emergency managers, first responders, elected officials, and the public make safer decisions. For small and under-resourced Texas communities, even a simple system with a few well-maintained gauges and clear notification procedures can improve road closure timing, evacuation decision-making, public messaging, and post-storm documentation.

Common systems include:

- Rain gauge and stream gauge monitoring networks
- Low-water crossing warning systems with water-level sensors, flashers, or gates
- Road flooding cameras and remote visual verification sites
- Local dashboards showing gauge readings, thresholds, and recent trends
- Regional or partner-supported systems that share data with the National Weather Service (NWS), river authorities, counties, or neighboring communities
- Forecasting systems that use observed rainfall, radar rainfall, external forecasts, or hydrologic and hydraulic models

Getting started:

FEWS can grow over time as funding and staff capacity allow. Small communities can begin with:

- An inventory of flood-prone locations
- Existing gauges or partner data
- Designating one primary and one backup responsible person
- Developing basic action thresholds, current contact lists, and a schedule for pre-season testing



Who maintains it?

Maintenance responsibility varies by ownership, funding source, and operating model. FEWS may be owned or maintained by municipal public works, emergency management, counties, drainage districts, river authorities, flood control districts, transportation departments, or regional partnerships. Certain components, such as software platforms, telemetry networks, cameras, cellular modems, or sensor calibration, may be maintained by vendors under service agreements.

At a minimum, each FEWS should have an asset inventory, an assigned owner, a backup contact, current thresholds, a tested notification pathway, a documented inspection schedule, calibration records, an outage log, and an annual pre-storm review.

Regardless of ownership, each community should clearly understand:

- Which sites, sensors, dashboards, signs, sirens, cameras, and alerting tools are part of the system
- Which department or partner is responsible for field maintenance, software administration, alert issuance, and emergency operations, including primary and backup contacts for each function
- Whether the system is used for internal decision support only or also issues public warnings
- Which warning thresholds apply at each monitored location, who has authority to change them, and when they should be reviewed

- Which outside partners receive data or support warning decisions, including NWS, river authorities, counties, TxDOT, and neighboring jurisdictions
- Weather written agreements, data-sharing arrangements, or mutual aid procedures identify partner responsibilities for maintaining equipment, sharing data, activating alerts, coordinating response actions, and communicating during outages
- Whether service agreements define vendor response times, outage support, cybersecurity responsibilities, software updates, and calibration requirements, and documentation expectations
- Whether a simple written operations plan identifies who monitors data, who can issue alerts or close roads, how outages are reported, how tests are documented, and how the plan is reviewed

Best maintenance practices & strategies

FEWS must work under the most difficult conditions: heavy rain, high water levels, limited visibility, power disruptions, and high public demand for information. Routine inspection and targeted maintenance protect the credibility of the warning program, reduce false alarms and missed alarms, and help staff make decisions with confidence. A system that is not maintained can create a false sense of security, especially when gauges are offline, thresholds are outdated, batteries fail, or public notification tools are not tested before storm season.

A. INSPECTION

Inspections confirm that the system can collect accurate field data, transmit that data to the correct platform, display it in a useful format, and support timely warning actions. An inspection checklist for FEWS is included with this reference sheet.

Inspection skill needs:

- Ability to recognize damaged gauges, sensors, cables, antennas, enclosures, and mounting hardware
- Familiarity with common FEWS components such as rain gauges, stage sensors, pressure transducers, radar sensors, staff gauges, data loggers, cameras, solar panels, batteries, telemetry equipment, dashboards, and warning devices
- Ability to compare gauge readings against nearby gauges, staff gauges, manual measurements, or expected field conditions
- Understanding of warning thresholds, alarm routing, data latency, and the difference between a monitoring issue and an emergency flood condition
- Ability to identify power problems, signal problems, and environmental conditions that cause intermittent data gaps
- Awareness of electrical hazards, traffic hazards, fast water, unstable banks, wildlife, and limited-access sites
- Ability to document conditions clearly with photos, asset IDs, date, time, weather, recent storm history, and simple condition ratings

What to look for:

- **Field gauge and sensor condition.** Check rain gauges, stage sensors, staff gauges, road sensors, pressure transducers, radar level sensors, cameras, and data loggers for damage, corrosion, loose components, insect nests, debris, sediment, or submergence. A sensor can appear intact while still producing unreliable readings if its sensing face is blocked, its reference point has shifted, or its housing has taken on water.
- **Calibration, accuracy, and reference checks.** Verify that readings are reasonable when compared to nearby gauges, manual field measurements, staff gauge readings, high-water marks, or known site conditions. Small calibration errors can become important when thresholds are close together, such as a road closure stage and a structure flooding stage. Calibration records should identify who performed the check, the method used, and whether any adjustments were made.
- **Telemetry and communications.** Confirm that radios, cellular modems, satellite systems, antennas, repeaters, cables, and connectors are transmitting data at the expected interval. Look for weak signal strength, intermittent outages, delayed data, repeated retries, damaged cable jackets, corroded connectors, loose antennas, or water intrusion into enclosures. Communication failure at a critical upstream gauge can reduce lead time for downstream communities.
- **Power supply and electrical condition.** Inspect batteries, solar panels, charge controllers, wiring, fuses, conduit, grounding, lightning protection, and backup generators where present. Low battery voltage, dirty or shaded solar panels, damaged wiring, or failed grounding can cause data loss during storms. Power systems should be checked before the wet season and after lightning, high wind, or flooding events.
- **Data display and dashboard function.** Confirm that readings appear correctly on internal and public dashboards, including units, labels, time stamps, map location, color coding, threshold status, and trend

graphs. A dashboard that displays stale data, incorrect units, or confusing threshold labels can mislead decision-makers. Verify whether the public sees the same information as internal users or a simplified public view.

- **Warning thresholds, alarms, and notification rules.** Review whether alert thresholds still match current field conditions, roadway elevations, flood stages, or community response procedures. Thresholds can become outdated when roads are reconstructed, channels aggrade or erode, gauges are relocated, or new development changes risk. Verify alarm routing, escalation rules, notification groups, and after-hours contacts.
- **Forecasting, models, and external data feeds.** If the system uses radar rainfall, NWS forecasts, river forecasts, hydrologic models, or hydraulic models, confirm that external feeds are current and that model outputs are not being presented without context. Missing model inputs, stale forecasts, or uncalibrated rating curves can reduce confidence in forecasted warning stages.
- **Public warning devices and notification channels.** Inspect sirens, flashing beacons, road warning signs, gates, barricade triggers, web alerts, Short Message Service (SMS) or phone notification systems, and social media procedures if they are part of the system. Public warning devices should be tested on a documented schedule. Confirm that warning messages are clear, actionable, and suitable for the intended audience. For outdoor warning sirens, also confirm documented tests, local and remote manual activation, backup power and communication status, and current public education materials.
- **Site access and safety.** Check whether staff can safely reach each site for inspection and repair. Access may be limited by washed-out roads, locked gates, steep banks, high water, vegetation, private property, traffic, or debris. Sites that cannot be accessed safely before or after storms should have an alternate maintenance plan or remote verification method.
- **Security, vandalism, and tampering.** Look for damaged locks, cut fencing, missing solar panels, opened enclosures, stolen batteries, loose screws, animal nests, bullet damage, graffiti, or evidence of tampering. Vandalism can disable the system and may also compromise data integrity. Repeated security issues may require stronger enclosures, relocation, cameras, or coordination with local law enforcement.
- **Storm damage and environmental exposure.** After storms, inspect for scour around foundations, debris

lodged against masts, submerged enclosures, sediment burial, impact damage from floating objects, lightning damage, and shifted reference points. Floodwater can move sensors or staff gauges slightly, producing readings that appear plausible but are no longer tied to the correct elevation.

- **Records, ownership, and maintenance history.** Confirm that asset IDs, coordinates, equipment type, installation dates, serial numbers, calibration records, warranty information, vendor contacts, and repair history are up to date. Good records allow small communities to budget replacements, justify funding requests, support after-action reviews, and maintain continuity when staff changes occur.

How to record conditions:

- Use a standard inspection form or digital tool. Consistent records make inspections comparable over time and help identify recurring failures by site or component type.
- Record system/site ID, location, date, time, weather, recent storm history, current water level or rainfall condition, and the name of the inspector
- Describe each component using simple condition categories such as operational, impaired, unreliable, failed, or not applicable. Note whether the condition affects internal operations, public warning, or both
- Document data performance indicators such as last successful transmission, battery voltage, signal strength, dashboard time stamp, missing data interval, and recent alarm history when available. For public notification devices, record the last test date and whether the test passed.
- Photograph key conditions, including sensor mounting, gauge location, enclosure interior, solar panels, batteries, antennas, warning devices, access route, and any storm damage
- Flag urgent issues that could cause missed warnings, false warnings, loss of public notification, road closure failure, or unsafe maintenance access. Urgent issues should be reported through the community's emergency or supervisor notification process.

B. MAINTENANCE

Maintenance preserves warning reliability, keeps data usable, and reduces emergency repairs during storms. Maintenance should address both field hardware and the operational procedures that turn data into warnings. A maintenance checklist for FEWS is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools for cleaning gauge housings, removing light debris, tightening mounts, and maintaining enclosures
- Sensor calibration tools or manufacturer-approved calibration procedures
- Electrical test equipment for batteries, solar charging systems, wiring, fuses, and grounding checks
- Communication testing equipment or software for radio, cellular, satellite, or network troubleshooting
- Replacement parts such as batteries, fuses, cables, desiccant, seals, antennas, solar controllers, modems, staff gauge hardware, and sensor mounts
- Laptop or tablet access to dashboards, data loggers, telemetry software, and vendor support portals
- Traffic control equipment and personal protective equipment for roadway, bridge, and low-water crossing sites
- Safe work training for electrical systems, ladders or masts, traffic exposure, steep banks, high water, wildlife, and post-storm debris
- Vendor or manufacturer support for firmware updates, calibration, software configuration, and warranty repairs

Key maintenance goals:

- **Maintain accurate field measurements.** Clean, calibrate, and verify gauges and sensors so rainfall, water level, and road flooding information can be trusted. Inaccurate readings can delay road closures, trigger unnecessary alarms, or create confusion during emergency operations.
- **Keep communication pathways reliable.** Test telemetry, cellular, radio, satellite, or network connections before storm season and after outages. A gauge that measures correctly but cannot transmit data does not support real-time warning.
- **Maintain power continuity.** Replace weak batteries, clean solar panels, verify charge controllers, test backup power, and protect wiring. Power failures often appear during long storm events when solar charging is limited and demand on the system is highest.
- **Protect equipment from flood and weather damage.** Secure enclosures, seal cable penetrations, raise vulnerable components when feasible, and maintain stable mounting. Post-storm repairs should correct the cause of damage, not just replace the failed part.
- **Keep dashboards and data tools operational.** Verify dashboards, alarm displays, maps, rating curves, thresholds, and data feeds. Internal users and the public should be able to see current information and understand

whether a reading is normal, elevated, or critical.

- **Maintain warning thresholds and notification procedures.** Review thresholds after road improvements, drainage changes, gauge relocation, major floods, or new flood studies. Update contact lists and escalation procedures at least annually and after staff changes.
- **Test public notification tools.** Exercise sirens, flashers, signs, gates, SMS systems, phone trees, social media procedures, and web alerts where applicable. Testing should confirm that alerts reach the intended recipients and that staff know who has authority to issue warnings. Keep plain-language outreach materials current so residents, visitors, businesses, schools, and vulnerable populations know what alerts mean, where to get official information, and what action to take.
- **Maintain safe and secure access.** Clear vegetation, maintain access paths, repair locks and fencing, and document access limitations. Field sites that cannot be serviced safely are more likely to remain offline during the periods when they are needed most.
- **Document outages, repairs, and lessons learned.** Record what failed, when it failed, how long the outage lasted, how it was repaired, and whether the issue affected public warning or emergency response. These records support budgeting, vendor accountability, and after-action improvement.
- **Plan replacements before failure.** Track equipment age, warranty status, recurring repairs, and manufacturer support. Sensors, modems, batteries, and software platforms should be replaced on a planned schedule when possible, especially at high-consequence sites.

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Conduct periodic field checks of gauges, sensors, enclosures, solar panels, batteries, antennas, warning devices, and site access conditions
- Clean sensors and rain gauge funnels; remove insects, leaves, sediment, bird nests, and other material that could affect readings
- Verify dashboard time stamps, data transmission intervals, battery voltage, and signal quality for each site
- Confirm that warning devices, signs, locks, and access paths are functional and visible
- Update the maintenance log when equipment is adjusted, repaired, or placed on watch status

2. Annual maintenance and comprehensive review

- Perform a full inspection of every monitoring site and public warning device before the primary storm season
- Calibrate gauges and sensors or verify calibration through manufacturer procedures, staff gauge checks, manual measurements, or comparison with nearby reference data
- Review alert thresholds, rating curves, alarm routing, emergency contact lists, vendor service contacts, and public message templates
- Test dashboards, external data feeds, telemetry networks, backup communication paths, and public notification systems
- Identify components approaching the end of useful life and plan replacements before the next high-risk season
- Review the written operations plan, activation authority, outage notification process, and staff backup assignments
- For siren-equipped systems, verify that required test records, backup power, backup communications, and public messaging procedures are current

3. Pre-, in-, and post-storm events

Pre-storm events

- Verify that priority gauges are online, batteries are charged, dashboards are functioning, staff contacts are current, and known problem sites have been checked

In-storms events

- Monitor system status, data gaps, alarms, and public notification tools. Do not send crews into unsafe locations solely to restore non-critical data during active flooding.
- Document observed performance issues such as missed alerts, delayed data, false alarms, dashboard outages, or communication failures

Post-storm events

- Inspect field sites when safe, document high-water marks and storm damage, restore failed components, and remove debris from sensors and access points
- Conduct an after-action review for significant events and update maintenance priorities, thresholds, contact lists, and training needs

4. Maintenance decision logic

- Continue planned maintenance when: equipment is online, readings are reasonable, power and communication systems are stable, public notification tools test successfully, and issues can be corrected through routine service
- Increase preventive maintenance when a site shows recurring communication gaps, battery weakness, sensor drift, vandalism, access limitations, storm damage, or repeated public complaints about missing or unclear information
- Plan rehabilitation or major repair when the site repeatedly fails during storms, mounting is unstable, equipment is frequently submerged or damaged, thresholds no longer match observed flooding, or the dashboard/alert platform no longer meets operational needs
- Consider replacement or system redesign when repeated repairs do not restore reliability, critical sites lack redundancy, vendor support has ended, the system cannot integrate with partner data, or warning coverage no longer matches current flood risk and development patterns

5. Factors that may influence the maintenance schedule

- **Storm intensity and frequency.** More intense or frequent rainfall increases sensor exposure, debris impacts, access problems, and demand for reliable warning data. Post-storm inspections should be required after significant events.
- **Site criticality.** Sites that inform road closures, evacuation routes, hospitals, fire stations, schools, low-water crossings, or high-risk neighborhoods require higher inspection frequency and faster repair response.
- **Communication reliability.** Remote sites with weak radio or cellular coverage should be monitored more closely and may require redundancy, antenna adjustments, or alternative transmission methods.
- **Power vulnerability.** Heavily shaded sites, older batteries, long-duration storms, or sites with high camera power demands may require more frequent power system checks.
- **Vandalism or theft history.** Sites with repeated tampering should receive more frequent security checks and may need stronger enclosures, locks, relocation, or law enforcement coordination.
- **Age and vendor support.** Older sensors, modems, software, and public warning devices should be tracked for replacement before parts become unavailable or cybersecurity support ends.

- **Hydraulic changes at the site.** Channel migration, sediment deposition, road reconstruction, new development, or changes to drainage patterns can affect the meaning of gauge readings and thresholds.
- **Public communication needs.** Systems that issue direct public warnings require more frequent testing of message templates, alert lists, sirens, signs, dashboards, and accessibility measures.

6. Repair vs. replacement considerations

Factors that indicate continued maintenance and repair

Choose repair/rehabilitation when:

- The problem is localized to a sensor, battery, cable, antenna, enclosure, or software configuration
- The site still provides reliable data after repair and calibration
- Telemetry and power systems remain compatible with current platforms and available vendor support
- Warning thresholds remain valid, and the site continues to serve a documented risk location
- Repair costs are reasonable compared to replacement and the component is not near end of useful life

Factors that indicate asset replacement or major upgrade

Consider replacing, relocating, or redesigning when:

- The same site repeatedly fails during storms or cannot be accessed safely for required service
- Sensors, modems, radios, software, or public notification devices are obsolete or no longer supported
- Readings cannot be made reliable because the site is hydraulically unstable, frequently buried by sediment, or repeatedly damaged by debris
- The system lacks redundancy at locations that are critical to road closures, evacuation routes, emergency services, or vulnerable populations
- The dashboard or notification system cannot meet current operational, public communication, cybersecurity, or data-sharing needs
- The consequence of failure is severe, such as loss of warning for a critical facility, low-water crossing, evacuation route, or repeatedly flooded neighborhood

Flood Early Warning Systems



Inspection Checklist

Asset Management Guidance for Community Flood Infrastructure

System Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Inspection Timing	☐ Routine ☐ Pre-Storm ☐ Post-Storm ☐ Annual
System status before maintenance	☐ Online ☐ Intermittent ☐ Offline ☐ Unknown
Public warning or operations affected?	☐ Yes ☐ No ☐ Unknown
Approximate outage/impaired service window	START: _____ END: _____ N/A
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Electrical hazard/exposed wiring	☐ Fast water/high flows	☐ Severe weather/lightning	☐ Unsafe access/traffic hazard
☐ Unstable bank/steep slope	☐ Unsafe structure/ladder/mast	☐ Hazardous wildlife/insects	☐ Other: _____

Public Notification Device Present:	☐ Yes	☐ No	☐ N/A	System Type: _____
Critical Site:	☐ Yes	☐ No	☐ N/A	Last Successful Transmission or Dashboard Timestamp: _____
Operations Plan/Contact List Current:	☐ Yes	☐ No	☐ N/A	Last Public Notification or Siren Test Date (if applicable): _____
Forecasting Capability:	☐ Yes	☐ No	☐ N/A	

System Name/ID : _____ Inspector Initials: _____

Flood Early Warning Systems



Inspection Checklist

Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Field Monitoring Equipment	Overall	☐	☐	☐	☐	☐
	Sensor or gauge physical condition	☐	☐	☐	☐	☐
	Gauge accuracy or calibration concern	☐	☐	☐	☐	☐
	Debris, sediment, or submergence affecting readings	☐	☐	☐	☐	☐
	Mounting, mast, enclosure, or stilling well stability	☐	☐	☐	☐	☐
Field Telemetry and Communications	Overall	☐	☐	☐	☐	☐
	Communication uptime and signal quality	☐	☐	☐	☐	☐
	Antenna, radio, modem, or cable condition	☐	☐	☐	☐	☐
	Data latency, gaps, or intermittent transmission	☐	☐	☐	☐	☐
	Redundant communication path or failover readiness	☐	☐	☐	☐	☐
Field Power Systems	Overall	☐	☐	☐	☐	☐
	Battery condition and charge retention	☐	☐	☐	☐	☐
	Solar panel, charger, or electrical connection condition	☐	☐	☐	☐	☐
	Backup power or generator readiness	☐	☐	☐	☐	☐
	Grounding, lightning protection, or surge protection condition	☐	☐	☐	☐	☐
Data Management and Forecasting Tools	Overall	☐	☐	☐	☐	☐
	Dashboard or data display functioning	☐	☐	☐	☐	☐
	Warning thresholds, rating curves, or alarm rules functioning	☐	☐	☐	☐	☐
	Model, forecast, or external data feed functioning (if present)	☐	☐	☐	☐	☐
	Data archiving, quality control, and record completeness	☐	☐	☐	☐	☐
	Operations plan, outage notices, and maintenance/test records current	☐	☐	☐	☐	☐
Warning Dissemination and Public Notification	Overall	☐	☐	☐	☐	☐
	Notification contact lists and escalation procedures	☐	☐	☐	☐	☐
	Public alerting tools, sirens, flashers, or signs functioning	☐	☐	☐	☐	☐

System Name/ID : _____ Inspector Initials: _____

Flood Early Warning Systems



Inspection Checklist

Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Warning Dissemination and Public Notification (Cont'd.)	Message templates, accessibility, and multilingual readiness	☐	☐	☐	☐	☐
	Siren/manual activation, backup alert method, and test records (if present)	☐	☐	☐	☐	☐
	Coordination with emergency management, NWS, or partner agencies	☐	☐	☐	☐	☐
Site Access, Security, and Safety	Overall	☐	☐	☐	☐	☐
	Site access route and work area condition	☐	☐	☐	☐	☐
	Fencing, locks, signage, or enclosure security	☐	☐	☐	☐	☐
	Evidence of vandalism, tampering, theft, or animal damage	☐	☐	☐	☐	☐
	Flood, debris, electrical, wildlife, or traffic hazards at site	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to warning reliability	☐	☐	☐	☐	☐
	Threat to emergency response operations	☐	☐	☐	☐	☐
	Threat to critical facilities or vulnerable populations	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐

Follow-Up Actions	Goal Resolution Date	Responsible Person

System Name/ID : _____ Inspector Initials: _____

Flood Early Warning Systems



Inspection Checklist

Asset Management Guidance for Community Flood Infrastructure

Follow-Up Actions	Goal Resolution Date	Responsible Person

Notes and Observations:

Attach additional pages, if required.

Flood Early Warning Systems



Rubrics and Guidelines

Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Field Monitoring Equipment	Sensor or gauge physical condition	Equipment is intact with only normal weathering; housing and sensor face are clean.	Minor wear, fading, or loose exterior hardware; equipment remains functional.	Damage, corrosion, or loose components may affect service; schedule repair.	Major damage, bent mast, cracked housing, or compromised sensor mounting; readings may be unreliable.	Equipment failed, missing, submerged, or destroyed; site cannot provide reliable warning data.
	Gauge accuracy or calibration concern	Readings are consistent with nearby gauges and expected conditions.	Small drift or minor calibration concern; monitor or recalibrate during routine service.	Calibration is overdue or readings differ from nearby/reference data; schedule calibration.	Readings appear significantly inaccurate and may trigger false or missed alerts.	Data are clearly wrong or unavailable; remove from operational decision-making until corrected.
	Debris, sediment, or submergence affecting readings	Sensor exposure and measurement area are clear.	Light debris or sediment nearby; no reading impact.	Buildup begins to interfere with measurement or staff access; cleanout needed.	Debris, sediment, vegetation, or submergence is significantly affecting readings.	Sensor is blocked, buried, or physically inaccessible; data are unusable.
	Mounting, mast, enclosure, or stilling well stability	Mounting is plumb, secure, and stable.	Minor looseness or corrosion; stable but should be tightened or treated.	Mounting movement, settlement, or stilling well debris may affect readings.	Mast/enclosure unstable or stilling well obstructed; failure likely in storm conditions.	Mounting failure, collapsed enclosure, or unsafe structure; immediate action required.

Flood Early Warning Systems

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Telemetry and Communications	Communication uptime and signal quality	Reliable communication; no recent unexplained outages.	Minor signal variation or brief outage; system recovers quickly.	Repeated weak signal or outage history; troubleshooting needed.	Frequent communication failure during routine conditions or storms.	No communication; site is offline and cannot support warning operations.
	Antenna, radio, modem, or cable condition	Components intact, sealed, and properly secured.	Minor wear or loose protective covering; no performance issue.	Damaged cable, connector, or antenna alignment issue affecting reliability.	Major damage, water intrusion, or corrosion likely to cause failure.	Antenna/radio/mode m/cable failed or missing; no transmission capability.
	Data latency, gaps, or intermittent transmission	Data are received at expected reporting interval.	Minor delays or isolated missing values.	Repeated latency or gaps affecting trend interpretation.	Major gaps reduce situational awareness during storms.	Timely data unavailable; warnings may be missed or substantially delayed.
	Redundant communication path or failover readiness	Backup communication path verified and ready.	Backup path available but not recently tested.	Backup path partially configured or unclear; test and correct.	Backup path failed or not dependable for priority sites.	No functional failover for a critical site where redundancy is required.
Power Systems	Battery condition and charge retention	Battery voltage and charge retention normal.	Battery aging or minor voltage concern; monitor.	Battery performance declining; replacement should be scheduled.	Battery frequently drops below operating range or causes outages.	Battery failed; equipment cannot operate without immediate replacement.
	Solar panel, charger, or electrical connection condition	Solar/charging equipment clean, secure, and operating.	Minor dirt, shading, or loose connection; routine service needed.	Reduced charging performance; intermittent power issues possible.	Charging system unreliable due to damaged panel, controller, or wiring.	No charging or unsafe electrical condition; site power will fail or has failed.

Flood Early Warning Systems

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Power Systems (Cont' d.)	Backup power or generator readiness	Backup power tested and operational.	Backup available but minor maintenance due.	Backup not recently tested or has reliability concern.	Backup equipment fails test or cannot support expected duration.	No backup power available for a critical site where backup is required.
	Grounding, lightning protection, or surge protection condition	Grounding and surge protection intact.	Minor corrosion or missing labels; no immediate functional concern.	Grounding connection, rod, or surge device condition uncertain; inspect soon.	Grounding or surge protection compromised; lightning/electrical damage risk elevated.	Electrical safety hazard or repeated lightning/surge failures; immediate correction required.
Data Management and Forecasting Tools	Dashboard or data display functioning	Dashboard displays current data clearly and consistently.	Minor display issue; operational data remain accessible.	Intermittent display or map-layer issue; users may miss information.	Major dashboard malfunction; critical users cannot reliably view conditions.	Dashboard unavailable or presenting misleading information.
	Warning thresholds, rating curves, or alarm rules functioning	Thresholds and alarm rules are current and verified.	Minor administrative update needed; no known warning risk.	Thresholds, rating curves, or alarm routing need review after changed conditions.	Alarm rules are inaccurate or unreliable; false or missed alerts likely.	Threshold or alarm failure prevents accurate warning issuance.
	Model, forecast, or external data feed functioning (if present)	Model/feed operating and current.	Minor feed delay or model warning; results still usable.	External feed or model inputs intermittently missing; forecast confidence reduced.	Model/feed unreliable during events; decision support significantly degraded.	Forecast/model unavailable or producing invalid outputs.

Flood Early Warning Systems

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Data Management and Forecasting Tools (Cont' d.)	Data archiving, quality control, and record completeness	Records complete; QC flags and archives current.	Minor metadata or archive gap; easily corrected.	Repeated gaps or missing metadata; historical analysis impaired.	Large gaps or unresolved suspect data; post-event review compromised.	Data records lost or unusable for operations, reporting, or after-action review.
	Operations plan, outage notices, and maintenance/test records current	Plan, notices, and records are current and easy to find.	Minor record update needed; operational responsibilities are clear.	Records or outage notices are incomplete; staff may need clarification.	Operations plan or records are outdated enough to delay maintenance or warning decisions.	No current operations plan, outage process, or test/maintenance records for a critical system.
Warning Dissemination and Public Notification	Notification contact lists and escalation procedures	Contacts and escalation roles verified.	Minor contact update needed; core contacts still valid.	Several contacts outdated or escalation roles unclear.	Major contact list gaps could delay warning decisions.	No reliable notification chain for critical warning operations.
	Public alerting tools, sirens, flashers, or signs functioning	All public notification devices tested and functional.	Minor maintenance needed; device still functional.	Device or channel intermittently fails; schedule repair.	Device/channel unreliable; public may not receive timely warning.	Public notification device/channel failed or absent where required.
	Message templates, accessibility, and multilingual readiness	Templates are clear, current, and accessible to intended users.	Minor language or formatting update needed.	Templates incomplete or outdated for some hazards or audiences.	Messages may be confusing, delayed, or inaccessible to key audiences.	No usable message template or accessible communication method for urgent alerts.

Flood Early Warning Systems

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Warning Dissemination and Public Notification (Cont' d.)	Siren/manual activation, backup alert method, and test records (if present)	Manual activation, backup alert method, and test records verified where applicable.	Minor documentation update needed; system remains usable.	Test records, manual activation method, or backup alert method not recently verified.	Manual activation or backup alert method unreliable; warning issuance could be delayed.	No usable manual activation or backup alert method for a public warning device where required.
	Coordination with emergency management, NWS, or partner agencies	Coordination procedures and data-sharing contacts are current.	Minor partner contact update needed.	Coordination not recently exercised; responsibilities may be unclear.	Partner coordination gaps could delay field response or warning issuance.	No functioning coordination process during flood warning conditions.
Site Access, Security, and Safety	Site access route and work area condition	Access route clear and safe for routine service.	Minor vegetation, rutting, or soft ground; caution needed.	Access limited; extra equipment or scheduling needed.	Access unsafe without traffic, slope, or water controls.	Access impossible or immediately dangerous; site cannot be serviced safely.
	Fencing, locks, signage, or enclosure security	Security features intact and legible.	Minor wear; site remains secure.	Damaged sign, lock, or enclosure; repair needed.	Security compromised; unauthorized access likely.	Open, unsecured, or hazardous site with immediate safety/security concern.
	Evidence of vandalism, tampering, theft, or animal damage	No evidence observed.	Minor nuisance damage; no system effect.	Tampering or animal damage requires repair and increased monitoring.	Damage affects equipment function or site security.	Critical damage, theft, or repeated tampering disables the warning site.
	Flood, debris, electrical, wildlife, or traffic hazards at site	No hazards observed.	Minor hazard manageable with standard procedures.	Hazard present; additional controls needed for maintenance.	Serious hazard; restrict access until controls are in place.	Immediate danger; stop work and escalate to emergency/safety lead.

Flood Early Warning Systems

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Overall Rating Based on Impacts to People and Infrastructure	Threat to warning reliability	No threat to warning reliability.	Minor reliability concern; routine correction acceptable.	Notable reliability concern; schedule corrective action.	Significant reliability threat; warning performance may fail during next event.	Critical failure; system cannot support dependable flood warning.
	Threat to emergency response operations	No impact to emergency response.	Minor operational inconvenience.	Response coordination could be slowed or less informed.	Emergency response decisions may be delayed or based on incomplete data.	Emergency response operations lack critical warning information.
	Threat to critical facilities or vulnerable populations	No critical exposure affected.	Minor exposure concern with alternative information available.	Notable exposure concern; prioritize correction if facility/population depends on site.	Significant exposure; critical facility or vulnerable area may lack timely warning.	Immediate risk to critical facility, evacuation route, or vulnerable population warning coverage.
	Public safety hazards	No safety hazard.	Minor hazard; mark or monitor.	Hazard present; controls needed before routine work.	Serious hazard; restrict access and prioritize repair.	Immediate danger to public or workers; emergency controls required.

Flood Early Warning Systems



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

System Name/ID			
Location			
Date/Time	START: ____ / ____ / ____	END: ____ / ____ / ____	
Foreman			
Maintenance Crew			
Contractor			
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F		
Inspection Timing	☐ Routine ☐ Pre-Storm ☐ Post-Storm ☐ Annual		
System status before maintenance	☐ Online ☐ Intermittent ☐ Offline ☐ Unknown		
Public warning or operations affected?	☐ Yes ☐ No ☐ Unknown		
Approximate outage/impaired service window	START: _____ END: _____ N/A		
Other/Details			
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____		

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up
☐ Complaint/service request	☐ Emergency/safety issue	☐ Sensor/gauge calibration issue
☐ Telemetry/communication failure	☐ Power system issue	☐ Dashboard/data issue
☐ Public notification device issue	☐ Vandalism/security issue	☐ Other (describe below)
☐ Failed routine test	☐ False alarm/missed alert follow-up	☐ Operations plan/contact list update

System Name/ID: _____ Foreman Initials: _____

Flood Early Warning Systems



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Other/Details:

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Clean rain gauge/sensor face	☐ Gauge calibration/verification
☐ Replace or repair sensor	☐ Repair gauge mount/mast/enclosure	☐ Remove debris or sediment near sensor
☐ Telemetry troubleshooting	☐ Antenna/radio/modem repair	☐ Cable/connector replacement
☐ Battery replacement or testing	☐ Solar panel cleaning/repair	☐ Charge controller/wiring repair
☐ Generator/backup power test	☐ Dashboard or software update	☐ Alarm rule/threshold adjustment
☐ Contact list/notification update	☐ Public warning device test	☐ Siren/flasher/sign repair
☐ Camera cleaning or alignment	☐ Security repair (locks/fencing/signage)	☐ Vegetation management at site
☐ Vendor/IT service performed	☐ Review false alarm/missed alert cause	☐ Test or outage notice documented
☐ Manual/remote alert activation test	☐ Backup power/communication failover test	☐ Other (describe below)
☐ Update operations plan/threshold log	☐ Update public education or message template	

Other maintenance actions performed:

System Name/ID: _____ Foreman Initials: _____

Flood Early Warning Systems



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

AREAS ADDRESSED

☐ Rain gauge	☐ Stream/stage gauge	☐ Road water-level sensor
☐ Camera	☐ Telemetry enclosure	☐ Antenna/repeater
☐ Battery/solar power system	☐ Generator/backup power	☐ Dashboard/database
☐ Forecasting or model feed	☐ Warning threshold/alarm rules	☐ Sirens/flashers/signs/gates
☐ Site access route	☐ Fencing/locks/security	☐ Data-sharing or MOU coordination
☐ Public messaging platform/IPAWS/alert vendor	☐ Siren activation trigger/manual override	☐ Other (describe below)

Other areas addressed:

MATERIALS AND EQUIPMENT USED

Equipment used (e.g., voltmeter, laptop, lift truck, antenna tester, calibration tools):

Maintenance hours/staff:

Materials used (e.g., battery, sensor, modem, antenna, cable, fuse, sealant, lock):

Quantity of materials (e.g., number, LF, units):

System Name/ID: _____ Foreman Initials: _____

Flood Early Warning Systems



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

SAFETY AND ENVIRONMENTAL CONTROLS

☐ Site access controlled and safe	☐ Traffic control in place (if needed)
☐ Electrical safety procedures followed	☐ Work performed outside active high flow/safe water conditions
☐ No fuel, oil, or material spills	☐ Equipment enclosure sealed and secured after work
☐ Data flagged if readings were unreliable during maintenance	☐ Area left clean and stable after work

CONDITION AFTER MAINTENANCE

System condition after work: ☐ Restored/acceptable ☐ Improved ☐ Still deficient	Communications after work: ☐ Stable ☐ Improved ☐ Needs follow-up ☐ N/A
Power condition after work: ☐ Stable ☐ Improved ☐ Needs follow-up ☐ N/A	Data/dashboard condition after work: ☐ Current and reliable ☐ Improved ☐ Still unreliable ☐ N/A
Warning notification condition after work: ☐ Tested and functional ☐ Improved ☐ Needs follow-up ☐ N/A	Site security/access after work: ☐ Secure and accessible ☐ Improved ☐ Needs follow-up
System returned to operational status: ☐ Yes ☐ No ☐ Restricted/Watch Status (describe below)	
Return-to-service notice issued to affected staff/partners/public (if applicable): ☐ Yes ☐ No ☐ N/A	
Operations plan, contact list, threshold log, or test schedule updated: ☐ Yes ☐ No ☐ N/A	

System Name/ID: _____ Foreman Initials: _____

Flood Early Warning Systems



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Other/Details:

DOCUMENTATION			
Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A
Vendor/IT ticket recorded:	☐ Yes	☐ No	☐ N/A
Calibration/test records attached:	☐ Yes	☐ No	☐ N/A
Test/activation/failover logs attached:	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED?

☐ Yes☐ No☐ N/A

(If yes, describe trigger)

Follow-Up Actions	Goal Resolution Date	Responsible Person

Maintenance Form



Notes and Observations:

System Name/ID: _____ Foreman Initials: _____

How to Maintain Your Stormwater Channels



What is it?

Stormwater channels are engineered or modified ditches and waterways that safely move stormwater runoff to rivers, creeks, or ponds.

Who maintains it?

Typically, stormwater channels are owned, maintained, and operated by cities; however, counties, drainage districts, or private entities such as homeowners' associations (HOAs) may also own/maintain these assets. Regardless of ownership, it is important to understand where the channels discharge and how they affect the community's flood infrastructure. Check whether the community has the authority and responsibility to inspect and maintain them, and whether there are any maintenance agreements between the community and the county, drainage district, or HOAs.

Best maintenance practices & strategies

Stormwater channels are built to safely carry water during rain events. Over time, trash, sediment, vegetation, and erosion can degrade their ability to perform this task. Routine inspection and maintenance can protect the channel's flow path, reduce flooding, and extend the asset's service life.

A. INSPECTION

Inspections confirm that the channel can still carry stormwater as intended and that water flows freely without causing damage. An inspection checklist for stormwater channels is included with this reference sheet.

Inspection skill needs:

- Ability to recognize blocked or narrowed flow paths
- Awareness of erosion, slumping banks, and damaged linings
- Familiarity with basic channel features such as slopes, bottoms, culverts, and outfalls
- Ability to safely observe conditions without entering fast-moving water
- Ability to document conditions clearly

What to look for:

- **Trash, debris, or sediment reducing channel depth or width.** Trash, fallen branches, and sediment can slowly fill the channel. When this happens, the channel cannot carry as much water as it was designed to handle. Even small buildups can raise water levels during storms and cause overflow. Sediment buildup often starts along the channel bottom or edges and grows over time if not removed.
- **Vegetation growing in the main flow path.** Vegetation in the center or bottom of the channel slows water and traps debris. This reduces flow capacity and increases the chance of flooding. While plants on the banks can help stabilize soil, plants growing where water is meant to flow freely should be controlled or removed.
- **Eroded banks or undercut slopes.** Erosion weakens the channel banks and can cause sections to collapse. Undercut slopes are especially dangerous because they may fail suddenly without warning. Bank erosion can also add sediment to the channel, further reducing capacity and increasing maintenance needs.

- **Cracked, missing, or displaced concrete or rock lining.** Concrete or rock linings protect the channel from erosion. Cracks, missing pieces, or shifted rocks allow water to reach and erode the underlying soil. Over time, this damage can spread and lead to larger structural failures or channel collapse if not repaired early.
- **Culverts or outfalls partially or fully blocked.** Culverts and outfalls are key points where water enters or leaves the channel. Blockages at these locations can cause water to back up quickly during storms. Even partial blockages can significantly reduce flow and increase the risk of upstream flooding.
- **Signs that water is flowing outside the channel during storms.** Evidence such as flattened grass, debris lines, stained soil, or erosion outside the channel indicates that stormwater is escaping the intended flow path. This may mean that the channel is undersized, blocked, or damaged. Overflow can threaten nearby roads, utilities, and private property.
- **Standing water where flow should drain freely.** Water that remains in the channel long after rainfall may indicate poor drainage, blockages, or low spots caused by sediment buildup or settlement. Standing water can weaken soils, attract mosquitoes, and signal reduced channel performance.

How to record conditions:

- Use a standard inspection form or digital tool. A consistent form ensures inspections are complete and comparable over time. Standardized records help track recurring problems, support maintenance planning, and provide documentation for budgeting and repairs.
- Record location, date, weather, and observed issues. Accurate location and date information help crews return to the right place and understand when issues began. Weather conditions provide context, especially if problems are related to recent storms or prolonged dry periods.
- Note whether flow capacity appears clear, restricted, or severely restricted. This simple rating helps prioritize work. Clear means water can flow freely. Restricted means some blockage or narrowing is present. Severely restricted means flooding or failure is likely if conditions persist.
- Take photos of erosion, blockages, or damage. Photos provide visual evidence of conditions and help supervisors and engineers assess severity without an immediate site visit. They also help track changes over time and confirm when repairs are complete.

- Flag urgent issues that could cause flooding or structural failure. Problems that threaten public safety, infrastructure, or property should be clearly marked as urgent. Early reporting allows faster response and reduces the risk of emergency repairs during storms.

B. MAINTENANCE

Maintenance restores the channel's ability to carry water safely and prevents minor issues from escalating into major repairs. A maintenance checklist for stormwater channels is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools for trash and light vegetation removal
- Mowers or trimmers suitable for slopes and channel bottoms
- Equipment for sediment removal when the buildup is significant
- Materials for minor bank stabilization or lining repair
- Training in safe work near water and on uneven ground

Key maintenance goals:

- Remove trash, debris, and sediment after storms. Storms often carry trash, branches, and soil into channels. This material reduces the space available for water to flow. If not removed, it can cause water to back up or overflow during the next rain. Removing debris soon after storms restores channel capacity and reduces future flood risk.
- Keep the main flow path clear and open. The main flow path is where water naturally moves during storms. Obstructions in this area impede water flow and direct it toward the banks or out of the channel. Keeping this path open helps water move safely downstream and protects nearby property and infrastructure.
- Mow and manage vegetation to maintain flow and inspection access. Vegetation can block water flow and hide damage if it grows unchecked. Regular mowing and trimming keep the channel visible and accessible for inspections. Vegetation within the channel should be maintained based on channel design. Mowing may not be needed for stormwater channels designed to include native vegetation.
- Repair small erosion areas before they spread: Small erosion spots grow quickly during repeated storms. Early repairs prevent larger bank failures and reduce repair costs. Addressing erosion early also limits downstream sediment transport, preventing additional blockages.

- Reset or replace displaced riprap or lining. Rock or concrete linings protect channels from erosion. When rocks shift or lining cracks, flowing water can reach bare soil. Resetting or replacing damaged protection restores stability and prevents further channel degradation.
- Clear culverts, outfalls, and appurtenances of blockages. Culverts and outfalls are critical points where water enters or exits the channel. Blockages at these locations can cause rapid upstream flooding. Keeping them clear ensures stormwater moves through the system as intended.
- Restore native vegetation or buffer areas where it is possible to improve stability. Native plants help hold soil in place and reduce erosion along channel banks. Restoring buffer areas where appropriate improves long-term stability and reduces maintenance needs. These areas also help slow runoff and trap sediment before it enters the channel. Maintenance crews should not mow down vegetation that was specifically designed and established to be taller and native.

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Conduct walk-through or drive-by inspections. Regular checks help catch issues early and maintain familiarity with channel conditions.
- Remove light debris and manage vegetation. Small amounts of routine maintenance prevent larger problems later.
- Check culverts and outfalls for early blockage. Early signs of blockage are easier to fix and reduce flood risk.
- Note changes in flow patterns or erosion. Changes in how water moves can signal developing problems.
- Update inspection records. Accurate records support planning, budgeting, and accountability.

2. Annual maintenance and comprehensive review

- Perform a full inspection of each channel segment. An annual inspection provides an overall picture of channel condition. It helps identify gradual changes that may not be obvious during quick checks.
- Compare current conditions to past inspection records. Comparing records shows whether conditions are improving or worsening. This helps crews focus on recurring trouble spots.
- Identify areas where sediment or vegetation is slowly reducing capacity. Slow changes can eventually cause major problems. Identifying these areas early enables planned maintenance rather than emergency repairs.

- Plan routine mowing, sediment removal, and minor repairs. Planned work is safer and more cost-effective than emergency response. Scheduling routine tasks helps maintain consistent performance.
- Review sections approaching the end of their service life. Older channel sections may need more frequent attention. Early planning allows for timely repair or replacement.

3. Pre-, in-, and post-storm events

Pre-storm events

- Inspect known trouble spots and low points. These areas are more likely to flood or clog. Checking them early reduces the need for emergency response.
- Remove visible debris from channels and culverts. Clearing debris before storms helps prevent blockages when water levels rise.
- Ensure access routes are clear for emergency response. Crews must be able to reach problem areas quickly during storm events.

In-storm events (only when safe)

- Monitor known problem areas. During active storms, known low points, bends, culverts, and undersized sections should be monitored if conditions allow. These locations are more likely to clog or overflow first. Observations during storms provide valuable information about how the channel actually performs under real conditions.
- Watch for rapid debris accumulation. Floating debris can quickly collect at culverts, trash racks, and narrow channel sections. If it is safe to do so, crews may remove visible blockages to prevent water from backing up. Crews should never enter fast-moving water or unstable areas.
- Observe flow behavior. Crews should note how water moves through the channel. Pay attention to areas where water overtops banks, bypasses the channel, or flows toward nearby structures. These observations help identify undersized or poorly performing sections that may require repair or redesign.
- Identify immediate safety hazards. During storms, erosion, slope failure, or undermining can happen quickly. If conditions threaten roads, utilities, or public safety, crews should report the issue immediately and coordinate with emergency or supervisory staff as needed.
- Prioritize safety over maintenance. No maintenance activity should put staff at risk. Work should stop if water velocity, depth, visibility, or weather conditions become unsafe. Documentation and observation are often the most valuable tasks during peak storm conditions.

Post-storm events

- Inspect channels as soon as conditions are safe. Early inspection identifies damage before the next storm occurs.
- Remove storm-deposited debris and sediment. Storms often leave new material behind. Removing it restores channel function.
- Check for new erosion, bank failure, or lining damage. Storm flows can cause sudden damage. These issues should be documented and addressed.
- Document damage and schedule needed repairs. Clear records ensure problems are tracked and repaired in a timely manner.

4. Repair vs. replacement considerations

- Is this channel critical for flood protection? Channels that protect homes, roads, or utilities should be prioritized. Failure in these areas has higher consequences.
- Does the issue reduce the channel's ability to carry storm flows? Any condition that limits flow capacity increases flood risk. These issues should be addressed promptly.
- Could failure impact homes, roads, or utilities? Potential impacts to people or infrastructure raise the priority of repairs. Safety and access should always come first.
- Does erosion threaten structural stability? Erosion near structures or steep banks can lead to sudden failure. These areas require immediate attention.
- Will delaying repairs increase long-term costs? Small repairs are usually cheaper than large reconstructions. Delays often lead to higher future expenses.

Stormwater Channels

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Channel Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: °F
Inspection Timing	☐ Routine ☐ Pre-Storm ☐ Post-Storm ☐ Annual
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Fast water	☐ Severe weather	☐ Bank failure	☐ Unsafe access
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Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Flow Path and Capacity	Overall	☐	☐	☐	☐	☐
	Flow path obstructed	☐	☐	☐	☐	☐
	Overtopping evident	☐	☐	☐	☐	☐
	Standing water after storms	☐	☐	☐	☐	☐
Trash, Debris, and Dumping	Overall	☐	☐	☐	☐	☐
	Aesthetics impacted	☐	☐	☐	☐	☐
	Trash restricting flow	☐	☐	☐	☐	☐
	Large obstructions due to debris	☐	☐	☐	☐	☐
	Illegal dumping evident	☐	☐	☐	☐	☐
	Debris traps blocked (if present)	☐	☐	☐	☐	☐
Sedimentation	Overall	☐	☐	☐	☐	☐
	Sediment is reducing the width/depth	☐	☐	☐	☐	☐
	Bars are forcing flow into banks	☐	☐	☐	☐	☐
	High-deposit areas are unstable	☐	☐	☐	☐	☐

Channel Name/ID: _____ Inspector Initials: _____

Stormwater Channels

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Vegetation Condition	Overall	☐	☐	☐	☐	☐
	Channel bottom choked	☐	☐	☐	☐	☐
	Banks are unstable due to vegetation	☐	☐	☐	☐	☐
	No access for crews	☐	☐	☐	☐	☐
Stability and Erosion	Overall	☐	☐	☐	☐	☐
	Active erosion	☐	☐	☐	☐	☐
	Exposed roots creating soil voids	☐	☐	☐	☐	☐
	Encroachment on improvements	☐	☐	☐	☐	☐
Lining/Rock Protection	Overall	☐	☐	☐	☐	☐
	Concrete/lining eroded	☐	☐	☐	☐	☐
	Rock protection is unstable	☐	☐	☐	☐	☐
	Inadequate protection at bends/drops	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to roads/bridges	☐	☐	☐	☐	☐
	Utilities impacted	☐	☐	☐	☐	☐
	Homes/structures impacted	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Channel Name/ID: _____ Inspector Initials: _____

Inspection Checklist



Channel Name/ID: _____ Inspector Initials: _____

Stormwater Channels

Rubrics and Guidelines



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Flow Path and Capacity	Flow path obstructed	Small localized obstruction. Flow is still free.	Obstruction reduces flow in one spot. Water slows but continues to pass.	Obstruction causes noticeable backup during rain. Water spreads within the channel.	Obstruction causes frequent overflow or bypass at that location.	Obstruction causes flooding outside the channel or creates a safety hazard (washout, collapse risk, or emergency response required).
	Overtopping evident	Overtopping is limited to the bank edge only. No offsite impact.	Overtopping reaches the floodplain/adjacent open ground. No roads affected.	Overtopping impacts streets/driveways or blocks access.	Overtopping reaches buildings/houses (yards, garages, foundations threatened) and/or poses a significant hazard on the roadway.	Overtopping causes flooding of occupied structures, creates an emergency hazard, or threatens life safety.
	Standing water after storms	Puddles drain within 24 hours. No odor.	Water remains 1–3 days. Minor nuisance.	Water remains for 3–7 days, causing soft ground and erosion spots.	Water remains >7 days, emits odors, supports mosquito habitat, or undermines banks.	Persistent standing water with public health risk, sinkholes, or clear capacity failure.
Sedimentation	Sediment is reducing the width/depth	Thin layer or small patches. No capacity loss.	Sediment along edges. Minor narrowing.	Noticeable buildup reducing capacity in a segment.	Major deposits are reducing capacity and redirecting flow.	Severe deposits causing overtopping, chronic standing water, or blockage at structures.
	Bars are forcing flow into banks	Small bars present, flow still centered.	Bars begin to push the flow toward one bank.	Flow regularly hits the bank and starts erosion.	Bank erosion is active and expanding due to redirected flow.	Rapid bank failure or infrastructure threat driven by redirected flow.
	High-deposit areas are unstable	Deposits are stable and vegetated or compacted.	Minor shifting during storms. No damage.	Deposits move and clog downstream points.	Deposits repeatedly reform after removal or storms.	Deposits trigger flooding, culvert burial, or channel failure.

Stormwater Channels

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Trash, Debris, and Dumping	Aesthetics impacted	Very clean.	Clean.	Noticeable.	Unsightly.	Unacceptable.
	Trash restricting flow	Light litter. No flow restriction.	Accumulation in one spot. The flow is slightly slowed.	Repeated accumulation that narrows the flow path.	Heavy trash is restricting flow at multiple points or at structures.	Trash causes backups or overflows or creates an immediate hazard.
	Large obstructions due to debris	Single small branch. Easy removal by hand tools.	Several branches/logs, but water still passes.	Log jam forming or debris wedged at the bend/structure.	Major blockage at culvert/outfall/trash rack causing backup.	Complete blockage causing flooding, bank failure, or emergency risk.
	Illegal dumping evident	Small household waste. No flow impact.	Dumped materials are present but do not restrict the flow.	Dumping includes bulky items or repeated piles.	Dumping restricts channel access or partially blocks the flow.	Dumping includes hazardous materials or causes flooding/safety risk.
	Debris traps blocked (if present)	<25% blocked. Function intact.	25–50% blocked. Needs scheduling.	50–75% blocked. High risk next storm.	>75% blocked. Likely backup.	Fully blocked or causing current flooding/overflow.
Vegetation Condition	Channel bottom choked	Light growth. Flow path still open.	Moderate growth is slowing the water in places.	Dense growth narrowing flow path over a segment.	Growth blocks flow at multiple points or around structures.	Channel bottom effectively blocked; overtopping likely or occurring.
	Banks are unstable due to vegetation	Vegetation stable; no damage.	Roots are lifting lining or creating small voids.	Vegetation weight/roots contributing to slumping.	Bank failures are linked to vegetation (trees leaning, undermined roots).	Major collapse risk or failure tied to vegetation, threatening infrastructure.
	No access for crews	Access is slightly difficult but possible.	Access limited; requires extra time/equipment.	Large sections are not reachable with standard equipment.	Access prevents routine maintenance; hazards are present.	Access is unsafe or impossible; emergency response is hindered.

