Prepared for

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Clean Watershed for a Clean Bay

Task 5 Implementation Plan Report

Municipal Regional Permit Provisions C.3.c.i (2) and C.3.c.iii(1)

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1. INTRODUCTION

1.1 CW4CB Project Background

The Bay Area Stormwater Management Agencies Association (BASMAA) is implementing a project to improve water quality in San Francisco Bay called Clean Watersheds for a Clean Bay (CW4CB). CW4CB is evaluating a variety of potential control options to reduce mass loadings of polychlorinated biphenyls (PCBs) as well as mercury and other pollutants in urban stormwater runoff to the Bay. The project will lay the groundwork for meeting Total Maximum Daily Load (TMDL) waste load allocations and restoring water quality in the future.

The project work plan consists of seven tasks. In Task 2 and Task 3, CW4CB has selected five high priority subwatersheds that discharge urban runoff with PCBs and other pollutants to the Bay, will identify PCB and mercury source areas within the project subwatersheds, and will refer these sites to regulatory agencies for cleanup and abatement. In Task 4, CW4CB is developing methods to enhance removal of sediment with PCBs and other pollutants during municipal sediment management activities. The objective of Task 5, the focus of this report, is to retrofit eight to ten urban runoff treatment facilities into existing infrastructure throughout the Bay Area and to evaluate their effectiveness at removing PCBs and other pollutants of concern. Task 6 will facilitate development and implementation of a regional risk reduction program that focuses on educating the public about the health risks of consuming certain species of Bay fish that contain high levels of PCBs and mercury. The knowledge and experience gained and the lessons learned during CW4CB will be promoted and made readily available to inform future similar efforts by others in the Bay Area and elsewhere in California and the United States as part of Task 7.

CW4CB is facilitated through a partnership among Bay Area municipalities and countywide municipal stormwater management programs and is funded by a grant to BASMAA from the United States Environmental Protection Agency (EPA). The total project cost is $7.04 million - $5M from USEPA and $2.04M matching funds from Bay Area municipal stormwater agencies, municipal wastewater treatment agencies, and industrial dischargers. The planned project period is four years (July 2010 – June 2014).

1.2 CW4CB Task 5

The objective of CW4CB Task 5 is to select and implement representative urban stormwater treatment retrofit projects that can be used to evaluate potential PCB load reductions at the larger Bay Area scale. This objective coincides with Municipal Regional Stormwater NPDES Permit (MRP, Order R2-2009-0074) provision C.12.e, which requires the permittees to identify and conduct on-site pilot treatment projects in ten locations during the MRP permit term and to document the knowledge and experience gained to provide a basis for determining the scope of implementation of on-site treatment retrofits in subsequent permit terms.

A CW4CB Task 5 Workgroup (Workgroup) was formed to facilitate the selection and implementation of the ten pilot projects. The Workgroup includes representatives from the EPA, the San Francisco Bay Regional Water Quality Control Board (SFRWQCB), BASMAA, BASMAA member agencies, and their consultants. Table 1 lists the Workgroup members (in alphabetical order).

Table 1: CW4CB Task 5 Workgroup

Name	Organizational Affiliation	Title
Khalil Abusaba	Brown & Caldwell	CCCWP Support
Lisa Austin	Geosyntec Consultants	Task Manager and Alameda CWP Support
Geoff Brosseau	BASMAA	Principal Investigator
Jamison Crosby	CCCWP	PMT representative
Kevin Cullen	FSURMP	PMT representative
Eric Dunlavey	City of San Jose	PMT representative
Arleen Feng	Alameda CWP	PMT representative
Jon Konnan	SMCWPPP	Project Manager and PMT representative
Richard Looker	SFRWQCB	SFRWQCB PCB TMDL Lead
Lynne Scarpa	City of Richmond	PMT representative
Chris Sommers	SCVURPPP	PMT representative
Rebecca Tuden	City of Oakland	PMT representative
Erica Yelensky	EPA	EPA Project Officer

PMT – Project Management Team

CW4CB Task 5 can be considered in the five phases described below:

Phase 1 Select Retrofit Pilot Projects (May through October 2011): Develop and implement a strategy for selecting appropriate locations for ten pilot retrofit projects. Prepare conceptual designs for the specific treatment facility best suited for each location. Provide planning level cost estimates for construction and O&M. The final product of Phase I is an Implementation Plan Report that describes each of the selected sites; each site's tributary catchment, land uses and expected pollutant concentrations; the selected treatment facilities; and planning level cost estimates.

Phase 2 Construction Planning and Permitting (May 2011 through April 2012): Conduct the necessary planning for constructing and monitoring of the ten pilot projects. By the end of Phase 2, a complete construction package including necessary design plans and specifications should be completed for each site that will be constructed. Evaluate the need for, and, if necessary, complete CEQA documentation and obtain necessary permits. Prepare a Sampling and Analysis Plan that is integrated with a Regional Study Design for each pilot project. Contract with the Cities for distribution of construction funds.

Phase 3 Construction Activities (May 2012 through October 2012): Install BMPs at the selected locations. Phase 3 work will be carried out by the municipality in whose jurisdiction the project is located.

Phase 4 Monitoring (2012/2013 wet season): Monitor each of the ten retrofit projects.

Phase 5 Reporting (Draft to Workgroup by January 15, 2014; Submit to Water Board by March 15, 2014): Monitoring contractor prepares section on field and lab work including QC review.

1.3 Report Organization

Section 2 of this report discusses the selection criteria and process used by the Workgroup to identify potential retrofit locations and to select ten projects for implementation. Project concepts for seven of the top ten potential projects are provided in Section 3. Section 4 discusses the next steps for implementation and the CW4CB Task 5 project schedule.

2. SITE SELECTION

2.1 Selection Criteria

Retrofit project site selection criteria included a variety of factors. Per MRP Provision C.12.e, the pilot study locations should be selected primarily on the basis of elevated PCBs concentrations with additional consideration to mercury concentrations, and the proposed retrofit projects should span treatment types and drainage characteristics.

The criteria used to select potential retrofit sites are listed below:

- **Pollutant loading:** Selected projects should have drainage catchments in the vicinity of medium to high detections of PCBs in past monitoring studies and/or should have current or historical land uses in the drainage catchment associated with medium to high PCB loadings. Potential mercury loadings were also assessed and considered.

- **Representativeness as a demonstration project:** The selected locations and drainage catchments should be representative, as a group, of the range of implementation feasibility characteristics within the MRP area.

- **Stormwater treatment measures**: Selected projects should include a range of stormwater treatment measures, including low impact development (LID measures) and conventional treatment measures. Hydrodynamic separators should be included as they are being installed across the Bay Area under a separate MRP provision related to trash reduction.

- **Ease of implementation:** Selected projects must be able to move forward with design, construction, permitting, and monitoring with reasonable design, permitting, and construction efforts within the grant and MRP deadlines (i.e., monitoring results should be included in the MRP's March 15, 2014 Integrated Monitoring Report).

- **Parcel ownership:** Selected projects may include publicly-owned parcels, privately-owned parcels, new and redevelopment parcels, or public/private partnerships, provided that the owner allows adequate access to the site for monitoring.

- **Feasibility considerations:** Feasibility of design and construction of treatment measures was considered for project selection. These considerations include the

presence of adequate space for treatment, accessibility for construction and operation and maintenance, lack of engineering barriers (e.g., existing utilities, site hydraulics, tidal issues, or geotechnical concerns) and other political factors (e.g., public visibility, municipality concerns, or neighboring citizen concerns).

- **Project location:** Per MRP Provision C.12.e, every county (San Mateo, Contra Costa, Alameda, Santa Clara, and Solano) should have at least one location.

2.2 Project Selection Process

The project selection process began with a Call for Projects to the BASMAA member agencies and independent evaluation of additional sites. The response to the Call for Projects was screened through correspondence with proposed project representatives and using available PCB data to identify those sites that warranted further consideration. Site visits were then conducted to identify those sites that best met the selection criteria listed above. Final selection was based on discussion and recommendations by the Workgroup. Table 2 outlines the steps taken to select the retrofit projects. Each step is further described below.

Table 2: Retrofit Pilot Projects Selection Process

Selection Process Steps	Date Complete
Call for Projects Sent Out	May 1, 2011
Submittal of Proposed Projects	May 31, 2011
Preliminary Screening of 27 Proposed Projects	June 21, 2011
Workgroup Meeting; Selection of 14 Potential Projects	June 22, 2011
Site Visits of Potential Projects	July 26, 2011
Workgroup Meeting to Discuss Site Visits; Selection of Top 6 Projects	July 27, 2011
Further Evaluation of 4 More Projects	August 12, 2011

2.2.1 Call for Projects

On May 1, 2011, a Call for Projects was sent out to Program representatives to assist in identifying potential retrofit projects. The stated purpose of the Call for Projects was to "seek participation from municipal permittees in assembling a list of municipal Capital Improvement Plan (CIP) candidate projects that include or could be modified to include stormwater treatment retrofits."

The Call for Projects summarized the preferred outcomes of the site selection process:

- Identify at least ten locations that present opportunities to install and evaluate treatment systems (e.g., detention basins, bioretention units, sand filters, infiltration basins, treatment wetlands).
- Assess the best treatment options for those locations.
- Select sites to perform pilot studies, with a minimum of one in each MRP county (San Mateo, Contra Costa, Alameda, Santa Clara, and Solano).
- Conduct pilot studies in 10 selected locations, which should span treatment types and drainage characteristics.

The Call for Projects also included a list of considerations for eligible projects. Important considerations listed in the Call for Projects were:

- The project may be already constructed, under construction, or sufficiently advanced in design and planning to allow construction by October 2012.
- The project already incorporates treatment device(s) or presents a fairly easy opportunity for adding one or more treatment devices through which stormwater runoff can be diverted.
- Proposed retrofit would treat runoff from an urban area where PCBs/mercury may be present.
- Proposed retrofit would require minimal or no CEQA permitting.
- Proposed retrofit would be safely accessible for monitoring by CW4CB contractor.
- Municipal commitment to ongoing maintenance of proposed retrofit.

Twenty-four responses to the Call for Projects were received on May 31, 2011. These projects, along with other projects independently examined as part of the selection process, are listed in Appendix A, Table A-1.

2.2.2 Preliminary Screening

A preliminary screening of the projects submitted in response to the Call for Projects was conducted to establish the desired range of land use and implementation feasibility characteristics. To do this, project attributes, including program, city, proposed treatment measures, adjacent land uses, construction/design phase, proximity to detected PCB concentrations, and other distinguishing factors were summarized. This allowed inspection of different groupings of projects and provided a means for

comparing projects. Based on the project information that was supplied, a preliminary desktop evaluation was conducted to determine potential site constraints using GIS datasets and aerial imagery. Following desktop evaluation, the preliminary selected sites were determined by the Workgroup to meet the criteria included in section 2.1 above.

To the extent feasible, the project site locations and drainage catchments were selected to be representative, as a group, of medium to high PCB loading and the range of implementation feasibility characteristics within the MRP region. These projects were researched further via site visits, discussions with project representatives, and a comprehensive analysis of available GIS datasets and aerial imagery.

Pollutant Loading

PCB Loading

The potential for medium to high PCB loads in stormwater runoff from each project site's drainage catchment was determined by analyzing available sediment data in a comprehensive database provided by the San Francisco Estuary Institute (SFEI), in addition to inspection of adjacent current land uses and historical industrial land uses. The database obtained from SFEI summarized results from the studies shown in Table 3. All of the studies listed in Table 3 (exclusive of the SFEI 2010 data) in the SFEI database did not indicate what data (if any) were less than the minimum detection limit (MDL); but rather included numerical estimates for all data records. The SFEI 2010 data did indicate non-detected data using the identifier "<MDL", and these data represent a little over a quarter of the total data set (194 of 724 data points). For the purpose of assigning concentrations to represent "High", "Medium" and "Low" PCB presence, these "<MDL" values were set equivalent to zero. The PCB results were ranked as shown in Table 4 below, which also includes the cumulative percentile corresponding to each concentration range.

Table 3: Studies included in SFEI Database

Author, Year	Title of Study
City of San Jose and EOA, Inc. 2003	Year Two Case Study Investigating Elevated Levels of PCBs in Storm Drain Sediments in San Jose, California
EOA, 2007	Summary of Polychlorinated Biphenyls (PCBs) Data in Sediment Collected from Richmond, California Streets and Storm Drains
EOA, Inc. 2002	Case Study Investigating Elevated Levels of PCBs in Storm Drain Sediments in San Mateo County
EOA, Inc. 2004	Case Study Investigating PCBs in Storm Drain Sediments from Colma Creek, Colma, California
Gunther et al, 2001.	Initial Characterization of PCB, Mercury, and PAH Contamination in the Drainages of Western, Alameda County, CA

Kleinfelder Inc., 2005	Sediment Sampling Report: Ettie Street Pump Station Watershed, Oakland, California.
Kleinfelder Inc., 2006	Private Property Sediment Sampling Report: Ettie Street Watershed, Oakland, California.
KLI and EOA, 2002	Joint Stormwater Agency Project to Study Urban Sources of Mercury, PCBs and Organochlorine Pesticides
Salop et al., 2002a	Analysis of 2000-01 Source Investigations in Ettie Street Pump Station and Glen Echo Creek Watersheds, Oakland, California
Salop et al., 2002b	2000-01 Alameda County Watershed Sediment Sampling Program: Two-Year Summary and Analysis
SFEI, 2010.	Regional Stormwater Monitoring and Urban BMP Evaluation
STOPPP, 2003.	Case Study Investigating Elevated Levels of PCBs in Storm Drain Sediments in the Pulgas Creek Pump Station Drainage, San Carlos, California

Table 4: PCB Categories, Corresponding Concentration and Percentile

Category	Concentration (mg PCBs/ kg sediment)	Percentile
Very High	10.0 +	98% - 100%
High	1.0 – 10	90% - 98%
Medium	0.1 – 1.0	61% - 90%
Low	0.01 – 0.1	37%[1] – 61%
Very Low	Less than 0.01[1]	Less than 37%[1]

[1] The "Very Low" category also includes not-detected values, which were set to zero. These values could actually be equivalent to up to 0.073 mg/kg sediment (the maximum concentration of the MDL). Depending on the actual values of the not detected samples and their distribution, the percentile value separating the "Low" and "Very Low" categories could be lower than 37%. Other defining percentile values would not be affected.

For a distribution of the detected data, see Appendix B, Figure B-1 (note logarithmic axis). The percentiles listed on the figure represent the percentiles calculated including the non-detected data as zero values. The non-detected values are thus included in the "Very Low" category. However, the values of the "<MDL" noted samples listed in the SFEI data could be equivalent to up to 0.073 mg/kg based on the list of congeners used for the SFEI study (Yee and McKee, 2010). Thus, some "<MDL" data points could possibly fall in the "Low" category. While a more robust estimation of the distribution of the "<MDL" samples could be obtained from statistical analyses, it is not needed for the sake of ranking the selected sites because all the sites were selected based on proximity to a "Medium", "High" or "Very high" PCB concentration. The percentile values above 0.1 mg/kg (61% and higher) would not change regardless of the estimated or actual values of the non-detected samples and their statistical distribution.

