SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.

555 County Center
Redwood City, CA 94063

P 650.599.1406
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flowstobay.org

September 30, 2016

Bruce Wolfe, Executive Officer
San Francisco Bay Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, CA 94612

SUBJECT: SUBMITTAL OF THE SAN MATEO COUNTYWIDE WATER POLLUTION PREVENTION PROGRAM'S FY 2015/16 ANNUAL REPORT

Dear Mr. Wolfe:

The San Mateo Countywide Water Pollution Prevention Program (SMCWPPP) is pleased to submit the attached Fiscal Year 2015/16 Annual Report. This report describes Municipal Regional Permit (MRP) compliance activities conducted at the regional and countywide levels on behalf of all of SMCWPPP's member agencies. It also incorporates by reference and includes as appendices several reports prepared by the Bay Area Stormwater Management Agencies Association (BASMAA) on behalf of all Bay Area MRP Permittees.

I certify under penalty of law that the SMCWPPP FY 2015/16 Annual Report and BASMAA's associated regional reports were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my enquiry of the person or persons who manage the system, or those directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SMCWPPP and its 22 member agencies look forward to continuing to work with you and your staff on implementation of the MRP. If you have any questions or comments, please call me at (650) 599-1419.

Sincerely,

Matthew Fabry
Program Manager

Attachment: SMCWPPP FY 2015/16 Annual Report

SAN MATEO COUNTYWIDE
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FY 2015-16 Annual Report

September 30, 2016

Credits

This report is being submitted by the participating agencies in the

SAN MATEO COUNTYWIDE
Water Pollution
Prevention Program
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Town of Atherton
City of Belmont
City of Brisbane
City of Burlingame
Town of Colma
City of Daly City
City of East Palo Alto
Citv of Foster Citv
City of Half Moon Bay
Town of Hillsborough
City of Menlo Park
City of Millbrae
City of Pacifica
Town of Portola Valley
City of Redwood City
Citv of San Bruno
City of San Carlos
City of San Mateo
County of San Mateo
SM County Flood Control District
City of South San Francisco
Town of Woodside

San Mateo Countywide Water Pollution Prevention Program
555 County Center
Redwood City, California 94063

A Program of the City/County Association of Governments
(C/CAG)

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LIST OF ACRONYMS

BASMAA:	Bay Area Stormwater Management Agencies Association
BAWSCA:	Bay Area Water Supply and Conservation Agency
BMPs:	Best Management Practices
BSM:	Biotreatment Soil Mix
C3TG:	C.3 Stormwater Technical Guidance
CALBIG:	California Building Inspectors Group
CASQA:	California Stormwater Quality Association
C/CAG:	City/County Association of Governments of San Mateo County
CEH:	County Environmental Health
CEQA:	California Environmental Quality Act
CII:	Commercial/Industrial/Illicit Discharge
CRM:	Constituent Relationship Management
DC:	Development Committee
DIY:	Do-It-Yourself
DO:	Dissolved Oxygen
DPR:	Department of Pesticide Regulation
EPA:	Environmental Protection Agency
FY:	Fiscal Year
GSRD:	Gross Solids Removal Device
GI:	Green Infrastructure
GIS:	Geographic Information System
IPM:	Integrated Pest Management
IMR:	Information Monitoring Report
JPA:	Joint Powers Authority
LID:	Low Impact Development
MRP:	Stormwater NPDES Municipal Regional Permit
MS4:	Municipal Separate Storm Sewer System
NPDES:	National Pollutant Discharge Elimination System
OAL:	California Office of Administrative Law
O&M	Operations and Maintenance
OSH:	Orchard Supply Hardware

LIST OF ACRONYMS (cont.)

OWOW:	Our Water Our World
PCBs:	Polychlorinated Biphenyls
PIP:	Public Information and Participation
POC:	Pollutants of Concern
POTW:	Publicly-Owned Treatment Works (sewage treatment plants)
RFQ:	Request for Qualifications
RMP:	San Francisco Estuary Regional Monitoring Program
SAP:	Sampling and Analysis Plan
SCVURPPP:	Santa Clara Valley Urban Runoff Pollution Prevention Program
SFEP:	San Francisco Estuary Partnership
SFEI:	San Francisco Estuary Institute
SMC:	San Mateo County
SMCWPPP:	San Mateo Countywide Water Pollution Prevention Program
SOP:	Standard Operating Procedure
STLS:	Small Tributaries Load Strategy
SWRP:	Stormwater Resource Plan
SWPPP:	Stormwater Pollution Prevention Plan
TAC:	Technical Advisory Committee
TMA:	Trash Management Area
TMDL:	Total Maximum Daily Load
UGBA:	Urban Greening Bay Area
WLA:	Waste Load Allocation
WY:	Water Year

EXECUTIVE SUMMARY

INTRODUCTION

This FY 2015/16 Annual Report was developed in compliance with the reissued National Pollutant Discharge Elimination System (NPDES) Municipal Regional Permit (referred to as the MRP)[1] for stormwater runoff discharges from San Mateo County and certain other San Francisco Bay Area communities. It summarizes stormwater management activities implemented by the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP or Countywide Program) in FY 2015/16. SMCWPPP's activities benefit all 22 of its member agencies: 15 cities, five towns, the County of San Mateo, and the San Mateo County Flood Control District. Each member agency also separately submits an individual Annual Report to the San Francisco Bay Regional Water Quality Control Board (Regional Water Board) focusing on that agency's stormwater management activities during FY 2015/16.

SMCWPPP is a program of the City/County Association of Governments (C/CAG) of San Mateo County. C/CAG is a Joint Powers Authority (JPA) for issues of regional importance to San Mateo County jurisdictions. The C/CAG Board of Directors is comprised of a local elected city council representative from each city and town, a member of the County Board of Supervisors, and representatives from the transit district and transportation authority. A 1993 amendment to the JPA Agreement made C/CAG responsible for assisting member agencies with complying with the NPDES municipal stormwater permit, including its latest incarnation as the MRP. Stormwater management-related activities of C/CAG and its various related committees and workgroups are described below.

C/CAG Board

Throughout FY 2015/16, the C/CAG Board of Directors received presentations, updates, and took actions on various stormwater-related issues, including

- A Request for Qualifications (RFQ) process for on-call consultant technical support services to SMCWPPP;
- Presentations on Countywide Program accomplishments and the reissued MRP;
- Formation of a new C/CAG committee to facilitate discussion on countywide approaches to water related issues;
- Appointment of new Stormwater Committee members;
- Information on the water quality petition requesting the State Water Board review the Regional Water Board's reissuance of the MRP;

[1]NPDES Permit No. CAS612008 (Order No. R2-2015-0049), dated November 19, 2015 and effective January 1, 2016. The MRP has a five-year term and expires December 31, 2020.

- Commitment of matching funds for a Bay Area Stormwater Management Agencies Association (BASMAA) grant proposal to the U.S. EPA's San Francisco Bay Water Quality Improvement Fund for projects addressing PCBs in building materials to help address related requirements in the reissued MRP;
- Payment to BASMAA for San Mateo County's outstanding share of regional stormwater projects conducted from FY 2009/10 to FY 2015/16; and
- Extension of the funding agreement with Bay Area Water Supply and Conservation Agency (BAWSCA) for rain barrel rebates in San Mateo County through June 30, 2017.

Program Manager

C/CAG's Program Manager oversees the overall Countywide Program, serving as staff to the C/CAG Board and liaison among C/CAG's member agencies, technical consultants, committees, the Bay Area Stormwater Management Agencies Association (BASMAA), the California Stormwater Quality Association (CASQA), and Regional Water Board staff. The Program Manager represents C/CAG's member agencies at regional and statewide meetings and manages technical consultants that support programmatic activities. In addition to providing regular staff support, agenda reports, and presentations to the C/CAG Board and the Stormwater and Technical Advisory Committees, the Program Manager participated in the following activities during the FY 2015/16 reporting year:

- BASMAA: Completed two-year term as Chair of the Board of Directors, participated in regular Board meetings, the Steering Committee for the MRP reissuance, the regional Green Infrastructure and Pollutants of Concern Workgroups, and BASMAA Development Committee;
- CASQA: Continued serving on the Board of Directors, participated in/attended monthly Board meetings/calls, quarterly meetings, strategic planning meetings, and the annual conference;
- San Francisco Estuary Partnership Implementation Committee: Continued serving on the committee representing the municipal stormwater perspective, participated in quarterly meetings;
- Presentations by Program Manager: numerous presentations (e.g., at workshops, conferences, C/CAG meetings, legislator meetings, city council meetings);
- Publications: "Green Streets: Getting to efficient, effective, and affordable." American Public Works Association's APWA Reporter, June 2016
- Grant Activities: Continued representing BASMAA on the Urban Greening Bay Area grant from EPA (Water Quality Improvement Fund) to the San Francisco Estuary Partnership/Association of Bay Area Governments (participated in quarterly grant status meetings and as a member of the Green Infrastructure Roundtable and Design Charrette task teams).

Stormwater Committee

C/CAG's stormwater management-related decisions are assisted by the NPDES Stormwater Committee. At its November 2012 meeting, the C/CAG Board authorized reconvening this committee to include director-level appointees with decision-making authority for implementing stormwater management programs within the member agencies in compliance with requirements

in the MRP. The Committee meets on an approximate bimonthly basis (depending on need) on the third Thursday of the month at the San Mateo County Transit District Office in San Carlos. Public notices for Committee meetings are posted in accordance with Brown Act requirements on the ground floor of the same location. The Stormwater Committee met six times during FY 2015/16 to assist with planning and organizing SMCWPPP's stormwater management activities including MRP compliance actions.

Technical Advisory Committee and Subcommittees

The Stormwater Committee provides direction to and receives feedback and recommendations from the Technical Advisory Committee (TAC). During FY 2012/13, the TAC transferred its former policy-related functions to the Stormwater Committee and transitioned to a quarterly workshop format. The new format allowed more detailed discussion of particular MRP compliance topics, including check-ins on what jurisdictions should be focused on in the coming quarter and what should have been accomplished and documented in the preceding quarter. The TAC met twice during FY 2015/16. SMCWPP has also established various subcommittees and work groups to the TAC that continued to meet periodically throughout FY 2015/16 to help implement the different aspects of the MRP, as summarized below.

C/CAG Water Committee

In October, C/CAG created a new "Water Committee" to serve as a forum for countywide discussion regarding water-related issues and to advise the C/CAG Board regarding countywide collaboration strategies relative to water issues, including potential creation of a new agency or modification of an existing agency to accomplish such collaboration, as well as explore potential funding options. Issues being evaluated include stormwater pollution control, flood control, and sea level rise. The Program Manager, in conjunction with the Executive Director, provides staff support to the Committee. Details on the Committee can be found on C/CAG's website. The Committee anticipates finalizing its recommendation to the C/CAG Board in Fall 2016.

SUMMARY OF ACCOMPLISHMENTS

This FY 2015/16 Annual Report is structured around the following major provisions of the reissued MRP:

- C.2. Municipal Operations
- C.3. New Development and Redevelopment
- C.4. Industrial and Commercial Site Controls
- C.5. Illicit Discharge Detection and Elimination
- C.6. Construction Site Control
- C.7. Public Information and Outreach
- C.8. Water Quality Monitoring
- C.9. Pesticides Toxicity Control
- C.10. Trash Load Reduction
- C.11. Mercury Controls

- C.12. PCBs Controls
- C.13. Copper Controls
- C.15. Exempted and Conditionally Exempted Discharges

The following sections briefly summarize how SMCWPPP provided assistance in FY 2015/16 in implementing the MRP for each of these provisions.

C.2 Municipal Operations

The objective of MRP Provision C.2 is to ensure development and implementation of appropriate Best Management Practices (BMPs) by all Permittees to control and reduce discharges of non-stormwater and stormwater runoff pollutants to storm drains and watercourses during operation, inspection, and routine repair and maintenance activities of municipal facilities and infrastructure. Most MRP-required Provision C.2 Municipal Operations tasks are implemented individually by each SMCWPPP member agency. SMCWPPP helps agency staff to understand MRP requirements and develops various tools that assist agency staff to effectively plan, implement, and report on compliance activities. SMCWPPP's assistance and the implementation of Municipal Operations tasks are coordinated through the SMCWPPP Public Works Municipal Maintenance Subcommittee.

During FY 2015/16, SMCWPPP performed a number of tasks to assist member agencies with implementation of Provision C.2, with input and assistance provided by the Public Works Municipal Maintenance Subcommittee. Accomplishments included the following:

- Held four Public Works Municipal Maintenance Subcommittee meetings;
- Engaged the Subcommittee in the review of the reissued MRP;
- Organized a trash full capture device O&M inspection/cleaning and municipal maintenance data management roundtable meeting;
- Organized a Gross Solids Removal Device Site Tour; and
- Developed a trash full capture device inspection and cleaning field form, Small Full Capture Device O&M Standard Operating Procedure (SOP), Hydrodynamic Separator O&M SOP, and Trash Full-Capture Device O&M Verification Program Template and Guidance, in coordination with the Trash Subcommittee and to help member agencies comply with Provision C.10.b.i.

C.3 New Development and Redevelopment

In the reporting year FY 2015/16 projects regulated by Provision C.3 continued to meet stormwater treatment requirements using low impact development (LID) measures, including infiltration, evapotranspiration, rainwater harvesting and use, and biotreatment. During FY 2015/16, SMCWPPP provided compliance assistance with MRP Provision C.3 (and MRP Provision C.6 Construction Site Controls) through the New Development Subcommittee. The subcommittee met quarterly and enjoyed good participation.

SMCWPPP's accomplishments during FY 2015/16 include the following major tasks to assist member agencies with implementation of Provision C.3:

- Updated the Subcommittee on the progress and content of the draft and final reissued MRP, solicited feedback, and summarized comments provided by SMCWPPP and BASMAA to the Regional Water Board;
- Updated guidance documents, checklists, and fact sheets for consistency with new MRP requirements;
- Prepared Version 5.0 of SMCWPPP's C.3 Stormwater Technical Guidance, including significant revisions to update the Guidance to be consistent with new requirements in the reissued MRP and other information to assist member agencies in complying with Provision C.3;
- Held the 2016 New Development (C.3) Workshop, entitled "Low Impact Development and Green Infrastructure: Don't Miss the Opportunity!", on June 14, 2016;
- Participated in the BASMAA Development Committee and its Biotreatment Soil Mix (BSM) and CIP Review Work Groups, including providing assistance with modifications to the BSM specification, support for the "BSM and Trees Roundtable" event on June 30, 2016, and assistance with development of guidance for review of municipal projects for Green Infrastructure (GI) opportunities;
- Began a countywide effort to develop different model components of the GI Plan required by MRP Provision C.3.j for local member agency review, use and/or modification in local GI Plans; and
- Established and held two meetings of a San Mateo Countywide GI Technical Advisory Committee (GI TAC) to participate in the development, review, and selection of elements in the model countywide GI Plan, and to educate GI TAC members.
- Conducted a variety of green infrastructure outreach activities, including various presentations by the Program Manager, a GI presentation to high schools, rain barrel program promotion, and social media posts.
- Began development of a Countywide Stormwater Resource Plan and supported the development of Proposition 1 implementation grant applications by the Cities of San Mateo and Redwood City that included a suite of multi-benefit stormwater projects.

C.4 Industrial and Commercial Site Controls

An important goal of SMCWPPP's Commercial, Industrial and Illicit Discharge (CII) component is to assist member agencies to control the discharge of pollutants in stormwater from commercial and industrial businesses to the maximum extent practicable. SMCWPPP member agencies are responsible for complying with various business inspection requirements under MRP Provision C.4. SMCWPPP's CII component assists member agency staff with understanding these MRP requirements and develops various related tools, templates, reporting forms, and other MRP compliance support materials. SMCWPPP's assistance with MRP Provision C.4 is coordinated through the CII Subcommittee.

During FY 2015/16, SMCWPPP performed a number of tasks to assist member agencies with implementation of MRP Provision C.4, with input and assistance provided by the CII Subcommittee. Accomplishments included the following:

- Held three CII Subcommittee meetings;

- Conducted a CII training workshop;
- Organized a group subscription to the CASQA Industrial and Commercial Stormwater BMP Handbook Portal; and
- Assisted San Mateo County Division of Environmental Health (referred to as County Environmental Health, or CEH) transition to a new stormwater inspection database and with updating stormwater inspection agreements with some cities to reflect the reissued MRP requirements.

C.5 Illicit Discharge Detection and Elimination

Another important goal of SMCWPPP's CII component is to assist member agencies effectively prohibit the discharge of illicit, non-stormwater discharges to the municipal storm drain system. SMCWPPP member agencies are responsible for controlling non-stormwater discharges prohibited by MRP Provision C.5. SMCWPPP's CII component assists member agency staff with understanding these MRP requirements and develops various related tools, templates, reporting forms, and other MRP compliance support materials. SMCWPPP's assistance with MRP Provision C.5 is coordinated through the CII Subcommittee.

During FY 2015/16, SMCWPPP performed a number of tasks to assist member agencies with implementation of MRP Provision C.5, with input and assistance provided by the CII Subcommittee. Accomplishments included the following:

- Revised the SMCWPPP Illicit Discharge Inspection Form template and data tracking table;
- Updated the table of mobile businesses with stormwater enforcement actions to share countywide with stormwater inspectors.

C.6 Construction Site Control

During FY 2015/16, SMCWPPP continued to provide compliance assistance with MRP Provision C.6 (and MRP Provision C.3) through the New Development Subcommittee (described above under C.3. New Development and Redevelopment).

SMCWPPP's accomplishments during FY 2015/16 include the following major tasks to assist member agencies with implementation of Provision C.6:

- Conducted a construction site controls training for the California Building Inspectors Group (CALBIG) on October 14, 2015;
- Printed 1,800 copies of the Construction Site Inspection Form and distributed them to the Subcommittee members; and
- Conducted the May 3, 2016 Construction Site Inspector Workshop.

C.7 Public Information and Outreach

The primary goals of SMCWPPP's Public Information and Participation (PIP) component are:

- To educate the public about the causes of stormwater pollution and its adverse effects on water quality in local creeks, lagoons, shorelines and neighborhoods;

- To encourage residents to adopt less polluting and more environmentally beneficial practices; and
- To increase resident's participation and involvement in SMCWPPP activities.

PIP is essential for controlling and reducing the source of pollution since many preventable pollutants originate from everyday residential activity. Stormwater pollution may be reduced when residents are educated and motivated by the benefits of reducing pollutants. This approach of education and motivation is cost effective and efficient in meeting the goal of reducing pollutants in stormwater to the maximum extent practicable. SMCWPPP's accomplishments during FY 2015/16 include the following major tasks to assist member agencies with implementation of Provision C.6:

- Distributed a total of 1,275 dog bag waste canisters during our Doggy Bag Giveaway Campaign from March-July 2016 in order to educate residents about the harmful effects of pet waste on our community and local waters and to encourage residents to pick-up after their pets and reduce the amount of harmful bacteria that flows into our waterways;
- Conducted 318 pet waste intercept surveys to uncover the major barriers and motivators for pet owners to properly dispose of waste and created a Pet Waste Pilot Program that provides action steps for the cities of San Mateo to implement as part of their pollution prevention efforts;
- Expanded the Car Wash Pollution Prevention Reward Program, in partnership with 11 car wash locations throughout the county, with redemption choices including text message and email paperless options. SMCWPPP recruited 2,755 text message subscribers and 1,248 email subscribers into the program and solicited over 750 discount redemptions;
- Doubled SMCWPPP's Facebook and Twitter followers: Facebook followers increased from 2,392 followers, starting on July 1, 2015 to 5,485 followers, ending on June 30, 2016. Twitter followers increased 673 followers starting on July 1, 2015 to 1,113 followers as of June 30, 2016;
- Collected 641 email newsletter signups from San Mateo County residents that SMCWPPP staff met during the nine public outreach and citizen involvement events attended this year;
- Coordinated Coastal Cleanup Day for San Mateo County at 55 sites, diverting an estimated 27,240 pounds of trash and 3,740 pounds of recyclables from waterways. Raised awareness of the event and litter issues throughout the county through various media coverage and social media and recruited an estimated 4,339 volunteers in 2015;
- Partnered with the Bay Area Water Conservation Supply Agency (BAWSCA) to promote a Rain Barrel Rebate program as a strategy to conserve water during the drought while reducing urban runoff pollution. Specific outreach efforts included posts on social media, content on the website, and disseminating applications at multiple outreach events. As a result of this partnership, 482 barrels were installed in FY 2015/16, with a total of 810 installed since program inception in October 2014; and

- Conducted high school presentations entitled, "Introduction to Stormwater Pollution and Solutions." The presentations emphasize educating students on basic problems and solutions of stormwater pollution, green infrastructure solutions, and encourage students to become involved by educating others. A total of four presentations were conducted at three schools.

C.8 Watershed Quality Monitoring

On behalf of it member agencies, SMCWPPP performs water quality monitoring activities in compliance with MRP Provision C.8. Some of this work is accomplished through participation in BASMAA regional projects. Per Provision C.8, a complete documentation of all water quality monitoring data collected from October 1, 2015 through September 30, 2016 (i.e., Water Year 2016 or WY2016) will be presented in SMCWPPP's Urban Creeks Monitoring Report, which will be submitted to the Water Board by March 31, 2017.

In addition, in accordance with MRP Provision C.8.f., Pollutants of Concern (POC) Monitoring, SMCWPPP will submit by October 15, 2016 a report describing the planned allocation of sampling effort for POC Monitoring for WY2017 and what was accomplished for POC Monitoring during WY2016. The report will include monitoring locations, number and types of samples collected, a description of the objectives of the sampling (i.e., management question addressed), and the analytes measured. However, per Provision C.8.h., the results of the monitoring will not be included, but instead will be documented in the Urban Creeks Monitoring Report, as described above.

C.9 Pesticides Toxicity Control

The primary objective of MRP Provision C.9 is to prevent the impairment of urban streams by pesticide-related toxicity, and thereby implements requirements of the *TMDL for Diazinon and Pesticide-related Toxicity for Urban Creeks* in the region. Permittees are required to implement a pesticide toxicity control program that addresses their own and others' use of pesticides within their jurisdictions that pose a threat to water quality and that have the potential to enter the municipal stormwater conveyance system. Most MRP-required Provision C.9 tasks are implemented individually by each SMCWPPP member agency. SMCWPPP helps agency staff to understand MRP requirements and develops various tools that assist agency staff to effectively plan, implement, and report on compliance activities. SMCWPPP's assistance with MRP Provision C.9 Pesticides Toxicity Control is mainly coordinated through the Parks Maintenance and Integrated Pest Management (IPM) Work Group.

During FY 2015/16, SMCWPPP performed a number of tasks to assist member agencies with implementation of Provision C.9, with input and assistance provided by the Parks Maintenance and IPM Work Group. Accomplishments included the following:

- Held two meetings of the Parks Maintenance and IPM Work Group;
- Developed periodic update documents with relevant pesticide-related news, events and regulatory developments for the Parks Maintenance and IPM Work Group;
- Conducted SMCWPPP's Annual Landscape IPM Training Workshop in March 2016;
- Continued coordinating with San Mateo County Agriculture / Weights and Measures;

- Continued to participate in the Department of Pesticide Regulation (DPR) grant to implement IPM techniques at multi-family residential buildings;
- Participated in relevant BASMAA and CASQA activities;
- Continued to maintain retail partnerships at 9 top-tier stores (e.g., Home Depot and OSH) stores within San Mateo County. Tasks included ordering materials, organizing outreach collateral, checking in with store managers, and providing outreach to residents;
- Educated hardware store employees to become program messengers and pass on the pollution prevention message to customers and conducted five instore trainings for store employees;
- Conducted outreach community events to educate customers on less toxic alternatives to commercial pesticides and fertilizers; and
- Motivated do-it-yourself (DIY) home owners and gardeners to adopt Best Management Practices (BMPs) and minimize their use of toxic products by conducting monthly visits to stores to place and refresh educational materials.

C.10 Trash Load Reduction

MRP Provision C.10 Trash Load Reduction tasks are implemented by each SMCWPPP member agency. SMCWPPP helps agency staff to understand trash load reduction requirements and develops various tools needed to effectively plan, implement, and report on compliance with trash management activities. Provision C.10 requires Permittees (as applicable) to:

- Reduce trash discharges from 2009 levels by 70% by July 2017 and 80% by July 2019;
- Ensure that lands they do not own or operate but that are plumbed directly to their storm drain systems in Very High, High and Moderate trash generation areas are equipped by full capture systems or managed to a level equivalent to full capture systems;
- Install and maintain full capture systems that treat a mandatory minimum acreage;
- Assess trash reductions associated with control measures other than full capture systems using an on-land visual assessment protocol;
- Develop and implement a receiving waters trash monitoring program plan;
- Annually cleanup and assess a mandatory minimum number of creek/shoreline trash hotspots; and
- Maintain a Long-Term Trash Load Reduction Plan designed to achieve 100% trash reduction by July 2022.

During FY 2015/16, SMCWPPP completed the tasks described below in support of member agency trash management activities conducted in compliance with the above requirements.

- Facilitated five Trash Subcommittee meetings;
- Assisted SMCWPPP member agencies in revising trash generation and management area maps;

- Continued implementing the Pilot Trash Assessment Strategy, which is intended to provide information on magnitude and extent of trash reductions associated with stormwater in San Mateo County. Program and Permittee staff conducted more than 680 on-land visual assessments at 233 sites (averaging 1,000 feet in length);
- Conducted a workshop entitled "SMCWPPP On-Land Visual Trash Assessment Training" which focused on how to conduct on-land visual trash assessments using the standardized assessment protocol;
- Finalized SMCWPPP's Full Capture Operation and Maintenance Verification Program in collaboration with SMCWPPP's Municipal Maintenance Subcommittee, including standard operating procedures for inspections and cleaning, and an operation and maintenance plan template for use by member agencies;
- Continued assisting SMCWPPP Permittees to assess and cleanup trash hot spots and report on this activity;
- In an ongoing effort to increase coordination among solid waste and recycling programs and SMCWPPP member agency MS4 trash reduction activities, SMCWPPP staff continued attending Countywide Recycling Committee meetings, specifically targeting outreach and coordination with municipal solid waste/recyclable haulers in San Mateo County to reduce trash impacts associated with inadequate waste container management and dispersal from waste transfer vehicles;
- Held four meetings of SMCWPPP's Litter Work group;
- Developed the FY 2015/16 Litter Work Group Work Plan including prioritized recommendations for improving container management programs, metrics and issues with franchise agreement negotiations, mapping of container overages, and countywide outreach coordination and branding;
- Prepared a report on "Litter Practices Recommendations for Solid Waste Franchise Agreements" on the subject of reducing litter related to waste hauling in the County;
- Coordinated with the SMCWPPP Public Information and Participation Subcommittee on countywide school outreach and countywide litter campaign branding efforts;
- Collected litter related data from franchised haulers and permittee staff for mapping of container overage and abandoned waste locations; and
- Continued participating in the Proposition 84 Stormwater Monitoring and Planning grant project entitled "Tracking California's Trash".

C.11 Mercury Controls

MRP Provision C.11 Mercury Controls implements stormwater runoff-related actions required by the San Francisco Bay mercury Total Maximum Daily Load (TMDL) water quality restoration program. SMCWPPP performs a variety of activities to address mercury in stormwater runoff in compliance with MRP Provision C.11. Some of this work has been accomplished through participation in BASMAA regional projects.

SMCWPPP's and its member agency's activities to address MPR Provisions C.11/12.a., Implement Control Measures to Achieve Mercury/PCBs Load Reductions, are described in a separate report (*Identifying Management Areas and Controls for Mercury and PCBs in San Mateo County*

Stormwater Runoff, SMCWPPP, September 30, 2016) that was submitted to the Regional Water Board concurrently with this Annual Report.

MPR Provisions C.11/12.b., Assess Mercury/PCBs Load Reductions from Stormwater, requires Permittees to submit in their 2015/16 Annual Report for Executive Officer approval an assessment methodology. Permittees are required to use the assessment methodology to quantify in a technically sound manner mercury and PCBs loads reduced through implementation of pollution prevention, source control, and treatment control measures, including source control, stormwater treatment, green infrastructure, and other measures. Beginning with their 2016/17 Annual Report, Permittees must report on the use of the methodology to demonstrate progress toward achieving the mercury and PCBs load reductions required in this permit term. SMCWPPP and its member agencies have addressed this requirement through participation in a BASMAA regional project. BASMAA's report on this project was submitted to the Regional Water Board concurrently with this Annual Report.

MRP Provisions C.11.e and C.12.h require Permittees to conduct an ongoing risk reduction program to address public health impacts of mercury and PCBs in San Francisco Bay fish. During FY 2015/16, SMCWPPP assisted its member agencies comply with the risk reduction program requirements by coordinating with and reporting on the Fish Smart program conducted by San Mateo County Environmental Health Services.

C.12 PCBs Controls

MRP Provision C.12 PCBs Controls implements stormwater runoff-related actions required by the San Francisco Bay PCB Total Maximum Daily Load (TMDL) water quality restoration program. SMCWPPP performs a variety of activities to address PCBs in stormwater runoff in compliance with MRP Provision C.12.

SMCWPPP's and its member agency's activities to address MPR Provisions C.11/12.a., Implement Control Measures to Achieve Mercury/PCBs Load Reductions, are described in a separate report (*Identifying Management Areas and Controls for Mercury and PCBs in San Mateo County Stormwater Runoff, SMCWPPP, September 30, 2016*) that was submitted to the Regional Water Board concurrently with this Annual Report.

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MRP Provisions C.11.e and C.12.h require Permittees to conduct an ongoing risk reduction program to address public health impacts of mercury and PCBs in San Francisco Bay fish. During FY

2015/16, SMCWPPP assisted its member agencies comply with the risk reduction program requirements by coordinating with and reporting on the Fish Smart program conducted by San Mateo County Environmental Health Services.

Provision C.12.f. requires that Permittees develop and implement or cause to be developed and implemented an effective protocol for managing materials with PCBs concentrations of 50 ppm or greater in applicable structures at the time such structures undergo demolition, so that PCBs do not enter municipal storm drain systems. During FY 2015/16, SMCWPPP participated in the BASMAA regional project to develop an implementation framework, guidance materials, and tools to assist Permittees in developing programs to manage PCBs-containing materials and wastes during building demolition in compliance with Provision C.12.f.

C.13 Copper Controls

Provision C.13 of the MRP addresses copper control measures identified in the San Francisco Bay Basin Water Quality Control Plan (commonly referred to as the Basin Plan) that the Regional Water Board has deemed necessary to support copper site-specific objectives in San Francisco Bay. SMCWPPP's accomplishments during FY 2015/16 include the following tasks to assist member agencies with implementation of Provision C.13:

- Continued to train municipal inspectors on the MRP requirements and BMPs for architectural copper installation, cleaning, and treating;
- Provided BMP information to illicit discharge inspectors during the June 1, 2016 SMCWPPP CII Training Workshop related to managing discharges from pools, spas and fountains that contain copper-based chemicals; and
- Provided training to industrial inspectors during the June 1, 2016 SMCWPPP CII Workshop regarding ensuring through routine industrial facility inspections that proper BMPs are in place at industrial facilities likely to use copper or have sources of copper.

C.15 Exempted and Conditionally Exempted Discharges

The objective of MRP Provision C.15, Exempted and Conditionally Exempted Discharges, is to exempt unpolluted non-stormwater discharges from the MRP's general non-stormwater discharge prohibition (Provision A.1) and to conditionally exempt non-stormwater discharges that are potential sources of pollutants. SMCWPPP assists municipal staff to understand the MRP's requirements and to make available for their use various MRP compliance support materials. The SMCWPPP CII Subcommittee facilitates and coordinates providing this assistance to the member agencies for a variety of different types of non-stormwater discharges that may be conditionally exempted. SMCWPPP activities that address outreach requirements for C.15.b.iv (Individual Residential Car Washing Discharge) are describe above – see C.7 Public Information and Outreach.

SECTION 1
INTRODUCTION

BACKGROUND

This FY 2015/16 Annual Report was developed in compliance with the reissued National Pollutant Discharge Elimination System (NPDES) Municipal Regional Permit (referred to as the MRP)[1] for stormwater runoff discharges from San Mateo County and certain other San Francisco Bay Area communities. It summarizes stormwater management activities implemented by the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP or Countywide Program) in FY 2015/16. SMCWPPP's activities benefit all 22 of its member agencies: 15 cities, five towns, the County of San Mateo, and the San Mateo County Flood Control District. Each member agency also separately submits an individual Annual Report to the San Francisco Bay Regional Water Quality Control Board (Regional Water Board) focusing on that agency's stormwater management activities during FY 2015/16.

The organizational structure of SMCWPPP is shown on Figure 1-1. SMCWPPP is a program of the City/County Association of Governments (C/CAG) of San Mateo County. C/CAG is a Joint Powers Authority (JPA) that addresses issues of regional importance to San Mateo County jurisdictions such as congestion management and water quality. The C/CAG Board of Directors is comprised of a local elected city council representative from each city and town in San Mateo County, a member of the County Board of Supervisors, and representatives from the transit district and transportation authority. A 1993 amendment to the JPA Agreement made C/CAG responsible for assisting member agencies with complying with the municipal stormwater NPDES permit, including its latest incarnation as the MRP. Stormwater management-related activities of C/CAG and its various related committees and workgroups are described below.

C/CAG Board

Throughout FY 2015/16, the C/CAG Board of Directors received presentations, updates, and took actions on various stormwater-related issues, as summarized below:

- August 2015: Based on the results of a Request for Qualifications (RFQ) process, authorized the C/CAG Chair to execute three-year agreements with 10 firms to provide on-call consultant services to the Countywide Water Pollution Prevention Program, and further authorized the C/CAG Executive Director to negotiate and issue task orders under

[1]NPDES Permit No. CAS612008 (Order No. R2-2015-0049), dated November 19, 2015 and effective January 1, 2016. The MRP has a five-year term and expires December 31, 2020.

said contracts for FY 2015/16. The RFQ divided the services into seven categories, and the highest rated three consultants were identified for each category, except that five consultants were identified for the Green Infrastructure category.

- September 2015: The SMCWPPP Program Manager gave a presentation on FY 2014/15 Countywide Program accomplishments and information on the draft reissued MRP.
- October 2015: Approved the framework for the formation of a new C/CAG committee to facilitate discussion on countywide approaches to water related issues, such as stormwater runoff pollution control, flood control, and sea level rise. The new committee includes seats for elected officials, city/county managers and the Bay Area Water Supply and Conservation Agency (BAWSCA).
- November 2015: Approved a resolution that affirmed C/CAG's commitment to supporting its member agencies in meeting stormwater permitting mandates, requested State Water Resources Control Board (State Water Board) partnership on addressing pollutants of concern, and expressed concern regarding the quantitative load reduction requirement for PCBs which are presented as Numeric Effluent Levels rather than Numeric Action Levels in the reissued MRP. Approved issuing a task order to EOA, Inc. to continue providing technical support services to the Countywide Program while C/CAG staff completes the competitive procurement process for selecting consultants to continue supporting the Program in the future.
- December 2015: Approved the appointment of a new Stormwater Committee member for the City of Millbrae. Received a presentation from the SMCWPPP Program Manager on key provisions of the reissued MRP.
- January 2016: Received a copy of the water quality petition requesting the State Water Board review the Regional Water Board's reissuance of the MRP. Approved the appointment of a new Stormwater Committee member for the City of Menlo Park.
- March 2016: Received a copy of an executed Task Order to EOA, Inc. for water quality monitoring services to the Countywide Program for FY 2015/16. Authorized the C/CAG Executive Director to execute Task Orders with EOA, Inc., Larry Walker Associates, and S. Groner & Associates for technical support services to the Countywide Program during FY 2015/16.
- May 2016: Received an update on the Petitions for Review filed with the State Water Board regarding the reissued MRP. Approved the appointment of a new Stormwater Committee member for the City of Half Moon Bay. Draft C/CAG budget.
- June 2016: Authorized the C/CAG Executive Director to commit matching funds for a Bay Area Stormwater Management Agencies Association (BASMAA) grant proposal to the U.S. EPA's San Francisco Bay Water Quality Improvement Fund for projects addressing PCBs in building materials to help address related requirements in the reissued MRP. Authorized the C/CAG Executive Director to pay BASMAA for San Mateo County's outstanding share of regional stormwater projects conducted from FY 2009/10 to FY 2015/16. Authorized extending the funding agreement with BAWSCA for rain barrel rebates in San Mateo County through June 30, 2017. Authorized the C/CAG Executive Director to execute Task Orders with EOA, Inc., Larry Walker Associates, and S. Groner Associates, Inc. for technical support services to the Countywide Program for FY 2016/17. Final C/CAG budget approval.

Program Manager

C/CAG's Program Manager oversees the overall Countywide Program, serving as staff to the C/CAG Board and liaison among C/CAG's member agencies, technical consultants, committees, the Bay Area Stormwater Management Agencies Association (BASMAA), the California Stormwater Quality Association (CASQA), and Regional Water Board staff. The Program Manager represents C/CAG's member agencies at regional and statewide meetings and manages technical consultants that support programmatic activities. In addition to providing regular staff support, agenda reports, and presentations to the C/CAG Board and the Stormwater and Technical Advisory Committees, the Program Manager participated in the following activities during the FY 2015/16 reporting year:

- BASMAA: Completed two-year term as Chair of the Board of Directors, participated in regular Board meetings, the Steering Committee for the MRP reissuance, the regional Green Infrastructure and Pollutants of Concern Workgroups, and BASMAA Development Committee;
- CASQA: Continued serving on the Board of Directors, participated in/attended monthly Board meetings/calls, quarterly meetings, strategic planning meetings, and the annual conference;
- San Francisco Estuary Partnership Implementation Committee: Continued serving on the committee representing the municipal stormwater perspective, participated in quarterly meetings;
- Presentations by Program Manager:
    - C/CAG Board of Directors ("Water Pollution Prevention Program Highlights, 2014-15," September)
    - EPA/Water Board Reasonable Assurance Analysis workshop ("Reasonable Assurance Analysis for Green Infrastructure Planning," September)
    - State of the Estuary/Regional Monitoring Program conference ("Green Infrastructure in San Mateo County: A Vision for the Future," September)
    - American Planning Association conference (participated on panel, "Trends, Opportunities, and Challenges for Integrating Green Infrastructure with Urban Design in the San Francisco Bay Area," October)
    - CASQA annual conference ("Paying for Sustainable Streets: Next Steps for Integrating Green Infrastructure & Transportation," October)
    - Sustainable San Mateo County Water Summit ("Stormwater and Green Infrastructure," November)
    - C/CAG Board of Directors ("The Revised Municipal Regional Permit," December)
    - SPUR Water and Policy Committee ("Green Infrastructure for Stormwater Management," December)
    - Presentation to staff representatives for Assemblymembers Mullin and Gordon and Senator Hill on stormwater issues (December)

- C/CAG Water Committee ("Stormwater Management in San Mateo County," December)
- SPUR Oakland lunch event ("Growing Sustainable Communities Through Green Infrastructure," February)
- San Carlos City Council (jointly with Jon Konnan, EOA, "PCBs, San Carlos, and the Municipal Regional Permit," May)
- C/CAG "Lobby Day" in Sacramento (presentations to local legislative delegation on stormwater, transportation, and green infrastructure issues, June)
- San Mateo County RecycleWorks Volunteer Academy ("Trash and Stormwater," June)

- Publications: "Green Streets: Getting to efficient, effective, and affordable." American Public Works Association's APWA Reporter, June 2016
- Grant Activities: Continued representing BASMAA on the Urban Greening Bay Area grant from EPA (Water Quality Improvement Fund) to the San Francisco Estuary Partnership/Association of Bay Area Governments (participated in quarterly grant status meetings and as a member of the Green Infrastructure Roundtable and Design Charrette task teams).

Stormwater Committee

C/CAG's stormwater management-related decisions are assisted by the NPDES Stormwater Committee. At its November 2012 meeting, the C/CAG Board authorized reconvening this committee to include director-level appointees with decision-making authority for implementing stormwater management programs within the member agencies in compliance with requirements in the MRP. The Committee meets on an approximate bimonthly basis (depending on need) on the third Thursday of the month at the San Mateo County Transit District Office in San Carlos. Public notices for Committee meetings are posted in accordance with Brown Act requirements on the ground floor of the same location. The Stormwater Committee met six times during FY 2015/16 to assist with planning and organizing SMCWPPP's stormwater management activities including MRP compliance actions. Appendix 1 includes a table summarizing attendance at the Stormwater Committee meetings held during FY 2015/16.

The below sections describe the Stormwater Committee's mission statement, membership criteria, and roles and responsibilities.

Mission Statement

The Stormwater Committee provides policy and technical advice and recommendations to the C/CAG Board of Directors and direction to technical committees (described below) on all matters relating to stormwater management and compliance with associated regulatory mandates from the State and Regional Water Boards.

Membership

The Stormwater Committee is comprised of one director-level representative from each of the member agencies, recommended by City/Town/County Managers, with decision-making

authority and primary responsibility for implementing stormwater management programs within their jurisdictions, and one non-voting executive management representative from the Regional Water Board staff, all appointed by the C/CAG Board. There are no term limits and members may be removed and replaced as needed.

Roles & Responsibilities

The role of the Stormwater Committee is to provide policy and technical advice and recommendations to the C/CAG Board and direction to stormwater technical committees on matters related to stormwater management and associated regulatory requirements. While the Stormwater Committee may consider any item reasonably related to stormwater and associated regulatory requirements, the following issues are the primary focus of the Stormwater Committee:

- Review and provide recommendations for SMCWPPP's annual budget as part of the overall C/CAG budget approval process.
- Authorize submittal of countywide and regional compliance documents on behalf of their respective agencies for activities performed via C/CAG through SMCWPPP or BASMAA.
- Convey relevant program and compliance information and direction to appropriate staff and departments within their agencies.
- Form ad-hoc work groups to address particular stormwater-related issues on an as-needed basis (e.g., permit reissuance).
- Discuss and provide policy recommendations on stormwater issues, such as:
    - funding stormwater compliance activities at the local and countywide level;
    - unfunded mandate test claims;
    - permit appeals and litigation;
    - reissuance of the Municipal Regional Permit;
    - permit requirements, especially those related to new and redevelopment, Green Infrastructure, monitoring, and pollutants of concern, including trash, mercury, PCBs, and pesticides;
    - training and technical support needs for municipal staffs; and
    - legislation and statewide policy issues impacting member agencies.

Technical Advisory Committee and Subcommittees

The Stormwater Committee provides direction to and receives feedback and recommendations from the Technical Advisory Committee (TAC). During FY 2012/13, the TAC transferred its former policy-related functions to the Stormwater Committee and transitioned to a quarterly workshop format. The new format allowed more detailed discussion of particular MRP compliance topics, including check-ins on what jurisdictions should be focused on in the coming quarter and what should have been accomplished and documented in the preceding quarter. The TAC met twice during FY 2015/16. Appendix 1 includes a table summarizing attendance at the TAC meetings held during FY 2015/16.

SMCWPPP has also established various subcommittees and work groups to the TAC to help implement the different aspects of MRP, as shown on Figure 1-1. The subcommittees and work groups are discussed further in the remaining sections of this report.

C/CAG Water Committee

In October, C/CAG created a new "Water Committee" to serve as a forum for countywide discussion regarding water-related issues and to advise the C/CAG Board regarding countywide collaboration strategies relative to water issues, including potential creation of a new agency or modification of an existing agency to accomplish such collaboration, as well as explore potential funding options. Issues being evaluated include stormwater pollution control, flood control, and sea level rise. The Program Manager, in conjunction with the Executive Director, provides staff support to the Committee. Details on the Committee can be found on C/CAG's website. The Committee anticipates finalizing its recommendation to the C/CAG Board in Fall 2016.

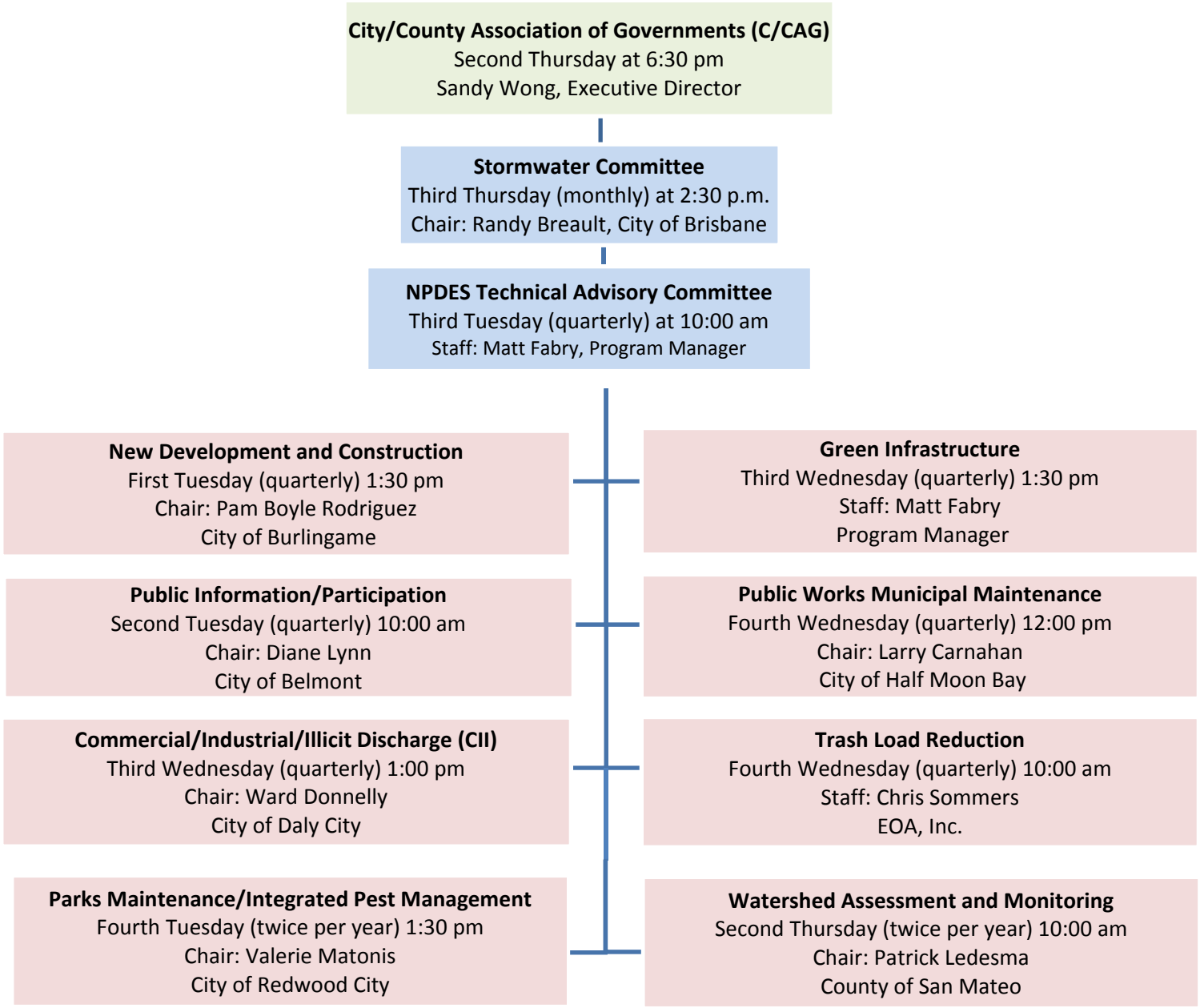
ORGANIZATION OF REPORT

This FY 2015/16 Annual Report is structured around the following major provisions of the reissued MRP:

- C.2. Municipal Operations
- C.3. New Development and Redevelopment
- C.4. Industrial and Commercial Site Controls
- C.5. Illicit Discharge Detection and Elimination
- C.6. Construction Site Control
- C.7. Public Information and Outreach
- C.8. Water Quality Monitoring
- C.9. Pesticides Toxicity Control
- C.10. Trash Load Reduction
- C.11. Mercury Controls
- C.12. PCBs Controls
- C.13. Copper Controls
- C.15. Exempted and Conditionally Exempted Discharges

The following sections of this report summarize how SMCWPPP provided assistance in FY 2015/16 in implementing the MRP for each of the above provisions. Each section includes three sub-sections: 1) Introduction, 2) Implementation of MRP Actions, and 3) Future Actions.

Figure 1-1. Organizational Structure and Meeting Schedule.



SECTION 2
C.2 MUNICIPAL OPERATIONS

INTRODUCTION

The objective of MRP Provision C.2 is "to ensure development and implementation of appropriate Best Management Practices (BMPs) by all Permittees to control and reduce discharges of non-stormwater and stormwater runoff pollutants to storm drains and watercourses during operation, inspection, repair and maintenance activities of municipal facilities and infrastructure."

Most MRP-required Provision C.2 Municipal Operations tasks are implemented individually by each SMCWPPP member agency. The Countywide Program helps agency staff to understand MRP requirements and develops various tools that assist agency staff to effectively plan, implement, and report on compliance activities. SMCWPPP's assistance and the implementation of Municipal Operations tasks are coordinated through the SMCWPPP Public Works Municipal Maintenance Subcommittee.

IMPLEMENTATION OF MRP PROVISIONS

During FY 2015/16, SMCWPPP performed a number of tasks to assist member agencies with implementation of Provision C.2, with input and assistance provided by the Public Works Municipal Maintenance Subcommittee. Accomplishments included the following:

- Held four Public Works Municipal Maintenance Subcommittee meetings;
- Engaged the Subcommittee in the review of the reissued MRP;
- Organized a trash full capture device O&M inspection/cleaning and municipal maintenance data management roundtable meeting;
- Organized a Gross Solids Removal Device Site Tour; and
- Developed a trash full capture device inspection and cleaning field form, Small Full Capture Device O&M Standard Operating Procedure (SOP), Hydrodynamic Separator O&M SOP, and Trash Full-Capture Device O&M Verification Program Template and Guidance, in coordination with the Trash Subcommittee and to help member agencies comply with Provision C.10.b.i.

More information on each of these accomplishments is provided below.

Public Works Municipal Maintenance Subcommittee

The Public Works Municipal Maintenance Subcommittee met four times during FY 2015/16 to share information about municipal operations-related MRP requirements and methods for

achieving compliance. The meetings provided a forum to share experiences with implementing MRP provisions and applying associated BMPs related to activities such as:

- Street and road repair maintenance activities;
- Sidewalk/plaza maintenance and pavement washing;
- Graffiti removal;
- Corporation yard activities; and
- Stormwater pump station monitoring and inspections.

Redwood City staff chaired the Subcommittee through December 2015. Larry Carnahan from the City of Half Moon Bay has chaired the Subcommittee since January 2016. A FY 2015/16 Subcommittee attendance summary table is included in Appendix 2. A majority of the Subcommittee's four meetings were attended by staff from the Cities of Belmont, Brisbane Burlingame, Colma, Daly City, Half Moon Bay, Hillsborough, Menlo Park, Millbrae, Redwood City, San Carlos and San Mateo and San Mateo County.

During FY 2015/16 Subcommittee meetings, Countywide Program staff focused on facilitating discussions about requirements that changed in the reissued MRP compared to the previous MRP and providing related guidance materials. Countywide Program staff also facilitated discussions about storm drain cleaning activities, addressing illegal dumping and graffiti, different types of storm drain inlet markers, corporation yard BMPs, street sweepers, residential "fix it" apps, storm drain system repairs, performance of trash full capture devices and drain inlet protection devices.

Municipal Operations Trainings

The Municipal Maintenance Subcommittee sponsored two training events.

A Gross Solids Removal Device (GSRD) Site Tour was held in Millbrae on June 1, 2016. Participants:

- Examined an installed trash full capture system and, for closer inspection, a new uninstalled unit;
- Learned about the design and installation process and device maintenance;
- Received information from a representative of the manufacturer; and
- Asked Millbrae maintenance staff questions regarding operation and maintenance (O&M) of the device.

The workshop flyer and final attendance list are included in Appendix 2.

A trash full capture device O&M inspection/cleaning and municipal maintenance data management roundtable discussion was held June 16, 2016. The purpose was for San Mateo County local agencies to share information about how they are collecting trash full capture device inspection and maintenance data and other relevant municipal maintenance data. Municipal staff from Belmont, Brisbane, Burlingame, Daly City, San Mateo and Redwood City provided information, presentations, and demonstrations of their data management tools. Topics discussed included how data are collected in the field and managed in field forms, spreadsheets, databases, GIS systems or other data management tools, and the successes and failures related to using

different data management tools. A list of presentations given at the roundtable and attendance list are included in Appendix 2.

Program Materials

Since the MRP was adopted, SMCWPPP staff has developed a variety of materials to assist municipal maintenance agency staff with implementing Provision C.2. These materials are all available on the SMCWPPP website (www.flowstobay.org) and continue to be useful tools that assist agency staff to achieve permit compliance. The materials are described below.

In FY 2009/10, SMCWPPP developed a Stormwater Pollution Prevention Plan (SWPPP) template for use by member agencies in tailoring, updating, or creating SWPPPs for their corporation yards, satellite facilities, and maintenance facilities.

In FY 2010/11, SMCWPPP prepared the "Municipal Corporation Yard Inspection Form." This form provides detailed checklists for the types of BMPs recommended in the corporation yard SWPPP template. During FY 2010/11, SMCWPPP also prepared "Sources of Stormwater BMP information for Maintenance Activities Listed in MRP's Provision C.2," to assist member agencies with complying with the following Provision C.2 requirements: Provision C.2.a Street and Road Repair and Maintenance; Provision C.2.b Sidewalk/Plaza Maintenance and Pavement Washing; Provision C.2.c Graffiti Removal; and Provision C.2.f Corporation Yards. The sources of BMP information used to develop these materials are CASQA's Stormwater BMP Handbook Maintenance and Caltrans' Storm Water Quality Handbook Maintenance Staff Guidance.

The following twelve agencies in San Mateo County operate stormwater pump stations: Cities of Belmont, Burlingame, East Palo Alto, Foster City, Menlo Park, Millbrae, Pacifica, Redwood City, San Carlos, San Mateo, and South San Francisco, and the San Mateo County Flood Control District. During FY 2010/11, SMCWPPP developed the "Stormwater Pump Station Dry Season DO Monitoring and Inspection Form" to assist member agencies in developing a systematic and efficient way to collect MRP-required DO monitoring and inspection information.

In FY 2015/16, SMCWPPP developed a trash full capture device inspection and cleaning field form template, a Small Full Capture Device O&M Standard Operating Procedure (SOP), a Hydrodynamic Separator O&M SOP, and a Trash Full-Capture Device O&M Verification Program Template and Guidance document. These materials were developed in coordination with the Trash Subcommittee to help municipal staff comply with new requirements in MRP Provision C.10.b.i., Full Trash Capture Systems. These requirements include certifying that trash full capture systems are operated and maintained to meet full trash capture system requirements and keeping associated maintenance records.

FUTURE ACTIONS

FY 2016/17 activities planned by SMCWPPP to assist member agencies comply with MRP requirements in Provision C.2 include the following:

- Continue holding Public Works Municipal Maintenance Subcommittee meetings.
- Update guidance materials and SOPs for trash full capture device inspection and O&M, as needed.

SECTION 3
C.3 NEW DEVELOPMENT AND REDEVELOPMENT

INTRODUCTION

This section describes SMCWPPP's activities to assist member agencies in complying with MRP Provision C.3, New Development and Redevelopment. SMCWPPP continued to provide compliance assistance with MRP Provision C.3 (and Provision C.6 Construction Site Controls – see Section 6) through the New Development Subcommittee (Subcommittee), which was chaired by Pamela Boyle Rodriguez, representing the City of Burlingame. SMCWPPP also obtained input and direction from agency representatives through the Subcommittee. The Subcommittee met three times (the Fall 2015 meeting was canceled) and enjoyed good participation, as shown by the FY 2015/16 attendance list, included in Appendix 3.

IMPLEMENTATION OF MRP PROVISIONS

SMCWPPP's accomplishments during FY 2015/16 include the following major tasks to assist member agencies with implementation of Provision C.3:

- Updated the Subcommittee on the progress and content of the draft and final reissued MRP, solicited feedback, and summarized comments provided by SMCWPPP and BASMAA to the Regional Water Board;
- Updated guidance documents, checklists, and fact sheets for consistency with new MRP requirements;
- Prepared Version 5.0 of SMCWPPP's C.3 Stormwater Technical Guidance, including significant revisions to update the Guidance to be consistent with new requirements in the reissued MRP and other information to assist member agencies in complying with Provision C.3;
- Held the 2016 New Development (C.3) Workshop, entitled "Low Impact Development and Green Infrastructure: Don't Miss the Opportunity!", on June 14, 2016;
- Participated in the BASMAA Development Committee and its Biotreatment Soil Mix (BSM) and CIP Review Work Groups, including providing assistance with modifications to the BSM specification, support for the "BSM and Trees Roundtable" event on June 30, 2016, and assistance with development of guidance for review of municipal projects for Green Infrastructure (GI) opportunities.
- Began a countywide effort to develop different model components of the GI Plan required by MRP Provision C.3.j for local member agency review, use and/or modification in local GI Plans;

- Established and held two meetings of a San Mateo Countywide GI Technical Advisory Committee (GI TAC) to participate in the development, review, and selection of elements in the model countywide GI Plan, and to educate GI TAC members;
- Conducted a variety of green infrastructure outreach activities, including various presentations by the Program Manager, a GI presentation to high schools, rain barrel program promotion, and social media posts.
- Began development of a Countywide Stormwater Resource Plan and supported the development of Proposition 1 implementation grant applications by the Cities of San Mateo and Redwood City that included a suite of multi-benefit stormwater projects.

More information on each of these accomplishments is provided below.

MRP Reissuance

SMCWPPP updated the Subcommittee at its three meetings on the progress and content of the draft and final reissued MRP, solicited feedback, and summarized comments provided by SMCWPPP and BASMAA to the Regional Water Board prior to the final adoption hearing on November 19, 2015. As noted below, the 2016 New Development Workshop provided an overview of the new requirements in the reissued MRP that became effective on January 1, 2016.

C.3 Implementation and Outreach Products

With the assistance of the Subcommittee, SMCWPPP developed, updated and/or assisted with the following technical and outreach products:

- Development Review Checklists – SMCWPPP made minor updates to the "C.3 and C.6 Development Review Checklist" (Word and Excel versions) and the Small Projects Checklist to make them consistent with new MRP requirements and to address Subcommittee comments. The revised checklists are posted on the SMCWPPP website (www.flowstobay.org).
- Biotreatment Soil Mix (BSM) Products – SMCWPPP developed and the Subcommittee approved an updated BSM Supplier List in August 2015. After the Water Board Executive Officer approved the new BSM specification on April 18, 2016 (see below), the BSM Specification Verification Checklist was also updated to be consistent with the new BSM specification. The documents are posted on the SMCWPPP website and provided in Appendix 3.
- C.3.h Inspection Report Forms – SMCWPPP prepared and the Subcommittee approved an updated operation and maintenance (C.3.h) inspection report form for permanent stormwater control inspections to address new MRP requirements and references and comments related to pervious pavement inspections. The form is posted on the SMCWPPP website and provided in Appendix 3.
- C.3 Stormwater Technical Guidance – SMCWPPP completed updates to the C.3 Stormwater Technical Guidance (C3TG) to be consistent with new requirements in the reissued MRP and include the following new or revised sections:
    - Updated guidance and specifications for pervious pavement and grid pavement;
    - A new recommended plant list for LID treatment measures (C3TG Appendix A);
    - The revised BSM Specifications, BSM Supplier List, BSM Specification Verification Checklist, and Certification Statement (C3TG Appendix K).

The updated C3TG (Version 5.0) was approved by the Subcommittee and SMCWPPP agency representatives in August and September 2016. The adoption of the C3TG's pervious pavement specifications provides compliance with Provision C.3.c.i.(2)(b) of the MRP, which requires Permittees to collectively, on a regional or countywide basis, develop and adopt design specifications for pervious pavement systems. The C3TG is posted on the SMCWPPP website at www.flowstobay.org/newdevelopment.

- C.3.a Guidance – SMCWPPP updated various guidance documents related to implementation of Provision C.3.a of the MRP, including outreach flyers for the development community and internal municipal documents for project review, to reflect changes in MRP requirements since 2009. The documents are available on the SMCWPPP internal website.
- Green Infrastructure Opportunities Guidance – SMCWPPP developed and provided guidance materials to member agency staff for the task of reviewing municipal projects for GI opportunities. The documents are posted on the training page of the SMCWPPP website.

2016 New Development (C.3) Workshop

The 2016 C.3 Workshop, entitled "Low Impact Development and Green Infrastructure: Don't Miss the Opportunity!" was held on June 14, 2016 at the City of San Mateo Public Library and was attended by 53 people. The full-day workshop started with "basic training" providing an overview of stormwater post-construction controls and the requirements that are in the newly reissued MRP. This was followed by a presentation on pervious pavement, including types of pavements and selection, construction, design, maintenance, and inspection tips. The next presentation provided an introduction to the requirements of a Green Infrastructure Plan and SMCWPPP countywide efforts to develop model language, products, and timelines to assist member agencies with development of their GI Plans. The day wrapped up with a group exercise practicing the two-step review of municipal projects for GI opportunities, using the guidance developed by BASMAA and a matrix for reviewing example projects. Copies of the workshop flyer, agenda, sign-in sheet, and evaluation form summary are provided in Appendix 3. Based on the evaluation forms submitted, attendees generally found that the workshop was valuable and met their expectations.

Green Infrastructure Plan

During FY 2015/16, SMCWPPP began to lead an effort to develop countywide GI Plan model documents and language for review, comment, and eventual use or modification by member agencies to meet the requirements of the MRP.

Green Infrastructure Technical Advisory Committee (GI TAC)

SMCWPPP worked with member agencies to form an ad-hoc GI TAC. The central purpose of the GI TAC is to ensure consistent jurisdictional involvement with and formal review and comment on work products prepared by SMCWPPP. The GI TAC is also providing input reflective of local issues, needs, and opportunities that should be taken into account in the development of the tools and model documents that will be used by local jurisdictions in their preparation of local GI Plans. The GI TAC plans to meet on a quarterly basis unless additional meetings are necessary for workflow and MRP deadline purposes.

Two GI TAC meetings were held in FY 2015/16, on April 12 and June 22, 2016, to explain elements of a GI Plan, the goals and intent of the GI TAC, model plan update materials, GI Plan workplan development, and deliverables and schedule. The agenda packages from these meetings are included in Appendix 3.

GI Plan Development

Member agencies have been provided an overview of what a GI Plan is, the various components needed to comply with the MRP, and milestone deadlines – the starting point for a GI Plan Workplan. An approach to develop countywide model documents for use and/or refinement by member agencies, and direction on how to achieve or complete other required elements, was presented to member agencies for review and comment. Multiple avenues of coordination and outreach are being used to ensure a consistent GI Plan approach is understood and accepted by all member agencies.

Green Infrastructure Outreach

SMCWPPP's Program Manager gave presentations on green infrastructure planning requirements in a variety of forums, as detailed below:

- Sustainable San Mateo County Water Summit (open to the public, part of SSMC's year-long look at Water as a key indicator of sustainability in San Mateo County, "Stormwater and Green Infrastructure," November 2015);
- C/CAG Board of Directors (21-member board of local elected officials, "The Revised Municipal Regional Permit," December 2015);
- Presentation to staff representatives for Assemblymembers Mullin and Gordon and Senator Hill on stormwater issues, including green infrastructure (December 2015);
- C/CAG Water Committee (elected officials and city managers, "Stormwater Management in San Mateo County," December 2015);
- C/CAG Stormwater Committee (C/CAG "Lobby Day" in Sacramento, presentations to local legislative delegation on stormwater, transportation, and green infrastructure issues, June 2016); and
- Sea level rise meeting (San Mateo County's joint meeting with its technical working group, policy advisory committee, and community task force, "Stormwater and Green Infrastructure," July 2016).

SMCWPPP performed additional green infrastructure outreach, as follows:

- Created and conducted high school presentation on GI as a solution to stormwater pollution;
- Promoted rain barrel rebate postcards and applications at all community events;
- Provided rain barrel rebate promotional materials to PIP members to disseminate to their residents;
- Brought Green Streets posters to community events and discussed with residents;
- Received 249 email sign ups from residents at community events specifically for GI updates;
- Between March and June, fourteen social media posts related to GI (examples included below), reaching 6,351 followers:
    - The Old County Rd. curb extensions in the City of San Carlos capture downward traveling stormwater from the nearby neighborhoods. Hooray to green infrastructure at work!
    - This boutique hotel coming to Menlo Park will be LEED certified and will include green design aspects such as solar panels and native plants http://bit.ly/1qHaJke

- Facebook's one-year-old, 9-acre green roof in Menlo Park may get some healthy competition from Cupertino. http://bit.ly/21zp2TC
- Green streets and parking lots are designed to convert stormwater from waste to a resource, used for watering plants and replenishing groundwater. Find out more about green infrastructure here: http://bit.ly/2917ekQ

Tracking and Reporting Progress on Green Infrastructure

SMCWPPP's progress on development and implementation of methods to track and report implementation of GI is described in a separate report (*Identifying Management Areas and Controls for Mercury and PCBs in San Mateo County Stormwater Runoff, SMCWPPP, September 30, 2016*) that was submitted to the Regional Water Board concurrently with this Annual Report.

San Mateo Countywide Stormwater Resource Plan

The Countywide Stormwater Resource Plan (SWRP) provides an ideal opportunity for SMCWPPP to proactively plan for GI planning and San Francisco Bay mercury and PCBs TMDL implementation requirements, while providing essential information needed to explore funding needs and opportunities (e.g., Proposition 1 grants) for project implementation. SMCWPPP is currently leading the development of the SWRP to address stormwater and water resources planning needs within watersheds of San Francisco Bay and the Pacific Ocean coast. Development of the SWRP has included:

- Compilation of GIS, hydrologic data, and reports to gain a thorough understanding of the watersheds and parallel planning efforts.
- Characterization of the physical and hydrologic watershed processes across the county.
- Screening of publicly owned parcels and street rights-of-way to identify opportunities for stormwater capture and GI projects, including onsite LID retrofit projects, green streets, and regional stormwater capture projects.
- Prioritization of projects based on a quantitative process considering: effectiveness for stormwater capture (e.g., imperviousness of drainage area, parcel size, soil type, slope); proximity to flood-prone channels, TMDL waterbodies, and potential PCBs risk areas; ability to co-locate the project with other city or county projects; and multiple benefits including potential to augment local water supplies, water quality source control, re-establishment of natural hydrology, creation or enhancement of natural habitat, or community enhancement.

This effort resulted in the identification of theoretical LID retrofit, Green Streets, and regional stormwater capture projects. The process has screened theoretical projects on public parcels within every city and unincorporated County jurisdictions and ranked them into high, medium, and low priority. Table 1 provides a summary of the parcels screened for planning evaluations. Theoretical projects reflect the understanding of watershed conditions given the available datasets and a desktop evaluation. Further evaluation and additional data gathering is necessary to determine if the theoretical projects represent viable project opportunities.

Table 3-1. Theoretical Public Parcel Projects Screening Results for Planning Evaluations

Ranking	Regional Stormwater Capture	Green Street	Low Impact Development
High	152	1,962	223
Medium	393	5,326	648
Low	740	9,066	1,049

The resulting prioritized list of potential projects provides an initial attempt to identify opportunities that can be considered (in combination with LID for new and redevelopment) for GI and TMDL implementation planning efforts to meet MRP requirements. For a subset of the highest priority projects, SMCWPPP developed conceptual designs to gain an understanding of technical and planning-level cost considerations for project implementation. Concept plans were developed for four LID retrofit projects, three regional projects, and 15 Green Streets. These concepts include maps of the proposed projects and associated drainage areas, information to support future designs, modeled estimates of stormwater capture volumes and mercury and PCBs loads reduced, and cost estimates. An example project concept of a Green Street retrofit project (Middlefield Streetscape in the City of Redwood City) is provided in Appendix 3. Presently, SMCWPPP is preparing the draft SWRP and planning for the associated public and stakeholder outreach efforts. The draft SWRP is expected to be available for public review in November 2016.

Proposition 1 Implementation Grant Applications – Early GI Opportunities

To take advantage of the early opportunity of funding for GI projects offered by the first round of Proposition 1 Water Board Implementation Grants, SMCWPPP supported the development of implementation grant applications by the Cities of San Mateo and Redwood City that included a suite of multi-benefit stormwater projects. These projects advance the goals of transforming the urban transportation infrastructure to integrate stormwater management systems that treat urban runoff as a resource and improve water quality in local creeks and San Francisco Bay, including helping to implement the Bay mercury and PCBs TMDLs.

- **City of Redwood City Sustainable Streets Project** proposes two GI locations: Middlefield Streetscape and Kennedy Middle School.
- **City of San Mateo Sustainable Streets and Parking Lot Project** proposes three GI locations: East Poplar Avenue, Beresford Park, and San Mateo Drive.

Collectively these projects will augment groundwater recharge, remove pollutants, and reduce the volume and velocity of stormwater runoff entering the storm drainage system and discharging into local creeks. The projects represent proactive implementation of GI while these cities develop their GI Plans required by the MRP. The project concepts presented in the Implementation Grant Applications are presented in Appendix 3. Implementation Grant award decisions are expected in the fall of 2016. SMCWPPP anticipates that the grant applications developed for Redwood City and San Mateo can serve as a framework customizable by other SMCWPPP member agencies for future grant opportunities.

Regional Collaboration

SMCWPPP participated in BASMAA's Development Committee (DC) throughout FY 2015/16, as in past years. Through the BASMAA DC, SMCWPPP participated in regional projects that assist SMCWPPP and its member agencies in meeting specific requirements of Provision C.3, as described below.

Biotreatment Soil Mix Specifications

SMCWPPP participated in the BASMAA DC BSM Work Group and assisted in the development of revisions to the BSM specification in the MRP. The revised specification was submitted by BASMAA to the Regional Water Board Executive Officer on February 5, 2016, and approved by the Executive Officer on April 18, 2016. The approved BSM specification is included in Appendix K of the updated C.3 Stormwater Technical Guidance, and is also provided in the FY 2015/16 BASMAA New and Redevelopment Regional Supplement (Appendix 11).

Biotreatment Soil Mix Specifications and Bioretention Design with Trees

As a result of the BSM specification work, the BASMAA DC BSM Work Group held a "Biotreatment Soil and Tree Roundtable" event on June 30, 2016 at the Regional Water Board offices in Oakland. SMCWPPP assisted with the Roundtable planning and logistics. The Roundtable was attended by 46 professionals representing a wide variety of disciplines involved in soil science, soil product supply, laboratory testing, urban forestry, and stormwater management, stormwater program managers, and Regional Water Board staff. The workshop started with a literature review of BSM specifications from other agencies and organizations on the West Coast and the issues concerning planting trees in BSM. The participants broke out into groups and discussed the various challenges and opportunities pertaining to trees and soil mixes for stormwater treatment, and then came back together to share observations and determine next steps. Attendees generally found that the event was valuable and that it met their expectations. Following the Roundtable, BASMAA's consultant (WRA Environmental Consultants) completed literature reviews on BSM Specifications and on Bioretention Design for Trees, which were approved by the BASMAA DC on September 1, 2016. The Roundtable agenda, sign-in sheet, and summary, and the two literature review reports, are provided in the FY 2015/16 BASMAA New and Redevelopment Regional Supplement in Appendix 11.

Municipal Project Review for GI Opportunities

SMCWPPP assisted the BASMAA DC CIP Review Work Group in the development of a guidance document entitled "Guidance for Identifying Green Infrastructure Potential in Municipal Capital Improvement Program Projects." This guidance assists permittees with the key task of reviewing their municipal projects for GI potential for the FY 2015/16 Annual Report and future reports, in compliance with MRP Provision C.3.j.ii. The final guidance is provided in the FY 2015/16 BASMAA New and Redevelopment Regional Supplement in Appendix 11.

Participation in Processes to Promote Green Infrastructure

BASMAA is part of a team with the San Francisco Estuary Partnership (SFEP) and San Francisco Estuary Institute (SFEI) that received a grant from US EPA's San Francisco Bay Water Quality Improvement Fund 2015 grant program to conduct the Urban Greening Bay Area (UGBA) project. One of the components of the project that BASMAA and its consultants will conduct is a Green Infrastructure Roundtable process to develop recommendations for integrating GI and stormwater management funding and investments with future climate change and transportation investments within the region. The Roundtable will include convening up to 12 meetings with local, regional, and state stakeholders, agencies, elected officials, and staff to produce draft and final task reports that will identify and recommend possible legislative fixes, agency agreements, consolidated funding mechanisms, and other means and actions as appropriate. The Roundtable is envisioned as a two-year effort using innovative participatory processes that will include key experts, regulators, decision-makers, and other stakeholders to share information,

solicit and discuss ideas and solutions, and to identify next steps which will be summarized in the draft and final task reports.

During FY 2015/16, BASMAA's accomplishments on the UGBA project included: finalization of the scope of work and development of contracts with EPA and SFEP; conducting an RFP process to obtain consultant services; building a task team of BASMAA, SFEP, EPA, Regional Water Board, and municipal representatives to further identify goals, desired outcomes, meeting formats, schedule, and Roundtable participants; developing a strategy for conducting the Roundtable meetings; preparing a project briefing sheet to help introduce the task to key stakeholders and encourage participation; and beginning informational interviews with key stakeholders. SMCWPPP is actively participating in the task team and its activities to plan the Roundtable meetings.

FUTURE ACTIONS

In FY 2016/17, SMCWPPP plans to continue working with the New Development Subcommittee to conduct the following activities to assist member agencies to comply with MRP Provision C.3:

- Continue to exchange information on MRP implementation and other timely issues with member agencies through quarterly New Development Subcommittee meetings and the annual New Development Workshop.
- Update checklists, outreach flyers, and the C.3 Technical Guidance Manual as needed to respond to member agency issues, concerns and suggestions for improvement.
- Continue to collaborate with BASMAA and other countywide stormwater programs to update the BSM specifications, BSM suppliers list and designs for biotreatment areas with trees. As budget allows, work with biotreatment mulch suppliers to develop better specifications for that product.
- Plan and conduct a New Development Workshop for municipal staff, to build on the training conducted in previous years, provide an update on GI Plan development and coordination and provide municipal staff opportunities to conduct practice reviews of development project plans (Spring 2017).
- Continue working with BASMAA on issues related to MRP implementation, particularly the GI requirements and related sections.
- Continue coordinating and working with member agencies on developing and refining countywide efforts on a GI Plan.
- Continue GI TAC meetings associated with the development of a countywide GI Plan effort, and work with the GI TAC to:
    - Begin development of prioritization criteria for GI project opportunities;
    - Develop and review a draft model workplan for development of GI Plans;
    - Begin development of model GI guidelines and standards; and
    - Develop draft model planning document update language.
- Support integration of GI supportive language in planning documents that member agencies are preparing or updating during the current permit term.
- Through the development of the San Mateo Countywide Stormwater Resource Plan, begin development of a GIS-based modeling tool for use in mapping, prioritizing, and phasing of potential and planned GI projects.

SECTION 4
C.4 INDUSTRIAL AND COMMERCIAL SITE CONTROLS

INTRODUCTION

An important goal of SMCWPPP's Commercial, Industrial and Illicit Discharge (CII) component is to assist member agencies control the discharge of pollutants in stormwater from commercial and industrial businesses to the maximum extent practicable. SMCWPPP member agencies are responsible for complying with various commercial and industrial business facility inspection requirements under MRP Provision C.4. SMCWPPP's CII component assists member agency staff with understanding these MRP requirements and develops various related tools, templates, reporting forms, and other MRP compliance support materials. SMCWPPP's CII component also assists with compliance with other MRP provisions that are discussed in other sections of this report (Sections 5, 13 and 15).

SMCWPPP's assistance with MRP Provision C.4 and other CII component provisions is coordinated through the CII Subcommittee.

IMPLEMENTATION OF MRP PROVISIONS

During FY 2015/16, SMCWPPP performed a number of tasks to assist member agencies with implementation of MRP Provision C.4, with input and assistance provided by the CII Subcommittee. Accomplishments included the following:

- Held three CII Subcommittee meetings;
- Conducted a CII training workshop;
- Organized a group subscription to the CASQA Industrial and Commercial Stormwater BMP Handbook Portal; and
- Assisted San Mateo County Division of Environmental Health (referred to as County Environmental Health, or CEH) transition to a new stormwater inspection database and with updating stormwater inspection agreements with some cities to reflect the reissued MRP requirements.

More information on each of these accomplishments is provided below.

CII Subcommittee

The CII Subcommittee met three times during FY 2015/16 to share information about MRP

requirements related to commercial/industrial facility inspections and methods for achieving compliance. The meetings provided the opportunity for municipal staffs to share their experiences with implementing MRP provisions related to the CII component, including Provision C.4. In addition, the meetings provide a forum for a CEH representative to discuss the status of CEH inspections and hear member agency feedback on the process, since many of the member agencies have agreements with CEH for CEH staff to conduct stormwater inspections of certain businesses. The agreements are for stormwater inspections at facilities that CEH already inspects for other reasons, including facilities with onsite hazardous materials and retail food facilities.

Ward Donnelly from the City of Daly City continued to chair the CII Subcommittee during FY 2015/16. Patrick Ledesma from CEH represented San Mateo County and some of the cities that have an agreement with CEH to conduct stormwater inspections of certain business facilities. Regional Water Board staff Devender Narala attended the March 16, 2016 Subcommittee meeting.

A FY 2015/16 subcommittee attendance summary table is included in Appendix 4. A majority of the subcommittee's four meetings were attended by staff from the Cities of Brisbane, Daly City, Half Moon Bay, Menlo Park, Redwood City, San Mateo, and South San Francisco and San Mateo County.

During FY 2015/16 Subcommittee meetings, Countywide Program staff focused on facilitating discussions about requirements that changed in the reissued MRP compared to the previous MRP and providing related guidance materials. SMCWPPP purchased a group subscription to the CASQA Industrial and Commercial Stormwater BMP Handbook Portal. Registration of municipal representatives was then coordinated through the Subcommittee. SMCWPPP also assisted CEH staff with the transition to a new stormwater inspection database with electronic (i.e., paperless) inspection forms. In addition, SMCWPPP assisted CEH with the process of updating the stormwater inspection agreements with some cities to reflect the reissued MRP requirements. The review also included a review of individual Cities' Enforcement Response Plans and Business Inspection Plans to determine if those documents met MRP requirements, and if the agencies had the explicit authority to contract with another agency (i.e., the CEH) for business inspections and to assess a stormwater inspection fee.

CII Training Workshop

The Commercial/Industrial/Illicit Discharge Inspector Training Workshop was held on June 1, 2016 at the City of San Mateo Public Library's Oak Room and was attended by 58 people. The workshop covered the following topics: reissued MRP requirements, facilities that CEH inspects, common BMPs, illicit discharge inspection basics, and a group exercise consisting of two inspection scenarios related to material storage and restaurant BMPs. Appendix 4 includes a copy of the workshop agenda, attendance list and evaluations summary. Based on the evaluation forms submitted, attendees generally found that the workshop was valuable and met their expectations.

FUTURE ACTIONS

FY 2016/17 activities planned by SMCWPPP to assist member agencies comply with MRP requirements in Provision C.4 include the following:

- Continue holding quarterly CII Subcommittee meetings.

- Assist member agencies with the implementation of commercial and industrial stormwater inspection tasks, including continuing to assist with business inspection plans and priorities, data management and enforcement response plans.

SECTION 5
C.5 ILLICIT DISCHARGE DETECTION AND ELIMINATION

INTRODUCTION

An important goal of SMCWPPP's Commercial, Industrial and Illicit Discharge (CII) component is to assist member agencies effectively prohibit the discharge of illicit, non-stormwater discharges to the municipal storm drain system. SMCWPPP member agencies are responsible for controlling non-stormwater discharges prohibited by MRP Provision C.5. SMCWPPP's CII component assists member agency staff with understanding these MRP requirements and develops various related tools, templates, reporting forms, and other MRP compliance support materials. There are additional MRP provisions that are implemented through SMCWPPP's CII component that are discussed in other sections of this report (Sections 4, 13 and 15).

SMCWPPP's assistance with the MRP provisions listed above is coordinated through the CII Subcommittee. Further details about the CII Subcommittee were provided in Section 4 of this report.

IMPLEMENTATION OF MRP PROVISIONS

During FY 2015/16, SMCWPPP performed a number of tasks to assist member agencies with implementation of MRP Provision C.5, with input and assistance provided by the CII Subcommittee. Accomplishments included the following:

- Revised the SMCWPPP Illicit Discharge Inspection Form template and data tracking table;
- Updated the table of mobile businesses with stormwater enforcement actions to share countywide with stormwater inspectors.

More information on each of these accomplishments is provided below.

Control of Mobile Businesses

Beginning in FY 2013/14, the CII Subcommittee surveyed San Mateo County agencies and compiled information on mobile businesses that have been subject to stormwater enforcement actions that year. This information was compiled in a table and made available on the password-protected section of the SMCWPPP website (www.flowstobay.org). The table is periodically updated with enforcement information. The table was updated twice during FY 2015/16. CII Subcommittee representatives were informed when each update was complete and available on the SMCWPPP website.

In FY 2012/13 the CII Subcommittee adapted a Mobile Business BMP brochure developed by the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) for use in San Mateo County. The brochure is available on the SMCWPPP website. During FY 2014/15 the CII Subcommittee worked with SMCWPPP's Public Information and Participation (PIP) Subcommittee to send an outreach message on Facebook in April 2015 aimed at mobile cleaner businesses with a link to the BMP brochure. During FY 2015/16 the SMCWPPP Illicit Discharge Inspection Form template and data tracking table were revised to include a mobile business category. This will facilitate reporting required in the FY 2016/17 Annual Report.

BASMAA has a long-standing Surface Cleaner Training and Recognition program that focuses on improving the use of BMPs for businesses that clean surfaces (i.e., sidewalks, plazas, parking areas and building exteriors). See the following BASMAA report for more information: *Annual Reporting for FY 2015-2016 - Regional Supplement for Training and Outreach* (Appendix 11). SMCWPPP member agencies have continued to refer cleaners to BASMAA's website for surface cleaning training materials. BASMAA continues to plan for an expansion of its surface cleaner training and recognition program to also include fleet washers and carpet cleaners. SMCWPPP staff and Subcommittee members provided comments to the BASMAA Municipal Operations Committee on draft carpet cleaning and transportation related cleaning mobile business BMPs in September 2014.

FUTURE ACTIONS

FY 2016/17 activities planned by SMCWPPP to assist member agencies comply with MRP requirements in Provision C.5 include the following:

- Continue holding CII Subcommittee meetings.
- Assist member agencies with the implementation of illicit discharge detection and elimination tasks, including continuing to assist with data management, enforcement response plans, and complaint tracking and follow-up.
- Help member agencies comply with the proposed requirements for controlling mobile sources described in MRP Provision C.5.e. This activity will include continuing SMCWPPP's programs related to mobile business BMPs and sharing enforcement information and outreach activities. SMCWPPP will also continue to participate in BASMAA's project to develop training and recognition materials for carpet cleaners and fleet washers.

SECTION 6
C.6 CONSTRUCTION SITE CONTROL

INTRODUCTION

This component of SMCWPPP assists member agencies in complying with MRP Provision C.6 (Construction Site Control). This assistance continued to be provided through the New Development Subcommittee (see Section 3 for more details about the Subcommittee). SMCWPPP staff also obtained input and direction from agency representatives through the Subcommittee when planning the trainings and other compliance assistance activities described below.

IMPLEMENTATION OF MRP PROVISIONS

SMCWPPP's accomplishments during FY 2015/16 include the following major tasks to assist member agencies with implementation of Provision C.6:

- Conducted a construction site controls training for the California Building Inspectors Group (CALBIG) on October 14, 2015;
- Printed 1,800 copies of the Construction Site Inspection Form and distributed them to the Subcommittee members; and
- Conducted the May 3, 2016 Construction Site Inspector Workshop.

CALBIG Training Meeting

In FY 2015/16, SMCWPPP continued its partnership with CALBIG, a group in which many building inspectors from SMCWPPP member agencies participate, and conducted a construction site controls training at the group's October 14, 2015 meeting. SMCWPPP staff gave a presentation on current stormwater requirements for construction sites, proper installation of construction BMPs, and tips for keeping construction inspection programs in compliance. Approximately 18 people attended the training, including agency inspectors, local stormwater program staff, and contractors. The meeting announcement, agenda and sign-in sheet are provided in Appendix 6.

Construction Site Inspection Form

In October 2015, SMCWPPP staff printed and distributed 1,800 copies of the Construction Site Inspection Report to SMCWPPP member agencies. In May 2016, the Subcommittee reviewed minor changes to the document which were approved in August 2016 and a new printing order was then scheduled. The updated document is included in Appendix 6.

2016 Construction Site Inspector Workshop

The 2016 Construction Site Inspector Workshop was held on May 3, 2016 at the City of San Mateo Public Library's Oak Room and was attended by 58 people. The morning session of the workshop began with a presentation by Water Board staff on inspection issues. The next presentation covered the following topics: requirements of MRP Provision C.6; differences between Provision C.6 and the Construction General Permit; the standard types of construction BMPs; and common issues during site inspections. The middle and end of the day focused on a new category of BMPs that use compost in various forms. The presentations discussed the various types of compost-based BMPs; differences between those BMPs and other products; installation and inspection tips; and lastly, experience from Caltrans comparing the effectiveness of various products on hillside and landscape restoration projects. Appendix 6 includes a copy of the workshop flyer, agenda, sign-in sheet, and evaluation summary. Based on the evaluation forms submitted, attendees generally found that the workshop was valuable, appreciated learning about the new compost-based BMPs, and indicated that it met their expectations.

FUTURE ACTIONS

In FY 2015/16, SMCWPPP staff plans to work with the New Development Subcommittee to conduct the following activities to assist member agencies comply with MRP Provisions C.6:

- Continue to exchange information with member agencies through quarterly New Development Subcommittee meetings and the annual Construction Site Inspector Workshop.
- Plan and conduct a Construction Site Inspector Workshop focusing on the new requirements in the MRP related to hillside projects, Enforcement Response Plans and/or other topics of interest to the Subcommittee.
- Continue to coordinate with partner organizations such as CALBIG to provide additional training on construction-related stormwater issues.

SECTION 7
C.7 PUBLIC INFORMATION AND PARTICIPATION

INTRODUCTION

The primary goals of SMCWPPP's Public Information and Participation (PIP) component are to:

- Educate the public about the cases of stormwater pollution and its adverse effects on water quality in local creeks, lagoons, shorelines and neighborhoods;
- Encourage residents to adopt less polluting and more environmentally beneficial practices; and
- Increase resident's participation and involvement in SMCWPPP activities.

PIP is essential for controlling and reducing the source of pollution since many preventable pollutants originate from everyday residential activity. Stormwater pollution may be reduced when residents are educated and motivated by the benefits of reducing pollutants. This approach of education and motivation is cost effective and efficient in meeting the goal of reducing pollutants in stormwater to the maximum extent practicable.

Summary of Accomplishments in FY 2015/16

The SMCWPPP PIP Subcommittee met two times in FY 2015/16 to oversee the development of educational materials and to guide the implementation of the PIP component of the program. A FY 2015/16 Subcommittee attendance summary table is included in Appendix 7.

SMCWPPP accomplished the following major public information and participation tasks during FY 2015/16:

- Distributed a total of 1,275 dog bag waste canisters during our Doggy Bag Giveaway Campaign from March-July 2016 in order to educate residents about the harmful effects of pet waste on our community and local waters and to encourage residents to pick-up after their pets and reduce the amount of harmful bacteria that flows into our waterways;
- Conducted 318 pet waste intercept surveys to uncover the major barriers and motivators for pet owners to properly dispose of waste and created a Pet Waste Pilot Program that provides action steps for the cities of San Mateo to implement as part of their pollution prevention efforts;
- Expanded the Car Wash Pollution Prevention Reward Program, in partnership with 11 car wash locations throughout the county, with redemption choices including text message and email paperless options. SMCWPPP recruited 2,755 text message subscribers and 1,248 email subscribers into the program and solicited over 750 discount redemptions;

- Doubled SMCWPPP's Facebook and Twitter followers: Facebook followers increased from 2,392 followers, starting on July 1, 2015 to 5,485 followers, ending on June 30, 2016. Twitter followers increased 673 followers starting on July 1, 2015 to 1,113 followers as of June 30, 2016;
- Collected 641 email newsletter signups from San Mateo County residents that SMCWPPP staff met during the nine public outreach and citizen involvement events attended this year;
- Coordinated Coastal Cleanup Day for San Mateo County at 55 sites, diverting an estimated 27,240 pounds of trash and 3,740 pounds of recyclables from waterways. Raised awareness of the event and litter issues throughout the county through various media coverage and social media and recruited an estimated 4,339 volunteers in 2015;
- Partnered with the Bay Area Water Conservation Supply Agency (BAWSCA) to promote a Rain Barrel Rebate program as a strategy to conserve water during the drought while reducing urban runoff pollution. Specific outreach efforts included posts on social media, content on the website, and disseminating applications at multiple outreach events. As a result of this partnership, over 784 rain barrel rebates have been issued within San Mateo County as of June 2016; and
- Conducted high school presentations entitled, "Introduction to Stormwater Pollution and Solutions." The presentations emphasize educating students on basic problems and solutions of stormwater pollution, green infrastructure solutions, and encourage students to become involved by educating others. A total of four presentations were conducted at three schools.

IMPLEMENTATION OF MRP PROVISION C.7

C.7.b. Outreach Campaigns

In FY 2015/16 SMCWPPP's PIP component focused on pet waste and carwashes as primary contributors to stormwater pollution. To address pet waste two campaigns were conducted, a dog waste canister giveaway and a research based pilot program which provides cities with a pilot program to implement in their city. To address carwash pollution a coupon program was conducted, increasing awareness and motivation for the use of eco-friendly carwashes over at home washing.

Dog Waste Canister Giveaway

Campaign Objectives

SMCWPPP continued a residential campaign to address pet waste pollution in the county; an extension of a previous pet waste campaign conducted in previous years. Our objectives for this program included:

1) Educate residents about the harmful effects of pet waste on our community and local waters, and; and
2) Encourage residents to pick-up after their pets and reduce the amount of harmful bacteria that flow into our waterways by providing them with a free dog waste bag canister.

Figure 7-1. Mailing Slip Included with Dog Waste Canister

A pet waste bag canister is a convenient way to carry pet waste bags and has proven to be an effective incentive to prompt dog owners to participate in a campaign, by providing an email address and pledging to pick up after their pet. Additionally, giving a canister to dog owners removes the barrier of not having a bag handy, making it easier to engage in the target behavior. See Figure 7-1 for the mailing slip included with the dog waste canister.

Campaign Promotion

SMCWPPP promoted the pet waste campaign on the program's website, Facebook page, local events where canisters were distributed, and through city newsletters (See Figure 7-2). SMCWPPP found that providing San Mateo County cities/permittees with promotional materials (such as the social media promotional image above and sample text) enabled them to easily spread the word of the campaign, maximizing reach and visibility of our campaign efforts. Here are some examples of our monthly promotional sample text:

Figure 7-2. Social Media Promotional Image for Dog Waste Canister Giveaway

- **Newsletter**
  - Do you pick up after your pooch? The San Mateo Countywide Water Pollution Prevention Program is giving away FREE dog waste bag canisters to county residents to help make it easier. Picking up after your pup keeps our neighborhoods clean and our creeks, ocean, and Bay free of harmful bacteria. Visit flowstobay.org/petwaste for your free bags!
- **Facebook Posts**
  - Keep our communities and waterways clean, San Mateo! Request a canister of dog waste bags at flowstobay.org/petwaste;
  - Stylish dogs wear dog waste bag canisters. Get yours for FREE at flowstobay.org/petwaste; and
  - Get a FREE canister of dog waste bags at flowstobay.org/petwaste. And thanks for picking up after your pet!

Campaign Results

SMCWPPP distributed a total of 1,275 canisters during March-July 2016 through: (1) distribution at community events throughout the county, (2) distribution at the PIP subcommittee meetings for permittees to distribute to their jurisdiction's residents, and (3) mailing to residents who requested on through the Program's website.

Community-Based Social Marketing studies have demonstrated commitment techniques, such as pledges, to be effective in promoting behavior change. A pledge changes the way individuals think about themselves in a way that increases the likelihood of sustaining behavior change. Pledges have also proven to be more effective when they are made publicly or acknowledged through a durable prompt. SMCWPPP also received a total of 243 emails and pledges from residents to "*pick up after my pet to do my part to help protect water quality*."

Pet Waste Intercept Surveys and Pilot Program

As pet waste is a major contributor to stormwater pollution in San Mateo County, SMCWPPP wanted to uncover the major barriers and motivators for pet owners to properly dispose of waste. With this knowledge SMCWPPP created a pet waste pilot plan that could be implemented anywhere in San Mateo County and promote proper disposal.

To uncover the barriers and motivators for proper waste disposal, SMCWPPP conducted intercept surveys in the city of San Mateo, Pacifica, and South San Francisco. The surveys examined several contributing factors; such as, frequency in which pet owners picked up after their pets in different environments and trash can availability. A total of 318 surveys were administered: 106 in each city.

The data from our intercept surveys then informed a community based social marketing pilot plan that provided action steps for the cities of San Mateo to implement the pilot as part of their pollution prevention efforts. This pilot plan included outreach to local vets and pet friendly businesses, suggesting that they be provided with branded pet waste canisters and bags to be handed out to residents. Social media marketing would provide promotion and contests to further involve the community.

Measurements of effectiveness are based on the number of local vets and pet friendly businesses participating in the program, the number of pet waste canisters provided to residents, and the number of social media fans and participants in promotional contests.

Copies of the Pilot Program and Intercept Survey Report can be found in Appendix 7.

Carwash Outreach Campaign

The Car Wash Program helped increase awareness of the hazardous pollutants that come from washing cars and promotes using car washes instead of washing cars at home. The program was designed to change the habits of car owners, moving them from at-home car washes to commercial car washes, and to develop water pollutant conscious attitudes.

SMCWPPP continued the car wash program in May 2016 and expanded reach with the addition of new partners and subscribers. The program was streamlined from previous years by creating a single 20%-off offer for all participating car washes for the entire 3-month period. By signing up for the SMCWPPP email list or the text message coupon list subscribers received a coupon each month, that could be used one time at any of the specified car washes in San Mateo County. SMCWPPP grew their email list by requesting emails from all text coupon subscribers. The Car Wash Program was set up to run from May 1 to August 31, 2016.

Car Wash Program

Campaign Partners:

- Continued to partner with Ducky's Car Wash in San Carlos, Menlo Park and San Mateo, Eagle Car Wash in Burlingame, Millbrae Express in Millbrae, South City Car Wash in South San Francisco, Eco Green Auto Clean in Redwood City, Redwood City Car Wash in Redwood City, San Mateo Car Wash in San Mateo, and Jack's Car Wash in San Mateo to provide monthly discounts that ranged from $5 off to a free exterior car wash; and

- Coordinated with the County of San Mateo to publish car wash pollution prevention messages and rewards to 56,380 out of the 285,901 households in San Mateo County logged onto NextDoor.com.

Campaign Promotion:

- Continued to encourage residents to opt into receiving paperless discounts via text message or email. Text message discounts were sent using a service called Call Loop. Residents signed up by texting the keyword "CARWASH" to 384-70. Subscribers that choose to receive discounts via email signed up by completing a web form on the website using a Constituent Relationship Management (CRM) System called Constant Contact;
- Recruited participants of the program by launching a series of social media posts on SMCWPPP social media platforms and by utilizing a partnership with the Health System social media platforms;
- Purchased a series of four newspaper advertisements in the San Mateo Daily Journal in an effort to recruit additional followers and promote the message that commercial car washes are the most sustainable method to keeping your car clean; and
- Communicated with car wash partners throughout the campaign to report records of the number of redemptions and the format in which the rewards were redeemed.

Campaign Results:

- Recruited 2,755 text message subscribers and 1,248 email subscribers into the program;
- Solicited over 750 discount redemptions with approximately 579 redemptions validated utilizing the electronic coupons (Table 7-1);

Table 7-1. Car Wash Program Partner Discount Tracking through October 2015

	Dicount:	$5 Off				$5 Off			
	Date:	July 23 - August 10				September 26 - October 13			
Car Wash Partner		Electronic (Text or Email)	Printed Email or Text Message	Hardcopy Bus Cars	Total	Electronic (Text or Email)	Printed Email or Text Message	Hardcopy Bus Cars	Total
Ducky's San Mateo		-	4	-	4	14	2	3	19
Ducky's San Carlos		-	4	-	4	77	3	0	80
Ducky's Menlo Park		-	4	-	4	1	0	0	1
Millbrea Express Car Wash		8	4	3	15	4	0	0	4
South City Car Wash		37	6	1	44	19	8	0	27
Eagle Car Wash Burlingame		6	0	0	6	5	0	0	5
San Mateo Car Wash		10	10	4	24	0	2	0	2
Redwood Car Wash		0	3	0	3	1	2	3	6
Eco Green Auto Clean		0	0	0	0	0	0	0	0
Jack's Car Wash		250	0	0	250	8	0	0	8
Redemption by Type Total		311	35	8		129	17	6	
Montly Totals					**354**				**152**

- Coordinated with Eco Green Auto Clean to provide free waterless car wash vouchers to residents that subscribe to the reward program or have access to NextDoor.com. Free vouchers were disseminated to text message subscribers on October 12, on Nextdoor.com on October 19th, and to email subscribers on October 26th. The free voucher is valid for one month from launch date; and
- Exported car wash subscriber lists from Call Loop and Constant Contact and uploaded both contact lists onto Google Drive.

May 1, 2016 – June 30 Car Wash Program

- Program was paused during the winter months and then reinstated starting May 1, 2016; due to transition of consulting firms.

Campaign Partners:

- Continued to partner with Ducky's Car Wash in San Carlos, Menlo Park and San Mateo, South City Car Wash in South San Francisco, Millbrae Express in Millbrae, Jack's Car Wash in San Mateo, San Mateo Car Wash in San Mateo, Redwood City Car Wash in Redwood City, Eco Green Auto Clean in Redwood City, Westlake Touchless Car Wash in Daly City, and Touchless Car Wash in Foster City and provided monthly discounts of 20% off a car wash; and
- Communicated with car wash partners throughout the campaign to report records of the number of redemptions.

Campaign Promotion:

- Continued to encourage residents to opt into receiving paperless discounts via text message or email. Text message discounts were sent using a service called Call Loop. Residents signed up by texting the keyword "CARWASH" to 38470. Subscribers that chose to receive discounts via email signed up by completing a web form on the website using an Email Server Provider (ESP) called MailChimp;
- Coordinated monthly emails and text blasts at the beginning of each month with a new car wash coupon design;
- Recruited participants of the program by launching a series of social media posts on SMCWPPP social media platforms and utilizing Facebook Campaigns to promote website clicks and car wash coupon conversions (Table 7-2); and

Table 7-2. May 1, 2016 – June 30 Car Wash Program Facebook Ad Conversion Campaign Totals

Facebook Ad Conversion Campaign Totals		
Link Clicks	Conversions	Total Spent
1157	19	$202.87

- Displayed promotional poster at the SMCWPPP booth present at the San Mateo County Fair.

Campaign Results:

- Recruited 59 text message subscribers and 74 email subscribers into the program (Table 7-3).

Table 7-3. May 1, 2016 – June 30 Car Wash Program Electronic Conversions

Electronic Conversions			
	May	June	Total
Text	8	51	59
Email	24	50	74
Monthly Total	32	101	

- Collected approximately 32 redemptions validated utilizing the electronic coupons (Table 7-4).

Table 7-4. May 1, 2016 – June 30 Car Wash Program Partner Tracking

Car Wash Partner Tracking 2016		
Car Wash Partner	May	June
Ducky's San Mateo	0	1
Ducky's San Carlos	0	1
Ducky's Menlo Park	0	12
South City Car Wash	0	0
Millbrea Express Car Wash	1	0
Jack's Car Wash	0	1
San Mateo Car Wash	0	9
Redwood Car Wash	0	0
Eco Green Auto Clean	0	0
Westlake Touchless Car Wash	1	5
Touchless Car Wash	1	0
Montly Totals	3	29

C.7.c. Stormwater Pollution Prevention Education

Website Flowstobay.org as a point of contact:

The Program continued to maintain the Flows to Bay website (www.Flowstobay.org) as the central point of contact. The website was updated several times a month to ensure that Program updates and contact information was up-to-date. These updates included changes to page text, images, newsletter functionality, and redesigns of pages, including, the car wash page and newsletter page. Regular maintenance and updates were also performed on the Program's "members only" pages for committee members, such as the PIP committee.

Work and maintenance on the website included:

- Replaced pollutionprevention@smcgov.org with info@flowstobay to use as the new SMCWPPP email point of contact;

- Programmed SMCWPPP incoming emails to be forwarded from Environmental Health Services' inbox to the contract manager's email account;
- Updated the website with a new email and phone number to display as the new primary point of contact starting November 1, 2015;
- Redesigned the newsletter page and integrated it with the email marketing service MailChimp;
- Added new MailChimp newsletter sign up information to the website side bar to encourage email newsletter sign ups;
- Redesigned the car wash campaign page to aid public education efforts and make the car wash campaign information more accessible;
- Provided resources for 18,946 users who went to an average of 2.2 pages (Unique Page Views/Unique Users), allowing them to engage with content related to multiple topics (see Table 7-5);
- Updated trainings page with latest reports and updates to provide transparent agency updates for the general public;
- Updated pet waste page to allow general public to request dog waste collection bags by using a simple form, thus streamlining the process for the general public and the Program;
- Created dog waste collection bag request form; and
- Regularly updated events on website on a bi-monthly basis.

Additional website activities:

- Monitored website visits on a daily and monthly basis; and
- Used monthly data to inform decisions about which improvements to make to specific pages, for example the newsletter page.

Table 7-5. Total statistics for website total visits, unique users, page views, and other significant website metrics for the 2015-2016 fiscal year.

Time Period	Sessions (Total Visits)	Users (Unique)	Page Views (Unique)	New Visitors %	Returning Visitors %	Overall Bounce Rate
July 1, 2015 - June 30, 2016	28,459	18,946	41,785	36%	64%	58%

Social Media Points of Contact

In addition to the website, SMCWPPP has established Facebook and Twitter social networks. These platforms were used as two-way communication tools that have emerged as an effective strategy to engage with residents in the absence of face-to-face interactions. Both social media platforms experienced a significant increase in followers this reporting period. Facebook followers increased from 2,392 fans, starting on July 1, 2015 to 5,485, ending on June 30, 2016. Twitter followers increased 673 followers starting on July 1, 2015 to 1,113 as of June 30th 2016.

The platforms were primarily used to inform the public of environmental outreach events, and to promote a shift towards incorporating sustainable behaviors into daily lifestyles. The accounts were monitored on a daily basis throughout the fiscal year. As part of the overall effort to enhance social presence and engagement with followers, several themed posts were created and aired during FY 2015/16. Relationships with other nonprofit and local agency coordinators were also established to routinely cross promote content and enhance social media.

The following is a breakdown of steps and results associated with social media activity for FY 2015/16:

- Continued utilizing Facebook and Twitter as a two-way communication tool to share and exchange information between SMCWPPP residents, businesses, non-profits, and community stakeholders within San Mateo County on pollution prevention messages. Specific program messages included watershed protection, household hazardous waste, and used motor oil & filter recycling content;
- Continued to utilize Facebook as SMCWPPP's advertising platform to further messages;
- Generated daily posts, monitored the page for engagement, and routinely visited stakeholder pages for potential opportunities to cross promote content;
- Continued to evaluate social media insights on Facebook and Twitter (see Tables 7-6 through 7-11);
- Facebook followers increased from 2,392 fans starting on July 1, 2015 to 5,485 as of June 30, 2016 (+3,093 fans);
- Twitter followers increased from 673 followers starting on July 1, 2015 to 1,113 as of June 30th 2016 (+440 followers); and
- Twitter content garnered 228,711 impressions between the dates of July 1, 2015 – June 30, 2016.

Table 7-6. Facebook Insights July 1, 2015 - October 31, 2015

	July	August	September	October	TOTAL
Total Page Likes	2,477	2,731	3,013	3,030	+638
Daily Total Reach	37,572	49,940	63,492	25,362	176,366
Lifetime Total Reach	30,838	29,734	47,194	24,771	132,537
Daily Total Impressions	59,571	68,174	89,278	37,614	254,637
Link Clicks	97	108	455	60	720
Video & Photo Clicks	302	388	577	380	1,647
Likes	1,041	925	1,391	966	4,323
Comments	144	101	174	72	491
Shares	218	159	290	110	777

Table 7-7. Facebook Insights November 1, 2015- February 29, 2016 (Transition Months)

	November	December	January	February	TOTAL
Total Page Likes	3,026	3,018	3,018	3,012	-18

Table 7-8. Facebook Insights March 1, 2016- June 30, 2016

	March	April	May	June	TOTAL
Total Page Likes	3,677	4,460	4,893	5,485	+2,473
Number of Posts	19	22	21	24	86
Lifetime Total Reach	7,554	10,504	7,029	12,809	37,896
Likes	195	283	178	228	884
Comments	6	4	6	16	32
Shares	34	45	35	49	163

Table 7-9. Twitter Insights July 1, 2015- October 31, 2015

	July	August	September	October	TOTAL
Total Followers	698	710	N/A	729	+56
Engagement	125	78	168	47	418
Engagement Rate	0.02%	0.01%	0.02%	0.01%	N/A
Retweets	24	10	24	6	64
Replies	4	0	2	0	6
Favorites	18	22	46	12	98
Impressions	10,375	5,059	8,024	3,938	27,396
Hashtag Clicks	4	2	2	3	11
URL clicks	22	22	20	11	75

Table 7-10. Twitter Insights November 1, 2015- February 29, 2016 (Transition Months)

	November	December	January	February	TOTAL
Total Followers	728	732	744	749	+20
Engagement Rate	1.1%	0.2%	0.9%	0.3%	N/A
Retweets	0	0	1	0	1
Replies	4	1	0	1	6
Favorites	0	0	6	2	8
Impression	1,165	985	1,267	1,198	4,615
URL clicks	0	2	3	1	6

Table 7-11. Twitter Insights March 1, 2016- June 30, 2016

	March	April	May	June	TOTAL
Total Followers	851	972	991	1,089	+340
Engagement	57	109	73	139	378
Engagement Rate	0.3%	0.4%	0.4%	0.8%	N/A
Retweets	4	17	10	26	53
Replies	2	4	2	4	12
Favorites	23	20	9	36	88
Impressions	71,600	68,500	21,300	35,300	196,700
URL clicks	21	34	17	38	110

In addition to the standard Facebook and Twitter social media activity, Facebook and Twitter Ad Campaigns were run from March 15 – June 30, 2016. These campaigns increased SMCWPPP's reach to potential community members through the use of audience location and interest analytics. Specific ads were created for targeted audience group on both social media platforms and were run on an appropriate monthly budget approved by SMCWPPP. Both social media ad campaigns experienced a significant increase in followers this reporting period. Facebook received 2,425 new fans from the ad campaign, starting on March 1, 2015 and ending on June 30, 2016. Twitter received 309 new fans from the ad campaign, starting on March 1, 2015 and ending on June 30, 2016.

The following is a breakdown of steps and results associated with social media ad campaigns for FY15-16 (See Table 7-12 and Table 7-13 for the results and costs of the social media ad campaigns):

- Ran Facebook ads: March 15 – April 15
    - March- April Campaign: Tested 5 different target audiences:
        - Pet Owners
        - Water Conservation
        - General/Pride
        - Green Infrastructure
        - DIY/Gardener
    - Ran a total of 20 ads
        - Most successful audience was "Water Conservation" (551 likes, $0.64) followed by "Pet Owners" (371 likes, $0.94), and "General Pride" (364 likes, $0.96)
- Ran Facebook ads: May 18th - June 18th
    - May- June Campaign: Tested 3 different target audiences:
        - General/Pride;
        - Pet Owners; and
        - Water Conservation
    - Ran a total of 12 ads

- Most successful audience was "Water Conservation" (418 likes, $0.48) followers by "General/Pride" (317, $0.63)

- Ran Twitter ads: March 15- June 30
  - A successful followers campaign is between 0.1% and 0.3%
  - 155K total impressions with 638 engagements were made within that time period

Table 7-12. FY 2015/16 Social Media Ad Campaign Results and Costs – Facebook

	Fans (Page Likes)	Reach	Cost Per Page Like	Amount Spent
March 15 - April 15, 2016	1,405	58,255	$0.86	$1,203.32
May 18 - June 18, 2016	1,020	17,644	$0.59	$600
TOTAL	2,425	75,899	N/A	$1,803.32

Table 7-13. FY 2015/16 Social Media Ad Campaign Results and Costs - Twitter

	Followers	Follower Rate	Cost Per Result	Spent
March 15- June 30, 2016	309	0.2%	$3.09	$920.91

C.7.d. Public Outreach and Citizen Involvement Events

SMCWPPP directly participated in nine public outreach and citizen involvement events in FY 15-16 in order to reach a wide array of residents in different parts of the county at popular events, such as Earth Day festivals, the San Mateo County Fair and Coastal Cleanup Day. To maximize resources, SMCWPPP also partnered with other county environmental agencies (including San Mateo County Environmental Health and the Office of Sustainability) and the individual permittees to distribute our outreach materials at events they attended.

SMCWPPP used online channels, such as Facebook, Twitter, Instagram, and flowstobay.org, to promote events, gather volunteers and identify champions for the events. In addition, SMCWPPP collected a total of 641 signups from San Mateo County residents to our email marketing program from the events SMCWPPP staffed.

Outreach Goals

- Educated residents through personal interaction and educational materials;
- Built a database of residents interested in stormwater issues;
- Provided a platform for residents to engage with SMCWPPP messages, projects and initiatives; and
- Developed outreach partnerships and shared outreach points talking guide with county agencies and local nonprofits.

List of Events and Metrics

A list of public outreach and citizen involvement events held in San Mateo County in FY 2015/16 is shown in Table 7-14 with the estimated attendance, eNewsletter signups, and estimated reach.

Table 7-14. FY 2015/16 Public Outreach and Citizen Involvement Events and Metrics

Dates Staffed	Event Location	Event Name	Type of Event	Est. Event Attendance	eNewsletter Signups	Estimated Reach
Sep 19, 2015	San Mateo County	Coastal Cleanup Day	Citizen Involvement	4,339 Volunteers	N/A	N/A
Sep 26, 2015	Pacifica	Fog Fest	Public Outreach	500	N/A	200
Jan 30, 2015	South San Francisco	SeaChange SMC Open House	Public Outreach	400	60	100
Apr 16, 2016	Redwood City	Earth Day on the Bay	Public Outreach	1,500	86	120
Apr 21, 2016	Redwood City	Seaport Centre Earth Day	Public Outreach	500	103	120
Apr 22, 2016	San Mateo	Earth Day at the College of San Mateo	Public Outreach	750	109	120
Apr 23, 2016	Pacifica	Earth Day of Action and EcoFest	Citizen Involvement	750	91	115
Apr 26, 2016	South San Francisco	Oyster Point Marina Plaza Green Fair	Public Outreach	250	109	120
Jun 11-19, 2016	San Mateo	San Mateo County Fair	Public Outreach	2,000	83	200 (in person)

Outreach Materials

The following SMCWPPP items were given out at outreach events and by request to jurisdictions, organizations, and residents in San Mateo County:

- "You're the Solution" stormwater brochure, English and Spanish;
- Keychain and car ashtrays;
- Four children's activity books: "Pest or Pal" (OWOW), "Watershed Protection," "Stormwater," and Don't Be a Litterbug;
- Children's promotional materials with SMCWPPP logo/messages: pencils, fish and water drop erasers, crayons;
- General promotional materials with SMWPPP logo/messages: reusable bamboo utensils, stainless steel water bottles, fish carabiner, sunglasses, lunch bag, reusable chico bag, sunglasses, carabiner;
- "Dirty Dozen & Clean Fifteen" pocket guide to pesticides and produce;
- OWOW fact sheets and "Pests Bugging You?" booklet of fact sheets;
- OWOW Low-flow hose nozzles;
- "Too Toxic to Trash" comprehensive toxics disposal and pollution guide, English and Spanish;
- "Less Toxic Cleaning Alternatives" fact sheet, in English and Spanish;
- The Healthy Home and Garden Booklet;

- Used Oil and Filter Recycling Options postcard;
- Linked for Life list of recycling used oil and filter locations, in English and Spanish;
- Kids Backyard Bugs Brochure;
- OWOW gardening gloves;
- Rain Barrel Rebate application and post cards;
- Pet waste tip card/ fact sheet;
- Dog waste bags canisters; and
- New outreach materials listed below.

New Outreach Materials Developed This Year

During FY 2015/16, SMCWPPP developed the *SMCWPPP Stormwater Tip Card*, a new outreach material for use at outreach events and on social media. Appendix 7 contains a copy of the Tip Card.

Coordination of California Coastal Cleanup Day - September 19, 2015

California Coastal Cleanup Day, held each year on the third Saturday in September, is the largest volunteer event in the state. The California Coastal Commission sponsors the event with the support of County and Regional Coordinators. SMCWPPP coordinated the event for the tenth year in San Mateo County, recognizing that this event is a great opportunity to get many residents of all ages actively involved with the problems associated with litter. This event qualifies as both a Public Outreach Event and Citizen Involvement Event. In preparation for the event the following tasks were completed this fiscal year:

Coastal Cleanup Day Highlights

- Disseminated assorted collateral pieces created by the California Coastal Commission (poster and postcards) to public schools, libraries, community centers, non-profit organizations, churches, youth groups, and site captains throughout the County;
- Drafted a Coastal Cleanup Day (CCD) article in the "Pollution Prevention Post" newsletter (Fall 2015) that informed residents about the event and where to find a location list of cleanup sites in San Mateo County;
- Coordinated with local newspapers to publish articles leading up to the event:
    - Local Patches (one example: http://patch.com/california/redwoodcity-woodside/join-your-fellow-californians-keep-our-coast-clean);
    - San Mateo County Times (http://www.mercurynews.com/san-mateo-county-times/ci_28830752/el-nino-brings-urgency-coastal-cleanup-day-volunteers) and (http://www.mercurynews.com/carolyn-livengood/ci_28794437/carolyn-livengood-bay-area-heart-walk-planned-raise);
    - San Mateo Daily Journal (http://www.smdailyjournal.com/articles/lnews/2015-09-18/being-good-stewards-saturday-is-coastal-cleanup-day-groups-seek-to-prepare-for-el-nino/1776425150363.html);

- Created a CCD web page (www.flowstobay.org/ccdcloations) that provided residents with event information and site locations utilizing Google Maps. The web page received 2,653 visits by the date of the event;
- Sent notifications to all public schools notifying teachers and staff about opportunities to support Coastal Cleanup Day, including an option to conduct a cleanup on the Friday prior to CCD. Over 600 students participated from 6 public schools (1 high school, 2 middle schools 3 elementary schools) in the cities of Daly City, Hillsborough, Menlo Park, Millbrae, San Mateo, and South San Francisco;
- Recruited three new sites in 2015: Posy Park in San Bruno, Redondo Beach in Half Moon Bay, and Tunitas Creek Beach;
- Coordinated with 29 site captains to host 55 cleanup sites Countywide. There were over 39 sites located along the Coast, and 16 sites along the San Francisco Bay; and
- Recruited a total of 4,339 volunteers to participate. Volunteers picked up 27,240 pounds of trash and 3,740 pounds of recyclables. An estimated 320,535 pounds of debris has been removed since 2005 (See Figure 7-3).

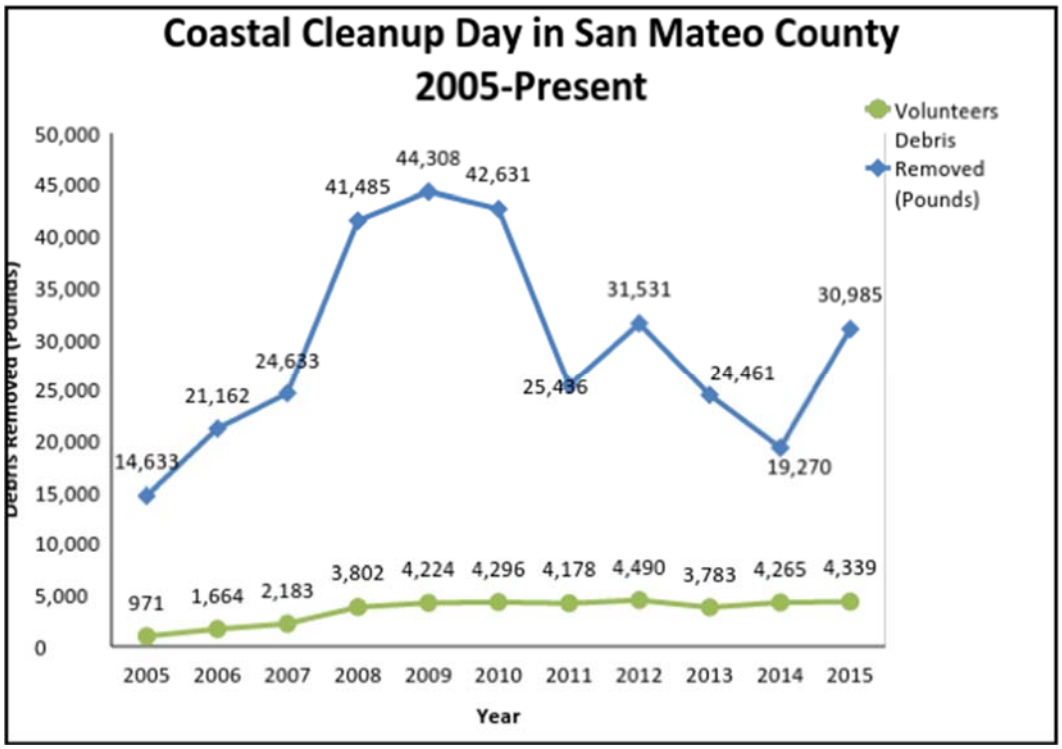


Figure 7-3. Debris Removed on Coastal Cleanup Day in San Mateo County from 2005 through 2015

C.7.e. Watershed Stewardship Collaborative Efforts

Rain Barrel Rebate Program

Program Objectives and Results

As a result of the California drought and in an attempt to pursue alternative approaches to public engagement, SMCWPPP partnered with the Bay Area Water Supply Conservation Agency (BAWSCA) in 2014 to implement a pilot countywide Rain Barrel Rebate Program. During FY 2015/16, SMCWPPP continued its partnership with BAWSCA to promote a Rain Barrel Rebate Program that subsidizes the cost of purchasing a rain barrel by providing rebates up of to $100. The program objectives include: 1) educate residents about the benefits of rain barrels to water conservation and water quality efforts, 2) promote green infrastructure tools for keeping local waters clean, and 3) encourage residents to participate in the Rain Barrel Rebate Program. 482 barrels were installed in FY 2015/16, with a total of 810 installed since program inception in October 2014.

Partnership with BAWSCA

Prior to this partnership, the only agency in San Mateo County offering rain barrel rebates was the City of Millbrae. C/CAG provided BAWSCA with an additional $25,000 in FY 2015/16 to subsidize the rebates for San Mateo County residents, which, like BAWSCA's other water conservation programs, is a subscription-based program in which BAWSCA's member agencies (water supply agencies that receive water from the San Francisco Public Utilities Commission) can choose to participate. The program provides rebates for up to two rain barrels for single-family residential and four for multi-family/commercial properties. C/CAG's funding provides rebates of $50 per barrel, countywide. Rebates are matched (total of $100 per barrel) in areas of the county where a water supply agency is participating in the program.

Program Promotion

Promotional efforts for the program included the creation of a postcard and poster, and partnering with BAWSCA to print a brochure with a hard copy application enclosed. Postcards, applications, and the poster were displayed at outreach events. SMCWPPP raffled out a rain barrel at the SeaChanges SMC Open House on 1/30/16 as a strategy to expand the reach of the program. In addition, multiple posts were created on social media highlighting a variety of rain barrels eligible for the rebate program and rain barrel workshops (See Figure 7-4). These posts were also shared with Permittees in a monthly newsletter to expand the program's visibility through local channels:

Figure 7-4. Rain Barrel Rebate Program Promotion

- **Newsletter**
    - Harvesting rainwater with the help of a rain barrel is one of the simplest ways to lighten your water footprint, fight pollution, and prevent flooding. San Mateo residents who buy and install qualifying rain barrels can collect rebates of up to $100 per barrel. More than 700 of these low-cost rain barrels have been installed in our County to date. Join the movement! Visit www.flowstobay.org/rainbarrel for rebate information, plus tips on installation and keeping your rain barrel ship-shape;

- **Facebook Posts**
    - One inch of rain can turn into 625 gallons of water. Capture every drop with a rain barrel--and get a rebate up to $100! flowstobag.org/rainbarrel;
    - Get ready for next year's rainy season. Join the rain barrel rebate program and get $100 off your next barrel! flowstobay.org/rainbarrel.

San Mateo Countywide Outreach Collaboration

SMCWPPP worked alongside San Mateo County's Office of Sustainability and Environmental Health Departments to share resources and outreach materials and align our environmental outreach efforts throughout FY15-16. These efforts were intended to make it convenient and easy for San Mateo County residents to learn more about the various environmental programs the county offers. Our efforts included: (1) providing SMCWPPP outreach materials to the other county environmental departments to bring to outreach events SMCWPPP did not staff, (2) devising a comprehensive summary of County of San Mateo Environmental programs (see Appendix 7) for residents, and (3) collaborating to create a County Environmental corner at the San Mateo County Fair.

Cigarette Butt Litter Reduction Pilot Study

In an effort to help reduce cigarette butt litter, the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP) partnered with San Mateo County Environmental Health Services (EHS) to launch the Cigarette Butt Litter Reduction Pilot Study. The study primarily assessed what strategies are effective at shifting littering behaviors in San Mateo County. SMCWPPP also collaborated with the cities of San Bruno, Pacifica, Belmont, Burlingame, Pillar Point Harbor in Half Moon Bay, and Oyster Point Marina in South San Francisco to host a total of 44 data collection test sites within the County from April – October 2015. Signs and cigarette butt disposal receptacles are the most frequently used tools to mitigate cigarette butt litter. While studies indicate that receptacle installations correlate to lower rates of cigarette butt littering, the cigarette butt pilot was designed to determine if receptacles and/or signs were effective in reducing cigarette butt litter in San Mateo County.

C.7.f. School-Age Children Outreach

Overview

Through SMCWPPP's School Outreach Program, high school students had the opportunity to learn about stormwater pollution, green infrastructure, and how they can contribute to the solution in a one-hour lesson. The lesson included a 5-min pre-lesson assessment, a 25-minute presentation, a 30-minute in-class activity that will enable students to engage with the material hands-on, and a 10-minute post-lesson assessment to check the students' understanding and conclude the lesson.

Lesson Plan

Part I. Pre-Lesson Assessment:

- Goal: Assess students' existing knowledge of stormwater pollution and solutions.

Part II. Introduction to Stormwater Pollution and Solutions Presentation:

- Goal: Educate students on stormwater pollution causes and effects, showcasing innovative GI projects spearheaded by SMCWPPP and provide ways for students to help stop pollution.

Part III. Green Infrastructure Planning Activity:

- Goal: Provide students with a hands on opportunity to participate in a mock green infrastructure design contest and interact with the presentation material in small groups.

Part IV. Post-Lesson Assessment:

- Goal: Assess students' grasp of the lesson objectives and gather student feedback on the lesson.

Part V. Community Event Sign-ups:

- Goal: Collect sign-ups to engage students in opportunities to participate in local cleanup events and apply what they learned in the presentation to improve their community.

Outcomes

- 4 Lessons delivered;
- 63 Students reached;
- 43% Pre-lesson quiz score;
- 89% Post-lesson quiz score; and
- 21 Community events sign-ups.

Results: Quiz Scores

Lesson Objective: Our lesson objective was for students to be able to correctly answer the following three questions:

- What's the problem with stormwater and urban runoff?
- How is green infrastructure a solution to stormwater pollution?
- How can they be a part of the solution to the pollution in their everyday lives?

The students received an average of 43% on the pre-lesson quiz, which tested the students' existing knowledge on the above questions. After our four school presentations, the students received an average of 89% on the post-lesson quiz and demonstrated their mastery of the lesson objectives (See Table 7-15).

Table 7-15. FY 2015/16 School-Age Children Outreach Lesson Results

School	Teacher	Pre-Lesson Quiz Score	Post-Lesson Quiz Score
Woodside High	Davina Ortiz	37%	86%
Aragon High	Megan Thaler	50%	94%
Woodside High	Marin Aldrich	39%	87%
J. Serra High	Allison Phillips	45%	88%
Average		43%	89%

FUTURE ACTIONS

In FY 2016/17, SMCWPPP plans to continue working with the PIP Subcommittee to conduct the following activities to assist member agencies to comply with MRP Provision C.7:

- Continue to grow reach, engagement, and following of all SMCWPPP social media platforms;
- Conduct outreach and involvement events as specified in the MRP;
- Maintain and update SMCWPPP's www.flowstobay.org website as needed;
- Continue Rain Barrel Rebate Program with BAWSCA, with C/CAG providing an additional $25,000;
- In upcoming years, SMCWPPP will build upon partnerships and expand the school outreach program to reach a larger portion of school aged children throughout San Mateo County, in accordance with our Five-Year Strategic Outreach Plan; and
- Implement a litter prevention pilot program, including researching barriers and motivators for proper disposal of trash and designing an outreach campaign for San Mateo County residents to reduce litter.

SECTION 8
C.8 WATER QUALITY MONITORING

On behalf of it member agencies, SMCWPPP performs water quality monitoring activities in compliance with MRP Provision C.8. Some of this work is accomplished through participation in BASMAA regional projects. Per Provision C.8, a complete documentation of all water quality monitoring data collected from October 1, 2015 through September 30, 2016 (i.e., Water Year 2016 or WY2016) will be presented in SMCWPPP's Urban Creeks Monitoring Report, which will be submitted to the Water Board by March 31, 2017.

In addition, in accordance with MRP Provision C.8.f., Pollutants of Concern (POC) Monitoring, SMCWPPP will submit by October 15, 2016 a report describing the planned allocation of sampling effort for POC Monitoring for WY2017 and what was accomplished for POC Monitoring during WY2016. The report will include monitoring locations, number and types of samples collected, a description of the objectives of the sampling (i.e., management question addressed), and the analytes measured. However, per Provision C.8.h., the results of the monitoring will not be included, but instead will be documented in the Urban Creeks Monitoring Report, as described above.

SECTION 9
C.9 PESTICIDE TOXICITY CONTROLS

INTRODUCTION

The primary objective of MRP Provision C.9 Pesticides Toxicity Control is to prevent the impairment of urban streams by pesticide-related toxicity, and thereby implements requirements of the *TMDL for Diazinon and Pesticide-related Toxicity for Urban Creeks* in the San Francisco Bay region. Permittees are required to implement a pesticide toxicity control program that addresses their own use of pesticides and use by others within their jurisdictions. The focus is on pesticides that pose a threat to water quality, including applications with the potential to enter the municipal stormwater conveyance system.

Most MRP-required Provision C.9 tasks are implemented individually by each SMCWPPP member agency. SMCWPPP helps agency staff to understand MRP requirements and develops various tools that assist agency staff to effectively plan, implement, and report on compliance activities. SMCWPPP's assistance with MRP Provision C.9 is coordinated through SMCWPPP's Parks Maintenance and Integrated Pest Management (IPM) Work Group (except Provision C.9.h, the public outreach portion of Provision C.9, which is implemented through the SMCWPPP Public Information and Participation component - see Section 7 of this report).

IMPLEMENTATION OF MRP PROVISIONS

During FY 2015/16, SMCWPPP performed a number of tasks to assist member agencies with implementation of Provision C.9, with input and assistance provided by the Parks Maintenance and IPM Work Group. Accomplishments included the following:

- Held two meetings of the Parks Maintenance and IPM Work Group.
- Developed periodic update documents with relevant pesticide-related news, events and regulatory developments for the Parks Maintenance and IPM Work Group.
- Conducted SMCWPPP's Annual Landscape IPM Training Workshop in March 2016.
- Continued coordinating with San Mateo County Agriculture / Weights and Measures.
- Continued to participate in the Department of Pesticide Regulation (DPR) grant to implement IPM techniques at multi-family residential buildings.
- Participated in relevant BASMAA and CASQA activities.
- Continued to maintain retail partnerships at 9 top-tier stores (e.g., Home Depot and OSH) stores within San Mateo County. Tasks included ordering materials, organizing outreach collateral, checking in with store managers, and providing outreach to residents.

- Educated hardware store employees to become program messengers and pass on the pollution prevention message to customers and conducted five instore trainings for store employees.
- Conducted outreach community events to educate customers on less toxic alternatives to commercial pesticides and fertilizers.
- Motivated do-it-yourself (DIY) home owners and gardeners to adopt Best Management Practices (BMPs) and minimize their use of toxic products by conducting monthly visits to stores to place and refresh educational materials.

More information on each of these accomplishments is provided below.

Parks Maintenance and IPM Work Group

The Parks Maintenance and IPM Work Group met two times during FY 2015/16 to share information about MRP Provision C.9 requirements and approaches for achieving compliance. Valerie Matonis from the City of Redwood City continued to chair the IPM Work Group. A FY 2015/16 work group attendance summary table is included in Appendix 9. Both Work Group meetings were attended by staff from Burlingame, Colma, Foster City, Pacifica, Daly City, Hillsborough, Redwood City, San Mateo County Parks, Menlo Park and South San Francisco. Cities that attended one meeting were San Carlos and San Mateo. In addition, both meetings were attended by staff from San Mateo County Agriculture / Weights and Measures.

In FY 2015/16 SMCWPPP staff continued to develop a periodic update document describing relevant pesticide-related news, events and regulatory developments, including upcoming IPM workshops and trainings. The update documents were distributed along with Parks and IPM Work Group meeting agenda packets.

Fifteenth Annual Landscape Integrated Pest Management Workshop

The fifteenth annual SMCWPPP Landscape IPM Workshop was held on March 9, 2016 at the City of Foster City's Library Community Center. The workshop was attended by 71 municipal staff and contractors and covered the following topics:

- Pesticides and Water Quality
- IPM for Trees and Urban Landscapes, and Emerging Issues
- Drip Irrigation for Municipal Landscapes and Trees
- Maintaining Healthy Soils
- Regulatory Update and Common Violations

Evaluation forms completed by the workshop's attendees included many positive comments and indicated that overall the workshop met their expectations. Appendix 9 includes the workshop agenda, attendance list and a summary of the evaluations. Other workshop materials are available on the SMCWPPP website (www.flowstobay.org).

Coordination with San Mateo County Agriculture / Weights and Measures

San Mateo County Agriculture / Weights and Measures staff attended both meeting of the Parks Maintenance and IPM Work Group and received information on water quality issues and the Municipal Regional Permit. In addition, SMCWPPP worked closely with San Mateo County Agriculture / Weights and Measures staff to provide Department of Pesticide Regulations Continuing Education Credits for participants in the Landscape IPM Workshop.

Department of Pesticide Regulation Grant

In May 2014, BASMAA received a Department of Pesticide Regulation (DPR) grant to implement IPM techniques at multi-family residential buildings. The project is focusing on structural pest controls that will be implemented in selected apartment buildings located in San Jose, East Palo Alto, Palo Alto and San Francisco. In FY 2015/16, SMCWPPP staff participated in the grant project meetings and assisted with the development and review of project materials.

Participation in BASMAA and CASQA

Provision C.9.f requires Permittees to track and participate in regulatory processes relevant to pesticide toxicity control. During FY 2015/16, SMCWPPP accomplished this task by working with BASMAA and CASQA. For additional information, see *Pesticides Subcommittee Annual Report and Effectiveness Assessment - 2015-2016, California Stormwater Quality Association, August 2016* (Appendix 11). In addition, SMCWPPP staff stayed current with pesticide controls and regulatory efforts by participating in selected CASQA Pesticide Committee meetings.

Public Outreach

SMCWPPP conducted point-of-purchase outreach to home improvement store staff and customers with tips for proper use and disposal of pesticides and other lawn and garden chemicals. The purpose of reaching out to home improvement stores was twofold. First, store employees were educated about stormwater pollution and provided with pollution prevention tips and resources. This provides employees with the information needed to encourage San Mateo County residents to apply IPM practices and purchase lawn and gardening supplies accordingly. Second, program materials were provided directly to the public when they may be most receptive to hearing the message, via the point-of-purchase displays.

To spread the message and help educate employees and customers, SMCWPPP conducted full-service outreach at five top-tier stores (e.g., Home Depot and OSH). The outreach included monthly visits to place and refresh educational materials, one training session for employees and one outreach community event to educate customers on less toxic alternatives to commercial pesticides and fertilizers. The Countywide Program:

- Continued to maintain retail partnerships at nine top-tier stores (e.g., Home Depot and OSH) stores within the County. Tasks included ordering materials, organizing outreach collateral, checking in with store managers, and providing outreach to residents.
- Educated store employees to become program messengers and pass on the IPM pollution prevention message to customers and conducted five instore trainings for employees, as summarized in Table 9-1.

Table 9-1. FY 2015/16 San Mateo County IPM Instore Employee Trainings

Date	Store Name	# of Employees Trained
5/16/2016	OSH Foster City	9
5/24/2016	OSH South San Francisco	5
6/21/2016	OSH Redwood City	8
6/1/2016	Home Depot Daly City	12
6/22/2016	Home Depot San Mateo	14
	Total	48

- Motivated do-it-yourself (DIY) home owners and gardeners to adopt BMPs and minimize their use of toxic products by conducting monthly visits to stores to place and refresh educational materials, as summarized Table 9-2.

Table 9-2. Number of Shelf Tabs and Literature Racks Placed in San Mateo County Stores in FY 2015/16

Dates	Store Name	# of Shelf Tags	# of Literature Racks
5/16/2016, 6/21/2016	OSH Foster City	325	1
5/24/2016, 6/21/2016	OSH South San Francisco	325	1
5/27/2016, 6/13/2016	Home Depot East Palo Alto	240	1
5/27/2016, 6/16/2016	Home Depot San Carlos	240	1
5/27/2016, 6/3/2016	Home Depot Colma	240	1
5/27/2016, 6/10/2016	Home Depot Daly City	240	1
5/31/2016, 6/21/2016	OSH Redwood City	325	1
6/22/2016	OSH Millbrae	325	1
6/21/2016	Home Depot San Mateo	240	1
	Totals	2500	9

- Conducted outreach community events to educate customers on less toxic alternatives to commercial pesticides and fertilizers, as summarized in Table 9-3.

Table 3. Materials Distributed to Customers in San Mateo County Stores in FY 2015/16

Dates	Store Name	# of Materials Distrubuted
6/17/2016	Home Depot East Palo Alto	20
6/16/2016	Home Depot San Carlos	20
6/3/2016	Home Depot Colma	15
6/17/2016	OSH Millbrae	15
6/10/2016	Home Depot Daly City	20
	Total	90

FUTURE ACTIONS

SMCWPPP activities planned for FY 2016/17 to assist member agencies comply with MRP requirements in Provision C.9 include the following:

- Continue to assist member agencies with implementation of Provision C.9, including their implementation of IPM programs and policies, with input and assistance provided by the Parks Maintenance and IPM Work Group;
- Continue holding Parks Maintenance and IPM Work Group meetings twice per year;
- Continue to develop periodic update documents with relevant pesticide-related news, events and regulatory developments for the Parks Maintenance and IPM Work Group;
- Continue conduct annual landscape and/or structural IPM training workshops;
- Continue to coordinate with County Agriculture / Weights & Measures;
- Continue to participate in the DPR grant to implement IPM techniques at multi-family residential buildings;
- Purchase and use the new signage and materials developed by BASMAA for the point-of-purchase program;
- Distribute information to San Mateo County residents on how to hire a pest control contractor certified in IPM via fact sheets, newsletters, and the SMCWPPP website; and
- Send direct mailers to pest control professionals that encourage IPM certification and education.

SECTION 10
C.10 TRASH LOAD REDUCTION

INTRODUCTION

Provision C.10 Trash Load Reduction tasks are implemented by each SMCWPPP member agency. SMCWPPP helps agency staff to understand trash load reduction requirements and develops various tools needed to effectively plan, implement, and report on compliance with the requirements. More detailed information about SMCWPPP's assistance in helping member agencies comply with MRP requirements in Provision C.10 is included in the following sections.