Stormwater Channels

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Stability and Erosion	Active erosion	Minor surface rills.	Small erosion spots are developing.	Erosion expanding; sediment entering the channel.	Significant erosion threatens bank stability.	Rapid erosion with collapse risk or immediate infrastructure threat.
	Exposed roots creating soil voids	Minor root exposure.	Root exposure with small voids.	Voids increasing; slumping likely.	Roots undermined; bank losing support.	Bank failure is likely or occurring at the root zone; hazards are present.
	Encroachment on improvements	Erosion far from assets.	Erosion is moving toward assets, but they are still separated.	Erosion within a "near zone" of roads/utilities/fences.	Erosion, undermining, or exposing utilities/structures.	Active threat to roads, bridges, utilities, or buildings (immediate action).
Lining/Rock Protection	Concrete/lining eroded	Minor surface wear.	Small cracks/spalls, but still largely functional.	Multiple cracks or missing pieces in spots.	Large areas damaged; soil exposed behind/under.	Widespread failure; structural integrity compromised; erosion accelerating.
	Rock protection is unstable	Minor displacement, stable overall.	Several rocks shifted; still protects the bank.	Gaps form; soil begins to erode.	Significant rock loss; bank unprotected in key areas.	Major washout; bank failure likely/occurring.
	Inadequate protection at bends/drops	Protection intact; no scour signs.	Minor scour indicators; protection borderline.	Clear scour is developing; protection needs an upgrade.	Severe scour; failures are likely next storm.	Active failure at the bend/drop threatens channel stability/infrastructure.

Stormwater Channels

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Overall Rating Based on Impacts to People and Infrastructure	Threat to roads/bridges	No threat.	Minor shoulder/edge impacts.	Road/bridge approach at risk during storms.	Undermining or damage present; closures possible.	Immediate failure risk or active damage requiring urgent action.
	Utilities impacted	No exposure.	Early exposure signs (minor scour).	Utility exposure visible; stability concern.	Utility support compromised; failure likely.	Utility failure imminent/occurred; public safety risk.
	Homes/structures impacted	No risk.	Yard impacts only.	Repeated nuisance flooding near structures.	Structural threat (foundation/retaining elements at risk).	Flooding in occupied structures or imminent structural damage.
	Public safety hazards	No hazards (no roadway flooding).	Minor hazards (roadway flooding unlikely; nuisance only).	Hazards present—controls needed (roadway flooding possible in intense rain events; short-term driving hazard).	Serious hazard (nuisance road flooding likely in frequent rain events and hazardous road/public infrastructure flooding likely in intense rain events; unsafe for vehicles/access).	Immediate danger (hazardous road/public infrastructure flooding likely in any significant rain event; high risk to the public).

Stormwater Channels

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Channel Name/ID	
Location	
Date/Time	START: _ / _ / _ END: _ / _ / _
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Inspection Timing	☐ Routine ☐ Pre-Flood ☐ Post-Flood ☐ Annual
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up	☐ Complaint/service request Date received: _____	☐ Emergency/safety issue or in-storm event
--	--	---	--	---

MAINTENANCE ACTIVITIES PERFORMED

☐ Trash and debris removal	☐ Sediment removal	☐ Vegetation mowing or trimming
☐ Bed/bank stabilization or erosion repair	☐ Access path restoration	☐ Other (describe below)

Other maintenance actions performed:

Channel Name/ID: _____ Foreman Initials: _____

Stormwater Channels

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

AREAS ADDRESSED

- | | | | | |
|---|------------------------------------|-------------------------------------|--|---|
| ☐ Channel bottom/flow path | ☐ Left bank | ☐ Right bank | ☐ Culvert/inlet | ☐ Other (describe below) |
|---|------------------------------------|-------------------------------------|--|---|

Other areas addressed:

MATERIALS AND EQUIPMENT USED

Equipment used (e.g., mower, excavator, vacuum truck):

Maintenance hours/staff:

Materials used (e.g., riprap, soil, seed, concrete):

Quantity of materials (e.g., volume or weight):

SAFETY, ENVIRONMENTAL, AND REGULATORY CONTROLS

- | | |
|---|---|
| ☐ Site access controlled and safe | ☐ Area left clean and stable |
| ☐ Work performed outside active flow | ☐ Erosion and sediment controls in place |
| ☐ No fuel, oil, or material spills | |

Channel Name/ID: _____ Foreman Initials: _____

Stormwater Channels

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

CONDITION AFTER MAINTENANCE	
Function/structural condition after work:	Embankment/slope condition after work:
☐ Restored/Acceptable	☐ Stable
☐ Improved	☐ Improved
☐ Still restricted	☐ Needs follow-up

DOCUMENTATION	
Before photos attached: ☐ Yes ☐ No	After photos attached: ☐ Yes ☐ No

ENGINEERING REVIEW REQUIRED? ☐ Yes ☐ No ☐ N/A

(If yes, describe trigger)

Follow-Up Actions	Goal Resolution Date	Responsible Person

Stormwater Channels

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Follow-Up Actions	Goal Resolution Date	Responsible Person

Notes and Observations:

Attach additional pages, if required

How to Maintain Your Storm Drain Systems



What is it?

A storm drain system is the network that collects runoff from streets and developed areas and conveys it to a discharge point. The storm drain system includes these core assets:

- Mains (Conduits and Culverts)
- Manholes
- Catch Basins/Inlets
- Outfalls

Who maintains it?

Typically, storm drain systems are owned, maintained, and operated by cities; however, counties, drainage districts, DOTs, or private entities (e.g., HOAs, commercial centers) may own or maintain portions. Regardless of ownership, communities should confirm:

- Asset ownership boundaries (public vs. private)
- Access rights (easements, outfall access, fenced properties)
- Maintenance responsibility (who cleans, who repairs, who replaces)
- Emergency response coordination (street flooding, road hazards, sinkholes)

Best maintenance practices & strategies

Storm drains are designed to convey water safely and quickly, but over time, trash, sediment, oils, roots, and structural deterioration can reduce capacity and lead to flooding, sinkholes, or water-quality issues. These systems often fail in predictable ways: inlets clog, sumps fill, pipes silt in, culverts plug, and outfalls erode or become blocked. Routine inspection and maintenance protect conveyance capacity, reduce flood complaints, and extend asset life.

A. INSPECTION

Inspections confirm the system can still capture runoff at inlets, convey it through mains, and discharge it safely at outfalls, without backups, flooding, or damage. Inspection checklists for each stormwater drain system asset are included with this reference sheet.

Signs the storm drain system is not performing as designed:

- Street or yard ponding near inlets even during moderate rain
- Water rising from manholes or gurgling and surcharging at inlets during storms
- Standing water in inlets long after rainfall ends
- Sediment cones, trash mats, or leaf buildup at inlet openings
- Sinkholes, pavement settlement, or cracking along pipe alignments. Outfall erosion, undermining, or blocked discharge
- Dry weather flow at outfalls that appears abnormal, which may indicate an illicit connection or other issue

Inspection skill needs:

- Ability to recognize capture problems, such as blocked inlets, silted sumps, versus conveyance problems such as pipe restrictions, surcharging
- Familiarity with asset types and function, such as mains and conduits, culverts, manholes, catch basins, and outfalls
- Ability to identify structural red flags, such as cracks, displacement, corrosion, deformation, and settlement
- Ability to recognize illicit discharge indicators, such as staining, odors, unusual flow during dry weather, and follow reporting protocols

- Ability to document conditions clearly, such as photos, location, and asset ID, and simple condition ratings

How to record conditions:

- Use a standard inspection form or digital tool. A consistent form ensures inspections are complete and comparable over time. Standardized records help track recurring problems, support maintenance planning, and provide documentation for budgeting and repairs.
- Record location, date, weather, and observed issues. Accurate location and date information help crews return to the correct location and determine when the issue began. Weather conditions provide context, especially if problems are related to recent storms or prolonged dry periods.
- Note whether flow capacity appears clear, restricted, or severely restricted. This simple rating helps prioritize work. Clear means water can flow freely. Restricted means some blockage or narrowing is present. Severely restricted means flooding or failure are likely if conditions persist.
- Take photos of erosion, blockages, or damage. Photos provide visual evidence of conditions and help supervisors and engineers assess severity without an immediate site visit. They also help track changes over time and confirm when repairs are complete.
- Flag urgent issues that could cause flooding or structural failure. Problems that threaten public safety, infrastructure, or property should be clearly marked as urgent. Early reporting allows faster response and reduces the risk of emergency repairs during storms.

B. MAINTENANCE

Maintenance restores the system's ability to capture and convey stormwater and prevents minor issues from escalating into major repairs. Maintenance checklists for each stormwater drain system asset are included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools for grate clearing and debris removal
- Vacuum and vactor (vacuum excavator) equipment for catch basin cleanout and structure cleaning
- Jetting and flushing equipment for mains where sediment deposits recur
- CCTV inspection capability (in-house or contractor) for condition assessment
- Traffic control capability for work in streets
- Confined space training and equipment where entry is

required (only when authorized)

- Safe handling practices and disposal options for collected debris and sediments

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Conduct drive-by or walk-by checks of known hot spots such as low points, high leaf streets, or heavy litter corridors
- Clear visible debris from inlet grates and curb openings
- Check culvert ends and outfalls for early blockage and erosion
- Update inspection records and log recurring locations for increased frequency

2. Annual maintenance and comprehensive review

- Perform a full inlet and catch basin inspection cycle and clean where needed
- Review records to identify repeat clog inlets and repeat deposit pipe segments
- Schedule targeted jetting and flushing for mains with recurring sediment
 - Prioritize CCTV inspection for pipe segments with:
 - Repeated backups and surcharging
 - History of flooding in the area
 - Sinkholes and settlement reports
- High consequence locations such as arterial roads or near critical facilities such as hospitals
- Review assets trending toward the end of life and plan repairs and rehabilitation proactively

3. Pre-, in-, and post-storm events

Pre-storm events

- Clear known problem inlets (especially low points and sag locations)
- Remove visible debris at culvert entrances and outfalls
- Confirm crews can access critical locations (gates unlocked, paths passable)
- Pre-stage barricades near chronic road overtopping locations

In-storm events (only when safe)

- Monitor known trouble locations for surcharging or rapid debris accumulation
- Document observed performance issues (where water ponds, where it overtops, where manholes surcharge)
- Prioritize personal and public safety. Avoid fast water,

unstable ground, and lightning.

- Deploy road barricades to close road sections when it becomes apparent that there is a high risk of hazardous overtopping. Continuously monitor or frequently check high-hazard locations to prevent barricades from being moved.

Post-storm events

- Remove storm-deposited debris from inlets, culvert ends, and outfalls
- Inspect outfalls for new erosion, undermining, or exposed pipe
- Identify new hot spots created by the event and update the priority list
- Take pictures of high water marks and debris lines

4. Factors that may influence the maintenance schedule

Use these to decide whether to stay at routine frequency or escalate to enhanced inspection and preventive maintenance:

- Storm intensity. Increasing rainfall intensity, short-duration high peak events.
- Overflows and surcharging. Water backing up, manholes surcharging, recurring street flooding.
- Sinkholes and settlement. Voids forming along mains, pavement cracking, and depressions.
- Collapsed mains or near-collapse indicators. Deformation, severe joint separation, major blockages that return quickly.
- Nearby critical facilities. Hospitals, fire stations, schools, evacuation routes, major arterials, utilities corridors.
- Optional common triggers (if you track them). Repeat clog locations, heavy sediment sources, construction, and nearby development.

5. Planned maintenance and inspection schedule

Use as a starting point, then increase the frequency where risk drivers are present.

Routine planned inspections

- Inlets and catch basins: routine checks in known hot spots and periodic checks system-wide
- Outfalls: periodic checks plus post-storm checks where erosion or blockage is common
- Manholes and junctions: periodic checks, especially at low points and known surcharge areas
- Mains and culverts: scheduled assessments; CCTV on a rotating basis or where symptoms occur

Routine planned maintenance

- Catch basin cleanout: scheduled, with increased frequency at repeat-fill locations
- Debris removal: inlet grates, curb openings, culvert ends, and outfalls
- Mainline cleaning: jetting and flushing in segments with recurring deposits

Enhanced preventive program (when risk drivers are present)

- Increase inspection frequency at priority assets: critical corridors, chronic overflow basins
- Add targeted CCTV screening (before failures occur)
- Establish hot-spot cleaning routes: repeat clog or repeat deposit segments

6. Repair vs. replacement considerations

Factors that indicate continued maintenance and repair

Choose repair/rehabilitation when:

- The issue is localized, and the rest of the assets are structurally stable
- Capacity is adequate, and the problem is blockage-related or minor structural distress
- Rehabilitation methods are appropriate (lining feasible, joints repairable, manhole rehab viable)
- Failures do not repeat after reasonable preventive maintenance

Factors that indicate asset replacement or redesign

Consider replacing or redesigning when:

- Repeated failures, such as recurring severe pipe or manhole collapse and chronic sinkholes, occur
- The main is undersized for current and expected conditions, resulting in frequent overflows even when clean
- Deteriorated lining or widespread structural defects make rehab unreliable
- Repairs are ineffective or repeatedly failing, increasing life-cycle cost and risk
- Design/engineering standards require changes with regard to access, resiliency, hydraulic capacity, safety, and constructability
- The consequences of failure could be severe (e.g., hazardous road overtopping, significant structural flooding, and risk to other key infrastructure)

Asset Type	Key Inspection Goals	Key Maintenance Goals
Catch Basins/Inlets 	Catch basins and inlets capture runoff and trap debris and sediment before it enters pipes. - Blocked openings: Leaves, litter, grass clippings, or sediment covering grates or curb openings reduce capture and cause street ponding. - Sediment level: If the basin/inlet is filling with sediment, the inlet is losing its ability to trap sediment and will pass material downstream, increasing pipe deposits. - Damaged or unsafe grates and frames: Broken grates, loose frames, missing bolts, or misaligned structures can create hazards and allow debris entry. - Settlement around the inlet: Depressions, cracking, or rocking structures suggest undermining or poor support. - History of repeated clogging: Indicates the area may need more frequent service, upstream housekeeping, or improved source control (street sweeping and litter control).	- Remove trash and organic debris routinely. Keeping inlet openings clear prevents immediate surface flooding and reduces emergency calls. - Clean sumps before capacity is lost. When sumps fill, sediment moves downstream, leading to pipe deposits and more costly maintenance. - Repair or replace damaged grates and frames. Unsafe grates are a public hazard and allow debris entry and structural damage. - Reset settled inlets. Settlement can create chronic ponding and accelerate pavement failure.
Manholes 	Manholes provide access and connections for storm drain mains, transitions, and direction changes. - Surcharging indicators: Water marks, debris lines, or reports of surcharging during storms suggest downstream restriction or inadequate capacity. - Structural condition: Cracks, displaced rings, corrosion, spalling, or broken lids. - Infiltration and exfiltration clues: Staining, persistent dampness, soil loss, or voids can signal leakage and erosion around the structure. - Access and safety: Lids that are difficult to open, damaged steps, or unsafe access areas.	- Remove sediment and debris at manholes where material accumulates, often at direction changes or low points. - Repair lids, rings, and frames to maintain safe access and prevent inflow of unwanted material. - Address leakage and voids early. Structural leakage can erode surrounding soils, causing settlement and potential collapse.

Asset Type	Key Inspection Goals	Key Maintenance Goals
Mains and Culverts 	Mains convey stormwater through the drainage network. • Surface symptoms: Frequent ponding, recurring backups, sinkholes and settlement, or repeated complaints in the same area. • Sediment deposition risk: Low slopes, flat reaches, and near outfalls are common deposition zones. • Blockage indicators: Slow inlet drainage, multiple inlets backing up along a line, or surcharging at upstream structures. • Culvert-specific issues: ○ Blocked inlet and outlet ends (trash, sediment, vegetation) ○ Damaged headwalls and wingwalls or undermined ends ○ Barrel damage (cracking, deformation, joint separation) ○ Hydraulic control problems (water backing up because the culvert entrance is restricted or the outlet is submerged) • Where feasible, it is recommended to use CCTV and remote inspection on mains to confirm internal condition (sediment depth, collapsed pipes, holes, cracks, root intrusion, deformation), especially in high-consequence areas.	• Maintain conveyance capacity. Use jetting and flushing in segments to address recurring deposits and confirm the restoration of flow. • Target chronic problem segments. If a pipe repeatedly silts in, consider root cause (e.g., low slope, upstream sediment sources, structural defects, or inlet sump overfilling). • Culvert end maintenance is critical. Keep entrances and exits clear, maintain headwalls, and stabilize inlets and outlets where erosion is present. • Plan rehabilitation when defects are structural. Cleaning will not fix a cracked, deformed, or failing pipe. These need repair, lining, or replacement.

Asset Type	Key Inspection Goals	Key Maintenance Goals
Outfalls 	Outfalls discharge stormwater from the pipe system to a receiving feature safely. - Blockage at the outfall: Debris mats, sediment plugs, collapsed end sections, or vegetation choking the opening. - Erosion and scour: Undermining beneath the outfall, headwall damage, exposed pipe bedding, or sinkholes near the discharge point. - Bank and grade instability: Slumping, cracking, or progressive erosion downstream of the outlet. - Unusual dry weather conditions: Flow, sheen, odor, staining, or abnormal color. Document and report for follow-up investigation.	- Keep outfalls clear. Blocked outfalls can cause rapid upstream backups and flooding. - Stabilize erosion and protect the outlet. Add or reset armoring, repair headwalls, and restore grade control to prevent undermining and pipe exposure. - Maintain access. Outfalls often become inaccessible due to vegetation or property constraints. Maintain safe access for inspection and emergency response. - Investigate abnormal dry weather flows. Maintenance crews should document and report; resolution may require follow-up investigation and correction of improper connections.

Stormwater Catch Basins/Inlets



Inspection Checklist

Asset Management Guidance for Community Flood Infrastructure

Catch Basin/Inlet Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Inspection Timing	☐ Routine ☐ Pre-Storm ☐ Post-Storm ☐ Annual
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK - STOP IF UNSAFE

If checked, report and do not enter.

☐ Open grate/fall hazard	☐ Hazardous materials (oil, etc.)	☐ Traffic hazard	☐ Slip/trip hazard
---	--	---	---

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Inlet Grate and Frame	Overall	☐	☐	☐	☐	☐
	Grate secure and seated; no rocking	☐	☐	☐	☐	☐
	Grate/frame damaged, cracked, or missing	☐	☐	☐	☐	☐
	Frame settlement/ponding around inlet	☐	☐	☐	☐	☐
Structural Condition	Overall	☐	☐	☐	☐	☐
	Basin walls/box cracked or deteriorated	☐	☐	☐	☐	☐
	Outlet connection condition (alignment, leaks)	☐	☐	☐	☐	☐
Hydraulic Performance	Overall	☐	☐	☐	☐	☐
	Ponding indicates the inlet is not capturing flow	☐	☐	☐	☐	☐
	Evidence of surcharge/backflow from system	☐	☐	☐	☐	☐
	Oily sheen/odor/unusual discharge	☐	☐	☐	☐	☐

Catch Basin/Inlet Name/ID: _____ Inspector Initials: _____

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Sediment, Trash, and Debris	Overall	☐	☐	☐	☐	☐
	Debris on the grate restricts inflow	☐	☐	☐	☐	☐
	Trash in the basin restricts outlet	☐	☐	☐	☐	☐
	Sump sediment depth reduces storage	☐	☐	☐	☐	☐
	Sediment entering the outlet connection	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to traffic/public safety	☐	☐	☐	☐	☐
	Localized flooding impacts to property	☐	☐	☐	☐	☐

Follow-Up Actions	Goal Resolution Date	Responsible Person

Notes and Observations:

Inspection Checklist



Catch Basin/Inlet Name/ID: _____ Inspector Initials: _____

Stormwater Catch Basins/Inlets

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Inlet Grate and Frame	Grate secure and seated; no rocking	Secure and flush.	Minor rocking.	Noticeable rocking; nuisance.	Loose; may dislodge; hazard.	Missing/dislodged; immediate hazard.
	Grate/frame damaged, cracked, or missing	No damage.	Minor wear.	Cracks/deformation visible; replace planned.	Major damage; replacement needed.	Failure/missing; immediate action required.
	Frame settlement/ponding around the inlet	No settlement; drains.	Minor depression; no ponding.	Ponding forms; sediment buildup likely.	Severe depression; trip/traffic hazard.	Sinkhole/rapid settlement; close area.
Structural Condition	Basin walls/box cracked or deteriorated	Sound.	Minor cracks.	Moderate cracking/spalls; repair needed.	Severe deterioration; structural concern.	Failure/collapse risk.
	Outlet connection condition (alignment, leaks)	Aligned; dry.	Minor seepage.	Active seepage or offset; debris catch.	Severe offset/leakage; voiding risk.	Disconnected/collapsed connection.
Hydraulic Performance	Ponding indicates the inlet is not capturing the flow	No ponding.	Brief ponding drains quickly.	Recurring ponding; capture reduced.	Frequent ponding affects traffic/access.	Flooding of property/roadway; emergency impact.
	Evidence of surcharge/backflow from the system	None.	Light staining.	Clear surcharge evidence; investigate downstream.	Frequent surcharge; downstream restriction likely.	Active backflow/flooding; urgent response.
	Oily sheen/odor/unusual discharge	None.	Minor staining.	Persistent odor/sheens; investigate.	Strong evidence of illicit discharge; report.	Hazardous release; immediate response.

Stormwater Catch Basins/Inlets

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Sediment, Trash, and Debris	Debris on the grate restricts inflow	Clear.	Light leaves; minimal restriction.	Partial blockage; reduced capture.	Heavy blockage; ponding likely.	Fully blocked; active flooding.
	Trash in the basin restricts the outlet	None/minor.	Some trash; schedule removal.	Accumulation narrows outlet; backup possible.	Heavy trash; outlet nearly blocked.	Outlet blocked; overflow/backflow.
	Sump sediment depth reduces storage	Thin layer.	Minor buildup in the sump.	Sump is half full; cleaning needed.	Sump near full; reduced function.	Sump full; sediment in outlet; urgent cleanout.
	Sediment entering the outlet connection	None.	Minor at the outlet.	Sediment at/into outlet; capacity reduced.	Outlet partially buried; backup likely.	Outlet is buried/blocked; immediate cleaning.
Overall Rating Based on Impacts to People and Infrastructure	Threat to traffic/public safety	No threat.	Minor hazard.	Traffic impacts are possible in storms.	Closures or hazards are likely; prioritize.	Immediate danger; emergency controls required.
	Localized flooding impacts to property	None.	Minor nuisance.	Repeated nuisance flooding near structures.	Structural threat (foundations/access).	Flooding in occupied structures or imminent damage.

Stormwater Catch Basins/Inlets

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Catch Basin/Inlet Name/ID	
Location	
Date/Time	START: ____ / ____ / ____ END: ____ / ____ / ____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Maintenance Timing	☐ Routine ☐ Pre-Storm ☐ Post-Storm ☐ Annual
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up	☐ Complaint/service request Date received: ____ / ____ / ____	☐ Emergency/safety issue or in-storm event
--	--	---	---	---

MAINTENANCE ACTIVITIES PERFORMED

☐ Trash and debris removal from grate	☐ Vacuum cleanout of basin (sediment/trash)	☐ Jetting/flushing of outlet connection
☐ Replace/repair grate and frame	☐ Adjust frame elevation/reset to grade	☐ Repair basin walls/box (patch, replace)
☐ Stabilize surrounding pavement/settlement repair	☐ Install/replace inlet protection (as needed)	☐ Other (describe below)

Basin/Inlet Name/ID: _____

Foreman Initials: _____

Page 1 of 5

Stormwater Catch Basins/Inlets

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Other maintenance actions performed:

AREAS ADDRESSED

☐ Grate/frame	☐ Throat/inlet opening	☐ Basin/sump
☐ Outlet connection	☐ Surrounding pavement	☐ Other (describe below)

Other areas addressed:

MATERIALS AND EQUIPMENT USED

Equipment used (e.g., vacuum truck, CCTV truck, jetter, excavator):

Maintenance hours/staff:

Materials used (e.g., aggregate, concrete, grout, sealant, riprap):

Quantity of materials (volume, etc.):

Basin/Inlet Name/ID: _____

Foreman Initials: _____

Stormwater Catch Basins/Inlets

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

SAFETY, ENVIRONMENTAL, AND REGULATORY CONTROLS

☐ Site access controlled and safe	☐ Traffic control in place (if needed)
☐ Work performed outside active flow	☐ Erosion and sediment controls in place
☐ No fuel, oil, or material spills	☐ Area left clean and stable
☐ Confined space procedures followed (if needed)	

CONDITION AFTER MAINTENANCE

Function/flow conditions after work:	☐ Clear/restored ☐ Improved ☐ Still restricted
Bed and bank conditions after work:	☐ Stable ☐ Improved ☐ Needs follow-up

DOCUMENTATION

Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED?

(If yes, describe trigger)

☐ Yes

☐ No

☐ N/A

Basin/Inlet Name/ID: _____

Foreman Initials: _____

Stormwater Catch Basins/Inlets

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Maintenance Form



Basin/Inlet Name/ID:

Foreman Initials:

Stormwater Manholes

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Manhole Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Inspection Timing	☐ Routine ☐ Pre-Storm ☐ Post-Storm ☐ Annual
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Open cover/fall hazard	☐ Hazardous atmosphere	☐ Traffic hazard	☐ Unstable surface/sinkhole
---	---	---	--

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Access and Safety	Overall	☐	☐	☐	☐	☐
	Sinkhole/voiding near rim or along alignment	☐	☐	☐	☐	☐
	Cover area accessible and safe	☐	☐	☐	☐	☐
	Hazards present (odor, low oxygen, gases)	☐	☐	☐	☐	☐
Cover and Frame	Overall	☐	☐	☐	☐	☐
	Cover seated and secure	☐	☐	☐	☐	☐
	Cover/frame damaged, cracked, or missing	☐	☐	☐	☐	☐
	Frame settlement/tilt; evidence of road depression	☐	☐	☐	☐	☐
Structural Conditions	Overall	☐	☐	☐	☐	☐
	Barrel cracks, spalls, corrosion, or deformation	☐	☐	☐	☐	☐
	Steps/ladder rungs/handholds damaged or corroded	☐	☐	☐	☐	☐
	Joints/leaks; infiltration through walls	☐	☐	☐	☐	☐
Hydraulic Conditions	Overall	☐	☐	☐	☐	☐
	Bench/invert intact; no significant erosion	☐	☐	☐	☐	☐
	Evidence of surcharge (staining, debris lines)	☐	☐	☐	☐	☐
Sediment and Debris	Overall	☐	☐	☐	☐	☐
	Sediment buildup reducing capacity	☐	☐	☐	☐	☐

Manhole Name/ID: _____ Inspector Initials: _____

Stormwater Manholes

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
	Debris/trash restricting flow	☐	☐	☐	☐	☐
Connections	Overall	☐	☐	☐	☐	☐
	Pipes aligned; no separation or offset	☐	☐	☐	☐	☐
	Root intrusion present	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to roads/bridges/critical facilities	☐	☐	☐	☐	☐
	Utilities impacted or exposed	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐

Follow-Up Actions	Goal Resolution Date	Responsible Person

Notes and Observations:

Inspection Checklist



Manhole Name/ID: _____ Inspector Initials: _____

Stormwater Manholes

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Access and Safety	Sinkhole/voiding near rim or along alignment	No settlement/cracking.	Minor cracking.	Cracks widening; small depressions.	Void suspected; potholes/surface failure.	Sinkhole/active collapse; immediate closure/repair.
	Cover area accessible and safe	Minor access issues; clear view and safe footing.	Minor obstruction; caution needed.	Access limited by vegetation/standing water/traffic; extra setup required.	Unsafe approach without control measures; traffic or steep slopes present.	Immediate hazard (sinkhole, collapse risk, active flooding); do not proceed.
	Hazards present (odor, low oxygen, gases)	No odor; no signs of gas; no entry planned.	Faint odor; monitor; entry only with procedures.	Noticeable odor; treat as hazardous; ventilate and test.	Strong odor or known hazard; entry requires a full confined space plan and rescue.	Confirmed hazardous atmosphere; do not enter; immediate reporting required.
Cover and Frame	Cover seated and secure	Fully seated; no rocking.	Minor rocking; still secure.	Noticeable rocking or minor misfit; nuisance noise likely.	Loose cover may dislodge; significant hazard.	Missing/dislodged cover; open hole; immediate safety action required.
	Cover/frame damaged, cracked, or missing	No damage.	Minor chips/wear.	Cracks or deformation visible; serviceability reduced.	Major cracking/broken sections; replacement needed.	Failure or missing components; immediate hazard.
	Frame settlement/tilt; evidence of road depression	No settlement; pavement intact.	Minor settlement; no ponding.	Ponding forms; depression noticeable.	Settlement creating a trip/traffic hazard; potential voiding.	Sinkhole/rapid settlement; roadway failure imminent.

Stormwater Manholes

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Structural Conditions	Barrel cracks, spalls, corrosion, or deformation	Sound structure; minor surface wear.	Small cracks/spalls; localized.	Multiple cracks/spalls; corrosion evident.	Significant deterioration; section loss; deformation.	Collapse risk or active failure.
	Steps/ladder rungs/handholds damaged or corroded	All present and sound.	Minor corrosion; still usable.	Several corroded/bent; restricted use.	Unsafe rungs; do not climb.	Missing/failed access system; entry prohibited.
	Joints/leaks; infiltration through walls	Dry; no seepage.	Damp spots; minor seepage.	Active seepage, staining, and deposits.	Multiple active leaks; inflow evident.	High inflow is degrading the soil; urgent repair is required.
Hydraulic Conditions	Bench/invert intact; no significant erosion	Bench and invert sound.	Minor abrasion.	Erosion/scour visible; depth changes.	Bench/invert failure; flow undermined.	Severe erosion causing blockage/collapse risk.
	Evidence of surcharge (staining, debris lines)	None observed.	Light staining.	Clear surcharge line; occasional.	Frequent surcharge evidence; backup likely.	Confirmed overflow or flooding; emergency impact.
Sediment and Debris	Sediment buildup reducing capacity	Thin layer; no capacity loss.	Sediment in sump; minor.	Sump nearing half full or covering the invert edges.	Sump full/near full; sediment in flow line.	Sediment blocking flow; immediate cleaning needed.
	Debris/trash restricting flow	None/minor litter.	Light debris; easy removal.	Debris accumulates, narrowing the flow area.	Heavy debris; blockage risk.	Complete blockage/overflow; urgent action.

Stormwater Manholes

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Connection	Pipes aligned; no separation or offset	Aligned; smooth transitions.	Minor offset.	Noticeable offset; debris catch likely.	Severe offset; structural concern.	Disconnected/collapsed connection.
	Root intrusion present	None.	Minor fine roots.	Root mass visible; capacity reduced.	Roots causing blockage/structural damage.	Severe root blockage with flooding risk.
Overall Rating Based on Impacts to People and Infrastructure	Threat to roads/bridges/critical facilities	No threat.	Minor shoulder impacts.	Roadway ponding or traffic disruption is possible.	Closures are possible during storms; undermining is evident.	Immediate failure risk; urgent response required.
	Utilities impacted or exposed	No exposure.	Early exposure signs.	Exposure is visible; there is a stability concern.	Support compromised; failure likely.	Failure imminent/occurred; safety risk.
	Public safety hazards	None.	Minor hazard; mark if needed.	Hazard present; control needed.	Serious hazard; restrict access.	Immediate danger; emergency controls required.

Stormwater Manholes



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Manhole Name/ID	
Location	
Date/Time	START: ____ / ____ / ____ END: ____ / ____ / ____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Recent storm event?	☐ Yes ☐ No
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up	☐ Complaint/service request Date received: ____ / ____ / ____	☐ Emergency/safety issue or in-storm event
--	--	---	---	---

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Trash and debris removal	☐ Vacuum/flush connected lines
☐ Remove roots/obstructions	☐ Adjust/replace cover and frame	☐ Seal leaks/joint grouting
☐ Repair bench/invert	☐ Replace steps/ladder components	☐ Stabilize surrounding surface/sinkhole repair
☐ Other (describe below)		

Manhole Name/ID: _____ Foreman Initials: _____

Stormwater Manholes

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Other maintenance actions performed:

AREAS ADDRESSED		
☐ Cover/frame	☐ Chimney	☐ Barrel/walls
☐ Bench/invert	☐ Connections	☐ Surrounding surface
☐ Other (describe below)		

Other areas addressed:

MATERIALS AND EQUIPMENT USED

Equipment used (e.g., vacuum truck, CCTV truck, jetter, excavator):

Maintenance hours/staff:

Materials used (e.g., aggregate, concrete, grout, sealant, riprap):

Quantity of materials (volume, etc.):

Stormwater Manholes

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

SAFETY, ENVIRONMENTAL, AND REGULATORY CONTROLS

☐ Site access controlled and safe	☐ Traffic control in place (if needed)
☐ Work performed outside active flow	☐ Erosion and sediment controls in place
☐ No fuel, oil, or material spills	☐ Area left clean and stable
☐ Confined space procedures followed (if needed)	

CONDITION AFTER MAINTENANCE

Function/flow conditions after work:	☐ Clear/restored ☐ Improved ☐ Still restricted
Bed and bank conditions after work:	☐ Stable ☐ Improved ☐ Needs follow-up

DOCUMENTATION

Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED?

☐ Yes ☐ No ☐ N/A

(If yes, describe trigger)

Manhole Name/ID: _____ Foreman Initials: _____

Stormwater Manholes

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Attach additional pages, if required.

Stormwater Mains and Culverts



Inspection Checklist

Asset Management Guidance for Community Flood Infrastructure

Storm Drain/Culvert Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Inspection Timing	☐ Routine ☐ Pre-Storm ☐ Post-Storm ☐ Annual
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Fast water/high flows	☐ Severe weather	☐ Traffic hazards	☐ Unsafe access
--	---	--	--

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Flow and Capacity	Overall	☐	☐	☐	☐	☐
	Evidence of illicit discharge or staining	☐	☐	☐	☐	☐
	Evidence of blockage or reduced size	☐	☐	☐	☐	☐
	Evidence of surcharge/pressurization	☐	☐	☐	☐	☐
Sedimentation and Debris	Overall	☐	☐	☐	☐	☐
	Sediment buildup in the pipe/culvert invert	☐	☐	☐	☐	☐
	Debris restricting flow at inlets/outlets	☐	☐	☐	☐	☐
Culvert-specific Conditions	Overall	☐	☐	☐	☐	☐
	Headwall/Wingwall condition	☐	☐	☐	☐	☐
	Scour at inlet/outlet/embankment	☐	☐	☐	☐	☐

Storm Drain/Culvert Name/ID: _____ Inspector Initials: _____

Stormwater Mains and Culverts

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Structural Conditions	Overall	☐	☐	☐	☐	☐
	Crack, deformation, corrosion, or holes	☐	☐	☐	☐	☐
	Joint separation, leakage, or infiltration	☐	☐	☐	☐	☐
	Sag/settlement indicated (ponding)	☐	☐	☐	☐	☐
	Lining deterioration	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to roads/bridges/critical facilities	☐	☐	☐	☐	☐
	Sinkholes/surface distress along alignment	☐	☐	☐	☐	☐
	Homes/structures impacted	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐

Follow-Up Actions	Goal Resolution Date	Responsible Person

Storm Drain/Culvert Name/ID: _____ Inspector Initials: _____

Inspection Checklist



Storm Drain/Culvert Name/ID: _____ Inspector Initials: _____

Stormwater Mains and Culverts

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Flow and Capacity	Evidence of illicit discharge or staining	No staining/odor.	Minor staining.	Persistent staining/odor; investigate.	Strong evidence of illicit discharge; report.	Hazardous discharge/ immediate response required.
	Evidence of blockage or reduced size	No blockage; full opening.	Minor debris; flow passes freely.	A partial blockage reduces capacity; a backup is possible.	Major blockage; frequent backups/overflow likely.	Complete blockage with flooding or collapse risk.
	Evidence of surcharge/pressurization	No evidence.	Light staining; occasional.	Clear surcharge indicators; repeat issue.	Frequent surcharge; upstream flooding risk.	Active flooding/overflow; emergency response required.
Sedimentation and Debris	Sediment buildup in the pipe/culvert invert	Trace sediment; no loss.	Sediment along edges; minor loss.	Moderate deposits reduce capacity.	Severe deposits; water diverted; blockage likely.	Sediment fully restricting flow; urgent cleanout.
	Debris restricting flow at inlets/outlets	None/minor litter.	Some debris; easy removal.	Debris accumulation forming a rack/jam.	Heavy debris at the structure; backup likely.	Complete blockage or active overflow.

Stormwater Mains and Culverts

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Culvert-specific Conditions	Headwall/Wingwall condition	Intact; no cracking.	Minor cracks/spalls.	Cracking with displacement or minor undermining.	Major damage/undermining; repair required.	Failure threatening roadway; urgent stabilization.
	Scour at inlet/outlet/embankment	No scour; stable.	Minor scour indicators.	Scour developing; protection borderline.	Severe scour undermining ends.	Active failure; roadway/structure threatened.
Structural Conditions	Crack, deformation, corrosion, or holes	Sound; minor wear.	Minor cracks/corrosion; localized.	Multiple defects; section loss starting.	Significant deformation/corrosion; structural concern.	Failure/collapse imminent or occurred.
	Joint separation, leakage, or infiltration	Dry; joints tight.	Damp joints; minor seepage.	Active seepage; soil fines present.	Multiple active leaks; voiding risk.	Severe leakage undermining roadway/embankment.
	Sag/settlement indicated (ponding)	No signs of sag.	Minor ponding after storms.	Recurring ponding; deposits indicate a low spot.	Severe sag causing backups; structural risk.	Sinkhole/rapid settlement; immediate hazard.
	Lining deterioration	Lining intact.	Minor abrasion or small cracks.	Areas delaminating or missing pieces.	Widespread lining failure; soil exposed.	Structural integrity compromised; urgent rehab.

Stormwater Mains and Culverts

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Overall Rating Based on Impacts to People and Infrastructure	Threat to roads/bridges/critical facilities	No threat.	Minor nuisance impacts.	Closures are possible during storms.	Damage present; closures likely.	Immediate failure risk; urgent action.
	Sinkholes/surface distress along alignment	None.	Minor cracking.	Cracking/depressions increasing; void possible.	Sinkhole risk; barricades may be needed.	Active sinkhole/collapse; close the area immediately.
	Homes/structures impacted	No risk.	Yard impacts only.	Repeated nuisance flooding near structures.	Structural threat (foundation/retaining elements at risk).	Flooding in occupied structures or imminent structural damage.
	Public safety hazards	None.	Minor hazard; mark.	Hazard present; controls needed.	Serious hazard; restrict access.	Immediate danger; emergency controls required.

Stormwater Mains and Culverts



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Storm Drain/Culvert Name/ID	
Location	
Date/Time	START: ____ / ____ / ____ END: ____ / ____ / ____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Maintenance Timing	☐ Routine Annual ☐ Pre-Storm ☐ Post-Storm ☐
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up	☐ Complaint/service request Date received: ____ / ____ / ____	☐ Emergency/safety issue or in-storm event
--	--	---	---	---

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Trash and debris removal (inlet/outlet)	☐ Sediment removal/vacuum cleanout
☐ Jetting/flushing	☐ CCTV inspection	☐ Root removal
☐ Spot repair (patch, clamp, grout)	☐ Repair/replace headwall/wingwall	☐ Scour repair/riprap placement
☐ Lining repair/rehabilitation (if applicable)	Replace segment/culvert (if applicable)	☐ Other (describe below)

Main/Culvert Name/ID: _____ Foreman Initials: _____

Stormwater Mains and Culverts



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Other maintenance actions performed:

AREAS ADDRESSED

☐ Inlet/upstream end

☐ Outlet/downstream end

☐ Joints/connections

☐ Headwall/wingwall

☐ Embankment/ditch

☐ Pipe/barrel segment

☐ Other (describe below)

Other areas addressed:

MATERIALS AND EQUIPMENT USED

Equipment used (e.g., vacuum truck, CCTV truck, jetter, excavator):

Maintenance hours/staff:

Materials used (e.g., aggregate, concrete, grout, sealant, riprap):

Main/Culvert Name/ID: _____ Foreman Initials: _____

Stormwater Mains and Culverts



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Quantity of materials (volume, etc.):

CONDITION AFTER MAINTENANCE

Function/flow conditions after work:	☐ Clear/restored	☐ Improved	☐ Still restricted
Bed and bank conditions after work:	☐ Stable	☐ Improved	☐ Needs follow-up

DOCUMENTATION

Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED?

☐ Yes

☐ No

☐ N/A

(If yes, describe trigger)

Main/Culvert Name/ID: _____ Foreman Initials: _____

Stormwater Mains and Culverts

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Stormwater Mains and Culverts



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Notes and Observations:

Attach additional pages, if required.

Stormwater Outfalls

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Outfall Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: _____ °F
Inspection Timing	☐ Routine ☐ Pre-Flood ☐ Post-Flood ☐ Annual
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Steep/unstable bank	☐ Fast water/high flows	☐ Wildlife/vegetation hazards	☐ Traffic hazards
--	--	--	--

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Outfall Condition	Overall	☐	☐	☐	☐	☐
	Outlet opening is clear and accessible	☐	☐	☐	☐	☐
	Headwall/pipe end condition (cracks, spalls, corrosion)	☐	☐	☐	☐	☐
	Flap gate/check valve present and functional (if applicable)	☐	☐	☐	☐	☐
	Scour at outlet; bank/bed erosion	☐	☐	☐	☐	☐
	Outfall protection (riprap/apron) is stable and adequate	☐	☐	☐	☐	☐
	Unusual staining, odor, floatables, or sheen	☐	☐	☐	☐	☐
Debris and Blockage	Overall	☐	☐	☐	☐	☐
	Debris rack/trash accumulation restricting flow	☐	☐	☐	☐	☐

Outfall Name/ID: _____ Inspector Initials: _____

Stormwater Outfalls

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Debris and Blockage (Cont'd.)	Sediment deposition at outlet (burial, bar formation)	☐	☐	☐	☐	☐
	Vegetation blocks access or flow	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to roads/bridges/critical facilities	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐

Follow-Up Actions	Goal Resolution Date	Responsible Person

Notes and Observations:

Inspection Checklist



Outfall Name/ID: _____ Inspector Initials: _____

Stormwater Outfalls

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Outfall Condition	Outlet opening is clear and accessible	Clear, full opening visible.	Minor obstruction; flow passes.	Partial obstruction; capacity reduced.	Major obstruction; backup likely.	Blocked/buried; flooding risk imminent.
	Headwall/pipe end condition (cracks, spalls, corrosion)	Sound; minor wear.	Small cracks/spalls; localized.	Moderate cracking/corrosion; repair needed.	Severe damage; undermining is likely.	Failure/collapse imminent or occurred.
	Flap gate/check valve present and functional (if applicable)	Operates freely; seals.	Minor stiffness; still functional.	Intermittent sticking; maintenance needed.	Failed open/closed; backflow risk.	Missing/failed with flooding/backflow impacts.
	Scour at outlet; bank/bed erosion	No scour.	Minor scour indicators.	Scour developing; stabilization needed.	Severe scour undermining outfall/embankment.	Active failure threatens infrastructure.
	Outfall protection (riprap/apron) is stable and adequate	Protection intact.	Minor displacement.	Gaps forming; soil exposed.	Significant loss; protection ineffective.	Protection failed; rapid erosion/failure risk.
	Unusual staining, odor, floatables, or sheen	None.	Minor staining.	Persistent odor/staining; investigate.	Strong evidence of illicit discharge; report.	Hazardous discharge; immediate response required.

Stormwater Outfalls

Rubrics and Guidelines



Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Debris and Blockage	Debris rack/trash accumulation restricting flow	None/minor litter.	Some buildup; schedule removal.	50% blocked; high risk next storm.	>75% blocked; backup likely.	Fully blocked or causing overflow.
	Sediment deposition at the outlet (burial, bar formation)	None/minor.	Small bar forming; minor impact.	Deposits reduce the opening or redirect the flow.	Severe deposits are burying the outlet; frequent backups.	Outlet buried; immediate excavation needed.
	Vegetation blocks access or flow	Access clear.	Minor trimming needed.	Dense growth reduces access or traps debris.	Vegetation prevents maintenance access; hazards are present.	Unsafe/impossible access; emergency response hindered.
Overall Rating Based on Impacts to People and Infrastructure	Threat to roads/bridges/critical facilities	No threat.	Minor nuisance impacts.	Impacts are likely during intense storms.	Damage present or likely; priority repair.	Immediate danger to structures/roads/utilities.
	Public safety hazards	None.	Minor hazard.	Hazard present; controls needed.	Serious hazard; restrict access.	Immediate danger; emergency controls required.

Stormwater Outfalls



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Outfall Name/ID	
Location	
Date/Time	START: __ / __ / __ END: __ / __ / __
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: __°F
Recent storm event?	☐ Yes ☐ No
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up	☐ Complaint/service request Date received: __ / __ / __	☐ Emergency/safety issue or in-storm event
--	--	---	---	---

MAINTENANCE ACTIVITIES PERFORMED

☐ Trash and debris removal	☐ Sediment excavation/removal	☐ Clear outlet opening/re-establish invert
☐ Repair/replace flap gate or check valve	☐ Repair headwall/pipe end (patch, replace)	☐ Stabilize bank/bed (riprap, apron repair)
☐ Remove invasive vegetation/restore access	☐ Investigate/report illicit discharge indicators	☐ Other (describe below)

Outfall Name/ID: _____ Foreman Initials: _____

Stormwater Outfalls



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Other maintenance actions performed:

AREAS ADDRESSED		
☐ Outlet opening	☐ Headwall/pipe end	☐ Flap gate/appurtenances
☐ Apron/riprap	☐ Downstream channel/swale	☐ Access path
☐ Other (describe below)		

Other areas addressed:

MATERIALS AND EQUIPMENT USED

Equipment used (e.g., vacuum truck, CCTV truck, jetter, excavator):

Maintenance hours/staff:

Materials used (e.g., aggregate, concrete, grout, sealant, riprap):

Quantity of materials (volume, etc.):

Stormwater Outfalls



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

SAFETY AND ENVIRONMENTAL CONTROLS	
☐ Site access controlled and safe	☐ Erosion and sediment controls in place
☐ Traffic control in place (if needed)	☐ No fuel, oil, or material spills
☐ Confined space procedures followed (if needed)	☐ Area left clean and stable
☐ Work performed outside active flow	

CONDITION AFTER MAINTENANCE			
Function/flow conditions after work:	☐ Clear/restored	☐ Improved	☐ Still restricted
Bed and bank conditions after work:	☐ Stable	☐ Improved	☐ Needs follow-up

DOCUMENTATION			
Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED? ☐ Yes ☐ No ☐ N/A

(If yes, describe trigger)

Stormwater Outfalls

Maintenance Form



FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Maintenance Form



Notes and Observations:

Attach additional pages, if required.

How to Maintain Your Pump Stations



What is it?

A pump station (or lift station) is a stormwater infrastructure asset that mechanically lifts and conveys stormwater from low-lying areas to a higher elevation or downstream discharge point when gravity drainage alone is insufficient.

Who maintains it?

Pump stations are typically owned and maintained by municipalities, drainage districts, or utility departments. Regardless of ownership, communities should confirm:

- Asset ownership boundaries (public vs. private)
- Access rights (easements, fenced stations)
- Maintenance responsibility (mechanical, electrical, and civil components)
- Emergency response coordination and after-hours on-call protocols
- Backup power availability and testing schedule
- Telemetry and alarm notification contacts

Best maintenance practices & strategies

Pump stations are active mechanical and electrical systems that operate continuously and are essential to flood protection in low-lying areas. Unlike passive gravity-drainage assets, pump stations require scheduled preventive maintenance and rapid response to component failures. Wet wells accumulate debris and sediment; pumps wear and cavitate; electrical systems degrade; and power interruptions can immediately halt drainage during storm events. Routine inspection and preventive maintenance protect conveyance capacity, prevent catastrophic failures, and extend asset life.

A. INSPECTION

Inspections confirm that pumps, controls, wet wells, and appurtenant components are operational and free of conditions that could impair performance during a storm event. An inspection checklist for pump stations is included with this reference sheet.

Inspection skill needs:

- Ability to recognize pump performance issues (cavitation, low flow, high amp draw, and seal failure)
- Familiarity with electrical control panels, motor starters, and telemetry systems
- Ability to identify wet well conditions (debris accumulation, sedimentation, infiltration, and corrosion)
- Ability to recognize valve and check valve issues (failed seating, corrosion, and stem damage)
- Familiarity with confined space requirements (wet wells are permit-required confined spaces)
- Ability to document conditions clearly (photos, readings, alarms, and equipment IDs)

What to look for:

- Wet well level rising abnormally or failing to draw down after storm events
- High water alarms triggered repeatedly or not clearing
- Unusual pump noise, vibration, excessive heat, or cycling on/off rapidly
- Float switches stuck, unresponsive, or showing incorrect water levels

- Control panel faults, tripped breakers, or error codes on Supervisory Control and Data Acquisition (SCADA) systems
- Evidence of sewage or pollutants entering the wet well (odors, staining)
- Discharge pressure below design operating range
- Standing water or flooding in the station structure, vault, or electrical room

How to record conditions:

- Use a standard inspection form or digital tool. A consistent form ensures inspections are complete and repeatable. Standardized records help identify recurring failures, support maintenance planning, and provide documentation for capital programming and emergency response.
- Record location, date, weather, and wet well level. Context is critical for interpreting pump performance data. Note recent storm activity and power outages that may have affected operations.
- Record pump run times, flow rates, and amp draws. Tracking operational data over time reveals trends such as declining efficiency, increasing energy consumption, or accelerating wear before failure occurs.
- Take photos of equipment condition, alarm panels, and wet well conditions. Photos provide visual evidence that allow supervisors and engineers to assess severity remotely and track changes between inspection cycles.
- Flag urgent issues that could impair performance during the next storm event. Pump failures, control panel faults, and inoperative backup power systems should be escalated immediately – not held for a routine maintenance cycle.

B. MAINTENANCE

Maintenance restores and preserves the pump station's ability to move stormwater during storm events and prevents minor mechanical and electrical issues from escalating into emergency failures. A maintenance checklist for pump stations is included with this reference sheet.