The distance selected to represent "proximity" to a medium or high PCB value was 2.5 kilometers, which is the distance estimated to be the maximum at which there is correlation of concentrations between proximate sites, per calculations by Yee and McKee (Yee and McKee, 2010). The 2.5-kilometer radius "halos" are shown and color-

coded based on concentration in Appendix B, Figure B-2. The locations of the screened retrofit projects are also shown on this figure.

In addition to the proximity to a "Medium", "High" or "Very high" PCB concentration, adjacent land uses and locations of historical industrial land uses were also considered when determining the PCB ranking of a site. The PCB rankings for all sites that were screened and those selected are listed in Appendix A, Table A-1 and Table A-2, respectively, and are illustrated in Appendix B, Figure B-2 and Figure B-3, respectively.

Mercury Loading

Mercury loadings in the vicinity of project sites were also determined using the SFEI database. All of the studies in the SFEI database did not indicate what data (if any) were less than the MDL; but rather included numerical estimates for all data records. Thus, the statistical issue presented in the PCB Loading discussion above did not carry over to the mercury distribution analysis.

The mercury results were ranked as shown in Table 5 below, which also includes the cumulative percentile corresponding to each range. Appendix B, Figure B-4 shows the proximity of projects to 2.5-kilometer radius mercury "halos".

Table 5: Mercury (Hg) Categories, Corresponding Concentration and Percentile

Category	Concentration (mg Hg/ kg sediment)	Percentile
Very High	2.0 +	98% - 100%
High	0.75 – 2.0	90% - 98%
Medium	0.25 – 0.75	63% - 90%
Low	0.01 – 0.25	20% – 61%
Very Low	Less than 0.01[1]	Less than 20%

2.2.3 Preliminary List of Retrofit Projects and Site Visits

On June 22, 2011, the Workgroup met to deliberate on a preliminary list of 14 projects that were screened from the initial list of 24 submitted and independently-identified projects. The preliminary projects that were selected for further consideration are listed in Table 6 below.

Table 6: Projects Selected for Site Visits based on Preliminary Screening

Program	Preliminary Projects
Alameda Clean Water Program (ACWP)	Ettie Street Pump Station Retrofit
	Fremont Tree Wells
	Oakland HDS Units (includes Alameda and High Streets HDS Unit and International and 73rd Streets HDS Unit)
Contra Costa Clean Water Program (CCCWP)	El Cerrito Green Streets
	Nevin Avenue Improvement
	PG&E Substation Retrofit
Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)	Leo Avenue HDS Unit
	Leo Avenue Sand Filter
	Mathilda Avenue Overpass
	River Oaks Pump Station
	Stanford Permeable Pavement
San Mateo Countywide Water Pollution Prevention Program (SMCWPPP)	Daly City Library
	Bransten Road Green Streets
Fairfield-Suisun Urban Runoff Management Program (FSURMP) and Vallejo	Solano County Project

Site visits were conducted to determine the feasibility of implementing the selected retrofit projects. Information collected during site visits included an inspection of the drainage area, information about the parcel(s), proposed treatment measure concept, design/construction phase, and inspection of proposed installation location. Additionally, project representatives were asked for more information as it was available, including design drawings, feasibility constraints, and cost and funding information. Additional information gathered in site visits is included in Appendix A, Table A-2.

2.2.4 Second Screening

Using information gathered from the site visits, as well as information gathered from project representatives and analysis of available GIS data and aerial images, ten sites were selected for further consideration. From this list of ten, the Workgroup selected six retrofit projects for implementation (Table 7). Project concepts for these six projects are provided in the Section 3 below.

Table 7: Projects Selected for Pilot Study by Workgroup

Program	Top Projects Selected
ACWP	Ettie Street Pump Station Retrofit
	Alameda and High Streets HDS Units
CCCWP	Nevin Avenue Improvement
	PG&E Substation Retrofit
SCVURPPP	Leo Avenue HDS Unit

Program	Top Projects Selected
SMCWPPP	Bransten Road Green Streets

In addition to the six projects listed in Table 7, the Workgroup agreed to further evaluate the projects listed in Table 8 below to achieve the target of 10 retrofit projects.

Table 8: Projects Selected for Further Evaluation

Program	Project Further Evaluated for Recommendation
ACWP	West Oakland Industrial Area Retrofit
CCCWP	El Cerrito Green Streets
SCVURPPP	TBD
Vallejo	Broadway and Redwood Streets Retrofit

Project concepts for the West Oakland Industrial Area Retrofit project and the Broadway and Redwood Streets Retrofit project are included in Section 3 below. A brief discussion of the El Cerrito Green Streets project is also provided. A second Santa Clara County project (in addition to the Leo Avenue HDS System project) has not yet been selected. Figures illustrating each project concept are provided in Appendix B.

3. PROJECT CONCEPTS

Project concepts are presented in this section for the selected projects. The project concepts include a discussion of the project background, the proposed treatment measure, catchment information, project design/ construction phase, and planning level cost estimates. The selected projects are in varying stages of design. For those projects with complete designs (i.e., the Nevin Avenue Improvement project and Alameda and High Streets HDS Unit), project design drawings or example specifications are referenced. For projects which in the conceptual planning stage (i.e., the Ettie Street Pump Station project, the PGE Substation project, the Bransten Road Green Street project, and the West Oakland Industrial Area project), treatment measure concepts are provided.

3.1 Ettie Street Pump Station Project

The Ettie Street Pump Station project is located in West Oakland at 3465 Ettie Street, adjacent to MacArthur Freeway to the north and Nimitz Freeway to the west (Appendix B, Figure B-5). The Ettie Street Pump Station is an Alameda County Flood Control and Water Conservation District (ACFCWCD) facility that collects and pumps stormwater runoff to the San Francisco Bay. The Ettie Street Pump Station drainage catchment is

comprised of approximately 1,200 acres in West Oakland and includes residential, commercial, and industrial areas. The proposed stormwater treatment measure for the project is a media filter system with two separate filter beds containing different media. The stormwater program and Alameda County representative for the project is Arleen Feng.

Treatment Measure Concept

The Ettie Street Pump Station project will install two parallel media filter beds to treat PCBs and mercury (Hg) that enter the Ettie Street Pump Station from the drainage catchment. The media filter would be located at grade outside the pump station building and would include a pump and pretreatment storage tank. The pump (nominally 1-2 gpm) would draw water up from one of the two wet wells into the pretreatment storage tank, designed to settle out the fine and coarse sand sizes (>63 µm).

Water from the pretreatment storage tank would then be split and conveyed to each tank containing the filter media. Water would be directed over a weir onto the surface of the media filter bed where it would infiltrate through the 2-foot-thick filter media to a 4 inch gravel drainage layer. One filter bed would contain sand and the second bed would contain a mix of media types, including sand, zeolite and granulated active carbon (GAC). The residence time in the pretreatment settling tank would be approximately 1.5 hours and the residence time in the sand filter bed would be approximately 12 hours.

To separate the filter media from the drainage layer, a geotextile filter fabric (or alternatively a choking stone layer) would be placed between the media and the drainage layer. Perforated PVC pipes (2 in diameter) would be located in the drainage layer to carry the water to a line to be discharged into the other wet well. The bottom of the filter bed would be sloped for drainage. The total depth of the media filter would be approximately 2 feet with an additional 6 inches for the underdrain layer.

The area of the pretreatment tank would be approximately 10 square feet and the total area of each filter bed would be approximately 50 square feet. These dimensions are well within the available project area identified as 14 feet by 14 feet and would allow space for access and testing (specific clearances to existing fence and structures will be provided at the start of the design phase).

Figure 1 below summarizes the proposed retrofit project configuration with respect to the primary components and monitoring locations. As shown in the figure, flows will be pumped from the Ettie Street Pump Station wet well through the settling tank, and then will be evenly split to each media bed using flow control valves. Discharge from the

media beds will be combined prior to returning to the storm drain system. Flows will be continuously monitored and water quality grab samples will be collected at influent and effluent locations. Additional solids monitoring locations could be added at the inflow from the wet well.

The primary components for the retrofit project include the inlet works, media beds, underdrains, outlet works, tanks, flow control valves, in-line strainer, PVC piping and connections, sampling ports, flow meter, filtration media, geotextile, and the slotted underdrain.

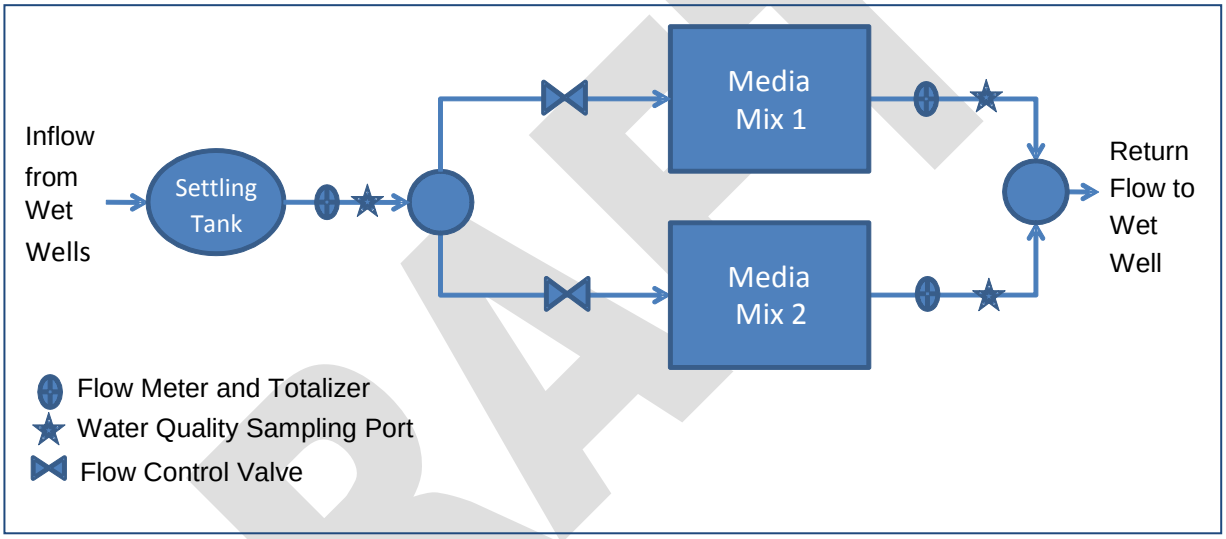


Figure 1. Overall Eddie Street Pump Station Pilot Project Components and Monitoring Locations

Project Design and Construction Schedule

The Ettie Street Pump Station Retrofit project is currently in the conceptual design phase. Design of the project would begin in November 2011 and construction would occur in 2012.

Project Catchment

The site is located in a highly industrial area, located adjacent to MacArthur Freeway to the north, Nimitz Freeway to the west, and industrial and residential areas to the south and east. The Ettie Street Pump Station receives rainfall and other flows from an approximately 1,200 acre watershed. The watershed contains mixed land uses currently

comprised of approximately 42% residential, 38% industrial, and 20% commercial land uses.

PCBs have been previously found in sediments collecting at both the Ettie Street Pump Station and in the surrounding catchment. A 2010 report by East Bay Municipal Utility District (EBMUD) presents data from water samples collected between April 2008 and February 2010, during dry weather, first flush, and wet weather events at the Ettie Street Pump Station wet well inlet and diversion outlet. The EBMUD report states that average concentrations for PCB congeners for the pump station effluent were 2,930 pg/L, 19,900 pg/L, and 34,500 pg/L, for dry weather, first flush and wet weather flows respectively. Additionally from 2004 to 2006, the City of Oakland performed an evaluation of potential source properties and collection of sediment samples from right-of-way areas and private properties, which found elevated PCB concentrations (http://www2.oaklandnet.com/Government/o/PWA/o/FE/s/ID/OAK024739).

Project Costs

The estimated planning level costs for the Ettie Street Pump Station Retrofit project are provided in Table 9; cost references and details are provided in Appendix D.

Table 9: Ettie Street Pump Station Retrofit Project Cost Estimate Summary

Project Phase	Cost
Construction	$32,600
Design	$13,000
Maintenance	$3,000/year

3.2 Alameda and High Street HDS Unit

The City of Oakland Alameda and High Street Hydrodynamic Separator (HDS) Unit project is located at the intersection of Alameda Avenue and High Street in Oakland (see Appendix B, Figure B-6). Figure B-6 also shows the location of another planned HDS project, at International boulevard and 73rd Street, which serves as an alternate site for this project. These HDS units are planned for installation as part of Oakland's Trash Load Reduction Plan. The stormwater program representative for the project is Arleen Feng of the Clean Water Program and the City of Oakland representative is Rebecca Tuden.

Project Concept

The HDS unit proposed for project is the Contech CDS unit. The unit combines hydrodynamic forces and treatment screens to remove solids from stormwater. Specifications for the Contech CDS Model used for a City of Oakland HDS Project in 2010 (located near Lake Merritt) are provided in Appendix C.

Project Design and Construction Schedule

The project is in the design phase and is expected to go out to bid by September, 2011. Construction would take place in 2012.

Project Catchment

The Alameda and High Street CDS unit is located in a watershed with a high concentration of old industrial land uses, including historic rail lines. The current watershed is a mix of industrial and commercial land uses.

Both HDS unit locations are located within 3 kilometers of medium (0.1 – 1.0 mg PCBs/ kg sediment) PCB concentrations.

Project Costs

The project design, installation, and maintenance costs will be paid by the City of Oakland.

3.3 Nevin Avenue Improvement Project

The Nevin Avenue Improvement project is a planned streetscape project along Nevin Avenue between 19th Street and 27th Street in the City of Richmond. This project includes stormwater treatment measures integrated into the streetscape. Planned streetscape features include standard street trees and curb extensions to make the street more bicyclist and pedestrian friendly. The city's base contract for the project includes rain garden curb extensions as the primary stormwater treatment measure. Additional treatment measures would be added by the CW4CB project, including permeable pavers with subterranean drainage, porous asphalt concrete pavement, and tree well filters. The stormwater program representative for the project is Jamison Crosby, with the Contra Costa Clean Water Program, and the municipal representative is Lynne Scarpa, Environmental Manager for the City of Richmond Stormwater Program.

Project Concept

The Nevin Avenue Improvement project is a streetscape project along eight blocks of Nevin Avenue, from the Richmond BART station to Richmond City Hall (See Appendix B, Figure B-7). The primary stormwater treatment measure proposed along Nevin is rain garden (bioretention) curb extensions. A total of 4,200 square feet of the bioretention curb extensions are proposed for as part of the improvements.

Additional stormwater treatment features proposed for the project include a pilot treatment train. The treatment train would include permeable pavers with subterranean drainage, porous asphalt concrete pavement, and tree well filters, along with the bioretention curb extensions, and would be installed on two blocks of the project (from 24th to Civic Center along Nevin Avenue). The treatment train concept would allow for added treatment benefit in this space-constrained location.

Project Design and Construction Schedule

The Nevin Avenue Improvement project is currently in the final design phase. Design of this project is scheduled to be completed in February, 2012. The project construction will be posted for bidders in April, 2012, and construction is proposed to begin in June, 2012. Schedule may change pending authorization from grant funding organizations.

