

## Operation and Maintenance

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

### 8.1 Summary of O&M Requirements

Maintenance is essential for assuring that stormwater treatment and structural 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 stormwater treatment measures and structural 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 AND HM measures.

#### 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 structural HM measures should be considered at the earliest stages of project planning, typically at the pre-application meeting with municipal staff. 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 Alameda County Mosquito Abatement District or Vector Control District staff.

### 8.1.2 Considerations When Selecting Treatment Measures

#### *Consider Operation And Maintenance*

When determining which types of treatment measures to incorporate into project plans, be mindful of how maintenance intensive they are. Study the operation manual for any manufactured, proprietary system. 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. Manufactured, proprietary systems tend to clog easily and therefore require frequent maintenance to ensure that they operate as intended and do not hold standing water. A properly designed and established bioretention area, by contrast, may require little maintenance beyond the typical requirements for areas of landscaping.

The party responsible for maintenance will also be required to **dispose of accumulated residuals properly**. Residuals are defined as trash, oil and grease, filter media and fine sediments that are collected from treatment measures that 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 disposed of residuals in the same way they would dispose of any uncontaminated soil.

The USEPA Fact Sheet titled Storm Water O&M Fact Sheet: Handling and Disposal of Residuals ([www.epa.gov/npdcs/pubs/handdisp.pdf](http://www.epa.gov/npdcs/pubs/handdisp.pdf)) provides useful information to help property owners dispose of residuals properly. The fact sheet describes the properties of stormwater residuals, O&M requirements for specific types of treatment measures, key

elements for a residual handling and disposal program, and specific information on residual disposal from case studies. Two landfills in Alameda County accept sediment (“soil”), contaminated or otherwise:

- Altamont Landfill and Resource Recovery, 1040 Altamont Pass Road, Livermore, (510) 430-8509
- Vasco Road Sanitary Landfill, 4001 N. Vasco Road, Livermore, (661) 257-3655.

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

Except for treatment measures designed to hold permanent pools of standing water, treatment measures should **drain completely within 72 hours** to suppress mosquito production.

***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 72 hours*** to effectively suppress mosquito production. The Clean Water Program has prepared a Vector Control Plan that includes mosquito control design guidance and maintenance guidance for treatment measures, which focus on mosquito control. This guidance is included in Appendix G.

***Consider Access***

The maintenance agreement for your project will need to guarantee access permission for local municipality staff, the Alameda County Mosquito Abatement District and Water Board staff to enter 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 structural HM measures are ***readily accessible to the inspectors***, and contact municipal staff to determine whether easements will be needed. Stormwater treatment and structural 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. By nature, it is more difficult to provide adequate access for below-ground treatment measures than above-ground treatment measures.

**8.1.3 Documentation Required with Permit Application**

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

- A legible conceptual plan of the site, clearly showing the locations of stormwater treatment measures, including areas of pervious pavement, and the locations of hydromodification management (HM) controls, if any. The plan should specifically identify all pervious pavements systems that total 3000 ft.<sup>2</sup> or more (excluding private-use patios for single-family homes, townhomes, or condominiums). Letter-sized plans are preferred; legal-sized plans may be accepted.
- Detailed maintenance plan for stormwater treatment and structural HM measures, including inspection checklists, as appropriate.
- A standard treatment measure O&M report form, to be attached to a maintenance agreement, or other maintenance assurance.

Please note that requirements may vary from one jurisdiction to another. Ask the staff from the local municipality if there are any additional requirements. Appendix H includes templates to assist project applicants in preparing their standard treatment measure O&M report form and maintenance plan. Guidance on preparing these documents is provided in Section 8.2.

**8.1.4 Maintenance Agreement or Other Maintenance Assurance**

Where a property owner is responsible for maintenance, the property owner is required to enter into a maintenance agreement with the municipality to ensure long-term maintenance of treatment and structural HM measures. The agreement will be ***recorded against the property*** to run with the title of the land. Contact your local jurisdiction to obtain a copy of its

standard maintenance agreement. The maintenance agreements require property owners to conduct maintenance inspections of all stormwater treatment measures, and – depending on the municipality – may require the annual submittal of a Standard Treatment Operation and Maintenance Inspection Report form.