Maintenance equipment and skill needs:

- Confined space entry equipment (harness, retrieval system, air monitor, ventilation) – wet well entry requires permit
- Electrical safety gear (PPE, lockout/tagout equipment) – all panel work requires qualified personnel
- Hand tools for valve operation, coupling inspection, and mechanical adjustments

- Pump testing capability (amp meter, pressure gauge, and flow measurement)
- Vactor or vacuum truck for wet well cleanout and debris removal
- Generator testing capability (load bank or field run test)
- SCADA/telemetry access for remote monitoring and alarm review
- Lubricants, seals, impellers, and commonly replaced spare parts

SCHEDULING MAINTENANCE

1. Monthly routine maintenance

- Verify all pumps are operational and cycling correctly through their normal lead/lag/standby sequence
- Check SCADA and telemetry for active alarms, recent fault history, and communication status
- Inspect wet well for debris accumulation, grease buildup, and abnormal inflow
- Verify backup power (generator or battery UPS) is ready and fuel levels are adequate
- Review pump run times and compare against historical baseline
- Log readings and update maintenance records

2. Annual maintenance and comprehensive review

- Perform a full visual and operational inspection of all pumps, motors, and controls
- Clean wet well: remove accumulated sediment, grease, and debris
- Inspect and exercise all valves through full range of motion
- Test and calibrate float switches, level sensors, and pressure transducers
- Inspect force main for corrosion, joint condition, and air-release valve operation
- Test backup generator under load; inspect fuel system, cooling, and battery
- Verify electrical panel condition: check for corrosion, loose connections, and tripped breakers
- Lubricate pump bearings, motor shafts, and valve stems per manufacturer specifications
- Inspect building/vault structure for water infiltration, ventilation adequacy, and security
- Assess pump impeller and seal wear; schedule replacement if approaching end of service life

3. Pre-, in-, and post-storm events

Pre-storm events

- Confirm all pumps are operational and controls are in automatic mode
- Verify backup power is fueled, tested, and set to auto-transfer
- Clear any visible debris from wet well screens and inlet grates
- Confirm SCADA is active and alarm notifications are reaching on-call personnel
- Pre-position staff or contractor resources if major storm is forecast
- Draw down wet wells to the lowest possible water surface elevation

In-storm events (only when safe)

- Monitor SCADA remotely for high wet well alarms and pump cycle anomalies
- Clear debris from screens
- Dispatch crew if high water alarm is triggered and the wet well is not drawing down
- Document pump operating conditions, wet well levels, and alarm events
- Avoid wet well entry during active storm conditions — prioritize operator safety

Post-storm events

- Confirm the wet well has returned to normal operating level
- Inspect the wet well for storm-deposited debris and clean as needed
- Review SCADA records for any anomalies during the event and document findings
- Inspect the force main and discharge structure for erosion or damage
- Record pump hours, power consumption, and any equipment issues observed

4. Factors that may influence the maintenance schedule

Use these to decide whether to stay at routine frequency or escalate to enhanced inspection and preventive maintenance:

- Age and condition of pumps. Units approaching 15+ years require more frequent monitoring and proactive rebuild.
- Inflow conditions. Stations receiving high debris, grease, or sediment loads require more frequent wet well cleaning.

- Storm intensity and frequency. Increasing extreme event frequency warrants higher inspection frequency pre-season.
- Repeated alarms or cycling anomalies. Escalate to full inspection and identify root cause.
- Nearby critical facilities. Stations draining hospitals, emergency routes, or densely populated areas warrant a higher level of readiness.
- Power reliability. Stations in areas prone to outages or remote locations that are difficult to refuel require more rigorous generator testing and fuel management.

5. Planned maintenance and inspection schedule

Use as a starting point, then increase frequency where risk drivers are present.

Routine planned inspections

- Pumps and motors: monthly checks; annual full inspection
- Wet well and screens: monthly checks; annual cleanout (more frequent where debris loads are high)
- Electrical controls and telemetry: monthly visual check; annual testing and calibration
- Backup power: monthly fuel/battery check; annual load test
- Valves and force main: annual inspection

Routine planned maintenance

- Wet well cleanout: scheduled annually or at trigger thresholds (sediment depth, grease accumulation)
- Lubrication: per manufacturer schedule or annually at minimum
- Generator service: annual load testing plus manufacturer-recommended service intervals

Enhanced preventive program (when risk drivers are present)

- Increase inspection frequency at high-consequence stations and stations with recurring alarm history
- Establish critical spare parts inventory (impellers, seals, float switches, fuses, etc.) to reduce downtime
- Schedule pump performance testing to detect declining efficiency before failure

Pump Stations

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Pump Station Name/ID	
Pump Power Source	☐ Gas ☐ Electric
Location/Address	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Recent storm event?	☐ Yes ☐ No — If yes, describe below
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Fast water/flooding	☐ Confined space/no permit	☐ Electrical hazard	☐ Unsafe access/structure
--	---	--	--

Station Design Capacity (cfs or gpm): _____

Generator Fuel Level: _____

Wet Well Diameter/Size: _____

Current Wet Well Level: _____

PUMP NO.	CAPACITY (CFS OR GPM)	LAST RUN (DATE/TIME)

Pump Station Name/ID: _____ Inspector Initials: _____

Pump Stations

Inspection Checklist

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Pump Performance	Overall	☐	☐	☐	☐	☐
	Flow rate/output deviation from design	☐	☐	☐	☐	☐
	Cycling anomalies (rapid cycling, fails to start/stop)	☐	☐	☐	☐	☐
	Unusual noise, vibration, or excessive heat	☐	☐	☐	☐	☐
Wet Well Condition	Overall	☐	☐	☐	☐	☐
	Sediment and trash screen debris accumulation	☐	☐	☐	☐	☐
	Grease buildup or odor indicating illicit inflow	☐	☐	☐	☐	☐
	Structural condition, corrosion, or infiltration	☐	☐	☐	☐	☐
Mechanical & Electrical	Overall	☐	☐	☐	☐	☐
	Control panel condition (corrosion, faults, breakers)	☐	☐	☐	☐	☐
	Float switches/level sensors (function, position)	☐	☐	☐	☐	☐
	Isolation valves and check valves (seating, corrosion, operability)	☐	☐	☐	☐	☐
	Force main (exposed sections, corrosion, pressure)	☐	☐	☐	☐	☐
Backup Power	Overall	☐	☐	☐	☐	☐
	Generator operability and auto-transfer function	☐	☐	☐	☐	☐
	Fuel level and fuel system condition	☐	☐	☐	☐	☐
	Battery/UPS condition and charge status	☐	☐	☐	☐	☐
Telemetry & SCADA	Overall	☐	☐	☐	☐	☐
	Communication status and alarm delivery	☐	☐	☐	☐	☐
	Alarm history review (recent faults, high water events)	☐	☐	☐	☐	☐
	Sensor calibration and data accuracy	☐	☐	☐	☐	☐

Pump Stations

Inspection Checklist

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Site Conditions	Overall	☐	☐	☐	☐	☐
	Fencing condition (integrity, gates, locks, signage)	☐	☐	☐	☐	☐
	Access road/driveway condition (surface, drainage, clearance)	☐	☐	☐	☐	☐
	Landscaping and site drainage (vegetation, grading, standing water)	☐	☐	☐	☐	☐
Building/Structure	Overall	☐	☐	☐	☐	☐
	Walls and roof (cracks, spalling, paint condition, weatherproofing)	☐	☐	☐	☐	☐
	Windows, louvers, and doors (damage, operability, sealing)	☐	☐	☐	☐	☐
	Interior floor (grease/oil spills, staining, trip hazards)	☐	☐	☐	☐	☐
	Interior flooding or evidence of water intrusion	☐	☐	☐	☐	☐
	Station lighting (interior and exterior functionality)	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to drainage area served (flooding risk if station fails)	☐	☐	☐	☐	☐
	Critical facilities or evacuation routes served	☐	☐	☐	☐	☐
	Public safety hazards (access, electrical, confined space)	☐	☐	☐	☐	☐

Follow-Up Actions	Goal Resolution Date	Responsible Person

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Follow-Up Actions	Goal Resolution Date	Responsible Person

Notes and Observations:

Attach additional pages, if required.

Pump Stations

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Pump Performance	Flow rate/output deviation from design	Meets design; no deviation.	Minor deviation; still draining.	Noticeable reduction; slow drawdown.	Significant loss; area surcharging.	No flow; flooding imminent or occurring.
	Cycling anomalies (rapid cycling, fails to start/stop)	Normal lead/lag cycling.	Occasional short cycling.	Repeated short cycling; investigate.	Fails to start/stop; repeated faults.	Complete failure to operate.
	Unusual noise, vibration, or excessive heat	Normal operation.	Minor vibration; within acceptable limits.	Noticeable increase; monitor closely.	Excessive vibration or heat; remove from service.	Overheating/seizure; immediate shutdown.
Wet Well Condition	Sediment and trash screen debris accumulation	Clean; trace material only.	Minor accumulation; cleanout at next cycle.	Moderate buildup; reduces effective capacity.	Heavy accumulation; pump suction at risk.	Blockage of pump suction; immediate cleanout.
	Grease buildup or odor indicating illicit inflow	No odor or staining.	Minor grease ring; light odor.	Significant grease; persistent odor.	Heavy grease; odor indicates illicit connection.	Confirmed illicit discharge; report immediately.
	Structural condition, corrosion, or infiltration	Sound; clean exterior.	Minor scaling or corrosion.	Active corrosion; localized infiltration.	Significant infiltration; structural concern.	Structural failure or severe infiltration.

Pump Stations

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Mechanical & Electrical	Control panel condition (corrosion, faults, breakers)	No faults; clean panel.	Minor corrosion or dust; functional.	Moderate corrosion or faults; investigate.	Multiple faults; tripped breakers.	Panel inoperable; immediate repair.
	Float switches/level sensors (function, position)	Functioning; accurate readings.	Minor lag; within tolerance.	Intermittent response; calibration needed.	Sensor failure; incorrect levels reported.	Complete loss of level control.
	Isolation valves and check valves (seating, corrosion, operability)	Operate freely; no leakage.	Minor stiffness or slight seepage.	Check valve not seating; some backflow.	Significant backflow; valve failing.	Complete valve failure; backflow uncontrolled.
	Force main (exposed sections, corrosion, pressure)	No visible issues.	Minor surface corrosion on exposed sections.	Active corrosion; pressure slightly low.	Confirmed leak or pressure loss.	Rupture or major pressure failure.
Backup Power	Generator operability and auto-transfer function	Starts and transfers automatically.	Transfers with minor delay.	Manual start only; auto-transfer fault.	Generator starts but cannot carry load.	Generator inoperable; no backup power.
	Fuel level and fuel system condition	>75% fuel; no leaks.	50–75%; fuel adequate.	25–50%; schedule refuel.	<25%; refuel immediately.	Fuel leak or empty tank.
	Battery/UPS condition and charge status	Fully charged; no faults.	Minor discharge; within tolerance.	Reduced capacity; test and replace.	Low capacity; fails to hold charge.	Battery dead; controls unprotected.

Pump Stations

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Telemetry & SCADA	Communication status and alarm delivery	All alarms reporting; communication active.	Minor delay; alarms delivered.	Intermittent communication; check connection.	Alarms not delivering; staff unaware of events.	Complete loss of telemetry; blind operation.
	Alarm history review (recent faults, high water events)	No alarms since last inspection.	1–2 minor alarms; resolved.	3–5 alarms; pattern emerging.	Repeated high water or fault alarms.	Persistent critical alarms; escalate immediately.
	Sensor calibration and data accuracy	Sensors accurate; no drift.	Minor drift; within allowable tolerance.	Noticeable drift; calibration overdue.	Significant inaccuracy; unreliable data.	Sensors completely failed or misreporting.
Site Conditions	Fencing condition	Intact; gates secure; signage present.	Minor damage; gate functional; signage faded.	Sections damaged or down; gate difficult to latch.	Significant breach; unsecured access to site.	Fence absent or completely compromised; site open to public.
	Access road/driveway condition	Surface intact; adequate drainage; clear of obstruction.	Minor surface cracking or rutting; passable.	Moderate damage; maintenance vehicle access difficult.	Major deterioration or obstruction; access impaired.	Access road impassable; emergency response delayed.
	Landscaping and site drainage	Vegetation maintained; site drains freely; no standing water.	Minor overgrowth or minor ponding; low impact.	Overgrowth impeding access; standing water near equipment.	Dense vegetation blocking access; standing water around structure.	Site drainage failed; chronic flooding around station; vegetation damaging infrastructure.

Pump Stations

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Building/Structure	Walls and roof condition	Sound; no cracks; paint in good condition; weathertight.	Minor surface cracks or paint peeling; no moisture intrusion.	Moderate cracking or spalling; localized weatherproofing concern.	Significant cracking or spalling; moisture intrusion is evident.	Structural failure risk; walls or roof compromised; immediate repair required.
	Windows, louvers, and doors	All intact; doors open/close freely; louvers unobstructed.	Minor damage or stiffness; functional; weathertight.	Broken pane or damaged louver; the door is difficult to operate.	Window/louver absent, or door unable to latch; security or weatherproofing compromised.	Multiple openings exposed; station unsecured or subject to weather intrusion.
	Interior floor (grease/oil spills, trip hazards)	Clean and dry; no spills or hazards.	Minor staining; no active spill; low slip risk.	Oil or grease present; slip hazard; cleanup needed.	Active spill or significant accumulation; immediate cleanup required.	Major spill uncontained; environmental or safety incident; report immediately.
	Interior flooding/water intrusion	Interior dry; no evidence of water entry.	Trace moisture or staining; no active intrusion.	Localized water intrusion; source identified; monitor.	Active water entry; equipment at risk; investigate and repair.	Interior flooding; electrical equipment exposed to water; evacuate and respond immediately.
	Station lighting (interior and exterior)	All lights are functional; adequate interior and exterior illumination is provided.	One fixture out; adequate overall illumination maintained.	Multiple fixtures are out; reduced illumination is affecting work safety.	The majority of the lighting failed; work or inspection is unsafe without supplemental lighting.	Complete lighting failure; station cannot be safely inspected or operated.

Pump Stations

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Overall Rating Based on Impacts to People and Infrastructure	Threat to drainage area served (flooding risk if station fails)	The station serves a low-density area; limited consequence if offline.	Residential area downstream; nuisance flooding possible.	Developed neighborhood; structural flooding risk if the station fails.	Dense development or major road; significant flooding impact.	Critical drainage area; failure causes immediate, uncontrolled structural flooding.
	Critical facilities or evacuation routes served	No critical facilities or key routes in drainage area.	Minor facilities nearby; low consequence if flooded.	School, commercial area, or local road in drainage area.	Hospital, emergency services, or arterial road dependent on station.	Evacuation route or critical infrastructure directly at risk; station failure is a life-safety event.
	Public safety hazards (access, electrical, confined space)	Site secure; no hazards observed.	Minor access concern; fencing and signage intact.	Gate, cover, or signage missing; accessible to public.	Open wet well, exposed electrical, or structural distress creating entrapment or electrocution risk.	Immediate life-safety hazard; close site, barricade, and notify supervisor.

Pump Stations



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Pump Station Name/ID	
Pump Power Source	☐ Gas ☐ Electric
Location	
Date/Time	START: ____ / ____ / ____ END: ____ / ____ / ____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Recent storm event?	☐ Yes ☐ No — If yes, describe below
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/Scheduled Maintenance	☐ Post-Storm Response	☐ Inspection Follow-Up	☐ Complaint/Service Request Date Received: ____ / ____ / ____	☐ Emergency/Safety Issue/In-Storm Response
--	--	---	---	---

Other/Details:

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Wet well cleanout (vacuum/vactor)	☐ Pump removal and inspection
☐ Wet well and trash rack debris removal	☐ Pump bearing lubrication	☐ Impeller inspection/replacement

Pump Station Name/ID: _____ Foreman Initials: _____

Pump Stations

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

MAINTENANCE ACTIVITIES PERFORMED

☐ Seal/packing replacement	☐ Valve exercise and inspection	☐ Valve inspection/repair
☐ Force main inspection	☐ Control panel inspection/reset	☐ Float switch/sensor calibration
☐ Generator service/load test	☐ Generator fuel top-off	☐ Battery/UPS inspection/replacement
☐ SCADA/telemetry service	☐ Alarm testing and verification	☐ Electrical connection tightening
☐ Structural/vault inspection	☐ Painting/corrosion treatment	☐ Other (describe below)

Other maintenance actions performed:

COMPONENTS ADDRESSED

☐ Wet well/trash screen	☐ Lead pump	☐ Lag pump(s)
☐ Standby/backup pump	☐ Check valve(s)	☐ Isolation valve(s)
☐ Force main	☐ Control panel/starters	☐ Float switches/level sensors
☐ Generator/backup power	☐ Telemetry/SCADA	☐ Vault/building/access

Other components addressed:

OPERATIONAL STATUS AFTER MAINTENANCE

☐ All pumps operational — returned to automatic mode	☐ Backup power operational — auto-transfer verified
☐ SCADA/telemetry confirmed active; alarms tested	☐ Station left in manual mode — notify supervisor
☐ One or more pumps out of service — see notes below	☐ Follow-up work order required

Pump Station Name/ID: _____ Foreman Initials: _____

Pump Stations

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

READINGS RECORDED AFTER MAINTENANCE

Wet Well Level (in/ft)		Generator Fuel Level (%)	
------------------------	--	--------------------------	--

PUMP NO.	AMP DRAW	DISCHARGE PRESSURE (PSI)

MATERIALS AND EQUIPMENT USED

Equipment used (e.g., vacuum truck, generator, multimeter, pump puller, crane):

Materials/parts used (e.g., impeller, seals, float switch, belts, lubricant):

Maintenance hours/staff:

ISSUES IDENTIFIED DURING MAINTENANCE

☐ Pump wear beyond acceptable tolerance — replacement recommended	☐ Valve corrosion — replace at next service	☐ Float switch inaccurate — replace
☐ Generator service overdue — schedule	☐ Panel corrosion — further assessment needed	☐ Force main condition — monitor
☐ Illicit inflow suspected — report to supervisor	☐ Structural deficiency — engineering review	☐ Other — describe below

Describe issues identified:

Pump Station Name/ID: _____ Foreman Initials: _____

Pump Stations

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

DOCUMENTATION			
Before photos attached:	☐ Yes	☐ No	☐ N/A
Photo locations/direction recorded?	☐ Yes	☐ No	☐ N/A
Sketch/map/GPS points attached?	☐ Yes	☐ No	☐ N/A
Inspection checklist attached?	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED? ☐ Yes ☐ No ☐ N/A
(If yes, describe trigger)

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Maintenance Form



Attach additional pages, if required.

How to Maintain Your Weirs



What is it?

A weir is a low overflow structure built across a channel, basin, or drainage conveyance to control water surface elevation, regulate flow, promote sediment deposition, or dissipate energy. Weirs appear across a wide range of stormwater assets and may serve as primary control structures or as components embedded within larger systems.

Who maintains it?

Weir ownership and maintenance responsibility varies by setting. Regardless of ownership, communities should confirm:

- Asset ownership boundaries (public vs. private easement)
- Maintenance responsibility for structural, hydraulic, and vegetation components
- Access rights—many weirs are within enclosed basins, fenced facilities, or drainage easements
- Regulatory compliance—weir crest elevations are typically part of permitted designs and cannot be altered without engineering and regulatory approval
- Emergency response coordination for weirs serving high-consequence assets such as detention ponds and emergency spillways

Best maintenance practices & strategies

Weirs are passive hydraulic structures that rely on an unobstructed crest and stable geometry to function as designed. Over time, sediment accumulation, debris loading, structural deterioration, vegetation encroachment, and unauthorized modification can compromise weir performance—causing improper water levels, reduced treatment efficiency, downstream erosion, or failure to convey flood flows safely. Because weirs often serve as the critical control point between upstream and downstream assets, their failure can cascade to affect the entire drainage system. Routine inspection and maintenance preserve hydraulic function, protect structural integrity, and extend asset life.

A. INSPECTION

Inspections verify that the weir crest is unobstructed, the structure is sound, water is flowing over or through the weir as designed, and no unauthorized modifications have occurred. An inspection checklist for weirs is included with this reference sheet.

Signs the weir is not performing as designed:

- Water surface upstream is abnormally high—indicates weir crest or notch is obstructed
- Water surface upstream is abnormally low—indicates scour under or around the weir, or structural breach
- Weir crest shows visible sediment mounding, debris mats, or vegetation growth, reducing hydraulic capacity
- Flow is bypassing the weir through erosion channels or gaps in the abutments rather than over the crest
- Visible cracking, spalling, displacement, settlement, leaning, or undermining of weir structure
- Riprap on or downstream of the weir is displaced, leaving the channel unprotected
- Standing or stagnant water in the forebay that is not draining within the expected drawdown period
- Weir notch or orifice plate appears missing, damaged, or modified

Inspection skill needs:

- Ability to recognize hydraulic performance problems: water levels above or below the design stage, flow bypassing the weir structure

- Familiarity with weir types and their function: sharp-crested, broad-crested, riprap, armored embankment, and multilevel intake
- Ability to identify structural defects: cracking, spalling, joint failure, displacement, undermining, and scour
- Ability to assess vegetation conditions: identifying encroachment on weir crest, undesirable woody growth, and inadequate cover on armored embankment
- Awareness of regulatory significance: weir crest elevations are typically permitted—any changes require engineering authorization
- Ability to document conditions clearly: photos, water level observations, debris description, and asset ID

How to record conditions:

- Use a standard inspection form. Consistent records enable comparison over time and are essential for tracking whether water levels, structural condition, and vegetation are changing between inspection cycles.
- Record location, date, weather, and current water surface level upstream and downstream of the weir. Water level elevations are critical—a clogged weir may result in abnormally high upstream water levels, and a structurally compromised weir may result in abnormally low upstream water levels.
- Note whether the flow is passing over, through, or around the weir as designed. Any deviation from the design flow path warrants investigation and documentation, and eventual repair.
- Measure and record the extent of any findings, for example: debris depth, scour dimensions, crack length/width, sediment accumulation, etc. Quantified observations enable tracking of progression between inspections and support work order prioritization.
- Take photos of the weir crest, upstream and downstream faces, flanking embankments or abutments, and any noted defects. Photos provide remote assessment capability and establish a visual baseline for comparison.
- Flag urgent issues immediately. Structural breaches and unauthorized modifications can alter hydraulic conditions for the entire drainage system and require engineering review before any maintenance action.

B. MAINTENANCE

Maintenance restores the weir's ability to control water levels and convey flow as designed and prevents minor defects from progressing to structural failure or hydraulic bypass. A maintenance form for weirs is included with this sheet.

Maintenance equipment and skill needs:

- Hand tools for debris removal from weir crest and notch (rakes, shovels, saws, trimming shears)
- Vacuum/vactor truck or hand tools for sediment removal from forebay weir zones
- Traffic control and site access equipment for weirs in active drainage channels or road embankments
- Concrete repair materials (patching compound, grout, epoxy injection) for structural repairs
- Riprap and filter fabric for rock weir maintenance and scour protection repair
- Licensed professional engineering support for any work that alters weir crest elevation, modifies orifice plates, or involves structural repair beyond minor patching
- Survey capability for post-maintenance confirmation that crest elevation matches design

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Inspect weir crest and notch for debris accumulation, sediment mounding, and vegetation encroachment
- Clear any visible debris blocking the weir opening or notch
- Observe upstream and downstream water levels—note any deviation from expected stage
- Check for flow bypassing the weir through gaps in flanking embankments or abutments
- Log observations and update maintenance records

2. Annual maintenance and comprehensive review

- Perform a full visual inspection of weir face, crest, flanking embankment, and downstream scour zone
- Remove accumulated sediment from upstream forebay to design depth
- Inspect concrete weir structures for cracking, spalling, joint deterioration, settlement, leaning, or undermining
- Inspect riprap weirs for displaced stones and gaps in armor; replace and regrade as needed

- Verify weir crest elevation matches design—survey if visual inspection suggests settlement or modification
- Inspect and clear trash racks, well screens, and orifice plates on composite weir/outlet structures
- Remove undesirable vegetation from weir crest and flanking embankment; reseed bare areas
- Inspect downstream energy dissipation features (stilling basin, riprap apron, step pools) for scour and displacement
- Confirm orifice plates and control features are present, undamaged, and secured

3. Pre-, in-, and post-storm events

Pre-storm events

- Clear debris from weir crest, notch, and trash rack openings
- Verify upstream channel and forebay approach are free of blockage that could back water up to the weir
- Confirm emergency spillway weirs are unobstructed and armoring is intact
- Pre-stage crew resources if major storm is anticipated for weirs serving high-consequence assets

In-storm events (only when safe)

- Monitor known problematic weirs remotely or from a safe vantage point for signs of overtopping embankment, bypassing, or debris loading
- Document observed performance issues—abnormal water levels, flow paths, or visible structural distress
- Do not enter basins or approach weirs in fast-water or flood conditions

Post-storm events

- Inspect weir crest and upstream face for storm-deposited debris and sediment
- Inspect downstream scour zone for new erosion, displaced riprap, or undermining
- Check flanking embankment for erosion channels or overtopping scars indicating flow bypassed the weir
- Survey weir crest elevation if structural distress or large flood flow occurred
- Photograph and document all post-storm conditions and update inspection records

4. Factors that may influence the maintenance schedule

Use these to decide whether to stay at routine frequency or escalate to enhanced inspection and preventive maintenance:

- Debris loading—weirs in high-litter corridors, upstream of construction areas, or downstream of wooded areas accumulate debris more rapidly and warrant more frequent clearing
- Sediment loading—weirs receiving high sediment from unstable upstream channels or construction sites require more frequent forebay cleanout to protect weir hydraulics
- Structural age and material—concrete weirs older than 30 years warrant increased inspection frequency for cracking, joint failure, and concrete deterioration
- High-consequence location—weirs controlling emergency spillways, detention ponds, or critical drainage corridors warrant higher readiness and tighter tolerances for defects
- Storm intensity—increasing frequency of extreme events accelerates scour, debris loading, and structural fatigue on weir structures
- Regulatory requirement—some weirs are subject to state dam safety or stormwater permit inspection requirements that set minimum inspection frequency

5. Planned inspection and maintenance schedule

Use as a starting point, then increase frequency where risk drivers are present.

Routine planned inspections

- Weir crest and notch: monthly debris checks; annual full structural and hydraulic inspection
- Forebay transition weirs: inspection at each forebay inspection cycle (at minimum annually); cleanout when sediment exceeds 3 inches depth or impairs drainage
- Riprap/rock weirs and step pools: annual inspection; post-storm inspection after events exceeding design frequency
- Emergency spillway weirs: annual inspection; pre-storm check before major forecast events
- Multilevel intake weirs: per facility-specific O&M plan; at minimum annually with outlet works inspection

Routine planned maintenance

- Debris clearing: scheduled based on site conditions—monthly minimum at high-debris-load locations that have experienced significant rain events since the last clearing
- Sediment removal from forebay zones: annually or when the trigger threshold is reached (3-inch accumulation or impaired drainage)
- Riprap replacement: as needed following annual inspection; stockpile compatible stone on site at high-risk locations

Enhanced preventive program (when risk drivers are present)

- Increase inspection frequency at high-consequence weirs, aging concrete structures, and weirs with recurring debris or scour history
- Schedule a professional survey of crest elevation for weirs showing any signs of settlement, structural distress, or modification
- Establish a clear prohibition on unauthorized modification of weir crest elevations or removal of orifice plates—post signage and confirm in O&M agreements

Weir Asset Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Recent storm event?	☐ Yes ☐ No —If yes, describe below
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Fast water/active overflow	☐ Unstable embankment/scour	☐ Confined or restricted access
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Weir Information		
Weir Type:	☐ Sharp-crested (V-notch/rectangular)	☐ Embankment notch/spillway
	☐ Broad-crested	☐ Skimmer/multilevel intake
	☐ Riprap/rock	☐ Forebay transition
Upstream Water Level (observed):		
Expected Design Stage:		
Weir Crest Elevation (if known):		

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Hydraulic Performance	Overall	☐	☐	☐	☐	☐
	Upstream water level different than expected design stage	☐	☐	☐	☐	☐
	Flow bypassing weir	☐	☐	☐	☐	☐
	Drawdown rate for forebay/basin weirs not optimal	☐	☐	☐	☐	☐
Weir Crest and Notch Condition	Overall	☐	☐	☐	☐	☐
	Debris/trash accumulation on crest or in notch	☐	☐	☐	☐	☐
	Sediment mounding on or immediately upstream of crest	☐	☐	☐	☐	☐
	Vegetation encroachment on crest or within notch	☐	☐	☐	☐	☐
Structural Condition	Overall	☐	☐	☐	☐	☐
	Cracking, spalling, or joint failure (concrete weirs)	☐	☐	☐	☐	☐
	Displacement, settlement, or tilting of weir structure	☐	☐	☐	☐	☐
	Undermining or scour at weir base or flanks	☐	☐	☐	☐	☐
	Orifice plate/notch insert present, secured, and undamaged	☐	☐	☐	☐	☐
Downstream Energy Dissipation	Overall	☐	☐	☐	☐	☐
	Riprap apron/stilling basin condition issues (displacement, scour)	☐	☐	☐	☐	☐
	Erosion at downstream toe or flanking embankment	☐	☐	☐	☐	☐
	Step pools/biofiltration conveyance (BFC) weir tiers: structural or functional issues	☐	☐	☐	☐	☐
Flanking Embankment and Approach	Overall	☐	☐	☐	☐	☐
	Vegetation cover issues on embankment flanks (sparse, adequate, encroaching)	☐	☐	☐	☐	☐
	Evidence of flow bypassing weir through embankment or erosion channel	☐	☐	☐	☐	☐
	Animal burrows or other embankment penetrations near weir	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to downstream drainage area (flooding risk if weir fails or bypasses)	☐	☐	☐	☐	☐
	Impact to regulated water level/permitted design stage	☐	☐	☐	☐	☐
	Proximity to high-consequence facilities or critical infrastructure	☐	☐	☐	☐	☐

Notes and Observations:

Weir Name/ID: _____ Inspector Initials: _____

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Hydraulic Performance	Upstream water level different than expected design stage	At or near design stage.	Slightly above design; minor ponding.	Noticeably above design; investigate cause.	Significant excess stage; flooding risk.	Severe overtopping or structural bypass imminent.
	Flow bypassing weir	All flow over/through weir as designed.	Trace flow at flank; monitor.	Visible bypass channel forming.	Significant bypass; weir partially ineffective.	Complete bypass; weir functionally failed.
	Forebay/basin drawdown rate	Draining within design period.	Slightly slow; within acceptable range.	Noticeably slow; clog likely.	Not draining; standing water persisting.	No drainage; structural blockage or damage.
Weir Crest and Notch Condition	Debris/trash on crest or notch	Clear; no debris.	Minor debris; does not impede flow.	Moderate mat; reduces effective width.	Heavy blockage; flow significantly impeded.	Complete blockage; weir non-functional.
	Sediment accumulation upstream of crest	No accumulation.	Trace sediment; no functional impact.	Deposit reducing available head.	Significant mound; weir hydraulics altered.	Sediment above crest elevation; weir buried.
	Vegetation encroachment	No vegetation on crest.	Minor grass growth; low impact.	Established vegetation reducing effective width.	Dense growth significantly impairs flow.	Woody vegetation damaging structure.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Structural Condition	Cracking/spalling/joint failure	Sound; no defects.	Minor surface crack; no leakage.	Multiple cracks; seepage possible.	Active seepage; structural concern.	Failure imminent; immediate action required.
	Displacement/settlement/tilting	No movement; plumb and level.	Trace settlement; within tolerance.	Noticeable tilt or differential settlement.	Significant movement; crest elevation altered.	Severe displacement; structural failure risk.
	Undermining/scour at base or flanks	No scour; foundation intact.	Minor scour marks; no void.	Active scour; erosion visible.	Void forming under weir structure.	Foundation undermined; collapse risk.
	Orifice plate/notch insert condition	Present, secured, undamaged.	Minor corrosion; functional.	Loose or partially damaged.	Significantly damaged or partially missing.	Missing or removed; unauthorized modification.
Downstream Energy Dissipation	Riprap apron/stilling basin	Fully intact; no displacement.	Minor stone displacement; stable overall.	Moderate displacement; exposure forming.	Significant gaps; unprotected soil exposed.	Riprap failed; active scour progressing.
	Erosion at downstream toe or flanks	No erosion; vegetation intact.	Minor rill; shallow and stable.	Active erosion channel forming.	Significant scour; embankment threatened.	Severe erosion; structural failure risk.
	Step pools/biofiltration conveyance (BFC) weir tiers: structural or functional issues	Sound and functional.	Minor displacement; functional.	Partial failure; reduced function.	Major damage; significant bypass.	Structural failure; flows uncontrolled.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Flanking Embankment and Approach	Embankment vegetation cover	Dense, healthy cover; no bare areas.	Minor sparse area; not eroding.	Bare patches; erosion starting.	Significant bare areas; rilling evident.	Severe erosion; embankment integrity at risk.
	Flow bypassing weir through embankment	No bypass; embankment intact.	Seepage at flank; trace flow.	Small bypass channel forming.	Active bypass reducing weir effectiveness.	Embankment breach; uncontrolled flow.
	Animal burrows near weir	None observed.	Minor activity; no penetration.	Burrows near weir footprint; investigate.	Penetration of embankment near weir.	Active burrow system compromising structure.
Overall Rating Based on Impacts to People and Infrastructure	Threat to downstream drainage area	No downstream flooding risk if weir fails.	Low-density area; minor risk.	Residential or commercial area downstream.	Dense development or road downstream; major risk.	Critical drainage; failure causes immediate flooding.
	Impact to regulated water level/permited stage	Within design tolerance; no concern.	Minor deviation; within acceptable range.	Deviation from permitted stage; document and monitor.	Significant deviation; regulatory notification likely.	Unauthorized modification confirmed; immediate report required.
	Proximity to high-consequence facilities	No critical facilities within drainage area.	Minor facility exposure; low consequence.	School, park, or commercial use nearby.	Hospital, evacuation route, or utility corridor affected.	Direct threat to critical infrastructure or public safety.

Weir Name/ID	
Location	
Date/Time	START: _ / _ / _ END: _ / _ / _
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: _ °F
Recent storm event?	☐ Yes ☐ No —If yes, describe below
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/ scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up	☐ Complaint/service request Date received: _ / _ / _	☐ Emergency/safety issue or in-storm event
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WEIR TYPE AND SETTING

☐ Sharp-crested weir (V-notch, rectangular, trapezoidal)	☐ Broad-crested weir (forebay transition, level spreader)
☐ Riprap/rock weir, biofiltration conveyance (BFC), step pool	☐ Armored embankment/emergency spillway weir
☐ Skimmer weir/multilevel intake (outlet works, reservoir)	☐ Other—describe below

Other weir type description:

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Weir crest debris removal (manual)	☐ Weir notch/opening clearing
☐ Trash rack/well screen cleaning	☐ Sediment removal from weir approach zone	☐ Forebay/upstream zone cleanout
☐ Orifice plate inspection and securing	☐ Riprap repair/replacement (weir face or apron)	☐ Rock weir stone reseating/regrading
☐ Concrete crack patching/grout injection	☐ Scour repair (apron, toe, flank)	☐ Embankment erosion repair and reseedling
☐ Vegetation removal from crest or notch	☐ Undesirable vegetation removal (embankment flank)	☐ Woody vegetation removal and stump treatment
☐ Downstream stilling basin/step pool maintenance	☐ Visual inspection of weir structure	☐ Other (describe below)

Other maintenance actions performed:

COMPONENTS ADDRESSED

☐ Weir crest/notch	☐ Upstream approach and forebay zone	☐ Weir face (upstream side)
☐ Weir face (downstream side)	☐ Downstream apron/riprap	☐ Stilling basin/plunge pool
☐ Flanking embankment (left)	☐ Flanking embankment (right)	☐ Trash rack/well screen
☐ Orifice plate/notch insert	☐ Step pools/biofiltration conveyance (BFC) weir tiers	☐ Embankment bypass repair

Weir Name/ID: _____ Foreman Initials: _____

HYDRAULIC STATUS AFTER MAINTENANCE

☐ Weir crest clear—flow passing over/through as designed	☐ Upstream stage returned to expected level
☐ Forebay/basin drawing down at appropriate rate	☐ Flow bypassing weir—requires further investigation
☐ Engineering review required before returning to service	☐ No change needed—condition within acceptable range

WEIR CREST ELEVATION (if confirmed or surveyed)

Design Crest Elevation	_____	Observed/Surveyed Crest Elevation	_____
Difference (+ above/– below design)	_____ _____	Survey Method/Instrument	_____

_____ : Any confirmed deviation between design and observed crest elevation must be reported to the engineer responsible before returning the weir to service.

MATERIALS AND EQUIPMENT USED

Equipment used (e.g., vactor truck, skid steer, hand tools, concrete pump, survey instrument):

Materials used (e.g., riprap size and quantity, concrete patching material, filter fabric, seed mix):

Maintenance hours/staff:

ISSUES IDENTIFIED DURING MAINTENANCE

☐ Crest elevation deviated from design—engineering review required	☐ Orifice plate missing or unsecured—replace and document	☐ Active scour at base or flanks—riprap repair needed
☐ Significant concrete deterioration—structural assessment needed	☐ Flow bypassing weir unresolved—further investigation required	☐ Animal burrow penetration—embankment repair needed
☐ Unauthorized modification suspected—report to engineer and regulatory authority	☐ Vegetation damage to structure—remove and treat	☐ Other—describe below

Describe issues identified:

DOCUMENTATION

Before photos attached:	☐ Yes	☐ No	☐ N/A
Photo locations/direction recorded?	☐ Yes	☐ No	☐ N/A
Sketch/map/GPS points attached?	☐ Yes	☐ No	☐ N/A
Inspection checklist attached?	☐ Yes	☐ No	☐ N/A
Work order attached?	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED?

☐ Yes

☐ No

☐ N/A

(If yes, describe trigger)

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Notes and Observations:

Attach additional pages, if required.

How to Maintain Your Reservoirs

What is it?

A reservoir is a constructed or modified water storage feature that temporarily or permanently holds water. A reservoir is typically formed by a dam. For community flood infrastructure, reservoirs may store stormwater, regulate downstream flows, provide detention, support raw water supply, or serve as part of a larger drainage system. Reservoirs may include an open-water pool, an excavated basin, a dam, a spillway, outlet works, inlet channels, shoreline protection, pumps, access roads, fencing, gauges, and other appurtenant features. These documents focus on the reservoir basin and related operating features used to maintain storage, conveyance, access, water quality, and public safety. Dam components should be inspected and maintained according to applicable Texas Commission on Environmental Quality (TCEQ) Dam Safety Program regulations.

Who maintains it?

Reservoir ownership and maintenance vary. Reservoirs may be owned or maintained by cities, counties, river authorities, municipal utility districts, drainage districts, water districts, flood control districts, private entities, or homeowners' associations. Some reservoirs serve more than one purpose, such as stormwater management, flood detention, water supply, irrigation storage, recreation, or environmental habitat. Regardless of ownership, the maintaining entity should understand:

- Which watershed and drainage system drains to the reservoir
- What storage, outlet, spillway, and operating functions the reservoir must provide
- Who is responsible for inspection, maintenance, emergency response, water quality monitoring, and capital repairs

Important note: A reservoir is typically formed by a dam. The owner should take care to determine whether the dam is regulated by the Texas Commission on Environmental Quality (TCEQ) Dam Safety Program.



Best maintenance practices & strategies

Reservoirs are built or managed to store water safely and release it in a controlled manner. Over time, sediment, shoreline erosion, aquatic vegetation, algae, trash, outlet blockages, spillway deterioration, and access problems can reduce storage volume and make the reservoir less reliable during storms. For under-resourced communities, the most effective program is often simple and consistent: inspect the same features each time, document trends with photographs, remove small blockages early, and escalate recurring or high-consequence issues before they become emergency repairs. Routine inspection and targeted maintenance protect flood storage capacity, reduce downstream flood risk, preserve water quality, support safe operations, and extend the service life of the reservoir and its appurtenant structures.

A. INSPECTION

Inspections confirm that the reservoir can store water as intended, pass inflows and outflows safely, and remain stable without creating hazards such as unsafe slopes, shoreline collapse, blocked outlets, contaminated water, or uncontrolled overflow. The inspection should cover the reservoir pool, shoreline, banks, embankments, inflow points, outlet works, spillways, screens, pumps or gates if present, access roads, security features, and monitoring equipment. Inspection records should be detailed enough to show whether conditions are stable, improving, or worsening over time. An inspection checklist for reservoirs is included with this reference sheet.

Signs that the reservoir is not performing well:

- Water levels rise faster than expected during moderate storms, or the reservoir overflows more frequently than historical records suggest
- Sediment deltas, raised basin areas, or shallow deposits are reducing effective storage volume
- Outlet structures, trash racks, culverts, pump intakes, or spillways are blocked by debris, vegetation, sediment, or floating material
- Shorelines are eroding, banks are slumping, or wave action is creating erosion benches along the normal pool level
- Water remains stagnant, produces strong odors, supports heavy algae, or shows oily sheen, unusual color, foam, or dead fish
- Access roads, gates, fencing, signs, staff gauges, or telemetry no longer support safe inspection and emergency response

Inspection skill needs:

- Familiarity with reservoir components: basin, pool, inflow channels, outlet works, spillway, trash rack, intake, embankment, shoreline protection, staff gauge, and access routes
- Ability to recognize storage loss, sediment deltas, changed water levels, and signs of reduced reservoir capacity
- Ability to identify erosion patterns such as shoreline erosion, wave erosion, rills, gullies, slumps, settlement, and unstable slopes
- Ability to recognize water quality concerns such as odors, discoloration, oil sheen, algae, fish kills, and suspicious dry-weather inflows
- Ability to document conditions clearly with photographs, location notes, water level observations, and simple condition ratings
- Ability to work safely around deep water, soft ground, steep slopes, confined spaces, traffic, wildlife, and storm-damaged structures
- Ability to recognize when engineering review, environmental coordination, water quality follow-up, or dam safety coordination is needed

What to look for:

- **Storage capacity and sediment accumulation.** Sediment is one of the most common long-term threats to reservoir function. It enters from upstream erosion, construction runoff, bank failures, road ditches, or inflow channels and then settles where

velocities slow. Look for deltas at inflows, shallow shelves, sediment benches along the pool margin, islands forming in the basin, or outlet approaches becoming buried. Reduced storage means the reservoir fills more quickly during storms and may release or overflow earlier than intended.

- **Inflow points and upstream drainage features.** Reservoir performance depends on inflows entering without eroding banks or bypassing the intended route. Check swales, pipes, culverts, flumes, forebays, and inlet channels for blockage, erosion, scour holes, broken headwalls, displaced rock, and sediment deposition. Concentrated inflows should be stabilized before they cut gullies into the reservoir, because those gullies can deliver large volumes of sediment and may damage nearby property or utilities.
- **Outlet works, spillways, screens, and pumps.** Outlets control how water leaves the reservoir. Inspect trash racks, screens, outlet pipes, gates, valves, risers, spillways, pump intakes, and downstream discharge channels. Blockage at these points can cause water levels to rise rapidly. Structural distress, settlement, corrosion, voids, cracking, or undermining can also reduce reliability. If the reservoir has a spillway, inspect the full flow path, including the approach, control section, chute, stilling area, and downstream channel.
- **Shoreline erosion and bank stability.** Check for wave erosion, bare soil, undercut banks, slumping, cracks at the top of the bank, and sediment plumes entering the pool. Erosion can reduce water quality, fill the reservoir with sediment, and threaten trails, roads, fences, utilities, or structures. Shoreline erosion may be caused by wind waves, boat wakes, fluctuating water levels, uncontrolled runoff, livestock access, or loss of protective vegetation.
- **Embankment and dam-related features.** Many reservoirs include an embankment or dam that may be regulated separately. From the reservoir side, look for eroded slopes, animal burrows, woody vegetation on the embankment, wet spots, settlement, cracks, displaced riprap, and debris against spillways or outlet controls. Do not treat these as ordinary landscaping issues if they could affect dam safety. Repeated settlement, seepage, sinkholes, or spillway voids should trigger engineering review.
- **Water quality and public health indicators.** Reservoirs can develop water quality problems when water becomes stagnant, nutrient-rich, or contaminated by runoff. Look for unusual odors, colors, oily sheens, foam, sewage indicators, dead fish, heavy algae,

floating mats, and trash. If the reservoir is used for raw water, irrigation, recreation, or public access, water quality observations should be recorded and routed to the appropriate operator or environmental staff. If the reservoir is part of a water supply system, follow applicable sampling, cleaning, disinfection, and return-to-service requirements.

- **Aquatic vegetation and algae.** Some vegetation along the reservoir edge can stabilize banks and provide habitat. However, dense aquatic vegetation in inlets, outlets, coves, spillway approaches, or pump intake areas can trap sediment, reduce capacity, impair access, and create odor or mosquito concerns. Record whether growth is seasonal and manageable, or whether it is affecting storage, water quality, or hydraulic function.
- **Access, security, and public safety.** Reservoirs often attract public access even where swimming, boating, or shoreline entry is not intended. Inspect access roads, gates, fencing, locks, signs, rescue equipment, and barriers. Look for unsafe slopes, soft ground, holes, broken railings, vandalism, illegal dumping, exposed structures, and deep-water hazards. Maintenance crews also need safe access for mowers, excavators, vacuum trucks, boats, or inspection vehicles.
- **Instrumentation and monitoring records.** Staff gauges, level sensors, telemetry, rain gauges, water quality equipment, and inspection records support decision-making during storms and operations. Verify that gauges are readable, sensors are secure, data are transmitting where applicable, and records are current. If reservoir levels or field measurements are used for decisions, equipment should be checked and calibrated according to the operator's procedures.
- **Downstream discharge and receiving channel.** A reservoir may appear functional while its downstream discharge point is eroding, blocked, or unsafe. Inspect the downstream channel, outfall, stilling basin, culvert, or drainage ditch. Look for scour, displaced riprap, bank failure, debris jams, and evidence that releases are damaging downstream property or infrastructure.
- **Adjacent land use and watershed changes.** Changes upstream can alter sediment, debris, and runoff reaching the reservoir. Note nearby construction, new development, clearing, livestock activity, erosion, illegal grading, or changes in drainage patterns. These observations help explain why sedimentation or flooding is increasing and may point to source control measures that are less expensive than repeated sediment removal.

- **Evidence from recent storms.** After storms, high water marks, debris lines, wrack deposits, erosion scars, overtopped areas, and downstream scour show how the reservoir actually performed. These observations are valuable even when no immediate repair is needed. They help define future maintenance priorities and support requests for budget, engineering assistance, or grant funding.

How to record conditions:

- Use a standard inspection form. A consistent form ensures the same items are inspected every time and helps small communities compare conditions from year to year. Standardized records support budgeting, grant applications, work orders, and engineering review.
- Record reservoir identification, location, date, weather, water level, and recent storm history. These details explain the context of observations. Erosion after a major storm does not mean the same thing as erosion observed during normal dry-weather operations.
- Describe storage and sediment conditions using simple categories. Use clear language such as storage appears normal, storage partially reduced, or storage severely reduced. Where possible, note approximate areas or depths of sediment deposits and whether they are near inlets, outlets, or the main pool.
- Document inlet, outlet, spillway, and pump performance indicators. Note whether structures are clear, partially restricted, or severely restricted. Record whether water is bypassing the intended controls, whether debris is collecting at the trash racks, and whether pumps, gates, or valves have been tested.
- Photograph key conditions from repeatable locations. Photos should include the inflow, outlet, spillway, shoreline erosion, sediment areas, safety hazards, and any water quality concerns. Repeat photographs from the same vantage points help track trends.
- Flag urgent hazards clearly. Issues that threaten life safety, downstream flooding, dam or embankment stability, outlet function, road access, or water supply operations should be marked for immediate response rather than routine scheduling.
- Record follow-up actions and responsible parties. Small communities often depend on part-time staff, contractors, or shared responsibilities. Clearly assigning the next action reduces the chance that a known problem will remain unresolved.

B. MAINTENANCE

Maintenance restores or preserves the reservoir's ability to store water, make controlled releases, protect downstream areas, and remain safe for crews and the public. Maintenance should focus first on items that reduce capacity or create immediate safety risks: blocked outlets, unstable slopes, failing spillways, severe erosion, unsafe public access, and water quality concerns. For smaller communities, a practical program typically combines routine housekeeping, post-storm response, periodic vegetation and sediment management, and planned engineering review for larger structural or capacity issues. A maintenance checklist for reservoirs is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools for trash removal, light vegetation control, and simple access maintenance
- Mowers, trimmers, or brush cutters suitable for reservoir perimeters, embankments, access roads, and shoreline areas
- Vacuum, jetting, or excavation equipment for inlet, outlet, culvert, or trash rack cleanout
- Excavation and hauling equipment for sediment removal when storage loss is significant
- Riprap, bedding stone, filter fabric, seed, mulch, erosion control blanket, soil, concrete, grout, and other stabilization materials
- Pump, valve, gate, and electrical maintenance support where mechanical or electrical components are present
- Boat, drone, remotely operated vehicle, or contractor support when safe visual access is not practical from shore
- Water quality field equipment when the community collects readings such as temperature, pH, dissolved oxygen, specific conductance, Secchi depth, or visual observations
- Traffic control, confined space procedures, water safety practices, and environmental protection measures where applicable

Key maintenance goals:

- Preserve storage capacity. Remove sediment when it measurably reduces the reservoir's ability to store water or support intended operations. Sediment removal should be planned with appropriate access, disposal, erosion controls, and regulatory review. Where sediment returns quickly, also address

upstream sediment sources.

- Keep inlets and outlets functional. Clear trash racks, screens, culverts, inlet channels, outlet works, and spillway approaches before the next storm season and after significant storms. Small blockages can become flood problems when debris collects at a restricted opening.
- Repair erosion before it becomes structural damage. Small shoreline rills, gullies, wave benching, and scour pockets should be stabilized early. Repeated erosion at the same location may indicate that drainage, wave energy, slope geometry, or protection type needs redesign rather than repeated repair.
- Protect embankments and dam-related features. Maintain grass cover or approved slope protection, remove inappropriate woody vegetation, repair animal burrows, and monitor settlement or seepage. Do not perform unauthorized excavation or grading on dam embankments or spillways.
- Maintain spillways and emergency overflow routes. Spillways and overflow routes must remain open, stable, and free of debris, unauthorized fill, fencing, dumped material, or vegetation that could impede or redirect flow. Inspect downstream areas for scour or damage after significant releases.
- Control vegetation without destabilizing banks. Manage vegetation to maintain access and hydraulic function. Preserve stable shoreline vegetation where it protects banks and filters runoff, but remove invasive, dense, or poorly located vegetation that blocks inlets, outlets, spillways, or pump intakes.
- Protect water quality. Remove trash, document suspicious discharges, manage algae and aquatic vegetation where they affect operations or public health, and coordinate with environmental or water utility staff when water quality concerns arise. If the reservoir is used for public water supply, cleaning and return-to-service practices must follow applicable requirements.
- Maintain safe access and public controls. Keep access roads, gates, signs, locks, fencing, and maintenance routes functional. Public safety hazards such as steep eroded banks, deep water, unstable ground, and exposed structures should be addressed promptly or restricted until corrected.
- Maintain monitoring and operating records. Inspection records, water level readings, maintenance work orders, equipment service logs, and photographs should be kept together. Good records are often the basis for prioritizing repairs and demonstrating need for outside funding.