Project Catchment

The site is located in a mixed civic, residential, and commercial area. Light industrial and historical industrial land uses are within close proximity to the Nevin Avenue Improvement project location. See Figure B-7 for the project extent and surrounding parcels. The project catchment contains mixed land uses. The area is largely residential in the lower blocks (19th through 23rd Streets), and is adjacent to the Richmond BART station. From 23rd to 25th Streets, the land use is largely commercial, and from 25th to 27th Streets, the City Hall buildings are the dominant land use (civic), with some commercial buildings interspersed.

The drainage to the treatment measures will be largely street drainage with possible drainage from adjacent parcels. Existing storm drains, partial culverts, and inlets can be seen in Figure B-7. Flow direction varies along the extent of the project. According to a survey obtained from City of Richmond, flow direction is to the west for the blocks between 19th Street and 23rd Street, and again for the blocks between 24th Street and 27th Street. Flow is to the east for the block between 23rd Street and 24th Street.

The site is adjacent to old industrial land uses and is within a 3 kilometer halo of high PCB concentrations.

Project Costs

A summary of the total cost of the stormwater treatment measures is included in the Table 10; cost references and details are provided in Appendix D (from BKF, e-mail correspondence August 2011).

Table 10: Nevin Avenue Improvement Project Cost Estimate Summary

Stormwater Treatment Measure	Unit	Cost per Unit	Total Proposed	Total Cost
Rain Garden Curb Extensions	sq-ft	$100	4,200 sq-ft	$420,000
Permeable Pavers with Subterranean Drainage	sq-ft	$80	1190 sq-ft	$95,000
Pervious Pavement	sq-ft	$10	3,200 sq-ft	$32,000
Tree Wells	•	-	-	$25,000
Total				**$572,000**

3.4 PG&E Substation Project

The PG&E Substation project is located at South 1st Street and Cutting Boulevard in the City of Richmond (See Appendix B, Figure B-8). PCBs have been detected in storm drains directly adjacent to the site as well as in the greater site vicinity. Bioretention facilities are the proposed stormwater treatment measure for the project. The stormwater program representative for the project is Jamison Crosby, with the Contra Costa Clean Water Program, and the municipal representative is Lynne Scarpa, Environmental Manager for the City of Richmond Stormwater Program.

Treatment Measure Design Concept

The proposed treatment measures for the project include bioretention facilities installed in the parkway adjacent to the PGE substation along Cutting Boulevard and South 1st Street (See Figure B-8). Bioretention Facility #1 would collect approximately 0.6 acres along Cutting Boulevard drainage and a small portion of the PGE substation entrance driveway. Bioretention Facility #2 would collect drainage from approximately two acres of South 1st Street and the substation. Figure B-9 illustrates similar bioretention treatment measures installed along roadways to those proposed for this project.

Project Design and Construction Schedule

The City of Richmond PG&E Substation project is currently in the conceptual planning phase. Design of this project would begin in November 2011. Construction of the project would occur in 2012.

Project Catchment

The PGE substation is bounded by rail and Interstate 580 to the north, a recreational vehicle parking lot to the west, Cutting Boulevard to the south and South 1st Street to the east. The substation is surrounded by a concrete berm which retains most stormwater runoff on the site. Ground cover is largely gravel, along with a parking lot which consists partially of concrete. There is no landscaping on site. There is landscaping (trees and mulch) and sidewalk to the south of the substation parcel, which runs along the public right-of-way of Cutting Blvd. There are also utilities (power line pole and a utility box) located along the landscaped strip. Along the eastern site boundary, there is bare compacted dirt and no sidewalk between the substation parcel boundary and South 1st Street.

There are two catch basins that the proposed project would connect to. The first catch basin (adjacent to Bioretention Facility #1 on Figure B-8) is located to the south of the substation directly adjacent to the driveway. This catch basin has an inlet depth of 3 to 4 feet based on visual inspection. The second (adjacent to Bioretention Facility #2 on Figure B-8) is located at the southeast corner of the site and has a drop inlet depth below storm grate of about one foot based on visual observation.

Sediment samples taken at the catch basins proposed for retrofit yielded high PCB concentrations.

Project Costs

The estimated planning level costs for the PG&E Substation project concept described above are provided in Table 11; cost references and details are provided in Appendix D.

Table 11: PG&E Substation Retrofit Project Cost Estimate Summary

Project Phase	Cost
Construction	$535,000
Design	$107,000
Maintenance	$2,500/year

3.5 Leo Avenue HDS Unit Project

The Leo Avenue Hydrodynamic Separator (HDS) Unit project is located on 7th Avenue just southeast of Phelan Avenue in southeast San Jose (see Appendix B, Figure B-10). This HDS unit is planned for installation as part of San Jose's Trash Load Reduction Plan, but a modified unit has been selected for enhanced sediment removal. The stormwater program representative for the project is Chris Sommers of the Santa Clara Valley Urban Runoff Pollution Prevention Program and the City of San Jose representative is Eric Dunlavey with the City of San Jose's Environmental Service Department.

Project Concept

The City of San Jose proposes to implement a modified prefabricated HDS unit which incorporates a larger sump for enhanced sediment collection.

Project Design and Construction Schedule

The project is in the design phase and is expected to go out to bid by February 2012. Construction would take place in 2012.

Project Catchment

The Leo Avenue HDS unit is expected to receive runoff from approximately 214 acres of commercial and industrial land uses. See Figure B-10 for the approximate catchment delineation.

Sediment samples taken on Leo Avenue, which is located within the project's drainage catchment have detected high levels of PCBs (SFEI database, 2010).

Project Costs

Cost estimates for the Leo Avenue HDS unit are currently under development, but are estimated to be approximately between $500,000 and $700,000.

3.6 Bransten Road Green Streets Project

The Bransten Road Green Streets project is located along Bransten Road, between Old County Road to the southwest and Industrial Road to the northeast, in the City of San Carlos. Curb extension bioretention facilities are the proposed stormwater treatment measure for the project. The countywide stormwater program representative for the

project is Jon Konnan, with the San Mateo Countywide Water Pollution Prevention Program. The City of San Carlos representative for the project is Ray Chan, Acting City Engineer.

Project Concept

The concept plan is a green street retrofit along Bransten Road (see Figure B-11). Curb extension bioretention facilities are proposed along Bransten Road between Old County Road and Industrial Road. The curb extension bioretention facilities are proposed to be similar to the stormwater curb extension illustrated in the Countywide Program's Sustainable Green Streets and Parking Lots Design Guidebook and the City of Portland design schematic (see Appendix C). The curb extension bioretention facilities would include an underdrain where the storm drain is present and would not include an underdrain, if allowable, upgradient of the existing storm drain (on Figure B-11, the start of storm drain is indicated with a 'star' symbol).

Stormwater would flow into the facilities through a curb cut located at the upstream end of the curb extension. The outlet from the facilities would be an elevated curb cut at the downstream end, which would act like an overflow weir designed to provide for 12 inches of ponding depth across the facility. The facility cross-section would include 1.5 feet of bioretention media underlain by gravel to provide storage and potential infiltration below these facilities, provided it is allowable. Approximately 770 linear feet of curb extension bioretention facility without an underdrain are proposed upstream of the storm drain. Approximately 500 linear feet of curb extension bioretention with an underdrain are proposed. The curb extensions are proposed to be approximately 6.0 feet wide, yielding a proposed total area of curb extension bioretention without an underdrain of 4,620 square feet, and a proposed total area of curb extension bioretention with an underdrain of 3,000 square feet.

Project Design and Construction Schedule

The Bransten Road Green Streets project is currently in the conceptual planning phase. Design of this project would begin in November 2011. Project construction would occur in 2012.

Project Catchment

The site is located in a highly industrial area, located adjacent to Caltrain tracks and El Camino Real to the southwest, and the 101 freeway to the northwest. The combined acreage of the estimated catchment, which consists of Bransten Road and adjacent

commercial and light industrial land uses, is approximately 25 acres. See Figure B-11 for estimated catchment delineation and an aerial view of surrounding parcels. The approximate area of the roadway right-of-way (sidewalks, parkways, and street width) is two acres. It is unknown if the drainage from the adjacent parcels flows into the street; it is assumed for this concept that parcel drainage would not be treated in the curb extension bioretention facilities.

Industrial land uses within the estimated tributary area include a concrete batch processing plant, a top soil facility, a transfer station and fire station, and other light industrial and commercial land uses, including a school bus yard.

Flow direction on the street is known to be towards the northeast. There are no storm drains along the upstream portion of Bransten Road. Beginning at 977 Bransten Road, there is a storm drain (unknown diameter) which runs along the center of the road towards Industrial Road. Soils underlying the site have low infiltration rates.

Sediment samples taken on Bransten Road have detected high levels of PCBs (SFEI database, 2010).

Project Costs

The estimated planning level costs for the Bransten Road Green Street project concept described above are provided in Table 12; cost references and details are provided in Appendix D.

Table 12: Bransten Road Green Streets Project Cost Estimate Summary

Project Phase	Cost
Construction	$600,000
Design	$120,000
Maintenance	$5,000/ year

3.7 West Oakland Industrial Area Project

The West Oakland Industrial Area Project is located in the vicinity of Peralta Street between 28th and 30th streets in the City of Oakland (See Appendix B, Figure B-12). PCBs have been detected in sediment at the site as well as in the greater site vicinity. Biofilter treatment measures (such as tree well filters) are proposed in up to three possible locations in the area. The stormwater program representative for the project is Arleen Feng with the Clean Water Program and the municipal representative is Rebecca Tuden with the City of Oakland.

Project Concept

The treatment measures would be designed to filter runoff from streets and an industrial site prior to discharging into adjacent catch basins. This project could be conducted cooperatively with Urban Releaf, an urban forestry/environmental non-profit 501(c)3 organization that was established in 1999 in the City of Oakland to address the needs of communities that have little greenery. Urban Releaf works with At Risk Youth organizations to promote and sustain community beautification projects, exposing youth to the various fields of arboriculture, biology, and advanced plant sciences. The At Risk Youth programs could be used to provide long term maintenance for the project.

Treatment measure option 1, which is proposed for Peralta between 26th street and 28th Street, is proposed to consist of three to four treatment measure facilities. The southern-most facility would involve retrofit of the existing catch basin on the corner of Peralta and 26th Streets to provide filtration or biofiltration of runoff prior to discharge to the storm drain. Additionally, a bioretention or biofilter facility is proposed for an existing sidewalk cut-out located one-third of the way between 26th and 28th. Finally, treatment measure option 1 would include retrofit of the catch basin located at Peralta and 28th streets to provide treatment of road runoff and runoff from the facility driveway located on 28th.

Treatment measure option 2 is proposed on Hannah street between 32nd and Peralta Streets. This facility would be designed as a biofilter or bioretention facility and would treat runoff along the street and possibly from the adjacent property, where an urban farm is proposed.

Treatment measure option 3 includes two facilities on Poplar Street, each adjacent to catch basins located on either side of 26th street. These facilities would be filtration or biofiltration catch basin retrofits, or possibly bioretention facilities.

Project Design and Construction Schedule

The West Oakland Industrial Area Project is currently in the conceptual planning phase. Design of this project would begin in November 2011. Construction of the project would occur in 2012.

Project Catchment

The project is located in the Ettie Street Pump Station watershed. The blocks adjacent to the three proposed treatment facility options are highly industrial, and include a metal

recycling facility, a concrete batch plant, various mixed light industrial and commercial properties, and some residential land use. Treatment measure option 1 is adjacent to the seven acre Custom Alloys Scrap Sales Inc. (CASS) property. CASS recycles metals and produces aluminum alloys; this site generates much truck traffic. Treatment measure option 2 is located adjacent to an open lot which is currently overgrown with vegetation. An urban farm is proposed for that location.

The drainage areas for the proposed facilities range from approximately 0.5 acres and 2 acres, and largely consist of road land uses.

Sediment samples taken at the catch basins adjacent to the proposed facilities yielded medium to very high PCB concentrations.

Project Costs

The estimated planning level costs for the West Oakland Industrial Area project concept described above are provided in Table 13; cost references and details are provided in Appendix D.

Table 13: West Oakland Industrial Area Project Cost Estimate Summary

Project Phase	Option 1	Option 2	Option 3
Construction	$237,000	$314,000	$205,000
Design	$47,000	$63,000	$41,000
Maintenance	Maintenance performed by Urban Releaf		

3.8 El Cerrito Green Streets Project

The El Cerrito Green Streets Project includes two constructed flow-through biotreatment facilities. One is located at San Pablo and Madison Avenues and the second is located at San Pablo and Eureka Avenues, both in the City of El Cerrito (see Appendix B, Figure B-13). Details about this project can be found on the City's website (http://www.el-cerrito.org/esd/landscapeandwater.html) and at the San Francisco Estuary Partnership website (http:// http://www.sfestuary.org/projects/detail.php?projectID=41).

This project is planned for monitoring by the SFEI in the 2012/ 2013 wet season. The project is being evaluated to determine if additional benefit would be gained by including additional monitoring parameters for the purposes of the CW4CB project.

3.9 Santa Clara County Project

A second Santa Clara County Project is to be recommended for the selected pilot projects.

3.10 Broadway and Redwood Project

The Broadway and Redwood project is located east of Broadway between Redwood and Valle Vista in downtown Vallejo (See Appendix B, Figure B-14). The project would retrofit a vegetated swale in the area between Broadway and the Southern Pacific Railroad tracks. The land is owned by Southern Pacific but the Vallejo Sanitation and Flood Control District has an easement on the property that would permit construction of a treatment measure within the easement. Kevin Cullen, with the Fairfield-Suisun Sewer District, Lance Barnett, with Vallejo Sanitation & Flood Control District, and Sam Kumar with the City of Vallejo are the municipal leads for the project.

Project Concept

The treatment measure concept is to install a vegetated swale between the railroad tracks and Broadway. The width of the swale will be designed within the VSFCD easement. The length of the swale will ideally extend along the entire block of Broadway between Redwood and Valle Vista, but may be shorter depending on the final design. Curb cuts would be made through the existing curb along Broadway to divert roadway runoff into the swale.

Project Design and Construction Schedule

The Broadway and Redwood Project is currently in the conceptual design phase. Design of the project would begin in November 2011 and construction would occur in 2012.

Project Catchment

The catchment would include (1) that portion of Broadway (between Redwood and Valle Vista) that drains to the east (from the crown in the road) and (2) the area between the railroad tracks and Broadway (See Figure B-14). The portion draining from Broadway is completely impervious, whereas the area draining between the tracks and Broadway is mostly pervious. The land use can be characterized as transportation.

The site is within a 3 kilometer halo of high PCB concentration.

Project Costs

The estimated planning level costs for the Broadway and Redwood project concept described above are provided in Table 14; cost references and details are provided in Appendix D.

