

Lessons learned from SF's GSI O&M Programming

2.27.2020

Polly Crocker | Senior Water Quality Specialist

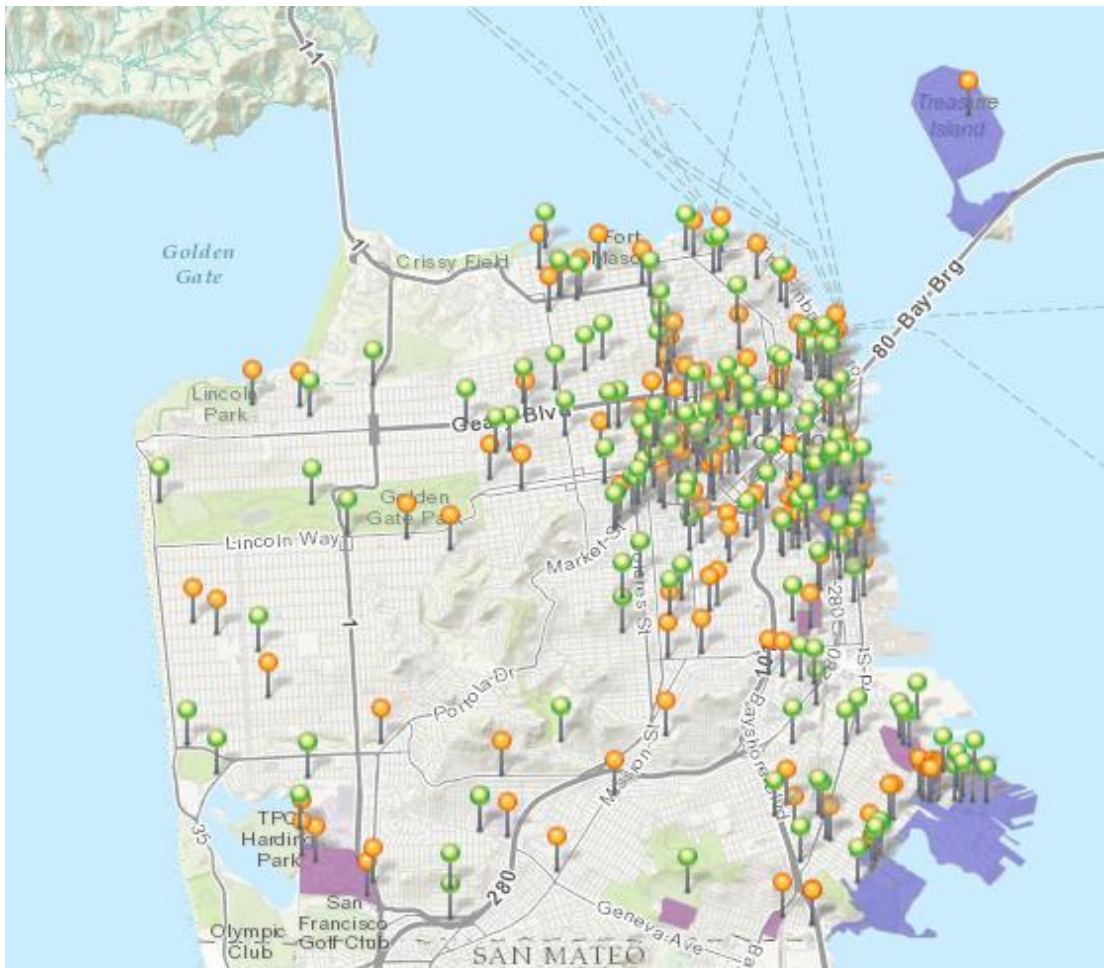
Green Infrastructure Operation & Maintenance Summit