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Conduct drive-by or walk-through checks of accessible reservoir perimeter, inlets, outlets, spillways, staff gauges, and known problem locations
- Remove trash and floating debris before it reaches outlet works or spillways
- Mow or trim access routes, embankment inspection paths, and designated maintenance areas while preserving stabilizing shoreline vegetation where appropriate
- Check gates, locks, signs, staff gauges, safety features, and access roads for damage, vandalism, or obstruction
- Record water levels and visible conditions, especially during unusually wet, dry, or high-use periods

2. Annual maintenance and comprehensive review

- Perform a full inspection of the basin, shoreline, inflows, outlets, spillways, access routes, pump/gate components, and monitoring equipment
- Compare current sediment, erosion, vegetation, water quality, and water level observations to prior inspection records
- Identify locations where sediment is reducing storage or where erosion is recurring, and schedule planned maintenance before the next storm season
- Review whether the reservoir is still meeting its intended purpose for flood storage, detention, water supply, or drainage system support
- Review maintenance agreements, emergency contacts, and any regulatory requirements for the facility

3. Pre-, in-, and post-storm events

Pre-storm events

- Inspect known problem inlets, outlets, spillways, access roads, trash racks, and low points
- Remove visible debris where safe

In-storm events (only when safe)

- Do not enter fast water, unstable slopes, confined spaces, or flooded roads
- Document water levels, overflow, and blocked structures when safe

Post-storm events

- Inspect as soon as conditions are safe

- Remove storm-deposited debris, document high water marks and debris lines, check for new erosion or slumping, and update the priority list
- Escalate immediately if spillway damage, outlet blockage, embankment seepage, sinkholes, or uncontrolled overflow is observed

4. Maintenance decision logic

- Continue planned maintenance when storage capacity appears acceptable, outlets and spillways are clear, erosion is minor, and safety controls are functional
- Increase preventive maintenance when sediment, debris, algae, outlet blockage, shoreline erosion, or vegetation problems are recurring or trending upward
- Plan repair or rehabilitation when storage loss is measurable, erosion is expanding, outlet structures are damaged, pumps or gates are unreliable, or spillway surfaces show cracking, voids, undermining, or settlement
- Seek engineering evaluation when the reservoir no longer meets expected performance, repeated repairs fail, embankment or spillway stability is uncertain, water levels change unexpectedly, or downstream consequences are high
- Consider replacement or redesign when the reservoir is undersized for current watershed conditions, sediment management is not sustainable, outlet controls do not meet operational needs, or failure would threaten life safety, critical facilities, or occupied structures

5. Factors that may influence the maintenance schedule

- Storm intensity and frequency. More frequent or intense rainfall increases sediment, debris, erosion, and outlet blockage. Post-storm inspection frequency should increase when heavy rainfall occurs.
- Upstream watershed changes. New development, construction, clearing, channel work, road ditch erosion, or livestock activity can increase runoff and sediment delivered to the reservoir.
- Sedimentation rate. Reservoirs with rapid sediment accumulation need measured tracking and planned sediment management, not only visual inspection.
- Reservoir purpose and consequence of failure. Reservoirs supporting flood detention, water supply, emergency storage, critical roads, or downstream neighborhoods require higher inspection frequency and faster response.

- Age and condition of outlet and spillway structures. Older concrete, metal, soil cement, culverts, gates, pumps, and valves require more frequent checks as deterioration begins.
- Water quality and public use. Reservoirs with public access, recreation, irrigation, water supply, or wildlife value need additional attention to algae, contamination, dumping, fish kills, and nuisance conditions.
- Regulatory and agreement requirements. Dam safety rules, water rights, environmental permits, maintenance agreements, utility operations, or emergency action plans may set minimum inspection or reporting requirements.

6. Repair vs. replacement considerations

Factors that indicate continued maintenance and repair

Choose repair/rehabilitation when:

- Sediment accumulation is localized and can be removed without repeated rapid return
- Erosion is minor or isolated and can be stabilized with standard materials and reasonable access
- Inlet, outlet, spillway, pump, gate, or valve issues are localized, and the remaining structure is sound
- Vegetation or debris management restores function without altering design grades or flow paths
- Water quality concerns are operational or seasonal and can be addressed through cleaning, source control, or monitoring
- Public safety hazards can be corrected with ordinary access control, signage, grading, or minor repairs

Factors that indicate asset replacement, major repair, or redesign

Consider major rehabilitation or replacement when:

- Storage capacity is repeatedly lost, and sediment removal alone is not sustainable
- The reservoir is undersized or cannot control current runoff from the watershed even when clean
- Spillways, outlet works, embankments, or pump systems show widespread structural distress or repeated failure
- Erosion repairs repeatedly fail, indicating hydraulic conditions or slope geometry need redesign
- Access or safety limitations prevent timely maintenance or emergency response
- The consequence of failure is severe, such as downstream flooding of occupied structures, loss of road access, or interruption of water supply or critical services

Reservoirs

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Reservoir Name/ID	
Reservoir Type	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temp.: °F
Recent storm event?	☐ Yes ☐ No
Approximate Water Level During Work	☐ Low ☐ Normal ☐ High ☐ Drawn Down ☐ Overtopping
Primary Function	☐ Flood Detention ☐ Raw Water ☐ Irrigation ☐ Recreation ☐ Other
Other/Details	
Normal Pool/Target Level	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Fast water/high flows	☐ Unstable slopes/sinkholes	☐ Deep water/drowning hazard	☐ Hazardous material or spill	☐ Severe weather/lightning
--	--	---	--	---

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Storage Capacity and Sedimentation	Overall	☐	☐	☐	☐	☐
	Sediment accumulation reducing storage	☐	☐	☐	☐	☐
	Delta formation at inflows	☐	☐	☐	☐	☐
	Excessive aquatic vegetation or algae	☐	☐	☐	☐	☐
	Floating debris or trash accumulation	☐	☐	☐	☐	☐
Shoreline, Banks, and Slopes	Overall	☐	☐	☐	☐	☐
	Shoreline erosion or bank undercutting	☐	☐	☐	☐	☐
	Slope instability or slumping	☐	☐	☐	☐	☐
	Wave benching or boat-wake erosion	☐	☐	☐	☐	☐
	Animal burrows or woody vegetation on embankments	☐	☐	☐	☐	☐

Reservoir Name/ID: _____ Inspector Initials: _____

Reservoirs

Inspection Checklist

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Inlets, Outlets, and Control Structures	Overall	☐	☐	☐	☐	☐
	Inlet blockage or erosion	☐	☐	☐	☐	☐
	Outlet works blockage or damage	☐	☐	☐	☐	☐
	Trash rack or screen condition	☐	☐	☐	☐	☐
	Valve/gate/pump operability (if present)	☐	☐	☐	☐	☐
	Spillway obstruction or deterioration	☐	☐	☐	☐	☐
Water Quality and Public Health Indicators	Overall	☐	☐	☐	☐	☐
	Unusual color, odor, sheen, or foam	☐	☐	☐	☐	☐
	Algal bloom or excessive aquatic growth	☐	☐	☐	☐	☐
	Fish kill or stressed aquatic life	☐	☐	☐	☐	☐
	Suspected illicit discharge or contamination	☐	☐	☐	☐	☐
Access, Security, and Safety	Overall	☐	☐	☐	☐	☐
	Access roads and maintenance routes	☐	☐	☐	☐	☐
	Fencing, gates, locks, and signage	☐	☐	☐	☐	☐
	Slips, trips, falls, or drowning hazards	☐	☐	☐	☐	☐
	Unsafe water levels or rapid changes	☐	☐	☐	☐	☐
Instrumentation and Monitoring	Overall	☐	☐	☐	☐	☐
	Staff gauge or level sensor condition	☐	☐	☐	☐	☐
	Data logger/telemetry functioning (if present)	☐	☐	☐	☐	☐
	Water quality monitoring equipment condition (if present)	☐	☐	☐	☐	☐
	Records current and complete	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to flood storage or detention function	☐	☐	☐	☐	☐
	Threat to downstream structures or roads	☐	☐	☐	☐	☐
	Threat to water supply or pump operations	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐

Inspection Checklist



Notes and Observations:

Attach additional pages, if required.

Reservoirs

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Storage Capacity and Sedimentation	Sediment accumulation reducing storage	Thin sediment layer; no visible capacity loss.	Localized sediment benches; minor loss of storage.	Noticeable deposition reducing pool or detention volume; plan sediment survey or removal.	Severe deposition causing reduced detention time, higher normal pool, or early overflow risk.	Storage largely lost or outlet buried; flooding or unsafe overflow likely without urgent action.
	Delta formation at inflows	No delta or only minor deposits at inflow.	Small delta forming but flow spreads normally.	Delta extends into reservoir and begins redirecting flow or trapping debris.	Large delta reduces storage or causes erosion at banks or inlet structures.	Delta blocks inflow, causes bypass flooding, or threatens inlet/outlet operation.
	Excessive aquatic vegetation or algae	Normal seasonal growth; no operational issue.	Localized growth; minor nuisance.	Growth traps sediment or debris and begins reducing usable storage or access.	Dense mats affect water quality, outlet operation, or public use.	Severe bloom or growth creates public health concerns, fish stress, or operational failure.
	Floating debris or trash accumulation	Minimal floatables; no action beyond routine pickup.	Localized debris near shoreline; schedule removal.	Debris collects at coves, inlets, or outlet approaches; removal needed.	Heavy debris restricts flow or could block outlet/spillway during next event.	Debris is blocking critical structures or creating immediate flood/public safety risk.
Shoreline, Banks, and Slopes	Shoreline erosion or bank undercutting	Banks stable; minor surface wear.	Small erosion spots or shallow undercutting; monitor and repair as needed.	Active erosion along a reach; sediment entering reservoir; stabilization should be scheduled.	Severe erosion approaching access roads, utilities, structures, or embankments.	Active bank failure or collapse threatens infrastructure, public safety, or reservoir function.
	Slope instability or slumping	Slopes stable; no cracks or slumps.	Minor sloughing or bare spots; routine repair.	Cracks, slumps, or soft areas developing; schedule stabilization.	Significant movement, settlement, or slide; restrict access and prioritize repair.	Active slide, sinkhole, or collapse risk; immediate closure and engineering review required.

Reservoirs

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Shoreline, Banks, and Slopes (Cont' d.)	Wave wash or boat-wake erosion	No wave-cutting observed.	Minor wave wear at normal pool line.	Wave notch or localized bank retreat visible; protection should be planned.	Repeated wave erosion undermines bank protection or access areas.	Rapid erosion threatens embankment, structures, or public areas; urgent stabilization.
	Animal burrows or woody vegetation on embankments	No burrows; vegetation appropriate and controlled.	Minor burrows or small woody growth; schedule removal/repair.	Active burrowing or woody roots may affect slope stability; repair needed.	Extensive burrows or mature trees on embankment; seepage or instability path possible.	Burrows, uprooted trees, or voids create immediate embankment or public safety hazard.
Inlets, Outlets, and Control Structures	Inlet blockage or erosion	Inlet clear and stable.	Minor debris or small scour; routine cleanout/repair.	Partial blockage or erosion at inflow; reduced reliability during storms.	Severe blockage or scour; flow bypassing intended path or damaging structure.	Inlet failure or blockage causing flooding, rapid erosion, or emergency risk.
	Outlet works blockage or damage	Outlet clear, accessible, and functional.	Minor debris, corrosion, or wear; routine maintenance.	Partial blockage or moderate damage; schedule repair.	Severe blockage, settlement, or structural damage; outlet function impaired.	Outlet failed or blocked; reservoir cannot drain/release as intended; emergency action.
	Trash rack or screen condition	Rack/screen intact and clear.	Minor debris or corrosion; routine cleaning.	Partial blockage or damaged bars; cleaning/repair needed.	Severe blockage or deformation; backup likely in next event.	Rack/screen failed, missing, or fully blocked; immediate flood/operation risk.

Reservoirs

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Inlets, Outlets, and Control Structures (Cont' d.)	Valve/gate/pump operability (if present)	Operates through full range; no abnormal noise or leakage.	Minor stiffness, minor leakage, or maintenance need.	Intermittent operation or reduced capacity; schedule service.	Cannot fully open/close or pump capacity is impaired; urgent repair.	Non-operational gate/valve/pump causing loss of control; emergency response required.
	Spillway obstruction or deterioration	Spillway clear and lining/vegetation stable.	Minor debris, cracking, or vegetation; routine maintenance.	Partial obstruction or localized deterioration; schedule removal/repair.	Major obstruction, scour, voids, or lining failure; capacity and stability reduced.	Spillway blocked or failing; uncontrolled overflow or dam safety concern.
Water Quality and Public Health Indicators	Unusual color, odor, sheen, or foam	No unusual observations.	Minor staining or natural odor; document and monitor.	Persistent odor, color, foam, or sheen; investigate source.	Strong evidence of pollutant, sewage, or chemical input; notify appropriate staff.	Active spill, strong chemical odor, or public health concern; immediate response required.
	Algal bloom or excessive aquatic growth	No bloom or only normal seasonal growth.	Light bloom or growth; monitor conditions.	Persistent bloom or growth affecting clarity, odor, or use.	Dense bloom with odors, scum, or likely low oxygen conditions.	Suspected harmful bloom, fish stress, or public health hazard; restrict access and notify.
	Fish kill or stressed aquatic life	Aquatic life appears normal.	Isolated dead fish or minor stress signs; document.	Multiple dead/stressed fish; investigate oxygen, temperature, or pollutant sources.	Fish kill observed; collect observations and notify environmental authority.	Major fish kill or evidence of acute contamination; emergency response and notification.
	Suspected illicit discharge or contamination	No suspicious inflow or dumping.	Minor dry-weather flow or staining; document and monitor.	Persistent dry-weather flow, dumping, or unknown discharge; initiate investigation.	Likely illicit discharge affecting reservoir; escalate to enforcement/utility staff.	Confirmed hazardous discharge or active contamination; emergency response required.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Access, Security, and Safety	Access roads and maintenance routes	Access clear and passable.	Minor rutting or vegetation encroachment; routine maintenance.	Access limited; crews need extra equipment or time.	Access unsafe during wet conditions or blocks routine maintenance.	Access impossible or hazardous; emergency response hindered.
	Fencing, gates, locks, and signage	Security and warning features intact.	Minor wear or fading; still functional.	Damage or missing signs/locks; repair scheduled.	Security compromised or public warnings inadequate; priority repair.	Open access to hazardous area or critical asset; immediate controls required.
	Slips, trips, falls, or drowning hazards	No observed hazards.	Minor uneven ground or slippery areas; mark if needed.	Hazards present near public or crew access; controls needed.	Serious fall/drowning hazard; restrict access until corrected.	Immediate danger due to unstable edge, deep water, or exposed structure; close area.
	Unsafe water levels or rapid changes	Water levels normal and stable.	Minor level fluctuation; no safety issue.	Water levels or drawdown rates require caution and signage.	Rapid changes or high water create access and public safety risk.	Unsafe levels, overtopping, or rapid drawdown create an immediate hazard.
Instrumentation and Monitoring	Staff gauge or level sensor condition	Gauge/sensor visible, stable, and readable.	Minor wear or calibration check needed.	Gauge partly unreadable or sensor reliability questionable.	Gauge/sensor damaged; level readings unreliable.	Gauge/sensor missing or failed; no reliable level information.
	Data logger/telemetry functioning (if present)	Data reporting normally.	Minor data gaps or battery/service need.	Repeated gaps or delayed data; maintenance needed.	Telemetry unreliable during storms or operations.	No data transmission or failed logger; immediate repair for critical sites.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Instrumentation and Monitoring (Cont' d.)	Water quality monitoring equipment condition (if present)	Equipment clean, calibrated, and functioning.	Minor maintenance or calibration due.	Sensor fouling or drift affects confidence; service soon.	Equipment unreliable or frequently out of range; priority maintenance.	Equipment failed or contaminated; data unusable until corrected.
	Records current and complete	Inspection, level, and maintenance records current.	Minor documentation gaps; correct during next update.	Recurring missing entries or outdated asset information.	Records incomplete enough to impair budgeting, compliance, or response.	No reliable records for critical reservoir condition or operations.
Overall Rating Based on Impacts to People and Infrastructure	Threat to flood storage or detention function	No threat to storage or detention function.	Minor reduction or nuisance issue.	Function reduced in part of reservoir; preventive work needed.	Major reduction likely to affect storm performance.	Critical loss of storage or uncontrolled release/overflow risk.
	Threat to downstream structures or roads	No downstream threat identified.	Minor nuisance impacts possible.	Overflows or releases could affect low-value areas or minor roads.	Likely damage to roads, utilities, or structures during next major event.	Immediate threat to occupied structures, critical facilities, or public roads.
	Threat to water supply or pump operations	No threat to water supply or pumping.	Minor operational inconvenience.	Sediment, debris, or water quality may affect pumps/intakes.	Operations likely impaired without repair or cleaning.	Intake, pump, or water supply function failed or unsafe.
	Public safety hazards	No public safety concerns.	Minor hazard manageable with routine controls.	Hazard present; signage, access control, or maintenance needed.	Serious hazard; restrict public or crew access.	Immediate life safety hazard; emergency controls required.

Reservoirs

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Reservoir Name/ID	
Reservoir Type	
Location	
Date/Time	START: __/__/____ END: __/__/____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Recent storm event?	☐ Yes ☐ No
Approximate Water Level During Work	☐ Low ☐ Normal ☐ High ☐ Drawn Down ☐ Overtopping
Primary Function	☐ Flood Detention ☐ Raw Water ☐ Irrigation ☐ Recreation ☐ Other
Other/Details	
Normal Pool/Target Level	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Complaint/service request
☐ Emergency/safety issue	☐ Inspection follow-up	☐ Sediment reducing storage capacity
☐ Trash/debris removal	☐ Inlet blockage or erosion	☐ Outlet/spillway issue
☐ Shoreline erosion repair	☐ Vegetation or algae management	☐ Water quality concern
☐ Access/security issue	☐ Pump/gate/valve maintenance	☐ Monitoring equipment issue
☐ Other (describe below)		

Other/Details:

Reservoir Name/ID: _____ Foreman Initials: _____

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Trash and floating debris removal	☐ Illegal dumping removal
☐ Sediment removal/excavation	☐ Sediment survey or bathymetry	☐ Inlet cleanout
☐ Outlet works cleanout	☐ Trash rack/screen cleaning	☐ Spillway debris removal
☐ Spillway concrete or lining repair	☐ Pump, gate, or valve exercise	☐ Pump, gate, or valve repair
☐ Shoreline erosion repair	☐ Bank grading/reshaping	☐ Riprap placement or repair
☐ Filter fabric/bedding placement	☐ Rill/gully repair	☐ Animal burrow filling/repair
☐ Vegetation mowing or trimming	☐ Aquatic vegetation management	☐ Algae response/water quality coordination
☐ Access road repair	☐ Fence/lock/signage repair	☐ Staff gauge/sensor repair or calibration
☐ Telemetry/data logger service	☐ Water quality monitoring equipment service	☐ Other (describe below)

Other maintenance actions performed:

AREAS ADDRESSED

☐ Reservoir pool/storage area	☐ Inlet channel/inflow point	☐ Outlet works/riser/culvert
☐ Trash rack/screen	☐ Service spillway	☐ Emergency spillway/overflow route
☐ Upstream shoreline	☐ Downstream shoreline	☐ Left bank (facing downstream)
☐ Right bank (facing downstream)	☐ Embankment/dam face	☐ Toe area/downstream channel
☐ Pump station/intake (if present)	☐ Access road/maintenance route	☐ Fencing/gates/signage
☐ Staff gauge/level sensor	☐ Telemetry/monitoring equipment	☐ Other (describe below)

Other areas addressed:

MATERIALS, EQUIPMENT, AND QUANTITIES

Equipment used (e.g., mower, excavator, dump truck, vacuum truck, boat, pump, survey equipment):

Maintenance hours/staff:

Materials used (e.g., riprap, filter fabric, bedding stone, concrete, grout, topsoil, seed, erosion blanket):

Sediment/debris removed (estimate volume, weight, or number of loads):

Disposal location/ticket number (if applicable):

SAFETY, ENVIRONMENTAL, AND REGULATORY CONTROLS

☐ Site access controlled and safe	☐ Traffic control in place (if needed)
☐ Work performed outside active high flow/safe water conditions	☐ Water level managed appropriately for work
☐ Erosion and sediment controls in place during earthwork	☐ No fuel, oil, or material spills
☐ Confined space procedures followed (if needed)	☐ Public access restricted where hazards remain
☐ Removed material disposed at approved location	☐ Environmental/water quality notification completed (if needed)
☐ Dam safety/regulatory notification completed (if needed)	☐ Area left clean and stable after work

CONDITION AFTER MAINTENANCE

Storage/capacity condition after work:	☐ Restored/acceptable	☐ Improved	☐ Still deficient
Inlet/outlet/spillway condition after work:	☐ Clear and functional	☐ Improved	☐ Needs follow-up ☐ N/A
Shoreline/slope condition after work:	☐ Stable	☐ Improved	☐ Needs follow-up ☐ N/A
Reservoir returned to intended operation:	☐ Yes	☐ No	☐ Restricted operation only (describe below)

Description:

FOLLOW-UP ACTIONS REQUIRED

☐ No follow-up required	☐ Additional maintenance needed	☐ Repair/rehabilitation recommended
☐ Sediment survey or storage evaluation recommended	☐ Evaluate for replacement or redesign	☐ Engineering evaluation recommended
☐ Water quality investigation recommended	☐ Regulatory/permit review required	☐ Dam safety authority notification required

Recommended follow-up date/notes:

DOCUMENTATION			
Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A
Water level/monitoring readings recorded:	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED? ☐ Yes ☐ No ☐ N/A

(If yes, describe trigger)

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Maintenance Form



Attach additional pages, if required.

How to Maintain Your Revetments

What is it?

A revetment is a sloped shoreline protection system that covers an erodible bank, bluff, embankment, or shoreline face with stone, concrete blocks, articulated mats, asphalt, gabions, or similar armor. Its primary purpose is to protect the shoreline from erosion caused by waves, tides, currents, and storm runoff. A typical revetment includes an armor layer, one or more filter or bedding layers, toe protection, crest treatment, side tie-ins, and sometimes drainage features.

Common forms include:

- Riprap or quarry stone placed on a sloped bank with filter fabric or granular bedding
- Concrete block, articulated concrete mattress, gabion, or formed concrete slope protection
- Sloped rubble-mound protection at the base of a seawall, levee, road embankment, or outfall
- Hybrid bank protection with vegetation above the armor and rock protection at the toe

Who maintains it?

Revetments may be maintained by cities, counties, flood control districts, drainage districts, port authorities, road departments, parks departments, private landowners, or homeowners' associations. Ownership can be unclear because the protected land, armor stone, access route, and adjacent waterway may be controlled by different parties. Communities should verify whether they have the right to inspect and maintain the revetment and whether work below the ordinary high water line or in coastal wetlands requires permits or coordination.

Regardless of ownership, it is important to understand:

- Which asset the revetment protects, such as a road, outfall, levee, shoreline park, seawall, channel bank, utility corridor, or private property
- Whether the revetment is designed as a flexible rock system, rigid slab system, concrete block system, gabion system, or temporary emergency repair
- Where the toe, crest, filter layer, flanks, and drainage outlets are located
- Whether the site has a history of subsidence, toe scour, overtopping, flanking, settlement, or repeated stone displacement



Best maintenance practices & strategies

Revetments work by absorbing and dissipating hydraulic energy before it can erode the underlying soil. Their performance depends on the complete system, not only the visible rocks or blocks. The armor must be stable, the filter fabric and/or granular bedding must keep soil from washing out, the toe must resist scour and undermining, the crest must not be eroded by overtopping, and the ends must not be flanked. Routine inspection and maintenance should focus on early signs of displacement, settlement, exposed filter, voids, toe scour, and erosion around the ends.

A. INSPECTION

Inspections confirm that the revetment continues to protect the slope without losing armor, exposing the filter, allowing soil loss, or being undermined at the toe. Inspectors should view the revetment from the crest, mid-slope, toe, and adjacent shoreline where safe. After storms or unusually high tides, inspections should focus on armor movement, new scour, overtopping damage, and erosion at transitions to unprotected shoreline. An inspection checklist for revetments is included with this reference sheet.

Inspection skill needs:

- Ability to recognize displaced armor, exposed filter fabric, missing bedding, slope settlement, and soil loss
- Familiarity with revetment components such as armor layer, underlayer, filter fabric, toe trench, crest, and flanks
- Ability to identify toe scour, overtopping erosion, flanking, and voids beneath armor

- Understanding that flexible rock revetments can tolerate minor movement, but rigid slab systems may fail quickly when undermined
- Ability to safely observe on slippery rock, steep slopes, unstable banks, and tidal areas without entering unsafe water
- Ability to document conditions with photos, stationing, measurements, and simple condition ratings

What to look for:

- **Armor displacement and missing material.** Look for rocks, blocks, mats, or gabions that have shifted downslope, rolled out of place, broken, or left gaps in the armor layer. Small gaps allow waves and runoff to reach the bedding layer. Repeated displacement often indicates undersized armor, steep slopes, toe loss, or wave conditions exceeding the original design.
- **Toe scour and undermining.** The toe is the most important part of most revetments. Look for scour holes, beach lowering, exposed geotextile, missing toe stone, or unsupported armor at the lower edge. If the toe fails, the armor layer can unravel upslope, and the underlying bank may erode quickly.
- **Filter exposure and soil loss.** Filter fabric, bedding stone, or underlayer material should not be exposed or washed out. Exposed fabric, sinkholes, muddy flow through the rocks, or voids behind armor suggest that soil is migrating through the revetment. This condition should be corrected before a larger slope failure occurs.
- **Slope settlement, slumping, or bulging.** Uneven slope profiles, depressions, scarps, bulges, and tension cracks may indicate settlement of the underlying bank or loss of foundation material. Revetments can hide slope instability until voids become large, so compare the current slope shape to prior photos and known design grades.
- **Crest erosion and overtopping damage.** Inspect the top of the revetment for erosion, gullies, washed-out soil, damaged access paths, and debris lines. Overtopping can erode the landward side or crest, allowing water to attack the revetment from behind. Crest damage is especially important where a road, trail, levee, or utility lies immediately landward.
- **Flanking at the ends.** Water can erode around the upstream, downstream, or lateral ends of a revetment. Look for new erosion, exposed edges, or a notch forming where armor ends and natural soil begins. Flanking can bypass the protected reach and cause progressive failure.

- **Drainage and upland runoff.** Surface runoff from roads, yards, or pipes can cut gullies through the crest and slope. Check whether drainage outlets are armored and whether water is being concentrated behind the revetment. Poor drainage can cause erosion from behind even when the seaward armor is intact.
- **Vegetation, roots, and animal activity.** Some vegetation above the revetment may be beneficial, but woody roots, burrows, and invasive vegetation can displace armor, open voids, or hide damage. Maintenance should preserve stabilizing vegetation where appropriate while keeping the armor and crest visible for inspection.
- **Debris and public access hazards.** Driftwood, trash, fishing debris, or displaced stones can create hazards on public shorelines and can increase local hydraulic forces. Record debris that blocks drainage, piles against the structure, or presents a safety hazard to crews and the public.
- **Adjacent shoreline response.** Hard protection can alter local erosion patterns. Inspect shoreline immediately beyond the revetment for downdrift erosion, beach lowering, or concentrated scour. If adjacent erosion is worsening, additional engineering review may be needed before extending or repairing the revetment.

How to record conditions:

- Use a standard inspection form or digital tool and record stationing, location, tide condition, recent storm history, and approximate water level
- Describe armor condition using consistent terms such as intact, localized displacement, sections missing, filter exposed, toe undermined, or slope unstable
- Record the approximate length and width of damaged areas and note whether damage is at the toe, mid-slope, crest, flank, or drainage outlet
- Photograph overview views and close-up details from repeatable locations, including the toe, slope face, crest, flanks, and adjacent shoreline
- Flag urgent conditions such as active toe undermining, exposed filter with soil loss, slope collapse, roadway threat, or erosion approaching utilities or structures
- Compare current observations with prior inspections to distinguish acceptable minor adjustments from progressive deterioration

B. MAINTENANCE

Maintenance of revetments should preserve the integrity of the armor layer, filter system, toe support, crest, drainage, and flanks. The goal is not to make every rock look perfectly uniform; the goal is to maintain a stable protective slope that does not allow erosion of the underlying soil. Small repairs are usually less expensive and less disruptive than emergency reconstruction after toe loss or slope failure. A maintenance checklist for revetments is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools for light debris removal and minor adjustments
- Excavator, loader, crane, or skid steer for placing armor stone, gabions, or blocks where access allows
- Riprap, bedding stone, filter fabric, granular filter, chinking stone, concrete blocks, gabion baskets, or articulated mat components matching the existing system
- Survey equipment or measuring tools to track toe elevation, crest elevation, and damaged area limits
- Erosion and sediment controls for work near water and disturbed upland soils
- Traffic and public access control for shoreline parks, roads, trails, and work zones
- Engineering support when damage suggests toe failure, global slope instability, or repeated armor displacement

Key maintenance goals:

- Maintain armor coverage and interlock. Reset displaced stone or blocks and replace missing material with properly sized and compatible armor. Do not fill large voids with undersized rock that can wash out quickly.
- Maintain toe support. Repair toe scour and replace missing toe stone before slope armor begins to unravel. Toe repairs should be keyed into stable ground or placed in a way that remains stable during scour.
- Protect the filter and underlying soil. Repair areas where filter fabric, bedding, or soil is exposed. Soil loss through the armor can create hidden voids and lead to settlement or sudden collapse.
- Repair crest and overtopping erosion. Fill and stabilize gullies, repair access paths, and direct runoff away from the slope. Overtopping damage should not be allowed to cut behind the revetment.

- Stabilize flanks and transitions. Repair end erosion and reinforce transitions to walls, outfalls, culverts, natural banks, or high ground. Flanking can make an otherwise stable revetment ineffective.
- Maintain drainage paths. Keep outlets, swales, weep paths, and upland runoff controls clear and armored. Drainage should not flow under the armor in a way that removes soil.
- Remove damaging debris and manage vegetation. Remove debris that traps water or displaces armor. Manage vegetation to keep the structure inspectable while avoiding unnecessary disturbance to stabilizing root systems.
- Document repairs and recurring damage. Repeated damage in the same location should trigger review of armor size, slope, toe design, drainage, and exposure conditions.

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Conduct walk-through inspections of accessible revetment reaches before storm season and after periods of high public use
- Remove trash and drift debris that blocks drainage or creates public hazards
- Trim vegetation that hides the toe, crest, or damaged armor while preserving stabilizing vegetation where appropriate
- Repair small gullies, displaced stones, and minor crest erosion before they expand

2. Annual maintenance and comprehensive review

- Inspect the full length of the revetment, including toe, slope, crest, flanks, drainage outlets, and adjacent shoreline
- Compare current conditions with prior photographs and measurements to identify progressive toe scour, settlement, or flanking
- Identify reaches where armor size, filter exposure, or repeated movement indicates the need for engineering review
- Review access limitations and pre-plan equipment routes for storm repair work

3. Pre-, in-, and post-storm events

Pre-storm events

- Inspect known weak locations, clear crest drainage, and restrict access to unstable or hazardous areas

In-storm events

- Do not enter wave runup zones, tidal water, or unstable slopes
- Observe only from safe locations

Post-storm events

- Inspect as soon as safe for displaced armor, toe scour, overtopping gullies, flanking, exposed filter, and threats to roads or utilities

4. Maintenance decision logic

- Continue planned maintenance when damage is minor, armor remains continuous, the toe is stable, and no soil loss is observed
- Increase preventive maintenance when stone movement, crest erosion, drainage gullies, or flanking are increasing, but can still be corrected with localized repairs
- Plan rehabilitation when sections of armor are missing, the filter is exposed, toe scour is advancing, or repairs are recurring in the same location
- Consider replacement or redesign when the revetment repeatedly fails, is undersized for current exposure, is affected by major beach lowering, or threatens public infrastructure if it fails

5. Factors that may influence the maintenance schedule

- Wave exposure, tide range, storm surge, and frequency of overtopping
- Beach or channel bed lowering at the toe and changes in sediment supply
- Armor type, armor size, slope steepness, filter condition, and toe configuration
- Upland runoff, drainage outlets, and erosion from behind the structure
- Adjacent shoreline erosion and risk of flanking around the revetment ends
- Public access, safety exposure, and proximity to roads, utilities, and critical facilities
- History of repeated storm damage and availability of compatible repair materials

6. Repair vs. replacement considerations

Factors that indicate continued maintenance and repair

Choose repair/rehabilitation when:

- Armor displacement is localized, and the underlying slope remains stable
- Toe scour is shallow and can be stabilized before the armor layer unravels
- Filter exposure is limited, and soil loss has not created large voids
- Crest erosion or flanking can be corrected without changing the overall alignment

Factors that indicate asset replacement or major repair

Consider replacement or major reconstruction when:

- Large sections of armor are missing or repeatedly displaced by storms
- The toe has lowered or migrated enough that ordinary stone replacement will not remain stable
- The underlying bank is sliding, settling, or losing soil through the revetment
- Adjacent land use, sea level, wave exposure, or road/utility criticality requires a higher level of protection than the existing revetment provides

Revetments

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Revetment Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Recent storm or high-tide event?	☐ Yes ☐ No
Tide/Water Level Condition	☐ Low ☐ Rising ☐ High ☐ Falling ☐ N/A
Segment length/stationing	
Shoreline exposure	☐ Open Coast ☐ Bay ☐ Estuary ☐ Channel
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Wave runup/high tide	☐ Unstable armor/slope	☐ Undercut bank	☐ Severe weather/lightning
---	---	--	---

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Armor Layer Condition	Overall	☐	☐	☐	☐	☐
	Armor displacement or missing units	☐	☐	☐	☐	☐
	Armor breakage or deterioration	☐	☐	☐	☐	☐
	Surface continuity and interlock	☐	☐	☐	☐	☐
Toe and Scour Protection	Overall	☐	☐	☐	☐	☐
	Toe scour or undermining	☐	☐	☐	☐	☐
	Toe stone or apron displacement	☐	☐	☐	☐	☐
Filter/Underlayer and Slope Stability	Overall	☐	☐	☐	☐	☐
	Exposed filter, bedding, or geotextile	☐	☐	☐	☐	☐
	Voids, sinkholes, or soil loss	☐	☐	☐	☐	☐
	Slope settlement, slumping, or bulging	☐	☐	☐	☐	☐

Revetment Name/ID: _____ Inspector Initials: _____

Revetments

Inspection Checklist

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Crest, Flanks, and Transitions	Overall	☐	☐	☐	☐	☐
	Crest erosion or overtopping damage	☐	☐	☐	☐	☐
	Flanking erosion at ends	☐	☐	☐	☐	☐
	Transitions to walls, outfalls, or natural banks	☐	☐	☐	☐	☐
Drainage and Upland Runoff	Overall	☐	☐	☐	☐	☐
	Surface runoff erosion	☐	☐	☐	☐	☐
	Drain outlets or weep paths	☐	☐	☐	☐	☐
	Seepage or piping indicators	☐	☐	☐	☐	☐
Debris, Vegetation, and Access	Overall	☐	☐	☐	☐	☐
	Debris accumulation	☐	☐	☐	☐	☐
	Vegetation or roots displacing armor	☐	☐	☐	☐	☐
	Inspection and maintenance access	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to roads, utilities, or structures	☐	☐	☐	☐	☐
	Threat to shoreline stability	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐

Inspection Checklist



Notes and Observations:

Revetement Name/ID: _____ Inspector Initials: _____

Revetments

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Armor Layer Condition	Armor displacement or missing units	No displacement.	Minor localized movement.	Several units missing or shifted.	Large area displaced; filter exposed.	Armor layer failed.
	Armor breakage or deterioration	No damage.	Minor weathering.	Cracked or deteriorated units.	Severe breakage or mass loss.	Armor unable to resist wave action.
	Surface continuity and interlock	Continuous and interlocked.	Minor gaps.	Gaps allow bedding exposure.	Interlock lost over large area.	Unraveling in progress.
Toe and Scour Protection	Toe scour or undermining	No scour.	Minor scour indicators.	Scour reaches toe stone.	Toe undermined or unsupported.	Toe failure causing slope unraveling.
	Toe stone or apron displacement	Intact.	Minor movement.	Gaps forming.	Major displacement.	Toe protection absent or failed.
Filter/Underlayer and Slope Stability	Exposed filter, bedding, or geotextile	Not exposed.	Very small exposure.	Localized exposure; repair needed.	Large exposure with soil loss.	Filter failed; active washout.
	Voids, sinkholes, or soil loss	None.	Minor depression.	Void suspected.	Sinkhole or soil loss evident.	Active collapse.
	Slope settlement, slumping, or bulging	Uniform slope.	Minor settlement.	Noticeable settlement or slumping.	Major slumping; urgent repair.	Slope failure occurring.

Revetments

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Crest, Flanks, and Transitions	Crest erosion or overtopping damage	None.	Minor rills.	Gullies or debris lines.	Major crest washout.	Crest breached or unstable.
	Flanking erosion at ends	No flanking.	Minor end erosion.	Erosion approaching armor end.	Bypass likely or progressing.	Active bypass around revetment.
	Transitions to walls, outfalls, or natural banks	Tied in well.	Minor gap.	Gap or settlement developing.	Transition undermined.	Transition failed.
Drainage and Upland Runoff	Surface runoff erosion	No erosion.	Minor rills.	Gullies forming.	Runoff undermines armor.	Severe washout.
	Drain outlets or weep paths	Clear.	Minor maintenance needed.	Partially blocked or unarmored.	Outlet erosion or blockage significant.	Outlet failure causing slope damage.
	Seepage or piping indicators	None.	Minor dampness.	Persistent seepage.	Seepage with soil movement.	Active piping or sinkhole.
Debris, Vegetation, and Access	Debris accumulation	Minimal.	Light debris.	Debris traps water or blocks drainage.	Heavy debris displaces armor.	Debris creates immediate hazard.
	Vegetation or roots displacing armor	No issue.	Minor growth.	Roots/growth affecting visibility.	Vegetation displacing armor.	Major displacement or unsafe access.
	Inspection and maintenance access	Safe.	Minor caution.	Access limited.	Unsafe without controls.	No safe access.

Revetments

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Overall Rating Based on Impacts to People and Infrastructure	Threat to roads, utilities, or structures	No threat.	Minor risk.	Erosion approaching assets.	Active threat to assets.	Damage occurring or imminent.
	Threat to shoreline stability	Stable.	Minor erosion.	Progressive erosion.	Large-scale instability likely.	Failure occurring.
	Public safety hazards	None.	Minor hazard.	Controls needed.	Serious hazard.	Immediate danger.

Revetments

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Revetment Name/ID	
Location	
Date/Time	START: __/__/____ END: __/__/____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Recent storm or high-tide event?	☐ Yes ☐ No
Tide/Water Level Condition	☐ Low ☐ Rising ☐ High ☐ Falling ☐ N/A
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up
☐ Complaint/service request	☐ Emergency/safety issue	☐ Armor displacement
☐ Toe scour/undermining	☐ Filter exposure/soil loss	☐ Crest or flank erosion
☐ Drainage outlet repair	☐ Debris/vegetation issue	☐ Other (describe below)

Other/Details:

Revetment Name/ID: _____ Foreman Initials: _____

Revetments



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Debris removal	☐ Reset displaced armor
☐ Place replacement riprap or blocks	☐ Repair toe scour/place toe stone	☐ Install/repair filter fabric or bedding
☐ Fill voids/repair sinkholes	☐ Repair crest erosion	☐ Repair flank/transition erosion
☐ Stabilize drainage outlet	☐ Vegetation management	☐ Survey/photo documentation
☐ Other (describe below)		

Other maintenance actions performed:

AREAS ADDRESSED

☐ Armor layer	☐ Toe/apron	☐ Filter/bedding layer
☐ Crest	☐ Left flank/transition	☐ Right flank/transition
☐ Drainage outlet	☐ Upland runoff area	☐ Adjacent shoreline
☐ Access route	☐ Other (describe below)	

Other areas addressed:

MATERIALS, EQUIPMENT, AND QUANTITIES

Equipment used (e.g., excavator, loader, vactor, crane, hand tools, survey equipment):

Maintenance hours/staff:

Revetement Name/ID: _____ Foreman Initials: _____

Revetments



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

Materials used (e.g., riprap, filter fabric, concrete, sealant, hardware, grout, topsoil, seed):

Quantities and disposal (sediment CY, debris CY, rock tons, LF repaired, disposal location):

SAFETY, ENVIRONMENTAL, AND REGULATORY CONTROLS

☐ Site access controlled and safe	☐ Traffic control in place (if near roadway or public access)
☐ Work performed outside unsafe flow, wave runup, or high tide conditions	☐ Erosion and sediment controls in place during earthwork
☐ No fuel, oil, or material spills; equipment operated from stable ground	☐ Regulatory permit requirements reviewed (USACE, TCEQ, TPWD, GLO, local floodplain permits as applicable)
☐ Confined space procedures followed if culvert, gate chamber, or structure entry was required	☐ Removed material disposed at approved location
☐ Area left clean and stable after work	

CONDITION AFTER MAINTENANCE

Armor condition after work:	☐ Restored/acceptable	☐ Improved	☐ Still deficient
Toe and slope condition after work:	☐ Stable	☐ Improved	☐ Needs follow-up
Drainage and flank condition after work:	☐ Stable	☐ Improved	☐ Needs follow-up

FOLLOW-UP ACTIONS REQUIRED

☐ No follow-up required	☐ Additional maintenance needed
☐ Repair/rehabilitation recommended	☐ Evaluate for replacement or redesign
☐ Engineering evaluation recommended	☐ Regulatory/permit review required
☐ Dam/levee/coastal authority notification required if applicable	☐ Other: _____

Revetement Name/ID: _____ Foreman Initials: _____

Revetments



Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

DOCUMENTATION			
Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A
GPS coordinates or stationing recorded:	☐ Yes	☐ No	☐ N/A
Tide/water level notes recorded:	☐ Yes	☐ No	☐ N/A
Measurements or survey data recorded:	☐ Yes	☐ No	☐ N/A
Maintenance entered into asset database:	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED? ☐ Yes ☐ No ☐ N/A

(If yes, describe trigger)

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Maintenance Form



Revetement Name/ID: _____ Foreman Initials: _____

How to Maintain Your Ponds



What is it?

A pond is a stormwater management basin designed to temporarily store runoff and release it at a controlled rate.

By detaining or retaining stormwater, ponds help reduce downstream flooding during storms and allow the system to drain gradually through a designed outlet structure. Many ponds also improve water quality by allowing sediments and pollutants to settle and supporting biological uptake.

Ponds are generally constructed as:

- Wet ponds (retention ponds) that maintain a permanent pool of water
- Dry ponds (detention basins) that fully drain between storm events

Who maintains it?

Pond ownership and maintenance responsibilities vary depending on how the system was developed, permitted, and recorded. A pond may be owned, maintained, and operated by cities, counties, drainage districts, or private entities such as homeowner associations. Responsibility typically depends on whether the pond is public infrastructure, privately owned, or part of a park or open space. As key components of the community's stormwater infrastructure, ponds should be understood in terms of how they are intended to function during and after rainfall events, as well as who has the authority and responsibility to inspect and maintain them.

Best maintenance practices & strategies

Ponds are built to reduce flooding and improve water quality. Over time, sediment accumulation, trash, invasive vegetation, erosion, burrowing animals, and deterioration of structural components can reduce their ability to perform as designed. Routine inspection and maintenance can protect storage volume, preserve inflow/outflow capacity, reduce erosion and nuisance conditions, and extend pond service life.

A. INSPECTION

Inspections confirm the pond can still store and release stormwater as designed and pass larger storms without damage to the pond or creation unsafe conditions. An inspection checklist for ponds is included with this reference sheet.

Signs that the pond is not performing well:

- Water levels remain unusually high or unusually low compared to normal conditions
- Flooding occurs upstream or downstream more often than expected
- Outlet structures clog frequently or show poor flow even when the basin is full
- Sediment benches are visible, and the pond appears shallower than expected
- Bank erosion, slumping, or undercutting increases over time
- The emergency spillway shows erosion, rutting, or signs of uncontrolled flow
- The embankment shows cracking, settlement, sinkholes, seepage, or wet spots
- Algae blooms, odors, fish kills, or excessive aquatic plant growth occur
- Mosquito breeding, stagnant water pockets, or nuisance wildlife activity increase
- Trash and debris accumulate at inlets, forebays, or trash racks after storms

Inspection skill needs:

- Ability to recognize blocked or reduce inflow/outflow paths

- Ability to recognize reduced storage and to identify erosion patterns on slopes, spillways, and inlet channels
- Familiarity with pond features such as embankments, inlet and outlet structures and emergency spillways
- Ability to recognize structural warning signs such as settlement, cracking, seepage, sinkholes, and slope instability
- Ability to identify water quality concerns such as algae blooms, unusual color, sheen, or odors; and to observe safely around steep slopes, soft sediments, deep water, and wildlife hazards
- Ability to document conditions clearly

Note: Ponds may be classified as dams and regulated by the Texas Commission on Environmental Quality (TCEQ) Dam Safety Program, depending on their size, embankment height, and downstream risks. Owners should understand these factors and consult an engineer if necessary.

What to look for:

- **Sediment accumulation and storage loss.** Sediment gradually fills ponds, reducing storage volume and water quality performance. Look for visible sediment deposits at inlets, sediment accumulation in forebays, and a raised basin bottom. In wet ponds, look for shallower water depths and emergent vegetation expanding into formerly open water.
- **Inlets and inflow channels.** Check for erosion everywhere water enters the pond, undermining, displaced riprap, and rills or gullies that carry sediment into the basin. Look for blockages that can redirect flow and cut new channels.
- **Outlet structures and flow control components.** Inspect risers, grates, trash racks, orifices, weirs, and low-flow devices for clogging, corrosion, damage, missing fasteners, misalignment, or obstructions. A partially blocked outlet can cause upstream flooding. A damaged outlet can cause uncontrolled drawdown or embankment risk.
- **Emergency spillway and overflow routing.** The emergency spillway must remain open and stable. Look for erosion, bare soil, rutting, head-cutting, obstructions, or grading changes that alter the design capacity of the spillway or redirect overflow toward buildings, streets, or utilities.
- **Embankment condition and structural warning signs.** Inspect the embankment crest and upstream and downstream faces. Look for cracking, settlement, sinkholes, animal burrows, seepage, wet spots, or unusual vegetation patterns that suggest leakage. Look for tree growth on the embankment that could weaken the embankment over time.
- **Side slopes and shoreline stability.** Check for slumping, undercutting, wave erosion, and bare soil areas that can expand quickly during storms. Note steep or unstable slopes that create public safety risks or maintenance access problems.
- **Water quality and nuisance conditions.** For wet ponds, look for algae blooms, odors, stagnant corners, surface scums, excessive aquatic plant growth, and signs of low oxygen, such as fish kills. For dry ponds, check for standing water that persists beyond the designed drawdown, which can indicate poor drainage, clogged outlets, or sediment buildup.
- **Vegetation condition and access.** Inspect grass on embankments and side slopes for full coverage and stable rooting. Look for invasive vegetation, woody growth on embankments, and vegetation that blocks access to structures. Confirm maintenance access routes are passable and that gates, perimeter fencing, and locks function properly. Note that native woody growth and vegetation could be beneficial along the pond or buffer areas.
- **Safety features and public hazards.** Check for damaged fences, missing signs, steep drop-offs, unstable edges, exposed pipes, debris hazards, and evidence of unauthorized activities.
- **Downstream discharge and outfall stability.** Inspect the outlet discharge area for erosion, undermining, scour holes, and damage to energy dissipation features. Downstream erosion can headcut toward the outlet, releasing sediment into the downstream channel and threatening the stability of the pond and channel.

How to record conditions:

- Use a standard inspection form. Consistent records make inspections comparable over time and help prioritize maintenance.
- Record location, date, weather, recent storm history, and observed issues. Context helps interpret water levels, erosion, debris, and performance.
- Note whether performance appears normal, restricted, or failing. Normal means the pond is performing as designed. Restricted indicates reduced storage or partial blockages. Failing indicates flooding risk, outlet malfunction, or structural concerns.

- Photograph key conditions, including sediment deltas, outlet blockage, spillway erosion, embankment cracks, seepage, slumping, and downstream scour.
- Flag urgent issues, especially embankment seepage, sinkholes, severe outlet blockage, spillway failure, unstable slopes, or conditions threatening roads, utilities, or structures.

B. MAINTENANCE

Maintenance restores the pond's ability to accept, hold, and release water as designed and prevents minor issues from escalating into major repairs. A maintenance checklist for ponds is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools for debris removal and light vegetation control
- Mowers or trimmers suitable for slopes and pond bottoms where appropriate
- Equipment for dewatering and sediment removal when storage capacity loss is significant
- Equipment and material for repairs to slopes, embankments, or control structures
- Training in safe work near uneven ground, open water, and wildlife hazards
- Confined space training (identification/entry) if entry into outlet structures is required

Key maintenance goals:

- Remove trash and debris. Debris commonly accumulates at inlets, forebays, and trash racks. Remove promptly, especially after storms, to prevent clogging and flooding.
- Maintain inlets and inlet protection. Repair erosion at inflows, stabilize channels, and keep inflow paths aligned to reduce sediment delivery and prevent gully growth.
- Keep outlet structures clear and functional. Clean trash racks, clear orifices and weirs, repair damaged components, and maintain safe access to the outlet.
- Keep emergency spillways open and stable. Remove obstructions, repair erosion, maintain vegetation cover, and prevent rutting or changes in grading.
- Maintain embankments and side slopes. Repair rills and gullies early, restore grass cover, address slumping, and prevent the growth of woody vegetation on embankments. Note that woody vegetation on embankments and structural areas should always be removed, while native woody vegetation along the

natural shoreline buffers can provide habitat or water quality benefits.

- Manage sediment to preserve storage. Remove sediment when it measurably reduces storage volume, fills forebays, or contributes to chronic high water and frequent overflow.
- Address nuisance and water quality issues. Control excessive algae and aquatic vegetation, reduce stagnant pockets, manage mosquitoes, and address sources of poor water quality.
- Control burrowing animals and slope damage. Repair burrows, stabilize affected areas, and use appropriate wildlife management practices where needed.
- Repair downstream erosion at the discharge. Maintain energy dissipation and stabilize outfall areas to prevent scour and undermining.

Key considerations while achieving the above maintenance goals:

- Preserve storage volume and design grades. Avoid maintenance actions that unintentionally reduce storage, alter outlet elevations, or change spillway control elevations.
- Keep principal outlets and emergency spillways functional. These components control flood risk and must remain unobstructed and stable.
- Control sediment at the source when possible. Stabilizing inlets and upstream erosion sources reduces long-term dredging needs.
- Maintain proper vegetation coverage. Grass vegetation on slopes provides stability, but woody growth on embankments and dense vegetation can damage embankments or structures.
- Protect structural integrity. Do not allow animal burrows, seepage, cracking, or settlement to persist without evaluation and repair.
- Prioritize safety. Address hazards near trails, public access areas, steep slopes, and deep-water edges promptly.
- Maintain access. Ensure crews can reach outlets, spillways, and inlets safely for routine work and emergency response.