Table 14: Broadway and Redwood Project Cost Estimate Summary

Project Phase	Cost
Construction	$56,000
Design	$22,000
Maintenance	$5,000/year

4. IMPLEMENTATION OF RETROFIT PROJECTS

4.1 Construction Activities

To implement the retrofit projects, construction plans and specifications will be prepared and permits will be obtained (including environmental review as needed) for each of the retrofit pilot projects that will be constructed (Table 15).

A Request for Qualifications (RFQ) was released on July 29, 2011, for the selection of a design firm(s) who will conduct this work. The RFQ described the purpose of CW4CB Task 5 and requested Statement of Qualifications (SOQs) for the selection of qualified on-call engineering firms to provide engineering design services in support of CW4CB Task 5 objectives. Up to 3 design firms will be selected and work orders will be issued for specific facility design needs. The requested SOQs were due by August 26, 2011.

Table 15: Retrofit Pilot Projects Implementation Process

Implementation Process Steps	Schedule
Design Contract RFQ Released	July 29, 2011
Design Contract SOQs Submitted	August 26, 2011
Negotiate Contracts with Selected Design Firm(s)	September 2011
Workgroup Meeting to Discuss Phase 2 Implementation	September 21, 2011
Issue Notice to Proceed /Task Orders to Selected Design Firm(s)	October 2011
BASMAA Contracts with Selected Cities for Construction Funding	October 2011
Workgroup/PMT Selects and BASMAA Contracts of 3rd Party Design and Construction Oversight Contractor	October 2011
Design Firm(s) Prepare Construction Packages of Necessary Design Plans and Specifications	November 2011 through March 2012
3rd Party Design and Construction Oversight Contractor and Cities work with Design Firm(s); 3rd Party Design and Construction Oversight Contractor	November 2011 through March 2012
Complete CEQA Documentation and Obtain Necessary Permits	November 2011 through April 2012
Select Sampling & Analysis Plan Contractor	March 2012
Prepare Sampling & Analysis Plans for Pilot Project	April 2012
Construction Activities	**May through October 2012 (Dry Season)**

In October 2011, a notice to proceed and task orders will be issued to the selected design firm(s) and BASMAA will contract with the Cities in which the pilot projects are

located for distributing the grant's construction funding and staff funding assistance. The Workgroup will select, either through a competitive Request for Proposal process or sole source, a 3rd Party Design and Construction Oversight Contractor whose scope of work will be to review and coordinate the work conducted by the Design Contractors for the Workgroup.

Over the course of November 2011 to March 2012, the Design Contractor(s) will complete the construction drawing and specification bid packages, in close cooperation with the municipality, for each site that will be constructed. The municipality will obtain the necessary permits and approvals for project construction, including any associated environmental review for compliance with CEQA. During this same period, the 3rd Party Design and Construction Oversight Contractor and municipal staff will review drafts (e.g., 30%, 60%, and 90% design drawings) produced by the Design Firm(s), who will revise the designs accordingly. The 3rd Party Design and Construction Oversight Contractor will report back to the Workgroup and will set up Workgroup meetings if necessary to discuss project design issues as they arise.

Construction activities will be conducted during the 2012 dry season (approximately between May through October). Construction activities will include the installation of the treatment facilities at the selected retrofit locations, installation of monitoring equipment, and quality assurance/quality control of all constructed facilities. Construction contracting and oversight will be provided by the municipality in whose jurisdiction the project is located. BASMAA will assist with construction oversight of the treatment facility via the 3rd Party Design and Construction Oversight Contractor.

4.2 Monitoring Activities

Monitoring of all ten retrofit projects will be conducted during the 2012-2013 wet season. A Sampling and Analysis Plan will be prepared, which will be integrated with the overall CW4CB Regional Study Design, for each pilot project. The Sampling and Analysis Plan will be prepared by a monitoring contractor, selected by a RFQ that will be sent out in early 2012. A Workgroup/TAC meeting will be held in April 2012 to discuss the Sampling and Analysis Plan.

Monitoring will follow the protocol established in the Sampling and Analysis Plan approved by the Workgroup and TAC. Laboratory results and data summaries will be provided by the monitoring contractor.

5. REFERENCES

Yee and McKee, 2010. "Concentrations of PCBs and Hg in soils, sediment and water in the urbanized Bay Area: Implications for best management." San Francisco Estuary Institute, March 31, 2010.

APPENDIX A

Project Tables

Table A-1 Screened Retrofit Projects

Program	Project Name	Owner/ Municipality	Treatment Measure	Final Selection	Expected PCB Concentration[1]	Selection Notes
ACWP	Alameda and High St HDS Units	Oakland	Hydrodynamic Separator Unit	Recommended	Medium	• High PCBs • Regular trash CDS unit design
ACWP	Davis Street	ACFCWCD / San Leandro	Stormdrain High Flow Bypass Treatment	Not Selected	High	• Not designed to treat water quality flows
ACWP	Ettie St. Pump Station Retrofit	ACFCWCD	Sand filter	Recommended	Very High	• Industrial and residential • High PCBs • Pump station • Amended sand filter BMP
ACWP	Grant Avenue	San Lorenzo	Biotreatment/ Tree Well	Not Selected	Low	• Low PCB Area • Other more representative green streets projects selected
ACWP	International Blvd and 73rd HDS Unit	Oakland	Hydrodynamic Separator Unit	Preliminary Selection	Medium	• Other HDS Units selected in higher PCB areas
ACWP	Meek land Ave	San Lorenzo	Tree Wells	Not Selected	Low	• Low PCB Area • Other more representative green streets projects selected
ACWP	Osgood Rd	Fremont	Tree Wells	Preliminary Selection	Low	• Low PCB Area • Other more representative green streets projects selected
ACWP	West Oakland Industrial Area	Oakland	Bioretention/ Biofilters	Further Evaluation	Very High	• Industrial and residential • High PCBs • Within Ettie St. Pump Station watershed • Amended tree well BMP
CCCWP	El Cerrito Green Streets	El Cerrito	Flow-Through Biofilters/ Green Streets	Further Evaluation	Medium	• Mixed Land Uses/High traffic arterial • Monitoring by SFEI in 2011-2012 wet season
CCCWP	Hartz Avenue Beautification	Danville	Bioretention	Not Selected	Low	• Low PCB Area

Program	Project Name	Owner/ Municipality	Treatment Measure	Final Selection	Expected PCB Concentration[1]	Selection Notes
CCCWP	Moraga Commons Parking Lot	Moraga	Bioretention, Detention Basin	Not Selected	Low	• Low PCB Area
CCCWP	N. San Carlos Drive Improvements	Walnut Creek	Bioretention, Flow-through Biotreatment	Not Selected	Low	• Low PCB Area
CCCWP	Nevin Avenue Improvement	Richmond	Tree Wells, Bioretention Curb Extensions, Permeable Pavement with Underground Storage	Recommended	High	• Mixed land uses • 60% design stage • Variety of different BMPs proposed • High PCB Area
CCCWP	PG&E Substation	Richmond	Bioretention	Recommended	High	• PG&E substation - High PCBs • In public right-of-way
CCCWP	San Pablo Avenue Greenspine	San Pablo Greenspine	Various	Not Selected	Low to High	• Specific projects not identified
Vallejo	Oakwood Avenue Channel	Vallejo	Flow-through Wetlands	Preliminary Selection	Low	• In channel wetlands too complicated to monitor
Vallejo	Broadway and Redwood	Vallejo	Bioretention/ Biotreatment	Further Evaluation	High	• Mixed land uses • Next to Railroad tracks • Flood Control easement
SCVURPPP	Hacienda Avenue	Campbell	Bioretention, Permeable Pavement	Not Selected	Medium	• Not in area indicative of High PCBs
SCVURPPP	Leo Avenue HDS unit	San Jose	Hydrodynamic Separator Unit	Recommended	Very High	• Highly industrial • High PCBs • WQ-enhanced HDS design
SCVURPPP	Leo Avenue Sand Filter	San Jose	Sand Filter	Preliminary Selection	High	• HDS unit preferred.

Program	Project Name	Owner/ Municipality	Treatment Measure	Final Selection	Expected PCB Concentration[1]	Selection Notes
SCVURPPP	Mathilda Avenue Caltrain Overpass	Sunnyvale/ Caltrans	Bioretention, Hydrodynamic Separators	Preliminary Selection	High	• High PCB land uses not treated by treatment measure
SCVURPPP	Packard Foundation Headquarters	Los Altos	Permeable Pavement, Tree Well	Not Selected	No Data; Anticipated Low	• Not in area indicative of High PCBs
SCVURPPP	River Oaks Pump Station	San Jose	Swale	Preliminary Selection	Low	• Not in area indicative of High PCBs
SCVURPPP	San Fernando Street Improvement	San Jose	Flow-through Biotreatment	Not Selected	Medium	• Other Green Street projects were selected
SCVURPPP	Santa Clara Street Bus Rapid Transit	San Jose	TBD	Not Selected	Medium	• Would not be constructed by 2012
SCVURPPP	Stanford Pervious Paving Demo. Project	Stanford	Permeable Pavement	Preliminary Selection	Low	• Low PCBs
SCVURPPP	Stevens Creek Corridor Park	Cupertino	Flow-through Biotreatment	Not Selected	No Data; Anticipated Very Low	• Low PCBs
SCVURPPP	The Alamea Street Improvement	San Jose	Biorention and Tree Wells	Not Selected	Low	• Low PCBs • Would not be constructed by 2012
SCVURPPP	TBD	TBD	TBD	Further Evaluation	TBD	
SMCWPPP	Bransten Road Green Streets	San Carlos	Bioretention Curb Extensions	Recommended	Very High	• High PCBs • Developed/ mixed industrial • Not a busy street
SMCWPPP	Daly City Public Library	SFEI/ Daly City	Bioretention	Preliminary Selection	Medium/ Low	• Site land use not indicative of High PCBs

Table A-2 Selected Retrofit Projects

	Program	No	Project Name	Owner/ Municipality	Range of Treatment Types: LID: Bioretention	LID: Permeable Pavement	LID: Flow-through Biotreatment (Planter or Swale)	LID: Tree Well	Other: Detention Basin/Wet Pond	Other: Sand Filter	Other: Hydrodynamic Separators	Land Use: Industrial	Land Use: Commercial/ Mixed Use	Land Use: Roads/ Rail	Land Use: Institutional	Land Use: Residential	Land Use: Recreational	Design/ Construction Status: Conceptual	Design	Constructed post-MRP Adoption	Constructed pre-MRP Adoption	Expected PCB Concentration[1]	Expected Mercury Concentration[2]	Reasons for Selection
Selected Top 6 Projects	ACWP	1	Ettie St. Pump Station Retrofit	ACFCWCD						X		X	X			X		X				Very High	High	• Industrial and residential • High PCBs • Pump station • Amended sand filter BMP
		2	Alameda and High St HDS Units	Oakland							X	X	X	X		X			X			Medium	High	• High PCBs • Regular trash CDS unit design
	CCCWP	3	Nevin Avenue Improvement	Richmond	X	X	X	X					X		X	X			X			High	High	• Mixed land uses • 60% design stage • Different BMPs possible including pervious pavement • In PCB halo source area
		4	PG&E Substation Retrofit	Richmond	X		X					X		X				X				High	High	• PG&E substation - High PCBs • In public right-of-way
	SCVURPPP	5	Leo Avenue HDS Unit	San Jose							X	X						X				Very High	Very High	• Highly industrial • High PCBs • WQ-enhanced HDS design
	SMCWPPP	6	Bransten Road Green Streets	San Carlos	X		X					X	X	X				X				Very High	High	• High PCBs • Developed/mixed industrial • Not a busy street
Projects Requiring Further Evaluation	ACWP	7	West Oakland Industrial Area	Oakland				X				X	X	X				X				Very High	High	• Industrial and residential • High PCBs • Within Ettie St. Pump Station watershed • Amended tree well BMP
	CCCWP	8	El Cerrito Green Streets	El Cerrito			X						X	X						X		Medium	High	• Mixed Land Uses/High traffic arterial • Monitoring by SFEI in 2011-2012 wet season
	SCVURPP	9	TBD	TBD																				•
	SC	10	Broadway and Redwood	Vallejo	X		X					X	X	X		X		X				High	High	• Mixed land uses • Next to Railroad tracks • Flood Control easement

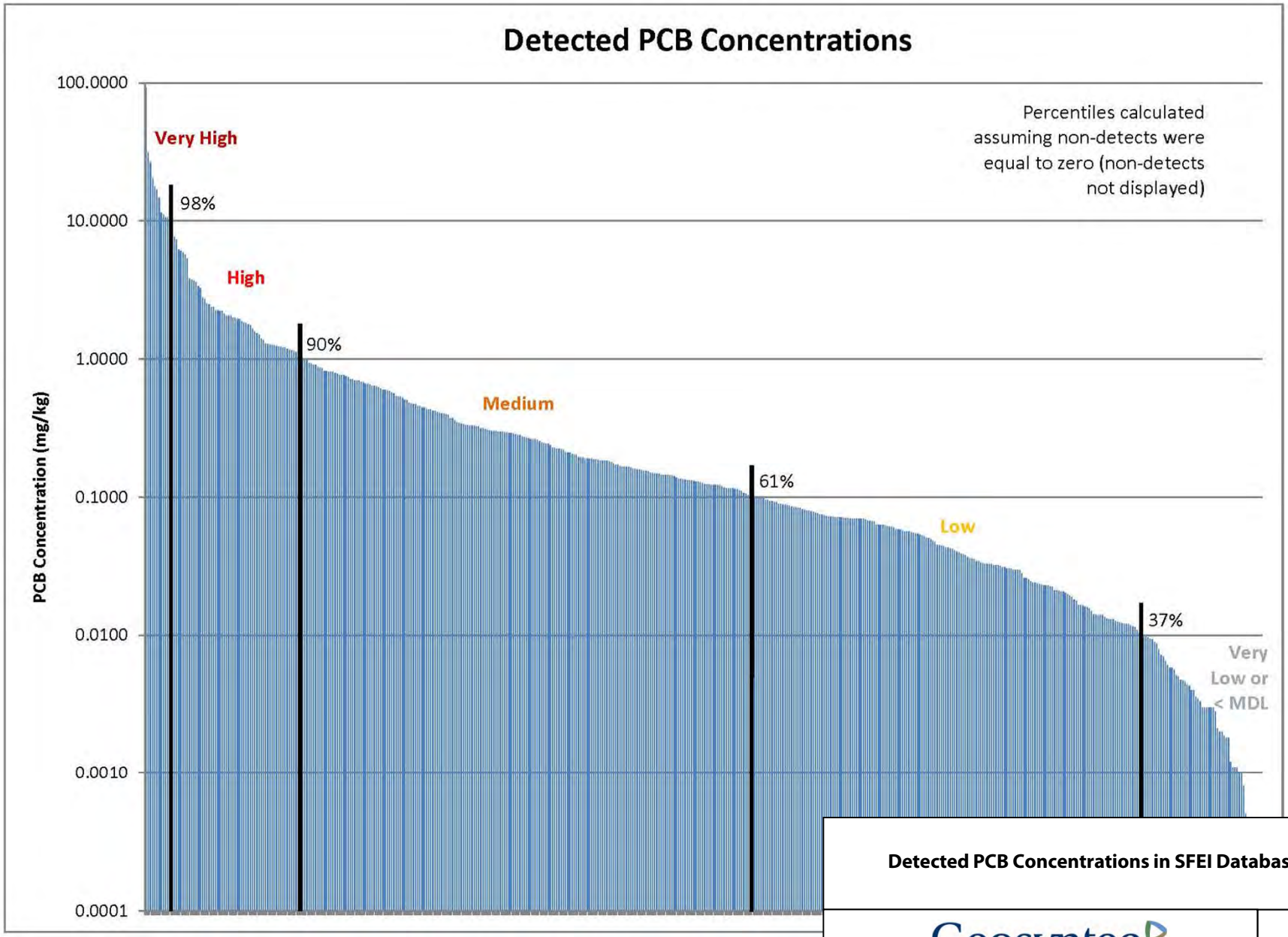
Footnotes:

1 PCB data from the San Francisco Estuary Institute database. PCB ranking (mg/kg sediment): Very Low (<0.01), Low (0.01-0.1); Medium (0.1-1.0); High (1.0-10); and Very high (>10)

2 Mercury data from the San Francisco Estuary Institute database. Mercury ranking (mg/kg sediment): Very Low (<0.1), Low (0.1-0.25); Medium (0.25-0.75); High (0.75-2.0); and Very high (>2.0)

APPENDIX B

Project Figures



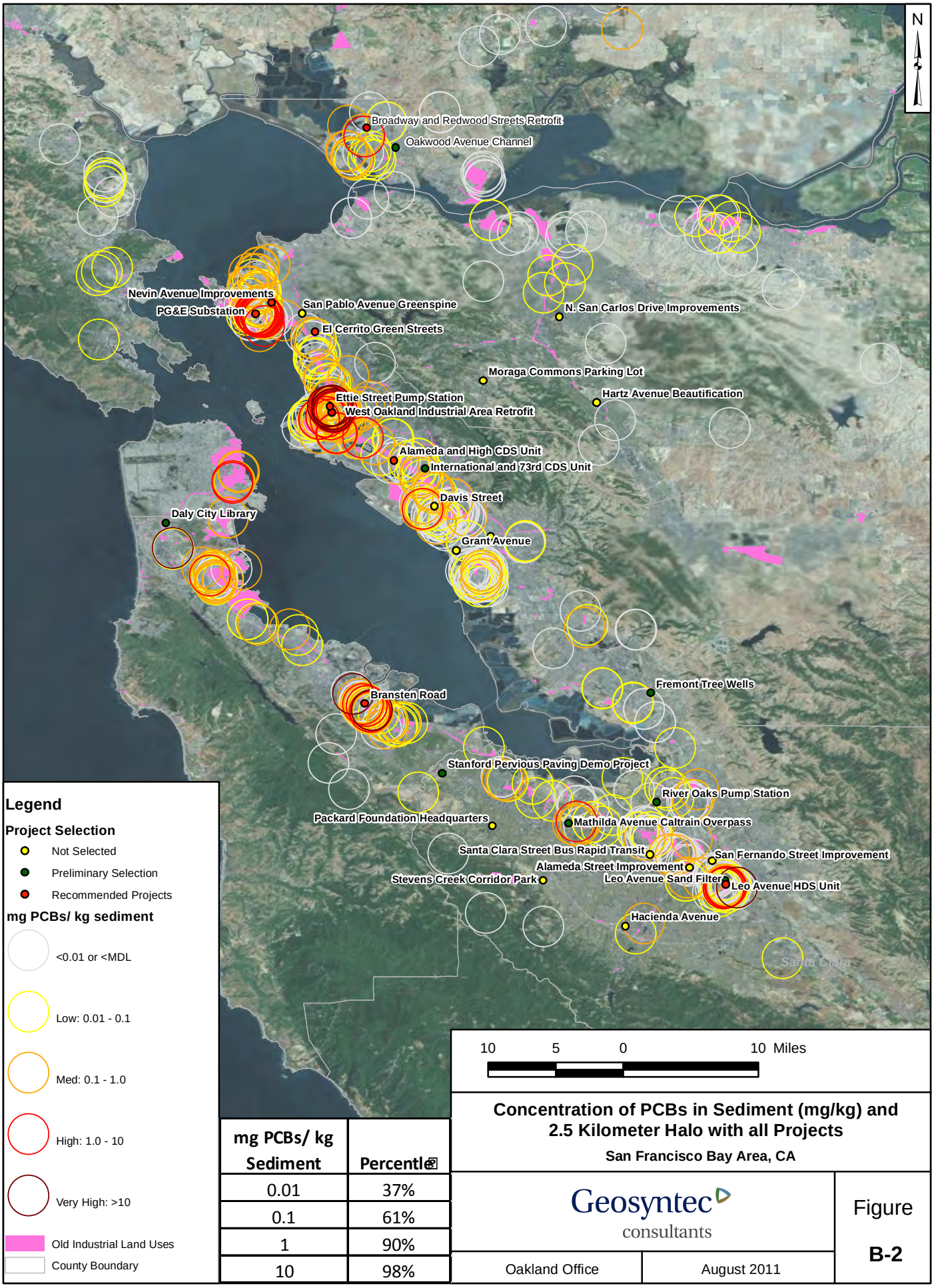
Detected PCB Concentrations in SFEI Database

Geosyntec consultants

Oakland, CA | August 2011

Figure **B-1**

PCB_Rank_081511.ppt



mg PCBs/ kg Sediment	Percentile
0.01	37%
0.1	61%
1	90%
10	98%

Concentration of PCBs in Sediment (mg/kg) and 2.5 Kilometer Halo with all Projects

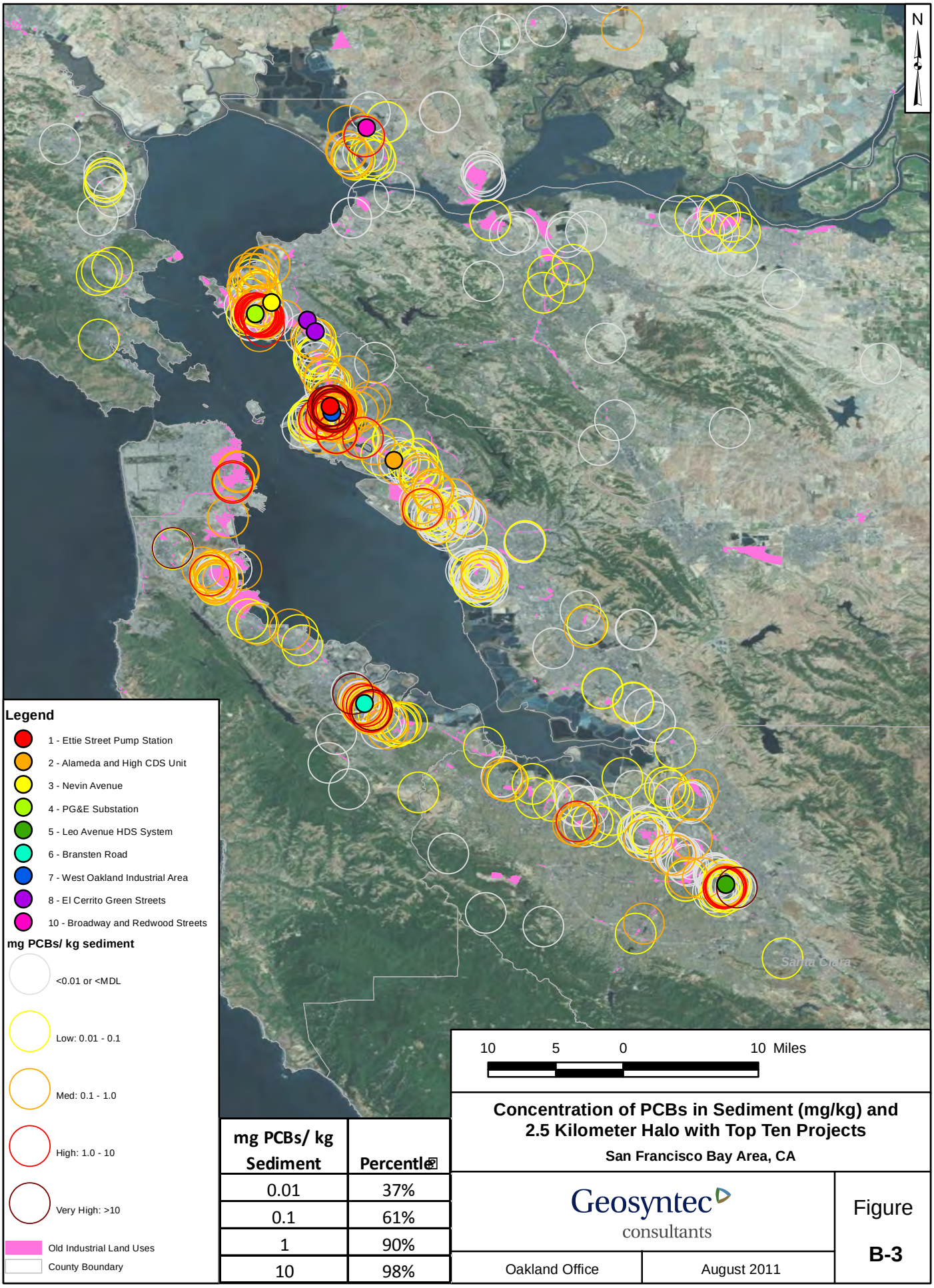
San Francisco Bay Area, CA

Geosyntec consultants

Oakland Office | August 2011

Figure **B-2**

P:\GIS\BASMAA_CW4CB\Projects\Yee_McKee_PCB_Conc_081511.mxd, KLH, Aug 15, 2011



mg PCBs/ kg Sediment	Percentile
0.01	37%
0.1	61%
1	90%
10	98%

Concentration of PCBs in Sediment (mg/kg) and 2.5 Kilometer Halo with Top Ten Projects

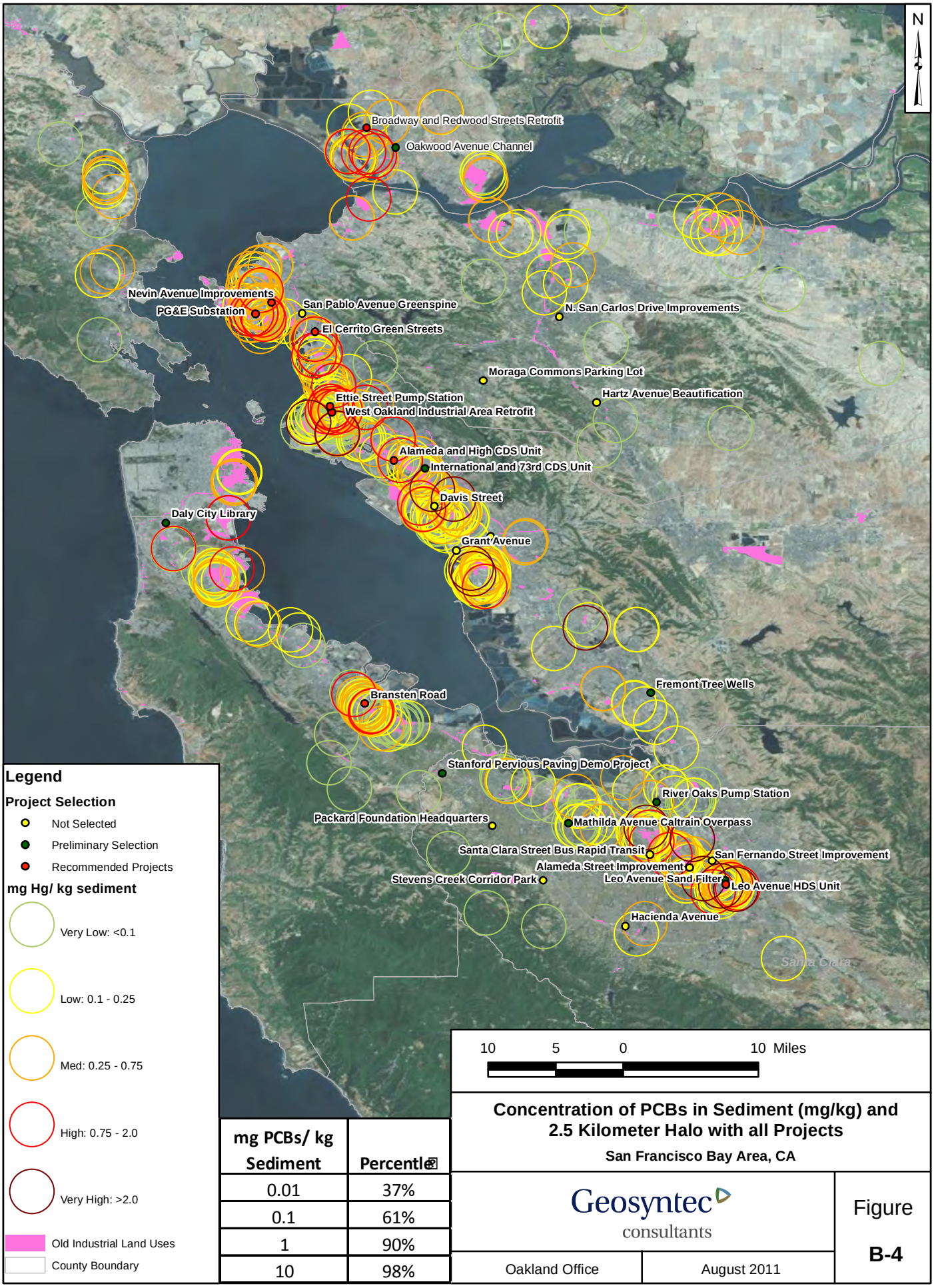
San Francisco Bay Area, CA

Geosyntec consultants

Oakland Office | August 2011

Figure **B-3**

P:\GIS\BASMAA_CW4CB\Projects\Yee_McKee_Top10_PCB_Conc_081511.mxd, KLH, Aug 15, 2011



mg PCBs/ kg Sediment	Percentile
0.01	37%
0.1	61%
1	90%
10	98%

Concentration of PCBs in Sediment (mg/kg) and 2.5 Kilometer Halo with all Projects