IMPLEMENTATION OF MRP PROVISIONS

MRP Provision C.10 (Trash Load Reduction) requires Permittees (as applicable) to:

- Reduce trash discharges from 2009 levels by 70% by July 2017 and 80% by July 2019;
- Ensure that lands they do not own or operate but that are plumbed directly to their storm drain systems in Very High, High and Moderate trash generation areas are equipped by full capture systems or managed to a level equivalent to full capture systems;
- Install and maintain full capture systems that treat a mandatory minimum acreage;
- Assess trash reductions associated with control measures other than full capture systems using an on-land visual assessment protocol;
- Develop and implement a receiving waters trash monitoring program plan;
- Annually cleanup and assess a mandatory minimum number of creek/shoreline trash hotspots; and
- Maintain a Long-Term Trash Load Reduction Plan designed to achieve 100% trash reduction by July 2022.

During FY 2015/16, SMCWPPP completed the tasks described below in support of member agency trash management activities conducted in compliance with the above requirements.

Participation and Coordination of the Trash Subcommittee

SMCWPPP's Trash Subcommittee assists member agencies with the implementation of new or enhanced trash control measures and actions required by the MRP. The Trash Subcommittee generally meets quarterly. Additional meetings are scheduled as necessary to address high priority issues. During FY 2015/16, SMCWPPP staff facilitated five Trash Subcommittee meetings, which were chaired by Chris Sommers, SMCWPPP staff. The FY 2015/16 Trash Subcommittee attendance list is included in Appendix 10. Staff from the following member agencies attended a majority of

the subcommittee's meetings during FY 2015/16: County of San Mateo and cities/towns of Belmont, Brisbane, Burlingame, Colma, Daly City, Half Moon Bay, Hillsborough, Millbrae, San Bruno, San Mateo and South San Francisco.

During the Trash Subcommittee meetings in FY 2015/16, Subcommittee members discussed and provided input on the following topics/projects:

- C.10 requirements in the reissued MRP.
- Developing the FY 2015/16 Annual Report format for Provision C.10.
- Developing the Trash Full Capture Device Operation and Maintenance Verification Program.
- Implementing the SMCWPPP Pilot Trash Assessment Strategy.
- Identifying or updating on-land trash assessment locations in Trash Management Areas (TMAs).
- Correcting and/or revising baseline trash generation area maps originally submitted to the Regional Water Board in February 2014.
- Participating in and tracking the BASMAA awarded State Water Board Proposition 84 Stormwater Monitoring and Planning grant project "Tracking California's Trash".
- Identifying opportunities for collaboration with Caltrans.
- Developing a Countywide Adopt-a-Block Program.

Long-Term Plan Revisions

SMCWPPP assisted SMCWPPP member agencies in revising trash generation and management area maps per the direction of member agency staff. Revisions were intended to provide a more accurate depiction of trash generation in San Mateo County. All revisions were made via GIS and the Program continued to store all trash-related data in its GIS data management system.

Pilot Trash Assessment Strategy

SMCWPPP continued implementing the Pilot Trash Assessment Strategy in FY 2015/16. The Strategy was submitted to the Regional Water Board on February 3, 2014 as part of the Long-Term Plan submittals. The Strategy is intended to provide information on magnitude and extent of trash reductions associated with stormwater in San Mateo County. The Strategy uses information on four indicators:

1. Level of trash observed on-land and available to MS4s;
2. Areas effectively treated by full-capture devices;
3. Extent and magnitude of trash control measures implementation; and
4. Levels of trash in receiving waters.

Information on the results of implementing the Strategy in FY 2015/16 is included in Section 10 of each member agency's Annual Report. The following summarizes the two major activities in support of the Strategy that were conducted by SMCWPPP during FY 2015/16:

- **On-land Visual Assessments** – In FY 2013/14, SMCWPPP staff developed guidance for member agencies on the selection of TMAs considered high priority for on-land visual trash assessments. Based on the TMAs selected by member agencies, SMCWPPP staff developed a randomized/probabilistic assessment approach that allows agencies to extrapolate data collected at assessment sites to an entire TMA. SMCWPPP staff and member agency staff began conducting on-land visual trash assessments in July 2014. Sites were initially selected in TMAs using a randomized approach to allow extrapolation of the assessment results to all or a subarea of a TMA. In November 2015, SMCWPPP staff again provided guidance and worked with member agency staff to better identify or update TMAs where on-land visual assessments should be conducted during FY 2015/16. Countywide Program staff also updated member agencies on the density/extent and frequency of on-land visual trash assessments likely required by MRP 2.0. For FY 2015/16, Countywide Program staff started conducting assessments in November 2015. Program and Co-permittee staff conducted more than 680 assessments at 233 sites (averaging 1,000 feet in length) in FY 2015/16. All sites (except for five) were assessed at least once with most sites being assessed at least three times. Data generated through these assessments are incorporated into each member agency's trash reduction estimate included in Section 10 of their Annual Report. Additional assessments are planned for FY 2016/17, consistent with the Program's Pilot Trash Assessment Strategy. Since July 2014, Program and Co-permittee staff have conducted 1,052 assessments in San Mateo County.
- **On-land Assessment Database –** In late FY 2014/15, SMCWPPP staff began developing a web-accessible database to house on-land trash visual assessment results. SMCWPPP member agencies now have the ability to view and download assessment data via the Program's Visual Trash Assessment Database, which became available for member agency use in June 2016.
- **On-land Trash Visual Assessment Training Workshop –** In late FY 2014/15, SMCWPPP staff began planning a half-day workshop entitled "SMCWPPP On-Land Visual Trash Assessment Training." The workshop was held in July 2015 and over 25 participants attended. The training workshop focused on how to conduct on-land visual trash assessments using the standardized assessment protocol. It included a group practice session performing assessments on city streets surrounding the workshop location. Information regarding the design of the protocol was also discussed.
- **Full Capture Operation and Maintenance Verification Program** – Starting in FY 2013/14, SMCWPPP made significant strides toward developing an operation and maintenance verification program for full-capture devices. Inspection and maintenance of these devices is required to maintain full-capture designation by the Regional Water Board. The program was initiated in collaboration with the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) and includes standard operating procedures for inspections and cleaning, and an operation and maintenance plan template for use by member agencies. Draft Model Program materials were distributed for review and discussed at the November 2014 Trash Subcommittee meeting. Permittee staff provided comments on the Draft Model Program in November and December 2014. Based on feedback from member agency staff, SMCWPPP tabled the development of the Draft Model Program until the adoption of MRP 2.0. After adoption, SMCWPPP revised in May 2016 the Draft Model Program to ensure consistency with newly-adopted MRP 2.0 requirements. All draft materials were reviewed by SMCWPPP's Municipal Maintenance

Subcommittee in May 2016 and finalized in June 2016. It is anticipated that member agencies with full capture devices will have an O&M verification program tailored to fit the types of devices in their stormwater conveyance system and the associated maintenance procedures needed to adequately maintain these devices.

Trash Hot Spot Cleanup and Assessment Guidance

Provision C.10.c.i of the MRP requires Permittees to clean up trash hot spots to a level of "no visual impact" at least one time per year for the term. To assist Permittees in meeting this requirement, SMCWPPP staff developed the necessary tools (i.e., guidance memorandum, Trash Hot Spot Cleanup Data Collection Form and Trash Hot Spot Activity Reports) used to report trash hot spot assessment and cleanup activities conducted during the reporting period. Trash Hot Spot Activity Reports for individual Permittees are included in Permittee Annual Reports.

During FY 2015/16, Permittees continued conducting annual cleanups and assessments required by the MRP. Results from this year's annual cleanups indicated that one cleanup/assessment was conducted at each of the 33 different sites within SMCWPPP member agency jurisdictions.[1] Approximately 73 cubic yards of trash was removed from these sites during FY 2015/16. The timing of annual assessments and cleanups vary among hot spots due to the location of the hot spot, potential for natural resource impacts, crew availability and other site-specific factors.

Coordination with San Mateo Countywide Recycling Committee

In an effort to increase coordination among solid waste and recycling programs and SMCWPPP member agency MS4 trash reduction activities, SMCWPPP staff began attending Countywide Recycling Committee meetings in FY 2012/13. SMCWPPP continued to coordinate with the Recycling Committee in FY 2015/16, specifically targeting outreach and coordination with municipal solid waste/recyclable haulers in San Mateo County to reduce trash impacts associated with inadequate waste container management and dispersal from waste transfer vehicles.

Continuation of the Litter Work Group of the Trash Subcommittee

Formed in March of 2014, SMCWPPP's Litter Work Group continued in FY 2015/16. The Work Group coordinated litter reduction efforts among SMCWPPP, waste and stormwater program staff from municipalities of San Mateo County, the San Mateo Countywide Recycling Committee and waste collection and processing companies serving those jurisdictions. Representatives from the local hauling community; Rethink Waste (the South Bayside Waste Management Authority); stormwater and trash program municipal staff; and community members working on litter reduction efforts both in Santa Clara County and San Mateo County, attended four meetings in fiscal year 2015/16. The goals of the group are to develop a litter reduction program for San Mateo County related to waste issues and specific to its needs; develop BMPs for the waste collection industry; educate the public and those involved with litter control efforts; and to coordinate and share information with the Zero Litter Initiative in Santa Clara County.

[1] Only hot spot cleanups and assessments conducted in compliance with MRP provision C.10.b.iii are included in the numbers presented in this paragraph. Some SMCWPPP member agencies conduct cleanups at trash hot spots more frequently than the MRP-required annual cleanup, and/or at more sites than the MRP requires. See Section 10, C.10.e of member agency Annual Reports for additional information.

The Litter Work group completed the following tasks in FY 2015/16:

- Held four meetings on the following dates: August 17, November 24, January 15, and April 4. Attendees represented the City of Belmont, City of Brisbane, City of Burlingame, City of East Palo Alto, City of Millbrae, City of San Bruno, City of San Carlos, City of San Mateo, City of South San Francisco, County of San Mateo, Recology San Mateo, South San Francisco Scavenger, Republic Services, South Bayside Waste Management Authority (Re-Think Waste) and SMCWPPP. The attendance record is included in Appendix 10.
- Developed the FY 2015/16 Litter Work Group Work Plan including prioritized recommendations for improving container management programs, metrics and issues with franchise agreement negotiations, mapping of container overages, and countywide outreach coordination and branding. The Work Plan is included in Appendix 10.
- Prepared a report on "Litter Practices Recommendations for Solid Waste Franchise Agreements" on the subject of reducing litter related to waste hauling in the County. The report is included in Appendix 10.
- Coordinated with the SMCWPPP Public Information and Participation Subcommittee on countywide school outreach and countywide litter campaign branding efforts.
- Collected litter related data from franchised haulers and permittee staff for mapping of container overage and abandoned waste locations.

Participation in BASMAA's Tracking California's Trash Project

In 2014, BASMAA was awarded a Proposition 84 Stormwater Monitoring and Planning grant by the State Water Board for a project entitled "Tracking California's Trash". SMCWPPP staff tracks the implementation of this project, which includes three major tasks: trash monitoring and assessment methods development, BMP effectiveness monitoring, and creek hotspot and on-land cleanup data management and website development. The project is funded for $870,000. Project partners include the Five Gyres Institute and the San Francisco Estuary Partnership (SFEP).

In FY 2013/14 a consultant team was selected through a Request for Qualifications (RFQ) process to assist on the project monitoring design and sampling/characterization. Draft monitoring, quality assurance/control, and project evaluation/assessment plans developed by the consultant were submitted to the State Water Board in April 2014. Additionally, a request for potential project partners was sent to municipal representatives and more than ten cities/counties in the Bay Area and Los Angeles region responded with interest in participating in the project.

An initial Project Management Team meeting was held on May 27, 2014 to orient potential project partners to the project and answer questions. Additionally, a Stakeholder Committee meeting was held on May 27, 2014 to allow for initial feedback from interested parties, including staff from non-governmental organizations. Potential project sites were visited in June 2014. Many of the sites within the Program's jurisdiction were not selected due to the limited amount of trash present on the streets. In July 2014, a BMP Literature Review and Draft Sampling and Analysis Plan (SAP) were completed. A Monitoring Technical Advisory Committee (TAC) meeting was held on August 20, 2014 to discuss the project and receive input on the study designs proposed in the Draft SAP. The Draft SAP was well received by technical advisors. Comments from technical advisors were incorporated into the Draft SAP in November/December 2014. The Final Draft SAP was approved by the BASMAA Board of Directors on December 5, 2014. The Draft Final SAP was submitted to the

State Water Board in mid-December 2014. A total of three study sites were selected for the evaluation of street sweeping performance and four sites were selected for receiving water monitoring.

A total of 32 monitoring/assessment events to evaluate street sweeping performance were performed between late February 2015 and April 2016. Four trash characterization events were conducted to quantify the trash observed during these events. Additionally, Five Gyres Institute conducted seven receiving water monitoring events at four sites (i.e., Colma Creek, San Mateo Creek, Coyote Creek and Arroyo Seco (Los Angeles)) between March 2015 and May 2016. Four trash characterization events were also conducted to quantify the trash observed during these events. Interpretations of the monitoring data and draft performance standards for street sweeping and partial capture devices will be completed in late September 2016. In October 2016, a draft technical report will be completed and a meeting with the TAC will occur. The Cities of South San Francisco and Santa Mateo and the County of San Mateo have all participated in the project to-date. The project is currently scheduled for completion in late 2016.

Tracking Statewide Trash Amendment Development

The State Board began the development of amendments to the *California Ocean Plan* and the *Inland Surface Waters, Enclosed Bays, and Estuaries Plan* in 2010 that are intended to significantly reduce the impacts of trash on receiving waters. The proposed amendments will include five elements: (1) Water Quality Objective, (2) Prohibition of Discharge, (3) Implementation Plan, (4) Compliance Schedule, and (5) Monitoring, and could directly affect San Mateo County Permittees and other municipalities throughout the region and state. The Proposed Trash Amendments and Draft Staff Report were released by the State Board on June 10, 2014 for public comment. SMCWPPP staff attended (via webcast) a State Board workshop on the Proposed Trash Amendments on July 16, 2014, and coordinated the development of the BASMAA comment letter on the Proposed Trash Amendments.

On November 12, 2014, SMCWPPP staff met with State Water Board staff to discuss comments provided in the BASMAA comment letter. The Proposed Final Trash Amendments and the final staff report were released on December 31, 2014. A response to comments was posted on March 24, 2015 and a final adoption hearing was held on April 7, 2015. The amendments were adopted by the State Board with minor modifications. The amendments are generally consistent with the trash reduction framework developed in the Bay Area. The adopted trash amendments were submitted to the California Office of Administrative Law (OAL) and the U.S. Environmental Protection Agency (EPA) for approval. The OAL approved the Trash Amendments on December 2, 2015. EPA approved the Trash Amendments on January 12, 2016. Requirements will be incorporated into permits over an 18-month period. The reissued MRP already contains requirements consistent with the amendments.

FUTURE ACTIONS

FY 2016/17 activities that are planned by SMCWPPP to assist member agencies comply with MRP requirements in Provision C.10 include the following:

- Continued facilitation of SMCWPPP Trash Subcommittee meetings.

- Continued implementation of the SMCWPPP pilot trash assessment strategy designed to demonstrate progress towards MRP trash load reduction goals.
- Continued maintenance of the SMCWPPP on-land assessment database.
- Continued support for long-term plan implementation and control actions for trash management.
- Continued calculation and reporting on trash load reductions for each member agency.
- Continued calculation and reporting on the amount and types of trash removed via creek and/or shoreline cleanups required by the MRP.
- Continued update/revision of trash generation and full capture system maps and GIS data layers in preparation for FY 2016/17 Annual Report submittal.
- Coordination and planning of the 3rd Litter Roundtable with municipal solid waste/recyclables haulers, in coordination with the San Mateo Countywide Recycling Committee and permittee staff.
- Continued coordination and information sharing with the SMCWPPP Public Information and Participation Subcommittee on countywide litter efforts with schools and the "Team Up to Clean Up" campaign.
- Continued coordination and information sharing with the Zero Litter Initiative in Santa Clara County.
- Continued implementation of the Litter Work Group Work Plan tasks, as appropriate.

SECTION 11
C.11 MERCURY CONTROLS

INTRODUCTION

MRP Provision C.11 Mercury Controls implements stormwater runoff-related actions required by the San Francisco Bay mercury Total Maximum Daily Load (TMDL) water quality restoration program. SMCWPPP performs a variety of activities to address mercury in stormwater runoff in compliance with MRP Provision C.11. Some of this work has been accomplished through participation in BASMAA regional projects.

Projects that address PCBs in addition to mercury and are described below in this section rather than Section 12 (PCBs Controls).

IMPLEMENTATION OF MRP PROVISIONS

C.11/12.a. Implement Control Measures to Achieve Mercury/PCBs Load Reductions

SMCWPPP's and its member agency's activities to address MPR Provisions C.11/12.a., Implement Control Measures to Achieve Mercury/PCBs Load Reductions, are described in a separate report (*Identifying Management Areas and Controls for Mercury and PCBs in San Mateo County Stormwater Runoff, SMCWPPP, September 30, 2016*) that was submitted to the Regional Water Board concurrently with this Annual Report.

C.11/12.b. Assess Mercury/PCBs Load Reductions from Stormwater

MPR Provisions C.11/12.b., Assess Mercury/PCBs Load Reductions from Stormwater, requires Permittees to submit in their 2015/16 Annual Report for Executive Officer approval an assessment methodology. Permittees are required to use the assessment methodology to quantify in a technically sound manner mercury and PCBs loads reduced through implementation of pollution prevention, source control, and treatment control measures, including source control, stormwater treatment, green infrastructure, and other measures. Beginning with their 2016/17 Annual Report, Permittees must report on the use of the methodology to demonstrate progress toward achieving the mercury and PCBs load reductions required in this permit term. SMCWPPP and its member agencies have addressed this requirement through participation in a BASMAA regional project. BASMAA's report on this project was submitted to the Regional Water Board concurrently with this Annual Report.

C.11.e./C.12.h. Risk Reduction Program

MRP Provisions C.11.e and C.12.h require Permittees to conduct an ongoing risk reduction program to address public health impacts of mercury and PCBs in San Francisco Bay fish. The fish risk reduction program is required to include actions to reduce actual and potential health risks in those people and communities most likely to consume San Francisco Bay-caught fish, such as subsistence fishers and their families. The program is required to have the potential to reach 3,000 individuals annually (Bay Area-wide total for all MRP 2.0 Permittees) who are likely consumers of San Francisco Bay-caught fish. Permittees are required to report on the status of the risk reduction program in each of their Annual Reports, including a brief description of actions taken, an estimate of the number of people reached, and why these people are deemed likely to consume Bay fish.

SMCWPPP is assisting its member agencies comply with the risk reduction program requirements by coordinating with and reporting on the Fish Smart program conducted by San Mateo County Environmental Health Services (CEH). Fish Smart builds upon the San Francisco Bay Fish Project (www.sfei.org/sfbfp#sthash.eOcfwrhA.dpbs), a risk reduction framework developed regionally in the previous permit term. The Fish Project funded Bay Area community-based organizations to develop and deliver appropriate communications to appropriately targeted individuals and communities about how to reduce their exposure to mercury and PCBs from consuming San Francisco Bay fish.

During FY 2015/16, CEH conducted the following activities that target at-risk populations (e.g., subsistence fisherman) via its Fish Smart program:

- Maintained signs that were previously posted by CEH along the Bay's shore (e.g., at fishing piers) in most cities in San Mateo County.
- Continued to distribute educational materials (i.e., a Fish Project brochure entitled "Guide to Eating Fish and Shellfish from San Francisco Bay") at targeted locations:
    - CEH provided 100 brochures to the San Mateo Medical Center (a county health services clinic).
    - CEH provided 50 brochures to Save Our Shores, a non-profit that works with boaters.
    - CEH displayed an example sign and provided brochures at the County Fair and interacted there with about 300 persons regarding Fish Smart and other CEH programs.
- Conducted a "train the trainer" effort by presenting risk reduction information to nurses with the San Mateo County Health System, including nurses who serve appropriate communities.
- Presented risk reduction information and handed out brochures at code enforcement and food inspection team meetings.
- Posted an entry dated June 7, 2016 about Fish Smart on the CEH blog which has been viewed 20 times based on a web page analytic report.

In addition, beginning early in FY 2016/17 CEH expanded the Fish Smart program to include conducting social media posts. For example, a recent Fish Smart posting to CEH's Facebook page

reached 518 residents, based on web page "hits." A separate Fish Smart posting concerning one fish species of concern, Surfperches, yielded 71 comments. CEH plans to continue conducting social media posts during the remainder of FY 2016/17. During FY 2016/17 CEH also plans to identify additional locations to distribute educational materials such as the Fish Project brochure. In addition, during FY 2016/17 CEH plans to begin evaluating the effectiveness of the Fish Smart outreach by surveying individuals who fish in the Bay in San Mateo County regarding their awareness of methods to reduce their exposure to mercury and PCBs from consuming San Francisco Bay fish.

FUTURE ACTIONS

SMCWPPP activities that are planned for FY 2016/17 to assist member agencies comply with MRP requirements in Provision C.11/12 to reduce mercury and PCBs loads in stormwater runoff are described in a separate report (*Identifying Management Areas and Controls for Mercury and PCBs in San Mateo County Stormwater Runoff, SMCWPPP, September 30, 2016*) that was submitted to the Regional Water Board concurrently with this Annual Report. In addition, SMCWPPP will continue assisting its member agencies comply with the risk reduction program requirements by coordinating with and reporting on the Fish Smart program conducted by CEH. CEH plans to continue all of the Fish Smart activities described above.

SECTION 12
C.12 PCBS CONTROLS

INTRODUCTION

MRP Provision C.12 PCBs Controls implements stormwater runoff-related actions required by the San Francisco Bay PCB Total Maximum Daily Load (TMDL) water quality restoration program. SMCWPPP performs a variety of activities to address PCBs in stormwater runoff in compliance with MRP Provision C.12. Many of these activities address mercury in addition to PCBs and are described in the previous section (Section 11, Mercury Controls) rather than this section.

IMPLEMENTATION OF MRP PROVISIONS

C.11/12.a. Implement Control Measures to Achieve Mercury/PCBs Load Reductions

SMCWPPP's and its member agency's activities to address MPR Provisions C.11/12.a., Implement Control Measures to Achieve Mercury/PCBs Load Reductions, are described in a separate report (*Identifying Management Areas and Controls for Mercury and PCBs in San Mateo County Stormwater Runoff, SMCWPPP, September 30, 2016*) that was submitted to the Regional Water Board concurrently with this Annual Report.

C.11/12.b. Assess Mercury/PCBs Load Reductions from Stormwater

SMCWPPP and its member agencies have addressed this requirement through participation in a BASMAA regional project. BASMAA's report on this project was submitted to the Regional Water Board concurrently with this Annual Report. Please see Section 11 for additional details.

C.11.e./C.12.h. Risk Reduction Program

SMCWPPP is assisting its member agencies comply with the risk reduction program requirements by coordinating with and reporting on the Fish Smart program conducted by San Mateo County Environmental Health Services (CEH). Please see Section 11 for additional details.

C.12.f. Manage PCB-Containing Materials and Wastes during Building Demolition Activities So That PCBs Do Not Enter Municipal Storm Drains

Provision C.12.f. requires that Permittees develop and implement or cause to be developed and implemented an effective protocol for managing materials with PCBs concentrations of 50 ppm or greater in applicable structures at the time such structures undergo demolition, so that PCBs do not enter municipal storm drain systems. Applicable structures include, at a minimum, non-residential structures constructed or remodeled between the years 1950 and 1980 with building

materials such as masonry and concrete with PCBs concentrations of 50 ppm or greater. Single-family residential and wood frame structures are exempt. A Permittee is exempt from this requirement if it provides evidence acceptable to the Executive Officer in its 2016/17 Annual Report that the only structures that existed pre-1980 within its jurisdiction were single-family residential and/or wood-frame structures. Permittees are required to develop a protocol by June 30, 2019 that includes each of the following components, at a minimum:

1. The necessary authority to ensure that PCBs do not enter municipal storm drains from PCBs-containing materials in applicable structures at the time such structures undergo demolition;
2. A method for identifying applicable structures prior to their demolition; and
3. Method(s) for ensuring PCBs are not discharged to the municipal storm drain from demolition of applicable structures.

By July 1, 2019 and thereafter, Permittees are required to:

- Implement or cause to be implemented the PCBs management protocol for ensuring PCBs are not discharged to municipal storm drains from demolition of applicable structures via vehicle track-out, airborne releases, soil erosion, or stormwater runoff.
- Develop an assessment methodology and data collection program to quantify in a technically sound manner PCBs loads reduced through implementation of the protocol for controlling PCBs during demolition of applicable structures.

On behalf of MRP Permittees, the Bay Area Stormwater Management Agencies Association (BASMAA) is conducting a multi-year regional project to develop an implementation framework, guidance materials, and tools to assist Bay Area Permittees in developing protocols to manage PCBs-containing materials and wastes during building demolition, in compliance with Provision C.12.f. During FY 2015/16, BASMAA made substantial progress towards completing the first phase of the regional project, which was developing a scope-of-work and budget for developing the regional framework, guidance, and tools. Accomplishments during FY 2015/16 included:

- Convened the BASMAA PCBs in Building Materials Workgroup to provide project oversight and guidance, including review of draft materials. The workgroup is composed of Permittee staff from various relevant municipal departments, countywide stormwater program representatives, and industry representatives. The workgroup held an initial meeting on June 20, 2016 to discuss all aspects of the project and has reviewed and provided comments on the project materials described below.
- Completed a list of barriers to implementation of the PCBs in building materials management protocol and summarized opportunities to overcome the identified barriers. For example, to address funding barriers, the project is examining opportunities for grant funding. BASMAA submitted an application for grant funding to the U.S. EPA (S.F. Bay Water Quality Improvement Fund) to develop the regional framework, guidance, and tools, but the proposed project was not selected for funding.
- Prepared a preliminary first draft of a scope-of-work for developing the regional framework, guidance, and tools. The draft was reviewed by the BASMAA PCBs in Building Materials Workgroup members and other BASMAA representatives. As part of this process, certain legal/liability issues (e.g., CEQA compliance) and the pros and cons of

various approaches to certain aspects of developing the PCBs in building materials management protocol (e.g., developing guidance for identification of PCBs in building materials) were extensively vetted by countywide stormwater program and Permittee staff.

The draft scope-of-work is currently being revised and finalized. It is anticipated that the next phase of the regional project, which entails implementing the scope-of-work to develop the actual framework, guidance and tools, will commence during the first half of FY 2016/17.

FUTURE ACTIONS

SMCWPPP activities that are planned for FY 2016/17 to assist member agencies comply with MRP requirements in Provision C.11/12 to reduce mercury and PCBs loads in stormwater runoff are described in a separate report (*Identifying Management Areas and Controls for Mercury and PCBs in San Mateo County Stormwater Runoff, SMCWPPP, September 30, 2016*) that was submitted to the Regional Water Board concurrently with this Annual Report. SMCWPPP will also continue assisting its member agencies comply with the risk reduction program requirements by coordinating with and reporting on the Fish Smart program conducted by CEH, as described in Section 11. In addition, SMCWPPP will continue participating in the BASMAA regional project to develop an implementation framework, guidance materials, and tools to assist Permittees in developing programs to manage PCBs-containing materials and wastes during building demolition in compliance with Provision C.12.f. SMCWPPP will also begin to tailor the BASMAA products for local application and train San Mateo County Permittees in their use, as appropriate.

SECTION 13
C.13 COPPER CONTROLS

INTRODUCTION

Provision C.13 of MRP 2.0 addresses copper control measures identified in the San Francisco Bay Basin Water Quality Control Plan (commonly referred to as the Basin Plan). The Regional Water Board has deemed these controls are necessary to support copper site-specific objectives in San Francisco Bay. C.13 includes the following sub-provisions:

- C.13.a. Manage waste generated from cleaning and treating copper architectural features, including copper roofs, during construction and post-construction;
- C.13.b. Manage discharges from pools, spas and fountains that contain copper-based chemicals; and
- C.13.c. Industrial Sources.

In FY 2015/16, Permittees and the Countywide Program continued to conduct activities related to complying with Provision C.13. Local actions are documented in each Permittee's individual Annual Report. This section summarizes copper control activities conducted by the Countywide Program.

IMPLEMENTATION OF MRP PROVISIONS

C.13.a. Copper Architectural Features

Provision C.13.a requires Permittees to manage waste from cleaning and treating copper architectural features, including copper roofs, during construction and post-construction.

During 2015/16, SMCWPPP continued to train municipal inspectors on the MRP requirements and BMPs for architectural copper installation, cleaning, and treating. The trainings utilized a SMCWPPP factsheet entitled "Requirements for Architectural Copper: Protect water quality during installation, cleaning, treating, and washing!" which targets suppliers and installers of copper materials and is available on the SMCWPPP website. Construction site inspectors received the information during the May 3, 2016 SMCWPPP Construction Site Inspection Workshop and building inspectors received the information from a SMCWPPP staff presentation at the California Building Inspectors Group (CALBIG) meeting on October 14, 2015 (see Section 6). Illicit discharge inspectors received information during the June 1, 2016 SMCWPPP CII Training Workshop (see Section 5).

C.13.b. Manage Discharges from Pools, Spas and Fountains

Provision C.13.b requires Permittees to manage discharges from pools, spas and fountains that contain copper-based chemicals by adopting local ordinances. These requirements are

implemented by individual Permittees and are reported on in their Annual Reports. Guidance on these requirements for illicit discharge inspectors is provided through SMCWPPP's CII Subcommittee and public outreach on related BMPs is provided through SMCWPPP's PIP Subcommittee. Illicit discharge inspectors received information on this topic during the June 1, 2016 SMCWPPP CII Training Workshop. The Our Water Our World Maintenance Tips for Pools, Spas, and Fountains is available on the SMCWPPP website.

C.13.c. Industrial Sources

Provision C.13.c requires Permittees to ensure through routine industrial facility inspections that proper BMPs are in place at industrial facilities likely to use copper or have sources of copper. SMCWPPP's CII Subcommittee assists member agency staff with understanding this MRP requirement and SMCWPPP develops MRP compliance support materials as necessary. In addition, in June 2010 BASMAA developed pollutants of concern commercial/industrial inspector training materials and a guidance manual that address industrial sources of copper. These materials are available on SMCWPPP's website (www.flowstobay.org). Industrial inspectors received information on this topic during the June 1, 2016 SMCWPPP CII Workshop.

FUTURE ACTIONS

FY 2016/17 activities planned by SMCWPPP to assist member agencies comply with MRP requirements in Provision C.13 include the following:

- Continue to provide information on MRP requirements regarding architectural sources of copper to construction site and building inspectors at New Development Subcommittee meetings, SMCWPPP's Construction Site Inspection Workshop and at presentations to CALBIG or other partner organizations.
- Provide guidance via SMCWPPP's CII Subcommittee and/or workshops to San Mateo County Permittees to assist them ensure through routine industrial facility inspections that proper BMPs are in place at industrial facilities likely to use copper or have sources of copper.
- Continue to provide outreach material and guidance via SMCWPPP's CII Subcommittee and PIP Subcommittee regarding pool, spa and fountain discharge BMPs.

SECTION 15
C.15 EXEMPTED AND CONDITIONALLY EXEMPTED DISCHARGES

INTRODUCTION

The objective of MRP Provision C.15, Exempted and Conditionally Exempted Discharges, is to exempt unpolluted non-stormwater discharges from the MRP's general non-stormwater discharge prohibition (Provision A.1) and to conditionally exempt non-stormwater discharges that are potential sources of pollutants. This section describes SMCWPPP's countywide activities conducted to help its member agencies to implement this provision. SMCWPPP's role is to help municipal staff to understand the MRP's requirements and to make available for their use various MRP compliance support materials. The SMCWPPP CII Subcommittee, discussed in Section 4, facilitates and coordinates providing this assistance to the member agencies for a variety of different types of non-stormwater discharges that may be conditionally exempted.

SMCWPPP and regional activities that address outreach requirements for C.15.b.iv (Individual Residential Car Washing Discharge) are discussed in Section 7 (Public Information and Outreach) of this report.

IMPLEMENTATION OF MRP PROVISIONS

SMCWPPP member agencies are responsible for complying with managing certain non-stormwater discharges exempted or conditionally exempted by the MRP (Provision C.15). SMCWPPP's CII component assists member agency staff with understanding these MRP requirements and developing various tools, templates, reporting forms, and other MRP compliance support materials.

Water Utility Work Group

The previous MRP, in effect until December 31, 2015, contained extensive tracking, monitoring, and reporting requirements in Provision C.15 for planned and unplanned potable water discharges by water purveyors. Permittees that are also potable water purveyors in San Mateo County are: Cities of Brisbane, Burlingame, Daly City, East Palo Alto, Foster City, Hillsborough, Menlo Park, Millbrae, Redwood City, and San Bruno and San Mateo County.

In April 2012 an ad hoc Water Utility Work Group was formed to specifically address the previous MRP (Order No R2-2009-0074) Provision C.15.b.iii requirements related to conditionally exempt planned and unplanned potable water discharges. The Work Group developed guidance materials (four Fact Sheets) and held a training workshop in FY 2012/13.

During FY 2014/15 the Water Utility Work Group met on June 16, 2015 to discuss the options for coverage under the MRP or State General Permit for Drinking Water System Discharges (Order 2014-0194-DWQ) adopted by the State Water Resources Control Board in November 2014. A draft fact sheet on the State General Permit was developed and two other Fact Sheets were updated to reflect the General Permit requirements.

The reissued MRP, effective January 1, 2016, does not contain any requirements related to drinking water system discharges. SMCWPPP permittees filed for coverage under the State General Permit and began implementation in January 2016. Since drinking water system discharges no longer covered under the MRP, the SMCWPPP Water Utility Work Group was disbanded.

FUTURE ACTIONS

FY 2016/17 activities planned by SMCWPPP to assist member agencies comply with MRP requirements in Provision C.15 include the following:

- Continue to assist member agency staff with understanding and implementing MRP Provision C.15 requirements, including developing tools, templates, reporting forms, and other compliance support materials as needed.

Appendix 1

- Stormwater Committee – Attendance List for FY 2015/16
- Technical Advisory Committee – Attendance List for FY 2015/16

Stormwater Committee Attendance Report - July 2015 thru June 2016

			2015						2016					
Agency	**Representative**	**Position**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**
Atherton	Gordon Siebert	Public Works Director		X										
Belmont	Afshin Oskoui	Public Works Director		X		X			X	O		X		X
Brisbane	Randy Breault	Public Works Director/City Engineer		X		X				O		X		X
Burlingame	Syed Murtuza	Public Works Director		X					X			O		X
Colma	Brad Donohue	Director of Public Works and Planning		X		X				X				X
Daly City	Patrick Sweetland	Director of Water & Wastewater		O		O			O	O		O		O
East Palo Alto	Kamal Fallaha	City Engineer		O		O			O	O		O		
Foster City	Jeff Moneda	Public Works Director		X					X	X		X		X
Half Moon Bay	Peykan Abbassi	City Engineer		X								X		X
Hillsborough	Paul Willis	Public Works Director		X		X			X	X		X		X
Menlo Park	Justin Murphy	Public Works Director							X	O		X		X
Millbrae	Ray Chan	Public Works Director							X					O
Pacifica	Van Ocampo	Public Works Director/City Engineer								X		X		
Portola Valley	Howard Young	Public Works Director		X										
Redwood City	Saber Sarwary	Supervising Civil Enginerr		X		X			X	X				X
San Bruno	Jimmy Tan	City Engineer		X		X			X	X				X
San Carlos	Jay Walter	Public Works Director		X		X			X	X		X		X
San Mateo	Brad Underwood	Public Works Director		X		O			X	O		X		X
South San Francisco	Brian McMinn	Public Works Director		X		X			X	O		X		X
Woodside	Vacant	Deputy Town Manager/Town Engineer												
San Mateo County	Jim Porter	Public Works Director		X					O	X		O		X
Regional Water Quality Control Board	Tom Mumley	Assistant Executive Officer								O		O		

X - Committee Member Attended

O - Other Jurisdictional Representative Attended

No Committee Meeting

2015 NPDES TAC Attendance Record			Month					
AGENCY AND NAME	Telephone #	Email Address	Jul	Aug	Sep	Oct	Nov	Dec
SMCWPPP/ CCAG								
Matt Fabry	599-1419	mfabry@co.sanmateo.ca.us	X			X		
Sandy Wong	599-1409	slwong@co.sanmateo.ca.us						
EOA, Inc.								
Jon Konnan	510 832-2852 x111	jkonnan@eoainc.com	X			X		
Adam Olivieri	510-832-2852x115	awo@eoainc.com						
Regional Board								
Sue Ma	510-622-2386	sma@waterboards.ca.gov						
Selina Louie	510-622-2383	slouie@waterboards.ca.gov						
Dale Bowyer	510-622-2323	dbowyer@waterboards.ca.gov						
Atherton								
Steve Tyler	752-0570	styler@ci.atherton.ca.us						
Belmont								
Gilbert Yau	595-7425	gyau@belmont.gov	X					
Leticia Alvarez	595-7469	lalvarez@belmont.gov						
Dalia Corpus	595-7468	dcorpus@belmont.gov						
Brisbane								
Randy Breault	415-508-2130	rbreault@ci.brisbane.ca.us						
Karen Kinser	415-508-2133	kkinser@ci.brisbane.ca.us						
Shelley Romriell	415-508-2128	sromriell@ci.brisbane.ca.us						
Burlingame								
Victor Voong	558-7230	vvoong@burlingame.org						
Eva Justimbaste		eva.justimbaste@veoliawaterna.com						
Kiley Kinnon	826-1554	kiley.kinnon@veolia.com	X					
Pamela Boyle Rodriguez	558-7381	pboylerodriguez@burlingame.org	X					
Colma								
Muneer Ahmed	757-8888	muneer.ahmed@colma.ca.gov						
Brad Donohue								
Saied Mostafavi								
Daly City								
Cynthia Royer	991-8203	croyer@dalycity.org						
John Fuller		jfuller@dalycity.org						
East Palo Alto								
Michelle Daher	853-3165	mdaher@cityofepa.org						
Vivian Ma	853-3126	vma@cityofepa.org						
Foster City								
Norm Dorais	286-3279	ndorais@fostercity.org						
Mike McElligott	286-8140	mmcelligott@fostercity.org						
Half Moon Bay								
Muneer Ahmed		muneer@csgengr.com						
Mark Lander		markl@csgengr.com						
Hillsborough								
Natalie Asai	375-7510	nasai@hillsborough.net						
Ali Hatefi						X		
Menlo Park								
Azalea Mitch		aamitch@menlopark.org	X					

2015 NPDES TAC Attendance Record			Month					
AGENCY AND NAME	Telephone #	Email Address	Jul	Aug	Sep	Oct	Nov	Dec
Millbrae								
Khee Lim	259-2347	klim@ci.millbrae.ca.us	X					
Pacifica								
Raymond Donguines	738-3768	donguinesr@ci.pacifica.ca.us						
Portola Valley								
Howard Young	851-1700x214	hyoung@portolavalley.net						
Redwood City								
Adrian Lee		alee@redwoodcity.org						
Terence Kyaw	780-7466	tkyaw@redwoodcity.org						
Charlie Drechsler		cdrechsler@redwoodcity.org						
Ramana Chinnakotla		rchinnakotla@redwoodcity.org						
San Bruno								
Joseph Cervantes	616-7068	jcervantes@sanbruno.ca.gov						
David Wong	616-7069	dhwong@sanbruno.ca.gov						
San Carlos								
Jay Walter		jwalter@cityofsancarlos.org						
Grace Le	802-4201	gle@cityofsancarlos.org	X					
Kaveh Forouhi		kforouhi@cityofsancarlos.org						
San Mateo, City								
Sarah Scheidt		sscheidt@cityofsanmateo.org				X		
San Mateo, County								
Dermot Casey	372-6257	djcasey@smcgov.org						
Julie Casagrande	599-1457	jcasagrande@smcgov.org	X			X		
Patrick Ledesma	372-6241	pledesma@smcgov.org	X					
Tim Swillinger	372-6245	tswillinger@smcgov.org						
Jim Eggemeyer	363-4189	jeggemeyer@smcgov.org						
Andrea Chow		achow@smcgov.org				X		
So. San Francisco								
Rob Lecel	829-3882	rob.lecel@ssf.net						
Andrew Wemmer	829-3883	andrew.wemmer@ssf.net						
Woodside								
Dong Nguyen	851-6790	dnguyen@woodsidetown.org						
Caltrans								
Karen Mai		kmai@caltrans.ca.gov						
Guests/Public								
Katherine Sheehan	522-2506	katherines@csgengr.com	X					
Attendance			11	0	0	6	0	0

Appendix 2

- Municipal Maintenance Subcommittee – Attendance List for FY 2015/16
- Gross Solids Removal Device (GSRD) Site Tour – June 3, 2016
    - Registration Flyer
    - Attendance List
- Trash Full Capture Device O&M Inspection/Cleaning and Municipal Maintenance Data Management Roundtable – June 16, 2016
    - List of Presentations
    - Attendance List

Municipal Maintenance Subcommittee Meetings - FY 2015/16

NAME	MUNICIPALITY	Aug 26	Dec 16	Mar 23	Jun 22
Steve Tyler	Atherton				✓
Brandon Tyler	Belmont	✓	✓		✓
Randy Ferrando	Belmont	✓		✓	
Tim Murray	Belmont	✓	✓	✓	✓
Crockeh Kessei	Brisbane			✓	
Keegan Black	Brisbane	✓		✓	
Carolyn Critz	Burlingame			✓	
Dylan Pastor	Burlingame			✓	
Pam Boyle Rodriguez	Burlingame			✓	
Rick Horne	Burlingame	✓			
Ray Jackson	City of San Mateo			✓	
Rick Pina	City of San Mateo		✓		
Steve Camilleri	City of San Mateo			✓	
Louis Gotelli	Colma	✓	✓	✓	✓
Dan Godwin	Daly City			✓	
Jeff Fornesi	Daly City			✓	
Joe Stabile Sr.	Daly City			✓	✓
Jay Farr	East Palo Alto		✓		
Michelle Daher	East Palo Alto		✓		
Kristin Kerr	EOA, Inc.	✓	✓	✓	✓
Larry Carnahan	Half Moon Bay	✓	✓	✓	
Gary Francis	Hillsborough	✓	✓		✓
Gabriel Ortiz	Menlo Park		✓	✓	
Hugo Torres	Menlo Park		✓	✓	
Irv Meachum	Menlo Park		✓	✓	
Natividad Alamo	Menlo Park		✓	✓	
Nelson Guitierrez	Menlo Park			✓	
Chris Junio	Millbrae	✓		✓	✓
Christopher Falzon	Millbrae	✓		✓	
Heather Henwood	Millbrae	✓			
John Erickson	Millbrae				✓
Michael Killigrew	Millbrae	✓		✓	
Bernie Mau	Pacifica	✓			
Albert Munguis	Redwood City				✓
Eddie Pastrano	Redwood City			✓	✓
Eddy Lopez	Redwood City	✓	✓	✓	✓
Rich Del Ben	Redwood City	✓	✓	✓	✓
Victor Castaneda	Redwood City	✓	✓	✓	
Ted Chapman	San Bruno	✓			
Frank Amoroso	San Carlos		✓	✓	
Lou Duran	San Carlos				
Ted Rutledge	San Carlos			✓	✓

Municipal Maintenance Subcommittee Meetings - FY 2015/16

NAME	MUNICIPALITY	Aug 26	Dec 16	Mar 23	Jun 22
Bryan Dexter	San Mateo County			✓	
Dewayne Johnson	San Mateo County		✓		
Mark Marelich	San Mateo County			✓	✓
Ryan Rasmussen	San Mateo County				✓
Brian Weber	San Mateo County Mosquito & Vector Control District			✓	
Casey Stevenson	San Mateo County Mosquito & Vector Control District			✓	
John Castech	South San Francisco			✓	
Kevin Selfridge	South San Francisco			✓	

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.

555 County Center
Redwood City, CA 94063

P 650.599.1406
F 650.361.8227
flowstobay.org

Gross Solids Removal Device (GSRD) Site Tour

Meeting Location: 92 Oak St., Millbrae, CA. 94030

(Corner of Center St. and Oak St.)

(Parking on Oak St.)

Friday, June 3, 2016

10:00 a.m. – 10:30 a.m.

There will be a short on-site briefing prior to the tour.
Please register for this event by Wednesday, June 1.

Who should attend:

- ✓ Municipalities who are considering the installation of large trash full capture devices.
- ✓ Maintenance staff who are interested in understanding GSRD maintenance.

What to bring:

- ✓ Good walking shoes. There is a short walk to the GSRD.
- ✓ Rain boots if you want to "touch" the GSRD. It is in 3" of standing water.

Register at:

http://smcwppp_grsd_sitetour_millbrae.eventbrite.com

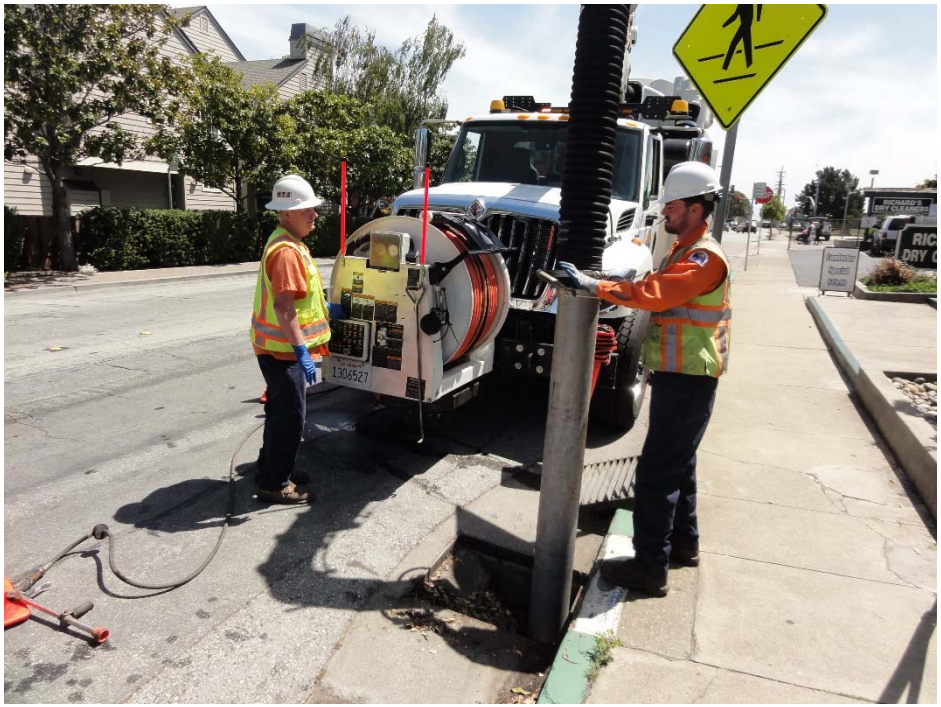
For additional information contact Lillian at 510-832-2852 ext. 101 or lquinata@eoainc.com

Gross Solid Removal Device (GRSD)
92 Oak St. Millbrae
June 3, 2016

	Last Name	**First Name**	**Municipality**
1	Boyle Rodriguez	Pam	City of Burlingame
2	Mallick	Rob	City of Burlingame
3	Fornesi	Jeff	City of Daly City
4	Sanchez	John	City of Daly City
5	Fuller	John	City of Daly City
6	Ritchie	HaeWon	City of Daly City
7	Brunmeier	Ryan	City of Daly City Public Works
8	Killigrew	Michael	City of Millbrae
9	Erikson	John	City of Millbrae
10	Vaz	Matthew	City of Millbrae
11	Chinnakotla	Ramana	City of Redwood City
12	Kyaw	Terence	City of Redwood City
13	Lopez	Eddie	City of Redwood City
14	Pastrano	Eddie	City of Redwood City
15	Sherman	Vicki	City of Redwood City
16	Chapman	Ted	City of San Bruno
17	Edlund	Sven	City of San Mateo
18	Kasper	Ron	City of San Mateo
19	Evans	Eric	City of South San Francisco
20	Wemmer	Andrew	City of South San Francisco

O&M/TRASH DATA COLLECTION ROUNDTABLE

THURSDAY, JUNE 16, 2016



SAN MATEO COUNTYWIDE
Water Pollution Prevention Program

PRESENTATION OUTLINE

- C.10.B Full Trash Capture Systems
  - Maintenance Requirements
  - Maintenance Records
  - Annual Reporting
- City Presentations – O&M/Trash Data Collection
  - Belmont
  - San Mateo
  - Brisbane
  - Burlingame
  - Daly City
  - Redwood City

TRASH FCD OPERATION AND MAINTENCE DATA COLLECTION ROUNDTABLE

SAN MATEO CITY HALL

JUNE 16, 2016

Attendance List

	Last Name	**First Name**	**Agency**
1	Murry	Tim	City of Belmont
2	Tyler	Brandon	City of Belmont
3	Black	Keegan	City of Brisbane
4	Boyle Rodriguez	Pam	City of Burlingame
5	Dawdy	Kevin	City of Burlingame
6	Pastor	Dylan	City of Burlingame
7	Fornesi	Jeff	City of Daly CIty
8	Barajos	Javier	City of Daly City
9	Sanchez	John	City of Daly City
10	McCarty	James	City of East Palo Alto
11	Henry	Brian	City of Menlo Park
12	Killigrew	Michael	City of Millbrae
13	Lopez	Eddie	City of Redwood City
14	Chapman	Ted	City of San Bruno
15	Camilleri	Steve	City of San Mateo
16	Pina	Rick	City of San Mateo
17	Rasmussen	Ryan	County of San Mateo
18	Dexter	Bryan	County of San Mateo
19	Casagrande	Julie	County of San Mateo DPW

Appendix 3

- New Development Subcommittee – Attendance List for FY 2015/16
- SMCWPPP Biotreatment Soil Mix Supplier List
- SMCWPPP Biotreatment Soil Mix Verification Checklist
- C.3.h Inspection Report Form
- New Development Workshop – June 14, 2016
    - Registration Flyer
    - Agenda
    - Attendance List
    - Summary of Workshop Evaluations
- GI TAC Meeting Agenda Packages
    - April 12, 2016
    - June 22, 2016
- Countywide Stormwater Resource Plan (SWRP) and Proposition 1 Implementation Grant Applications
    - Example Project Concept of a Green Street Retrofit
    - Project Concept: City of Redwood City Sustainable Streets
    - Project Concept: City of San Mateo Sustainable Streets and Parking Lot Project

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New Development Subcommittee
FY 2015/16 Meeting Attendance

Representing	Name	Phone Number	Meetings Attended		
			Aug	Feb	May
Atherton	David Huynh	650-752-0555		X	
Belmont	Gilbert Yau/Brian Pong	650-595-7467	X	X	X
Brisbane	Ken Johnson	415-508-2120		X	X
	Julia Capasso		X		
Burlingame	Pam Boyle Rodriguez	650-342-3727	X	X	X
	Dylan Pastor	707-326-3193		X	X
	Kevin Gardener	650-558-7253	X		
Colma	Michael Laughlin	650-757-8896			
	Turhan Sonmez	650-757-8898	X	X	X
	Muneer Ahmed	650-757-8894		X	X
Daly City	Mike Van Lonkhuysen	650-991-8158		X	
	Tendai Mtunga	650-991-8035		X	X
East Palo Alto	Michelle Daher	650-853-3197			
EOA/SMCWPPP	Jill Bicknell	408-720-8811 x 1		X	X
	Peter Schultze-Allen	510-832-2852 x128	X	X	X
Foster City	Robin Lee (S&W)	415-271-3117	X		
	Norm Dorais				
Half Moon Bay	Mark Lander	925-785-4518			
Hillsborough	Natalie Asai	650-375-7444	X	X	X
	Ali Hatefi	650-375-7446	X	X	X
Menlo Park	Shaun Mao	650-330-6740			
	Ebby Sohrabi	650-330-6740			
	Harris Siddiqui		X	X	X
Millbrae	Tanya Benedik	650-259-2339			
	Tonya Ward	650-259-2346			
Pacifica	Christian Murdock	650-738-7444		X	X
Portola Valley	Greg Beverlin	650-851-1700			
	CheyAnne Brown		X		
Redwood City	Patrick LaBruzzo	650-780-7366			
	James O'Connell	650-780-5923	X	X	X
San Bruno	Matt Neuebaumer	650-616-7042	X	X	X
	Michael Smith	650-616-7062		X	
San Carlos	Paige Safe	650-802-4196	X	X	X
San Mateo	Ken Pacini	650-522-7333	X	X	X
	Evan Albert	650-522-7330	X		
	Jocelyn Walker	650-522-7331		X	
County of San Mateo	Camille Leung	650-363-1826	X		X
	Andrea Chow	650-363-4125		X	X
	Diana Shu	650-599-1414			
Countywide Program	Matt Fabry	650-599-1419		X	
South S.F.	Andrew Wemmer	650-829-3840			
	Rob Lecel	650-829-3882	X	X	
Woodside	Dong Nguyen	650-851-6790			
Water Board	Sue Ma	510-622-2386			

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BIOTREATMENT SOIL MIX SUPPLIER LIST

Company	Contact Name	Phone	Address	City	Zip	E-mail	Website
American Soil & Stone Products Inc.	Ryan Hoffman	510-292-3018	Richmond Annex, 2121 San Joaquin St., Bldg. A	Richmond	94804	ryan@americansoil.com	www.americansoil.com
L.H. Voss Materials, Inc	Nyoka Corley	925-676-7910	5965 Dougherty Road	Dublin	94568	nyoka.corley@gmail.com	www.lhvoss.com
Lehigh Hanson Aggregates	Chris Stromberg	510-246-0393	4501 Tidewater Ave.	Oakland	94601	chris.stromberg@lehighhanson.com	www.lehighhanson.com
Lyngso Garden Materials, Inc.	Paul Truyts	650-333-1044 650-364-1730 x131	19 Seaport Blvd.	Redwood City	94063	ptruyts@lyngsogarden.com	www.lyngsogarden.com
Marshall Brothers Enterprises, Inc.	Phillip Marshall	925-449-4020	P.O. Box 2188	Livermore	94551	phillip@mbenterprises.com	www.mbenterprises.com
Pleasanton Trucking Inc.	Tom Bonnell	925-449-5400	P.O. Box 11462	Pleasanton	94588	pleasanton_trucking@yahoo.com	www.pleasantontrucking.com
Redi-Gro Corporation	Sharon Yon	916-381-6063 800-654-4358	8909 Elder Creek Road	Sacramento	95828	redigropro@redi-gro.com	www.redi-gro.com
TMT Enterprises, Inc.	Matt Moore	408-432-9040	1996 Oakland Road	San Jose	95131	info@tmtenterprises.net	www.tmtenterprises.net

As of: 8/1/2015

Disclaimer: SMCWPPP provides this list of biotreatment soil mix suppliers for the use of its member agencies, contractors, designers and others in finding suppliers for their projects. Suppliers are listed based on a general review of their soil mix product including test results, adherence to the Attachment L specification in the MRP and knowledge of the specification. Therefore users of this SMCWPPP list must make the final determination as to the products and adherence to Attachment L of the MRP. Users of the list assume all liability directly or indirectly arising from use of this list. The listing of any soil supplier is not be construed as an actual or implied endorsement, recommendation, or warranty of such soil provider or their products, nor is criticism implied of similar soil suppliers that are not listed. This disclaimer is applicable whether the information is obtained in hard copy or downloaded from the Internet. Check the SMCWPPP website for the “Biotreatment Soil Mix Verification Checklist” and “Biotreatment Soil Mix Supplier Verification Statement” for assistance in reviewing and approving soil mix submittals. www.flowstobay.org/newdevelopment

Biotreatment Soil Mix
Specification Verification Checklist

This checklist is intended to supply municipal staff, contractors, designers and others with an easy-to-read summary of the detailed information needed to verify that the biotreatment soil mix being provided by the Soil Mix Supplier meets the BASMAA Regional Biotreatment Soil Specification[1] approved by the Regional Water Board Executive Officer on April 18, 2016[2].

The checklist should be provided to the Soil Mix Supplier by the municipality or contractor before the soil mix has been ordered to allow for sufficient time to compile the information and time to review the completed checklist before delivery of the soil mix to the job site.

Use of this checklist is not required by the MRP and is intended only for assistance in reviewing submittals. Additionally or alternatively, the one page Supplier Certification Statement, developed by the stormwater programs listed below, can be requested from the Supplier to guarantee that the product meets the specification.

The Certification Statement, a list of Soil Mix Suppliers, the BASMAA Regional Biotreatment Soil Specification (2016) and other materials are available at the following websites:

- Santa Clara Valley Urban Runoff Pollution Prevention Program: www.scvurppp-w2k.com/nd_wp.shtml#other
- San Mateo Countywide Water Pollution Prevention Program: www.flowstobay.org/newdevelopment
- Alameda Countywide Clean Water Program: www.cleanwaterprogram.org/business/development2.html

If a municipality chooses to use the checklist, the following five items are required to be submitted by the Soil Mix Supplier to the requesting municipality or contractor:

- **Sample of the Biotreatment Soil Mix**
  A minimum 1-gallon bag of soil mix.

- **Attachment A – Supplier Analysis of the Biotreatment Soil Mix**
  To be completed by the Soil Mix Supplier providing the soil mix.

- **Attachment B – Lab Analysis of Sand Component of the Biotreatment Soil Mix**
  To be completed by the laboratory conducting the analysis of the sand.

- **Attachment C – Lab Analysis of Compost Component of the Biotreatment Soil Mix**
  To be completed by the laboratory conducting the analysis of the compost. Compost analysis of a sample collected (in accordance with the STA sample collection protocol) shall be completed within the last 120 days. Analysis must be completed by a laboratory enrolled in the US Composting Council's Compost Analysis Proficiency program, and shall use the Test Methods for the Evaluation of Composting and Compost (TMECC).

- **Attachment D – Supplier Analysis of Compost Component of the Biotreatment Soil Mix**
  To be completed by the Compost Supplier providing the compost component of the soil mix.

1. www.basmaa.org
2. www.swrcb.ca.gov/rwqcb2/water_issues/programs/stormwater/mrp.shtml

Attachment A

Supplier Analysis of Biotreatment Soil Mix

The table below shall be completed by the Biotreatment Soil Mix Supplier.

Date: **(All lab tests must be done within the last 120 days)**	**Name of Person Filling Out This Form:**
Title:	**Signature:**
Phone:	**Email:**
Company Name:	**City:**
Street Address:	**Zip:**

I certify that the provided Biotreatment Soil Mix meets the requirements of the BASMAA Regional Biotreatment Soil Specification (2016).	☐ Yes (Pass) ☐ No (Fail)

Describe the equipment and methods used to mix the compost and sand components of the Biotreatment Soil Mix.	

Material	Standard Percent (by volume)	Actual Mix %	Pass	Fail
Sand	60% - 70%		☐	☐
Compost	30% - 40%		☐	☐

Does the soil mix have a permeability of at least 5 inches per hour?[1]	☐ Yes (Pass) ☐ No (Fail)

Will the soil mix support vigorous plant growth?	☐ Yes (Pass) ☐ No (Fail)

[1]Soil mix permeability testing is only required for alternative biotreatment soil mixes. Soil permeability tests must be conducted on a minimum of two samples using constant head permeability in accordance with ASTM D2434 with a 6-inch mold and vacuum saturation.

Attachment B

Lab Analysis of Sand Component of Biotreatment Soil Mix

The table below shall be completed by the laboratory conducting the sand analysis.

Name of Person Filling Out This Form:	**Signature:**
Title:	**Date:**
Phone:	**Email:**
Company:	**City:**
Street Address:	**Zip:**
Qualifications & relevant certifications (ASTM, CTM or approved equivalent certifications):	

Is sand free of wood, waste, coating (such as clay, stone dust, carbonate, etc.), or any other deleterious material?	☐ Yes (Pass) ☐ No (Fail)
Is all aggregate passing the No. 200 sieve non-plastic?	☐ Yes (Pass) ☐ No (Fail)

Particle size analysis shall be conducted in accordance with ASTM D 422 (Standard Test Method for Particle Size Analysis of Soils) or CTM 202. Other equivalent methods acceptable only if approved.

Sieve Size	Standard Percent Passing (% by weight)	Testing Results (%)	Pass	Fail
3/8 inch	100%		☐	☐
No. 4	90% - 100%		☐	☐
No. 8	70% - 100%		☐	☐
No. 16	40% - 95%		☐	☐
No. 30	15% - 70%		☐	☐
No. 40 or 50	5% - 55%		☐	☐
No. 100	0% - 15%		☐	☐
No. 200	0% - 5%		☐	☐

Attachment C

Lab Analysis of Compost Component of Biotreatment Soil Mix

The table below shall be completed by the laboratory conducting the compost analysis.

Name of Person Filling Out This Form:	**Signature:**
Title:	**Date:**
Phone:	**Email:**
Company:	**City:**
Street Address:	**Zip:**
Qualifications & relevant certifications: (STA, ASTM or approved equivalent certification)	

Specification	Standard	Testing Results		Pass	Fail
Organic Matter Content	35% - 75% (by dry weight)		%	☐	☐
Carbon-to-Nitrogen Ratio	15:1 to 25:1 (C:N)		C:N	☐	☐
Salinity	< 6.0 mm hos/cm		mm hos/cm	☐	☐
pH	6.2 - 8.2		pH	☐	☐
Bulk Density	500 – 1100 dry lbs / yd^3		dry lbs / yd^3	☐	☐
Moisture Content	30%-55% (of dry solids)		%	☐	☐
Percent inert ingredients (incl. plastic, glass, paper)	< 1% (by weight or volume)		%	☐	☐

Provide the results of <u>at least one</u> of the following analyses to indicate compost stability:

Specification	Standard	Testing Results		Pass	Fail
Oxygen Test	< 1.3 0_2 /unit TS/hr		0_2 /unit TS/hr	☐	☐
Specific Oxygen Test	< 1.5 0_2/unit BVS/hr		0_2/unit BVS/hr	☐	☐
Respiration Test	< 8mg CO_2-C/g OM/day		mgCO_2-C/g OM/day	☐	☐
Dewar test	< 20 ˚C Temp. rise e.		˚C Temp. rise e.	☐	☐
Solvita® Index value	> 5 Index value		Index value	☐	☐

Provide the results of at least one of the following analyses to indicate compost toxicity:

Specification	Standard	Testing Results		Pass	Fail
Ratio NH_4^+N: NO_3^--N	< 3		NH_4^+-N : NO_3^--N	☐	☐
Ammonium	< 500 ppm, dry basis		ppm, dry basis	☐	☐
Seed Germination	> 80% of control		% of control	☐	☐
Plant Trials	> 80% of control		% of control	☐	☐
Solvita® Index value	= 5 Index value		Index value	☐	☐

Provide the analysis of the nutrient content of the compost, including the following:

Specification	Standard	Testing Results		Pass	Fail
Boron (total, in ppm)	< 80 ppm		ppm	☐	☐
Nitrogen (N)(total %)	> 0.9% preferred.		%		
Phosphorus (as P_2O_5)	*[not specified]*		%		
Potassium (as K_2O)	*[not specified]*		%		
Calcium (Ca)	*[not specified]*		%		
Sodium (Na)	*[not specified]*		%		
Magnesium (Mg)	*[not specified]*		%		
Sulfur (S)	*[not specified]*		ppm		

Provide the results of at least one of the following select pathogens:

Specification	Standard	Testing Results		Pass	Fail
Salmonella	< 3 MPN/4 grams TS		MPN/4 grams TS	☐	☐
Coliform Bacteria	< 10,000 MPN/gram		MPN/gram	☐	☐

Does the product meet US EPA, 40CFR 503 regulations regarding trace contaminants metals (Lead, Mercury, etc.)?	☐ Yes (Pass) ☐ No (Fail)

Particle size analysis shall be conducted in accordance with ASTM D 422 (Standard Test Method for Particle Size Analysis of Soils)-washing not required. Equivalent methods acceptable if approved.

Sieve Size	Standard Percent Passing (by weight)	Testing Results (%)	Pass	Fail
1 inch	**99% - 100%**		☐	☐
½ inch	**90% - 100%**		☐	☐
¼ inch	**40% - 90%**		☐	☐
No. 200	**1% - 10%**		☐	☐

Attachment D

Supplier Analysis of Compost Component of Biotreatment Soil Mix

The table below shall be completed by the Compost Supplier providing the compost for the mix.

Name of Company:	**Date of Delivery:**
Qualifications & relevant certifications: **(STA, ASTM or approved equivalent certifications)**	**Date of the Compost Lab Analysis Report:** **(Must be dated within 120 days prior to delivery)**
Name of Person Filling Out This Form:	**Date:**
Signature:	**Street Address:**
Email address:	**City:**
Phone:	**Zip:**

Feedstock materials have been specified and include only the following: Landscape/yard trimmings, grass clippings, food scraps, or agricultural crop residues?	☐ Yes (Pass) ☐ No (Fail)
Compost has a dark brown color and a soil-like odor, does not exhibit a sour or putrid smell, does not contain recognizable grass or leaves, and is not hot (120˚F) upon delivery or rewetting?	☐ Yes (Pass) ☐ No (Fail)
The compost has gone through the process to further reduce pathogens (PFRP)? For example, turned windrows must reach a minimum temperature of 55˚C for 15 days with at least 5 turnings during that period.	☐ Yes (Pass) ☐ No (Fail)

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program

Municipality: _____

Inspector Name:_____ Inspector Signature:_____ Date: _____

Facility has closed or Facility Information has changed: ☐ Yes ☐ No

Stormwater Treatment or Hydromodification Management (HM) BMP O&M Verification Inspection Report Form

Reason for Inspection: ☐ Installation Inspection ☐ Routine Inspection ☐ Response to Complaint ☐ Follow-up					Follow-up Inspection Due: _____
NAME OF FACILITY:		SITE ADDRESS:		PHONE:	ID# OR APN:
CONTACT NAME:	EMAIL:	PROJECT TYPE/ACTIVITY:	SIC:		Map Code:
Is the property owner different than the facility owner? ☐ Yes ☐ No		If yes, complete the following:			Location:
NAME: MAILING ADDRESS:		TITLE: EMAIL:	PHONE:		
Is the BMP Operator different than the facility owner? ☐ Yes ☐ No		If yes, complete the following:			
NAME: MAILING ADDRESS:		TITLE: EMAIL:	PHONE:		

Needed maintenance noted for the Treatment and/or HM BMPs below shall be completed within 30 days and notification of correction faxed, emailed or mailed to the oversight agency.

Treatment BMP Type (Numbers in parentheses correspond to fact sheets in CASQA's New Development Handbook)	**Needed Maintenance**																								
	No visible problems	Trash or Debris	Pollutants	Rodent Holes	Hazardous Trees/Brush	Erosion or Scouring	Excessive Sediment	Liner Condition (if visible)	Spillway/Berm Damaged, Settled	Damaged Trash Rack or Screen	Inlet/Outlet Condition	Security (fence, gates)	Coating/Paint	Standing Water	Mosquitoes/ Other Insects	Flow Spreader/ Equalizer	Invasive Weeds or Vegetation	Poor Vegetation Cover < 90%	Pedestrian Path De-vegetation/ Compaction	Vegetation Overgrown	Odors	Mulch replenish	Pavement Cracked or Broken	Aggregate Loss in Paver Joints	Settlement of pavement surface	Other:
Vegetated Swale (TC-30)									■			■	■													
Extended Detention Basin (TC-22)																■						■	■	■	■	
Bioretention Facility (TC-32)/ Flow-Through Planter												■	■										■	■	■	
Vortex Separator (MP-51)				■	■	■		■	■							■	■	■	■	■		■	■	■	■	
Infiltration Basin (TC-11)								■		■						■						■	■	■	■	
Water Quality Inlets –Oil/ grit/water Separator (TC-50)				■	■	■		■	■							■	■	■	■	■		■	■	■	■	
Media/Sand Filters (TC-40)				■	■	■		■		■						■	■	■	■	■		■	■	■	■	
Drain Inserts (MP-52)				■	■	■		■	■	■		■				■	■	■	■	■		■	■	■	■	
HM Tank or Vault				■	■	■		■	■	■		■				■	■	■	■	■		■	■	■	■	
Pervious Paving (SD-20) – Note pavement type in Comments				■				■	■	■		■	■			■			■			■				
Other _____																										

COMMENTS: Date Treatment/HM BMP Installed (for first inspection only): _____ Maintenance Documentation Reviewed? ☐ Yes ☐ No Maintenance required in storm drain system? ☐ Yes ☐ No

Pervious Pavement Type(s): ☐ pervious concrete ☐ porous asphalt ☐ interlocking concrete pavers ☐ grid pavers ☐ turf block

BMP brochures distributed? ☐ Describe: Follow-up required? ☐ Yes ☐ No Comments:

Indicate the last date on which the Applicant submitted annual report for project O&M: _____ (attach report)

PRIORITY FOR RE-INSPECTION: ☐ First ☐ Second ☐ Third REQUIRED COMPLIANCE DATE: _____ DATE CORRECTED: _____

ENFORCEMENT: ☐ None ☐ Verbal Notice ☐ Warning Notice ☐ Administrative Action ☐ Administrative Action w/ Penalty &/or Cost Recovery ☐ Legal Action

Appendix: O&M Annual Report Form

Needed Maintenance	Conditions When Maintenance Is Needed
Trash or Debris	Treatment or HM BMP/Pervious Paving: Trash, debris, or litter dumped or accumulated in BMP. Vortex separator floatables should be removed according to maintenance plan. Check for mulch washout.
Pollutants	Treatment BMP/Pervious Paving: Any evidence of oil, gasoline, improper pesticide or fertilizer use, spill, or other visible pollutants.
Rodent Holes	Extended Detention or HM Basin: If facility acts as dam/berm, any evidence of rodent holes or water piping through dam/berm via rodent holes.
Hazardous Trees/ Brush	Extended Detention or HM Basin: Growth does not allow access or interferes with maintenance; dead, diseased or dying trees. Growth >4 ft. high on berms/emergency spillway or covering >10% of spillway. Pervious Paving: Root encroachment or pavement lift.
Erosion or Scouring	Treatment or HM BMP: Eroded or scoured bottom due to flow channelization or higher flows. Extended Detention or HM Basin: Side slopes eroded >2 inches deep where cause of damage is present or there is potential for continued erosion; Erosion on compacted berm embankment.
Excessive Sediment	Vegetated Swale/Bioretention: Sediment accumulated >2 inches deep on vegetation. Extended Detention or HM Basin: Accumulated sediment >10% of designated basin depth or affects inletting/outletting condition of facility. Pervious Paving: Clogging.
Liner Condition (if visible)	Extended Detention or HM Basin: Liner is visible and has more than 3, ¼-inch holes in it.
Spillway/Berm Damaged, Settled	Extended Detention or HM Basin: Spillway and/or berm settlement is 4 inches lower than design elevation. Rock missing & soil exposed at top of spillway or outside slope.
Damaged Trash Rack or Screen	Treatment or HM BMP: Trash/debris plugging openings in barrier. Vortex Separator: Screen damaged. Extended Detention or HM Basin: Bars missing, loose, bent out of shape or deteriorating due to excessive corrosion.
Inlet/Outlet Condition	Treatment or HM BMP/Pervious Paving: Inlet/outlet areas clogged with sediment, vegetation and/or debris. Check any high-flow bypass for clogging. Extended Detention or HM Basin: Debris barrier missing or not attached to pipe.
Security (fence, gates, and/or covers)	Treatment or HM BMP: Any defect or damage to fence/gate that prevents easy entry to the BMP and/or cover for below surface BMPs.
Coating/Paint	Treatment BMP: Parts that are corroding or have scaling paint.
Standing Water	Treatment or HM BMP/Pervious Paving: When water stands in BMP for longer than 5 days between storms and does not drain freely, unless this is part of the BMP's design. Check for irrigation problems.
Mosquitoes/Other Insects	Treatment or HM BMP/Pervious Paving: If mosquitoes or mosquito larvae are present in a BMP, contact the San Mateo County Mosquito Abatement District at (650) 344-8592 or www.smcmvcd.org/contact-us. Insects such as wasps and hornets interfere with maintenance activities.
Flow Spreader	Vegetated Swale/Bioretention: Spreader uneven/clogged (flow not uniformly distributed over entire swale width).
Invasive Weeds or Vegetation	Treatment or HM BMP: Examples - Arundo, Castor Bean, Cattails, Pampas Grass, Tamarisk, Willows, Morning Glory, English Ivy, Blackberry, Scotch Broom, or Poison Oak. Vegetated Swale/Bioretention: Planted vegetation becomes excessively tall; nuisance vegetation/weeds start to take over. Pervious Paving: Weeds in joints of permeable joint paving: turf block not mowed per maintenance plan.
Poor Vegetation Coverage < 90%	Treatment or HM BMP: Check for mulch failure. Vegetated Swale/Turf block paving: When planted vegetation is sparse, bare or eroded patches occur in >10% of turf block or swale bottom. Bioretention: Ten percent of plants have died and not been replaced.
Pedestrian Path De-vegetation/Compaction	Vegetated Swale/Bioretention: Pedestrian trails are forming or been established that are devegetating portion of BMP and compacting soil.
Odor	Treatment or HM BMP/Pervious Paving: Any odor associated with the accumulation and decomposition of pollutants or other material in the BMP that is causing a nuisance.
Pervious Pavement Defects	Any of the following: major cracks or trip hazards, concrete spalling and raveling, cracked or broken pavers, visible aggregate loss between pavers, substantial settlement of paved surface.

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Registration Flyer

Annual C.3 Stormwater Workshop

Low Impact Development and Green Infrastructure:

"Don't Miss the Opportunity!"

This workshop is for:

✓ Municipal Engineering, Planning, Forestry, Landscaping, Transportation, CIP, Maintenance & Stormwater Staff

San Mateo Public Library – Oak Room
55 W. 3rd Avenue, San Mateo

Tuesday, June 14, 2016

9:00am – 10:00am: Basic Training
10:00am – 3:30 pm: Main Workshop

Green Street Project in Colma

Workshop Highlights:

- **Basic Training:**
  Stormwater Permit Requirements and Reviewing Projects for Permit Compliance

  Main Workshop:
- **What's in the New Permit**
- **Green Infrastructure Overview**
- **Pervious Paving Information**
- **Lunch!**
- **Capital Improvement Projects – How to Review Projects for Green Infrastructure Opportunities**

Click Below to Register for the Workshop:
http://smcwppp_annual_c3_workshop.eventbrite.com

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.

ANNUAL C.3 STORMWATER WORKSHOP:

Low Impact Development and Green Infrastructure:

Don't Miss the Opportunity!

Tuesday, June 14, 2016

San Mateo Public Library – Oak Room
55 W. 3rd Avenue, San Mateo

WORKSHOP AGENDA

8:45 am	**Registration and Refreshments**	
9:00 am	Basic Training: Stormwater Controls for Development Projects	*Jill Bicknell, P.E.* *EOA, Inc.*
9:45 am	**Break/Main Session Registration**	
10:00 am	Welcome and Introduction	
10:05 am	What's New in the Municipal Regional Stormwater Permit?	*Jill Bicknell*
10:30 am	Focus on Pervious Pavement for Stormwater Control: • Application, Selection, and Design Considerations • Construction, Maintenance, and Inspection Considerations	*Jill Bicknell and* *Peter Schultze-Allen* *EOA, Inc.*
12:00 pm	**Lunch**	
12:30 pm	The Green Infrastructure Plan Requirement: Shifting from Gray to Green Infrastructure	*Connie Goldade* *Community Design + Architecture*
1:10 pm	What Are Opportunities for Green Infrastructure?	*Peter Schultze-Allen*
1:40 pm	**Break**	
1:50 pm	How Will Agencies Identify Green Infrastructure Opportunities?	*Jill Bicknell*
2:20 pm	Group Exercise: CIP Project Review	*Peter Schultze-Allen*
3:00 pm	Adjourn	

SMCWPPP
ANNUAL C.3 STORMWATER WORKSHOP
LOW IMPACT DEVELOPMENT AND GREE INFRASTRUCTURE
JUNE 14, 2016

	Last Name	First Name	Municipality	Signature
1	Adlao	Damon	Midpeninsula Regional Open Space District	
2	Albert	Evan	City of San Mateo	
3	Andersen	Julie	Midpeninsula Regional Open Space District	
4	Anderson	Will	City of San Bruno	
5	Apple	Bryan		
6	Azzari	Zack	San Mateo County, PWs	
7	Black	Keegan	City of Brisbane	
8	Boo	Olivia	San Mateo County Planning	
9	Boyle Rodriguez	Pam	City of Burlingame	
10	Burlison	Summer	San Mateo County Planning	
11	Capasso	Julia	City of Brisbane	
12	carnam	daniel	N/A	
13	Casagrande	Julie	County of San Mateo DPW	
14	Chan	Leslie	MROSD	
15	Chan	Alex	City of Redwood City	
16	Choi	Carter	County of San Mateo Department of Public Works	

SMCWPPP
ANNUAL C.3 STORMWATER WORKSHOP
LOW IMPACT DEVELOPMENT AND GREE INFRASTRUCTURE
JUNE 14, 2016

	Last Name	First Name	Municipality	Signature
17	Chow	Leo	City of San Mateo	
18	Daher	Michelle	City of East Palo Alto	
19	Del Rosario	Ferd	CSG Consultants	
20	Edlund	Sven	City of San Mateo	
21	Evans	Eric	City of South San francisco	
22	Goldade	connie	CD+A	
23	Gonzales	Eric	CSG Consultants	
24	Hakhamaneshi	Rambod	CSG Consultants Inc	
25	Hatefi	Ali	Town of Hillsborough	
26	Hosseini-Bidohkti	Eman	San Mateo County, PWs	
27	Jackson	Emmett	San Mateo County, PWs	
28	johnson	ken	City of Brisbane	
29	Khatkar	Jaspreet	City of San Mateo	
30	Laustsen	Gretchen	MROSD	
31	Leung	Camille	San Mateo County Planning	
32	Lin	Jay	MROSD	unable to attend due to project deadline

SMCWPPP
ANNUAL C.3 STORMWATER WORKSHOP
LOW IMPACT DEVELOPMENT AND GREE INFRASTRUCTURE
JUNE 14, 2016

	Last Name	First Name	Municipality	Signature
33	Ma	Vivian	City of Foster City	
34	Manion	Jennell	San Mateo County DPW	
35	Manning	Meredith		
36	Mark	Jane	MROSD	
37	Murdock	Christian	City of Pacifica, California	
38	Ngo	Michael	City of Foster City	
39	O'Connell	James	City of Redwood City	
40	O'Connor	Bonny	City of Pacifica, California	
41	Oran	Alexandra	Schaaf & Wheeler	
42	Orellana	Adolfo	San Mateo County	
43	Pacini	Ken	City of San Mateo	
44	Pastor	Dylan	City of Burlingame	
45	Pozzi	Tara	Schaaf & Wheeler	
46	Riddell	Anthony	City of San Carlos	
47	Safe	Paige	City of San Carlos	
48	Scheidt	Sarah	City of San Mateo Wastewater Treatment Plant	

SMCWPPP
ANNUAL C.3 STORMWATER WORKSHOP
LOW IMPACT DEVELOPMENT AND GREE INFRASTRUCTURE
JUNE 14, 2016

	Last Name	First Name	Municipality	Signature
49	Schrotenboer	Patti	City of Redwood City	
50	Seto	David	CSG Consultant	
51	Sharifi	Mehdi	CSG Consultants Inc	
52	shu	diana	smc	
53	Siddiqui	Harris	City of Menlo Park	
54	Smith	Robert	City of Pacifica, California	
55	Tourel	Gil	San Mateo County DPW	
56	Velasquez	Alan	San Mateo County	
57	Wong	David	City of San Bruno	
58	CHOW	ANDREA	COUNTY	
59	Swenson	Mark	City of San Mateo	
60	UPPAL	Paramjit	Town of Hillsborough	
61	~~Lau Lawrence~~	Lawrence	CSG Consultants	
62	Asavi	Natalie	TOWN OF HILLSBOROUGH	
63	MTUNGA	TENDAI	DALY CITY	
64	Ahmed	Muneer	Town of Colma	

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Water Pollution Prevention Program
Clean Water. Healthy Community.

Summary of Evaluation Form

ANNUAL C.3 STORMWATER WORKSHOP: LOW IMPACT DEVELOPMENT AND GREEN INFRASTRUCTURE

San Mateo, CA

Tuesday, June 14, 2016
Attendance: 53
Evaluations: 40

MORNING SESSION

1. **Basic Training: Stormwater Controls for Development Projects –** Given by Jill Bicknell

   Very Useful 31 **Somewhat Useful 6** **Not useful 0**

   Comments:
   Good summary (already knew the information)
   Good overview for newbies
   Appreciate basic overview for new attendees
   As a stormwater treatment/MRP novice, some additional explanation of jargon and/or basic procedural requirements would be great
   Already know it, but a refresher is always good
   Explained in plain language some of the basic terms and concepts that are often assumed to be understood universally (but which are not)
   It's good to include it as part of the workshop as a refresher course

2. **What's New in the Municipal Regional Stormwater Permit? –** Given by Jill Bicknell

   Very Useful 39 **Somewhat Useful 0** **Not useful 0**

   Comments:
   Like the way talk was broken into sections of same, new good, new problematic
   Add frequently asked questions to PowerPoint
   Always appreciate the updates and reporting requirements of revised permit
   Repeat questions from audience to make sure everyone understands question/answer

3. **Pervious Pavement for Stormwater Control: Application, Selection and Design Considerations –** Given by Jill Bicknell

   Very Useful 35 **Somewhat Useful 4** **Not useful 0**

   Comments:
   Good explanation of difference and similarity of various systems
   It seems like a lot of this needs to be added to the technical guidance
   Add frequently asked questions to PowerPoint
   Good tips on developing bids, construction oversight and maintenance needs for using these materials
   Good examples provided
   Repeat questions from audience to make sure everyone understands question/answer

4. **Pervious Pavement for Stormwater Control: Construction, Maintenance and Inspection Considerations –** Given by Peter Schultze-Allen

Very Useful 35 **Somewhat Useful 4** **Not useful 0**

Comments:
Inspection tips very helpful
Good to know that overpowered vacuuming can damage pavers.
Good examples
Add frequently asked questions to PowerPoint
Good Q & A opportunity
Repeat questions from audience to make sure everyone understands question/answer

5. **The Green Infrastructure Plan Requirement: Shifting from Gray to Green Infrastructure –** Given by Connie Goldade, Community Design & Architecture

Very Useful 21 **Somewhat Useful 17** **Not useful 1**

Comments:
Not very engaging; not sure exactly what CDA is doing
Did not hear the follow-up questions
It would have helped for her to layout the timing and tasks by the TAC and consultants more clearly
More detail about background work/timing would have been helpful
She should have spoken from her firm's perspective as regulatory requirements and program deadlines are SMCWPPP's strengths.

6. **What are Opportunities for Green Infrastructure? –** Given by Peter Schultze-Allen

Very Useful 35 **Somewhat Useful 4** **Not useful 0**

Comments:
Photo examples were helpful
Like missed opportunities discussion
I really liked the missed opportunities section at the end
Made me think about new ways to fit in GI where otherwise I wouldn't even have considered it

7. **How will Agencies Identify Green Infrastructure Opportunities? –** Given by Jill Bicknell

Very Useful 33 **Somewhat Useful 5** **Not useful 0**

Comments:
Probably need more help with Table A & B
More clarity needed on public agencies (special districts) that are not co-permittee of MRP/how this assessment works for voluntary, non-C-3 regulated projects

8. **Group Exercise –** CIP Project Review Given by Peter Schultze-Allen

Very Useful 34 **Somewhat Useful 4** **Not useful 0**

Comments:
Not enough time
Extremely useful!
I really liked it
Some subjectivity to the assessment of GI potential

9. **Did this training meet your expectations? Yes: 37 No: 0**

10. **What parts of the training were most useful to you?**
Photo examples, design details, suggestions
CIP Assessment
The group exercise and the opportunities for Green Infrastructure
Afternoon portion – GI Topics
MRP 2.0 updates
What's new in MRP and Green Infrastructure plan requirements
Pervious paving practical advice
What's new and GI exercise
GI item 7 & 8
New MRP permit requirements
Discussion of GI opportunities
Opportunities for Green information
What is not required?
As a city without many C-3 projects, I appreciated the GI plan information especially
The intro session
Group exercise
Group exercise, examples given
The information of the GI plan
The GI stuff
Sub drain pipe outlet elevation and reviewing CIP for GI
All was informative
GI plan
Opportunities for GI exercise
The group exercise
Visuals on implementation and stormwater requirements
Pervious pavement for stormwater treatment
Group exercise
Green infrastructure and new permit requirements
Examples

11. What would have made this training more useful?

Having more training on C.3 review on private development for people who are new to it (like me)
Best practice policy reference (or ordinance)
Links to PowerPoint
A water jug
Providing this online via skype as well
Provide clarity on how Green Infrastructure plan requirement applies to other public agencies such as special districts
More detailed schedule of county-wide activities that are going on for GI compliance
Have it be more interactive
List of vendors, plants & trees
More real life examples and discussions
The examples of GI

12. What topics would you recommend for a future training?

Record keeping requirements
More GI implementation
The topics covered were good
Any information on agencies or 3rd parties who can provide offsite sites to perform/install GI/LID for agencies that don't have own space/land/area to install such facilities to get credit.
Flow and volume based bioretention sizing
More in-depth review of C.3 checklist and associated requirements
Please consider providing this training online via skype or other so that employees can attend remotely due to scheduling conflicts
Feedback from other agencies
Good coverage of issues here
Clearly state if GI projects (sole purpose) needs anything further

13. General Comments?

I don't like these sandwiches
Good training
Great lecture
Good overall training
Very good
Good job
Very good workshop
Thank you so much – learned a lot!
Would be helpful to provide list of key contacts in Santa Clara County and San Mateo County to contact if there are questions on developing Annual Report and Green Infrastructure Plan
Make sure PowerPoint handouts are readable and in color
Very good class
Thanks

Site Information

Jurisdiction	City of Redwood City
Street Name	Middlefield Rd
Bounding Streets	Main St / Woodside Rd
Street Typology	Arterial
Co-Located Project	Middlefield Streetscape Project
Capture Area (acres)	4.16
Impervious Area (%)	90
85th Percentile Rainfall (in)	0.85
Generated Runoff (ac-ft)	0.27


Curb Extension on an Arterial Street

Site Description:

The proposed project consists of green street improvements along Middlefield Road between Main Street and Woodside Road. The street segment is approximately 2,250 feet long. Middlefield Road is an arterial street that is relatively narrow. Limited space is divided between bike lanes, multiple lanes each direction, turn lanes, and parking lanes. This presents a challenge with siting green infrastructure without sacrificing some usage of the roadway. Curb extensions are recommended as the primary treatment type. Segments of the street that feature two lanes may be reduced to single lanes to allow adequate area for improvements. Center medians can be removed to provide additional area. Curb extensions can also be placed at crosswalks to improve pedestrian safety while increasing stormwater capture capacity. Where lanes cannot be reduced, some parking may need to be removed.

The proposed improvements would capture 100% of the 85th percentile runoff volume (0.27 ac-ft) while providing flood risk mitigation, community enhancement, increased property values, safer pedestrian routes, and other multiple benefits.

DISCLAIMER: All elements of this conceptual design are planning-level. Locations of opportunities for placement of green infrastructure shown in the map are preliminary and subject to further site assessment and design. Percent imperviousness is based on best professional judgement. All design assumptions/parameters and cost estimates must be re-evaluated during the detailed design process.

Design Summary

Green Infrastructure Type	Design Width (ft)	Design Length (ft)	Capture Volume (ac-ft)
Bioretention (Curb Extension)	8	780	0.270

Cost Estimate

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL
Excavation/Hauling	1,160	CY	$50.00	$58,000
Bioretention	6,240	SF	$25.00	$156,000
Curbs and Gutters	780	LF	$17.25	$14,000
			CONSTRUCTION SUBTOTAL	$228,000
Planning (20%), Mobilization (10%), Design (30%), Contingency (25%)				$194,000
			TOTAL COST	**$422,000**

Concept for a Green Street Retrofit for Stormwater Capture

Site: Middlefield Road (City of Redwood City)

San Mateo Countywide Water Pollution Prevention Program

PARADIGM ENVIRONMENTAL

Figure 5. Middlefield Streetscape project site

Figure 6. Kennedy Middle School project elements

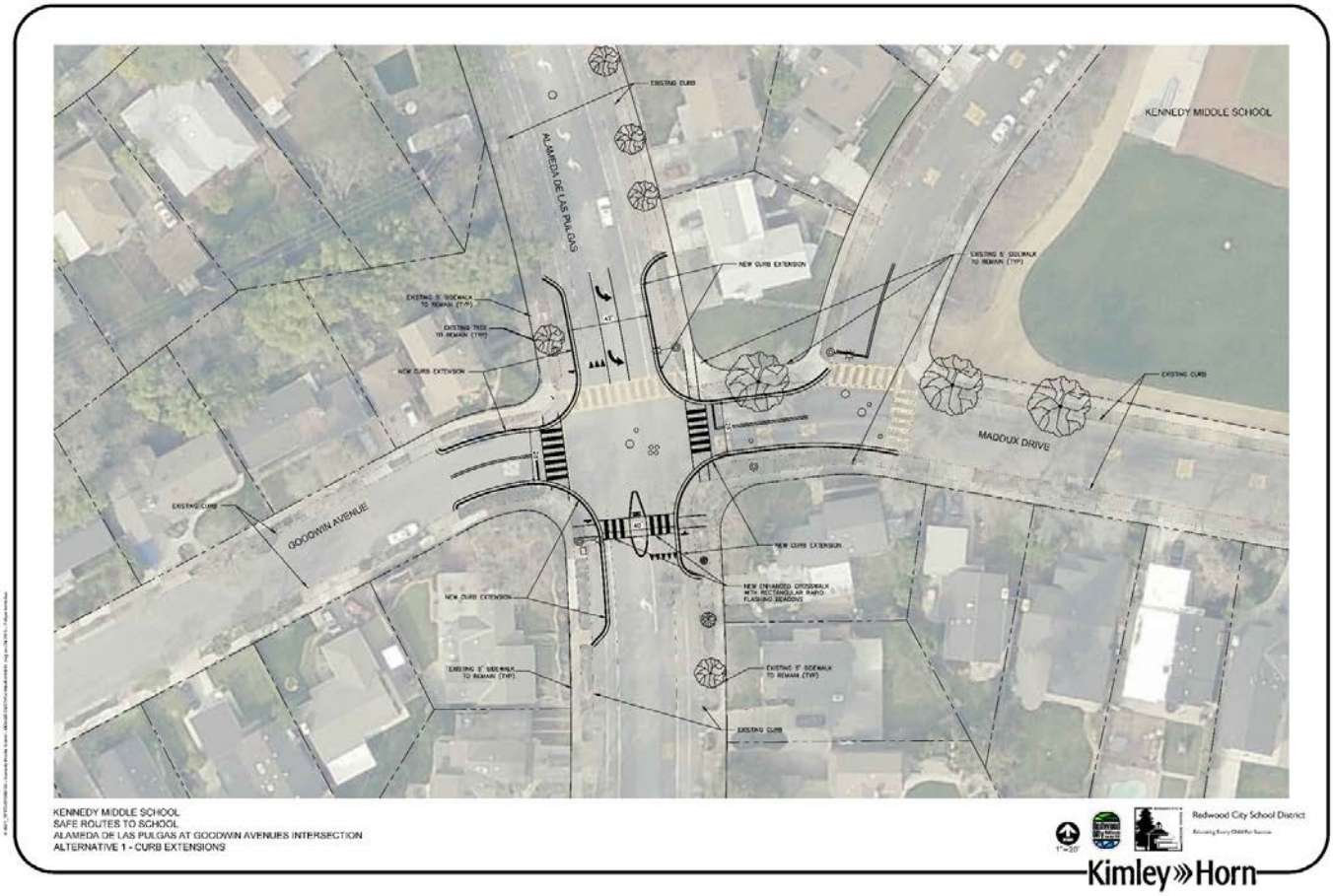

Figure 7. Kennedy Middle School draft plans

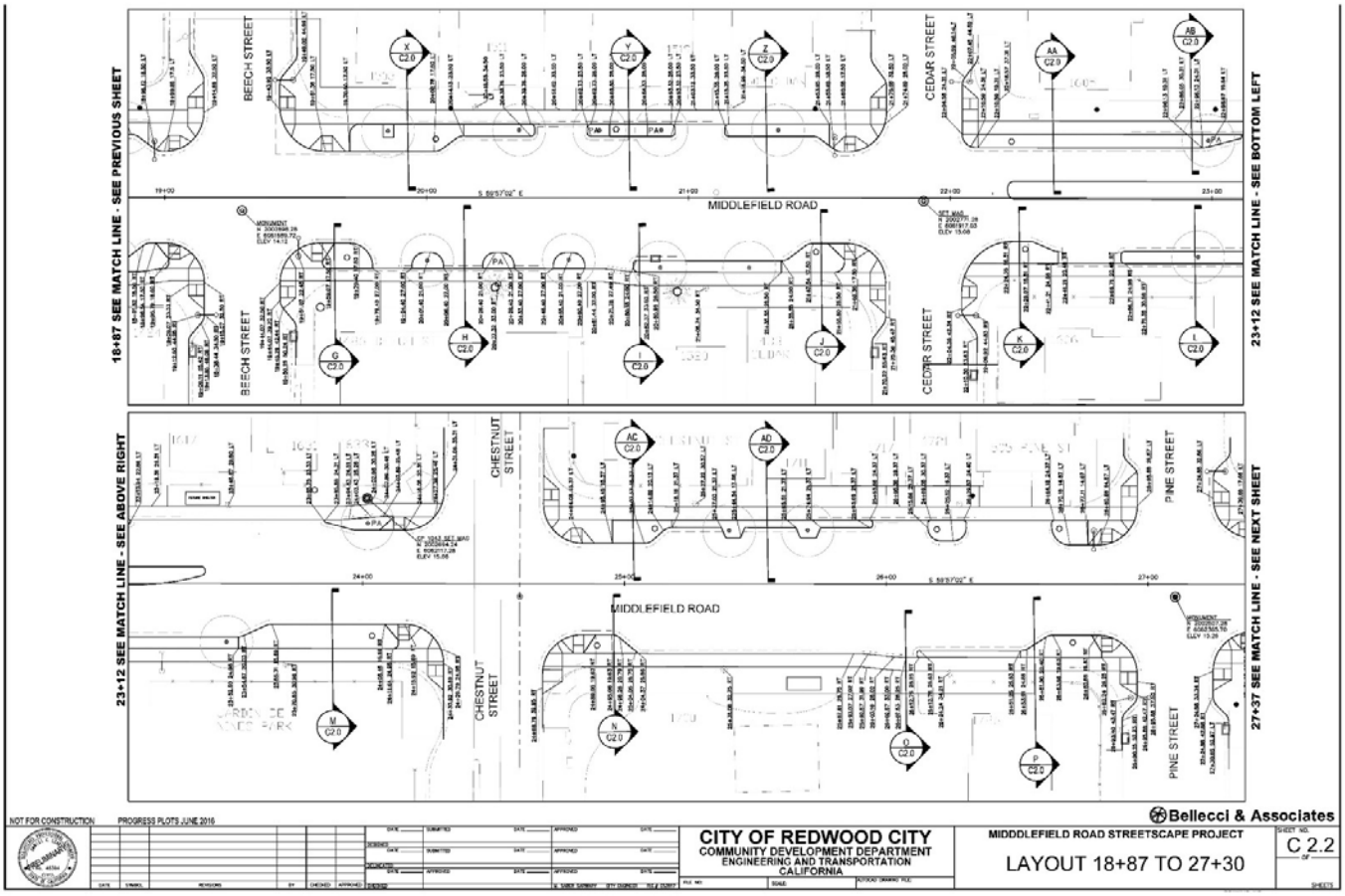

Figure 8. Middlefield Streetscape draft plans

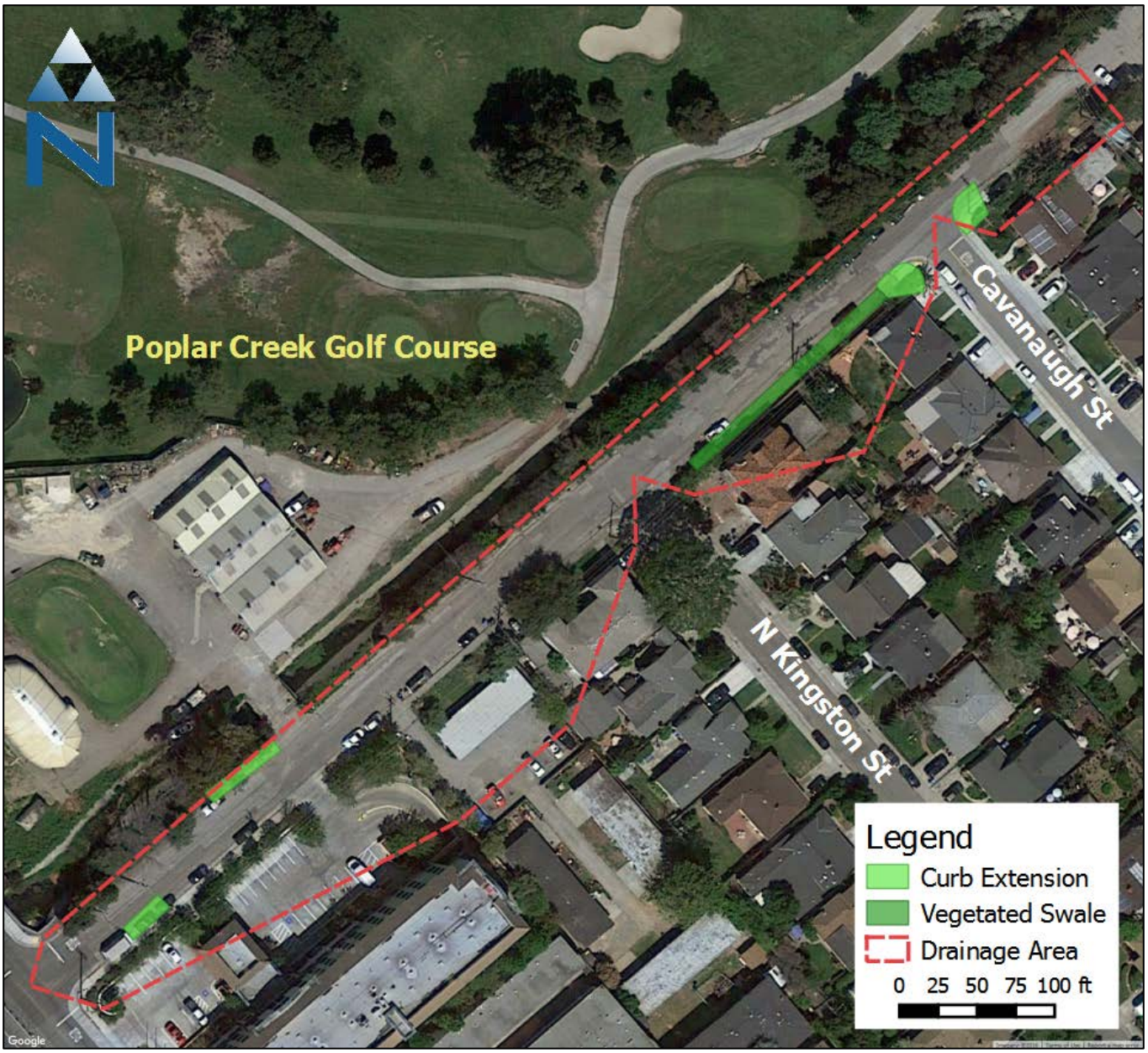

Figure 5. East Poplar Avenue sustainable street element

Figure 6. Beresford Park sustainable parking lot element

Figure 7. San Mateo Drive sustainable street element

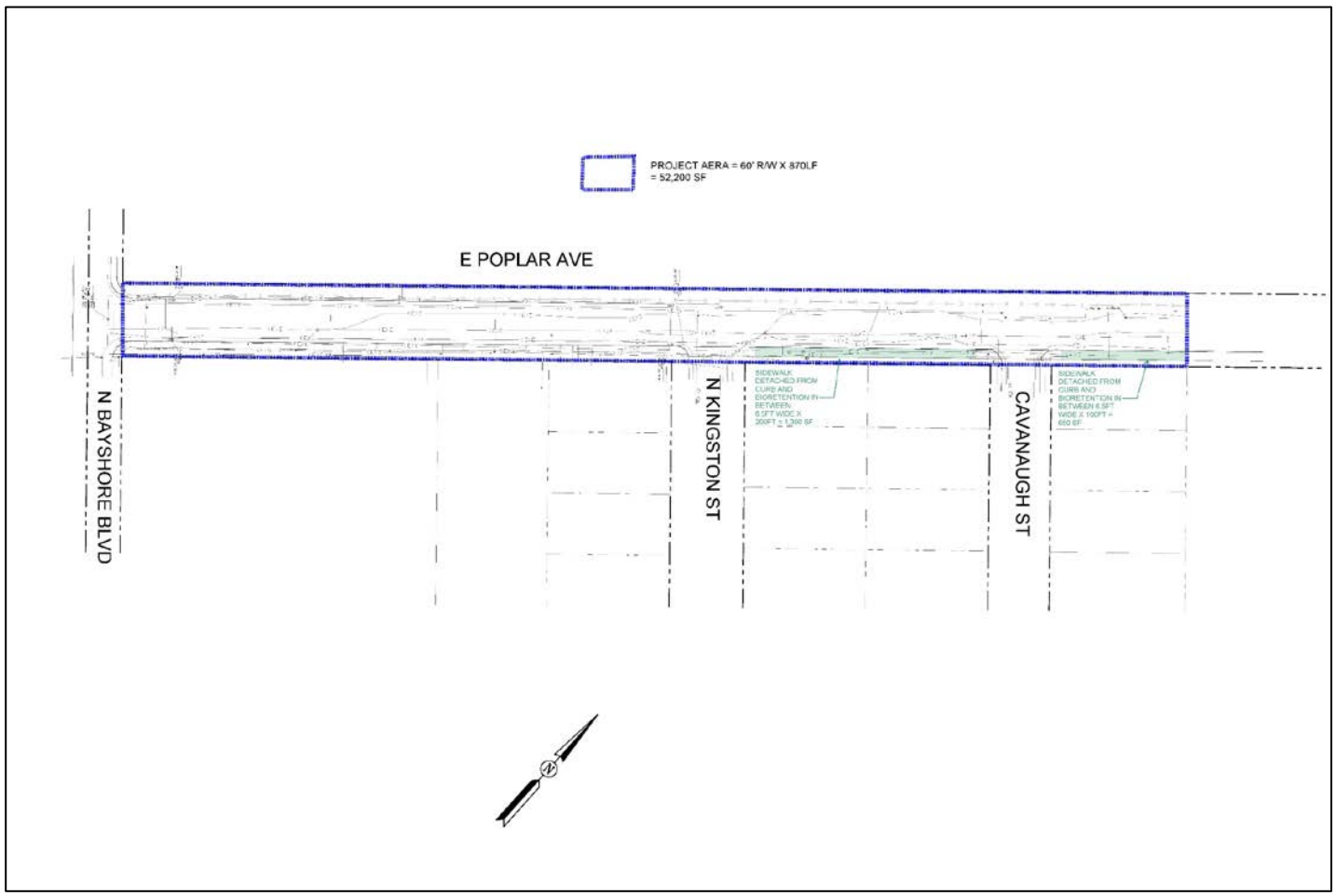

Figure 8. East Poplar Avenue draft plan

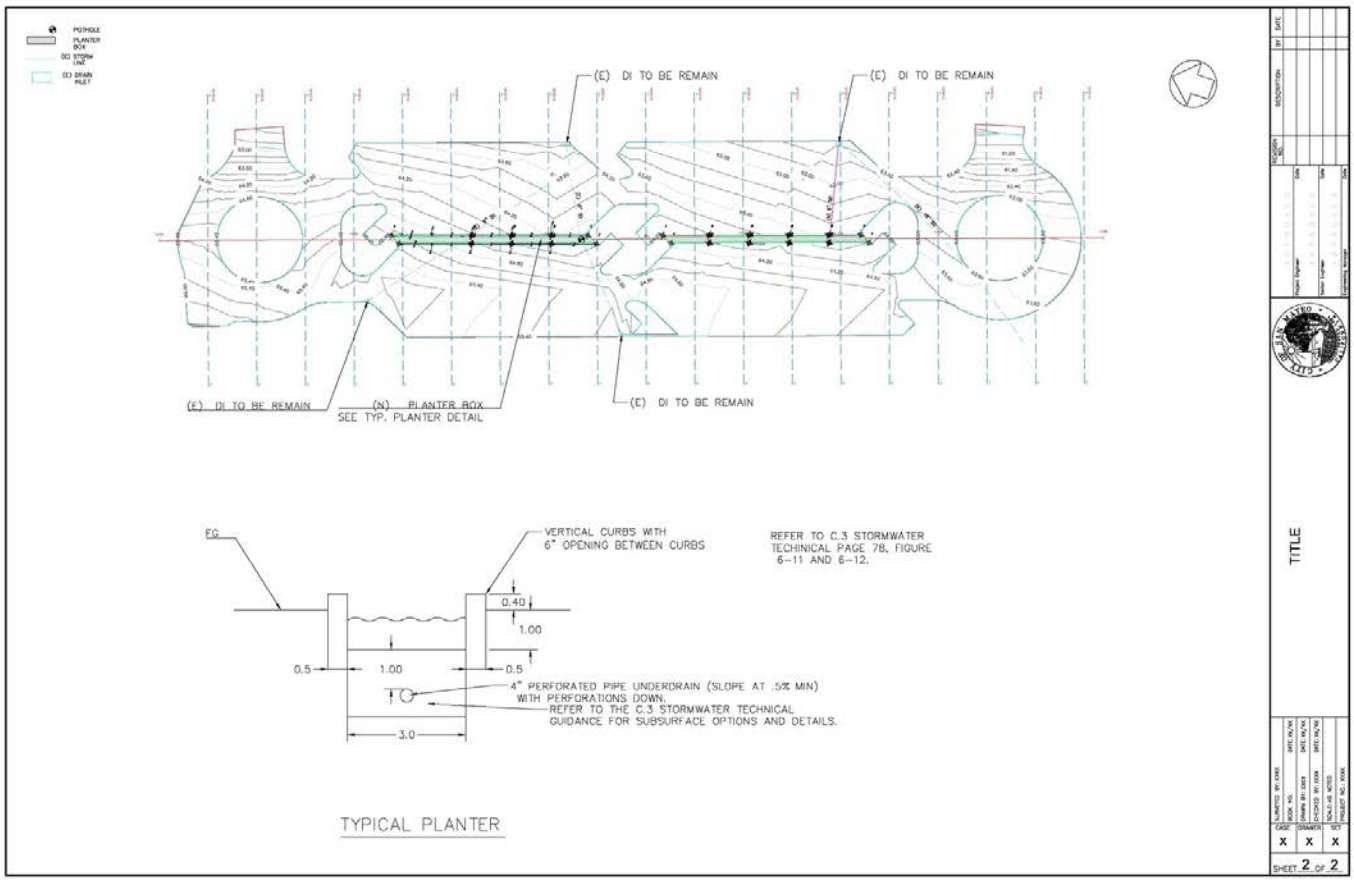

Figure 9. Beresford Park draft plan

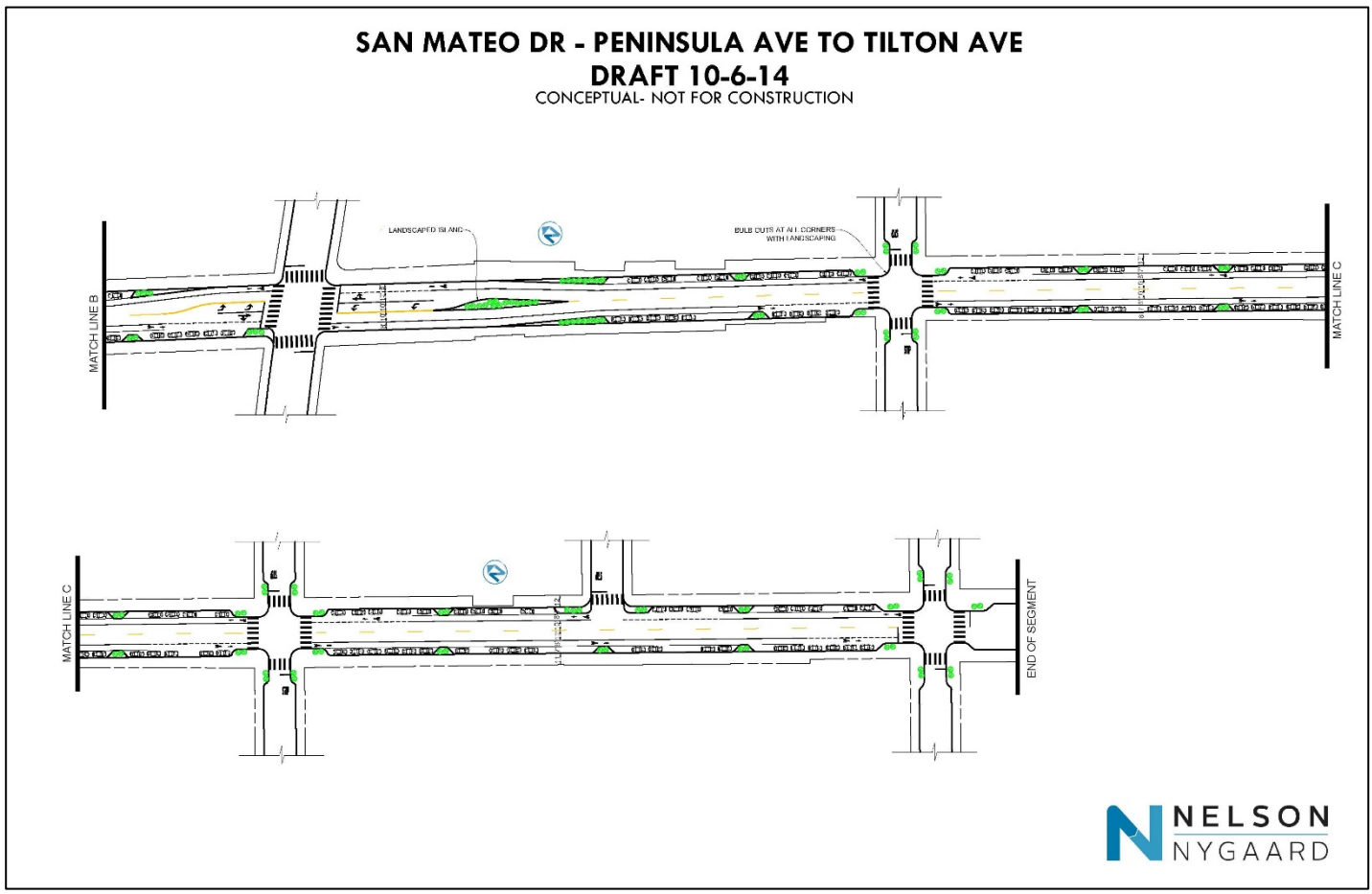

Figure 10. San Mateo Drive draft plan 1 of 2

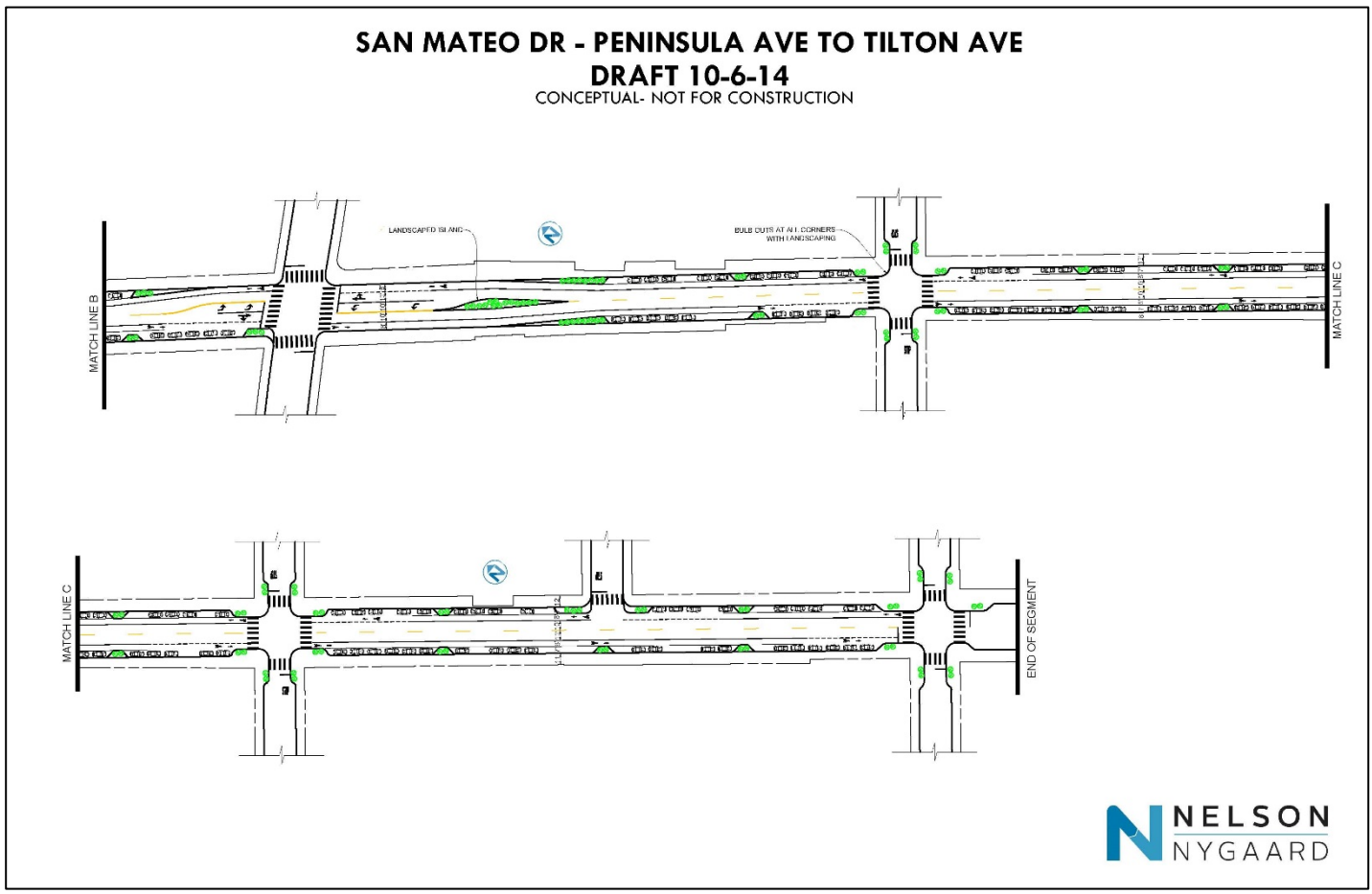

Figure 11. San Mateo Drive draft plan 2 of 2

Appendix 4

- CII Subcommittee – Attendance List for FY 2015/16
- CII Training Workshop – June 1, 2016
    - Agenda
    - Attendance List
    - Summary of Workshop Evaluations

SMCWPPP Commercial/Industrial/Illicit Discharge (CII) Subcommittee Attendance – FY 2015/16

Name	Agency	Sept. 16th	March 16th	June 15th
Bozhena Palatnik	City of Belmont		✓	
Randy Breault	City of Brisbane	✓	✓	
Keegan Black	City of Brisbane		✓	✓
Carolyn Critz	City of Burlingame		✓	✓
Kiley Kinnon	City of Burlingame	✓		
Louis Gotelli	City of Colma		✓	
Ward Donnelly	City of Daly City	✓	✓	✓
Larry Carnahan	City of Half Moon Bay		✓	
Mark Lander	City of Half Moon Bay	✓		✓
Ali Hatefi	Town of Hillsborough	✓		
Virginia Parks	City of Menlo Park	✓	✓	
Kevin Cesar	City of Millbrae			✓
Cliff Ly	City of Millbrae			✓
Adrian Lee	City of Redwood City	✓		✓
Mark Swenson	City of San Mateo	✓		
Sven Edlund	City of San Mateo	✓	✓	
Andy Wemmer	South San Francisco	✓	✓	✓
Daniel Garza	South San Francisco		✓	
Pat Ledesma	County of San Mateo	✓	✓	✓
Kristin Kerr	EOA, Inc.	✓	✓	✓
Devender Narala	RWQCB		✓	

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.

COMMERCIAL/INDUSTRIAL STORMWATER INSPECTION WORKSHOP

Sponsored by the SMCWPPP Commercial/Industrial/Illicit Discharge (CII) Subcommittee

Wednesday, June 1, 2016

San Mateo Public Library – Oak Room
55 W. 3rd Avenue, San Mateo

WORKSHOP AGENDA

12:00 Noon	**Registration and Lunch**	
12:15 PM	Welcoming Remarks	Ward Donnelly *City of Daly City and CII Subcommittee Chair*
12:20 PM	Reissued MRP: What is Different and What is the Same?	Kristin Kerr *EOA/ SMCWPPP Program Staff*
1:00 PM	Facilities CEH Inspects and Common BMPs	Patrick Ledesma *County Environmental Health*
1:35 PM	Illicit Discharge Inspection Basics	Lynne Scarpa *Contractor*
2:05 PM	Break	
2:15 PM	Group Exercise: Discussing Inspection Scenarios	*SMCWPPP Program Staff*
2:55 PM	Closing Remarks	Ward Donnelly *CII Chair*

*** Attendance at this training is acceptable for 2.5 Contact Hours toward maintaining CWEA certifications. ***

SMCWPPP CII Subcommittee
Industrial Commercial Inspector Stormwater Training
June 1, 2016

	Last Name	First Name	Municipality
1	West	Craig	City of Belmont Public Works
2	Black	Keegan	City of Brisbane
3	Breault	Randy	City of Brisbane
4	Boyle Rodriguez	Pam	City of Burlingame
5	Donnelly	Ward	City of Daly City
6	Todisco	Nicholas	City of East Palo Alto Building Inspector
7	Timoteo	Donald	City of East Palo Alto Code Enforcement
8	Daher	Michelle	City of East Palo Alto Inspectors
9	Lewis	Kevin	City of East Palo Alto Public Works Inspector
10	Galli	Laura	City of Foster City
11	Ngo	Michael	City of Foster City
12	Mitch	Azalea	City of Menlo Park
13	Morley	Zephyrus	City of Menlo Park
14	Parks	Virginia	City of Menlo Park
15	Rohlfs	Sam	City of Menlo Park
16	Tang	Lawrence	City of Menlo Park
17	Cesar	Kevin	City of Millbrae WPCP
18	Ly	Cliff	City of Millbrae WPCP
19	Donguines	Raymund	City of Pacifica
20	Edlund	Sven	City of San Mateo
21	Swenson	Mark	City of San Mateo
22	Christensen	Braden	City of South San Francisco
23	Garza	Daniel	City of South San Francisco
24	Yuk	Nelson	City of South San Francisco WQCP
25	Banning	Monica	San Mateo County
26	Dowell	Sharon	San Mateo County
27	Ernest	Frobie	San Mateo County
28	Helm	Apollonia	San Mateo County
29	Hum	Cristina	San Mateo County
30	Reed	Robert	San Mateo County
31	Cerezo	Liberty	San Mateo County Environmental Health
32	DeMoe	Amy	San Mateo County Environmental Health
33	Gonzales	Jennifer	San Mateo County Environmental Health
34	Gorecho	Jeanette	San Mateo County Environmental Health
35	Gregerson	Michelle	San Mateo County Environmental Health
36	Jensen	Dirk	San Mateo County Environmental Health
37	Jordan	Milt	San Mateo County Environmental Health
38	Ledesma	Patrick	San Mateo County Environmental Health
39	Lew	Sheldon	San Mateo County Environmental Health

	Last Name	First Name	Municipality
40	McLaughlin	Joan	San Mateo County Environmental Health
41	Mejia-Barbaran	Liliana	San Mateo County Environmental Health
42	Mih	Sabrina	San Mateo County Environmental Health
43	Mora	Gene	San Mateo County Environmental Health
44	Myszka	Emmy	San Mateo County Environmental Health
45	Nichols	Kameisha	San Mateo County Environmental Health
46	Patino	Bernardo	San Mateo County Environmental Health
47	Quevedo	Juan Carlos	San Mateo County Environmental Health
48	Romif	Dan	San Mateo County Environmental Health
49	Sekhon	Amrinder	San Mateo County Environmental Health
50	Terrell	Marjorie	San Mateo County Environmental Health
51	Thomas	Erin	San Mateo County Environmental Health
52	Tong	Edmond	San Mateo County Environmental Health
53	Tubig	Ezra	San Mateo County Environmental Health
54	Wong	Ngai	San Mateo County Environmental Health
55	Ahmed	Muneer	Town of Colma
56	Gotelli	Louis	Town of Colma
57	Critz	Carolyn	Veolia North America
58	Luu	Annie	

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.

Summary of Evaluation Form

Attendance: 58
Evaluations: 48

COMMERCIAL/INDUSTRIAL STORMWATER INSPECTOR WORKSHOP

San Mateo, CA Wednesday, June 1, 2016

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1. **Reissued MRP –** Given by Kristin Kerr, SMCWPPP Program Staff

   Very Useful 33 **Somewhat Useful 14** **Not useful**

   Comments:
   - Great pictures!
   - BIP – I thought this was good to talk about. I was not aware needed to be updated annually.
   - Good update regarding MRP changes
   - All very new to me, but I'll use the handouts to increase knowledge
   - Good overview
   - When going over abbreviations, the BPMs… etc. Go through them at least once for new comers
   - What does stormwater look like?

2. **Facilities CEH Inspects and Common BMPs –** Given by Patrick Ledesma, San Mateo County Environmental Health

   Very Useful 39 **Somewhat Useful 8** **Not useful**

   Comments:
   - Good pictures
   - It made me aware of what SMCEH will inspect and what they are not inspecting in the city I work
   - Nice examples
   - Lots of side commentary on audit
   - Good overview of local agency roles and responsibilities

3. **Illicit Discharge Inspection Basics –** Given by Lynne Scarpa, Contractor

   Very Useful 39 **Somewhat Useful 8** **Not useful**

   Comments:
   - Great Insight
   - Just because I only deal with HazMat Businesses

- A lot of excellent material discussed
- Nice
- Good information, presenter
- Great advise

4. **Group Exercise –** SMCWPPP Program Staff

   Very Useful 30 **Somewhat Useful 12** **Not useful**

   Comments:
   - It was somewhat confusing to follow the scenarios
   - Real practice
   - Examples had good photos, but entire layouts could have been more clear

5. **Did this training meet your expectations? Yes: 47 No:**
   - Crammed a lot of info in short period might be better suited for a morning session

6. **What parts of the training were most useful to you?**
   - The jurisdiction scheme
   - New MRP 2.0 requirements & exercises
   - Every aspect
   - Illicit Discharge Scenario at end
   - Understanding the requirements of the new MRP
   - Specific examples, pictures, photo
   - Changes to MRP, refresh on inspection basics, group exercises
   - Visuals and differentiating b/w potential vs actual
   - Scenarios
   - Case scenarios
   - Review of changes to MRP
   - New permit requirements – overview
   - Pictures
   - Group exercise
   - Lynn Scarpa's presentation w/specific scenarios and great photos
   - Info on the general permit
   - Pat's training on what inspectors should be looking for when inspecting
   - Exercises & regulation updates
   - Patrick's section because he explained how to do inspections
   - Illicit discharge training
   - Explanation of permits
   - The exercise
   - The new MRP requirements
   - County inspection methods
   - Examples during presentations
   - Examples
   - BIP & ERP

- The real world examples of illicit actual/potential discharges
- All aspects
- Examples of BMP's
- Group work
- Examples
- Exercises are practical & useful
- Inspection basic
- Pictures
- Inspection checklist review
- Hazmat and Hazmat related
- Dumpsters

7. **What would have made this training more useful?**
    - Video presentations
    - Visuals
    - More examples
    - Diagrams, flow-chart for taking actions
    - Training in the morning
    - Breaks, stretching every 50 minutes
    - Possibly more times for scenarios and discussion
    - Video inspections not photos
    - It was excellent training
    - I enjoyed the examples, but more case studies would be beneficial
    - Maybe a little bit shorter on the presentations
    - The food
    - Someone working on IGP (Regional Board)
    - More visuals
    - The actual contacts for the agencies we may contact
    - Spaghetti
    - Functional inspection instructions
    - More pictures
    - More practical scenarios
    - I think the whole training was great
    - More examples and discussion
    - More case studies
    - More pictures

8. **What topics would you recommend for a future training?**
    - SFPUC Topics
    - Video
    - Step by step evaluation of administrative fines, enforcement, company or outside agency who get fined based on potential/illicit discharge.
    - More scenarios
    - More illicit discharge pictures

- More BMP pictures (dos & don'ts)
- Mobile businesses
- Construction sites
- Focus more on changes in regulation/permit requirements
- Great work
- Get someone from CA EPA or County District Attorney
- Excellent workshop
- Examples of citations & fines recently
- Local agency role/responsibility regarding SMCWPPP inspection at NOI facility
- Filling out Stormwater Forms
- More mobile food training
- Stormdrain vs sewer

9. **General Comments?**
    - Thank you
    - Great training
    - Thank you
    - Thanks
    - Thank you
    - Nice work
    - Great venue!
    - Lunch options with more veggies, fruit, no bread
    - Drinks w/o sugar, no cups for water, no tea
    - Good
    - It would be helpful if the course description could be more detailed
    - Very helpful
    - Thanks!
    - None at this time
    - Good training
    - Ok
    - Thank You
    - Good training

Appendix 6

- CALBIG Meeting: Construction Site Stormwater Compliance – October 14, 2015
  - Announcement flyer
  - Agenda
  - Attendance list
- Construction Site Inspection Report
- Stormwater Training for Construction Site Inspectors – May 3, 2016
  - Announcement Flyer
  - Agenda
  - Attendance List
  - Summary of Workshop Evaluations

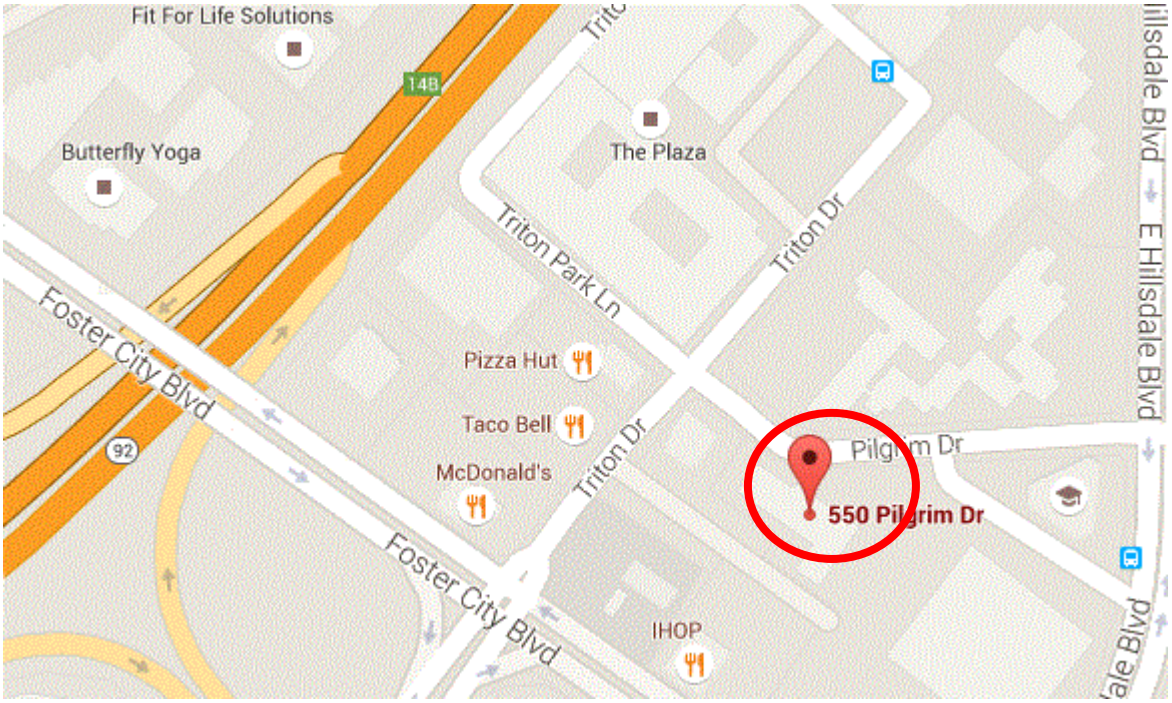
CALBIG MEETING ANNOUNCEMENT

Stormwater Requirements for Construction Sites

(See Below)

This month's CALBIG meeting will be held on Wednesday, October 14, 2015 from 11:30am to 1pm at (please note) CSG's new Foster City offices, 550 Pilgrim Drive.

For directions, see map below.



Directions: Take US 101 to Hwy 92 East. Exit Hwy 92 at Foster City Blvd. Turn left to Metro Center Blvd, cross Foster City Blvd (becomes Triton Dr), at Carl's Jr. turn right to Pilgrim Dr.

Fee: $20 in cash or check payable to CALBIG

Lunch: A catered lunch will be provided

Speaker: Kristin Kerr (PE), EOA, Inc.

Topic: Stormwater Requirements for Construction Sites

Highlights: Review of stormwater requirements for construction sites, documenting and tracking inspections, when to take enforcement actions and when to escalate enforcement, tips for keeping your stormwater program in compliance, SMCWPPP resources.

CSG Consultants
550 Pilgrim Drive
Foster City, CA
October 14, 2015

Agenda

Registration/Seating	**11:30 - 11:45**
Dan Mauldin, President - Welcome and Pledge of Allegiance	**11:45 - 11:46**
Old Business - Approve minutes of August meeting	**11:46 - 11:52**
New Business - Continuing education opportunities	**11:52 - 12:00**
Keynote Speaker: Kristin Kerr, EOA	**12:00 - 1:00**
Dan Mauldin, President - Closing	**1:00**

Please RSVP to Michael Gorman (mgorman@smcgov.org) by 5:00 PM Monday, October 12. Out of consideration for the catering order, we need an accurate head count.

Thank you !

Attendance - October 14, 2015

First	Last	City or Business	Email	Initial	Paid
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COURTNEY RIDER CSG

FAILURE TO CORRECT VIOLATION(S) within 10 business days (or as specified in this notice) may result in PENALTIES described on page 2!

SAN MATEO COUNTYWIDE Water Pollution Prevention Program
Clean Water. Healthy Community.

CONSTRUCTION SITE INSPECTION REPORT

1. Inspection Date:_____ 1a. Current weather conditions: _____

2. Name of Project: _____ 2a. Project No./Permit No._____

3. Project Address: _____

4. Inspection Type: ❑ Routine ☐ Follow-up ☐ Other

5. Permit Type: ☐ Building Permit ☐ Grading Permit ☐ Site Development ☐ CIP Project

6. Project disturb ≥ 1 acre?:___(Y/N - If Yes, inspect monthly during wet season.) NOI Required:___(Y/N) SWPPP dated ___/___/___
Project covered under statewide Construction General Permit?___(Y/N) SWPPP on site?____(Y/N)

7. High Priority Site (significant threat to water quality)? _____ 7.a Hillside Project?_____ (Y/N - If Yes, inspect monthly during wet season.)

8. Project Type: ❑ Residential ❑ Commercial/Industrial ❑ Institutional ❑ Landscaping
❑ Utility (water,sewer, PG&E) ❑ Grading ❑ Demolition ❑ Street Improvement ❑ Other:_____

	Inspection Finding (A / NM / P / NA)*	Location on site/Comments
9. Erosion Control Measures:		
☐ Jute Netting/Fiber Blankets		
☐ Mulch		
☐ Hydroseed/Soil binder/Compost blanket		
☐ Mark Areas to be Preserved		
☐ Tree Protection Fencing		
☐ Riparian Area Barrier		
10. Sediment Control Measures		
☐ Stabilized construction entrance		
☐ Street Sweeping		
☐ Dust Control		
☐ Wattles / Fiber Rolls / Compost Socks		
☐ Silt Fences / Compost Berms		
☐ Sedimentation Basin		
☐ Check Dams		
☐ Inlet Filters (Gravel bags)		
☐ Earth Dikes / Drainage Swales		
11. Run-on and Runoff Control		
☐ Earth Dikes / Drainage Swales		
☐ Sampling is conducted, if required		
12. ☐ **Active Treatment System (if any)**		
13. Good Site Management		
☐ Soil Stockpiles		
☐ Waste Systems Management		
☐ ConstructionMaterials (wood,cement,...)		
☐ Hazardous Materials (paint,solvents)		
☐ Petroleum Products (oil, fuel)		
☐ Vehicle Servicing		
14. Non-Stormwater Management		
☐ Concrete/Stucco washout area		
☐ Architectural copper rinsewater		
☐ Other:		

* A=Adequate, NM=needs maintenance, P=Problem(s), NA=Not Applicable

15. Is there an actual illicit discharge or evidence of illicit discharge to storm drain/discharge point? ☐ Yes ☐ No

16. Comments:_____

17. **Enforcement/Follow-Up** Date problem first identified:_____ Next follow-up inspection date:_____
Comments:_____
Enforcement: ❑ None/In compliance ❑ Verbal Warning ❑ Notice of Violation ❑ Notice to Comply ❑ Stop Work ❑ Administrative Fine

18. **Resolution:** ❑ Problem Fixed ❑ Need More Time (include rationale in comments) ❑ Escalate Enforcement Date resolved: ___/___/___
Was there rain with runoff after problem identified and before resolution? ❑ Yes ❑ No ❑ Items corrected during inspection (see comments)
Comments:_____

19. Inspector's Signature:_____Date:_____
Inspector's Name (Print):_____ Phone Number: _____

☐ No one on site or no responsible person present.

20. Name of Site Contact Person (Print) _____ Phone No. _____
Site Contact Signature_____Job Title:_____Date:_____

☐ Left report copy at site.

NOTES AND DEFINITIONS OF TERMS USED IN THE
CONSTRUCTION SITE INSPECTION REPORT

NOTES:

PENALTIES. Agency staff are required to verify correction of any stormwater violations within 10 business days or before the next rainfall with runoff. If a violation is not corrected within this time frame, enforcement will escalate per the Enforcement Response Plan. This may result in the jurisdiction taking one or all of the following actions: 1) Issuance of a Stop Work Notice (such that inspections on all permits will be stopped until all violation(s) have been corrected); 2) Application of fines/re-inspection fees of $_____ per day; 3) and/or Referral of the violation(s) to the Regional Water Quality Control Board. Erosion control measures, or other best management practices, in addition to those shown on the plans may be required by agency staff to ensure effective stormwater management.

Stormwater Inspection Requirement - Agency staff are required to inspect the following categories of sites at least once per month during the rainy season: sites that disturb 1 acre of land or more, Hillside Projects and High Priority Sites (see definitions below).

Construction General Permit Compliance - Projects that disturb 1 acre or more of land are required to obtain coverage under the statewide Construction General Permit (see www.swrcb.ca.gov/water_issues/programs/stormwater/constpermits.shtml for information and to download the permit). To obtain coverage under the Construction General Permit, file a Notice of Intent using the SMARTS database, at https://smarts.waterboards.ca.gov/smarts/faces/SwSmartsLogin.xhtml.

Requirement to Verify Construction General Permit Coverage - Agency staff must verify that projects disturbing one acre or more of land have obtained coverage under the statewide Construction General Permit.

Where to Find Information on Construction BMPs - Detailed information on construction best management practices (BMPs) is available at the California Stormwater Quality Association's online Construction BMP Portal, at www.casqa.org/resources/bmp-handbooks. A subscription fee is required to access the portal. For information on access to the portal, inspectors should contact their agency's representative to the Countywide Program's New Development Subcommittee.

DEFINITIONS:

Active Treatment System - Active Treatment Systems (ATS) reduce turbidity of construction site runoff by collecting runoff in a tank and introducing chemicals through direct dosing or an electrical current to enhance flocculation, coagulation, and settling of the suspended sediment. The increased flocculation aids in sedimentation and ability to remove fine suspended sediments, thus reducing stormwater runoff turbidity and improving water quality.

Check Dam - a small barrier constructed of rock, gravel bags, sandbags, fiber rolls, or other proprietary products, placed across a constructed swale or drainage ditch. Check dams reduce the effective slope of the channel, thereby reducing scour and channel erosion by reducing flow velocity and increasing residence time within the channel, allowing sediment to settle.