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Conduct periodic walk-through inspections of inlets, outlets, spillways, and accessible perimeter areas
- Remove trash and debris from racks, grates, and shoreline areas

- Mow and manage vegetation as needed to maintain access and stable turf cover
- Repair small rills and bare spots early to prevent larger erosion problems
- Monitor water level patterns and nuisance conditions, especially during warm seasons

2. Annual maintenance and comprehensive review

- Perform a full inspection of the basin, embankment, side slopes, inlets, outlet structures, and emergency spillway
- Compare current conditions to prior records to identify trends in sedimentation, erosion, and structural wear
- Evaluate sediment accumulation, especially at inlets and forebays, and plan removal when storage loss becomes significant
- Identify structural repairs needed for outlets, spillways, embankments, and access features
- Review wet pond water quality indicators and plan corrective actions if nuisance conditions persist

3. Pre-, in-, and post-storm events

Pre-storm events

- Inspect known trouble spots such as outlet trash racks, spillways, and inflow channels
- Remove visible debris that could clog outlets or redirect flow
- Confirm access routes are clear for maintenance and emergency response

In-storm events (only when safe)

- Observe whether outlets pass flow as intended and whether emergency spillways function without uncontrolled erosion
- Note overtopping, unexpected overflow locations, or rapid erosion at inflows and spillways

Post-storm events

- Remove storm-deposited debris from inlets, outlets, and spillways
- Inspect for new erosion, slope instability, embankment wet spots, and downstream scour
- Document high water marks, debris lines, and problem areas to refine maintenance targeting

4. Maintenance decision logic

- Continue planned maintenance when storage and overflow routing remain functional, erosion is minor,

and issues can be corrected through routine tasks

- Increase preventive maintenance when sediment and erosion are trending upward, inlet stabilization is degrading, or overflow routes show early damage
- Plan rehabilitation or redesign when repeated erosion repairs fail, sediment returns quickly due to upstream conditions, slopes repeatedly slump, or hydraulic performance no longer matches surrounding development risk; or when playas that were formerly dry begin to hold water
- Consider replacement or major reconstruction of engineered features when outlet structures, pump stations, or stabilized inlets repeatedly fail or no longer meet current standards, and the long-term cost of repeated repairs exceeds a redesign to modern criteria
- If a pond is classified as a dam, ensure that all applicable TCEQ Dam Safety Program regulations are met

5. Factors that may influence the maintenance schedule

Maintenance frequency should be adjusted based on risk, performance trends, and site conditions. Increase inspection and maintenance frequency when any of the following occur:

- Storm intensity and frequency. More frequent high-intensity storms can increase debris loading, erosion, and bank instability. Short-duration intense rainfall can overwhelm inlets and forebays and accelerate sediment deposition.
- Repeated high water levels or slow drawdown. Wet ponds staying above normal pool elevations for long periods. Dry ponds remaining wet or ponded long after storms, indicating outlet restriction, or sediment buildup.
- Overflows and spillway use. Evidence of emergency spillway flow such as debris lines, rutting, or erosion. Reports of upstream flooding or bypass flow around the pond.
- Sediment loading and upstream sources. Construction activity, unstable upstream channels, bare areas, or failing upstream BMPs. Rapid forebay filling, sediment deltas at inflows, or increased turbidity after storms.
- Erosion and slope instability. New rills, gullies, undercutting, shoreline loss, or slumping on side slopes. Scour at inlet channels, outlet aprons, or downstream discharge areas.
- Structural warning signs. Cracks, settlement, sinkholes, seepage, wet spots on the downstream embankment face, or displaced outlet components. Corrosion or deterioration of risers, trash racks, or control structures.

- Vegetation and nuisance conditions. Woody growth on embankments, invasive vegetation choking inlets and outlets, or vegetation preventing safe access. Persistent algae blooms, odors, mosquito habitat, or excessive aquatic vegetation in wet ponds.
- Proximity to critical facilities and consequences of failure (if the pond is classified as dam). Nearby hospitals, fire stations, schools, evacuation routes, major arterials, utilities corridors, or dense development. Limited overflow pathways where misrouting could affect structures or public safety.
- History of complaints or repeated maintenance calls. Locations requiring frequent debris removal, repeated clogging of trash racks, or recurring erosion repairs. Prior failures of outlet controls, spillways, or embankment features.

6. Repair vs. replacement considerations

Factors that indicate continued maintenance and repair

Continued maintenance and localized repairs are typically appropriate when:

- The pond still provides the intended storage volume, with only minor sediment accumulation
- Outlet and spillway function is reliable, with occasional clogging that is resolved through routine cleaning
- Erosion is minor and stable, such as small rills or limited shoreline wear that can be corrected with spot stabilization and re-vegetation
- Structural components show early wear but remain serviceable, such as minor corrosion, minor cracking, or isolated joint issues
- Nuisance conditions are seasonal and manageable through routine vegetation management and housekeeping
- Problems are not repeating after reasonable preventive maintenance actions

Factors that indicate replacement or repair

Major repair or replacement of specific components is often more cost-effective when:

- Outlet structures are deteriorated or frequently malfunction due to corrosion, broken components, misalignment, or chronic blockage
- Emergency spillway damage is recurring, including repeated erosion, head-cutting, or loss of spillway grade that threatens reliable overflow control

- Embankment issues are present, such as persistent seepage, repeated animal burrowing, localized settlement, or recurring wet spots that do not resolve with routine repair.
- Sediment accumulation is significant, reducing storage and requiring dredging, forebay rebuild, or sediment management beyond routine cleanout.
- Inlet protection and energy dissipation features are failing repeatedly, causing continued erosion and sediment delivery despite spot fixes.
- The pond no longer meets operational needs because of aging materials, poor access, or unsafe conditions around structures.

Factors that indicate reconstruction or redesign

Consider reconstructing or redesigning when:

- If a pond is determined to be classified as a dam, the owner needs to ensure that all applicable TCEQ Dam Safety Program regulations are met
- Repeated failures occur, such as embankment instability, severe sinkholes, major outlet failure, or spillway failure
- The pond is undersized for current conditions, shown by frequent overflows, chronic upstream flooding, or the emergency spillway functioning too often
- The pond has lost a large portion of its storage volume due to long-term sedimentation and requires extensive excavation and regrading to restore its function
- The outlet design no longer performs as intended, such as:
 - Control elevations are incorrect
 - Drawdown is too fast or too slow
 - Hydraulic capacity is insufficient for modern design storms
- The pond configuration creates ongoing safety or nuisance problems that cannot be managed through routine means, such as unstable slopes, persistent stagnant zones, or inaccessible structures
- Downstream impacts indicate the pond is not controlling discharge energy adequately, such as recurring scour, channel erosion, or damage to receiving infrastructure
- Site conditions have changed materially, including upstream redevelopment, new impervious cover, altered flow paths, or constrained overflow routing
- Long-term life-cycle costs show that repeated repairs are more expensive than rebuilding to modern standards

7. Repair and replacement scheduling questions

- Is the pond critical for flood protection? Does it protect homes, roadways, utilities, or downstream channels from frequent flooding?
- Does the condition threaten life safety? Are there sinkholes, unstable embankments, deep water hazards near public areas, or sudden failure risk?
- Does it threaten infrastructure or is it classified as a dam? Could failure damage homes, roads, bridges, utilities, trails, buildings, or downstream channels?
- Is performance currently impaired? Is storage volume reduced, is the outlet restricted, is drawdown unreliable, or is overflow misrouted?
- Is the issue getting worse? Are erosion features expanding, is seepage increasing, are cracks lengthening, or is settlement accelerating?
- Are failures repeated despite prior repairs? Has the same slope, spillway, inlet, or outlet required repeated fixes within a short period?
- Is replacement or reconstruction more cost-effective than continued repairs? Consider repeated mobilizations, emergency response costs, downstream damage risk, and the likelihood of recurrence.
- Are there nearby critical facilities or high consequence? Would a failure affect emergency services, schools, major arterials, or dense neighborhoods?
- Can the work be scheduled to reduce risk? Can repairs occur before the wet season, before forecast major storms, or during periods when water levels are low?
- Is access available and safe for the required work? Are easements clear, gates accessible, and slopes stable enough for equipment and crews?
- Will temporary controls be needed until a permanent fix is completed? Do you need interim debris control, temporary stabilization, access restrictions, or bypass measures?

Ponds

Inspection Checklist

Pond Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: °F
Recent high water?	☐ Yes ☐ No
Recent storm event?	☐ Yes ☐ No
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Steep slopes/deep water hazard	☐ Unstable embankment/sinkhole/seepage	☐ Severe Weather/lightning	☐ Wildlife hazards/unsafe access
---	---	---	---

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Basin Storage and Sedimentation	Overall	☐	☐	☐	☐	☐
	Sediment accumulation/storage loss	☐	☐	☐	☐	☐
	Forebay or inlet buildup (if present)	☐	☐	☐	☐	☐
	Standing water duration/drawdown performance (dry ponds)	☐	☐	☐	☐	☐
Inlets and Flow Paths	Overall	☐	☐	☐	☐	☐
	Erosion at inflow/undermining/displaced riprap	☐	☐	☐	☐	☐
	Blockage by debris or vegetation	☐	☐	☐	☐	☐
	Short-circuiting, riling, or defined flow path damage	☐	☐	☐	☐	☐

Ponds

Inspection Checklist

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Outlet Structures and Drawdown	Overall	☐	☐	☐	☐	☐
	Trash rack/grate condition and blockage	☐	☐	☐	☐	☐
	Orifice/weir/low-flow device condition and blockage	☐	☐	☐	☐	☐
	Structure damage, corrosion, joint separation, or improper ponding level or slow drawdown	☐	☐	☐	☐	☐
Emergency Spillway, Vegetation, and Embankment Conditions	Overall	☐	☐	☐	☐	☐
	Emergency spillway erosion, obstruction, or critical slopes	☐	☐	☐	☐	☐
	Cracking, settlement, sinkholes, or depressions	☐	☐	☐	☐	☐
	Proper vegetation condition for embankments and designed spillways	☐	☐	☐	☐	☐
	Animal burrows or woody vegetation on embankment	☐	☐	☐	☐	☐
	Slumping, undercutting, or bare soil areas	☐	☐	☐	☐	☐
Water Quality and Nuisance Conditions	Overall	☐	☐	☐	☐	☐
	Algae blooms, odor, scum, unusual color, or sheen	☐	☐	☐	☐	☐
	Mosquito habitat/stagnant pockets	☐	☐	☐	☐	☐
	Fish kills or stressed aquatic life (wet ponds)	☐	☐	☐	☐	☐
Vegetation and Access	Overall	☐	☐	☐	☐	☐
	Proper grass cover on slopes and embankment	☐	☐	☐	☐	☐
	Undesirable invasive/woody vegetation	☐	☐	☐	☐	☐
	Access roads, gates, and safe approach to structures	☐	☐	☐	☐	☐
Downstream Discharge and Outfall Stability	Overall	☐	☐	☐	☐	☐
	Scour/erosion at discharge area; undermining	☐	☐	☐	☐	☐
	Energy dissipation features stable and adequate	☐	☐	☐	☐	☐
	Downstream channel impacts migrating toward outlet	☐	☐	☐	☐	☐
Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to homes/roads/bridges/utilities/critical facilities	☐	☐	☐	☐	☐
	Public safety hazards (fencing, signage, drop-offs)	☐	☐	☐	☐	☐

Ponds

Inspection Checklist



FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Attach additional pages, if required.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Basin Storage and Sedimentation	Sediment accumulation/storage loss	Light sediment; storage essentially intact.	Sediment benches forming; minor storage reduction.	Storage visibly reduced; frequent ponding higher/longer than expected; plan removal.	Major storage loss; pond fills quickly; overflow risk elevated.	Severe infill; detention function compromised; high flood/overflow risk.
	Forebay or inlet delta buildup (if present)	Forebay/delta lightly deposited; still functioning.	Noticeable deposition; still capturing most coarse sediment.	Forebay/delta substantially filled; bypassing sediment to the main basin.	Forebay mostly filled; flow paths altered; maintenance urgent.	Forebay/delta failed as a sediment trap; rapid basin infill; immediate maintenance.
	Standing water duration/drawdown performance (dry ponds)	Drawdown occurs as designed; no persistent water.	Slightly longer drawdown after storms; no nuisance.	Drawdown frequently slow; standing water persists beyond typical window; investigate.	Chronic standing water; odor/mosquito potential; outlet/infiltration likely impaired.	Persistent water creating hazards or mosquito/nuisance conditions; immediate corrective action.
Inlets and Flow Paths	Erosion at inflow/undermining/displaced riprap	Minor rilling/scour; armor intact.	Localized scour; small voids; minor rock displacement.	Undermining evident; riprap displaced; gully forming; repair needed.	Major scour/gully; inlet unstable; rapid sediment delivery; risk to structures.	Inlet collapse/near-collapse; severe undercutting threatening roadway/pipe; immediate stabilization.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Inlets and Flow Paths (Cont' d.)	Blockage by debris or vegetation	Light debris; flow unobstructed.	Partial blockage; reduced conveyance in small storms.	Frequent/meaningful blockage; water backs up or reroutes; remove soon.	Major blockage; bypassing/ponding occurs; urgent clearing.	Full blockage causing flooding/bypass toward structures/roads; immediate removal.
	Short-circuiting, rilling, or defined flow path damage	Flow enters as intended; no new channels.	Minor off-line flow; shallow rills.	New gully/channel developing; some bypass of stabilization/forebay.	Major gully and bypass; erosion expanding rapidly; corrective grading/stabilization needed.	Uncontrolled bypass directing flow toward infrastructure or outside easement; immediate action/engineering.
Outlet Structures and Drawdown	Trash rack/grate condition and blockage	Rack intact; minimal debris.	Some debris; no functional restriction.	Debris accumulation reduces opening area; needs cleaning.	Heavy blockage or damage; flow control compromised; urgent clearing/repair.	Rack missing/collapsed or fully blocked; imminent overtopping/uncontrolled discharge; immediate action.
	Orifice/weir/low-flow device condition and blockage	Clear and functioning; normal drawdown.	Minor deposits; performance likely fine.	Partial blockage/corrosion; drawdown altered; schedule maintenance.	Major blockage/damage; drawdown/controls unreliable; urgent repair.	Failed or obstructed device causing unsafe water levels or uncontrolled flows; immediate action.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Outlet Structures and Drawdown (Cont' d)	Structural damage, corrosion, or joint separation	Minor surface corrosion; no deformation.	Moderate corrosion or minor hardware loss; monitor/repair planned.	Structural deterioration evident; alignment/hardware issues affecting function.	Significant damage/corrosion; risk of component failure; urgent repair.	Structural failure imminent or access unsafe; immediate repair/engineering review.
	Emergency spillway erosion, obstruction, or critical slopes	Clear; no obstruction.	Light vegetation/debris; minimal effect.	Partial obstruction reduces capacity or redirects flow; remove soon.	Major obstruction; overflow likely diverted/ponded; urgent clearing.	Blocked spillway causing overtopping at unintended location; immediate removal.
	Cracking, settlement, sinkholes, or depressions	Hairline/cosmetic; no progression.	Small cracks/low spots; monitor.	Noticeable cracks/settlement; potential voids; needs investigation.	Large cracks/sinkholes; crest/shoulder compromised; urgent repair.	Rapidly worsening settlement/sinkholes; imminent breach risk; immediate action.
	Proper vegetation condition for embankments and designed spillways	Proper grass coverage, well maintained, no issues.	Grass coverage inconsistent, vegetation shows inconsistent mowing/maintenance	Grass coverage inconsistent and small trees/woody vegetation becoming established; clear lack of consistent mowing/maintenance	Grass coverage is poor, trees or woody vegetation encroaching on embankment or designed spillways; complete lack of mowing/maintenance ; urgent maintenance required	Trees or woody vegetation threaten embankment or structural integrity; breach risk; immediate action required
Emergency Spillway, Vegetation, and Embankment Conditions						

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Emergency Spillway, Vegetation, and Embankment Conditions (Cont' d.)	Animal burrows or woody vegetation on embankment	No burrows/woody growth.	Few small burrows or seedlings; remove/repair.	Multiple burrows or established woody growth; structural risk increasing.	Extensive burrowing or large woody plants; slope integrity threatened; urgent control.	Major burrows/voids or large root systems causing seepage/instability; immediate action.
	Slumping, undercutting, or bare soil areas	Minor bare patches; no movement.	Small rills/bare bands; early undercutting.	Slump cracks/undercutting are evident; repair is required.	Major slump/undercut; erosion expanding; access unsafe; urgent repair.	Active failure with rapid retreat near structures/trails; immediate stabilization.
Water Quality and Nuisance Conditions	Algae blooms, odor, scum, unusual color or sheen	No bloom/odor; normal clarity.	Mild algae/odor during warm periods.	Persistent bloom/odor/scum; investigate sources and circulation.	Severe bloom/odor or sheen suggesting pollution; urgent corrective actions.	Evidence of spill/illicit discharge (strong sheen, chemical odor); immediate response.
	Mosquito habitat/stagnant pockets	No stagnant pockets; minimal habitat.	Minor stagnant zones after storms; short duration.	Recurrent stagnant pockets; larvae likely; address grading/vegetation.	Chronic stagnant water; public complaints likely; urgent mitigation.	Significant mosquito breeding with public health concern; immediate action/coordination.
	Fish kills or stressed aquatic life (wet ponds)	No issues observed.	Isolated stressed fish; minor.	Multiple distressed fish or small kill; investigate oxygen/water quality.	Large fish kill event or recurring stress; urgent investigation/response.	Major kill with suspected contamination; immediate response and notifications.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Vegetation and Access	Proper grass cover on slopes and embankment	Dense grass; no bare spots.	Small bare areas; early thinning.	Multiple bare areas exposing soil; erosion starting; reseed/repair.	Large bare zones with active erosion; urgent stabilization.	Extensive cover failure on critical slopes/crest; instability risk; immediate stabilization.
	Undesirable invasive/woody vegetation	None present or minimal.	Scattered invasives; minor trimming needed.	Dense patches affecting access or hydraulic paths; plan removal.	Encroachment into embankment or structures, Major blockage of access/flow paths; urgent removal.	Threatens embankment stability, Obstructs spillway/outlet/inlets or creates safety hazard; immediate removal.
	Access roads, gates, and safe approach to structures	Fully accessible; safe working area.	Minor rutting/vegetation; passable.	Access intermittently limited; repairs needed to ensure routine maintenance.	Access frequently blocked/unsafe; urgent repair needed.	No safe access to critical outlet/spillway; emergency response hindered; immediate action.
Downstream Discharge and Outfall Stability	Scour/erosion at discharge area; undermining	Minor scour; no undercutting.	Localized erosion; shallow.	Undermining starting or channel incision evident; repair needed.	Major scour/undermining threatening pipe/headwall/embankment; urgent stabilization.	Outlet structure undermined or failing; immediate stabilization/engineering.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Downstream Discharge and Outfall Stability (Cont' d.)	Energy dissipation features stable and adequate	Dissipation intact and effective.	Minor displacement; still functional.	Partial failure/inadequate for observed flows; plan improvements.	Significant displacement/failure; downstream erosion accelerating; urgent repair.	Missing/failed dissipation causing severe erosion and structural threat; immediate action.
	Downstream channel impacts migrating toward outlet	No migration; stable channel.	Early signs of incision/bank wear; monitor.	Migration toward outlet visible; plan stabilization.	Rapid migration threatening outlet/adjacent assets; urgent action.	Migration has reached outlet or imminent; structural/flood risk; immediate response.
Impacts to People and Infrastructure	Threat to homes/roads/bridges/utilities/ critical facilities	No threat; setbacks adequate.	Minor erosion/ponding near assets; understand if regulated as a "Dam"	Erosion/overflow trending toward assets; understand if regulated as a "Dam"; plan protection.	Asset at risk in next major storm; understand if regulated as a "Dam"; urgent stabilization/protection.	Imminent failure/flooding threatening critical access/utilities; understand if regulated as a "Dam"; immediate action.
	Public safety hazards (fencing, signage, drop-offs)	No hazards; controls present.	Minor deficiencies (faded sign, small gap).	Deficiencies could cause injury (missing sign near hazard); correct soon.	Significant hazard exposure (missing fence at steep area); urgent correction.	Immediate danger (open drop-off, unstable ground in public area); restrict access now and fix.

Ponds

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Pond Name/ID	
Location	
Date/Time	START: __/__/____ END: __/__/____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Recent high water?	☐ Yes ☐ No
Recent storm event?	☐ Yes ☐ No
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/seasonal tasks	☐ Post-storm response	☐ Complaint/observation
☐ Trash/debris removal	☐ Erosion repair needed (inlet, slopes, spillway, discharge)	☐ Sediment reducing storage
☐ Outlet structure blockage/repair	☐ Emergency spillway issue	☐ Embankment concern (seepage, cracking, burrows)
☐ Water quality/nuisance issue	☐ Access/safety hazard (steep slopes, fencing, signage)	☐ Other (describe below)

Other/Details:

Pond Name/ID: _____

Foreman Initials: _____

Ponds

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Trash and debris removal (inlets, shoreline, racks), emergency spillway clearing	☐ Remove illegally dumped materials
☐ Vegetation management (mow/trim) to maintain access and stable turf	☐ Inlet/outlet structure cleanout and stabilization	☐ Burrow repair/void fill/wildlife control actions (as approved)
☐ Repair/replace outlet components (grates, fasteners, valves)	☐ Sediment removal/excavation/forebay cleanout	☐ Slope repair/regrading/shoreline stabilization
☐ Install/repair fencing/signage (if present)	☐ Other (describe below)	

Other maintenance actions performed (describe):

AREAS ADDRESSED

☐ Basin bottom/storage area	☐ Side slopes/shoreline	☐ Inlet points/inflow channels
☐ Outlet structure/riser/controls	☐ Access roads/gates/paths	☐ Emergency spillway/overflow route
☐ Embankment crest/downstream face	☐ Downstream discharge/outfall area	☐ Other (describe below)

Other areas addressed:

Pond Name/ID: _____

Foreman Initials: _____

MATERIALS, QUANTITIES, AND DISPOSAL

Sediment removed (estimate):

Disposal location/ticket #:

Rock/stabilization materials used:

Erosion control materials used:

Other materials:

CONDITION AFTER MAINTENANCE

Function/structural condition after work:	Stability after work:
☐ Restored/Acceptable	☐ Stable
☐ Improved	☐ Improved
☐ Still deficient	☐ Needs follow-up

DOCUMENTATION

Before photos attached:	☐ Yes	☐ No	☐ N/A
Photo locations/direction recorded?	☐ Yes	☐ No	☐ N/A
Sketch/map/GPS points attached?	☐ Yes	☐ No	☐ N/A
Inspection checklist attached?	☐ Yes	☐ No	☐ N/A
Work order attached?	☐ Yes	☐ No	☐ N/A
Instrumentation readings recorded?	☐ Yes	☐ No	☐ N/A

Ponds

Maintenance Form



ENGINEERING REVIEW REQUIRED?

☐ Yes ☐ No ☐ N/A

(If yes, describe trigger)

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Maintenance Form



Pond Name/ID: _____

Foreman Initials: _____

How to Maintain Your Playas



What is it?

A playa is a shallow depression that collects and temporarily stores stormwater runoff. It serves as a natural stormwater detention basin and can be part of a larger drainage system, where water flows through overflow paths to downstream playas. Some playas are engineered with features like shaped slopes and outlet structures, while others are left natural.

Who maintains it?

Ownership and maintenance of playas can differ. They may be owned by cities, drainage districts, private entities, or homeowners' associations. Some serve as stormwater detention basins, while others function as parks, affecting maintenance expectations for public access, mowing, irrigation, and amenities. Regardless of ownership, it is important to understand:

- Which watershed drains to the playa, and how runoff enters it
- Whether the playa has an overflow route and where that overflow goes
- Whether the community has authority and responsibility to inspect and maintain the playa and any related features such as flumes, inlets, outlet structures, or pump stations
- Whether maintenance agreements exist for private facilities within the playa area

Best maintenance practices & strategies

Playas are designed by nature and sometimes modified by engineering to store stormwater safely. Over time, sediment accumulation, erosion, debris, invasive vegetation, and damage to inlet or outlet features can reduce storage volume, create safety hazards, and increase flood risk. Routine inspection and targeted maintenance protect storage capacity, preserve overflow routing, reduce erosion costs, and extend service life.

A. INSPECTION

Inspections confirm the playa can still store runoff, pass overflow safely when applicable, and remain stable without creating hazards such as sinkholes, severe erosion, unsafe slopes, or damaged inlet and outlet features. An inspection checklist template for playas should include the basin, side slopes, inlet points, overflow routes, and outlet structures. An inspection checklist for playas is included with this reference sheet.

Inspection skill needs:

- Ability to recognize sediment filling and reduced storage capacity
- Ability to identify erosion patterns such as sheet erosion, rill erosion, and gully erosion
- Awareness of side slope instability, slumping, and unsafe walking conditions
- Familiarity with key playa features such as the basin bottom, dry-land vegetation line, side slopes, inlets, flumes, overflow routes, and outlet structures or pump stations (if present)
- Ability to identify trash, dumping, and potential water quality concerns
- Ability to document conditions clearly and recognize when engineering review is needed
- Ability to observe safely without entering unstable slopes, soft sediments, or standing water

What to look for:

- **Sediment accumulation in the basin.** Sedimentation or excavation/grading that removes the natural clay liner is the most common long-term threat to playa function. As sediment builds up, the playa loses storage volume and fills more quickly during storms. This can increase the likelihood of overflow and raise water levels closer to surrounding development.
- **Pits, excavations, or unnatural depressions.** Pits can concentrate water, trap sediment, create steep edges, and reduce the playa's natural function. They can also create safety hazards and complicate maintenance.
- **Sheet, rill, and gully erosion around the playa.** Rills on disturbed slopes, bare soil bands, and gullies at concentrated inflow points indicate early-stage erosion. Erosion can grow quickly during repeated storms and can transport more sediment into the playa, accelerating storage loss.
- **Erosion at flumes, inlets, and downstream ends of drainage features.** Concentrated inflows can cut channels, undercut edges, and form gullies that expand over time.
- **Damaged, blocked, or misdirected inflow points.** Check curb cuts, swales, storm drain outfalls into the playa, energy dissipators, and any inlet structures for blockage or erosion. Misaligned inflow or undersized outfalls can carve new gullies and bypass intended stabilization features.
- **Side slope instability and unsafe slopes.** Look for slumps, cracks near the crest, undercutting, or areas where slopes have become too steep due to erosion or past excavation. Unstable slopes can fail suddenly and can be a public safety issue.
- **Standing water duration and ponding patterns.** Wet and dry cycles are normal, but long-lasting water combined with odor, algae, mosquito habitat, soft ground, or a non-functional playa may indicate poor drainage, excessive sediment, blocked outlets, or altered basin grades.
- **Trash, debris, and illegal dumping.** Dumping can reduce storage, block overflow routes, damage vegetation buffers, and create hazards for crews and the public.
- **Vegetation condition and buffer integrity.** Overflow routes must remain open and stable. Look for obstructions, illegal grading, fencing that blocks flow, dumped material, or erosion that could redirect overflow toward buildings, streets, or utilities.
- **Outlet structures, pipes, or pump stations (if present).** Check for blockage, structural damage, corrosion,

settlement, access issues, and signs of leakage or seepage around structures. Check for erosion around or undermining outfall structures.

How to record conditions:

- Use a standard inspection form or digital tool. Consistent records make inspections comparable over time and help prioritize maintenance.
- Record location, date, weather, high water marks, and recent storm history. Context is important for interpreting erosion, water level, and debris conditions.
- Describe storage and sediment conditions using simple categories. For example, describe storage as normal, partially reduced, or severely reduced based on visible sediment benches, raised basin bottom, or chronic high water.
- Document inflow and overflow performance indicators. Note erosion at inflows, evidence of overflow such as debris lines, and any signs of water leaving the intended overflow route.
- Photograph key conditions. Include basin sediment areas, erosion features, damaged inlets or outlets, overflow route obstructions, and slope instability.
- Flag urgent hazards. Mark issues that threaten life safety, nearby critical facilities, roads, utilities, or structures, or that could lead to rapid failure in the next storm.

B. MAINTENANCE

Maintenance restores or protects the playa's storage capacity, keeps overflow routes functional, reduces erosion, and addresses safety hazards. Maintenance should focus on preventing sediment delivery, stabilizing concentrated inflows, and correcting problems early before they become major reconstruction projects. A maintenance checklist for playas is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools for trash and light vegetation management
- Mowers or trimmers for buffer and perimeter maintenance where appropriate
- Erosion control materials such as erosion control blankets, rock, or other stabilization measures as approved
- Equipment for sediment removal when storage loss is significant
- Equipment for grading and slope repair when erosion has altered side slopes or basin shape

- Confined space or specialized training if outlet structures, manholes, or pump station components are involved
- Training for working safely on soft ground, steep slopes, and around standing water
- Spill response awareness if oil, grease, or suspicious discharges are observed

Key maintenance goals:

- Remove trash, debris, and illegal dumping. Debris reduces storage, creates hazards, and can block overflow routes. Remove promptly, especially after storms.
- Protect and maintain buffer areas. Healthy buffers reduce sediment inflow and improve water quality. Repair bare or disturbed buffer zones and prevent concentrated flow from cutting through them.
- Restore storage capacity (while maintaining the natural clay pan) when sediment accumulation becomes significant. When sediment has measurably reduced basin volume or contributes to chronic high water, plan sediment removal and appropriate disposal.
- Keep overflow routes open and stable. Remove obstructions and repair erosion along overflow paths to ensure controlled discharge to downstream areas.
- Maintain outlet structures and pump systems where present. Clear blockages, repair damage, and ensure access and functionality so the playa drains as designed, when applicable.
- Correct slope failures and address sinkholes or settlement. Repair unstable slopes, fill voids, and stabilize areas where erosion undermines the ground surface.

Key considerations while achieving the above maintenance goals:

- Preserve storage capacity and natural function. Avoid maintenance actions that unintentionally reduce storage volume, alter overflow elevations, or remove the natural clay liner at the bottom of the playa.
- Do not block or redirect overflow routes. Overflow routing is a critical part of the system. Any changes to overflow paths should be reviewed for no adverse downstream impacts.
- Control sediment at the source when possible. Buffers, stabilized inflow points, and upstream erosion controls often reduce long-term sediment removal needs.
- Stabilize concentrated inflows. Inlet stabilization prevents gullies that rapidly deliver sediment to the basin.

- Balance vegetation management with stability. Some vegetation supports soil stability and buffers, while invasive or poorly located growth can trap debris, redirect flow, or reduce capacity.
- Prioritize safety. Address sinkholes, steep, unstable slopes, and undermining near trails, roads, or structures as high-priority items.

SCHEDULING MAINTENANCE**1. Routine and seasonal maintenance**

- Conduct periodic walk-through inspections of accessible areas, focusing on inflows, overflow routes, and known erosion spots
- Manage trash and minor debris before it accumulates
- Maintain buffer vegetation and access paths where required for inspection and public use

2. Annual maintenance and comprehensive review

- Perform a full inspection of the basin, side slopes, inflows, overflow routes, and outlet features
- Compare current sediment levels, erosion areas, and water patterns to past records to identify trends
- Identify playas where sediment accumulation is reducing capacity and plan sediment management before flooding or overflow becomes chronic
- Review older or heavily modified playas for long-term rehabilitation needs such as slope reshaping, inlet redesign, playa restoration, or major sediment removal

3. Pre-, in-, and post-storm events***Pre-storm events***

- Inspect known trouble spots such as concentrated inflows, flumes, and overflow routes
- Remove visible debris that could wash into inlets or block overflow paths
- Confirm access routes are clear for emergency response

In-storm events (only when safe)

- Observe whether inflows are stable or cutting new gullies
- Note whether overflow is occurring and whether it follows the intended route
- Document any immediate hazards such as slope slumping, rapid erosion, or water approaching roads or structures

Post-storm events

- Inspect as soon as conditions are safe

- Remove storm-deposited debris and address new erosion at inflows and overflow routes
- Document high water marks, debris lines, and any new problem areas to improve future maintenance targeting

4. Maintenance decision logic

- Continue planned maintenance when storage and overflow routing remain functional, erosion is minor, and issues can be corrected through routine tasks
- Increase preventive maintenance when sediment and erosion are trending upward, inlet stabilization is degrading, or overflow routes show early damage
- Plan rehabilitation or redesign when repeated erosion repairs fail, sediment returns quickly due to upstream conditions, slopes repeatedly slump, or hydraulic performance no longer matches surrounding development risk; or when playas that were formerly dry begin to hold water
- Consider replacement or major reconstruction of engineered features when outlet structures, pump stations, or stabilized inlets repeatedly fail or no longer meet current standards, and the long-term cost of repeated repairs exceeds a redesign to modern criteria

5. Factors that may influence the maintenance schedule

Use these to decide whether to stay at routine frequency or escalate to enhanced inspection and preventive maintenance:

- Storm intensity and frequency. More intense storms increase erosion at concentrated inflows and along overflow routes. More frequent storms reduce recovery time and accelerate sediment deposition.
- Overflows and routing sensitivity. Evidence of overflow occurring more often than expected, overflow approaching buildings, streets, utilities, or critical facilities, overflow route obstructions, illegal grading, or fencing that alters flow paths, or flooding.
- Sinkholes, settlement, and ground instability. Settlement along edges, at access paths, near structures, or near inlet and outlet features. Soft ground, voids, or slumping slopes that suggest instability.
- Collapsed features or near-failure indicators. Collapse at flumes, inlet channels, outlet structures, or stabilized spillways, rapidly expanding gullies that threaten to cut back toward streets or structures.
- Nearby critical facilities. Hospitals, fire stations, schools, evacuation routes, major arterials, utility corridors, parks with high public use and safety exposure.

6. Repair vs. replacement considerations

Playas are natural basins but can include engineered components. Use these considerations to decide whether to continue maintenance and repairs or move to reconstruction and redesign.

Factors that indicate continued maintenance and repair

Choose repair/rehabilitation when:

- Issues are minor or localized and do not change basin shape or overflow elevations
- Erosion can be stabilized without repeated failure
- Sediment removal restores storage and sediment return rates are manageable
- Inflow and overflow features remain aligned and functional with standard maintenance
- Safety concerns can be corrected with straightforward repairs and access control

Factors that indicate asset replacement or repair

Consider replacing or repairing when:

- Repeated failures, such as recurring severe pipe or manhole collapse, and chronic sinkholes, occur
- The main is undersized for current and expected conditions, resulting in frequent overflows even when clean
- Deteriorated lining or widespread structural defects make rehab unreliable
- Repairs are ineffective or repeatedly failing, increasing life-cycle cost and risk
- Design/engineering standards require changes with regard to access, resiliency, hydraulic capacity, safety, and constructability
- The consequences of failure could be severe, such as hazardous road overtopping, significant structural flooding, risk to other key infrastructure

Factors that indicate reconstruction or redesign

Consider reconstructing or redesigning when:

- Repeated failures occur (gullies return after repair, inflow stabilization repeatedly fails, spillway erosion recurs)
- The playa is losing storage rapidly and requires repeated sediment removal that is not sustainable
- Overflow routing is no longer reliable or safe due to surrounding development or changed grades
- Slopes repeatedly slump or show chronic instability
- Engineered outlet or control features repeatedly fail or no longer meet current standards
- The long-term cost and risk of repeated repairs exceed the cost of a redesign to modern criteria

7. Repair and replacement scheduling questions

- Is this playa critical for flood protection? Does it protect neighborhoods, roads, or downstream drainage systems?
- Does the condition threaten life safety? Sinkholes, unstable slopes, deep water hazards, or public access hazards
- Does it threaten infrastructure? Roads, trails, utilities, buildings, or critical facility access
- Are failures repeated or worsening? Same erosion zone reappears, sediment returns quickly, overflow occurs more frequently
- Is reconstruction more cost-effective than continued repairs? Compare life-cycle costs, emergency response costs, and risk reduction
- Will storm intensity or nearby development increase future consequences? Higher runoff peaks, more erosion potential, greater exposure, and liability

Playa Name/ID	
Location	
Date/Time	START: __/__/____ END: __/__/____
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: __°F
Inspection Timing	Pre-Storm/Routine/Post-Storm
Recent high water?	☐ Yes ☐ No
Recent storm event?	☐ Yes ☐ No
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Traffic hazards/unsafe access	☐ Steep or unstable slopes/slumping	☐ Soft ground/sinkhole/settlement	☐ Standing water/deep water hazard
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Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Basin Storage and Sedimentation	Overall	☐	☐	☐	☐	☐
	Sediment accumulation	☐	☐	☐	☐	☐
	Unnatural pits or excavations	☐	☐	☐	☐	☐
	Standing water duration and ponding	☐	☐	☐	☐	☐

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Erosion and Slope Stability	Overall	☐	☐	☐	☐	☐
	Sheet/rill/gully erosion	☐	☐	☐	☐	☐
	Erosion at inflows/flumes	☐	☐	☐	☐	☐
	Side slope instability or slumping	☐	☐	☐	☐	☐
Inlets and Overflow Routing	Overall	☐	☐	☐	☐	☐
	Damaged or blocked inflow points	☐	☐	☐	☐	☐
	Overflow route obstructions	☐	☐	☐	☐	☐
	Overflow route erosion/instability	☐	☐	☐	☐	☐
Trash, Dumping, and Water Quality	Overall	☐	☐	☐	☐	☐
	Trash/debris and illegal dumping	☐	☐	☐	☐	☐
	Suspicious discharges or oil sheen	☐	☐	☐	☐	☐
Vegetation and Buffers	Overall	☐	☐	☐	☐	☐
	Buffer integrity	☐	☐	☐	☐	☐
	Invasive or dense vegetation in flow paths	☐	☐	☐	☐	☐
Outlet Structures or Pump Systems (if present)	Overall	☐	☐	☐	☐	☐
	Blockage, access, or structural condition	☐	☐	☐	☐	☐
	Seepage, leakage, or settlement	☐	☐	☐	☐	☐
Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat level and consequence	☐	☐	☐	☐	☐

Notes and Observations:

Attach additional pages, if required.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Basin Storage and Sedimentation	Sediment accumulation	Minor sediment; storage appears normal.	Localized sediment benches; small capacity loss.	Noticeable deposition; storage partially reduced; plan sediment management.	Severe deposition; chronic high water/early overflow risk; prioritize removal.	Storage largely lost; frequent unsafe overflow or flooding; engineering review/rehabilitation.
	Unnatural pits or excavations	No pits; basin grades consistent.	Small depressions; minor ponding or safety concern.	Pits concentrate water/sediment; begin shaping/backfill plan.	Large/steep pits; trap water; public hazard; urgent grading control.	Deep/expanding excavation undermines function or stability; restrict access; redesign.
	Standing water duration and ponding	Dries within expected period; no odors/algae.	Longer ponding in spots; minor soft ground.	Persistent water with odor/algae/mosquito potential; investigate grade/outlet.	Chronic standing water; soft sediments; access unsafe; corrective grading/outlet work needed.	Persistent deep water or contaminated conditions posing health/safety risk; immediate action and review.
Erosion and Sope Stability	Sheet/rill/gully erosion	Stable soils; minor rills only.	Sediment along edges; minor loss.	Gullies forming at concentrated flow; schedule stabilization.	Active gully growth delivering sediment; threatens slopes or access; prioritize repair.	Rapidly expanding erosion threatens roads, utilities, or structures; emergency stabilization and engineering.
	Erosion at inflows/flumes	Energy dissipation intact; no scour.	Small scour pockets; minor rock/matting repair.	Undercutting/scour expanding; inflow misalignment possible; repair soon.	Major scour/undermining; stabilization failing; urgent reconstruction of inflow protection.	Inlet failure with severe headcutting/backcutting; imminent risk to upstream infrastructure; emergency response.
	Side slope instability or slumping	Slopes stable; no cracks or slumps.	Minor sloughing; localized bare spots; minor repair.	Cracks/slumps present; slope becoming unsafe; schedule stabilization.	Significant slumping/undercutting near crest or paths; restrict access; prioritize repair.	Active failure or sinkhole/void conditions; collapse risk; close area and obtain engineering review.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Inlets and Overflow Routing	Damaged or blocked inflow points	Inlets open; flow enters as intended.	Minor blockage/debris; routine cleanout.	Partial blockage or misdirected inflow causing erosion; repair/realign.	Severely blocked or damaged inlet; flow bypassing controls; urgent repair.	Inlet failure causing rapid erosion or overflow toward assets; emergency repair and review.
	Overflow route obstructions	Overflow route clear and stable.	Minor debris/vegetation; remove routinely.	Obstruction (fencing/dumping/grading) restricts flow; schedule removal and enforcement.	Route partially blocked; overflow may redirect toward streets/buildings; urgent correction.	Route blocked or altered; high consequence misrouting imminent or occurring; immediate action and engineering.
	Overflow route erosion/instability	No erosion; grades stable.	Minor rills; spot repair.	Noticeable erosion; stabilize before next season.	Major erosion/headcutting; route reliability reduced; prioritize stabilization.	Spillway failure or uncontrolled overflow threatening life/infrastructure; emergency stabilization and redesign.
Trash, Dumping, and Water Quality	Trash/debris and illegal dumping	Minimal litter; no dumping.	Localized trash; routine pickup.	Recurring debris or small dumping piles; schedule cleanup and deterrents.	Large dumping or hazardous debris; restrict access; coordinate removal.	Hazardous/illegal dumping with immediate health risk; notify authorities and respond promptly.
	Suspicious discharges or oil sheen	No abnormal flow, sheen, or odors.	Minor staining/odor; document and monitor.	Persistent dry-weather flow or sheen; initiate investigation.	Evidence of illicit discharge impacting water quality; escalate to enforcement/utility.	Active spill/strong odors/fish kill indicators; emergency response and agency notification.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Vegetation and Buffers	Buffer integrity	Buffer intact; good ground cover.	Small bare areas; reseed/repair.	Bare bands or disturbed buffer allows sediment inflow; restore and add controls.	Extensive buffer failure; sediment delivery high; prioritize restoration and upstream controls.	Buffer lost and erosion/sediment threatens capacity and safety; comprehensive rehabilitation needed.
	Invasive or dense vegetation in flow paths	Vegetation supports stability; flow paths clear.	Minor overgrowth; routine trimming.	Vegetation traps debris or redirects flow; manage and re-establish defined paths.	Dense growth blocks inflow/overflow or hides hazards; prioritize removal and stabilization.	Vegetation conditions create repeated flooding/erosion or public hazard; redesign flow paths and management plan.
Outlet Structures or Pump Systems (if present)	Blockage, access, or structural condition	Structure accessible; no blockage or damage.	Minor debris/corrosion; routine maintenance.	Partial blockage or moderate damage; schedule repair.	Severe blockage/damage or settlement; function impaired; urgent repair.	Failure of outlet/pump system causing prolonged ponding or overflow; emergency repair and engineering.
	Seepage, leakage, or settlement	No seepage; stable surrounding soils.	Minor seepage staining; monitor.	Ongoing seepage/voids starting; investigate and repair.	Significant seepage/soil piping; restrict access; urgent stabilization.	Active piping/void collapse risk; immediate closure and engineering intervention.
Impacts to People and Infrastructure	Threat level and consequence	No impact to roads, utilities, or public areas.	Low consequence; issues contained within basin.	Moderate consequence potential; near trails/parks/adjacent lots; schedule corrective work.	High consequence; threatens roads, utilities, buildings, or critical facilities; prioritize action.	Immediate life-safety or critical infrastructure threat; emergency response and mitigation.

Playa Name/ID	
Location	
Date/Time	START: __/__/____ END: __/__/____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Recent high water?	☐ Yes ☐ No
Recent storm event?	☐ Yes ☐ No
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/seasonal tasks	☐ Post-storm response	☐ Complaint/observation
☐ Trash/debris removal	☐ Erosion repair needed	☐ Sediment reducing storage capacity
☐ Overflow route obstruction/erosion	☐ Inlet/flume stabilization issue	☐ Outlet/pump issue (if present)
☐ Safety hazard (sinkhole, unstable slope)	☐ Access/amenity issue (if present)	☐ Other (describe below)

Other/Details:

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Trash and debris removal	☐ Remove illegal dumping
☐ Vegetation/buffer management (mow/trim)	☐ Inlet/flume cleanout	☐ Repair/replace erosion control (blankets, matting)
☐ Rill repair/minor grading	☐ Gully repair/grade control	☐ Rock placement/energy dissipation repair
☐ Sediment removal/excavation	☐ Slope repair/regrading	☐ Fill voids/sinkhole repair
☐ Overflow route clearing	☐ Overflow route erosion repair	☐ Outlet structure cleanout/repair (if present)
☐ Pump system check/repair (if present)	☐ Install/repair fencing/signage (if present)	☐ Other (describe below)

Other maintenance actions performed:

AREAS ADDRESSED

☐ Basin bottom/storage area	☐ Side slopes	☐ Inlet points/flumes
☐ Overflow route/spillway	☐ Buffer/perimeter	☐ Outlet structure (if present)
☐ Pump station/controls (if present)	☐ Access paths/park amenities	☐ Other (describe below)

Other areas addressed:

MATERIALS, QUANTITIES, AND DISPOSAL

Sediment removed (estimate):

Disposal location/ticket #:

Rock/stabilization materials used:

Erosion control materials used:

CONDITION AFTER MAINTENANCE

Function/flow condition after work:	Bed and bank condition after work:
☐ Restored/Acceptable	☐ Stable
☐ Improved	☐ Improved
☐ Still deficient	☐ Needs follow-up
Storage capacity:	Overflow route:
☐ Restored/Acceptable	☐ Open and stable
☐ Improved	☐ Improved
☐ Still deficient	☐ Needs follow-up
Inlets:	Safety hazards:
☐ Stable	☐ Stable
☐ Improved	☐ Improved
☐ Needs follow-up	☐ Needs follow-up

DOCUMENTATION

Before photos attached:	☐ Yes	☐ No	☐ N/A
Photo locations/direction recorded?	☐ Yes	☐ No	☐ N/A
Sketch/map/GPS points attached?	☐ Yes	☐ No	☐ N/A
Inspection checklist attached?	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED?

☐ Yes ☐ No ☐ N/A

(If yes, describe trigger)

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Attach additional pages, if required.

How to Maintain Your Tidal Barriers

What is it?

A tidal barrier is a flood control structure placed across or along a tidal channel, slough, drainage outlet, or inlet to limit tidal flooding and storm surge movement into low-lying areas. Unlike a small tidal gate mounted to a single pipe, a tidal barrier is usually a larger structure (note that a tidal gate would be part of a tidal barrier). It may include a wall, embankment, sill, closure panels, stoplogs, sluice gates, flap gates, a pump station, or a manually operated closure system. Some barriers remain in place at all times, while others are closed only when high-tide or storm-surge conditions are expected.

Common forms include:

- Concrete or sheet pile barriers across tidal drainage channels with one or more gate openings
- Stoplog, slide gate, sector gate, flap gate, or closure panel systems installed at tidal inlets or canal openings
- Local storm surge barriers that remain open under normal conditions and close for extreme water levels
- Barrier structures integrated with levees, seawalls, pump stations, culverts, or drainage ditches

Who maintains it?

Tidal barriers may be owned or maintained by cities, counties, drainage districts, flood control districts, navigation districts, ports, levee improvement districts, state agencies, or private entities. Maintenance responsibility can be shared because one entity may own the barrier wall, another may operate the closure system, and another may maintain the upstream drainage ditch or pump station. Communities should document who closes the barrier, who inspects it, who repairs it, and who is contacted when closure affects traffic, drainage, navigation, or emergency access.

Regardless of ownership, it is important to understand:

- Which tidal waterbody the barrier protects against and which inland drainage area it services, determined by the barrier opening or pump system
- Whether the barrier is normally open, normally closed, or only closed during forecast/operational high water events
- How closure decisions are made, who has authority to close, and what forecast or tide trigger is used
- Whether closure creates interior drainage risk and whether pumps, bypass gates, or emergency storage are needed while the barrier is closed



Best maintenance practices & strategies

Tidal barriers protect communities by interrupting a direct hydraulic connection between a tidal waterbody and low-lying inland areas. Their reliability depends on both structural condition and operational readiness. A barrier with a good wall but a jammed gate can fail. A barrier with a working closure system, but eroded tie-ins can be bypassed. Routine inspection and maintenance must therefore address the full system: crest elevation, wall or embankment, movable closures, seals, sill, scour protection, tie-ins, debris, sediment, operating procedures, and safe access.

A. INSPECTION

Inspections confirm that the barrier can resist tidal or surge loading, close when needed, pass interior drainage when open or pumped, and avoid creating new hazards. Inspections should include the seaward face, landward face, crest, gate bays, sill, closure panels, seals, electrical or mechanical systems, access platforms, scour protection, and tie-ins to adjacent levees, walls, or high ground. When possible, inspect after high tides and storms to see whether overtopping, seepage, or bypass has occurred. An inspection checklist for tidal barriers is included with this reference sheet.

Inspection skill needs:

- Ability to recognize overtopping evidence, settlement, structural cracking, scour, erosion, and seepage
- Familiarity with barrier components such as closure panels, stoplogs, gates, gate bays, seals, sills, actuators, hoists, trash racks, and tie-ins

- Ability to confirm whether operating procedures and closure equipment are ready before a forecast event
- Understanding of how tides, storm surge, rainfall, and upstream runoff interact while a barrier is closed
- Ability to document conditions with photos, stationing, tide stage, closure status, and simple condition ratings
- Ability to recognize when engineering review, emergency management coordination, or regulatory notification is required

What to look for:

- **Crest elevation, freeboard, and overtopping evidence.** Look for low spots, settlement, erosion, water marks, wrack lines, or damage on the landward side of the barrier. Overtopping evidence indicates that the barrier may not provide the expected level of protection under current tide and surge conditions. Even minor low areas can become failure points during repeated overtopping.
- **Closure system readiness.** Inspect stoplogs, panels, gate leaves, hinges, rails, hoists, actuators, chains, seals, and locking devices. Confirm components are present, accessible, and not seized by corrosion or sediment. A barrier that is only closed occasionally must still be exercised and tested so staff know it will close under time pressure.
- **Seal, sill, and seating condition.** Closure elements must seat against a clean sill or frame. Sediment, concrete damage, marine growth, or displaced hardware can create gaps that allow high tide or surge water to pass through the barrier. Small leakage may be acceptable in some designs, but any increase in leakage should be recorded and corrected.
- **Structural wall or embankment condition.** Check concrete, steel sheet pile, timber, earthen embankment, and masonry components for cracking, spalling, corrosion, displacement, bulging, settlement, voids, or loss of backfill. Structural deterioration can reduce the barrier capacity and may prevent gates from aligning properly.
- **Tie-ins and flank protection.** Inspect the ends of the barrier where it connects to levees, seawalls, high ground, road embankments, or buildings. Water often bypasses protection at weak transitions. Look for erosion, settlement, animal burrows, gaps under fencing, new grading, or flood paths around the ends of the barrier.
- **Scour protection and channel bed condition.** Look for scour holes, undermining at the sill, displaced riprap, exposed geotextile, eroded apron edges, or channel

incision. Strong flow through a gate opening or over a sill can remove bed material and undermine the structure. Scour protection must remain stable on both sides of the barrier.

- **Debris, sediment, and vegetation.** Debris can stop a gate from closing, block drainage when the barrier is open, or increase local water levels. Sediment can bury sills and rails. Dense vegetation can hide damage and prevent access. These conditions should be recorded early and corrected before storm season.
- **Interior drainage impacts.** When a barrier closes, rainfall and river discharge can back up on the landward side. Inspect for high water marks, long-duration ponding, pump station stress, or undersized bypass features. A barrier that prevents tidal flooding can still cause inland flooding if interior drainage is not managed.
- **Access, traffic, and public safety.** Closure operations often require staff to work near water, traffic, electrical systems, and heavy panels. Inspect platforms, ladders, railings, gates, lighting, signage, and access roads. Unsafe access can make a functional barrier unusable during an emergency.
- **Operation records and closure triggers.** Confirm that operating procedures, tide triggers, emergency contacts, and equipment inventories are current. Communities should know when the barrier closes, how long it can remain closed, who has the authority to reopen it, and what conditions require emergency management coordination.

How to record conditions:

- Use a standard inspection form or digital tool and record the barrier segment, gate bay, tide condition, closure status, and weather context
- Record whether the barrier was open, closed, partially closed, or being tested during the inspection
- Document structural conditions separately from operating conditions so a sound wall is not mistaken for a ready system
- Photograph seaward and landward sides, gate bays, sills, seals, tie-ins, scour protection, and any overtopping or seepage evidence
- Flag urgent issues that could prevent closure, allow bypass, cause structural instability, or create interior flooding while closed
- Update maps and asset records when gates, panels, stoplogs, or appurtenances have been added, removed, or replaced

B. MAINTENANCE

Maintenance keeps the barrier ready to perform during relatively infrequent but high-consequence events.