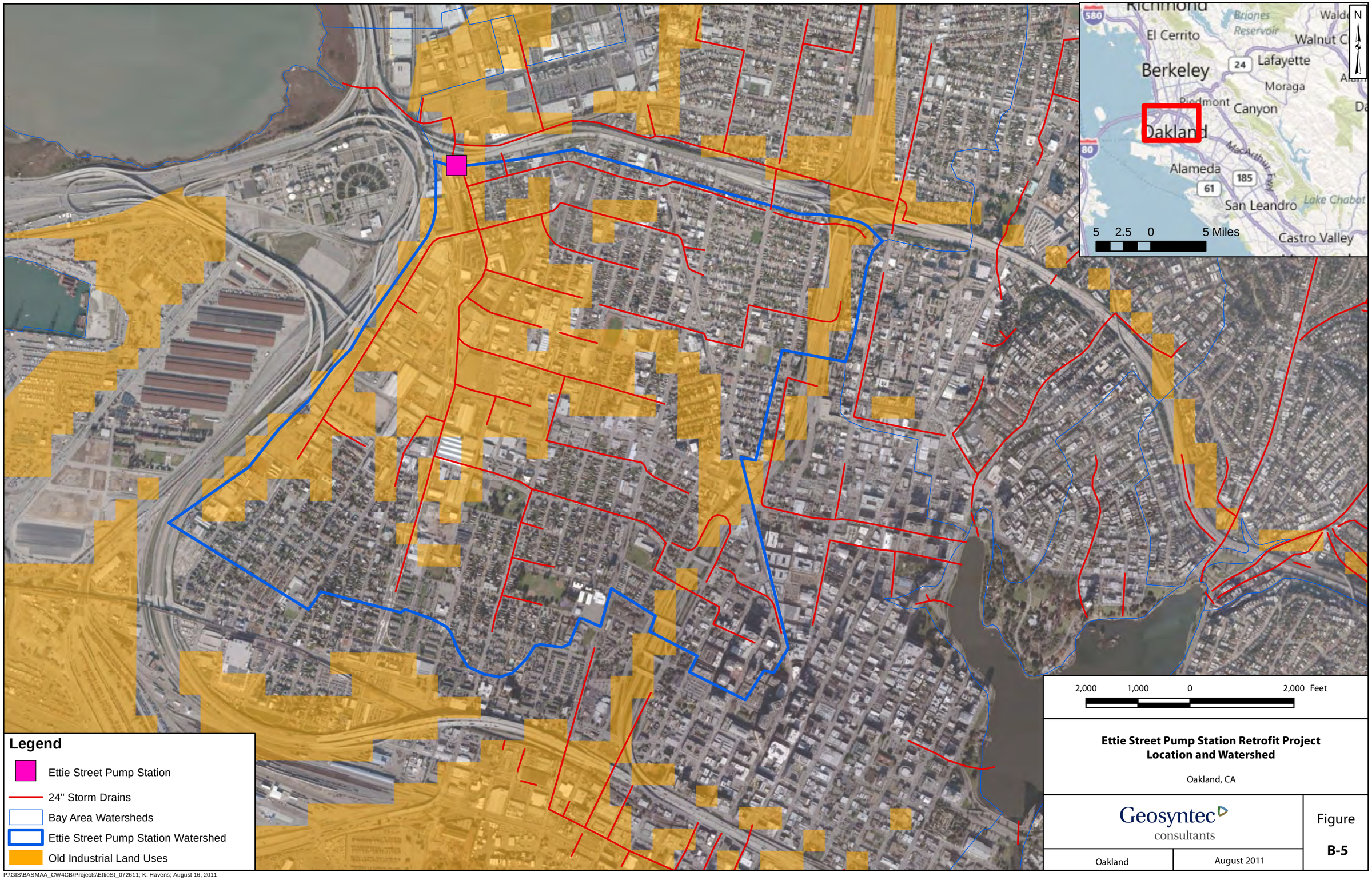
San Francisco Bay Area, CA

Geosyntec consultants

Oakland Office | August 2011

Figure **B-4**

P:\GIS\BASMAA_CW4CB\Projects\Yee_McKee_Hg_Conc_081511.mxd, KLH, Aug 15, 2011



Ettie Street Pump Station Retrofit Project
Location and Watershed

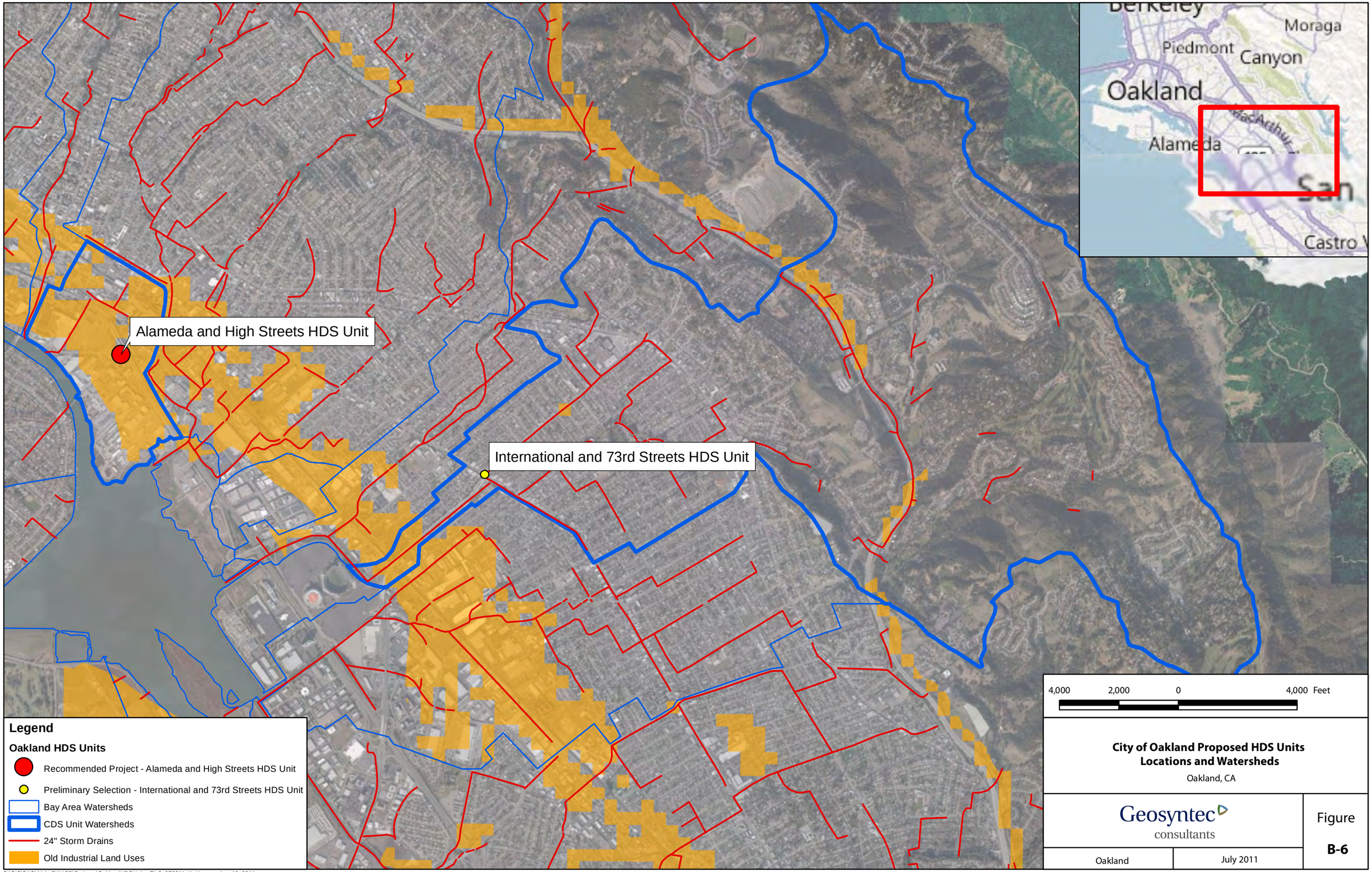
Oakland, CA

Geosyntec consultants

Figure **B-5**

Oakland | August 2011

P:\GIS\BASMAA_CW4CB\Projects\EttieSt_072611; K. Havens; August 16, 2011



City of Oakland Proposed HDS Units Locations and Watersheds

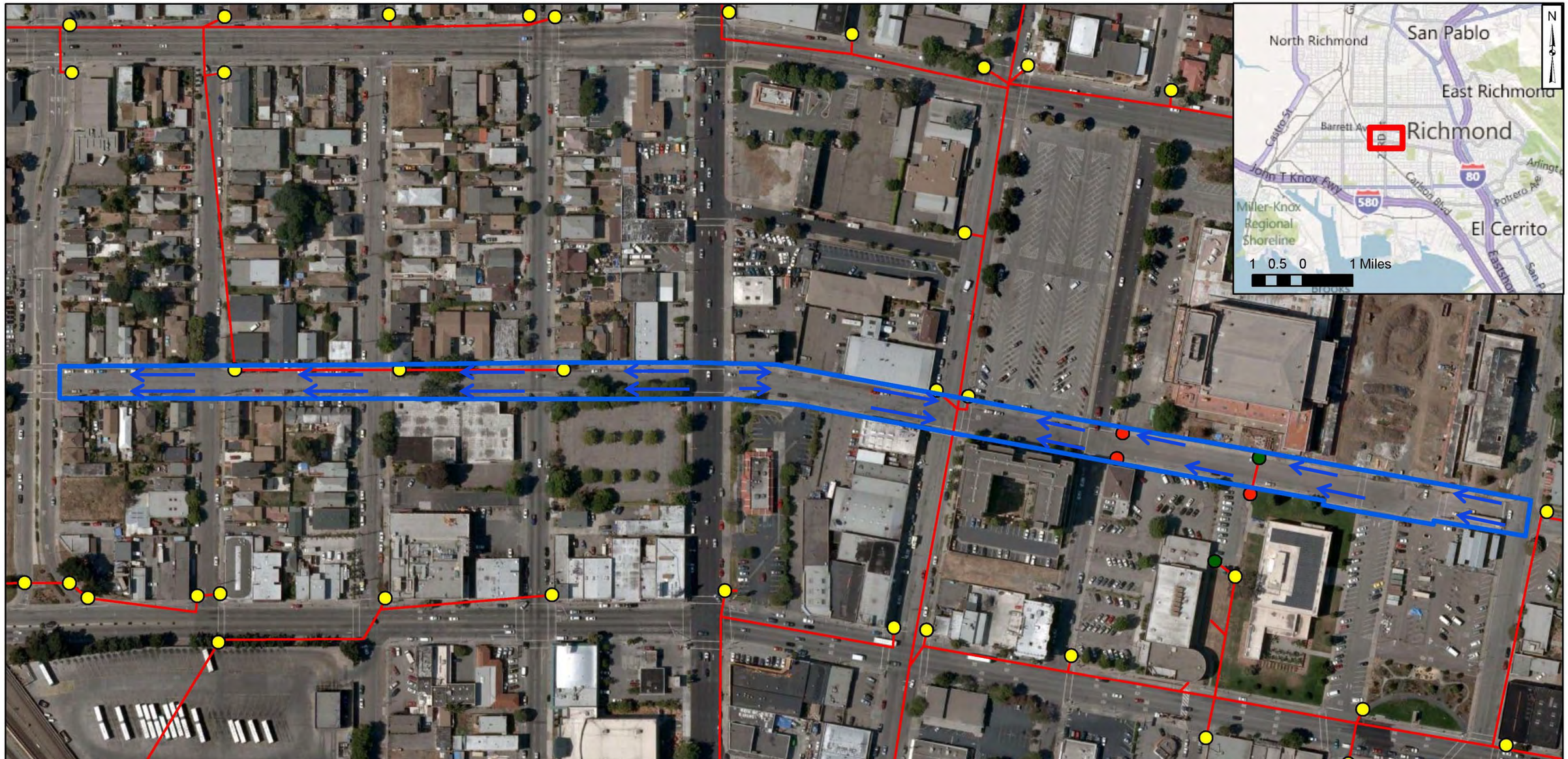
Oakland, CA

Geosyntec consultants

Figure **B-6**

Oakland | July 2011

P:\GIS\BASMAA_CW4CB\Projects\OaklandHDSUnits_Fig2_072611; K. Havens; Aug 16, 2011



Nevin Avenue
Drainage Area and Proposed Treatment Measures

Richmond, CA

Geosyntec consultants

Oakland | August 2011

Figure **B-7**

P:\GIS\BASMAA_CW4CB\Projects\NevinAve_072511; K. Havens; August 16, 2011

PG&E Substation
Drainage Area and Proposed Treatment Measures

Richmond, CA

Geosyntec consultants

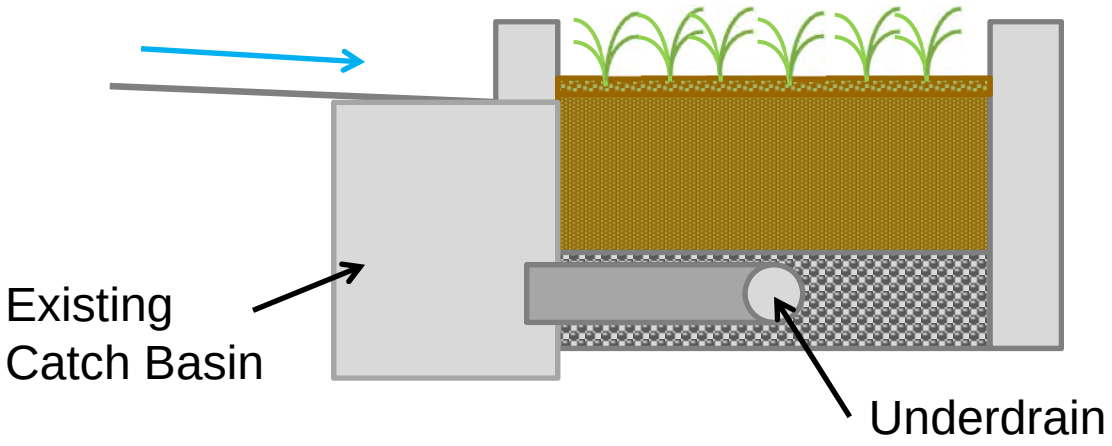
Oakland | August 2011

Figure **B-8**

P:\GIS\BASMAA_CW4CB\Projects\PGE_072611; K. Havens; August 16, 2011

Example Bioretention Facility with Curb Cuts from San Mateo County Sustainable Green Streets and Parking Lots Design Guidebook, Photo Credit Nevue Ngan Associates

