Section C

Construction Site Runoff Control Program

Stormwater Management Plan
Honolulu Harbor
and Kalaeloa Barbers Point Harbor



Mālama I Ke Awa Kai
Protect our Harbor Waters

Prepared for:
State of Hawaii
Department of Transportation
Harbors Division

This page intentionally left blank

Final

Construction Site Runoff Control Program Manual



State of Hawaii
Department of Transportation
Harbors Division
Hale Awa Ku Moku Building
79 South Nimitz Highway
Honolulu Hawaii 96813-5898

April 2022

Version 12.0

Final

Construction Site Runoff Control Program Manual

State of Hawaii
Department of Transportation
Harbors Division
Hale Awa Ku Moku Building
79 South Nimitz Highway
Honolulu, Hawaii 96813-4898

"Mālama I Ke Awa Kai"
Protect Our Harbor Waters

April 2022

Version 12.0

Record of Revision

Revision	Date	Description	Sections Affected
1.0	December 2012	Initial Release	All
2.0	January 2013	Version 2.0	Most
3.0	February 2013	Version 3.0	Most
4.0	June 2013	Version 4.0	3, 4, and 5
5.0	July 2013	Version 5.0	4, 5, 6, and 7
6.0	October 2013	Version 6.0	All
7.0	February 2014	Version 7.0	All
8.0	May 2014	Version 8.0	All
9.0	May 2014	Version 9.0	3, 4, and 5
10.0	August 2014	Version 10.0	1
11.0	September 2021	Version 11.0	All
12.0	April 2022	Version 12.0	Attachment 1

Table of Contents

1.0 INTRODUCTION **1-1**

2.0 CONSTRUCTION PROJECT DEFINITIONS AND GENERAL REQUIREMENTS **2-1**

2.1 Applicability **2-1**

2.2 Roles and Responsibilities **2-1**

2.3 Exempted Projects Less Than One Acre **2-2**

3.0 HDOT HARBORS CONSTRUCTION PROJECTS **3-1**

3.1 Pre-Design Meeting **3-1**

3.2 Project Review During Design **3-1**

3.2.1 Projects Less Than One Acre 3-1

3.2.2 Projects Subject to NPDES (NOI-C) Program 3-1

3.3 Project Review after Contract Award **3-2**

3.4 Construction Site Best Management Practice Inspections **3-2**

3.4.1 Initial BMP Inspection 3-3

3.4.2 Recurring BMP Inspection 3-3

3.4.3 Final BMP Inspection 3-4

3.4.4 Contractor Self-Inspection Requirements 3-4

4.0 TENANT IMPROVEMENT PROJECTS **4-1**

4.1 Regulatory Programs **4-1**

4.1.1 NPDES Permit for Construction Sites 4-1

4.1.2 NPDES Permit for Dewatering 4-1

4.2 Project Review During Design **4-2**

4.2.1 Projects Less Than One Acre 4-2

4.2.2 Projects Subject to NPDES (NOI-C) Program 4-3

4.3 Project Review **4-3**

4.4 Construction Site BMP Inspections **4-4**

4.4.1 Initial BMP Inspection 4-4

4.4.2 Recurring BMP Inspection 4-4

4.4.3 Final BMP Inspection 4-4

4.4.4 Tenant Self-Inspection Required by the NPDES NOI-C Permit 4-5

5.0 TRAINING PROGRAM **5-6**

5.1 Training for Harbors Staff and Consultants **5-6**

5.2 Initial Training Content **5-6**

6.0 OUTREACH TO CONSTRUCTION CONTRACTORS **6-1**

6.1 Informational Exchange Sessions **6-1**

6.2 Harbors SWMP Website **6-1**

7.0 ENFORCEMENT 7-1
7.1 Scope of Authority 7-1
7.2 Harbors Construction Project Enforcement 7-1
7.3 Harbors Tenant Construction Project Enforcement 7-2
8.0 CONSTRUCTION BMP FIELD MANUAL 8-1
8.1 BMP Selection 8-1
9.0 REFERENCES 9-1

List of Tables

Number	Title	Page
2-1	The Harbors Functional Groups for Harbors Projects	2-2
2-2	Harbors Functional Groups for Tenant Projects	2-2

List of Figures

Number	Title	Page
2-1	Construction Site Runoff Control Program Overview	2-3

List of Attachments

Attachment 1	HDOT Harbors Division Administrative Organizational Chart
Attachment 2	Construction Process Flow Charts
Attachment 3	Permit for Connection to HDOT Harbors Division Small MS4 Permit to Discharge into HDOT Harbors Division Small MS4
Attachment 4	Construction Site Design Review Checklist
Attachment 5	Construction Site Best Management Practices Inspection Checklist
Attachment 6	Notification Forms for Project Site Disturbing Less Than One Acre
Attachment 7	List of City and County of Honolulu BMP Fact Sheets for Construction
Attachment 8	Temporary Water Pollution, Dust, and Erosion Control Specifications
Attachment 9	HDOT Harbors Division Rules and Regulations for Construction Site
Attachment 10	Suspected Illicit Discharge Reporting Form
Attachment 11	Training Materials
Attachment 12	HDOT Harbors Division Construction and Post-Construction Program Brochures

List of Acronyms and Abbreviations

%	Percent
ACR	Annual Compliance Report
ASCE	American Society of Civil Engineers
BMP	Best Management Practice
CCH	City and County of Honolulu
CFR	Code of Federal Regulations
CGP	Construction General Permit
CM	Construction Manager
CWA	Clean Water Act
CWB	Clean Water Branch
CZM	Coastal Zone Management
DA	Department of Army
ECO	Environmental Compliance Officer
ELD	Environmental Liquidated Damages
ERP	Enforcement Response Plan
HAR	Hawaii Administrative Rules
HDOH	State of Hawaii, Department of Health
HDOT	State of Hawaii, Department of Transportation
MS4	Municipal Separate Storm Sewer System
NAV	Notice of Apparent Violation
NFVO	Notice and Finding of Violation Order
NGPC	Notice of General Permit Coverage
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NTP	Notice to Proceed
NWP	Nationwide Permit 33
PjM	Project Manager
SIDR	Suspected Illicit Discharge Reporting
SWMP	Stormwater Management Program
SWMPP	Stormwater Management Program Plan
SWPPP	Stormwater Pollution Prevention Plan
USACE	United States Army Corps of Engineers
USC	United States Code
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
WEF	Water Environment Federation
WQC	Water Quality Certification

Definitions of Key Terms

Best Management Practices (BMPs) are schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of "waters of the United States." BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Clean Water Act is an act passed by the U.S. Congress to control water pollution. It was formerly referred to as the Federal Water Pollution Control Act of 1972 or Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500), 33 U.S.C. 1251 et seq., as amended by Public Law 96-483, Public Law 97-117, and Public Laws 95-217, 97-117, 97-440, and 100-04. Requirements of the NPDES program are defined under Sections 307, 402, 318, and 405 of the CWA.

Code of Federal Regulations codified all rules of the executive departments and agencies of the federal government. It is divided into fifty volumes, known as titles. Title 40 of the CFR (referenced as 40 CFR) lists all environmental regulations.

Discharge is a release or flow of stormwater or other substance from a conveyance system or storage container. Broader discharges include release to storm drains, etc.

Disturbance of Land refers to the penetration, turning, or moving of soil or resurfacing of pavement or the exposure of bare soil or ground surface, including the land surface exposed by construction roads, baseyards, headquarters, and parking areas. It does not include grass or weed cutting, bush or tree trimming that leaves the soil or ground intact. It includes grubbing in its normal meaning of the use of equipment to knock down and push vegetation out of the way, typically uprooting vegetation and disturbing the ground surface.

Erosion is the wearing-away of land surface by wind or water. Erosion occurs naturally from weather or runoff but can be intensified by land-clearing practices related to farming, new development, redevelopment, road building, or timber cutting.

Grading is any excavation or fill, or combination thereof.

Illicit Discharge is a non-storm water discharge that poses a risk to the environment.

Large Common Plan of Development or Sale is a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under one plan. "Common Plan" is broadly defined as any announcement or piece of documentation (including a sign, public notice or hearing, sales pitch, advertisement, drawing, permit application, zoning request, computer design, etc.) or physical demarcation (including boundary signs, lot stakes, surveyor markings, etc.) indicating construction activities may occur on a specific plot.

Maximum Extent Practicable is defined by economically achievable measures to the control of the addition of pollutants from existing and new categories of point sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available point source pollution control practices, technologies, processes, siting criteria, operating methods or other alternatives.

New Development defined as new construction or installation of a building or structure or the creation of impervious surfaces that disturb greater than or equal to one acre, or less than one acre if it is part of a larger common plan of development or sale that would disturb one acre or more.

Notice of Intent is a formal notice submitted to the State of Hawaii Clean Water Branch by the owner of an industrial site or construction site that said owner/operator seeks coverage under a General Permit for discharges associated with industrial and construction activities. The NOI provides information on the owner, location, type of project, and certifies that the owner/operator will comply with the conditions of the construction General Permit.

Notice of Cessation is a formal notice submitted to the State of Hawaii Clean Water Branch by owner/developer that a construction project is complete.

Qualified Inspector is personnel who have met the training requirements in this document.

Redevelopment defined as development that would create or add impervious surface area on an already developed site. Redevelopment includes, but is not limited to, any construction project that requires demolition or complete removal of existing structures or impervious surfaces at a site and replacement with new impervious surfaces. Maintenance activities such as top-layer grinding, repaving (where all pavement is not removed), and reroofing are not considered to be redevelopment. Interior remodeling projects and improvements are also not considered to be redevelopment.

Secondary Containment is structure, usually dikes or berms, surrounding tanks or other storage containers, designed to catch spilled materials from the storage containers.

Sediments are soil, sand, and minerals washed from land into water, usually after rain, that collect in reservoirs, rivers, and harbors, destroying fish nesting areas and clouding the water, thus preventing sunlight from reaching aquatic plants. Farming, mining, and building activities without proper implementation of BMPs will expose sediment materials, allowing them to be washed off the land after rainfalls.

Stormwater Pollution Prevention Plan (SWPPP) is a site-specific, written document that, among other things: (1) identifies potential sources of stormwater pollution t the construction site; (2) describes stormwater control measures to reduce or eliminate pollutants in stormwater

discharges from the construction site; and (3) identifies procedures the permittee will implement to comply with the terms and conditions of Notice of General Permit Coverage. It is required by Hawaii Administrative Rules (HAR) 11-55, Appendix C, Section 7, when a project is subject to NPDES NOI-C permit requirements.

State Waters means all waters, fresh, brackish, or salt, around and within the State of Hawaii, including, but not limited to, coastal waters, streams, rivers, drainage ditches, ponds, reservoirs, canals, ground waters, and lakes – provided that drainage ditches, ponds, and reservoirs required as a part of a water pollution control system are excluded.

Stormwater Runoff is generated from rain and snowmelt events that flow over land or impervious surfaces, such as paved streets, parking lots, and building rooftops, and does not soak into the ground. The runoff can pick up pollutants like trash, chemicals, oil, dirt, and sediment that can harm rivers, streams, lakes, and coastal waters.

Tenant Improvement Projects are projects undertaken by entities including tenants and easement holders who have leases or revocable permits that authorize the use of the property, or a project by any other entity with permission to construct the project under Harbors Division jurisdiction.

1.0 INTRODUCTION

The State of Hawaii Department of Transportation [HDOT] Harbors Division (hereinafter referred to as "Harbors") **Construction Site Runoff Control Program** is an element of the Harbors Stormwater Management Program [SWMP]. This **Program** seeks to limit the impact of construction activities on the storm conveyance system and receiving state waters. The program consists of a pre-construction design and review process; a construction phase inspection process; a training program and a Construction Best Management Practices [BMP] field manual; and a compliance and enforcement process. This program manual is designed to guide Harbors personnel tasked with the responsibility of ensuring that construction projects discharging into Harbors small Municipal Separate Storm Sewer System [MS4] comply with Harbors rules to protect Hawaii's coastal water from pollution.

This program manual is intended to be used by inspectors, contractors, designers, tenants, developers, to comply with the Harbors rules and regulations, State of Hawaii Department of Health [HDOH] National Pollutant Discharge Elimination System [NPDES] permit requirements, Clean Water Act, and all other State, local, and Federal laws, rules and regulations through the use of this manual.

2.0 CONSTRUCTION PROJECT DEFINITIONS AND GENERAL REQUIREMENTS

Construction means the process of building, altering, repairing, improving, or demolishing any public structure or building, or other public improvements of any kind to any public real property. This term includes the routine operations, routine repairs, or routine maintenance of existing structures, buildings, or real property. Construction projects are activities resulted from these actions. It also includes construction related support activities such as concrete or asphalt batch plants, equipment staging areas, material storage areas, borrow areas, excavated material disposal areas, etc. Construction activities that do not disturb land, such as interior remodeling (with no outside exposure of construction materials or construction waste to stormwater), are exempt from the Harbors **Construction Site Runoff program**.

2.1 Applicability

Harbors implements this **Construction Site Runoff Control Program** at the following harbors:

- Honolulu Harbor (Oahu District)
- Kalaeloa Barbers Point Harbor (Oahu District)

These two harbors operate under small MS4 permits. The Permit File Numbers are ***HI 03KB482*** for Honolulu Harbor and ***HI 03KB488*** for Kalaeloa Barbers Point Harbor.

All construction projects on Island of Oahu are subject to the Harbors **Construction Site Runoff Control Program** unless explicitly exempted under the conditions in Section 2.2. The **Construction Site Runoff Control Program** requirements for Harbors and tenant construction projects are depicted in Figure 2-1.

2.2 Roles and Responsibilities

Harbors **Construction Site Runoff Control Program** is developed by the Harbors Engineering Branch Environmental Section, located at the Hale Awa Ku Moku Building – 79 South Nimitz Highway, Honolulu Hawaii 96813. This program manual is for use by the Harbors sections and offices designated with the responsibility of implementing this program. *HDOT Harbors Division Administrative Organizational Chart* is enclosed in Attachment 1 with the Environmental Section and its designated consultant highlighted in green.

Construction projects at Harbors are managed in two ways: 1) HDOT Harbors projects, which are managed by Division personnel, or 2) Tenant Improvement projects, which are managed by Harbors tenant or the entity authorized to undertake the project. Assigned specific responsibilities in related to the program implementation are further described in Tables 2-1 and 2-2.

Table 2-1 Harbors Functional Groups for Harbors Projects

Functional Group	Area of Responsibility
Environmental Section and Consultant	Responsible for overall implementation of the **Construction Site Runoff Control Program** including plan review, site inspection, and relevant enforcement.
Planning Section, Design Section, Maintenance Section,	Responsible for budget planning, project development, and design of BMPs through the project planning and design phases.
Construction Section	Responsible for implementation of applicable BMPs through the project construction phase (from the contract award stage to completion). Authority includes enforcement of construction contract terms.

Table 2-2 Harbors Functional Groups for Tenant Projects

Functional Group	Area of Responsibility
Environmental Section and Consultant	Responsible for overall implementation of the **Construction Site Runoff Control Program** including plan review, site inspection, and relevant enforcement.
Property Management Section	Responsible for implementation of land use agreement (e.g. lease, revocable permit, construction right-of-entry) and relevant enforcement.

2.3 Exempted Projects Less Than One Acre

The following activities, provided they do not impact Harbors small MS4 and disturb less than one acre, are exempt from documented project review and construction site stormwater compliance inspection requirements under the Harbors **Construction Site Runoff Control Program**. These sites will, however, be covered under the *Illicit Discharge Detection and Elimination Program* (e.g., through outfall reconnaissance):

- Minor land disturbance activities on a single lot (such as minor landscaping activities and interior improvements).
- Post, pole, sign, and fencing installation.
- Utility repair work.
- Parking lot, driveway, or similar paved surface repairs.
- Repair and maintenance activities.

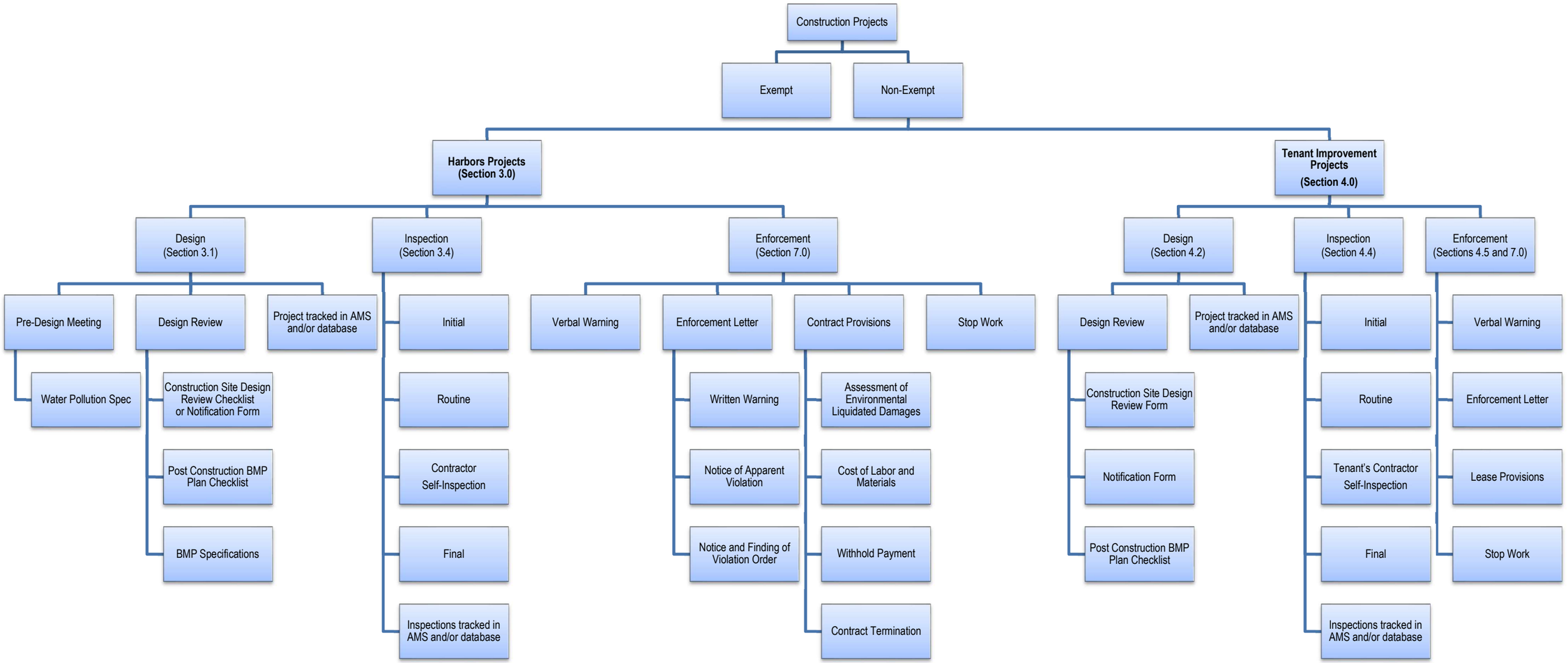


Figure 2-1: Construction Site Runoff Control Program Overview

3.0 HDOT HARBORS CONSTRUCTION PROJECTS

HDOT Harbors construction projects are these that are developed with state funding to improve facilities and managed by the Harbors. These projects are typically assigned to a Harbors Project Manager [PjM] who oversees the project during the design phase and a Construction Manager [CM] during the construction phase. Harbors PjM and CM are typically employees from the Engineering Branch. Construction projects subject to the Harbors **Construction Site Runoff Control Program** must be managed according to the program requirements.

3.1 Pre-Design Meeting

When necessary, the Harbors PjM can convene a Pre-Design meeting with Environmental Section at the start of the Design Phase to discuss the *Construction Site Design Review Checklist* (Attachment 4), as well as the *Permanent Post-Construction BMP Plan Checklist*, which is contained in Appendix B of the ***Post-Construction Stormwater Management in New Development and Redevelopment***. Related discussions may be carried into the Design Phase. These discussions and meetings will allow the Harbors PjM and Environmental Section to exchange information related to applicable site-specific and post-construction BMPs during the Design Phase.

3.2 Project Review During Design

All projects must be reviewed by the Harbors PjM, CM, and Environmental Section before construction activities commence. The process is presented in *Construction Process Flow Chart for HDOT Harbors Division Project* (Attachment 2).

3.2.1 Projects Less Than One Acre

For non-exempt projects (see section 2.2) with land disturbance less than one acre, the summary of design phase submittal requirements is listed below.

- One (1) complete *Notification Form for Project Site Disturbing Less Than One Acre* (HDOT HAR-EE Form SD<1_NF; Attachment 6). The Notification Form must be signed and dated by the PjM and Harbors Environmental Section.

These projects are also subject to initial, recurring, and final stormwater compliance BMP inspections.

3.2.2 Projects Subject to NPDES (NOI-C) Program

The Construction Site Design Review Checklist (Attachment 4) and Permanent Post-Construction BMP Plan Checklist (contained in Appendix B of the **Post-Construction Stormwater**

Management in New Development and Redevelopment) will be prepared by the Harbors Engineering Branch with each design submittal phase (i.e., preliminary, semi-final, final, or similar). Plan sheets showing Construction Site BMPs and Post-Construction BMPs will be included in the construction drawings. All projects will be required to have Post-Construction BMPs unless it is determined by the Harbors PjM and Environmental Section that these are infeasible for the project.

During the Design Phase, a project review package containing the items listed below will be provided by the designated PjM to the Harbors Environmental Section when applicable:

- Construction Site Design Review Checklist;
- Permanent Post-Construction BMP Plan Checklist;
- NPDES permit application package;
- Construction Site BMPs and Post-Construction BMPs plan sheets and BMP installation details;
- Post-Construction Stormwater Mitigation Plan [PSMP]; and
- Stormwater Pollution Prevention Plan [SWPPP].

The Harbors Environmental Section will review the project plans to ensure that the plans meet the requirements of the Harbors **Construction Site Runoff Control Program**. If it is determined that the environmental impacts of the construction activities have not been adequately addressed, the project review package must be revised and resubmitted until concurrence is received from the Environmental Section. The project will be subsequently advertised. Upon receiving competitive bids, the contract will be awarded to the selected bidder.

3.3 Project Review after Contract Award

The awarded contractor will submit or update an SWPPP to the CM for inclusion in the project review package following the review procedures outlined in the flow chart in Attachment 2. The Environmental Section will notify the CM when the project review package has conformed to environmental rules, regulations, and policies utilizing an interoffice memorandum. Following approval, Harbors will issue a **Notice to Proceed** [NTP] to the contractor, with a copy to the PjM. The NTP will indicate the following:

- Work on-site shall not commence until all required submittals (such as site-specific BMP Plan) have been approved and materials have been obtained.

3.4 Construction Site Best Management Practice Inspections

Non-exempt projects will be inspected by the designated Harbors qualified inspectors (including the Environmental Section personnel or an authorized consultant), as a part of the Harbors **Construction Site Runoff Control Program** requirements. These inspections include the ones

held prior to, during, and at the conclusion of construction. The contractor needs to conduct self-inspections triggered by the NPDES Notice of Intent [NOI] C permit requirements. The *Construction Site Best Management Practices Inspection Checklist* (Attachment 5) or its equivalent form in a Cityworks© powered Asset Management System [AMS], will be utilized during Harbors stormwater compliance inspections. Inspection records will be kept in the AMS and/or database maintained by the Environmental Section. Inspection data will be summarized in the Annual Compliance Report [ACR].

3.4.1 Initial BMP Inspection

Following the issuance of the NTP, the contractor will start to procure sufficient materials and install necessary BMPs to get ready for an initial BMP inspection, to be conducted by a qualified inspector using *Construction Site Best Management Practices Inspection Checklist* (Attachment 5 or its equivalent form in the AMS). This inspection is conducted to ensure that site-specific BMPs have been properly installed prior to soil-disturbing construction activities (except for the installation of required BMPs).

The contractor will be notified whether the site-specific BMPs are (or are not) installed in accordance with the SWPPP (or other similar documented plans, e.g., BMP Plan) and in compliance with the Harbors SWMP. No construction activities involving ground disturbance shall commence until the site-specific BMPs are determined to be in full compliance.

3.4.2 Recurring BMP Inspection

A qualified inspector will conduct recurring BMP inspections at the construction site no less than once every two weeks between the months of October through March, and once every two months, otherwise. Any observed non-compliance will be documented and addressed following the procedures in Section 7.0 Harbors will follow the procedures in the **Enforcement Response Plan** [ERP] (Harbors, 2020) to take elevated enforcement action against contractor for unresolved non-compliance when necessary. The inspector will provide the contractor and the Harbors Environmental Section with a copy of the completed inspection checklist within five (5) calendar days upon completion of the inspection.

The inspector may suspend recurring inspections until the final inspection only when the following conditions are met.

- Construction is inactive for a period of 14 days or longer and exposed soil has been stabilized; or
- Remaining construction activities will have no or minimal adverse impact to stormwater runoff.

This determination will be dependent on the construction project and site conditions. Justification for inspection suspension will be documented on the inspection form in the *"Additional Notes"*

section. The site condition will be continuous monitored to ensure that on-site construction activities have not changed to warrant the resumption of inspections.

3.4.3 Final BMP Inspection

Once the contractor has completed all construction activities, a final BMP inspection will be conducted. This inspection will be combined with a post-construction BMP final inspection (if applicable), to ensure that the soil is stabilized, site-specific BMPs have been removed, and post-construction BMPs are properly installed. The Harbors PjM, CM, and Environmental Section personnel can jointly conduct the final inspection to ensure compliance with the contract documents. Findings noted during the final BMP inspection must be corrected, and then the CM can issue the project final acceptance and make final payment.

3.4.4 Contractor Self-Inspection Requirements

The contractor has the primary responsibilities of regular inspecting and maintaining of their site-specific BMPs to ensure that the BMPs are in workable condition and functioning effectively, and to make appropriate repairs as needed (e.g., replacing deteriorated fabric filter). All major or regulated modifications to the original BMPs are required to be documented on the site-specific BMP plans or similar documents.

For projects subject to NPDES NOI-C permit requirements, the contractor shall keep their self-inspection records on-site and made available to the inspector for review when requested, and shall perform self-inspections at a frequency according to the following or HDOH issued permit:

- Weekly; and
- Within 24 hours of any rainfall of 0.25 inches or greater; daily during periods of prolonged rainfall; and within 24 hours after the end of the rainfall.

In addition, the contractor shall not cause or contribute to a violation of the basic water quality criteria, specified in HAR 11-54-4, and shall timely inspect the receiving waters, stormwater runoff, and relevant control measures (or BMPs) to detect hazard or abnormal conditions (e.g., stormwater discharges and receiving waters for turbidity, color, floating oil and grease, floating debris and scum, materials that will settle, substances that will produce taste in the water or detectable off-flavor in fish, and inspect for items that may be toxic or harmful to human or environmental health) which may cause violations of the basic water quality criteria.

4.0 TENANT IMPROVEMENT PROJECTS

Tenant improvement projects are those that are developed by tenants, easement holders or other authorized entities on Harbors property. These projects are typically managed by tenant(s) with approvals from Harbors Property Management Staff and Engineering Branch.

4.1 Regulatory Programs

Tenant improvement projects resulting in discharging into Harbors small MS4s need to apply for a *Permit for Connection to HDOT Harbors Division Small MS4* and/or *Permit to Discharge into HDOT Harbors Division Small MS4* from the Harbors Engineering Branch (Attachment 3).

In addition to Harbors **Construction Site Runoff Control Program**, tenants are required to ensure their own compliance with all other county, state, and federal rules and regulations. A specific construction project may require additional permits beyond those described herein. It will be the responsibility of the tenant to contact regulatory agencies and obtain all necessary permits.

4.1.1 NPDES Permit for Construction Sites

The Clean Water Act [CWA] is the primary federal law in the United States governing water pollution. This Act introduced the NPDES program for construction sites that disturb one acre or greater of land, which includes activities that disturb less than one acre of land if they are a part of a larger common plan of development or sale that will ultimately disturb one acre or more of total land area. Construction projects which fall under the NPDES program require the submittal of a NOI to HDOH Clean Water Branch [CWB] at least 30 calendar days prior to the start of construction activities. Permitting forms are available at the HDOH e-Permitting portal. Upon issuing of Notice of General Permit Coverage [NGPC] by the HDOH, the permit usually becomes effective within 30 days. Additionally, the tenant must notify the HDOH one week prior to the start of construction activities.

HDOH website address for the e-Permitting portal: https://eha-cloud.doh.hawaii.gov/epermit/

Tenants will be responsible for obtaining their own NPDES permits and shall provide proof to Harbors Engineering Branch prior to commencement of construction phase.

4.1.2 NPDES Permit for Dewatering

Due to their proximity to the ocean, the groundwater level at Harbors properties are relatively high and are significantly influenced by tidal activities. Dewatering operations may be required during a construction project. An NPDES permit for dewatering covers discharges from the dewatering process of construction activities of any site, including treated storm discharges, into a storm

conveyance system. These activities are regulated by the HDOH under HAR 11-55 Appendix G.

Construction projects which require dewatering fall under the NPDES program and an NOI must be filed at least 30 calendar days prior to the start of dewatering activities. After the NOI has been submitted to the HDOH, the permit becomes effective within 30 days. Additionally, the applicant must notify the HDOH one week prior to the start of construction activities.

The tenant shall be responsible for obtaining the NPDES permit for dewatering operations and shall provide proof to the Harbors Engineering Branch before commencing dewatering activities.

4.2 Project Review During Design

Non-exempt tenant projects must be reviewed by the Harbors Engineering Branch prior to commencement of construction phase. The process is demonstrated in ***Construction Process Flow Chart for Tenant Improvement Project*** in Attachment 2.

4.2.1 Projects Less Than One Acre

For non-exempt tenant projects (see section 2.2 for a list of exemptible projects) with land disturbance less than one acre, the summary of submittal requirements during design phase is listed below.

- One (1) complete *Notification Form for Project Site Disturbing Less Than One Acre* (HDOT HAR-EE Form SD<1_NFT; Attachment 6). The Notification Form must be signed and dated by the representative designated or authorized by the Project Owner/Operator.
- One copy of a sketched plan outlining the anticipated activities and the location of all proposed sediment and erosion control measures.
- The sketched plan is not required to be prepared by a licensed engineer, surveyor, or architect. If an individual with one of these licenses prepares the plan, they must sign and seal the plans.
- The sketched plan should include: (i) A site location drawing of the proposed project, indicating the location of the proposed project in relation to roadways, jurisdictional boundaries, streams and rivers; (ii) The boundary lines of the site on which the work is to be performed; (iii) The location of temporary and/or permanent vegetative and structural storm management and sediment control measures; and (iv) A topographic map of the site. If feasible, the required information may be combined into one sketch plan.
- A narrative description of the stormwater management and sediment and erosion control plan to be used during land disturbing activities. Note: This may be included on the plans instead of in a written narrative. Include a general description of topographic and soil conditions of the property. Include a general description of adjacent property and a description of existing structures, buildings, and other fixed improvements on surrounding properties when applicable.

4.2.2 Projects Subject to NPDES (NOI-C) Program

The tenant or its authorized representative shall submit the Construction Site Design Review Checklist (Attachment 4) and Permanent Post-Construction BMP Plan Checklist (contained in Appendix B of the ***Post-Construction Stormwater Management in New Development and Redevelopment*** manual) with each design submittal phase. The tenant or its authorized representative shall include plan sheets specifically titled "Site-Specific BMPs" and "Post-Construction BMPs" in their design.

At the end of the Design Phase, the tenant or its authorized representative shall submit copies of the project review package to the Harbors Engineering Branch for review. The number of copies will be determined by the Engineering Program Manager. The project review package to be submitted shall contain the following:

- Project location information;
- Project schedule;
- Completed Construction Site Design Review Checklist and Permanent Post-Construction BMP Plan Checklist;
- Completed proof of permits;
- SWPPP and Post-Construction Stormwater Mitigation Plan;
- Contact information for the reviewer if additional information is necessary.

4.3 Project Review

The Harbors Engineering Branch Environmental Section will review the plans to ensure that the environmental impact of the construction project has been limited to the maximum extent practicable. If it is determined that the environmental impacts have not been adequately addressed, the tenant or their authorized representative shall revise and resubmit the project review package until consent is granted by the Harbors.

The Harbors Engineering Branch will notify the tenant or their authorized representative to proceed with the following caveats when the project review package has been evaluated and accepted:

- The tenant's Contractor, usually as the first order of work and prior to the commencement of any ground disturbance (except for installation of relevant BMPs), shall install applicable site-specific BMPs and inform the Harbors Engineering Branch for an initial BMP inspection, to ensure conformance and compliance with accepted plans and permits.

4.4 Construction Site BMP Inspections

A critical part of the oversight process is the requirement for inspection of the BMPs by a designated Harbors Inspector, as a part of the Harbors **Construction Site Runoff Control Program** requirements, including BMP inspections held prior to, during, and at the conclusion of construction phase. *Construction Site Best Management Practices Inspection Checklist* (Attachment 5 or its equivalent form in AMS) will be utilized to document BMP inspections and will be recorded in Harbors AMS. The contractor shall conduct self-inspections required by tenant's own NPDES NOI-C or other permit(s).

4.4.1 Initial BMP Inspection

After the consent is granted for the project, Harbors will conduct an initial BMP inspection prior to commencement of construction activities to ensure that the site-specific BMPs have been properly installed. The Tenant will be notified whether the site-specific BMPs are (or are not) in full compliance with the Harbors SWMP. No construction activities shall commence until the site-specific BMPs are determined by Harbors to be in full compliance.

4.4.2 Recurring BMP Inspection

The Harbors will conduct regular site BMP inspections at specified frequencies (i.e., biweekly from October to March and bimonthly otherwise). Any instance of non-compliance observed during the inspections will be documented with photographs as well as on the *Construction Site Best Management Practices Inspection Checklist* (Attachment 5 or its equivalent form in AMS). Harbors will follow the procedures in the ERP to take elevated enforcement action again the tenant for unresolved non-compliance when necessary.

If the inspector determines that project site has reached to a point where exposed soil has been stabilized and any remaining construction activities prior to project completion would have negligible stormwater impact, the Environmental Section has the discretion to suspend further inspections until it is the time for a final inspection. However, the site condition will continuous be monitored to ensure that such activities have changed, which would warrant the resumption of regular inspections.

4.4.3 Final BMP Inspection

Once the Tenant has completed all construction activities, a final inspection by a Harbors designated Inspector must be conducted. This inspection will be conducted combined with a post-construction BMP final inspection, if applicable, to ensure that the soil is stabilized, site-specific BMPs have been removed, and post-construction BMPs are properly installed.

The Environmental Section shall be notified at the time to schedule the final BMP inspection. Any

deficiencies noted during the final inspection must be rectified. Final acceptance of the project by the Harbors will be dependent upon a satisfactory final inspection.

4.4.4 Tenant Self-Inspection Required by the NPDES NOI-C Permit

Site-specific BMPs are usually temporary measures that require frequent maintenance to keep up their effectiveness and may require relocation, re-installation, or repair, particularly as the construction project progresses. The Tenant (or the Tenant's Contractor) has the primary responsibility for inspecting and maintaining of their site-specific BMPs in order to ensure that the BMPs are properly maintained, functioning effectively, and to make appropriate repairs as needed (e.g., replace biosocks). All major changes to the original BMPs should be documented within the site plans.

The contractor shall keep their inspection records on-site and made available to the Harbors for review upon request. The Contractor shall perform self-inspections for projects that are subject to NPDES NOI-C program according to following schedule.

- Weekly; and
- Within 24 hours of any rainfall of 0.25 inches or greater; daily during periods of prolonged rainfall; and within 24 hours after the end of the rainfall.

In addition, the Contractor shall not cause or contribute to a violation of the basic water quality criteria, specified in HAR 11-54-4, and shall timely inspect the receiving waters, stormwater runoff and control measures (or BMPs) to detect hazard or abnormal conditions (e.g., stormwater discharges and receiving waters for turbidity, color, floating oil and grease, floating debris and scum, materials that will settle, substances that will produce taste in the water or detectable off-flavor in fish, and inspect for items that may be toxic or harmful to human or environmental health), which may cause violations of the basic water quality criteria.

5.0 TRAINING PROGRAM

Training is one of the essential keys to a successful stormwater management program. The Harbors policy and practice is to provide education and training to ensure that all employees have the knowledge and skills necessary to perform their functions effectively and efficiently.

Harbors engineers, inspectors, and consultants whose primary job duties are related to implementing this program receive annual training directly pertinent to their responsibilities associated with the program. Harbors engineers and inspectors who have attended the annual training are considered qualified inspectors. See Tables 2-1 and 2-2 for a description of Harbors staff responsibilities for Harbors and Tenant Projects respectively.

The Environmental Section includes designated Erosion and Sediment Control Engineer and Inspector working alongside a Consultant assigned to assist with and coordinate the overall Stormwater Management Program.

5.1 Training for Harbors Staff and Consultants

Harbors engineers, inspectors, and consultants who have primary construction stormwater responsibilities will receive initial and annual refresher training. These training sessions will provide a detailed review of stormwater pollution prevention concepts and practices; and a discussion of the procedures and protocols of the Harbors **Construction Site Runoff Control Program**, as described below.

Harbors will hold annual refresher training which will include a review of stormwater pollution prevention concepts and practices, a review of the Harbors **Construction Site Runoff Control Program**, relevant highlights over the past year, issues/problems encountered during the implementation of the program, and suggestions for improvements to the program.

5.2 Initial Training Content

In calendar years 2014 to 2019, Harbors has hired an USEPA and HDOH approved consultant to provide an initial and annual trainings to Harbors engineers, inspectors, and their consultants who have construction stormwater responsibilities. After that time period, Harbors provides the training in-the-house to new employees. The training would usually cover the following:

- **General Program Management**. This portion will consist of overall program administration and implementation and be administered to the Construction, Design, Maintenance, and Planning Sections. The content of the training will include:
  - Goals and objectives of the **Construction Site Runoff Control Program**;
  - Regulatory Background;
  - Inventory of Construction Sites;

- The ***City and County of Honolulu Best Management Practice Manual for Construction*** (CCH, 2011);
- Hawai'i's Construction General Permit Stormwater Pollution Control Plan requirements;
- Plan Review including the use of the *Construction Site Design Review Checklist* (Attachment 4) and *Permanent Post-Construction BMPs Plan Checklist* (contained in Appendix B of the **Post-Construction Stormwater Management in New Development and Redevelopment Program**); and Concurrence;
- The roles and responsibilities of Harbors staff regarding implementation of the **Construction Site Runoff Control Program** to achieve compliance;
- Proper installation and maintenance of BMPs for Construction Sites; and
- Overview of the Inspection Program and Enforcement Requirements.

- **Construction Site BMP Inspections**. In addition to the above training, the new inspectors will receive on-the-job training focusing on inspection procedures including the ones developed by HDOH and USEPA, use of the *Construction Site Best Management Practice Inspection Checklist* (Attachment 5) and enforcement procedures. The new inspectors will gain inspection experience by conducting at least three rounds of inspection with the experienced Erosion and Sediment Control Engineer or Inspector. During the inspections, the new inspectors will observe how the experienced inspectors conduct the inspections as well as conduct their own inspections with assistance from the experienced ones. New inspectors will continue to have frequent interactions with experienced inspectors to discuss inspection issues as they arise. Training inspections will be documented on the inspection report and tracked to ensure that new inspectors conduct at least three inspections with an experienced inspector.

All participants will be required to complete a quiz. Training effectiveness will be evaluated via a survey. Information regarding how many employees attend the training will be reported in ACR. Input collected from the survey will be evaluated and used for the development of future training sessions. Additionally, the evaluation results and any necessary program improvements will be included in the ACR.

6.0 OUTREACH TO CONSTRUCTION CONTRACTORS

Harbors provides outreach to construction contractors and consultants on stormwater pollution prevention and to explain their roles and responsibilities. This outreach is conducted primarily through informational exchanges among the Harbors PjM, CM, and their contractors. The informational exchanges cover the following topics:

- The provisions, conditions, and requirements of the **Program** that apply to their projects;
- The availability of guidance material prepared by Harbors and other agencies for construction contractors and consultants; including the Harbors *Construction Site Design Review Checklist*, the USEPA Construction BMP library, the USEPA Post-construction BMP library, and the ***City and County of Honolulu Best Management Practices Manual for Construction***; and
- General responsibilities of construction contractors regarding implementation of the Harbors **Construction Site Runoff Control Program**, and the preparation and requirements of their SWPPP.

6.1 Informational Exchange Sessions

Harbors utilizes three types of informational exchange sessions, as needed, to provide outreach to construction contractors on stormwater pollution prevention concepts and practices and preparation of SWPPP (or other similar documents) for construction activities. A list of construction and post-construction program brochures are included in Attachment 12.

- Pre-Bid Meeting, Stormwater Permit Compliance Requirements: Pre-bid meetings may be conducted to discuss a given upcoming construction project. The Harbors PjM provides general information to construction contractors regarding the requirements of the permit(s) and the **Harbors Construction Site Runoff Control Program**, applicable to the project. This information generally includes a discussion of the need for the development of a project-specific SWPPP (or other similar documents).
- Pre-Construction Meeting, Stormwater Permit Compliance Requirements: The Harbors Project Engineer. PjM, or CM provides project-specific guidance to construction contractors covering topics such as SWPPP (or other similar documents) preparation, selection of BMPs, BMP inspections, and relevant operation and maintenance.
- Additional Informational Exchanges: The Harbors Engineering Branch Environmental Section will hold informal training sessions with construction contractors, as needed, prior to the commencement of construction phase.

6.2 Harbors SWMP Website

Harbors prepares and posts key **Construction Site Runoff Control Program** related forms and documents at its website at: http://hidot.hawaii.gov/harbors/malamaikeawakai/.

7.0 ENFORCEMENT

Enforcement of construction projects will be undertaken by the designated Harbors personnel who have internal enforcement authority through established policies and procedures as detailed in the ERP. There are several enforcement mechanisms and penalties to ensure compliance with local ordinances, permits, and contract documents. The enforcement actions proceed along different routes depending upon whether the project is a Harbors Project or a Tenant Improvement Project.

7.1 Scope of Authority

The enforcement options available to Harbors range from administrative actions (including verbal warnings and written warnings) to damage assessment, withholding of contractor's payment, and termination of agreements (such as tenant leases, revocable permits, and construction contracts). The general areas authorizing environmental enforcement are enclosed in Attachment 9 as follows:

- HRS Title 15 Chapter 266 authorizes Harbors to issue citations and summons for violations of its rules and have its actions enforced through the district courts by verdict of a misdemeanor or fine.
- HAR Title 19 Chapters 41 to 44 establishes uniform safety measures, operational standards and requirements, and the conduct for a responsible party at State of Hawaii harbors.
- The Construction Contract that provides Harbors with the right of entry to conduct inspection and authority to issue **Stop Work Order** or fines, and to withhold a contractor's payment.
- 2016 General Provisions for Construction Projects (DOT, 2016).

7.2 Harbors Construction Project Enforcement

Enforcement at construction projects will be undertaken by the designated Harbors personnel in accordance with the terms of the construction contract. Non-compliance with the BMP Plan discovered during inspections should be immediately corrected by the contractor, if practical.

Any illicit discharge originating from the construction site will be investigated and appropriate actions will be taken following the procedures outlined in the Harbors ***ERP*** (Harbors, 2020). There are nine possible enforcement outcomes from construction site inspections – verbal warnings, written warnings, Notice of Apparent Violation [NAV], Notice and Finding of Violation Order [NFVO], stop work order [SWO], Assessment of Environmental Liquidated Damages [ELD], Cost of Labor and Materials [L&M], Withholding of Payments, Termination of Agreements. Detailed discussions related to each type of enforcement are listed in Section 3.2 of ERP.

7.3 Harbors Tenant Construction Project Enforcement

Enforcement at tenant construction projects will be undertaken by the designated Harbors personnel in accordance with the terms of the lease, revocable permit, or construction right-of-entry, as applicable. Non-compliance with the BMP Plan discovered during inspections should be immediately corrected by the contractor, if practical. If no corrective actions are taken, Harbors has the authority to issue a written warning, a NAV, a NFVO, SWO (stopping the tenant project and depriving its contractor of the basis to request payment), and/or termination of tenant lease or revocable permit (Section 5.5.2 of ERP). If necessary, further actions in accordance with the Harbors ERP may be taken.

Any illicit discharge originating from the construction site will be investigated and appropriate actions would be taken in accordance with the Harbors **ERP** (Harbors, 2020).

8.0 CONSTRUCTION BMP FIELD MANUAL

The Harbors adopts the ***City and County of Honolulu Best Management Practice Manual for Construction*** (CCH, 2011) as a Construction BMP Field Manual to guide both Harbors' construction projects and tenant improvement projects.

> **City and County of Honolulu Best Management Practice Manual for Construction** can be downloaded online at https://hidot.hawaii.gov/harbors/files/2013/01/CCH_BMP_Manual_2011-11.pdf

The purpose of the Construction BMP Field Manual is to provide guidance on the installation and maintenance of BMPs that address construction activities. Each BMP identified in the manual includes a general description, application, limitations, installation and implementation requirements, and maintenance and inspections.

8.1 BMP Selection

The Designer and the Contractor shall evaluate which BMPs will be applicable for a particular construction project. The first step in the selection phase will be to determine which construction activities may result in or generate potential pollutants. Once those activities are identified, the BMPs can be chosen according to the CCH "*Rules Relating to Water Quality* (CCH, 2017)," which can be downloaded from their website listed below.

> **Rules Relating to Water Quality** issued by City and County of Honolulu can be downloaded at http://www.honoluludpp.org/ApplicationsForms/StormWaterQuality.aspx

9.0 REFERENCES

Airports, 2012, *Storm Water Management Program Plan – Section C: Construction Site Runoff Control Program*: State of Hawaii, Department of Transportation, Airports Division, Version 4.0, February 2012.

ASCE and WEF, 1992, *Design and Construction of Urban Stormwater Management Systems - ASCE Manual and Reports on Engineering Practice and WEF Manual of Practice FD-20*: American Society of Civil Engineers and Water Environment Federation, 1992.

Blanco Humberto & Lal Rattan, 2010, *Principles of Soil Conservation and Management*: Springer, p. 56-57, ISBN 978-90-481-8529-0, 2010.

CCH, 2011, *Storm Water Best Management Practice Manual for Construction*: State of Hawaii, City and County of Honolulu, Department of Environmental Services, November 2011.

CCH, 2017, *Rules Relating to Water Quality*: State of Hawaii, City and County of Honolulu, Department of Planning and Permitting, August 16, 2017.

DOT, 2016, *General Provisions for Construction Projects*: State of Hawaii, Department of Transportation, Air and Water Transportation Facilities Division, 2016.

Giambelluca TW, Chen Q, Frazier AG, Price JP, Chen Y-L, Chu P-S, Eischeid J., and Delparte, D. , 2011, *The Rainfall Atlas of Hawai'i*: http://rainfall.geography.hawaii.edu, 2011.

Gray Donald H. & Sotir Robbin B., 1996, *Biotechnical and Soil Bioengineering Slope Stabilization – A Practical Guide for Erosion Control*: John Wiley & Sons, Inc., p. 20, ISBN 978-0-471-04978-4, 1996.

Harbors 2020, Enforcement Response Plan: State of Hawaii Department of Transportation, Harbors Division, April 2020.

Norris E. Joanne, Stokes Alexia, Mickovski B. Slobodan, Cammeraat Erik, van Beek Rens, Nicoll C. Bruce, and Achim Alexis, 2008, *Slope Stability and Erosion Control: Ecotechnological Solutions*: Springer, Chapter 3 – Hillslope Processes: Mass Wasting, Slope Stability and Erosion, ISBN 978-0-470-71076-0, 2008.

The Weather Channel, 2013, *Average Weather for Honolulu, HI – Temperature and Precipitation*: http://www.weather.com/weather/wxclimatology/monthly/graph/USHI0026, 2013.

US Climate Data, 2013, *United States Climate Data, Honolulu Climate Graph – Hawaii Climate Chart*: http://www.usclimatedata.com/climate.php?location=USHI0026, 2013.

USACE, 2012, *Final Notice of Issuance and Modification on Nationwide Permits*: Federal Register, Department of the Army, Corps of Engineers, March 19, 2012.

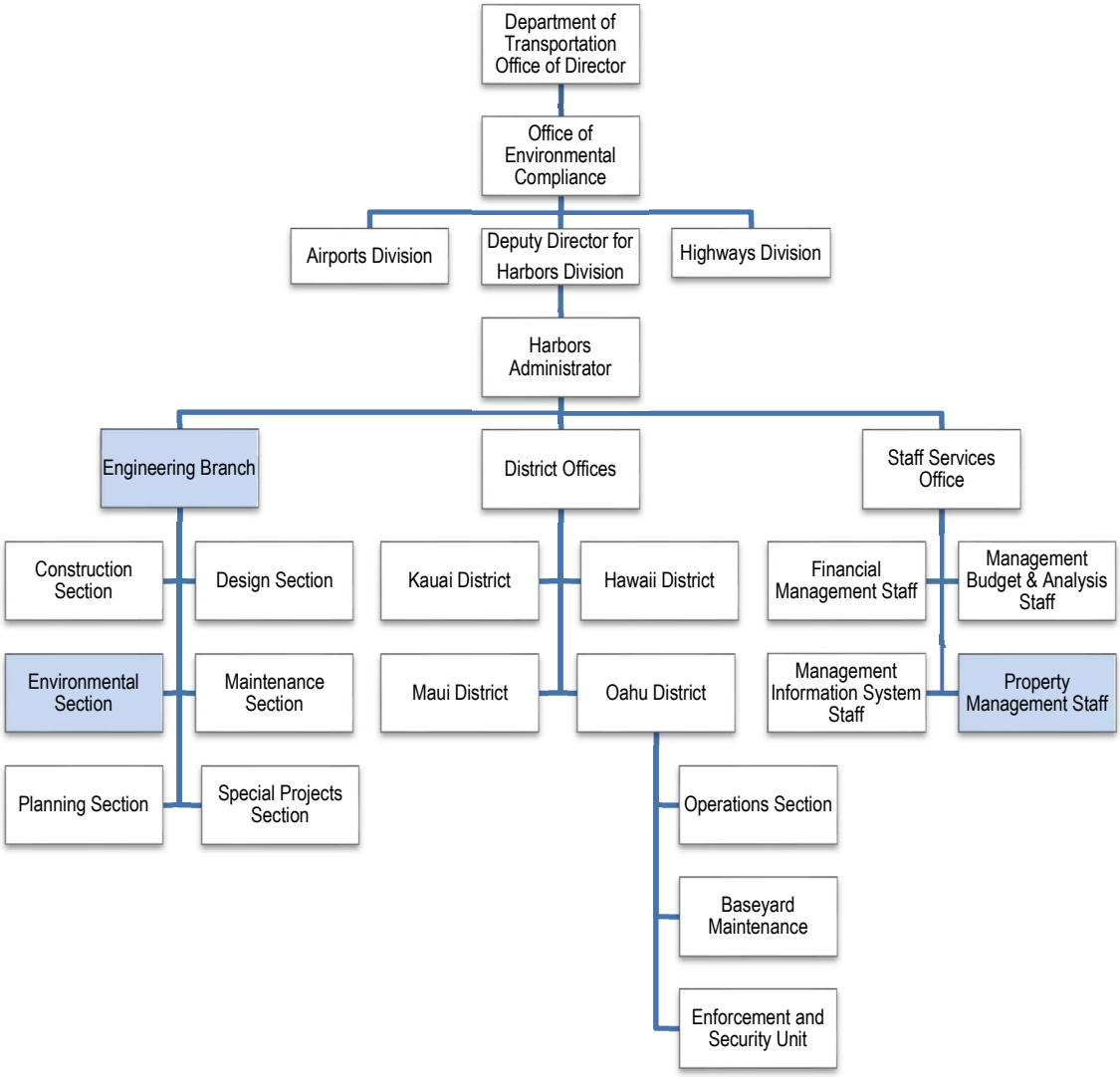
USEPA, 2007, *Developing Your Stormwater Pollution Prevention Plan - A Guide for Construction Sites*: United States Environmental Protection Agency, EPA-833-R-06-004, May 2007.

USEPA, 2012, *Overview of EPA Authorities for Natural Resource Managers Developing Aquatic Invasive Species Rapid Response and Management Plans: CWA Section 404-Permits to Discharge Dredged or Fill Material*: http://water.epa.gov/type/oceb/habitat/cwa404.cfm, March 6, 2012.

Attachment 1

HDOT Harbors Division Administrative Organizational Chart

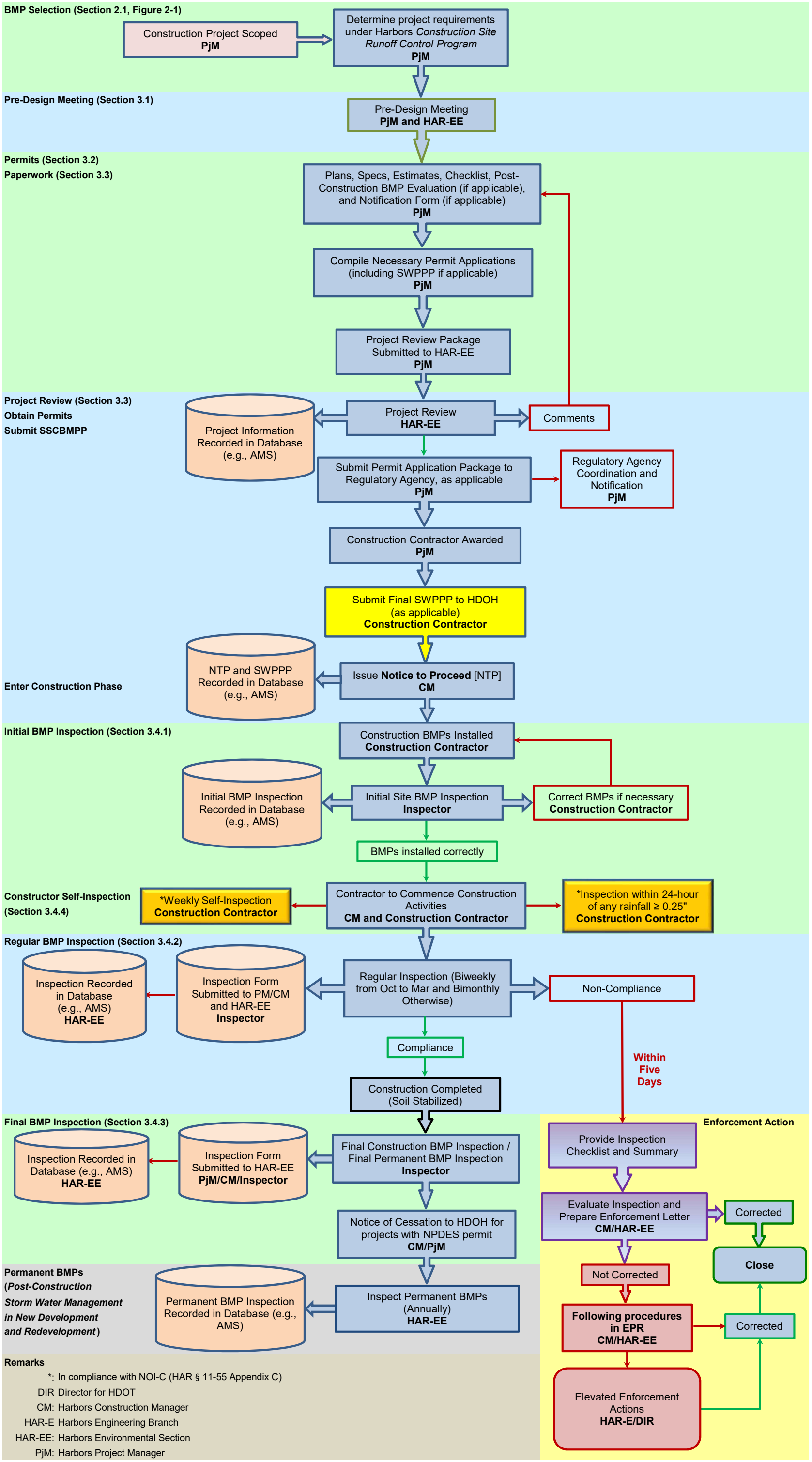
State of Hawaii Department of Transportation, Harbors Division
Administrative Organizational Chart



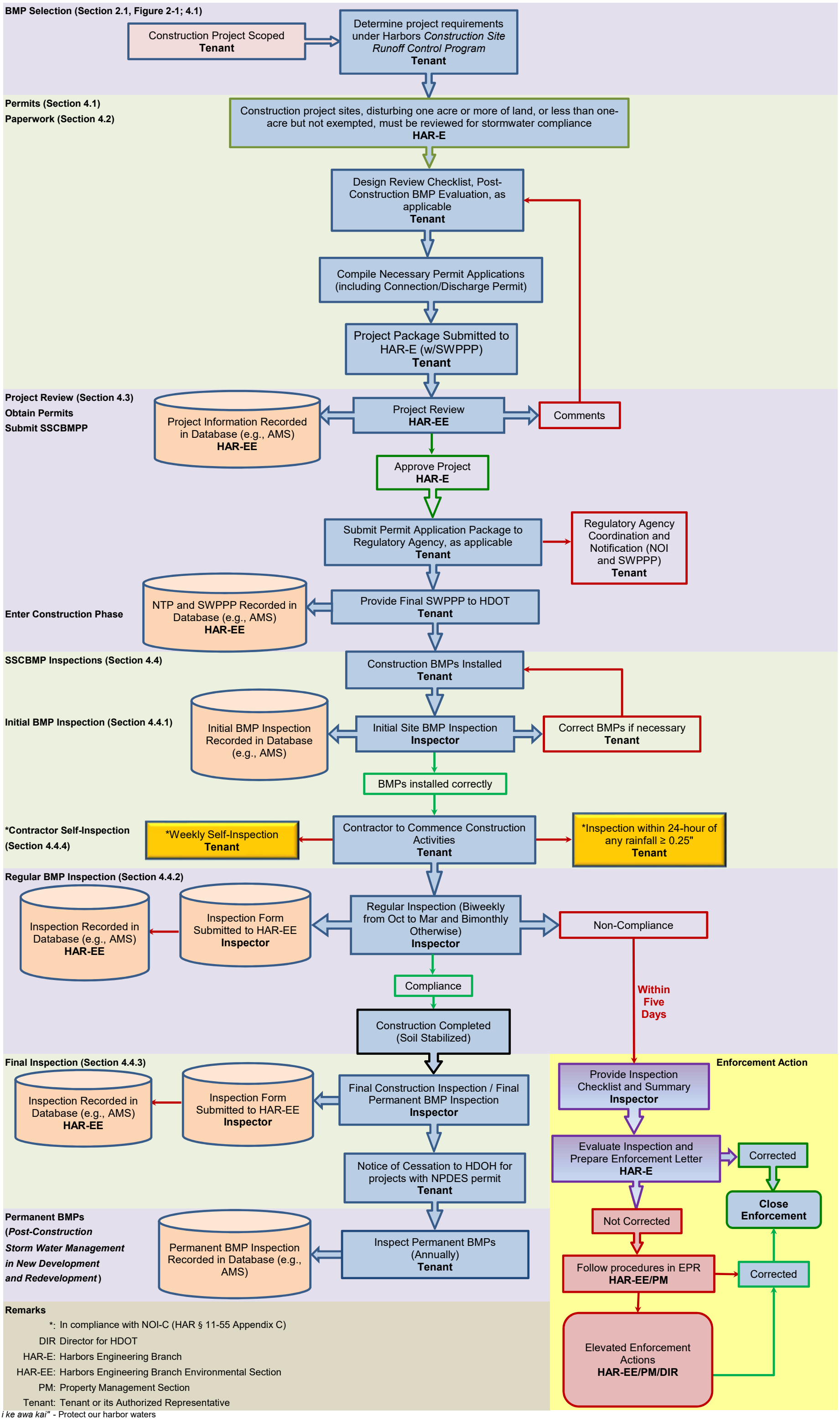
Attachment 2

Construction Process Flow Charts

Construction Process Flow Chart for HDOT Harbors Project



Construction Process Flow Chart for HDOT Tenant Improvement Project



Remarks

*: In compliance with NOI-C (HAR § 11-55 Appendix C)
DIR Director for HDOT
HAR-E: Harbors Engineering Branch
HAR-EE: Harbors Engineering Branch Environmental Section
PM: Property Management Section
Tenant: Tenant or its Authorized Representative

Attachment 3

Permit for Connection to HDOT Harbors Division Small MS4

Permit to Discharge into HDOT Harbors Division Small MS4

FOR OFFICE USE ONLY		
Harbors. I.D. No.: _____	Harbor: _____	HDOH NPDES File No. (if applicable) _____

Permit for Connection to HDOT Harbors Division Small MS4

Application Date:_____

Note: This form is to be used for connection to Harbors Division Small MS4. Permanent structure(s) will be constructed at the location(s) below if approved. Otherwise, please use ***Permit to Discharge into HDOT Harbors Division Small MS4*** form.

Pursuant to Hawaii Administrative Rules, Chapter 11-55, application is hereby made to connect to the State Department of Transportation (HDOT) Harbors Division Small Municipal Separate Storm Sewer System (MS4) at the location(s) specified below and at no other place.

1.	Name of Harbor:	
2.	Tax Map Key No:	
3.	Location:	
4.	Description of Connection(s):	
5.	Complete the Drain Connection Worksheet on Page 3 and attach related Plan(s).	

Licensee*, the undersigned, hereby agrees to the following:

1. That the Licensee shall bear the entire cost of engineering, construction, and maintenance of the private storm drainage system.
2. That the Licensee shall indemnify and hold the State free and harmless from all suits and actions caused by the Licensee's acts or failure to act in connection with engineering construction and maintenance of the Licensee's private storm drainage system and its connection to the HDOT Harbors Division Small MS4.
3. That the construction of the storm drainage system shall be made in accordance with plans and specifications approved by the Harbors Division, and subject to compliance with all applicable statutes, ordinances, and rules and regulations of Federal, State or City agencies having the effect of the law. If a National Pollutant Discharge Elimination System (NPDES) Permit is warranted in accordance with Hawaii Administrative Rules (HAR) 11-55, the Licensee shall obtain the permit as required by the State Department of Health (HDOH) and submit a copy to the HDOT Harbors Division with this form.
4. That prior to any construction work, the Licensee shall obtain permission to perform work from the HDOT Harbors Division Engineering Program Manager, and comply with Harbors *Construction Site Runoff Control Program* and *Post-Construction Storm Water Management in New Development and Redevelopment*.
5. That in the event any portion of the HDOT Harbors Division Small MS4 is damaged or destroyed during the construction of the private storm drain connection, the Licensee shall bear the entire cost of engineering and construction, or replacement of the damaged system.
6. That no additions or alterations to the private storm drainage system will be made without the prior written consent of the HDOT Harbors Division.
7. That the private storm drainage system shall remain at the Licensee's property and that the Licensee will be solely responsible for its maintenance and upkeep.
8. That in the event, the private storm drainage system within the State right-of-way shall at any time interfere with any public use, the Licensee will relocate the private water drainage system at the Licensee's sole expense.

9. That any time the private storm drainage system discharges pollutants or other objectionable material into the HDOT Harbors Division Small MS4 which exceeds applicable water quality standards of the HDOH as identified in Section 11-54-4, Hawaii Administrative Rules, or otherwise misuses the system, or causes a violation of any provisions of the State's NPDES permit, the HDOT Harbors Division, by written notice, may terminate this licensee and have the system removed at the Licensee's expense. In addition, the Licensee shall be liable for any and all penalties as a result of discharges from the Licensee's system.
10. That discharge into the HDOT Harbors Division Small MS4 shall be composed entirely of storm water, or other discharges allowed by HDOH. In the event the discharge into the HDOT Harbors Division Small MS4 comes from a point or non-point source regulated by HDOH, the Licensee shall obtain the proper NPDES permit(s) from HDOH in accordance with HAR 11-55, and shall provide effluent monitoring reports required by their NPDES permit to HDOT Harbors Division when requested.
11. That the HDOT Harbors Division, or its authorized representative, may during reasonable hours and upon notification to the Licensee, enter building or premises to inspect or investigate, measure or test any effluent discharged directly or indirectly to the HDOT Harbors Division Small MS4.
12. That the Licensee will notify the Harbors Environmental Section at (808) 587-1962 at least 72 hours before commencing construction work, to arrange for necessary inspectional services.
13. That the Licensee shall require this permit to be part of the contract with its construction contractor.
14. That this agreement shall be made a condition of any subsequent transfer of property ownership.

Print Name of Licensee	Company Name
Licensee's Title	Company Address
	City, State, Zip Code
Signature of Licensee Date	E-mail Address
Telephone No.	Fax No.

Reviewed By:

Environmental Section	Date

Approved By:

Engineering Program Manager	Date

CONSTRUCTION DATA

Work Started: _____

Work Completed: _____

Inspector:

*Licensee shall be the authorized representative of the party seeking to connect and discharge to the HDOT Harbors Small MS4 under this permit.

Drain Connection Worksheet

If "**No**" is checked, please provide justification beneath each item.		
Item	**Yes**	**No**
1. Site Map showing subject discharge point(s) to Harbors drainage system in NAD 83 Geographic coordinates (latitude, longitude) is attached.	☐	☐
2. Storm Water Flow Map is attached.	☐	☐
3. Quantity of storm water and site process water entering Harbors drainage system is attached.	☐	☐
4. Description of Best Management Practices and location(s) are attached.	☐	☐
5. Drain Construction/Structure Plan is attached.	☐	☐
6. Type of Discharge and copy of NPDES permit issued by HDOH (if applicable).	☐	☐

Please refer to *City and County of Honolulu Storm Water Best Management Practice Manual – Construction, November 2011,* for more information.

FOR OFFICE USE ONLY		
Harbors. I.D. No.: _____	Harbor: _____	HDOH NPDES File No._____

Permit to Discharge into HDOT Harbors Division Small MS4

Application Date:_____

Note: This form is to be used for discharge to Harbors Division Small MS4 system ONLY. No permanent structure will be constructed at the location(s) specified below. Otherwise, please use ***Permit for Connection to HDOT Harbors Division Small MS4*** form.

Pursuant to Hawaii Administrative Rules, Chapter 11-55, application is hereby made to discharge into the State of Hawaii Department of Transportation (HDOT) Harbors Division Small Municipal Separate Storm Sewer System (MS4) at the location(s) specified below and at no other place.

1. Name of Harbor: _____
2. Tax Map Key No: _____
3. Location: _____

4. Type of Discharge
   - ☐ Storm water associated with industrial activities
   - ☐ Hydrotesting water
   - ☐ Storm water associated with construction activities
   - ☐ Dewatering
   - ☐ Others (Specify):

5. Complete the *Drain Discharge Worksheet* on Page 3 and attach related Plan(s).

Licensee*, the undersigned, hereby agrees to the following:

1. That the Licensee shall indemnify and hold the State free and harmless from all suits and actions resulting from the licensee's discharge operations.
2. That the Licensee shall provide appropriate control measures and/or treatment devices for the removal of soil particles, and/or other pollutant(s) in the discharge, and such discharge shall meet the basic water quality criteria applicable to all state waters, as identified in Section 11-54-4, and any other applicable sections in Chapter 11-54, Hawaii Administrative Rules, at the point of discharge into state waters.
3. That the Licensee shall obtain National Pollutant Discharge Elimination System (NPDES) permit as required by the State of Hawaii Department of Health (HDOH) and submit a copy to the HDOT Harbors Division with this form, if necessary.
4. That a copy of any effluent monitoring required by the NPDES permit shall be furnished to the HDOT Harbors Division, when requested.
5. That the Licensee shall make all restoration to any State property damaged during the Licensee's discharge operations in accordance with the HDOT Harbors Division requirements.
6. That the Licensee shall discontinue the discharge, should the HDOH determine that the receiving waters are being polluted, the discharge does not meet the effluent requirements of the NPDES permit, and the Licensee's operations are not in the best interest of the general public. In addition, the Licensee shall be liable for any and all penalties as a result of discharges from the Licensee's system.

7. That if the HDOT Harbors Division determines that any material or substance from the Licensee's discharge operations have settled into Harbors Small MS4, the Licensee shall immediately remove and clear any material and substance to the satisfaction of the HDOT Harbors Division.
8. That the Licensee shall comply with Harbors *Construction Site Runoff Control Program* and *Post-Construction Storm Water Management in New Development and Redevelopment*, and inspect and clean the Harbors Small MS4 prior to discharging, when applicable.
9. That the Licensee shall notify the Harbors Environmental Section at (808) 587-1962 at least 72 hours before commencing discharge and at the conclusion of the discharge operation to arrange for necessary inspectional services.
10. That the Licensee shall require this permit to be part of the contract with its construction contractor when applicable.

Print Name of Licensee	Company Name
Licensee's Title	Company Address
	City, State, Zip Code
Signature of Licensee Date	E-mail Address
Telephone No.	Fax No.

Reviewed By:

Environmental Section	Date

Approved By:

Engineering Program Manager	Date

CONSTRUCTION DATA

Work Started: _____

Work Completed: _____

Inspector: _____

*Licensee shall be the authorized representative of the party seeking to discharge into the HDOT Harbors Division Small MS4 under this permit.

Drain Discharge Worksheet

If "**No**" is checked, please provide justification beneath each item.

Item	Yes	No
1. Site Map showing subject discharge point(s) to Harbors drainage system in NAD 83 Geographic coordinates (latitude, longitude) is attached.	☐	☐
2. Storm Water Flow Map is attached.	☐	☐
3. Quantity of storm water and site process water entering Harbors drainage system is attached.	☐	☐
For Construction Project (Please refer to *City and County of Honolulu Storm Water Best Management Practice Manual – Construction, November 2011,* for more information)		
4. Description of erosion controls and location(s) are attached.	☐	☐
5. Project schedule is attached.	☐	☐

Attachment 4

Construction Site Design Review Checklist

Hawaii Department of Transportation – Harbors Division

"Mālama i ke awa kai" - Protect our harbor waters

Construction Site Design Review Checklist

Project Description	
Project Title:	
Project Job No:	Acreage of Site:
Name of Design Firm:	
Projected Construction Timeframe:	
Description of Project:	

Site Information			
Construction Site Location:			
Latitude:		Longitude:	
Tax Map Key No(s).:			
Disturbed Area (to nearest tenth of an acre):		Total Project Area (to nearest tenth of an acre):	
Existing Percentage of Impervious Area:		Percentage of Impervious Area After Completion:	

Nearest Water Body Information	
Name of Nearest Receiving Water Body(s) and Distance:	
Any New or Modified Storm Drain Connections:	
Description of Existing Storm Drains On or Adjacent to Project Area:	

Design Submittal (Check one):		
☐ Preliminary Design	☐ Semi-Final Design	☐ Final Design

Signature and Certifications	
Designer: I certify that the design is complete, accurate, and addresses the items on this checklist to the best of my knowledge.	
Print Name:	Job Title:
Signature:	Date:
Review: HDOT Harbors Project Manager and Environmental Section.	
Harbors Project Manager Signature:	Print Name: Date:
Harbors Environmental Section Signature:	Print Name: Date:

Existing and Proposed Site Features	Yes	No	N/A
1. The following site features should be included on the plans, if deemed necessary based on project type, size, and scope.			
• Existing and proposed topography, features, and storm water flow paths	☐	☐	☐
• Preliminary location, size in square feet, and limits of disturbance	☐	☐	☐
• Locations of existing and proposed roads, curbs, gutters, storm drains, inlets, buildings, signs, sidewalks, traffic signals, light standards, guardrails, and other structures	☐	☐	☐
• Location of internal swales and ditches, and other drainage facilities	☐	☐	☐
• Maps of predominant soils from USDA soil surveys	☐	☐	☐
• Boundaries of existing predominant vegetation and proposed limits of clearing and grubbing	☐	☐	☐
• Existing and proposed utilities and easements	☐	☐	☐
• Preliminary location and dimensions of proposed channel modifications, such as bridge or culvert crossings	☐	☐	☐
2. If the project or site includes, is adjacent to, or otherwise may impact any of the following, they should be included on the plans.			
• Perennial and intermittent streams or other surface water	☐	☐	☐
• Location and boundaries of resource protection areas such as wetlands, lakes, ponds, and other setbacks (e.g., stream buffers, drinking water well setbacks, septic setbacks)	☐	☐	☐
• Location of floodplain/floodway limits and relationship of site to upstream and downstream properties and drainages	☐	☐	☐
• The limits of the existing and proposed maps and plans shall extend past the project limits if any existing condition has an impact to the project. Include future projects that have the potential to start prior to the subject project.	☐	☐	☐
• Stream flow velocity for stream work	☐	☐	☐
3. Identify potential pollutants related to non-storm water on site.	☐	☐	☐

Scheduling	Yes	No	N/A
1. Include sequencing of construction activities with the implementation of construction site BMPs is provided?	☐	☐	☐
2. Show how the rainy season relates to soil-disturbing and re-stabilization activities?	☐	☐	☐
3. Include detail on the implementation and deployment of soil stabilization, sediment control, non-storm water management, construction material management, waste management, pollution control, spill control practices, and inspection and maintenance BMPs?	☐	☐	☐
4. If the project is performed in multiple phases, are the phase-specific BMPs that take into account relevant potential pollutants?	☐	☐	☐

Construction Site BMPs (Please refer to *City and County of Honolulu Storm Water BMP Manual – Construction, November 2011,* for more information)	Yes	No	N/A
1. Soil Stabilization Practices (Plans address or include the following practices and situations?)			
• Preservation of existing vegetation	☐	☐	☐
• Stabilization of construction entrance	☐	☐	☐
• Protection of stockpiles	☐	☐	☐
• Bank stabilization	☐	☐	☐
• Topsoil management	☐	☐	☐
• Mulching, seeding, and/or planting with installation/application procedures and requirements	☐	☐	☐
• Velocity reduction devices in storm water flow paths	☐	☐	☐
• Geotextiles, plastic covers, turf reinforce mats, and/or erosion control blankets/mats, with installation/application procedures and requirements	☐	☐	☐
• Temporary drains, swales, earth dikes, and/or lined ditches	☐	☐	☐

• Slope drains, subsurface drains	☐	☐	☐
• Top and toe of slope diversion ditches/berms	☐	☐	☐
2. Sediment Control Practices (Plans address or include the following practices and situations?)			
• Location of potential sediment sources	☐	☐	☐
• Does on-site drainage enter into off-site drainage	☐	☐	☐
• Dust/Silt fence, wattles, perimeter socks, and matting rolls	☐	☐	☐
• Watering	☐	☐	☐
• Soil binders, including acrylic polymers	☐	☐	☐
• Storm drain inlet protection	☐	☐	☐
• Temporary sediment basin	☐	☐	☐
• Sediment trap	☐	☐	☐
• Flared culvert end sections	☐	☐	☐
• Outlet protection	☐	☐	☐
• Temporary stream crossing	☐	☐	☐
• Ingress/Egress sediment control	☐	☐	☐
• Slope roughening/terracing/rounding	☐	☐	☐
• Sand bag barrier	☐	☐	☐
• Brush or rock filter	☐	☐	☐
• Shoveling, sweeping, and disposing	☐	☐	☐
3. Non-Storm Water Management Practices (Plans address or include the following practices and situations?)			
• Employee training	☐	☐	☐
• Vehicle and equipment cleaning, refueling, and maintenance	☐	☐	☐
• Dewatering operations	☐	☐	☐
• Paving operations	☐	☐	☐
• Concrete washout procedure	☐	☐	☐
• Structure construction and painting	☐	☐	☐
• Water conservation	☐	☐	☐
• Good housekeeping practices	☐	☐	☐
4. Construction Material Management, Waste Management and Spill Control Practices (Plans address or include the following practices and situations?)			
• Material delivery, use, and storage	☐	☐	☐
• Spill prevention control, spill kit	☐	☐	☐
• Hazardous waste properly stored in designated areas	☐	☐	☐
• Sanitary/Septic waste management	☐	☐	☐
• Liquid waste managed with storage containment devices	☐	☐	☐
• Contaminated soil management	☐	☐	☐
• Concrete waste management	☐	☐	☐
• Fertilizer, pesticide, herbicide, fungicide, and biocide management	☐	☐	☐

Inspection and Maintenance Responsibility	Yes	No	N/A
(Plans address or include the following practices and situations?)			
1. Long-term inspection entity, operation, and maintenance identified	☐	☐	☐
2. Minimum maintenance frequency identified	☐	☐	☐
3. Recordkeeping	☐	☐	☐
4. Schedule and/or triggers for inspection of BMP measures	☐	☐	☐
5. Rain gauge monitoring	☐	☐	☐
6. Incident report	☐	☐	☐

Permits, Reports, and Plans	Yes	No	N/A
Assess if the project requires any of the following that may include or impact BMPs. If not required, check N/A.			
1. NPDES Form C for Construction Activities is provided, if required.	☐	☐	☐
2. NPDES Form F for Hydrotest waters discharge is provided, if required.	☐	☐	☐
3. NPDES Form G for Dewatering discharge is provided, if required.	☐	☐	☐

4. 401 Water Quality Certification is provided, if required.	☐	☐	☐
5. 404 Department of Army Permit is provided, if required.	☐	☐	☐
6. Coastal Zone Management Permit is provided, if required.	☐	☐	☐
7. Special Management Area Permit is provided, if required.	☐	☐	☐
8. Post-construction Stormwater Mitigation Plan is provided, if required.	☐	☐	☐
9. Grading Permit with temporary erosion control plan is provided. (if project requires City and County approval and meets requirements)	☐	☐	☐
10. Permit for Connection to the State Harbors Drainage System (if applicable)	☐	☐	☐
11. Permit to Discharge into the State Harbors Drainage System (if applicable)	☐	☐	☐
12. If multiple permits or approvals are required for the project, BMPs are consistent in all permits and plans.	☐	☐	☐

"Mālama i ke awa kai" - Protect our harbor waters

Attachment 5

Construction Site Best Management Practices Inspection Checklist

Construction Site Best Management Practices Inspection Checklist

Date of Inspection:		**Project Title:**							
Contractor:		**Project Job No.:**					**NPDES No.:**		
Inspector:		**SWPPP Updated and Onsite:** ☐ Yes ☐ No					**Photographs Attached:** ☐ Yes ☐ No		
Inspection Type: ☐ Initial ☐ Recurring ☐ Final ☐ Other									
Weather:									
AC: Adequate **C**ontainment **ACoC: A**dequate **C**over **o**r **C**ontainment		**N/A**	**Control Device(s) Properly Installed**		**Require Maintenance**		**Description of Any Findings**	**Notes**	
			Yes	**No**	**Yes**	**No**			
1.	Stabilized Construction Ingress/Egress?	☐	☐	☐	☐	☐			
	Vehicular Tracking	☐	☐	☐	☐	☐			
2.	Erosion Control Device(s) - Slopes/Exposed Area	☐	☐	☐	☐	☐			
	Sediment Control (Silt fence, Perimeter sock)	☐	☐	☐	☐	☐			
	Storm Drain Inlet Protection (Fabric filter, Witch's hat)	☐	☐	☐	☐	☐			
3.	Dust Control/Suppressant - Sawcutting/Demolition	☐	☐	☐	☐	☐			
	Concrete Washout Area (AC)	☐	☐	☐	☐	☐			
4.	Vehicle/Equipment Maintenance Area (ACoC)	☐	☐	☐	☐	☐			
	Vehicle/Equipment Cleaning Area (AC)	☐	☐	☐	☐	☐			
	Vehicle/Equipment Fueling Area (AC)	☐	☐	☐	☐	☐			
	Vehicle/Equipment Storage Area (AC)	☐	☐	☐	☐	☐			
5.	Construction Material Storage Area (ACoC)	☐	☐	☐	☐	☐			
	Stockpiles of Aggregate (ACoC)	☐	☐	☐	☐	☐			
6.	Flammable/Fuel Storage Area (ACoC)	☐	☐	☐	☐	☐			
	Hazardous Material Storage (ACoC)	☐	☐	☐	☐	☐			
	Waste Storage Area (ACoC)	☐	☐	☐	☐	☐			
7.	Good Housekeeping Practices (Is project generally free of litter, sediment, etc.?)	☐	☐	☐	☐	☐			
8.	Spill Prevention/Control - Spill Kit	☐	☐	☐	☐	☐			

Major Site Activities (please check any if applicable):

☐ Demolition ☐ Paving ☐ Excavation ☐ Hauling Materials ☐ Concrete Pouring ☐ Other, please specify:

If any of the item listed below checked "Yes", please provide detailed information under Additional Notes.

A. Is contaminated soil present? ☐ Yes ☐ No

B. Is sediment basin(s) present? ☐ Yes ☐ No

C. Is any illicit discharge present? ☐ Yes ☐ No

D. Dewatering and/or Hydrotesting - Is this project in compliance with these NPDES storm water permitting requirements? ☐ Yes ☐ No ☐ N/A

Verified By (HDOT Project Inspector/Engineer's Signature) **Date**

Construction Site Best Management Practices Inspection Checklist

Permanent Post-Construction BMP Inspection			
Please indicate inspection status here:	☐ Initial Inspection	☐ Inspection During Construction Phase	☐ Final Inspection after Installation
Post-construction BMPs are being installed in accordance with construction plans.	☐ Yes	☐ No	☐ N/A
Notes:			

Additional Notes:

A. Management of Contaminated Soil:

B. Control and Maintenance Related to Sediment Basin(s):

C. Evidence of Discharge of Pollutant(s) to State Receiving Waters:

D. Summary of Dewatering and/or Hydrotesting Activity (please list permit numbers and verify compliance):

E.

F.

G.

Remarks: This checklist is to be completed before commencement of grading or site-work and then every two weeks from October through March, otherwise, bimonthly. State of Hawaii Department of Transportation Harbors Division will not allow construction activities to commence until the project engineer or qualified project inspector have inspected the construction site and determined that the site-specific BMPs and pollution prevention control measures are implemented properly.

State of Hawaii
Department of Transportation
Harbors Division

Attachment 6

Notification Forms for Project Site Disturbing Less Than One Acre

Hawaii Department of Transportation – Harbors Division

"Mālama i ke awa kai" - Protect our harbor waters

Notification Form for Project Site Disturbing Less Than One Acre

(To be used for Harbors Project)

Project Description			
Project Title:			
Project Job No:		Acreage of Site:	
Name of Design Firm:			
Projected Construction Timeframe:			
Description of Project:			

Site Information			
Construction Site Location:			
Tax Map Key No(s).:			
Disturbed Area (to nearest tenth of an acre):		Total Project Area (to nearest tenth of an acre):	
Existing Percentage of Impervious Area:		Percentage of Impervious Area After Completion:	

Nearest Water Body Information	
Name of Nearest Receiving Water Body(s) and Distance:	
Any New or Modified Storm Drain Connections:	
Description of Storm Drains On or Adjacent to Project Area (e.g., location or ID#):	

Review: HDOT Harbors Project Manager and Environmental Section.	
Harbors Project Manager Signature:	Print Name: Date:
Harbors Environmental Section Signature:	Print Name: Date:

Notes:

1. This form is for the use on non-exempt project site that will disturb less than one (1) acre of land and are not a part of Larger Common Plan (LCP) for development. **If this project is part of a LCP for sale or development, this form may not be used.**

2. Please type or print legibly. Please include the originally signed notification form and one (1) copy of a sketched plan outlining the anticipated activities and the location of all proposed sediment and erosion control measures.

3. The following activities, if they do not affect the Harbors storm drainage system, are exempt from any formal project review and construction site best management practice (BMP) inspection requirements under the ***Harbors Construction Site Runoff Control Program***.

- Minor land disturbance activities on a single lot (such as minor landscaping activities). Activities must disturb no more than 10 cubic yards or ¼ acre.
- Post and pole installation (less than 2 cubic yards excavation at any one contiguous project location).
- Utility repair work (less than 2 cubic yards excavation at any one contiguous project location).
- Parking lot, driveway, and other paved surfaces repair (less than ¼ acre disturbed and no sediment leaves the property.
- All repair and maintenance activities.

Hawaii Department of Transportation – Harbors Division

"Mālama i ke awa kai" - Protect our harbor waters

Notification Form for Project Site Disturbing Less Than One Acre

(To be used for Non-Harbors Project)

Project Description			
Project Title:			
Project Job No:		Acreage of Site:	
Name of Design Firm:			
Projected Construction Timeframe:			
Description of Project:			

Site Information			
Construction Site Location:			
Tax Map Key No(s).:			
Disturbed Area (to nearest tenth of an acre):		Total Project Area (to nearest tenth of an acre):	
Existing Percentage of Impervious Area:		Percentage of Impervious Area After Completion:	

Project Information			
Project Owner/Operator			
Business Name			
Project Point of Contact:			
(Note: Must be an authorized representative with signatory authority)			
Mailing Address:			
Phone:		Email Address:	
Engineering/Design Company			
Company Name			
Project Point of Contact:			
Mailing Address:			
Phone:		Email Address:	
Construction Contractor			
Company Name			
Project Point of Contact:			
Mailing Address:			
Phone:		Email Address:	

Nearest Water Body Information	
Name of Nearest Receiving Water Body(s) and Distance:	
Any New or Modified Storm Drain Connections:	
Description of Storm Drains On or Adjacent to Project Area (e.g., location or ID#):	

Signature and Certifications	
Project Owner/Operator: Per my signature below, I hereby certify that this project is not part of a Larger Common Plan (LCP) for Development. I understand that additional construction activities at this site may require permit coverage and I am responsible for obtaining any federal, state, or local permits that may be required for this project. I certify that all land-disturbing construction and associated activity pertaining to this site shall be accomplished pursuant to and in keeping with the terms and conditions of all relevant regulations including, but not limited to, the Federal Clean Water Act (33 USC 1251), Hawaii Revised Statutes 342D, Hawaii Administrative Rules §11-54 and §11-55, Honolulu Harbor and Kalaeloa Barbers Point Harbor's small Municipal Storm Water Sewer System (MS4) National Pollutant Discharge Elimination System Permits (NPDES Permit Nos. HI 03KB482 and HI 03KB488), other applicable MS4 NPDES Permit(s), and Harbors Storm Water Management Plan. Failure to do so may result in penalties. I hereby acknowledge that personnel from the Hawaii Department of Transportation Harbors Division or Hawaii Department of Health has the right of access to the site at all times for the purpose of on-site inspections during the course of construction and to perform inspections following the project completion. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.	
Print Name:	Job Title:
Signature:	Date:
Review: HDOT Harbors Engineering Branch Environmental Section.	
	Print Name:
Harbors Environmental Section Signature:	Date:

Notes:

1. This form is for the use on non-exempt project site that will disturb less than one (1) acre of land and are not a part of Larger Common Plan (LCP) for development. **If this project is part of a LCP for sale or development, this form may not be used.**

2. Please type or print legibly. Please include the originally signed notification form and one (1) copy of a sketched plan outlining the anticipated activities and the location of all proposed sediment and erosion control measures.

3. The following activities, if they do not affect the Harbors storm drainage system, are exempt from any formal project review and construction site best management practices (BMP) inspection requirements under the ***Harbors Construction Site Runoff Control Program***.

- Minor land disturbance activities performed on a single lot (such as minor landscaping activities). Activities must disturb no more than 10 cubic yards or ¼ acre.
- Post and pole installation (less than 2 cubic yards excavation at any one contiguous project location).
- Utility repair work (less than 2 cubic yards excavation at any one contiguous project location).
- Parking lot, driveway, and other paved surfaces repair (less than ¼ acre disturbed and no sediment leaves the property.
- All repair and maintenance activities.

Attachment 7

List of City and County of Honolulu BMP Fact Sheets for Construction

Serial #	Erosion Control (EC) Fact Sheets
EC-0	Employee/Subcontractor Training
EC-1	Scheduling
EC-2	Preservation of Existing Vegetation
EC-3	Hydraulic Mulch
EC-4	Hydroseeding
EC-5	Soil Binders
EC-7	Geotextiles and Mats
EC-8	Wood Mulching
EC-9	Earth Dikes and Drainage Swales
EC-10	Velocity Dissipation Devices
EC-11	Slope Drains
EC-12	Streambank Stabilization
EC-14	Seeding, Planting and Sodding
EC-15	Slope Roughening/Terracing
EC-16	Topsoil Management
Serial #	**Sediment Control (SE) Fact Sheets**
SE-1	Silt Fence
SE-2	Sediment Basin
SE-3	Sediment Trap
SE-4	Check Dams
SE-5	Fiber Rolls
SE-6	Gravel Bag Berm
SE-7	Street Sweeping and Vacuuming
SE-8	Sandbag Barrier
SE-10	Storm Drain Inlet Protection
SE-11	Chemical Treatment
SE-12	Location of Potential Sources of Sediment
SE-13	Level Spreader
SE-14	Rip-Rap & Gabion Inflow Protection
SE-15	Vegetated Buffer Strips and Channels
SE-16	Compost Socks and Berms
Serial #	**Wind Erosion Control (WE) Fact Sheets**
WE-1	Wind Erosion Control
Serial #	**Tracking Control (TR) Fact Sheets**
TR-1	Stabilized Construction Entrance/Exit
TR-2	Stabilized Construction Roadway
TR-3	Entrance/Outlet Tire Wash

Serial #	Non-Storm Water management (NS) Fact Sheets
NS-1	Water Conservation Practices
NS-2	Dewatering Operations
NS-3	Paving and Grinding Operations
NS-4	Temporary Stream Crossing
NS-5	Clear Water Diversion
NS-6	Illicit Connection/Discharge
NS-7	Potable Water/Irrigation
NS-8	Vehicle and Equipment Cleaning
NS-9	Vehicle and Equipment Fueling
NS-10	Vehicle and Equipment Maintenance
NS-11	Pile Driving Operations
NS-12	Concrete Curing
NS-13	Concrete Finishing
NS-14	Material over Water
NS-15	Demolition Adjacent to Water
NS-16	Temporary Batch Plants

Serial #	Waste Management (WM) and Materials Pollution Control Fact Sheets
WM-1	Material Delivery and Storage
WM-2	Material Use
WM-3	Stockpile Management
WM-4	Spill Prevention and Control
WM-5	Solid Waste Management
WM-6	Hazardous Waste Management
WM-7	Contaminated Soil Management
WM-8	Concrete Waste Management
WM-9	Sanitary/Septic Waste Management
WM-10	Liquid Waste Management

Attachment 8

Temporary Water Pollution, Dust, and Erosion Control Specifications

ARTICLE XXX – TEMPORARY WATER POLLUTION, DUST, AND EROSION CONTROL
For Project NOT Subject to NPDES NOI-C Permit

XXX.XX Description. This section is required for all work, including the Contractor's storage sites. It describes the following:

(A) A detailed site-specific Best Management Practice (BMP) Plan including diagrams and narratives; constructing, maintaining, and repairing temporary water pollution, dust, and erosion control measures at the project site including local material sources, work areas and access roads; removing and disposing of wastes and hazardous wastes; and control of fugitive dust (defined as uncontrolled emission of solid airborne particulate matter from any source other than combustion). Additionally, all projects at Honolulu, Kalaeloa Barbers Point, and Kahului Harbors are subject to State of Hawaii, Department of Transportation (HDOT) Harbors Division, Stormwater Management Plan (SWMP) requirements, unless exempted, and are subject to Harbors Stormwater BMP inspections. If any requirement conflicts with those administered by State of Hawaii, Department of Health (HDOH), the Contractor shall follow the more stringent requirement.

(B) Compliance with applicable federal and other state permit conditions.

(C) Work associated with dewatering and hydrotesting activities and compliance with conditions of the NPDES general permit coverage authorizing discharges associated with construction activity dewatering and hydrotesting.

XXX.XX General Requirements. In order to provide for the control of water pollution, dust, and erosion arising from the construction activities of the Contractor and his subcontractors in the performance of this contract, the work performed shall comply with all applicable federal, state, and local laws and regulations concerning water pollution control including, but not limited to, the following regulations:

(A) State of Hawaii, HDOH, Hawaii Administrative Rules (HAR) Chapter 11-54 – Water Quality Standards and Chapter 11-55 – Water Pollution Control.

(B) For projects at Honolulu, Kalaeloa Barbers Point, and Kahului Harbors ONLY, HDOT Harbors Division, Stormwater Management Plan.

(C) For projects at Honolulu, Kalaeloa Barbers Point, and Kahului Harbors ONLY, City and County of Honolulu (CCH), Rules Relating to Water Quality.

(D) For projects at Honolulu, Kalaeloa Barbers Point, and Kahului Harbors ONLY, CCH, Storm Water BMP Manual for Construction.

(E) 40 CFR Part 110, Environmental Protection Agency (EPA), Discharge of Oil.

(F) 40 CFR Part 117, EPA, Determination of Reportable Quantities for Hazardous Substances.

(G) 40 CFR Part 261, EPA, Identification and Listing of Hazardous Waste.

(H) 40 CFR Part 302, EPA, Designation, Reportable Quantities, and Notification.

(I) 49 CFR Part 171, U.S. Department of Transportation, Hazardous Materials Regulations.

XXX.XX Materials. Materials shall conform to the following when applicable:

(A) Slope Drains. Slope drains may be constructed of pipe, fiber, mats, erosion control fabric, geotextiles, rubble, Portland cement concrete, bituminous concrete, plastic sheets, or other materials acceptable to the Construction Engineer.

(B) Grass. Grass shall be quick growing species such as rye grass, Italian grass, or cereal grasses. Grass shall be suitable to the area and provide a temporary cover that will not compete later with permanent cover. Alternative grasses are allowable if acceptable to the Construction Engineer.

(C) Fertilizer and Soil Conditions. Fertilizer and soil conditioners shall be a standard commercial grade acceptable to the Construction Engineer.

(D) Silt Fences. Silt fences shall be synthetic filter fabric mounted on posts and embedded in compacted ground in compliance with American Society for Testing and Materials (ASTM) D6462-03, Standard Practice for Silt Fence Installation.

(E) Berms. Berms shall be gravel or sand wrapped with geotextile material. Alternate materials are allowable if acceptable to the Construction Engineer.

(F) Alternate materials or methods to control, prevent, remove, and dispose of pollution are allowable if acceptable to the Construction Engineer.

XXX.XX Construction.

(A) Preconstruction Requirements.

(1) Temporary Water Pollution, Dust, and Erosion Control Meeting. The contractor shall be required to submit a site-specific BMP Plan to the Construction Engineer and address all comments by the Construction Engineer. After the Plan is accepted in writing by the Construction Engineer, the Contractor shall schedule a meeting with the Construction Engineer before the start of construction work to discuss the sequence of

work, and plans and proposals for water pollution, dust, and erosion control.

(2) Temporary Water Pollution, Dust, and Erosion Control Submittals. The Contractor shall submit the site-specific BMP Plan to the Construction Engineer prior to the start of work for review of compliance with this Article.

(a) Written site-specific BMP Plan shall include the following as applicable:

1. Identification of potential pollutants and their sources and other factors that may cause water pollution, dust, and erosion.

2. A list of all material and heavy equipment to be used during construction. Vehicles and equipment shall be well maintained and free from any type of fluid leaks.

3. Construction schedule.

4. Name(s) of specific individual(s) designated responsible for water pollution, dust and erosion controls on the project site. Include home, business, and cellular telephone numbers, fax numbers, and e-mail addresses.

5. Descriptions of the methods and devices used to eliminate certain pollutants (e.g., wastewater, fuels, solvents, detergents, toxic or hazardous substances) from discharging into state waters and drainage systems, and provide details of BMP(s) to be installed or utilized. Indicate approximate dates when BMP(s) will be installed and removed.

6. Description of maintenance and subsequent removal of BMP(s).

7. Method(s) of removal and disposal of solid and regulated hazardous wastes encountered or generated during construction. The Contractor is advised to procure regulated hazardous materials on an as-needed basis, as feasible. All excess regulated hazardous materials at the conclusion of this project shall remain the property of the Contractor and shall be removed from HDOT Harbors Division property upon the completion of the project.

8. Method(s) of removing and disposing concrete and asphalt pavement cutting slurry, concrete curing water, and hydrodemolition water.

9. Method(s) of containing, removing and disposing of demolition dust and debris to minimize the discharge of these pollutants into state waters and drainage systems.

10. Spill kit contents and location.

11. Fugitive dust control, including dust from grinding, sweeping, or brooming off operations or combination thereof.

12. Method(s) of storing and handling of regulated hazardous materials (e.g. oils, paints) and other products used for the project. Safety Data Sheets (SDS) for all regulated hazardous materials used during construction activities shall be kept on-site throughout the duration of the project and readily available upon inspection. All containers of regulated hazardous materials should be provided with secondary containment during storage. Regulated hazardous materials not specifically needed in the execution of this project shall not be brought or stored on site. As feasible, the Contractor is encouraged to use products that do not contain any regulated constituents. The use of green products is encouraged.

13. Method(s) of concrete washout/waste control.

14. Method(s) of managing material stockpiles to minimize erosion and dust.

15. Good housekeeping practices.

a. Minimize tracking of sediment offsite from project entrances and exits.

b. Litter management. The Contractor shall have a comprehensive housekeeping policy and shall actively enforce housekeeping requirements. Housekeeping items include, but are not limited to, cups, cans, bottles and other forms of lightweight litter, unattended containers of hazardous materials, concrete debris (e.g. dust, chips, and other sweepings), and discarded articles of disposable

Personal Protective Equipment (e.g., earplugs, dust masks, and gloves). Employees who are specifically tasked with housekeeping duties shall be identified by name.

c. The Contractor should provide and maintain covered waste receptacles. No construction debris or other refuse that is generated as a result of project activities is to be disposed in HDOT Harbors Division-owned waste receptacles.

16. Provide plan(s)/drawing(s) showing location of followings when applicable:

a. Boundaries of the property and the locations where construction activities will occur, including:

i. Locations where earth-disturbing activities will occur (noting any sequencing of construction activities);

ii. Approximate slopes and drainage patterns with flow arrows before and after the construction;

iii. Locations where sediment, soil, or other construction materials will be stockpiled;

iv. Locations of any contaminated soil or contaminated soil stockpiles;

v. Locations of any crossings of state waters;

vi. Designated points on the site where vehicle will exit onto paved roads;

vii. Locations of structures and other impervious surfaces upon completion of construction; and

viii. Locations of construction support activity areas.

b. Locations of all state waters, including wetlands and indicate which water bodies are listed as impaired.

c. The boundary lines of any natural buffers.

d. Topography of the site, existing vegetative cover, and features (e.g., forest, pasture, pavement, structures), and drainage pattern(s) of stormwater onto, over, and from the site property before and after major grading activities.

e. Stormwater discharge locations, including locations of any storm drain inlets on-site and in the immediate vicinity of the site to receive stormwater runoff from the project; and locations where stormwater will be discharging to state waters (including wetlands).

f. Locations of all potential pollutant-generating activities.

g. Locations of stormwater control measures; and

h. Locations where chemicals will be used and stored.

17. Procedures for notification of appropriate facility personnel, emergency response agencies, and regulatory agencies where a leak, spill, or other release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR Parts 110, 117, or 302, occurs during a 24-hour period. Contact information must be in locations that are readily accessible and available.

18. The Contractor shall date and sign the site-specific BMP Plan.

(b) The Contractor shall keep the accepted Plan on-site or at an easily accessible location throughout the duration of the project. Revisions to the Plan shall be included with the original plan. The Contractor shall obtain written acceptance from the Construction Engineer before revising BMP. An updated Plan shall be kept on-site throughout the remainder duration of the project.

The Contractor shall follow guidelines in the "*The City and County of Honolulu Storm Water Best Management Practice Manual – Construction*," (dated November 2011) in developing, installing, and maintaining BMP for the project. Additionally, the Contractor shall follow applicable CCH *Rules Relating to Water Quality* **for**

all projects at Honolulu, Kalaeloa Barbers Point, and Kahului Harbors, and use respective Soil Erosion Guidelines for other Maui, Kauai and Hawaii County projects. Information can be found at the respective County websites.

(B) Construction Requirements are as follows.

(1) No work shall be allowed to begin until submittals detailed in Subsection XXX.XX A.2 – Temporary Water Pollution, Dust, and Erosion Control Submittals are completed and accepted in writing by the Construction Engineer. The Contractor shall prevent pollutants from entering state waters. These efforts shall address areas such as those that drain to water, are over water, or drain to storm drains adjacent and in the area of the project site. The Contractor shall design, operate, implement, and maintain the Plan to ensure that stormwater discharges associated with construction activities will not cause or contribute to a violation of applicable state water quality standards.

(2) All projects at Honolulu, Kalaeloa Barbers Point, and Kahului Harbors are subject to HDOT Harbors Division SWMP requirements for construction at those harbors unless the project meets a specified exemption class. The requirements include, but are not limited to, construction site BMP initial, recurring (i.e. every two weeks from October through March and every two months otherwise), and final inspections at the frequencies outlined in the SWMP. No grading or land disturbance activities are allowed until the initial BMP inspection is completed and required BMPs are found to be properly installed.

(3) Address all comments received from the Construction Engineer.

(4) Modify and resubmit plans and construction schedules to correct conditions that develop during construction which were unforeseen during the design and pre-construction stages.

(5) Coordinate temporary control provisions with permanent control features throughout the construction and post-construction period.

(6) BMP shall be in place and operational until the construction is completed and accepted by Harbors.

(7) Install and maintain either or both stabilized construction entrances and wheel washes to minimize tracking of dirt and mud onto roadways. Restrict traffic to stabilized construction areas only. Clean dirt, mud, or other material tracked onto the road immediately. Modify stabilized construction entrances to prevent mud from being tracked onto roadways.

(8) Chemicals may be used as soil stabilizers for either or both erosion and dust control if acceptable to the Construction Engineer.

(9) Cover exposed surface of materials completely with tarpaulin or similar device when transporting aggregate, soil, excavated material or material that may be a source of fugitive dust.

(10) Cleanup and remove any pollutant that can be attributed to the Contractor.

(11) Install or modify BMP due to change in the Contractor's means and methods, or for omitted condition that should have been allowed for in the accepted site-specific BMP Plan or a BMP that replaces an accepted site-specific BMP that is not satisfactorily performing.

(12) Properly maintain BMP.

(13) Remove, replace or relocate any BMP that must be removed, replaced or relocated due to potential or actual flooding, or potential danger or damage to the project or public.

(14) The Contractor's designated representative specified in Subsection XXX.XX A.2.a.4 shall address any BMP concerns brought up by the Construction Engineer within 24 hours of notification, including weekends and holidays. Should the Contractor fail to satisfactorily address these concerns, the Construction Engineer reserves the right to employ outside assistance or use the Construction Engineer's own labor forces to provide necessary corrective measures. The Construction Engineer will charge the Contractor such incurred costs plus any associated project engineering costs. The Construction Engineer will make appropriate deductions from the Contractor's monthly progress estimate. Failure to apply BMP shall result in either or both the establishment and increase in the amount of retainage due to unsatisfactory progress or withholding of monthly progress payment. Continued failure to apply BMP may result in one or more of the following: The Contractor being fully responsible for all additional costs incurred by HDOT Harbors Division including any fines levied by HDOH, suspension of the Contract, or cancellation of the Contract.

(C) **Hydrotesting Activities**. If work includes removing, relocation or installing waterlines, and the Contractor elects to flush waterline or discharge hydrotesting effluent into state waters or drainage systems, obtain a Notice of General Permit Coverage (NGPC) authorizing discharges associated with hydrotesting waters from the HDOH Clean Water Branch (CWB). If a permit is required, prepare and submit permit application (CWB-Notice of Intent (NOI) Form F) to the HDOH CWB.

Do not begin hydrotesting activities until the HDOH CWB has issued a NGPC. Hydrotesting operations shall be in accordance with conditions in the NGPC. Submit a copy of the NPDES Hydrotesting Waters Application and Permit to the Construction Engineer.

(D) **Dewatering Activities**. If excavation of backfilling operations requires dewatering, and the Contractor elects to discharge dewatering effluent into state waters or existing drainage systems, obtain an NGPC authorizing discharges associated with construction activity dewatering from the HDOH CWB. If a permit is required, prepare and submit permit application (CWB-NOI Form G) to the HDOH CWB.

Do not begin dewatering activities until the HDOH-CWB has issued an NGPC. Conduct dewatering operations in accordance with the conditions in the NGPC. Submit a copy of the NPDES Dewatering Application and Permit to the Construction Engineer.

XXX.XX **Payment**. Payment for Temporary Water Pollution, Dust, and Erosion Control shall not be measured and paid for separately but shall be considered incidental to the applicable items described in Article XX of these Specifications.

No progress payment will be authorized until the Construction Engineer accepts in writing the site-specific BMP Plan or when the Contractor fails to maintain the project site in accordance with the accepted BMP Plan.

The Contractor shall reimburse the State of Hawaii within 30-day for the full amount of all outstanding costs incurred by the State of Hawaii for all citations or fines received as a result of the Contractor's non-compliance with regulations.

ARTICLE XXX – TEMPORARY WATER POLLUTION, DUST, AND EROSION CONTROL
For Project Subject to NPDES NOI-C Permit

XXX.XX Description. This section is required for all work, including the Contractor's storage sites. It describes the following:

(A) A detailed Storm Water Pollution Prevention Plan (SWPPP) required by a National Pollutant Discharge Elimination System (NPDES) Appendix C General Permit from the State of Hawaii Department of Health (HDOH) and prepared according to Section 7 of Hawaii Administrative Rules (HAR) Chapter 11-55, Appendix C, will satisfy this requirement. Additionally, all projects at Honolulu, Kalaeloa Barbers Point, and Kahului Harbors are subject to State of Hawaii, Department of Transportation (HDOT) Harbors Division, Storm Water Management Plan (SWMP) requirements, and are subject to Harbors Best Management Practice (BMP) inspections. If any requirement conflicts with those administered by HDOH, the Contractor shall follow the more stringent requirement.

(B) Compliance with applicable federal and other state permit conditions.

(C) Work associated with dewatering and hydrotesting activities and compliance with conditions of the NPDES general permit coverage authorizing discharges associated with construction activity dewatering and hydrotesting.

XXX.XX General Requirements. In order to provide for the control of temporary water pollution, dust, and erosion arising from the construction activities of the Contractor and his subcontractors in the performance of this contract, the work performed shall comply with all applicable federal, state, and local laws and regulations concerning water pollution control including, but not limited to, the following regulations:

(A) State of Hawaii, HDOH, HAR Chapter 11-54 – Water Quality Standards and Chapter 11-55 – Water Pollution Control.

(B) For projects at Honolulu, Kalaeloa Barbers Point, and Kahului Harbors ONLY, HDOT Harbors Division, Storm Water Management Plan.

(C) For projects at Honolulu, Kalaeloa Barbers Point, and Kahului Harbors ONLY, City and County of Honolulu (CCH), Rules Relating to Water Quality.

(D) For projects at Honolulu, Kalaeloa Barbers Point, and Kahului Harbors ONLY, CCH, Storm Water BMP Manual for Construction.

(E) 40 CFR Part 110, Environmental Protection Agency (EPA), Discharge of Oil.

(F) 40 CFR Part 117, EPA, Determination of Reportable Quantities for Hazardous Substances.

(G) 40 CFR Part 261, EPA, Identification and Listing of Hazardous Waste.

(H) 40 CFR Part 302, EPA, Designation, Reportable Quantities, and Notification.

(I) 49 CFR Part 171, U.S. Department of Transportation, Hazardous Materials Regulations.

XXX.XX Materials. Materials shall conform to the following when applicable:

(A) Slope Drains. Slope drains may be constructed of pipe, fiber, mats, erosion control fabric, geotextiles, rubble, Portland cement concrete, bituminous concrete, plastic sheets, or other materials acceptable to the Construction Engineer.

(B) Grass. Grass shall be quick growing species such as rye grass, Italian grass, or cereal grasses. Grass shall be suitable to the area and provide a temporary cover that will not compete later with permanent cover. Alternative grasses are allowable if acceptable to the Construction Engineer.

(C) Fertilizer and Soil Conditions. Fertilizer and soil conditioners shall be a standard commercial grade acceptable to the Construction Engineer.

(D) Silt Fences. Silt fences shall be synthetic filter fabric mounted on posts and embedded in compacted ground in compliance with American Society for Testing and Materials (ASTM) D6462-03, Standard Practice for Silt Fence Installation.

(E) Berms. Berms shall be gravel or sand wrapped with geotextile material. Alternate materials are allowable if acceptable to the Construction Engineer.

(F) Alternate materials or methods to control, prevent, remove, and dispose of pollution are allowable if acceptable to the Construction Engineer.

XXX.XX Construction.

(A) Preconstruction Requirements.

(1) Temporary Water Pollution, Dust, and Erosion Control Meeting. The contractor shall be required to submit a SWPPP to the Construction

Engineer and address all comments by the Construction Engineer. After the SWPPP is accepted in writing by the Construction Engineer, the Contractor shall schedule a meeting with the Construction Engineer before the start of construction work to discuss the sequence of work, and plans and proposals for water pollution, dust, and erosion control.

(2) Temporary Water Pollution, Dust, and Erosion Control Submittals. The Contractor shall submit the SWPPP to the Construction Engineer prior to the start of work for review of compliance with this Article.

(a) The following information shall be described in the SWPPP as specified in Section 7 of HAR 11-55, Appendix C, at a minimum:

1. **Storm water team** (by name or position), which is responsible for the development of the SWPPP, any later modifications to it, and for compliance with the requirements in the NPDES permit. The SWPPP must identify the personnel that are part of the storm water team as well as their individual responsibilities.

2. **Nature of construction activities** including the size of the project site (in acres) and the total area expected to be disturbed by the construction activities (in acres), construction support activity areas covered by permit, and the maximum area expected to be disturbed at any one time.

3. **Emergency-related projects** in response to a public emergency (e.g., natural disaster, extreme flooding conditions). If this applies to the project, documentation of the cause of the public emergency, information substantiating its occurrence, and a description of the construction necessary to re-establish affected public services shall be included in the SWPPP. The proclamation of a civil defense emergency or similar proclamation is required to be from the President of the United States or State Governor.

4. **Identification of other site contractors** (e.g., sub-contractors) who will be engaged in construction activities at the site, and the areas of the site over which each contractor has control. If this piece of information is not available at the time the SWPPP is submitted, the plan must

be amended to include the information prior to the start of construction activities.

5. **Sequence and estimated dates of construction activities** including a schedule of the estimated start dates and the duration of the following activities, according to Section 7.2.5 of HAR 11-55, Appendix C:

   a. Installation of storm water control measures.

   b. Commencement and duration of earth-disturbing activities.

   c. Cessation, temporarily or permanently, of construction activities on-site, or in designated portions of the project site.

   d. Final or temporary stabilization of areas of exposed soil.

   e. Removal of temporary storm water conveyances/ channels and other storm water control measures, removal of construction equipment and vehicles, and cessation of any pollution-generating activities.

6. **Site map or series of maps**, showing the following features of the project, according to Section 7.2.6 of HAR 11-55, Appendix C:

   a. Boundaries of the property and the locations where construction activities will occur, including:

      i. Locations where earth-disturbing activities will occur (noting any sequencing of construction activities);

      ii. Approximate slopes and drainage patterns with flow arrows before and after construction;

      iii. Locations where sediment, soil, or other construction materials will be stockpiled;

iv. Locations of any contaminated soil or contaminated soil stockpiles;

v. Locations of any crossings of state waters;

vi. Designated points on the site where vehicle will exit onto paved roads;

vii. Locations of structures and other impervious surfaces upon completion of construction; and

viii. Locations of construction support activity areas covered by the permit.

b. Locations of all state waters, including wetlands and indicate which water bodies are listed as impaired.

c. The boundary lines of any natural buffers.

d. Topography of the site, existing vegetative cover, and features (e.g., forest, pasture, pavement, structures), and drainage pattern(s) of storm water onto, over, and from the site property before and after construction.

e. Storm water discharge locations, including locations of any storm drain inlets on-site and in the immediate vicinity of the site to receive storm water runoff from the project; and locations where storm water will be discharging to state waters (including wetlands).

f. Locations of all potential pollutant-generating activities.

g. Locations of storm water control measures; and

h. Locations where chemicals will be used and stored.

7. Construction site pollutants generated by on-site activities. For each pollutant-generating activity, an inventory of pollutants or pollutant constituents (e.g.,

sediment, fertilizers and/or pesticides, paints, solvents, fuels) associated with that activity, which could be exposed to rainfall and could be discharged from the construction site (include potential spills and leaks).

A list of all materials and heavy equipment to be used during construction. Vehicles and equipment shall be well maintained and free from any type of fluid leaks.

8. **Sources of non-storm water**, including, but not limited to, the design, installation, and maintenance of the control measures to prevent its discharge.

9. **Buffer documentation**. When a State water is located within 50 feet of the project's earth disturbances, the Contractor shall describe which compliance alternative has been selected for the site, and comply with Section 5.1.2.1 of HAR 11-55, Appendix C.

10. **Description of storm water control measures** to be used during construction activity including information on:

a. Storm water control measures to be used during construction activity meet the requirements of Section 5 of HAR 11-55, Appendix C.

i. Information on the type of storm water control measure to be installed and maintained, including design information;

ii. What specific sediment controls will be installed and made operational prior to conducting earth-disturbing activities in any given portion of the site to meet the requirement of Section 5.1.2.2.1 of HAR 11-55, Appendix C.

iii. If contaminated soil exists on-site, the control measures to either prevent the contact of storm water with the contaminated soil, including any contaminated soil stockpiles, or prevent the discharge of any storm water runoff which has

contacted contaminated soil or any contaminated soil stockpiles;

iv. For exit points on the site, document stabilization techniques to be used and any additional controls that are planned to remove sediment prior to vehicle exit.

v. For linear projects, document the location where the use of perimeter controls in portions of the site is impracticable and the reason why (refer to Section 5.1.2.2.1 of HAR 11-55, Appendix C).

b. Stabilization practices including specific vegetative and/or non-vegetative practices. Document the circumstances preventing from meeting the deadlines specified in Section 5.2.1.1 and/or 5.2.1.2 of HAR 11-55, Appendix C.

c. Post-construction measures that will minimize the discharge of pollutants via storm water discharges after construction operations have been finished.

11. Pollution prevention procedures.

a. Spill prevention and response procedures, including:

i. Procedures for expeditiously stopping, containing, and cleaning up spills, leaks, and other releases. Identify the name or position of the employee(s) responsible for detection and response of spills or leaks;

ii. Procedures for notification of appropriate facility personnel, emergency response agencies, and regulatory agencies where a leak, spill, or other release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR Parts 110, 117, or 302, occurs during a 24-hour period.

Spill Contact information must be in location that is readily accessible and available.

b. Waste management procedures on handling and disposing of all wastes generated at the site, including, but not limited to, clearing and demolition debris, sediment removed from the site, construction and domestic waste, hazardous or toxic waste, and sanitary waste.

The Contractor is advised to procure regulated hazardous materials on an as-needed basis, as feasible. All excess regulated hazardous materials at the conclusion of this project shall remain the property of the Contractor and shall be removed from HDOT Harbors Division property upon the completion of the project.

12. Procedures for inspection, maintenance, and corrective action to be followed for conducting site inspections, maintaining the storm water control measures, and, where necessary, taking corrective actions. Additionally, include following information in the SWPPP:

a. Personnel responsible for conducting inspections;

b. Inspection schedule. Contractor's Self-Inspections shall be conducted at applicable schedules listed below. Note that inspections are only required during the project's normal working hours.

i. **Inspection Frequency for sites discharging to impaired waters[1]**. For any portion of the site that discharges to an impaired water, the inspection shall be conducted at the following intervals:

[1] "Impaired waters" are waters identified as impaired on the State Clean Water Act Section 303(d) list, and waters with a State-established and EPA-approved Total Maximum Daily Load (TMDL). The construction site will be considered to discharge to an impaired water if the first State water to which the discharge enters is to a water on the section 303(d) list or one with a State established and EPA-approved TMDL. For a discharge that enters a storm water drainage system prior to discharge, the first State water to which discharge occurs is the water body that receives the storm water discharge from the storm water drainage system.

(a) Once every seven (7) calendar days; and

(b) Within 24 hours of the occurrence of the storm event of 0.25 inches or greater.

(c) Daily during periods of a prolonged storm event of 0.25 inches or greater.

ii. **Inspection Frequency for sites NOT discharging to impaired waters**. At a minimum, the inspection shall be conducted in accordance with one of the two schedules listed below:

(a) At least weekly; or

(b) Biweekly (once every 14 calendar days), and within 24 hours of the occurrence of a storm event of 0.25 inches or greater, daily during periods of a prolonged storm of 0.25 inches or greater, and within 24 hours after the end of the storm.

iii. **Reductions in inspection frequency**. For stabilized areas, the Contractor may reduce the frequency of inspections to monthly (once per month) in any area of the site where the stabilization steps have been completed as follows:

(a) For vegetative stabilization, all activities necessary to initially seed or plant the area to be stabilized; and/or

(b) For non-vegetative stabilization, the installation or application of all such non-vegetative measures.

c. Any inspection or maintenance checklists or other forms that will be used.

Contractor shall either keep a properly maintained rain gauge in a secure location to monitor rainfall at the project site, or obtain the storm event information from a weather station that is representative of the location. If a rain gauge is to be utilized to determine if a storm event of 0.25 inches or greater has occurred on the site, it must have a tolerance of at least 0.05 inches of rainfall, and an opening of at least 1-inch diameter. Install the rain gauge on the project site in an area that will not deter rainfall from entering the gauge opening. Maintain the rain gauge and replace the gauge if stolen, it does not function properly or accurately, is worn out, or needs to be relocated. Do not begin fieldwork until the rain gauge is installed and the SWPPP is in place. For any day of rainfall during normal business hours that measures 0.25 inches or greater, the Contractor shall record the total rainfall measured for that day.

13. **Staff training documentation** that the required personnel were trained in accordance with Section 7.2.13 of HAR 11-55, Appendix C, to ensure that all activities on the site comply with the requirements of the issued permit. The list of major required personnel is as listed below:

a. Personnel responsible for the design, installation, maintenance, and/or repair of storm water controls (including pollution prevention measures);

b. Personnel responsible for the application and storage of chemicals (if applicable);

c. Personnel responsible for conducting BMP inspections;

d. Personnel responsible for taking corrective actions

At a minimum, personnel must be trained to understand the following, if related to the scope of their job duties (e.g., only personnel responsible for conducting inspections need to understand how to conduct inspections):

a. The location of all storm water controls on the site required by the issued permit, and how they are to be maintained;

b. The proper procedures to follow with respect to the permit's pollution prevention requirements; and

c. When and how to conduct inspections, record applicable findings, and take corrective actions.

The Contractor is not required to provide or document formal training for subcontractor or other outside service providers, but must ensure that such personnel understand any requirements of the permit that may be affected by the work they are subcontracted to perform. Detailed discussion is provided in Section 7.2.13.2 of HAR 11-55 Appendix C.

14. Documentation of compliance with Safe Drinking Water Act Underground Injection Control (UIC) requirements for certain subsurface storm water controls, if using any of the following storm water controls at the project site**:**

a. Infiltration trench (if storm water is directed to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has a subsurface fluid distribution system);

b. Commercially manufactured precast or pre-built proprietary subsurface detention vaults, chambers, or other devices designed to capture and infiltrate storm water flow; and

c. Drywells, seepage pits, or improved sinkholes (if storm water is directed to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has a subsurface fluid distribution system).

15. Other information listed below.

a. Contractor information (general and subcontractors) including legal name, street address, contact person's name and position title, telephone number, and email address.

b. Other state, federal, or county permits including:

i. Copy of the drainage system owner's approval allowing the discharge to enter their drainage system (if applicable);

ii. Copy of the Department of the Army permit and Section 401 water quality certification (if applicable); and

iii. A list of other permits (if applicable).

16. Any other information as requested by the Director of HDOH and/or HDOT.

17. **SWPPP certification.** The owner or its duly authorized representative must certify, sign, and date the Plan in accordance with Section 15 of HAR 11-55, Appendix A.

(b) The Contractor shall keep the current accepted SWPPP on-site or at an easily accessible location throughout the duration of the project. Revisions to the Plan shall be included with the original plan. The Contractor shall obtain written acceptance from the Construction Engineer before revising SWPPP. Additionally, the planned modifications to the BMP meeting the conditions listed in Section 7.4.1 of HAR 11-55, Appendix C, shall be documented and updated in the SWPPP according to Section 7.4 of HAR-55 Appendix C. An updated Plan shall be kept on-site throughout the remainder duration of the project.

The Contractor shall follow guidelines in the "*The City and County of Honolulu Storm Water Best Management Practice Manual – Construction*," (dated November 2011) in developing, installing, and maintaining BMP for the project. Follow applicable CCH *Rules Relating to Water Quality on Erosion Sediment Control Plan and Post Construction Best Management Practices* **for all projects at Honolulu, Kalaeloa Barbers Point, and Kahului Harbors**, and use respective Soil Erosion Guidelines for other Maui, Kauai

and Hawaii County projects. Information can be found at the respective County websites.

(B) Construction Requirements are as follows.

(1) No work shall be allowed to begin until submittals detailed in Subsection XXX.XX A.2 – Temporary Water Pollution, Dust, and Erosion Control Submittals are completed and accepted in writing by the Construction Engineer. The Contractor shall prevent pollutants from entering state waters. These efforts shall address areas such as those that drain to water, are over water, or drain to storm drains in the area of the project site. The Contractor shall design, operate, implement, and maintain the Plan to ensure that storm water discharges associated with construction activities will not cause or contribute to a violation of applicable state water quality standards.

(2) All projects at Honolulu, Kalaeloa Barbers Point, and Kahului Harbors are subject to HDOT Harbors Division SWMP requirements for construction at those harbors. The requirements include, but are not limited to, construction site BMP initial, recurring (i.e. every two weeks from October through March and every two months otherwise), and final inspections at the frequencies outlined in the SWMP. No grading or land disturbance activities are allowed until the initial BMP inspection is completed and required BMPs are found to be properly installed.

(3) Address all comments received from the Construction Engineer.

(4) Modify and resubmit plans and construction schedules to correct conditions that develop during construction which were unforeseen during the design and pre-construction stages.

(5) Coordinate temporary control provisions with permanent control features throughout the construction and post-construction period.

(6) BMP shall be in place and operational until the construction is completed and accepted by Harbors.

(7) Install and maintain either or both stabilized construction entrances and wheel washes to minimize tracking of dirt and mud onto roadways. Restrict traffic to stabilized construction areas only. Clean dirt, mud, or other material tracked onto the road immediately. Modify stabilized construction entrances to prevent mud from being tracked onto roadways.

(8) Chemicals may be used as soil stabilizers for either or both erosion and dust control if acceptable to the Construction Engineer.

(9) Cover exposed surface of materials completely with tarpaulin or similar device when transporting aggregate, soil, excavated material or material that may be a source of fugitive dust.

(10) Cleanup and remove any pollutant that can be attributed to the Contractor.

(11) Install or modify BMP due to change in the Contractor's means and methods, or for omitted condition that should have been allowed for in the accepted SWPPP or a BMP that replaces an accepted one that is not satisfactorily performing.

(12) Properly maintain BMP. For projects that require an NPDES Appendix C General Permit from the HDOH, inspect, prepare a **monthly compliance report,** and make repairs to BMP on a timely basis. Maintain records of BMP inspections for the duration of the project. Submit copies of the inspection reports to the Construction Engineer upon request.

(13) Remove, replace or relocate any BMP that must be removed, replaced or relocated due to potential or actual flooding, or potential danger or damage to the project or public.

(14) The Contractor's designated representative specified in Subsection XXX.XX A. 2.a.1 shall address any BMP concerns brought up by the Construction Engineer within 24 hours of notification, including weekends and holidays. Should the Contractor fail to satisfactorily address these concerns, the Construction Engineer reserves the right to employ outside assistance or use the Construction Engineer's own labor forces to provide necessary corrective measures. The Construction Engineer will charge the Contractor such incurred costs plus any associated project engineering costs. The Construction Engineer will make appropriate deductions from the Contractor's monthly progress estimate. Failure to apply BMP shall result in either or both the establishment and increase in the amount of retainage due to unsatisfactory progress or withholding of monthly progress payment. Continued failure to apply BMP may result in one or more of the following: The Contractor being fully responsible for all additional costs incurred by HDOT Harbors Division including any fines levied by HDOH, suspension of the Contract, or cancellation of the Contract.

(15) The owner or its duly authorized representative shall be responsible for fulfilling the reporting requirements (e.g., state of construction activities, incident notification) according to Section 12 of HAR 11-55, Appendix C and submittal requirements (e.g., monthly compliance report, Notice of Cessation form) according to Section 13 of HAR 11-55, Appendix C.

(C) **Hydrotesting Activities**. If work includes removing, relocation or installing waterlines, and the Contractor elects to flush waterline or discharge hydrotesting effluent into state waters or drainage systems, obtain a Notice of General Permit Coverage (NGPC) authorizing discharges associated with hydrotesting waters from the HDOH Clean Water Branch (CWB). If a permit is required, prepare and submit permit application (CWB-Notice of Intent (NOI) Form F) to the HDOH CWB.

Do not begin hydrotesting activities until the HDOH CWB has issued a NGPC. Hydrotesting operations shall be in accordance with conditions in the NGPC. Submit a copy of the NPDES Hydrotesting Waters Application and Permit to the Construction Engineer.

(D) **Dewatering Activities**. If excavation of backfilling operations requires dewatering, and the Contractor elects to discharge dewatering effluent into state waters or existing drainage systems, obtain an NGPC authorizing discharges associated with construction activity dewatering from the HDOH CWB. If a permit is required, prepare and submit permit application (CWB-NOI Form G) to the HDOH CWB.

Do not begin dewatering activities until the HDOH-CWB has issued an NGPC. Conduct dewatering operations in accordance with the conditions in the NGPC. Submit a copy of the NPDES Dewatering Application and Permit to the Construction Engineer.

XXX.XX **Payment**. Payment for Temporary Water Pollution, Dust, and Erosion Control shall not be measured and paid for separately but shall be considered incidental to the applicable items described in Article XX of these Specifications.

No progress payment will be authorized until the Construction Engineer accepts in writing the SWPPP or when the Contractor fails to maintain the project site in accordance with the accepted SWPPP.

The Contractor shall reimburse the State of Hawaii within 30-day for the full amount of all outstanding costs incurred by the State of Hawaii for all citations or fines received as a result of the Contractor's non-compliance with regulations.

Attachment 9

HDOT Harbors Rules and Regulations for Construction Site

HARBORS RULES AND REGULATIONS FOR ENVIRONMENTAL COMPLIANCE

The Harbors environmental inspectors have been given authority to initiate enforcement actions including verbal warnings, written citations, and potential tenant eviction.

Hawaii Revised Statutes Title 15 Chapter 266

HRS 266-2 describes the powers and duties of the State of Hawaii Department of Transportation Harbors Division. **HRS 266-3** establishes the Director of Transportation authority to establish and enforce rules to control and manage all commercial harbors and roadsteads, all commercial harbor improvements, and all vessels and shipping within the commercial harbors and roadsteads. The Harbors then relies on **HRS 266-24**, which permits the Director of Transportation the authority to designate persons to enforce Chapter 266 and all rules and orders issued pursuant thereto and of all other laws of the state.

Such officers, employee's agents, and representatives of Harbors have police powers to serve and execute warrants and arrest offenders, and the power to serve notices and orders. When arresting or issuing a citation to a purported violator of any provision of Chapter 266, the Director of Transportation's designee, hereinafter referred to as "enforcement officer" can issue a summons or citation (similar to a traffic ticket) warning or directing the violator to appear and answer the charge before a district judge or take the purported violator without delay before a district judge.

Penalties for violating the provision of Chapter 266 or rules or orders issued pursuant to Chapter 266 are issued by the district court and includes a finding or guilty or not guilty verdict of a misdemeanor and a fine. Fines arising from environmental protection violations include reimbursing the HDOT for the entire amount of the HDOH or USEPA fine under HRS **§266-28** and can include an additional amount of not more than $10,000 for each day of violation under HRS **§266-25**.

Hawaii Administrative Rules Title 19 Chapters 41 to 44

HDOT adopted these chapters to regulate operations at the state harbors. **Chapter 42-126 and 42-127** specifically apply to environmental regulation. These rules require that no litter be left within a state harbor, except in properly marked bins. In addition, oil, oily refuse, sludge, chemicals, or other hydrocarbons should only be deposited in designated collection points. Specifically, Chapter 42-127 can be applied to activities such as maintenance or washing that has the potential to generate pollutants to be discharged into state waters. Below is an excerpt from Chapter 42-127:

> *"No person shall place, throw, deposit, or discharge, or cause to be placed, thrown, deposited, or discharged into the waters of any harbor, river or shore waters of the State any litter, or other gaseous, liquid or solid materials which render the water unsightly, noxious or otherwise unwholesome so as to be detrimental to the public health and welfare or a navigational hazard. No person shall discharge oil sludge, oil refuse, fuel oil or*

molasses either directly or indirectly, or pump bilges or ballast tanks containing other than clean water into the waters of any harbor, river or into any shore waters in the State."

In addition, Chapter 42 contains language on storage, usage, and/or handling requirements for hazardous materials or other regulated potential pollutants or hazardous substances. These chapters detail specific environmental practices where enforcement is implemented through arrest or citation and presented before the district judge. The major components of Chapter 42, related to enforcement, inspection, safety, cleanliness, use of facilities, and construction, are summarized below.

Chapter 42-15 – Compliance with Federal, State, and County Laws, Ordinances and Rules

- Use of state harbors and harbors facilities is subject to compliance with all applicable federal, state, and county laws, ordinances, rules and regulations. Particular attention is directed to:
    - Rules of the United States Public Health Service and of the state department of health, relating to the use of rat guards and other measures to prevent rodents from leaving the vessel.
    - Rules of the state department of health pertaining to air and water pollution.
    - Rules of the fire department of each county.

Chapter 42-16 – Citation for Violation

- Citations issued, pursuant to HRS 266-24.1, to a commercial firm for violation of this part may be issued to any agent, officer, or manager of the firm.

Chapter 42-50 – <u>Inspection</u>

All small craft and smaller commercial vessels moored or berthed at a state-owned or controlled pier, wharf, quay, bulkhead, landing dolphin, anchorage, mooring, or other facilities located in the shore waters, navigable streams, harbors, ports, and roadsteads of the State shall be subject to inspection by the department or any peace officer of the State or its political subdivisions at any time where necessary and proper for the purpose of enforcing these rules.

Chapter 42-52 - Small Craft and Smaller Commercial Vessel Repairs, Reconstruction or Major Modification

- Minor repairs to small craft and smaller commercial vessels may be made at the assigned berth and shall be completed within thirty days.
- If repairs are estimated to, or actually do, require that the vessel be out of service for more than thirty days, prior approval shall be sought from the department to initiate or complete the repairs in the harbor.
- Prior approval shall be sought from the department for any repairs requiring the use of cranes, lifts, and any similar devices within the harbor.
- Repair, reconstruction or major modification that would interfere with the free flow of other vessels, pedestrian, or vehicle traffic shall only be accomplished in an area designated by

the department. Failure to seek approval as required by this section shall be grounds for the revocation of the use permit.

Chapter 42-103 Vessel Loaded with Explosives

- No vessel containing more than five hundred founds of Class A, one tone of Class B, and/or ten tons of Class C explosives (net explosive content) shall enter or be loaded in any harbor in the State except on prior written permission of the harbor master of the district concerned, or the director.
- No Class A explosives, as defined by the United States Coast Guard in its regulations in existence as of June 1, 1993, will be admitted in any harbor in quantities in excess of the limitations established by the USCG for the various harbors unless otherwise authorized by the director in writing. Other cargos may not be moved concurrently with Class A explosive cargo.

Chapter 42-104 Handing of Explosives

- All handling and loading or unloading of explosives shall be done in a safe and careful manner and shall be accordance with the federal regulations pertinent thereto in force at the time. Explosives shall be off-loaded prior to the off-loading of any other cargo.

Chapter 42-105 Hauling of Explosives

- All hauling of explosives away from or to the pier shall be done in a safe and careful manner and shall be in accordance with rules of the state department of labor and industrial relations.

Chapter 42-106 – Containers for Flammable Liquids

- No empty containers which have been used to hold flammable liquids shall be delivered onto any wharf or structure under control of the department unless the same are securely closed with metal screw plugs.
- Any such containers shall be delivered onto a wharf or structure only at such times as a carrier is prepared to take immediately delivery.

Chapter 42-107 – Nitrate of Soda, Nitrate of Ammonia, Sulfur, and Other Similar Materials

- No nitrate of soda, nitrate of ammonia, sulfur, or other similar material shall be stored or left upon any wharf for more than four hours unless packed in sound and non-leaking containers. Such material shall be under the continuous care of a competent guard satisfactory to the harbor master until removed.
- Masters, owners, or agents of vessels or consignees of cargoes of nitrate of soda, sulfur, or other similar materials during the process of loading, unloading, and removing such cargoes, must at all times keep the wharf swept clean and free of such materials.
- If loose nitrate of soda, sulfur, or other similar material is to be discharged onto or loaded from any wharf or structure at any harbor, it shall be placed directly into the carrier and immediately removed. A protective device approved by the harbor master shall be used

during the period of loading or unloading to prevent the material being handled from falling upon the wharf structure.

- During the process of handling nitrate of soda, sulfur, or other similar material on any wharf at any harbor under control of the department, it shall be obligatory on the part of the master, owners, or agents of a vessel to provide containers of not less than 50 gallons capacity filled with a solution of nitrate of soda and water at distances of not more than 50 feet apart, with suitable buckets placed alongside each container, for the purpose of fighting any fire which may occur in such cargo.

Chapter 42-108 – Dangerous Acids; Electric Storage Batteries

- Acids of a dangerous character such as sulfuric, muriatic, and nitric acids shall be removed from the wharf immediately upon discharge from any vessel and no such acid shall be put upon a wharf under control of the department for shipment until the carrier is ready to receive it. Prior permission of the harbor master shall be secured in the event it becomes necessary to handle such cargo at other times.
- Electric storage batteries containing electrolyte or corrosive battery fluid of non-spillable type, protected against short circuits and completely and securely boxed, shall be exempt from this provision.

Chapter 42-109 – Flammable Substances; Leaky Containers

- No gasoline, distillate, kerosene, benzene, naphtha, turpentine, paints, oils, or other flammable substances in leaky containers shall be delivered onto any wharf under control of the department for shipment.
- All such substances unloaded from any vessel in leaky containers shall be removed immediately.

Chapter 42-110 – Heating Combustibles on Vessels

- No combustible material such as pitch, tar resin, or oil shall be flame heated on board any vessel within the harbors or streams of the State without the permission of a harbor master.

Chapter 42-111 – Fumigation of Vessel

- No vessel shall be fumigated or smoked at any wharf under control of the department without the prior permission in writing from the director, the chief, or the harbor master.
- If fumigation is to be with cyanogen products or hydrocyanic acid gas in any form, however generated, the applicant or applicant's agent shall be in possession of a permit as required by HDOH rules and shall have a guard on duty so long as any danger exists, in order that no one, unless properly entitled to do so, be allowed to board such vessel.

Chapter 42-112 – Use of Fuel Burning Steam Generating Appliances

- All fuel burning steam generating appliances when used on any wharf under control of the department or on any scow, pile driver, or other vessel working alongside or near any

wharf under control of the department shall be equipped with spark arresters satisfactory to the harbor master.

- At the close of each day's work, all ashes, cinders, waste, or other deposits caused by such appliances upon any wharf shall be promptly removed and shall not be disposed of in or upon any waters of the harbor.

Chapter 42-113 – Repair, Manufacturing, Construction, or Maintenance Work on Wharf

- No person shall make any repair or do any kind of manufacturing, construction, or maintenance work on any wharf without the permission of the harbor master.

Chapter 42-114 – Smoking Prohibited

- Smoking is positively prohibited at all times within any cargo shed, or upon any wharf apron, and during the time cargo is being loaded, unloaded, or stored on any unshedded pier under control of the department, and no person shall enter into, stand in, or under, or pass through any such wharf or structure with a lighted pipe, cigar, cigarette, match, fire, or any flame of whatever nature, excepting only within those areas designated by the harbor master and plainly marked "Smoking Area."
- No smoking or lighting of a match or any other fire-creating device shall be permitted within 50 feet of any fueling operation.

Chapter 42-115 – Use of Explosives

- The use of explosives on land, on any wharf, or in a shed or other structure under control of the department, or in the water in the immediate vicinity of the same, without the written approval of the harbor master is strictly prohibited.

Chapter 42-116 – Keeping Wharf in Sanitary Condition and Clear of Fire Hazard

- Vessel owners, charterers, agents, or private terminal operators utilizing wharves and sheds under the control of the department for the handling of merchandise shall keep such wharves and sheds in a clean and sanitary condition, clear of materials which create a fire hazard and shall ensure that passageways and established fire lanes are not obstructed.

Chapter 42-117 – Standards of Cleanliness

- All vessels moored at a state-owned mooring or berthing facility shall be kept, at all times, in a condition of reasonable cleanliness and sanitation so as not to constitute a common nuisance or potential source of danger to public health.

Chapter 42-118 – Charges for Cleaning Wharves

- In cases where the department takes over the cleaning of wharves the charge therefore shall be assessed against the vessel which is responsible for the necessary of cleaning.

Chapter 42-119 – Identification of Mobile Equipment

- All mobile equipment used on any property under the control of the department in connection with the handling of cargo or shipping containers, such as folk lifts, cranes, tractors, and straddle trucks, shall be clearly identified as to the owner thereof.

Chapter 42-121 – Fowl, Animal, or Livestock

- No fowl, animal, or livestock of any kind shall be allowed to remain on any wharf under control of the department for a period longer than six hours without being properly fed and watered. After any fowl, animal, or livestock unloaded on a state wharf, it shall be removed from the same wharf within twenty-four hours.
- No shipment of such fowl, animal, or livestock subject to quarantine shall be unloaded on a state wharf by any shipping company or its agents unless first passed by the state department of agriculture or unless arrangement have been made of acceptance of quarantine. All such fowl, animal, or livestock requiring quarantine shall be removed from the wharf within eighteen hours.
- All expenses incurred in the care and maintenance of such fowl, animal, or livestock while on a state wharf shall be paid by the consignee thereof and shall constitute a lien upon the same until such charges are paid.

Chapter 42-122 – Private Use of State Harbor Property or Facilities; Business Activities; Signs

- No regular or extensive use of any state harbor property or facility for private gain or purpose shall be permitted without corresponding and reasonable benefits and returns to the public.
- No person shall engage in any business or commercial activity at any state harbor without the prior written approval of the department. Without limiting its generality, the term “engage in any business or commercial activity” as used in this section includes (1) solicitation, and (2) distribution of advertisement or circulars, intended for private gain or purpose.
- No person shall post or display any signs at any state harbor without the prior written approval of the department, except that approval will not be required for the posting or displaying of any sign on a vessel which relates solely to the sale of such vessel if the maximum dimension of such sign does not exceed three feet.

Chapter 42-123 – Placement of Goods and Equipment

- Any person handling goods or using equipment on a wharf or within a shed under control of the department or bringing goods whereon or therein for shipment, shall place, store, or stack such goods or equipment in such a way as not to be an impediment to the approaches to same nor an obstacle to the removal of other goods, not to cause damage to the shed or wharf.
- No goods shall be so placed as to restrict or prevent the use of mooring bitts, cleats, or any other device used for mooring purposes.
- No goods shall be so placed as to restrict or prevent the use of tracks, water connections, fire hydrants, gutters, liquid connections or drains, telephone or electric connections.

Chapter 42-124 – Closing of Wharves for Safety Reasons

- The harbor master may close the wharves or any portion thereof and regulate and control the use of the same whenever in the harbor master's opinion it is advisable to do so for reasons of safety, fire prevention, or probable interference with cargo handling or vessel operations.
- No person shall enter upon any wharf so closed without the permission of the harbor master.

Chapter 42-125 – Liability for Damage to or Loss of Merchandise and Cargo

- The department shall not be liable for any damage to or loss of merchandise or other property on any wharf under its control.
- It shall be the responsibility of shipping concerns or their agents to exert every effort to protect cargo from the effect of weather conditions while same is stored on state wharves. This responsibility shall include the proper closing of all openings such as outside doors and windows, and the placing of cargo on pallets or dunnage so that it will not be damaged by moisture from the shed floors. Unless the above precautions are taken and unless carelessness on the part of department employees can be shown, no claim for damaged cargo due to inclement weather shall be considered.

Chapter 42-126 – Littering or Polluting Land Areas Prohibited

- No person shall throw, place, leave, deposit, abandon, or cause or permit to be thrown, placed, left, deposited or abandoned any litter within a state harbor, except in receptacles designated by the department for the disposal of such materials. "Litter" as used in this section includes any and all types of debris and substances, whether liquid or solid, and materials such as garbage, refuse, rubbish, glass, cans, bottles, paper, wrappings, fish or animal carcasses or any other substances which render harbor lands or facilities unsightly, noxious or otherwise unwholesome to the detriment of the public health and welfare and effective and safe operation of the harbor.
- No person shall deposit oil, oily refuse, sludge, chemicals, or other hydrocarbons on state property except in specially designated collection points. These items may not be left in or near standard refuse containers or anywhere else on harbors property. Penalties, including but not limited to the revocation of mooring permits and the right to use the facilities, may be invoked.

Chapter 42-127 – Littering or Polluting of Water Prohibited

- No person shall place, throw, deposit, or discharge, or cause to be place, thrown, deposited, or discharges into the waters of any harbor, river or shore waters of the State any litter, or other gaseous, liquid or solid materials which render the water unsightly, noxious or otherwise unwholesome so as to be detrimental to the public health and welfare or a navigational hazard.
- No person shall discharge oil sludge, oil refuse, fuel oil, or molasses either directly or indirectly, or pump bilges or ballast tanks containing other than clean water into the waters of any harbor, river or into any shore waters in the State.

Chapter 42-128 – Disposal of Salvage of Derelict Craft

- When any owner, agent, or individual contemplates or plans the disposal or salvage of a derelict craft, vessel or other object of any size, type or description, by transporting across, within or on navigable waters, whether a part or whole craft or whether a floating or suspended object of any sort which might, if sunk, lost or abandoned in the harbors, channels or shore waters, become a hazard to navigation, to dredging or to other operation of state or federal government, or the public in those waters, that person shall obtain the written permission of the harbor master before taking such action.

Chapter 42-129 – Duty of Persons Who Lose, Drop, or Abandon Any Floating or Sinking Object

- Should any owner, operator, charter, agent, or individual, without permission of the harbor master, lose, sink, drop, or abandon any floating or sinking object in or on the navigable waters and shore waters of the State, that person shall immediately notify the harbor master and shall immediately take such action as is necessary for removal of the object.
- Upon failure on the part of the owner, operator, charterer, agent or individual to remove such object the department will take such actions through federal or commercial channels as are necessary for such removal and will charge all costs incurred by the department in effecting the necessary removal to the owner. The harbor master may require the posting of a bond to assure payment.

Chapter 42-130 – Approved Backflow Prevention Device Required for Water Supply System

- No person shall connect a vessel's water supply system, siphon or other water water-operated device, equipment or mechanism connected to the water supply system or operate any water-operated device, equipment or mechanism connected to the water supply system, unless an approved backflow prevention device has been installed at the faucet or other point of connection. An "approved backflow prevention device" means a backflow prevention device that meets the requirements contained in Standard 1001, American Society of Sanitary Engineers as it existed on June 1, 1993, or the Uniform Plumbing Code adopted by the International Association of Plumbing and Mechanical Officials.

Chapter 42-131 – Dumping of Materials at Sea

- When any owner, agent or individual contemplates the dumping of sinkable materials at sea by hauling across, within or on the navigable and/or shore waters of the State that person shall notify and obtain the permission of the department as specified in §19-42-161 and §19-42-162 prior to movement and shall not fail to perform any duty imposed thereby. All dumping at sea of sinkable objects or materials shall be done in the areas designated by the Secretary of the Army for such disposal and in accordance with the Corps of Engineers requirements and applicable state agency requirements.
- The dumping of floating objects is strictly prohibited.

Chapter 42-132 – Waste Outlets; Permit Required

- Notwithstanding the issuance of a permit pursuant to §19-42-161, no person shall do any of the following within a state commercial harbor without first having obtained a permit from the HDOH (not applicable to vessels):
    - Discharge any wastes from shore into the waters of a state commercial harbor so as to reduce the quality of the water below the standards of water quality adopted for such waters by the HDOH.
    - Construct, install, modify, alter, or operate any treatment works or part thereof or any extension of addition thereto which discharges from shore into the waters of a state commercial harbor.
    - Construct or use new outlet for the discharge of any wastes from shore into the waters of a state commercial harbor.

Chapter 42-133 – Loading or Unloading Flammable Liquids

- Loading or unloading of flammable liquids shall be in strict accordance with applicable federal laws and regulations.

Chapter 42-134 – Appliances and Electrical Wiring

- All cooking or heating appliances or any other machinery, equipment, utensils, or apparatus which are used by small craft or smaller commercial vessels at a state commercial harbor and could be the cause of fire shall be so constructed, installed, wired, situated, maintained, and used so as not to constitute a potential fire hazard. The failure to conform to any statute, rule, regulation, standard, or ordinance affecting fire safety may be considered by the department in determining any violation of this section.
- Particular attention is directed to the applicable provisions of the state boating rules of the Department of Land and Natural Resources. In addition, the approval of any machinery, equipment, utensils, or apparatus by Underwriter' Laboratories, Factory Mutual System, Marine Testing Institute, Inc., or any other nationally recognized electrical testing agency, may be considered by the department in determining compliance with this section.
- All electrical equipment must be properly grounded.

Chapter 42-135 – Fire Extinguishing Equipment for Small Craft

- Any small craft utilizing the waters of the state commercial harbor shall be provided with approved fire extinguishers as prescribed in the applicable provisions of the state boating rules of the DLNR. The fire extinguishers shall at all times be maintained in good and serviceable condition for immediate and effective use an shall be mounted on wall brackets so located as to be readily accessible. In addition, if any person is living aboard any small craft or contrivance, which is not a visiting small craft temporarily using the harbor, the small craft or contrivance shall be equipped with at least one approved hand portable fire extinguisher containing ten pounds of dry chemicals placed on each separate level or floor of habitable living space. Each extinguisher shall be mounted on a wall bracket so placed as to be readily accessible.

Chapter 42-136 – <u>Fueling</u>

- All fueling operations shall be done in compliance with the stricter of any applicable federal, state, or county rules. The fueling of vessels at a state commercial harbor where a marine fueling station has been established, or where authorized tank trucks or tank trailers are available shall be accomplished only at a station, or by tank trucks or tank trailers with a state permit. A permit shall be issued only if:
    - Proper application has been submitted;
    - Established fees have been paid to the department by the applicant;
    - There exists a comprehensive general liability insurance policy or policies, or a certificate of insurance in lieu thereof evidencing that a policy has been issued and is in force with a combined single limit of not less than $500,000. The specification of limits contained in this section shall not be construed in any way to be a limitation on the liability of the permittee for any injury or damage proximately caused by it. The insurance shall (A) be issued by an insurance company or surety company authorized to do business in the State; (B) name the State as an additional insured; (C) provide that the department shall be notified at least thirty (30) days prior to any termination, cancellation, or material change in its insurance coverage; (D) cover all injuries, losses, or damages arising from, growing out of, or caused by any acts or omissions of the permittee, its officers, agents, employees, invitees, or licensees, in connection with the permittee's use or occupancy of the premises; and (E) be maintained and kept in effect at the permittee's own expense throughout the life of the permit. The permittee shall submit evidence to the department of renewals of other actions to indicate that the insurance policy remains in effect as prescribed in this section.
- Prior to fueling a vessel at a state commercial harbor, the operator shall:
    - Securely moor the vessel;
    - Stop all engines, motors, fans, and devices which could provide sparks;
    - Extinguish all fires;
    - Close all ports, windows, doors, and hatches; and
    - Clear the area of people not directly involved with the operation of the vessel or servicing of the vessel.
- Persons fueling a vessel at a state commercial harbor shall:
    - Refrain from smoking, striking matches, or throwing switches; and
    - Keep the nozzle of the fuel hose, or fuel can in continuous contact with fuel tank opening to guard against static sparks.
- After fueling is completed, the following action shall be taken:
    - Close fill openings;
    - Wipe up all spilled fuel;
    - Open all ports, windows, doors, and hatches;
    - Permit vessel to ventilate for at least five minutes; and
    - Check that there are no fuel fumes in the vessel's bilges or below deck spaces before starting machinery or lighting fires.
- Fueling a vessel from a fuel barge or tanker barge shall be allowed only when it is down in accordance with operational procedures approved by the USCG.

Chapter 42-137 – Fishing Prohibited

- Fishing, as defined in HRS 187A-1 is prohibited from all piers, wharves, and bulkhead walls in Kewalo Basin and Honolulu Harbor except Piers 5, 6, and 7; and all piers and wharves in Barbers Point Harbor. Casting of fishing lines beyond the shallow marginal reef and into the boat channel is prohibited from the Waikiki side of the Kewalo Basin entrance channel. Fishing with nets is prohibited in the basin and channel areas of Kewalo Basin, Barbers Point Harbor, and Honolulu Harbor except for the use of hand-held scoop nets for landing hooked fish at Piers 5, 6, and 7 in Honolulu Harbor and the shallow marginal reef at the Waikiki side of the Kewalo Basin entrance channel and as provided in these rules and HAR 188-34.

Chapter 42-138 – Lifesaving Equipment Required

- Any small craft and smaller commercial vessel utilizing the waters of a state commercial harbor shall be equipped with lifesaving equipment as required by and approved by the USCG. Wearable PFDs must be readily accessible and throwable devices must be immediately available for use
    - Boats 16 feet or over in length shall carry one Type I, II, or III (wearable) PFD for each person on board and one Type IV (throwable) PFD in each boat.
    - Boats less than 16 feet in length and all canoes and kayaks shall carry one Type I, II, III, or IV PFD for each person on board.

Chapter 42-139 – Fire Signal for Small Craft or Smaller Commercial Vessel in Harbor

- Five prolonged blasts on a vessel's whistle, horn or other sound producing device indicates (1) a fire on board small craft or smaller commercial vessel not under way or (2) a fire at any facility to which the small craft or smaller commercial vessel may be moored. The words "prolonged blasts" used in this section shall mean a blast from four to six seconds duration. The fire signal shall not be used for other purposes in any state harbor.

Chapter 42-140 – Liquor Prohibited on State Piers and Waterfront Properties without Permit

- No person shall consume any liquor as defined in HRS 281-1, on any state pier or waterfront property not under lease except by prior permission from the department for each occasion.

Chapter 42-141 – Responsibility for Vessel Gangplanks

- It shall be the responsibility of the vessel to provide a reliable and safe means of access and egress to and from the vessel and the pier for crew members, passengers, and visitors to the vessel.

Chapter 42-161 – Dredging, Filling, and Construction

- Any person, firm, or corporation desiring to perform any dredging, filling, or erecting of any construction within commercial harbors and entrance channels belonging to or controlled by the State, shall first obtain a permit therefore from the department.

- The application for any dredging, filling, or construction shall be in the form prescribed by the department, accompanied by maps and drawings which shall clearly show the location, scope, character, and details of the proposed work, and shall be further accompanies by a fee of $50 to cover costs of the necessary investigation. This fee is not refundable whether or not a permit is granted.

Chapter 42-162 – Jurisdiction of Other Agencies

- The United States Army Corps of Engineers, the State Department of Health, and the Department of Land and Natural Resources may have certain jurisdiction over navigable waters.
- The approval of these agencies shall also be secured before performing work within their jurisdictions. When directed, the applicant shall notify the USCG of such work for publication of a "Notice to Mariners."

Chapter 42-163 – Installation of Buoys

- Any person desiring to install mooring or anchorage buoys in any harbor under the jurisdiction of the department, shall apply to the department in writing for permission to install such buoys.
- Applications must be accompanied by comprehensive plans showing the exact proposed location of buoys and anchors, as well as plans and specifications of the type and size of buoy and anchoring equipment. The director may grant permission for the installation of moorings or buoys in any area under the department jurisdiction if, in the director's judgment, it is advisable and will not be a menace to or interfere with navigation. The right is reserved by the director to revoke any license or permission for installation at any time, if the director's opinion revocation is necessary or advisable. Upon revocation, the owner shall remove the moorings or buoys without delay.

Chapter 42-164 – Construction of Structures

- No buildings or structures of any nature shall be erected or constructed on state property, nor shall existing structures be modified, without obtaining the prior permission of the division and any other governmental agency as required by law. The division may require plans, specifications, and other pertinent data to accompany any request for construction or modification of state facilities. In General, approval shall be dependent on an agreement to return the property to its original state when vacating the property, if requested by the division.

Note: The majority of Chapter 42 deals with loading and unloading of hazardous materials and does not apply to storage of materials and waste that are used/stored at harbor tenant facilities or construction sites. In the case of improper use, manage, or storage of hazardous substances or wastes, Harbors will follow the terms and conditions contained in the tenant lease agreement or revocable permit, or construction contracts as stated below.

Enforcement Officers may issue penalties under HAR Title 19 for the following circumstances:

- A responsible party in violation of an environmental regulation, but where a Written Warning is not an effective tool.
- A responsible party in violation of a Harbors requirement, but not in violation of HDOH stormwater regulations.
- A transient vessel owner in violation of a Harbors requirement, BMP, or HDOH stormwater regulation, although not subject to a tenant lease agreement, revocable permit, construction contract.

Attachment 10

Suspected Illicit Discharge Reporting Form

Hawaii Department of Transportation – Harbors Division
"Malama I ke awa kai" – Protect our harbor waters

Suspected Illicit Discharge Reporting Form

General Information: Use this form to report a suspected illicit discharge. If you are unsure, please contact your supervisor or HAR-EE. Examples of illicit discharges: uncontained vehicle/equipment/building/sidewalk washing, sink discharging directly to ground or storm drain inlet, petroleum spills/sheens, unpermitted vessel discharges, uncontained vessel painting/chipping/sandblasting/cleaning, etc.

Observer Information

Name:			
Office Code:		Telephone Number:	
Report Date:			

Description of Suspected Illicit Discharge

Address or Location:		Date and Time:	
Description: (Include Substance and Amount, if known)			

Media into which the discharge occurred:
☐ Air ☐ Natural Soil ☐ Concrete/Asphalt Pavement ☐ Stream ☐ Harbor ☐ Other:_____

Responsible Party: (if known)	
Cause of Discharge: (if known)	
Clean-up Actions: (if applicable)	
Notifications Made:	

Please forward completed form and/or picture(s) to HAR-EE office. Fax Number: (808) 587-1864

Point of Contact for Reporting

Agency	Telephone Number
Harbor Traffic Control (Aloha Tower) [HAR-OCT]	(808) 587-2076, (808) 587-2077
Harbors Engineering Environmental Section [HAR-EE]	(808) 587-1962

Additional Follow-up By HAR-EE (to be filled by HAR-EE):

Attachment 11

Training Materials

STORMWATER RUNOFF AND ITS IMPACTS

Stormwater runoff is rain or snowmelt that flows over land and does not percolate into the soil (USEPA, 2007). Stormwater runoff occurs naturally, in small amounts, from almost any type of land surface, especially during larger storm events. Impervious surfaces, such as buildings, homes, roads, sidewalks, and parking lots can significantly alter the natural hydrology of the land by increasing the volume, velocity, and temperature of runoff and by decreasing its infiltration capacity. Increasing the volume and velocity of stormwater runoff can cause severe stream bank erosion, flooding, and degrade the biological habitat of these streams. Reducing infiltration can lower groundwater levels and affect drinking water supplies.

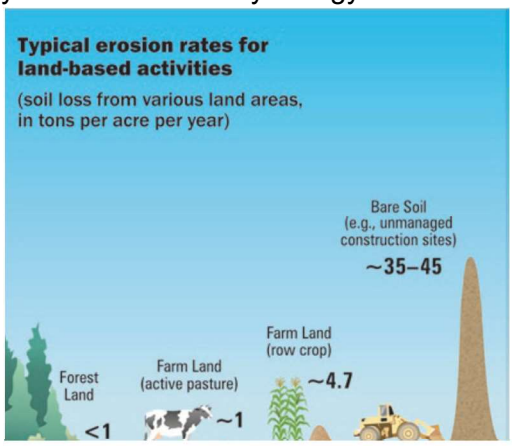


Figure 2-1. Typical erosion rates from land-based activities.

In addition, as stormwater runoff moves across surfaces, it picks up trash, debris, and pollutants such as sediment, oil and grease, pesticides, and other toxics. Changes in ambient water temperature, sediment, and pollutants from stormwater runoff can be detrimental to aquatic life, wildlife, habitat, and human health. Soil exposed by construction activities is especially vulnerable to erosion. Runoff from an un-stabilized construction site can result in the loss of approximately 35 to 45 tons of sediment per acre each year, compared to less than one ton in forested land (American Society of Civil Engineers [ASCE] and Water Environment Federation [WEF], 1992; Figure 2-1). Even during a short period of time, construction sites can contribute more sediment to streams that would be deposited naturally over several decades. Excess sediment can cloud the water reducing the amount of sunlight reaching aquatic plants, clog fish gills, smother aquatic habitat and spawning areas, and impede navigation in waterways.

Importance of Construction Site Runoff Control Program

This **Construction Site Runoff Control Program** has been developed to address the potential pollutants that are generated as a result of construction activities conducted at Harbors. These potential pollutants pose a risk to Harbors Small MS4 and the receiving water bodies through stormwater runoff. Uncontrolled stormwater runoff from construction sites can significantly impact our ocean water.

Construction Impacts

Construction activities can impact the environment through several different processes. The primary stormwater pollutant at a construction site is sediment, a common result of erosion.

Erosion and Sedimentation

Excessive erosion and sedimentation are the most visible water quality impacts. Erosion is the process by which the soil and rock are removed from the earth's surface by the action of water,

wind, and gravity, and then transported and deposited in other locations. Sedimentation is the movement and settling out of suspended soil particles. It is usually easier and less expensive to prevent erosion than it is to control sediment from leaving a construction site. To control erosion at a construction site, it is important to understand the different types of erosion that can occur.

Water Erosion

In Hawaii, water erosion is typically occurring in six different forms (i.e., raindrop erosion, sheet erosion, rill erosion, gully erosion, stream-bank erosion, and coastal erosion). Raindrop erosion involves the dislodging of soil particles by raindrops. Once the rate of rainfall is faster than the rate of infiltration into the soil, surface runoff occurs and carries the loosened soil particles down slopes. Sheet erosion is the transport of loosened soil particles by surface runoff that is flowing downhill in thin sheets. Rill erosion removes soil through the formation of concentrated runoff that creates many small channels. Gully erosion is the result of highly concentrated runoff that cuts down into the soil along the line of flow. Stream-bank erosion occurs when flowing water erodes unstable stream-banks. Coastal (or shoreline) erosion primarily occurs on both exposed and sheltered coasts through the action of currents, waves, and tidal change.

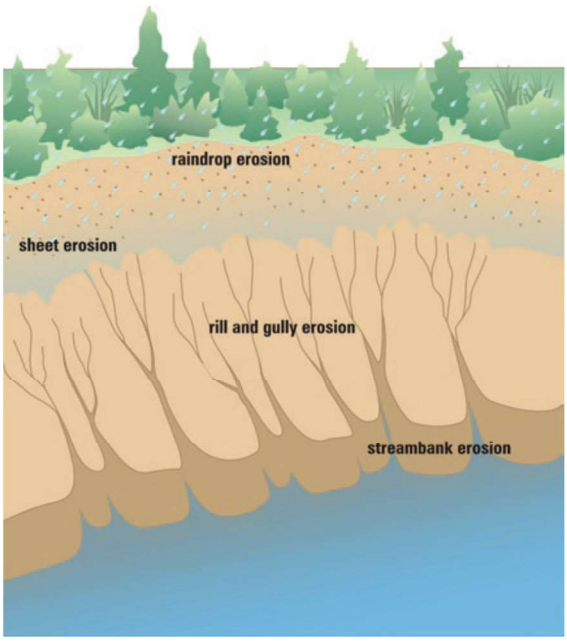


Figure 2-2. Types of Erosion.

Generally, water erosion begins when raindrops break down the soil structure and dislodge soil particles. Runoff carrying the soil particles becomes sheet erosion, which eventually forms smaller rills and larger gullies (Figure 2-2). The best way to stop water erosion is to keep the soil in place through vegetation, erosion control blankets, or other methods that prevent the soil from becoming dislodged during rain events.

Wind Erosion

Wind erosion is of two primary varieties (i.e., deflation and abrasion; Blanco & Lal, 2010). Deflation occurs when the wind picks up and carries loose soil particles, and abrasion occurs when the surfaces are worn down as they are struck by airborne particles carried by wind. Deflation is divided into three categories, including surface creep, saltation, and suspension (Figure 2-3). Surface creep occurs when larger heavier particles slide or roll along the ground. Saltation occurs when particles are lifted a short height into the air and bounce and saltate across the surface of the soil. Suspension is a phenomenon when very small and light particles are lifted

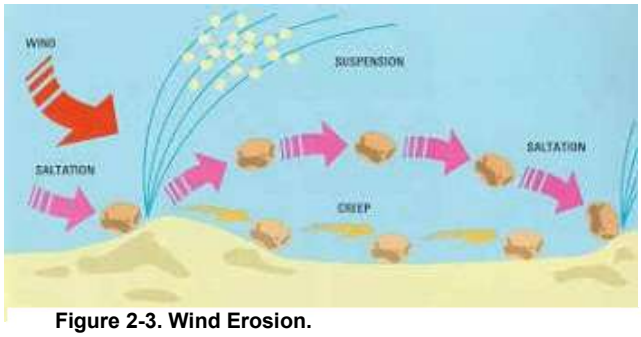


Figure 2-3. Wind Erosion.

into the air by the wind and are carried for long distances. Saltation is responsible for the majority (50 to 70 percent [%]) of wind erosion, followed by suspension (30 to 40 %), and then surface creep (5 to 25 %; Blanco & Lal, 2010). Wind erosion is much more severe in arid areas, and during times of drought.

Wind erosion is another potential hazard at construction sites and is commonly referred to as dust. Dust is defined as solid particles or particulate matter predominantly large enough to eventually settle out from the air but small enough to remain temporarily suspended in the air for an extended period. Common sources of dust at construction sites include vehicle and equipment use, exposed areas of soil, and contractor activities such as land clearing, drilling, and demolition.

Gravitational Erosion

Gravitational erosion, or mass movement, is the downward and outward movement of rock and sediments on a sloped surface, mainly due to the force of gravity (Gray & Sotir, 1996; Norris *et al.*, 2008). Gravitational erosion is often the first stage in the breakdown and transport of weathered material in sloped areas. It moves material from a higher elevation to a lower elevation. This type of erosion occurs continuously on all slopes (some act very slowly, while others occur very suddenly with disastrous results).

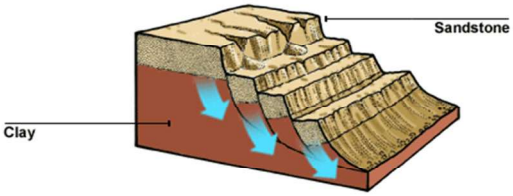


Figure 2-4: Landslide.

Any perceptible downward movement of rock or sediment is often referred to in general terms as a "landslide." However, landslides can be classified in a much more detailed way that reflects the mechanisms responsible for the movement and the velocity at which the movement occurs (Figure 2-4). One of the visible topographical manifestations of a very slow form of such erosion is a scree slope (Figure 2-5).

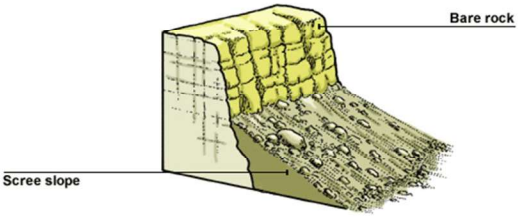


Figure 2-5: Scree Slope.

Slumping happens on steep hillsides (Figure 2-6). It occurs along distinct fracture zones, often within soil materials like clay that may move quite rapidly downhill upon being released. In some cases, slumping is caused by water beneath the slope weakening it. In many cases, it is simply the result of poor engineering control or measurement. Surface creep is the slow movement of soil and rock by gravity, which is usually not perceptible except through extended observation. It can also describe the rolling of dislodged soil particles 0.5 to 1.0 millimeters in

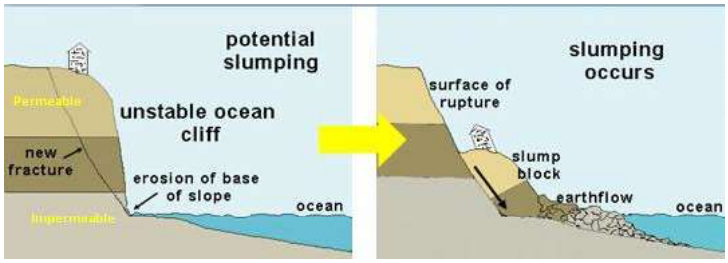


Figure 2-6: Slumping.

diameter by wind along the soil surface.

Factors Affecting Erosion

The erosion process is typically influenced by climate, topography, soils, and vegetative cover. Understanding how these factors influence erosion, will help with selection, design, and implementation of appropriate controls to minimize erosion from the construction site (USEPA, 2007).

Climate: The frequency, intensity, and duration of rainfall are the principal factors influencing erosion from a construction site. Know the weather patterns in the area and, if possible, plan soil disturbance activities for periods of dry weather. The mean annual rainfall in the areas of Honolulu and Kalaeloa Barbers Point Harbors is 23.6 inches (Giambelluca *et al.,* 2011). Generally, weather in Hawaii is very consistent, with only minor changes in temperature throughout the year. For the majority of Hawaii, there are only two seasons – summer/dry (from April to September) and winter/wet (from October to March), based on the rainfall data presented at The Weather Channel website (The Weather Channel, 2013) and U.S. Climate Data website (The US Climate Data, 2013).

Topography: The longer and steeper a slope, the greater the potential there is for erosion from the slope. Use practices such as diversions or fiber rolls to break up long slopes. Consider minimizing soil disturbance activities on steeper slopes.

Soils: Soil type can also impact erosion. Soil texture, structure, organic matter content, compaction, and permeability can all influence erosion rates.

Vegetative Cover: Vegetative cover provides a number of critical benefits in preventing erosion. It absorbs the energy of raindrops, slows velocity of runoff, increases infiltration, and helps bind the soil. Soil erosion can be greatly reduced by maximizing vegetative cover at construction site.

Other Common Pollutants

In addition to sedimentation, other common pollutants, which have the potential to impact water quality, including nutrients, trace metals, pesticides, oil and grease, fuels, and other toxic chemicals. Nutrients, including nitrogen and phosphorus, are often used in fertilizers and, can cause excessive algae growth. Bacteria and viruses can contaminate stormwater from animal excrement or sanitary sewer overflows. Oil and grease includes a wide array of petroleum hydrocarbons from various sources, such as leaks from vehicles and equipment and used oil disposal. Metals can enter the stormwater after impact with corroded equipment. It is important to note that over half of the trace metal load carried in stormwater is associated with sediments. Organics can contaminate the stormwater as a result of spilled or improperly disposed cleaners and solvents.

Each construction site should be assessed to determine which pollutants may present a potential hazard, and select and implement BMPs to reduce the potential contaminants.

Site Specific Construction Best Management Practices Plan

An SSCBMPP is a site-specific written document that identifies potential sources of stormwater pollution at the construction site. It describes practices to reduce pollutants in stormwater discharges from the construction site. Reduction of pollutants is often achieved by controlling the volume of stormwater runoff (e.g., taking steps to allow stormwater to infiltrate into the soil). In addition, it identifies procedures that the operator will implement to comply with the terms and conditions of a construction general permit.

An effective SSCBMPP is the primary key to prevent or reduce stormwater pollution resulted from a construction site. If sediment and erosion controls and good housekeeping practices are followed, construction activity can result in the discharge of significantly less sediment and other common pollutants.

Attachment 12

HDOT Harbors Division Construction and Post-Construction Program Brochures

CONSTRUCTION PROJECTS DEFINED

Any activity that results in the disturbance of land, including clearing, grading, excavating and activities that support the project such as stockpiles, washouts, fueling and storage areas.

STORMWATER IMPACTS

Construction activities may cause pollution and impact stormwater runoff which eventually discharges to the harbor and other surface waters without prior treatment.

HDOT-HARBORS CONSTRUCTION SITE RUNOFF CONTROL PROGRAM

All construction projects under Harbors jurisdiction are subject to the requirements of this program as well as local, state, and federal environmental laws.

EXEMPT PROJECTS

Activities that result in no or minimal land disturbance such as:

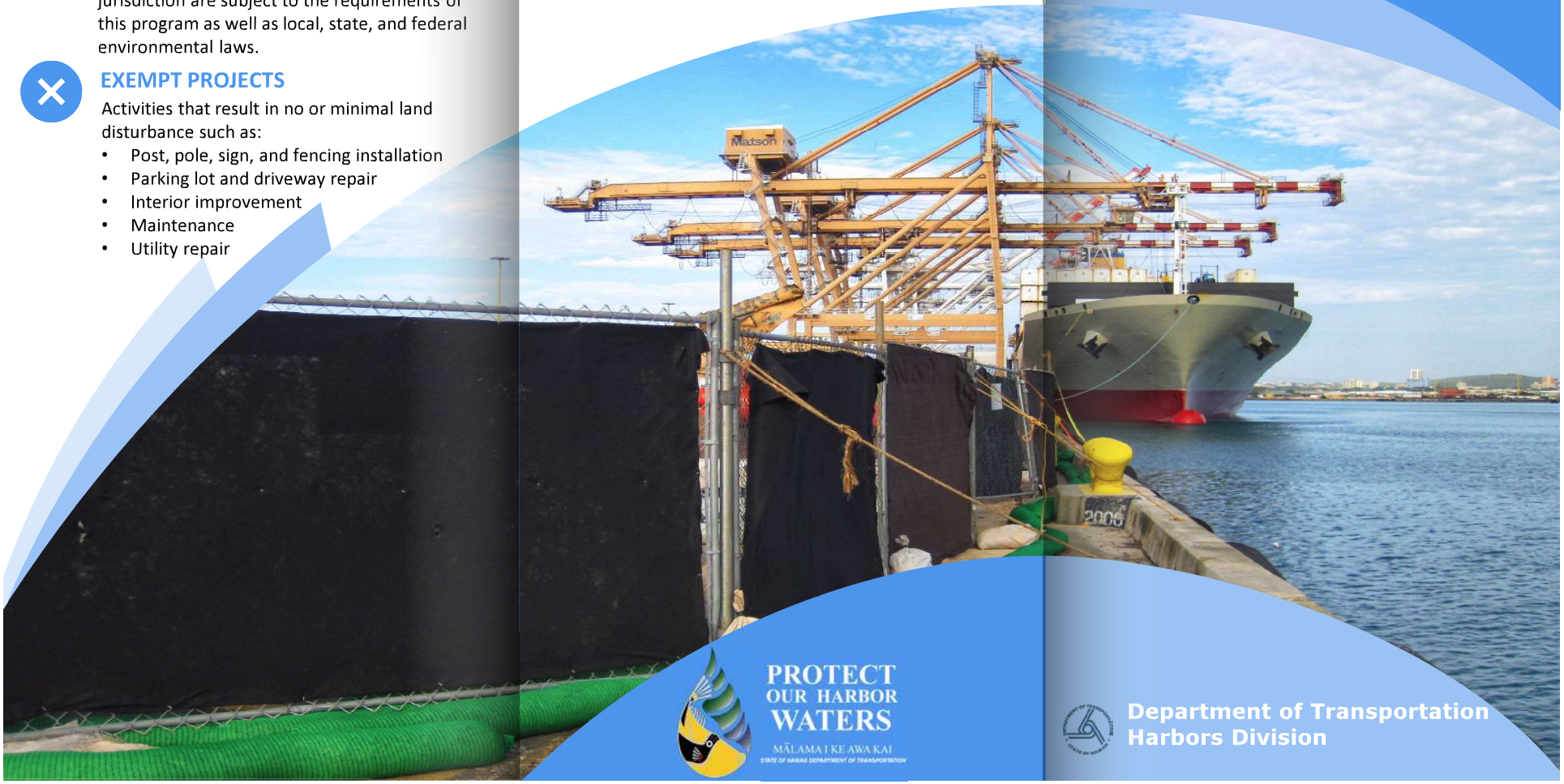
- Post, pole, sign, and fencing installation
- Parking lot and driveway repair
- Interior improvement
- Maintenance
- Utility repair

REPORT SUSPECTED ILLICIT DISCHARGES

Harbors Environmental Hotline:	**808-587-1962**
Harbor Traffic Control:	**808-587-2076**
U.S. Coast Guard:	**808-842-2600**
Hawaii Department of Health, Clean Water Branch:	**808-586-4309**

MAILING ADDRESS

Hawaii Department of Transportation, Harbors Division
Hale Awa Ku Moku Building
79 South Nimitz Highway
Honolulu, Hawaii 96813-4898



PROTECT OUR HARBOR WATERS
MĀLAMA I KE AWA KAI
STATE OF HAWAII DEPARTMENT OF TRANSPORTATION

CONSTRUCTION SITE RUNOFF CONTROL PROGRAM

Department of Transportation
Harbors Division



CONSTRUCTION PROJECT CLASSIFICATION AND MANAGEMENT:

1. HDOT-Harbors Projects are managed by division personnel.

2. Tenant Improvement Projects are managed by the entity authorized to undertake the project. Tenants must obtain consent from HDOT-Harbors Division.

PLAN SUBMITTAL AND REVIEW

The following must be submitted to HDOT-Harbors Engineering Branch Environmental Section (HAR-EE) for review. For more information, refer to the **Construction Site Runoff Control Program Manual** and **Post-Construction Stormwater Management Manual** at:
http://hidot.hawaii.gov/harbors/malamaikeawakai/

PROJECTS LESS THAN ONE ACRE:

- Notification Form
- Site Plan
- Narrative of proposed work and applicable BMPs

PROJECTS ONE ACRE OR GREATER:

- Construction Design Review Checklist
- Permanent Post-Construction BMP Plan Checklist
- Construction Drawings and Plans
- Stormwater Pollution Prevention Plan (SWPPP)
- Post-Construction Stormwater Mitigation Plan (if applicable)
- Copies of NPDES Permit Applications
- Other Applicable Permit Applications

OTHER REFERENCES:

1. CCH Rules Relating to Water Quality & Related Resources at: https://www.honolulu.gov/dfmswq/rules-relating-to-water-quality.html.
2. CCH Stormwater Best Management Practice Manual for Construction (dated November 2011)

ENVIRONMENTAL COMPLIANCE

All construction projects are required to comply with local, state, and federal environmental laws. Enforcement for non-compliance may include:

- Oral or Verbal Warning
- Written Warning
- Notice of Violation
- Stop Work Order
- Withhold Payment
- ELD and L&M Assessment
- Contract Termination

TRAINING REQUIREMENTS

Harbors engineers, inspectors, and consultants who have primary construction stormwater responsibilities will receive initial and annual refresher training.

PERMIT REQUIREMENTS

DISCHARGE/CONNECTION PERMIT (TENANT IMPROVEMENT AND NON-HARBOR PROJECTS ONLY):

Complete the Discharge/Connection Permit application and submit to HDOT-Harbors Engineering Branch, Environmental Section for review.

NPDES PERMIT:

Submit all applicable permit applications to the State of Hawaii Department of Health, Clean Water Branch per Hawaii Administrative Rules, Chapter 11-55 and provide proof of application and issue permit(s) to HDOT-Harbors Engineering Branch, Environmental Section.

HDOH NPDES Permit Applications:
https://eha-cloud.doh.hawaii.gov/epermit

HDOT-HARBORS INSPECTIONS

Conducted by HAR-EE or a designated and qualified inspector and documented on the *Construction Site Best Management Practices Inspection Checklist.*

INITIAL INSPECTIONS: To be conducted prior to the start of construction activities to ensure site-specific BMPs have been properly installed in accordance with the SWPPP or similar. No construction activities will commence until this inspection is conducted and any deficiencies are satisfactorily addressed.

RECURRING INSPECTIONS: To be conducted throughout the duration of the construction phase at the following frequencies to ensure that BMPs are properly maintained:

- October – March: Once every two weeks
- April – September: Once every two months

FINAL INSPECTIONS: To be conducted after construction activities have been completed to ensure the following:

- Disturbed soil is stabilized
- Temporary BMPs have been removed
- Permanent BMPs have been properly installed, where applicable

In addition to the HDOT-Harbors inspections listed above, the construction contractor must conduct self-inspections per the requirements in HAR 11-55, Appendix C.



POST-CONSTRUCTION BMPS

Designed to minimize water quality impacts following the completion of construction projects while complying with HDOT-Harbors Small Municipal Separate Storm Sewer System (MS4) Permits. Refer to the **Post-Construction Stormwater Management Program Manual** at:

http://hidot.hawaii.gov/harbors/malamaikeawakai/

LOW IMPACT DEVELOPMENT (LID)

Systems and practices that mimic a site's natural hydrology to mitigate stormwater runoff and pollution.

SOURCE CONTROL

Measures to prevent pollutants from coming into contact with stormwater runoff or discharging into HDOT-Harbors small MS4.

TREATMENT CONTROL

Measures that treat stormwater runoff that has come into contact with pollutants. Examples include:

- Retention
- Bioinfiltration
- Mechanical methods

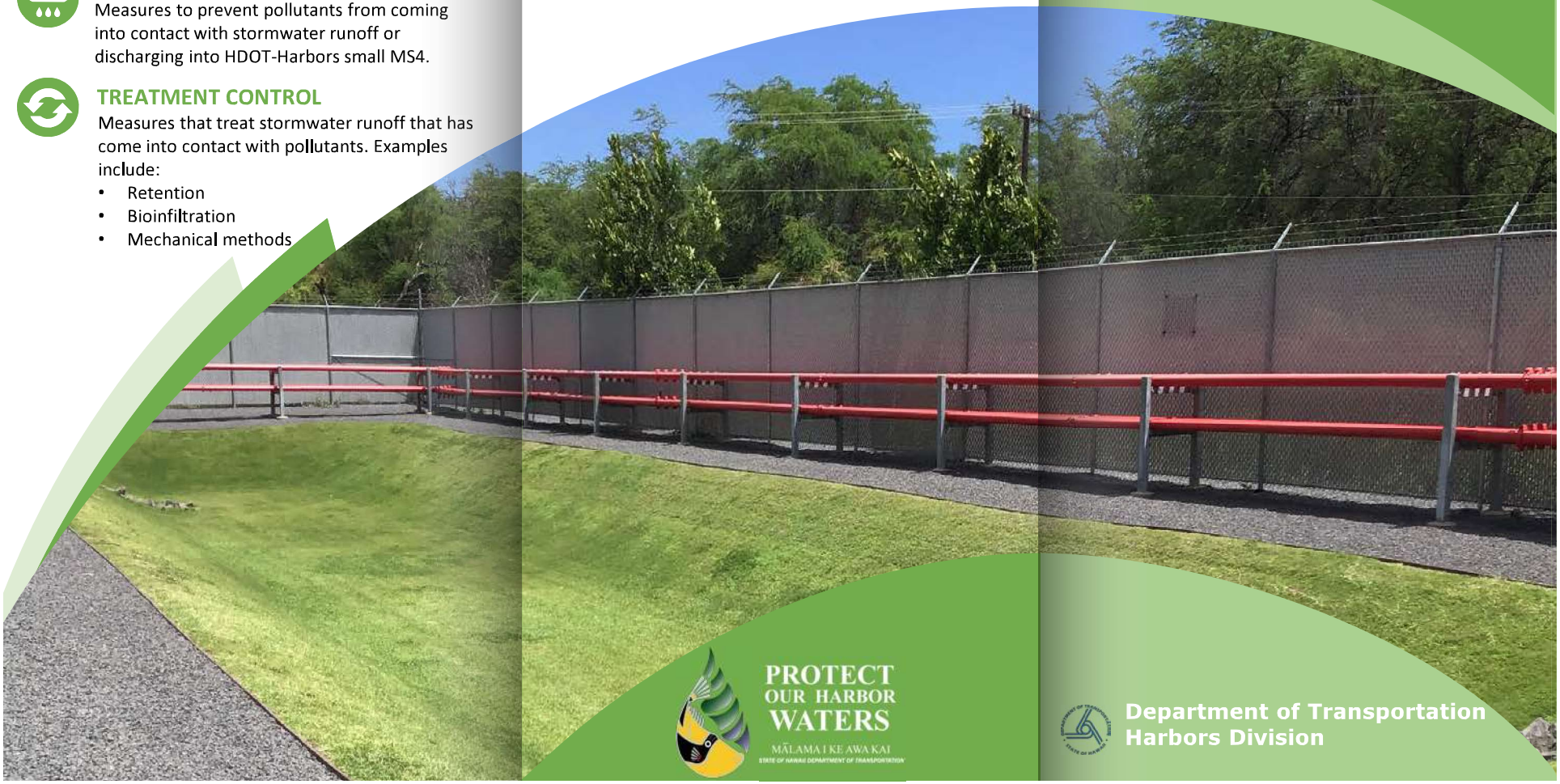
REPORT SUSPECTED ILLICIT DISCHARGES

Harbors Environmental Hotline:	**808-587-1962**
Harbors Construction Section:	**808-587-1866**
Harbor Traffic Control (24/7):	**808-587-2076**
Hawaii Department of Health, Clean Water Branch:	**808-586-4309**

MAILING ADDRESS

Hawaii Department of Transportation, Harbors Division
Hale Awa Ku Moku Building
79 South Nimitz Highway
Honolulu, Hawaii 96813-4898

POST-CONSTRUCTION STORMWATER MANAGEMENT PROGRAM



PROTECT OUR HARBOR WATERS
MĀLAMA I KE AWA KAI
STATE OF HAWAII DEPARTMENT OF TRANSPORTATION

Department of Transportation
Harbors Division



POST-CONSTRUCTION STORMWATER MANAGEMENT PROGRAM

Required for all projects that result in land disturbance of one acre or more under HDOT-Harbors jurisdiction unless exempt.

1. **NEW DEVELOPMENT:** New construction or installation of a building or structure, or the creation of impervious surface that disturbs one acre or more; or less than one acre if it is a part of a larger common plan of development or sale that disturbs one acre or more.

2. **REDEVELOPMENT:** Development that would create or add an impervious surface area on an already developed site including, but not limited to, any construction project that requires demolition or complete removal of existing structures or impervious surfaces at a site and replacement with new impervious surfaces.

PROGRAM EXEMPTIONS

HDOT-Harbors Division may exempt certain types of projects from this program that pose a minimum risk of stormwater pollution including, but not limited to:

- Maintenance activities (e.g., top layer grinding, repaving, and reconfiguring surface parking lots)
- Reroofing
- Interior remodeling and improvement
- Routine maintenance to original line and grade, hydraulic capacity, or original purpose of facility
- Trenching and resurfacing associated with utility work
- Replacement of damaged pavement
- Emergency construction activities

GENERAL POST-CONSTRUCTION PROJECT REQUIREMENTS

DESIGN PHASE:

- Incorporate Post-Construction BMPs into design
- Submit the *Permanent Post-Construction BMP Plan Checklist*
- Apply for Appropriate Permits
- Submit Post-Construction Stormwater Mitigation Plan and other applicable plans
- Wait for concurrence and Notice to Proceed

CONSTRUCTION PHASE:

- Install Post-Construction BMPs according to approved PSMP
- Monitor and inspect installation and inventory
- Enforcement, if necessary
- Submit O&M Plan for review and acceptance

POST-CONSTRUCTION PHASE:

- Conduct long-term O&M of Post-Construction BMPs, if applicable
- Inspect Post-Construction BMPs regularly
- **For tenant projects,** tenant must submit annual O&M and inspection records to HDOT-Harbors, when applicable
- Enforcement, if necessary

OTHER REFERENCES:

1. CCH Stormwater BMP Guide for New and Redevelopment (dated July 2017)

For more information, review the Post-Construction Stormwater Manual located on the HDOT-Harbors website at:
http://hidot.hawaii.gov/harbors/malamaikeawakai/

ENVIRONMENTAL COMPLIANCE

All construction projects are required to comply with local, state, and federal environmental laws. Enforcement for non-compliance may include:

- Oral or Verbal Warning
- Written Warning
- Notice of Violation
- Stop Work Order
- Withhold Payment
- ELD and L&M Assessment
- Contract Termination

TRAINING REQUIREMENTS

Appropriate training is provided to Designers, Plan Reviewers, Engineers, Inspectors, Construction Managers, Contractors, and Operators who have primary responsibilities in the implementation of the Harbors Post-Construction Stormwater Management Program. The training video is available on the HDOT-Harbors Stormwater Management website:
http://hidot.hawaii.gov/harbors/malamaikeawakai/

STORMWATER IMPACT

Urban runoff from a developed site may contain pollutants that can enter the MS4 without prior treatment before discharging to the harbor.



BEST MANAGEMENT PRACTICES

Review HDOT-Harbors Division **Construction Site Runoff Control Program Manual** and the **Post-Construction Stormwater Management Manual** for more information on BMPs and required procedures and process at:
http://www.hidot.hawaii.gov/harbors/malamaikeawakai

CONSTRUCTION BMPs ARE:

- Schedules of activities
- Prohibition of practices
- Maintenance procedures
- Other management procedures

POST-CONSTRUCTION BMPs ARE:

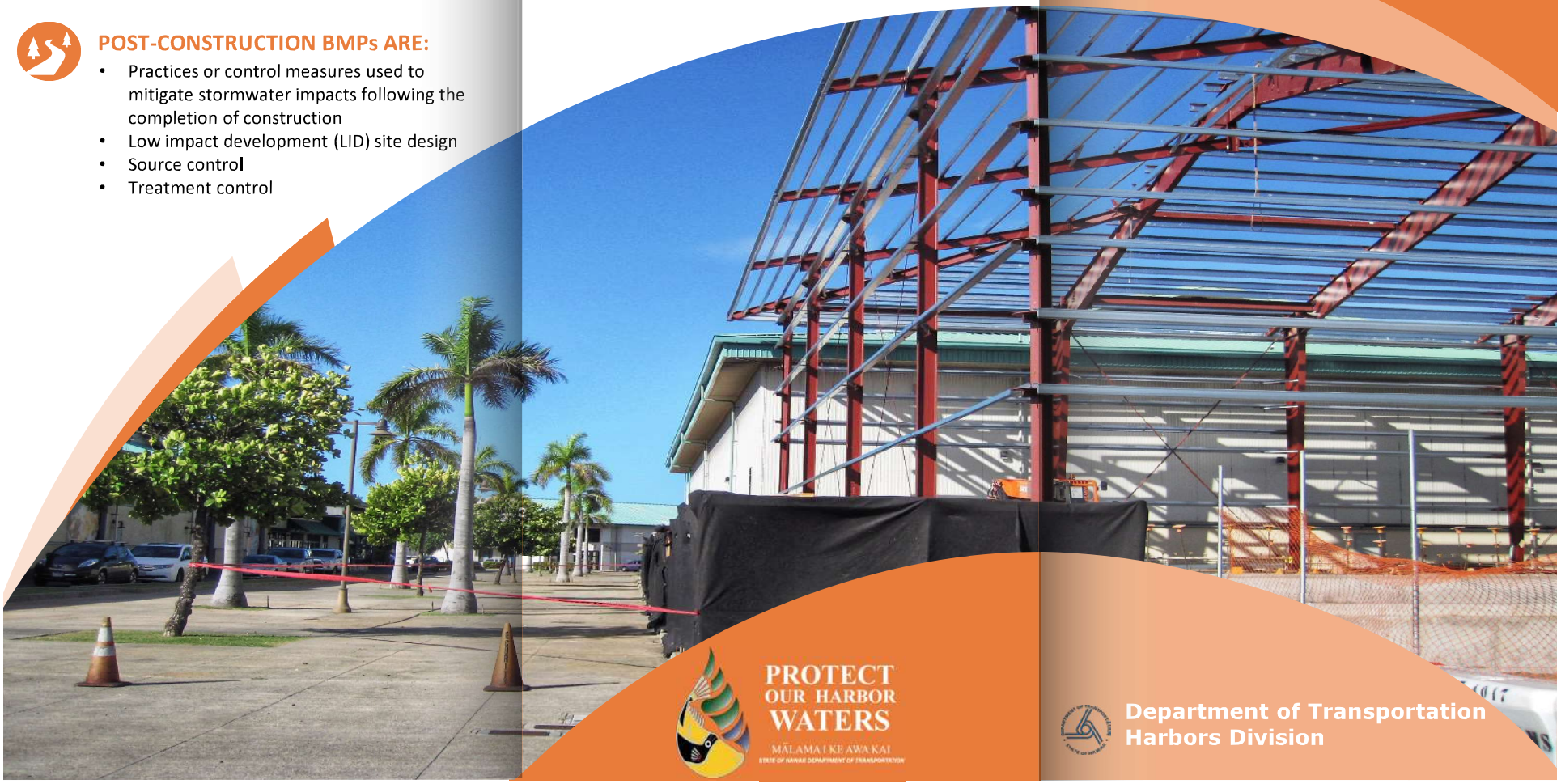
- Practices or control measures used to mitigate stormwater impacts following the completion of construction
- Low impact development (LID) site design
- Source control
- Treatment control

REPORT SUSPECTED ILLICIT DISCHARGES

Harbors Environmental Hotline:	**808-587-1962**
Harbors Construction Section:	**808-587-1866**
Harbor Traffic Control (24/7):	**808-587-2076**
Hawaii Department of Health, Clean Water Branch:	**808-586-4309**

MAILING ADDRESS

Hawaii Department of Transportation, Harbors Division
Hale Awa Ku Moku Building
79 South Nimitz Highway
Honolulu, Hawaii 96813-4898



PROTECT OUR HARBOR WATERS
MĀLAMA I KE AWA KAI
STATE OF HAWAII DEPARTMENT OF TRANSPORTATION

BEST MANAGEMENT PRACTICES (BMPs) FOR CONSTRUCTION AND POST-CONSTRUCTION

Department of Transportation
Harbors Division



CONSTRUCTION BMPs

A qualified inspector will conduct BMP inspections at the regulated project site to ensure BMPs are properly implemented. There are many different types of BMPs including, but not limited to the following:

EROSION CONTROL:
- Preserve existing vegetation
- Geotextiles and mats
- Slope drains

SEDIMENT CONTROL:
- Silt fence
- Storm drain inlet protection
- Sediment trap
- Sediment basin

WIND EROSION CONTROL:
- Dust control

TRACKING:
- Stabilize and maintain ingress and egress

GOOD HOUSEKEEPING:
- Material management
- Waste management
- Stockpile management
- Vehicle and equipment management
- Paving and grinding operations
- Concrete washout waste management



Properly covered and contained stockpile.



Concrete washout containment.

Direct pavement runoff towards vegetated or landscaped areas (e.g., swales), if possible.



POST-CONSTRUCTION BMPs

All new development and redevelopment projects should consider applying post-construction BMPs during the planning and design phase of the project. Post-construction BMPs include:

1 LOW IMPACT DEVELOPMENT:
- Conserve natural areas, soils, and vegetation
- Minimize disturbances to natural drainages
- Minimize soil compaction
- Minimize impervious surfaces
- Direct runoff to landscaped areas

2 SOURCE CONTROL:
- Conduct operations indoors or under cover if possible to prevent contact with stormwater runoff
- Landscaped areas
- Storm drain inlet signs

3 TREATMENT CONTROL:
- Infiltration basin or infiltration trench
- Manufactured treatment device
- Dry well
- Bioretention Basin
- Permeable pavement
- Green roof
- Swale

Section D

Post-Construction Stormwater Management in New Development and Redevelopment

Stormwater Management Plan
Honolulu Harbor
and Kalaeloa Barbers Point Harbor

Mālama I Ke Awa Kai
Protect our Harbor Waters

Prepared for:
State of Hawaii
Department of Transportation
Harbors Division

This page intentionally left blank

Final

Post-Construction Stormwater Management in New Development and Redevelopment Program Manual

State of Hawaii
Department of Transportation
Harbors Division
Hale Awa Ku Moku Building
79 South Nimitz Highway
Honolulu Hawaii 96813-5898

April 2022

Version 9.0

Final

Post-Construction Stormwater Management in New Development and Redevelopment Program Manual

State of Hawaii
Department of Transportation
Harbors Division
Hale Awa Ku Moku Building
79 South Nimitz Highway
Honolulu, Hawaii 96813-4898

"Mālama I Ke Awa Kai"
Protect Our Harbor Waters

April 2022

Version 9.0

RECORD OF REVISION

Revision No.	Revision Date	Description	Sections Affected
1.0	January 2013	Initial Release	All
2.0	June 2013	Version 2.0	All
3.0	October 2013	Version 3.0	All
4.0	December 2013	Version 4.0	All
5.0	February 2014	Version 5.0	All
6.0	May 2014	Version 6.0	All
7.0	May 2014	Version 7.0	5
8.0	October 2021	Version 8.0	All
9.0	April 2022	Version 9.0	Appendix A

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 COMPONENT OVERVIEW 1
1.2 EXEMPTIONS 3
2.0 IMPLEMENTATION PROCESS 4
2.1 RESPONSIBILITIES 4
2.2 HARBORS PROJECT 5
2.3 TENANT IMPROVEMENT PROJECT 6
3.0 BMP REQUIREMENTS AND SELECTION PROCEDURE 8
3.1 IDENTIFYING POLLUTANTS OF POTENTIAL CONCERN AND RECEIVING WATER BODIES 8
3.2 DRAINAGE STUDY AND IDENTIFICATION OF CONDITIONS OF CONCERN 9
3.3 POST-CONSTRUCTION STORMWATER BMP SELECTION 10
3.4 FEASIBILITY CRITERIA AND LIMITATIONS 13
3.4.1 Infiltration BMPs 13
3.4.2 Harvest/Reuse 13
3.4.3 Vegetated Biofilters 14
3.4.4 Green Roof 14
3.4.5 Dry Swales 14
3.4.6 Vegetated Swales or Vegetated Filter Strips 14
3.5 POST-CONSTRUCTION STORMWATER MITIGATION PLAN DEVELOPMENT 15
3.5.1 Introduction of Low Impact Development 16
3.5.2 LID Site Design Strategies 17
3.5.3 Source Control BMPs 18
3.5.4 Treatment Control BMPs 21
3.5.5 Numeric Sizing Criteria 21
4.0 POST-CONSTRUCTION BMP INSTALLATION 24
4.1 INSTALLATION INSPECTION DURING CONSTRUCTION PHASE 24
5.0 POST-CONSTRUCTION BMP MAINTENANCE, INVENTORY AND RECORDKEEPING 25
5.1 MAINTENANCE REQUIREMENTS 25
5.2 VERIFICATION MECHANISMS 26
5.3 POST-CONSTRUCTION BMP INSPECTION 26
5.4 POST-CONSTRUCTION BMP INVENTORY AND RECORDKEEPING 26
6.0 ENFORCEMENT 28
6.1 SCOPE OF AUTHORITY 28
6.2 ENFORCEMENT ACTIONS 28
7.0 TRAINING 30
8.0 REFERENCES 31

LIST OF TABLES

Number	Title
2-1	Responsibilities for Post-Construction Program Implementation – Harbors Project
2-2	Responsibilities for Post-Construction Program Implementation – Tenant Improvement Project
3-1	Pollutants of Potential Concern
3-2	Post-Construction Best Management Practices
3-3	Fundamental Components of a PSMP for Regulated for Regulated Project
3-4	List of Source Control Categories (taken from CCH Storm Water BMP Guide)
3-5	Runoff Coefficients for Water Quality Flow Calculations (taken from CCH Storm Water BMP Guide)

LIST OF FIGURES

Number	Title
1-1	General Post-Construction Project Requirements Flow Chart
3-1	Post-Construction BMP Selection Procedure Flow Chart
3-2	BMP Selection Process for Pollutants of Potential Concern

LIST OF APPENDICES

Number	Title
Appendix A	HDOT Harbors Division Administrative Organizational Chart
Appendix B	Permanent Post-Construction Best Management Practices Plan Checklist
Appendix C	CCH Storm Water BMP Guide
Appendix D	CCH Rules Relating to Water Quality
Appendix E	A Sample of CDS Unit Operation and Maintenance Guideline
Appendix F	HDOT Harbors Division Construction and Post-Construction Program Brochures

LIST OF ACRONYMS AND ABBREVIATIONS

%	Percent
ACR	Annual Compliance Report
AMS	Asset Management System
BMP	Best Management Practice
CASQA	California Stormwater Quality Association
CCH	City and County of Honolulu
DA	Drainage Area
ELD	Environmental Liquidated Damages
HAR	Hawaii Administrative Rules
HAR-E	Harbors Division Engineering Branch
HAR-EC	Harbors Division Engineering Branch Construction Section
HAR-ED	Harbors Division Engineering Branch Design Section
HAR-EE	Harbors Division Engineering Branch Environmental Section
HAR-EM	Harbors Division Engineering Branch Maintenance Section
HAR-EP	Harbors Division Engineering Branch Planning Section
HAR-PM	Harbors Division Property Management Section
HDOT	State of Hawaii Department of Transportation
HRS	Hawaii Revised Statutes
HSG	Hydrologic Soil Group
L&M	Labor and Materials
LID	Low Impact Development
MS4	Municipal Separate Storm Sewer System
NAV	Notice of Apparent Violation
NFVO	Notice and Finding of Violation Order
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
O&M	Operation and Maintenance
PjM	Harbors Division Project Manager
POPC	Pollutants of Potential Concern
PSWP	Post-Construction Stormwater Mitigation Plan
SWO	Stop Work Order
TMDL	Total Maximum Daily Loads
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
WQF	Water Quality Flow Rate
WQV	Water Quality Volume

GLOSSARY

Best Management Practices (BMPs) means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of "waters of the United States." BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Clean Water Act is an act passed by the United States Congress to control water pollution. It was formerly referred to as the Federal Water Pollution Control Act of 1972 or Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500), 33 U.S.C. 1251 et seq., as amended by Public Law 96-483, Public Law 97-117, and Public Laws 95-217, 97-117, 97-440, and 100-04. Requirements of the NPDES program are defined under Sections 307, 402, 318 and 405 of the CWA.

Code of Federal Regulation codified all rules of the executive departments and agencies of the federal government. It is divided into fifty volumes, known as titles. Title 40 of the CFR (referenced as 40 CFR) lists all environmental regulations.

Discharge is a release or flow of stormwater or other substance from a conveyance system or storage container. Broader discharges include release to storm drains, etc.

Disturbance of Land refers to the penetration, turning, or moving of soil or resurfacing of pavement with exposure of the base course or the exposure of bare soil or ground surface, including the land surface exposed by construction of roads, buildings, utilities, baseyards, staging areas, demolition, headquarters, and parking areas. It does not include grass or weed cutting, bush or tree trimming or felling that leaves soil or ground intact. It includes "grubbing" in its normal meaning of the use of equipment to knock down and push vegetation out of the way, typically uprooting vegetation and disturbing the ground surface.

Erosion is the wearing-away of land surface by wind or water. Erosion occurs naturally from weather or runoff but can be intensified by land-clearing practices related to farming, new development, redevelopment, road building, or timber cutting.

Grading is any excavation or fill, or combination thereof.

Illicit Discharge is a non-storm water discharge that poses a risk to the environment.

Impervious Surface is a surface covering or pavement of a developed parcel of land that prevents the land's natural ability to absorb and infiltrate rainfall/stormwater. Impervious surfaces include, but are not limited to, rooftops; walkways; patios; driveways; parking lots; storage areas; impervious concrete and asphalt; and any other continuous watertight pavement or covering.

Landscaped soil and pervious pavement, underlain with pervious soil or pervious storage materials, are not impervious surfaces.

LID Site Design Strategy combines a hydrologically functional site design with pollution prevention measures to compensate for land development impacts on hydrology and water quality. They mimic the predevelopment site hydrology by using site design techniques that store, infiltrate, evaporate, and detain runoff to reduce off-site runoff and ensure adequate groundwater recharge. LID aims to preserve, restore, and create green space using soils, vegetations, and rain harvest techniques.

MS4 is conveyance or system of conveyances that is owned by a state, city, town, village, or other public entity that discharges to waters of the United States. It is designed or used to collect or convey stormwater (e.g., storm drains, pipes, ditches). It is usually not a combined sewer and not part of a sewage treatment plant or publicly owned treatment works. It is categorized as either "small," "medium," or "large," by USEPA. The Phase I regulation covers medium and large MS4s, serving a population of 100,000 or more. The Phase II regulation covers a subset of small MS4s in urbanized area (as defined by the Bureau of the Census) and non-traditional MS4s such as public universities, departments of transportation, hospitals, and prisons. Other small MS4s located outside these areas may be designated on a case-by-case basis by the NPDES permitting authority.

New Development is any action that is undertaken to alter the natural condition of real property or improvement on real property if a building, electric, grading, grubbing, plumbing, stockpiling or trenching permit would be required for the project, that may result in different or increased pollutant discharges to (Small) MS4 or receiving waters. New Development usually does not include work that does not involve any land disturbing activity, the installation of signs and traffic control devices, the installation of temporary BMPs, emergency work necessary to repair surfaces that are in immediate need of stabilization, the marking of improved surfaces with striping or signage, and minor and ordinary repairs to existing improvements, provided that the work will not increase the impervious surface area of the project site.

Post-Construction BMP refers to practices or control measures used to mitigate stormwater impacts from new development and redevelopment site. It includes LID site design strategies, source control BMPs, and treatment control BMPs. These practices treat, store, or infiltrate runoff onsite before it can affect water bodies downstream. Innovative site designs that reduce imperviousness and smaller-scale low impact development practices dispersed throughout a site are also ways to achieve the goals of reducing flows and improving water quality.

Pretreatment is treatment of waste stream before it is discharged to a collection system.

Redevelopment shall mean development that would create or add impervious surface area on an already developed site. Redevelopment includes, but is not limited to, any construction project that requires demolition or complete removal of existing structures or impervious surfaces at a

site and replacement with new impervious surfaces. Maintenance activities such as top-layer grinding, repaving (where all pavement is not removed), and reroofing are not considered to be redevelopment. Interior remodeling projects and improvements are also not considered to be redevelopment.

Secondary Containment is structure, usually dikes or berms, surrounding tanks or other storage containers, designed to catch spilled materials from the storage containers.

Sediments are soil, sand, and minerals washed from land into water, usually after rain, that collect in reservoirs, rivers, and harbors, destroying fish nesting areas and clouding the water, thus preventing sunlight from reaching aquatic plants. Farming, mining, and building activities without proper implementation of BMPs will expose sediment materials, allowing them to be washed off the land after rainfalls.

Source Control Best Management Practice is any practice designed to prevent pollutants from contacting stormwater runoff or to prevent discharge of contaminated runoff into storm drainage system.

State Waters means all waters, fresh, brackish, or salt, around and within the State of Hawaii, including, but not limited to, coastal waters, streams, rivers, drainage ditches, ponds, reservoirs, canals, ground waters, and lakes; provided that drainage ditches, ponds, and reservoirs required as a part of a water pollution control system are excluded.

Treatment Control means measures that treat stormwater and non-stormwater that has come into contact with pollutants.

1.0 INTRODUCTION

The **Post-Construction Stormwater Management Program** is intended for the following audiences: (1) State of Hawaii Department of Transportation [HDOT] Harbors Division (hereinafter referred to as the "Harbors") staff whose primary duties involving plan review and approval for Harbors capital projects (hereinafter referred to as the "Harbors Project") and Tenant[1] Improvement projects (hereinafter referred to as the "Tenant Improvement Project," (2) Harbors staff tasked with construction project oversight, (3) Harbors staff tasked with inspection of post-construction Best Management Practices [BMPs] during construction phase, and (4) the development community including engineers and architects tasked with creating and submitting construction plans for approval.

This program is complementary to Harbors ***Construction Site Runoff Control Program*** in that post-construction BMPs are required by Harbors National Pollutant Discharge Elimination System [NPDES] permit, and therefore will be incorporated into site-specific BMP plans consistent with this manual. This manual defines requirements and provides guidance for the project specific planning, selection, and design of post-construction BMPs to minimize pollutants in post-construction runoff and to minimize the amount of potentially polluted runoff leaving the site.

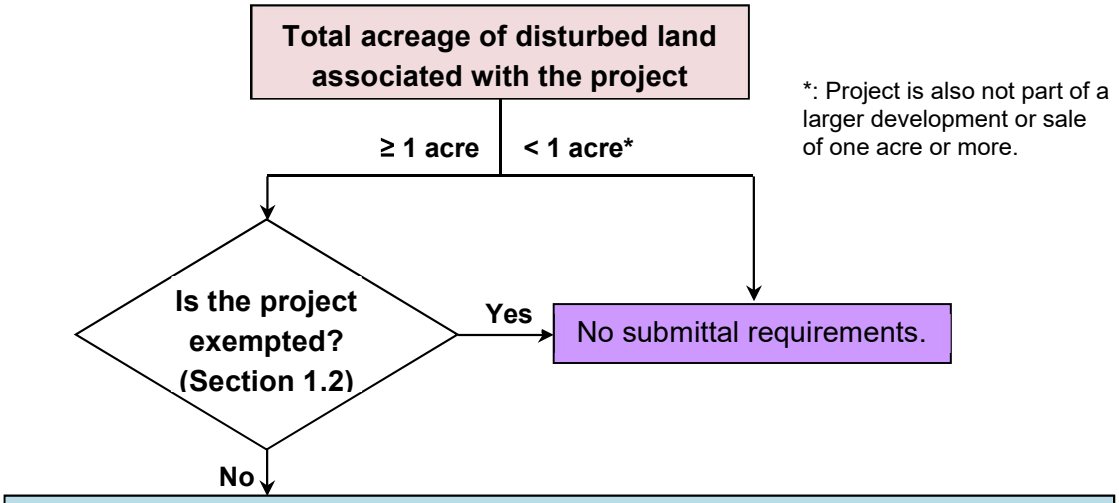
New development and redevelopment projects that result in a land disturbance of one (1) acre or more (hereinafter referred to as "**Regulated Project**"), are subject to Harbors **Post-Construction Stormwater Management Program**. All **Regulated Projects** must implement post-construction BMPs, unless the project is exempted according to Section 1.2. BMPs shall be designed and installed in accordance with the criteria, guidelines, and design standards described in this manual. Harbors has adopted City and County of Honolulu [CCH] ***Storm Water BMP Guide for New and Redevelopment*** (CCH, 2017; Appendix C) and ***Rules Relating to Water Quality*** (CCH, 2018; Appendix D) to guide both Harbors and Tenant Improvement Projects, when applicable and practical.

1.1 Component Overview

Sections 2 to 5 of this manual describe the planning, design, construction, inspection, and long-term maintenance requirements for post-construction BMPs. The post-construction general requirements for Harbors and Tenant Improvement Projects are depicted in Figure 1-1. General requirements for Harbors reviewers and inspectors are depicted in Attachment 1 of ***Construction Site Runoff Control Program*** manual.

[1] "Tenant" shall mean a person, group, partnership, corporation, or any other entity that has an executed lease, revocable permit or disposition instrument under chapter 171, Hawaii Revised Statutes [HRS] to use or occupy land, a building, structure, or other property owned by Harbors. This term also includes Harbors' approved sub-tenants and entities using container or terminal facilities.

Figure 1-1:
General Post-Construction Project Requirements Flow Chart



In **Design** Phase:

1. Incorporate post-construction BMP into project design – Section 2.0 and **CCH Storm Water BMP Guide for New and Redevelopment**
2. Submit *Permanent Post-Construction BMP Plan Checklist* – Appendix B
3. Apply for necessary permits (consult with appropriate agencies) – Attachments 1 and 2 of **Construction Site Runoff Control Program Manual**
4. Submit plans including PSMP for review – Section 3.0
5. Submit O&M Plan, if applicable, for review – Section 5.1
6. Wait for concurrence and **Notice to Proceed**.

In **Construction** Phase:

1. Install Post-Construction BMP according to approved PSMP – Section 3.0
2. Inspection during installation and inventory – Attachment 4 of **Construction Site Runoff Control Program Manual**
3. Enforcement if necessary – Section 7.0 of **Construction Site Runoff Control Program**
4. Submit O&M Plan for review – Section 5.1

In **Post-Construction** Phase:

1. Conduct long-term O&M of post-construction BMP, If applicable – Section 5.0
2. Inspect post-construction BMP regularly – Section 5.3
3. For Tenant Project, tenant may submit annual O&M and inspection report to Harbors, if applicable – Section 5.2
4. Enforcement if necessary – Section 6.0

The following lists the major components covered under the Harbors **Post-Construction Stormwater Management Program.**

- **BMP requirements for Regulated Projects**, including Low Impact Development [LID] Site Design Strategies, Source Control BMPs, and Treatment Control BMPs. These BMPs are to be included and described in a Post-Construction Stormwater Mitigation Plan [PSMP].
- CCH Rules Relating to Water Quality (CCH, 2018).
- Plan and permit application review to ensure that a Regulated Project is incorporating post-construction BMPs in accordance with the program.
- Inspections during construction phase to ensure that post-construction BMPs are installed and maintained properly.
- Enforcement when BMPs are not installed or maintained properly.
- Recordkeeping and references to support and facilitate compliance with the program, including, but not limited to:
  - ***Storm Water BMP Guide for New and Redevelopment*** (CCH, 2017), providing the minimum requirements needed to achieve compliance with LID Site Design Strategies, Source Control BMPs, and Treatment Control BMPs.
  - Post-Construction BMP GIS and database (e.g., Citywork© powered Access Management System [AMS]) to keep track of Harbors owned post-construction stormwater BMPs.
- Training for plan and permit application reviewers, inspectors, and maintenance personnel.
  - Education for project applicants, contractors, developers, designers, and other responsible parties.

1.2 Exemptions

Harbors may exempt certain types of projects (posing no to minimum risk of stormwater pollution) from this program, including, but not limited to:

- Maintenance activities such as top-layer grinding, repaving (where all pavement is not removed) and reconfiguring surface parking lots.
- Reroofing.
- Interior remodeling and improvement.
- Routine maintenance to maintain original line and grade, hydraulic capacity, or other original purpose of facility.
- Trenching and resurfacing associated with utility work or fence installation.
- Replacement of damaged pavement.
- Emergency construction activities required to immediately protect public health and safety.

2.0 IMPLEMENTATION PROCESS

All new and redevelopment projects under Harbors jurisdiction undergo an environmental review during planning phase. The project review and approval process are a critical point at which the Harbors can introduce applicable conditions or standards that will minimize the impacts of urban runoff on adjacent state waters. Project developers must address the potential impacts of stormwater discharges derived from development activities in the project planning and design phases. **Regulated Projects** that have the potential to negatively impact stormwater runoff to the Honolulu and Kalaeloa Barbers Point Harbors Small MS4s, will be required to identify post-construction BMPs that will be included in the project design, constructed as part of the project, and maintained in the long-term.

PSMP and the *Permanent Post-Construction BMP Plan Checklist* (Appendix B) must be included in the submittal package and completed properly for the project during design phase for Harbors approval.

Development projects are segregated by two major categories – (1) Harbors Projects and (2) Tenant Improvement Projects. Harbors has different project review and approval processes for Harbors Projects (Section 2.2) and Tenant Improvement Projects (Section 2.3). Personnel responsibilities for design, plan review, and approval of PSMP are outlined in Section 2.1 (Tables 2-1 and 2-2).

2.1 Responsibilities

General responsibilities involved in the implementation of Harbors **Post-Construction Stormwater Management Program** are listed in Table 2-1 for Harbors Projects and Table 2-2 for Tenant Improvement Projects. Harbors Engineering Branch consists of Construction Section [HAR-EC], Design Section [HAR-ED], Environmental Section [HAR-EE], Maintenance Section [HAR-EM], and Planning Section [HAR-EP]. A *Harbors Environmental Group Organization Chart* is enclosed in Attachment A.

For Harbors Projects, HAR-EP initiates the planning of the project including budgeting. HAR-ED, HAR-EE, and HAR-EM each review project plans and specifications on different aspects. Additionally, HAR-EE reviews the submitted PSMP and other program forms. The inspectors from HAR-EC conduct inspections during construction phase to ensure structural post-construction BMPs installed according to the approved plans. HAR-EE also verifies that the post-construction BMPs proposed in the PSMP are installed according to approved plans. Harbors Oahu District staff is responsible for the proper operation and maintenance [O&M] of the installed post-construction BMPs.

For Tenant Projects, HAR-PM will forward construction plans, specifications, and PSMP to HAR-E for review and comment. Each section under HAR-E will review and provide their comments. During the construction phase, HAR-EE will inspect and verify that the post-construction BMPs

proposed in the PSMP are installed properly. Tenants will be responsible for long-term O&M of the installed post-construction BMPs. HAR-EE will inspect these BMPs during regular tenant inspections, at the frequency identified in Harbors ***Tenant Inspection Manual*** (HDOTb, 2021).

Table 2-1
Responsibilities for Post-Construction Program Implementation
- Harbors Project

	Harbors Engineering Branch					Oahu
	EC	ED	EE	EM	EP	District
Harbors Project Planning					X	
Harbors Project Design		X		X		
Harbors Project Review		X	X	X		X
Harbors Project Approval	X					
PSMP Review and Approval			X			
Inspection during Construction	X		X			
Inspection after Construction			X			X
Harbors Project O&M						X
Provide Training			X			
Enforcement	X		X			

Table 2-2
Responsibilities for Post-Construction Implementation
- Tenant Project

	Tenant	Harbors Engineering Branch					PM
		EC	ED	EE	EM	EP	
Tenant Project Planning	X						X
Tenant Project Review				X	X	X	X
PSMP Review and Approval				X			
Tenant Project Approval							X
Inspection during Construction				X			
Inspection after Construction	X			X			
Tenants Project O&M	X						
Provide Training	X			X			
Enforcement				X			X

2.2 Harbors Project

Personnel from Harbors Engineering Branch Environmental Section [HAR-EE] initiates the review process by evaluating whether post-construction requirements are applicable to the projects. The key criteria for determining the need for post-construction BMPs are (a) the acreage of the project and (b) whether it can be exempt (Section 1.2).

When post-construction requirements are applicable, as described in Section 3.1 of the ***Construction Site Runoff Control Program*** Manual, HAR-EE will exchange the program requirement(s) with Harbors Project Manager [PjM] at the **Preliminary Design Phase** to discuss the *Construction Site Design Review Checklist* (HDOTa, 2021), as well as the *Permanent Post-Construction BMP Plan Checklist* (include in Attachment B). The PjM may convene a Pre-Design meeting with HAR-EE for further consultation. *Construction Design Review Checklist* discussions may continue into the **Design Phase**. These discussions and meetings will allow the PjM and HAR-EE to discuss applicable site-specific post-construction BMPs.

HAR-EE will advise PjM that a PSMP, describing how the project would meet Harbors **Post-Construction Stormwater Management** program requirements, must be submitted during design phase. At this stage, project-specific environmental mitigation measures are developed and a submittal package (including plans, specifications, designs, and PSMP) is forwarded to HAR-EE for review and comment.

HAR-EE reviews the PSMP document and final design plans to verify that post-construction program requirements are met. HAR-EE will then notify PjM when the PSMP is complete and contains necessary BMPs (refer to Sections 3.2 to 3.4), utilizing an interoffice memorandum. Once this memo has been issued (and placed in the project file), Harbors can proceed with putting the project out for bid. This process ensures that Harbors Post-Construction Stormwater Management program requirements are incorporated into the project design and shown on the plans prior to bidding for construction contractors or completion of construction work by Harbors itself. The process for Harbors plan reviewers is depicted in Attachment 1 of ***Construction Site Runoff Control Program*** manual (HDOTa, 2021).

2.3 Tenant Improvement Project

Harbors tenants who wish to perform new construction, reconstruction, modification, or demolition, must submit a request to HDOT or Harbors for review and approval. As described in Section 4.2.2 of the ***Construction Site Runoff Control Program*** manual, HAR-EE will review the request received from the tenant and assess whether the tenant improvement project is subject to Harbors **Post-Construction Stormwater Management Program** requirements. If post-construction requirements are applicable, HAR-EE will advise Harbors Property Management Staff [HAR-PM] of the assessment results and require that the tenant prepare and submit a PSMP, *Construction Site Design Review Checklist* (HDOTa, 2021), as well as the *Permanent Post-Construction BMP Plan Checklist* (include in Attachment B) during the design phase. At this stage, project-specific stormwater pollution mitigation measures are developed and submittal package (including design plans and specifications, forms, and PSMP) is forwarded to HAR-EE for review and comment.

HAR-EE reviews the PSMP document and final design plans to verify that PSMP requirements are met. HAR-EE will notify HAR-PM when the PSMP is complete and contains necessary BMPs

(refer to Sections 3.2 to 3.4), utilizing an interoffice memorandum. Once this memo has been issued (and placed in the project file), HAR-PM can notify the tenant that the project is approved.

This process ensures that Harbors **Post-Construction Stormwater Management Program** requirements are incorporated into the project design and shown on the plans prior to approval. Any mitigation measures required by the environmental review process, such as implementation and maintenance of post-construction BMPs, become part of the lease or revocable permit and are inspected by tenants regularly as outlined in the PSMP.

3.0 BMP REQUIREMENTS AND SELECTION PROCEDURE

To comply with its NPDES permit requirements and to minimize water quality impacts from new development and redevelopment, **all Regulated Projects shall consider and apply post-construction BMPs, as appropriate**.

This section provides a procedure for selecting post-construction BMPs for Regulated Projects. It includes identifying a list of pollutants of potential concern [POPC] and developing a PSMP to minimize water quality impacts through LID Site Design, Source Control, and Treatment Control BMPs. The procedure for determining the combination of these BMPs and their respective sizing is based on the ***CCH Rules Relating to Water Quality*** (Appendix D; CCH, 2018). It is also recommended that ***CCH Storm Water BMP Guide*** be used as a guide for post-construction BMP design and implementation (Appendix C; CCH, 2017). A flow chart summarizing the BMP selection procedure is depicted in Figure 3-1.

Figure 3-1
Post-Construction BMP Selection Procedure Flow Chart



3.1 Identifying Pollutants of Potential Concern and Receiving Water Bodies

Two major water bodies under Harbors jurisdiction are Honolulu Harbor and Kalaeloa Barbers Point Harbor. Hawaii Department of Health [HDOH] lists Honolulu Harbor as impaired water for NH_4 and trash (HDOH, 2020). Kalaeloa Barbers Point Harbor has not been fully assessed. No state Total Maximum Daily Loads [TMDL] have been established for either harbor.

Urban runoff from a developed site can be potentially contaminated by pollutants (including trash, oil and grease, suspended solids, metals, gasoline, pesticides, and pathogens) prior to discharging into the stormwater conveyance system and receiving waters. The types of pollutant that may be generated at a site are related to land use and activities conducted on-site. A list of POPC is provided in Table 3-1. The ***CCH Storm Water BMP Guide*** provides a general guideline for a list of post-construction BMPs and targeted POPC.

Table 3-1
Pollutants of Potential Concern

Priority Project Categories	General Pollutant Categories								
	Sediment	Trash & Debris	Metals	Organic Compounds	Nutrients	Oxygen Demanding Substances	Oil & Grease	Bacteria & Viruses	Pesticides
Commercial Development > 1 acre	P[1]	P	P	P[2]	P[1]	P[5]	P	P[3]	P[5]
(Heavy) Industry Development	P	P	P	P		P	P		
Automotive Repair Shops		P	P	P[4,5]			P		
Restaurants		P				P	P	P	P[1]
Parking Lots	P[1]	P	P		P[1]	P[1]	P		P[1]
Fueling Facility		P	P	P		P	P		
Driveways	P	P	P	P[4]	P[1]	P[5]	P		P[1]

P: Potential

1: A potential pollutant if landscaping exists on-site.

2: A potential pollutant if the project includes uncovered parking areas.

3: A potential pollutant if land use involves food or animal waste projects.

4: Including petroleum hydrocarbons.

5: Including solvents.

3.2 Drainage Study and Identification of Conditions of Concern

Common impacts to the regional hydrology resulting from development typically include increased runoff volume and velocity; reduced infiltration; increased flow frequency, duration, and peak; shorter time to reach peak flow; and water quality degradation. These changes have the potential to negatively impact receiving water bodies, habitat integrity, and downstream channels (if any). A change to Regulated Project site's hydrology would be considered a condition of concern. To mitigate these potential impacts, the project proponent must prepare the following supporting documentation:

- **Evaluate the project's conditions of concern in a drainage study as part of the PSMP**. The drainage study and the PSMP shall be prepared by a registered civil engineer in the State of Hawaii, with experience in drainage design and water resources management. The report shall consider the project location (from the larger watershed perspective), topography, soil and vegetation conditions, percent impervious area, natural and infrastructure drainage features, wet season groundwater depth, and any other relevant hydrologic and environmental factors to be protected specific to the nearest watershed.

- **Field reconnaissance including observations of the site and upstream and downstream conditions.** Existing conditions, such as undercutting erosion, slope stability, vegetative stress, and areas susceptible to erosion and/or habitat alteration as a result of altered flow regimes should be pointed out.

- **Existing hydrologic conditions** including description of the location, type, and percent cover of onsite vegetation, description of existing impervious features, description of existing stormwater conveyance features, description of distance to downstream water bodies, description of soil type (Natural Resources Conservation Service [NRCS] hydrologic soil classification and types), description of depth to groundwater during the wet season, description of offsite vegetation types, location, and percent cover.

- **Drainage study** information including, at a minimum, existing and post-construction descriptions of impervious area and percentages, rainfall intensities, geotechnical conditions regarding any planned uses of infiltration techniques (slope stability, expansive soils, compressive soils, seepage, groundwater depth, loss of foundation or pavement sub-grade strength), site constraints (impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, high-intensity land use, vehicular traffic, restricted right-of-way, or safety concerns), flow rates, velocities, and/or durations for a peak rainfall intensity of 0.4 inches per hour and Water Quality Volume of one (1) inch. The drainage study must also include an analysis of proposed post-construction LID Site Design Strategies, Source Control, and/or Treatment Control BMPs to mitigate (downstream) impacts and attempt to maintain or improve pre-project hydrologic conditions.

3.3 Post-Construction Stormwater BMP Selection

Post-construction BMPs shall be considered during the planning and design phases of a project. Each applicable project shall provide an account of how each drainage area's runoff is managed and treated. The entire project area can be divided into individual/discrete Drainage Areas [DA].

Post-construction BMPs include LID Site Design Strategies, Source Control, and Treatment Control BMPs.

Table 3-2
Post-Construction Best Management Practices

Element		Description
LID Site Design Strategies		Reducing the hydrologic impact of development and incorporating techniques that maintain or restore the site's hydrologic and hydraulic functions.
Source Control		Preventing pollutants from coming into contact with runoff and preventing polluted runoff from discharging into small MS4.
Treatment Control	LID Retention	Retaining runoff on-site with no off-site discharge by infiltration, evapotranspiration, and harvesting/reuse.
	LID Biofiltration	Removing pollutants from runoff by filtering stormwater through vegetation and soils.
	Other Treatment	Removing pollutants from runoff by detention, settling, filtration, and vortex separation.

To comply with this manual and be consistent with the ***CCH Rules Relating to Water Quality***, the following criteria shall be met for all Regulated Projects where applicable:

1. Incorporate appropriate LID Site Design Strategies - Either retain the developing site Water Quality Volume with appropriate ID Retention Treatment Control BMPs, or biofilter the Water Quality Volume with appropriate LID Biofiltration Treatment Control BMPs, or a combination of the two, unless determined to be infeasible due to infiltration issues.
2. Incorporate appropriate Source Control BMPs.
3. If it is determined to be infeasible to retain and/or biofilter the Water Quality Volume then treat and discharge with appropriate Treatment Control BMPs any portion of the water that is not retained on-site or biofiltered using the CCH guidance in § 20-3-58 of the ***Rules Relating to Water Quality*** (CCH, 2018), unless a waiver is granted based on the infeasibility of all Treatment Control BMPs.

Consistent with the ***CCH Storm Water BMP Guide*** and based on collected precipitation data, **1 inch (or 1.5 inches) is the depth for all volume-based BMPs and a peak rainfall intensity of 0.4 inches per hour shall be used for flow-based BMPs.** A flow chart summarizing the BMP selection process is provided in Figure 3-2 below.

LID Retention BMPs rely on the soil's ability to infiltrate stormwater runoff. Due to its proximity to ocean water, groundwater underneath Harbors property is relatively shallow and tidally influenced. Therefore, it is recognized that LID Retention BMPs may prove infeasible for majority of Regulated Projects. However, broader LID Site Design Strategies must be considered. For a

detailed discussion on infiltration requirements, please refer to General Infiltration Requirements outlined in Section 3 of ***CCH Storm Water BMP Guide***.

Selection of Treatment Control BMPs must prioritize and maximize the removal of pollutants of potential concern. Treatment Control BMP design must also consider any impacts caused by tidal influence, which is particularly relevant to subsurface filtration systems, hydrodynamic separator systems, detention or infiltration basins, and wet ponds/wetlands.

Figure 3-2
BMP Selection Process for Pollutants of Potential Concern

Implement LID Site Design Strategies

- Conserve natural areas, soils and vegetation – retain functions of predevelopment hydrology, including rainfall interception, evapotranspiration, and infiltration and therefore reduce runoff.
- Minimize disturbances to natural drainages and optimize the site layout – preserve natural drainage features and design buildings and circulation to minimize roofs and paving.
- Minimize Soil Compaction – retain existing beneficial hydrologic function.
- Minimize Impervious Surface – allow natural processes to filter and reduce non-point sources of pollution.
- Direct runoff to landscaped areas and reduce directly connected impervious surfaces – move runoff from impervious surfaces on to adjacent pervious surfaces (e.g., direct a roof downspout to disperse runoff onto a lawn).

⇩

Implement Source Control BMPs at these Areas

- Landscaped areas
- Automatic irrigation
- Storm drain inlets (stenciling and signage)
- Vehicle/equipment fueling
- Vehicle/equipment maintenance/repair
- Vehicle/equipment washing/cleaning
- Loading docks
- Outdoor trash storage
- Outdoor material storage
- Outdoor work areas
- Outdoor process equipment operations
- Parking areas

⇩

Implement Treatment Control BMPs that Maximize Removal of Pollutant(s) of Potential Concern

Considering Numeric Sizing Criteria and General Infiltration Requirements for:

Retention BMPs	Biofiltration BMPs	Alternative Compliance BMPs
• Infiltration basin/trench • Subsurface infiltration system • Dry well • Bioretention basin • Permeable pavement • Harvest/Reuse	• Green roof • Vegetated bio-filter • Dry Swale • Vegetated swale • Vegetated buffer strip	• Manufactured treatment device • Detention basin • Sand filter

3.4 Feasibility Criteria and Limitations

Different treatment control BMPs have their own limitations. This section is focused on the discussion of their feasibility criteria and limitations.

3.4.1 Infiltration BMPs

Infiltration BMPs are considered infeasible and must not be used if any of the following conditions are met:

1) Soil beneath the BMP invert have measured infiltration rates of less than 0.5 inch/hour or are United States Department of Agriculture [USDA] Hydrologic Soil Group [HSG] “C” or “D” as reported by the USDA NRCS;
2) The seasonally high groundwater table is within 3 feet from the BMP invert;
3) There is a documented concern that there is a potential onsite for soil pollutants, groundwater pollutants, or pollutants associated with industrial activities to be mobilized;
4) There are geotechnical concerns at the site;
5) Excavation for the installation of the BMP would disturb any archeological resources;
6) The BMP cannot be built within the following setbacks:
    a. 50 feet from the nearest drinking water wells;
    b. 35 feet from the nearest septic system;
    c. 10 feet from the nearest private property line;
    d. 20 feet from the nearest building foundation at the project site;
    e. 100 feet from the nearest down-gradient building foundation; or
7) Infiltration facilities would conflict with the location of existing or proposed underground utilities or easements, or would result in their placement on top of underground utilities, or otherwise oriented to underground utilities, such that they would discharge to the utility trench, restrict access, or cause stability concerns.

3.4.2 Harvest/Reuse

Harvest/Reuse is considered infeasible for any of the following reasons:

1) The demand is inadequate to reuse the required volume of water;
2) The technical requirements cause the harvesting system to exceed 2 percent of the total project cost;
3) The site where a cistern must be located is at a slope greater than 10 percent;
4) There is no available space to locate a cistern of adequate size to harvest and use the required amount of water;
5) The cistern cannot be built within the following setbacks:
    a. 10 feet from the nearest septic system;
    b. 5 feet from the nearest private property line;
    c. 5 feet from the nearest building foundation at the project site; or

6) The project includes a reclaimed water system and demand for a harvest/reuse system cannot be met.

3.4.3 Vegetated Biofilters

Vegetated biofilters are infeasible for any of the following reasons:

1) Excavation would disturb any archaeological resources;
2) The invert of underdrain layer is below seasonally high groundwater table;
3) The site does not receive enough sunlight to support vegetation;
4) The site lacks sufficient hydraulic head to support BMP operation by gravity; or
5) Unable to operate off-line with bypass and unable to operate in line with safe overflow mechanism;

3.4.4 Green Roof

Green roofs are infeasible for any of the following reasons:

1) Roof space is unavailable dur to renewable energy, electrical, and/or mechanical systems; or
2) Slope on roof exceeds 25 percent (14 degrees)

3.4.5 Dry Swales

Dry swales are infeasible for any of the following reasons:

1) Excavation would disturb any archaeological resources;
2) The invert of underdrain layer is below seasonally high groundwater table;
3) The site lacks sufficient hydraulic head to support BMP operation by gravity; or
4) Unable to operate off-line with bypass and unable to operate in-line with safe overflow mechanism.

3.4.6 Vegetated Swales or Vegetated Filter Strips

Vegetated swales are infeasible for any of the following reasons:

1) The excavation would disturb any archaeological resources;
2) The site does not receive enough sunlight to support vegetation; or
3) Unable to operate off-line with bypass and unable to operate in-line with safe overflow mechanism.

3.5 Post-Construction Stormwater Mitigation Plan Development

In order to ensure that a PSMP is adequately designed and integrated into each Regulated Project, project proponents are required to prepare a PSMP by a licensed civil engineer, registered in State of Hawaii. In general, the PSMP must clearly convey the process used to identify pollutants of potential concern, conditions of concern, selected BMPs for the project as well as identifying BMP long-term maintenance requirements. The fundamental components in preparation of PSMP are provided in Table 3-3. The CCH Storm Water BMP Guide provides a more complete list of LID Site Design Strategies, Source Control BMPs, and Treatment Control BMPs and must be utilized by project proponents. Additionally, project proponents must comply with all applicable requirements by Harbors **Post-Construction Stormwater Management Program** and not rely solely on the outline in Table 3-3.

PSMPs must contain a table of contents to assist reviewers in finding required parts of the document. PSMPs must contain a vicinity map (in scale) containing major roadways, geographic features or landmarks, the project site perimeter, general topography, downstream receiving water body, and north arrow. In addition, PSMPs must also contain a site map (including the entire property on one map or using a key map if multiple sheets are required), scale, north arrow, and legend, impervious features (including location of proposed impervious areas such as paved areas, buildings, covered areas, etc.), potential pollutant source areas (such as fueling area, garage, outdoor storage area, waste container area, wash-rack, potentially hazardous substance storage area). PSMP should contain the information specified in Table 3-3.

Table 3-3
Fundamental Components of a Post-Construction Stormwater Mitigation Plan for Regulated Project

Major Components	Descriptions
Organization & Content	• Table of contents • Vicinity map • Project description • Narrative of project activities
Site Map	• Entire property included on one map (use key map if multi-sheets) • Drainage areas and direction of stormwater flow • Private storm drain system(s) • Nearby water bodies and other municipal storm drain inlets • Location of stormwater conveyance systems (ditches, inlets, storm drains, etc.) • Location of existing and proposed stormwater controls • Location of “impervious” areas (i.e., paved areas, buildings, and covered areas) • Locations where materials would be directly exposed to stormwater

Major Components	Descriptions
	• Location of building and activity areas (e.g., fueling area, garages, waste container area, wash racks, potential hazardous substance storage areas, etc.) • Areas of potential soil erosion (including areas downstream of project)
Pollutants of Potential Concern	• Pollutants based upon land use • Impaired water bodies downstream of the project
Drainage Study and Conditions of Concern*	• Site-specific drainage analysis indicating pre- and post-development runoff calculations. • Impacts to hydrologic regime (hydromodification evaluation, as applicable)
Types of Post-Construction BMPs*	*LID and Site Design BMP Examples* • Conserve natural areas, soils, and vegetation • Minimize impervious surface • Direct runoff to landscaped areas *Source Control BMP Examples* • Covered trash storage • Covered and bermed vehicle wash areas *Treatment Control BMP Examples* • Subsurface infiltration • Manufactured treatment device
Post-Construction BMP Maintenance	• O&M Plan • Access Agreement

* Refer to ***CCH Rules Relating to Water Quality*** and ***CCH Storm Water BMP Guide***

3.5.1 Introduction of Low Impact Development

LID is a stormwater management strategy concerned with maintaining or restoring the natural hydrologic functions of a site to achieve natural resource protection objectives and fulfill environmental regulatory requirements (CCH, 2017). It utilizes a variety of natural and built features that reduce the rate of runoff, filter out pollutants, and facilitate the infiltration of water into the ground. By reducing water pollution and increasing groundwater recharge, it helps sustain the quality of receiving waters and stabilize the flow rates of nearby surface waters. The goal of LID site design is to reduce the hydrologic impact of development and to incorporate techniques that maintain or restore the site's hydrologic and hydraulic functions. The optimal LID site design minimizes runoff volume and preserves existing flow paths.

LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater **as a resource rather than a waste product**. Many practices have been used to adhere to these principles such as bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements. By implementing LID principles and practices, water can be managed in

a way that reduces the impact of developed areas and promotes the natural movement of water within an ecosystem or watershed. The Harbors approach will consist of specific elements that are represented in Table 3-3.

3.5.2 LID Site Design Strategies

Consideration of LID Site Design Strategies are required for each Regulated Project. A Regulated Project shall be designed to minimize directly connected impervious surfaces and to promote infiltration using LID techniques. A Regulated Project shall minimize the introduction of POPCs generated from site runoff to the stormwater conveyance system. A Regulated Project can address these objectives through the creation of a hydrologically functional project design that attempts to mimic the natural hydrologic regime. These techniques are outlined in Section 3.2 of ***CCH Storm Water BMP Guide*** (Appendix C; CCH 2017).

Mimicking a site's natural hydrologic regime can be pursued by:

- Reducing imperviousness, conserving natural resources and areas, maintaining and using natural drainage courses in the stormwater conveyance system, and minimizing clearing and grading.
- Providing runoff storage measures dispersed throughout a site's landscape with the use of bioretention facilities and detention, retention, and infiltration practices.
- Implementing on-lot hydrologically functional landscape design and management practices.

These design principles offer an innovative approach to urban stormwater management, one that does not rely on the conventional end-of-pipe or in-the-pipe structural methods but instead uniformly or strategically integrates stormwater controls throughout the urban landscape.

The following five LID components, taken from ***CCH Storm Water BMP Guide***, must be considered for each Regulated Project.

Conserve Natural Areas, Soils, and Vegetation

This design strategy helps retain numerous functions of predevelopment hydrology, including rainfall interception, evapotranspiration, and infiltration. Maximizing these functions will thereby reduce the amount of runoff that must be treated. Protection of mature trees and vegetation provides habitat, prevents erosion, captures significant rainfall, provides summer shading, and reduces runoff volume and velocity, which protects and enhances downstream water quality.

Minimize Disturbances to Natural Drainages

Natural drainages offer a benefit to stormwater management as the soils and habitat already function as a natural filtering/infiltrating swale. Minimizing disturbances to natural drainage patterns preserves the predevelopment timing, rate, and duration of runoff as well as

preserving streamside habitats. When determining the development footprint of the site, natural drainages should be avoided. By keeping the development envelope set back from natural drainages, the drainage can retain its water quality benefit to the watershed.

Minimize Soil Compaction

Clearing, grading, and compaction by construction traffic reduces the natural absorption and infiltration capacities of the native soils. Soil compaction damages soil structure, reduces infiltration rates, limits root growth and plant survivability, and destroys soil organisms. Subsequent tilling and/or addition of soil amendments such as compost can help, but may not restore the original infiltration capacity of the soils. By protecting native soils and vegetation in appropriate areas during the clearing and grading phase of development, the site can retain some of its existing beneficial hydrologic function.

Direct Runoff to Landscaped Areas and Reduce Directly Connected Impervious Areas

Any impervious surface that drains into a catch basin, area drain, or other conveyance structure is a "directly connected impervious area." As stormwater runoff flows across parking lots, roadways, and paved areas, the oil, sediment, metals, and other pollutants are collected and concentrated. If this runoff is collected by a drainage system and carried directly along impervious gutters or in closed underground pipes, it has no opportunity for filtering by plant material or infiltration into the soil. It also increases in speed and volume, which may cause higher peak flows downstream, and may require larger capacity storm drain systems, increasing flood and erosion potential. Solutions that reduce "directly connected impervious areas" prevent runoff, detain or retain surface water, attenuate peak runoff rates, benefit water quality and convey stormwater.

Minimize Impervious Surfaces

The increased volume, increased velocity, and discharge duration of stormwater runoff from developed areas has the potential to accelerate downstream erosion and impair stream habitat in natural drainages. Studies have demonstrated a direct correlation between the degree of imperviousness of an area and the degradation of its receiving waters. Impervious surfaces (such as pavement and concrete) can neither absorb water nor remove pollutants, and thus the natural purification characteristics are lost. Reducing impervious surfaces to the minimum amount needed retains the permeability of the project site, allowing natural processes to filter and reduce non-point sources of pollution.

3.5.3 Source Control BMPs

Source control BMPs are required for each Regulated Project. Proactively controlling POPC at their source is fundamental to effective stormwater quality management. Design of BMPs to minimize or prevent pollutant generation is guided by two general principles:

- Prevent stormwater from contacting operation and storage areas. These areas should be designed to prevent stormwater runoff from passing through shipping areas, vehicle

maintenance yards, and other work places before it reaches storm drains. The objective is to prevent the discharge of water laden with grease, oil, heavy metals and process fluids to surface waters or sensitive resource areas.

- Prevent pollutants from contacting surfaces that mingle with stormwater runoff. Precautionary measures should be employed to keep POPC from coming into contact with storm or wash water runoff.

In preparation of PSMP, following items need to be provided:

- All potential sources of stormwater pollutants that can be potentially generated at the site.
- Corresponding post-construction BMPs that need to be shown on the site map included in the PSMP.
- A brief narrative description of the source control BMPs to be used including a discussion of the project applicant will ensure their continued operation.

Justification of why a particular source control could not be implemented for this project because of any special condition or situation, shall also be provided. Fact Sheets for applicable source control BMPs may be obtained from Appendix A of the ***CCH Storm Water BMP Guide*** (CCH, 2017) and/or the ***California Stormwater Quality Association [CASQA] Stormwater Quality Handbooks*** (CA, 2003). Descriptions of each Source Control Category (taken from **CCH *Storm Water BMP Guide***) are summarized in Table 3-4.

Table 3-4
List of Source Control Categories
(taken from CCH Storm Water BMP Guide)

Source Control Category	General Description/Approach
Landscaped Areas	Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the maximum extent possible, maximize natural water storage and infiltration opportunities, and minimized project slopes and channels.
Automatic Irrigation Systems	Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into storm water drainage systems. Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the storm water conveyance system.
Storm Drain Inlets	Storm drain signs and stencils are highly visible source controls that are placed directly adjacent to storm drain inlets. The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system.

Source Control Category	General Description/Approach
	Stencils and signs alert the public to the destination of pollutants discharged to the storm drain.
Vehicle/Equipment Fueling	Fueling areas have the potential to discharge oil and grease, solvents, car battery acid, coolant and gasoline to the storm drain. Spills can be a significant source of pollution because fuels contain toxic materials and heavy metals that are not easily removed by storm water treatment devices.
Vehicle/Equipment Repair	Several measures can be taken to prevent operations at maintenance bays from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the storm water conveyance system. In designs for maintenance bays containment is encouraged. Preventive measures include overflow containment structures are dead-end sumps.
Vehicle/Equipment Washing & Cleaning	Vehicle/equipment washing, and steam cleaning may contribute high concentrations of pollutants to wash waters that drain to storm water conveyance systems. Wash water may not be conveyed to a sewer without a sewer connection permit.
Loading Docks	Several measures can be taken to prevent operations at loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the storm water conveyance system. In designs for loading docks, containment is encouraged. Preventive measures include overflow containment structures and dead-end sumps.
Outdoor Trash Storage	Storm water runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or streams. Preventive measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.
Outdoor Material Storage	Proper design of outdoor storage areas for materials reduces opportunity for pollutants to enter the storm water conveyance system. Materials may be in the form of raw products, by-products, finished products, and waste products. In outdoor storage areas, containment is encouraged.
Outdoor Work Areas	Proper design of outdoor work areas (such as grinding, painting, coating, sanding, parts cleaning, etc.) reduces opportunity for pollutants to enter the storm water conveyance system. In outdoor work areas, infiltration and discharge to the storm drain are

Source Control Category	General Description/Approach
	discouraged; collection and conveyance to the sanitary sewer are encouraged.
Outdoor Process Equipment Operation	Outdoor process equipment operations such as rock grinding or crushing, painting or coating, grinding or sanding, degreasing or parts cleaning, may contribute a variety of pollutants to the storm conveyance system. In outdoor process equipment areas, containment is encouraged, accompanied by collection and conveyance.
Parking Areas	Parking lots and storage areas can contribute polluting substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through storm water runoff or non-storm water discharge. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas.

3.5.4 Treatment Control BMPs

When a site cannot retain all or portion of the Water Quality Volume on-site, the remaining portions of the water must be treated using Treatment Control BMPs specified in §20-3-58 of the ***CCH Rules Relating to Water Quality*** (Appendix D; CCH, 2018). Treatment Control BMPs are engineered technologies designed to remove pollutants from storm water runoff prior to being discharged to the storm drain system or receiving waters. Details on BMP numeric sizing criteria and general requirements for infiltration BMPs are further discussed in Section 3.5.5. Individual fact sheets for various treatment control BMPs may be found in Appendix B of the ***CCH Storm Water BMP Guide*** (Appendix C; CCH, 2017) and/or ***CASQA Stormwater Quality Handbooks***.

Engineering details and specifications shall be included in the PSMP for the selected Treatment Control BMPs. Alternative post-construction BMPs not identified in the ***CCH Storm Water BMP Guide*** may be acceptable at the discretion of the Harbors, provided the alternative BMP is as effective in removal of pollutants of concern as other feasible BMPs.

3.5.5 Numeric Sizing Criteria

This section presents the methodology for calculating the Water Quality Volume [WQV] and Water Quality Flow Rate [WQF], which are used to size the majority of the Treatment Control BMPs.

Water Quality Volume

The *WQV* is calculated using this equation: *WQV = PCA x 3630*, where:

WQV = water quality design volume (in cubic feet)

P = design storm runoff depth (in inches)
C = volumetric runoff coefficient
A = total drainage area (in acres)

As specified in the CCH's Rules (CCH, 2018), a design storm runoff depth of **1 inch** shall be used for LID retention BMPs. A design storm runoff depth of **1.5 inches** shall be used for volume-based Biofiltration and Alternative Compliance BMPs. The volumetric runoff coefficient shall be calculated using the following equation as developed by USEPA for smaller storms in urban areas: $C = 0.05 + 0.009I$, where:

C = volumetric runoff coefficient
I = percent of impervious cover (expressed as a percentage)

Water Quality Flow Rate

The *WQF* is calculated using this equation: $WQF = 1.5 \times CiA$, where:

WQF = water quality design flow rate (in cubic feet per second)
C = volumetric runoff coefficient
i = peak rainfall intensity (in inches per hour)
A = total drainage area (in acres)

As specified in the CCH's Rules (CCH, 2018), a peak rainfall intensity of **0.4 inches per hour** shall be used. The runoff coefficient shall be determined from Table 3-5 below, based on the drainage area, and shall be, at a minimum, the midpoint of the given range of values. The higher value should be used if soil conditions indicate that pervious areas will have little infiltration/interception potential. For drainage areas containing multiple land uses, the following formula may be used to compute a composite weighted runoff coefficient:

$C_C = (\sum_{i=1}^{n} C_i A_i)/A_t$, where:

C_c = composite weighted runoff coefficient
$C_{1,2,\ldots,n}$ = runoff coefficient for each land use cover type
$A_{1,2,\ldots,n}$ = drainage area of each land use cover type (in acres)
A_t = total drainage area (in acres)

Drainage Areas

The entire area of applicable project shall be divided into individual, discrete DAs and clearly presented in a site map. DAs may be defined using grade breaks and roof ridge lines. Separate DAs shall be used for each surface type (e.g., landscaping, pervious paving, or roofs). Each type of DA surface has a unique runoff factor that estimates how much rainfall will produce effective rainfall, or runoff from that drainage area. A list of runoff coefficient for surfaces draining to BMPs is included in Table 3-5 of this manual and Subchapter 7 §20-3-58 of the ***CCH Rules Relating to Water Quality*** (CCH, 2018; Appendix D).

Table 3-5
Runoff Coefficients for Water Quality Flow Calculations

Type of Surface	Runoff Coefficient (*C*)	Type of Surface	Runoff Coefficient (*C*)
Roof	0.90	Gravel over Porous Plastic	0.05
Concrete	0.80	Pervious Concrete	0.10
Stone, brick, or concrete pavers with mortared joints and bedding	0.80	Stone, brick, or concrete pavers with sand joints and bedding	0.70
Asphalt	0.70	Porous asphalt	0.10
Permeable interlocking concrete pavement	0.10	Grid pavements with grass or aggregate surface	0.10
Grass	0.10	Grass over Porous Plastic	0.05
Crushed aggregate	0.10		

Note: These runoff coefficients are only appropriate for small storm treatment design and should not be used for flood control sizing.

4.0 POST-CONSTRUCTION BMP INSTALLATION

4.1 Installation Inspection during Construction Phase

Inspections will be conducted at multiple stages of construction to ensure the proper installation of all LID Site Design Strategies, Source and Treatment Control BMPs. For Harbors Projects, these inspections shall coincide with the site-specific construction site BMP inspections described in Sections 3.4.1 to 3.4.3 of Harbors ***Construction Site Runoff Control Program*** manual. For Tenant projects, these inspections shall coincide with the site-specific construction site BMP inspections described in Sections 4.4.1 to 4.4.3 of Harbors ***Construction Site Runoff Control Program*** manual. In either case, inspections shall include:

- Initial BMP Inspection prior to commencement of construction;
- Recurring BMP Inspection during active construction to ensure selected post-construction BMP is installed in accordance with accepted plan; and
- Final BMP Inspection upon completion of construction to ensure proper installation and maintainability.

The BMP inspections may be combined with other inspections provided that they will be conducted by trained personnel, as identified in Section 7. The findings from these inspections will be recorded on the *Construction Site Best Management Practices Inspection Checklist* contained in Attachment 4 of the ***Construction Site Runoff Control Program*** (or its equivalent form in AMS). Each inspection will be reported in the Annual Compliance Report [ACR] and shall be clearly linked to the referenced project and note the stage of the project and the dates of inspections.

5.0 POST-CONSTRUCTION BMP MAINTENANCE, INVENTORY AND RECORDKEEPING

Once built, post-construction stormwater BMPs must be properly maintained to make sure they are operating as designed and intended.

- For Harbors project, O&M will be conducted by Oahu District following the plan that was submitted and approved as part of the project review and approval process.
- For Tenant projects, O&M and inspection requirements are documented in an O&M plan that must be submitted to the Harbors prior to completion of construction. All O&M activities will be the responsibility of the tenant and shall be conducted following the O&M plan that was submitted and approved as part of the project review process and recorded with the lease, revocable permit, or other contractual document provisions. The tenant O&M plan shall be consistent with the requirements in Section 5.1 below.

Harbors will verify that appropriate mechanisms, including O&M plans, are in-place for all projects under Harbors jurisdiction that have post-construction BMPs. Maintenance requirements identified below are required by Harbors **Post-Construction Stormwater Management Program**.

5.1 Maintenance Requirements

Operation & Maintenance Plan:

For a Regulated Project, Harbors will require that a copy of a satisfactory O&M plan, monitoring plan where applicable (for example, a sample O&M and Inspection Checklist for a CDS unit is enclosed in Appendix E), and a process for ongoing maintenance verification of installed controls be included in the design submittal package. The O&M Plan must contain the following major components:

- The designated responsible party to manage the post-construction stormwater BMP(s).
- Post-Construction operating schedule, maintenance frequency, specific maintenance activities.
- Any necessary employee training and duties.
- Recordkeeping and reporting on inspecting and servicing of all post-construction BMPs (on source/treatment control) at least annually, which are documented using the form(s) in the O&M plan.

Access Agreement: The Harbors maintains rights to access tenant properties as part of lease or revocable permit provisions. These rights extend to any access required related to post-construction BMPs. An example of the access agreement is included in Attachment 2 of Harbors ***Tenant Inspection Manual*** (HDOTb, 2021).

5.2 Verification Mechanisms

Annual O&M record of each approved post-construction BMP by the responsible party (e.g., contractor, consultant, or tenant) is required to be submitted to the Harbors.

- For Harbors Projects, HAR-E will verify that post-construction BMPs reflected in the approved PSMP be implemented at the completion of construction. District office will be responsible for long-term O&M of post-construction BMPs and related recordkeeping. Records will be reported in the ACR.
- For Tenant Project, HAR-EE and HAR-PM will verify that post-construction BMPs in the approved PSMP be implemented at the completion of construction. The tenant will be responsible for long-term O&M of post-construction BMPs by conducting routine inspections, documenting all maintenance requirements, submitting annual reports (to Harbors), and retaining records for at least three years. These documents shall be made available to the Harbors for inspection upon request at any time.

5.3 Post-Construction BMP Inspection

To ensure that post-construction stormwater BMPs are being operated and maintained in accordance with the approved O&M plan, all LID Site Design, Source and Treatment Control BMPs in the O&M plan will be inspected no less than once a year. Additionally, some BMPs may be inspected more frequently as recommended in ***CCH Storm Water BMP Guide*** (CCH, 2017; Appendix C) or manufacturer's manual. When possible, inspections shall occur after a storm event to allow an evaluation of the BMP's effectiveness, identification of any damage that may have occurred, and a determination if any additional maintenance may be required. Specifically, O&M inspections shall be performed and documented as following:

- For Harbors Projects, Oahu District will inspect the post-construction stormwater BMPs as specified in the O&M plan but no less than annually.
- For Tenant Projects, the tenant is to conduct inspections per the approved O&M plan and submit an annual report to Harbors when specified in the lease agreement and revocable permit. HAR-EE inspectors will check the post-construction BMP O&M records at a frequency determined by Harbors ***Tenant Inspection Program*** (i.e., every six months, annually, or every five years).
- Inspection should be documented using the Inspection Checklist included as part of the O&M plan. Relevant records will be retained in the AMS. All deficiencies noted during the inspections shall be conveyed to the responsible party and HAR-EE will conduct timely follow-up to ensure deficiencies are rectified.

5.4 Post-Construction BMP Inventory and Recordkeeping

Harbors has been utilizing the AMS to keep track of approved post-construction BMPs (i.e., LID Site Design Strategies, Source Control, and Treatment Control BMPs) and the related O&M,

which serves as the basis for the maintenance, inspection, enforcement, and reporting elements of the program. This inventory includes the BMPs for Harbors project(s) and Tenants project(s) (subject to Lease Agreement and Revocable Permit) that discharge into the Honolulu and Kalaeloa Barbers Point Harbors Small Municipal Separate Storm Sewer Systems [MS4s].

All known post-construction BMPs at Honolulu and Kalaeloa Barbers Point Harbors have been logged into the electronic inventory. All new post-construction BMPs, as reflected in the approved PSMP will be added to the AMS following construction project acceptance. The construction project review, submittal requirements, and procedures, detailed in Section 4.3 of the ***Construction Site Runoff Control Program***, provide information about the new post-construction BMPs. General site information includes:

- Project Identifier, Owner Information
- Project Location (Harbor, Pier Number, Tax Map Key Number, Latitude/Longitude coordinates)
- Acreage
- Control Type and Description of post-construction BMPs
- Photographs of BMPs during construction (if available) and at acceptance
- Date of Acceptance/Construction
- Date of Agreement
- O&M plan
- Maintenance Records
- Inspection Dates and Summary
- Corrective Actions
- Replacement or Repair Date

6.0 ENFORCEMENT

A detailed discussion on enforcement is presented in the Harbors **Enforcement Response Plan** (HDOT, 2020). Enforcement of tenant construction projects will be undertaken by the HAR-EE, HAR-PM, and/or other staff who possess enforcement authority through established policies and procedures as described in Harbors Enforcement Response Plan. There are several enforcement mechanisms and penalties to ensure compliance with local ordinances, permits, and contract documents. The enforcement actions proceed along different routes depending upon whether the project is a Harbors Project or a Tenant Project.

When post-construction stormwater BMP inspections reveal improper installation or maintenance, Harbors will undertake appropriate enforcement action. The level of enforcement (summarized in Section 6.2) and associated penalty are typically issued by designated personnel after considering all relevant circumstances regarding the violation. Records of all inspections and follow-up activities for deficiencies are to be retained for a minimum of five years.

6.1 Scope of Authority

The enforcement options available to Harbors range from administrative actions (including verbal/written warnings) to the termination of agreements, such as leases, revocable permits, and construction contracts. In addition to applicable federal, state, and county laws, rules, and regulations, Harbors regulatory and enforcement authority is found in:

- Hawaii Revised Statutes [HRS] Chapter 266 authorizes Harbors to issue citations and summons for violations of its rules and have its actions enforced through the district courts by verdict of a misdemeanor or fine.
- Hawaii Administrative Rules [HAR] Title 19 Chapters 41 to 44 establishes uniform safety measures, operational standards and requirements, and the conduct for all tenants at State of Hawaii harbors.
- The construction contracts that provide Harbors with the right of entry to conduct inspections and authority to issue a Stop Work Order [SWO] and/or withhold Contractor payments.
- The tenant lease agreement, revocable permit, or other occupancy agreements that provides Harbors with the right of entry to conduct inspection and authority to terminate the agreements, through the processes, as applicable, identified in HRS Title 12 Chapter 171 and Title 15 Chapter 266, and HAR Title 19 (Chapters 41 through 44).

6.2 Enforcement Actions

The levels of enforcement actions to be utilized, in order of increasing severity, are as follows:

- Oral or Verbal Warning
- Written Warning (e.g., Tenant Inspection Report or Letter with Tenant Inspection Report)

- Notice of Apparent Violation [NAV]
- Notice and Finding of Violation Order [NFVO]
- Stop Work Order
- Assessment of Environmental Liquidated damages [ELD]
- Cost of Labor and Materials [L&M]
- Withholding of Payments
- Termination of Agreements

Detailed discussion of these enforcement actions could be found in the Harbors **Enforcement Response Plan** (HDOT, 2020).

There are two types of violations – Class I Violation and Class II Violation, which are based on potential to discharge or cause environmental harm, magnitude of the violation (e.g., failure to apply for Industrial General Permit Coverage), duration of the violation, and violator's compliance history. A range of issues, which could result in enforcement (either informal or formal) in terms of post-construction BMP, includes:

- Failure to maintain a BMP specified in the submitted PSMP,
- Failure to maintain a BMP consistent with O&M Plan,
- Failure to address deficiencies,
- Failure to conduct annual inspection,
- Failure to submit required inspection documentation.

In the event that an enforcement action is required, the designated staff will identify the appropriate enforcement response to achieve compliance. If the violator cannot achieve compliance by implementing the appropriate corrective action, the designated staff will "escalate" the enforcement response as outlined in Harbors **Enforcement Response Plan**.

7.0 TRAINING

Training is a vital component of any successful stormwater program. Harbors will adopt ***CCH Rules Relating to Water Quality*** and ***CCH Storm Water BMP Guide*** as a reference for those parties who apply for project approvals on selection, design, installation, O&M of stormwater BMPs via the state website and handouts.

Harbors provides training so that employees have the knowledge and skills necessary to perform their functions effectively and efficiently. Related training courses provide a comprehensive review of post-construction stormwater BMPs, introduce LID practices, and provide updates on the relevant requirements of the Harbors SWMP.

Appropriate Harbors staff whose primary job duties are related to implementing post-construction BMPs will be trained to have a clear understanding of their responsibilities. The post-construction BMPs training will consist of overall program goals and implementation. The content of the training will include:

- Post-Construction Technical Standards and use of the *Post-Construction BMP Checklist* including the existing and ***CCH Rules Relating to Water Quality*** and ***CCH Storm Water BMP Guide***
- Content and Requirements of PSMP and O&M Plans
- Inspection Procedures
- Implementing the Enforcement Response Plan
- Recordkeeping

Annual Training for Designers, Plans Reviewers, Inspectors, Construction managers, and Contractors

This training course for HAR-E engineers and available to other Harbors employees and consulting engineers, construction consulting professionals, and contractors will cover planning and design considerations for the proper selection, design, installation, operation, and maintenance of post-construction stormwater BMPs. It also includes an introduction to LID stormwater management practices.

Training for Operations and Maintenance

This course for Oahu District and available to other Harbors employees, will cover proper O&M of post-construction BMPs owned and operated by Harbors.

Training effectiveness will be evaluated through a survey of the participants. All participants will be required to sign in. Feedback from the survey will be collected and evaluated and used for the development of future training session. Relevant training records will be included in the ACR.

8.0 REFERENCES

CA, 2003a, *California Stormwater BMP Handbooks* – Industrial and Commercial): State of California, January 2003.

CA, 2003b, California Stormwater BMP Handbooks – New Development and Redevelopment: State of California, January 2003.

CCH, 2011, *Best Management Practices Manual for Construction Sites in Honolulu*: City and County of Honolulu, Department of Environmental Services, November 2011.

CCH, 2017, *Stormwater BMP Guide for New and Redevelopment*: City and County of Honolulu, Department of Planning and Permitting, July 2017.

CCH, 2018, *Rules Relating to Water Quality*: City and County of Honolulu, Department of Facility Maintenance, December 24, 2018.

CSD, 2007, *Low Impact Development Handbook – Stormwater Management Strategies*: County of San Diego, Department of Planning and Land Use, December 31, 2007.

Edward, 2001, Honolulu International Airport Stormwater Pollution Control Plan and Related Stormwater Management Program Components: Edward K. Noda and Associates, Inc. November 2001.

HDOH, 2014, *Hawaii Administrative Rules, Chapters 11-54*: State of Hawaii, Department of Health. November 2014.

HDOH, 2019, *Hawaii Administrative Rules, Chapters 11- 55 Appendix B*: State of Hawaii, Department of Health. February 2019.

HDOH, 2020, *2020 State of Hawaii Water Quality Monitoring and Assessment Report*: Integrated Report to the U.S. Environmental Protection Agency and the U.S. Congress Pursuant to §303(d) and §305(b), Clean Water Act (P.L.97-117), State of Hawaii, Department of Health, June 30, 2020.

HDOT, 2020, *Enforcement Response Plan,* State of Hawaii, Department of Transportation, Harbors Division, April 2020.

HDOTa, 2021, *Construction Site Runoff Control Program*, Version 11.0: State of Hawaii, Department of Transportation, Harbors Division, September 2021.

HDOTb, 2021, *Tenant Inspection Manual, Version 10.0*: State of Hawaii, Department of Transportation, Harbors Division, September 2021.

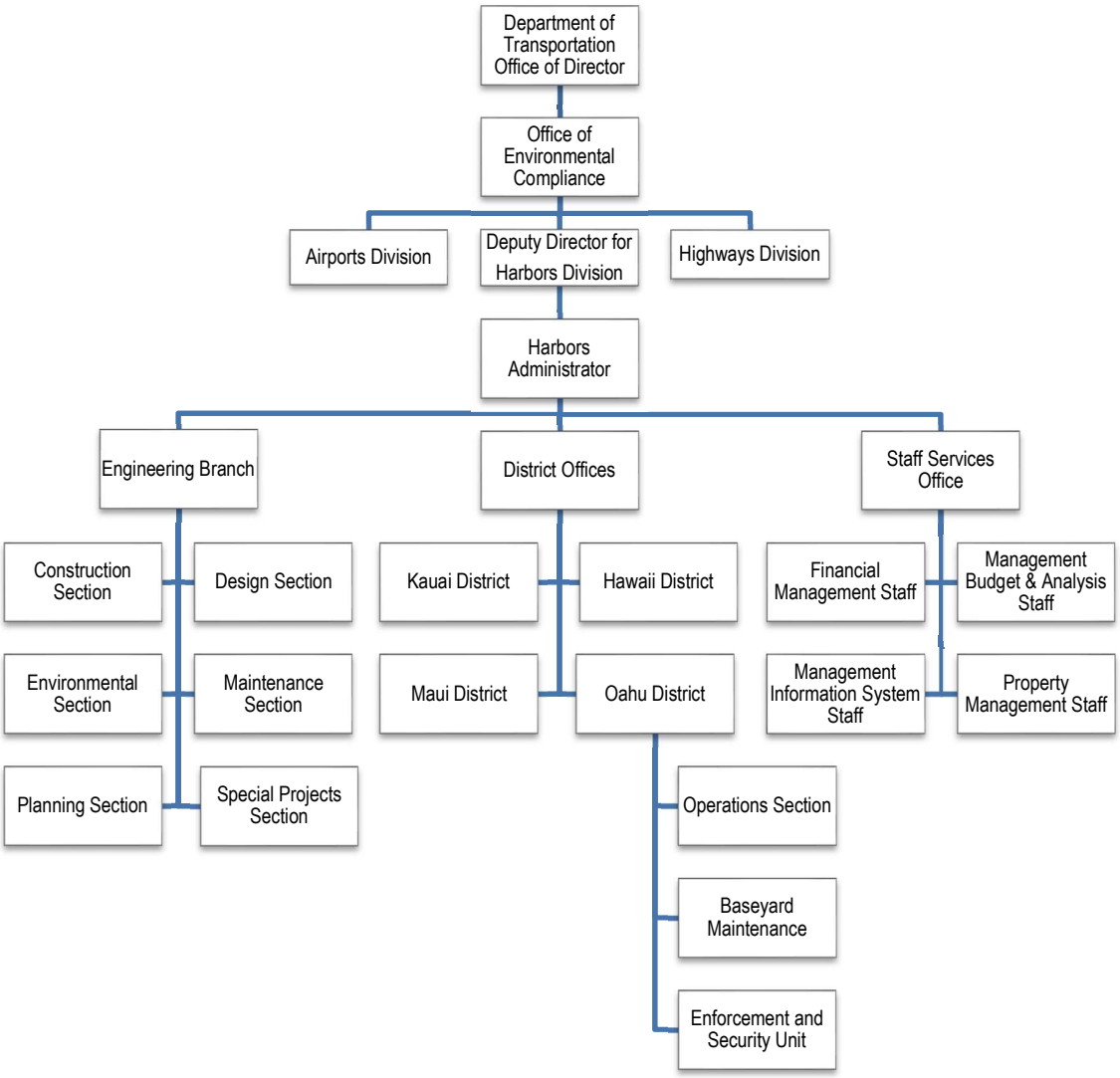
USEPA, 2006, *National Summary of Impaired Waters and TMDL Information - Listed Waters for Reporting Year 2006 – Hawaii, Oahu*: Environmental Protection Agency, http://iaspub.epa.gov/tmdl_waters10/attains_watershed.control

USEPA, 2012, *Stormwater Discharges (applicable to State NPDES Programs*: Environmental Protection Agency, Code of Federal Regulations, Title 40, §122.26.

Appendix A

HDOT Harbors Division Administrative Organizational Chart

State of Hawaii Department of Transportation Harbors Division
Administrative Organizational Chart



Appendix B

Permanent Post-Construction Best Management Practices Plan Checklist

Permanent Post-Construction Best Management Practice Plan Checklist

For a Harbors Project, please fill in this section	
Project Title:	
Project Location:	
Acreage of Site:	Harbors Project No.:
Name of Design Firm:	
Email:	Phone No.:

For a Tenant Improvement or other non-Harbors Project, please fill in this section	
Tenant Business Name:	Date:
Project Title:	
Project Location:	
Acreage of Site:	TMK No. (if any):
Applicant Name:	Job Title:
Email:	Phone No.:

Signature and Certifications	
Designer: I certify that the design is complete, accurate, and addresses the items on this checklist to the best of my knowledge.	
Print Name:	Job Title:
Signature:	Date:
Review: HDOT Harbors Project/Property Manager and Environmental Section.	
Harbors Project/Property Manager Signature:	Print Name: Date:
Harbors Environmental Section Signature:	Print Name: Date:

Part One - Low Impact Development Site Design Strategies

The following checked strategies will be incorporated and area(s) is denoted on the map:

- ☐ Conserve natural areas, soils, and vegetation
- ☐ Minimize soil compaction
- ☐ Minimize disturbances to natural drainages
- ☐ Minimize impervious surface
- ☐ Direct Runoff to Landscaped Areas
- ☐ None (all infeasible)

If "None" is checked, please provide justification here:

Part Two – Source Control

The following checked Source Control BMP(s) will be incorporated and area(s) is denoted on the map:

- ☐ Automatic irrigation systems
- ☐ Landscaped areas
- ☐ Loading docks
- ☐ Vehicle/Equipment fueling
- ☐ Vehicle/Equipment repair
- ☐ Vehicle/Equipment washing
- ☐ Outdoor work areas
- ☐ Outdoor material storage
- ☐ Outdoor trash storage
- ☐ Outdoor process operations
- ☐ Parking areas
- ☐ Others

If "Others" is checked, please describe here (attach separate sheets if needed):

Part Three – Treatment Control

The following checked Treatment Control BMP(s) will be incorporated and area(s) is denoted on the map:

- ☐ Infiltration basin
- ☐ Infiltration trench
- ☐ Subsurface Infiltration
- ☐ Dry well
- ☐ Bioretention basin
- ☐ Permeable pavement
- ☐ Green roof
- ☐ Bioretention filter
- ☐ Dry swale
- ☐ Downspout dispersion
- ☐ Vegetated swale
- ☐ Vegetated buffer strip
- ☐ Tree box filter

Alternative Compliance. The following alternative compliance is proposed and area(s) is denoted on the map:

- ☐ Incorporate the following alternative Treatment Control BMP(s):
  - ☐ Detention basin
  - ☐ Sand filter
  - ☐ Rain barrel
  - ☐ Manufactured treatment device
- ☐ Other (specify):

- ☐ **Source Control BMPs are designed with reference to the City and County of Honolulu Storm Water BMP Guide.**
- ☐ **Treatment Control BMPs are designed with reference to the City and County of Honolulu Storm Water BMP Guide.**

Appendix C

CCH Storm Water BMP Guide

STORM WATER BMP GUIDE

FOR NEW AND REDEVELOPMENT

for the City and County of Honolulu

Permit No. HI S000002

July 2017

Prepared by
City and County of Honolulu,
Department of Planning and Permitting



This page is intentionally left blank.

Table of Contents

TABLE OF CONTENTS ..... **i**

LIST OF TABLES ..... **v**

LIST OF FIGURES ..... **vii**

LIST OF APPENDICES ..... **ix**

LIST OF ACRONYMS AND ABBREVIATIONS ..... **xi**

GLOSSARY ..... **xiii**

ACKNOWLEDGEMENTS ..... **xix**

1. INTRODUCTION **1-1**

1.1. Purpose and Scope 1-1

1.2. Users of the Manual 1-1

1.3. Organization of the Manual 1-2

1.4. Low Impact Development and Storm Water Quality 1-2

1.5. Regulatory Requirements 1-6

1.5.1. Federal Programs *1-6*

1.5.2. State Programs *1-6*

1.5.3. Other Relevant Regulatory Programs *1-7*

1.5.4. Total Maximum Daily Loads *1-7*

1.5.5. Endangered Species Act *1-7*

1.5.6. Clean Water Act Section 404 Dredge and Fill Permits *1-7*

1.5.7. Clean Water Act Section 401 Water Quality Certification *1-8*

2. APPLICATION OF PERMANENT BMP REQUIREMENTS IN THE CITY AND COUNTY OF HONOLULU **2-1**

2.1. City and County of Honolulu Plan Review Requirements 2-3

2.1.1. Storm Water Quality Strategic Plans *2-3*

2.1.2. Storm Water Quality Reports *2-3*

2.1.3. Storm Water Quality Checklists *2-4*

2.1.4. Operations and Maintenance Plan *2-5*

2.1.5. BMP Certification and Recording *2-5*

2.1.6. Variances *2-6*

3. STORM WATER QUALITY PLANNING FOR NEW DEVELOPMENT AND REDEVELOPMENT 3-1
3.1. Assess Site Conditions 3-2
3.1.1. Understand Hydrologic Conditions of Concern 3-2
3.2. Site Design Strategies 3-4
3.2.1. Conserve Natural Areas, Soils, and Vegetation 3-4
3.2.2. Minimize Disturbances to Natural Drainages 3-4
3.2.3. Minimize Soil Compaction 3-5
3.2.4. Direct Runoff to Landscape Areas and Reduce Directly Connected Impervious Areas 3-5
3.2.5. Minimize Impervious Surfaces 3-6
3.3. Control Sources of Pollutants 3-10
3.4. Treat Runoff 3-12

4. SITE AND FACILITY DESIGN FOR WATER QUALITY PROTECTION 4-1
4.1. Infiltration 4-1
4.2. Retention and Detention 4-3
4.3. Biofilters 4-4
4.4. Street Design 4-5
4.5. Street Trees 4-7
4.6. Parking Lots 4-7
4.6.1. Hybrid Parking Lots 4-7
4.6.2. Parking Grove 4-9
4.6.3. Overflow Parking 4-9
4.6.4. Porous Pavement with Subsurface Infiltration 4-10
4.7. Driveways 4-10
4.8. Landscape and Open Space 4-12
4.9. Multiple Small Basins 4-12
4.10. Planning Development Strategies in Practice 4-13

5. TREATMENT CONTROL BMP DESIGN 5-1
5.1. Best Management Practices Selection 5-1
5.1.1. Determine Drainage Management Areas 5-1
5.1.2. Evaluate Pollutants of Concern 5-2
5.1.3. Identify Candidate BMPs 5-2
5.1.4. Consider Operation and Maintenance Requirements 5-5
5.1.5. Other Considerations 5-7
5.2. Numeric Sizing Criteria 5-7
5.2.1. Volume-Based Best Management Practice Design 5-7
5.2.2. Flow-Based BMP Design 5-8
5.2.3. Combined Volume-Based and Flow-Based BMP Design 5-10

5.3. Infiltration Requirements 5-10
5.3.1. Soil Types and Textures 5-10
5.3.2. Field Investigations 5-12
5.3.3. Design Infiltration Rates 5-13
5.4. Technology Certification 5-13
5.5. Feasibility Criteria 5-14
5.5.1. Infiltration Feasibility 5-14
5.5.2. Harvest/Reuse Feasibility 5-14
5.5.3. Biofiltration Feasibility 5-15

6. CONSIDERATIONS FOR CONSTRUCTION TREATMENT CONTROL BMPS 6-1

7. OPERATIONS AND MAINTENANCE OF BMPS 7-1
7.1. Consideration when Selecting Treatment BMPs 7-1
7.1.1. Sediment and Oil Removal and Disposal 7-1
7.1.2. Maintenance Costs 7-1
7.2. Developing the O&M Plan 7-2
7.3. Maintenance Agreements, Certification, and Modifications 7-2
7.4. Inspection Requirements 7-3
7.5. Minimum Maintenance Requirements 7-3

8. REFERENCES 8-1

This page is intentionally left blank.

List of Tables

Table 1.1: Pollutants and Impacts on Water Quality 1-5
Table 2.1: Summary of Post-Construction Requirements for New and Redevelopment 2-3
Table 3.1: Estimated C-Factor for Various Surfaces during Small Storms 3-8
Table 3.2: Conventional Paving Surface Small Storm C-Factor versus Alternative Paving C-Factors .. 3-10
Table 4.1: Comparison of Three Alternatives 4-16
Table 5.1: Typical Pollutants Associated with Priority Projects 5-3
Table 5.2: Treatment Control BMP Categories 5-3
Table 5.3: Treatment Control BMP Expected Pollutant Removals 5-4
Table 5.4: Recommended Selection of Permanent BMPs 5-5
Table 5.5: Summary of Operation and Maintenance Effort for BMPs 5-5
Table 5.6: Maintenance Rank Definition 5-6
Table 5.7: Runoff Coefficients for Water Quality Flow Calculations 5-9
Table 5.8: Typical Soil Infiltration Rates[a] 5-11
Table 5.9: Test Pit/Boring Requirements for Infiltration 5-13

This page is intentionally left blank.

List of Figures

Figure 1.1: Document Organization 1-3
Figure 1.2: Impacts of Urbanization 1-4
Figure 2.1: Implementation of the CCH Water Quality Rules 2-2
Figure 3.1: Project Life Cycle 3-1
Figure 3.2: Hydraulic Altercation after Certain BMPs are Implemented 3-3
Figure 3.3: Directly Connected Impervious Area versus Directing Runoff to Landscaped Areas 3-5
Figure 3.4: Parking Lot Directing Runoff to Landscape Areas 3-6
Figure 3.5: Use of Self-Mitigating Areas 3-9
Figure 3.6: Self-Mitigating Areas Treatment Volume 3-9
Figure 3.7: Example of Source Control Design for Outdoor Material Storage 3-11
Figure 4.1: Infiltration Basin 4-1
Figure 4.2: Typical Infiltration Facility Schematic 4-2
Figure 4.3: Typical Bioretention Schematic 4-2
Figure 4.4: Simple Detention System 4-3
Figure 4.5: Retention System 4-3
Figure 4.6: Vegetated Swale 4-4
Figure 4.7: Schematic of Planter Box with Down Spout Connection and Underdrain 4-5
Figure 4.8: Comparison of Street Cross-Section (Two-Way, Residential Access Streets) 4-6
Figure 4.9: Hybrid Parking Lot 4-8
Figure 4.10: Hybrid Parking Lot (Honolulu, HI) 4-8
Figure 4.11: Turf Blocks 4-8
Figure 4.12: Permeable Joints 4-8
Figure 4.13: Parking Grove 1 4-9
Figure 4.14: Parking Grove 2 4-9
Figure 4.15: Overflow Parking 4-9
Figure 4.16: Subsurface Infiltration System 4-10
Figure 4.17: Unit Pavers 4-11
Figure 4.18: Crushed Aggregate 4-11
Figure 4.19: Paving only under Wheels 4-11
Figure 4.20: Alternative 1 - Conventional 4-14

Figure 4.21: Alternative 2 - Hybrid/Best Practices 4-15
Figure 4.22: Alternative 3 - Neo-Traditional 4-15
Figure 5.1: DMA Delineation 5-1
Figure 5.2: Unit Water Quality Volume for 1 and 1.5 inch Runoff Depth 5-8
Figure 5.3: Unit Water Quality Flow 5-10
Figure 5.4: USDA Soils Textural Triangle 5-11

List of Appendices

APPENDIX A: SOURCE CONTROL BMP FACT SHEETS A-1
SC-01: Landscaped Areas A-3
SC-02: Roof Runoff Controls A-7
SC-03: Automatic Irrigation System A-11
SC-04: Storm Drain Inlet A-15
SC-05: Alternative Building Materials A-19
SC-06: Vehicle/Equipment Fueling A-23
SC-07: Vehicle/Equipment Repair A-27
SC-08: Vehicle/Equipment Cleaning A-29
SC-09: Loading Dock A-33
SC-10: Outdoor Trash Storage A-37
SC-11: Outdoor Material Storage A-41
SC-12: Outdoor Work Areas A-45
SC-13: Outdoor Process Equipment Operations A-49
SC-14: Parking Areas A-53

APPENDIX B: TREATMENT CONTROL BMP FACT SHEETS B-1
TC-01: Infiltration Basin B-3
TC-02: Infiltration Trench B-9
TC-03: Subsurface Infiltration B-15
TC-04: Dry Well B-17
TC-05: Bioretention Basin B-21
TC-06: Permeable Pavement B-27
TC-07: Green Roof B-33
TC-08: Vegetated Bio-Filter B-37
TC-09: Enhanced Swale B-43
TC-10: Vegetated Swale B-49
TC-11: Vegetated Buffer Strip B-55
TC-12: Harvest/Reuse B-59
TC-13: Detention Basin B-67
TC-14: Manufactured Treatment Device B-73
TC-15: Sand Filter B-75

APPENDIX C: O&M FACT SHEETS C-1
OM-01: Bio-Retention Basin C-3
OM-02: Detention Basin C-5
OM-03: Green Roof C-7
OM-04: Infiltration Trench/Basin C-9
OM-05: Manufactured Treatment Device C-11
OM-06: Pervious Pavement C-13
OM-07: Rainwater Harvesting C-15
OM-08: Sand Filter C-17
OM-09: Vegetated Biofilter C-19
OM-10: Vegetated Swale/Strip C-21

List of Acronyms and Abbreviations

§	Section
%	Percent
ACQ	Ammoniacal Copper Quarentary
BMP	Best Management Practice
CASQA	California Stormwater Quality Association
CCA	Chromated Copper Arsenate
City	City and County of Honolulu (or CCH)
COE	See USACE
CORP	See USACE
cu-ft	Cubic Feet (or feet^3)
CWA	Clean Water Act
CWB	Clean Water Branch, Department of Health, State of Hawaii
CWPPP	Certified Water Pollution Plan Preparer
CZMA	Coastal Zone Management Act
DCIA	Directly Connected Impervious Area
DFM	Department of Facility Maintenance, City and County of Honolulu
DLNR	State of Hawaii, Department of Land and Natural Resources
DMA	Drainage Management Area
DOFAW	Division of Forestry and Wildlife, Department of Land and Natural Resources, State of Hawaii
DOH	Department of Health, State of Hawaii
DPP	Department of Planning and Permitting, City and County of Honolulu
ft	foot (or feet)
HAR	Hawaii Administrative Rules
HDPE	High-Density Polyethylene
hr	Hour
HSG	Hydrologic Soil Group
in	Inch (or inches)
IPM	Integrated Pest Management
LID	Low Impact Development
MEP	Maximum Extent Practicable
min	Minute
mph	Miles per Hour

MS4	Municipal Separate Storm Sewer System
NJCAT	New Jersey Department of Environmental Protection, New Jersey Corporation for Advanced Technology
NJDEP	New Jersey Department of Environmental Protection Protocols
NOC	Notice of Cessation
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
PCB	Polychlorinated Biophenyls
POC	Pollutants of Concern
RV	Recreational Vehicle
SC	Source Control
sec	second (or seconds)
SPCC	Spill Prevention Control and Countermeasure
sq-ft	Square Feet (of feet^2)
SSBMP	Site-Specific Best Management Practice Plan
State	State of Hawaii
Strategic Plan	Storm Water Quality Strategic Plan
SUSMP	Standard Urban Stormwater Mitigation Plan
SWMPP	Storm Water Management Program Plan
SWPCP	Storm Water Pollution Control Plan
SWQ	Storm Water Quality Branch, Department of Facility Maintenance, City and County of Honolulu
SWQR	Storm Water Quality Report
TAPE	Washington State Department of Ecology, Technology Assessment Protocol - Ecology
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UIC	Underground Injection Control
USACE	United States Army Corporation of Engineers (also CORP or COE)
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Services
Water Quality Rules	City and County of Honolulu, Rules Relating to Water Quality (or WQR)
WQF	Water Quality Flow
WQMP	Water Quality Management Plan
WQV	Water Quality Volume

Glossary

As used in this document, the following definitions shall apply unless the context indicates otherwise:

303(d) Listed: Water bodies listed as impaired as per Section 303(d) of the 1972 Clean Water Act.

Best Management Practices or BMPs: means schedules of activities, prohibitions of practices, maintenance procedures, management practices, treatments, and temporary or permanent Structures or devices that are intended and designed to eliminate and Minimize the discharge of pollutants, directly or indirectly, to receiving waters, to the maximum extent practicable.

Biofiltration: A pollution control technique that uses living material to capture, and absorb or biologically degrade pollutants.

Catch Basin (Also known as Inlet): Box-like underground concrete structure with openings in curbs and gutters designed to collect runoff from streets and pavement.

Check Dams: Small temporary dams constructed across a swale or drainage ditch. Check dams reduce the velocity of concentrated storm water flows, thereby reducing erosion of the swale or ditch. The dams also decrease water velocity to increase sediment capture.

Clean Water Act (CWA): (33 U.S.C. 1251 et seq.) Requirements of the NPDES program are defined under Sections 307, 402, 318 and 405 of the CWA.

Construction Activity: Includes clearing, grading, excavation, and contractor activities that result in soil disturbance. Construction activities are regulated by the NPDES General Permit Coverage Hawaii Administrative Rules (HAR) Chapter 11-55 Water Pollution Control, Appendix C-Storm Water Associated with Construction Activities, effective October 22, 2007.

Denuded: Land stripped of vegetation or land that has had its vegetation worn down due to the impacts from the elements or humans.

Detention: The capture and subsequent release of storm water runoff from the site at a slower rate than it is collected, the difference being held in temporary storage.

Development: The sum of any and all actions that are undertaken to alter the natural or existing condition of real property or improvements on real property if a building, electric, grading, grubbing, plumbing, stockpiling or trenching permit is required for the Project. Development also includes Redevelopment and changes in land use that may result in different or increased Pollutant discharges to the MS4 or Receiving Waters. Development does not include work that does not involve any Land Disturbing Activity, the installation of signs and traffic control devices, the construction of individual bus shelters, the installation of temporary BMPs, emergency work necessary to repair surfaces that are in immediate need of stabilization, the marking of improved surfaces with striping or signage, and minor and ordinary repairs to

existing improvements in the City's right of way, provided that the work will not increase the impervious surface area of the Project Site or involve replacing 50 percent or more of the on-Site impervious surfaces area.

Discharge: A release or flow of storm water or other substance from a conveyance system or storage container. Broader discharges includes release to storm drains, etc.

Disturbed Area: Any and all portions of Project Site affected by Land Disturbing Activities. Disturbed Areas include, but are not limited to, soils and surface areas affected by excavation, areas that are graded, grubbed, or clearing by uprooting vegetation, areas affected by the demolition of foundations, areas used for equipment staging, materials, or staging, and areas affected by heavy pedestrian or vehicular traffic that disrupts ground covers or surface soil conditions.

Effluent Limits: Limitations on amounts of pollutants that may be contained in a discharge. Can be expressed in a number of ways including as a concentration, as a concentration over a time period (i.e., 30-day average must be less than 20 milligram/liter), or as a total mass per time unit, or as a narrative limit.

Erosion: The wearing-away of land surface by wind or water. Erosion occurs naturally from weather or runoff but can be intensified by land-clearing practices related to farming, new development, redevelopment, road building, or timber cutting.

Evapotranspiration: The combined loss of water into the atmosphere by evaporation (water changing from a liquid to a vapor from soil, water, or plant surfaces) and transpiration (water that is taken up by plant roots and transpired through plant tissue and leaves).

Facility: Is a collection of industrial processes discharging storm water associated with industrial activity within the property boundary or operational unit.

Flood or Flooding: The inundation to a depth of three inches or more of any property not ordinarily covered by water. The terms do not apply to inundation caused by tsunami wave action.

Grading: Any excavation or fill, or combination thereof.

Hazardous Waste: A waste or combination of wastes that, because of its quantity, concentration, or physical, chemical or infectious characteristics, may either cause or significantly contribute to an increase in mortality or an increase in serious irreversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of or otherwise managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity) or appears on special USEPA or state lists. Regulated under the federal Resource Conservation and Recovery Act and the California Health and Safety Code.

Illicit Discharges: Any discharge to a municipal separate storm sewer that is not in compliance with applicable laws and regulations as discussed in this document.

Impervious Surface: A surface covering or pavement of a developed parcel of land that prevents the land’s natural ability to absorb and infiltrate rainfall/storm water. Impervious surfaces include, but are not limited to, rooftops; walkways; patios; driveways; parking lots; storage areas; impervious concrete and asphalt; and any other continuous watertight pavement or covering. Landscaped soil and pervious pavement, underlain with pervious soil or pervious storage material, are not impervious surfaces.

Industrial General Permit: A National Pollutant Discharge Elimination System (NPDES) Permit issued by the State of Hawaii Department of Health Clean Water Branch for discharge of storm water associated with industrial activity.

Industrial Park: A land development that is set aside for industrial development. Industrial parks are usually located close to transport facilities, especially where more than one transport modalities coincide: highways, railroads, airports, and navigable rivers. It includes office parks, which have offices and light industry.

Infiltration: Practices which capture and temporarily store a design storm volume of water before allowing it to infiltrate into the soil.

Inlet: An entrance into a ditch, storm drain, or other waterway.

Integrated Pest Management (IPM): An ecosystem-based strategy that focuses on long-term prevention of pests or its damage through a combination of techniques such as: biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism.

Land Disturbing Activity or Land Disturbance: Any action, activity, or land use that alters the integrity, structure, texture, density, permeability, contents, or stress conditions of soil or ground surfaces if a building, electric, grading, grubbing, plumbing, stockpiling or trenching permit is required for the Project. Land disturbing activities include, but are not limited to actions that result in the turning, penetration, or moving of soil, the resurfacing of pavement that involves the exposure of the base course or subsurface soils, and the use of portions of a Project Site as staging areas or base yards.

Low Impact Development or "LID": Systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration or use storm water in order to protect water quality and the aquatic habitat. At both site and regional scales, LID aims to preserve, restore, and create green space using soils, vegetation, and rain harvest techniques.

Maximum Extent Practicable or MEP: Economically achievable measures for the control of the addition of pollutants from existing and new categories of nonpoint sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint source pollution control practices, technologies, processes, siting criteria, operating methods or other alternatives.

Municipal Separate Storm Sewer System (MS4): The City's drainage infrastructure that is designed or intended to collect and convey storm water and includes, but is not limited to, City roads with drainage improvements, City streets, catch basins, curbs, gutters, ditches, man-made channels, and storm drains.

National Pollutant Discharge Elimination System Permit or "NPDES Permit": The permit issued to the City pursuant to *Title 40, Code of Federal Regulations, Part 122*, Subpart B, Section 122.26(a) (1) (iii), for storm water discharge from the City's separate storm sewer systems; or the permit issued to a person or property owner for a storm water discharge associated with industrial activity pursuant to *Title 40, Code of Federal Regulations, Part 122*, Subpart B, Section 122.26(a) (1) (ii), or other applicable section of Part 122; or the permit issued to a person or property owner for the discharge of any pollutant from a point source into the state waters through the City's separate storm sewer system pursuant to Hawaii Administrative Rules, Chapter 11-55, "Water Pollution Control."

New Development: Land disturbing activities; structural development, including construction or installation of a building or structure, the creation of impervious surfaces; and land subdivision.

Non-Storm Water Discharge: Any discharge to municipal separate storm sewer that is not composed entirely of storm water.

Nonpoint Source Pollution: Pollution that does not come from a point source. Nonpoint source pollution originates from aerial diffuse sources that are mostly related to land use.

Notice of Intent (NOI): A formal notice to the State of Hawaii Clean Water Branch submitted by the owner of an industrial site or construction site that said owner seeks coverage under a General Permit for discharges associated with industrial and construction activities. The NOI provides information on the owner, location, type of project, and certifies that the owner will comply with the conditions of the construction General Permit.

Notice of Cessation (NOC): Formal notice to the State of Hawaii Clean Water Branch submitted by owner/developer that a construction project is complete.

Outfall: The end point where storm drains discharge water into a waterway.

Point Source: Any discernible, confined, and discrete conveyance from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural storm water runoff.

Pollutant: Any dredge, spoil, solid refuse, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical waste, biological materials, radioactive materials, heat, wrecked or dismantled equipment, rock, sand, soil, sediment, dirt, industrial, municipal, or agricultural waste and substances of similar nature.

Pollution Prevention: Practices and actions that reduce or eliminate the generation of pollutants.

Precipitation: Any form of rain.

Pretreatment: Treatment of waste stream before it is discharged to a collection system.

Reclaim (Water Reclamation): Planned use of treated effluent that would otherwise be discharged without being put to direct use.

Redevelopment: The creation, addition, and/or replacement of impervious surface on improved real property. Redevelopment does not include trenching and resurfacing associated with utility work, resurfacing and reconfiguring existing impervious surfaces, the repair of sidewalks or pedestrian ramps, pothole repair, ordinary road maintenance, or the marking of vehicular or pedestrian lanes on existing roads.

Retail Mall: One or more buildings that house or form a complex of retail stores with interconnecting walkways. Retail and Commercial malls include, but are not limited to, mini-malls, strip malls, retail complexes, and enclosed shopping malls or shopping centers.

Retention: The storage of storm water to prevent it from leaving the development site.

Reuse (Water Reuse): (see Reclaim)

Runoff: Water originating from rainfall and other sources (i.e., sprinkler irrigation) that flows over the land surface to drainage facilities, rivers, streams, springs, seeps, ponds, lakes, and wetlands.

Run-on: Offsite storm water surface flow or other surface flow which enters your site.

Scour: The erosive and digging action in a watercourse caused by flowing water.

Secondary Containment: Structures, usually dikes or berms, surrounding tanks or other storage containers, designed to catch spilled materials from the storage containers.

Sedimentation: The process of depositing soil particles, clays, sands, or other sediments that were picked up by runoff.

Sediments: Soil, sand, and minerals washed from land into water, usually after rain, that collect in reservoirs, rivers, and harbors, destroying fish nesting areas and clouding the water, thus preventing sunlight from reaching aquatic plants. Farming, mining, and building activities without proper implementation of BMPs will expose sediment materials, allowing them to be washed off the land after rainfalls.