The most important routine tasks are to keep closure elements functional, keep sills and rails clean, maintain the crest and tie-ins, repair scour and erosion before they expand, and keep operating procedures current. Communities with limited staff should focus on pre-season readiness, documented test closures, and reliable access to specialized repair vendors when the barrier includes mechanical or electrical components. A maintenance checklist for tidal barriers is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools and pressure washing equipment for debris, marine growth, and sediment cleanup
- Hoists, lifting devices, stoplog handling equipment, or actuator tools specific to the closure system
- Replacement seals, pins, bolts, hinges, corrosion-resistant hardware, hydraulic hoses, or electrical components
- Excavation equipment, riprap, bedding stone, grout, concrete patch, and filter fabric for scour and structural repair
- Traffic control and fall protection equipment for work near roads, platforms, and water
- Portable pumps or bypass equipment where closure affects interior drainage
- Vendor support for specialized gates, control systems, and emergency closure testing

Key maintenance goals:

- Keep the closure system operable. Exercise gates, panels, stoplogs, hoists, and actuators on a planned schedule. Components that are used only during emergencies can seize, corrode, or be misplaced if they are not periodically tested.
- Maintain clean sills, rails, and seal surfaces. Remove sediment, marine growth, concrete debris, and trash that prevent closure elements from seating. Clean contact surfaces reduce leakage and improve closure speed.
- Maintain crest continuity and tie-ins. Fill low spots, repair crest erosion, and stabilize barrier ends. A barrier is only as effective as its weakest bypass path.
- Repair scour, undermining, and apron damage. Reset riprap, replace displaced bedding, and repair scour holes before they undermine the sill, wall, or

embankment. Scour is a common trigger for larger structural repairs.

- Maintain interior drainage capacity. Keep pumps, bypass gates, culverts, or storage areas functional if the barrier reduces gravity drainage during high tides or storms.
- Protect structural materials from corrosion and deterioration. Coat, patch, seal, or replace deteriorated steel, concrete, timber, and mechanical components before they affect operation or structural stability.
- Keep access and operating procedures ready. Maintain keys, signage, closure checklists, staff contacts, and equipment locations. Emergency operation should not depend on undocumented local memory.
- Document test closures and performance after storms. Records of closure time, leakage, interior water levels, and repairs help determine whether the barrier needs rehabilitation or redesign.

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Clear debris and sediment from gate bays, stoplog slots, rails, sills, and access routes
- Check visible structural condition, crest continuity, and security of panels, gates, and appurtenances
- Lubricate, exercise, or test movable components according to manufacturer and environmental requirements
- Trim vegetation that hides damage or blocks closure operations

2. Annual maintenance and comprehensive review

- Conduct a full pre-season inspection of the entire barrier alignment, including tie-ins and landward drainage features
- Perform a documented test closure or partial closure where feasible and safe
- Review tide triggers, closure authority, emergency contact lists, equipment inventory, and vendor availability
- Evaluate whether sea level, subsidence, development, or drainage changes have reduced the barrier level of service

3. Pre-, in-, and post-storm events

Pre-storm events

- Clear closure bays, stage equipment, confirm staffing, and verify pumps or bypass systems

In-storm events (only when safe)

- Monitor only from safe locations and track water levels on both sides of the barrier if gauges are available

Post-storm events

- Inspect for overtopping, seepage, scour, gate damage, debris loading, settlement, and interior drainage problems before returning to normal operation

4. Maintenance decision logic

- Continue planned maintenance when the barrier alignment is stable, closure components are present and operable, and minor debris or corrosion can be addressed routinely
- Increase preventive maintenance when test closures become difficult, leakage increases, sills fill with sediment, or scour and tie-in erosion are progressing
- Plan rehabilitation when structural repairs, actuator repairs, seal replacement, or scour reconstruction are needed but the barrier remains appropriate for the site
- Consider replacement or redesign when the barrier cannot be reliably closed, is too low for current water levels, causes repeated interior drainage problems, or has repeated structural failures

5. Repair vs. replacement considerations***Factors that indicate continued maintenance and repair***

Choose repair/rehabilitation when:

- Damage is localized to closure panels, seals, hardware, minor concrete defects, or riprap protection
- The barrier crest, alignment, and tie-ins remain adequate for current flood protection needs
- The barrier can be safely operated after maintenance and test closure
- Interior drainage can be managed during closure through existing pumps, bypasses, or storage

Factors that indicate asset replacement or major repair

Consider replacement or major reconstruction when:

- The barrier has repeated closure failures or major structural movements
- Crest elevations or gate sizes are no longer adequate for current tide, surge, rainfall, or drainage conditions
- Tie-ins cannot be stabilized with ordinary maintenance
- The barrier creates unacceptable interior flooding or safety risks when closed

6. Factors that may influence the maintenance schedule

- Forecast storm surge exposure, tide range, and frequency of high-water closure events
- Interior watershed size, rainfall intensity, and pump station or storage capacity
- Condition of gates, stoplogs, actuators, seals, and electrical or mechanical systems
- Scour potential at the sill, gate bays, and barrier ends
- Settlement, subsidence, sea level trends, and known crest low spots
- Critical facilities, evacuation routes, utilities, and neighborhoods protected by the barrier
- Availability of trained operators, spare parts, and specialized contractors

Tidal Barriers



Inspection Checklist

Asset Management Guidance for Community Flood Infrastructure

Tidal Barrier Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Recent storm or high tide event?	☐ Yes ☐ No
Tide/Water Level Condition	☐ Low ☐ Rising ☐ High ☐ Falling ☐ N/A
Barrier Type	☐ Fixed ☐ Movable ☐ Stoplog ☐ Gate ☐ Other
Other/Details	
Number of Closure Openings	
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Fast water/high tide	☐ Unsafe closure operation	☐ Structural instability	☐ Severe weather/lightning
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Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Barrier Alignment and Crest	Overall	☐	☐	☐	☐	☐
	Crest elevation or low spots	☐	☐	☐	☐	☐
	Settlement or alignment change	☐	☐	☐	☐	☐
	Overtopping evidence	☐	☐	☐	☐	☐
Closure/Gate and Operating Components	Overall	☐	☐	☐	☐	☐
	Gate, stoplog, or panel operability	☐	☐	☐	☐	☐
	Seals, sill, or seating surface	☐	☐	☐	☐	☐
	Hoists, actuators, chains, or controls	☐	☐	☐	☐	☐
Structural Condition	Overall	☐	☐	☐	☐	☐
	Concrete, steel, timber, or masonry condition	☐	☐	☐	☐	☐
	Joints, connections, or tie-ins	☐	☐	☐	☐	☐
	Backfill, voids, or sinkholes	☐	☐	☐	☐	☐

Tidal Barrier Name/ID: _____ Inspector Initials: _____

Tidal Barriers

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Scour, Sill, and Channel Protection	Overall	☐	☐	☐	☐	☐
	Scour at sill or gate bay	☐	☐	☐	☐	☐
	Riprap, apron, or bedding protection	☐	☐	☐	☐	☐
	Channel bank or tie-in erosion	☐	☐	☐	☐	☐
Debris, Sediment, and Vegetation	Overall	☐	☐	☐	☐	☐
	Debris at openings or trash racks	☐	☐	☐	☐	☐
	Sediment at sill, bay, or channel	☐	☐	☐	☐	☐
	Vegetation limiting access or closure	☐	☐	☐	☐	☐
Access, Safety, and Operations	Overall	☐	☐	☐	☐	☐
	Access platforms, ladders, or roads	☐	☐	☐	☐	☐
	Closure procedures and equipment readiness	☐	☐	☐	☐	☐
	Warning signs, barriers, or public controls	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to a protected area	☐	☐	☐	☐	☐
	Threat to interior drainage	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Tidal Barrier Name/ID: _____ Inspector Initials: _____

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Notes and Observations:

Attach additional pages, if required.

Tidal Barriers

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Barrier Alignment and Crest	Crest elevation or low spots	No low spots observed.	Minor rutting or settlement.	Localized low area; monitor.	Low section likely to overtop.	Crest breached or below the required protection elevation.
	Settlement or alignment change	No settlement.	Minor settlement.	Noticeable settlement or offset.	Major offset affecting performance.	Rapid settlement or structural displacement.
	Overtopping evidence	None.	Minor splash or staining.	Debris lines or minor erosion.	Repeated overtopping damage.	Severe overtopping with active erosion.
Closure/Gate and Operating Components	Gate, stoplog, or panel operability	Operates as intended.	Minor stiffness.	Difficult or slow operation.	Partially inoperable.	Failed or missing closure.
	Seals, sill, or seating surface	Clean and tight.	Minor wear.	Leakage or sediment at the seat.	Major leakage or damaged sill.	No effective seal.
	Hoists, actuators, chains, or controls	Functional.	Minor maintenance needed.	Intermittent or degraded operation.	Function impaired; urgent repair.	Failed; no operational capability.
Structural Condition	Concrete, steel, timber, or masonry condition	No defects.	Minor wear.	Cracks, corrosion, or decay are developing.	Severe deterioration.	Structural failure.
	Joints, connections, or tie-ins	Tight and stable.	Minor wear.	Open joints or minor movement.	Major separation or leakage path.	Tie-in failed or bypass occurred.
	Backfill, voids, or sinkholes	No voids.	Minor surface depression.	Void suspected.	Sinkhole or support loss likely.	Active collapse.

Tidal Barriers

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Scour, Sill, and Channel Protection	Scour at sill or gate bay	No scour.	Minor scour indicators.	Scour hole forming.	Severe scour near the foundation.	Foundation undermined.
	Riprap, apron, or bedding protection	Intact.	Minor displacement.	Gaps or soil exposure.	Protection largely ineffective.	Protection failed.
	Channel bank or tie-in erosion	Stable.	Minor erosion.	Erosion approaching the tie-in.	Erosion threatens the tie-in and could allow bypass.	Active bypass or bank failure.
Debris, Sediment, and Vegetation	Debris at openings or trash racks	Clear.	Minor debris.	Partial blockage.	Major blockage likely to back up water.	Full blockage or active overflow.
	Sediment at the sill, bay, or channel	No issue.	Minor deposits.	Capacity reduced.	Closure or drainage impaired.	Opening buried or non-functional.
	Vegetation limiting access or closure	No interference.	Minor trimming needed.	Access or inspection limited.	Operation obstructed.	Unsafe/impossible operation.
Access, Safety, and Operations	Access platforms, ladders, or roads	Safe.	Minor wear.	Access limited.	Unsafe without controls.	Do not access.
	Closure procedures and equipment readiness	Current and complete.	Minor updates needed.	Missing some information or tools.	Closure likely delayed.	No reliable procedure/equipment.
	Warning signs, barriers, or public controls	Adequate.	Minor wear.	Controls incomplete.	Public hazard likely.	Immediate public danger.
Overall Rating Based on Impacts to People and Infrastructure	Threat to a protected area	No threat.	Minor reduction.	Protection reliability is reduced.	Flooding likely during high water.	Active or imminent flooding.
	Threat to interior drainage	No threat.	Minor ponding risk.	Drainage constrained during closure.	Interior flooding likely.	Interior flooding is occurring.
	Public safety hazards	None.	Minor hazard.	Controls needed.	Serious hazard.	Immediate danger.

Tidal Barriers

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Tidal Barrier Name/ID	
Location	
Date/Time	START: __/__/____ END: __/__/____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Recent storm or high tide event?	☐ Yes ☐ No
Tide/Water Level Condition	☐ Low ☐ Rising ☐ High ☐ Falling ☐ N/A
Barrier Type	☐ Fixed ☐ Movable ☐ Stoplog ☐ Gate ☐ Other
Other/Details	
Number of Closure Openings	
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up
☐ Complaint/service request	☐ Emergency/safety issue	☐ Closure test/readiness issue
☐ Gate/stoplog/panel repair	☐ Seal or sill cleaning	☐ Scour or apron repair
☐ Crest or tie-in repair	☐ Interior drainage concern	☐ Other (describe below)

Other/Details:

Tidal Barrier Name/ID: _____ Foreman Initials: _____

Tidal Barriers

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Debris and sediment removal	☐ Sill/rail/stoplog slot cleaning
☐ Gate/panel/stoplog exercise	☐ Repair or replace seals	☐ Hoist/actuator/control repair
☐ Concrete/steel/timber repair	☐ Crest low spot repair	☐ Tie-in/flank stabilization
☐ Riprap/apron placement	☐ Pump or bypass system check	☐ Vegetation clearing for access
☐ Other (describe below)		

Other maintenance actions performed:

AREAS ADDRESSED

☐ Barrier crest	☐ Seaward face	☐ Landward face
☐ Gate bay/closure opening	☐ Sill/rails/stoplog slots	☐ Hoist/actuator/controls
☐ Tie-ins/flanks	☐ Scour apron/riprap	☐ Interior drainage feature
☐ Access platform/road	☐ Other (describe below)	

Other areas addressed:

MATERIALS, EQUIPMENT, AND QUANTITIES

Equipment used (e.g., excavator, loader, vactor, crane, hand tools, survey equipment):

Maintenance hours/staff:

Tidal Barrier Name/ID: _____ Foreman Initials: _____

Tidal Barriers

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Materials used (e.g., riprap, filter fabric, concrete, seal, hardware, grout, topsoil, seed):

Quantities and disposal (e.g., sediment CY, debris CY, rock tons, LF repaired, disposal location):

SAFETY, ENVIRONMENTAL, AND REGULATORY CONTROLS

☐ Site access controlled and safe	☐ Traffic control in place (if near roadway or public access)
☐ Work performed outside unsafe flow, wave runup, or high tide conditions	☐ Erosion and sediment controls in place during earthwork
☐ No fuel, oil, or material spills; equipment operated from stable ground	☐ Regulatory permit requirements reviewed (USACE, TCEQ, TPWD, GLO, local floodplain permits as applicable)
☐ Confined space procedures followed if culvert, gate chamber, or structure entry was required	☐ Removed material disposed at approved location
☐ Area left clean and stable after work	

CONDITION AFTER MAINTENANCE

Barrier condition after work:	☐ Clear/restored ☐ Improved ☐ Still restricted
Closure readiness after work:	☐ Ready ☐ Improved ☐ Needs follow-up
Scour and tie-in condition after work:	☐ Stable ☐ Improved ☐ Needs follow-up

DOCUMENTATION

Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A
GPS coordinates or stationing recorded:	☐ Yes	☐ No	☐ N/A
Tide/water level notes recorded:	☐ Yes	☐ No	☐ N/A
Measurements or survey data recorded:	☐ Yes	☐ No	☐ N/A
Maintenance entered into asset database:	☐ Yes	☐ No	☐ N/A

Tidal Barrier Name/ID: _____ Foreman Initials: _____

Tidal Barriers

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

ENGINEERING REVIEW REQUIRED? ☐ Yes ☐ No ☐ N/A

If yes, describe trigger (movement, scour, undermining, seepage, overtopping, structural damage, repeated failure, or hydraulic capacity concern):

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Notes and Observations:

Attach additional pages, if required.

How to Maintain Your Tidal Gates

What is it?

A tidal gate, also called a tide gate, flap gate, duckbill gate, or tidal check valve, is a one-way water control device installed at a culvert, pipe, channel, or drainage outfall. It allows interior runoff to drain toward a tidal creek, bay, or coastal waterbody when the upstream water level is higher, and it closes when the tide or storm surge pushes water back toward the community.

Common forms include:

- Flap gates or tide gates mounted to a headwall, pipe end, or box culvert
- Rubber duckbill valves are used where a flexible check valve is appropriate
- Slide gates, sluice gates, or flap gates that are operated manually or by an actuator
- Gate structures combined with trash racks, pump stations, culverts, or drainage ditches

Who maintains it?

Ownership and maintenance may fall to cities, counties, drainage districts, levee improvement districts, flood control districts, TxDOT, private owners, or homeowners' associations. In small communities, the gate may be physically small but operationally critical because one failed hinge, missing seal, blocked trash rack, or buried outlet can allow tidal backflow into streets, yards, pump station wet wells, or storm drain pipes. Communities should confirm ownership, access rights, emergency-response responsibilities, and who has the authority to repair or replace the gate.

Regardless of ownership, it is important to understand:

- Which drainage area does the gate serve, and what streets, properties, pump stations, or critical facilities would be affected if the gate failed
- Whether the gate is gravity-operated, manually operated, mechanically operated, or part of a pump station system
- Whether the gate must be inspected under both low-tide and high-tide conditions to confirm opening and sealing performance
- Whether work on the headwall, pipe, channel, or tidal wetland requires regulatory coordination or environmental review



Best maintenance practices & strategies

Tidal gates are small assets with high consequences. They are exposed to saltwater corrosion, debris loading, sediment burial, vegetation growth, animal damage, vandalism, and repeated wet-dry cycles. A gate that looks acceptable from the road may still be leaking at high tide or stuck closed at low tide. Routine inspection and targeted maintenance help maintain gravity drainage, prevent tidal backflow, protect pump station performance, and reduce nuisance and emergency flooding in low-lying coastal areas.

A. INSPECTION

Inspections confirm the gate can open freely when interior drainage must discharge and close tightly enough to limit tidal backflow when the downstream tide rises. A good inspection examines the gate leaf or valve, hinge, and connection hardware; seals; frame; headwall; trash rack; upstream and downstream channels; scour protection; access; and site safety. When possible, inspect at both low and high tide, as different problems are visible under different tidal conditions. An inspection checklist for tidal gates is included with this reference sheet.

Inspection skill needs:

- Ability to recognize whether a gate is opening, closing, seating, or leaking
- Familiarity with gate components such as hinges, pins, seats, seals, frames, stops, lifting cables, trash racks, headwalls, and outlet pipes

- Ability to identify corrosion, missing hardware, cracked concrete, settlement, scour, worn gaskets/seals, and undermining
- Understanding of how tide stage affects inspection observations and drainage performance
- Ability to work safely near tidal water, slippery structures, traffic, wildlife, and unstable banks
- Ability to document conditions clearly with photos, tide stage, location, asset ID, and simple condition ratings

What to look for:

- **Gate movement and seating.** At low tide, observe whether the gate hangs freely and can open enough to drain the upstream ditch, pipe, or channel. At high tide, look for poor contact between the gate and seat, visible gaps, backflow, rattling, or seepage around the frame. A gate that remains stuck open can allow tidal flooding; a gate that remains stuck closed can trap stormwater inside the community.
- **Hinges, pins, cables, stops, and actuators.** Inspect metal hardware for corrosion, broken welds, missing pins, bent brackets, loose bolts, missing cables, or damaged actuators. Gate hardware often fails before the headwall or pipe fails. Minor corrosion can become a major operational issue if it prevents the gate from swinging or sealing during a storm tide.
- **Seals and contact surfaces.** Check rubber gaskets, metal seats, frames, and contact surfaces for tears, abrasion, warping, marine growth, or sediment buildup. A small piece of debris lodged in the seal can keep the gate from closing. Deteriorated seals should be repaired before repeated leakage causes chronic tidal backflow.
- **Trash racks and debris accumulation.** Trash racks, branches, reeds, mats of floating vegetation, and dumped debris can restrict flow into or out of the gate. Debris can also hold the gate open or prevent it from opening. Small debris accumulation should be removed before it becomes a blockage during high tide and rainfall.
- **Sediment burial and shoaling.** Sediment can bury the gate invert, block the outlet, or hold the flap partially submerged at low tide. Sediment deposits near the gate often indicate reduced downstream channel capacity or tidal deposition. If sediment repeatedly returns, the community may need a larger channel maintenance or design review rather than repeated isolated cleanouts.
- **Headwall, pipe end, and structural support.** Inspect concrete, steel, timber, or masonry supports for cracking, spalling, corrosion, displacement, settlement, missing anchors, and exposed reinforcing steel. Structural movement can misalign the gate and prevent

proper seating. A gate may be new or functional but still fail if the frame or headwall moves.

- **Scour, undermining, and bank erosion.** Look at the toe, sides, and downstream apron for scour holes, displaced riprap, exposed pipe, or bank erosion. Tidal currents and storm discharge can remove material from around the gate, which can undermine the headwall or create a bypass path for water. Scour around a tide gate should be addressed before it expands into structural failure.
- **Access, visibility, and site security.** Confirm crews can safely reach the gate for inspection and maintenance. Vegetation, fences, soft ground, steep banks, locked access, or traffic hazards can delay emergency work. Gates should be visible enough to observe movement and document condition without entering unsafe water.
- **Upstream drainage impacts.** Record whether upstream channels, ditches, culverts, or pump station wet wells appear backed up, stagnant, or tidally influenced. High water marks, debris lines, salt staining, or recurring standing water can indicate a gate that is not sealing or a gate that is restricting discharge.
- **Water quality and environmental concerns.** Note oily sheens, unusual odors, discolored water, fish kills, or suspicious dry-weather discharges. Tidal gates are often located at sensitive marsh or bay interfaces, so maintenance should avoid spills, sediment releases, and unnecessary disturbance to tidal vegetation or wildlife habitat.

How to record conditions:

- Use a standard inspection form or digital tool. Consistent records allow staff to compare gate conditions over time and identify recurring problems.
- Record date, time, tide condition, recent rainfall, upstream water level, downstream water level if known, and whether the gate was observed open, closed, or partially obstructed
- Describe gate function using simple terms such as opens freely, opens with restriction, stuck open, stuck closed, seals adequately, or leaks during high tide
- Photograph the gate from upstream and downstream when safe, including hinges, seals, trash rack, headwall, scour protection, and any debris or sediment accumulation
- Flag urgent issues that could allow tidal backflow, block interior drainage, threaten a road or utility, or prevent pump station operation
- Update the asset inventory if the gate type, size, location, number of barrels, ownership, or maintenance responsibility differs from existing records

B. MAINTENANCE

Maintenance restores gate movement, sealing, structural support, and safe access. Because tidal gates can fail due to minor mechanical defects, routine maintenance should focus on simple, repeatable tasks: keep the opening clear, keep moving parts functional, keep the gate aligned, and keep scour protection stable. Work should be scheduled around tide windows whenever possible so crews can access components safely and observe the gate under the conditions that matter. A maintenance checklist for tidal gates is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools for trash, vegetation, and light sediment removal
- Vacuum truck, jetting equipment, or small excavator for sediment cleanout where appropriate
- Corrosion-resistant replacement hardware, pins, hinges, bolts, cables, seals, and lubricants suitable for marine exposure
- Traffic control equipment and safe access equipment for work near roads, bridges, or steep banks
- Pumps, portable cofferdams, or temporary bypass equipment when work must occur in wet conditions
- Environmental controls for sediment, debris, fuel, oil, and work near tidal wetlands
- Vendor or mechanical support for actuator, electrical, or automated gate systems

Key maintenance goals:

- Keep the gate clear and able to move. Remove trash, sticks, vegetation, sediment, and marine growth that prevent the gate from opening or closing. This is the most common and most cost-effective maintenance action.
- Maintain the seal and contact surface. Clean, repair, or replace worn rubber seals, warped seats, and damaged frame surfaces. Good sealing reduces tidal backflow and helps maintain the intended flood protection function.
- Maintain hinges, pins, stops, and operating hardware. Replace missing or corroded hardware before the gate becomes misaligned or detached. Hardware should be corrosion-resistant and compatible with the gate material.
- Protect the headwall and structural support. Repair cracked concrete, loose anchors, deteriorated frames, and displaced supports. The gate must remain square to the frame to function.
- Restore scour and bank protection. Reset displaced

riprap, repair scour holes, and stabilize eroded banks around the outlet. Scour can create a bypass around the gate or undermine the structure.

- Maintain safe access and clear visibility. Trim vegetation and maintain access routes so crews can inspect and respond quickly. Safe access is especially important before storms and during post-storm recovery.
- Coordinate gate operation with rainfall and tide conditions. For manually or mechanically operated gates, keep operating procedures up to date and confirm who is responsible for opening, closing, testing, and emergency response.
- Document maintenance and recurring problems. Repeated debris, sediment, leakage, or mechanical failures should trigger an engineering review or adjustment to the maintenance frequency.

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Inspect visible gate condition and clear light debris at accessible gates on a routine schedule
- Lubricate or exercise operating hardware where recommended by the manufacturer and where environmental rules allow
- Trim vegetation that blocks inspection views or interferes with the gate, trash rack, or access route
- Confirm signs, locks, and access routes are in usable condition

2. Annual maintenance and comprehensive review

- Inspect each gate at low tide and, where feasible, again at high tide to evaluate both discharge and sealing performance
- Compare current photographs to prior records to identify misalignment, increasing corrosion, repeated sedimentation, or progressive scour
- Check whether the gate still matches the community drainage needs, especially where development, rainfall intensity, or tide levels have changed
- Review repair history and identify gates that should be upgraded, replaced, or added to a capital improvement plan

3. Pre-, in-, and post-storm events

Pre-storm events

- Inspect known problem gates, remove debris, confirm access, and test manually or mechanically operated systems where safe

In-storm events (only when safe)

- Monitor high-risk locations only from safe vantage points and do not enter fast water, confined spaces, or unstable banks

Post-storm events

- Remove debris, document high water marks, inspect for gate damage, scour, seal leakage, and sediment burial, and confirm the gate has returned to normal operation

4. Maintenance decision logic

- Continue planned maintenance when the gate opens and closes, the seal is adequate, the hardware is intact, and minor debris can be removed through routine tasks
- Increase preventive maintenance when debris or sediment repeatedly accumulates, minor leakage is increasing, hardware corrosion is advancing, or access is becoming difficult
- Plan repair or rehabilitation when hinges, seals, frames, headwalls, or scour protection are damaged, but the gate location and hydraulic function remain appropriate
- Consider replacement or redesign when the gate is repeatedly stuck, undersized, misaligned, structurally unsupported, unsafe to access, or no longer meets current drainage or tidal backflow conditions

5. Repair vs. replacement considerations

Factors that indicate continued maintenance and repair

Choose repair/rehabilitation when:

- Defects are localized to seals, hinges, pins, cables, bolts, or minor concrete repairs
- The gate structure remains aligned, and the drainage opening is still hydraulically adequate
- Scour or sediment issues can be corrected and do not return immediately after maintenance
- Replacement parts are available, and repairs can be performed safely within normal tide windows

Factors that indicate asset replacement or major repair

Consider replacement or major reconstruction when:

- The gate leaf, frame, hinge system, or headwall has failed or repeatedly fails after repair
- The gate cannot seal during high tide or cannot open during interior runoff events
- Sediment burial, outlet submergence, or downstream channel change makes the existing configuration unreliable
- The gate is a high-consequence asset serving critical facilities, evacuation routes, or areas with repeated tidal flooding

6. Factors that may influence the maintenance schedule

- Tide range, storm surge exposure, and frequency of high-tide backwater events
- Recent rainfall intensity, upstream runoff volume, and combined rainfall plus high-tide events
- Saltwater corrosion, marine growth, and wet-dry cycling of hardware and seals
- Sediment supply from the upstream drainage system or tidal channel
- Debris load from vegetation, floating trash, illegal dumping, and nearby development
- Criticality of the drainage area, including roads, utilities, pump stations, emergency routes, and low-lying neighborhoods
- Age of gate, availability of replacement parts, and history of repeated failures

Tidal Gates

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Tidal Gate Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Recent storm or high tide event?	☐ Yes ☐ No
Tide/Water Level Condition	☐ Low ☐ Rising ☐ High ☐ Falling ☐ N/A
Pipe or Opening Size	
Gate Type	☐ Flap ☐ Duckbill ☐ Slide ☐ Sluice ☐ Other
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Fast water/high tide	☐ Unsafe bank or access	☐ Traffic hazard	☐ Gate/structure instability
---	--	---	---

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Gate Function and Seating	Overall	☐	☐	☐	☐	☐
	Gate opens freely	☐	☐	☐	☐	☐
	Gate seals during high tide	☐	☐	☐	☐	☐
	Hinges, pins, cables, or actuator condition	☐	☐	☐	☐	☐
	Gate alignment and frame contact	☐	☐	☐	☐	☐

Tidal Gate Name/ID: _____ Inspector Initials: _____

Tidal Gates

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Structure, Frame, and Connections	Overall	☐	☐	☐	☐	☐
	Headwall or pipe end condition	☐	☐	☐	☐	☐
	Anchor bolts and mounting frame	☐	☐	☐	☐	☐
	Concrete, steel, or timber deterioration	☐	☐	☐	☐	☐
Debris, Sediment, and Vegetation	Overall	☐	☐	☐	☐	☐
	Trash rack or inlet debris	☐	☐	☐	☐	☐
	Sediment at gate invert or outlet	☐	☐	☐	☐	☐
	Vegetation blocking access or movement	☐	☐	☐	☐	☐
Scour and Bank Protection	Overall	☐	☐	☐	☐	☐
	Scour at outlet or toe	☐	☐	☐	☐	☐
	Riprap or apron condition	☐	☐	☐	☐	☐
	Bank erosion near structure	☐	☐	☐	☐	☐
Access, Safety, and Site Security	Overall	☐	☐	☐	☐	☐
	Access route condition	☐	☐	☐	☐	☐
	Fencing, locks, or signage condition	☐	☐	☐	☐	☐
	Traffic, fall, or wildlife hazards	☐	☐	☐	☐	☐
Overall Rating Based on Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to drainage or pump operations	☐	☐	☐	☐	☐
	Threat to roads, utilities, or structures	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐

Tidal Gate Name/ID: _____ Inspector Initials: _____

Page 2 of 3

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Attach additional pages, if required.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Gate Function and Seating	Gate opens freely	Opens freely; no obstruction.	Minor stiffness or limited debris.	Partial restriction; drainage reduced.	Gate opens only partly or intermittently.	Gate stuck closed or cannot discharge.
	Gate seals during high tide	Seats tightly; no visible leakage.	Minor leakage or wear.	Clear leakage; monitor and repair.	Major leakage causing tidal backflow.	Gate stuck open or seal failed; immediate risk.
	Hinges, pins, cables, or actuator condition	Hardware sound.	Minor corrosion or wear.	Moderate corrosion; repair planned.	Missing/bent/seized components; function impaired.	Hardware failed or gate detached.
	Gate alignment and frame contact	Aligned with full contact.	Minor misalignment; still seats.	Misalignment causes leakage or rubbing.	Misalignment prevents reliable seating.	Frame/gate displaced or unusable.
Structure, Frame, and Connections	Headwall or pipe end condition	Sound; no cracks.	Minor cracks or wear.	Moderate cracking/spalling.	Severe cracking, undermining, or displacement.	Headwall/pipe end failed.
	Anchor bolts and mounting frame	Secure and intact.	Minor corrosion; still secure.	Loose or corroded components.	Multiple anchors loose; frame movement.	Frame detached or unsafe.
	Concrete, steel, or timber deterioration	No deterioration.	Minor surface wear.	Moderate deterioration; repair needed.	Severe section loss or decay.	Material failure affecting support.
Debris, Sediment, and Vegetation	Trash rack or inlet debris	Clear.	Minor debris; easy removal.	Partial blockage.	Major blockage; backup likely.	Fully blocked or causing overflow.
	Sediment at gate invert or outlet	No sediment issue.	Minor deposits.	Deposits reduce opening.	Gate partially buried.	Gate buried or non-functional.
	Vegetation blocking access or movement	No interference.	Minor trimming needed.	Vegetation limits access or catches debris.	Dense vegetation restricts gate or inspection.	Unsafe/impossible access; operation hindered.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Scour and Bank Protection	Scour at outlet or toe	No scour.	Minor scour indicators.	Scour hole forming.	Severe scour near structure.	Undermining threatens failure.
	Riprap or apron condition	Intact.	Minor displacement.	Gaps forming; soil exposed.	Protection ineffective in areas.	Protection failed; rapid erosion.
	Bank erosion near structure	Banks stable.	Minor erosion.	Erosion approaching structure.	Erosion undermining support.	Bank failure or bypass path.
Access, Safety, and Site Security	Access route condition	Clear and safe.	Minor obstruction.	Limited access; extra setup needed.	Unsafe access during wet conditions.	Access impossible or hazardous.
	Fencing, locks, or signage condition	Secure and legible.	Minor wear.	Damage or missing items.	Site security compromised.	Open hazardous site.
	Traffic, fall, or wildlife hazards	No hazard.	Minor hazard; caution.	Hazard present; controls needed.	Serious hazard; restrict access.	Immediate danger.
Overall Rating Based on Impacts to People and Infrastructure	Threat to drainage or pump operations	No threat.	Minor reduction.	Reduced reliability during storms.	Likely drainage failure under high tide/rainfall.	Active drainage failure or pump impact.
	Threat to roads, utilities, or structures	No threat.	Minor nuisance.	Impacts possible during storms.	Damage likely; priority repair.	Immediate threat or damage occurring.
	Public safety hazards	None.	Minor hazard.	Hazard requires controls.	Serious hazard; restrict access.	Immediate danger; emergency controls.

Tidal Gates

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Tidal Gate Name/ID	
Location	
Date/Time	START: __/__/____ END: __/__/____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Recent storm or high tide event?	☐ Yes ☐ No
Tide/Water Level Condition	☐ Low ☐ Rising ☐ High ☐ Falling ☐ N/A
Gate Type	☐ Flap ☐ Duckbill ☐ Slide ☐ Sluice ☐ Other
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up
☐ Complaint/service request	☐ Emergency/safety issue	☐ Gate stuck open or closed
☐ Backflow/leakage issue	☐ Trash rack or debris blockage	☐ Sediment burial/outlet blockage
☐ Hinge/seal/hardware repair	☐ Scour or erosion repair	☐ Other (describe below)

Other/Details:

Tidal Gate Name/ID: _____ Foreman Initials: _____

Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Debris removal from trash rack	☐ Sediment removal at gate/outlet
☐ Clean gate seat and seal surface	☐ Replace or repair seal/gasket	☐ Replace hinge, pin, cable, or stop
☐ Lubricate or exercise gate hardware	☐ Repair actuator or manual operator	☐ Repair headwall or mounting frame
☐ Repair pipe end or culvert connection	☐ Reset riprap/scour protection	☐ Vegetation clearing for access
☐ Other (describe below)		

Other maintenance actions performed:

AREAS ADDRESSED

☐ Gate leaf/flap/duckbill	☐ Hinge/pins/cables	☐ Seal/seat/frame
☐ Trash rack/inlet	☐ Headwall/pipe end	☐ Outlet/downstream channel
☐ Upstream ditch/channel	☐ Riprap/apron/toe	☐ Access route/fencing
☐ Other (describe below)		

Other areas addressed:

Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

MATERIALS, EQUIPMENT, AND QUANTITIES

Equipment used (e.g., excavator, loader, vactor, crane, hand tools, survey equipment):

Maintenance hours/staff:

Materials used (e.g., riprap, filter fabric, concrete, seal, hardware, grout, topsoil, seed):

Quantities and disposal (e.g., sediment CY, debris CY, rock tons, LF repaired, disposal location):

SAFETY, ENVIRONMENTAL, AND REGULATORY CONTROLS

☐ Site access controlled and safe	☐ Traffic control in place (if near roadway or public access)
☐ Work performed outside unsafe flow, wave runup, or high-tide conditions	☐ Erosion and sediment controls in place during earthwork
☐ No fuel, oil, or material spills; equipment operated from stable ground	☐ Regulatory permit requirements reviewed (USACE, TCEQ, TPWD, GLO, local floodplain permits as applicable)
☐ Confined space procedures followed if culvert, gate chamber, or structure entry was required	☐ Removed material disposed at approved location
☐ Area left clean and stable after work	

CONDITION AFTER MAINTENANCE

Gate function after work:	☐ Opens and seals	☐ Improved	☐ Still restricted
Outlet and drainage condition after work:	☐ Clear/restored	☐ Improved	☐ Still restricted
Scour and bank protection after work:	☐ Stable	☐ Improved	☐ Needs follow-up

Tidal Gate Name/ID: _____ Foreman Initials: _____

FOLLOW-UP ACTIONS REQUIRED

☐ No follow-up required	☐ Additional maintenance needed
☐ Repair/rehabilitation recommended	☐ Evaluate for replacement or redesign
☐ Engineering evaluation recommended	☐ Regulatory/permit review required
☐ Dam/levee/coastal authority notification required if applicable	☐ Other: _____

Recommended follow-up date/notes:

DOCUMENTATION

Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A
GPS coordinates or stationing recorded:	☐ Yes	☐ No	☐ N/A
Tide/water level notes recorded:	☐ Yes	☐ No	☐ N/A
Measurements or survey data recorded:	☐ Yes	☐ No	☐ N/A
Maintenance entered into asset database:	☐ Yes	☐ No	☐ N/A

Additional notes or observations:

Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

ENGINEERING REVIEW REQUIRED?

☐ Yes ☐ No ☐ N/A

(If yes, describe trigger: movement, scour, undermining, seepage, overtopping, structural damage, repeated failure, or hydraulic capacity concern)

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Maintenance Form



Tidal Gate Name/ID: _____ Foreman Initials: _____

How to Maintain Your Wetlands



What is it?

A stormwater wetland is a shallow, vegetated basin that collects, stores, treats, and slowly releases runoff. It typically includes a permanent pool, shallow marsh zones, a forebay, wetland vegetation, an outlet structure, and an overflow route. Some wetlands are constructed facilities; others are natural or modified features that can also help reduce flooding.

Common types:

- Shallow wetland
- Extended detention shallow wetland
- Pond/wetland system
- Pocket wetland
- Submerged gravel wetland

Who maintains it?

Ownership and maintenance can differ. Wetlands may be owned or maintained by cities, counties, drainage districts, special utility districts, homeowners' associations, commercial property owners, or private owners. Communities should confirm ownership, access, discharge points, and maintenance agreements before work begins. Some work in natural wetlands that could be waters of the U.S. (WOTUS), or in connected channels/streams, may require environmental coordination before grading, sediment removal, or vegetation clearing.

Best maintenance practices & strategies

Wetlands can reduce flood risk by slowing stormwater, storing runoff, and supporting stable flow paths. They can also remove sediment and pollutants through settling, filtration, and plant uptake. Over time, sediment, debris, vegetation shifts, erosion, and clogged control structures can reduce storage and treatment performance. Routine inspection and targeted maintenance can help maintain flood storage, water quality, vegetation, public safety, and the wetland's service life.

A. INSPECTION

Routine inspections can assist in determining that the wetland can receive, store, pass, and discharge stormwater while potentially reducing risks associated with flooding, erosion, water quality concerns, or unsafe conditions. The inspection checklist template for wetlands should cover hydrology and storage, inlets and forebay, outlet and spillway, impacts from wildlife, vegetation and buffer, water quality, embankment and slope stability, and impacts to people and infrastructure. An inspection checklist for wetlands is included with this reference sheet.

Inspection skill needs:

- Ability to recognize blocked or damaged inlets, outlets, trash racks, and overflow routes
- Ability to identify sediment accumulation in forebays, marsh cells, and micro-pools
- Basic understanding of wetland vegetation health and identification, invasive species identification, and buffer condition
- Awareness of erosion, bank slumping, animal burrows, and unstable slopes
- Ability to recognize water quality concerns such as dry-weather flow, sheen, odor, algae, or dumping
- Ability to observe safely without entering deep water, soft sediment, fast flow, or unstable slopes
- Ability to document conditions clearly and flag when engineering or environmental review is needed

What to look for:

- **Water levels and zone depths that do not match the expected condition.** A wetland should hold water in the intended permanent pool and marsh zones while releasing stormwater through the outlet and overflow route. Water levels that are too high, too low, or ponded in the wrong location may indicate a blocked outlet, altered grading, excessive sediment, or a failed control structure.
- **Sediment accumulation in the forebay or wetland cells.** The forebay is intended to collect sediment before it reaches the wetland. If excessive sediment is in the forebay, or if sediment is moving into the wetland cells, capacity and plant health can decline. Sediment that chokes plants or reduces pool volume should be addressed before flood storage is compromised.
- **Blocked or damaged inlets, outlets, trash racks, or weirs.** These features control how water enters and leaves the wetland. Blockages can cause upstream flooding, prolonged ponding, erosion, or bypass of the treatment area. Damage to control structures can also change water levels and stress vegetation.
- **Erosion at inflows, embankments, spillways, or discharge points.** Concentrated inflows can scour slopes and move sediment into the wetland. Erosion around outlets or spillways can undermine and threaten the integrity of structures and redirect water toward roads, utilities, or private property.
- **Vegetation coverage, health, and invasive growth.** Wetland plants should be dense enough to stabilize soils and slow stormwater, but not so dense that they block flow or trap excessive sediment. Look for bare areas, dead or stressed vegetation, woody growth on embankments, and invasive or nuisance plants replacing the intended community.
- **Trash, dumping, oil sheen, odor, algae, or mosquito concerns.** Trash and illegal dumping can reduce storage, clog structures, and create hazards. Dry-weather flow, oil sheen, unusual color, strong odor, or excessive algae may indicate a water quality or illicit discharge issue that should be reported under local procedures.
- **Overflow route condition and nearby impacts.** Overflow routes should remain open, stable, and directed away from structures unless designed otherwise. Debris lines, flattened grass, erosion, or water marks near streets, homes, utilities, or critical facilities indicate that overflow performance should be reviewed.

How to record conditions:

- Use the standard wetlands inspection checklist or a digital tool so conditions are comparable over time
- Record the wetland ID, location, date, weather, recent storm history, wetland type, and observed water level
- Describe whether storage and flow appear clear, restricted, or severely restricted
- Photograph key conditions: forebay sediment, blocked structures, erosion, structural damage, vegetation failure, dumping, water quality concerns, and overflow evidence
- Flag urgent issues that could cause increased flooding, structural failure, public safety hazards, or environmental concerns

B. MAINTENANCE

Maintenance helps restore the wetland's ability to store and treat stormwater, keeps inlet and outlet controls functional, protects vegetation and buffers, and prevents small issues from becoming costly rehabilitation projects. A maintenance checklist for wetlands is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools for trash, light vegetation clearing, and trash-rack cleanout
- Mowers or trimmers for side slopes, access corridors, and buffers where appropriate
- Vacuum, excavation equipment, or hauling equipment for sediment cleanout when needed
- Erosion control materials such as seed, mulch, matting, riprap, bedding stone, or soil stabilization materials
- Native wetland planting knowledge or contractor support for replanting and invasive species control
- Traffic control, access control, and safe work practices near water, soft ground, and steep slopes
- Confined space or specialized procedures if outlet structures, manholes, or vaults require entry
- Disposal plan for sediment, vegetation, trash, and potentially contaminated materials

Key maintenance goals:

- Keep inlets, outlets, trash racks, and overflow routes clear. Clean these features before problems cause backup, erosion, or unsafe overflow.
- Remove trash, debris, and illegal dumping. Trash can block structures, reduce storage, create hazards, and degrade water quality.

- Manage forebay sediment before it reaches the wetland. Use sediment markers or visual estimates where available. Plan forebay cleanout when capacity is reduced, commonly around half full, or when sediment begins bypassing into the wetland.
- Protect native wetland vegetation and buffers. Remove invasive or nuisance growth, replant bare areas, and avoid unnecessary mowing within the wetland cells. Mow side slopes and maintenance access areas only as needed to preserve access and stability.
- Repair erosion and stabilize banks, slopes, and discharge points. Small rills, scour holes, and displaced riprap should be corrected early to avoid slope failure or structural damage.
- Address water quality, odor, algae, and mosquito concerns. Investigate dry-weather flow, sheen, odor, or unusual color. Coordinate with local environmental or vector-control staff when needed.
- Protect access and public safety. Maintain safe access for inspection and emergency response. Restrict access where slopes, water depths, sinkholes, or contaminated material create hazards.

SCHEDULING MAINTENANCE

1. Post-storm checks

- Remove trash and debris from inlet and outlet structures, trash racks, overflow routes, and access points
- Check for new scour, blockages, or water quality concerns after heavy rainfall events
- Review vegetation health, invasive species growth, forebay sediment, side slope stability, access, and standing water patterns
- Newer wetlands may need more frequent checks until vegetation becomes established

2. Annual maintenance and comprehensive review

- Inspect structural components, embankments, spillways, outlet controls, wetland cells, buffers, and downstream discharge points
- Update the maintenance priority list and budget needs

3. Periodic sediment and vegetation work

- Remove forebay sediment when capacity is reduced
- Consider larger wetland sediment removal activities or vegetation harvesting only when storage, flow, or plant function is clearly impaired and environmental requirements have been addressed

4. Factors that may influence the maintenance schedule

- Storm intensity and recent large events
- Recurring overflow, surcharge, or flooding complaints
- Upstream construction, erosion, or sediment sources
- Forebay filling rate or repeated sediment bypass into the wetland
- Vegetation failure, invasive species, or vegetation interfering with structural components and flow conveyance
- Bank erosion, embankment settlement, animal burrows, or slope instability
- Water quality complaints, dry-weather flow, odor, algae, oil sheen, or mosquito concerns
- Nearby roads, utilities, homes, schools, emergency routes, or other critical facilities

5. Maintenance decision logic

- Unsafe condition, active flooding, hazardous discharge, or structural failure? Restrict access, notify the appropriate supervisor or agency, and initiate emergency response or engineering review.
- Blocked inlet, outlet, trash rack, or overflow route? Remove blockage promptly when safe, then inspect upstream and downstream for erosion or repeated debris sources.
- Forebay or wetland sediment reducing storage? Schedule sediment measurement and cleanout. Confirm disposal requirements before excavation.
- Vegetation failing, excessive invasive species, or vegetation restricting flow? Remove nuisance growth, replant native wetland species, and verify that maintenance does not destabilize banks or impact regulated areas.
- Erosion, settlement, or slope failure recurring? Complete short-term stabilization if needed and request engineering evaluation for a more durable repair.

6. Repair vs. replacement considerations

- Continue maintenance or minor repair when issues are localized, capacity can be restored by cleanout, vegetation can be re-established, and inlets/outlets remain aligned and functional
- Consider engineering review, reconstruction, or redesign when repeated flooding occurs even when clean, sedimentation returns rapidly, outlet or overflow elevations are no longer appropriate, embankment or bank failures recur, native vegetation cannot establish, or failure consequences could threaten public safety or key infrastructure

Wetlands

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Wetland Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Recent storm event?	☐ Yes ☐ No
Wetland Type	☐ Shallow ☐ Extended Detention ☐ Pond-Wetland ☐ Pocket ☐ Other
Area (Acre/ft ²)	
Approximate Water Level	
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Fast water/high flows	☐ Steep or unstable slopes/slumping	☐ Soft ground/deep water hazard	☐ Hazardous discharge/wildlife
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Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Wetland Hydrology and Storage	Overall	☐	☐	☐	☐	☐
	Permanent pool or depth zones inconsistent	☐	☐	☐	☐	☐
	Extended detention drawdown not functioning	☐	☐	☐	☐	☐
	Storage capacity reduced	☐	☐	☐	☐	☐
Inlets, Forebay, and Pretreatment	Overall	☐	☐	☐	☐	☐
	Damaged or blocked inflow points	☐	☐	☐	☐	☐
	Forebay sediment accumulation	☐	☐	☐	☐	☐
	Inlet scour or energy dissipation failure	☐	☐	☐	☐	☐

Wetland Name/ID: _____ Inspector Initials: _____

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Outlet, Spillway, and Overflow Routing	Overall	☐	☐	☐	☐	☐
	Outlet structure or trash rack blocked/damaged	☐	☐	☐	☐	☐
	Spillway or overflow route obstructed	☐	☐	☐	☐	☐
	Downstream scour or unstable discharge	☐	☐	☐	☐	☐
Vegetation and Buffer	Overall	☐	☐	☐	☐	☐
	Wetland vegetation coverage and health	☐	☐	☐	☐	☐
	Invasive or nuisance vegetation	☐	☐	☐	☐	☐
	Buffer and access vegetation condition	☐	☐	☐	☐	☐
Trash, Dumping, and Water Quality	Overall	☐	☐	☐	☐	☐
	Trash/debris and illegal dumping	☐	☐	☐	☐	☐
	Oil sheen	☐	☐	☐	☐	☐
	Odor, algae, or mosquito conditions	☐	☐	☐	☐	☐
Embankment, Banks, and Slope Stability	Overall	☐	☐	☐	☐	☐
	Bank or slope erosion	☐	☐	☐	☐	☐
	Slumping, settlement, or animal burrows	☐	☐	☐	☐	☐
	Riprap, liner, or soil protection condition	☐	☐	☐	☐	☐
Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to roads, utilities, or critical facilities	☐	☐	☐	☐	☐
	Homes or structures impacted	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Attach additional pages, if required.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Wetland Hydrology and Storage	Permanent pool or depth zones inconsistent	Pool and depth zones appear normal.	Small variation from expected water line; no stress observed.	Water depths inconsistent; marsh or pool zones losing function.	Large areas too shallow/deep or prolonged high water stressing vegetation.	Depth zones failed or water level creates flooding or safety risk.
	Extended detention drawdown not functioning	Drains within expected time; no nuisance standing water.	Minor slow drawdown after storms.	Water remains longer than expected; investigate outlet or grading.	Chronic high water or poor drawdown affects access or vegetation.	Persistent unsafe water, structure flooding, or clear outlet failure.
	Storage capacity reduced	No visible capacity loss.	Localized buildup; minor capacity loss.	Capacity partly reduced; plan sediment or vegetation management.	Severe capacity loss; early overflow likely.	Storage largely lost; frequent flooding or unsafe overflow.
Inlets, Forebay, and Pretreatment	Damaged or blocked inflow points	Inlets open; flow enters as intended.	Minor debris or wear; routine cleanout.	Partial blockage or misdirected inflow causing localized erosion.	Severely blocked or damaged inlet; flow bypassing controls.	Inlet failure causing flooding or rapid erosion toward assets.
	Forebay sediment accumulation	Forebay trapping sediment; ample capacity remains.	Sediment visible; capacity loss is minor.	Forebay nearing half full; schedule cleanout.	More than half full or sediment passing into marsh; priority cleanout.	Forebay full/bypassed; wetland capacity loss or flooding likely.
	Inlet scour or energy dissipation failure	Energy dissipation intact; no scour.	Small scour pockets; minor rock or matting repair.	Scour expanding; inlet alignment or protection needs repair.	Major undercutting or failed stabilization; urgent reconstruction.	Head-cutting or inlet failure threatens upstream infrastructure.
	Outlet structure or trash rack blocked/damaged	Clear and in good condition.	Minor debris; flow passes.	Partial blockage or minor damage; backup possible.	Major blockage or damage; frequent backup likely.	Failed or blocked outlet causing flooding, backwater, or emergency risk.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Inlets, Forebay, and Pretreatment (Cont' d.)	Spillway or overflow route obstructed	Overflow route clear and stable.	Minor debris or vegetation; remove routinely.	Obstruction restricts flow; schedule removal and enforcement if needed.	Route partially blocked or redirected toward streets/buildings.	Route blocked or altered; high consequence misrouting imminent or occurring.
	Downstream scour or unstable discharge	Discharge point stable; no scour.	Minor scour; monitor or spot repair.	Scour developing; stabilization needed.	Severe scour undermining outlet or downstream bank.	Active failure threatens downstream road, utility, or structure.
Vegetation and Buffer	Wetland vegetation coverage and health	Healthy coverage consistent with the plan or local standard.	Localized thin or stressed plants; monitor.	Patchy or dead zones; replacement planting needed.	Widespread dieback or low coverage; erosion/treatment function reduced.	Vegetation failure causing erosion, exposed soils, or loss of treatment.
	Invasive or nuisance vegetation	None observed or isolated plants only.	Localized nuisance growth; routine removal.	Invasive plants spreading; schedule targeted control.	Invasives/nuisance growth dominate or choke flow path.	Vegetation blocks flow or requires major restoration.
	Buffer and access vegetation condition	Buffer stable and access open.	Minor trimming needed; access mostly clear.	Dense vegetation limits inspection or hides structures.	Access blocked or woody growth affects embankment/structures.	Unsafe access or roots/trees contributing to failure.
Trash, Dumping, and Water Quality	Trash/debris and illegal dumping	Minimal litter; no dumping.	Localized trash; routine pickup.	Recurring debris or small dumping piles; schedule cleanup/deterrents.	Large dumping or hazardous debris; restrict access and coordinate removal.	Hazardous dumping or blockage creates flood/health risk.
	Oil sheen	No abnormal flow, staining, sheen, or odor.	Minor staining or faint odor; document and monitor.	Persistent dry-weather flow or sheen; initiate investigation.	Strong evidence of illicit discharge; report and escalate.	Active spill or hazardous discharge; immediate response required.
	Odor, algae, or mosquito conditions	No odor, excess algae, or mosquito concern.	Minor seasonal nuisance; monitor.	Persistent odor, algae, or mosquito potential; investigate cause.	Chronic nuisance condition; corrective action and coordination needed.	Public health risk or unsafe water condition; immediate action.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Embankment, Banks, and Slope Stability	Bank or slope erosion	Stable soils; minor rills only.	Localized erosion; minor loss.	Rills or gullies forming; schedule stabilization.	Active gully growth or undercutting threatens slope or access.	Rapid failure threatens roads, utilities, structures, or wetland function.
	Slumping, settlement, or animal burrows	No slumps, settlement, or burrows.	Minor sloughing or small burrows; routine repair.	Cracks, slumps, or active burrows present; schedule stabilization.	Significant settlement or burrows through embankment; restrict access.	Active collapse, sinkhole, or failure condition; emergency response.
	Riprap, liner, or soil protection condition	Protection intact; no soil exposure.	Minor displacement or weathering; spot repair.	Gaps forming; soil exposed; repair needed.	Protection failed over significant area; erosion active.	Protection or liner failure causing rapid erosion or system compromise.
Impacts to People and Infrastructure	Threat to roads, utilities, or critical facilities	No threat.	Minor nuisance impacts only.	Impacts likely during intense storms.	Damage present or closures likely; priority repair.	Immediate danger to roads, utilities, or critical facilities.
	Homes or structures impacted	No risk.	Yard or open-space nuisance only.	Repeated nuisance flooding near structures.	Foundation, garage, or access threatened.	Occupied structure flooding or imminent structural damage.
	Public safety hazards	None.	Minor hazard; mark or monitor.	Hazard present; controls needed.	Serious hazard; restrict access.	Immediate danger; emergency controls required.