Possible BMP Cross-Section



Not to Scale

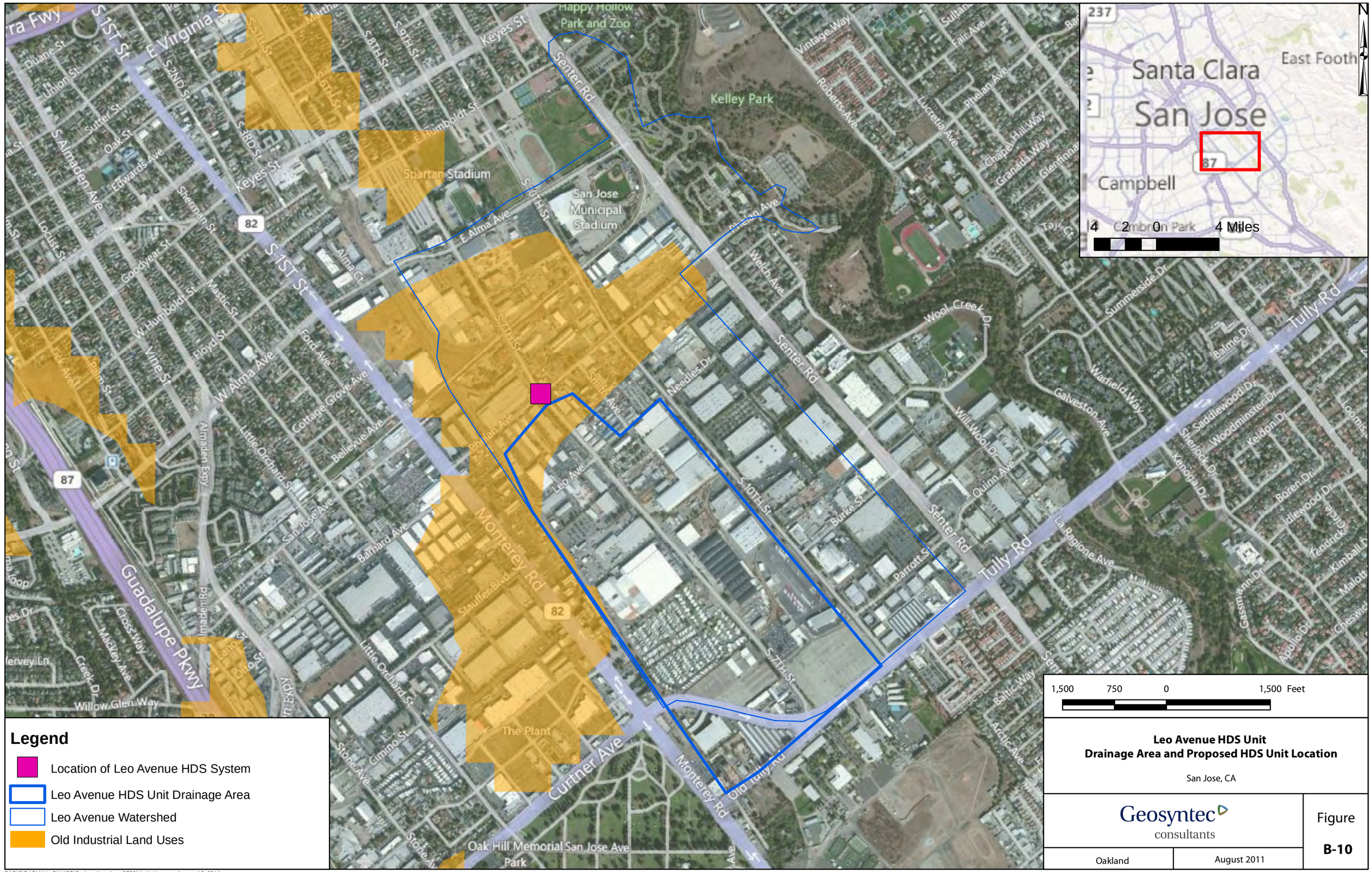
PG&E Substation
Example Bioretention Facility and Cross-Section
Richmond, CA

Geosyntec consultants

Oakland | August 2011

Figure
B-9

PGE_Fig2_0801411; K.Havens; Aug 16, 2011



Legend

- Location of Leo Avenue HDS System
- Leo Avenue HDS Unit Drainage Area
- Leo Avenue Watershed
- Old Industrial Land Uses

Leo Avenue HDS Unit
Drainage Area and Proposed HDS Unit Location

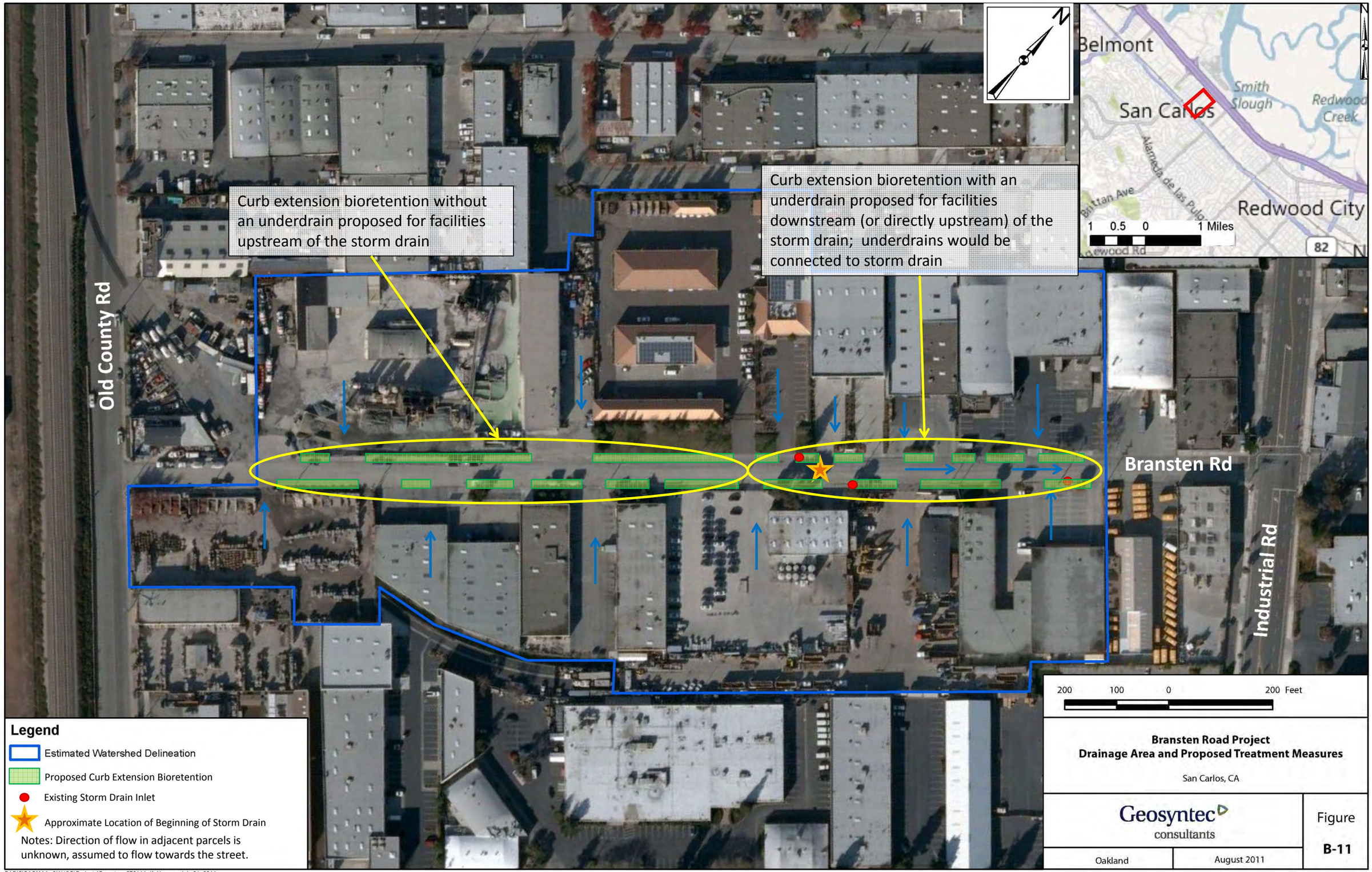
San Jose, CA

Geosyntec consultants

Oakland | August 2011

Figure **B-10**

P:\GIS\BASMAA_CW4CB\Projects\LeoAve_072611; K. Havens; August 16, 2011

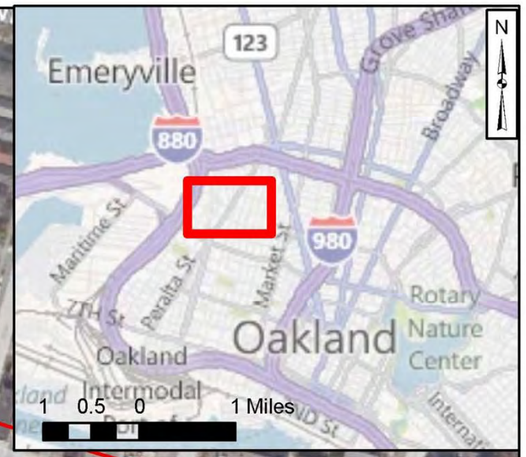


P:\GIS\BASMAA_CW4CB\Projects\Bransten_072111; K. Havens; July 21, 2011

Option 2: Biofilter along Hannah Street, adjacent to proposed Urban Farm

Option 1: Treat runoff along Peralta street, design treatment measures and retrofit catch basins to capture runoff from recycling facility driveway and Peralta street

Option 3: Treat runoff along Poplar Street



Legend

mg PCBs/ kg sediment

- <0.01 or <MDL
- Low: 0.01 - 0.1
- Med: 0.1 - 1.0
- High: 1.0 - 10
- Very High: >10
- 24" Storm Drains
- Catch Basins
- Proposed Biofilter Treatment Locations

350 175 0 350 Feet

Treatment Measure Proposed Locations from Hyphae Design Laboratory

West Oakland Industrial Area Project
Drainage Area and Proposed Treatment Measures

Oakland, CA

Geosyntec consultants

Oakland | August 2011

Figure **B-12**

P:\GIS\BASMAA_CW4CB\Projects\WestOakland_081511.mxd; K. Havens; Aug 16, 2011

San Pablo and Madison Location

San Pablo and Eureka Location

1,000 500 0 1,000 Feet

Legend

- El Cerrito Green Street Project Locations
- Bay Area Watershed Boundaries
- Old Industrial Land Uses

El Cerrito Green Streets Project
Drainage Area and Treatment Measure Locations

El Cerrito, CA

Geosyntec consultants

Oakland | August 2011

Figure **B-13**

P:\GIS\BASMAA_CW4CB\Projects\ElCerrito_072611.mxd; K. Havens; August 16, 2011

Broadway and Redwood Streets Retrofit Project
Drainage Area and Proposed Treatment Measure

Vallejo, CA

Geosyntec consultants

Oakland | August 2011

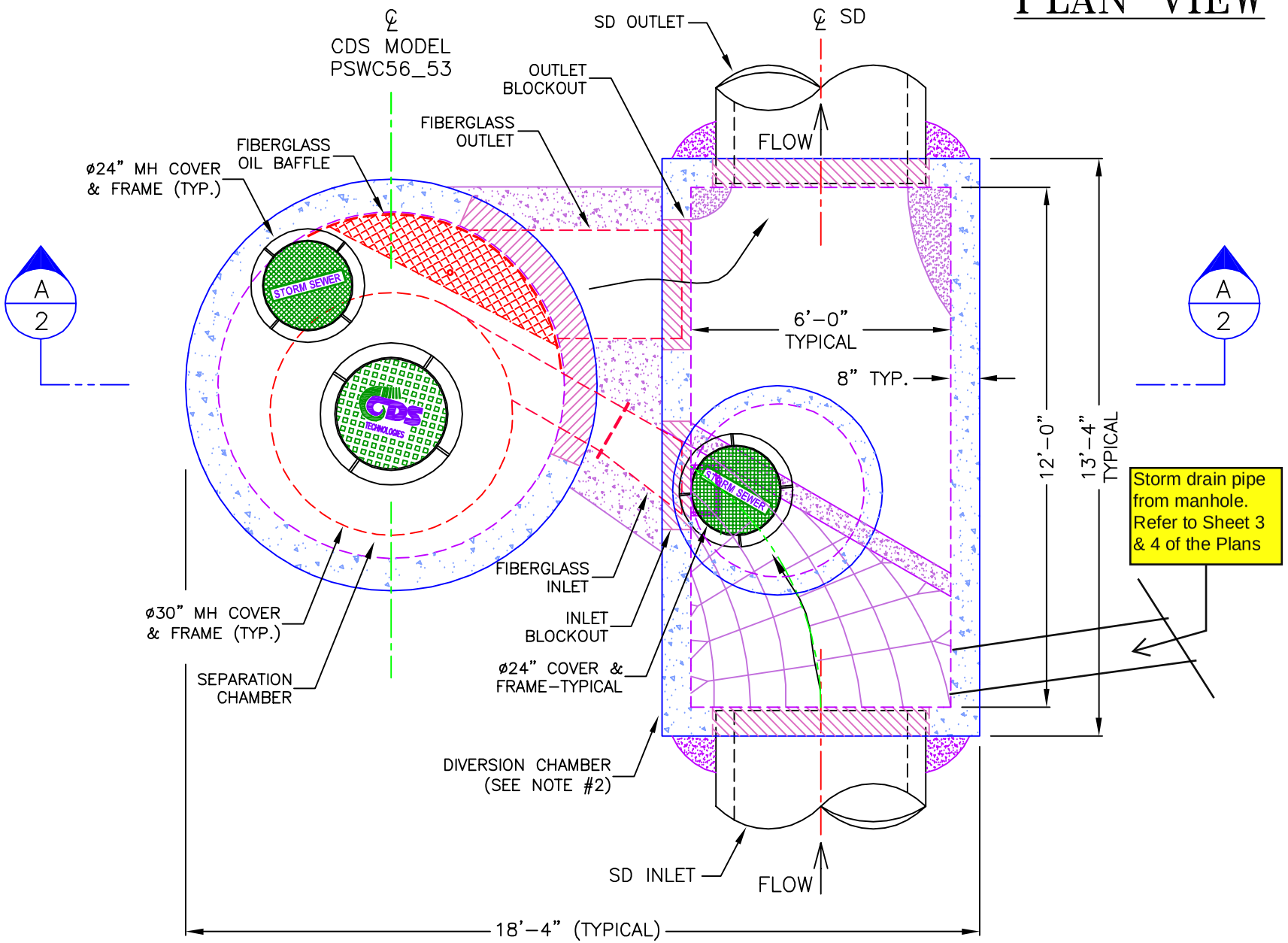
Figure **B-14**

P:\GIS\BASMAA_CW4CB\Projects\Vallejo_081211; W. Lewis rev K. Havens; August 16, 2011

APPENDIX C

Proposed Treatment Measure Specifications

PLAN VIEW



NOTES:
1. CDS UNIT SHOWN IN LEFT-HAND CONFIGURATION.
2. DIVERSION CHAMBER MAY BE PRECAST OR CAST IN FIELD BY CONTRACTOR.