For residential properties where the stormwater treatment 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:

- Explain the post-construction stormwater controls requirements;
- Provide information on what stormwater controls are present;
- Describe the need for maintenance;
- Explain how necessary maintenance can be performed; and
- For the initial deed transfer, describe the assistance that the project applicant can provide.

If stormwater treatment measures are proposed to be located in a public area for transfer to the municipality, these treatment measures must meet the design guidelines specified in Chapter 6 and shall remain the property owner’s responsibility for maintenance until the treatment measures are accepted for transfer.

**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 begins to implement the maintenance plan. Inspection reports are submitted to the municipality as required by the maintenance agreement, or other maintenance assurance.

The municipality, Water Board and Mosquito Abatement District staff may conduct **O&M verification inspections** to make sure that treatment and HM measures are maintained.

The municipality, Water Board and Alameda County Mosquito Abatement District may conduct **operation and maintenance verification inspections** to make sure that stormwater treatment measures are being maintained. In the event adequate maintenance is not conducted, the municipality will take necessary steps to restore the treatment measures to good working order. The property owner will be responsible for reimbursing the municipality for expenditures associated with restoring the treatment measures to good working order.

**8.2 Preparing Maintenance-Related Documents**

This section provides instructions for preparing the following documents that will typically be required as parts of the building permit application, if your project includes stormwater treatment measures and/or structural HM measures:

- A standard treatment measure O&M report form
- A maintenance plan, including a schedule of maintenance activities.

### 8.2.1 Standard Treatment Measure O&M Report Form

The municipality may require the property owner, or other responsible party, to submit an annual report summarizing the maintenance and inspections of treatment measures included in the project. To standardize and simplify the reporting process, the property owner submits a “Standard Treatment Measure O&M Report Form” with the building permit application, and the municipality includes the report form as an Exhibit to the maintenance agreement. After the agreement is executed, the property owner, or other responsible party, uses this form to prepare the annual report, which is typically submitted by December 31 of each calendar year. When submitting the completed report form each year, the responsible party will typically be required to attach the inspection forms that were completed during that calendar year.

To help you prepare your Standard Treatment Measure O&M Report Form, a template is included in Appendix H. **Check with the local jurisdiction** for an electronic version of the template.

When using the template to prepare your report form, please insert project-specific information where you find highlighted prompts such as the following:

[[= insert name of property owner/responsible party =]]

### 8.2.2 Maintenance Plan

The maintenance plan must be sufficiently detailed to demonstrate to the municipality that stormwater treatment measures, including pervious paving, and/or structural HM 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 Assessors Parcel Number and directions to the site.
- Identification of the number, type and location of all stormwater treatment/structural HM measures on the site
- A site plan that shows the location of each stormwater treatment measure, including areas of pervious paving, and /structural HM measures. The site plan should specifically identify all pervious pavements systems that total 3,000 square feet or more (excluding private-use patios for single-family homes, townhomes, or condominiums). Letter-sized plans are preferred; legal-sized plans may be accepted.

- 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.”)
- An inspection checklist, specific to the treatment/HM measure(s) included in your project, which indicates the items that will be reviewed during regular maintenance inspections. You will typically be required to submit completed inspection forms as part of the annual Stormwater Treatment Measure O&M Report, as described in Section 8.2.1.

Maintenance plan templates are provided, in Appendix H, for commonly-used stormwater treatment measures.

The following materials are available to help you prepare your maintenance plan:

- Maintenance plan templates included in Appendix H. Electronic versions of the templates are available at [www.cleanwaterprogram.org](http://www.cleanwaterprogram.org) (Click on “Businesses,” then “Development” and go to Appendix H of the C.3 Technical Guidance).
- A list of common maintenance concerns for the frequently used stormwater treatment measures, provided below.

When using a template to prepare your maintenance plan, 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. If your project includes different treatment/HM measures, you may also refer to the **treatment measure-specific maintenance information** presented in the following paragraphs.

***Bioretention Areas<sup>1</sup> – Common Maintenance Concerns:***

The primary maintenance requirement for bioretention areas is the regular inspection and repair or replacement of the treatment measure's components, to avoid obstructions and clogging. Generally, the level of effort is similar to the routine, periodic maintenance of any landscaped area.