High Priority Site - A site that has a steep slope or is adjacent to a creek or other water body, or a site that the agency or the Regional Water Quality Control Board (Water Board) has determined to have significant threat to water quality based on site-specific evaluation of the following additional factors: soil erosion potential or soil type, project size and type, sensitivity of receiving water bodies, proximity to receiving water bodies, non-stormwater discharge, or any other relevant factors as determined by the local agency or Water Board.

Illicit Discharge - Any discharge to a municipal storm drain system that is prohibited under local, state, or federal law, including all non-stormwater discharges not composed entirely of stormwater and discharges prohibited under the Municipal Regional Stormwater Permit (MRP).

Hillside Project - As defined in the MRP, those projects on sites disturbing 5,000 square feet or more of land area and with slopes greater than or equal to 15% (or based on the Permittee's map of hillside development areas or criteria.)

SAN MATEO COUNTYWIDE
Water Pollution
Prevention Program

SUPPLEMENT TO INSPECTION REPORT

1. Inspection Date:_____

2. Name of Project: _____ 2a. Project No./Permit No._____

3. Project Address: _____

4. Notes regarding inspection:

5. Inspector's Signature:_____Date:_____

6. Name of Project Manager (Print) _____ Phone Number _____

Signature of Project Manager_____Date:_____

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.

555 County Center
Redwood City, CA 94063

P 650.599.1406
F 650.361.8227
flowstobay.org

Construction Site Stormwater Compliance Training for Municipal Inspectors

San Mateo Public Library – Oak Room
55 W. 3rd Avenue, San Mateo

Tuesday, May 3, 2016

10:00 am – 2:00 pm

Registrations Due by April 26th

Workshop Highlights:

- ✓ Changes in the newly reissued Municipal Regional Stormwater Permit (MRP)
- ✓ Construction BMPs and recognizing issues
- ✓ BMP Trends and Experience from Caltrans

Lunch will be provided

Register at:

www.smcwppp-May-3-stormwater-compliance.eventbrite.com

OR

Email RSVP to Lillian @ lquinata@eoainc.com, by ***Tuesday, April 26, 2016***.

For additional information, contact Lillian at 510-832-2852 ext. 101.

Name:_____ **Agency:** _____

Phone:_____ **Email:**_____

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.

CONSTRUCTION SITE STORMWATER INSPECTION WORKSHOP

Implementing the requirements in Provision C.6
of the New Municipal Regional Stormwater Permit (MRP)

Tuesday, May 3, 2016

San Mateo Public Library – Oak Room
55 W. 3rd Avenue, San Mateo

WORKSHOP AGENDA

10:00 AM	**Registration and Refreshments**	
10:10 AM	Welcome and Introductions	Kristin Kerr *Program Staff*
10:20 AM	Water Board Perspective: Construction General Permit	Devender Narala *Regional Water Board Staff*
10:50 AM	Reissued MRP: How Same and How Different	Kristin Kerr *Program Staff*
11:20 AM	Vendor Presentation	David Franklin *Filtrexx Sustainable Technologies*
12:00 PM	**Lunch**	
12:30 PM	Caltrans' Experience with Compost BMPs	Peter Schultze-Allen *Program Staff*
1:10 PM	Group Exercise	*Program Staff*
1:55 PM	Summary Remarks, Adjourn	Peter Schultze-Allen *Program Staff*

*** Attendance at this workshop is acceptable for 3.3 PDUs toward maintaining CPESC, CESSWI and/or CPSWQ certifications. ***

SMCWPPP
Stormwater Construction Site Inspection Training
May 3, 2016

	Last Name	First Name	Municipality
1	Dong	Brian	City of Belmont
2	Tallitsch	John	City of Belmont
3	West	Craig	City of Belmont DPW
4	Black	Keegan	City of Brisbane
5	Morris	Greg	City of Brisbane
6	Boyle Rodriguez	Pam	City of Burlingame
7	Lowrie	Bill	City of Burlingame
8	Lowrie	Mik	City of Burlingame
9	Pastor`	Dylan	City of Burlingame
10	NGO	Micheal	City of Foster City
11	Morales	Rene	City of Menlo Park
12	Giang	Bill	City of MIllbrae
13	Larks	Dennis	City of Oakland
14	Donguines	Raymond	City of Pacifica
15	Chan	Alex	City of Redwood City
16	Kim	Philip	City of Redwood City
17	Varela	Carlos	City of Redwood City
18	Iwan	Calvin	City of San Bruno
19	Wong	David	City of San Bruno
20	Riddell	Anthony	City of San Carlos
21	Albert	Evan	City of San Mateo
22	Chow	Leo	City of San Mateo
23	Hathaway	Mark	City of San Mateo
24	Kenyon	Michelle	City of San Mateo
25	Pacini	Kenneth	City of San Mateo
26	Raj	Jai	City of San Mateo
27	Ung	Mario	City of San Mateo
28	Vann	James	City of San Mateo
29	Edlund	Sven	City of San Mateo Public Works
30	Albini	Bryan	County of San Mateo
31	Azzari	Zack	County of San Mateo
32	Boo	Olivia	County of San Mateo
33	Burlison	Summer	County of San Mateo
34	Carlos	Armando	County of San Mateo

35	Carlos	Hector	County of San Mateo
36	Crivello	Mike	County of San Mateo
37	Francis	Aaron	County of San Mateo
38	Hosseini-Bidokhti	Eman	County of San Mateo
39	Huynh	Michael	County of San Mateo
40	Jackson	Emmett	County of San Mateo
41	Pons	Jeremiah	County of San Mateo
42	Rasmussen	Ryan	County of San Mateo
43	Smith	Kimberly	County of San Mateo
44	Velasquez	Alan	County of San Mateo
45	Burklin	Scott	County of San Mateo DPW
46	Casagrande	Julie	County of San Mateo DPW
47	Engle	Theresa	County of San Mateo DPW
48	Manalo	Michelle	County of San Mateo DPW
49	Hokhamaneshi	Rombod	CSG CONSULTANTS
50	Navarro	Frank	CSG CONSULTANTS
51	Nehma	Mojaba	CSG CONSULTANTS
52	Osalbo	Jun	CSG CONSULTANTS
53	Ramos	Reggie	CSG CONSULTANTS
54	Sharifi	Mehdi	CSG CONSULTANTS
55	Navaler	Devender	Regional Water Board
56	Lee	Robin	Schaaf & Wheeler
57	Pozzi	Tara	Schaaf & Wheeler
58	Huynh	David	Town of Atherton
59	Ahmed	Muneer	Town of Colma
60	Asai	Natalie	Town of Hillsborough
61	Critz	Carolyn	Veolia Water North America

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.

Evaluation Summary
39 Evaluation Forms
61 Attendees

CONSTRUCTION SITE STORMWATER INSPECTOR WORKSHOP

San Mateo, CA Tuesday, May 3, 2016

MORNING SESSION

1. **Water Board Perspective –** Given by Devender Narala, Regional Water Board Staff

Very Useful: 21 Somewhat Useful: 17 Not useful: 0

Comments:

- Power Point visuals needed
- Should hand out cards/contact info.
- Need videos & photos at situations
- Better with some presentation slides
- Good to know that they are willing to be there for us
- Helps humanize team
- Good to show Water Board as resource
- I am a new inspector and this information was very helpful
- Good to have a contact from the county
- Power point presentation would provide better information we can read
- Great to get direct line contact for San Mateo County representative of RWB

2. **Reissued MRP –** Given by Kristin Kerr, SMCWPPP Program Staff

Very Useful: 28 Somewhat Useful: 11 Not useful: 0

Comments:

- Very last explanation w/too much to cover. Difficult for young new Engineers/Inspectors to follow
- Good update of the C.6 changes
- Seemed rushed. As a new engineer would be great to discuss these practices.
- Good information about new changes
- Good quick overview
- Good to get a quick overview of what's new in the MRP.
- Highlights of MRP 2.0 were great with limited redundant info
- Statement about dewatering and uncontaminated groundwater are not clear and

contradictory

3. **Vendor Presentation –** Given by David Franklin, Filtrexx Sustainable Technologies

Very Useful: 19 **Somewhat Useful: 17** **Not useful: 2**

Comments:

- Comprehensive & useful
- Most of the slides provided duplicate information with a different picture. Had to take notes on most of presentations because it was not included on slide.
- Sales pitch
- Showing points of failure of BMPS and how to look for good/bad bmps.
- Photos could be clearer explaining good layout vs. bad layout
- Make sure to clearly point out the point of each photo
- I thought the content was good and interesting but the Power Point Presentation was terrible.
- Should be for designer and contractors "A lecture for them!"
- A little more explanation on slide with relevant text
- Very difficult to follow presenter
- A lot of the material went over our heads
- Keep this presenter excellent insight/info great
- Slides can't be used for further review - useless. Very unclear. Slides all have same bullets to left with no indication of relevance or relation to slide. Moved way too fast for non-experts. Sales pitchy as well - not enough basic knowledge.

4. **Caltrans Experience –** Given by Peter Schultze-Allen, SMCWPPP Program Staff

Very Useful: 31 **Somewhat Useful: 8** **Not useful: 0**

Comments:

- Good examples of BMP's & pros & cons of each.
- Good information on what work and does not, great images with side by side comparisons
- 2nd half more for designers
- Would have been good to have more details from presenter
- Good example of new BMPS
- Good examples of good and bad and effective implementation
- Much much better and suited to audience
- Slides have more info. Useful

5. **Group Exercise –** SMCWPPP Program Staff

Very Useful: 22 **Somewhat Useful: 13** **Not useful: 1**

Comments:

- Some of the best parts of the program
- Too many references to go online/go to the website, wanted to leave with answer for each group exercise, not have to find it on the website at some time in the future
- Interesting to hear how others would handle each situation; would have been better if the inspector from the site gave the presentation; better explanation of the site and why things were done the way they were.

- Too large of groups.
- Group setting not that effective; better to lead discussion
- Examples were not that great
- Helpful for practical woes
- Get more exposure
- Very helpful to see and critique BMPS
- A good chance to share info & site experiences with other agencies
- The ending breakdowns caused confusion between presenters and the audience
- Somewhat limited a CAD type layout would serve better in my opinion
- Always good to see examples. More time for this and formalize

6. **Did this training meet your expectations? Yes: 33 No: 3**

- I expected Caltrans to present as that was implied. I did not expect sales pitch.
- Much improved from previous years
- Why did you cut training time?

7. **What parts of the training were most useful to you?**

- Actual problems and solutions. Group exercise.
- Erosion control/Sediment control contractor discussion and examples
- Showing the updated requirement and exercises to show the thought processes of other industry professional's relation the BMP's
- BMP examples
- All was pretty useful, vendor least
- Updates and group
- Group exercise
- All
- Updates
- Compost overview
- #3 & #4
- Group exercise
- Case studies
- Where the commenters explained the negative effects
- The real life examples
- Pictures and firsthand experience
- Group exercise
- Learn more about compost
- Having Water Board present
- Group discussion
- Item #4 Caltrans
- Reissued MRP presentation and BMP measures
- Group Exercise were very helpful in illustration real life situations
- Contact information
- Group discussion
- Slide show and group exercise
- MRP Update
- New MRP changes

- Discussions about BMPs (group exercise) to identify what is correct practice.
- Talk about changes to new Permit
- MRP Presentation and the Caltrans Presentations
- Example photos, the increased use and success of compost as erosion control

8. **What would have made this training more useful?**

- BMP presentation by QSP or QSD not vendor. BMP presentation appropriate for audience not experts. Better description on each slide.
- If using sites as group exercise, get sites with better images that show "totality of site" too difficult at times with pics that don't show the whole picture i.e. Top, site size etc.
- More presentable information from water board to understand the logic and ways to enforce regulations. SMARTS overview.
- Color printouts for group exercise
- Coffee after lunch
- More discussion/open dialogue between municipalities on what constitutes violation/enforcement/inspection
- Better/more clear pictures
- More info on copper and zinc aspect
- More case studies
- Go over more BMP categories
- Pictures in group exercise needed more background
- More of a detail class
- Too short
- Nothing very informative
- More time to adequately cover the programs - too much material
- Use street resurfacing projects
- Add 10 min. breaks once an hour

9. **What topics would you recommend for a future training?**

- More info to create consistency with types of enforcement
- Groundwater/dewatering how to handle
- Please go back to the 9 am – 3 pm workshop with a bit slower presentations
- Actual enforcement steps beginning with verbal all the way up to actual violation report
- Details from cities about their specific inspection/compliance program
- Add construction adjacent to waterways as group exercise
- Updated info, etc.…
- Longer allocation of time for the group exercise
- Good as is
- Plan reviews
- Providing a lot of failures and their reason
- More BMPs
- Inspection techniques, reporting, documentation, etc.

10. **General Comments?**

- Lunch was good.
- Alternate numbering of people to make more diverse teams
- Please offer some healthy alternatives to white bread sandwiches. Whole grain, salads, even V-8. My special dietary request was not fulfilled.
- Thank you
- This course is evolving and improving each time I attend. Good, thanks
- Thank you very good info. See you again thanks
- Very good
- Good lunch
- Good info
- Good training
- Great workshop overall
- It was a good workshop
- Thank you
- Engineers and contractors should be required to attend these types of trainings. I think there is a lot of useful BMP practices that would be beneficial to those who actually install them.

Appendix 7

- Public Information and Participation Subcommittee – Attendance List– FY 2015/16
- Pet Waste Pilot Program and Intercept Surveys
- SMCWPPP Stormwater Tip Card
- Summary of County of San Mateo Environmental Programs

Public Information and Participation Subcommittee					FY 15-16	
AGENCY	**NAME**	**ALTERNATE**	**ALTERNATE**	**PHONE**	**April 14, 2016**	**June 30, 2016**
Prog. Coordinator	Matt Fabry				X	X
Atherton	Stephanie Bertollo-Davis			650-752-0544		
Belmont	Diane Lynn (Chair)			650-595-7425	X	X
Brisbane	Shelley Romriell	Keegan Black		415-508-2130	X	X
Burlingame	Pam Boyle Rodriguez	Carolyn Critz		650-558-7381	X	X
Colma	Muneer Ahmed	Jason Chen		650-757-8888		
Daly City	Ward Donnelly			650-991-8200		
East Palo Alto	Michelle Daher			650-853-3197		
Foster City	Mike McElligot	Norm Dorais	Nick Leonoudakis	650-286-3546		
Half Moon Bay	Mark Lander	Peykan Abbassi		650-522-2562	X	
Hillsborough	Rachelle Ungaretti					
Menlo Park	Vanessa Marcadejas	Heather Abrams		650-330-6768	X	X
Millbrae	Shelly Reider			650-259-2444	X	X
Pacifica	Yessika Dominguez	Raymond Donquines		650-738-3767	X	X
Portola Valley	Brandi de Garmeaux	Howard Yound	Adrienne Smith	650-851-1700		X
Redwood City	Vicki Sherman	Christopher Fajikos	Adrian Lee	650-780-7472		X
San Bruno	Jim Burch	Ted Chapman	William Li			X
San Carlos	Paige Safe				X	X
San Mateo City	Mark Swenson	Sven Edlund	Sarah Schedit	650-522-7349	X	
San Mateo Co	Kirsten Pringle	Julie Casagrande	Mark Chow	650-599-1457	X	X
San Mateo Co	Andrea Chow	Edelzar Garcia		650-363-4125	X	
So. San Francisco	Daniel Garza	Rob Lecel		650-829-3880	X	X
So. San Francisco	Andrew Wemmer					
Woodside	Dong Nguyen			650-851-6790		
Public Information and Participation Consultants						
SGA	Stephen Groner	Megan Kang			X	X
Guests						
EOA	Peter Schultz-Allen	Kristin Kerr	Jon Konnan		X	

S.GRONER ASSOCIATES, INC.

C/CAG Intercept Survey 2016

S. Groner Associates, Inc.
100 West Broadway, Suite 290
Long Beach, CA 90802

p|(562) 597-0205 f|(562) 597-0231

29 June, 2016

EXECUTIVE SUMMARY

SGA was contracted by CCAG to conduct an intercept survey study in order to both chart current behavioral trends as well as to understand motivations, barriers and attitudes concerning proper dog waste disposal.

Chief findings are as follows:

- When participants were asked as to what motivated them to pick up after their dogs, the majority of dog owners cited moral/ethical duty as their motivation followed by a desire to safeguard the health of other dogs and pets.
- Majority of the participants were unaware of the possibility of water contamination that can be caused by improper disposal of dog waste.
- Participants of San Mateo reported unanimously that there are a lack of trash cans to dispose of dog waste in the area.
- The vast majority of participants understood that dog waste should be placed within a trash can for disposal. Improper disposal of dog waste in San Mateo mainly stems from an issue of inconvenience and motivation and not due to a lack of understanding.
- Dog owners observed were predominantly white and tended to be female. The proportions observed diverged from census data. This difference can be indicative of differences in pet ownership or utilization of public services amongst demographic lines.

Contents

METHODOLOGY

Given the diversity of San Mateo County in terms of geography, income, culture and ethnicity, surveys were implemented in three distinct locations of San Mateo County: Pacifica, South San Francisco, and San Mateo City.
The survey consisted of 20 questions which were designed to take a little more than 5 minutes and was executed in person at a dog park within the target cities: Centennial Way Dog Park (South San Francisco), Seal Point Park (San Mateo), and Esplanade beach (Pacifica).

The participants were incentivized to participate with a $5 Amazon gift card. The surveys were both read out loud by the surveyors and the corresponding answers were recorded by the surveyors. In order to avoid potentially biasing the survey, the surveys took place during the weekends which we believed was the most neutral time frame of implementation e.g. weekday mornings are likely to attract seniors and students who do not have scheduled work to the park. Sample size of 106 per location was determined given that 8% margin of error and 90% confidence level was targeted for this study.

Nonparametric inferential tests were utilized given that the majority of the data collected substantially diverged from a normal distribution as confirmed by q-q plots and the Shapiro-Wilk test. The Mann-Whitney U test or the Kruskal-Wallis analysis of variance was used for analysis when comparing two independent groups, whereas analysis comparing related samples applied the Wilcoxon signed-rank test or Friedman's rank test for correlated samples at a significance level of 5%. Post Hoc tests on analysis of variance were all adjusted by Bonferroni correction in lines with the standard.

KEY FINDINGS

The following key findings were observed:

- DOG OWNERS ARE MOTIVATED BY A MORAL/ETHICAL IMPERATIVE
- MAJORITY OF PARTICIPANTS STATED TO USE A GENERAL OR DOG PARK BUT A SURVEY LOCATION BIAS IS LIKELY
- A LACK OF TRASH CANS LIKELY EXISTS IN SURVEYED LOCATION BUT A REGIONAL REPRESENTATION IS UNCLEAR
- MAJORITY OF THE PARTICIPANTS REPORTED MOST FREQUENTLY DISPOSING OF THE DOG WASTE CORRECTLY
- MAJORITY OF THE PARTICIPANTS CORRECTLY PLACES THE DOG WASTE IN A TRASH CAN IF THEY DECIDE TO COLLECT IT
- PACIFICA PARTICIPANTS MOST FREQUENTLY LET THEIR DOG OFF THE LEASH
- PARTICIPANTS REPORT TO BE MORE LIKELY TO DISPOSE OF WASTE IF BAG IS PROVIDED
- LOCATION DIFFERENCES OBSERVED IN RATE OF WASTE BAGS AT HAND
- "DON'T HAVE A BAG" WAS THE MOST FREQUENT REASON FOR IMPROPER DISPOSAL
- DIFFERENT LEVELS OF IMPORTANCE PLACED ON CORRECT DISPOSAL DEPENDING ON SETTING
- MAJORITY OF PARTICIPANTS UNDERSTOOD WHERE TO PROPERLY DISPOSE OF THE WASTE

- MAJORITY OF PARTICIPANTS DID NOT KNOW THAT DOG WASTE CONTRIBUTES TO WATER POLLUTION
- LARGE NUMBER OF PARTICIPANTS WERE WHITE AND FEMALE

REGIONAL DIFFERENCES IN MOTIVATIONS OBSERVED

As an aggregate, participants most frequently stated that they are motivated to pick up after their dog as "it is the right thing to do." Looking at the answers regionally, we see that a disproportionately large number of participants from South San Francisco stated "it is the right thing to do" as their answer which contributed greatly to the aggregated trend. "Health of other dogs and pets" was stated most frequently both in Pacifica and San Mateo whereas "it is the right thing to do" trailed in 3rd place for the two cities.

Although the health of the community and its water supply is the main impetus for this study and the program as a whole, participants of the surveys certainly did not share this perspective. This is mainly attributable to the lack of understanding in the community regarding proper waste disposal and pollution which will be further discussed later in this report.

Figure 1. Aggregated count of participant motivations

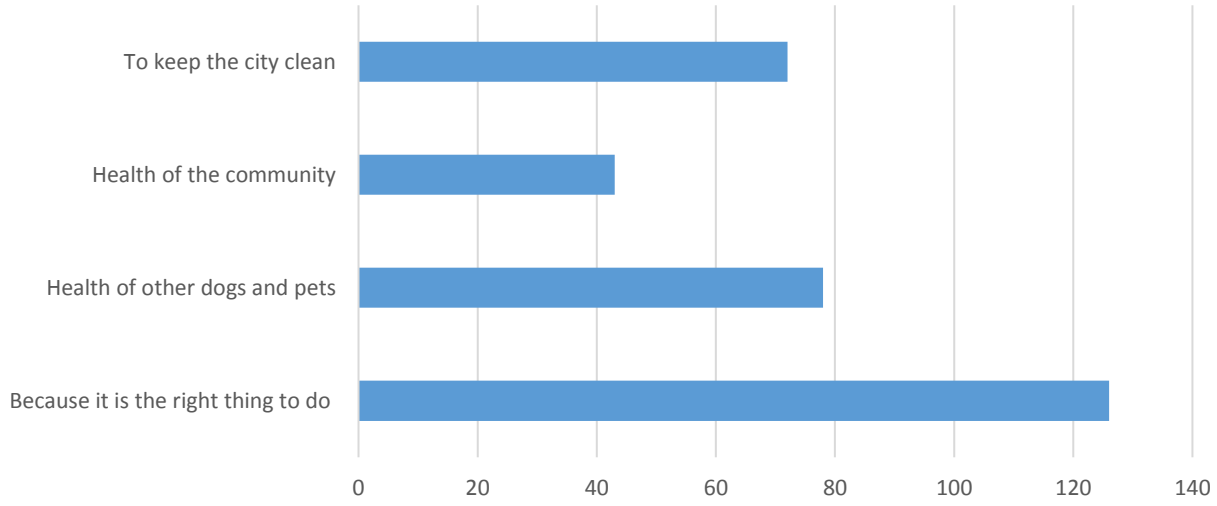


Figure 2. Count of motivation by city

Cities	Count	Count Percent
Pacifica	**106**	
Because it is the right thing to do	24	23%
Health of other dogs and pets	33	31%
Health of the community	23	22%
To keep the city clean	26	25%
San Mateo	**106**	
Because it is the right thing to do	23	22%
Health of other dogs and pets	38	36%
Health of the community	14	13%
To keep the city clean	31	29%
South San Francisco	**107**	
Because it is the right thing to do	79	74%
Health of other dogs and pets	7	7%
Health of the community	6	6%
To keep the city clean	15	14%
TOTAL	**319**	

MAJORITY OF PARTICIPANTS STATED TO USE A GENERAL OR DOG PARK BUT A SURVEY LOCATION BIAS IS LIKELY

As an aggregate, participants most frequently stated to use a general park (32%) or dog park (21%) to walk their dogs. However, looking at the survey responses by location, a location specific bias seems to surface.

Majority of Pacifica participants, for instance, stated to most frequently walk their dogs at the beach and the participants of Pacifica were recruited at Esplanade Beach. Similarly, participants of South San Francisco most frequently stated to walk their dog at a dog park: the participants of South San Francisco were gathered at Centennial Way Dog Park. Likewise, participants of Seal Point Park cited using a general park to walk their dog most frequently. Encompassing over 200 acres, Seal Point Park is a very large general park with a smaller area reserved for dogs. In other words, it is difficult to assess how reliable it is to project the location sample to its respective region given the extent of location specific trend being observed. This bias was expected before implementation but given the limitation in time and resources at hand, further stratification of sampling posed to be a real challenge.

Figure 3. Aggregated preferred setting to walk dog

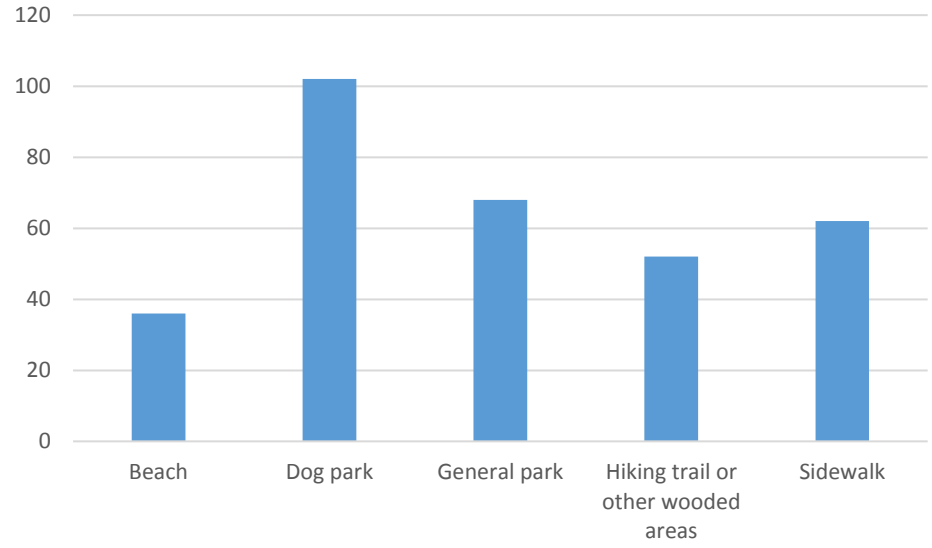


Figure 4. Preferred setting to walk dog by city

Row Labels	Count
Pacifica Esplanade Beach	**106**
Beach	35
Dog park	23
General park	19
Hiking trail or other wooded areas	22
Sidewalk	7
San Mateo Seal Point	**106**
Beach	
Dog park	15
General park	40
Hiking trail or other wooded areas	22
Sidewalk	29
South San Francisco	**108**
Beach	1
Dog park	64
General park	9
Hiking trail or other wooded areas	8
Sidewalk	26
Total	**320**

A LACK OF TRASH CANS LIKELY EXISTS IN SURVEYED LOCATION BUT A REGIONAL REPRESENTATION IS UNCLEAR

Slightly more than half of the participants in Pacifica believed that there were not enough trash cans to dispose their dog waste in where they normally walk their dog. Participants of San Mateo unanimously believed that there were not enough trash cans whereas participants of South San Francisco mostly believed that there were adequate numbers of trash cans.

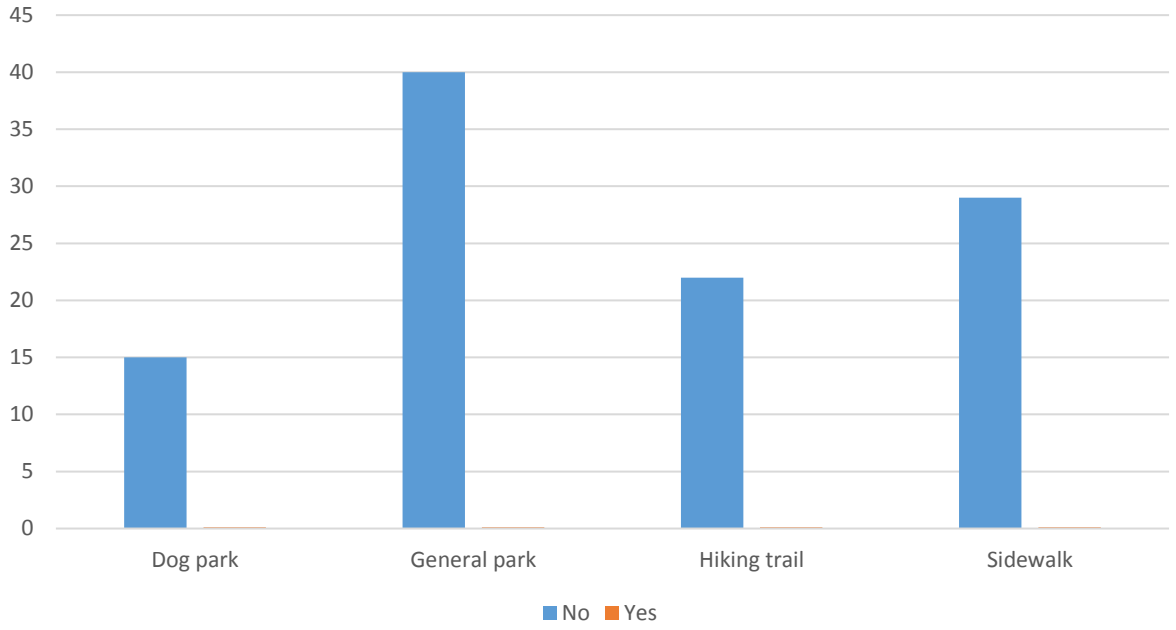
Participants were specifically asked in question 4 to judge the need for more trash cans specific to the setting where they have stated to most frequently walk their dog in question 3. Given the human tendency to make unnecessary implicit associations in judgment, it is difficult to assess whether or not the rating of need was based on the locale in which the survey was taken (e.g. Seal Point Park in San Mateo) or the locale which was specified in the question.

For example, participants of San Mateo unanimously believed that all setting in which they walked their dog lacked trash cans, which included dog parks, general parks, hiking trails and sidewalks presumably within the San Mateo area. However, it is unclear as to whether this rating is representative of an over encompassing need in the San Mateo area or whether the frustration of not having enough trash cans, specifically within Seal Point Park, is influencing participant's ratings for locales other than the park at which they were present. A second study and analysis of geographic distribution of trash cans, pedestrian flow and resident needs is necessary in order to come to a conclusion.

Figure 5. Count of "Are there enough trash cans to dispose of your dog's waste where you walk your dog?"

Cities	Pacifica	San Mateo	South San Francisco
Yes	49%	0%	75%
No	51%	100%	25%
Sample Size	106	106	108

Figure 6. Answers of Q4 categorized by participant answers to Q3



MAJORITY OF THE PARTICIPANTS CORRECTLY PLACED THE DOG WASTE IN A TRASH CAN IF THEY DECIDE TO COLLECT IT

Participants were asked the following "After bagging the dog waste, where do you most frequently dispose of it?" 71% of the participants answered that they dispose of the dog waste in a trash can. This figure should be somewhat attenuated given that survey participants at times give false answers to maintain a prosocial identity.

23% and 28% of participants in San Mateo reported to most frequently not bag their dog's waste or leave it on the side of a walk way, respectively. Improper disposal of dog waste was disproportionately larger for San Mateo participants relative to the participants of the other two cities. This reported behavior corresponds with the previous finding pertaining to the reported lack of trash cans within San Mateo

Figure 7. Aggregated frequency of most common disposal methods

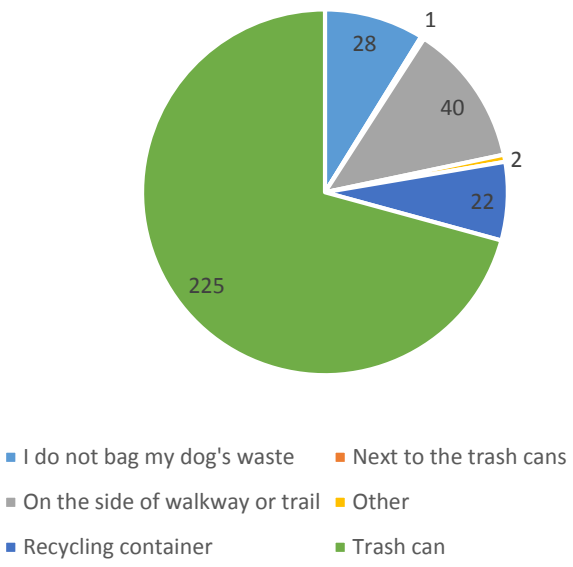


Figure 8. Most common disposal method per city

Row Labels	Frequency	Percent
Pacifica	**105**	
I do not bag my dog's waste	4	4%
Next to the trash cans	1	1%
On the side of walkway or trail	9	9%
Recycling container	11	10%
Trash can	78	74%
San Mateo	**106**	
I do not bag my dog's waste	24	23%
Next to the trash cans	0	0%
On the side of walkway or trail	30	28%
Recycling container	8	8%
Trash can	44	42%
South San Francisco	**107**	
I do not bag my dog’s waste	0	0%
Next to the trash cans	0	0%
On the side of walkway or trail	1	1%
Recycling container	3	3%
Trash can	103	96%
Total	**318**	

PACIFICA PARTICIPANTS MOST FREQUENTLY LET THEIR DOG OFF THE LEASH

The reported rate at which participants let their dogs off their leash during walks were compared between the three locations. A Kruskal-Wallis analysis of variance revealed the three groups to have a significant difference. Post hoc tests were implemented and a statistically significant difference was observed between Pacifica and South San Francisco whereby Pacifica dog owners let their dogs off their leash more frequently than their South San Francisco counterparts. Likewise, a statistically significant difference exists between Pacifica and San Mateo dog owners in which Pacifica participants let their dogs roam free more often. A statistically significant difference was not observed between participants of South San Francisco and San Mateo.

Figure 9. Aggregate preference for dog leashing

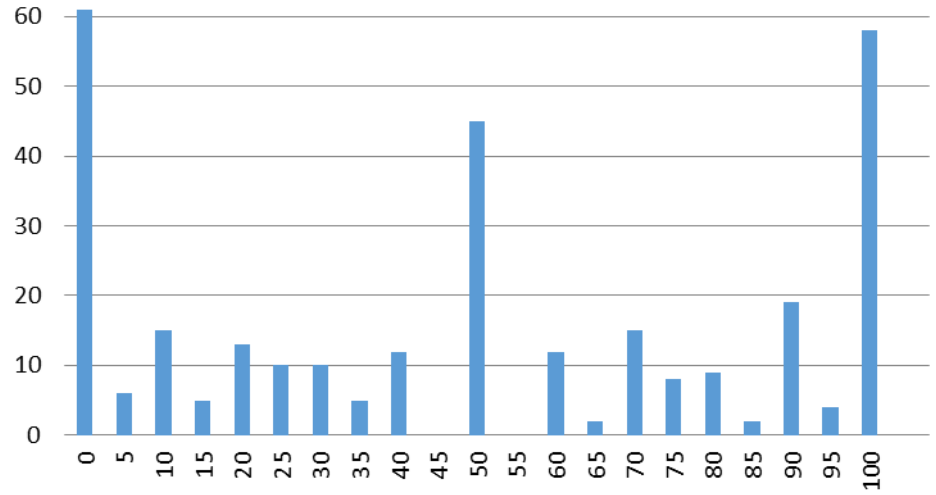


Figure 10. Preference for dog leashing: Pacifica

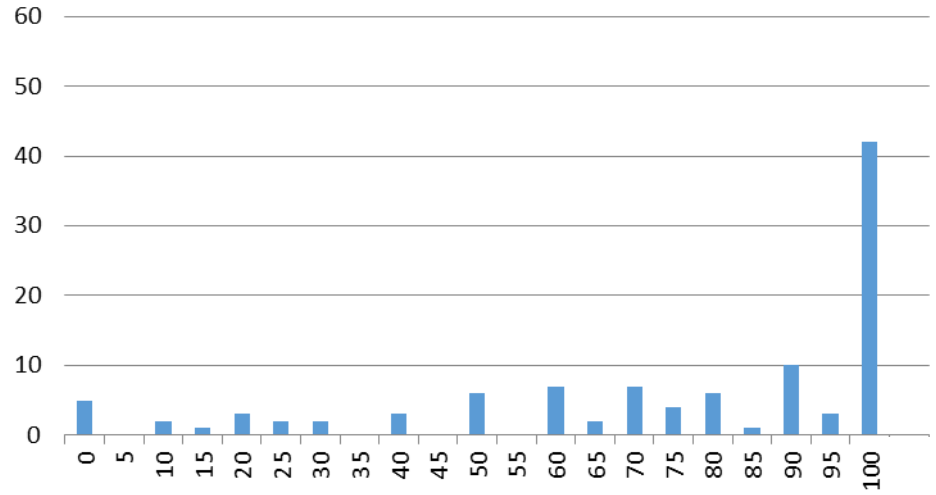


Figure 11. Preference for dog leashing: San Mateo

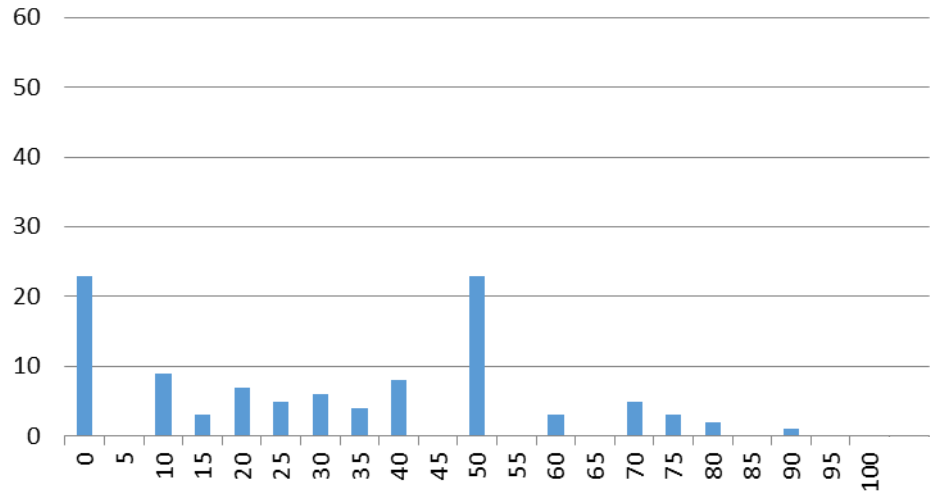
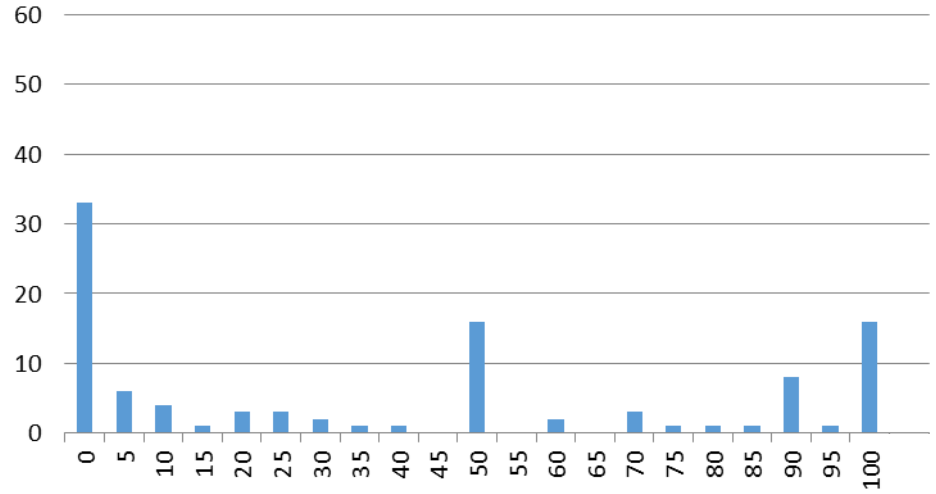


Figure 12. Preference for dog leashing: South San Francisco



PARTICIPANTS REPORT TO BE MORE LIKELY TO DISPOSE OF WASTE IF BAG IS PROVIDED

Collectively, majority of participants stated that they would be much more likely to collect and dispose of their dog's waste (score of 3) if bags were provided in convenient locations. Looking at the differences regionally, a statistically significant discrepancy surfaces. Post hoc tests revealed that San Mateo participants were more motivated by provided waste bags towards action than both South San Francisco and Pacifica participants. In fact, a large portion of the aggregated positive response to free bags is attributable to San Mateo participants.

Figure 13. Aggregated utility of waste bags

Score	Count
1	103
2	66
3	151
Total	**320**

Figure 14. Utility of waste bags per city

Score	Count
Pacifica	**106**
1	52
2	30
3	24
San Mateo	**106**
1	5
2	17
3	84
South San Francisco	**108**
1	46
2	19
3	43
Total	**320**

LOCATION DIFFERENCES OBSERVED IN RATE OF WASTE BAGS AT HAND

Participants were asked as to what percentage of time they have a waste bag at hand and the results were compared between the regions. A statistically significant difference was observed where pet owners of South San Francisco carried with them a waste bag when walking their dog more frequently than both Pacifica and San Mateo pet owners. Pacifica dog owners carried a waste bag with them at statistically higher numbers than San Mateo dog owners.

Figure 15. Aggregate rate of bag possession

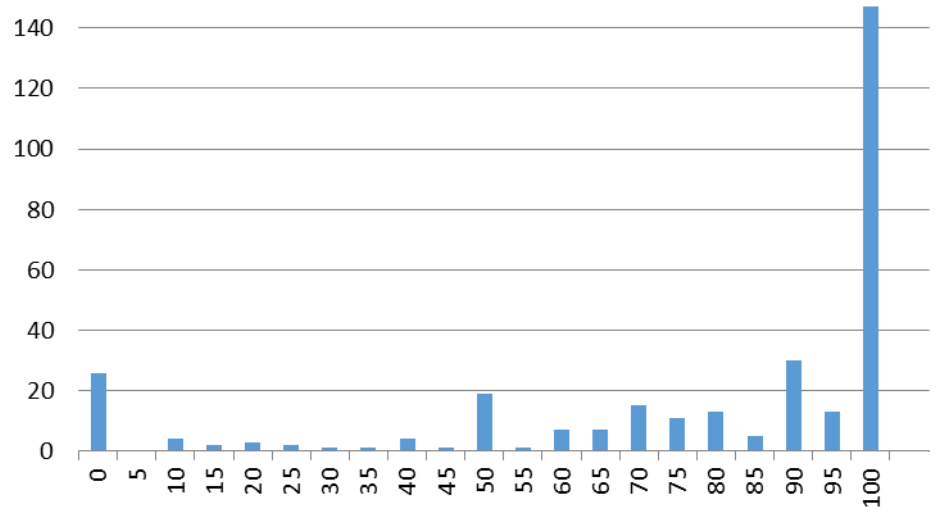


Figure 16. Rate of bag possession: Pacifica

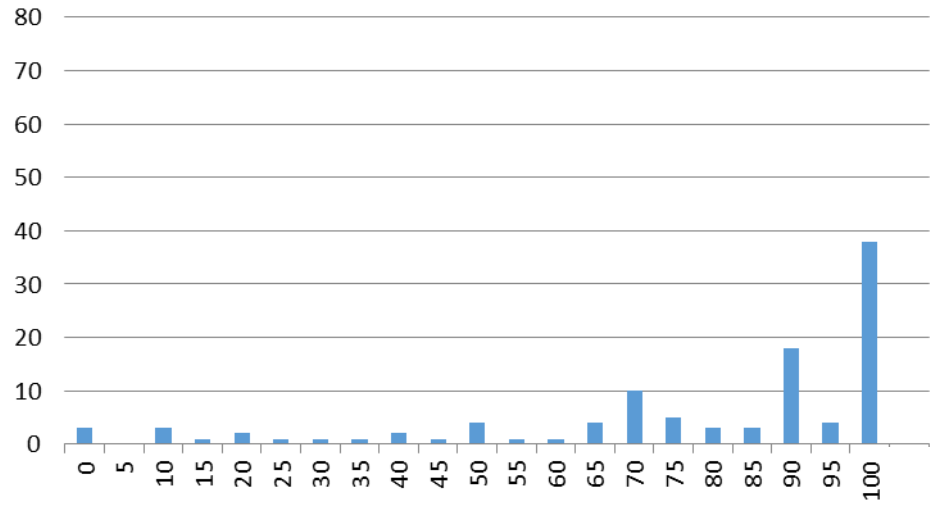


Figure17. Rate of bag possession: San Mateo

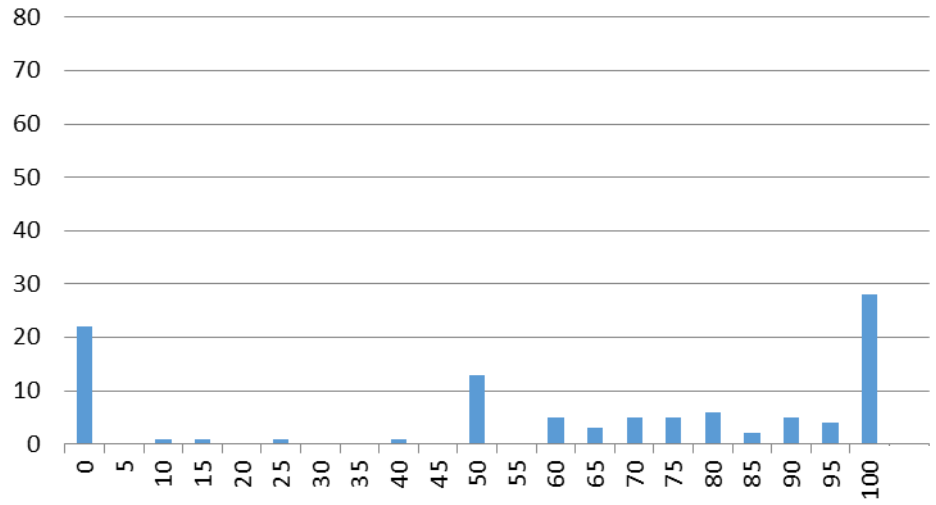
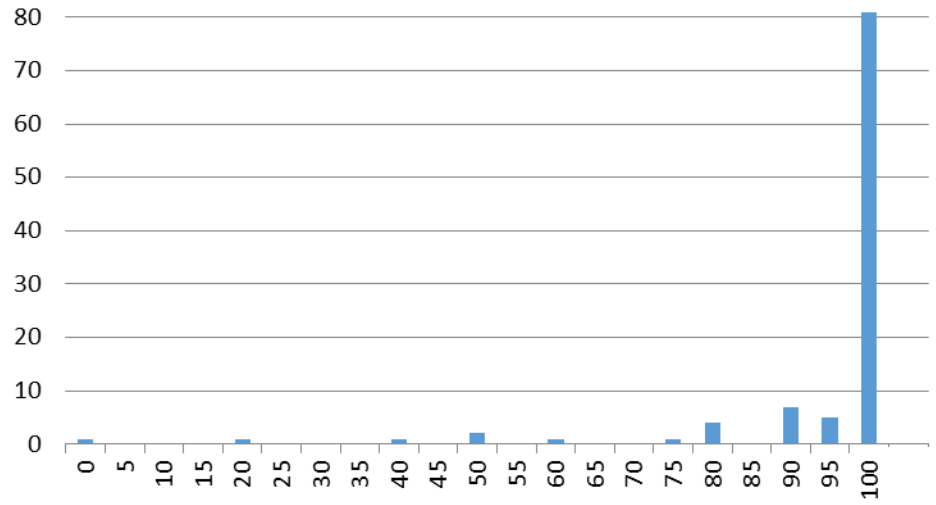


Figure 18. Rate of bag possession: South San Francisco



"DON'T HAVE A BAG" WAS THE MOST FREQUENT REASON FOR IMPROPER DISPOSAL

"Don't have a bag" was the most frequent reason for improper disposal both as an aggregate as well as on a per city basis. "No Trash can" was the second highest reason for improper disposal in San Mateo and this reasoning was disproportionally larger compared to other cities. This is consistent with previous observations made in San Mateo.

Figure 19. Aggregate reason for improper disposal

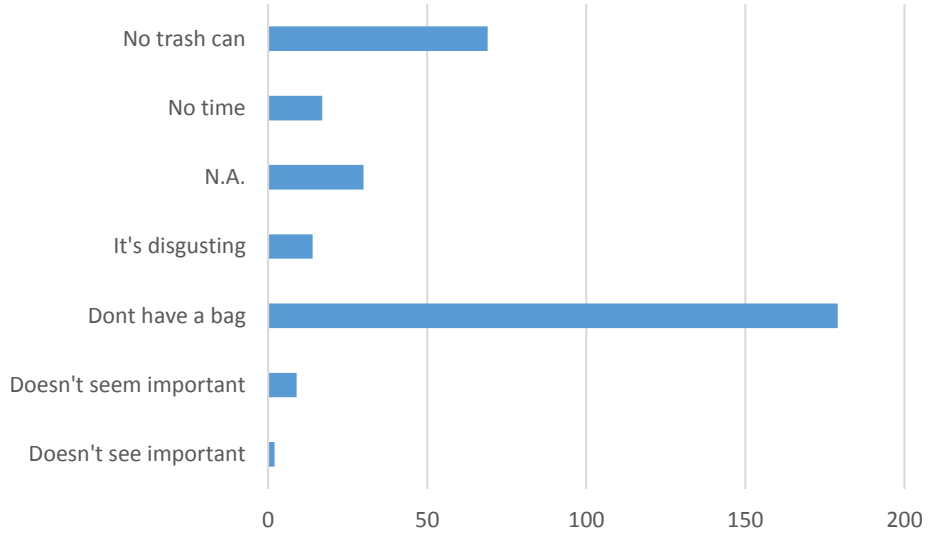


Figure 20. Reason for improper disposal by city

Row Labels	Count	Count Percent
Pacifica Esplanade Beach	**106**	
Doesn't seem important	6	6%
Don’t have a bag	61	58%
It's disgusting	8	8%
No time	11	10%
No trash can	16	15%
San Mateo Seal Point	**106**	
Doesn't seem important	3	3%
Don’t have a bag	51	48%
It's disgusting	3	3%
No time	0	0%
No trash can	49	46%
South San Francisco	**108**	
Doesn't seem important	2	2%
Don’t have a bag	67	62%
It's disgusting	3	3%
No time	6	6%
No trash can	4	4%
Total	**320**	

DIFFERENT LEVELS OF IMPORTANCE PLACED ON CORRECT DISPOSAL DEPENDING ON SETTING

Participants were asked to rate the importance of proper waste disposal when on a sidewalk, at dog parks, city parks, beaches and hiking trails. These sets of questions were designed to be comparative and a matrix table design was used for these series of questions to highlight this fact. Friedman test was used to determine significant difference amongst the answers and Wilcoxon Signed Rank Test was used for the post hoc procedure. The following observations had a statistically significant difference:

- Proper disposal on a **sidewalk** was rated to be more important than at a **dog park.**
- Proper disposal on a **sidewalk** was rated to be more important than on a **hiking trail.**
- Proper disposal on a **sidewalk** was rated to be more important than at a **beach.**
- Proper disposal on a **city park** was rated to be more important than at a **dog park.**
- Proper disposal on a **city park** was rated to be more important than at a **hiking trail.**
- Proper disposal on a **city park** was rated to be more important than at a **beach.**
- Proper disposal on a **dog park** was rated to be more important than at a **hiking trail**.
- Proper disposal on a **beach** was rated to be more important than at a **hiking trail**.

In other words, participants ranked the importance of disposal in the following order:

1st: Sidewalk and city park
2nd: Dog park and beach
3rd: Hiking trail

The difference between sidewalk and city park, as well as the difference between the dog park and the beach, was not statistically significant enough to make a distinction. Despite the hierarchy of importance observed, all settings had a high average score.

Figure 21. Rate of bags at hand per city

	Sidewalk	Dog park	City park	Beach	Hiking trail
Sum	1446	1406	1436	1411	1333
Mean	4.51	4.37	4.47	4.39	4.14

A SIZABLE DIFFERENCE IN WASTE PICK UP ACROSS THE LOCATIONS

A sizable difference in the amount of waste pick up was observed between the locations. Post hoc tests verified that South San Francisco pet owners significantly picked up after their pets (mean = 87.18) more frequently than San Mateo (mean = 57.19) and Pacifica (mean = 85.36) pet owners. San Mateo picked up after their pets at a statistically significant lower rate than the other two cities. Participants of high (100%) pick up rate and very low pick up rate (<46%) were isolated and compared. However, no noteworthy discrepancy was observed.

Figure 22. Aggregate rate of proper disposal

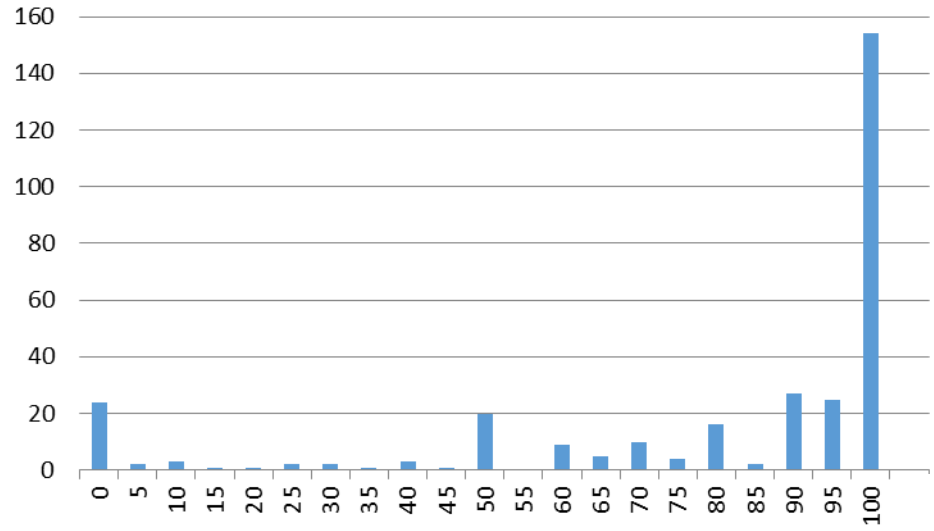


Figure 23. Rate of proper disposal: Pacifica

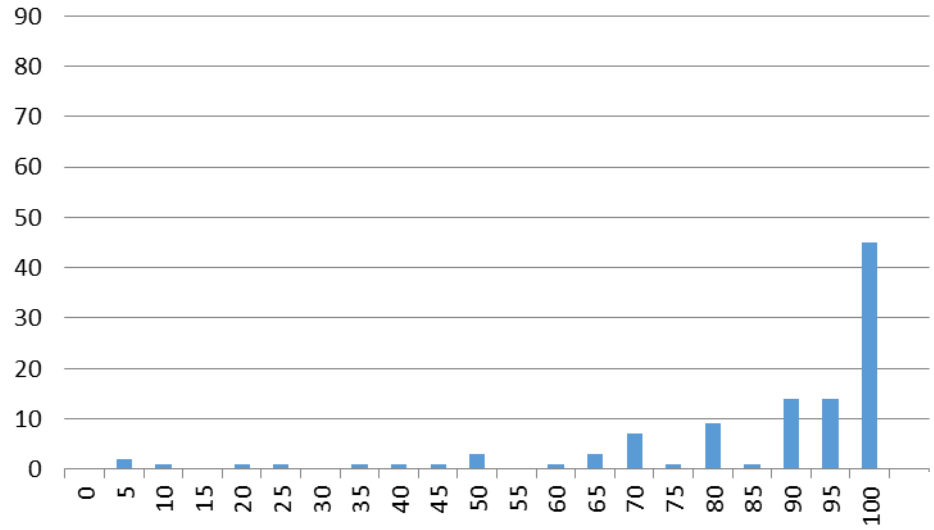


Figure 24. Rate of proper disposal: San Mateo

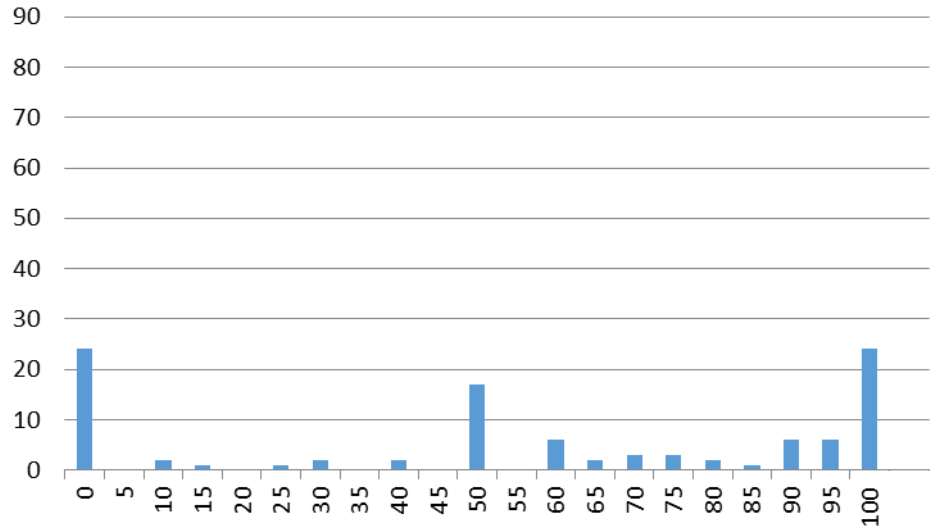
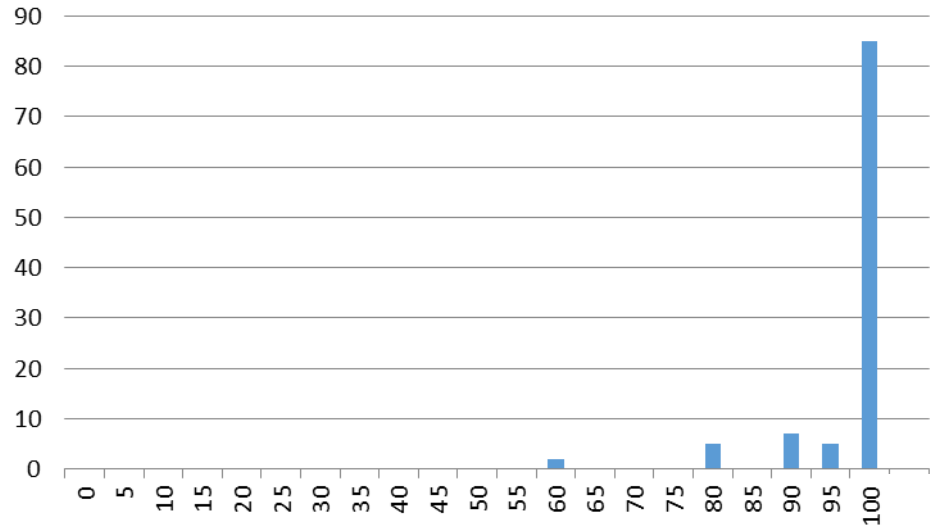


Figure 25. Rate of proper disposal: South San Francisco



MAJORITY OF PARTICIPANTS UNDERSTOOD WHERE TO PROPERTY DISPOSE OF THE WASTE

91% of the 320 participants understood that the dog waste must be disposed of in a trash can rather than in a recycling container, side of walkway or next to the trash can. Figure 25 shows that the San Mateo County residents, for the vast majority, understand how to and where to properly dispose; but are not motivated or too inconvenienced to do so. The following answers were submitted by individuals who answered correctly:

Figure 26. Wrong answers categorized

MAJORITY OF PARTICIPANTS DID NOT KNOW THAT DOG WASTE CONTRIBUTES TO WATER POLLUTION

62% of those surveyed did not know before taking the survey that improper disposal of dog waste contributed to water pollution. Interestingly, there were a sizably larger number of participants who understood this issue in South San Francisco relative to other cities. This could perhaps be representative of a difference in civic/ecological engagement levels of the different communities.

Figure 27. Aggregated frequency of pre-knowledge: "Before taking this survey, were you aware that uncollected dog waste washes into storm drains and significantly contributes to water pollution?"

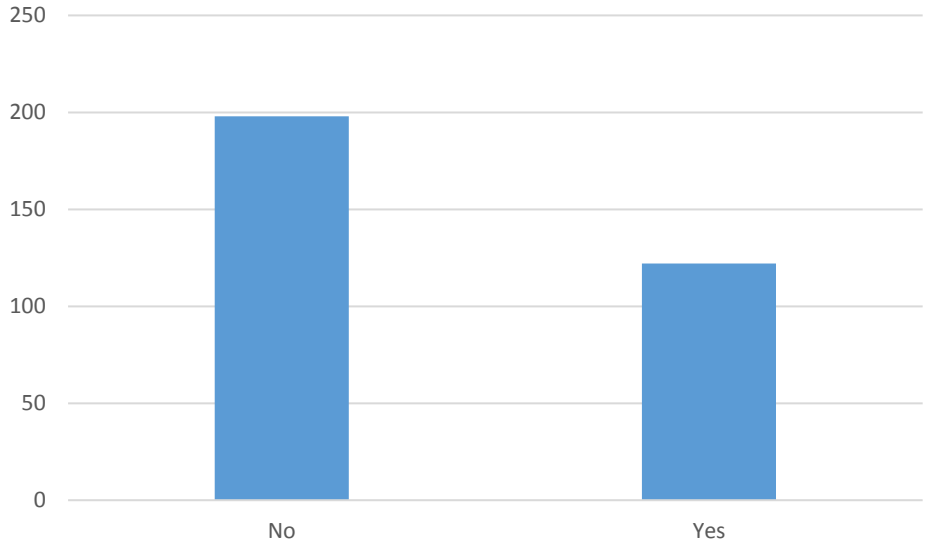


Figure 28. Frequency of pre-knowledge by city

Row Labels	Count
Pacifica Esplanade Beach	**106**
No	74
Yes	32
San Mateo Seal Point	**106**
No	70
Yes	36
South San Francisco	**108**
No	54
Yes	54
Total	**320**

LARGE NUMBER OF PARTICIPANTS WERE WHITE AND FEMALE

The ethnicity trends recorded in our study sizably diverged from the ethnicity distribution recorded by the census. This can be suggestive of many causes including but not limited to: a) difference in number of ownership of dogs amongst cultures, b) difference in utilization of public spaces, or c) difference in understanding or beliefs of a pet's exercise needs.

Figure 29. Observed ethnicity distribution

Row Labels	Count of What is your ethnicity?	Count Percent
Pacifica Esplanade Beach	**105**	
Asian	18	17%
Black	21	20%
Caucasian	29	28%
Indian/South Asian	10	10%
Latino	20	19%
Middle Eastern	7	7%
San Mateo Seal Point	**104**	
Asian	7	7%
Black	19	18%
Caucasian	46	44%
Indian/South Asian	3	3%
Latino	28	27%
Middle Eastern	1	1%
South San Francisco	**100**	
Asian	32	32%
Black	2	2%
Caucasian	41	41%
Indian/South Asian	2	2%
Latino	20	20%
Middle Eastern	3	3%
Total	**309**	

Likewise, the sex ratio (males per 100 females) observed at the dog parks were sizably different from the one recorded in the census for each city and leaned towards a female demographic.

Figure 30. Sex ratio: observed v. census

	South San Francisco	Pacifica	San Mateo
Observed	63	100	76
Census	85.7	93.9	97.1

APPENDIX

MISC. FIGURES

Figure 31. Observed participant ages

Row Labels	South San Francisco	Pacifica	San Mateo Seal Point
10 to 14	0%	0%	0%
15 to 19	9%	13%	8%
20 to 24	9%	19%	20%
25 to 29	12%	19%	9%
30 to 34	7%	11%	16%
35 to 39	12%	12%	11%
40 to 44	12%	8%	8%
45 to 49	7%	5%	13%
50 to 54	13%	5%	3%
55 to 59	5%	4%	5%
60+	16%	4%	9%
Total	106	102	104

Figure 32. Count of When your dog is off the leash, how often do you notice if he or she has gone to the bathroom? Please answer as a percentage where 0% is never and 100% is always.

Percentage	Count
0	10
2	1
5	2
10	3
20	2
25	5
30	5
45	1
50	38
55	1
60	4
65	3
70	12
75	11
80	28
85	7
90	42
95	16
96	1
97	2
98	6
99	8

100	104
N.A.	8
Total	**320**

SAN MATEO COUNTYWIDE WATER POLLUTION PREVENTION PROGRAM DOG WASTE SURVEY

1. What motivates you the most to pick up after your dog?
   a. Health of the community
   b. Health of other dogs and pets
   c. To keep the city clean
   d. Because it is the right thing to do

2. After bagging dog waste, where do you most frequently dispose of it?
   a. Trash can
   b. Recycling container
   c. On the side of walkway or trail
   d. Next to the trash cans
   e. I do not bag my dog's waste
   f. Other [open ended]

3. In which setting have you walked your dog most frequently in the last six months?
   a. Hiking trail or other wooded areas
   b. General park
   c. Dog park
   d. Beach
   e. Sidewalk

4. Are there enough trash cans to dispose of your dog's waste where you walk your dog?
   a. Yes
   b. No

5. How frequently do you let your dog off his leash during walks?
   [Please answer as a percentage with 0% being never and 100% being always]

6. Would you be more likely to collect and dispose of your dog's waste if bags were provided for you at convenient locations?
   a. Makes no difference
   b. More likely
   c. Much more likely

7. When walking your dog in the last six months, how frequently did you have a dog waste bag with you?
   [Please answer as a percentage with 0% being never and 100% being always]

8. When your dog is off leash, how often do you notice if he or she has gone to the bathroom?
   [Please answer as a percentage with 0% being never and 100% being always]

9. What's the most common reason for not picking up after your dog?
    a. Don't have a bag
    b. No trash can
    c. No time
    d. Doesn't seem important
    e. It's disgusting

10.

How important is it to collect and dispose of your dog's waste when walking your dog...

	Very not important	Not important	Neutral	Important	Very important
...on a sidewalk?	○	○	○	○	○
...in a dog park?	○	○	○	○	○
...in a city park?	○	○	○	○	○
...on a beach?	○	○	○	○	○
...on a hiking trail or other wooded areas?	○	○	○	○	○

11. When walking your dog in the last six months, how frequently have you collected and disposed of your dog's waste?
    [Please answer as a percentage with 0% being never and 100% being always]

12. Where is it correct to dispose of dog waste? Mark all that apply.
    a. Trash can
    b. Recycling container
    c. On the side of walkway or trail
    d. Next to the trash cans
    e. Other [open ended]

13. Before taking this survey, were you aware that uncollected dog waste washes into storm drains and significantly contributes to water pollution?
    a. Yes
    b. No

14. What is your ethnicity?
    a. Indian/South Asian
    b. Asian
    c. Black
    d. Caucasian
    e. Latino
    f. Middle Eastern

15. What is your gender? (Make note of this. Do not ask.)
    a. Male
    b. Female

16. What is your age?
    a. 10 to 14
    b. 15 to 19
    c. 20 to 24
    d. 25 to 29
    e. 30 to 34
    f. 35 to 39
    g. 40 to 44
    h. 45 to 49
    i. 50 to 54
    j. 55 to 54
    k. 55 to 59
    l. 60+

CLEAN WATER IS A TEAM EFFORT.

What is stormwater pollution?

When it rains, water flows over sidewalks, streets, and parking lots, carrying pollutants like trash, pesticides and dog waste into our storm drains. That stormwater runoff washes straight into our creeks, ocean and bay, harming wildlife and our quality of life.

flowstobay.org

WE'RE SOCIAL!
Visit us at flowstobay.org
info@flowstobay.org

Printed on recycled paper

CLEAN WATER IS A TEAM EFFORT.

What can you do?

- Never dump anything down storm drains.
- Pick up litter.
- Clean up after your pet.
- Bring your car to the car wash.
- Install a rain barrel.
- Use less toxic pest control products.
- Participate in local cleanups.

Spread the word!

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Summary of County of San Mateo Programs

Contents

Environmental Health Pollution Prevention Program- *www.smchealth.org/pollutionprevention*

Healthy Nail Salon Recognition Program- *www.smchealth.org/healthynails*

- Bay Area cities joined forces to create the Healthy Nail Salon Recognition Program to improve the air quality of nail salons and reduce carcinogenic and reproductive health impacts to nail technicians.

- There are 10 criteria that improve air quality through safer products and practices. Safer products include using less toxic nail polishes, free of the "toxic-trio" (toluene, dibutyl phthalate, and formaldehyde) and acrylic powders free of Methyl-Methacrylate (MMA). Safer practices include using a localized ventilation unit to filter out particulate dust and fumes generated by acrylic nail services.

- 13 Healthy Nail Salons have been certified by San Mateo County. The Program encourages customers to protect everyone's health by visiting one of these certified salons that have committed to healthier

products and practices. Periodic text or email discounts of up to $5 off any nail salon service are now available. Customers may sign up by texting "HEALTHYNAILS" to 38470.

Contact: Kathryn Cooke, kcooke@smcgov.org

Coastal Cleanup Day- *www.flowstobay.org/ccd*

- Coastal Cleanup Day (CCD) is an annual beach and waterway cleanup event held on the third Saturday in September. As California's largest volunteer event, it brings community awareness to cleaning up and protecting our environment.

- In San Mateo County, thousands of volunteers head to local beaches, neighborhoods, creeks, parks and bay sites to prevent trash from entering local waterways. Join the movement to help keep San Mateo County clean!

Contact: Julia Au, jau@smcgov.org

Safe Medicine Disposal Ordinance- *www.smchealth.org/rxdisposal*

- Since 2006, San Mateo County has managed a medicine collection program at 14 law enforcement locations around the County to properly dispose of unwanted medicines, including over the counter and prescription medications (including controlled substances), medicated ointments, lotions/creams and liquid medications for humans and pets.

- While 14 locations in the County is a good start, residents want more convenient disposal options. So in 2015 the San Mateo County Board of Supervisors passed the Safe Medicine Disposal Ordinance.

- The Ordinance requires medicine producers of prescription and over-the-counter medicines offered for sale in San Mateo County to design, develop, and fund a medicine collection and disposal program for unwanted medicines. The program should be up and running by the end of 2016.

Contact: Julia Au, jau@smcgov.org

Fish Smart- *www.smchealth.org/fishsmart*

- The Fish Smart program educates people who eat fish caught in the San Francisco Bay on what fish is safe and not safe to eat.

- Some fish in the SF Bay contain high levels of chemicals harmful to your health - PCBs (linked to cancer), and mercury (can negatively affect how the brain develops in unborn babies and children).

- Women and children are especially susceptible to the health risks associated with eating these high chemical fish.

Contact: Allison Milch, amilch@smcgov.org

Household Hazardous Waste Program- *www.smchealth.org/hhw*

- Educates residents how and why to safely dispose of common household hazardous wastes (HHW) found in homes such as batteries, household chemicals, pesticides, fluorescent lights, and paint.

- The program promotes various options for safe disposal of HHW that are easy and free, and include the County's permanent HHW facility, temporary HHW events held in different cities, retail take back locations, and collection at your curb.

- The program also promotes a healthy home by educating the public on alternatives to hazardous products for cleaning and pesticides by using safer cleaning methods, items one may already have at home, or more common products.

- Collection at your door is available to cities in the RethinkWaste Service area (East Palo Alto to Burlingame and East of Highway 280) contact At Your Door Special Collection at 800-HHW-PKUP (800-449-7587) and explain the type and quantity of waste you wish to have picked up from your home.

- In addition to the Door-to-Door HHW collection program, the County's HHW program, and free drop-off of latex paint at the Shoreway Environmental Center, residents have one more new way to recycle old paint. The PaintCare program is an industry sponsored paint stewardship, non-profit program launched in October 2012, the link is http://www.paintcare.org/

Contact: Julia Au, jau@smcgov.org

Used Motor Oil & Recycling Program- *www.flowstobay.org/usedoil*

- Educates the Do-it-Yourselfer (DIY) public on how and why to safely dispose of used motor oil and oil filters, as well as other hazardous automotive products (high emphasis on filters).

- Promotes safe disposal through free an easy options, such as retail take-back locations, auto mechanic shops, quick lubes, and curbside collection in some cities through your waste hauler (contaminated oil must be disposed of at the Permanent HHW Facility only).

- Conducts direct community outreach with DIYers through hosting Oil Filter Exchange events at auto parts stores throughout the County.

Contact: Cynthia Knowles, cknowles@smcgov.org

Office of Sustainability- *www.smcgov.org/green*

RecycleWorks' Program- *www.recycleworks.org*

- Visit our website for an online database on where to reuse, recycle or buy recycled materials.
- Residents can call the RecycleWorks' hotline **(1-888-442-2666)** to connect with someone to help find out where to reuse, recycle or buy recycled materials.
- There is a RecycleWorks Volunteer Academy that includes classes and workshops about resource conservation and composting to community members. In addition to the classes, attendees are provided opportunities to volunteer in the community.
- The RecycleWorks Schools Program offers classroom workshops, curriculum assistance, onsite compost assembly and more available to all schools in the County.
- There are several guides on composting, a Reuse Guide and a Recycling Guide to help you learn where to reuse or recycle items.
- Surplus property sales are held where you can buy used equipment and furniture from the County.

Volunteer Academy, contact: Eun-Soo Lim, eulim@smcgov.org

Schools, contact: Gerald Schwartz, gschwartz@smcgov.org

Surplus sales, contact: Russ Hayes, rhayes@smcgov.org

General questions, contact: 1-888-442-2666

Active Transportation- *www.Green.smcgov.org/Active-Transportation*

- Active transportation is bicycling, using scooters or skateboards to add healthy physical activity to the short trips we make each day. That's what Active Transportation is about: getting some activity while reducing traffic and cutting pollution."
- The goal is to enhance communities in San Mateo County so that it's easy and comfortable for everyone to make some of their daily short trips by walking, bicycling, scootering or taking transit. Using the bus or train adds enough daily steps to meet recommended physical activity.
- **Active Transportation resources can help you see if there are more opportunities for shifting a short car trip to walking. The "Change One Trip" Challenge can be a good way to start.**
- **What's the "Change One Trip" Challenge?**
    1. Take a map of your location – home, work, school, any destination
    2. Draw a ½ mile-radius circle around the location
    3. Identify destinations within that circle and plan to walk to those.

- **Safe Routes to School-** contact the County Office of Education to find out if your school is involved – or to help start a program.

- **May is National Bike Month** and San Mateo County is supplying bicycle safety education in conjunction with a month of festivities.

What to say about the printed materials:

- **Bicycle Commuter Booklet**: A wealth of information to help get started with riding to work or school. Tips on the rules of the road and how to follow traffic rules on a bike. Includes great pointers on understanding how your bike works, how to carry your belongings, and how to securely lock your bike.

- **Bike Map:** A terrific resource for helping plan your bike route along quiet streets and trails. The color coding shows where the trails are and which streets have dedicated bike lanes. The best part is finding the trail bridges that allow low-stress access across highways and train tracks. The map is from data in 2009, so in many areas even more bike lanes have been installed.

- **Bike to Shop Day Cards (or fliers):** Bike to Shop Day gives you rewards for bicycling to local participating retailers on May 21. Check out BikeToShopDay.com to see the map and list of participating shops, pump up your tires, and bike around your downtown. Businesses give gifts, discounts, or prizes for people who arrive by bike that day. Take extra cards and ask your favorite businesses to sign up.

- **Bike Month Poster:** Shows a sampling of the many Bike Month events taking place in May 2016. The North Fair Oaks Bike Rodeo will take place just after May where children can learn bicycle traffic skills and get bike safety checks. New in 2016 the Rodeo will include cargo bike demonstration booth hosted by Suburban Bikes. Cargo bikes make it easy to carry kids, groceries, and even surf boards. There will be an area to test ride new electric-assist bikes that make it comfortable to get up hills without sweating.

Contact: Drew Harrington, dharrington@smcgov.org or Ellen Barton, ebarton@smcgov.org

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Bay Area Regional Energy Network (BayREN)- *www.BayAreaEnergyUpgrade.org*

- There are rebates available to **single family homeowners** in any of the 9 Bay Area Counties who are interested in making energy efficiency upgrades to their homes. Upgrades include: high efficiency furnaces, water heaters, air conditioners, windows, insulation, air sealing and more.

- Rebates **do not** cover renewable energy or water efficiency upgrades like solar panels, artificial turf or washing machines.

- You must choose a participating contractor from our website to be eligible for rebates.

- If someone is interested in rebates:
    - Direct them to the website so that they can connect with a contractor and get started

- Direct them to our hotline to speak with a building science professional. They can help them understand this rebate, they can help them find a contractor, review technical specifications of equipment, review contractor bids, and refer them to complementary rebate programs.

For general questions, call: 1-866-878-6008 **or email:** rlonder@smcgov.org

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SeaChange SMC- *www.seachangesmc.com*

- Why are sea levels rising?
  - Higher temperatures cause land-based ice to melt, and ocean waters to warm and expand. These two factors results in higher sea levels.

- How much will seas rise? We could see:
  - .5 foot to 2 feet by 2050
  - 1 foot to 5.5 feet by 2100

- What's at risk?
  - Natural areas, including 73% of the County's wetlands
  - $24 billon of assets
  - 530 miles of roads
  - 115,000 people who live in low-lying areas

- What can we do?
  - Avoid new development in vulnerable areas
  - Design to accommodate risks
  - Remove at-risk structures
  - Protect critical structures
  - Restore wetlands

- How can I get involved?
  - Join our SeaChange SMC Facebook Group to stay up to date on our program: www.facebook.com/groups/ SeaChangeSMC
  - Attend (or host) future SeaChange SMC community events to share your thoughts and concerns on the issue.
  - Participate in Citizen Science Projects– Share photos of king tides on www.flickr.com/groups/cakingtides/

Contact: TJ Carter, tjcarter@smcgov.org

Peninsula Clean Energy- *www.PeninsulaCleanEnergy.com*

- Peninsula Clean Energy (PCE) is a new organization in San Mateo County that will provide an alternative electricity supply from what people are currently receiving. For the first time ever, residents in the County will be able to choose their electricity supplier and more renewable energy.

How is PCE different than your current supplier?

- PCE will allow residents to choose a cleaner power supply, while maintaining competitive rates, and keeping program profits in the County.
- PCE will offer customers a default electricity product that is at least 50% renewable – that's nearly double the amount of renewable energy County residents currently receive!
- If you choose PCE, your current level of service won't be affected. The change will be completely seamless. General maintenance and billing will be exactly the same. The only change you'll notice is that your electricity bill may be lower!

What is the PCE timeline?

- PCE will begin serving customers in October of this year.
- Customers will be enrolled through three phases over the course of 12 months.
- We've developed an early adopter program for residents who want to be the first to start receiving clean, renewable energy from PCE.
- The early adopter program enables customers to receive 100% renewable energy as soon as the program is launched in October.

Where can residents get more information?

- County residents can visit the PCE website at PeninsulaCleanEnergy.com.
- We also host public meetings on the fourth Thursday of each month at 7:00pm at 101 Twin Dolphin Drive in Redwood City.

How can residents choose PCE?

- Residents who want to receive service from PCE do not have to do anything – you will be automatically enrolled in the program, but will have the option to opt-out if you choose.

Contact: Carolyn Raider, craider@smcgov.org

Green Business Program- *www.recycleworks.org/green_business*

- The San Mateo County Green Business Program is part of the Bay Area Green Business Program and the larger California Green Business Network (there are currently 30 city and county programs statewide). The Program serves a wide variety of business types in **ALL** cities and unincorporated areas.

- The Program partners with public agencies and local utilities to provide participating businesses with cost free energy and water audits, Environmental Health and food safety inspections, FISHNICK consultations, etc.

- The Green Business checklist of sustainability measures covers energy conservation, water conservation, pollution prevention, waste reduction, and wastewater. The certification process includes enrollment and registration, initial walk-throughs and consultation, audits and compliance checks, implementation of measures, final site visit and verification, certification and recognition!

Contact: Emi Hashizume, ehashizume@smcgov.org

San Mateo County Water Pollution Prevention Program- *www.flowstobay.org*

- Storm drains carry water and pollutants directly to our local creeks, the Bay, and the Pacific Ocean.

- **Pet Waste**: Make sure to pick up after your dog! Dog waste is a significant contributor to water contamination. You can request a *free* doggy bag canister sent to your home at http://www.flowstobay.org/petwaste.

- **Car Wash Coupon:** Every time you wash your car in the driveway or street, contaminants such as oil, grease, metals (copper, nickel and zinc), dirt and soap can flow into storm drains. Storm drains discharge directly into our local creeks, the San Francisco Bay, and Pacific Ocean, polluting our environment. *Take your car to a commercial car wash to prevent pollution and save up to 150 gallons of water per car wash!* **Text Carwash to 384-70 for your 20% off coupon!**
    - **Program dates:** May 1 to August 31, 2016
    - **Coupon:** 20% off a car wash at any of our partner locations
    - **To Redeem:** Show the attendant your email or text coupon on your electronic device, or print and give the coupon to the attendant.

- **Rain Barrel Rebate:** With California facing a record breaking drought, rain barrels are one of the best ways to save money and water. Rain barrels protect local creeks, the San Francisco Bay, and the Ocean by reducing urban runoff that transports litter, motor oil, copper and other pollutants from entering stormdrains.
    - San Mateo County has a rebate program that provides a rebate of up to $100!
    - Visit the Bay Area Water Supply and Conservation Agency
    - Buy a rain barrel. Consider buying it at your local hardware store (*must be at least 50 gallons*)
    - Fill out a rebate application
    - Send the completed application, a post-installation photo, & proof of purchase to: *BAWSCA, 155 Bovet Road, Suite 650, San Mateo, CA 94402.*

- **FlowstoBay Newsletter**: Stay connected to our program in order to receive information about our latest rebates, giveaways, and events by signing up for our Newsletter http://www.flowstobay.org/newsletter.

Contact: Megan Kang mkang@sga-inc.net or (562) 597-0205

Appendix 9

- Parks Maintenance & IPM Work Group Attendance List FY 2015/16
- Landscape Integrated Pest Management Workshop – March 9, 2016
    - Agenda
    - Attendance List
    - Summary of Workshop Evaluations

San Mateo Countywide Water Pollution Prevention Program
Parks Maintenance & IPM Work Group Attendance List - FY 2015/16

Contact Information				Attendance	
MUNICIPALITY	**REPRESENTATIVE**	**EMAIL**	**TELEPHONE NO.**	**8/25/2015**	**2/23/2016**
Atherton	Steve Tyler	styler@ci.atherton.ca.us			
Belmont	Daniel Ourtiague	dourtiague@belmont.gov	650-595-7441		
	Jonathan Gervais	Jgervais@belmont.gov			
Brisbane	Joe Friars	jfriars@ci.brisbane.ca.us	650-766-4353		
Burlingame	Rich Holtz	Rholtz@burlingame.org		X	X
	Bob Disco	bdisco@burlingame.org			
Colma	Louis Gotelli	Louis.Gotelli@colma.ca.gov	650-333-0295	X	X
	Brian Dossey	brian.dossey@colma.ca.gov			
Daly City	Paul Thompson	pthompson@dalycity.org	650-991-8006	X	X
	Dennis Bray	dbray@dalycity.org			
East Palo Alto	Jay Farr	jfarr@cityofepa.org	650-853-3105		
	Michelle Daher	mdaher@cityofepa.org			
Foster City	Dorte Drastrup	ddrastrup@fostercity.org	650-286-3553	X	X
Half Moon Bay	Larry Carnahan	larryC@hmbcity.com	650-726-7177		
	Mark Lander	markl@csgengr.com			
Hillsborough	Garry Francis	gfrancis@hillsca.org	650-375-7506	X	X
	John Mullins	jmullins@hillsborough.net			
Menlo Park	David Mooney	damooney@menlopark.org	650-330-6794		
	Sheena Ignacio	smignacio.menlopark.org	650-330-6767	X	X
Millbrae	Ken Crosetti	kcrosetti@ci.millbrae.ca.us			
	John Gianoli	jgianoli@ci.millbrae.ca.us			
Pacifica	Ron Fascenda	fascendar@ci.pacifica.ca.us	650-738-3760		
	Jean Pierre Elissetche		650-738-3760	X	X
	Raymond Donguines	donguinesr@ci.pacifica.ca.us			
Portola Valley	Howard Young	hyoung@portolavalley.net	650-851-1700 x.214		
	Tony Macias	tmacias@portolavalley.net			
Redwood City	Valerie Matonis	vmatonis@redwoodcity.org	650-780-7280	X	X
	Terence Kyaw	TKyaw@redwoodcity.org			
	Daniel Burton	dburton@redwoodcity.org			
	Francisco Espinoza	fespinoza@redwoodcity.org	650-280-5094		
San Bruno	Rene Walsh	rwalsh@ci.sanbruno.ca.us	650-616-7193		
	Dan Barros	Dbarros@sanbruno.ca.gov			
San Carlos	Arturo Burgueno	aburgueno@cityofsancarlos.org	650-802-4140		
	Paige Safe	psafe@cityofsancarlos.org	650-802-4196		X
City of San Mateo	Mike Blondino	mblondino@cityofsanmateo.org			
	Bruce Reed	breed@cityofsanmateo.org			
	Mark Swensen	Mswenson@cityofsanmateo.org			X
	Dennis Pawl	dpawl@cityofsanmateo.org			
San Mateo Co. Parks	Stephen Kraemer	SKraemer@smcgov.org		X	X
	Maria Mastrangelo	mmastrangelo@co.sanmateo.ca.us			
	Sam Herzberg	SHerzberg@co.sanmateo.ca.us			
	Scott Lombardi	slombardi@co.sanmateo.ca.us			
	Ramona Arechiga	TRArechiga@smcgov.org	650-599-1375		
	Andrea Chow	Achow@smcgov.org	650-363-4125		
	J Hannen	jhannen@co.sanmateo.org			
	Julie Casagrande	jcasagrande@co.sanmateo.ca.us			
	Matthew DelCarlo	madelcarlo@smcgov.org			
	Suzanne Bontempo	suzannebontempo@gmail.com			
SM County PW	Jeff Pacini	JPacini@co.sanmateo.ca.us			

San Mateo Countywide Water Pollution Prevention Program
Parks Maintenance & IPM Work Group Attendance List - FY 2015/16

Contact Information				Attendance	
MUNICIPALITY	**REPRESENTATIVE**	**EMAIL**	**TELEPHONE NO.**	**8/25/2015**	**2/23/2016**
County Agriculture Weights and Measures	Ricard Garcia	rgarcia@co.sanmateo.ca.us		X	X
	Jeremy Wagner	JWagner@smcgov.org	650-776-5583	X	X
	Koren Widdel	kwiddel@smc.gov.org			
	Fred Crowder	fcrowder@co.sanmateo.ca.us			
SSF	Donald Louie	donald.louie@ssf.net	650-829-3837	X	X
	Brian Brunelli	brian.brunelli@ssf.net	650-829-3837		
	Andrew Arzaga	andrew.arzaga@ssf.net			
Woodside	Dong Nguyen	DNguyen@woodsidetown.org			
UCCE/UC IPM	Andrew Sutherland	amsutherland@ucanr.edu	510-499-2930		
EOA	Jon Konnan	jkonnan@eoainc.com	510-832-2852 x.111		
	Vishakha Atre	vatre@eoainc.com	408-720-8811		
SMCWPPP	Matt Fabry	mfabry@smcgov.org	415-508-2134		
SM County	Kathryn Cooke	kcooke@smcgov.org			
Other Attendees					
Dionara Dunsmore-Bertoni	San Mateo County Parks				
Salvador Vela	Frank and Grossman Landscpare Contractors	salvador@frankandgrossman.com	415-601-9705		
Micheline Chagniot	Frank and Grossman Landscpare Contractors	michelin@frankandgrossman.com	415-260-7167		
SM County	John Beall	jbeall@smcgov.org	650 -363-4200		X

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.

AGENDA

Landscape Integrated Pest Management (IPM) Workshop

(Sponsored by SMCWPPP Parks Maintenance and IPM Workgroup)
Wind Room, Library Community Center
1000 E. Hillsdale Blvd.
Foster City, CA 94404
Wednesday, March 9, 2016
11:00 a.m. – 3:00 p.m.

Lunch *Registration*	11:00 am – 11:30 am
Welcoming Remarks	11:30 am – 11:35 am
Pesticides and Water Quality Vishakha Atre, *EOA*	11:35 am – 11:45 am
IPM for Trees and Urban Landscapes, and Emerging Issues Igor Lacan, *UC Cooperative Extension*	11:45 am – 12:35 pm
Drip Irrigation for Municipal Landscapes and Trees Dino Viale, *Netafim USA*	12:35 pm – 1:15 pm
Break	1:15 pm – 1:25 pm
Living Soil: The Foundation for Healthy Plants Theresa Lyngso, *Lyngso Garden Supplies*	1:25 pm – 2:00 pm
Regulatory Update, Common Violations, and Safe Use and Mixing Jeremy Wagner, *San Mateo County Agriculture/Weights and Measures*	2:00 pm – 3:00 pm
Closing Remarks	3:00 pm – 3:05 pm

SMCWPP
IPM Parks Maintenance Workshop
Wednesday, March 9, 2016

A - E

Last Name	First Name	Title	Municpality	Initial
Acker	Alan		City of Menlo Park	
Aizawa	Brian		City of Redwood City	
Armenta	Martin	Park Maintenance	City of Foster City	
Barros	Dan	Parks Supervisor	City of San Bruno	
Bergstrom	Paul		Loral Landscaping	
Braas	Kelley		City of Daly City	
Bravo	Omar		City of Redwood City	
Bravo	Jose Antonio	Parks Maintenance	City of Redwood City	
Bronsan	Sean	Parks Maintenance	City of Belmont	
Camfield	Mark	Tree Maintenance Specialist	City of San Mateo	
Cardenas	Jorge	Supervisor	Loral Landscaping	J. C.
Chiamos	Peter		City of Foster City	
Cipres	Hector	Parks maintenance	City of Menlo Park	H. C. *
Clark	Aren	Parks Supervisor	City of Pacifica	AC
Cornell	Patrick	Parks	City of Belmont	PRC
Cronin	Kieran	Park's	City of Belmont	KC
Dahl	Clayton		Town of Hillsborough	
Delaney	James	Parks	City of Burlingame	
DelCarlo	Matthew	Park Ranger IV	San Mateo County Parks	
Deoliveira	Joao		City of San Bruno	
Deras	Miguel	Miguel Deras	City of Redwood City	
Disco	Bob		City of Burlingame	
Dowdell	Keith	Park maintenance	City of Menlo Park	
Drastrup	Dorte	Parks Manager	City of Foster City	
Dunsmore-Bertoni	Dinora	park Ranger III	San Mateo County Parks	DDB
Echecerria	James		City of Foster City	
Elissetche	Jean Pierre	Maintenance Worker	City of Pacifica	
Escoto	Greg	Park Ranger II	San Mateo County Parks	
Espinoza	Francisco	Francisco Espinoza	City of Redwood City	F. E
Espinoza	Jesus (Alex)		City of Redwood City	
Evans	Charles		City of Redwood City	

Parks

SMCWPP
IPM Parks Maintenance Workshop
Wednesday, March 9, 2016

F-M

Last Name	First Name	Title	Municpality	Initial
Fa	Matiu		City of Foster City	
Finocchiaro	Domenic		City of Burlingame	
Francis	Gary	Street Supervisor	Town of Hillsborough	GF
~~Fred~~	~~Matthew~~	~~Managing Arborist~~	~~City of San Mateo~~	
Friars	Joe	Maint. Team Leader	City of Brisbane	
Fukudome	Glenn		City of Redwood City	✓
Gonzalez	Rosalio		City of Redwood City	✓
Gostisha	Sheila		San Mateo County	
Gotthardt	Garrett		City of Foster City	
Haena	Todd		City of Foster City	
Harmison	Richard		City of Foster City	✓
Harmison	Robin		City of Foster City	
Hernandez	Martin		City of Redwood City	✓
Hollis	Mike		City of Redwood City	✓
Holtz	Richard		City of Burlingame	
Hummel	Gordon		City of Menlo Park	GH
Hurtado	Oswaldo		City of Menlo Park	O.H.
Keiffer	Ed		City of Menlo Park	EK
Kioa	Lava		City of Foster City	LK
Kraemer	Stephen	Park Ranger IV	San Mateo County Parks	
Louie	Donald	Maintenance Craftsworker	City of South SF	
Lundgaard	Ryan		County of San Mateo	RL
Mailau	Paul		City of Burlingame	
Matonis	Valerie	Parks Manager	City of Redwood City	
Mejia	Chris		City of Burlingame	CV.M.
Mitchell	Cynthia		City of Redwood City	✓
Moreno	Leonardo	Leonardo Moreno	City of Redwood City	✓
Munoz	Genaro		City of Foster City	✓

N- IW

SMCWPP
IPM Parks Maintenance Workshop
Wednesday, March 9, 2016

Last Name	First Name	Title	Municpality	Initial
Newman	John	Maintenance 1	City of Burlingame	J.N
Nicholls	Ed	Maintenance Worker II	City of San Bruno	E.M.N.
Niehuser	Paul	Lead Worker	City of San Bruno	P.N
Ochoa	Juan		City of Redwood City	
Palmini	Mari		City of San Bruno	
Penisini	Sharom		City of Redwood City	S.P.
Perez	Lorenzo		City of Menlo Park	
Perez-Rubio	Elga	Sr Leadworker	City of San Mateo	
Pimentel	Jason		Town of Hillsborough	
Rice	Dustin		Town of Hillsborough	
Rogers	Mark	Park Ranger	San Mateo County Parks	MR
Ryan	Matthew	LEAD WORKER	City of Foster City	MCR
Salazar	Raul		City of Foster City	RS
Schaffer	Kurt		City of Foster City	
Schroeder	Nazmeen		City of Foster City	
Smith	Miles		City of Foster City	MS
Stipp	Randy		City of Daly City	V
Templin	Jeff	Lead Gardener	City of Daly City	
Thompson	Tim	Parks Worker	City of San Bruno	
Thompson	Paul		City of Daly City	P.T.
Tschierchky	Zack		City of Burlingame	ZT
Valente	Matt		Town of Hillsborough	
Venezia	Daniel	Maintenance	City of San Bruno	
Ventura	Wilber		City of Foster City	W.V.
Vetter	Stephen	Maintenance Worker	City of San Bruno	SJV
Walsh	Rene	Parks Supervisor	City of San Bruno	
Weber	Daniel	Maintenance Worker II	City of Foster City	DW
Wheeler	Howard		Loral Landscaping	

SMCWPP
IPM Parks Maintenance Workshop
Wednesday, March 9, 2016

Last Name	First Name	Title	Municpality	Initial
Perez	Leno		City of Menlo Park	
Mooney	David		city of Menlo Park	

Evaluation Form Summary
Number of Attendees: 71
Number of Evaluations: 23

Landscape Integrated Pest Management Workshop

SMCWPPP Parks Maintenance and IPM
Wind Room, Library Community Center
1000 E. Hillsdale Blvd., Foster City, CA 94404
Wednesday, March 9, 2016
11:00 a.m. – 3:00 p.m.

What Did You Think of the Following Presentations?

1. **Pesticides and Water Quality** – Vishakha Atre, *EOA*

   16 very helpful **6** somewhat helpful **1** not helpful

2. **IPM for Trees and Urban Landscapes, and Emerging Issues** – Igor Lacan, *UC Cooperative Extension*

   19 very helpful **4** somewhat helpful **0** not helpful

3. **Drip Irrigation for Municipal Landscapes and Trees -** Dino Viale, *Netafim USA*

   17 very helpful **6** somewhat helpful **0** not helpful

4. **Living Soil: The Foundation for Healthy Plants -** Theresa Lyngso, *Lyngso Garden Supplies*

   16 very helpful **5** somewhat helpful **1** not helpful

5. **Regulatory Update, Common Violations, and Safe Use and Mixing -** Jeremy Wagner, *San Mateo County Agriculture/ Weights and Measures*

   17 very helpful **4** somewhat helpful **0** not helpful

Did this workshop meet your expectations? **22** Yes **0** No

Suggestions for future workshop topics:

- SOD update.
- Urban tree planting and design.
- Gopher control.
- Mole control.

Please submit at the end of the workshop. ***Thank You for Your Comments!***

General Comments:

- Great class.
- Great speakers.
- Great training with useful information.
- Very good.
- Thank you.
- Good workshop.
- Please have longer breaks between speakers.
- Great job!
- Wonderful!
- Lunch was excellent.

Please submit at the end of the workshop. ***Thank You for Your Comments!***

Appendix 10

- Trash Subcommittee Attendance List– FY 2015/16
- Litter Work Group Attendance List– FY 2015/16
- FY 2015/16 Litter Work Group Work Plan
- Litter Practices Recommendations for Solid Waste Franchise Agreements

Trash Work Group Meeting Attendance – FY 2015/16

Name	Agency	Phone	E-Mail	08/26/15	11/12/15	12/16/15	04/07/16	06/02/16
Steve Tyler	Town of Atherton	(650) 752-0541	styler@ci.atherton.ca.us					
Liz Ruess	Town of Atherton	(650) 752-0544	lruess@ci.atherton.ca.us					
Randy Ferrando	City of Belmont	(650) 595-7464	rferrando@belmont.gov	X	X			
Tim Murray	City of Belmont	(650) 222-6460	tmurray@belmont.gov	X		X		X
Leticia Alvarez	City of Belmont	(650) 595-7469	lalvarez@belmont.gov					
Dianne Lynn	City of Belmont	(650) 595-7425	dlynn@belmont.gov					
Brandon Tyler	City of Belmont	(650) 222-5240	btyler@belmont.gov	X		X	X	X
Matt Fabry	SMCWPPP Program Coordinator	(650) 599-1410	mfabry@co.sanmateo.ca.us				X	
Shelley Romriell	City of Brisbane	(415) 508-2128	sromriell@ci.brisbane.ca.us					
Keegan Black	City of Brisbane	(415) 728-7986	kblack@ci.brisbane.ca.us	X		X	X	X
Karen Kinser	City of Brisbane	(415) 508-2133	kkinser@ci.brisbane.ca.us					
Randy Breault	City of Brisbane	(415) 508-2131	rbreault@ci.brisbane.ca.us					
Jerry Flanagan	City of Brisbane	(415) 508-2137	jflanagan@ci.brisbane.ca.us					
Vincent Falzon	City of Burlingame	(650) 558-7679	vfalzon@burlingame.org					
Peter Gaines	City of Burlingame	(650) 558-7672	pgaines@burlingame.org					
John Baack	City of Burlingame		JBaack@burlingame.org					
Rob Mallick	City of Burlingame	(650) 558-7673	rmallick@burlingame.org					
Eva Justimbaste	City of Burlingame	(650) 342-3727	eva.justimbaste@veoliawaterna.com					
Rick Horne	City of Burlingame	(650) 558-7672	rhorne@burlingame.org					
Pamela Boyle Rodriquez	City of Burlingame	(650) 558-7381	pboylerodriguez@burlingame.org	X	X		X	X
Louis Gotelli	Town of Colma	(650) 333-0295	louis.gotelli@colma.ca.gov	X	X	X	X	X
Muneer Ahmed	Town of Colma	(650) 757-8894	Muneer.ahmed@colma.ca.gov			X	X	
Brad Donohue	Town of Colma	(650) 757-8888	Brad.donohue@colma.ca.gov					
Jeff Fornesi	City of Daly City	(650) 991-5752	jfornesi@dalycity.org					
John Fuller	City of Daly City	(650) 991-8039	jfuller@dalycity.org					
John Sanchez	City of Daly City	(650) 991-8265	jsanchez@dalycity.org	X	X	X	X	X
Michelle Daher	City of East Palo Alto	(650) 853-3197	mdaher@cityofepa.org					X
Jay Farr	City of East Palo	(650) 853-3105	jfarr@cityofepa.org					
Norm Dorais	City of Foster City	(650) 286-3279	ndorais@fostercity.org				X	
Larry Carnahan	City of Half Moon Bay	(650) 636-3753	larryc@hmbcity.com	X	X	X	X	X
Mark Lander	City of Half Moon Bay	(650) 522-2562	markl@csgengr.com			X	X	
Gary Francis	Town of Hillsborough	(650) 375-7506	gfrancis@hillsborough.net	X	X	X		

Name	Agency	Phone	E-Mail	08/26/15	11/12/15	12/16/15	04/07/16	06/02/16
Vanessa Marcadejas	City of Menlo Park	(650) 330-6768	VAMarcadejas@menlopark.org	X		X		
Heather Abrams	City of Menlo Park	(650) 330-6765	habrams@menlopark.org					
Brian Henry	City of Menlo Park	(650) 330-6799	bphenry@menlopark.org				X	X
Craig Centis	City of Millbrae	(650) 259-2369	ccentis@ci.millbrae.ca.us					
Mike Killigrew	City of Millbrae	(650) 259-2374	mkilligrew@ci.millbrae.ca.us	X	X		X	X
Heather Henwood	City of Millbrae	(650) 259-2374	hhenwood@ci.millbrae.ca.us	X	X			
Raymund Donguines	City of Pacifica	(650) 738-3767	donguinesr@ci.pacifica.ca.us	X				
Ron Fascenda	City of Pacifica	(650) 738-3762	Fascendar@ci.pacifica.ca.us	X				
Howard Young	Town of Portola Valley	(650) 851-1700 X214	hyoung@portolavalley.net					
Terrance Kwan	City of Redwood City	(650) 780-7466	TKyaw@redwoodcity.org					
Adrian Lee	City of Redwood City	(650) 780-7468	alee@redwoodcity.org	X				X
Vicki Sherman	City of Redwood City	(650) 780-7468	vsherman@redwoodcity.org					X
Jim Burch	City of San Bruno	(650) 616-7179	jburch@sanbruno.ca.gov					
Robert Wood	City of San Bruno	(650) 616-7046	rwood@sanbruno.ca.gov					
Ted Chapman	City of San Bruno	(650) 616-7169	TChapman@sanbruno.ca.gov	X			X	X
Lou Duran	City of San Carlos	(650) 743-6769	lduran@cityofsancarlos.org					
Rick Viles	City of San Carlos	(650) 863-6782	rviles@cityofsancarlos.org					
Sarah Scheidt	City of San Mateo	(650) 522-7385	sscheidt@cityofsanmateo.org	X	X		X	X
Roxanne Murray	City of San Mateo	(650) 522-7346	rmurray@cityofsanmateo.org	X	X	X	X	
Kristine Corneillie	LWA/City of San Mateo	(408) 261-3996	KrisC@lwa.com					
Rob Lecel	City of So. San Francisco	(650) 829-3882	rob.lecel@ssf.net					
Andrew Wemmer	City of So. San Francisco	(650) 829-3883	andrew.wemmer@ssf.net	X	X	X	X	X
Braden Christensen	City of So. San Francisco	(650) 829-3883	braden.christensen@ssf.net				X	
Julie Casagrande	County of San Mateo - DPW	(650) 599-1457	jcasagrande@co.sanmateo.ca.us	X	X	X	X	X
Dewayne Johnson	County of San Mateo - DPW	(650) 222-3125				X		
Gordon Tong	County of San Mateo	(650) 363-4159	gtong@smcgov.org	X				
Diana Shu	County of San Mateo		dshu@co.sanmateo.ca.us					
Lillian Clark	County of San Mateo		lclark@co.sanmateo.ca.us					
Cara Bautista	County of San Mateo	(650) 363-4125	cxbautista@smcgov.org					
Stephen Stolte	County of San Mateo	(650) 363-4133	sstolte@smcgov.org					
Andrea Chow	County of San Mateo	(650) 363-4133	achow@smcgov.org				X	X
Tim Swillinger	County of San Mateo-Environmental Health	(650) 372-6245	tswillinger@co.sanmateo.ca.us					

Name	Agency	Phone	E-Mail	08/26/15	11/12/15	12/16/15	04/07/16	06/02/16
James Counts	SMC Mosquito and Vector Control District	(650) 642-4846	james@smcmad.org					
Chindi Peavey	SMC Mosquito and Vector Control District	(650) 344-8592	cpeavey@smcmad.org					
Dong Nguyen	Town of Woodside	(650) 851-6790	dnguyen@woodsidetown.org					
Katherine Sheehan	CSG Consultants	(650) 522-2506	katherines@csgengr.com	X				
Chris Sommers	EOA, Inc.	(510) 832-2852 X109	csommers@eoainc.com	X	X	X	X	X
John Fusco	EOA, Inc.	(510) 832-2852 X130	jrfusco@eoainc.com	X	X	X	X	X
Peter Schultze-Allen	EOA, Inc.	(510) 832-2852 X128	pschultze-allen@eoainc.com				X	
Kristin Kerr	EOA, Inc.	(510) 832-2852 X122	kakerr@eoainc.com			X		
No. Attending				**24**	**14**	**17**	**23**	**19**

San Mateo Countywide Water Pollution Prevention Program (SMCWPPP) 2015-16

Litter Work Group

Name (e-mail)	Phone	Agency	17-Aug	24-Nov	15-Jan	4-Apr
Matt Fabry mfabry@smcgov.org	650-599-1419	CCAG/SMCWPP		Yes		
Diane Lynn dlynn@belmont.gov	650-595-7425	City of Belmont	Yes			
Randy Ferrando rferrando@belmont.gov		City of Belmont	Yes			
Keegan Black kblack@ci.brisbane.ca.gov	415-508-2131	City of Brisbane		Yes	Yes	Yes
Pamela Boyle Rodriguez pboylerodriguez@burlingame.org	650-558-7381	City of Burlingame	Yes	Yes		
Michelle Daher mdaher@cityofepa.org	650-853-3197	City of East Palo Alto	Yes		Yes	
Shelly Reider sreider@ci.millbrae.ca.us	650-259-2444	City of Millbrae	Yes	Yes		
William Li WLi@sanbruno.ca.gov	650-616-7069	City of San Bruno	Yes			
Lou Duran lduran@cityofsancarlos.org		City of San Carlos	Yes			
Roxanne Murray rmurray@cityof sanmateo.org	650-522-7346	City of San Mateo	Yes	Yes		Yes
Andrew Wemmer awemmer@southsf.org	650-829-3883	City of South SF	Yes	Yes	Yes	
Lillian Clark lclark@smcgov.org	650-599-1447	San Mateo County	Yes		Yes	
Julie Casagrande jcasagrande@smcgov.org	650-599-1457	San Mateo County Public Works	Yes	Yes		
Cliff Feldman cfeldman@rethinkwaste.org	650-802-3502	Rethink Waste		Yes		Yes
Gino Gasparini ggasparini@recology.com	650-598-8254	Recology-SM County	Yes	Yes	Yes	Yes
Mia Rossi mrossi@recology.com	650-598-8232	Recology-SM County	Yes	Yes		
Monica Devincenzi MDevincenzi@republicservices.com	650-756-1130 x224	Republic Services	Yes	Yes		
Barbara Bernardini barbarab@ssfscavenger.com	650-589-4020 x105	South SF Scavenger		Yes	Yes	
Susan Kennedy skennedy@ssfscavenger.com		South SF Scavenger	Yes	Yes	Yes	Yes
Sabrine Bortol		South SF Scavenger	Yes			
Teresa Montgomery teresa@ssfscavenger.com		South SF Scavenger	Yes			Yes
Chris Sommers csommers@eoainc.com	510-832-2852 x 109	EOA Inc.	Yes			
Peter Schultze-Allen pschultze-allen@eoainc.com	510-832-2852 x 128	EOA Inc.	Yes	Yes	Yes	Yes

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
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SMCWPPP Litter Work Group

Proposed FY 2015/16 Work Plan

FINAL

September 30, 2015

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INTRODUCTION AND BACKGROUND

Trash Impacts on Water Bodies and Regulatory Responses

Trash (i.e., litter, floatables, gross pollutants, or solid waste) is a serious problem for watersheds where it presents an aesthetic nuisance, and a serious threat to aquatic life in creeks and the oceans. Data suggest that plastic trash in particular persists for hundreds of years in the environment and can pose a threat to wildlife through ingestion, entrapment, as well as harboring chemicals potentially harmful to the aquatic environment. Types of trash commonly observed in watersheds and water bodies include food and beverage containers (e.g., plastic bags and bottles) and packaging, cigarette butts, food waste, construction and landscaping materials, furniture, electronics, tires, and hazardous materials (e.g., paint and batteries). The San Francisco Bay Regional Water Quality Control Board (Water Board) has listed multiple tributaries and shorelines as being impaired for trash.

In response to concerns about urban trash impacts on receiving water bodies in the San Francisco Bay area, in 2009 the Water Board included trash reduction requirements in the Municipal Regional Stormwater (MRP) National Pollutant Discharge Elimination System (NPDES) Permit for Phase I communities in the Bay area (Order R2-2009-0074.) These provisions require applicable Bay Area municipalities (Permittees) to reduce trash from their Municipal Separate Storm Sewer Systems (MS4s) by 40 percent before July 1, 2014, 70 percent by 2017, and to a point of "no adverse impacts" to water bodies by 2022.

Trash Sources and Pathways

Trash in San Francisco Bay Area creeks and shorelines originates from a variety of sources: pedestrian litter, waste containers, illegal dumping on land areas, and litter from vehicles. Pedestrian litter includes trash sources from high traffic areas near businesses and schools, transitional areas where food/drinks are not permitted (e.g. bus stops), and from public or private special events with high volumes of people. Inadequate waste container management includes sources such as overflowing or uncovered containers and dumpsters as well as the dispersion of household and business-related trash and recycling materials before, during, and after collection. On-land illegal dumping of trash is related to a variety of societal issues including construction activity, inadequate collection services and homeless encampments. Trash from vehicles occurs due to littering from automobiles and uncovered loads of material being transported to transfer stations, processing facilities and landfills.

Types of Trash Control Measures

SMCWPPP Permittees are attempting to address trash load reduction requirements outlined in the MRP by implementing a number of control measures designed to significantly reduce trash in local creeks and the Bay. Control measures implemented to-date include:

- Installation and maintenance of trash capture devices that intercept trash once in the storm drain system;
- Adoption and enforcement of product-related ordinances, such as single-use plastic bag bans;
- Enhanced street sweeping;
- Strategic placement and selection of public trash containers;
- Improvements to inadequately-sized or serviced private containers/bins;
- Public outreach and education campaigns;
- On-land cleanups and illegal dumping prevention;
- Enhanced storm drain inlet maintenance; and,
- Creek and shoreline cleanups and prevention programs.

SMCWPPP Trash Subcommittee and Litter Work Group

The San Mateo Countywide Water Pollution Prevention Program (SMCWPPP) was established in 1990 to reduce the pollution carried by stormwater into local creeks, the San Francisco Bay, and the Pacific Ocean. The program is a partnership of the City/County Association of Governments (C/CAG), each

incorporated city and town in the county, and the County of San Mateo, which share a common municipal stormwater NPDES permit. The SMCWPPP Technical Advisory Committee (TAC) functions as the decision-making body for routine program activities and provides oversight and guidance to five subcommittees.

The SMCWPPP Trash Subcommittee assists member agencies with the implementation of new or enhanced trash control measures and actions required by the MRP. The Trash Subcommittee generally meets four to six times a year. In FY 2013-14, the Subcommittee recommended that a work group be formed to enhance coordination between representatives from the local hauling community and municipal staff focused on stormwater and trash management.

In response, the SMCWPPP Litter Work Group began meeting on regular basis in March of 2014. The meetings are attended by representatives from: Recology San Mateo and South San Francisco Scavenger Company; Rethink Waste (the South Bayside Waste Management Authority); stormwater and trash program municipal staff; and community members and consultants working on litter reduction efforts both in Santa Clara County and San Mateo County. The goals of the Litter Work Group are to collectively identify opportunities to reduce the contributions of litter generated from disposal, collection-associated sources and illegal dumping; educate the public and those involved with litter control efforts; and to coordinate and share information with the Zero Litter Initiative (ZLI) in Santa Clara County.

Work Group Tasks Completed in Previous Fiscal Years

The Litter Work Group completed the following task in previous fiscal years:

- The Work Group coordinated the 1st Annual Litter Roundtable event in June 2014 that focused on various aspects of container management.

- At Work Group meetings held between August 2014 and May 2015, the Work Group discussed and prioritized issues for the 2nd Roundtable Event. Attendees representing the City of San Mateo, County of San Mateo, City of East Palo Alto, City of Brisbane, City of South San Francisco, Recology San Mateo, South San Francisco Scavenger, South Bayside Waste Management Authority (Re-Think Waste) and SMCWPPP were present at the meetings.

- The Work Group organized the County's 2nd Annual Litter Roundtable event for municipal staff and waste hauling company staff. The meeting was held on June 24, 2015 at the San Mateo Public Library and focused on commercial waste container management. The thirty-one attendees included municipal staff and their respective waste haulers. Using a five-step guided discussion with a matrix of issues for reducing litter focusing primarily on commercial waste container management issues, the attendees outlined possible outreach efforts for their community and through dialogue, learned about the existing programs from their haulers.

WORK PLAN OBJECTIVES AND TASKS

To assist municipalities with achieving the 70% and 100% trash/litter reduction goals in the MRP, the SMCWPPP Trash Committee and Litter Work Group developed this work plan to achieve the following objectives in FY 15-16:

- **Improve Waste Storage** - Most properties have collection services for disposing of materials generated on-site. Those services are usually contracted by the municipality through a franchise agreement with a collection company. When containers for those materials are not sized correctly, overflows can lead to litter before, during or after the servicing of those containers by collection companies. Additionally, municipalities provide the public with the convenience of easy disposal of materials by positioning publically maintained containers in pedestrian areas and emptying those cans on a regular basis. Often franchised service providers are contracted to empty the containers on a given frequency.

- **Improve Collection and Transportation Practices** - Vehicles used to transport materials, either to a transfer station, processing location or a landfill, can disperse litter into the environment if the vehicle does not cover the load.

- **Reduce Illegal Dumping** - Municipalities and their franchised collection companies often work together to reduce and clean up incidences of illegal dumping of disposed materials on public property. Illegal dumping on private property is usually referred to municipal code enforcement officers who contact the private property owner and require the owner to abate the material.

- **Educate Targeted Sectors of the Community on these Issues** - Coordinate with the SMCWPPP Public Information and Participation (PIP) Subcommittee on the investigation of potential enhanced outreach efforts at schools, multi-family homes, and business communities.

To achieve these objectives and address the recommendations[1] from attendees that participated in the 2nd Roundtable event, the SMCWPPP Trash Committee and Litter Work Group propose to conduct the following tasks in FY 2015-16:

1. Mapping of Public and Private Container Overages and On-land Illegal Dumping

A. Private Container Overage Mapping – SMCWPPP will collect data from the Solid Waste and Recycling Franchised Haulers and each requesting County/City program member agency to produce maps in GIS and PDF formats of waste container overages at businesses and homes in San Mateo County. Mapping of this data will allow for targeting and tracking of potential "Right Size, Right Service" outreach efforts and comparisons to trash generation levels depicted on existing Permittee trash generation maps. Typically customers receive some free collection of overages from the Franchised Haulers, but repeat overages lead to extra charges on the customer's bill. Mapping will also allow Permittees to better track improvements in litter conditions in these areas over time.

B. Public Container Overage Mapping – SMCWPPP will also collect data from the Solid Waste and Recycling Franchised Haulers and each requesting County/City program member agency to produce maps in GIS and PDF formats of waste container overages of publically-owned/maintained containers. Public containers are usually serviced on a set schedule by either municipal crews or the franchised haulers. These containers can occasionally overflow with increased usage or changes in neighborhood demographics or behavior. Work Group members with larger numbers of public containers expressed an interest in mapping these to help identify where additional containers or service may be needed, or where outreach efforts and/or enforcement actions could be programmed.

C. Illegal Dumping Incident Mapping – SMCWPPP will collect data from the Solid Waste and Recycling Franchised Haulers and each requesting City/County program member agency documents to produce maps in GIS and PDF formats of illegal dumping incidents on public property. Similar to public container overflows, incidents of illegal dumping can have geographical and spatial patterns that change with neighborhood characteristics, collection services and rates, enforcement levels, and development, construction and economic activity. Some Permittees have already mapped their illegal dumping incidents, which has led other jurisdictions to see the value in the Program providing assistance to coordinate this mapping effort. Data assessment and investigation will be an important aspect of this task.

[1] Recommendations included: 1) Develop a work plan with the Litter Work Group including prioritized recommendations for improving container management programs, metrics and issues with franchise agreement negotiations; 2) Coordinate and plan the 3rd Annual Litter Roundtable with municipal solid waste/recyclables haulers, in coordination with the San Mateo Countywide Recycling Committee and permittee staff; 3) Prepare Best Management Practices materials for SMCWPPP on the subject of Litter Reduction and Waste Hauling in San Mateo County; and 4) Continue to coordinate and share information with the Zero Litter Initiative in Santa Clara County.

2. **Review Existing Franchise Agreements and recommendations of best practices –** SMCWPPP in coordination with the Litter Work Group will produce a recommended list of franchise agreement best practices. The Program will compile the various agency franchise agreements and provide to the Litter Work Group for review with recommendations for best practices. Examples from other jurisdictions around the Bay Area will also be reviewed and used as needed to develop the best practice list. The Santa Clara Valley ZLI program has produced an example of this type of review, which will serve as a starting point for this SMCWPPP effort.

3. **Education, Communication and Outreach**

    A. **Investigate a Countywide Litter Campaign –** The Program will coordinate with the PIP Subcommittee to investigate options for a litter-focused outreach effort that includes a consistent message across different sectors. Branding and logos will be developed that can also be used for litter prevention efforts targeting businesses.

    B. **Investigate a Countywide Adopt-A-Block Litter Campaign** – The Program will coordinate with the PIP Subcommittee on the investigation of existing programs in the City of Oakland and the City of San Mateo as model "Adopt-A-Block" litter reduction effort. The goal of this task is to explore the expansion of the model Adopt-A-Block campaign to countywide.

4. **Litter Work Group Support**

    A. **Work Group Facilitation –** The Program will continue to convene meetings, provide agendas and summaries.

    B. **Roundtable Facilitation –** The Program will coordinate one annual Roundtable event with the focus of the event determined by the Litter Work Group.

Estimated Costs and Schedule

The proposed work plan schedule and associated cost estimates are included in Table 1. Depending on the complexities and challenges associated with implementation of the tasks described in the work plan, the proposed schedule may be revised. Costs associated with each task are estimates and some have ranges to reflect that more definition of each task will be necessary once the work plan or a portion thereof is approved by the TAC.

Table 1. SMCWPPP Trash Committee and Litter Work Group Proposed FY 15-16 Tasks, Schedule and Estimated Costs.

Task #	Task	Description	Start Date	Complete Date	Estimated Program Cost
1. Information and Reporting of Overages and Illegal Dumping					
1.A	Private Container Overage Mapping	Produce maps in GIS and PDF formats of incidents of overages from private containers of disposed materials for each member agency.	January 2016	June 2016	$7-10,000
1.B	Public Container Overage Mapping	Produce maps in GIS and PDF formats of incidents of overages from public containers for each member agency.	January 2016	June 2016	$7-10,000
1.C	Illegal Dumping Mapping	Produce maps in GIS and PDF format of incidents of illegal dumping on public property for each member agency.	January 2016	June 2016	$7-10,000
2. Franchise Agreement Modifications					
2.A	Strategic Review of Franchise Agreements and Recommendations of Best Practices	Compile and review the various agency franchise agreements and make recommendations of best practices related to litter control.	October 2015	Dec 2015	$8-10,000
3. Education, Communication and Outreach					
3.A	Investigate a Countywide Litter Campaign	Coordinate with the SMCWPPP PIP Subcommittee on the development of a countywide outreach program.	January 2016	June 2016	$5,000
3.B	Investigate a Countywide Adopt-A-Block Litter Campaign	Coordinate with the SMCWPPP PIP Subcommittee on the development of a countywide Adopt-A-Block outreach effort.	January 2016	June 2016	$5,000
4. Litter Work Group Support					
4.A	Work Group Facilitation	Convene quarterly meetings, provide agendas and summaries.	October 2015	June 2016	$10,000
4.B	Roundtable Facilitation	Coordinate annual Roundtable event.	January 2016	June 2016	$7,500
			Total Cost	$56,500-$67,500	

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.

SMCWPPP Litter Work Group

Litter Practices Recommendations for Solid Waste Franchise Agreements

January 19, 2016

INTRODUCTION AND BACKGROUND

Trash Impacts on Water Bodies and Regulatory Responses

Trash (i.e., litter, floatables, gross pollutants, or solid waste) is a serious problem for watersheds where it presents an aesthetic nuisance, and a serious threat to aquatic life in creeks and the oceans. Data suggest that plastic trash in particular persists for hundreds of years in the environment and can pose a threat to wildlife through ingestion, entrapment, as well as harboring chemicals potentially harmful to the aquatic environment. The San Francisco Bay Regional Water Quality Control Board (Water Board) has listed multiple tributaries and shorelines as being impaired for trash.

In response to concerns about urban trash impacts on receiving water bodies in the San Francisco Bay area, in 2009 the Water Board included trash reduction requirements in the Municipal Regional Stormwater (MRP) National Pollutant Discharge Elimination System (NPDES) Permit for Phase I communities in the Bay area (Order R2-2009-0074.) These provisions require applicable Bay Area municipalities (Permittees) to reduce trash from their Municipal Separate Storm Sewer Systems (MS4s) by 40 percent before July 1, 2014, 70 percent by 2017, and to a point of "no adverse impacts" to water bodies by 2022. MRP 2.0 (Order R2-2015-0049), adopted on November 19, 2015, continues to require the reductions in trash.

Trash Sources and Pathways

Trash in San Francisco Bay Area creeks and shorelines originates from a variety of sources: pedestrian litter, waste containers, illegal dumping on land areas, and litter from vehicles. Inadequate waste container management includes sources such as overflowing or uncovered containers and dumpsters as well as the dispersion of household and business-related trash and recycling materials before, during, and after collection. Trash from vehicles occurs due to littering from automobiles and uncovered loads of material being transported to transfer stations, processing facilities and landfills.

SMCWPPP Litter Work Group

The San Mateo Countywide Water Pollution Prevention Program (SMCWPPP) was established in 1990 to reduce the pollution carried by stormwater into local creeks, the San Francisco Bay, and the Pacific Ocean. The program is a partnership of the City/County Association of Governments (C/CAG), each incorporated city and town in the county, and the County of San Mateo (i.e., member agencies), which share a common municipal stormwater NPDES permit.

The SMCWPPP Litter Work Group began meeting on regular basis in March of 2014. The meetings are attended by representatives from: Recology San Mateo County; South San Francisco Scavenger Company; Republic Services; Rethink Waste (the South Bayside Waste Management Authority); stormwater and trash program municipal staff; and community members and consultants working on litter reduction efforts both in Santa Clara County and San Mateo County. The goals of the Litter Work Group are to collectively identify opportunities to reduce the contributions of litter generated from disposal, collection-associated sources and illegal dumping; educate the public and those involved with litter control efforts; and to coordinate and share information with the Zero Litter Initiative (ZLI) in Santa Clara County.

REVIEW OF BEST PRACTICES AND RECOMMENDATIONS FOR LITTER MANAGEMENT

SMCWPPP member agencies are attempting to address trash load reduction requirements outlined in the MRP by implementing a number of control measures designed to significantly reduce trash in local creeks and the Bay. This report focuses on control measures related to the storage, collection and transportation of municipal solid waste, recyclable and compostable materials, and the franchise agreements that haulers and agencies have established to govern those services.

To assist member agencies with achieving reduction goals in the MRP, the Work Group developed this report with the following objective:

- **Recommend Best Litter Management Practices to the South Bayside Waste Management Authority (SBWMA) and the SMCWPPP Member Agencies** – Several SMCWPPP member agencies participate in the SBMWA to coordinate waste management in South San Mateo County. In the Spring of 2016, the SBWMA will begin to discuss the process by which a franchise hauler will be obtained and potential modifications to waste hauling practices and agreement specifications. The remaining member agencies contract directly with waste haulers outside of the SBWMA, and the terms of these agreements are also periodically renegotiated or new agreements are executed. This report is intended to provide a menu of best practices for litter control that should be considered during future discussions regarding the revision of existing agreements or the development of new agreements between SMCWPPP member agencies and franchise waste haulers.

The Litter Work Group has produced this report using the following process:

- Review franchise agreements of municipalities in San Mateo County, other jurisdictions in the Bay Area, and best practices identified from the report produced by the Zero Litter Initiative in Santa Clara County;
- Identify and summarize best practices for solid waste franchise agreements to better address litter issues that may impact stormwater quality; and
- Compile a menu of recommendations for best practices that may be incorporated into future franchise agreements or when making revisions to existing agreements.

The franchise agreements between various hauling companies and the municipalities of San Mateo Company were reviewed (see Table 1). Additionally, excerpts from the Best Management Practices Report from the Zero Litter Initiative (ZLI) from the Santa Clara Valley Urban Run-off Pollution Prevention Program (SCVURPPP) were identified for inclusion in the report.

Table 1. Agencies, Haulers and Franchise Agreements in San Mateo County[1]

Municipality/Agency/District	***Franchisee or Hauler***	**Agreement Reviewed?**
City of Daly City	Allied Waste of DC	Yes
City of Colma	Allied Waste of DC	Yes
Broadmoor	Allied Waste of DC	Yes
City of Half Moon Bay	Allied Waste of HMB	Yes
San Mateo County - La Honda, Pescadero etc.	Allied Waste of HMB	No Agreement
Town of Portola Valley	Greenwaste Recovery	No
Town of Woodside	Greenwaste Recovery	No
City of Pacifica	Recology of the Coast	Yes
City of San Bruno	Recology San Bruno	No
Town of Atherton	Recology SMC	Yes[2]
City of Belmont	Recology SMC	Yes[2]
City of Burlingame/Veolia	Recology SMC	Yes[2]
City of East Palo Alto	Recology SMC	Yes[2]
City of Foster City	Recology SMC	Yes[2]
City of Menlo Park	Recology SMC	Yes[2]
City of Redwood City	Recology SMC	Yes[2]
City of San Carlos	Recology SMC	Yes[2]
City of San Mateo	Recology SMC	Yes[2]
Town of Hillsborough	Recology SMC	Yes[2]
San Mateo County - North Fair Oaks and Uninc.	Recology SMC	Yes[2]
City of Millbrae	SSF Scavenger	Yes
City of South San Francisco	SSF Scavenger	Yes
City of Brisbane	SSF Scavenger and Recology	Yes - SSFSC

[1] The franchise agreements listed above will be posted on the Member Agency webpage on the Program website at: http://flowstobay.org/privatetrash

[2] These municipalities are member agencies of the South Bayside Waste Management Authority and all use the same base model agreement for services. Therefore only a subset of the agreements was reviewed. However, the franchise fees for each jurisdiction do vary and so a table of those fees was analyzed for recommendations.

Summary of Recommendations for Litter Management

In 1989, Assembly Bill 939 (the Integrated Waste Management Act) was signed into law requiring California municipalities, and subsequently their franchised haulers, to reduce the amount of materials being sent to landfill. In the quarter of a century since that landmark bill, many franchise agreements have incorporated the requirements of that law by including new provisions to increase recycling and composting services, monitor and reduce contamination, manage special types of waste such bulky items, household hazardous waste and e-waste, and educate the public. Additionally, with the advent of climate change, additions to recent agreements include language to reduce the carbon footprints of franchisee operations and use alternative fuels.

This report summarizes recommended practices for reducing the problem of litter, spurred by the requirements in Bay Area municipal stormwater permit and the growing awareness of the large amounts of plastic are accumulating in the world's oceans and other water bodies, potentially impacting aquatic resources. It is likely that provisions in existing franchise agreements related to diversion and contamination can be modified or expanded for the purpose of controlling and reducing litter.

The recommended practices for litter management are summarized in this section. Best practices are grouped by topic area and further detailed in Table 2.

1. **Collection**
    - **A. Service Days -** The days of the week that services are offered for collection, processing, transfer and disposal as well as services open to the public or others at facilities. Offering Saturday and Sunday collection services can be an important way to reduce overloading of containers over the weekend – especially for restaurants and other similar businesses that are busiest during those times.
    - **B. Container Management** - Procedures for managing and reducing the occurrence of over-full collection containers. These include identifying, reporting, tagging, collecting, charging, educating, training, mapping, assessing and prioritizing.
    - **C. Equipment Standards** - Requirements to use and maintain collection vehicles and containers that prevent litter generation.
    - **D. Public Litter Containers** - Strategic placement, selection, mapping, servicing of public trash containers and effects of scavenging.
    - **E. Route Audits** - On a regular basis, routes should be assessed for service issues such as overages, chronic or acute litter problems and levels of service verified for billing purposes.
2. **Right Size – Right Service**
    - **A. Material Service Levels** - Matching the right volume and frequency of service for each stream of material with each customer's actual generation results in less overage and more environmental benefit – towards both zero waste and zero litter.
    - **B. Rate Structure** - Most rate structures are based primarily on the collection of solid waste and sometimes secondarily on the collection of other materials that are not disposed in landfills. This can lead to disincentives for the franchisee to increase diversion and the right-sizing of service levels. More details on this concept are in Table 2.
    - **C. Coordination and Communication** - In order to most effectively use limited funds available for outreach and technical service, communication between the hauler, municipality and customer needs to be well coordinated.

3. **Outreach and Public Education**

    A. **Coordination on Litter Campaigns** - Integrating, understanding and coordinating the needs of the franchisee, municipality and customer are key elements of a successful outreach and public education program. The campaign can be integrated with other litter efforts and regulations such as with schools.

4. **Training of Franchisee Staff**

    A. **Litter Control Training (Drivers)** - Regular training on driver safety is an important part of every franchise agreement and can include training on litter control.

    B. **Litter Control Training (Service Representatives, Supervisors and Dispatch Staff) -** Training of staff who oversee drivers, communicate with the public or coordinate between office and field functions.

5. **Franchise Fees Providing Funding for Litter Control Programs**

    A. **Line Item Support** - Some jurisdictions have inserted line item franchise fees into their agreements to support litter control related programs.

6. **Financial Incentives and Disincentives**

    A. **Litter Control Effort Incentives** - Some franchise agreements have a new type of section with financial rewards related to goals that are important to the jurisdiction such as diversion and/or contamination. These sections can be modified to control litter.

    B. **Litter Control Effort Disincentives** - Some franchise agreements have a new type of section with financial penalties related to goals that are important to the jurisdiction such as diversion and/or contamination. These sections can be modified to control litter.

7. **Liquidated Damages**

    A. **Litter Control Damages** - Typically a franchise agreement will have a section on Liquidated Damages to ensure that various sections of the agreement can be enforced and that if performance criteria are not met, damages are assessed. Agreements should contain specific criteria for litter control practices in the Liquidated Damages section.

Table 2. Recommend Litter Reduction Practices for Future Franchise Agreements.

Task#	Practice Description	Recommended Practices	Sample Language	Source Document
1. Collection				
1.A	**Service Days -** The days of the week that services are offered for collection, processing, transfer and disposal as well as services open to the public or others at facilities.	1. Include Saturday and Sunday hours of operation to allow businesses and individuals access to services on the weekends when they may be most busy. This can be a key factor in mitigating overflowing containers on Mondays where no Sunday service is offered.	1.a. Recology San Mateo County's contract has services for Multi-Family and Commercial customers on Saturday and Sunday. 1.b. SSF Scavenger provides Saturday service to some commercial customers and the facility is open to the public on Saturdays.	1.a. Recology SMC Agreement 1.b. SSF Scavenger Agreement
1.B	**Container Management -** Identifying, reporting, tagging, collecting, charging, educating, training, mapping, assessing and prioritizing	1. Tagging, Collecting and Billing for Overages, Spills and Litter - Drivers should collect and/or clean up the overage, spill or litter and after a pre-determined number of overages in a given time period charge the customer.	1.a. Contractor shall direct its employees to Collect an Overage on two (2) occasions each Rate Year at no additional cost to Customer. Contractor must provide a notice to Customer documenting the Overage in order to count the Overage Collection towards the allocated two (2) per Rate Year for each Customer. Customers that place an Overage for Collection for a third and subsequent events, may **[will]**[3] be assessed an Overage fee by Contractor if Contractor documents said Overage with a photograph and sends the Customer a letter within two (2) Business Days notifying them of the Overage Collected. 1.b. The Contractor shall clean up litter in the immediate vicinity of any Solid Waste, Recyclable Materials, Organic Materials, or Yard Trimmings storage area (including the areas where collection containers or bins and debris boxes are placed for collection) <u>whether or not Contractor has caused the litter</u>. Contractor shall notify the Customer and the City after the second such occurrence at any specific Premises in a calendar year. City may require the Customer to accept and pay for increased service (i.e., a larger bin or more frequent collections).	1.a. Recology SMC Agreement 1.b. ZLI Best Practices Report – Palo Alto and Greenwaste Recovery Agreement
		2. Drivers must photograph [a. all /b. residential /c. commercial/d. flagrant] set-outs where the container lids <u>are not closed</u>, and at locations where there is litter on the ground adjacent to the collection container when the driver arrives at the customer's set-out location. These photographs must be relayed to the company's [a. hauler customer service representative, b. hauler route supervisor /c. city contract manager]	2. Third Non-Compliance Occurrence - Driver Responsibilities: Container service will be delayed until contact has been made to the Customer by Scavenger customer service. Driver will radio Scavenger Dispatch/Customer Service. Driver will take photo.	2. ZLI Best Practices Report and Brisbane-SSFSC Agreement
		3. Close lids after service and clean up litter during collection	3. In all multi-family collections, drivers always ensure the lid of the bin is closed before leaving the area and will clean up any litter as a result of the collection activity.	3. Daly City–Allied Agreement

[3] The language in brackets "[will]" has been suggested by the Work Group and does not appear in the source document.

Table 2. Recommend Litter Reduction Practices for Future Franchise Agreements.

Task#	Practice Description	Recommended Practices	Sample Language	Source Document
		4. Develop a Container Overage Management Program with procedures for municipal communication, customer notification and warnings, outreach materials, overage charges and litter cleanup issues.	4. No later than 90 days after the effective date of this Agreement, Scavenger Company shall develop a Trash Container Management Policy, which will be submitted to the City's Director of Public Works or City Engineer for review and approval. Said policy shall contain procedures for notification to the owner or user of trash containers when such containers are filled beyond their maximum closed-lid capacity, and after first-time warnings and provision of outreach material on alternatives to overfilling containers, may include charging an additional fee for the collection and disposal of solid waste from containers that are filled beyond maximum capacity and require Scavenger to manually mitigate ensuing safety or litter issues.	4. Brisbane–SSFSC Agreement
		5. Mapping of overages on a regular basis will help assess, evaluate and visually identify hot-spots for follow-up procedures.	5. The City of Oakland and Waste Management of Alameda County coordinate on the use of photo-documentation and mapping.	5. City of Oakland and Waste Management of Alameda County
		6. Technologies that automate photo documentation of overages with billing can reduce litter by improving the process and allowing the driver to stay out of the issue.	6.a. Waste Management of Alameda County uses the "Snap Shot" program of photo-documentation and overages to facilitate billing. 6.b. By July 1, 2017, when the 70% trash and litter reduction requirements of the Regional Water Quality Control Board take effect, all collection vehicles shall have cameras mounted at strategic locations to assist the driver in documenting overfull containers and litter on the customer's property when the truck arrives; and to help identify the cause of litter generated during the collection of garbage and recyclable materials. 6.c. Before July 1, 2017, and as soon as feasible, cameras shall be installed or used on collection vehicles along routes identified as problematic litter areas due to their proximity to waterways or trash hot spots.	6.a. Waste Management of Alameda County 6.b. ZLI Best Practices Report 6.c. ZLI Best Practices Report
1.C	Equipment Standards Policies related design, use and maintenance of containers and vehicles.	1. Equipment shall only be used that prevent litter generation and shall be maintained in good working order. All containers shall have lids or other mechanisms to seal the container during collection. Lids and seals shall be repaired/replaced within a set time.	1. The Franchisee shall maintain all containers in good working order with lids that completely close and so that the container does not leak. Bin lids must be repaired or replaced within [a. 24-hours / b. 7 days / c. one month] of damage being reported.	1. ZLI Best Practices Report
		2. All loads shall be covered or tarped during transportation.	2.a. Covering of Loads. Contractor shall cover all open Drop Boxes with an Agency-approved cover, at the Collection location before transporting materials to the Designated Transfer and Processing Facility.	2.a. Recology SMC Agreement 2.a. SSF Scavenger Agreement

Table 2. Recommend Litter Reduction Practices for Future Franchise Agreements.

Task#	Practice Description	Recommended Practices	Sample Language	Source Document
			2.b. Transfer station and Landfill scale house operators shall check that incoming and outgoing open loads are tarped and shall not allow vehicle operators with un-tarped open loads to enter or exit the facility.	2.b. None
		3. Vehicles shall be equipped and operated with best litter management practices and designs.	3. Vehicles shall be designed and operated so as to prevent collected materials from escaping from the vehicles. All hoppers shall be closed on top and on all sides with screening material to prevent collected materials from leaking, blowing or falling from the vehicles.	3. ZLI Best Practices Report
1.D	Public Litter Containers Efficient, regular collection of material from containers in the public realm	1. Decrease frequency of overages at public litter containers	1. Big Belly Solar Compacting Public Litter Containers compact the litter so capacity is increased.	1. Several municipalities now use Big Belly litter cans and/or require their hauler to install and service them
		2. Assign staff to clean up litter around containers 3. Assign staff to clean up the complete inside contents of the container including around any liner within the container.	2. Collection personnel shall carry cleanup equipment and shall clean up any spilled or dropped material and any litter within fifteen (15) feet of the Container location or route to the Collection equipment. 3. Collection personnel shall carry cleanup equipment and shall clean up any spilled or dropped material and any litter within fifteen (15) feet of the Container location including within the container itself between any liner and the exterior of the container, or route to the Collection equipment.	2. Daly City–Allied Agreement 3. None
		4. Use technology to increase efficiency and reduce overages	4. Big Belly Solar Compacting Public Litter Containers have GPS systems that alert the collector when the container is full. Overtime labor savings can also be realized for containers that were previously serviced on weekends and had less capacity.	4. See #1 above
		5. Mapping of locations with repeat overages	5. None.	5. None
		6. Litter-reducing containers	6. Contractor and Municipality will work collaboratively to select a public litter container best designed and constructed to reduce litter including issues related to scavenging, wind, animals and rain.	6. None
1.E	Route Audits Assessment of service issues such as overages, chronic or acute litter problems and levels of	1. Auditing of routes should occur on a regular basis and by request of the municipality (and not more frequently than reasonable.)	1. City may conduct or require that Contractor shall conduct a route audit for each of Contractor's Collection routes by type of material Collected. The period in which the audit is conducted shall be set by City. City reserves the right to determine which routes will be audited in a particular week and, if City exercises this right, shall notify Contractor of the routes not less than seventy-two (72) hours in advance.	1. Daly City–Allied Agreement

Table 2. Recommend Litter Reduction Practices for Future Franchise Agreements.

Task#	Practice Description	Recommended Practices	Sample Language	Source Document
	service verified for billing purposes.	2. Audits should include the number of overages on the audit day and identify repeat overage customers, for possible Right-Sizing.	2. The route audits shall include the following information for each Collection route: For Collection routes, the number of Service Recipients by category which set out overages and the total number of overages Collected.	2. Daly City–Allied Agreement
2. Right Size – Right Service				
2.A	Material Service Levels Matching the right volume of service for each stream of material for each customer's needs results in less overage and more environmental benefit.	1. When matching the volume of materials generated with the correct container size and service frequency, integrate Zero Waste goals with Litter control requirements.	1. The City of Oakland coordinates with their hauler, Waste Management of Alameda County (WMAC), using GIS information, overage data, trash management plan information and other data to integrate inspections and enforcement of zero waste and stormwater programs.	1. City of Oakland – WMAC
		2. When overages occur on a regular basis, the customer can be contacted and right sizing of the services adjusted. Automatic increases in the Solid Waste service level should be avoided unless that is the only service subscribed.	2. The Franchisee shall communicate with the City about all problem locations with consistently overfull containers and provide customer account contact information. Depending on the contract, the City or the Franchisee will follow up to contact the customer and adjust the service level for the amount of waste generated at the property (right-size service).	2. ZLI Best Practices Report
2.B	Rate Structures Agreements should incentivize diversion and Right-Sizing of services. This issue can be summarized as follows: under most rate structures currently, zero waste means zero revenue. As the proportion of solid waste to the total of all materials collected, processed and disposed of is reduced, the rate structure must change to support the costs or revenue will be reduced.	1. Rate structures should be developed that do not reduce revenue as diversion increases. The structure should reflect the real costs of landfilling, including externalities that may not currently be included in the structure, actual costs for the processing of compostables and recyclables minus any revenue for the sale of those commodities, and the collection services expenditures for all streams of materials. This will require a public education campaign to change the current understanding that recycling and composting pay for themselves and do not have any costs. One challenge to the changing of rate structures includes the current commonly held belief by the public that recycling and composting pay for themselves and do not have any costs. The recent San Juan Capistrano Water Rate court case may also require a different approach to rate setting.	1. One solution that has been developed in San Francisco is to require a base subscription fee for service that is independent of the volume of materials collected - then each stream of materials collected can be charged for based on weekly service volume and added to the base fee. To incentivize diversion the total fee can be reduced by the diversion rate. But reduction to the total fee for service is limited to an amount needed to cover a minimum level of expense thereby protecting revenue and limiting the impact of diversion and Right-Sizing.	1. City/County of San Francisco Agreement with Recology SF
2.C	Coordination and Communication In order to most effectively use limited funds available for outreach and technical service,	1. In order to most effectively use limited funds available for outreach and technical service, communication between the hauler, municipality and customer needs to be coordinated.	1. Multi-Family Dwelling Promotion. Contractor shall provide adequate staff to work directly with Owners or property managers of Multi-Family Residential Complexes to implement the Single-Stream Targeted Recyclable Materials Collection services and to assess Customer service needs at least annually for each Multi-Family Residential Complex. The Contractor's implementation activities shall include, but not be limited to,	1. Recology SMC Agreement

Table 2. Recommend Litter Reduction Practices for Future Franchise Agreements.

Task#	Practice Description	Recommended Practices	Sample Language	Source Document
	communication between the hauler, municipality and customer needs to be coordinated.		the following tasks for each Multi-Family Residential Complex that subscribes to Single-Stream Targeted Recyclable Materials Collection services: - Site Assessments. Contractor shall meet in person with Owner or property manager to explain the Single-Stream Targeted Recyclable Materials Collection program and conduct an on-site assessment of Multi-Family Residential Complexes containing twenty (20) or more Residential units to determine the appropriate number and type of Solid Waste and Recyclable Materials Containers and the frequency of Collection. Contractor shall provide Containers for Single-Stream Targeted Recyclable Materials or Source Separated Targeted Recyclable Materials such as newspaper, cardboard, mixed paper, glass, aluminum, etc. depending on the needs of the Multi-Family Residential Complex. If practical, Contractor shall locate the Solid Waste and Recyclable Materials Containers in the same area so tenants carry materials to one location. Contractor shall also offer Recyclable Materials Carts for use in the mail area of the Premises. The site assessment shall be conducted by Contractor when Targeted Recyclable Materials Collection services are initially provided at a Multi-Family Residential Complex, and once every three (3) years thereafter. - Service Level Adjustments. Within five (5) Business Days of completing the site assessment or receiving a request from a Customer, Contractor shall adjust the Customer's service level by providing any Solid Waste or Recyclable Materials Containers needed for change in service, removing unneeded Containers, and revising the billing system to reflect the monthly Rate for the new service level. At the time new Containers are delivered or existing Containers are removed, the Contractor shall confirm that all Containers are properly labeled and shall provide public education signage for the Container areas and extra signs for public and common areas such as mail and laundry rooms, etc. - Preparation and Distribution of Public Education Materials. Contractor shall provide Owner or property manager with education materials developed by Agency or SBWMA which describe the requirements of the Recyclable Materials Collection program, including flyers, door hangers and Recycling Tote-Bags for distribution to tenants, signage for common areas such as mail rooms and laundry rooms, and move-in kits for new tenants.	
3. Outreach and Public Education				

Table 2. Recommend Litter Reduction Practices for Future Franchise Agreements.

Task#	Practice Description	Recommended Practices	Sample Language	Source Document
3.A	Controlling Litter Campaigns Integrating, understanding and coordinating the needs of the franchisee, municipality and customer are key elements of a successful outreach and public education program.	1. Consider a program for controlling litter similar to the ones used for controlling contamination. For litter control outreach efforts to work, there has to be financial incentives and performance standards to go along with the outreach efforts.	1. Contractor shall assist in controlling Contamination levels by helping to educate Customers on acceptable and non-acceptable materials, by monitoring the contents of Collection Containers and by refusing to Collect Containers of Targeted Recyclable Materials, Plant Materials and Organic Materials that appear to exceed the maximum contamination levels in Section 6.02 Table 1, all as and to the extent set forth in this Section 6.03.	1. Recology SMC Agreement
4. Training of Franchisee Staff				
4.A	Litter Control Training – Drivers Training of staff who operate vehicles of any kind.	1. Training on litter control and response should be added to regular driver safety training. Drivers should receive training related to billing, spills and overages and the environmental background for litter rules and regulations.	1. Monthly Drivers Safety Meetings - the September 2013 meeting will introduce drivers to the City's new Anti-litter ordinance (CMC 9.18.215) which covers prohibition of overfilled bins and uncontained debris.	1. ZLI Best Practices Report – Cupertino
			2. Environmental issues will be covered in depth during driver training, such as spill response procedures. Not only will procedures be reviewed in detail, but drivers will receive an explanation of what happens when environmental hazards are not appropriately responded to, such that they have an adequate frame of reference for the material.	2. ZLI Best Practices Report
			3. Contractor will discuss instances of repeated spillage not caused by it directly with the Waste Generator responsible and will report such instances to City in its monthly report filed in accordance with Section 6.03. City will attempt to rectify such situations with the Waste Generator if Contractor has already attempted to do so without success.	3. ZLI Best Practices Report – Sunnyvale
			4. Cities and Franchisees shall prepare or use prepared videos to instruct drivers on the importance of (1) cleaning up all litter generated during their collection activities and (2) reporting litter and overfull containers observed during their work day.	4. ZLI Best Practices Report
4.B	Litter Control Training – Service Representatives, Supervisors and Dispatch Staff Training of staff who oversee drivers, communicate with the	1. Customer Service Representatives (CSRs), Supervisors and Dispatch staff should receive training on litter control issues related to billing, spills and overages and the environmental background for litter rules and regulations.	1. Contract specifications inserted into franchise agreements requiring personnel to attend specific trainings. Cities can develop training messages cooperatively and training can be done by individual hauler sending key personnel to a regional training of each City can ensure training has occurred.	1. ZLI Best Practices Report

Table 2. Recommend Litter Reduction Practices for Future Franchise Agreements.

Task#	Practice Description	Recommended Practices	Sample Language	Source Document
	public or coordinate between office and field functions.			
5. Franchise Fees Providing Funding for Municipal Litter Control Programs				
5.A	Line Item Program Support One method for funding programs.	1. Some jurisdictions have inserted line item franchise fees into their agreements to support litter control related programs.	1. City of Belmont – Trash Management Device Funding City of East Palo Alto – Litter Control Funding City of South SF – Street Sweeping Funding	1. Recology SMC Agreement – Belmont and East Palo Alto 1. SSF Scavenger – City of SSF
6. Financial Incentives and Disincentives				
6.A	Financial Incentives Rewards for meeting franchise agreement goals.	1. These are financial rewards that can be tied to rate increases, increased revenue for the franchisee or extension negotiations. Rewards for reducing litter, cleaning up litter, right sizing of customers etc. can be integrated into the financial reward schemes that exist in some agreements.	1. An example that could be used is “Exhibit I – Contamination” but it could be modified for litter control.	1. Recology SMC Agreement
6.B	Financial Disincentives Penalties for not meeting franchise agreement goals.	1. These are financial penalties that can be tied to decreased revenue for the franchisee or extension negotiations. Fines for not reducing litter and cleaning up litter can be integrated into the financial penalty schemes that exist in some agreements. If customers are not right-sized correctly, diversion rates could go down causing other penalties depending on the agreement specifics. Liquidated damages are also used for this purpose. See #7 below.	1. An example that could be used is “Exhibit I – Contamination” but it could be modified for litter control.	1. Recology SMC Agreement
7. Liquidated Damages				
7.A	Liquidated Damages Fines on Franchisee can be assessed for failing to meet performance standards	1. If performance standards for litter control (as defined in the agreement) are not met, a Liquidated Damage assessment can be made. One example is related to the cleaning of litter generated during collection of materials and left behind after service. (not cleaned up by the driver as required.) The Liquidated Damages Table should identify the Event, the Performance Standard, the Definition of Complaint, the Tracking Method, and the Amount of the Liquidated Damage. The data is reported on a regular basis to the jurisdiction and then the determination of whether liquidated damages should be assessed or not is made.	1. The following table lists the events that constitute breaches. of the Agreement's standard of performance warranting the imposition of liquidated damages; the acceptable performance level; the definition of the Complaint, incident or event; the method by which occurrences will principally be tracked (by Contractor or Agency), and the amount of liquidated damages for failure to meet the contractually-required standard of performance. Contractor is required to maintain records of Customer Complaints which show for each Complaint: date and time received; name, address and telephone number of caller; nature of Complaint (e.g., missed pick-up, excessive noise, property damage, etc.); name of employee receiving Complaint; action taken by Contractor to respond to Complaint; and date Complaint was resolved. Contractor shall submit to Agency with its quarterly report a liquidated damages report which	1. Recology SMC Agreement

Table 2. Recommend Litter Reduction Practices for Future Franchise Agreements.

Task#	Practice Description	Recommended Practices	Sample Language	Source Document
			summarizes the number of Complaints in each category and computes the amount (if any) of liquidated damages accrued by month during the preceding quarter. If Agency requests, Contractor shall also provide a printout of the full records for the quarter. Complaints of Spills of Discarded Materials - The number of "Complaints of spills of Discarded Materials" shall be less than or equal to one-hundred and twenty (120) per month for the SBWMA Service Area. Table 2 provides the proportional distribution of the total monthly allowance to all Member Agencies.	
			2. Service Standards: Liquidated Damages for Failure to Meet Standards. For each failure over 10 annually to timely clean up solid waste spilled from solid waste containers (cans, carts, bins, debris boxes or compactors) in accordance with Section 5.12A: $300	2. Sunnyvale Agreement with Specialty Solid Waste and Recycling

Appendix 11

- Annual Reporting for FY 2015-2016, Regional Supplement for Training and Outreach, BASMAA
- Pesticides Subcommittee Annual Report and Effectiveness Assessment 2015-2016, CASQA
- FY 2015/16 New and Redevelopment Regional Supplement, BASMAA

Annual Reporting for FY 2015-2016

Regional Supplement for Training and Outreach

San Francisco Bay Area Municipal Regional Stormwater Permit

B A S M A A

Bay Area Stormwater Management Agencies Association

September 2016

Alameda Countywide
Clean Water Program

Contra Costa
Clean Water Program

Fairfield-Suisun
Urban Runoff
Management Program

Marin County
Stormwater Pollution
Prevention Program

Napa County
Stormwater Pollution
Prevention Program

San Mateo Countywide
Water Pollution
Prevention Program

Santa Clara Valley
Urban Runoff Pollution
Prevention Program

Sonoma County
Water Agency

Vallejo Sanitation
and Flood
Control District

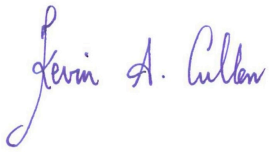
BASMAA

To Whom It May Concern:

We certify under penalty of law that this document was prepared under our direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on our inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of our knowledge and belief, true, accurate, and complete. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

James Scanlin, Alameda Countywide Clean Water Program

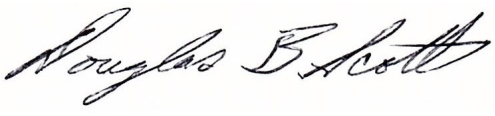
Tom Dalziel, Contra Costa Clean Water Program



Kevin Cullen, Fairfield-Suisun Urban Runoff Management Program

Matthew Fabry, San Mateo Countywide Water Pollution Prevention Program

Adam Olivieri, Santa Clara Valley Urban Runoff Pollution Prevention Program



Douglas Scott, Vallejo Sanitation and Flood Control District

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Stormwater Management

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LIST OF ATTACHMENTS:

C.5.e. Control of Mobile Sources

Screen shots of Updated Website

C.9.e.ii.(1) Point of Purchase Outreach

New *Our Water, Our World* graphic / display materials
Photos of trade show booths
Copy of *Our Water, Our World* advertisement
Screen shots of Mobile Inline Content in the Chinook Book App

C.9.e.ii.(3) Outreach to Pest Control Professionals

Letter to pest control companies with EcoWise Certified IPM practitioner employees

INTRODUCTION

This Regional Supplement has been prepared to report on regionally implemented activities complying with portions of the Municipal Regional Stormwater Permit (MRP), issued to 76 municipalities and special districts (Permittees) by the San Francisco Bay Regional Water Quality Control Board (Water Board). The Regional Supplement covers training and outreach activities related to the following MRP provisions:

- Provision C.5.e., Control of Mobile Sources,
- Provision C.7.c.ii.(1)., Stormwater Point of Contact,
- Provision C.9.e.ii.(1), Point of Purchase Outreach, and
- Provision C.9.e.ii.(3), Outreach to Pest Control Professionals

These regionally implemented activities are conducted under the auspices of the Bay Area Stormwater Management Agencies Association (BASMAA), a 501(c)(3) non-profit organization comprised of the municipal stormwater programs in the San Francisco Bay Area. Most of the 2015-2016 annual reporting requirements of the specific MRP Provisions covered in this Supplement are completely met by BASMAA Regional Project activities, except where otherwise noted herein or by Permittees in their reports. Scopes, budgets and contracting or in-kind project implementation mechanisms for BASMAA Regional Projects follow BASMAA's operational Policies and Procedures as approved by the BASMAA Board of Directors. MRP Permittees, through their program representatives on the Board of Directors and its committees, collaboratively authorize and participate in BASMAA Regional Projects or Regional Tasks. Depending on the Regional Project or Task, either all BASMAA members or Phase I programs that are subject to the MRP share regional costs.

Training

C.5.e. Control of Mobile Sources

This provision requires:

Each Permittee shall implement a program to reduce the discharge of pollutants from mobile businesses.

(1) The program shall include the following:

(a) Implementation of minimum standards and BMPs for each of the various types of mobile businesses, such as automobile washing, power washing, steam cleaning, and carpet cleaning.

(b) Implementation of an enforcement strategy that specifically addresses the unique characteristics of mobile businesses.

(c) Regularly updating mobile business inventories.

(d) Implementation of an outreach and education strategy to mobile businesses operating within the Permittee's jurisdiction.

(e) Inspection of mobile businesses, as needed.

(2) Permittees may cooperate county-wide and/or region-wide with the implementation of their programs for mobile businesses, including sharing of mobile business inventories, BMP requirements, enforcement action information, and education.

BASMAA's long-standing Surface Cleaner Training and Recognition program addresses these aspects of the provision by focusing on the most common type of outdoor cleaning – cleaning of flat surfaces like sidewalks, plazas, parking areas, and buildings. Individual Permittees address the inspection and enforcement aspects of the provision.

Previously, BASMAA, the Regional Water Board, and mobile businesses jointly developed best management practices. The BMPs were packaged and delivered in training materials (e.g., *Pollution from Surface Cleaning* folder), and via workshops and training videos. The folder and the training video have since been translated into Spanish. Cleaners that take the training and a self-quiz are designated by BASMAA as Recognized Surface Cleaners. BASMAA also created and provides marketing materials for use by Recognized Surface Cleaners. Previously, BASMAA converted the delivery mechanism to being online so that mobile businesses would have on-demand access to the materials and the training. BASMAA continues to maintain the Surface Cleaner Training and Recognition program. Cleaners can use the website to get trained and recognized for the first time or renew their training and recognition, as required annually. Recognized cleaners can also download marketing materials from the website. Potential customers, including Permittees can use the site to verify the recognition status of any cleaner, as can municipal inspectors.

Subsequent to the development and implementation of the existing program, BASMAA and the Permittees scoped and budgeted for a new project to enhance the existing Surface Cleaner Training and Recognition program in the following ways.

1. Expand the existing Surface Cleaner Training and Recognition Program to include two new mobile business categories - vehicle-related cleaning and carpet cleaning;
2. Develop best management practices for the two new categories based on existing BMPs;
3. Review and revise as necessary BMPs for surface cleaning to be in compliance with the State Water Board's new drought-driven Emergency Regulation for Statewide Urban Water Conservation, and
4. Create outreach materials for the new categories and revise outreach for surface cleaning.

The following has been accomplished:

- Website – Completed major update of the site.

- BMPs – Best management practices were developed and are being finalized for vehicle-related cleaning and carpet cleaning based on existing sets from BASMAA member agencies, other public agencies, and the trade association. BMPs for surface cleaning are being reviewed and revised to incorporate the State Water Board's Emergency Regulation for Statewide Urban Water Conservation.

- Outreach – Outreach materials are being developed for vehicle-related cleaning and carpet cleaning.

MRP Regional Supplement for Training and Outreach
Annual Reporting for FY 2015-2016

Public Information and Outreach

C.7.c.ii.(1) Stormwater Point of Contact

This provision requires:

> *Each Permittee shall maintain and publicize one point of contact for information on stormwater issues, watershed characteristics, and stormwater pollution prevention alternatives. This point of contact can be maintained individually or collectively and Permittees may combine this function with the spill and dumping complaint central contact point required in C.5.*

BASMAA assists with this provision by using the regional website: BayWise.org to list or link to member programs' lists of points of contact and contact information for the stormwater agencies in the Bay Area (http://baywise.org/about-us).

Pesticides Toxicity Control

C.9.e.ii.(1) Point of Purchase Outreach

This provision requires Permittees to:

- *Conduct outreach to consumers at the point of purchase;*
- *Provide targeted information on proper pesticide use and disposal, potential adverse impacts on water quality, and less toxic methods of pest prevention and control; and*
- *Participate in and provide resources for the "Our Water, Our World" program or a functionally equivalent pesticide use reduction outreach program.*

The Annual Reporting provision requires:

> *Outreach conducted at the county or regional level shall be described in Annual Reports prepared at that respective level; reiteration in individual Permittee reports is discouraged. Reports shall include a brief description of outreach conducted…, including level of effort, messages and target audience. (The effectiveness of outreach efforts shall be evaluated only once in the Permit term, as required in Provision C.9.f. [Ed. C.9.g]).*

Below is a report of activities and accomplishments of the *Our Water, Our World* program for FY 2015-2016.

- Completed comprehensive review and major overhaul of program materials resulting in new (see attachments):
  - Logo,
  - Shelf tag,
  - Literature rack header and side panel signage,
  - Product Guides (3 versions – generic, OSH, Home Depot),
  - Product Guide dispenser,
  - Aisle signage,
  - Business cards, and
  - Fact sheets (14 English, 3 Spanish).

- Coordinated program implementation with major chains Home Depot, Orchard Supply Hardware (OSH), and Ace Hardware National. Corporate office of OSH (San Jose) and Home Depot (Atlanta) directed support of the program with their stores.

- Twice printed an inventory of the following: fact sheets, shelf tags, and Home Depot-specific pocket guide, from which participating agencies could purchase materials.

- Updated less-toxic Product Lists: 4 versions – generic product-by-pesticide-fertilizer, generic product-by-pest, OSH product-by-pest, and Home Depot product-by-pest

- Maintained *Our Water, Our World* website.

- Provided Ask-the-Expert service—which provides 24-hour turnaround on answers to pest management questions.

- Provided and staffed exhibitor booths (see photos attached).
  - Excel Gardens Dealer Show, Las Vegas (August 2015)
  - L&L Dealer Show, Reno (October 2015)
  - NorCal trade show, San Mateo (February 2016)

- Provided on-call assistance (e.g., display set-up, training, IPM materials review) to specific stores (e.g., OSH, Home Depots).

- Provided print and web advertising – Chinook Coupon Book (see back cover ad attached).

- Maintained Chinook Book mobile application (app) – OWOW mobile app (see attached screen shots of Mobile Inline Content in the Chinook Book App).

Although effectiveness information need only be provided in the 2019 annual reports (C.9.g), below are some timely quantitative metrics provided by store partners:

- OSH reported sales in the less toxic and organic category were up 3-4% over the previous year.
- Home Depot reported:
  - They increased their shelf space for less toxic products in their main product aisle by 20% over last year.
  - They merchandized most of these products together in one bay in the main pesticide/garden aisle.
  - Scott's Miracle Gro increased the sales of their less toxic pesticide product line Nature's Care in Home Depot by 30-92%.

C.9.e.ii.(3) Outreach to Pest Control Professionals

This provision requires:

The Permittees shall conduct outreach to pest control operators, urging them to

> *promote IPM services to customers and to become IPM-certified by Ecowise Certified or a functionally-equivalent certification program. Permittees are encouraged to work with the Pesticide Applicators Professional Association; the California Association of Pest Control Advisors; DPR; county agricultural commissioners; UC-IPM; BASMAA; EcoWise Certified Program (or functionally equivalent certification program); Bio-integral Resource Center and others to promote IPM to pest control operators.*

The annual reporting requirements are the same as for provision C.9.e.ii.(1) above.

In FY 15-16, BASMAA's Public Information/Participation Committee provided a vehicle for MRP Programs to share information on their efforts to outreach to pest control professionals, including presentations made by MRP Programs to local pest control professional association chapters.

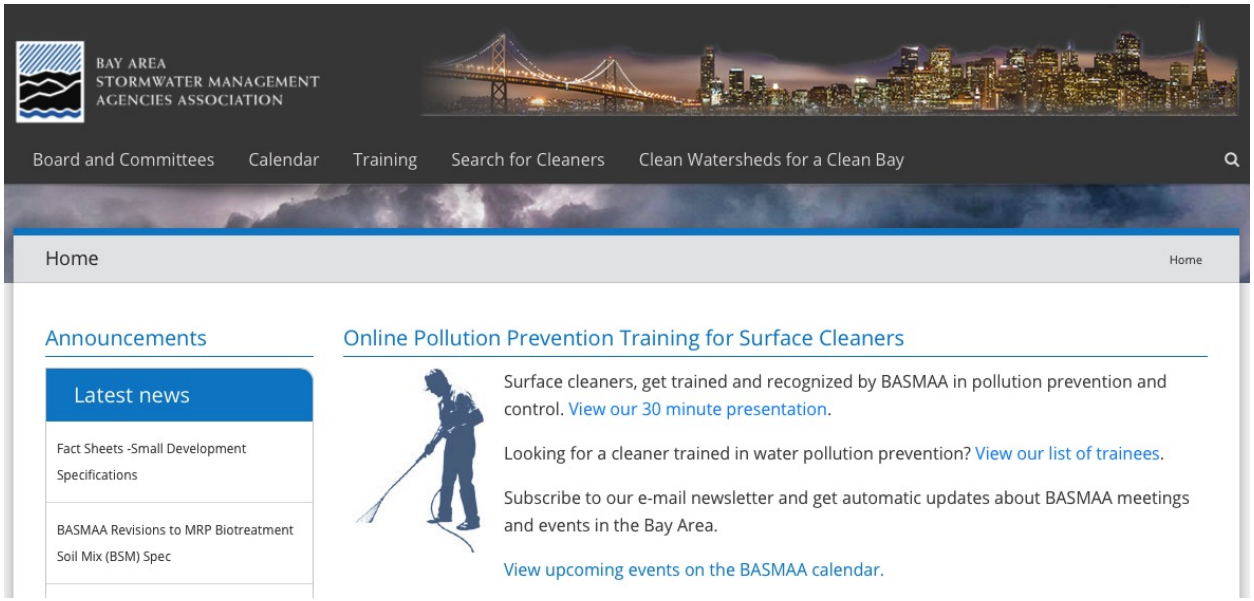
BASMAA believes the most cost-effective way to "urge" pest control operators to promote IPM services to their customers and to become IPM-certified is to work with the Bay Area's own EcoWise Certified Program, which conducted such outreach and whose website now provides a focal point to both recruit new IPM providers and assist customers to find and hire companies and individuals who practice integrated pest management. BASMAA's *Our Water, Our World* website provides a link on its home page (http://ourwaterourworld.org/Quick-Links/Pest-Control-Operators-and-Landscapers) to the EcoWise Certified IPM Program.

This year, BASMAA worked with the Bio-Integral Resource Center (BIRC) to conduct a major update of its EcoWise Certified Program online listing of IPM providers – contacting the listed companies and revising the listing to make it clearer which companies are EcoWise Certified (http://www.ecowisecertified.org/ecowise_find.html) ("Service Providers") vs. individuals (http://www.ecowisecertified.org/ecowise_find2.html) ("practitioners") who are EcoWise Certified but whose companies are not. In making that distinction, BASMAA and BIRC strongly encouraged companies to be become EcoWise Certified themselves, and structuring the online listings that way provides a constant encouragement to do so.

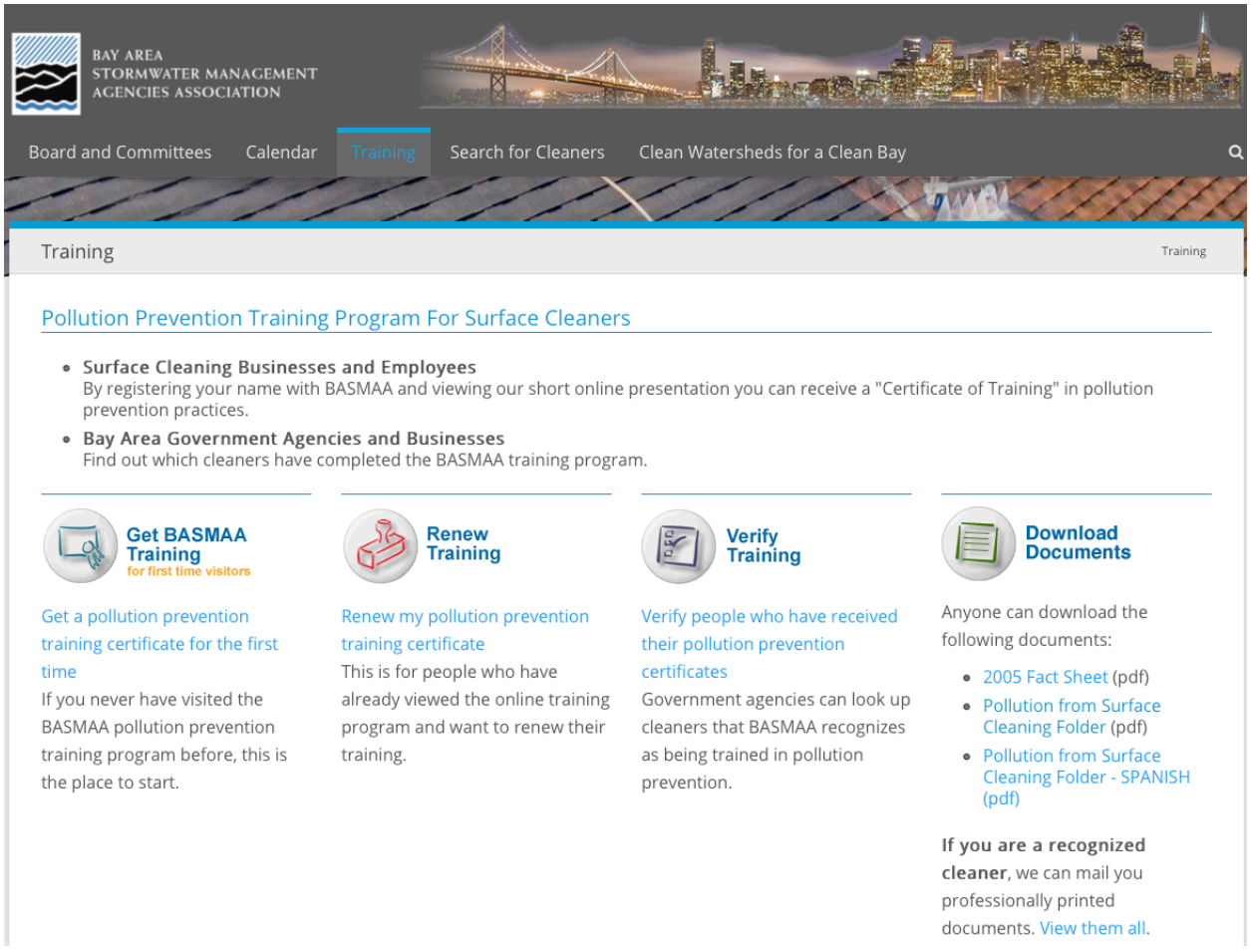
BASMAA followed up the update with a letter (attached) to the approximately 19 Bay Area companies (of about 30 listed statewide) that were not Certified IPM Service Providers but that had Certified IPM practitioners on staff noting their listing status and encouraging them to apply to become Certified IPM Service Providers.

Attachments

Mobile Cleaner Training and Recognition Program



Updated Website (Home page)



Updated Website (Cleaner Training and Recognition Program page)

Attachments

New *Our Water, Our World* graphic / display materials

Logo

Shelf tag

Literature rack header signage

Literature rack side panel signage

Attachments

New *Our Water, Our World* graphic / display materials (continued)

EFFECTIVE • ECO-FRIENDLY

Less Toxic Products

Manage Pests in Your Home and Garden

www.ourwaterourworld.org

LOOK FOR THESE LESS-TOXIC PRODUCTS

Ants
- Amdro Kills Ants (bait stations)
- Bonide Boric Acid Roach Powder
- Caulk (for entry points)
- EcoLogic Ant and Roach Killer
- EcoSmart Ant and Roach Killer
- Orange Guard
- Safer Brand Ant and Crawling Insect Killer Diatomaceous Earth
- Terro Ant Killer II Liquid Ant Baits

Aphids and Whiteflies
- Biocare Aphid & Whitefly Traps
- Bonide All Seasons Horticultural and Dormant Spray Oil
- Bug Blaster (spray nozzle to hose off bugs)
- Dr. Earth Final Stop insecticides
- Horticultural oils (Bonide, Monterey, Summit)
- Insecticidal Soaps (such as Bayer Advanced Natria, Bonide, Garden Safe, Safer Brand)
- Ladybugs and lacewings
- Neem Oil (such as Bayer Advanced Natria, Bonide, Monterey)
- Safer Brand Yard and Garden Insect Killer

Fleas
- Beneficial nematodes (*Steinernema carpocapsae*)
- Flea Traps (Biocare, Enforcer, Victor)
- Ecology Works Dustmite and Flea Control
- Insecticidal Soaps (such as Bayer Advanced Natria, Bonide, Garden Safe, Miracle-Gro Nature's Care, Safer Brand; apply outdoors where pets lie)
- Safer Brand Ant and Crawling Insect Killer Diatomaceous Earth
- St. Gabriel Organics Insect Dust Diatomaceous Earth

Gophers and Moles
- Bonide Mole Max Mole and Gopher Repellent
- Digger's Root Guard Gopher Baskets
- Gopher Scram
- Gopher traps
- Uncle Ian's Mole & Gopher, Deer, Rabbit & Squirrel Repellent

Mites
- AzaMax
- Azatrol
- Bonide All Seasons Horticultural and Dormant Spray Oil
- Bonide Captain Jack's Deadbug Brew
- Bonide Mite-X
- Dr. Earth Final Stop insecticides
- Insecticidal Soaps (such as Bayer Advanced Natria, Bonide, Garden Safe, Miracle-Gro Nature's Care, Safer Brand)
- Monterey 70% Neem Oil
- Monterey Horticultural Oil
- Miracle-Gro Nature's Care 3-in-1 Insect Disease and Mite Control

Mosquitoes
- Bonide Mosquito Beater WSP (Plunks) with Bti
- Summit Mosquito Bits
- Summit Mosquito Dunks

Cockroaches
- Black Flag Roach Motel
- Bonide Boric Acid Roach Powder
- Caulk (for entry points)
- Combat Source Kill 5 bait station
- Safer Brand Ant and Crawling Insect Killer Diatomaceous Earth
- St. Gabriel Organics Insect Dust Diatomaceous Earth

Snails and Slugs
- Bayer Advanced Natria Snail and Slug Killer Bait
- Bonide Slug Magic
- Corry's Slug and Snail Copper Tape Barrier
- Monterey Sluggo

Yellowjackets
- Rescue W-H-Y Spray for Wasp, Hornet & Yellowjacket Nests
- Rescue W-H-Y Traps
- Rescue Yellowjacket Traps JT-1
- Victor Yellowjacket Traps

Products may vary by location.

Adapted from the original developed by Marin County Stormwater Pollution Prevention Program (MCSTOPPP), San Rafael CA, with assistance from Ann Joseph Consulting.

MANAGE PESTS WITH EFFECTIVE, ECO-FRIENDLY PRODUCTS!

When you water your lawn or garden after using pesticides or fertilizer, polluted water can run off into storm drains and on to local creeks, lakes, bays, or the ocean. But—there are plenty of ways to keep pests away that don't pollute, like using the less-toxic products you'll find in this guide!

Our Water Our World is a partnership between home and garden centers and local government agencies working together to reduce water pollution caused by pesticides. Look for Our Water Our World fact sheets on the literature stand in your local store.

Look for this tag to find less-toxic products

Product Name

Eco-friendly Less-toxic Product!

PLANTS THAT ATTRACT HELPFUL INSECTS AND BUTTERFLIES

- Aster (*Aster spp.*)
- Baby blue eyes (*Nemophila menziesii*)
- Calendula (*Calendula spp.*)
- California poppy (*Eschscholzia californica*)
- California wild lilac (*Ceanothus spp.*)
- Chervil (*Anthriscus cerefolium*)
- Chrysanthemum (*Chrysanthemum spp.*)
- Coriander (*Coriander sativum*)
- Cosmos (*Cosmos spp.*)
- Coyote brush (*Baccharis pilularis*)
- Dill (*Anethum graveolens*)
- Elderberry (*Sambucus spp.*)
- Fleabane (*Erigeron spp.*)
- Pincushion flower (*Scabiosa columbaria*)
- Rosemary (*Rosmarinus officinalis*)
- Rudbeckia (*Rudbeckia spp.*)
- Sticky monkey flower (*Mimulus aurantiacus*)
- Sunflower (*Helianthus spp.*)
- Sweet alyssum (*Lobularia maritima*)
- Wild buckwheat (*Eriogonum spp.*)
- Yarrow (*Achillea millefolium*)
- Zinnia (*Zinnia spp.*)

LESS TOXIC ACTIVE INGREDIENTS

Active ingredients are listed on the front of the product. For a more complete list, go to **www.ourwaterourworld.org**.

- Abamectin
- Ammoniated soaps of fatty acids
- Azadirachtin
- *Bacillus subtilis*
- *Bacillus thuringiensis isrealensis*
- Borax and boric acid
- Canola oil
- Castor oil
- Citric acid
- Clove oil
- Corn gluten
- Cottonseed oil
- D-Limonene
- Diatomaceous earth
- Eugenol
- Hydramethylnon (ONLY use in containerized bait or gel form)
- Clarified hydrophobic extract of neem oil
- Iron phosphate
- Lemon eucalyptus oil
- Methoprene
- Orthoboric acid
- Paraffinic oil
- Petroleum oil
- Picaridin
- Potassium bicarbonate
- Potassium soap (or salts) of fatty acids
- Pyrethrins
- Rosemary oil
- Sesame oil
- Sodium tetraborate decahydrate
- Soybean oil
- Spinosad
- Thyme oil

MORE INFORMATION

Visit **www.ourwaterourworld.org** for more information, including:
- Common pests and ways to manage them without using toxic products
- Photos and information about helpful bugs that eat pests, and the plants that attract them

Learn more about less-toxic pest control:
- To see photos and learn more about helpful insects, visit the Natural Enemies Gallery at the UC IPM website at **www.ipm.ucdavis.edu/PMG/NE/index.html**
- Contact your local Agricultural Extension Office for help identifying and managing pests.

GETTING RID OF UNWANTED PRODUCTS

Take pest control products you don't want to a household hazardous waste collection site. To find a site near you, go to **search.earth911.com** and type 'pesticides' and your zip code into the search fields.

Product Guide – Generic (above) and Home Depot versions (below)

EFFECTIVE • ECO-FRIENDLY

Less Toxic Products

Manage Pests in Your Home and Garden

www.ourwaterourworld.org

LOOK FOR THESE LESS-TOXIC PRODUCTS

Ants
- Amdro Kills Ants (bait stations)
- Caulk (for entry points)
- Dr. Earth Pest Control Killer Spray
- EcoLogic Ant and Roach Killer
- EcoLogic Home Insect Control
- Raid Ant Baits III
- Safer Brand Ant and Crawling Insect Killer Diatomaceous Earth
- Terro Ant Killer II Liquid Ant Baits
- Time Out for Roaches and Ants

Aphids and Whiteflies
- Bonide All Seasons Horticultural and Dormant Spray Oil
- Bonide Rose RX 3-in-1
- Dr. Earth Final Stop Vegetable Garden Insect
- Ladybugs (order from Home Depot online)
- Miracle-Gro Nature's Care Insecticidal Soap
- Miracle-Gro Nature's Care 3-in-1 Insect Disease and Mite Control
- Miracle-Gro Nature's Care Garden Insect Control
- Ortho Insect, Mite and Disease 3-in-1
- Organic Labs Organocide 3-in-1 Garden Spray
- Southern Ag Triple Action Neem Oil

Fleas
- Beneficial nematodes (*Steinernema feltiae, Steinernema glaseri*)
- EcoLogic Lawn and Yard Insect Killer
- Hot Shot Bed Bug and Flea Killer Powder
- Miracle-Gro Nature's Care Insecticidal Soap (apply outdoors where pets lie)
- Safer Brand Ant and Crawling Insect Killer Diatomaceous Earth
- Victor Ultimate Flea Trap (monitoring tool)

Gophers and Moles
- Bonide Mole Max Mole and Gopher Repellent
- Diggers Root Guard Gopher Baskets
- Gopher Traps
- Tomcat Mole & Gopher Repellent
- Uncle Ian's Mole & Gopher, Deer, Rabbit & Squirrel Repellent

Mites
- Bonide All Seasons Horticultural and Dormant Spray Oil
- Bonide Citrus, Fruit & Nut Orchard Spray
- Bonide Captain Jack's Deadbug Brew
- Bonide Rose RX 3-in-1
- Dr. Earth Final Stop insecticides
- Miracle-Gro Nature's Care Insecticidal Soap
- Miracle-Gro Nature's Care 3-in-1 Insect, Disease and Mite Control
- Ortho Insect Killer Tree and Shrub Concentrate
- Ortho Insect, Mite & Disease 3-in 1
- Southern AG Triple Action Neem Oil

Mosquitoes
- Summit Mosquito Dunks

Roaches
- Black Flag Roach Motel
- EcoLogic Ant and Roach Killer
- EcoLogic Home Insect Control
- Harris Famous Roach Tablets
- Hot Shot Max Attrax Roach Killing Powder
- Safer Brand Ant and Crawling Insect Diatomaceous Earth
- Time Out for Roaches and Ants

Snails and Slugs
- Miracle-Gro Nature's Care Slug and Snail Killer
- Monterey Sluggo

Yellowjackets
- Rescue W-H-Y Trap for Wasps, Hornets, & Yellowjackets
- Rescue W-H-Y Trap Attractant
- Rescue Yellowjacket Trap JT-1
- Rescue Disposable Yellowjacket Trap
- Rescue Yellowjacket Trap Attractant

Products may vary by location.

Adapted from the original developed by Marin County Stormwater Pollution Prevention Program (MCSTOPPP), San Rafael CA, with assistance from Ann Joseph Consulting.

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When you water a lawn or garden after using pesticides or fertilizer, polluted water can run off into storm drains and on to local creeks, lakes, bays, or the ocean. But there are plenty of ways to keep pests away that don't pollute, like using the less-toxic products you'll find in this guide!

Our Water Our World is a partnership between Home Depot stores and local government agencies, working together to reduce water pollution caused by pesticides. The Our Water Our World literature stand has a wide selection of fact sheets that explain less toxic ways to manage common pests.

This pocket guide highlights Home Depot products that are less toxic to people, pets, and the environment. For a longer list and more information, visit www.ourwaterourworld.org

Look for this tag to find less-toxic products

Product Name

Eco-friendly Less-toxic Product!

PLANTS THAT ATTRACT HELPFUL INSECTS AND BUTTERFLIES

- Aster (*Aster spp.*)
- Baby blue eyes (*Nemophila menziesii*)
- Calendula (*Calendula spp.*)
- California poppy (*Eschscholzia californica*)
- California wild lilac (*Ceanothus spp.*)
- Chervil (*Anthriscus cerefolium*)
- Chrysanthemum (*Chrysanthemum spp.*)
- Coriander (*Coriander sativum*)
- Cosmos (*Cosmos spp.*)
- Coyote brush (*Baccharis pilularis*)
- Dill (*Anethum graveolens*)
- Elderberry (*Sambucus spp.*)
- Fleabane (*Erigeron spp.*)
- Pincushion flower (*Scabiosa columbaria*)
- Rosemary (*Rosmarinus officinalis*)
- Rudbeckia (*Rudbeckia spp.*)
- Sticky monkey flower (*Mimulus aurantiacus*)
- Sunflower (*Helianthus spp.*)
- Sweet alyssum (*Lobularia maritima*)
- Wild buckwheat (*Eriogonum spp.*)
- Yarrow (*Achillea millefolium*)
- Zinnia (*Zinnia spp.*)

LESS TOXIC ACTIVE INGREDIENTS

Active ingredients are listed on the front of the product. For a more complete list, go to **www.ourwaterourworld.org**.

- Abamectin
- Ammoniated soap of fatty acid
- Azadirachtin
- *Bacillus subtilis*
- *Bacillus thuringiensis isrealensis*
- Borax and boric acid
- Canola oil
- Castor oil
- Citric acid
- Clove oil
- Corn gluten
- Cottonseed oil
- D-Limonene
- Diatomaceous earth
- Eugenol
- Hydramethylnon (ONLY use in containerized bait or gel form)
- Clarified hydrophobic extract of neem oil
- Iron phosphate
- Lemon eucalyptus oil
- Methoprene
- Orthoboric acid
- Paraffinic oil
- Picaridin
- Potassium bicarbonate
- Potassium soap (or salts) of fatty acids
- Pyrethrins
- Rosemary oil
- Sesame oil
- Sodium tetraborate decahydrate
- Soybean oil
- Spinosad
- Thyme oil

MORE INFORMATION

Visit **www.ourwaterourworld.org** for more information, including:
- Common pests and ways to manage them without using toxic products
- Photos and information about helpful bugs that eat pests, and the plants that attract them

Learn more about less-toxic pest control:
- To see photos and learn more about helpful insects, visit the Natural Enemies Gallery at the UC IPM website at **www.ipm.ucdavis.edu/PMG/NE/index.html**
- Contact your local Agricultural Extension Office for help identifying and managing pests.

GETTING RID OF UNWANTED PRODUCTS

Take pest control products you don't want to a household hazardous waste collection site. To find a site near you, go to **search.earth911.com** and type 'pesticides' and your zip code into the search fields.

Attachments

New *Our Water, Our World* graphic / display materials (continued)

EFFECTIVE • ECO-FRIENDLY

Less Toxic Products

OUR WATER OUR WORLD

Orchard SUPPLY HARDWARE

Manage Pests in Your Home and Garden

www.ourwaterourworld.org

LOOK FOR THESE LESS-TOXIC PRODUCTS

Ants
- Amdro Kills Ants (bait stations)
- Dr. Earth Final Stop Pest Control Killer Spray
- Bonide Boric Acid Roach Powder
- Caulk (for entry points)
- Orange Guard
- Safer Brand Ant and Roach Killer
- Safer Brand Ant and Crawling Insect Killer Diatomaceous Earth
- Terro Ant Killer II Liquid Ant Baits

Aphids and Whiteflies
- Biocare Aphid & Whitefly Traps
- Bonide All Seasons Horticultural and Dormant Spray Oil
- Bonide Insecticidal Soap for Houseplants
- Bonide Mite-X
- Bonide Neem Oil
- Dr. Earth Final Stop insecticides
- Ladybugs and lacewings
- Orchard Insecticidal Soap
- Orchard 3-in-1 Rose and Flower with Neem Oil
- Orchard 3-in-1 Tomato and Vegetable with Neem Oil
- Organic Labs Organocide 3-in-1 Garden Spray
- Safer Brand Insect Killing Soap

Fleas
- Beneficial nematodes (*Steinernema carpocapsae*)
- Biocare Flea Traps
- Dr. Earth Final Stop Yard and Garden Insect Killer
- Orchard Insect Killing Soap (apply outdoors where pets lie)
- Safer Brand Ant and Crawling Insect Killer Diatomaceous Earth
- Safer Brand Insect Killing Soap (apply outdoors where pets lie)

Gophers and Moles
- Bonide Mole Max Mole and Gopher Repellent
- Bonide Gopher Max Repellent
- Gonzo Gopher Shield (barrier net)
- Gopher Traps
- Tomcat Mole Trap

Mites
- Bayer Advanced Natria Insect, Disease and Mite Control
- Bonide All Seasons Horticultural and Dormant Spray Oil
- Bonide Captain Jack's Deadbug Brew
- Bonide Mite-X
- Bonide Sulfur
- Dr. Earth Final Stop Insecticides
- Orchard Insecticidal Soap
- Orchard Rose and Flower Insect Spray
- Safer Brand Insect Killing Soap

Mosquitoes
- Bonide Mosquito Beater WSP (Plunks) with Bti

Cockroaches
- Biocare Roach Trap
- Black Flag Roach Motel
- Bonide Boric Acid Roach Powder
- Safer Brand Ant and Roach Killer
- Safer Brand Ant and Crawling Insect Killer Diatomaceous Earth

Snails and Slugs
- Bonide Bug and Slug Killer
- Corry's Slug and Snail Copper Tape Barrier
- Orchard Slug and Snail Killer (jug)
- Monterey Sluggo
- Monterey Sluggo Plus

Yellowjackets
- Rescue Decorative Yellowjacket Traps
- Rescue Disposable Yellowjacket Trap
- Rescue W-H-Y Spray for Wasp, Hornet & Yellowjacket Nests
- Rescue W-H-Y Traps for Wasps, Hornets & Yellowjackets
- Rescue W-H-Y Trap Attractant
- Rescue Yellowjacket Traps
- Rescue Yellowjacket Trap Attractant

Adapted from the original developed by Marin County Stormwater Pollution Prevention Program (MCSTOPPP), San Rafael CA, with assistance from Ann Joseph Consulting.

Products may vary by location.

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When you water your lawn or garden after using pesticides or fertilizer, polluted water can run off into storm drains and on to local creeks, lakes, bays, or the ocean. But there are plenty of ways to keep pests away that don't pollute, like using the less-toxic products you'll find in this guide!

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Look for this tag to find less-toxic products

Product Name

Eco-friendly Less-toxic Product!

OUR WATER OUR WORLD

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- Aster (*Aster spp.*)
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- Coriander (*Coriander sativum*)
- Cosmos (*Cosmos spp.*)
- Coyote brush (*Baccharis pilularis*)
- Dill (*Anethum graveolens*)
- Elderberry (*Sambucus spp.*)
- Fleabane (*Erigeron spp.*)
- Pincushion flower (*Scabiosa columbaria*)
- Rosemary (*Rosmarinus officinalis*)
- Rudbeckia (*Rudbeckia spp.*)
- Sticky monkey flower (*Mimulus aurantiacus*)
- Sunflower (*Helianthus spp.*)
- Sweet alyssum (*Lobularia maritima*)
- Wild buckwheat (*Eriogonum spp.*)
- Yarrow (*Achillea millefolium*)
- Zinnia (*Zinnia spp.*)

LESS TOXIC ACTIVE INGREDIENTS

Active ingredients are listed on the front of the product. For a more complete list, go to **www.ourwaterourworld.org**.

- Abamectin
- Ammoniated soap of fatty acids
- Azadirachtin
- *Bacillus subtilis*
- *Bacillus thuringiensis isrealensis*
- Borax and boric acid
- Canola oil
- Castor oil
- Citric acid
- Clove oil
- Corn gluten
- Cottonseed oil
- D-Limonene
- Diatomaceous earth
- Eugenol
- Hydramethylnon (ONLY use in containerized bait or gel form)
- Clarified hydrophobic extract of neem oil
- Iron phosphate
- Lemon eucalyptus oil
- Methoprene
- Orthoboric acid
- Paraffinic oil
- Picaridin
- Potassium bicarbonate
- Potassium soap (or salts) of fatty acids
- Pyrethrins
- Rosemary oil
- Sesame oil
- Sodium tetraborate decahydrate
- Soybean oil
- Spinosad
- Thyme oil

MORE INFORMATION

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- Photos and information about helpful bugs that eat pests, and the plants that attract them

Learn more about less-toxic pest control:
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- Contact your local Agricultural Extension Office for help identifying and managing pests.

GETTING RID OF UNWANTED PRODUCTS

Take pest control products you don't want to a household hazardous waste collection site. To find a site near you, go to **search.earth911.com** and type 'pesticides' and your zip code into the search fields.

Product Guide (OSH)

Product Guide dispenser (with Product Guides in pockets)

Attachments
New *Our Water, Our World* graphic / display materials (continued)

Aisle signage

Business Cards (example)

EFFECTIVE ECO-FRIENDLY PEST CONTROL • LESS-TOXIC PRODUCTS

CONTROLLING ANTS IN YOUR HOME

CONTROL ANTS IN YOUR HOME WITH THESE ECO-FRIENDLY PRODUCTS

Baits containing borates	Amdro Kills Ants Ant Killer (liquid ant bait), KM Ant Pro ant bait delivery system, Terro Ant Killer II Liquid Ant Bait Station (pre-filled bait stations)
Containerized baits containing hydramethylnon	Amdro Kills Ants Ant Killing Bait (bait stations), Combat Source Kill 4 Ant Bait Stations (use only in enclosed bait stations)
Desiccating dust containing diatomaceous earth (DE)	Concern Diatomaceous Earth Crawling Insect Killer, Safer Brand Ant and Crawling Insect Killer—Diatomaceous Earth, St. Gabriel Organics Diatomaceous Earth Insect Dust
Applicator for diatomaceous earth (DE)	Pest Pistol
Plant-based insecticides	EcoLogic Ant and Roach Killer, Ecosmart Ant and Roach Killer, Orange Guard
Hose attachment	Bug Blaster
Sticky barrier	Stikem Special pest glue, Tree Tanglefoot Insect Barrier

Argentine ants are frequent invaders in California homes. They are tiny (1/8 inch). They come inside a few at a time at first (the scouts), and then in long lines, following scent trails to a food source.

A QUICK FIX FOR AN ANT EMERGENCY

If you deal with ants when they first come inside, a few simple steps can take care of the problem.

1. Find what ants are after (usually leftover food) and where they are entering the room (usually through a crack in the wall). Mark the spot so you can find it again. If you can't find an entry point, see Step 4.
2. Spray lines of ants with soapy water and wipe up with a sponge, and clean up any food or spills.
3. Next, block entry points temporarily with a smear of petroleum jelly or a piece of tape.
4. If you can't find an entry point, clean up the ants (Step 2). Place a bait station in an out-of-the-way spot on the line the ants have been following. Remember to remove the bait station when the line of ants has disappeared so you don't attract more ants into the house. (See *Tips for Using Ant Baits*.)

While they can be pests , ants are helpful creatures, especially outside . Ants kill and eat many pest insects, help to aerate soil, and recycle animal and vegetable material. This is good news, because it's probably not possible to eliminate ants from their outdoor habitat. The best way to manage an ant invasion is to keep them outside.

KEEP ANTS AWAY

- Store food in the refrigerator, or in containers that seal tightly.
- Keep things clean and dry, and fix leaking faucets and pipes (ants come in to find water as well as food).

OUR WATER OUR WORLD

Choose eco-friendly products for your home and garden. Look for this symbol before you buy.

Fact sheets – Ants (example front)

- Weather-strip doors and windows.
- Put pet dishes in a soapy moat—partially fill a wide, shallow container with soapy water and place pet bowls in the water.
- Use silicone caulk to permanently close holes in walls, cracks along moldings and baseboards, and gaps around pipes and ducts to keep ants outside.

- Use a hand duster, such as Pest Pistol, to apply desiccating dust such as diatomaceous earth (DE) in wall openings and cracks before sealing. DE kills insects by absorbing their outer waxy coating, causing dehydration and death. It has little toxicity to humans or pets but inhaling it can cause respiratory problems, so wear a dust mask and goggles when applying. Be sure to buy food-grade DE, not DE for pool filters.

OUTDOORS

- Follow indoor ant trails back to the spot where ants come in from outside, and place enclosed bait stations there.
- Caulk cracks where ants are entering the house.
- Ants are attracted to the sweet, sticky honeydew made by aphids, whiteflies, and scale insects. Use sticky barriers around the trunk of a tree or bush to keep ants away while you deal with the source of the honeydew. Prune any branches that touch walls, fences, or the ground so ants cannot get around the barrier.

ANTS IN YOUR PLANTS?

If ants are nesting in a pott ed houseplant, move it out doors. Water it thoroughly and place the pot in a bucket fi lled with water that comes an inch below the rim of the pot. Use a stick t o make a br idge for ants to get out of the pot and the bucket without getting in the water. The ants will soon begin carrying their white-colored young to safety. When no more ants emerge, drain the pot and r eturn it to the house.

TIPS FOR USING ANT BAITS

Baits use a minimum of insecticide and confine it to a very small area. Ants carry small quantities of bait back to the nest to share, which can reduce the local ant population.

- Use baits with active ingredients borate or hydramethylnon. Bait stations with hydramethylnon should be enclosed.
- Argentine ants change their food preferences frequently. If one bait is not working, try another type. Wait at least a day to see if ants take the bait.
- Do not spray insecticide around the bait; it will repel the ants.
- Baits may take several weeks to kill the ants. At first you may see more ants coming to the bait, but after a few days to a week you should see many fewer ants.
- When ants are gone, remove the bait so you don't attract more ants. Return enclosed bait stations to the original box to save and use again. Put the box inside a plastic bag, seal it with a twist-tie, and store away from children and pets.

WWW.OURWATEROURWORLD.ORG

Common home and garden pesticides are found in stormwater runoff, treated wastewater, and in local waterways, sometimes at levels that can harm sensitive aquatic life. **Our Water Our World** is a joint effort by water pollution prevention agencies, participating retail stores, and pesticide distributors and manufacturers—working together to reduce the risks associated with pesticide use.

Our Water Our World fact sheets and store displays educate residents about less-toxic pest management. For the rest of the series of fact sheets, visit **www.OurWaterOurWorld.org**. Look for the ***Less Toxic • Eco-friendly*** tag next to less-toxic products in participating stores and nurseries. See the *Pesticides and Water Pollution* fact sheet for information on active ingredients in common pesticides that may cause water quality problems.

Pest control strategies and methods described in this publication are consistent with integrated pest management (IPM) concepts, and are based on scientific studies and tests in actual home and garden settings. Use suggested products according to label directions and dispose of unwanted or leftover pesticides at a household hazardous waste collection facility or event. For more information on pesticide disposal, visit **www.earth911.com**. No endorsement of specific brand name products is intended, nor is criticism implied of similar products that are not mentioned.

For more information, contact:

Bio-Integral Resource Center (BIRC), 510.524.2567, www.birc.org

University of California Cooperative Extension Master Gardeners in your area

University of California IPM website, www.ipm.ucdavis.edu

Paper content: 25% post-consumer waste, 50% recycled content. Printed with soy-based ink.

March 2016

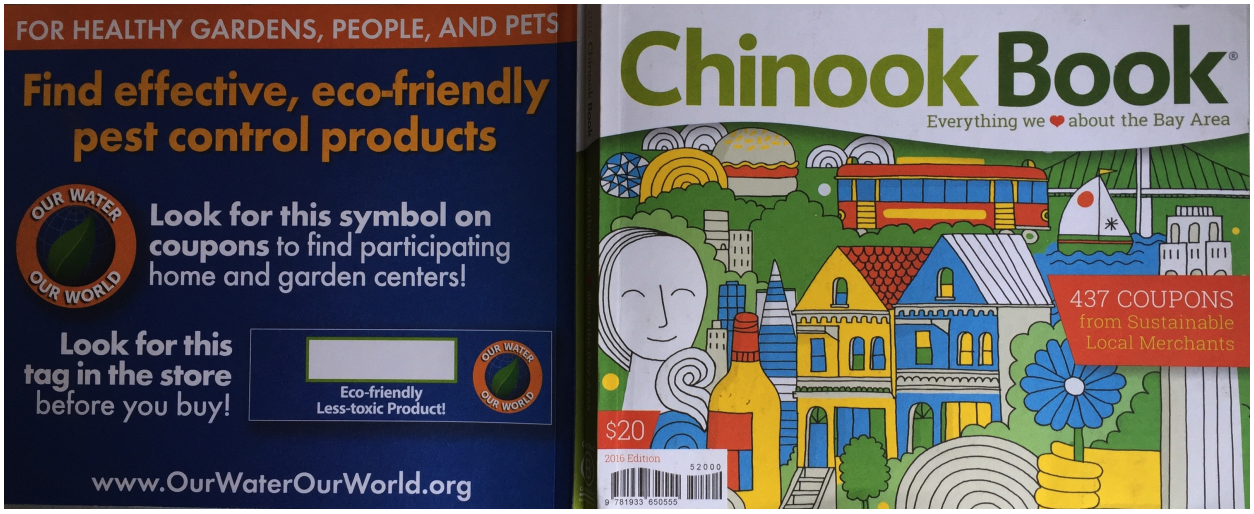
Fact sheets – Ants (example back)

Attachments
Photos from trade shows

Presentation to attendees

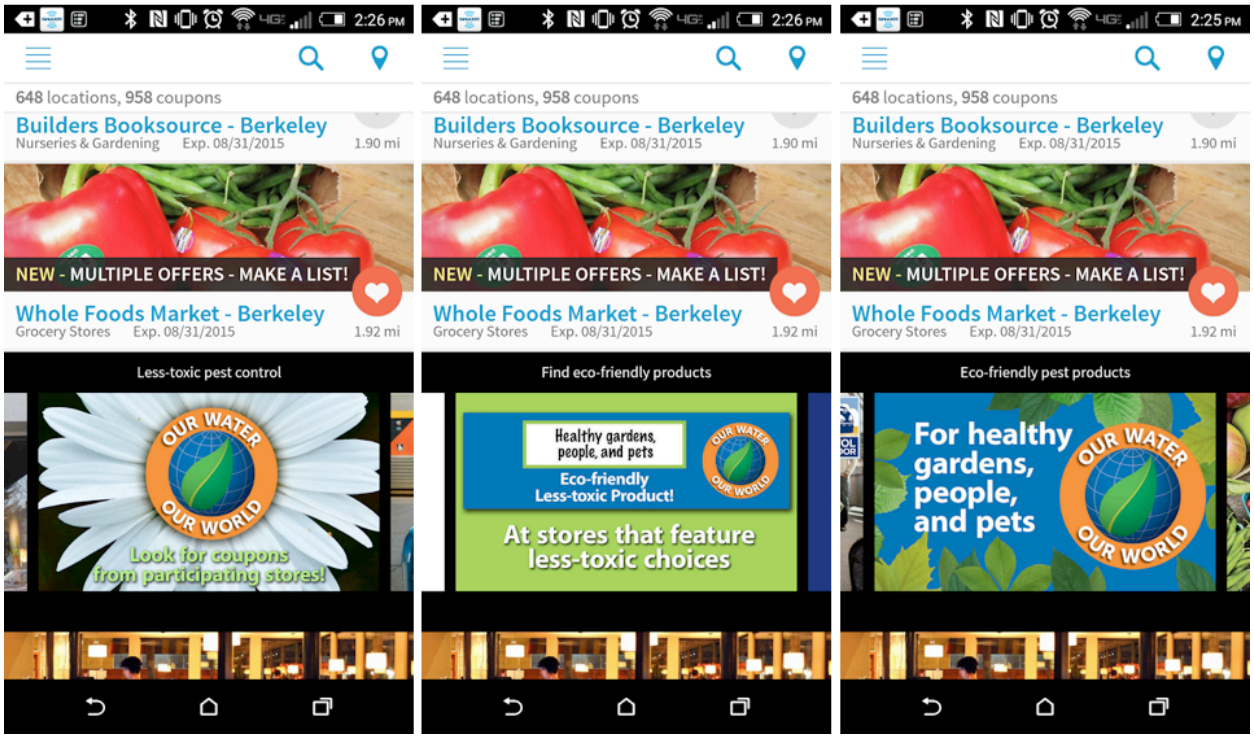
Trade show booth

Attachments
Copy of *Our Water, Our World* advertisement

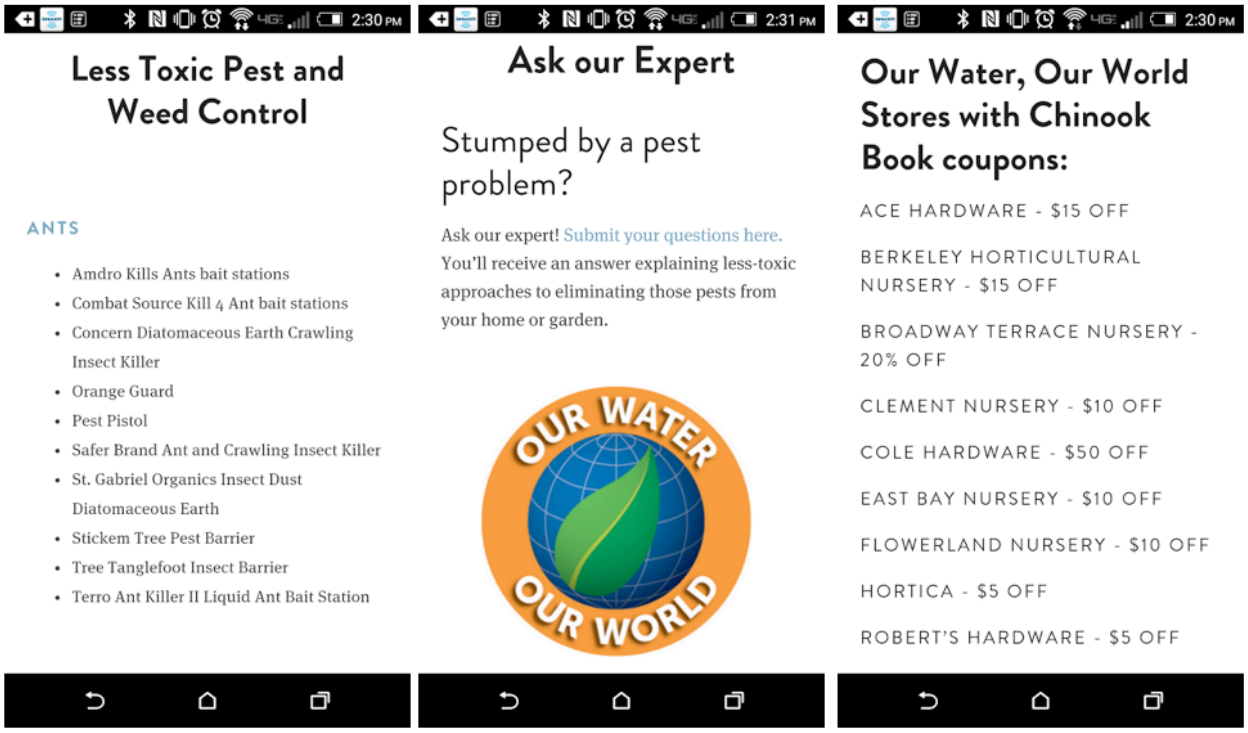


Attachments
Screen shots of Mobile Inline Content in the Chinook Book App

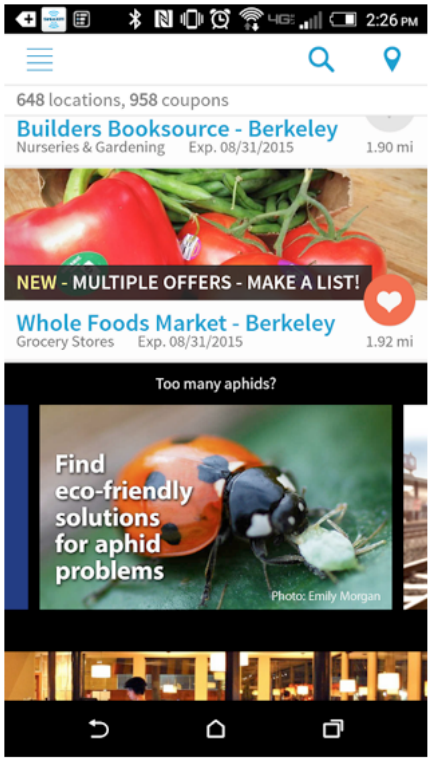
Inline Ads:



Article Content (all these pages are linked together, but only showed the top content of each page here)



Attachments



Attachments

Attachments

Outreach to Pest Control Professionals

Letter to pest control companies with EcoWise Certified IPM practitioner employees

Alameda Countywide
Clean Water Program

Contra Costa
Clean Water Program

Fairfield-Suisun
Urban Runoff
Management Program

Marin County
Stormwater Pollution
Prevention Program

Napa County
Stormwater Pollution
Prevention Program

San Mateo Countywide
Water Pollution
Prevention Program

Santa Clara Valley
Urban Runoff Pollution
Prevention Program

Sonoma County
Water Agency

Vallejo Sanitation
and Flood
Control District

BASMAA

Subject: Becoming an EcoWise Certified IPM Service Provider

Dear Pest Management Company:

I am writing to you because one or more of your pest management professionals has received EcoWise certification as a qualified practitioner of integrated pest management (IPM). The Bay Area Stormwater Management Agencies Association (BASMAA) encourages your company to raise its status in the EcoWise Certified Program—to become an EcoWise Certified IPM Service Provider.

BASMAA, a Bay Area-wide non-profit organization comprised of our region's municipal stormwater programs, would like to promote your business, as an EcoWise certified company, to Bay Area customers. We represent 100 agencies, including 85 cities and towns, 8 counties, and 7 special districts, all working together to improve the quality of stormwater flowing to our local creeks, the Delta, San Francisco Bay, and the Pacific Ocean. Pesticide pollution in Bay Area waterways, caused by use of pesticides around homes and businesses in urban and suburban areas is a key problem that agencies must address. The EcoWise Certified Program gives us an opportunity to direct people to certified businesses that customers can count on to provide less toxic pest control services.

As you may know, the Bio-Integral Resource Center (BIRC), which administers the EcoWise Certified Program, has revised the online listing of IPM providers so that the distinction between companies that have received Eco Wise certification, and individuals that have received the EcoWise certification is clearer (see attached screen shots of web pages):

- EcoWise Certified Service Providers – companies (http://www.ecowisecertified.org/ecowise_find.html)
- EcoWise Certified practitioners – individuals (http://www.ecowisecertified.org/ecowise_find2.html)

We want your company's name to appear on the EcoWise Certified Service Providers list. Our member agencies promote the EcoWise Certified Program locally and through BASMAA's *Our Water, Our World* website (http://ourwaterourworld.org/Quick-Links/Pest-Control-Operators-and-Landscapers). We encourage you to visit http://www.ecowisecertified.org/ecowise_cert_summary.html to find out how your company can become EcoWise Certified.

Thank you for your consideration of this opportunity. Please contact me (info@basmaa.org) or BIRC (BIRC@igc.org) with any questions.

Sincerely,

Geoff Brosseau, BASMAA Executive Director

Bay Area
Stormwater Management
Agencies Association

P.O. Box 2385

Menlo Park, CA 94026

510.622.2326

info@basmaa.org

About EcoWise
Who We Are
EcoWise Standards
Guiding Principles download as pdf (1 p.)
Steps to be Certified (21 pp. pdf)
Quick Summary of Steps download as pdf (2 pp.)
Application Forms
Sample Practice Exam (2 pp.)
Exam Study Guide (28 pp.)
IPM Service Forms
Materials Criteria/Examples (download pdf - 8 pp.)

EcoWise Certified IPM Service Providers

EcoWise Certified IPM Service Providers must demonstrate through a rigorous program of testing, service record reviews, and field audits that they are offering Integrated Pest Management (IPM) services that meet EcoWise Certified standards. EcoWise Certified standards are designed to reduce pesticide exposures to people, pets, and environment. The EcoWise Service Providers listed below can manage ants, roaches, flies, spiders, rodents, stinging insects, bed bugs, and many other pests using proven, effective IPM methods.

Note: EcoWise Certification does not cover termites or other wood destroying organisms.

Be sure to mention EcoWise certification and ask for EcoWise Certified IPM services when you call!

San Francisco Bay Area and Northern California

Screen shot of top of EcoWise Certified IPM Service Providers web page

About EcoWise
Who We Are
EcoWise Standards
Guiding Principles download as pdf (1 p.)
Steps to be Certified (21 pp. pdf)
Quick Summary of Steps download as pdf (2 pp.)

EcoWise Certified IPM practitioners

We also certify individual professionals, who may work for companies that have not completed EcoWise company certification.

When you call these companies, be sure to request services from a certified practitioner listed below, and ask the company to apply for EcoWise certification!

Screen shot of top of EcoWise Certified IPM practitioners web page

Alert Pest Control
182 School Street
Daly City, CA 94014

Best Pest Solutions
1547 Palos Verde Mall, Suite 408
Walnut Creek, CA 94597

Bio-Pest
427 Aaron Street, Suite E
Cotati, CA 97431

Crown And Shield Exterminators
PO Box 4897
Petaluma, CA 94955

Donovan's Pest Control
PO Box 6910
San Mateo, CA 94403

Genesis Building Services
916 S. Claremont St.
San Mateo, CA 94402

Killroy Pest Control (Sensitive Solutions)
1175 Dell Avenue
Campbell, CA 95008

Leading Edge Pest Control
1250 Contra Costa Blvd., Suite 201
Pleasant Hill, CA 94523

Marina Pest Control
150 South Spruce St.
South San Francisco, CA 94080

Orkin Pest Control
3095 Independence Dr., Suite C
Livermore, CA 94551

Orkin Pest Control
377 Oyster Point Blvd., Suite 13
South San Francisco, CA 94080

Pestec San Jose
888 N. First St., Suite G
San Jose, CA 95112

Pest Protection Services
2829 Stamm Drive
Antioch, CA 94509

Sensitive Solutions
1175 Dell Avenue
Campbell, CA 95008

Terminix International
32980 Alvarado Niles Road, Suite 826
Union City, CA 94587

Western Exterminator Company
1320 Marsten Road, Suite D
Burlingame, CA 94010

Western Exterminator Company
3481 Arden Road
Hayward, CA 94545

Western Exterminator Company
30 A Pamaron Way
Novato, CA 94949

Western Exterminator Company
901 76th Avenue
Oakland, CA 94621

Alameda Countywide
Clean Water Program

Contra Costa
Clean Water Program

Fairfield-Suisun
Urban Runoff
Management Program

Marin County
Stormwater Pollution
Prevention Program

Napa County
Stormwater Pollution
Prevention Program

San Mateo Countywide
Water Pollution
Prevention Program

Santa Clara Valley
Urban Runoff Pollution
Prevention Program

Sonoma County
Water Agency

Vallejo Sanitation
and Flood
Control District

B A S M A A

Bay Area

Stormwater Management

Agencies Association

P.O. Box 2385

Menlo Park, CA 94026

510.622.2326

info@basmaa.org

September 30, 2016

Bruce Wolfe, Executive Officer
California Regional Water Quality Control Board, San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

Subject: FY 2015-16 Annual Report: MRP Provision C.9.f - Track and Participate in Relevant Regulatory Processes

Dear Mr. Wolfe:

This letter and attachments are submitted on behalf of all 76 municipalities subject to the requirements of the Municipal Regional Stormwater NPDES Permit (MRP).

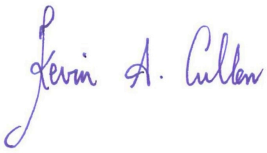
The essential requirements of provision C.9.f (text attached) are to track U.S. Environmental Protection Agency (USEPA) and California Department of Pesticide Regulation (DPR) actions related to urban-uses of pesticides and actively participate in the shaping of regulatory efforts currently underway. This provision allows for cooperation among Permittees through the California Stormwater Quality Association (CASQA), BASMAA, and/or the Urban Pesticide Pollution Prevention Project (UP3 Project) – an approach the Permittees have engaged in for a number of years. Recognizing this approach is the most likely to result in meaningful changes in the regulatory environment, Permittees elected to continue on this course in FY 2015-16 to achieve compliance with this provision. Oversight of this provision is the purview of the BASMAA Board of Directors.

The actual work of tracking and participating in the ongoing regulatory efforts related to pesticides was accomplished through CASQA. CASQA conducted its activities on behalf of members and coordinated funding contributions and activities through its Pesticides Subcommittee, a group of stormwater quality agencies affected by pesticides or pesticides-related toxicity listings, TMDLs, or permit requirements, as well as others knowledgeable about pesticide-related stormwater issues. FY 2015-16 was another productive year for the Subcommittee. The CASQA Pesticides Subcommittee's annual report for FY 2015-16 (attached) provides a comprehensive and detailed accounting of efforts to track and participate in relevant regulatory processes as well as accomplishments related to pesticides and stormwater quality.

We certify under penalty of law that this document was prepared under our direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on our inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of our knowledge and belief, true, accurate, and complete. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

James Scanlin, Alameda Countywide Clean Water Program

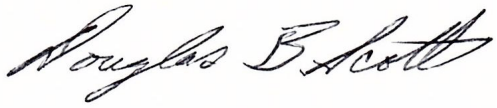
Tom Dalziel, Contra Costa Clean Water Program



Kevin Cullen, Fairfield-Suisun Urban Runoff Management Program

Matthew Fabry, San Mateo Countywide Water Pollution Prevention Program

Adam Olivieri, Santa Clara Valley Urban Runoff Pollution Prevention Program



Douglas Scott, Vallejo Sanitation and Flood Control District

Attachments

MRP Provision C.9.f

Pesticides Subcommittee Annual Report and Effectiveness Assessment 2015-2016; California Stormwater Quality Association; August 2016

FY 2015-16 Annual Report: MRP Provision C.9.f - Track and Participate in Relevant Regulatory Processes

MRP Provision C.9.f states:

C.9.f. Track and Participate in Relevant Regulatory Processes

i. **Task Description –** The Permittees shall conduct the following activities, which may be done at a county, regional, or statewide level:

   (1) The Permittees shall track U.S. EPA pesticide evaluation and registration activities as they relate to surface water quality and, when necessary, encourage U.S. EPA to coordinate implementation of the Federal Insecticide, Fungicide, and Rodenticide Act and the CWA and to accommodate water quality concerns within its pesticide registration process;

   (2) The Permittees shall track DPR pesticide evaluation activities as they relate to surface water quality and, when necessary, encourage DPR to coordinate implementation of the California Food and Agriculture Code with the California Water Code and to accommodate water quality concerns within its pesticide evaluation process;

   (3) The Permittees shall assemble and submit information (such as monitoring data) as needed to assist DPR and county agricultural commissioners in ensuring that pesticide applications comply with WQS; and

   (4) As appropriate, the Permittees shall submit comment letters on U.S. EPA and DPR re-registration, re-evaluation, and other actions relating to pesticides of concern for water quality.

ii. **Reporting –** In their Annual Reports, the Permittees shall summarize participation efforts, information submitted, and how regulatory actions were affected. Permittees who contribute to a county, regional, or statewide effort shall submit one report at the county or regional level. Duplicate reporting is discouraged.

Pesticides Subcommittee Annual Report and Effectiveness Assessment 2015 - 2016

California Stormwater Quality Association

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION®

Final Report

August 2016

Pesticides Subcommittee Annual Report and Effectiveness Assessment

2015-2016

California Stormwater Quality Association

August 4, 2016

Preface

The California Stormwater Quality Association (CASQA) is comprised of stormwater quality management organizations and individuals, including cities, counties, special districts, industries, and consulting firms throughout California. CASQA's membership provides stormwater quality management services to more than 22 million people in California. This report was funded by CASQA to provide CASQA's members with focused information on its efforts to prevent pesticide pollution in urban waterways. It is a component of CASQA's Source Control Initiative, which seeks to address stormwater and urban runoff pollutants at their sources.

This report was prepared by Stephanie Hughes, assisted by Jamie Hartshorn, under the direction of the CASQA Pesticides Subcommittee Co-Chairs Dave Tamayo and Katie Keefe. The Co-Chairs, along with Dr. Kelly Moran of TDC Environmental, provided documents, guidance, and review.

Disclaimer

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Abbreviations Used in this Report

ACS – American Chemical Society
CASQA – California Stormwater Quality Association
CWA – Clean Water Act
DPR – California Department of Pesticide Regulation
EPA – United States Environmental Protection Agency
ESA – Endangered Species Act
FY – Fiscal Year (July 1 through June 30)
MS4 – Municipal Separate Storm Sewer System
OPP – U.S. EPA Office of Pesticide Programs
OW – U.S. EPA Office of Water
PAH – Polycyclic aromatic hydrocarbon
PEAIP – Program Effectiveness Assessment and Improvement Plan
PPDC – Pesticide Program Dialogue Committee
PSC – CASQA Pesticides Subcommittee
SPCB – Structural Pest Control Board
SETAC – Society of Environmental Toxicology and Chemistry
SFBRWQCB – San Francisco Bay Regional Water Quality Control Board
STORMS – Strategy to Optimize Resource Management of Storm Water (a program of the State Water Board)
SWAMP – California Water Boards Surface Water Ambient Monitoring Program
TMDL – Total Maximum Daily Load (regulatory plan for solving a water pollution problem)
UP3 Partnership – Urban Pesticides Pollution Prevention Partnership
USGS – U. S. Geological Survey
Water Boards – California State Water Resources Control Board together with the California Regional Water Quality Control Boards

Pesticides Subcommittee Annual Report and Effectiveness Assessment

2015-2016

California Stormwater Quality Association

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Executive Summary

To address the problems caused by pesticides in California's urban waterways, CASQA collaborates with the California State Water Resources Control Board and the California Regional Water Quality Control Boards (Water Boards) in a coordinated statewide effort, referred to as the Urban Pesticides Pollution Prevention (UP3) Partnership. By working with the Water Boards and other water quality organizations, we address the impacts of pesticides efficiently and proactively through the statutory authority of the California Department of Pesticide Regulation (DPR) and EPA's Office of Pesticide Programs (OPP). More than a decade of collaboration with UP3 Partners, as well as EPA and DPR staff, has resulted in significant changes in pesticide regulation in the last five years. CASQA's 2015-16 activities and outcomes are described in Section 2. This year's highlights include the State Water Board's urban pesticide reduction project (see right) as well the pesticide regulator actions described below.

Urban Pesticide Reduction is a Top Priority of State Water Board

In response to CASQA's efforts, the State Water Board established urban pesticide reduction as a top priority project for 2016 under the comprehensive stormwater strategy it adopted in December 2015, known as "Strategy to Optimize Resource Management of Storm Water" or STORMS. The project recognizes "source control through pesticide regulatory authorities as a primary mechanism for addressing pesticide-caused water quality impairments," which has been a cornerstone of CASQA's goals for addressing pesticides in urban water bodies. As a priority project, it has executive level sponsorship, assigned staff support, and an aggressive timeline. The project is expected to culminate with a 2017 adoption of a statewide Water Quality Control Plan amendment for urban pesticides reduction. *(See Section 2.4.)*

(Near term/Current problems) – Are actions being taken by State and Federal pesticides regulators and stakeholders that are expected to end recently observed pesticide-caused toxicity or exceedances of pesticide water quality objectives in surface waters receiving urban runoff?

- In direct response to continued communication from CASQA and UP3 regarding **fipronil** water pollution in urban areas, DPR has conferred with manufacturers, announced plans to initiate formal regulatory action, and initiated both numeric modeling and experimental studies to validate potential mitigation strategies to reduce fipronil use on impervious surfaces directly flowing to gutters/storm drains. *(See Table 3.)*
- In direct response to continued communication from CASQA and UP3 regarding **pyrethroid** water pollution in urban areas, DPR is expanding its pyrethroid monitoring and enforcement programs, partnering with local governments on a special study to examine non-professional pyrethroid use and to evaluate the effectiveness and level of compliance with State regulations on professional use (the largest pyrethroid source in urban runoff). *(See Table 3 and Section 2.4.)*

- Based on information provided by CASQA, EPA's review of the herbicide **triclopyr** will include urban use (previously overlooked) as well as sales and use data available from DPR. Further, EPA will consider a degradate in its analysis, which may be more toxic than the parent chemical. *(See Table 3.)*
- Based in part on a UP3 request, to support its review of the wood preservative **creosote**, EPA is requiring a "*Leaching study for release of creosote components from creosote impregnated wood*" to better identify the **polycyclic aromatic hydrocarbon (PAH)** species in leachate. *(See Table 3.)*
- In direct response to communication from CASQA and its UP3 Partners, DPR agreed to route three storm drain pesticide product registration applications to its surface water program for review. (While most outdoor urban pesticide registration applications automatically receive surface water review, storm drain antimicrobial products do not.) *(See Table 3.)*
- Due in part to information shared with EPA by CASQA and the Water Boards over the last decade, manufacturers have withdrawn all **tributyltin** products from the urban marketplace *(See Section 2.1.)*

(Long term/Prevent future problems) – Do pesticides regulators have an effective system in place to exercise their regulatory authorities to prevent pesticide toxicity in urban water bodies?

- EPA is currently reworking its water quality risk assessment methods to integrate Endangered Species Act (ESA) compliance. CASQA representatives communicated to EPA the importance of retaining specific elements of a traditional risk assessment. Outcomes cannot yet be assessed. *(See Page 17.)*
- DPR's special study on pyrethroids includes a detailed examination of its systems for regulating urban professional pesticide applicators, with the goal of determining if changes are needed to ensure their effectiveness.
- DPR and the State Water Board initiated an update to their Management Agency Agreement to improve and formalize the systems that the two agencies have in place to work together to prevent pesticide toxicity in California water bodies.
- CASQA prepared comment letters to EPA for 3 pesticide reviews, provided the Water Boards information that triggered 3 additional comment letters, wrote 2 letters to DPR on its registration processes, and participated in numerous meetings and conference calls, focused on priority pesticides and long-term regulatory structure improvements. *(See Tables 3, 4 and 5.)*
- CASQA/UP3 provided presentations to DPR, scientific meetings, and professional associations; served on DPR and Water Board policy and science advisory committees; and prepared and delivered public testimony. *(See Table 5.)*
- CASQA/UP3 reviewed scientific literature in order to update and prioritize the Pesticide Watch List, which it shared with pesticides regulators and with government agency and university scientists to stimulate generation of surface water monitoring and aquatic toxicity data for the highest priority pesticides. *(See Table 2.)*

In FY 2016-2017, CASQA plans to undertake numerous activities to continue to address near-term pesticide concerns and seek long-term regulatory change. Future near-term and long-term tasks are identified in Section 3. Key topics include:

- The immediate need to participate in pyrethroid, fipronil, and imidacloprid regulatory actions (the only such opportunity for these chemicals over the next 15 years).
- The opening of a strategic window of opportunity to improve urban water quality risk assessments created by EPA's revision of its pesticide risk assessment procedures to comply with the ESA.
- A chance to leverage our recent success at the state level and continue to be a key stakeholder in the development of a statewide Water Quality Control Plan amendment for urban pesticides reduction.

Section 1: Introduction

This report by the Pesticides Subcommittee (PSC) of the California Stormwater Quality Association (CASQA) describes CASQA's activities related to the goal of preventing pesticide pollution in urban waterways from July 2015 through June 2016. The PSC works in collaboration with the California State and Regional Water Boards (Water Boards), Partners,[1] and other stakeholders to bring about change in how pesticides are regulated by the United States Environmental Protection Agency (EPA) and the California Department of Pesticide Regulation (DPR), with the goal of ensuring that currently registered pesticides do not impair urban receiving waters. This collaborative effort is referred to as the UP3 Partnership.[2]

1.1 Importance of CASQA's Efforts to Improve Pesticide Regulation

For decades now, the uses of certain pesticides in urban areas – even when applied in compliance with pesticide regulations – have adversely impacted urban water bodies. Under the Clean Water Act (CWA), when pesticides impact water bodies, local agencies may be held responsible for costly monitoring and mitigation efforts. To date, some California municipalities[3] have incurred substantial costs to comply with Total Maximum Daily Loads (TMDLs) and additional permit requirements. In the future, more municipalities throughout the state could be subject to similar requirements, as additional TMDL and Basin Plan amendments are adopted (Table 1). Meanwhile local agencies have no authority to restrict or regulate when or how pesticides are used[4] in order to proactively prevent pesticide pollution and avoid these costs.

Instead, EPA and DPR regulate pesticides, and their regulations in some cases have not adequately protected urban water bodies from adverse effects. Indeed, in 2013, CASQA compiled water and sediment sampling data that bears this out: pollution from some of the newer pesticides – pyrethroids and fipronil – is now present in nearly every urbanized area in California at concentrations above the EPA chronic Aquatic Life Benchmark for aquatic invertebrates in water.[5]

---

[1] Partners: USGS NACWA (national monitoring); other states; Water Board SWAMP (Statewide and 9 regions); DPR; POTWs; urban runoff programs; university researchers; pesticide manufacturers.

[2] The UP3 Partnership collaborations are generally through information sharing, coordinating communications with pesticide regulators, and contributing staff time and other resources in support of the shared goal. The UP3 Partnership is an outgrowth of the UP3 *Project*, a broader effort with activities that are no longer supported.

[3] For example, Sacramento-area municipalities spent more than $75,000 in the 2008-2013 permit term on pyrethroid pesticide monitoring alone; Riverside-area municipalities spent $617,000 from 2007 to 2013 on pyrethroid pesticide chemical and toxicity monitoring.

[4] Local agencies in California have authority over their own use of pesticides, but are pre-empted by state law from regulating pesticide use by consumers and businesses.

[5] Ruby, Armand. 2013. Review of Pyrethroid, Fipronil and Toxicity Monitoring from California Urban Watersheds.

Table 1. California TMDLs and Basin Plan Amendments Addressing Current-Use Pesticides in Urban Watersheds[6]

Water Board Region	Water Body	Pesticide	Status
Statewide	Statewide Water Quality Control Plan amendment for urban pesticides reduction (all MS4s/ all urban waterways)	All	In preparation
San Francisco Bay (2)	All Bay Area Urban Creeks	All Pesticide-Related Toxicity	Adopted
Central Coast (3)	Santa Maria River Watershed	Pyrethroids, Toxicity	Adopted
Central Coast (3)	Lower Salinas River Watershed	Pyrethroids, Toxicity	In preparation
Los Angeles (4)	Marina del Rey Harbor	Copper (Marine antifouling paint)	Adopted
Los Angeles (4)	Oxnard Drain 3 (Ventura County)	Bifenthrin, Toxicity	EPA-Adopted Technical TMDL
Central Valley (5)	Nine urban creeks in Sacramento, Placer, and Sutter Counties (TMDL) Sacramento River and San Joaquin River Basins (Basin Plan Amendment)	Pyrethroids	In preparation
Central Valley (5)	Sacramento River and San Joaquin River Basins	Diuron	In preparation
Santa Ana (8)	Newport Bay	Copper (Marine antifouling paint)	In preparation
San Diego (9)	Shelter Island Yacht Basin (San Diego Bay)	Copper (Marine antifouling paint)	Adopted

For years, CASQA members have creatively tried to work around their lack of regulatory authority over pesticide use by pioneering award-winning public outreach and integrated pest management programs that encourage less-toxic alternatives. Local agencies also conduct collection events for banned pesticide products at their own cost. These "source control" efforts have established an extremely important and growing movement toward less-toxic alternatives; however, these activities fail to sufficiently compensate for the root problem: as currently implemented, pesticide regulatory actions at the state and federal levels do not adequately account for and mitigate potential water quality impacts from urban pesticide uses.

Clearly, if we continue to conduct business as usual, more receiving waters will become impaired by urban pesticide use, and more local agencies will face increased monitoring, TMDLs, and permit requirements for pesticides (Figure 1). ***CASQA is actively engaged with state and federal regulators in an effort to develop an effective regulatory system to identify urban uses of a pesticide that pose a threat to water quality and then restrict or disallow those uses proactively, thereby avoiding water quality impacts (Figure 2).***

[6] Excludes pesticides that are not currently used in meaningful quantities in California urban areas, such as organochlorine pesticides and diazinon and chlorpyrifos.

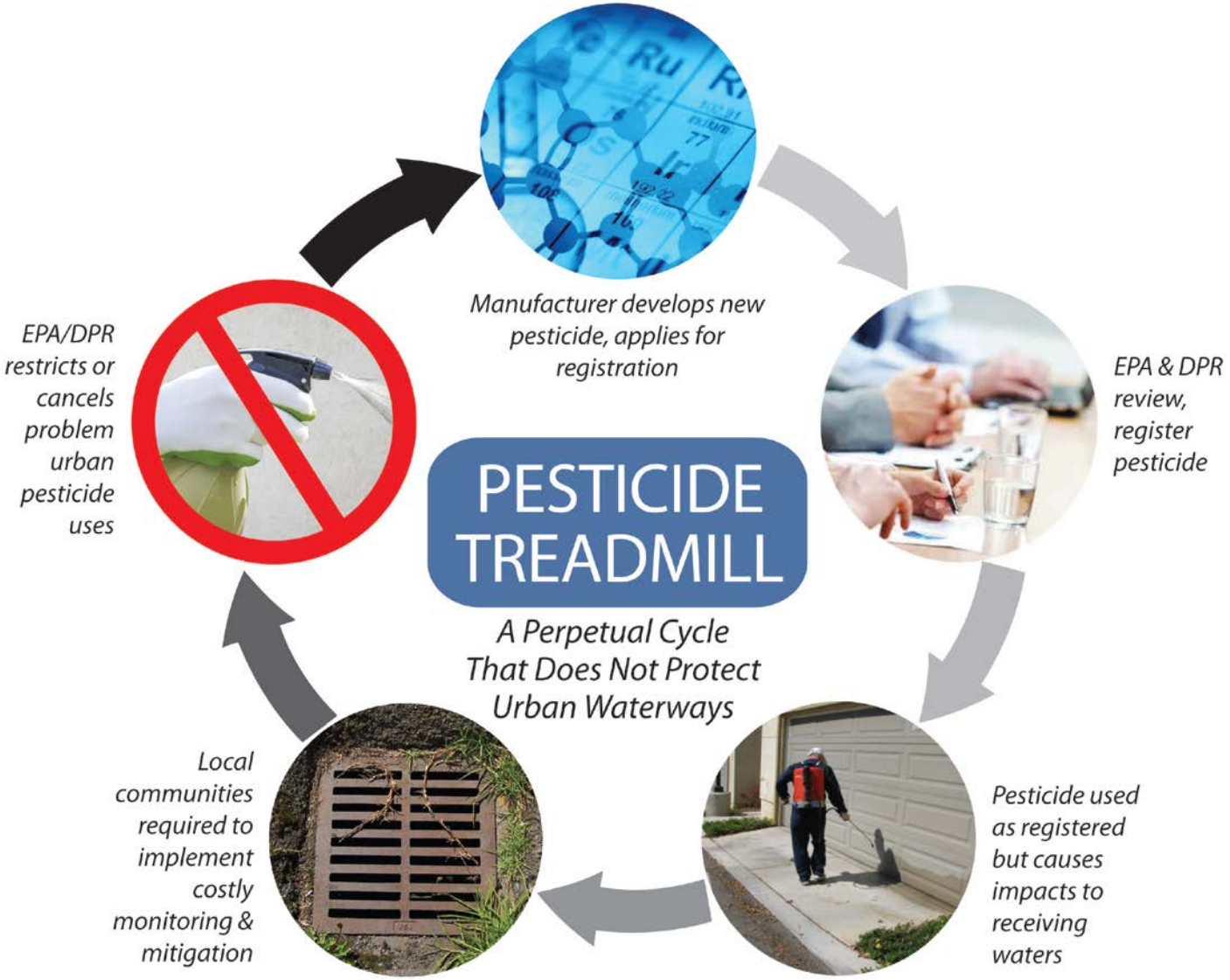


Figure 1. Current Pesticide Regulatory System.[7]

[7] Photo in Figures 1 and 2 of spraying pesticide along a garage was taken by Les Greenberg, UC Riverside.

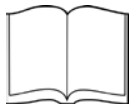
Figure 2. Proactive Use of the Pesticide Regulatory Structure to Restrict Pesticide Uses That Have the Potential to Cause Urban Water Quality Problems.

1.2 CASQA's Goals and Application to PEAIP Management Questions

CASQA's ultimate goal in engaging in pesticide-related regulatory activities is to protect water quality by eliminating problems stemming from urban pesticide use. The CASQA PSC envisions a future when the following goals have been attained:

Goal 1: EPA and DPR will conduct effective, proactive evaluations of pesticide risks. EPA and DPR registration and registration reviews will include effective evaluations for the potential of all pesticide active ingredients and formulated products to impact urban waterways. Staff will understand all urban use patterns, and models will accurately reflect urban use patterns, the impervious nature of the urban environment, drainage systems and pathways to receiving waters. Data required of manufacturers will support proactive evaluations. Cumulative risk assessments will be conducted, especially for pesticides with similar modes of action.

Goal 2: Pesticide regulators and water quality regulators will work in coordination to protect water quality. The Water Boards, DPR, EPA's Office of Water (OW) and OPP will have a consistent definition of what comprises a water quality problem. EPA's OW and OPP will complete "harmonization" of methodologies and approaches to protect aquatic life.



Goal 3: Pesticide regulations and statutes will be used to solve pesticide-related water quality impairments resulting from the registered uses of pesticides. Rather than look to the Clean Water Act, the EPA and Water Boards will work with DPR and the EPA's Office of Pesticide Programs to manage problem pesticides without the use of the costly, slow and burdensome TMDL process.

Goal 4: Pesticide monitoring will be coordinated at the state level to support rapid response to emerging pesticide problems in urban waterways. DPR and the Water Boards will coordinate statewide monitoring to identify emerging pesticide problems in urban waterways before they become widespread and severe. Urban-specific, use-specific mitigation measures will be used to address water quality problems.

The effectiveness of CASQA's efforts toward these goals can be expressed in relation to management questions established as part of MS4s' Program Effectiveness Assessment and Improvement Plans (PEAIP)[8]. With respect to addressing urban pesticide impacts on water quality, the following two management questions, derived from CASQA's goals, are suggested for inclusion in MS4s' PEAIPs:

[8] The Phase II Small Municipal Separate Storm Sewer System (MS4) General Permit Phase II (MS4 Permit) requires the development and implementation of a Program Effectiveness Assessment and Improvement Plan (PEAIP).

Question 1: (Near term/Current problems) – Are actions being taken by State and Federal pesticides regulators and stakeholders that are expected to end recently observed pesticide-caused toxicity or exceedances of pesticide water quality objectives in surface waters receiving urban runoff? (Parallel to CASQA Goal 3)

Question 2: (Long term/Prevent future problems) – Do pesticides regulators have an effective system in place to exercise their regulatory authorities to prevent pesticide toxicity in urban water bodies? (Parallel to CASQA Goal 1, as well as Goals 2 and 4)

This report is organized to answer these management questions, and is intended to serve as an annual compliance submittal for both Phase I and Phase II MS4s. It describes the year's status and progress, provides detail on stakeholder actions (by CASQA and others), and provides a roadmap/timeline showing the context of prior actions as well as anticipated end goal of these activities. This report may also be used as an element of PEAIPs and future effectiveness assessment annual reporting.

Section 2: Results of CASQA 2015-2016 Efforts

To prevent urban water quality impacts from registered pesticide uses, CASQA employs a two-pronged approach:

- Address near-term regulatory concerns (Goal 3)
- Seek long-term changes in the pesticide regulatory structure (Goals 1, 2, and 4)

At any given time there are dozens of pesticides with current or pending actions from the EPA or DPR; therefore CASQA prioritizes regulatory efforts using the pesticide "Watch List" created by the PSC and the UP3 Partnership (Section 2.1). The Watch List aids CASQA and the UP3 Partnership in their prioritization of near-term efforts (Section 2.2). Meanwhile, CASQA and the UP3 Partnership are also working on a parallel effort to effect long-term change in the regulatory process. By identifying inadequacies and inefficiencies in the pesticide regulatory process, and persistently working with EPA and DPR to improve the overall system of regulating pesticides, CASQA and the UP3 are gradually achieving results (Sections 2.3 and 2.4).

2.1 Updated Pesticide Watch List

CASQA, working through the UP3 Partnership, reviews scientific literature and monitoring studies as they are published. This information is used to prioritize pesticides based on urban uses and the latest understanding of surface water quality toxicity (for pesticides and their degradates). The PSC uses these insights to update a Pesticide "Watch List" (Table 2) which serves as a management tool to prioritize and track pesticides used outdoors in urban areas.[9] Two changes have been made since the Watch List was published in the 2014-15 PSC Annual Report – one indicating a rise in prioritization and one deletion.

Imidacloprid (in the "neonicotinoid" (neonic) family) was moved from Priority 4 to Priority 1. OPP is currently reviewing imidacloprid. New scientific information indicates that imidacloprid may have much greater toxicity to sensitive aquatic organisms than previously recognized. Meanwhile, imidacloprid use in California has increased substantially from 1996 through 2012 including products that are broadcast applied to outdoor impervious surfaces (e.g., a perimeter band around buildings to control ants).[10]

Tributyltin was deleted because manufacturers have withdrawn all products from the urban marketplace. Well known for the water pollution associated with its historic use in marine antifouling paint, tributyltin was also used as a preservative for indoor and outdoor

[9] The first Watch List was published by the UP3 in 2010.

[10] Simon-Delso, et al., Systemic insecticides (neonicotinoids and fipronil): trends, uses, mode of action and metabolites. Env. Science and Poll. Research, Vol. 22, 2015.

materials and a biocide with multiple applications. The only remaining federally approved use of tributyltin is for a very narrow application (preserving rubber in military sonar domes and oceanographic instruments). Old tributyltin products are likely to remain in the chain of commerce until used up, but these will eventually disappear.

Table 2. Current Pesticide Watch List (August 2016) [11]

Priority	Basis for Priority Assignment	Pesticides		
1	Monitoring data exceeding benchmarks; linked to toxicity in surface waters; urban 303(d) listings	Pyrethroids (20 chemicals[12])	Fipronil	Imidacloprid (neonic)
2	Monitoring data approaching benchmarks; modeling predicts benchmark exceedances; very high toxicity and broadcast application on impervious surfaces; urban 303(d) listing for pesticide, degradate, or contaminant that also has non-pesticide sources	Carbaryl Chlorantraniliprole Chlorothalonil (dioxins)	Copper pesticides Creosote (PAHs) Dacthal (dioxins) Indoxacarb	Malathion Pentachlorophenol (dioxins) Polyhexamethylenebiguanide Zinc pesticides
3	Pesticide contains a Clean Water Act Priority Pollutant; 303(d) listing for pesticide, degradate, or contaminant in watershed that is not exclusively urban	Arsenic pesticides Chlorpyrifos Chromium pesticides	Diazinon Diuron Naphthenates	Simazine Silver pesticides Trifluralin
4	High toxicity (parent or degradate) and urban use pattern associated with water pollution; synergist for higher tier pesticide; on DPR or Central Valley Water Board priority list	Abamectin Acetamiprid (neonic) Chlorinated isocyanurates DIDAC Dithiopyr Halohydantoins	Hydramethylnon Mancozeb MGK-264 Oxadiazon Oxyfluorfen Pendimethalin Phenoxy herbicides[13]	Piperonyl butoxide Pyrethrins Spinosad/ Spinetoram Thiamethoxam (neonic)[14] Thiophanate-methyl Triclopyr Triclosan
New	New pesticides that may threaten water quality depending on the urban use patterns that are approved	Chlorfenapyr Clothianidin (neonic) Cyantraniliprole	Cyclaniliprole Dinotefuran (neonic) Flupyradifurone	Novaluron Thiacloprid (neonic)
None	No tracking trigger	Most of the 1,000 existing pesticides		
Unknown	Lack of information. No systematic screening has ever been completed for urban pesticides.	Unknown		

[11] The UP3 Partnership also watches two non-priorities pesticides (Glyphosate and Metaldehyde) due to frequent member questions about them.
[12] Allethrins, Bifenthrin, Cyfluthrin, Cyhalothrin, Cypermethrin, Cyphenothrin, Deltamethrin, Esfenvalerate, Etofenprox, Flumethrin, Imiprothrin, Metofluthrin, Momfluothrin, Permethrin, Prallethrin, Resmethrin, Sumethrin [d-Phenothrin], Tau-Fluvalinate, Tetramethrin, Tralomethrin.
[13] MCPA and salts, 2,4-D, 2,4-DP, MCPP, dicamba
[14] Degrades into Clothianidin

2.2. Results of Efforts Addressing Near-Term Regulatory Concerns

CASQA seeks to ensure that the Water Boards and EPA's OW work with DPR and the EPA's OPP to manage problem pesticides that are creating near-term water quality impairments. These efforts address CASQA's Goal 3 as well as PEAIP Management Question 1 regarding observed pesticide-caused toxicity or exceedances of pesticide water quality objectives in surface waters receiving urban runoff.

Immediate pesticide concerns may arise from regulatory processes undertaken at DPR or EPA's OPP. For example, when EPA receives an application to register a new pesticide, there may be two opportunities for public comment that are noticed in the Federal Register, as depicted in green in Figure 3. EPA's process usually takes less than a year while DPR typically evaluates new pesticides or major new uses of active ingredients within 120 days. Now that DPR implements relatively robust surface water quality review procedures for new pesticide registrations, this reduces the need for CASQA to provide input to EPA on new pesticides.

Figure 3. EPA's New Pesticide Registration Process

Another regulatory process, "Registration Review," depicted in Figure 4, is meant to evaluate currently registered pesticides about every 15 years, to account for new data available since initial registration. In general, it takes EPA 5 to 8 years to complete the entire process. EPA regularly updates its schedule for approximately 50 pesticides that will begin the review process in a given year.[15]

Figure 4. EPA's Registration Review – Process to Review Registered Pesticides at a Minimum of Every 15 Years.

[15] See http://www.epa.gov/oppsrrd1/registration_review/schedule.htm for schedule information.

While EPA must consider water quality in all of its pesticide registration decisions, a few outdoor urban pesticide registration applications are not yet routinely routed by DPR for surface water review. In 2015-16, CASQA and its members successfully requested that 3 storm drain products be routed by DPR for surface water review. DPR is considering CASQA's request that all storm drain pesticides be automatically routed for surface water review.

DPR also has an ongoing, but informal review process (called continuous evaluation) that can address pesticides water pollution. If it needs to obtain data from manufacturers, DPR can initiate a formal action, called "Reevaluation." DPR reviews of pyrethroids and fipronil in urban runoff have occurred in response to CASQA and Water Board requests. These have involved ongoing communication with CASQA and the UP3 Partnership.

Table 3 presents a summary of recent UP3 activities and their associated results to address near-term regulatory concerns. All but two of the items listed in Table 3 represent activity conducted by CASQA and Partners during FY 2015-16. The triclopyr and creosote EPA registration review actions represent 2014-15 activities for which we have since obtained responses.

The positive outcomes in Table 3 reflect the success of CASQA's teamwork in the UP3 Partnership. Some of this work occurs during formal public comment periods. To accomplish this, CASQA monitors the Federal Register and DPR's website for notices of regulatory actions related to new pesticide registrations and registration reviews. CASQA watches for pesticides that appear to have any of the following characteristics: proposed urban, outdoor uses with direct pathways for discharge to storm drains, high aquatic toxicity, or containing a priority pollutant. Participating in these regulatory processes can take many years to complete.

Top tier pesticides were the current push for this year, and CASQA concentrated efforts on educating EPA and collaborating with the State Board and DPR on the big picture (next section). Fewer letters were written than in past years, in part because the EPA review schedule did not include any public comment opportunities on the highest priority pesticides and because DPR now routinely routes most new outdoor urban pesticide registration applications for surface water review. The most significant comment letter may have been that for malathion, for which the EPA published a biological evaluation (in response to ESA litigation), rather than a traditional risk assessment. *(See page 17 for details.)* As our comments were just submitted in June, it is too early to discern any outcome.

While CASQA has had considerable success in working with DPR and the Water Board, our mixed results with EPA indicate that there are opportunities for further communications and discussions. ***A major challenge and opportunity in the upcoming fiscal year will be that of working to influence EPA OPP to ensure positive outcomes from its registration reviews of the pyrethroids, fipronil, and imidacloprid***.

Table 3. Results of Recent Efforts Communicating Near-Term Regulatory Concerns[16]

Regulatory Action or Concern	CASQA Efforts			Partner Support	Outcomes and notes
	Letter(s)	Call(s)	Mtg(s)		
DPR					
Fipronil and Pyrethroids			✓		***Promising.*** In February 2016, CASQA and Water Board representatives met with DPR for an update regarding its fipronil and pyrethroid activities. DPR has decided to pursue mitigation of fipronil during 2016. The next update will be in summer 2016.
Indoxacarb product application process				SFBRWQCB	***Success!*** DPR agreed to route this registration application to its surface water program for review.
Oblitiroot Dichlobenil storm drain product	✓				***Success!*** DPR routed this registration application to its surface water program for review.
Fabguard registration application				SFBRWQCB	***Success!*** DPR routed this registration application to its surface water program for review.
Registration applications – all storm drain products – request automatic routing for surface water review	✓				***Pending***
EPA					
Pyrethroids Registration Review				UP3	***Pending.*** In September 2015, UP3 representative spoke with EPA to continue to share information and insights with OPP to assist it with developing a scientifically sound, complete, straightforward risk assessment that provides a solid basis for identification of specific risk management measures. (Instead of completing 18 separate water quality risk assessments for 18 pyrethroids, OPP will prepare a joint risk assessment that it anticipates releasing for public review in September 2016.)
Fipronil Registration Review		✓		UP3	***Pending.*** CASQA is continuing to provide information and insight via teleconference meetings and emails; the preliminary risk assessment is anticipated in December 2016.

[16] Color coding in this table is meant to reflect the "Watch List" prioritization color coding in Table 2.

Regulatory Action or Concern	CASQA Efforts			Partner Support	Results and notes
	Letter(s)	Call(s)	Mtg(s)		
Creosote Registration Review				SFBRWQCB	***Partial Success***. While the EPA originally focused on only 8 PAHs (and associated 303(d) listings), we requested that the toxicity associated with any PAHs be reviewed in order to better understand the water quality impacts of these chemical mixes. Based in part on our request, the EPA is requiring a "*Leaching study for release of creosote components from creosote impregnated wood*" to better identify leachate composition. The risk assessment will use the information from these studies as well as any relevant open literature to assess acute and chronic risks of creosote leached from wood structures. While this still does not address mixes of PAHs that may be in a water body due to a variety of sources, including creosote, EPA is attempting to more accurately characterize the leachate.
Ziram and Chromated Arsenicals Preliminary Workplan				SFBRWQCB	***Negative outcome.*** While we requested that workplans for metal-based pesticides reflect the many related 303(d) listings and TMDLs associated with these metals, the EPA concluded that zinc is not a degradate of ziram so will not include zinc 303(d) listings. Further the EPA appears to only consider the locations where the wood product is treated with the chemical rather than the eventual location of the treated wood (e.g., treated wood placed in water).
Malathion Biological Evaluation (Registration Review risk assessment substitute document)	✓	✓		BACWA SFBRWQCB	***Pending***. We cited numerous concerns as it appears that the EPA intends to use an onerous and largely not replicable Biological Evaluation (part of an ESA consultation) as a replacement for the typical risk assessment in Registration Review. See the detailed discussion on page 17.
Diuron Registration Review Preliminary Workplan	✓				***Pending***. EPA virtually ignored urban uses despite DPR's database indicating that urban uses, particularly for rights-of-way, are quite significant. We provided these data and further requested that use patterns and leaching rates from paints, caulks, and sealants be included in modeling, particularly for urban areas, so that mitigation opportunities can subsequently be identified. We also requested that urban uses be accurately modeled to assess their fate and transport from application sites to receiving waters.

Regulatory Action or Concern	CASQA Efforts			Partner Support	Outcomes and notes
	Letter(s)	Call(s)	Mtg(s)		
Triclopyr Registration Review Workplan	✓				***Success***. Triclopyr is among the most commonly detected pesticides in urban watersheds and is a DPR urban monitoring priority. The draft EPA work plan appeared to be unaware of urban uses and data available from DPR. The CASQA letter also drew attention to the issue of persistent toxic degradates. EPA's response indicates they will recognize the urban uses of triclopyr and look more thoroughly at its degradate, TCP, which may be more toxic than the parent chemical.
Chlorfenapyr Proposed Interim Reregistration Review Decision	✓			SFBRWQCB	***Pending.*** We requested that the labeling be consistent with that of pyrethroids to avoid a pre-construction exposure pathway, and mitigate potential contamination from outdoor uses generally, while maintaining the chemical as a pest control option in urban areas.

EPA's Response to ESA Litigation May Impact Risk Assessment Process

In response to ESA litigation, the EPA released a set of documents in April for public comment: "Draft Biological Evaluations: Chlorpyrifos, Diazinon, and Malathion Registration Review." Such biological evaluations (BEs) are part of an ESA consultation process. CASQA is pleased that the EPA and the Fish and Wildlife Service (FWS) are cooperating to address endangered species in pesticide registration review but we have the following concerns that this may undermine the traditional risk assessment process:

1. **The BEs did not address sensitive aquatic species.** In a traditional risk assessment, sensitive non-endangered species (particularly aquatic invertebrates) are identified and considered in order to develop appropriate mitigation measures protective of all species.
2. **The BE approach may create a regulatory gap for agencies with CWA permits.** The EPA's OW develops water quality criteria to be protective of aquatic ecosystems, i.e., all organisms and their supportive habitat, including endangered and non-endangered species. Rather than use EPA's own water quality criterion, the malathion BE used an effects threshold well above it. Further, the EPA's water quality criterion is far lower than the estimated environmental concentration in virtually every model scenario in the draft BE and lower than surface water concentrations occasionally measured in both urban and agricultural areas.
3. **The BE approach does not provide an opportunity to publicly comment on environmental risks and subsequent mitigation analysis.** Typically a risk assessment is the last opportunity for public comment prior to the Registration Review decision. If EPA employs a BE in the place of a risk assessment, then it is possible that assessment of environmental risks (which forms the essential groundwork for development of mitigations) could be outside of a public discourse.
4. **The profoundly detailed analysis will not be replicable for the vast majority of urban pesticides.** EPA indicated that these BEs are meant to be the pilot for a new ESA consultation process. However, the analysis completed is unlikely to set the stage for future ESA pesticide consultations because the extent of the ecotoxicity data will not be matched for most other pesticides, for which only a small set of aquatic toxicity data are available.
5. **Urban uses were not handled in a manner that will lead to practical and effective mitigation measures.** In the BEs, urban and agricultural information were not addressed separately. Due to differences in use patterns and transport pathways, urban areas require customized risk assessments and mitigation strategies. Unless risk assessments separate urban and agricultural areas, EPA will not obtain an understanding of the factors in the use of a pesticide (e.g., application surface, quantity, timing) that link to instances of water pollution. Without this understanding, EPA lacks the scientific insights to support development of practical and effective urban mitigation strategies.

Since EPA has indicated it is considering modifying its Registration Review process based on its experience with these draft BEs, CASQA views this as a strategic opportunity to engage EPA in a dialogue regarding this this pilot process and its relationship to OPP's Registration Review process.

2.3 Long-Term Change in the Pesticides Regulatory Structure

CASQA continues to work towards a future in which the regulatory structure proactively restricts pesticide uses that have the potential to cause urban water quality problems. These efforts directly relate to PEAIP Management Question 2: "Do pesticides regulators have an effective system in place to exercise their regulatory authorities to prevent pesticide toxicity in urban water bodies?"

There are several processes currently under way at both EPA and DPR that will move us closer to that future. Many of these processes were prompted by the persistent work of CASQA and the UP3 Partnership to educate regulators on the problems with current approaches. Table 4 presents a summary of 2015-16 outcomes achieved and identifies issues that need to be addressed to achieve CASQA's goals.

Table 5 presents the communication, educational outreach, and advisory efforts of the past year. In the next year, CASQA will continue to educate diverse audiences on the nexus of urban pesticide regulation and water quality and the key scientific issues involved in identifying, addressing, and preventing pesticides water pollution.

Table 4. Latest Outcomes and Next Steps Regarding Long-Term Regulatory Change (5 pages)

Goal	Agency	Topics Influenced	Latest (2015/16) Outcomes	Remaining Issues to Address to Achieve CASQA Goals
1 – Effective, Proactive Evaluations of Pesticide Risks	DPR	Pesticide registration application routing for surface water evaluations	Most outdoor urban pesticide registration applications are automatically routed for surface water review, but storm drain products are not yet part of the automatic routing. DPR continued to route registration applications for surface water review in response to emailed or written requests by CASQA/UP3.	Surface water evaluation automatically conducted for all outdoor, uncontained pesticides. More transparent DPR registration notices. Aquatic toxicity and environmental fate data requirements sufficient to support quantitative evaluation of pesticides and degradates in water and sediment. Regulatory authority for outdoor pesticide-impregnated materials.
		Pesticide Registration Surface Water Evaluation	DPR added an urban module that explicitly addresses impervious surfaces and other key characteristics of urban environments.[17]	Finalize methodology modifications to address stable, toxic degradates. Improve methods to model the full range of outdoor urban pesticide applications, and improve urban runoff modeling accuracy (see below).
		Urban Runoff Modeling	DPR published a California urban modeling scenario to use with existing EPA models and continued working on more detailed urban runoff modeling.	More accurate urban runoff modeling of all outdoor urban pesticide applications through the full life cycle of the pesticide and its environmentally relevant degradates. Consideration of product formulation.
		Chemical analysis methods	DPR required chemical analysis methods for some new pesticides and continued work with state laboratories on new methods to support monitoring priorities.	Chemical analysis methods suitable for commercial laboratories measuring environmental samples for all currently registered UP3 priority pesticides and their stable degradates for which commercial lab methods are not available.

[17] Luo, Y. (2014). *Methodology for Evaluating Pesticides for Surface Water Protection III. Module for Urban Scenarios.* Calif. Department of Pesticide Regulation, Sacramento CA.

Goal	Agency	Topics Influenced	Latest (2015/16) Outcomes	Remaining Issues to Address to Achieve CASQA Goals
1 – Effective, Proactive Evaluations of Pesticide Risks	EPA	Pesticide environmental fate & aquatic toxicity data requirements	OPP expanded requirements for sediment toxicity data, used predictive methods to justify important new requirements for environmental fate and toxicity data for key degradates, and required salt water aquatic toxicity data more often.	Establish systems to require all data necessary to establish water quality criteria and protective levels for sediments, potentially through new water quality criteria development methodologies based on limited data sets or computational methods.
		Urban Runoff Modeling	No changes.	In the short-term, use the DPR California scenario when modeling urban runoff, and integrate all of the pathways by which a pesticide can reach MS4s into pesticide reviews for pesticides other than antimicrobials. In the long term, more accurately model all outdoor urban pesticide applications through the full life cycle of the pesticide and its environmentally relevant degradates.
		Effects Assessment	The EPA updated its water quality benchmarks and sediment toxicity concentration reference values for fipronil and degradates and for pyrethroids.	
		Effects Assessment	OPP started to include sediments in risk assessments on a routine basis.	Use the same methods that EPA OW uses for identifying surface water impairment as significance standards in pesticide environmental risk assessments.
		Risk Management Decisions	No changes.	Make Clean Water Act compliance a fundamental goal of OPP risk management decisions. Include water quality compliance costs in OPP's cost-benefit analyses.

Goal	Agency	Topics Influenced	Latest (2015/16) Outcomes	Remaining Issues to Address to Achieve CASQA Goals
2 – Coordination Between Pesticide Regulators and Water Quality Regulators	DPR & Water Boards	Effects assessment	DPR determined that exceedances of OPP benchmarks warrant mitigation responses.	Since some benchmarks are higher than water quality criteria, agreement is needed among DPR, Water Boards, and EPA OW on criteria for identifying surface water impairment requiring mitigation by pesticides regulators.
		Pesticide Management requirements in Permits	The State Water Board has initiated an urban pesticide reduction project. By December 2016, Board staff is poised to develop language for a Water Quality Control Plan amendment targeting urban pesticides.	CASQA needs to ensure that the Board continues to include "minimum source control efforts" for MS4s and recognizes the need for DPR and EPA to take the lead in addressing pesticides in urban water bodies.
		Pesticide TMDLs	Adopted Santa Maria River pyrethroids TMDL and proposed Salinas River and Central Valley pyrethroids TMDL recognize that DPR and EPA should be lead in addressing pesticides. Central Valley's proposed regulatory approach includes MS4 monitoring and numeric triggers that would require implementation of management plans, including education and outreach and coordination with DPR.	Ensure that all future urban pesticide TMDLs and permits continue to recognize the need for DPR and EPA to take the lead in addressing pesticide water pollution and provide reasonable responsibilities for MS4s.
	EPA	Effects Assessment	The nearly completed OW-OPP Common Effects Assessment project remained stalled. OW kicked off a process to review its 1985 Guidelines for developing water quality criteria and invited OPP's participation.	Complete and implement common effects assessment methodology, which could be integrated into the OW water quality criteria methodology update process. Modify OPP and OW procedures to provide for consistent time frames for water quality assessments.

Goal	Agency	Topics Influenced	Latest (2015/16) Outcomes	Remaining Issues to Address to Achieve CASQA Goals
3 – Use of Regulations and Statutes to Solve Pesticide-Related Impairments	DPR	Pyrethroids	DPR's monitoring and enforcement programs are partnering with the Placer County Agricultural Commissioner and the City of Roseville to examine non-professional use of pyrethroids and DPR's urban regulatory programs *(See Section 2.4)*. DPR continued monitoring and other work to evaluate the effectiveness and level of compliance with the regulations.	Increased enforcement and follow up actions as necessary to achieve water quality improvements and eventually end pyrethroids-caused toxicity in California urban watersheds
		Fipronil	DPR has decided to take action to reduce fipronil in urban runoff. DPR has both numeric modeling (DPR staff) and experimental studies (UC Riverside) underway to validate potential mitigation strategies to reduce fipronil use on impervious surfaces directly flowing to gutters/storm drains. Although DPR has announced its intent to develop regulations, it is meeting with manufacturers and is still hopes that the two manufacturers of structural pest control products will voluntarily agree to change product labels.	Implementation of any mitigation actions necessary to reduce concentrations of fipronil and degradates below benchmarks / toxic concentrations in in California urban watersheds.
	EPA	Pyrethroids and Fipronil Registration Reviews	EPA is continuing its single risk assessment for all pyrethroids	EPA implementation of actions to mitigate risks associated with products not readily regulated by DPR (consumer products, impregnated materials). Clear label language consistent with DPR regulations and DPR's agreement with bifenthrin manufacturers for extra mitigation measures.

Goal	Agency	Topics Influenced	Latest (2015/16) Outcomes	Remaining Issues to Address to Achieve CASQA Goals
4 – Coordinated State Monitoring to Support Response to Emerging Problems	DPR & Water Boards	Coordinated Pesticides Monitoring in Urban Watersheds.	The State Water Board and DPR continued coordinated urban monitoring for pyrethroids and fipronil. The scope for the anticipated State Water Board's Urban Pesticide Reduction Project includes coordinating pesticide/toxicity monitoring.	Full coordination of California's pesticides/toxicity monitoring programs at DPR and the Water Boards and direct linkage of these programs with reasonable MS4 pesticides monitoring requirements.

Table 5. Communication, Education, and Advisory Efforts to Support CASQA's Goals

Agency or Conference	Latest Outcomes
DPR's Pest Management Advisory Committee (PMAC)	***Success!*** Participation on the PMAC has resulted in continued focus by DPR on urban pest management and water quality issues and generated funding for urban integrated pest management programs. DPR's Pest Management Alliance Grants, for which the PMAC reviews proposals, continues to include urban IPM as an eligible category. Two of the projects invited to submit full proposals focused on urban pest management issues (Argentine ant control and pollinator protection in urban landscape), although no urban projects were recommended by the PMAC for funding by DPR.
Cal-EPA's Urban Pesticide Reduction Project	***Promising.*** PSC is participating in on-going work-teams with DPR and Water Board staff to develop the statewide framework for urban pesticide reduction. Anticipate next steps in 2016 and final outcome in 2017.
US EPA's advisory committee, Pesticide Program Dialogue Committee (PPDC)	A PSC member has served on this OPP external stakeholder advisory committee in the past; there is not currently a PSC member on the committee.
California Structural Pest Control Board (SPCB)	***Success!*** A PSC member is an appointed member of the SPCB. The SPCB recognizes the potential for excessive pesticide application to impact water quality. The SPCB approved adoption of regulations to increase continuing education hours required for IPM. The rulemaking process is on hold pending evaluation of the effect of proposed US EPA training requirements for applicators of restricted materials. The SPCB also began consideration of mechanisms, such as increased auditing, to ensure the quality of continuing education courses
University of California Statewide IPM (UCIPM)	***Success!*** A PSC member was appointed to UCIPM's Strategic Planning Committee. Resulting final draft strategic plan includes key actions to "expand efforts to reach urban IPM clientele." PSC member was appointed to selection committee for new UCIPM Director. Next steps to include meeting with incoming UCIPM director and Urban Associate Director to ensure awareness of and continued attention to CASQA issues regarding urban pesticides and pest management issues.
CASQA Conference	Presentation at conference by the City of Santa Barbara Creeks Division: "Neonicotinoid Pesticides: Not Just a Bee Problem" (Oct. 21) The objective was to inform members that neonicotinoid pesticides are widespread in urban runoff and potentially causing chronic, cumulative toxicity in receiving waters.
State of the Estuary Conference (SF)	Presented scientific poster: "Fipronil Water Pollution and Its Sources" (Sept. 17)

As presented in Tables 4 and 5, CASQA has been actively involved in guiding pesticide regulations in order to protect urban water quality. While we have indeed witnessed some progress towards our four management goals, there are numerous gaps and barriers that remain. Figure 5 seeks to present CASQA's perception of the regulatory situation at the state and federal level, relative to each of CASQA's long-term goals. The PSC has witnessed great improvements in a collaborative approach to protect urban water quality, particularly at the state level. It appears that the primary challenges and opportunities for success lie at the federal level, facilitating communication between OPP and OW to dovetail each of their efforts into the coordinated efforts within the state.

Figure 5. CASQA's Assessment of Recent Progress and Remaining Gaps Relative to Long-Term Goals[18]

CASQA's Long-Term Goals	Progress Assessment	Assessment Basis
	Maximum possible: 5 drops	
DPR and State Programs		
1. Effective proactive evaluations	💧💧💧💧	*DPR is utilizing effective WQ modeling and screening mechanisms as part of its registration process. The overall process has a high likelihood of identifying problem chemicals in advance of registration.*
2. Coordinated regulatory bodies	💧💧💧💧	*Via STORMS, State Water Board is developing an Urban Pesticide Reduction Plan to incorporate reliance on DPR and OPP as the primary mechanisms for addressing pesticide impacts. The Board's goals include minimum source control efforts for MS4s.*
3. Effective use of regulations and statutes to solve and prevent pesticide impairment	💧💧💧💧	*In response to pyrethroids, DPR has established surface water protection regulations and is actively evaluating compliance and effectiveness. DPR is responding in a timely manner to identified fipronil issues.*
4. Coordinated state monitoring	💧💧💧💧	*DPR established statewide surface water surveillance monitoring for timely detection of water quality problems, has begun coordination with State Water Board. The State Water Board's Urban Pesticide Reduction Plan is expected to further elucidate a coordinated monitoring approach.*
EPA OPP and OW Programs		
1. Effective proactive evaluations	💧💧	*OPP has improved some of its registration processes (risk assessments, data requirements) for individual chemicals, but needs to make these improvements more consistent for all urban use chemicals, and for all divisions. OPP should adopt better modeling, similar to what DPR has developed. In making final registration decisions, OPP does not consistently give adequate weight to identified urban water quality impacts. OPP registration processes need to address the use phase of pesticide-impregnated materials (e.g., paint and other outdoor building materials).*
2. Coordinated regulatory bodies	💧💧	*OPP has made significant progress with OW on common effects methodology (evaluation of toxic effects), but work on this has stalled for the last several years.*
3. Effective use of regulations and statutes to solve and prevent pesticide impairment	💧💧💧	*OPP has accelerated and coordinated registration review for pyrethroids, although it has not yet committed to utilizing the best evaluation methods for this entire class, as recommended by CASQA.*

LEGEND

💧 The number of drops, out of 5 possible, is intended as a *qualitative* representation of our overall perception of progress in the regulation of pesticides, relative to CASQA's long-term goals.

[18] These goals have been adapted from the CASQA document, "End Goals for Pesticide Regulatory Activities," 2014. Goal 3, above, is directly tied to Goals 2, 4, and 5 of that document.

2.4 Highlights in California

The most significant changes in pesticide regulation have been with DPR and its coordination with the Water Boards, CASQA, and the UP3 Partnership. In particular, the state's Urban Pesticide Reduction Project and DPR's review of the implementation of its urban surface water protection pyrethroids regulations are examples of state resources now being devoted to both the management and scientific evaluation of pesticide impacts to urban waterways.

Urban Pesticide Reduction Project

The State Water Board established urban pesticide reduction as a top priority project for 2016 under the comprehensive stormwater strategy it adopted in December 2015, known as "Strategy to Optimize Resource Management of Storm Water" or STORMS.[19] To date, the State Board is demonstrating commitment through policy as well as staffing, management support, executive sponsorship and involvement, and an aggressive timeline. This commitment by the State Water Board stems from a November 2014 workshop that it held, in response to CASQA's request, to review collaboration with DPR toward resolving and preventing adverse water quality impacts associated with urban-use pesticides.

> *"The goal of this Urban Pesticides Reduction project is to establish statewide source control efforts for pesticides in urban storm water. The main project deliverable is a statewide Water Quality Control Plan amendment for urban pesticides reduction, which will establish a program of implementation for urban pesticide (and related toxicity) water quality standards (numerical and narrative water quality objectives and antidegradation) that will recognize source control through pesticide regulatory authorities as a primary mechanism for addressing pesticide-caused water quality impairments."* [20]

The current project scope directly correlates to CASQA's goals illustrating that the State Water Board is poised to embrace CASQA's vision for pesticide control. The project is planned to culminate with a 2017 adoption of a statewide Water Quality Control Plan amendment for urban pesticides discharges that will:

(1) Recognize one of the primary mechanisms for urban pesticide pollution prevention is through use management under the authority of agencies that regulate pesticide use.
(2) Establish a framework for working with DPR and U.S. EPA OPP to improve pesticide evaluation and mitigation processes.

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[19] STORMS' overall mission is to "lead the evolution of storm water management in California by advancing the perspective that storm water is a valuable resource, supporting policies for collaborative watershed-level storm water management and pollution prevention, removing obstacles to funding, developing resources, and integrating regulatory and non-regulatory interests." (http://www.waterboards.ca.gov/water_issues/programs/stormwater/storms/)
[20] http://www.swrcb.ca.gov/water_issues/programs/stormwater/storms/obj6_proj6a.shtml

(3) Establish a framework for coordinating pesticide/toxicity monitoring by appropriate agencies.
(4) Establish minimum source control efforts for urban storm water permittees.

CASQA, on invitation of State Water Board staff, is an active participant in a stakeholder committee tasked with fleshing out this project. Water Board Regions 2 and 5, DPR, U.S. EPA Region 9, and CASQA are all meeting regularly and frequently with the State Board to move this along expeditiously. Because most participants have been working together effectively for years on this subject (prior to STORMS) the program is moving ahead rapidly and effectively. We are now at a critical point, at which continued effective engagement by CASQA PSC will help ensure that key elements of CASQA's vision for pesticides are fully supported and institutionalized in state policy and procedures.

DPR's Review of Urban Surface Water Protection Pyrethroids Regulations Implementation

DPR has initiated a comprehensive effort to review and evaluate the implementation of its urban surface water protection pyrethroids regulations, including both the "preventive" components (such as local outreach and management practices to reduce runoff) and the "responsive" components (including mitigation options and regulatory approaches). A recent key part of these efforts is a special study in which DPR has partnered with the City of Roseville and the Placer County Agricultural Commissioner to evaluate urban bifenthrin use.[21] The bifenthrin study focuses on all major aspects of DPR's urban regulatory programs including use, compliance and enforcement, and reporting (Table 6). This focused project is expected to provide considerable insight on DPR's urban programs that may lead to statewide actions.

Table 6. DPR's Bifenthrin Study Is Evaluating Both Preventive and Responsive Approaches [22]

Identified Objectives of the DPR Bifenthrin Evaluation	Preventive Components (data quality, training, outreach)	Responsive Components (mitigation and enforcement)
1) Investigate potential errors in the Pesticide Use Reporting (PUR) bifenthrin data.	✓	
2) Determine trends in PCB bifenthrin use in urban Placer County.	✓	
3) Identify bifenthrin products available to non-professional users.	✓	
4) Identify and evaluate contributions of potential sources of bifenthrin not addressed by 3CCR 6970 to urban runoff load. [23]	✓	
5) Assess the level of 3CCR 6970 compliance by professional applicators.		✓
6) Assess consistency and adherence of bifenthrin labels to DPR's MOA with registrants for designated bifenthrin products.		✓

[21] Bifenthrin is the pyrethroid most frequently detected above toxicity thresholds in urban monitoring studies.
[22] http://www.cdpr.ca.gov/docs/emon/pubs/protocol/study303_pyrethroids.pdf
[23] 3CCR 6790 refers to the California Code of Regulations, Surface Water Protection in Outdoor Nonagricultural Settings.

Section 3: CASQA's Approach Looking Ahead

At any given time, EPA and DPR may be in the process of evaluating and registering various pesticides for urban use. To address near-term concerns that may arise out of these ongoing pesticide regulatory processes, CASQA and the UP3 Partnership continuously track and engage in EPA and DPR activities. Typically, these efforts press for changes in an individual product's registration or request that regulators obtain more data from manufacturers. CASQA and the UP3 Partnership are also working on a parallel effort to effect long-term change in the regulatory process, often using specific regulatory actions as educational opportunities on long-term issues.

In the coming year, CASQA plans to undertake numerous activities to both address near-term pesticide concerns and seek long-term regulatory change.[24] Meeting our end goals at the federal level continues to be critical to the achievement of our end goals for addressing pesticides. In FY 2016-2017, we propose to increase engagement at the federal level while continuing our critical "end game" activities at the state level. This is in response to:

- the immediate need to participate in pyrethroid, fipronil, and imidacloprid regulatory actions (the only such opportunity for these chemicals the next 15 years);
- the opening of a strategic window of opportunity created by OPP's requirements to revise risk assessment procedures under the ESA; and
- a chance to leverage our recent success at the state level.

CASQA's current priority activities are as follows:

(1) Continue collaboration with DPR to address near-term regulatory concerns, while seeking OPP and OW actions to reduce inconsistencies:

- Obtain DPR action on fipronil water pollution
- Ensure DPR enforces mitigation measures for pyrethroids and adopts additional measures if necessary
- Ensure the state continues to conduct surveillance monitoring to evaluate pyrethroids (and fipronil) mitigation effectiveness
- Initiate discussions with DPR on imidacloprid water pollution. To support these discussions, develop a conceptual model of imidacloprid sources in urban runoff and work with UP3 partners to assemble scientific publications with relevant toxicity and monitoring data.

[24] Activities in 2017 are subject to available funding.

- Encourage EPA to establish scientific groundwork for implementation of pyrethroids, fipronil, and imidacloprid mitigation measures, in case necessary mitigation cannot be implemented entirely by DPR

(2) Seek long-term changes in the pesticide regulatory structure:

- Leverage our recent success at the state level and continue to be a key stakeholder in the STORMS project that is developing a statewide Water Quality Control Plan amendment for urban pesticides reduction. Through this process, seek restructuring of California's urban surface water pesticides monitoring to increase its effectiveness and improve coordination.
- Seek procedure changes such that EPA avoids approving new pesticides that cause urban water pollution and DPR refines its registration procedures to address gaps in water quality protection.
- Encourage EPA to develop robust urban surface water risk assessment procedures for pesticide reviews
    - Focus on priority pesticides, particularly the pyrethroid family, fipronil, and imidacloprid, for which there will be public input opportunities
    - Focus on completing effort to improve OPP urban runoff modeling procedures and continued efforts regarding consistency with OW regarding effects assessment and risk assessment timeframes
    - Discourage OPP's apparent approach of substituting ESA consultation for a typical risk assessment, but use the ESA Consultation process as an opportunity to improve OPP surface water risk assessment procedures

CASQA will continue to coordinate with the Water Boards through the UP3 Partnership to take advantage of efficiencies, increase effectiveness, and ensure that the water quality community has a consistent message. The details regarding the types of activities that CASQA and the UP3 Partnership engage on an ongoing basis in are presented Table 7. Table 8 presents upcoming regulatory action items that are likely to proceed in the coming year.

CASQA looks forward to working with our Partners to continue towards proactive management to protect water quality.