San Francisco's Sewer System



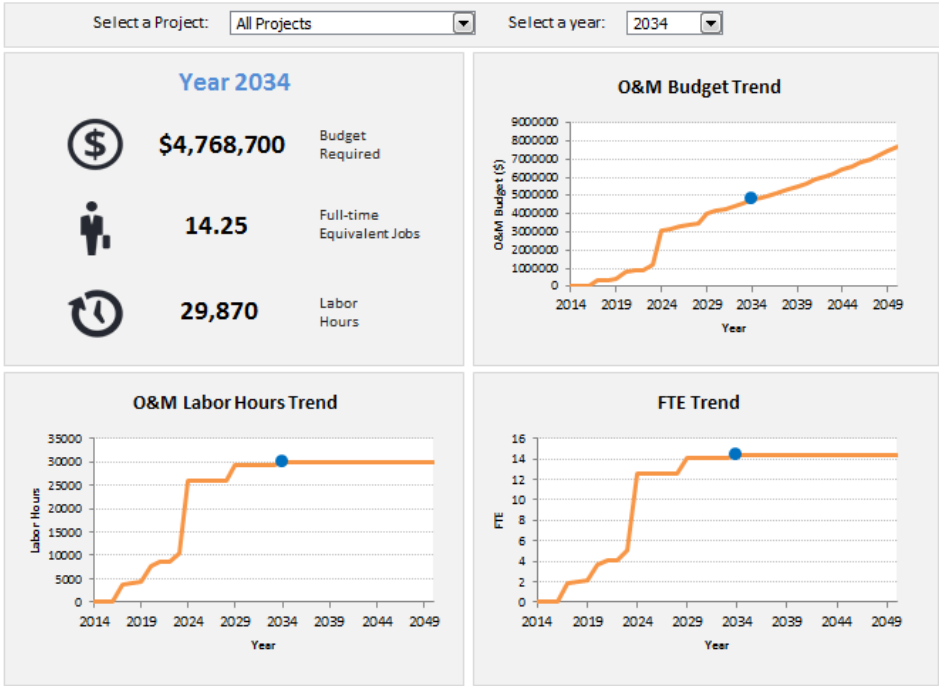
- 3 Wastewater Treatment Plants
- 1,900 mi sewer mains
- 25,000 catch basins
- 20+ pump stations
- Transport storage tunnel network

San Francisco's Sewer System...is getting greener!



Planning - GI Maintenance Model & Asset Management

Ref #	BMP Type	BMP Sub-type	BMP Sub-sub-type	Spatial Distribution of BMP	BMP Size	BMP Unit of Measure	Proportion of BMP cost for which SFPUC has O&M Responsibility (% of cost)	Cost Adjustment Factor (%)	Comments (text)	SFPUC Maintenance Start Date (YYYY)	SFPUC Maintenance End Date (YYYY)
1	Bioretention	Hard Edge (a.k.a. Planter)	Underdrained	Typical	4,508	square feet	100%	100%	ECDM Bulb-outs	2019	
2	Bioretention	Hard Edge (a.k.a. Planter)	Underdrained	Typical	753	square feet	100%	100%	Bulbouts on Sea Cliff	2019	
3	Pervious Paving	Infiltrative	Local Road	Typical	19,278		100%	100%	Sea Cliff Ave curb-to-curb b/t 25th & 26th Aves.	2019	
4	Infiltration Gallery	none	none	Typical	9,801	square feet	100%	100%	Under ECDM b/t bulb-outs.	2019	



Selected Project(s):

- Baker Beach Green Street EIP
- Candlestick Point
- Cesar Chavez
- Chinatown Green Alley
- Fell/Oak Bike & Ped Improvement Project
- Holloway Green Street
- Hunters Point Shipyard Phase 2
- Mission Bay
- Mission Valencia Green Gateway
- Sunnydale HOPE SF
- Sunset Boulevard
- Van Ness Corridor Transit Improvement Project
- Visitation Valley Green Nodes
- Wiggle Neighborhood Green Corridor
- Yosemite Creek EIP

<input checked="" type="checkbox"/> WW:Wastewater Enterprise	<input checked="" type="checkbox"/> CWP-VEH:CLEAN WATER - VEHICLES
<input checked="" type="checkbox"/> 1550EVANS:"DECOMMISSIONED" Office Space / Warehouse at 1550 Evans Ave	<input checked="" type="checkbox"/> WWTREATMENT:Wastewater Treatment
<input checked="" type="checkbox"/> COLLECT.SYS:WWE Collection System	<input checked="" type="checkbox"/> COLL.TREAT:WWE Joint Collection / Treatment
<input checked="" type="checkbox"/> CWP-EQP:CLEAN WATER - CARTS AND EQUIPMENT	<input checked="" type="checkbox"/> DISCHARGE PT:WWE Discharge Points
<input checked="" type="checkbox"/> CWP-RADIOS:CLEAN WATER - BROADBAND RADIOS	<input checked="" type="checkbox"/> FORCE MAINS:WWE Force Mains
<input checked="" type="checkbox"/> CWP-VEH:CLEAN WATER - VEHICLES	<input checked="" type="checkbox"/> GREASE COLL:Grease Collection
<input checked="" type="checkbox"/> WWTREATMENT:Wastewater Treatment	<input checked="" type="checkbox"/> GREEN INFRASTRUCTURE:WWE Green Infrastructure Facilities
	<input checked="" type="checkbox"/> TRANS STORAG:WWE Transport/Storage Boxes & Tunnels
	<input checked="" type="checkbox"/> IPC LEVEL 1:WWE DCS, SCADA, Communications, CMMS/EAMS
<input checked="" type="checkbox"/> CWP-VEH:CLEAN WATER - VEHICLES	<input checked="" type="checkbox"/> GREEN INFRASTRUCTURE:WWE Green Infrastructure Facilities
<input checked="" type="checkbox"/> WWTREATMENT:Wastewater Treatment	<input checked="" type="checkbox"/> GI CCH:Cesar Chavez Streetscape
<input checked="" type="checkbox"/> COLL.TREAT:WWE Joint Collection / Treatment	<input checked="" type="checkbox"/> GI MVG:Mission Valencia Green Gateway
<input checked="" type="checkbox"/> IPC LEVEL 1:WWE DCS, SCADA, Communications, CMMS/EAMS	<input checked="" type="checkbox"/> GI SBG:Sunset Boulevard Greenway
<input checked="" type="checkbox"/> MANAGEDPROP:WWE Managed Properties	<input checked="" type="checkbox"/> GI WNC:Wiggle Neighborhood Green Corridor
<input checked="" type="checkbox"/> PUMP STATION:WWE Pump Stations	<input checked="" type="checkbox"/> TRANS STORAG:WWE Transport/Storage Boxes & Tunnels
<input checked="" type="checkbox"/> TREAT PLANTS:WWE Treatment Plants	<input checked="" type="checkbox"/> IPC LEVEL 1:WWE DCS, SCADA, Communications, CMMS/EAMS
<input checked="" type="checkbox"/> ZZZA:ENGINEERING PROJECTS	<input checked="" type="checkbox"/> MANAGEDPROP:WWE Managed Properties
<input checked="" type="checkbox"/> ZZZB:FACILITIES REMOTE OPERATING	<input checked="" type="checkbox"/> PUMP STATION:WWE Pump Stations

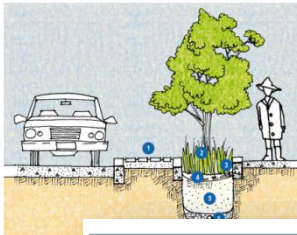
Facility Code	Description	Three-letter Abbreviation	San Francisco Neighborhoods	Three-letter Abbreviation	SFPUC WWGI Projects (partial list of planned or constructed projects as of 2017)	Facility Type Abbreviation	SFPUC WWGI Facility Types
GI	Green Infrastructure	BVW	Bayview	BBG	Baker Beach Green Street	BRS	Bioretention System
		BHT	Bernal Heights	CCH	Cesar Chavez Streetscape	PPS	Permeable Pavement System
		CAS	Castro/Upper Market	CGA	Chinatown Green Alley	SSS	Subsurface Systems
		CHN	Chinatown	HGS	Holloway Green Street	RWH	Rainwater Harvesting
		CRA	Crocker Amazon	SHR	Sunnydale HOPE redevelopment	CWT	Constructed Wetlands and Ponds
		DHT	Diamond Heights	HPR	Hunters Point Shipyard redevelopment	CKD	Creek Daylighting
		DCC	Downtown/Civic Center	CPR	Candlestick Point redevelopment	VGR	Vegetated Roof
		EXC	Excelsior	MVG	Mission Valencia Green Gateway	IFT	Infiltration Trench
		GPX	Glen Park	SBG	Sunset Blvd Greenway	CVS	Conveyance Swale
		HTA	Haight Ashbury	TIR	Treasure Island / Yerba Buena Island redevelopment		
		INR	Inner Richmond	VNC	Van Ness Corridor Transit Improvement		
		INS	Inner Sunset	VVG	Visitation Valley Green Nodes		
		LKS	Lakeshore	WNC	Wiggle Neighborhood Green Corridor		
		MAR	Marina	YCD	Yosemite Creek Daylighting		
		MSN	Mission				
		NOB	Nob Hill				
		NOE	Noe Valley				
		NBH	North Beach				
		OCV	Outer View				
		OUM	Outer Mission				
		OUR	Outer Richmond				
		OUS	Outer Sunset				
		PCH	Piedmont Heights				

Education & Consistency

Bioretention

Also known as: bioretention cell, bioretention basin, bioretention planter, flow-through planter, stormwater planter, rain garden, bioretention swale.

- Parking area with curb cut
- Dense wet- and dry-tolerant vegetation
- 6-inch minimum ponding depth
- 2- to 3-inch mulch depth
- 18-inch bioretention planting soil
- Perforated underdrain gravel layer (if infiltration of native soil is <0.5 inches per hour)
- Infiltration where feasible



Bioretention Terminology

There are three general types of bioretention facility terminology used in the City: "rain gardens," also known as "bioretention basins," which are installed directly in the ground in a depressed area of the landscape with no hard edges; "bioretention planters," which are located in a curb or hard-edged container; and "bioretention swales," which are linear, sloped bioretention systems. All terms can be encompassed by "bioretention cell."

Description

Bioretention refers to a design approach to manage stormwater runoff. Through three functions: peak flow, and improve with high organic content. If designed properly, the stormwater.

Typical Maintenance Activities for Bioretention

Activity	Schedule
Regularly water during the first three months as vegetation establishes roots.	Post-construction
Trim vegetation as needed to maintain desired appearance.	Monthly or as needed
Remove visible contaminants, debris, and trash from inlets and outlets to avoid clogging.	Semi-annually (beginning and end of rainy season)
Add mulch to bare areas and remove any mulch that has become fouled with sediment, oil and grease, or other hazardous material.	Semi-annually (beginning and end of rainy season)
Prune vegetation obstructing line of sight at roadway or intersection.	Quarterly
Replace dead, damaged, or diseased plants and provide weed control.	Annually
Regrade soil surface if erosion or scouring has occurred.	Annually
Till or aerate soil and replant if the system does not drain within the design drain time.	As needed (expected to be 3 to 5 years)
Repair or replace damaged or detached impermeable liners, if applicable.	Semi-annually or as needed
Consult with a licensed professional pest control service if rodent or animal damage is observed.	Annually or as needed
Utilize Integrated Pest Management (IPM) strategies to safely and effectively minimize pest damage and hazard.	As needed

GREEN INFRASTRUCTURE MAINTENANCE GUIDE BOOK

GUIDE BOOK

GREEN INFRASTRUCTURE CONSTRUCTION GUIDE BOOK

GUIDE BOOK

APPENDIX A

Bioretention Planter Maintenance Checklist

Maintenance Date: _____ Facility Location: _____ Number of Planters Serviced at Facility: _____
Supervisor Name: _____ City Crew ☐ Property Owner ☐ Site Manager ☐ Contractor ☐ Other: _____
of staff at the facility: _____ Start Time: _____ End Time: _____ Recent Storm? ☐ Yes ☐ No
Can you access the facility easily? ☐ Yes ☐ No If not, why? _____

Preliminary Site Inspection

Document in writing and with photos and report to your supervisor or property owner if any of the following conditions are present. (See the "Things to Look out for and Report" section in the Maintenance Manual on page 26)

Is there standing water in the facility more than 48 hours after the most recent rainfall? ☐

Is there structural damage to any of the hard infrastructure (concrete/wood/metal) elements? ☐

Is there erosion to the planter bed or side slopes? ☐

Are there irrigation leaks or any other visible indication that the irrigation system is not working properly? ☐

Is there any vandalism or graffiti to any part of the facility? ☐

Is there any evidence of contamination in the facility? ☐

Are there any signs of pest damage or infestation? ☐

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Weeding

Pull plants upward at the base to remove roots entirely and dig out stubborn root systems with a trowel.

Smooth the soil & pat down to prevent air pockets & to fill any holes.

Cover any bare soil with mulch.

Pile all weed debris outside of the planter and dispose of them properly.

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Vegetation

Prune vegetation as needed to maintain desired appearance.

Remove visible contaminants, debris, and trash from inlets and outlets to avoid clogging.

Add mulch to bare areas and remove any mulch that has become fouled with sediment, oil and grease, or other hazardous material.

Prune vegetation obstructing line of sight at roadway or intersection.

Replace dead, damaged, or diseased plants and provide weed control.

Regrade soil surface if erosion or scouring has occurred.

Till or aerate soil and replant if the system does not drain within the design drain time.

Repair or replace damaged or detached impermeable liners, if applicable.

Consult with a licensed professional pest control service if rodent or animal damage is observed.

Utilize Integrated Pest Management (IPM) strategies to safely and effectively minimize pest damage and hazard.

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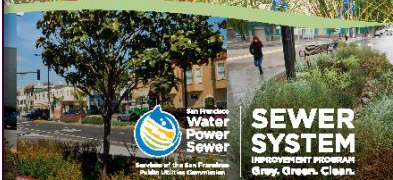
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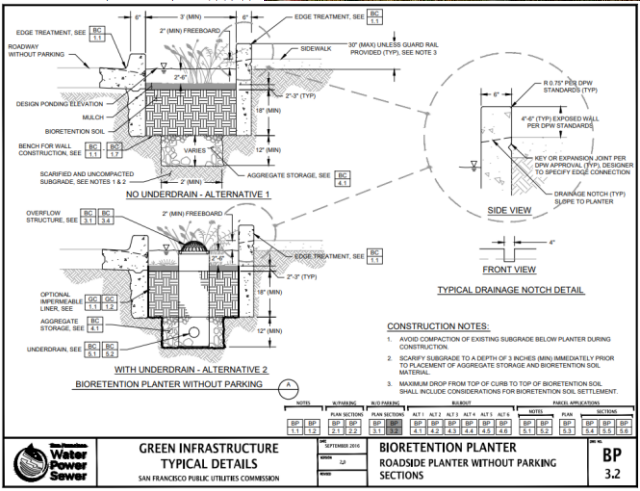
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San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission
SEWER SYSTEM IMPROVEMENT PROGRAM
Grey, Green, Clean.



GREEN INFRASTRUCTURE
TYPICAL DETAILS
SAN FRANCISCO PUBLIC UTILITIES COMMISSION

BIORETENTION PLANTER
ROADSIDE PLANTER WITHOUT PARKING
SECTIONS

BP
3.2

COMPLETE CHECKLIST IN BLUE PEN AND SUBMIT ELECTRONICALLY OR BY MAIL TO THE ADDRESSES BELOW



Annual Self-Inspection Checklist

Urban Watershed Management Program
ATTN: Stormwater Review
525 Golden Gate Ave., 11th Floor
SAN FRANCISCO, CA 94102
stormwaterreview@water.org

LINED BIORETENTION

Inspection Date: _____ Address: _____ Block / Lot #: _____ Installation Date: _____
Inspected By: Name: _____ Phone: _____ ☐ Property Owner ☐ Site Manager ☐ Contractor ☐ Other: _____

INSTRUCTIONS: All inspections, maintenance tasks, and repairs are to be completed prior to the beginning of the rainy season (October 15). Mark all status boxes with an S or U, where S = Satisfactory (no maintenance required), and U = Unsatisfactory (maintenance required). See the Lined Bioretention Inspection Instructions included in this packet for detailed descriptions of conditions requiring maintenance and further action.

Item #	Inspection Item Description	Status	Indicate Action Required or Action Planned	Indicate Action Taken (Include Date Completed)
1	Unpleasant odors			
2	Extended drawdown time (Ponded water > 48 hrs.)			
3	Excessive trash / debris accumulation			
4	Visible surface contaminants / pollution			
5	Vandalism / catastrophic damage to components or entire system			
6	Unauthorized modifications			
7	Excessive weed growth			
-	Impermeable liner visible			

DO NOT SUBMIT WITH CHECKLIST



Annual Self-Certification Checklist Instructions

LINED BIORETENTION

NOTE: These instructions are intended to be a companion piece to the Annual Self-Certification Checklist. The information contained herein is to be used to help the preparer of the Annual Self-Certification Checklist accurately conduct an inspection and properly complete the form.

Abbreviations: SPM: San Francisco Stormwater Management Regulations and Design Guidelines; SPM: Stormwater Control Plan; SPM: San Francisco Stormwater Management Ordinance; BMP: Best Management Practice (Lined Bioretention Planter); GI: Green Infrastructure

Item #	Inspection Item Description	Inspection Instructions and Explanation
1	Unpleasant odors	<p>Area of Concern: Several maintenance-related factors can lead to anaerobic soil conditions that create unpleasant odors in GI installations. Any installation that consistently fails to draw down completely within 48 hours can become anaerobic. The buildup of bacteria in anaerobic soils, along with decaying organic materials can cause these odors.</p> <p>Maintenance Solution: For more information on ponded water and extended drawdown time, see item #2 below.</p>
2	Extended drawdown time (Ponded water > 48 hrs.)	<p>Area of Concern: Ponded water resulting from extended drawdown times beyond 48 hours can lead to several problems such as: lack of filtration capacity, unpleasant odors, plant die-off, and creation of mosquito habitats.</p> <p>Ponded water and drawdown failure can be caused by the following:</p> <ul style="list-style-type: none">• crusting or sealing of the bioretention soil surface via accumulation of fine-grained soil, organic matter, etc.• heavily compacted bioretention soil• large amounts of sediment accumulation in the bioretention soil• blocked, clogged, or broken underdrains• blocked or clogged outflow structures and/or sand traps• the improper use of weed barrier fabric or geotextiles in the planter structure <p>Maintenance Solution: Irrigation testing can determine if soil compaction or sediment clogging may be the cause of the problem, which can be remedied by scarifying, tilling, shallow or deep aerating, or by replacing the soil in extreme cases.</p> <p>Inspecting the underdrain for clogging can be done visually by looking for standing water in the cleanout or by running a garden hose into the cleanout and determining if the water flows freely or backs up and overflows the cleanout pipe. Video inspection of the underdrain pipe may be performed to determine the source of the underdrain failure. Inspecting the outflow structure or sand trap can be done by removing the lid or grate from the structure and visually inspecting for standing water or excessive debris accumulation. Clogged underdrains and outflow structures can be cleared by jetting or snaking the underdrain pipe or culvert that connects the structure to the sewer, and by removing accumulated debris and sediment from the bottom of the structure with hand tools or by use of a vacuum truck.</p> <p>If weed barriers are determined to be the cause of ponding, removal of the weed barrier within the footprint of the bioretention planter is required. The removal of clogged subsurface geotextiles requires the excavation of the bioretention soil.</p>

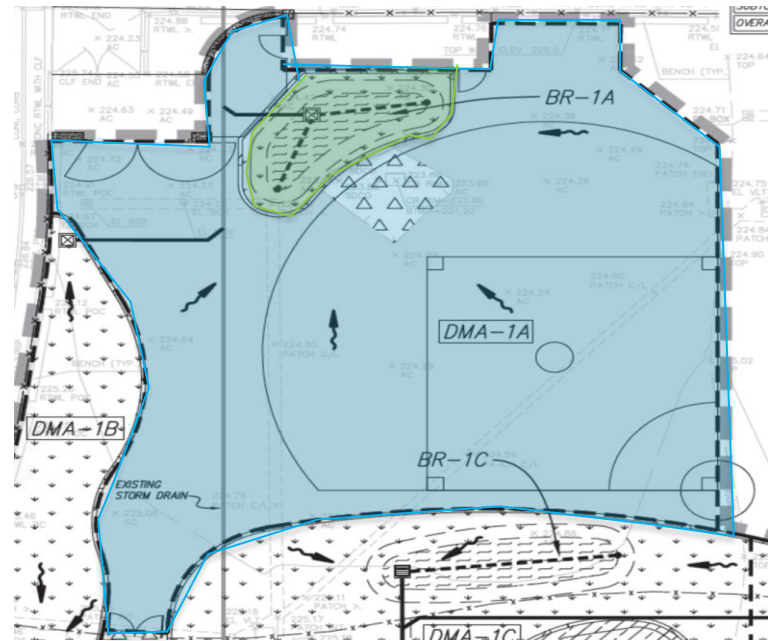
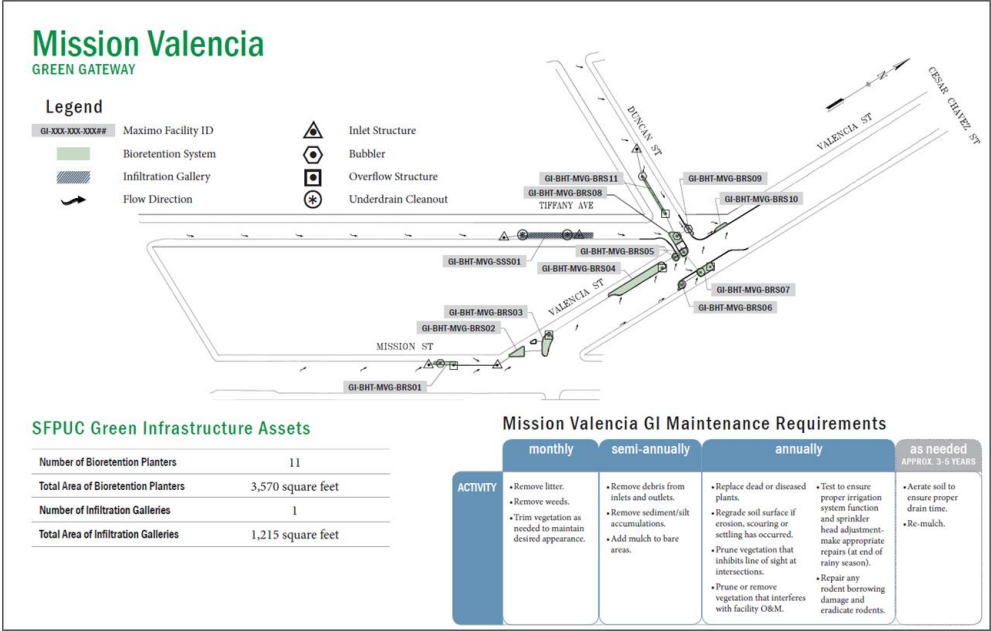
May 2016



TRAINING – it starts upstream!



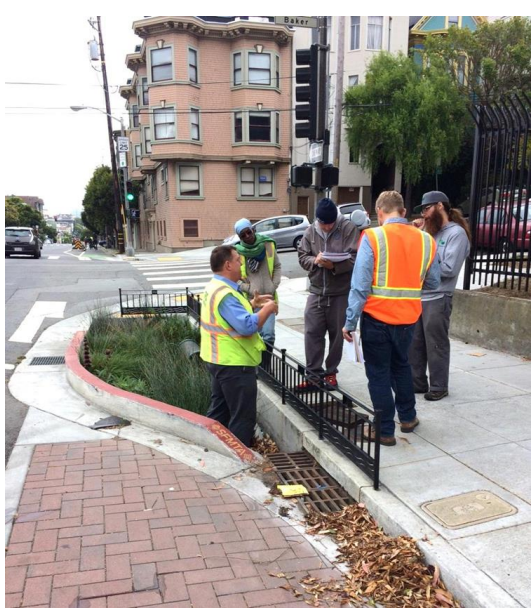
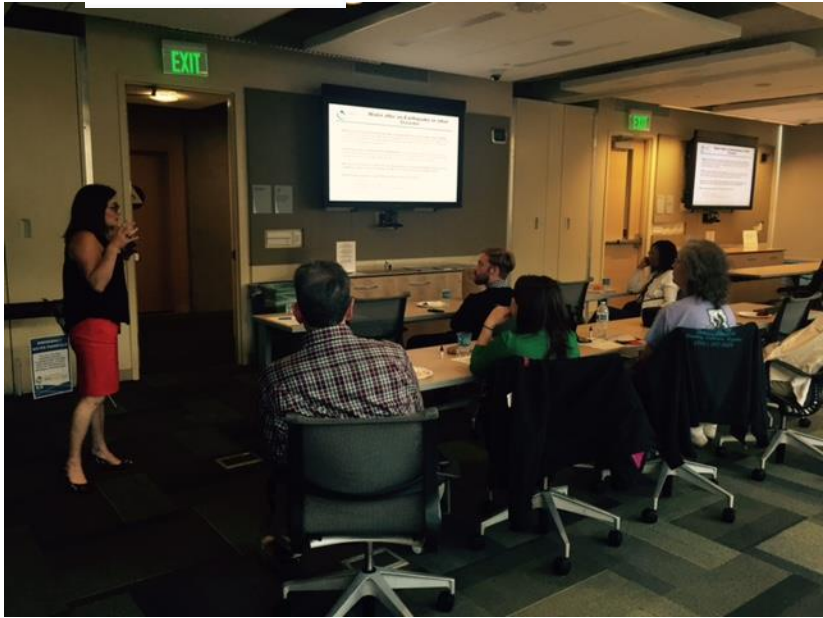
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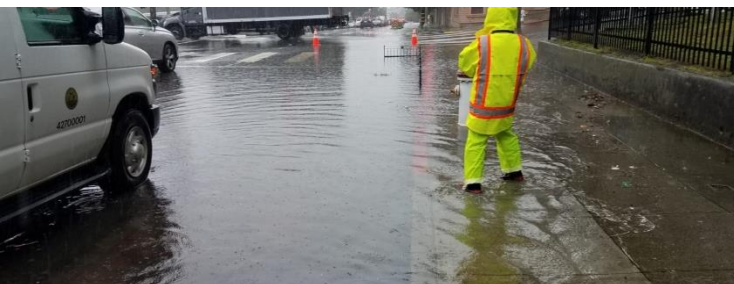
During



After



Integration – Disaster, Maintenance Sheets & Knowing Your Peeps



Wiggle Neighborhood Green Corridor - Phase 1

SFPUC Green Infrastructure Assets

Total Area of Bioretention	524 square feet
Total Area of Permeable Pavement	2,999 square feet
Number of Bioretention Systems	4
Number of Permeable Pavement Parking Strips	4

Wiggle Phase 1 GI Maintenance Requirements

ACTIVITY	monthly	semi-annually	annually	as needed APPROX. 3-5 YEARS
	<ul style="list-style-type: none">Remove litter.Remove weeds.Trim vegetation as needed to maintain desired appearance.	<ul style="list-style-type: none">Remove debris from inlets and outlets.Remove sediment/silt accumulations.Add mulch to bare areas.	<ul style="list-style-type: none">Replace dead or diseased plants.Regrade soil surface if erosion, scouring or settling has occurred.Prune vegetation that inhibits line of sight at intersections.Prune or remove vegetation that interferes with facility O&M.	<ul style="list-style-type: none">Aerate soil to ensure proper drain time.Re-mulch.

Legend

- GI-XXX-XXX-XXXX Maximo Facility ID
- Bioretention System
- Permeable Pavement
- Flow Direction
- Inlet Structure
- Outlet Structure
- Underdrain Cleanout

Permeable Pavement Underdrain Cleanout

Bioretention System Inlet

Bioretention System Outlet 1

GI-WAD-WNC-BRS01, BRS02, BRS04

Bioretention System Outlet 2

GI-WAD-WNC-BRS03

Permeable Pavement Maximo Asset ID

ASSET TYPE	GI-WAD-WNC-PPS01	GI-WAD-WNC-PPS02	GI-WAD-WNC-PPS03	GI-WAD-WNC-PPS04
Paver	PICP-0001	PICP-0002	PICP-0003	PICP-0004
Checkdam	CKDM-0017, -0018, -0019, -0020	CKDM-0021, -0022, -0023, -0024, -0025	CKDM-0026, -0027, -0028	CKDM-0029, -0030
Underdrain	UNDR-0011	UNDR-0012	UNDR-0013	UNDR-0014

Bioretention System Maximo Asset ID


ASSET TYPE	GI-WAD-WNC-BRS01	GI-WAD-WNC-BRS02	GI-WAD-WNC-BRS03	GI-WAD-WNC-BRS04
Inlet	INLS-0005	INLS-0006	INLS-0007	INLS-0008
Media	MDIA-0035	MDIA-0036	MDIA-0037	MDIA-0038
Underdrain	UNDR-0007	UNDR-0008	UNDR-0009	UNDR-0010
Outlet	OVFS-0007	OVFS-0008	OVFS-0009	OVFS-0010
Irrigation	IRRG-0012	IRRG-0013	IRRG-0014	IRRG-0015



Stewardship

Enter Address

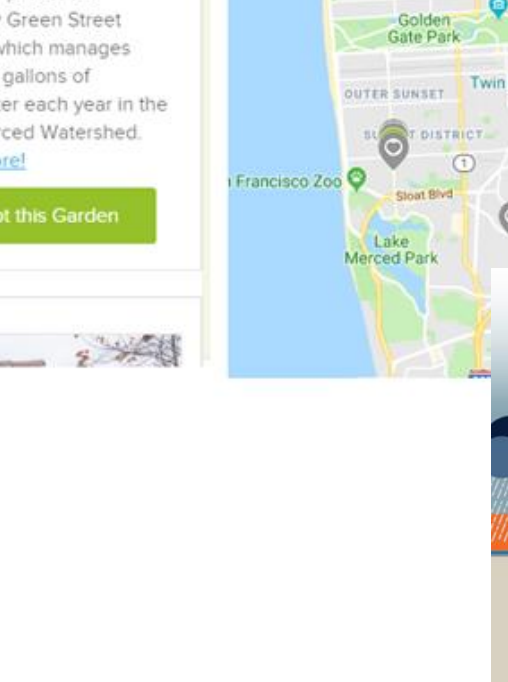
Search



Garden Description: This rain garden is part of the Holloway Green Street project, which manages 950,000 gallons of stormwater each year in the Lake Merced Watershed.

[Learn more!](#)


Adopt this Garden



THIS IS A GREEN STREET AND DRAINS TO OUR RAIN GARDENS.

Be a RAIN GUARDIAN and keep greasy wash water, oils, and pollutants off the sidewalks, streets, and rain gardens.

REPORT POLLUTION, CALL 311



San gardens connect to our sewer system and prevent oil and grease from entering the sewer system, protecting the aquatic habitat, the sewer pipes, and treatment plants.

Learn more: sfwater.org/greeninfrastructure

Visit rainguardians.org to adopt a rain garden and learn about tool and gear giveaway events.

Acknowledgements/References

GI Maintenance Model

- Contact wlogsdon@sfwater.org
- Instruction packet & Excel spreadsheet for customization

Educational Materials

- www.sfwater.org/smr

Other SF GI Info

- www.sfwater.org/greeninfrastructure

Rain Guardians

- www.rainguardians.org

Thank you!

Contact / pcrocker@stone-env.com