Self-Mitigating Area: A natural or landscaped area, including green roofs, which retains and/or treats rainfall within its perimeter without accepting runoff from other areas. Self-Mitigating Areas must retain all collected storm water or drain directly to the MS4.

Significant Materials: Includes, but not limited to, raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designed under Section 10 1(14) of CERLCA; any chemical the facility is required to report pursuant to Section 313 of Title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharges.

Significant Quantities: The volume, concentrations, or mass of a pollutant in storm water discharge that can cause or threaten to cause pollution, contamination, or nuisance that adversely impact human health or the environment and cause or contribute to a violation of any applicable water quality standards for receiving water.

Site Design Strategies: LID design techniques that are intended to maintain or restore the site's hydrologic and hydraulic functions with the intent of minimizing runoff volume and preserving existing flow paths.

Source Control BMPs: Low-technology practices designed to prevent pollutants from contacting storm water runoff or to prevent discharge of contaminated runoff to the storm drainage system.

Source Reduction (also Source Control): The technique of stopping and/or reducing pollutants at their point of generation so that they do not come into contact with storm water.

Storm Drains: Above- and below-ground structures for transporting storm water to streams or outfalls for flood control purposes.

Storm Water: Storm water runoff, surface runoff, street wash, or drainage and may include discharges from fire fighting activities.

Storm Water Discharge Associated with Industrial Activity: Discharge from any conveyance which is used for collecting and conveying storm water from an area that is directly related to manufacturing, processing, or raw materials storage activities at an industrial plant.

Storm Water Hotspots: Storm water hotspots are areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants exceeding those typically found in storm water.

Storm Water Pollution Control Plan (SWPCP): A written plan that documents the series of phases and activities that, first, characterizes your site, and then prompts you to select and carry out actions which prevent the pollution of storm water discharges. For construction activities NOI, the Department of Health Clean Water Branch has renamed SWPCP to site-specific BMPs plan.

Storm Water Retrofit: A storm water retrofit is a storm water management practice (usually structural) put into place after development has occurred, to improve water quality, protect downstream channels, reduce flooding, or meet other specific objectives.

Treatment Control BMPs: Engineered technologies designed to remove pollutants from storm water runoff prior to discharge to the storm drain system or receiving waters.

Toxicity: Adverse responses of organisms to chemicals or physical agents ranging from mortality to physiological responses such as impaired reproduction or growth anomalies.

Acknowledgements

The Storm Water Best Management Practice (BMP) Manuals are adaptations of products of the California Stormwater Quality Association (CASQA) and other municipalities and guidance documents.

The development of the City Storm Water BMP Guide was guided by Technical Contributions from representatives of regulatory agencies (water quality and health), industry, transportation, and consulting. The quality of this manual is a result of the diverse expertise and experience of the committee and the workgroup.

This page is intentionally left blank.

1. Introduction

Storm water runoff is part of a natural hydrologic process. However, human activities particularly urbanization and agriculture, can alter natural drainage patterns and add pollutants to lakes, and streams as well as coastal bays and estuaries, and ultimately, the ocean. Numerous studies have shown urban runoff to be a significant source of water pollution, causing declines in fisheries, restrictions on swimming, and limiting our ability to enjoy many of the other benefits that water resources provide. Urban runoff in this context includes all flows discharged from urban land uses into storm water conveyance systems and receiving waters and includes both dry weather non-storm water sources (i.e., runoff from landscape irrigation, etc.) and wet weather storm water runoff. In this manual, urban runoff and storm water runoff are used interchangeably.

For many years the effort to control the discharge of storm water focused on quantity (i.e., drainage and flood control) and only to a limited extent on quality of the storm water (i.e., sediment and erosion control). However, in recent years awareness of the need to improve water quality has increased. With this awareness, Federal, State, and City programs have been established to pursue the ultimate goal of reducing pollutants contained in storm water discharges to our waterways. The emphasis of these programs is to promote the concept and the practice of preventing pollution at the source, before it can cause environmental problems (United States Environmental Protection Agency [USEPA], 1992). Other BMPs to reduce or eliminate post-project runoff should also be implemented. However, where further controls are needed, treatment of polluted runoff may be required.

1.1. Purpose and Scope

The City and County Rules Relating to Water Quality (*Water Quality Rules* or WQR) specifies that regulated new development and redevelopment projects include Low Impact Development (LID) Site Design Strategies, Source Control BMPs (best management practices), and Post-Construction Treatment Control BMPs to reduce the pollution associated with storm water runoff. This document provides planning and design guidelines to support implementation of the *Water Quality Rules*. Presented in this manual are the minimum design and technical criteria for the analysis and design of storm drainage facilities and water quality. This document also provides guidance for storm water quality during the planning phase and Operations and Maintenance (O&M) guidance. Implementing structural and operational controls that go beyond the minimum is encouraged.

1.2. Users of the Manual

This manual provides guidance suitable for use by individuals involved in development or redevelopment site water pollution control and planning. Each user of the manual is responsible for working within their capabilities obtained through training and experience, and for seeking the advice and consultation of appropriate experts at all times.

The target audience for this manual includes:

- Developers (including their planners and engineers);
- Contractors and subcontractors (including their engineers, superintendents, foremen, and construction staff);
- City agencies involved in site development and redevelopment (including their engineers, planners, and construction staff);
- Regulatory agencies (including permit and planning staff); and
- General public with an interest in storm water pollution control.

This manual also references the necessary forms and worksheets that developers, designers, consultants, contractors, and other applicants need to complete and have approved by the City and County of Honolulu (City or CCH).

1.3. Organization of the Manual

The manual is organized to assist the user in selecting and implementing BMPs to reduce impacts of storm water and non-storm water discharges on receiving waters. Sections of this manual are displayed in **Figure 1.1**.

1.4. Low Impact Development and Storm Water Quality

When rain falls in natural, undeveloped areas, the water is absorbed and filtered by soil and plants. However, for the past decades, typical urban development and storm drain systems have been designed using impermeable materials to convey storm water away from developed areas as quickly and efficiently as possible. Excess rainfall, or the portion of rainfall that is not abstracted by interception, infiltration, or depression storage, becomes surface runoff. Large areas of connected impervious cover and changes in land use often found in urban environments dramatically increase the volume and rate of storm water discharges.

Under natural and undeveloped conditions, surface runoff can range from 10 to 30 percent (%) of the total annual precipitation (**Figure 1.2**). Depending on the level of development and the site planning methods used, the alteration of physical conditions can result in a significant increase of surface runoff to over 50% of the overall precipitation. Alteration in site runoff characteristics can cause an increase in the volume and frequency of runoff flows (discharge) and velocities that cause flooding, accelerated erosion, and reduced groundwater recharge and contribute to degradation of water quality and the ecological integrity of streams.

Additionally, storm water runoff naturally contains numerous constituents, however, urbanization and urban activities including development and redevelopment typically increase constituent concentrations to levels that impact water quality. Urban activities can also result in the generation of new dry-weather runoff that may contain many of the pollutants listed in **Table 1.1**.

Pollutants associated with storm water include sediment, nutrients, bacteria and viruses, oil and grease, metals, organics, pesticides, and trash (floatables). In addition, nutrient-rich storm water runoff is an attractive medium for vector production when it accumulates and stands for more than 72 hours (hrs).

Section 1: Introduction

- *This section provides a general review of the Regulatory Background and an overview of LID.*

Section 2: Application of Permanent BMP Requirements in the City and County of Honolulu

- *This section provides an overview of the requirements for New and Redevelopment projects to comply with the City and County of Honolulu, Department of Planning and Permitting's, "Rules Relating to Water Quality."*

Section 3: Storm Water Quality Planning for New Development and Redevelopment

- *This section describes planning principles for New and Redevelopment projects including site assessment, site design strategies, and source control design.*

Section 4: Site and Facility Design for Water Quality Protection

- *This section describes how infiltration BMPs, retention/detention basins, biofilters, and structural controls can be incorporated into common site features.*

Section 5: Treatment Control BMP Design

- *This section describes BMP selection, feasibility criteria, numerical sizing criteria, and infiltration testing for the design of Treatment Control BMPs.*

Section 6: Considerations for Construction Treatment Control BMPs

- *This section outlines construction sequencing and considerations to protect permanent BMPs during construction.*

Section 7: Operations and Maintenance of BMPs

- *This section provides guidance for the operation and maintenance of BMPs to ensure BMP effectiveness.*

Section 8: References

- *This section provides a list of reference documents.*

Figure 1.1: Document Organization

LID reduces peak runoff and improves water quality by allowing rainwater to infiltrate into the ground, allowing rainwater to evaporate and transpire, or collecting rainwater as a resource for irrigation and other methods of reuse. Rather than moving storm water off-site through a conveyance system, the goal of LID is to restore the natural ability of a developed site to absorb storm water, resulting in an area more closely resembling pre-development hydrology. Importantly, the LID strategy seeks to control storm water quality at its source, using a range of small-scale, economical devices such as native landscaping and constructed green spaces, bioretention facilities, vegetated swales, infiltration through permeable pavement, and green roofs.

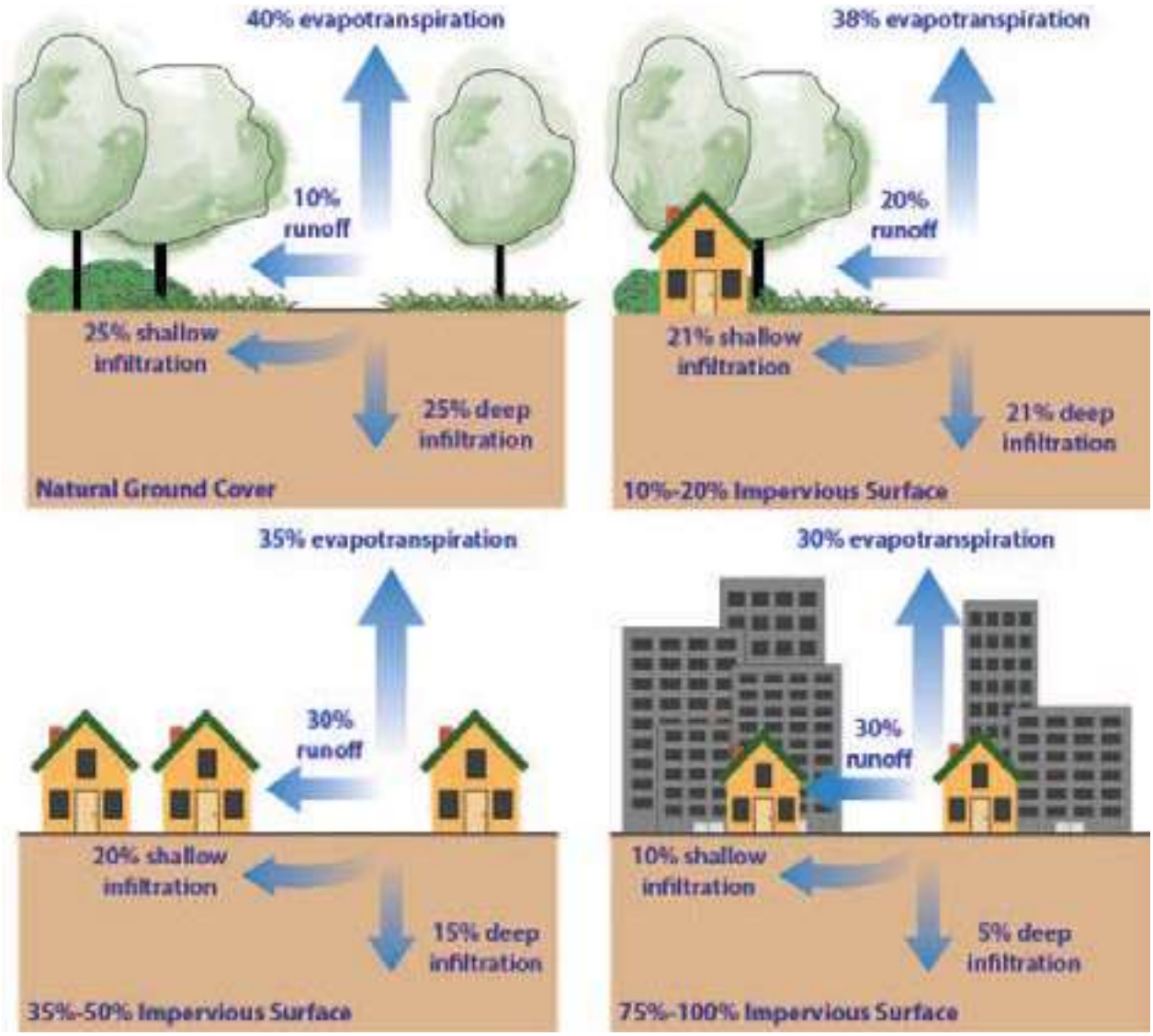


Figure 1.2: Impacts of Urbanization

Table 1.1: Pollutants and Impacts on Water Quality

Pollutant	Impact
Sediment	Sediment is a common component of storm water, and can be a pollutant. Sediment can be detrimental to aquatic life (primary producers, benthic invertebrates, coral reefs and fish) by interfering with photosynthesis, respiration, growth, reproduction, and oxygen exchange in water bodies. Sediment can transport other pollutants that are attached to it including nutrients, trace metals, and hydrocarbons. Sediment is the primary component of total suspended solids (TSS), a common water quality analytical parameter.
Nutrients	Nutrients including nitrogen and phosphorous are the major plant nutrients used for fertilizing landscapes, and are often found in storm water. These nutrients can result in excessive or accelerated growth of vegetation, such as algae, resulting in impaired use of water in lakes and other sources of water supply.
Bacteria and Viruses	Bacteria and viruses are common contaminants of storm water. For separate storm drain systems, sources of these contaminants include animal excrement and sanitary sewer overflow. High levels of indicator bacteria in storm water have led to the closure of beaches, lakes, and streams to contact recreation such as swimming.
Oil and Grease	Oil and grease includes a wide array of hydrocarbon compounds, some of which are toxic to aquatic organisms at low concentrations. Sources of oil and grease include leakage, spills, cleaning and sloughing associated with vehicle and equipment engines and suspensions, leaking and breaks in hydraulic systems, restaurants, and waste oil disposal.
Metals	Metals including lead, zinc, cadmium, copper, chromium, and nickel are commonly found in storm water. Many of the artificial surfaces of the urban environment (i.e., galvanized metal, paint, automobiles, or preserved wood) contain metals, which enter storm water as the surfaces corrode, flake, dissolve, decay, or leach. Over half the trace metal load carried in storm water is associated with sediments. Metals are of concern because they are toxic to aquatic organisms, can bioaccumulate (accumulate to toxic levels in aquatic animals such as fish), and have the potential to contaminate drinking water supplies.
Organics	Organics may be found in storm water in low concentrations. Often synthetic organic compounds (adhesives, cleaners, sealants, solvents, etc.) are widely applied and may be improperly stored and disposed. In addition, deliberate dumping of these chemicals into storm drains and inlets causes environmental harm to waterways.
Pesticides	Pesticides (including herbicides, fungicides, rodenticides, and insecticides) have been repeatedly detected in storm water at toxic levels, even when pesticides have been applied in accordance with label instructions. As pesticide use has increased, so too have concerns about adverse effects of pesticides on the environment and human health. Accumulation of these compounds in simple aquatic organisms, such as plankton, provides an avenue for biomagnification through the food web, potentially resulting in elevated levels of toxins in organisms that feed on them, such as fish and birds.
Gross Pollutants	Gross Pollutants (trash, debris, and floatables) may include heavy metals, pesticides, and bacteria in storm water. Typically resulting from an urban environment, industrial sites and construction sites, trash and floatables may create an aesthetic “eye sore” in waterways. Gross pollutants also include plant debris (such as leaves and lawn-clippings from landscape maintenance), animal excrement, street litter, and other organic matter. Such substances may harbor bacteria, viruses, vectors, and depress the dissolved oxygen levels in streams, lakes, and estuaries sometimes causing fish kills.

1.5. Regulatory Requirements

The Federal Water Pollution Control Act of 1972 also known as the Clean Water Act (CWA), as amended in 1987, is the principal legislation for establishing requirements for the control of storm water pollutants from urbanization and related activities. However, other Federal, State, and City requirements deal directly or indirectly with controlling storm water discharges. Requirements for storm water under some of these programs are evolving: Coastal Zone Management Act (CZMA), State of Hawaii Administrative Rules (HAR), City Ordinances, Total Maximum Daily Loads (TMDLs), 401 Water Quality Certifications and Endangered Species Act. The user is advised to contact local regulatory and/or City officials for further information.

1.5.1. Federal Programs

In 1972, provisions of the CWA were amended so that discharge of pollutants to waters of the United States from any point source is effectively prohibited, unless the discharge is in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. The 1987 amendments to the CWA added Section 402(p), which established a framework for regulating municipal, industrial, and construction storm water discharges under the NPDES program. On November 16, 1990, USEPA published final regulations that established application requirements for storm water permits for municipal separate storm sewer systems (MS4s) serving a population of over 100,000 (Phase I communities) and certain industrial facilities, including construction sites greater than five (5) acres.

On December 8, 1999, USEPA published the final regulations for communities under 100,000 (Phase II MS4s) and operators of construction sites between one (1) and five (5) acres.

1.5.2. State Programs

The statutory framework for the NPDES program requires that all point sources that discharge pollutants in the waters of the United States must obtain an NPDES permit from the USEPA or an authorized State (Hawaii is a delegated state). Storm water is regulated under the NPDES program. There has been a phased approach to regulation of storm water. Phase I, in 1990, regulated discharges from Medium and Large MS4s, industrial activity, and construction sites greater than or equal to five (5) acres. Phase II became effective March 10, 2003 and regulated discharges from Small MS4s and construction sites from one (1) acre to five (5) acres. Large, Medium, and Small MS4s were defined by the size of the population that the system serves. The regulations required the issuance of permits to regulated dischargers.

In Hawaii, Small MS4s, industrial facilities, and construction activities greater than or equal to one acre are normally covered by general permits. However if such facilities discharge storm water into sensitive water bodies designated as Class AA marine, or Class 1 inland State waters, or areas restricted in accordance with the State's "No Discharge" policy, then those facilities must be covered by an individual permit. Also, Small MS4s and industrial facilities could be covered under an individual permit issued to a Large MS4.

Regulatory emphasis is placed on pollution prevention by regulating "end of pipe" discharges in lieu of setting effluent limits. Prevention is accomplished through the development and implementation of plans such as the MS4 Storm Water Management Program Plan (SWMPP), Industrial Storm Water Pollution Control Plans (SWPCPs), and erosion control plans and Site-Specific BMP Plans (SSBMPs) for construction sites.

Projects designated by the City as "Priority Projects" have been identified to have a greater potential for activities which may contribute sources for pollutants. These projects, described in Section 2, have been developed to reduce the risk of pollutant sources exposure to storm water runoff.

1.5.3. Other Relevant Regulatory Programs

In addition to meeting City storm water program requirements under CWA section 402(p), municipalities are increasingly subject to other regulatory drivers that relate to the protection of surface water quality and beneficial uses of water bodies in their communities. Several other regulatory programs that can significantly affect new development and redevelopment planning and design are:

- TMDLs
- Endangered Species Act
- CWA Section 404 Dredge and Fill Permits
- Section 401 Water Quality Certification (regulated under HAR, Chapter 11-54)

In the coming years, these regulatory drivers will likely have at least as much impact on the design and implementation of municipal storm water programs and BMP selection and maintenance as current storm water regulations.

1.5.4. Total Maximum Daily Loads

TMDLs are a regulatory mechanism to identify and implement additional controls on both point and non-point source discharges in water bodies that are impaired from one or more pollutants and are not expected to be restored through normal point source controls. States identify impairments and pollutants by putting impaired water bodies on a list as required under Section 303(d) of the CWA.

Storm water or urban runoff is listed as a suspected source for many of the water body pollutant combinations in the current 303(d) list. Storm water programs must be designed not only to be in compliance with the storm water NPDES permit regulations, but they must also be designed to implement TMDLs in which storm water or urban runoff is named as a source.

1.5.5. Endangered Species Act

Like TMDLs, Endangered Species Act (Hawaii Revised Statutes Title 12) issues are becoming increasingly important to storm water program design and implementation. The presence or potential presence of an endangered species impacts storm water management programs and the selection and maintenance of BMPs. The Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW) and the US Fish & Wildlife Service (USFWS) provides information on the designation of critical habitat in Hawaii.

The developers or public agency intending to conduct activities in or discharge to an area that serves as a critical habitat must contact resource agencies such as DLNR, DOFAW, and the USFWS to learn about specific compliance requirements and actions.

1.5.6. Clean Water Act Section 404 Dredge and Fill Permits

In 1972, Section 404 of the CWA was passed prohibiting the discharge of dredged or filled material into U.S. waters without a permit from the Army Corps of Engineers (USACE or CORP or COE). Subsequent

court rulings and litigation further defined "Waters of the U.S." to include virtually all surface waters, including wetlands. Activities in waters of the United States that are regulated under this Act include fills for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry.

The basic premise of the CWA is that no discharge of dredged or fill material is permitted if a practicable alternative exists that is less damaging to the aquatic environment or if the nation's waters would be significantly degraded. When applying for a permit, it must be shown that:

- Steps have been taken to avoid wetland impacts where practicable.
- Potential impacts to wetlands have been minimized.
- Compensation for any remaining, unavoidable impacts through activities has been provided to restore or create wetlands.

An individual permit is usually required for potentially significant impacts. However, for most discharges that will have only minimal adverse effects, the USACE often grants up-front general permits. These may be issued on a nationwide or state basis for particular categories of activities (for example, minor road crossings, utility line backfill, and bedding) as a means to expedite the permitting process.

1.5.7. Clean Water Act Section 401 Water Quality Certification

Anyone proposing to conduct a project that requires a Federal permit (404) or involves dredge or fill activities that may result in a discharge to U.S. surface waters and/or "Waters of the State" is required to obtain a CWA Section 401 Water Quality Certification and/or Waste Discharge Requirements (Dredge/Fill Projects) from the State of Hawaii (State) Department of Health (DOH) Clean Water Branch (CWB), verifying that the project activities will comply with state water quality standards (HAR Chapter 11-54). The rules and regulations apply to all "Waters of the State," including isolated wetlands and stream channels that may be dry during much of the year, have been modified in the past, look like a depression or drainage ditch, have no riparian corridor, or are on private land.

Section 401 of the CWA grants each state the right to ensure that the state's interests are protected on any federally permitted activity occurring in or adjacent to "Waters of the State." In Hawaii, the CWB is the agency mandated to ensure protection of the State's waters. If a proposed project requires a USACE, CWA Section 404 permit and has the potential to impact Waters of the State, the CWB through HAR Chapter 11-54 will regulate the project and associated activities through a Water Quality Certification determination (Section 401), as part of the 404 process.

2. Application of Permanent BMP Requirements in the City and County of Honolulu

According the *Water Quality Rules*, the following projects are required to implement post-construction BMPs for water quality:

Priority A	Priority B
• All new development and redevelopment, including any incremental development, that proposes land disturbing activities of 1 acre or more.	• Any project that may have significant water quality impacts due to its location or associated land use activities, including but not limited to the development or redevelopment of: ▪ Retail gas outlets ▪ Automotive repair shops ▪ Restaurants ▪ Parking lots with 20 stalls or more ▪ Buildings greater than 100 feet in height ▪ Retail malls ▪ Industrial park

Priority B is further divided into Priority B1 and Priority B2. Priority B1 is any Priority Project with 5,000 square feet (sq-ft) or greater of impervious area. Priority B2 is any Priority Project with less than 5,000 sq-ft of Impervious Area.

The *Water Quality Rules* criteria must be met for Priority A, B1, and B2 projects as follows:

1. Incorporate appropriate LID Site Design Strategies to the maximum extent practicable (MEP).
2. Incorporate appropriate Source Control BMPs to the MEP.

In addition, the following criteria must be met for Priority A and B1 projects as follows:

1. Retain on-site by infiltration, evapotranspiration or harvest/reuse, as much of the Water Quality Volume (WQV) as feasible, with appropriate LID Retention Post-Construction Treatment Control BMPs.
2. Biofilter the remaining portion of the WQV that is not retained on-site with appropriate LID Biofiltration Post-Construction Treatment Control BMPs as much as feasible.
3. If it is demonstrated to be infeasible to retain and/or biofilter the WQV, one of the following alternative compliance measures is required:
    a. Treat (by detention, filtration, settling, or vortex separation) and discharge with appropriate Alternative Compliance Post-Construction Treatment Control BMPs, any portion of the WQV that is not retained on-site or biofiltered.
    a. Retain or biofilter at an offsite location, the volume of runoff equivalent to the difference between the project's WQV and the amount retained on-site or biofiltered. Offsite mitigation projects must be submitted for City approval.

A flowchart of implementation of the CCH *Water Quality Rules* is shown in **Figure 2.1**.

Site Design, Source Control, and Treatment Control BMPs are discussed throughout this document. **Table 2.1** summarizes the requirements of the *Water Quality Rules* and objectives of each requirement.

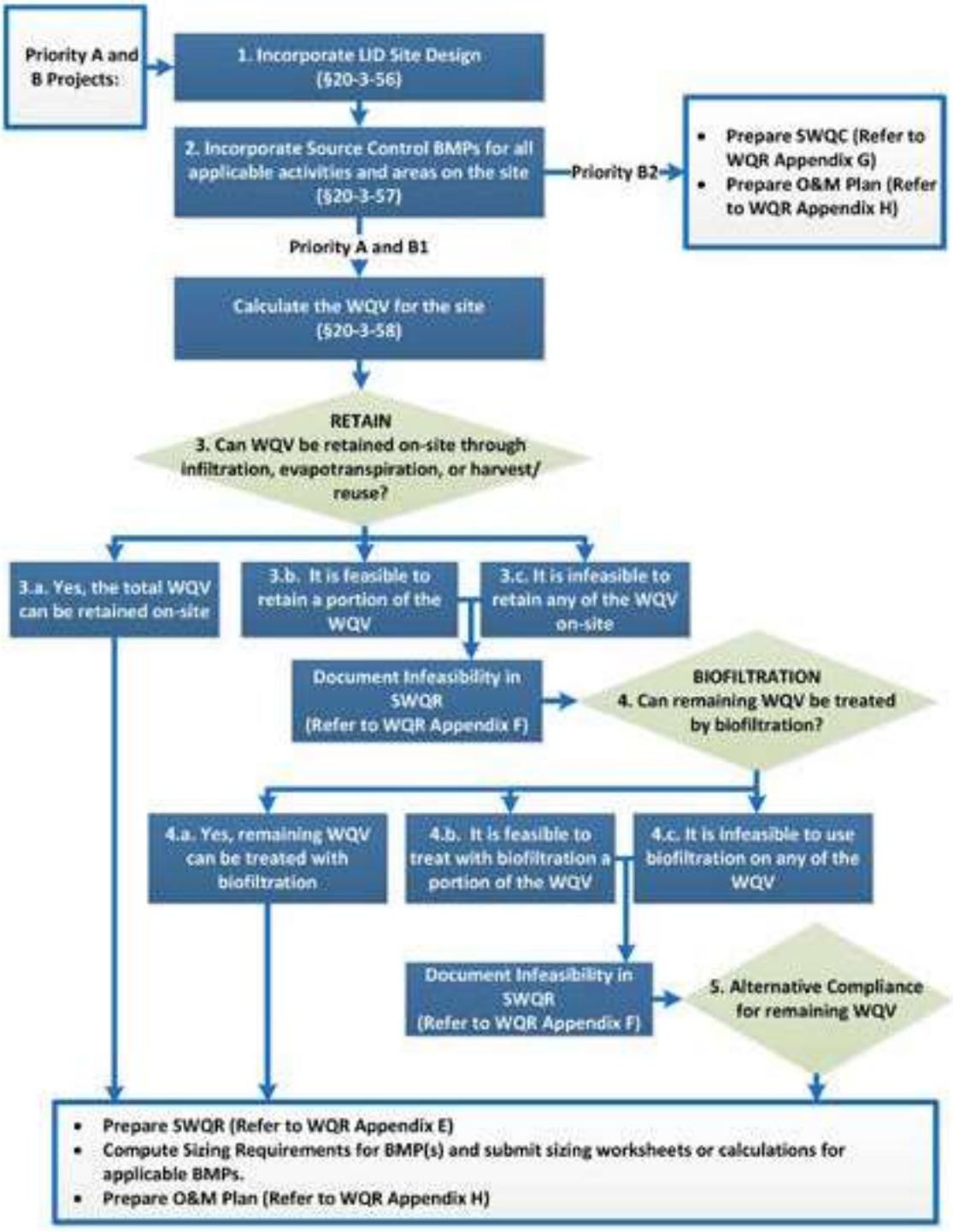


Figure 2.1: Implementation of the CCH Water Quality Rules

Table 2.1: Summary of Post-Construction Requirements for New and Redevelopment

BMP Category		Applicable Projects	Pollution Prevention Objective
LID Site Design		Required for all Priority projects; recommended for all others. See Section 3.2.	Strategies integrated into the facility design to maintain or restore the natural hydrologic functions of a site to reduce the rate of runoff, filter out its pollutants, and facilitate the infiltration of water into the ground.
Source Control		Required for all Priority projects; recommended for all others. See Source Control BMPs in Section 3.3 and **Appendix A**.	Low-technology practices designed to prevent pollutants from contacting storm water runoff or to prevent discharge of contaminated runoff to the storm drainage system.
Treatment Control	**LID Retention**	Required for Priority A and B1 projects if feasible; recommended for all others if feasible. See Treatment Control BMPs in Section 5 and **Appendix B**.	Engineered technologies designed to retain runoff on-site by infiltration, evapotranspiration, or reuse.
	LID Biofiltration	Required for Priority A and B1 projects if LID Retention is infeasible; recommended for all others if feasible. See Treatment Control BMPs in Section 5 and **Appendix B**.	Engineered technologies designed to remove pollutants from runoff by filtration, adsorption, and biological uptake.
	Alternative Compliance BMPs	Required for Priority A and B1 projects when retention and biofiltration are infeasible. See Treatment Control BMPs in Section 5 and **Appendix B**.	Engineered technologies designed to remove pollutants from runoff by detention, filtration, settling, or vortex separation.

2.1. City and County of Honolulu Plan Review Requirements

The City's *Water Quality Rules* requires several documents to be prepared and submitted prior to permit issuance.

2.1.1. Storm Water Quality Strategic Plans

Storm Water Quality Strategic Plans (Strategic Plans) should be submitted with or within the Master Development Plan. This requirement ensures that project developers, planners, and designers are considering storm water management early in the planning process. The Strategic Plan must include a written description of the proposed development, expected activities and pollutants that will be generated by activities at the site, and LID site design strategies that will be used to comply with the *Water Quality Rules*. The Strategic Plan must also include a development schedule.

2.1.2. Storm Water Quality Reports

An effective mechanism for documenting the incorporation of storm water quality controls into new development and redevelopment projects on a site or watershed basis is to develop a written plan known as a Storm Water Quality Report (SWQR). An effective SWQR clearly sets forth the means and methods

for long-term storm water quality protection. The SWQR will also prove to be useful during ownership transitions to convey critical storm water quality control information to subsequent owners.

SWQRs must be submitted with either a building permit application or, for projects which require a grading, grubbing, stockpiling or trenching permit, the SWQR must be submitted with construction plans for review. SWQRs must be prepared by a Certified Water Pollution Plan Preparer (CWPPP). A CWPPP must be an Architect, Engineer, Land Surveyor, or Landscape Architect licensed in the State of Hawaii. Certification can be obtained from the DPP by the successful completion of an on-line training and test.

A template is provided by the City on the Department of Planning and Permitting (DPP) website. SWQRs must contain the following information:

1. Project Name;
2. Master Plan Development Name;
3. Project Address;
4. Project Size (acres);
5. Tax Map Key;
6. The name, address, and telephone number of the owner(s)/developers of the property;
7. A description of site characteristics including drainage patterns, soils, vegetation, and steep or unstable slopes that may be of concern;
8. A description of the future activities at the site including those that would require Source Control BMPs
9. A description of the pollutants of concern (POC) expected to be generated at the site; and
10. A description of the BMPs that will be implemented including Site Design and Self-mitigating Areas, Source Control, Retention, Biofiltration, and Alternative Compliance and which POCs are addressed by those BMPs.

The following reports and plans should be included as attachments as applicable.

1. Location Map and Site Plans;
2. Existing and Proposed Drainage Plans;
3. Permanent BMP Plan including locations of all Source Control and Treatment Control BMPs and a clear and definite delineation of areas covered by vegetation or trees that will be saved;
4. Treatment Control BMP Sizing Spreadsheets;
5. Infiltration Testing Results/Geotechnical Reports;
6. Operation and Maintenance Plan;
7. Proprietary Treatment Device Information; and/or
8. Evidence or explanation for any infeasibility criteria claimed in order to comply with the requirements for infiltration, harvest/reuse, and biofiltration. Infeasibility criteria is discussed more in Section 5.5 and must be documented on the form provided by DPP which can be accessed on their website.

2.1.3. Storm Water Quality Checklists

Storm Water Quality Checklists (SWQCs) are required for Priority B2 Projects. An SWQC is similar to an SWQR but requires less information. A template is provided by on the DPP website.

SWQCs must contain the following information:

1. Project Name;
2. Master Plan Development Name;
3. Project Address;
4. Project Size (acres of square feet);
5. Impervious Area; ;
6. Tax Map Key
7. The name, address, and telephone number of the owner(s)/developers of the property;
8. BMPs that will be implemented including Site Design Strategies, Self Mitigating Areas, and Source Control BMPs.

The following reports and plans shall be included as attachments:

1. Permanent BMP Plan including locations of all Site Design Strategies, Source Control BMPs and vegetated or landscaped areas; and
2. Operations and Maintenance Plan.

2.1.4. Operations and Maintenance Plan

The *Water Quality Rules* require new development and redevelopment projects that implement Source Control and Treatment Control BMPs to regularly inspect and maintain installed BMPs to ensure they operate as designed. Permanent BMPs are also subject to annual inspections by the City's Department of Facility Maintenance (DFM). The owner/developer is required to keep records of inspection and maintenance activities for a minimum of five (5) years and be made available to the City upon request.

The owner of the property on which a permanent structural BMP is located must submit a BMP maintenance plan with the SWQR for all permanent structural BMPs. Modifications to the O&M Plan after DPP acceptance are permitted before closing applicable building and/or grading, grubbing, stockpiling, or trenching permits.

A template has been provided by the City and is available on the DPP website. O&M Plans shall include:

1. Name, phone number, and mailing address for the owner of the property.
2. Name and phone number for the individual(s), association, or management company responsible ensuring maintenance is being performed.
3. Maintenance activities for each BMP.
4. Inspection frequencies for each BMP.
5. A post-construction BMP plan showing the location of each BMP with a summary of the maintenance activities and inspection schedule for each BMP.

2.1.5. BMP Certification and Recording

Approved post-construction record drawings and the accepted O&M Plan must be recorded with the drainage connection permit in the deed for the real property on which the permanent BMP will be located. One copy of the drainage connection permit and recorded O&M Plan shall be submitted to the Director of DFM prior to closing the building and/or grading, grubbing, stockpiling, or trenching permits.

A CWPPP shall inspect to confirm that the permanent post-construction BMPs have been installed in conformance with the approved construction plans and submit the signed Certificate of Completion form prior to closing the building and/or grading permits. The certification of completion form is available on the DPP website.

2.1.6. Variances

Whenever there are practical difficulties involved in carrying out the LID Regulations, the DPP Director has the authority to grant modifications to the provisions for individual cases. These must be filed for individually and the applicant must demonstrate that the situation is unique, not caused by their own actions, and will not result in unreasonable threat of Pollutant Discharges to the MS4 or State Waters.

3. Storm Water Quality Planning for New Development and Redevelopment

The City's program requires BMPs to be implemented by developers, property owners, and public agencies engaged in new development or redevelopment activities. Understanding new development and redevelopment in the context of the project life cycle is important for proper selection and implementation of BMPs as shown in **Figure 3.1**. The concept, planning, and design phases of a project may be spread over a period of months to many years. BMPs incorporated into the concept, planning, and design phase are much more cost-effective than the retrofit of developed projects with BMPs.

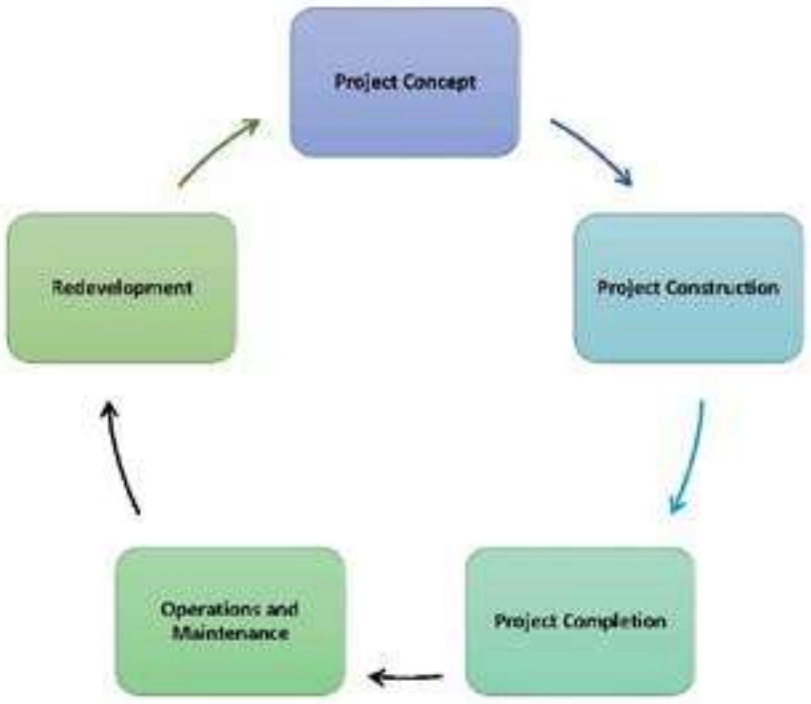


Figure 3.1: Project Life Cycle

Planning for storm water quality protection employs a multi-level strategy. To comply with the *Water Quality Rules*, the strategy consists of: 1) Site design strategies to reduce or eliminate post-project runoff; 2) Controlling sources of pollutants; and 3) Treating the remaining storm water runoff before discharging it to the storm drain system or to receiving waters.

This section describes how Elements 1 and 2 of the strategy can be incorporated into the site and facility planning and design process, and by doing so, eliminating or reducing the amount of storm water runoff that may require treatment at the point where storm water runoff ultimately leaves the site. It also describes considerations when selecting treatment to achieve Element 3.

Element 1 is referred to as a "site design strategy" because it utilizes strategies during site design to reduce or eliminate runoff.

Element 2 may be referred to as "source controls" because they emphasize reducing or eliminating pollutants in storm water runoff at their source through runoff reduction and by keeping pollutants and storm water segregated.

Element 3 of the strategy is referred to as "treatment control" because it utilizes treatment mechanisms to remove pollutants that have entered storm water runoff. Treatment controls integrated into and throughout the site usually provide enhanced benefits over the same or similar controls deployed only at the "end of the pipe" where runoff leaves the project site.

These principles are consistent with the permit and the program requirements for Priority Projects that require a combination of site design, source control BMPs (that reduce or eliminate runoff and control pollutant sources) and treatment control BMPs with specific quantitative standards. The extent to which projects can incorporate site design strategies that reduce or eliminate post project runoff will depend upon the land use and local site characteristics of each project. Reduction in post project runoff offers a direct benefit by reducing the required size of treatment controls to meet the numeric standard included in the *Water Quality Rules*. Therefore, project developers can evaluate tradeoffs between the incorporation of alternative site design and source control techniques that reduce runoff and pollutants, and the size of required treatment controls.

3.1. Assess Site Conditions

Site and watershed assessment includes assessing and describing the pre- and post-development site conditions and how the site fits into the overall watershed or drainage area. The assessment should include sufficient detail to allow for assessment of the need for and application of storm water BMPs. Information typically required is listed below and can be refined during the detailed design process.

Site Information:

- Historic features
- Existing features and vegetation
- Planned features and activities
- Topography and drainage patterns
- Discharge locations
- Soil types
- Subsurface hydrology characterization
- General climate including average precipitation and microclimates including areas of full or partial shade
- Setbacks and buffer requirements

Vicinity Information:

- Major roadways
- Geographic features or landmarks
- Area surrounding the site
- General topography
- Area drainage

Watershed or Drainage Area Information:

- Receiving waters
- Watershed drainage
- Depth to groundwater

3.1.1. Understand Hydrologic Conditions of Concern

Development of impervious areas changes the landform and therefore the runoff hydrograph. Modifications to the runoff hydrograph change downstream hydrology. New development typically results in more runoff volume and higher rates of runoff. Many BMPs, such as detention basins, which

detain volume, effectively remove the top part of the hydrograph, but extend the duration of flow. See **Figure 3.2**.

Recent findings indicate that while such actions mitigate peak flows, the increased duration associated with these actions has impacts as well. Problems include washing out habitat, eroding streambed and banks, and changing downstream ecosystems. In addition to volume, rate, and duration, other factors such as the amount of energy in the water and peak flow impact downstream conditions.

A comprehensive understanding of these factors is necessary to develop meaningful storm water management plans. To be effective, these solutions must be done on an individual watershed basis.

Ideally, the runoff hydrograph that exists after construction would parallel the pre-construction hydrograph. It is difficult to ask upstream developers to be concerned about what is happening several miles below them in a watershed. On the other hand, storm water planners and policy makers must ask what can be done to make the watershed more stable, and what enhancements are needed to balance impacts to the watershed from development. Storm water quality planning for new development and redevelopment can be used to make qualitative predictions concerning channel impacts due to changes in runoff or sediment loads from the watershed.

The best way to resolve the watershed stability and balance issues is through a comprehensive drainage water master plan. A formal drainage study considers the project area's location in the larger watershed, topography, soil and vegetation conditions, percent impervious area, natural and infrastructure drainage features, and any other relevant hydrologic and environmental factors. A drainage study is typically prepared by a licensed civil engineer. As part of the study, the drainage report includes:

- Field reconnaissance to observe downstream conditions.
- Computed rainfall and runoff characteristics including a minimum of peak flow rate, flow velocity, runoff volume, time of concentration and retention volume.
- Establishment of site design, source control and treatment control measures to be incorporated and maintained to address downstream conditions of concern.

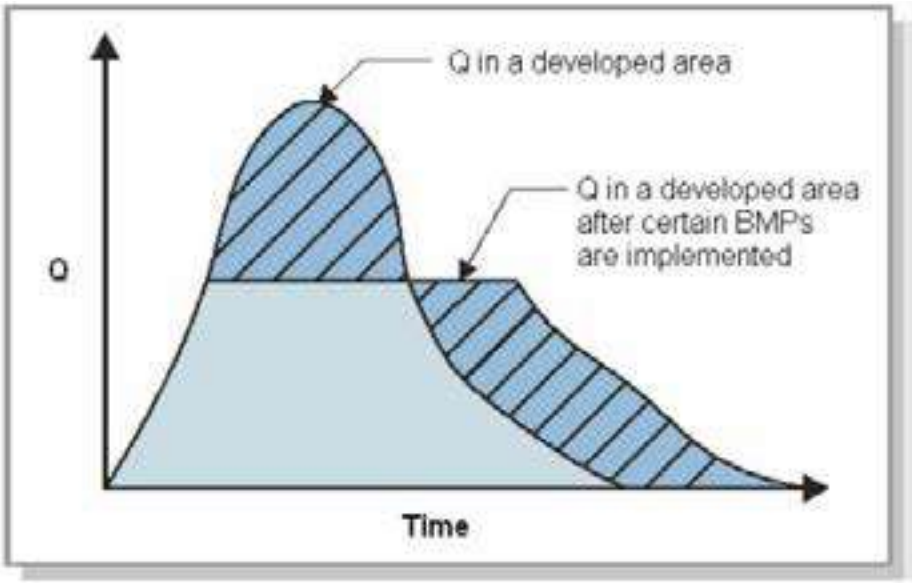


Figure 3.2: Hydraulic Altercation after Certain BMPs are Implemented

3.2. Site Design Strategies

The goal of LID Site Design is to reduce the hydrologic impact of development and to incorporate techniques that maintain or restore the site's hydrologic and hydraulic functions. The optimal LID site design minimizes runoff volume and preserves existing flow paths.

The City requires five (5) Site Design strategies:

1. Conserve natural areas, soils, and vegetation.
2. Minimize disturbances to natural drainages.
3. Minimize soil compaction.
4. Direct runoff to landscaped areas and reduce directly connected impervious areas (DCIA).
5. Minimize impervious surfaces.

3.2.1. Conserve Natural Areas, Soils, and Vegetation

The conservation of natural areas, soils, and vegetation helps to retain numerous functions of predevelopment hydrology, including rainfall interception, evapotranspiration, and infiltration. Maximizing these functions will thereby reduce the amount of runoff that must be treated. Protection of mature trees and vegetation provides habitat, prevents erosion, captures significant rainfall, provides summer shading, and reduces runoff volume and velocity which protects and enhances downstream water quality. Specific measures are:

- Preserve/protect riparian buffers.
- Preserve/protect wetlands.
- Preserve/protect natural flow pathways.
- Preserve/protect steep slopes.
- Preserve/protect sensitive environmental areas.
- Preserve/protect undisturbed vegetated areas/corridors.
- Preserve native trees and restrict disturbance of soils beneath tree canopies.
- Limit construction activities and disturbances to areas with previously disturbed soils.
- Avoid disturbing vegetation and soil on slopes and near surface waters.
- Leave an undisturbed buffer along both sides of natural streams.

Refer to Section 6 regarding considerations and sequencing practices to preserve existing vegetation during construction.

3.2.2. Minimize Disturbances to Natural Drainages

Natural drainages offer a benefit to storm water management as the soils and habitat already function as a natural filtering/infiltrating swale. Minimizing disturbances to natural drainage patterns preserves the predevelopment timing, rate, and duration of runoff as well as preserving streamside habitats. When determining the development footprint of the site, natural drainages should be avoided. By keeping the development envelope set back from natural drainages, the drainage can retain its water quality benefit to the watershed. Specific measures are:

- Limit site disturbance, clearing, and grading to the smallest areas necessary.
- Maintain surface flow patterns of undeveloped sites.

- Maintain existing water body alignments, sizes, and shapes.
- Minimize and control construction traffic areas.
- Minimize and control construction stockpiling and storage areas.
- Use construction fencing to mark where no disturbances will be allowed.

3.2.3. Minimize Soil Compaction

Clearing, grading and compaction by construction traffic reduces the natural absorption and infiltration capacities of the native soils. Soil compaction damages soil structure, reduces infiltration rates, limits root growth and plant survivability, and destroys soil organisms. Subsequent tilling and/or addition of soil amendments such as compost can help, but will not restore the original infiltration capacity of the soils. By protecting native soils and vegetation in appropriate areas during the clearing and grading phase of development the site can retain some of its existing beneficial hydrologic function. Specific measures are:

- Protect soils against compaction and rutting in areas where traffic is unavoidable.
- Minimize the size of construction easements and material storage areas.
- Limit areas of heavy equipment.
- Prohibit working on wet soils with heavy equipment.
- Restore compacted open space areas with tilling and soil amendments.
- Avoid extensive and unnecessary clearing and stockpiling of topsoil.
- Avoid/minimize soil compaction in open space, landscaped, and proposed LID BMP areas.
- Prepare soil amendments off-site.

3.2.4. Direct Runoff to Landscape Areas and Reduce Directly Connected Impervious Areas

Any impervious surface that drains into a catch basin, area drain, or other conveyance structure is a DCIA. Impervious areas directly connected to the storm drain system are the greatest contributor to non-point source pollution. The first effort in site planning and design for storm water quality protection is to minimize the DCIA as shown in **Figure 3.3**.

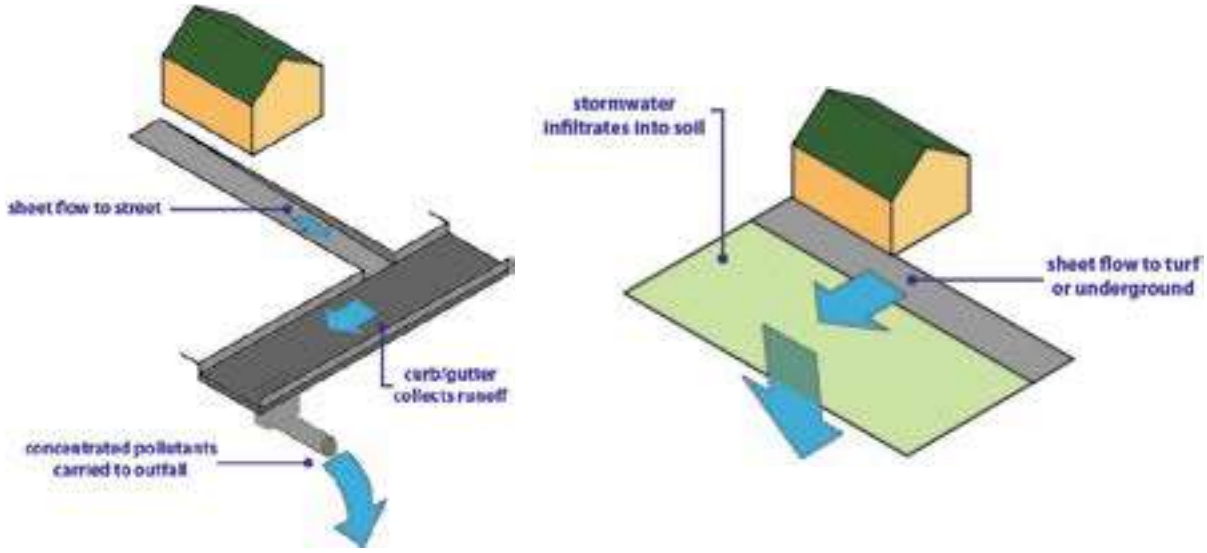


Figure 3.3: Directly Connected Impervious Area versus Directing Runoff to Landscaped Areas

As storm water runoff flows across parking lots, roadways, and paved areas, the oils, sediments, metals, and other pollutants are collected and concentrated. If this runoff is collected by a drainage system and carried directly along impervious gutters or in closed underground pipes, it has no opportunity for filtering by plant material or infiltration into the soil. It also increases in speed and volume, which may cause higher peak flows downstream, and may require larger capacity storm drain systems, increasing flood and erosion potential. Solutions that reduce DCIA prevent runoff, detain or retain surface water, attenuate peak runoff rates, benefit water quality and convey storm water. Specific measures are:

- Design roof drains to flow to vegetated areas.
- Direct flow from paved areas to stabilized landscaped/vegetated areas (See **Figure 3.4**).
- Grade paved areas to achieve sheet flow to landscaped areas.
- Break up flow directions from large paved surfaces.



Figure 3.4: Parking Lot Directing Runoff to Landscape Areas

3.2.5. Minimize Impervious Surfaces

The principle of runoff reduction starts by recognizing that developing or redeveloping land within a watershed inherently increases the imperviousness of the areas and therefore the volume and rate of runoff and the associated pollutant load.

The extent of impervious land covering the landscape is an important indicator of storm water quantity and quality and the health of urban watersheds. Studies have demonstrated a direct correlation between the degree of imperviousness of an area and the degradation of its receiving waters. Impervious land coverage is a fundamental characteristic of the urban and suburban environment; rooftops, roadways, parking areas, and other impenetrable surfaces cover soils that allowed rainwater to infiltrate before development.

Without these impervious coverings, inherent watershed functions would naturally filter rainwater and prevent receiving water degradation. Impervious surfaces associated with urbanization can cause adverse receiving water impacts in four (4) ways:

1. Rainwater is prevented from filtering into the soil, adversely affecting groundwater recharge and reducing base stream flows.
2. Because it cannot filter into the soil, more rainwater runs off, and runs off more quickly, causing increased flow volumes, accelerating erosion in natural channels, and reducing habitat and other stream values. Flooding and channel destabilization often require further intervention. As a result, riparian corridors are lost to channelization, further reducing habitat values.

3. Pollutants that settle on the impervious pavements and rooftops are washed untreated into storm sewers and nearby stream channels, increasing pollution in receiving water bodies.
4. Impervious surfaces retain and reflect heat, increasing ambient air and water temperatures. Increased water temperature negatively impacts aquatic life and reduces the oxygen content of nearby water bodies.

These techniques include actions to:

- Manage watershed impervious area.
- Include self-mitigating areas.
- Consider runoff reduction areas.

Manage Watershed Impervious Area

Land use planning on the watershed scale is a powerful tool to manage the extent of impervious land coverage and is especially applicable to larger scale community development and master planning. First, identify open space and sensitive resource areas and target growth to areas that are best suited to development, and second, plan development that is compact to reduce overall land conversion to impervious surfaces and reliance on land-intensive streets and parking systems.

Water resource protection is becoming more complex. A wide variety of regulatory agencies, diverse sources of non-point source pollution, and a multitude of stakeholders make it difficult to achieve a consistent, easily understandable strategy for watershed protection. Impervious land coverage is a scientifically sound, easily communicated, and practical way to measure the impacts of new development on water quality.

Impervious area reductions also provide additional benefits such as reduced urban heat island effect, resulting in less energy use to cool structures and more efficient irrigation use by plants. Reductions have also been attributed to more human-scale landscaping and higher property values.

Strategies for reducing impervious land coverage include:

- Cluster buildings so that they require less driveways and pathways.
- Taller narrower buildings rather than lower spreading ones.
- Sod or vegetative “green roofs” rather than conventional roofing materials.
- Pervious pavement for light duty roads, parking lots, and pathways.
- Use open space or hybrid street plan instead of grid and curvilinear.
- Maximize utilization of compact car spaces in parking areas.
- Reduce driveway sizes.

Many of these strategies are discussed in Section 3. Two (2) of the strategies to Minimize Impervious Surfaces result in direct benefit to treatment control requirements: Self-Mitigating Areas and Runoff Reduction Areas. These two (2) strategies result in a smaller WQV requiring treatment under the City’s *Water Quality Rules*.

Include Self-Mitigating Areas

Developed areas may provide "self-mitigation" of runoff if properly designed and drained.

A self-mitigating area is a natural or landscape area which retain and/or treat rainfall over the footprint of the self-mitigating area but do not accept runoff from other areas. Self-mitigating areas can drain directly offsite or to the public storm drain system without being treated by a structural BMP.

Self-mitigating areas might include:

- Conserved natural spaces
- Landscaped areas (including parks and lawns)
- Grass/vegetated swales
- Green roofs

The infiltration and biotreatment inherent to such areas provides the treatment control necessary. These areas therefore act as their own BMP, and no additional BMPs to treat runoff are required.

As illustrated in **Figure 3.5**, site drainage designs must direct runoff from self-treating areas away from other areas of the site that require treatment of runoff. Otherwise, the volume from the self-mitigating area will only add to the volume requiring treatment from the impervious area as demonstrated in **Figure 3.6**.

Likewise, under this philosophy, self-mitigating areas receiving runoff from treatment-required areas would no longer be considered self-mitigating, but rather would be considered as the BMPs in place to treat that runoff. These areas could remain as self-mitigating, or partially self-mitigating areas, if adequately sized to handle the excess runoff addition.

Consider Runoff Reduction Areas

Using alternative surfaces with a lower coefficient of runoff or "C-Factor" can reduce runoff from developed areas. The C-Factor is a representation of the surface's ability to produce runoff. Surfaces that produce higher volumes of runoff are represented by higher C-Factors, such as impervious surfaces. Surfaces that produce smaller volumes of runoff are represented by lower C-Factors, such as more pervious surfaces. See **Table 3.1** for typical C-Factor values for various surfaces during small storms.

Table 3.1: Estimated C-Factor for Various Surfaces during Small Storms

Paving Surfaces	C-Factor		Paving Surfaces	C-Factor
Concrete	0.80		Permeable interlocking concrete pavement	0.10
Stone, brick, or concrete pavers with mortared joints and bedding	0.80		Grid pavements with grass or aggregate surface	0.10
Asphalt	0.70		Crushed aggregate	0.10
Stone, brick, or concrete pavers with sand joints and bedding	0.70		Grass	0.10
Pervious concrete	0.10		Grass over porous plastic	0.05
Porous asphalt	0.10		Gravel over porous plastic	0.05
Note: C-Factors for small storms are likely to differ (be lower) than C-Factors developed for large, flood control volume size storms. The above C-Factors were produced by selecting the lower end of the best available C-Factor range for each paving surface. These C-Factors are only appropriate for small storm treatment design, and should not be used for flood control sizing.				

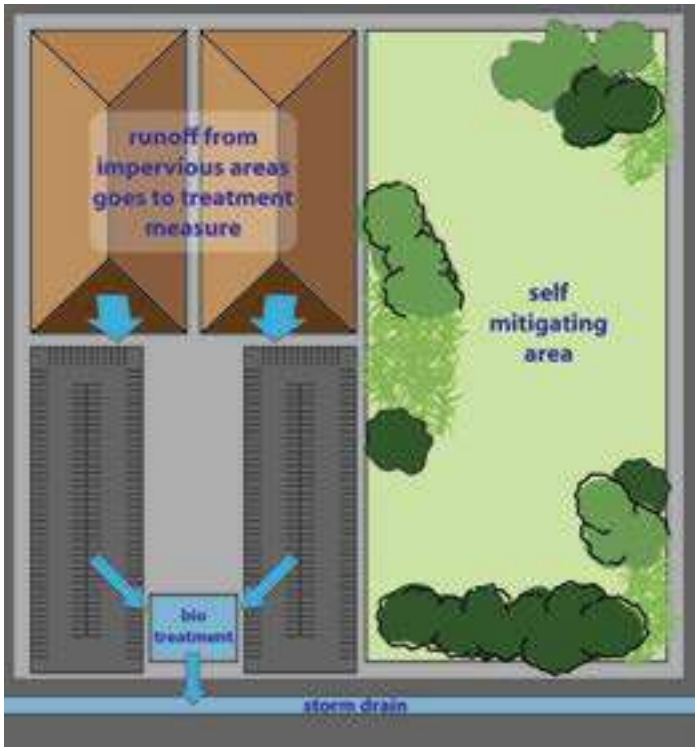


Figure 3.5: Use of Self-Mitigating Areas

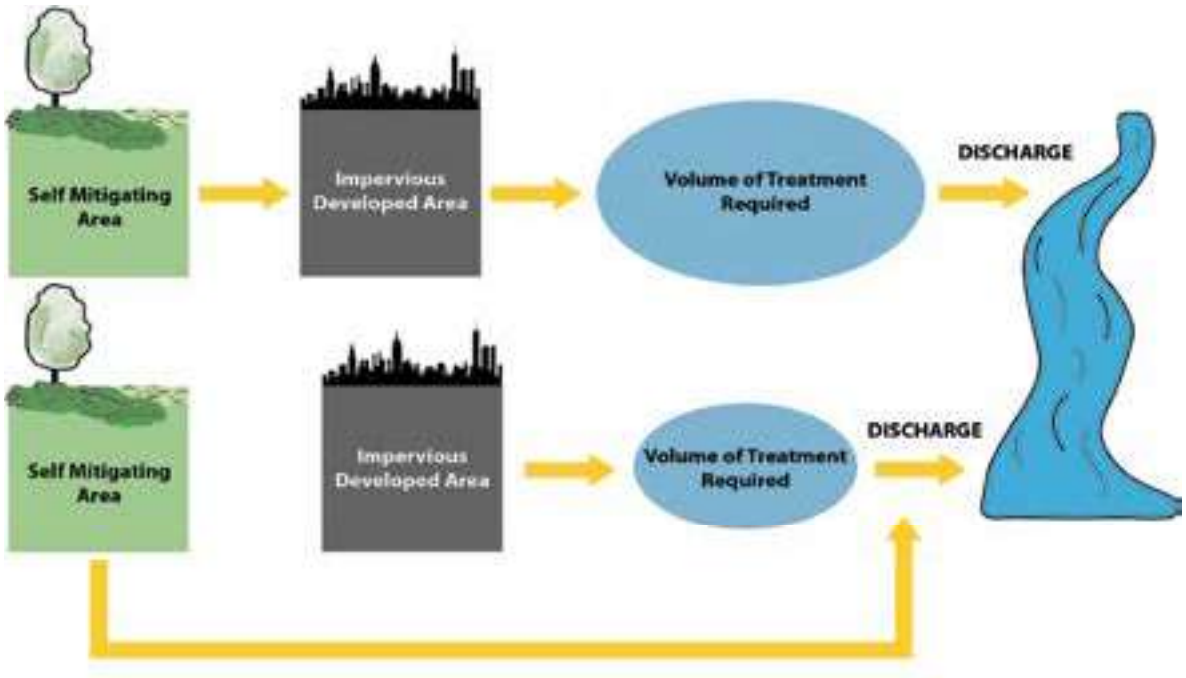


Figure 3.6: Self-Mitigating Areas Treatment Volume

Site design techniques that incorporate pervious materials may be used to reduce the C-Factor of a developed area, reducing the amount of runoff requiring treatment. These materials include:

- Pervious concrete
- Pervious asphalt
- Turf block
- Brick (un-grouted)
- Natural stone
- Concrete unit pavers
- Crushed aggregate
- Cobbles
- Wood mulch

Table 3.2 compares the C-Factors of conventional paving surfaces to alternative; lower C-Factor paving surfaces. By incorporating more pervious, lower C-Factor surfaces into a development (see **Figure 3.7**); lower volumes of runoff may be produced. Lower volumes and rates of runoff translate directly to lower treatment requirements.

Table 3.2: Conventional Paving Surface Small Storm C-Factor versus Alternative Paving C-Factors

Conventional Paving Surface C-Factors	Reduced C-Factor for Paving Alternatives
• Concrete Patio/Plaza (0.80) • Asphalt Parking Area (0.70)	• Decorative unit Pavers on Sand (0.10) • Turf Block Overflow Parking Area (0.10) • Pervious Concrete (0.10) • Pervious Asphalt (0.10) • Crushed Aggregate (0.10)

Other site design techniques such as disconnecting impervious areas, preservation of natural areas, and designing concave medians may be used to reduce the overall C-Factor of development areas.

3.3. Control Sources of Pollutants

There are a number of items that can be routinely designed into a project that function as source controls once a project is completed. Design of BMPs to control exposure to pollutants is guided by two (2) general principles:

1. Prevent water from contacting work areas. Work and storage areas should be designed to prevent storm water runoff from passing through shipping areas, vehicle maintenance yards, and other work places before it reaches storm drains. The objective is to prevent the discharge of water laden with grease, oil, heavy metals and process fluids to surface waters or sensitive resource areas.
2. Prevent pollutants from contacting surfaces that come into contact with storm water runoff. Precautionary measures should be employed to keep pollutants from contacting surfaces that come into contact with runoff. This means controlling spills and reviewing operational practices and equipment to prevent pollutants from coming into contact with storm or wash water runoff.

Examples of structural source controls include covers, impermeable surfaces, secondary containment facilities, runoff diversion berms, and diversions to wastewater treatment plants. See **Figure 3.7**.

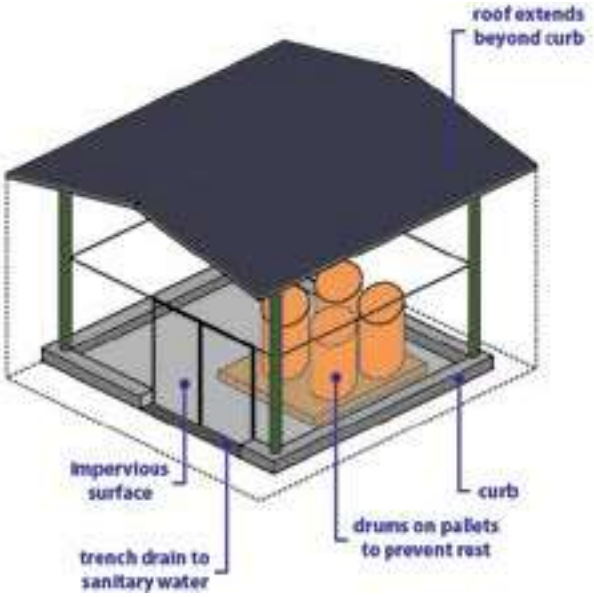


Figure 3.7: Example of Source Control Design for Outdoor Material Storage

The *Water Quality Rules* require that Source Control BMPs are required for all Priority A and B projects for the following activities and areas:

Activity or Area Required to Implement Source Control	BMP Fact Sheet (Appendix A)
Landscaped Areas	SD-01
Automatic Irrigation System	SD-03
Storm Drain Inlets	SD-04
Vehicle/Equipment Fueling	SD-06
Vehicle/Equipment Repair	SD-07
Vehicle/Equipment Cleaning	SD-08
Loading Docks	SD-09
Outdoor Trash Storage	SD-10
Outdoor Material Storage	SD-11
Outdoor Work Areas	SD-12
Outdoor Process Equipment Operations	SD-13
Parking Areas	SD-14

Source control fact sheets are provided in **Appendix A**. In addition, fact sheets are provided for Roof Runoff Controls (SD-02) and Alternative Building Materials (SD-05) which are not required by the *Water Quality Rules*.

The following information is provided for each of the above-listed BMPs:

- Brief Description/Approach
- Suitable Applications
- Design Considerations

- Design Guidelines
- Examples
- Operations & Maintenance Recommendations

3.4. Treat Runoff

Today's drainage systems must meet multiple purposes: protect property from flooding, control stream bank erosion, and protect water quality. To achieve this, designers must integrate conventional flood control strategies for large, infrequent storms with storm water quality control strategies.

There are several basic water quality strategies for treating runoff:

- Infiltrate runoff into the soil.
- Capture, store, and reuse runoff on site.
- Convey runoff slowly through vegetation.
- Treat runoff on a flow-through basis using various treatment technologies.
- Retain/detain runoff for later release with the detention providing treatment.

Solutions should be based on an understanding of the water quality and economic benefits inherent in construction of systems that utilize or mimic natural drainage patterns. Site designs should be based on site conditions and use these as the basis for selecting appropriate storm water quality controls. The drainage system design process considers variables such as local climate, the infiltration rate and erosivity of the soils, and slope.

Unlike conveyance models, which are assessed by simple quantitative measures (flood control volumes and economics), water quality designs must optimize a complex array of both quantitative and qualitative standards, including engineering worthiness, environmental benefit, horticultural sustainability, aesthetics, functionality, maintainability, economics and safety.

Treatment Control BMPs are discussed in more detail in Section 5.

4. Site and Facility Design for Water Quality Protection

Many common site features can achieve storm water management goals by incorporating one or more basic elements, either alone or in combination, depending on site and other conditions. The basic elements include infiltration, retention/detention, biofilters, and structural controls. This section first describes these basic elements, and then describes how these elements can be incorporated into common site features.

4.1. Infiltration

Infiltration is the process where water enters the ground and moves downward through the unsaturated soil zone. Infiltration is ideal for management and conservation of runoff because it filters pollutants through the soil and restores natural flows to groundwater and downstream water bodies. See **Figure 4.1**.

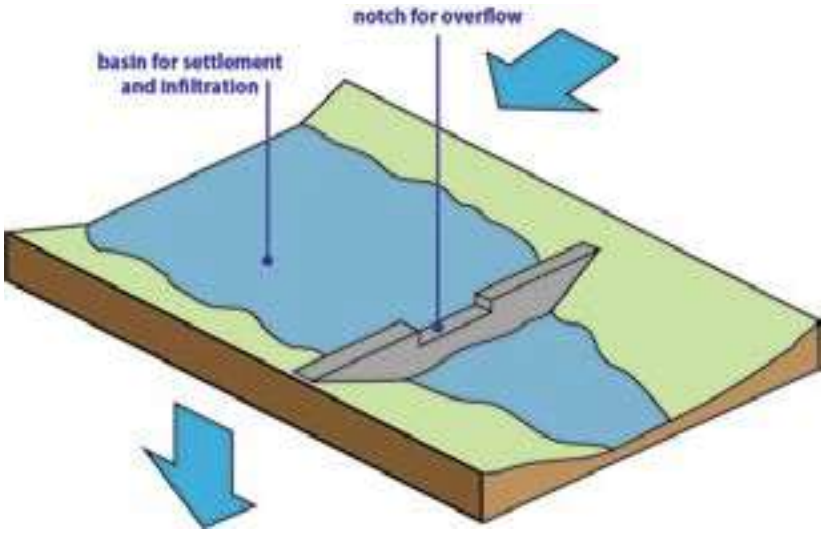


Figure 4.1: Infiltration Basin

The infiltration approach to storm water management seeks to "preserve and restore the hydrologic cycle." An infiltration storm water system seeks to infiltrate runoff into the soil by allowing it to flow slowly over permeable surfaces (see **Figure 4.2** and **Figure 4.3**).

The slow flow of runoff allows pollutants to settle into the soil where they are naturally mitigated. The reduced volume of runoff that remains takes a long time to reach the outfall, and when it empties into a natural water body or storm sewer, its pollutant load is greatly reduced.

Infiltration basins can be either open or closed. Open infiltration basins include ponds, swales and other landscape features and are usually vegetated to maintain the porosity of the soil structure and to reduce erosion. Infiltration trenches and dry wells can also fall into this category although not typically vegetated.

Closed infiltration basins can be constructed under the land surface with open graded crushed stone, leaving the surface to be used for parking or other uses. Subsurface closed basins are generally more difficult to maintain and more expensive than open filtration systems, and are used primarily where high land costs demand that the land surface be reclaimed for economic use.

Infiltration systems are often designed to capture the "first flush" storm event and used in combination with a detention basin to control peak hydraulic flows. They effectively remove suspended solids, particulates, bacteria, organics and soluble metals and nutrients through the vehicle of filtration, absorption and microbial decomposition. Groundwater contamination should be considered as a potential adverse effect and should be considered where shallow groundwater is a source of drinking water. In cases where groundwater sources are deep, there is a very low chance of contamination from normal concentrations of typical urban runoff.

Bioretention facilities have the added benefit of aesthetic appeal and small scale applicability. These systems can be placed in parking lot islands, landscaped areas surrounding buildings, perimeter parking lots, and other open space sections. Placing bioretention facilities on land that City regulations require developers to devote to open space efficiently uses the land. An experienced landscape architect can choose plant species and planting materials that are easy to maintain, aesthetically pleasing, and capable of effectively reducing pollutants in runoff from the site.

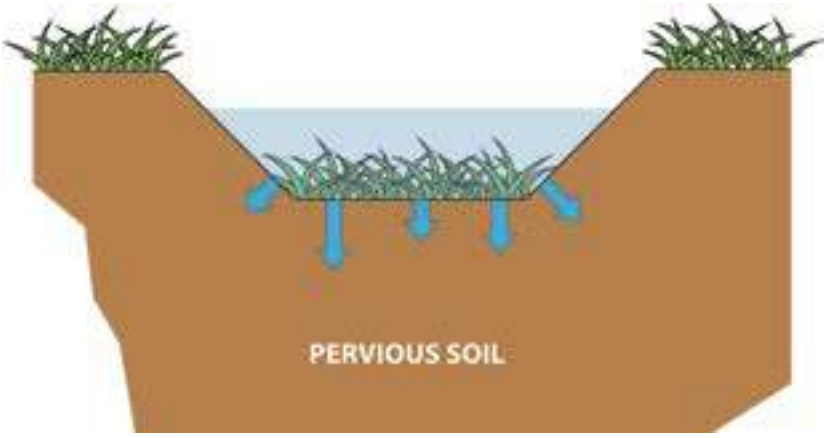


Figure 4.2: Typical Infiltration Facility Schematic

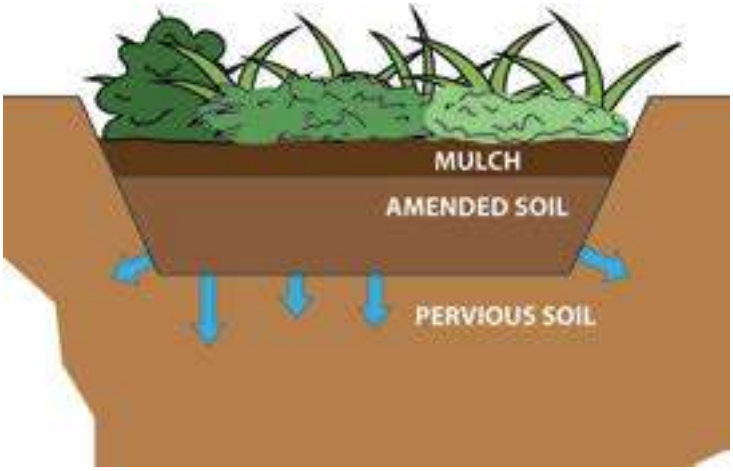


Figure 4.3: Typical Bioretention Schematic

4.2. Retention and Detention

Retention and detention systems differ from infiltration systems primarily in intent. Retention and detention systems may release runoff slowly enough to reduce downstream peak flows to their pre-development levels, allow fine sediments to settle, and uptake dissolved nutrients in the runoff where wetland vegetation is included. Detention systems are designed to capture and retain runoff temporarily and release it to receiving waters at predevelopment flow rates (see **Figure 4.4**). Permanent pools of water are not held between storm events. Pollutants settle out and are removed from the water column through physical processes. Detention systems are allowed under the *Water Quality Rules* for the portions of the WQV that are infeasible to treat with infiltration, harvest/reuse, and Biofiltration BMPs.

Retention systems capture runoff and retain it between storms as shown in **Figure 4.5**. While infiltration does occur, water held in the system is displaced by the next significant rainfall event. Pollutants settle out and are thereby removed from the water column. Because water remains in the system for a period of time, retention systems benefit from biological and biochemical removal mechanisms provided by aquatic plants and microorganisms.

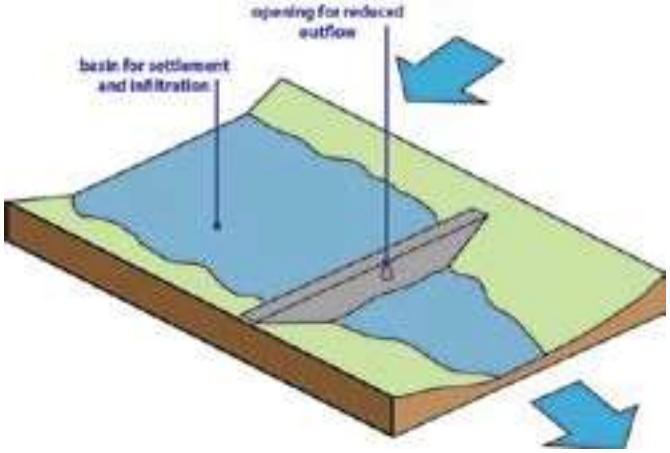


Figure 4.4: Simple Detention System

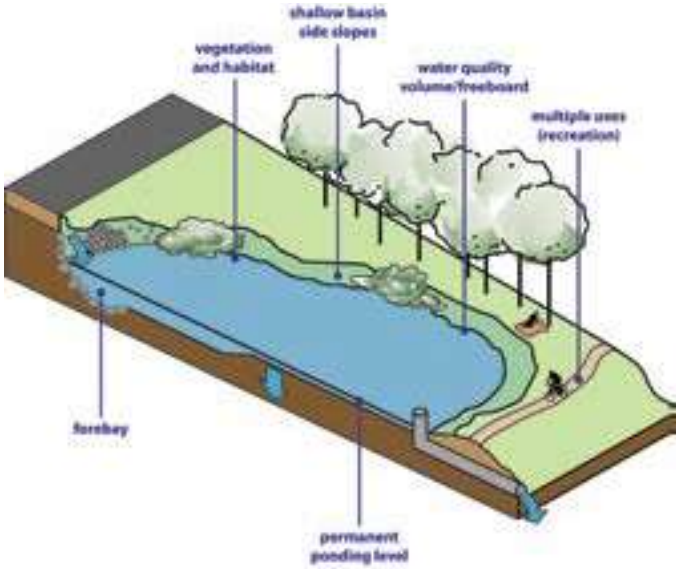


Figure 4.5: Retention System

Constructed wetland systems retain and release storm water in a manner that is similar to retention or detention basins. The design mimics natural ecological functions and uses wetland vegetation to filter pollutants. The system needs a permanent water source to function properly and must be engineered to remove coarse sediment, especially construction related sediments, from entering the pond. Storm water has the potential to negatively affect natural wetland functions and constructed wetlands can be used to buffer sensitive resources.

4.3. Biofilters

Biofilters can consist of vegetated swales and filter strips, green roofs, and engineered or proprietary biofiltration devices such as planter boxes and tree box filters.

Swales are vegetated slopes and channels designed and maintained to transport shallow depths of runoff slowly over vegetation (see **Figure 4.6**). Swales are generally effective if flows are slow [1 ft/second (sec) maximum] and depths are shallow (4 inch maximum). The slow movement of runoff through the vegetation provides an opportunity for sediments and particulates to be filtered and degraded through biological activity. In most soils, the biofilter can also provide an opportunity for storm water infiltration, which further removes pollutants and reduces runoff volumes.

Swales intercept both sheet and concentrated flows and convey these flows in a concentrated, vegetation-lined channel. Grass filter strips intercept sheet runoff from the impervious network of streets, parking lots, and rooftops and divert storm water to a uniformly graded meadow, buffer zone, or small forest. Typically, the vegetated swale and grass strip-planting palette can comprise a wide range of possibilities from dense vegetation to turf grass. Grass strips and vegetated swales can function as pretreatment systems for water entering bioretention systems or other BMPs. If biofilters are to succeed in filtering pollutants from the water column, the planting design must consider the hydrology, soils, and maintenance requirements of the site.

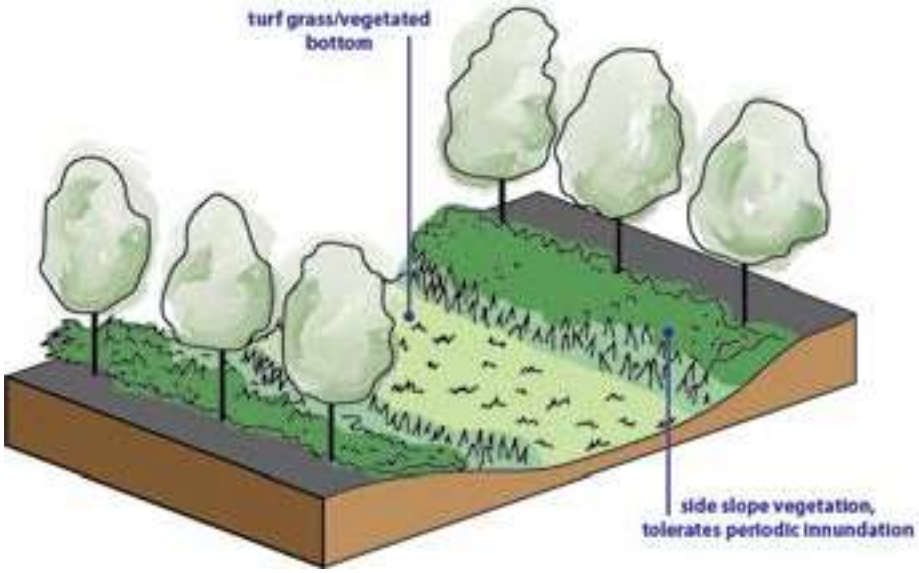


Figure 4.6: Vegetated Swale

Appropriate plants not only improve water quality, but provide habitat and aesthetic benefits. Selected plant materials must be able to adapt to variable moisture regimes. Turf grass is acceptable if it can be watered in the dry season, and if it is not inundated for long periods.

Biofilters also include engineered or proprietary systems such as planter boxes, tree box filters, or similar. They function as soil and plant-based filtration systems, similar to swales that remove pollutants through a variety or physical, biological and chemical treatment processes. The components normally consist of a ponding area, mulch layer, planting soils, plantings, and either a pervious or impervious bottom layer with underdrain (see **Figure 4.7**). These devices can work hand in hand with down spout disconnections.

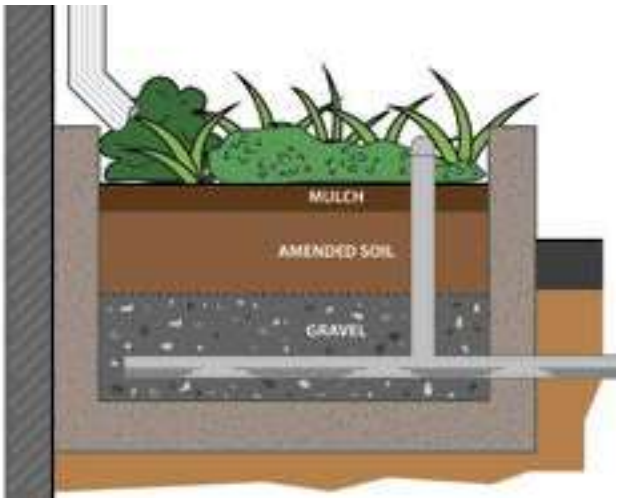


Figure 4.7: Schematic of Planter Box with Down Spout Connection and Underdrain

4.4. Street Design

Street design is mandated by City standards. More than any other single element, street design has a powerful impact on storm water quality. Street and other transportation-related structures typically can comprise between 60 to 70% of the total impervious coverage in urban areas and, unlike rooftops, streets are almost always directly connected to an underground storm water system.

Recognizing that street design can be the greatest factor in development's impact on storm water quality, it is important that designers and developers employ street standards that reduce impervious land coverage. Directing runoff to biofilters or swales rather than underground storm drains produces a street system that conveys storm water efficiently while providing both water quality and aesthetic benefits.

On streets where a more urban character is desired, or where a rigid pavement edge is required, curb and gutter systems can be designed to empty into drainage swales. These swales can run parallel to the street, in the parkway between the curb and the sidewalk, or can intersect the street at cross-angles, and run between residences, depending on topography or site planning. Runoff travels along the gutter, but instead of being emptied into a catch basin and underground pipe, multiple openings in the curb direct runoff into surface swales or infiltration/detention basins.

In recent years, new street standards have been gaining acceptance that meets the access requirements of local residential streets while reducing impervious land coverage. These standards create a new class of street that is narrower and more interconnected than the current local street standard, called an "access"

street. An access street is at the lowest end of the street hierarchy and is intended only to provide access to a limited number of residences.

A street standard that allows an interconnected system of narrow access streets for residential neighborhoods has the potential to achieve several complimentary environmental and social benefits. A hierarchy of streets sized according to average daily traffic volumes yields a wide variety of benefits: improved safety from lower speeds and volumes, improved aesthetics from street trees and green parkways, reduced impervious land coverage, less heat island effect, and lower development costs. If the reduction in street width is accompanied by a drainage system that allows for infiltration of runoff, the impact of streets on storm water quality can be greatly mitigated.

A comparison of street cross-sections is shown in **Figure 4.8**.

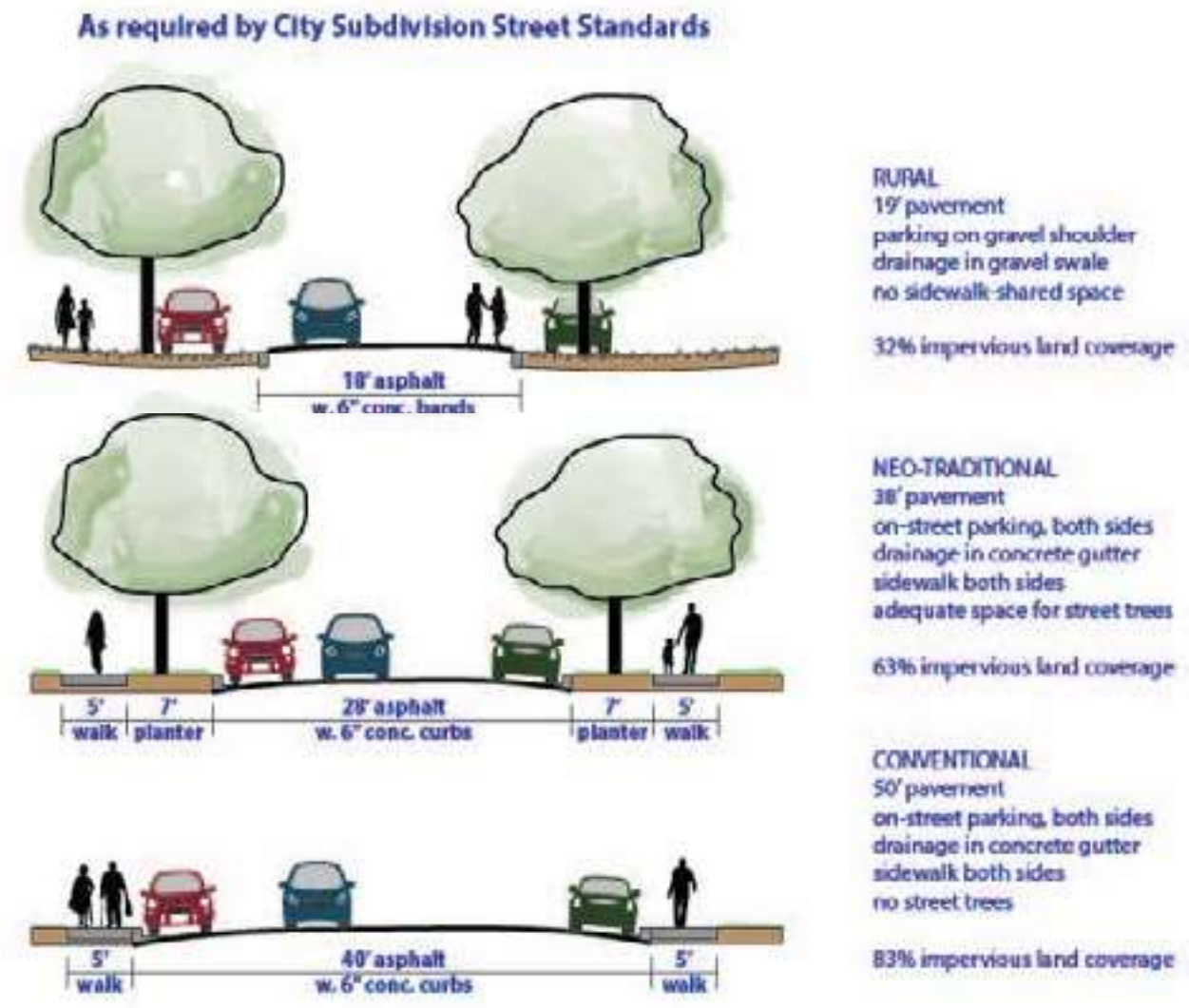


Figure 4.8: Comparison of Street Cross-Section (Two-Way, Residential Access Streets)

4.5. Street Trees

Trees improve water quality by intercepting and storing rainfall on leaves and branch surfaces, thereby reducing runoff volumes and delaying the onset of peak flows. A single street tree can have a total leaf surface area of several hundred to several thousand sq-ft, depending on species and size. This aboveground surface area created by trees and other plants greatly contributes to the water holding capacity of the land. They attenuate conveyance by increasing the soil's capacity to filter rainwater and reduce overland flow rates. By diminishing the impact of raindrops on un-vegetated soil, trees reduce soil erosion. Street trees also have the ability to reduce ambient temperature of storm water runoff and absorb surface water pollutants.

4.6. Parking Lots

In any development, storage space for stationary vehicles can consume many acres of land area, often greater than the area covered by streets or rooftops. In a neighborhood of single-family homes, this parking area is generally located on private driveways or along the street. In higher density residential developments, parking is often consolidated in parking lots.

The space for storage of the automobile, the standard parking stall, occupies only 160 sq-ft, but when combined with aisles, driveways, curbs, overhang space, and median islands, a parking lot can require up to 400 sq-ft per vehicle, or nearly one acre per 100 cars. Since parking is usually accommodated on an asphalt or concrete surface with conventional underground storm drain systems, parking lots typically generate a great deal of DCIA.

There are many ways to both reduce the impervious land coverage of parking areas and to filter runoff before it reaches the storm drain system.

4.6.1. Hybrid Parking Lots

Hybrid lots work on the principle that pavement use differs between aisles and stalls. Aisles must be designed for speeds between 10 and 20 miles per hour (mph), and durable enough to support the concentrated traffic of all vehicles using the lot. The stalls, on the other hand, need only be designed for the 2 or 3 mph speed of vehicles maneuvering into place. Most of the time the stalls are in use, vehicles are stationary. Hybrid lots reduce impervious surface coverage in parking areas by differentiating the paving between aisles and stalls, and combining impervious aisles with permeable stalls, as shown in **Figures 4.9 and 4.10**.

If aisles are constructed of a more conventional, impermeable material suitable for heavier vehicle use, such as asphalt, stalls can be constructed of permeable pavement. This can reduce the overall impervious surface coverage of a typical double loaded parking lot by 60% and avoid the need for an underground drainage system.

Permeable stalls can be constructed of a number of materials including pervious concrete, unit pavers such as brick or stone spaced to expose a permeable joint and set on a permeable base, crushed aggregate, porous asphalt, turf block, and cobbles in low traffic areas. Turf blocks and permeable joints are shown in **Figures 4.11 and 4.12**.

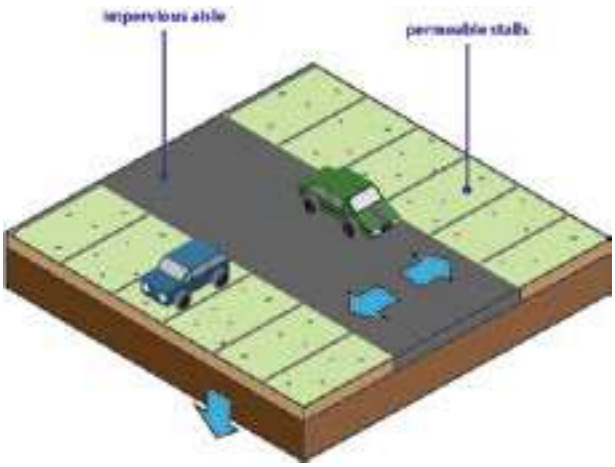


Figure 4.9: Hybrid Parking Lot



Figure 4.10: Hybrid Parking Lot (Honolulu, HI)

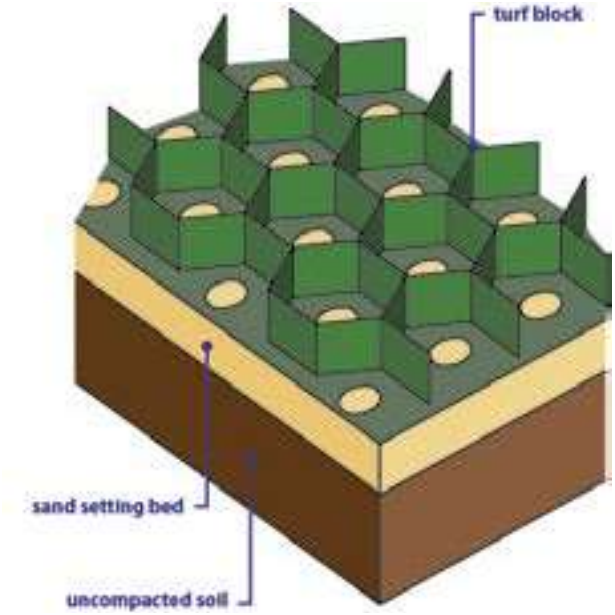


Figure 4.11: Turf Blocks

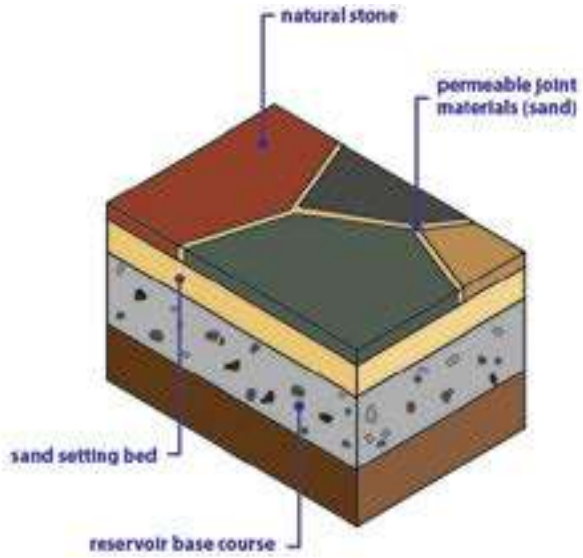


Figure 4.12: Permeable Joints

4.6.2. Parking Grove

A variation on the permeable stall design, a grid of trees and bollards can be used to delineate parking stalls and create a "parking grove." If the bollard and tree grids are spaced approximately 19 ft apart, two (2) vehicles can park between each row of the grid. This 9.5 ft stall spacing is slightly more generous than the standard 8.5 to 9 ft stall, and allows for the added width of the tree trunks and bollards. A benefit of this design is that the parking grove not only shades parked cars, but also presents an attractive open space when cars are absent. Examples of parking groves are shown in **Figures 4.13 and 4.14**.

4.6.3. Overflow Parking

Parking lot design is often required to accommodate peak demand, generating a high proportion of impervious land coverage of very limited usefulness. An alternative is to differentiate between regular and peak parking demands, and to construct the peak parking stalls of a different, more permeable, material. This "overflow parking" area can be made of a turf block, which appears as a green lawn when not occupied by vehicles, or crushed stone or other materials (see **Figure 4.15**). The same concept can be applied to areas with temporary parking needs, such as emergency access routes, or in residential applications, recreational vehicle (RV), or trailer parking.



Figure 4.13: Parking Grove 1



Figure 4.14: Parking Grove 2



Figure 4.15: Overflow Parking

4.6.4. Porous Pavement with Subsurface Infiltration

In some cases, parking lots can be designed to perform more complex storm water management functions. Constructing a stone-filled reservoir below the pavement surface and directing runoff underground by means of perforated distribution pipes can achieve subsurface storm water storage and infiltration as shown in **Figure 4.16**. Subsurface infiltration basins eliminate the possibilities of mud, mosquitoes and safety hazards sometimes perceived to be associated with ephemeral surface drainage. They also can provide for storage of large volumes of runoff, and can be incorporated with roof runoff collection systems.

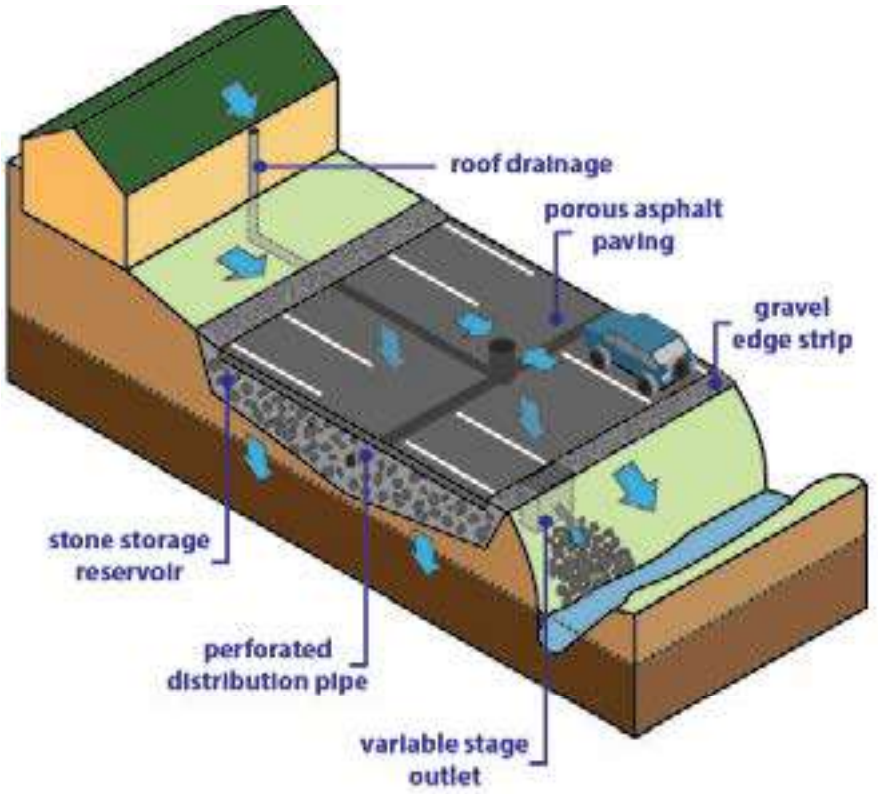


Figure 4.16: Subsurface Infiltration System

4.7. Driveways

Driveways can comprise up to 40% of the total transportation network in a conventional development, with streets, turn-arounds, and sidewalks comprising the remaining 60%.

Driveway length is generally determined by garage setback requirements and width by city codes and land use ordinances. Driveways to City streets shall have a minimum width of 12 ft excluding flares (reference: City Standard Details for Public Works Construction). If garages are setback from the street, long driveways are required, unless a rear alley system is included to provide garage access. If parking for two vehicles side by side is required, a 20 ft minimum width is required. Thus, if a 20 ft setback and a two-car-wide driveway are required, a minimum of 400 sq-ft of driveway will result, or 4% of a typical 10,000 sq-ft residential lot. If the house itself is compact, and the driveway is long, wide, and paved with an impervious material such as asphalt or concrete, it can become the largest component of impervious land coverage on the lot.

An option to reduce the area dedicated to driveways is to allow for tandem parking (one vehicle in front of another on a narrow driveway). In addition, if shared driveways are permitted, then two (2) or more garages can be accessed by a single driveway, further reducing required land area. Rear alley access to the garage can reduce driveway length, but overall impervious surface coverage may not be reduced if the alleys are paved with impervious materials and the access streets remain designed to conventional city standards.

Alternative solutions that work to reduce the impact of water quality problems associated with impervious land coverage on city streets also work on driveways. Sloping the driveway so that it drains onto an adjacent turf or groundcover area prevents driveways from draining directly to storm drain systems. Use of turf-block or unit pavers on sand creates attractive, low maintenance, permeable driveways that filter storm water (see **Figure 4.17**). Crushed aggregate can serve as a relatively smooth pavement with minimal maintenance as shown in **Figure 4.18**. As shown in **Figure 4.19**, paving only under wheels is a viable, inexpensive design if the driveway is straight between the garage and the street, and repaving temporary parking areas with permeable unit pavers such as brick or stone can significantly reduce the percentage of impervious area devoted to the driveway.

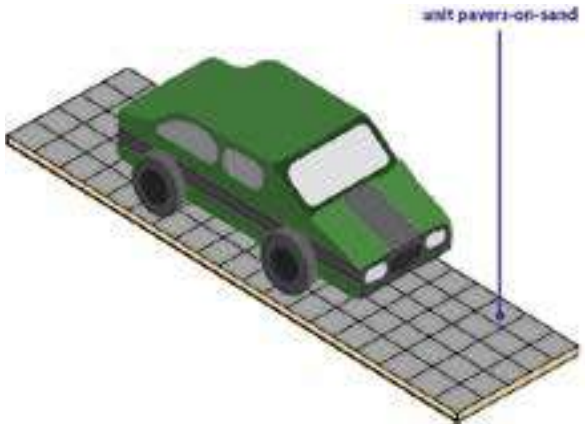


Figure 4.17: Unit Pavers

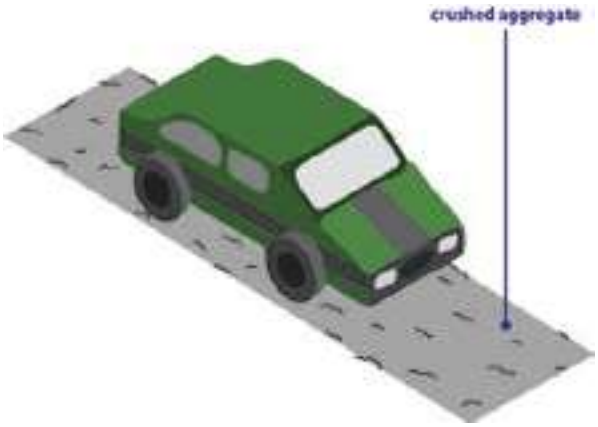


Figure 4.18: Crushed Aggregate

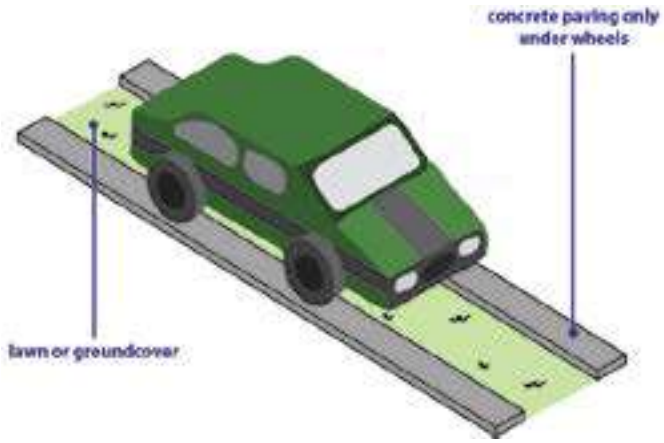


Figure 4.19: Paving only under Wheels

4.8. Landscape and Open Space

In the natural landscape, most soils infiltrate a high percentage of rainwater through a complex web of organic and biological activities that build soil porosity and permeability. Roots reach into the soil and separate particles of clay, insects excavate voids in the soil mass, roots decay leaving networks of macro pores, leaves fall and form a mulch over the soil surface, and earthworms burrow and ingest organic detritus to create richer, more porous soil. These are just a few examples of the natural processes that occur within the soil.

Maintenance of a healthy soil structure through the practice of retaining or restoring native soils where possible and using soil amendments where appropriate can improve the land's ability to filter and slowly release storm water into drainage networks. Construction practices such as decreasing soil compaction, storing topsoil on-site for use after construction, and chipping wood for mulch as it is cleared for the land can improve soil quality and help maintain healthy watersheds. Practices that reduce erosion and help retain water on-site include incorporating organic amendments into disturbed soils after construction, retaining native vegetation, and covering soil during revegetation.

Subtle changes in grading can also improve infiltration. Landscape surfaces are conventionally graded to have a slight convex slope. This causes water to run off a central high point into a surrounding drainage system, creating increased runoff. If a landscape surface is graded to have a slightly concave slope, it will hold water. The infiltration value of concave vegetated surfaces is greater in permeable soils. Soils of heavy clay or underlain with hardpan provide less infiltration value. In these cases, concave vegetated surfaces must be designed as retention/detention basins, with proper outlets or under drains to an interconnected system.

4.9. Multiple Small Basins

Biofiltration, infiltration, and retention/detention basins are the basic elements of a landscape designed for storm water management. The challenge for designers is to integrate these elements creatively and attractively in the landscape – either within a conventional landscape aesthetic or by presenting a different landscape image that emphasizes the role of water and drainage.

Multiple small basins can provide a great deal of water storage and infiltration capacity. These small basins can fit into the parkway planting strip or shoulders of street rights-of-way. If connected by culverts under walks and driveways, they can create a continuous linear infiltration system. Infiltration and retention/detention basins can be placed under wood decks, in parking lot planter islands, and at roof downspouts. Outdoor patios or seating areas can be sunken a few steps, paved with a permeable pavement such as flagstone or gravel, and designed to hold a few inches of water collected from surrounding rooftops or paved areas for a few hours after a rain.

All of these are examples of small basins that can store water for a brief period, allowing it to infiltrate into the soil, slowing its release into the drainage network, and filtering pollutants. An ordinary lawn can be designed to hold a few inches of water for a few hours after a storm, attracting birds and creating a landscape of diversity. Grass/vegetated swales can be integrated with landscaping, providing an attractive, low maintenance, linear biofilter. Extended detention basins (dry ponds) store water during storms, holding runoff to predevelopment levels. Pollutants settle and are removed from the water column before discharging to streams. Wet ponds serve a similar purpose and can increase property values by providing a significant aesthetic, and passive recreation opportunity.

Plant species selection is critical for proper functioning of infiltration areas. Proper selection of plant materials can improve the infiltration potential of landscape areas. Deep-rooted plants help to build soil porosity. Plant leaf-surface area helps to collect rainwater before it lands on the soil, especially in light rains, increasing the overall water-holding potential of the landscape.

A large number of plant species will survive moist soils or periodic inundation. These plants provide a wide range of choices for planted infiltration/detention basins and drainage swales. Most inundated plants have a higher survival potential on well-drained alluvial soils than on fine textured shallow soils or clays.

4.10. Planning Development Strategies in Practice

The importance of site planning in storm water quality protection is illustrated in the following examples of development strategies: conventional residential subdivision (**Figure 4.20: Alternative 1**), conventional subdivision employing BMPs (**Figure 4.21: Alternative 2**), and a mixed-use transit-oriented development (**Figure 4.22: Alternative 3**). All three (3) examples are intended to accommodate approximately 660 housing units on a 220-acre site adjacent to a stream.

The conventional residential subdivision (**Figure 4.20: Alternative 1**) accommodates 660 single-family homes on individual lots. One-sixth acre lots are accessed by a network of 40 ft wide cul-de-sac streets, with 5 ft sidewalks adjacent to the curb on each side of the street. The street and sidewalks are located within a 60 ft right-of-way, which is covered with a 40 ft wide street and two (2)- 5 ft sidewalks, or 50 ft of pavement, 100% impervious land coverage (streets only), and no room for street trees. No variation exists in housing types (all single-family).

Both the streets and the open space features lack structure or hierarchy. The few direct connections through the neighborhood result in long stretches of overly wide streets that discourage walking.

Conventional development design does not use the recreational or storm water benefits of the available open space and does not respond to natural and topographic features. Preservation of open space is a low priority, and the setback between the development and the stream is minimal. The remaining open space character is remnant space offering residents no stream access or parks. Storm water travels through a 15,000 ft network of drainpipes and in the absence of current permit requirements would discharge untreated runoff directly into the stream. However, applying typical permit requirements, the development would still be required to incorporate runoff treatment for the water quality design volume defined in the local permit or MS4 new development program. For example, if the permit required treatment of the runoff from 0.75 inches of rainfall, the development as planned had an overall percent impervious value of 45%, and the designer was considering the use of an extended detention basin for treatment, this would require a treatment volume of approximately 8.3 acre-ft. Based on typical detention basin design practices, this could result in the need to dedicate approximately 2 to 3 acres of land, or the equivalent of approximately 12 to 18 lots to incorporate the basin into the development near the point where drainage enters the stream. Alternatively, if a watershed master plan for water quality had been adopted in which the development could participate financially, the project would contribute financially based on its required treatment volume and the cost allocation plan for the watershed program.

The hybrid/best practices subdivision (**Figure 4.21: Alternative 2**) illustrates a conventional neighborhood that applies some storm water management practices. This attempt accommodates 660 single-family homes on individual lots. Streets are narrower, with the interior access streets at 28 ft wide, while internal neighborhood collectors are 32 ft wide. All streets have detached sidewalks that accommodate street trees planted between the sidewalk and the curb. This development sets the houses

100 ft back from the stream and offers residents 12 acres of access to open space and parks. The overall imperviousness has been reduced to about 41%, thereby reducing the volume to be treated to approximately 7.5 acre-ft. A detention basin has been created in open space within the development. Nearly 25% of the 13,000 ft network of piped storm water drains to a detention pond.

By employing a hierarchy of narrower streets this neighborhood requires 1,475 sq-ft of street per housing unit, a reduction of 19% relative to the conventional sub-division.

The neo-traditional mixed-use neighborhood is illustrated as Alternative 3 (**Figure 4.22**). This neighborhood includes 660 housing units, but also introduces other uses: retail, office, and live-work, within a network of tree-lined streets and open space. The neighborhood drains to an open space park adjacent to the stream, naturally and efficiently filtering storm water before it enters the stream. Bioswales along key streets capture and treat storm water en-route to the stream, providing aesthetic appeal and recreational opportunities. Alternative 3 requires 965 sq-ft of street per housing unit, a reduction of 47% relative to the conventional sub-division. A strategically located transit system stops near shops and higher density housing makes transit feasible. Every dwelling unit in the neighborhood is within a 5-minute (min) walk from shops or transit. The overall imperviousness of this site has been reduced to approximately 36%, further reducing the treatment volume. In addition, there are a variety of opportunities to incorporate treatment for all of the remaining runoff within the open space park without the need to dedicate any additional developable land.

A comparison of the three (3) alternatives is shown in **Table 4.1**.



Figure 4.20: Alternative 1 - Conventional



Figure 4.21: Alternative 2 - Hybrid/Best Practices



Figure 4.22: Alternative 3 - Neo-Traditional

Table 4.1: Comparison of Three Alternatives

	Alternative 1	Alternative 2	Alternative 3
Total Site (acre)	220	220	220
Number of Housing Units	660	660	660
Parks and Open Space (acre)	0	12	12
Stream Setback (feet)	0	100	500
Impervious Land Coverage - Street (acre)	28	22	15
Percentage of Site that is Impervious - Street only	13%	10%	7%
Percentage of Site that is Impervious - Street only (relative to conventional)	100%	81%	53%
Linear feet of Pipe	15,000	13,000	10,000
Linear feet of Swale	0	0	4,700
Width of Major Streets (feet)	40	32	32
Width of Minor Streets (feet)	None	28	28

Typical lots in Alternatives 2 and 3 are illustrated in three (3) forms: street loaded, alley fed and rural. In the street-loaded form, lot size is still approximately 1/6 acre, but the lot is narrower and deeper, thus reducing the amount of street frontage per household. The two-car garage is accessed from a front driveway. This front-loaded street accounts for 63% impervious land coverage in the 60 ft right-of-way.

Looking at a typical street, the traditional residential neighborhood reduces the number of feet of street and sidewalk per housing unit by nearly 40% compared to the conventional subdivision. This is accomplished by two (2) means: a narrower street width (28 ft versus 40 ft), and narrower, deeper lots (60 ft versus 65 ft wide). Narrower lots mean less street frontage per lot.

In the alley-loaded form, the street right-of-way is narrowed to 50 ft, leaving 4 ft for trees between the sidewalk and curb. This form also employs the narrower street, achieving a 40% reduction in pavement dedicated to street and sidewalk. A 16 ft-wide alley is provided in the back to access a garage at the rear of each lot. Additional pavement for the alley is balanced by elimination of pavement for the front driveway. This model assumes an impervious asphalt or concrete alley. Gravel alleys are feasible, and improve permeability. In this form, narrower, deeper lots are employed to accommodate the depth required for the alley.

The rural street form dramatically reduces impervious land coverage. The street is 19 ft wide with gravel shoulders for trees and parking. Pedestrians walk on the gravel shoulder or share the street with slow-moving cars.

Looking at a typical street, the rural form provides the greatest reduction in impervious land coverage. Only 570 sq-ft of pavement of street is required per housing unit, a reduction of 62% compared to the conventional sub-division.

5. Treatment Control BMP Design

Treatment Control BMPs are engineered technologies designed to remove pollutants from storm water runoff prior to discharge to the storm drain system or receiving waters. This section addresses BMP numeric sizing criteria, guidance for infiltration testing BMPs, and individual BMP fact sheets to support compliance with the *Water Quality Rules*.

5.1. Best Management Practices Selection

5.1.1. Determine Drainage Management Areas

Drainage management areas (DMAs) provide an important framework for feasibility screening, BMP prioritization, and storm water management system configuration. BMP selection, sizing, and feasibility determinations must be made at the DMA level; therefore, delineation of DMAs is highly recommended at the conceptual site planning phase and is mandatory for completing the project design and meeting submittal requirements. This section provides guidance on delineating DMAs that is intended to be used when choosing BMPs.

DMAs are defined based on the proposed drainage patterns of the site and the BMPs to which they drain. During the early phases of the project, DMAs shall be delineated based onsite drainage patterns and possible BMP locations identified in the site planning process. DMAs should not overlap and should be similar with respect to BMP opportunities and feasibility constraints. More than one DMA can drain to the same BMP. However, because the BMP sizes are determined by the runoff from the DMA, a single DMA may not drain to more than one (1) BMP (see **Figure 5.1**).

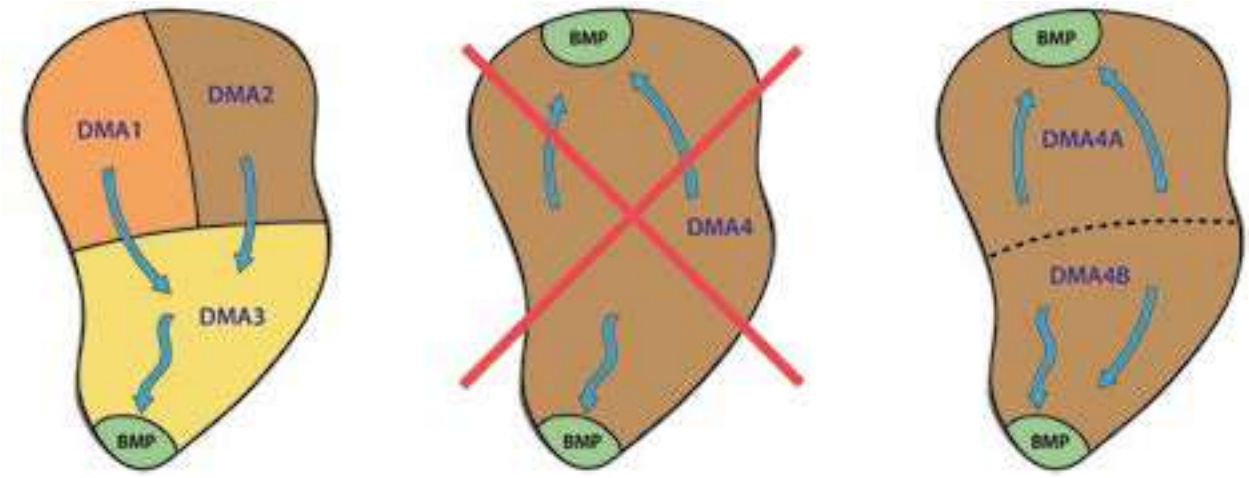


Figure 5.1: DMA Delineation

In some cases, it may be appropriate in early planning phases to generalize the proposed treatment plan by simply assigning a certain BMP type to an entire planning area and calculating the total sizing requirement without identifying the specific BMP locations at that time. This planning area would be later subdivided for design-level calculations.

BMPs must be sized to treat the WQV or Water Quality Flow (WQF) from the total area draining to the BMP, including any offsite or onsite areas that combine with project runoff and drains to the BMP. To minimize offsite flows treated by project BMPs, consider diverting upgradient flows subject to local drainage and flood control regulation.

5.1.2. Evaluate Pollutants of Concern

BMPs selected for each DMA should address anticipated pollutants of concern. Pollutants identified in the USEPA 303(d) list for specific water bodies in Hawaii include metals, nitrogen, nutrients (without specifying nitrogen or phosphorus), indicator bacteria (i.e., fecal coliform), pesticides, and trash. Less commonly cited pollutants include suspended solids, polychlorinated biophenyls (PCBs), and ammonium. With respect to metals, typically, only the general term is used. In some cases, lead is identified.

The BMP plan development process typically includes consideration of:

- Receiving water quality (including pollutants for which receiving waters are listed as impaired under CWA section 303(d)).
- Land use type of the development project and pollutants associated with that land use type.
- Pollutants expected to be present on site.
- Changes in storm water discharge flow rates, velocities, durations, and volumes resulting from the development project.
- Sensitivity of receiving waters to changes in storm water discharge flow rates, velocities, durations, and volumes.

It is important to realize that pollutants of concern for a water body can extend beyond those pollutants listed in the 303(d) list as causing impairment. For example, trash is a pollutant of concern in most communities, yet only a few water bodies are presently listed as impaired by trash. The key is to remember that a pollutant does not need to cause an immediate impairment for it to be considered when developing a BMP Plan.

Table 5.1 summarizes pollutants typically associated with Priority Project land uses and can be used as general guidance when selecting BMPs.

5.1.3. Identify Candidate BMPs

Selecting BMPs based on pollutants of concern is a function of site constraints, constituents of concern, BMP performance, stringency of permit requirements, and watershed specific requirements such as TMDLs. Pollutants of concern are especially important in water limited stream segments and must be carefully reviewed in relationship to BMP performance.

To facilitate comparison of the BMP characteristics and selection, a summary of the BMP categories, expected pollutants, and BMP performance is presented in **Tables 5.2, 5.3 and 5.4**, respectively. Developers shall consider the expected pollutants that could be generated at the site when choosing BMPs.

Table 5.1: Typical Pollutants Associated with Priority Projects

Priority Project Categories	Nutrients	Sediment	Trash	Pathogens	Pesticides	Oil & Grease	Metals	Organic Compounds
Priority A: Residential Development > one acre	X	X	X	X	X	X		
Priority A: Commercial Development >one acre	P(1)	P(1)	X	P(3)	P(5)	X	X	P(2)
Priority B: Industrial		X	X			X	X	X
Priority B: Automotive Repair Shops			X			X	X	X(4)(5)
Priority B: Restaurants			X	X	P(1)	X		
Priority B: Parking Lots	P(1)	P(1)	X		P(1)	X	X	
Priority B: Retail Gasoline Outlets			X			X	X	X
Priority B: Buildings taller than 100 ft in height	X	X	X	X	X	X		
(All) Streets, Highways & Freeways	P(1)	X	X	X	P(1)	X	X	X(4)

X = anticipated P = potential
(1) A potential pollutant if landscaping exists onsite.
(2) A potential pollutant if the project includes uncovered parking areas.
(3) A potential pollutant if land use involves food or animal waste products.
(4) Including petroleum hydrocarbons.
(5) Including Solvents

Table 5.2: Treatment Control BMP Categories

BMP	Retention	Biofiltration	Other
Infiltration Basin	✓		
Infiltration Trench	✓		
Subsurface Infiltration	✓		
Dry Well	✓		
Bioretention Basin	✓		
Permeable Pavement	✓		
Harvesting/Reuse	✓		
Green Roof		✓	
Vegetated Bio-filter[1]		✓	
Enhanced Swale		✓	
Downspout Disconnection		✓	
Vegetated Swale		✓	
Vegetated Buffer Strip		✓	
Detention Basin			✓
Manufactured Treatment Device			✓
Sand Filter			✓

[1] Includes both proprietary and non-proprietary systems.

Table 5.3: Treatment Control BMP Expected Pollutant Removals

Priority Project Categories	Nutrients	Sediment	Trash	Pathogens	Pesticides	Oil & Grease	Metals	Organic Compounds
Infiltration Basin	H	H	H	H	H	H	H	H
Infiltration Trench	H	H	H	H	H	H	H	H
Subsurface Infiltration	H	H	H	H	H	H	H	H
Dry Well	H	H	H	H	H	H	H	H
Bioretention Basin	H	H	H	H	H	H	H	H
Permeable Pavement	H	H	L	H	H	H	H	H
Green Roof	M	H	H	M	M	H	M	M
Vegetated Bio-Filter	M	H	H	M	U	H	H	H
Enhanced Swale	M	H	H	U	U	M	M	U
Vegetated Swale	L	M	L	L	U	M	M	U
Vegetated Buffer Strip	L	M	M	L	U	M	M	M
Manufactured Tree Filter	M	H	H	M	U	H	H	H
Harvesting/Reuse	H	H	L	H	H	H	H	H
Detention Basin	L	M	H	L	U	M	L/M	U
Manufactured Treatment Device	L	M/H	H	L	L	M/H	L	L
Sand Filter	L/M	H	H	M	U	H	M/H	M/H
H = High, M = Medium, L = Low, U = Unknown								

By using BMPs that are applicable and feasible, the project can achieve benefits of these practices, while not incurring unnecessary expenses (associated with using practices that do not apply or would not be effective) or creating undesirable conditions (for example, infiltration-related issues, vector concerns including mosquito breeding, etc.).

For example, on Oahu, many high-density, ultra-urban districts are in tidally influenced coastal areas and frequently encounter high ground water where infiltration may not be feasible. These projects would most typically fall into the redevelopment category rather than new development, which presents additional challenges with space constraints and soil quality. In these cases, Developers are encouraged to utilize multiple BMPs in combination or series to meet the LID retention and treatment criteria. While infiltration may not be possible, the Rules prioritize harvest and reuse systems to capture roof runoff and use the water onsite. For the remaining runoff, biofiltration BMPs can be integrated into the overall facility landscaping which may include green roofs, aboveground planter boxes, and tree box filters. Configuration of these BMPs as either aboveground systems or with shallow footprints can overcome the challenges associated with high ground water levels so that underdrain inverts are compatible with the surrounding drainage infrastructure.

Table 5.4 presents several development types and BMPs that are generally appropriate to meet the requirements of the *Water Quality Rules* for the various priority project types.

Table 5.4: Recommended Selection of Permanent BMPs

Priority	Development Type	Infiltration	Permeable Pavement[1]	Green Roof	Bio-filtration	Harvest/Reuse	Manufactured Treatment Device	Source Control
A	Single Family Residential	H	H	NR[1]	H	M	H	H
	Commercial/Institutional/Mixed Use	H	H	M[1]	H	H	H	H
	Parks and Open Space	H	H	N/A	H	N/A	M	N/A
A or B	High Density/Ultra-urban, Buildings Greater than 100 feet tall, Retail Malls	M[2]	H	H	H	H	H	H
A or B	Parking Lots	H	H	N/A	H	N/A	H	H
B	Industrial, Automotive Repair Shops, Restaurants, Retail Gasoline Outlets	M[3]	M[3]	M	H	M	H	H

H= Highly Appropriate; M= May be Appropriate; NR= Not Recommended; N/A= Not Applicable

1. Green roofs are not recommended for single family homes.
2. High density/ultra-urban redevelopment projects may frequently encounter space constraints and high ground water levels which may limit the appropriateness or feasibility of infiltration BMPs.
3. Infiltration BMPs are not recommended for areas with high potential for concentrated pollutants or chemical spills. Source Control BMPs should be implemented in those areas.

5.1.4. Consider Operation and Maintenance Requirements

Once BMPs have been selected based on performance and appropriateness for site conditions, both installation cost and operation and maintenance cost can become an important differentiator in BMP selection. Treatment Control BMP costs vary depending on the type of BMP installed. **Table 5.5** shows maintenance costs compiled by the County of San Diego which looked at the maintenance time and costs for large, medium, and small BMPs. In general, the more time consuming maintenance resulted in higher costs. While permanent BMP maintenance is the responsibility of the owner, the City recommends that BMPs be chosen with consideration to maintenance requirements when possible. For instance, underground vault-type devices may provide valuable space savings, but there are concerns that regular maintenance will not be provided, as well as the worker safety and public safety risks presented during maintenance activities.

Table 5.5: Summary of Operation and Maintenance Effort for BMPs

BMP	Small BMP		Medium BMP		Large BMP	
	Annual Hours	Annual Cost	Annual Hours	Annual Cost	Annual Hours	Annual Cost
Bioretention Area	32.0	$ 3,174	44.0	$ 4,078	68.0	$ 5,877
Flow-Through Planter	24.0	$ 2,367	30.0	$ 2,882	42.0	$ 3,781
Cistern With Bioretention	33.2	$ 3,186	38.2	$ 3,505	48.2	$ 4,255
Dry Detention Basin with Grass/ Vegetated Lining	25.8	$ 2,433	32.6	$ 3,204	53.0	$ 4,734

Source: San Diego Stormwater Urban Mitigation Plan website: http://www.sandiegocounty.gov/content/dam/sdc/dpw/WATERSHED_PROTECTION_PROGRAM/susmppdf/bmp_om_cost_2012.xlsx. Costs in Hawaii may be higher.

Table 5.5: Summary of Operation and Maintenance Effort for BMPs (Continued)

BMP	Small BMP		Medium BMP		Large BMP	
	Annual Hours	Annual Cost	Annual Hours	Annual Cost	Annual Hours	Annual Cost
Dry Detention Basin with Impervious Lining	15.8	$ 1,412	20.6	$ 2,067	35.0	$ 3,147
Underground Vault	19.8	$ 1,819	24.6	$ 2,418	39.0	$ 3,498
Cistern	15.2	$ 1,423	17.2	$ 1,830	23.2	$ 2,280
Infiltration Basin	28.6	$ 2,679	33.0	$ 3,297	46.2	$ 4,287
Infiltration Trench	17.8	$ 1,564	25.0	$ 2,418	46.6	$ 4,037
Wet Pond/Basin (Permanent Pool)	113.8	$ 10,037	214.6	$ 17,081	517.0	$ 39,752
Constructed Wetland	109.8	$ 9,708	210.6	$ 16,763	513.0	$ 39,433
Vegetated Swale	15.3	$ 1,476	20.9	$ 2,203	26.5	$ 2,623
Austin Sand Filter	19.6	$ 1,712	24.4	$ 2,374	38.8	$ 3,454
Delaware Sand Filter	19.6	$ 1,712	24.4	$ 2,374	38.8	$ 3,454
Multi-Chambered Treatment Train	27.9	$ 2,587	32.7	$ 3,114	47.1	$ 4,194
Tree-Pit-Style Unit	15.6	$ 1,491	15.6	$ 1,491	15.6	$ 1,491
Vault Based Filtration with Replaceable Cartridges	23.8	$ 2,050	28.6	$ 2,690	43.0	$ 3,769
Swirl Concentrator	15.0	$ 2,062	15.0	$ 2,062	15.0	$ 2,062
Catch Basin Insert	15.0	$ 1,493	15.0	$ 1,493	15.0	$ 1,493
Catch Basin Insert with Hydrocarbon Boom	17.0	$ 1,707	17.0	$ 1,707	17.0	$ 1,707
Permeable Pavements	7.8	$ 808	13.6	$ 1,206	23.2	$ 1,926
Self-Retaining	6.8	$ 598	6.8	$ 598	6.8	$ 598
Vegetated Roof	17.0	$ 1,975	21.0	$ 2,252	33.0	$ 3,152
Source: San Diego Stormwater Urban Mitigation Plan website: http://www.sandiegocounty.gov/content/dam/sdc/dpw/WATERSHED_PROTECTION_PROGRAM/susmppdf/bmp_om_cost_2012.xlsx. Costs in Hawaii may be higher.						

For the purpose of this document, the average annual maintenance time for a BMP device used to determine the Maintenance Ranks are defined in **Table 5.6**. These maintenance ranks are specified on each treatment control fact sheet (**Appendix B**).

Table 5.6: Maintenance Rank Definition

Maintenance Rank	Definition
Low	BMPs with an average maintenance requirement of less than 25 hours per year.
Medium	BMPs with an average maintenance requirement of between 25 and 50 hours per year.
High	BMPS with an average maintenance requirement of over 50 hours per year.

Long-term O&M guidelines are presented in Section 7.

5.1.5. Other Considerations

Vector Breeding Considerations

The potential of a BMP to create vector breeding habitat and/or harborage should also be considered when selecting BMPs. Mosquito and other vector production is a nuisance and public health threat.

Mosquitoes can breed in standing water almost immediately following a BMP installation and may persist at unnaturally high levels and for longer seasonal periods in created habitats. BMP siting, design, construction, and maintenance must be considered in order to select a BMP that is least conducive to providing habitat for vectors. Tips for minimizing vector-breeding problems in the design and maintenance of BMPs are presented in the BMP fact sheets. Certain BMPs, including ponds and wetlands and those designed with permanent water sumps, vaults, and/or catch basins (including below ground installations), may require routine inspections and treatments.

Threatened and Endangered Species Considerations

The presence or potential presence of threatened and endangered species should also be considered when selecting BMPs. Although preservation of threatened endangered species is crucial, treatment BMPs are not intended to supplement or replace species habitat except under special circumstances. The presence of threatened or endangered species can hinder timely and routine maintenance, which in turn can result in reduced BMP performance and an increase in vector production. In extreme cases, rights to the treatment BMP and surrounding land may be lost if threatened or endangered species utilize or become established in the BMP.

When considering BMPs where there is a presence or potential presence of threatened or endangered species, early coordination with DLNR and USFWS is essential. During this coordination, the purpose and the long-term operation and maintenance requirements of the BMPs need to be clearly established through written agreements or memorandums of understanding. Absent firm agreements or understandings, proceeding with BMPs under these circumstances is not recommended.

5.2. Numeric Sizing Criteria

Based on the selected BMPs, the capacity and primary design sizing criteria must be established using a combination of local hydrology, project drainage characteristics (i.e., percent imperviousness or runoff coefficient), and numerical sizing requirements. BMPs will be volume-based, flow-based, or demand-based, and must be able to effectively treat the design quantity. Peak storm event flows must also be taken into account if the BMP is a flow-based BMP, or a volume-based BMP that must also safely pass the design storm (i.e., an in-line detention basin).

This section presents the methodology for calculating the WQV and WQF Rate, which are used to size the majority of the Treatment Control BMPs. Calculations for the WQV and WQF should not include DMAs that are considered Self-Mitigating (refer to Site Design Strategies).

5.2.1. Volume-Based Best Management Practice Design

Volume-based BMP design standards apply to BMPs whose primary mode of pollutant removal depends on the volumetric capacity of the BMP. Examples of BMPs in this category include detention basins, retention basins, and infiltration. Typically, a volume-based BMP design criteria calls for the capture and infiltration or treatment of a certain percentage of the runoff from the project site.

The WQV is calculated using the following equation:

$$WQV = PCA \times 3630$$

Where WQV = Water Quality Design Volume [cubic feet (cu-ft)]
P = Design Storm Runoff Depth (in)
C = Volumetric Runoff Coefficient
A = Tributary Drainage Area (acres)

As specified in the *Water Quality Rules*, a design storm runoff depth of 1 inch shall be used for LID retention BMPs and 1.5 inches shall be used for all treat and release BMPs including LID biofiltration and alternative compliance BMPs. In previous analysis, the City determined that the 1-inch design storm was equal to or exceeded the 24-hr 85th percentile storm for most of Oahu.

The volumetric runoff coefficient shall be calculated using the following equation as developed by USEPA for smaller storms in urban areas:

$$C = 0.05 + 0.009I$$

Where C = Volumetric Runoff Coefficient
I = Percent of Impervious Cover (percent)

A graph presenting the relationship between the percent of impervious cover and the unit water quality design volume for a 1-inch and 1.5-inch runoff depth is shown in **Figure 5.2**.

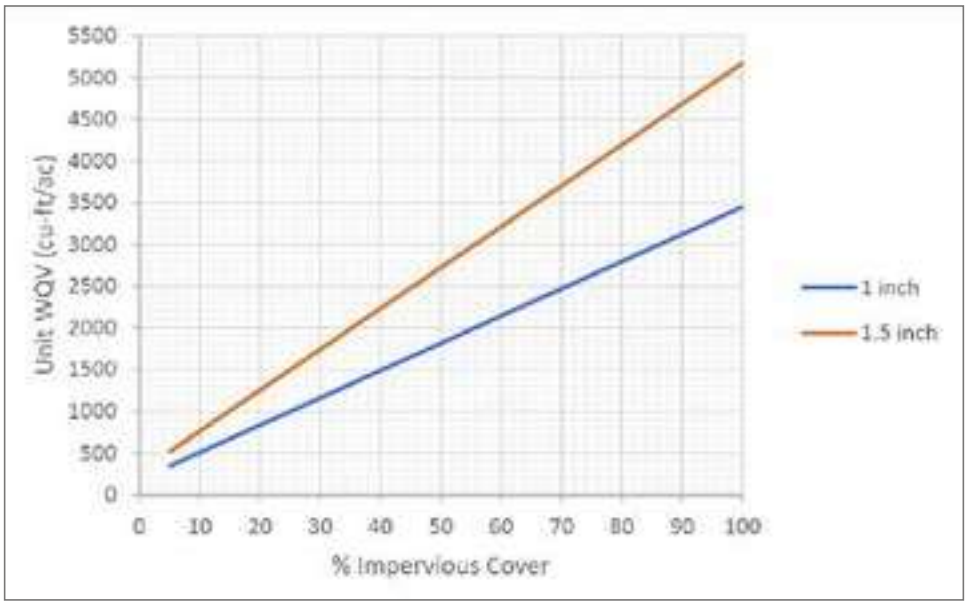


Figure 5.2: Unit Water Quality Volume for 1 and 1.5 inch Runoff Depth

5.2.2. Flow-Based BMP Design

Flow-based BMP design standards apply to BMPs whose primary mode of pollutant removal depends on the rate of flow of runoff through the BMP. Examples of BMPs in this category include swales, screening devices, and many proprietary products. Typically, flow-based BMP design criteria calls for the capture and infiltration or treatment of the flow runoff produced by rain events of a specified magnitude.

The design WQF rate is calculated using the Rational Formula:

$$WQF = 1.5 \times CiA$$

Where WQF = Water Quality Design Flow Rate (cu-ft/sec)
C = Runoff Coefficient
i = Peak Rainfall Intensity (in/hr)
A = Tributary Drainage Area (acres)

As specified in the *Water Quality Rules*, a peak rainfall intensity of 0.4 inches per hour shall be used. The runoff coefficient shall be determined from **Table 5.7**. For drainage areas containing multiple land uses, the following formula may be used to compute a composite weighted runoff coefficient:

$$C_C = \left(\sum_{i=1}^{n} C_i A_i\right) / A_t$$

Where C_C = Composite Weighted Runoff Coefficient
$C_{1,2,..n}$ = Runoff Coefficient for each Land Use Cover Type
$A_{1,2,..n}$ = Drainage Area to each Land Use Cover Type (acres)
A_t = Total Drainage Area (acres)

Table 5.7: Runoff Coefficients for Water Quality Flow Calculations

Type of Drainage Area	Runoff Coefficient		Type of Drainage Area	Runoff Coefficient
Roofs	0.90		Permeable interlocking concrete pavement	0.10
Concrete	0.80		Grid pavements with grass or aggregate surface	0.10
Stone, brick, or concrete pavers with mortared joints and bedding	0.80		Crushed aggregate	0.10
Asphalt	0.70		Grass	0.10
Stone, brick, or concrete pavers with sand joints and bedding	0.70		Grass over Porous Plastic	0.05
Pervious Concrete	0.10		Gravel over Porous Plastic	0.05
Porous asphalt	0.10			
Note that these C-factors are only appropriate for small storm treatment design and are not appropriate for flood control facilities.				

A graph presenting the relationship between the weighted runoff coefficient and the unit water quality design flow rate is shown in **Figure 5.3**.



Figure 5.3: Unit Water Quality Flow

5.2.3. Combined Volume-Based and Flow-Based BMP Design

Volume-based BMPs and flow-based BMPs do not necessarily treat precisely the same storm water runoff. For example, an on-line volume-based BMP such as a detention basin will treat the design runoff volume and is essentially unaffected by runoff entering the basin at an extremely high rate, say from a very short, but intense storm that produces the design volume of runoff. However, a flow-based BMP might be overwhelmed by the same short, but intense storm if the storm intensity results in runoff rates that exceed the flow-based BMP design flow rate. By contrast, a flow-based BMP such as a swale will treat the design flow rate of runoff and is essentially unaffected by the duration of the design flow, say from a long, low intensity storm. However, a volume-based detention basin subjected to this same rainfall land runoff event will begin to provide less treatment or will go into bypass or overflow mode after the design runoff volume is delivered.

Therefore, there may be some situations where designers need to consider both volume-based and flow based BMP design criteria. An example of where both types of criteria might apply is an off-line detention basin. For an off-line detention basin, the capacity of the diversion structure could be designed to comply with the flow-based BMP design criteria while the detention basin itself could be designed to comply with the volume-based criteria.

When both volume-based and flow based criteria apply, the designer should determine which of the criteria apply to each element of the BMP system, and then size the elements accordingly.

5.3. Infiltration Requirements

LID Retention BMPs rely on the soil's ability to infiltrate storm water runoff. This section outlines the design requirements applicable to all infiltration facilities.

5.3.1. Soil Types and Textures

The soil types within the subsoil profile, extending a minimum of 3 ft below the bottom of the proposed facility, should be identified to verify the infiltration rate or permeability of the soil. The infiltration

rate, or permeability, measured in inches per hour, is the rate at which water passes through the soil profile during saturated conditions. Although the units of infiltration rate and hydraulic conductivity of soils are similar, there is a distinct difference between these two (2) quantities. They cannot be directly related unless the hydraulic boundary conditions are known, such as hydraulic gradient and the extent of lateral flow of water, or can be reliably estimated. Minimum and maximum infiltration rates establish the suitability of various soil textural classes for infiltration. Each soil texture and corresponding hydrologic properties within the soil profile are identified through analysis of a gradation test of the soil boring material. **Table 5.8** presents a list of the infiltration rates for the soil textures of the U.S. Department of Agriculture (USDA) Textural Triangle, presented in **Figure 5.4**.

Table 5.8: Typical Soil Infiltration Rates[a]

Texture Class	Hydrologic Soil Group	Infiltration Rate (inches/hour)
Sand	A	8.00
Loamy Sand	A	2.00
Sandy Loam	B	1.00
Loam	B	0.50
Silt Loam	C	0.25
Sandy Clay Loam	C	0.15
Clay Loam	D	0.09
Silt Clay Loam	D	< 0.09
Clay	D	< 0.05
a - Source: ASCE, 1998		



Figure 5.4: USDA Soils Textural Triangle

Soil textures acceptable for use with infiltration systems include those with infiltration rates equal to or above 0.50 inches per hour (a soil texture indicative of loam). Soil textures with rates less than 0.50 inches per hour are not suitable as it increases the risk of the BMP not draining properly and creating localized areas of standing water. It is important to note however, that Hydrologic Soil Group (HSG) "D" soils (e.g., clay loam, silty clay loam, and silty clay) in Oahu have been shown to perform better than their counterparts in the Continental United States. As a result, locations with HSG "D" soils should not be automatically rejected as candidate sites for infiltration BMPs without the opinion of a licensed professional engineer with geotechnical expertise.

5.3.2. Field Investigations

According to the *Water Quality Rules*, infiltration can be considered infeasible if the soil at the site is HSG "C" or "D," or if the infiltration rate is less than 0.5 in/hr. For HSG "A" and "B" soils, and those sites who wish to use infiltration even with HSG C or D soils, soil investigations and infiltration tests are required for infiltration facilities to accurately determine the local soil characteristics and capacity for infiltration.

Soil Lithology and Depth to Groundwater

An initial soil investigation is recommended to adequately evaluate soil lithology and determine if there are potential problems in the soil structure that would inhibit the rate or quantity of infiltration desired; or if there are potential adverse impacts to structures, slopes or groundwater that could result from locating the device nearby.

Geotechnical test pits or borings should be dug to a minimum of 5 ft deep below the proposed device invert, or as determined by the licensed professional engineer with geotechnical expertise. A test pit allows visual observation of the soil horizons and overall soil conditions both horizontally and vertically in that portion of the site. Although the use of soil borings is permitted at the recommendation of a geotechnical professional, it is discouraged as a substitute for test pits as visual observation is narrowly limited in a soil boring and the soil horizons cannot be observed in-situ, but must be observed from the extracted borings.

The soil profiles should be carefully logged to determine variations in the subsurface profile. Samples should be collected from the soil profiles at different horizons and transported to a laboratory for soil indices testing, plasticity, and chemical testing. In addition, the test pits or samples from borings should be examined for other characteristics that may adversely affect infiltration. These include evidence of significant mottling (indicative of high groundwater), restrictive layer(s), and significant variation in soil types, either horizontally or vertically.

An initial indication of the seasonal high groundwater water table elevation should be determined by using a piezometer or other accepted geotechnical means. The piezometer should be installed to a depth of at least 20 ft below the proposed device invert using the direct push or other suitable method. Initial groundwater levels shall be recorded at least 24 hrs after installation. The geotechnical professional will make a determination whether the groundwater elevation determined after 24 hrs can be considered to be a reasonable indication of the seasonal high water table for the site.

Permeability Testing

Infiltration rate tests are used to help estimate the maximum sub-surface vertical infiltration rate of the soil below a proposed infiltration facility (e.g., infiltration trench or infiltration basin). The tests are intended

to simulate the physical process that will occur when the facility is in operation; therefore a saturation period is required to approximate the soil moisture conditions that may exist prior to the onset of a runoff event. Laboratory tests are strongly discouraged, as a homogeneous laboratory sample does not represent field conditions. Infiltration tests should be conducted in the field. Tests should not be conducted in the rain or within 24 hrs of significant rainfall events (greater than 0.5 inches).

There are a variety of infiltration field test methodologies to determine the infiltration rate of a soil, the two most coming being the Falling Head Percolation Test and the Double-Ring Infiltrometer Test. The actual testing protocols and methods used for a specific project should be determined by a licensed professional engineer with geotechnical expertise.

Table 5.9: Test Pit/Boring Requirements for Infiltration

Facility	Recommended # of Permeability Tests
• Infiltration Basin • Subsurface Infiltration • Dry Well • Bioretention Basin • Permeable Pavement	1 test per 2,500 sq-ft
• Infiltration Trench	1 test per 100 linear ft

5.3.3. Design Infiltration Rates

To account for uncertainties and inaccuracies in testing, a correction (i.e., safety) factor shall be applied to the assumed or measured infiltration rate to produce a design infiltration rate for BMP sizing calculations. The minimum safety factor for infiltration facilities is 2.

5.4. Technology Certification

This manual does not endorse specific proprietary products, although many are described. It is left to each developer to determine which proprietary products may be used, and under what circumstances. When considering a proprietary product, the *Water Quality Rules* require that the developer consider performance data, determined by established protocols. The City accepts certifications of product performance by the Washington State Department of Ecology [Technology Assessment Protocol- Ecology (TAPE)], for the New Jersey's Department of Environmental Protection [New Jersey Corporation for Advanced Technology (NJCAT)].

For proprietary biofiltration systems, the BMP must be certified for general use by TAPE for Enhanced Treatment (for the treatment of dissolved metals), Phosphorous Treatment, or Oil Treatment, according to the predominant pollutant(s) of concern at that site.

For alternative compliance, the device must provide, at minimum, a TSS removal rate of 80%, certified for general use by TAPE or verified by NJCAT consistent with the New Jersey Department of Environmental Protection (NJDEP) protocols.

It can be expected that subsequent to the publishing of this manual, new public-domain technologies will be proposed (or design criteria for existing technologies will be altered) by development engineers. As with proprietary products, it is advised that new public-domain technologies be considered only if performance data are available and have been collected following a widely accepted protocol.

5.5. Feasibility Criteria

Individual BMPs may not be feasible at the site due to site constraints or activities. The City specified feasibility criteria for each BMP in an effort to protect ground water quality, archaeological resources, facilities from inadequate drainage, and avoid compromising the geotechnical/structural integrity of surrounding properties. Infeasibility must be documented using the Feasibility Screening Worksheet (Appendix F of the *Water Quality Rules*).

5.5.1. Infiltration Feasibility

Infiltration BMPs are infeasible and must not be used if any of the following conditions are met:

1. Soils beneath the BMP invert have measured infiltration rates of less than 0.5 in/hr or are USDA HSG "C" or "D" as reported by the USDA Natural Resources Conservation Service.
2. The seasonally high groundwater table is within 3 ft from the BMP invert.
3. There is a documented concern that there is a potential onsite for soil pollutants, ground water pollutants, or pollutants associated with industrial activities to be mobilized.
4. There are geotechnical concerns at the site.
5. Excavation for the installation of the BMP would disturb iwi kupuna or other archeological resources.
6. The BMP cannot be built within the following setbacks:

Distance	From the nearest...
10 ft	private property line
20 ft	building foundation at the project site
35 ft	septic system
50 ft	drinking water well
100 ft	down-gradient building foundation

5.5.2. Harvest/Reuse Feasibility

Harvest/Reuse is considered infeasible for the any of the flowing reasons:

1. The demand is inadequate to reuse the required volume of water.
2. The technical requirements cause the harvesting system to exceed 2% of the total project cost.
3. The site where a cistern must be located is at a slope greater than 10%.
4. There is no available space to locate a cistern of adequate size to harvest and use the required amount of water.
5. The cistern cannot be built within the following setbacks:

Distance	From the nearest...
5 ft	private property line or building foundation
10 ft	septic system

6. The project includes a reclaimed water system and demand for a harvest/reuse system cannot be met.

5.5.3. Biofiltration Feasibility

Biofiltration BMPs must be evaluated individually for feasibility as each has different applications. Only if all biofiltration BMPs are infeasible can alternative compliance be used.

1. Vegetated Biofilters are infeasible for any of the following reasons:
   a. Excavation would disturb iwi kupuna or other archaeological resources.
   b. The invert of underdrain layer is below seasonally high groundwater table.
   c. The site does not receive enough sunlight to support vegetation.
   d. The site lacks sufficient hydraulic head to support BMP operation by gravity.
   e. Unable to operate off-line with bypass and unable to operate in-line with safe overflow mechanism.
2. Green Roofs are infeasible for any of the following reasons:
   a. The roof is for a single family residential dwelling.
   b. Roof space is unavailable due to renewable energy, electrical, and/or mechanical systems.
   c. Slope on roof exceeds 25% (14 degrees).
3. Dry Swales or Enhanced Swales are infeasible for any of the following reasons:
   a. Excavation would disturb iwi kupuna or other archaeological resources.
   b. The invert of underdrain layer is below seasonally high groundwater table.
   c. The site lacks sufficient head to support BMP operation by gravity.
   d. Unable to operate off-line with bypass and unable to operate in-line with safe overflow mechanism.
4. Vegetated Swales are infeasible for any of the following reasons:
   a. The excavation would disturb iwi kupuna or other archaeological resources.
   b. The site does not receive enough sunlight to support vegetation.
   c. Unable to operate off-line with bypass and unable to operate in-line with safe overflow mechanism.
5. Vegetated filter strips are infeasible for any of the following reasons:
   a. Excavation would disturb iwi kupuna or other archaeological resources.
   b. The site does not receive enough sunlight to support vegetation.
   c. Unable to operate off-line with bypass and unable to operate in-line with safe overflow mechanism.

This page is intentionally left blank.

6. Considerations for Construction Treatment Control BMPs

As described in Section 1 of this document, the *Water Quality Rules* requires that a licensed engineer inspect BMPs during construction and must certify that they were built according to plan. Precautions must be taken during construction to ensure that permanent BMPs are installed as designed and function as intended.

The first and most important step in protecting permanent BMPs during construction is to utilize phasing to minimize the exposure of these structures to sediment. The following is a typical construction sequence. Depending on the BMP and design variation, alterations may be necessary. Note that Erosion and Sediment Control methods must adhere to the *Water Quality Rules* requirements throughout the duration of construction.

1. Protect future infiltration areas from compaction prior to installation. Clearly mark the existing vegetated areas to be preserved and future infiltration facilities with flags or temporary fencing.
2. Stabilize the entire area draining to the infiltration facility before construction of the infiltration facility begins. Or, construct a diversion berm around the perimeter of the infiltration site to prevent sediment transport during construction.
3. Excavate Structural Infiltration facilities to a uniform, level, uncompacted subgrade, free from rocks and debris. Excavation should be performed with the lightest practical equipment and should be placed outside the limits of the infiltration facility. If the use of heavy equipment on the base of the facility cannot be avoided, the infiltrative capacity must be restored by soil amendments or aerating prior to placing the infiltrative bed.
4. Complete final grading to achieve proposed design elevations, leaving space for upper layer of compost, mulch or topsoil as specified on plans.
5. Plant vegetation according to planting plan. Erosion and sediment control measures, such as temporary seeding and erosion control mats, should be used on vegetated slopes if appropriate.
6. Where pervious pavement is to be installed, installation of the pavement shall be scheduled as the last installation at a development site. Vehicular traffic should be prohibited for at least two (2) days following installation. Site materials should not be stored on pervious pavement.
7. Continue to use erosion and sediment control BMPs such as inlet protection and perimeter control to protect permanent BMPs until they are ready to be brought online. Once the drainage area is completely and permanently stabilized, the system can be brought online.
8. Consider re-verifying permeability prior to acceptance of the BMP.

For proprietary systems, the City recommends to follow manufacturers' installation guidelines while applying the basic principles outlined above.

Guidance on maintenance of BMPs after construction is presented in Section 7.

This page is intentionally left blank.

7. Operations and Maintenance of BMPs

Once built, BMPs require ongoing, long-term inspection and maintenance to ensure that BMPs are meeting the specified design criteria for storm water flow rate, volume and water quality. If the BMPs are not properly maintained the effectiveness of the BMP decreases and may impact water quality. Routine maintenance will also help avoid more costly rehabilitative maintenance to repair damages that may occur when BMPs have not been adequately maintained on a regular basis. For these reasons, the City requires project applicants to develop and record an O&M Plan as part of the permitting process.

7.1. Consideration when Selecting Treatment BMPs

The long-term performance of BMPs hinges on ongoing and proper maintenance. Consideration of the time and funding necessary to support long term maintenance should be included as part of the process when selecting treatment BMP(s). Maintenance costs will also include disposal of accumulated residuals. Residuals include trash, oil and grease, filter media and fine sediments.

7.1.1. Sediment and Oil Removal and Disposal

Over time, BMPs will accumulate sediment, which will need to be removed to prevent clogging and reduction in effectiveness. Routine maintenance activities need to include measuring the depth of sediment as part of routine maintenance events and included in the maintenance log. Sediment should be removed when sediment accumulation reaches thirty (30) percent of total capacity. Thirty (30) percent of a facility's capacity is calculated by multiplying the total capacity by 0.30.

Some facilities may require professional assistance, such as underground facilities and manufactured facilities that have confined spaces. These types of facilities require proper certifications to enter or must be cleaned by a vactor truck. Vacuuming with a vactor truck or street sweeping equipment may be required for certain components, such as collection basins, piping or pervious pavement systems.

The owner is responsible for properly disposing accumulated residuals. Current research generally indicates that residuals are not hazardous wastes and can be disposed of residuals the same way any uncontaminated soil would be dispose of, following dewatering. If the BMP treats runoff from areas where chemical or hazardous wastes could come into contact with storm water and an oily sheen, odor, discoloration or other signs of pollution is observed, hire a professional laboratory or sampling firm to assess whether the material needs specialized hauling, treatment, or disposal. If you need assistance deciding whether the solids must be managed as hazardous waste, contact the City Department of Environmental Services - Solid Waste Division.

7.1.2. Maintenance Costs

The City requires the applicant to include a description of the funding mechanism for long-term operation and maintenance in the SWQR. For homeowner associations, this could be a portion of homeowner fees or a specific assessment.

Maintenance costs need to include both routine (i.e., inspection, debris removal, or vegetation management) and non-routine (i.e., sediment removal, facility component repair/replace or major replanting) maintenance activities. The annual routine maintenance costs are typically between five (5) to ten (10) percent of the facility's total capital cost. For non-routine maintenance costs (i.e.: sediment removal or vegetative replacement), the owner should set aside a percentage of the non-routine maintenance costs per year based on the needed frequency. For example, if the facility needs sediment removal every five (5) years, twenty (20) percent of the total cost for sediment removal must be put aside each year. An additional three (3) to five (5) percent of the capital costs should also be incorporated into the overall maintenance costs for eventual facility replacement. The life expectancy for most treatment BMPs is between twenty-five (25) to fifty (50) years. The owner is responsible for replacing BMPs at the end of their lifecycle.

7.2. Developing the O&M Plan

Detailed O&M plans are required under the *Water Quality Rules* Section (§) 20-3-53. The O&M Plan is required to identify the specific maintenance activities and frequencies for each type of BMP. In addition, these should include indicators for assessing when "as needed" maintenance activities are required.

An O&M plan should be prepared by the project proponents and submitted to the DFM Storm Water Quality Branch (SWQ) prior to closure of any building, grading, grubbing, trenching, or stockpiling permits for Priority A and B projects.

The *Water Quality Rules* require the following as part of the O&M Plan

- Name, phone number and mailing address for the owner of the property.
- Name and phone number for the individual(s), association, or management company responsible ensuring maintenance is being performed.
- Maintenance activities for each BMP.
- Inspection frequencies for each BMP.
- A post-construction BMP plan showing the location of each BMP with a summary of the maintenance activities and inspection schedule for each BMP.

An O&M Template is available from the CCH and is available on their website. General maintenance activities and frequencies that should be included in the O&M plan are provided in **Appendix C**.

7.3. Maintenance Agreements, Certification, and Modifications

An O&M plan is particularly valuable during ownership transitions; for example, when a developer transitions maintenance to a homeowners association, or when a developer turns over maintenance to a new owner. The BMP maintenance plan is also important when evaluating properties for acquisition, allowing long-term costs associated with BMPs to be factored into the property purchase agreement.

Because of the long-term nature of these BMPs, the City requires that the BMP plan and O&M plan be recorded in the State of Hawaii Land Court or Bureau of Conveyances for privately-owned Real Property. A copy of the recorded O&M plan shall be submitted to the Department and Director of the DFM prior to closing the building and/or grading, grubbing, stockpiling or trenching permit(s).

Another valuable factor for ensuring BMP effectiveness is ensuring the BMP is installed according to plan. The City requires the owner to retain/hire a Licensed Engineer in the State of Hawaii and certified

by the DPP to observe the installation of BMPs during construction and submit a signed Certificate of Completion Form to the City prior to closing the building and/or grading, grubbing, stockpiling or trenching permit(s).

Any modifications to the O&M plan after permit closure must be approved by DFM. Modifications to the O&M plan will not be accepted if it reduces the level of protection from pollutant discharge.

7.4. Inspection Requirements

The owner is responsible for operation and maintenance inspections under the *Water Quality Rules*. The owner is required, at a minimum, to conduct an annual inspection of the installed BMP(s) and retain maintenance and inspection records for at least five (5) years. Furthermore, the owner is required to allow the City access to the BMPs for annual inspections to confirm compliance with the approved O&M plan.

The actual maintenance needs may be more frequently than annually. The need for maintenance depends on the type of BMP, amount and quality of runoff delivered to the structural BMP and any pretreatment facilities for that BMP. Maintenance should be performed on a routine basis and whenever needed, based on maintenance indicators. The optimum maintenance frequency is each time the maintenance threshold for removal of materials (sediment, trash, debris or overgrown vegetation) is met. If this maintenance threshold has been exceeded by the time the structural BMP is inspected, the BMP has been operating at reduced capacity. This would mean it is necessary to inspect and maintain the structural BMP more frequently.

During the first year of normal operation of a structural BMP (i.e., when the project is fully built out and occupied), inspection by the property owner's representative is recommended at least monthly. Inspection during a storm event is also recommended. It is during and after a rain event when one can determine if the components of the BMP are functioning properly. The inspection and maintenance frequency can be adjusted, based on the results of the inspections performed during the first year.

7.5. Minimum Maintenance Requirements

There are many different variations of structural BMPs, and structural BMPs may include multiple components. For the purpose of maintenance, the structural BMPs have been grouped into categories based on common maintenance requirements. The following fact sheets are available in **Appendix C**:

- Bioretention Basin
- Detention Basin
- Green Roof
- Infiltration Trench/Basin
- Manufactured Treatment Device
- Pervious Pavement
- Rainwater Harvesting
- Sand Filter
- Vegetated Biofilter
- Vegetated Swale/Strip

The project civil engineer is responsible for tailoring the maintenance activities and frequency based on the components of the structural BMP, and identifying the applicable maintenance indicators. The factsheets are intended to be general guidance and are meant to help prepare the maintenance plan, more explicit maintenance activities may be necessary to ensure proper operation and maintenance.

8. References

Alameda Countywide Clean Water Program. www.cleanwaterprogram.org/businesses_home.htm

Arizona Department of Transportation. 2009. *ADOT Post-Construction Best Management Practices Manual*. http://www.azdot.gov/inside_adot/OES/Water_Quality/Stormwater/Manuals.asp

ASCE. 1998. *Urban Runoff Quality Management, Manual and Report of Engineering Practice 87*. Reston, Virginia.

Atlanta Regional Commission. 2001. *Georgia Stormwater Management Manual, Volume 2: Technical Handbook*. http://www.georgiastormwater.com/

California Stormwater Quality Association. 2003. *Stormwater Best Management Practice Handbook, Industrial and Commercial*. http://www.cabmphandbooks.com/

California Stormwater Quality Association. 2003. *Stormwater Best Management Practice Handbook, New Development and Redevelopment*. http://www.cabmphandbooks.com/

City and County of Honolulu. 2012. *Green Infrastructure for Homeowners*. https://www.honolulu.gov/rep/site/dfmswq/library/Green_Infrastructure_for_Homeowners-FINAL.pdf

City and County of Denver. 2013. *Storm Drainage Design and Technical Criteria*. https://www.denvergov.org/Portals/711/documents/StormMasterPlan/StormDrainageDesignTechnicalCriteria.pdf

City of Boulder, Colorado. Partners for a Clean Environment. www.bouldercolorado.gov/www/pace/government/index.html

City of Los Angeles, California. *Stormwater Program, Best Management Practices for Businesses and Commercial Industries*. www.lastormwater.org/Siteorg/businesses/bmpbusiness.htm

County of Maui, Hawaii, Document Center, Department of Water. Water Resource Planning Division. www.co.maui.hi.us/DocumentCenterii.aspx

County of Orange, California. OC Watersheds Industrial/Commercial Businesses Activities. www.ocwatersheds.com/IndustrialCommercialBusinessesActivities.aspx

County of Santa Barbara, California. Storm Water Management Program. www.sbprojectcleanwater.org/swmp.html

County of Suffolk, New York. Stormwater Management Program. www.co.suffolk.ny.us/stormwater/bmps_businesses.html

City of Long Beach Development Services. 2012. *Low Impact Development (LID) Best Management Practices (BMP) Design Manual*. http://www.lbds.info/civica/filebank/blobdload.asp?BlobID=3855

City of Portland. 2014. *Stormwater Management Manual*. http://www.portlandoregon.gov/bes/47952

City of San Diego. 2016. *Storm Water Standards.* https://www.sandiego.gov/stormwater/regulations

Clean Water Services. 2009. *Low Impact Development Approaches Handbook*. http://www.cleanwaterservices.org/Content/Documents/Permit/LIDA%20Handbook.pdf

Connecticut Department of Environmental Protection. 2004. *Connecticut Stormwater Quality Manual*. http://ct.gov/dep/cwp/view.asp?a=2721&q=325704&depNav_GID=1654

County of Los Angeles Department of Public Works. 2014. *Low Impact Development (Standards Manual)*. http://dpw.lacounty.gov/DES/design_manuals/

County of San Diego Department of Public Works. 2012. *Operation and Maintenance Cost Table for Treatment Control BMPs*. http://www.sandiegocounty.gov/dpw/watersheds/susmp/susmp.html

County of San Diego. 2014. *Low Impact Development Handbook, Stormwater Management Strategies*. http://www.sandiegocounty.gov/content/dam/sdc/dplu/docs/LID_Handbook_2014.pdf

County of Santa Clara. 2012. *C.3. Stormwater Handbook*. http://www.scvurppp-w2k.com/c3_handbook_2012.shtml

Ekern, P.C., and Chang, J.H. 1985. *Pan Evaporation: State of Hawaii, 1894-1983*. State of Hawaii, Department of Land and Natural Resources, Division of Water and Land Development.

Idaho Department of Environmental Quality. 2005. *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties*. http://www.deq.idaho.gov/water/data_reports/storm_water/catalog/

Iowa State University Institute for Transportation. 2009. *Iowa Stormwater Management Manual*. http://www.intrans.iastate.edu/pubs/stormwater/index.cfm

King County Department of Natural Resources and Parks. 2009. *King County, Washington Surface Water Design Manual*. http://www.kingcounty.gov/environment/waterandland/stormwater.aspx

Maine Coastal Program, State Planning Office. 2007. *LID Guidance Manual for Maine Communities*. http://www.maine.gov/dep/blwq/docwatershed/materials.htm

Maine Department of Environmental Protection. 2006. *Stormwater Management for Maine, Volume III BMPs Technical Design Manual*. http://www.maine.gov/dep/blwq/docstand/stormwater/stormwaterbmps/index.htm

Maryland Department of the Environment. 2000. *Maryland Stormwater Design Manual*. http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/MarylandStormwaterDesignManual/

New Hampshire Department of Environmental Services. 2008. *New Hampshire Stormwater Manual, Volume 2, Post-Construction Best Management Practices Selection and Design*. http://des.nh.gov/organization/divisions/water/stormwater/

New Jersey Department of Environmental Protection, Division of Watershed Management. 2009. *New Jersey Stormwater Best Management Practices Manual*. http://www.state.nj.us/dep/stormwater/

North Carolina State University. 2009. *Low Impact Development, A Guidebook for North Carolina*. http://www.ces.ncsu.edu/depts/agecon/WECO/lidguidebook/

National Oceanic Atmospheric Association Coral Reef Conservation Program. 2014. *Storm Water management in Pacific and Caribbean Islands: A practitioner's guide to Implementing LID*. http://data.nodc.noaa.gov/coris/library/NOAA/CRCP/project/1906/Feb2014_IslandBMPGuide_wAppendix.pdf

Pennsylvania Department of Environmental Protection. 2006. *Pennsylvania Stormwater Best Management Practices Manual*. http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-8305

Prince George's County, Maryland, Department of Environmental Resource. 1999. *Low Impact Development Design Strategies, An Integrated Design Approach*. http://www.lowimpactdevelopment.org/publications.htm

Prince George's County, Maryland, Department of Environmental Resources. 2007. *Bioretention Manual*. http://www.princegeorgescountymd.gov/der/esg/bioretention/bioretention.asp

Rawls, W. J., D. L. Brakensiek and K. E. Saxton. 1982. *Estimation of Soil Water Properties*. Transactions ASAE, 25(5)1316-1320, 1328.

Riverside County Flood Control and Water Conservation District. 2006. *Riverside County Stormwater Quality Best Management Practice Design Handbook*. http://www.floodcontrol.co.riverside.ca.us/downloads/Planning/BMP%20Handbook%20(draft%208).pdf

San Francisco Public Utilities Commission. *Rainwater Harvesting System Sizing Calculator*. http://sfwater.org/msc_main.cfm/MC_ID/17/MSC_ID/404

Southeast Michigan Council of Governments. 2008. *Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers*. http://www.semcog.org/lowimpactdevelopment.aspx

State of California Department of Transportation. 2010. *Stormwater Quality Handbooks, Project Planning and Design Guide*. http://www.dot.ca.gov/hq/oppd/stormwtr/

State of Hawaii, Department of Health, Wastewater Branch. 2009. *Guidelines for the Reuse of Gray Water*. http://hawaii.gov/wastewater/pdf/graywater_guidelines.pdf

State of Hawaii Department of Transportation. 2007. *Storm Water Permanent Best Management Practices Manual*. http://stormwaterhawaii.com/pdfs/PermanentManual.pdf

State of Hawaii Office of Planning, Coastal Zone Management Program. 2006. *Hawaii Low Impact Development, A Practitioner's Guide.* http://hawaii.gov/dbedt/czm/initiative/lid.php

State of New York Department of Environmental Conservation. 2010. *New York State Stormwater Management Design Manual*. http://www.dec.ny.gov/chemical/29072.html

University of California Cooperative Extension, California Department of Water Resources. 2000. *A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California*. http://www.water.ca.gov/wateruseefficiency/docs/wucols00.pdf

University of Hawaii at Manoa, College of Tropical Agriculture and Human Resources. 2010. *Guidelines on Rainwater Catchment Systems for Hawaii*. http://www.ctahr.hawaii.edu/Site/PubList.aspx?key=Forest%20and%20Natural%20Resource%20Management

Urban Drainage and Flood Control District. 2010. U*rban Storm Drainage Criteria Manual, Volume 3 - Best Management Practices*. http://www.udfcd.org/downloads/down_critmanual.htm

U.S. Department of Agriculture, Natural Resources Conservation Service. 2006. *Soil Data Mart*. http://soildatamart.nrcs.usda.gov/

U.S. Department of Commerce National Oceanic and Atmospheric Administration, National Climatic Data Center. 2002. *Climatography of the United States No. 81, Monthly Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1971-2000, Hawaii.* http://cdo.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl

U.S. Environmental Protection Agency. 2004. *Stormwater Best Management Practice Design Guide, Volume 2, Vegetative Biofilters*. http://www.epa.gov/ORD/NRMRL/pubs0402.html

U.S. Environmental Protection Agency. 2004. *Stormwater Best Management Practice Design Guide, Volume 3, Basin Best Management Practices*. http://www.epa.gov/ORD/NRMRL/pubs0402.html

U.S. Soil Conservation Service. 1986. *Urban Hydrology for Small Watersheds, Technical Release 55*. http://www.wsi.nrcs.usda.gov/products/w2q/H&H/Tools_Models/other/TR55.html

Ventura Countywide Stormwater Quality Management Program. 2010. *Ventura County Technical Guidance Manual for Stormwater Quality Control Measures*. http://www.vcstormwater.org/technicalguidancemanual.html

Virginia Department of Conservation and Recreation. 2011. *Virginia DCR Stormwater Design Specification No. 3, Grass Channels*. http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html

Virginia Department of Conservation and Recreation. 2011. *Virginia DCR Stormwater Design Specification No. 5, Vegetated Roof*. http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html

Virginia Department of Conservation and Recreation. 2011. *Virginia DCR Stormwater Design Specification No. 7, Permeable Pavement*. http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html

Virginia Department of Conservation and Recreation. 2011. *Virginia DCR Stormwater Design Specification No. 8, Infiltration Practices*. http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html

Virginia Department of Conservation and Recreation. 2011. *Virginia DCR Stormwater Design Specification No. 9, Bioretention*. http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html

Virginia Department of Conservation and Recreation. 2011. *Virginia DCR Stormwater Design Specification No. 10, Dry Swales*. http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html

Washington State University Extension. 2012. *Low Impact Development Technical Guidance Manual for Puget Sound*. http://www.psp.wa.gov/downloads/LID/20121221_LIDmanual_FINAL_secure.pdf

Western Regional Climate Center, National Oceanic and Atmospheric Administration. *Average Pan Evaporation Data by State*. http://www.wrcc.dri.edu/htmlfiles/westevap.final.html

Western Regional Climate Center, National Oceanic and Atmospheric Administration. *Comparative Data for the Western States*. http://www.wrcc.dri.edu/htmlfiles/

This page is intentionally left blank.

Appendix A: Source Control BMP Fact Sheets

This section describes specific Source Control (SC) BMPs to be considered for incorporation into newly developed public and private infrastructure, as well as retrofit into existing facilities to meet storm water management objectives.

Source Control BMPs are required for all Priority A and B projects for the following activities and areas:

- Landscaped Areas
- Automatic Irrigation Systems
- Storm Drain Inlets
- Vehicle/Equipment Fueling
- Vehicle/Equipment Repair
- Vehicle/Equipment Washing/Cleaning
- Loading Docks
- Outdoor Trash Storage
- Outdoor Material Storage
- Outdoor Work Areas
- Outdoor Process Equipment Operations
- Parking Areas

The following fact sheets are included in this guidance manual and recommended by CCH but are not required by the *Water Quality Rules*.

- Alternative Building Materials
- Roof Runoff Controls

The following information is provided for each of the above-listed BMPs:

- Brief Description/Approach
- Suitable Applications
- Design Considerations
- Design Guidelines
- Examples
- Operations & Maintenance Recommendations

This page is intentionally left blank.

SC-01: Landscaped Areas



Design Objectives	
✓	Maximum Infiltration
✓	Provide On-Site Retention
✓	Slow Runoff
✓	Minimize Impervious Land Coverage
✓	Implement LID
	Prohibit Dumping of Improper Materials
	Contain Pollutants
	Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from storm water.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the maximum extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

Design Guidelines

- Conserve natural areas to the extent possible.
- Maximize natural water storage and infiltration opportunities to the extent possible.
- Limit runoff from landscaped areas to impervious areas.
- Protect slopes and channels.

Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open un-wooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (i.e., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.
- Evaluating infiltration opportunities by referring to the storm water management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydro-geological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetated slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

The City's SWMPP defines "redevelopment" as development that would create or add impervious surface area on an already developed site. Redevelopment includes, but is not limited to:

- Expansion of a building footprint.
- Addition to or replacement of a structure.
- Replacement of an impervious surface that is not part of a routine maintenance activity.
- Land disturbing activities related to structural or impervious surfaces.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, and disconnect directly connected impervious areas.

O&M Recommendations

- Do not use pesticides and fertilizers during wet weather or when rain is forecast, and minimize their use during dry weather.
- Do not blow or rake leaves, grass, or garden clippings into the street, gutter, or storm drain.
- Do not apply any chemicals (insecticide, herbicide, or fertilizer) directly to surface waters, unless the application is approved and permitted by the state.

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.
- Check irrigation schedules so pesticides will not be washed away and to minimize non-storm water discharge.

References

California Stormwater Quality Association (CASQA) Best Management Practices Handbook New Development and Redevelopment, 2003.

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County, Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

SC-02: Roof Runoff Controls



Design Objectives	
✓	Maximum Infiltration
✓	Provide On-Site Retention
✓	Slow Runoff
	Minimize Impervious Land Coverage
✓	Implement LID
	Prohibit Dumping of Improper Materials
✓	Contain Pollutants
	Collect and Convey

Description

Various roof runoff controls are available to address storm water that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; green roofs (LID, see TC-07), pop-up emitters, and foundation planting. The first three (3) approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved storm water quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One (1) method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least two (2) rain barrels, with a minimum storage capacity of 1,000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store storm water for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering storm water runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry Wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They should be sized according to the amount of rooftop runoff received, but are typically 4 to 5 sq-ft, and 2 to 3 ft deep, with a minimum of 1-ft soil cover over the top (maximum depth of 10 ft).

To protect the foundation, dry wells must be set away from the building at least 10 ft. The location of drywells should be determined by a licensed engineer. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility. Overflow shall be directed away from the structure and surrounding buildings.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives storm water runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for storm water infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

The City's SWMPP defines "redevelopment" as development that would create or add impervious surface area on an already developed site. The definition of "redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Examples

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

References

California Stormwater Quality Association (CASQA) Best Management Practices Handbook New Development and Redevelopment, 2003.

Hager, Marty Catherine, Stormwater, "Low-Impact Development," January/February 2003. http://www.stormh2o.com/SW/Articles/226.aspx

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net.

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition.

This page is intentionally left blank.

SC-03: Automatic Irrigation System



Design Objectives	
✓	Maximum Infiltration
✓	Provide On-Site Retention
✓	Slow Runoff
	Minimize Impervious Land Coverage
✓	Implement LID
	Prohibit Dumping of Improper Materials
✓	Contain Pollutants
	Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into storm water drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the storm water conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. Detached residential single-family homes are typically excluded from this requirement.

Design Considerations

Design Guidelines

- Design irrigation systems to each landscape area's specific water requirements.
- Implement landscape plans consistent with City water conservation resolutions, which may include provision of drip irrigation, water sensors, programmable irrigation times (for short cycles), etc.
- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration.

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.
- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff.
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect.
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible.
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth.
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

The City's SWMPP defines "redevelopment" as development that would create or add impervious surface area on an already developed site. The definition of "redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

O&M Recommendations

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring.
- Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.

References

California Stormwater Quality Association (CASQA) Best Management Practices Handbook New Development and Redevelopment, 2003.

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

This page is intentionally left blank.

SC-04: Storm Drain Inlet



Design Objectives	
	Maximum Infiltration
	Provide On-Site Retention
	Slow Runoff
	Minimize Impervious Land Coverage
	Implement LID
✓	Prohibit Dumping of Improper Materials
	Contain Pollutants
	Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Stencils and signs alert the public to the destination of pollutants discharged to the storm drain.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Design Guidelines

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language.
- Place the marker in clear sight facing toward anyone approaching the inlet from either side.

- Be aware that signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.
- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Designing New Installations

The following methods should be considered for inclusion in the project design and shown on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "Dump No Waste" and/or other graphical icons to discourage illegal dumping.
- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note: DFM-SWQ has approved specific signage and/or storm drain message placards for use. Consult local agency storm water staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

The City's SWMPP defines "redevelopment" as development that would create or add impervious surface area on an already developed site. If the project meets the definition of "redevelopment," then the requirements stated under "designing new installations" above should be included in all project design plans.

Supplemental Information

Maintenance Considerations

Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.
- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

O&M Recommendations

- Inspect signage regularly and maintain as appropriate to ensure legibility.
- Inspect regularly, at least annually, for structural deterioration or significant build-up of debris or sediment.

References

California Stormwater Quality Association (CASQA) Best Management Practices Handbook New Development and Redevelopment, 2003.

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

This page is intentionally left blank.

SC-05: Alternative Building Materials



Design Objectives	
✓	Maximum Infiltration
✓	Provide On-Site Retention
✓	Slow Runoff
	Minimize Impervious Land Coverage
✓	Implement LID
	Prohibit Dumping of Improper Materials
	Contain Pollutants
	Collect and Convey

Description

Alternative building materials are selected instead of conventional materials for new construction and renovation. These materials reduce potential sources of pollutants in storm water runoff by eliminating compounds that can leach into runoff, reducing the need for pesticide application, reducing the need for painting and other maintenance, or by reducing the volume of runoff.

Approach

Alternative building materials are available for use as lumber for decking, roofing materials, home siding, and paving for driveways, decks, and sidewalks.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design New Installations

Decking

One of the most common materials for construction of decks and other outdoor construction has traditionally been pressure treated wood, which is now being phased out. The standard treatment is called CCA, for chromated copper arsenate. The key ingredients are arsenic (which kills termites, carpenter ants and other insects), copper (which kills the fungi that cause wood to rot) and chromium (which reacts with the other ingredients to bind them to the wood). The amount of arsenic is far from trivial. A deck just 8 ft by 10 ft contains more than 1 1/3 pounds of this highly potent poison. Replacement materials include a new type of pressure treated wood, plastic and composite lumber.

There are currently over 20 products in the market consisting of plastic or plastic-wood composites. Plastic lumber is made from 100% recycled plastic, # 2 high-density polyethylene (HDPE), and polyethylene plastic milk jugs and soap bottles. Plastic-wood composites are a combination of plastic and wood fibers or sawdust. These materials are a long lasting exterior weather, insect, and chemical resistant wood lumber replacement for non-structural applications. Use it for decks, docks, raised garden beds and planter boxes, pallets, hand railings, outdoor furniture, animal pens, boat decks, etc.

New pressure treated wood uses a much safer recipe, ACQ, which stands for ammoniacal copper quartenary. It contains no arsenic and no chromium. Yet the American Wood Preservers Association has found it to be just as effective as the standard formula. ACQ is common in Japan and Europe.

Roofing

Several studies have indicated that metal used as roofing material, flashing, or gutters can leach metals into the environment. The leaching occurs because rainfall is slightly acidic and slowly dissolved the exposed metals. Common traditional applications include copper sheathing and galvanized (zinc) gutters.

Coated metal products are available for both roofing and gutter applications. These products eliminate contact of bare metal with rainfall, eliminating one source of metals in runoff. There are also roofing materials made of recycled rubber and plastic that resemble traditional materials.

A less traditional approach is the use of green roofs (See TC-07). These roofs are not just green, they're alive. Planted with grasses and succulents, low- profile green roofs reduce the urban heat island effect, storm water runoff, and cooling costs, while providing wildlife habitat and a connection to nature for building occupants. These roofs are widely used on industrial facilities in Europe and have been established as experimental installations in several locations in the US, including Portland, Oregon.

Paved Areas

Traditionally, concrete is used for construction of patios, sidewalks, and driveways. Although it is non-toxic, these paved areas reduce storm water infiltration and increase the volume and rate of runoff. This increase in the amount of runoff is the leading cause of stream channel degradation in urban areas.

There are a number of alternative materials that can be used in these applications, including porous concrete and asphalt, modular blocks, and crushed granite. These materials, especially modular paving blocks, are widely available and well established methods to reduce storm water runoff.

Building Siding

Wood siding is commonly used on the exterior of residential construction. This material weathers fairly rapidly and requires repeated painting to prevent rotting. Alternative "new" products for this application include cement-fiber and vinyl. Cement-fiber siding is a masonry product made from Portland cement, sand, and cellulose and will not burn, cup, swell, or shrink.

Pesticide Reduction

A common use of powerful pesticides is for the control of termites. Chlordane was used for many years for this purpose and is now found in urban streams and lakes nationwide. There are a number of physical barriers that can be installed during construction to help reduce the use of pesticides.

Sand barriers for subterranean termites are a physical deterrent because the termites cannot tunnel through it. Sand barriers can be applied in crawl spaces under pier and beam foundations, under slab foundations, and between the foundation and concrete porches, terraces, patios and steps. Other possible locations include under fence posts, underground electrical cables, water and gas lines, telephone and electrical poles, inside hollow tile cells and against retaining walls.

Metal termite shields are physical barriers to termites which prevent them from building invisible tunnels. In reality, metal shields function as a helpful termite detection device, forcing them to build tunnels on the outside of the shields which are easily seen. Metal termite shields also help prevent dampness from wicking to adjoining wood members which can result in rot, thus making the material more attractive to termites and other pests. Metal flashing and metal plates can also be used as a barrier between piers and beams of structures such as decks, which are particularly vulnerable to termite attack.

Redeveloping Existing Installations

The City's SWMPP defines "redevelopment" as development that would create or add impervious surface area on an already developed site. The definition of "redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

There are no good, independent, comprehensive sources of information on alternative building materials for use in minimizing the impacts of storm water runoff. Most websites or other references to "green" or "alternative" building materials focus on indoor applications, such as formaldehyde free plywood and low VOC paints, carpets, and pads. Some supplemental information on alternative materials is available from the manufacturers.

References

California Stormwater Quality Association (CASQA) Best Management Practices Handbook New Development and Redevelopment, 2003.

This page is intentionally left blank.

SC-06: Vehicle/Equipment Fueling



Design Objectives	
	Maximum Infiltration
	Provide On-Site Retention
	Slow Runoff
	Minimize Impervious Land Coverage
	Implement LID
	Prohibit Dumping of Improper Materials
✓	Contain Pollutants
✓	Collect and Convey

Description

Fueling areas have the potential to discharge oil and grease, solvents, car battery acid, coolant and gasoline to the storm drain. Spills can be a significant source of pollution because fuels contain toxic materials and heavy metals that are not easily removed by storm water treatment devices.

Approach

Project plans must be developed for cleaning near fuel dispensers, emergency spill cleanup, containment, and leak prevention.

Suitable Applications

Appropriate applications include commercial, industrial, and any other areas planned to have fuel dispensing equipment, including retail gasoline outlets, automotive repair shops, and major non-retail dispensing areas.

Design Considerations

Design requirements for fueling areas are governed by Building and Fire Codes and by current local agency ordinances and zoning requirements. Design requirements described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements.

Design Guidelines

- **Covering**. Include an overhanging roof structure or canopy over fuel dispensing areas. The cover's minimum dimensions must be equal to or greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. If fueling large equipment or vehicles that prohibit the use of covers or roofs, the fueling island should be designed to accommodate the larger vehicles and equipment and to prevent storm water run-on and runoff.

- **Surfacing.** Pave fuel dispensing areas with Portland cement concrete (or equivalent smooth impervious surface). Extend the paved area a minimum of 6.5 ft from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 ft, whichever is less. The use of asphalt concrete is prohibited. Use asphalt sealant to protect asphalt paved areas surrounding the fueling area.
- **Grading/Contouring.** Slope the dispensing areas to prevent ponding, and separate it from the rest of the site by a grade break that prevents run-on. Grade the fueling areas to drain toward a dead-end sump or vegetated/landscaped area. Direct runoff from downspouts/roofs away from fueling areas towards vegetated/landscaped areas if possible.
- **Drains.** Label all drains within facility boundaries using paint or stencil, to indicate whether flow is to the storm drain, sewer, or oil/water separator.

Designing New Installations

Covering

Fuel dispensing areas should provide an overhanging roof structure or canopy. The cover's minimum dimensions must be equal to or greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. The fueling area should drain to the project's treatment control BMP(s) prior to discharging to the storm water conveyance system. Note: If fueling large equipment or vehicles that would prohibit the use of covers or roofs, the fueling island should be designed to sufficiently accommodate the larger vehicles and equipment and to prevent storm water run-on and runoff. Grade to direct storm water to a dead-end sump.

Surfacing

Fuel dispensing areas should be paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete should be minimized. Use asphalt sealant to protect asphalt paved areas surrounding the fueling area. This provision may be made to sites that have pre-existing asphalt surfaces.

The concrete fuel dispensing area should be extended a minimum of 6.5 ft from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 ft, whichever is less.

Grading/Contouring

Dispensing areas should have an appropriate slope to prevent ponding, and be separated from the rest of the site by a grade break that prevents run-on of urban runoff (slope is required to be 2 to 4% in some jurisdictions' storm water management and mitigation plans).

Fueling areas should be graded to drain toward a dead-end sump. Runoff from downspouts/roofs should be directed away from fueling areas. Do not locate storm drains in the immediate vicinity of the fueling area.

Redeveloping Existing Installations

The City's SWMPP defines "redevelopment" as development that would create or add impervious surface area on an already developed site. The definition of "redevelopment" must be consulted to determine

whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

Supplemental Information

In the case of an emergency, provide storm drain seals, such as isolation valves, drain plugs, or drain covers, to prevent spills or contaminated storm water from entering the storm water conveyance system.

O&M Recommendations

- Maintain clean fuel-dispensing areas using dry cleanup methods such as sweeping, or use of rags and absorbents for leaks and spills.
- If you clean by washing, place a temporary plug in the downstream drain and pump out the accumulated water. Properly dispose the water.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank. Cover storm drains in the vicinity during transfer.
- Post signs at the fuel dispenser or fuel island warning vehicle owners/operators against "topping off" of vehicle fuel tanks.
- Develop and implement a Spill Prevention Control and Countermeasure (SPCC) Plan.

References

California Stormwater Quality Association (CASQA) Best Management Practices Handbook New Development and Redevelopment, 2003.

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

This page is intentionally left blank.

SC-07: Vehicle/Equipment Repair



Design Objectives	
	Maximum Infiltration
	Provide On-Site Retention
	Slow Runoff
	Minimize Impervious Land Coverage
	Implement LID
	Prohibit Dumping of Improper Materials
✓	Contain Pollutants
✓	Collect and Convey

Description/Approach

Several measures can be taken to prevent operations at maintenance bays from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the storm water conveyance system. In designs for maintenance bays containment is encouraged. Preventive measures include overflow containment structures and dead-end sumps.

Design Guidelines

Design requirements for vehicle maintenance and repair are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. The design requirements described hereon are meant to enhance and be consistent with these code requirements.

- Locate repair/maintenance bays indoors; or design them to preclude run-on and runoff.
- Pave repair/maintenance floor areas with Portland cement concrete (or equivalent smooth impervious surface).
- Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters from entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited.
- Label all drains within facility boundaries using paint or stencil, to indicate whether flow is to the storm drain, sewer, or oil/water separator.

O&M Recommendations

- Avoid hosing down work areas. If work areas are washed, collect and direct wash water to sanitary sewer.
- Do not pour liquid waste down floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.

- Do not dispose of used or leftover cleaning solutions, solvents, and automotive fluids and oil in the sanitary sewer.
- Keep drip pans or containers under vehicles or equipment that may drip during repairs.
- When steam cleaning or pressure washing parts, the wastewater must be discharged to an on-site oil water separator that is connected to a sanitary sewer or blind sump.
- Develop and implement a Spill Prevention Control and Countermeasure (SPCC) Plan.

SC-08: Vehicle/Equipment Cleaning



Design Objectives	
	Maximum Infiltration
	Provide On-Site Retention
	Slow Runoff
	Minimize Impervious Land Coverage
	Implement LID
	Prohibit Dumping of Improper Materials
✓	Contain Pollutants
✓	Collect and Convey

Description

Vehicle washing, equipment washing, and steam cleaning may contribute high concentrations of pollutants to wash waters that drain to storm water conveyance systems. Wash water may not be conveyed to a sewer without a sewer connection permit.

Approach

Project plans should include appropriately designed area(s) for washing-steam cleaning of vehicles and equipment. Depending on the size and other parameters of the wastewater facility, wash water may be conveyed to a sewer, an infiltration system, recycling system or other alternative. Pretreatment may be required for conveyance to a sanitary sewer.

Suitable Applications

Appropriate applications include commercial developments, restaurants, retail gasoline outlets, automotive repair shops, condominiums, apartment buildings, and others.

Design Considerations

Design requirements for vehicle maintenance are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. Design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

Design Guidelines

Commericial Applications

Incorporate at least one of the following features for equipment washing/steam cleaning:

- Be self-contained and/or covered with a roof or overhang.
- Be equipped with a clarifier or other pretreatment facility.

- Have a proper connection to a sanitary sewer.
- Install sumps or drain lines to collect wash water. Divert wash water to the sanitary sewer, an engineered infiltration system, or an equally effective alternative.
- Direct and divert surface water runoff away from the exposed area around the wash pad, and wash pad itself to alternatives other than the sanitary sewer.
- Cover areas used for regular washing of vehicles, trucks, or equipment, surround them with a perimeter berm, and clearly mark them as a designated washing area.
- Label all drains within facility boundaries using paint or stencil, to indicate whether flow is to the storm drain, sewer, or oil/water separator.

Residential Applications

- Designate a car wash area and post signs for area.
- Divert wash water to a vegetated area where it may percolate into the ground, the sanitary sewer, an engineered Infiltration system, or an equally effective alternative.
- Direct and divert surface water runoff away from the wash area to alternatives other than the sanitary sewer.
- Approval for a sanitary connection must be obtained from the City Department of Environmental Services.

Designing New Installations

Areas for washing/steam cleaning should incorporate one of the following features:

- Be self-contained and/or covered with a roof or overhang.
- Be equipped with a clarifier or other pretreatment facility.
- Have a proper connection to a sanitary sewer.
- Include other features which are comparable and equally effective.

Car Wash Areas

Wash water from the areas may be directed to the sanitary sewer, to an engineered infiltration system, or to an equally effective alternative. Pre-treatment may also be required. For residential applications, it can be appropriate to direct wash water to a planted area and allow it to percolate into the ground.

Developers are to direct and divert surface water runoff away from the exposed area around the wash pad (parking lot, storage areas), and wash pad itself to alternatives other than the sanitary sewer. Roofing may be required for exposed wash pads.

It is generally advisable to cover areas used for regular washing of vehicles, trucks, or equipment, surround them with a perimeter berm, and clearly mark them as a designated washing area. Sumps or drain lines can be installed to collect wash water, which may be treated for reuse or recycling, or for discharge to the sanitary sewer. Some areas may require some form of pretreatment, such as a trap, for these areas.

Redeveloping Existing Installations

The City's SWMPP defines "redevelopment" as development that would create or add impervious surface area on an already developed site. The definition of "redevelopment" must be consulted to determine

whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Maintenance Considerations

Storm water and non-storm water will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

O&M Recommendations

- Mark the area clearly as a wash area.
- Post signs to state that washing is only allowed in wash area.
- Provide trash container with lids in wash area.
- Recycle, collect or treat wash water effluent prior to discharge to the sanitary sewer system.
- Do not conduct oil changes and other engine maintenance in the designated washing area. Perform these activities in a place designated for oil change and maintenance activities.
- Cover the wash area when not in use to prevent contact with rain water.
- Do not permit steam cleaning wash water to enter the storm drain.
- Develop and implement a Spill Prevention Control and Countermeasure (SPCC) Plan.

References

California Stormwater Quality Association (CASQA) Best Management Practices Handbook New Development and Redevelopment, 2003.

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Storm Water Quality Control Measures, July 2002.

This page is intentionally left blank.

SC-09: Loading Dock



Design Objectives	
	Maximum Infiltration
	Provide On-Site Retention
	Slow Runoff
	Minimize Impervious Land Coverage
	Implement LID
✓	Prohibit Dumping of Improper Materials
✓	Contain Pollutants
	Collect and Convey

Description

Several measures can be taken to prevent operations at loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the storm water conveyance system.

Approach

In designs for loading docks, containment is encouraged. Preventive measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.

Suitable Applications

Appropriate applications include commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for vehicle maintenance and repair are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

Design Guidelines

Design requirements for vehicle maintenance and repair are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. The design requirements described hereon are meant to enhance and be consistent with these code requirements.

- Cover all loading dock areas, or design them to preclude run-on and runoff.
- Do not allow runoff from depressed loading docks (truck wells) to discharge into storm drains.

- Drain below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items through water quality inlets, an engineered infiltration system, or an equally effective alternative.
- Grade and/or berm the loading/unloading area to a drain that is connected to a dead-end.
- Pave loading areas with concrete instead of asphalt.

Designing New Installations

Designs of maintenance bays should consider the following:

- Repair/maintenance bays and vehicle parts with fluids should be indoors; or designed to preclude urban run-on and runoff.
- Repair/maintenance floor areas should be paved with Portland cement concrete (or equivalent smooth impervious surface).
- Repair/maintenance bays should be designed to capture all wash water leaks and spills. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters from entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.
- Other features may be comparable and equally effective.

The following designs of loading/unloading dock areas should be considered:

- Loading dock areas should be covered, or drainage should be designed to preclude urban run-on and runoff.
- Direct connections into storm drains from depressed loading docks (truck wells) are prohibited.
- Below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items should drain through water quality inlets, or to an engineered infiltration system, or an equally effective alternative. Pre-treatment may also be required.
- Other features may be comparable and equally effective.

Redeveloping Existing Installations

The City's SWMPP defines "redevelopment" as development that would create or add impervious surface area on an already developed site. The definition of "redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Storm water and non-storm water will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

O&M Recommendations

- Develop an operations plan that describes procedures for loading and/or unloading.
- Conduct loading and unloading in dry weather if possible.

- Load and unload all materials and equipment in covered areas if feasible.
- Load/unload only at designated loading areas.
- Check loading and unloading equipment regularly for leaks.
- Look for dust or fumes during loading or unloading operations.
- Develop and implement a Spill Prevention Control and Countermeasure (SPCC) Plan.

References

California Stormwater Quality Association (CASQA) Best Management Practices Handbook New Development and Redevelopment, 2003.

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

This page is intentionally left blank.

SC-10: Outdoor Trash Storage



Design Objectives	
	Maximum Infiltration
	Provide On-Site Retention
	Slow Runoff
	Minimize Impervious Land Coverage
	Implement LID
	Prohibit Dumping of Improper Materials
✓	Contain Pollutants
	Collect and Convey

Description

Storm water runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or streams.

Approach

Preventive measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Suitable Applications

Appropriate applications include residential, commercial, and industrial areas planned for development or redevelopment. Detached residential single-family homes are typically excluded from this requirement.

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Hawaii Administrative Rules Title 11 Chapter 58.1 Solid Waste Management Control, and enforcement by the State of Hawaii Department of Health Solid and Hazardous Waste Branch.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Design Guidelines

- Hazardous waste must be handled in accordance with legal requirements established in Hawaii Administrative Rules Title 11 Chapter 58.1 Solid Waste Management Control, and enforcement by the State of Hawaii Department of Health solid and Hazardous Waste Branch.
- Berm trash storage areas to prevent run-on from adjoining roofs and pavement, or grade areas towards vegetated/landscaped areas.
- Reduce/prevent leaking of liquid waste by incorporating at least one of the following:
  - Lined bins or dumpsters.
  - Low containment berm around the dumpster area.
  - Drip pans underneath dumpsters.
- Prevent rainfall from entering containers with roofs, awnings, or attached lids.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on dumpsters indicating that hazardous material are not to be disposed of therein.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of storm water.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.
- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous material are not to be disposed of therein.

Redeveloping Existing Installations

The City's SWMPP defines "redevelopment" as development that would create or add impervious surface area on an already developed site. The definition of "redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/ operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

O&M Recommendations

- Spot clean leaks and drips routinely to prevent runoff of spillage.
- Post “no littering” signs.
- Use only watertight waste receptacle(s) and keep the lid(s) closed.
- Do not overfill or fill with any liquid. Keep lid closed at all times.
- Periodically inspect for leaks. If found contact the leasing company immediately.
- Never wash down or rinse with a hose. Contact leasing company for cleaning.
- Develop and implement a Spill Prevention Control and Countermeasure (SPCC) Plan.

References

California Stormwater Quality Association (CASQA) Best Management Practices Handbook New Development and Redevelopment, 2003.

Hawaii Administrative Rules Title 11 Chapter 58.1 Solid Waste Management Control, Honolulu Hawaii Department of Health, 2003: http://health.hawaii.gov/shwb/files/2013/06/11-5811.pdf

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

This page is intentionally left blank.

SC-11: Outdoor Material Storage



Design Objectives	
	Maximum Infiltration
	Provide On-Site Retention
	Slow Runoff
	Minimize Impervious Land Coverage
	Implement LID
	Prohibit Dumping of Improper Materials
✓	Contain Pollutants
✓	Collect and Convey

Description

Proper design of outdoor storage areas for materials reduces opportunity for pollutants to enter the storm water conveyance system. Materials may be in the form of raw products, by-products, finished products, and waste products.

Approach

Outdoor storage areas require a drainage approach different from the typical infiltration/detention strategy. In outdoor storage areas, infiltration is discouraged and containment is encouraged. Preventative measures include enclosures, secondary containment structures and impervious surfaces.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Some materials are more of a concern than others. Toxic and hazardous materials must be prevented from coming in contact with storm water. Non-toxic or non-hazardous materials do not have to be prevented from storm water contact. However, these materials may have toxic effects on receiving waters if allowed to be discharged with storm water in significant quantities. Accumulated material on an impervious surface could result in significant impact on the rivers or streams that receive the runoff.

Material may be stored in a variety of ways, including bulk piles, containers, shelving, stacking, and tanks. Storm water contamination may be prevented by eliminating the possibility of storm water contact with the material storage areas either through diversion, cover, or capture of the storm water. Control measures may also include minimizing the storage area. Design requirements for material storage areas are governed by Building and Fire Codes, and by current City ordinances and zoning requirements. Control measures are site specific, and must meet local agency requirements.

Design Guidelines

Design requirements for material storage areas are governed by Building and Fire Codes, and by current City ordinances and zoning requirements. Control measures are site specific, and must meet local agency requirements.

- Materials with the potential to contaminate storm water must either be placed in an enclosure that prevents contact with runoff or spillage to the storm water conveyance system, or protected by secondary containment structures such as berms, dikes, or curbs.
- Pave the storage area with Portland cement concrete (or equivalent smooth impervious surface) to contain leaks and spills.
- Slope the storage area towards a dead-end sump to contain spills.
- Direct runoff from downspouts/roofs away from storage areas.
- Cover the storage area with an awning that extends beyond the storage area to minimize collection of storm water within the secondary containment area. A manufactured storage shed may be used for small containers.

Designing New Installations

Where proposed project plans include outdoor areas for storage of materials that may contribute pollutants to the storm water conveyance system, the following structural or treatment BMPs should be considered:

- Materials with the potential to contaminate storm water should be:
  - Placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the storm water conveyance system, or
  - Protected by secondary containment structures such as berms, dikes, or curbs.
- The storage area should be paved and sufficiently impervious to contain leaks and spills.
- The storage area should slope towards a dead-end sump to contain spills and direct runoff from downspouts/roofs should be directed away from storage areas.
- The storage area should have a roof or awning that extends beyond the storage area to minimize collection of storm water within the secondary containment area. A manufactured storage shed may be used for small containers.

Note that the location(s) of installations of where these preventative measures will be employed must be included on the map or plans identifying BMPs.

Redeveloping Existing Installations

The City's SWMPP defines "redevelopment" as development that would create or add impervious surface area on an already developed site. The definition of "redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Storm water and non-storm water will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permits.

O&M Recommendations

- Protect materials from rainfall, run-on, runoff, and wind dispersal.
- Employ safeguards against accidental releases.
- Inspect storage areas regularly for leaks or spills.
- Keep storage areas clean and dry.
- Keep containers in good condition without corrosion or leaky seams.
- Cover and contain stockpiles of raw materials to prevent storm water run-on. If infeasible, implement erosion control practices around site perimeter and catch basins.
- Develop and implement a Spill Prevention Control and Countermeasure (SPCC) Plan.

References

California Stormwater Quality Association (CASQA) Best Management Practices Handbook New Development and Redevelopment, 2003.

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

This page is intentionally left blank.

SC-12: Outdoor Work Areas



Design Objectives	
	Maximum Infiltration
	Provide On-Site Retention
	Slow Runoff
	Minimize Impervious Land Coverage
	Implement LID
	Prohibit Dumping of Improper Materials
✓	Contain Pollutants
✓	Collect and Convey

Description

Proper design of outdoor work areas (grinding, painting, coating, sanding, parts cleaning, etc.) reduces opportunity for pollutants to enter the storm water conveyance system.

Approach

In outdoor work areas, infiltration and discharge to the storm drain are discouraged; collection and conveyance to the sanitary sewer are encouraged.

Suitable Applications

Appropriate applications include residential, commercial, and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for outdoor work areas are governed by Building and Fire Codes, and by current City ordinances, and zoning requirements.

Design Guidelines

Design requirements for outdoor work areas are governed by Building and Fire Codes, and by current City ordinances, and zoning requirements.

- Create an impermeable surface such as concrete or asphalt, or a prefabricated metal drip pan, depending on the use.
- Cover the area with a roof to prevent rain from falling on the work area and becoming polluted runoff.
- Berm or perform mounding around the perimeter of the area to prevent water from adjacent areas from flowing on to the surface of the work area.

- Directly connect runoff to the sanitary sewer or other specialized containment system(s). This allows the more highly concentrated pollutants from these areas to receive special treatment that removes particular constituents. Approval for this connection must be obtained from the City.
- Locate the work area away from storm drains or catch basins.

Designing New Installations

Outdoor work areas can be designed in particular ways to reduce impacts on both storm water quality and sewage treatment plants.

- Create an impermeable surface such as concrete or sealed asphalt, or a prefabricated metal drip pan, depending on the use.
- Cover the area with a roof. This prevents rain from falling on the work area and becoming polluted runoff.
- Berm or perform mounding around the perimeter of the area to prevent water from adjacent areas from flowing on to the surface of the work area.
- Directly connect runoff. Unlike other areas, runoff from work areas is directly connected to the sanitary sewer or other specialized containment system(s). This allows the more highly concentrated pollutants from these areas to receive special treatment that removes particular constituents. Approval for this connection must be obtained from the appropriate sanitary sewer agency.
- Locate the work area away from storm drains or catch basins.

Redeveloping Existing Installations

The City's SWMPP defines "redevelopment" as development that would create or add impervious surface area on an already developed site. The definition of "redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

O&M Recommendations

- Dry clean the work area regularly.
- Inspect storage areas regularly for leaks or spills.
- Develop and implement a Spill Prevention Control and Countermeasure (SPCC) Plan.

References

California Stormwater Quality Association (CASQA) Best Management Practices Handbook New Development and Redevelopment, 2003.

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

This page is intentionally left blank.

SC-13: Outdoor Process Equipment Operations



Design Objectives	
	Maximum Infiltration
	Provide On-Site Retention
	Slow Runoff
	Minimize Impervious Land Coverage
	Implement LID
	Prohibit Dumping of Improper Materials
✓	Contain Pollutants
✓	Collect and Convey

Description

Outdoor process equipment operations such as rock grinding or crushing, painting or coating, grinding or sanding, degreasing or parts cleaning, may contribute a variety of pollutants to the storm conveyance system.

Approach

In outdoor process equipment areas, infiltration is discouraged and containment is encouraged, accompanied by collection and conveyance.

Suitable Applications

Appropriate applications include commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for outdoor processing areas are governed by Building and Fire codes, and by current local agency ordinances, and zoning requirements.

Design Guidelines

Design requirements for outdoor processing areas are governed by Building and Fire codes, and by current local agency ordinances, and zoning requirements.

- Cover or enclose areas that would be the most significant source of pollutants; or slope the area toward a dead-end sump; or, discharge to the sanitary sewer system following appropriate treatment in accordance with conditions established by the applicable sewer agency.
- Grade or berm area to prevent run-on from surrounding areas.
- Do not install storm drains in areas of equipment repair.

- Provide secondary containment structures (not double wall containers) where wet material processing occurs (e.g., electroplating), to hold spills resulting from accidents, leaking tanks, or equipment, or any other unplanned releases. Note: if these are plumbed to the sanitary sewer, they must be with the prior approval of the City.

Designing New Installations

Operations determined to be a potential threat to water quality should consider to the following recommendations:

- Cover or enclose areas that would be the most significant source of pollutants; or slope the area toward a dead-end sump; or, discharge to the sanitary sewer system following appropriate treatment in accordance with conditions established by the applicable sewer agency.
- Grade or berm area to prevent run-on from surrounding areas.
- Do not install storm drains in areas of equipment repair.
- Consider other features that are comparable or equally effective.
- Provide secondary containment structures (not double wall containers) where wet material processing occurs (i.e., electroplating), to hold spills resulting from accidents, leaking tanks, or equipment, or any other unplanned releases. Note: if these are plumbed to the sanitary sewer, they must be with the prior approval of the City or other applicable sanitary sewer agency.

Redeveloping Existing Installations

The City's SWMPP defines "redevelopment" as development that would create or add impervious surface area on an already developed site. The definition of "redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Storm water and non-storm water will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

O&M Recommendations

- Dry clean the work area regularly.
- Inspect storage areas regularly for leaks or spills.
- Develop and implement a Spill Prevention Control and Countermeasure (SPCC) Plan.

References

California Stormwater Quality Association (CASQA) Best Management Practices Handbook New Development and Redevelopment, 2003.

A Manual for the Standard Urban Storm Water Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

This page is intentionally left blank.

SC-14: Parking Areas



Design Objectives	
✓	Maximum Infiltration
✓	Provide On-Site Retention
✓	Slow Runoff
✓	Minimize Impervious Land Coverage
✓	Implement LID
	Prohibit Dumping of Improper Materials
	Contain Pollutants
	Collect and Convey

Description/Approach

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through storm water runoff or non-storm water discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas.

Design Guidelines

Direct pavement runoff towards vegetated/landscaped areas if possible.

O&M Recommendations

- Clean leaves, trash, sand, and other debris regularly.
- Routinely sweep, shovel, and dispose of litter in the trash. Sweep entire parking lot at least once before the onset of the wet season.
- Provide an adequate number of covered trash receptacles. Clean out frequently.
- Re-seal or pave only on dry days, and stop immediately before rainfall.
- Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
- Do not allow any solids, liquids, or slurries to enter storm drains.
- Use dry clean-up methods (absorbents) on auto spills and/or drips.
- Do not hose down unless absolutely necessary. If you must pressure wash, discharge wash water to the sanitary sewer or a vegetated area. Do not allow wash water to enter storm drains.

This page is intentionally left blank.

Appendix B: Treatment Control BMP Fact Sheets

On the following pages are fact sheets for each Treatment Control BMP specified in the *Water Quality Rules*. The following information is provided for each BMP:

- Brief description
- BMP category
- Expected pollutant removals
- Minimum design criteria
- Feasibility criteria
- Step-by-stem sizing procedure
- Pretreatment considerations
- Area requirements
- Sizing example
- Other design considerations
- Typical schematic
- General maintenance rank and requirements

The sizing procedures are based on simple dynamic and static principles and therefore may result in larger BMPs than are necessary. More rigorous sizing methods (such as detailed routing methods or continuous simulation models) may be used with City approval. Sizing worksheets are available on the DPP's website.

BMPs not included herein, such as Stormwater wetlands, wet ponds, and proprietary devices, may be used with written City approval.

This page is intentionally left blank.

TC-01: Infiltration Basin



Halawa District Park

BMP Category	
Retention	●
Biofiltration	○
Other	○

O&M Requirements
Medium

Expected Pollutant Removals			
Nutrients	High	Pesticides	High
Sediment	High	Oil & Grease	High
Trash	High	Metals	High
Pathogens	High	Organic Compounds	High

Description

An infiltration basin is a shallow impoundment with no outlet, where storm water runoff is stored and infiltrates through the basin invert and into the soil matrix.

Minimum Design Criteria

Design Parameter	Units	Value
Invert Slope	percent	0
Maximum Interior Side Slope (length per unit height)		3:1
Drawdown (drain) Time	hours	48
Minimum Soil Infiltration Rate	inches/hour	0.5
Minimum Freeboard	feet	1.0
Minimum Depth from Basin Invert to Groundwater Table	feet	3

Feasibility Criteria

See Section 5.5: Feasibility Criteria.

Sizing Procedure

Step 1. Use the procedure presented previously to compute the Volumetric Runoff Coefficient and WQV.

Step 2. Calculate the maximum allowable water storage depth (d_{max}) using the underlying soil infiltration rate (k) and the required drawdown time (t):

$$d_{max} = kt/(F_s \times 12)$$

Where d_{max} = Maximum Storage Depth (ft)
k = Soil Infiltration Rate (in/hr)
t = Drawdown (drain) Time (hrs)
F_s = Infiltration Rate Factor of Safety (see Section 5)

Step 3. Select a design ponding depth no greater than the maximum allowable depth calculated in Step 2.

$$d_p \leq d_{max}$$

Where d_p = Design Ponding Depth (ft)
d_{max} = Maximum Storage Depth from Step 2 (ft)
k = Soil Infiltration Rate (in/hr)

Step 4. Calculate the basin bottom surface area (A_b):

$$A_b = WQV/(d_p + kT/12F_s)$$

Where A_b = Bottom Surface Area (sq-ft)
WQV = WQV from Step 1 (cu-ft)
d_p = Design Ponding Depth from Step 3 (ft)
k = Soil Infiltration Rate (in/hr)
T = Fill Time (time for the BMP to fill with water [hrs])
F_s = Infiltration Rate Factor of Safety (see Section 5)

Step 5. Select a basin bottom width (w_b), and calculate the basin bottom length (l_b):

$$l_b = A_b/w_b$$

Where l_b = Bottom Length (ft)
A_b = Bottom Surface Area from Step 4 (sq-ft)
w_b = Bottom Width (ft)

Step 6. Calculate the total area occupied by the BMP excluding pretreatment (A_{BMP}) using the basin bottom dimensions, embankment side slopes, and freeboard:

$$A_{BMP} = [W_b + 2z(d_p + f)] \times [l_b + 2z(d_p + f)]$$

Where A_{BMP} = Area Occupied by BMP Excluding Pretreatment (sq-ft)
w_b = Bottom Width from Step 5 (ft)
z = Basin Interior Side Slope (length per unit height)
d_p = Design Ponding Depth from Step 3 (ft)
f = Freeboard (ft)
l_b = Bottom Length from Step 5 (ft)

If the calculated area does not fit in the available space, either reduce the drainage area, increase the ponding depth (if it's not already set to the maximum depth), and/or reduce the Infiltration Rate Factor of Safety (if minimum number of test pits and permeability tests have not been performed) and repeat the calculations.

Pretreatment Considerations

Infiltration facilities are highly susceptible to clogging and premature failure from sediment, trash, and other materials. Suitable pretreatment systems maintain the infiltrate rate of the device without frequent and intensive maintenance. For measured soil infiltration rates below 3 in/hr, pretreatment is strongly recommended, and the pretreatment device should be sized for at least 25% of the WQV. For measured soil infiltration rates greater than 3 in/hr, pretreatment is mandatory to minimize groundwater contamination risks, and the pretreatment device must be sized for at least 50% of the WQV if the measured soil infiltration rate is below 5 in/hr and 100% of the WQV if the measured soil infiltration rate is greater than 5 in/hr. Pretreatment may be achieved with vegetated swales, vegetated filter strips, sedimentation basins or forebays, sedimentation manholes, and manufactured treatment devices.

Area Requirements

An infiltration basin requires a footprint equivalent to 7% - 20% of its contributing impervious drainage area, excluding pretreatment. The lower value reflects the maximum allowable infiltration rate and minimum allowable factor of safety, while the upper value reflects the minimum allowable infiltration rate and maximum allowable factor of safety.

Sizing Example

Calculate the size of an infiltration basin serving a 1-acre residential development. Assume the following design parameters:

Design Parameter	Units	Value
Percent Impervious Cover, I	%	70
Design Storm Depth, P	inches	1
Basin Fill Time, T	hours	2
Drawdown (drain) Time, t	hours	48
Basin Interior Side Slope (length per unit height), z		3

Design Parameter	Units	Value
Soil Infiltration Rate, k	inches/hour	1.0
Infiltration Rate Factor of Safety, F_s		2
Freeboard, f	feet	1

1. Calculate the volumetric runoff coefficient (C) and WQV:

   $C = 0.05 + 0.009I$
   $C = 0.05 + 0.009 \times 70$
   $C = 0.68$

   $WQV = PCA \times 3630$
   $WQV = 1 \times 0.68 \times 1 \times 3630$
   $WQV = 2{,}468$ cu-ft

2. Calculate the maximum allowable water storage depth of the infiltration trench (d_{max}):

   $d_{max} = kt/12F_s$
   $d_{max} = 1.0 \times 48/(12 \times 2)$
   $d_{max} = 2.0$ ft

3. Select a ponding depth (d_p) is no greater than the maximum allowable depth:

   $d_p = 2.0$ ft

4. Calculate the basin bottom surface area (A_b):

   $A_b = WQV/(d_p + kT/12F_s)$
   $A_b = 2{,}468/[2.0 + 1.0 \times 2.0/(12 \times 2)]$
   $A_b = 1{,}185$ sq-ft

5. Set the basin bottom width (w_b) to 25 ft, and calculate the basin bottom length (l_b):

   $l_b = A_b/W_b$
   $l_b = 1{,}185/25$
   $l_b = 47.4$ ft

6. Calculate the total area excluding pretreatment (A_{BMP}):

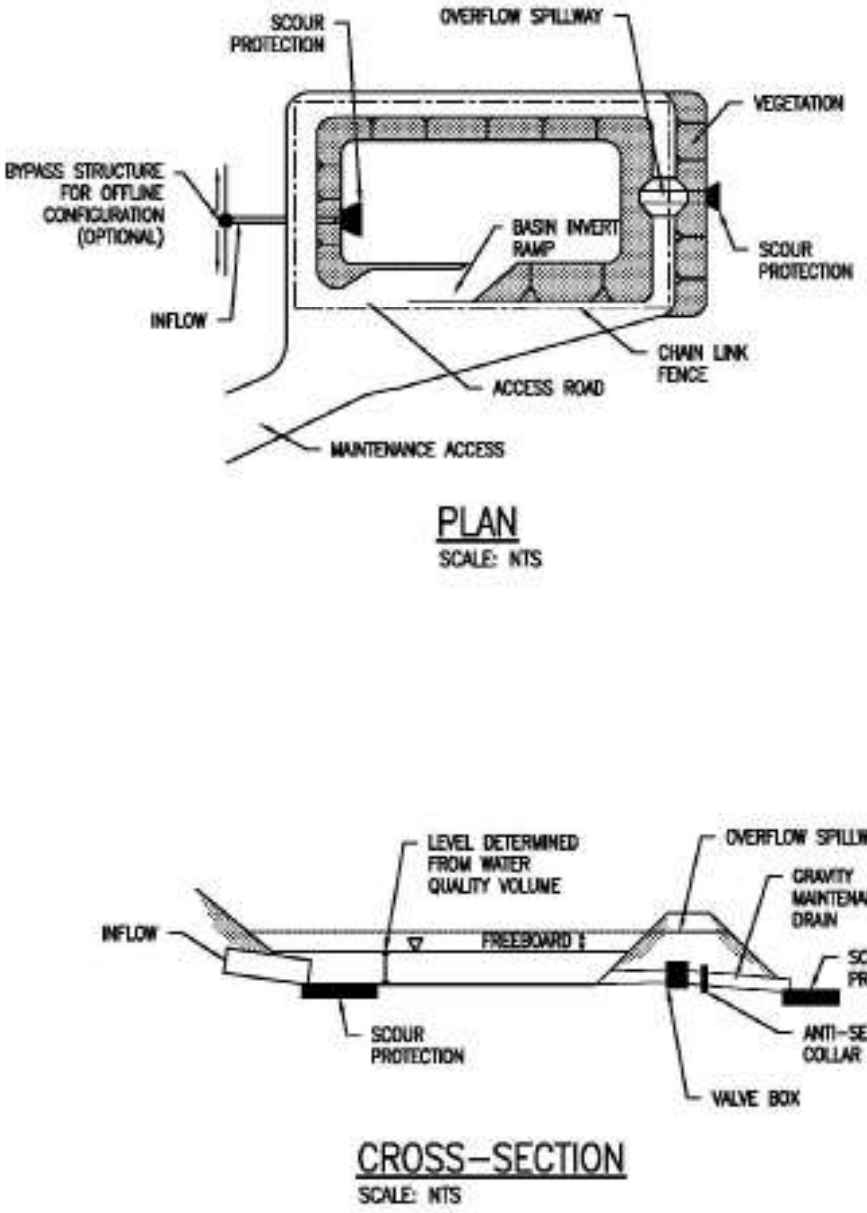
   $A_{BMP} = [w_b + 2z(d_p + f)] \times [l_b + 2z(d_p + f)]$
   $A_{BMP} = [25 + 2 \times 3(2 + 1)] \times [47.4 + 2 \times 3(2 + 1)]$
   $A_{BMP} = 2{,}812$ sq-ft

Other Design Considerations

- If a temporarily-filled pond creates a potential public safety issue, perimeter fencing may be considered. A vegetative screen around the basin to restrict direct view from adjacent properties may improve the aesthetics of the site and public acceptance of the facility.
- If feasible, include vehicle access to the basin invert for maintenance.
- If the area around the basin has a recreational use, a safety shelf around the perimeter of the basin can be included for times when the basin is flooded.
- The infiltration basin should be designed with an outlet structure to pass peak flows during a range of storm events, as well as with an emergency spillway to pass peak flows around the embankment during extreme storm events that exceed the combined infiltration capacity and outlet structure capacity of the facility.
- To help ensure maintenance of the design permeability rate over time, a 6-inch layer of sand may be placed on the bottom of an infiltration basin. This sand layer can intercept silt, sediment, and debris that could otherwise clog the top layer of the soil below the basin. The sand layer will also facilitate silt, sediment, and debris removal from the basin and can be readily restored following removal operations.
- Observation wells are recommended. They will indicate how quickly the basin dewaters following a storm and it will provide a method of observing how quickly the basin fills up with sediments.

Construction/Inspection Considerations

- Before construction begins, stabilize the entire area draining to the facility. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction or remove the top two (2) inches of soil after the site is stabilized. Stabilize the entire contributing drainage area, including the side slopes, before allowing any runoff to enter once construction is complete.
- Place excavated material such that it cannot be washed back into the basin if a storm occurs during construction of the facility.
- Build the basin without driving heavy equipment over the infiltration surface. Any equipment driven on the surface should have extra-wide (“low pressure”) tires. Prior to any construction, rope off the infiltration area to stop entrance by unwanted equipment.
- After final grading, till the infiltration surface deeply.
- Use appropriate erosion control seed mix for the specific project and location.



Schematic of an Infiltration Basin

TC-02: Infiltration Trench



City of Bellingham, WA (source: cob.org/services/environment/lake-whatcom)

BMP Category	
Retention	●
Biofiltration	○
Other	○

O&M Requirements
Medium

Expected Pollutant Removals			
Nutrients	High	Pesticides	High
Sediment	High	Oil & Grease	High
Trash	High	Metals	High
Pathogens	High	Organic Compounds	High

Description

An infiltration trench is a rock-filled trench with no outlet, where storm water runoff is stored in the void space between the rocks and infiltrates through the bottom and into the soil matrix.

Minimum Design Criteria

Design Parameter	Units	Value
Maximum Trench Depth	feet	8
Maximum Trench Width	feet	25
Maximum Top Backfill Layer Thickness	inches	6
Maximum Bottom Sand Layer Thickness	inches	12
Drawdown (drain) Time	hours	48
Minimum Soil Infiltration Rate	inches/hour	0.5
Trench Rock Size	inches	1.5 – 3.0
Minimum Depth from trench invert to groundwater table	feet	3

Feasibility Criteria

See Section 5.5: Feasibility Criteria.

Sizing Procedure

Step 1. Use the procedure presented previously to compute the Volumetric Runoff Coefficient and WQV.

Step 2. Calculate the maximum allowable water storage depth (d_{max}) using the underlying soil infiltration rate (k) and the required drawdown time (t):

$$d_{max} = kt/(F_s \times 12)$$

Where d_{max} = Maximum Storage Depth (ft)
k = Soil Infiltration Rate (in/hr)
t = Drawdown (drain) Time (hrs)
F_s = Infiltration Rate Factor of Safety (see Section 5)

Step 3. Select a ponding depth (optional), trench rock (or alternative material) depth, and sand layer depth (optional) such that the total effective storage depth is no greater than the maximum allowable depth calculated in Step 2:

$$d_t = d_p + l_b n_b + l_s n_s \leq d_{max}$$

Where d_t = Total Effective Water Storage Depth (ft)
d_p = Ponding Depth (ft)
l_b = Backfill Material Thickness Depth (ft)
n_b = Backfill Material Porosity
l_s = Sand Layer Thickness Depth (ft)
n_s = Sand Porosity
d_{max} = Maximum Storage Depth from Step 2 (ft)

Step 4. Calculate the trench surface area (A_{BMP}):

$$A_{BMP} = WQV/(d_t + kT/12F_s)$$

Where A_{BMP} = BMP Surface Area excluding Pretreatment (sq-ft)
WQV = WQV from Step 1 (cu-ft)
d_t = Total Effective Water Storage Depth from Step 3 (ft)
k = Soil Infiltration Rate (in/hr)
T = Fill Time (time for the BMP to fill with water [hrs])
F_s = Infiltration Rate Factor of Safety (see Section 5)

If the calculated area does not fit in the available space, either reduce the drainage area, increase the ponding depth or trench rock depth or sand layer depth (if the total effective depth is not already equal to the maximum depth), and/or reduce the Infiltration rate factor of safety (if minimum number of test pits and permeability tests have not been performed) and repeat the calculations.

Pretreatment Considerations

Infiltration facilities are highly susceptible to clogging and premature failure from sediment, trash, and other materials. Suitable pretreatment systems maintain the infiltrate rate of the device without

frequent and intensive maintenance. For measured soil infiltration rates below 3 in/hr, pretreatment is strongly recommended, and the pretreatment device should be sized for at least 25% of the WQV. For measured soil infiltration rates greater than 3 in/hr, pretreatment is mandatory to minimize groundwater contamination risks, and the pretreatment device must be sized for at least 50% of the WQV if the measured soil infiltration rate is below 5 in/hr and 100% of the WQV if the measured soil infiltration rate is greater than 5 in/hr. Pretreatment may be achieved with vegetated swales, vegetated filter strips, sedimentation basins or forebays, sedimentation manholes, and manufactured treatment devices.

Area Requirements

An infiltration trench requires a footprint equivalent to 2% - 20% of its contributing impervious drainage area, excluding pretreatment. The lower value reflects the maximum allowable infiltration rate, minimum allowable factor of safety, and minimal ponding, while the upper value reflects the minimum allowable infiltration rate, maximum allowable factor of safety, and no ponding.

Sizing Example

Calculate the size of an infiltration basin serving a 1-acre residential development. Assume the following design parameters:

Design Parameter	Units	Value
Percent Impervious Cover, I	percent	70
Design Storm Depth, P	inches	1
Trench Fill Time, T	hours	2
Drawdown (drain) Time, t	hours	48
Backfill porosity, n_b		0.35
Sand porosity, n_s		0.40
Soil Infiltration Rate, k	inches/hour	1
Infiltration Rate Factor of Safety, F_s		2

1. Calculate the volumetric runoff coefficient (C) and WQV:

   $C = 0.05 + 0.009I$
   $C = 0.05 + 0.009 \times 70$
   $C = 0.68$

   $WQV = PCA \times 3630$
   $WQV = 1 \times 0.68 \times 1 \times 3630$
   $WQV = 2{,}468$ cu-ft

2. Calculate the maximum allowable water storage depth in the basin (d_{max}):

   $d_{max} = kT/12F_s$
   $d_{max} = 1.0 \times 48/(12 \times 2)$
   $d_{max} = 2.0$ ft

3. Select a design ponding depth (d_p), trench rock depth (d_r), and optional sand layer depth (d_s) such that the total effective storage depth (d_t) is no greater than the maximum allowable depth:

   $d_p = 0.0$ ft
   $l_b = 5.0$ ft
   $l_s = 0.5$ ft

   $d_t = d_p + l_b n_b + l_s n_s$
   $d_t = 0.0 + 5.0 \times 0.35 + 0.5 \times 0.40$
   $d_t = 1.95$ ft

4. Calculate the BMP surface area excluding pretreatment (A_{BMP}):

   $A_{BMP} = WQV/(d_t + kT/12F_s)$
   $A_{BMP} = 2{,}468/[1.95 + 1.0 \times 2.0/(12 \times 2)]$
   $A_{BMP} = 1{,}214$ sq-ft

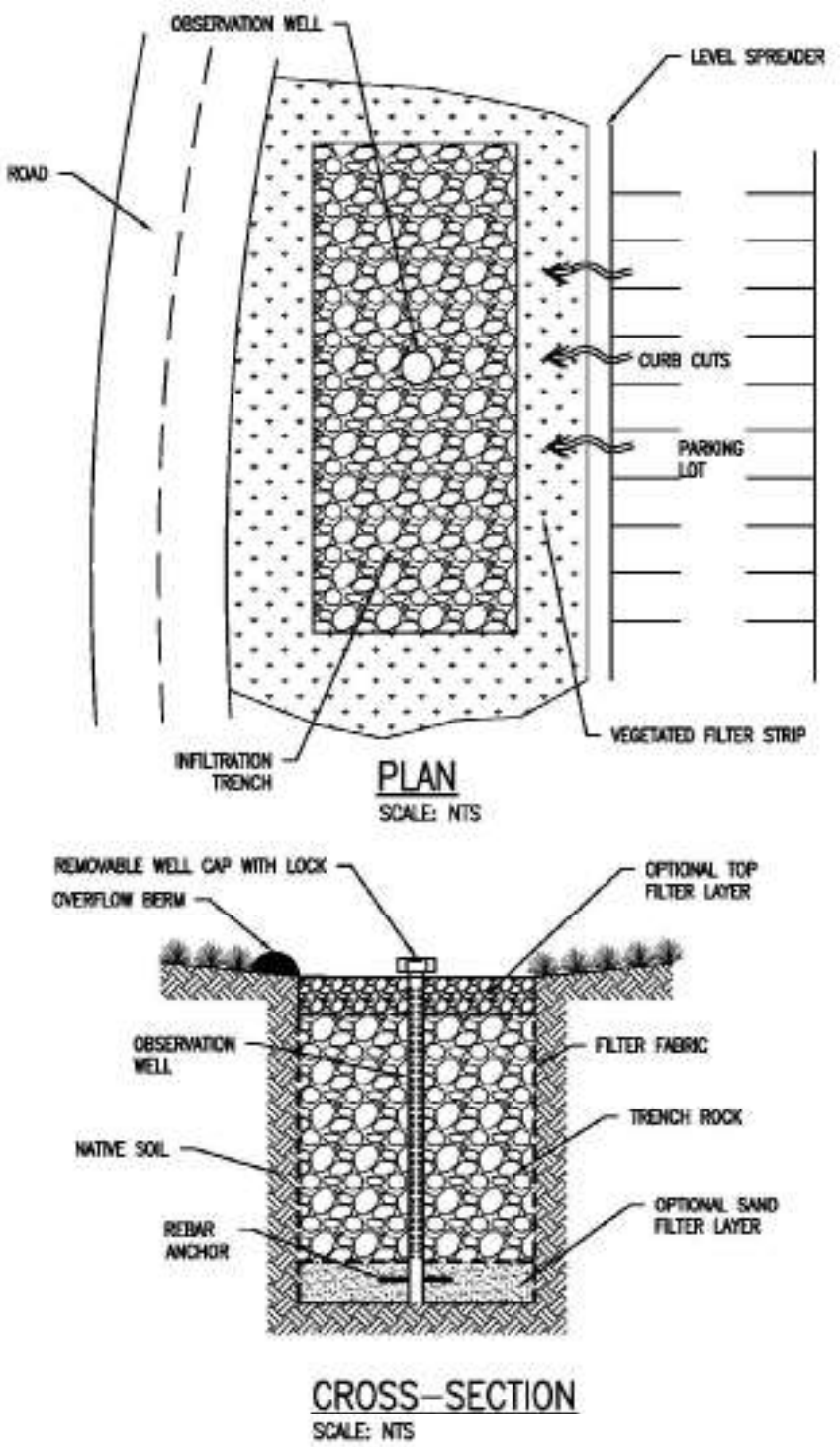
Other Design Considerations

- Observation wells are recommended at 50 ft intervals over the length of the infiltration trench. They will indicate how quickly the trench dewaters following a storm and it will provide a method of observing how quickly the trench fills up with sediments.
- Infiltration trenches should not be deeper than the longest surface area dimension. Otherwise, they meet the USEPA definition of Class V Injection Wells under the federal Underground Injection Control (UIC) Program, and are subject to applicable federal and state requirements.
- Vegetation may be planted over the infiltration trench provided that adequate soil media is provided above the trench.
- There must be an overflow route for storm water flows that overtop the facility or in case the infiltration facility becomes clogged.

Construction/Inspection Considerations

Stabilize the entire area draining to the infiltration before construction begins. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction.

Stabilize the entire contributing drainage area before allowing any runoff to enter once construction is complete.



Schematic of an Infiltration Trench

This page is intentionally left blank.

TC-03: Subsurface Infiltration



Kroc Community Center, Kapolei

BMP Category	
Retention	●
Biofiltration	○
Other	○

O&M Requirements
Medium

Expected Pollutant Removals			
Nutrients	High	Pesticides	High
Sediment	High	Oil & Grease	High
Trash	High	Metals	High
Pathogens	High	Organic Compounds	High

Description

An subsurface infiltration system is a rock storage (or alternative pre-manufactured material) bed below other surfaces such as parking lots, lawns, and playfields for temporary storage and infiltration of runoff.

Minimum Design Criteria

Design Parameter	Units	Value
Drawdown (drain) Time	hours	48
Minimum Soil Infiltration Rate	inches/hour	0.5
Minimum Depth from system invert to groundwater table	feet	3
Any applicable manufacturer's criteria		

Feasibility Criteria

See Section 5.5: Feasibility Criteria.

Sizing Procedure

Follow the manufacturer’s guidelines for appropriate sizing calculations and selection of appropriate device/model.

Pretreatment Considerations

Infiltration facilities are highly susceptible to clogging and premature failure from sediment, trash, and other materials. Suitable pretreatment systems maintain the infiltrate rate of the device without frequent and intensive maintenance. For measured soil infiltration rates below 3 in/hr, pretreatment is strongly recommended, and the pretreatment device should be sized for at least 25% of the WQV. For

measured soil infiltration rates greater than 3 in/hr, pretreatment is mandatory to minimize groundwater contamination risks, and the pretreatment device must be sized for at least 50% of the WQV if the measured soil infiltration rate is below 5 in/hr and 100% of the WQV if the measured soil infiltration rate is greater than 5 in/hr. Pretreatment may be achieved with vegetated swales, vegetated filter strips, sedimentation basins or forebays, sedimentation manholes, and manufactured treatment devices.

Area Requirements

The below-grade footprint requirements for commercially-available infiltration chambers vary by manufacturer. However, similarly to above-grade non-proprietary systems, the space will be minimized for sites with higher infiltration rates and lower infiltration rate factors of safety.

Sizing Example

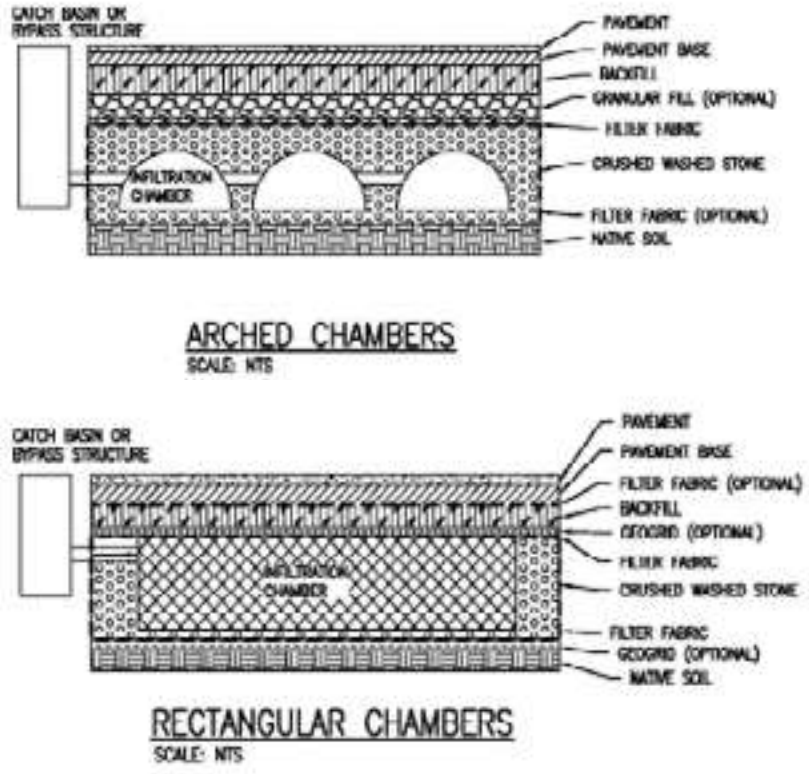
Follow the manufacturer's guidelines for appropriate sizing calculations and selection of appropriate configuration.

Other Design Considerations

Refer to manufacturer guidelines.

Construction/Inspection Considerations

Refer to manufacturer guidelines.



Schematic of a Subsurface Infiltration

TC-04: Dry Well



Courtesy www.brickstoremuseum.org

BMP Category	
Retention	●
Biofiltration	○
Other	○

O&M Requirements
Medium

Expected Pollutant Removals			
Nutrients	High	Pesticides	High
Sediment	High	Oil & Grease	High
Trash	High	Metals	High
Pathogens	High	Organic Compounds	High

Description

A dry well is a subsurface aggregate-filled or prefabricated perforated storage facility, where roof runoff is stored and infiltrates into the soil matrix.

Minimum Design Criteria

Design Parameter	Units	Value
Drawdown (drain) Time	hours	48
Minimum Soil Infiltration Rate	inches/hour	0.5
Aggregate Size (if used)	inches	1.0 - 3.0
Minimum Depth from well invert to groundwater table	feet	3

Feasibility Criteria

See Section 5.5: Feasibility Criteria.

Sizing Procedure

Step 1. Use the procedure presented previously to compute the Volumetric Runoff Coefficient and WQV.

Step 2. Calculate the maximum allowable water storage depth (d_{max}) using the underlying soil infiltration rate (k) and the required drawdown time (t):

$$d_{max} = kt/(F_s \times 12)$$

Where d_{max} = Maximum Storage Depth (ft)
k = Soil Infiltration Rate (in/hr)
t = Drawdown (drain) Time (hrs)
F_s = Infiltration Rate Factor of Safety (see Section 5)

Step 3. Select a ponding depth (optional) and dry well backfill material depth such that the total effective storage depth is no greater than the maximum allowable depth calculated in Step 2:

$$d_t = d_p + l_b n_b \leq d_{max}$$

Where d_t = Total Effective Water Storage Depth (ft)
d_p = Ponding Depth (ft)
l_b = Backfill Material Thickness Depth (ft)
n_b = Backfill Material Porosity
d_{max} = Maximum Storage Depth from Step 2 (ft)

Step 4. Calculate the BMP surface area (A_{BMP}):

$$A_{BMP} = WQV/(d_t + kT/12F_s)$$

Where A_{BMP} = BMP Surface Area (sq-ft)
WQV = WQV from Step 1 (cu-ft)
d_t = Total Effective Water Storage Depth from Step 3 (ft)
k = Soil Infiltration Rate (in/hr)
T = Fill Time (time for the BMP to fill with water [hrs])
F_s = Infiltration Rate Factor of Safety (see Section 5)

If the calculated area does not fit in the available space, either reduce the drainage area, increase the ponding depth or rock depth (if the total effective depth is not already equal to the maximum depth), and/or reduce the infiltration rate factor of safety (if minimum number of test pits and permeability tests have not been performed) and repeat the calculations.

Pretreatment Considerations

Roof gutter guards or leaf gutter screens are required for roof runoff to reduce dry well clogging from sediment, leaves, and other organic material. If the dry well receives non-roof runoff, pretreatment must be provided by vegetated swales, vegetated filter strips, or manufactured treatment devices.

Area Requirements

A dry well requires a footprint equivalent to 2% - 20% of its contributing impervious drainage area. The lower value reflects the maximum allowable infiltration rate, minimum allowable factor of safety,

and minimal ponding, while the upper value reflects the minimum allowable infiltration rate, maximum allowable factor of safety, and no ponding.

Sizing Example

Calculate the size of a dry well serving the roof runoff from a 3,000 sq-ft commercial building. Assume the following design parameters:

Design Parameter	Units	Value
Percent Impervious Cover, I	percent	100
Design Storm Depth, P	inches	1.0
Dry Well Fill Time, T	hours	2
Drawdown (drain) Time, t	hours	48
Backfill material porosity, n_b		0.35
Soil Infiltration Rate, k	inches/hour	1.0
Infiltration Rate Factor of Safety, F_s		2

1. Calculate the volumetric runoff coefficient (C) and WQV:

   $C = 0.05 + 0.009I$
   $C = 0.05 + 0.009 \times 100$
   $C = 0.95$

   $WQV = PCA \times 3630$
   $WQV = 1 \times 0.95 \times (3{,}000/43{,}560) \times 3630$
   $WQV = 238$ cu-ft

2. Calculate the maximum allowable water storage depth in the dry well (d_{max}):

   $d_{max} = kt/12F_s$
   $d_{max} = 1.0 \times 48/(12 \times 2)$
   $d_{max} = 2.0$ ft

3. Select a design ponding depth (d_p) and backfill material depth (l_b) such that the total effective storage depth (d_t) is no greater than the maximum allowable depth:

   $d_p = 0.0$ ft
   $l_b = 5.5$ ft

   $d_t = d_p + l_b n_b$
   $d_t = 0.0 + 5.5 \times 0.35$
   $d_t = 1.925$ ft

4. Calculate the BMP surface area:

$A_{BMP} = WQV/(d_t + kT/12F_s)$

$A_{BMP} = 238/[1.925 + 1.0 \times 2.0/(12 \times 2)]$

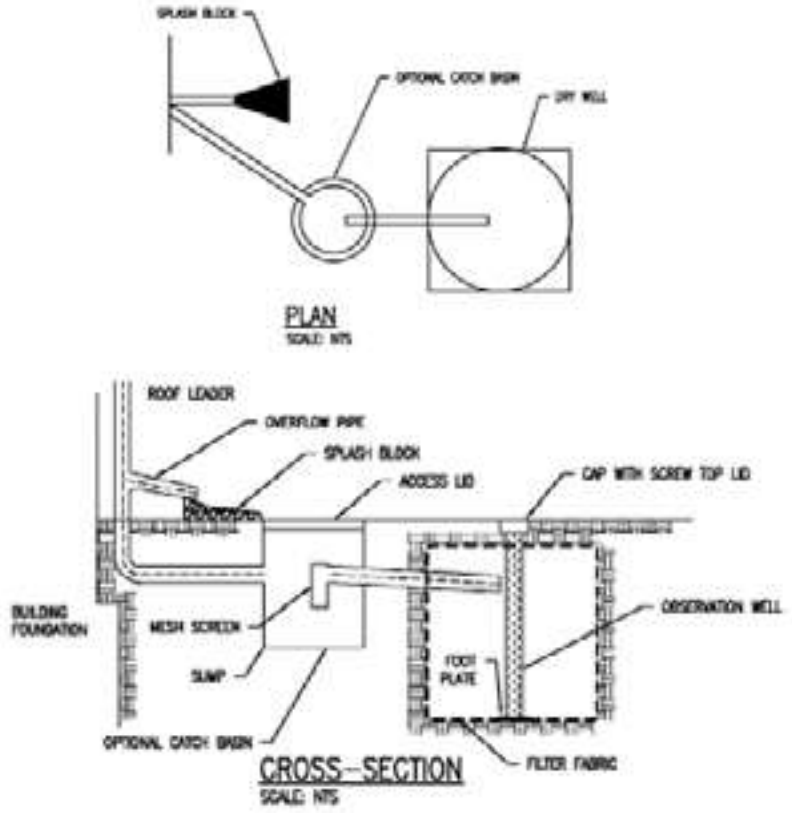
$A_{BMP} = 118$ sq-ft

Other Design Considerations

- Dry wells are typically deeper than they are wide or long, and therefore meet the USEPA definition of Class V Injection Wells under the federal Underground Injection Control (UIC) Program, and are subject to applicable federal and state requirements.
- The dry well must be able to safely convey overflows to either vegetated areas or the storm drain system.
- The design may include an intermediate box with an outflow higher to allow sediments to settle out. Water would then flow through a mesh screen and into the dry well.
- Trees and other large vegetation should be planted away from drywells such that drip lines do not overhang infiltration beds.

Construction/Inspection Considerations

Refer to manufacturer guidelines.



Schematic of a Dry Well

TC-05: Bioretention Basin



Heeia State Park (www.huihawaii.org)

BMP Category	
Retention	●
Biofiltration	○
Other	○

O&M Requirements
Medium

Expected Pollutant Removals			
Nutrients	High	Pesticides	High
Sediment	High	Oil & Grease	High
Trash	High	Metals	High
Pathogens	High	Organic Compounds	High

Description

Sometimes referred to as a rain garden, a bioretention basin is an engineered shallow depression that collects and filters storm water runoff using conditioned planting soil beds and vegetation. The filtered runoff infiltrates through the basin invert and into the soil matrix.

Minimum Design Criteria

Design Parameter	Units	Value
Mulch Thickness	inches	2 - 4
Planting Soil Depth	feet	2 - 4
Drawdown (drain) Time	hours	48
Maximum Interior Side Slope (length per unit height)		3:1
Maximum Ponding Depth	inches	12
Minimum Depth from basin invert to groundwater table	feet	3
Minimum Freeboard	feet	1.0
Minimum Soil Infiltration Rate	inches/hour	0.5

Feasibility Criteria

See Section 5.5: Feasibility Criteria.

Sizing Procedure

Step 1. Use the procedure presented previously to compute the Volumetric Runoff Coefficient and WQV.

Step 2. Calculate the maximum allowable water storage depth (d_{max}) using the underlying soil infiltration rate (k) and the required drawdown time (t):

$$d_{max} = kt/(F_s \times 12)$$

Where d_{max} = Maximum Storage Depth (ft)
k = Soil Infiltration Rate (in/hr)
t = Drawdown (drain) Time (hrs)
F_s = Infiltration Rate Factor of Safety (see Section 5)

Step 3. Select a ponding depth, planting media thickness (depth), and reservoir layer thickness (depth, optional) such that the total effective storage depth is no greater than the maximum allowable depth calculated in Step 2:

$$d_t = d_p + l_m n_m + l_r n_r \leq d_{max}$$

Where d_t = Total Effective Water Storage Depth (ft)
d_m = Ponding Depth (ft)
l_m = Planting Media Thickness Depth (ft)
n_m = Planting Media Porosity
l_r = Reservoir Layer Thickness Depth (ft)
n_r = Reservoir Layer Porosity
d_{max} = Maximum Storage Depth from Step 2 (ft)

Step 4. Calculate the basin bottom surface area (A_b):

$$A_b = WQV/(d_t + kT/12F_s)$$

Where A_{BMP} = Bottom Surface Area (sq-ft)
WQV = WQV from Step 1 (cu-ft)
d_t = Total Effective Water Storage Depth from Step 3 (ft)
k = Soil Infiltration Rate (in/hr)
T = Fill Time (time for the BMP to fill with water [hrs])
F_s = Infiltration Rate Factor of Safety (see Section 5)

Step 5. Select a basin bottom width (w_b), and calculate the basin bottom length (l_b):

$$A_b = WQV/(d_t + kT/12F_s)$$

Where l_b = Bottom Length (ft)
A_b = Bottom Surface Area from Step 4 (sq-ft)
w_b = Bottom Width (ft)

Step 6. Calculate the total area occupied by the BMP excluding pretreatment (A_{BMP}) using the basin bottom dimensions, embankment side slopes, and freeboard:

$$A_{BMP} = [w_b + 2z(d_p + f)] \times [l_b + 2z(d_p + f)]$$

Where A_{BMP} = Area Occupied by BMP Excluding Pretreatment (sq-ft)
w_b = Bottom Width from Step 5 (ft)
z = Basin Interior Side Slope (length per unit height)
d_b = Design Ponding Depth from Step 3 (ft)
f = Freeboard (ft)
l_b = Bottom Length from Step 5 (ft)

If the calculated area does not fit in the available space, either reduce the drainage area, increase the ponding depth or planting soil depth or gravel depth (if the total effective depth is not already equal to the maximum depth), and/or reduce the Infiltration rate factor of safety (if minimum number of test pits and permeability tests have not been performed) and repeat the calculations.

Pretreatment Considerations

Infiltration facilities are highly susceptible to clogging and premature failure from sediment, trash, and other materials. Suitable pretreatment systems maintain the infiltrate rate of the device without frequent and intensive maintenance. For measured soil infiltration rates below 3 in/hr, pretreatment is strongly recommended, and the pretreatment device should be sized for at least 25% of the WQV. For measured soil infiltration rates greater than 3 in/hr, pretreatment is mandatory to minimize groundwater contamination risks, and the pretreatment device must be sized for at least 50% of the WQV if the measured soil infiltration rate is below 5 in/hr and 100% of the WQV if the measured soil infiltration rate is greater than 5 in/hr. Pretreatment may be achieved with vegetated swales, vegetated filter strips, sedimentation basins or forebays, sedimentation manholes, and manufactured treatment devices.

Area Requirements

A bioretention basin requires a footprint equivalent to 4% - 13% of its contributing impervious drainage area, excluding pretreatment. The lower value reflects the maximum allowable infiltration rate and minimum allowable factor of safety, while the upper value reflects the minimum allowable infiltration rate and maximum allowable factor of safety.

Sizing Example

Calculate the size of a bioretention basin serving a 1-acre residential development. Assume the following design parameters:

Design Parameter	Units	Value
Percent Impervious Cover, I	percent	70
Design Storm Depth, P	inches	1.0
Basin Fill Time, T	hours	2
Drawdown (drain) Time, t	hours	48

Design Parameter	Units	Value
Basin Interior Side Slope (length per unit height), z		3
Planting Media Porosity, n_m		0.25
Reservoir Layer Porosity, n_r		0.30
Soil Infiltration Rate, k	inches/hour	1.0
Freeboard, f	feet	1.0
Infiltration Rate Factor of Safety, F_s		2

1. Calculate the volumetric runoff coefficient (C) and WQV:

   $C = 0.05 + 0.009I$
   $C = 0.05 + 0.009 \times 70$
   $C = 0.68$

   $WQV = PCA \times 3630$
   $WQV = 1 \times 0.68 \times 1 \times 3630$
   $WQV = 2{,}468$ cu-ft

2. Calculate the maximum allowable water storage depth in the dry well (d_{max}):

   $d_{max} = kt/12F_s$
   $d_{max} = 1.0 \times 48/(12 \times 2)$
   $d_{max} = 2.0$ ft

3. Select a ponding depth (d_p), planting media depth (l_m), and optional reservoir layer depth (l_r) such that the total effective storage depth (d_t) is no greater than the maximum allowable depth:

   $d_p = 0.67$ ft
   $l_m = 4.0$ ft
   $l_r = 1.0$ ft

   $d_t = d_p + l_m n_m + l_r n_r$
   $d_t = 0.67 + 4.0 \times 0.25 + 1.0 \times 0.30$
   $d_t = 1.97$ ft

4. Calculate the basin bottom surface area (A_b):

   $A_b = WQV/(dt + kT/12Fs)$
   $A_b = 2{,}468/[1.97 + 1.0 \times 2.0/(12 \times 2)]$
   $A_b = 1{,}204$ sq-ft

5. Set the basin bottom width (w_b) to 25 ft, and calculate the basin bottom length (l_b):

   $l_b = A_b/w_b$
   $l_b = 1{,}204/25$
   $l_b = 48.2$ sq-ft

6. Calculate the total area excluding pretreatment (A_{BMP}):

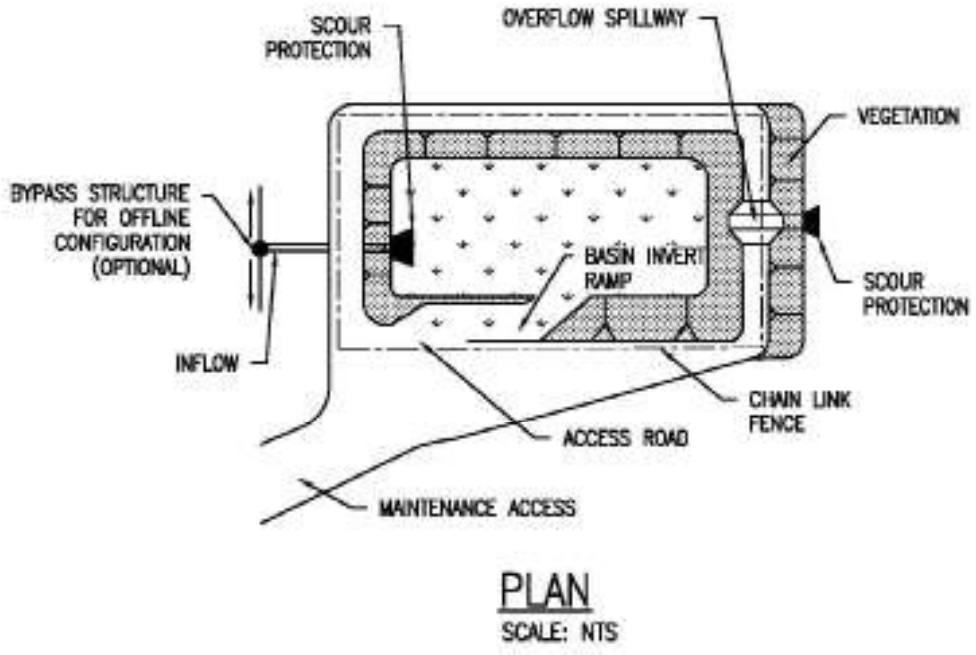
   $A_{BMP} = [w_b + 2z(d_p + f)] \times [l_b + 2z(d_p + f)]$
   $A_{BMP} = [25 + 2 \times 3(0.67 + 1)] \times [48.2 + 2 \times 3(0.67 + 1)]$
   $A_{BMP} = 2{,}037$ sq-ft

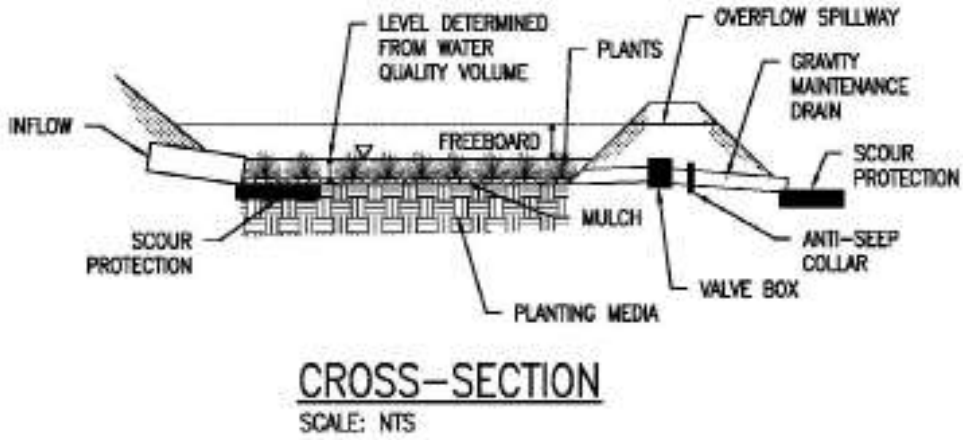
Other Design Considerations

- The plantings should emulate a terrestrial forest community ecosystem. Native species should be selected, taking into account the local climate, expected water depth in the basin, and expected tolerances to pollutant loads and varying soil moistures. The trees should be smaller ones similar to those found in the forest understory, since it is more difficult to perform maintenance with the tall trees that are normally part of the forest canopy. Ground cover, such as grasses or legumes, should be planted after the trees and shrubs are in place.
- An overflow device (e.g., domed riser, spillway) must be included to safely convey runoff from large storm events when the surface/subsurface capacity is exceeded.
- If a mulch layer is used on the surface of the planting bed, consideration should be given to problems caused by flotation during storm events.
- Observation wells are recommended. They will indicate how quickly the basin dewaters following a storm and it will provide a method of observing how quickly the basin fills up with sediments.

Construction/Inspection Considerations

Bioretention basins should not be established until contributing watershed is stabilized.





Schematic of a Bioretention Basin

TC-06: Permeable Pavement



UH Hale Halawai Overflow Parking

BMP Category	
Retention	●
Biofiltration	○
Other	○

O&M Requirements
Low

Expected Pollutant Removals			
Nutrients	High	Pesticides	High
Sediment	High	Oil & Grease	High
Trash	High	Metals	High
Pathogens	High	Organic Compounds	High

Description

Sometimes referred to as pervious pavement or porous pavement, permeable pavement refers to any porous, load-bearing surface that allows for temporary rainwater storage in an underlying aggregate layer until it infiltrates into the soil matrix. It includes pervious concrete, porous asphalt, interlocking paver blocks, and reinforced turf and gravel filled grids.

Minimum Design Criteria

Design Parameter	Units	Value
Maximum Depth of Reservoir Layer	feet	3
Drawdown (drain) Time	hours	48
Minimum Depth from Reservoir Invert to Groundwater Table	feet	3
Minimum Soil Infiltration Rate	inches/hour	0.5

Feasibility Criteria

See Section 5.5: Feasibility Criteria.

Sizing Procedure

Step 1. Use the procedure presented previously to compute the Volumetric Runoff Coefficient and WQV.

Step 2. Calculate the maximum allowable water storage depth (d_{max}) using the underlying soil infiltration rate (k) and the required drawdown time (t):

$$d_{max} = kt/(F_s \times 12)$$

Where d_{max} = Maximum Storage Depth (ft)
k = Soil Infiltration Rate (in/hr)
t = Drawdown (drain) Time (hrs)
F_s = Infiltration Rate Factor of Safety (see Section 5)

Step 3. Select a pavement course thickness (l_p) and reservoir course thickness (l_r) such that the total effective storage depth (d_t) is no greater than the maximum allowable depth:

$$d_t = (l_p n_p + l_r n_r)/12 \leq d_{max}$$

Where d_t = Total Effective Water Storage Depth (ft)
l_p = Pavement Course Thickness (in)
n_p = Pavement Course Porosity
l_r = Reservoir Layer Thickness Depth (in)
n_r = Reservoir Layer Porosity
d_{max} = Maximum Storage Depth from Step 2 (ft)

Step 4. Calculate the BMP surface area (A_{BMP}):

$$A_{BMP} = WQV/(d_t + kT/12F_s)$$

Where A_{BMP} = BMP Surface Area (sq-ft)
WQV = WQV from Step 1 (cu-ft)
d_t = Total Effective Water Storage Depth from Step 3 (ft)
k = Soil Infiltration Rate (in/hr)
T = Fill Time (time for the BMP to fill with water [hrs])
F_s = Infiltration Rate Factor of Safety (see Section 5)

If the calculated area does not fit in the available space, either reduce the drainage area, increase the pavement course depth or reservoir course depth or gravel depth (if the total effective depth is not already equal to the maximum depth), and/or reduce the Infiltration rate factor of safety (if minimum number of test pits and permeability tests have not been performed) and repeat the calculations.

Pretreatment Considerations

Pretreatment is not required as long as the permeable pavement does not receive run-on from other surfaces. If it does, pretreatment is necessary to prevent premature failure due to clogging with fine sediment, and may be achieved with gravel filter strips, vegetated buffer strips, or vegetated swales.

Area Requirements

Permeable pavement requires a footprint equivalent to 5% - 18% of its contributing impervious drainage area. The lower value reflects the maximum allowable infiltration rate and minimum allowable factor of safety, while the upper value reflects the minimum allowable infiltration rate and maximum allowable factor of safety.

Sizing Example

Calculate the size of a section of permeable pavement serving the runoff from a 1-acre parking lot. Assume the following design parameters:

Design Parameter	Units	Value
Percent Impervious Cover, I	percent	100
Design Storm Depth, P	inches	1.0
Reservoir Layer Time, T	hours	2
Drawdown (drain) Time, t	hours	48
Pavement Course Porosity, n_p		0.15
Reservoir Course Porosity, n_r		0.35
Soil Infiltration Rate, k	inches/hour	1.0
Infiltration Rate Factor of Safety, F_s		2

1. Calculate the volumetric runoff coefficient (C) and WQV:

   $C = 0.05 + 0.009I$

   $C = 0.05 + 0.009 \times 100$

   $C = 0.95$

   $WQV = PCA \times 3630$

   $WQV = 1 \times 0.95 \times 1 \times 3630$

   $WQV = 3{,}449$ cu-ft

2. Calculate the maximum allowable water storage depth in the dry well (d_{max}):

   $d_{max} = kT/12F_s$

   $d_{max} = 1.0 \times 48/(12 \times 2)$

   $d_{max} = 2.0$ ft

3. Select a pavement course thickness (l_p) and reservoir course thickness (l_r) such that the total effective storage depth (d_t) is no greater than the maximum allowable depth:

   $l_p = 12.0$ ft
   $l_r = 24.0$ ft

   $d_t = (l_p n_p + l_r n_r)/12$
   $d_t = (12 \times 0.15 + 24.0 \times 0.35)/12$
   $d_t = 0.85$ ft

4. Calculate the pavement surface area:

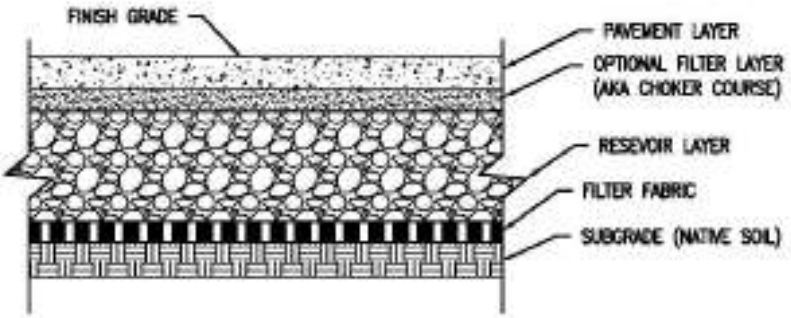
   $A_{IMP} = WQV/[d_t + (kT/12F_s)]$
   $A_{IMP} = 3{,}449/[0.85 + (1.0 \times 2.0/(12 \times 2)]$
   $A_{IMP} = 3{,}695$ sq-ft

Other Design Considerations

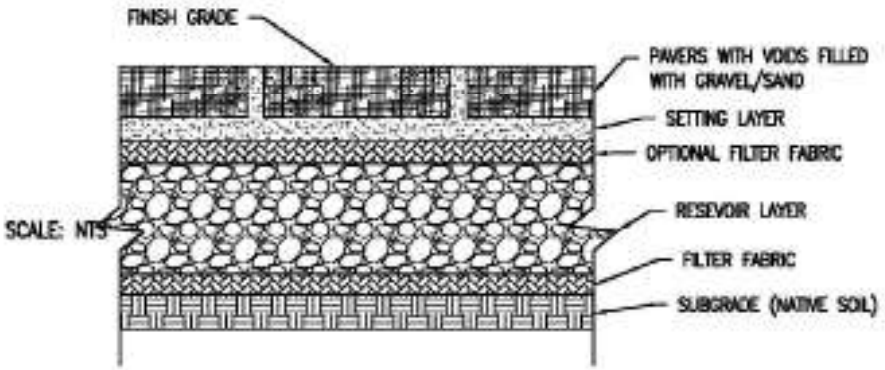
- All porous paving and permeable paver with storage bed systems must include measures that will allow runoff from the design storm to enter the storage bed in the event that the porous or permeable paver surface course becomes clogged or otherwise incapable of conveying the maximum design storm runoff to the bed.
- Additional design details on specific pavement systems are provided by the National Asphalt Pavement Association, the National Ready Mix Concrete Association, the Interlocking Concrete Pavement Institute, and the American Association of State Highway and Transportation Officials.
- Perforated pipes along the bottom of the bed may be used to evenly distribute runoff over the entire bed bottom. Pipes should lay flat along the bed bottom and provide for uniform distribution of water. Depending on size, these pipes may provide additional storage volume.
- Flows in excess of the design capacity of the permeable pavement system will require an overflow system connected to a downstream conveyance or other storm water runoff BMP.

Construction/Inspection Considerations

- Permeable surfaces can be laid without cross-falls or longitudinal gradients.
- The blocks should be lain level.
- They should not be used for storage of site materials, unless the surface is well protected from deposition of silt and other spillages.
- The pavement should be constructed in a single operation, as one of the last items to be built, on a development site. Landscape development should be completed before pavement construction to avoid contamination by silt or soil from this source.
- Surfaces draining to the pavement should be stabilized before construction of the pavement.
- Inappropriate construction equipment should be kept away from the pavement to prevent damage to the surface, sub-base or sub-grade.



TYPICAL SECTION– PERVIOUS CONCRETE OR POROUS ASPHALT
SCALE: NTS



TYPICAL SECTION – PERMEABLE PAVERS

Schematic of a Permeable Pavement

This page is intentionally left blank.

TC-07: Green Roof



University of Hawaii C-MORE Hale (hahana.soest.hawaii.edu)

BMP Category	
Retention	○
Biofiltration	●
Other	○

O&M Requirements
Medium

Expected Pollutant Removals			
Nutrients	Medium	Pesticides	Medium
Sediment	High	Oil & Grease	High
Trash	High	Metals	Medium
Pathogens	Medium	Organic Compounds	Medium

Description

Sometimes referred to as a vegetated roof or eco-roof, a green roof is a roof that is entirely or partially covered with vegetation and soils for the purpose of filtering, absorbing, evapotranspirating, and retaining/detaining the rain that falls upon it.

Minimum Design Criteria

Design Parameter	Units	Value
Minimum Depth of Soil Media	inches	2
Minimum Depth of Drainage Layer	inches	2
Maximum Slope on Roof	percent	20

Feasibility Criteria

See Section 5.5: Feasibility Criteria.

Sizing Procedure

Step 1. Use the procedure presented previously to compute the Volumetric Runoff Coefficient and WQV.

Step 2. Select initial values for the soil media thickness (l_m), drainage layer thickness (l_d), and allowable ponding depth (d_p).

Step 3. Calculate the total effective storage depth based on instantaneous storage capacity using the void space in the soil media and drainage layer, and the allowable ponding:

$$d_t = (d_p + l_m n_m + l_d n_d)/12$$

Where d_t = Total Effective Water Storage Depth (ft)
d_p = Ponding Depth (in)
l_m = Planting Media Thickness Depth (in)
n_m = Planting Media Porosity
l_d = Drainage Layer Thickness (in)
n_d = Drainage Layer Porosity

Step 4. Calculate area required (A_{BMP}) based on the instantaneous storage capacity:

$$A_{BMP} = WQV/d_t$$

Where A_{BMP} = BMP Area (sq-ft)
WQV = WQV from Step 1 (cu-ft)
d_t = Total Effective Water Storage Depth from Step 3 (ft)

If the calculated area does not fit in the available space, either reduce the tributary area and/or increase one or more of the design depths (ponding, soil media, drainage layer), and repeat the calculations.

Pretreatment Considerations

Green roofs do not require pretreatment.

Area Requirements

A green roof requires a footprint equivalent to 11% - 100% of the contributing roof drainage area. The lower value corresponds to 4 inches of ponding and maximum depths for both the planting media and drainage layer depths, while the higher value corresponds to no ponding and minimum planting media and drainage layer depths.

Sizing Example

Calculate the size of a green roof serving the roof runoff from a 1,500 sq-ft fast food restaurant. Assume the following design parameters:

Design Parameter	Units	Value
Percent Impervious Cover, I	percent	100
Design Storm Depth, P	inches	1.0
Soil Media Porosity, n_m		0.20
Drainage Layer Porosity, n_d		0.25

1. Calculate the volumetric runoff coefficient (C) and WQV:

   $C = 0.05 + 0.009I$
   $C = 0.05 + 0.009 \times 100$
   $C = 0.95$

   $WQV = PCA \times 3{,}630$
   $WQV = 1 \times 0.95 \times (1{,}500/43{,}560) \times 3{,}630$
   $WQV = 119$ cu-ft

2. Select initial values for the soil media depth (d_m), drainage layer depth (d_d), and ponding depth (d_p):

   $d_m = 3$ in
   $d_d = 2$ in
   $d_p = 0.5$ in

3. Calculate the total effective storage depth:

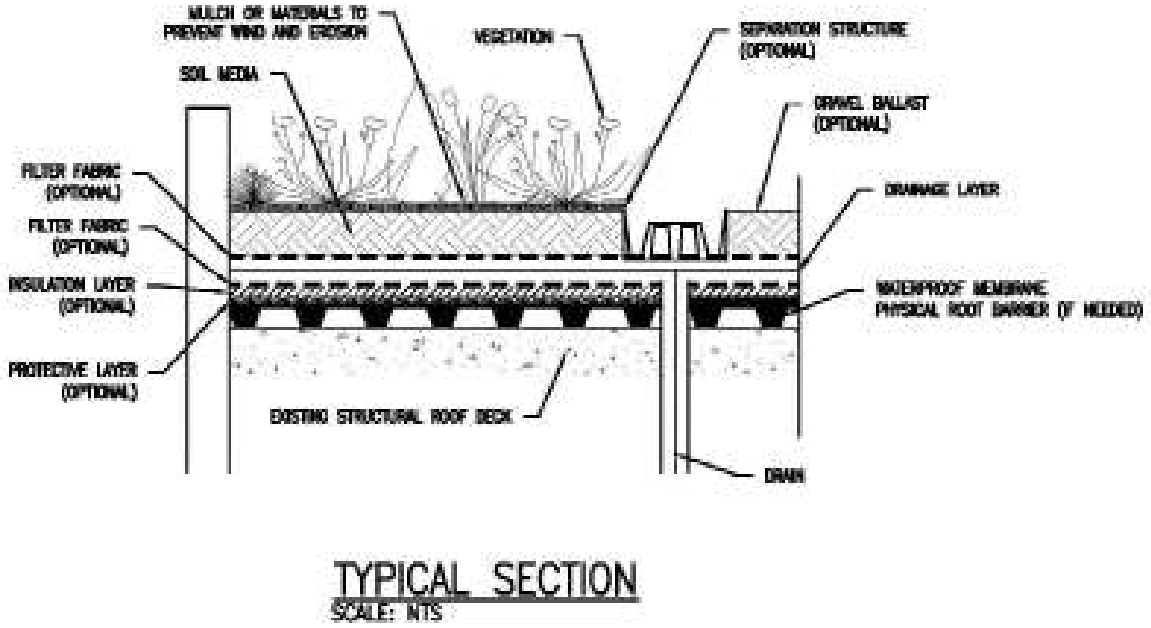
   $d_t = (d_p + l_m n_m + l_d n_d)/12$
   $d_t = (0.5 + 3 \times 0.20 + 2 \times 0.25)/12$
   $d_t = 0.133$ ft

4. Calculate the area (A_{BMP}):

   $A_{BMP} = WQV/d_t$
   $A_{BMP} = 119/0.133$
   $A_{BMP} = 891$ sq-ft
   891 sq-ft is available, so the design is okay.

Other Design Considerations

- Safety measures against wind uplift must be taken into account during design, especially for areas susceptible to high winds during the summer trade-wind period.
- The maximum load bearing capacity of the roof construction must be considered when installing vegetated roofs. The water saturated weight of the green roof system, including vegetation must be calculated as permanent load. Generally, vegetated roofs weigh between 15 and 30 lb/sq-ft depending on the thickness of the vegetated roof system. In addition, construction elements such as pergolas and walkways cause high point loads and, therefore, have to be calculated accordingly.
- The design must include adequate roof access for delivery of construction materials and for routine maintenance.
- The drainage layer below the growth media should be designed to convey the flood design storm without backing water up to into the growing media. The drainage layer should convey flow to an outlet or overflow system such as a traditional rooftop drainage system with inlets set slightly above the elevation of the vegetated roof surface.



Schematic of a Green Roof

TC-08: Vegetated Bio-Filter



Waikiki

BMP Category	
Retention	○
Biofiltration	●
Other	○

O&M Requirements
Low

Expected Pollutant Removals			
Nutrients	Medium	Pesticides	Unknown
Sediment	High	Oil & Grease	High
Trash	High	Metals	High
Pathogens	Medium	Organic Compounds	High

Description

This category of BMPs may also be referred to as a bioretention filter, storm water curb extension, tree box filter, or planter box. A vegetated bio-filter is an engineered shallow depression or above ground system that collects and filters storm water runoff using conditioned planting soil beds and vegetation. The filtered runoff discharges through an underdrain system.

Minimum Design Criteria

Design Parameter	Units	Value
Planting Soil Coefficient of Permeability	feet/day	1.0
Mulch Thickness	inches	2 – 4
Planting Soil Depth	feet	2 – 4
Drawdown (drain) Time	hours	48
Maximum Ponding Depth	inches	12
Minimum Underdrain Diameter	inches	6

For proprietary systems, follow the manufacturer's guidelines for appropriate sizing calculations and selection of appropriate device/model.

Feasibility Criteria

See Section 5.5: Feasibility Criteria.

Sizing Procedure

Step 1. Use the procedure presented previously to compute the Volumetric Runoff Coefficient and WQV.

Step 2. Select initial values for the soil media thickness (l_m), drainage layer thickness (l_d), and allowable ponding depth (d_p).

Step 3. Use Darcy's Law to calculate the required Filter Bed Surface Area:

$$A_b = (WQV \times l_m)/k\,(l_m + d_p/24)\,(t/24)$$

Where A_b = Filter Bed Surface Area (sq-ft)
WQV = WQV from Step 1 (cu-ft)
l_m = Planting Media Depth from Step 2 (ft)
k = Planting Media Permeability Coefficient (ft/day)
d_p = Maximum Ponding Depth from Step 2 (in)
t = Filter Bed Drain Time (hr)

Step 4. Select a filter bed width (w_b), and calculate the filter bed length (l_b):

$$l_b = A_b/w_b$$

Where l_b = Filter Bed Length (ft)
A_b = Filter Bed Surface Area from Step 3 (sq-ft)
w_b = Filter Bed Width (ft)

Step 5. Calculate the total area occupied by the BMP excluding pretreatment (A_{BMP}) using the filter bed dimensions, embankment side slopes, and freeboard:

$$A_{BMP} = [\, w_b + 2z(d_p+f)\,] \times [\, l_b + 2z(d_p+f)\,]$$

Where A_{BMP} = Area occupied by BMP excluding Pretreatment (sq-ft)
w_b = Filter Bed Width from Step 4
z = Filter Bed Interior Slope (length per unit height)
d_p = Maximum Ponding Depth from Step 2 (ft)
f = Freeboard (ft)
l_p = Filter Bed Length from Step 4 (ft)

If the calculated area does not fit in the available space, either reduce the drainage area, reduce the planting soil depth (if it's not already set to the minimum), and/or increase the ponding depth (if it's not already set to the maximum depth), and repeat the calculations.

Pretreatment Considerations

Pretreatment should be provided where sediments or trash may cause a concern or decreased BMP functionality, and when space permits. Pretreatment may be achieved with vegetated swales, vegetated buffer strips with pea gravel or stone diaphragm, or manufactured treatment device.

Area Requirements

A vegetated bio-filter requires a footprint equivalent to 3.3% - 3.8% of its contributing impervious drainage area, excluding pretreatment. The lower value reflects the minimum planting media depth and maximum ponding depth, while the upper value reflects the maximum planting media depth and minimum ponding depth.

Sizing Example

Calculate the size of a vegetated bio-filter serving a 1-acre residential development. Assume the following design parameters:

Design Parameter	Units	Value
Percent Impervious Cover, I	percent	70
Design Storm Depth, P	inches	1.0
Planting Soil Coefficient of Permeability, k	feet/day	1.0
Drawdown (drain) Time, t	hours	48
Interior Side Slope (length per unit height), z		0
Freeboard, f	feet	0.5

1. Calculate the volumetric runoff coefficient (C) and WQV:

   $C = 0.05 + 0.009I$

   $C = 0.05 + 0.0039 \times 70$

   $C = 0.68$

   $WQV = PCA \times 3{,}630$

   $WQV = 1 \times 0.68 \times 1 \times 3{,}630$

   $WQV = 2{,}468$ cu-ft

2. Select a planting soil depth (d_s) and ponding depth (d_p):

   $d_s = 2$ ft

   $d_p = 6$ in

3. Calculate the Filter Bed Surface Area (A_{BMP}):

   $A_{BMP} = WQV \times d_s / [\, k(d_s + (d_p/24))(t/24) \,]$

   $A_{BMP} = 2{,}468 \times 2 / [\, 1(2 + (6/24))(48/24) \,]$

   $A_{BMP} = 1{,}097$ sq-ft

4. Set the bottom width (w_b) to 6 ft, and calculate the bottom length (l_b):

   $l_b = A_b / w_b$

   $l_b = 1{,}097/6$

   $l_b = 182.8$ ft

5. Calculate the total area excluding pretreatment (A_{BMP}):

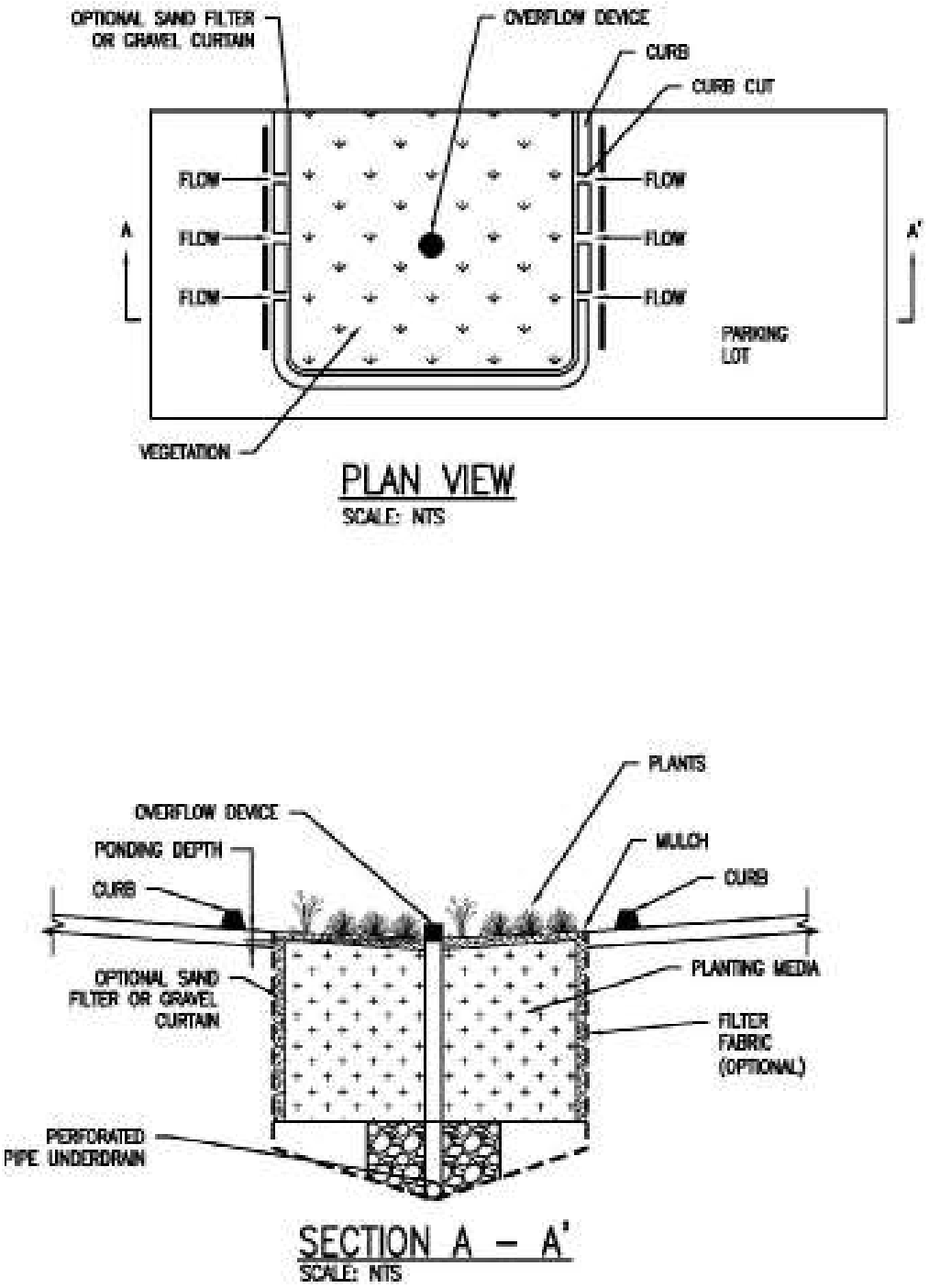
$$A_{BMP} = [w_b + 2z(d_p + f)] \times [l_b + 2z(d_p + f)]$$
$$A_{BMP} = [6 + 2 \times 0 \times (0.5 + 0.5)] \times [182.8 + 2 \times 0 \times (0.5 + 0.5)]$$
$$A_{BMP} = 1{,}097 \text{ sq-ft}$$

Other Design Considerations

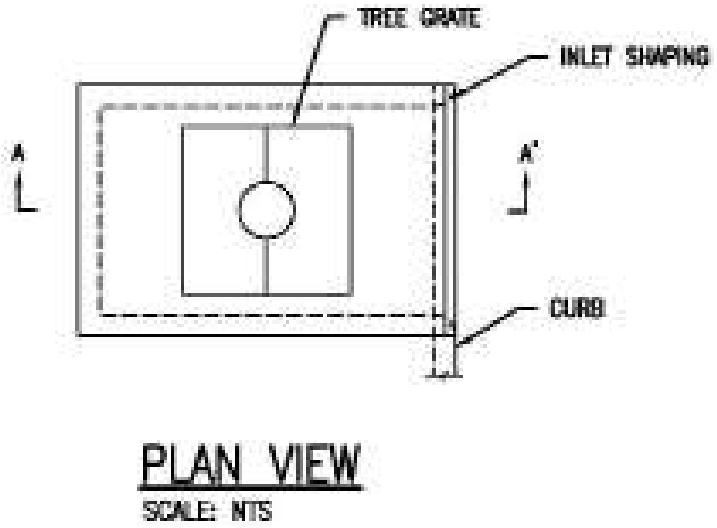
- All bio-filters must be able to safely overflow or bypass flows in excess of the storm water quality design storm to downstream drainage systems when the surface/subsurface capacity is exceeded.
- If a mulch layer is used on the surface of the planting bed, consideration should be given to problems caused by flotation during storm events.
- A cleanout pipe should be tied into the end of all underdrain pipe runs.

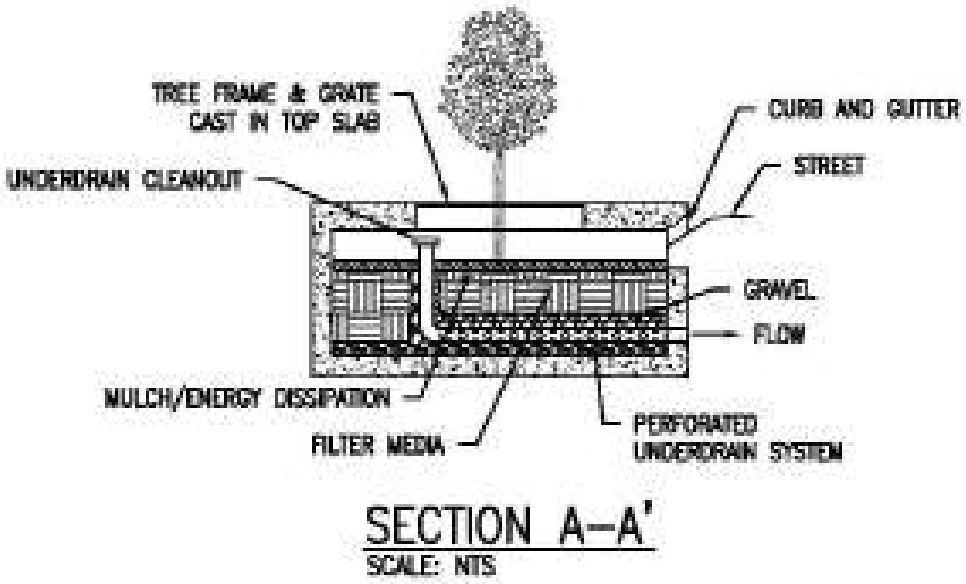
Construction/Inspection Considerations

Vegetated biofilters should not be established until contributing watershed is stabilized.



Schematic of a Vegetated Bio-Filter





Schematic of a Tree Box Filter

TC-09: Enhanced Swale



Georgia Stormwater Management Manual, 2001.

BMP Category	
Retention	○
Biofiltration	●
Other	○

O&M Requirements
Medium

Expected Pollutant Removals			
Nutrients	Medium	Pesticides	Unknown
Sediment	High	Oil & Grease	Medium
Trash	High	Metals	Medium
Pathogens	Unknown	Organic Compounds	Unknown

Description

Sometimes referred to as a bioretention swale or dry swale, an enhanced swale is a shallow linear channel with a planting bed and covered with turf or other surface material (other than mulch or plants). Runoff filters through a planting bed, is collected in an underdrain system, and discharged at the downstream end of the swale.

Minimum Design Criteria

Design Parameter	Units	Value
Maximum Interior Side Slope (length per unit height)		3:1
Bottom width	feet	2 - 8
Maximum Longitudinal Slope without check dams	percent	2
Maximum Longitudinal Slope with check dams	percent	5
Maximum check dam height	inches	12
Maximum Ponding Depth at downstream end	inches	18
Media depth	inches	18 - 36
Minimum Freeboard	feet	0.5
Minimum Underdrain Diameter	inches	6

Feasibility Criteria

See Section 5.5: Feasibility Criteria.

Sizing Procedure

Step 1. Use the procedure presented previously to compute the Volumetric Runoff Coefficient and WQV.

Step 2. Select values for the planting media thickness, drainage layer thickness, planting media porosity, drainage layer porosity, maximum surface ponding depth (if check dams are used), bottom width, and interior side slope (length per unit height).

Step 3. Calculate the total effective storage depth based on the instantaneous storage capacity using the void space in the planting media and drainage layer, and the average ponding depth (assumed to be one-half the maximum ponding depth):

$$d_t = [(d_p/2) + l_m n_m + l_d n_d)]/12$$

Where d_t = Total Effective Water Storage Depth (ft)
d_p = Maximum Ponding Depth from Step 2 (in)
l_m = Planting Media Thickness from Step 2 (in)
n_m = Planting Media Porosity, typically around 0.25
l_d = Drainage Layer Thickness from Step 2 (in)
n_d = Drainage Layer Porosity, typically around 0.40

Step 4. Calculate the swale invert area required (A_b) based on the instantaneous storage capacity (neglecting the additional ponding capacity due to the shape of the swale sides):

$$A_b = WQV/d_t$$

Where A_b = Bottom Surface Area (sq-ft)
WQV = WQV from Step 1 (cu-ft)
d_t = Total Effective Water Storage Depth from Step 3 (cu-ft)

Step 5. Calculate the total area required (A_{BMP}) taking into account the side slopes along the length of the swale:

$$A_{BMP} = [\, b + 2z(f + d_p/12) \,] \times (\, A_b/b \,)$$

Where A_{BMP} = Total Surface Area (sq-ft)
b = Swale Bottom Width from Step 2 (ft)
z = Interior Swale Side Slope (length per unit height) from Step2
d_p = Ponding Depth from Step 2 (in)
f = Freeboard (ft)
A_b = Bottom Surface Area from Step 4 (sq-ft)

If the minimum surface area is larger than the available space, reduce the tributary area and/or increase one or more design depths (media, gravel, ponding), and repeat the calculations.

Pretreatment Considerations

Pretreatment for enhanced swales is provided by a shallow sediment forebay at the initial point of the channel. The volume of this forebay should be equal to at least 0.05 in. per impervious acre of drainage.

A pea gravel diaphragm can be used along the top of the channel to provide pretreatment for lateral flows entering the swale.

Area Requirements

An enhanced swale requires a footprint equivalent to 8% - 40% of its contributing impervious drainage area. The lower value corresponds to the maximum allowable values for the mentioned dependent variables, while the upper value reflects the minimum allowable values for all specified parameters.

Sizing Example

Calculate the size of an enhanced swale serving a 1-acre residential development. Assume the following design parameters:

Design Parameter	Units	Value
Percent Impervious Cover, I	percent	70
Design Storm Depth, P	inches	1.0
Media porosity, n_m		0.25
Drainage layer porosity, n_d		0.40
Freeboard, f	feet	0.5
Drawdown (drain) Time, t	hours	48

1. Calculate the volumetric runoff coefficient (C) and WQV:

   $C = 0.05 + 0.009I$

   $C = 0.05 + 0.0039 \times 70$

   $C = 0.68$

   $WQV = PCA \times 3{,}630$

   $WQV = 1 \times 0.68 \times 1 \times 3{,}630$

   $WQV = 2{,}468$ cu-ft

2. Select a media thickness (l_m), drainage layer thickness (l_d), ponding depth (d_p), bottom width (b), and interior side slope (z):

   $l_m = 18$ in

   $l_d = 6$ in

   $d_p = 12$ in

   $b = 8$ ft

   $z = 3$

3. Calculate the total effective storage depth:

   $d_t = [(d_p/2) + l_m n_m + l_d n_d]/12$

   $d_t = (6 + 18 + 0.25 + 6 \times 0.40)/12$

   $d_t = 1{,}075$ sq-ft

4. Calculate the minimum invert area (A_b) needed for the WQV and depths:

   $A_b = WQV/d_t$
   $A_b = 2{,}468/1.075$
   $A_b = 2{,}296$ sq-ft

5. Calculate the total area required (A_{BMP}):

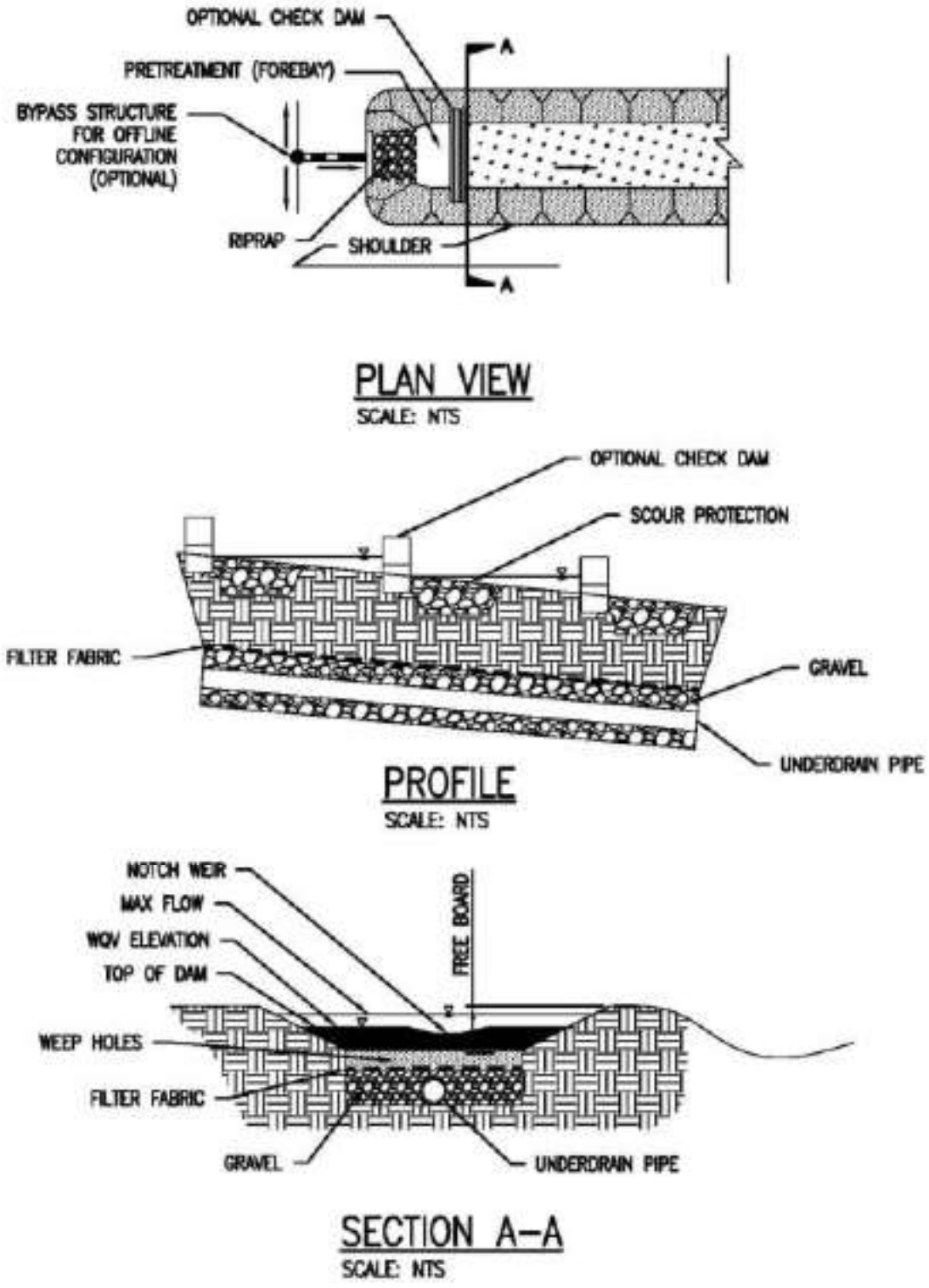
   $A_{BMP} = [\, b + 2z(f + d_p/12) \,] \times (\, A_b/b)$
   $A_{BMP} = [\, 8 + 2 \times 3 \times (0.5 + 12/12) \,] \times (\, 2{,}296/8)$
   $A_{BMP} = 4{,}879$ sq-ft

Other Design Considerations

- Landscape design should specify proper grass species based on specific site, soils and hydric conditions present along the channel. Vegetation should be designed for regular mowing, like a typical lawn, or less frequently (annually or semi-annually).
- Enhanced swales must be adequately designed to safely pass flows that exceed the design storm flows.

Construction/Inspection Considerations

- Include directions in the specifications for use of appropriate fertilizer and soil amendments based on soil properties determined through testing and compared to the needs of the vegetation requirements.
- Install swales at the time of the year when there is a reasonable chance of successful establishment without irrigation; however, it is recognized that rainfall in a given year may not be sufficient and temporary irrigation may be used.
- If sod tiles must be used, they should be placed so that there are no gaps between the tiles; stagger the ends of the tiles to prevent the formation of channels along the swale or strip.
- Use a roller on the sod to ensure that no air pockets form between the sod and the soil.
- Where seeds are used, erosion controls will be necessary to protect seeds for at least 75 days after the first rainfall of the season.



Schematic of an Enhanced Swale

This page is intentionally left blank.

TC-10: Vegetated Swale



Kauai Federal Credit Union (courtesy of Group 70)

BMP Category	
Retention	○
Biofiltration	●
Other	○

O&M Requirements
Low

Expected Pollutant Removals			
Nutrients	Low	Pesticides	Unknown
Sediment	Medium	Oil & Grease	Medium
Trash	Low	Metals	Medium
Pathogens	Low	Organic Compounds	Unknown

Description

Sometimes referred to as a grass swale, grass channel, or biofiltration swale, a vegetated swale is a broad shallow earthen channel vegetated with erosion resistant and flood tolerant grasses. Runoff typically enters the swale at one end and exits at the other end.

Minimum Design Criteria

Design Parameter	Units	Value
Maximum Interior Side Slope (length per unit height)		3:1
Maximum Flow Velocity	feet/second	1
Maximum Water Depth	inches	4
Minimum Hydraulic Residence Time	minutes	7
Maximum Bottom Width	feet	10
Minimum Freeboard	feet	0.5

Feasibility Criteria

See Section 5.5: Feasibility Criteria.

Sizing Procedure

Step 1. Use the procedure presented previously to compute the WQF Rate.

Step 2. Select initial values for swale bottom width (b), depth of flow (y), swale side slope (z), swale longitudinal slope (s), and hydraulic residence time (T).

Step 3. Calculate the cross-sectional area (A), wetted perimeter (WP), and hydraulic radius (R) using the dimensions established in Step 2:

$$A = (by/12) + (zy^2/144)$$
$$WP = b\ (2y/12)\sqrt{(1+z^2)}$$
$$R = A/WP$$

Where	A	=	Cross Sectional Area (sq-ft)
	WP	=	Wetter Perimeter (ft)
	R	=	Hydraulic Radius (ft)
	b	=	Swale Bottom Width from Step 2 (ft)
	y	=	Depth of Flow for WQV from Step 2 (in)
	z	=	Swale Side Slope (length per unit height) from Step 2

Step 4. Calculate the design flow rate in the swale using the selected dimensions and Manning's Equation:

$$Q = (1.49AR^{2/3}s^{1/2})/n$$

Where	Q	=	Design Flow Rate (cu-ft/sec)
	A	=	Cross Sectional Area from Step 3 (sq-ft)
	R	=	Hydraulic Radius from Step 3 (ft)
	s	=	Longitudinal Slope from Step 2 (percent)
	R	=	Manning's n value

Unless another value can be justified, use a Manning's n value of 0.20 for water quality calculations (lower values, such as 0.035, are only applicable for flood control calculations). If the calculated flow rate is not equal to or greater than the WQF from Step 1, decrease the tributary area and/or increase one or more swale dimensions (bottom width, depth of flow, side slope, or longitudinal slope) and repeat the calculations.

Step 5. Once an appropriate design flow rate is achieved, calculate the design flow velocity using the flow continuity equation:

$$V = Q/A$$

Where	V	=	Design Flow Velocity (ft/sec)
	Q	=	Design Flow Rate from Step 4 (cu-ft/sec)
	A	=	Cross Sectional Area from Step 3 (sq-ft)

If the design flow velocity is greater than the maximum allowed velocity, either include check dams with vertical drops of no more than 12 inches, or revise one or more swale dimensions and repeat the calculations.

Step 6. Multiply the velocity by the hydraulic residence time to determine the length:

$$L = 60VT$$

Where L = Swale Length (ft)
T = Hydraulic Resistance Time from Step 2 (min)
V = Design Flow Velocity from Step 5 (ft/sec)

Step 7. Calculate the total area required (A_{BMP}) taking into account the side slopes along the length of the swale and the freeboard:

$$A_{BMP} = [\, b + 2z(f + y/12)] \times L$$

Where A_{BMP} = Total Surface Area (sq-ft)
b = Swale Bottom Width from Step 2 (ft)
z = Interior Swale Side Slope (length per unit height) from Step2
y = Depth of Flow from WQV from Step 2 (in)
f = Freeboard (ft)
L = Swale Length from Step 6 (ft)

If the calculated are does not fit in the available area, reduce the drainage area, reduce the hydraulic residence time (if it is longer than the minimum), and/or revise one or more swale dimensions, and repeat the calculations.

Pretreatment Considerations

Vegetated swales do not require pretreatment.

Area Requirements

A vegetated swale requires a footprint equivalent to 2% - 4% of its contributing impervious drainage area. The lower value corresponds to maximizing the flow depth and slope, while the upper value corresponds to maximizing the bottom width and slope.

Sizing Example

Calculate the size of a grass swale serving the runoff from a one acre parking lot. Assume the following design parameters:

Design Parameter	Units	Value
Weighted Runoff Coefficient, C		0.95
Rainfall Intensity, i	inches/hour	0.4
Interior Side Slope (length per unit height)		3
Manning's n value	-	0.20
Longitudinal Slope, s		0.016
Hydraulic Residence Time, T	minutes	7
Freeboard, f	feet	0.5

1. Calculate the WQF Rate:

   WQF = CiA
   WQF = $0.95 \times 0.4 \times 1.0$
   WQF = 0.38 cu-ft/sec

2. Select initial values for swale bottom width (b), depth of flow (y), swale side slope length per unit height (z), swale longitudinal slope (s), and hydraulic residence time (T):

   b = 2.75 ft
   y = 3.5 in
   z = 3 in
   s = 0.017
   T = 7 mins

3. Calculate the cross-sectional area (A), wetted perimeter (WP), and hydraulic radius (R):

   $A = (by/12) + (zy^2/144)$
   $A = (2.75 \times 3.5/12) + (3 \times 3.5^2/144)$
   A = 1.06 sq-ft

   $WP = b + (2y/12)\sqrt{(1+z^2)}$
   $WP = 2.75 + (2 \times 3.5/12)\sqrt{(1+3^2)}$
   WP = 4.59 ft

   R = A/WP
   R = 1.06/4.59
   R = 0.23 ft

4. Calculate the design flow rate (Q):

   $Q = 1.49 AR^{2/3}s^{1/2}/n$
   $Q = 1.49 \times 1.06 \times 0.23^{2/3} \times 0.017^{1/2}/0.20$
   Q = 0.39 cu-ft/sec (≥ WQF, OK)

5. Calculate the velocity in the swale (V):

   V = Q/A
   V = 0.39/1.06
   V = 0.36 ft/sec (< 1 ft/sec, OK)

6. Calculate the minimum length of the swale (L):

   $L = 60 \times VT$

   $L = 60 \times 0.36 \times 7$

   $L = 153$ ft

7. Calculate the total area required (A_{BMP}):

   $A_{BMP} = [\, b + 2z(f + y/12)] \times L$

   $A_{BMP} = [\, 2.75 + 2 \times 3(0.5 + 3.5/12)] \times 153$

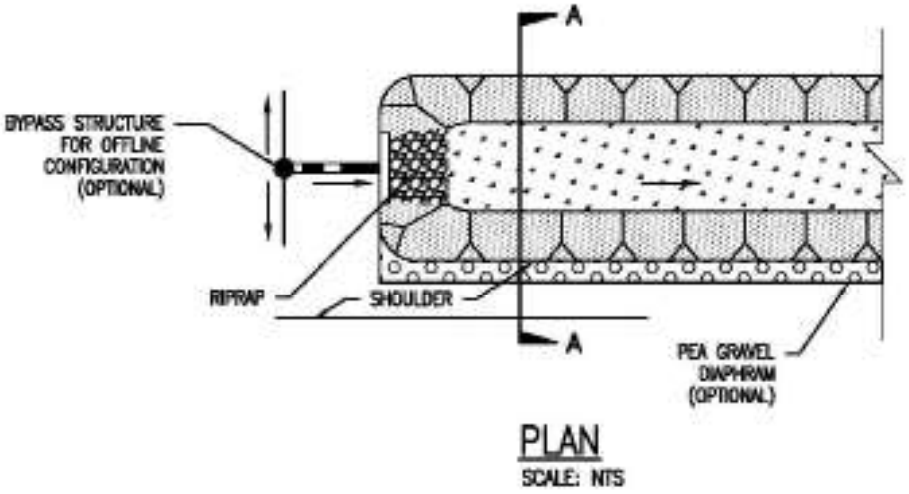
   $A_{BMP} = 1{,}148$ sq-ft

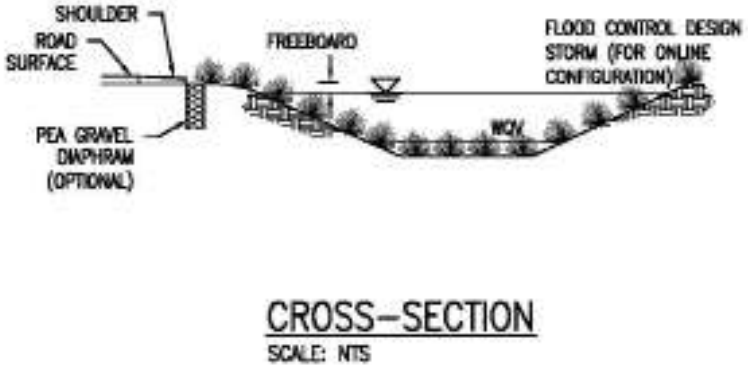
Other Design Considerations

- The calculated WQF may be reduced by 25% if the soil beneath the BMP is classified as Hydrologic Soils Group (HSG) "A" or "B", as reported by the USDA Natural Resources Conservation Service (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm), or if the soil beneath the BMP is amended by incorporating 6 inches of compost/amendments and tilled up to 8 inches.
- In cases where a vegetated swale is located on-line, it should be sized as a treatment facility and as a conveyance system per the CCH's standards for flood control.
- Vegetate the swale with dense turf grass to promote sedimentation, filtration, and nutrient uptake, and to limit erosion through maintenance of low flow velocities.
- Check dams may be used to achieve flow velocity requirements. They are often employed to enhance infiltration capacity, decrease runoff volume, rate, and velocity, and promote additional filtering and settling of nutrients and other pollutants.

Construction/Inspection Considerations

- Include directions in the specifications for use of appropriate fertilizer and soil amendments based on soil properties determined through testing and compared to the needs of the vegetation requirements.
- Install swales at the time of the year when there is a reasonable chance of successful establishment without irrigation; however, it is recognized that rainfall in a given year may not be sufficient and temporary irrigation may be used.
- If sod tiles must be used, they should be placed so that there are no gaps between the tiles; stagger the ends of the tiles to prevent the formation of channels along the swale or strip.
- Use a roller on the sod to ensure that no air pockets form between the sod and the soil.
- Where seeds are used, erosion controls will be necessary to protect seeds for at least 75 days after the first rainfall of the season.





Schematic of a Vegetated Swale

TC-11: Vegetated Buffer Strip



Virginia DCR Stormwater Design Specification No. 2. 2001.

BMP Category	
Retention	○
Biofiltration	●
Other	○

O&M Requirements
Low

Expected Pollutant Removals			
Nutrients	Low	Pesticides	Unknown
Sediment	Medium	Oil & Grease	Medium
Trash	Medium	Metals	Medium
Pathogens	Low	Organic Compounds	Medium

Description

Sometimes referred to as a vegetated filter strip or biofiltration strip, a vegetated buffer strip is a grassy slope vegetated with turf grass that is designed to accommodate sheet flow. They may resemble natural ecological communities and remove pollutants by vegetative filtration.

Minimum Design Criteria

Design Parameter	Units	Value
Maximum Flow Velocity	feet/second	1
Maximum Upstream Area Flow Length	feet	75
Minimum Length	feet	15
Maximum Flow Depth	inches	1

Feasibility Criteria

See Section 5.5: Feasibility Criteria.

Sizing Procedure

Step 1. Use the procedure presented previously to compute the WQF Rate.

Step 2. Select values for the buffer strip width (w) and buffer strip longitudinal slope (s). Note that if a strip width is selected that is not the same as the width of the upstream flow path, a transition structure will be necessary to capture all the runoff and/ or establish uniform sheet flow across the entire strip width.

Step 3. Compute the design flow depth for the WQF using a simplified form of Manning's Equation assuming a shallow flow depth:

$$y = 12 \times [nQ/1.49\sqrt{(s/100)}]^{0.6}$$

Where y = Design Flow Depth for WQF (in)
n = Manning's n Value
Q = WQF Rate from Step one (cu-ft/sec)
w = Design Width from Step 2 (ft)
s = Longitudinal Slope from Step 2 (percent)

Unless another value can be justified, use a Manning's n value of 0.25 for water quality calculations (lower values, such as 0.035, are only applicable for flood control calculations). If the calculated depth is greater than the maximum allowed depth, reduce the tributary area, increase the design width, or increase the longitudinal slope, and repeat the calculation.

Step 4. Calculate the Design flow velocity across the strip using the flow continuity equation:

$$V = 12Q/wy$$

Where V = Design Flow Velocity (ft/sec)
Q = WQF Rate from Step 1 (cu-ft/sec)
w = Design Width from Step 2 (ft)
d = Design Flow Depth from Step 3 (in)

If the design flow velocity is greater than the maximum allowed velocity, revise one or more design parameters and repeat the calculations.

Step 5. Select a design buffer strip length (L) equal to or greater than the minimum length, and calculate the total BMP area:

$$L = 20.0\ ft$$

$$A_{BMP} = L \times w$$

Where A_{BMP} = Vegetated Buffer Strip Area (sq-ft)
L = Design Length (ft)
w = Design Width from Step 2 (ft)

Pretreatment Considerations

Vegetated Buffer Strips do not require pretreatment.

Area Requirements

A vegetated buffer strip requires a footprint equivalent to no less than 0.4% of its contributing impervious drainage area. While there is no upper value because there is no maximum design width or design length, the minimum footprint corresponds to the minimum length and the maximum slope and minimum width combination that provide the maximum allowable design depth.

Sizing Example

Calculate the size of a vegetated buffer strip serving the runoff from a one acre parking lot. Assume the following design parameters:

Design Parameter	Units	Value
Weighted Runoff Coefficient, C		0.95
Rainfall Intensity, i	inches/hour	0.4
Manning's n value	-	0.25
Longitudinal Slope		0.06

1. Calculate the WQF Rate:

   $WQF = CiA$

   $WQF = 0.95 \times 0.4 \times 1.0$

   $WQF = 0.38$ cu-ft/sec

2. Select a design buffer strip width (w) and longitudinal slope (s):

   $w = 20.0$ ft

   $s = 0.06$

3. Calculate the depth of flow for the WQF (y):

   $y = 12 \times (WQF \times n/1.49w\sqrt{s})^{0.6}$

   $y = 12 \times [0.38 \times 0.25/1.49 \times 20\sqrt{(0.06]})^{0.6}$

   $y = 0.89$ in (≤ 1 in, OK)

4. Calculate the velocity across the buffer strip (V):

   $V = 12 \times WQF/(yw)$

   $V = 12 \times 0.38/(0.89 \times 20.0)$

   $V = 0.26$ cu-ft/sec (≤ 1 cu-ft/sec, OK)

5. Select a design buffer strip length (L) at least equal to the minimum required length, and calculate the total BMP area (A_{BMP}):

   $A_{BMP} = L \times w$

   $A_{BMP} = 20 \times 20$

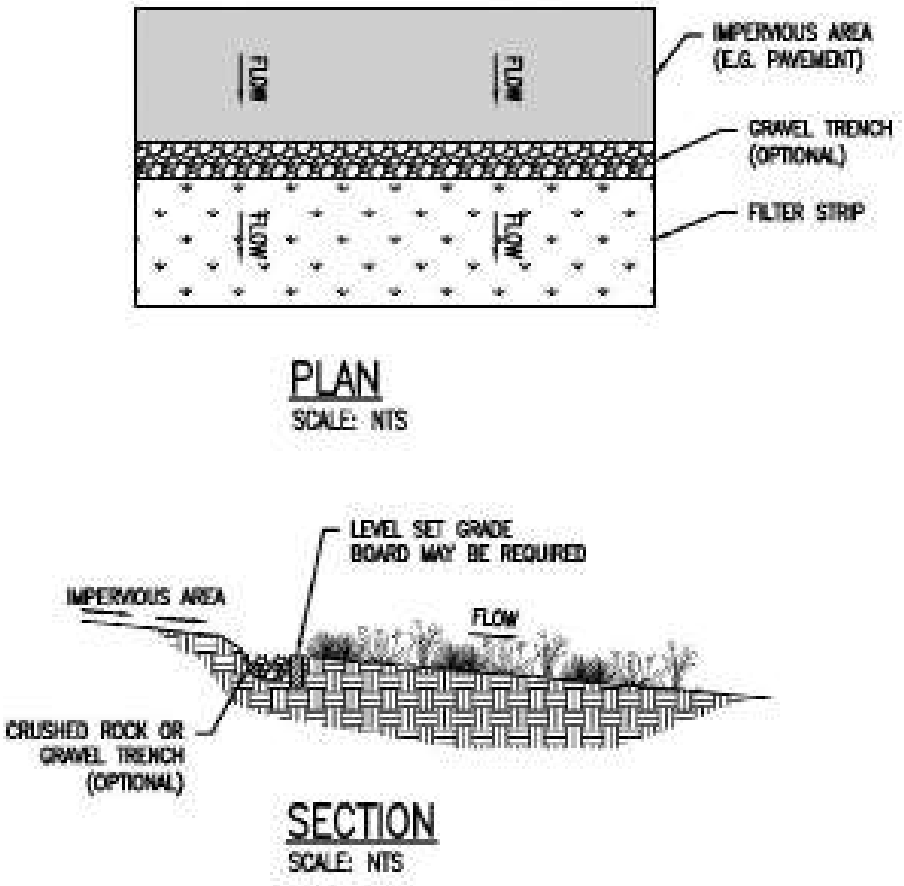
   $A_{BMP} = 400$ sq-ft

Other Design Considerations

- The calculated WQF may be reduced by 25% if the soil beneath the BMP is classified as Hydrologic Soils Group (HSG) "A" or "B," as reported by the USDA Natural Resources Conservation Service (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm), or if the soil beneath the BMP is amended by incorporating 6 inches of compost/ amendments and tilled up to 8 inches.
- A pea gravel diaphragm or engineered level spreader should be provided at the upper edge of the BMP when the width of the contributing drainage area is greater than that of the filter. Level spreader options include porous pavement strips, stabilized turf strips, slotted curbing, rock-filled trench, or concrete sills.
- The selection of plants should be based on their compatibility with climate conditions, soils and topography, and their ability to tolerate urban stresses from pollutants, variable soil moisture conditions and ponding fluctuations.

Construction/Inspection Considerations

Vegetated filter strips should protected with temporary sediment and erosion control BMPs until contributing areas are stabilized.



Schematic of a Vegetated Buffer Strip

TC-12: Harvest/Reuse



Hawaii Baptist Academy (Courtesy of Group 70)

BMP Category	
Retention	●
Biofiltration	○
Other	○

O&M Requirements
Low

Expected Pollutant Removals			
Nutrients	Low	Pesticides	Unknown
Sediment	Medium	Oil & Grease	Medium
Trash	Medium	Metals	Medium
Pathogens	Low	Organic Compounds	Medium

Description

Sometimes referred to as capture/reuse or rainwater harvesting, is the collection and temporary storage of roof runoff in rain barrels or cisterns for subsequent non-potable outdoor use (landscape irrigation, vehicle washing).

Minimum Design Criteria

One of two equivalent performance standards shall be met:

1. Harvest and use BMP is designed to capture at least 80% of average annual (long term) runoff volume and meet 80% of the annual overall demand.
2. Harvest and use BMPs are sized to drain the tank in 48 hrs following the end of rainfall. The size of the BMP is dependent on the demand at the site.

It is rare cisterns can be sized to capture the full WQV and use this volume in 48 hrs. So when using Infeasibility worksheets in the *Water Quality Rules* Appendix F, if it is determined that harvest and use BMP is feasible then the BMP should be sized to the estimated 48-hr demand. The remaining WQV not captured needs to be either retained onsite or, if infeasible, treated with biofiltration per the requirements in Section 1.3.

Feasibility Criteria

See Section 5.5: Feasibility Criteria.

Sizing Procedure

Step 1. Define the irrigation demand by selecting values for the irrigation area (A_i), pan evaporation coefficient (K_p), landscape coefficient (K_l), irrigation system efficiency (e). Unless specific data is available, use a value of 0.80 for K_p (*Guidelines for the Reuse of Gray Water*), 0.60 for

K_l (warm season turfgrass, *A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California*), and 0.90 for e (well-designed system, *Estimating Irrigation Water Needs of Landscape Plantings in California*).

Step 2. Define the non-irrigation demand (D_0) which may include other non-potable use.

Step 3. Define the runoff available for reuse by selecting values for the drainage (i.e., roof) area (A_d), percent of impervious cover (I), and cistern size (C).

Step 4. Identify the project's nearest reference point (Makakilo City, Waimanalo, Waialua, Village Park, Waianae, UH Mauka, Mililani, Opaeula, Maunawili, and Kalihi Valley) and use the corresponding monthly rainfall rates and monthly pan evaporation rates (E_{pan}).

Step 5. Perform a month-to-month analysis, starting with January and ending with December. Set the beginning cistern volume in January to 0.

Step 5a. Calculate the reference evapotranspiration rate for the month using the pan evaporation rate and the pan evaporation coefficient:

$$ET_0 = E_{pan} \times K_p$$

Where ET_0 = Reference Evapotranspiration Rate for the Month (in)
E_{pan} = Pan Evaporation Rate for the Month (in) from Step 4
K_p = Pan Evaporation Coefficient from Step 1

Step 5b. Calculate the actual evapotranspiration rate for the month using the reference evapotranspiration rate and the landscape coefficient:

$$ET_a = ET_o \times K_l$$

Where ET_a = Actual Evapotranspiration Rate for the Month (in)
ET_0 = Reference Evapotranspiration Rate from Step 5a
K_l = Landscape Coefficient from Step 1

Step 5c. Calculate the total demand for the month by multiplying the irrigation area by the difference between the actual evapotranspiration rate and the rainfall, and adding the non-irrigation demand:

$$D_t = 7.48 \times A \times (ET_a - r)/(12 \times e) + D_0$$

Where D_t = Total Demand for the Month (gallons)
A = Irrigation Area from Step 1 (sq-ft)
ET_a = Actual Evapotranspiration Rate from Step 5b
r = Total Rainfall for the Month (in) from Step 4
e = Irrigation System Efficiency from Step 1
D_0 = Other Non-Irrigation Demand for the Month (gallons) from Step 2

If the total demand for the month is negative (because the rainfall amount exceeds the evapotranspiration rate), set the total demand to 0.

Step 5d. Calculate the amount of runoff generated for the month by multiplying the drainage area by the rainfall by the volumetric runoff coefficient:

$$R_g = 7.48 \times A_d \times r \times (0.05 + 0.009 \times I)/12$$

Where R_g = Runoff Generated for the Month (gallons)
A_d = Drainage Area from Step 2 (sq-ft)
r = Total Rainfall for the Month (in) from Step 4
I = Percent of Impervious Cover from Step 3 (percent)

Step 5e. Compare the total demand (D_t) to the amount of runoff in the cistern at the beginning of the month (C_b) plus the runoff generated during the month (R). If the monthly demand is greater, set the amount of runoff reused (R_u) to the sum of C_b and R. If the monthly demand is less, set the amount of runoff reused to D_t.

Step 5f. Compare the Cistern capacity (C) to the amount in the cistern at the beginning of the month (C_b) plus the Runoff generated during the month (R_g) minus the amount of runoff used (R_u). Set the amount of runoff in the cistern at the end of the month (C_e) to the lower of the two values.

Step 5g. Calculate the amount of cistern overflow by the following:

$$O = C_b + R_g - D_t - C_e$$

Where O = Total Cistern Overflow for the Month (gallons)
C_b = Amount of Runoff in Cistern at the beginning of the Month (gallons)
R_g = Runoff Generated for the Month (gallons)
D_t = Total Demand for the Month (gallons)
C_e = Amount of Runoff in Cistern at the end of the Month (gallons)

If the overflow is negative (because the amount of runoff in the cistern at the end of the month is less than the cistern capacity), set the overflow to 0.

Step 5h. Calculate the amount of runoff captured in the cistern by subtracting the Overflow from the amount of runoff generated:

$$R_c = R_g - O$$

Where R_c = Runoff Capture in the Cistern for the Month (gallons)
R_g = Runoff Generated for the Month (gallons)
O = Total Cistern Overflow for the Month (gallons)

Step 5i. Set the beginning cistern amount for the next month equal to the ending cistern amount for the current month. Repeat Steps 5 through 13 for each subsequent month. Continue on to Step 5 after Steps 4a through 4i have been performed for all 12 months.

Step 6. Calculate the overall runoff capture efficiency by dividing the cumulative runoff captured by the cumulative runoff generated:

$$E_c = 100 \times \sum_{1}^{12} R_c / \sum_{1}^{12} R_g$$

Where E_c = Overall Runoff Capture Efficiency (percent)
R_c = Runoff Capture from each Month (gallons)
R_g = Runoff Generated from each Month (gallons)

If the calculated efficiency is below the minimum design criteria value, revise one or more of the following parameters and return to Step 3: drainage area (A_d), cistern size (C), irrigation area (A_i), and other non-irrigation demand (D_0).

Step 7. Calculate the overall demand met efficiency by dividing the cumulative runoff used by the cumulative demand:

$$E_d = 100 \times \sum_{1}^{12} R_u / \sum_{1}^{12} D_t$$

Where E_d = Overall Demand Met Efficiency (percent)
R_u = Runoff Used from each Month (gallons)
D_t = Total Demand from each Month (gallons)

If the calculated efficiency is below the minimum design criteria value, revise one or more of the following parameters and return to Step 3: drainage area (A_d), cistern size (C), irrigation area (A_i), and other non-irrigation demand (D_0).

Pretreatment Considerations

Roof gutter guards or leaf gutter screens are required for roof runoff to reduce dry well clogging from sediment, leaves, and other organic material.

Area Requirements

Rain barrel/cistern sizes can vary greatly depending on the project area, roof size, and irrigation area. The size can be anywhere from less than 1,000 gallons to more than 10,000 gallons per 1,000 sq-ft of roof area.

Sizing Example

Calculate the size of a cistern serving the roof runoff from an 800 sq-ft auto repair shop in Kapolei. Assume the following design parameters:

Design Parameter	Units	Value
Minimum overall runoff capture efficiency, E_c	percent	80
Minimum overall demand met efficiency, E_d	percent	80

1. Select initial demand values for the Irrigation Area (A_i), pan evaporation coefficient (K_p), landscape coefficient (K_l), irrigation system efficiency (e), and non-irrigation demand (D_0):

   A_i = 115 sq-ft
   K_p = 0.80
   K_l = 0.60
   e = 0.90
   D_0 = 0

2. Select initial values for the drainage area (A_d), percent of impervious cover (I), and cistern size (C):

   A_d = 800 sq-ft
   I = 100%
   C = 5,000 gallons

3. The nearest reference point to Kapolei is Makakilo City.

4a. Calculate the monthly reference evapotranspiration rates (ET_0). The calculation for January is as follows, and the results for the entire year are provided in the table in #4c.

   $ET_0 = E_{pan} \times K_l$
   $ET_0 = 5.46 \times 0.8$
   $ET_0 = 4.37$ in

4b. Calculate the actual evapotranspiration rates (ET_a). The calculation for January is as follows, and the results for the entire year are provided in the table in #4c.

   $ET_a = ET_0 \times K_l$
   $ET_a = 4.37 \times 0.6$
   $ET_a = 2.62$ in

4c. Calculate the total demand (D_t). The calculation for January is as follows, and the results for the entire year are provided in the table below.

$D_t = 7.48A_i (ET_i - r)/(12e) + D_0$
$D_t = 7.48 \times 115 \times (2.62 - 2.58)/(12 \times 0.9) + 0$
$D_t = 3$ gallons

Month	Rainfall (inches)	P (inches)	ET_0 (inches)	ET_a (inches)	D_t (gallons)
January	2.58	5.46	4.37	2.62	3
February	3.05	5.75	4.60	2.76	0
March	1.87	7.12	5.70	3.42	123
May	1.12	7.75	6.20	3.72	207
May	0.86	8.41	6.73	4.04	253
June	0.55	8.99	7.19	4.32	300
July	0.58	9.74	7.79	4.68	326
August	0.48	9.65	7.72	4.63	331
September	0.74	8.48	6.78	4.07	265
October	2.00	7.54	6.03	3.62	129
November	2.06	6.29	5.03	3.02	76
December	2.69	5.59	4.47	2.68	0

4d. Calculate the generated roof runoff (R_g). The calculation for January is as follows, and the results for the entire year are provided in the table below:

$R_g = 7.48A_d r (0.05 + 0.009I)/12$
$R_g = 7.48 \times 800 \times 2.58 (0.05 + 0.009 \times 100)/12$
$R_g = 1{,}222$ gallons

4e. Calculate the runoff used (R_u) by comparing the total demand (D_t) to the amount of runoff in the cistern at the beginning of the month (C_b) plus the runoff generated during the month (R). The calculation for January is as follows, and the results for the entire year are provided in the table below:

$C_b = 0$ gallon
$R_u = D_t = 3$ gallons [since $R_g + C_b > D_t$]

4f. Calculate the amount of runoff in the Cistern at the end of the month (C_e) by setting it to the lower value of the amount of runoff in the Cistern at the beginning of the month (C_b) plus the runoff generated (R_g) minus the runoff used (R_u), and the cistern capacity (C). The calculation for January is as follows, and the results for the entire year are provided in the table below:

$C_e = \min(C_b + R_g - R_u, \quad C)$
$C_e = \min(0 + 1{,}222 - 3, \quad 500)$
$C_e = 1{,}219$ gallons

4g. Calculate the Cistern overflow (O). The calculation for January is as follows, and the results for the entire year are provided in the table below:

$$O = C_b + R_g - D_t - C_e$$
$$O = 0 + 1{,}222 - 3 - 1{,}219$$
$$O = 0 \text{ gallons}$$

4h. Calculate the runoff captured in Cistern (R_c). The calculation for January is as follows, and the results for the entire year are provided in the table below:

$$R_c = R_g - O$$
$$R_c = 1{,}222 - 0$$
$$R_c = 1{,}222 \text{ gallons}$$

4i. Set C_b for the next month equal to C_e of the previous month and repeat the calculations.

Month	r (inches)	D (gallons)	R_g (gallons)	C_b (gallons)	C_e (gallons)	R_u (gallons)	O (gallons)	R (gallons)
January	2.58	3	1,222	0	1,219	3	0	1,222
February	3.05	0	1,445	1,219	2,664	0	0	1,445
March	1.87	123	886	2,664	3,426	123	0	886
May	1.12	207	531	3,426	3,750	207	0	531
May	0.86	253	407	3,750	3,904	253	0	407
June	0.55	300	261	3,904	3,865	300	0	261
July	0.58	326	275	3,865	3,814	326	0	275
August	0.48	331	227	3,814	3,710	331	0	227
September	0.74	265	351	3,710	3,796	265	0	351
October	2.00	129	947	3,796	4,614	129	0	947
November	2.06	76	976	4,614	5,000	76	514	462
December	2.69	0	1,274	5,000	5,000	0	1,274	0
Total	**18.58**	**2,014**	**8,802**			**2,014**	**1,788**	**7,014**

5. Calculate the overall runoff capture efficiency (E_c) and overall demand efficiency (E_d):

$$E_c = 100 \times \sum_{1}^{12} R_c / \sum_{1}^{12} R_g$$
$$E_c = 100 \times 7{,}014/8{,}802$$
$$E_c = 80\%$$

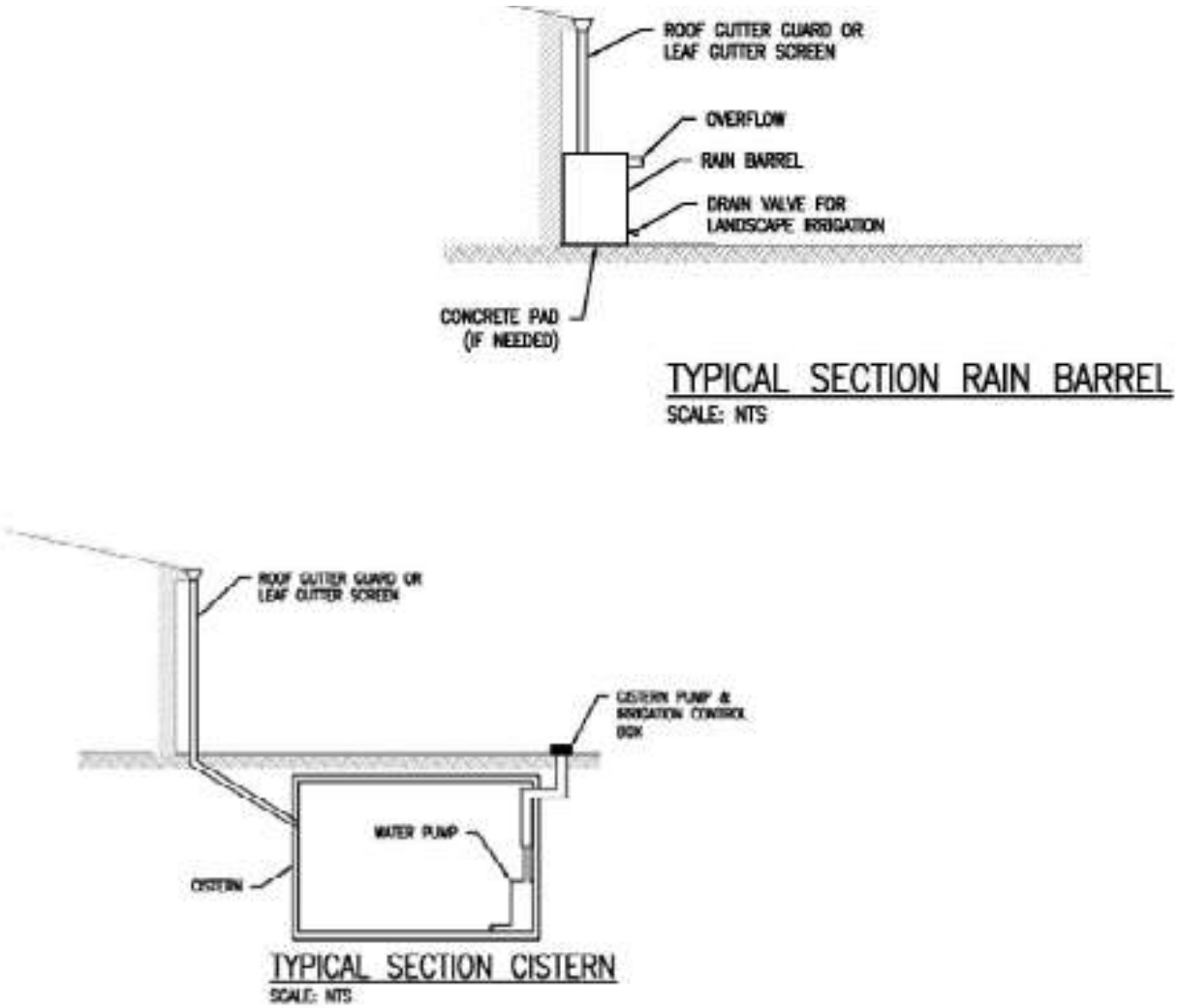
$$E_d = 100 \times \sum_{1}^{12} R_u / \sum_{1}^{12} D_t$$
$$E_d = 100 \times 2{,}014/2{,}014$$
$$E_d = 100\%$$

6. Calculate the WQV for which credit is received:

   WQV = PCA × 3,360
   WQV = 1 × (0.05 + 0.009 × 100) × (800/43,560) × 3,360
   WQV = 63 cu-ft

Other Design Considerations

- Local pan evaporation and rainfall data may be used if available.
- Tanks should have tight fitting covers to exclude contaminants and animals, and above ground tanks should not allow penetration of sunlight to limit algae growth
- In areas where the tank is to be buried partially below the water table, special design features must be employed to keep it from "floating."



Schematic of a Harvesting/Reuse System

TC-13: Detention Basin



Miliani Mauka

BMP Category	
Retention	○
Biofiltration	○
Other	●

O&M Requirements
Low

Expected Pollutant Removals			
Nutrients	Low	Pesticides	Unknown
Sediment	Medium	Oil & Grease	Medium
Trash	High	Metals	Low/Med
Pathogens	Low	Organic Compounds	Unknown

Description

Sometimes referred to as a dry extended detention basin, a detention basin is a shallow man-made impoundment intended to provide for the temporary storage of storm water runoff to allow particles to settle. It does not have a permanent pool and is designed to drain between storm events.

Minimum Design Criteria

Design Parameter	Units	Value
Maximum Interior Side Slope (length per unit height)		3:1
Minimum length to width ratio		2:1
Maximum depth	feet	8
Drawdown (drain) time for WQV	hours	48
Drawdown (drain) time for 50% of WQV	hours	24-36
Basin invert slope	percent	1-2
Minimum outlet size	inches	4
Minimum freeboard	feet	1

Feasibility Criteria

Detention Basins are considered infeasible for any of the following conditions:

- Basin invert would be below seasonally high groundwater table.
- Unable to operate off-line and unable to operate in-line with safe overflow mechanism.
- Excavation would disturb iwi kupuna or other archaeological resources.
- Unable to meet minimum length to width ratio design criteria naturally or artificially.

Sizing Procedure

Detention Basins are sized using detailed routing calculations to demonstrate that the storage volume is adequate. However, a reasonable first estimate can be determined using the following simple routing method which assumes triangular hydrographs for the inflow and outflow.

Step 1. Use the procedure presented previously to compute the pre-project (i.e., undeveloped) and post-project (i.e., developed) weighted runoff coefficients.

Step 2. Compute the peak inflow rate using the Rational Method:

$$q_i = C_a i A$$

Where q_i = Peak Inflow Rate into Basin (cu-ft)
C_a = Post-Project Weighted Runoff Coefficient
i = Peak Rainfall Intensity (in/hr)
A = Drainage Area (acres)

Step 3. Compute the peak outflow rate using the pre-project runoff coefficient, which effectively forces the detention basin to maintain pre-project discharge rates:

$$q_o = C_b i A$$

Where q_o = Peak Inflow Rate leaving Basin (cu-ft)
C_b = Pre-Project Weighted Runoff Coefficient
i = Peak Rainfall Intensity (in/hr)
A = Drainage Area (acres)

Step 4. Calculate the estimated basin storage volume:

$$s = 3{,}630 \times PA\,[1 - (q_o/q_i)]$$

Where s = Storage Volume in the Basin (cu-ft)
P = Design Storm Runoff Depth (in)
A = Drainage Area (acres)
q_o = Peak Outflow Rate from Step 3 (cu-ft)
q_i = Peak Inflow Rate from Step 2 (cu-ft)

Step 5. Select initial values for the detention basin total width (w_t), total length (l_t), and depth (d) based on space availability, topography and existing drainage facilities. Also select values for the interior side slopes (z) and required freeboard (f). Calculate the basin invert width and invert length:

$$w_b = w_t - 2z(d+f)$$

$$l_b = l_t - 2z(d+f)$$

Where w_b = Basin Bottom Width (ft)
l_b = Basin Bottom Length (ft)
w_t = Basin Total Width (ft)
l_t = Basin Total Length (ft)
z = Basin Interior Side Slope (length per unit height)
d = Depth of Flow for Storage Volume (ft)
f = Freeboard (ft)

Step 6. Calculate the resulting storage volume using the prismoidal formula for trapezoidal basins:

$$V = w_b l_b d + (w_b + l_b) z d^2 + 4 z^2 d^3 / 3$$

Where V = Volume of Trapezoidal Basin (cu-ft)
w_b = Basin Bottom Width from Step 5 (ft)
l_b = Basin Bottom Length from Step 5 (ft)
d = Depth of Flow for Storage Volume from Step 5 (ft)
z = Basin Interior Side Slope from Step 5

Compare the calculated volume (V) to the required volume (s) from Step 4. If the calculated volume is greater than or equal to the required volume, the selected dimensions (w_t and l_t) and depth (d) are adequate for preliminary design. If the calculated volume is less than the required volume, increase one or both of the dimensions and/or the depth (d) and repeat Steps 5 and 6. If the footprint area and depth are set to maximum allowable values based on site characteristics and the calculated volume is still less than the required volume, reduce the drainage area (A) and repeat Steps 2 through 6.

Pretreatment Considerations

If significant amounts of sediment or sand are anticipated at the site, sediment forebays should be located at each major inlet to provide pretreatment, preserve the capacity of the basin, and reduce maintenance requirements in the basin. The forebay consists of a separate cell that drains into the main basin, formed by an acceptable barrier, such as an earthen berm or gabion baskets, etc.). If used, the total volume of all forebays should be at least 5% of the total WQV.

Area Requirements

A detention basin requires a footprint equivalent to 1% - 9% of its contributing impervious drainage area. The actual value is dependent on a number of variables, including the drainage area, pre-project and post-

project runoff coefficients, and basin depth. Footprints at the lower range reflect deep basins (e.g., 8 ft) serving large drainage areas (e.g., 50 acres), while footprints at the upper range reflect shallow basins (e.g., 1 ft) serving small drainage areas (e.g., 1 acre).

Sizing Example

Calculate the preliminary size of a detention basin serving the runoff from a one acre parking lot. Assume the following design parameters:

Design Parameter	Units	Value
Rainfall Intensity, i	inches/hour	0.4
Runoff Volume, Q	inches	1
Basin Interior Side Slope (length per unit height), z		3
Freeboard, f	feet	1

1. Compute the pre-project (i.e., undeveloped) and post-project (i.e., developed) weighted runoff coefficients:

   $C_b = 0.20$
   $C_a = 0.95$

2. Compute the peak inflow rate:

   $q_i = C_a iA$
   $q_i = 0.95 \times 0.40 \times 1$
   $q_i = 0.38$ cu-ft

3. Compute the peak outflow rate:

   $q_o = C_b iA$
   $q_o = 0.20 \times 0.40 \times 1$
   $q_o = 0.08$ cu-ft

4. Calculate the estimated basin storage volume:

   $s = 3{,}630 \times PA[1 - (q_o/q_i)]$
   $s = 3{,}630 \times 1 \times 1 \times [1 - (0.08/0.38)]$
   $s = 2{,}866$ cu-ft

5. Select initial values for the detention basin total width (w_t), total length (l_t), depth (d), interior side slopes (z) and required freeboard (f):

   $w_t = 38$ ft
   $l_t = 53$ ft
   $d = 3.5$ ft
   $z = 3$ ft
   $f = 1$ ft

Calculate the basin bottom width and length:

$$w_b = w_t - 2z(d + f)$$
$$w_b = 38 - 2 \times 3 \times (3.5 + 1)$$
$$w_b = 11 \text{ ft}$$

$$l_b = l_t - 2z(d + f)$$
$$l_b = 53 - 2 \times 3 \times (3.5 + 1)$$
$$l_b = 26 \text{ ft}$$

6. Calculate the resulting storage volume using the prismoidal formula for trapezoidal basins:

$$V = w_b l_b d + (w_b + l_b) z d^2 + 4 z^2 d^3/3$$
$$l_t = 11 \times 26 \times 3.5 + (11 + 26) \times 3 \times 3.5^2 + 4 \times 3^2 \times 3.5^3/3$$
$$d = 2{,}875 \text{ cu-ft}$$

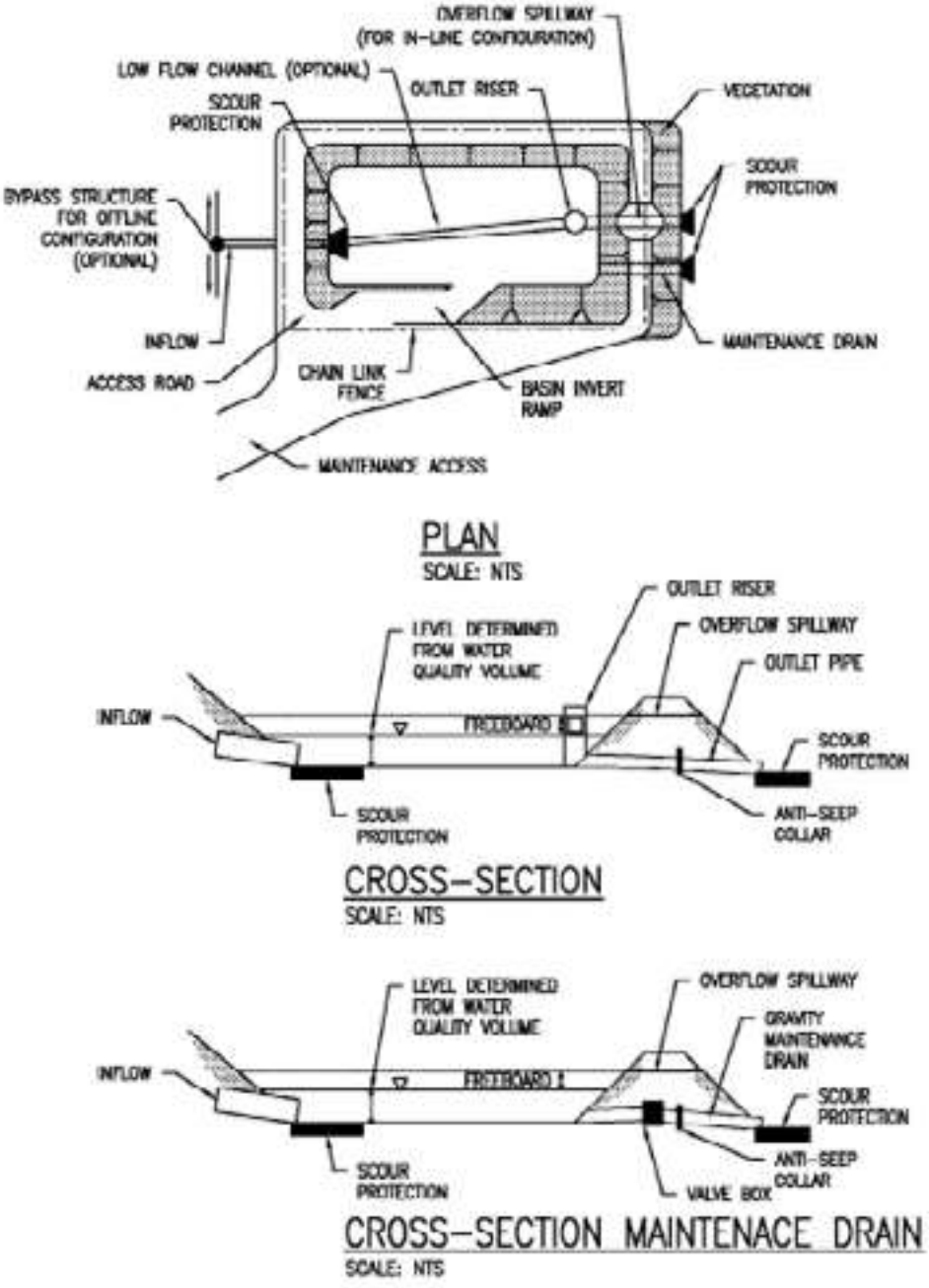
The calculated volume is greater than the required volume, so the preliminary design is acceptable.

Other Design Considerations

- Credit for infiltration may be given if the soils beneath the detention basin invert have a measured infiltration rate of at least 0.5 inches per hour and none of the infeasibility criteria for infiltration basins are applicable. However, low flow channels should not be included if infiltration is expected.
- If a temporarily-filled pond creates a potential public safety issue, perimeter fencing may be considered. Warning signs should be used wherever appropriate
- In order to meet designs storm requirements, detention basins should have a multistage outlet structure. Three elements are typically included in this design:
    1. A low-flow outlet that controls the extended detention and functions to slowly release the water quality design storm.
    2. A primary outlet that functions to attenuate the peak of larger design storms.
    3. An emergency overflow outlet/spillway
- Design methodology options are provided in manuals included in the References, including the Georgia Stormwater Management Manual, the Urban Storm Drainage Criteria Manual, and the USEPA Stormwater Best Management Practice Design Guide.

Construction/Inspection Considerations

- Inspect facility after first large storm to determine whether the desired residence time has been achieved.
- When constructed with small tributary area, orifice sizing is critical and inspection should verify that flow through additional openings such as bolt holes does not occur.



Schematic of a Detention Basin

TC-14: Manufactured Treatment Device



BMP Category	
Retention	○
Biofiltration	○
Other	●

O&M Requirements
Low to Medium

Expected Pollutant Removals
Varies based on System

Description

A manufactured treatment device is a proprietary water quality structure utilizing settling, filtration, adsorptive/absorptive materials, vortex separation, vegetative components, or other appropriate technology to remove pollutants from storm water runoff.

Minimum Design Criteria

Design Parameter	Units	Value
Minimum Total Suspended Solids water (TSS) Removal	Percent	80

Feasibility Criteria

Manufactured treatment devices are considered infeasible for any of the following conditions:

- Bottom of BMP is below seasonally high groundwater table.
- Unable to operate off-line and unable to operate in-line with safe overflow mechanism.
- Excavation would disturb iwi kupuna or other archaeological resources.

Sizing Procedure

Follow the manufacturer's guidelines for appropriate sizing calculations and selection of appropriate device/model.

Pretreatment Considerations

No pretreatment is required.

Area Requirements

The footprint requirements for proprietary manufactured treatment devices vary by manufacturer.

Sizing Example

No example is provided as sizing procedures vary by manufacturer, and presenting any specific product might be interpreted as an endorsement.

Other Design Considerations

- The device must provide a TSS removal rate of 80%, certified for general use by the Washington State Department of Ecology Technology Assessment Protocol (TAPE) or certified by the New Jersey Department of Environmental Planning (NJDEP).
- Systems not meeting the required TSS removal criteria can be used as pre-treatment for other BMPs.
- Although the device must meet TSS requirements, many manufactured treatment devices also treat other pollutants. The City recommends selecting devices capable of treating the potential pollutants at your site.
- All manufactured treatment devices must be able to safely overflow or bypass flows in excess of the storm water quality design storm to downstream drainage systems.

Construction/Inspection Considerations

Follow manufacturer's recommendations.

TC-15: Sand Filter



Portland Stormwater Management Manual, 2004.

BMP Category	
Retention	○
Biofiltration	○
Other	●

O&M Requirements
Medium

Expected Pollutant Removals			
Nutrients	Low/Med	Pesticides	Unknown
Sediment	High	Oil & Grease	High
Trash	High	Metals	Med/High
Pathogens	Medium	Organic Compounds	Med/High

Description

A sand filter is an open chambered structure that captures, temporarily stores, and treats storm water runoff by passing it through sand.

Minimum Design Criteria

Design Parameter	Units	Value
Sand Coefficient of Permeability	feet/day	3.5
Filter media depth	inches	18
Drawdown (drain) Time	hours	48
Maximum Interior Side Slope if earthen (length per unit height)		3:1
Minimum Underdrain Diameter	inches	6

Feasibility Criteria

Sand filters are considered infeasible for any of the following conditions:

- Bottom of BMP is below seasonally high groundwater table.
- Unable to operate off-line and unable to operate in-line with safe overflow mechanism.
- Excavation would disturb iwi kupuna or other archaeological resources.
- Site lacks sufficient hydraulic head to support BMP operation by gravity.

Sizing Procedure

Step 1. Use the procedure presented previously to compute the Volumetric Runoff Coefficient and WQV.

Step 2. Select values for the filter media depth (l_m) and maximum ponding depth (d_p).

Step 3. Use Darcy's Law to calculate the required Filter Bed Surface Area:

$$A_{fb} = (WQV \times l_m)/[\, k(l_m + d_p/24)(t/24)]$$

Where A_{fb} = Filter Bed Surface Area (sq-ft)
WQV = WQV from Step 1 (cu-ft)
l_m = Filter Media Depth from Step 2 (ft)
k = Filter Media Permeability Coefficient (ft/day)
d_p = Maximum Ponding Depth from Step 2 (in)
t = Filter Bed Drain Time (hr)

Step 4. Calculate the total area occupied by the BMP (A_{BMP}) using the embankment side slopes and assuming a square basin:

$$A_{BMP} = [\, \sqrt{(A_{fb})} + 2z(d_p/12 + f)\,]^2$$

Where A_{BMP} = Area Occupied by BMP (sq-ft)
A_{fb} = Filter Bed Surface Area from Step 3 (sq-ft)
z = Filter Bed Interior Side Slope (length per unit height)
d_p = Maximum Ponding Depth from Step 2 (in)
f = Freeboard (ft)

If the calculated area does not fit in the available space, either reduce the drainage area, increase the ponding depth, and/or increase the interior side slope (if it's not already set to the maximum) and repeat the calculations.

Pretreatment Considerations

Pretreatment is required for sand filters in order to reduce the sediment load entering the sand bed, prevent premature clogging, and ensure filter longevity. The pretreatment device must be sized for at least 25% of the WQV, and may be achieved with vegetated swales, vegetated filter strips, sedimentation basins or forebays, sedimentation manholes, and manufactured treatment devices. The typical method is a sedimentation basin that has a length to width ratio of 2:1, and is sized using the Camp-Hazen equation.

Area Requirements

A sand filter requires a footprint equivalent to 1.5% - 3% of its contributing impervious drainage area, excluding pretreatment. The lower value reflects minimum filter media and ponding depths, while the upper value reflects higher filter media and ponding depths.

Sizing Example

Calculate the size of a sand filter serving a 1-acre residential development. Assume the following design parameters:

Design Parameter	Units	Value
Percent Impervious Cover, I	percent	70
Design Storm Depth, P	inches	1.0
Sand Coefficient of Permeability, k	feet/day	3.5
Interior Side Slope (length per unit height)		3:1
Freeboard	feet	0.5
Drawdown (drain) Time, t	hours	48

1. Calculate the volumetric runoff coefficient and WQV:

   $C = 0.05 + 0.009I$
   $C = 0.05 + 0.009 \times 70$
   $C = 0.68$

   $WQV = PCA \times 3{,}630$
   $WQV = 1 \times 0.68 \times 1 \times 3{,}630$
   $WQV = 2{,}468$ cu-ft

2. Select a filter media depth (l_m) and maximum ponding depth (d_p):

   $l_m = 1.5$ ft
   $d_p = 24$ in

3. Calculate the Filter Bed Surface Area (A_{fb}):

   $A_{fb} = (WQV \times l_m)/[\ k(l_m + d_p/24)(t/24)]$
   $A_{fb} = (2{,}468 \times 1.5)/[3.5(1.5 + 24/24)(48/24)]$
   $A_{fb} = 212$ sq-ft

4. Calculate the total area occupied by the BMP (A_{BMP}):

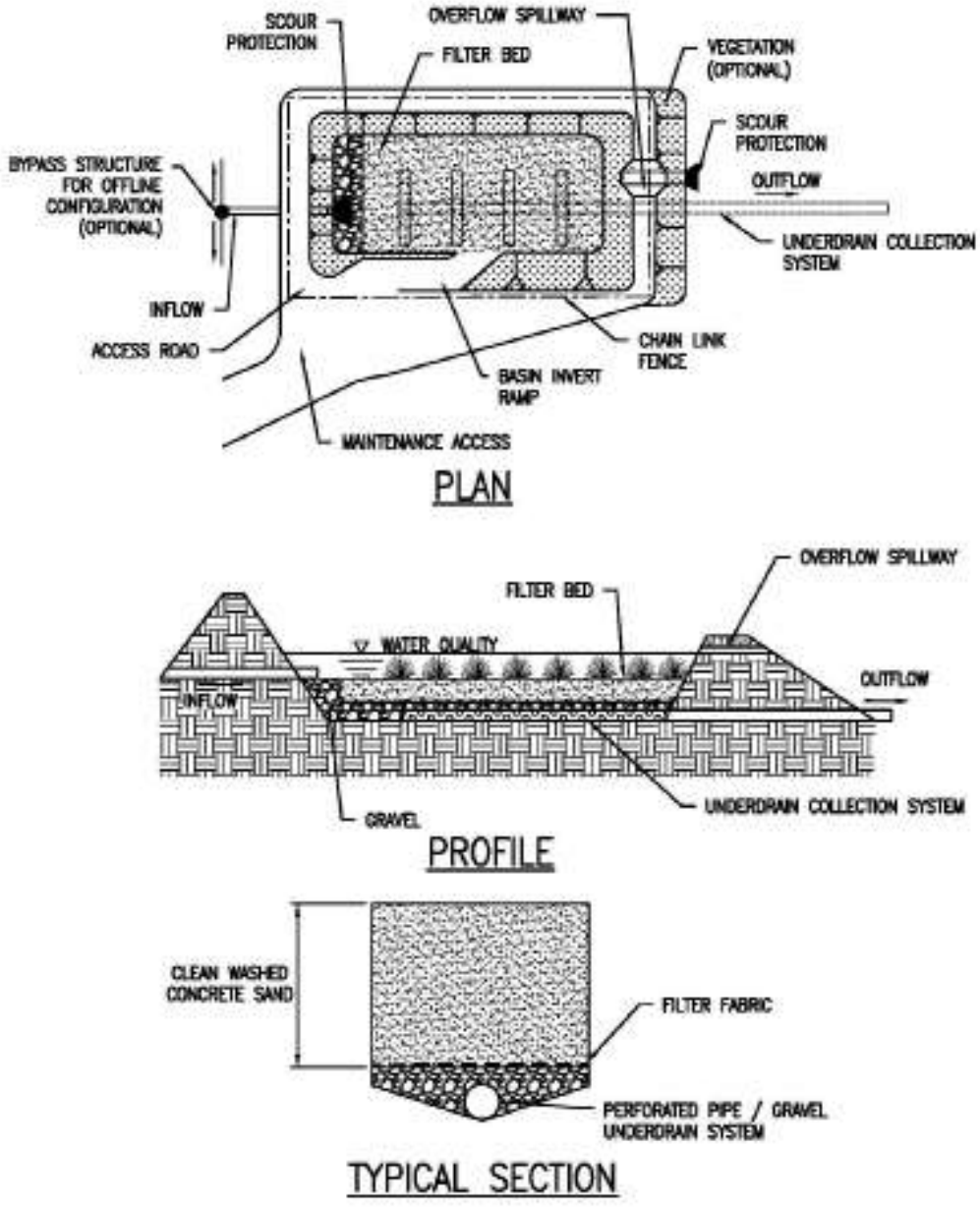
   $A_{BMP} = [\ \sqrt{(A_{fb})} + 2z(d_p/12 + f)\ ]^2$
   $A_{BMP} = [\ \sqrt{(212)} + 2 \times 3(24/12 + 0.5\ ]^2$
   $A_{BMP} = 873$ sq-ft

Other Design Considerations

- A flow spreader should be installed at the inlet along one side of the filter to evenly distribute incoming runoff across the filter and to prevent erosion of the filter device.
- A cleanout pipe should be tied into the end of all underdrain pipe runs.

Construction/Inspection Considerations

Tributary area should be completely stabilized before media is installed to prevent premature clogging.



Schematic of a Sand Filter

Appendix C: O&M Fact Sheets

This section describes minimum inspection and maintenance requirements for post-construction BMPs. Actually inspection and maintenance may be more frequent to ensure long-term performance of post-construction BMPs then what is suggested. Maintenance should be performed whenever needed, based on maintenance indicators presented in the fact sheets below.

The fact sheets have been grouped into the following categories based on common maintenance requirements:

- Bio-Retention Basin
- Detention Basin
- Green Roof
- Infiltration Trench/Basin
- Manufactured Treatment Device
- Pervious Pavement
- Rainwater Harvesting
- Sand Filter
- Vegetated Biofilter
- Vegetated Swale/Strip

This page is intentionally left blank.

OM-01: Bio-Retention Basin

● Bio-Retention Basin ● Rain Garden

This category includes BMPs that treat storm water by infiltrating it through vegetation and/or soil. Regular inspection and maintenance is needed to ensure flow is unobstructed, erosion is prevented, and soils are biologically active. General conditions when maintenance is needed and the associated maintenance action triggered by those conditions are provided below.

Monthly or as Needed After Storm Event

- Remove obstructions, debris and trash from bio-retention area and dispose of properly.
- Inspection bio-retention area for ponded water.
- Inspect inlets for channeling, soil exposure or other evidence of erosion. Clear obstructions and remove sediment.
- Inspect depth of mulch and replenish as necessary (2 inches per soil specifications).

Bi-Annually

- Maintain vegetation and irrigation system.
- Prune, weed and remove/replace any dead plants.

Annually

- Inspect energy dissipation at the inlet.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Standing Water	
Water stands in the bio-retention area between storms and does not drain within 24 hrs after rainfall.	Any of the following results could apply: sediment or trash blockages removed, improved grade from head to foot of bio-retention area, and drains per design specification.
Trash and Debris	
Trash and debris accumulated in the bio-retention area and around the inlet and outlet.	Trash and debris removed from the bio-retention area and disposed of properly.
Sediment	
Evidence of accumulated sediment in the basin. Visual evidence of dumping.	Material removed so that there is no clogging or blockage. Material is disposed of properly.
Erosion	
Channels have formed around inlets, there are areas of bare soil, or there is other evidence of erosion.	Obstructions and sediment removed so that water flows freely and disperses over a wide area. Obstructions and sediment are disposed of properly.
Vegetation	
Vegetation is dead, diseased or overgrown.	Vegetation is healthy and attractive. Grass is maintained at least 3 inches in height.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Mulch	
Mulch is missing or patchy. Areas of bare earth are exposed or mulch layer is less than 3 inches deep.	All bare earth is covered, except mulch is kept 6 inches away from trunks of trees and shrubs. Mulch is even at a depth of 3 inches.
Inlet/Outlet	
Sediment accumulations.	Inlet/outlet is clear of sediment and debris and allows water to flow freely.
Miscellaneous	
Any condition not covered above that needs attention for the bio-retention area to function as designed.	The design specifications are met.

OM-02: Detention Basin

● Detention Basin ● Constructed Wetlands ● Wet Ponds ● Wetlands

This category includes BMPs that are designed to treat storm water by allows pollutants to settle out and gradually release detained storm water through an orifice. Maintenance primarily consists of vegetation management, sediment removal, and mosquito abatement when there is standing water. General conditions when maintenance is needed and the associated maintenance action triggered by those conditions are provided below.

Monthly or as Needed After Storm Event

- Inspect for clogging and that it drains between storms per design specifications.
- Trim vegetation and inspect for woody vegetation.
- Inspect the level of sediment in the forebay.

Bi-Annually

- Evaluate the health of vegetation.
- Remove sediment, litter and debris.
- Inspect the outlet, embankment, dikes, berms, and side slopes for structural integrity and signs of erosion or rodent burrows.
- Inspect outlets and overflow structures for plugging and signs of erosion.
- Check inlets to ensure the piping is intact and not plugged.
- Inspect security measures around the facility.

Annually

- Harvest vegetation during dry periods.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Standing Water	
Water stands in the basin between storms and does not drain per design specifications.	Corrected any circumstances that restrict the flow of water from the system and drainage is restored to design condition.
Tree/Brush Growth, Woody Vegetation	
Growth does not allow maintenance access or interferes with maintenance activity, dead, diseased, or dying trees.	Trees do not hinder maintenance activities. Vegetation harvested annually, during dry periods.
Sediment	
Accumulated sediment >10% of design basin depth.	Sediment cleaned out to design shape and depth. Basin reseeded to control erosion, if needed. Sediment disposed of properly.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Erosion	
Erosion on compacted berm embankment. Rodent burrows on slope.	Cause of erosion is managed appropriately. Side slopes or berm restored to design specifications, as needed. Rodent burrows filled.
Inlet/Outlet	
Piping broken or inlet/outlet blocked.	Piping fixed. Debris/sediment removed and disposed of properly.
Fences/Security Measures	
Fences/security measures broken or missing.	Fences/security measures around facility are secure.
Miscellaneous	
Any condition not covered above that needs attention for the detention basin to function as designed.	The design specifications are met.

OM-03: Green Roof

● Green Roof

Green roofs are designed to reduce storm water runoff volume and improve water quality by intercepting, filtering, absorbing, retaining or detaining storm water. Green roofs consist of the following components: waterproof membrane, drainage layer, vegetated media and vegetation. Regular inspection and maintenance is needed to ensure water flows unimpeded through the green roof and vegetation is healthy. General conditions when maintenance is needed and the associated maintenance action triggered by those conditions are provided below.

Monthly or as Needed After Storm Event

- Inspect media for runoff or wind scouring/exposed underlayment components.
- Inspect for standing water.

Bi-Annually

- Inspect inlet outlet for litter and debris accumulation.
- Inspect vegetation. Prune, weed and remove/replace any dead plants.
- Replenish mulch.

Annually

- Inspect for exposure of liner.
- Inspect for roof leaks.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Standing Water	
Roof drainage system is clogged.	There should be no areas of standing water on the green roof. The drainage system is inspected for clogging conditions and repaired or replaced as needed.
Erosion	
Areas of scoured media or bare roof.	Green roof media stays in place and does not migrate across or erode from roof surface. Eroded media replaced and re-vegetated. If problem is recurrent, consider media more resistant to wind erosion or installing media retention components.
Leaky Roof	
Roof liner has failed.	Evaluate liner for cause of leaks. Repair or replace as necessary.
Miscellaneous	
Any condition not covered above that needs attention for the green roof to function as designed.	The design specifications are met.

This page is intentionally left blank.

OM-04: Infiltration Trench/Basin

● Dry Well ● Infiltration Basin ● Infiltration Trench

This category includes BMPs that are designed to detain storm water by storing it in the void spaces of the aggregate and then infiltrated into the underlying soil. Infiltration trenches/basins are prone to clogging and maintenance consists primarily of preventing sediment buildup and clogging. General conditions when maintenance is needed and the associated maintenance action triggered by those conditions are provided below.

Monthly or as Needed After Storm Event

- Remove obstructions, debris and trash from treatment device and perimeter.
- Check observation well 2 to 3 days after storm to confirm drainage.
- Mow and trim surrounding vegetation.
- Inspect inflow and outflow structures for erosion. Repair as needed.

Annually

- Monitor observation well to confirm that trench is draining properly.
- Inspect the trench for clogging and restore to design conditions, if needed.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Standing Water	
Water stands in the infiltration trench between storms and does not drain within 24 hrs after rainfall.	There should be no areas of standing water once inflow has ceased. Any of the following can apply: sediment or trash blockages removed, grade improved, or removed clogging at check dams.
Trash and Debris	
Trash and debris accumulated in the infiltration trench and around the inlet and outlet.	Trash and debris removed and disposed of properly.
Sediment	
Evidence of accumulated sediment in the infiltration trench.	Material removed so that there is no clogging or blockage. Material is disposed of properly.
Erosion	
Channels have formed around inlets, there are areas of bare soil, or there is other evidence of erosion.	Obstructions and sediment removed so that water flows freely and disperses over a wide area. Obstructions and sediment are disposed of properly.
Inlet/Outlet	
Sediment accumulations.	Inlet/outlet is clear of sediment and debris and allows water to flow freely.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Surface Materials	
Material is missing or patchy; areas of bare earth are exposed.	All bare earth is covered, except mulch is kept 6 inches away from trunks of trees and shrubs. Mulch is even at a depth of 3 inches.
Miscellaneous	
Any condition not covered above that needs attention for the infiltration trench to function as designed.	The design specifications are met.

OM-05: Manufactured Treatment Device

● Hydrodynamic/Vortex Separator
● Other Devices Approved by TAP or NJCAT with a TSS Removal Rate of 80 or more

This category includes manufactured treatment devices. Each BMP is designed differently to treatment storm water and has different maintenance needs. Please refer to the manufacture's requirements for maintenance for more detailed information on inspection and maintenance activities and frequencies. General conditions when maintenance is needed and the associated maintenance action triggered by those conditions are provided below.

Follow manufacture's requirement. Typical maintenance requirements may include:

- Inspect for clogging and standing water.
- Remove accumulated sediment, trash and debris.
- Replace media material, if applicable.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Standing Water	
When water stands over the manufactured treatment device between storms and does not drain per design specifications.	There should be no areas of standing water after inflow has ceased Filer drains per design specification. Any of the following could apply: sediment or trash blockage removed, mulch media replaced, and/or overflow pipe flushed/repaired in manner that does not cause an illegal discharge.
Sediment, Trash, and Debris Accumulation	
Sediment, trash and debris accumulated in the media material, vault, or piping.	Sediment, trash and debris removed and disposed of properly.
Mosquitoes	
Evidence of mosquito larvae in treatment unit.	No evidence of mosquito larvae.
Miscellaneous	
Any condition not covered above that needs attend in order for the manufactured treatment device to function as designed.	The design specifications are met.

This page is intentionally left blank.

OM-06: Pervious Pavement

● Pervious Concrete ● Porous Asphalt ● Interlocking Paver Blocks
● Reinforced Turf Grassing/Gravel Filled Grids

This category includes BMPs that are designed to treat storm water by detaining storm water in the void spaces and then infiltrated into the underlying soil. Pervious pavement is prone to clogging and maintenance consists primarily of preventing sediment buildup and clogging. General conditions when maintenance is needed and the associated maintenance action triggered by those conditions are provided below.

Quarterly or as Needed After Storm Event

- Check for sediment and debris accumulation. Prevent soil from washing or flowing onto the pavement. Do not store sand, soil, mulch or other landscaping materials on pervious pavement surfaces.
- Use commercially available regenerative air or vacuum sweeper to remove sediment and debris from the surface.
- Perform vacuum sweeping, power washing, and/or reconstruction to restore surface permeability as needed.
- Inspect for signs of pavement failure. Repair any surface deformations or broken pavers.
- Check for standing water on pavement within 30 minutes following a storm event.
- Inspect underdrain outlets. Remove trash and debris.
- Remove weeds. Mow vegetation in grid pavement (i.e., turf block) as needed.
- Replenish aggregate in joints or grids as needed.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Standing Water	
Water stands on the surface of the permeable pavement and 48 hrs has passed since the last rainfall.	There should be no areas of ponded/standing water more than 48 hrs after a rain event. Any of the following can apply: surface swept or vacuumed, underdrains added, underdrains flushed in manner that does not cause an illegal discharge.
Trash and Debris	
Leaves, grass clippings, trash, etc., are preventing water from draining into the permeable pavement and are unsightly.	Area is free of all debris and the permeable pavement is draining properly.
Vegetation	
Vegetation around the perimeter of the permeable pavement is dead, diseased, or overgrown. Weeds are growing on the surface of the permeable pavement.	Area adjacent to pavement is well-maintained and no bare/exposed areas exist; grass is maintained at a height of 3–6 inches. No weeds present in the pavement area.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Deteriorating Surface	
The pavement is cracked; paver blocks are misaligned or have settled.	The surface area is stabilized, exhibiting no signs of cracks or uneven areas in the pavement area.
Miscellaneous	
Any condition not covered above that needs attention for the pervious pavement to function as designed.	The design specifications are met.

OM-07: Rainwater Harvesting

● Cisterns ● Rain Barrels ● Vehicle Washing
● Other Non-Potable Water uses Approved by the Building Code

This category includes BMPs that are designed to store water a specific volume of water to use later for irrigation, non-potable water plumbing, vehicle washing, or other non-potable water uses. Maintenance is primarily focused on preventing sediment buildup and clogging, which reduces the capacity of the system. General conditions when maintenance is needed and the associated maintenance action triggered by those conditions are provided below.

Quarterly or as Needed After Storm Event

- Inspect, clean and replace filters and screens, as needed.
- Inspect and clean debris from roof, gutters, downspouts, first flush devices, roof washers, or other collection surfaces.
- Inspect for and repair leaks.
- If rainwater is used for indoor use, inspect and verify that treatment systems are operational and maintaining minimum water quality requirements as determined by DPP or DOH.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Sediment and Debris Accumulation	
Sediment or debris accumulated in filter, screens, gutters, downspouts, first flush device, or roof washers or on roof or other collection surfaces. Sediment accumulated in cisterns(s).	Sediment removed. Collection surfaces do not contribute sediment and debris.
Leaks	
Water leaking from system.	No leakage.
Water Quality	
Treatment system is not working properly.	Treatment system is operational and maintaining minimum water quality requirements.
First Flush Diverter	
First flush filter is full or clogged causing permanent flow to the cistern.	First flush is diverted away from the cistern when the first flush diverter valve is removed and cleaned.
Cistern does not Drain within 48 hours	
Outlet is clogged.	Cistern completely drains in less than 48 hrs.
Cistern Drain under 24 hours	
Cistern leaks or outlet allows excessive flows.	Cistern drains in 24 to 48 hrs.
Miscellaneous	
Any condition not covered above that needs attention for the pervious pavement to function as designed.	The design specifications are met.

This page is intentionally left blank.

OM-08: Sand Filter

● Sand Filter

Sand Filters are designed to treat storm water by removing pollutants as the storm water flows through the media. Regular inspection and maintenance is needed to prevent sediment buildup and clogging, which reduces pollutant removal efficiency. General conditions when maintenance is needed and the associated maintenance action triggered by those conditions are provided below.

Monthly or as Needed After Storm Event

- Inspect for standing water, sediment, trash and debris.
- Remove accumulated trash and debris in the unit during routine inspections.

Annually

- Inspect to ensure that the facility is draining completely within five days and per manufacturer's specifications.

Per Manufacturer's Specification

- Replace the media per manufacturer's inspection or as indicated by the condition of the unit.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Standing Water	
When water stands over the sand filter media between storms and does not drain within 24 hours after rainfall.	There should be no areas of standing water after inflow has ceased. Any of the following could apply: sediment or trash blockages removed, filter media surface scarified, media replaced underdrains flushed in manner that does not cause an illegal discharge.
Mosquitoes	
Evidence of mosquito larvae in treatment unit.	No evidence of mosquito larvae.
Sediment, Trash, and Debris Accumulation	
Sediment, trash and debris accumulated in the sand filter unit and around the inlet and outlet.	Sediment, trash, and debris removed so there is no clogging.
Erosion	
Channels have formed around inlets, there are areas of bare soil, or there is other evidence of erosion.	Obstructions and sediment removed so that water flows freely and disperses throughout the sand filter media. Obstructions and sediment are disposed of properly.
Inlet/Outlet	
Sediment accumulations.	Inlet/outlet is clear of sediment and debris and allows water to flow freely.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Miscellaneous	
Any condition not covered above that needs attention for the sand filter to function as designed.	The design specifications are met.

OM-09: Vegetated Biofilter

● Stormwater Curb Extension ● Tree Box Filter ● Planter Box

This category includes BMPs that are designed to detain and treat runoff without draining into the underlying soil. Maintenance is primarily focused on maintaining healthy vegetation, avoiding clogging and proper functioning of inlets, outlet and high-low bypass. General conditions when maintenance is needed and the associated maintenance action triggered by those conditions are provided below.

Monthly or as Needed After Storm Event

- Inspect bio-filter system, overflow pipe, inlets, and sheet flow areas for clogging and impediments to flow. Repair damaged pipes.
- Remove accumulated sediment, debris, sediment and repair damaged pipes.
- Inspect and repair/replace or replenish splash blocks or rocks, as needed.

Bi-Annually

- Inspect vegetation. Prune, weed and remove/replace any dead plants. Replenish mulch.
- Inspection irrigation system.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Standing Water	
Water stands in the vegetated biofilter between storms and does not drain within 24 hrs after rainfall.	There should be no areas of standing water after inflow has ceased. Any of the following could apply: sediment or trash blockages removed, mulch replaced, underdrains flushed in manner that does not cause an illegal discharge.
Trash and Debris	
Trash and debris accumulated in and around the inlet and outlet.	Trash and debris removed and disposed of properly.
Sediment	
Evidence of accumulated sediment.	Material removed so that there is no clogging or blockage. Material is disposed of properly.
Erosion	
Channels have formed around inlets, there are areas of bare soil, or there is other evidence of erosion.	Obstructions and sediment removed so that water flows freely and disperses over a wide area. Obstructions and sediment are disposed of properly.
Vegetation	
Vegetation is dead, diseased, or overgrown.	Vegetation is healthy and attractive. Grass is maintained at least 3 inches in height.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Mulch	
Mulch is missing or patchy. Areas of bare earth are exposed or mulch layer is less than 3 inches deep.	All bare earth is covered, except mulch is kept 6 inches away from trunks of trees and shrubs. Mulch is even at a depth of 3 inches.
Inlet/Outlet	
Sediment accumulations.	Inlet/outlet is clear of sediment and debris and allows water to flow freely.
Affected Impervious Areas of Structures	
Obvious effects on surrounding impervious areas or structures.	Hydraulic restriction layers prevent impacts from infiltration to surrounding structures.
Miscellaneous	
Any condition not covered above that needs attention for the vegetated bio-filter to function as designed.	The design specifications are met.

OM-10: Vegetated Swale/Strip

● Dry Swale ● Vegetated Buffer Strip ● Vegetated Swale

This category includes BMPs that are designed to provide to remove pollutants by physically straining and filtering water through vegetation or cobble within the swale/strip. Maintenance is primarily focused on maintaining healthy vegetation and avoiding clogging. General conditions when maintenance is needed and the associated maintenance action triggered by those conditions are provided below.

Monthly or as Needed After Storm Event

- Inspect swale/strip for ponding.
- Inspect inlets and sheet flow areas for impediments.
- Remove accumulated sediment, litter and debris.

Bi-Annually

- Inspect vegetation. Prune, mow, weed and remove/replace any dead plants.
- Replenish mulch.
- Inspection irrigation system.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Standing Water	
Water stands in the vegetated swale/strip between storms and does not drain within 24 hrs after rainfall.	There should be no areas of standing water once inflow has ceased. Any of the following could apply: improved grading or underdrains flushed in manner that does not cause an illegal discharge.
Sediment, Trash, and Debris Accumulation	
Sediment, trash and debris accumulated in the swale and around the inlet and outlet.	Material removed so that there is no clogging or blockage. Sediment deposits removed without significant disturbance of the vegetation.
Erosion	
Channels have formed around inlets, there are areas of bare soil, or there is other evidence of erosion.	No erosion or scouring evident. Damaged areas repaired with crushed gravel. Over time grass will start to cover over rock.
Vegetation	
Vegetation is dead, diseased, or overgrown.	Vegetation is healthy and attractive. Grass is maintained at least 3 inches in height.
Mulch (if used)	
Mulch is missing or patchy. Areas of bare earth are exposed or mulch layer is less than 3 inches deep.	All bare earth is covered, except mulch is kept 6 inches away from trunks of trees and shrubs. Mulch is even at a depth of 3 inches.
Inlet/Outlet	
Sediment or debris accumulations.	Inlet/outlet is clear of sediment and debris and allows water to flow freely.

Condition When Maintenance is Needed	Results When Maintenance is Performed
Flow Spreader (if applicable)	
Flow spreader uneven or clogged so that flows are not uniformly distributed through entire swale width.	Spreader leveled and cleaned such that flows are distributed evenly over the entire swale width.
Visual Contaminants and Pollution	
Visual evidence of oil, gasoline, contaminants, or other pollutants.	No visual evidence of contaminants or pollutants present.
Miscellaneous	
Any condition not covered above that needs attention for the vegetated swale/strip to function as designed.	The design specifications are met.

Appendix D

CCH Rules Relating to Water Quality

DEPARTMENT OF PLANNING AND PERMITTING
CITY AND COUNTY OF HONOLULU

ADOPT THE PROPOSED AMENDMENTS TO THE RULES RELATING TO WATER QUALITY (ADOPTED AUGUST 16, 2016, AMENDED JULY 14, 2017)

1) Amended the Rules Relating to Water Quality (Rules) to reflect minor corrections and clarifications, including revisions to the following Sections: §20-3-2 Purpose – added language to clarify the Rules also apply to projects that do not discharge into the City's MS4, §20-3-3 Definitions – added the terms Authorized Agent, Certified Erosion and Sediment Control Plan Preparer, Repair, and Routine Maintenance; and revised the terms Industrial Park, Development, Redevelopment, and Replacement of Impervious Surface; §20-3-4 Construction - Revised language to exempt an entity that is covered by a large MS4 NPDES permit to comply with a separate NPDES construction and post-construction runoff control program if approved by DPP; §20-3-14 Project Categories for Development - Revised the description of Category 1B and Category 2 projects; and added description and requirements for the new Minor Development Category; §20-3-16 Processing and Approval of Erosion and Sediment Control Plan – clarified regulated Development; §20-3-17 Requirements for Trenching Projects – revised; §20-3-18 Requirement for Category 1A Projects – revised; §20-3-19 Requirement for Category 1B Projects – revised; §20-3-20 Requirement for Category 1C Projects – revised; §20-3-21 Requirement for Category 2 Projects – revised; §20-3-22 Requirement for Category 3 Projects – revised; §20-3-23 Requirement for Category 4 Projects – revised; §20-3-24 Requirement for Category 5 Projects – revised; §20-3-28 Project Schedule – clarified method of notifying the City of the scheduled start date. §20-3-31 Permanent Stabilization – clarified requirements; §20-3-32 Diversion BMP – clarified requirements; §20-3-38 Sediment Barriers – clarified requirements; §20-3-45(4) Dust Control – omitted spray on chemical soil treatment; §20-3-48 Priority Projects – revised the term "Industrial Park", redefined Priority B2 projects, and added language to clarify exempted projects; §20-3-49 Post-Construction Storm Water Requirements – omitted vortex separator; §20-3-52 Storm Water Quality Checklists – revised O&M plan requirement for Priority B2 projects, §20-3-53 Operation And Maintenance (O&M) Plans – clarified O&M Plan requirement; §20-3-54 Post-Construction BMP Certification and Recording – clarified requirements for Priority B2; §20-3-54(b) Post-Construct BMP Certification and Recording – clarified requirements for regional Post Construction BMPs; §20-3-55 BMP Selection – added Retail Malls to the POC table; §20-3-56 Site Design Strategies & §20-3-58 Treatment Control BMP numerical sizing criteria – added Self Retaining Area and revised size criteria of the De Minimis area; §20-3-60 (g) Harvest/ Reuse - clarified method of storage volume calculation; §20-3-62 Alternative Compliance BMPs – revised description.

2) The templates in Appendices A, B, C, D, E, F, and G were reformatted and the contents were revised to be consistent with the proposed amendments listed above.

ADMINISTRATIVE RULES

TITLE 20

DEPARTMENT OF PLANNING AND PERMITTING

CHAPTER 3

RULES RELATING TO WATER QUALITY

SUBCHAPTER 1 GENERAL PROVISIONS AND REQUIREMENTS

§20-3-1 Short Title
§20-3-2 Purpose
§20-3-3 Definitions
§20-3-4 Construction
§20-3-5 Enforcement Authority
§20-3-6 Enforcement of Post-Construction Violations
§20-3-7 Responsible Parties
§20-3-8 Additional Standards

SUBCHAPTER 2 GENERAL REQUIREMENTS FOR DEVELOPMENT AND LAND DISTURBING ACTIVITIES

§20-3-9 Best Management Practices Required
§20-3-10 Minimum BMP Requirements
§20-3-11 Conditions of Approval
§20-3-12 BMP Use and Maintenance Required

SUBCHAPTER 3 PROJECT CATEGORIES AND CLASSIFICATIONS

§20-3-13 Projects
§20-3-14 Project Categories for Development

SUBCHAPTER 4 REQUIREMENTS FOR REGULATED PROJECTS AND ACTIVITIES DURING CONSTRUCTION

§20-3-15 Erosion and Sediment Control Plans for Development
§20-3-16 Processing and Approval of Erosion and Sediment Control Plans
§20-3-17 Requirements for Trenching Projects
§20-3-18 Requirements for Category 1A Projects

§20-3-19 Requirements for Category 1B Projects
§20-3-20 Requirements for Category 1C Projects
§20-3-21 Requirements for Category 2 Projects
§20-3-22 Requirements for Category 3 Projects
§20-3-23 Requirements for Category 4 Projects
§20-3-24 Requirements for Category 5 Projects
§20-3-25 Additional Requirements for Development
§20-3-26 BMP Inspections

SUBCHAPTER 5 BMPS, STANDARDS, AND SPECIFICATIONS FOR ACTIVITIES DURING CONSTRUCTION

§20-3-27 Project Planning and Design
§20-3-28 Project Scheduling
§20-3-29 Slope Management and Protection
§20-3-30 Temporary Stabilization
§20-3-31 Permanent Stabilization
§20-3-32 Diversion BMPs
§20-3-33 Preservation of Existing Vegetation
§20-3-34 Minimize Soil Compaction
§20-3-35 Velocity Dissipation Devices
§20-3-36 Perimeter Control
§20-3-37 Silt Fences
§20-3-38 Sediment Barriers
§20-3-39 Storm Drain Inlet Protection
§20-3-40 Vegetated Buffers
§20-3-41 Sediment Basins
§20-3-42 Sediment Traps
§20-3-43 Tracking Control
§20-3-44 Stabilized Construction Entrances and Exits
§20-3-45 Dust Control
§20-3-46 Good Housekeeping Practices
§20-3-47 Dewatering Operations

SUBCHAPTER 6 POST-CONSTRUCTION REQUIREMENTS

§20-3-48 Priority Projects
§20-3-49 Post-Construction Storm Water Requirements
§20-3-50 Storm Water Quality Strategic Plans
§20-3-51 Storm Water Quality Reports
§20-3-52 Storm Water Quality Checklists
§20-3-53 Operations and Maintenance Plans
§20-3-54 Post-Construction BMP Certification and Recording

SUBCHAPTER 7 BMPS, STANDARDS, AND SPECIFICATIONS FOR PERMANENT POST-CONSTRUCTION BMPS AND LOW IMPACT DEVELOPMENT

§20-3-55 BMP Selection
§20-3-56 Site Design Strategies
§20-3-57 Source Control BMPs
§20-3-58 Treatment Control BMPs Numeric Sizing Criteria
§20-3-59 Infiltration Testing
§20-3-60 Retention BMPs
§20-3-61 Biofiltration BMPs
§20-3-62 Alternative Compliance BMPs
§20-3-63 Feasibility Criteria

SUBCHAPTER 8 VARIANCES

§20-3-64 Variances

SUBCHAPTER 9 VIOLATIONS AND ENFORCEMENT

§20-3-65 BMP Deficiencies
§20-3-66 Enforcement
§20-3-67 Penalties

SUBCHAPTER 10 APPEALS

§20-3-68 Appeals
§20-3-69 Computation of Time
§20-3-70 Mandatory Filing Deadline
§20-3-71 Representation in Contested Case Hearings
§20-3-72 Prehearing Procedure
§20-3-73 Intervention
§20-3-74 Withdrawal of Petition
§20-3-75 Contested Case Hearing
§20-3-76 Decision and Order
§20-3-77 Judicial Remand

SUBCHAPTER 1
GENERAL PROVISIONS AND REQUIREMENTS

§20-3-1 Short Title
§20-3-2 Purpose
§20-3-3 Definitions
§20-3-4 Construction
§20-3-5 Enforcement Authority
§20-3-6 Enforcement of Post-Construction Violations
§20-3-7 Responsible Parties
§20-3-8 Additional Standards

§20-3-1 Short Title. This document and its provisions, inclusive of any additions and/or amendments hereto, shall be known as the *Rules Relating to Water Quality* and may from time to time be referred to herein as the "Rules."

[Eff August 16, 2017] (Auth: ROH §§ 1-9.1, 14-12.1 et. seq., ROH § 14-13.1 et. seq., ROH § 14-16.1 et. seq.) (Imp: ROH § 14-12.1 et. seq.).

§20-3-2 Purpose. The Rules Relating to Water Quality are adopted to further the City and County of Honolulu's compliance with, and, performance of duties under Article XI, Section 1 of the Hawaii State Constitution, Hawaii Revised Statutes Chapters 180C and 342D, Chapter 14 of the Revised Ordinances of Honolulu 1990 (*as amended*), and the City and County of Honolulu's National Pollutant Discharge Elimination System Permit, NPDES Permit No. HI S000002, 2015 (*as amended*).

The Rules Relating to Water Quality apply to all Development and Land Disturbing Activities within the City and County of Honolulu and establish minimum requirements for the selection, design, implementation and maintenance of best management practices ("BMPs") to protect the MS4 and Receiving Waters from Pollutants that are associated with land disturbance, surface hardening, and land use activities. The pollutants of concern ("POC") addressed by these Rules include, but are not limited to, sediment, nutrients, trash, pathogens, pesticides, oil, grease, hazardous waste, toxic waste, metals, and organic compounds.

The standards and requirements established by these Rules are not a maximum limit to the design requirements for BMPs. Compliance with the minimum requirements and standards established by these Rules does not guarantee that selected BMPs will meet their pollution control and/or drainage objectives. Land owners, design professionals, developers, and contractors are encouraged to implement BMPs that go beyond that requirements of these Rules and seek the advice of other agencies that are responsible for water quality, pollution control, Receiving Waters, water rights, flood plains, and storm water.

Compliance with these rules does not excuse violations of State or Federal law, City Ordinances, or permits issued by Department of Planning and Permitting or other permitting authorities. These Rules shall not be limited to only those areas that drain to the City's drainage facilities or those natural drainage ways that the City has ownership and/or responsibility for.

[Eff December 24, 2018] (Auth: ROH §§ 1-9.1, 14-12.1 et. seq., ROH § 14-13.1 et. seq. , ROH §

14-16.1 et. seq.) (Imp: ROH § 14-12.1 et. seq).

§20-3-3 Definitions. As used in this Chapter, unless the context clearly requires otherwise:

"Action of the Director" or "Director's Action" means a written decision by the Director of Planning and Permitting or his authorized agent regarding an application submitted to the Department pursuant to Chapter 14 of the Revised Ordinances of Honolulu or the Rules Relating to Water Quality.

"Architect" means an Architect licensed in the State of Hawai'i.

"Authorized Agent" means a person authorized in writing by the owner of the property to sign for erosion and sediment control requirements on their behalf including Erosion and Sediment Control Plans, designation of the Erosion and Sediment Control Plan Coordinator.

"Best Management Practices" or "BMPs" means schedules of activities, prohibitions of practices, maintenance procedures, management practices, treatments, and temporary or permanent Structures or devices that are intended and designed to eliminate and Minimize the Discharge of Pollutants, directly or indirectly, to Receiving Waters, to the maximum extent practicable.

"Biofiltration" means a pollution control technique that uses living material to capture, and absorb or biologically degrade Pollutants.

"Bonded Fiber Matrix" means a matrix consisting of strands of continuous, elongated wood fibers combined with a stabilizing emulsion and water. Bonded fiber matrix must be 100 percent biodegradable, mixed with water in a hydraulic mulcher, and applied as liquid slurry.

"Certified Erosion and Sediment Control Plan Preparer" or "CESCPP" means a Civil Engineer licensed in the State of Hawaii who has a current Erosion and Sediment Control Plan Preparer Certificate from the Department.

"Certified Water Pollution Plan Preparer" or "CWPPP" means an Architect, Engineer, Land Surveyor, or Landscape Architect licensed in the State of Hawaii who has a current Water Pollution Plan Preparer Certificate from the Department.

"City" means the City and County of Honolulu.

"Contested case" means a proceeding in which the legal rights, duties, or privileges of specific parties are required by law to be determined after a hearing before the Department.

"Days" means calendar days, including weekends and holidays, unless otherwise indicated.

"Department" or "DPP" means the City and County of Honolulu Department of Planning and Permitting.

"Department of Health" or "DOH" means the State of Hawai'i Department of Health.

"Design Engineer" means a licensed Civil Engineer in the State of Hawaii who stamps or certifies plans that are submitted to the Department for review and approval.

"Developer" means the owner of Real property subject to Development and includes any person that causes, contributes to, or participates in the actions necessary to accomplish Development.

"Development" means the sum of any and all actions that are undertaken to alter the natural or existing condition of Real property or improvements on Real property if a building, electric, grading, grubbing, plumbing, stockpiling or trenching permit is required for the Project. Development does not include the installation of signs and traffic control devices, emergency

work necessary to repair surfaces that are in immediate need of stabilization, and the marking of improved surfaces with striping or signage. "Director" means the director of the City and County of Honolulu Department of Planning and Permitting or the Director's authorized agent or representative.

"Discharge" means the deposit, disposal, injection, dumping, spilling, leaking, tracking or placing of any substance into the MS4 or Receiving Waters, directly or indirectly, and includes allowing the foregoing to occur.

"Disturbed Area" means any and all portions of Project Site affected by Land Disturbing Activities. Disturbed Areas include, but are not limited to, soils and surface areas affected by excavation, areas that are graded, grubbed, or cleared by uprooting vegetation, areas affected by the demolition of foundations, areas used for equipment staging and materials storage, and areas affected by heavy pedestrian or vehicular traffic that disrupts ground covers or surface soil conditions.

"Engineer" means an Engineer licensed in the State of Hawai'i.

"Erosion and Sediment Control Plan" or "ESCP" means a plan prepared to prevent and control erosion and sediment Discharges from a construction Site. ESCPs also include good housekeeping BMPs to limit or reduce other Pollutants associated with construction activities.

"ESCP Coordinator" means the designee responsible for the implementation of an ESCP who has a current ESCP coordinator certificate from the Department. The designation of an ESCP Coordinator does not relieve the property owner or other responsible parties from compliance with these Rules or liability for violations of the same.

"Erosion Control" means practices and devices that are intended and designed to prevent wind and water erosion, water pollution, soil loss, and Pollutant Discharges to the MS4 and Receiving Water. Erosion Control may be achieved, among other things, by the appropriate and effective use of BMPs to address energy and/or velocity dissipation, slope and surface stabilization, and the creation of physical barriers that separate erodible soils from factors that cause or contribute to erosion. Erosion control BMPs include, but are not limited to: Rolled Erosion Control Products, fiber matrix devices, mulching, hydroseeding, and the preservation of existing vegetation.

"Erosion Control Blankets" means biodegradable or photodegradable blankets that are designed to Minimize and/or prevent erosion.

"Evapotranspiration" means the loss of water from soil by evaporation and vegetative transpiration.

"Excavation" or "cut" means any act by which earth material is dug into or moved, and shall include conditions resulting therefrom.

"Final action" means placing an Action of the Director in the U.S. mail for delivery to a person.

"Geotextiles" or "Geotextile Mats" means woven non-biodegradable polypropylene fabric designed for use on Disturbed Areas where high strength materials are needed to endure abrasive forces through the life of a Project. Geotextiles can be used for drainage control and slope stabilization.

"Grading" means any excavation or fill, or combination thereof.

"Grubbing" means the uprooting of vegetation, including trees, shrubbery, and plant life from the surface of the ground.

"Hearings officer" means a person appointed by the Director to preside over a Contested case hearing.

"Hydraulic Matrix" means a matrix consisting of stabilizing emulsion combined with wood fiber, paper fiber, and water.

"Impervious Surface" means a surface covering or pavement of a developed parcel of land that prevents the land's natural ability to absorb and infiltrate rainfall/ storm water. Impervious surfaces include, but are not limited to rooftops, walkways, patios, driveways, parking lots, storage areas, impervious concrete and asphalt, and any other continuous watertight pavement or covering.

"Improvement" means any structure or work on Real property that increases the usefulness or value of the realty.

"Industrial facility" means an area of land used or zoned for industrial use as set forth under the City and County of Honolulu Land Use Ordinance, ROH Chapter 21.

"Infeasible" means not technologically possible, or, cost prohibitive and not achievable in light of best industry practices.

"Infiltration" means practices which capture and temporarily store a design storm volume of water before allowing it to infiltrate into the soil.

"Land Disturbing Activity" or "Land Disturbance" means any action, activity, or land use that alters the integrity, structure, texture, density, permeability, contents, or stress conditions of soil or ground surfaces if a building, electric, grading, grubbing, plumbing, stockpiling or trenching permit is required for the Project. Land disturbing activities include, but are not limited to actions that result in the turning, penetration, or moving of soil, the resurfacing of pavement that involves the exposure of the base course or subsurface soils, and the use of portions of a Project Site as staging areas or base yards.

"Low Impact Development" or "LID" means systems and practices that use or mimic natural processes that result in the Infiltration, evapotranspiration or use storm water in order to protect water quality and the aquatic habitat. At both site and regional scales, LID aims to preserve, restore, and create green space using soils, vegetation, and rain harvest techniques.

"Maximum Extent Practicable" or "MEP" means economically achievable measures that prevent or reduce the addition of Pollutants to the environment to the greatest degree achievable through the application of the best available pollution control practices, technologies, processes, siting criteria, operating methods and other alternatives.

"Minimize" means to reduce and/or eliminate to the extent achievable using BMPs and storm water controls that are technologically available and economically practicable and achievable in light of the best industry practices.

"Minor Development" means Development that requires a trenching, building, grading, grubbing or stockpiling permit where the total Project scope is limited to the activities listed in §20-3-14(i).

"Municipal Separate Storm Sewer System" or "MS4" means the City's drainage infrastructure that is designed or intended to collect and convey storm water and includes, but is not limited to, City roads with drainage improvements, City streets, catch basins, curbs, gutters, ditches, man-made channels, and storm drains.

"National Pollutant Discharge Elimination System permit" or "NPDES permit" means the permit issued to the City pursuant to *Title 40, Code of Federal Regulations, Part 122,* Subpart B, Section 122.26(a) (1) (iii), for storm water Discharge from the City's separate storm sewer systems; or the permit issued to a person or property owner for a storm water Discharge associated with industrial activity pursuant to *Title 40, Code of Federal Regulations, Part 122*, Subpart B, Section 122.26(a) (1) (ii), or other applicable section of Part 122; or the permit issued

to a person or property owner for the Discharge of any Pollutant from a point source into the State Waters through the City's separate storm sewer system pursuant to *Hawaii Administrative Rules*, Chapter 11-55, "Water Pollution Control".

"Netting" means plastic or geotextile netting that is biodegradable or photodegradable and designed to secure loose mulches to the ground.

"Permanent BMP" or "Post-Construction BMP" means a BMP that will remain on site after the completion of a Project in order to prevent or reduce the Discharge of Pollutants to the MS4 and/or Receiving Waters.

"Person" means an individual, association, partnership, corporation, municipality, State or Federal agency, or an officer, agent or employee thereof. Person also includes trusts, estates, associations, groups of individuals and legal entities. Where person refers to a corporation, association, or other legal entity that has directors or corporate officers, person shall also refer to the individual directors or corporate officers that authorize, allow, or direct actions governed by these rules.

"Plastic Sheeting" means covers comprised of plastic that are impervious, non-biodegradable, and designed for short-term drainage control, slope stabilization, or stockpile and/or materials management.

"Pollutant" means any dredge, spoil, solid refuse, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical waste, biological materials, radioactive materials, heat, wrecked or dismantled equipment, rock, sand, soil, sediment, dirt, industrial, municipal, or agricultural waste and substances of similar nature.

"Project" means all planned or intended Development, Land Disturbing Activities, construction activities, and Improvements to Real property and includes any unplanned construction, Developments, and/or Improvements that occur on Site.

"Real property" means realty, real estate, or land and includes all Structures and Improvements upon the same.

"Receiving Waters" or "State Waters" means all waters, fresh, brackish, or salt, around and within the State of Hawai'i, including but not limited to coastal waters, streams, rivers, ponds, estuaries, reservoirs, canals, ground waters, and lakes. Waters in drainage ditches, drainage ponds, and drainage reservoirs required as part of a water pollution control system are excluded.

"Redevelopment" means the creation, addition, and/or Replacement of Impervious Surface on improved Real property. Redevelopment also includes changes in land use that may result in increased Pollutant Discharges to the MS4 or Receiving Waters. Redevelopment does not include Minor Development as described in §20-3-14(i).

"Repair" means activities to mend, fix, or restore existing Improvements on Real property to an acceptable operating or useable condition after damage has occurred.

"Replacement of Impervious Surface" includes any activity that is not part of Routine Maintenance and Repair and where impervious materials are removed, exposing underlying soil or base course during construction.

"Routine Maintenance" means activities performed for the regular upkeep of existing Improvements to Real property including recurring, preventative and on-going maintenance necessary to delay or prevent the failure of existing Improvements.

"Retail Mall" or "Commercial mall" means one or more buildings that house or form a complex of retail stores with interconnecting walkways. Retail and Commercial malls include, but are not limited to, mini-malls, strip malls, retail complexes, and enclosed shopping malls or

shopping centers.

"Rolled Erosion Control Products" means geotextiles, Plastic Sheeting, Erosion Control blankets, Netting, and mats used to protect disturbed soil areas from erosion by water and wind. Rolled Erosion Control products can be used as stand-alone soil stabilization BMPs, in conjunction with re-vegetation, or to reinforce mulch.

"Sediment Control" means practices and devices that are intended and designed to prevent soils on a Project Site from being transported to the MS4 and Receiving Waters. Sediment Control may be achieved, among other things, by the appropriate and effective use of silt fences, fiber rolls, gravel bags, drain inlet protection devices, and dewatering filtration.

"Self-Mitigating Area" means a natural or landscaped area, including green roofs, which retains and/or treats rainfall within its perimeter without accepting runoff from other areas. Self-Mitigating Areas must retain all collected storm water or drain directly to the MS4.

"Site" means the Real property on which Development, construction, or other Land Disturbing Activities occur and/or are intended to occur.

"Site Design Strategies" means LID design techniques that are intended to maintain or restore the Site's hydrologic and hydraulic functions with the intent of minimizing runoff volume and preserving existing flow paths.

"Source Control BMPs" means BMPs that are designed to prevent Pollutants from contacting storm water runoff and prevent their Discharge into the MS4 or Receiving Waters.

"Structure" means a building, improvement on Real property, or arrangement of items on property that has or requires a fixed location on the ground.

"Temporary BMPs" means BMPs that will discontinue or be removed from the Site after construction or land disturbing activities are complete.

"Treatment Control BMPs" means engineered technologies designed to remove Pollutants from storm water runoff prior to Discharge to the storm drain system or Receiving Waters.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2).

§20-3-4 Construction. In the interpretation and application of these Rules, the following shall be observed unless it is apparent from the context of the Rules that a different construction is intended:

(a) General Rule. All words and phrases shall be construed and understood according to the common and approved usage of the language, but technical words and phrases that have acquired a peculiar and appropriate meaning in the law shall be construed and understood according to such peculiar and appropriate meaning.

(b) Construction of Ambiguous Words. Where the words are ambiguous:

(1) The meaning of the ambiguous words may be sought by examining the context, with which the ambiguous words, phrases, and sentences may be compared, in order to ascertain their true meaning.

(2) The reason and spirit of the rule and the cause which induced enactment or promulgation of the rule may be considered to discover its true meaning.

(3) Every construction which leads to an absurdity shall be rejected.

(c) Rules in pari materia. Rules in pari materia, or upon the same subject matter, shall

be construed with reference to each other. What is clear in one ordinance may be called in aid to explain what is doubtful in another.

(d) Number and Gender. Words in the masculine gender signify both the masculine and feminine gender, those in the singular or plural number signify both the singular and plural number, and words importing adults include youths or children.

(e) Tenses. Every word used in the present tense shall include the future.

(f) Acts by Subordinate Officer. When any provision herein requires an act to be done, which may by law as well be done by a subordinate officer as by the superior officer, such requirement shall be construed to include all such acts when done by an authorized subordinate officer.

(g) Rules Not Retrospective. No rule or regulation herein has any retrospective operation, unless otherwise expressed or obviously intended.

(h) Persons Subject to Rules and Regulations. The Rules and regulations are obligatory upon all persons within the jurisdiction of the City. Entities who hold a Large MS4 NPDES Permit may request an exemption from these Rules to comply with a NPDES construction and post-construction runoff control program approved by DOH. The exemption must be approved by the Director prior to the approval of any permit issued by the Department.

(i) Effect of Prohibitory Rules. Whatever is done in contravention of a prohibitory Rule is void, although the nullity be not formally directed.

(j) References Apply to Amendments. Whenever reference is made to any portion of the Revised Ordinances of Honolulu, any permit issued to the City, or of any other law, the reference applies to all amendments thereto.

(k) References Inclusive. Whenever reference is made to a series of sections in the Revised Ordinances of Honolulu by citing only the numbers of the first and last sections connected by the word "to," the reference includes both the first and last sections.

(l) Effect of Rules. In requirements of these Rules are to be regarded as minimum requirements for the protection of the public health, safety, and welfare.

(m) Use of capitalized terms. Defined words and phrases have been capitalized in the body of these Rules to ensure that the reader is aware of the intended use and meaning of defined words and phrases. The failure to capitalize any defined term or phrase does indicate an intention to apply a meaning or definition to a defined word or phrase other than that provided in §20-3-3 of these Rules. All defined terms and phrases shall be construed in accordance with their defined meanings unless such construction will necessarily lead to an absurd result.

(n) Conflicts with Other Laws or Standards. If other laws, ordinances, rules or regulations cover the same subject as these Rules, conflicts shall be resolved by applying the stricter standard as between conflicting authorities.

(o) No abrogation. These Rules shall not abrogate or annul any permits or approved drainage reports, construction plans, easements, or covenants issued or approved by the Director before the effective date of the Rules unless the permit or approved construction plans is expired. Approved construction plans expire two years after the Director's approval.

(p) Appendices. Appendices to the Rules may be amended by the Director without a public hearing. All current appendices to the Rules shall be available on the Department website.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2).

§20-3-5 Enforcement Authority. Except as otherwise specified in these Rules, the Director shall be responsible for the administration and enforcement of the requirements and regulations contained in these Rules.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-6 Enforcement of Post-Construction Violations. Violations involving the failure to effectively prevent Pollutant Discharges to the MS4 or Receiving Waters and violations involving the failure to properly inspect, document, implement, monitor, use, or maintain Permanent BMPs may be enforced by the Director of the Department of Facility Maintenance.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-7 Responsible Parties. The owner of Real property located within the City and County of Honolulu is absolutely responsible for compliance with these Rules and shall be held liable for any violations occurring on, or, arising from, their property. In addition, the Director may hold any person that causes, contributes to, or fails to prevent a violation of these Rules responsible for the violation and any penalties for the same. Where more than one person is deemed responsible for a violation, the Director may cite and penalize each responsible person separately or hold one or more responsible parties jointly and severally responsible for the violation and penalty.

[Eff December 24, 2018] (Auth: ROH §§ 1-9.1, 14-12.1 et. seq., ROH § 14-13.1 et. seq. , ROH § 14-16.1 et. seq.) (Imp: ROH § 14-12.1 et. seq).

§20-3-8 Additional Standards. The reader is advised to review the documents listed below for informational purposes:

(a) City and County of Honolulu, Storm Water Best Management Practices Manual, Construction, 2011 (as amended);

(b) City and County of Honolulu, Storm Water BMP Guide, 2012 (as amended);

(c) City and County of Honolulu, Storm Water Management Program Plan, 2016 (as amended);

(d) Hawaii Administrative Rules, Title 11, Chapter 54, Water Quality Standards, 2014 (as amended); and

(e) Hawaii Administrative Rules, Title 11, Chapter 55, Water Pollution Control, 2014 (as amended).

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2).

SUBCHAPTER 2
GENERAL REQUIREMENTS FOR DEVELOPMENT AND LAND DISTURBING ACTIVITIES

§20-3-9 Best Management Practices Required
§20-3-10 Minimum BMP Requirements
§20-3-11 Conditions of Approval
§20-3-12 BMP Use and Maintenance Required

§20-3-9 Best Management Practices Required. All persons who engage in Development or Land Disturbing Activities shall install, implement, and maintain appropriate BMPs to prevent the Discharge of Pollutants to the MS4 and Receiving Waters.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§1-9.1, 14-12.31, 18-4.1) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-10 Minimum BMP Requirements. BMPs for all Development and Land Disturbing Activities must effectively prevent the Discharge of the following to the MS4 and Receiving Waters:

(a) Material that will settle to form objectionable sludge or bottom deposits;

(b) Floating debris, oil, grease, scum or particulates;

(c) Substances in amounts sufficient to produce taste in the water or detectable flavor in the flesh of aquatic life, or in amounts sufficient to produce objectionable color, turbidity, or other conditions in Receiving Waters;

(d) High or low temperatures; biocides, pathogenic organisms, toxic, radioactive, corrosive, or other deleterious substances at levels or in combinations sufficient to be toxic or harmful to human, animal, or plant life, or in amounts to interfere with the beneficial uses of water;

(e) Substances or conditions or combinations thereof in concentrations that produce undesirable aquatic life;

(f) Soil particles resulting from erosion on land involved in earthwork, such as the construction of public works, highways, subdivisions, recreational, commercial, or industrial Developments, or the cultivation and management of agricultural lands; and

(g) Discharges that cause or contribute to a violation of Chapter 11-54 of the Hawaii Administrative Rules.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§1-9.1, 14-12.31, 18-4.1) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-11 Conditions of Approval. The Director may condition the approval of any permit issued by the Department on the implementation and maintenance of temporary or permanent BMPs to address the following to the Maximum Extent Practicable:

(a) Erosion Control;

(b) Run-on Control;
(c) Run-off Control;
(d) Sediment Control;
(e) Pollution Control;
(f) Post-Construction Pollutant Control;
(g) Low Impact Development objectives; and
(h) Water treatment and/or remediation.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§1-9.1, 14-12.31, 18-4.1) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-12 BMP Use and Maintenance Required. (a) All BMPs must be designed, used, and maintained in compliance with the standards and specifications set forth in these rules at all times. Where these Rules do not provide standards and specifications for a BMP, the BMP must be installed and maintained in compliance with the manufacturer's specifications, which must be kept onsite and immediately made available for inspection upon request by the Director. If BMPs fail, notwithstanding their intent or design, the BMPs shall be modified or upgraded to prevent any further failure in the same or similar circumstances.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§1-9.1, 14-12.31, 18-4.1) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

SUBCHAPTER 3
PROJECT CATEGORIES AND CLASSIFICATIONS

§20-3-13 Projects
§20-3-14 Project Categories for Development

§20-3-13 Projects. (a) A Project is the sum of all Development and Land Disturbing Activities that are planned or conducted on a Project Site. Individual actions, Project phases, and incremental improvements to Real property shall be construed as a single Project where:

(1) The Development and any associated Land Disturbing Activities are phases or increments of a larger total Project or undertaking;
(2) The Development and any associated Land Disturbing Activities are a necessary precedent for a larger total Project or undertaking;
(3) The Development and any associated Land Disturbing Activities represent a commitment to a larger Project or undertaking; or
(4) The combined effects of Development and Land Disturbing Activities on adjoining lots cannot be adequately addressed by separate BMP planning and/or implementation.

(b) All Development shall be categorized as a Trenching Project, Category 1A, Category 1B, Category 1C, Category 2, Category 3, Category 4, Category 5 Project, or as Minor Development.

(c) Where Development qualifies a Project for placement in more than one Project category, the higher Project category shall apply to that Project unless it meets the criteria to be categorized as Minor Development.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-14 Project Categories for Development. (a) Trenching Projects. Development that requires a trenching permit for excavation work in the City owned or City maintained roads and thoroughfare but does not require a building, grading, grubbing, or stockpiling permit.

(b) Category 1A Projects. Development that requires a building permit but does not require a grading, grubbing, or stockpiling permit shall be classified as a Category 1A Project if it meets all of the following criteria:

(1) The Development is for single-family or two-family dwellings;
(2) The total Disturbed Area for the Project is less than 1,000 square feet; and
(3) Land Disturbing Activities will not occur on slopes equal to or greater than 15 percent at the Site.

(c) Category 1B Projects. The following shall be classified as a Category 1B:

(1) Development with less than one acre of Disturbed Area that requires a building permit, which does not meet the Category 1A Project criteria, and does not require a grading, grubbing, or stockpiling permit; or
(2) Development of the zoning lot or portion thereof subject to the permit is less than 15,000 square feet for single-family or two-family dwelling uses and less than 7,500 square feet for other uses that requires a building permit and a grading or stockpiling permit.

(d) Category 1C Projects. Development that requires a building permit but is not required to obtain a grading, grubbing, or stockpiling permit shall be classified as a Category 1C Project if it involves a Disturbed Area of one acre or more or requires a NPDES General/ Individual Permit Authorizing Discharges of Storm Water Associated with Construction Activity, issued by the DOH.

(e) Category 2 Projects. Development requiring a grading or stockpiling permit but does not require a building permit shall be classified as a Category 2 Project if the area of the zoning lot or portion thereof subject to the permit is less than 15,000 square feet for single-family or two-family dwelling uses and less than 7,500 square feet for other uses.

(f) Category 3 Projects. Development requiring a grading, grubbing, or stockpiling permit shall be classified as a Category 3 Project if the area of the zoning lot or portion thereof subject to the permit is 15,000 square feet or more for single-family or two-family dwelling uses, or 7,500 square feet or more for other uses, but where the total area graded or stockpiled upon is less than 15,000 square feet for single-family or two-family dwellings uses and less than 7,500 square feet for other uses.

(g) Category 4 Projects. Development requiring a grading, grubbing, or stockpiling permit shall be classified as a Category 4 Project if the total area including any areas developed incrementally that is to be graded, grubbed, or stockpiled upon is 15,000 square feet or more for single-family or two-family dwelling uses, or 7,500 square feet or more for other uses, or in the

event a proposed cut or fill is greater than 15 feet in height for single-family or two-family dwelling uses, or 7.5 feet in height for other uses.

(h) Category 5 Projects. Development requiring a grading, grubbing, or stockpiling permit shall be classified as a Category 5 Project if it involves a Disturbed Area of one acre or more and which requires a NPDES General/Individual Permit Authorizing Discharges of Storm Water Associated with Construction Activity issued by the DOH.

(i) Minor Development.

(1) Development that requires a trenching, building, grading, grubbing or stockpiling permit where the Project scope is limited to the following activities shall be classified as Minor Development:

(i) Work where Land Disturbing Activities are limited to incidental equipment and material staging for permitted work which is not land disturbing. Examples include enclosing existing outdoor patios or lanais and second story additions where the existing concrete slab will remain;

(ii) The installation of temporary BMPs;

(iii) Land Disturbing Activity that takes place completely under a roof or other enclosure and where existing site conditions preclude storm water run-on to the Disturbed Area;

(iv) The construction of individual bus shelters;

(v) The installation of footings or posts for the construction of fences, decks, roof coverings, and trellises for single-family or two-family dwelling use;

(vi) Trenching project that takes place in the City right-of-way for laterals serving one property;

(vii) Borings; and

(viii) Work not listed above that disturbs no greater than 120 square feet of land, except for fence wall, retaining wall, and driveway apron projects.

(2) The Director may require the Owner of a Minor Development Project to develop and implement an ESCP if necessary to achieve compliance with the requirements of these Rules to reduce Pollutant Discharges to the MS4 and/or Receiving Waters to the MEP. A Minor Development Project may be recategorized as a Category 1A, 1B or Trenching Project and subject to the requirements in Subchapters 4 and 5 if the Director determines that an ESCP is necessary.

(3) Minor Development Projects must include the following notes with the approved construction plans.

(i) Use Best Management Practices (BMPs) to prevent and reduce the discharge of pollutants from the project site onto off-site streets, storm drains, streams and the ocean. Potential pollutants include but are not limited to soil, oil products, paint, solvents, construction demolition waste, trash, portable toilets, AC materials, concrete, and any other liquid, paving or washout material that could be detrimental if released to the environment.

(ii) Any exposed soil from this activity must be permanently or

temporarily stabilized immediately using vegetation, gravel, pavers, rolled erosion control products, or an equivalent method unless active work is scheduled within 14 days.

(iii) All construction waste and washout water must be properly contained and disposed of.

(iv) Sediment tracked off site must be swept or vacuumed daily.

(v) Dust from the project site shall not be transported or discharged to off-site areas. The work must be in conformance with air pollution control standards contained in the Hawaii Administrative Rules: Title 11 Chapter 60.1, "Air Pollution Control."

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

SUBCHAPTER 4
REQUIREMENTS FOR REGULATED PROJECTS AND ACTIVITIES DURING CONSTRUCTION

§20-3-15 Erosion and Sediment Control Plans for Development
§20-3-16 Processing and Approval of Erosion and Sediment Control Plans
§20-3-17 Requirements for Trenching Projects
§20-3-18 Requirements for Category 1A Projects
§20-3-19 Requirements for Category 1B Projects
§20-3-20 Requirements for Category 1C Projects
§20-3-21 Requirements for Category 2 Projects
§20-3-22 Requirements for Category 3 Projects
§20-3-23 Requirements for Category 4 Projects
§20-3-24 Requirements for Category 5 Projects
§20-3-25 Additional Requirements for Development Projects
§20-3-26 BMP Inspections

§20-3-15 Erosion and Sediment Control Plans for Development. (a) No person shall conduct, participate in, or allow any Development categorized as a Trenching Project, Category 1A, 1B, 1C, 2, 3, 4 or 5 Project without an Erosion and Sediment Control Plan (ESCP) approved by the Director.

(b) It is a violation of these Rules to conduct, participate in, or allow any Development categorized as a Trenching Project, Category 1A, 1B, 1C, 2, 3, 4 or 5 Project that is not conducted in accordance with an ESCP approved by the Director.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-16 Processing and Approval of Erosion and Sediment Control Plans. (a)

ESCPs must be reviewed and approved by the Director prior to issuance of a building, grading, grubbing, stockpiling, or trenching permit for Development categorized as a Trenching Project, Category 1A, 1B, 1C, 2, 3, 4 or 5 Project.

(b) ESCPs shall be submitted to the Director for review and approval with the first set of plans for a building, grading, grubbing, stockpiling, or trenching permit for work on the Project or Site.

(c) The Director shall review ESCPs for conformance with the requirements of these Rules and require any revisions necessary to achieve compliance with these Rules. The Director may condition the approval of an ESCP on the implementation, use, and/or maintenance of BMPs not expressly required by these Rules if additional BMPs are necessary to reduce Pollutant Discharges to the MS4 and/or Receiving Waters to the MEP.

(d) Minor changes to an ESCP may be made during construction if approved by a Department Inspector. Minor changes to an ESCP shall be noted on the Site copy of the ESCP and initialed by the approving inspector.

(e) Major changes to an ESCP must be proposed to the Director in writing and approved by the Director before work resumes.

(f) Each failure to comply with the requirements of an ESCP approved by the Director shall be a separate violation of these rules. In addition, each day continuance of a violation shall be separate offense.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§1-9.1, 14-12.31, 18-4.1) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1 18-5.1).

§20-3-17 Requirements for Trenching Projects. (a) Projects which require a trenching permit but do not require a building, grading, grubbing, or stockpiling permit must include, at a minimum, the following BMPs as part of their trenching plan and notes which shall constitute the ESCP:

(1) Project Scheduling;
(2) Storm Drain Inlet Protection for storm drains that may receive runoff from the Disturbed Area;
(3) Stockpile Management BMPs;
(4) Perimeter Controls;
(5) Dewatering Operations BMPs; and
(6) Good Housekeeping Practices for work area and staging areas.

(b) The owner of the property or their Authorized Agent must sign the Trenching Project ESCP and must designate a person responsible for implementing the ESCP at the Project Site ("ESCP Coordinator") using the form provided as Appendix A to these Rules. The form must include the name, phone number, mailing address, and email address of the ESCP Coordinator and must be signed by the owner of the property or their Authorized Agent and the ESCP Coordinator prior to permit issuance. Changes to the ESCP Coordinator shall be submitted to the Director in writing immediately for the Department's acceptance.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-18 Requirements for Category 1A Projects. (a) ESCPs for Category 1A Projects may be prepared by the owner of the property subject to Development or their Authorized Agent. The owner or their Authorized Agent must sign the ESCP and shall designate a person responsible for implementing the ESCP at the Project Site ("ESCP Coordinator") prior to permit issuance using the form provided as Appendix A to these Rules or the Small Project ESCP Template provided as Appendix B to these Rules. Changes to the ESCP Coordinator shall be submitted to the Director in writing immediately for the Department's acceptance.

(b) ESCPs for Category 1A Projects shall include, at a minimum, a BMP Site Plan, which depicts the outline of buildings and Structures, provides a clear delineation of Disturbed Areas, and the proximate location of proposed BMPs and any drainage Structures and Receiving Waters located within 50 feet of the Project Site.

(c) ESCPs for Category 1A Projects shall include, at a minimum, BMPs to address and achieve:

(1) Erosion Control which shall include the following BMPs:
- (i) Project Planning and Design;
- (ii) Project Scheduling; and
- (iii) Permanent Stabilization.

(2) Sediment Control to prevent release of sediment laden waters to the MS4 and Receiving Waters, which shall include the following BMPs:
- (i) Storm Drain Inlet Protection; and
- (ii) Perimeter Controls.

(3) Good Housekeeping practices to prevent and Minimize Pollutant Discharges to the MS4 and Receiving Waters, which shall include the following BMPs:
- (i) BMP and Site Maintenance;
- (ii) Dust Control;
- (iii) Material Delivery, Storage, and Use BMPs;
- (iv) Stockpile Management BMPs;
- (v) Spill Prevention and Control BMPs;
- (vi) Solid Waste Management BMPs;
- (vii) Hazardous Waste Management BMPs;
- (viii) Contaminated Soil Management BMPs;
- (ix) Concrete Waste Management BMPs;
- (x) Sanitary/Septic Waste Management BMPs;
- (xi) Liquid Waste Management BMPs;
- (xii) Vehicle and Equipment Cleaning BMPs;
- (xiii) Vehicle and Equipment Fueling BMPs;
- (xiv) Vehicle and Equipment Maintenance BMPs; and
- (xv) Tracking Control.

(d) ESCPs for Category 1A Projects shall be completed using the Small Project ESCP template provided as Appendix B to these Rules or as a set of drawings, design details and notes with equivalent information to Appendix B, and may include additional plans and materials to aid the Director's review.

(e) If any of the BMPs listed above are not included in an ESCP for a Category 1A Project, the ESCP narrative shall provide a brief explanation of why the omitted BMP is unnecessary or impracticable for the Project.

(f) The Director shall approve an ESCP if it complies with the requirements of these Rules and reduces the risk of onsite erosion, off-site sedimentation, and Pollutant Discharges to the MS4 and Receiving Waters to the MEP. The Director may require revisions to ESCPs and Project schedules or approve the same subject to conditions in order to achieve practicable reductions to the risk of Pollutant Discharges to the MS4 and/or Receiving Waters.

(g) Copies of the approved ESCP and Project schedule must be kept on the Project Site at all times and immediately made available for review by the Director upon request.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-19 Requirements for Category 1B Projects. (a) ESCPs for Category 1B Projects may be prepared by the owner of the property subject to Development or their Authorized Agent. The owner or Authorized Agent must sign the ESCP and shall designate a person responsible for implementing the ESCP at the Project Site ("ESCP Coordinator") prior to permit issuance using the form provided as Appendix A to these Rules or the Small Project ESCP Template provided as Appendix B to these Rules. Changes to the ESCP Coordinator shall be submitted to the Director in writing immediately for the Department's acceptance.

(b) ESCPs for Category 1B Projects shall include, at a minimum, a BMP Site Plan, which depicts the outline of buildings and Structures, provides a clear delineation of Disturbed Areas, and the proximate location of proposed BMPs and any drainage Structures and Receiving Waters located within 50 feet of the Project Site.

(c) ESCPs for Category 1B Projects shall include, at a minimum, BMPs to address and achieve:

(1) Erosion Control which shall include the following BMPs:
- (i) Project Planning and Design;
- (ii) Project Scheduling;
- (iii) Slope Management and Protection;
- (iv) Temporary Stabilization; and
- (v) Permanent Stabilization.

(2) Sediment Control to prevent release of sediment laden waters to the MS4 and Receiving Waters, which shall include the following BMPs:
- (i) Storm Drain Inlet Protection; and
- (ii) Perimeter Controls.

(3) Good Housekeeping Practices to prevent and Minimize Pollutant Discharges to the MS4 and Receiving Waters, which shall include the following BMPs:
- (i) BMP and Site Maintenance;
- (ii) Dust Control;
- (iii) Material Delivery, Storage, and Use BMPs;
- (iv) Stockpile Management BMPs;
- (v) Spill Prevention and Control BMPs;
- (vi) Solid Waste Management BMPs;
- (vii) Hazardous Waste Management BMPs;
- (viii) Contaminated Soil Management BMPs;

(ix) Concrete Waste Management BMPs;
(x) Sanitary/Septic Waste Management BMPs;
(xi) Liquid Waste Management BMPs;
(xii) Vehicle and Equipment Cleaning BMPs;
(xiii) Vehicle and Equipment Fueling BMPs;
(xiv) Vehicle and Equipment Maintenance BMPs; and
(xv) Tracking Control.

(d) ESCPs for Category 1B Projects shall be completed using the Small Project ESCP template provided as Appendix B to these Rules or as a set of drawings, design details and notes with equivalent information to Appendix B, and may include additional plans and materials to aid the Director's review.

(e) If any of the BMPs listed above are not included in an ESCP for a Category 1B Project, the ESCP narrative shall provide a brief explanation of why the omitted BMP is unnecessary or impracticable for the Project.

(f) The Director shall approve an ESCP if it complies with the requirements of these Rules and reduces the risk of onsite erosion, off-site sedimentation, and Pollutant Discharges to the MS4 and Receiving Waters to the MEP. The Director may require revisions to ESCPs and Project schedules or approve the same subject to conditions in order to achieve practicable reductions to the risk of Pollutant Discharges to the MS4 and/or Receiving Waters.

(g) Copies of the approved ESCP and Project schedule must be kept on the Project Site at all times and immediately made available for review by the Director upon request.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-20 Requirements for Category 1C Projects. (a) ESCPs for Category 1C Projects must be prepared by a Certified Erosion and Sediment Control Plan Preparer. The owner of the property or their Authorized Agent must designate a person responsible for implementing the ESCP at the Project Site ("ESCP Coordinator") prior to permit issuance using the form provided as Appendix A to these Rules. Changes to the ESCP Coordinator shall be submitted to the Director in writing immediately for the Department's acceptance.

(b) The ESCP shall include, at a minimum:

(1) A location map showing the name, coordinate, and classification (e.g., Class 1, 2, Class A, Class AA waters) of Receiving Waters, as identified through the DOH State Water Quality Map, available at the DOH Clean Water Branch website;
(2) A vicinity map showing the location of streams, channels, and drainage Structures located within 100 feet of the Project Site;
(3) The location of the 100-year flood plain as shown on the FEMA Map Service Center website;
(4) The location of drainage Structures located within 100 feet of the Project Site;
(5) Topographic maps showing the existing and finished contours of the Site;
(6) Existing and final drainage patterns and Discharge points;
(7) Proposed Structures, impervious areas, existing vegetation, final

landscaping conditions, and appurtenant improvements;

(8) Erosion Control construction notes including non-structural BMPs that cannot be shown on a Site plan;

(9) A BMP Site Plan, drawn to scale, which depicts the outline of buildings and Structures, provides a clear delineation of Disturbed Areas, and the proximate location of proposed BMPs;

(10) BMP design details and notes clearly identifying temporary BMPs, permanent BMPs, a schedule for BMP implementation, and BMP maintenance activities;

(11) A list or table of preconstruction, during construction, and post-construction BMPs;

(12) Any additional information required by the Director.

(c) ESCPs for Category 1C Projects shall include, at a minimum, BMPs to address and achieve:

(1) Erosion Control which shall include the following BMPs:

(i) Project Planning and Design;
(ii) Project Scheduling;
(iii) Slope Management and Protection;
(iv) Temporary Stabilization;
(v) Permanent Stabilization;
(vi) Diversion BMPs to divert runoff from upstream areas around Disturbed Areas of the Site;
(vii) Velocity Dissipation Devices;
(viii) Preserve Existing Vegetation; and
(ix) Minimize Soil Compaction.

(2) Sediment Control to prevent release of sediment laden waters to the MS4 and Receiving Waters, which shall include following BMPs:

(i) Storm Drain Inlet Protection;
(ii) Perimeter Controls;
(iii) Buffer Zones; and
(iv) Sediment Barriers.

(3) Good Housekeeping Practices to prevent and Minimize Pollutant Discharges to the MS4 and Receiving Waters, which shall include the following BMPs:

(i) BMP and Site Maintenance;
(ii) Dust Control;
(iii) Material Delivery, Storage and Use BMPs;
(iv) Stockpile Management BMPs;
(v) Spill Prevention and Control BMPs;
(vi) Solid Waste Management BMPs;
(vii) Hazardous Waste Management BMPs;
(viii) Contaminated Soil Management BMPs;
(ix) Concrete Waste Management BMPs;
(x) Sanitary/Septic Waste Management BMPs;
(xi) Liquid Waste Management BMPs;
(xii) Vehicle and Equipment Cleaning BMPs;

(xiii) Vehicle and Equipment Fueling BMPs;
(xiv) Vehicle and Equipment Maintenance BMPs;
(xv) Tracking Control;
(xvi) Stabilized Construction Entrance and Exit; and
(xvii) Dewatering Operations BMPs.

(d) If any of the BMPs listed above are not included in an ESCP for a Category 1C Project, the ESCP notes shall provide a list of the omitted BMPs with a brief explanation of why each omitted BMP is unnecessary or impracticable for the Project.

(e) The Director shall approve an ESCP if it complies with the requirements of these Rules and reduces the risk of onsite erosion, off-site sedimentation, and Pollutant Discharges to the MS4 and Receiving Waters to the MEP. The Director may require revisions to ESCPs and Project schedules or approve the same subject to conditions in order to achieve practicable reductions to the risk of Pollutant Discharges to the MS4 and/or Receiving Waters.

(f) Copies of the approved ESCP and Project schedule must be kept on the Project Site at all times and immediately made available for review by the Director upon request.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-21 Requirements for Category 2 Projects. (a) ESCPs for Category 2 Projects may be prepared by the owner of the property subject to Development or their Authorized Agent. The owner or Authorized Agent must sign the ESCP and shall designate a person responsible for implementing the ESCP at the Project Site ("ESCP Coordinator") prior to permit issuance using the form provided as Appendix A to these Rules or the Small Project ESCP Template provided as Appendix B to these Rules. Changes to the ESCP Coordinator shall be submitted to the Director in writing immediately for the Department's acceptance.

(b) ESCPs for Category 2 Projects shall include, at a minimum, a BMP Site Plan, which depicts the outline of buildings and Structures, provides a clear delineation of Disturbed Areas, and the proximate location of proposed BMPs and any drainage Structures and Receiving Waters located within 50 feet of the Project Site.

(c) ESCPs for Category 2 Projects shall include, at a minimum, BMPs to address and achieve:

(1) Erosion Control which shall include the following BMPs:
(i) Project Planning and Design;
(ii) Project Scheduling;
(iii) Slope Management and Protection;
(iv) Temporary Stabilization; and
(v) Permanent Stabilization.

(2) Sediment Control to prevent release of sediment laden waters to the MS4 and Receiving Waters, which shall include the following BMPs:
(i) Storm Drain Inlet Protection; and
(ii) Perimeter Controls.

(3) Good Housekeeping Practices to prevent and Minimize Pollutant Discharges to the MS4 and Receiving Waters, which shall include the following BMPs:

(i) BMP and Site Maintenance;
(ii) Dust Control;
(iii) Material Delivery, Storage, and Use BMPs;
(iv) Stockpile Management BMPs;
(v) Spill Prevention and Control BMPs;
(vi) Solid Waste Management BMPs;
(vii) Hazardous Waste Management BMPs;
(viii) Contaminated Soil Management BMPs;
(ix) Concrete Waste Management BMPs;
(x) Sanitary/Septic Waste Management BMPs;
(xi) Liquid Waste Management BMPs;
(xii) Vehicle and Equipment Cleaning BMPs;
(xiii) Vehicle and Equipment Fueling BMPs;
(xiv) Vehicle and Equipment Maintenance; and
(xv) Tracking Control.

(d) ESCPs for Category 2 Projects shall be completed using the Small Project ESCP template provided as Appendix B to these Rules or as a set of drawings, design details and notes with equivalent information to Appendix B, and may include additional plans and materials to aid the Director's review.

(e) If any of the BMPs listed above are not included in an ESCP for a Category 2 Project, the ESCP notes shall provide a list of the omitted BMPs that are unnecessary or impracticable for the Project.

(f) The Director shall approve an ESCP if it complies with the requirements of these Rules and reduces the risk of onsite erosion, off-site sedimentation, and Pollutant Discharges to the MS4 and Receiving Waters to the MEP. The Director may require revisions to ESCPs and Project schedules or approve the same subject to conditions in order to achieve practicable reductions to the risk of Pollutant Discharges to the MS4 and/or Receiving Waters.

(g) Copies of the approved ESCP and Project schedule must be kept on the Project Site at all times and immediately made available for review by the Director upon request.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-22 Requirements for Category 3 Projects. (a) ESCPs for Category 3 Projects must be prepared by a Certified Erosion and Sediment Control Plan Preparer. The owner of the property or their Authorized Agent must designate a person responsible for implementing the ESCP at the Project Site ("ESCP Coordinator") prior to permit issuance using the form provided as Appendix A to these Rules. Changes to the ESCP Coordinator shall be submitted to the Director in writing immediately for the Department's acceptance.

(b) The ESCP shall include, at a minimum:

(1) A BMP Site Plan, drawn to scale, which depicts the outline of buildings and Structures, provides a clear delineation of Disturbed Areas, and the proximate location of proposed BMPs;

(2) Construction notes with a narrative description of any BMPs that cannot be shown on a Site plan; and

(3) A vicinity map showing any drainage Structures and Receiving Waters located within 50 feet of the Project Site.

(c) ESCPs for Category 3 Projects must include, at a minimum, BMPs to address and achieve:

(1) Erosion Control which shall include the following BMPs:
- (i) Project Planning and Design;
- (ii) Project Scheduling;
- (iii) Slope Management and Protection;
- (iv) Temporary Stabilization;
- (v) Permanent Stabilization; and
- (vi) Velocity Dissipation Devices.

(2) Sediment Control to prevent release of sediment laden waters to the MS4 and Receiving Waters, which shall include the following BMPs:
- (i) Storm Drain Inlet Protection;
- (ii) Perimeter Controls; and
- (iii) Sediment Barriers.

(3) Good Housekeeping Practices to prevent and Minimize Pollutant Discharges to the MS4 and Receiving Waters, which shall include the following BMPs:
- (i) BMP and Site Maintenance;
- (ii) Dust Control;
- (iii) Material Delivery, Storage, and Use BMPs;
- (iv) Stockpile Management BMPs;
- (v) Spill Prevention and Control BMPs;
- (vi) Solid Waste Management BMPs;
- (vii) Hazardous Waste Management BMPs;
- (viii) Contaminated Soil Management BMPs;
- (ix) Concrete Waste Management BMPs;
- (x) Sanitary/Septic Waste Management BMPs;
- (xi) Liquid Waste Management BMPs;
- (xii) Vehicle and Equipment Cleaning BMPs;
- (xiii) Vehicle and Equipment Fueling BMPs;
- (xiv) Vehicle and Equipment Maintenance;
- (xv) Tracking Control;
- (xvi) Stabilized Construction Entrance and Exit; and
- (xvii) Dewatering Operations BMPs.

(d) If any of the BMPs listed above are not included in an ESCP for a Category 3 Project, the ESCP notes shall provide a list of omitted BMPs with a brief explanation of why each omitted BMP is unnecessary or impracticable for the Project.

(e) The Director shall approve an ESCP if it complies with the requirements of these Rules and reduces the risk of onsite erosion, off-site sedimentation, and Pollutant Discharges to the MS4 and Receiving Waters to the MEP. The Director may require revisions to ESCPs and Project schedules or approve the same subject to conditions in order to achieve practicable reductions to the risk of Pollutant Discharges to the MS4 and/or Receiving Waters.

(f) Copies of the approved ESCP and Project schedule must be kept on the Project Site at all times and immediately made available for review by the Director upon request.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-23 Requirements for Category 4 Projects. (a) ESCPs for Category 4 Projects must be prepared by a Certified Erosion and Sediment Control Plan Preparer. The owner of the property or their Authorized Agent must designate a person responsible for implementing the ESCP at the Project Site ("ESCP Coordinator") prior to permit issuance using the form provided as Appendix A to these Rules. Changes to the ESCP Coordinator shall be submitted to the Director in writing immediately for the Department's acceptance.

(b) The ESCP shall include, at a minimum:

(1) A location map showing the name, coordinate, and classification (e.g., Class 1, 2, Class A, Class AA waters) of Receiving Waters, as identified through the DOH State Water Quality Map, available at available at the DOH Clean Water Branch website;

(2) A vicinity map showing the location of streams, channels, and drainage Structures located within 100 feet of the Project Site;

(3) The location of the 100-year flood plain as shown on the FEMA Map Service Center website;

(4) The location of drainage Structures located within 100 feet of the Project Site;

(5) Topographic maps showing the existing and finished contours of the Site;

(6) Existing and final drainage patterns and Discharge points;

(7) Proposed Structures, impervious areas, existing vegetation, final landscaping conditions, and appurtenant improvements;

(8) Erosion Control construction notes including non-structural BMPs that cannot be shown on a Site plan;

(9) A BMP Site Plan, drawn to scale, which depicts the outline of buildings and Structures, provides a clear delineation of Disturbed Areas, and the proximate location of proposed BMPs;

(10) BMP design details and notes clearly identifying temporary BMPs, permanent BMPs, a schedule for BMP implementation, and BMP maintenance activities;

(11) A list or table of preconstruction, during construction, and post-construction BMPs; and

(12) Any additional information required by the Director.

(c) ESCPs for Category 4 shall include, at a minimum, BMPs to address and achieve:

(1) Erosion Control which shall include the following BMPs:

(i) Project Planning and Design;

(ii) Project Scheduling;

(iii) Slope Management and Protection;

(iv) Temporary Stabilization;

(v) Permanent Stabilization;

(vi) Velocity Dissipation Devices; and

(vii) Diversion BMPs to divert runoff from upstream areas around

Disturbed Areas of the Site.

(2) Sediment Control to prevent release of sediment laden waters to the MS4 and Receiving Waters, which shall include the following BMPs:
  (i) Storm Drain Inlet Protection;
  (ii) Perimeter Controls; and
  (iii) Sediment Barriers.

(3) Good Housekeeping Practices to prevent and Minimize Pollutant Discharges to the MS4 and Receiving Waters, which shall include the following BMPs:
  (i) BMP and Site Maintenance;
  (ii) Dust Control;
  (iii) Material Delivery, Storage and Use BMPs;
  (iv) Stockpile Management BMPs;
  (v) Spill Prevention and Control BMPs;
  (vi) Solid Waste Management BMPs;
  (vii) Hazardous Waste Management BMPs;
  (viii) Contaminated Soil Management BMPs;
  (ix) Concrete Waste Management BMPs;
  (x) Sanitary/Septic Waste Management BMPs;
  (xi) Liquid Waste Management BMPs;
  (xii) Vehicle and Equipment Cleaning BMPs;
  (xiii) Vehicle and Equipment Fueling BMPs;
  (xiv) Vehicle and Equipment Maintenance BMPs;
  (xv) Tracking Control;
  (xvi) Stabilized Construction Entrance and Exit; and
  (xvii) Dewatering Operations BMPs.

(d) If any of the BMPs listed above are not included in an ESCP for a Category 4 Project, the ESCP notes shall provide a list of the omitted BMPs with a brief explanation of why each omitted BMP is unnecessary or impracticable for the Project.

(e) The Director shall approve an ESCP if it complies with the requirements of these Rules and reduces the risk of onsite erosion, off-site sedimentation, and Pollutant Discharges to the MS4 and Receiving Waters to the MEP. The Director may require revisions to ESCPs and Project schedules or approve the same subject to conditions in order to achieve practicable reductions to the risk of Pollutant Discharges to the MS4 and/or Receiving Waters.

(f) Copies of the approved ESCP and Project schedule must be kept on the Project Site at all times and immediately made available for review by the Director upon request.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-24 Requirements for Category 5 Projects. (a) ESCPs for Category 5 Projects must be prepared by a Certified Erosion and Sediment Control Plan Preparer. The owner of the property or their Authorized Agent must designate a person responsible for implementing the ESCP at the Project Site ("ESCP Coordinator") prior to permit issuance using the form provided as Appendix A to these Rules. Changes to the ESCP Coordinator shall be submitted to the

Director in writing immediately for the Department's acceptance.

(b) The ESCP shall include, at a minimum:

(1) A location map showing the name, coordinate, and classification (e.g., Class 1, 2, Class A, Class AA waters) of Receiving Waters, as identified through the DOH State Water Quality Map, available at the DOH Clean Water Branch website;

(2) A vicinity map showing the location of streams, channels, and drainage Structures located within 100 feet of the Project Site;

(3) The location of the 100-year flood plain as shown on the FEMA Map Service Center website;

(4) The location of drainage Structures located within 100 feet of the Project Site;

(5) Topographic maps showing the existing and finished contours of the Site;

(6) Existing and final drainage patterns and Discharge points;

(7) Proposed Structures, impervious areas, existing vegetation, final landscaping conditions, and appurtenant improvements;

(8) Erosion Control construction notes including non-structural BMPs that cannot be shown on a Site plan;

(9) A BMP Site Plan, drawn to scale, which depicts the outline of buildings and Structures, provides a clear delineation of Disturbed Areas, and the proximate location of proposed BMPs;

(10) BMP design details and notes clearly identifying temporary BMPs, permanent BMPs, a schedule for BMP implementation, and BMP maintenance activities;

(11) A list or table of preconstruction, during construction, and post-construction BMPs; and

(12) Any additional information required by the Director.

(c) ESCPs shall include, at a minimum, BMPs to address and achieve:

(1) Erosion Control which shall include the following BMPs:

(i) Project Planning and Design;

(ii) Project Scheduling;

(iii) Slope Management and Protection;

(iv) Temporary Stabilization;

(v) Permanent Stabilization;

(vi) Diversion BMPs to divert runoff from upstream areas around Disturbed Areas of the Site;

(vii) Velocity Dissipation Devices;

(viii) Preserve Existing Vegetation; and

(ix) Minimize Soil Compaction.

(2) Sediment Control to prevent release of sediment laden waters to the MS4 and Receiving Waters, which shall include the following BMPs:

(i) Storm Drain Inlet Protection;

(ii) Perimeter Controls;

(iii) Buffer Zones;

(iv) Sediment Traps;

(v) Sediment Basins; and

(vi) Sediment Barriers.

(3) Good Housekeeping Practices to prevent and Minimize Pollutant Discharges to the MS4 and Receiving Waters, which shall include the following BMPs:

(i) BMP and Site Maintenance;
(ii) Dust Control;
(iii) Material Delivery, Storage and Use BMPs;
(iv) Stockpile Management BMPs;
(v) Spill Prevention and Control BMPs;
(vi) Solid Waste Management BMPs;
(vii) Hazardous Waste Management BMPs;
(viii) Contaminated Soil Management BMPs;
(ix) Concrete Waste Management BMPs;
(x) Sanitary/Septic Waste Management BMPs;
(xi) Liquid Waste Management BMPs;
(xii) Vehicle and Equipment Cleaning BMPs;
(xiii) Vehicle and Equipment Fueling BMPs;
(xiv) Vehicle and Equipment Maintenance BMPs;
(xv) Tracking Control;
(xvi) Stabilized Construction Entrance and Exit; and
(xvii) Dewatering Operations BMPs.

(d) If any of the BMPs listed above are not included in an ESCP for a Category 5 Project, the ESCP notes shall provide a list of the omitted BMPs with a brief explanation of why each omitted BMP is unnecessary or impracticable for the Project.

(e) The Director shall approve an ESCP if it complies with the requirements of these Rules and reduces the risk of onsite erosion, off-site sedimentation, and Pollutant Discharges to the MS4 and Receiving Waters to the MEP. The Director may require revisions to ESCPs and Project schedules or approve the same subject to conditions in order to achieve practicable reductions to the risk of Pollutant Discharges to the MS4 and/or Receiving Waters.

(f) Copies of the approved ESCP and Project schedule must be kept on the Project Site at all times and immediately made available for review by the Director upon request.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-25 Additional Requirements for Development Projects.

(a) Category 1C and Category 5 Projects may not begin work unless an NPDES General/Individual Permit Authorizing Discharges of Storm Water Associated with Construction Activity has been issued by the DOH.

(b) Dewatering non-storm water. For all categories, including work for trenching permits only, non-storm water from dewatering activities shall not be Discharged from the Site unless an NPDES Permit Authorizing Discharges Associated with Construction Activity Dewatering has been issued by the DOH.

(c) Hydrotesting water. For all categories, including work for trenching permits only, hydrotesting water shall not be Discharged from the Site unless an NPDES Permit Authorizing

Discharges of Hydrotesting Waters has been issued by the DOH.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-26 BMP Inspections. (a) All Projects involving Development or Land Disturbing Activities shall be inspected on a regular basis to ensure that BMPs are properly installed, used, and maintained.

(b) A preconstruction inspection must be performed for Trenching Projects and all Categories 1A to 5 Projects by the ESCP Coordinator prior to commencing ground-disturbing activities, to confirm that BMPs are installed correctly and according to the ESCP.

(c) Requirements for Category 1A, 1B, and 2 Projects. Category 1A, 1B and 2 Projects must be inspected once every 30 days by the ESCP Coordinator. However, if the Project will be completed in less than thirty days, inspection shall occur midway through the Project. Inspection results and corrective actions shall be documented with photographs and by completing the form provided as Appendix C to these Rules.

(d) Requirements for Category 3 and 4 Projects and Trenching Projects. Category 3 and 4 Projects and Trenching Projects must be inspected by the ESCP Coordinator once every seven days. Inspection results and corrective actions shall be documented with photographs and by completing the form provided as Appendix C to these Rules.

(e) Requirements for Category 1C and 5 Projects. Category 1C and 5 Projects must be inspected by the ESCP Coordinator once every seven days. Inspection results and corrective actions shall be documented with photographs and by completing the form provided as Appendix D to these Rules.

(f) Any deficiencies or BMPs that may violate any provision of these Rules or may result in Pollutant Discharges to the MS4 or State Waters and requires corrective actions shall be addressed immediately.

(g) All photographs and inspection reports must be compiled in a 3-ring folder or binder or kept electronically, which shall be the Project Log. The Project Log shall be kept on Site or electronically accessible from the Site at all times, in a complete condition, and immediately produced for inspection if request by the Director.

(h) At the conclusion of the Project, the property owner, Authorized Agent, or ESCP Coordinator shall inspect the Site and confirm that all Disturbed Areas have been stabilized and all temporary BMPs have been removed. An electronic copy of the final Project Log and a letter confirming compliance with this subsection shall be provided to the Director within 5 business days of completing work on the Project. Permits for work on the Project Site will not be closed until compliance with this subsection is achieved.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§1-9.1, 14-12.31, 14-12.32) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 14-12.32, 18-4.1, 18-5.1).

SUBCHAPTER 5
BMPS, STANDARDS, AND SPECIFICATIONS FOR ACTIVITIES DURING CONSTRUCTION

§20-3-27 Project Planning and Design
§20-3-28 Project Scheduling
§20-3-29 Slope Management and Protection
§20-3-30 Temporary Stabilization
§20-3-31 Permanent Stabilization
§20-3-32 Diversion BMPs
§20-3-33 Preservation of Existing Vegetation
§20-3-34 Minimize Soil Compaction
§20-3-35 Velocity Dissipation Devices
§20-3-36 Perimeter Control
§20-3-37 Silt Fences
§20-3-38 Sediment Barriers
§20-3-39 Storm Drain Inlet Protection
§20-3-40 Vegetated Buffers
§20-3-41 Sediment Basins
§20-3-42 Sediment Traps
§20-3-43 Tracking Control
§20-3-44 Stabilized Construction Entrances and Exits
§20-3-45 Dust Control
§20-3-46 Good Housekeeping Practices
§20-3-47 Dewatering Operations

§20-3-27 Project Planning and Design. (a) Projects should be planned and designed to eliminate and prevent Pollutant Discharges to the MS4 and Receiving Waters to the MEP. All Project planning and design should be executed in a manner that prioritizes the following to the MEP:

(1) Preserve native topsoil;
(2) Minimization of soil compaction;
(3) Directing Discharges from storm water controls to vegetated areas;
(4) Preservation and use of natural buffers;
(5) Restriction of vehicle use to necessary areas;
(6) Location of materials and stockpiles outside of buffers;
(7) Effective primary and secondary containment for potential sources of pollution;
(8) Establishment of effective perimeter controls;
(9) Protection of storm drain inlets; and
(10) Effective prohibition of off-site Discharges from wastewater and concrete washout, washout or cleanout water containing stucco, paint, release oils, curing compounds, and waste from construction materials, and Discharges containing fuels, oils, soaps, solvents, detergents, and toxic and/or hazardous substances.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-28 Project Scheduling. (a) All Trenching Permit and Category 1A, 1B, 1C, 2, 3, 4 and 5 Projects must be performed according to a written Project schedule approved by the Director.

(b) Project schedules must establish a sequence of all planned actions and activities on the Project Site, including, but not limited to, all Land Disturbing Activities, the implementation of the BMPs identified in the Project ESCP, scheduled inspections and maintenance of BMPs, and the removal of temporary BMPs. Deadlines for the implementation and removal of BMPs shall be provided in the form of specific dates or Project milestones. The scheduled start date shall be submitted to the Director in writing or by telephone 2 weeks prior to commencing any work governed by these Rules.

(c) Project schedules must be designed to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff and vehicle tracking to the MEP and sequence Land Disturbing Activities to Minimize onsite storage of equipment, materials and wastes that may cause or contribute to pollution Discharges to the MS4 and/or Receiving Waters. In addition, all Project Schedules shall include a rain response plan that identifies work that will not be performed during defined rain conditions and/or events.

(d) The Director may require DPP approval of BMPs and/or Site conditions at one or more points on a Project schedule before work may commence on the next sequenced action or event.

(e) Project schedules must be revised if delays or disruptions to the Project necessitate changes to the sequence of work or BMPs. Revisions to a Project schedule must be proposed by the submission of a revised Project schedule to DPP and approved by the Director before work may be performed pursuant to the revised schedule.

(f) A copy of the original Project schedule and all revised Project schedules must be kept on Site, in chronological order, and stored in a three-ring folder or binder or electronically, which shall be the Project Log. A complete version of the Project Log shall be on Site or electronically accessible from the Site at all times and immediately made available for inspection by the Director upon request.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-29 Slope Management and Protection. (a) Land Disturbing Activities on slopes with a grade of 15 percent or greater must be Minimized to the MEP. Where necessary, work on slopes with a grade of 15 percent or more should be phased to Minimize the amount disturbed to no greater than 5 acres at any time.

(b) Slopes with a grade of 15 percent or more must be stabilized at all times unless the slopes are being actively worked. Slope Stabilization must be initiated immediately unless active work is scheduled on the slope within 7 calendar days or where necessary due to anticipated weather conditions.

(c) Minimum stabilization of slopes 15 percent or greater shall consist of one or more of the following:

(1) Rolled Erosion Control Products that conform to the requirements of the American Association of State Highway and Transportation Officials M288 may be installed and maintained per the manufacturer's specifications, which must be kept onsite at all times and immediately made available for inspection by the Director upon request;

(2) Hydraulic mulch or hydroseed consisting of at least 5 percent soil binder and applied at a minimum of rate of 2000 lb/acre, unless otherwise required by the manufacturer's instructions, which shall be kept onsite at all times and immediately produced for inspection upon request;

(3) Hydraulic or Bonded Fiber Matrix installed and maintained per the manufacturer's specifications, which must be kept onsite at all times and immediately made available for inspection by the Director upon request; or

(4) Planting and/or vegetation providing at least 70 percent surface cover for Temporary Stabilization and at least 90 percent surface cover for Permanent Stabilization.

(d) Category 1C, 4 and 5 Projects with slopes with a grade of 15 percent or more must provide at minimum a 10-foot buffer with a maximum slope of 5 percent at the toe of the slope.

(e) Category 1C, 4, and 5 Projects must provide upstream runoff diversion using such measures as earth dikes, drainage swales and/or slope drains to intercept and direct surface flow away from disturbed slope areas of 15 percent or more.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-30 Temporary Stabilization. (a) Temporary Stabilization must be initiated immediately for Disturbed Areas that are not on slopes with a grade of 15 percent or more when they reach final grade or when active work is not scheduled within 14 calendar days.

(b) Minimum stabilization of Disturbed Areas shall consist of one or more of the following:

(1) Rolled Erosion Control Products that conform to the requirements of the American Association of State Highway and Transportation Officials M288 may be installed and maintained per the manufacturer's specifications, which must be kept onsite at all times and immediately made available for inspection by the Director upon request;

(2) Hydraulic mulch or hydroseed consisting of at least 5 percent soil binder and applied at a minimum of rate of 2000 lb/acre, unless otherwise required by the manufacturer's instructions, which shall be kept onsite at all times and immediately produced for inspection upon request;

(3) Hydraulic or Bonded Fiber Matrix installed and maintained per the manufacturer's specifications, which must be kept onsite at all times and immediately made available for inspection by the Director upon request;

or

(4) Planting and/or vegetation providing at least 70 percent surface cover for Temporary Stabilization and at least 90 percent surface cover for Permanent Stabilization.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-31 Permanent Stabilization. (a) Prior to final approval and closing of the permits for work on the Site, permanent stabilization must be in place.

(b) All Disturbed Areas must be stabilized with permanent Erosion Control BMPs such as vegetation, gravel, or pavers;

(c) Rain gutters, downspouts, and channelized flows must be installed and functioning as designed;

(d) In seeded areas, grass or vegetation must cover at least 90 percent of the disturbed soils;

(e) Seeded areas that have not achieved 90 percent ground cover must be stabilized by tackifiers, mulch, turf reinforcement mats, or Rolled Erosion Control Products until 90 percent vegetative cover is established;

(f) Temporary Erosion Control measures, such as sediment fences, should be removed when permanent measures are in place;

(g) Ditches and areas of concentrated flow must be lined with rock, appropriately installed geosynthetics, or similar materials to prevent scour;

(h) All paved surfaces must be clean; and

(i) Storm drain inlet filters must be removed after all cleanup activities have been completed.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-32 Diversion BMPs. (a) Diversion BMPs consist of Earth Dikes, Drainage Swales and Slope Drains. Category 1C, 4, and 5 Projects must provide runoff diversion upstream of disturbed areas on slopes of 15 percent or more as described in §20-3-29(e).

(b) Earth dikes are ridges of compacted soil that may be placed at the top or base of a disturbed slope or along the perimeter of a Disturbed Area to intercept runoff and direct flows to areas where erosion can be controlled. The tributary area addressed by a single earth dike may not exceed 5 acres. Design capacity for earth dikes must be equal to or greater than the peak flow from a 10-year, 1-hour storm. The upslope side of the dike must provide positive drainage to the dike outlet. No erosion shall occur at the outlet. Earth dikes must be fully compacted and stabilized with vegetation and/or riprap.

(c) Drainage swales are sloped depressions in the soil surface to convey runoff to a desired location. The tributary area addressed by a single drainage swale may not exceed 5 acres. Design capacity for drainage swale must be equal to or greater than the peak flow from a 10-year, 1-hour storm. Drainage swale must be fully stabilized with vegetation and/or riprap.

(d) Earth dikes and drainage swales can be used with slope drains to divert water from the top of a slope to the bottom of a slope. Slope Drains may be a rigid pipe, such as corrugated metal, a flexible conduit, or a lined terrace drain with the inlet placed on the top of a slope and the outlet at the bottom of the slope. The capacity for temporary slope drains intercepting offsite or on-site runoff should be sufficient to convey at least the peak runoff from a 10-year, 1-hour storm. The tributary area addressed by a single slope drain may not exceed 10 acres. Outlets should be stabilized with riprap, concrete or other type of Velocity Dissipation Device, or directed into a stable sediment trap or basin.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-33 Preservation of Existing Vegetation. (a) Preservation of existing vegetation is to Minimize the potential of removing or injuring existing trees, vines, shrubs, and grasses that protect soil erosion. Clearly mark the areas to be preserved with flags or temporary fencing. Where temporary fencing is used, fencing must be adequately supported by posts and maintained in an upright position.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-34 Minimize Soil Compaction. (a) Areas where the final stabilization will occur and areas where Infiltration practices will be installed must be protected from excessive compaction by restricting the vehicle and equipment use to appropriate areas or implementing soil conditioning techniques.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-35 Velocity Dissipation Devices. (a) Velocity dissipation devices are channel linings, Structures, or flow barriers that are placed at outlets for storm drains, pipes, culverts, steep ditches, flumes and areas of contacted flow to lower flow velocities, prevent scour and dissipate energy.

(b) Velocity dissipation devices are required where the Director, Engineer, or preparer of the ESCP determines that Discharge velocities and energies are sufficient to erode the immediate downstream reach of Discharges.

(c) The apron length and materials for velocity dissipation devices must be adequate to accommodate the peak flow of a 10-year, 1-hour storm without resulting in scour or erosion in immediate downstream areas.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-36 Perimeter Controls. (a) Perimeter Controls shall be required if a Project involves any Land Disturbing Activities within 50 feet of State Waters unless the Project has obtained a CWA 404 Permit for the work or the Land Disturbing Activities relate to a water-dependent structure such as a pier or boat ramp. Perimeter Controls shall also be required if the Director, Engineer, or ESCP Coordinator determines that Pollutant Discharges to the MS4 or State Waters are likely to occur based on Site conditions, the nature of planned construction activities, or the location of planned Land Disturbing Activities, or expected weather conditions.

(b) At a minimum, perimeter controls shall consist of vegetated buffers, sediment barriers, or silt fences along those perimeter areas of the Site that will receive storm water from earth disturbing activities.

(c) For Category 1C and 5 Projects that are within 50 feet of State Waters, perimeter controls must be installed along the perimeter of the Site along areas that will receive storm water from Disturbed Areas and consist of a 50 foot wide, undisturbed, natural buffer or in-series perimeter controls consisting of two or more sediment barriers or silt fences with spacing of at least 5 feet between the sediment barriers or silt fences (refer to §20-3-40 Vegetated Buffers).

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-37 Silt Fences. (a) Silt fences are temporary, linear sediment barriers that are composed of permeable fabric and vertical posts. Silt fence fabric shall conform to the requirements set forth under American Society for Testing and Materials (ASTM) designation D4632, or an approved equal, and shall have an integral reinforcement layer. The reinforcement layer shall be a polypropylene or equivalent provided by the manufacturer.

(b) Silt fences may be used as sediment barriers on the face of slopes, at the toe of slopes, down-slope from exposed soil areas, around temporary stockpiles, along streams and channels, and along the perimeter of a Project Site.

(c) Silt fences may not be used at the toe of slopes subject to creep, slumping, or landslides, or, in streams, channels, drain inlets and areas of concentrated flow. Slit fences may not be used to divert flows.

(d) Silt fences used for erosion and runoff control shall comply with the following minimum design standards and criteria:

(1) Silt fence fabric shall be woven polypropylene with a minimum width of 36 inches and a minimum tensile strength of 100 lbs. force. The fabric shall conform to the requirements set forth under ASTM designation D4632 and shall have an integral reinforcement layer. The reinforcement layer shall be a polypropylene or equivalent provided by the manufacturer.

(2) Silt fence fabric shall retain 85 percent of soil by weight, based on sieve analysis. The permittivity of the fabric shall be between 0.1 $sec.^{-1}$ and 0.15 $sec.^{-1}$

(3) Silt fences shall be installed along a trench line at least 6 inches wide and 6 inches deep, set back a minimum of 3 feet from the toe of an abutting slope. Silt fences shall be keyed to a minimum depth of 12 inches. Fence posts shall be no more than 6 feet apart and driven securely to a depth of no less than 18 inches from top soil or 12 inches below the trench line.

When overlap is necessary, silt fence fabric shall be spliced together securely at a fence post and overlap by no less than 6 inches. Staples used to fasten fabric to posts shall be no less than 1.75 inches long and composed of 15 gauge or heavier wire. Wire used at fence joints shall be 9 gauge or heavier. Metal stakes with holders for silt fence must have No. 4 or greater bar reinforcement.

(4) Silt fences shall not be the only Sediment or Erosion Control BMP on slopes greater than 2:1.

(e) Silt fence fabric has a general life of 5 to 8 months. All spilt, torn, weathered or slumping portions of any fence shall be replaced immediately.

(f) Water depth along a silt fence may not exceed 1.5 feet at any point and accumulated sediments may not exceed one third of the fence height at any time.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-38 Sediment Barriers. (a) Sediment barriers are temporary BMPs that intercept sediment-laden runoff from small drainage areas in order to slow runoff velocities and allow suspended solids to settle out of storm water. Sediment barriers may consist of gravel bags, sandbags, fiber rolls, compost filter socks a minimum of 8 inches in diameter or an equivalent BMP approved by the Director.

(b) Sediment barriers must be used to protect disturbed or denuded soils that are not scheduled for active work within 24 hours if the Engineer, preparer of the ESCP, or Director determines that sediment Discharge to State Waters or the MS4 is likely due to Site conditions, the nature of work that will occur in the vicinity of the Disturbed Area, or the proximity of the Disturbed Area to State Waters or portions of the MS4.

(c) Unless more specific criteria apply to the specific type of sediment barrier selected, the contributing drainage area addressed by a single sediment barrier may not exceed 1/4 acre per 100 feet of barrier length. In addition, the maximum length of slope above a barrier may not exceed 100 feet. Unless more specific criteria apply to the type of sediment barrier selected, the spacing between sediment barriers along the slopes must follow the following requirements:

Slope	**Minimum Sediment Barrier Spacing**
< 5 percent	50 feet
5 to 15 percent	30 feet
> 15 percent	20 feet

(d) Sediment barriers may not be used in areas of concentrated flows, such as drainage channels, live streams or in swales where there is the possibility of a washout.

(e) Sediment levels shall not exceed one half of the height of a sediment barrier at any point along the length of the sediment barrier.

(f) Sediment collected from sediment barriers must be reincorporated into the Project Site or disposed of at off-site locations that are approved by the Director (refer to Solid Waste

Management §20-3-46(i)).

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-39 Storm Drain Inlet Protection. (a) All drain inlets and catch basins that are not connected to a sediment basin or trap must be protected by sediment barriers or inlet protection devices if they are capable of receiving sediment or runoff from the Project Site unless severe weather conditions make the use of such devices unsafe or Infeasible.

(b) Sediment levels may not exceed one third of the height of a sediment barrier or inlet protection device at any point along the length of the sediment barrier or the inlet protection device.

(c) Sediment barriers and inlet protection devices must be unclogged and cleaned when performance is compromised.

(d) Torn, weathered or sagging sediment barriers or inlet protection devices must be repaired or replaced immediately.

(e) Sediment collected from sediment barriers and inlet protection devices must be reincorporated into the Project Site or disposed of at off-site locations that are approved by the Director (refer to Solid Waste Management §20-3-46(i)).

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-40 Vegetated Buffers. (a) Vegetated buffer strips are vegetated surfaces that are designed to treat sheet flow from adjacent surfaces by slowing runoff velocities and allowing sediment and other Pollutants to settle and partially infiltrate into underlying soils.

(b) The width of the vegetative buffer strips must have slope of 5 percent or less. The vegetative buffer must be one foot wide for every 3 feet of upslope drainage area directed to the vegetative buffer.

(c) Categories 1C and 5 Projects must maintain a 50-foot undisturbed natural buffer and sediment control between State Waters and the Construction Site. If a 50-foot natural buffer zone cannot be maintained, provide a natural undisturbed buffer zone that is less than 50 feet and either double sediment barriers or silt fences spaced at a minimum of 5 feet apart. If it is Infeasible to provide and maintain an undisturbed natural buffer of any size, provide double sediment barriers or silt fences spaced a minimum of five feet apart and complete stabilization within 7 consecutive days of the temporary or permanent cessation of earth disturbing activities. All Discharges from the area of earth disturbance to the natural buffer must be treated by the Site's erosion and sediment controls before release to buffer areas.

(d) Planned vegetated buffer strips must be shown in the ESCP for a Project. During clearing and grubbing, vegetation designated for use in a vegetated buffer must be enclosed by temporary fencing made of orange polypropylene that is stabilized against ultraviolet light. The temporary fencing must be at least 4 feet tall and have openings not larger than 2 inches by 2 inches. Fence posts must be comprised of wood or metal, driven securely to a depth of no less than one foot, and spacing to completely support the fence in an upright position without sagging

at all times.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§1-9.1, 14-12.31, 14-12.32) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 14-12.32, 18-4.1, 18-5.1).

§20-3-41 Sediment Basins. (a) Sediment basins are excavated or depressed areas that are used to collect and detain runoff to allow suspended solids to settle out of storm water before storm water is Discharged to off-site areas.

(b) The use of sediment basins shall be mandatory for Category 5 Projects with 5 acres of Disturbed Area or greater

(c) Sediment basins shall provide sufficient storage to accommodate the volume of runoff for the 2-year, 24-hour storm for the Project Site or at least 3,600 cubic feet per acre area to be drained.

(d) The embankment slopes must be no steeper than 3 horizontal to 1 vertical. Basin depth must be no less than 3 feet and the length to settling depth ratio must be less than 200, where length is the average distance between the inlet and outlet structure of the basin. Discharges from sediment basins shall pass though outlet Structures that withdraw surface waters from the basin in order to Minimize Pollutant Discharges. Outlet Structures shall be sized to Minimize clogging and achieve a draw-down time between 36 and 72 hours.

(e) Sediment basins shall use stabilization controls such as Erosion Control blankets to prevent erosion of exterior basin surfaces and use velocity dissipation devices to reduce flow rates at inlets and outlets.

(f) Sediment basins shall have emergency spillways to accommodate overflow bypass. Emergency spillways may not direct overflow to sloped areas or other areas of concentrated flow. Emergency spillways and outlets require erosion protection such as velocity dissipation devices.

(g) Sediment basins must be kept in effective operating condition and sediment shall be removed to maintain at least one half of the design capacity of the sediment basin at all times.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§ 20-3-42 Sediment Traps. (a) Sediment traps are excavated or depressed areas that are used to collect and detain sediments from areas of the Site that were cleared or graded during construction.

(b) The use of Sediment traps shall be mandatory for Category 5 Projects with [less than] 5 acres of Disturbed Area.

(c) The drainage area addressed by a single sediment trap shall not exceed 5 acres.

(d) The traps must be designed to provide storage for calculated volume of runoff for the 2-year, 24-hour storm for the Project Site or at least 3,600 cubic feet per acre to be drained.

(e) The embankment slopes shall be no steeper than 3 horizontal to 1 vertical.

(f) Sediment traps shall have an emergency spillway to accommodate overflow or bypass flows that exceed the design storm event. Emergency spillways and outlets require erosion protection such as velocity dissipation devices.

(g) Sediment traps must be kept in effective operating condition and sediment shall be removed when the sediment accumulation reaches one third of the trap capacity.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-43 Tracking Control (a) All Projects must Minimize sediment track-out onto off-site streets, other paved areas, and sidewalks from vehicles exiting the construction Site by restricting vehicle traffic to properly designated areas and using additional controls to remove sediment from vehicle tires prior to exiting the Site.

(b) Vehicular parking and movements on Project sites must be confined to paved surfaces or predefined parking areas and vehicle paths, which shall be marked with flags or boundary fencing.

(c) All Pollutants and materials that are dropped, washed, tracked, spilled, or otherwise Discharged from a Project Site to off-site streets, other paved areas, sidewalks or the MS4 must be cleaned immediately using dry methods such as sweeping or vacuuming. Washing Pollutants and materials that are Discharged from the Project Site to the MS4 into drain inlets or catch basins is prohibited unless the material is sediment and the inlets are directed to a sediment basin or sediment trap.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-44 Stabilized Construction Entrance and Exits. (a) Except where vehicular traffic is limited to paved surfaces, all construction entrances and exits for Categories 1C, 3, 4, and 5 shall provide an effective buffer for the deposit of mud and sediment from the Project Site prior to vehicles entering a paved or public road.

(b) Unpaved construction entrances and exits for Categories 1C, 4 and 5 Projects must consist of 3-6 inch diameter gravel placed upon a geotextile mat. The gravel must have a minimum depth of 12 inches above geotextile mat. The graveled entrance must be at least 50 feet long and 30 feet wide. Entrances and exits must provide a turning radius sufficient to accommodate the construction vehicles entering and exiting the Project Site.

(c) Unpaved construction entrances and exits for Categories 3 Projects must consist of 3-6 inch diameter gravel placed upon a geotextile mat. The gravel must have a minimum depth of 8 inches above geotextile mat. The graveled entrance must be at least 30 feet long and 20 feet wide. Entrances and exits must provide a turning radius sufficient to accommodate the construction vehicles entering and exiting the Project Site.

(d) Where Site conditions prevent the removal of all sediment and mud from tires traveling across construction entrances and exits, tire wash facilities must be provided to allow for the removal of mud and sediments from vehicle tires before they are allowed to enter a public road. Tire wash racks and facilities must direct all wash water and sediments away from the construction entrance or exit to a designated settling area located on the Project Site. The Discharge of wash water or sediment from the wash area to the MS4 or State Waters is prohibited.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-45 Dust Control. (a) Dust from a Project Site shall not be transported or Discharged to off-site areas. The work must be in conformance with air pollution control standards contained in the Hawaii Administrative Rules: Title 11 Chapter 60.1, "Air Pollution Control." All ESCPs shall provide for the control of dust by one or more of the following:

(1) Mulching to a depth of no less than 1 inch;
(2) Sprinkling exposed soils with water to maintain moistness at a depth of 2-3 inches during working hours and not to generate any runoff; and
(3) Vertical dust barriers no less than 6 feet in height, constructed of materials capable of effectively preventing the spread of dust particles.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-46 Good Housekeeping Practices. All Projects must implement and maintain Good Housekeeping Practices to eliminate and Minimize Pollutant Discharges to the MEP. Mandatory Good Housekeeping Practices include, but are not limited to:

(a) Street Sweeping and Vacuuming. All Pollutants Discharged from a construction Site to off-site areas must be swept or vacuumed each day before leaving the job site.

(b) Materials Delivery, Storage and Use Management. Prevent, reduce, or eliminate the Discharge of Pollutants from material delivery, storage, and use to the storm water system or watercourses by minimizing the storage of hazardous materials onsite, storing materials in a designated area, installing secondary containment. Construction materials, waste, toxic and hazardous substances, stockpiles and other sources of pollution shall not be stored in buffer areas, near areas of concentrated flow, or areas abutting the MS4, Receiving Waters, or drainage improvements that Discharge off-site. Primary and secondary containment controls and covers shall be implemented to the MEP.

(c) Spill Prevention and Control. Projects shall create and implement spill prevention and response plans to eliminate and Minimize the Discharge of Pollutants to the MS4 and Receiving Waters from leaks and spills by reducing the chance for spills, absorbing, containing, and cleaning up spills and properly disposing of spill materials. At a minimum, all Projects shall cleanup all leaks and spills immediately.

(d) Hazardous Materials. Prevent or reduce the Discharge of Pollutants to storm water from hazardous waste through proper material use and waste disposal. In the event that hazardous materials are Discharged to the MS4, the property owner or ESCP Coordinator shall immediately notify the Department of Facilities Maintenance, Honolulu Fire Department, and Honolulu Police Department of the Discharge by telephone. A written report describing the Pollutants that were Discharged, the reasons for the Discharge, and the measures that have been taken or will be taken to prevent a reoccurrence of the Discharge shall be submitted to the Director no less than 3 days after notification by phone.

(e) Nonhazardous Materials. In the event that nonhazardous materials are Discharged to the MS4, the property owner or ESCP Coordinator shall notify the City Department of

Facilities Maintenance by telephone no later than the next business day. A written report describing the Pollutants that were Discharged, the reasons for the Discharge, and the measures that have been taken or will be taken to prevent a reoccurrence of the Discharge shall be submitted to the Director no less than 3 days after notification by phone.

(f) Vehicle and Equipment Cleaning. Eliminate and Minimize the Discharge of Pollutants to storm water from vehicle and equipment cleaning operations by using off-site facilities when feasible, washing in designated, contained areas only, and eliminating Discharges to the storm drain system by evaporating and/or treating wash water, as appropriate or infiltrating wash water for exterior cleaning activities that use water only.

(g) Vehicle and Equipment Fueling. Prevent fuel spills and leaks by using off-site facilities, fueling only in designated areas, enclosing or covering stored fuel, and implementing spill controls such as secondary containment and active measures using spill response kits.

(h) Vehicle and Equipment Maintenance. Eliminate and Minimize the Discharge of Pollutants to storm water from vehicle and equipment maintenance operations by using off-site facilities when feasible, performing work in designated areas only, using spill pads under vehicles and equipment, checking for leaks and spills, and containing and cleaning up spills immediately.

(i) Solid Waste Management. Prevent or reduce Discharge of Pollutants to the land, groundwater, and in storm water from solid waste or construction and demolition waste by providing designated waste collection areas, collect Site trash daily, and ensuring that construction waste is collected, removed, and disposed of only at authorized disposal areas.

(j) Sanitary/Septic Waste Management. Temporary and portable sanitary and septic waste systems shall be mounted or staked in, well-maintained and scheduled for regular waste disposal and servicing. Sources of sanitary and/or septic waste shall not be stored near the MS4 or Receiving Waters.

(k) Stockpile Management. Stockpiles shall not be located in drainage ways, within 50 feet from areas of concentrated flows, and are not allowed in the City right-of-way. Sediment barriers or silt fences shall be used around the base of all stockpiles. Stockpiles shall not exceed 15 feet in height. Stockpiles greater than 15 feet in height shall require 8-foot wide benching in accordance with ROH Chapter 14, Article 15. Stockpiles must be covered with Plastic Sheeting or a comparable material if they will not be actively used within 7 days.

(l) Liquid Waste Management. Liquid waste shall be contained in a controlled area such as a holding pit, sediment basin, roll-off bin, or portable tank of sufficient volume and to contain the liquid wastes generated. Containment areas or devices must be impermeable and leak free and should not be located where accidental release of the contained liquid can Discharge to water bodies, channels, or storm drains.

(m) Concrete Waste Management. Prevent or reduce the Discharge of Pollutants to storm water from concrete waste by conducting washout offsite or performing onsite washout in a designated area constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations. Plastic lining material should be a minimum of 10-millimeter polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material. Containment areas or devices should not be located where accidental release of the contained liquid can Discharge to water bodies, channels, or storm drains. Washout facilities must be cleaned, or new facilities must be constructed and ready for use once the washout is 75 percent full. Once concrete wastes are washed into the designated area and allowed to harden, the concrete should be broken up,

removed, and disposed of as solid wastes.

(n) Contaminated Soil Management. At minimum contain contaminated material soil by surrounding with impermeable lined berms or cover exposed contaminated material with Plastic Sheeting. Contaminated soil should be disposed of properly in accordance with all applicable regulations.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-47 Dewatering Operations. (a) Dewatering Operations are practices that manage the Discharge of Pollutants when non-storm water and accumulated precipitation must be removed from a work location so that construction work may be accomplished and may include sediment basins, sediment traps, weir tanks, dewatering tanks, filtration systems, or other manufactured systems. Dewatering non-storm water cannot be Discharged from the Site without prior notice to and approval from the DOH.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

SUBCHAPTER 6
POST-CONSTRUCTION REQUIREMENTS

§20-3-48 Priority Projects
§20-3-49 Post-Construction Storm Water Requirements
§20-3-50 Storm Water Quality Strategic Plans
§20-3-51 Storm Water Quality Reports
§20-3-52 Storm Water Quality Checklists
§20-3-53 Operations and Maintenance Plans
§20-3-54 Post-Construction BMP Certification and Recording

§20-3-48 Priority Projects. (a) Priority Projects must include or provide permanent structural BMPs to effectively prevent the Discharges of Pollutants to the MS4 and State Waters by implementing Low Impact Development (LID) Site Design Strategies, Source Control BMPs, and Treatment Control BMPs which retain and/or treat storm water on Site. All Projects that meet one or more of the following criteria are Priority Projects:

(1) Priority A: All new Development and Redevelopment, including any incremental Development, that proposes Land Disturbing Activities of one acre or more, excluding contractor staging areas and base yards.

(2) Priority B1: Any new Development and Redevelopment Project that results in 5,000 square feet or greater of Impervious Surface area that may have significant water quality impacts due to its location or associated land use activities, including but not limited to the Development or Redevelopment of:

(i) Retail gas outlets;

(ii) Automotive repair shops;
(iii) Restaurants;
(iv) Parking lots with 20 stalls or more;
(v) Buildings greater than 100 feet in height;
(vi) Retail malls; and
(vii) Facilities used or zoned for industrial use.

(3) Priority B2: Any new Development and Redevelopment Project that results in between 500 and 5,000 square feet of Impervious Surface area that may have significant water quality impacts due to its location or associated land use activities, including but not limited to the Development or Redevelopment of:
(i) Retail gas outlets;
(ii) Automotive repair shops;
(iii) Restaurants;
(iv) Parking lots with 20 stalls or more;
(v) Buildings greater than 100 feet in height;
(vi) Retail malls; and
(vii) Facilities used or zoned for industrial use.

(b) Where 50 percent or more of the Impervious Surface of a previously developed Site will be altered, the entire Development Site must meet the requirements of these Rules.

(c) Where less than 50 percent of the Impervious Surface of a previously developed Site will be altered, only the proposed alteration must meet the requirements of these Rules.

(d) Priority Projects do not include Routine Maintenance and Repair of Impervious Surfaces, trenching and resurfacing work associated with utility installation in Real property or public and private streets, and the construction of temporary or permanent basins and drainage ways.

(e) A Priority Project is not determined by the cumulative areas of multiple noncontiguous and unrelated work.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-49 Post-Construction Storm Water Requirements. (a) The criteria must be met for Priority A, Priority B1, and Priority B2 Projects as follows:

(1) Incorporate appropriate LID Site Design Strategies to the MEP.
(2) Incorporate appropriate Source Control BMPs to the MEP.

(b) The criteria must be met for Priority A and B1 Projects as follows:

(1) Retain on-site by Infiltration, Evapotranspiration or Harvest/Reuse, as much of the Water Quality Volume or "WQV" as feasible, with appropriate LID Retention Post-Construction Treatment Control BMPs. The WQV is defined in §20-3-58.
(2) Biofilter the remaining portion of the WQV that is not retained on-site with appropriate LID Biofiltration Post-Construction Treatment Control BMPs as much as feasible.
(3) If it is demonstrated to be Infeasible to retain and/or biofilter the Water

Quality Volume (WQV) by the criteria in §20-3-63 one of the following alternative compliance measures is required:

(i) Treat (by detention, filtration, or settling) and Discharge with appropriate Alternative Compliance Post-Construction Treatment Control BMPs, any portion of the Water Quality Volume that is not retained on-site or biofiltered.

(ii) Retain or biofilter at an offsite location, the volume of runoff from a non-tributary drainage area equivalent to the difference between the Project's WQV and the amount retained on-site or biofiltered. Offsite mitigation Projects must be submitted for City approval.

(c) Post-Construction Treatment Control BMPs are categorized as Retention BMPs, Biofiltration BMPs, and BMPs for Alternative Compliance according to the following:

Treatment Control	**Retention**	**Biofiltration**	**Alternative Compliance**
Infiltration Basin	●		
Infiltration Trench	●		
Subsurface Infiltration[1]	●		
Dry Well	●		
Bioretention Basin	●		
Permeable Pavement	●		
Harvest / Reuse	●		
Green Roof		●	
Vegetated Bio-Filter[1]		●	
Enhanced Swale		●	
Vegetated Swale		●	
Vegetated Buffer Strip		●	
Detention Basin			●
Manufactured Treatment Device			●
Sand Filter			●

[1]Includes both proprietary and non-proprietary systems

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-50 Storm Water Quality Strategic Plans. (a) Priority A Projects must submit a Storm Water Quality Strategic Plan with or as a part of the Master Development Plan for Department review. The Strategic Plan shall include a written description of the proposed Development, expected activities and Pollutants that will be generated by activities at the Site, and LID Site Design Strategies that will be used to comply with these Rules. The Strategic Plan must include a Development schedule.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-51 Storm Water Quality Reports. (a) Priority A and Priority B1 Projects must submit a Storm Water Quality Report (SWQR) prepared by a Certified Water Pollution Plan Preparer (CWPPP), which must be reviewed and approved by the Director prior to issuance of a building, grading, grubbing, or stockpiling permit for Development. The CWPPP must be designated by the owner of the property using the form provided as Appendix A to these Rules.

(b) SWQRs shall be submitted using the report template provided as Appendix E to these Rules. The SWQR must address the requirements in §20-3-49 and must include the following information:

(1) Project Name;
(2) Master Plan Development Name;
(3) Project Address;
(4) Project size (acres);
(5) Impervious Area (square feet);
(6) Tax Map Key;
(7) The name, address, and telephone number of the owner(s)/ developers of the property;
(8) A description of Site characteristics including drainage patterns, soils, vegetation, and steep or unstable slopes that may be of concern;
(9) A description of the future activities at the Site including those that would require Source Control BMPs;
(10) A description of the Pollutants of concern (POC) expected to be generated at the Site (see §20-3-55); and
(11) A description of the BMPs that will be implemented including Site Design, Self-Mitigating Areas, Self-Retaining Areas, Source Control, Retention, Biofiltration, and Alternative Compliance and which POCs are addressed by those BMPs.
(12) The following reports and plans shall be included as attachments:
    (i) Location Map and Site Plans;
    (ii) Existing and Proposed Runoff Maps with Drainage Management Areas;
    (iii) Permanent BMP Plan including locations of all Source Control and Treatment Control BMPs and a clear and definite delineation of areas covered by vegetation or trees that will be saved;
    (iv) Treatment Control BMP Sizing Calculations or Spreadsheets;
    (v) Infiltration testing results;
    (vi) Operation and Maintenance Plan;
    (vii) Proprietary Treatment Device Washington State Department of Ecology Technology Assessment Protocol (TAPE) Certification or New Jersey Corporation for Advanced Technology (NJCAT) Verification Documentation; and
    (viii) Evidence or explanation for any feasibility and/or infeasibility criteria claimed in order to comply with the requirements for Infiltration, Harvest/ Reuse, and Biofiltration. Infeasibility criteria must be documented on the form provided as Appendix F to these Rules.

(c) SWQRs shall be submitted to the Director for review and approval with the first

set of building, grading, or construction plans for work on the Project or Site.

(d) The Director shall review SWQRs for conformance with the requirements of these Rules and require any revisions necessary to achieve compliance with these Rules. The Director may condition the approval of an SWQR on the implementation, use, and/or maintenance of BMPs not expressly required by these Rules if additional BMPs are necessary to reduce Pollutant Discharges to the MS4 and/or Receiving Waters to the MEP.

(e) Changes to an SWQR must be proposed to the Director in writing and approved by the Director before work resumes.

(f) Each failure to comply with the requirements of an SWQR approved by the Director shall be a separate violation of these rules. In addition, each day continuance of a violation shall be separate offense.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-52 Storm Water Quality Checklists. (a) Priority B2 Projects must submit a Storm Water Quality Checklist (SWQC) prepared by a CWPPP, which must be reviewed and approved by the Director prior to issuance of a building, grading, grubbing, or stockpiling permit for Development. The CWPPP must be designated by the owner of the property using the form provided as Appendix A to these Rules.

(b) SWQCs shall be submitted using the report template provided as Appendix G to these Rules. The SWQC must address the requirements in §20-3-49 and must include the following information:

(1) Project Name;
(2) Master Plan Development Name;
(3) Project Address;
(4) Total Project Size (acres or square feet);
(5) Impervious Area (square feet);
(6) Tax Map Key;
(7) The name, address, and telephone number of the owner(s)/ developers of the property;
(8) BMPs that will be implemented including Site Design Strategies, Self-Mitigating Areas, and Source Control BMPs;
(9) The Permanent BMP Plan including locations of all Site Design Strategies, Source Control BMPs, and vegetated or landscaped areas.

(c) SWQCs shall be submitted to the Director for review and approval with the first set of building, grading, or construction plans for work on the Project or Site.

(d) The Director shall review SWQCs for conformance with the requirements of these Rules and require any revisions necessary to achieve compliance with these Rules. The Director may condition the approval of an SWQC on the implementation, use, inspection, documentation, monitoring, and/or maintenance of BMPs not expressly required by these Rules if additional BMPs are necessary to reduce Pollutant Discharges to the MS4 and/or Receiving Waters to the MEP.

(e) Changes to an SWQC must be proposed to the Director in writing and approved by the Director before work resumes.

(f) Each failure to comply with the requirements of an SWQC approved by the Director shall be a separate violation of these rules. In addition, each day continuance of a violation shall be a separate offense.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-53 Operation and Maintenance Plans. (a) The owner of the property or the designated easement on which a permanent structural BMP is located must submit to the Director for acceptance an Operation and Maintenance Plan for all permanent structural BMPs. The Operation and Maintenance Plan must provide contact information for the individual(s), association, management company, or other responsible entity who shall inspect, document, implement, monitor, and maintain each of the BMPs, excluding those that are designated within limited common areas of individual subdivided lots or condominium property regimes (CPR), in compliance with the Operation and Maintenance Plan. Permanent structural BMPs include Self-Mitigating Areas, Self-Retaining Areas, Source Control BMPs, and Treatment Control BMPs. An Operation and Maintenance Plan is required for Priority A and Priority B1 projects.

(b) Operation and Maintenance Plans shall include:

(1) Name, phone number and mailing address for the owner of the property;

(2) Name and phone number for the individual(s), association, or management company responsible ensuring maintenance is being performed;

(3) Maintenance activities for each BMP;

(4) Inspection frequencies for each BMP;

(5) A Post-Construction BMP plan showing the location of each BMP with a summary of the maintenance activities and inspection schedule for each BMP; and

(6) Identification of the source of funds and/or revenue for implementation of the Operations and Maintenance Plan.

(c) Inspections of post-construction BMPs must be performed regularly and maintenance performed as needed. At a minimum, inspections shall be performed quarterly (4 times per year) and maintenance of all post-construction BMPs performed at least once annually.

(d) For facilities that will be dedicated to the City, the City reserves the right to alter the maintenance plan to conform to its practices.

(e) Modifications to the Operations and Maintenance plan after Department acceptance are permitted before closing applicable building and/or grading, grubbing, stockpiling, or trench permits.

(f) A record of inspection and maintenance activities must be kept on Site, in chronological order, and stored in a three-ring binder or electronically for a minimum of 5 years. The records must be kept on Site or electronically accessible from the Site at all times and shall be made available to the City immediately upon request.

(g) The Operations and Maintenance Plan must be prepared using the template provided as Appendix H to these Rules.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-54 Post-Construction BMP Certification and Recording. (a) Owners shall retain and/or hire a Certified Water Pollution Plan Preparer to observe the installation of Treatment Control BMPs during construction. The Certified Water Pollution Plan Preparer shall inspect the installation of post-construction BMPs at least 2 times prior to final stabilization to confirm that the Treatment Control BMPs and Source Control BMPs have been installed in conformance with the approved construction plans and submit the signed Certificate of Completion form provided as Appendix I to these Rules prior to closing the building and/or grading permits. Inspection Reports shall include photographic evidence, visual observation, maps, and test data, to confirm the installation of all required BMPs.

(b) Approved Permanent Post-Construction BMP Record Drawings and the accepted Operations and Maintenance Plan for projects on privately owned Real property shall be recorded in the State of Hawaii Land Court or Bureau of Conveyances, as appropriate. Post-Construction BMP Record Drawings and Operation and Maintenance Plans for regional BMPs shall be recorded with the land that contains the BMPs. Designated limited common areas or private areas with post-construction BMPs shall be defined in the recorded deed of each affected subdivided lot or CPR with a description of the permanent structural BMPs and the Operation and Maintenance Plan.

(c) For all Priority Projects, one copy of the drainage connection permit and Operations and Maintenance Plan shall be submitted to the Department and Director and Chief Engineer of the Department of Facility Maintenance prior to closing the building and/or grading, grubbing, or stockpiling permits.

(d) Modifications to the BMP Plan or Operations and Maintenance Plan after permit closure or after the drainage connection permit has been issued must be approved with the Department of Facility Maintenance. Any modifications to BMP plans or Operations and Maintenance Plans shall not reduce the level of protection from Pollutant Discharges afforded to State Waters or the MS4 when compared to the accepted plans prior to permit closure.

(e) Facilities with Post-Construction BMPs are subject to annual inspection by an Inspector from the Department of Facility Maintenance and must provide access to the facility for the annual inspections. Failure to comply with this requirement shall be a separate violation of these Rules. In addition, each day the violation continues shall be a separate offense.

(f) Each failure to comply with the requirements of an Operations and Maintenance Plan approved by the Director and on file at the Department of Facility Maintenance shall be a separate violation of these rules. In addition, each day the violation continues shall be a separate offense.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

SUBCHAPTER 7
BMPS, STANDARDS, AND SPECIFICATIONS FOR PERMANENT POST-CONSTRUCTION BMPS AND LOW IMPACT DEVELOPMENT

§20-3-55 BMP Selection
§20-3-56 Site Design Strategies
§20-3-57 Source Control BMPs

§20-3-58 Treatment Control BMPs Numeric Sizing Criteria
§20-3-59 Infiltration Testing
§20-3-60 Retention BMPs
§20-3-61 Biofiltration BMPs
§20-3-62 Alternative Compliance BMPs
§20-3-63 Feasibility Criteria

§20-3-55 BMP Selection. (a) Post-construction BMPs shall be chosen to address identified POCs for each Project Site and/or the Receiving Water for that Site.

Note: The following table summarizes the pollutants typically associated with the priority project land uses and more than one category may apply to a project.

Priority Project Categories	**Nutrients**	**Sediment**	**Trash**	**Pathogens**	**Pesticides**	**Oil & Grease**	**Metals**	**Organic Compounds**
Priority A: Residential Development > one acre	X	X	X	X	X	X		
Priority A: Commercial Development >one acre	P(1)	P(1)	X	P(3)	P(5)	X	X	P(2)
Priority B: Facilities used or zoned for industrial use		X	X			X	X	X
Priority B: Automotive Repair Shops			X			X	X	X(4)(5)
Priority B: Restaurants			X	X	P(1)	X		
Priority B: Parking Lots	P(1)	P(1)	X		P(1)	X	X	X
Priority B: Retail Gas Outlets			X			X	X	X
Priority B: Buildings greater than 100 feet in height	X	X	X	X	X	X		
Priority B: Retail malls	P(1)	P(1)	X	P(3)	P(5)	X	X	P(2)
(All) Streets, Highways & Freeways	P(1)	X	X	X	P(1)	X	X	X(4)

X = anticipated P = potential

(1) A potential Pollutant if landscaping exists onsite.
(2) A potential Pollutant if the Project includes uncovered parking areas.
(3) A potential Pollutant if land use involves food or animal waste products.
(4) Including petroleum hydrocarbons.
(5) Including solvents

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-56 Site Design Strategies. (a) All Priority A and Priority B Projects shall implement Site Design Strategies. Site Design strategies are LID design techniques that are intended to maintain or restore the Site's hydrologic and hydraulic functions with the intent of minimizing runoff volume and preserving existing flow paths. Site Design Strategies reduce the

amount of storm water runoff that requires treatment, resulting in smaller Treatment Control BMP size. They include:

(1) Conserve natural areas, soils, and vegetation.
(2) Minimize disturbances to natural drainages.
(3) Minimize soil compaction.
(4) Minimize Impervious Surfaces.
(5) Direct Runoff to Landscaped Areas and Reduce directly connected impervious areas (DCIA).

(b) Site Design Strategies may be used to exclude drainage management areas on the Site from requiring additional Treatment Control BMPs if they are Self-Mitigating or Self-Retaining.

(1) Self-Mitigating Areas consist of natural or landscaped area, including green roofs, which retain and/or treat rainfall over the footprint of the Self-Mitigating Area but do not accept runoff from other areas. Self-Mitigating Areas may drain directly to the MS4 or other off-site drainage without further treatment and can be excluded in calculation of the WQV or WQF. They must meet all the following criteria to be eligible for exclusion:
   (i) Vegetation in the natural or landscaped area is native and/or non-native/non-invasive drought tolerant species that do not require regular application of fertilizers and pesticides.
   (ii) Soils are undisturbed native topsoil, or disturbed soils that have been amended and aerated to promote water retention characteristics equivalent to undisturbed native topsoil.
   (iii) The incidental impervious areas are less than 5 percent of the Self-Mitigating Area.
   (iv) Impervious area within the Self-Mitigating Area should not be hydraulically connected to other impervious areas unless it is a storm water conveyance system (such as brow ditches).
   (v) The Self-Mitigating Area is hydraulically separate from other drainage areas that contain permanent storm water Pollutant control BMPs.
(2) Self-Retaining Areas are areas of a development site that are designed to retain the first 1 inch of rainfall (by ponding and infiltration and/ or evapotranspiration) on itself and from adjacent areas without producing storm water runoff. Self-Retaining Areas may be created by designing concaved landscaped areas at a lower elevation or which are bermed or ditched to accept runoff from adjacent impervious areas. They must meet all the following criteria to be eligible for exclusion:
   (i) A maximum of 1:1 ratio of impervious area to the receiving pervious area is acceptable. The maximum impervious to pervious area ratio may be increased to 1.5:1 if the soils in the pervious receiving area have been amended by incorporating at least 8 inches of compost/ amendments and tilled/ aerated to promote water infiltration and retention.
   (ii) The functional area of the Self-Retaining Area must be flat (less than 5%), designed for sheet flow, and with a minimum of 10 feet from

inflow to overflow route. Berms or other design features may be required to distribute flow throughout the Self-Retaining Area.

(iii) Side slopes and flow paths shall be protected from erosion by minimizing concentrated flows into the Self-Retaining Area using appropriate velocity dissipation methods (e.g. riprap or level spreaders).

(iv) Vegetation should be native and/or non-native/non-invasive drought tolerant species that can tolerate periodic ponding and do not require regular application of fertilizers and pesticides.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-57 Source Control BMPs. (a) Source Control BMPs are required for all Priority A and B Projects for the following activities and areas: Landscaped areas, Automatic irrigation systems, Storm drain Inlets, Vehicle/equipment fueling, Vehicle/equipment repair, Vehicle/equipment washing/cleaning, Loading docks, Outdoor trash storage, Outdoor material storage, Outdoor work areas, Outdoor process equipment operations, and Parking areas. They shall be implemented to the MEP.

(b) Landscaped areas.
  (1) Limit runoff from landscaped areas to impervious areas
  (2) Protect slopes and channels

(c) Automatic Irrigation.
  (1) Design irrigation systems to each landscape area's specific water requirements.
  (2) Implement landscape plans consistent with City water conservation resolutions, which may include provision of drip irrigation, water sensors, or programmable irrigation times (for short cycles)
  (3) Design timing and application methods of irrigation water to Minimize the runoff of excess irrigation water into the storm water drainage system.
  (4) Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration.

(d) Storm Drain Inlets.
  (1) Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the Project area with prohibitive language.
  (2) Place the marker in clear sight facing toward anyone approaching the inlet from either side
  (3) Signage must not be placed on the face of curbs to avoid contact with vehicle tires and sweeper brooms.
  (4) Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and streams within the Project area.

(e) Vehicle and Equipment fueling areas.
  (1) Covering. Include an overhanging roof structure or canopy over fuel dispensing areas. The cover's minimum dimensions must be equal to or

greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. If fueling large equipment or vehicles that prohibit the use of covers or roofs, the fueling island should be designed to accommodate the larger vehicles and equipment and to prevent storm water run-on and runoff.

(2) Surfacing. Pave fuel dispensing areas with Portland cement concrete (or equivalent smooth Impervious Surface). Extend the paved area a minimum of 6.5 feet from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot, whichever is less. The use of asphalt concrete is prohibited. Use asphalt sealant to protect asphalt paved areas surrounding the fueling area.

(3) Grading/Contouring. Slope the dispensing areas to prevent ponding, and separate it from the rest of the Site by a grade break that prevents run-on. Grade the fueling areas to drain toward a dead-end sump or vegetated/landscaped area. Direct runoff from downspouts/roofs away from fueling areas towards vegetated/landscaped areas if possible.

(4) Drains. Label all drains within facility boundaries using paint or stencil, to indicate whether flow is to the storm drain, sewer, or oil/water separator.

(f) Vehicle and Equipment Repair.

(1) Locate repair/ maintenance bays indoors; or design them to preclude run-on and runoff.

(2) Pave repair /maintenance floor areas with Portland cement concrete (or equivalent smooth Impervious Surface).

(3) Provide impermeable berms, drop inlets, trench drain, catch basins, or overflow containment Structures around repair bays to prevent spilled materials and wash-down waters from entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/ maintenance bays to the storm drain system is prohibited.

(4) Label all drains within facility boundaries using paint or stencil, to indicate whether flow is to the storm drain, sewer, or oil/ water separator.

(g) Vehicle and Equipment Washing and Cleaning. At least one of the following features for vehicle and equipment washing must be incorporated into the Project design:

(1) Be self-contained and/or covered with a roof or overhang; or

(2) Be equipped with a clarifier or other pretreatment facility; or

(3) Have a proper connection to a sanitary sewer; or

(4) Install sumps or drain lines to collect wash water. Divert wash water to the sanitary sewer, an engineered Infiltration system, or an equally effective alternative; or

(5) Direct and divert surface water runoff away from the exposed area around the wash pad, and wash pad itself to alternatives other than the sanitary sewer; or

(6) Cover areas used for regular washing of vehicles, trucks, or equipment, surround them with a perimeter berm, and clearly mark them as a

designated washing area

(7) Label all drains within facility boundaries using paint or stencil, to indicate whether flow is to the storm drain, sewer, or oil/water separator.

(8) Approval for a sanitary connection must be obtained from the City Department of Environmental Services and may require an industrial wastewater Discharge permit.

(h) Residential Vehicle and Equipment Washing for Condominiums and Apartment Buildings.

(1) Designate a car wash area and post signs for area.

(2) Divert wash water to a vegetated area where it may percolate into the ground, the sanitary sewer, an engineered Infiltration system, or an equally effective alternative.

(3) Direct and divert surface water runoff away from the wash area to alternatives other than the sanitary sewer.

(4) Approval for a sanitary connection must be obtained from the City Department of Environmental Services.

(d) Loading Docks.

(1) Cover all loading dock areas, or design them to preclude run-on and runoff.

(2) Do not allow runoff from depressed loading docks (truck wells) to Discharge into storm drains.

(3) Drain below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items through water quality inlets, an engineered Infiltration system, or an equally effective alternative.

(4) Grade and/or berm the loading/unloading area to a drain that is connected to a dead-end.

(5) Pave loading areas with Portland cement concrete.

(j) Outdoor Trash Storage.

(1) Hazardous waste must be handled in accordance with legal requirements established in Hawaii Administrative Rules Title 11 Chapter 58.1 Solid Waste Management Control, and enforcement by the State of Hawaii Department of Health solid and Hazardous Waste Branch.

(2) Berm trash storage areas to prevent run-on from adjoining roofs and pavement, or grade areas towards vegetated/landscaped areas.

(3) Reduce/prevent leaking of liquid waste by incorporating at least one of the following: Lined bins or dumpsters, Low containment berm around the dumpster area, or Drip pans underneath dumpsters

(4) Prevent rainfall from entering containers with roofs, awnings, or attached lids.

(5) Pave trash storage areas with an Impervious Surface to mitigate spills.

(6) Do not locate storm drains in immediate vicinity of the trash storage area.

(7) Post signs on dumpsters indicating that hazardous material are not to be disposed of therein.

(k) Outdoor Material Storage may be in the form of raw products, by-products, finished products, and waste products.

(1) Materials with the potential to contaminate storm water must either be placed in an enclosure that prevents contact with runoff or spillage to the storm water conveyance system, or protected by secondary containment Structures such as berms, dikes, or curbs.
(2) Pave the storage area with Portland cement concrete (or equivalent smooth Impervious Surface) to contain leaks and spills.
(3) Slope the storage area towards a dead-end sump to contain spills.
(4) Direct runoff from downspouts/roofs away from storage areas.
(5) Cover the storage area with an awning that extends beyond the storage area to Minimize collection of storm water within the secondary containment area. A manufactured storage shed may be used for small containers.

(l) Outdoor Work Areas may include but are not limited to areas where grinding, painting, coating, sanding, and parts cleaning are performed.

(1) Use an impermeable surface such as concrete or asphalt, or a prefabricated metal drip pan, appropriate for the work area.
(2) Cover the area with a roof to prevent rain from falling on the work area and becoming polluted runoff.
(3) Berm or perform mounding around the perimeter of the area to prevent water from adjacent areas from flowing on to the surface of the work area.
(4) Directly connect runoff to the sanitary sewer or other specialized containment system(s). This allows the more highly concentrated Pollutants from these areas to receive special treatment that removes particular constituents. Approval for a sanitary connection must be obtained from the City Department of Environmental Services and may require an industrial wastewater Discharge permit.
(5) Locate the work area away from storm drains or catch basins.

(m) Outdoor Process Equipment Operations may include but are not limited to rock grinding or crushing, painting or coating, grinding or sanding, and degreasing or parts cleaning.

(1) Cover or enclose areas that would be the most significant source of Pollutants; or slope the area toward a dead-end sump; or, Discharge to the sanitary sewer system following appropriate treatment in accordance with conditions established by the City Department of Environmental Services.
(2) Grade or berm area to prevent run-on from surrounding areas.
(3) Do not install storm drains in areas of equipment repair.
(4) Provide secondary containment Structures (not double wall containers) where wet material processing occurs (e.g., electroplating), to hold spills resulting from accidents, leaking tanks, or equipment, or any other unplanned releases (Note: if these are plumbed to the sanitary sewer, they must be with the prior approval of the City.)

(n) Parking Areas that are paved with impermeable material must be graded to direct runoff towards vegetated/landscaped areas or other Post-Construction Treatment Control BMPs.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-58 Treatment Control BMPs numeric sizing criteria. (a) Treatment Control BMPs include retention (Infiltration and Harvest/ Reuse) BMPs, Biofiltration BMPs, and manufactured treatment devices and are sized either based on volume, flow, or demand, depending on the BMP.

(b) Treatment Control BMPs shall be designed off-line from the drainage system, unless a bypass system is provided for the design storm.

(c) Drainage management areas should be defined based on proposed drainage patterns of the Site and BMPs to which they drain. More than one drainage management area can drain to a single BMP but a single drainage management area cannot drain to more than one BMP unless those BMPs are in series and not parallel. Drainage management area calculations for Treatment Control should not include Self-Mitigating Areas and Self-Retaining Areas.

(d) De Minimis Areas are very small drainage areas that are not significant contributors of Pollutants. Examples include portions of sidewalks, driveways, and retaining walls at the external boundary of a Project. De Minimis Areas can be excluded from Treatment Control requirements and WQV or WQF calculations if they meet all of the following characteristics:

(1) Areas abut the perimeter of the Development Site.

(2) Topography or land ownership constraints make BMP construction Infeasible.

(3) The sum of all De Minimis areas should represent less than 5 percent of the total Project size.

(e) Volume based BMPs numeric sizing criteria. Volume based storm water quality facilities include LID retention BMPs: Infiltration Basins, Infiltration Trenches, Subsurface Infiltration Systems, Dry Wells, Bioretention Basins, Permeable Pavement; Biofiltration BMPs: Green Roofs, Vegetated Bio-Filters, Enhanced Swales; and Alternative Compliance BMPs: Detention Basins, and Sand Filters.

(1) Volume based BMPs shall be sized for the Water Quality Volume (WQV), which is calculated as follows:

$$WQV = P C A \times 3630$$

Where:

WQV	=	water quality volume (cubic feet)
P	=	design storm runoff depth (inches)
C	=	volumetric runoff coefficient
A	=	drainage management area(s) (acres)

(2) A design storm runoff depth of 1 inch shall be used for LID retention BMPs. A design storm runoff depth of 1.5 inches shall be used for volume-based Biofiltration and Alternative Compliance BMPs.

(3) The volumetric runoff coefficient shall be calculated using the following equation as developed by EPA for smaller storms in urban areas:

$$C = 0.05 + 0.009I$$

Where:

C	=	volumetric runoff coefficient
I	=	percent of impervious cover, expressed as a percentage

(f) Flow-through based BMPs Numeric Sizing Criteria. Flow-through based BMPs include Vegetated Swales, Vegetated Filter Strips, and Alternative Compliance Manufactured Treatment Devices.

(1) Flow-through based BMPs shall be sized for the Water Quality Flow Rate

(WQF), which is calculated using the Rational Formula as follows:

WQF = 1.5 X CiA

Where: WQF = water quality flow rate (cubic feet per second)
C = runoff coefficient
i = peak rainfall intensity (inches per hour)
A = drainage management area(s) (acres)

(2) A peak rainfall intensity of 0.4 inches per hour shall be used.

(3) The runoff coefficient shall be determined from the table below.

(4) For drainage areas containing multiple land uses the following formula may be used to compute a composite weighted runoff coefficient:

$$C_c = \left(\sum_{i=1}^{n} C_i A_i\right) / A_t$$

Where: C_c = composite weighted runoff coefficient
$C_{1,2,\ldots n}$ = runoff coefficient for each land use cover type
$A_{1,2,\ldots n}$ = drainage area of each land use cover type (acres)
A_t = total drainage area (acres)

(5) The calculated WQF for Vegetated Swales and Vegetated Filter Strips may be reduced by 25 percent if the soil beneath the BMP is classified as Hydrologic Soils Group (HSG) "A" or "B", as reported by the United States Department of Agriculture (USDA) Natural Resources Conservation Service, or if the soil beneath the BMP is amended by incorporating 6 inches of compost/amendments and tilled up to 8 inches.

Note: the following table provides runoff coefficients to be used for Flow-through based BMP calculations

Type of Surface	**Runoff Coefficient**
Roofs	0.90
Concrete	0.80
Stone, brick, or concrete pavers with mortared joints and bedding	0.80
Asphalt	0.70
Stone, brick, or concrete pavers with sand joints and bedding	0.70
Pervious Concrete	0.10
Porous asphalt	0.10
Permeable interlocking concrete pavement	0.10
Grid pavements with grass or aggregate surface	0.10
Crushed aggregate	0.10
Grass	0.10

Grass over Porous Plastic	0.05
Gravel over Porous Plastic	0.05

Note: These runoff coefficients are only appropriate for small storm treatment design and should not be used for flood control sizing.

(g) The sizing procedures for BMP size based on the WQV and WQF are based on simple dynamic and static principles and therefore may result in larger BMPs than are necessary. More rigorous sizing methods, such as detailed routing methods or continuous simulation models, may be used with Director approval. Any other sizing method for retention BMPs must retain the first 1 inch of rainfall. Any treat and release BMP must use a design storm depth of 1.5 inches.(h) Demand based BMP Numeric Sizing Criteria. Demand based BMPs include Harvest /Reuse. One of two equivalent performance standards shall be met:

(1) Harvest and Reuse BMPs must be designed to capture at least 80 percent of average annual (long term) runoff volume AND meet 80 percent of the annual overall demand. If these criteria are met then no further BMPs are required to retain the WQV for the contributing drainage management area(s).

(2) Harvest and Reuse BMPs must be sized to meet] the 48-hour demand at the Site at a minimum. It is rare that cisterns can be sized to capture the full WQV and use this volume in 48 hours, therefore the BMP should be sized to meet the estimated 48-hour demand and the remaining WQV not captured is required to be retained onsite through Infiltration/ evapotranspiration or, if Infeasible, treated with Biofiltration or Alternative Compliance as required in §20-3-49.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-59 Infiltration Testing. (a) The Infiltration rate, or permeability, measured in inches per hour, is the rate at which water passes through the soil profile during saturated conditions. Soil investigations and Infiltration tests are required to accurately determine the local soil characteristics and capacity for Infiltration. For Infiltration basins, subsurface Infiltration systems, dry wells, bioretention basins, and permeable pavement, at a minimum, one permeability test must be performed for every 2,500 square feet. For Infiltration trenches, at a minimum, one permeability test must be performed for every 100 linear feet.

(b) Design Infiltration Rates. To account for uncertainties and inaccuracies in testing, a correction (i.e., safety) factor shall be applied to the assumed or measured Infiltration rate to produce a design Infiltration rate for BMP sizing calculations. The minimum safety factor shall be 2 for Infiltration facilities.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-60 Retention BMPs. Retention BMPs include Infiltration BMPs and Harvest/

Reuse.

(a) Infiltration Basin. An Infiltration basin is a shallow impoundment with no outlet, where storm water runoff is stored and infiltrates through the basin invert and into the soil matrix.

(1) Infiltration Basins shall have a flat invert, interior side slopes (length per unit height) no steeper than 3 horizontal to 1 vertical unless approved by a licensed Engineer with geotechnical expertise, and at least 3 feet from the basin invert to the seasonally high groundwater table. For side slopes greater than 3 horizontal to 1 vertical, permanent Erosion Control using Geotextiles or Rolled Erosion Control Products and grassing is required.

(2) The soil Infiltration rate below the basin invert shall be at least 0.5 inches per hour, and drain completely in 48 hours.

(b) Infiltration Trench. An Infiltration trench is a rock-filled trench with no outlet, where storm water runoff is stored in the void space between the rocks and infiltrates through the bottom and into the soil matrix.

(1) Infiltration Trenches shall have no more than 6 inches of a top backfill layer, no more than 12 inches of a bottom sand layer, and 1.5-3.0 inch diameter trench rock.

(2) The soil Infiltration rate below the trench invert shall be at least 0.5 inches per hour, the depth from the trench invert to the seasonally high groundwater table shall be at least 3 feet, and the trench shall completely drain in 48 hours.

(3) The depth of the Infiltration trench shall not exceed the greater of the trench width and trench length to avoid classification as an Underground Injection Control (UIC) Class V injection well.

(c) Subsurface Infiltration System. A subsurface Infiltration system is a rock (or alternative pre-manufactured material) storage bed below other surfaces such as parking lots, lawns and playfields for temporary storage and Infiltration of runoff.

(1) In addition to applicable manufacturer's guidelines, the soil Infiltration rate below the system invert shall be at least 0.5 inches per hour, the depth from the system invert to the seasonally high groundwater table shall be at least 3 feet, and the system shall completely drain in 48 hours.

(2) The depth of the subsurface Infiltration system storage bed shall not exceed the greater of the storage bed's width and storage bed's length to avoid classification as a UIC Class V injection well.

(d) Dry Well. A dry well is a subsurface aggregate-filled or prefabricated perforated storage facility, where roof runoff is stored and infiltrates into the soil matrix.

(1) The soil Infiltration rate below the dry well invert shall be at least 0.5 inches per hour, the depth from the dry well invert to the seasonally high groundwater table shall be at least 3 feet, and the dry well shall completely drain in 48 hours.

(2) If the dry well is aggregate-filled, 1.0-3.0 inch aggregate shall be used unless an alternative is approved by a licensed Engineer with geotechnical expertise.

(3) The depth of the dry well shall not exceed the diameter to avoid classification as an UIC Class V injection well.

(e) Bioretention Basin. Sometimes referred to as a Rain Garden, a Bioretention Basin is an engineered shallow depression that collects and filters storm water runoff using conditioned planting soil beds and vegetation. The filtered runoff infiltrates through the basin invert and into the soil matrix.

(1) Bioretention Basins shall have a flat invert, interior side slopes (length per unit height) no steeper than 1:1 for single family residential installations and no steeper than 3 horizontal to 1 vertical for all other installations unless approved by a licensed Engineer with geotechnical expertise, and at least 3 feet from the basin invert to the seasonally high groundwater table. For side slopes greater than 3 horizontal to 1 vertical, permanent Erosion Control using geotextiles or erosion mats and grassing is required.

(2) The ponding depth shall be no greater than 12 inches, the mulch thickness shall be 2-4 inches, and the planting soil depth shall be 2-4 feet.

(3) The soil Infiltration rate below the basin invert shall be at least 0.5 inches per hour, and the basin shall drain completely in 48 hours.

(f) Permeable Pavement. Sometimes referred to as pervious pavement or porous pavement, permeable pavement refers to any porous, load-bearing surface that allows for temporary rainwater storage in an underlying aggregate layer until it infiltrates into the soil matrix. It includes pervious concrete, porous asphalt, interlocking paver blocks, and reinforced turf grassing and gravel filled grids.

(1) Permeable pavement shall have a reservoir layer no thicker than 3 feet and have at least 3 feet from the reservoir invert to the seasonally high groundwater table.

(2) The soil beneath the reservoir layer invert shall have an Infiltration rate of at least 0.5 inches per hour, and the reservoir layer shall drain completely in 48 hours.

(g) Harvest/Reuse. Sometimes referred to as Capture/Reuse or Rainwater Harvesting, Harvest/Reuse is the collection and temporary storage of roof runoff in rain barrels or cisterns for subsequent non-potable use (landscape irrigation, vehicle washing and other uses as allowed by the Building Code).

(1) Harvest/ Reuse facilities must be sized according to the sizing criteria in §20-3-58 or other methods appropriate to compute the storage volume.

(2) Harvest/ Reuse facilities must not conflict with any applicable building codes.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-61 Biofiltration BMPs.

(a) Green Roof. Sometimes referred to as a Vegetated Roof or Eco-roof, a green roof is a roof that is entirely or partially covered with vegetation and soils for the purpose of filtering, absorbing, evapotranspirating, and retaining/ detaining the rain that falls upon it.

(1) Green roofs shall have a slope no greater than 20 percent, at least 2 inches of soil media, and at least 2 inches of drainage layer.

(b) Vegetated Bio-Filter. This category of BMPs may be referred to as a Bioretention

Filter, Stormwater Curb Extension, Tree box filter, or Planter Box. A Vegetated Bio-Filter is an engineered or proprietary system that collects and filters storm water runoff using conditioned planting soil beds and vegetation. The filtered runoff Discharges through an underdrain system.

(1) Engineered vegetated Bio-Filters shall have a relatively flat invert, the ponding depth shall be no greater than 12 inches, the mulch thickness shall be 2-4 inches, and the planting soil depth shall be 2-4 feet.

(2) Engineered vegetated Bio-Filters planting soil shall have a coefficient of permeability equal to at least 1.0 foot per day, and the WQV shall drain completely in 48 hours.

(3) Non-vegetated filter media may be used in lieu of planting soil.

(4) For proprietary systems, the BMP must be certified for general use by the Washington State Department of Ecology Technology Assessment Protocol (TAPE) for Enhanced Treatment (for the treatment of dissolved metals), Phosphorous Treatment, or Oil Treatment, according to the predominant Pollutant(s) of concern at that Site.

(c) Dry Swale. Sometimes referred to as a Bioretention Swale or Enhanced Swale, a Dry Swale is a shallow linear channel with a planting bed and covered with turf or other surface material (other than mulch or plants). Runoff filters through a planting bed, is collected in an underdrain system, and Discharged at the downstream end of the swale.

(1) Enhanced Swales shall have interior side slopes (length per unit height) no steeper than 3 horizontal to 1 vertical unless approved by a licensed Engineer with geotechnical expertise, a bottom width between 2-8 feet, and a longitudinal slope no greater than 2 percent without check dams or 5 percent with check dams. For side slopes greater than 3 horizontal to 1 vertical, permanent Erosion Control using geotextiles or erosion mats and grassing is required.

(2) If used, check dams shall be no higher than 12 inches. The maximum ponding depth is 18 inches and the minimum media depth is 18 inches.

(d) Vegetated Swale. Sometimes referred to as a Grass Swale, Grass Channel, or Biofiltration Swale, a vegetated swale is a broad shallow earthen channel vegetated with erosion resistant and flood tolerant grasses. Runoff typically enters the swale at one end and exits at the other end.

(1) Vegetated Swales shall have interior side slopes (length per unit height) no steeper than 3 horizontal to 1 vertical unless approved by a licensed Engineer with geotechnical expertise, a bottom width no greater than 10 feet, and a water depth no greater than 4 inches.

(2) The velocity in the swale shall not exceed 1 foot per second, and the hydraulic residence time shall be at least 7 minutes.

(e) Vegetated Buffer Strip. Sometimes referred to as a Vegetated Filter Strip or Biofiltration Strip, a vegetated buffer strip is a grassy slope vegetated with turf grass that is designed to accommodate sheet flow. They may remove Pollutants by vegetative filtration.

(1) Vegetated Buffer Strips shall have a length (in the direction of flow) no less than 15 feet, the depth of flow shall not exceed 1 inch, and the velocity shall not exceed 1 foot per second. The length of the filter strip in the direction of flow may be noncontiguous so long as the minimum length is met for the tributary area.

(2) The flow length of the tributary area discharging perpendicularly onto the strip shall not exceed 75 feet.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-62 Alternative Compliance BMPs.

(a) Manufactured Treatment Device. A manufactured treatment device is a proprietary water quality structure utilizing settling, filtration, adsorptive/absorptive materials, or other appropriate technology to remove Pollutants from storm water runoff.

(1) The device must provide, at minimum, a total suspended solids (TSS) removal rate of 80 percent, certified for general use by the Washington State Department of Ecology Technology Assessment Protocol (TAPE) or verified by the New Jersey Corporation for Advanced Technology (NJCAT) consistent with the New Jersey Department of Environmental Protection (NJDEP) protocols.

(2) Systems not meeting the required TSS removal criteria are allowed as pre-treatment for other BMPs

(b) Detention Basin. Sometimes referred to as a Dry Extended Detention Basin, a detention basin is a shallow man-made impoundment intended to provide for the temporary storage of storm water runoff to allow particles to settle. It does not have a permanent pool and is designed to drain between storm events.

(1) Detention Basins shall have an invert sloped between 1 to 2 percent, interior side slopes (length per unit height) no steeper than 3 horizontal to 1 vertical unless approved by a licensed Engineer with geotechnical expertise, a minimum length to width ratio of 2 to 1, and a maximum depth of 8 feet.

(2) With outlets no smaller than 4 inches in diameter, the basin shall drain completely in 48 hours when full and 24-36 hours when half full.

(c) Sand Filter. A sand filter is an open chambered structure that captures, temporarily stores, and treats storm water runoff by passing it through an engineered media (e.g., sand).

(1) Sand filter beds shall have at least 18 inches of sand with a coefficient of permeability of at least 3.5 feet per day, and shall drain completely in 48 hours.

[Eff December 24, 2018] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

§20-3-63 Feasibility Criteria. For compliance with §20-3-49 of these Rules, the following feasibility criteria are established.

(a) Infiltration Feasibility. Infiltration BMPs are Infeasible and must not be used if any of the following conditions are met:

(1) Soils beneath the BMP invert have measured Infiltration rates of less than

0.5 in/ hr or are USDA HSG "C" or "D" as reported by the USDA Natural Resources Conservation Service;

(2) The seasonally high groundwater table is within 3 feet from the BMP invert;

(3) There is a documented concern that there is a potential onsite for soil Pollutants, ground water Pollutants, or Pollutants associated with industrial activities to be mobilized;

(4) There are geotechnical concerns at the Site;

(5) Excavation for the installation of the BMP would disturb iwi kupuna or other archeological resources;

(6) The BMP cannot be built within the following setbacks:

(i) 50 feet from the nearest drinking water well;

(ii) 35 feet from the nearest septic system;

(iii) 10 feet from the nearest private property line;

(iv) 20 feet from the nearest building foundation at the Project Site;

(v) 100 feet from the nearest down-gradient building foundation; or

(7) Infiltration facilities would conflict with the location of existing or proposed underground utilities or easements, or would result in their placement on top of underground utilities, or otherwise oriented to underground utilities, such that they would Discharge to the utility trench, restrict access, or cause stability concerns.

(b) Harvest/Reuse feasibility. Harvest/ Reuse is considered Infeasible for the any of the flowing reasons:

(1) The demand is inadequate to reuse the required volume of water;

(2) The technical requirements cause the harvesting system to exceed 2 percent of the total Project cost;

(3) The Site where a cistern must be located is at a slope greater than 10 percent;

(4) There is no available space to locate a cistern of adequate size to harvest and use the required amount of water;

(5) The cistern cannot be built within the following setbacks:

(i) 10 feet from the nearest septic system;

(ii) 5 feet from the nearest private property line;

(iii) 5 feet from the nearest building foundation at the Project Site; or

(6) The Project includes a reclaimed water system and demand for a harvest/ reuse system cannot be met.

(c) Biofiltration feasibility.

(1) Vegetated Biofilters are Infeasible for any of the following reasons:

(i) Excavation would disturb iwi kupuna or other archaeological resources;

(ii) The invert of underdrain layer is below seasonally high groundwater table;

(iii) The Site does not receive enough sunlight to support vegetation;

(iv) The Site lacks sufficient hydraulic head to support BMP operation by gravity; or

(v) Unable to operate off-line with bypass and unable to operate in-

line with safe overflow mechanism;

(2) Green Roofs are Infeasible for any of the following reasons:
  (i) The roof is for a single family residential dwelling;
  (ii) Roof space is unavailable due to renewable energy, electrical, and/or mechanical systems; or
  (iii) Slope on roof exceeds 25 percent (14 degrees);

(3) Dry Swales are Infeasible for any of the following reasons:
  (i) Excavation would disturb iwi kupuna or other archaeological resources;
  (ii) The invert of underdrain layer is below seasonally high groundwater table;
  (iii) The Site lacks sufficient hydraulic head to support BMP operation by gravity; or
  (iv) Unable to operate off-line with bypass and unable to operate in-line with safe overflow mechanism.

(4) Vegetated Swales are Infeasible for any of the following reasons:
  (i) The excavation would disturb iwi kupuna or other archaeological resources;
  (ii) The Site does not receive enough sunlight to support vegetation; or
  (iii) Unable to operate off-line with bypass and unable to operate in-line with safe overflow mechanism.

(5) Vegetated filter strips are Infeasible for any of the following reasons:
  (i) Excavation would disturb iwi kupuna or other archaeological resources;
  (ii) The Site does not receive enough sunlight to support vegetation; or
  (iii) Unable to operate off-line with bypass and unable to operate in-line with safe overflow mechanism.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1)

SUBCHAPTER 8
VARIANCES

§20-3-64 Variances

§20-3-64 Variances. (a) Petitions for variances from the requirements of these rules may be submitted to the Director.

(b) Petitions for a variance must include:
  (1) The name, address, phone number and email address of the petitioner;
  (2) A designation of the specific sections and provisions of these rules from which variance is sought;
  (3) A narrative explanation of the grounds on which the variance may be granted; and

(4) Engineer certified plans, illustrations, and/or calculations in support of the petition.

(c) The Director may authorize a petitioner to vary from any requirement established by these rules if the petitioner is able to establish all of the following are true:

(1) The variance is necessary to prevent a hardship caused by unique Site conditions on the property that are not ordinarily found in other areas within the City;

(2) The unique conditions on the property are not the result of petitioner's own actions or the actions of h/her agents, contractors, consultants, or tenants;

(3) Granting a variance will not adversely affect the rights of abutting property owners;

(4) The variance requested will not result in an unreasonable threat of Pollutant Discharges to the MS4 or State Waters;

(5) The variance requested is the minimum accommodation needed to overcome the hardship caused by naturally occurring conditions on the property; and

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§1-9.1, 14-12.31, 14-12.32) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 14-12.32, 18-4.1, 18-5.1).

SUBCHAPTER 9
VIOLATIONS AND ENFORCEMENT

§20-3-65 BMP Deficiencies
§20-3-66 Enforcement
§20-3-67 Penalties

§20-3-65 BMP Deficiencies. BMP Deficiencies and violations of ESCPs shall be classified as critical, major, and minor deficiencies as follows.

(a) Critical deficiencies are any BMP deficiencies that result in or pose an immediate threat of Pollutants Discharges to the MS4 or state waters.

(b) Major deficiencies are non-critical deficiencies that indicate a lack of good-faith efforts to comply with the requirements of these rules and those deficiencies that may reasonably be expected to result in the Discharge of Pollutants to the MS4 or state waters under rain conditions with a 10 year recurrence interval or less.

(c) Minor deficiencies means those deficiencies that do not pose a threat for Discharge of untreated storm water or Pollutants to the MS4, surface waters, or State waters, but are not in strict conformance with an approved ESCP.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-66 Enforcement. (a) If the Director determines that any person is violating any provision of these rules, the Director may issue a notice of violation and order to the person or persons responsible for the violation. The person responsible for a violation of these rules shall be the owner of the Real property on which the violation occurs and the person responsible for implementing the ESCP for the Project. The responsible person or persons may also include all persons who directed, authorized, allowed, or participated in the acts of omissions that cause the violation to occur.

(b) The notice of violation shall contain the following:

(1) The date of the notice
(2) The name and address of the person or persons served with the notice
(3) The section of the ordinance or rule that has been violated
(4) The nature of the violation; and
(5) The deadline for compliance with the notice.

(c) Contents of the Order. The order may require the person or persons responsible for the violation to do any or all of the following:

(1) Cease and desist from the violation;
(2) Correct the violation at the person's own expense;
(3) Pay and administrative fine; or
(4) Appear before the Director at the time and place specified by the order to answer charges and explain why a fine for the violation should not be imposed; and
(5) Clean and abate any Discharge to the MS4.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.24, 14-12.26, 14-12.28, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

§20-3-67 Penalties. (a) Any person violating the provisions of these rules may be ordered to pay an administrative or civil penalty of not less than $1,000.00 nor more than $25,000.00 per violation per day, except that in cases where such offense shall continue after due notice, each day's continuance of the same shall constitute a separate offense.

(b) A civil fine that remains unpaid after all rights to a Contested case hearing have expired or been exhausted may be added by administrative action of the Director to any taxes, fees, or chargers collected by the City, other than charges for residential water and sewer use. Once added to fees or charges collected by the City, no permit, approval, or license shall be issued to a person responsible for the unpaid fine until said fines are paid in full. Taxes, fees, and charges that unpaid civil fines may be added to include, but are not limited to:

(1) Building, grading, grubbing, stockpiling, trenching, sign, special management area, shoreline variance, subdivision approval, building relocation, conditional use, and general plan amendment, and state land use district boundary amendment permits issued by the Department;
(2) Motor vehicle registration and vehicle weight tax, motor vehicle transfer of ownership fee, driver's license renewal fees, and business license fees collected by the customer services department;
(3) Liquor license and liquor license renewal fees collected by the Liquor Commission;

(4) Refuse collection and disposal fees collected by the Department of Environmental Services; and

(5) Real property taxes collected by the Department of Budget and Fiscal services. However, fines added to Real property taxes after the effective date of these rules shall be junior to all interests recorded against Real property before the unpaid fines are added to the Real property taxes for the property.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.24, 14-12.26, 14-12.28, 14-12.31) (Imp: ROH §§ 14-12.1, 14-12.23, 14-14.2, 18-4.1, 18-5.1).

SUBCHAPTER 10
APPEALS

§20-3-68 Appeals
§20-3-69 Computation of Time
§20-3-70 Mandatory Filing Deadline
§20-3-71 Representation in Contested Case Hearings
§20-3-72 Prehearing Procedure
§20-3-73 Intervention
§20-3-74 Withdrawal of Petition
§20-3-75 Contested Case Hearing
§20-3-76 Decision and Order
§20-3-77 Judicial Remand

§20-3-68 Appeals. (a) A property owner, permit holder, Discharger, or person that is personally and adversely affected by an action of the Director in the administration of these rules may appeal the Director's action by filing a petition for appeal with the Department of Planning and Permitting within thirty days of the mailing of the Director's action.

(b) A petition for appeal shall not exceed ten pages in length and must be signed by the petitioner or the petitioner's attorney. A petition for appeal must also include all of the following:

(1) The petitioner's name, address, phone number, and interest in the Director's action;

(2) All pertinent facts;

(3) The provisions of the Director's action that are objected to;

(4) The reasons for the objection;

(5) The alternate provisions, if any, that petitioner seeks to place in the Director's action; and

(6) The reasons why the petitioner believes that the Director's action is based on an erroneous finding of material fact, arbitrary or capricious decision making, or an abuse of discretion.

(c) Upon receipt of a petition for appeal containing all required information, the Director shall assign a hearings officer to hold a Contested case hearing on the petition.

(d) A petition for appeal shall only be sustained if the petitioner is able to prove, by a preponderance of the evidence, that the Director's action is based on an erroneous finding of material fact, arbitrary or capricious decision-making, or an abuse of discretion. In all other cases, an appeal shall be denied.

(e) If an appeal is sustained, the hearings officer shall remand the Director's action or to the Department for further action consistent with the hearings officer's findings and decision.

(f) The filing of a petition for appeal shall not stay an action of the Director of the requirements of a notice of violation and order.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: HRS §§ 91-2, 91-9, 91-9.5, 91-12, ROH § 14-12.27).

§20-3-69 Computation of Time. Whenever these rules specify a period of days for the completion of an action, the action shall be completed by 4:30 p.m. on the last day specified in the period, except when the specified period of days ends on a weekend, observed holiday, or other day on which the City is not open for business. In such cases, the action shall be completed by 4:30 p.m. on the next business day.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: HRS §91-2).

§20-3-70 Mandatory Filing Deadline. (a) A petition for appeal must be received by the Department within thirty days of the mailing or personal service of the Director's action. The date of mailing may be established by a postal receipt or official Department records which state the date on which the director's action was placed in the US mail or hand delivered to the petitioner.

(b) If a petition for appeal is not filed within thirty days, it shall be dismissed upon motion by the Director.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.27, 14-12.31) (Imp: HRS §91-2, ROH § 14-12.27).

§20-3-71 Representation in Contested Case Hearings. (a) A person may appear before the hearings officer in the person's own behalf, a partner may represent a partnership, an officer, trustee, or authorized employee of a corporation, trust, or association may represent the corporation, trust, or association, and an officer or employee of an agency may represent the agency in Contested case proceedings.

(b) A person may be represented by counsel in any proceedings under these rules.

(c) A person may not be represented in proceedings before the hearings officer except as stated in (a) and (b).

(d) When a person who is not an attorney acts in a representative capacity and appears in person or signs documents or papers in practice before the hearings officer, the person shall provide proof of h/her authority to act on behalf of the represented person upon request of

the hearings officer or the Director.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.27, 14-12.31) (Imp: HRS §91-2, ROH § 14-12.27).

§20-3-72 Prehearing Procedure. (a) Within thirty days of receiving a petition for appeal, the hearings officer shall schedule a prehearing conference with the parties by issuing a notice of prehearing conference. The notice shall be served upon the parties by certified mail, with return receipt requested, no less than seven days prior to the prehearing conference. If the notice is mailed to the address provided by the petitioner in h/her petition for appeal and returned to the hearings officer as unclaimed, notice of the scheduling may then be provided by publishing a copy of the notice in a newspaper published in the State of Hawaii and having a general circulation within the City and County of Honolulu at least once per week in two successive weeks.

(b) At the prehearing conference, the hearings officer shall establish a date for the Contested case hearing and a schedule for the submission of prehearing motions, prehearing briefs, witness lists, and exhibit lists by the parties.

(c) Prehearing briefs must contain a statement of relevant facts, the relief sought, and all grounds on which relief is sought. The petitioner's prehearing brief shall be filed with the Department no less than 30 days prior to the Contested case hearing. The Director's reply brief shall be filed no less than seven days prior to the Contested case hearing. Arguments that are not presented in the petitioner's prehearing brief shall not be heard in the Contested case hearing.

(d) After the conclusion of the prehearing conference, the hearings officer shall issue a notice of Contested case hearing to the parties. The notice shall be served upon the parties by certified mail no less than seven days before the Contested case hearing date and include the following information:

(1) The date time, place and nature of the Contested case hearing,
(2) The legal authority under which the hearing is to be held,
(3) The particular sections of the statutes and rules involved,
(4) An explicit statement, in plain language, of the issues involved and the facts alleged by the Director, unless the hearings officer is unable to determine the same and
(5) The fact that any party may retain counsel or be represented in accordance with §20-3-71 of these rules.

If the notice is mailed to the address provided by the petitioner in h/her petition for appeal and returned to the hearings officer as unclaimed, notice of the scheduling may then be provided by publishing a copy of the notice in a newspaper published in the State of Hawaii and having a general circulation within the City and County of Honolulu at least once per week in two successive weeks. The last required publication of the notice shall be no less than seven days before the Contested case hearing date.

(e) Any procedure in a Contested case may be modified or waivered by stipulation of the parties and an information disposition of the appeal may be made by agreement, consent order, or default, which shall be entered against any party that fails to appear at two consecutive hearings on the petition for appeal or motion thereon after receiving due notice of the same.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.27, 14-12.31) (Imp: HRS §91-2, ROH § 14-12.27).

§20-3-73 Intervention. (a) Persons with a financial interest in the Real property concerned by the Director's action and persons who will be directly and personally affected by the Director's action may submit a petition to intervene in a Contested case appeal from an action of the Director.

(b) Petitions to intervene shall only be granted if the petitioner meets the requirements of subsection (a).

(c) Petitioners who are in support of the petition for appeal shall submit all prehearing documents concurrently with the petitioner-appellant. Petitioners who oppose the petition for appeal shall submit all prehearing documents concurrently with the Director.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.27, 14-12.31) (Imp: HRS §91-2, ROH § 14-12.27).

§20-3-74 Withdrawal of Petition. A written request for the withdrawal of a petition for appeal may be filed at any time. A request to withdraw the petition may be approved by the hearings officer shall be approved if submitted with the concurrence of all parties.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.27, 14-12.31) (Imp: HRS §91-2, ROH § 14-12.27).

§20-3-75 Contested Case Hearings. (a) The party initiating the proceedings shall have the burden of proof, which includes the burden of producing evidence and the burden of persuasion. The degree or quantum of proof shall be a preponderance of the evidence.

(b) Any oral or documentary evidence may be received; however, the hearings officer shall exclude all irrelevant, immaterial, or unduly repetitious evidence and shall give effect to the rules of privilege recognized by law.

(c) Every party shall have the right to conduct cross-examination as required for the full and fair disclosure of the facts.

(d) All parties shall have the right to submit rebuttal evidence;

(e) The hearings officer may take judicial notice of judicially recognizable facts and generally recognized technical or scientific facts within the specialized knowledge of the Department, provided that the parties shall be given notice of any judicially noticed facts and given the opportunity to dispute or contest the same.

(f) If any party fails to appear at two consecutive hearings on a matter, their right to a Contested case hearing shall be waived and the petition for appeal shall be dismissed.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.27, 14-12.31) (Imp: HRS §91-2, 91-9, 91-10, ROH § 14-12.27).

§20-3-76 Decision and Order. (a) At the conclusion of the Contested case hearing,

the hearings officer may enter an oral ruling and direct the prevailing party to prepare a proposed findings of fact, conclusions of law, and decision and order for adoption by the hearings officer or take the matter under consideration for a period of time not to exceed 60 days.

(b) Where the matter is taken under consideration, the hearings officer shall issue a findings of fact, conclusions of law, and decision and order prepared by the hearings officer.

(c) If the hearings officer requires the prevailing party to prepare a prosed findings of fact, conclusions of law, and decision and order, the other parties to the case may submit written objections or exceptions to the proposed findings of fact, conclusions of law, and decision and order within fourteen days of receiving a copy of the same. A hearing to adopt or modify the proposed order shall be held within thirty days of the filing of exceptions or the expiration of the opportunity to do the same.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: HRS §§ 91-2, 91-9, 91-12, 91-14, ROH § 14-12.27).

§20-3-77 Judicial Remand. (a) If a matter is remanded to the Department or hearings officer for further proceedings pursuant to HRS §91-14, the judicial record shall be incorporated into the record of proceedings before the hearings officer.

(b) Upon notice of the remand, the hearings officer shall schedule a public hearing within sixty (60) days of the remand. Notice of the hearing shall be transmitted to the parties by certified mail no less than fifteen (15) days prior to the public hearing

(c) At the public hearing, the hearings officer shall identify the issues on remand and the scope of the additional testimony or evidence that may be received based on the needs of the case and the order directing remand to the Department or hearings officer.

(d) The hearings officer shall conduct further proceedings in compliance with the requirements for Contested cases in these rules and may require additional briefs, witness lists, and/or exhibit lists.

[Eff August 16, 2017] (Auth: HRS §91-2, RCH §4-105, ROH §§ 1-9.1, 14-12.31) (Imp: HRS §§ 91-2, 91-9, 91-14, ROH § 14-12.27).

These amendments to the Rules Relating to Water Quality were adopted on September 17, 2018, following a public hearing held on August 31, 2018, after public notice was given on July 31, 2018, in the Honolulu Star Advertiser, State and County Public Notices Section, Honolulu, Hawaii.

These amendments shall take effect fourteen days after filing with the City Clerk.

KATHY K. SOKUGAWA
Acting Director
Department of Planning and Permitting

APPROVED:

KIRK CALDWELL
Mayor
City and County of Honolulu

Dated: 11/30/18

APPROVED AS TO FORM AND LEGALITY:

Deputy Corporation Counsel
BRAD T. SAITO

FILED:
Given unto my hand and affixed with the Seal of the City and County of Honolulu this 10th day of December, 2018.

Glen I. Takahashi, City Clerk

Appendix E

A Sample of CDS Unit Operation and Maintenance Guideline

OPERATIONS AND MAINTENANCE GUIDELINES

CDS Stormwater Treatment Unit

INTRODUCTION

The CDS unit is an important and effective component of your storm water management program and proper operation and maintenance of the unit are essential to demonstrate your compliance with local, state and federal water pollution control requirements.

The CDS technology features a patented non-blocking, indirect screening technique developed in Australia to treat water runoff. The unit is highly effective in the capture of suspended solids, fine sands and larger particles. Because of its non-blocking screening capacity, the CDS unit is un-matched in its ability to capture and retain gross pollutants such as trash and debris. In short, CDS units capture a very wide range of organic and in-organic solids and pollutants that typically result in tons of captured solids each year such as: Total suspended solids (TSS) and other sedimentitious materials, oil and greases, trash, and other debris (including floatables, neutrally buoyant, and negatively buoyant debris). These pollutants will be captured even under very high flow rate conditions.

CDS units are equipped with conventional oil baffles to capture and retain oil and grease. Laboratory evaluations show that the CDS units are capable of capturing up to 70% of the free oil and grease from storm water. CDS units can also accommodate the addition of oil sorbents within their separation chambers. The addition of the oil sorbents can ensure the permanent removal of 80% to 90% of the free oil and grease from the storm water runoff.

OPERATIONS

The CDS unit is a non-mechanical self-operating system and will function any time there is flow in the storm drainage system. The unit will continue to effectively capture pollutants in flows up to the design capacity even during extreme rainfall events when the design capacity may be exceeded. Pollutants captured in the CDS unit's separation chamber and sump will be retained even when the units design capacity is exceeded.

CDS UNIT INSPECTION

Access to the CDS unit is typically achieved through two manhole access covers – one allows inspection (and clean out) of the separation chamber (screen/cylinder) & sump and another allows inspection (and cleanout) of sediment captured and retained behind the screen.

The unit should be periodically inspected to determine the amount of accumulated pollutants and to ensure that the cleanout frequency is adequate to handle the predicted pollutant load being processed by the CDS unit. The unit should be periodically inspected for indications of vector infestation, as well. The recommended cleanout of

solids within the CDS unit's sump should occur at 75% to 85% of the sump capacity. However, the sump may be completely full with no impact to the CDS unit's performance.

CONTECH Stormwater Solutions (previously CDS Technologies) recommends the following inspection guidelines: For new initial operation, check the condition of the unit after every runoff event for the first 30 days. For ongoing operations, the unit should be inspected after the first six inches of rainfall at the beginning of the rainfall season and at approximately 30-day intervals. The visual inspection should ascertain that the unit is functioning properly (no blockages or obstructions to inlet and/or separation screen), evidence of vector infestation, and to measure the amount of solid materials that have accumulated in the sump, fine sediment accumulated behind the screen, and floating trash and debris in the separation chamber. This can be done with a calibrated dipstick, tape measure or other measuring instrument so that the depth of deposition in the sump can be tracked.

CDS UNIT CLEANOUT

The frequency of cleaning the CDS unit will depend upon the generation of trash and debris and sediments in your application. Cleanout and preventive maintenance schedules will be determined based on operating experience unless precise pollutant loadings have been determined.

Access to the CDS unit is typically achieved through two manhole access covers – one allows cleanout of the separation chamber (screen/cylinder) & sump and another allows cleanout of sediment captured and retained behind the screen. For units possessing a sizable depth below grade (depth to pipe), a single manhole access point would allow both sump cleanout and access behind the screen.

CONTECH Stormwater Solutions Recommends The Following:

NEW INSTALLATIONS: Check the condition of the unit after every runoff event for the first 30 days. The visual inspection should ascertain that the unit is functioning properly (no blockages or obstructions to inlet and/or separation screen), measuring the amount of solid materials that have accumulated in the sump, the amount of fine sediment accumulated behind the screen, and determining the amount of floating trash and debris in the separation chamber. This can be done with a calibrated "dip stick" so that the depth of deposition can be tracked. Refer to the "Cleanout Schematic" **(Appendix B) f**or allowable deposition depths and critical distances. Schedules for inspections and cleanout should be based on storm events and pollutant accumulation.

ONGOING OPERATION: During the rainfall season, the unit should be inspected at least once every 30 days. The floatables should be removed and the sump cleaned when the sump is 75-85% full. If floatables accumulate more rapidly than the settleable solids, the floatables should be removed using a vactor truck or dip net before the layer thickness exceeds approximately one foot.

Cleanout of the CDS unit at the end of a rainfall season is recommended because of the nature of pollutants collected and the potential for odor generation

from the decomposition of material collected and retained. This end of season cleanout will assist in preventing the discharge of pore water from the CDS ® unit during summer months.

USE OF SORBENTS –The addition of sorbents is **not a requirement** for CDS units to effectively control oil and grease from storm water. The conventional oil baffle within a unit assures satisfactory oil and grease removal. However, the addition of sorbents is a unique enhancement capability unique to CDS units, enabling increased oil and grease capture efficiencies beyond that obtainable by conventional oil baffle systems.

Under normal operations, CDS units will provide effluent concentrations of oil and grease that are less than 15 parts per million (ppm) for all dry weather spills where the volume is less than or equal to the spill capture volume of the CDS unit. During wet weather flows, the oil baffle system can be expected to remove between 40 and 70% of the free oil and grease from the storm water runoff.

CONTECH Stormwater Solutions only recommends the addition of sorbents to the separation chamber if there are specific land use activities in the catchment watershed that could produce exceptionally large concentrations of oil and grease in the runoff, concentration levels well above typical amounts. If site evaluations merit an increased control of free oil and grease then oil sorbents can be added to the CDS unit to thoroughly address these particular pollutants of concern.

Recommended Oil Sorbents

Rubberizer® Particulate 8-4 mesh or OARS ™ Particulate for Filtration, HPT4100 or equal. Rubberizer is supplied by Haz-Mat Response Technologies, Inc. 4626 Santa Fe Street, San Diego, CA 92109 (800) 542-3036. OARS is supplied by AbTech Industries, 4110 N. Scottsdale Road, Suite 235, Scottsdale, AZ 85251 (800) 545-8999.

The amount of sorbent to be added to the CDS separation chamber can be determined if sufficient information is known about the concentration of oil and grease in the runoff. Frequently the actual concentrations of oil and grease are too variable and the amount to be added and frequency of cleaning will be determined by periodic observation of the sorbent. As an initial application, CDS recommends that approximately 4 to 8 pounds of sorbent material be added to the separation chamber of the CDS units per acre of parking lot or road surface per year. Typically this amount of sorbent results in a ½ inch to one (1") inch depth of sorbent material on the liquid surface of the separation chamber. The oil and grease loading of the sorbent material should be observed after major storm events. Oil Sorbent material may also be furnished in pillow or boom configurations.

The sorbent material should be replaced when it is fully discolored by skimming the sorbent from the surface. The sorbent may require disposal as a special or hazardous waste, but will depend on local and state regulatory requirements.

CLEANOUT AND DISPOSAL

A vactor truck is recommended for cleanout of the CDS unit and can be easily accomplished in less than 30-40 minutes for most installations. Standard vactor operations should be employed in the cleanout of the CDS unit. Disposal of material from the CDS unit should be in accordance with the local municipality's requirements. Disposal of the decant material to a POTW is recommended. Field decanting to the storm drainage system is not recommended. Solids can be disposed of in a similar fashion as those materials collected from street sweeping operations and catch-basin cleanouts.

MAINTENANCE

The CDS unit should be pumped down at least once a year and a thorough inspection of the separation chamber (inlet/cylinder and separation screen) and oil baffle performed. The unit's internal components should not show any signs of damage or any loosening of the bolts used to fasten the various components to the manhole structure and to each other. Ideally, the screen should be power washed for the inspection. If any of the internal components is damaged or if any fasteners appear to be damaged or missing, please contact CONTECH at 800.338.2211 to make arrangements to have the damaged items repaired or replaced.

The screen assembly is fabricated from Type 316 stainless steel and fastened with Type 316 stainless steel fasteners that are easily removed and/or replaced with conventional hand tools. The damaged screen assembly should be replaced with the new screen assembly placed in the same orientation as the one that was removed.

CONFINED SPACE

The CDS unit is a confined space environment and only properly trained personnel possessing the necessary safety equipment should enter the unit to perform particular maintenance and/or inspection activities beyond normal procedure. Inspections of the internal components can, in most cases, be accomplished by observations from the ground surface.

VECTOR CONTROL

Most CDS units do not readily facilitate vector infestation. However, for CDS units that may experience extended periods of non-operation (stagnant flow conditions for more than approximately one week) there may be the potential for vector infestation. In the event that these conditions exist, the CDS unit may be designed to minimize potential vector habitation through the use of physical barriers (such as seals, plugs and/or netting) to seal out potential vectors. The CDS unit may also be configured to allow drain-down under favorable soil conditions where infiltration of storm water runoff is permissible. For standard CDS units that show evidence of mosquito infestation, the

application of larvicide is one control strategy that is recommended. Typical larvicide applications are as follows:

SOLID B.t.i. LARVICIDE: ½ to 1 briquet (typically treats 50-100 sq. ft.) one time per month (30-days) or as directed by manufacturer.

SOLID METHOPRENE LARVICIDE (not recommended for some locations): ½ to 1 briquet (typically treats 50-100 sq. ft.) one time per month (30-days) to once every 4-½ to 5-months (150-days) or as directed by manufacturer.

RECORDS OF OPERATION AND MAINTENANCE

CONTECH Stormwater Solutions recommends that the owner maintain annual records of the operation and maintenance of the CDS unit to document the effective maintenance of this important component of your storm water management program. The attached **Annual Record of Operations and Maintenance** form (see **Appendix A**) is suggested and should be retained for a minimum period of three years.

Appendix F

HDOT Harbors Division Construction and Post-Construction Program Brochures

CONSTRUCTION PROJECTS DEFINED

Any activity that results in the disturbance of land, including clearing, grading, excavating and activities that support the project such as stockpiles, washouts, fueling and storage areas.

STORMWATER IMPACTS

Construction activities may cause pollution and impact stormwater runoff which eventually discharges to the harbor and other surface waters without prior treatment.

HDOT-HARBORS CONSTRUCTION SITE RUNOFF CONTROL PROGRAM

All construction projects under Harbors jurisdiction are subject to the requirements of this program as well as local, state, and federal environmental laws.

EXEMPT PROJECTS

Activities that result in no or minimal land disturbance such as:

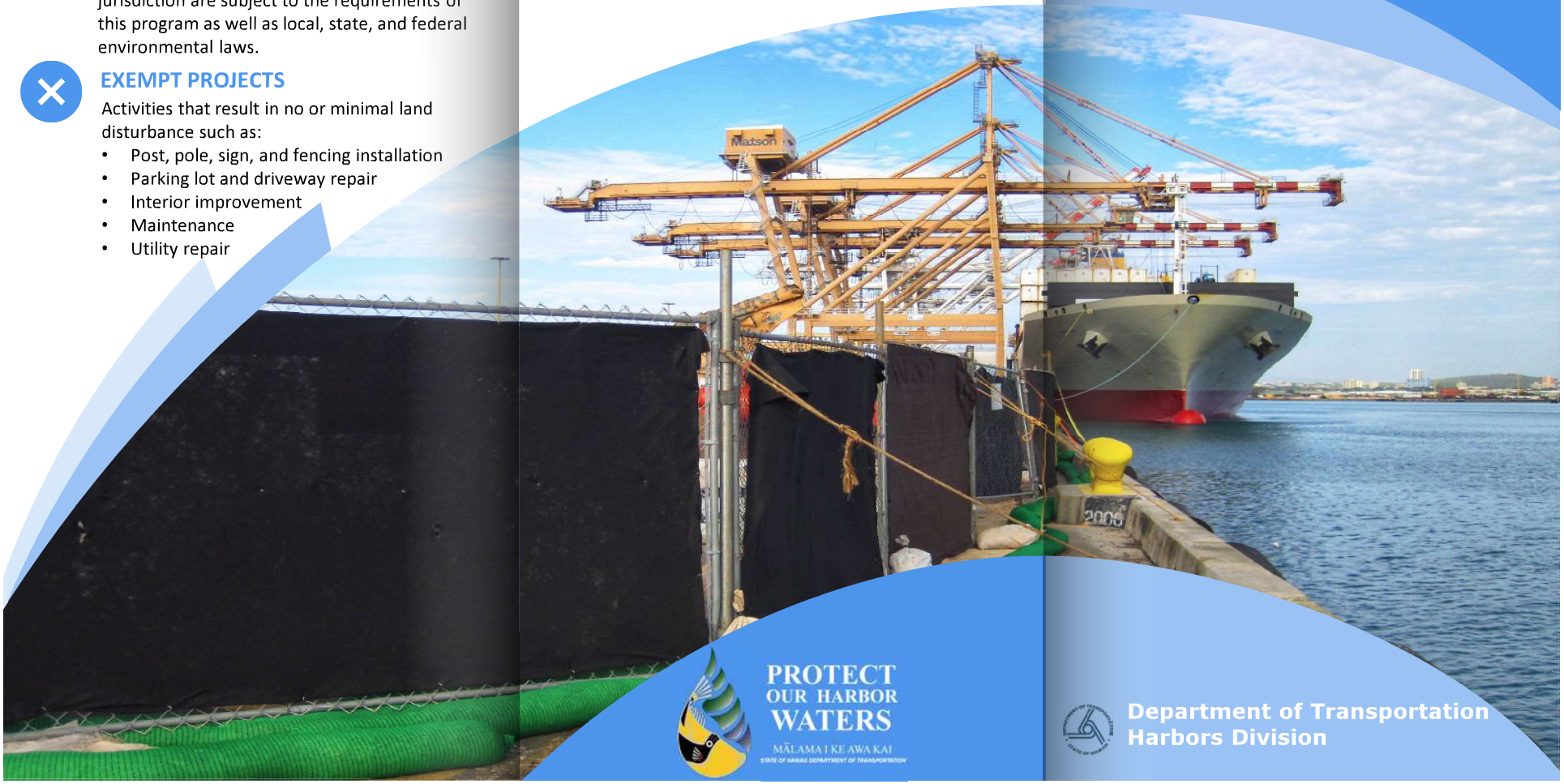
- Post, pole, sign, and fencing installation
- Parking lot and driveway repair
- Interior improvement
- Maintenance
- Utility repair

REPORT SUSPECTED ILLICIT DISCHARGES

Harbors Environmental Hotline:	**808-587-1962**
Harbor Traffic Control:	**808-587-2076**
U.S. Coast Guard:	**808-842-2600**
Hawaii Department of Health, Clean Water Branch:	**808-586-4309**

MAILING ADDRESS

Hawaii Department of Transportation, Harbors Division
Hale Awa Ku Moku Building
79 South Nimitz Highway
Honolulu, Hawaii 96813-4898



PROTECT OUR HARBOR WATERS
MĀLAMA I KE AWA KAI
STATE OF HAWAII DEPARTMENT OF TRANSPORTATION

CONSTRUCTION SITE RUNOFF CONTROL PROGRAM

Department of Transportation
Harbors Division



CONSTRUCTION PROJECT CLASSIFICATION AND MANAGEMENT:

1. HDOT-Harbors Projects are managed by division personnel.

2. Tenant Improvement Projects are managed by the entity authorized to undertake the project. Tenants must obtain consent from HDOT-Harbors Division.

PLAN SUBMITTAL AND REVIEW

The following must be submitted to HDOT-Harbors Engineering Branch Environmental Section (HAR-EE) for review. For more information, refer to the **Construction Site Runoff Control Program Manual** and **Post-Construction Stormwater Management Manual** at:
http://hidot.hawaii.gov/harbors/malamaikeawakai/

PROJECTS LESS THAN ONE ACRE:

- Notification Form
- Site Plan
- Narrative of proposed work and applicable BMPs

PROJECTS ONE ACRE OR GREATER:

- Construction Design Review Checklist
- Permanent Post-Construction BMP Plan Checklist
- Construction Drawings and Plans
- Stormwater Pollution Prevention Plan (SWPPP)
- Post-Construction Stormwater Mitigation Plan (if applicable)
- Copies of NPDES Permit Applications
- Other Applicable Permit Applications

OTHER REFERENCES:

1. CCH Rules Relating to Water Quality & Related Resources at: https://www.honolulu.gov/dfmswq/rules-relating-to-water-quality.html.
2. CCH Stormwater Best Management Practice Manual for Construction (dated November 2011)

ENVIRONMENTAL COMPLIANCE

All construction projects are required to comply with local, state, and federal environmental laws. Enforcement for non-compliance may include:

- Oral or Verbal Warning
- Written Warning
- Notice of Violation
- Stop Work Order
- Withhold Payment
- ELD and L&M Assessment
- Contract Termination

TRAINING REQUIREMENTS

Harbors engineers, inspectors, and consultants who have primary construction stormwater responsibilities will receive initial and annual refresher training.

PERMIT REQUIREMENTS

DISCHARGE/CONNECTION PERMIT (TENANT IMPROVEMENT AND NON-HARBOR PROJECTS ONLY):

Complete the Discharge/Connection Permit application and submit to HDOT-Harbors Engineering Branch, Environmental Section for review.

NPDES PERMIT:

Submit all applicable permit applications to the State of Hawaii Department of Health, Clean Water Branch per Hawaii Administrative Rules, Chapter 11-55 and provide proof of application and issue permit(s) to HDOT-Harbors Engineering Branch, Environmental Section.

HDOH NPDES Permit Applications:
https://eha-cloud.doh.hawaii.gov/epermit

HDOT-HARBORS INSPECTIONS

Conducted by HAR-EE or a designated and qualified inspector and documented on the *Construction Site Best Management Practices Inspection Checklist.*

INITIAL INSPECTIONS: To be conducted prior to the start of construction activities to ensure site-specific BMPs have been properly installed in accordance with the SWPPP or similar. No construction activities will commence until this inspection is conducted and any deficiencies are satisfactorily addressed.

RECURRING INSPECTIONS: To be conducted throughout the duration of the construction phase at the following frequencies to ensure that BMPs are properly maintained:

- October – March: Once every two weeks
- April – September: Once every two months

FINAL INSPECTIONS: To be conducted after construction activities have been completed to ensure the following:

- Disturbed soil is stabilized
- Temporary BMPs have been removed
- Permanent BMPs have been properly installed, where applicable

In addition to the HDOT-Harbors inspections listed above, the construction contractor must conduct self-inspections per the requirements in HAR 11-55, Appendix C.



POST-CONSTRUCTION BMPS

Designed to minimize water quality impacts following the completion of construction projects while complying with HDOT-Harbors Small Municipal Separate Storm Sewer System (MS4) Permits. Refer to the **Post-Construction Stormwater Management Program Manual** at:

http://hidot.hawaii.gov/harbors/malamaikeawakai/

LOW IMPACT DEVELOPMENT (LID)

Systems and practices that mimic a site's natural hydrology to mitigate stormwater runoff and pollution.

SOURCE CONTROL

Measures to prevent pollutants from coming into contact with stormwater runoff or discharging into HDOT-Harbors small MS4.

TREATMENT CONTROL

Measures that treat stormwater runoff that has come into contact with pollutants. Examples include:

- Retention
- Bioinfiltration
- Mechanical methods

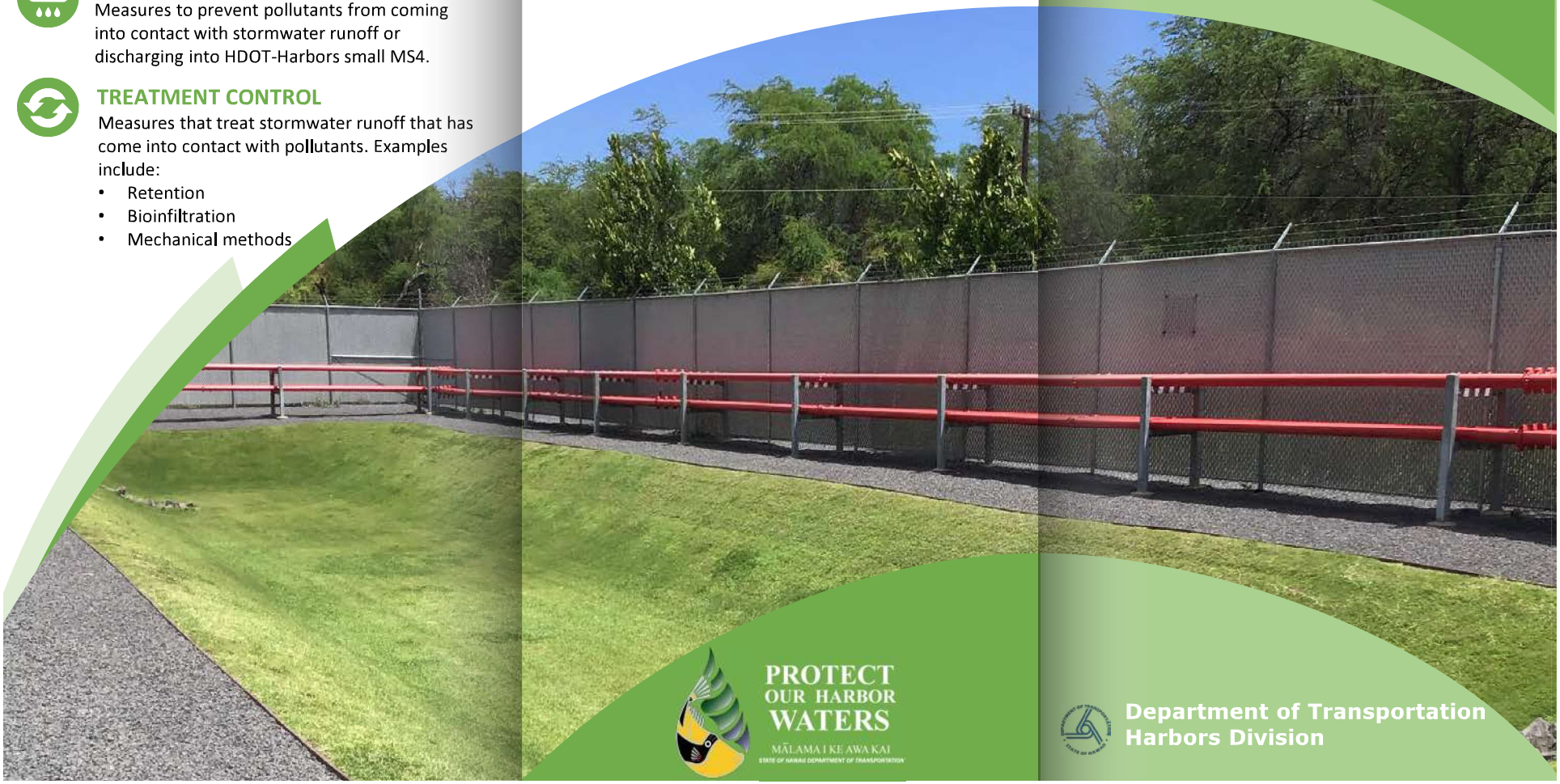
REPORT SUSPECTED ILLICIT DISCHARGES

Harbors Environmental Hotline:	**808-587-1962**
Harbors Construction Section:	**808-587-1866**
Harbor Traffic Control (24/7):	**808-587-2076**
Hawaii Department of Health, Clean Water Branch:	**808-586-4309**

MAILING ADDRESS

Hawaii Department of Transportation, Harbors Division
Hale Awa Ku Moku Building
79 South Nimitz Highway
Honolulu, Hawaii 96813-4898

POST-CONSTRUCTION STORMWATER MANAGEMENT PROGRAM



PROTECT OUR HARBOR WATERS
MĀLAMA I KE AWA KAI
STATE OF HAWAII DEPARTMENT OF TRANSPORTATION

Department of Transportation
Harbors Division



POST-CONSTRUCTION STORMWATER MANAGEMENT PROGRAM

Required for all projects that result in land disturbance of one acre or more under HDOT-Harbors jurisdiction unless exempt.

1. **NEW DEVELOPMENT:** New construction or installation of a building or structure, or the creation of impervious surface that disturbs one acre or more; or less than one acre if it is a part of a larger common plan of development or sale that disturbs one acre or more.

2. **REDEVELOPMENT:** Development that would create or add an impervious surface area on an already developed site including, but not limited to, any construction project that requires demolition or complete removal of existing structures or impervious surfaces at a site and replacement with new impervious surfaces.

PROGRAM EXEMPTIONS

HDOT-Harbors Division may exempt certain types of projects from this program that pose a minimum risk of stormwater pollution including, but not limited to:

- Maintenance activities (e.g., top layer grinding, repaving, and reconfiguring surface parking lots)
- Reroofing
- Interior remodeling and improvement
- Routine maintenance to original line and grade, hydraulic capacity, or original purpose of facility
- Trenching and resurfacing associated with utility work
- Replacement of damaged pavement
- Emergency construction activities

GENERAL POST-CONSTRUCTION PROJECT REQUIREMENTS

DESIGN PHASE:

- Incorporate Post-Construction BMPs into design
- Submit the *Permanent Post-Construction BMP Plan Checklist*
- Apply for Appropriate Permits
- Submit Post-Construction Stormwater Mitigation Plan and other applicable plans
- Wait for concurrence and Notice to Proceed

CONSTRUCTION PHASE:

- Install Post-Construction BMPs according to approved PSMP
- Monitor and inspect installation and inventory
- Enforcement, if necessary
- Submit O&M Plan for review and acceptance

POST-CONSTRUCTION PHASE:

- Conduct long-term O&M of Post-Construction BMPs, if applicable
- Inspect Post-Construction BMPs regularly
- **For tenant projects,** tenant must submit annual O&M and inspection records to HDOT-Harbors, when applicable
- Enforcement, if necessary

OTHER REFERENCES:

1. CCH Stormwater BMP Guide for New and Redevelopment (dated July 2017)

For more information, review the Post-Construction Stormwater Manual located on the HDOT-Harbors website at:
http://hidot.hawaii.gov/harbors/malamaikeawakai/

ENVIRONMENTAL COMPLIANCE

All construction projects are required to comply with local, state, and federal environmental laws. Enforcement for non-compliance may include:

- Oral or Verbal Warning
- Written Warning
- Notice of Violation
- Stop Work Order
- Withhold Payment
- ELD and L&M Assessment
- Contract Termination

TRAINING REQUIREMENTS

Appropriate training is provided to Designers, Plan Reviewers, Engineers, Inspectors, Construction Managers, Contractors, and Operators who have primary responsibilities in the implementation of the Harbors Post-Construction Stormwater Management Program. The training video is available on the HDOT-Harbors Stormwater Management website:
http://hidot.hawaii.gov/harbors/malamaikeawakai/

STORMWATER IMPACT

Urban runoff from a developed site may contain pollutants that can enter the MS4 without prior treatment before discharging to the harbor.



BEST MANAGEMENT PRACTICES

Review HDOT-Harbors Division **Construction Site Runoff Control Program Manual** and the **Post-Construction Stormwater Management Manual** for more information on BMPs and required procedures and process at:
http://www.hidot.hawaii.gov/harbors/malamaikeawakai

CONSTRUCTION BMPs ARE:

- Schedules of activities
- Prohibition of practices
- Maintenance procedures
- Other management procedures

POST-CONSTRUCTION BMPs ARE:

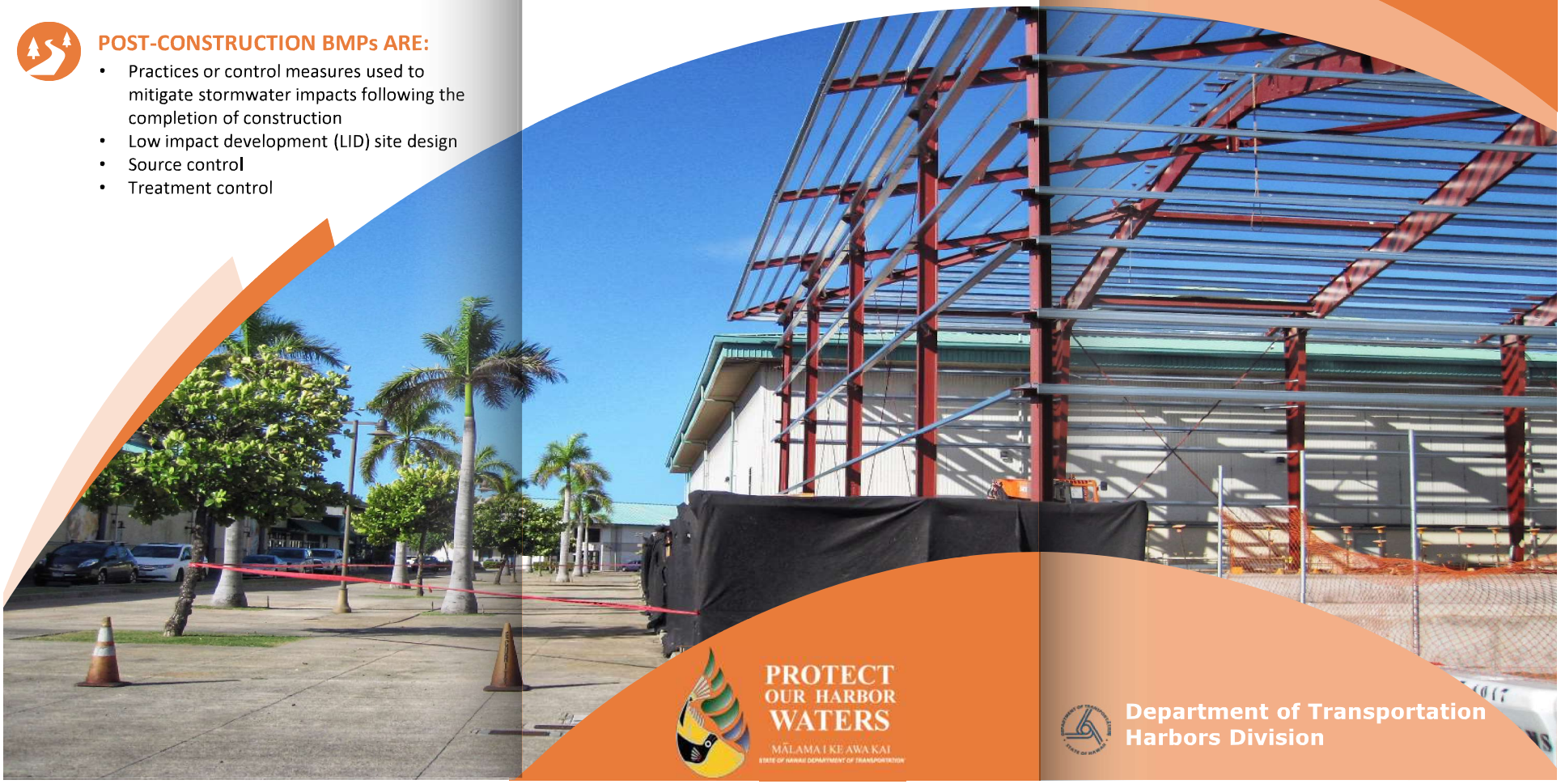
- Practices or control measures used to mitigate stormwater impacts following the completion of construction
- Low impact development (LID) site design
- Source control
- Treatment control

REPORT SUSPECTED ILLICIT DISCHARGES

Harbors Environmental Hotline:	**808-587-1962**
Harbors Construction Section:	**808-587-1866**
Harbor Traffic Control (24/7):	**808-587-2076**
Hawaii Department of Health, Clean Water Branch:	**808-586-4309**

MAILING ADDRESS

Hawaii Department of Transportation, Harbors Division
Hale Awa Ku Moku Building
79 South Nimitz Highway
Honolulu, Hawaii 96813-4898



PROTECT OUR HARBOR WATERS
MĀLAMA I KE AWA KAI
STATE OF HAWAII DEPARTMENT OF TRANSPORTATION

BEST MANAGEMENT PRACTICES (BMPs) FOR CONSTRUCTION AND POST-CONSTRUCTION

Department of Transportation
Harbors Division



CONSTRUCTION BMPs

A qualified inspector will conduct BMP inspections at the regulated project site to ensure BMPs are properly implemented. There are many different types of BMPs including, but not limited to the following:

EROSION CONTROL:
- Preserve existing vegetation
- Geotextiles and mats
- Slope drains

SEDIMENT CONTROL:
- Silt fence
- Storm drain inlet protection
- Sediment trap
- Sediment basin

WIND EROSION CONTROL:
- Dust control

TRACKING:
- Stabilize and maintain ingress and egress

GOOD HOUSEKEEPING:
- Material management
- Waste management
- Stockpile management
- Vehicle and equipment management
- Paving and grinding operations
- Concrete washout waste management



Properly covered and contained stockpile.



Concrete washout containment.

Direct pavement runoff towards vegetated or landscaped areas (e.g., swales), if possible.



POST-CONSTRUCTION BMPs

All new development and redevelopment projects should consider applying post-construction BMPs during the planning and design phase of the project. Post-construction BMPs include:

1 LOW IMPACT DEVELOPMENT:
- Conserve natural areas, soils, and vegetation
- Minimize disturbances to natural drainages
- Minimize soil compaction
- Minimize impervious surfaces
- Direct runoff to landscaped areas

2 SOURCE CONTROL:
- Conduct operations indoors or under cover if possible to prevent contact with stormwater runoff
- Landscaped areas
- Storm drain inlet signs

3 TREATMENT CONTROL:
- Infiltration basin or infiltration trench
- Manufactured treatment device
- Dry well
- Bioretention Basin
- Permeable pavement
- Green roof
- Swale

Section E

Pollution Prevention and Good Housekeeping Program

Stormwater Management Plan
Honolulu Harbor
and Kalaeloa Barbers Point Harbor

Mālama I Ke Awa Kai
Protect our Harbor Waters

Prepared for:
State of Hawaii
Department of Transportation
Harbors Division

This page intentionally left blank

SECTION E TABLE OF CONTENTS

1.0 STORM SEWER SYSTEM OPERATION AND MAINTENANCE PROGRAM 1-1

2.0 MAINTENANCE AND HOUSEKEEPING PRACTICES 2-1

2.1 SWEEPING COMMON AREAS AND SELECT TENANT FACILITIES..... 2-1

2.2 WASTE COLLECTION 2-2

3.0 REVIEW OF WASH AREAS, DRY WELLS, AND INFILTRATION SINKS 3-1

3.1 WASH AREAS 3-1

3.2 DRY WELLS AND INFILTRATION SINKS 3-1

4.0 TENANT EDUCATION AND EMPLOYEE TRAINING..... 4-1

TABLES

Table 2-1 Grounds Maintenance Sweeping Schedule 2-2

APPENDICES

Attachment 1 – Storm Sewer System Operation & Maintenance Program Manual

This page intentionally left blank

1.0 STORM SEWER SYSTEM OPERATION AND MAINTENANCE PROGRAM

Harbors has developed an SSS O&M Program that covers inspection and cleaning procedures for the small MS4s at Honolulu Harbor and KBPH. The SSS O&M Program is included as Attachment 1 and is summarized in this section.

Since 2015, HAR-O has been conducting recurring cleaning of all accessible inlets, pipes (as necessary), drainage features, and outfalls (as necessary) by removing accumulated debris, trash, and sediment, at Honolulu Harbor and KBPH.

The goal of this program is to identify structural defects, trash, debris, and other issues that have the potential to limit the flow of stormwater. Harbors will inspect drains concurrently with cleaning activities and track results of the inspections in an AMS. A storm drain is determined in need of cleaning when a visual inspection or "stick test" determines accumulated soil, wet organic material, and debris have accumulated to certain threshold measurements. If debris has accumulated beyond 6 inches but less than 12 inches, then the drain will be cleaned within 30 working days. If debris has accumulated beyond 12 inches, then the drain will be cleaned within 10 working days.

Harbors identifies "hot spots" where there is a greater risk for potential discharges of pollutants to the storm sewer system. In terms of small MS4 O&M, a hot spot is defined as: *a storm drain location where more than six inches of accumulated soil, wet organic material, or debris were observed and incurred cleaning within two consecutive inspection cycles.*

Appropriate BMPs, including more frequent cleaning and maintenance to minimize potential discharges of pollutants will be implemented at or near hot spot locations. If an illicit discharge is observed due to accumulated sediment, trash or other pollutant related to drainage system cleaning, response will be conducted as detailed in the SSS O&M Program document.

2.0 MAINTENANCE AND HOUSEKEEPING PRACTICES

Maintenance is ongoing at both tenant and Harbors facilities. The following maintenance activities will be conducted:

- ✓ Emptying dumpsters, removing and disposing of discarded objects, machinery or equipment;
- ✓ Prompt repair/replacement of malfunctioning dumpsters;
- ✓ General maintenance and repair of public facilities will be conducted in-house, while a contractor will be used for most large-scale projects;
- ✓ Personnel will use fertilizer or herbicides following the manufacturer's instructions and in a manner that eliminates potential for runoff into the gutters, or storm drain system;
- ✓ Pier apron and common areas are swept regularly, and their cleanliness is assessed for debris and staining, and responsible parties will be required to keep these areas clean;
- ✓ Tenants having rail tracks are required to conduct routine maintaining and cleaning;
- ✓ Operators with leaking vehicles are required to park vehicles and equipment indoors/under cover, provide drip pans and repair leaks on a timely manner;
- ✓ Vehicle and equipment washing under Harbors jurisdiction is generally prohibited unless performed in an approved wash facility and properly contained; and
- ✓ Clean up stains, spills, oil spots using dry cleanup methods.

2.1 SWEEPING COMMON AREAS AND SELECT TENANT FACILITIES

Sweeping prevents microscopic pollutants from entering the harbor water by removing them before they flow into the storm drainage system. Regular sweeping will be performed by HAR-OC. HAR-OC has four sweepers dedicated to Honolulu Harbor and KBPH. Sweeping will be conducted at all common areas and certain areas on tenant facilities where cleaning is requested, according to the following schedule presented in Table 2-1 (subject to change as deemed necessary).

Table 2-1 Grounds Maintenance Sweeping Schedule

Location	Frequency	Duration (Hours)
Young Brothers	M, Th	2.5
Matson	Tu, F	2.75
Horizon Lines Terminal	W	3
Aloha Cargo Pier 1	Once per month	2.5
Piers 10, 11	M, F	1
Oahu District Maintenance Baseyard	T, W	1
Fishing Village Parking Lot and Road Ways, Pier 35	Once per week	1.5
Piers 30, 31, 32 and Shed Areas	Twice per week	1.5
Piers 27, 28, 29	Twice per week	1.5
Piers 18, 19, 23, 24	Twice per week	1.5
Channel Street, Pier 2 Outside and Inside of Shed Areas	M, F	3
Pier 1 Entrance	Twice per week	1
Piers 1, 2 Common Roadways	Twice per week	1
KBPH Common Roadways & Apron	Twice per month	4

All waste from Honolulu Harbor and KBPH will be combined and disposed of through the appropriate disposal contractors.

2.2 WASTE COLLECTION

HAR-OC picks up and disposes of other potential pollutants left in drop off areas or discarded illegally by the public in order to minimize and/or prevent pollution to the environment. This includes automobile, boat, and motorcycle lead acid batteries, scrap metals, discarded used tires, and construction debris. Waste from drop off areas, illegal dumping, and sweeping activities are disposed of with the appropriate waste contractors. The destination of each type of waste will be reported in the AR.

3.0 REVIEW OF WASH AREAS, DRY WELLS, AND SINKS

3.1 WASH AREAS

Washing activities are crucial to the business operations of some tenants. Washing practices that are improperly performed can generate illicit discharges and are prohibited. All washing wastewater needs to be properly contained and properly disposed of. Harbors requires tenants to formally submit applications to perform permitted washing activities with the goal of minimizing potential pollutants from being discharged into MS4 or adjacent harbor water.

Harbors will require that applications for washing include at least the following information:

- ✓ Washing activity (type of equipment or vehicle the tenant intends to wash);
- ✓ Equipment used (such as pressure sprayer, hose, etc.) and flow rate;
- ✓ Type of detergent the tenant intends to use (biodegradable detergent is preferred);
- ✓ Wash water containment method (permanent wash rack, temporary berm, etc.);
- ✓ Wash water capture method (vacuum truck, evaporation, etc.);
- ✓ Wash water collection container capacity; and
- ✓ Wash water disposal method.

Tenants are prohibited from washing equipment and vehicles without obtaining prior consent from Harbors. Following the acceptance of the washing application, Harbors will issue a formal letter of approval once these conditions are met. The application and review process are tracked on an annual basis and reported in the AR.

If the washing facility discharges to the CCH sanitary sewer, an Industrial Wastewater Discharge Permit (IWDP) will be required. It is the tenant's responsibility to apply for and meet the requirements of the CCH IWDP permit.

3.2 DRY WELLS AND SINKS

Harbors will require that applications for sinks or drains that are not connected to the sanitary sewer include the following information when applicable:

- ✓ The intended use of the sink;
- ✓ A list of substances that may be washed into the sink (e.g. bio-degradable soaps and dirt);
- ✓ Construction drawings for the sink;
- ✓ Proposed treatment of the wash water (filtration fabric, sand, carbon filters, oil-absorbent material, etc.);
- ✓ Final destination of wash water; and
- ✓ Routine maintenance schedule for the sink (replacement of filtration material).

Tenants are prohibited from using unapproved sinks until Harbors verifies that the sinks do not create a potential hazard to receiving waters. Harbors may issue a formal letter of approval once these conditions are met. The application and review process will be tracked on an annual basis and reported in the AR.

4.0 TENANT EDUCATION AND EMPLOYEE TRAINING

Tenants will be educated regarding pollution prevention and good housekeeping practices at the Annual Tenant Stormwater Pollution Prevention Awareness Training. Meanwhile, Harbors will provide information to all employees about its stormwater management program on an annual basis. In addition, Harbors will provide annual IDDE awareness training to employees including Harbor Police, Marine Cargo Specialists, and Grounds Supervisors. Slides depicting examples of proper and improper BMPs will be presented to illustrate acceptable procedures.

ATTACHMENT 1
STORM SEWER SYSTEM OPERATION & MAINTENANCE PROGRAM MANUAL



Storm Sewer System Operations & Maintenance Program Manual

PROTECT
OUR HARBOR WATERS

MĀLAMA I KE KAI
STATE OF HAWAII DEPARTMENT OF TRANSPORTATION

State of Hawaii Department of Transportation, Harbors Division
Honolulu Harbor Small MS4 NPDES Permit No. HI 03KB482
Kalaeloa Barbers Point Harbor Small MS4 NPDES Permit No. HI 03KB488
February 2017

STORM SEWER SYSTEM OPERATIONS AND MAINTENANCE PROGRAM MANUAL
Volumes I and II

Honolulu Harbor Small MS4 NPDES Permit No. HI 03KB482

Kalaeloa Barbers Point Harbor Small MS4 NPDES Permit No. HI 03KB488

PROTECT
OUR HARBOR WATERS
MĀLAMA I KE KAI
STATE OF HAWAII DEPARTMENT OF TRANSPORTATION

State of Hawaii Department of Transportation
Harbors Division
79 South Nimitz Highway
Honolulu, Hawaii 96813

February 2017

This page intentionally left blank.

TABLE OF CONTENTS

LIST OF FIGURES ..... *vii*

LIST OF TABLES ..... *ix*

LIST OF ACRONYMS AND ABBREVIATIONS ..... *xi*

Volume I Foundational Data Resources

CHAPTER 1 INTRODUCTION 1

1.1 Requirements 2

1.2 Port Hawaii Commercial Harbors System 4

1.2.1 Honolulu Harbor 4

1.2.2 Kalaeloa Barbers Point Harbor 6

1.3 Harbors Storm Sewer System Operations & Maintenance Program 8

1.4 Organization of the *SSS O&M Manual* 8

1.4.1 Volume I Foundational Data Resources – Chapters 1 to 4 9

1.4.2 Volume II User Guides for Storm Sewer System O&M Activities – Chapters 5 to 8 9

1.5 *SSS O&M Manual* Audience and Intended Uses 9

CHAPTER 2 HARBORS STORM SEWER SYSTEM AND GIS MAPPING 11

2.1 Honolulu Harbor Pier Use Areas 11

2.1.1 Pier 1 and Pier 2 – Fort Armstrong GIS Map of Storm Drain Assets 15

2.1.2 Piers 5 through 11 – Aloha Tower Market Place Complex GIS Map of Storm Drain Assets 19

2.1.3 Piers 12 through 18 GIS Map of Storm Drain Assets 24

2.1.4 Piers 19 through 29 GIS Map of Storm Drain Assets 26

2.1.5 Piers 31 through 35 GIS Map of Storm Drain Assets 31

2.1.6 Piers 36 through 38 – Domestic Commercial Fishing Village GIS Map of Storm Drain Assets 35

2.1.7 Piers 39 through 45 GIS Map of Storm Drain Assets 38
2.1.8 Piers 51 through 53 – Sand Island GIS Map of Storm Drain Assets 43
2.2 Honolulu Harbor Post-Construction BMPs GIS Map 51
2.3 Honolulu Harbor Outfall Drainage Basin 56
2.4 Honolulu Harbor Signage and Stenciling GIS Mapping 56
2.5 Kalaeloa Barbers Point Harbor Pier Use Area 62
2.5.1 Kalaeloa Barbers Point Harbor Piers GIS Mapping of Storm Drain Assets 63
2.5.2 Rail Tracks Location Map 68

CHAPTER 3 HARBORS PERSONNEL AND STORM SEWER SYSTEM ACTIVITIES 69

3.1 Engineering Branch 69
3.1.1 Environmental Section 70
3.1.2 Planning Section 70
3.1.3 Maintenance Section 73
3.2 Harbors Administrator 73
3.3 Harbors Oahu District 73
3.3.1 Operations Section 74
3.3.1.1 Pier Utilization Unit 74
3.3.1.2 Kalaeloa Barbers Point Harbor Unit 75
3.3.1.3 Harbor Traffic Control Unit 75
3.3.1.4 Sanitation & Grounds Unit 76
3.3.2 Maintenance Section 76
3.3.2.1 Wharf Maintenance Unit 77
3.3.2.2 Construction & Maintenance Unit 77
3.4 SSS OMP Implementation and BMPs 77
3.5 Regulatory Requirements 79
3.5.1 2014 Consent Decree 79
3.5.2 NPDES NGPCs for Honolulu and Kalaeloa Barbers Point Harbors 79
3.5.2.1 40 Code of Federal Regulations 122 80
3.5.2.2 Hawaii Revised Statutes 80

3.5.2.3 Hawaii Administrative Rules 80
3.5.3 SWMP for Honolulu and Kalaeloa Barbers Point Harbors 81
3.6 Notifications Information and Contacts 81
3.6.1 MOU for HDOT and City & County of Honolulu 83

CHAPTER 4 HARBORS ASSET MANAGEMENT SYSTEM (AMS) 85

4.1 ArcGIS Online and Server Configuration 85
4.1.1 Cityworks® AMS – How It Works 85
4.1.1.1 AMS Alignment with *SWMP* and CD 86
4.1.1.2 Tasks Workflow Process Using Cityworks® AMS 86
4.1.2 Asset Configuration 86
4.1.2.1 Configured Assets 86
4.2 Work Orders 89
4.2.1 Work Order Security 93
4.2.1.1 Work Order Tables 93
4.2.1.2 Permissions 93
4.2.2 Work Order Status 94
4.2.2.1 Tasks 97
4.2.3 Task-Specific Workflows 98
4.2.3.1 Illicit Discharge/Leaking Pipe 98
4.2.3.2 Tenant Inspection 99
4.2.3.3 Tenant List Administration 99
4.2.3.4 Environmental Design Review 100
4.2.3.5 Storm Inlet/Open Line/Manhole Inspection Process 100
4.2.3.6 Property Damage Report 101
4.2.3.7 Street Sweeper Downtime 101
4.2.3.8 GIS Updates 101
4.2.3.9 Cityworks® AMS Configuration Updates 101
4.2.3.10 New Tenant and Tenant Project Notification 102
4.3 Inspections 102
4.3.1 Screening Inspections 103

4.3.2 Inspect Comprehensive & Cleaning.....105
4.3.3 Comprehensive Inspection for BMP Work Order 106
4.4 Service Requests 106
4.5 Equipment, Labor & Materials (ELM) 107
4.6 Defining Hotspots 109
4.7 Rail Tracks Off-Loading at Kalaeloa Barbers Point Harbor 110
4.8 Searches in Cityworks® AMS 110
4.8.1 Asset Search 110
4.8.2 Service Requests and Work Orders Search 110
4.8.3 Saved Searches 111
4.9 Reports in Cityworks® AMS 111
4.10 Mobile Devices 111
4.11 Quality Control 111

Volume II User Guides for Storm Sewer System O&M Activities

CHAPTER 5 HARBORS TRANSITION TO AMS TASKS WORKFLOW 113

5.1 HAR-O Management Tools 113
5.2 Supervisor Responsible for Data Quality Control 114
5.2.1 Designate Data Input Backup Staff 114
5.3 Service Requests (Area Survey) 114
5.4 Cityworks® AMS Streamline Tasks Workflow 116
5.5 Storm Drain Tasks Workflow Processes.....116

CHAPTER 6 HARBORS STORM SEWER SYSTEM INSPECTIONS 119

6.1 Cityworks® AMS Inbox 120
6.1.1 Main Toolbar 120
6.1.2 Add a New Tab to Inbox 120
6.1.3 Gear Button to Customize Setting Options 120
6.1.4 Four Basic Inbox Tabs 121
6.2 Work Orders 122
6.2.1 Parent Work Orders 122
6.2.1.1 Initial Inspection and Cleaning of Storm Drains 122
6.2.1.2 Screening Inspections Schedule 2016 Adjustment ..122
6.3 Responsibility for Data Accuracy 123
6.4 Standard for Screening Inspections 123
6.4.1 Visual Observation 123
6.4.2 Stick Test 123
6.4.3 Observations and Measurements, and Actions Required 124
6.5 Storm Inlet and Open Line Inspection Process 124
6.5.1 Tier One – Screening Inspections 124
6.5.1.1 Map Event Layers 124
6.5.1.2 The Map 125
6.5.1.3 Complete Inspection and Record Observations 126
6.5.1.4 Tracking Labor Expenses 127

6.5.2 Tier Two – Comprehensive Inspections 129
6.5.3 HAR-OCG Supervisor Management Tools 129
6.6 Hotspot Inspections 130
6.6.1 Removal of Hotspot Designation 131
6.7 Stencils Inspections 131

CHAPTER 7 STORM SEWER SYSTEM CLEANING AND MAINTENANCE 133

7.1 Service Requests for Cleaning 133
7.2 Storm Drain Cleaning Work Orders 133
7.2.1 'Inspect & Clean Ad Hoc' 134
7.2.2 'Inspect Comprehensive & Clean within 30 Days' 134
7.2.3 'Inspect Comprehensive & Clean within 10 Days' 134
7.2.4 'Inspect & Comprehensive Clean BMP' 134
7.3 Supervisors Responsible for Follow-up Work.....134
7.3.1 Quality Control Report for Inspection Follow-up Work 135
7.4 Inspect Comprehensive & Clean BMPs 138
7.4.1 Increase Frequency of BMP Inspections 138
7.5 Sweeping Common Areas Work Orders.....138
7.5.1 Sweeping Routes 139
7.6 Kalaeloa Barbers Point Harbor Rail Tracks Cleaning 140
7.7 Waste Collection and Disposal 140
7.8 Harbors Maintenance Section (HAR-OM) 140

CHAPTER 8 EQUIPMENT AND VEHICLES 141

LIST OF FIGURES

Figure 1	Honolulu Harbor Piers	5
Figure 2	Honolulu Harbor aerial view shows the surrounding ocean, channels, and basins	5
Figure 3	Kalaeloa Barbers Point Harbor contains specialized cargo handling facilities	7
Figure 4	Piers 1 and Pier 2 – Fort Armstrong GIS map of storm drain assets	15
Figure 5	Piers 5 through 11 – Aloha Tower Market Place Complex GIS map of storm drain assets	19
Figure 6	Piers 12 through 18 GIS Map of storm drain assets	24
Figure 7	Piers 19 through 29 GIS Map of storm drain assets	26
Figure 8	Piers 31 through 35 GIS Map of storm drain assets	31
Figure 9	Piers 36 through 38 GIS map of storm drain assets	35
Figure 10	Piers 39 through 45 GIS map of storm drain assets	38
Figure 11	Piers 51 through 53 – Sand Island GIS map of storm drain assets	43
Figure 12A	Honolulu Harbor Post-Construction BMPs with GIS map of BMP locations	51
Figure 12B	Honolulu Harbor Post-Construction BMPs with GIS map of BMP locations	52
Figure 12C	Honolulu Harbor Post-Construction BMPs with GIS map of BMP locations	53
Figure 13	Honolulu Harbor flood hazard assessment map	56
Figure 14	Harbors three types of stencils BMP installation	57
Figure 15	Honolulu Harbor storm drain signage GIS map	58
Figure 16	Kalaeloa Barbers Point Harbor Piers GIS map of storm drain assets	63
Figure 17	Kalaeloa Barbers Point Harbor Post-Construction BMP map	67
Figure 18	Kalaeloa Barbers Point Harbor rail tracks at Pier 6 and Pier 7	68

Figure 19 Harbors Division Organizational Chart with responsibilities for the SSS OMP activities highlighted in yellow 71
Figure 20 Harbors Oahu District Position Titles and SSS Activities Organizational Chart 72
Figure 21 Prohibition practice BMP signage informs the public that "Pollution is Prohibited by Law" 78
Figure 22 Honolulu Harbor Storm Sewer System Assets 87
Figure 23 Kalaeloa BP Harbor Storm Sewer System Assets 88
Figure 24 Work Order screen displays status field as "Assigned" 95
Figure 25 Work Order Details panel 96
Figure 26 Illicit Oil Discharge Notifications screen 98
Figure 27 Task Hierarchy Configured for Harbors 98
Figure 28 Harbors Inspection Templates 102
Figure 29 Harbors customized outfall reconnaissance inspection template 103
Figure 30 Screening Inspection form example 104
Figure 31 Comprehensive Inspection & Cleaning form example 105
Figure 32 Inspect Comprehensive & Clean BMP Work Order screen 106
Figure 33 Material / Entity Task Panel 108
Figure 34 Equipment / Entity Task Panel 109
Figure 35 Cityworks® AMS Search Query screen 110
Figure 36 HAR-OCM MCS and HA inspection tasks workflow 117
Figure 37 HAR-OCG cleaning tasks workflow 118

LIST OF TABLES

Table 1	Consent Decree Requirements for the *SSS O&M Manual*	2
Table 2	Honolulu Harbor Piers and name, principal cargo/pier use, container yard area, and shed area	12
Table 3	Piers 1 and 2 storm drain inlet, manhole, and catch basin assets; and ID number, location, and stencil type	16
Table 4	Piers 5 through 11 storm drain inlet, manhole, and catch basin assets; and ID number, location, and stencil type	20
Table 5	Piers 5 through 11 storm drain open channel asset, ID number, and location	23
Table 6	Piers 12 through 18 storm drain inlet assets, ID number, location, and stencil type	25
Table 7	Piers 19 through 29 storm drain inlet and manhole assets, ID number, location, and stencil type	27
Table 8	Piers 19 through 29 storm drain open channel assets, ID number, and location	29
Table 9	Piers 31 through 35 storm drain inlet and manhole assets, ID number, location, and stencil type	32
Table 10	Piers 31 through 35 storm drain open channel assets, ID number, and location	34
Table 11	Piers 36 through 38 storm drain inlet and manhole assets, ID number, location, and stencil type	36
Table 12	Piers 36 through 38 storm drain open channel assets, ID number, and location	37
Table 13	Piers 39 through 45 storm drain inlet, manhole, and catch basin assets; and ID number, location, and stencil type	39
Table 14	Piers 51 through 53 storm drain inlet, manhole, and catch basin assets; and ID number, location, and stencil type	44
Table 15	Piers 51 through 53, and Pier 60 storm drain open channel, swale, and other assets; and ID number and location	48

Table 16 Honolulu Harbor Post-Construction BMP ID number, structural type, BMP type, BMP subtype, and location 54
Table 17 Honolulu Harbor signage ID and location…..59
Table 18 Kalaeloa Barbers Point Harbor signage ID and location 61
Table 19 Kalaeloa Barbers Point Harbor Piers, principal cargo, container yard area, and shed area 62
Table 20 Kalaeloa Barbers Point Harbor storm drain inlet and manhole assets, ID number, location, and stencil type 64
Table 21 Kalaeloa Barbers Point Harbor open channel, trench drain, and swale assets; and ID number and location 65
Table 22 Post-Construction BMP ID number, structural type, BMP type, BMP subtype, and location 66
Table 23 Storm Water BMPs and Harbors programmatic roles 78
Table 24 Notifications Information and Contacts 81
Table 25 Cityworks® AMS configured asset groups 89
Table 26 Work Orders assigned to Harbors personnel for follow-up and completion 89
Table 27 Service Requests assigned to Harbors personnel for follow-up work required 107

LIST OF ACRONYMS AND ABBREVIATIONS

AMS	Asset Management System
ArcGIS	GIS maps and geographic information developed by ESRI
BMP	Best Management Practice
CCH	City & County of Honolulu
CCTV	Closed circuit television
CD	Consent Decree
CFR	Code of Federal Regulations
CM	Curb Marker (stencil)
Config	Configuration
COTS	Commercial Off the Shelf
CWA	Clean Water Act
CWB	Clean Water Branch
DIR	Office of Director, HDOT
DepH	Deputy Director for Harbors
DMR	Discharge Monitoring Report
ELM	Equipment, Labor & Materials
ENV	Office of Environmental Compliance, HDOT
EPA or USEPA	US Environmental Protection Agency
ESRI	Environmental Systems Research Institute
FTE	Full Time Equivalent
GIS	Geographical Information System
HA	Harbor Agent
HAR	Harbors Division; also Harbors Administrator; also Hawaii Administrative Rules
HAR-E	Engineering Branch, Harbors Division
HAR-EE	Environmental Section, Engineering Branch, Harbors Division
HAR-EM	Maintenance Engineering Section, Engineering Branch, Harbors Division
HAR-EP	Planning Section, Engineering Branch, Harbors Division
HAR-O	Oahu District, Harbors Division
HAR-OC	Operations Section, Oahu District
HAR-OCB	Kalaeloa Barbers Point Unit, Operations Section, Oahu District
HAR-OCG	Sanitations & Grounds Unit, Operations Section, Oahu District

HAR-OCM	Pier Utilization Unit, Operations Section, Oahu District
HAR-OCT	Harbor Traffic Control Unit, Operations Section, Oahu District
HAR-OE	Security & Enforcement Unit, Operations Section, Oahu District
HAR-OM	Maintenance Section, Oahu District
HC	Harbors Construction project prefix
HDOH	Hawaii Department of Health
HDOT	Hawaii Department of Transportation
HOS	Harbor Operations Supervisor
IDDE	Illicit Discharge and Detection Elimination
Illct Dsch Oil Notf	Illicit Oil Discharge Notification
Illct Dsch Misc Notf	Illicit Discharge Notification Miscellaneous
INSP	Inspection
KBPH	Kalaeloa Barbers Point Harbor
MCS	Marine Cargo Specialist
MEP	Maximum Extent Practicable
MM	Metal Marker (stencil bolted to grate)
MOU	Memorandum of Understanding
MS4	Municipal Separate Storm Sewer System
NGPC	Notice of General Permit Coverage
NPDES	National Pollutant Discharge Elimination System
NOTI	Notify
O&M	Operations and Maintenance
PBMP	Permanent BMP
QC	Quality Control
RO/RO	Terminal Forklift Trucks
SR	Service Request
SSS	Storm Sewer System
SSS OMP	Storm Sewer System Operation & Maintenance Plan
SSS O&M Manual	Storm Sewer System Operation & Maintenance Program Manual
SWMP	Stormwater Management Plan
US	United States
USACE	United States Army Corps of Engineers, Pacific Ocean Division
USEPA	United States Environmental Protection Agency
USCG	United States Coast Guard
WO	Work Order

Volume I Foundational Data Resources

CHAPTER 1

INTRODUCTION

The State of Hawaii Department of Transportation (HDOT), Harbors Division (hereinafter "Harbors") owns and operates a Small Municipal Separate Storm Sewer System (MS4) at Honolulu Harbor and Kalaeloa Barbers Point Harbor (KBPH). Storm water flowing over Harbors property into the drainage network of inlets, manholes, open channels and trench drains enters the Small MS4 at each harbor and discharges into receiving waters.

Honolulu Harbor and KBPH are subject to the United States Environmental Protection Agency (USEPA) National Pollutant Discharge Elimination System (NPDES) regulations, and requirements of Title 40 Code of Federal Regulations (CFR) Part 122, because the harbors are located in urban areas based on the *U.S. Census* and *U.S. Census Urban Area Maps*, on the Island of Oahu. Locally, the State of Hawaii Department of Health (HDOH) Clean Water Branch (CWB) oversees Hawaii's NPDES program in accordance with Chapter 342D of the Hawaii Revised Statute (HRS) and Chapter 11-55 of the Hawaii Administrative Rules (HAR).

The HDOH CWB issued the Notice of General Permit Coverage (NGPC) NPDES Permit No. HI 03KB482 to Honolulu Harbor, and the NGPC NPDES Permit No. HI 03KB488 to Kalaeloa Barbers Point Harbor, which authorizes storm water and certain non-storm water discharges to enter receiving State Waters. The NGPC NPDES Permits required Harbors to develop a *Storm Water Management Plan (SWMP)* in 2009 and revise the SWMP in 2015 (hereinafter "*SWMP"*). The *SWMP* identifies the control measures and Best Management Practices (BMP) to reduce, to the Maximum Extent Practicable (MEP), the amount of pollutants from the Small MS4s that enter the receiving State Waters. The *SWMP* control measures for Pollution Prevention and Good Housekeeping Program include the Storm Sewer System Operations & Maintenance Program (SSS O&M Program).

On November 5, 2014, the USEPA enjoined HDOH to enter into a Consent Decree (CD) with HDOT Harbors Division in order to increase awareness, to improve the storm water program, and to ensure compliance. The CD requires Harbors to comply with specific requirements of the Clean Water Act (CWA), as amended, along with the provisions set forth in the NGPC NPDES Permits.

The 2014 CD Section 20.a through d, requires Harbors to develop the *Storm Sewer System Operations & Maintenance Plan.* This Storm Sewer System Operations & Maintenance Program Manual (hereinafter "*SSS O&M Manual"*) contains information about the storm sewer system Geographical Information System (GIS) mapping; the Asset Management System (AMS); and identifies the specific tasks, schedules, and requirements of Harbors personnel who conduct inspections and cleaning in the operations and maintenance of the storm sewer system (SSS).

This *SSS O&M Manual* provides the schedules of inspection and cleaning of storm drains; creates the Standard for inspection; details the operation and maintenance activities performance; details the documentation and record keeping procedures; and describes the supervision and management of the SSS OMP.

The *SSS O&M Manual* is prepared in accordance with the 2014 Consent Decree Civil Case 1:14-cv-00408-JMS-KSC, the NPDES NGPC Permits for Honolulu and Kalaeloa Barber's Point Harbors, and relevant sections of the Federal and State laws, rules, and regulations.

1.1 Requirements

The Consent Decree requirements for this *SSS O&M Manual* are provided in Table 1.

Table 1. Consent Decree Requirements for the *SSS O&M Manual.*

CONSENT DECREE REQUIREMENTS	CHAPTERS
20. Storm Sewer System Operations and Maintenance. *. . .The SSS O&M Plan shall establish recurring schedules for inspection and cleaning of the entire storm sewer system as described below. The SSS O&M Plan shall describe: 1) the range of operation and maintenance activities to be performed, 2) timelines and recurring schedules for each activity, 3) departments and personnel responsible for activity implementation, and 4) dates and timelines for procurement of necessary equipment. The SSS O&M Plan shall address the provisions in Paragraphs 20.a. through d.*	Chapter 1
a. Storm Sewer System Mapping. *. . . HDOT-Harbors shall create and submit a comprehensive storm sewer system map that identifies all HDOT-Harbors assets including inlets, manhole, pipes, above-ground drainage features, post-construction control measures, and outfalls. HDOT-Harbors shall include areas where Harbor Property discharges directly to the Harbors or their tributaries and are at risk of flooding. The map shall be developed in GIS format and shall include relevant information for each asset class. For pipes, drainage features and outfalls, this shall include the type of material, size, condition, and date of installation, if known. Data for inlets shall include type, condition and presence of stencil. The map shall allow for the determination of outfall drainage basins including the identification of up-gradient*	Chapter 2

CONSENT DECREE REQUIREMENTS	CHAPTERS
tributaries both within the HDOT-Harbors storm sewer system and where the system is connected to offsite tributary storm drain systems to the extent that information is included in the geodatabase delivered by the Army Corps of Engineers under the Army Corps of Engineers Scope of Work. . . . The map and associated GIS shall provide foundation data for the Asset Management System described below.	
b. Asset Management System. *HDOT-Harbors shall develop and maintain an Asset Management System, which shall include and inventory of HDOT-Harbors' assets and a schedule for recurring inspection, cleaning, other maintenance, and renewal. The Asset Management System shall be capable of generating and tracking work orders for inspection, cleaning, and other maintenance and shall be capable of assisting HDOT-Harbors with prioritization of capital improvement projects. The Asset Management System shall be fully implemented not later than December 31, 2015 or within 180 days of completion of Storm Sewer Mapping described in Paragraph 20.a.*	Chapter 3 Chapter 4
c. Storm Sewer System Inspections. *As described in the SSS O&M Plan, and in accordance with the schedule described in the SSS O&M Plan, HDOT-Harbors shall conduct physical inspections of the storm sewer system to identify structural defects, trash and debris accumulation, and other constraints that limit the flow of stormwater. HDOT-Harbors shall also inspect areas where Harbor Property discharges directly to the Harbors or their tributaries and are at risk for flooding. The inspection of the storm sewer system can occur concurrently with the cleaning program required in Paragraph 20.d.*	Chapter 5 Chapter 6
d. Storm Sewer System Cleaning. *The SSS O&M Plan shall include a cleaning schedule for the storm sewer system, and shall include an initial cleaning of all inlets, pipes (as necessary), drainage features and outfalls (as necessary) by 270 days after the entry of the Consent Decree, or another date agreed upon by EPA and DOH. Cleaning shall be accomplished by removing accumulated debris, trash, and sediment. HDOT-Harbors shall develop a recurring cleaning cycle that ensures that each inlet and drainage feature are cleaned no less than once every five years following the initial cleaning. Outfalls will be cleaned as necessary.* *i. In the cleaning schedule, HDOT-Harbors shall identify "hotspots" where there is a greater risk for potential discharges of pollutants to the storm sewer system, and describe the process for defining hotspots in the SSS O&M Plan. HDOT-Harbors shall implement appropriate BMPs, including more frequent cleaning and maintenance to minimize potential discharges of pollutants to the storm sewer system. . . .* *ii. HDOT-Harbors shall require the tenant to develop and implement a schedule for routine cleaning of rail tracks at Kalaeloa Barbers Point Harbor to prevent discharge of pollutants to the receiving water.*	Chapter 5 Chapter 7 Chapter 8

1.2 Port Hawaii Commercial Harbors System

Pursuant to HRS Chapter 266, HDOT is responsible for the care and control of the commercial harbors and roadsteads in Hawaii. The Harbors controls properties at Honolulu and Kalaeloa Barbers Point Harbors, along with the nine commercial harbors serving Island of Hawaii, Kauai, Maui, Molokai and Lanai. The Port Hawaii Commercial Harbors System (hereinafter "Port Hawaii") delivers passengers and goods via ocean transportation, and supports every facet of Hawaii's economy—tourism, construction, national defense, agriculture, and industries.

Hawaii imports 80% of all consumer goods, including food and fuel, and 98% of these goods are received and processed through the ten commercial ports on six islands.

1.2.1 Honolulu Harbor

Honolulu Harbor is one of the largest container handling ports in the United States and the busiest harbor in Hawaii with over 11 million short tons of cargo handled annually, and serves as the primary commercial and transportation center in the Port Hawaii system. Honolulu Harbor provides facilities for passenger, excursion, research and fishing vessels and supports numerous tenants engaged in shipping, commercial fishing, and other maritime-related activities.

Honolulu Harbor is a natural harbor created through the restriction of coral growth by the fresh water pouring into it from Nuuanu Stream, and is well protected from wind and surge action. Located on the southern coast of Oahu, Honolulu Harbor receives most of the State's containerized cargo where it is unloaded and distributed to its final destination.

Honolulu Harbor offers over 200 acres of container yard and over 30 major berth facilities with over 5 linear miles of mooring space. Honolulu Harbor is 40-feet deep and contains five components: Main Channel, Main Harbor Basin, Kapalama Channel, Kapalama Channel Basin, and Kalihi Channel.

Figure 1 shows a rendering of the Honolulu Harbor Piers.

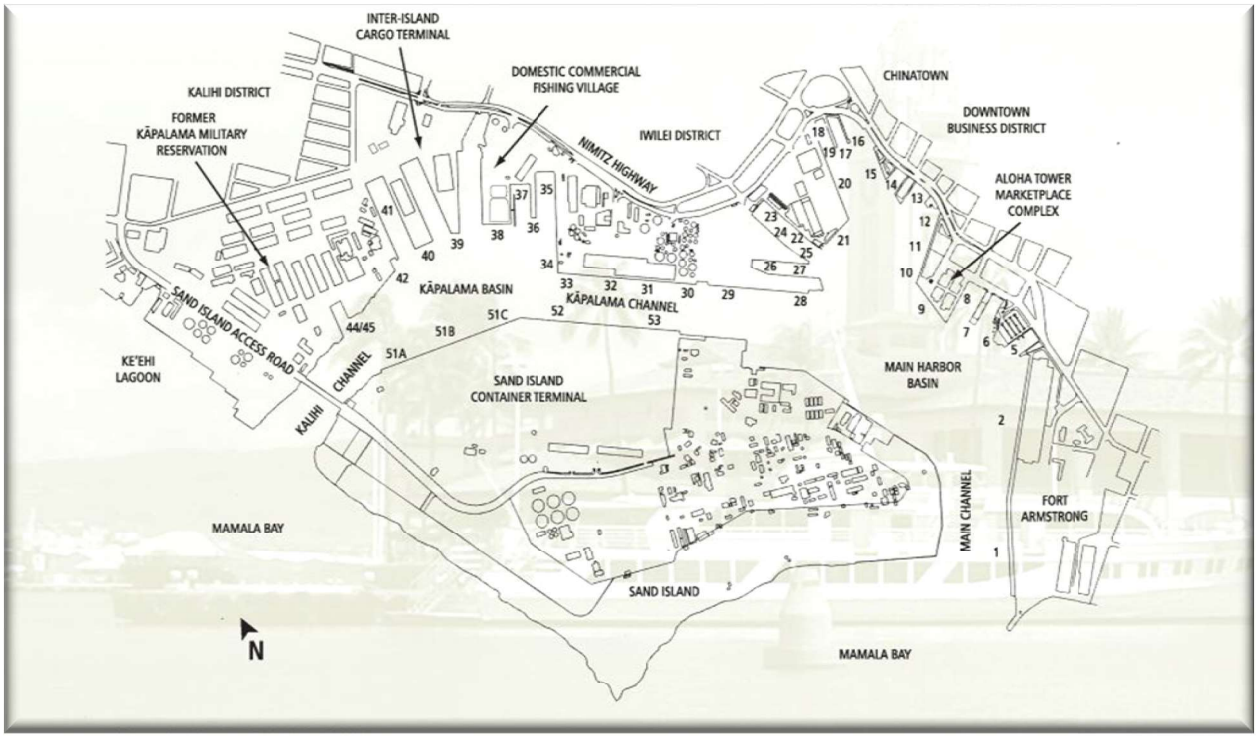


Figure 1. Honolulu Harbor Piers. (Courtesy *Port Hawaii Commercial Harbors System Handbook 2012.)*

Figure 2 shows Honolulu Harbor aerial view with ocean receiving waters.



Figure 2. Honolulu Harbor aerial view shows the surrounding ocean, channels, and basins.

The Main Channel, often referred to as the Fort Armstrong Channel, is Honolulu Harbor's entry and exit point. It is located at the harbor's east end and has a depth of 45 feet. The Kalihi Channel is located west of Sand Island but is not used because the Sand Island Access Road drawbridge over the channel is permanently fixed in place to allow for uninterrupted flow of containers to and from the container terminals on Sand Island.

The types of cargo handled at Honolulu Harbor include the following:

- Liquid-bulk cargo, e.g., petroleum products.
- Dry-bulk cargo, e.g., aggregates.
- Neo-bulk cargo, e.g., construction materials such as lumber.
- Break-bulk cargo, e.g., miscellaneous general cargo.

Linking Honolulu Harbor to the Honolulu International Airport is Nimitz Highway.

1.2.2 Kalaeloa Barbers Point Harbor

Kalaeloa Barbers Point Harbor is the second busiest port in Hawaii and enables business to ship their products directly to the Neighbor Islands. It is the newest commercial harbor constructed in 1990, and is located 19 nautical miles west of Honolulu Harbor near the south-western tip of Oahu.

Figure 3 shows the Kalaeloa Barbers Point Harbor that contains specialized cargo handling facilities, e.g., the pneumonic cement pump system.

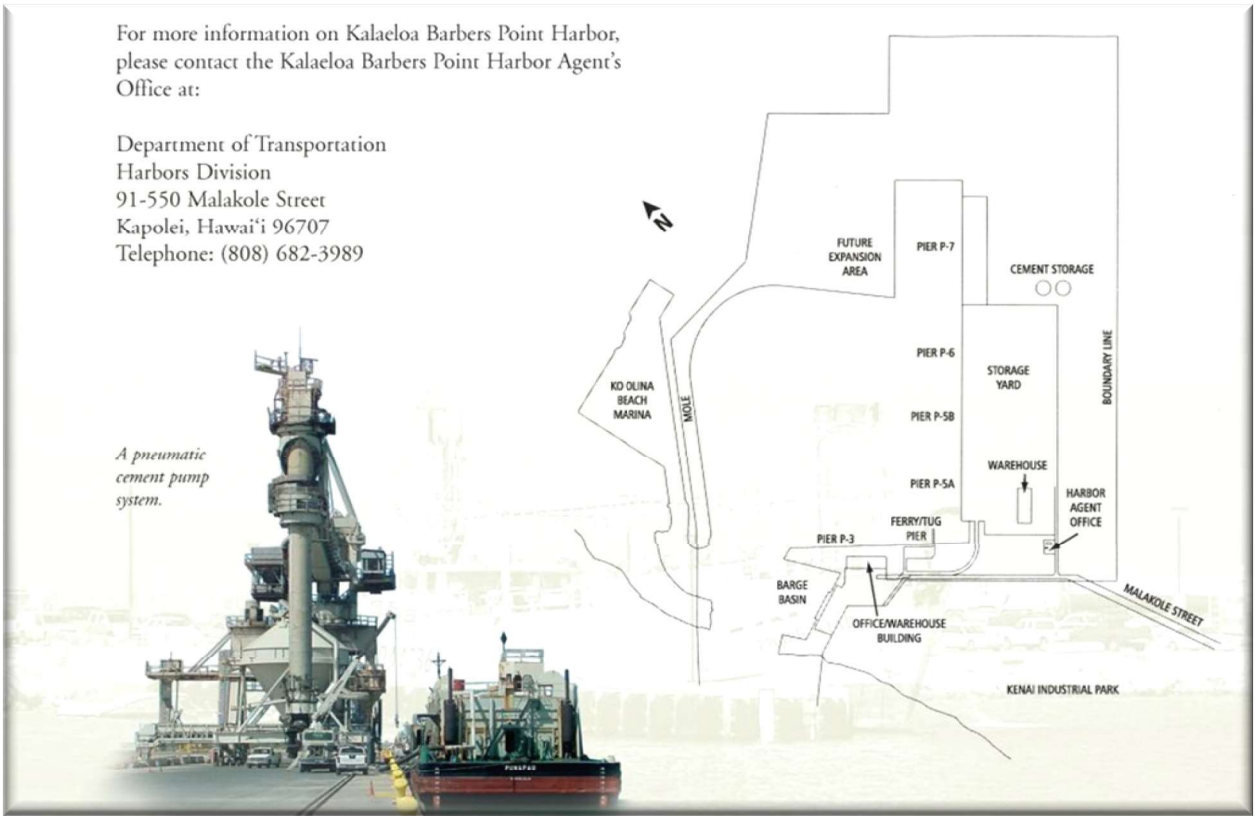


Figure 3. Kalaeloa Barbers Point Harbor contains specialized cargo handling facilities. (Courtesy *Port Hawaii Commercial Harbors System Handbook 2012.)*

Kalaeloa Barbers Point Harbor services a niche market; and contains specialized cargo handling facilities not found at Honolulu Harbor such as a coal bulk off-loader system and pneumatic cement pump station.

The main channel entrance measures 3,100-feet long and 38-feet deep. The recently expanded main basin is approximately 2,300-feet long by 1,800-feet wide.

The commodities primarily handled at Kalaeloa Barbers Point Harbor include the following types of cargo:

- Liquid-bulk cargo, e.g., petroleum products.
- Dry-bulk cargo, e.g., coal, sand, cement, gravel, and scrap metal.

In addition to commodities and lesser amounts of miscellaneous general cargo and containers, Kalaeloa Barbers Point Harbor provides space for commercial ship maintenance and repair facilities.

Kalaleloa Barbers Point Harbor is served by Interstate Highway H-1 and Farrington Highway, and is connected to Honolulu International Airport and downtown Honolulu by about 20 miles of high capacity roadway.

1.3 Storm Sewer System Operations and Maintenance Program

Honolulu Harbor and Kalaeloa Barbers Point Harbor are working harbors, busy with industrial activity that includes the use and maintenance of heavy diesel equipment, delivery vehicles, construction projects, container operations, fresh fish operations, and various tenant operations. Storm water flows over and through harbor lands and is captured into storm drains of the storm sewer system, and empties into receiving ocean waters. Storm water flows can transport pollutants from the land into the ocean through storm drains, swales, or other uncontrolled access points across the piers. This storm water flow requires the adoption and implementation of BMPs to mitigate and prevent oil, debris, silt, and other potential pollutants from entering our ocean waters.

The SWMP Pollution Prevention /Good Housekeeping Program includes the SSS OMP; general maintenance and housekeeping activities for sweeping and refuse collection; reviews and on-site inspections of wash areas, dry wells, and infiltration sinks; and storm water awareness training.

The SSS OMP defines the implementation of BMPs for storm drain inspection, cleaning, and preventive maintenance. The SSS OMP goals are to inspect storm drains to identify structural defects; clean accumulated trash, debris, and sediment; and investigate issues that have the potential to limit the storm drain flow of storm water.

1.4 Organization of the *SSS O&M Manual*

This *SSS O&M Manual* provides resource GIS maps, storm drain asset data tables, and the Operations and Maintenance (O&M) procedures documentation for Harbors personnel. This document serves to facilitate compliance performance; establish timelines and recurring schedules, routes, and routine frequencies; identify Harbors personnel responsible for specific tasks; and discuss future procurement requirements. The *SSS O&M Manual* is organized as set forth in the CD Section 20.a through d.

The Harbors GIS maps and the AMS serve as reference materials for implementation of the environmental compliance activities. The O&M procedures documentation serve as user guides for personnel who perform the Harbors storm sewer system activities and

tasks utilizing the Citiworks® AMS generated workflow processes. For ease of use, the *SSS O&M Manual* is divided into the following two volumes.

1.4.1 Volume I Foundational Data Resources – Chapters 1 to 4

- GIS maps of the Harbors storm sewer system in Pier functional areas, with data tables of storm drain assets inventories (e.g., inlets and manholes, pipes, open channels and trench drains, and outfalls).
- Citiworks® AMS management of compliance activities for performance of storm sewer system inspection, cleaning, and maintenance activities and tasks.

1.4.2 Volume II User Guides for Storm Sewer System O&M Activities – Chapters 5 to 8

- Inspection activities utilizing Citiworks® AMS with screen prints of workflow processes that manage Harbors personnel tasks from initiation to reporting.
- Cleaning activities with Harbors O&M personnel responsible to perform tasks.

1.5 *SSS O&M Manual* Audience and Intended Uses

This *SSS O&M Manual* is written for Harbors personnel, and describes the necessary activities and tasks performed to ensure proper operations and maintenance of the storm sewer system. The target audience includes Managers, Superintendents, and Supervisors with programmatic responsibilities for manpower and funding resources.

The *SSS O&M Manual* integrates the Cityworks® AMS storm drain asset maps with predefined schedules and work assignments to inspect, clean, and maintain the storm drain system; and provides O&M user guides for Harbors Inspectors and Subunit personnel.

The comprehensive Oahu District storm drain asset maps and data tables are supplemented with Harbors organizational charts, and may be useful for training personnel and new employee orientation.

The *SSS O&M Manual* may serve as a reference document for the HDOT, all Harbors personnel, environmental consultants, and regulatory agencies.

This page intentionally left blank.

CHAPTER 2
HARBORS STORM SEWER SYSTEM AND GIS MAPPING

Harbors personnel performs the storm sewer system O&M for the storm drain infrastructure that currently includes 529 inlets, 114 manholes, 124 outfalls, 84 fittings, 720 lines, 107 open lines, 43 Permanent BMPs, 82 signage, and 14 sweeping routes at Honolulu Harbor and Kalaeloa Barbers Point Harbor.

The storm sewer system captures storm water flows at the Honolulu Harbor's 5 linear miles of mooring space for 30 major berth facilities on 48 piers, and over 232 acres of container yard and 842,362 square feet of shed areas. At Kalaeloa Barbers Point Harbor, storm water flows over and through the Barge Basin, five commercial piers, and the Ferry Terminal/Tug Pier.

During 2015, Harbors implemented a geodatabase containing an inventory of storm sewer system assets and GIS mapping with the assistance of the US Army Corps of Engineers (USACE). An environmental engineering consultant conducted GIS data gap surveys using closed-circuit television crews on land, and kayak and scuba diving teams for discharge outfall reconnaissance to investigate unknown storm sewer system connections and to assess the condition of subsurface features associated with the data gaps.

The storm sewer system geodatabase data gathered by the USACE and consultant are currently hosted by ESRI ArcGIS server feature map services and managed in ArcGIS Desktop. These web-based services are available to authorized users with Internet access.

The GIS mapping of the Harbors storm sewer system was integrated into the AMS, which provides the information needed to monitor and manage the storm sewer system, and supports the preparation of *Annual Compliance Reports*. The GIS mapping locates storm drain features and ties other structures into a map. The GIS mapping allows for accurate accumulation of data for each feature.

2.1 Honolulu Harbor Pier Use Areas

The principal cargo and pier use areas for Honolulu Harbor structure the routes for the storm sewer system inspection and cleaning tasks, and Harbors personnel are assigned as the inspectors for specific pier areas.

The *SSS O&M Manual* presents storm drain assets inventoried with GIS mapping and data tables for each pier use area.

Table 2 lists the Honolulu Harbor Piers, area name, principal cargo/pier use, container yard area, and shed areas.

Table 2. Honolulu Harbor Piers and name, principal cargo/pier use, container yard area, and shed area.

PIER	NAME	PRINCIPAL CARGO/PIER USE	YARD AREA (ACRES)	SHED AREA (SQ. FT.)
1	Fort Armstrong	Foreign containers and neo-bulk cargo.	20.1	11,337
2		Commercial ship terminal, Foreign-Trade Zone No. 9, and neo-bulk cargo.	8.9	169,355
5	Aloha Tower Market Place Complex	Small passenger vessels.		
6		Small passenger vessels and vehicle parking.		
7		Falls of Clyde and the Hawaii Maritime Center.		
8		Small passenger vessels and retail space.		
9		Miscellaneous vessels and retail space.		
10		Cruise ship terminal and vehicle parking.		
11		Cruise ships and Harbors Division Administrative Office.		
12	Piers 12 – 18	Vehicle parking, Clean Island Council (oil spill response vessel), Equipment storage.		
13		Tugboats, office space, and vehicle parking.		13,824
14		Tugboats, office space, and vehicle parking.		13,825
15		Marine Spill Response Center, Oil Spill response vessel(s).	0.4	5,498
16		Commercial fishing boats.		
17		Commercial fishing boats.		
18		Pilot boats, loading dock, storage, and repair sheds.		
19	Piers 19 – 29	Tugboats, barges, cruise ships, ferry terminal, general cargo, and storage shed.	0.3	87,845
20		Tugboats, barges, cruise ships, general cargo.	3.0	
21		Tugboats, barges, and office space.	0.4	

PIER	NAME	PRINCIPAL CARGO/PIER USE	YARD AREA (ACRES)	SHED AREA (SQ. FT.)
22		Tugboats and water taxis.	0.8	
23		Barges and other big berth vessels.	2.9	
24		Pacific Shipyards.	3.4	
25		Pacific Shipyards.	0.5	
26		Tugboats, barges, and work boats.	3.9	
27		Work boats, dinner cruise ship, and submarine maintenance facility.	2.4	
28		Tugboats, barges, and maintenance operation.	0.9	
29		Tugboats, barges, general cargo, and RO/RO (terminal forklift trucks).	7.8	
30	Piers 31 – 35	*Privately owned.*		
31		General cargo, RO/RO, office space, and storage sheds.	0.2	74,130
32		Bunkering, pipelines, general cargo, and RO/RO.	3.3	99,400
33		General cargo, dry bulk, cargo, and RO/RO.	4.1	67,228
34		Bunkering, pipelines, and general cargo.	2.0	
35		University of Hawaii Marine Center research vessel(s).	1.9	
36	Domestic Commercial Fishing Village	Commercial fishing boats.		32,400
37		Commercial fishing boats, ice plant, retail, food restaurants, fish brokerage, and sales.		
38		Commercial fishing boats, fish auction, and propane barge.		
39		Barges and tugboats, break-bulk and container cargos, and RO/RO.	16.1	98,239
40		Barges and tugboats, break-bulk and container cargos, and RO/RO.	10.8	67,500
41		Dry-dock and ship repair facility.		
42		Container freight station.		
44	Snug Harbor			
45				
51A	Sand Island	Domestic containers, autos, RO/RO, and petroleum.	26.3	

PIER	NAME	PRINCIPAL CARGO/PIER USE	YARD AREA (ACRES)	SHED AREA (SQ. FT.)
51B		Domestic containers and autos, maintenance facility.	31.1	
51C		Domestic containers and autos, maintenance facility.	11.9	
52		Domestic containers and autos.	31.5	50,300
53		Domestic containers and autos.	37.4	51,481
60	KIPA	Bulk Cargo, user has own permit.		
		TOTALS	**232.3**	**842,362**

2.1.1 Pier 1 and Pier 2 – Fort Armstrong GIS Map of Storm Drain Assets



Figure 4. Piers 1 and 2 – Fort Armstrong GIS map of storm drain assets.

Table 3 shows **Piers 1 and 2** with 71 storm drain inlet, manhole, and catch basin assets; and identification number, location, and stencil type.

Table 3. Piers 1 and 2 storm drain inlet, manhole, and catch basin assets; and ID number, location, and stencil type.

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE*.
Drain Inlet	SDIHO010102	HO01	SP
Drain Inlet	SDIHO010152	HO01	SP
Drain Inlet	SDIHO010202	HO01	SP
Drain Inlet	SDIHO010208	HO01	SP
Drain Inlet	SDIHO010212	HO01	SP
Drain Inlet	SDIHO010214	HO01	SP
Drain Inlet	SDIHO010112	HO01	SP
Drain Inlet	SDIHO010122	HO01	SP
Drain Inlet	SDIHO010224	HO01	SP
Drain Inlet	SDIHO010252	HO01	SP
Drain Inlet	SDIHO010254	HO01	SP
Drain Inlet	SDIHO010162	HO01	SP
Drain Inlet	SDIHO010210	HO01	SP
Manhole	SDJHO010220	HO01	N/A
Manhole	SDJHO010222	HO01	N/A
Manhole	SDJHO010204	HO01	N/A
Manhole	SDJHO020802	HO01	N/A
Manhole	SDJHO010206	HO01	N/A
Manhole	SDJHO020208	HO02	N/A
Drain Inlet	SDIHO010172	HO02	SP
Drain Inlet	SDIHO020178	HO02	SP
Drain Inlet	SDIHO020176	HO02	SP
Drain Inlet	SDIHO020174	HO02	SP
Drain Inlet	SDIHO020810	HO02	SP
Drain Inlet	SDIHO020804	HO02	SP
Drain Inlet	SDIHO020806	HO02	SP
Drain Inlet	SDIHO020808	HO02	SP
Drain Inlet	SDIHO020520	HO02	SP
Drain Inlet	SDIHO020512	HO02	SP

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE*.
Drain Inlet	SDIHO020812	HO02	SP
Drain Inlet	SDIHO020814	HO02	SP
Drain Inlet	SDIHO010256	HO02	SP
Drain Inlet	SDIHO010258	HO02	SP
Drain Inlet	SDIHO010260	HO02	SP
Drain Inlet	SDIHO010262	HO02	SP
Drain Inlet	SDIHO010264	HO02	SP
Drain Inlet	SDIHO010266	HO02	SP
Drain Inlet	SDIHO010268	HO02	SP
Drain Inlet	SDIHO010270	HO02	SP
Drain Inlet	SDIHO010272	HO02	SP
Drain Inlet	SDIHO010274	HO02	SP
Drain Inlet	SDIHO010276	HO02	SP
Drain Inlet	SDIHO010278	HO02	SP
Drain Inlet	SDIHO010280	HO02	SP
Drain Inlet	SDIHO010282	HO02	SP
Drain Inlet	SDIHO010284	HO02	SP
Drain Inlet	SDIHO010286	HO02	SP
Drain Inlet	SDIHO010288	HO02	SP
Drain Inlet	SDIHO010290	HO02	SP
Drain Inlet	SDIHO010292	HO02	SP
Catch Basin	SDIHO020650	HO02	SP
Catch Basin	SDIHO020640	HO02	SP
Catch Basin	SDIHO020642	HO02	SP
Catch Basin	SDIHO020644	HO02	SP
Catch Basin	SDIHO020522	HO02	SP
Catch Basin	SDIHO020508	HO02	SP
Catch Basin	SDIHO020510	HO02	SP
Manhole	SDJHO020604	HO02	N/A
Manhole	SDJHO020606	HO02	N/A
Manhole	SDJHO020602	HO02	N/A
Manhole	SDJHO020638	HO02	N/A
Manhole	SDJHO020636	HO02	N/A
Manhole	SDJHO020722	HO02	N/A

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE*.
Manhole	SDJHO020634	HO02	N/A
Manhole	SDJHO020632	HO02	N/A
Manhole	SDJHO020702	HO02	N/A
Manhole	SDJHO020704	HO02	N/A
Manhole	SDJHO020706	HO02	N/A
Manhole	SDJHO020506	HO02	N/A
Manhole	SDJHO020502	HO02	N/A
Manhole	SDJHO020504	HO02	N/A

* *SP = spray paint; MM = metal marker (bolted to grate); CM = curb marker (durable plastic requires special adhesive); and N/A = not applicable.*

2.1.2 Piers 5 through 11 – Aloha Tower Market Place Complex GIS Map of Storm Drain Assets

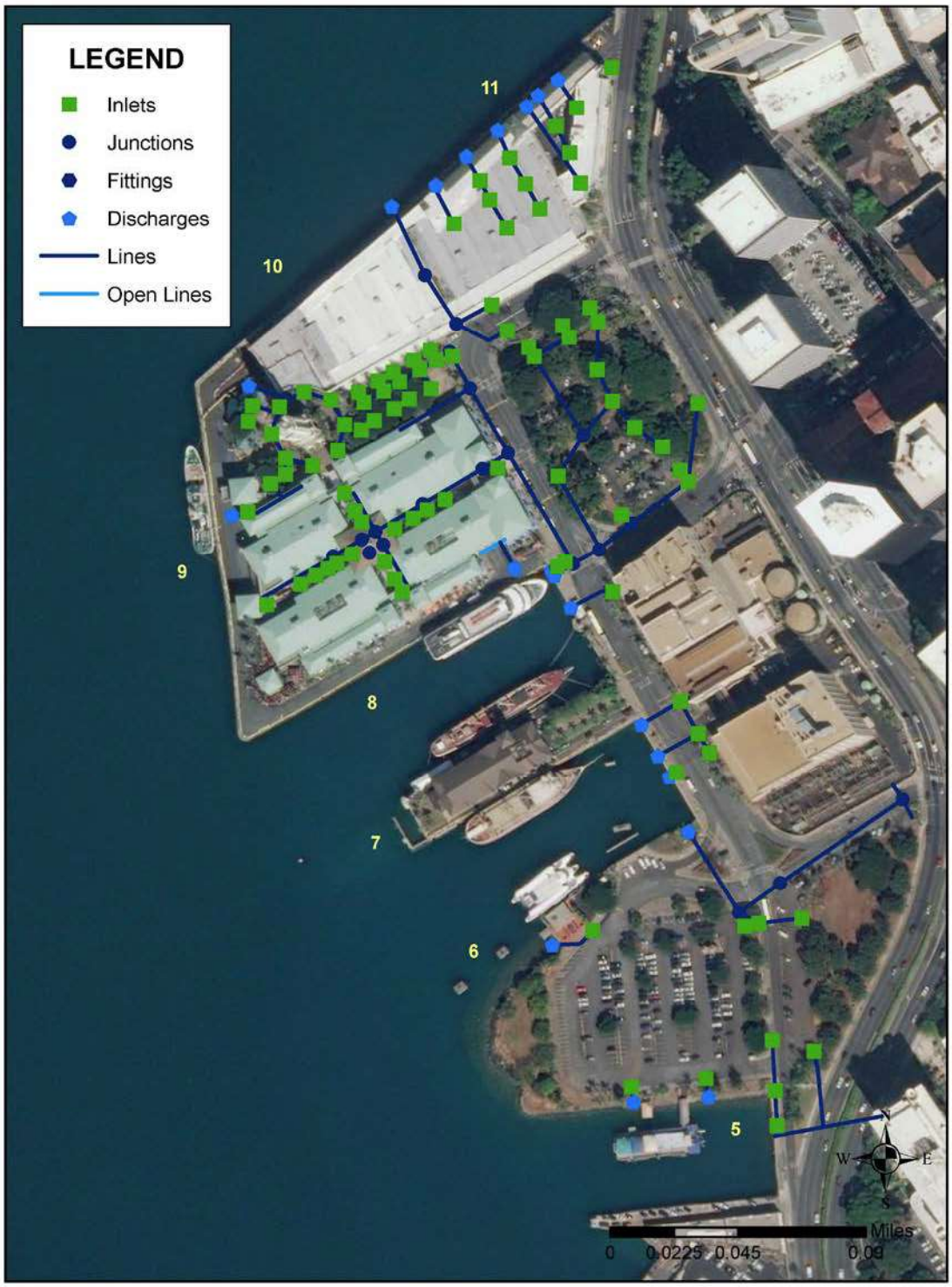


Figure 5. Piers 5 through 11 – Aloha Tower Market Place Complex GIS map of storm drain assets.

Table 4 shows **Piers 5 through 11** with 106 storm drain inlet, manhole, and catch basin assets; and identification number, location, and stencil type.

Table 4. Piers 5 through 11 storm drain inlet, manhole, and catch basin assets; and ID number, location, and stencil type.

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE*
Drain Inlet	SDIHO051012	HO05	SP
Drain Inlet	SDIHO051002	HO05	SP
Drain Inlet	SDIHO0519427	HO05	SP
Drain Inlet	SDIHO0519429	HO05	MM
Drain Inlet	SDIHO0528874	HO05	MM
Drain Inlet	SDIHO0519423	HO05	SP
Drain Inlet	SDIHO061042	HO06	SP
Catch Basin	SDIHO061162	HO06	SP
Drain Inlet	SDIHO061098	HO06	SP
Drain Inlet	SDIHO061102	HO06	SP
Drain Inlet	SDIHO061100	HO06	SP
Manhole	SDJHO061110	HO06	N/A
Manhole	SDJHO061096	HO06	N/A
Drain Inlet	SDIHO081504	HO08	SP
Catch Basin	SDIHO081506	HO08	SP
Catch Basin	SDIHO081242	HO08	SP
Catch Basin	SDIHO081288	HO08	SP
Catch Basin	SDIHO081286	HO08	SP
Catch Basin	SDIHO081284	HO08	SP
Catch Basin	SDIHO081282	HO08	SP
Catch Basin	SDIHO081240	HO08	SP
Catch Basin	SDIHO081238	HO08	SP
Catch Basin	SDIHO081260	HO08	SP
Catch Basin	SDIHO081244	HO08	SP
Manhole	SDJHO081236	HO08	N/A
Manhole	SDJHO061112	HO08	N/A
Manhole	SDJHO081234	HO08	N/A
Manhole	SDJHO081232	HO08	N/A
Manhole	SDJHO081502	HO08	N/A

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE*
Manhole	SDJHO081280	HO08	N/A
Drain Inlet	SDIHO092030	HO09	SP/MM
Drain Inlet	SDIHO091292	HO09	SP
Drain Inlet	SDIHO091290	HO09	SP
Drain Inlet	SDIHO091486	HO09	MM
Drain Inlet	SDIHO091462	HO09	MM
Drain Inlet	SDIHO091464	HO09	MM
Drain Inlet	SDIHO091466	HO09	MM
Drain Inlet	SDIHO091456	HO09	MM
Drain Inlet	SDIHO091458	HO09	MM
Drain Inlet	SDIHO091470	HO09	MM
Drain Inlet	SDIHO091472	HO09	MM
Drain Inlet	SDIHO091474	HO09	MM
Drain Inlet	SDIHO091478	HO09	MM
Drain Inlet	SDIHO091480	HO09	MM
Drain Inlet	SDIHO091482	HO09	MM
Drain Inlet	SDIHO091488	HO09	MM
Drain Inlet	SDIHO091490	HO09	MM
Drain Inlet	SDIHO091434	HO09	MM
Drain Inlet	SDIHO091432	HO09	MM
Drain Inlet	SDIHO091430	HO09	MM
Drain Inlet	SDIHO091420	HO09	MM
Drain Inlet	SDIHO091422	HO09	MM
Drain Inlet	SDIHO091424	HO09	MM
Drain Inlet	SDIHO091384	HO09	MM
Drain Inlet	SDIHO091388	HO09	MM
Drain Inlet	SDIHO091390	HO09	MM
Drain Inlet	SDIHO091364	HO09	MM
Drain Inlet	SDIHO091392	HO09	MM
Drain Inlet	SDIHO091394	HO09	MM
Drain Inlet	SDIHO091396	HO09	MM
Drain Inlet	SDIHO091362	HO09	MM
Drain Inlet	SDIHO091360	HO09	MM
Drain Inlet	SDIHO091356	HO09	MM

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE*
Drain Inlet	SDIHO091352	HO09	MM
Drain Inlet	SDIHO091654	HO09	MM
Drain Inlet	SDIHO091652	HO09	MM
Drain Inlet	SDIHO091656	HO09	MM
Drain Inlet	SDIHO091650	HO09	MM
Drain Inlet	SDIHO091648	HO09	MM
Drain Inlet	SDIHO091630	HO09	MM
Drain Inlet	SDIHO091622	HO09	MM
Drain Inlet	SDIHO091620	HO09	MM
Drain Inlet	SDIHO091604	HO09	MM
Drain Inlet	SDIHO091608	HO09	MM
Drain Inlet	SDIHO091572	HO09	MM
Drain Inlet	SDIHO091610	HO09	MM
Catch Basin	SDIHO092022	HO09	SP/MM
Catch Basin	SDIHO091452	HO09	SP/CM
Catch Basin	SDIHO091296	HO09	SP
Catch Basin	SDIHO091310	HO09	SP
Catch Basin	SDIHO091308	HO09	SP
Catch Basin	SDIHO091294	HO09	SP
Drain Inlet	SDIHO091626	HO09	MM
Drain Inlet	SDIHO091624	HO09	MM
Manhole	SDJHO091454	HO09	N/A
Manhole	SDJHO092020	HO09	N/A
Manhole	SDJHO091350	HO09	N/A
Manhole	SDJHO091450	HO09	N/A
Manhole	SDJHO091386	HO09	N/A
Manhole	SDJHO091428	HO09	N/A
Manhole	SDJHO091380	HO09	N/A
Manhole	SDJHO091358	HO09	N/A
Manhole	SDJHO091354	HO09	N/A
Manhole	SDJHO091426	HO09	N/A
Manhole	SDJHO091382	HO09	N/A
Manhole	SDJHO101732	HO10	N/A
Drain Inlet	SDIHO111834	HO11	SP

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE*
Drain Inlet	SDIHO111796	HO11	SP
Drain Inlet	SDIHO111798	HO11	SP
Drain Inlet	SDIHO111764	HO11	SP
Drain Inlet	SDIHO111794	HO11	SP
Drain Inlet	SDIHO111854	HO11	SP
Drain Inlet	SDIHO111766	HO11	SP
Drain Inlet	SDIHO111836	HO11	SP
Drain Inlet	SDIHO111824	HO11	SP
Drain Inlet	SDIHO111744	HO11	SP

** SP = spray paint; MM = metal marker (bolted to grate); CM = curb marker (durable plastic requires special adhesive); and N/A = not applicable.*

Table 5 shows **Piers 5 through 11** with 1 open channel asset, identification number, and location.

Table 5. Piers 5 through 11 storm drain open channel asset, ID number, and location.

ASSET TYPE	ID NUMBER	PIER LOCATION
Open Channel	SDOHO081515	HO08

2.1.3 Piers 12 through 18 GIS Map of Storm Drain Assets



Figure 6. Piers 12 through 18 GIS map of storm drain assets.

Table 6 shows **Piers 12 through 18** with 12 storm drain inlet assets, identification number, location, and stencil type.

Table 6. Piers 12 through 18 storm drain inlet assets, ID number, location, and stencil type.

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Drain Inlet	SDIHO152202	HO15	SP
Drain Inlet	SDIHO182310	HO18	SP
Drain Inlet	SDIHO182308	HO18	SP
Drain Inlet	SDIHO182304	HO18	SP
Drain Inlet	SDIHO182302	HO18	SP
Drain Inlet	SDIHO182320	HO18	SP
Drain Inlet	SDIHO182422	HO18	SP
Drain Inlet	SDIHO182432	HO18	SP
Drain Inlet	SDIHO182420	HO18	SP
Drain Inlet	SDIHO182430	HO18	SP
Drain Inlet	SDIHO182434	HO18	SP
Drain Inlet	SDIHO182306	HO18	SP

* *SP = spray paint; MM = metal marker (bolted to grate); CM = curb marker (durable plastic requires special adhesive); and N/A = not applicable.*

2.1.4 Piers 19 through 29 GIS Map of Storm Drain Assets



Figure 7. Piers 19 through 29 GIS map of storm drain assets.

Table 7 shows **Piers 19 through 29** with 74 storm drain inlet and manhole assets, identification number, location, and stencil type.

Table 7. Piers 19 through 29 storm drain inlet and manholes assets, ID number, location, and stencil type.

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Drain Inlet	SDIHO192410	HO19	SP
Drain Inlet	SDIHO192544	HO19	SP
Drain Inlet	SDIHO192504	HO19	SP
Drain Inlet	SDIHO202502	HO19	SP
Drain Inlet	SDIHO192520	HO19	SP
Drain Inlet	SDIHO192484	HO19	CM
Manhole	SDJHO192482	HO19	N/A
Drain Inlet	SDIHO202662	HO20	SP
Drain Inlet	SDIHO202674	HO20	SP
Drain Inlet	SDIHO202580	HO20	SP
Drain Inlet	SDIHO202582	HO20	SP
Drain Inlet	SDIHO202704	HO20	SP
Drain Inlet	SDIHO202670	HO20	SP
Drain Inlet	SDIHO202666	HO20	SP
Drain Inlet	SDIHO202672	HO20	SP
Drain Inlet	SDIHO202664	HO20	SP
Drain Inlet	SDIHO202660	HO20	SP
Drain Inlet	SDIHO202658	HO20	SP
Drain Inlet	SDIHO202648	HO20	SP
Drain Inlet	SDIHO202650	HO20	SP
Drain Inlet	SDIHO202646	HO20	SP
Drain Inlet	SDIHO202642	HO20	SP
Drain Inlet	SDIHO202584	HO20	SP
Drain Inlet	SDIHO202656	HO20	SP
Drain Inlet	SDIHO202654	HO20	SP
Drain Inlet	SDIHO202652	HO20	SP
Drain Inlet	SDIHO212792	HO21	SP
Drain Inlet	SDIHO212612	HO21	SP
Drain Inlet	SDIHO212602	HO21	SP

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Drain Inlet	SDIHO202700	HO21	SP
Drain Inlet	SDIHO222802	HO22	SP
Drain Inlet	SDIHO232678	HO23	MM
Drain Inlet	SDIHO232440	HO23	MM
Drain Inlet	SDIHO232438	HO23	MM
Drain Inlet	SDIHO232448	HO23	MM
Drain Inlet	SDIHO232682	HO23	MM
Drain Inlet	SDIHO232442	HO23	MM
Drain Inlet	SDIHO192554	HO23	SP
Drain Inlet	SDIHO192562	HO23	SP
Drain Inlet	SDIHO232680	HO23	MM
Drain Inlet	SDIHO232686	HO23	MM
Drain Inlet	SDIHO232812	HO23	SP
Drain Inlet	SDIHO232814	HO23	SP
Drain Inlet	SDIHO233030	HO23	SP
Drain Inlet	SDIHO233008	HO23	SP
Drain Inlet	SDIHO233006	HO23	SP
Drain Inlet	SDIHO233010	HO23	SP
Drain Inlet	SDIHO233002	HO23	SP
Drain Inlet	SDIHO222806	HO23	SP
Drain Inlet	SDIHO233004	HO23	SP
Manhole	SDJHO232810	HO23	N/A
Manhole	SDJHO232684	HO23	N/A
Drain Inlet	SDIHO243072	HO24	SP
Drain Inlet	SDIHO243074	HO24	SP
Drain Inlet	SDIHO243242	HO24	SP
Drain Inlet	SDIHO243202	HO24	SP
Drain Inlet	SDIHO243522	HO25	SP
Drain Inlet	SDIHO243502	HO25	SP
Drain Inlet	SDIHO263552	HO26	SP
Drain Inlet	SDIHO263556	HO26	SP
Drain Inlet	SDIHO263554	HO26	SP
Drain Inlet	SDIHO263572	HO26	SP
Drain Inlet	SDIHO263592	HO26	SP

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Drain Inlet	SDIHO273632	HO27	SP
Drain Inlet	SDIHO293672	HO29	SP
Drain Inlet	SDIHO293224	HO29	SP
Drain Inlet	SDIHO293204	HO29	SP
Drain Inlet	SDIHO293222	HO29	SP
Drain Inlet	SDIHO293206	HO29	SP
Drain Inlet	SDIHO293620	HO29	SP
Drain Inlet	SDIHO293612	HO29	SP
Manhole	SDJHO293614	HO29	N/A
Manhole	SDJHO293616	HO29	N/A
Manhole	SDJHO293618	HO29	N/A

** SP = spray paint; MM = metal marker (bolted to grate);CM = curb marker (durable plastic requires special adhesive); and N/A = not applicable.*

Table 8 shows **Piers 19 through 29** with 25 storm open channel assets, identification number, and location.

Table 8. Piers 19 through 29 storm drain open channel assets, ID number, and location.

ASSET TYPE	ID NUMBER	LOCATION
Open Channel	SDOHO202703	HO20
Open Channel	SDOHO202701	HO20
Open Channel	SDOHO232815	HO23
Open Channel	SDOHO29550A	HO29
Open Channel	SDOHO29500B	HO29
Open Channel	SDOHO29050A	HO29
Open Channel	SDOHO29100A	HO29
Open Channel	SDOHO29150A	HO29
Open Channel	SDOHO29200A	HO29
Open Channel	SDOHO29250A	HO29
Open Channel	SDOHO29300A	HO29
Open Channel	SDOHO29350A	HO29
Open Channel	SDOHO29400A	HO29

ASSET TYPE	ID NUMBER	LOCATION
Open Channel	SDOHO29450A	HO29
Open Channel	SDOHO29500A	HO29
Open Channel	SDOHO29050B	HO29
Open Channel	SDOHO29100B	HO29
Open Channel	SDOHO29150B	HO29
Open Channel	SDOHO29200B	HO29
Open Channel	SDOHO29250B	HO29
Open Channel	SDOHO29300B	HO29
Open Channel	SDOHO29350B	HO29
Open Channel	SDOHO29400B	HO29
Open Channel	SDOHO29450B	HO29
Open Channel	SDOHO29530B	HO29

2.1.5 Piers 31 through 35 GIS Map of Storm Drain Assets

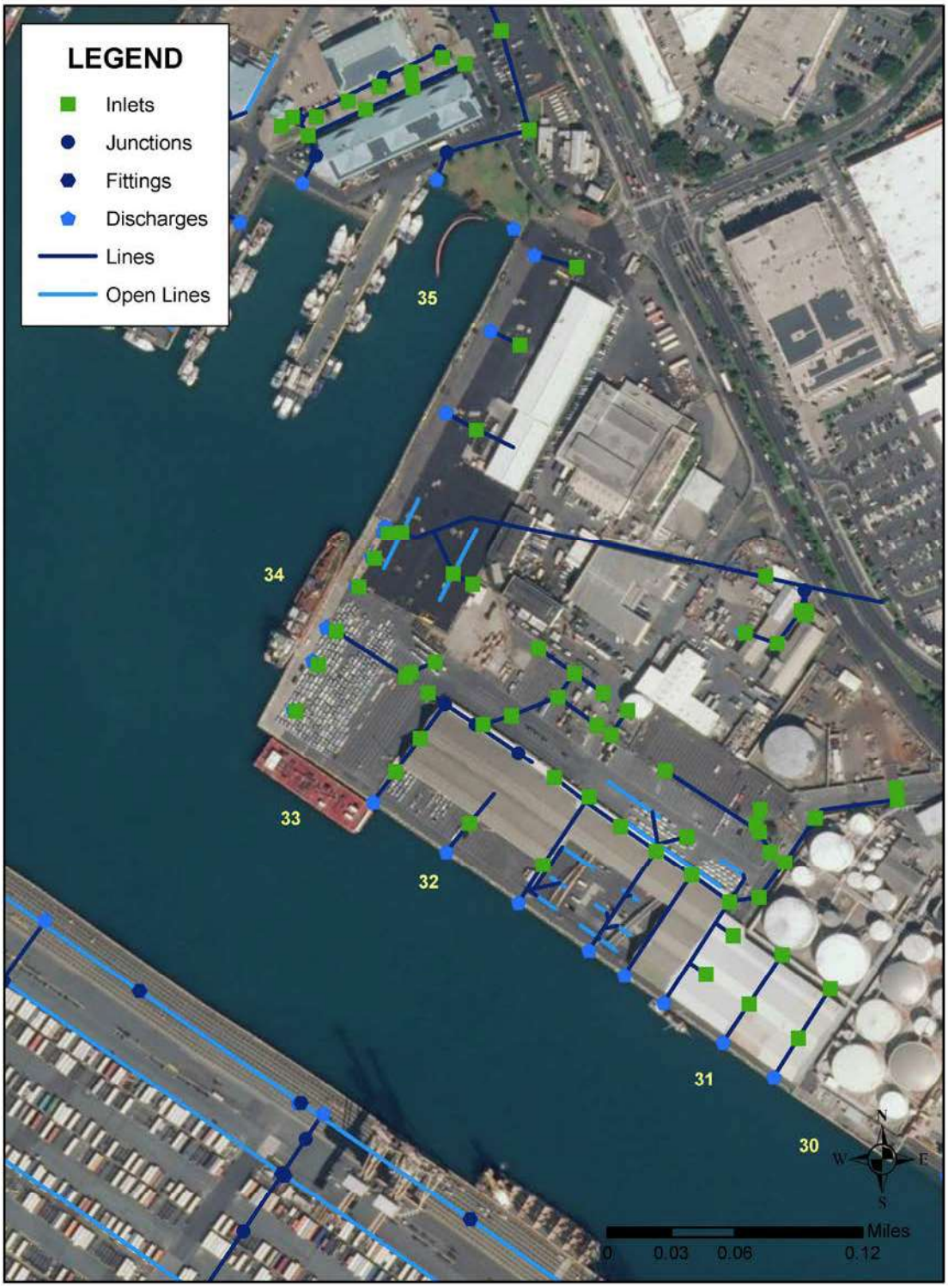


Figure 8. Piers 31 through 35 GIS map of storm drain assets.

Table 9 shows **Piers 31 through 35** with 58 storm drain inlet and manhole assets, identification number, location, and stencil type.

Table 9. Piers 31 through 35 storm drain inlet and manhole assets, ID number, location, and stencil type.

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Drain Inlet	SDIHO313924	HO30	SP
Drain Inlet	SDIHO313904	HO30	SP
Drain Inlet	SDIHO313922	HO31	SP
Drain Inlet	SDIHO313902	HO31	SP
Drain Inlet	SDIHO314154	HO31	SP
Drain Inlet	SDIHO313970	HO31	SP
Drain Inlet	SDIHO314002	HO31	SP
Drain Inlet	SDIHO313968	HO31	SP
Drain Inlet	SDIHO313966	HO31	SP
Drain Inlet	SDIHO314134	HO31	SP
Drain Inlet	SDIHO314130	HO31	SP
Drain Inlet	SDIHO314012	HO31	SP
Drain Inlet	SDIHO314136	HO31	SP
Drain Inlet	SDIHO314132	HO31	SP
Drain Inlet	SDIHO314390	HO31	SP
Drain Inlet	SDIHO314392	HO31	SP
Drain Inlet	SDIHO314398	HO31	SP
Drain Inlet	SDIHO314402	HO31	SP
Drain Inlet	SDIHO314396	HO31	SP
Drain Inlet	SDIHO314400	HO31	SP
Drain Inlet	SDIHO313972	HO31	SP
Drain Inlet	SDIHO313964	HO31	SP
Drain Inlet	SDIHO313962	HO31	SP
Drain Inlet	SDIHO314160	HO31	SP
Drain Inlet	SDIHO314142	HO31	SP
Drain Inlet	SDIHO313958	HO31	SP
Drain Inlet	SDIHO313954	HO31	SP
Drain Inlet	SDIHO314152	HO31	SP
Drain Inlet	SDIHO314016	HO31	SP

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Manhole	SDJHO314394	HO31	N/A
Drain Inlet	SDIHO324246	HO32	SP
Drain Inlet	SDIHO324242	HO32	SP
Drain Inlet	SDIHO324244	HO32	SP
Drain Inlet	SDIHO324262	HO32	SP
Drain Inlet	SDIHO324208	HO32	SP
Drain Inlet	SDIHO324236	HO32	SP
Drain Inlet	SDIHO324234	HO32	SP
Drain Inlet	SDIHO324260	HO32	SP
Drain Inlet	SDIHO324232	HO32	SP
Drain Inlet	SDIHO314162	HO32	SP
Drain Inlet	SDIHO324204	HO32	SP
Drain Inlet	SDIHO324202	HO32	SP
Drain Inlet	SDIHO324182	HO32	SP
Drain Inlet	SDIHO324264	HO32	SP
Manhole	SDJHO324206	HO32	N/A
Manhole	SDJHO324212	HO32	N/A
Manhole	SDJHO324230	HO32	N/A
Drain Inlet	SDIHO344328	HO33	SP
Drain Inlet	SDIHO344326	HO33	SP
Drain Inlet	SDIHO344324	HO33	SP
Drain Inlet	SDIHO344312	HO34	SP
Drain Inlet	SDIHO344352	HO34	SP
Drain Inlet	SDIHO344302	HO34	SP
Drain Inlet	SDIHO344322	HO34	SP
Drain Inlet	SDIHO344362	HO34	SP
Drain Inlet	SDIHO354462	HO35	SP
Drain Inlet	SDIHO354452	HO35	SP
Drain Inlet	SDIHO354472	HO35	SP

* *SP = spray paint; MM = metal marker (bolted to grate); CM = curb marker (durable plastic requires special adhesive); and N/A = not applicable.*

Table 10 shows **Piers 31 through 35** with 16 storm drain open channel assets, identification number, and location.

Table 10. Piers 31 through 35 storm drain open channel assets, ID number, and location.

ASSET TYPE	ID NUMBER	PIER LOCATION
Open Channel	SDOHO314049	HO31
Open Channel	SDOHO314109	HO31
Open Channel	SDOHO314071	HO31
Open Channel	SDOHO314395	HO31
Open Channel	SDOHO314397	HO31
Open Channel	SDOHO314399	HO31
Open Channel	SDOHO314401	HO31
Open Channel	SDOHO314403	HO31
Open Channel	SDOHO314393	HO31
Open Channel	SDOHO314405	HO31
Open Channel	SDOHO314073	HO31
Open Channel	SDOHO314391	HO32
Open Channel	SDOHO405403	HO32
Open Channel	SDOHO405401	HO32
Open Channel	SDOHO350001	HO35
Open Channel	SDOHO350003	HO35

2.1.6 Piers 36 through 38 – Domestic Commercial Fishing Village GIS Map of Storm Drain Assets

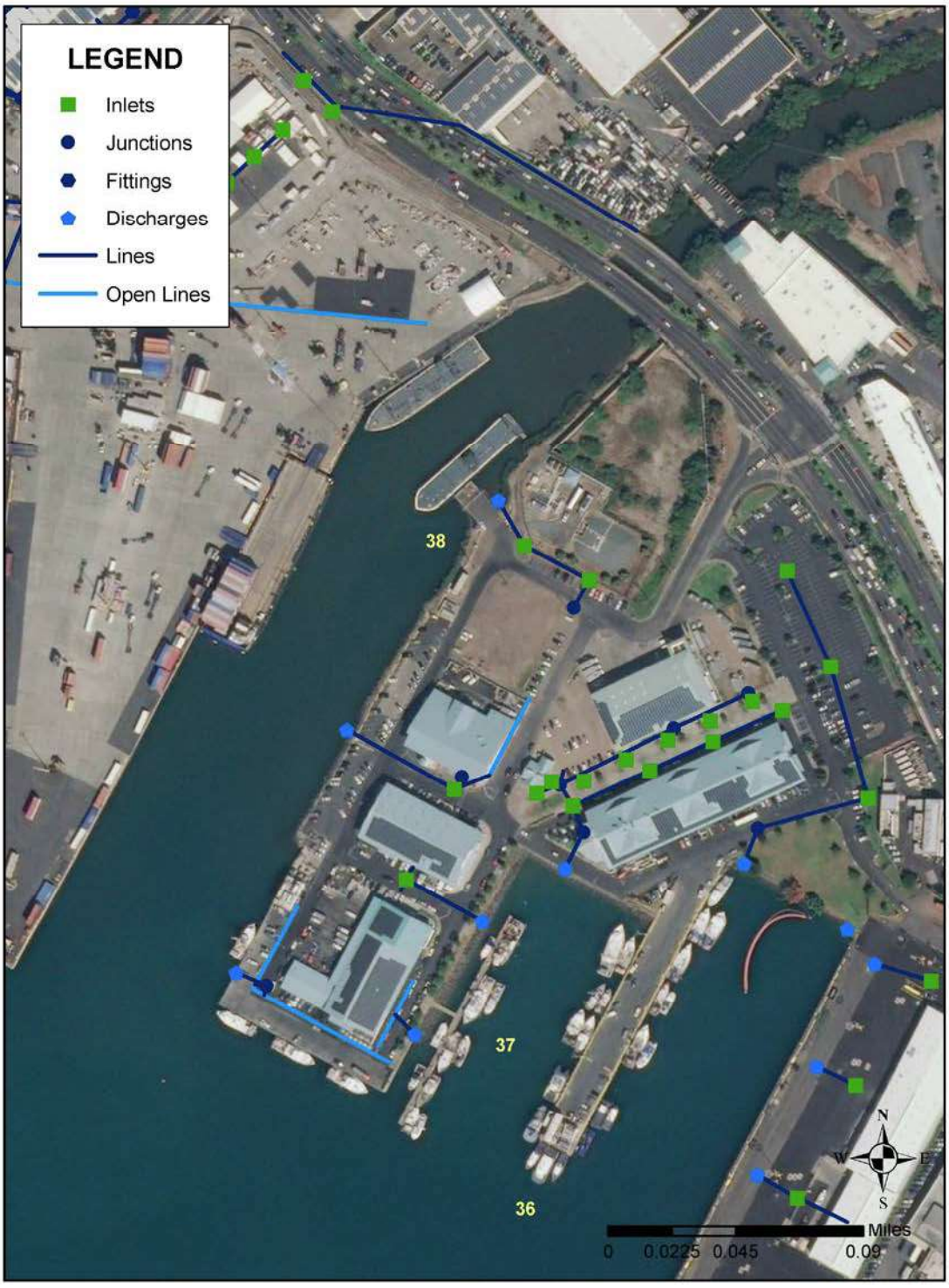


Figure 9. Piers 36 through 38 GIS map of storm drain assets.

Table 11 shows **Piers 36 through 38** with 26 storm drain inlet and manhole assets, identification number, location, and stencil type.

Table 11. Piers 36 through 38 storm drain inlet and manholes assets, ID number, location, and stencil type.

ASSET TYPE	ID NUMBER	LOCATION	STENCIL TYPE *
Drain Inlet	SDIHO364604	HO36	MM
Manhole	SDJHO364602	HO36	N/A
Drain Inlet	SDIHO384608	HO38	SP
Drain Inlet	SDIHO384606	HO38	SP
Drain Inlet	SDIHO384710	HO38	SP
Drain Inlet	SDIHO384822	HO38	CM
Drain Inlet	SDIHO384820	HO38	CM
Drain Inlet	SDIHO384816	HO38	CM
Drain Inlet	SDIHO384814	HO38	CM
Drain Inlet	SDIHO384812	HO38	CM
Drain Inlet	SDIHO384806	HO38	SP
Drain Inlet	SDIHO384808	HO38	SP
Drain Inlet	SDIHO384704	HO38	SP
Drain Inlet	SDIHO384706	HO38	SP
Drain Inlet	SDIHO384708	HO38	SP
Drain Inlet	SDIHO384902	HO38	SP
Drain Inlet	SDIHO385152	HO38	MM
Drain Inlet	SDIHO385154	HO38	MM
Manhole	SDJHO384818	HO38	N/A
Manhole	SDJHO384824	HO38	N/A
Manhole	SDJHO384810	HO38	N/A
Manhole	SDJHO384702	HO38	N/A
Manhole	SDJHO385156	HO38	N/A
Manhole	SDJHO395502	HO38	N/A
Manhole	SDJHO385052	HO38	N/A
Manhole	SDJHO385104	HO38	N/A

* *SP = spray paint; MM = metal marker (bolted to grate); CM = curb marker (durable plastic requires special adhesive); and N/A = not applicable.*

Table 12 shows **Piers 36 through 38** with 4 storm drain open channel assets, identification number, and location.

Table 12. Piers 36 through 38 storm drain open channel assets, ID number, and location.

ASSET TYPE	ID NUMBER	LOCATION
Open Channel	SDOHO385057	HO38
Open Channel	SDOHO385059	HO38
Open Channel	SDOHO385003	HO38
Open Channel	SDOHO385107	HO38

2.1.7 Piers 39 through 45 GIS Map of Storm Drain Assets



Figure 10. Piers 39 through 45 GIS map of storm drain assets.

Table 13 shows **Piers 39 through 45** with 110 storm drain inlet, manhole, and catch basin assets; and identification number, location, and stencil type.

Table 13. Piers 39 through 45 storm drain inlet, manhole, and catch basin assets; and ID number, location, and stencil type.

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Drain Inlet	SDIHO395516	HO39	SP
Drain Inlet	SDIHO395514	HO39	SP
Drain Inlet	SDIHO395512	HO39	SP
Drain Inlet	SDIHO395510	HO39	SP
Drain Inlet	SDIHO395596	HO39	SP
Drain Inlet	SDIHO395592	HO39	SP
Catch Basin	SDIHO395612	HO39	SP
Manhole	SDJHO395506	HO39	N/A
Manhole	SDJHO395508	HO39	N/A
Drain Inlet	SDIHO405802	HO40	SP
Drain Inlet	SDIHO406562	HO40	SP
Drain Inlet	SDIHO405722	HO40	SP
Drain Inlet	SDIHO405708	HO40	SP
Drain Inlet	SDIHO405712	HO40	SP
Drain Inlet	SDIHO405790	HO40	SP
Catch Basin	SDIHO405610	HO40	SP
Drain Inlet	SDIHO405608	HO40	SP
Manhole	SDJHO395504	HO40	N/A
Manhole	SDJHO405650	HO40	N/A
Manhole	SDJHO405632	HO40	N/A
Manhole	SDJHO405634	HO40	N/A
Manhole	SDJHO405630	HO40	N/A
Manhole	SDJHO405606	HO40	N/A
Manhole	SDJHO405706	HO40	N/A
Manhole	SDJHO405710	HO40	N/A
Manhole	SDJHO405664	HO40	N/A
Manhole	SDJHO405652	HO40	N/A
Drain Inlet	SDIHO416994	HO41	SP
Drain Inlet	SDIHO416982	HO41	SP

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Drain Inlet	SDIHO416992	HO41	SP
Drain Inlet	SDIHO417004	HO41	SP
Drain Inlet	SDIHO427040	HO41	SP
Drain Inlet	SDIHO417002	HO41	SP
Drain Inlet	SDIHO427038	HO41	SP
Drain Inlet	SDIHO427036	HO41	SP
Drain Inlet	SDIHO427034	HO41	SP
Drain Inlet	SDIHO427032	HO41	SP
Drain Inlet	SDIHO417012	HO41	SP
Drain Inlet	SDIHO417014	HO41	SP
Drain Inlet	SDIHO416984	HO41	SP
Catch Basin	SDIHO416572	HO41	SP
Catch Basin	SDIHO416574	HO41	SP
Drain Inlet	SDIHO427220	HO42	SP
Drain Inlet	SDIHO427206	HO42	SP
Drain Inlet	SDIHO427204	HO42	SP
Drain Inlet	SDIHO427222	HO42	SP
Drain Inlet	SDIHO427200	HO42	SP
Drain Inlet	SDIHO427226	HO42	SP
Drain Inlet	SDIHO427320	HO42	SP
Drain Inlet	SDIHO427202	HO42	SP
Drain Inlet	SDIHO427224	HO42	SP
Manhole	HDOA_Entry2	HO42	N/A
Manhole	HDOA_B-1	HO42	N/A
Manhole	SDJHO427302	HO42	N/A
Drain Inlet	SDIHO427352	HO42E	SP
Drain Inlet	SDIHO427708	HO42E	SP
Drain Inlet	SDIHO427350	HO42E	SP
Drain Inlet	SDIHO427710	HO42E	SP
Drain Inlet	SDIHO427318	HO42E	SP
Drain Inlet	SDIHO427642	HO42E	SP
Drain Inlet	SDIHO427630	HO42E	SP
Drain Inlet	SDIHO427310	HO42E	SP
Drain Inlet	SDIHO427606	HO42E	SP

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Drain Inlet	SDIHO427312	HO42E	SP
Drain Inlet	SDIHO427604	HO42E	SP
Drain Inlet	SDIHO427626	HO42E	SP
Drain Inlet	SDIHO427624	HO42E	SP
Drain Inlet	SDIHO427622	HO42E	SP
Drain Inlet	SDIHO427620	HO42E	SP
Drain Inlet	SDIHO427306	HO42E	SP
Drain Inlet	SDIHO427308	HO42E	SP
Drain Inlet	SDIHO427314	HO42E	SP
Drain Inlet	SDIHO427316	HO42E	SP
Drain Inlet	SDIHO427700	HO42E	SP
Drain Inlet	SDIHO427722	HO42E	SP
Drain Inlet	SDIHO427726	HO42E	SP
Drain Inlet	SDIHO427724	HO42E	SP
Drain Inlet	SDIHO427640	HO42E	SP
Drain Inlet	SDIHO427610	HO42E	SP
Drain Inlet	SDIHO427608	HO42E	SP
Drain Inlet	SDIHO427602	HO42E	SP
Drain Inlet	SDIHO427584	HO42E	SP
Drain Inlet	SDIHO427582	HO42E	SP
Drain Inlet	SDIHO427562	HO42E	SP
Drain Inlet	SDIHO426972	HO42E	SP
Drain Inlet	SDIHO427728	HO42E	SP
Drain Inlet	SDIHO427730	HO42E	SP
Drain Inlet	SDIHO427732	HO42E	SP
Drain Inlet	SDIHO427734	HO42E	SP
Drain Inlet	SDIHO427736	HO42E	SP
Drain Inlet	SDIHO427738	HO42E	SP
Drain Inlet	SDIHO427740	HO42E	SP
Drain Inlet	SDIHO427742	HO42E	SP
Drain Inlet	SDIHO427744	HO42E	SP
Drain Inlet	SDIHO427746	HO42E	SP
Drain Inlet	SDIHO427748	HO42E	SP
Drain Inlet	SDIHO427750	HO42E	SP

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Drain Inlet	SDIHO427752	HO42E	SP
Drain Inlet	SDIHO427754	HO42E	SP
Drain Inlet	SDIHO427756	HO42E	SP
Drain Inlet	SDIHO427758	HO42E	SP
Drain Inlet	SDIHO427760	HO42E	SP
Manhole	HDOA_B-3	HO42E	N/A
Manhole	HDOA_B-4A	HO42E	N/A
Manhole	HDOA_B-2	HO42E	N/A
Manhole	SDJHO427702	HO42E	N/A
Manhole	SDJHO427720	HO42E	N/A
Manhole	SDJHO427704	HO42E	N/A
Manhole	SDJHO427706	HO42E	N/A
Drain Inlet	SDIHO447751	HO44	SP

** SP = spray paint; MM = metal marker (bolted to grate); CM = curb marker (durable plastic requires special adhesive); and N/A = not applicable.*

2.1.8 Piers 51 through 53 – Sand Island GIS Map of Storm Drain Assets

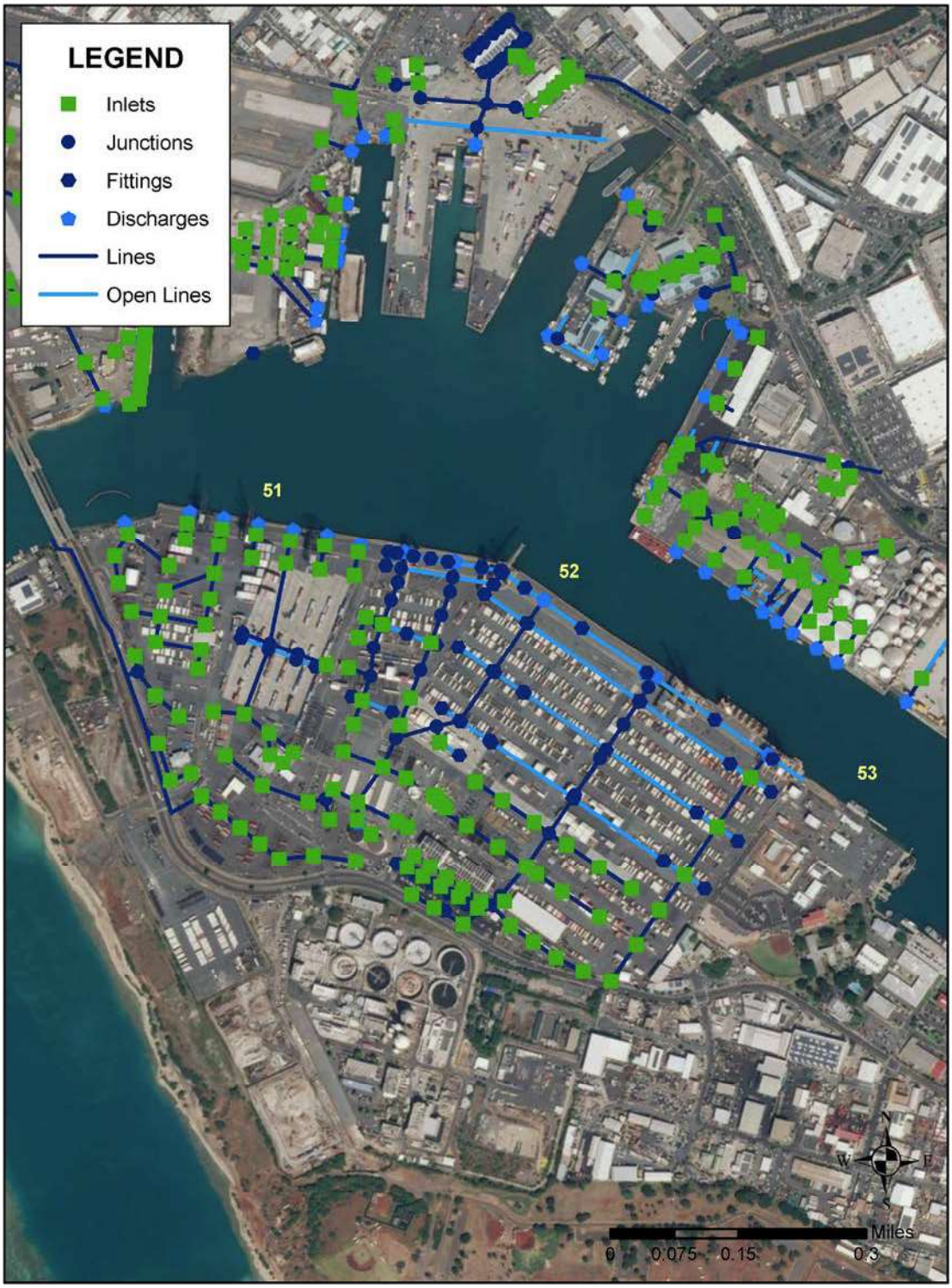


Figure 11. Piers 51 through 53 – Sand Island GIS map of storm drain assets.

Table 14 shows **Piers 51 through 53** storm drain inlet, manhole, and catch basin assets; and identification number, location, and stencil type.

Table 14. Piers 51 through 53 storm drain inlet, manhole, and catch basin assets; and ID number, location, and stencil type.

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Drain Inlet	SDIHO517806	HO51	SP
Drain Inlet	SDIHO517804	HO51	SP
Drain Inlet	SDIHO517810	HO51	SP
Drain Inlet	SDIHO517854	HO51	SP
Drain Inlet	SDIHO517886	HO51	SP
Drain Inlet	SDIHO517892	HO51	SP
Drain Inlet	SDIHO517896	HO51	SP
Drain Inlet	SDIHO517902	HO51	SP
Drain Inlet	SDIHO517900	HO51	SP
Drain Inlet	SDIHO517894	HO51	SP
Drain Inlet	SDIHO517898	HO51	SP
Drain Inlet	SDIHO518012	HO51	SP
Drain Inlet	SDIHO518010	HO51	SP
Drain Inlet	SDIHO518464	HO51	SP
Drain Inlet	SDIHO518002	HO51	SP
Drain Inlet	SDIHO517964	HO51	SP
Drain Inlet	SDIHO518004	HO51	SP
Drain Inlet	SDIHO518052	HO51	SP
Drain Inlet	SDIHO518056	HO51	SP
Drain Inlet	SDIHO518152	HO51	SP
Drain Inlet	SDIHO518150	HO51	SP
Drain Inlet	SDIHO518372	HO51	SP
Drain Inlet	SDIHO518370	HO51	SP
Drain Inlet	SDIHO518410	HO51	SP
Drain Inlet	SDIHO518476	HO51	SP
Drain Inlet	SDIHO518376	HO51	SP
Drain Inlet	SDIHO518364	HO51	SP
Drain Inlet	SDIHO518414	HO51	SP
Drain Inlet	SDIHO518366	HO51	SP

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Drain Inlet	SDIHO518140	HO51	SP
Drain Inlet	SDIHO518146	HO51	SP
Drain Inlet	SDIHO518466	HO51	SP
Drain Inlet	SDIHO518360	HO51	SP
Drain Inlet	SDIHO518026	HO51	SP
Drain Inlet	SDIHO518382	HO51	MM
Drain Inlet	SDIHO517888	HO51	SP
Drain Inlet	SDIHO518374	HO51	SP
Drain Inlet	SDIHO518260	HO51	SP
Drain Inlet	SDIHO518262	HO51	SP
Drain Inlet	SDIHO517930	HO51	SP
Drain Inlet	SDIHO517932	HO51	SP
Drain Inlet	SDIHO517940	HO51	SP
Drain Inlet	SDIHO517944	HO51	SP
Drain Inlet	SDIHO517942	HO51	SP
Drain Inlet	SDIHO518468	HO51	SP
Drain Inlet	SDIHO518402	HO51	SP
Drain Inlet	SDIHO518474	HO51	SP
Drain Inlet	SDIHO518472	HO51	SP
Drain Inlet	SDIHO518470	HO51	SP
Drain Inlet	SDIHO518408	HO51	SP
Drain Inlet	SDIHO518404	HO51	SP
Drain Inlet	SDIHO518400	HO51	SP
Drain Inlet	SDIHO517802	HO51	SP
Drain Inlet	SDIHO517890	HO51	SP
Drain Inlet	SDIHO518054	HO51	SP
Drain Inlet	SDIHO518378	HO51	MM
Catch Basin	SDIHO518416	HO51	SP
Drain Inlet	SDIHO518058	HO51	SP
Drain Inlet	SDIHO517926	HO51	SP
Manhole	SDJHO517928	HO51	N/A
Manhole	SDJHO518142	HO51	N/A
Manhole	SDJHO518406	HO51	N/A
Manhole	SDJHO518368	HO51	N/A

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Manhole	SDJHO518362	HO51	N/A
Manhole	SDJHO518358	HO51	N/A
Manhole	SDJHO518138	HO51	N/A
Manhole	SDJHO518020	HO51	N/A
Manhole	SDJHO518356	HO51	N/A
Manhole	SDJHO518136	HO51	N/A
Manhole	SDJHO518144	HO51	N/A
Manhole	SDJHO518006	HO51	N/A
Manhole	SDJHO518024	HO51	N/A
Manhole	SDJHO518008	HO51	N/A
Manhole	SDJHO518028	HO51	N/A
Drain Inlet	SDIHO517852	HO51A	SP
Drain Inlet	SDIHO517882	HO51A	SP
Drain Inlet	SDIHO517962	HO51A	SP
Drain Inlet	SDIHO517884	HO51A	SP
Drain Inlet	SDIHO518074	HO51B	SP
Drain Inlet	SDIHO518084	HO51B	SP
Drain Inlet	SDIHO518082	HO51B	SP
Drain Inlet	SDIHO518072	HO51B	SP
Manhole	SDJHO518134	HO51C	N/A
Manhole	SDJHO518352	HO51C	N/A
Drain Inlet	SDIHO528874	HO52	SP
Drain Inlet	SDIHO528876	HO52	SP
Drain Inlet	SDIHO528880	HO52	MM
Drain Inlet	SDIHO528662	HO52	SP
Drain Inlet	SDIHO528664	HO52	SP
Drain Inlet	SDIHO528690	HO52	SP
Drain Inlet	SDIHO528692	HO52	SP
Drain Inlet	SDIHO528660	HO52	SP
Drain Inlet	SDIHO528734	HO52	SP
Drain Inlet	SDIHO528710	HO52	SP
Drain Inlet	SDIHO528712	HO52	SP
Drain Inlet	SDIHO528714	HO52	SP
Drain Inlet	SDIHO528716	HO52	SP

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Drain Inlet	SDIHO528718	HO52	SP
Drain Inlet	SDIHO528730	HO52	SP
Drain Inlet	SDIHO528732	HO52	SP
Drain Inlet	SDIHO528738	HO52	SP
Drain Inlet	SDIHO528736	HO52	SP
Drain Inlet	SDIHO528680	HO52	SP
Drain Inlet	SDIHO528684	HO52	SP
Drain Inlet	SDIHO528510	HO52	SP
Drain Inlet	SDIHO528682	HO52	SP
Drain Inlet	SDIHO528688	HO52	SP
Manhole	SDJHO528760	HO52	N/A
Manhole	SDJHO528756	HO52	N/A
Manhole	SDJHO528752	HO52	N/A
Manhole	SDJHO528764	HO52	N/A
Manhole	SDJHO528770	HO52	N/A
Manhole	SDJHO528502	HO52	N/A
Manhole	SDJHO528504	HO52	N/A
Manhole	SDJHO528508	HO52	N/A
Manhole	SDJHO528506	HO52	N/A
Drain Inlet	SDIHO538902	HO53	SP
Drain Inlet	SDIHO538668	HO53	SP
Drain Inlet	SDIHO538696	HO53	SP
Drain Inlet	SDIHO538698	HO53	SP
Drain Inlet	SDIHO538670	HO53	SP
Drain Inlet	SDIHO538700	HO53	SP
Drain Inlet	SDIHO538672	HO53	SP
Drain Inlet	SDIHO538792	HO53	SP
Drain Inlet	SDIHO538794	HO53	SP
Drain Inlet	SDIHO538796	HO53	SP
Drain Inlet	SDIHO538798	HO53	SP
Drain Inlet	SDIHO538868	HO53	SP
Drain Inlet	SDIHO538910	HO53	SP
Drain Inlet	SDIHO538906	HO53	SP
Drain Inlet	SDIHO538904	HO53	SP

ASSET TYPE	ID NUMBER	PIER LOCATION	STENCIL TYPE *
Drain Inlet	SDIHO538908	HO53	SP
Drain Inlet	SDIHO538890	HO53	SP
Drain Inlet	SDIHO538912	HO53	SP
Manhole	SDJHO538866	HO53	N/A
Manhole	SDJHO538872	HO53	N/A
Manhole	SDJHO538860	HO53	N/A
Manhole	SDJHO538862	HO53	N/A
Manhole	SDJHO538852	HO53	N/A
Manhole	SDJHO538856	HO53	N/A
Manhole	SDJHO538870	HO53	N/A
Drain Inlet	SDIHO609156	HO60	SP
Drain Inlet	SDIHO609116	HO60	CM
Drain Inlet	SDIHO609158	HO60	SP
Drain Inlet	SDIHO609114	HO60	SP
Drain Inlet	SDIHO609118	HO60	SP

* *SP = spray paint; MM = metal marker (bolted to grate); CM = curb marker (durable plastic requires special adhesive); and N/A = not applicable.*

Table 15 shows the **Piers 51 through 53, and Pier 60** with 62 storm drain open channel, swale, and other assets; and identification number and location.

Table 15. Piers 51 through 53, and Pier 60 storm drain open channel, swale, and other assets; and ID number and location.

ASSET TYPE	ID NUMBER	PIER LOCATION
Open Channel	SDOHO518265	HO51
Open Channel	SDOHO518291	HO51
Open Channel	SDOHO518269	HO51
Open Channel	SDOHO518285	HO51
Open Channel	SDOHO518231	HO51
Open Channel	SDOHO518235	HO51
Open Channel	SDOHO518241	HO51
Open Channel	SDOHO518277	HO51
Open Channel	SDOHO518271	HO51

ASSET TYPE	ID NUMBER	PIER LOCATION
Open Channel	SDOHO518031	HO51C
Open Channel	SDOHO518205	HO51C
Open Channel	SDOHO518181	HO51C
Open Channel	SDOHO518185	HO51C
Open Channel	SDOHO518189	HO51C
Open Channel	SDOHO518193	HO51C
Open Channel	SDOHO518197	HO51C
Open Channel	SDOHO518201	HO51C
Open Channel	SDOHO518209	HO51C
Open Channel	SDOHO528213	HO51C
Open Channel	SDOHO528611	HO52
Open Channel	SDOHO528641	HO52
Open Channel	SDOHO528637	HO52
Open Channel	SDOHO528631	HO52
Open Channel	SDOHO528601	HO52
Open Channel	SDOHO528607	HO52
Open Channel	SDOHO528571	HO52
Open Channel	SDOHO528577	HO52
Open Channel	SDOHO528545	HO52
Concrete with metal grate	SDOHO528517	HO52
Open Channel	SDOHO528877	HO52
Open Channel	SDOHO528541	HO52
Open Channel	SDOHO528555	HO52
Open Channel	SDOHO528559	HO52
Open Channel	SDOHO538563	HO53
Open Channel	SDOHO538649	HO53
Open Channel	SDOHO538619	HO53
Open Channel	SDOHO538585	HO53
Open Channel	SDOHO538617	HO53
Open Channel	SDOHO538613	HO53
Open Channel	SDOHO538647	HO53
Open Channel	SDOHO538643	HO53
Open Channel	SDOHO538651	HO53

ASSET TYPE	ID NUMBER	PIER LOCATION
Open Channel	SDOHO538579	HO53
Open Channel	SDOHO538583	HO53
Open Channel	SDOHO528765	HO53
Open Channel	SDOHO528751	HO53
Open Channel	SDOHO528757	HO53
Open Channel	SDOHO528761	HO53
Open Channel	SDOHO528769	HO53
Open Channel	SDOHO528755	HO53
Open Channel	SDOHO528759	HO53
Open Channel	SDOHO528763	HO53
Open Channel	SDOHO528771	HO53
Open Channel	SDOHO528753	HO53
Open Channel	SDOHO609165	HO60
Open Channel	SDOHO609185	HO60
Open Channel	SDOHO609189	HO60
Other	SDOHO609190	HO60
Open Channel	SDOHO609181	HO60
Swale	SDOHO609191	HO60

2.2 Honolulu Harbor Post-Construction BMPs GIS Map

Harbors is responsible for inspection, cleaning, and maintenance of the 43 Post-Construction Permanent BMPs (PBMP) at Honolulu Harbor, specifically located at Pier 29 (23 BMPs), Pier 31 (8), Pier 35 (6), and Pier 60 (6).

Figure 12A shows GIS mapping of post construction BMP locations.

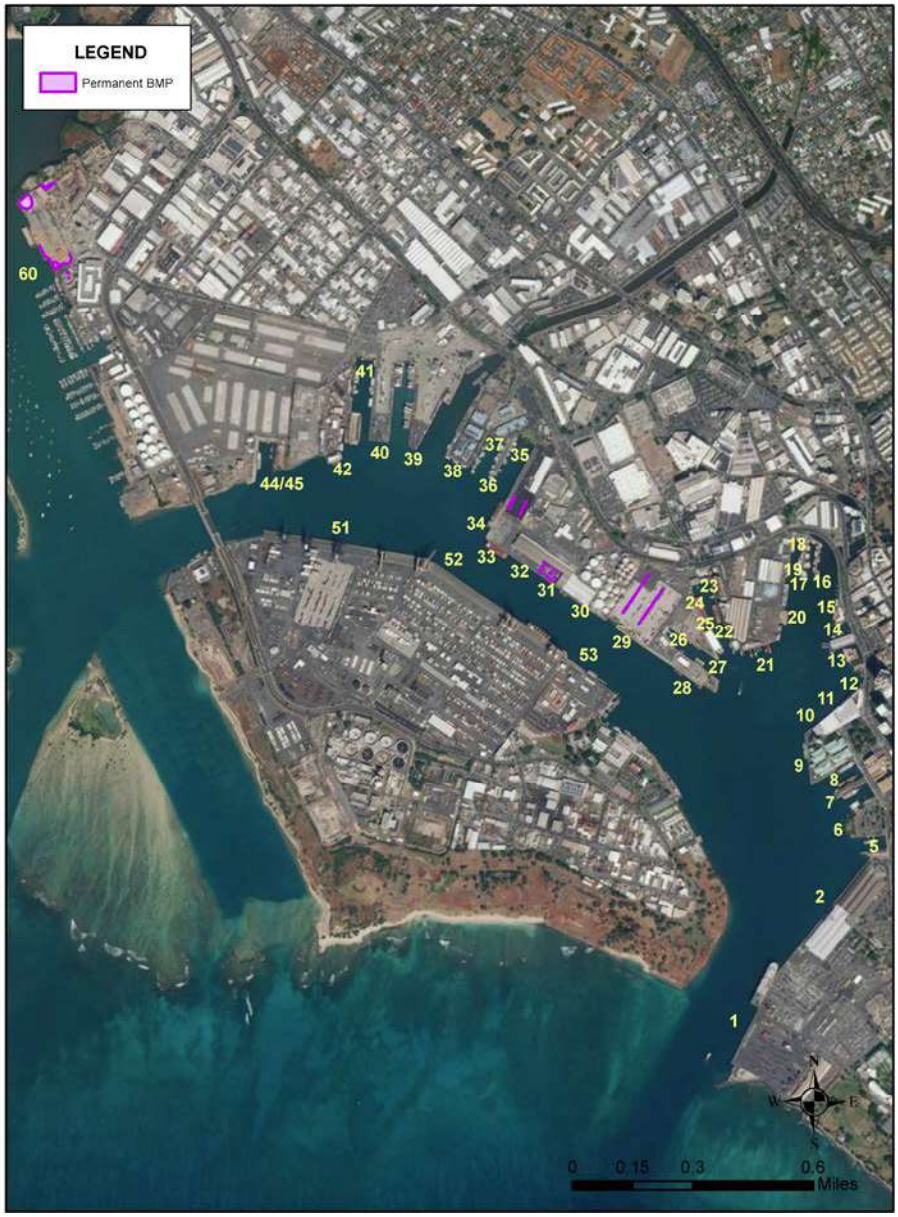


Figure 12A. Honolulu Harbor Post-Construction BMPs with GIS map of BMP locations.

Figure 12B shows post construction BMP locations at Piers 29 through 35.



Figure 12B. Honolulu Harbor Post-Construction BMPs with GIS map of BMP locations.

Figure 12C shows post construction BMP locations at Pier 60.



Figure 12C. Honolulu Harbor Post-Construction BMPs with GIS map of BMP locations.

Table 16 shows the Post-Construction BMP ID number, structural type, BMP type, BMP subtype, and location at Honolulu Harbor.

Table 16. Honolulu Harbor Post-Construction BMP ID number, structural type, BMP type, BMP subtype, and location.

PBMP ID	STRUCTURAL	BMP TYPE	BMP SUBTYPE	PIER
EHBMPHO29500B	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29550A	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29050A	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29100A	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29150A	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29200A	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29250A	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29050B	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29100B	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29150B	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29200B	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29250B	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29350B	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29300B	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29400B	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29450B	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29530B	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO293620	Yes	Treatment Control	Manufactured	HO29

PBMP ID	STRUCTURAL	BMP TYPE	BMP SUBTYPE	PIER
			Treatment Device	
EHBMPHO29450A	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29400A	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29500A	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29350A	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO29300A	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO293672	Yes	Treatment Control	Manufactured Treatment Device	HO29
EHBMPHO314152	Yes	Treatment Control	Manufactured Treatment Device	HO31
EHBMPHO314153	Yes	Treatment Control	Manufactured Treatment Device	HO31
EHBMPHO314154	Yes	Treatment Control	Manufactured Treatment Device	HO31
EHBMPHO314155	Yes	Treatment Control	Manufactured Treatment Device	HO31
EHBMPHO314156	Yes	Treatment Control	Manufactured Treatment Device	HO31
EHBMPHO314157	Yes	Treatment Control	Manufactured Treatment Device	HO31
EHBMPHO314158	Yes	Treatment Control	Manufactured Treatment Device	HO31
EHBMPHO350035	No	BioClean Filters		HO35
EHBMPHO350036	No	BioClean Filters		HO35
EHBMPHO350037	No	BioClean Filters		HO35
EHBMPHO350039	No	BioClean Filters		HO35
EHBMPHO350040	No	BioClean Filters		HO35
EHBMPHO350041	No	BioClean Filters		HO35
EHBMPHO609903	Yes	Treatment Control	Infiltration Basin	HO60
EHBMPHO609900	Yes	Treatment Control	Infiltration Basin	HO60
EHBMPHO609902	Yes	Treatment Control	Dry Swale	HO60
EHBMPHO609901	Yes	Source Control	Outdoor Process Equipment Operations	HO60

2.3 Honolulu Harbor Outfall Drainage Basin

Honolulu Harbor outfalls drain into areas at risk for flooding, as shown on the map from Hawaii Department of Land and Natural Resources (DLNR) *Flood Hazard Assessment Report 2014* (www.hawaiinfip.org).

Figure 13 shows the Honolulu Harbor flood hazard assessment map.

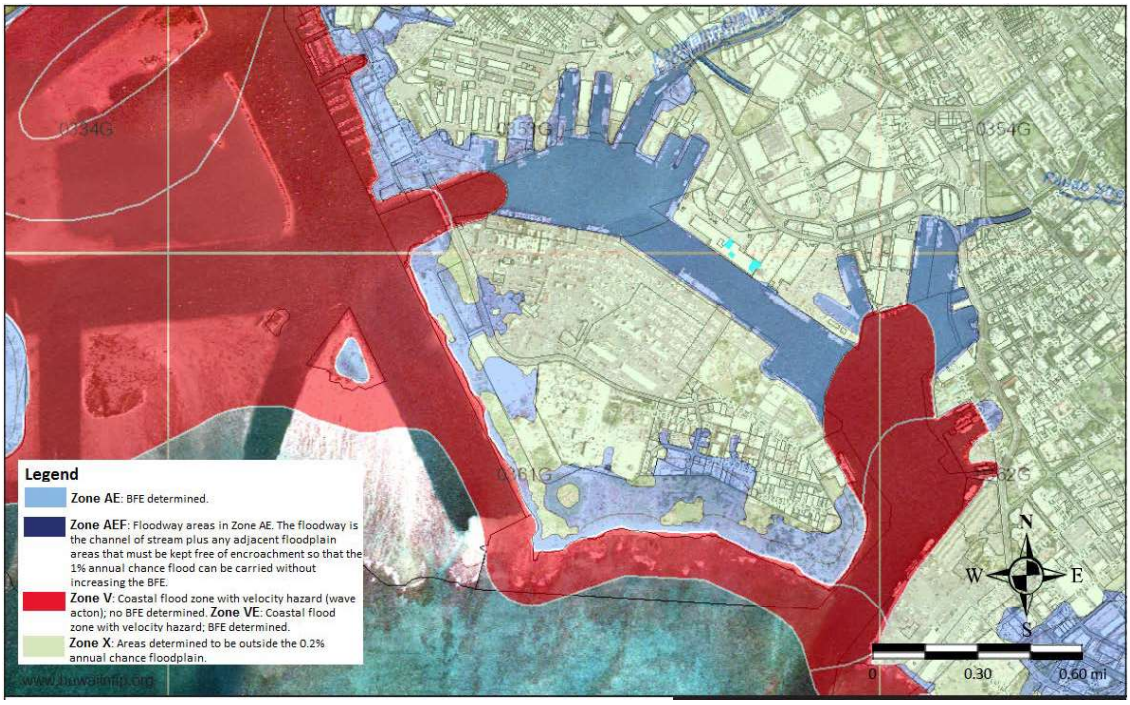


Figure 13. Honolulu Harbor flood hazard assessment map. *(Courtesy DLNR 2014.)*

2.4 Honolulu Harbor Signage and Stenciling GIS Mapping

Signage that prohibit dumping or discarding pollutants are installed at suitable locations on Harbor property. Suitable areas include visible public locations, high traffic tenant areas or areas with a history of illicit discharges, and locations at wharfs and piers. Future signs will include information about illicit discharges, Harbors storm water awareness message, and the storm water hotline for reporting storm water issues.

Harbors stencils or labels all inlets and open channels on Honolulu Harbor and Kalaeloa Barbers Point Harbor to promote storm water awareness and reduce non-storm water discharges into harbor waters. Every year, the legibility of the stencils or labels nearest each inlet will be evaluated prior to the wet season. If necessary, Harbors

will re-stencil or re-label the inlet. Three types of labels are available for installation depending on the surface conditions, as follows:

- Aluminum stencils are used to paint rough surfaces.
- Duracast hi-visibility placards are installed on curbs in public areas.
- Metal medallions are installed on grates or where the first two stencil types are not feasible.



Aluminum stencils are used to paint rough surfaces.



Duracast hi-visibility placards are installed on curbs in public areas



Metal medallions are installed on grates.

Figure 14. Harbors three types of stencils BMP installation.

The appropriate stencil type and installation location is determined by HAR-EE.

The Signage and Inlet Stenciling is assigned to HAR-OM Wharf Maintenance Unit for signage installation, repair, and replacement. There are currently 82 signs installed and maintained at Honolulu Harbor.

Figure 15 shows Honolulu Harbor map of storm drain signage currently installed and maintained.

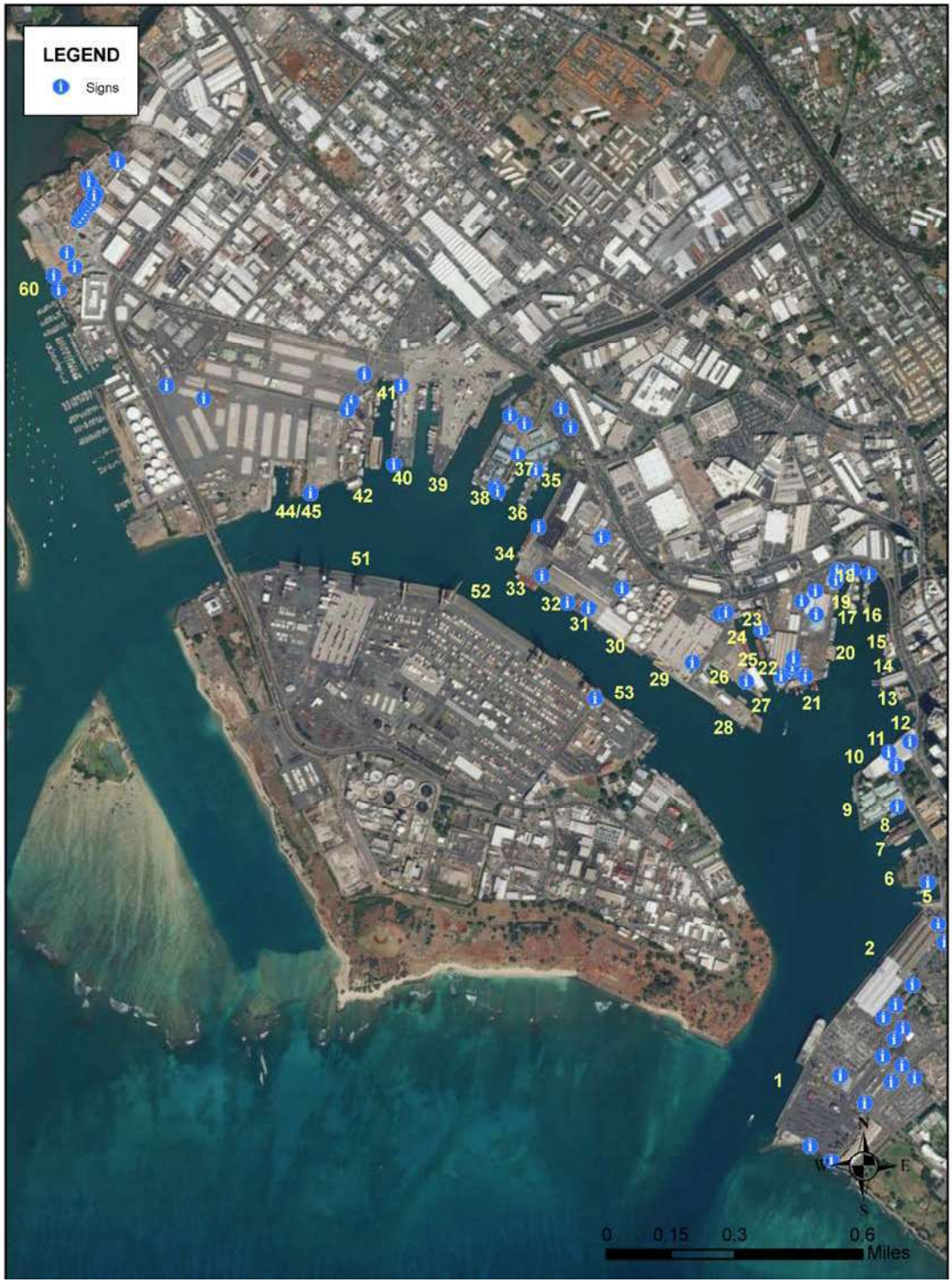


Figure 15. Honolulu Harbor storm drain signage GIS map.

Table 17 lists the signage ID and location at Honolulu Harbor.

Table 17. Honolulu Harbor signage ID and location.

ITEM	SIGN ID	PIER LOCATION
1	IMSHO010223	HO01
2	IMSHO010253	HO01
3	IMSHO010221	HO01
4	IMSHO010214	HO01
5	IMSHO010215	HO01
6	IMSHO020257	HO02
7	IMSHO020810	HO02
8	IMSHO020650	HO02
9	IMSHO020520	HO02
10	IMSHO020290	HO02
11	IMSHO020259	HO02
12	IMSHO020274	HO02
13	IMSHO020256	HO02
14	IMSHO020805	HO02
15	IMSHO020501	HO02
16	IMSHO051060	HO05
17	IMSHO081516	HO08
18	IMSHO101744	HO10
19	IMSHO102030	HO10
20	IMSHO111836	HO11
21	IMSHO162208	HO16
22	IMSHO172210	HO17
23	IMSHO182306	HO18
24	IMSHO182308	HO18
25	IMSHO182304	HO18
26	IMSHO192562	HO19
27	IMSHO182432	HO19
28	IMSHO202612	HO21
29	IMSHO232850	HO23
30	IMSHO232806	HO23
31	IMSHO232648	HO23
32	IMSHO232652	HO23
33	IMSHO232656	HO23
34	IMSHO232440	HO23
35	IMSHO243202	HO24

ITEM	SIGN ID	PIER LOCATION
36	IMSHO263509	HO26
37	IMSHO263511	HO26
38	IMSHO293641	HO29
39	IMSHO293222	HO29
40	IMSHO314135	HO31
41	IMSHO314060	HO31
42	IMSHO324389	HO32
43	IMSHO324387	HO32
44	IMSHO324151	HO32
45	IMSHO334202	HO33
46	IMSHO354415	HO35
47	IMSHO364680	HO36
48	IMSHO384608	HO38
49	IMSHO384806	HO38
50	IMSHO385014	HO38
51	IMSHO385012	HO38
52	IMSHO385140	HO38
53	IMSHO384606	HO38
54	IMSHO385153	HO38
55	IMSHO405781	HO40
56	IMSHO405701	HO40
57	IMSHO417061	HO41
58	IMSHO427041	HO42
59	IMSHO427200	HO42A
60	IMSHO427723	HO42E
61	IMSHO427701	HO42E
62	IMSHO426981	HO42E
63	IMSHO518901	HO51
64	IMSHO608905	HO60
65	IMSHO608900	HO60
66	IMSHO608908	HO60
67	IMSHO609008	HO60
68	IMSHO609183	HO60
69	IMSHO609181	HO60
70	IMSHO609131	HO60
71	IMSHO609123	HO60
72	IMSHO609125	HO60
73	IMSHO609127	HO60
74	IMSHO609129	HO60

ITEM	SIGN ID	PIER LOCATION
75	IMSHO609107	HO60
76	IMSHO609109	HO60
77	IMSHO609111	HO60
78	IMSHO609113	HO60
79	IMSHO609115	HO60
80	IMSHO609117	HO60
81	IMSHO609119	HO60
82	IMSHO609121	HO60

There are currently 8 signs installed and maintained at Kalaeloa Barbers Point Harbor. Table 18 lists the signage ID and location at Kalaeloa Barbers Point Harbor.

Table 18. Kalaeloa Barbers Point Harbor signage ID and location.

ITEM	SIGN ID	PIER LOCATION
1	IMSBP043660	BP04
2	IMSBP055250	BP05A
3	IMSBP077102	BP07
4	IMSBP077140	BP07
5	IMSBP077142	BP07
6	IMSBP077144	BP07
7	IMSBP097605	Area 9
8	IMSBP097603	Area 9

2.5 Kalaeloa Barbers Point Harbor Pier Use Area

Kalaeloa Barbers Point Harbor services a niche market with specialized cargo handling facilities, and Harbors Personnel are assigned for specific pier areas for the storm sewer system inspection and cleaning activities and tasks.

Table 19 lists the piers, principal cargo, container yard area, and shed area for Kalaeloa Barbers Point Harbor.

Table 19. Kalaeloa Barbers Point Harbor Piers, principal cargo, container yard area, and shed area.

PIER	PRINCIPAL CARGO/PIER USE	YARD AREA (ACRES)	SHED AREA (SQ. FT.)
Barge Basin	Liquid-bulk cargo and pipelines. Scrap metal and sand.	4.4	
P-3	Dry-dock.		
Ferry/Tug Pier	Ferry terminal.		
P-5A	Neo-bulk cargo, petroleum, and scrap metal.		
P-5B	Liquid-bulk cargo and pipelines. Neo-bulk cargo and scrap metal.	4.7	45,000
P-6	Liquid-bulk cargo and pipelines. DRY and neo-bulk cargos, and scrap metal. Dry-bulk unloader and storage.	30.0	
P-7	Dry-bulk cargo.	3.1	
	TOTALS	**42.4**	**45,000**

2.5.1 Kalaeloa Barbers Point Harbor Piers GIS Mapping of Storm Drain Assets

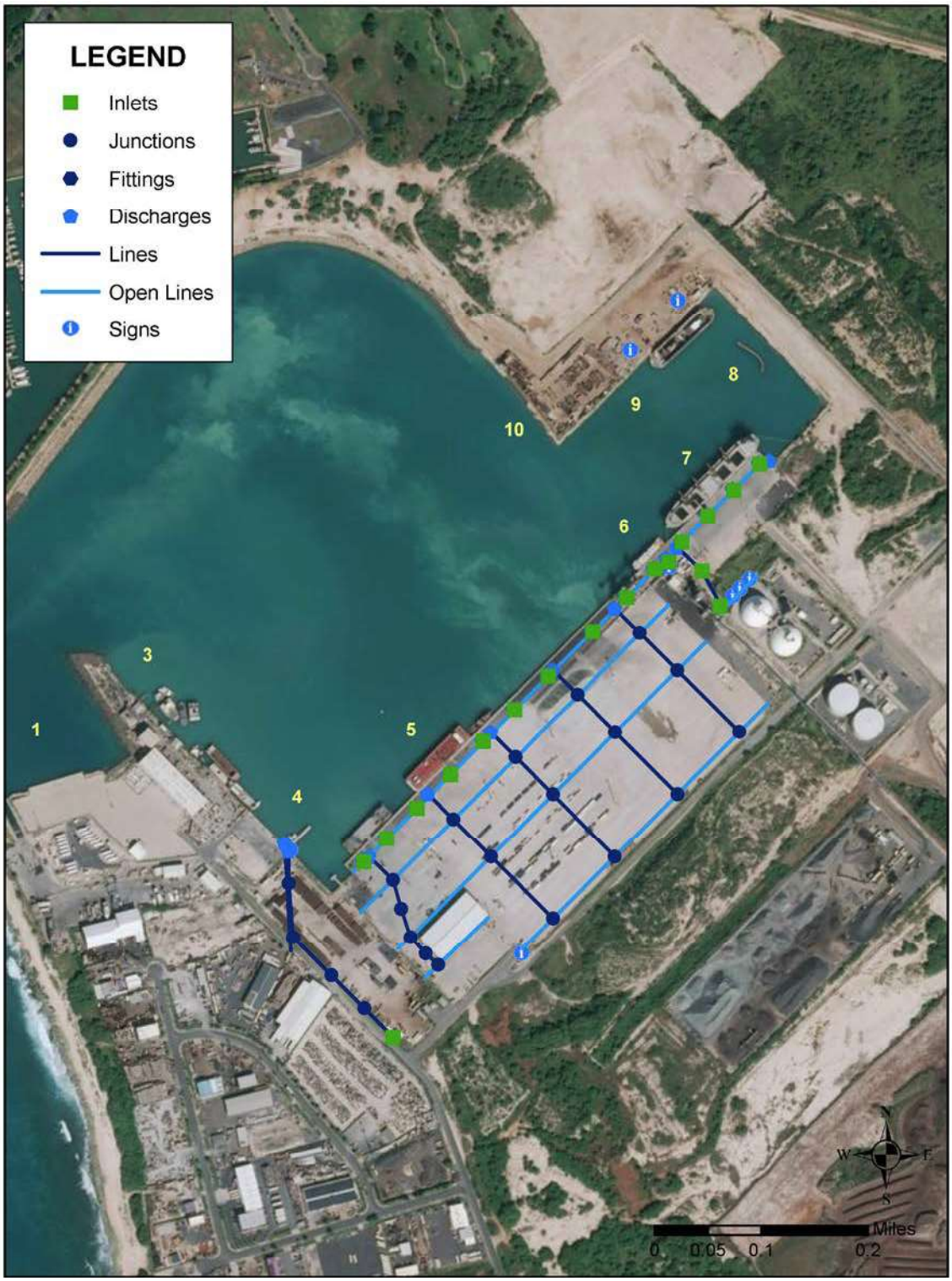


Figure 16. Kalaeloa Barbers Point Harbor Piers GIS map of storm drain assets.

Table 20 shows Kalaeloa Barbers Point Harbor storm drain inlet and manhole assets, identification number, location, and stencil type.

Table 20. Kalaeloa Barbers Point Harbor storm drain inlet and manhole assets, ID number, location, and stencil type.

ASSET TYPE	ID NUMBER	LOCATION	STENCIL TYPE *
Drain Inlet	SDIBP044102	BP04	MM
Manhole	SDJBP044072 (NR)	BP04	N/A
Manhole	SDJBP044042	BP04	N/A
Manhole	SDJBP044007	BP04	N/A
Manhole	SDJBP043865	BP04	N/A
Manhole	SDJBP055862	BP05	N/A
Manhole	SDJBP055832	BP05	N/A
Manhole	SDJBP055815	BP05	N/A
Manhole	SDJBP055462	BP05	N/A
Manhole	SDJBP055432	BP05	N/A
Manhole	SDJBP055415	BP05	N/A
Manhole	SDJBP055022	BP05A	N/A
Manhole	SDJBP054886	BP05A	N/A
Manhole	SDJBP054875	BP05A	N/A
Manhole	SDJBP054860	BP05A	N/A
Manhole	SDJBP055015	BP05A	N/A
Drain Inlet	SDIBP066202	BP06	SP
Drain Inlet	SDIBP066502	BP06	SP
Drain Inlet	SDIBP066802	BP06	SP
Manhole	SDJBP066715	BP06	N/A
Manhole	SDJBP066732	BP06	N/A
Manhole	SDJBP066762	BP06	N/A
Manhole	SDJBP066262	BP06	N/A
Manhole	SDJBP066215	BP06	N/A
Manhole	SDJBP066232	BP06	N/A

* *SP = spray paint; MM = metal marker (bolted to grate); CM = curb marker (durable plastic requires special adhesive); and N/A = not applicable.*

Table 21 shows Kalaeloa Barbers Point Harbor open channel, trench drain, and swale assets; and identification number, and location.

Table 21. Kalaeloa Barbers Point Harbor open channel, trench drain, and swale assets; and ID number and location.

ASSET TYPE	ID NUMBER	LOCATION
Open Channel	SDOBP05001A	BP05
Open Channel	SDOBP05002B	BP05
Open Channel	SDOBP05002C	BP05
Open Channel	SDOBP05002A	BP05
Open Channel	SDOBP05002D	BP05
Open Channel	SDOBP05002E	BP05
Open Channel	SDOBP05002F	BP05
Trench Drain	SDIBP055902	BP05
Trench Drain	SDIBP055702	BP05
Trench Drain	SDIBP055502	BP05
Trench Drain	SDIBP055302	BP05
Trench Drain	SDIBP055202	BP05A
Trench Drain	SDIBP055002	BP05A
Open Channel	SDOBP05002G	BP06
Open Channel	SDOBP05002H	BP06
Open Channel	SDOBP05002I	BP06
Open Channel	SDOBP05002J	BP06
Open Channel	SDOBP05002K	BP06
Open Channel	SDOBP05002L	BP06
Swale	SDOBP077135	BP07
Trench Drain	SDIBP077302	BP07
Trench Drain	SDIBP077402	BP07
Trench Drain	SDIBP077202	BP07
Trench Drain	SDIBP077002	BP07
Open Channel	SDOBP0502A1	BP05A
Open Channel	SDOBP0502C1	BP05A
Open Channel	SDOBP0502B1	BP05A

Table 22 shows the Post-Construction BMP ID number, structural type, BMP type, BMP subtype, and location at Kalaeloa Barbers Point Harbor.

Table 22. Post-Construction BMP ID number, structural type, BMP type, BMP subtype, and location.

PBMP ID	STRUCTURAL	BMP TYPE	BMP SUBTYPE	PIER
EHBMPBPGP7730	Yes	treatment control	infiltration basin	GLP
EHBMPBPGP7731	Yes	treatment control	downspout disconnection	GLP
EHBMPBP035010	Yes	treatment control	dry well	3
EHBMPBP035011	Yes	treatment control	dry well	3
EHBMPBP035022	Yes	source control	emergency valve	3
EHBMPBP035020	Yes	source control	emergency valve	3
EHBMPBP035021	Yes	source control	emergency valve	3

Figure 17 shows the Kalaeloa Barbers Point Harbor Post-Construction BMP map.

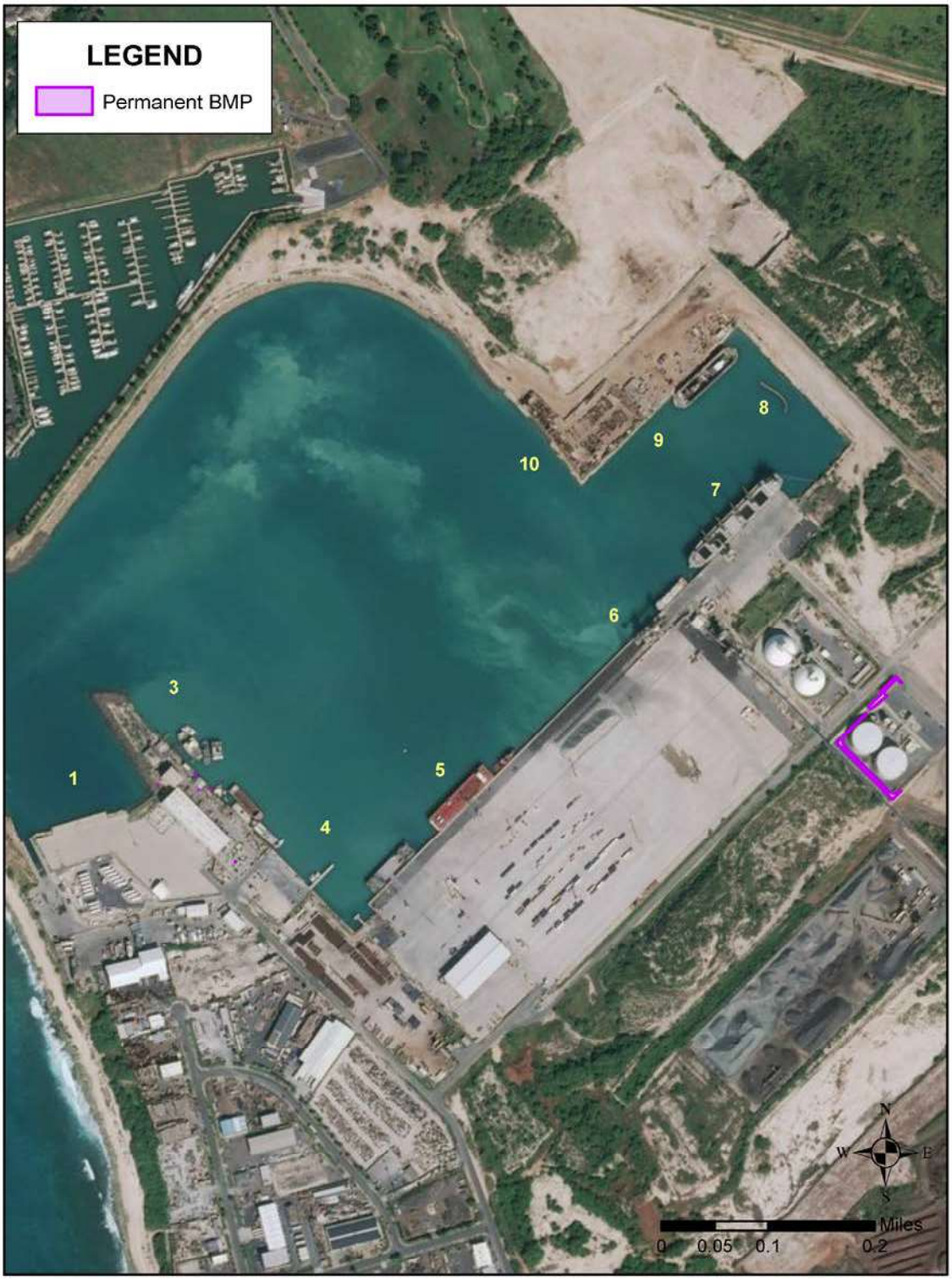


Figure 17. Kalaeloa Barbers Point Harbor Post-Construction BMP map.

2.5.2 Rail Tracks Location Map

The rail tracks at Kalaeloa Barbers Point Harbor are used for off-loading dry bulk cargo at Pier 6 and Pier 7. These lands are under leases to tenants and these tenants are required to clean the tracks after each off-loading event. The Harbor Agent then inspects the area.

Figure 18 shows the Kalaeloa Barbers Point Harbor rail tracks and storm trench drains.



Figure 18. Kalaeloa Barbers Point Harbor rail tracks at Pier 6 and Pier 7.

CHAPTER 3
HARBORS PERSONNEL AND STORM SEWER SYSTEM ACTIVITIES

The Hawaii Department of Transportation Director provides oversight for, and delegates authority and responsibility to, the Office of Environmental Compliance (ENV) to oversee compliance with all environmental requirements relating to Small MS4 compliance, including the storm water permits and storm water management plans for the Harbors, Airports, and Highways Divisions. The ENV staff reports to the Director.

The ENV staff coordinates with the Harbors Division to achieve and maintain compliance with Federal, State, and local environmental regulations, including the CD requirements for the SSS OMP.

The Director confers Program authority to the Deputy Director Harbors (DEP-H) who maintains direct oversight of all Harbors staff, leads the compliance effort for the division, and ensures that program focus and resources are assigned to personnel who perform the inspection, cleaning, and maintenance of the Harbors storm sewer system. The ENV supports the DEP-H who leads the compliance efforts to ensure sufficient resources are allocated for successful implementation of the SSS OMP. The DEP-H directs the development and execution of the SSS OMP through the Engineering Branch and the Harbors Administrator. Both the Engineering Branch and the Harbors Administrator ensures implementation of the Harbors SSS OMP.

Figure 19 shows the Harbors Division, Oahu District Storm Sewer System Organizational Chart with yellow highlighted boxes for the Departments, Divisions, Branches, Sections, Units and Subunits responsible for the implementation of SSS OMP activities and tasks.

Figure 20 shows Oahu District Position Titles and SSS OMP Tasks Organizational Chart.

3.1 Engineering Branch

The Engineering Branch (HAR-E) through the *Branch Head Engineering Program Manager* provides engineering management and storm water program oversight through the DEP-H to the Harbors Administrator (*see* Section 3.2), for the Harbors overall environmental compliance activities, including the CD requirements.

The HAR-E is responsible for ensuring implementation of the Construction Site Runoff Control Program and the Post-Construction Storm Water Management Program.

3.1.1 Environmental Section

The Engineering Environmental Section (HAR-EE) through the *Section Head Engineer* oversees permit compliance with all relevant environmental regulations, including the CD requirements. The HAR-EE administers the *SWMP* control measures for Harbors through the following program elements:

1. Public Education and Outreach Program – *Training, Signage and Inlet Stenciling*
2. Public Involvement/Participation Program
3. Illicit Discharge Detection and Elimination Program –*Tenant Inspection Program, Outfall Reconnaissance Inventory and Inspection Program, Site Assessment Program, Enforcement Response Program*
4. Construction Site Runoff Control Program
5. Post-Construction Storm Water Management Program
6. Pollution Prevention and Good Housekeeping Program – *Storm Sewer System Operations & Maintenance Program*

Note: Programs 1 and 6 are addressed herein; whereas, Programs 2, 3, 4, and 5 are outside the scope of this manual. Refer to current *SWMP* for program details.

The HAR-EE provides oversight on the implementation of the Harbors SSS OMP and tracks the overall environmental compliance progress; and is responsible for the Reporting requirements. The HAR-EE is the Project Coordinator and assists the HAR-EP who develops the AMS.

The HAR-EE and its environmental consultants perform tenant inspections and provide technical support to Harbors Property Management (HAR-PM) regarding enforcement of tenant violations, and applicable environmental issues (e.g., implementation of BMPs, leaking, etc.).

3.1.2 Planning Section

The Engineering Planning Section (HAR-EP) through the *Section Head Engineer* develops the Harbor Master Plans, six-year capital project budget plan, and capital project biennial budget for new development and redevelopment projects. The HAR-EP was assigned to develop GIS map layers for storm sewer, tenant, and projects at Honolulu Harbor and the Kalaeloa Barbers Point Harbor. Since the completion of the GIS mapping in 2015, HAR-EP personnel also serve as GIS and AMS technical Administrators.

HAWAII DEPARTMENT OF TRANSPORTATION, HARBORS DIVISION, OAHU DISTRICT, STORM SEWER SYSTEM ORGANIZATIONAL CHART

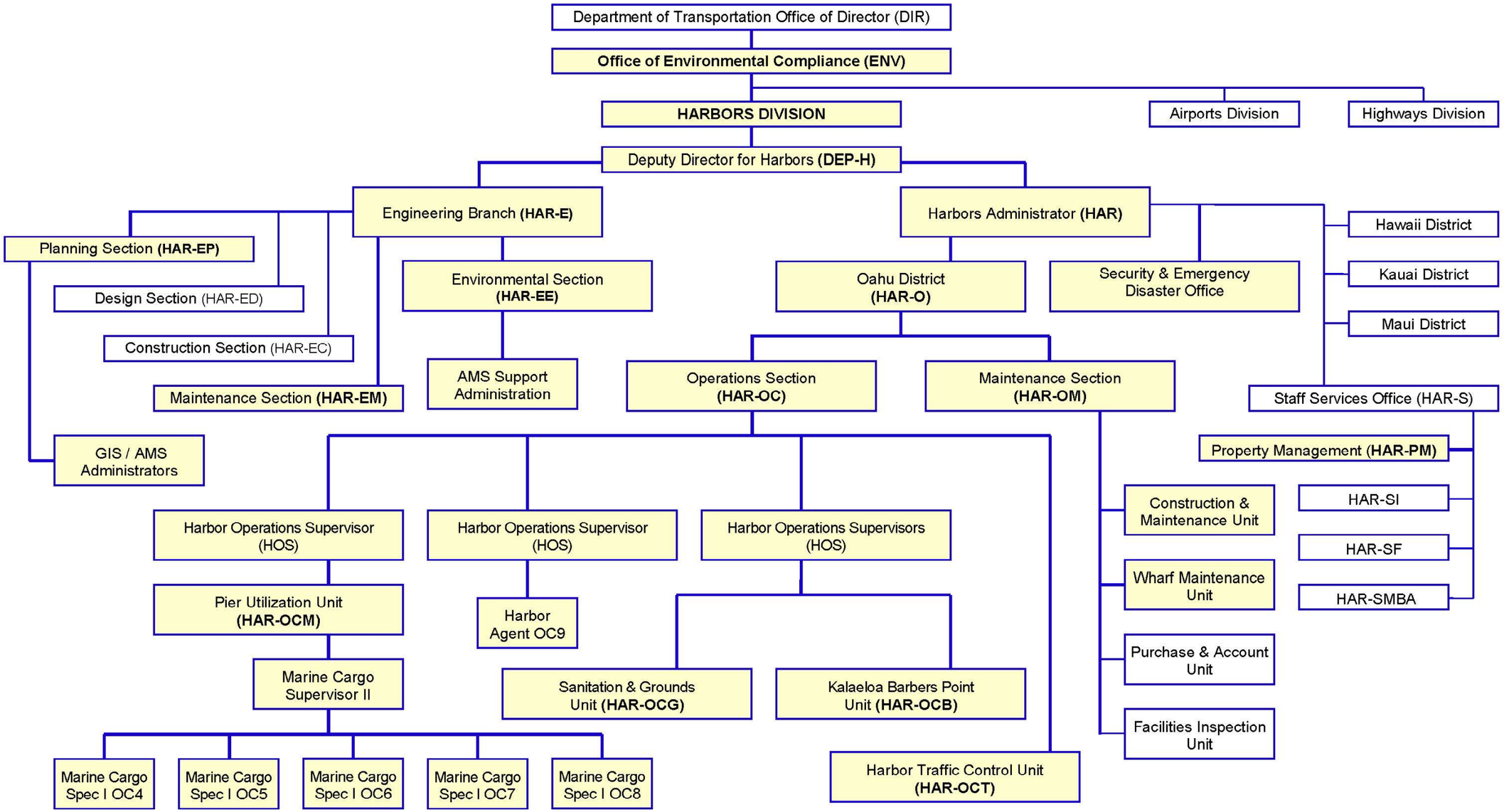


Figure 19. Harbors Division Organizational Chart with responsibilities for the SSS OMP activities highlighted in yellow.

OAHU DISTRICT POSITION TITLES AND STORM SEWER SYSTEM TASKS ORGANIZATIONAL CHART

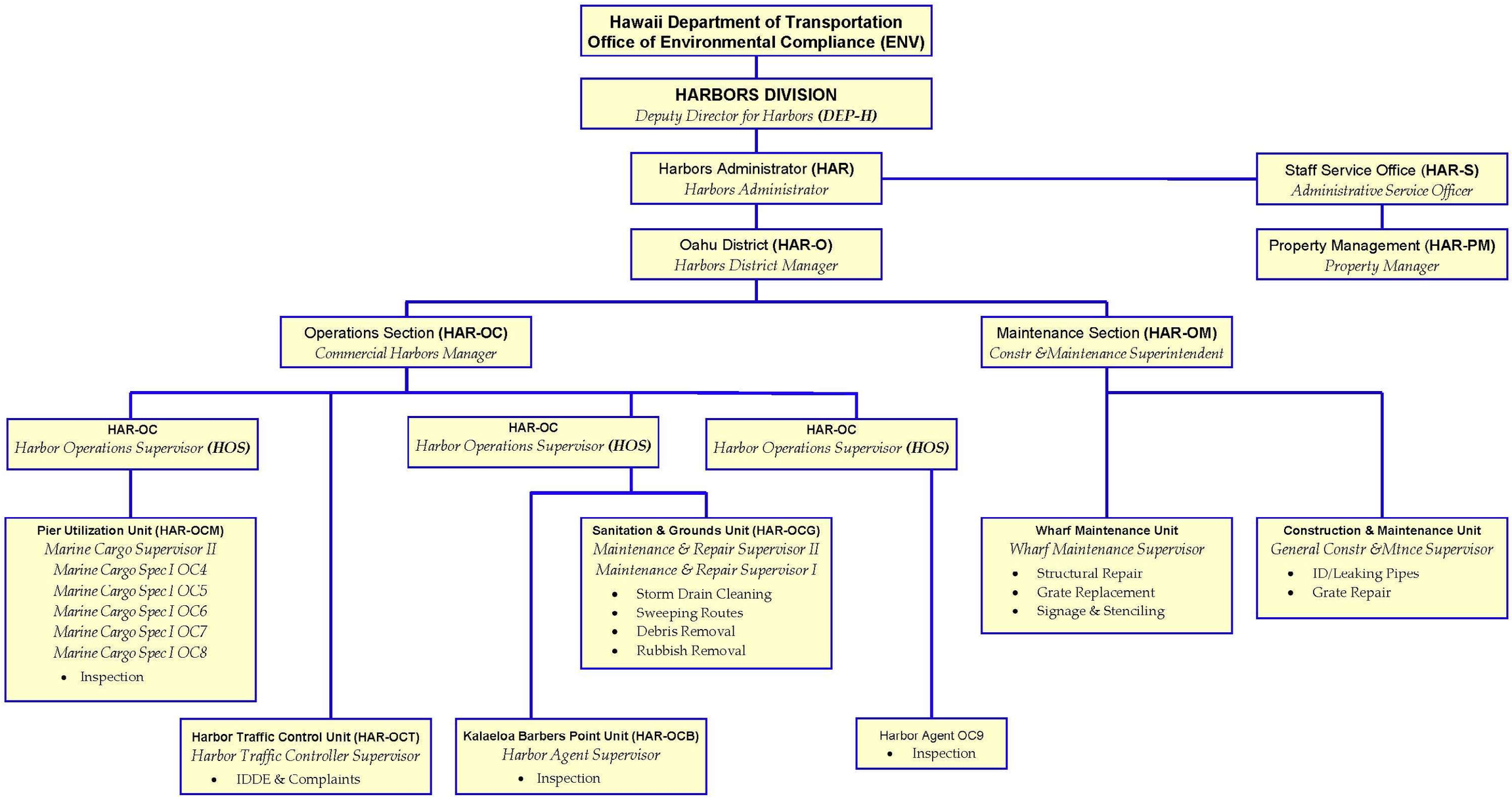


Figure 20. Harbors Oahu District Position Titles and SSS Activities Organizational Chart.

The AMS Administrators are responsible for the updates and enhancements of both database systems capabilities, and to ensure continued function as configured. Minor configuration and GIS changes may be made, as necessary; however, major changes may require a consultant. The AMS Administrators also serve as trainers to train and assist users as necessary.

3.1.3 Maintenance Section

The Engineering Maintenance Section (HAR-EM) through the *Section Head Engineer* is responsible for construction plans, specifications, and contract preparation and execution for special maintenance and repair projects. The HAR-EM regularly provides engineering maintenance support functions to Oahu District Maintenance Section (HAR-OM), to maintain and repair or replace the damaged and worn features of the Harbors storm sewer system.

3.2 Harbors Administrator

The Harbors Administrator (HAR) is responsible for the management of all properties for the Oahu District, as well as the Hawaii District, Kauai District, and Maui District harbors. The HAR procures the personnel, financial, equipment, and material resources needed to execute the environmental compliance efforts for the SSS OMP.

3.3 Harbors Oahu District

The Harbors Oahu District (HAR-O) through the *Harbors District Manager* is responsible to manage the day-to-day direction and assignments, manpower, requests and allocates resources for routine Operations and Maintenance procedures at the Honolulu and Kalaeloa Barbers Point Harbors. The HAR-O manages the staff resources and program budget for the Harbors Oahu District SSS OMP implementation; and evaluates data, conducts meetings and consultations for improvement.

The HAR-O Sections, Units, and Subunits play vital roles in the implementation of the SSS OMP inspections and cleaning of storm drains, placement of storm water signs, stenciling, noting illicit discharges, and maintenance of BMPs.

The Harbors Oahu District Operations Section (HAR-OC) and Maintenance Section (HAR-OM) assign key personnel in their Units and Subunits to conduct inspections, prepare and submit Work Orders / Service Requests into the AMS, and perform cleaning and preventive maintenance activities for the storm sewer system.

3.3.1 Operations Section

The Harbors Operations Section (HAR-OC) is led by the *Commercial Harbors Manager*, who oversees Harbor operations including vessel scheduling and berthing, monitoring of operations, street and yard sweeping, and trash collection and disposal. The Commercial Harbor Manager supervises three (3) *Harbor Operations Supervisors* (HOS) who are responsible for these Units:

- Pier Utilization Unit (HAR-OCM)
- Sanitation (HAR-OCG) & Kalaeloa Barbers Point Units (HAR-OCB)
- Harbor Agent (OC9) for Commercial Fishing Village

Oahu District personnel have primary responsibilities to observe, report, and enforce tenant activities in cargo yards surrounding a single tenant area, and common pier facilities with multi-cargo operators.

The HOS supervises Harbors staff who conduct the Routine Inspections, and reviews the Environmental Inspection Reports, Area Surveys (Service Requests), Work Orders (WO), and Illicit Discharge Reports submitted by the *Marine Cargo Specialist Supervisor* (OCM), *Harbor Agent Supervisor* (OCB), *Maintenance & Repair Supervisors* (OCG), and the *Harbor Traffic Controller Supervisor* (OCT). The HOS conducts follow-up to review or reconcile inspections with Work Orders for cleaning.

- The HOS and the Marine Cargo Supervisor II supervise Storm Sewer System inspection.
- The HOS and the HAR-OCG Maintenance & Repair Supervisors manage cleaning requirements of the CD Section 20.c and d.
- The HOS supervises the Harbor Agent (HA) who conducts daily inspections of the Domestic Commercial Fishing Village at Honolulu Harbor Piers 36 through 38. The HA at Kalaeloa Barbers Point Unit is responsible for day-to-day, on-scene supervision of the harbor.

3.3.1.1 Pier Utilization Unit

The HOS supervises the Harbors Pier Utilization Unit (HAR-OCM) which consists of *Marine Cargo Specialists* (MCS) staff that conduct Routine Inspections of pier areas.

- The MCS perform semiannual Screening Inspections of storm sewer system drain inlets and Hotspot Inspections of select storm sewer system drain inlets as required by the CD Section 20.c.

Based on inspection observations, MCS and HA may prepare the following reports to submit to the MCS Supervisor for review:

- Environmental Compliance Screening Inspections
- Service Requests (previously Area Surveys)
- Illicit Discharge Service Requests

Routine Inspections

The MCS are responsible for pier use and/or damage, and pier wharfs and cargo yards of the harbors based on pier assignments, to inspect activities in their assigned areas; and to inspect, monitor, observe, and advise cargo operators that have potential sources of illicit discharges.

Screening Inspections

The MCS and HA conduct semiannual Screening Inspections on 100% of the accessible drain inlets and open channels (trench drains) and quarterly Hotspot Inspections of select drain inlets and open channels. The physical inspections identify structural defects, trash and debris accumulation, drain guard presence, and illegible drain inlet stenciling.

3.3.1.2 Kalaeloa Barbers Point Harbor Unit

The Kalaeloa Barbers Point Harbor Unit (HAR-OCB) through the *Harbor Agent Supervisor* conducts Routine Inspection and Screening Inspections of the harbor and may prepare reports similar to MCS:

- Environmental Compliance Screening Inspections
- Service Requests (previously Area Surveys)
- Illicit Discharge Service Requests

3.3.1.3 Harbor Traffic Control Unit

The Harbor Traffic Control Unit (HAR-OCT) is also known as "Tower Operators" and through the *Harbor Traffic Controller Supervisor* is responsible for the potential reports coming into HAR-OCT. The Tower Operator assesses the report, and provides notifications depending on the assessment. Types of reports received are suspected illicit discharges/spills, leaking pipes, illegal dumping, clogged drains, damages and acts of vandalism, and other environmental concerns reported by employees or the general public. The 24/7 Tower Operators record and process the information received; and per relevant regulatory reporting requirements, provides notification to the regulatory agencies with jurisdiction, such as the US Coast Guard and HDOH.

The IDDE and Complaint reports may be initiated by the Tower Operator who faxes a copy to HAR-EE. HAR-EE generates the necessary and appropriate Service Request in the Citiworks® AMS.

3.3.1.4 Sanitation & Grounds Unit

The Sanitation & Grounds Unit (HAR-OCG) through the *Maintenance & Repair Supervisors* manage personnel who utilize heavy equipment to open the drain inlets to conduct follow-up work. HAR-OCG operates a vacuum truck that substantially increases the capabilities to clean drain inlets; and a rubbish truck for debris removal. HAR-OCB has a staging area for bulk pickup by HAR-OCG.

- The HAR-OCG Supervisors are responsible for managing the Subunit and data input to Citiworks® AMS, and the follow up Work Orders.
- The Kalaeloa Barbers Point Unit (HAR-OCB) Harbor Agent Supervisor uses Citiworks® AMS to create Service Requests as needed.
- HAR-OCG is responsible for storm drain cleaning and removal of accumulated debris, trash and sediment, and proper disposal with appropriate waste contractors.
- HAR-OCG performs sweeping of the pier common areas and select tenant facilities to prevent pollutants from entering the harbor by removing solids prior to flowing into the storm sewer system.
- HAR-OCG provides housekeeping practices for refuse collection and debris removal as an ongoing activity for Harbors facilities.
- HAR-OCG regularly conducts emptying of dumpsters for refuse collection; removal and disposal of discarded objects, machinery or equipment; and prompt repair/replacement of malfunctioning dumpsters.

3.3.2 Maintenance Section

The Harbors Maintenance Section (HAR-OM) through the *Construction & Maintenance Superintendent* is responsible for construction, maintenance, and routine repair for HAR-O, including the storm sewer system. The HAR-OM personnel perform daily maintenance functions at the piers and tenant areas in the cargo yards, and supervise the skilled labor and maintain mobile equipment resources for the Oahu District. The various skilled trade subunits are grouped under two primary units – Wharf Maintenance Unit and Construction & Maintenance Unit.

3.3.2.1 Wharf Maintenance Unit

The Wharf Maintenance Unit through the *Wharf Maintenance Supervisor* oversees the Building & Wharf Maintenance Subunit; Building, Paving & Grounds Subunit; Carpentry & Masonry Subunit; Equipment Operations Subunit; and Painting Subunit. The Wharf Maintenance Unit assists the storm water program with skilled trade subunits to support the following SSS O&M needs:

- Repair storm drain inlet boxes.
- Maintain legible stenciling and markers at storm drain inlets, and install required signage.

3.3.2.2 Construction & Maintenance Unit

The Construction & Maintenance Unit through the *General Construction & Maintenance Supervisor* oversees the Electrical Subunit, the Automotive Maintenance Subunit, the Plumbing Subunit, the Welding Subunit, the Equipment Maintenance Subunit, the Air Conditioning Subunit, and the Parking Meter Subunit. The Construction and Maintenance Unit assists the storm water program with skilled trade subunits to support the following SSS O&M needs:

- Regular maintenance to fix leaking pipes.
- Provide scheduled maintenance for vehicles.
- Repair and replace metal grates.

See Chapter 5 for details about the MCS/HA and HAR-OCG tasks workflow processes.

3.4 SSS OMP Implementation and BMPs

The SSS OMP implements BMPs that are effective, practical means of preventing or reducing pollution from storm water runoff. Storm water BMPs are defined as a schedule or schedules of operational inspection activities, prohibitions or designations of practices, maintenance procedures, and management practices to prevent or reduce the pollution to receiving water and/or Harbors storm water drainage system.

Figure 21 shows a prohibition practice BMP of signage informing the public that "Pollution is Prohibited by Law."



Figure 21. Prohibition practice BMP signage informs the public that "Pollution is Prohibited by Law."

BMPs include treatment control requirements; operating procedures; and practices to prevent illicit discharges and to control runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

BMPs related to treatment control utilize physical devices or systems that remove pollutants from storm water.

BMPs related to operational practices are intended to prevent pollutants from entering surface waters and/or Harbors storm water drainage system by altering activities to eliminate and minimize the pollution.

BMPs related to spill response rely on a combination of structural controls, employee awareness and relevant training to be effective methods for protection of environment.

Table 23 shows the storm water BMPs and Harbors Oahu District programmatic roles that provide oversight for the SSS OMP activities and tasks.

Table 23. Storm Water BMPs and Harbors programmatic roles.

STORM WATER BMPS	UNITS
Semiannual Storm Drain Screening Inspections	OCM, MCS/HA
Quarterly Hotspot Inspections	OCM, MCS/HA
Comprehensive Inspections	OCG, OCB
Storm Drain Cleaning	OCG
IDDE and Complaint Inspections	MCS, OCG, OCB
Structural Repairs	Wharf Maintenance

STORM WATER BMPS	UNITS
Grate Replacements	Wharf Maintenance
Grounds Special Maintenance	OCG, OCB, WM
Routine Sweeping Routes	OCG, OCB
Refuse Collection	OCG
Repair Leaking Pipes	Construction & Maintenance
Signage and Stenciling	Wharf Maintenance

3.5 Regulatory Requirements

The regulatory requirements guiding the *Storm Sewer System O&M Program Manual* are listed with relevant information or language.

3.5.1 2014 Consent Decree

The Hawaii Department of Transportation CD with the USEPA and HDOH was entered in the US District Court for the District of Hawaii, Docket No. 1:14-CW-00408-JMS-KSC on November 5, 2014. The CD requires Harbors to comply with specific requirements of the CWA, as amended, along with the provisions set forth in the Notice of General Permit Coverage (NGPC) permit.

The CD Section 20 requires Harbors to develop and implement a SSS OMP for Honolulu Harbor and Kalaeloa Barbers Point Harbor.

3.5.2 NPDES NGPCs for Honolulu and Kalaeloa Barbers Point Harbors

The Honolulu Harbor NPDES NGPC HI 03KB482, and the Kalaeloa Barbers Point Harbor NPDES NGPC HI 03KB488, issued by the HDOH, set forth requirements for Harbors to implement minimum control measures to reduce the discharge of pollutants from Harbors MS4 to the MEP in order to protect water quality and satisfy appropriate water quality requirements of the CWA.

The HDOH CWB granted NGPCs for both harbors in separate letters dated May 19, 2003. Coverage was extended by HDOH administrative extension to December 9, 2013, at which time the HDOH renewed the NGPCs for both harbors. The NGPCs for both Honolulu and Kalaeloa Barbers Point Harbors new administrative extension date is December 2, 2016.

The NGPCs require that Harbors effectively prohibit non-storm water discharges through its storm sewer system into State Waters.

3.5.2.1 40 Code of Federal Regulations 122

Harbors is required to comply with the USEPA NPDES regulations (40 CFR Part 122) for urbanized areas.

3.5.2.2 Hawaii Revised Statutes

The Hawaii Revised Statutes (HRS) Chapter 342D Water Pollution, Part III Water Pollution Control states:

> § 342D-50 Prohibition. (a) No person, including any public body, shall discharge any water pollutant into state waters, or cause or allow any water pollutant to enter state waters except in compliance with this chapter, rules adopted pursuant to this chapter, or a permit or variance issued by the director.

3.5.2.3 Hawaii Administrative Rules

The Harbors Division is required to comply with Hawaii Administrative Rules (HAR) Title 11, Chapter 54 Water Quality Standards.

The Harbors Division is required to comply with HAR Chapter 11-55 Water Pollution Control, Appendix K, Appendix A, and HAR Sections 11-55-34.04(a), 11-55-34.07, 11-55-34.11, 11-55-34.12, and other applicable Sections of HAR Chapter 11-55.

The HAR Chapter 11-55 Appendix K NPDES Permit Authorizing Discharges of Storm Water and Certain Non-Storm Water Discharges from Small Municipal Separate Storm Sewer Systems, Section 6 Storm Water Plan Requirements, Subsection (a) Minimum Control Measures, item (6) Pollution Prevention/Good Housekeeping states:

> Develop, implement, and enforce an operation and maintenance program to prevent and reduce storm water pollution from activities, including, but not limited to, park and open space maintenance, fleet and building maintenance, new construction and land disturbances, and storm water system maintenance that, at a minimum, includes the following:
>
> (A) Good housekeeping and other control measures, and
>
> (B) Employee and contractor training on good housekeeping practices to ensure that good housekeeping measures and best management practices are properly implemented.

3.5.3 SWMP for Honolulu and Kalaeloa Barbers Point Harbors

In compliance with the CWA, as amended, HRS Chapter 342D, and HAR Chapters 11-54 and 11-55, Harbors is authorized to discharge storm water runoff and certain non-storm water discharges as identified in the NGPCs.

The *SWMP* identifies the six minimum control measures established by the USEPA and required by HAR 11-55 Appendix K; and a schedule for implementation of BMPs to reduce, to the MEP, the amount of pollutants from the Small MS4s that enter the receiving State Waters.

The *SWMP* control measures for Public Education and Outreach Program target Harbors tenants, the general public including visitors to our islands, Harbors employees, vessel operators, and general contractors who perform construction on Harbors property. The Signage and Stenciling Program installs signs that prohibit dumping or discarding pollutants at suitable locations on Harbor property. Harbors stencils or labels all inlets and open channels on Honolulu Harbor and Kalaeloa Barbers Point Harbor to promote storm water awareness and reduce non-storm water discharges into harbor waters.

The *SWMP* control measures for Pollution Prevention and Good Housekeeping Program include the SSS OMP.

3.6 Notifications Information and Contacts

Harbors internal procedures determine the point of contact personnel responsible for contacts to the HDOH and CCH agencies for specific circumstances.

Table 24 provides notifications information and contacts.

Table 24. Notifications information and contacts.

NOTIFICATIONS INFORMATION AND CONTACTS	PHONE NUMBER
Harbors Stormwater Hotline (working hours only)	(808) 587-1962
Harbors Traffic Control Center (available 24 hours)	(808) 587-2076
Harbors Environmental Section (HAR-EE) Notify HAR-EE for IDDE and applicable environmental issues or concerns. Connection and Discharge Permittees must notify HAR-EE at least 24 hours before commencing discharge or construction work to arrange for necessary inspectional services.	(808) 587-1962
DOH Clean Water Branch (CWB) Immediately notify the DOH CWB of pollutants entering or threatening to enter State Waters. Immediately notify DOH of any municipal wastewater spills or overflows from private laterals and failing septic systems that discharges into the MS4. Immediately notify the DOH CWB of any spills of any chemical of a *reportable quantity*; and a written notification must also be submitted no later than thirty (30) days after the initial release. *Note:* The reportable quantity for oil and fuel products is a spill of 25 gallons or more, a spill not cleaned within 72 hours, or a spill that threatens ground or surface waters.	(808) 586-4309
DOH Hazard Evaluation and Emergency Response (HEER) Office Notify HEER office of any discharge/spill that enter State Waters after work hours. Notify HEER office of any chemical spill of a *reportable quantity*, and a written notification must also be submitted no later than thirty (30) days after the initial release.	(808) 586-4249 or (808) 247-2191 *(after hours)*
DOH Solids and Hazardous Waste Branch	(808) 586-4226
US Coast Guard Marine Safety Office, Oahu The US Coast Guard should be notified of any quantity spill that reaches the ocean.	(808) 522-8260
CCH Department of Environmental Services (ENV) Sanitary Sewer Spills/Trouble	(808) 768-7272
CCH Environmental Concern Line	(808) 768-3300
CCH Industrial Discharges to Sanitary Sewer	(808) 768-8210
CCH Storm Drain Permit Connection	(808) 768-8106

3.6.1 MOU for HDOT and City & County of Honolulu

Harbors is not involved in the 2002 Memorandum of Understanding (MOU) for HDOT and the City & County of Honolulu (CCH); however, the MOU serves to identify the owners of upstream storm sewer system network connectivity that impacts Harbors. Harbors property is located between the lower portions of both HDOT and City systems and the receiving State Waters.

Pertinent sections are provided, as follows.

> "The purpose of this Memorandum of Understanding (MOU) is to define the roles and responsibilities of the State Department of Transportation, Highways Division, (DOT), and the City and County of Honolulu (City) Department of Environmental Services (ENV), and Department of Facility Maintenance (DFM), as part of permit requirements on the control of illicit discharges and nonpoint sources of pollution into the DOT's municipal separate storm sewer system on Oahu, and the City's municipal separate storm sewer system.
>
> On Oahu, the regulations require both the DOT and the City to have NPDES permits for their respective municipal storm sewer systems. Because the DOT and City systems are interconnected, DOH regulations require that an interagency agreement between the DOT and the City or a Memorandum of Understanding (MOU), be executed that delineates policies governing interconnection and enforcement that will control the discharge of pollutants from the upper portions of the municipal separate storm sewer systems into the lower portions of both DOT and City systems to waters of the United States.
>
> The objectives of this MOU are to:
>
> a) Establish effective intergovernmental coordination between the DOT and the City;
>
> b) To clearly delineate the roles and responsibilities of each agency in an effort to minimize, to the maximum extent practicable, the discharge of any pollutant from one municipal separate storm sewer system to the other municipal separate storm sewer system;
>
> c) Minimize duplication of effort; and
>
> d) Ensure accountability through judicious application of best management practices, design and engineering methods, and periodic water quality monitoring.

The DOT, through the Oahu District Engineer, will . . .

3. Implement a storm water monitoring program in conformance with the requirements of the DOT municipal NPDES Permit, and provide analytical data of storm water discharges to the ENV whenever such discharges are conveyed into the City's municipal separate storm sewer system.

The City and County of Honolulu, Department of Environmental Services (ENV) will . . .

3. Implement a storm water monitoring program in conformance with the requirements of the City' municipal NPDES Permit, and provide, upon request, analytical data of storm water discharges to the DOT whenever such discharges are conveyed into the DOT's municipal separate storm sewer system."

CHAPTER 4
HARBORS ASSET MANAGEMENT SYSTEM (AMS)

The Harbors AMS is a commercial off the shelf (COTS) solution using ESRI GIS and Cityworks® AMS software which requires Internet browser access to log in. The AMS interface enables staff to track and manage Harbors storm water infrastructure assets and MS4 permit compliance through a centralized database.

The AMS collects data from specific geospatial features of the Harbors storm water system (i.e., inlets, manholes, pipes, aboveground drainage features, post-construction control measures, and outfalls), drain inspections and cleaning activities, BMP inspections for construction and post-construction projects, and tenant and outfall inspections. The AMS manages schedules and special reports, and tracks the Work Orders and Service Requests required for drain inspections and cleaning. The data serves to identify higher risk "hotspots" with greater potential to discharge pollutants.

This chapter presents an introduction to Cityworks® AMS capabilities. Chapter 6 information presents a guide for Cityworks® AMS usage.

4.1 ArcGIS Online and Server Configuration

Cityworks® uses ArcGIS Server to provide the map and other tools, such as geocoding, to the user. Different maps may be configured for individual users or groups to display data relevant to their responsibilities and daily activities.

4.1.1 Cityworks® AMS – How It Works

Cityworks® is a proprietary GIS-centric asset management software solution that combines elements of ArcGIS data with asset data management capabilities in order to allow users to perform intelligent and cost-effective inspection, monitoring, and condition assessments. The AMS takes into account the interdependencies of maintenance, operations, asset performance, environmental conditions, life cycle costs, and capital planning to maximize the useful remaining life of system assets.

4.1.1.1 AMS Alignment with *SWMP* and CD

The Cityworks® AMS approach adopted Service Requests, Work Orders, and Inspections work activities—cyclical or reactive—with their associated costs, to align with Harbors compliance activities with the *SWMP* requirements. This alignment ensures Harbors personnel capabilities to address the storm sewer system compliance requirements of the CD.

4.1.1.2 Tasks Workflow Process Using Cityworks® AMS

Map layers are created to display the progressive relationships among open Service Requests, status of Work Orders, and schedules for Inspections through a customized inbox or map screen for Harbors personnel users.

Reports of many types may be generated through search parameters or customized report templates so field users can receive the information they need to efficiently perform their jobs.

This section introduces Cityworks® AMS capabilities. Chapter 5 provides a transition from what Cityworks® AMS can do to how tasks are performed in coordination with Cityworks® AMS. *See* Chapter 5 for details about the HAR-OC and HAR-OM tasks workflow processes.

4.1.2 Asset Configuration

Cityworks® AMS uses the ArcGIS geodatabase as the asset database, and differentiates assets types as follows:

- *Feature* classes with assets shown as points, lines, and polygons.
- *Other* types with no records in the geodatabase but still allow tracking of work activities, e.g., training, meetings, etc.

4.1.2.1 Configured Assets

Each configured asset fits the designated storm sewer system tasks, which are grouped to correspond with the CD. These assets exist as GIS layers and class tables within the Cityworks® AMS on which users can create activities.

Figure 22 shows the Honolulu Harbors storm sewer system assets.

Figure 23 shows Kalaeloa Barbers Point Harbor storm sewer system assets.

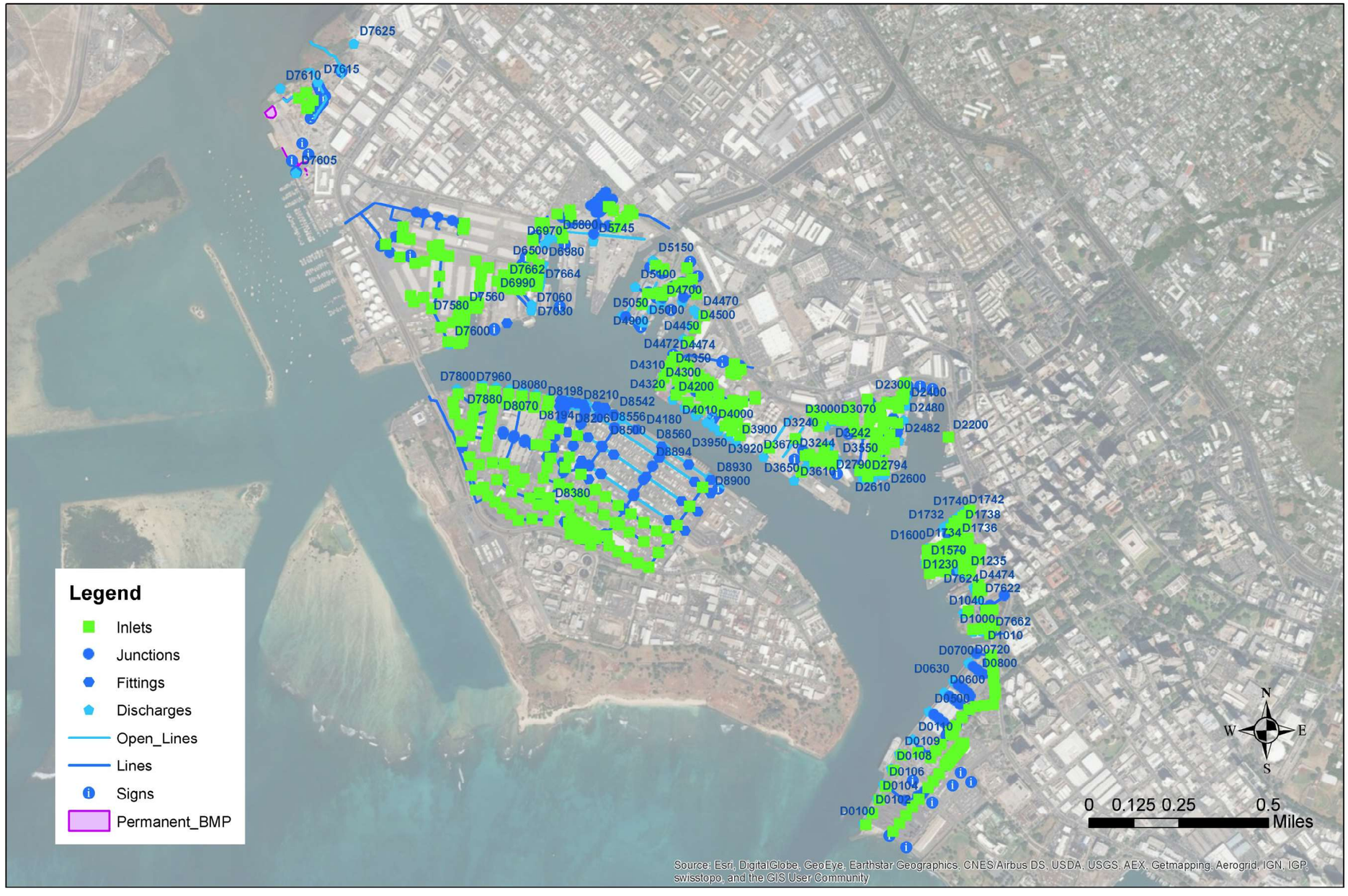


Figure 22. Honolulu Harbor Storm Sewer System Assets.

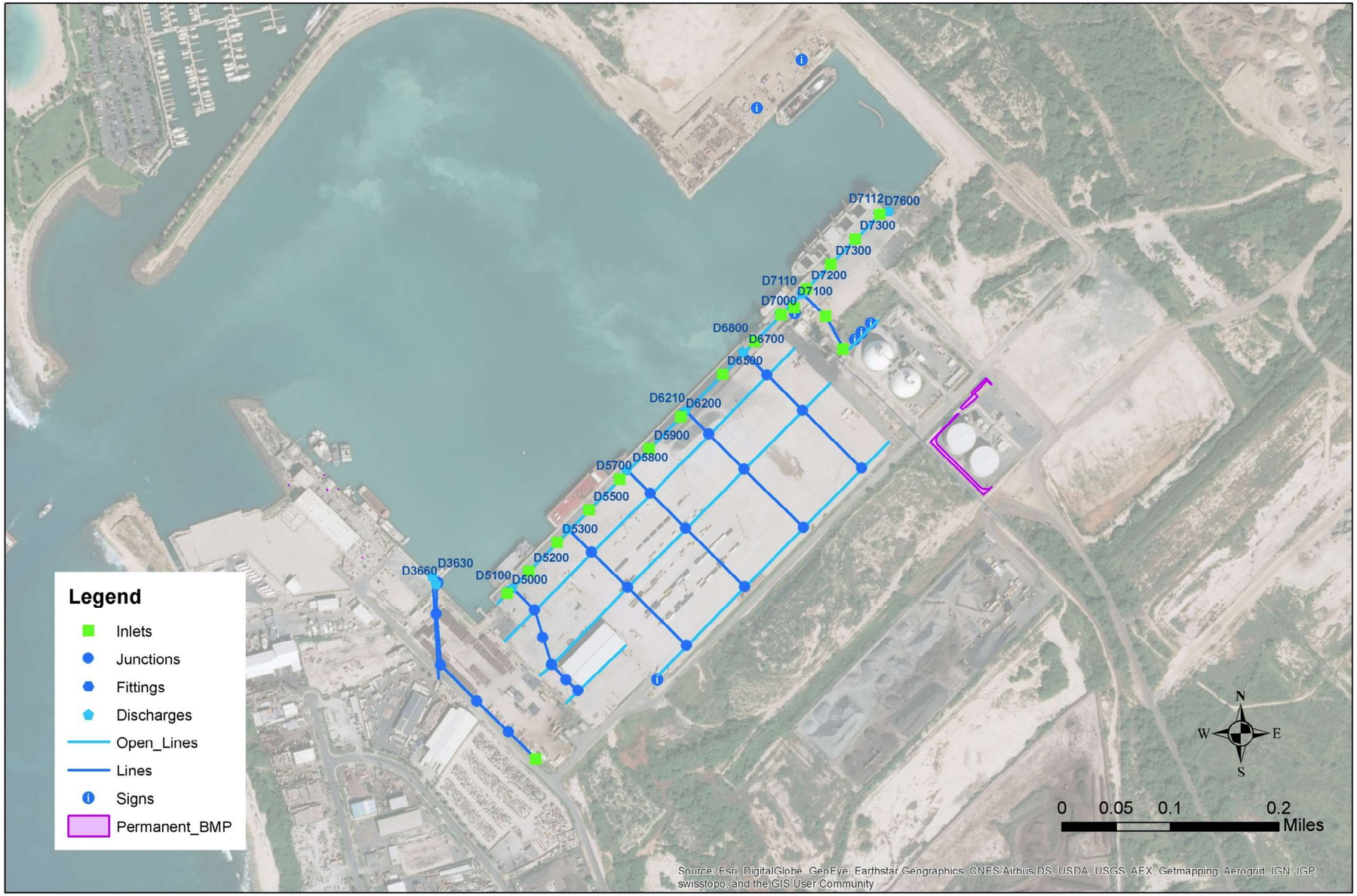


Figure 23. Kalaeloa Barbers Point Harbor Storm Sewer System Assets.

Table 25 shows the Cityworks® AMS configured assets groups defined for Harbors.

Table 25. Cityworks® AMS configured asset groups.

ASSET GROUP	ASSET NAME
Enforcement	Enforcement
Engineering	Project (HC Footprint) BMP
Environmental Sec A	Public Outreach, Training Employee
Environmental Sec B	Discharge (Outfall), Enforcement, Illicit Discharge, Tenant
Operations	Grounds, Refuse, Sweeping, Vehicle
Storm drain	Fitting, Inlet, Line, Manhole, Open Line, PBMP, Signs
Administration	Config

4.2 Work Orders

Work management involves initiation, screening (qualifying), planning, dispatching, and performing (executing) requests for work, called a *Work Order*.

Work Order configuration templates are designed to incorporate the current SSS OMP work practices and modernize data entry by the Harbors personnel who perform inspections of the storm drain system.

Harbors O&M activities are cyclic or reactive, and Cityworks® AMS generates schedules and tasks for "asset-based" Work Orders and Inspections, and address or "location-based" Service Requests.

Work Order generation is the primary decision making point, and work assignments are routed to specific Harbors Sections, Units, and Subunits.

Table 26 shows the Work Orders configured in Cityworks® AMS based on asset group, GIS layer, and asset types.

Table 26. Work Orders assigned to Harbors personnel for follow-up and completion.

ASSET GROUP	GIS LAYER ASSET NAME	ASSET TYPE	WORK ORDER DESCRIPTION	ASSOCIATED PERSONNEL
Engineering	Project (HC Footprint)	Feature	Construction BMP Inspect – Harbors – 1 Initial	EE
Engineering	Project (HC Footprint)	Feature	Construction BMP Inspect – Harbors – 2 Recurring	EE
Engineering	Project (HC Footprint)	Feature	Construction BMP Inspect – Harbors – 3 Final	EE, OM

ASSET GROUP	GIS LAYER ASSET NAME	ASSET TYPE	WORK ORDER DESCRIPTION	ASSOCIATED PERSONNEL
Engineering	Project (HC Footprint)	Feature	Environmental Design Review - Harbors	EP
Environmental Sec A	Training Employee	Other	IDDE Training	O, OC, OM, OCM, OE, OCT, OCG, OCB, MCS, HA
Environmental Sec A	Training Employee	Other	IDDE Survey & Review / Update	O, OC, OM, OCM, OE, OCT, OCG, OCB, MCS, HA
Environmental Sec A	Training Employee	Other	Stormwater Awareness Training	O, OC, OM, OCM, OE, OCT, OCG, OCB, MCS, HA
Environmental Sec A	Training Employee	Other	Stormwater Awareness Training Survey & Review / Update	O, OC, OM, OCM, OE, OCT, OCG, OCB, MCS, HA
Operations	Refuse	Other	Bulk Waste Disposal	OCG, OCB
Operations	Refuse	Other	Repair / Replace	OCG, OCB
Operations	Refuse	Other	Refuse Collect Ad Hoc	OCG, OCB
Operations	Sweeping	Other	Street Sweeper Downtime	HOS, OCB,
Operations	Sweeping	Other	Sweep – Aloha Marine Lines P29	OCG
Operations	Sweeping	Other	Sweep – Channel Street, P02 Shed	OCG
Operations	Sweeping	Other	Sweep – Fishing Village P35	OCG
Operations	Sweeping	Other	Sweep – KBPH Common Roads	OCB
Operations	Sweeping	Other	Sweep – Matson	OCG
Operations	Sweeping	Other	Sweep – NYK P01	OCG
Operations	Sweeping	Other	Sweep – P01 Entrance	OCG
Operations	Sweeping	Other	Sweep – P01, P02 Common Roadways	OCG
Operations	Sweeping	Other	Sweep – P02 for Cruise Ship	OCG
Operations	Sweeping	Other	Sweep – P10, P11	OCG
Operations	Sweeping	Other	Sweep – P18 P19, P23, P24	OCG
Operations	Sweeping	Other	Sweep – P27, P28	OCG
Operations	Sweeping	Other	Sweep – P30, P31, P32, and Shed Areas	OCG
Operations	Sweeping	Other	Sweep – Pasha	OCG
Operations	Sweeping	Other	Sweep – Sand Island Base Yard	OCG
Operations	Sweeping	Other	Sweep – Young Brothers	OCG

ASSET GROUP	GIS LAYER ASSET NAME	ASSET TYPE	WORK ORDER DESCRIPTION	ASSOCIATED PERSONNEL
Operations	Sweeping	Other	Sweep Waste Disposal	OCG
Stormdrain	Fitting	Feature	Inspect	OM
Stormdrain	Fitting	Feature	Install	OM
Stormdrain	Fitting	Feature	Remove	OM
Stormdrain	Fitting	Feature	Repair	OM
Stormdrain	Fitting	Feature	Replace	OM
Stormdrain	Inlet	Feature	Clean & Inspect AD Hoc	OCG, OCB
Stormdrain	Inlet	Feature	Clean & Inspect Hotspot	OCG, OCB
Stormdrain	Inlet	Feature	Inspect Ad Hoc	MCS
Stormdrain	Inlet	Feature	Inspect Comprehensive & Clean	OCG
Stormdrain	Inlet	Feature	Inspect Screening	MCS
Stormdrain	Inlet	Feature	Inspect Screening Wet Weather	MCS
Stormdrain	Inlet	Feature	Install	OM
Stormdrain	Inlet	Feature	Install & Remove Plate	OM
Stormdrain	Inlet	Feature	Install Biosock / Drain Guard	OCG
Stormdrain	Inlet	Feature	Remove	OM
Stormdrain	Inlet	Feature	Remove Biosock /Drain	OCG
Stormdrain	Inlet	Feature	Repair Box	EE, EM, OM
Stormdrain	Inlet	Feature	Repair Frame	OM
Stormdrain	Inlet	Feature	Repair Grate	OM
Stormdrain	Inlet	Feature	Replace Biosock /Drain Guard	OCG
Stormdrain	Inlet	Feature	Replace Box	OM
Stormdrain	Inlet	Feature	Replace Frame	OM
Stormdrain	Inlet	Feature	Replace Grate	OM, CMV
Stormdrain	Inlet	Feature	Stencil New	OM
Stormdrain	Inlet	Feature	Stencil Restencil	OM
Stormdrain	Line	Feature	Clean	OM
Stormdrain	Line	Feature	Install	OM
Stormdrain	Line	Feature	Remove	OM
Stormdrain	Line	Feature	Repair	OM
Stormdrain	Line	Feature	Replace	OM
Stormdrain	Manhole	Feature	Inspect Comprehensive	OCG
Stormdrain	Manhole	Feature	Inspect Screening	MCS, HA

ASSET GROUP	GIS LAYER ASSET NAME	ASSET TYPE	WORK ORDER DESCRIPTION	ASSOCIATED PERSONNEL
Stormdrain	Manhole	Feature	Inspect Screening Wet Weather	OCG
Stormdrain	Manhole	Feature	Install	OM
Stormdrain	Manhole	Feature	Rebuild Cone	OM
Stormdrain	Manhole	Feature	Remove	OM
Stormdrain	Manhole	Feature	Repair	OM
Stormdrain	Manhole	Feature	Replace	OM
Stormdrain	Manhole	Feature	Replace	OM
Stormdrain	Open Line	Feature	Clean & Inspect Ad Hoc	OCG
Stormdrain	Open Line	Feature	Clean & Inspect Hotspot	OCG, OCB
Stormdrain	Open Line	Feature	Inspect Comprehensive & Clean	OCG, OCB
Stormdrain	Open Line	Feature	Inspect Screening	MCS
Stormdrain	Open Line	Feature	Inspect Screening Wet Weather	MCS
Stormdrain	Open Line	Feature	Install	OM
Stormdrain	Open Line	Feature	Install & Remove Plate	OM
Stormdrain	Open Line	Feature	Install Biosock /Drain	OCG
Stormdrain	Open Line	Feature	Remove	OM
Stormdrain	Open Line	Feature	Remove Biosock /Drain Guard	OCG
Stormdrain	Open Line	Feature	Repair	OM
Stormdrain	Open Line	Feature	Repair Box	OM
Stormdrain	Open Line	Feature	Repair Frame	OM
Stormdrain	Open Line	Feature	Repair Grate	OM
Stormdrain	Open Line	Feature	Replace Biosock /Drain Guard	OCG
Stormdrain	Open Line	Feature	Replace Box	OM
Stormdrain	Open Line	Feature	Replace Frame	OM
Stormdrain	Open Line	Feature	Replace Grate	OM
Stormdrain b	Project Permanent BMP	Feature	Inspect Comprehensive & Clean	OCG
Stormdrain b	Project Permanent BMP	Feature	Install	OM
Stormdrain b	Project Permanent BMP	Other	Permanent BMP O&M Training	OCG
Stormdrain b	Project Permanent BMP	Feature	Remove	OM
Stormdrain b	Project Permanent BMP	Feature	Repair	OM

ASSET GROUP	GIS LAYER ASSET NAME	ASSET TYPE	WORK ORDER DESCRIPTION	ASSOCIATED PERSONNEL
Stormdrain b	Project Permanent BMP	Feature	Replace	OM
Stormdrain b	Signs	Feature	Clean	OCG
Stormdrain b	Signs	Feature	Evaluate Annual	EE
Stormdrain b	Signs	Feature	Install	OM
Stormdrain b	Signs	Feature	Remove Graffiti	OCG
Stormdrain b	Signs	Feature	Repair Pole	OM
Stormdrain b	Signs	Feature	Replace Pole	OM
Stormdrain b	Signs	Feature	Replace Sign	OM

4.2.1 Work Order Security

Each Work Order template has a security configuration that can only be altered by Harbors AMS Administrators.

4.2.1.1 Work Order Tables

A table is a collection of related data columns and rows held in a structured format within a database.

- Work Order – Primary Work Order information
- Labor – Labor added to Work Order
- Material – Material added to Work Order
- Equipment – Equipment added to Work Order
- Tasks – Tasks associated to Work Order

4.2.1.2 Permissions

Users and groups are created and assigned a range of database access permissions to the Work Order Tables. Permissions set by the AMS Administrator allow users to create and update, and view work management activities and data fields.

- View – Users may view data, but not add, update, or delete.
- Add – Users may view and add data, but not delete.
- Update – Users may add data and update screen details, but not delete.
- Delete – Users may add, update, and delete data.

- View Labor Costs – Users may view the financial information.

Each permission is applied to each Work Order Table depending on the permission level assigned to a given domain group.

4.2.2 Work Order Status

A Work Order, like an asset, has a life cycle of its own in the Cityworks® AMS. The steps and functions of the Work Order life cycle are integrated to ensure that issues are resolved or activities are efficiently completed.

The Work Order status can be viewed as the time it takes to accept a request for work through the time it takes to complete the Work Order. These stages are as follows:

0. Initiated
1. Assigned
2. In Progress
3. Work Complete
4. On Hold
5. QA Rejected

Status can be thought of as the state, condition, or situation of the Work Order. Status is used for Service Requests and Work Orders. The Status field is designed to change as work progresses. Values in the Status field are pre-populated by Harbors AMS Administrators to reflect the possible stages of work for Harbors personnel.

A Work Order may go through each of these stages from work initiation to QA review and completion, or it may bypass certain stages – it is entirely dependent on what Harbors requires based on the asset work required. In addition, stages may be combined based on the Harbors staff roles and responsibilities. This standard Work Order life cycle process provides a streamlined, consistent method to manage work throughout Harbors.

Every configuration includes workflows that do not follow the standard Work Order life cycle. These are grouped as custom flows to support the remaining 20% of the configuration for which Task Specific Workflows have been specially configured for Harbors. These Task-Specific Workflows are discussed in Section 4.2.3.

Figure 24 displays a Work Order screen shot with selected Status "Assigned."

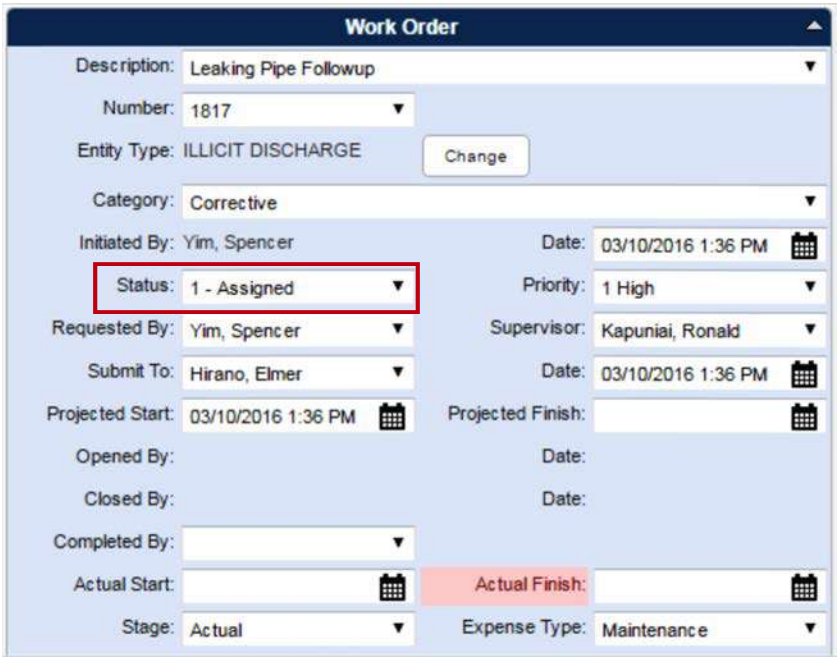


Figure 24. Work Order screen displays status field as "Assigned."

Initiated Work Order Status

The *Initiated* Work Order may go through a screening process to make sure the initial details and information are accurate, and the Work Order or Service Request is valid. If the information is accurate, the Manager / Superintendent / Supervisor keeps the Status field "Initiated."

However, if the information is not accurate, the Screener will tab to the Details Panel to cancel the Work Order by checking the *Cancel Work Order* checkbox.

The Manager / Superintendent / Supervisor will document the reasons for cancellation, and click the Save button to save the Work Order and the screen display will update the Work Order *Status* field to "Cancelled."

Figure 25 displays the Details panel with the checked Cancel Work Order checkbox.

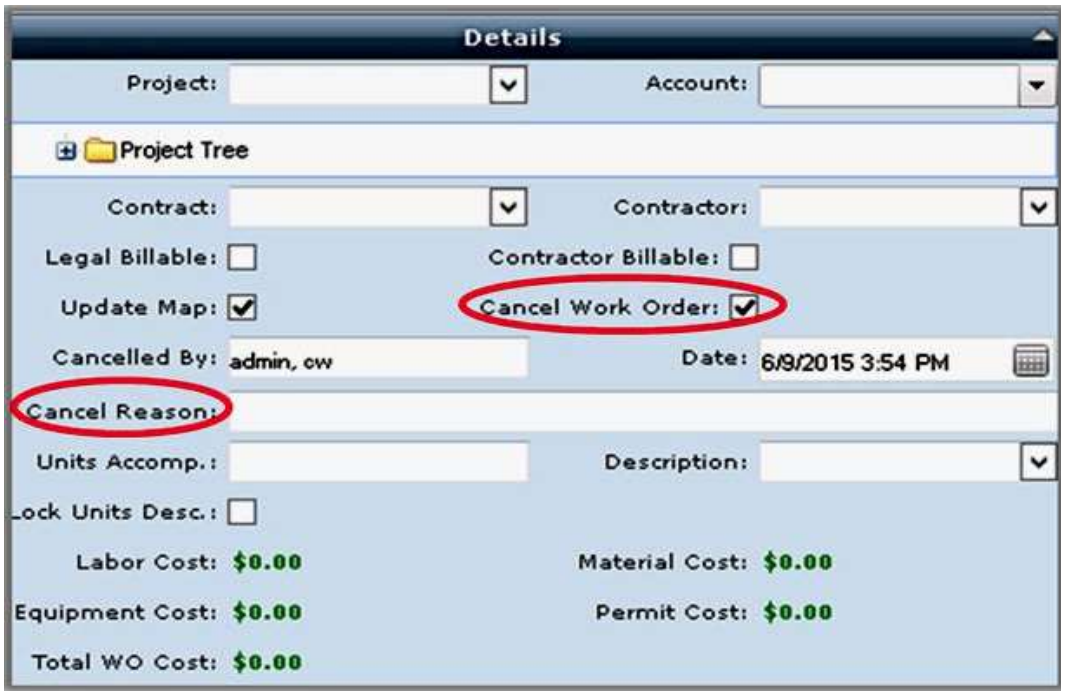


Figure 25. Work Order Details panel.

Work Orders are initiated based upon issues identified during the execution of other maintenance activities or a pre-defined schedule of preventive tasks. Regardless of the circumstances under which a Work Order must be completed, the process for doing so is generally the same, using Cityworks® AMS functionality along with the common Work Order life cycle.

New reactive, corrective, predictive, or preventive Work Orders are initiated based upon reported and observed deficiencies in the storm drain system, or automatically initiated by Cityworks® AMS predefined inspections and cleaning schedules. The asset related to the issue is attached to the Work Order upon selecting the *Initiated* status.

Screening Work Order Status

The Work Order displays in the Cityworks® AMS Inbox (hereinafter Inbox) of the supervisory staff responsible for screening, scheduling, and assigning each specific type of work. HAR-O supervisory staff is responsible for assessing and checking the Inbox in Cityworks® AMS to review the Work Order to determine priority and assign an immediate response, or assign and schedule for a later date.

Work Orders assigned for immediate response (first response Work Order) are followed up by phone or radio notification to the assigned individual. Otherwise, the Work Order will appear in the assigned employee's Inbox before it is scheduled for execution.

Assigned Work Order Status

The MCS, HA, HAR-OCG, and HAR-OM crew will complete the work in the field and the crew leader will fill out all necessary information in Cityworks® AMS. This information will include, but is not limited to, the following:

- Time started, date, and time finished,
- Resources consumed (labor, equipment, and materials)
- Notable findings (damage to the asset or equipment therein, safety hazards, etc.)
- Other information as specified on the Work Order.

Additional corrective actions or follow-up Work Orders for any conditions observed that require action or review will be created by supervisory staff based on MCS and HA inspections.

A Supervisor will prioritize and assign this work.

Completed Work Order Status

After the Work Order information is entered into Cityworks® AMS, HAR-O personnel will change the Status field to "Work Complete" and assign the Work Order back to the Supervisor to review. It will appear in the Inbox Work to Review area for the appropriate Supervisor (HOS, HAR-OCG, HAR-OCB, Marine Cargo, and HAR-OM), who will review and approve, and close the Work Order.

In the event that mobile devices cannot maintain Internet connectivity, Work Order information may be recorded on a pre-printed form for later entry into the system.

4.2.2.1 Tasks

Tasks are used to define distinct work activities within a Work Order. Tasks are typically used for more complex Work Orders that require multiple work activities performed by different people. Simpler Work Orders that only require one type of activity may not have any tasks. Tasks can be predefined and automatically added to each Work Order, as applicable. When one task is complete, the system automatically activates the next task, and the person in charge of the task is assigned the Work Order.

For example, tasks can be used to define or create a workflow on a Work Order for a work activity that requires formal approval or notification, such as reports of illicit discharges of oil that require immediate notification of certain agencies and individuals.

Figure 26 displays the screen for Illicit Oil Discharge Notifications.

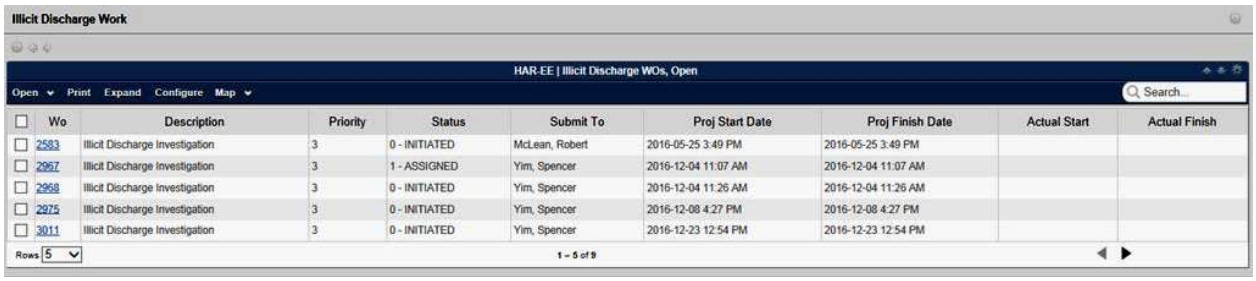


Figure 26. Illicit Oil Discharge Notifications screen.

Task Hierarchy

The task hierarchy is a folder hierarchy in which defined tasks can be organized. The hierarchy allows Harbors personnel users to easily locate a task based on the type of work for which the task is executed, the group that uses the task, or the type of asset(s) on which the task is used.

Figure 27 displays the task hierarchy configured for Harbors.

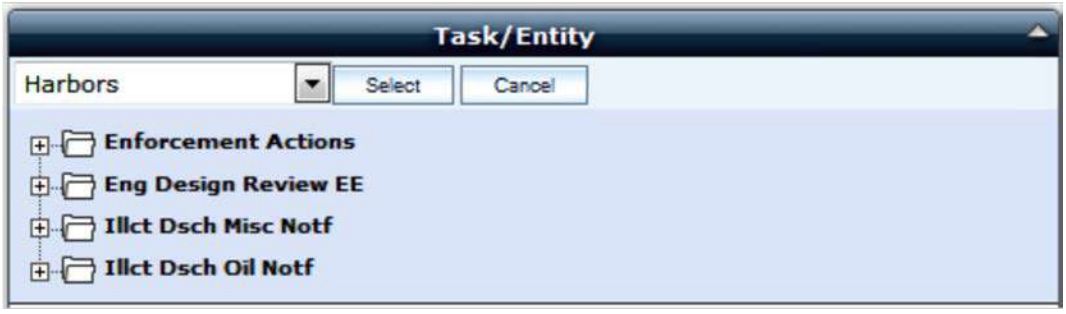


Figure 27. Task hierarchy configured for Harbors.

4.2.3 Task-Specific Workflows

Ten (10) Task-Specific Workflows are custom workflows that do not follow the standard Work Order life cycle, and are specially configured for the unique requirements of Harbors. They are briefly described below.

4.2.3.1 Illicit Discharge / Leaking Pipe

When a report is received or a discovery is made of a suspected illicit discharge or leaking pipe, the receiver or discoverer, likely HAR-OCT, a MCS / HA, or a HAR-EE

employee, will create a 'Suspected Illicit Discharge' or 'Suspected Leaking Pipe' Service Request and answer the specified questions on the electronic form.

If the Service Request is confirmed as an illicit discharge, HAR-EE will create a child Work Order for 'Illicit Discharge Investigation' or 'Leaking Pipe Investigation'. The Work Order should be attached to the closest asset participating in the discharge. Then, if notification of other agencies is required, HAR-EE will enter the notification tasks, found in the 'Illct Dsch Misc Notf' and 'Illct Dsch Oil Noft' trunks of the task hierarchy. The Actual Finish Date of each task will indicate when the notification was made, and comments can be made on the details of the notification. The 'Illicit Discharge Investigation' or 'Leaking Pipe Investigation' work orders are intended to track only the investigation process, and contain custom fields configured to gather the details of the discharge.

In discharge cleanup, an 'Illicit Discharge Cleanup' or 'Leaking Pipe Cleanup' Work Order may be created as a child Work Order for the Investigation to track costs associated with the cleanup, including contracted costs.

If long-term follow-up is required to ensure that the source of the discharge is eliminated, an 'Illicit Discharge Followup' or 'Leaking Pipe Followup' work order may be created as a child to the investigation Work Order.

4.2.3.2 Tenant Inspection

New, recurring, and final tenant inspections, conducted by HAR-EE and its consultants to assist the HAR-Property Management, are tracked using Work Orders that describe the type of inspection being conducted, and usually result in the creation of a Storm Tenant Inspection form. The tenant risk ranking criteria on the Tenant Inspection form developed by Harbors are assessed and scored based on the observations and findings of the inspection. Additionally, tenants categorized as low risk, only reconnaissance is conducted. Tenant reconnaissance inspections are tracked using the 'Inspect – Low Risk Reconnaissance' Work Order. The results of reconnaissance inspections, including pictures and the tracking spreadsheet, will be attached to the 'Inspect – Low Risk Reconnaissance' Inspection.

4.2.3.3 Tenant List Administration

To support including tenant information on the printable version of the tenant inspection, tenant records from GIS will be imported by the AMS Administrator into the Cityworks® customer table using the Bulk Import tool in Designer.

4.2.3.4 Environmental Design Review

When a Harbors or tenant construction project requires design review, HAR-EE is notified of the project via a hardcopy 'blue memo' and creates either an 'Environmental Design Review – Harbors' or 'Environmental Design Review – Tenant' Work Order attached to a HC Footprint or Tenant asset, respectively. HAR-EE adds design review tasks as necessary by selecting from the predefined task list for those Work Orders. Every Work Order has either an 'Exempt from Construction Site Runoff Control Reqs' or 'Not Exempt from Construction Site Runoff Control Reqs' task added to facilitate annual compliance reporting.

4.2.3.5 Storm Inlet / Open Line / Manhole Inspection Process

This process is conducted in two tiers. Supervisors will be responsible for creating their own follow-up work based on the results of inspections. Marine Cargo Specialists conduct screening inspections of every accessible Harbors inlet and open line using a blanket 'Inspect Screening' Work Order for all assets, which creates a 'Storm Inlet Insp Screening' inspection for each asset. The AMS Administrator or HAR-EE initiates this Work Order semiannually from the start date of January 2016. If, on any inspection, follow-up work is required based on the 'Stenciling required', 'Grate condition', or 'Debris depth' observations, the MCS will set the Resolution of the inspection to 'Followup Work Required' and close the inspection.

The HAR-OCG Supervisors will have saved searches in their Inbox for Screening Inspections where follow-up work is required. For the assets where the Screening Inspection recorded more than 6 inches of debris in an inlet, HAR-OCG will create a single 'Inspect Comprehensive & Clean' Work Order, which creates a related 'Storm Inlet Insp Comprehensive' inspection. HAR-OCG will clean the inlet and inspect it with the grate or lid off, recording cleaning and inspection results on the inspection form. If, on any inspection, follow-up work is required based on the 'Structure condition', 'Illicit connection', or 'Guard recommendation' observations, the Resolution will be set to 'Followup Work Required' and the inspection will be closed through the normal process.

HAR-EE, HAR-OCG, and HAR-OM supervisors have 'Saved Searches' for screening and comprehensive inspections that require follow-up work. Supervisors in each branch (HOS, HAR-OCM, HAR-OCG, HAR-OM) will be responsible for creating their own follow-up work based on the results of these inspections.

The *HAR-O|Inlet Insp QC Report* is available which summarizes inspections requiring follow-up work and the follow-up Work Orders created from those inspections to assist in the quality control for this process.

4.2.3.6 Property Damage Report

When a MCS / HA or other Harbors employee discovers damage to state property that can be attributed to a specific party, the damage information is collected using the 'Property Damage Report' custom fields available on all Service Request types that cover damaged assets. If an appropriate Service Request type cannot be identified, a 'Property Damage Report' Service Request can be created and the 'Property Damage Report' custom fields populated there.

4.2.3.7 Street Sweeper Downtime

When a street sweeper is down for repair, HAR-OCG Supervisors will create a Street Sweeper Downtime Work Order. The Actual Start Date and Actual Finish Date of the Work Order will be used to calculate downtime, and the Street Sweeper Downtime custom field template will be used to track the sweeper unit that is down (instead of entering that unit as a Work Order equipment cost) and the reason the sweeper is down. This downtime model is planned to be expanded to other equipment in the future.

4.2.3.8 GIS Updates

Any time a GIS update is required, a Cityworks® user can create a new Administration GIS Update Work Order, preferably as a child to the Work Order requiring GIS updates. The user enters comments and attaches marked-up maps as appropriate to indicate the changes to be made. The GIS Update is routed by default to the appropriate GIS Administrator. After updating the GIS, the GIS Administrator completes and closes the GIS Update Work Order.

4.2.3.9 Cityworks® AMS Configuration Updates

Any user can request a Cityworks® update, such as changes to the list of people in the Supervisor or Submit To drop downs, the addition of a new Work Order type, or a new contractor for instance. To request a configuration update, a user creates a new Administration Cityworks® Configuration Update Work Order. The user enters comments describing their update request.

The Cityworks® Configuration Update Work Order is routed by default to the appropriate Cityworks® AMS Administrator for review. If the configuration change is approved, the Cityworks® AMS Administrator will complete and close the Configuration Update Work Order.

4.2.3.10 New Tenant and Tenant Project Notification

When a new Harbors tenant arrives, HAR-PM will create an Administration 'Tenant – New' Work Order, and attach the new lease or permit documents. The Work Order is routed by default to the GIS and AMS Administrator to update GIS and Cityworks® AMS with the new information.

Likewise, when a tenant applies for permission to undertake a new project, HAR-PM will create an Administration 'Tenant – Project Application' Work Order, and attach the project application. The Work Order will be routed by default to the GIS and AMS Administrator to update GIS and Cityworks® AMS with the new information.

4.3 Inspections

Inspections are used to define and capture observations during the planned and unplanned inspections of asset condition and operability. Inspections may be created from Work Orders or Service Requests by HAR-EE, MCS, HA, or HAR-OCG, depending on the inspection type. All inspections must have an associated Work Order in order to record the labor, equipment, or materials on inspections.

Each custom inspection is comprised of a number of general data fields. These fields are used to record the name of the person that performed the inspection, when the inspection was performed, general observations, recommendations, repairs completed, etc. In addition to this standard information, each inspection contains custom observation fields to record information required of that specific inspection. The ability to edit asset information is also available.

Figure 28 displays five custom Inspection templates configured for Harbors to comply with the inspection requirements contained in the CD.

Asset Name	Inspection Template Name	Inspection Template Description
Project/ HC Footprint	Storm Const Site BMP Insp	Storm Construction Site BMP Inspection Checklist
Tenant	Storm Tenant Inspection	Storm Tenant Inspection
Outfall	Storm Outfall Reconnaissance	Storm Outfall Reconnaissance
Inlet, Open Channel	Storm Inlet Insp Screening	Storm Inlet Inspection Screening
Inlet, Open Channel	Storm Inlet Insp Comprehensive	Storm Inlet Inspection Comprehensive

Figure 28. Harbors Inspection templates.

Figure 29 displays a customized outfall reconnaissance inspection template.

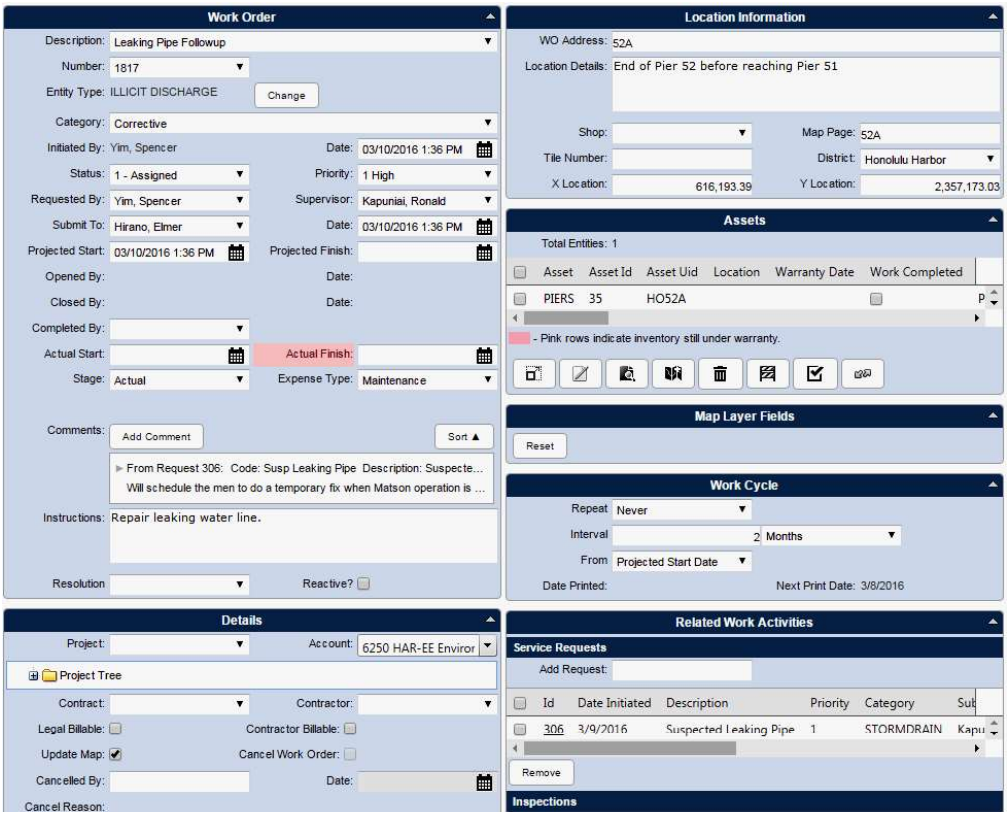


Figure 29. Harbors customized outfall reconnaissance inspection template.

4.3.1 Screening Inspections

The semi-annual Screening Inspections of the drain inlets and open lines, and the 'Inspect Comprehensive & Clean' Work Order that is performed as needed, are configured in the Cityworks® AMS to comply with the CD Section 20.c and 20.d requirements for Storm Sewer System Inspections and Cleaning.

Screening Inspections of all accessible drain inlets (including open channels or trench drains) at Honolulu Harbor and Kalaeloa Barbers Point Harbor are conducted semiannually by the HAR-OCM Marine Cargo Specialists (MCSs) and Harbor Agents (HAs) using the Inspection form configured for this type of inspection. Note that it is impractical for the MCSs and HAs to open drain grates which are bulky, heavy, and traffic rated, and thus can only observe the condition of the inlet from the surface and measure the debris depth through the opening of the inlet (if it can be done reliably).

Figure 30 displays an example of a completed Screening Inspection form.

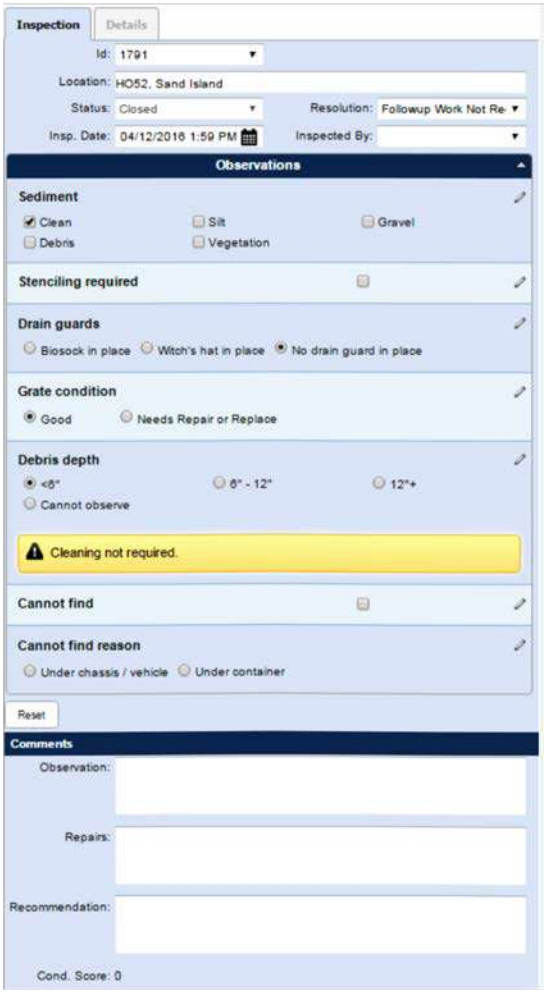


Figure 30. Screening Inspection form example.

As indicated on the Figure 30 example of a completed inspection form, the drain inlet was found to be clean of sediment, no stenciling is required, the grate is in good condition and the debris depth is less than 6 inches (Cleaning not required) – therefore, "Followup Work is Not Required" as indicated in the Resolution box. As a result, the MCS or HA selected Close in the Status Box for the inspection.

If, on the other hand, a drain guard prevented the MCS or HA from observing the debris depth inside the inlet, clicking on Cannot Observe prompts HAR-OCG to generate a Comprehensive Inspection & Cleaning Work Order (see example below) for

a crew with heavy equipment resources to complete the comprehensive inspection and to clean the drain inlet if necessary.

4.3.2 Inspect Comprehensive & Cleaning

Figure 31 displays an initiated Work Order for 'Inspect Comprehensive & Clean within 30 days.'

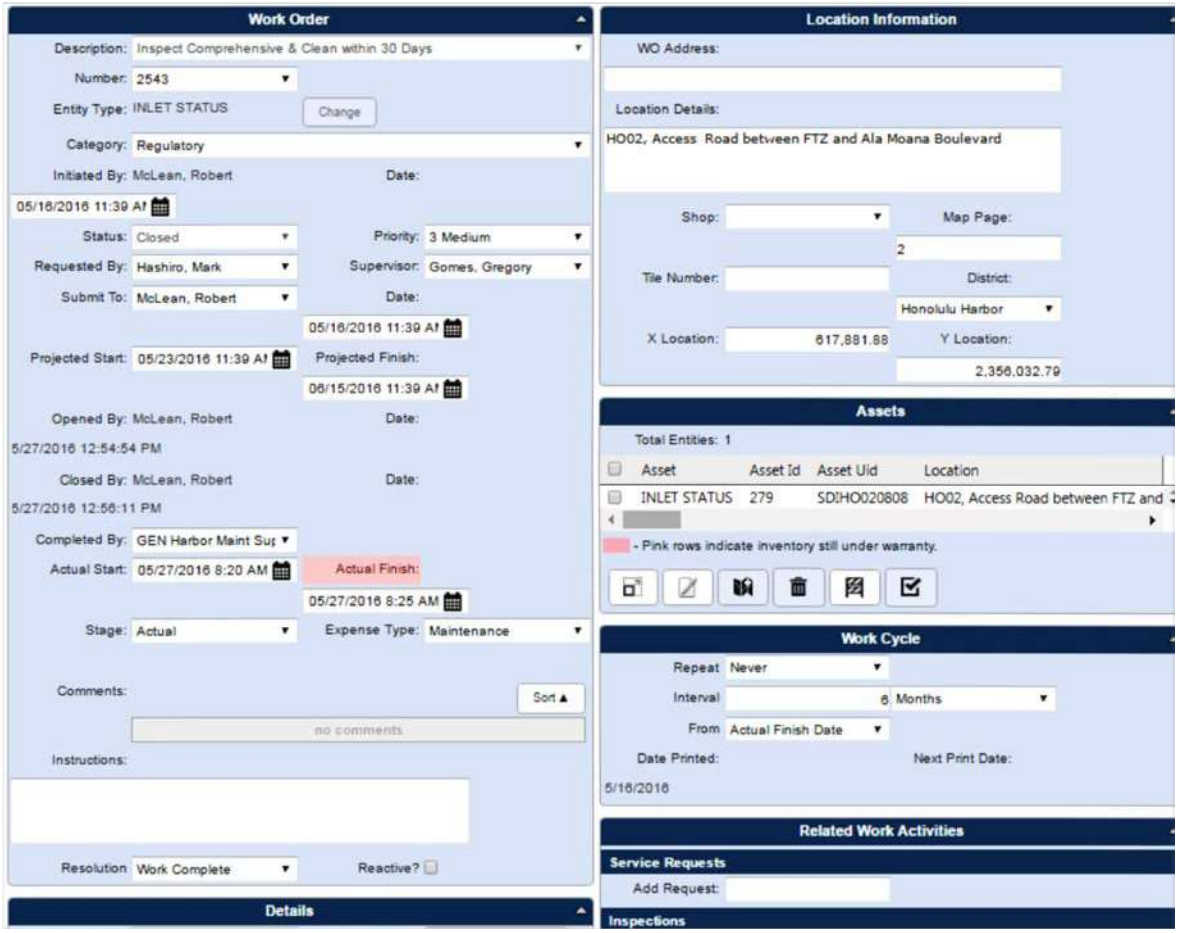


Figure 31. Comprehensive Inspection & Cleaning form example.

4.3.3 Comprehensive Inspection for BMP Work Order

Figure 32 displays an example of Comprehensive Inspection for BMP Work Order.

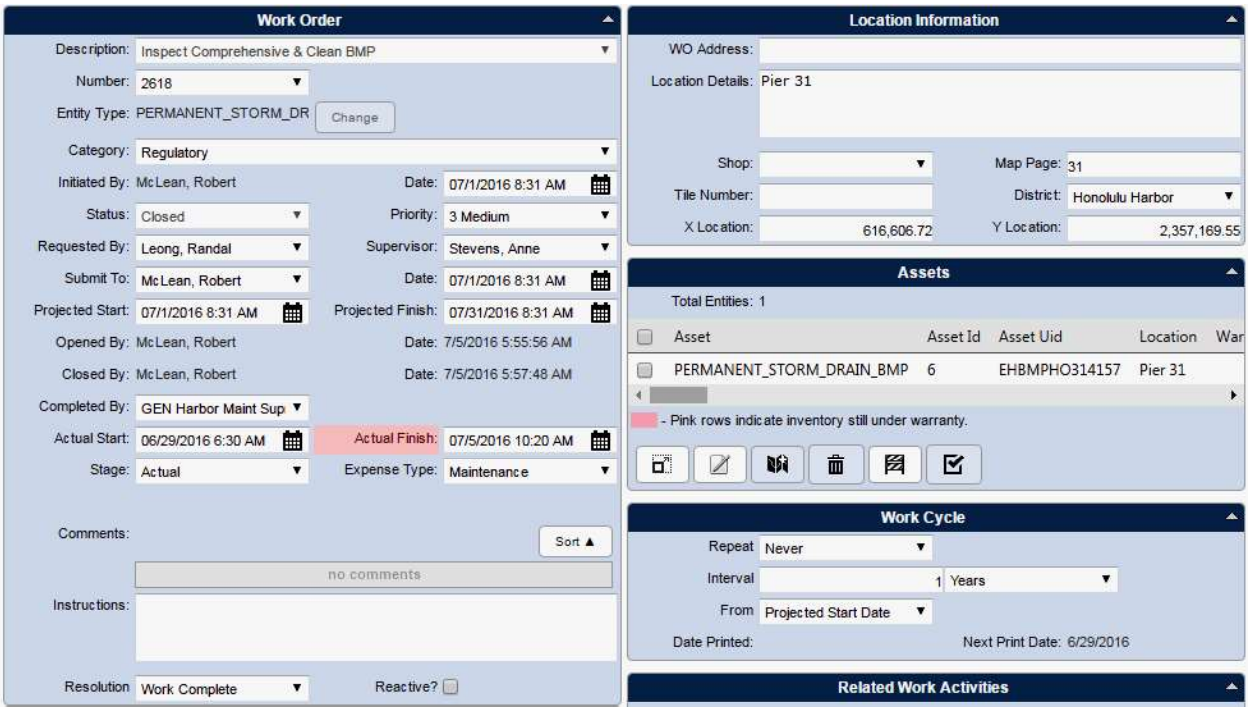


Figure 32. Inspect Comprehensive & Clean BMP Work Order screen.

4.4 Service Requests

Storm water issues and infrastructure needs are identified by Harbors personnel, tenants, and the general public through Service Requests.

The Service Requests are assigned to Harbors personnel for follow-up and completion.

Chapter 4 is a description of Cityworks® AMS capabilities. Chapter 6 provides a user guide and includes details on how to generate a Service Request.

Table 27 shows the Service Requests for storm sewer system tasks assigned to Harbors personnel for follow-up work required.

Table 27. Service Requests assigned to Harbors personnel for follow-up work required.

LIST OF SERVICE REQUEST TYPES	
Grounds Maintenance Special Request	Storm Drain Clogged
Illegal Dumping, e.g., debris in Harbor	Storm Drain Collapsed
Refuse Bulk Pickup	Storm Drain Inlet / Grate Repair
Refuse Overflow Collection	Storm Drain Maintenance Misc
Storm Debris Removal	Storm Drain Missing MH Cover
Erosion Control Measures, on Const Site	Street Flooding, Water in Street
Erosion Problem, not Const Site (KBPH)	Suspected Illicit Connection
Sign Damaged / Vandalized / Stolen	Suspected Illicit Discharge
Stencil/Marker/Medallion Missing/Faded	Suspected Leaking Pipe
Ditch/Stream Vegetation Overgrown & Debris Removal	Sweeping
Abandoned Vehicle	Refuge Bulk Pick-Up
HAZMAT	Refuge Overflow Collection
Dead Animals	

Chapter 4 is a description of Cityworks® AMS capabilities. Volume II is a user guide for storm sewer system O&M activities. Volume II, Chapter 5 discusses tasks work flow processes. Chapter 6 discusses how to use the Cityworks® AMS for inspections and Chapter 7 discusses how to use the Cityworks® AMS for cleaning and maintenance.

4.5 Equipment, Labor & Materials (ELM)

The Harbors SSS OMP implementation costs are broken down by major SWMP component and reported each year as part of the Annual Compliance Report submittal, as required by the CD Section 20.b. To satisfy this requirement, the Cityworks® AMS tracks resource utilization for equipment, labor, and materials.

Resource tracking is organized by category – equipment, labor, and materials – and costs can be tracked as estimated and actual. Tracking resources is done through its corresponding area in the Work Order form and can be performed in the office or in the field.

The Harbors Cityworks® AMS is configured to manage labor, material, and equipment in a single integrated tool named ELM for faster data entry. It accounts for labor hours and costs associated with a Work Order, Service Request, or Inspection. The labor type can include employees or contractors with each having its own hierarchy to choose from. Both estimated and actual resource usage is tracked. Summary costs statistics are available for each Work Order, and can be broken down by resource.

The Material panel of the Work Order tracks materials used and associated costs to complete a Work Order. At any time, the user can view estimated and actual materials assigned to the Work Order along with associated costs. Materials can be added or removed based on actual usage. Stock on hand is adjusted as materials are recorded onto a Work Order. If materials are removed from a Work Order, the stock on hand is adjusted to reflect a return to the storeroom. Material usage can be associated directly to tasks and asset entities.

Figure 33 shows the Material panel of the Work Order to track material use and associated cost.

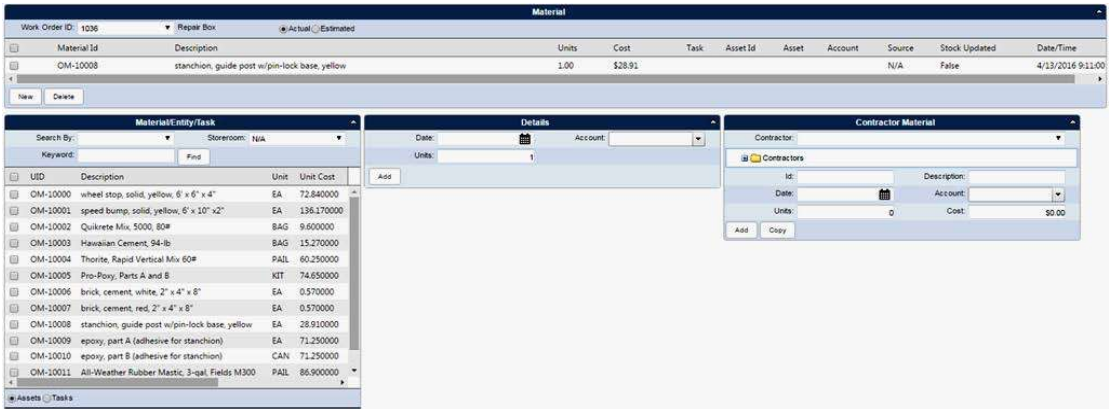


Figure 33. The Material/Entity Task panel.

Work Orders track equipment used by hour and associated cost to complete the Work Order. Equipment can be associated to specific assets and/or tasks on a Work Order.

Figure 34 shows the Equipment/Entity Task panel.

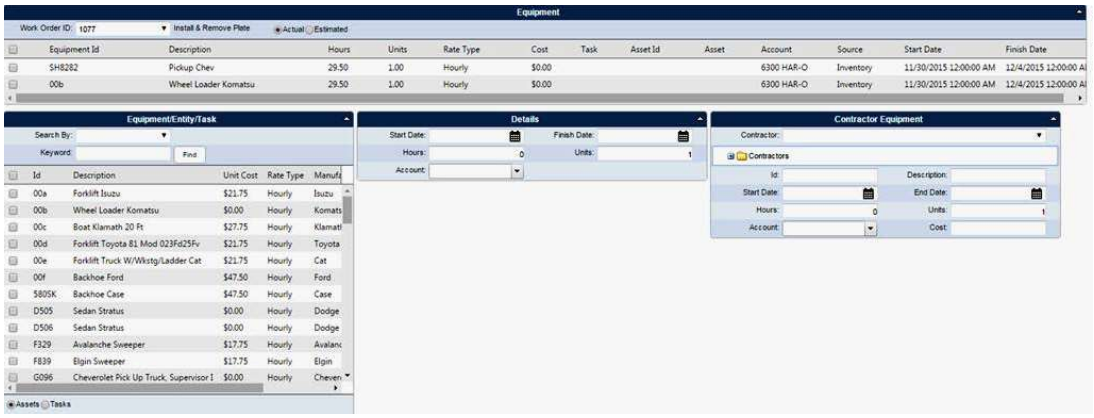


Figure 34. The Equipment/Entity Task panel.

4.6 Defining Hotspots

Hotspots are those storm drain inlets and open channels (trench drains) that present a greater risk of potentially discharging pollutants to the Harbors storm sewer system, as stated in the CD Section 20.d.i. To identify where hotspots exist, the Screening Inspections are performed by the MCS/HA on semiannual schedules for all storm drain inlets (i.e., 100% coverage where a drain can be accessed); and the follow-up 'Inspect Comprehensive & Clean' Work Orders are utilized, as needed. Based on the inspection findings and cleaning results, the Harbors definition of a hotspot is a storm drain location with two (2) consecutive comprehensive inspection and cleaning measurements of sediment and debris over 6 inches.

Currently, no hotspots are identified by this definition.

In the 4th Quarter of 2016, HAR-EE and HAR-EP with input from the MCS elected to broaden the hotspot definition to inlets that required two (2) consecutive Screening Inspections for debris over 6 inches, and any additional inlets that the MCS identified as an area of concern. Under these expanded criteria, 15 discretionary hotspots for quarterly inspection were identified, and Screening Inspections were scheduled in the AMS.

As time progresses and more data are gathered in the Cityworks® AMS, Harbors anticipates that a clearer definition of hotspot criteria will be available, thereby

prompting more frequent cleaning of the hotspots to further reduce the potential discharge of pollutants to the Harbors storm sewer system.

4.7 Rail Tracks Off-Loading at Kalaeloa Barbers Point Harbor

The rail tracks at Kalaeloa Barbers Point Harbor are routinely cleaned by tenants after bulk cargo transfer operations are concluded, in compliance with CD Section 20.d.ii.

4.8 Searches in Cityworks® AMS

Searches are among the most useful functions found in Cityworks®. Search types include the following.

4.8.1 Asset Search

The Asset Search allows for searching assets without using the map. If specific information is known about an asset, the asset search may be an easier way to locate the asset and its information. Work Orders can be initiated and work history can be viewed from the Asset Search.

4.8.2 Service Requests and Work Orders Search

Searching for Service Requests and Work Orders is allowed on any visible field on a Service Request or Work Order. It also allows the search definitions to be saved for later use, or for the results to be shown in an inbox, or on the map as an event layer.

Figure 35 displays the Search Query screen, as well as the fields visible in Search Results.

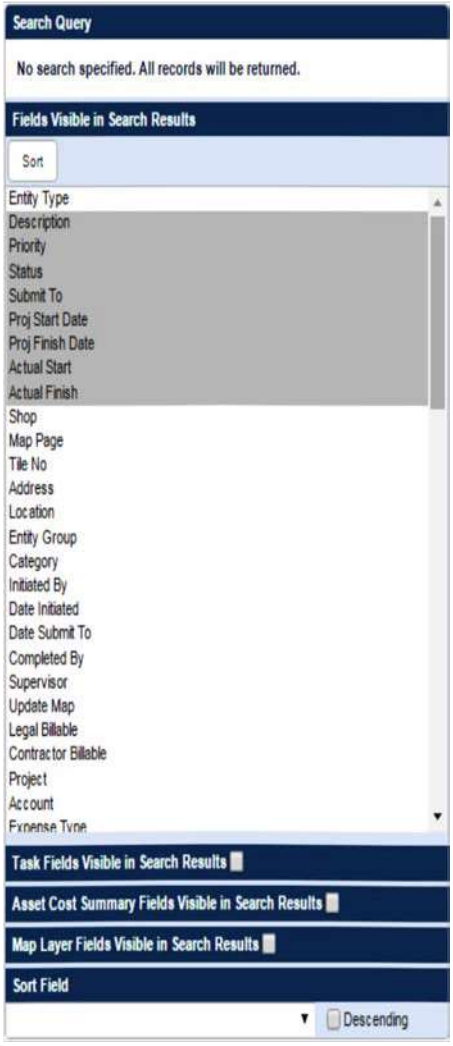


Figure 35. Cityworks® AMS Search Query screen.

4.8.3 Saved Searches

Saved Searches allow users to quickly execute those searches in the future without the need to redefine all of the criteria.

Saved searches are also used to set up Inboxes, Event Layers and Work History.

Event Layers allow a user to add events generated from search criteria to be displayed as a layer on the map. Setting up event layers is one of the more beneficial, advanced functions available in Cityworks® as it fully utilizes spatial representation. Semi-annual activities such as the Screening Inspections conducted by HAR-OCM MCSs and HAs are scheduled using event layers that alert personnel when inspections are due, and record each asset screening inspection when work is completed.

4.9 Reports in Cityworks® AMS

Predefined reports and specific queries can be produced from the Cityworks® AMS database tables and fields. Custom reports created in Crystal Reports and then uploaded to the Cityworks® Server using Report Manager are also available.

4.10 Mobile Devices

Currently, HAR-EE personnel working the storm water program are using Apple iPad Air 2 tablets. HAR-O personnel in HAR-OCM, HAR-OCG and HAR-OM along with their supervisors were recently issued and trained on using the Microsoft Surface Pro laptops or tablets. The mobile devices, which have photo taking and uploading capabilities to the Internet, allow one-time entries into Cityworks® AMS by the users that promote efficiencies in terms of time-savings and information gathering while eliminating the need for multiple entries, associated errors and unnecessary paperwork.

4.11 Quality Control

Supervisors are responsible for conducting regular QC reviews of the various work documents entered in Cityworks® AMS using the searching tools described above. When questionable entries – or lack thereof – are found, the responsible users are notified and corrective action is requested.

Additionally, the Harbors AMS Administrators hold monthly Cityworks® AMS workshops with Harbors employees to reinforce efforts to remedy issues found, hold Q&A sessions as needed, and to apprise Harbors users of new developments and upcoming events associated with the Cityworks® AMS.

This page intentionally left blank.

Volume II User Guides for Storm Sewer System O&M Activities

CHAPTER 5

HARBORS TRANSITION TO AMS TASKS WORKFLOWS

Application of the AMS to Harbors management and future decision making is dependent on the quality and accuracy of the data input to the Cityworks® AMS discussed in Chapter 4. The data input responsibility of Harbors operations and maintenance follows the same line of authority that existed with the paper routing of the pink, white, and gold copies progressing up the Harbors supervisory chain.

See Figure 20 for the HAR-O hierarchy of Sections and Units.

The hierarchy of Managers, Superintendents, and Supervisors are responsible to open their Inbox to review and manage the workload on a regular basis. Determinations that they make are similar to the paper process of transmitting work as appropriate, until it is received by those expected to execute it. In this line of authority, personnel are responsible to one supervisor who only assigns work to staff immediately below them.

The AMS tasks workflow processes match the existing chain of responsibilities with electronic Work Orders and Service Requests.

5.1 HAR-O Management Tools

Work assignments are transmitted through Service Requests, Work Orders, and Inspections that contain information for inspection and cleaning, plus proactive queries that trigger follow-up work required. Work Orders and Inspections tend to be work for predefined schedules, e.g., MCS/HA Screening Inspections, OCG storm drain cleaning, and refuse and sweeping. A Service Request tends to be reactive to a situation or location on Harbors property, e.g. suspected illicit discharge.

The Harbors Cityworks® AMS presents a tool for *real-time* operational management, where input data is processed within seconds and a reporting engine makes data available immediately as feedback. The Managers, Superintendents, and Supervisors may look at the data for program improvement.

The 2016 *beta* testing of Harbors Cityworks® AMS is complete, and the remaining minor adjustments require user participation. The evaluation of user feedback will help the AMS Administrator to improve the GIS database with new configurations that expedite analysis and deliver instructive support to Supervisors using the AMS for management of workflow processes.

5.2 Supervisor Responsible for Data Quality Control

The validity of the information and data collected and stored is an important part of effectively maintaining and managing Harbors storm sewer system assets and submitting accurate and reliable reports to EPA and HDOH.

The Service Requests and Work Orders replace the paper tracking of work assignments. The Cityworks® Inbox provides performance dashboards that set targets and informs management of reality versus expectations.

Learning the basic skills to use the database helps Harbors supervisory hierarchy and their Subunits and Crews manage the task workflow processes. Data input provides a quantifiable means to measure progress of performance by Crews, and the costs and time required to complete the work.

Both the resulting information and intuitive map view allow Managers, Superintendents, and Supervisors to easily identify, understand, and mitigate performance related issues. Reports and performance metrics can be directly incorporated into the Inbox allowing information to be readily available to decision makers throughout Harbors.

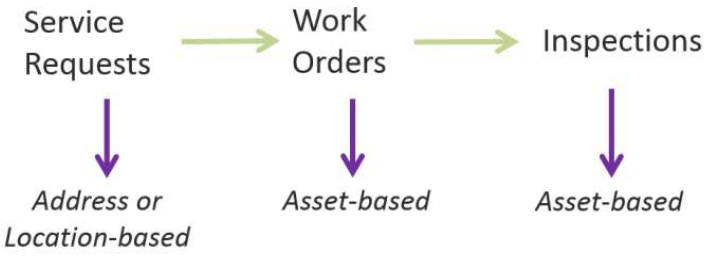
Data input is the responsibility of the Harbors supervisory line of authority that assigns the work and performs oversight.

5.2.1 Designate Data Input Backup Staff

Supervisor designees will be responsible for identification of backup staff for data input for continuous data recording and recordkeeping in the event of vacations and vacancies. Data input validates Harbors fulfillment of the CD requirements, as well as collects information to provide an evaluation tool for prudent decision making. The Supervisors will identify their back-up staff.

5.3 Service Requests (Area Survey)

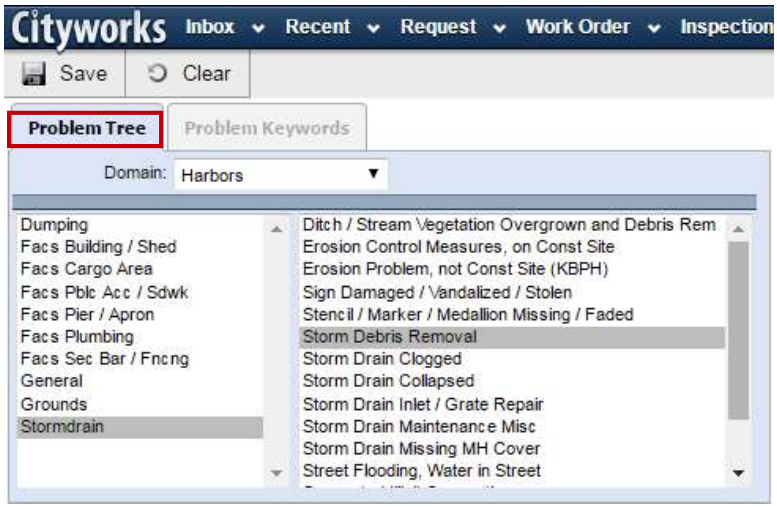
There is a basic progressive relationship between Service Request (Area Survey), Work Orders, and Inspections. The distinction is made that Service Requests are address or location-based; whereas, Work Orders and Inspections are asset-based.



Service Requests can be initiated by Harbors personnel based on inquiries reported by Harbors personnel or the general public whenever a potential problem is identified.

Each problem code (or Service Request template) has unique information and workflow depending on the problem type and the Harbors Section responsible for investigating or fulfilling the request.

The Service Request hierarchy, or Problem Tree, is a folder hierarchy where defined Service Request templates can be organized. The hierarchy allows a user to easily locate a problem type based on a category or the responsible department.



Service Requests may require follow up Work Orders, inspections, and investigations of complaints for suspected illicit discharge/spills, leaking pipes, illegal dumping, clogged drains, environmental concerns, damages, and acts of vandalism.

Service Requests are closed once a Work Order is generated for the next step.

5.4 Cityworks® AMS Streamline Tasks Workflow

The Cityworks® AMS integrates work performed by the HAR-O and HAR-E Branches. The database streamlines the paper system with a virtually paperless system to monitor, manage, and implement corrective actions for the operations, maintenance, repairs, replacement, and management of the Harbors Division storm sewer system.

5.5 Storm Drain Tasks Workflow Processes

MCS/HA inspections result in requests for cleaning and maintenance work performed by HAR-OCG (Work Orders created by HAR-OCG Supervisors). Service Requests for cleaning and maintenance can also be submitted to HAR-OCG Supervisors by Harbors personnel.

Figure 34 shows MCS/HA Inspection Tasks Workflow Processes.

Figure 35 shows HAR-OCG Cleaning Tasks Workflow Processes.

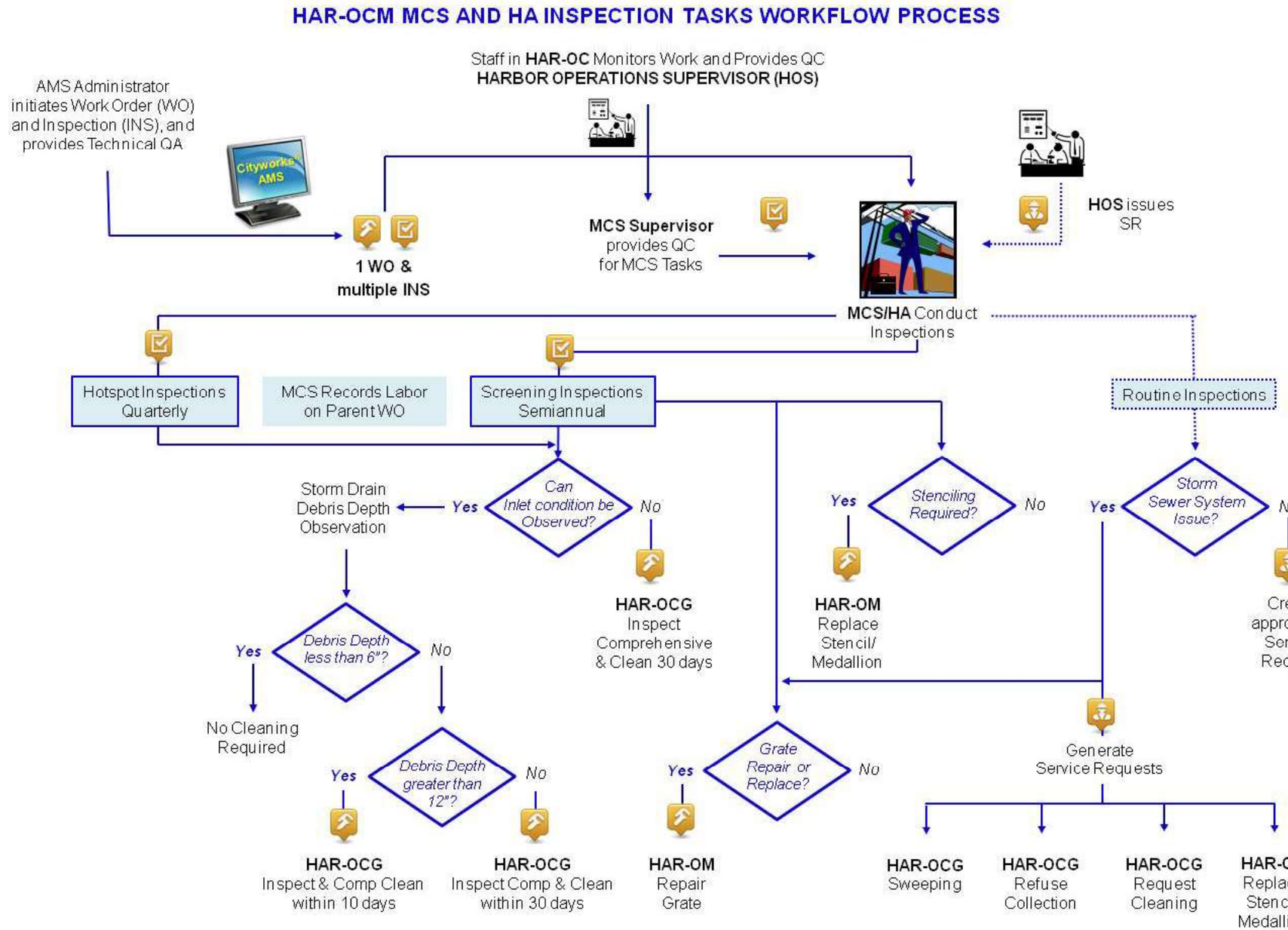


Figure 36. HAR-OCM MCS and HA inspection tasks workflow.

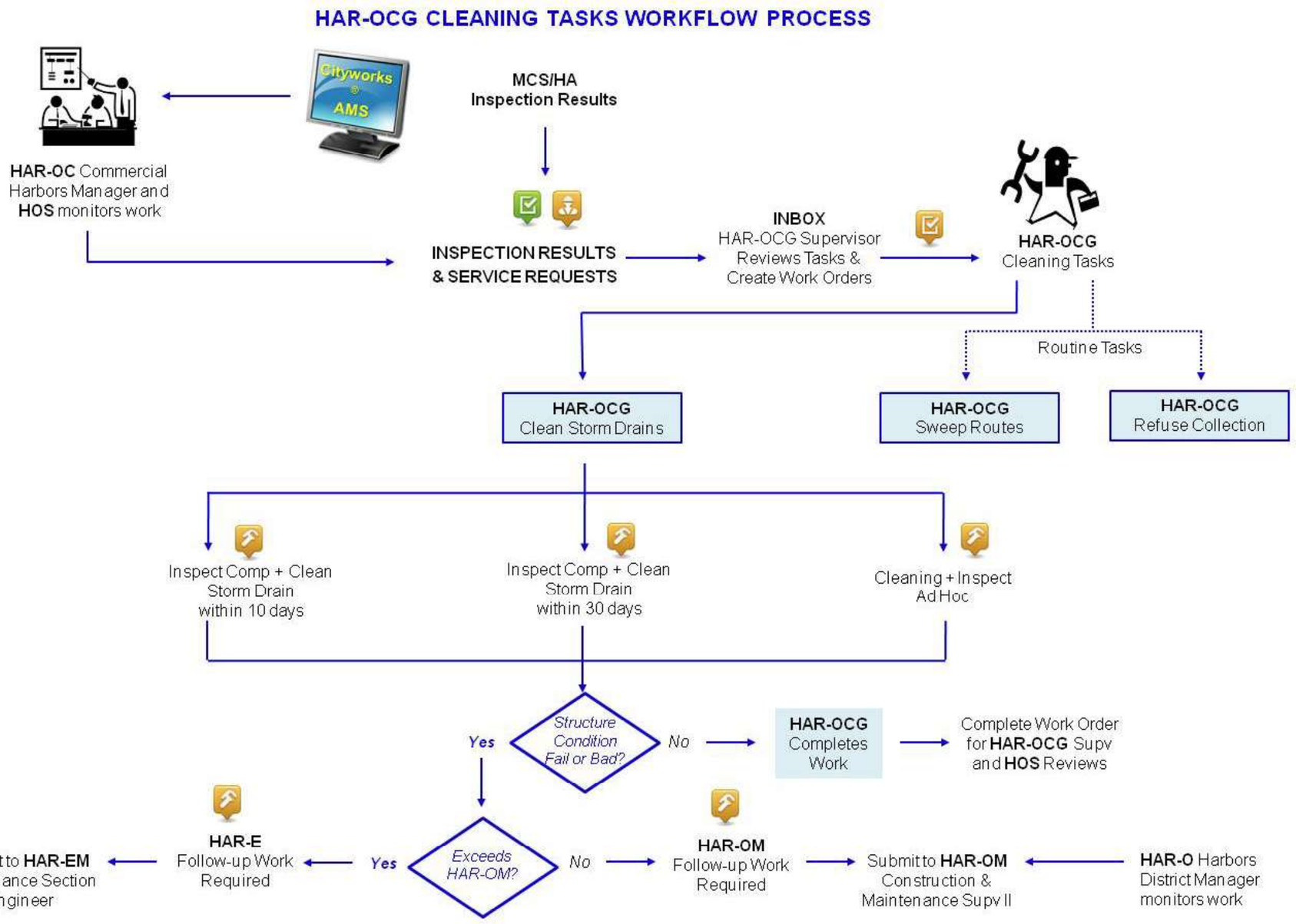


Figure 37. HAR-OCG cleaning tasks workflow.

CHAPTER 6
HARBORS STORM SEWER SYSTEM INSPECTIONS

The Pollution Prevention and Good Housekeeping Program in the *SWMP* identifies the following BMP activities:

- Storm Sewer System Operation and Maintenance Program
- Maintenance and Housekeeping Practices that includes Sweeping Common Areas and Select Tenant Facilities, and Waste Collection
- Tenant Education and Employee Training

This chapter provides user guidance for scheduling and tracking the inspection activities of the Storm Sewer System Operation and Maintenance Program using Cityworks® AMS.

Harbors deployed Cityworks® AMS in December 2015 in compliance with the CD. Computerization streamlines the previous paper routing process, and guides the AMS workflow processes for scheduling and performance of O&M procedures. Cityworks® AMS login is https://ams-har.hidot.hawaii.gov/Cityworks/Login.aspx. Enter username and password, or obtain login information from the Harbors AMS Administrator. Refer to the *Cityworks® User Manual* for details.

There are three Harbors personnel trained as Cityworks® AMS Administrators; additionally, HAR-EE staff are trained as trainers. The AMS Administrators are responsible to keep the asset inventory up to date, and manage the processes for GIS updates and configuration updates (*see* Chapter 4.2.3.8 and 4.2.3.9). The AMS Administrators will determine how often the inventory needs to be reconciled as new storm sewer system assets are added to the system through the GIS update process.

Manpower and resources are mobilized by *cyclical or reactive triggers* that initiate Harbors property storm drain inspections. This chapter focuses on the inspections of storm drain inlets, open channels, trench drains, and identified hotspots of the Harbors storm sewer system network.

There are *cyclical inspections* and preventive maintenance activities routinely scheduled. There are also *reactive inspections* such as follow-up work based on the observations and findings of cyclical inspections; response to illicit discharge and complaint reports by employees and the public; and as needed based on Harbors routine inspections of tenant activities in assigned piers for damage, pier use by cargo operators, and tenant activities that have potential sources of illicit discharges.

6.1 Cityworks® AMS Inbox

The Inbox is the first screen Harbors personnel see after login. Harbors personnel may personalize their Inbox with a dashboard configured to display information features relevant to their responsibilities. The Inbox dashboard may display work activities in lists, reports, charts and graphs, and GIS maps that pinpoint location of assets.

Inbox customization facilitates the workflow processes for Harbors operations and maintenance procedures, and provides a user friendly dashboard to help manage the daily workload.

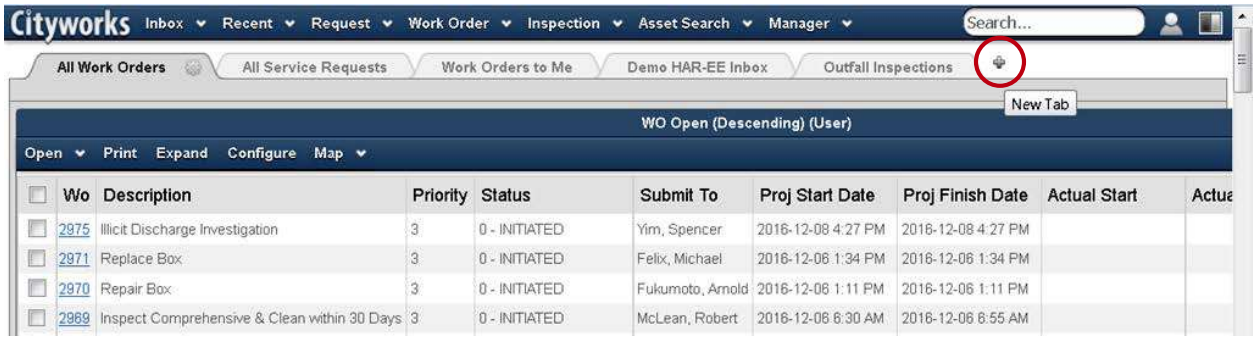
6.1.1 Main Toolbar

The Cityworks® ribbon or blue bar is always visible at the top of each screen and provides primary navigating buttons with dropdown menus for user functions.



6.1.2 Add a New Tab to Inbox

To add a new tab, click the "**+**" icon located below the main toolbar.

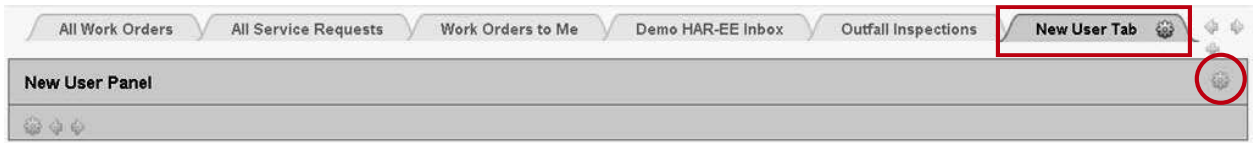


Click the User Tab for additional setup options.

6.1.3 Gear Button to Customize Setting Options

The gear icon or button allows users to edit the setting options. Users may customize or configure the Index tabs, panels, and widget selections. Use the gear button to display options to update, delete, and close functions for selections.

The screen will display the New User Tab. Click on the gear button to rename tab.

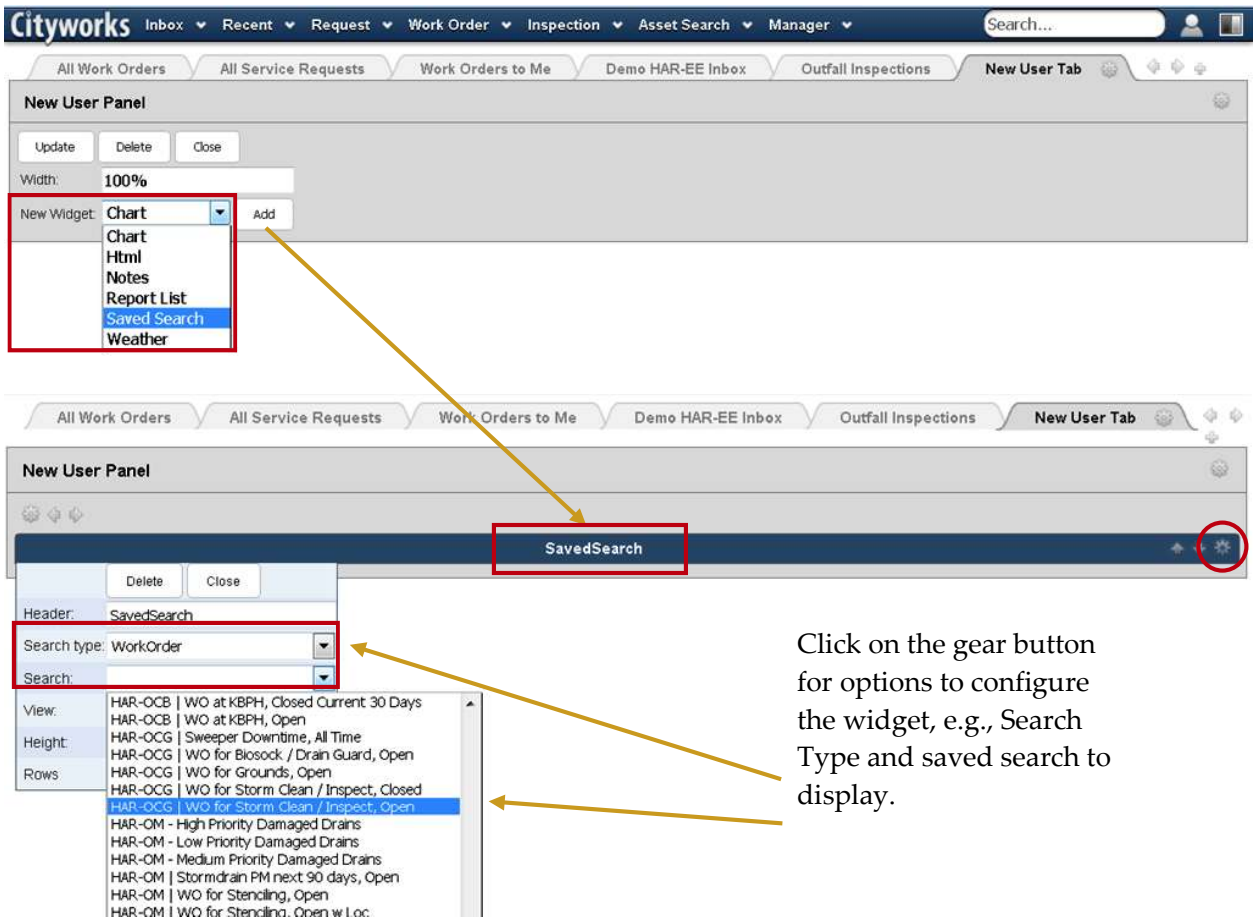


Enter new tab name in text box. Next, click on the user panel gear button to customize the user Panel name.

Then, click on the new panel gear button to add a new widget to the Inbox.



The screen displays options to select a widget that enables a user to perform a function or access a service, e.g., SavedSearch panel. Select a widget and click the Add button.



6.1.4 Four Basic Inbox Tabs

The four basic tabs for all Harbors personnel are All Work Orders, All Service Requests, Work Orders to Me, and Service Requests to Me. However, Supervisors may choose to display additional tabs on their staff's Inbox dashboard.

6.2 Work Orders

Work Orders can be generated in response to Service Requests or the findings of inspections conducted to identify structural defects, trash and debris accumulation, and other constraints that limit the flow of storm water. Initiated or requested Work Orders are screened for validity and prioritization by Supervisors.

6.2.1 Parent Work Orders

The AMS Administrator generates the parent Work Order that schedules cyclical inspections: semiannual Screening Inspections of 100% of the accessible storm drain assets and quarterly Hotspot Inspections. The Screening Inspections and Hotspot Inspections show up in the Inbox of the MCS / HA Inspectors and on their map via Event Layers, with a copy to the Supervisor's Inbox. The MCS / HA then conduct inspections and record observations and findings.

6.2.1.1 Initial Inspection and Cleaning of Storm Drains

The initial system-wide inspection and cleaning of all Harbors storm drain inlets, drainage features, and outfalls was completed in July 2015 by a contractor. The contractor collected data on the structural condition of the drainage features, and removed debris from drain inlets to identify repair work needed.

6.2.1.2 Screening Inspections Schedule 2016 Adjustment

Screening Inspections were performed on a quarterly basis following the initial cleaning. However, review of data collected over three quarterly inspections showed the inlets and manholes did not accumulate debris frequently (no inlets contained over 6 inches of debris in consecutive inspections); therefore for the fourth quarter, Harbors decided to reduce the Screening Inspections of storm inlets, open lines, and trench drains to the current semiannual schedule. Hotspot Inspections remained on a quarterly schedule and Inspect and Comprehensive Cleaning of BMPs inspections remained on an annual schedule.

6.3 Responsibility for Data Accuracy

The validity of the information and data collected and stored is an important part of effectively maintaining and managing Harbors storm sewer system assets and submitting accurate and reliable reports to EPA and HDOH.

Harbors Supervisors and Staff users who enter task performance data are responsible for data input to the AMS. Supervisors are responsible to review staff performance as well as staff data input to the AMS to ensure that accurate and valid data and information are entered for quality control. HAR-EE staff also assists with training, data review, and data quality control.

6.4 Standard for Screening Inspections

Harbors established the standard for Screening Inspections to determine when storm sewer drains require cleaning. The primary test is by visual observation. However, if the MCS / HA Inspector observes sediment and/or debris accumulated at the bottom of the drain and is unable to determine the debris thickness, the stick test is used.

During regular inspections, the results of the observation and measurement of accumulated soil, wet organic material, and debris will determine the follow-up action required.

6.4.1 Visual Observation

Visual observation by the MCS / HA is the primary method to measure the levels of accumulated sediment, e.g., silt, gravel, soil, wet organic material, vegetation, and debris.

6.4.2 Stick Test

The stick test is utilized to measure debris levels when the MCS / HA cannot discern the debris thickness through visual observation. The measurement is made from the bottom of the drain structure to the height or depth of the material to determine if cleaning is required.

When observation is blocked, the MCS / HA will note "cannot observe" on the inspection. The inspection will be routed to the HAR-OCG Supervisor's Inbox and the HAR-OCG Supervisor will create a Comprehensive Inspection and Cleaning Work Order.

6.4.3 Observations and Measurements, and Actions Required

The observations and measurements, and follow-up actions required are as follows.

OBSERVATION	ACTION REQUIRED
0 – 6 inches	Cleaning not required
6 – 12 inches	Requires Inspect Comprehensive & Cleaning within 30 days
12 inches or more	Requires Inspect Comprehensive & Cleaning within 10 days
Cannot Observe	Requires Inspect Comprehensive & Cleaning within 30 days
Stencil Required	Requires Replace Stencil Work Order
Grate Condition	Requires Repair Grate Work Order

6.5 Storm Inlet and Open Line Inspection Process

Storm drain inlet and open line (trench drain) inspections are conducted in two tiers, and may trigger follow-up work based on the inspection observations and findings.

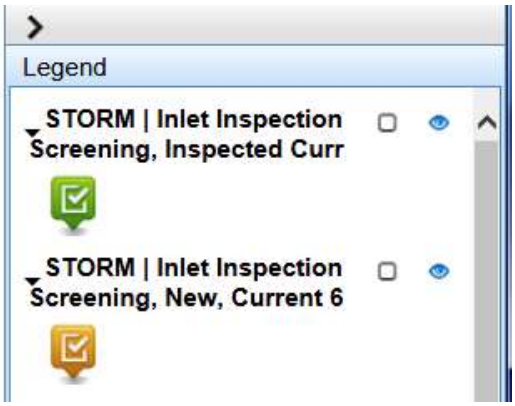
6.5.1 Tier One – Screening Inspections

HAR-OC is staffed with MCSs and HAs who are assigned to conduct a Screening Inspection of every accessible Harbors inlet and open line using the 'Inspect Screening' Work Order for all assets, and the individual 'Storm Inlet Insp Screening' inspections for each asset. These inspections are initiated as a parent Work Order on the 1st day of every semiannual period by the AMS Administrator.

6.5.1.1 Map Event Layers

The MCSs and HAs utilize Event Layers, which are saved searches displayed on the Map to guide the Inspection tasks workflow. This workflow requires that each MCS and HA has the Event Layers configured and available to them in Cityworks® AMS.

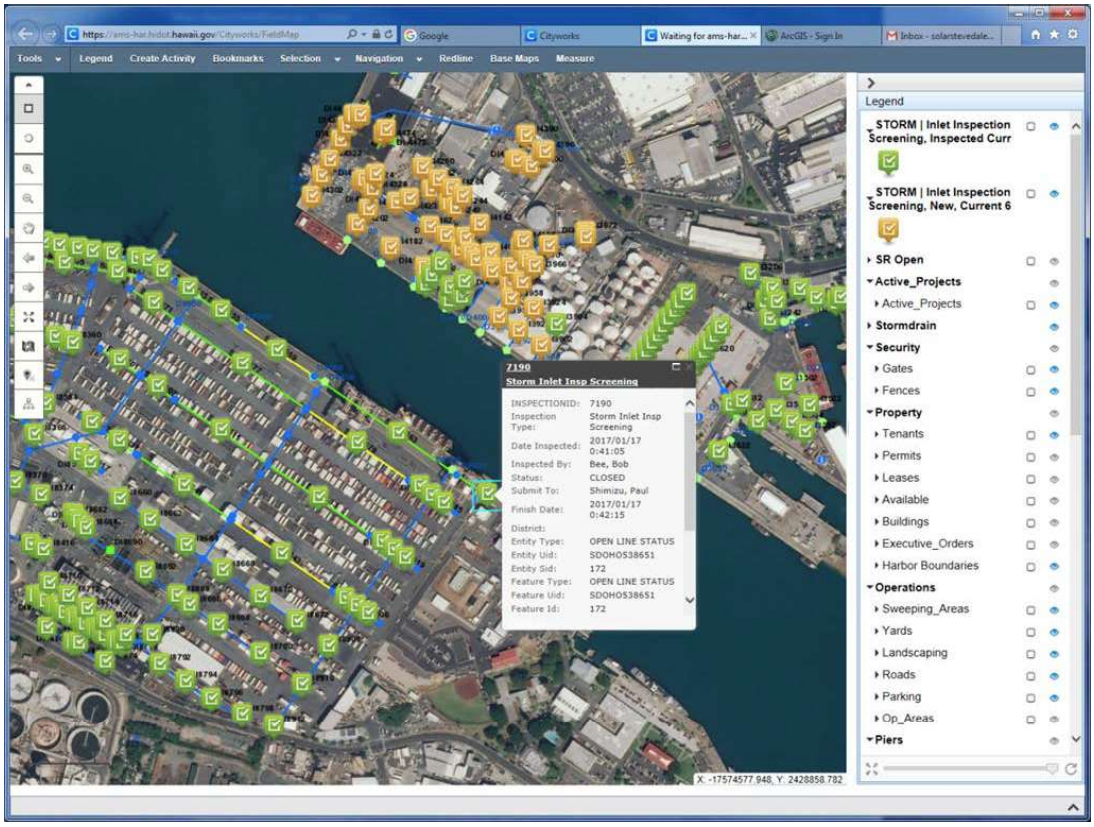
Please request assistance from the AMS Administrator if the Event Layers and map are not setup for Storm Inlet Inspection Screening, as shown in the Legend screen.



6.5.1.2 The Map

The Map is populated with selected event layer symbols—grey, yellow and/or green inspection icons. Each grey or yellow symbol represents an inspection waiting to be completed.

The MCS or HA will open the Inspection screen for a specific asset by clicking the mouse button on the inspection icons on the map, as shown on the screen below.



6.5.1.3 Complete Inspection and Record Observations

The MCS or HA conducts the field investigation of the storm drain asset, and records their observations on the Inspection screen with complete responses for each field.

Follow-up Work Required

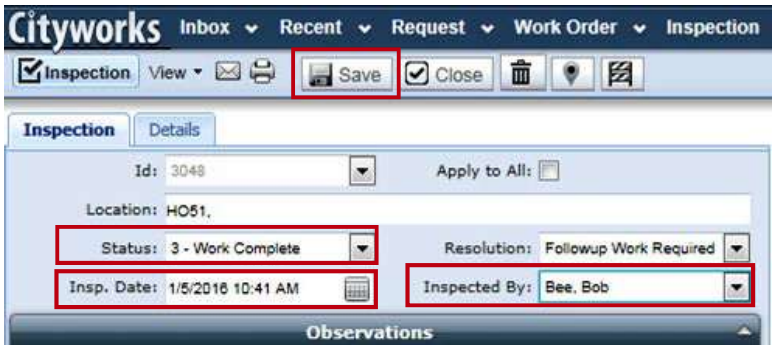
When follow-up work is required for 'Stenciling required' or 'Grate condition' needs repair or 'Debris depth' is over 6 inches, set the Resolution field to the 'Followup Work Required' option.



Set Status Field to 3 - Work Complete and Save Data

On the Inspection screen, set the option in the 'Status' field option to '3 – Work Complete', and fill in the 'Inspection Date' and 'Inspected By' fields.

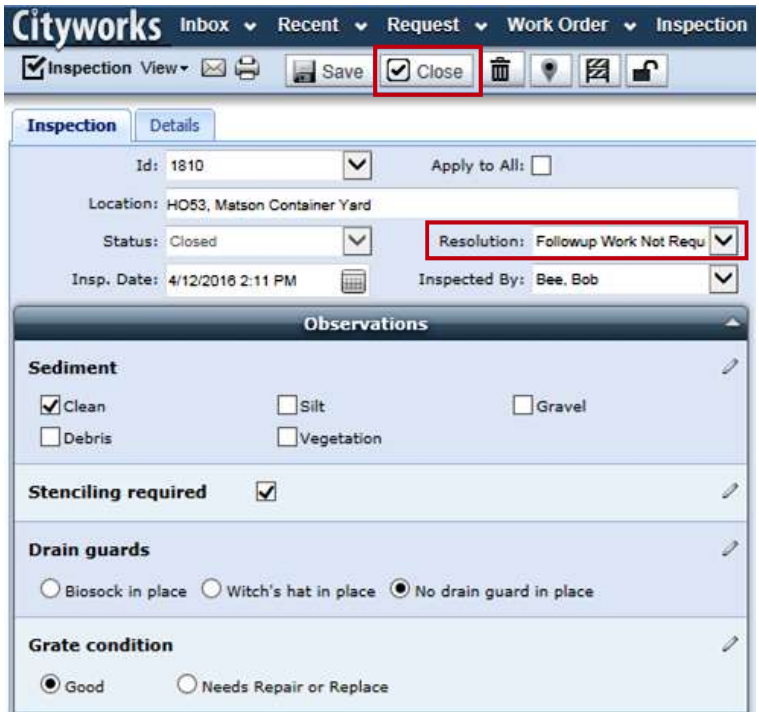
To save the Inspection screen data, click the Save button.



Supervisor Review of Inspections

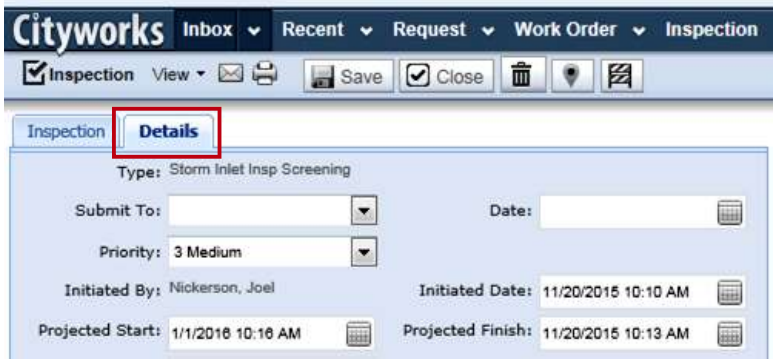
For inspections that the MCS or HA want reviewed by the Harbor Operations Supervisor, leave the inspection open and proceed to the next inspection.

For routine inspections when there is no need to alert the Harbors Operations Supervisor of items to be aware of, the MCS or HA may close the inspection. Click the Close button.

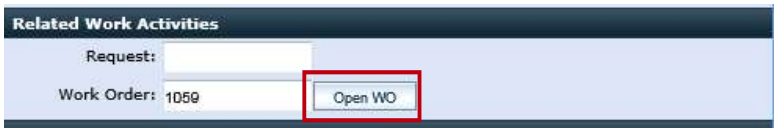


6.5.1.4 Tracking Labor Expenses

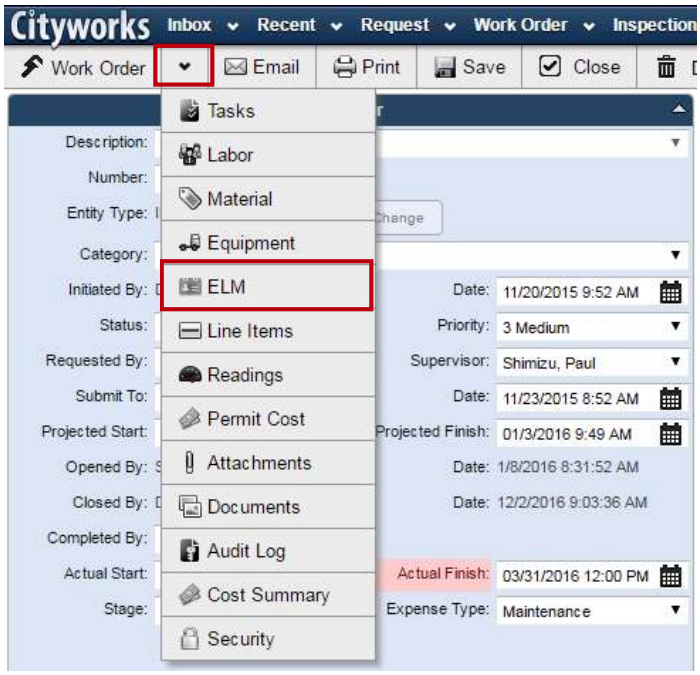
To keep track of the labor expended on the inspections performed, open the Details tab, and go to the Related Work Activities panel.



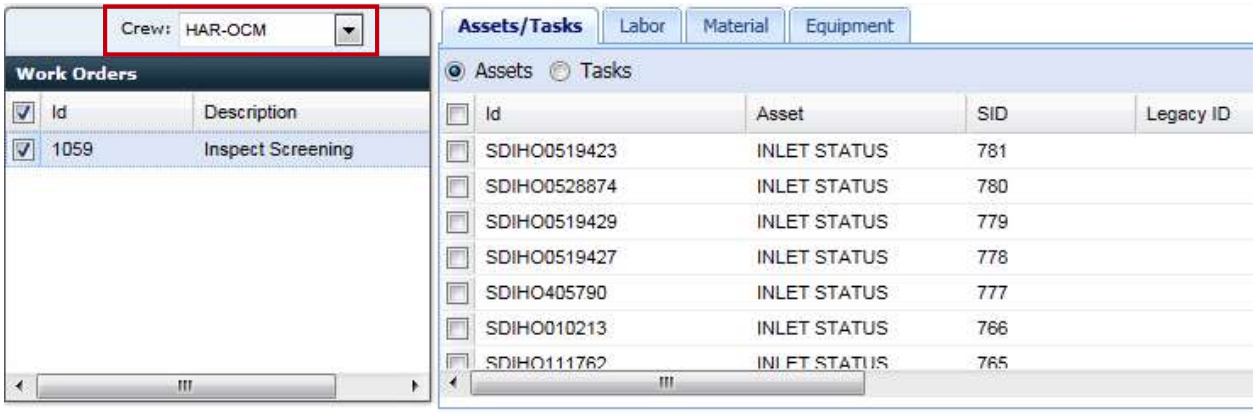
In the Related Work Activities panel, navigate to the parent Work Order to record all labor using the ELM screen. Click the Open WO button.



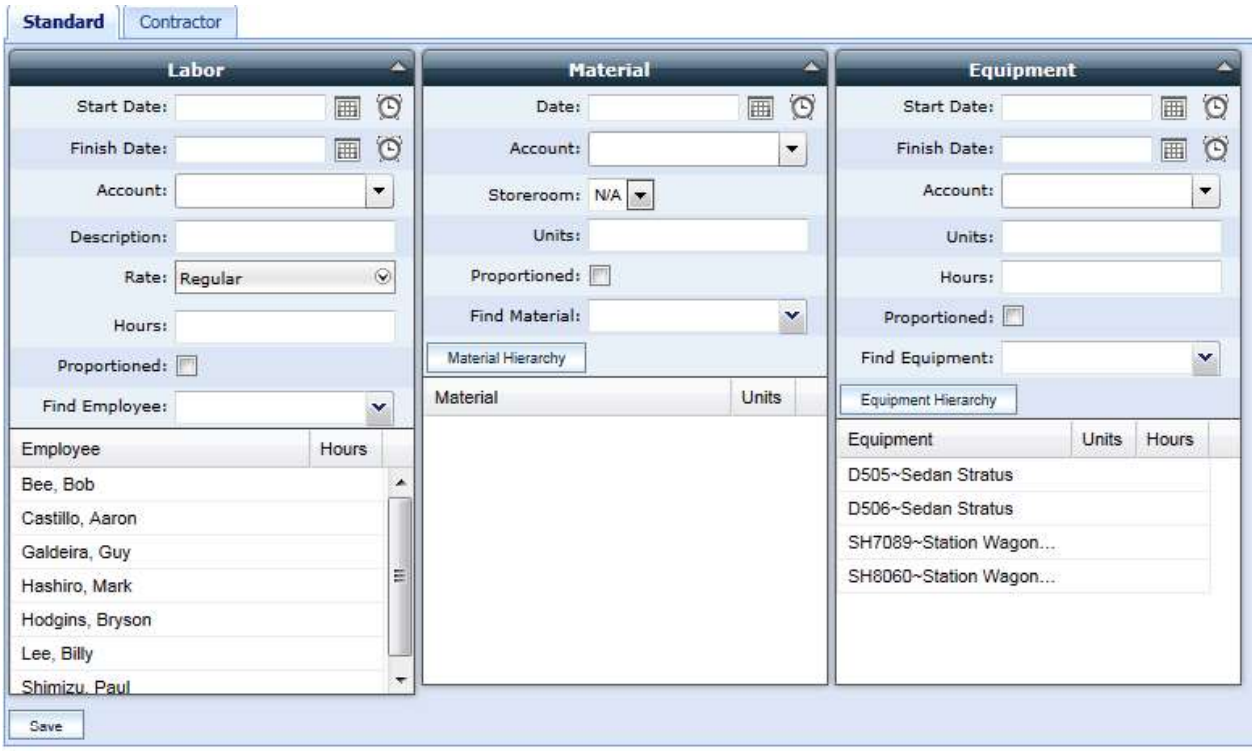
In the parent Work Order screen, click the View button and select ELM.



Select HAR-OCM crew from the menu.



Select the appropriate name in the Employee scrolling menu, and record the labor hours expended on this inspection (or all the inspections performed). Save data by clicking the Save button.

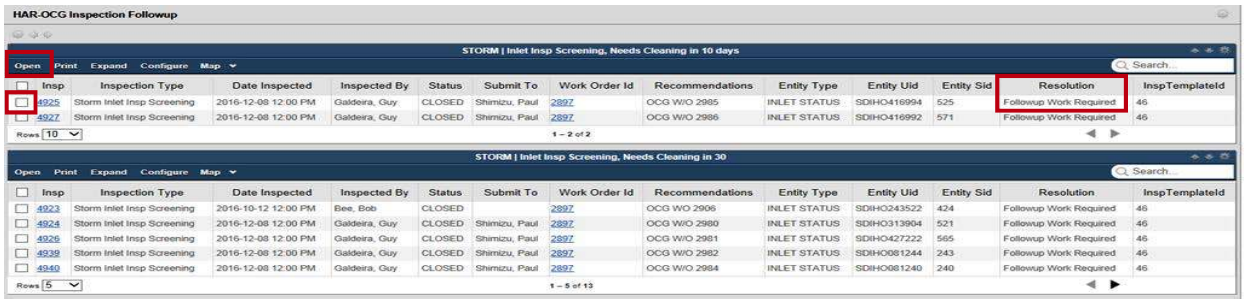


6.5.2 Tier Two – Comprehensive Inspections

Comprehensive inspections are *reactive inspections* performed as needed, in response to follow-up work required based on the MCS/HA observations and findings during storm drain asset inspections. When the MCS/HA indicate '6 to 12 inches' or 'cannot observe' in the 'Debris depth' field of the inspection screen, an 'Inspect Comprehensive & Cleaning within 30 Days' Work Order is required. When the MCS/HA indicate '>12 inches' in the 'Debris depth' field of the inspection screen, an 'Inspect Comprehensive & Cleaning within 10 Days' Work Order is required. The inspections appear in the HAR-OCG Supervisors' Inbox and the HAR-OCG Supervisors create the Work Orders. HAR-OCG Supervisors then schedule staff to remove the grate or lid, clean/inspect the inlet, and track the cleaning/inspection results on the 'Storm Inlet Insp Comprehensive' screen.

6.5.3 HAR-OCG Supervisor Management Tools

To facilitate management of task workflows, the HAR-OCG Supervisors may review a Saved Search in their Inbox which generates a list of Screening Inspections where follow-up work is required. The HAR-OCG Supervisors' Inbox displays the saved search for assets with 'Followup Work Required'. See the example below for HAR-OCG. To create a follow-up work, the HAR-OCG Supervisors will check the box to select the failed inspection, and click Open.



On the Inspection screen, the HAR-OCG Supervisors will open the Details tab and go to the Entity panel. Click the 'Highlight' button to select the asset (inlet or trench drain). To create a new Work Order for the asset and assign work, click the Work Order button in the main toolbar.

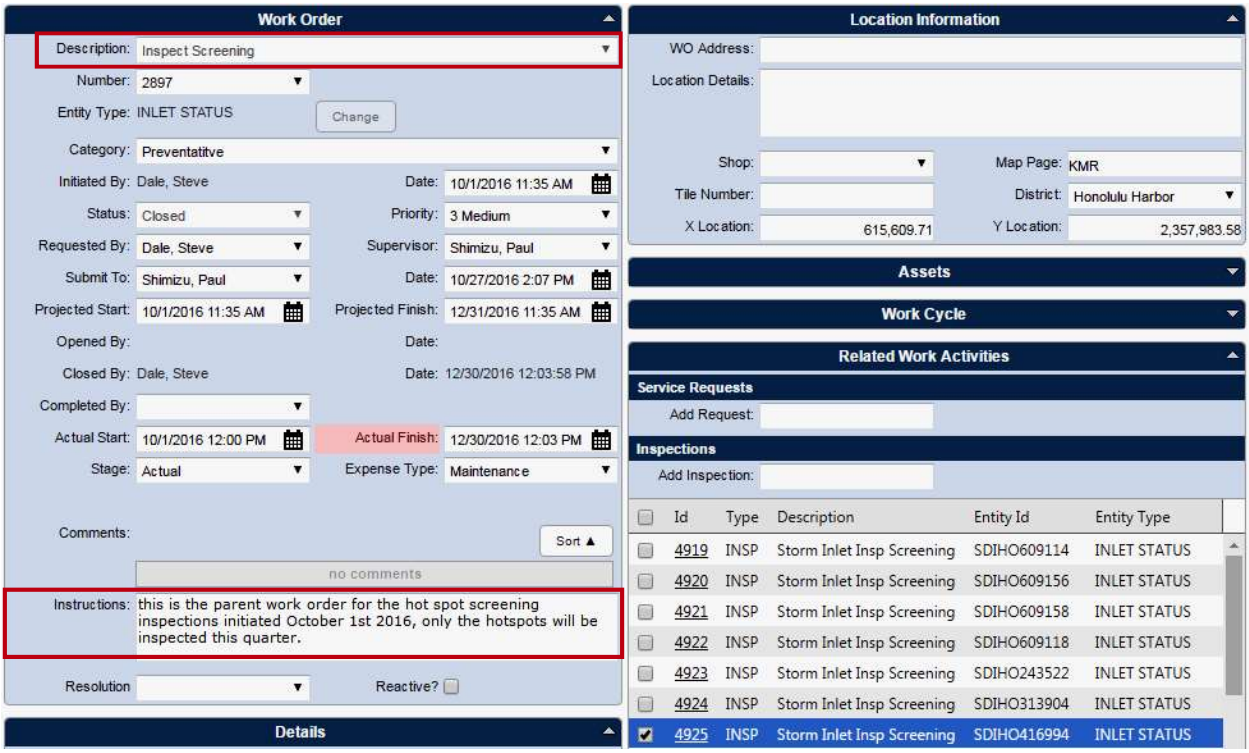
6.6 Hotspot Inspections

A "hotspot" is defined as a storm drain inlet or open line with two (2) consecutive comprehensive inspection and cleaning measurements of sediment and debris over 6 inches (recorded on the 'Inspect Comprehensive & Clean' Inspection).

Currently, no hotspots are identified by this definition.

In the 4th Quarter of 2016, HAR-EE and HAR-EP elected to broaden the hotspot definition to inlets that required two consecutive Screening Inspections for debris over 6 inches, and any additional inlets which the MCS / HA and HAR-OCG Supervisors identified as areas of concern. Under this expanded criterion, 15 discretionary hotspots for quarterly inspection were identified.

Quarterly hotspot inspections are scheduled by an AMS Administrator who initiates the parent Work Order for 'Inspect Screening'. The 'Submit To' field routes the Work Order to the HAR-OCM Marine Cargo Specialist Supervisor who is responsible to assign the Hotspot Inspection tasks to the MCS / HA staff.



6.6.1 Removal of Hotspot Designation

Removal of the hotspot designation occurs after two (2) consecutive comprehensive inspection measurements show less than 6 inches of accumulated trash and debris removed. The inspection frequency will change from quarterly back to semiannual inspections.

6.7 Stencils Inspections

Harbors tracks the locations of existing and newly installed signage and stencils which are preventive control measures to mitigate pollution. Stencils are inspected during cyclical and screening inspections.

Additional locations for signage installation are considered by HAR-EE for areas identified with frequent public dumping, or high traffic tenant areas or areas with a history of illicit discharges.

Service Requests for signage installation, repair, and replacement are routed to the HAR-OM Wharf Maintenance Supervisor who is responsible to assign the tasks to subordinate staff.

This page intentionally left blank.

CHAPTER 7
STORM SEWER SYSTEM CLEANING AND MAINTENANCE

The Pollution Prevention and Good Housekeeping Program tasks for the SSS OMP involve storm drain cleaning, pier sweeping routes, refuse and debris removal, and cleaning of the Kalaeloa Barbers Point Harbor rail tracks. The Sanitation & Grounds Unit (HAR-OCG) utilize heavy equipment and personnel resources to open the drain inlets to conduct Comprehensive Inspections, and to perform the actual cleaning of accumulated debris, trash, and sediment.

Work Orders for the second tier Comprehensive Inspection and Cleaning are created by the HAR-OCG Supervisors for follow-up work required when the drain inlet cannot be observed or inspected by the MCS or HA, or when the debris depth is recorded over 6 inches.

The HAR-OCG Supervisors determine the priority, and schedule or assign the work to subordinate crews.

The HAR-OCG Supervisors manage the Grounds Crew, the Refuse Crew, and the Custodial Crew. The Refuse / Grounds crews provide the manpower and operate equipment to conduct street sweeping, refuse/debris removal, and drain cleaning

The HAR-OCB Unit HA Supervisor is responsible for scheduling work at Kalaeloa Barbers Point Harbor, and support is provided by HAR-OCG.

7.1 Service Requests for Cleaning

Cleaning tasks may be submitted as Service Requests to the HAR-OCG Supervisor who is responsible to screen the request, prioritize, and schedule or assign the work to the subordinate staff.

7.2 Storm Drain Cleaning Work Orders

Inspections resulting in the requirement for cleaning are routed to the HAR-OCG Supervisors Inboxes for review. The HAR-OCG Supervisors create Work Orders and assign subordinate staff to inspect the inlet with the grate or lid off, clean the inlet, and track the cleaning and inspection results on the 'Storm Inlet Insp Comprehensive' screen (*see* Chapter 6.5.3). The cleaning schedule of storm drains is determined by the results of the tier one Screening Inspections, as they are *reactive* work.

7.2.1 'Inspect & Clean Ad Hoc'

Harbors personnel may submit Service Requests to HAR-OCG Supervisors who will determine based on the Service Request, whether it is appropriate to create a follow up Inspect & Clean Ad Hoc Work Order and comprehensive inspection.

7.2.2 'Inspect Comprehensive & Clean within 30 Days'

As the MCS / HA cycles through the Screening Inspections schedule, follow-up cleaning is required within 30 days if the storm drain inlets have 6 – 12 inches of accumulated sediment and debris.

7.2.3 'Inspect Comprehensive & Clean within 10 Days'

As the MCS / HA cycles through the Screening Inspections schedule, follow-up cleaning is required within 10 days if the storm drain inlets have over 12 inches of accumulated sediment and debris.

7.2.4 'Inspect & Comprehensive Clean BMP'

Harbors personnel presently proceeds straight to comprehensive cleanings on storm drain inlet and open line permanent BMPs on an annual basis. The storm drain inlets and open lines they inhabit are screened as normal.

7.3 Supervisors Responsible for Follow-up Work

The HOS or HAR-OCG Supervisors are responsible to create follow-up Work Orders based on the results of inspections. The procedure is the same as Section 6.5.1.3, i.e., highlight the asset from the Inspection form Details panel, and create a new Work Order, as appropriate.

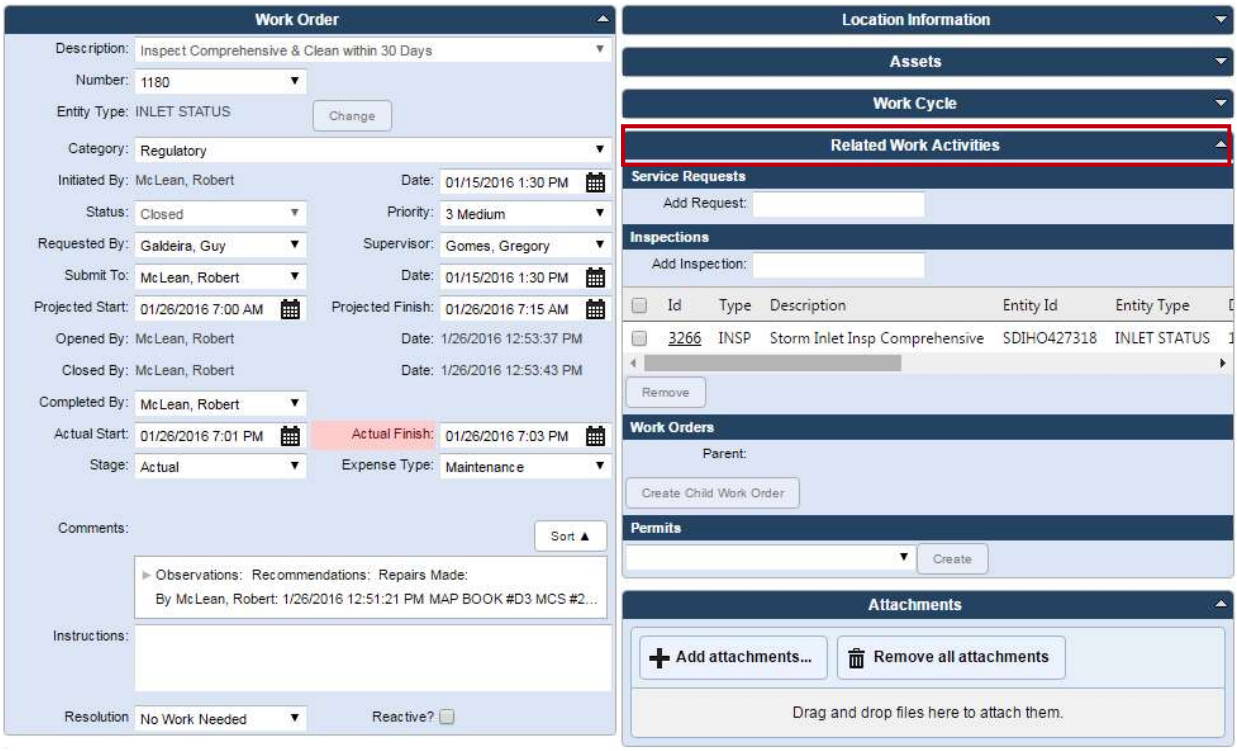
HAR-EE, HAR-OCG Supervisors, and HAR-OM Maintenance Supervisors are responsible for saved searches for Screening Inspections and Comprehensive Inspections which require follow-up work, as follows:

SECTION / UNIT	INSPECTION TYPE	INSPECTION OBSERVATION
OCG / OCB Units	Comprehensive	Cleaning required
Environmental Section	Comprehensive	Illicit connection
Maintenance Section	Comprehensive	Structure condition
Maintenance Section	Screening	Grate condition

SECTION / UNIT	INSPECTION TYPE	INSPECTION OBSERVATION
Maintenance Section	Screening	Stenciling required

The HOS and HAR-OCG Supervisors should check the Related Work Activities panel for a summary of other work before creating a new Work Order screen, to see if that type of Work Order has already been created on that asset.

The Related Work Activities is located as shown below.



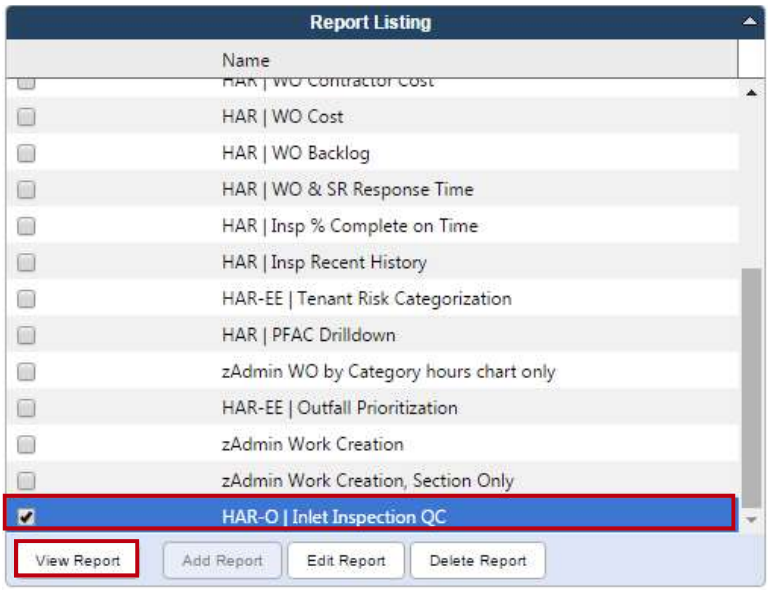
7.3.1 Quality Control Report for Inspection Follow-up Work

For quality control of the inspection follow-up work process, the Cityworks® AMS can generate a report that summarizes inspections which require follow-up work and the follow-up Work Orders created from those inspections.

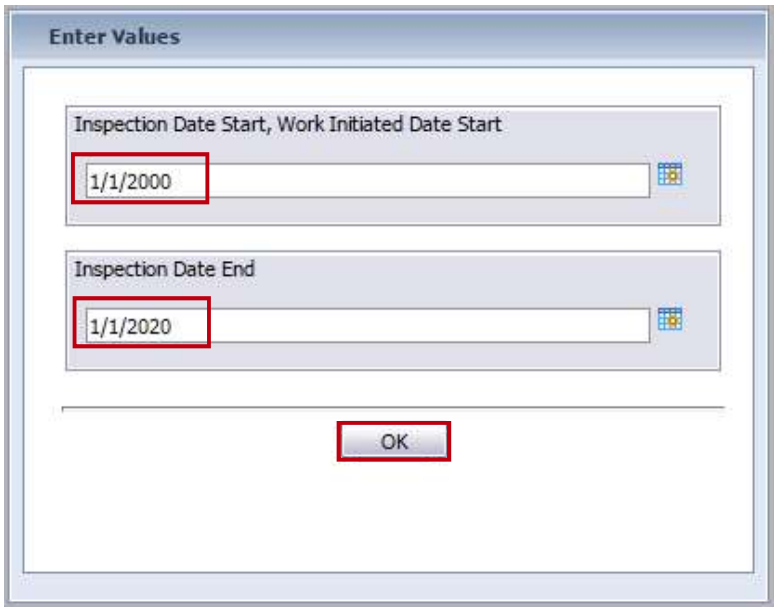
To run the quality control report on inspection follow-up work, click on the Manager button in the main toolbar, and select Reports.



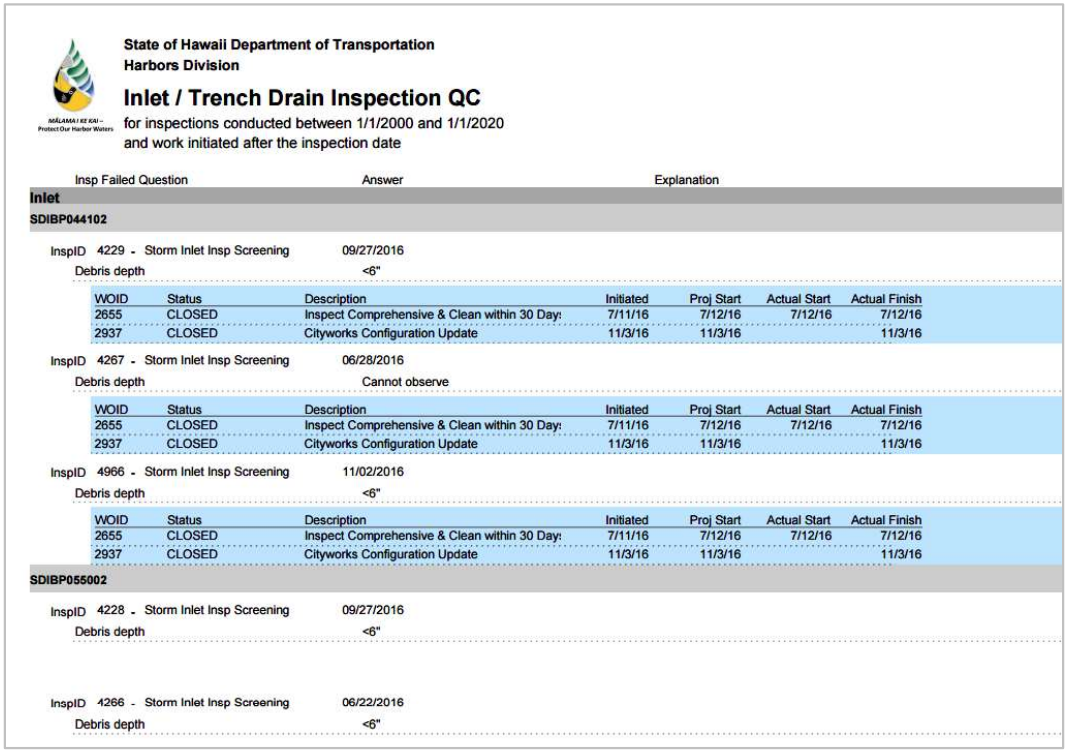
Select 'HAR-O | Inlet Inspection QC' report for a list of follow-up work required. Select from the options at the bottom such as 'View Report'.



Set the Inspection Start and End dates in the window that appears and press the OK button.



The selected 'HAR-O | Inlet Inspection QC' report will appear as shown below. Each asset is listed, along with inspections on that asset which have observations that require follow-up work. If follow-up work has already been created on the asset, those Work Orders are shown in blue.



State of Hawaii Department of Transportation
Harbors Division

Inlet / Trench Drain Inspection QC

for inspections conducted between 1/1/2000 and 1/1/2020
and work initiated after the inspection date

Insp Failed Question	Answer	Explanation
Inlet		
SDIBP044102		
InspID 4229 - Storm Inlet Insp Screening	09/27/2016	
Debris depth	<6"	

WOID	Status	Description	Initiated	Proj Start	Actual Start	Actual Finish
2655	CLOSED	Inspect Comprehensive & Clean within 30 Days	7/11/16	7/12/16	7/12/16	7/12/16
2937	CLOSED	Cityworks Configuration Update	11/3/16	11/3/16		11/3/16

InspID 4267 - Storm Inlet Insp Screening	06/28/2016	
Debris depth	Cannot observe	

WOID	Status	Description	Initiated	Proj Start	Actual Start	Actual Finish
2655	CLOSED	Inspect Comprehensive & Clean within 30 Days	7/11/16	7/12/16	7/12/16	7/12/16
2937	CLOSED	Cityworks Configuration Update	11/3/16	11/3/16		11/3/16

InspID 4966 - Storm Inlet Insp Screening	11/02/2016	
Debris depth	<6"	

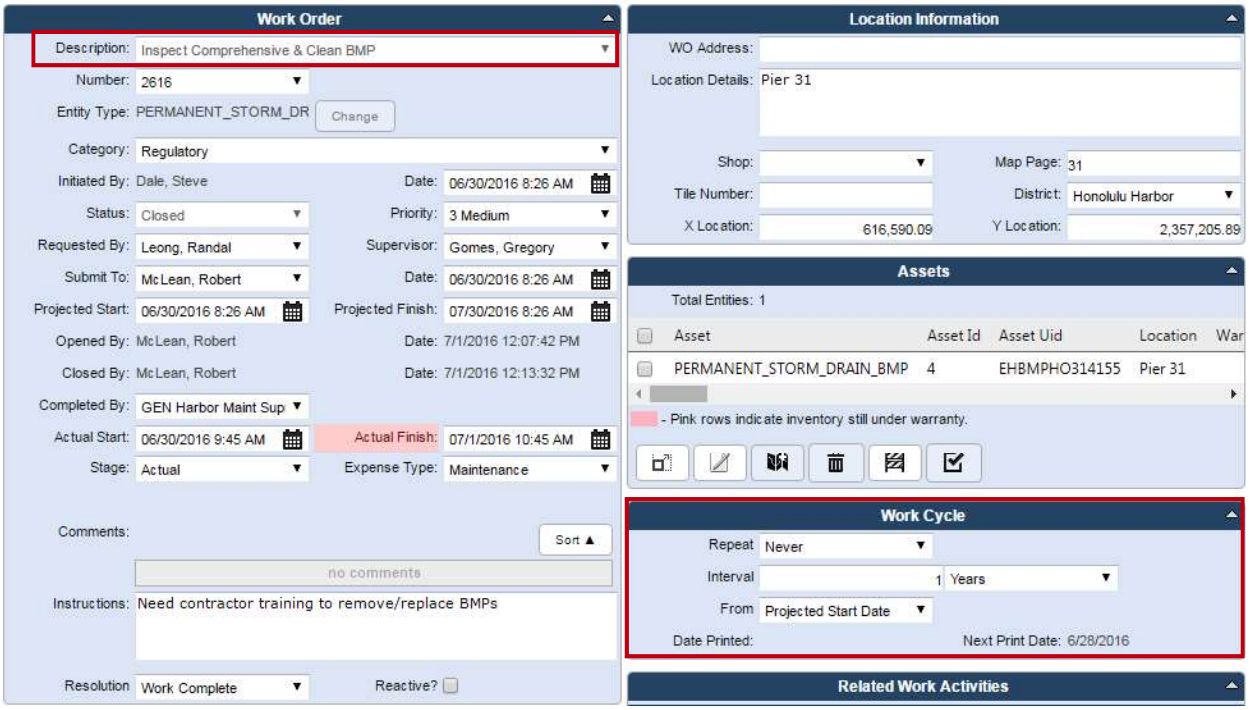
WOID	Status	Description	Initiated	Proj Start	Actual Start	Actual Finish
2655	CLOSED	Inspect Comprehensive & Clean within 30 Days	7/11/16	7/12/16	7/12/16	7/12/16
2937	CLOSED	Cityworks Configuration Update	11/3/16	11/3/16		11/3/16

SDIBP055002		
InspID 4228 - Storm Inlet Insp Screening	09/27/2016	
Debris depth	<6"	
InspID 4266 - Storm Inlet Insp Screening	06/22/2016	
Debris depth	<6"	

7.4 Inspect Comprehensive & Clean BMPs

HAR-EE and HAR-OCG are responsible for maintaining the post-construction BMP inventory, and BMP inspections and maintenance. For Harbors projects, HAR-EE performs the inspection of post-construction storm water BMPs no less than annually.

HAR-EE annually initiates the Work Order for 'Inspect Comprehensive & Clean BMP'. The 'Submit to' field routes the Work Order to the HAR-OCG Supervisor who is responsible to assign the inspection tasks to subordinate staff.



7.4.1 Increase Frequency of BMP Inspections

Some BMPs may be inspected and cleaned more frequently as recommended by the manufacturer manual, or because they are located on a tenant site that is inspected more frequently as part of the Tenant Inspection Program.

7.5 Sweeping Common Areas Work Orders

The Harbors storm drainage system collects rainfall from storm events and releases it directly into the receiving ocean waters. As rainfall travels over surfaces such as roofs, roads, and parking lots, the surface flow may pick up contaminants before entering Harbor waters. Implementation of BMPs and good housekeeping practices that help to reduce the amount of pollutants that enter the storm sewer system include sweeping

floors, processing and storage areas, access roads, parking lots, and sidewalks. HAR-OCG has specialized equipment dedicated to Honolulu Harbor and Kalaeloa Barbers Point Harbor to conduct sweeping activities.

Work Orders for routine operations are routed to HAR-OCG to sweep common areas, and select tenant facilities where cleaning is requested. The HAR-OCG Supervisors are responsible for closing the Work Orders on a regular basis.

7.5.1 Sweeping Routes

Based on availability of equipment and personnel, the sweeping routes and targeted schedule are presented below.

PIER LOCATION	SCHEDULE
Young Brothers	Three times per week
Matson	Twice per week
Horizon Lines Terminal	Once per week
Aloha Cargo Pier 1	Once per month
Piers 10 11	Twice per week
Sand Island Base Yard T	Once per week
Fishing Village Parking Lot and Roadways, Pier 35	Once per week
Piers 30, 31, 32, and Shed Areas	Twice per week
Piers 27, 28, 29	Twice per week
Piers 18, 19, 23, 24	Twice per week
Channel Street Pier 2 Outside and Inside Shed Areas	Twice per week
Pier 1 Entrance	Twice per week
Piers 1 2 Common Roadways	Twice per week
KBPH Common Roadways & Apron	Twice per month

7.6 Kalaeloa Barbers Point Harbor Rail Tracks Cleaning

The HAR-OCB Unit Supervisor is responsible to ensure the rail tracks at Kalaeloa Barbers Point Harbor are routinely cleaned by tenants after bulk cargo transfer "post offloading"operations are concluded.

7.7 Waste Collection and Disposal

HAR-OCG picks up and disposes of certain potential pollutants left in drop off areas or discarded illegally by the public in order to minimize and/or prevent pollution to the environment. This includes automobile parts, boats, lead acid batteries, scrap steel, discarded used tires, and construction debris.

Waste from drop off areas, illegal dumping, and sweeping activities are disposed of with the appropriate waste contractors. The amounts and destination of each type of waste is reported in the *Annual Compliance Report.*

HAR-OCG is responsible for the routine cleaning activities at Harbors facilities, which include emptying dumpsters, and removing and disposing of discarded objects, machinery or equipment; and the prompt repair or replacement of malfunctioning dumpsters.

7.8 Harbors Maintenance Section (HAR-OM)

The HAR-OM Construction & Maintenance Superintendent is responsible to route Service Requests and/or Work Orders for follow-up work to the Wharf Maintenance Unit or the Construction and Maintenance Units. The Unit Supervisors assign tasks to the Subunits for storm drain inlet structural repairs, grate replacement, signage and stenciling installation and maintenance; and repairs for grate, leaking pipes, and other skilled work.

CHAPTER 8
EQUIPMENT AND VEHICLES

Harbors operates the necessary equipment for implementation of operations and maintenance tasks, and does not anticipate the need for additional equipment.

The initial contract for street sweepers included the request for extra brooms. Maintenance and warranty for parts including the providing of broom replacements are covered by the contract. When the service contract and warranty expires, replacement parts will have to be ordered, and spare brooms and other items are planned for inclusion within the operational budget. A street sweeper downtime Work Order is created to address issues associated with street sweepers.

For all equipment, scheduled maintenance is based on hours of use, or semiannually. Repairs for burnout, fuel leaks, etc., which occur outside of scheduled maintenance, are done through the manufacturer by purchase order.