Table 7. Types of Activities Undertaken to Address Immediate Pesticide Concerns and Long-term Regulatory Change (3 pages)

Activity		Purpose	Level of Effort
Regulatory Tracking	Track Federal Register notices	Identify regulatory actions that may require review.	Daily review; analyze EPA's scientific work and provide notification to CASQA members and partners as needed.
	Track DPR notices of registration applications and decisions	Identify pesticides meriting surface water review that are not within DPR's automatic routing procedures, identify gaps or potential problems with current DPR evaluation or registration plans other regulations, procedures & policies.	Weekly review; obtain water quality assessments from DPR through public record requests; analyze and provide notification to CASQA members and partners as needed.
	Track activities at the Water Boards	Identify opportunities for improvements in TMDLs, Basin Plan Amendments, and permits.	Often weekly phone calls with Water Board staff; weekly review of noticed proceedings; review scientific information.
	Review regulatory actions, guidance documents, and work plans	Identify potential problems with current EPA evaluation or registration plans, other regulations, procedures, and policies.	According to need as identified by tracking activities (average of 6 per month).
Regulatory Communications	Briefing phone calls, informal in-person meetings, teleconference meetings, and emails with EPA and DPR	Information sharing about immediate issues or ongoing efforts; educate EPA and DPR about issues confronting water quality community. Provide early communication on upcoming proceedings that help reduce the need for time-intensive letters.	As needed, but often several times per week. In-person meetings with DPR and EPA Region 9 approximately quarterly and OPP about 1-2 times per year (due to budget limitations, these are always in association with advisory committee meetings and scientific conferences).
	Convene formal meetings, write letters and track responses to letters	Ensure current pesticide evaluation or registration process addresses potential water quality concerns, and take advantage of opportunities to formally suggest solutions to shift regulatory process in the future. Request and maintain communication on mitigation actions addressing highest priority pesticides.	Typically engage with regard to a dozen or so pesticides annually that could pose threats to water quality if EPA or DPR does not initiate certain procedures. Letters vary in length, but often are many pages and require many hours to write. As dockets are updated, review responses to comments and identify next opportunities. 4-6 meetings per year with DPR on mitigation actions.
Advisory	Serve on EPA, DPR, and Water Board policy and scientific advisory committees	Provide information and identify data needs and collaboration opportunities toward development of constructive approaches for managing pesticides.	Two to six meetings per committee per year. The PSC is currently represented on DPR's external advisory committee and has sporadic representation on water board panels related to pesticides.
Educational	Presentations to and informal discussions with EPA, DPR, Water Board, CASQA members, pesticide manufacturers, water quality researchers, and other collaborators.	Educate EPA, DPR, Water Board, and CASQA members about the problems with existing pesticide regulatory process, encourage change, report on achievements. Encourage research and monitoring programs to address urban runoff data needs and priorities. Stimulate academic, government, or	As many as a dozen opportunities to present at water quality, pesticides and chemical conferences nationally. Additional 8-10 opportunities per year for state and regional events. Informal interactions weekly. Budget limits participation to just a few formal events because preparation of presentations and coordination with water quality community can take as

Activity		Purpose	Level of Effort
		private development of analytical and toxicity identification methods to address anticipated urban runoff monitoring needs. Inform development of new pesticides by manufacturers and selection of pesticides by professional users.	much as 40 hours per opportunity.
	Developing and delivering public testimony	Educate Water Board members about the problems with existing pesticide regulatory process, encourage change, report on achievements.	Two to three times per year. Preparation and coordination can take as much as 40 hours per opportunity.
Monitoring and Science	Track major urban runoff monitoring and pesticide scientific studies; review scientific literature, monitoring data, and government reports; and maintain reference database	Stay abreast of the latest scientific findings in order to identify pesticide priorities for monitoring and mitigation, to improve methods for identifying sources of pesticides in urban runoff, and to support input and discussions with regulators toward improving pesticide regulation, which is science-based.	About 10 important publications per month and a dozen meetings per year.
	Peer review EPA, DPR, and Partner work plans and reports	Provide insights and ensure that work plans and reports are utilizing latest science regarding urban pesticide use, fate and transport, and water quality impacts and study designs focus on the most important information gaps about urban runoff pesticides water pollution.	About 6 peer reviews per year, which can take up to 8 hours each.
	Update Pesticide Watch List based on new scientific and regulatory information	The Pesticide Watch List (Table 2) serves as a management tool to prioritize and track pesticides used outdoors in urban areas.	2-3 updates per year
	Develop urban conceptual models and track urban runoff numeric model development	Identify major sources of pesticides in urban runoff to focus identification of mitigation and prevention opportunities. Encourage better EPA and DPR predictive modeling to improve pesticide registration decisions.	1-2 modeling publications per month. Develop one conceptual model annually (20-40 hours).
	Data analysis of DPR/SWAMP/USGS/MS4 monitoring, pesticide use data, and information from scientific literature	Summarize data to educate CASQA members and water quality community, Water Boards, DPR, and EPA.	Detailed analysis is infrequent because finding, compiling, and analyzing data requires very high level of effort and funding. CASQA undertook a detailed monitoring summary in 2013. Report is available at www.casqa.org. CASQA/UP3 summarized information on fipronil water pollution and its sources in 2014 and 2015 in a presentation and scientific poster.

Activity		Purpose	Level of Effort
Reporting	Prepare Monthly Action Plans	Coordinate CASQA's regulatory actions with Partners	3 hours/month
	Prepare PSC Annual Report to describe the year's status and progress, provide detail on stakeholder actions, and the context of prior actions as well as anticipated end goal of these activities.	Provide CASQA's members with focused information on its efforts to prevent pesticide pollution in urban waterways. The document serves annual compliance submittal for both Phase I and Phase II MS4s. It may also be used as an element of PEAIPs and future effectiveness assessment annual reporting.	Preparation and coordination takes about 50 to 60 hours.

Table 8. Anticipated Opportunities for CASQA and the UP3 Partnership Pesticides Regulatory Engagement in 2016-2017

EPA Pesticide Registration Review (15-year cycle)
Environmental Risk Assessments • Priority 1 pesticides: Pyrethroids, Fipronil, and Imidacloprid • Priority 2-4 pesticides: 2,4-D, Carbaryl Copper, Malathion, Simazine, Spinosad • Other opportunities: Dichlobenil (root control in storm drains), Lithium hypochlorite (model swimming pool discharge language); Endangered Species Act risk assessment methodology pilot pesticides (multiple pesticides)
Proposed Decisions • Malathion; others (schedule unknown)
DPR New Pesticide Registration Proposed Decisions
• Momfluorothrin (new pyrethroid) • Copper-silver-zinc marine antifouling paint • Storm drain antimicrobial and root control products (4 products) • New urban indoxacarb product (proposed new outdoor uses) • New fipronil foam product (proposed expanded fipronil use)
Other DPR-related Items
• Fipronil – possible water quality protection regulations • Updates to Methodology for Evaluating Pesticide Registration Applications for Surface Water Protection – development of new and updated modules to continue to improve accuracy of urban evaluations. • Registration Application Surface Water Reviews – continue to follow up on communications requesting review of all storm drain products, outdoor antimicrobials, and swimming pool additives
Water Boards
• STORMS urban pesticide reduction draft language for a Basin Plan amendment • Current-use urban pesticides TMDLs and Basin Plan Amendments: Central Valley Water Board pyrethroids and diuron and Central Coast Lower Salinas River Watershed pyrethroids / toxicity • Pesticide TMDL implementation requirements for Phase II permittees
Structural Pest Control Board
• Regulations to increase licensee continuing education requirements for IPM and water quality protection

Appendix – State's Online Summary of STORMS Urban Pesticide Reduction Project[25]

Project 6a: Establish Statewide Framework for Urban Pesticide Reduction

Priority: High
Assessment: Important, achievable with moderate barriers

Prerequisite:

None

Project Objective:

Establish statewide source control efforts for pesticides in urban storm water.

Scope:

Amend the statewide Water Quality Control Plans to account for urban pesticide discharges to: (1) recognize one of the primary mechanisms for urban pesticide pollution prevention is through use management under the authority of agencies that regulate pesticide use; (2) establish a framework for working with the Department of Pesticide Regulation (DPR) and U.S. EPA Office of Pesticide Programs (OPP) to improve pesticide evaluation and mitigation processes; (3) establish a framework for coordinating pesticide/toxicity monitoring by appropriate agencies; and (4) establish minimum source control efforts for urban storm water permittees.

Background:

Pesticides continue to cause impairments to urban water bodies across the state, even as "old" pesticide uses are banned and replaced by new pesticides. Some practices and structures can reduce pesticide concentrations, but practically speaking, attaining reductions necessary to meet water quality standards through engineering changes to storm water systems and municipal discharger-led changes to pesticide use practices would likely be cost-prohibitive for two reasons: (1) the pesticides of interest are widely used and cause or contribute to toxicity at very low concentrations, and (2) state law does not allow local authorities to ban or limit pesticide sales and use. Accordingly, the most effective way to reduce urban pesticide-related impairments is through managing pesticide usage via existing state and federal pesticide regulatory authorities. Previous experiences suggest that resources focused on working with pesticide regulators (i.e., DPR and U.S. EPA OPP) to implement their authority will more effectively achieve our goals, as compared to attempting to control pesticides solely by using our own regulatory authorities on municipal dischargers.

A statewide framework for urban pesticide pollution control efforts, established via an amendment to the state's Water Quality Control Plans, with a scope including the four elements listed above, could help more effectively and consistency control urban pesticides.

Regional Board staff, mainly from San Francisco Bay and Central Valley Regional Boards, in coordination with CASQA and other members of the Urban Pesticide Pollution Prevention Partnership, has invested significant efforts into working with DPR and U.S. EPA OPP with considerable success. A formal commitment by the Water Boards to implement a pollution

PHASE I

OBJECTIVE 6

Increase Source Control and Pollution Prevention

GOAL 4

Collaborate in Order to Solve Water Quality and Pollutant Problems with an Array of Regulatory and Non-Regulatory Approaches

PROJECT INFORMATION	
Name	Establish Statewide Framework for Urban Pesticide Reduction
Start	2016
Completion	2018
Progress	Finalizing workplan and timeline. Work on specific deliverables will begin in April.

(Continued on next page)

[25] http://www.swrcb.ca.gov/water_issues/programs/stormwater/storms/obj6_proj6a.shtml

prevention framework could strengthen these proactive efforts and relationships with pesticide regulators. A statewide plan would also encourage collective monitoring, data sharing, and education efforts by the regulated community, and establish consistent minimum pesticide source control efforts for urban storm water permittees.

This effort relates to increased use of storm water as a resource for groundwater recharge, as pesticide pollution prevention will benefit groundwater quality in areas where urban runoff is captured for groundwater recharge. Additionally, this project will contribute to the reduction and filtration of runoff, as well as conversion to sustainable landscapes that require fewer chemical inputs.

Products and Timelines:

6 Months: Develop a detailed project management and scoping plan.

1 Year: Draft staff report for a general framework to improve pesticide evaluation, establish mitigation processes, coordinate pesticide/toxicity monitoring, and establish minimum source control efforts for urban storm water permittees. This effort will include holding stakeholder meetings, approximately quarterly, during development.

6 Months: Develop Item for State Water Board consideration of adoption with proposed plan amendment language.

Executive Sponsors	Tom Mumley
Lead Staff	Noelle Patterson (916) 341-5280
Support Staff	Matthew Freese (916) 341-5485
Contract Information	
Performance Metrics	Project 6a
NPDES Storm Water Facilities annual Performance Report	

(Updated 4/13/16)

Annual Reporting for FY 2015-2016

Regional Supplement for New Development and Redevelopment

San Francisco Bay Area Municipal Regional Stormwater Permit

B A S M A A

Bay Area Stormwater Management Agencies Association

September 2016

Alameda Countywide
Clean Water Program

Contra Costa
Clean Water Program

Fairfield-Suisun
Urban Runoff
Management Program

Marin County
Stormwater Pollution
Prevention Program

Napa County
Stormwater Pollution
Prevention Program

San Mateo Countywide
Water Pollution
Prevention Program

Santa Clara Valley
Urban Runoff Pollution
Prevention Program

Sonoma County
Water Agency

Vallejo Sanitation
and Flood
Control District

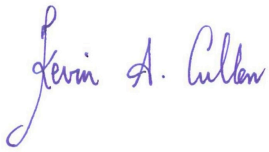
BASMAA

To Whom It May Concern:

We certify under penalty of law that this document was prepared under our direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on our inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of our knowledge and belief, true, accurate, and complete. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

James Scanlin, Alameda Countywide Clean Water Program

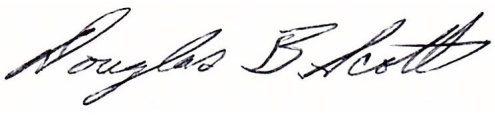
Tom Dalziel, Contra Costa Clean Water Program



Kevin Cullen, Fairfield-Suisun Urban Runoff Management Program

Matthew Fabry, San Mateo Countywide Water Pollution Prevention Program

Adam Olivieri, Santa Clara Valley Urban Runoff Pollution Prevention Program



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LIST OF ATTACHMENTS:

C.3.c.i.(2)(c)(ii) Model Biotreatment Soil Media Specifications

Proposed Revised Model Biotreatment Soil Media Specifications (February 5, 2016)

Approval of Revisions to Biotreatment Soil Media Specifications in Water Board Order No. R2-2015-0049, Municipal Regional Stormwater NPDES Permit (April 18, 2016)

Biotreatment Soil Media Specifications Roundtable Agenda and Attendance List

Biotreatment Soil Media and Specification: Current Research on Trees and Water Quality Treatment; Literature Review

Biotreatment Soil and Tree Roundtable Summary; Improvements for the Health of Trees

Bioretention Design for Tree Health: Literature Review

C.3.j.ii. Early Implementation of Green Infrastructure Projects

Guidance for Identifying Green Infrastructure Potential in Municipal Capital Improvement Program Projects

C.3.j.iii. Participate in Processes to Promote Green Infrastructure

Scope of Work – *Urban Greening Bay Area*

BASMAA comments to the Air Resources Board on the Urban Greening and Green Infrastructure Section of the Natural and Working Lands Discussion Paper

INTRODUCTION

This Regional Supplement has been prepared to report on regionally implemented activities complying with portions of the Municipal Regional Stormwater Permit (MRP), issued to 76 municipalities and special districts (Permittees) by the San Francisco Bay Regional Water Quality Control Board (Water Board). The Regional Supplement covers new development and redevelopment activities related to the following MRP provisions:

- C.3.c.i.(2)(c)(ii) Model Biotreatment Soil Media Specifications,
- C.3.j.ii. Early Implementation of Green Infrastructure Projects, and
- C.3.j.iii. Participate in Processes to Promote Green Infrastructure.

These regionally implemented activities are conducted under the auspices of the Bay Area Stormwater Management Agencies Association (BASMAA), a 501(c)(3) non-profit organization comprised of the municipal stormwater programs in the San Francisco Bay Area. Most of the 2016 annual reporting requirements of the specific MRP Provisions covered in this Supplement are completely met by BASMAA Regional Project activities, except where otherwise noted herein or by Permittees in their reports. Scopes, budgets and contracting or in-kind project implementation mechanisms for BASMAA Regional Projects follow BASMAA's Operational Policies and Procedures as approved by the BASMAA Board of Directors. MRP Permittees, through their program representatives on the Board of Directors and its committees, collaboratively authorize and participate in BASMAA Regional Projects or Regional Tasks. Depending on the Regional Project or Task, either all BASMAA members or Phase I programs that are subject to the MRP share regional costs.

Low Impact Development

C.3.c.i.(2)(c)(ii) Model Biotreatment Soil Media Specifications

This provision requires:

> *Biotreatment (or bioretention) systems shall be designed to have a surface area no smaller than what is required to accommodate a 5 inches/hour stormwater runoff surface loading rate, infiltrate runoff through biotreatment soil media at a minimum of 5 inches per hour, and maximize infiltration to the native soil during the life of the Regulated Project. The soil media for biotreatment (or bioretention) systems shall be designed to sustain healthy, vigorous plant growth and maximize stormwater runoff retention and pollutant removal.*
>
> *Permittees shall ensure that Regulated Projects use biotreatment soil media that meet the minimum specifications set forth in Attachment L of the previous permit (Order No. R2-2009-0074), dated November 28, 2011. Permittees may collectively (on an all-Permittee scale or countywide scale) develop and adopt revisions to the soil media minimum specifications, subject to the Executive Officer's approval.*

In 2015, the biotreatment soil media (BSM) specification had been in use Bay Area-wide for 5 years and in that time Permittees had identified several components of the soil

specification for which review was warranted, including:

- Compost gradation specifications, soluble Boron criteria, and pH limit;
- Potential effect on stormwater treatment / retention of additives recommended by soil suppliers to augment plant health;
- Locally appropriate and available mulch options to include in biotreatment systems, for both the bottom and side slopes;
- Appropriate plant palette and irrigation requirements for biotreatment systems in drought conditions;
- How to create a living soil to enhance the performance of the treatment systems, both for pollutant removal and plant vigor; and
- Typographical errors and missing or incorrectly identified units of measurement in the specification.

In August 2015, the BASMAA Development Committee formed a Work Group on behalf of the Permittees to re-evaluate the soil specification. The Work Group took a two-step approach: first, immediately propose minor modifications to the current soil specification to ensure suppliers can deliver material that complies with the specification, and second, convene a soil specification "roundtable" (similar to the 2010 roundtable used to reach consensus on the MRP 1.0 Attachment L specification). The newly convened soil specification roundtable would investigate the need for alternative specifications that might enhance the performance of bioretention facilities under varying microclimates and drought conditions and with diverse planting palettes, including trees.

Revisions to Attachment L Specification of Soils for Biotreatment or Bioretention Facilities

The Development Committee addressed the following issues in step one:

- Compost suppliers having difficulties meeting the gradation specifications, soluble Boron criteria, and occasionally the pH limit listed in the specification; and
- Typographical errors and missing or incorrectly identified units of measurement in the specification.

The BASMAA Soil Specifications Work Group met several times, reviewed the specification regarding the two issues above, researched and made proposed changes, and vetted the proposed changes with the Development Committee and Permittees. In its January 2016 meeting, the BASMAA Board of Directors approved the transmittal of Revised Model Biotreatment Soil Media Specifications to the Regional Water Board. The revised specifications were transmitted to the Regional Water Board on February 5, 2016 (see attached) and the Regional Water Board Executive Officer approved the revised specifications on April 18, 2016 (attached).

Biotreatment Soil Media Specifications Roundtable

The BASMAA Soil Specifications Work Group also initiated a Roundtable project to start to address the remaining issues identified above. BASMAA engaged consultant assistance in February 2016 to prepare research and design considerations for updating the BASMAA Biotreatment Soil Media Specifications to incorporate considerations

regarding trees in bioretention areas. The major project tasks included a literature review and the Roundtable, which was conducted in June 2016. The Roundtable agenda and attendance list are attached. The project also resulted in three products (attached):

- *Biotreatment Soil Media and Specification: Current Research on Trees and Water Quality Treatment; Literature Review* – This report: 1) examines potential changes to the BSM and to the design of bioretention systems for the benefit of trees, 2) examines concerns with the performance of the current Biotreatment Soil Media specification, 3) addresses changes to the mix and the design of bioretention that could reduce pollutant leaching and flushing and correct identified problems, 4) provides a review of the available literature and municipal specifications for BSM, and 5) incorporates numerous interviews of experts and stakeholders involved in BSM.

- *Biotreatment Soil and Tree Roundtable Summary; Improvements for the Health of Trees* – This report provides a summary of the discussion, identifies action items from the Roundtable and a summary of the Roundtable evaluation survey responses.

- *Bioretention Design for Tree Health: Literature Review* – This report focuses on how to enhance the soil volume for trees in bioretention – one of the most important factors effecting urban tree health and is relatively limited in bioretention systems as they are currently designed.

The last product is a direct result of a recommended action item from the June 2016 Roundtable. The Development Committee expects to continue to implement action items in FY 16-17.

Green Infrastructure Planning and Implementation

C.3.j.ii. Guidance for Identifying Green Infrastructure Potential in Municipal Capital Improvement Program Projects

This provision requires Permittees to:

> *(1) Prepare and maintain a list of green infrastructure projects, public and private, that are already planned for implementation during the permit term and infrastructure projects planned for implementation during the permit term that have potential for green infrastructure measures.*

The list must be submitted with each Annual Report, including:

> *(2) … a summary of how each public infrastructure project with green infrastructure potential will include green infrastructure measures to the maximum extent practical during the permit term. For any public infrastructure project where implementation of green infrastructure measures is not practicable, submit a brief description for the project and the reasons green infrastructure measures were impracticable to implement.*

The BASMAA Development Committee initiated and competed a regional project in FY 15-16 to address this provision. A Work Group of the Committee formed in February 2016 and met several times to scope the project, and develop and review the guidance. The Development Committee received regular updates from the Work Group, and recommended and the BASMAA Board of Directors approved as a final BASMAA product in May 2016 the document: *Guidance for Identifying Green Infrastructure Potential in Municipal Capital Improvement Program Projects* (attached). The document also provides guidance to Permittees on using the Annual Report Format to provide the required information on the projects.

Note that this guidance primarily addresses the review of proposed or planned public projects for green infrastructure opportunities. Permittees may also be aware of proposed or planned private projects, not subject to LID treatment requirements, that may have the opportunity to incorporate green infrastructure. The guidance recommends that planned private projects should be addressed in the same way as planned public projects.

C.3.j.iii. Participation in Processes to Promote Green Infrastructure

This provision requires:

> *(1) The Permittees shall, individually or collectively, track processes, assemble and submit information, and provide informational materials and presentations as needed to assist relevant regional, State, and federal agencies to plan, design, and fund incorporation of green infrastructure measures into local infrastructure projects, including transportation projects. Issues to be addressed include coordinating the timing of funding from different sources, changes to standard designs and design criteria, ranking and prioritizing projects for funding, and implementation of cooperative in-lieu programs.*

The BASMAA activities described in this section provide compliance for MRP Permittees with this provision.

Grant – Urban Greening Bay Area

Urban Greening Bay Area is a large-scale, grant-funded effort to re-envision Bay Area urban landscapes to develop stormwater-friendly dense, green urban infrastructure that addresses challenges associated with climate change, infiltrates or captures stormwater and pollutants near their sources, and in turn, promotes improved water quality in San Francisco Bay. *Urban Greening Bay Area* is funded by an EPA Water Quality Improvement Fund grant awarded to the Association of Bay Area Governments (ABAG), a joint powers agency acting on behalf of the San Francisco Estuary Partnership (SFEP), a program of ABAG. The term of the *Urban Greening Bay Area* grant project is July 1, 2015 to June 30, 2018.

BASMAA is one of the subrecipients of the grant and is taking the lead on two of the grant project tasks (see attached scope of work) – a Regional Green Infrastructure Roundtable process and a Design Charrette, both of which are scheduled to be

implemented between May 2016 and May 2018.

The Regional Roundtable will be a two year process, with work groups as needed, to identify and develop a list of recommendations for integrating green infrastructure and stormwater management funding and investments with future climate change and transportation investments within the region. The Roundtable will include convening meetings with local, regional, and state stakeholders, agencies, elected officials, and staff to produce draft and final task reports that will identify and recommend possible legislative fixes, agency agreements, consolidated funding mechanisms, and other means and actions as appropriate. The Roundtable is envisioned as using innovative participatory processes that will include key experts, regulators, decision-makers, and other stakeholders to share information, solicit and discuss ideas and solutions, and to identify next steps (i.e., a roadmap), which will be summarized in the draft and final task reports.

The Design Charrette task involves coordinating with the cities of Sunnyvale and San Mateo to conduct a Bay Area design charrette to develop cost-effective and innovative "typical" designs for integrating green infrastructure with bicycle and pedestrian improvements at roadway intersections. The overall goal of developing standardized, transferable designs is to make progress in addressing the high cost of design, implementation, operations, and maintenance that inhibits the widespread use of green infrastructure and LID features. The charrette will utilize actual intersection locations in San Mateo and Sunnyvale that are as representative as possible of the common features of road segments that make up intersections found throughout Bay Area cities. Charrette participants will be solicited by BASMAA and will include multiple representatives, including contractors, engineers, landscape architects, plant specialists, and city transportation engineers and planners, and design, construction management, and operations and maintenance staff. Final designs will be constructed at the San Mateo and Sunnyvale locations to verify costs and serve as demonstration projects for other agencies throughout the Bay Area.

During FY 15-16 and early FY 16-17, BASMAA's accomplishments on the *Urban Greening Bay Area* project included:

1. Finalizing the scope of work and development of contracts with EPA and ABAG;
2. Conducting an RFP process to obtain consultant services;
3. Building a task team of BASMAA, SFEP, EPA, Water Board, and municipal representatives to further identify goals, desired outcomes, meeting formats, schedule, and Roundtable participants;
4. Developing a strategy for conducting the Roundtable meetings;
5. Preparing a project briefing sheet to help introduce the task to key stakeholders and encourage participation; and
6. Conducting informational interviews with key stakeholders.

Presentations and Comments

Presentations

In addition to the *Urban Greening Bay Area* grant efforts described above, Matt Fabry (SMCWPPP Manager, BASMAA Board member and former Board Chair) made the following presentations and comments "…*to assist relevant regional, State, and federal agencies to plan, design, and fund incorporation of green infrastructure measures into local infrastructure projects*…" These presentations helped to lay the foundation for the *Urban Greening Bay Area* grant project by raising awareness of regional issues and securing commitments from various agencies to support and participate in the project, thus benefitting all Permittees.

a. CASQA 2014 Annual Conference; "Stormwater, Climate Change, and Complete Streets – The Transportation Connection" (September 2014)
b. C/CAG "Lobby Day" in Sacramento (presentations to local legislative delegation on stormwater, transportation, and green infrastructure issues (April 2015, June 2016)
c. State of the Estuary Conference/RMP Annual Meeting; "Green Infrastructure in San Mateo: A Vision for the Future" (September 2015)
d. San Francisco Bay Regional Monitoring Program Annual Meeting; "Green Infrastructure – Planning for the Future" (October 2015)
e. American Public Works Association, Silicon Valley Chapter; "Stormwater, Climate Change, and Complete Streets – The Transportation Connection" (October 2015)
f. State Coastal Conservancy staff; "Green Infrastructure – Planning for the Future" (October 2015)
g. SPUR Water Committee; "Green Infrastructure for Stormwater Management" (December 7, 2015)
h. U.S. Environmental Protection Agency, Region 9 staff; "Green Infrastructure – Planning for the Future" (January 2016)
i. Stanford's Water in the West Program, Dr. Newsha Ajami; "Green Infrastructure – Planning for the Future" (February 2016)
j. Alameda Countywide Pedestrian Bicycle Working Group; "Green Infrastructure – Planning for the Future" (February 2016)
k. SPUR Oakland; "Growing Sustainable Communities Through Green Infrastructure"; Matt Fabry and Kristin Hathaway, City of Oakland (February 2016)

The BASMAA Development Committee also helped strengthen the connection between green infrastructure and land development/transportation planning by partnering with the American Planning Association, Northern California section, to organize and conduct a field tour and panel discussion at the 2015 APA Conference in Oakland. The sessions included the following presentations:

a. Mobile Workshop: "Green Infrastructure Bay Area: Green Infrastructure Takes Root in the East Bay"; Kristin Hathaway, Josh Bradt and Peter Schultze-Allen, moderated by Laura Prickett (October 4, 2015);
b. Panel: "Trends, Opportunities, and Challenges for Integrating Green Infrastructure

with Urban Design in the San Francisco Bay Area"; Matt Fabry, Josh Bradt, Rosey Jencks, Laura Prickett, Brent Bucknum, and Peter Schultze-Allen, moderated by John Steere (October 5, 2015).

The attendees came from within and outside of California and represented various professions in addition to planners. The mobile workshop brought attendees into the streets of the East Bay to see green infrastructure projects in El Cerrito, Emeryville, and Oakland. Design, construction, maintenance and neighborhood outreach were discussed on the tour, with the hosts giving details and insights into the projects. The panel provided an interactive discussion with the audience on green infrastructure policies and programs, identifying the challenges and opportunities to implementation.

Comments

BASMAA submitted comments to the Air Resources Board on the Urban Greening and Green Infrastructure Section of the Natural and Working Lands Discussion Paper on May 3, 2016 (attached).

ATTACHMENT

C.3.c.i.(2)(c)(ii) Model Biotreatment Soil Media Specifications

Proposed Revised Model Biotreatment Soil Media Specifications (February 5, 2016)

Alameda Countywide Clean Water Program

Contra Costa Clean Water Program

Fairfield-Suisun Urban Runoff Management Program

Marin County Stormwater Pollution Prevention Program

Napa County Stormwater Pollution Prevention Program

San Mateo Countywide Water Pollution Prevention Program

Santa Clara Valley Urban Runoff Pollution Prevention Program

Sonoma County Water Agency

Vallejo Sanitation and Flood Control District

B A S M A A

Bay Area Stormwater Management Agencies Association

P.O. Box 2385

Menlo Park, CA 94026

510.622.2326

info@basmaa.org

February 5, 2016

Bruce Wolfe, Executive Officer
California Regional Water Quality Control Board
San Francisco Bay Region

Subject: Model Biotreatment Soil Media Specifications–MRP 2.0 Provision C.3.c.i.(2)(c)(ii)

Dear Mr. Wolfe:

This letter and attachments are submitted on behalf of all 76 Permittees subject to the requirements of the Municipal Regional Stormwater NPDES Permit (MRP). In December 2010, the Permittees, per Provision C.3.c.iii.(3) of the MRP[1], submitted a biotreatment soil specification to the Regional Water Board and received approval to use the specification in low impact development (LID) treatment measures. The permit was amended on November 28, 2011 to include the biotreatment soil specification as Attachment L.

The recently adopted "MRP 2.0," which took effect on January 1, 2016, allows Permittees to collectively develop and adopt revisions to the biotreatment soil media minimum specifications, subject to the Executive Officer's approval[2]. The biotreatment soil mix is required to meet the performance criteria stated in the MRP, including a long-term minimum permeability of 5 inches-per-hour over the life of the facility, support healthy plant growth, and remove pollutants.

The current biotreatment soil specification has been in use Bay Area-wide for 5 years[3]. The following immediate issues with the specification have been identified:

- Compost suppliers are having difficulties meeting the gradation specifications, soluble Boron criteria, and occasionally the pH limit listed in the specification;
- There are typographical errors and missing or incorrectly identified units of measurement.

In August 2015, the BASMAA Development Committee formed a Work Group on behalf of the Permittees to re-evaluate the soil specification. The Work Group decided to take a two-prong approach: first, immediately propose minor modifications to the current soil specification to ensure suppliers can deliver

[1] Reference is to the "original" MRP, Order R2-2009-0074, NPDES Permit No. CAS612008, adopted October 14, 2009.
[2] Provision C.3.c.i.(2)(c)(ii), Order No. R2-2015-XXXX, NPDES Permit No. CAS612008, adopted November 19, 2015.
[3] The original very similar specification was developed by the Contra Costa Clean Water Program beginning in 2007, and has been in formal effect in Contra Costa County and its 19 cities and towns since March 2009.

material that complies with the specification, and second, concurrently convene a soil specification "roundtable" (similar to the 2010 roundtable used to reach consensus on the MRP 1.0 Attachment L specification). The newly convened soil specification roundtable will investigate the need for alternative specifications that might enhance the performance of bioretention facilities under varying microclimates and drought conditions and with diverse planting palettes, including trees.

The attachment to this letter includes the following revisions to the Attachment L specification:

For the compost fraction of the mix:

1. Reduce the minimum percent of the #200 sieve size gradation from 2% to 1%;
2. Change the allowable pH range from 6.5-8.0 to 6.2-8.2;
3. Remove the soluble Boron specification;
4. Fix typographical errors, and
5. Correct missing or erroneous units of measure.

There are no proposed changes to the sand fraction of the mix.

Your approval of these minor changes will make it possible for suppliers to meet the letter of the mix specification without compromising performance of the mix. Biotreatment soil mixes having those revised specification limits have in fact been used successfully in meeting the permit requirements. Using the alternative biotreatment soil mix option in Attachment L, the products were able to meet the specification.

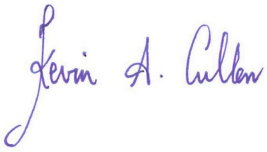
The Work Group plans to convene the stakeholder roundtable meeting during Spring 2016. We hope your staff will participate in this effort.

We thank you for your prompt consideration. If we do not hear from you by March 9, 2016, we will assume that the modified soil specification has been approved.

We certify under penalty of law that this document was prepared under our direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on our inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of our knowledge and belief, true, accurate, and complete. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

James Scanlin, Alameda Countywide Clean Water Program

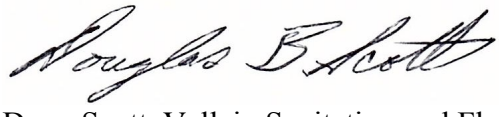
Tom Dalziel, Contra Costa Clean Water Program



Kevin Cullen, Fairfield-Suisun Urban Runoff Management Program

Matt Fabry, San Mateo Countywide Water Pollution Prevention Program

Adam Olivieri, Santa Clara Valley Urban Runoff Pollution Prevention Program



Doug Scott, Vallejo Sanitation and Flood Control District

Attachments:
Mark-up of Specification of Soils for Biotreatment or Bioretention Facilities
Proposed Revised Specification of Soils for Biotreatment or Bioretention Facilities

cc: Tom Mumley, Regional Water Board
Keith Lichten, Regional Water Board
Dale Bowyer, Regional Water Board
Sue Ma, Regional Water Board
BASMAA Board of Directors, Development Committee, and Soil Specifications Work Group

~~ATTACHMENT L~~

~~Provision C.3.c.i.(1)(b)(vi)~~

Specification of soils for Biotreatment or Bioretention Facilities

Soils for biotreatment or bioretention areas shall meet two objectives:

- Be sufficiently permeable to infiltrate runoff at a minimum rate of 5" per hour during the life of the facility, and
- Have sufficient moisture retention to support healthy vegetation.

Achieving both objectives with an engineered soil mix requires careful specification of soil gradations and a substantial component of organic material (typically compost).

Local soil products suppliers have expressed interest in developing 'brand-name' mixes that meet these specifications. At their sole discretion, municipal construction inspectors may choose to accept test results and certification for a 'brand-name' mix from a soil supplier.

Tests must be conducted within 120 days prior to the delivery date of the bioretention soil to the project site.

Batch-specific test results and certification shall be required for projects installing more than 100 cubic yards of bioretention soil.

SOIL SPECIFICATIONS

Bioretention soils shall meet the following criteria. "Applicant" refers to the entity proposing the soil mixture for approval by a Permittee.

1. General Requirements – Bioretention soil shall:
   a. Achieve a long-term, in-place infiltration rate of at least 5 inches per hour.
   b. Support vigorous plant growth.
   c. Consist of the following mixture of fine sand and compost, measured on a volume basis:
      60%-70% Sand
      30%-40% Compost
2. Submittal Requirements – The applicant shall submit to the Permittee for approval:
   a. A minimum one-gallon size sample of mixed bioretention soil.
   b. Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.
   c. Grain size analysis results of the fine sand component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils or Caltrans Test Method (CTM) C202.
   d. Quality analysis results for compost performed in accordance with Seal of Testing Assurance (STA) standards, as specified in 4.
   e. Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".

f. Grain size analysis results of compost component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
g. A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.
h. Provide the name of the testing laboratory(s) and the following information:

(1) Contact person(s)

(2) Address(s)

(3) Phone contact(s)

(4) E-mail address(s)

(5) Qualifications of laboratory(s), and personnel including date of current certification by USCC~~STA~~, ASTM, Caltrans, or approved equal

3. Sand for Bioretention Soil
   a. Sand shall be free of wood, waste, coating such as clay, stone dust, carbonate, etc., or any other deleterious material. All aggregate passing the No. 200 sieve size shall be nonplastic.
   b. Sand for Bioretention Soils shall be analyzed by an accredited lab using #200, #100, #40 or #50, #30, #16. #8, #4, and 3/8 inch sieves (ASTM D 422, CTM 202 or as approved by municipality), and meet the following gradation:

Sieve Size	**Percent Passing (by weight)**	
	Min	***Max***
3/8 inch	100	100
No. 4	90	100
No. 8	70	100
No. 16	40	95
No. 30	15	70
No. 40 or No.50	5	55
No. 100	0	15
No. 200	0	5

Note: all sands complying with ASTM C33 for fine aggregate comply with the above gradation requirements.

4. Composted Material

Compost shall be a well decomposed, stable, weed free organic matter source derived from waste materials including yard debris, wood wastes or other organic materials not including manure or biosolids meeting the standards developed by the US Composting Council (USCC). The product shall be certified through the USCC Seal of Testing Assurance (STA) Program (a compost testing and information disclosure program).

a. Compost Quality Analysis by Laboratory – Before delivery of the soil, the supplier shall submit a copy of lab analysis performed by a laboratory that is enrolled in the US Composting Council's Compost Analysis Proficiency (CAP) program and using approved Test Methods for the Examination~~Evaluation~~ of Composting and Compost (TMECC). The lab report shall verify:
   ~~(1) Feedstock Materials shall be specified and include one or more of the following: landscape/yard trimmings, grass clippings, food scraps, and agricultural crop residues.~~
   ~~(2)~~(1) Organic Matter Content: 35% - 75% by dry wt.
   ~~(3)~~(2) Carbon and Nitrogen Ratio: C:N < 25:1 and C:N >15:1
   ~~(4)~~(3) Maturity/Stability: ~~shall have a dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell, containing recognizable grass or leaves, or is hot (120F) upon delivery or rewetting is not acceptable. In addition~~ Aany one of the following is required to indicate stability:
      (i) Oxygen Test < 1.3 O2 /unit TS /hr
      (ii) Specific oxy. Test < 1.5 O2 / unit BVS /hr
      (iii) Respiration test < 8 mg CO_2-C /g OM ~~unit VS~~ / day
      (iv) Dewar test < 20 Temp. rise (°C) e.
      (v) Solvita® > 5 Index value
   ~~(5)~~(4) Toxicity: Aany one of the following measures is sufficient to indicate non-toxicity.
      (i) ~~NH4- : NO3-N < 3~~ NH_4^+ : NO_3^--N < 3
      (ii) Ammonium < 500 ppm, dry basis
      (iii) Seed Germination > 80 % of control
      (iv) Plant Trials > 80% of control
      (v) Solvita® ~~=>~~ 5 Index value
   ~~(6)~~(5) Nutrient Content: provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S, and B.
      (i) Total Nitrogen content 0.9% or above preferred.
      (ii) Boron: Total shall be <80 ppm; ~~Soluble shall be <2.5 ppm~~
   ~~(7)~~(6) Salinity: Must be reported; < 6.0 mmhos/cm
   ~~(8)~~(7) pH shall be between 6.2~~5~~ and 8.2 May vary with plant species.

b. Compost Quality Analysis by Compost Supplier – Before delivery of the compost to the soil supplier the Compost Supplier shall verify the following:
   (1) Feedstock materials shall be specified and include one or more of the following: landscaping/yard trimmings, grass clippings, food scraps, and agricultural crop residues.

(2) Maturity/Stability: shall have a dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell or containing recognizable grass or leaves, or is hot (120F) upon delivery or rewetting is not acceptable.
(3) Weed seed/pathogen destruction: provide proof of process to further reduce pathogens (PFRP). For example, turned windrows must reach min. 55C for 15 days with at least 5 turnings during that period.

~~b.~~c. Compost for Bioretention Soil Texture – Compost for bioretention soils shall be analyzed by an accredited lab using #200, 1/4 inch, 1/2 inch, and 1 inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	**Percent Passing (by weight)**	
	Min	***Max***
1 inch	99	100
1/2 inch	90	100
1/4 inch	40	90
No. 200	1~~2~~	10

~~c.~~d. Bulk density shall be between 500 and 1100 dry lbs/cubic yard
~~d.~~e. Moisture content shall be between 30% - 55% of dry solids.
~~e.~~f. Inerts – compost shall be relatively free of inert ingredients, including glass, plastic and paper, < 1 % by weight or volume.
~~f. Weed seed/pathogen destruction – provide proof of process to further reduce pathogens (PFRP). For example, turned windrows must reach min. 55C for 15 days with at least 5 turnings during that period.~~
~~f.~~g. Select Pathogens – Salmonella <3 MPN/4grams of TS, or Coliform Bacteria <10000 MPN/gram.
~~g.~~h. Trace Contaminants Metals (Lead, Mercury, Etc.) – Product must meet US EPA, 40 CFR 503 regulations.
~~h.~~i. Compost Testing – The compost supplier will test all compost products within 120 calendar days prior to application. Samples will be taken using the STA sample collection protocol. (The sample collection protocol can be obtained from the U.S. Composting Council, 4250 Veterans Memorial Highway, Suite 275, Holbrook, NY 11741 Phone: 631-737-4931, www.compostingcouncil.org). The sample shall be sent to an independent STA Program approved lab. The compost supplier will pay for the test.

VERIFICATION OF ALTERNATIVE BIORETENTION SOIL MIXES

Bioretention soils not meeting the above criteria shall be evaluated on a case by case basis. Alternative bioretention soil shall meet the following specification: "Soils for bioretention facilities shall be sufficiently permeable to infiltrate runoff at a minimum rate of 5 inches per hour during the life of the facility, and provide sufficient retention of moisture and nutrients to support healthy vegetation."

The following steps shall be followed by municipalities to verify that alternative soil mixes meet the specification:

1. General Requirements – Bioretention soil shall achieve a long-term, in-place infiltration rate of at least 5 inches per hour. Bioretention soil shall also support vigorous plant growth. The applicant refers to the entity proposing the soil mixture for approval.
   a. Submittals – The applicant must submit to the municipality for approval:
      (1) A minimum one-gallon size sample of mixed bioretention soil.
      (2) Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.
      (3) Certification from an accredited geotechnical testing laboratory that the Bioretention Soil has an infiltration rate between 5 and 12 inches per hour as tested according to Section 1.b.(2)(ii).
      (4) Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".
      (5) Grain size analysis results of mixed bioretention soil performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
      (6) A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.
      (7) The name of the testing laboratory(s) and the following information:
         (i) Contact person(s)
         (ii) Address(s)
         (iii) Phone contact(s)
         (iv) E-mail address(s)
         (v) Qualifications of laboratory(s), and personnel including date of current certification by STA, ASTM, or approved equal.
   b. Bioretention Soil
      (1) Bioretention Soil Texture: Bioretention Soils shall be analyzed by an accredited lab using #200, and 1/2" inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	Percent Passing (by weight) *Min* *Max*

1/2 inch	97	100
No. 200	2	5

(2) Bioretention Soil Permeability testing: Bioretention Soils shall be analyzed by an accredited geotechnical lab for the following tests:

(i) Moisture – density relationships (compaction tests) shall be conducted on bioretention soil. Bioretention soil for the permeability test shall be compacted to 85 to 90 percent of the maximum dry density (ASTM D1557).

(ii) Constant head permeability testing in accordance with ASTM D2434 shall be conducted on a minimum of two samples with a 6-inch mold and vacuum saturation.

MULCH FOR BIORETENTION FACILITIES

Three inches of m~~M~~ulch is recommended for the purpose of retaining moisture, preventing erosion and minimizing weed growth. Projects subject to the State's Model Water Efficiency Landscaping Ordinance (or comparable local ordinance) will be required to provide at least three~~two~~ inches of mulch. Aged mulch, also called compost mulch, reduces the ability of weeds to establish, keeps soil moist, and replenishes soil nutrients. Aged mulch can be obtained through soil suppliers or directly from commercial recycling yards. It is recommended to apply 1" to 2" of composted mulch, once a year, preferably in June following weeding.

Specification of Soils for Biotreatment or Bioretention Facilities

Soils for biotreatment or bioretention areas shall meet two objectives:

- Be sufficiently permeable to infiltrate runoff at a minimum rate of 5" per hour during the life of the facility, and
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Achieving both objectives with an engineered soil mix requires careful specification of soil gradations and a substantial component of organic material (typically compost).

Local soil products suppliers have expressed interest in developing 'brand-name' mixes that meet these specifications. At their sole discretion, municipal construction inspectors may choose to accept test results and certification for a 'brand-name' mix from a soil supplier.

Tests must be conducted within 120 days prior to the delivery date of the bioretention soil to the project site.

Batch-specific test results and certification shall be required for projects installing more than 100 cubic yards of bioretention soil.

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   g. A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.
   h. Provide the name of the testing laboratory(s) and the following information:

(1) Contact person(s)
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(5) Qualifications of laboratory(s), and personnel including date of current certification by USCC, ASTM, Caltrans, or approved equal

3. Sand for Bioretention Soil
   a. Sand shall be free of wood, waste, coating such as clay, stone dust, carbonate, etc., or any other deleterious material. All aggregate passing the No. 200 sieve size shall be nonplastic.
   b. Sand for Bioretention Soils shall be analyzed by an accredited lab using #200, #100, #40 or #50, #30, #16. #8, #4, and 3/8 inch sieves (ASTM D 422, CTM 202 or as approved by municipality), and meet the following gradation:

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Note: all sands complying with ASTM C33 for fine aggregate comply with the above gradation requirements.

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(3) Maturity/Stability: Any one of the following is required to indicate stability:
  (i) Oxygen Test < 1.3 O2 /unit TS /hr
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  (iii) Respiration test < 8 mg CO_2-C /g OM / day
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  (v) Solvita® > 5 Index value
(4) Toxicity: Any one of the following measures is sufficient to indicate non-toxicity.
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  (ii) Ammonium < 500 ppm, dry basis
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No. 200	1	10

d. Bulk density shall be between 500 and 1100 dry lbs/cubic yard
e. Moisture content shall be between 30% - 55% of dry solids.
f. Inerts – compost shall be relatively free of inert ingredients, including glass, plastic and paper, < 1 % by weight or volume.
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         (iii) Phone contact(s)

(iv) E-mail address(s)
(v) Qualifications of laboratory(s), and personnel including date of current certification by STA, ASTM, or approved equal.

b. Bioretention Soil

(1) Bioretention Soil Texture: Bioretention Soils shall be analyzed by an accredited lab using #200, and 1/2" inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	**Percent Passing (by weight)**	
	Min	***Max***
1/2 inch	97	100
No. 200	2	5

(2) Bioretention Soil Permeability testing: Bioretention Soils shall be analyzed by an accredited geotechnical lab for the following tests:
(i) Moisture – density relationships (compaction tests) shall be conducted on bioretention soil. Bioretention soil for the permeability test shall be compacted to 85 to 90 percent of the maximum dry density (ASTM D1557).
(ii) Constant head permeability testing in accordance with ASTM D2434 shall be conducted on a minimum of two samples with a 6-inch mold and vacuum saturation.

MULCH FOR BIORETENTION FACILITIES

Three inches of mulch is recommended for the purpose of retaining moisture, preventing erosion and minimizing weed growth. Projects subject to the State's Model Water Efficiency Landscaping Ordinance (or comparable local ordinance) will be required to provide at least three inches of mulch. Aged mulch, also called compost mulch, reduces the ability of weeds to establish, keeps soil moist, and replenishes soil nutrients. Aged mulch can be obtained through soil suppliers or directly from commercial recycling yards. It is recommended to apply 1" to 2" of composted mulch, once a year, preferably in June following weeding.

ATTACHMENT

C.3.c.i.(2)(c)(ii) Model Biotreatment Soil Media Specifications

Approval of Revisions to Biotreatment Soil Media Specifications in Water Board Order No. R2-2015-0049, Municipal Regional Stormwater NPDES Permit (April 18, 2016)

April 18, 2016
CIWQS Place No. 756972 (SKM)

To: Municipal Regional Stormwater NPDES Permit (Order No. R2-2015-0049) Permittees

Sent via email to:

Mr. James Scanlin, Alameda Countywide Clean Water Program: jimd@acpwa.org
Mr. Tom Dalziel, Contra Costa Clean Water Program: tdalz@pw.cccounty.us
Mr. Kevin Cullen, Fairfield-Suisun Urban Runoff Management Program: kcullen@fssd.com
Matt Fabry, San Mateo countywide Water Pollution Prevention Program: mfabry@smcgov.org
Adam Olivieri, Santa Clara Valley Urban Runoff Pollution Prevention Program: awo@eoainc.com
Doug Scott, Vallejo Sanitation and Flood Control District: dscott@vsfcd.com
Geoff Brosseau, Bay Area Stormwater Management Agencies Association: Geoff@brosseau.us

Subject: Approval of Revisions to Biotreatment Soil Media Specifications in Water Board Order No. R2-2015-0049, Municipal Regional Stormwater NPDES Permit

On February 5, 2016, the Bay Area Stormwater Management Agencies Association (BASMAA) submitted proposed revisions to the biotreatment soil media specifications referenced in Provision C.3.c.i.(2)(c)((ii) of Board Order No. R2-2015-0049, the Municipal Regional Stormwater NPDES Permit (MRP). The proposed revisions were submitted on behalf of the 76 Permittees regulated by the MRP and were submitted as allowed under and in accordance with the requirements of Provision C.3.c.i.(2)(c)((ii).

The proposed revisions address issues with the current soil media specifications that Permittees have identified, based on implementation of these soil media specifications for the last 5 years under the previous MRP. These identified issues are as follows:

- Compost suppliers are having difficulties meeting the gradation specifications, soluble boron criteria, and occasionally the pH limits listed in the specifications.
- The specifications contain typographical errors and missing or incorrectly identified units of measurement.

This letter approves the Permittees' proposed changes to the biotreatment soil media specifications referenced in Provision C.3.c.i.(2)(c)(ii) of the MRP. We understand that BASMAA intends to convene a soil specification roundtable in Spring 2016 to investigate the need for alternative specifications that might enhance the performance of bioretention facilities under varying microclimates and drought conditions and with diverse planting palettes, including trees.

If you have questions, please contact Sue Ma of my staff at (510) 622-2386 or via email to sma@waterboards.ca.gov.

Sincerely,

for Bruce H. Wolfe
Executive Officer

ATTACHMENT

C.3.c.i.(2)(c)(ii) Model Biotreatment Soil Media Specifications

Biotreatment Soil Media Specifications Roundtable Agenda and Attendance List

B A S M A A
Bay Area Stormwater Management Agencies Association

Biotreatment Soil and Tree Round Table
June 30, 2016
9:00 am – 3:00 pm
Elihu Harris State Office Building
Room #2 (Second Floor)
1515 Clay Street, Oakland, CA, 94612

9:00 – 9:15 am	Welcome/Goals for the Day/Logistics

Goals:

- Maximize the discussion of what we know now about these topics, what we do not know but want to know, and how we may go about increasing our knowledge moving forward.
- Include your voice, your concerns, and your knowledge in our consideration of whether and how to refine the current soil specification.
- Come to a consensus regarding improvements that may be made to improve the current soil specification.
- Be efficient with your time and input.

9:15 – 10:00 am	Recap of Literature Review
10:00 – 10:15 am	Break
10:15 – Noon	Breakouts – Discuss the questions provided and develop a scenario for how the soil specification might be modified or improved to ensure the long-term health of trees.

Breakout Conversation Rules:

- Note taker will write down what is said without censoring or changing it.
- Allow each participant an opportunity to speak.
- Share information and answer questions from your professional expertise. If you have practical considerations stemming from another participant's suggestion, please mention it.

Noon - 1:00 pm	Lunch (provided)
1:00 – 2:45 pm	Summary/Highlights/Group Discussion

Report out from the morning breakout session. Participants will engage in discussions to try to develop a consensus on an approach for an alternative or revised soil specification.

2:45 – 3:00 pm	Wrap-up/Next steps

- Overview of consensus points
- Further opportunities to participate
- Fill out evaluation forms

9/23 NO VISUAL TAKE

Attendance	First Name	Last Name	Email	Interested in follow-up information?
	Alex	McDonald	alex.mcdonald@dot.ca.gov	
	Alexander	Lopez		
	Allan	Laca	alaca@woodrodgers.com	yes
	Amber	Schat	Amber.Schat@sanjoseca.gov	
	Annmarie	Lucchesi	alucchesi@soilandplantlaboratory.com	yes alucchesi@waypoint analytical.com
	Ann-Marie	Benz	annmarie@bayfriendlycoalition.org	
	Bill	Sowa	bsowa@hmhca.com	YES
	Brian	Currier	dorothy.abeyta@sanjoseca.gov brian.currier@owp.csus.edu	yes.
	Christine	Boschen	cboschen@waterboards.ca.gov	
	Connie	Goldade	connie@community-design.com	yes
	Dale	Bowyer	dbowyer@waterboards.ca.gov	
	Dan	Cloak	dan@dancloak.com	
	David	Swartz	dswartz@fremont.gov	
	David	Haas	David.Haas@fire.ca.gov	
	Dorothy	Abeyta	dorothy.abeyta@sanjoseca.gov	
	Elizabeth	Lanham	elizabeth.lanham@davey.com	yes
	Glenn	Flamik	Glenn.Flamik@fire.ca.gov	
	Glenn	Bohling	GBohling@republicservices.com	
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	Igor	Lacan	ilacan@ucanr.edu	
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	Jing	Wu	jingw@sfei.org	
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	Kelly	Carroll	kcarroll@wvcwp.org	
	LeighAnna	Johnson		
	Matt	Moore	matt@tmtenterprises.net	yes
	Meagan	Hynes	info@talussoil.com	yes
	Megan	Stromberg	stromberg@wra-ca.com	
	Mike	Adamow	MAdamow@sfwater.org	
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	Walter	Passmore	walter.passmore@cityofpaloalto.org	
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	Kevin Robert	Perry	kevin@urbanraindesign.com	
	Bhaskar	Joshi	bhaskar.joshi@dot.ca.gov	

NAMETAGS ON TABLE

RACHEL ROBERTS

BRIAN ROWLEY

ATTACHMENT

C.3.c.i.(2)(c)(ii) Model Biotreatment Soil Media Specifications

Biotreatment Soil Media and Specification: Current Research on Trees and Water Quality Treatment; Literature Review

Biotreatment Soil Media and Specification:

Current Research on Trees and Water Quality Treatment

Literature Review
San Francisco Bay Area, California

Prepared For:

BASMAA
Contact: Shannan Young
Shannan.young@dublin .ca.gov

WRA Contact:

Megan Stromberg
stromberg@wra-ca.com

Date:

September 14, 2016

WRA #20066

ENVIRONMENTAL CONSULTANTS

2169-G East Francisco Blvd., San Rafael, CA 94901 (415) 454-8868 tel (415) 454-0129 fax info@wra-ca.com www.wra-ca.com

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List of Appendices

1.0 INTRODUCTION

Provision C.3 of the Municipal Regional Permit (MRP) requires that biotreatment (or bioretention) systems use biotreatment soil media (BSM) that meets the minimum specifications of the BASMAA BSM Specification. Like other municipalities around the country, the BASMAA Specification requires the BSM to be a mixture of sand and compost (Appendix A):

60% - 70% Sand
30% - 40% Compost

The Bay Area Stormwater Management Agencies Association (BASMAA) and its associated members have identified items of concern with the current specifications for BSM. In particular, trees have failed to thrive in bioretention systems. Trees have a number of potential benefits when included in bioretention: increased nutrient uptake, reduced stormwater runoff through rainfall interception and evapotranspiration, enhanced soil infiltration, soil stabilization, increased aesthetic appeal, wildlife habitat, and shading. Trees have been shown to capture stormwater, reducing the runoff volume directly and potentially reducing peak flows. Tree roots can also directly enhance infiltration rates. Studies in collaboration between Cornell, Virginia Tech, and University of California at Davis showed that black oak and red maple tree roots can penetrate compacted subsoils and increase infiltration rates by an average of 153% (Day and Dickinson 2008).

This report examines potential changes to the BSM and to the design of bioretention systems for the benefit of trees. A variety of potential additives to the BSM have been studies and have the potential to increase water holding capacity and/or compensate for minimal soil volume available in bioretention systems.

Additional concerns with the performance of the current BSM mix are also examined. In particular, nutrient and other pollutant leaching and flushing from bioretention has emerged as a concern in many municipalities. This report addresses changes to the mix and the design of bioretention that could reduce pollutant leaching and flushing.

Lastly, within the current specification, there are a number of improvements that can be made to correct identified problems. These items include:

- Sand Analysis: A need to qualify the sand source due to potential for toxicity, high pH, or other contaminants.
- Compost particle size gradation changes:
- Provide corrections to the infiltration test methods for meeting the alternative specification

This report provides a review of the available literature and municipal specifications for (BSM). In addition, numerous interviews of experts and stakeholders involved in BSM were conducted and incorporated into the report. Experts and stakeholders include: municipal representatives, soil and compost testing laboratories, soil suppliers, urban foresters, and stormwater soil researchers.

This report was presented at Roundtable hosted by BASMAA on June 30, 2016 which is summarized in a separate report dated July 27, 2016 (BASMAA 2016).

2.0 POTENTIAL ADDITIVES OR CHANGES TO BIOTREATMENT SOIL MIX TO BENEFIT TREES AND WATER QUALITY

Biotreatment Soil Mix (BSM) is designed to balance the needs to sustain healthy soil and plant growth, to optimize water quality treatment, and provide an infiltration rate of between 5 – 12 inches per hour. BSM in the Bay Area and in many other regions is a mix of 60% - 70% Sand and 30% - 40% Compost. Most municipalities and researchers (SFEI, San Diego, Seattle, Redmond, Washington State) expressed concern that high levels of nutrients and other pollutants are leaching from bioretention BMPs using the compost/sand BSM (Gilbreath, et al. 2015, BES City of Portland, 2010, RICK Engineering 2014, Herrera 2015, Hinman, personal communication 2016). San Diego, San Francisco, and Seattle have adopted specifications within the last 12 months that adjusted their mix to reduce the proportion of compost to a maximum of 30% by volume in response to this concern.

These concerns are backed by recent studies. Herrera Environmental Consultants, in a study for the City of Redmond, Washington, reports that of 19 different BSM mixes tested, the 60% sand and 40% compost mix was the worst performer in terms of pollutant flushing and pollutant reduction. Curtis Hinman confirmed that after testing numerous different potential BSM mixes, all mixes that contain compost and sand flushed pollutants initially and continued to leach over time (Hinman, personal communication 2016). Most notably, the 60/40 mixes leached nitrogen, phosphorous, and copper.

Others, including Caltrans, are concerned that bioretention BMPs may flush solids when first installed (Penders, personal communication, 2016). BASMAA has identified additional concerns with tree survival and the need for heavy irrigation in the drought limited Bay Area. This section reviews alternative mixes and additives to address tree health and water quality improvements.

Overall, much research has been done in recent years to identify BSMs that improve water quality performance of bioretention BMPs. Emerging trends in municipal specifications point toward providing for recommended alternative mixes to target different goals such as nutrient reduction, or metals reduction, or supporting trees. In general, the standard sand and compost mix is broadly available in our region and the cheapest. Most of the additives will add considerable cost and may need to be shipped from other parts of the country or world (Butch Voss, personal communication, 2016). However, the additional cost may be warranted to meet water quality goals or tree/plant performance goals in some locations.

At this time, research regarding plant growth in various BSMs is much more limited. Some studies of plant performance in alternative mixes are being launched in coming months. Nonetheless, this section summarizes the available research on both the water quality treatment potential and the potential to benefit trees and plants of each additive below.

2.1 Alternative Mixes in Specifications

In general, most municipalities allow for the use of alternative BSM mixes with additional performance testing to ensure they meet the performance criteria. Curtis Hinman feels that the standard 60/40 sand compost mix may be “just fine” for many locations, namely those that are not sensitive to nutrients or copper, and those without underdrains (Personal communication 2016). However, he sees municipalities moving towards a range of alternative mixes.

This is taking place in California as well. The City of San Francisco allows the replacement of up to 15% of the sand volume with other media or soil admixtures to enhance moisture retention capacity of the soil, provided admixtures are low in fines (less than 5% passing the 200 sieve) and do not break down under normal handling and use. However, San Francisco bars the use of topsoil, peat, silts, or clays as admixtures and any materials deleterious to plant growth. San Diego recently adopted recommended alternative BSM mixes including a mix with coconut coir for certain areas sensitive to phosphorous (see below for more detail).

2.2 Topsoil in Biotreatment Soil Mixes

In the San Diego Region, concern for the leaching of nutrients lead the County to evaluate and ultimately revise their BSM specification. Based on input from a task force that included engineers, soil agronomists, landscape architects, and geotechnical engineers, it was deemed important to introduce a sandy loam topsoil component that would still allow good plant growth but reduce the potential leaching of nutrients associated with high levels of organics in the compost. The collective agreement resulted in a mixture (by volume) of 65% sand, 20% Sandy Loam, and 15% Compost. This mix results in approximately 1.5% to 5% organic matter (by weight), once mixed (RICK Engineering, 2014). This mix was adopted and incorporated into the County of San Diego LID Handbook in 2014.

In contrast, the City of San Diego in its most recent *Stormwater Guidebook* (2016), the adopted a standard BSM of sand and compost only, but they encourage use of an alternative mixes for improving plant growth and performance in some areas. The standard mix is 70% to 85% by volume washed sand and 15% to 30% by volume compost 'or alternative organic amendment'. In order to reduce the potential for leaching of nutrients, the City requires that the proportion of compost or alternative organic amendment in the mix is "held to a minimum level that will support the proposed vegetation in the system" (City of San Diego 2016). San Diego allows for 'natural soils' subject to approval by the City Engineer.

In areas where phosphorous is associated with water quality impairment or a Total Maximum Daily Load (TMDL) and underdrains are required, the City recommends replacing the compost component with coco coir pith (see below) or adding an activated alumina polishing layer below the standard BSM to control phosphorous leaching. These recommended alternatives were added per the advice of Geosyntec consultants (Talamayan, personal communication, 2016). According to Jonard Talamayan at the City of San Diego, not many projects were installed while the topsoil BSM was in place. Of primary concern in their region has been the availability of the mix components rather than tree performance but few installations have taken place with trees to date.

CalTrans recently undertook testing of BSM that was a mix of 50% sand, 25% compost, and 25% topsoil (by weight). The mix was designed to have a higher fines content to retain moisture and support grasses and forbs. After 5 years, the overall long-term average infiltration rate was 15 in/hr despite the inclusion of added fines in the mix. In addition, vegetation (grasses) density was healthy and the sites showed improved water quality. Specific water quality data is not yet avialable (CalTrans 2016).

The City of Portland also allows for the inclusion of topsoil in their stormwater facility mix. Their specification calls for "any material that is a blend of loamy soil, sand, and compost that is 30-40% compost (by volume) and meets the other criteria" (City of Portland 2014). Other criteria include a particle size gradation limiting fines in the overall mix, however, hydraulic conductivity or infiltration testing is not required.

In Washington State, numerous studies are on-going to find superior alternatives to the standard sand and compost BSM and reduce pollutant flushing and leaching (Hinman, personal communication, 2016). One study for the City of Redmond Washington, evaluated a mix of 50% Sand and 50% Loamy Sand Topsoil. They tested two mixes to compare two separate sources of loamy sand topsoil. Overall, they found that compared to other BSM mixes, the loamy sand mix exported fewer nutrients but had the poorest infiltration rates at between 1.3 and 5.1 in/hour, based on lab permeability testing (Herrerra Engineering 2015). Herrera Environmental Consultants recommends against the use of the loamy sand mix because of the inconsistency of hydraulic performance. As a part of the Herrera Environmental Consultants study, the 'Loamy Sand Mix' was also tested for its ability to support plant growth (primarily grasses). In comparison to the 60/40 sand and compost mix, the loamy sand mix plant community was not as robust; however, the plant community was still healthy, indicating that growing conditions are at least favorable in the loamy sand mix.

2.3 Biochar in Biotreatment Soil Mixes

Biochar is made from biomass via pyrolysis, a thermochemical decomposition of organic material at elevated temperatures in the absence of oxygen. Raw biochar has no nutrients but it serves as a structure or lattice that can hold nutrients and water to improve soil structure (MacDonagh 2016). This internal carbon architecture is so stable that microorganisms can flourish there, and the long-term stable symbiotic root/microorganism relationships build more sustainable soil environments for tree function. The outcome of enhancing the nutrient- and water-holding capacity and biotic community, is that biochar strengthens soil structure and arrests soil leaching (Fite 2015). When added to soil along with compost, or otherwise activated with fertilizer, the response of trees is greater than with either raw biochar or compost alone (Fite and Macdonagh 2016).

Biochar also has the potential to improve water quality treatment of stormwater in bioretention applications. According to a study out of Oregon State University, researcher Myles Gray found that filtration with biochar alone removed copper and zinc from runoff at a boatyard in Washington State. This study used rinsed biochar, which had the fines removed from the raw biochar material (Gray 2015).

Other studies have examined biochar as an additive to typical sand-compost BSM. Herrera Environmental Consultants tested a mix containing 60% sand, 15% Compost, 15% Biochar, and 10% shredded bark (Herrera Environmental Consultants 2015). As compared to the Bay Area BSM, this mix has less compost but the same quantity of sand. The results showed that the biochar mix had a lower infiltration rate (6.0 in/hr) and seemed to be a source of nutrients. According to the study, the systems with the standard sand-compost mix exported the highest levels of copper, while the systems with biochar exported the highest levels of nutrients. The reduction in infiltration rate with the biochar additive is most likely because the biochar used in this study contained fines (Herrera Environmental Consultants 2015). According to Macdonagh and Fite (2016), washed biochar could be specified to avoid reduction in hydraulic performance. However, according to Curtis Hinman, washed biochar has also been shown to export nutrients and reduce the infiltration rate (personal communication, 2016).

Other studies show biochar has a significant benefit to plants when added under certain conditions. Cao et. al. (2015) studied a biochar mix for use in greenroof soil media and found that biochar significantly increased water retention in green roof substrates. Additional water was plant available and wilting was delayed by 2 days. Kelby Fite, Arboriculture Researcher

with the Bartlett Tree Laboratory, conducted research on biochar amendments for street trees. Fite's research revealed that for trees, Biochar should be added to soil at a rate of no more than 5% by volume. When added at greater volumes, plant benefits level off or decline. He believes this may be because the biochar can hold too tightly to water and nutrients (Fite and MacDonagh 2016).

Fite's research and experience revealed a number of additional recommendations for soil amendment with biochar which he described in a recent presentation (Fite and MacDonagh 2016):

- Characteristics of biochar vary based on the feed source and how it is made.
- There are no known open-source specifications for biochar, however, the International Biochar Initiative provides standards for selecting a biochar.
- Biochar for trees is best from a hardwood feed source.
- According to MacDonagh, for low flow bioretention applications, biochar does not cause clogging; however, washed biochar may reduce compromises to hydraulic capacity.

2.4 Coconut Coir Pith in Biotreatment Soil Mixes

Coco coir pith, or coconut coir, is a byproduct of the coconut industry and has previously been used as an alternative to peat moss in soil-less media. This product is not produced in the US and must be shipped from Asia.

In terms of BSM, coco coir pith is recommended in City of San Diego's most recent guidebook as an alternative to compost in areas where phosphorous is associated with water quality impairment or a Total Maximum Daily Load (TMDL) and underdrains are required. No specification for the type or quality of the coco coir is provided.

Curtis Hinman (pers. Communication 2016) and Herrerra Engineering (2015) also identify coconut coir (or coco coir pith) as an additive with potential as an alternative to compost. In their study, they tested a number of BSMs with coco coir replacing the compost component (Herrera Environmental Consultants 2015). The mixes tested included:

- 80% sand, 20% coconut coir
- 70% sand, 20% coconut coir, 10% diatomaceous earth
- 70% sand, 20% coconut coir, 10% granular activated carbon
- 70% sand, 20% coconut coir, 10% high carbon wood ash

The coconut coir mixes outperformed the 60% sand/40% compost mixes in terms of pollutant flushing and pollutant leaching. Basic tests of plant germination and growth were conducted on these mixes with cucumber, barley and clover. All mixes germinated plants. Mixes with compost were the best performers.

Plant growth studies in the context of bioretention systems, beyond the basic germination test, haven't been conducted but Washington State is about to begin some studies in 2016. In general, coconut coir has been shown to promote plant growth and it has been used as an alternative to peat in many hydroponic products. Some negative results have been reported when no other soil is present. Bugbee (2005) indicates that media with more than 50% coir may have reduced growth because of nitrogen immobilization and a high C:N ratio in the coir. Other studies find that coir has a high potassium and low calcium content, and potentially high sodium

levels. Lastly, there are different types of coconut coir available on the market and one may be better than others in supporting plants.

2.5 Vermicompost in Biotreatment Soil Mixes

Vermicompost, also known as worm compost or worm castings, uses earthworms and microorganisms to turn organic wastes into high quality compost. The chemical secretions in the earthworm's digestive tract help break down soil and organic matter, so the castings contain more nutrients that are immediately available to plants. The level of nutrients in compost depends upon the source of the raw material and the species of earthworm; however, in general, vermicompost contains higher percentage of macro and micronutrients than traditional 'hot' compost (Nelson 2010). Vermicompost can also be produced at a faster rate than traditional compost. Vermicompost generally always has a high percentage of fines, whereas traditional compost can vary considerably depending on the feed source and processing. The "quality of the fines" is also an important consideration. Assaf Sadeh of Soil Control Lab, indicated that in his experience of testing BSM for permeability, worm castings are highly compressible such that if compacted, no water will infiltrate through a BSM containing a high proportion of vermicompost (Sadeh, personal communication, 2016).

Researchers at Cornell University Department of Plan Pathology and Plant Microbe Biology have shown that vermicompost has potential for plant nutrient management and suppression of plant disease especially for container plants without synthetic fertilizers (Nelson 2010). However, no other studies were identified to evaluate vermicompost over traditional compost for use in BSM. Anecdotally, in San Diego, prior the establishment of a BSM including topsoil, some soil suppliers were experimenting with alternative BSM mixes that included vermicompost (RICK Engineering 2014), but no data on its performance was available.

2.6 Perlite in Biotreatment Soil Mixes

Perlite is a mined material that is quickly heated to expand the mineral. Perlite has been utilized in stormwater treatment facilities and is comparable to sand. Perlite is also used in soil-less media in combination with peat or coco coir to grow plants. Perlite improves drainage and wicks water well much like sand but is more porous. It dries out quickly between rain events or watering. Perlite is not widely used in bioretention mixes although it is specified as part of the BSM in Montgomery County, Maryland. The planting media specified includes 1/3 perlite, 1/3 compost, and 1/3 topsoil (Montgomery County 2005). Studies of perlite for use in media filters have shown it to be superior in capturing fine particles and metals (Wigart 2011). Perlite could be considered as an alternative to the sand component but it appears to have minimal or no benefit for plants and is considerably costlier than sand meeting the current specification.

2.7 Volcanic Sands in Biotreatment Soil Mixes

Volcanic sand is an alternative to silica based sands such as those commonly used to meet the BASMAA Specification. Volcanic sands are more porous than sand specified in the current specification. Their pores can hold air and water and create favorable conditions for rich microbial life and strong root systems. Laboratory tests by researchers in Washington showed that volcanic sand and compost BSM reduce some pollutants in water more effectively that riverine sands mixed with compost (Gealogica 2015). Preliminary research by Gealogica has also shown volcanic sands surpass riverine sands in plant growth. As a pilot project in Washington, researchers installed identical planter boxes with either 60% volcanic sand and 40% compost or 60% riverine sand and 40% compost. After eight months, the planter boxes

with the volcanic sands grew to a height that was 140-160% greater than the sedges in the silica sand mix with the same compost component. Tests also revealed that the volcanic sand mixes held water for longer periods of time (Amy Waterman, personal communication 2016). Fassman-Beck et al. (2015) also found that pumice sand had greater than 2.5 times the plant available water as compared to marine sands.

Herrera Environmental Consultants (2015) also tested a number of BSM mixes containing volcanic sand. In all cases, the compost component was either reduced to 10% or replaced with coco coir pith. As described above, the alternative volcanic sand was tested because previous studies had indicated that C-33 sand (the sand commonly used for BASMAA specified bioretention in Seattle and our region) tend to have a higher copper content than other sands. In contrast, the volcanic sand does have a lower copper content and did not leach copper. Volcanic sands could be considered as an alternative to the sand component to reduce copper leaching or possibly improve water holding capacity. Volcanic sands are also being studied for their potential use in polishing layers as described in Section 6 below.

2.8 Diatomaceous Earth in Biotreatment Soil Mixes

Diatomaceous earth or diatomite is the fossilized skeletal remains of single celled aquatic plants called diatoms. Diatomaceous earth is harvested from sedimentary rock and has been widely used as a material for water treatment for over 100 years in the chemical, beverage industries, and potable water production (Marsh 2004). Diatomaceous earth is naturally porous mineral and has the potential to increase drainage, oxygen access, and cation exchange capacity in soil. The pores trap bacteria, clay particles, and other suspended solids. It is also commonly used to repel insects without use of pesticides. Manufacturers recommend an amendment rate of between 5-10% to improve infiltration, reduce compaction, and to increase water availability in the soil. Researchers have confirmed that it can improve soil physical properties including soil moisture content under laboratory conditions when incorporated at a rate of 10% to 30% (Aksakal 2012).

Herrera Environmental Consultants (2015) tested a number of BSM mixes containing diatomaceous earth. Mixes tested contained 70% volcanic sand, 10% diatomaceous earth, and either 20% iron-coated wood chips or 20% coconut coir pith. These mixes out-performed the standard 60/40 sand and compost mix for nutrient and copper reduction. Herrera Environmental Consultants performed basic tests of plant germination and growth on the mixes with cucumber, barley and clover plants. All mixes germinated plants; however, mixes with compost were the best performers for plant coverage and biomass.

2.9 Fines in Biotreatment Soil Mixes

Fines are the clay and silt fraction of soil. Fines are beneficial for bioretention because they increase soil water and nutrient holding capacity, they improve pollutant removal, and they improve soil structure (Shanstrom 2016). Conversely, they have been associated with clogging and are more likely to flush out of a facility.

BSM specifications typically greatly limit fines content in order to protect from failure due to clogging. The current BASMAA specification limits fines (those passing the 200 sieve size) to a maximum of 5% for the sand component and up to 10% in the compost. The lower limit of fines in the compost was recently reduced from 2% to 1%. While this ensures that suppliers are meeting the required permeability, it also likely reduces the water holding capacity of the mix.

More “mature and stable” compost typically has more fines because the material has spent more time decomposing. More mature compost, is typically higher in nutrients – particularly nitrogen. Medium-coarse composts, produced from green waste material, typically more woody, less mature, together with a higher C:N ratio, seem to release less nitrogen than the finer, more mature products. (Greg Balzer, Caltrans, personal communication 2016)

Fines have been documented to contribute to clogging but other factors may mitigate their importance in hydraulic conductivity. Natural soils have better soil structure and therefore higher infiltration rates than an engineered soil with the same particle size profile. Some studies of infiltration rates in bioretention basins show that rather than decreasing over time due to clogging, many bioretention cells exhibit an increase in infiltration rates (Shanstrom 2016).. Lucas (2010) observed 21 bioretention systems in Australia. In systems with initial infiltration rates of over 7 in/hr, rates declined towards an average infiltration rate of 4 in/hr. In contrast, in systems with an initial rate of 0.4 in/hr, these systems increased over time to average nearly 0.8 in/hr, presumably due to the development of macropores (Le Coustumer et al. 2007). Other studies in the US also showed an increase in infiltration rates over time in rain gardens with sand and clay soils (Selbig and Baster 2010, Jenkins et al. 2010). Numerous basins have been documented to have infiltration rates above 1” per hour and up to 6” per hour with greater than 12% fines (Shanstrom 2016, Wardynski et al 2012). Possible explanations for this phenomenon are the presence and development of macropores in healthy soils. Growth and death of plants, earthworms, and other soil organisms can create soil structure than enhances permeability (Shanstrom 2016).

Besides clogging, variable compaction is another possible explanation for the variability seen in BSM that allow for natural soils and fines. Compaction has been shown to decrease infiltration by up to an order of magnitude (Pitt et al. 2008).

2.10 Granular Activated Carbon in Biotreatment Soil Mixes

Granular activated carbon (GAC), like biochar, is a form of stable carbon processed to have small pores that increase the surface area available for adsorption. It has been used for a number of years in water treatment and deodorizing systems. GAC can be specified at various sizes similar to sand. Infiltration rates are typically comparable or faster than sand depending on the specification of the granule size. GAC is one of the costliest additives available and is not made in California.

Pitt and Clarke (2010) in a comparison of filter media including local sand, rhyolite sand, peat moss, surface modified zeolite, and combinations of these materials, found that GAC provided the best reductions in pollutants including copper, lead, and dioxins. GAC was also shown to provide superior performance for removal of metals in the studies by Herrera Environmental Consultants (2015, 2016).

GAC alone does not provide any nutrients to plants. In water treatment studies, GAC was observed to provide sorption of dissolved organic nitrogen but was ineffective for phosphorous attenuation (Wendling 2013). GAC is not locally available and is the most expensive potential additive reviewed in this report.

2.11 High Carbon Wood Ash in Biotreatment Soil Mixes

High carbon wood ash is a waste product from electricity generation wood-fired boilers. Wood ash contains high concentrations of carbon and exhibits some of the properties of GAC and

biochar, like high surface area and cation exchange capacity, but is generally cheaper.

Andrew Carpenter of Northern Tilth prepared a study of high carbon wood ash as a soil amendment. He found that the benefits of wood ash include: neutralization of soil acidity, reduction of aluminum toxicity, increased phosphorous availability, provides a source of some micronutrients but is not a source of nitrogen. In his study of germination and growth, wood ash amended soils showed increased cucumber and tomato plant growth after five weeks. When amended at 10% by volume with wood ash, the soil also had greater porosity and water holding capacity (Carpenter 2013). Another recent study in boreal peatland forests showed that amendment with granulated wood ash increased microbial activity and tree growth over two years (Maljanen et al. 2014).

Herrera Environmental Consultants (2015, 2016) tested this product in combination with sand and coconut coir in a mix that contained 70% sand, 20% coconut coir and 10% high carbon wood ash. Hinman believes this mix has the most potential to avoid nutrient and metals flushing after installation and leaching over the long-term for bioretention basins (personal communication, 2016). Basic tests of plant germination and growth were conducted on this mix with cucumber, barley and clover. While this mix did germinate plants, the mixes containing compost outperformed this mix for plant germination and growth.

2.12 Availability and Cost of Additives

We reached out to local suppliers to provide some insight to the costs and feasibility of obtaining additives locally in the Bay Area. Some items were not readily available locally and would require further research to establish a supply chain. In their similar study of costs, Herrera Engineers concluded that the use of additives improves water quality but adds cost to the BSM.

Table 6. Relative Cost of Bioretention Soil Components

Additive	**Potential % in mix by volume**	**Cost per yard (delivered to Bay Area)**	**Nearest Origin (bulk)**
BASMAA Compost	10% - 40%	$15 - 25	Bay Area
BASMAA Sand	50% - 90%	$40 - 45	Bay Area
Biochar, washed	Up to 5%	$350.00[1]	unknown
Coconut Coir Pith	20%	$176.7[1]	India, SE Asia, South Pacific
Vermicompost	15% to 40%	Bulk source not identified	unknown
Perlite	Up to 5%	$50 - 75	Bay Area
Volcanic Sand (Scoria, Pumice)	50% - 70%	$55 - 60	Bay Area
Diatomaceous earth	10%	$300.00[1]	unknown
Clay (clean, non-dredge)	1% - 5%	$15 - 40	Bay Area
Granular Activated Carbon	10%	$718[1]	Nebraska
High Carbon Wood Ash	5-10%	$300[1]	unknown

[1]Local costing not available. Costs based on Seattle sources provided by Herrera Environmental Consultants (2016)

3.0 MODIFICATIONS TO THE CURRENT SPECIFICATION

This section reviews the potential changes to the current BSM Specification. Through working with the current specification BASMAA identified the following problems that warrant consideration:
These items include:

- Sand Analysis: A need to qualify the sand source due to potential for toxicity, high pH, copper, or other contaminants.
- Does the compost particle size gradation provide adequate balance between hydraulic conductivity and treatment?
- Provide corrections to the infiltration test methods for meeting the alternative specification

3.1 Sand Analysis and Qualification

BASMAA identified concerns that the sand component has the potential to contain toxins, high or low pH, or other contaminants. Anecdotally, at least one submitted BSM contained dredge sand material. Caltrans and Washington State also identified issues with potential contamination of the sand component.

Sean Penders, Senior Engineer at Caltrans, describes instances when the sand source was not uniform. Qualifying tests were conducted on the top of the sand pile, while the bottom of the sand pile contained significantly higher proportion of fines resulting in the export of solids from the built bioretention basin.

Herrera Consultants undertook synthetic precipitation leaching protocol (SPLP) testing of the sand component of the BSM mix for the City of Redmond, Washington. The Herrera results indicate that C-33 sands tend to have a higher copper content than other sands. They found that volcanic sands exhibit lower leachable copper levels (Herrera 2015). However, C-33 sand is inexpensive and locally available. Herrera recommends adding a requirement to test for copper in the C-33 sand for default and custom blends. The synthetic precipitation leaching protocol testing is relatively cheap whereas, requiring volcanic or other washed sand sources may add considerable cost to the BSM mix. Anecdotally, Curtis Hinman of Herrera Consultants tested several sands from the Puget Sound region and only found two sands that passed the synthetic precipitation leaching protocol testing (personal communication 2016).

The City of San Diego now specifies chemical suitability testing of the mixed BSM for systems with underdrains. Suitability criteria were established for Nitrate, Phosphorous, Zinc, Copper, Lead, Arsenic, Cadmium, Mercury and Selenium. San Diego requires either the Saturated Media Extract Method or the SPLP test to confirm BSM has limited potential to leach pollutants (Appendix D). It should be noted that Saturation Extract and SPLP tests are expected to result in somewhat more leaching than would be experienced with real storm water; therefore, a direct comparison to water quality standards or effluent limitations is not relevant (City of San Diego 2016).

Caltrans also has developed a sand specification to ensure the sand is clean and will not export solids (Appendix E).

3.2 Compost Particle Size Gradation

Fines, particles passing the 200 sieve, are the clay and silt fraction of soil. Fines are beneficial for bioretention because they increase soil water and nutrient holding capacity, they improve pollutant removal, and they improve soil structure (Shanstrom 2016). Conversely, they have been associated with clogging and are more likely to flush out of a facility. BSM specifications typically greatly limit fines content in order to protect from failure due to clogging.

Across municipalities, the sand gradation is relatively consistent and conforms to ASTM C33 sand. On the other hand, the compost gradation varies considerably more. In the Bay Area, the compost gradation was recently adjusted for the BASMAA specification as well as the City of San Francisco specification to allow a minimum of 1 percent passing the 200 sieve versus the previously required minimum of 2 percent passing. Reducing the allowable minimum fines component may allow soil suppliers to ensure they are meeting the hydraulic conductivity needed in the BSM but could reduce water holding capacity or result in permeability that far exceeds the upper target of 12" per hour.

Below Tables 1 through 4 provide a comparison of allowable compost gradation in bioretention soil mixes from different municipalities.

Table 1. Bay Area Compost Required Gradation (BASMAA, 2016 and San Francisco, 2016):

Sieve Size	Percent Passing (by weight)	
	Min	Max
1 inch	99	100
½ inch	90	100
¼ inch	40	90
No. 200 (0.0029")	1	10

Note: Sand gradation allows 0 – 5% passing 200 sieve.

Table 2. Los Angeles Compost Gradation (Los Angeles County, 2012):

Sieve Size	Percent Passing (by weight)	
	Min	Max
1 inch	99	100
½ inch	90	100
¼ inch	40	90
No. 200 (0.0029")	2	10

Note: This gradation is equivalent to the previously adopted BASMAA guidance. Sand gradation allows 0 – 5% passing 200 sieve.

Table 3. San Diego Compost Gradation (San Diego, 2016)

Sieve Size	Percent Passing (by weight)	
	Min	Max
5/8 inch	99	100
¼ inch	40	95
2 mm (0.079")	40	90
No. 200 (0.0029")	Not specified	

Note: Sand gradation allows 0 – 5% passing 200 sieve. Mixed BSM must have hydraulic conductivity of between 8 – 20 inches per hour.

Table 4. Seattle Compost Gradation (City of Seattle, 2016)

Sieve Size	Percent Passing (by weight)	
	Min	Max
2 inch	100	100
1 inch	99	100
5/8 inch	90	100
¼ inch	75	100

Note: Mixed BSM must have infiltration rate of at least 6"/hour

In addition to these examples, the City of Portland requires gradation of the blended soil to be tested. They allow for fines to be between 5 and 15% passing the 200 sieve size but do not require testing of the compost component and do not test the hydraulic conductivity. Los Angeles also has requirements for alternative BSM. They require the particles passing the 200 sieve size in alternative mixes to be between 2 and 5% by weight (Los Angeles, 2012). For municipalities that do not specify a gradation of fines in either the compost or the mixed BSM, they require hydraulic conductivity testing which may effectively limit the proportion of fines in the mix.

Fines have been documented to contribute to clogging but other factors may mitigate their importance in hydraulic conductivity. Natural soils have better soil structure and therefore higher infiltration rates than an engineered soil with the same particle size profile. Some studies of infiltration rates in bioretention basins show that rather than decreasing over time due to clogging, many bioretention cells exhibit an increase in infiltration rates (Shanstrom 2016). Lucas (2010) observed 21 bioretention systems in Australia. In systems with initial infiltration rates of over 7 in/hr, rates declined towards an average infiltration rate of 4 in/hr. In contrast, in systems with an initial rate of 0.4 in/hr, these systems increased over time to average nearly 0.8 in/hr, presumably due to the development of macropores (Le Coustumer et al. 2007). Other studies in the US also showed an increase in infiltration rates over time in rain gardens with sand and clay soils (Selbig and Baster 2010, Jenkins et al. 2010). Numerous basins have been documented to have infiltration rates above 1" per hour and up to 6" per hour with greater than 12% fines (Shanstrom 2016, Wardynski et al 2012). Possible explanations for this phenomenon are the presence and development of macropores in healthy soils. Growth and death of plants, earthworms, and other soil organisms can create soil structure than enhances permeability (Shanstrom 2016); however, in soils with a high sand content like the BASMAA BSM, soil structure is slow to develop, or may never develop.

Besides clogging, inconsistent compaction is another possible explanation for the variability seen in BSM that allow for natural soils and fines. Compaction has been shown to decrease infiltration by up to an order of magnitude (Pitt et al. 2008). Hinman (2009) showed that at constant relative compaction of 85 percent of maximum dry density), the percent fines is a strong controlling factor in the permeability test. However, variable compaction will result in variable infiltration across equivalent soils.

In contrast to the focus on fines, Assaf Sadeh, of Soil Control Lab, feels that the controlling particle size gradient does not always translate to passing the hydraulic conductivity performance criteria. Sadeh feels that the quality of the fine particles, i.e. are they angular, round, or humus-like, can play a major role in the hydraulic conductivity. In his experience, he has seen compost that meet the gradation but don't pass the permeability testing (Personal communication 2016). He emphasized the need for hydraulic conductivity or permeability testing of all BSM. The allowable gradation may also be linked to the permeability testing

methods described in the next section.

3.3 Permeability Test Methods

The BASMAA Specification requires permeability testing of the BSM standard mix every 120 days and on a project basis for large scale projects. Mixed BSM must have a permability of at least 5" per hour with no upper limit. However, a provision for meeting the performance standard of between 5 and 12 inches per hour for a custom BSM that deviates from the standard mix is provided. The current specification calls for compaction to 85 to 90% of the maximum dry density (ASTM D1557) and testing of hydraulic conductivity via the constant head permeability test ASTM D2434. According to Assaf Sadeh of Soil Control Laboratories, the specified testing method requires compaction to a degree that is above and beyond what is required in field installations. The method then produces a much reduced rate of permeability and is not representative of field conditions for alternative BSM mixes. Sadeh recommends using an alternative testing method that he believes to be more similar to actual installations of BSM: the Proctor Compaction Test or ASTM D698.

Other municipalities have modified the ASTM D2434 to make it more compatible with the goals of the BSM specification. The Cities of San Francisco and Seattle issued modifications to ASTM D2434 to make it more compatible with bioretention performance goals (SFPUC 2016 and Aspect Consulting, 2011).

In Washington State, the City of Redmond undertook a Bioretention Performance Study to evaluate alternatives to the standard sand and compost BSM (Herrera Environmental Consultants 2015). As a part of this study, eight types of different BSM mixes were tested including the Bay Area equivalent BSM mix of 60% sand and 40% compost. For this mix, researchers found that the permeability testing done with method ASTM D2434 at the lab resulted in a slightly higher but fairly comparable rate to field infiltration tests. The column falling head test, however, resulted in a much lower value than found in the field. The table below summarizes the results:

Table 5. Results from 60% Sand/40% Compost BSM Infiltration Rate Testing for Five Studies in Washington (Herrera Environmental Consultants 2015)

Infiltration Test	Rate (In/Hour)
Tacoma Field Test	20.9
Redmond Field Test Site 1	2.9
Redmond Field Test Site 2	11.8
Field Infiltration Average	**11.9**
WSU Column Falling Head Test	41.7
Redmond Column Falling Head Test	49.0
Kitsap Column Falling Head Test	84.0
Column Falling Head Average	**58.2**
Redmond Permeability ASTM 2434	11.9
Kitsap Permeability ASTM 2434	210
Permeability ASTM 2434 Average	**112.6**

4.0 EVALUATION OF MULCH OPTIONS

Many bioretention design guides specify placement of a mulch layer over the surface of bioretention devices. Mulch is specified to protect the medium from erosion, suppress weed growth, and increase water availability for plants during establishment. However, some organic mulches are prone to floating. Floating mulch can expose and erode the underlying growing medium, block overflows, and contaminate receiving waters.

Interviews with California municipal representatives revealed that few had tackled the issue of mulch. Most reported they leave the decision up to the designer and recommend inorganic mulches like stone mulches in areas of direct flow. The City of Seattle recommends 'coarse compost' for which they provide a specific gradation that contains larger particle sizes and limited fines.

A literature search revealed few resources; however, the City of Auckland, New Zealand did undertake a detailed study of mulch options for bioretention to minimize mulch movement into the storm system. Simcock and Dando (2013) evaluated several different mulch types in the field and through lab testing of floatability. The resulting recommendation is to use primarily inorganic mulch: stone and crushed shell mulches. This study also found that some organic mulches (shredded wood waste, shredded bark, arborist pruning and green waste) have reduced floatability when moisture contents and wet bulk density are higher. Here in California, shredded wood products are often barred from use by fire codes. Simcock and Dando found that the most floatable mulches were decorative bark or bark nuggets.

5.0 REFERENCES

Aksakal, E. 2012. "Effects of diatomite on soil physical properties" Catena 88(1): 1-5. January 2012.

Aspect Consulting, 2011. "Recommended Modifications for Permeability Testing of Bioretention Soils" Prepared for the City of Seattle. Accessed on May 10, 2016 at: http://www.seattle.gov/util/cs/groups/public/@spu/@usm/documents/webcontent/01_017616.pdf

California Compost Quality Council, 2001. *Compost Maturity Index*. www. ccqc.org.

Caltrans 2016. "SFOBB Media vs. BASMAA Media" SFOBB Bioretention RWQCB Meeting. Presented May 11, 2016.

Center for Watershed Protection 2012. *Trees in Bioretention*. Prepared for the city of Arlington, Virginia. Accessed on May 27, 2016 at: http://www.urbanforestrysouth.org/resources/library/trees-in-bioretention/at_download/file

Central Coast Low Impact Development Initiative 2011. *LID Plant Guidance for Bioretention*. UC Davis LID Initiative.

Central Coast Low Impact Development Initiative 2013. *Bioretention Standard Details and Technical Specifications*. UC Davis LID Initiative Technical Memo 3/6/13.

Central Coast Low Impact Development Initiative 2013. *Bioretention Technical Specifications*. Version 4/17/13. UC Davis LID Initiative

City of Fremont 2016. *City of Fremont Low Impact Development Tree Well Filter Evaluation Project, Estuary 2100 Phase 2: Building Partnerships for Resilient Watersheds.* March 30, 2016.

City of New York Parks and Recreation 2014. *Tree Planting Standards*. (Adopted by City of Santa Monica for 2015 Esplanade Green Streets project.)

City of Portland Bureau of Environmental Services 2009. *Stormwater Planter Bench Test Report.*

City of Portland 2014. *Portland Stormwater Management Manual.* Accessed online at: https://www.portlandoregon.gov/bes/64040

City of San Diego 2016. "Appendix F: Biofiltration Standard and Checklist" *Storm Water Standards: BMP Design Manual - Appendices.* Prepared by Geosyntec Consultants. Accessed on May 20, 2015 at: https://www.sandiego.gov/sites/default/files/storm-water-standards-manual-2016-1-appx_0.pdf

City of San Francisco Public Utilities Commission, 2016. "Section 33 47 27 – Bioretention." *Engineering Standard Specifications.*

City of Seattle, 2014. "Section 9-14 Erosion and Landscape Materials." *Standard Specifications For Road, Bridge and Municipal Construction*. P9-58 to 9-61.

City of Seattle 2016. *Stormwater Manual*. Published October 1, 2015 and adopted January 1, 2016. Accessed at: http://www.seattle.gov/dpd/cs/groups/pan/@pan/documents/web_informational/p2358283.pdf

City of Seattle, 2014. Appendix V-B Recommended Modifications to ASTM 2434 When Measuring Hydraulic Conductivity for Bioretention Soil Mixes

City of Tucson 2010. Green Infrastructure for Public Right of Ways. Prepared by Watershed Management Group.

City of Tucson 2013. Green Streets Active Practice Guidelines. Prepared by Gary Wittwer for Tucson Department of Transportation.

Conway et. al. 2007. Technical Memorandum: Review of Surface Soil and Shallow Groundwater Conditions and the Feasibility of Infiltrating Urban Runoff in the Salinas Area. Prepared for the City of Salinas.

County of San Diego 2014. "Appendix G. Bioretention Soil Media Example Specifications." *County of San Diego Low Impact Development Handbook.*

Day et. al. 2008. "Stormwater Management that Combines Paved Surfaces and Urban Trees". *GeoCongress 2008*. March 9-12, 2008. Pp.1129-1136.

Deeproot Green Infrastructure, L.P. 2013. *Planting Soil for Soil Cells.* Model Specification.

Deeproot Green Infrastructure, L.P. 2016. "How Sandy Does Bioretention Soil Need to Be?" *Deeproot Blog.* Accessed online at: http://www.deeproot.com/blog/blog-entries/how-sandy-does-bioretention-soil-need-to-be

Deeproot Infrastructure, L.P. 2015. "At the Forefront of Bioretention Media Specifications: an Interview with Curtis Hinman" *Deeproot Blog.* Accessed online at: http://www.deeproot.com/blog/blog-entries/at-the-forefront-of-bioretention-media-specifications-an-interview-with-curtis-hinman

Deeproot Green Infrastructure, L.P. 2016. "Biochar: What Designers need to know." *Deeproot Blog.* Accessed online at: http://deeprootgreeninfrastructure.cmail19.com/t/i-l-hdthkdt-jyhhuyyhk-t/

Fassman-Beck, E. et al. 2015. "Assessing the Effects of Bioretention's Engineered Media Composition and Compaction on Hydraulic Conductivity and Water Holding Capacity" *J. Sustainable Water Built Environ*., 10.1061/JSWBAY.0000799, 04015003

Facility for Advancing Water Biofiltration. 2009. Guidelines for Filter Media in Biofiltration Systems. Version 3.01.

Gilbreath, Hunt and McKee, 2015. *Fremont Tree Well Filters: LID Performance on a Redeveloped Urban Roadway.* SFEI Technical Report. Accessed at: http://www.sfestuary.org/fremont-tree-well-filters

Herrera Environmental Consultants 2015. *DRAFT Pacific Northwest Bioretention Performance Study Synthesis Report.* Prepared for City of Redmond, Washington.

Herrera Environmental Consultants 2016. *Technical Memorandum: Analysis of Water Quality Treatment Performance for Polishing Layers with Compost-Based Bioretention Media.* Prepared for City of Seattle, Washington.

Bugbee, B. 2005. *A comparison of Coconut Coir and Sphagnum Peat as Soil-less Media Components for Plant Growth*. Utah State University. Accessed on May 23, 2016 at: http://cpl.usu.edu/files/publications/factsheet/pub__9468201.pdf

Jenkins, J., Wadzuk, B., and Welker, A. (2010). "Fines Accumulation and Distribution in a Storm-Water Rain Garden Nine Years Postconstruction." J. Irrig. Drain Eng., 10.1061/(ASCE)IR.1943-4774.0000264, 862-869.

Le Coustumer, S., Fletcher, T. D., Deletic, A., and Barraud, S. 2007. "Hydraulic performance of biofilters for stormwater management: First lessons from both laboratory and field studies." Water Sci. Technol., 56(10), 93–100.

Lee et al., 2013. "Nitrogen Removal in saturated zone with vermicompost as an organic carbon source." Sustainable Environmental Research, 23 (2), pp. 85-92.

Lucas, William C. 2010. Design of Integrated Bioinfiltration-Detention Urban Retrofits with Design Storm and Continuous Simulation Methods. *JOURNAL OF HYDROLOGIC ENGINEERIN*G:486-498.

Marritz, L. 2013. "Our Recommended Soil Volume for Urban Trees" *Deeproot Blog.* Accessed online at: http://www.deeproot.com/blog/blog-entries/our-recommended-soil-volume-for-urban-trees

Maljanen et al. 2014. "The effect of granulated wood-ash fertilization on soil properties and greenhouse gas (GHG) emissions in boreal peatland forests." *Boreal Environment Research* 19:295-309. ISSN 1239-6095. August 2014 Accessed online at: http://www.borenv.net/BER/pdfs/ber19/ber19-295.pdf

MacDonagh, P., 2014 "The State of the Science and Practice of Using Urban Trees as a Stormwater Control Measure." Presentation at International Society of Arboriculture Conference August, 2014.

Montgomery County 2005. Biofiltration (BF). Montgomery County Maryland, Department of Permitting Services, Water Resources Section.

Nelson, E. 2010. *Vermicompost: A Living Soil Amendment.* Accessed online at http://cwmi.css.cornell.edu/vermicompost.htm on May 15, 2016.

North Carolina Department of Environmental Quality, 2009. "Landscape and Soil Composition Specifications." *Stormwater BMP Manual*. Accessed online at: https://deq.nc.gov/about/divisions/energy-mineral-land-resources/energy-mineral-land-permit-guidance/stormwater-bmp-manual

Office of Water Programs, 2016. *Engineered Soils to remove Barriers to Low Impact Development.* Prepared for State Water Resources Control Board.

Pitt et al. 2008. "Compaction's impact on urban storm-water infiltration. *Journal of Irrigation and Drainage Engineering* 134 (5), 652-658

Pitt and Clark, 2010. "Evaluation of Biofiltration Media for Engineered Natural Treatment Systems" *Presentation for the 2013 Stormwater Treatment Engineering Workshop* on April 5, 2013.

Reddy, K. et. al. 2014. "Evaluation of Biochar as a Potential Filter Media for the Removal of Mixed Contaminants from Urban Stormwater Runoff." *Midwest Biochar Conference*, Champaign IL. August 8, 2014.

Rick Engineering, 2014. Memorandum: Summary of Bioretention Soil Specifications for the San Diego Region. Prepared for The Low Impact Development Initiative. Accessed at: http://www.centralcoastlidi.org/soil-guidance-for-bioretention.php

Ron Alexander 2011. *Compost Parameters and their rationale for inclusion.* Prepared by R. Alexander and Associates.

Schultze-Allen, P. 2014. *Technical Memorandum: Biotreatment Soil Mix Research and Verification Guidance Development*. Prepared for SMCWPPP, SCVURPPP and ACCWP Member Agencies.

Schultze-Allen, P. 2014. *Technical Memorandum: Guidance on Biotreatment Soil Mix Review and Approval Options*. Prepared for SMCWPPP, SCVURPPP and ACCWP Member Agencies.

Selbig, W.R., and N. Balster. 2010. Evaluation of turf-grass and prairie-vegetated rain gardens in a clay and sand soil: Madison, Wisconsin, water years 2004–08: U.S. Geological Survey, *Scientific Investigations Report* 2010–5077, 75 p.

Simcock R and Dando, J. 2013. Mulch specification for stormwater bioretention devices. Prepared by Landcare Research New Zealand Ltd for Auckland Council. Auckland Council technical report, TR2013/056

Stone Environmental, Inc. 2014. *Stormwater Management Benefits of Trees, Final Report*. Prepared for: Urban and Community Forestry, Vermont Dept. of Forests, Parks & Rec.

Stromberg 2016. Biotreatment Soil and Tree Roundtable Summary. Prepared for BASMAA. Roundtable held on June 30, 2016.

U. S. Environmental Protection Agency, 2013. *Stormwater to Street Trees: Engineering Urban Forests for Stormwater Management.* Washington D.C.

Ventura County 2011. *Ventura County Technical Guidance Manual for Stormwater Quality Control Measures*. Prepared by Geosyntec and Larry Walker Associates.

Virginal Department of Environmental Quality, 2011. Stormwater Design Specification No. 9: Bioretention. Version 1.9.

Wardynski, B. and Hunt, W., III (2012). "Are Bioretention Cells Being Installed Per Design Standards in North Carolina? A Field Study." *J. Environ. Eng*., 10.1061/(ASCE)EE.1943-7870.0000575, 1210-1217.

Watershed Management Group 2012. *Green Infrastructure for Southwestern Neighborhoods*. Tucson, Arizona: United States Environmental Protection Agency and the Arizona Deparmment of Environmental Quality.

Wendling LA. 2013. "Nutrient dissolved organic carbon removal from natural waters using industrial by-products." *Sci Total Environ.* 2013 Jan 1;442:63-72. doi: 10.1016/j.scitotenv.2012.10.008. Epub 2012 Nov 21

Wigart, R. 2011. Urban Stormwater Fine Sediment Filtration Using Granular Perlite.

Wenz, Erin, 2006. StormFilter with Perlite Filter Media. Environmental Technology Verification (ETV) Program. US Environmental Protection Agency.

Xiao, McPherson, and Shakur, 2007. *Ettie Street Watershed Restoration and Protection Project Final Report.* University of California, USDA Forest Service, and Urban ReLeaf.

Xiao et. al. 1998. "Rainfall Interception by Sacramento's Urban Forest" *Journal of Arboriculture*: 24(4): July 1998. Pp. 235-244.

Xiao and McPherson, 2003. "Rainfall Interception by Santa Monica's Municipal Urban Forest" *Urban Ecosystems, 6.* Pp. 291-302.

Appendix A.
BASMAA Regional Biotreatment Soil Specification

Specification of Soils for Biotreatment or Bioretention Facilities

Soils for biotreatment or bioretention areas shall meet two objectives:

- Be sufficiently permeable to infiltrate runoff at a minimum rate of 5" per hour during the life of the facility, and
- Have sufficient moisture retention to support healthy vegetation.

Achieving both objectives with an engineered soil mix requires careful specification of soil gradations and a substantial component of organic material (typically compost).

Local soil products suppliers have expressed interest in developing 'brand-name' mixes that meet these specifications. At their sole discretion, municipal construction inspectors may choose to accept test results and certification for a 'brand-name' mix from a soil supplier.

Tests must be conducted within 120 days prior to the delivery date of the bioretention soil to the project site.

Batch-specific test results and certification shall be required for projects installing more than 100 cubic yards of bioretention soil.

SOIL SPECIFICATIONS

Bioretention soils shall meet the following criteria. "Applicant" refers to the entity proposing the soil mixture for approval by a Permittee.

1. General Requirements – Bioretention soil shall:
   a. Achieve a long-term, in-place infiltration rate of at least 5 inches per hour.
   b. Support vigorous plant growth.
   c. Consist of the following mixture of fine sand and compost, measured on a volume basis:
      60%-70% Sand
      30%-40% Compost
2. Submittal Requirements – The applicant shall submit to the Permittee for approval:
   a. A minimum one-gallon size sample of mixed bioretention soil.
   b. Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.
   c. Grain size analysis results of the fine sand component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils or Caltrans Test Method (CTM) C202.
   d. Quality analysis results for compost performed in accordance with Seal of Testing Assurance (STA) standards, as specified in 4.
   e. Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".
   f. Grain size analysis results of compost component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
   g. A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.

h. Provide the name of the testing laboratory(s) and the following information:

(1) Contact person(s)

(2) Address(s)

(3) Phone contact(s)

(4) E-mail address(s)

(5) Qualifications of laboratory(s), and personnel including date of current certification by USCC, ASTM, Caltrans, or approved equal

3. Sand for Bioretention Soil
   a. Sand shall be free of wood, waste, coating such as clay, stone dust, carbonate, etc., or any other deleterious material. All aggregate passing the No. 200 sieve size shall be nonplastic.
   b. Sand for Bioretention Soils shall be analyzed by an accredited lab using #200, #100, #40 or #50, #30, #16. #8, #4, and 3/8 inch sieves (ASTM D 422, CTM 202 or as approved by municipality), and meet the following gradation:

Sieve Size	**Percent Passing (by weight)**	
	Min	***Max***
3/8 inch	100	100
No. 4	90	100
No. 8	70	100
No. 16	40	95
No. 30	15	70
No. 40 or No.50	5	55
No. 100	0	15
No. 200	0	5

Note: all sands complying with ASTM C33 for fine aggregate comply with the above gradation requirements.

4. Composted Material

Compost shall be a well decomposed, stable, weed free organic matter source derived from waste materials including yard debris, wood wastes or other organic materials not including manure or biosolids meeting the standards developed by the US Composting Council (USCC). The product shall be certified through the USCC Seal of Testing Assurance (STA) Program (a compost testing and information disclosure program).

a. Compost Quality Analysis by Laboratory – Before delivery of the soil, the supplier shall submit a copy of lab analysis performed by a laboratory that is enrolled in the US Composting Council's Compost Analysis Proficiency (CAP) program and using approved Test Methods for the Examination of Composting and Compost (TMECC). The lab report shall verify:
   (1) Organic Matter Content: 35% - 75% by dry wt.
   (2) Carbon and Nitrogen Ratio: C:N < 25:1 and C:N >15:1
   (3) Maturity/Stability: Any one of the following is required to indicate stability:
      (i) Oxygen Test < 1.3 O2 /unit TS /hr
      (ii) Specific oxy. Test < 1.5 O2 / unit BVS /hr
      (iii) Respiration test < 8 mg CO_2-C /g OM / day
      (iv) Dewar test < 20 Temp. rise (°C) e.
      (v) Solvita® > 5 Index value
   (4) Toxicity: Any one of the following measures is sufficient to indicate non-toxicity.
      (i) NH_4^+ : NO_3^--N < 3
      (ii) Ammonium < 500 ppm, dry basis
      (iii) Seed Germination > 80 % of control
      (iv) Plant Trials > 80% of control
      (v) Solvita® = 5 Index value
   (5) Nutrient Content: provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S, and B.
      (i) Total Nitrogen content 0.9% or above preferred.
      (ii) Boron: Total shall be <80 ppm;
   (6) Salinity: Must be reported; < 6.0 mmhos/cm
   (7) pH shall be between 6.2 and 8.2 May vary with plant species.

b. Compost Quality Analysis by Compost Supplier – Before delivery of the compost to the soil supplier the Compost Supplier shall verify the following:
   (1) Feedstock materials shall be specified and include one or more of the following: landscaping/yard trimmings, grass clippings, food scraps, and agricultural crop residues.
   (2) Maturity/Stability: shall have a dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell or containing recognizable grass or leaves, or is hot (120F) upon delivery or rewetting is not acceptable.
   (3) Weed seed/pathogen destruction: provide proof of process to further reduce pathogens (PFRP). For example, turned windrows must reach min. 55C for 15 days with at least 5 turnings during that period.

c. Compost for Bioretention Soil Texture – Compost for bioretention soils shall be analyzed by an accredited lab using #200, 1/4 inch, 1/2 inch, and 1 inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	**Percent Passing (by weight)**	
	Min	***Max***

1 inch	99	100
1/2 inch	90	100
1/4 inch	40	90
No. 200	1	10

d. Bulk density shall be between 500 and 1100 dry lbs/cubic yard
e. Moisture content shall be between 30% - 55% of dry solids.
f. Inerts – compost shall be relatively free of inert ingredients, including glass, plastic and paper, < 1 % by weight or volume.

g. Select Pathogens – Salmonella <3 MPN/4grams of TS, or Coliform Bacteria <10000 MPN/gram.
h. Trace Contaminants Metals (Lead, Mercury, Etc.) – Product must meet US EPA, 40 CFR 503 regulations.
i. Compost Testing – The compost supplier will test all compost products within 120 calendar days prior to application. Samples will be taken using the STA sample collection protocol. (The sample collection protocol can be obtained from the U.S. Composting Council, 4250 Veterans Memorial Highway, Suite 275, Holbrook, NY 11741 Phone: 631-737-4931, www.compostingcouncil.org). The sample shall be sent to an independent STA Program approved lab. The compost supplier will pay for the test.

VERIFICATION OF ALTERNATIVE BIORETENTION SOIL MIXES

Bioretention soils not meeting the above criteria shall be evaluated on a case by case basis. Alternative bioretention soil shall meet the following specification: “Soils for bioretention facilities shall be sufficiently permeable to infiltrate runoff at a minimum rate of 5 inches per hour during the life of the facility, and provide sufficient retention of moisture and nutrients to support healthy vegetation.”

The following steps shall be followed by municipalities to verify that alternative soil mixes meet the specification:

1. General Requirements – Bioretention soil shall achieve a long-term, in-place infiltration rate of at least 5 inches per hour. Bioretention soil shall also support vigorous plant growth. The applicant refers to the entity proposing the soil mixture for approval.
   a. Submittals – The applicant must submit to the municipality for approval:
      (1) A minimum one-gallon size sample of mixed bioretention soil.
      (2) Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.

(3) Certification from an accredited geotechnical testing laboratory that the Bioretention Soil has an infiltration rate between 5 and 12 inches per hour as tested according to Section 1.b.(2)(ii).
(4) Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".
(5) Grain size analysis results of mixed bioretention soil performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
(6) A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.
(7) The name of the testing laboratory(s) and the following information:
  (i) Contact person(s)
  (ii) Address(s)
  (iii) Phone contact(s)
  (iv) E-mail address(s)
  (v) Qualifications of laboratory(s), and personnel including date of current certification by STA, ASTM, or approved equal.

b. Bioretention Soil
(1) Bioretention Soil Texture: Bioretention Soils shall be analyzed by an accredited lab using #200, and 1/2" inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	**Percent Passing (by weight)**	
	Min	***Max***
1/2 inch	97	100
No. 200	2	5

(2) Bioretention Soil Permeability testing: Bioretention Soils shall be analyzed by an accredited geotechnical lab for the following tests:
  (i) Moisture – density relationships (compaction tests) shall be conducted on bioretention soil. Bioretention soil for the permeability test shall be compacted to 85 to 90 percent of the maximum dry density (ASTM D1557).
  (ii) Constant head permeability testing in accordance with ASTM D2434 shall be conducted on a minimum of two samples with a 6-inch mold and vacuum saturation.

MULCH FOR BIORETENTION FACILITIES

Three inches of mulch is recommended for the purpose of retaining moisture, preventing erosion and minimizing weed growth. Projects subject to the State's Model Water Efficiency Landscaping Ordinance (or comparable local ordinance) will be required to provide at least three inches of mulch. Aged mulch, also called compost mulch, reduces the ability of weeds to establish, keeps soil moist, and replenishes soil nutrients. Aged mulch can be obtained through soil suppliers or directly from commercial recycling yards. It is recommended to apply 1" to 2" of composted mulch, once a year, preferably in June following weeding.

Appendix B.
Caltrans Sand Specificaiton

Add to section 68-2.02F:

68-2.02F(6) Class 5 Permeable Material

Class 5 permeable material for use in media filters must consist of hard, durable, clean sand, and must be free from organic material, clay balls, or other deleterious substances.

The percentage composition by weight of Class 5 permeable material in place must comply with the grading requirements shown in the following table:

Class 5 Permeable Material
Grading Requirements

Sieve sizes	Percentage passing
3/8"	100
No. 4	95–100
No. 8	80–100
No. 16	45–85
No. 30	15–60
No. 50	3–15
No. 100	0–4
No. 200	0

Standard ASTM 6913	Range
Effective Particle size (ES)=(D_{10})	0.0098”-0.0197”
Uniformity Coefficient Uc = (D_{60}/D_{10})	< 4

Class 5 permeable material must have a durability index of not less than 40.

At least 5 days before placing Class 5 permeable material, submit a certificate of compliance for gradation of the material.

No more than 5 days after placing Class 5 permeable material, submit:

1. At least one ASTM D 6913 test on the permeable material at an authorized location.
2. Verification that the placed permeable material complies with the grading requirements

Prior to placement, wash Class 5 permeable material:

1. To remove silt and clay particles.
2. With potable water equal to at least four times the volume of the material to be placed.

After placement, wash Class 5 permeable material:

1. With potable water.
2. Until the discharged water has a turbidity reading of:
   a. 30 NTU or less for jobs within the Tahoe Hydrologic Unit
   b. 200 NTU or less for jobs outside of the Tahoe Hydrologic Unit

You must capture and dispose of the wash water, and

1. Dispose of outside the state right of way.
2. Use as dust control.
3. Disperse onsite in an authorized location other than the BMP.

Place Class 5 permeable material:

1. In a manner that will not damage or cause permanent displacement of the filter fabric.
2. Using methods that will produce a finished surface as shown.

Appendix C.
City of San Diego Bioretention Soil Media (BSM) Specificaiton

F.4. Bioretention Soil Media (BSM)

F.4.1 General

Bioretention Soil Media (BSM) is a formulated soil mixture that is intended to filter storm water and support plant growth while minimizing the leaching of chemicals found in the BSM itself. BSM consists of 70% to 85% by volume washed sand and 15% to 30% by volume compost or alternative organic amendment. Alternative proportions may be justified under certain conditions. BSM shall be mixed thoroughly using a mechanical mixing system at the plant site prior to delivery. In order to reduce the potential for leaching of nutrients, the proportion of compost or alternative organic amendment shall be held to a minimum level that will support the proposed vegetation in the system.

F.4.1.1 Sand for Bioretention Soil Media.

The sand shall conform to ASTM C33 "fine aggregate concrete sand" requirements. A sieve analysis shall be performed in accordance with ASTM C 136, ASTM D 422, or approved equivalent method to demonstrate compliance with the gradation limits shown in Table F.4-1. The sand shall be thoroughly washed to remove fines, dust, and deleterious materials prior to delivery. Fines passing the No. 200 sieve shall be non-plastic.

Table F.4-1 Sand Gradation Limits

Sieve Size (ASTM D422)	Percent Passing (by weight)	
	Minimum	Maximum
3/8 inch	100	100
#4	95	100
#8	80	100
#16	50	85
#30	25	60
#50	5	30
#100	0	10
#200	0	5

Note: Coefficient of Uniformity (Cu = D60/D10) equal to or greater than 4.

F.4.1.2 Compost.

Compost shall be certified by the U.S. Composting Council's Seal of Testing Assurance Program or an approved equivalent program. Compost shall comply with the following requirements:

1. Organic Material Content shall be 35% to 75% by dry weight.

2. Carbon to nitrogen (C:N) ratio shall be between 15:1 and 40:1, preferably above 20:1 to reduce the potential for nitrogen leaching/washout.
3. Physical contaminants (manmade inert materials) shall not exceed 1% by dry weight.
4. pH shall be between 6.0 and 7.5.
5. Soluble Salt Concentration shall be less than 10 dS/m (Method TMECC 4.10-A, USDA and U.S. Composting Council).
6. Maturity (seed emergence and seedling vigor) shall be greater than 80% relative to positive control (Method TMECC 5.05-A, USDA and U.S. Composting Council)
7. Stability (Carbon Dioxide evolution rate) shall be less than 2.5 mg CO_2-C per g compost organic matter (OM) per day or less than 5 mg CO_2-C per g compost carbon per day, whichever unit is reported. (Method TMECC 5.08-B, USDA and U.S. Composting Council). Alternatively a Solvita rating of 6 or higher is acceptable.
8. Moisture shall be 25%-55% wet weight basis.
9. Select Pathogens shall pass US EPA Class A standard, 40 CFR Section 503.32(a).
10. Trace Metals shall pass US EPA Class A standard, 40 CFR Section 503.13, Tables 1 and 3.
11. Shall be within gradation limits in Table F.4-2 (ASTM D 422 sieve analysis or approved equivalent).

Table F.4-2 Compost Gradation Limits

Sieve Size	Percent Passing (by weight)
16 mm (5/8")	99 to 100
6.3 mm (1/4")	40 to 95
2 mm	40 to 90

F.4.1.3 Alternative Mix Components and Proportions.

Alternative mix components and proportions may be utilized, provided that the whole blended mix (F.4.2) conforms to agricultural, chemical, and hydraulic suitability criteria, as applicable. Alternative mix designs may include alternative proportions, alternative organic amendments and/or the use of natural soils. Alternative mixes are subject to approval by the City Engineer.

Alternative mixtures may be particularly applicable for systems with underdrains in areas where phosphorus is associated with a water quality impairment or a Total Maximum Daily Load (TMDL) in a downstream receiving water. BSM with 15% to 30% compost by volume (as specified in F.4.1.3) will likely contribute to increased phosphorus in effluent. Alternative organic amendments, such as

coco coir pith, in place of compost should be considered in these areas. A sand or soil substrate with low plant available phosphorus (< 5 mg/kg) should also be considered. The use of compost in these mixes should be limited to the top three to six inches of soil and limited to the minimum level needed to augment fertility. Additionally, an activated alumina polishing layer can be considered to control phosphorus leaching.

Additional mix components, such as granular activated carbon, zeolite, and biochar may be considered to improve performance for other parameters.

F.4.2 Whole BSM Testing Requirements and Criteria.

The Contractor shall submit the following information to the City Engineer at least 30 days prior to ordering materials:

- Source/supplier of BSM,
- Location of source/supplier,
- A physical sample,
- Available supplier testing information,
- Whole BSM test results from a third party independent laboratory,
- Description of proposed methods and schedule for mixing, delivery, and placement of BSM.

Test results shall be no older than 120 days and shall accurately represent the materials and feed stocks that are currently available from the supplier.

Test results shall demonstrate conformance to agricultural suitability criteria (F.4.2.1), chemical suitability criteria (F.4.2.2), and hydraulic suitability criteria (F.4.2.3). No delivery, placement, or planting of BSM shall begin until test results confirm the suitability of the BSM. The Contractor shall submit a written request for approval which shall be accompanied by written analysis results from a written report of a testing agency. The testing agency must be registered by the State for agricultural soil evaluation which indicates compliance stating that the tested material proposed source complies with these specifications. Third party independent laboratory tests shall be paid for by the Contractor.

F.4.2.1 BSM Agricultural Suitability

The BSM shall be suitable to sustain the growth of the plants specified and shall conform to the following requirements:

a) pH range shall be between 6.0-7.5

b) Salinity shall be less than 3.0 millimho/cm (as measured by electrical conductivity)

c) Sodium adsorption ration (SAR) shall be less than 3.0

d) Chloride shall be less than 150 ppm

The test results shall show the following information:

a) Date of Testing

b) Project Name

c) The Contractor's Name

d) Source of Materials and Supplier's Name

e) pH

f) E_C

g) Total and plant available elements (mg/kg particle concentration): phosphorus, potassium, iron, manganese, zinc, copper, boron, calcium, magnesium, sodium, sulfur, molybdenum, nickel, aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, mercury, selenium, silver, strontium, tin, and vanadium. Plant available concentration shall be assessed based on weak acid extraction(ammonium Bicarbonate/DTPA soil analysis or similar)

h) Soil adsorption ratio

i) Carbon/nitrogen ratio

j) Cation exchange capacity

k) Moisture content

l) Organic content

m) An assessment of agricultural suitability based on test results

n) Recommendations for adding amendments, chemical corrections, or both.

BSM which requires amending to comply with these specifications shall be uniformly blended and tested in its blended state prior to testing and delivery.

F.4.2.2 BSM Chemical Suitability

For systems with underdrains, the BSM shall exhibit limited potential for leaching of pollutants that are at levels of concern. Potential for pollutant leaching shall be assessed using either the Saturated Media Extract Method (aka, Saturation Extract) that is commonly performed by agricultural laboratories or the Synthetic Precipitation Leaching Procedure (SPLP) (EPA SW-846, Method 1312). The referenced tests express the criteria in terms of the pollutant concentration in water that is in contact with the media. In areas in which a pollutant or pollutants are associated with a water quality impairment or a TMDL, BSM in systems with underdrains shall conform to the following Saturation Extract or SPLP criteria for applicable pollutant(s):

a) Nitrate < 3 mg/L

b) Phosphorus < 1 mg/L[10]

c) Zinc < 0.1 mg/L

d) Copper < 0.025 mg/L

10 Alternative mixtures should be considered for systems with underdrains in areas where phosphorus is associated with a water quality impairment or a TMDL or where the BSM does not achieve the Saturation Extract or SPLP criteria of < 1 mg/L total phosphorus as specified in 800-4.2.2. Details regarding alternative mixtures requirements and potential components are included in F.4.1.3.

e) Lead < 0.025 mg/L

f) Arsenic < 0.02 mg/L

g) Cadmium < 0.01 mg/L

h) Mercury < 0.01 mg/L

i) Selenium < 0.01 mg/L

Criteria shall be met as stated where a pollutant is associated with a water quality impairment or Total Maximum Daily Load (TMDL) in any downstream receiving water. Criteria may be waived or modified, at the discretion of the City Engineer, where a pollutant does not have a nexus to a water quality impairment or TMDL of downstream receiving water(s). Criteria may also be modified at the discretion of the City Engineer if the Contractor demonstrates that suitable BSM materials cannot be feasibly sourced within a 50-mile radius of the project site and a good faith effort has been undertaken to investigate available materials.

Note that Saturation Extract and SPLP tests are expected to result in somewhat more leaching than would be experienced with real storm water; therefore, a direct comparison to water quality standards or effluent limitations is not relevant.

The chemical suitability criteria listed in this section do not apply to systems without underdrains, unless groundwater is impaired or susceptible to nutrients contamination.

F.4.2.3 BSM Hydraulic Suitability

The saturated hydraulic conductivity or infiltration rate of the whole BSM shall be measured by one of the following methods:

a. Measurement of hydraulic conductivity (USDA Handbook 60, method 34b) (commonly available as part of standard agronomic soil evaluation), or

b. ASTM D2434 Permeability of Granular Soils (at approximately 85% relative compaction Standard Proctor, ASTM D698)

BSM shall conform to hydraulic criteria associated with the BMP design configuration that best applies to the facility where the BSM will be installed (options describe below).

Systems with unrestricted underdrain system (i.e., media control). For systems with underdrains that are not restricted, the BSM shall have a minimum measured hydraulic conductivity of 8 inches per hour to ensure adequate flow rate through the BMP and longevity of the system. The BSM should have a maximum measured hydraulic conductivity of no more than 20 inches per hour. BSM with higher measured hydraulic conductivity may be accepted at the discretion of the City Engineer. In all cases, an upturned elbow system on the underdrain, measuring 9 to 12 inches above the invert of the underdrain, should be used to control velocities in the underdrain pipe and reduce potential for solid migration through the system.

Systems with restricted underdrain system (i.e., outlet control). For systems in which the flowrate of water through the media is controlled via an outlet control device (e.g., orifice or valve) affixed to the outlet of the underdrain system, the hydraulic conductivity of the media should be at least 15 inches per hour and not more than 40 inches per hour. The outlet control device should control the flowrate to between 5 and 12 inches per hour. This configuration reduces the sensitivity of system performance to the hydraulic conductivity of the material, reduces the likelihood of

preferential flow through media, and allows more precise design and control of system flow rates. For these reasons, outlet control should be considered the preferred design option.

Systems without underdrains. For systems without underdrains, the BSM shall have a hydraulic conductivity at least 4 times higher than the underlying soil infiltration rate, but shall not exceed 12 inches per hour.

F.4.3 Delivery, Storage and Handling

The Contractor shall not deliver or place soils in frozen, wet, or muddy conditions. The Contractor shall protect soils and mixes from absorbing excess water and from erosion at all times. The Contractor shall not store materials unprotected during large rainfall events (>0.25 inches). If water is introduced into the material while it is stockpiled, the Contractor shall allow the material to drain to the acceptance of the City Engineer before placement.

BSM shall be thoroughly mixed prior to delivery using mechanical mixing methods such as a drum mixer. BSM shall be lightly compacted and placed in loose lifts approximately 12 inches (300 mm) to ensure reasonable settlement without excessive compaction. Compaction within the BSM area should not exceed 75 to 85% standard proctor within the designed depth of the BSM. Machinery shall not be used in the bioretention facility to place the BSM. A conveyor or spray system shall be used for media placement in large facilities. Low ground pressure equipment may be authorized for large facilities at the discretion of the City Engineer.

Placement methods and BSM quantities shall account for approximately 10% loss of volume due to settling. Planting methods and timing shall account for settling of media without exposing plant root systems.

The Engineer may request up to three double ring infiltrometer tests (ASTM D3385) or approved alternative tests to confirm that the placed material meets applicable hydraulic suitability criteria (800-4.2.3). In the event that the infiltration rate of placed material does not meet applicable criteria, the City Engineer may require replacement and/or decompaction of materials.

F.4.4 Quality Control and Acceptance

Close adherence to the material quality controls herein are necessary in order to support healthy vegetation, minimize pollutant leaching, and assure sufficient permeability to infiltrate/filter runoff during the life of the facility. Amendments may be included to adjust agronomic properties. Acceptance of the material will be based on test results certified to be representative. Test results shall be conducted no more than 120 days prior to delivery of the blended BSM to the project site. For projects installing more than 100 cubic yards of BSM, batch-specific tests of the blended mix shall be provided to the City Engineer for every 100 cubic yards of BSM along with a site plan showing the placement locations of each BSM batch within the facility.

F.4.5 Integration with Other Specifications

This specification includes is related to, and may depend or have dependency on other specifications, including but not limited to:

- Plantings and Hydroseed
- Mulch
- Aggregate (choking stone, drainage stone, energy dissipation)
- Geotextiles
- Underdrains
- Outlet control structures
- Excavation

Execution of this specification requires review and understanding of related specifications. Where conflicts with other specifications exist or appear to exist, the Contractor shall consult with the City Engineer to determine which specifications prevail.

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F.5. Aggregate Materials for BSM Drainage Layers

Drainage of BSM requires the use of specific aggregate materials for filter course (aka choking layer) materials and for an underlying drainage and storage layer.

F.5.1 Rock and Sand Products for Use in BSM Drainage

Size classifications detailed in Tables F.5-1 and F.5-2 shall apply with respect to BSM drainage materials. All sand and stone products used in BSM drainage layers shall be clean and thoroughly washed.

Table F.5-1 Crushed Rock and Stone Gradation Limits

Sieve Size	Percent Passing Sieves	
	AASHTO No. 57	ASTM No. 8
3 in	-	-
2.5 in	-	-
2 in	-	-
1.5 in	100	-
1 in	95 – 100	-
0.75 in	-	-
0.5 in	25 – 60	100
0.375 in	-	85 – 100
No. 4	10 max.	10 – 30
No. 8	5 max.	0 – 10
No. 16		0 – 5
No. 50		-

Table F.5-2 Sand Gradation Limits

Sieve Size	Percent Passing Sieves
	Choker Sand - ASTM C33
0.375 in	100
No. 4	95 – 100
No. 8	80 – 100
No. 16	50 – 85
No. 30	25 – 60
No. 50	5 – 30
No. 100	0 – 10
No. 200	0 – 3

F.5.2 Graded Aggregate Choker Stone

Graded aggregate choker material is installed as a filter course to separate BSM from the drainage rock reservoir layer. This ensures that no migration of sand or other fines occurs. The filter course consists of two layers of choking material increasing in particle size. The top layer of the filter course shall be constructed of thoroughly washed ASTM C33 fine aggregate sand material conforming to gradation limits contained in Table F.5-2. The bottom layer of the filter course shall be constructed of thoroughly washed ASTM No. 8 aggregate material conforming to gradation limits contained in Table F.5-1.

F.5.3 Open-Graded Aggregate Stone

Open-graded aggregate material is installed to provide drainage for overlying BSM and filter course layers, provide additional storm water storage capacity, and contain the underdrain pipe(s). This layer shall be constructed of thoroughly washed AASHTO No. 57 open graded aggregate material conforming to gradation limits contained in Table F.5-1.

F.5.4 Spreading

Imported BSM drainage material shall be delivered to the BMP system installation site as uniform mixtures and each layer shall be spread in one operation. Segregation within each aggregate layer shall be avoided and the layers shall be free from pockets of coarse or fine material.

Aggregate shall be deposited on underlying layers at a uniform quantity per linear foot (meter), which quantity will provide the required compacted thickness within the tolerances specified herein without resorting to spotting, picking up, or otherwise shifting the aggregate material.

The thickness of the aggregate storage layer (AASHTO No. 57) will depend on site specific design and shall be detailed in contract documents.

The bottom layer of the filter course (ASTM No.8) shall be installed to a thickness of 3 inches (75 mm). The layer shall be spread in one layer. The top layer of the filter course (ASTM C33) shall be installed to a thickness of 3 inches (75 mm). The layer shall be spread in one layer. Marker stakes should be used to ensure uniform lift thickness.

F.5.5 Compacting

Filter course material and aggregate storage material shall be lightly compacted to approximately 80% standard proctor without the use of vibratory compaction.

F.5.6 Measurement and Payment

Quantities of graded aggregate choker material and open-graded aggregate storage material will be measured as shown in the Bid. The volumetric quantities of graded aggregate choker stone material and open-graded storage material shall be those placed within the limits of the dimensions shown on the Plans.

The weight of material to be paid for will be determined by deducting (from the weight of material delivered to the Work) the weight of water in the material (at the time of weighing) in excess of 1% more than the optimum moisture content. No payment will be made for the weight of water deducted as provided in this subsection.

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Appendix D.
San Francisco Bioretention Specification 33 47 27

DIVISION 33 – UTILITIES

Section 33 47 27 – Bioretention

DESIGNER NOTE: Green text corresponds to notes to the designer. Remove prior to use.

DESIGNER NOTE: Replace "Engineer/Landscape Architect" with person in responsible charge for the project (e.g., Owner, Engineer, Landscape Architect).

PART 1 GENERAL

1.01 SUMMARY

A. This section includes:

1. Bioretention Soil Mix

2. Aggregate Storage

3. Mulch [To be completed by designer.]

4. Streambed Gravel [To be completed by designer.]

B. Related Sections:

1. Section 01 57 29 – Temporary Protection of Green Infrastructure Facilities

DESIGNER NOTE: The designer should list any additional specification sections which relate to the bioretention work (i.e., clean outs and underdrains, overflow structures, planting, temporary erosion control, utilities, irrigation, earthwork, other appurtenances, etc.).

1.02 STANDARDS AND CODES

A. Reference Standards: This section incorporates by reference the latest versions of the following documents. These references are a part of this section as specified and modified.

Reference	Title
Caltrans	Standard Specifications
San Francisco DPW	Engineering Standard Specifications
ASTM	Annual Book of ASTM Standards, American Society for Testing and Materials, Philadelphia, PA, 1997 or latest edition.

1.03 DEFINITIONS

A. Bioretention Soil Mix (BSM): A soil mix that has been specially blended and tested for use in bioretention facilities with the intent to meet the following objectives:

1. Infiltrate runoff at a minimum rate of 5 inches per hour throughout the life of the facility, and

2. By nature of its components be capable of the removal of certain suspended and dissolved stormwater pollutants, and

3. Have sufficient moisture retention and other agronomic properties to support healthy vegetation.

1.04 REFERENCES

DESIGNER NOTE: Designer to provide references to all project specific documents (e.g., geotechnical report).

1.05 SUBMITTALS

A. Pre-Installation Submittals: The Contractor shall submit to the Engineer/Landscape Architect the following a minimum of 20 calendar days (or as directed by the Engineer/Landscape Architect) prior to the construction of bioretention facilities:

1. BSM Submittals

a. Two one (1) gallon samples of the BSM.

b. Source certificates for all BSM materials.

c. Sieve analysis of BSM per ASTM D422 performed within two (2) months of product delivery to site

d. Certification from the soil supplier or an accredited testing agency that the BSM, including sand and compost components, conforms to all industry or technical society reference standards specified in Sections 2.01.A, 2.01.B, and 2.01C.

e. A description of the equipment and methods used to mix the sand and compost to produce BSM.

f. Organic content test results of the BSM, performed in accordance with Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, “Loss-On-Ignition Organic Matter Method.”

g. Permeability test results for BSM per ASTM D2434 (Modified). See SFPUC Modified ASTM D2434 Procedures for required modifications to test.

DESIGNER NOTE: On larger projects, it may be appropriate to require that the above testing be performed on samples taken at the supplier’s yard from the stockpile to be used for the project; see designer note in Section 1.06.C.2.

2. Sand Submittals

a. Sieve analysis of sand per ASTM D422 performed within two (2) months of product delivery to site.

DESIGNER NOTE: Consider revising acceptable age of sieve tests depending on scale of project. On a larger project it may be appropriate to require testing on samples taken at the supplier’s yard from the stockpile to be used for the project.

3. Compost Submittals

a. Quality analysis results for compost performed in accordance with Seal of Testing Assurance (STA) standards, as specified in Section 2.01.C, and performed within two (2) months of product delivery to site.

b. Sieve analysis of compost per TMECC 02.02-B performed within two (2) months of product delivery to site.

4. Other Submittals

a. Cut sheets of any media or soil admixes to enhance moisture retention properties, if used.

b. Testing agency qualifications as specified in Section 1.06.B.

DESIGNER NOTE: Designer should include relevant submittal requirements for mulch and streambed gravel (e.g., sieve analysis), to ensure quality of delivered products.

1.06 QUALITY CONTROL AND QUALITY ASSURANCE

A. General: Test and inspect bioretention materials and operations as Work progresses as described in this section. Failure to detect defective Work or materials at any time will not prevent rejection if a defect is discovered after installation, nor shall it constitute final acceptance.

B. Testing Agency Qualification:

1. General: Agencies that perform testing on bioretention materials, including permeability testing, shall be accredited by STA, ASTM, AASHTO, or other designated recognized standards organization. All certifications shall be current. Testing agency shall be capable of performing all tests to the designated and recognized standards specified and shall provide test results with an accompanying Manufacturer's Certificate of Compliance. The following information shall be provided for all testing laboratories used:

a. Name of lab(s) and contact person(s)

b. Address(es) and phone number(s)

c. Email address(es)

d. Qualifications of laboratory and personnel including the date of current certification by STA, ASTM, AASHTO, or approved equal.

2. Compost: Laboratory that performs testing shall be independent, enrolled in the US Composting Council's (USCC) Compost Analysis Proficiency (CAP) program, and perform testing in accordance with USCC Test Method for The Examination of Composting and Compost (TMECC). The sample collection protocol can be obtained from the U.S. Composting Council, 4250 Veterans Memorial Highway,

Suite 275, Holbrook, NY 11741, 631-737-4931, www.compostingcouncil.org.

C. Responsibilities of Contractor

1. Submittals: Some of the tests required for this specification are unique, and BSM shall be considered a long-lead-time item. Under no circumstance shall failure to comply with all specification requirements be an excuse for a delay or for expedient substitution of unacceptable material(s). The requirements of Division 0 apply in their entirety.

Pre-Placement Conference: A mandatory pre-placement conference will take place, including at a minimum the Engineer/Landscape Architect, the Resident Engineer, the Owner/Client Representative, Installer, and general Contractor, to review schedule, products, soil testing, permeability testing, and installation. The Contractor shall notify the Engineer/Landscape Architect a minimum of 2 working days prior to conference.

DESIGNER NOTE: Pre-placement conference is mandatory for all projects within the public right-of-way, or on other public property, and is strongly recommended for privately-owned parcel projects.

2. Testing: All testing specified herein is the responsibility of the Contractor and shall be conducted by an independent testing agency, retained by the Contractor. The Owner reserves the right to conduct additional testing on all materials submitted, delivered, or in-place to ensure compliance with Specifications.

DESIGNER NOTE: Batch-specific test results and certifications shall be required for projects installing more than 500 cubic yards of BSM.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect the BSM and mulch from contamination and all sources of additional moisture at supplier site, during transport, and at the project site, until incorporated into the Work.

B. The Contractor is required to coordinate delivery of BSM and aggregates with bioretention facility excavation and soil installation. A written schedule shall be submitted for review as part of the submittal package. BSM should not be stockpiled onsite for any length of time. In no case shall BSM be stockpiled onsite for more than 24 hours without prior written approval by the Engineer/Landscape Architect. If stockpiling onsite for any length of time, BSM stockpiles shall meet the following requirements:

1. Locate stockpiles away from drainage courses, inlets, sewer cleanout vents, and concentrated stormwater flows

2. Place stockpiles on geotextile fabric

3. Cover stockpiles with plastic or comparable material

4. Contain stockpiles (and prevent contamination from adjacent stockpiles) with temporary perimeter barrier (e.g., sand bags, wattles, silt fence)

PART 2 PRODUCTS

2.01 BIORETENTION SOIL MIX (BSM)

A. General: BSM shall be a well-blended mixture of sand and compost, shall have sufficient moisture retention to support healthy plant growth, and shall meet the following criteria:

1. Mixture proportions: 30 to 40 percent Compost by volume and 60 to 70 percent Sand by volume

DESIGNER NOTE: Up to 15 percent of the sand fraction may be replaced with other media or soil admixtures (e.g., scoria, coconut coir, perlite, expanded shale, gypsum, vermiculite, pumice, biochar, etc.) to enhance moisture retention capacity of soil, provided admixtures are low in fines (less than 5 percent passing the 200 sieve) and do not break down under normal handling and use. No topsoil, peat, silts, or clays are permitted to be used as admixtures. Admixtures shall be free of sediments and other materials deleterious to plant growth.