Wetland Name/ID	
Location	
Date/Time	START: __/__/____ END: __/__/____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Recent storm event?	☐ Yes ☐ No
Wetland Type	☐ Shallow ☐ Extended Detention ☐ Pond-Wetland ☐ Pocket ☐ Other
Area (Acre/ft ²)	
Approximate Water Level	
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE		
☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up
☐ Complaint/observation	☐ Trash/debris removal	☐ Sediment reducing storage capacity
☐ Forebay cleanout needed	☐ Inlet/outlet blockage or damage	☐ Erosion or slope repair needed
☐ Vegetation replacement/invasive control	☐ Water quality or odor concern	☐ Overflow route obstruction/erosion
☐ Safety hazard (unstable slope or deep water)	☐ Access issue	☐ Other (describe below)

Other/details:

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic control/access setup	☐ Trash and debris removal	☐ Remove illegally dumped material
☐ Inlet/outlet/trash rack cleanout	☐ Forebay sediment removal	☐ Wetland sediment removal/excavation
☐ Mow side slopes/access corridor	☐ Remove invasive or nuisance vegetation	☐ Replant native wetland vegetation
☐ Harvest/trim vegetation choking flow	☐ Erosion repair/bank stabilization	☐ Repair/replace riprap or energy dissipation
☐ Outlet/spillway repair	☐ Control structure/valve repair	☐ Berm or embankment settlement repair
☐ Animal burrow/void repair	☐ Water quality investigation/spill reporting	☐ Other (describe below)

Other maintenance actions performed:

AREAS ADDRESSED

☐ Forebay/pretreatment area	☐ Inlet/inflow points	☐ Shallow marsh/wetland cells
☐ Permanent pool/micro-pool	☐ Embankment/side slopes	☐ Outlet control structure
☐ Emergency spillway/overflow route	☐ Buffer/perimeter	☐ Access paths/maintenance easement
☐ Downstream channel/outfall	☐ Other (describe below)	

Other areas addressed:

MATERIALS, QUANTITIES, AND DISPOSAL

Sediment removed (estimate)	
Disposal location/ticket #	
Vegetation removed/replaced	
Rock/stabilization materials used	
Erosion control materials used	
Equipment used (e.g., mower, excavator, vacuum truck)	
Maintenance hours/staff	

SAFETY, ENVIRONMENTAL, AND REGULATORY CONTROLS

☐ Site access controlled and safe	☐ Traffic control in place (if needed)
☐ Work performed outside active high flow/safe water conditions	☐ Erosion and sediment controls in place
☐ No fuel, oil, or material spills	☐ Area left clean and stable
☐ Confined space procedures followed (if needed)	☐ Disturbed areas stabilized before demobilization
☐ Removed material disposed at approved location	☐ Environmental coordination completed or not required

POST-MAINTENANCE CONDITION AND FOLLOW-UP

☐ Inlets and outlets clear and operational	☐ Forebay function restored/acceptable
☐ Overflow route open and stable	☐ Wetland vegetation acceptable or follow-up planting scheduled
☐ Erosion and safety hazards addressed	☐ Access restored/acceptable

CONDITION AFTER MAINTENANCE

Function/flow conditions after work:	☐ Clear/restored	☐ Improved	☐ Still restricted
Bank/slope conditions after work:	☐ Stable	☐ Improved	☐ Needs follow-up

DOCUMENTATION		
Before photos attached:	☐ Yes	☐ No
After photos attached:	☐ Yes	☐ No

ENGINEERING REVIEW REQUIRED? ☐ Yes ☐ No ☐ N/A

(If yes, describe trigger: repeated flooding, capacity loss, failed outlet, unstable slope, recurring erosion, or public safety concern)

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Notes and Observations:

Attach additional pages, if required.

How to Maintain Your Dunes



What is it?

A coastal dune is a wind-formed sand ridge or mound along a sandy shore. Dunes store sand, support dune vegetation, and provide a natural buffer against storm surge, wave run-up, overwash, and coastal erosion.

Common types:

- Natural dune system
- Restored or rehabilitated dune
- Artificial or nourished dune
- Dune with sand fencing or vegetation
- Dune walkover/boardwalk access area

Who maintains it?

Ownership and maintenance can differ. Dunes may be managed by cities, counties, state agencies, parks departments, drainage districts, HOAs, private owners, or shoreline managers. Communities should confirm ownership, easements, public beach access requirements, and maintenance agreements before work begins.

Note: Some work on Texas beaches and dunes may require regulatory coordination or a local dune protection/beach access review before grading, sand movement, fencing, vegetation work, boardwalk work, or nourishment.

Best maintenance practices & strategies

Dunes reduce coastal flood and erosion risk by storing sand, absorbing wave energy, limiting overwash, and supporting a wider beach-dune system. Over time, storms, wind, beach use, foot traffic, vehicles, invasive vegetation, outfall scour, and damaged access controls can reduce dune performance. Routine inspection and targeted maintenance protect sand storage, vegetation, access, public safety, and nearby infrastructure.

A. INSPECTION

Inspections confirm that the dune still stores sand, supports vegetation, directs public access, and protects adjacent infrastructure without unsafe erosion, overwash, or uncontrolled access. The inspection checklist template for Dunes should cover dune form, vegetation, access controls, drainage and adjacent structures, debris or beach grooming impacts, and impacts to people and infrastructure. An inspection checklist for dunes is included with this reference sheet.

Inspection skill needs:

- Ability to recognize dune erosion, scarping, blowouts, low spots, and overwash pathways
- Awareness of how vegetation, sand fencing, and designated access paths protect dune stability
- Ability to identify damage to boardwalks, rope, fencing, signage, and public access controls
- Ability to recognize outfall scour, concentrated runoff, encroachment, and nearby infrastructure exposure
- Ability to observe safely near steep scarps, soft sand, high water, and public traffic
- Ability to document conditions clearly and flag when engineering or regulatory review is needed

What to look for:

- **Dune crest, continuity, and low spots that do not match the expected condition.** The dune should remain continuous enough to serve as a storm buffer. Low spots, breaches, or gaps can become overwash pathways during high water or storm surge and may direct water toward roads, utilities, homes, or public facilities.

- **Scarping, erosion, blowouts, and sand loss.** Storms and wind can reshape dunes. Some erosion is part of normal dune function, but steep scarps, expanding blowouts, or rapid sand loss can be signs of damage that reduce protection and create unsafe conditions. Compare current conditions to prior photos, profiles, or known reference points.
- **Vegetation coverage, health, and invasive growth.** Native dune vegetation traps wind-blown sand and stabilizes the dune surface. Look for thinning, dead plants, exposed roots, invasive species, or pathways where vegetation shows damage/removal by trampling, vehicles, mowing, or beach grooming. Replace failed plantings, repair signage, or conduct local outreach campaign to explain the importance of dunes, where appropriate.
- **Access paths, fencing, signs, and boardwalks.** Foot traffic and vehicles can damage dune vegetation and create new erosion paths. Designated walkovers and paths should remain clear, stable, and easy to use. Ropes, posts, sand fencing, and signs should be repaired before users cut new paths through the dune.
- **Stormwater outfalls, runoff paths, and adjacent structures.** Concentrated runoff from pipes, roads, parking lots, or roof drains can scour sand and cut channels through dunes. Seawalls, roads, utilities, and buildings that encroach on the dune can limit recovery and increase consequences if erosion continues.
- **Trash, dumping, hazardous materials, and beach grooming impacts.** Trash and dumping create hazards and can damage vegetation. Oil sheen, unusual odor, or suspicious discharge should be reported under local procedures. Beach grooming or wrack removal near the dune can reduce natural sand trapping and plant recovery.
- **Public safety hazards and infrastructure exposure.** Steep scarps, unstable boardwalks, exposed utilities, undermined pavement, vehicle ruts, or unsafe access points should be flagged quickly. Restrict access where hazards threaten the public or work crews.

How to record conditions:

- Use the standard dunes inspection checklist or a digital tool so conditions are comparable over time
- Record dune ID or reach, location, date, weather, recent storm or high-water history, and observed beach/dune condition
- Describe whether dune form and access controls appear clear, impaired, or severely impaired
- Photograph key conditions from fixed points when possible, including scarping, low spots, vegetation loss, damaged fencing, informal trails, outfall scour, debris, and nearby infrastructure
- Flag urgent issues that could cause flooding, structural failure, public safety hazards, access conflicts, or environmental concerns

B. MAINTENANCE

Maintenance preserves dune function while avoiding unnecessary disturbance. The goal is to keep the dune stable, vegetated, accessible only at designated routes, and able to recover naturally after storm events. A maintenance checklist for dunes is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools for trash removal, light fence repair, rope repair, and signage work
- Materials for sand fencing, rope, posts, signs, and access control repairs
- Native dune plant knowledge or contractor support for replacement planting and invasive control
- Limited, permitted earthwork equipment for authorized sand placement or dune reshaping when needed
- Traffic and pedestrian control for work near roads, parking areas, beach access points, or boardwalks
- Safe work practices near high water, steep scarps, soft sand, wildlife habitat, and public beach users
- Disposal plan for trash, treated wood, invasive vegetation, and potentially contaminated materials

Key maintenance goals:

- Keep dune crest continuity and sand storage intact. Repair small blowouts, low spots, and sand loss early when authorized. Avoid flattening, mining, or grading dunes for convenience.
- Protect native dune vegetation. Preserve stabilizing vegetation, remove invasive or nuisance plants selectively, replace failed plantings, and avoid unnecessary mowing or disturbance within dune areas.
- Maintain designated access routes. Keep boardwalks, walkovers, paths, ropes, fencing, and signs functional so the public uses intended routes and does not create new paths across the dune.
- Control runoff and outfall scour. Repair erosion at drainage discharge points and redirect concentrated runoff only through designed, stable routes.
- Remove trash, dumping, and hazards. Remove debris

without disturbing vegetation or sand unnecessarily. Escalate hazardous material, oil sheen, or suspicious discharge under local procedures.

- Let dunes function naturally after storms. Some storm erosion is expected. Use inspection records to decide whether natural recovery, minor repair, sand fencing, planting, or engineering review is appropriate.
- Protect public safety and nearby infrastructure. Restrict access to steep scarps, damaged boardwalks, exposed utilities, undermined pavement, or unsafe work areas until corrected.

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Review vegetation health, informal trails, fence and signage condition, sand accumulation or loss, and access path performance before high-use seasons and storm seasons
- Plan planting, invasive removal, sand-fence repair, access improvements, and authorized sand placement or reshaping when inspection findings show recurring impairment

2. Annual maintenance and comprehensive review

- Review inspection history, fixed-point photos, survey data if available, recurring erosion or access issues, and budget needs
- Update the maintenance priority list

3. Pre-, in-, and post-storm events

- After significant coastal storms, high-water events, or public complaints, check for new scarps, low spots, access-control damage, boardwalk hazards, outfall scour, debris, and infrastructure exposure

4. Maintenance decision logic

- Unsafe condition, active overwash, exposed utility, hazardous discharge, or failing access structure? Restrict access, notify the appropriate supervisor or agency, and initiate emergency response or engineering review.
- Small blowout, low spot, damaged fence, or informal path? Repair access controls, install or repair sand fencing where appropriate, replant or stabilize, and document with photos.
- Vegetation failing or invasive growth spreading? Remove invasive species selectively, replace failed native dune plants, and identify stress sources such as trampling or over-irrigation.

- Outfall scour, concentrated runoff, or recurring erosion? Stabilize the discharge point, repair energy dissipation, and request engineering review if the problem returns.
- Storm erosion is visible, but no infrastructure or public safety issue exists? Monitor recovery before disturbing the dune. Dunes are dynamic and may rebuild naturally through wind-blown sand and vegetation growth.

5. Factors that may influence the maintenance schedule

- Recent tropical storms, high tides, storm surge, wave run-up, or repeated overwash
- Known erosion hot spots, low dune crest areas, or narrow beach-dune sections
- High public use, unauthorized trails, vehicle access, or beach access conflicts, for example, after a beach festival weekend
- New or damaged boardwalks, fences, ropes, signage, or access controls
- Vegetation failure, invasive species spread, drought stress, or establishment watering needs
- Outfall scour, concentrated runoff, drainage complaints, or wet sand instability
- Nearby roads, utilities, homes, schools, emergency routes, parks, or other critical facilities
- Permit conditions, local dune protection requirements, beach access requirements, or monitoring commitments

6. Repair vs. reconstruction/redesign considerations

- Continue maintenance or minor repair when issues are localized, vegetation can re-establish, access controls can guide users, and the dune can recover without changing beach access or adjacent drainage patterns
- Consider engineering review, reconstruction, or redesign when dune breaches recur, public access controls repeatedly fail, outfall scour persists, beach width is insufficient, structures are exposed, or consequences to people and infrastructure are high

Note: Do not grade, mine, lower, breach, fence, plant, nourish, or reshape a dune without confirming ownership, public access requirements, environmental constraints, regulatory requirements, and impacts to adjacent properties and infrastructure.

Inspection Checklist

Asset Management Guidance for Community Flood Infrastructure

Dune Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Recent high water?	☐ Yes ☐ No
Recent storm event?	☐ Yes ☐ No
Regulatory/Access Status	☐ Public Beach ☐ Dune Protection Area ☐ Private ☐ Other
Other/Details	
Reach Length	
Approximate Beach Width	
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Steep scarp/unstable sand	☐ High water/wave run-up	☐ Damaged boardwalk/fall hazard	☐ Traffic or vehicle hazard
--	---	--	--

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Dune Form and Sand Storage	Overall	☐	☐	☐	☐	☐
	Crest height or dune continuity reduced	☐	☐	☐	☐	☐
	Beach-dune toe scarping	☐	☐	☐	☐	☐
	Sand loss, blowouts, or low spots	☐	☐	☐	☐	☐

Dune Name/ID: _____ Inspector Initials: _____

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Vegetation and Habitat Condition	Overall	☐	☐	☐	☐	☐
	Native dune vegetation coverage and health	☐	☐	☐	☐	☐
	Invasive or nuisance vegetation	☐	☐	☐	☐	☐
	Bare sand or trampling impacts	☐	☐	☐	☐	☐
Access, Fencing, and Public Use	Overall	☐	☐	☐	☐	☐
	Designated access paths functioning	☐	☐	☐	☐	☐
	Sand fence, rope, signage, or boardwalk condition	☐	☐	☐	☐	☐
	Unauthorized trails or vehicle/pedestrian damage	☐	☐	☐	☐	☐
Drainage, Outfalls, and Adjacent Structures	Overall	☐	☐	☐	☐	☐
	Stormwater outfalls or pipes causing scour	☐	☐	☐	☐	☐
	Seawalls, roads, utilities, or structures encroaching	☐	☐	☐	☐	☐
	Ponding or runoff concentration	☐	☐	☐	☐	☐
Debris, Dumping, and Beach Grooming	Overall	☐	☐	☐	☐	☐
	Trash/debris and illegal dumping	☐	☐	☐	☐	☐
	Hazardous materials, oil sheen, or suspicious discharge	☐	☐	☐	☐	☐
	Beach grooming or wrack removal affecting dunes	☐	☐	☐	☐	☐
Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to roads, utilities, or critical facilities	☐	☐	☐	☐	☐
	Homes or structures impacted	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Attach additional pages, if required.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Dune Form and Sand Storage	Crest height or dune continuity reduced	Crest continuous and unbroken.	Small low spots; no flow path.	Low spot or gap reduces storm buffer.	Gap allows overwash or flow toward landward areas.	Crest breached or no effective barrier remains.
	Beach-dune toe scarping	Toe stable; minor seasonal change.	Small scarp; no vegetation loss.	Scarp extending; monitor and plan repair.	Steep or undercut scarp threatens dune face.	Active collapse or rapid retreat; emergency review.
	Sand loss, blowouts, or low spots	No blowouts; sand stored in place.	Small wind channels; routine observation.	Blowout expanding; schedule fencing/planting or sand repair.	Major sand loss exposes roots or nearby assets.	Rapid loss or breach threatens infrastructure.
Vegetation and Habitat Condition	Native dune vegetation coverage and health	Healthy coverage consistent with local plan.	Localized thin or stressed plants; monitor.	Patchy or dead zones; replacement planting needed.	Widespread dieback or bare dune; function reduced.	Vegetation failure causing erosion or loss of treatment/buffer.
	Invasive or nuisance vegetation	None observed or isolated plants only.	Localized nuisance growth; routine removal.	Invasive plants spreading; schedule targeted control.	Invasive/nuisance growth dominates or blocks access.	Vegetation blocks management or contributes to failure.
	Bare sand or trampling impacts	No trampling; stable surface.	Isolated footprints; no defined path.	Bare bands or informal path developing.	Deep ruts or trampled area causing erosion.	Vehicle or pedestrian damage threatens dune function.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Access, Fencing, and Public Use	Designated access paths functioning	Paths clear, stable, and used.	Minor sand buildup or wear.	Damage or blockage encourages detours.	Path unsafe or bypassed; users enter dune.	Path failed/closed and causing damage or hazard.
	Sand fence, rope, signage, or boardwalk condition	Intact and functional.	Minor loose posts, rope, or sign wear.	Gaps or damaged sections; maintenance needed.	Large failures allow public entry or trap debris.	Failed/missing controls create immediate hazard or loss of protection.
	Unauthorized trails or vehicle/pedestrian damage	No unauthorized access.	Isolated incursion; monitor.	Recurring trail, rut, or crossing visible.	Widespread damage; access control ineffective.	Severe damage; restrict access and coordinate enforcement.
Drainage, Outfalls, and Adjacent Structures	Stormwater outfalls or pipes causing scour	No scour; discharge stable.	Minor scour pocket; monitor.	Scour hole forming; repair energy dissipation.	Headcut or major scour threatens dune.	Outfall failure or rapid dune loss; immediate action.
	Seawalls, roads, utilities, or structures encroaching	Adequate separation; no exposure.	Minor encroachment; no damage.	Structure limits dune recovery or access; monitor.	Structure exposed or undermining likely; priority review.	Infrastructure undermined or immediate danger present.
	Ponding or runoff concentration	No concentrated runoff or ponding.	Minor wet spots; no erosion.	Runoff channel or ponding alters dune surface.	Chronic concentrated flow destabilizes sand.	Active washout or sinkhole; close area.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Debris, Dumping, and Beach Grooming	Trash/debris and illegal dumping	Minimal litter; no dumping.	Localized trash; routine pickup.	Recurring debris or small dumping piles; schedule cleanup.	Large dumping affects access or vegetation; coordinate removal.	Hazardous dumping or blockage creates safety risk.
	Hazardous materials, oil sheen, or suspicious discharge	None observed.	Minor staining; document and monitor.	Persistent odor, sheen, or suspicious discharge; investigate.	Strong evidence of illicit discharge; report and escalate.	Active spill or hazardous condition; emergency response.
	Beach grooming or wrack removal affecting dunes	Grooming avoids dune; sand trapping intact.	Minor edge disturbance; monitor.	Grooming or wrack removal reduces sand trapping; adjust practice.	Repeated disturbance removes vegetation or sand.	Dune recovery prevented or erosion risk worsened.
Impacts to People and Infrastructure	Threat to roads, utilities, or critical facilities	No threat.	Minor nuisance impacts only.	Impacts likely during intense storms.	Damage or closures likely; priority repair.	Immediate danger to roads, utilities, or critical facilities.
	Homes or structures impacted	No risk.	Yard or open-space nuisance only.	Repeated nuisance flooding or erosion near structures.	Foundation, access, or service line threatened.	Occupied structure flooding or undermining imminent.
	Public safety hazards	None.	Minor hazard; mark or monitor.	Hazard present; controls needed.	Serious hazard; restrict access.	Immediate danger; emergency controls required.

Dune Name/ID			
Location			
Date/Time	START: __/__/____	END: __/__/____	
Foreman			
Maintenance Crew			
Contractor			
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F		
Recent high water?	☐ Yes	☐ No	
Recent storm event?	☐ Yes	☐ No	
Regulatory/Access Status	☐ Public Beach	☐ Dune Protection Area	☐ Private ☐ Other
Other/Details			
Reach Length			
Approximate Beach Width			
Other/Details			
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____		

REASON FOR MAINTENANCE		
☐ Routine/scheduled maintenance	☐ Post-storm/high-water response	☐ Inspection follow-up
☐ Complaint/service request	☐ Emergency/safety issue	☐ Dune erosion/scarping
☐ Sand fence/access control repair	☐ Vegetation establishment or invasive removal	☐ Trash/dumping removal
☐ Outfall scour/runoff issue	☐ Boardwalk/access path issue	☐ Other (describe below)

Other/Details:

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic/pedestrian access setup	☐ Trash and debris removal	☐ Remove illegal dumping
☐ Repair rope/posts/signage	☐ Repair or replace sand fencing	☐ Boardwalk/path repair
☐ Redirect or close unauthorized path	☐ Invasive species removal	☐ Native dune planting/replacement
☐ Establishment watering	☐ Repair small blowouts/low spots	☐ Authorized sand placement/reshaping
☐ Erosion repair/stabilization	☐ Outfall scour repair/energy dissipation	☐ Remove vehicle ruts/unsafe depressions
☐ Hazard control/restrict access	☐ Engineering or regulatory coordination	☐ Other (describe below)

Other maintenance actions performed:

AREAS ADDRESSED

☐ Dune crest	☐ Dune face/slope	☐ Beach-dune toe
☐ Blowout/low spot	☐ Vegetation area	☐ Access path/trail
☐ Boardwalk/walkover	☐ Sand fence/rope/signage	☐ Stormwater outfall/drainage point
☐ Adjacent road/utility/structure	☐ Public use area	☐ Other (describe below)

Other areas addressed:

Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

MATERIALS, EQUIPMENT, AND QUANTITIES

Equipment used (e.g., hand tools, truck, small equipment, loader, excavator, water tank):

Maintenance hours/staff:

Sand placed or moved (estimate CY and source if applicable):

Plant materials used (e.g., species, quantity, source):

Fence/rope/signage/boardwalk materials used:

Debris or material removed (estimate volume and disposal location):

SAFETY, ENVIRONMENTAL, AND REGULATORY CONTROLS	
☐ Site access controlled and safe	☐ No fuel, oil, or material spills
☐ Traffic/pedestrian control in place (if needed)	☐ Wildlife, nesting, or sensitive habitat concerns checked before work
☐ Work performed outside unsafe high-water, wave run-up, or storm conditions	☐ Permit/authorization confirmed for sand movement, fencing, planting, grading, or boardwalk work
☐ Access routes protected dune vegetation and avoided unnecessary disturbance	☐ Area left clean, stable, and access controls functional

CONDITION AFTER MAINTENANCE			
Dune form/sand condition after work:	☐ Acceptable	☐ Improved	☐ Still vulnerable
Access, vegetation, and control condition after work:	☐ Stable	☐ Improved	☐ Needs follow-up

DOCUMENTATION			
Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A
Fixed photo point or GPS location recorded:	☐ Yes	☐ No	☐ N/A
Regulatory coordination documented:	☐ Yes	☐ No	☐ N/A
Public access controls restored:	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED? ☐ Yes ☐ No ☐ N/A

(If yes, describe trigger)

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Attach additional pages, if required.

How to Maintain Your Sinkholes

What is it?

A sinkhole is a surface depression, collapse, or open void caused by soil loss into subsurface openings or by dissolution of soluble bedrock. In flood infrastructure work, a sinkhole may be a natural karst feature, a collapse feature near drainage infrastructure, or a stabilized inlet to a subsurface drainage path.

Feature Classifications (may overlap)

- Natural or suspected karst sinkhole
- Subsidence or collapse feature
- Feature affected by erosion (rill, gully, piping)
- Stabilized or treated sinkhole or engineered vertical drain
- Sinkhole near a road, channel, basin, pipe, or outfall
- Sinkhole near people, roads, utilities, structures, channels, basins, pipes, or outfalls

Who maintains it?

Maintenance responsibility depends on ownership, easements, drainage function, and location. Sinkholes may be on city, county, drainage district, road agency, HOA, or private property. Communities should confirm authority to inspect, restrict access, remove debris, control runoff, and coordinate geotechnical or environmental review before any work that could alter the feature, drainage path, or groundwater protection.

Note: Do not use a sinkhole for disposal of trash, sediment, brush, concrete washout, chemicals, oils, or untreated runoff. Do not enter or probe an open void. Do not fill, excavate, pipe flow to, or alter a sinkhole without confirming ownership, safety, groundwater protection, and agency notification/permit requirements.



Best maintenance practices & strategies

For this guidance, sinkholes are managed as natural or stabilized flood-infrastructure features, not as disposal points or assumed treatment facilities. They can be direct pathways to groundwater and may be unstable at the surface. Maintenance should focus on safety, preventing pollutants and sediment from entering the feature, stabilizing runoff before it reaches the rim, preserving intended drainage where applicable, and escalating unstable or expanding features for qualified review.

A. INSPECTION

Inspections confirm whether the sinkhole is stable, protected from unsafe access, receiving runoff through documented, stable flow paths, and not creating flooding, erosion, water quality, or infrastructure risks. An inspection checklist for Sinkholes is included with this sheet.

Skill needs:

- Ability to recognize open voids, settlement, slumping, edge recession, and signs of recent collapse
- Ability to identify erosion patterns such as rills, gullies, headcuts, and soil piping toward the sinkhole
- Awareness that sinkholes may connect rapidly to groundwater and may bypass normal stormwater treatment
- Familiarity with drainage features such as swales, culverts, inlets, outfalls, sediment controls, vertical drains, buffers, and overflow routes

- Ability to observe safely from stable ground and document changes with photos, measurements, and a consistent rating system
- Ability to recognize when engineering, geotechnical, environmental, regulatory, utility, or emergency response support is needed

What to look for:

Use the full inspection checklist and the following pages to document conditions consistently over time.

1. Unsafe ground, open voids, or rapid enlargement

Look for fresh cracks, slumps, newly exposed soil, soft ground, open holes, broken pavement, or a sinkhole that is larger than the last inspection. Restrict access from stable ground when collapse is possible. Do not enter or probe the void.

2. Runoff concentrating into the sinkhole from outside the intended, stabilized flow path

Concentrated flow can enlarge a sinkhole quickly. Check swales, curb cuts, culverts, roof drains, ditches, and field drainage that may be directing water toward the rim or through un-stabilized soil.

3. Gully, rill, headcut, or piping Erosion

Erosion into the feature can deliver sediment to groundwater, reduce local drainage function, and expand the collapse area. Early stabilization is usually less costly than repairing a large gully or road failure.

4. Sediment, trash, dumping, or blocked throat

A sinkhole is not a disposal point. Sediment, brush, concrete, tires, household waste, and dumped material can block drainage, contaminate groundwater, create hazards, and make later repairs more expensive. Do not handle suspected hazardous material; restrict access and notify the responsible authority.

5. Oil or Oil sheen, chemical, odor, staining, wastewater or suspicious discharge

Because some sinkholes connect to groundwater with little treatment, oil sheen, solvent odors, wastewater signs, pesticide runoff, fertilizer piles, or unusual dry-weather flow should be documented and reported promptly.

6. Vegetation and buffer condition

A stable vegetated buffer helps slow runoff and capture sediment before water reaches the feature. Bare soil, mowing to the edge, vehicle ruts, or disturbed buffers can accelerate erosion and collapse.

7. Stabilization or vertical drain features, if present

Check trash racks, risers, pipes, concrete collars, rock protection, filter material, and surrounding soil for blockage, cracking, settlement, seepage, or undermining. These features may need specialized repair.

8. Impacts to people and infrastructure

Identify nearby roads, trails, culverts, utilities, buildings, critical facilities, or access routes that could be affected by collapse, flooding, or uncontrolled overflow.

How to record conditions:

- Record location/coordinates, date, weather, recent storm history and approximate rainfall, estimated diameter and depth if visible from stable ground, and whether the feature is in a known (mapped) karst, aquifer recharge, or groundwater protection area
- Photograph the rim, throat, buffer, inflow paths, erosion features, nearby infrastructure, and any stabilization or vertical drain features
- Mark approximate sinkhole limits from a safe distance, and compare to prior photos or measurements when available
- Flag urgent hazards immediately, including collapse near roads, utilities, structures, public access areas, suspicious discharges, or flooding affecting homes or critical routes. Record the immediate control, notification, work order, responsible party, and target date.

B. MAINTENANCE

Maintenance should reduce safety hazards, keep runoff controlled, prevent sediment and pollutants from entering the sinkhole, and protect nearby infrastructure. Work outside the approved routine scope (if defined) including repairs, filling, excavation, drainage rerouting, or structural / vertical drain repair required qualified professional review and confirmation of applicable permits or authorizations before work begins.

Maintenance equipment and skill needs:

- Hand tools for trash removal, light vegetation work, and minor sediment control repair
- Temporary fencing, barricades, cones, signs, or traffic control for unsafe areas
- Erosion-control materials such as seed, mulch, erosion-control blanket, rock, straw wattles, silt fence, or other approved controls
- Mowing or trimming equipment for maintaining buffers and inspection access from stable ground

- Survey or measuring tools for tracking sinkhole limits and changes
- Vacuum, excavator, or specialized contractor support only under an approved work plan that addresses stability, equipment stand-off, utilities, and groundwater protection
- Spill response supplies when oil, fuel, pesticides, or suspicious discharges are observed
- Geotechnical, engineering, utility, or environmental / regulatory support for expanding features, infrastructure threats, or suspected groundwater contamination

Key maintenance goals:

- 1. Protect public safety first.** Barricade or fence unsafe areas, post signs, and keep crews and the public away from open voids, soft ground, steep slopes, and active collapse areas.
- 2. Keep pollutants and dumped material out of the sinkhole.** Remove nonhazardous trash and debris promptly. Do not stockpile soil, chemicals, concrete washout, fuel, oil, pesticides, fertilizers, or waste where runoff can carry material into the feature. If material may be hazardous, restrict access and use the owner's spill or emergency response procedure.
- 3. Control erosion and sediment before runoff reaches the sinkhole.** Repair rills and gullies early, stabilize bare soil, maintain sediment controls, and use buffers or pretreatment to reduce sediment entering karst drainage paths.
- 4. Maintain stable inflow and overflow paths.** Runoff should enter only through documented, stabilized paths. Remove obstructions that cause water to bypass toward roads, structures, or utilities when safe and within the approved scope. Do not create a sudden release.
- 5. Maintain stabilization or vertical drain features if present.** Clear trash racks and risers from stable ground, keep access visible and safe, and repair damaged rock, concrete, or filter areas when qualified review confirms the repair approach.
- 6. Track changes and escalate unstable conditions.** Repeated enlargement, new depressions, active slumping, piping, seepage, or infrastructure impacts require prompt engineering or geotechnical evaluation.

Key considerations for achieving maintenance goals:

- Do not assume a sinkhole is a normal detention basin, channel, or inlet. It may be connected to groundwater and may be unstable below the visible surface.
- Before disturbing a feature, confirm whether the site is in a mapped karst, aquifer recharge / transition, or groundwater protection area
- Do not route untreated hotspot runoff to a sinkhole. Pretreat runoff where needed and coordinate with the appropriate local or state authority.
- Do not fill an active sinkhole with random soil, debris, concrete, brush, or trash. Improper filling can worsen collapse, redirect water, or contaminate groundwater.
- Maintain a vegetated buffer where practical. Buffers slow runoff, reduce sediment delivery, and help mark a safe perimeter. Buffer width and vegetation management should follow the approved plan and site-specific safety, hydraulic, access, and environmental constraints.
- Use geotechnical or engineering review for expanding sinkholes, sinkholes near infrastructure, vertical drains, or repairs that involve excavation, grouting, pipe installation, or changed drainage routing
- When a sinkhole is part of a designed drainage system, maintain design intent and document any observed change in capacity, drainage time, or overflow route

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- The asset owner should assign and document a routine frequency based on risk. Walk the accessible perimeter from stable ground.
- Check access controls, buffer, inflow paths, and visible rim condition
- Before wet seasons, check for bare soil, failed sediment controls, blocked inflows, dumping, and buffer continuity

2. Post-storm inspections

- After owner-defined trigger events, observed flooding, erosion, or credible complaints, check for new cracks, slumps, debris lines, erosion, ponding, overflow, or rapid enlargement

3. Periodic condition verification

- Measure or survey feature limits where movement is suspected or where nearby roads, utilities, structures, or trails are present

4. Enhanced inspections

- Increase frequency when the feature is expanding, located near infrastructure, receives concentrated runoff, or has a history of complaints or emergency response

5. Repair vs. engineering review Considerations:

Continue routine maintenance when:

- Conditions are stable, access controls are intact, no new enlargement is observed, runoff paths are stable, and issues are limited to trash, minor vegetation, or small sediment-control repairs

Increase preventive maintenance when:

- Bare soil, minor erosion, recurring trash, buffer gaps, or blocked inflow/overflow paths are beginning to affect the feature

Request engineering or geotechnical review when:

- The sinkhole expands, new depressions appear, slopes slump, water backs up, seepage/piping is observed, a vertical drain or stabilization feature is damaged, or the feature is close to infrastructure

Initiate emergency response when:

- There is active collapse, a road/trail/utility/structure is threatened, flooding is occurring, hazardous material is present, or the public cannot be kept safely away

Sinkholes

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Sinkhole Name/ID			
Location			
Date/Time	START: __/__/____	END: __/__/____	
Inspector			
Inspection Team			
Contractor			
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F		
Recent storm event?	☐ Yes ☐ No		
Feature classification (check all that apply)	☐ Natural or suspected karst ☐ Subsidence or collapse ☐ Stabilized or treated ☐ Engineered vertical drain ☐ Unknown		
Estimated Diameter/Depth and units (from stable ground)			
Mapped karst, aquifer recharge, or groundwater-protection area	☐ Yes ☐ No	☐ Unknown	
Engineering/Geotechnical Review Required?	☐ Yes ☐ No	☐ Pending	
Public Access Present?	☐ Yes ☐ No		
Other/Details			
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____		

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Active collapse, open void, rapid enlargement	☐ Unstable or soft ground/cracking/slumping	☐ Standing water or deep water/unsafe to approach	☐ Suspected hazardous material/vapor/odor/unsafe access
--	--	--	--

Sinkhole Name/ID: _____ Inspector Initials: _____

Sinkholes

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Access and Public Safety	Overall	☐	☐	☐	☐	☐
	Access control, fencing, and signage	☐	☐	☐	☐	☐
	Unsafe ground, open void, or fall hazard	☐	☐	☐	☐	☐
	Evidence of recent collapse or rapid enlargement	☐	☐	☐	☐	☐
Sinkhole Geometry and Stability	Overall	☐	☐	☐	☐	☐
	Sinkhole edge recession or enlargement	☐	☐	☐	☐	☐
	Side slope slumping or cracking	☐	☐	☐	☐	☐
	Settlement or depressions around the feature	☐	☐	☐	☐	☐
Drainage and Flow Function	Overall	☐	☐	☐	☐	☐
	Runoff entering outside intended flow path	☐	☐	☐	☐	☐
	Water backing up, ponding, or flooding nearby	☐	☐	☐	☐	☐
	Overflow or bypass toward roads, structures, or utilities	☐	☐	☐	☐	☐
Erosion and Sediment Delivery	Overall	☐	☐	☐	☐	☐
	Gully, rill, or headcut erosion into sinkhole	☐	☐	☐	☐	☐
	Sediment accumulation, soil loss, or piping at throat	☐	☐	☐	☐	☐
	Upstream soil source or failed sediment controls	☐	☐	☐	☐	☐
Water Quality and Contamination Risk	Overall	☐	☐	☐	☐	☐
	Trash, dumping, or floatable debris	☐	☐	☐	☐	☐
	Oil sheen, odor, staining, or suspicious discharge	☐	☐	☐	☐	☐
	Fertilizer, pesticide, chemical, or wastewater exposure risk	☐	☐	☐	☐	☐

Sinkhole Name/ID: _____ Inspector Initials: _____

Page 2 of 4

Sinkholes

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Vegetation and Buffer Condition	Overall	☐	☐	☐	☐	☐
	Vegetated buffer continuity and width	☐	☐	☐	☐	☐
	Bare soil or disturbed buffer area	☐	☐	☐	☐	☐
	Woody growth, root disturbance, or vegetation hiding hazards	☐	☐	☐	☐	☐
Stabilization or Vertical Drain Features (If Present)	Overall	☐	☐	☐	☐	☐
	Trash rack, inlet pipe, or riser condition	☐	☐	☐	☐	☐
	Concrete, rock, filter, or lining condition	☐	☐	☐	☐	☐
	Settlement, seepage, or undermining around structure	☐	☐	☐	☐	☐
Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Threat to roads, trails, or public access	☐	☐	☐	☐	☐
	Threat to utilities, structures, or critical facilities	☐	☐	☐	☐	☐
	Repeated complaints, flooding, maintenance or emergency response history	☐	☐	☐	☐	☐

Notes and Observations:

Sinkhole Name/ID: _____ Inspector Initials: _____

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

[illegible]**Notes and Observations:**

Attach additional pages, if required.

Sinkholes

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Access and Public Safety	Overall	Access appears controlled; no public hazard.	Minor access or signage issue; monitor.	Access control incomplete; schedule repair.	Unsafe access or likely fall hazard; restrict area.	Immediate public hazard; close area and respond.
	Access control, fencing, and signage	Controls present and serviceable.	Minor wear or fading; still effective.	Missing signs or localized fence damage.	Access control ineffective; public can reach hazard.	No control around open/active hazard; immediate closure.
	Unsafe ground, open void, or fall hazard	Stable surface; no open void visible.	Minor uneven ground; caution needed.	Small void, soft ground, or trip/fall hazard.	Open void or unstable edge; barricade and evaluate.	Collapse/fall hazard threatens life safety; emergency action.
	Evidence of recent collapse or rapid enlargement	No change observed from prior record.	Minor sloughing or settlement; monitor.	Noticeable new movement; schedule evaluation.	Rapid edge loss or collapse indicators; urgent review.	Active collapse or expanding void; emergency response.
Sinkhole Geometry and Stability	Overall	Feature stable and documented.	Minor change; continue monitoring.	Geometry change developing; schedule survey/evaluation.	Significant instability; restrict and repair with review.	Active failure or collapse threatens safety/infrastructure.
	Sinkhole edge recession or enlargement	No edge recession observed.	Small localized edge loss.	Edge recession measurable or recurring.	Rapid enlargement; protective setback reduced.	Expanding into road, structure, utility, or public area.
	Side slope slumping or cracking	Slopes stable; no cracks.	Minor shallow sloughing.	Cracks or slump blocks forming.	Large slump or steepening; failure likely.	Active slope collapse; do not approach.
	Settlement or depressions around the feature	No settlement beyond known feature.	Small depression; monitor.	Depression expanding or affecting access.	Settlement suggests void migration; urgent evaluation.	Surface collapse or sinkhole opening outside known area.

Sinkholes

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Drainage and Flow Function	Overall	Drainage follows intended path; no adverse ponding.	Minor flow concentration; monitor.	Flow path or ponding issue developing.	Drainage change increases flood or collapse risk.	Active flooding or unsafe routing; emergency response.
	Runoff entering outside intended flow path	Runoff enters as expected.	Minor sheet flow variation.	Concentrated flow forming outside intended path.	Uncontrolled inflow eroding or destabilizing rim.	Uncontrolled inflow accelerates collapse or floods assets.
	Water backing up, ponding, or flooding nearby	No unusual ponding or backup.	Brief nuisance ponding after storms.	Recurring ponding near feature; investigate cause.	Ponding/flooding affects access or property.	Flooding threatens roads, structures, or emergency access.
	Overflow or bypass toward roads, structures, or utilities	No overflow or bypass observed.	Overflow contained in open area.	Bypass approaches public or private improvements.	Overflow reaches road, utility corridor, or structure.	Active overflow/flooding creates life-safety or critical risk.
Erosion and Sediment Delivery	Overall	No active erosion; sediment controlled.	Minor rills or deposits; routine repair.	Erosion or sediment delivery measurable; schedule work.	Severe erosion/sediment delivery; urgent stabilization.	Erosion threatens collapse, drainage failure, or infrastructure.
	Gully, rill, or headcut erosion into sinkhole	No rills, gullies, or headcuts.	Small rills; stabilize soon.	Gully/headcut forming; repair and add controls.	Gully deepening or migrating upstream; urgent work.	Headcut threatens road/structure or expands sinkhole.
	Sediment accumulation, soil loss, or piping at throat	Throat stable; no excessive deposits.	Minor sediment; function maintained.	Sediment buildup or soil piping signs visible.	Severe deposition or soil loss reduces stability/function.	Throat blocked or piping/collapse imminent.
	Upstream soil source or failed sediment controls	Upstream area stable; controls functional.	Minor bare area or small control repair needed.	Failed controls deliver sediment during storms.	Repeated sediment source overwhelms buffer/feature.	Uncontrolled sediment source drives collapse or flooding.

Sinkholes

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Water Quality and Contamination Risk	Overall	No contamination indicators.	Minor housekeeping issue; clean and monitor.	Potential contaminant source; investigate and correct.	Likely contaminant entry; stop the source if safe, restrict access and report.	Active spill, hazardous material, or groundwater threat.
	Trash, dumping, or floatable debris	No trash or dumping.	Minor litter; routine removal.	Dumping present; remove and deter recurrence.	Bulky debris or repeated dumping blocks flow/access.	Hazardous dumping or debris creates emergency risk.
	Oil sheen, odor, staining, wastewater, or suspicious discharge	None observed.	Minor staining; document and monitor.	Persistent odor, sheen, staining, or dry-weather flow.	Strong evidence of illicit discharge; report promptly.	Active release, strong vapor, or acute exposure, emergency response.
	Fertilizer, pesticide, wastewater, or chemical exposure risk	No chemical exposure observed.	Chemical use nearby but separated from feature.	Potential runoff pathway from treated/storage area.	Chemical exposure likely; restrict and investigate.	Chemical release into sinkhole; urgent agency response.
Vegetation and Buffer Condition	Overall	Buffer stable; vegetation supports protection.	Minor vegetation issue; routine care.	Buffer disturbance allows sediment or hides hazards.	Buffer failure contributes to erosion or unsafe access.	Buffer lost; erosion/contamination threatens feature.
	Vegetated buffer continuity and width	Continuous healthy buffer around feature.	Small bare or thin areas.	Breaks in buffer allow flow concentration.	Large buffer gaps deliver sediment or pollutants.	No effective buffer; active erosion threatens features; comprehensive restoration needed.
	Bare soil or disturbed buffer area	No bare/disturbed soil.	Small bare patch; reseed or mulch.	Bare area drains toward sinkhole; repair and control.	Extensive disturbance; high sediment risk.	Active erosion from bare area threatens stability.
	Woody growth, root disturbance, or vegetation hiding hazards	Vegetation appropriate; hazards visible.	Minor woody growth; monitor/manage.	Woody growth or dense cover hides edge/hazards.	Trees/roots destabilize slope or block access.	Vegetation conceals active void or causes failure risk.

Sinkholes

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Stabilization or Vertical Drain Features (If Present)	Overall	Structure/features intact and functional.	Minor wear or debris; routine service.	Feature partly impaired; schedule maintenance.	Feature damaged or unstable; urgent repair/evaluation.	Feature failed; flooding, collapse, or contamination risk.
	Trash rack, inlet pipe, or riser condition	Clear and intact.	Minor debris; easy cleanout.	Partial blockage or damage; schedule service.	Severe blockage/damage; function impaired.	Blocked/failed feature causing flooding or collapse risk.
	Concrete, rock, filter, or lining condition	Stable and intact.	Minor displacement or cracking.	Gaps, cracks, or exposed soil; repair planned.	Major loss of protection; undermining likely.	Protection failed; rapid erosion/collapse occurring.
	Settlement, seepage, or undermining around structure	No settlement, seepage, or undermining.	Minor staining or small settlement; monitor.	Ongoing settlement/voiding; investigate and repair.	Significant seepage/undermining; restrict access.	Active piping, void collapse, or structure failure.
Impacts to People and Infrastructure	Overall	No people or infrastructure impact.	Low consequence; monitor.	Moderate consequence; schedule corrective work.	High consequence; urgent mitigation needed.	Immediate life-safety or critical infrastructure threat.
	Threat to roads, trails, or public access	No threat to access corridors.	Minor edge issue or nuisance.	Feature moving toward trail/road; plan repair.	Road/trail/access threatened or restricted.	Road/trail collapse or unsafe public access present.
	Threat to utilities, structures, or critical facilities	No utilities or structures at risk.	Distant utility/structure; monitor.	Potential exposure or settlement near asset.	Utility/structure/critical facility access threatened.	Active damage or imminent failure of critical asset.
	Repeated complaints, flooding, maintenance, or emergency response history	No repeat issue.	One recent report; monitor.	Recurring complaint or maintenance response.	Repeated flooding/collapse response; prioritize evaluation.	Chronic emergency issue; redesign or major mitigation.

Sinkholes

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Sinkhole Name/ID	
Location	
Date/Time	START: __/__/____ END: __/__/____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Recent storm event?	☐ Yes ☐ No
Feature classification (check all that apply)	☐ Natural or suspected karst ☐ Subsidence or collapse ☐ Stabilized or treated ☐ Engineered vertical drain ☐ Unknown
Estimated Diameter/Depth and units (from stable ground)	
Mapped karst, aquifer recharge, or groundwater-protection area	☐ Yes ☐ No ☐ Unknown
Engineering/Geotechnical Review Required?	☐ Yes ☐ No ☐ Pending
Public Access Present?	☐ Yes ☐ No
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE		
☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up
☐ Complaint/service request	☐ Emergency/safety issue	☐ Collapse/open void or rapid enlargement
☐ Sediment or erosion issue	☐ Trash/illegal dumping	☐ Water quality/suspicious discharge
☐ Buffer restoration	☐ Access/fence/sign repair	☐ Stabilization/Vertical drain issue
☐ Increased ponding or flooding	☐ Other (describe below)	

Sinkhole Name/ID: _____ Foreman Initials: _____

Sinkholes

Maintenance Form



Other/Details:

MAINTENANCE ACTIVITIES PERFORMED		
☐ Traffic control/access setup	☐ Restrict access/install barricades	☐ Repair/install fencing or signage
☐ Trash and debris removal	☐ Remove nonhazardous illegal dumping	☐ Sediment control repair
☐ Stabilize upstream soil source	☐ Minor erosion repair (rills)	☐ Temporary Gully/headcut stabilization pending review
☐ Buffer vegetation repair/reseed	☐ Invasive or woody vegetation management	☐ Inlet/flow path stabilization
☐ Vertical drain/riser/trash rack cleanout	☐ Approved minor rock/filter/concrete repair	☐ Water quality response/reporting
☐ Survey or mark feature limits	☐ Geotechnical/engineering coordination	☐ Utility coordination
☐ Other (describe below)		

Other maintenance actions performed:

Sinkholes

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

AREAS ADDRESSED

☐ Sinkhole rim/perimeter	☐ Sinkhole throat/opening	☐ Side slopes
☐ Upstream drainage area	☐ Inflow swale/channel/pipe	☐ Overflow or bypass route
☐ Vegetated buffer	☐ Sediment controls/pretreatment	☐ Vertical drain/riser/trash rack
☐ Adjacent road/trail/utility/structure/property	☐ Access/fencing/signage	☐ Other (describe below)

Other areas addressed:

MATERIALS, EQUIPMENT, AND QUANTITIES

Equipment used (e.g., hand tools, mower, excavator, vacuum truck, survey equipment):

Maintenance hours/staff:

Materials used (e.g., topsoil, seed, erosion blanket, rock, filter material, concrete, fencing, signage):

Quantity of materials (volume, weight, area):

Sediment/debris removed (quantity and condition) and approved disposal location:

Sinkhole Name/ID: _____ Foreman Initials: _____

Sinkholes

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

SAFETY AND ENVIRONMENTAL CONTROLS

Stop work and re-establish access controls if new cracking, slumping, rapid enlargement, seepage/piping, hazardous material, or unstable ground is observed.

☐ Site access controlled and safe	☐ Unsafe area barricaded or fenced
☐ Work performed from stable ground	☐ No entry or probing into sinkhole/void
☐ Traffic/pedestrian control in place (if needed)	☐ Utility conflicts checked before excavation or equipment unloading (if needed)
☐ Erosion and sediment controls in place	☐ Spill response supplies available
☐ No fuel, oil, or material spills	☐ Removed material disposed in approved location away from sinkhole and drainage path
☐ Pesticide/fertilizer use avoided near feature	☐ Applicable regulatory coordination completed if needed
☐ Geotechnical/engineering review completed for work outside approved routine scope	☐ Area left clean and stable

CONDITION AFTER MAINTENANCE

Overall post-maintenance rating (use the inspection scale): _____/5

Safety/access condition:	☐ Controlled/acceptable	☐ Needs follow-up
Drainage/flow condition:	☐ Clear/restored	☐ Improved ☐ Still restricted
Erosion/sediment condition:	☐ Stable	☐ Improved ☐ Needs follow-up
Water quality/buffer condition:	☐ Acceptable	☐ Needs follow-up
Stabilization/vertical drain feature condition:	☐ Functional/not present	☐ Needs repair/review

Sinkhole Name/ID: _____ Foreman Initials: _____

Sinkholes

Maintenance Form



DOCUMENTATION			
Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A
Feature limits/edge measurements or survey recorded from stable ground:	☐ Yes	☐ No	☐ N/A
Water-quality, spill, or unauthorized-discharge report completed:	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED? ☐ Yes ☐ No ☐ N/A
(If yes, describe trigger)

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Attach additional pages, if required.

How to Maintain Your Bioswales



What is it?

A bioswale is a shallow, vegetated channel that receives stormwater runoff from streets, parking lots, sidewalks, roofs, and other hard surfaces. It slows runoff, and filters sediment and some stormwater pollutants through vegetation, soil, or engineered media, and safely conveys runoff to an outlet, downstream BMPs, storm drain system, or receiving drainage area.