- Maintain vegetation and the irrigation system. Prune and weed, as needed, to keep the bioretention area neat and orderly in appearance.
- On a monthly basis, remove obstructions, debris, accumulated sediment and trash.
- On a biannual basis (pre- and post-wet season) evaluate the health of plants, remove and replace any dead or diseased vegetation, and till or replace soil (using biotreatment soil mix specified in Appendix K) as needed to maintain the design elevation of soil.
- Before and after the wet season, and monthly during the wet season, conduct inspections to assure proper functioning of bioretention area. Items to inspect include:
  - Inspect and, if needed, replace mulch before the wet season begins and when erosion is evident or when the bioretention area begins to look unattractive. The entire area may need mulch replacement every two to three years, although spot mulching may be sufficient when there are random void areas.
  - Inspect bioretention area for ponded water. If ponded water does not drain within 72 hours, remove surface soils and replace with biotreatment soil. If mosquito larvae are observed, contact the Alameda County Mosquito Abatement District at 510/783-7744. (In Albany, contact the Alameda County Vector Control District, at 510/567-6800.) Inspect inlets for channels, exposure of soils, or other evidence of erosion. Clear any obstructions and remove any accumulation of sediment.
- On an ongoing basis, treat diseased vegetation, as needed, using preventative and low-toxic measures to the extent possible, and replace any dead plants.

- The use of pesticides and quick-release synthetic fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed. Check with the local jurisdiction for any local policies regarding the use of pesticides and fertilizers.



*Photo 8-1. Bioretention Area in the City of Fremont*

<sup>1</sup> A bioretention area that is unlined and has a raised underdrain in the underlying rock layer to promote infiltration, as shown in Section 6.1, may also be called a “bioinfiltration area”.

***Flow-Through Planters – Common Maintenance Concerns:***

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.

- Maintain vegetation and the irrigation system. Prune and weed as needed to keep the flow-through planter neat and orderly in appearance. Prune or remove any overgrown plants or shrubs that may interfere with planter operation. Clean up fallen leaves or debris.
- On a biannual basis (pre- and post-wet season) evaluate the health of plants, remove and replace any dead or diseased vegetation, and till or replace soil (using biotreatment soil mix specified in Appendix K) as needed to maintain the design elevation of soil.
- Before and after the wet season, and monthly during the wet season, conduct inspections to assure proper functioning of flow-through planter. Items to inspect include:
  - Inspect planter box to ensure structural integrity of the box.
  - Check that the soil is at the appropriate depth to allow water to temporarily pond above the soil surface and is sufficient to effectively filter stormwater. Remove any accumulations of sediment, litter, and debris. Confirm that soil is not clogging and that the planter will drain within 72 hours after a storm event. Inspect and, if needed, replenish mulch.
  - Inspect downspouts from rooftops or sheet flow from paving to ensure that flow to the planter is unimpeded. Inspect the overflow pipe to make sure that it can safely convey excess flows to a storm drain. Remove any debris and repair any damaged or disconnected pipes. Check splash blocks or rocks and repair, replace or replenish as necessary.
- Treat diseased vegetation, as needed, using preventative and low-toxic measures to the extent possible.
- The use of pesticides and quick-release synthetic fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed. Check with the local jurisdiction for any local policies regarding the use of pesticides and fertilizers.



*Photo 8-2. Flow through planter in the City of Emeryville*



***Tree Well Filters – Common Maintenance Concerns:***

For proprietary tree well filters, consult product documents; some manufacturers require a maintenance agreement, under which the manufacturer conducts the maintenance. The following maintenance requirements are typical for non-proprietary tree well filters:

- On a biannual basis (pre- and post-wet season) evaluate the health of plants, remove and replace any dead or diseased vegetation, and till or replace soil (using biotreatment soil mix specified in Appendix K) as needed to maintain the design elevation of soil.
- Before and after the wet season, and monthly during the wet season, conduct inspections to assure proper functioning of tree well filter. Items to inspect include:
  - 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.
  - Check that the biotreatment soil is at the appropriate depth. Remove any accumulations of sediment, litter, and debris. Confirm that the tree well filter is not clogging and will drain within 72 hours after rainfall. Till or replace the biotreatment soil as necessary.
  - 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.
  - Treat diseased vegetation, as needed, using preventative and low-toxic measures to the extent possible.
  - The use of pesticides and quick-release synthetic fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed. Check with the local jurisdiction for any local policies regarding the use of pesticides and fertilizers.