2. Organic matter content: 4 to 8 percent as determined by TMECC 05.07-A, Loss on Ignition Method.

3. Extraneous materials: BSM shall be free of all roots, plants, weeds, sod, stones, clods, pockets of coarse sand, construction debris, or other extraneous materials harmful to plant growth.

4. Permeability/Saturated Hydraulic Conductivity: 10 inches per hour (minimum) tested in accordance with ASTM D2434 (Modified). See SFPUC Modified ASTM D2434 Procedures for required modifications to test.

DESIGNER NOTE: 10-inch-per-hour minimum rate assumes a design rate of 5 inches per hour and a correction factor of 2 to account for reduction in performance from initially measured rates.

5. Acceptance of BSM quality and performance may be based on samples taken from stockpiles at supplier's yard, submitted test results, and/or onsite and laboratory testing of installed material at the discretion of the Engineer/Landscape Architect. The point of acceptance will be determined in the field by the Engineer/Landscape Architect.

DESIGNER NOTE: Designer to consider non-compost based BSM specification if facility is serviced by an underdrain and if it is draining to phosphorus sensitive water body.

B. Sand: Sand in the BSM shall conform to the requirements for Sand, Type [specify type from table below] specified herein, unless otherwise approved by the Engineer/Landscape Architect.

DESIGNER NOTE: Designer to specify sand type based on project specific requirements. If bioretention facilities will be subjected to heavy sediment loads (e.g., arterial runoff), consider specifying Sand, Type B (low fines sand) in an effort to reduce clogging risk (pending local availability). Additionally, projects anticipating heavy sediment loads should incorporate pre-settling measures at the upstream end of the facility to allow for more efficient maintenance of facilities.

1. Sand shall be free of wood, waste, coating, or any other deleterious material.

2. Sand material shall meet the following specifications for gradation.

Sieve Size[1]	Percent Passing by Weight	
	Type A[2]	Type B (low fines)[3]
3/8 inch	100	100
No. 4	90 to 100	90 to 100
No. 8	70 to 100	70 to 100
No. 16	40 to 95	40 to 85
No. 30	15 to 70	15 to 60
No. 50	5 to 55	8 to 15
No. 100	0 to 15	0 to 4
No. 200	0 to 5	0 to 2

[1] Sieve provided in nominal size square openings or United States Standard Sieve Series sizes.

[2] Sand conforming to ASTM C33 for Fine Aggregate satisfies the requirements of this specification for Sand, Type A.

[3] Type B (low fines) sand gradation pending local availability.

3. Coefficient of Uniformity: $C_u = \frac{D_{60}}{D_{10}}$: 4 or less for Sand, Type B.

4. Effective Particle Size (D_{10}): 0.3 to 0.5 mm for Sand, Type B.

5. All aggregate passing the No. 200 sieve shall be non-plastic.

6. Acceptance of grading and quality of the sand may be based on samples taken from stockpiles at supplier's yard or a submitted gradation report at the discretion of the Engineer/Landscape Architect. The point of acceptance will be determined in the field by the Engineer/Landscape Architect.

C. Compost: Compost in the BSM shall be well decomposed, stable, weed free organic matter sourced from waste materials including yard debris, wood wastes or other organic materials, not including biosolids or manure feedstock. Compost shall conform to California Code of Regulations

Title 14, Division 7, Chapter 3.1 requirements, be certified through the USCC Seal of Testing Assurance (STA) Program, and meeting the criteria specified herein.

1. Feedstock: Feedstock materials shall be specified and include one or more of the following: landscape/yard trimmings, grass clippings, food scraps, and agricultural crop residues. Feedstock shall not include biosolids or manure.

2. Organic Matter Content: 35 to 75 percent by dry weight tested in accordance with TMECC 05.07-A (Loss on Ignition Organic Matter Method).

3. Carbon to Nitrogen Ratio: C:N between 15:1 and 25:1 when tested in accordance with TMECC 05.02-A.

4. Maturity/Stability: shall have a dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell, containing recognizable grass or leaves, or is hot (120°F) upon delivery or rewetting is not acceptable. In addition any one of the following is required to indicate stability:

a. Specific Oxygen Uptake Rate (SOUR): 1.5 milligrams O_2 per gram biodegradable volatile solids per hour (maximum) per TMECC 05.08-A.

b. Carbon Dioxide Evolution Rate: 8 milligrams CO_2 per gram volatile solids per day per TMECC 05.08-B.

c. Dewar Self Heating Test: 20°C temperature rise (maximum) per TMECC 05.08-D (Class IV or V).

d. Solvita®: Index value greater than 6 per TMECC 05.08-E.

5. Toxicity: Seed Germination: greater than 80 percent of control AND Vigor: greater than 80 percent of control per TMECC 05.05-A.

6. Nutrient Content: provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S, and B.

a. Total Nitrogen: 0.9 percent (minimum).

b. Boron: Total shall be < 80 ppm

7. Salinity/Electrical Conductivity: less than 6.0 deciSiemen per meter (dS/m or mmhos/cm) per TMECC 04.10-A (1:5 Slurry Method, Mass Basis).

8. pH: 6.5 to 8 per TMECC 04.11-A (1:5 Slurry pH).

9. Gradation: Compost for BSM shall meet the following size gradation per TMECC 02.02-B (test shall be run on dry compost sample):

Sieve Size	Percent Passing by Weight

	Min	***Max***
1 inch	99	100
1/2 inch	90	100
1/4 inch	40	90
No. 200	1	10

10. Bulk density: 500 to 1,100 dry pounds per cubic yard.

11. Moisture content: 30 to 55 percent of dry solids.

12. Inerts: compost shall be relatively free of inert ingredients, including glass, plastic and paper, less than 1 percent by weight or volume per TMECC 03.08A.

13. Weed seed/pathogen destruction: provide proof of process to further reduce pathogens (PFRP). For example, turned windrows must reach minimum 55°C for 15 days with at least 5 turnings during that period.

14. Select Pathogens

a. Salmonella: less than 3 Most Probable Number per 4 grams of total solids, dry weight per TMECC 07.02.

b. Coliform Bacteria: fecal coliform less than 1,000 Most Probable Number per gram of total solids, dry weight per TMECC 07.01.

15. Trace Contaminants Metals (lead, mercury, etc.): Product must meet US EPA, 40 CFR 503 regulations.

D. Soil Admixtures: [Specify admixtures, if used]

2.02 AGGREGATE STORAGE

DESIGNER NOTE: Aggregate storage layer requirements are dependent on location of project (i.e., MS4 areas vs. combined sewer areas), site specific conditions (e.g., native soil infiltration rates, storage volume needs of project). The designer should update this specification based on the aggregate storage materials required for the project.

DESIGNER NOTE: Aggregate storage is optional in combined sewer areas for facilities without underdrains. BSM depth may also be increased for additional storage capacity (in lieu of an aggregate storage layer), provided the facility is within a combined sewer area and not serviced by an underdrain.

A. Aggregate Storage shall consist of hard, durable, and clean, sand, gravel, or mechanically crushed stone, substantially free from adherent coatings. Materials shall be washed thoroughly to remove fines, organic matter, extraneous debris, or objectionable materials. Recycled materials are not permitted. The material shall be obtained only from a source(s) approved by the Engineer/Landscape Architect. Written requests for source approval shall be submitted to the Engineer/Landscape Architect not less than ten (10) working days prior to the intended use of the Material. Should the proposed source be one that the Engineer/Landscape Architect has no

history of Material performance with, the Engineer/Landscape Architect reserves the right to take preliminary samples at the proposed source, and make preliminary tests, to first determine acceptability of the new source and then perform the applicable Material approval testing. Continued approval of a source is contingent upon the Materials from that source continuing to meet Contract requirements. Materials shall meet the Standard Specifications for grading and quality for use in the Work; however, allowable exceptions may be specified in the Contract.

B. Aggregate storage shall meet the following specifications for grading and quality.

1. Aggregate gradation testing in accordance with ASTM C136 at least once per 500 cubic yards.

Sieve[1]	Percent Passing by Weight		
	Choking Course ASTM No. 9 (Modified)[3]	**Reservoir Course ASTM No. 7 (Modified)[4]**	**Caltrans Class 2 Permeable Aggregate (MS4 Areas Only)**
1 inch	–	–	100
3/4 inch	–	100	90 to 100
1/2 inch	100	90 to 100	–
3/8 inch	100	40 to 70	40 to 100
No. 4	85 to 100	0 to 15	25 to 40
No. 8	10 to 40	0 to 5	18 to 33
No. 16	0 to 10	–	–
No. 30	–	–	5 to 15
No. 50	–	–	0 to 7
No. 200[2]	0 to 2	0 to 2	0 to 3

[1] Sieve provided in nominal size square openings or United States Standard Sieve Series sizes.

[2] Gradation modified from ASTM for portion passing the No. 200 sieve.

[3] Materials likely to meet this specification are available locally as Graniterock 1/4” premium screenings (Wilson 1/4" x #10 Premium Screenings).

[4] Materials likely to meet this specification are available locally as Graniterock 1/2” premium screenings (Wilson 1/2" x #4 Roofing Aggregate).

2. Crushed Particles: 90 percent (minimum) fractured faces tested in accordance with California Test 205. Do not use rounded river gravel.

3. L.A. Abrasion: 40 percent (maximum) tested in accordance with ASTM C 131.

DESIGNER NOTE: If the designer chooses to specify materials that differ from those provided herein, the designer should check their filter criteria to evaluate the likelihood of finer-graded material migration into underlying coarser graded materials or reduction in permeability relative to the underlying material. Refer to the SFPUC Aggregate Filter Criteria Guidance document for information on selecting appropriate alternate materials.

DESIGNER NOTE: Designer should verify that underdrain slot dimensions for project are compatible with aggregate gradation specified. Refer to the SFPUC Aggregate Filter Criteria Guidance document for information on selecting appropriate underdrain materials.

2.03 MULCH

DESIGNER NOTE: This section intentionally left blank. Designer to specify mulch requirements for bioretention facilities. Mulch may be wood, compost, or rock mulch. Mulch shall be free of dyes, recycled dimensional lumber, and bark. Materials selected shall be sufficiently permeable to allow water to pass through at a rate equal to or greater than the underlying BSM. Typical mulch recommended for this application includes tree trimming mulch per Caltrans Standard Specification Section 20-7.02D(6)(a) and (e), or other comparable material (e.g., arbor mulch).

2.04 STREAMBED GRAVEL

DESIGNER NOTE: This section intentionally left blank. Designer to specify gravel requirements, including gradation, for bioretention facilities. Streambed Gravel shall be sized to provide energy dissipation and to minimize erosion at facility inlets and outlets. The following text is a sample/template specification for cobbles within a bioretention facility:

Streambed Cobbles shall be clean, naturally occurring water rounded gravel material. Streambed Cobbles shall have a well-graded distribution of cobble sizes and conform to the following gradation [Designer to specify]:

Streambed Cobbles	
Approximate Size[1]	**Percent Passing by Weight**

[1] Approximate size can be determined by taking the average dimension of the three axes of the rock, Length, Width, and Thickness, by use of the following calculation: (Length + Width + Thickness)/3 = Approximate Size Length is the longest axis, width is the second longest axis, and thickness is the shortest axis.

The grading of the cobbles shall be determined by the Engineer/Landscape Architect by visual inspection of the load before it is dumped into place, or, if so ordered by the Engineer/Landscape Architect, by dumping individual loads on a flat surface and sorting and measuring the individual rocks contained in the load. Cobbles must be washed before placement.

PART 3 EXECUTION

3.01 GENERAL

A. Prevent runoff from adjacent pervious and impervious surfaces from entering the bioretention facility (e.g., sand bag inlet curb cuts, stabilize adjacent areas, flow diversion) until authorization is given by the

Engineer/Landscape Architect. Refer to SFPUC Specification Section 01 57 29 Temporary Protection of Green Infrastructure Facilities.

B. Exclude equipment from bioretention facilities. No equipment shall operate within the facility once bioretention facility excavation has begun, including during and after excavation, backfilling, mulching, or planting.

C. Prevent foreign materials and substances, such as silt laden run-off, construction debris, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid from entering or being stored in the facility at any point during construction.

3.02 GRADING

A. The Contractor shall not start bioretention facility grading until all areas draining to the facility are stabilized and authorization has been given by the Engineer/Landscape Architect.

B. Construct bioretention facility subgrade to +/- 3/4 inch of the grades and slopes specified on the Plans.

C. Excavation within 6 inches of final native soil grade shall not be permitted if facility soils have standing water, or have been subjected to more than 1/2 inch of precipitation within the previous 48 hours.

3.03 SUBGRADE PREPARATION AND PROTECTION

A. Protect the bioretention excavation from over compaction and/or contamination.

1. Areas which have been over compacted by equipment or vehicle traffic or by other means and which need to be ripped, over excavated, receive additional scarification, or other restorative means shall be done at the Contractor's expense and at the direction of the Engineer/Landscape Architect.

2. Excavated areas contaminated by sediment laden runoff prior to placement of BSM or Aggregate Storage material shall be remediated at the Contractor's expense by removing the contaminated soil (top 3 inches minimum) and replacing with a suitable material, as determined by the Engineer/Landscape Architect.

B. Remove all trash, debris, construction waste, cement dust and/or slurry, or any other materials that may impede infiltration into prepared subgrade.

C. The subgrade shall be inspected and accepted by the Engineer/Landscape Architect prior to placement of any materials or final subgrade scarification.

D. Scarify the surface of the subgrade to a minimum depth of 3 inches immediately prior to placement of BSM or aggregate storage material. Acceptable methods of scarification include use of excavator bucket teeth or a rototiller to loosen the surface of the subgrade.

E. Place aggregate storage material, where shown on drawings with conveyor belt or with an excavator or loader from a height no higher than 6 feet unless otherwise approved by the Engineer/Landscape Architect (i.e., do not dump material directly from truck into cell).

F. Aggregate Storage areas contaminated by sediment-laden runoff prior to placement of BSM shall be remediated at the Contractor's expense by removing the contaminated aggregate storage material (top 3 inches minimum or as directed by the Engineer/Landscape Architect) and replacing with clean aggregate storage material per Section 2.03, to the lines and grades on the Plans.

G. Aggregate Storage material shall be inspected and accepted for placement and finish grade by the Engineer/Landscape Architect prior to the installation of BSM. Any material that does not conform to this Specification shall be removed and replaced with acceptable material or remediated to the satisfaction of the Engineer/Landscape Architect, at the Contractor's expense.

3.04 BIORETENTION SOIL MIX PLACEMENT

A. The Contractor shall not place BSM until the Engineer/Landscape Architect has reviewed and confirmed the following:

1. BSM delivery ticket(s): Delivery tickets shall show that the full delivered amount of BSM matches the product type, volume and manufacturer named in the submittals. Each delivered batch of BSM shall be accompanied by a certification letter from the supplier verifying that the material meets specifications and is supplied from the approved BSM stockpile.

2. Visual match with submitted samples: Delivered product will be compared to the submitted 1-gallon sample, to verify that it matches the submitted sample. The Engineer/Landscape Architect may inspect any loads of BSM on delivery and stop placement if the soil does not appear to match the submittals; and require sampling and testing of the delivered soil to determine if the soil meets the requirements of Section 2.01 before authorizing soil placement.

3. Inspection of the aggregate storage layer, underdrain, cleanout, and overflow structure installation, where included on the plans.

DESIGNER NOTE: On larger projects, it may be appropriate to require that the testing specified in Section 2.01 be performed on samples taken at the supplier's yard from the stockpile to be used for the project; see designer note in Section 1.06.C.2.

B. BSM placement, grading and consolidation shall not occur when the BSM is excessively wet, or has been subjected to more than 1/2 inch of precipitation within 48 hours prior to placement. Excessively wet is defined as being at or above 22 percent soil moisture by a General Tools &

Instruments DSMM500 Precision Digital Soil Moisture Meter with Probe (or equivalent). A minimum of three readings with the soil moisture probe will be used to determine the average percent soil moisture reading per each truck load. There should be no visible free water in the material.

C. The Contractor shall place BSM loosely with a conveyor belt or with an excavator or loader from a height no higher than 6 feet, unless otherwise approved by the Engineer/Landscape Architect (i.e., do not dump material directly from truck into cell). Soil shall be placed upon a prepared subgrade in accordance with these Specifications and in conformity with the lines, grades, depth, and typical cross-section shown in the Drawings or as established by the Engineer/Landscape Architect.

D. Excessively dry BSM may be lightly and uniformly moistened, as necessary, to facilitate placement and workability.

E. Compact BSM using non-mechanical compaction methods (e.g., boot packing, hand tamping, or water consolidation) to 83 percent (+/- 2 percent) of the maximum dry density per modified Proctor test (ASTM D1557), or as directed by the Geotechnical Engineer. Determination of in-place density shall be made using a nuclear gauge per ASTM D6938. Moisture content determination shall be conducted on a soil sample taken at the location of the nuclear gage reading per ASTM D2216.

DESIGNER NOTE: BSM compaction target density will be updated as more data from installed projects becomes available on the optimal compaction to minimize settlement while maintaining the infiltration capacity of the media. Designers are encouraged to report field density measurements, observed infiltration rates (if available), and anecdotal field observations (e.g., soil appears well draining, settlement observed minimal).

F. Grade BSM to a smooth, uniform surface plane with loose, uniformly fine texture. Rake, remove ridges, and fill depressions to meet finish grades.

G. Final soil depth shall be measured and verified only after the soil has been compacted. If after consolidation, the soil is not within +/- 3/4 inch of the grades and slopes specified on the Plans, add material to bring it up to final grade and raked.

H. The BSM shall be inspected and accepted for placement and finish grade by the Engineer/Landscape Architect prior to the installation of planting and mulch. Any BSM that does not conform to this Specification shall be remediated to the satisfaction of the Engineer/Landscape Architect, or removed and replaced with acceptable BSM, at the Contractor's expense.

3.05 PLANTING AND MULCHING

A. Bioretention facilities shall be planted and mulched as shown on the Plans.

B. Bioretention facilities shall not be planted or mulched when soils are excessively wet as defined in Section 3.04.

C. Bioretention facility areas contaminated by sediment laden runoff prior to planting or placement of mulch shall be remediated at the Contractor's expense by removing the contaminated BSM (top 3 inches minimum) and replacing with BSM per Section 2.01, to the lines and grades on the Plans.

D. All mulch shall be inspected and accepted by the Engineer/Landscape Architect to ensure appropriate depth and material prior to facility commissioning (e.g., unblocking of inlets).

DESIGNER NOTE: Planting and mulching requirements shall be determined by the designer and included or referenced herein.

3.06 FLOOD TESTING

A. Inlets shall be constructed per the Plans and free from all obstructions prior to commencing flow testing.

B. Testing shall be conducted at the conclusion of the 90-day plant grow-in period. Protection and flow diversion measures installed to comply with Section 01 57 29 Temp Protection of GI Facilities shall be removed in their entirety prior to commencing flow testing.

C. Underdrains shall be plugged at the outlet structure to minimize water consumption during testing.

D. Prior to testing, broom sweep gutter and other impervious surfaces within the test area to remove sediments and other objectionable materials.

E. The Engineer/Landscape Architect shall be present during the demonstration. The Contractor shall notify the Engineer/Landscape Architect a minimum of 2 working days prior to testing.

F. The Contractor shall water test each facility to demonstrate that all inlet curb openings are capturing and diverting all water in the gutter to the facility, outlet structures are engaging at the elevation specified, and the designed ponding depth is achieved. Testing shall include application of water from a hydrant or water truck per Section 00 73 73, Article 3.04 (Requirements for Using Water For Construction), at a minimum rate of 10 gallons per minute, into the gutter a minimum of 15 feet upstream of the inlet curb opening being tested. Each inlet shall be tested individually. If erosion occurs during testing, restore soils, plants, and other affected materials.

DESIGNER NOTE: Designer should update test flow rate for inlets to reflect project-specific design, as needed.

G. Engineer/Landscape Architect will identify deficiencies and required corrections, including but not limited to relocating misplaced plants, adjusting streambed gravel, adjusting mulch, adjusting inlets, splash aprons, and forebays, removing and replacing inlets, and removing debris.

H. Once adjustments are made, the Contractor shall re-test to confirm all test water flows into the facility from the gutter and correct any remaining deficiencies identified by Engineer/Landscape Architect.

I. Inlets, outlets, and other bioretention facility appurtenances shall not be accepted until testing and any required correction and retesting is complete and accepted by the Engineer/Landscape Architect.

DESIGNER NOTE: The Owner may, at any time, conduct additional testing on all materials submitted, delivered, or in-place, to ensure compliance with the Specifications. Testing may include permeability testing per ASTM D2434 (Modified), density testing per ASTM D6938, etc., if the Engineer/Landscape Architect suspects the facility does not conform to these specifications (e.g., as evidenced by lower than anticipated infiltration capacity).

DESIGNER NOTE: Designer should consider adding a similar requirement to the Concrete Paving and Sanitary Sewerage Utilities sections of the Specifications, as needed.

END OF SECTION

ATTACHMENT

C.3.c.i.(2)(c)(ii) Model Biotreatment Soil Media Specifications

Biotreatment Soil and Tree Roundtable Summary; Improvements for the Health of Trees

Biotreatment Soil and Tree Roundtable Summary

Improvements for the Health of Trees

Held on June 30, 2016

Prepared For:

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Date of Summary:

July 27, 2016

WRA #20066

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1.0 INTRODUCTION

The Municipal Regional Stormwater NPDES Permit Order No. R2-2015- 0049 (MRP) Provision C.3 mandates that Regulated Projects meeting certain impervious surface area thresholds include low impact development (LID) stormwater treatment measures in the project design. The current MRP biotreatment soil specification (biotreatment soil) required to be used in LID stormwater treatment measures (e.g. bioretention areas, tree well filters, etc.) consists of a 60-70% sand/30-40% compost mix. This mix was specified to: 1) ensure long-term biotreatment soil permeability of 5 inches per hour; 2) sustain healthy, vigorous plant life; and 3) maximize stormwater runoff retention and pollutant removal. The complete specification may be viewed at http://basmaa.org/

On June 30, BASMAA convened a biotreatment soil and tree round table to review the current soil specifications to determine if improvements to the specification can be made to positively impact the health of trees planted in biotreatment areas. Participants at the Roundtable included numerous stakeholders: Municipal representatives, compost providers, soil suppliers, soil laboratory technicians, civil engineers, landscape architects, soil scientists, construction inspectors, and Water Board representatives.

Round Table participants broke into small discussion groups to address common questions and foster smaller discussions. The group then came together to share the results of these small discussions, highlight common themes, find areas of consensus, and identify areas that require more research or discussion. This Report provides a summary of the discussion, identifies action items from the Round Table anda summary of the survey responses.

2.0 DISCUSSION SUMMARY

Participants were broken into five smaller discussion groups with experts from as many disciplines as possible in each group. Team leaders and note takers provided the attached notes from the small group discussion (Appendix A). Team leaders then shared main talking points with the larger group. The following provides a summary of the comments organized into the ten most common points that emerged from the small and large group discussions.

1. **Provide trees with access to native soil via design changes**
    - Remove barriers to roots including tall curbs, liners, aggregate, compaction, moving trees to edge
    - Engineers/designers prefer liners and tall curbs to limit risk of water damage to adjacent road, building, utilities, etc. Education of engineers will be needed for further understanding of why these elements are included and how they can be changed to accommodate trees.
    - Explore alternative designs: “Window trees in” to basins, “Tree pockets”, Vertical and Horizontal “potholes” for roots, treatment train, silva cells, forebays and structural soil
    - 90% of tree roots are in the top 18” of soil. Provide lateral access to native soil.
    - Roots grow deeper in sandy soils when water is available. Provide a deeper soil profile in addition to lateral access to native soil, increase the overall soil volume or access to native soil.
    - Soil volume is important for tree health but research from Cornell is not accurate for California. The “maximize soil volume” guideline still applies but not the quantities given.
    - Raising the underdrain on the system might provide a longer-term reservoir of water

- Aggregate layer: may be too porous, too dry and plant roots can't access water stored in aggregate; Make longer/deeper where there are no trees, remove from under trees and replace with structural soil under trees.
- Trees not appropriate in all basins
- Some sites have poor/no/compacted soil adjacent. Improve/evaluate adjacent soil to support trees
- Structural soil may be an alternative in tight spaces adjacent to basins
- Water Board is open to design changes to "window trees in" to bioretention in lieu of or in addition to changing the soil spec

2. **Conflict between water holding capacity vs. permeability rate; irrigation vs. pathogens & drought**
   - The permeability rate of 5" is based on a sizing design constraint developed by Dan Cloak based on rainfall patterns; lowering the rate would make basins larger.
   - The current spec results in a permeability well above 5" per hour in most cases. Based on moisture sensor data, basins become very dry, very quickly.
   - Achieving a mix closer to 5" per hour that is repeatable is very challenging.
   - Irrigation may help to overcome soil volume constraint and water holding capacity
   - Over irrigation leads to increase in pathogens, especially phytopthera
   - Over irrigation is unlikely in a fast draining soil like BSM
   - Using irrigation as a solution is not sustainable due to drought
   - Trees without irrigation are not practical because of the summer dry climate
   - It is difficult to provide even coverage Irrigation in a fast draining soil
   - Plants often die due to lack of water
   - There is a misconception that basins are always wet and that trees should withstand flooding. They drain incredibly fast.

3. **Topsoil in the BSM is both beneficial for plants and challenging to specify**
   - Trees need healthy soil biota, soil structure, and better water holding capacity: all provided by soil.
   - Topsoil must be a loamy sand which is not a sustainable locally sourced product (strip mining).
   - Topsoil supplies are variable with inconsistent gradation and permeability.
   - Topsoil specifications exist for landscapes, street trees, structural soils, etc. that have gradation included.
   - Handling soil degrades the structure and leads to loss of permeability

4. **More study is needed to understand what is out there, what is working and what is not working.**
   - On-going tree study by UC Cooperative Extension open to enroll more trees. Results not yet available.
   - Need to look at long-term soil conductivity and soil/plant health. Trees only beginning to mature after 10+ years. Does BSM change over time, develop into soil? What tests do we perform on existing BSM?
   - Look at soil/natural systems to find something that will sustain plants over time.
   - Are micro-organisms, soil structure, organic matter, increasing or decreasing overtime in existing BSM?
   - Are existing BSM soils getting more or less permeable over time?

- We need more data, who has the data?
- The problem is not well defined. What are the underlying issues?
- Do we have a problem with effluent water quality?

5. **Trees can fail for many variable reasons. Successful trees all have: a) adequate soil volume, b) healthy soil, c) adequate water and drainage, d) nutrients, e) quality nursery stock.**
    - Reasons for failure: Shade, not draining, compaction, barriers to soil, shallow soil, draining too fast, wrong tree, poor nursery stock
    - Changes to the soil mix may only solve some of these issues. Need to look at design as well.

6. **The soil specification should meet performance goals but also be realistic, feasible, repeatable, available and sustainably- and locally- sourced and not too expensive.**
    - Submittals for meeting current soil standard specification almost always fail.
    - Change the compaction test per lab recommendations to reduce compaction and match field conditions better. Changing the compaction test won't fix the problem because the mixes are generally way over the lower threshold as it is now.
    - Permeability testing is very expensive. Repeat testing is a challenge.
    - Involve more compost suppliers to address compost specification issues
    - Add pH requirement for sand and maybe whole mix
    - Add chemical analysis for sand, maybe whole mix
    - Give a permeability performance spec and leave the mix up to the supplier

7. **Additives to BSM**
    - Need locally sourced sustainable options**.**
    - Topsoil: improves plant/tree health but challenging to engineer and may inhibit permeability
    - Biochar lowers permeability but adds microbial activity. In its infancy and is inconsistent. No viable data.

8. **Education for city staff, designers/engineers, and soil providers needed.**
    - Provide decision tree to give clear easy way of choosing designs, soil mix, trees, etc.

9. **Revisit the specification**

10. **Compost**
    - Revisit compost gradation with compost providers
    - Consider soil to replace some or all of compost
    - Revisit testing methods

3.0 ACTION ITEMS

The following action items were identified during the large group discussion.

1. Convene a work group of compost suppliers, soil suppliers, soil labs to consider adding topsoil and/or more fines to the BSM mix. Some representatives of plants and soil health should also be present to ensure tree health needs are considered.

- Involve more compost suppliers.
- Address issues with compost and inability to meet current specification
- Address potential to include topsoil and resolve challenges in specifying and sourcing topsoil.
- Address potential to add topsoil/fines without reducing permeability below performance threshold.

2. Workgroup needed to look specifically at design of bioretention for tree health.
    - Remove barriers to roots accessing native soil.
    - "Windows" for trees, "pot holes", treatment trains, forebay, tree pockets, silva cells, structural soils
    - Increase vertical and horizontal soil volume
    - Reconfigure the aggregate layer

3. Evaluate trees in bioretention that are currently built.
    - Enroll trees in Igor Lancan (UCCE) research project
    - More clearly define the problem
    - Understand how BSM changes over time: permeability, organic matter, soil structure

4. Change the compaction test method to the Standard Proctor test (ASTM D698).
    - BASMAA to consider changing the test method in the specification. Potential to try both methods side by side for comparison prior to adoption.

4.0 SUMMARY OF SURVEY EVALUATION RESPONSES

Thirty eight participants completed the evaluation survey at the end of the Bioretention Soil and Tree Round Table. Overall 94% of participants felt the round table met their expectations and 83% were satisfied with the consensus reached. The following provides a summary of the ratings and paraphrases the comments provided.

Question	**% agree or highly agree**	**Comments**
1. The goals for the meeting and logistics were clearly expressed at the beginning of the round table	84%	• Well organized & managed • Allowed for free expression of ideas & flexibility • Goals unclear • More history would be useful
2. The literature review was sufficiently recapped	89%	• Additional topics reduced clarity • Look at more regions with similar climate • Good job/communication for time allowed • Distilled a lot of information into useful summary
3. Breakouts - the questions were helpful	58%	• Questions helpful and provided guidance, but we didn't use them • Discussion flowed freely and covered the topics without answering specific questions • Conversation lead more to design than soil • Survey and material should have focused

		on plant interplay
4. Breakouts - this exercise allowed for adequate input to develop scenarios for modified/improved soil for tree health.	89%	• Discussion was engaged, robust, productive • I learned a lot • More questions than answers • What is the goal of the Water Board relative to biotetention, trees and soil
5. The outcomes of the breakout sessions were adequately summarized.	89%	• By necessity, they were condensed • Summary raised significant areas of discussion
6. The group discussion sufficiently addressed concerns, opinions, and agreements.	89%	• Soil testing would be helpful • Subcommittees a good outcome • Would have preferred less summary or more time for group discussion • Not all issues discussed • Useful discourse but didn't resolve much
7. The facilitator managed the discussion well and provided an opportunity for all participants' voices to be heard.	97%	• Well done, effective facilitator • Great ability to synthesize and summarize
8. The right mixes of professionals were included in the round table.	91%	• Developers, contractors/installers, and more composters, more civil engineers should have been included • Fantastic/healthy mix of participants
Did this round table meet your expectations?	94%	(Limited comments)
Were you satisfied with the consensus reached?	83%	• Somewhat/no: best that could be achieved; to be expected due to complexity of the issue, varied perspectives, and difficulty to reconcile goals. •
What parts of the round table meeting were most useful to you?	Not rated	• Small group breakout session & summary • Open discussions were informative • Mix of disciplines, expertise, and different opinions
What would have made this round table meeting more useful?	Not rated	• Better management of discussion • Case studies showing successes/failures • More time needed • Send fewer papers beforehand • Give better understanding of end goal • Provide soil providers/mixers education on the spec and goals • Hard to follow the group consensus. Find consensus in small group and build from there
General comments?	Not rated	• More time needed • No real consensus • Address design outside of soil mix; design influences the success of the mix • Good work towards a difficult goal; Action items provide a path forward • Important topic to continue discussing with all disciplines

Appendix A.
Complete Round Table Notes

BASMAA Bioretention Break out group notes

6-30-2016

Blue group participants:

1. **Paul Truyts**- lyngso: goal- help make spec more realistic
   Cost is a big factor
2. **Walter Passmore**- Urban forester Palo Alto- goal: creating new standard designs for the configuration and soil volume- more relevant for tree and plant health
3. **Dan Cloak**- stormwater compliance and LID expansion- Contra Costa Clean Water Program's 2007 interest in fixing failed soil mixes (no filtration), hired Megan Stromberg to help guide creation of a spec. In 2010, Megan assisted BASMAA adopting current spec. Goal: want to see investigation and data on quality of soil for supporting plant life and infiltration after the 3 year. 5-year, 10-year mark for LID facilities.
4. **Kelly Schoonmaker**-stop waste program manager- regional public agency- rep city of Alameda. Lead compost and mulch market development education programs. Bay Friendly original trainings. Water efficient Landscape Ordinance enforcement, and lawn conversion. Goal: don't fix spec at cost of sustainably sourced material and entire materials management cycle.
5. **Sarah Sutton**- Placeworks landscape architect- Also on BoD of Rescape California. Goal: wholistic approach, 7 principles, protect water quality, conserve water, conserve energy, landscape locally, habitat creation. Need rooting volume, healthy soils, sequester carbon, microbe populations. Project example: multi benefit rain garden Ohlone green way Bart station. Treats road runoff.
6. **Sue Ma**- waterboard, engineering background. Goal: to learn about bioretention. Seen both good and poor examples. Need to focus on trees.
7. **Alan Laca**- sacramento- private consulting firm (development and transport)- meeting post construction requirements. Example Caltrans job in Colusa- designed planters for trees and treatment but species did not do well in planters.
8. **Nabiul Afrooz**- Stanford university. Design new soil media to treat stormwater and improve water quality. Recently concluded some studies with foci on pathogens, nutrients, etc. using BIOCHAR. Looking for testing locations!
9. **Brian Currier**- sac state office of water programs. Bench scale and some field scale testing. Proprietary side of mixes in recent past, but looking to share info. Goal: Identify research gaps, keep implementation moving forward.
10. **Amber Schat**- City of San Jose- stormwater management. Tree and plant health and ability to sequester/remove pollutants. Long term health of systems, maintenance requirements. Edu and training of engineers, contractors and landscaping companies

Team Leader- Dan Cloak

1. Soil Spec
    - Challenges
        - Blender perspective: spec is relatively new (2002), different spec introduced and refined and they kept changing, blenders can't control how it is used off site by contractors. What is the life span of product? Want to see someone checking it to make sure there is not experiencing over-compaction issues. Maintenance is needed to make sure weeds and imported fines are not affecting the system in the long term.
        - Reasons to keep bioretention facilities open with living soil that is renewing, as opposed to a non organic filter or drain
        - Long term soil conductivity and health viable over longer periods? Might still be draining even after 10 years, but supporting plant life? Mixed results.
        - Useful to highlight failures and find opportunities for developing criteria
        - Like creating a recipe without knowing how the cake turned out
        - Find research students and look at long term trends
        - View recent landscape installations (even non stormwater) and see what similar issues are happening (irrigation, not enough soil volume). Separate stormwater from general (general landscaping issues vs. bioretention-specific issues).
        - Lack of tree and root structure (spokes on a wheel) is not encouraging plant vigor
        - Introduce bacteria to create biofilm, increase conductivity. With biochar, lots of microbe activity but reduces conductivity.
        - Tree health issues- 10 years investigations are not long enough to really determine tree health, but after 10 is really when you start to see how that tree will perform in the long term. Conflict between infiltration and water holding capacity. Trees are survivors, but almost no trees perform well in such extremes (inundation vs drought).
        - Augment with irrigation? Tree stand chance of getting to native soil and improving beyond the bioretention, water storage potential is limited in tree, vs. if it can access below the retention line.
        - Tradeoffs in design to focus on water quality benefits vs. plant health and increases conductivity and can penetrate biofilm
        - Sand performs ok with pollutant removal, but can get clogged at surface..
        - Bioretention with healthy plants can process fines and pollutants because of soil organisms and health. What happens to soils after 5-10 years? Dead or alive?
        - Reason for 5 inch/hr is a sizing design constraint to the goal of managing big storms in small urban environments. 4% sizing factor.

- Trying to hit a lower specified infiltration rate is more difficult than appears, so 5 inches/hour is not really the issue
- Configuration: Raising underdrains on systems
    - Porous spec is leaving plants dry too often and have trouble penetrating to area below bioretention areas (true for plants and trees?)
    - Modern config any better? Dead water stored for plants, available?
    - Tree roots cant access the water if the surface tension is not present

2. Structural/Design Configuration
    - Challenges

        - Tree Pocket solution? Placement on sides instead of over drain?
        - Structural Soils? Allows trees to penetrate and has good water holding capacity that you can develop fine roots in medium.
        - Engineered soils too complex for most buyers-
        - 90% of adsorbing tree roots are in top 18" of soil
        - The transitions from soil mix to gravel and gravel to native soils may create barriers to root penetration
        - Horizontal component more important than vertical- the width of tree wells is much more important. Create paths of least resistance.
        - Structural soils are used in parking lots, streets, tree cells, etc…
        - Urban constraints really dictate the ability to include trees
        - Determine where trees are appropriate
        - Success and failure observed in many scenarios, sometimes issues are obvious.
        - Need to include bioretention in foundation plans- train city staff and engineers to include tree space- have to work with old thinking to show geo tech engineers that it can work.
        - Tree health guidance is related to wind, light, exposure, water, and appropriate tree species selection given the specific location constraints.
        - Select subspecies/cultivars from climates with no summer rain.

    - Supplemental Irrigation:

        - Issues with plants trying to access adjacent water sources during no irrigation, or outside episodic events?
        - Temporary? For how long?
        - Establishment periods for tree is minimum of 3 years, and then remove it and trees will have to seek out their own long term sources.
        - Can configuration changes account for this need?
        - Trees find its way to get to where it needs to get water and soil, but need to design so that trees can access these areas (path of least resistance)

- Vic Cluasen- UC davis- insert tubes down to 1 meter for plants to get established quicker, and get away from temp irrigation reqs
- Roots will move where the available soil, water, nutrients are, but still have majority of fine roots in top 18"
- Training trees inappropriately to live within confines of bioretention and creating major failures? BSM to sand or clay outside retention area?
    - **Natural barriers to root growth** (gravel layers in bottom of profile)
- Alleviating compaction created during construction? In the spec already (rip bottom)
- Vertical and Horizontal potholes included in design to allow root movement (pockets within the BSM mix that have ability to support trees).

3. Soil Additive:

o Challenges

- Gel polymer (Cornell university) that is supposed to have better water holding capacity is added to structural soils, but tree roots just move through to native soils (only acts as a conduit) so water holding capacity of the structural soil not as important in long run.
- Biochar does hold water well, but creates low permeability (6 " with 15% biochar and sand)
- Using biochar and compost does not remove much pollutants
- Compost tea instead of compost- requires repeated applications. But helps inoculate soil. Most results with trees are favorable, but not a silver bullet
- Inoculating with Michorizal fungi? Variability with injection studies
- Inoculation process/method makes a difference and use broadsprectum because of uncertainty in which will take hold.
- Reserve small quantity of "native" or topsoil that has some resident microbes still present.
- Treatment train to deal with nutrient export issues with compost? Secondary containment? Complex and more expensive? Another area for failure.
- No current reqs on nutrient export. How does it perform after 3+ years?
- Some sensitive areas require special approaches: e.g. Tahoe needed to work with supplier to get extra rinse of additives in retention areas (primary issues are with Phosphorus and nitrogen).
- Compost suppliers (finished and unfinished)- making and selling it like crazy.
- Sheer volume of material that is used and moved every day. Reality is tough to please all players with test results, price point, and availability. Commercial scale needs are different than designers, engineers, planners, etc…
- **Tree pathogens**: phytophera- more irrigation, the more vigorous the pathogen is

- Many nurseries have issue with this pathogen and spreading it to projects
- Plans to test coconut fiber/pith and biochar-Nabuil Afrooz- issues with it coming compacted and hard to break apart
- Wood fiber is perhaps easier to obtain, locally sourced, byproduct of sustainable forest practices?
- Activated alumina- does not look plant friendly, any research on how plants respond to it?

BMP Database- contains info on effluent quality (import vs export of pollutants and pathogens)

Enforceability of compost spec? suppliers provide test every few month of material not older than 120 days. Almost always immature. Space is expensive. Testing on site not feasible. Ask for the last six sheets to determine if there is a trend in product quality.

Cal Recycle allows 0.5% by weight for inert materials (glass and plastic)- because of feedstock (foodwaste, green waste, safeway)

RED GROUP

Dale Bowyer (Water Board), Jill Bicknell (SCVURPP), David Haas (CalFire), Robert Schott (CalTrans), Will Bakx (Sonoma Compost), Annamarie Lucchesi (Waypoint Analytical), Shawn Freedberg (Deep Root), Peter Schultze-Allen (SMCWPPP/SCVVURPPP), Katheryne Kim (Wood Rodgers)

Dale's main goal: window trees through to the underlying soil, and there's no way to make bioretention soil suitable for growing trees

Dale Bowyer: Bay bridge Caltrans project used a little more topsoil. Infiltrometer testing found it was averaging 15 in/hour (really high permeability). Probably grew saltgrass on it, but permeability was much higher than anyone expected

Katheryn Kim, Wood Rodgers (landscape architecture dept.): Wants to stay on top of what's new in the industry. Not much in the way of input; mostly has knowledge of what trees need. Interested in learning about solutions for this problem

Peter Schultze-Allen: It's hard to find a solution based on what everyone else is doing due to soil conditions, climate differences (even within the Bay Area). Thinking a lot about this particular test to compact the mix (ASTM D1557 test). This was a conservative approach (worst case scenario), but now we're learning that we're not compacting it that much during construction so hopefully we can use less conservative testing (ASTM D698 test). Would like to hear more about what this group thinks about changing the spec to make a huge difference in the amount of finds in these tests.

Worst case scenario for failure: puddles/standing water form due to clogging/compaction

Found a green street project that wasn't infiltrating quickly enough; compaction is usually the culprit. The problem is having good records about what they installed, except without any soil mix records. We should be keeping track of this now

DB: Guessing contractors think it's cheaper to get surrounding (clay) soil or whatever is cheaper

Jill Bicknell: mostly here to listen and understand all the issue. Whatever proposal comes out, she wants to become educated.

Robert Schott, Caltrans: big fan of case studies, and the science of proving/disproving something after the fact. Interested in hearing this/similar soil blend in different applications and how well it performed in bioretention, water retention, how much washed away, etc. Doesn't think bay bridge is a good study because they pumped water up, and it's a different thing when it comes to rain gardens. (He recognized that he and Dale might be talking about two different parts of the bay bridge treatment system.)

David Haas: pretty new to all this, coming from a plant based background, increasing volume to promote tree establishment/growth. Some ideas have already been discussed in slides from earlier, esp. in regards to soil depth. You need to increase depth and not just lateral soil space. Agrees a small gravel layer would seriously deteriorate root growth in that area.

KK: Soil with lots of cobble tend to result in roots sticking near the surface

DH: When that happens, that's when you have tree failure

Annemarie Lucchesi: Also results in soil pH of 9-10

RS: When it gets rinsed, the pH issue disappears. But a well-drained layer results in trees having a hard time going down to where it's dry.

DH: restricting root to size of a certain hole

AML: seen failed testing on fawning setups due to improper installations. Can we adjust the specs to have some mineral fines that won't clog the system and not have the copper and issues from defined compost? A lot of times they're dealing with a really coarse compost that's not providing an adequate nutrient source in loamy soils, in particular. Small plants tend to be a common installation.

PSA: Haven't gotten much information back from small plant installation

Shawn Freedberg: We are at the end of the line in terms of what we're dealing with. Involved in development driven projects. Since we're putting such a high volume of water into a small surface area of bioretention, the soil has been developed to accommodate that. But if we want to plant trees, then it seems that the relationship of surface area to treatment area needs to be looked at. If we were able to make that space larger, we could use more topsoil and less fabricated soil to provide SW treatment AND plant trees. The fact of the matter is they're testing a lot of products and highly specific mixes that will be very hard to find, supply, and install in the precise mixes that they're producing in the lab. We're trying to bring things back to a pre-developed condition. Bioretention needs to be bigger, and surface area needs to increase.

DB: Shawn F is up against California real estate.

JB: Retrofitting urban environment. Things need to be balanced.

SF: If you go from 4 to 6%, could we see impacts to these issues? Because of the demand and return on development, I see how willing those developments are to pay for more regulatory enforcement because the return is so great. When the city/staff pushes back on them, they just want to get it over with.

JB: AS we move forward, the cities are going to be the developers. It's not just private sector. This needs to work for a city street as well.

SF: In Palo Alto, they want a quick turnaround to get things built as quickly as possible.

PSA: Problems with street trees in very tiny holes. Start with giving trees root space. IF you want a bigger tree, give them a bigger area. Maybe what the tree needs, the permit requires can find a happy medium.

DB: Trees and bioretention systems need to both be happy and both be able to function. I think there are ways to do that. Bioretention systems around the tree – we need to figure out a standard design for this, and I think this has already been done in OR and WA.

JB: motion to generate consensus that trees and bioretention systems are compatible? Not promoting either one, but it might be interesting to think about.

SF: Not only are they compatible (debatable), but what role do trees have when we're trying to do with bioretention? WE need to find a role for trees in treating the stormwater. Some people in this room don't think they're compatible due to difference in soil necessities, but trees in open bioretention are going to do a lot better than standard street trees. From my view, bioretention is a golden opportunity for a strong tree to grow vs. the alternative surrounded by concrete and asphalt. Once you have that open space, you have a lot of potential to grow a healthy tree. Cites a U of Chicago study where trees are taking that water up. We need to find a way to make these compatible.

PSA: One of the things I've learned over the years is people think you can just plant a tree in a bioretention area. We also need to think of the design from the tree's perspective – what does the tree need. We can't do one without the other and we need to start thinking about that. Perhaps a hybrid design/treatment train with a forebay with soil w/ high flow rate, small plants and then downstream a tree with a different soil mixture. There's also trash (esp. in street environment) and leaves from other trees. How can we prevent clogging from this trash? There are several different factors that go into a street environment design. Silva cells can also be used in the design.

When it gets narrow you need to spread out the water, but otherwise it's pretty flexible.

RS: Look at how much water you have and size accordingly

PSA: Know how many square feet you need, but be flexible.

DB: Old timey swales used to require water to traverse over certain distance. Now, as long as it moves through it's fair play.

SF: Is it true that we have the soil spec we have today because we know it starts out at 15-20 in/hr with the anticipation that it'll eventually get to 5 in/hr?

DB: actually you might get more permeability over time.

SF: I've seen studies that trees/woody perennials would increase porosity over time. If we can create a soil that provides more permeability after time.

PSA: The 12 in/hr max is only in the alternative spec. The regular spec has no maximum. If you mix the specified compost and specified sand it should be about 20 in/hr.

JB: But we design it for 5 in/hr

DH: Tree care is always the first to go in financial troubles

JB: but there is a long term commitment to these bioretention areas. And it's the landowner's responsibility.

DB: unless they leave the responsibility to the homeowners.

PSA: I think it would be good if we could write down all the ways tree-based systems are from small plant-based systems. Size change over time is an obvious one. If you design a system that will allow a tree to grow to 50 years old, that would be better. How the roots grow through the soil, root size, root uptake, needs of tree later in life (increased irrigation) are all possible problems to consider. If we could use our clay soil, that would help a lot (if it's not compacted).

Will Bakx: Trees are in a claustrophobic environment. If you allow it to grow deep, that can affect irrigation growth as well. When you take that and apply it to the soil itself, you get soils that are well aggregated/structured. Sandy soils are not well structured. That over time increases permeability. Well managed soils w/ OM are very permeable. Don't just apply compost at one time. Sandy soils decompose compost very quickly. Compost is in essence the kickstarter. Mulch: fungi try to break down mulch, which breaks into soil for nutrients. Look more in the whole ecosystem of what's in the soil instead of just the plants and soil.

RS: Yes, take natural systems into account.

WB: Assist the ecosystem to get a natural aggregation going. Also, when materials are being imported, I don't like it. Look at resources that exist in my community that people perceive as waste. What can we make use out of with it? Taking these materials and making them a beneficial use (diatomaceous earth). Winery waste is expensive to dispose of. I've included it in my compost (5-10%), so now I'm going after big wineries and working with them to tell them how to divert the waste to compost operations.

DH: Why is mulch such a concern?

PSA: It's not a contained system. Water can overflow and follow the same line it always follows. IN line systems – anytime it fills up, it moves around.

KK: Water fish and landscape ordinance requires 3 in of mulch

WB: Mulch is lacking nutrients (pretty much C). Fungi (hyphae) see this as a good thing to break down, but needs to dig down into soil to actually get nutrients. Hyphae makes a very stable aggregate. This is the best way to do it.

PSA: Doesn't biochar do this as well?

WB: Yes, but biochar is in its infancy. Not all biochar performs. High absorption rate will attract heavy metals, but other biochar won't do so. Industry needs regulation in order to standardize conditions. Low temp is good, but high temp is bad. (There is no scientific literature to prove this, and the makers don't know.) Right now biochar is on a case by case basis.

PSA: JB and I know of a system with 25% biochar in Richmond that was built about 1-2 years ago. We'll see how the monitoring turns out for that one.

WB: That's a lot. Biochar is expensive – about $350/cu. yard. The price point should be $75/cu. yd., and right now its way higher. You have to think about what you are getting and what you want. The compost that's being mentioned out here is the same way too. These are most likely native plants that don't need high nutrient compost, so what you're looking for is low N compost. That's not being talked about. (low N for native plants, high N for ag). You design what you need, and bring it to the table. That nutrient budget needs to be taken into account.

PSA: The BASMAA spec has a minimum Total N content of 0.9%. Is that high or low?

WB: That sounds low, but they need to specify wet or dry.

PSA: There's no top limit.

WB: They need a top limit. You need to actually calculate the N budget needed. You need to have a mature compost but a ratio of 25/1 is robbing N out of the soil. You'll mobilize it, which goes straight to microbes and none to plants. 20/1 should be the max. Above 20/1 is robbing N from the plants. 12/1 is equilibrium. Now how can we get thrown off there? 12/1 isn't necessarily mature.

PSA: So what do you think is a good upper limit?

WB: Invite Assaf from Control Lab (Not here today), look at how much compost is being added.

RS: When it comes to compaction I'd like to see the closest conditions to the field.

WB: Assaf has some ideas about how to achieve that. I think he'd be good at getting us results.

PSA: N in this product was 1.9%, C/N ratio 17/1.

WB: The particle size distribution does not reflect the size we use

PSA: 200 sieve

AL: I think that's 0.5 mm

PSA: We require the 200 sieve in our standards. It's not typically asked for in the STA compost test. It's seen as a good at pollutant removal/cation removal. But it's better when it's dry. The #200 does seem to get finer as the compost matures too. That's another thing that could be a variable over time.

WB: They thought it deteriorates to humus but surprise! Humus doesn't really exist!

PSA: Any other questions we haven't addressed?

KK: Curiosity: it seems like there's a lot of focus on the soil, but is that the only thing that's going to be actually perfected out of this or are we also going to talk about design?

JB: We do need to keep exploring overall design but I don't think we can talk about all those components today.

WB: I think the problem is if you look at system design but you are myopic with your approach. You solve one problem and create another one. You have to look at how everything behaves in the whole system and if it answers the whole problem

JB: Our basic premise is: "What is the best bioretention soil for the tree?" but there are a lot of factors in this.

PSA: And the soil we came up with is best for small plants - not trees.

JB: Basic goal of these things is to remove pollutants. We don't even need 18 in. The nutrients are usually trapped in the first 6-12 in.

WB: Also trees are huge water pumps. That is a huge benefit.

JB: They're also intercepting rain water before it hits the ground.

SF: Seattle/VA rainy seasons are way different than the bay area too. It's something we should be thoughtful of as we move forward.

PSA: What particular trees would be the best?

RS: The soil you proposed is good for wetland species but also bad for growing trees because the soil depth is inadequate and because the soil mix of fines/aggregates is inappropriate.

JB: Depth is a design issue

RS: But it's a system

JB: What if you had a 4 foot deep system?

RS: I'd still like more native soil. It's a more natural habitat. If you're doing this in isolation and add fines then the system may fail. But getting the fines in the soil will promote the aggregation of the soil.

JB: Best way to introduce fines? Artificial or native soils from the site?

WB: If you have an adobe soil and blend it with sand, you get a dry brick. There has to be some specifications about what you have to do.

JB: Maybe its better to find a way to get the tree to go down to the native soil like what DB said

RS: also, are the native soils down there truly native soils? CalTrans is developing soils like this artificially. It's a big different problem. Brining in your soil is impractical. What depth do you need? What compaction are we looking at?

PSA: We've also been thinking about trees that are dormant in the winter. How do they absorb water in the wet winter? Deciduous vs Evergreen. We need to find an evergreen tree that works well in a street environment (not that many), but the Brisbane box (non-native) seems to do the job and is popular. What works well with environment and street environment?

WB: is Brisbane box deep rooted or surface tree?

PSA: I think it's a surface tree since it does well in the street.

AL: Would it work with our compost? Not a lot of Australian trees take up phosphorus.

PSA: Seems to be a hardy tree, not a lot of pest problems

DH: for now.

PSA: it would be better to have multiple species, but we don't have that many species.

WB: also, how does it interact with other trees around it? Also, what are other plants that grow around the trees and make a community?

PSA: This hybrid concept about forward bay w/ small plants and a tree further downstream would be something to explore.

RS: your highland/wetland analysis works well here. Wetland plants want sunshine and so do trees.

PSA: Any other questions?

PSA: Diatomaceous earth: some of our suppliers are experimenting with different things.

WB; if he's using virgin earth, lets' talk to the guy who's here.

PSA: are there any human health issues?

WB: depends if DE is wet or dry. At 25% moisture content human health shouldn't be an issue. Recycled DE comes as a wet clay.

PSA: Allowable MC is 30-55% (AL agrees)

WB: I think that's a reasonable amount. 65% is the upper limit. Below 35 creates a dust problem.

PSA: sandy usually gets dry.

PSA: Drought – trees need lots of water. That's why people went to smaller plants. What can we do to minimize irrigation requirements, esp. with street trees?

RS: I don't think it's practical to not have irrigation system due to dry summers.

DB and PSA: exit

SF: if a tree is successful in 5 years, wouldn't it be self-sustaining?

RS: however, wetland species at a certain depth need supplemental water

WB: if you have drain rock underneath it, I don't think that tree will be dependent on irrigation water.

RS; but tree won't live past 5 years

WB: true. But a shallow tree would be independent

JB: I wish Dale was here to answer questions about design of reservoir that goes through the soil but includes gravel to retain water.

WB: soil would also be more permeable at a lower level

SF: there's a difference between systems with and without an underdrain. From what I've heard, the 12 inches of gravel may need different designs depending on whether or not they have one.

JB: 90% of our systems do include an underdrain though since we don't want clay retention. Maybe the systems that are not lined…

RS: gravel systems used as a reservoir hold the water in the gravel reservoir so it can infiltrate over a longer period of time. That's a good basin design, but it's not good for trees.

SF: another thing that's challenging is looking at small bioretention spaces and variability.

PSA returns: recent change in impervious paving?

JB: I don't know if that's relevant. Everyone complains about the rock underneath

SF: all that rock needs to be brought in. It's not very sustainable.

JB: requirements vary across the state. Bay area can treat and release so that's why you see more underdrains here

PSA: Dan Cloak has talked about systems with adjustable openings in the outflow.

JB: we do have flow reduction/retention standards, but I don't think that would benefit the tree.

SF: I think the issue of the water and the tree is not that significant of a problem in general. It's not a species issue. Water flow of 5 in/hour + rain in the bay area = not gonna be a significant problem in terms of oversaturation.

PSA: when I talked about what tree to use, I was thinking of reducing irrigation.

SF: I think the experts would agree irrigation is necessary and there will never be too much water for the tree.

WB: Well it might not need irrigation after 5 years. It'll be out of the sandy soil in no time.

SF: once its past 5 years, it's finding water, oxygen and nutrients on its own and won't need outside help.

PSA: but once you get to the native soil you can't turn it off.

RS: with native soil, you need to provide all its inputs. You need to make sure the roots drain, tree gets nutrients.

PSA: we should anticipate that there might not be native soil beneath

SF: but there's middle ground in ultra-urban developments and bioretention is being implemented. Only native soils are underneath parking structures, are compacted. Irrigation and long term success of the tree are nuanced.

PSA: It's the same in Emeryville as well.

SF: Facebook didn't want bay high water coming into their system. There's goals and then there's practicality.

PSA: Does soil with more volume eventually make a difference? Water retention?

RS: I don't think they'll make significant difference and I don't think it'll be cost effective. I see green roofs that don't have this

AL: some of these have hybrid layers though.

SF: I feel like this group is going towards a movement away from additives and towards topsoil in the system. Engineers want to make sure that hydrology of the system continues to function.

RS: I think you need a different structural design for bioretention and a different for trees. I think they can be next to each other, but they're very different systems.

PSA: Forebay could be sized for 10 in/hr, and tree system for 2.5 in/hr, and you combine them to equal 5

SF: If the goal is 5, can we start out at something that starts out at 5 instead of something at 25 that will eventually clog to 5? Pull back so we can actually get some retention and account for failure.

JB: I'm not sure how much scientific footing 5 in/hr has.

RS: Caltrans has filters that do 100 in/hr and we're trying to get up to 4. We're looking at what water treatment plans are using. Soil: maybe less would be a better number.

SF: isn't 5 in/hr driving the 4%?

JB: It's the 5 in/hr and the design of rainfall intensity for a flow-based system. Designing for frequent storms. It's a very simplistic method. Soil mix as a filter drains through and you have to have a minimum of filtration to the soil. Bioretention should be a combination system. NO one wants to go above 4%.

What you're proposing is radical. But if we're talking about a 2 stage system, we can do 4% first and something else later.

SF: we see a lot of designs that are missing the intent. I'd rather have them get more credit in the development process if they can make the system bigger and allow trees.

JB: Green infrastructure is trying to get street trees etc. in the big picture.

SF: Some people can't plant these trees because the 4% will increase to 4.5%

Takeaways:

- design differently for different situations and take natural systems into account. Look at overall designs, and redefining specs for compost would be a good idea. It deserves extra attention.
- Bioretention should also find a way to incorporate without massively retrofitting the urban environment
- Look at systems approach and not just fixing the soil itself. This includes access to native soils, which go back to soil volume.
- Don't force trees down places where they can't grow.
- Think about why we integrate trees with stormwater/bioretention facilities in the first place? Why does it increase the function of the facility?
    - Improves efficiency of the bioretention facility due to water uptake (but is it necessarily true here in California?)
    - Also, are there any native plants that aren't dormant in the wet winter that can do the job?

6/30/16

Green Breakout Group

Tom Bonnell (Pleasant Trucking), Nelda Matheny (Hortscience), Greg Balzer (Caltrans), Robert Campos (Wood Rodgers), Jing Wu (SFEI), Teresa Eade (StopWaste), Nyoka Corley (LH Voss), Joshi Bhaskar (CalTrans, phone), Shannan Young (City of Dublin)

What brought participants to the Round Table:

Nelda: Soil volume for trees. Doesn't think the ratio of soil volume to trees canopy that is commonly quoted is appropriate for CA. Climate based model developed by Nina Bassuck at Cornell. Her formula was based on the soil volume required for adequate water for a 10 day supply, in sandy loam soil, in Ithaca NY. Stop using as a guideline. Instead, concentrate on growing the biggest root system possible into landscape/native soil.

Greg: Lots of different functions for bioretention areas (i.e water quality vs trees/building an ecology). Try to verify what the goal is. You aren't going to grow plants/trees in a 60-70% sand mix. Need more of a sandy-loam mix and research/testing of any new mix.

Robert: Need to pick the right tree in the correct location within the treatment area, and have appropriate irrigation.

Jing W: We will be planting trees in urban landscapes and it is beneficial to have stormwater systems with trees. Maybe have a tree specific mix. Do future research/monitoring.

Teresa E: Create sustainable landscapes, compost is the cornerstone of sustainable landscapes because of water holding and biological component. The biological component is missing in the current mix, and these are high demand systems. Additives mentioned in lit review don't have any of the biological metric. It is difficult to get bioretention areas to perform multiple functions. Maybe just have shrubs/small plants in bioretention areas.

Tom B: He's not seeing many trees in bioretention areas. He thinks it makes more sense to have only shrubs/small plants in bioretention areas. His interest is in having a specification that they can meet. They are still missing a couple of components on the compost side (i.e. Not passing the spec). Additives: everything costs, and most are not local. He thinks the top soil is good and we should go back to using that. He takes samples from different portions of the pile in order to get samples that pass the requirements.

Nyoka: Confusing regarding the quarter inch (1/4") screen. Spec indicates 40-90 % passing is required, but the compost is coming in finer than that (typically 95% passing). Alternative mix specifications indicate that only 2-5 % fines are allowed, but the sand component is already at 5% max so you can't add compost.

Greg: Are we looking at a performance spec or materials and methods?

Tom B: Cost is an issue. It's costing them $800/permeability test. Go through two different labs.

Phone (Joshi): Mostly been concerned with stormwater pollutant removal. Need a mix that shouldn't be compacted too much for stormwater pollutant removal, but that can be used in roadway conditions; it's difficult to do that. Also trying to work in narrow roadway conditions, creating environments that work for stormwater treatment and also not creating unsafe environments for vehicles and pedistrians.

Nelda: If you have 30% compost in the specification, when it degrades, you've lost 30% volume.

Teresa: Add mulch on a regular basis to help with that (compost) problem. (Not everyone wants mulch because of floating issues).

Jing: Does the biological activity of compost decrease over time as the tree uptakes/uses the compost? Nelda: plants are constantly adding organic matter (to assist with biological component). Benefit of grasses is that they add the most root mass to the soil.

Nyoka: Planted trees in Gateway Safeway in Pleasanton. They are doing well in LH Voss soil. They have been installed for three years. What is the sizing of BRAs? Some seem really small.

Shannan: Sizing is either 4% of the impervious surface drainage area, or based on the combo flow-volume sizing (as small as 2% with more surface ponding).

Teresa: Crazy idea: Hydroponic trees. Happiest trees are the ones that have broken through sewer pipes.

Nelda: It's like the Green Machine. Take the black water from the building to irrigate the landscape.

Greg: In his experience, bioretention doesn't work because it's shady, not draining, or because of compaction issues. Caltrans doesn't have a soil mix, only compost spec; no topsoil standard. They use whatever the locals want them to use. They would love a regional or state mix.

Jing: Monitored the Ceaser Chavez project in San Francisco. BRA sizing for that project: 4%. She has seen that there is no problem with standing water with 4% sizing, but with smaller BRAs, you may see problems.

Nelda: How do you irrigate in a soil that is designed to drain? Getting uniform soil moisture is difficult when you have a fast draining soil.

Nelda: What is magic about the 5-10 inches per hour? At what point are we supposed to reach the 5-10 inches per hour? At installation?

Jing: If we get failure during large storms, then we shouldn't consider it a failure because the BRAs are not designed for large storms.

Nelda: Are there maintenance standards? Are municipalities testing infiltration rates after some period of time? Haz waste issues? Teresa: we don't know yet. She thinks San Jose did a study and didn't find anything, but we still don't know. She will try to find the study.

Nyoka: Add more compost and if it's really working the way it should, then it shouldn't be hazardous waste.

Tom: The theory was that BRAs would last 7-10 years at the beginning of this. The facilities that were installed 7-10 years ago look good now. However, did it with gorilla hair to back then.

Jing: Sediment will be added over time and maintenance will be needed to maintain permeability.

Nelda: How do we encourage infiltration into native soils? Add organic matter to the native soil? Scarification?

People don't like the gravel layer. Prefer to have the gravel layer go deeper (i.e. long, narrow), or on the side? Is it really true that tree roots won't grow in the gravel?

Maintenance is huge. In order for the trees to be successful, you need to have a good maintenance program.

Nelda: We need a statement opposing lining. Edges made of concrete. Why? One landscape architect (not in the breakout group) thinks it is to keep moisture out of the adjacent landscape.

Change the soil type depending on the design of the bioretention area (more urban vs. rural) (parking lot or street trees).

Nelda: tree roots don't really go deeper than 18 inches in clay soils because they need the oxygen. In sandy soils, they can go deeper because oxygen is available. However, she thinks that we don't need to increase the depth of bioretention mix.

Big ideas:

Can't separate BRA design from materials (i.e. soil).

1) Look at the gravel layer. Will the tree roots really not penetrate into gravel layer? If they do penetrate, will they utilize the gravel layer in preference to native soil since it is less work? If so, then we would need to irrigate in warm months to keep the gravel layer wet; not a sustainable system. Think vertically instead of laterally. Jing: have to be sure that it is designed such that you are not causing more storm bypass.

Nelda, Teresa, Robert: goal is to get the tree roots into native soil as quick as possible.

2) 18 inches for the treatment soil layer seems to be working, you go deeper = dryer at the surface = more irrigation.

Materials:

3) Would having some larger woody material (composted mulch) included in the compost mix help address some of the coarseness? Tom expressed frustration that the specification has mixed goals: want it coarse at the top end for infiltration and want it fine at the bottom end for

pollutant removal. Teresa: use the same mix as in compost socks. Greg: it's difficult to get the compost socks mix because they have to compost it again. Teresa thought it is more widely available in Nor Cal than So Cal. Teresa: Why are we using such finely screened compost?

4) The group is not feeling most additives (unless you are focusing on a particular pollutant problem), except for compost and top soil (but top soil is not consistent). Focus on local sources.
5) Need to require a spec for chemical component of sand. Need threshold for salinity.
6) Maintenance standards are needed and training for landscapers.

If we are going to change the standards, we need lab testing standards.

WDOT studies on Compost amended vegetated filter systems. First flush, pollutants are exported, after that: net removal.

Group participants:
Megan Stromberg (WRA), Jeff Sinclair (City of San Jose), Alex McDonald (Caltrans), Elizabeth Lanham (Davey Resource Group), Igor Lancan (UCCE), David Swartz (City of Fremont), Meagan Hynes (Talus Soil Consulting), Connie Goldade (Community Design and Architecture).

From: Megan Stromberg
To: Shannan Young
Subject: Notes from my discussion group
Date: Sunday, July 03, 2016 11:24:31 AM

Hi Shannan,

Well done. I get that you were hoping for more concrete direction but I think it was significant forward progress.

My group had the following main points in no particular order:
-Change the compaction test to reflect the field conditions better.
-The mix needs to be slower, closer to 5"/hour. The max flow rate is too high. It needs more fines. The interim spec moved in the wrong direction.
-When mulch floats it indicates a design problem, not a problem with mulch. if basin is designed correctly, mulch won't float.
-Need to educate everyone on terminology of permeability/infiltration/hydraulic conductivity testing. Meagan Hynes to provide summary.
- pH range of sand acceptance should be up to 7.8 (7.5 at the very least). Would be good to add a pH range for the mixed BSM.
-Chemical suitability testing seems like a good idea. Especially in watersheds with TMDL
Could test for target pollutants. Do we need to test sand for metals? Look at local sands to determine if there are problems.
-Would like to have a decision tree to aid designers and reviewers. Help determine which design and/or soil mix is best to meet different goals.
-Trees need access to native soil. Tree roots grow mostly laterally not down below 18". Side barriers are most important to remove, not the aggregate layer.
Engineers commonly want deepened curb and liner (concern for water moving into utility aggregate layer or building impacts.)
-We don't want to require any additives that aren't locally available. Consider the sustainability of changing mix.
-Most submittals fail to meet standard and have to get treated like the alternative mix almost always. Alternative mix spec may be too lenient.
-Look at adding Silva cells outside bioretention
-Look at work by Geofortis on diatomaceous earth

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BASMAA Meeting notes 6/30/16

Biotreatment Soil and Tree: Yellow Group

Participants: Paul Niemuth (City of Fremont), Glenn Flamik (Cal Fire), Matt Moore (TMT), Bill Sowa (HMH engineers), Dorothy Abeyta (City of San Jose), Anne –Marie Benz (BFLGC), LeighAnna Johnson (WB, note taker).

Beginning concerns/comments

What is trying to be accomplished with the soil compositions itself? Is this because of reduced space? – Glenn

Too micro of a view, wants to look at the big picture – Ann-Marie

Biotreatment cells are replacing the space in the urban environment where trees should be. How can we make biocells accommodate trees? – Dorothy

We've gotten away from our professional experience, solutions are diminishing. Wants to open the dialogue and open solutions to water quality treatment. Has concern for risk management for his clients, wants less risk at the agency level, less risk at construction level where materials are available. Find the benefit for natural reasons compared to engineering solutions, we're becoming less creative. Get away from cite and look at the regional outlook to support the Water Board. - Bill Sowa

Treatment areas need to be confined to a certain area, you can't grow plants, trees, or irrigate- isn't there a zone for alternative treatment? Engineers just want the numbers to work, not if the treatment or soil health is actually beneficial. -Paul

Can we keep a consistent amount of topsoil? Finding soil for a decent price.

The import compost material for soil may contain pollutants, or excessive nutrient content that leach in the beginning. Do we really need something to filter it if it's a short term problem?

How do we reassess something if we don't know it's broken?

Group Discussion Questions: Bioretention facility experience

What has been your experience using the current bioretention soil mix specification? What are the biggest advantages, drawbacks, most vexing difficulties?

- Inspector looks at the soil mix, they test to make sure the plant material is it alive and functioning. Results are soil sluffing; dead plants that need replacement; plants, splash blocks or cobblestone getting buried in the biotreatment soil.

Have you experienced any failures (inadequate percolation through the soil mix?) What did you discern was the cause?

- An alternative mix of soil based media (worm castings) making up 3 ft tested great in the lab, but out in the field locked up in the wood spaces and turned into clay in the rain. The cause- Bad combination of sandy loam based soil 20% fines, 10% worm casting, coco is supposed to keep soil loose but it bounded everything up even more.
- In consistent test results: Over-compaction during installation or soil design can be tested at a certain percolation rate but you can't duplicate that percolation rate during lab tests or in the field. Even with a duplicate procedure, you obtain completely different results.
- Consultant came in to tell the team how to do sheet mulching and it made it completely anaerobic, water doesn't go through it.
- Plant establishment with biotreatment is difficult, percolation ability, different areas of the cell performing in different ways.
- Failure- dead plants because we can't water them enough or failing/absent percolation. Biotreatment soil sluffing down and covering the plants.
- Loose soils

Have you noted large quantities of water were needed for plant establishment in comparison to a similar typical landscape setting, and or for long term maintenance? Are you able to meet WELO water budget with this soil? If so, how did this problem relate to selection of the plant palette? To irrigation system features and design? Could Changes to either address the water issue?

- Large quantities of water are needed and irrigation is needed much more frequently. To keep Juncus from looking like rags, you need to water much more heavily.
- Excess irrigation is affecting plant palette, it's really narrow depending on irrigation.
- Water holding capability of the soil needs to be addressed. It needs to be increased.
- Weeds are an issue because they do not want to use pesticides. Discerning and educating maintanance on weeds vs plants that are supposed to be there.
- Mulch is producing weeds. Recommendation-

Are you familiar with any bioretention facilities that have been installed for 5 years or longer? 10 yrs? What changes if any in characteristics or performance have you noted?

What aspects of bioretention design and construction stand out as factors affecting long-term performance?

- Do milk crates under soil affect long term?
- Must be patient with soil structure

Have you had experience with trees in bioretention facilities? What features of design and construction were innovated to support tree survival and health? Did any problems of failures occur?

- Trees were getting irrigated by a bubbler in a 3 ft deep PVC tube. It was not an effective method to deliver water to the tree roots. How do we get out of an established narrowed option solution? It took so long to create a solution. How do you beat a long term accepted plan that isn't best for planting design?

- Recommendation -Do not plant trees in concrete boxes, and get rid of Filteras.

- Plumb irrigation to where we're planting and water with truck water until the trees are established.

Do you have any ideas or recommendations for design, installation, soil characteristics, or other features for supporting trees in bioretention facilities?

- Liners are not recommended unless you cut open a hole in the liner. Use native soil to establish roots beyond the biotreatment wall.
- Recommendation -put the liners to the side from the trees. Mechanical treatment opposed to liners because they are not sustainable and chemicals leach out of liners.
- Open bottom planters is another recommendation.

Soil Testing

- It's easy to get soil approved/accepted in Fremont. - Matt
- Problem- A separate City department approves soils even though they have no experience interpreting data. – Dorothy
- There is significant inconsistency and variability with soil testing (due to environmental conditions, availability of fully compliant material, availability to aged compost)
- Batch specific is highly impractical and no one in the Bay area can do it because of needed real estate.
- Quarterly or monthly testing is much more practical.
- Lack of testing might be because of inconsistency.

Compost specification

- If compost has never met spec, what needs to change?
- It's difficult to get a sieve test on compost.
- pH is a good marker for effective composition

- You need to test the finished blended components and test for soil chemistry, not the individual components.

Question 4-

- There is no aged compost in this region, it moves faster than it should. Composted mulch works. Compost from ZBest works in sheet mulching.
- Gorilla hair or shredded wood-concerning from the fire standpoint or it matted too much yet it's effective and locks into place. It needs to be replenished because it mats down but doesn't move away.
- Subsurfaced load exceeded surface load.

Additives

- It's hard to justify the extra costs. It's better to use local resources – for environment and cost.
- Biochar has no viable data and results are hard to duplicate.
- Volcanic sand is not as costly
- Perlite and vermiculite are an environmental disaster.
- What works? engineered soil to mimic native soil. The challenge is getting consistent long term product.

Concensus and Summary:

- We need a bigger broader solution to the problem.
- We need to treat areas before they drain to sites, not once they reach every certain site.
- "More tools for the toolbox"
- High alkalinity compost or sand is a concern. Yet when you buffer sand or compost it changes the composition, stability, and effect.
- Plants are dying – wash the roots and examine and the result of the plants dying is almost every time lack of water.
- We need education on soil placement
- Educate irrigation maintenance and inspectors.
- Testing methods for the component need to be improved, need more local testing on local sites.
- Do we have enough sites and come up with funding to improve more consistent testing.
- If we can't compare what's working with the soil and water quality we need more data, but who has the data?
- Collaborate and come up with sites that are three years old and maybe apply for a grant to test and see what's working and what's not working because that is the underlying issue.

- No one is identifying the problem at hand.

Notes from Christine. Big picture comments from large group discussion are listed below.

Paul report out

- Need more data to see if we have a problem that we need to fix.

Dan (blue group)

- Knowns: locally sourced, sustained materials. WE have a process for getting the spec. Problems: age and maturity due to supply/demand. Food waste as a source, so inerts will continue to be a problem.
- Unknowns: effluent quality and if that is a concern. How does the export of ss and nutrients change over time? More research is needed.
- Configuration and volume. In the design of BRAs, need to look at the path of least resistance for tree roots. Sandwich effect of layer maybe causing problems with root expansion.
- Trees: relationship between irrigation and plant pathogens.

Megan (red group)

- Design of BRAs, in particular barriers. How do you design BRAs without barriers.
- Options. Developing a matrix/process for alternatives. Decision tree the big item.
- Add pH testing to the whole mix.

Nelda (green group)

- Tree roots into native soil. Modify the gravel layer so that it's not a flat pancake into a deeper layer.
- Improve the native soil to encourage roots to grow into it.
- 2:1 tree canopy ratio is an east coast specification
-
- BRA soil is integral to the type of design that is used
- Avoid using additives that are not locally sourced
- Chemical analysis for sand
- Consider including medium and large size compost in the specified compost mix.
- Maintenance guidelines and training for the landscape maintenance professionals.

Peter (red group)

- Integrated system design and how it evolves over time.
- How does the size of the tree over time impact the design
- How did we get to this point of today? Where did the 5" per hour come from? Dan: what is an infiltration rate that could reasonably be used in the urban landscape? Dan imported the Portland standard of 5" per hour.

- More complex, hybrid design
- Maybe there are some instances in which trees shouldn't be used.
- What do trees bring to the discussion? There are a lot of advantages to big trees (i.e. uptake of water and increase performance of BRAs)
- Access to native soil
- Maybe 18 inches of BSM isn't enough
- Workgroup of compost suppliers (maybe an action item that could come out of today)

Compost

¼ compost people can't meet it. Request is to change to 95%. Someone else thinks that is not the right approach. Need bigger particle size. ½ minus. Most trees are low nitrogen requiring plants. Look at nutrient loading of the trees and then look at the compost needs. Moving forward suggestion: compost suppliers and soil labs to develop a good spec.

Why 30% compost? Include soil instead of as much sand/compost. Include more fines to slow the infiltration rate. Fines are mostly clay, depending on your component gradations (i.e sand), then you may have plugging. But from a blenders perspective, each soil batch is different.

Define the most appropriate testing methodology. Maybe methods that are used in lab don't reflect what is happening in situ

Dan. We need to evaluate trees that have been in the ground. Igor offered to evaluate trees.

Other ideas for additives. Biochar (will slow down infiltration rate).

Soil – specification to limit variability? Suppliers say it's a natural product that is all variable, supplies variable. Horticultural people say there are specifications for landscape soils.

When we start adding sand, there is a high probability of locking up. The less you handle the soil, the better. Over time, the soil will improve.

Evaluate topsoil so we know what we are getting. Suppliers: Where are you going to get the soil (strip mining)?

What about adding about 5-10% of the compost as the compost sock variety? Available carbon is higher, then more nitrogen is immediately available.

Need to look at systems that sustain themselves over time in regard to nitrogen renewal.

Question from Dan: when the trees have been in the ground for some time, does the soil develop into a more complete soil? Is there a lab test? Maybe (ask) Can you visually look at the soil (Igor says yes, to some extent, but soils don't really form in such a short time frame (i.e. ten years).) Dorothy thinks that

soil can actually form (via the topsoil SJ specification) in a couple of years. But the BSM mix does not form soil.

Want a carbon mix that doesn't create bioavailable nitrogen so the biological breakdown doesn't starve the plants.

Focus:

Dale: treeable bioretention soil is not attainable. What we really need is a bioretention design that can accommodate trees to help them grow.

Supplier: performance spec, but don't give ingredients. Soil lab would need to be able to test performance and have it be repeatable.

How does the BSM mix function as a soil

Supplier: can't meet the ¼ inch spec. Need to change it.

Jill: two working groups: 1) to look at compost/fines, and one to look at design.

Idea of degrading infiltratin rate over time may not be accurate. Tree and plant roots will increase/maintain permeability. Design for a healthy environment and infiltration rate will follow.

What is the target initial infiltration rate? From where did the 12 inches per hour come?

Constrained right-of-way

Peter: Try out the use a different test with less compaction which supposedly mimics more in the ground conditions. Thumbs up on that from the group. Dale, we WB will allow it. Labs: maybe try out both methods side-by-side to see how it impacts infiltration.

Ron Alexander: helped CalTrans, Washington DOT spec, (include on subcommittee).

Compost suppliers are not involved. Need to involve more of them.

ATTACHMENT

C.3.c.i.(2)(c)(ii) Model Biotreatment Soil Media Specifications

Bioretention Design for Tree Health: Literature Review

Bioretention Design for Tree Health:

Literature Review
San Francisco Bay Area, California

Prepared For:

BASMAA
Contact: Shannan Young
Shannan.young@dublin .ca.gov

WRA Contact:

Megan Stromberg
stromberg@wra-ca.com

Date:

September 15, 2016

WRA #20066

ENVIRONMENTAL CONSULTANTS

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1.0 INTRODUCTION

On June 30, the Bay Area Stormwater Management Agencies Association (BASMAA) convened over 40 experts at a biotreatment soil and tree round table to review the current soil specifications to determine if improvements to the specification can be made to positively impact the health of trees planted in bioretention areas. Participants at the Roundtable included numerous stakeholders: Municipal representatives, compost providers, soil suppliers, soil laboratory technicians, civil engineers, landscape architects, soil scientists, construction inspectors, and Water Board representatives. One outcome of the Round Table was the consensus that the standard design of bioretention areas should be evaluated to promote improved tree health. A complete summary of the Roundtable hosted by BASMAA on June 30, 2016 is summarized in a separate report dated July 27, 2016 (BASMAA 2016).

To begin to improve bioretention basins for trees it is important to first understand the basic needs of urban trees. James Urban, one of the contributing designers of silva cells and structural planting soils, describes the six critical requirements to grow a successful tree paraphrased below (Urban 2013):

1. Sufficient soil volume
2. Room for growth at the base of the tree
3. Water flow in to the soil
4. Water draining out of the soil
5. Room for canopy growth
6. Quality nursery root stock

Bioretention generally adequately provides for items two through five. This report will focus on how to enhance the soil volume for trees in bioretention.

2.0 DESIGNING BIORETENTION FOR TREES

2.1 Soil Volume Guidelines

Soil volume is one of the most important factors effecting urban tree health and is relatively limited in bioretention systems as they are currently designed. While there have been studies of urban tree soil volume requirements on the east coast of the US, these studies don't apply in California where irrigation is the norm. Limited research on the minimum soil volume required for urban trees in summer dry climates has been conducted. In general, researchers suggest that irrigation can compensate for limited soil volume. We were not able to locate any research based guidelines applicable to the Bay Area for soil volume for trees. However, researchers recommended that soil volume should be maximized, especially considering the fast-draining engineered soils in bioretention. While general guidelines don't exist for the arid west, some cities have issued guidelines. The City of Emeryville has adopted minimum urban tree soil volume standards in Table 1.

Table 1. City of Emeryville Minimum Soil Volume Standards[1]

Size	**Volume (cubic feet)**	**SF needed in 18" deep soil**
Large Tree	1200	800
Medium	900	600
Small	600	400

1 Water Efficient Landscape Requirements referred to in Section 9-4.602 of the Emeryville Municipal Code. Found at: http://emeryville.org/DocumentCenter/View/1754

2.2 Increase Access to Native Soil

BASMAA bioretention standard designs require a minimum soil depth of 18" which is widely used as the standard depth. The biotreatment soil media (BSM) is underlain with a 12" aggregate layer (Figure 1). Loren Oki, Landscape Horticultural Specialist at UC Davis, indicates that trees roots are unlikely to utilize the drainage aggregate layer below the BSM for rooting because it does not contain soil and the roots are unable to access the water that may be stored there below the underdrain (Personal communication, 2016). Changes in soil texture (actually changes in soil pore space) create a texture interface that impedes water and air movement across the texture change. This impedes the movement of roots into the aggregate layer as well. Furthermore, the change in soil texture between the soil in the nursery grown root ball and the BSM can have the same effect. It is imperative that the root ball come to the soil surface with no BSM soil covering the root ball soil. The interface between the root ball and the BSM will impede water and air movement into the root ball.

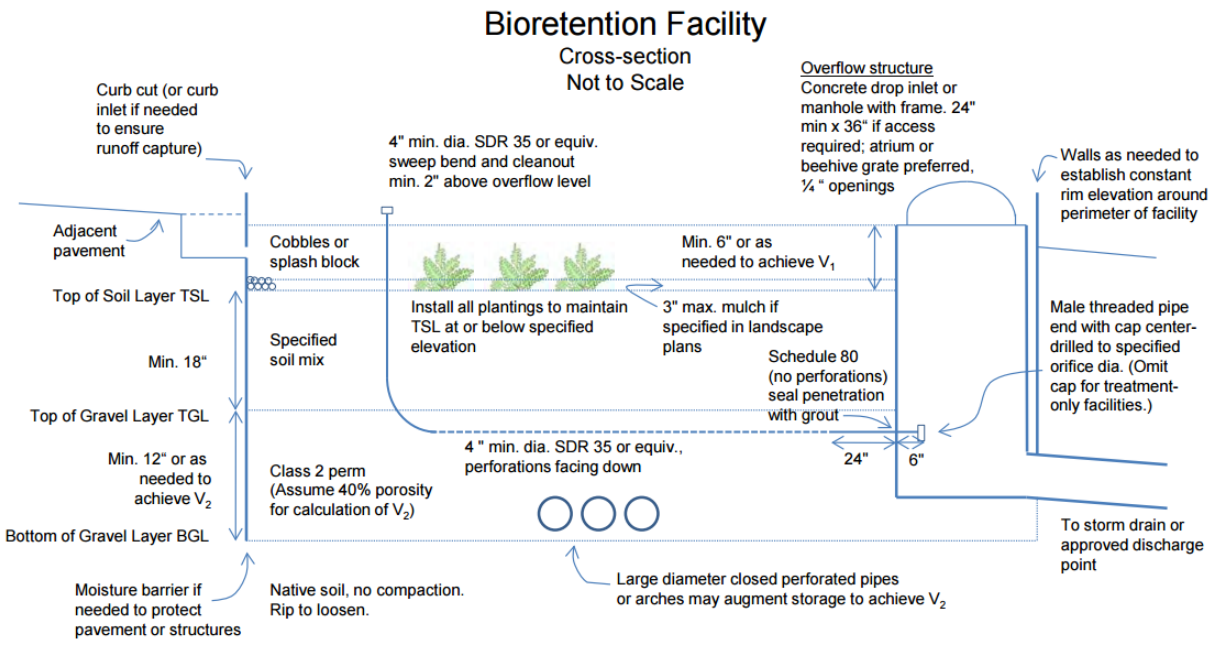

Figure 1. Contra Costa County (2012) Bioretention Facility Cross-section

In a traditional landscape planting, trees should be planted in a wide saucer-shaped planting hole with broadly sloped sides (Colorado Master Gardener 2016). This is because, if the roots have a hard time penetrating compacted site soil (due to low oxygen) sloped sides direct roots upward and outward toward higher oxygen soil near the surface. Roots that do not penetrate site soil begin to circle in the hole leading to trunk girdling roots.

Bioretention basins which are surrounded by increased height vertical curbs, retaining walls, adjacent to compacted soil, road base, pavement, utility corridors, and structures do not provide trees with access to native soil and promote circling roots (Colorado Master Gardener 2016). They are further limited by the aggregate layer that underlays the root ball. The urban Horticulture Institute at Cornell University suggests that limited volume planters can be designed with sleeves through the planter box walls to allow tree roots to access the structural or native soil adjacent to a bioretention area with vertical walls (Figure 2). Structural soil is discussed in more detail in Section 3.0.

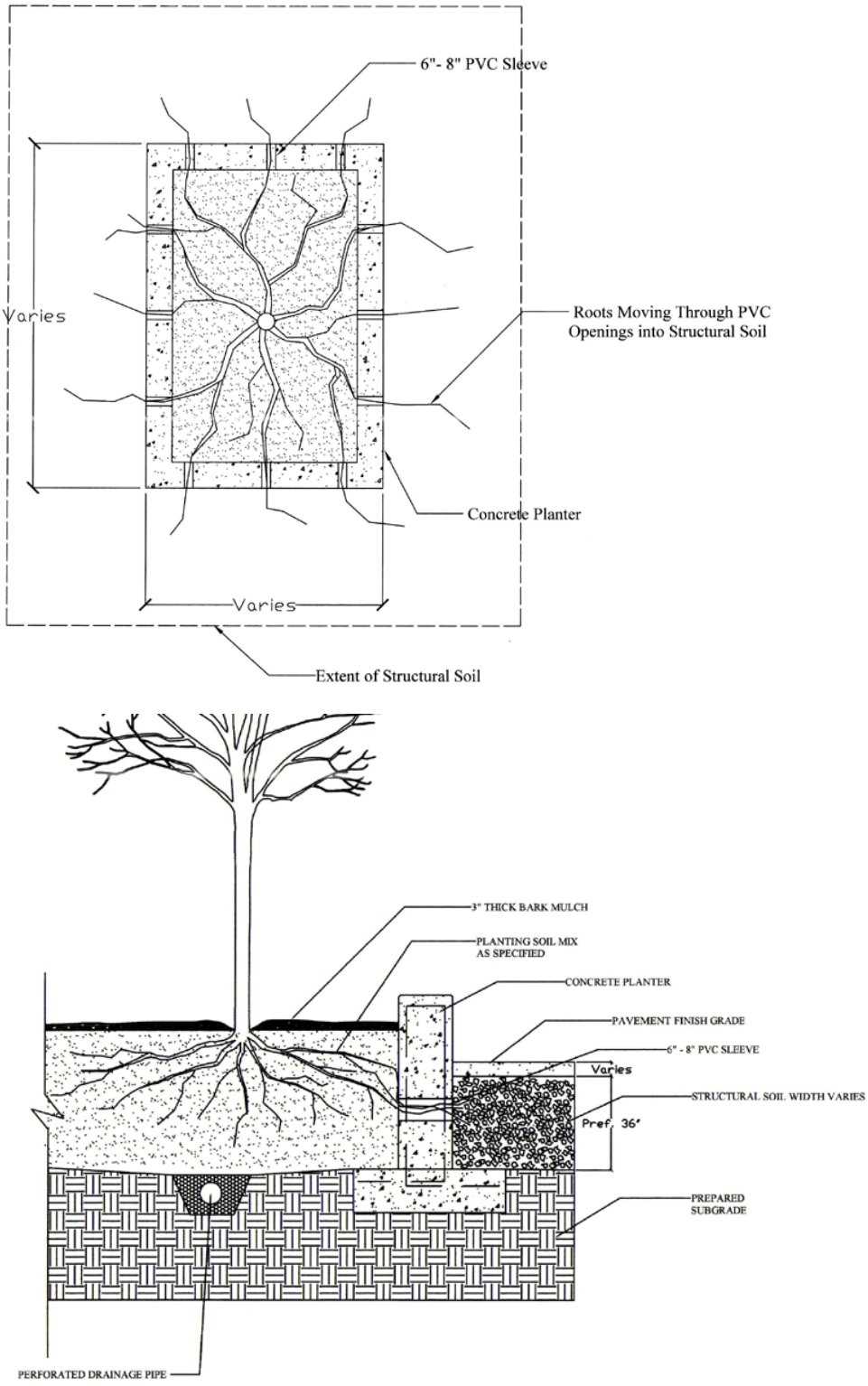

Figure 2. Roots move through PVC openings in concrete planter box wall into structural soil under pavement (Urban Horticulture Institute 2007).

Curtis Hinman, of Herrera Environmental Consultants, also reports that trees and plants, in

general, have thrived in bioretention systems around the Puget Sound (Hinman, personal communication 2016). Potentially, this could be a result of the different rainfall pattern with a much reduced drought period as compared to the Bay Area. However, it may also be significant to note that, according to Hinman, Portland also reports problems with tree survival. Portland and the Bay Area are similar in their design of bioretention systems in that both require a full width aggregate drain layer beneath the BSM layer. Seattle systems are designed such that the aggregate layer is only 12" wide and deep around the perforated drain (See Figure 3 below). The remaining areas of the basin bottom are in contact with the native soil, greatly expanding the available soil volume for trees. In the Bay Area systems, the drain rock provides added storage volume for infiltration but limits the tree's access to native soil. However, healthy trees have the potential to capture a significant volume of stormwater.

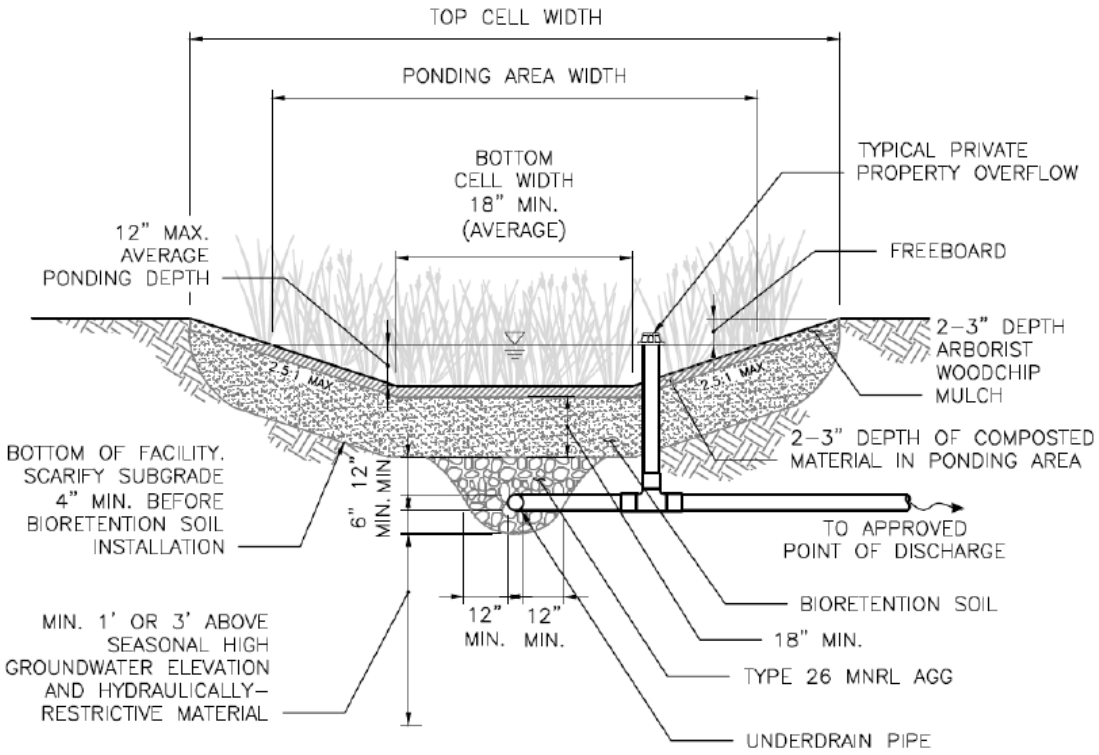

Figure 3. City of Seattle (2016) Infiltrating Bioretention Facility with Underdrain Standard Detail

2.3 Increase Soil Depth

Increasing the soil depth may also aid tree health. It is widely accepted that most tree roots grow near the surface, within the top 18" of the top of the soil. This is because tree roots require air, which is most plentiful near the surface. (Colorado Master Gardener Program 2016) However, engineered soils and structural soils may promote deeper root growth. In sandier and loamy soils that have oxygen and water moving freely through the soil column, similar to BSM, tree roots will move freely downward as long as they are not under drought stress (Urban 2010). Other municipalities around the country recommend deeper soil planting for trees in bioretention. The City of Arlington, Virginia recommends 4 feet deep planting holes for trees in bioretention.

2.4 Additional Example Cross Sections for Trees in Bioretention

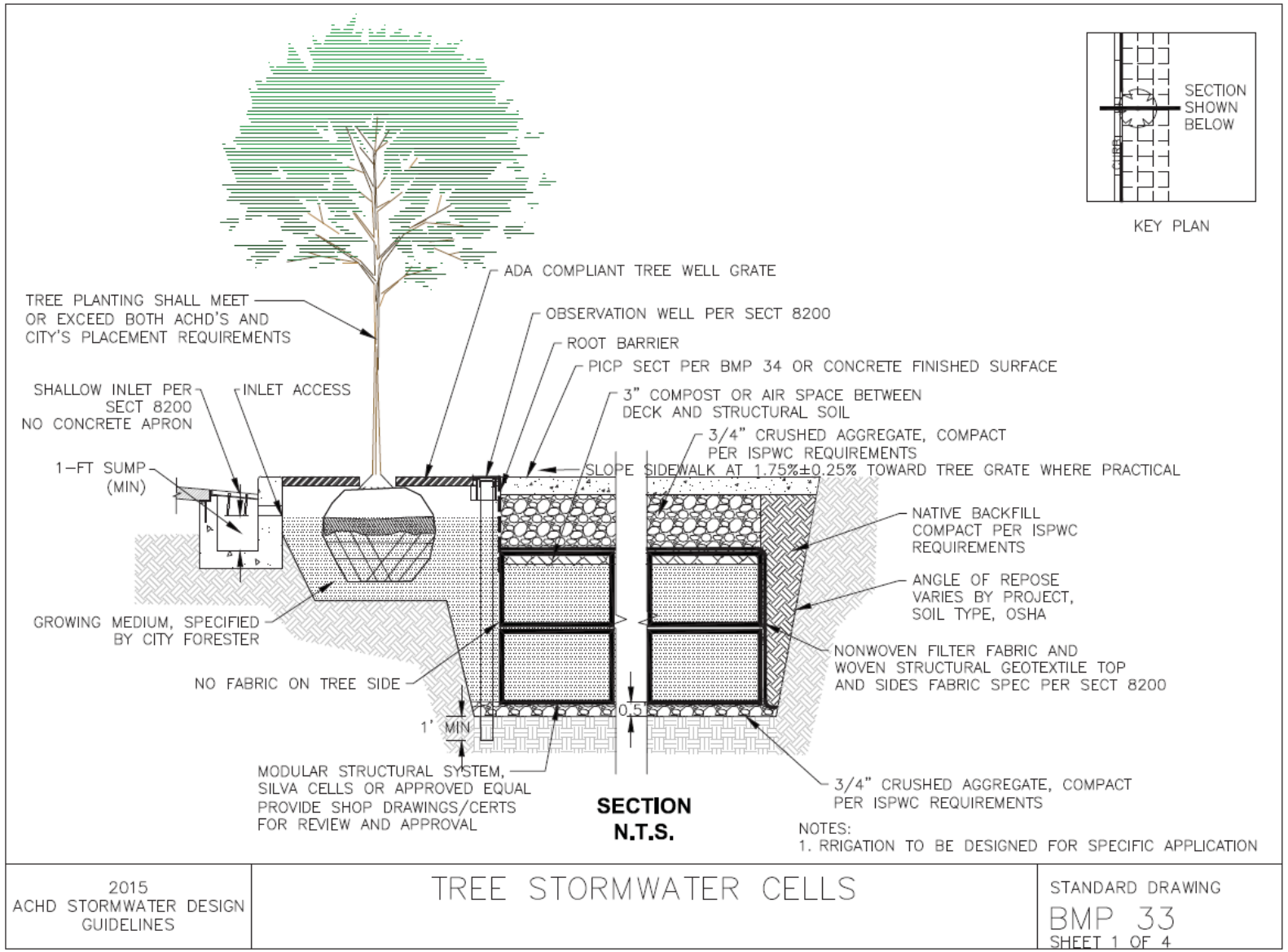

Figure 4. Ada County Highway District Tree Stormwater Cell Detail 1 of 3. (ACHD 2015)

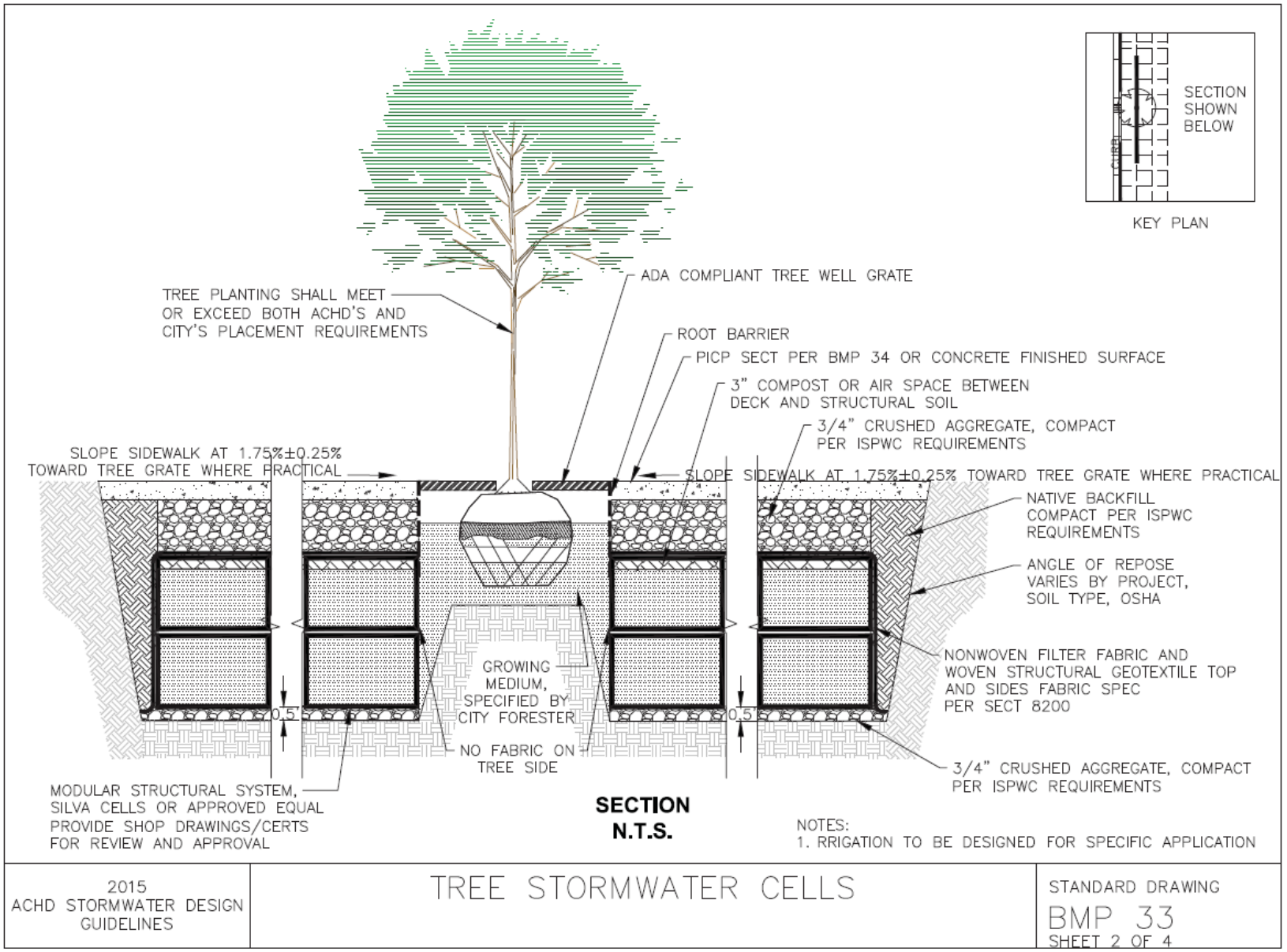

Figure 5. Ada County Highway District Tree Stormwater Cell Detail 2 of 3. (ACHD 2015)

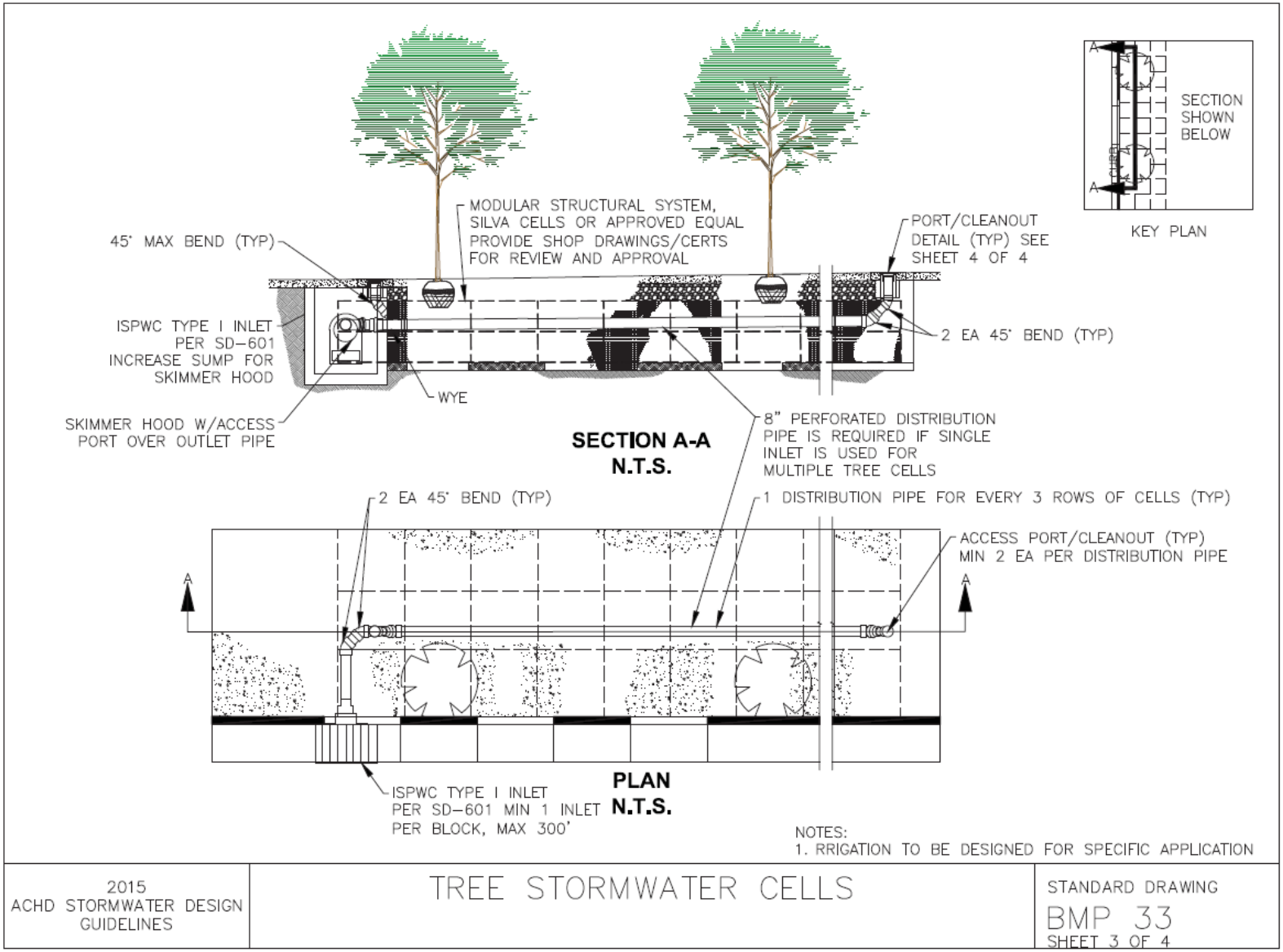

Figure 6. Ada County Highway District Tree Stormwater Cell Detail 3 of 3. (ACHD 2015)

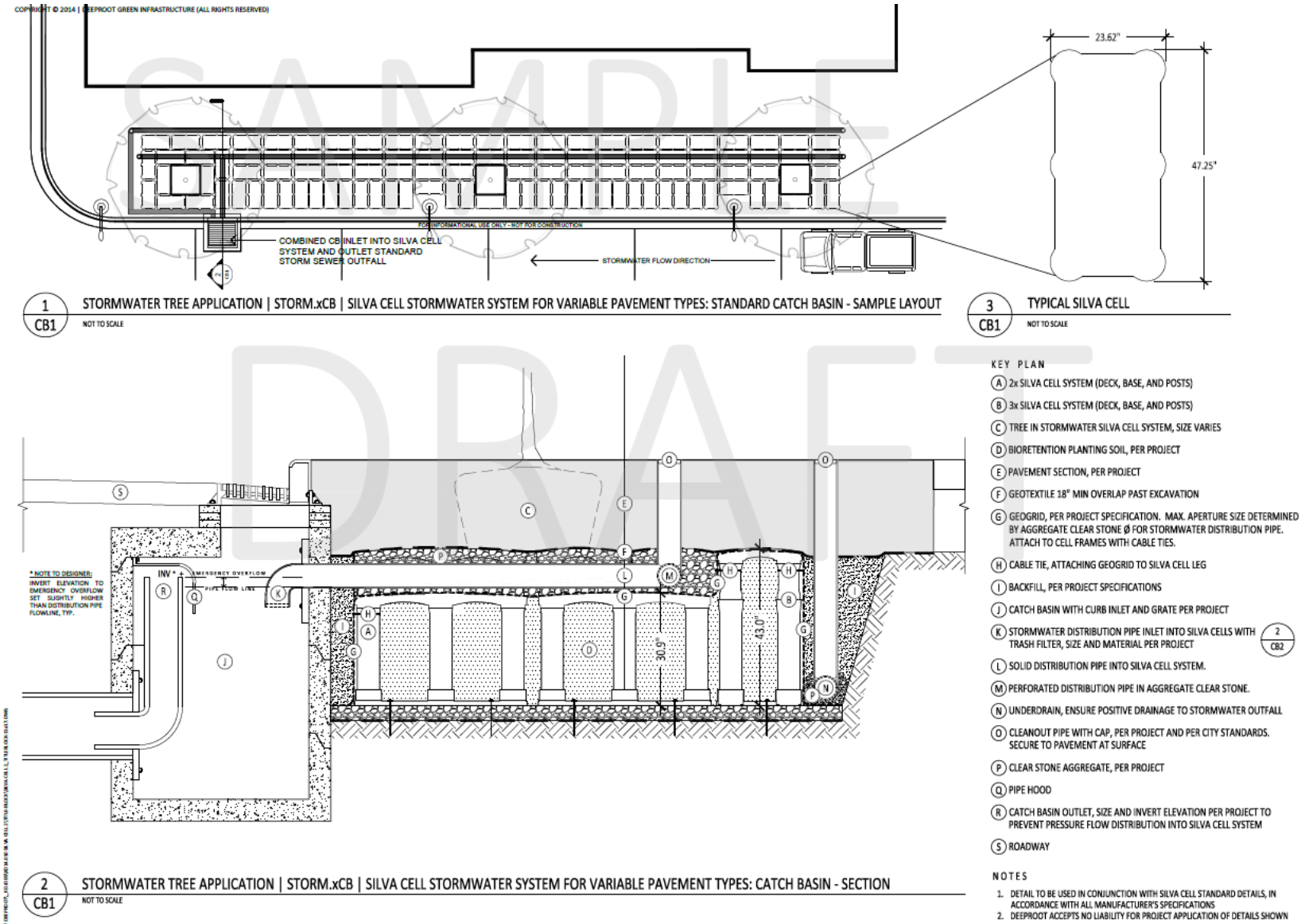

Figure 7. Draft Silva Cells for Stormwater Tree Applications. (Deeproot 2014)

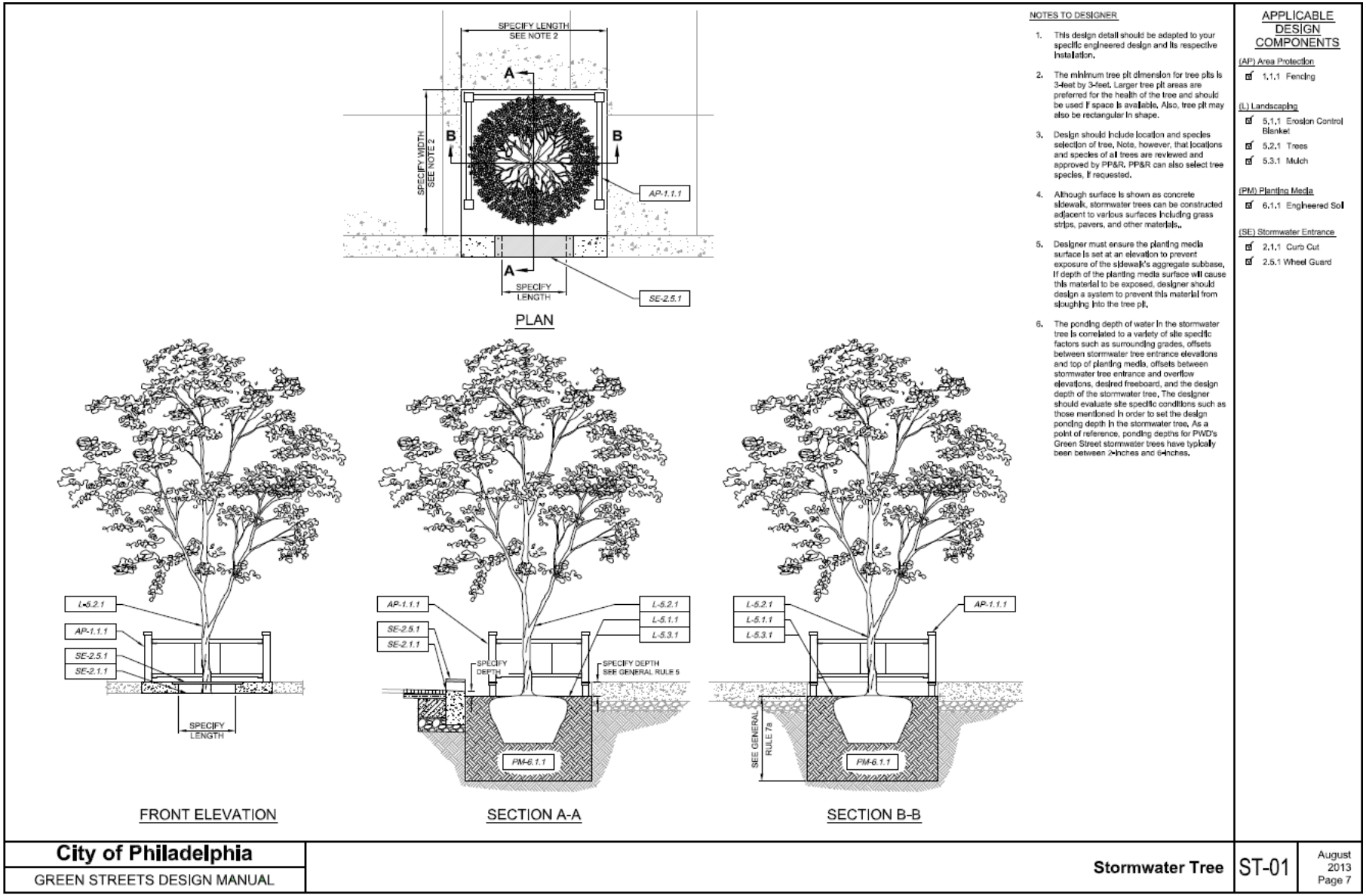

Figure 8. Stormwater Tree Standard Detail, City of Philadelphia. (City of Philadelphia 2013)

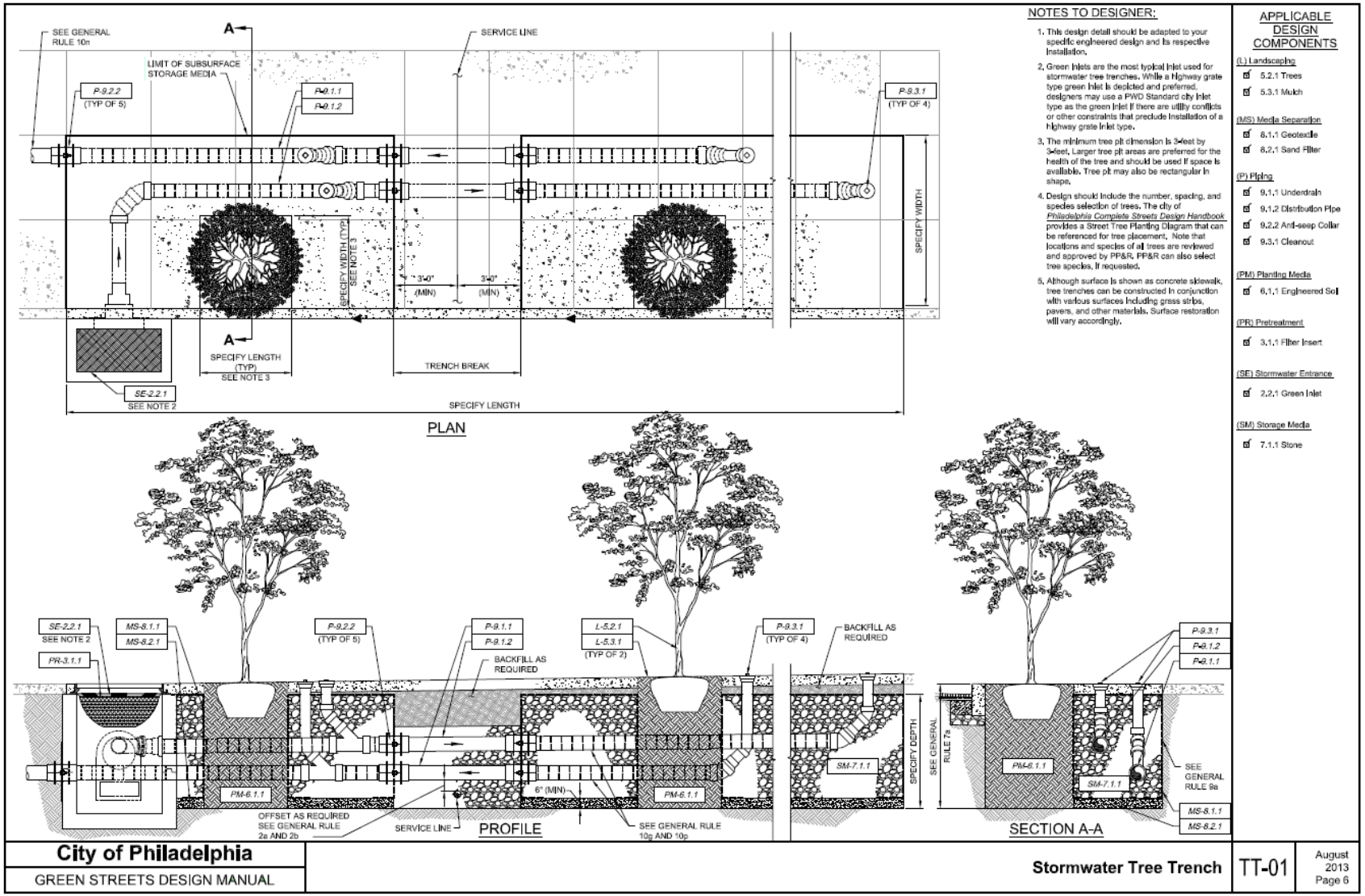

Figure 9. Stormwater Tree Trench Standard Detail, City of Philadelphia. (City of Philadelphia 2013)

2.5 Additional Design Recommendations for Trees in Bioretention

The following recommendations are compiled from a number of sources including the Center for Watershed Protection 2012, Colorado Master Gardener Program 2016, and Deeproot 2013 – 2016.

- **Compacted soils:** On extremely compacted soils, rototill a rind around the backfill area to a width of four, five, or more times the root ball diameter.
- **Select species** that do not provide excessive litter, particularly when planting near impervious surfaces.
- **Select species** that are tolerant of bioretention conditions
- **Root Ball Uncovered:** Do not cover the root ball soil with BSM soil as the texture change will impede the movement of air and water into the root ball.
- **Location:** Plant trees along the bioretention edge on side slopes and where there is no aggregate drainage layer below

3.0 OTHER TREE BMPS

Outside of bioretention, the benefits of trees for capturing and treating stormwater are well recognized. Best practices for urban trees in general have been developed by others as well. While they are not specific to stormwater or bioretention applications, there are numerous best practices that could improve the trajectory of trees in bioretention basins. Specifications for growing urban trees were developed by tree experts, Dr. Ed Gilman, Brian Kempf, and Jim Urban with the Urban Tree Foundation. The best practices guidelines are open source and include planting details and written specifications for planting, staking, soil modifications, irrigation and tree protection. These are included in Appendix A.

A variety of other stormwater BMPs have been developed specifically to support trees and manage stormwater as well. Tree BMPs can mimic certain physical, chemical, and biological processes that occur in the natural environment. Depending upon the design of a facility, different processes can be maximized or minimized depending on the type of pollutant loading expected. Tree BMPs may be able to be linked with bioretention in a treatment train, placed adjacent to a bioretention to share hydrology, or aspects of their design may inform bioretention basin design to enhance tree health.

Suspended Pavement Systems: In areas that do not have enough open space to grow large trees, techniques like structural cells or suspended pavement systems can be used to extend tree rooting volume under load-bearing surfaces and create favorable conditions to grow large trees in urban areas. This rooting volume can also be used for bioretention. While suspended pavement has been built in several different ways, all suspended pavement is held slightly above the soil by a structure that “suspends” the pavement above the soil so that the soil is protected from the weight of the pavement and the compaction generated from its traffic. Another option is modular pre-constructed soil cells that support pavement while allowing the soil below to be tailored to the desired functions like tree growth and stormwater management. Silvacells, Stratacell and Stratavault are three examples of this type of product. Examples are shown in Figures 7 and 10.

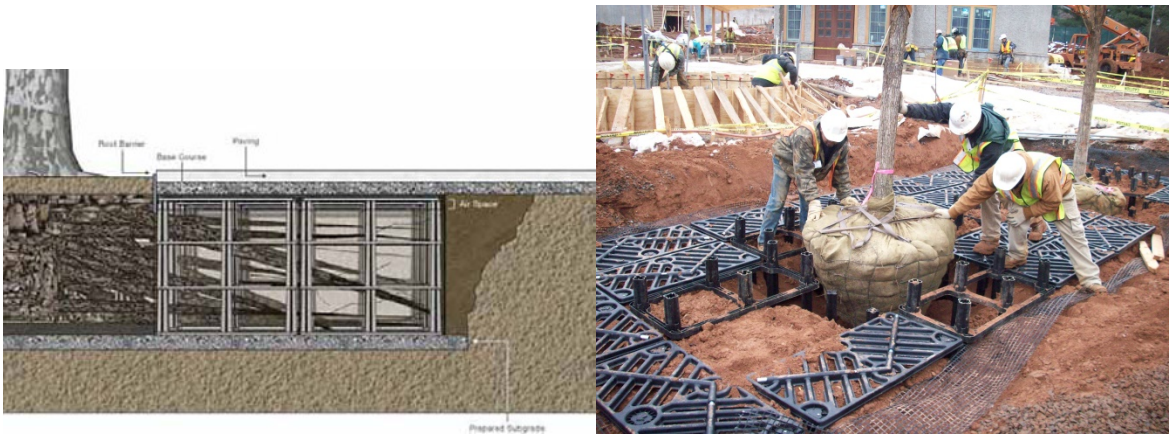

Figure 10. Silva Cell diagram (left), and installation (right)

Rock Based Structural Soil: Rock based structural soils are typically engineered to be able to be compacted to 95 percent Proctor density without impeding root growth. Rock based structural soils are typically gap graded engineered soils with the following components:

- Stones to provide load bearing capacity and protect soil in its void spaces from compaction. The stones should be uniformly graded and crushed or angular for maximum porosity, compaction, and structural interface (Bassuk et al,, 2005). Mean pore size should be large enough to accommodate root growth (Lindsey, 1994). Significant crushing of stone should not occur during compaction (Lindsey 1994).
- Soil in rock void spaces for tree root growth. Soil needs to have adequate nutrient and water holding capacity to provide for the tree's needs. Although rock-based structural soils consist primarily of rock, with perhaps about 20 percent of the volume consisting of soil, a study by Grabowsky et al. (2009) showed the available water holding capacity of a Cornell University structural soil ranged from 7 to 11 percent. This compares to a typical water holding capacity of about 15 to 20 percent for a loam soil. The structural soil appears to retain water on the aggregate surfaces, meaning a structural soil with only 20 percent soil behaves more like a system with about 50 percent soil in terms of water holding capacity.
- Tackifier to keep the soil uniformly distributed in the rock void spaces (tackifier is only found in some kinds of rock based structural soil). Two (2) inch stones would be able to support most tree roots. The tackifier, if used, should be non-toxic and non-phototoxic.
- Tree species tolerant of extremely well drained soils (Bassuk 2010) because rock based structural soils drain quickly (greater than 24 inches per hour).
- Tree species tolerant of structural soil pH. If limestone-based structural soil is used, trees tolerant of alkaline pH must be selected, as limestone can raise the pH of soil to 8.0 or higher (Bassuk, 2010 soil debate; Urban, 2008).

4.0 REFERENCES

Bassuk, Nina. 2010. Using CU-Structural Soil to Grow Trees Surrounded by Pavement. In The Great Soil Debate Part II: Structural soils under pavement. ASLA Annual Meeting Handout.

Bassuk, Nina, Jason Grabosky, and Peter Trowbridge. 2005. Using CU-Structural Soil™ in the Urban Environment.

Colorado Master Gardener Program 2016, “The Science of Planting Trees” accessed at : http://www.ext.colostate.edu/mg/gardennotes/633.html

Cornell University. 2005. Using CU-Structural Soil™ in the Urban Environment.

Deeproot Green Infrastructure, L.P. 2010. “How Deep do Tree Roots Grow?” accessed at http://www.deeproot.com/blog/blog-entries/how-deep-do-tree-roots-grow

Deeproot Green Infrastructure, L.P. 2010. “Illustrated Guide to Using Trees and Soils to Manage Stormwater” accessed at http://www.deeproot.com/blog/blog-entries/illustrated-summary-of-using-trees-and-soils-to-manage-stormwater

Grabosky, Jason, Edward Haffner, and Nina Bassuk. 2009. Plant Available Moisture in Stone-soil Media for Use Under Pavement While Allowing Urban Tree Root Growth. Arboriculture & Urban Forestry 35(5): 271-278.

Minnesota Pollution Control Agency 2014. “Types of Tree BMPs” accessed at: http://stormwater.pca.state.mn.us/index.php/Types_of_tree_BMPs

Urban, James. 2008. Up by Roots. Published by International Society of Arboriculture. 479 pages.

Urban Horticulture Institute 2007. “CU-Structural Soil Graphics and Plan Views” accessed at http://www.hort.cornell.edu/uhi/outreach/csc/graphics.html

Xiao, Qingfu, and E. Greg McPherson. 2008. Urban Runoff Pollutants Removal Of Three Engineered Soils. USDA Center for Urban Forest Research and UC Davis Land, Air and Water Resources.

Appendix A
Urban Tree Foundation Open Source Specifications

32 9100 Planting Soil

DISCLAIMER AND RESPONSIBILITY OF THE USER

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INSTRUCTIONS TO THE SPECIFICATION WRITER:

The following document is intended as a general specification to guide the writing of a project-specific specification. Each project is unique and it is required that the specification be developed accordingly. DO NOT USE THE FOLLOWING SPECIFICATION WITHOUT MAKING IMPORTANT ADJUSTMENTS to reflect local conditions, regulations, market standards, project schedules and local and regional practices. The following are specific items that need to be addressed.

1. General instructions for using this specification: *These instructions are intended to guide the specification writer (the specifier) through the process of editing this document into a Planting Soil specification. Be sure to delete these instructions (i.e. all the text in red displayed above the paragraph) before issuing the specifications.*

2. General Requirements - Division 01 (Construction Specification Institute) specifications and other contract elements: *This specification is designed to be used in conjunction with standard Division 01 specifications, which cover project general conditions and project wide contract elements. THIS IS NOT A STAND-ALONE SPECIFICATION and should not be used as a contract for the modification, purchase of and installation of planting soil. Important issues of project ownership, liability, insurance, contract language, project controls, Instructions to bidders, change orders and review and approval of the work are normally in the Division 01 specifications.*

3. The construction team: *A construction project is a team effort where the Owner, in effect, creates a partnership with all the Contractors to build a project. As with any good contract there are protections for all parties that the Owner will get the quality of project that they desire within the time limits and budget available; and the Contractor will be paid for the work satisfactorily completed. In between the initial bidding and the final completion there will be many places where parts of the construction do not work out as originally intended. This is normal and a good contract should allow for these changes in a manner that is equitable to both the Owner and the Contractor. To get there, a team approach and spirit must prevail. All parties must assume that each is operating in the best interest of the project goals. The clearer the goals and description of the project, the smoother the flow of a successful project.* ***The more each of the team members can trust the other members, the better the project****. This should be a critical principle in approaching interpretation of the specification.*

4. Other project documents: *This specification is intended to be used in conjunction with other project documents including the bid forms, the construction contract, Division 1 specifications, other specifications directly related to this section; other specifications that are not directly related to this work and most critically the Project construction drawings. It is very critical that all these documents be prepared with consistent terminology and that they be coordinated. The terms used for the parts of trees and other plants, different soil types, drainage features, irrigation features and structures such as paving, walls and planters must be consistent across disciplines. A very common mistake is the use of different terms and details for soil and the extent of soil work. The terms and details for planting, planting soil, subsoil and other materials must be well coordinated.*

5. Related specification sections: *This specification requires an additional specification section to describe several important related parts of the planting process.*

> ***Tree Protection:*** *This specification assumes that there is a separate specification section and construction drawings and details for tree protection; remove this section if there are no existing trees to be protected on the project.*
>
> ***Planting:*** *This specification assumes that there is a separate specification section and construction*

drawings for installation of plants.

Irrigation: *This specification assumes that there might be a separate specification section for irrigation associated with the project planting.*

6. Reviewing and approval authority: *Each specification identifies a certain entity as responsible for the review and approval of the work, project submittals, changes to the work and final acceptance of the work The entity is normally identified in Division 1. For the purposes of this specification, the term the "Owner's Representative" has been used as a placeholder for this entity. Once the proper term is defined (for example Contracting Officer, The Architect, The Landscape Architect, The Engineer etc.) this term should replace the words "Owner's Representative" wherever it appears in this specification.*

7. Header and footer requirements: *Change the header/footer language to meet the project requirements.*

8. Note to specifier: *Before issuing the document, be sure to remove all "**Note to specifier**" incorporated into this document in red text after you have read them and responded to the recommendations.*

9. Submittals: *Submittals are a critical part of any construction contract. This is where all products and materials are reviewed and approved in advance of the work. Planting Soil quality control is in this section. Including very specific requirements for approval of submittals, while a good practice, assumes that the reviewing authority has the skills needed to make these reviews and interpret the results. A common practice is to make very specific requirements but not have the time or expertise to enforce them. Lack of review of submittals does not automatically transfer quality control to the Contractor. In fact, lack of review or inappropriate review can make the reviewing authority responsible for having accepted the submittal even if it was not acceptable.* ***Do not put into the specification submittal requirements that you do not have the time, resources or knowledge, which you knew or should have known, to enforce.***

10. Specification modifications: *There are locations in this specification where additional information is required to reflect project region or contract conditions. Please insert the requested information.*

SECTION 32 9100

PLANTING SOIL

PART 1 – GENERAL

1.1 SUMMARY

Note to specifier: *Remove parts of this work description that do not apply.*

A. The scope of work includes all labor, materials, tools, supplies, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with furnishing, delivery, and installation of Planting Soil and /or the modification of existing site soil for use as Planting Soil, complete as shown on the drawings and as specified herein.

B. The scope of work in this section includes, but is not limited to, the following:

1. Locate, purchase, deliver and install Imported Planting Soil and soil amendments.
2. Harvest and stockpile existing site soils suitable for Planting Soil.
3. Modify existing stockpiled site soil.
   a. Modify existing site soil in place for use as Planting Soil.
   b. Install existing or modified existing soil for use as Planting Soil.
4. Locate, purchase, deliver and install subsurface Drain Lines.
5. Fine grade Planting Soil.
6. Install Compost into Planting Soil.
7. Clean up and disposal of all excess and surplus material.

1.2 CONTRACT DOCUMENTS

A. Shall consist of specifications, general conditions, and the drawings. The intent of these documents is to include all labor, materials, and services necessary for the proper execution of the work. The documents are to be considered as one. Whatever is called for by any parts shall be as binding as if called for in all parts.

1.3 RELATED DOCUMENTS AND REFERENCES

A. Related Documents:

Note to specifier: *Coordinate this list with the other related specification sections. Add or delete sections as appropriate.*

1. Drawings and general provisions of contract, including general and supplementary conditions and Division I specifications, apply to work of this section.
2. Related Specification Section
   a. Section - Planting
   b. Section - Irrigation
   c. Section – Lawn
   d. Section – Tree and Plant Protection

B. References: The following specifications and standards of the organizations and documents listed in this paragraph form a part of the Specification to the extent required by the references thereto. In the event that the requirements of the following referenced standards and specification conflict with this specification section the requirements of this specification shall prevail. In the event that the requirements of any of the following referenced standards and specifications conflict with each other the more stringent requirement shall prevail.

1. ASTM: American Society of Testing Materials cited section numbers.
2. U.S. Department of Agriculture, Natural Resources Conservation Service, 2003. National Soil

Survey Handbook, title 430-VI. Available Online.

3. US Composting Council *www.compostingcouncil.org and* http://compostingcouncil.org/admin/wp-content/plugins/wp-*pdfupload/pdf/191/LandscapeArch_Specs.pdf.*
4. *Methods of Soil Analysis*, as published by the Soil Science Society of America (http://www.soils.org/).
5. Up by Roots: healthy soils and trees in the built environment. 2008. J. Urban. International Society of Arboriculture, Champaign, IL.

1.4 VERIFICATION

A. All scaled dimensions on the drawings are approximate. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions and quantities, and shall immediately inform the Owner's Representative of any discrepancies between the information on the drawings and the actual conditions, refraining from doing any work in said areas until given approval to do so by the Owner's Representative.

1.5 PERMITS AND REGULATIONS

A. The Contractor shall obtain and pay for all permits related to this section of the work unless previously excluded under provision of the contract or general conditions. The Contractor shall comply with all laws and ordinances bearing on the operation or conduct of the work as drawn and specified. If the Contractor observes that a conflict exists between permit requirements and the work outlined in the contract documents, the Contractor shall promptly notify the Owner's Representative in writing including a description of any necessary changes and changes to the contract price resulting from changes in the work.

B. Wherever references are made to standards or codes in accordance with which work is to be performed or tested, the edition or revision of the standards and codes current on the effective date of this contract shall apply, unless otherwise expressly set forth.

C. In case of conflict among any referenced standards or codes or among any referenced standards and codes and the specifications, the more restrictive standard shall apply or Owner's Representative shall determine which shall govern.

Note to specifier: *Remove the paragraph below if the project is not in California.*

D. Comply with the requirements of the California code of regulation title 23 waters, division 2 department of water resources chapter 2.7 model water efficient landscape ordinance, 492.5 soil management report.

1. Where requirements of specification section Planting Soil are more stringent than the California code, the more stringent requirements shall prevail.

1.6 PROTECTION OF WORK, PROPERTY AND PERSON

A. The Contractor shall adequately protect the work, adjacent property, and the public, and shall be responsible for any damages or injury due to the Contractor's actions.

1.7 CHANGES IN WORK

A. The Owner's Representative may order changes in the work, and the contract sum adjusted accordingly. All such orders and adjustments plus claims by the Contractor for extra compensation must be made and approved in writing before executing the work involved.

B. All changes in the work, notifications and contractor's request for information (RFI) shall conform to the contract general condition requirements.

1.8 CORRECTION OF WORK

A. The Contractor shall re-execute any work that fails to conform to the requirements of the contract and shall remedy defects due to faulty materials or workmanship upon written notice from the Owner's Representative, at the soonest possible time that can be coordinated with other work and seasonal

weather demands but not more than 180 (one hundred and eighty) days after notification.

1.9 DEFINITIONS

Note to specifier: *Use the following definitions as needed to define words used in this specification. Delete and words that are not used.*

A. Acceptable drainage: Drainage rate is sufficient for the plants to be grown. Not too fast and not too slow. Typical rates for installed Planting Soil are between 1 - 5 inches per hour. Turf soils are often higher, but drainage rates above 2 - 3 inches per hour will dry out very fast. In natural undisturbed soil a much lower drainage rate, as low as 1/8th inch per hour can still support good plant growth. Wetland plants can grow on top of perched water layers or even within seasonal perched water layers, but could become unstable in high wind events.

B. Amendment: material added to Topsoil to produce Planting Soil Mix. Amendments are classified as general soil amendments, fertilizers, biological, and pH amendments.

C. Biological Amendment: Amendments such as Mycorrhizal additives, compost tea or other products intended to change the soil biology.

D. Compacted soil: soil where the density of the soil is greater that the threshold for root limiting, and further defined in this specification.

E. Compost: well decomposed stable organic material as defined by the US Composting Council and further defined in this specification.

F. Drainage: The rate at which soil water moves through the soil transitioning the soil from saturated condition to field capacity. Most often expressed as saturated hydraulic conductivity (Ksat; units are inches per hour).

Note to specifier: *The following is a general introduction to soil drainage terminology and is intended for the benefit of the specifier only. Do not include the following information in the completed specifications.*

The drainage rate of any soil is also influenced by the drainage rate of the soil lower in the profile. A compacted hard pan or Cliché layer below a free drainage soil can create poor drainage in the upper soil profile. To understand soil drainage one must investigate the total profile. Measured drainage rates are also highly influenced by soil compaction particularly in installed soil. A soil that drains at 1 inch per hour at 200 psi might become anaerobic if compacted to 350 psi. The amount of organic matter also influences drainage particularly if the organic matter is the result of adding Compost to the soil. A little Compost (10% by volume) will almost always increase drainage, but at higher amounts of Compost above 20% by volume will begin to slow drainage in the lower level of the profile because the Compost also holds water. In general it is not advisable to add much Compost to Planting Soil Mixes that are to be placed deeper than 12 inches but lots of Compost can be added to the upper 6 inches of the soil profile.

G. End of Warranty Acceptance: The date when the Owner's Representative accepts that the plants and work in this section meet all the requirements of the warranty. It is intended that the materials and workmanship warranty for Planting, Planting Soil, and Irrigation (if applicable) work run concurrent with each other, and further defined in this specification.

H. Existing Soil: Mineral soil existing at the locations of proposed planting after the majority of the construction within and around the planting site is completed and just prior to the start of work to prepare the planting area for soil modification and/or planting, and further defined in this specification.

I. Fertilizer: amendment used for the purpose of adjusting soil nutrient composition and balance.

J. Fine grading: The final grading of the soil to achieve exact contours and positive drainage, often accomplished by hand rakes or drag rakes other suitable devices, and further defined in this specification, and further defined in this specification.

K. Finished grade: surface or elevation of Planting Soil after final grading and 12 months of settlement of the soil, and further defined in this specification.

L. Graded soil: Soil where the A horizon has been stripped and relocated or re-spread; cuts and fills deeper than 12 inches, and further defined in this specification.

M. Installed soil: Planting soil and existing site soil that is spread and or graded to form a planting soil, and further defined in this specification.

N. Minor disturbance: Minor grading as part of agricultural work that only adjusts the A horizon soil, minor surface compaction in the top 6 inches of the soil, applications of fertilizers, installation of utility pipes smaller than 18 inches in diameter thru the soil zone.

O. Owner's Representative: The person or entity, appointed by the Owner to represent their interest in the review and approval of the work and to serve as the contracting authority with the Contractor. The Owner's Representative may appoint other persons to review and approve any aspects of the work.

P. Ped: a clump or clod of soil held together by a combination of clay, organic matter, and fungal hyphae, retaining the original structure of the harvested soil.

Q. Planting Soil: Topsoil, or Planting Soil Mixes which are imported or existing at the site, or made from components that exist at the site, or are imported to the site; and further defined in this specification.

R. *Poor drainage: Soil drainage that is slower than that to which the plants can adapt. This is a wide range of metrics, but generally if the soil is turning grey in color it is reasonable preferable to either to plant moisture adaptive plants at smaller sizes that are young in age with shallow root balls or look at options to improve the drainage*

S. Scarify: Loosening and roughening the surface of soil and sub soil prior to adding additional soil on top, and further defined in this specification.

T. Soil Fracturing: Deep loosening the soil to the depths specified by using a back hoe, and further defined in this specification.

Note to specifier: *The following paragraph is a general introduction to soil fracturing terminology and is intended for the benefit of the specifier only. Do not include the following information in the completed specifications.*

The back hoe method of soil fracturing is more practical in small spaces and can be more selective in areas and depths loosened when constrained by utility lines and structures such as walks, curbing or walls. The back hoe digs into the soil lifting and then dropping the soil immediately back into the hole. The bucket then moves to the adjacent soil and repeats. Optimally, a layer of Compost is spread over the soil before fracturing is begun and the Compost falls into the spaces between the soil chunks created by the effort. The deeper the fracturing and the more compact and dryer the soil the more difficult the operation becomes, but is generally less limited by built objects than soil ripping. Fracturing is not practical when soil moisture is close to or above field capacity. Fracturing leaves the soil surface quite rough with large soil clods. These must be broken by additional tilling. Tilling in more Compost to the surface after fracturing will help create an A horizon soil and/or imported or reused Topsoil can be added on top of the fractured soil.

U. Soil Horizons: as defined in the USDA National Soil Survey Handbook

http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242.

V. Soil Ripping: Loosening the soil by dragging a ripping shank or chisel thru the soil to the depths and spacing specified, and further defined in this specification.

Note to specifier: *The following is a general introduction to soil ripping terminology and is intended for the benefit of the specifier only. Do not include the following paragraph in the completed specifications.*

Soil ripping requires large heavy equipment to be able to operate in the space. The deeper the ripping and the more compact and dryer the soil the more difficult the operation becomes. Ripping is not practical when soil moisture is close to or above field capacity. Existing shallow utilities such as electric and particularly irrigation lines make ripping near these lines difficult if not impossible.

W. Soil Tilling: Loosening the surface of the soil to the depths specified with a **rotary tine tilling machine, roto tiller, (or spade tiller)**, and further defined in this specification**.**

Note to specifier: *The following is a general introduction to soil tilling terminology and is intended for the benefit of the specifier only. Do not include the following information in the completed specifications.*

Compost can be added at the time of tilling. Tilling has the advantage of using more compact equipment that can work in small spaces. The great disadvantage is that even large commercial tillers are limited to about 8 inches maximum tilling depth. Garden tillers typically have a maximum depth of 6 inches. The second disadvantage is that the tines create additional compaction below the tilled soil and drainage will be reduced between the tilled soil and the undisturbed subsoil.

A new tiller called a ***spade tiller*** *is becoming available that does a better job at breaking the interface between the tilled soil and the subsoil as well as retaining some of the original soil structure. This type of tiller, originally developed for the wine industry, is preferred if one is available.*

As with all soil modification techniques, Soil Tilling is more difficult the more compact and dryer the soil. Soil Tilling is not practical when soil moisture is close to or above field capacity.

X. Soil trenching: Cutting narrow trenches thru the soil at the depths and spacing specified to loosen the soil profile, and further defined in this specification.

Note to specifier: *The following is a general introduction to soil trenching terminology and is intended for the benefit of the specifier only. Do not include the following paragraph in the completed specifications.*

Where space is limited and soil fracturing is not practical, the soil can be trenched using a standard chain trenching machine. This can cut trenches easily in compacted soil to depths of 30 inches or more. The trenches are dug about 3 feet on center and backfilled with Compost. This improves drainage and over time loosens the soil between the trenches. Trenching is usually combined with additional Compost and surface soil tilling to create a new A horizon. Soil trenching is not practical when soil moisture is close to or above field capacity but not very limited by dry soil conditions.

Y. Subgrade: surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing Planting Soil.

Z. Substantial Completion Acceptance: The date at the end of the Planting, Planting Soil, and Irrigation installation (if applicable) where the Owner's Representative accepts that all work in these sections is complete and the Warranty period has begun. This date may be different than the date of substantial completion for the other sections of the project, and further defined in this specification.

AA. Topsoil: naturally produced and harvested soil from the A horizon or upper layers or the soil as further defined in this specification.

BB. Undisturbed soil: Soils with the original A horizon intact that have not been graded or compacted. Soils that have been farmed, subjected to fire or logged but not graded, and natural forested land will be considered as undisturbed.

1.10 SUBMITTALS

A. See the contract General Conditions for policy and procedures related to submittals.

B. Submit all product submittals eight weeks prior to the start of the soil work.

Note to specifier: *Confirm submittal time above is appropriate for project schedule.*

C. Product data and certificates: For each type of manufactured product, submit data and certificates that the product meets the specification requirements, signed by the product manufacturer, and complying with the following:

1. Submit manufacturers or supplier's product data and literature certified analysis for standard products and bulk materials, complying with testing requirements and referenced standards and

specific requested testing.

a. For each Compost product submit the following analysis by a recognized laboratory:
   1.) pH
   2.) Salt concentration (electrical conductivity)
   3.) Moisture content %, wet weight basis
   4.) Particle size % passing a selected mesh size, dry weight basis
   5.) Stability carbon dioxide evolution rate mg CO2-C per g OM per day
   6.) Solvita maturity test
   7.) Physical contaminants (inerts) %, dry weight basis
   8.) US EPA Class A standard, 40CFR § 503.13, Tables 1 and 3 levels Chemical Contaminants mg/kg (ppm)

b. For Coarse Sand product submit the following analysis by a recognized laboratory:
   1.) pH
   2.) Particle size distribution (percent passing the following sieve sizes):
   3/8 inch (9.5 mm)
   No 4 (4.75 mm)
   No 8 (2.36 mm)
   No 16(1.18 mm)
   No 30 (.60 mm)
   No 50 (.30 mm)
   No 100 (.15 mm)
   No 200 (.075 mm)

D. Samples: Submit samples of each product and material, where required by Part 2 of the specification, to the Owner's Representative for approval. Label samples to indicate product, characteristics, and locations in the work. Samples will be reviewed for appearance only.

1. Submit samples a minimum of 8 weeks prior to the anticipated date of the start of soil installation.

2. Samples of all Topsoil, Coarse Sand, Compost and Planting Soil shall be submitted at the same time as the particle size and physical analysis of that material.

E. Soil testing for Imported and Existing Topsoil, existing site soil to be modified as Planting Soil and Planting Soil Mixes.

1. Topsoil, existing site soil and Planting Soil Mix testing: Submit soil test analysis report for each sample of Topsoil, existing site soil and Planting Soil from an approved soil-testing laboratory and where indicated in Part 2 of the specification as follows:
   a. Submit Topsoil, Planting Soil, Compost, and Coarse Sand for testing at least 8 weeks before scheduled installation of Planting Soil Mixes. Submit Planting Soil Mix test no more than 2 weeks after the approval of the Topsoil, Compost and Coarse Sand. Do not submit to the testing laboratory, Planting Soil Mixes, for testing until all Topsoil, Compost and Coarse Sand have been approved.
   b. If tests fail to meet the specifications, obtain other sources of material, retest and resubmit until accepted by the Owner's Representative.
   c. All soil testing will be at the expense of the Contractor.

2. Submit all testing required by California Code of regulation Title 23 waters, Division 2 Department of Water resources Chapter 2.7 Model Water Efficient Landscape Ordinance, 492.5 Soil Management Report.
   Note to specifier: *Delete the above paragraph if the project is not in California.*

3. Provide a particle size analysis (% dry weight) and USDA soil texture analysis. Soil testing of Planting Soil Mixes shall also include USDA gradation (percentage) of gravel, coarse sand, medium sand, and fine sand in addition to silt and clay.

4. Provide the following other soil properties:
   a. pH and buffer pH.

b. Percent organic content by oven dried weight.
c. Nutrient levels by parts per million including: phosphorus, potassium, magnesium, manganese, iron, zinc and calcium. Nutrient test shall include the testing laboratory recommendations for supplemental additions to the soil for optimum growth of the plantings specified.
d. Soluble salt by electrical conductivity of a 1:2 soil water sample measured in Milliohm per cm.
e. Cation Exchange Capacity (CEC).

1.11 SOIL INSTALLATION MOCKUP

Note to specifier: *This section is designed to provide the construction team an opportunity to test means and methods and to record expectations on the finished soil installation. The Owner's Representative must understand enough about soil installation to make an assessment of the mockup and have sufficient observation fee budget to review the work. Mockups add to the cost of the project and this section should be evaluated for its critical nature to the soil installation scope.*

A. Prior to installation or modification of Topsoil, site soil, Planting Soil, or Planting Soil Mixes, construct at the site, a mockup of each soil type using the means and methods and equipment proposed by the Contractor to complete the work. Installation of the mockup shall be in the presence of the Owner's Representative. The purpose of the mockup is to test the methods of installation and compaction of the soil and to serve as a benchmark for completed soil compaction and serve to calibrate penetrometer readings to the known proctor density of the mockup. The mockup shall be as follows:

1. Following acceptance of the soil submittals, in areas that can be protected from disturbance and further compaction, install mockups of each soil type and soil modification, 20 foot X 20 foot X the full depth of the deepest installation, using the requirements of these specifications. Compaction methods, including the type of compaction equipment and number of passes required to achieve the required compaction, shall be evaluated and results measured.

2. Compaction in the mockup soil shall be tested using the penetrometer. A minimum of four penetrometer readings from each Planting Soil shall be taken at the specified depths of the soil profile. Record the soil moisture at each penetrometer test site. In the event that the penetrometer readings exceed the specified densities, reconstruct the mockup, adjusting the soil density to achieve the desired results. Where the modification requires ripping, tilling or fracturing soils that are over compacted, start the procedure in a new location so that the process is working on soil that is similar to the density of the expected soil.

3. Submit a report of the final methods of soil installation, the penetrometer and soil moisture readings to the Owner's Representative.

4. The mockup area may remain as part of the installed work at the end of the project if protected from further compaction, contamination or other disturbance.

5. Provide a protective 4 foot high fence on metal posts around each mockup to keep all work and equipment from entering the surface of the mockup area.

1.12 OBSERVATION OF THE WORK

A. The Owner's Representative may observe the work at any time. They may remove samples of materials for conformity to specifications. Rejected materials shall be immediately removed from the site and replaced at the Contractor's expense. The cost of testing materials not meeting specifications shall be paid by the Contractor.

1. The Owner's Representative may utilize the Contractor's penetrometer and moisture meter at any time to check soil compaction and moisture.

B. The Owner's Representative shall be informed of the progress of the work so the work may be observed at the following key times in the construction process. The Owner's Representative shall be afforded sufficient time to schedule visit to the site. Failure of the Owner's Representative to make field observations shall not relieve the Contractor from meeting all the requirements of this specification.

1. SOIL MOCKUP REVIEW: At the time of construction of all soil mockups.
2. EXISTING SOIL CONDITIONS REVIEW: Prior to the start of any soil modification that will utilize or modify the existing soil.
3. EXCAVATION REVIEW: Observe each area of excavation prior to the installation of any Planting Soil.
4. DRAIN LINE INSTALLATION REVIEW: Upon completion of the installation of drain lines and prior to the installation of any Planting Soil
5. COMPLETION of SOIL MODIFICATIONS REVIEW: Upon completion of all soil modification and installation of planting soil.
6. COMPLETION OF FINE GRADING AND SURFACE SOIL MODIFICATIONS REVIEW: Upon completion of all surface soil modifications and fine grading but prior to the installation of shrubs, ground covers, or lawns.

1.13 PRE-CONSTRUCTION CONFERENCE

A. Schedule a pre-construction meeting with the Owner's Representative at least seven (7) days before beginning work to review any questions the Contractor may have regarding the work, administrative procedures during construction and project work schedule.

1.14 QUALITY ASSURANCE

A. Installer Qualifications: The installer shall be a firm having at least 5 years of experience of a scope similar to that required for the work, including the preparation, mixing and installation of soil mixes to support planting. The installer of the work in Section: Planting, shall be the same firm installing the work in this section.
   1. The bidders list for work under this section shall be approved by the Owner's Representative.
   2. Installer Field Supervision: When any Planting Soil work is in progress, installer shall maintain, on site, an experienced full-time supervisor who can communicate in English with the Owner's Representative.
   3. Installer's field supervisor shall have a minimum of five years experience as a field supervisor installing soil, shall be trained and proficient in the use of field surveying equipment to establish grades and can communicate in English with the Owner's Representative.
   4. The installer's crew shall be experienced in the installation of Planting Soil, plantings, and irrigation (where applicable) and interpretation of planting plans, soil installation plans, and irrigation plans (where applicable).
   5. Submit references of past projects and employee training certifications that support that the Contractors meet all of the above installer qualifications and applicable licensures.

B. Soil testing laboratory qualifications: an independent laboratory, with the experience and capability to conduct the testing indicated and that specializes in USDA agricultural soil testing, Planting Soil Mixes, and the types of tests to be performed. Geotechnical engineering testing labs shall not be used.

C. All delivered and installed Planting Soil shall conform to the approved submittals sample color, texture and approved test analysis.
   1. The Owner's Representative may request samples of the delivered or installed soil be tested for analysis to confirm the Planting Soil conforms to the approved material.
   2. All testing shall be performed by the same soil lab that performed the original Planting Soil testing.
   3. Testing results shall be within 10% plus or minus of the values measured in the approved Planting Soil Mixes.

4. Any Planting Soil that fails to meet the above criteria, if requested by the Owner's Representative, shall be removed and new soil installed.

D. Soil compaction testing: following installation or modification of soil, test soil compaction with a penetrometer.

1. Maintain at the site at all times a soil cone penetrometer with pressure dial and a soil moisture meter to check soil compaction and soil moisture.
   a. Penetrometer shall be AgraTronix Soil Compaction Meter distributed by Ben Meadows, www.benmeadows.com or approved equal.
   b. Moisture meter shall be "general digital soil moisture meter" distributed by Ben Meadows, www.benmeadows.com or approved equal.

2. Prior to testing the soil with the penetrometer check the soil moisture and penetrometer readings in the mockup soils. Penetrometer readings are impacted by soil moisture and excessively wet or dry soils will read significantly lower or higher than soils at optimum moisture.

3. The penetrometer readings shall be within 20% plus or minus of the readings in the approved mockup when at similar moisture levels.

1.15 SITE CONDITIONS

A. It is the responsibility of the Contractor to be aware of all surface and subsurface conditions, and to notify the Owner's Representative, in writing, of any circumstances that would negatively impact the health of plantings. Do not proceed with work until unsatisfactory conditions have been corrected.

1. Should subsurface drainage or soil conditions be encountered which would be detrimental to growth or survival of plant material, the Contractor shall notify the Owner's Representative in writing, stating the conditions and submit a proposal covering cost of corrections. If the Contractor fails to notify the Owner's Representative of such conditions, they shall remain responsible for plant material under the warrantee clause of the specifications.

2. This specification requires that all Planting Soil and Irrigation (if applicable) work be completed and accepted prior to the installation of any plants.

1.16 SOIL COMPACTION – GENERAL REQUIREMENTS

A. Except where more stringent requirements are defined in this specification. The following parameters shall define the general description of the threshold points of soil compaction in existing, modified or installed soil and subsoil.

Note to specifier: *All soil has some level of compaction and subsoil is naturally more compacted than Topsoil simply from the static weight of the upper level soil. There are three common ways to measure, quantify and assess levels of compaction that may be used to determine compaction levels.*

1. *Bulk Density Method*
   Units - Bulk density lb./cf or g/cc dry weight. Threshold results that determine critical bulk density are different for each soil texture.
   Measurement tool - Bulk density cores.
   Pro/cons - Requires one day or more per test, accurate, somewhat expensive. Landscape architect can own and operate equipment or hire a soil testing service.

2. *Standard Proctor Method ASTM D 698*
   Units - % maximum dry bulk density as tested by the standard proctor method. Threshold results that determine critical bulk density are the same for each soil texture. A proctor test will typically also provide results as Bulk density lb./cf dry weight.
   Measurement Tool - Densitrometer
   Pro/cons - Moderately slow 10 minutes per test, accurate, expensive, lab test required to determine every specific soil texture's Proctor density curve, readings are impacted by soil organic matter, must hire a soil testing service.

3. *Penetration Resistance Method*

Units – PSI (lb. pressure per sq. in.) Threshold results that determine critical bulk density are somewhat the same for each soil texture.
Measurement tool - Penetrometer
*Pro/cons - Fast less than one minute per test, **not very accurate**. The Owner's representative may interpret the results and require different limits based on soil type, and moisture content at the time the soil is tested.*
Inexpensive, limited by soil moisture and gravel, landscape architect can own and operate equipment, no soil testing service required.

B. The following are threshold levels of compaction as determined by each method.

1. Acceptable Compaction: Good rooting anticipated, but increasing settlement expected as compaction is reduced and/or in soil with a high organic matter content.
   a. Bulk Density Method – Varies by soil type see Chart on page 32 in Up By Roots.
   b. Standard Proctor Method – 75-85%; soil below 75% is unstable and will settle excessively.
   c. Penetration Resistance Method – about 75-250 psi, below 75 psi soil becomes increasingly unstable and will settle excessively.

2. Root limiting Compaction: Root growth is limited with fewer, shorter and slower growing roots.
   a. Bulk Density Method – Varies by soil type see Chart on page 32 in Up By Roots.
   b. Standard Proctor Method – above approximately 85%.
   c. Penetration Resistance Method – about 300 psi.

3. Excessive Compaction: Roots not likely to grow but can penetrate soil when soil is above field capacity.
   a. Bulk Density Method – Varies by soil type see Chart on page 32 in Up By Roots.
   b. Standard Proctor Method – Above 90%.
   c. Penetration Resistance Method – Approximately above 400 psi

1.17 DELIVERY, STORAGE, AND HANDLING

A. Weather: Do not mix, deliver, place or grade soils when frozen or with moisture above field capacity.

B. Protect soil and soil stockpiles, including the stockpiles at the soil blender's yard, from wind, rain and washing that can erode soil or separate fines and coarse material, and contamination by chemicals, dust and debris that may be detrimental to plants or soil drainage. Cover stockpiles with plastic sheeting or fabric at the end of each workday.

C. All manufactured packaged products and material shall be delivered to the site in unopened containers and stored in a dry enclosed space suitable for the material and meeting all environmental regulations. Biological additives shall be protected from extreme cold and heat. All products shall be freshly manufactured and dated for the year in which the products are to be used.

D. Deliver all chemical amendments in original, unopened containers with original labels intact and legible, which state the guaranteed chemical analysis. Store all chemicals in a weather protected enclosure.

E. Bulk material: Coordinate delivery and storage with Owner's Representative and confine materials to neat piles in areas acceptable to Owner's Representative.

1.18 EXCAVATING AND GRADING AROUND UTILITIES

A. Contractor shall carefully examine the civil, record, and survey drawings to become familiar with the existing underground conditions before digging.

B. Determine location of underground utilities and perform work in a manner that will avoid damage. Hand excavate as required. Maintain grade stakes set by others until parties concerned mutually agree upon removal.

C. Notification of the *local utility locator service*, *Insert PHONE NUMBER*, is required for all planting areas. The Contractor is responsible for knowing the location and avoiding utilities that are not covered by the *local utility locator service*.

Note to specifier: *Insert the telephone number and correct name of the local utility locator service to the paragraph above if available.*

PART 2 – PRODUCTS

Note to specifier: *Delete all products not applicable to this specific project. Local conditions for the harvested materials will vary and these specifications may need to be revised to reflect local source requirements, availability, budgets and plants to be grown.*

2.1 IMPORTED TOPSOIL

A. Imported Topsoil definition: Fertile, friable soil containing less than 5% total volume of the combination of subsoil, refuse, roots larger than 1 inch diameter, heavy, sticky or stiff clay, stones larger than 2 inches in diameter, noxious seeds, sticks, brush, litter, or any substances deleterious to plant growth. The percent (%) of the above objects shall be controlled by source selection not by screening the soil. Topsoil shall be suitable for the germination of seeds and the support of vegetative growth. Imported Topsoil shall not contain weed seeds in quantities that cause noticeable weed infestations in the final planting beds. Imported Topsoil shall meet the following physical and chemical criteria:

Note to specifier: Make adjustments in the following to account for the fact that these idea soils may not be available in your area.

1. Soil texture: USDA loam, sandy clay loam or sandy loam with clay content between 15 and 25%. And a combined clay/silt content of no more than 55%.
2. pH value shall be between 5.5 and 7.0.
3. Percent organic matter (OM): 2.0-5.0%, by dry weight.
4. Soluble salt level: Less than 2 mmho/cm.
5. Soil chemistry suitable for growing the plants specified.

B. Imported Topsoil shall be a harvested soil from fields or development sites. The organic content and particle size distribution shall be the result of natural soil formation. Manufactured soils where Coarse Sand, Composted organic material or chemical additives has been added to the soil to meet the requirements of this specification section shall not be acceptable. Retained soil peds shall be the same color on the inside as is visible on the outside.

Note to specifier: *Make adjustments to the above to account for the fact that these idea soils may not be available in your area. Soil peds may not normally occur, especially where soils have a high sand content.*

C. Imported Topsoil for Planting Soil shall NOT have been screened and shall retain soil peds or clods larger than 2 inches in diameter throughout the stockpile after harvesting.

D. Stockpiled Existing Topsoil at the site meeting the above criteria may be acceptable.

E. Provide a two gallon sample from each Imported Topsoil source with required soil testing results. The sample shall be a mixture of the random samples taken around the source stockpile or field. The soil sample shall be delivered with soil peds intact that represent the size and quantity of expected peds in the final delivered soil.

2.2 COMPOST

A. Compost: Blended and ground leaf, wood and other plant based material, composted for a minimum of 9 months and at temperatures sufficient to break down all woody fibers, seeds and leaf structures, free of toxic material at levels that are harmful to plants or humans. Source material shall be yard waste trimmings blended with other plant or manure based material designed to produce Compost high in fungal material.

1. Compost shall be commercially prepared Compost and meet US Compost Council STA/TMECC criteria or as modified in this section for “Compost as a Landscape Backfill Mix Component”.

http://compostingcouncil.org/admin/wp-content/plugins/wp-pdfupload/pdf/191/LandscapeArch_Specs.pdf

2. Compost shall comply with the following parameters:
   a. pH: 5.5 - 8.0.
   b. Soil salt (electrical conductivity): maximum 5 dS/m (mmhos/cm).
   c. Moisture content %, wet weight basis: 30 – 60.
   d. Particle size, dry weight basis: 98% pass through 3/4 inch screen or smear.
   e. Stability carbon dioxide evolution rate: mg CO_2-C/ g OM/ day < 2.
   f. Solvita maturity test: > 6.
   g. Physical contaminants (inerts), %, dry weight basis: <1%.
   h. Chemical contaminants, mg/kg (ppm): meet or exceed US EPA Class A standard, 40CFR § 503.13, Tables 1 and 3 levels.
   i. Biological contaminants select pathogens fecal coliform bacteria, or salmonella, meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) level requirements.

B. Provide a two gallon sample with manufacturer's literature and material certification that the product meets the requirements.

2.3 COARSE SAND

A. Clean, washed, sand, free of toxic materials

1. Coarse concrete sand, ASTM C-33 Fine Aggregate, with a Fines Modulus Index of 2.8 and 3.2.

2. Coarse Sands shall be clean, sharp, natural Coarse Sands free of limestone, shale and slate particles. Manufactured Coarse Sand shall not be permitted.

3. pH shall be lower than 7.0.

4. Provide Coarse Sand with the following particle size distribution:

Sieve	Percent passing
3/8 inch (9.5 mm)	100
No 4 (4.75 mm)	95-100
No 8 (2.36 mm)	80-100
No 16 (1.18 mm)	50-85
No 30 (.60 mm)	25-60
No 50 (.30 mm)	10-30
No 100 (.15 mm)	2-10
No 200 (0.75 mm	2-5

B. Provide a two gallon sample with manufacturer's literature and material certification that the product meets the requirements.

2.4 FERTILIZER, BIOLOGICAL AND OTHER AMENDMENTS

Note to specifier: *Fertilizers and specialty biological amendment products such as* Mycorrhizal amendments *or Compost Tea are not generally required or recommended at planting and are not included in this specification. If the project team would like to add any of these amendments, add the product descriptions here. These types of amendments, if used at all, should never be applied without a soil test that documents their need and application rate.*

2.5 LIME

A. ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:

1. Class: Class T, with a minimum 99 percent passing through No. 8 (2.36-mm) sieve and a minimum 75 percent passing through No. 60 (0.25-mm) sieve.

2. Provide lime in form of dolomitic limestone.

B. Provide manufacturer's literature and material certification that the product meets the requirements.

2.6 EXISTING SOIL (Acceptable for planting with minimum modifications)

Note to specifier: *If existing soil is to be retained and reused, it is prudent to document the condition of this soil prior to the start of construction. Documentation (called a soil report) should include standard agricultural chemical soil testing, soil profile condition, as well as documenting soil penetration resistance to anticipated rooting depth. Such testing is typically already needed in order to make the decision of reusing this resource and the testing and observations can easily be inserted into this section of the specification.*

Undisturbed soil or soil with minor disturbance to soil profiles (e.g. farming) has at least two of the following attributes:

A. Site soils not excessively graded or not compacted at root limiting or above.
B. Soils previously disturbed have a restored A horizon (min 2.5% organic matter dry weight) at least 6 inches deep and B and/or C horizons that drain and have acceptable compaction.
C. Soils are currently supporting mature tree and or large shrub growth with high vitality.
D. Sufficient soil volumes meeting the above criteria above rock or other limiting structures to support the proposed plants.

In addition to the above, the soil organic matter, pH, and chemistry in the A horizon should be suitable for the proposed plants, or may need to be modified if required. In dry climates and sandy soils plants are often adapted to grow in soil with very low organic matter and high pH. Raising the organic matter too high or lowering the pH may negatively impact native or adapted plant performance.

A. General definition of existing soil: Surface soil in the areas designated on the soils plan as existing soil, that is not altered, compacted to root limiting density, graded or contaminated before or during the construction process and considered acceptable for planting and long term health of the plants specified either as it exists or with only minor modification.

   1. The Owner's Representative shall verify that the soil in the designated areas is suitable at the beginning of planting bed preparation work in that area. In the event that the work of this project construction has damaged the existing soil in areas designated for use as Planting Soil to the point where the soil is no longer suitable to support the plants specified, the Owner's Representative may require modification of the damaged soil up to and including removal and replacement with soil of equal quality to the soil that existed prior to construction. Examples of damage include further compaction, contamination, grading, creation of hard pan or drainage problems, and loss of the O, and or A horizon.
      a. Do not begin work on additional modifications until changes to the contract price are approved by Owner's Representative.
   2. Soil testing results and soil observation notes that describe the pre-construction soil conditions in the existing soil areas are included as an appendix to this specification:

      Note to specifier: *Delete the above sentence if no soil test are included.*

B. Protect existing soil from compaction, contamination, and degradation during the construction process.

C. Unless otherwise instructed, remove all existing plants, root thatch, and non-soil debris from the surface of the soil using equipment that does not increase compaction of soil to root limiting levels.

D. Modifications:

   1. When results of soil tests recommend chemical adjustments, till surface soil to six inches or greater after chemical adjustments have been are applied.
   2. Remove existing turf thatch, ground cover plants and weeds.
   3. Provide pre-emergent weed control if indicated.
   4. Make chemical adjustment as recommended by the soil test.

2.7 MODIFIED EXISTING SOIL (SOIL SUITABLE FOR PLANTING WITH INDICATED MODIFICATION)

Note to specifier: *SOILS PLANS: This specification assumes that there will be separate set of drawings in the construction documents titled Soils Plans. These plans and details will define the areas on the site where different type of soil modification practices will occur. The plan should be a simple diagram with each type of soil modification keyed to a detail. Details of different modifications are included in the set of details that accompany this set of specifications. Using this method allows a wide range of different modifications to be required such that the modifications can easily fix the existing soil conditions, the expectations for plant performance, the project budget and schedule.*

In the event that there is not a separate Soils Plan, this information can be added to the Planting Plan. On simple sites where one soil modification may be appropriate, the specification could be used without having a plan. If no Soils Plan is included, be sure to remove reference to a Soils Plan from these specifications and replace it with the appropriate reference that defines the limits of soil modification.

A. General definition: Surface soil in the areas designated on the soils plan as Modified Existing Soil has been altered and or graded before or during the construction process but is still considered acceptable for planting and long term health of the plants specified with the proposed modifications. Modifications respond to the soil problems expected or encountered. The Owner's Representative shall verify that the soil in the designated areas is suitable for modification at the beginning of planting bed preparation work in that area.

   1. The Owner's Representative shall verify that the soil in the designated areas is suitable for the specified modification at the beginning of planting bed preparation work in that area. In the event that the work of this project construction has damaged the existing soil in areas designated for modification to the point where the soil is no longer suitable to support the plants specified with the specified modification, the Owner's Representative may require further modification of the damaged soil up to an including removal and replacement with soil of equal quality to the soil that would have resulted from the modification. Damage may include further compaction, contamination, grading, creation of hard pan or drainage problem, and loss of the O, and or A horizon.

   2. General requirements for all soil modifications:
      a. Take soil samples, test for chemical properties, and make appropriate adjustments.
      b. Unless otherwise instructed, remove all existing plants, root thatch, and non-soil debris from the surface of the soil using equipment that does not add to the compaction in the soil.
      c. All soil grading, tilling and loosening must be completed at times when the soil moisture is below field capacity. Allow soil to drain for at least two days after any rain event more than 1 inch in 24 hours, or long enough so that the soil does not make the hand muddy when squeezed.
      d. Provide pre-emergent weed control after the soil work is complete and plants planted but prior to adding mulch to the surface, if indicated by weed type and degree of threat.

B. Modified existing soil – soil removed, stockpiled, and spread

   1. Description of condition to be modified: Existing soil that is suitable for reuse as Planting Soil but is in the wrong place of elevation, or cannot be adequately protected during construction. Soil is to be harvested, stockpiled and re-spread with or without further modifications as indicated.

      Note to specifier; *If existing soils are to be harvested and reused, the areas where soil may be reused and the depths of soil harvesting must be described on the drawings and the specifications. This requires that the specifier has site and soil knowledge sufficient to make these decisions. Additionally, one of the greatest limitations on reuse of soil at many projects is finding a suitable place to store the soil during construction. This coordination must be resolved during the design process with the project manager.*

   2. Modifications:
      a. Excavate existing soil from the areas and to depths designated on the drawings. Stockpile in

zones noted on the drawings or in areas proposed by the Contractor.
1.) Prepare a soil stock pile plan for approval.

b. Excavate soil using equipment and methods to preserve the clumps and peds in the soil. Generally this means using the largest piece of equipment that is practical for the project size and scope.
c. Protect stock piles from erosion by compacting or tracking the soil surface, covering with breathable fabric or planting with annual grasses as appropriate for the season, location, and length of expected time of storage.
d. Re-spread soil as required in Part 3 of this specification.

C. Modified existing soil – compacted surface soil (Tilling Option)

Note to specifier: *If the soil problem is limited to surface compaction, one of two options should be considered: Tilling option or Radial Trenching option. Tilling prepares an entire root zone for trees and other plants but is relatively shallow. The radial trenching goes deeper. As the level of compaction increases, these two methods become less effective. Select one of these options based on the project requirements and delete the other or use both options to treat the upper (Tilling) and lower (Trenching) portions of the soil profile..*

1. Description of condition to be modified: Surface soil compaction to a maximum of 6 inches deep from traffic or light grading. Original A horizon may be previously removed or graded but lower profile intact with acceptable compaction levels and limited grading. The soil organic matter, pH and chemistry in the A horizon may not be suitable for the proposed plants and may need to be modified as required.

2. Modifications:
Note to specifier: *A spade tiller is a superior tiller than the standard roto tiller. A spade tiller leaves a soil with larger peds and less glazing between the loose soil and the subsoil. However these tillers are limited in availability and may be more costly than the conventional tiller. Check with local Contractors before requiring a spade tiller over roto tiller.*

a. Till top 6 inches or deeper of the soil surface, with a *roto tiller, spade tiller,* ripper or agricultural plow. Spread 2 - 3 inches of Compost on the surface of the tilled soil and make any chemical adjustment as recommended by the soil test.
1.) If spade tillers are to be required, add a paragraph to that effect here.
b. Till or disk the Compost into the loosened soil. Smooth out grades with a drag rake or drag slip.

D. Modified existing soil – compacted surface soil (Radial Trenching Option)

1. Description of condition to be modified: Surface soil compaction to a maximum of 24 inches deep from traffic or light grading. Original A horizon may be previously removed or graded but lower profile below 24 inches intact with acceptable compaction levels and limited grading. The soil organic matter, pH and chemistry in the A horizon may not be suitable for the proposed plants and may need to be modified as required.

2. Modifications:
a. Using a trenching machine, dig trenches to the extent and depth shown on the plans and details.
b. Backfill the trench with the soil removed from the trench. Add additional site soil if needed to fill the trench to be flush to the existing grade after the soil settlement.

E. Modified existing soil – compacted subsoil

1. Description of condition to be modified: Deep soil compaction the result of previous grading, filling and dynamic or static compaction forces. Original A horizon likely removed or buried. The soil organic matter, pH and chemistry in the A horizon is likely not suitable for the proposed plants and should be modified as required.
Note to specifier: *Select one of the following options as appropriate to the constraints at the site, and the project budget. Do not give the contractor the option to select any of the below alternative*

as they are not equal treatments. Soil fracturing is the most effective and may be the most cost effective in small to medium size spaces. Soil ripping is usually the cheapest option but only appropriate in large spaces, approximately ¼ acre or greater, accessible by large size grading machines, and where there are no underground utilities or where limited utility locations can be avoided. Soil trenching is only suitable for spaces where only small sized equipment such as a walk-behind chain trencher can access the area. If different treatments are appropriate for different locations on the same project be clear on the drawings the extent of each treatment.

The Trenching modification below is for compacted soil that is NOT within the root zone of existing trees and is substantially different from the modification "Radial Trenching" described above. The practice of radial trenching within the root zone of an existing tree is not described in this specification.

2. Soil Ripping:
   a. Step one: After grading and removing all plants and debris from the surface, using a tracked dozer or similar large grading equipment, loosen the soil by dragging a ripping shank or chisel thru the soil to depths of 24 inches with ripping shanks spaced 18 inches or less apart in two directions. The number of shanks per pull is dependent on the degree of soil compaction and the size of the dozer.
   b. Step 2: Spread 3-4 inches of Compost over the ripped area and till into the top 6 inches of the soil surface.
3. Soil Fracturing:
   a. Step one: After grading and removing all plants and debris from the surface, spread 2 – 3 inches of Compost over the surface of the soil. Loosen the soil to depth of 18 - 24 inches, using a backhoe to dig into the soil through the Compost. Lift and then drop the loosened soil immediately back into the hole. The bucket then moves to the adjacent soil and repeats the process until the entire area indicated has been loosened.
   b. Step 2: Spread 3-4 inches of Compost over the ripped area and till into the top 6 inches of the soil surface.
4. Trenching:
   a. Step one: After grading and removing all plants and debris from the surface using a chain trenching machine, dig 24 inch deep trenches, 24 inches apart across the entire area. Maintain an 18-inch standoff from the edges of all curbs, paving and structures. Backfill the trenches with Compost.
   b. Step 2: Spread 3-4 inches of Compost over the trenches area and till into the top 6 inches of the soil surface. Compost tilling treatment shall extend to the edges of curbs, paving and structures.
5. Following soil ripping or fracturing the average penetration resistance should be less than 250 psi to the depth of the ripping or fracturing.
6. Do not start planting into ripped or fractured soil until soil has been settled or leave grades sufficiently high to anticipate settlement of 10 – 15% of ripped soil depth.

F. Modified existing soil – low organic matter

1. Description of condition to be modified: Low soil organic matter and/or missing A horizon but soil is not compacted except for some minor surface compaction. The soil organic matter, pH and/or chemistry are likely not suitable for the proposed plants and should be modified as required.
2. Modifications:
   a. Spread 3 - 4 inches of Compost over the surface of the soil and make chemical adjustment as recommended by the soil test.
   b. Till Compost into the top 6 inches of the soil.

G. Modified existing soil – soil within the root zone of existing established trees

Note to specifier: *Any of the above soil conditions may be present within the root zone areas of*

large existing trees to remain but these must be dealt with in a different manner in order to preserve the root system of the tree. Options are limited. On the other hand, usually problems with soil within the root zone of mature trees are limited to the surface 6 - 12 inches of soil. These are most often excess surface soil compaction, chemical changes from applied material, added soil over an existing soil, severed roots, and drainage problems caused by adjacent work that changed drainage patterns. Deep compaction and other deep soil disturbances would likely already have killed the tree or the tree has adapted to the condition.

Modifications to consider:

Surface compaction - *There are several methods to remediate excess surface soil compaction within a root zone. The preferred method is to use a pneumatic digging device such as an Air Knife or Air Spade that can loosen soil without significant damage to roots. Compost is added to the soil as part of the loosening process. A specification section on this process is included. Other methods include vertical mulching, radial trenching, surface applications of Compost or mulch, Compost Tea injections into soil, and soil-injected air combined with added material. Each of these has demonstrated limited success depending on the level of compaction and many variables in the process. Due to the complexity of each of these options they will not be included in the specification. Consult a local soils and / or arboricultural expert to develop a specification.*

Chemical changes - *Changes in soil chemistry due to applications intentional and inadvertent are too complex to determine and remediate to be part of this specification. Consult a local soils and / or arboricultural expert to develop a specification.*

Soil added over the root zone - *Small amounts of soil added over the root zone may not be a problem for the tree, and leaving it there or mixing with an air knife may be the best option. Often the greatest damage to the tree is caused not by the soil, even at relatively deep layers of soil, but the damage caused by the equipment that brought in the soil or is used to remove the soil. Setting requirements to remediate soil added over the root zone are too complex to be part of this specification. Consult a local soils and / or arboricultural expert to develop a specification.*

Drainage problems - *The different types of conditions that cause drainage problems and how to remediate them around existing trees are too complex to be part of this specification. Consult a local soils and / or arboricultural expert to develop a specification.*

1. Description of condition to be modified: Surface compaction near or above root limited levels in the upper soil horizon the result of traffic or other mechanical compaction.
2. Modifications:
   a. Remove the tops of all plants to be removed from the root zone. Remove sod with a walk behind sod cutter. Do not grub out the roots of plats to be removed.
   b. Use a pneumatic air knife to loosen the top 9 – 12 inches of the soil. Surface roots may move and separate from soil during this process but the bark on roots should not be broken
      1.) Pneumatic air knife shall be as manufactured by:
      Concept Engineering Group, Inc., Verona, PA (412) 826-8800
      or
      Supersonic Air Knife, Inc., Allison Park, PA (866) 328 5723
   c. Make chemical adjustment as recommended by the soil test and add 2 - 3 inches of Compost over the soil.
   d. Using the pneumatic air knife, mix the Compost into the top 6 – 8 inches of the loosened soil.
   e. Work in sections such that the entire process - including irrigation - can be completed in one day. Apply approximately one inch of water over the loosened soil at the completion of each day's work. Apply mulch or turf as indicated on the drawings within one week of the completion of work.

2.8 PLANTING SOIL MIXES

Note to specifier: *The subject of Planting Soil Mixes is quite complex and requires significant*

information about the goals of the planting. Mixes can include free draining high use turf planting soil mixes, bio-retention mixes, specialty mixes for palm planting or slow draining mixes designed to reduce water use and maintenance. The specifier will need to design the Planting Soil Mix that is best for each part of the project. The following specification is for a moderately slow draining Mix that would be good for trees and shrubs and can serve as a template for other mixes. The key adjustment for most applications is to change the proportion Topsoil/Coarse Sand and Compost. Local suppliers may also have their own specification or Mix design. These can be inserted into this specification.

Note that the topsoil and planting mix is not to be screened or mixed in a sol blending machine. Screening and blending breaks down important topsoil peds and reduces drainage in the soil. Machine blended and screened mixes typically will require more sand

A. General definition: Mixes of Existing Soil or Imported Topsoil, Coarse Sand, and or Compost to make a new soil that meets the project goals for the indicated planting area. These may be mixed off site or onsite, and will vary in Mix components and proportions as indicated.

B. Planting Mix - moderately slow draining soil for trees and shrub beds

1. A Mix of Imported Topsoil, Coarse Sand and Compost. The approximate Mix ratio shall be:

Mix component	% by moist volume
Imported Topsoil unscreened	45-50%
Coarse sand	40-45%
Compost	10%

2. Final tested organic matter between 2.75 and 4% (by dry weight).

3. Mix the Coarse Sand and Compost together first and then add to the Topsoil. Mix with a loader bucket to loosely incorporate the Topsoil into the Coarse Sand/Compost Mix. DO NOT OVER MIX! Do not mix with a soil blending machine. Do not screen the soil. Clumps of Soil, Compost and Coarse Sand will be permitted in the overall Mix.

4. At the time of final grading, add fertilizer if required to the Planting Soil at rates recommended by the testing results for the plants to be grown.

5. Provide a two gallon sample with testing data that includes recommendations for chemical additives for the types of plants to be grown. Samples and testing data shall be submitted at the same time.

2.9 PRE-EMERGENT HERBICIDES

***Note to specifier**: Pre-emergent herbicides have known environmental impacts. The project team must evaluate the risks and rewards of using chemical treatments to control weeds and consider specifying hand weed removal.*

A. Chemical herbicides are designed to prevent seeds of selective plants from germinating. Exact type of herbicide shall be based on the specific plants to be controlled and the most effective date of application.

B. Submit report of expected weed problems and the recommendation of the most effective control for approval by Owner's Representative. Provide manufacturer's literature and material certification that the product meets the requirements.

***Note to specifier:** Insert additional products as needed for the specific project requirements.*

***Note to specifier:** If soil drainage rates or subsurface conditions indicate that additional drainage beyond modification in needed subsurface drain lines may need to be added.*

There are many pipe options available from heavy duty Schedule 40 PVC pipes to lightweight ABS corrugated flexible pipes. This specification will provide three pipe options. The specifier must select the appropriate pipe from the below list that meets the budget and operational needs of the project and delete the other options. It is advised not to use the corrugated pipe as it is too easily crushed and tends to silt up faster than the other alternatives.

Note that filter fabric socks and other filter cloth applications around the pipe or the pipe bedding material is not include in this specification and is not recommended due to tendency of the filter cloth to clog.

2.10 HEAVY DUTY PIPE DRAIN PIPE

A. Drain pipe shall be 4 inch diameter, perforated, PVC, Schedule 40 pipe. Holes in the pipe shall only be on the bottom quadrant. All fittings, elbows, unions, T's and screw caps shall be the same material and from the same manufacturer as the pipe. "T" and elbow joints shall be sanitary type connections. All joints shall be solvent welded. Submit manufacturers product literature for approval by the Owner's Representative.

1. When pipe has perforations on all quadrants, drape a 12 inch wide 4 mil plastic sheet over the length of the pipe to force water to the bottom of the pipe.

B. Clean out: Clean out risers shall be 4 inch diameter Schedule 40 PVC solid pipe compatible with the bottom fitting and clean out screw cap. Elbow fitting at the bottom of the clean out riser. When the cleanout is in the middle of a pipe run the fitting shall be a sanitary T fitting. Screw cap FITTING shall be PVC Schedule 40.

2.11 MEDIUM DUTY PIPE DRAIN PIPE

A. Drain pipe shall be 4 inch diameter, perforated, PVC, double wall (smooth interior wall / corrugated exterior wall) pipe. Holes in the pipe shall only be on the bottom quadrant. All fittings, elbows, unions, T's and screw caps shall be the same material and from the same manufacturer as the pipe. "T" and elbow joints shall be sanitary type connections. All joints shall be gasketed bell and spigot. Example source A -2000 by Contech Construction Products or approved equal. Submit manufacturers product literature for approval by the Owner's Representative.

1. When pipe has perforations on all quadrants, drape a 12 inch wide 4 mil plastic sheet over the length of the pipe to force water to the bottom of the pipe.

B. Clean out: Clean out risers shall be 4 inch diameter Schedule 40 PVC solid pipe compatible with the bottom fitting and clean out screw cap. Elbow fitting at the bottom of the clean out riser. When the cleanout is in the middle of a pipe run the fitting shall be a sanitary T fitting. Screw cap FITTING shall be PVC Schedule 40.

2.12 LIGHT DUTY PIPE DRAIN PIPE

A. Drain pipe shall be 4 inch diameter, perforated, HDPE, single wall corrugated exterior pipe. ASTM F405. All fittings, elbows, unions, T's and screw caps shall be the same material and from the same manufacturer as the pipe. All joints shall be gasketed bell and spigot. Example source ADS Single Wall Pipe by Advance Drainage Systems or approved equal. Submit manufacturers product literature for approval by the Owner's Representative.

1. When pipe has perforations on all quadrants, drape a 12 inch wide 4 mil plastic sheet over the length of the pipe to force water to the bottom of the pipe.

B. Clean out: Clean out risers shall be 4 inch diameter Schedule 40 PVC solid pipe compatible with the bottom fitting and clean out screw cap. Elbow fitting at the bottom of the clean out riser. When the cleanout is in the middle of a pipe run the fitting shall be a sanitary T fitting. Screw cap FITTING shall be PVC Schedule 40.

PART 3 – EXECUTION

3.1 SITE EXAMINATION

A. Prior to installation of Planting Soil, examine site to confirm that existing conditions are satisfactory for the work of this section to proceed.

1. Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope toward the under drain lines as shown on the drawings.
2. Confirm that surface all areas to be filled with Planting Soil are free of construction debris, refuse, compressible or biodegradable materials, stones greater than 2 inches diameter, soil crusting films of silt or clay that reduces or stops drainage from the Planting Soil into the subsoil; and/or standing water. Remove unsuitable material from the site.
3. Confirm that no adverse drainage conditions are present.
4. Confirm that no conditions are present which are detrimental to plant growth.
5. Confirm that utility work has been completed per the drawings.
6. Confirm that irrigation work, which is shown to be installed below prepared soil levels, has been completed.

B. If unsatisfactory conditions are encountered, notify the Owner's Representative immediately to determine corrective action before proceeding.

3.2 COORDINATION WITH PROJECT WORK

A. The Contractor shall coordinate with all other work that may impact the completion of the work.

B. Prior to the start of work, prepare a detailed schedule of the work for coordination with other trades.

C. Coordinate the relocation of any irrigation lines, heads or the conduits of other utility lines that are in conflict with tree locations. Root balls shall not be altered to fit around lines. Notify the Owner's Representative of any conflicts encountered.

3.3 GRADE AND ELEVATION CONTROL

A. Provide grade and elevation control during installation of Planting Soil. Utilize grade stakes, surveying equipment, and other means and methods to assure that grades and contours conform to the grades indicated on the plans.

3.4 SITE PREPARATION

A. Excavate to the proposed subgrade. Maintain all required angles of repose of the adjacent materials as shown on the drawings or as required by this specification. Do not over excavate compacted subgrades of adjacent pavement or structures. Maintain a supporting 1:1 side slope of compacted subgrade material along the edges of all paving and structures where the bottom of the paving or structure is above the bottom elevation of the excavated planting area.

B. Remove all construction debris and material including any construction materials from the subgrade.

C. Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope approximately parallel to the finished grade and/or toward the subsurface drain lines as shown on the drawings.

D. In areas where Planting Soil is to be spread, confirm subgrade has been scarified.

E. Protect adjacent walls, walks and utilities from damage or staining by the soil. Use 1/2 inch plywood and or plastic sheeting as directed to cover existing concrete, metal and masonry work and other items as directed during the progress of the work.

1. At the end of each working day, clean up any soil or dirt spilled on any paved surface.
2. Any damage to the paving or site features or work shall be repaired at the Contractor's expense.

3.5 SOIL MOISTURE

A. Volumetric soil moisture level, in both the Planting Soil and the root balls of all plants, prior to, during and after planting shall be above permanent wilt point and below field capacity for each type of soil texture within the following ranges.

Soil texture	Permanent wilting point	Field capacity
Sand, Loamy sand, Sandy loam	5-8%	12-18%
Loam, Sandy clay, Sandy clay loam	14-25%	27-36%
Clay loam, Silt loam	11-22%	31-36%
Silty clay, Silty clay loam	22-27%	38-41%

B. The Contractor shall confirm the soil moisture levels with a moisture meter (Digital Soil Moisture Meter, DSMM500 by General Specialty Tools and Instruments, or approved equivalent). If moisture is found to be too low, the planting holes shall be filled with water and allowed to drain before starting any planting operations. If the moisture is too high, suspend planting operations until the soil moisture drains to below field capacity.

3.6 EXISTING SOIL MODIFICATION

A. Follow the requirements for modifying existing soil as indicated in Part 2 for the different types of soil modifications. The extent of the areas of different soil modification types are indicated on the Soils Plan or as directed by the Owner's Representative.

Note to specifier: *Note above that it is critical for the contract documents to define the extent of all soil improvement work on a Soil Plan and detail drawing that is part of the contract documents.*

3.7 DRAIN PIPE INSTALLATION

1. Trench lines to depths and widths shown on plans.
2. Place 2 – 3 inches Coarse Sand as bedding for pipes.
3. Place pipe (holes facing down) to invert elevations shown on the plan.
   a. If pipe with holes on all sides is used drape a piece of 4 mil plastic 12 inches wide over top of pipe.
   b. Cover sides and top of pipe with Coarse Sand with min 4 inches of Coarse Sand cover above top of pipe.
   c. Backfill trench with Planting Soil compacted to same level as Planting Soil requirements.
4. Add cleanout pipe reaching the surface at the uphill end of each pipe run as shown on drawings.
5. Connect pipes to manhole or daylight outfall as shown on the drawings.

3.8 PLANTING SOIL AND PLANTING SOIL MIX INSTALLATION

Note to specifier: *These specifications are not intended to include Planting Soils over architectural structures that are waterproofed. If this condition exists, add special installation instructions in this paragraph.*

A. Prior to installing any Planting Soil from stockpiles or Planting Soil Mixes blended off site, the Owner's Representative shall approve the condition of the subgrade and the previously installed subgrade preparation and the installation of subsurface drainage.

B. All equipment utilized to install or grade Planting Soils shall be wide track or balloon tire machines rated with a ground pressure of 4 psi or less. All grading and soil delivery equipment shall have buckets equipped with 6 inch long teeth to scarify any soil that becomes compacted.

C. In areas of soil installation above existing subsoil, scarify the subgrade material prior to installing Planting Soil.

1. Scarify the subsoil of the subgrade to a depth of 3 – 6 inches with the teeth of the back hoe or loader bucket, tiller or other suitable device.

2. Immediately install the Planting Soil. Protect the loosened area from traffic. DO NOT allow the loosened subgrade to become compacted.

3. In the event that the loosened area becomes overly compacted, loosen the area again prior to installing the Planting Soil.

D. Install the Planting Soil in 12 - 18 inch lifts to the required depths. Apply compacting forces to each lift as required to attain the required compaction. Scarify the top of each lift prior to adding more Planting Soil by dragging the teeth of a loader bucket or backhoe across the soil surface to roughen the surface.

E. Phase work such that equipment to deliver or grade soil does not have to operate over previously installed Planting Soil. Work in rows of lifts the width of the extension of the bucket on the loader. Install all lifts in one row before proceeding to the next. Work out from the furthest part of each bed from the soil delivery point to the edge of the each bed area.

Note to specifier: *The following 4 paragraphs are not normal to most soil installation specifications but are deemed critical to the process.* Be sure that the Owner's Representative is familiar with these requirements during construction observation.

F. Where possible place large trees first and fill Planting Soil around the root ball.

G. Installing soil with soil or mulch blowers or soil slingers shall not be permitted due to the over mixing and soil ped breakdown cause by this type of equipment.

H. Where travel over installed soil is unavoidable, limit paths of traffic to reduce the impact of compaction in Planting Soil. Each time equipment passes over the installed soil it shall reverse out of the area along the same path with the teeth of the bucket dropped to scarify the soil. Comply with the paragraph "Compaction Reduction" (section 3.9) in the event that soil becomes over compacted.

I. The depths and grades shown on the drawings are the final grades after settlement and shrinkage of the compost material. The Contractor shall install the Planting Soil at a higher level to anticipate this reduction of Planting Soil volume. A minimum settlement of approximately 10 - 15% of the soil depth is expected. All grade increases are assumed to be as measured prior to addition of surface Compost till layer, mulch, or sod.

3.9 COMPACTION REQUIREMENTS FOR INSTALLED OR MODIFIED PLANTING SOIL

A. Compact installed Planting Soil to the compaction rates indicated and using the methods approved for the soil mockup. Compact each soil lift as the soil is installed.

B. Existing soil that is modified by tilling, ripping or fracturing shall have a density to the depth of the modification, after completion of the loosening, such that the penetrometer reads approximately 75 to 250 psi at soil moisture approximately the mid-point between wilting point and field capacity. This will be approximately between 75 and 82% of maximum dry density standard proctor.

C. Installed Planting Soil Mix and re-spread existing soil shall have a soil density through the required depth of the installed layers of soil, such that the penetrometer reads approximately 75 to 250 psi at soil moisture approximately the mid-point between wilt point and field capacity. This will be approximately between 75 and 82% of maximum dry density standard proctor.

D. Planting Soil compaction shall be tested at each lift using a penetrometer calibrated to the mockup soil and its moisture level. The same penetrometer and moisture meter used for the testing of the mockup shall be used to test installed soil throughout the work.

E. Maintain moisture conditions within the Planting Soil during installation or modification to allow for satisfactory compaction. Suspend operations if the Planting Soil becomes wet. Apply water if the soil is overly dry.

F. Provide adequate equipment to achieve consistent and uniform compaction of the Planting Soils. Use the smallest equipment that can reasonably perform the task of spreading and compaction. Use the same equipment and methods of compaction used to construct the Planting Soil mockup.

G. Do not pass motorized equipment over previously installed and compacted soil except as authorized below.

1. Light weight equipment such as trenching machines or motorized wheel barrows is permitted to pass over finished soil work.

2. If work after the installation and compaction of soil compacts the soil to levels greater than the above requirements, follow the requirements of the paragraph "Over Compaction Reduction" below.

3.10 OVER COMPACTION REDUCTION

A. Any soil that becomes compacted to a density greater than the specified density and/or the density in the approved mockup shall be dug up and reinstalled. This requirement includes compaction caused by other sub-contractors after the Planting Soil is installed and approved.

B. Surface roto tilling shall not be considered adequate to reduce over compaction at levels 6 inches or greater below finished grade.

3.11 INSTALLATION OF CHEMICAL ADDITIVES

A. Following the installation of each soil and prior to fine grading and installation of the Compost till layer, apply chemical additives as recommended by the soil test, and appropriate to the soil and specific plants to be installed.

B. Types, application rates and methods of application shall be approved by the Owner's Representative prior to any applications.

3.12 FINE GRADING

A. The Owner's Representative shall approve all rough grading prior to the installation of Compost, fine grading, planting, and mulching.

B. Grade the finish surface of all planted areas to meet the grades shown on the drawings, allowing the finished grades to remain higher (10 – 15% of depth of soil modification) than the grades on the grading plan, as defined in paragraph Planting Soil Installation, to anticipate settlement over the first year.

C. Utilize hand equipment, small garden tractors with rakes, or small garden tractors with buckets with teeth for fine grading to keep surface rough without further compaction. Do not use the flat bottom of a loader bucket to fine grade, as it will cause the finished grade to become overly smooth and or slightly compressed.

D. Provide for positive drainage from all areas toward the existing inlets, drainage structures and or the edges of planting beds. Adjust grades as directed to reflect actual constructed field conditions of paving, wall and inlet elevations. Notify the Owner's Representative in the event that conditions make it impossible to achieve positive drainage.

E. Provide smooth, rounded transitions between slopes of different gradients and direction. Modify the grade so that the finish grade before adding mulch and after settlement is one or two inches below all paving surfaces or as directed by the drawings.

F. Fill all dips and remove any bumps in the overall plane of the slope. The tolerance for dips and bumps in shrub and ground cover planting areas shall be a 2 inch deviation from the plane in 10 feet. The tolerance for dips and bumps in lawn areas shall be a 1 inch deviation from the plane in 10 feet.

3.13 INSTALLATION OF COMPOST TILL LAYER

Note to specifier: *The following paragraph is critical to building a proper A/O horizon in installed Planting Soil Mixes. This added layer of Compost must be shown on the soil details in the drawings.*

A. After Planting Soil Mixes are installed in planting bed areas and just prior to the installation of shrub or groundcover plantings, spread 3 – 4 inches of Compost over the beds and roto till into the top 4 - 6 inches of the Planting Soil. This step will raise grades slightly above the grades required in paragraph

"Fine Grading". This specification anticipates that the raise in grade due to this tilling will settle within a few months after installation as Compost breaks down. Additional settlement as defined in paragraph "Planting Soil and Planting Soil Mix installation" must still be accounted for in the setting of final grades.

3.14 CLEAN-UP

A. During installation, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.

1. Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.

B. Once installation is complete, wash all soil from pavements and other structures. Ensure that mulch is confined to planting beds and that all tags and flagging tape are removed from the site. The Owner's Representative seals are to remain on the trees and removed at the end of the warranty period.

1. Make all repairs to grades, ruts, and damage to the work or other work at the site.

2. Remove and dispose of all excess Planting Soil, subsoil, mulch, plants, packaging, and other material brought to the site by the Contractor.

3.15 PLANTING SOIL AND MODIFIED EXISTING SOIL PROTECTION

A. The Contractor shall protect installed and/or modified Planting Soil from damage including contamination and over compaction due to other soil installation, planting operations, and operations by other Contractors or trespassers. Maintain protection during installation until acceptance. Utilize fencing and matting as required or directed to protect the finished soil work. Treat, repair or replace damaged Planting Soil immediately.

B. Loosen compacted Planting Soil and replace Planting Soil that has become contaminated as determined by the Owner's Representative. Planting Soil shall be loosened or replaced at no expense to the Owner.
   a. Till and restore grades to all soil that has been driven over or compacted during the installation of plants.
   b. Where modified existing soil has become contaminated and needs to be replaced, provide imported soil that is of similar composition, depth and density as the soil that was removed.

3.16 PROTECTION DURING CONSTRUCTION

A. The Contractor shall protect planting and related work and other site work from damage due to planting operations, operations by other Contractors or trespassers.

1. Maintain protection during installation until the date of plant acceptance (see specifications section – Planting). Treat, repair or replace damaged work immediately.

2. Provide temporary erosion control as needed to stop soil erosion until the site is stabilized with mulch, plantings or turf.

B. Damage done by the Contractor, or any of their sub-contractors to existing or installed plants, or any other parts of the work or existing features to remain, including large existing trees, soil, paving, utilities, lighting, irrigation, other finished work and surfaces including those on adjacent property, shall be cleaned, repaired or replaced by the Contractor at no expense to the Owner. The Owner's Representative shall determine when such cleaning, replacement or repair is satisfactory. Damage to existing trees shall be assessed by a certified arborist.

3.17 SUBSTANTIAL COMPLETION ACCEPTANCE

A. Upon written notice from the Contractor, the Owners Representative shall review the work and make a determination if the work is substantially complete.

B. The date of substantial completion of the planting soil shall be the date when the Owner's

Representative accepts that all work in Planting, Planting Soil, and Irrigation installation sections is complete.

3.18 FINAL ACCEPTANCE / SOIL SETTLEMENT

A. At the end of the plant warrantee and maintenance period, (see Specification section - Planting) the Owner's Representative shall observe the soil installation work and establish that all provisions of the contract are complete and the work is satisfactory.

1. Restore any soil settlement and or erosion areas to the grades shown on the drawings. When restoring soil grades remove plants and mulch and add soil before restoring the planting. Do not add soil over the root balls of plants or on top of mulch.

B. Failure to pass acceptance: If the work fails to pass final acceptance, any subsequent observations must be rescheduled as per above. The cost to the Owner for additional observations will be charged to the Contractor at the prevailing hourly rate of the Owner's Representative.

APPENDIX TO 32 9100 PLANTING SOIL

Existing Soil Test Data

Note to specifier: *If existing soil test data is available, add such testing reports in this location. Include a plan of the site designating the extent of the different soil types identified and the location of all soil test pits. If no testing was completed, remove the appendix.*

END OF SECTION 32 9100

32 8400 Irrigation

DISCLAIMER AND RESPONSIBILITY OF THE USER

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INSTRUCTIONS TO THE SPECIFICATION WRITER:

The following document is intended as a general specification to guide the writing of a project-specific specification. Each project is unique and it is required that the specification be developed accordingly. DO NOT USE THE FOLLOWING SPECIFICATION WITHOUT MAKING IMPORTANT ADJUSTMENTS to reflect local conditions, regulations, market standards, project schedules and local and regional practices. The following are specific items that need to be addressed.

1. General instructions to use this specification: *These instructions are intended to guide the specification writer (the specifier) through the process of editing this document into an Irrigation specification. Be sure to delete these instructions (i.e. all the text in red displayed above the paragraph) before issuing the specifications.*

2. General Requirements - Division 01 (Construction Specification Institute) specifications and other contract elements: *This specification is designed to be used in conjunction with standard Division 01 specifications, which cover project general conditions and project wide contract elements. THIS IS NOT A STAND-ALONE SPECIFICATION and should not be used as a contract for the purchase of and installation of an irrigation system. Important issue of project ownership, liability, insurance, contract language, project controls, Instructions to bidders, change orders and review and approval of the work are normally in the Division 01 specifications.*

3. The construction team: *A construction project is a team effort where the owner, in effect, creates a partnership with all the Contractors to build a project. As with any good contract there are protections for both sides; that the Owner will get the quality of project that they desire within the time limits and budget available; and the Contractor will be paid for the work satisfactorily completed. In between the initial bidding and the final completion there will be many places where parts of the construction do not work out as originally intended. This is normal and a good contract should allow for these changes in a manner that is equitable to both the Owner and the Contractor. To get there, a team approach and spirit must prevail. Both sides must assume that each is operating in the best interest of the project goals. The clearer the goals and description of the project, the smoother the flow of a successful project.* ***The more each of the team members can trust the other members, the better the project.*** *This should be a critical principle in approaching the interpretation of the specification.*

4. Other project documents: *This specification is intended to be used in conjunction with other project documents including the bid forms, the construction contract, Division 1 specifications, other specifications directly related to this section; other specifications that are not directly related to this work, and most critically the Project construction drawings. It is very critical that all these documents be prepared with consistent terminology and that they be coordinated. The terms used for the parts of trees and other plants, different soil types, drainage features, irrigation features and structures such as paving, walls and planters must be consistent across disciplines. A very common mistake is the use of different terms and details for soil and the extent of soil work. The terms and details for Planting Soil, subsoil and other materials must be well coordinated.*

5. Relate specification sections: *This specification requires additional specification sections to describe several important related parts of the planting process.*

> ***Tree Protection:*** *This specification assumes that there is a separate specification section and construction drawings and details for tree protection; remove this section if there are no existing trees to be protected on the project.*
>
> ***Planting:*** *This specification assumes that there is a separate specification section and separate plans and details for installation of Planting.*

Planting Soil: *This specification assumes that there may be a separate specification section for Planting Soil associated with the project planting.*

6. Reviewing and approval authority: *Each specification identifies a certain entity as responsible for the review and approval of the work, project submittals, changes to the work and final acceptance of the work. The entity is normally identified in Division 1. For the purposes of this specification, the term the "Owner's Representative" has been used as a placeholder for this entity. Once the proper term is defined, for example another term such as; Contracting Officer, The Architect, The Landscape Architect, The Engineer etc.; this term should replace the words "Owner's Representative" wherever it appears in this specification.*

7. Header and footer requirements: *Change the header/footer language to meet the project requirements.*

8. Notes to specifiers: *Before issuing the document, be sure to remove all "**Notes to specifiers**" incorporated into this document after you have read them and responded to the recommendations.*

9. Submittals: *Submittals are a critical part of any construction contract. This is where all products and materials are reviewed and approved in advance of the work. Including very specific requirements for approval of submittals, while a good practice, assumes that the reviewing authority has the skills needed to make these reviews and interpret the results. A common practice is to make very specific requirements but not have the time or expertise to enforce them. Lack of review of submittals does not automatically transfer quality control to the Contractor. In fact, lack of review or inappropriate review can make the reviewing authority responsible for having accepted the submittal even if it was not acceptable.* ***Do not put into the specification submittal requirements that you do not have the time, resources or knowledge, which you knew or should have known, to enforce.***

10. Specification modifications: *There are locations in this specification where additional information is required to reflect project region or contract conditions. Please insert the requested information.*

11. SPECIAL REQUIREMENTS OF THIS SPECIFICATION:

Product specification: *This specification offers three approaches to product quality. The first is a generic quality non-proprietary product specification. The second option is to peg the generic product quality to a specific manufacture or several or equal manufactures product lines (inserted by the specifier) without specifying specific products. The third option is to allow the specifier to specify specific products where that product exactly fits the design premise of the system design and quality. If the specifier desires to specify specific products a schedule including the product descriptions and model numbers needs to be added either to the drawings or to the specification. DO NOT add a schedule to both documents.*

Irrigation system design assumptions: *This specification assumes that the specifier and the system designer understand the system design assumptions such as the supply pipe size and water pressure. This information must be incorporated onto the drawing. Other design features on the plan such as head type and spacing are a function of water pressure, requirements of completeness of water cover, topography and wind factors. This makes substitutions of head type, for example, have impact on the layout and spacing of heads and even the number of heads on a specific zone. Given the integration of design considerations, drawings and specifications, it is critical for the specifier to work closely with the system design team during the preparation of this document and the resulting construction observation and submittal process.*

SECTION 32 8400

IRRIGATION

PART 1 – GENERAL

1.1 SUMMARY

Note to specifier: *Remove any parts of this work description that does not apply.*

A. Irrigation system required for this work includes but is not limited to the furnishing of all labor, tools, materials, appliances, tests, permits, taxes, etc., necessary for the installation of a landscape irrigation system as herein specified and shown on the drawings, and the removal of all debris from the site.

Note to specifier: *Confirm if the installing Contractor or the general Contractor or the owner is paying for water and electric use fees and hook up charges. Amend the above paragraph if the installing Contractor is required to pay any of these fees.*

1. Locate, purchase, deliver and install piping, conduit, sleeves, 120 volt and low voltage electrical and water connections, valves, backflow preventer devices, controllers, rain sensors, spray and bubbler heads, drip irrigation lines, and associated accessories for a fully operational automatic irrigation system.
2. Trenching and water settling of backfill material.
3. Testing and startup of the irrigation system.
4. Prepare an as built record set of drawings.
5. Training of the Owner's maintenance personnel in the operational requirements of the Irrigation system.
6. Clean up and disposal of all excess and surplus material.
7. Maintenance of the irrigation system during the proscribed maintenance period.

B. The system shall efficiently and evenly irrigate all areas and be complete in every respect and shall be left ready for operation to the satisfaction of the Owner's Representative.

C. Coordinate with other trades, as needed to complete work, including but not limited to Water Meter, Point of Connection (POC) and Backflow Preventer Device (BFPD) location and electrical hookups.

1.2 CONTRACT DOCUMENTS

A. Shall consist of specifications and its general conditions and the drawings. The intent of these documents is to include all labor, materials, and services necessary for the proper execution of the work. The documents are to be considered as one. Whatever is called for by any part shall be as binding as if called for in all parts.

1.3 RELATED DOCUMENTS AND REFERENCES

A. Related Documents:

Note to specifier: *Coordinate this list with the other related specification sections. Add or delete sections as appropriate.*

1. Drawings and general provisions of contract, including general and supplementary conditions and Division I specifications, apply to work of this section.
2. Related Specification Sections
   a. Section - Planting
   b. Section - Planting Soil
   c. Section – Lawn
   d. Sections - Mechanical/Plumbing
   e. Section – Tree and Plant Protection

f. Sections - Electrical

B. References:

1. American Society of Testing Materials (ASTM): cited section numbers.
2. National Sanitation Foundation (NSF): rating system.
3. Irrigation Association: Turf & Landscape Irrigation Best Management Practices

1.4 VERIFICATION

A. Irrigation piping and related equipment are drawn diagrammatically. Scaled dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions and immediately notify the Owner's Representative of discrepancies between the drawings or specifications and the actual conditions. Although sizes and locations of plants and or irrigation equipment are drawn to scale wherever possible, it is not within the scope of the drawings to show all necessary offsets, obstructions, or site conditions. The Contractor shall be responsible to install the work in such a manner that it will be in conformance to site conditions, complete, and in good working order.

B. Piping and equipment is to be located within the designated planting areas wherever possible unless specifically defined or dimensioned otherwise.

1.5 PERMITS AND REGULATIONS

A. The Contractor shall obtain and pay for all permits related to this section of the work unless previously excluded under provision of the contract or general conditions. The Contractor shall comply with all laws and ordinances bearing on the operation or conduct of the work as drawn and specified. If the Contractor observes that a conflict exists between permit requirements and the work outlined in the contract documents, the Contractor shall promptly notify the Owner's Representative in writing including a description of any necessary changes and changes to the contract price resulting from changes in the work.

B. Wherever references are made to standards or codes in accordance with which work is to be performed or tested, the edition or revision of the standards and codes current on the effective date of this contract shall apply, unless otherwise expressly set forth.

C. In case of conflict among any referenced standards or codes or between any referenced standards and codes and the specifications, the more restrictive standard shall apply or Owner's Representative shall determine which shall govern.

1.6 PROTECTION OF WORK, PROPERTY AND PERSON

A. The Contractor shall adequately protect the work, adjacent property, and the public, and shall be responsible for any damages or injury due to the Contractor's actions.

1.7 CHANGES IN THE WORK

A. The Owner's Representative may order changes in the work, and the contract sum being adjusted accordingly. All such orders and adjustments plus claims by the Contractor for extra compensation must be made and approved in writing before executing the work involved.

B. All changes in the work, notifications and Contractor's request for information (RFI) shall conform to the contract general condition requirements.

1.8 CORRECTION OF WORK

A. The Contractor shall re-execute any work that fails to conform to the requirements of the contract and shall remedy defects due to faulty materials or workmanship upon written notice from the Owner's Representative, at the soonest as possible time that can be coordinated with other work, and seasonal weather demands, but not more than 90 (ninety) days after notification**.**

1.9 DEFINITIONS

A. Owner's Representative: The person appointed by the Owner to represent their interest in the review

and approval of the work and to serve as the contracting authority with the Contractor. The Owner's Representative may appoint other persons to review and approve any aspects of the work.

B. Substantial Completion Acceptance: The date at the end of the Planting, Planting Soil, and Irrigation installation where the Owner's Representative accepts that all work in these sections is complete and the Warranty period has begun. This date may be different that the date of substantial completion for the other sections of the project.

C. Final Acceptance: The date when the Owner's Representative accepts that the plants and work in this section meet all the requirements of specification. It is intended that the materials and workmanship warranty for Planting, Planting Soil, and Irrigation work run concurrently.

1.10 SUBMITTALS

A. See the contract General Conditions for policy and procedures related to submittals.

B. Product data

1. Submit a minimum of (3) complete lists of all irrigation equipment to be used, manufacturer's brochures, maintenance manuals, warrantees and operating instructions, within 15 days after the notice to proceed.
    a. This submission may be done digitally and all documents shall be submitted in one PDF document.
2. The submittals shall be packaged and presented in an organized manner, in the quantity described in Division 1 of the specifications. Provide a table of contents of all submitted items.
3. Clearly identify on each submitted sheet by underlining or highlighting (on each copy) the specific product being submitted for approval. Failure to clearly identify the specific product being submitted will result in a rejection for the entire submittal. No substitutions of material or procedures shall be made concerning these documents without the written consent of an accepted equivalent by the Owner's Representative.
4. Equipment or materials installed or furnished without prior approval of the Owner's Representative, may be rejected by the Owner's Representative and the Contractor shall be required to remove such materials from the site at their own expense.
5. Approval of substitution of material and/or products, other than those specified shall not relieve the Contractor from complying with the requirements of the contract documents and specifications. The Contractor shall be responsible, at their own expense, for all changes that may result from the approved substitutions, which affect the installation or operations other items of their own work and/or the work of other Contractors.

C. Samples: Samples of the equipment may be required at the request of the Owner's Representative if the equipment is other than that specified.

D. Other Submittals: Submit for approval:

1. Documentation of the installer's qualifications.
2. As built record set of drawings.
3. Testing data from all required pressure testing.
4. Backflow prevention device certification: Certification from the manufacturer or their representative that the back flow prevention device has been installed correctly according to the manufactures requirements.
5. Booster pump certification: Certification from the manufacturer or their representative that the booster pump has been installed correctly according to the manufacturer's requirements.
6. Irrigation controller certification: Certification from the manufacturer or an authorized distributor that the Controller has been installed correctly according to the manufactures requirements.

1.11 OBSERVATION OF THE WORK

A. The Owner’s Representative may inspect the work at any time. They may remove samples of materials for conformity to specifications. Rejected materials shall be immediately removed from the site and replaced at the Contractor's expense. The cost of testing materials not meeting specifications shall be paid by the Contractor.

B. The Owner’s Representative shall be informed of the progress of the work so the work may be observed at the following key times in the construction process. The Owner’s Representative shall be afforded sufficient time to schedule visit to the site. Failure of the Owner’s Representative to make field observations shall not relieve the Contractor from meeting all the requirements of this specification.

1. Trenching, directional boring, and sleeving review.
2. Hydrostatic pressure testing.
3. Adjustment and coverage test.
4. Pre-maintenance observation.
5. Final acceptance / system malfunction corrections.

1.12 PRE-CONSTRUCTION CONFERENCE

A. Schedule a pre-construction meeting with the Owner’s Representative at least seven (7) days before beginning work to review any questions the Contractor may have regarding the work, administrative procedures during construction and project work schedule.

1.13 QUALITY ASSURANCE

A. It is the intention of this specification to accomplish the work of installing an automatic irrigation system, which will operate in an efficient and satisfactory manner. The irrigation system shall be installed and made operational according to the workmanlike standards established for landscape installation and sprinkler irrigation operation as set forth by the most recent Best Management Practices (BMP) of the Irrigation Association.

B. The specification can only indicate the intent of the work to be performed rather than a detailed description of the performance of the work. It shall be the responsibility of the Contractor to install said materials and equipment in such a manner that they shall operate efficiently and evenly and support optimum plant growth and health.

C. The Owner’s Representative shall be the sole judge of the true intent of the drawings and specifications and of the quality of all materials furnished in performance of the contract.

D. The Contractor shall keep one copy of all drawings and specifications on the work site, in good order. The Contractor shall make these documents available to the Owner’s Representative when requested.

E. In the event of any discrepancies between the drawings and the specification, the final decision as to which shall be followed, shall be made by the Owner’s Representative.

F. In the event the installation is contradictory to the direction of the Owner’s Representative, the installation shall be rectified by the Contractor at no additional cost to the Owner. The Contractor shall immediately bring any such discrepancies to the attention of the Owner’s Representative.

G. It shall be distinctly understood that no oral statement of any person shall be allowed in any manner to modify any of the contract provisions. Changes shall be made only on written authorization of the Owner’s Representative.

H. Installer Qualifications: The installer shall be a firm having at least 5 years of successful experience of a scope similar to that required for the work.

a. Installer Field Supervision: The installer shall maintain on site an experienced full-time supervisor who can communicate in English with the Owner’s Representative.
b. Submit the installer’s qualifications for approval.

1.14 IRRIGATION SYSTEM WARRANTY:

A. The Contractor shall Warrantee all workmanship and materials for a period of X year (s) following the acceptance of the work.

Note to specifier: *Insert above the length of time for the system warrantee period. It is advised to make the irrigation system and the plants have the same length of warrantee.*

1. Any parts of the irrigation work that fails or is defective shall be replaced or reconstructed at no expense to the Owner including but not limited to: restoring grades that have settled in trenches and excavations related to the work. Reconstruction shall include any plantings, soil, mulch or other parts of the constructed landscape that may be damaged during the repair or that results from soil settlement.

B. The date of acceptance of the work and start of the Guarantee period shall be determined by the Owner's Representative, upon the finding that the entire irrigation system is installed as designed and specified, and found to be operating correctly, supplying water evenly to all planting and/or lawn areas.

C. The system controller shall be warranted by the equipment manufacturer against equipment malfunction and defects for a period of X years, following the acceptance of the work.

Note to specifier: *Insert the length of time that the selected controller is warrantied.* ***Verify material warranty with the controller manufacturer.*** *If a specific controller is not specified, delete the above paragraph.*

D. Neither the final acceptance nor any provision in the contract documents shall relieve the Contractor of responsibility for faulty materials or workmanship. The Contractor shall remedy any defects within a period of 7 days (s) from the date of notification of a defect.

1.15 SITE CONDITIONS

A. It is the responsibility of the Contractor to be aware of all surface and sub-surface conditions, and to notify the Owner's Representative, in writing, of any circumstances that would negatively impact the installation of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

1.16 DELIVERY, STORAGE, AND HANDLING

A. All materials and equipment shall be stored properly and protected as required by the Contractor. The Contractor shall be entirely responsible for damages or loss by weather or other cause to work under the contract. Materials shall be furnished in ample quantities and at such times as to ensure uninterrupted progress of the work.

B. Deliver the products to the job site in their original unopened container with labels intact and legible at time of use.

C. Store in accordance with the manufacturers' recommendations.

1.17 PROTECTION

A. The Contractor shall continuously maintain adequate protection of all their work from damage, destruction, or loss, and shall protect the owner's property from damage arising in connection with this contract. Contractor shall make good any such damage, destruction, loss or injury. Contractor shall adequately protect adjacent property as provided by law and the contract documents.

B. The Contractor shall maintain sufficient safeguards, such as railings, temporary walks, lights, etc., against the occurrence of accidents, injuries or damage to any person or property resulting from their work, and shall alone be responsible for the same if such occurs.

C. All existing paving, structures, equipment or plant material shall be protected at all times, including the irrigation system related to plants, from damage by workers and equipment. The Contractor shall follow all protection requirements including plant protection provision of the general contract documents. All damages shall be repaired or replaced at the Contractor's expense. Repairs and or

replacement shall be to the satisfaction of the Owner's Representative, including the selection of a Contractor to undertake the repair or maintenance. Repairs shall be at no cost to the owner.

1. For trees damaged to the point where they will not be expected to survive or which are severely disfigured and that are too large to replace, the cost of damages shall be as determined by the Owner's arborist using accepted tree value evaluation methods.

D. The Contractor shall refrain from trenching within the drip line of any existing tree to remain. The Owner's Representative may require the Contractor to relocate proposed irrigation work, bore lines beneath roots or use air spade technology to dig trenches through and under the root system to avoid damage to existing tree root areas.

1.18 EXCAVATING AROUND UTILITIES

A. Contractor shall carefully examine the civil, record, and survey drawings to become familiar with the existing underground conditions before digging.

1. Do not begin any excavation until all underground utilities have been located and marked.

Determine location of underground utilities and perform work in a manner that will avoid possible damage. Hand excavate, as required. Maintain stakes and or markings set by others until parties concerned mutually agree to their removal.

Note to specifier: *Insert the telephone number and correct name of the Local Utility Locator Service if available to the paragraph below.*

B. Notification of *Local Utility Locator Service*, *Insert PHONE NUMBER*, is required for all excavation around utilities. The Contractor is responsible for knowing the location and avoiding utilities that are not covered by the *Local Utility Locator Service*.

Note to specifier: *If the project is not in California remove the following paragraph.*

C. Section 4216/4217 of the government code requires a dig-alert identification number be issued before a "permit to excavate" will be valid. For your dig-alert identification number call underground service alert toll free 1-800-422-4133 two working days before beginning construction.

1.19 POINT OF CONNECTION

Note to specifier: *Confirm exactly where the irrigation Contractor is to connect to the water and high voltage electrical supply. Often the General Contractor and their plumber and electrician are to provide the connections, including the electrical junction box or plug receptacle, back flow preventer, main shutoff valve and other items. Where non-potable water is used another Contractor may provide some of the required equipment and connections. This specification provides two options, which may also need further modification by the specifier. The specifier must confirm assumptions and pick one of the following options.*

Point of connection option 1 - Irrigation Contractor provided

A. The point of connection of the irrigation system to its electrical power sources shall be provided by the irrigation installer. All connections shall be made by a licensed electrical Contractor per governing codes at the location shown on the drawings.

B. The point of connection of the irrigation system to its potable and or non-potable water sources, including the main shutoff valve and backflow preventer shall be provided by the irrigation installer. All connections shall be made by a licensed Contractor per governing codes, at the location shown on the drawings.

Point of connection option 2 – General Contractor provided

A. The point of connection of the irrigation system to its electrical power sources shall be provided by the General Contractor's licensed electrical Contractor per governing codes at the location shown on the drawings. The irrigation Contractor will connect the power to provided junction box or grounded plug receptacle.

B. The point of connection of the irrigation system to its potable and or non-potable water sources, including the main shutoff valve and backflow preventer shall be provided by the General Contractor's licensed plumbing Contractor per governing codes at the location shown on the drawings. The minimum size and water pressure of the pressurized line will be as noted on the irrigation drawing.

1.20 TEMPORARY UTILITIES

A. All temporary piping, wiring, meters, panels and other related appurtenances required between source of supply and point of use shall be provided by the Contractor and coordinated with the Owner's Representative. Existing utilities may be used with the written permission of the owner.

1.21 CUTTING, PATCHING, TRENCHING AND DIGGING

A. The Contractor shall do all cutting, fitting, trenching or patching of their work that may be required to make its several parts come together as shown upon, or implied by, the drawings and specifications for the completed project.

B. Digging and trenching operations shall be suspended when the soil moisture is above field capacity.

1.22 USE OF PREMISES

A. The Contractor shall confine their apparatus; the storage of materials, and the operations of their workers to limits indicated by the law, ordinances, or permits and shall not unreasonably encumber the premises with their materials.

B. Contractor parking, and material and equipment storage shall in areas approved by the Owner's Representative.

1.23 AS BUILT RECORD SET OF DRAWINGS

A. Immediately upon the installation of any buried pipe or equipment, the Contractor shall indicate on the progress record drawings the locations of said pipe or equipment. The progress record drawings shall be made available at any time for review by the Owner's Representative.

B. Before final acceptance of work, the Contractor shall provide an as built record set of drawings showing the irrigation system work as built. The drawings shall be transmitted to the Owner's Representative in paper format and as a pdf file of each document on compact disk or flash drive. The drawings shall include all information shown on the original contract document and revised to reflect all changes in the work. The drawings shall include the following additional information

1. All valves shall be numbered by station and corresponding numbers shall be shown on the as built record set of drawings.

2. All main line pipe or irrigation equipment including sleeves, valves, controllers, irrigation wire runs which deviate from the mainline location, backflow preventers, remote control valves, grounding rods, shut-off valves, rain sensors, wire splice locations, and quick coupling valves shall be located by two (2) measured dimensions, to the nearest one-half foot. Dimensions shall be given from permanent objects such as buildings, sidewalks, curbs, walls, structures and driveways. All changes in direction and depth of main line pipe shall be noted exactly as installed. Dimensions for pipes shall be shown at no greater than a 50 ft. maximum interval.

3. As built record set of drawings shall be signed and dated by the Contractor attesting to and certifying the accuracy of the as built record set of drawings. As built record set of drawings shall have "As Built Record Set of Drawings", company name, address, phone number and the name of the person who created the drawing and the contact name (if different).

C. The Owner shall make the original contract drawing files available to the Contractor.

1.24 CONTROLLER CHARTS:

A. Provide one controller chart for each automatic controller installed.

1. On the inside surface of the cover of each automatic controller, prepare and mount a color-coded chart showing the valves, main line, and systems serviced by that particular controller. All valves shall be numbered to match the operation schedule and the drawings. Only those areas controlled by that controller shall be shown. This chart shall be a plot plan, entire or partial, showing building, walks, roads and walls. The plan, reduced as necessary and legible in all details, shall be made to a size that will fit into the controller cover. This print shall be approved by the Owner's Representative and shall be protected in laminated in a plastic cover and be secured to the inside back of the controller cabinet door.
2. The controller chart shall be completed and approved prior to acceptance of the work.

1.25 TESTING

A. Provide all required system testing with written reports as described in part 3.

1.26 OPERATION AND MAINTENANCE MANUALS AND GUARANTEES

A. Prepare and deliver to the Owner's Representative within ten calendar days prior to completion of construction, two 3-ring hard cover binders containing the following information:
   1. Index sheet stating Contractor's address and telephone number, list of equipment with name and addresses of local manufacturers' representatives.
   2. Catalog and parts sheets on all material and equipment.
   3. Guarantee statement. The start of the guarantee period shall be the date the irrigation system is accepted by the Owner.
   4. Complete operating and maintenance instruction for all major equipment.
   5. Irrigation product manufacturers warrantees.
B. In addition to the above-mentioned maintenance manuals, provide the Owner's maintenance personnel with instructions for maintaining major equipment and show evidence in writing to the Owner's Representative at the conclusion of the project that this has been rendered.

PART 2 – PRODUCTS

2.1 MATERIALS GENERAL

A. All materials shall be of standard, approved and first grade quality and shall be new and in perfect condition when installed and accepted.

***Note to specifier**: The following are three options for the use of specific manufacturer's product to set quality and capability of the installation. Confirm the desired approach and select only one of the following options, Modify the text as needed.*

***Option 1** – Use of a manufacturer's name on the drawing only as a general guide.*

B. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and configuration desired only. Other manufacturer's equipment may be submitted for approval with written approval by the Owner's Representative. Substituted equipment shall not substantially alter the operations of the system.

***Option 2** – Use of a manufacturer's name or names in the specification as a specific requirement to use their products but where no specific products are required.*

B. All controllers, valves, and heads *(add other product categories if needed)* shall be manufactured by the following manufacturer(s) *(or approved equal)*.
1. Insert manufacturer's name(s) and contact information.

Option 3 *- Use of a specific manufacturer's name and product model for critical products. If this option is selected modify the product specific specifications that follow so that the text is consistent with the product required.*

B. See the parts schedule on the drawings *(or below)* for specific components and manufacturers.
1. Insert schedule of required parts with manufactures name(s) and contact information or add to the various product specifications below.

C. Approval of any items or substitutions indicates only that the product(s) apparently meet the requirements of the drawings and specifications on the basis of the information or samples submitted. The Contractor shall be responsible for the performance of substituted items. If the substitution proves to be unsatisfactory or not compatible with other parts of the system, the Contractor shall replace said items with the originally specified items, including all necessary work and modifications to replace the items, at no cost to the owner.

Note to specifier: *Some of the following product specifications have a clause that say that further product descriptions are on the drawings. Confirm that this is the case. If this is the desired option for the specification, select Option 3 above. If this is not the case remove reference to the product being described on the drawings. Add additional specifications as needed to strengthen the product requirements as needed by the project goals and tolerance for tightening industry product options.*

Delete all products in the following paragraphs not applicable to this specific project.

2.2 RECLAIMED WATER SYSTEM DESIGNATION

A. Where irrigation systems use reclaimed water, all products including valve boxes, lateral and main line pipe, etc. where applicable and/or required by local code shall have the reclaimed water purple color designation.

2.3 PIPING MATERIAL

A. Individual types of pipe and fittings supplied are to be of compatible manufacturer unless otherwise approved. Pipe sizes shown are nominal inside diameter unless otherwise noted.

B. Plastic pipe:

1. All pipe shall be free of blisters, internal striations, cracks, or any other defects or imperfections. The pipe shall be continuously and permanently marked with the following information: manufacturer's name or trade mark, size, class and type of pipe pressure rating, quality control identifications, date of extrusion, and National Sanitation Foundation (NSF) rating.

2. Pressure main line for piping upstream of remote control valves and quick coupling valves:
   a. Pipe smaller than 2 inch diameter shall be plastic pipe for use with solvent weld or threaded fittings. Shall be manufactured rigid virgin polyvinyl chloride (PVC) 1220, Type 1, Grade 2 conforming to ASTM D 1785, designated as Schedule 40.
   b. Pipe 2 - 3 inch diameter shall be manufactured rigid virgin polyvinyl chloride (PVC), Type 1, Grade 2 conforming to ASTM D 1785, designated as bell gasket Class 315.
   c. Pipe larger than 3 inch diameter shall be manufactured rigid virgin polyvinyl chloride (PVC), Type 1, Grade 2 conforming to ASTM D 1785, designated as bell gasket Class 200 PVC.

3. Non-pressure lateral line for piping downstream of remote control valves: plastic pipe for use with solvent weld or threaded fittings. Shall be manufactured rigid virgin polyvinyl chloride PVC 1220 (type 1, grade 2) conforming to ASTM d 1785, designated as Class 200, 3/4″ minimum size.

C. Galvanized pipe shall be used for above ground connections to, backflow prevention device assemblies, hose bibs, and booster pumps and as shown on the plans and details.

1. Pipe shall be hot dip galvanized continuous welded, seamless, Schedule 40 conforming to applicable current ASTM standards.

2.4 FITTINGS AND CONNECTIONS:

A. Polyvinyl chloride pipe fittings and connections: Type II, Grade 1, Schedule 40, high impact molded fittings, manufactured from virgin compounds as specified for piping tapered socket or molded thread type, suitable for either solvent weld or screwed connections. Machine threaded fittings and plastic saddle and flange fittings are not acceptable. Furnish fittings permanently marked with following information: nominal pipe size, type and schedule of material, and National Sanitation Foundation (NSF) seal of approval. PVC fittings shall conform to ASTM D2464 and D2466.

B. Brass pipe fittings, unions and connections: standard 125 pound class 85% red brass fittings and connections, IPS threaded.

C. PVC Schedule 80 threaded risers and nipples: Type I, grade 1, Schedule 80, high impact molded, manufactured from virgin compounds as specified for piping and conforming to ASTM D-2464. Threaded ends shall be molded threads only. Machined threads are not acceptable.

D. Galvanized pipe fittings shall be galvanized malleable iron ground joint Schedule 40 conforming to applicable current ASTM standards.

2.5 SOLVENT CEMENTS AND THREAD LUBRICANT

A. Solvent cements shall comply with ASTM D2564. Socket joints shall be made per recommended procedures for joining PVC plastic pipe and fittings with PVC solvent cement and primer by the pipe and fitting manufacturer and procedures outlined in the appendix of ASTM D2564.

B. Thread lubricant shall be Teflon ribbon-type, or approved equal, suitable for threaded installations as per manufacturer's recommendations.

C. Pipe Joint Compound (Pipe dope) shall be used on all galvanized threaded connections. Pipe Joint Compound is a white colored, non-separating thread sealant compound designed to seal threaded connections against leakage due to internal pressure. It shall contain PTFE (Polytetrafluoroethylene) to permit a tighter assembly with lower torque, secure permanent sealing of all threaded connections and allow for easy disassembly without stripping or damaging threads.

2.6 BACKFLOW PREVENTION DEVICES

A. The backflow prevention device shall be certified to NSF/ANSI 372 shall be ASSE Listed 1013, rated to 180 degree F, and supplied with full port ball valves.

B. The main body and access covers shall be low lead bronze (ASTM B 584)

C. The seat ring and all internal polymers shall be NSF Listed Noryl and the seat disc elastomers shall be silicone.

D. Backflow Preventer shall be as indicated on the drawings.

2.7 PRESSURE REGULATOR

A. Pressure regulator shall certified to NSF/ANSI 372, consisting of low lead bronze body bell housing, a separate access cap shall be threaded to the body and shall not require the use of ferrous screws.

B. The main valve body shall be cast bronze (ASTM B 584).

C. The access covers shall be bronze (ASTM B 584 or Brass ASTM B 16)

D. The assembly shall be of the balanced piston design and shall reduce the pressure in both flow and no flow conditions.

E. Pressure regulator shall be as indicated on the drawings.

2.7. Wye Strainer

A. Strainer shall conform to MIL –S-16293, and be ANSI 3rd party certified to comply with the states lead plumbing law 0.25% maximum weighted average lead content.

B. The main body shall be low lead bronze (ASTM B 584)

C. The access covers shall be yellow brass or cast bronze (ASTM B 16 or ASTM B 584)

D. Strainer screen shall be 300 series stainless steel available in 20, 40, 60, 80, or 100 mesh.

F. Wye strainer shall be as indicated on the plans.

2.8 BACKFLOW PREVENTER CAGE

A. A heavy-duty steel mesh cage with rust proof finish. The caging shall be sized to allow space for the entire piping assembly associated with the Backflow Preventer unit, and all associated equipment.

B. The cage shall include the manufacturers' standard tamper proof locking mechanism.

C. Provide a concrete base as detailed on the drawings.

D. Backflow Preventer Cage type, manufacturer and color shall be as indicated on the plans.

2.9 BOOSTER PUMP

Note to specifier: *Booster pumps are used when available static pressure is too low for the system to operate, demand is high requiring multiple stations to operate at once, future expansion of the system of the water window is very small due to maintenance practices or site use (such as in the case of parks, sports fields, or schools). It is the responsibility of the specifier to consider all such factors in determining whether or not a booster pump is required. IN many cases booster pumps are specified when they are not needed due to all of the variables not being taken into consideration.*

A. Booster pump shall be housed in a sturdy, locking, weather-resistant case, furnished for maximum exterior protection.

B. Booster pump shall be as indicated on the drawings. .

2.10 BALL VALVES

A. Ball valves for 3/4 inch through 2-1/2 inch shall be of PVC, block, tru-union design with EDPDM seals and o-ring.

B. Ball valves for 3 inch and larger shall be gate design and shall be iron body, brass or bronze mounted AWWA gate valves, and shall have a clear waterway equal to the full nominal diameter of the valve, and shall be rubber gasket, flanged or mechanical joint only, and shall be able to withstand a continuous working pressure of 150 PSI. Valve shall be equipped with a square-operating nut.

C. All ball valves located in a valve manifold shall be the same size as the main line (1-1/2 inch size minimum). Provide pipe-reducing adapters down stream of valves, as required. All ball valves in line shall be the same size as the pipe.

D. Ball valves shall be as indicated on the drawings.

2.11 CHECK VALVES

A. Swing check valves 2 inch and smaller shall be 200 lbs., W.O.G., bronze construction with replaceable composition, neoprene or rubber disc and shall meet or exceed federal specification WW-V- 5ld, class a, type iv.

B. Anti-drain valves shall be of heavy-duty virgin PVC construction with female iron pipe thread inlet and outlet. Internal parts shall be stainless steel and neoprene. Anti-drain valves shall be field adjustable against draw out from 5 to 40 feet of head.

C. Check valves shall be as indicated on the drawings.

2.12 REMOTE CONTROL VALVES

A. Remote control valves shall be electrically operated, single seat, normally closed configuration, equipped with flow control adjustment and capability for manual operation.

B. Valves shall be actuated by a normally closed low wattage solenoid using 24 volts, 50/60 cycle solenoid power requirement. Solenoid shall be epoxy encased. A union shall be installed on the discharge end.

C. Remote control valves shall be wired to controller in same numerical sequence as indicated on drawings.

D. Remote control valves shall be as indicated on the drawings.

2.13 MASTER CONTROL VALVES

Note to specifier: *The master valve and flow sensor specifications must meet the requirements or recommendations of the controller manufacturer. Additional specifications are required for this product.*

A. Master Control Valve shall be compatible with the irrigation controller.

B. Master control valves shall be as indicated on the drawings.

2.14 FLOW SENSOR

A. Flow sensor shall be compatible with the irrigation controller.

B. Flow sensor shall be as indicated on the drawings.

2.15 HYDROMETER

Note to specifier: *The hydrometer specifications must meet the requirements or recommendations of the controller manufacture. The Hydrometer can be either Reed Switch or Photo Diode Register, specifier needs to verify with the controller manufacturer. Additional specifications are required for this product.*

A. Hydrometer shall be compatible with the irrigation controller.

B. Hydrometer shall be as indicated on the drawings.

2.16 QUICK COUPLER VALVES

A. Quick coupler valves shall be a one or two piece, heavy-duty brass construction with a working pressure of 150 PSI with a built in flow control and a self-closing valve.

B. Quick coupler shall be equipped with locking red brass cap covered with durable yellow thermo-plastic rubber cover. Key size shall be compatible with quick coupler and of same manufacturer.

C. Quick coupler valves shall be as indicated on the drawings.

2.17 SPRINKLER HEADS

Note to specifier: *The selection of irrigation heads is a complex decision and needs far stronger specifications than are listed here. Confirm the approach to selecting heads and revise the text.*

A. All sprinkler heads shall have check valves installed.

B. All sprinkler heads shall be as indicated on the drawings.

C. Riser nipples for all sprinkler heads shall be the same size as the riser opening in the sprinkler body and fabricated as shown on the drawings.

2.18 AUTOMATIC CONTROLLER

Note to specifier: *Irrigation controllers vary upon the designer's preferences, users needs, and education of the owner/maintenance personal. The specifier shall develop these specifications based upon those factors.*

A. Controller shall be housed in a sturdy, locking, weather-resistant case, furnished for maximum exterior protection.

B. Controller shall be equipped with evapo-transpiration (ET) sensor, which adjusts the controller programming based on local climatic conditions. The sensor shall also have a rain sensing shut-off switch, wind sensing shut off switch, and freeze sensing shut-off of switch.

1. If a moisture sensor is used in lieu of an evapo-transpiration sensor an additional sensor, which has a rain-sensing shut-off switch, wind sensing shut-off switch, and freeze sensing shut-off switch shall be provided.

C. Automatic controller shall be as indicated on the drawings.

2.19 CONTROLLER DECODERS

Note to specifier: *Controller decoders for 2-wire systems are specific to each controller manufacturer. In addition the installation warranty can be connected to the purchase of the 2-wire controller and decoders from the same distributor. The specifier shall develop these specifications based upon those factors.*

A. All decoders shall be per the controller manufacturer's specifications.

B. Decoder model number shall be as shown on the drawings.

2.20 ELECTRICAL CONTROL WIRING

A. Low voltage

1. The electrical control wire shall be direct burial type UF, no. 14 AWG, solid, single conductor, copper wire UL approved or larger, if required to operate system as designed.
2. For 2-Wire controllers all irrigation wire for the controller, flow sensor, master valve, hydrometer, remote control valves and moisture sensors shall be per the controller manufacturer's specifications and recommendations.
3. Color code wires to each valve. Common wire shall be white.
4. If multiple controllers are being utilized, and wire paths of different controllers cross each other, both common and control wires from each controller to be of different colors.
5. Control wire splices: Splices are when required shall be placed in splice boxes.
6. Wire connections shall be per the controller manufacturer's specifications and recommendations.

B. High voltage

1. Shall be of type as required by local codes and ordinances.
2. Shall be of proper size to accommodate needs of equipment it is to serve.

2.21 VALVE BOXES AND MATERIALS

Note to specifier: *Valve box color shall differentiate depending on the specifier's preference or the irrigation system is using non potable water.*

A. Valve boxes: valve boxes shall be constructed of ABS (acrylonitrile butadiene styrene) plastic, green in color, with rigid base and sides and shall be supplied with bolt lock cover secured with stainless steel bolts. Cover shall be identified as shown on drawings. Provide box extensions as required.

1. Master valves, flow sensors, remote control irrigation valves, gate valves, and ball valves 3 inch or less in size shall use a 14 inch x 19 inch x 12 inch rectangular box.

2. Quick coupler valves, wire splices, and grounding rods shall use a 10 inch circular box.

2.22 CONCRETE THRUST BLOCKS

A. Concrete thrust blocks shall be sized per the pipe manufactures requirement or as indicated on the drawings.

2.23 VALVE IDENTIFICATION TAGS

A. Valve Identification Tags shall be 2.25 inch x 2.65 inch polyurethane. Color: potable water; yellow / Non-potable water; purple. Tags shall be permanently attached to each remote control valve with

tamper proof seals as indicated on the drawings.

2.24 EQUIPMENT TO BE FURNISHED TO OWNER

A. Two (2) sets of keys for each automatic controller.

B. Two (2) 48 inch tee wrenches for operating the gate valves.

C. Three (3) sets of special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied on this project.

D. Five (5) Extra sprinkler heads, nozzles, shrub adapters, nozzle filter screens, for each type used on the project.

E. Two (2) quick coupler keys to match manufacturer type of quick coupler.

2.25 INCIDENTAL MATERIALS AND EQUIPMENT

A. Furnish all materials and equipment not specified above, but which are necessary for completion of the work as intended.

2.26 MAIN LINE LOCATOR TAPE

A. 3 - inch wide plastic detectable locator tape.

2.27 MAIN LINE AND LATERAL LINE BEDDING SAND

A. Sand shall consist of natural or manufactured granular material, free of organic material, mica, loam, clay or other substances not suitable for the intended purpose.

B. Sand shall be masonry sand ASTM C 144 or coarse concrete sand, ASTM C 33.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

A. Code requirements shall be those of state and municipal codes and regulations locally governing this work, providing that any requirements of the drawings and specifications, not conflicting therewith, but exceeding the code requirements, shall govern unless written permission to the contrary is granted by the Owner's Representative.

B. Extreme care shall be exercised at all times by the Contractor in excavating and working in the project area due to existing utilities and irrigation systems to remain. Contractor shall be fully responsible for expenses incurred in the repair of damages caused by their operation.

1. The Contractor is responsible for identifying and maintaining existing irrigation main lines that supply water to areas on the site as noted on the drawings and outside of the proposed limit of work. The Contractor shall relocate or replace existing irrigation main line piping as required to provide a continuous supply of water to all areas of existing irrigation on site.
    a. Providing continuous water supply shall include hand watering and or the use of watering trucks to provide adequate water.

C. Plan locations of backflow preventers, valves, controllers, irrigation lines, sleeves, spray heads and other equipment are diagrammatic and indicate the spacing and relative locations of all installations. Final site conditions and existing and proposed plantings shall determine final locations and adjusted as necessary and as directed to meet existing and proposed conditions and obtain complete water coverage. Minor changes in locations of the above from locations shown shall be made as necessary to avoid existing and proposed trees, piping, utilities, structures, etc. at the Contractor's expense or when directed by the Owner's Representative.

1. The Contractor shall be held responsible for relocation of any items without first obtaining the Owner's Representative's approval. The Contractor shall remove and relocate such items at their expense if so directed by the Owner's Representative.

D. Prior to any work the Contractor shall stake out locations of all pipe, valves, equipment and irrigation heads and emitters using an approved staking method and maintain the staking of the approved layout in accordance with the drawings and any required modifications. Verify all horizontal and vertical site dimensions prior to staking of heads. Do not exceed spacing shown on drawings for any given area. If such modified spacing demand additional or less material than shown on the drawings, notify the Owner's Representative before beginning any work in the adjacent area.

E. Stub out main line at all end runs and as shown on drawings. Stub out wires for future connection where indicated on plan and as directed.

F. Point of connection shall be approximately as shown on drawings. Connect new underground piping and valves and provide all flanges, adapters or other necessary fittings for connection.

G. Permission to shut off any existing in-use water line must be obtained 48 hours in advance, in writing from the Owner. The Contractor shall receive instructions from the Owner's Representative as to the exact length of time of each shut-off.

H. No fittings shall be installed on pipe underneath pavement or walls.

I. Prior to starting any work, Contractor shall obtain a reading of existing static water pressure (no flow condition) at the designated point of connection and immediately submit written verification of pressure with date and time of recording to Owner's Representative.

3.2 TRENCHING, DIRECTIONAL BORING AND SLEEVING

A. Perform all trenching, directional boring, sleeving and excavations as required for the installation of the work included under this section, including shoring of earth banks to prevent cave-ins.

B. The Contractor may directional bore lines where it is practical or where required on the plans.

1. Extend the bore 1' past the edge of pavement unless noted differently on the plans
2. Cap ends of each bore and locate ends at finished grade using metal stakes.
3. All boring and sleeving shall have detectable locator tape placed at the ends of the pipe.

C. Make trenches for mains, laterals and control wiring straight and true to grade and free of protruding stones, roots or other material that would prevent proper bedding of pipe or wire.

D. Excavate trenches wide enough to allow a minimum of 4 - inch between parallel pipelines and 8 inch from lines of other trades. Maintain 3 - inch vertical clearance between irrigation lines. Minimum transverse angle is 45 degrees. All pipes shall be able to be serviced or replaced without disturbing the other pipes.

E. Trenches for pipelines shall be made of sufficient depth to provide the minimum cover from finished grade as follows:

Note to specifier: *Mainline depths shall vary based on geography and climate conditions. For colder climates mainline depths shall be deeper. Specifier shall verify local and or state requirements.*

1. Pressure main line: 18 inches below finish grade and 24-30 inches below paved areas in Schedule 40 PVC sleeves.
2. Reclaimed water constant pressure main lines shall cross at least twelve (12) inches below potable water lines.
   a. If a constant pressure reclaimed water main line must be installed above a potable water line or less than twelve (12) inches below a potable water line, then reclaimed water line shall be installed within an approved protective sleeve. The sleeve shall extend ten (10) feet from each side of the center of the potable line, for a total of twenty (20) feet. The sleeve shall be color-coded (purple) for use with reclaimed water.
3. Lateral lines: 12 inches below finish grade and 18 inches below paved areas in Schedule 40 PVC sleeves.

4. Control wiring: to the side of pressure main line and 24 inches below paved areas in Schedule 40 PVC sleeves.

F. On new on-site systems (post-meter), the required horizontal separation between potable water lines, reclaimed water constant pressure main lines and sewer lines shall be a minimum of four (4) feet apart as directed by the project engineer and/ or regulatory agency. Measurements shall be between facing surfaces, not pipe centerlines.

G. When trenching through areas of imported or modified soil, deposit imported or modified soils on one side of trench and subsoil on opposite side.

H. Backfill the trench per the requirements in paragraphs “Backfilling and Compacting” below.

3.3 PIPE INSTALLATION

A. General Pipe Installation

1. Exercise caution in handling, loading and storing, of plastic pipe and fittings to avoid damage.
   a. The pipe and fittings shall be stored under cover until using, and shall be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat so as not to be subjected to undue bending or concentrated external load at any point.
   b. All pipe that has been dented or damaged shall be discarded unless such dent or damaged section is cut out and pipe rejoined with a coupling.
2. Trench depth shall be as specified above from the finish grade to the top of the pipe.
3. Install a detectable pipe locator tape 6 to 8 inches above all main line pipes.

B. Polyvinyl Chloride Pipe (PVC) Installation

1. Under no circumstance is pipe to rest on concrete, rock, wood blocks, construction debris or similar items.
2. No water shall be permitted in the pipe until a period of at least 24 hours has elapsed for solvent weld setting and curing.
3. Install assemblies and pipe to conform to respective details and where shown diagrammatically on drawings, using first class workmanship and best standard practices as approved. All fittings that are necessary for proper connections such as swing joints, offsets, and reducing bushings that are not shown on details shall be installed as necessary and directed as part of the work.
4. Dielectric bushings shall be used in any connections of dissimilar metals.
5. Gasketed plastic pipe: pipe-to-pipe joints or pipe to fittings shall be made in accordance with manufacturer’s specifications.
6. Solvent weld or threaded plastic pipe:
   a. Installation of all pipe and fittings shall be in strict accordance with manufacturer’s specifications.
   b. Pipe shall be cut using approved PVC pipe cutters only. Sawed joints are disallowed. All field cuts shall be beveled to remove burrs and excess before gluing.
   c. Welded joints shall be given a minimum of 15 minutes to set before moving or handling. Excess solvent on the exterior of the joint shall be wiped clean immediately after assembly.
   d. Plastic to metal connections shall be made with plastic adapters and if necessary, short (not close) brass threaded-nipples. Connection shall be made with two (2) wraps of Teflon tape and hand tightened plus one turn with a strap wrench.
   e. Snake pipe horizontally in trench to allow one (1) foot of expansion and contraction per 100 feet of straight run.
   f. Threaded pipe joints shall be made using Teflon tape. Solvent shall not be used with threaded joints. Pipe shall be protected from tool damage during assembly. All damaged pipe shall be removed and replaced. Take up threaded joints with light wrench pressure.
   g. No close nipples or risers are allowed. Cross connections in piping is disallowed.

h. Center load pipe at 10 feet on center intervals with small amount of backfill to prevent arching and slipping under pressure. Other than this preliminary backfill all pipe joints, fittings and connections are to remain uncovered until successful completion of hydrostatic testing and written approval of the testing report.
i. Concrete thrust blocks shall be constructed behind all pipe fittings 1-1/2 inch diameter and larger at all changes of direction of 45 degrees or more.

C. Galvanized Pipe Installation

1. All joints shall be threaded with pipe joint compound used on all threads.
2. Dielectric bushings shall be used in any connections of dissimilar metals.

3.4 TRENCHING, DIRECTIONAL BORING, AND SLEEVING REVIEW:

A. Upon completion and installation of all trenching, directional boring, and sleeving, all installed irrigation control wiring, lines and fittings shall be visually observed by the Owner's Representative unless otherwise authorized. Do not cover any wires, lines or fittings until they have been tested and observed by the Owner's Representative.

3.5 FLUSHING

A. Openings in piping system during installation are to be capped or plugged to prevent dirt and debris from entering pipe and equipment. Remove plugs when necessary to flush or complete system.

B. After completion and prior to the installation of any terminal fittings, the entire pipeline system shall be thoroughly flushed to remove dirt, debris or other material.

3.6 HYDROSTATIC PRESSURE TESTING

A. After flushing, and the installation of valves the following tests shall be conducted in the sequence listed below. The Contractor shall furnish all equipment; materials and labor necessary to perform the tests and all tests shall be conducted in the presence of the Owner's Representative.

B. Water pressure tests shall be performed on all pressure main lines before any couplings, fittings, valves and the like are concealed.

C. Immediately prior to testing, all irrigation lines shall be purged of all entrapped air or debris by adjusting control valves and installing temporary caps forcing water and debris to be discharged from a single outlet.

D. Test all pressure main line at 150 PSI. For a minimum of four (4) hours with an allowable loss of 5 PSI. Pressure and gauges shall be read in PSI, and calibrated such that accurate determination of potential pressure loss can be ascertained.

E. Re-test as required until the system meets the requirements. Any leaks, which occur during test period, will be repaired immediately following the test. All pipe shall be re-tested until final written acceptance.

F. The Contractor is responsible for proving documentation stating the weather conditions, date, the start time and initial water pressure readings, the finish time and final water pressure readings and the type of equipment used to perform the test. The documentation must be signed by a witness acceptable to the Owner, verifying all of the above-mentioned conditions.

G. Submit a written report of the pressure testing results with the other above required information to the Owner's Representative for approval.

3.7 BACKFLOW PREVENTER TESTING

A. The backflow preventer shall be tested according to procedures and results per the requirements of the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California or American Water Works Association whichever is more stringent.

B. Testing shall be performed by a Backflow Prevention Assembly Tester with a current certification

from the American Backflow Preventer Association.

3.8 CONTROLLER AND BOOSTER PUMP TESTING AND CERTFICIATION

Note to specifier: *Testing and certification of the installation of the controller and the booster pump (if installed) is sometimes preferred by the specifier for a third party verification that the equipment was installed and working in accordance with the manufacturer's specifications. The specifiers knowledge of the manufacturer's installation requirements, along with their level of construction observation and administration on the project, should be taken into consideration on whether or not to proceed with certification. Not having the installation certified does not relieve the Contractor of any responsibility for installation but does provide the specifier with an additional mechanism so that the equipment is installed correct and technical support, if a non-manufacturing issue were to arise with the equipment, is available. Remove this section if certification is not required.*

A. Controller and booster Pump shall be certified by xxxxx of (name the company). Contact xxxxxxxx at xxx.xxx.xxxx.

3.9 BACKFILLING AND COMPACTING

A. Irrigation trenches shall be carefully backfilled with material approved for backfilling and free of rocks and debris one (1) inch in diameter and larger. When back filling trenches in areas of imported or modified planting soil, replace any excavated subsoil at the bottom and the imported soil or modified planting soil at the top of the trench.

B. Backfill shall be compacted with approved equipment to the following densities

1. Backfill under pavement and within 2 feet of the edge of pavement: Compact to 95% or greater of maximum dry density standard proctor.
2. Backfill of subsoil under imported planting mixes or modified existing planting soil: Between 85 and 90% of maximum dry density standard proctor.
3. Backfill of imported planting mixes or modified existing planting soil: Compact to the requirements of the adjacent planting mix or planting soil as specified in section "Planting Soil".

C. Finish grade of all trenches shall conform to adjacent grades without dips or other irregularities. Dispose of excess soil or debris off site at Contractor's expense.

D. Any settling of backfill material during the maintenance or warranty period shall be repaired at the Contractor's expense, including any replacement or repair of soil, lawn, and plant material or paving surface.

3.10 RESURFACING PAVING OVER TRENCHES

Note to specifier: *In some projects paving restoration may be the responsibility of the General Contractor. Coordinate with other specification sections and amend this paragraph as needed.*

A. Restore all surfaces and repair existing underground installations damaged or cut as a result of the excavation to their original condition, satisfactory to the Owner's Representative.

B. Trenches through paved areas shall be resurfaced with same materials quality and thickness as existing material. Paving restoration shall be performed by the project paving Sub-contractor or an approved Contractor skilled in paving work.

C. The cost of all paving restoration work shall be the responsibility of the irrigation Contractor unless the trenching thru the paving was, by previous agreement, part of the general project related construction.

3.11 INSTALLATION OF EQUIPMENT

A. General:

1. All equipment shall be installed to meet all installation requirements of the product manufacturer. In the event that the manufactures requirements cannot be implemented due to particular condition at the site or with other parts of the design, obtain the Owner's Representative's written authorization and approval for any modifications.

2. Install all equipment at the approximately at the location(s) and as designated and detailed on the drawings. Verify all locations with the Owner's Representative.
3. Install all valves within a valve box of sufficient size to accommodate the installation and servicing of the equipment. Group valves together where practical and locate in shrub planting areas.
4. All sprinkler irrigation systems that are using water from potable water systems shall require backflow prevention. All backflow prevention devices shall meet and be installed in accordance with requirements set forth by local codes and the health department.

B. Pressure regulator:
1. Set regulator for required PSI per manufacturer's specifications.

C. Check Valve:
1. Install check valves approximately at the locations necessary to prevent low head run off.

D. Remote control valves:
1. Install one remote control valve per valve box.
2. Remote control valve manifolds and quick coupler valves shall be separate allowing use of a quick coupler with all remote control valves shut off.
3. Install boxes no farther than 12 inches from edge of paving and perpendicular to edge of paving and parallel to each other. Allow 12 inches clearance between adjacent valve boxes.

E. Quick coupler valve:
1. Install each quick coupler valve in its own valve box.
2. Install thrust blocks on quick couplers.
3. Place no closer than 12 inches to adjacent paving.
4. Install 18 inches off set from main line.

F. Sprinkler heads:
1. All main lines and lateral lines, including risers, shall be flushed and pressure tested before installing sprinkler heads.
2. Install specified sprinkler heads as shown in details at locations shown on the drawings. Adjust layout for full coverage, spacing of heads shall not exceed the maximum spacing recommended by the manufacturer.
3. All sprinkler heads shall be set perpendicular to finish grade unless otherwise designated on the drawings or details.

G. Irrigation controllers:
1. Remote control valves shall be connected to controller in numerical sequence as shown on the drawings.
2. Controller shall be tested with complete electrical connections. The Contractor shall be responsible for temporary power to the controller for operation and testing purposes.
3. Connections to control wiring shall be made within the pedestal of the controller. All wire shall follow the pressure main insofar as possible.
4. Electrical wiring shall be in a rigid gray PVC plastic conduit from controller to electrical outlet. The electrical Contractor shall be responsible for installing all wiring to the controller, in order to complete this installation. A disconnect switch shall be included.

H. Wiring:
1. Low Voltage
   a. Control wiring between controller and electrical valves shall be installed in the same trench as

the main line where practical. The wire shall be bundled and secured to the lower quadrant of the trench at 10 foot intervals with plastic electrical tape.

b. When the control wiring cannot be installed in the same main line trench it shall be installed a minimum of 18 inches below finish grade and a bright colored plastic ribbon with suitable markings shall be installed in the trench 6 inches below grade directly over the wire.

c. An expansion loop shall be provided every 500 feet in a box and inside each valve box. Expansion loop shall be formed by wrapping wire at least eight (8) times around a ¾ inch pipe and withdrawing pipe.

d. Provide one control wire to service each valve in system.

Note to specifier: *A majority of the newer irrigation controllers have more than one port for common wire allowing for multiple directional runs. Depending on the controller location within the irrigation system it might be more efficient to have more than one common wire in the system. The specifier must confirm the number of common wires and fill in below.*

e. Provide XX common wire(s) per controller.

f. Run two (2) spare #14-1 wires from controller along entire main line to last electric remote control valve on each and every leg of main line. Label spare wires at controller and wire stub to be located in a box.

g. All control wire splices not occurring at control valve shall be installed in a separate splice valve box.

h. Wire markers (sealed, 1 inch to 3 inch square) are to identify control wires at valves and at terminal strips of controller. At the terminal strip mark each wire clearly indicting valve circuit number.

2. High Voltage

a. All electrical work shall conform to local codes, ordinances and any authorities having jurisdiction. All high voltage electrical work to be performed by licensed electrician.

b. The Contractor shall provide 120-volt power connection to the automatic controller unless noted otherwise on drawings.

I. Valve boxes:

1. Install one valve box for each type of valve installed as per the details.

2. Gravel sump shall be installed after compaction of all trenches. Final portion of gravel shall be placed inside valve box after valve is backfilled and compacted.

3. Permanently label valve number and or controller letter on top of valve box lid using a method approved by the Owners Representative.

J. Tracer wire:

1. Tracer wire shall be installed with non-metallic plastic irrigation main lines where controller wires are not buried in the same trench as the main line.

2. The tracer wire shall be placed on the bottom of the trench under the vertical projection of the pipe with spliced joints soldered and covered with insulation type tape.

3. Tracer wire shall be of a color not used for valve wiring. Terminate wire in a valve box. Provide enough length of wire to make a loop and attach wire marker with the designation "tracer wire".

K. Drip Installation:

1. Clamp fittings with Oetiker clamps or approved equal when operating pressure exceeds specific drip tubing fitting requirements.

2. When installing drip tubing, install soil staples as listed below:

a. Sandy Soil - One staple every three (3') feet and two (2) staples on each change of direction (tee, elbow, or cross).

b. Loam Soil - One staple every four (4') feet and two (2) staples on each change of direction (tee, elbow, or cross).

c. Clay Soil - One staple every five (5') feet and two (2) staples on each change of direction (tee, elbow, or cross).

3. Cap or plug all openings as soon as lines have been installed to prevent the intrusion of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.

4. Thoroughly flush all water lines before installing valves and other hydrants.

3.12 ADJUSTMENT AND COVERAGE TEST

A. Adjustment:

1. The Contractor shall flush and adjust all sprinkler heads, valves and all other equipment to ascertain that they function according to the manufacturer's data.

2. Adjust all sprinkler heads not to overspray onto walks, roadways and buildings when under maximum operating pressure and during times of normal prevailing winds.

B. Coverage test:

1. The Contractor shall perform the coverage test in the presence of the Owner's Representative after all sprinkler heads have been installed, flushed and adjusted. Each section is tested to demonstrate uniform and adequate coverage of the planting areas serviced.

2. Any systems that require adjustments for full and even coverage shall be done by the Contractor prior to final acceptance at the direction of the Owner's Representative at no additional cost. Adjustments may also include realignment of pipes, addition of extra heads, and changes in nozzle type or size.

3. The Contractor at no additional cost shall immediately correct all unauthorized changes or improper installation practices.

4. The entire irrigation system shall be operating properly with written approval of the installation by the Owner's representative prior to beginning any planting operations.

3.13 REPAIR OF PLANTING SOIL

A. Any areas of planting soil including imported or existing soils or modified planting soil which become compacted or disturbed or degraded as a result of the installation of the irrigation system shall be restored to the specified quality and compaction prior to beginning planting operations at no additional expense to the Owner. Restoration methods and depth of compaction remediation shall be approved by the Owner's Representative.

3.14 CLEAN-UP

A. During installation, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.

a. Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.

B. Once installation is complete, wash all soil from pavements and other structures.

1. Make all repairs to grades ruts, and damage to the work or other work at the site.

2. Remove and dispose of all excess soil, packaging, and other material brought to the site by the Contractor.

3.15 PROTECTION

A. The Contractor shall protect installed irrigation work from damage due to operations by other Contractors or trespassers.

1. Maintain protection during installation until Acceptance. Treat, repair or replace damaged work immediately. The Owner's Representative shall determine when such treatment, replacement or repair is satisfactory.

3.16 PRE-MAINTENANCE OBSERVATION:

A. Once the entire system shall be completely installed and operational and all planting is installed, the Owner's Representative shall observe the system and prepare a written punch list indicating all items to be corrected and the beginning date of the maintenance period.

B. This is not final acceptance and does not relieve the Contractor from any of the responsibilities in the contract documents.

3.17 GENERAL MAINTENANCE AND THE MAINTENANCE PERIOD

A. General maintenance shall begin immediately after installation of irrigation system. The general maintenance and the maintenance period shall include the following:

1. On a weekly basis the Contractor shall keep the irrigation system in good running order and make observations on the entire system for proper operation and coverage. Repair and cleaning shall be done to keep the system in full operation.

2. Records of all timing changes to control valves from initial installation to time of final acceptance shall be kept and turned over to the Owner's Representative at the time of final acceptance.

3. During the last week of the maintenance period, provide equipment familiarization and instruction on the total operations of the system to the personnel who will assume responsibility for running the irrigation system.

4. At the end of the maintenance period, turn over all operations logs, manuals, instructions, schedules, keys and any other equipment necessary for operation of the irrigation system to the Owner's Representative who will assume responsibility for the operations and maintenance of the irrigation system.

B. The maintenance period for the irrigation system shall coincide with the maintenance period for the Planting. (See specification section "Planting"

3.18 SUBSTANTIAL COMPLETION ACCEPTANCE

A. Upon written notice from the Contractor, the Owners Representative shall review the work and make a determination if the work is substantially complete.

B. The date of substantial completion of the irrigation shall be the date when the Owner's Representative accepts that all work in Planting, Planting Soil, and Irrigation installation sections is complete.

3.19 FINAL ACCEPTANCE / SYSTEM MALFUNCTION CORRECTIONS

A. At the end of the Plant Warrantee and Maintenance period, (See specification section "Planting") the Owner's Representative shall inspect the irrigation work and establish that all provisions of the irrigation system are complete and the system is working correctly.

1. Restore any soil settlement over trenches and other parts of the irrigation system.

2. Replace, repair or reset any malfunctioning parts of the irrigation system.

B. The Contractor shall show all corrections made from punch list. Any items deemed not acceptable shall be reworked and the maintenance period will be extended.

C. The Contractor shall show evidence that the Owner's Representative has received all charts, records, drawings, and extra equipment as required before final acceptance.

D. Failure to pass review: If the work fails to pass final review, any subsequent observations must be rescheduled as per above. The cost to the Owner for additional observations will be charged to the Contractor at the prevailing hourly rate of the reviewer.

END OF SECTION 32 8400

32 9300 Planting

DISCLAIMER AND RESPONSIBILITY OF THE USER

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INSTRUCTIONS TO THE SPECIFICATION WRITER:

The following document is intended as a general specification to guide the writing of a project-specific specification. Each project is unique and it is required that the specification be developed accordingly. DO NOT USE THE FOLLOWING SPECIFICATION WITHOUT MAKING IMPORTANT ADJUSTMENTS to reflect local conditions, regulations, market standards, project schedules and local and regional practices. The following are specific items that need to be addressed.

1. General instructions for using this specification: *These instructions are intended to guide the specification writer (the specifier) through the process of editing this document into a Planting specification. Be sure to delete these instructions (i.e. all the text in red displayed above the paragraph) before issuing the specifications.*

2. General Requirements - Division 01 (Construction Specification Institute) specifications and other contract elements: *This specification is designed to be used in conjunction with standard Division 01 specifications, which cover project general conditions and project-wide contract elements. THIS IS NOT A STAND-ALONE SPECIFICATION and should not be used as a contract for the purchase of and installation of plants. Important issues of project ownership, liability, insurance, contract language, project controls, instructions to bidders, change orders and review and approval of the work are normally in the Division 01 specifications.*

3. The construction team: *A construction project is a team effort where the Owner, in effect, creates a partnership with all the Contractors to build a project. As with any good contract there are protections for all parties; that the Owner will get the quality of project that they desire within the time limits and budget available; and the Contractor will be paid for the work satisfactorily completed. In between the initial bidding and the final completion there will be many places where parts of the construction do not work out as originally intended. This is normal and a good contract should allow for these changes in a manner that is equitable to both the Owner and the Contractor. To get there, a team approach and spirit must prevail. All parties must assume that each is operating in the best interest of the project goals. The clearer the goals and description of the project, the smoother the flow of a successful project.* ***The more each of the team members can trust the other members, the better the project.*** *This should be a critical principle in approaching interpretation of the specification.*

4. Other project documents: *This specification is intended to be used in conjunction with other project documents including the bid forms, the construction contract, Division 1 specifications, other specifications directly related to this section; other specifications that are not directly related to this work and most critically the project construction drawings. It is very critical that all these documents be prepared with consistent terminology and that they be coordinated. The terms used for the parts of trees and other plants, different soil types, drainage features, irrigation features and structures such as paving, walls and planters must be consistent across disciplines. A very common mistake is the use of different terms and details for soil and the extent of soil work. The terms and details for planting soil, subsoil and other materials must be well coordinated.*

5. Related specification sections: *This specification requires an additional specification section to describe several important related parts of the planting process.*

> ***Tree Protection:*** *This specification assumes that there is a separate specification section and construction drawings and details for tree protection; remove this section if there are no existing trees to be protected on the project.*
>
> ***Planting Soil:*** *This specification assumes that there is a separate specification section and construction*

drawings and details for installation of planting soils.

Irrigation: *This specification assumes that there might be a separate specification section for irrigation associated with the project planting.*

6. Reviewing and approval authority: *Each specification identifies a certain entity as responsible for the review and approval of the work, project submittals, changes to the work, and acceptance of the work The entity is normally identified in Division 1. For the purposes of this specification, the term the "Owner's Representative" has been used as a placeholder for this entity. Once the proper term is defined (for example Contracting Officer, The Architect, The Landscape Architect, The Engineer etc); this term should replace the words "Owner's Representative" wherever it appears in this specification.*

7. Header and footer requirements: *Change the header/footer language to meet the project requirements.*

8. Notes to specifiers: *Before issuing the document, be sure to remove all "**Notes to specifiers**" incorporated into this document in red text after you have read them and responded to the recommendations.*

9. Submittals: *Submittals are a critical part of any construction contract. This is where all products and materials are reviewed and approved in advance of the work. Planting soil quality control is in this section. Including very specific requirements for approval of submittals while a good practice assumes that the reviewing authority has the skills needed to make these reviews and interpret the results. A common practice is to make very specific requirements but not have the time or expertise to enforce them. Lack of review of submittals does not automatically transfer quality control to the Contractor. In fact, lack of review or inappropriate review can make the reviewing authority responsible for having accepted the submittal even if it was not acceptable.* ***Do not put into the specification submittal requirements that you do not have the time, resources or knowledge, which you knew or should have known, to enforce.***

10. Specification modifications: *There are locations in this specification where additional information is required to reflect project region or contract conditions. Please insert the requested information.*

11. SPECIAL REQUIREMENTS OF THIS SPECIFICATION:

Plant observations: *The area of plant observations is one of the most critical points in the planting process. Ideally this should take place at the growing nursery prior to digging and or shipping the plant. This is very time consuming but its importance cannot be over stated. This is the only time where meaningful alterations can be made to find and correct many of the most common root quality issues found in nurseries. If you cannot make these observations do not require them. Failure of the Owner or their representative to* make observations where *they are required can result in the Contractor being able to defend the use of poor quality plants. Once a plant is shipped from the nursery, it is very difficult to reject. The defects must be very severe and visible. Often root defects and buried root collars are quite difficult to identify within the root ball package.*

Many plants are purchased from re-wholesale yards. These plants are more difficult to observe than in the field but if observed prior to purchase by the Contractor there is a better chance of rejecting them. Re-wholesale plants may have other problems such as having been held too long without adequate water, and loss of the ability to make corrections in root collar depth in the root ball package.

Root ball package options: *There are many root ball packages available in the industry in certain regions. That is, the methods used to contain the roots and the type of system used to grow or manage the roots of the plant. It is critical that the specifications herein be amended to reflect allowable root ball packages. All projects do not have to accept all types of root ball packages. Since this can have a huge impact on the ultimate success of the plant, careful consideration must be made in selecting the type of packages permitted. Do not leave in references to root ball packages you do not want to use on the project in the specification (i.e. B&B, container, bare root, etc.).*

Warranty: *This specification assumes or implies a 1-year warranty. Modify the warranty to meet the project requirements.*

Maintenance: *This specification includes an option for no maintenance during the warranty period and optional language for maintenance during the warranty period.*

PART 1 – GENERAL

1.1 SUMMARY

Note to specifier: Remove parts of this work description that do not apply. *This specification section is only for the planting and maintenance of trees, shrubs and ground covers. If construction and maintenance of lawn areas are included in the project, the provisions for construction and maintenance of lawns must be covered under a separate specification section.*

A. The scope of work includes all labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with furnishing, delivery, and installation of plant (also known as "landscaping") complete as shown on the drawings and as specified herein.

B. The scope of work in this section includes, but is not limited to, the following:

1. Locate, purchase, deliver and install all specified plants.
2. Water all specified plants.
3. Mulch, fertilize, stake, and prune all specified plants.
4. Maintenance of all specified plants until the beginning of the warranty period.
5. Plant warranty.
6. Clean up and disposal of all excess and surplus material.
7. Maintenance of all specified plants during the warranty period.

1.2 CONTRACT DOCUMENTS

A. Shall consist of specifications and general conditions and the construction drawings. The intent of these documents is to include all labor, materials, and services necessary for the proper execution of the work. The documents are to be considered as one. Whatever is called for by any parts shall be as binding as if called for in all parts.

1.3 RELATED DOCUMENTS AND REFERENCES

A. Related Documents:

Note to specifier: *Coordinate this list with the other related specification sections. Add, delete or modify sections as appropriate.*

1. Drawings and general provisions of contract including general and supplementary conditions and Division I specifications apply to work of this section
2. Related Specification Sections
   a. Section - Planting Soil
   b. Section - Irrigation
   c. Section - Lawn
   d. Section - Tree Protection and Plant Protection

B. References: The following specifications and standards of the organizations and documents listed in this paragraph form a part of the specification to the extent required by the references thereto. In the event that the requirements of the following referenced standards and specification conflict with this specification section the requirements of this specification shall prevail. In the event that the requirements of any of the following referenced standards and specifications conflict with each other the more stringent requirement shall prevail or as determined by the Owners Representative.

Note to specifier: *Remove any references that do not apply in the project region.*

1. State of California, Department of Food and Agriculture, Regulations for Nursery Inspections, Rules and Grading.

2. ANSI Z60.1 American Standard for Nursery Stock, most current edition.
3. ANSI A 300 – Standard Practices for Tree, Shrub and other Woody Plant Maintenance, most current edition and parts.
4. Florida Grades and Standards for Nursery Stock, current edition (Florida Department of Agriculture, Tallahassee FL).
5. Interpretation of plant names and descriptions shall reference the following documents. Where the names or plant descriptions disagree between the several documents, the most current document shall prevail.
   a. USDA - The Germplasm Resources Information Network (GRIN) http://www.ars-grin.gov/npgs/searchgrin.html
   b. Manual of Woody Landscape Plants; Michael Dirr; Stipes Publishing, Champaign, Illinois; Most Current Edition.
   c. The New Sunset Western Garden Book, Oxmoor House, most current edition.
6. Pruning practices shall conform to recommendations “Structural Pruning: A Guide For The Green Industry” most current edition; published by Urban Tree Foundation, Visalia, California.
7. Glossary of Arboricultural Terms, International Society of Arboriculture, Champaign IL, most current edition.

1.4 VERIFICATION

A. All scaled dimensions on the drawings are approximate. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions and quantities, and shall immediately inform the Owner’s Representative of any discrepancies between the information on the drawings and the actual conditions, refraining from doing any work in said areas until given approval to do so by the Owner’s Representative.

B. In the case of a discrepancy in the plant quantities between the plan drawings and the plant call outs, list or plant schedule, the number of plants or square footage of the planting bed actually drawn on the plan drawings shall be deemed correct and prevail.

1.5 PERMITS AND REGULATIONS

A. The Contractor shall obtain and pay for all permits related to this section of the work unless previously excluded under provision of the contract or general conditions. The Contractor shall comply with all laws and ordinances bearing on the operation or conduct of the work as drawn and specified. If the Contractor observes that a conflict exists between permit requirements and the work outlined in the contract documents, the Contractor shall promptly notify the Owner’s Representative in writing including a description of any necessary changes and changes to the contract price resulting from changes in the work.

B. Wherever references are made to standards or codes in accordance with which work is to be performed or tested, the edition or revision of the standards and codes current on the effective date of this contract shall apply, unless otherwise expressly set forth.

C. In case of conflict among any referenced standards or codes or between any referenced standards and codes and the specifications, the more restrictive standard shall apply or Owner’s Representative shall determine which shall govern.

1.6 PROTECTION OF WORK, PROPERTY AND PERSON

A. The Contractor shall adequately protect the work, adjacent property, and the public, and shall be responsible for any damages or injury due to his/her actions.

1.7 CHANGES IN THE WORK

A. The Owner’s Representative may order changes in the work, and the contract sum should be adjusted accordingly. All such orders and adjustments plus claims by the Contractor for extra compensation must be made and approved in writing before executing the work involved.

B. All changes in the work, notifications and contractor's request for information (RFI) shall conform to the contract general condition requirements.

1.8 CORRECTION OF WORK

A. The Contractor, at their own cost, shall re-execute any work that fails to conform to the requirements of the contract and shall remedy defects due to faulty materials or workmanship upon written notice from the Owner's Representative, at the soonest as possible time that can be coordinated with other work and seasonal weather demands**.**

1.9 DEFINITIONS

Note to specifier: *Delete any words below that are not used in the final specification.*

All terms in this specification shall be as defined in the "Glossary of Arboricultural Terms" or as modified below.

A. Boxed trees: A container root ball package made of wood in the shape of a four-sided box.

B. Container plant: Plants that are grown in and/or are currently in a container including boxed trees.

C. Defective plant: Any plant that fails to meet the plant quality requirement of this specification.

D. End of Warranty Final Acceptance: The date when the Owner's Representative accepts that the plants and work in this section meet all the requirements of the warranty. It is intended that the materials and workmanship warranty for Planting, Planting Soil, and Irrigation work run concurrent with each other.

E. Field grown trees (B&B): Trees growing in field soil for at least 12 months prior to harvest.

F. Healthy: Plants that are growing in a condition that expresses leaf size, crown density, color; and with annual growth rates typical of the species and cultivar's horticultural description, adjusted for the planting site soil, drainage and weather conditions.

G. Kinked root: A root within the root package that bends more than 90 degrees.

H. Maintenance: Actions that preserve the health of plants after installation and as defined in this specification.

I. Maintenance period: The time period, as defined in this specification, which the Contractor is to provide maintenance.

J. Normal: the prevailing protocol of industry standard(s).

K. Owner's Representative: The person appointed by the Owner to represent their interest in the review and approval of the work and to serve as the contracting authority with the Contractor. The Owner's Representative may appoint other persons to review and approve any aspects of the work.

L. Reasonable and reasonably: When used in this specification relative to plant quality, it is intended to mean that the conditions cited will not affect the establishment or long term stability, health or growth of the plant. This specification recognizes that it is not possible to produce plants free of all defects, but that some accepted industry protocols and standards result in plants unacceptable to this project.

When reasonable or reasonably is used in relation to other issues such as weeds, diseased, insects, it shall mean at levels low enough that no treatment would be required when applying recognized Integrated Plant Management practices.

This specification recognizes that some decisions cannot be totally based on measured findings and that professional judgment is required. In cases of differing opinion, the Owner's Representative's expert shall determine when conditions are judged as reasonable.

M. Root ball: The mass of roots including any soil or substrate that is shipped with the tree within the root ball package.

N. Root ball package. The material that surrounds the root ball during shipping. The root package may include the material in which the plant was grown, or new packaging placed around the root ball for

shipping.

O. Root collar (root crown, root flare, trunk flare, flare): The region at the base of the trunk where the majority of the structural roots join the plant stem, usually at or near ground level.

P. Shrub: Woody plants with mature height approximately less than 15 feet.

Q. Spade harvested and transplanted: Field grown trees that are mechanically harvested and immediately transplanted to the final growing site without being removed from the digging machine.

R. Stem: The trunk of the tree.

S. Substantial Completion Acceptance: The date at the end of the Planting, Planting Soil, and Irrigation installation where the Owner's Representative accepts that all work in these sections is complete and the Warranty period has begun. This date may be different than the date of substantial completion for the other sections of the project.

T. Stem girdling root: Any root more than ¼ inch diameter currently touching the trunk, or with the potential to touch the trunk, above the root collar approximately tangent to the trunk circumference or circling the trunk. Roots shall be considered as Stem Girdling that have, or are likely to have in the future, root to trunk bark contact.
Note to specifier regarding the Stem Girdling Root specification: *1/4 inch min. root diameter is in debate. Check most recent opinions from trusted researchers and practitioners. Insert the diameter standard that may be attainable from regional or selected growers.*

U. Structural root: One of the largest roots emerging from the root collar.

V. Tree: Single and multi-stemmed plants with mature height approximately greater than 15 feet.

1.10 SUBMITTALS

A. See contract general conditions for policy and procedure related to submittals.

B. Submit all product submittals 8 weeks prior to installation of plantings.

Note to specifier**:** *Confirm submittal time above is appropriate for project schedule.*

C. Product data: Submit manufacturer product data and literature describing all products required by this section to the Owner's Representative for approval. Provide submittal eight weeks before the installation of plants.

D. Plant growers' certificates: Submit plant growers' certificates for all plants indicating that each meets the requirements of the specification, including the requirements of tree quality, to the Owner's Representative for approval. Provide submittal eight weeks before the installation of plants.

E. Samples: Submit samples of each product and material where required by the specification to the Owner's Representative for approval. Label samples to indicate product, characteristics, and locations in the work. Samples will be reviewed for appearance only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

F. Plant sources: Submit sources of all plants as required by Article – "Selection of Plants" to the Owner's Representative for approval.

G. Close out submittals: Submit to the Owner's Representative for approval.

1. Plant maintenance data and requirements.

H. Warranty period site visit record: If there is no maintenance during the warranty period, after each site visit during the warranty period, by the Contractor, as required by this specification, submit a written record of the visit, including any problems, potential problems, and any recommended corrective action to the Owner's Representative for approval.

Note to specifier: *The paragraph above is only required if maintenance during the warranty period is not required.*

I. Installation plan submitted a minimum of 14 days prior to the scheduled installation. Plan should describe the methods, activities, materials and schedule to achieve installation of plants.

Note to specifier: *The paragraph above is only required if a contractor submitted Plant Installation Plan is required.*

1.11 OBSERVATION OF THE WORK

A. The Owner's Representative may observe the work at any time. They may remove samples of materials for conformity to specifications. Rejected materials shall be immediately removed from the site and replaced at the Contractor's expense. The cost of testing materials not meeting specifications shall be paid by the Contractor.

B. The Owner's Representative shall be informed of the progress of the work so the work may be observed at the following key times in the construction process. The Owner's Representative shall be afforded sufficient time to schedule visit to the site. Failure of the Owner's Representative to make field observations shall not relieve the Contractor from meeting all the requirements of this specification.

1. SITE CONDITIONS PRIOR TO THE START OF PLANTING: review the soil and drainage conditions.
2. COMPLETION OF THE PLANT LAYOUT STAKING: Review of the plant layout.
3. PLANT QUALITY: Review of plant quality at the time of delivery and prior to installation. Review tree quality prior to unloading where possible, but in all cases prior to planting.
4. COMPLETION OF THE PLANTING: Review the completed planting.

1.12 PRE-CONSTRUCTION CONFERENCE

A. Schedule a pre-construction meeting with the Owner's Representative at least seven (7) days before beginning work to review any questions the Contractor may have regarding the work, administrative procedures during construction and project work schedule.

Note to specifier: *Confirm time frame above is appropriate for project schedule.*

1.13 QUALITY ASSURANCE

A. Substantial Completion Acceptance - Acceptance of the work prior to the start of the warranty period:

1. Once the Contractor completes the installation of all items in this section, the Owner's Representative will observe all work for Substantial Completion Acceptance upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date of the observation.
2. Substantial Completion Acceptance by the Owner's Representative shall be for general conformance to specified size, character and quality and not relieve the Contractor of responsibility for full conformance to the contract documents, including correct species.
3. Any plants that are deemed defective as defined under the provisions below shall not be accepted.

B. The Owner's Representative will provide the Contractor with written acknowledgment of the date of Substantial Completion Acceptance and the beginning of the warranty period and plant maintenance period (if plant maintenance is included).

C. Contractor's Quality Assurance Responsibilities: The Contractor is solely responsible for quality control of the work.

D. Installer Qualifications: The installer shall be a firm having at least 5 years of successful experience of a scope similar to that required for the work, including the handling and planting of large specimen trees in urban areas. The same firm shall install planting soil (where applicable) and plant material.

1. The bidders list for work under this section shall be approved by the Owner's Representative.
2. Installer Field Supervision: When any planting work is in progress, installer shall maintain, on site, a full-time supervisor who can communicate in English with the Owner's Representative.
3. Installer's field supervisor shall have a minimum of five years experience as a field supervisor installing plants and trees of the quality and scale of the proposed project, and can communicate in English with the Owner's Representative.
4. The installer's crew shall have a minimum of 3 years experienced in the installation of Planting Soil, Plantings, and Irrigation (where applicable) and interpretation of soil plans, planting plans and irrigation plans.
5. Submit references of past projects, employee training certifications that support that the Contractors meets all of the above installer qualifications and applicable licensures.

1.14 PLANT WARRANTY

A. Plant Warranty:

1. The Contractor agrees to replace defective work and defective plants. The Owner's Representative shall make the final determination if plants meet these specifications or that plants are defective.

   Plants warranty shall begin on the date of Substantial Completion Acceptance and continue for the following periods, classed by plant type:

   Note to specifier: *Modify below to state the number of years of the warranty.*
   a. Trees – XX Year(s).
   b. Shrubs – XX Year(s).
   c. Ground cover and perennial flower plants – XX Year(s).
   d. Bulbs, annual flower and seasonal color plants – for the period of expected bloom or primary display.
2. When the work is accepted in parts, the warranty periods shall extend from each of the partial Substantial Completion Acceptances to the terminal date of the last warranty period. Thus, all warranty periods for each class of plant warranty, shall terminate at one time.
3. All plants shall be warrantied to meet all the requirements for plant quality at installation in this specification. Defective plants shall be defined as plants not meeting these requirements. The Owner's representative shall make the final determination that plants are defective.
4. Plants determined to be defective shall be removed immediately upon notification by the Owner's Representative and replaced without cost to the Owner, as soon as weather conditions permit and within the specified planting period.
5. Any work required by this specification or the Owner's Representative during the progress of the work, to correct plant defects including the removal of roots or branches, or planting plants that have been bare rooted during installation to observe for or correct root defects shall not be considered as grounds to void any conditions of the warranty. In the event that the Contractor decides that such remediation work may compromise the future health of the plant, the plant or plants in question shall be rejected and replaced with plants that do not contain defects that require remediation or correction.
6. The Contractor is exempt from replacing plants, after Substantial Completion Acceptance and during the warranty period, that are removed by others, lost or damaged due to occupancy of project, lost or damaged by a third party, vandalism, or any natural disaster.
7. Replacements shall closely match adjacent specimens of the same species. Replacements shall be subject to all requirements stated in this specification. Make all necessary repairs due to plant replacements. Such repairs shall be done at no extra cost to the Owner.
8. The warranty of all replacement plants shall extend for an additional one-year period from the

date of their acceptance after replacement. In the event that a replacement plant is not acceptable during or at the end of the said extended warranty period, the Owner's Representative may elect one more replacement items or credit for each item. These tertiary replacement items are not protected under a warranty period.

9. During and by the end of the warranty period, remove all tree wrap, ties, and guying unless agreed to by the Owner's Representative to remain in place. All trees that do not have sufficient caliper to remain upright, or those requiring additional anchorage in windy locations, shall be staked or remain staked, if required by the Owner's Representative.

B. End of Warranty Final Acceptance - Acceptance of plants at the end of the warranty period.

1. At the end of the warranty period, the Owner's Representative shall observe all warranted work, upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date for final observation.

2. End of Warranty Final Acceptance will be given only when all the requirements of the work under this specification and in specification sections Planting Soil and Irrigation have been met.

1.15 SELECTION AND OBSERVATION OF PLANTS

A. The Owner's Representative may review all plants subject to approval of size, health, quality, character, etc. Review or approval of any plant during the process of selection, delivery, installation and establishment period shall not prevent that plant from later rejection in the event that the plant quality changes or previously existing defects become apparent that were not observed.

B. Plant Selection: The Owner's Representative reserves the right to select and observe all plants at the nursery prior to delivery and to reject plants that do not meet specifications as set forth in this specification. If a particular defect or substandard element can be corrected at the nursery, as determined by the Owner's Representative, the agreed upon remedy may be applied by the nursery or the Contractor provided that the correction allows the plant to meet the requirements set forth in this specification. Any work to correct plant defects shall be at the contractor's expense.
1. The Owner's Representative may make invasive observation of the plant's root system in the area of the root collar and the top of the root ball in general in order to determine that the plant meets the quality requirements for depth of the root collar and presence of roots above the root collar. Such observations will not harm the plant.
2. Corrections are to be undertaken at the nursery prior to shipping.

C. The Contractor shall bear all cost related to plant corrections.

D. All plants that are rejected shall be immediately removed from the site and acceptable replacement plants provided at no cost to the Owner.

E. Submit to the Owner's Representative, for approval, plant sources including the names and locations of nurseries proposed as sources of acceptable plants, and a list of the plants they will provide. The plant list shall include the botanical and common name and the size at the time of selection. Observe all nursery materials to determine that the materials meet the requirements of this section.

1. The following nurseries are pre-approved to supply plants for this project:
XXXXXX

Note to specifier: *Insert pre-approved growers. If pre-approved growers are not to be required, eliminate the above paragraph. If specific nurseries are going to be REQUIRED for specific plants this is the place to insert that language.*

F. Trees shall be purchased from the growing nursery. Re-wholesale plant suppliers shall not be used as sources unless the Contractor can certify that the required trees are not directly available from a growing nursery. When Re-wholesale suppliers are utilized, the Contractor shall submit the name and location of the growing nursery from where the trees were obtained by the re-wholesale seller. The re-wholesale nursery shall be responsible for any required plant quality certifications.

G. The Contractor shall require the grower or re-wholesale supplier to permit the Owner's Representative to observe the root system of all plants at the nursery or job site prior to planting including random removal of soil or substrate around the base of the plant. Observation may be as frequent and as extensive as needed to verify that the plants meet the requirements of the specifications and conform to requirements.

H. Each tree shall have a numbered seal applied by the Contractor. The seal shall be placed on a lateral branch on the north side of the tree. The seal shall be a tamper proof plastic seal bearing the Contractors name and a unique seven-digit number embossed on the seal.
   1. Do not place seals on branches that are so large that there is not sufficient room for the branch growth over the period of the warranty.

I. The Owner's Representative may choose to attach their seal to each plant, or a representative sample. Viewing and/or sealing of plants by the Owner's Representative at the nursery does not preclude the Owner's Representative's right to reject material while on site. The Contractor is responsible for paying any up charge for the Owner's Representative to attach their seal to specific plants.

J. Where requested by the Owner's Representative, submit photographs of plants or representative samples of plants. Photographs shall be legible and clearly depict the plant specimen. Each submitted image shall contain a height reference, such as a measuring stick. The approval of plants by the Owner's Representative via photograph does not preclude the Owner's Representative's right to reject material while on site.

1.16 PLANT SUBSTITUTIONS FOR PLANTS NOT AVAILABLE

A. Submit all requests for substitutions of plant species, or size to the Owner's Representative, for approval, prior to purchasing the proposed substitution. Request for substitution shall be accompanied with a list of nurseries contacted in the search for the required plant and a record of other attempts to locate the required material. Requests shall also include sources of plants found that may be of a smaller or larger size, or a different shape or habit than specified, or plants of the same genus and species but different cultivar origin, or which may otherwise not meet the requirements of the specifications, but which may be available for substitution.

1.17 SITE CONDITIONS

A. It is the responsibility of the Contractor to be aware of all surface and sub-surface conditions, and to notify the Owner's Representative, in writing, of any circumstances that would negatively impact the health of plantings. Do not proceed with work until unsatisfactory conditions have been corrected.

   1. Should subsurface drainage or soil conditions be encountered which would be detrimental to growth or survival of plant material, the Contractor shall notify the Owner's Representative in writing, stating the conditions and submit a proposal covering cost of corrections. If the Contractor fails to notify the Owner's Representative of such conditions, he/she shall remain responsible for plant material under the warranty clause of the specifications.

B. It is the responsibility of the Contractor to be familiar with the local growing conditions, and if any specified plants will be in conflict with these conditions. Report any potential conflicts, in writing, to the Owner's Representative.

C. This specification requires that all Planting Soil and Irrigation (if applicable) work be completed and accepted prior to the installation of any plants.

   1. Planting operations shall not begin until such time that the irrigation system is completely operational for the area(s) to be planted, and the irrigation system for that area has been preliminarily observed and approved by the Owner's Representative.

D. Actual planting shall be performed during those periods when weather and soil conditions are suitable in accordance with locally accepted horticultural practices.

1. Do not install plants into saturated or frozen soils. Do not install plants during inclement weather, such as rain or snow or during extremely hot, cold or windy conditions.

1.18 PLANTING AROUND UTILITIES

A. Contractor shall carefully examine the civil, record, and survey drawings to become familiar with the existing underground conditions before digging.

B. Determine location of underground utilities and perform work in a manner that will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until parties concerned mutually agree upon removal.

C. Notification of *Local Utility Locator Service*, *Insert PHONE NUMBER*, is required for all planting areas: The Contractor is responsible for knowing the location and avoiding utilities that are not covered by the *Local Utility Locator Service*.

Note to specifier: *Insert the telephone number and correct name of the Local Utility Locator Service if available.*

PART 2 – PRODUCTS

2.1 PLANTS: GENERAL

A. Standards and measurement: Provide plants of quantity, size, genus, species, and variety or cultivars as shown and scheduled in contract documents.

1. All plants including the root ball dimensions or container size to trunk caliper ratio shall conform to ANSI Z60.1 “American Standard for Nursery Stock” latest edition, unless modified by provisions in this specification. When there is a conflict between this specification and ANSI Z60.1, this specification section shall be considered correct.

2. Plants larger than specified may be used if acceptable to the Owner’s Representative. Use of such plants shall not increase the contract price. If larger plants are accepted the root ball size shall be in accordance with ANSI Z-60.1. Larger plants may not be acceptable if the resulting root ball cannot be fit into the required planting space.

3. If a range of size is given, no plant shall be less than the minimum size and not less than 50 percent of the plants shall be as large as the maximum size specified. The measurements specified are the minimum and maximum size acceptable and are the measurements after pruning, where pruning is required.

B. Proper Identification: All trees shall be true to name as ordered or shown on planting plans and shall be labeled individually or in groups by genus, species, variety and cultivar.

C. Compliance: All trees shall comply with federal and state laws and regulations requiring observation for plant disease, pests, and weeds. Observation certificates required by law shall accompany each shipment of plants.

1. Clearance from the local county agricultural commissioner, if required, shall be obtained before planting trees originating outside the county in which they are to be planted.
Note to specifier: *Confirm that the above sentence is applicable to the region of the project.*

D. Plant Quality:
Note to specifier: *The following paragraphs are necessary to assure that quality plant material is installed. With a few exceptions such as the Florida Grades and Standards for Nursery Plants and the Guideline Specifications for Nursery Tree Quality, current nursery standards for root systems do not exist. It is critical that the purchaser of plants have sufficient resources to enforce these quality standards through* observation*s and well-conceived plans, details, specifications, and contracts.*

1. **General**: Provide healthy stock, grown in a nursery and reasonably free of die-back, disease, insects, eggs, bores, and larvae. At the time of planting all plants shall have a root system, stem, and branch form that will not restrict normal growth, stability and health for the expected life of the plant

2. **Plant quality above the soil line:** ***Note to specifier:*** *Determining acceptability of crown quality is subjective. These specifications are designed to have the Crown Acceptance details included with the other planting details. An alternative is to use the Florida Grades and Standards for Nursery Plants and specify tree grades as either Florida #1 or Florida Fancy Grades. If the project does not want to use the Florida Grades and Standards or does not include the Crown Acceptance details on the drawings delete these references in the following paragraph*.

   a. Plants shall be healthy with the color, shape, size and distribution of trunk, stems, branches, buds and leaves normal to the plant type specified. Tree quality above the soil line shall comply with the project Crown Acceptance details (or Florida Grades and Standards, tree grade Florida Fancy or Florida #1) and the following:
      1.) Crown: The form and density of the crown shall be typical for a young specimen of the species or cultivar pruned to a central and dominant leader.
         a.) Crown specifications do not apply to plants that have been specifically trained in the nursery as topiary, espalier, multi-stem, clump, or unique selections such as contorted or weeping cultivars.
      2.) Leaves: The size, color, and appearance of leaves shall be typical for the time of year and stage of growth of the species or cultivar. Trees shall not show signs of prolonged moisture stress or over watering as indicated by wilted, shriveled, or dead leaves.
      3.) Branches: Shoot growth (length and diameter) throughout the crown should be appropriate for the age and size of the species or cultivar. Trees shall not have dead, diseased, broken, distorted, or otherwise injured branches.
         a.) Main branches shall be distributed along the central leader not clustered together. They shall form a balanced crown appropriate for the cultivar/species.
         b.) Branch diameter shall be no larger than two-thirds (one-half is preferred) the diameter of the central leader measured 1 inch above the branch union.
         c.) The attachment of the largest branches (scaffold branches) shall be free of included bark.
      4.) Trunk: The tree trunk shall be relatively straight, vertical, and free of wounds that penetrate to the wood (properly made pruning cuts, closed or not, are acceptable and are not considered wounds), sunburned areas, conks (fungal fruiting bodies), wood cracks, sap leakage, signs of boring insects, galls, cankers, girdling ties, or lesions (mechanical injury).
      5.) Temporary branches, unless otherwise specified, can be present along the lower trunk below the lowest main (scaffold) branch, particularly for trees less than 1 inch in caliper. These branches should be no greater than 3/8-inch diameter. Clear trunk should be no more than 40% of the total height of the tree.
         Note to specifier*: Delete the last sentence above if more clearance is needed.*

   b. Trees shall have one central leader. If the leader was headed, a new leader (with a live terminal bud) at least one-half the diameter of the pruning cut shall be present.
      1.) All trees are assumed to have one central leader trees unless a different form is specified in the plant list or drawings.
   c. All graft unions, where applicable, shall be completely closed without visible sign of graft rejection. All grafts shall be visible above the soil line.
   d. Trunk caliper and taper shall be sufficient so that the lower five feet of the trunk remains vertical without a stake. Auxiliary stake may be used to maintain a straight leader in the upper half of the tree.

3. **Plant quality at or below the soil line:**
   a. Plant roots shall be normal to the plant type specified. Root observations shall take place without impacting tree health. Root quality at or below the soil line shall comply with the project Root Acceptance details and the following:

      1.) The roots shall be reasonably free of scrapes, broken or split wood.
      2.) The root system shall be reasonably free of injury from biotic (e.g., insects and

pathogens) and abiotic (e.g., herbicide toxicity and salt injury) agents. Wounds resulting from root pruning used to produce a high quality root system are not considered injuries.

3.) A minimum of three structural roots reasonably distributed around the trunk (not clustered on one side) shall be found in each plant. Root distribution shall be uniform throughout the root ball, and growth shall be appropriate for the species.
    a.) Plants with structural roots on only one side of the trunk (J roots) shall be rejected.

4.) The root collar shall be within the upper 2 inches of the substrate/soil. Two structural roots shall reach the side of the root ball near the top surface of the root ball. The grower may request a modification to this requirement for species with roots that rapidly descend, provided that the grower removes all stem girdling roots above the structural roots across the top of the root ball.

5.) The root system shall be reasonably free of stem girdling roots over the root collar or kinked roots from nursery production practices.
    a.) Plant Grower Certification: The final plant grower shall be responsible to have determined that the plants have been root pruned at each step in the plant production process to remove stem girdling roots and kinked roots, or that the previous production system used practices that produce a root system throughout the root ball that meets these specifications. Regardless of the work of previous growers, the plant's root system shall be modified at the final production stage, if needed, to produce the required plant root quality. The final grower shall certify in writing that all plants are reasonably free of stem girdling and kinked roots as defined in this specification, and that the tree has been grown and harvested to produce a plant that meets these specifications.

Note to specifier: *The above certification requirement is not an industry standard and will require that the project team is willing to enforce the process.*

6.) At time of observations and delivery, the root ball shall be moist throughout. Roots shall not show signs of excess soil moisture conditions as indicated by stunted, discolored, distorted, or dead roots.

E. Submittals: Submit for approval the required plant quality certifications from the grower where plants are to be purchased, for each plant type. The certification must state that each plant meets all the above plant quality requirements.
    1. The grower's certification of plant quality does not prohibit the Owner's Representative from observing any plant or rejecting the plant if it is found to not meet the specification requirements.

2.2 ROOT BALL PACKAGE OPTIONS: The following root ball packages are permitted. Specific root ball packages shall be required where indicated on the plant list or in this specification. Any type of root ball packages that is not specifically defined in this specification shall not be permitted.

Note to specifier: *It is critical to* ***remove*** *any of the following root ball package descriptions and requirement paragraphs that are not to be permitted for the project. Assure that the plants and root ball packages specified are available from regional growers as not all plant types are available in all root ball package types. Consider specifying preapproved growers to obtain higher quality root ball package types and overall tree quality.*

Each of these final root ball package types has advantages and disadvantages. Not all root ball package types are available in every market region and for every tree species. Some species may only be available in a few root ball package types. To complicate the decision of which to specify, trees may be grown in more than one type of root ball system during the production phase and normally the final grower may have purchased seedlings or liners from another nursery. The methods used at the different stages in the nursery production process can affect the root system of a plant, leaving root problems and difficult root architecture that the plant may struggle with for many years after planting. These root system problems may cause premature decline and even kill the tree well after the end of the warranty period.

The quality control and root ball package type in the initial production nursery may not be known or

apparent to the final grower. It can be quite difficult for the purchaser to determine the quality of the trees root system. The current American Nursery and Landscape Association (ANLA) "American Standards for Nursery Stock (ANSI Z60.1)" does not adequately address these issues, set acceptable standards for root architecture, or offer solutions to the problems. It is up to the purchaser to set their own quality standards, recommend solutions, and to enforce those standards with appropriate observations. Simply stating "Trees shall meet the ANSI Z60.1 standard" does NOT address nor guarantee quality.

It is NEVER REQUIRED for any specification to accept all products available from an industry or to use the ANLA "American Standards for Nursery Stock" as the only requirement that a grower must comply with. The specifier has a choice of what to accept as long as they can verify that the products that meet the specification are available. Until significant changes are made in the nursery industry, it may be difficult, in many regions and for many species, to specify large numbers of trees with an optimum root system. Check your local suppliers to specify the best quality root ball package prior to making specification edits in this section.

It is critical that the specifications be amended to reflect the root ball packages that will be allowable on the project. Since this has a huge impact on the ultimate success of the tree, careful consideration must be made in selecting the type of packages permitted. It is not required that a project accept all types of root ball packages. Some root ball package types can be strictly prohibited in the specification.
Do not leave references to any of the root ball packages you do not want to permit for the project in the specification. Remove the paragraphs related to both the package option descriptions in Part 2 and the special planting requirements in Part 3 of all root ball packages that will not be permitted.

A. BALLED AND BURLAPPED PLANTS

Note to specifier: *Remove this paragraph if Balled and Burlapped plants are not to be permitted.*

1. All Balled and Burlapped Plants shall be field grown, and the root ball packaged in a burlap and twine and/or burlap and wire basket package.
2. Plants shall be harvested with the following modifications to standard nursery practices.
    a. Prior to digging any tree that fails to meet the requirement for maximum soil and roots above the root collar, carefully removed the soil from the top of the root ball of each plant, using hand tools, water or an air spade, to locate the root collar and attain the soil depth over the structural roots requirements. Remove all stem girdling roots above the root collar. Care must be exercised not to damage the surface of the root collar and the top of the structural roots.

    Note to specifier: *Modify paragraph below to reflect climatic differences.*

    b. Trees shall be dug for a minimum of 4 weeks and a maximum of 52 weeks prior to shipping. Trees dug 4 to 52 weeks prior to shipping are defined as hardened-off. Digging is defined as cutting all roots and lifting the tree out of the ground and either moving it to a new location in the nursery or placing it back into the same hole. Tress that are stored out of the ground shall be placed in a holding area protected from extremes of wind and sun with the root ball protected by covering with mulch or straw and irrigated sufficiently to keep moisture in the root ball above wilt point and below saturation
    c. If wire baskets are used to support the root ball, a "low profile" basket shall be used. A low profile basket is defined as having the top of the highest loops on the basket no less than 4 inches and no greater than 8 inches below the shoulder of the root ball package.
        1.) At nurseries where sandy soils prevent the use of "low profile baskets", baskets that support the entire root ball, including the top, are allowable.

    Note to specifier: *Where removal of all or a portion of the wire basket is desirable, insert language to that effect in the above paragraph.*

    d. Twine and burlap used for wrapping the root ball package shall be natural, biodegradable material. If the burlap decomposes after digging the tree then the root ball shall be re-wrapped prior to shipping if roots have not yet grown to keep root ball intact during shipping.

3. The following tree species when harvested at a size greater than X inches in caliper shall be root-pruned a minimum of XX months before digging in the nursery. All root pruning and hardening off procedures shall be accomplished utilizing accepted horticultural practices.

   Note to specifier: *Remove the paragraph above if root pruning is not required. Add the minimum caliper size and time needed for root pruning and/or hardening off. Add required species as considered by local knowledge as benefitting from hardening off and/or root pruning.*

B. SPADE HARVESTED AND TRANSPLANTED

Note to specifier: *Remove the paragraph below if Spade Harvested and Transplanted plants are not to be permitted.*

1. Spade Harvested and Transplanted Plants shall meet all the requirements for field grown trees. Root ball diameters shall be of similar size as the ANSI Z60.1 requirements for Balled and Burlapped plants.
2. Trees shall be harvested prior to leafing out (bud break) in the spring or during the fall planting period except for plants know to be considered as fall planting hazards. Plants that are fall planting hazards shall only be harvested prior to leafing out in the spring.
3. Trees shall be moved and planted within 48 hours of the initial harvesting and shall remain in the spade machine until planted.

C. CONTAINER (INCLUDING ABOVE-GROUND FABRIC CONTAINERS AND BOXES) PLANTS

Note to specifier: *Remove the paragraph below if Container plants are not to be permitted.*

1. Container plants may be permitted only when indicated on the drawing, in this specification, or approved by the Owner's Representative.
2. Provide plants shall be established and well rooted in removable containers.
3. Container class size shall conform to ANSI Z60.1 for container plants for each size and type of plant.

D. BARE ROOT PLANTS

Note to specifier: *Remove the paragraph below if Bare Root plants are not to be permitted.*

1. Harvest bare root plants while the plant is dormant and a minimum of 4 weeks prior to leaf out (bud break).
2. The root spread dimensions of the harvested plants shall conform to ANSI Z60.1 for nursery grown bare root plants for each size and type of plant. Just prior to shipping to the job site, dip the root system into a slurry of hydrogel (cross linked polyacrylamide) and water mixed at a rate of 15 oz. of hydrogel in 25 gallons of water. Do not shake off the excess hydrogel. Place the root system in a pleated black plastic bag and tie the bag snugly around the trunk. Bundle and tie the upper branches together.
3. Keep the trees in a cool dark space for storage and delivery. If daytime outside temperatures exceeds 70 degrees F, utilize a refrigerated storage area with temperature between 35 and 50 degrees.
4. Where possible, plan time of planting to be before bud break. For trees to be planted after bud break, place the trees before bud break in an irrigated bed of pea gravel.
   a. The pea gravel bed shall be 18 inches deep over a sheet of plastic.
   b. Space trees to allow the unbundled branches to grow without shading each other.
   c. Once stored in pea gravel, allow the trees sufficient time for the new root system to flush and spring growth of leaves to fully develop before planting.
   d. Pea gravel stored trees may be kept for up to one growing season.
   e. Pea gravel stored trees shall be dipped, packaged and shipped similar to the requirements for freshly dug bare root trees above.

E. IN-GROUND FABRIC BAG-GROWN

Note to specifier: *Remove this paragraph if trees grown in In-ground fabric containers are not to be permitted.*

1. In-ground fabric container plants may be permitted only when indicated on the drawing, in this specification, or approved by the Owner's Representative.
2. Provide plants established and well rooted.

2.3 ANNUAL FLOWERING AND SEASONAL COLOR PLANTS

Note to specifier: *Annual and Seasonal color plants may require project specific requirements. Add special plant requirements here as needed.*

A. Container or flat-grown plants should be sized as noted in the planting plan. Plants shall be well-rooted and healthy.

2.4 PALMS

Note to specifier: *If palms are included in this planting add any special requirements for this classification of plant here. The following is a general product specification. If Palms are not to be included, delete this section.*

A. Except as modified below or where the requirements are not appropriate to the specification of palms, palms shall meet all the requirements of the plant quality section above.

B. Defronding, tying, and hedging:
   1. In preparing palm trees for relocation, all dead fronds shall be removed.
   2. All remaining fronds above horizontal shall be lifted up and tied together around the crown in an upright position. Up to 2/3 of the oldest live fronds can be removed; all fronds can be removed on Sabal palms. Do not tie too tightly, bind or injure the bud. Jute binder twine shall be used in tying up the fronds; wire will not be permitted. Fronds shall be untied immediately after planting.

C. Digging the root ball:
   1. When digging out the root ball, no evacuation shall be done closer than XX Inches to the trunk at ground level and the excavation shall extend below the major root system to a minimum depth of 3.5 feet. The bottom of the root ball shall be cut off square and perpendicular to the trunk below the major root system.

D. The Contractor shall not free-fall, drag, roll or abuse the tree or put a strain on the crown (bud area) at any time. A protective device shall be used around the trunk of the tree while lifting and relocating so as not to injure the bud, or scar or skin the trunk in any way.

2.5 PLANTING SOIL

Note to specifier: *It is critical to this planting specification that a separate specification section Planting Soil be included. If no such section is included the specifier MUST add in any needed soil requirements to the Planting specification; however, this alternative is NOT recommended.*

A. Planting Soil as used in this specification means the soil at the planting site, or imported as modified and defined in specification Section Planting Soil. If there is no Planting Soil specification, the term Planting Soil shall mean the soil at the planting site within the planting hole.

2.6 MULCH

Note to specifier: *Revise this paragraph to reflect regionally available mulch materials or project specific mulch quality or type requirements where appropriate. The coarse grade mulch specified here is considered superior for its water retention and soil building properties in areas of tree and shrub roots when irrigation is drip, bubblers or flood methods. The term "Walk on Mulch" is a California regional term. Use regional terminology.*

Add additional requirements as needed to more tightly define tree species source, % bark if desired

and size.

A. Mulch shall be "Walk on" grade, coarse, ground, from tree and woody brush sources. The size range shall be a minimum (less than 25% or less of volume) fine particles 3/8 inch or less in size, and a maximum size of individual pieces (largest 20% or less of volume) shall be approximately 1 to 1-1/2 inch in diameter and maximum length approximately 4 to 8". Pieces larger than 8 inch long that are visible on the surface of the mulch after installation shall be removed.

1. It is understood that mulch quality will vary significantly from supplier to supplier and region to region. The above requirements may be modified to conform to the source material from locally reliable suppliers as approved by the Owner's Representative.

B. Submit supplier's product specification data sheet and a one gallon sample for approval.

2.7 TREE STAKING AND GUYING MATERIAL

***Note to specifier**: Do not leave references to any of the staking and guying types you do not want to permit for the project in the specification. Remove the paragraphs below of the types that will not be permitted. Add specifications for other types of staking and guying.*

A. Tree guying to be flat woven polypropylene material, 3/4 inch wide, and 900 lb. break strength. Color to be Green. Product to be ArborTie manufactured by Deep Root Partners, L.P. or approved equal.

B. Stakes shall be lodge pole stakes free of knots and of diameters and lengths appropriate to the size of plant as required to adequately support the plant.

C. Below ground anchorage systems to be constructed of 2 x 2 dimensional untreated wood securing (using 3 inch long screws) horizontal portions to 4 feet long vertical stakes driven straight into the ground outside the root ball.

D. Submit manufacturer's product data for approval.

2.8 TREE BARK PROTECTOR

***Note to specifier:** This is a specialty application generally only used in locations such as streetscapes and parks where tree trunks may be subject to mechanical abuse. Remove these paragraphs if this is not applicable.*

A. Tree Bark Protectors shall be black extruded resin mesh, 4 inches in diameter, 5 feet long. As manufactured by Industrial Netting, Minneapolis, MN, USA or approved equal.

B. Fasten the split side of the Tree Bark Protector together in three places with black plastic tape.

C. Submit manufacturers' product data for approval.

2.9 WATERING BAGS

***Note to specifier:** Remove this paragraph it this is not applicable*.

A. Plastic tree watering bags holding a minimum of 15 gallons of water and with a slow drip hole(s) water release system, specifically designed to water establishing trees. Water should release over a several day period, not within a few hours

B. Watering bags shall be:
1. Treegator Irrigation Bags sized to the appropriate model for the requirements of the plant, manufactured by Spectrum Products, Inc., Youngsville, NC 27596.
2. Ooze Tube sized to the appropriate model for the requirements of the plant, manufactured by Engineered Water Solutions, Atlanta, GA.
3. Or approved equal.

C. Submit manufacturer's product data for approval.

2.10 CHEMICAL OR BIOLOGICAL ADDITIVES

***Note to specifier:** Insert additives, as desired for the specific project requirements.*

PART 3 – EXECUTION

3.1 SITE EXAMINATION

A. Examine the surface grades and soil conditions to confirm that the requirements of the Specification Section – Planting Soil - and the soil and drainage modifications indicated on the Planting Soil Plan and Details (if applicable) have been completed. Notify the Owner's Representative in writing of any unsatisfactory conditions.

3.2 DELIVERY, STORAGE AND HANDLING

A. Protect materials from deterioration during delivery and storage. Adequately protect plants from drying out, exposure of roots to sun, wind or extremes of heat and cold temperatures. If planting is delayed more than 24 hours after delivery, set plants in a location protected from sun and wind. Provide adequate water to the root ball package during the shipping and storage period.

1. All plant materials must be available for observation prior to planting.

2. Using a soil moisture meter, periodically check the soil moisture in the root balls of all plants to assure that the plants are being adequately watered. Volumetric soil moisture shall be maintained above wilting point and below field capacity for the root ball substrate or soil.

B. Do not deliver more plants to the site than there is space with adequate storage conditions. Provide a suitable remote staging area for plants and other supplies.

1. The Owner's Representative or Contractor shall approve the duration, method and location of storage of plants.

C. Provide protective covering over all plants during transporting.

3.3 PLANTING SEASON

A. Planting shall only be performed when weather and soil conditions are suitable for planting the materials specified in accordance with locally accepted practice. Install plants during the planting time as described below unless otherwise approved in writing by the Owner's Representative. In the event that the Contractor request planting outside the dates of the planting season, approval of the request does not change the requirements of the warranty.

Note to specifier: *Insert required regional appropriate planting date limitations including limitations if any for fall planting hazard plants.*

1. Deciduous trees and shrubs XXX to XXX and YYY to YYY

2. Evergreen trees and shrubs XXX to XXX and YYY to YYY

3.4 ADVERSE WEATHER CONDITIONS

A. No planting shall take place during extremely hot, dry, windy or freezing weather.

3.5 COORDINATION WITH PROJECT WORK

A. The Contractor shall coordinate with all other work that may impact the completion of the work.

B. Prior to the start of work, prepare a detailed schedule of the work for coordination with other trades.

C. Coordinate the relocation of any irrigation lines, heads or the conduits of other utility lines that are in conflict with tree locations. Root balls shall not be altered to fit around lines. Notify the Owner's Representative of any conflicts encountered.

3.6 LAYOUT AND PLANTING SEQUENCE

A. Relative positions of all plants and trees are subject to approval of the Owner's Representative.

B. Notify the Owner's Representative, one (1) week prior to layout. Layout all individual tree and shrub locations. Place plants above surface at planting location or place a labeled stake at planting location. Layout bed lines with paint for the Owner's Representative's approval. Secure the Owner's Representative's acceptance before digging and start of planting work.

C. When applicable, plant trees before other plants are installed.

D. It is understood that plants are not precise objects and that minor adjustments in the layout will be required as the planting plan is constructed. These adjustments may not be apparent until some or all of the plants are installed. Make adjustments as required by the Owner's Representative including relocating previously installed plants.

3.7 SOIL PROTECTION DURING PLANT DELIVERY AND INSTALLATION

A. Protect soil from compaction during the delivery of plants to the planting locations, digging of planting holes and installing plants.

1. Where possible deliver and plant trees that require the use of heavy mechanized equipment prior to final soil preparation and tilling. Where possible, restrict the driving lanes to one area instead of driving over and compacting a large area of soil.

2. Till to a depth of 6 inches, all soil that has been driven over during the installation of plants.

3.8 SOIL MOISTURE

A. Volumetric soil moisture level, in both the planting soil and the root balls of all plants, prior to, during and after planting shall be above permanent wilting point and below field capacity for each type of soil texture within the following ranges.

Soil type	**Permanent wilting point**	**Field capacity**
Sand, Loamy sand, Sandy loam	5-8%	12-18%
Loam, Sandy clay, Sandy clay loam	14-25%	27-36%
Clay loam, Silt loam	11-22%	31-36%
Silty clay, Silty clay loam	22-27%	38-41%

1. Volumetric soil moisture shall be measured with a digital moisture meter. The meter shall be the Digital Soil Moisture Meter, DSMM500 by General Specialty Tools and Instruments, or approved equivalent.

B. The Contractor shall confirm the soil moisture levels with a moisture meter. If the moisture is too high, suspend planting operations until the soil moisture drains to below field capacity.

3.9 INSTALLATION OF PLANTS: GENERAL

A. Installation plan shall be submitted a minimum of 14 days prior to the scheduled installation. Plan should describe the methods, activities, materials and schedule to achieve installation of plants.

***Note to specifier**: Remove the above paragraph if no Installation Plan is required. Also remove the submittal requirement in Part One – Submittals.*

B. Observe each plant after delivery and prior to installation for damage of other characteristics that may cause rejection of the plant. Notify the Owner's Representative of any condition observed.

C. No more plants shall be distributed about the planting bed area than can be planted and watered on the same day.

D. The root system of each plant, regardless of root ball package type, shall be observed by the Contractor, at the time of planting to confirm that the roots meet the requirements for plant root quality in Part 2 Products: Plants General: Plant Quality. The Contractor shall undertake at the time of planting, all modifications to the root system required by the Owner's Representative to meet these quality standards.

1. Modifications, at the time of planting, to meet the specifications for the depth of the root collar and removal of stem girdling roots and circling roots may make the plant unstable or stress the plant to the point that the Owner's Representative may choose to reject the plant rather than permitting

the modification.

2. Any modifications required by the Owner's Representative to make the root system conform to the plant quality standards outlined in Part 2 Products: Plants General: Quality, or other requirements related to the permitted root ball package, shall not be considered as grounds to modify or void the plant warranty.
3. The resulting root ball may need additional staking and water after planting. The Owner's Representative may reject the plant if the root modification process makes the tree unstable or if the tree is not healthy at the end of the warranty period. Such plants shall still be covered under the warranty
4. The Contractor remains responsible to confirm that the grower has made all required root modifications noted during any nursery observations.

E. Container and Boxed Root Ball Shaving: The outer surfaces of ALL plants in containers and boxes, including the top, sides and bottom of the root ball shall be shaved to remove all circling, descending, and matted roots. Shaving shall be performed using saws, knives, sharp shovels or other suitable equipment that is capable of making clean cuts on the roots. Shaving shall remove a minimum of one inch of root mat or up to 2 inches as required to remove all root segments that are not growing reasonably radial to the trunk.

F. Exposed Stem Tissue after Modification: The required root ball modifications may result in stem tissue that has not formed trunk bark being exposed above the soil line. If such condition occurs, wrap the exposed portion of the stem in a protective wrapping with a white filter fabric. Secure the fabric with biodegradable masking tape. DO NOT USE string, twine, green nursery ties or any other material that may girdle the trunk if not removed.

G. Excavation of the Planting Space: Using hand tools or tracked mini-excavator, excavate the planting hole into the Planting Soil to the depth of the root ball measured after any root ball modification to correct root problems, and wide enough for working room around the root ball or to the size indicated on the drawing or as noted below.
   1. For trees and shrubs planted in soil areas that are NOT tilled or otherwise modified to a depth of at least 12 inches over a distance of more than 10 feet radius from each tree, or 5 feet radius from each shrub, the soil around the root ball shall be loosened as defined below or as indicated on the drawings.
      a. The area of loosening shall be a minimum of 3 times the diameter of the root ball at the surface sloping to 2 times the diameter of the root ball at the depth of the root ball.
      b. Loosening is defined as digging into the soil and turning the soil to reduce the compaction. The soil does not have to be removed from the hole, just dug, lifted and turned. Lifting and turning may be accomplished with a tracked mini excavator, or hand shovels.
   2. If an auger is used to dig the initial planting hole, the soil around the auger hole shall be loosened as defined above for trees and shrubs planted in soil areas that are NOT tilled or otherwise modified.
   3. The measuring point for root ball depth shall be the average height of the outer edge of the root ball after any required root ball modification.
   4. If motorized equipment is used to deliver plants to the planting area over exposed planting beds, or used to loosen the soil or dig the planting holes, all soil that has been driven over shall be tilled to a depth of 6 inches.

Note to specifier: *Most other planting specifications set a minimum planting hole size, often 2 or 3 times the root ball diameter. This specification assumes that all soil preparation and the preparation of the planting hole is specified in the specification section Planting Soil and the Contractor needs to dig the hole in the already prepared soil only as large as is required to accomplish the planting process; the smaller the planting hole the better. Revise the paragraph Installation of Plants, above to reflect other project requirements if needed.*

In some circumstance (soil type or budget) it may be reasonable or necessary to allow the use of an auger to dig planting holes. While augers are not recommended, if they are allowed, the soil around the top and sides of the holes must be loosened as defined for holes that are dug with other equipment.
Motorized equipment used to dig planting holes or deliver plants to the planting location will compact the soil surface. Tilling of the surface soil that has been compacted, as noted in this specification, is critical to the health of the soil after planting.

H. For trees to be planted in prepared Planting Soil that is deeper than the root ball depth, compact the soil under the root ball using a mechanical tamper to assure a firm bedding for the root ball. If there is more than 12 inches of planting soil under the root ball excavate and tamp the planting soil in lifts not to exceed 12 inches.

I. Set top outer edge of the root ball at the average elevation of the proposed finish. Set the plant plumb and upright in the center of the planting hole. The tree graft, if applicable, shall be visible above the grade. Do not place soil on top of the root ball.

J. The Owner's Representative may request that plants orientation be rotated when planted based on the form of the plant.

K. Backfill the space around the root ball with the same planting soil or existing soil that was excavated for the planting space. See Specification Section Planting Soil, for requirements to modify the soil within the planting bed.

L. Brace root ball by tamping Planting Soil around the lower portion of the root ball. Place additional Planting Soil around base and sides of ball in six-inch (6") lifts. Lightly tamp each lift using foot pressure or hand tools to settle backfill, support the tree and eliminate voids. DO NOT over compact the backfill or use mechanical or pneumatic tamping equipment. Over compaction shall be defined as greater than 85% of maximum dry density, standard proctor or greater than 250 psi as measured by a cone penetrometer when the volumetric soil moisture is lower than field capacity.

1. When the planting hole has been backfilled to three quarters of its depth, water shall be poured around the root ball and allowed to soak into the soil to settle the soil. Do not flood the planting space. If the soil is above field capacity, allow the soil to drain to below field capacity before finishing the planting. Air pockets shall be eliminated and backfill continued until the planting soil is brought to grade level.

M. Where indicated on the drawings, build a 4 inch high, level berm of Planting Soil around the outside of the root ball to retain water. Tamp the berm to reduce leaking and erosion of the saucer.

N. Thoroughly water the Planting Soil and root ball immediately after planting.

O. Remove all nursery plant identification tags and ribbons as per Owner's Representative instructions. The Owner's Representative's seals are to remain on plants until the end of the warranty period.

P. Remove corrugated cardboard trunk protection after planting.

Q. Follow additional requirements for the permitted root ball packages.

3.10 PERMITTED ROOT BALL PACKAGES AND SPECIAL PLANTING REQUIREMENTS

A. The following are permitted root ball packages and special planting requirements that shall be followed during the planting process in addition to the above General planting requirements.

B. BALLED AND BURLAPPED PLANTS

Note to specifier: *Remove this paragraph if BALLED AND BURLAPPED PLANTS are not permitted. Removing some or all of the wire of a wire basket after the plant is positioned in the planting hole is controversial. Despite the scientific evidence showing that roots grow to engulf the wire, and lack of documented cases of wire impacting tree health, some professionals insist that some or all wire be removed. Delete, accept, or modify sections B.1 and 2 below as you feel necessary.*

1. After the root ball has been backfilled, remove all twine and burlap from the top of the root ball. Cut the burlap away; do not fold down onto the Planting Soil.
2. If the plant is shipped with a wire basket that does not meet the requirements of a “Low Rise” basket, remove the top 6 - 8 inches of the basket wires just before the final backfilling of the tree.
3. Earth root balls shall be kept intact except for any modifications required by the Owner’s Representative to make root package comply with the requirement in Part 2 Products.

C. SPADE HARVESTED AND TRANSPLANTED PLANTS

Note to specifier: *Remove this paragraph if Tree Spade Harvested and Transplanted Plants are not to be permitted.*

1. After installing the tree, loosen the soil along the seam between the root ball and the surrounding soil out to a radius from the root ball edge equal to the diameter of the root ball to a depth of 8 - 10 inches by hand digging to disturb the soil interface.
2. Fill any gaps below this level with loose soil.

D. CONTAINER (INCLUDES BOXED AND ABOVE-GROUND FABRIC CONTAINERS) PLANTS

Note to specifier: *Remove this paragraph if CONTAINER PLANTS are not permitted. All of the items below can be included if the following details are included in the contract: 1) root ball shaving, 2) root observations, 3) root correction. Remove sections below that will not be required.*

1. This specification assumes that most container plants have significant stem girdling and circling roots, and that the root collar is too low in the root ball.
2. Remove the container.
3. Perform root ball shaving as defined in Installation of Plants: General above.
4. Remove all roots and substrate above the root collar and the main structural roots according to root correction details so root system conforms to root observations detail.
5. Remove all substrate at the bottom of the root ball that does not contain roots.
6. Using a hose, power washer or air excavation device, wash out the substrate from around the trunk and top of the remaining root ball and find and remove all stem girdling roots within the root ball above the top of the structural roots.

E. BARE ROOT PLANTS

Note to specifier: *Remove this paragraph if BARE ROOT PLANTS are not permitted.*

1. Dig the planting hole to the diameter of the spread of the roots to a depth in the center that maintains the root collar at the elevation of the surrounding finished grade and slightly deeper along the edges of the hole.
2. Spread all roots out radial to the trunk in the prepared hole making the hole wider where needed to accommodate long roots. Root tips shall be directed away from the trunk. Prune any broken roots removing the least amount of tissue possible.
3. Maintain the trunk plumb while backfilling soil around the roots.
4. Lightly tamp the soil around the roots to eliminate voids and reduce settlement.

F. IN-GROUND FABRIC CONTAINERS

Note to specifier: *Remove this paragraph if FABRIC CONTAINERS are not permitted.*

1. Remove the fabric container from the root ball. Cut roots at the edge of the container as needed to extract the fabric from the roots. Make clean cuts with sharp tools; do not tear roots away from the fabric.
2. Observe the root system after the container is removed to confirm that the root system meets the quality standards.

3.11 GROUND COVER, PERENNIAL AND ANNUAL PLANTS

A. Assure that soil moisture is within the required levels prior to planting. Irrigation, if required, shall be applied at least 12 hours prior to planting to avoid planting in muddy soils.

B. Assure that soil grades in the beds are smooth and as shown on the plans.

C. Plants shall be planted in even, triangularly spaced rows, at the intervals called out for on the drawings, unless otherwise noted. The first row of Annual flower plants shall be 6 inches from the bed edge unless otherwise directed.

D. Dig planting holes sufficiently large enough to insert the root system without deforming the roots. Set the top of the root system at the grade of the soil.

E. Schedule the planting to occur prior to application of the mulch. If the bed is already mulched, pull the mulch from around the hole and plant into the soil. Do not plant the root system in the mulch. Pull mulch back so it is not on the root ball surface.

F. Press soil to bring the root system in contact with the soil.

G. Spread any excess soil around in the spaces between plants.

H. Apply mulch to the bed being sure not to cover the tops of the plants with or the tops of the root ball with mulch.

I. Water each planting area as soon as the planting is completed. Apply additional water to keep the soil moisture at the required levels. Do not over water.

3.12 PALM PLANTING

A. Palm trees shall be placed at grade making sure not to plant the tree any deeper in the ground than the palm trees originally stood.

B. The trees shall be placed with their vertical axis in a plumb position.

C. All backfill shall be native soil except in cases where planting in rock. Water-settle the back fill.

D. Do not cover root ball with mulch or topsoil.

E. Provide a watering berm at each palm. Berms shall extend a minimum of 18 inches out from the trunk all around and shall be a minimum of (6) inches high.

F. Remove twine which ties fronds together after placing palm in planting hole and securing it in the upright position.

3.13 STAKING AND GUYING

Note to specifier: *There are many staking systems available in the market. Special project requirements and regional or designer preferences may indicate different approach. Modify the following paragraphs to reflect project requirements.*

If palms are include then add palm bracing detail.

A. Do not stake or guy trees unless specifically required by the Contract Documents, or in the event that the Contractor feels that staking is the only alternative way to keep particular trees plumb.

1. The Owner's Representative shall have the authority to require that trees are staked or to reject staking as an alternative way to stabilize the tree.

2. Trees that required heavily modified root balls to meet the root quality standards may become unstable. The Owner's Representative may choose to reject these trees rather than utilize staking to temporarily support the tree.

B. Trees that are guyed shall have their guys and stakes removed after one full growing season or at other times as required by the Owner's Representative.

C. Tree guying shall utilize the tree staking and guying materials specified. Guying to be tied in such a

manner as to create a minimum 12-inch loop to prevent girdling. Refer to manufacturer's recommendations and the planting detail for installation.
1. Plants shall stand plumb after staking or guying.
2. Stakes shall be driven to sufficient depth to hold the tree rigid.

D. For trees planted in planting mix over waterproofed membrane, use dead men buried 24 inches to the top of the dead man, in the soil. Tie the guy to the dead man with a double wrap of line around the dead man followed by a double half hitch. When guys are removed, leave the dead men in place and cut the guy tape 12 inches above the ground, leaving the tape end covered in mulch.

3.14 TREE BARK PROTECTION

Note to specifier: *This is a specialty application generally only used in location such as streetscapes where tree trunks may be subject to mechanical abuse. Remove this paragraph it this is not applicable.*

A. For all street trees in commercial areas where indicted on the drawings, apply a Tree Bark Protector to each tree.

3.15 STRAIGHTENING PLANTS

A. Maintain all plants in a plumb position throughout the warranty period. Straighten all trees that move out of plumb including those not staked. Plants to be straightened shall be excavated and the root ball moved to a plumb position, and then re-backfilled.

B. Do not straighten plants by pulling the trunk with guys.

3.16 INSTALLATION OF FERTILIZER AND OTHER CHEMICAL ADDITIVES

A. Do not apply any soluble fertilizer to plantings during the first year after transplanting unless soil test determines that fertilizer or other chemical additives is required. Apply chemical additives only upon the approval of the Owner's Representative.

B. Controlled release fertilizers shall be applied according to the manufacturer's instructions and standard horticultural practices.

3.17 PRUNING OF TREES AND SHRUBS

A. Prune plants as directed by the Owner's Representative. Pruning trees shall be limited to addressing structural defects as shown in details; follow recommendations in "Structural Pruning: A Guide For The Green Industry" published by Urban Tree Foundation, Visalia CA.

B. All pruning shall be performed by a person experienced in structural tree pruning.

C. Except for plants specified as multi-stemmed or as otherwise instructed by the Owner's Representative, preserve or create a central leader.

D. Pruning of large trees shall be done using pole pruners or if needed, from a ladder or hydraulic lift to gain access to the top of the tree. Do not climb in newly planted trees. Small trees can be structurally pruned by laying them over before planting. Pruning may also be performed at the nursery prior to shipping.

E. Remove and replace excessively pruned or malformed stock resulting from improper pruning that occurred in the nursery or after.

F. Pruning shall be done with clean, sharp tools.

G. No tree paint or sealants shall be used.

3.18 MULCHING OF PLANTS

A. Apply 4 inches of mulch before settlement, covering the entire planting bed area. Install no more than 1 inch of mulch over the top of the root balls of all plants. Taper to 2 inches when abutting pavement. ***Note to specifier:*** *Mulch thickness varies by mulch type, project location, and project requirements. Four inches of coarse mulch is for dry climates. In wet climates 4 inches of shredded bark mulch would be far too much mulch and have detrimental effect to the plants. Adjust the mulch thickness in*

both the specifications and details.

B. For trees planted in lawn areas the mulch shall extend to a 5 foot radius around the tree or to the extent indicated on the plans.

C. Lift all leaves, low hanging stems and other green portions of small plants out of the mulch if covered.

3.19 PLANTING BED FINISHING

A. After planting, smooth out all grades between plants before mulching.

B. Separate the edges of planting beds and lawn areas with a smooth, formed edge cut into the turf with the bed mulch level slightly lower, 1 and 2 inches, than the adjacent turf sod or as directed by the Owner's Representative. Bed edge lines shall be a depicted on the drawings.

3.20 WATERING

A. The Contractor shall be fully responsible to ensure that adequate water is provided to all plants from the point of installation until the date of Substantial Completion Acceptance. The Contractor shall adjust the automatic irrigation system, if available, and apply additional or adjust for less water using hoses as required.

B. Hand water root balls of all plants to assure that the root balls have moisture above wilt point and below field capacity. Test the moisture content in each root ball and the soil outside the root ball to determine the water content.

C. The Contractor shall install 25 gallon watering bag for each tree to be maintained and used for tree watering during the warranty period.

Note to specifier: *Watering bags come in various sizes from 15 to 25 gallons. Confirm bag size needed and adjust the above paragraph. Confirm if the watering bags are to be given to the Owner or remain the property of the Contractor. Adjust the below paragraph as required.*

1. The watering bags shall remain the property of the Owner at the completion of the work.

3.21 CLEAN-UP

A. During installation, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.
   1. Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.

B. Once installation is complete, wash all soil from pavements and other structures. Ensure that mulch is confined to planting beds and that all tags and flagging tape are removed from the site. The Owner's Representative's seals are to remain on the trees and removed at the end of the warranty period.

C. Make all repairs to grades, ruts, and damage by the plant installer to the work or other work at the site.

D. Remove and dispose of all excess planting soil, subsoil, mulch, plants, packaging, and other material brought to the site by the Contractor.

3.22 PROTECTION DURING CONSTRUCTION

A. The Contractor shall protect planting and related work and other site work from damage due to planting operations, operations by other Contractors or trespassers. Maintain protection during installation until Substantial Completion Acceptance. Treat, repair or replace damaged work immediately.

B. Damage done by the Contractor, or any of their sub-contractors to existing or installed plants, or any other parts of the work or existing features to remain, including roots, trunk or branches of large existing trees, soil, paving, utilities, lighting, irrigation, other finished work and surfaces including those on adjacent property, shall be cleaned, repaired or replaced by the Contractor at no expense to

the Owner. The Owner's Representative shall determine when such cleaning, replacement or repair is satisfactory.

3.23 PLANT MAINTENANCE PRIOR TO SUBSTANTIAL COMPLETION ACCEPTANCE

A. During the project work period and prior to Substantial Completion Acceptance, the Contractor shall maintain all plants.

B. Maintenance during the period prior to Substantial Completion Acceptance shall consist of pruning, watering, cultivating, weeding, mulching, removal of dead material, repairing and replacing of tree stakes, tightening and repairing of guys, repairing and replacing of damaged tree wrap material, resetting plants to proper grades and upright position, and furnishing and applying such sprays as are necessary to keep plantings reasonably free of damaging insects and disease, and in healthy condition. The threshold for applying insecticides and herbicide shall follow established Integrated Pest Management (IPM) procedures. Mulch areas shall be kept reasonably free of weeds, grass.

3.24 SUBSTANTIAL COMPLETION ACCEPTANCE

A. Upon written notice from the Contractor, the Owners Representative shall review the work and make a determination if the work is substantially complete.
   1. Notification shall be at least 7 days prior to the date the contractor is requesting the review.

B. The date of substantial completion of the planting shall be the date when the Owner's Representative accepts that all work in Planting, Planting Soil, and Irrigation installation sections is complete.

C. The Plant Warranty period begins at date of written notification of substantial completion from the Owner's Representative. The date of substantial completion may be different than the date of substantial completion for the other sections of the project.

Note to specifier: *The following two sections are options for maintenance during the warranty period: Maintenance During the Warranty Period by Others" and "Maintenance During the Warranty Period by the Plant Installer". Confirm the approach that is appropriate to the project and delete the other option. These options may also need to be modified to meet the project requirements.*

Confirm that the lengths and timing of beginning and end of maintenance periods are suitable to the project owner's requirements. If the owner does not want to purchase plant maintenance during warranty period, use option one below. If plant maintenance is to be included the extent of the maintenance must be defined.

The maintenance specification assumes that maintenance of lawn grass areas, if required, would be covered under a separate specification for lawn installation.

3.25 MAINTENANCE DURING THE WARRANTY PERIOD BY OTHERS

A. After Substantial Completion Acceptance, the Contractor shall make sufficient site visits to observe the Owner's maintenance and become aware of problems with the maintenance in time to request changes, until the date of End of Warranty Final Acceptance.

   1. Notify the Owner's Representative in writing if maintenance, including watering, is not sufficient to maintain plants in a healthy condition. Such notification must be made in a timely period so that the Owner's Representative may take corrective action.

      a. Notification must define the maintenance needs and describe any corrective action required.

   2. In the event that the Contractor fails to visit the site and or notify, in writing, the Owner's Representative of maintenance needs, lack of maintenance shall not be used as grounds for voiding or modifying the provisions of the warranty.

3.26 MAINTENANCE DURING THE WARRANTY PERIOD BY THE PLANT INSTALLER

A. During the warranty period, provide all maintenance for all plantings to keep the plants in a healthy state and the planting areas clean and neat.

B. General requirements:
   1. All work shall be undertaken by trained planting crews under the supervision of a foreman with a minimum of 5 years experience supervising commercial plant maintenance crews.
   2. All chemical and fertilizer applications shall be made by licensed applicators for the type of chemicals to be used. All work and chemical use shall comply with all applicable local, provincial and federal requirements.
   3. Assure that hoses and watering equipment and other maintenance equipment does not block paths or be placed in a manner that may create tripping hazards. Use standard safety warning barriers and other procedures to maintain the site in a safe manner for visitors at all times.
   4. All workers shall wear required safety equipment and apparel appropriate for the tasks being undertaken.
   5. The Contractor shall not store maintenance equipment at the site at times when they are not in use unless authorized in writing by the Owner's Representative.
   6. Maintenance vehicles shall not park on the site including walks and lawn areas at any time without the Owner's Representative's written permission.
   7. Maintain a detailed log of all maintenance activities including types of tasks, date of task, types and quantities of materials and products used, watering times and amounts, and number of each crew. Periodically review the logs with the Owner's Representative, and submit a copy of the logs at the end of each year of the maintenance agreement.
   8. Meet with the Owner's Representative a minimum of three times a year to review the progress and discuss any changes that are needed in the maintenance program. At the end of the warranty period attend a hand over meeting to formally transfer the responsibilities of maintenance to the Owner's Representative. Provide all information on past maintenance activities and provide a list of critical tasks that will be needed over the next 12 months. Provide all maintenance logs and soil test data. Make the Contractor's supervisor available for a minimum of one year after the end of the warranty period to answer questions about past maintenance.

C. Provide the following maintenance tasks:
   1. Watering; Provide all water required to keep soil within and around the root balls at optimum moisture content for plant growth.
      a. Maintain all watering systems and equipment and keep them operational.
      b. Monitor soil moisture to provide sufficient water. Check soil moisture and root ball moisture with a soil moisture meter on a regular basis and record moisture readings. Do not over water.
   2. Soil nutrient levels: Take a minimum of 4 soil samples from around the site in the spring and fall and have them tested by an accredited agricultural soil testing lab for chemical composition of plant required nutrients, pH, salt and % organic matter. Test results shall include laboratory recommendations for nutrient applications. Apply fertilizers at rates recommended by the soil test.
      a. Make any other soil test and/or plant tissue test that may be indicated by plant conditions that may not be related to soil nutrient levels such as soil contaminated by other chemicals or lack of chemical uptake by the plant.
   3. Plant pruning: Remove cross over branching, shorten or remove developing co dominant leaders, dead wood and winter-damaged branches. Unless directed by the Owner's Representative, do not shear plants or make heading cuts.
   4. Restore plants: Reset any plants that have settled or are leaning as soon as the condition is noticed.
   5. Guying and staking: Maintain plant guys in a taught position. Remove tree guys and staking after the first full growing season unless directed by Owner's Representative.
   6. Weed control: Keep all beds free of weeds. Hand-remove all weeds and any plants that do not appear on the planting plan. Chemical weed control is permitted only with the approval of the Owner's Representative. Schedule weeding as needed but not less *12 times per year*.
      Note to specifier: *Insert the frequency of weed control above based on the project budget and need to keep the plantings weed free.*
   7. Trash removal: Remove all trash and debris from all planting beds and maintain the beds in a neat and tidy appearance. The number of trash and debris removal visits shall be no less than 12 times per year and may coincide with other maintenance visits.

Note to specifier: *Insert the frequency of trash removal based on the project budget and need to keep the site trash free.*

8. Plant pest control: Maintain disease, insects and other pests at manageable levels. Manageable levels shall be defined as damage to plants that may be noticeable to a professional but not to the average person. Use least invasive methods to control plant disease and insect outbreaks.
   a. The Owner's Representative must approve in advance the use of all chemical pesticide applications.
9. Plant replacement: Replace all plants that are defective as defined in the warranty provisions, as soon as the plant decline is obvious and in suitable weather and season for planting as outlined in above sections. Plants that become defective during the maintenance period shall be covered and replaced under the warranty provisions.
10. Mulch: Refresh mulch once a year to maintain complete coverage but do not over mulch. At no time shall the overall mulch thickness be greater that 4 inches. Do not apply mulch within 6 inches of the trunks or stems of any plants. Replacement mulch shall meet the requirements of the original approved material. Mulch shall be no more than one inch on top of the root ball surface.

    Note to specifier: *Insert the maximum depth of mulch based on the project budget and need to keep the mulch in the beds. Often after bed foliage completely fills in, no or little additional mulch is needed.*
11. Bed edging: Check and maintain edges between mulch and lawn areas in smooth neat lines as originally shown on the drawings.
12. Leaf, fruit and other plant debris removal: Remove fall leaf, spent flowers, fruit and plant part accumulations from beds and paved surfaces. Maintain all surface water drains free of debris. Debris removal shall be undertaken at each visit to weed or pick up trash in beds.
13. Damage from site use: Repair of damage by site visitors and events, beyond normal wear, are not part of this maintenance. The Owner's Representative may request that the Contractor repair damage beds or plantings for an additional cost. All additional work shall be approved in advance by the Owner's Representative.

3.27 END OF WARRANTY FINAL ACCEPTANCE / MAINTENANCE OBSERVATION

A. At the end of the Warranty and Maintenance period the Owner's Representative shall observe the work and establish that all provisions of the contract are complete and the work is satisfactory.
   1. If the work is satisfactory, the maintenance period will end on the date of the final observation.
   2. If the work is deemed unsatisfactory, the maintenance period will continue at no additional expense to the Owner until the work has been completed, observed, and approved by the Owner's Representative.

B. FAILURE TO PASS OBSERVATION: If the work fails to pass final observation, any subsequent observations must be rescheduled as per above. The cost to the Owner for additional observations will be charged to the Contractor at the prevailing hourly rate of the Owners Representative.

END OF SECTION 32 9300

015639 Tree and Plant Protection

DISCLAIMER AND RESPONSIBILITY OF THE USER

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INSTRUCTIONS TO THE SPECIFICATION WRITER:

The following document is intended as a general specification to guide the writing of a project-specific specification. Each project is unique and it is required that the specification be developed accordingly. DO NOT USE THE FOLLOWING SPECIFICATION WITHOUT MAKING IMPORTANT ADJUSTMENTS to reflect local conditions, regulations, market standards, project schedules and local and regional practices. The following are specific items that need to be addressed.

1. General instructions for using this specification: *These instructions are intended to guide the specification writer (the specifier) through the process of editing this document into a Tree and Plant Protection specification. Be sure to delete these instructions (i.e. all the text in red displayed above the paragraph) before issuing the specifications.*

2. General Requirements - Division 01 (Construction Specification Institute) specifications and other contract elements: *This specification is designed to be used in conjunction with standard Division 01 specifications, which cover project general conditions and project wide contract elements. THIS IS NOT A STAND-ALONE SPECIFICATION and should not be used as a contract for the protection of plants. Important issue of project ownership, liability, insurance, contract language, project controls, Instructions to bidders, change orders and review and approval of the work are normally in the Division 01 specifications.*

3. The construction team: *A construction project is a team effort where the Owner, in effect, creates an agreement with all the Contractors to build a project. As with any good contract there are protections for both sides; that the Owner will get the quality of project that they desire within the time limits and budget available; and the Contractor will be paid for the work satisfactorily completed. In between the initial bidding and the final completion there will be many places where parts of the construction do not work out as originally intended. This is normal and a good contract should allow for these changes in a manner that is equitable to both the Owner and the Contractor. To get there, a team approach and spirit must prevail. Both sides must assume that each is operating in the best interest of the project goals. The clearer the goals and description of the project, the smoother the flow of a successful project.* ***The more each of the team members can trust the other members, the better the project.*** *This should be a critical principle in approaching interpretation of the specification.*

4. Unique aspects of Tree and Plant Protection: *Most specification sections describe how a particular trade or sub contractor should proceed to accomplish certain tasks to construct a specific part of the project. There is an assumption in almost all specifications that if the subcontractor damages the work of another they must provide a remedy to fix the damage. With plants, particularly large trees, there is not effective remedy if significant damage occurs to the plant. Often the damage particularly to the root system of a tree may not be readily apparent and may not express itself as decline in the tree till after the construction project is finished. For this reason Tree and Plant Protection specification is as much about preventing damage as it is instructions to the subcontractor related to what to build. It is also unique specification section in that it applies to all Contractors working on the site effecting where they can park, store equipment and perform excavations by making certain areas off limits except for the activities permitted by the specification. Conflicts between this specification and other requirements must be resolved prior to the start of work. The Tree and Plant Protection requirements begin at the very beginning of construction and are enforce for the entire construction contract period.*

5. Other project documents: *This specification is intended to be used in conjunction with other project documents including the bid forms, the construction contract, Division 1 specifications, other specifications directly related to this section; other specifications that are not directly related to this work and most critically the Project*

construction drawings. It is very critical that all these documents be prepared with consistent terminology and that they be coordinated. The terms used for the parts of trees and other plants, different soil types, drainage features, irrigation features and structures such as paving, walls and planters must be consistent across disciplines.

6. Related specification sections: *This specification requires additional specification sections to describe several important related parts of the Tree and Plant Protection process.*

> ***Planting:*** *This specification assumes that there is a separate specification section and separate plans and details for installation of plants.*
>
> ***Planting Soil:*** *This specification assumes that there is a separate specification section and separate plans and details for installation of planting soils.*
>
> ***Irrigation:*** *This specification assumes that there is a separate specification section for Irrigation that might be associated with the project planting.*
>
> ***Other sections:*** *such as plumbing, electric, excavation, paving site structures.*

7. Reviewing and approval authority: *Each specification identifies a certain entity as responsible for the review and approval of the work, project submittals, changes to the work and acceptance of the work. The entity with this authority is normally identified in Division 1. For the purposes of this specification, the term the "Owner's Representative" has been used as a placeholder for this entity. Once the proper term is defined for example another term such as; Contracting Officer, The Architect, The Landscape Architect, The Engineer etc.; this term should replace the words "Owner's Representative" wherever it appears in this specification.*

8. Header and footer requirements: *Change the header/footer language to meet the project requirements.*

9. Notes to specifier: *Before issuing the document, be sure to remove all "**Notes to specifier**" incorporated into this document after you have read them and responded to the recommendations.*

10. Submittals: *Submittals are a critical part of any construction contract. This is where all products and materials are reviewed and approved in advance of the work. Tree and Plant Protection quality control is in this section. Including very specific requirements for approval of submittals while a good practice assumes that the reviewing authority has the skills needed to make these reviews and interpret the results. A common practice is to make very specific requirements but not have the time or expertise to enforce them. Lack of review of submittals does not automatically transfer quality control to the Contractor. In fact, lack of review or inappropriate review can make the reviewing authority responsible for having accepted the submittal even if it was not acceptable. Take great care in putting into the specification submittal requirements that you do not have the time or knowledge to enforce.*

11. Specification modifications: *There are locations in this specification where additional information is required to reflect project region or contract conditions. Please insert the requested information.*

PART 1 – GENERAL

1.1 SUMMARY

Note to specifier: *Remove parts of this work description that do not apply.*

A. The scope of work includes all labor, materials, tools, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with protection of existing trees and other plants as shown on the drawings and as specified herein.

1. Provide preconstruction evaluations
2. Provide tree and plant protection fencing.
3. Provide protection of root zones and above ground tree and plants
4. Provide pruning of existing trees and plants.
5. Coordinate with the requirements of Section Planting Soil for modifications to the soil within the root zone of existing trees and plants.
6. Provide all insect and disease control.
7. Provide maintenance of existing trees and plants including irrigation during the construction period as recommended by the arborist report.
8. Provide maintenance of existing trees and plants including irrigation during the post construction plant maintenance period.
9. Remove tree protection fencing and other protection from around and under trees and plants.
10. Clean up and disposal of all excess and surplus material.

1.2 CONTRACT DOCUMENTS

A. Shall consist of specifications and general conditions and the drawings. The intent of these documents is to include all labor, materials, and services necessary for the proper execution of the work. The documents are to be considered as one. Whatever is called for by any parts shall be as binding as if called for in all parts.

B. It is the intent of this section that the requirements apply to all sections of the project specification such that any subcontractor must comply with the restrictions on work within designated Tree and Plant Protection Areas.

1.3 RELATED DOCUMENTS AND REFERENCES

A. Related Documents:

Note to specifier: *Coordinate this list with the other related specification sections. Add or delete sections as appropriate.*

1. Drawings and general provisions of contract including general and supplementary conditions and Division I specifications apply to work of this section.
2. Section - Planting Soil
3. Section - Irrigation
4. Section - Planting
5. Section - Lawn

B. References: The following specifications and standards of the organizations and documents listed in this paragraph form a part of the specification to the extent required by the references thereto. In the event that the requirements of the following referenced standards and specification conflict with this specification section the requirements of this specification shall prevail. In the event that the

requirements of any of the following referenced standards and specifications conflict with each other the more stringent requirement shall prevail.

1. ANSI A 300 (Part 5) – Standard Practices for Tree, Shrub and other Woody Plant Maintenance, most current editions.
2. Pruning practices shall conform with recommendations “Structural Pruning: A Guide For The Green Industry”; Published by Urban Tree Foundation, Visalia, California; most current edition.
3. Glossary of Arboricultural Terms, International Society of Arboriculture, Champaign Il, most current edition.

1.4 VERIFICATION

A. All scaled dimensions on the drawings are approximate. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions and quantities, and shall immediately inform the Owner’s Representative of any discrepancies between the information on the drawings and the actual conditions, refraining from doing any work in said areas until given approval to do so by the Owner’s Representative.

1.5 PERMITS AND REGULATIONS

A. The Contractor shall obtain and pay for all permits related to this section of the work unless previously excluded under provision of the contract or general conditions. The Contractor shall comply with all laws and ordinances bearing on the operation or conduct of the work as drawn and specified. If the Contractor observes that a conflict exists between permit requirements and the work outlined in the contract documents, the Contractor shall promptly notify the Owner’s Representative in writing including a description of any necessary changes and changes to the contract price resulting from changes in the work.

B. Wherever references are made to standards or codes in accordance with which work is to be performed or tested, the edition or revision of the standards and codes current on the effective date of this contract shall apply, unless otherwise expressly set forth.

C. In case of conflict among any referenced standards or codes or between any referenced standards and codes and the specifications, the more restrictive standard shall apply or Owner’s Representative shall determine which shall govern.

1.6 PROTECTION OF WORK, PROPERTY AND PERSON

A. The Contractor shall protect the work, adjacent property, and the public, and shall be responsible for any damages or injury due to his/her actions.

1.7 CHANGES IN THE WORK

A. The Owner’s Representative may order changes in the work, and the contract sum should be adjusted accordingly. All such orders and adjustments plus claims by the Contractor for extra compensation must be made and approved in writing before executing the work involved.

1.8 CORRECTION OF WORK

A. The Contractor shall re-execute any work that fails to conform to the requirements of the contract and shall remedy defects due to faulty materials or workmanship upon written notice from the Owner’s Representative, at the soonest possible time that can be coordinated with other work and seasonal weather demands**.**

1.9 DEFINITIONS

Note to specifier: *Delete any words below that are not used in the final specification.*

All terms in this specification shall be as defined in the “Glossary of Arboricultural Terms” or as modified below.

A. Owner’s Representative: The person appointed by the Owner to represent their interest in the review

and approval of the work and to serve as the contracting authority with the Contractor. The Owner's Representative may appoint other persons to review and approve any aspects of the work.

B. Reasonable and reasonably: When used in this specification is intended to mean that the conditions cited will not affect the establishment or long term stability, health or growth of the plant. This specification recognizes that plants are not free of defects, and that plant conditions change with time. This specification also recognizes that some decisions cannot be totally based on measured findings and that profession judgment is required. In cases of differing opinion, the Owner's Representative expert shall determine when conditions within the plant are judged as reasonable.

C. Shrub: Woody plants with mature height approximately less than 25 feet.

D. Tree and Plant Protection Area: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and defined by a circle centered on the trunk with each tree with a radius equal to the clown dripline unless otherwise indicated by the owner's representative.

E. Tree: Single and multi-stemmed plants, including palms with anticipated mature height approximately greater than 25 feet or any plant identified on the plans as a tree.

1.10 SUBMITTALS

Note to specifier: *The arborist report, described below is to provide a current assessment of all trees to remain and serve as the basis for determining if trees are damaged. The Contractor is made responsible for the preparation of this report with the Owner's Representative responsible for approval of the report so that both sides of the contract are satisfied that the condition of these trees is accurately reported before any work has started. Add or delete any portions that do not apply.*

A. ARBORIST REPORT: Prior to the start of construction, submit, for approval by the Owner's Representative, the report of a consulting arborist who is a registered Consulting Arborist® (RCA) with American Society of Consulting Arborists or an ISA Board Certified Master Arborist, which details the following information for all trees to remain within the area designated on the drawings as the Tree and Plant Protection Area. The report shall include the following:
   1. A description of each tree to remain indicating its genus and species, condition including any visible damage to the root system or soil within the root zone, tree diameter at breast height (dbh) and approximate height, size and any visible disease, insect infestations and or branch and trunk structural deficiencies.
   2. The report shall note all trees or parts of trees, which are considered a hazard or significant or extreme risk level. Include the International Society of Arboriculture hazard evaluation sheet for each tree, which may reasonably be identified as a potential hazard tree.
   3. Recommendations as to treatment of all insect, disease and structural problems encountered.
   4. Recommendations for fertilizer treatments, if any.
   5. A plan of the site showing the location of all trees included in the report.

B. PRODUCT DATA: Submit manufacturer product data and literature describing all products required by this section to the Owner's Representative for approval. Provide submittal four weeks before the start of any work at the site.

   Note to specifier: *Confirm submittal time is appropriate for project schedule.*

C. QUALIFICATIONS SUBMITTAL: For each applicable person expected to work on the project, provide copies of the qualifications and experience of the Consulting arborist, proof of either the registered Consulting Arborist® (RCA) with American Society of Consulting Arborists or an ISA Board Certified Master Arborist and any required Herbicide/Pesticide license to the Owner's Representative, for review prior to the start of work.

1.11 OBSERVATION OF THE WORK

A. The Owner's Representative may inspect the work at any time.

1.12 PRE-CONSTRUCTION CONFERENCE

A. Schedule a pre - construction meeting with the Owner's Representative at least seven (7) days before beginning work to review any questions the Contractor may have regarding the work, administrative procedures during construction and project work schedule.
   1. The following Contractors shall attend the preconstruction conference:
      a. General Contractor.
      b. Consulting Arborist.
      c. Subcontractor assigned to install Tree and Plant Protection measures.
      d. Earthwork Contractor.
      e. All site utility Contractors that may be required to dig or trench into the soil.
      f. Landscape subcontractor.
      g. Irrigation subcontractor

B. Prior to this meeting, mark all trees and plants to remain and or be removed as described in this specification for review and approval by the Owner's Representative.

1.13 QUALITY ASSURANCE

A. Contractor qualifications:
   1. All pruning, branch tie back, tree removal, root pruning, and fertilizing required by this section shall be performed by or under the direct supervision of ISA Certified Arborist Submit aforementioned individual's qualifications for approval by the Owner's Representative.
   2. All applications of pesticide or herbicide shall be performed by a person maintaining a current state license to apply chemical pesticides valid in the jurisdiction of the project. Submit copies of all required state licensing certificates including applicable chemical applicator licenses.

PART 2 – PRODUCTS

2.1 MULCH

Note to specifier: *Revise this paragraph to reflect regionally available mulch materials or project specific mulch quality or type requirements where appropriate. The coarse grade Mulch specified here is considered superior for its water retention and soil building properties in areas of tree and shrub roots when irrigation is drip, bubblers or flood methods.*

A. Mulch shall be coarse, ground, from tree and woody brush sources. The minimum range of fine particles shall be 3/8 inch or less in size and a maximum size of individual pieces shall be approximately 1 to 1-1/2 inch in diameter and maximum length of approximately 4 to 8 inches. No more that 25% of the total volume shall be fine particles and no more than 20% of total volume be large pieces.
   1. It is understood that Mulch quality will vary significantly from supplier to supplier and region to region. The above requirements may be modified to conform to the source material from locally reliable suppliers as approved by the Owner's Representative.

B. Submit suppliers product data that product meets the requirements and two gallon sample for approval.

2.2 WOOD CHIPS:

Note to specifier**:** *Woodchips if available may be a suitable and more sustainable alternative to other types of Mulch. Consider permitting Mulch or Wood Chips; however be sure to coordinate requirements with the drawings. Remove this paragraph if Wood Chips are not to be permitted.*

A. Wood Chips from an arborist chipping operation with less than 20% by volume green leaves. Chips stockpiled from the tree removal process may be used.

2.3 TREE PROTECTION FENCING:

Note to specifier: *Two fencing options are provided. The more robust chain link fencing is often*

required at urban sites where there are significant conflicts between tree preservation and other work tasks. Amend this specification and the tree protection details to be clear as to the required fencing. Remove the paragraph of the fence type that is not to be used. If both types are to be permitted coordinate with the drawings so that use is correctly identified.

A. PLASTIC MESH FENCE: Heavy - duty orange plastic mesh fencing fabric 48 inches wide. Fencing shall be attached to metal “U” or “T” post driven into the ground of sufficient depth to hold the fabric solidly in place with out sagging. The fabric shall be attached to the post using attachment ties of sufficient number and strength to hold up the fabric without sagging. The Owner’s Representative may request, at any time, additional post, deeper post depths and or additional fabric attachments if the fabric begins to sag, lean or otherwise not present a sufficient barrier to access.

B. CHAIN LINK FENCE: 6 feet tall metal chain link fence set in metal frame panels on movable core drilled concrete blocks of sufficient size to hold the fence erect in areas of existing paving to remain.

C. GATES: For each fence type and in each separate fenced area, provide a minimum of one 3 foot wide gate. Gates shall be lockable. The location of the gates shall be approved by the Owner's Representative.

D. Submit suppliers product data that product meets the requirements for approval.

2.4 TREE PROTECTION SIGN:

A. Heavy-duty cardboard signs, 8.5 inches x 11 inches, white colored background with black 2 inch high or larger letters block letters. The signs shall be attached to the tree protection fence every 50 feet o.c. The tree protection sign shall read “Tree and Plant Protection Area- Keep Out”.

2.5 TREE GROWTH REGULATOR (TGR)

A. Cambistat 25C.

B. Submit suppliers product data that product meets the requirements for approval.

2.6 MATTING

A. Matting for vehicle and work protection shall be heavy duty matting designed for vehicle loading over tree roots, Alturnamats as manufactured by Alturnamats, Inc. Franklin, PA 16323 or approved equal.

B. Submit suppliers product data that product meets the requirements for approval.

2.7 GEOGRID

A. Geogrid shall be woven polyester fabric with PVC coating, Uni-axial or biaxial geogrid, inert to biological degradation, resistant to naturally occurring chemicals, alkalis, acids.
   1. Geogrid shall be Miragrid 2XT as manufactured by Ten Cate Nicolon, Norcross, GA. http://www.tencate.com or approved equal.

B. Submit suppliers product data that product meets the requirements for approval.

2.8 FILTER FABRIC

A. Filter Fabric shall be nonwoven polypropylene fibers, inert to biological degradation and resistant of naturally occurring chemicals, alkalis and acids.
   1. Mirafi 135 N as manufactured by Ten Cate Nicolon, Norcross, GA. http://www.tencate.com or approved equal.

B. Submit suppliers product data that product meets the requirements for approval.

PART 3 – EXECUTION

3.1 SITE EXAMINATION

A. Examine the site, tree, plant and soil conditions. Notify the Owner’s Representative in writing of any conditions that may impact the successful Tree and Plant Protections that is the intent of this section.

3.2 COORDINATION WITH PROJECT WORK

A. The Contractor shall coordinate with all other work that may impact the completion of the work.

B. Prior to the start of Work, prepare a detailed schedule of the work for coordination with other trades.

C. Coordinate the relocation of any irrigation lines currently present on the irrigation plan, heads or the conduits of other utility lines or structures that are in conflict with tree locations. Root balls shall not be altered to fit around lines. Notify the Owner's Representative of any conflicts encountered.

3.3 TREE AND PLANT PROTECTION AREA: The Tree and Plant Protection Area is defined as all areas indicated on the tree protection plan. Where no limit of the Tree and Plant Protection area is defined on the drawings, the limit shall be the drip line (outer edge of the branch crown) of each tree.

3.4 PREPARATION:

A. Prior to the preconstruction meeting, layout the limits of the Tree and Plant Protection Area and then alignments of required Tree and Plant Protection Fencing and root pruning. Obtain the Owner's Representative's approval of the limits of the protection area and the alignment of all fencing and root pruning.

B. Flag all trees and shrubs to be removed by wrapping orange plastic ribbon around the trunk and obtain the Owner's Representative's approval of all trees and shrubs to be removed prior to the start of tree and shrub removal. After approval, mark all trees and shrubs to be removed with orange paint in a band completely around the base of the tree or shrub 4.5 feet above the ground.

C. Flag all trees and shrubs to remain with white plastic ribbon tied completely around the trunk or each tree and on a prominent branch for each shrub. Obtain the Owner's Representative's approval of all trees and shrubs to be remain prior to the start of tree and shrub removal.

D. Prior to any construction activity at the site including utility work, grading, storage of materials, or installation of temporary construction facilities, install all tree protection fencing, Filter Fabric, silt fence, tree protection signs, Geogrid, Mulch and or Wood Chips as shown on the drawings.

3.5 SOIL MOISTURE

A. Volumetric soil moisture level, in all soils within the Tree and Plant Protection Area shall be maintained above permanent wilt point to a depth of at least 8 inches. No soil work or other activity shall be permitted within the Tree and Plant Protection Area when the volumetric soil moisture is above field capacity. The permanent wilt point and field capacity for each type of soil texture shall be defined as follows (numbers indicate percentage volumetric soil moisture).

Soil type	**Permanent wilt point v/v**	**Field capacity v/v**
Sand, Loamy sand, Sandy loam	5-8%	12-18%
Loam, Sandy clay, Sandy clay loam	14-25%	27-36%
Clay loam, Silt loam	11-22%	31-36%
Silty clay, Silty clay loam	22-27%	38-41%

1. Volumetric soil moisture shall be measured with a digital, electric conductivity meter. The meter shall be the Digital Soil Moisture Meter, DSMM500 by General Specialty Tools and Instruments, or approved equivalent meter.

B. The Contractor shall confirm the soil moisture levels with a moisture meter. If the moisture is too high, suspend operations until the soil moisture drains to below field capacity.

3.6 ROOT PRUNING:

A. Prior to any excavating into the existing soil grade within 25 feet of the limit of the Tree and Plant Protection Area or trees to remain, root prune all existing trees to a depth of 24 inches below existing grade in alignments following the edges of the Tree and Plant Protection Area or as directed by the

Owner’s Representative. Root pruning shall be in conformance with ANSI A300 (part 8) latest edition.

1. Using a rock saw, chain trencher or similar trenching device, make a vertical cut within 2 feet of the limit of grading.
2. After completion of the cut, make clean cuts with a lopper, saw or pruner to remove all torn root ends on the tree side of the excavation, and backfill the trench immediately with existing soil, filling all voids.

3.7 INSTALLATION OF GEOGRIDS, FILTER FABRIC, MATTING, WOOD CHIPS AND OR MULCH

A. Install Geogrids, Filter Fabric, matting, Wood Chips and or Mulch in areas and depths shown on the plans and details or as directed by the Owner's representative. In general it is the intent of this specification to provide the following levels of protection:
   1. All areas within the Tree and Plant Protection area provide a minimum of 5 inches of Wood Chips or Mulch.
   2. Areas where foot traffic or storage of lightweight materials is anticipated to be unavoidable provide a layer of Filter Fabric under the 5 inches of Wood Chips or Mulch.
   3. Areas where occasional light vehicle traffic is anticipated to be unavoidable provide a layer of Geogrids under 8 inches of Wood Chips or Mulch.
   4. Areas where heavy vehicle traffic is unavoidable provide a layer of Geogrids under 8 - 12 inches of Wood Chips or Mulch and a layer of matting over the Wood Chips or Mulch.

B. The Owner's Representative shall approve the appropriate level of protection.

C. In the above requirements, light vehicle is defined as a track skid steer with a ground pressure of 4 psi or lighter. A heavy vehicle is any vehicle with a tire or track pressure of greater than 4 psi. Lightweight materials are any packaged materials that can be physically moved by hand into the location. Bulk materials such as soil, or aggregate shall never be stored within the Tree and Plant Protection Area.

3.8 PROTECTION:

A. Protect the Tree and Plant Protection Area at all times from compaction of the soil; damage of any kind to trunks, bark, branches, leaves and roots of all plants; and contamination of the soil, bark or leaves with construction materials, debris, silt, fuels, oils, and any chemicals substance. Notify the Owner’s Representative of any spills, compaction or damage and take corrective action immediately using methods approved by the Owner’s Representative.

3.9 GENERAL REQUIREMENTS AND LIMITATIONS FOR OPERATIONS WITHIN THE TREE AND PLANT PROTECTION AREA:

A. The Contractor shall not engage in any construction activity within the Tree and Plant Protection Area without the approval of the Owner's Representative including: operating, moving or storing equipment; storing supplies or materials; locating temporary facilities including trailers or portable toilets and shall not permit employees to traverse the area to access adjacent areas of the project or use the area for lunch or any other work breaks. Permitted activity, if any, within the Tree and Plant Protection Area maybe indicated on the drawings along with any required remedial activity as listed below.

B. In the event that construction activity is unavoidable within the Tree and Plant Protection Area, notify the Owner’s Representative and submit a detailed written plan of action for approval. The plan shall include: a statement detailing the reason for the activity including why other areas are not suited; a description of the proposed activity; the time period for the activity, and a list of remedial actions that will reduce the impact on the Tree and Plant Protection Area from the activity. Remedial actions shall include but shall not be limited to the following:
   1. In general, demolition and excavation within the drip line of trees and shrubs shall proceed with extreme care either by the use of hand tools, directional boring and or Air Knife excavation where indicated or with other low impact equipment that will not cause damage to the tree, roots or soil.
   2. When encountered, exposed roots, 1 inches and larger in diameter shall be worked around in a manner that does not break the outer layer of the root surface (bark). These roots shall be

covered in Wood Chips and shall be maintained above permanent wilt point at all times. Roots one inch and larger in diameter shall not be cut with out the approval of the owners representative. Excavation shall be tunneled under these roots without cutting them. In the areas where roots are encountered, work shall be performed and scheduled to close excavations as quickly as possible over exposed roots.

3. Tree branches that interfere with the construction may be tied back or pruned to clear only to the point necessary to complete the work. Other branches shall only be removed when specifically indicated by the Owner's Representative. Tying back or trimming of all branches and the cutting of roots shall be in accordance with accepted arboricultural practices (ANSI A300, part 8) and be performed under supervision of the arborist.
4. Matting: Install temporary matting over the Wood Chips or Mulch to the extent indicated. Do not permit foot traffic, scaffolding or the storage of materials within the Tree and Plant Protection Area to occur off of the temporary matting.
5. Trunk Protection: Protect the trunk of each tree to remain by covering it with a ring of 8 foot long 2 inch x 6 - inch planks loosely banded onto the tree with 3 steel bands. Staple the bands to the planks as necessary to hold them securely in place. Trunk protection must by kept in place no longer than 12 months. If construction requires work near a particular tree to continue longer than 12 months, the steel bands shall be inspected every six months and loosened if they are found to have become tight.
6. Air Excavation Tool: If excavation for footings or utilities is required within the Tree and Plant Protection Area, air excavation tool techniques shall be used where practical or as designed on the drawings.
    a. Remove the Wood Chips from an area approximately 18 inches beyond the limits of the hole or trench to be excavated. Cover the Wood Chips for a distance of not less than 15 feet around the limit of the excavation area with Filter Fabric or plastic sheeting to protect the Wood Chips from silt. Mound the Wood Chips so that the plastic slopes towards the excavation.
    b. Using a sprinkler or soaker hose, apply water slowly to the area of the excavation for a period of at least 4 hours, approximately 12 hours prior to the work so that the ground water level is at or near field capacity at the beginning of the work. For excavations that go beyond the damp soil, rewet the soil as necessary to keep soil moisture near field capacity.
    c. Using an air excavation tool specifically designed and manufactured for the intended purpose, and at pressures recommended by the manufacturer of the equipment, fracture the existing soil to the shape and the depths required. Work at rates and using techniques that do not harm tree roots. Air pressure shall be a maximum of 90-100 psi.
        1.) The air excavation tool shall be "Air-Spade" as manufactured by Concept Engineering Group, Inc., Verona, PA (412) 826-8800, or Air Knife as manufactured by Easy Use Air Tools, Inc. Allison Park, Pa (866) 328-5723 or approved equal.
    d. Using a commercial, high-powered vacuum truck if required, remove the soil from the excavation produced by the Air Knife excavation. The vacuum truck should generally operate simultaneously with the hose operator, such that the soil produced is picked up from the excavation hole, and the exposed roots can be observed and not damaged by the ongoing operation. Do not drive the vacuum truck into the Tree and Plant Protection Area unless the area is protected from compaction as approved in advance by the Owner's Representative.
    e. Remove all excavated soil and excavated Wood Chips, and contaminated soil at the end of the excavation.
    f. Schedule the work so that foundations or utility work is completed immediately after the excavation. Do not let the roots dry out. Mist the roots several times during the day. If the excavated area must remain open over night, mist the roots and cover the excavation with black plastic.
    g. Dispose of all soil in a manner that meets local laws and regulations.
    h. Restore soil within the trench as soon as the work is completed. Utilize soil of similar texture to the removed soil and lightly compact with hand tools. Leave soil mounded over the trench to a height of approximately 10% of the trench depth to account for settlement.
    i. Restore any Geogrids, Filter Fabric, Wood Chips or Mulch and or matting that was previously

required for the area.

3.10 TREE REMOVAL:

A. Remove all trees indicated by the drawings and specifications, as requiring removal, in a manner that will not damage adjacent trees or structures or compacts the soil.

B. Remove trees that are adjacent to trees or structures to remain, in sections, to limit the opportunity of damage to adjacent crowns, trunks, ground plane elements and structures.

C. Do not drop trees with a single cut unless the tree will fall in an area not included in the Tree and Plant Protection Area. No tree to be removed within 50 feet of the Tree and Plant Protection Area shall be pushed over or up-rooted using a piece of grading equipment.

D. Protect adjacent paving, soil, trees, shrubs, ground cover plantings and understory plants to remain from damage during all tree removal operations, and from construction operations. Protection shall include the root system, trunk, limbs, and crown from breakage or scarring, and the soil from compaction.

E. Remove stumps and immediate root plate from existing trees to be removed. Grind trunk bases and large buttress roots to a depth of the largest buttress root or at least 18 inches below the top most roots which ever is less and over the area of three times the diameter of the trunk (DBH).
   1. For trees where the stump will fall under new paved areas, grind roots to a total depth of 18 inches below the existing grade. If the sides of the stump hole still have greater than approximately 20% wood visible, continue grinding operation deeper and or wider until the resulting hole has less than 20% wood. Remove all wood chips produced by the grinding operation and back fill in 8 inch layers with controlled fill of a quality acceptable to the site engineer for fill material under structures, compacted to 95% of the maximum dry density standard proctor. The Owner's Representative shall approve each hole at the end of the grinding operation.
   2. In areas where the tree location is to be a planting bed or lawn, remove all woodchips and backfill stump holes with planting soil as defined in Specification Section Planting Soil, in maximum of 12 inch layers and compact to 80 - 85% of the maximum dry density standard proctor.

3.11 PRUNING:

A. Within six months of the estimated date of substantial completion, prune all dead or hazardous branches larger than 2 inch in diameter from all trees to remain.

B. Implement all pruning recommendations found in the arborist report.

C. Prune any low, hanging branches and vines from existing trees and shrubs that overhang walks, streets and drives, or parking areas as follows:
   1. Walks - within 8 feet vertically of the proposed walk elevation.
   2. Parking areas - within 12 feet vertically of the proposed parking surface elevation.
   3. Streets and drives - within 14 feet vertically of the proposed driving surface elevation.

D. All pruning shall be done in accordance with ANSI A300 (part 1), ISA BMP Tree Pruning (latest edition, and the "Structural Pruning: A Guide for the Green Industry", Edward Gilman, Brian Kempf, Nelda Matheny and Jim Clark, 2013 Urban Tree Foundation, Visalia CA.

E. Perform other pruning task as indicated on the drawings or requested by the Owner's Representative.

F. Where tree specific disease vectors require, sterilize all pruning tools between the work in individual trees.

3.12 TREE GROWTH REGULATOR INJECTION (TGR)

Note to specifier: *Confirm that Tree Growth Regulator is appropriate for the project. If not remove this paragraph and the TGR product in Part 2. If appropriate, be sure that the specific trees to be treated are labeled on the Tree and Plant Protection Plan. There is little data on the effectiveness of*

TGR treatments. Use you own judgment on including it in the requirements.

A. At the start of the construction contract period, treat all trees, indicated on the Plan, with Tree Growth Regulator at recommended rates, time of year and methods indicated by the product distributor.

3.13 WATERING

A. The Contractor shall be fully responsible to ensure that adequate water is provided to all plants to be preserved during the entire construction period. Adequate water is defined to be maintaining soil moisture above the permanent wilt point to a depth of 8 inches or greater.

B. The Contractor shall adjust the automatic irrigation system, if available, and apply additional water, using hoses or water tanks as required.

C. Periodically test the moisture content in the soil within the root zone to determine the water content.

3.14 WEED REMOVAL

A. During the construction period, control any plants that seed in and around the fenced Tree and Plant Protection area at least three times a year.
   1. All plants that are not shown on the planting plan or on the Tree and Plant Protection Plan to remain shall be considered as weeds.

B. At the end of the construction period provide one final weeding of the Tree and Plant Protection Area.

3.15 INSECT AND DISEASE CONTROL

A. Monitor all plants to remain for disease and insect infestations during the entire construction period. Provide all disease and insect control required to keep the plants in a healthy state using the principles of Integrated Plant Management (IPM). All pesticides shall be applied by a certified pesticide applicator.

3.16 CLEAN-UP

A. During tree and plant protection work, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.
   1. Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.

B. Once tree protection work is complete, wash all soil from pavements and other structures. Ensure that Mulch is confined to planting beds.

C. Make all repairs to grades, ruts, and damage to the work or other work at the site.

D. Remove and dispose of all excess Mulch, Wood Chips, packaging, and other material brought to the site by the Contractor.

3.17 REMOVAL OF FENCING AND OTHER TREE AND PLANT PROTECTION

A. At the end of the construction period or when requested by the Owner's Representative remove all fencing, Wood Chips or Mulch, Geogrids and Filter Fabric, trunk protection and or any other Tree and Plant Protection material.

3.18 DAMAGE OR LOSS TO EXISTING PLANTS TO REMAIN

Note to specifier: *This clause is not written to cover high value heritage trees. A specification to address high value heritage trees should be added here if any exist on the project.*

A. Any trees or plants designated to remain and which are damaged by the Contractor shall be replaced in kind by the Contractor at their own expense. Trees shall be replaced with a tree of similar species and of equal size or 6 inch caliper which ever is less. Shrubs shall be replaced with a plant of similar species and equal size or the largest size plants reasonably available which ever is less. Where replacement plants are to be less than the size of the plant that is damaged, the Owner's

Representative shall approve the size and quality of the replacement plant.

1. All trees and plants shall be installed per the requirements of Specification Section Planting.

B. Plants that are damaged shall be considered as requiring replacement or appraisal in the event that the damage affects more than 25 % of the crown, 25% of the trunk circumference, or root protection area, or the tree is damaged in such a manner that the tree could develop into a potential hazard. Trees and shrubs to be replaced shall be removed by the Contractor at his own expense.

1. The Owner's Representative may engage an independent arborist to assess any tree or plant that appears to have been damaged to determine their health or condition.

C. Any tree that is determined to be dead, damaged or potentially hazardous by the Owner's arborist and upon the request of the Owner's Representative shall be immediately removed by the Contractor at no additional expense to the owner. Tree removal shall include all clean up of all wood parts and grinding of the stump to a depth sufficient to plant the replacement tree or plant, removal of all chips from the stump site and filling the resulting hole with topsoil.

D. Any remedial work on damaged existing plants recommended by the consulting arborist shall be completed by the Contractor at no cost to the owner. Remedial work shall include but is not limited to: soil compaction remediation and vertical mulching, pruning and or cabling, insect and disease control including injections, compensatory watering, additional mulching, and could include application tree growth regulators (TGR).

E. Remedial work may extend up to two years following the completion of construction to allow for any requirements of multiple applications or the need to undertake applications at required seasons of the year.

END OF SECTION 015639

ATTACHMENT

C.3.j.ii. Early Implementation of Green Infrastructure Projects

Guidance for Identifying Green Infrastructure Potential in Municipal Capital Improvement Program Projects

BASMAA Development Committee

Guidance for Identifying Green Infrastructure Potential
in Municipal Capital Improvement Program Projects
May 6, 2016

Background

In the recently reissued Municipal Regional Stormwater Permit ("MRP 2.0"), Provision C.3.j. requires Permittees to develop and implement Green Infrastructure Plans to reduce the adverse water quality impacts of urbanization on receiving waters over the long term. Provisions C.11 and C.12 require the Permittees to reduce discharges of Mercury and PCBs, and portion of these load reductions must be achieved by implementing Green Infrastructure. Specifically, Permittees collectively must implement Green Infrastructure to reduce mercury loading by 48 grams/year and PCB loading by 120 grams/year by 2020, and plan for substantially larger reductions in the following decades. Green Infrastructure on both public and private land will help to meet these load reduction requirements, improve water quality, and provide multiple other benefits as well. Implementation on private land is achieved by implementing stormwater requirements for new development and redevelopment (Provision C.3.a. through Provision C.3.i.). These requirements were carried forward, largely unchanged, from MRP 1.0.

MRP 2.0 defines Green Infrastructure as:

> Infrastructure that uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems that mimic nature by soaking up and storing water.

In practical terms, most green infrastructure will take the form of diverting runoff from existing streets, roofs, and parking lots to one of two stormwater management strategies:

1. Dispersal to vegetated areas, where sufficient landscaped area is available and slopes are not too steep.
2. LID (bioretention and infiltration) facilities, built according to criteria similar to those currently required for regulated private development and redevelopment projects under Provision C.3.

In some cases, the use of tree-box-type biofilters may be appropriate[1]. In other cases, where conditions are appropriate, existing impervious pavements may be removed and replaced with pervious pavements.

In MRP 2.0, Provision C.3.j. includes requirements for Green Infrastructure planning and implementation. Provision C.3.j. has two main elements to be implemented by municipalities:

1. Preparation of a Green Infrastructure Plan for the inclusion of LID drainage design into storm drain infrastructure on public and private land, including streets, roads, storm drains, etc.
2. Early implementation of green infrastructure projects ("no missed opportunities"),

This guidance addresses the second of these requirements. The intent of the "no missed opportunities" requirement is to ensure that no major infrastructure project is built without assessing the opportunity for incorporation of green infrastructure features.

Provision C.3.j.ii. requires that each Permittee prepare and maintain a list of green infrastructure projects, public and private, that are already planned for implementation during the permit term (not including C.3-regulated projects), and infrastructure projects planned for

[1] Standard proprietary tree-box-type biofilters are considered to be non-LID treatment and will only be allowed under certain circumstances. Guidance on use and sizing of these facilities will be provided in a separate document.

implementation during the permit term that have potential for green infrastructure measures. The list must be submitted with each Annual Report, including:

> "… a summary of how each public infrastructure project with green infrastructure potential will include green infrastructure measures to the maximum extent practical during the permit term. For any public infrastructure project where implementation of green infrastructure measures is not practicable, submit a brief description for the project and the reasons green infrastructure measures were impracticable to implement".

This requirement has no specified start date; "during the permit term" means beginning January 1, 2016 and before December 31, 2020. The first Annual Report submittal date will be September 30, 2016.

Note that this guidance primarily addresses the review of proposed or planned public projects for green infrastructure opportunities. The Permittee may also be aware of proposed or planned private projects, not subject to LID treatment requirements, that may have the opportunity to incorporate green infrastructure. These should be addressed in the same way as planned public projects, as described below.

Procedure for Review of Planned Public Projects and Annual Reporting

The municipality's Capital Improvement Program (CIP) project list provides a good starting point for review of proposed public infrastructure projects. Review of other lists of public infrastructure projects, such as those proposed within separately funded special districts (e.g., lighting and landscape districts, maintenance districts, and community facilities districts), may also be appropriate. This section describes a two-part procedure for conducting the review.

Part 1 – Initial Screening

The first step in reviewing a CIP or other public project list is to screen out certain types of projects from further consideration. For example, some projects (e.g., interior remodels, traffic signal replacement) can be readily identified as having no green infrastructure potential. Other projects may appear on the list with only a title, and it may be too early to identify whether green infrastructure could be included. Still others have already progressed past the point where the design can reasonably be changed (this will vary from project to project, depending on available budget and schedule).

Some "projects" listed in a CIP may provide budget for multiple maintenance or minor construction projects throughout the jurisdiction or a portion of the jurisdiction, such as a tree planting program, curb and sidewalk repair/upgrade, or ADA curb/ramp compliance. It is recommended that these types of projects not be included in the review process described herein. The priority for incorporating green infrastructure into these types of projects needs to be assessed as part of the Permittees' development of Green Infrastructure Plans, and standard details and specifications need to be developed and adopted. During this permit term, Permittees will evaluate select projects, project types, and/or groups of projects as case studies and develop an approach as part of Green Infrastructure planning.

The projects removed through the initial screening process do not need to be reported to the Water Board in the Permittee's Annual Report. However, the process should be documented and records kept as to the reason the project was removed from further consideration. Note that projects that were determined to be too early to assess will need to be reassessed during the next fiscal year's review.

The following categories of projects may be screened out of the review process in a given fiscal year:

1. **Projects with No Potential -** The project is identified in initial screening as having no green infrastructure potential based on the type of project. For example, the project does not include any exterior work. Attachment 1 provides a suggested list of such projects that Permittees may use as a model for their own internal process.

2. **Projects Too Early to Assess –** There is not yet enough information to assess the project for green infrastructure potential, or the project is not scheduled to begin design within the permit term (January 2016 – December 2020). If the project is scheduled to begin within the permit term, an assessment will be conducted if and when the project moves forward to conceptual design.
3. **Projects Too Late to Change –** The project is under construction or has moved to a stage of design in which changes cannot be made. The stage of design at which it is too late to incorporate green infrastructure measures varies with each project, so a "percent-complete" threshold has not been defined. Some projects may have funding tied to a particular conceptual design and changes cannot be made even early in the design process, while others may have adequate budget and time within the construction schedule to make changes late in the design process. Agencies will need to make judgments on a case-by-case basis.
4. **Projects Consisting of Maintenance or Minor Construction Work Orders –** The "project" includes budgets for multiple maintenance or minor construction work orders throughout the jurisdiction or a portion of the jurisdiction. These types of projects will not be individually reviewed for green infrastructure opportunity but will be considered as part of a municipality's Green Infrastructure Plan.

Part 2 – Assessment of Green Infrastructure Potential

After the initial screening, the remaining projects either already include green infrastructure or will need to go through an assessment process to determine whether or not there is potential to incorporate green infrastructure. A recommended process for conducting the assessment is provided later in this guidance. As a result of the assessment, the project will fall into one of the following categories with associated annual reporting requirements. Attachment 2 provides the relevant pages of the FY 15-16 Annual Report template for reference.

- **Project is a C.3-regulated project and will include LID treatment.**

  Reporting: Follow current C.3 guidance and report the project in Table C.3.b.iv.(2) of the Annual Report for the fiscal year in which the project is approved.

- **Project already includes green infrastructure and is funded**.

  Reporting: List the project in "Table B-Planned Green Infrastructure Projects" in the Annual Report, indicate the planning or implementation status, and describe the green infrastructure measures to be included.

- **Project may have green infrastructure potential** pending further assessment of feasibility, incremental cost, and availability of funding.

  Reporting: If the feasibility assessment is not complete and/or funding has not been identified, list the project in "Table A-Public Projects Reviewed for Green Infrastructure" in the Annual Report. In the "GI Included?" column, state either "TBD" (to be determined) if the assessment is not complete, or "Yes" if it has been determined that green infrastructure is feasible. In the rightmost column, describe the green infrastructure measures considered and/or proposed, and note the funding and other contingencies for inclusion of green infrastructure in the project. Once funding for the project has been identified, the project should be moved to "Table B-Planned Green Infrastructure Projects" in future Annual Reports.

- **Project does not have green infrastructure potential.** A project-specific assessment has been completed, and Green Infrastructure is impracticable.

  Reporting: In the Annual Report, list the project in "Table A-Public Projects Reviewed for Green Infrastructure". In the "GI Included?" column, state "No." Briefly state the reasons for the determination in the rightmost column. Prepare more detailed documentation of the reasons for the determination and keep it in the project files.

Process for Assessing Green Infrastructure Potential of a Public Infrastructure Project

Initial Assessment of Green Infrastructure Potential

Consider opportunities that may be associated with:

- Alterations to roof drainage from existing buildings
- New or replaced pavement or drainage structures (including gutters, inlets, or pipes)
- Concrete work
- Landscaping, including tree planting
- Streetscape improvements and intersection improvements (other than signals)

Step 1: Information Collection/Reconnaissance

For projects that include alterations to building drainage, identify the locations of roof leaders and downspouts, and where they discharge or where they are connected to storm drains.

For street and landscape projects:

- Evaluate potential opportunities to substitute pervious pavements for impervious pavements.
- Identify and locate drainage structures, including storm drain inlets or catch basins.
- Identify and locate drainage pathways, including curb and gutter.

Identify landscaped areas and paved areas that are adjacent to, or down gradient from, roofs or pavement. These are potential facility locations. *If there are any such locations, continue to the next step.* Note that the project area boundaries may be, but are not required to be, expanded to include potential green infrastructure facilities.

Step 2: Preliminary Sizing and Drainage Analysis

Beginning with the potential LID facility locations that seem most feasible, identify possible pathways to direct drainage from roofs and/or pavement to potential LID facility locations—by sheet flow, valley gutters, trench drains, or (where gradients are steeper) via pipes, based on existing grades and drainage patterns. Where existing grades constrain natural drainage to potential facilities, the use of pumps may be considered (as a less preferable option).

Delineate (roughly) the drainage area tributary to each potential LID facility location. Typically, this requires site reconnaissance, which may or may not include the use of a level to measure relative elevations.

Use the following preliminary sizing factor (facility area/tributary area) for the potential facility location and determine which of the following could be constructed within the existing right-of-way or adjacent vacant land. Note that these sizing factors are guidelines (not strict rules, but targets):

- Sizing factor ≥ 0.5 for dispersal to landscape or pervious pavement[2] (i.e., a maximum 2:1 ratio of impervious area to pervious area)
- Sizing factor ≥ 0.04 for bioretention
- Sizing factor ≥ 0.004 (or less) for tree-box-type biofilters

For bioretention facilities requiring underdrains and tree-box-type biofilters, note if there are potential connections from the underdrain to the storm drain system (typically 2.0 feet below soil surface for bioretention facilities, and 3.5 feet below surface for tree-box-type biofilters).

[2] Note that pervious pavement systems are typically designed to infiltrate only the rain falling on the pervious pavement itself, with the allowance for small quantities of runoff from adjacent impervious areas. If significant runoff from adjacent areas is anticipated, preliminary sizing considerations should include evaluation of the depth of drain rock layer needed based on permeability of site soils.

If, in this step, you have confirmed there may be feasible potential facility locations, *continue to the next step*.

Step 3: Barriers and Conflicts

Note that barriers and conflicts do not necessarily mean implementation is infeasible; however, they need to be identified and taken into account in future decision-making, as they may affect cost or public acceptance of the project.

Note issues such as:

- Confirmed or potential conflicts with subsurface utilities
- Known or unknown issues with property ownership, or need for acquisition or easements
- Availability of water supply for irrigation, or lack thereof
- Extent to which green infrastructure is an "add on" vs. integrated with the rest of the project

Step 4: Project Budget and Schedule

Consider sources of funding that may be available for green infrastructure. It is recognized that lack of budget may be a serious constraint for the addition of green infrastructure in public projects. For example, acquisition of additional right-of-way or easements for roadway projects is not always possible. Short and long term maintenance costs also need to be considered, and jurisdictions may not have a funding source for landscape maintenance, especially along roadways. The objective of this process is to identify opportunities for green infrastructure, so that if and when funding becomes available, implementation may be possible.

Note any constraints on the project schedule, such as a regulatory mandate to complete the project by a specific date, grant requirements, etc., that could complicate aligning a separate funding stream for the green infrastructure element. Consider whether cost savings could be achieved by integrating the project with other planned projects, such as pedestrian or bicycle safety improvement projects, street beautification, etc., if the schedule allows.

Step 5: Assessment—Does the Project Have Green Infrastructure Potential?

Consider the ancillary benefits of green infrastructure, including opportunities for improving the quality of public spaces, providing parks and play areas, providing habitat, urban forestry, mitigating heat island effects, aesthetics, and other valuable enhancements to quality of life.

Based on the information above, would it make sense to include green infrastructure into this project—*if funding were available for the potential incremental costs of including green infrastructure in the project?* Identify any additional conditions that would have to be met for green infrastructure elements to be constructed consequent with the project.

Attachment 1

Examples of Projects with No Potential for Green Infrastructure

- ☐ Projects with no exterior work (e.g., interior remodels)
- ☐ Projects involving exterior building upgrades or equipment (e.g., HVAC, solar panels, window replacement, roof repairs and maintenance)
- ☐ Projects related to development and/or continued funding of municipal programs or related organizations
- ☐ Projects related to technical studies, mapping, aerial photography, surveying, database development/upgrades, monitoring, training, or update of standard specs and details
- ☐ Construction of new streetlights, traffic signals or communication facilities
- ☐ Minor bridge and culvert repairs/replacement
- ☐ Non-stormwater utility projects (e.g., sewer or water main repairs/replacement, utility undergrounding, treatment plant upgrades)
- ☐ Equipment purchase or maintenance (including vehicles, street or park furniture, equipment for sports fields and golf courses, etc.)
- ☐ Irrigation system installation, upgrades or repairs

Attachment 2

Excerpts from the C.3 Section of the FY 15-16 Annual Report Template:
Tables for Reporting C.3-Regulated Projects and Green Infrastructure Projects

C.3.b.iv.(2) ►Regulated Projects Reporting Table (part 1) – Projects Approved During the Fiscal Year Reporting Period

Project Name Project No.	Project Location[9], Street Address	Name of Developer	Project Phase No.[10]	Project Type & Description[11]	Project Watershed[12]	Total Site Area (Acres)	Total Area of Land Disturbed (Acres)	Total New Impervious Surface Area (ft^2)[13]	Total Replaced Impervious Surface Area (ft^2)[14]	Total Pre-Project Impervious Surface Area[15](ft^2)	Total Post-Project Impervious Surface Area[16](ft^2)
Private Projects											
Public Projects											

Comments:

Guidance: If necessary, provide any additional details or clarifications needed about listed projects in this box. Do not leave any cells blank.

[9]Include cross streets
[10]If a project is being constructed in phases, indicate the phase number and use a separate row entry for each phase. If not, enter "NA".
[11]Project Type is the type of development (i.e., new and/or redevelopment). Example descriptions of development are: 5-story office building, residential with 160 single-family homes with five 4-story buildings to contain 200 condominiums, 100 unit 2-story shopping mall, mixed use retail and residential development (apartments), industrial warehouse.
[12]State the watershed(s) in which the Regulated Project is located. Downstream watershed(s) may be included, but this is optional.
[13]All impervious surfaces added to any area of the site that was previously existing pervious surface.
[14]All impervious surfaces added to any area of the site that was previously existing impervious surface.
[15]For redevelopment projects, state the pre-project impervious surface area.
[16]For redevelopment projects, state the post-project impervious surface area.

C.3.b.iv.(2) ►Regulated Projects Reporting Table (part 2) – Projects Approved During the Fiscal Year Reporting Period (public projects)

Project Name Project No.	Approval Date[29]	Date Construction Scheduled to Begin	Source Control Measures[30]	Site Design Measures[31]	Treatment Systems Approved[32]	Operation & Maintenance Responsibility Mechanism[33]	Hydraulic Sizing Criteria[34]	Alternative Compliance Measures[35/36]	Alternative Certification[37]	HM Controls[38/39]
Public Projects										

Comments:

Guidance: If necessary, provide any additional details or clarifications needed about listed projects in this box. Note that MRP Provision C.3.c. contains specific requirements for LID site design and source control measures, as well as treatment measures, for all Regulated Projects. Entries in these columns should not be "None" or "NA". Do not leave any cells blank.

[29]For public projects, enter the plans and specifications approval date.
[30]List source control measures approved for the project. Examples include: properly designed trash storage areas; storm drain stenciling or signage; efficient landscape irrigation systems; etc.
[31]List site design measures approved for the project. Examples include: minimize impervious surfaces; conserve natural areas, including existing trees or other vegetation, and soils; construct sidewalks, walkways, and/or patios with permeable surfaces, etc.
[32]List all approved stormwater treatment system(s) to be installed onsite or at a joint stormwater treatment facility (e.g., flow through planter, bioretention facility, infiltration basin, etc.).
[33]List the legal mechanism(s) (e.g., maintenance plan for O&M by public entity, etc…) that have been or will be used to assign responsibility for the maintenance of the post-construction stormwater treatment systems.
[34]See Provision C.3.d.i. "Numeric Sizing Criteria for Stormwater Treatment Systems" for list of hydraulic sizing design criteria. Enter the corresponding provision number of the appropriate criterion (i.e., 1.a., 1.b., 2.a., 2.b., 2.c., or 3).
[35]For Alternative Compliance at an offsite location in accordance with Provision C.3.e.i.(1), on a separate page, give a discussion of the alternative compliance site including the information specified in Provision C.3.b.v.(1)(m)(i) for the offsite project.
[36]For Alternative Compliance by paying in-lieu fees in accordance with Provision C.3.e.i.(2), on a separate page, provide the information specified in Provision C.3.b.v.(1)(m)(ii) for the Regional Project.
[37]Note whether a third party was used to certify the project design complies with Provision C.3.d.
[38]If HM control is not required, state why not.
[39]If HM control is required, state control method used (e.g., method to design and size device(s) or method(s) used to meet the HM Standard, and description of device(s) or method(s) used, such as detention basin(s), biodetention unit(s), regional detention basin, or in-stream control).

C.3.j.ii.(2) ► Table A - Public Projects Reviewed for Green Infrastructure

Project Name and Location[43]	Project Description	Status[44]	GI Included?[45]	Description of GI Measures Considered and/or Proposed or Why GI is Impracticable to Implement[46]
EXAMPLE: Storm drain retrofit, Stockton and Taylor	Installation of new storm drain to accommodate the 10-yr storm event	Beginning planning and design phase	TBD	Bioretention cells (i.e., linear bulb-outs) will be considered when street modification designs are incorporated

C.3.j.ii.(2) ► Table B - Planned Green Infrastructure Projects

Project Name and Location[47]	Project Description	Planning or Implementation Status	Green Infrastructure Measures Included
EXAMPLE: Martha Gardens Green Alleys Project	Retrofit of degraded pavement in urban alleyways lacking good drainage	Construction completed October 17, 2015	The project drains replaced concrete pavement and existing adjacent structures to a center strip of pervious pavement and underlying infiltration trench.

[43] List each public project that is going through your agency's process for identifying projects with green infrastructure potential.
[44] Indicate status of project, such as: beginning design, under design (or X% design), projected completion date, completed final design date, etc.
[45] Enter "Yes" if project will include GI measures, "No" if GI measures are impracticable to implement, or "TBD" if this has not yet been determined.
[46] Provide a summary of how each public infrastructure project with green infrastructure potential will include green infrastructure measures to the maximum extent practicable during the permit term. If review of the project indicates that implementation of green infrastructure measures is not practicable, provide the reasons why green infrastructure measures are impracticable to implement.
[47] List each planned (and expected to be funded) public and private green infrastructure project that is not also a Regulated Project as defined in Provision C.3.b.ii. Note that funding for green infrastructure components may be anticipated but is not guaranteed to be available or sufficient.

ATTACHMENT

C.3.j.iii. Participate in Processes to Promote Green Infrastructure

Scope of Work – *Urban Greening Bay Area*

B A S M A A

Urban Greening Bay Area
Scope of Work

Introduction: The Bay Area Stormwater Management Agencies Association (BASMAA) is contracting with the Association of Bay Area Governments (ABAG)/San Francisco Estuary Partnership (SFEP) to manage and execute the Green Infrastructure Roundtable and Design Charrette elements of the Urban Greening Bay Area project funded by the US EPA's San Francisco Bay Water Quality Improvement Fund 2015 grant program.

Task 1 – Task Management
Subcontract with qualified consultants to assist with the performance of the listed tasks. Coordinate with SFEP, consultants, and partner cities (San Mateo and Sunnyvale) to ensure the tasks are completed on time and on budget. Submit quarterly reports and invoices, information for administrative and financial reports prepared by SFEP (e.g., FFR, MBE/WBE utilization, progress reports, final report), and deliverables as completed.

Task 1. Deliverables
A. Quarterly Reports and Invoices
B. Information for administrative and financial reports

Task 2 – Regional Roundtable
Organize and staff a two year Green Infrastructure Roundtable process, with work groups as needed, to identify and develop a list of recommendations for integrating green infrastructure and stormwater management funding and investments with future climate change and transportation investments within the region. The Roundtable will include convening up to 12 meetings with local, regional, and state stakeholders, agencies, elected officials, and staff to produce draft and final task reports that will identify and recommend possible legislative fixes, agency agreements, consolidated funding mechanisms, and other means and actions as appropriate. The Roundtable is envisioned as a two year effort using innovative participatory processes that will include key experts, regulators, decision-makers, and other stakeholders to share information, solicit and discuss ideas and solutions, and to identify next steps (i.e., a roadmap), which will be summarized in the draft and final task reports.

Task 2a: Planning. Build a task team of BASMAA, SFEP, US EPA, the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB), and municipal representatives, as appropriate, to further identify goals, desired outcomes, meeting formats, schedule, and Roundtable participants. Prepare a project briefing sheet, including statement of purpose and summary of tasks and schedule, fact sheets, or other outreach information to help introduce the task to key stakeholders and encourage participation. Conduct informational interviews as an initial step to assist in designing the Roundtable process, and prepare interview summaries. Prepare a Draft and Final Roundtable Strategy that describes the approach and plan for conducting Task 2.

In addition to the task team, an advisory team may be established of high-level stakeholders that may be key to achieving task goals (see Task 2c). Schedule meeting locations and dates. Identify and subcontract with partners and technical experts, as appropriate. Develop a list of key experts, regulators, decision-makers, and other stakeholders to invite to the various Roundtable meetings and send out invitations.

Task 2b: Roundtable Meetings. Convene up to 12 meetings with key agency stakeholders, interested environmental/policy organizations, and technical experts. The meeting presentations and discussions will be summarized in the draft and final task reports that will serve as a roadmap for needed next steps to integrate green infrastructure and stormwater management funding and programs with future climate change and transportation investments in the Bay Area. The goals of the meetings are to:

- Educate participants on the drivers for a long-term distributed green infrastructure approach for meeting stormwater regulatory requirements;
- Illustrate the challenges in funding such an approach strictly from a stormwater perspective; with a particular emphasis to:
    - Quantify the numerous green infrastructure benefits beyond water quality improvement;
    - Demonstrate the ways green infrastructure can be effectively integrated with active transportation investments intended to achieve greenhouse gas emission reductions and climate change adaptation;
    - Highlight the current barriers and challenges to such an integrated approach from the perspective of planning, design and implementation; and,
    - Develop recommendations on how to effectively integrate green infrastructure with these future transportation and stormwater management infrastructure investments.

Task 2c: Expert Input. Identify key experts knowledgeable about green infrastructure, stormwater management, and climate change and transportation funding and investments. Work with experts on quantification of benefits and innovative finance, including identification of tools. Solicit experts to participate in appropriate Roundtable meetings/forums to apply their expertise and help problem solve particular issues key to achieving task goals.

Task 2d: Roundtable Report. Draft a comprehensive report on Task 2, including a roadmap for integrating green infrastructure and stormwater management funding and programs with future climate change and transportation investments in the Bay Area. The roadmap will identify key policies, documents, legislation, agencies, and specific actions needed to effectively integrate and fund green infrastructure and stormwater management with transportation programs and funding mechanisms. The intended audience includes entities that play a role in implementing solutions, and is expected to include the State legislature, the Metropolitan Transportation Commission, ABAG, the Strategic Growth Council, the Department of Water Resources, the State Water Resources Control Board and SFBRWQCB, county congestion management agencies, and municipal stormwater management agencies and associations.

Task 2. Deliverables

A. Outreach Information
B. Interview Summaries
C. Draft and Final Roundtable Strategy
    - Outline
    - Draft Strategy
    - Final Strategy
D. Meeting Agendas, Meeting Summaries, and Lists of Meeting Attendees
E. Draft and Final Roundtable Report (i.e., roadmap)
    - Outline
    - 1st Draft Report
    - 2nd Draft Report
    - Final Report

Task 3 – Design Charrette

Coordinate with the cities of Sunnyvale and San Mateo to conduct a Bay Area design charrette to develop cost-effective and innovative "standard" designs for integrating green infrastructure with bicycle and pedestrian improvements at roadway intersections. The overall goal of developing standardized, transferable designs is to make progress in addressing the high cost of design, implementation, operations, and maintenance that inhibits the widespread use of green infrastructure and LID features. The charrette will utilize actual intersection locations in San Mateo and Sunnyvale that are as representative as possible of the common features of road segments that make up intersections found throughout Bay Area cities. Charrette participants will be solicited by BASMAA and will include multiple representatives, including contractors, engineers, landscape architects, plant specialists, and city transportation engineers and planners, and design, construction management, and operations and maintenance staff. Final designs will be constructed at the San Mateo and Sunnyvale locations to verify costs and serve as demonstration projects for other agencies throughout the Bay Area.

Task 3a: Charrette Pre-Coordination. Convene advisory committee of SFEP, BASMAA, US EPA, and San Mateo/Sunnyvale representatives. Purpose of the committee will be to provide advice on design of the charrette. The grant Project Team may serve as the advisory committee on this task.

Task 3b: Site Identification. Coordinate with San Mateo and Sunnyvale staffs to identify intersections in those cities with common features of road segments with a focus on characterizing typical stormwater management and active transportation scenarios, such as parallel vs. angled parking, pedestrian bulbouts, storm drain inlet locations, presence or absence of bike lanes, etc. Estimate the relative frequency of occurrence of the road segment features in Bay Area cities. Summarize the results of this task in a technical memorandum.

Task 3c: Call for Charrette Participants. Issue a Request for Qualifications (RFQ) from contractors and engineering/landscape architecture design firms identifying individuals interested in participating in the design charrette and providing statements of qualifications (SOQs).

Task 3d: Select Charrette Panel. Grantee representatives will perform an SOQ review process that may include interviews to select a diverse design panel that will participate in the design charrette, with the goal to have representation from individuals throughout the design, construction, and operations and maintenance phases of projects.

Task 3e: Site Visits/Information Compilation. Convene charrette participants to tour the San Mateo and Sunnyvale site locations and identify necessary design information to be provided by cities to enable the charrette to proceed. Cities will then compile the necessary information.

Task 3f: Design Charrette. Host a design charrette event, at which participants will be educated on the overall goals and desired outcomes of the process, the group will develop, discuss, and evaluate various design alternatives to identify the most cost-effective integrated solution. Outputs will be transferable design details that can be used by all agencies.

Task 3g: Final Designs Support. Provide outputs and relevant related information from Task 3f to San Mateo and Sunnyvale. Cities will work with the design charrette team to finalize the designs to 100% designs with necessary plans, specifications, and cost estimates in preparation for bidding.

Task 3h: Bidding and Construction. San Mateo and Sunnyvale will initiate and manage bid processes for the final designs, award contracts to winning bidders, issue notices-to-proceed, and manage construction.

Task 3i: Charrette Summary. BASMAA and SFEP will develop an electronic summary for web posting of the charrette results, final designs, photos of constructed projects, and lessons learned. Package and distribute designs and standard details to Bay Area municipal and regional governments to support future planning and implementation efforts.

Task 3j: Outreach. BASMAA and SFEP will perform outreach to generate interest and participation in the charrette, generate press coverage of the process, final designs, and constructed projects, as well as post-charrette debriefs, potentially through conference or other meeting presentations.

Task 3. Deliverables

A. Site Identification Technical Memorandum
B. Information Compilations
C. Design Details
D. Charrette Summary
    - Draft Summary
    - Final Summary
E. Outreach Presentation

ATTACHMENT

C.3.j.iii. Participate in Processes to Promote Green Infrastructure

BASMAA comments to the Air Resources Board on the Urban Greening and Green Infrastructure Section of the Natural and Working Lands Discussion Paper

Alameda Countywide Clean Water Program

Contra Costa Clean Water Program

Fairfield-Suisun Urban Runoff Management Program

Marin County Stormwater Pollution Prevention Program

Napa County Stormwater Pollution Prevention Program

San Mateo Countywide Water Pollution Prevention Program

Santa Clara Valley Urban Runoff Pollution Prevention Program

Sonoma County Water Agency

Vallejo Sanitation and Flood Control District

B A S M A A

May 3, 2016

Mary Nichols, Chair
Air Resources Board
1001 I St.
Sacramento, CA 95814

Subject: Comments on the Urban Greening and Green Infrastructure Section of the Natural and Working Lands Discussion Paper

Dear Ms. Nichols:

On behalf of the Bay Area Stormwater Management Agencies Association (BASMAA)[1] thank you for the opportunity to provide comments on the Urban Greening and Green Infrastructure Section of the Natural and Working Lands Discussion Paper. Below are some general comments followed by comments on the discussion topics and questions at the end of the Discussion Paper. The main purpose for our commenting is to point out the many natural linkages between stormwater quality management, transportation planning, greenhouse gas reductions, and climate change mitigation strategies. And having recognized those linkages, to suggest actions that would take advantage of those linkages to effect the goals of California's Climate Change Scoping Plan.

General Comments:

Green infrastructure (GI) has a direct connection with water, both through stormwater capture, treatment, and infiltration, and recharging groundwater and stream flows. GI is also directly connected to transportation as a means of treating polluted runoff from roadways, which are the primary surface conveyance system for stormwater runoff. Transportation infrastructure and vehicles have two primary environmental impacts: 1) air quality impacts through vehicle emissions, and 2) water quality impacts from stormwater runoff. As such, GI should be directly incorporated into both the water and transportation sectors, with sector-specific goals and objectives adopted in regard to GI's connection with both.

Quantitative Targets Questions:

Stormwater management is likely the primary driver for implementing green infrastructure in California in response to municipal stormwater permit mandates adopted by the State and Regional Water Boards. As such, it may be most appropriate to establish targets connected to stormwater management requirements, with secondary targets related to issues such as urban heat island reduction or carbon sequestration. It may be appropriate to establish specific targets for pollutant removal, greened acreage, treated acres of roadway, and/or stormwater volumes captured.

Bay Area

Stormwater Management

Agencies Association

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[1] BASMAA is a 501(c)(3) non-profit organization comprised of the municipal stormwater programs in the San Francisco Bay Area representing 100 agencies, including 85 cities and towns, 8 counties, and 7 special districts. BASMAA focuses on regional challenges and opportunities to improve the quality of stormwater flowing to our local creeks, the Delta, San Francisco Bay, and the Pacific Ocean.

Stormwater management via green infrastructure is already being mandated throughout the state via municipal stormwater permits. Green infrastructure, in the form of Low Impact Development, is mandated for most new and redevelopment projects throughout the state. Municipalities are required to achieve pollutant load reductions, in the form of Total Maximum Daily Loads, via management measures that are frequently GI-based.

For example, municipalities regulated under the San Francisco Bay Regional Water Board's Municipal Regional Permit are required to develop GI Plans designed to achieve 3 kg/year reduction in PCBs discharging to San Francisco Bay by 2040. Local agencies are also mandated to develop Stormwater Resource Plans that identify and prioritize stormwater capture projects in order to compete for voter-approved bond funding. Quantitative targets for stormwater treatment could be developed in coordination with the State and Regional Water Boards to reflect the mandates already in place related to GI. Targets for pollutant reduction, greened acreage, and/or stormwater volumes captured can be connected to funding programs for implementing GI Plans, Stormwater Resource Plans, or Watershed Management Plans.

Targets will likely need to be regional based on the stormwater management mandates set by the State and Regional Water Boards. Regional targets also make more sense for issues like urban heat island reduction, which is likely different region to region.

The appropriate timescale is likely decades, given that it will require costly retrofit of urban infrastructure developed over the past century or more to achieve the targets.

Regarding implementation mechanisms, municipal stormwater mandates are likely the most significant existing mechanism pushing GI implementation; however, stormwater management is also the most under-resourced utility throughout the state due to the constitutional restrictions imposed by Proposition 218 on generating new or increased stormwater fees. As such, programs that support municipal implementation of GI to achieve water quality mandates are key for widespread deployment of GI. One of the most important changes that could be made to support GI implementation is to integrate water and transportation funding streams. Beyond GI implementation on private parcels via new and redevelopment, the primary location in which GI will be implemented is in roadways in the form of green streets. Therefore, funding programs that readily support integrated transportation/GI projects would greatly expedite the rate of GI implementation. The state needs to move beyond "Complete Streets" to "Sustainable Streets." Flexible funding is needed to implement integrated projects – transportation funds won't pay for GI and water quality funds won't pay for bike lanes. If all of the funding the state is directing toward active transportation could include a GI "add-on" from water quality or other sustainability funding sources, it would enable more rapid retrofit of urbanized areas and speed the transition to more sustainable, resilient, walkable, livable communities.

Incentive-based programs or mandates for private development to expand GI implementation into adjacent public rights-of-way may be appropriate. This would encourage more public/private partnerships on stormwater management and blur the lines between public and private stormwater.

Engaging Local Communities through Innovation Question

As stated above, moving communities from the current focus on Complete Streets that address active transportation issues to Sustainable Streets that also incorporate green infrastructure for

stormwater management, urban heat island reduction, improved aesthetics, reduced flooding, etc., would be a significant improvement. Engaging the MPOs in incentivizing the move toward Sustainable Streets with funding awards would help shift the dial. Working with Caltrans to integrate its active transportation programs with its own water quality requirements could lead to more integrated funding opportunities for local agencies. Incorporating GI into Climate Action Planning is another approach. Agencies that already have to implement GI for stormwater permit requirements should include it in their CAPs to show how related climate action benefits.

Land Use Valuation and Co-Benefits

There are several tools available for quantifying the multiple benefits of green infrastructure. The US EPA Green Infrastructure website has a list of cost-benefit analysis tools: (https://www.epa.gov/green-infrastructure/green-infrastructure-cost-benefit-resources).

In particular, the Center for Neighborhood Technology's "The Value of Green Infrastructure" tool (http://www.cnt.org/sites/default/files/publications/CNT_Value-of-Green-Infrastructure.pdf) provides means of quantifying various benefits of GI, but does also highlight that additional research is needed for quantifying things like air pollution uptake of GI. This is an area for which that the Agencies may want to direct resources for additional studies.

Philadelphia also did a triple-bottom line assessment of GI approaches in comparison to traditional grey infrastructure which provides useful information in quantifying the multiple benefits (https://www.epa.gov/sites/production/files/2015-10/documents/gi_philadelphia_bottomline.pdf).

Thank you again for the opportunity to comment. If you have any questions, please contact me at 650-599-1419 or our Executive Director, Geoff Brosseau at 650-365-8620.

Sincerely,

Matt Fabry, Immediate Past Chair
Bay Area Stormwater Management Agencies Association

cc: Bruce Wolfe, Executive Officer, San Francisco Bay Regional Water Board
Tom Mumley, Assistant Executive Officer, San Francisco Bay Regional Water Board
Keith Lichten, Watershed Management, San Francisco Bay Regional Water Board
Felicia Marcus, Chair, State Water Board
Steven Moore, Member, State Water Board
BASMAA Board of Directors