Common Configurations

- Roadside or street-side bioswale
- Grass swale or enhanced swale
- Dry swale with engineered soil media
- Wet swale with permanent wet vegetation
- Bioswale with check dams or underdrain

Who maintains it?

Ownership and maintenance can differ. Bioswales may be maintained by cities, counties, drainage districts, TxDOT, HOAs, commercial property owners, or private owners. Communities should confirm ownership, easements, access rights, and responsibility for mowing, cleanout, vegetation care, underdrain work, and structural repairs.

Do not fill, regrade, compact, park in, alter check dams, remove vegetation, or change outlet elevations without confirming ownership, design requirements, and any local stormwater or permit obligations.

Best maintenance practices & strategies

Bioswales reduce runoff velocity, improve small-storm capture, and protect downstream systems by keeping sediment, trash, and pollutants out of pipes, channels, and receiving waters. Over time, sediment buildup, vegetation loss, erosion, rutting, blocked inlets, clogged underdrains, or damaged outlets can reduce performance and increase local flooding. Routine inspection and targeted maintenance preserve conveyance, filtration, drainage, public safety, and nearby infrastructure.

A. INSPECTION

Inspections confirm that runoff can enter the bioswale, flow through the vegetated channel, pond only as intended, and leave through the outlet, underdrain, or overflow route without erosion, clogging, nuisance standing water, or damage to adjacent property. An inspection checklist for bioswales is included with this reference sheet.

Inspection skill needs:

- Ability to recognize blocked inlets, sediment buildup, and narrowed flow paths
- Awareness of standing water, slow drawdown, erosion, and bypass flow
- Familiarity with basic features: drainage area, inflow, pretreatment, swale bottom, side slopes, check dams, underdrain, and outlet
- Ability to identify weeds, sparse vegetation, rutting, compaction, odors, oil sheen, or suspicious discharge
- Ability to document conditions clearly and flag when engineering or utility support is needed

What to look for:

- **Runoff sources that send excess sediment or pollutants to the swale.** Bare soil, eroding slopes, stockpiled dirt, grass clippings, leaves, oils, or other materials upstream can quickly clog vegetation and soil. Correcting the source is usually cheaper than rebuilding the swale.
- **Blocked or damaged inflow points.** Curb cuts, pipes, driveway openings, level spreaders, and rock aprons should be clear and stable. Blocked inlets can cause bypass flooding; damaged inflows can erode and deposit sediment into the swale.

- **Pretreatment or forebay areas filling with sediment.** Forebays, pea gravel diaphragms, and sediment traps are intended to catch coarse material before it reaches the main swale. If not cleaned routinely, sediment can smother vegetation and reduce capacity.
- **Standing water or slow drawdown.** A bioswale should drain or pond only as designed. Persistent water may indicate clogged soil, compaction, damaged grade control, a blocked underdrain, or an outlet problem. Compare observed water levels and drawdown to the approved configuration. Standing water beyond the specified drawdown period may indicate a problem in a dry bioswale, but saturated soil or permanent wet conditions may be intentional in a wet swale.
- **Sediment, leaves, trash, or mulch in the flow path.** Small accumulations should be removed before they seal the surface, block check dams, or divert flow into side slopes. Avoid moving loose mulch or clippings into the swale.
- **Vegetation health, weeds, and woody growth.** Vegetation slows water, traps sediment, and stabilizes soil. Sparse plants, dead areas, invasive growth, or woody vegetation in the main flow path should be corrected before erosion or clogging develops. Note that woody vegetation is not always undesirable; some Bioswales are intentionally designed with shrubs or trees outside the primary low-flow path(s). Remove volunteer woody growth only where it obstructs the intended flow path, damages structures, interferes with access, or conflicts with the approved planting plan.
- **Erosion, rutting, compaction, and side slope stability.** Look for rills, gullies, tire tracks, exposed soil, animal burrows, sinkholes, or slumping. These conditions reduce treatment and may redirect runoff toward streets, sidewalks, utilities, or buildings. However, animal burrows should not be repaired or eliminated automatically. Some have little impact on bioswale functionality, and wildlife considerations may apply. Evaluate burrows or holes for impacts to grades, vegetation, slope stability, structures, or public safety. Coordinate control or repair when required and permitted.
- **Underdrain, outlet, and access condition.** Cleanouts should be visible and accessible, outlets should be clear, and access routes should not be blocked by fences, parking, landscaping, or unauthorized structures.

How to record conditions:

- Use the standard bioswales inspection checklist or a digital tool so ratings are comparable over time

- Record Bioswale ID or facility name, location, date, weather, recent rainfall, and whether an underdrain is present
- Photograph inflows, pretreatment areas, flow path, vegetation, check dams, outlet, and any safety or flooding issue
- Note whether drainage appears clear, partially restricted, or severely restricted; describe where the problem occurs
- Flag urgent issues that could cause flooding, structural failure, illicit discharge, or public safety concerns

B. MAINTENANCE

Maintenance keeps the bioswale functioning as a stormwater treatment and conveyance feature. The goal is to keep the drainage area, inflow points, pretreatment areas, vegetated flow path, check dams, underdrain, and outlet working without disturbing the design grade or damaging vegetation.

Maintenance equipment and skill needs:

- Hand tools for trash removal, sediment scraping, weed removal, and minor grading
- Landscape tools for mowing, trimming, reseeding, plant replacement, and establishment watering
- Materials such as approved seed, plants, topsoil, erosion-control fabric, rock, and replacement cleanout caps
- Vacuum or jet-vac equipment when underdrains, cleanouts, or outlet connections are blocked
- Traffic/pedestrian control for work near streets, sidewalks, parking lots, schools, or public facilities
- Disposal plan for sediment, trash, invasive vegetation, and potentially contaminated material

Key maintenance goals:

- Keep runoff entering through designed inflow points. Remove debris and sediment from curb cuts, pipes, rock aprons, level spreaders, and forebays. Repair erosion before it sends more sediment into the swale.
- Maintain the vegetated flow path. Mow or trim to the design height, remove weeds and woody growth, reseed bare areas, and protect vegetation from parking, foot traffic, and compaction. Be sure to verify the approved planting and vegetation-management plan before mowing, trimming, pruning, or removing vegetation.
- Keep pretreatment working. Clean forebays, diaphragms, and sediment traps before accumulated material bypasses into the swale bottom.

- Protect grade controls and check dams. Remove trash and sediment around check dams. Repair bypass, settlement, or scour before flow cuts around the structure.
- Maintain drainage and drawdown. Remove accumulated sediment and/or repair settlement where it changes the intended flow path. Do not fill ponding areas or low points until the design profile and intended storage have been confirmed. . Control erosion and sediment sources. Stabilize bare soil, side slopes, and concentrated flow paths. Correct upstream sediment sources when possible rather than repeatedly cleaning the same material from the swale.
- Document and escalate unresolved problems. Record before/after conditions, drawdown concerns, materials used, and remaining issues. Request engineering review for repeated ponding, structural damage, persistent flooding, or suspected design issues.

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Remove trash and debris, check vegetation health, spot weed, mow or trim as appropriate, verify inflow paths, and clear outlets or cleanouts
- Before and after the main storm season, review sediment accumulation, drawdown, vegetation coverage, erosion, check dams, underdrain condition, and structural components
- Remove trash and debris, check vegetation health, spot weed, mow or trim as appropriate, verify inflow paths, and clear outlets or cleanouts

2. Annual maintenance and comprehensive review

- Review inspection history, repeated issues, photos, material quantities, access requirements, and budget needs. Confirm ownership, easements, access, and maintenance agreements remain current.
- Plan regrading, soil/media restoration, revegetation, underdrain jet-vac work, erosion repair, or structural repair when inspections show repeated impairment.

3. Pre-, in-, and post-storm events

- Before and after the main storm season, review sediment accumulation, drawdown, vegetation coverage, erosion, check dams, underdrain condition, and structural components
- After significant rainfall (e.g., reported overtopping/flooding or visible sediment transport), public complaints, or known construction/sediment activity upstream, check inlets, pretreatment areas, standing water, erosion, and public safety hazards

4. Maintenance decision logic

- Unsafe condition, flooding, illicit discharge, sinkhole, or structural failure? Restrict access, notify the appropriate supervisor or agency, and initiate emergency response or engineering review.
- Inlet, forebay, or flow spreader blocked? Remove sediment, trash, leaves, or mulch; restore inflow; then document source conditions upstream.
- Water standing beyond the drawdown? Check for surface sediment, compaction, blocked underdrain, damaged check dam, or blocked outlet. Clean minor problems first; escalate recurring ponding.
- Vegetation sparse, weeds spreading, or mowing too low? Remove weeds before seed set, reseed or replant with appropriate species, and correct stress sources such as sediment, drought, mowing, or foot/vehicle traffic.
- Erosion, bypass, or sediment source recurring? Stabilize the flow path and request engineering review if concentrated flow, grade control failure, slope failure, or design geometry is causing repeat damage.

5. Factors that may influence the maintenance schedule

- Recent heavy rainfall, repeated small storms, flooding complaints, or standing water beyond the design drain time
- Upstream construction, bare soil, damaged pavement, leaf drop, mowing practices, or illegal dumping
- High public use, school or park settings, traffic exposure, blocked sidewalks, or access limitations
- New or recurring weeds, dead plants, drought stress, irrigation problems, rutting, or compaction
- Known underdrain, outlet, check dam, or pretreatment problems; repeated sediment removal at the same location
- Nearby roads, utilities, buildings, schools, emergency routes, or other critical facilities

6. Repair vs. reconstruction/redesign considerations

- Continue maintenance or minor repair when sediment, vegetation, mowing, access, or small erosion problems are localized and the swale drains and conveys runoff as intended
- Consider engineering review, reconstruction, or redesign when ponding repeats after surface cleaning, the underdrain appears failed, check dams repeatedly bypass, vegetation cannot establish, the outlet is blocked by design, structural features are damaged, or consequences to people and infrastructure are high

KEY REMINDER:

Do not fill, compact, over-mow, over-fertilize, spray, regrade, alter check dams, replace soil/media, change underdrains, or modify overflow elevations without confirming the approved design, ownership, environmental constraints, and impacts to adjacent properties and infrastructure.

Bioswale Name/ ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Recent Storm Event?	☐ Yes ☐ No
Underdrain Present	☐ Yes ☐ No ☐ Unknown
Bioswale Type	☐ Dry ☐ Wet ☐ Enhanced ☐ With Underdrain ☐ Other
Area (Acre/ft ²)	
Design Drawdown	
Recent Rainfall	
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Traffic hazards/unsafe access	☐ Standing water/deep water hazard	☐ Hazardous material/oil sheen	☐ Unstable side slope/sinkhole
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Note: Check whether this is a wet or dry Bioswale. Compare observed water levels and drawdown to the approved configuration. Standing water beyond the specified drawdown period may indicate a problem in a dry bioswale, but saturated soil or permanent wet conditions may be intentional in a wet swale. Please be sure that the inspection checklist distinguishes between an extended temporary ponding and ponding beyond the intended design duration. Without this distinction, it may be easy for staff to mistakenly alter a properly functioning wet swale.

Bioswales

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Drainage Area and Source Conditions	Overall	☐	☐	☐	☐	☐
	Bare soil or erosion sending sediment to swale	☐	☐	☐	☐	☐
	Yard waste, leaves, or trash entering swale	☐	☐	☐	☐	☐
	Hazardous material, oil, or suspicious discharge	☐	☐	☐	☐	☐
Inflow Points and Pretreatment	Overall	☐	☐	☐	☐	☐
	Inlet or curb cut blocked by sediment, debris, mulch, or vegetation	☐	☐	☐	☐	☐
	Erosion at inflow or energy dissipater	☐	☐	☐	☐	☐
	Pretreatment or forebay sediment buildup	☐	☐	☐	☐	☐
	Level spreader or flow spreader damaged	☐	☐	☐	☐	☐
Swale Flow Path and Capacity	Overall	☐	☐	☐	☐	☐
	Flow path obstructed or narrowed	☐	☐	☐	☐	☐
	Standing water or slow drawdown	☐	☐	☐	☐	☐
	Channel bottom uneven, compacted, or clogged	☐	☐	☐	☐	☐
	Check dams or grade controls bypassing or damaged	☐	☐	☐	☐	☐
Vegetation and Soil Cover	Overall	☐	☐	☐	☐	☐
	Planned vegetation coverage and health	☐	☐	☐	☐	☐
	Weeds, invasive plants, or woody growth	☐	☐	☐	☐	☐
	Vegetation height or density unsuitable	☐	☐	☐	☐	☐
	Bare soil, rutting, or compaction	☐	☐	☐	☐	☐
Erosion and Side Slopes	Overall	☐	☐	☐	☐	☐
	Rill or gully erosion in bottom or side slopes	☐	☐	☐	☐	☐
	Side slope instability or settlement	☐	☐	☐	☐	☐
	Outfall undercut or scour	☐	☐	☐	☐	☐
	Animal burrows or holes	☐	☐	☐	☐	☐

Bioswale Name/ID : _____ Inspector Initials: _____

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Underdrain and Outlet Structures (if present)	Overall	☐	☐	☐	☐	☐
	Evidence of clogged underdrain	☐	☐	☐	☐	☐
	Cleanout or observation port damaged or inaccessible	☐	☐	☐	☐	☐
	Outlet or trash rack blocked	☐	☐	☐	☐	☐
	Structural damage	☐	☐	☐	☐	☐
Access, Easements, and Safety	Overall	☐	☐	☐	☐	☐
	Maintenance access blocked	☐	☐	☐	☐	☐
	Encroachment or unauthorized structures	☐	☐	☐	☐	☐
	Traffic or pedestrian hazards	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐
Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Localized flooding impacts to property	☐	☐	☐	☐	☐
	Threat to roads, sidewalks, or critical facilities	☐	☐	☐	☐	☐
	Utilities or structures impacted	☐	☐	☐	☐	☐

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

Attach additional pages, if required.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Drainage Area and Source Conditions	Bare soil or erosion sending sediment to swale	No bare soil or erosion observed.	Small bare area; no sediment reaching swale.	Erosion or rills send some sediment toward inlet.	Active erosion repeatedly deposits sediment in swale.	Major sediment source overwhelms swale; engineering review.
	Yard waste, leaves, or trash entering swale	No source debris observed.	Minor loose material nearby; easy cleanup.	Material entering swale; remove and correct source.	Recurring buildup blocks inflow or vegetation.	Large dumping or blockage creates flooding or safety risk.
	Hazardous material, oil, or suspicious discharge	None observed.	Minor staining; document and monitor.	Persistent stain, odor, or dry-weather flow; investigate.	Strong evidence of illicit discharge; report and isolate.	Active spill or hazardous condition; immediate response.
Inflow Points and Pretreatment	Inlet or curb cut blocked by sediment, debris, mulch, or vegetation	Clear; water can enter as intended.	Minor debris; flow still enters.	Partial blockage diverts or slows inflow.	Major blockage; runoff bypasses swale.	Blocked inlet causing flooding or roadway/property impacts.
	Erosion at inflow or energy dissipater	No erosion; dissipater stable.	Minor surface wear; monitor.	Rill or scour developing; repair and stabilize.	Undercutting or gully threatens inlet/rundown.	Active failure threatens structure or sends heavy sediment.
	Pretreatment or forebay sediment buildup	Little or no buildup.	Localized grit or leaves; remove routinely.	Noticeable buildup; pretreatment capacity reduced.	Heavy buildup washing sediment into swale.	Forebay filled or blocked; immediate cleanout.
	Level spreader or flow spreader damaged	Intact, level, and distributing flow.	Minor wear; monitor.	Low spot or crack concentrates some flow.	Damage directs flow to one area and causes erosion.	Failure bypasses swale or creates hazard.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Swale Flow Path and Capacity	Flow path obstructed or narrowed	Open with design shape visible.	Minor growth or debris; flow passes.	Partial narrowing; water slows or concentrates.	Major narrowing; bypass likely during storms.	Blocked or severely narrowed; flooding likely or active.
	Standing water or slow drawdown	Drains within expected design time.	Short-lived ponding; monitor.	Water remains beyond expected time in some areas.	Frequent standing water across much of swale.	Persistent water causes odor, mosquito, or failure concerns.
	Channel bottom uneven, compacted, or clogged	Bottom even and uncompacted.	Small ruts or low spots; monitor.	Compaction or low spots alter flow pattern.	Major compaction, crusting, or clogging reduces infiltration.	Severe clogging; swale no longer treats runoff.
	Check dams or grade controls bypassing or damaged	Structures stable; flow through intended notch or path.	Minor wear or sediment; function maintained.	Bypass or damage beginning; schedule repair.	Major bypass, scour, or settling affects grade control.	Failed structure causes erosion, flooding, or unsafe ponding.
Vegetation and Soil Cover	Planned vegetation coverage and health	Plants healthy and covering intended area.	Localized stress or thin spots.	Patchy coverage; reseedling or replanting needed.	Large bare or dead areas reduce stability and treatment.	Vegetation failure causing erosion or loss of function.
	Weeds, invasive plants, or woody growth	None observed or isolated plants only.	Localized weeds; routine removal.	Weeds/invasives spreading; targeted control needed.	Dense growth blocks flow, access, or desired plants.	Woody or invasive growth damages swale or structures.
	Vegetation height or density unsuitable	Height and density support flow and filtration.	Slightly high or thin; monitor.	Height/density reducing flow or filtration; adjust maintenance.	Vegetation too tall, matted, or scalped over large areas.	Height/density causes bypass, erosion, or safety issue.
	Bare soil, rutting, or compaction	No bare soil, rutting, or compaction.	Small localized bare or rutted area.	Ruts or compaction altering flow; repair planned.	Large ruts or compacted areas reduce infiltration and stability.	Severe rutting/compaction causes bypass or slope failure.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Erosion and Side Slopes	Rill or gully erosion in bottom or side slopes	No erosion.	Minor rills; easy repair.	Rills/gullies forming; repair and stabilize.	Gullies deliver sediment or divert flow.	Active severe erosion; urgent repair.
	Side slope instability or settlement	Slopes stable; no settlement.	Minor settlement or sloughing.	Settlement or slumping may affect slope stability.	Slope movement threatens swale, access, or outlet.	Slope failure or collapse; close area and repair.
	Outfall undercut or scour	No scour; outlet stable.	Minor scour indicators.	Scour hole developing; stabilization needed.	Severe scour undermines outlet or downstream channel.	Outfall failure or headcutting threatens infrastructure.
	Animal burrows or holes	None observed.	Minor shallow holes; monitor.	Burrows affect vegetation or grade; repair needed.	Burrows threaten slope stability or create trip hazards.	Active collapse/voids; restrict access and correct.
Underdrain and Outlet Structures (if present)	Evidence of clogged underdrain	No backup or slow-drain indicators.	Slightly slow drain time; monitor.	Repeated slow drawdown suggests partial clog.	Standing water indicates likely clogged underdrain.	Blocked underdrain; facility not functioning.
	Cleanout or observation port damaged or inaccessible	Cleanout visible and intact.	Minor obstruction; accessible.	Access partly blocked or cap damaged.	Cleanout inaccessible; maintenance delayed.	Cleanout missing/damaged with safety or system concern.
	Outlet or trash rack blocked	Clear; outlet path visible.	Minor debris; remove routinely.	Partial blockage; capacity reduced.	Major blockage; backup likely during storms.	Blocked outlet causing or threatening flooding.
	Structural damage	Structure sound.	Minor crack, spall, or grate wear.	Moderate damage; repair needed.	Severe cracking, settlement, or grate failure.	Collapse or imminent failure; immediate action.

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Access, Easements, and Safety	Maintenance access blocked	Access route open and usable.	Minor vegetation or obstruction; remove routinely.	Access partially blocked; extra setup needed.	Access blocked for equipment or safe inspection.	No safe access to critical area; urgent correction.
	Encroachment or unauthorized structures	No encroachment observed.	Minor movable item in easement.	Fence, storage, or landscape limits access or flow.	Encroachment blocks access or alters stormwater flow.	Encroachment creates flooding or emergency response issue.
	Traffic or pedestrian hazards	No hazard.	Minor nuisance near walkway or curb.	Hazard present; mark or schedule controls.	Serious hazard; restrict access or add traffic controls.	Immediate danger; emergency controls required.
	Public safety hazards	None observed.	Minor hazard; monitor.	Hazard present; controls needed.	Serious hazard; restrict access.	Immediate danger to public; emergency response required.
Impacts to People and Infrastructure	Localized flooding impacts to property	No flooding impact.	Minor nuisance ponding in landscape only.	Repeated nuisance flooding or overflow near property.	Flooding threatens structures, pavement, or access.	Active flooding of structures or critical access.
	Threat to roads, sidewalks, or critical facilities	No threat.	Minor nuisance near paved area.	Repeated ponding or erosion near roadway/sidewalk.	Road, sidewalk, or facility damage likely.	Immediate threat to roadway, utility, or critical facility.
	Utilities or structures impacted	No impact.	Minor proximity concern; monitor.	Erosion or flooding approaching utility/structure.	Utility/structure exposed, undermined, or repeatedly flooded.	Immediate utility/structure failure or life safety concern.

Bioswale Name/ID	
Location	
Date/Time	START: __/__/____ END: __/__/____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Recent Storm Event?	☐ Yes ☐ No
Underdrain Present	☐ Yes ☐ No ☐ Unknown
Bioswale Type	☐ Dry ☐ Wet ☐ Enhanced ☐ With Underdrain ☐ Other
Area (Acre/ft ²)	
Design Drawdown	
Recent Rainfall	
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

Note: Check whether this is a Wet or a Dry Bioswale. Compare observed water levels and drawdown to the approved configuration. Standing water beyond the specified drawdown period may indicate a problem in a dry bioswale, but saturated soil or permanent wet conditions may be intentional in a wet swale. Please be sure that the inspection checklist distinguishes between an extended temporary ponding and ponding beyond the intended design duration. Without this distinction, it may be easy for staff to mistakenly alter a properly functioning wet swale.

Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up
☐ Complaint/service request	☐ Emergency/safety issue	☐ Standing water/slow drawdown
☐ Trash/debris removal	☐ Sediment buildup reducing capacity	☐ Inflow/pretreatment blockage
☐ Vegetation/weeds/reseeding	☐ Erosion repair needed	☐ Underdrain/outlet issue
☐ Structural/check dam damage	☐ Encroachment/access issue	☐ Other (describe below)

Other/Details:

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic/pedestrian access setup	☐ Trash and debris removal	☐ Remove illegal dumping
☐ Clear inlet/curb cut/pipe	☐ Pretreatment/forebay cleanout	☐ Remove sediment from swale bottom
☐ Mow/trim to design height	☐ Weed/invasive vegetation removal	☐ Reseed/replant vegetation
☐ Repair bare soil/ruts/compaction	☐ Establishment watering/irrigation repair	☐ Minor grading/restore design section
☐ Erosion repair/stabilization	☐ Rock apron/energy dissipater repair	☐ Check dam/grade control repair
☐ Underdrain cleanout/jet-vac	☐ Outlet/trash rack cleaning	☐ Structural repair
☐ Remove encroachments/restore access	☐ Engineering/regulatory coordination	☐ Other (describe below)

Other maintenance actions performed:

Maintenance Form

Asset Management Guidance for Community Flood Infrastructure

AREAS ADDRESSED		
☐ Drainage area/source area	☐ Inflow points	☐ Pretreatment/forebay
☐ Swale bottom/flow path	☐ Side slopes	☐ Vegetation/soil cover
☐ Check dams/grade controls	☐ Underdrain cleanout	☐ Outlet structure
☐ Access/easement area	☐ Adjacent pavement/sidewalk	☐ Nearby road/utility/structure
☐ Other (describe below)		

Other areas addressed:

MATERIALS, EQUIPMENT, AND QUANTITIES

Equipment used (e.g., hand tools, shovel, mower/string trimmer, vacuum truck, jetter, water tank):

Maintenance hours/Staff:

Sediment, trash, or debris removed (estimate volume and disposal location):

Soil/media, seed, plants, rock, or erosion-control materials used:

Check dam, underdrain, outlet, grate, or structural parts repaired/replaced:

Watering, mowing, vegetation, or access work completed:

SAFETY, ENVIRONMENTAL, AND REGULATORY CONTROLS

☐ Site access controlled and safe	☐ Removed sediment and debris disposed where it cannot re-enter the system
☐ Work performed outside unsafe active flow or storm conditions	☐ No fuel, oil, or material spills
☐ Traffic/pedestrian control in place (if needed)	☐ Fertilizer, pesticide, or herbicide avoided unless approved and documented
☐ Erosion and sediment controls in place	☐ Area left clean and stable, with inflow/outflow routes open

CONDITION AFTER MAINTENANCE

Inflow and pretreatment condition after work:	☐ Clear/restored	☐ Improved	☐ Still restricted
Swale bottom/flow path condition after work:	☐ Clear/restored	☐ Improved	☐ Still restricted
Vegetation and soil cover condition after work:	☐ Stable	☐ Improved	☐ Needs follow-up
Erosion and side slope condition after work:	☐ Stable	☐ Improved	☐ Needs follow-up
Outlet/underdrain condition after work:	☐ Clear/restored	☐ Improved	☐ Still restricted

DOCUMENTATION

Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A
Rainfall or storm timing recorded:	☐ Yes	☐ No	☐ N/A
Sediment/debris disposal documented:	☐ Yes	☐ No	☐ N/A
Underdrain or outlet work documented:	☐ Yes	☐ No	☐ N/A
Vegetation/seed/mowing work documented:	☐ Yes	☐ No	☐ N/A
Engineering/regulatory coordination documented:	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED?

(If yes, describe trigger)

☐ Yes ☐ No ☐ N/A

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

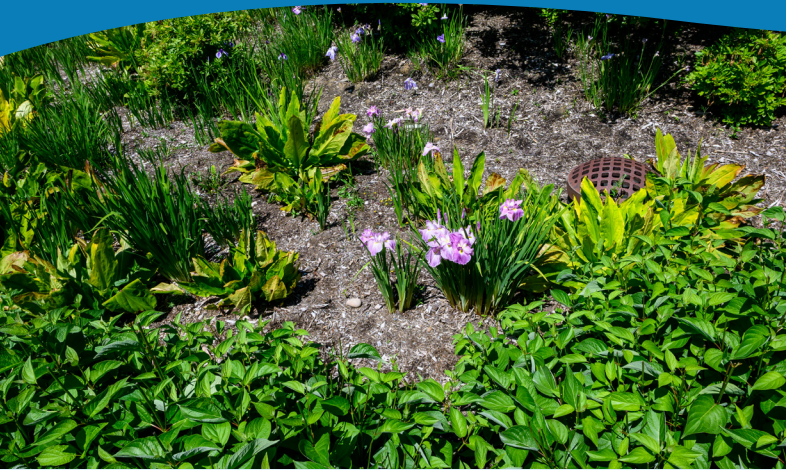
Maintenance Form



Notes and Observations:

Bioswale Name/ID: _____ Foreman Initials: _____

How to Maintain Your Rain Gardens



What is it?

A rain garden is a landscaped depression that captures and temporarily stores runoff, using engineered or well-draining native soils and vegetation to filter pollutants and allow infiltration. These systems use engineered or well-draining native soils and vegetation to filter, treat, and infiltrate runoff on-site.

Common Settings

- Residential or neighborhood
- Street or curbside
- Parking-lot bioretention cell (Note: Rain Gardens are a form of bioretention cells, but terminology and design complexity can vary)
- Adjacent to rooftop downspouts

Common Configurations

- With forebay or pretreatment
- With underdrain and overflow outlet

Who maintains it?

Ownership and maintenance can differ. Rain gardens may be maintained by cities, counties, drainage districts, school districts, HOAs, commercial property owners, or private owners. Communities should confirm ownership, easements, access rights, and responsibility for inspection, cleanout, planting care, underdrain work, and structural repairs.

Do not regrade, fill, remove filter media, alter an underdrain, or block the overflow route without confirming ownership, design requirements, and any local stormwater or permit obligations.

Best maintenance practices & strategies

Rain gardens reduce small-storm runoff, slow peak flows, and improve water quality by allowing stormwater to pond briefly and filter through vegetation and media, when properly sited, designed, and maintained. Over time, sediment, mulch, trash, invasive vegetation, erosion, clogged underdrains, or blocked overflow routes can reduce performance and create local flooding. Routine inspection and targeted maintenance preserve filtration, drainage, vegetation, public safety, and nearby infrastructure.

A. INSPECTION

Inspections confirm that runoff can enter the rain garden, pond only temporarily, filter through the surface, and leave through the underdrain or overflow route without erosion, clogging, nuisance standing water, or damage to adjacent property. An inspection checklist for rain gardens is included with this reference sheet.

Inspection skill needs:

- Ability to recognize blocked inlets, sediment buildup, and clogged surface media
- Awareness of ponding, slow drawdown, erosion, and overflow routing problems
- Familiarity with basic features: drainage area, inflow, forebay, filter media, plants, underdrain, overflow outlet, and embankments
- Ability to identify weeds, sparse vegetation, mulch displacement, trash, odors, oil sheen, or suspicious discharge
- Ability to document conditions clearly and flag when engineering or utility support is needed

What to look for:

- **Runoff sources that send excess sediment or pollutants to the garden.** Bare soil, eroding slopes, stockpiled dirt, grass clippings, leaves, oils, or other materials upstream can quickly clog the garden. Correcting the source is usually cheaper than rebuilding the media.
- **Blocked or damaged inflow points.** Curb cuts, pipes, run-downs, rock aprons, and sheet-flow openings should be clear and stable. Blocked inlets can cause

bypass flooding; damaged inlets can erode and deposit sediment into the garden.

- **Forebay or pretreatment areas filling with sediment.** A forebay is intended to catch sediment before it reaches the filter media. If it is not cleaned routinely, the main surface will clog faster, and maintenance costs will increase.
- **Standing water or slow drawdown.** Rain gardens should drain by the design drain time (typically 24 to 48 hours). Persistent ponding may indicate clogged media, compacted surface, blocked underdrain, or an incorrect outlet elevation.
- **Sediment, mulch, leaves, or trash on the filter surface.** Small accumulations should be removed before they seal the surface or block overflow grates. Avoid adding too much mulch because it can float and clog inlets or outlets.
- **Vegetation health and weeds.** Plants help maintain infiltration, uptake water, stabilize soil, and improve appearance. Sparse plants, invasive growth, or dead areas should be corrected before erosion or clogging develops.
- **Underdrain, overflow outlet, and embankment condition.** Cleanouts should be accessible, overflow structures should be clear, and side slopes should be stable. Damage or settlement may require repair beyond routine landscape work.
- **Public safety, property, and access impacts.** Flag hazards such as deep standing water, sinkholes, unstable slopes, exposed structures, blocked sidewalks, or recurring flooding near roads, utilities, or buildings.

How to record conditions:

- Use the standard rain garden inspection checklist or a digital tool so ratings are comparable over time
- Record Rain Garden ID or facility name/ID, location, date, weather, recent rainfall, and whether the underdrain is present
- Photograph inflows, forebay, filter surface, vegetation, overflow outlet, and any safety or flooding issue
- Note whether drainage appears clear, partially restricted, or severely restricted; describe where the problem occurs
- Flag urgent issues that could cause flooding, standing-water hazards, structural failure, illicit discharge, or public safety concerns

B. MAINTENANCE

Maintenance keeps the rain garden functioning as a stormwater treatment and small-storm storage feature. The goal is to keep the inflow, surface media, vegetation, underdrain, and overflow route working without disturbing the design grade or damaging the planting system. A maintenance checklist for rain gardens is included with this reference sheet.

Maintenance equipment and skill needs:

- Hand tools for trash removal, sediment scraping, mulch adjustment, and light grading
- Landscape tools for pruning, weed removal, plant replacement, and establishment watering
- Materials such as approved filter media, mulch, seed, plants, erosion-control fabric, rock, and replacement cleanout caps
- Vacuum or jet-vac equipment when underdrains, cleanouts, or outlet connections are blocked
- Traffic/pedestrian control for work near streets, sidewalks, parking lots, or school/public facilities
- Disposal plan for sediment, trash, invasive vegetation, and potentially contaminated material

Key maintenance goals:

- Keep runoff entering through designed inflow points. Remove debris and sediment from curb cuts, pipes, rock aprons, forebays, and sheet-flow openings. Repair erosion before it sends more sediment into the garden.
- Maintain infiltration and drawdown. Remove surface sediment and excess mulch. Replace the top layer of media only when inspection findings show persistent ponding or clogging and use media that matches the approved design.
- Keep pretreatment working. Clean forebays before accumulated material bypasses into the planting bed. Repair cracked or settled concrete pads, weirs, or drain pipes when they affect drainage.
- Protect vegetation and mulch. Maintain healthy planned vegetation, remove weeds and invasive growth, replace failed plants, and keep mulch at a functional depth without blocking inlets or outlets.
- Keep underdrains and overflow outlets clear. Keep cleanouts accessible, remove trash and vegetation from overflow structures, and use jet-vac cleaning when underdrain blockage is suspected.
- Control erosion and sediment sources. Stabilize bare soil, side slopes, and concentrated flow paths. Correct upstream sediment sources when possible rather

than repeatedly cleaning the same material from the garden.

- Document and escalate unresolved problems. Record before/after conditions, drain-time concerns, materials used, and remaining issues. Request engineering review for repeated ponding, structural damage, persistent flooding, or suspected design issues.

SCHEDULING MAINTENANCE

1. Routine and seasonal maintenance

- Remove trash and debris, check plant health, spot weed, adjust mulch, verify inflow paths, and clear overflow grates or cleanouts.
- Before and after the main storm season, review sediment accumulation, drawdown, vegetation coverage, erosion, and structural condition. Update the maintenance priority list.
- Plan surface media restoration, plant replacement, underdrain jet-vac work, erosion repair, or structural repair when inspections show repeated impairment.

2. Annual maintenance and comprehensive review

- Review inspection history, repeated issues, photos, material quantities, and budget needs. Confirm ownership, access, and maintenance agreements remain current.

3. Frequent/post-storm events

- After significant rainfall (reported instances of overtopping, reported flooding, visible sediment transport, etc.), public complaints, or known construction/sediment activity upstream, check inlets, forebay, ponding, overflow outlet, erosion, and public safety hazards.

4. Maintenance decision logic

- **Unsafe condition, flooding, illicit discharge, sinkhole, or structural failure**
Restrict access, notify the appropriate supervisor or agency, and initiate emergency response or engineering review.
- **Inlet or forebay blocked**
Remove sediment, trash, leaves, or mulch; repair the inflow surface; then document source conditions upstream.
- **Water standing beyond the design drain time**
Check for surface sediment, excess mulch, compaction, blocked underdrain, or blocked outlet. Clean minor problems first; escalate recurring ponding.

- **Vegetation sparse or weeds spreading**

Remove weeds before seed set, replace failed plants with appropriate species, and correct stress sources such as sediment, drought, or prolonged ponding.

- **Erosion or sediment source recurring**

Stabilize the flow path and request engineering review if concentrated flow, slope failure, or design geometry is causing repeat damage.

5. Factors that may influence the maintenance schedule

- Recent heavy rainfall, repeated small storms, flooding complaints, or standing water beyond the design drain time
- Upstream construction, bare soil, damaged pavement, leaf drop, mowing practices, or illegal dumping
- High public use, school or park settings, traffic exposure, or blocked sidewalks and accessible routes
- New or recurring weeds, dead plants, drought stress, irrigation problems, or mulch displacement
- Known underdrain, overflow outlet, or forebay problems; repeated sediment removal at the same location
- Nearby roads, utilities, buildings, schools, emergency routes, or other critical facilities

6. Repair vs. replacement considerations

- **Factors that indicate continued maintenance and repair** include localized sediment, vegetation, mulch, or small erosion problems when the garden drains and overflows as intended.
- **Factors that indicate reconstruction or redesign** include repeated ponding after surface cleaning, failed underdrains, blocked overflow routes, contaminated or severely clogged media, damaged structural features, or high consequences to people and infrastructure.

KEY REMINDER:

Do not fill, compact, over-mulch, fertilize, spray, regrade, replace media, alter an underdrain, or change overflow elevations without confirming the approved design, ownership, environmental constraints, and impacts to adjacent properties and infrastructure.

Rain Gardens

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Rain Garden Name/ID	
Location	
Date/Time	
Inspector	
Inspection Team	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____ °F
Recent storm events?	☐ Yes ☐ No
Underdrain Present	☐ Yes ☐ No ☐ Unknown
Drainage Area (Acre/ft ²)	
Design Drain Time	
Recent Rainfall	
Rain Garden Type	☐ Residential ☐ Street ☐ Parking Lot ☐ Planter ☐ Other
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

SAFETY CHECK – STOP IF UNSAFE

If checked, report and do not enter.

☐ Traffic hazards/unsafe access	☐ Standing water/deep water hazard	☐ Hazardous material/oil sheen	☐ Unstable slope/sinkhole
--	---	---	--

Required drawdown time: ____ hours after the end of the design storm, based on approved plans or design criteria.

To avoid relying on a one-time observation of standing water, the maintenance staff should record, if applicable:

- Approximate rainfall date and end time _____
- Estimated maximum ponding depth, where observable _____
- Time water was first observed _____
- Time the basin became free of standing water _____

Rain Garden Name/ID: _____ Inspector Initials: _____

Rain Gardens

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Drainage Area and Source Conditions	Overall	☐	☐	☐	☐	☐
	Bare soil or erosion sending sediment to garden	☐	☐	☐	☐	☐
	Yard waste, mulch, leaves, or trash entering garden	☐	☐	☐	☐	☐
	Hazardous material, oil, or suspicious discharge	☐	☐	☐	☐	☐
Inflow Points	Overall	☐	☐	☐	☐	☐
	Inlet blocked by sediment, debris, mulch, or vegetation	☐	☐	☐	☐	☐
	Erosion present/outfall undercut	☐	☐	☐	☐	☐
	Riprap/run-down, curb cut, or pipe damaged	☐	☐	☐	☐	☐
Forebay/Pretreatment	Overall	☐	☐	☐	☐	☐
	Sediment/debris accumulation	☐	☐	☐	☐	☐
	Concrete cracking/failing	☐	☐	☐	☐	☐
	Drain pipe/weir clogged or damaged	☐	☐	☐	☐	☐
Filter Media and Ponding Area	Overall	☐	☐	☐	☐	☐
	Standing water or slow drawdown	☐	☐	☐	☐	☐
	Sediment or mulch buildup on filter surface	☐	☐	☐	☐	☐
	Surface uneven, compacted, or clogged	☐	☐	☐	☐	☐
Vegetation and Mulch	Overall	☐	☐	☐	☐	☐
	Native/planned vegetation coverage and health	☐	☐	☐	☐	☐
	Woody growth/weeds/invasive vegetation	☐	☐	☐	☐	☐
	Mulch depth or mulch blocking flow	☐	☐	☐	☐	☐
Underdrain System (if present)	Overall	☐	☐	☐	☐	☐
	Evidence of clogged system	☐	☐	☐	☐	☐
	Cleanout/observation port damaged or inaccessible	☐	☐	☐	☐	☐

Rain Garden Name/ID: _____ Inspector Initials: _____

Rain Gardens

Inspection Checklist



Asset Management Guidance for Community Flood Infrastructure

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Overflow Outlet Structure	Overall	☐	☐	☐	☐	☐
	Outlet or trash rack blocked	☐	☐	☐	☐	☐
	Structural damage	☐	☐	☐	☐	☐
	Woody growth/undesirable vegetation	☐	☐	☐	☐	☐
Embankments and Side Slopes	Overall	☐	☐	☐	☐	☐
	Vegetation sparse	☐	☐	☐	☐	☐
	Erosion present	☐	☐	☐	☐	☐
	Settlement, sinkhole, or animal burrows	☐	☐	☐	☐	☐
Impacts to People and Infrastructure	Overall	☐	☐	☐	☐	☐
	Localized flooding impacts to property	☐	☐	☐	☐	☐
	Threat to roads/sidewalks/critical facilities	☐	☐	☐	☐	☐
	Public safety hazards	☐	☐	☐	☐	☐

Rain Garden Name/ID: _____ Inspector Initials: _____

Rain Gardens

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Drainage Area and Source Conditions	Bare soil or erosion sending sediment to garden	No bare soil or erosion observed.	Small bare area; no sediment reaching garden.	Erosion or rills send some sediment toward inlet.	Active erosion repeatedly deposits sediment in garden.	Major sediment source overwhelms garden; engineering review.
	Yard waste, mulch, leaves, or trash entering garden	No source debris observed.	Minor loose material nearby; easy cleanup.	Material entering garden; remove and correct source.	Recurring buildup blocks inflow or surface.	Large dumping or blockage creates flooding or safety risk.
	Hazardous material, oil, or suspicious discharge	None observed.	Minor staining; document and monitor.	Persistent stain, odor, or dry-weather flow; investigate.	Strong evidence of illicit discharge; report and isolate.	Active spill or hazardous condition; immediate response.
Inflow Points	Inlet blocked by sediment, debris, mulch, or vegetation	Clear; water can enter as intended.	Minor debris; flow still enters.	Partial blockage diverts or slows inflow.	Major blockage; runoff bypasses garden during storms.	Blocked inlet causing flooding or roadway/property impacts.
	Erosion present/outfall undercut	No erosion; dissipater stable.	Minor surface wear; monitor.	Rill or scour developing; repair and stabilize.	Undercutting or gully threatens inlet/rundown.	Active failure threatens structure or sends heavy sediment.
	Riprap/rundown, curb cut, or pipe damaged	Intact and aligned.	Minor displacement or wear.	Damage visible; repair planned.	Broken or displaced feature reduces performance.	Feature failed; immediate repair needed to prevent flooding.
Forebay/Pretreatment	Sediment/debris accumulation	Little or no buildup.	Localized grit or leaves; remove routinely.	Noticeable buildup; capacity reduced.	Heavy buildup; sediment washing into filter media.	Forebay filled or blocked; immediate cleanout.
	Concrete cracking/failing	Concrete sound.	Hairline cracks or minor spalls.	Cracks/spalls need repair planning.	Settlement or broken concrete affects flow path.	Failure undermines pretreatment or creates hazard.
	Drain pipe/weir clogged or damaged	Drain/weir clear and intact.	Minor debris; drains.	Partial clog or minor damage; standing water possible.	Clogged or damaged; forebay not draining correctly.	Failed feature causes overflow, mosquito nuisance, or bypass.

Rain Gardens

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Filter Media and Ponding Area	Standing water or slow drawdown	Drains within expected design time.	Short-lived ponding; monitor.	Water remains beyond expected time in some areas.	Frequent standing water across much of surface.	Standing water persists for days or creates safety/vector issue.
	Sediment or mulch buildup on filter surface	Surface free of excess buildup.	Minor localized buildup.	Buildup covers parts of surface; remove.	Heavy buildup restricts infiltration or raises grade.	Surface buried or sealed; media rehabilitation needed.
	Surface uneven, compacted, or clogged	Surface even and uncompacted.	Small low spots or foot traffic; monitor.	Compaction or low spots alter ponding pattern.	Major compaction or crusting reduces infiltration.	Severe clogging; garden no longer treats runoff.
Vegetation and Mulch	Native/planned vegetation coverage and health	Plants healthy and covering intended area.	Localized stress or dead plants.	Patchy coverage; replacement planting needed.	Large bare or dead areas reduce treatment and stability.	Vegetation failure causing erosion or loss of function.
	Woody growth/weeds/invasive vegetation	None observed or isolated plants only.	Localized weeds; routine removal.	Weeds/invasives spreading; targeted control needed.	Dense growth blocks flow, access, or desired plants.	Vegetation blocks outlet/underdrain access or damages facility.
	Mulch depth or mulch blocking flow	Mulch depth appropriate; not mobile.	Minor thin or displaced mulch.	Mulch too thin/thick or collecting at inlet/outlet.	Mulch movement blocks flow or smothers plants.	Mulch causes blockage, bypass, or surface clogging.
Underdrain System (if present)	Evidence of clogged system	No standing water or backup indicators.	Slightly slow drain time; monitor.	Repeated slow drawdown suggests partial clog.	Standing water indicates likely clogged underdrain.	Blocked underdrain; facility not functioning.
	Cleanout/observation port damaged or inaccessible	Cleanout visible and intact.	Minor obstruction; accessible.	Access partly blocked or cap damaged.	Cleanout inaccessible; maintenance delayed.	Cleanout missing/damaged with safety or system failure concern.

Rain Gardens

Rubrics and Guidelines

Category	Subcategory	1 Minor	2 Mild	3 Notable	4 Major	5 Critical
Overflow Outlet Structure	Outlet or trash rack blocked	Clear; overflow path visible.	Minor debris; remove routinely.	Partial blockage; capacity reduced.	Major blockage; backup likely during storms.	Blocked outlet causing or threatening flooding.
	Structural damage	Structure sound.	Minor crack, spall, or grate wear.	Moderate damage; repair needed.	Severe cracking, settlement, or grate failure.	Collapse or imminent failure; immediate action.
	Woody growth/undesirable vegetation	No obstruction by vegetation.	Minor growth near structure.	Vegetation beginning to block access or grate.	Dense growth blocks overflow or hides structure.	Vegetation causes overflow blockage or structural damage.
Embankments and Side Slopes	Vegetation sparse	Adequate cover.	Small thin areas.	Sparse areas expose soil; reseed or plant.	Large bare areas likely to erode.	Vegetation loss causing active sediment loading.
	Erosion present	No erosion.	Minor surface erosion.	Rills forming; repair and stabilize.	Gullies or slope cuts deliver sediment to garden.	Active slope failure or severe erosion; urgent repair.
	Settlement, sinkhole, or animal burrows	None observed.	Minor depression or shallow burrow.	Settlement or burrows may affect slope stability.	Voids or settlement threaten embankment or outlet.	Active sinkhole/collapse; close area and repair.
Impacts to People and Infrastructure	Localized flooding impacts to property	No flooding impact.	Minor nuisance ponding in landscape only.	Repeated nuisance flooding or overflow near property.	Flooding threatens structures, pavement, or access.	Active flooding of structures or critical access.
	Threat to roads/sidewalks/critical facilities	No threat.	Minor nuisance near paved area.	Repeated ponding or erosion near roadway/sidewalk.	Road, sidewalk, or facility damage likely.	Immediate threat to roadway, utility, or critical facility.
	Public safety hazards	None.	Minor hazard; mark or monitor.	Hazard present; controls needed.	Serious hazard; restrict access.	Immediate danger; emergency controls required.

Rain Gardens

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

Rain Garden Name/ID	
Location	
Date/Time	START: __/__/____ END: __/__/____
Foreman	
Maintenance Crew	
Contractor	
Current Weather Conditions	☐ Dry ☐ Light Rain ☐ Moderate Rain ☐ Heavy Rain ☐ Sunny ☐ Cloudy Temperature: ____°F
Recent storm events?	☐ Yes ☐ No
Underdrain Present	☐ Yes ☐ No ☐ Unknown
Drainage Area (Acre/ft ²)	
Design Drain Time	
Recent Rainfall	
Rain Garden Type	☐ Residential ☐ Street ☐ Parking Lot ☐ Planter ☐ Other
Other/Details	
Certification	By signing, I confirm the work was performed within the approved scope and hazards, if observed, were reported. Signature: _____ Date: _____

REASON FOR MAINTENANCE

☐ Routine/scheduled maintenance	☐ Post-storm response	☐ Inspection follow-up
☐ Complaint/service request	☐ Emergency/safety issue	☐ Standing water/slow drawdown
☐ Trash/debris removal	☐ Sediment reducing capacity	☐ Inflow or forebay blockage
☐ Vegetation/weeds/plant replacement	☐ Erosion repair needed	☐ Outlet or underdrain issue
☐ Structural damage	☐ Illicit discharge/water quality issue	☐ Other (describe below)

Other/Details:

Rain Garden Name/ID: _____ Foreman Initials: _____

Rain Gardens

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

MAINTENANCE ACTIVITIES PERFORMED

☐ Traffic/pedestrian access setup	☐ Trash and debris removal	☐ Remove illegal dumping
☐ Clear inflow point/curb cut	☐ Forebay cleanout	☐ Remove sediment from filter surface
☐ Adjust or replace mulch	☐ Weed/invasive vegetation removal	☐ Pruning/plant care
☐ Native plant replacement/seeding	☐ Establishment watering/irrigation repair	☐ Minor grading/restore surface level
☐ Erosion repair/stabilization	☐ Rock apron/energy dissipater repair	☐ Overflow outlet cleaning
☐ Underdrain cleanout/jet-vac	☐ Cleanout cap or port repair	☐ Structural repair
☐ Filter media replacement (approved media)	☐ Engineering/regulatory coordination	☐ Other (describe below)

Other maintenance actions performed:

AREAS ADDRESSED

☐ Drainage area/source area	☐ Inflow points	☐ Forebay/pretreatment
☐ Filter media/ponding area	☐ Vegetation/mulch area	☐ Underdrain cleanout
☐ Overflow outlet structure	☐ Embankments/side slopes	☐ Access or perimeter area
☐ Adjacent pavement/sidewalk	☐ Nearby road/utility/structure	☐ Other (describe below)

Other areas addressed:

Rain Garden Name/ID: _____ Foreman Initials: _____

Rain Gardens

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

MATERIALS, EQUIPMENT AND QUANTITIES

Equipment used (e.g., hand tools, shovel, mower/string trimmer, vacuum truck, jetter, water tank):

Maintenance hours/staff:

Sediment, trash, or debris removed (estimate volume and disposal location):

Filter media removed/replaced (depth, area, source, and quantity):

Mulch, plants, seed, soil, rock, or erosion-control materials used:

Underdrain, cleanout, grate, or structural parts repaired/replaced:

SAFETY, ENVIRONMENTAL AND REGULATORY CONTROLS

☐ Site access controlled and safe	☐ Removed sediment and debris disposed where it cannot re-enter the system
☐ Traffic/pedestrian control in place (if needed)	☐ No fuel, oil, or material spills
☐ Work performed outside unsafe active flow or storm conditions	☐ Fertilizer, pesticide, or herbicide avoided unless approved and documented
☐ Erosion and sediment controls in place	☐ Area left clean, stable, and with inflow/outflow routes open

Rain Garden Name/ID: _____ Foreman Initials: _____

Rain Gardens

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

CONDITION AFTER MAINTENANCE

Inflow and forebay condition after work:	☐ Clear/ restored	☐ Improved	☐ Still restricted
Filter media/ponding condition after work:	☐ Draining/ acceptable	☐ Improved	☐ Needs follow-up
Vegetation and mulch condition after work:	☐ Stable	☐ Improved	☐ Needs follow-up
Outlet/underdrain condition after work:	☐ Clear/restored	☐ Improved	☐ Still restricted

DOCUMENTATION

Before photos attached:	☐ Yes	☐ No	☐ N/A
After photos attached:	☐ Yes	☐ No	☐ N/A
Rainfall or storm timing recorded:	☐ Yes	☐ No	☐ N/A
Sediment/debris disposal documented:	☐ Yes	☐ No	☐ N/A
Underdrain or outlet work documented:	☐ Yes	☐ No	☐ N/A
Engineering/regulatory coordination documented:	☐ Yes	☐ No	☐ N/A

ENGINEERING REVIEW REQUIRED?

☐ Yes

☐ No

☐ N/A

(If yes, describe trigger)

Rain Garden Name/ID: _____ Foreman Initials: _____

Rain Gardens

Maintenance Form



Asset Management Guidance for Community Flood Infrastructure

FOLLOW-UP ACTIONS	GOAL RESOLUTION DATE	RESPONSIBLE PERSON

Notes and Observations:

