

Operation and Maintenance

This Chapter summarizes the operation and maintenance requirements for stormwater treatment and hydromodification management measures.

8.1 Summary of O&M Requirements

Maintenance is essential for assuring that stormwater treatment and hydromodification management (HM) measures continue to function effectively and do not cause flooding, provide habitat for mosquitoes, or otherwise become a nuisance. The maintenance requirements described in this chapter apply to regulated projects with stormwater treatment measures, including areas of pervious pavement, if any, and HM measures included in your project. The operation and maintenance (O&M) process can be organized into five phases, as described below:

- Determining ownership and maintenance responsibility;
- Identifying maintenance requirements when selecting treatment measures;
- Preparing the maintenance plan and other documentation;
- Executing a maintenance agreement or other maintenance assurance; and
- Ongoing inspections and maintenance.

O&M requirements apply to stormwater treatment, pervious pavement, AND HM measures, and are the responsibility of the

8.1.1. Responsibility for Maintenance

The responsibility for the maintenance of stormwater treatment and structural HM measures ***belongs to the project applicant and/or property owner*** unless other specific arrangements have been made. Ownership and maintenance responsibility for stormwater treatment measures and HM measures should be considered at the earliest stages of project planning. The municipal stormwater permit also requires that the project applicant provide a signed statement accepting responsibility for maintenance until this responsibility is legally transferred, as well as ensuring access to municipal, Water Board, and Santa Clara County Vector Control District staff to inspect the control measures.

8.1.2 Considerations When Selecting Treatment Measures

OPERATION AND MAINTENANCE

When determining which types of treatment measures to incorporate into project plans, be mindful of their maintenance requirements. Maintenance obligations will vary depending on the system design, so review O&M requirements for LID systems and study the operation manual for any manufactured, proprietary system. Note that some jurisdictions may require more frequent maintenance than the minimums outlined in this section. Treatment measures must be maintained so that they continue to treat stormwater runoff effectively **throughout the life of the project** and do not provide habitat for mosquito breeding. Adequate funds must be allocated to support long-term site maintenance.

The party responsible for maintenance will also be required to **dispose of accumulated residuals properly**. Residuals such as trash, filter media, weeds, dead vegetation, and fine sediments collected from treatment measures may or may not be contaminated. At present, research generally indicates that residuals are not hazardous wastes and as such, after dewatering, property owners can generally dispose of residuals in the same way they would dispose of any uncontaminated soil. Two landfills in Santa Clara Valley accept sediment ("soil"), contaminated or otherwise:

- Newby Island Sanitary Landfill, 1601 Dixon Landing Road, Milpitas, (408) 432-1234.
- Guadalupe Rubbish Disposal Company, 15999 Guadalupe Mines Road, San Jose, (408) 268-1666.

Alternatively, property owners may choose to contract with the treatment device manufacturer or other service provider to maintain their treatment measures. Services typically provided include inspection, maintenance, handling and disposal of all residuals.

CONTROL MOSQUITOES

When selecting and installing stormwater treatment devices, you will need to consider the various environmental, construction, and local factors that may influence mosquito breeding. With the exception of certain treatment measures designed to hold permanent pools of standing water, treatment measures should drain completely within five days to effectively prevent mosquito production. Guidance on controlling mosquitoes with proper treatment measure design and maintenance is included in Appendix F.

Treatment measures should **drain completely within five days** to prevent mosquito production.

CONSIDER ACCESS

The O&M agreement or other means of maintenance assurance for your project will need to grant permission to local municipal staff, the Santa Clara County Vector Control District, and Water Board staff to access the property to verify that maintenance is being conducted in accordance with the maintenance plan, throughout the life of the project. Make sure stormwater treatment and HM measures are **readily accessible to the inspectors** and contact municipal staff to determine whether easements will be needed. Stormwater treatment and HM measures must also be accessible to equipment needed to maintain them. Maintenance needs vary by the type of treatment measure that is used. Review the maintenance requirements described in Section 8.2 to identify the accessibility needs for maintenance equipment.

8.1.3 Documentation Required with Permit Application

As part of the building permit application, Regulated Project applicants typically need to prepare and submit the documents listed below. ***Check with the local jurisdiction*** for exact requirements.

- A conceptual plan of the site, clearly showing the locations of stormwater treatment and HM measures, as well as areas of pervious pavement. The plan should specifically identify all pervious pavements systems that total 3000 ft.² or more (excluding private-use patios for single-family homes, townhomes, or condominiums).
- Detailed maintenance plan for pervious pavement, stormwater treatment and HM measures, including inspection checklists, as appropriate.

Please note that requirements may vary from one jurisdiction to another. However, most will require the O&M agreement to be signed and notarized before any certificates (temporary or final) of occupancy are issued.

Appendix G includes templates to assist project applicants in preparing their maintenance plans. Guidance on preparing these documents is provided in Section 8.2.

8.1.4 Maintenance Agreement or Other Maintenance Assurance

Where a property owner of a regulated project is responsible for maintenance, they will be required to provide assurance of long-term maintenance. This may be in the form of a maintenance agreement with the municipality, or conditions of approval, or another mechanism to ensure long-term maintenance of stormwater control measures. Contact your local jurisdiction to obtain a copy of its standard maintenance agreement or other mechanism.

For residential properties where the stormwater control measures are located within a common area that will be maintained by a homeowner's association, language regarding the responsibility for maintenance must be included in the project's conditions, covenants and restrictions (CC&Rs). Printed educational materials regarding on-site stormwater controls are typically required to be included with the first, and any subsequent, deed transfer. The educational materials typically include the following information:

- The post-construction stormwater control requirements;
- What stormwater controls are present onsite;
- The need for maintenance;
- How necessary maintenance should be performed; and
- For the initial deed transfer, the assistance that the project applicant can provide.

If stormwater control measures will be located in the public right-of-way and ownership will be transferred to the municipality, the property owner has responsibility for maintenance until the treatment measures are accepted by the municipality.

8.1.5 Ongoing Inspections and Maintenance

After the maintenance agreement is executed, or the municipality approves other maintenance assurance such as CC&Rs, the party responsible for maintenance must begin to implement the maintenance plan. Inspection reports must be submitted to the municipality if required by the maintenance agreement or other maintenance assurance.

The municipality, Water Board staff, and/or the Santa Clara County Vector Control District will conduct **operation and maintenance verification inspections** to make sure that stormwater control measures are being maintained. In the event adequate maintenance is not conducted, the municipality will inform the property owner, and require maintenance to be performed. If necessary (and authorized by local ordinance), the municipality will either take an enforcement action against the responsible party or take steps to restore the stormwater control measures to good working order, in which case the property owner will be responsible for reimbursing the municipality for expenditures.

8.2 Preparing Maintenance Plans

This section provides instructions for preparing the maintenance plan that will typically be required as part of the building or development permit application, if your project is a regulated project and includes 3,000 sq. ft. or more of pervious pavement, stormwater treatment measures, and/or HM measures.

The maintenance plan must be sufficiently detailed to demonstrate to the municipality that stormwater control measures will receive **adequate inspections and maintenance** to continue functioning as designed over the life of the project. A maintenance plan typically includes the following elements:

- Contact information for the property owner or other responsible party.
- Project address and, if required, the Assessor's Parcel Number and directions to the site.
- Identification of the number, type and location of all stormwater control measures on the site.
- A list of specific, routine maintenance tasks that will be conducted, and the intervals at which they are conducted. (For example, "Inspect treatment measure once a month, using the attached checklist.")
- A self-inspection checklist, specific to the stormwater control measure(s) included in your project, which indicates the items that will be reviewed during regular maintenance inspections. The checklist should include maintenance indicator 'triggers' to determine when maintenance activities must be performed. You may be required to submit completed inspection forms as part of an annual report to the municipality or make the forms available during an inspection by the municipality or other agency. Check with your local jurisdiction for requirements.

Maintenance plan templates to help you prepare your maintenance plan are provided in Appendix G. When using a template, please insert project-specific information where you find prompts such as the following: `[[= insert name of property owner/responsible party =]]`. Each template includes sample inspection checklists. Common maintenance concerns for frequently used stormwater control measures are presented in the following sections.

8.2.1 Bioretention Areas

The primary maintenance requirement for bioretention areas is the regular inspection and repair or replacement of the treatment measure's components. Because these systems remove pollutants by filtering runoff through biotreatment soil, routine maintenance is needed to ensure the flow is unobstructed, erosion is prevented, and the soils and plants are biologically active. Generally, the level of effort is similar to the routine, periodic maintenance of any landscaped area. It is recommended that certain maintenance tasks be conducted quarterly, annually before the rainy season, and annually after the rainy season and/or after large storm events.

- Depending on the system needs, conduct quarterly inspections as follows:
 - Inspect the bioretention surface area, inlets and outlets for obstructions and trash; clear any obstructions and remove weeds and trash.
 - Inspect bioretention areas for standing water. Presence of algae growth in ponded water is a good indicator of problems. In general, if standing water does not drain within 2-3 days, there may be a problem with the system. First check the cleanout riser (if there is one) and clean out any material in underdrains. Other causes of standing water can include clogged outlets, faulty irrigation systems, and/or improperly specified or installed biotreatment soil media, mulch, or plant materials. If needed, replace problematic materials with approved biotreatment soil media, mulch, new plants and/or other components as needed. Compaction of native soil can also be a cause of standing water; in which case the whole system may need to be reconstructed. If mosquito larvae are observed, contact the County Vector Control District at (408) 918-4770 or (800) 675-1155.

- Before and after the rainy season, an evaluation of the whole treatment system should be conducted, including the following activities:
 - Ensure that the vegetation is healthy and dense enough to provide filtering and protect soils from erosion. Prune and weed the bioretention area and remove trash. Remove and/or replace any dead plants. Do not use pesticides or other chemical applications to treat diseased plants, control weeds or remove unwanted growth.
 - Use compost and other natural soil amendments and fertilizers. Do not use synthetic fertilizers, especially if the system uses an underdrain.
 - Inspect the energy dissipator at the inlet to ensure it is functioning adequately, and that there is no scour of the surface mulch. Remove any accumulation of sediment.
 - Inspect the overflow pipe to make sure that it can safely convey excess flows to a storm drain. Repair or replace any damaged or disconnected piping. Use the cleanout riser to clear underdrains of obstructions or clogging material.
 - Maintain the irrigation system and ensure that plants are receiving the correct amount of water (if applicable). Repair or replace any improperly functioning equipment.
 - Inspect and, if needed, replace wood or rock mulch. It is recommended that 3" of composted arbor mulch be applied once a year. Mulch should also be replaced when erosion is evident. The entire area may need mulch replacement every two to three years, although spot mulching may be sufficient for random void areas. Rock mulch can be raked up or manually collected and redistributed after maintenance is performed.

- Annually at the end of the rainy season, and/or after large storm events, inspect the system for:
 - Erosion of biotreatment soil, loss of mulch, standing water, structural failure, clogged overflows, weeds, trash and dead plants. If using rock mulch, check for 3” of coverage.

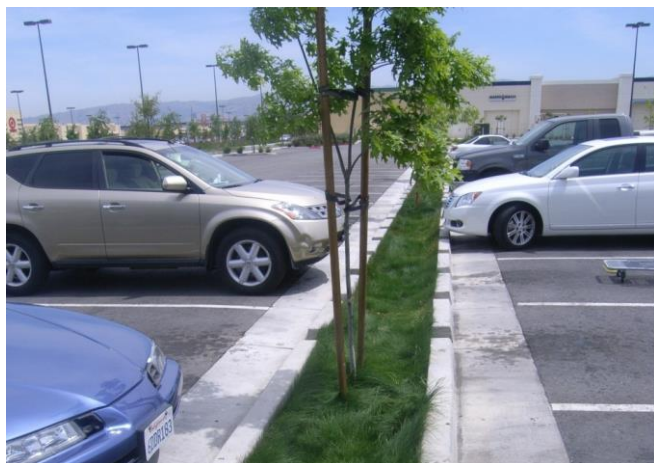


Figure 8-1: Bioretention area at a shopping center in San Jose.

8.2.2 Flow-Through Planters

Flow-through planters function similar to bioretention areas. Maintenance objectives include maintaining healthy vegetation at an appropriate size; avoiding clogging; and ensuring the structural integrity of the planter and the proper functioning of inlets, outlets, and the high-flow bypass. It is recommended that certain maintenance tasks be conducted quarterly, annually before the rainy season, and annually after the rainy season and/or after large storm events.

- Depending on the system needs, conduct quarterly inspections as follows:
 - Inspect the planter surface area, inlets and outlets for obstructions and trash; clear any obstructions and remove trash.
 - Inspect planter for standing water. Presence of algae growth in ponded water is a good indicator of problems. In general, if standing water does not drain within 1 day, there may be a problem with the system. First check the cleanout riser (if there is one) and clean out any material in underdrains. Other causes of standing water can include clogged outlets, faulty irrigation systems, and/or improperly specified or installed biotreatment soil media, mulch, or plant materials. If needed, replace problematic materials with approved biotreatment soil media, mulch, new plants and/or other components as needed. If mosquito larvae are observed, contact the County Vector Control District at (408) 918-4770 or (800) 675-1155.
 - Check for eroded or settled biotreatment soil media. Level soil with rake and remove/replant vegetation as necessary.
- Before and after the rainy season, conduct a complete evaluation of the system, including the following activities:

- Ensure that vegetation is healthy and dense enough to provide filtering and protect soils from erosion. Prune and weed as necessary. Replace dead plants. Remove excessive growth of plants that are too close together to allow water flow and/or causing other issues. Do not use pesticides or other chemical applications to treat diseased plants, control weeds or remove unwanted growth.
 - Remove trash and sediment.
 - Use compost and other natural soil amendments and fertilizers. Do not use synthetic fertilizers, especially if the system uses an underdrain.
 - Inspect the overflow pipe to make sure that it can safely convey excess flows to a storm drain. Repair or replace any damaged or disconnected piping. Use the cleanout riser to clear underdrains of obstructions or clogging material.
 - Inspect the energy dissipator at the inlet to ensure it is functioning adequately, and that there is no scour of the surface mulch. Remove any accumulation of sediment.
 - Inspect and, if needed, replace wood or rock mulch. It is recommended that 3" of composted arbor mulch be applied once a year. Spot mulching may be sufficient for random void areas. Rock mulch can be raked up or manually collected and redistributed after maintenance is performed.
- Annually at the end of the rainy season and/or after large storm events, inspect the system for:
 - Erosion of biotreatment soil media, loss of mulch, standing water, clogged overflows, weeds, trash and dead plants.
 - Structural integrity of walls, flow spreaders, energy dissipators, curb cuts, outlets and flow splitters.



Figure 8-2: Flow-through planter in the City of Emeryville

8.2.3 Tree Well Filters

The following maintenance requirements are typical of both proprietary and non-proprietary tree well filters:

- Conduct a biannual (twice yearly) evaluation of the health of trees and any ground cover. Remove and replace any dead or dying vegetation.
- Maintain vegetation and the irrigation system. Prune and weed as needed to keep the tree well filter neat and orderly in appearance. Clean up fallen leaves or debris.
- Do not use pesticides or other chemical applications to control weeds or unwanted growth.
- Use compost and other natural soil amendments and fertilizers instead of synthetic fertilizers, especially if the system uses an underdrain.
- Before the wet season begins, check that the media is at the appropriate depth. Replenish mulch as needed. Remove any accumulations of sediment, litter, and debris.
- Inspect tree well filter after storms to ensure that it has not clogged and is draining per design specifications. Till or replace the media as necessary.
- Periodically inspect the overflow pipe to make sure that it can safely convey excess flows to a storm drain. Repair or replace any damaged or disconnected piping.

For proprietary tree well filters, follow the manufacturer's requirements for maintenance. Some manufacturers require a maintenance agreement, under which the manufacturer conducts the maintenance.



Figure 8-3: Pervious asphalt directs water to an enlarged tree well filled with engineered 'structural soil', San José.

8.2.4 Infiltration Trenches

The primary maintenance objective is to prevent clogging, which may lead to trench failure. Typical inspection and maintenance tasks are as follows:

- Conduct a thorough inspection annually, including inspection of the observation well to confirm that there is no standing water in the trench. If inspection indicates that the trench is partially or completely clogged, it should be restored to its design condition.
- Inspect the trench after large storm events and remove any accumulated debris or material. Repair any erosion at inflow or overflow structures.
- Check the observation well 2 to 3 days after storms to confirm drainage. The trench should completely dewater within 5 days.
- Mow and trim vegetation around the trench as needed to maintain a neat and orderly appearance. Routinely remove trash, grass clippings and other debris along the trench perimeter and dispose of these materials properly.
- Trees or other large vegetation should be prevented from growing adjacent to the trench to prevent damage to the trench.
- Do not use pesticides or other chemical applications to control weeds or unwanted growth of vegetation near the trench.



Figure 8-4: Infiltration Trench at former Agilent site, Palo Alto

8.2.5 Detention Basins

Primary maintenance activities include vegetation management and sediment removal. Mosquito control is also a concern in extended detention basins that are designed to include pools of standing water. The typical maintenance requirements include:

- Conduct semi-annual inspection as follows:
 - Evaluate the health of the vegetation and remove and replace any dead or dying plants.
 - Remove any trash and debris.
 - Inspect the outlet, embankments, dikes, berms, and side slopes for structural integrity and signs of erosion or rodent burrows. Fill in any holes detected in the side slopes.
 - Examine outlets and overflow structures and remove any debris plugging the outlets. Identify and minimize any sources of sediment and debris. Check rocks or other erosion control and replace, if necessary.
 - Check inlets to make sure piping is intact and not plugged. Remove accumulated sediment and debris near the inlet. Ensure that engineered energy dissipation is functioning adequately by checking for evidence of local scour around the inlet.

- Inspect for standing water and correct any problems that prevent the extended detention basin from draining as designed.
- Confirm that any fences around the facility are secure.
- If you observe mosquito larvae, contact the Santa Clara County Vector Control District at (408) 918-4770 or (800) 675-1155.
- Maintenance activities at the bottom of the basin shall NOT be performed with heavy equipment, which would compact the soil and limit infiltration.
- Harvest vegetation annually, during the summer.
- Trim vegetation at beginning and end of the wet season and inspect monthly to prevent establishment of woody vegetation and for aesthetic and mosquito control reasons.
- Do not use pesticides or other chemical applications to control weeds or unwanted growth in the basin.
- Remove sediment from the forebay as needed.
- Remove accumulated sediment within the basin area and regrade about every 10 years or when the accumulated sediment volume exceeds 10 percent of the basin volume.



Figure 8-5: Detention pond at a retirement center in Saratoga

8.2.6 Pervious Pavement

Types of pervious pavement include pervious concrete, porous asphalt, and permeable interlocking concrete pavement (PICP), concrete grid pavers, and plastic reinforcement grid pavers. All pervious pavement can become clogged with sediment over time if routine maintenance is not performed. Sources of sediment include vehicles and eroding soil, leaves and mulch from adjacent landscaped areas. Regular surface cleaning will help maintain a high surface infiltration rate and keep out vegetation.

Routine maintenance (two to four times annually):

- Prevent soil from washing or blowing onto the pavement. Do not store sand, soil, mulch or other landscaping materials on pervious pavement surfaces.
- Conduct preventative surface cleaning, using commercially available regenerative air or vacuum sweepers, to remove sediment and debris.

Inspection (two to four times annually):

- Check for sediment and debris accumulation on pervious pavement.
- Check for standing water on the pavement surface within 30 minutes after a storm event if possible. Standing water indicates that restorative cleaning may be required.
- Inspect pervious pavement for any signs of pavement failure.
- Inspect underdrain outlets and cleanouts annually, preferably before the wet season. Remove accumulated trash/debris.

As needed maintenance:

- Remove weeds from permeable pavement as needed. Do not use pesticides or other chemical applications to control weeds or unwanted growth near pavement or between pavers. Vegetation in grid pavements (such as turf block) should be mowed as needed.
- Repair any surface deformations or broken pavers. Replace missing joint filler in PICP.
- If routine cleaning does not maintain infiltration rates, then restorative surface cleaning with a vacuum sweeper and/or reconstruction of part of the pervious surface may be required. Adjust the vacuum sweeper suction to a level that does not remove portions of the pervious pavement base layer or joint filler.
- Power washing with simultaneous vacuuming also can be used to restore surface infiltration to highly clogged areas of pervious concrete, porous asphalt or PICP, but is not recommended for grid pavements.
- Replenish aggregate in PICP joints or grids as needed after restorative surface cleaning.



Fig. 8-6 Porous asphalt, pervious concrete and pervious interlocking concrete pavers at Stanford University demonstration project.

8.2.7 Rainwater Harvesting Systems

- Conduct annual inspections of all components, including pumps, valves, tanks, and backflow prevention systems, and verify operation.
- Inspect and clean filters and screens every three months and replace when necessary.
- Inspect and verify that disinfection, filters, and other water quality treatment devices are operational, in accordance with manufacturer's recommendations or local jurisdiction requirements.
- If rainwater is provided for indoor use, conduct annual water quality testing per the requirements of the local jurisdiction.
- Inspect and clear debris from rainwater gutters, roof surfaces, downspouts, roof washers, and first-flush devices every six months, or as needed, to prevent clogging. Remove tree branches and vegetation overhanging roof surfaces to reduce amount of debris.
- Maintenance requirements specific to cisterns:

- Flush cisterns annually to remove sediment. Flushed water should drain to landscaping or to the sanitary sewer.
- For buried structures, vacuum removal of sediment is required.
- Maintenance requirements specific to rain barrels:
 - Regularly inspect the gutters and gutter guards, downspouts, spigots, and rain barrels, and clean or replace parts as needed.
 - Inspect screens and seals prior to the wet season to make sure debris is not collecting on the surface and that there are not holes allowing mosquitoes to enter the rain barrel. Inspect screens more frequently if there are trees that drop debris on the roof.
 - Clean the inside of the rain barrel once a year (preferably at the end of the dry season when the rain barrel has been fully drained) to prevent buildup of debris. If debris cannot be removed by rinsing, use vinegar or another non-toxic cleaner. Use a large scrub brush on a long stick and avoid actually entering the rain barrel. Drain washwater to landscaping.

8.2.8 Media Filters

Follow manufacturer's requirements for maintenance. Clogging is the primary maintenance concern for media filters, although mosquito control is also an issue. Typical maintenance requirements are as follows:

- During the wet season, inspect periodically for standing water, sediment, trash and debris, and to identify potential problems.
- Remove any accumulated trash and debris in the unit during routine inspections.
- Inspect the media filter once during the wet season after a large rain event to determine whether the facility is draining completely within five days and per manufacturer's specifications.
- Replace the media per manufacturer's instructions or as indicated by the condition of the unit.