*Photo 8-3. Series of non-proprietary tree well filters installed along roadway, City of Fremont*

***Infiltration Trenches – Common Maintenance Concerns:***

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

- Inspect infiltration trench after large storm events and remove any accumulated debris or material.
- Check the observation well 2 to 3 days after storms to confirm drainage.
- Repair any erosion at inflow or overflow structures.
- Conduct thorough inspection annually, including monitoring of the observation well to confirm that the trench is draining within the specified time.
- Trenches with filter fabric should be inspected annually for sediment deposits by removing a small section of the top layer.
- If inspection indicates that the trench is partially or completely clogged, it shall be restored to its design condition.
- Mow and trim vegetation around the trench as needed to maintain a neat and orderly appearance.
- The use of pesticides and quick-release synthetic fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed. Check with the local jurisdiction for any local policies regarding the use of pesticides and fertilizers.
- Routinely remove trash, grass clippings and other debris from 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.



*Photo 8-4. Infiltration Trench*

*(Source: California Stormwater Quality Association)*

***Extended Detention Basins – Common Maintenance Concerns:***

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

- 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.
- The use of pesticides and quick-release synthetic fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed. Check with the local jurisdiction for any local policies regarding the use of pesticides and fertilizers.
- Conduct a biannual (twice yearly) evaluation of the health of the vegetation and remove and replace any dead or dying plants.
- Conduct semiannual inspection as follows
  - Inspect the outlet, embankments, dikes, berms, and side slopes for structural integrity and signs of erosion.
  - 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.
  - Inspect for standing water and correct any problems that prevent the extended detention basin from draining as designed.
  - If you observe mosquito larvae, contact Alameda County Mosquito Abatement District, 510/783-7744. (In Albany, Alameda County Vector Control District, 510/567-6800.)
  - Check for slope stability and the presence of rodent burrows. Fill in any holes detected in the side slopes.
  - Inspect for and remove any trash and debris.
  - Confirm that any fences around the facility are secure.
  - Check for sediment accumulation.
- Remove sediment from the forebay when the sediment level reaches the level shown on the fixed vertical sediment marker.
- Remove accumulated sediment and regrade about every 10 years or when the accumulated sediment volume exceeds 10 percent of the basin volume.
- Remove accumulated trash and debris from the basin at the middle and end of wet season (January and April), or as needed.



*Photo 8-5. Extended Detention Basin, Palo Alto*

Pervious Concrete and Asphalt – common maintenance concerns:

Standards for Ongoing Maintenance and Upkeep:

- On a monthly basis, remove any accumulated trash or debris from pervious paving surface. Also remove any trash or debris from downspouts to pervious paving facility or in outlets to storm drains.
- On a biannual basis (pre- and post-wet season) vacuum sweep and clean surface of pervious pavement. If power washing is used, avoid forcing fine sediments into the pervious pavement.
- Before and after the wet season, and monthly during the wet season, conduct inspections to assure proper functioning of pervious paving. Items to inspect include:
  - Check for standing water on the pavement surface.
  - Inspect pervious paving for any signs of hydraulic failure.
- Inspect outlets and remove accumulated trash/debris.
- Keep landscaped areas well maintained.

As needed maintenance:

- If any signs of clogging are noted, use high performance vacuum equipment. If pavement is determined to be clogged after vacuuming with high performance equipment, test sections test the infiltration rate using ASTM C1701 and compare against original test results after construction, if available. A minimum tested infiltration rate of 10 inches per hour indicates the system is approaching near-clogged condition.
- If routine cleaning does not restore infiltration rates, then reconstruction of the pervious surface area that is not infiltrating is required.
- The surface area affected by hydraulic failure should be lifted after vacuuming, if possible, for inspection of the internal materials to identify the location and extent of the blockage.
- Surface materials should be lifted and replaced if damaged by abrasive or brush cleaning. Geotextiles may need complete replacement.
- Sub-surface layers may need cleaning and replacing.
- Removed silts may need to be disposed of as controlled waste.

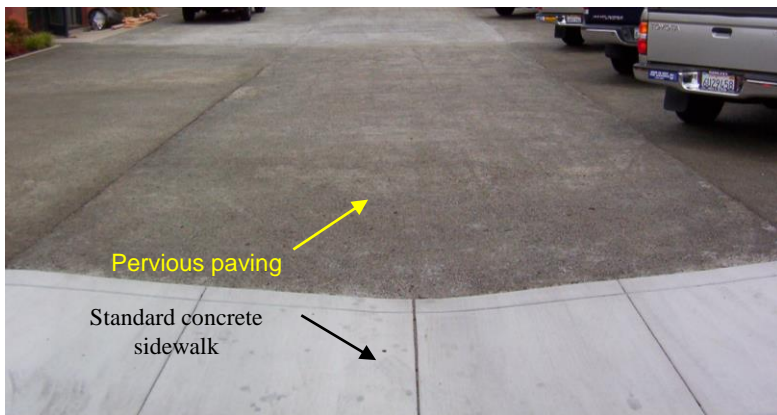


Photo 8-6. Parking Lot with Pervious Pavement, Emeryville



*Turf Block and Permeable Joint Pavers – common maintenance concerns:*  
Standards for Ongoing Maintenance and Upkeep:

- Irrigate and mow turf block grass as required for selected turf species; no-mow and low-water species are advised.
- On a monthly basis, remove any accumulated trash or debris from pervious paving surface and/or between joints. Also remove any trash or debris from downspouts to pervious paving facility or in outlets to storm drains.
- On a biannual basis (pre- and post-wet season) Vacuum sweep the surface of the unplanted turf block and permeable joint pavers (for pervious joint pavers with sand in joints use minimum suction required to remove surface debris and minimize aggregate loss) and clean surface of pervious pavement, taking care not to move fine sediments into any permeable joints. If power washing is used, aim the spray at a minimum 45 degree angle in relation to the pavement surface, to avoid dislodging aggregate. Avoid forcing fine sediments into the pervious pavement.
- Before and after the wet season, and monthly during the wet season, conduct inspections to assure proper functioning of pervious paving. Items to inspect include:
  - Check for standing water on the pavement surface.
  - Inspect permeable joint pavers for any signs of hydraulic failure.
  - Inspect outlets and remove accumulated trash and debris.
- Keep landscaped areas well maintained.

As needed maintenance:

- If any signs of clogging are noted, use high performance vacuum equipment. If pavement is determined to be clogged after vacuuming with high performance equipment, test sections test the infiltration rate using ASTM C1781 and compare against original post-infiltration test results, if available. A minimum tested infiltration rate of 10 inches per hour indicates the system is approaching near-clogged condition.
- If routine cleaning does not restore infiltration rates, then reconstruction of the pervious surface area that is not infiltrating is required.
- The surface area affected by hydraulic failure should be lifted, if possible, for inspection of the internal materials to identify the location and extent of the blockage.



Photo 8-7. Turf block fire lane

- Surface materials should be lifted and replaced if damaged by brush (or abrasive) cleaning.
- Sub-surface layers may need periodic cleaning and replacing.
- Deposits may need to be disposed of as controlled waste.
- Replace permeable joint materials, as necessary.

***Rainwater Harvesting And Use – Common Maintenance Concerns:***

Routine maintenance:

- Conduct annual inspections of backflow prevention systems.
- If rainwater is provided for indoor use, conduct annual water quality testing.
- Clean gutters and first-flush devices at least annually, and as needed, to prevent clogging.
- Conduct regular inspection and replacement of treatment system components, such as filters and UV lights.
- If the system includes a roof washer, regularly inspect and clean the roof washer to avoid clogging.
- Regularly inspect for and repair leaks.
- Maintenance requirements specific to cisterns:
  - Flush cisterns annually to remove sediment.
  - For buried structures, vacuum removal of sediment is required.
  - Brush the inside surfaces and thoroughly disinfect twice per year.
- Maintenance requirements specific to rain barrels
  - Inspect rain barrels four times per year and after major storms
  - Remove debris from screens as needed.
  - Replace screens, spigots, downspouts, and rain leaders as needed.



*Photo 8-8. Rainwater harvesting system, Mills College, Oakland*

***Media Filters – Common Maintenance Concerns:***

Follow manufacturer 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 accumulated trash and debris in the sedimentation basin, from the riser pipe, and the filter bed 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 72 hours.
- If the facility drain time exceeds 72 hours, remove the top 50 millimeters (2 inches) of sand and dispose of sediment. Restore media depth to 450 millimeters (18 inches) when overall media depth drops to 300 millimeters (12 inches).

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