CDS MODEL PSWC56_53
STORMWATER TREATMENT UNIT
(LEFT HANDED UNIT SHOWN)

CDS TECHNOLOGIES™

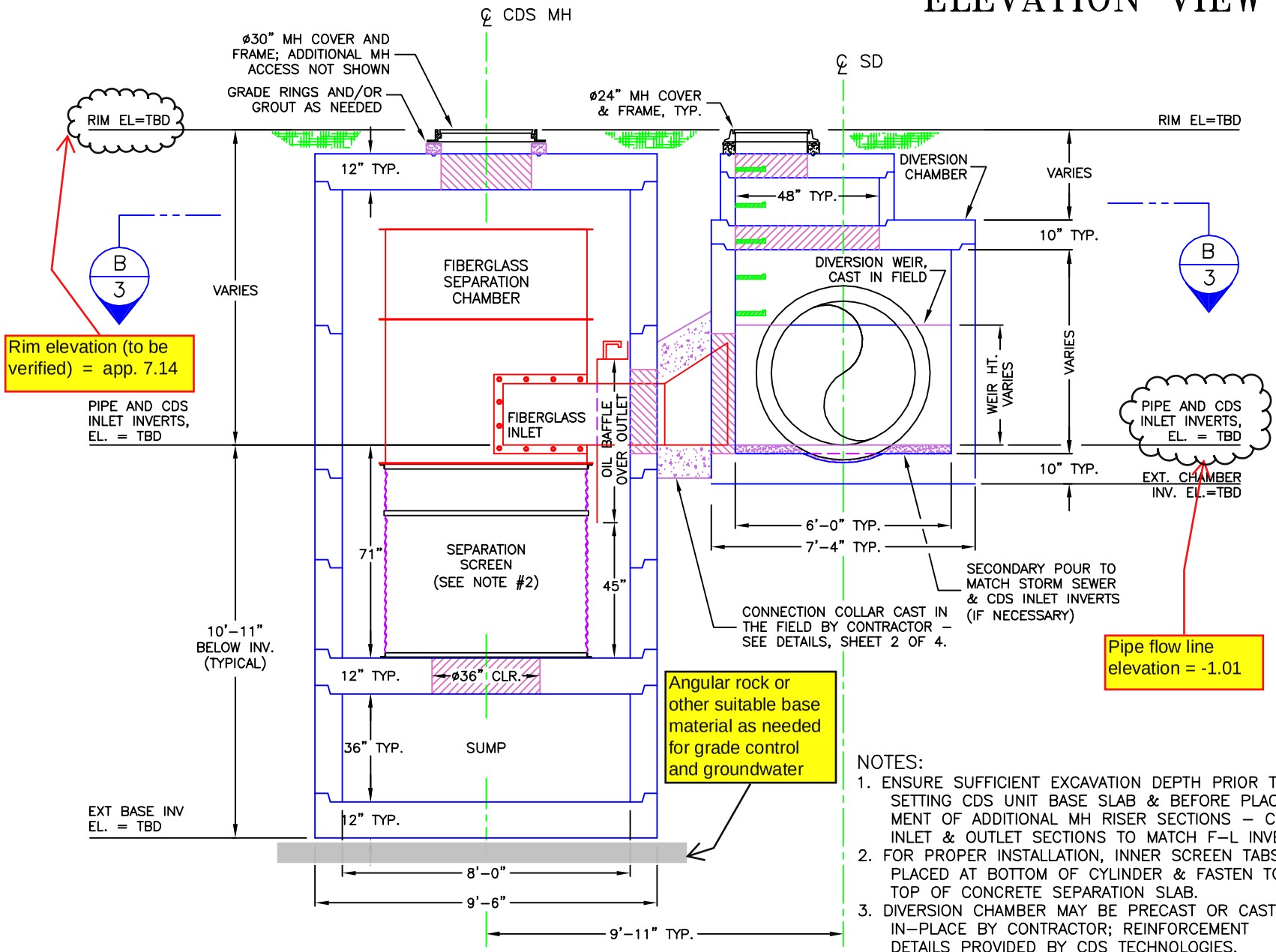
16360 S. MONTEREY RD. SUITE 250 MORGAN HILL, CA. 95037 TEL: (888) 535-7559

PROJECT NAME
PROJECT LOCATION

JOB#
DATE:
DRAWN:
APPROV.

SCALE 1"=40"
SHEET 1

SECTION A–A
ELEVATION VIEW



NOTES:
1. ENSURE SUFFICIENT EXCAVATION DEPTH PRIOR TO SETTING CDS UNIT BASE SLAB & BEFORE PLACEMENT OF ADDITIONAL MH RISER SECTIONS – CDS INLET & OUTLET SECTIONS TO MATCH F–L INVERT.
2. FOR PROPER INSTALLATION, INNER SCREEN TABS PLACED AT BOTTOM OF CYLINDER & FASTEN TO TOP OF CONCRETE SEPARATION SLAB.
3. DIVERSION CHAMBER MAY BE PRECAST OR CAST–IN–PLACE BY CONTRACTOR; REINFORCEMENT DETAILS PROVIDED BY CDS TECHNOLOGIES.

CDS MODEL PSWC56_53
STORMWATER TREATMENT UNIT
(LEFT HANDED UNIT SHOWN)

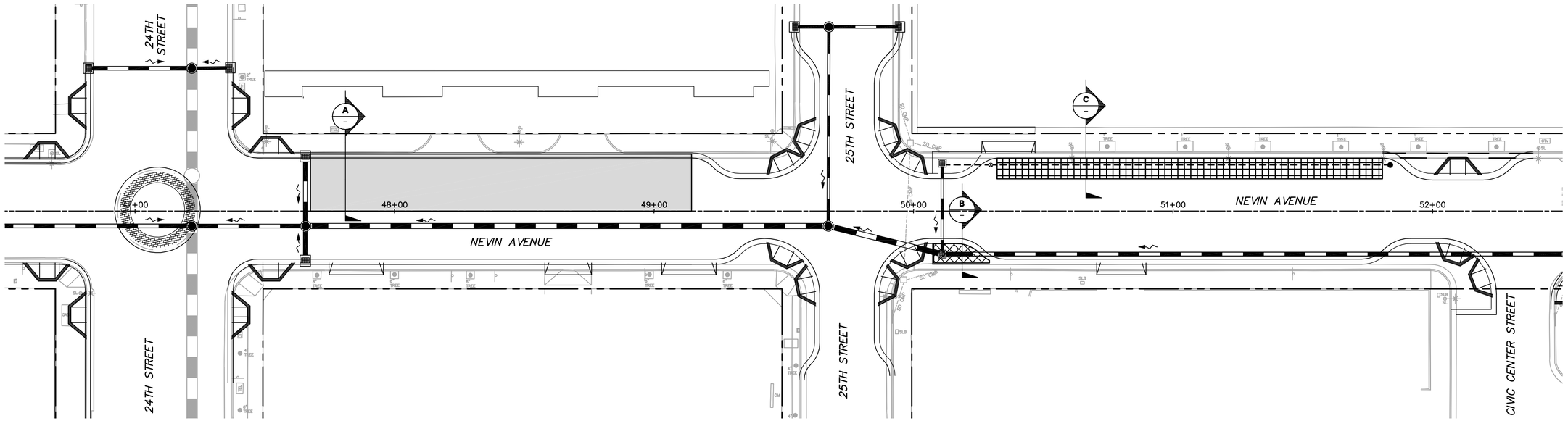
CDS TECHNOLOGIES™

16360 S. MONTEREY RD. SUITE 250 MORGAN HILL, CA. 95037 TEL: (888) 535–7559

PROJECT NAME
PROJECT LOCATION

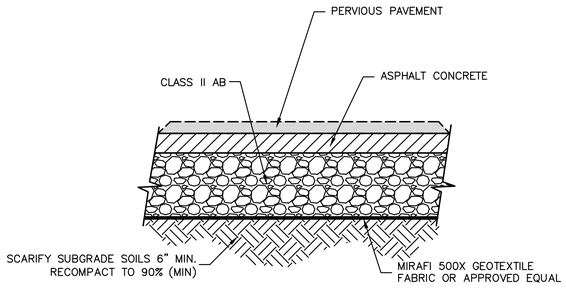
JOB#
DATE:
DRAWN:
APPROV.

SCALE 1"=48"
SHEET 2



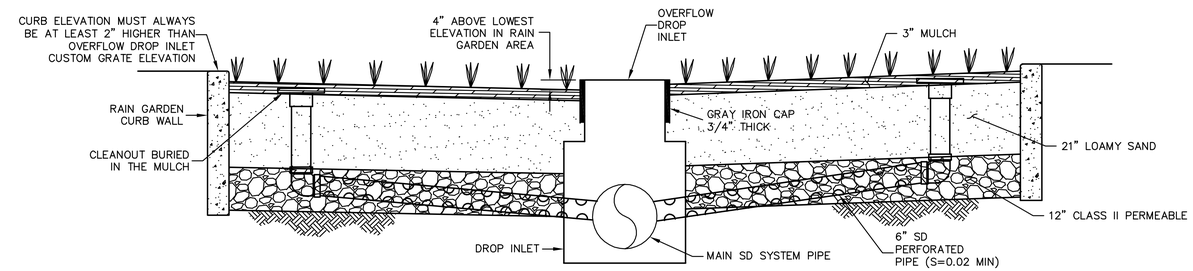
NEVIN AVENUE (STA 46+50 TO 52+50)

SCALE: 1" = 20'



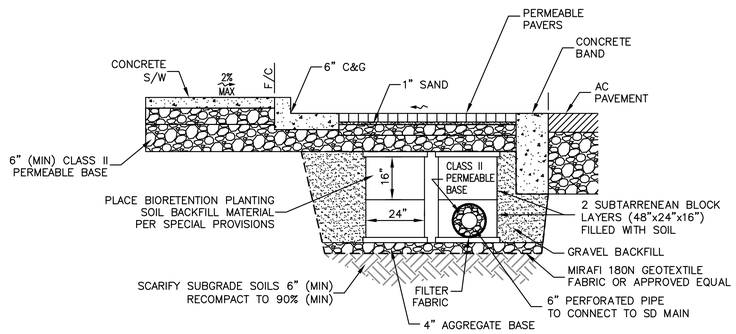
A PERVIOUS PAVEMENT

NTS



B RAIN GARDEN PROFILE

NTS



C SUBTERRANEAN SYSTEM

NTS

C.3 FEATURES

- RAIN GARDEN AREA
- SUBTERRANEAN SYSTEM (PERMEABLE PAVER)
- PERVIOUS PAVEMENT

VALLIER DESIGN ASSOCIATES, INC.
LANDSCAPE ARCHITECTURE PLANNING DESIGN
210 WASHINGTON AVENUE, SUITE C
POINT RICHMOND, CA 94801
T: 510.237.7745 F:510.237.5751

BKF
ENGINEERS / SURVEYORS / PLANNERS
322 HARBOUR WAY, STE 23
RICHMOND, CA 94801
PH: (510) 529-0336

NO.	DATE	REVISION

SHEET TITLE: STORM WATER MANAGEMENT OPTIONS (BETWEEN 24TH ST. AND CIVIC CENTER DRIVE)

PROJECT: RICHMOND TRANSIT VILLAGE
NEVIN AVENUE PEDESTRIAN IMPROVEMENTS

SCALE: 1" = 20'-0"

0 10 20 40

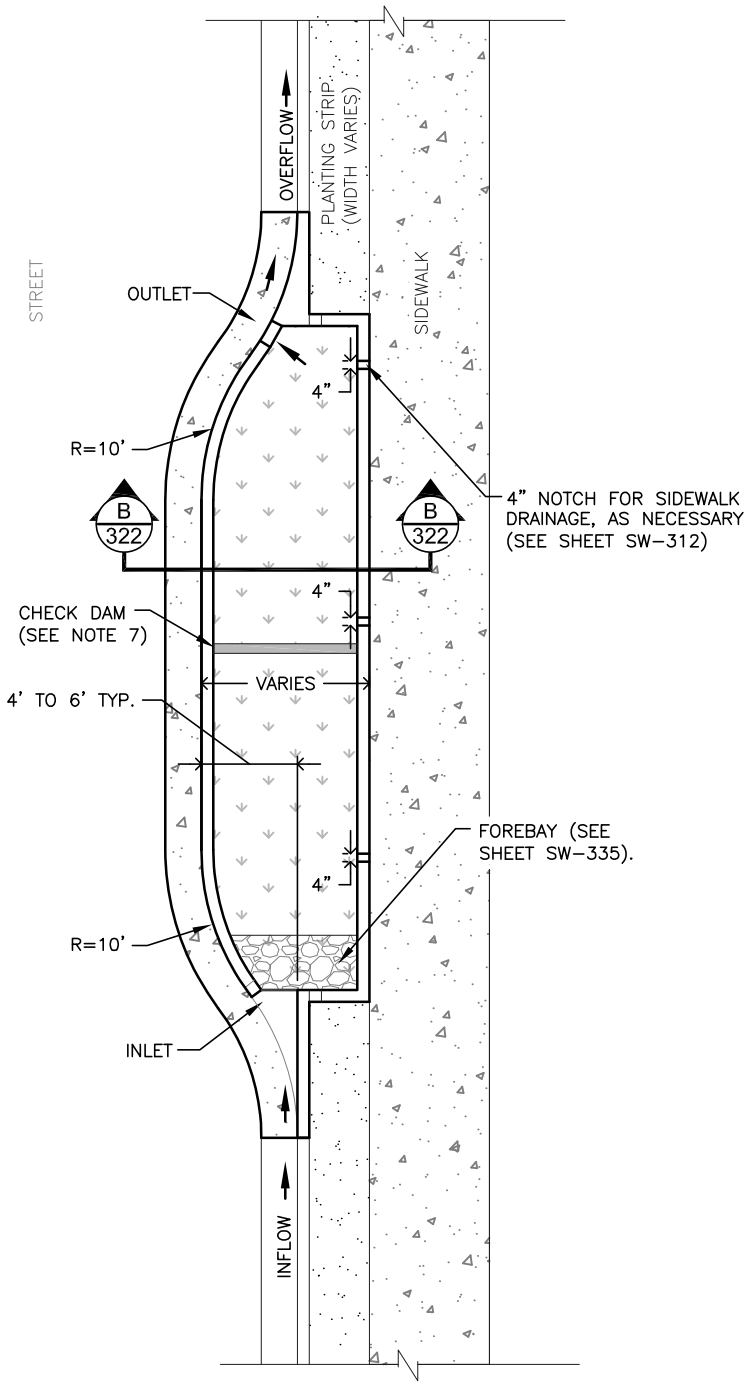
DATE: 08-09-2010

SHEET

FIG - 1

XX OF XX

60% CONSTRUCTION DOCUMENT SUBMITTAL



PLAN VIEW

NOTES:

1. See City of Portland Standard Construction Specifications Section 00415 - Vegetated Stormwater Facilities.
2. Area and depth of facility are based upon engineering calculations and right-of-way constraints. See Chapter 2 of the City of Portland Stormwater Management Manual (SWMM).
3. Longitudinal slope of planter matches road.
4. Include beginning and ending stations for each facility. Provide stations and elevations at every check dam, outlet, and planter wall corner.
5. Sidewalk elevation must be set above inlet and outlet elevations to allow overflow to drain to street before sidewalk.
6. See sheet SW-335 for inlet and outlet details.
7. Check dams may be required: See sheets SW-341 and SW-342 for details.
8. See Appendix F.3 in the SWMM for stormwater facility topsoil requirements.
9. Special requirements for water lines, meters, and fire hydrants: See sheet SW-324 for details.
10. Utility lines may need to be sleeved or relocated.
11. Curb and Gutter: Standard Drawing P-540. Use 1'-6" wide gutter.
12. See Landscape Planting Templates on SW-323.

IMPORTANT: Utility conflicts and existing conditions can create major design variables. Locate utilities and survey existing conditions prior to beginning design work.

The Portland Bureau of Transportation (PBOT), Portland Water Bureau (PWB), and Bureau of Environmental Services (BES) are responsible for the review and approval of Stormwater Swales in the public right of way. Stormwater facilities in *Well Field Protection Areas* may require special containment measures.

For more information contact:

PBOT (503) 823-7884	BES (503) 823-7761
PWB (503) 823-7368	Urban Forestry (503) 823-4489

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

- 2010 Green Streets -

In-Planting Strip Plan View

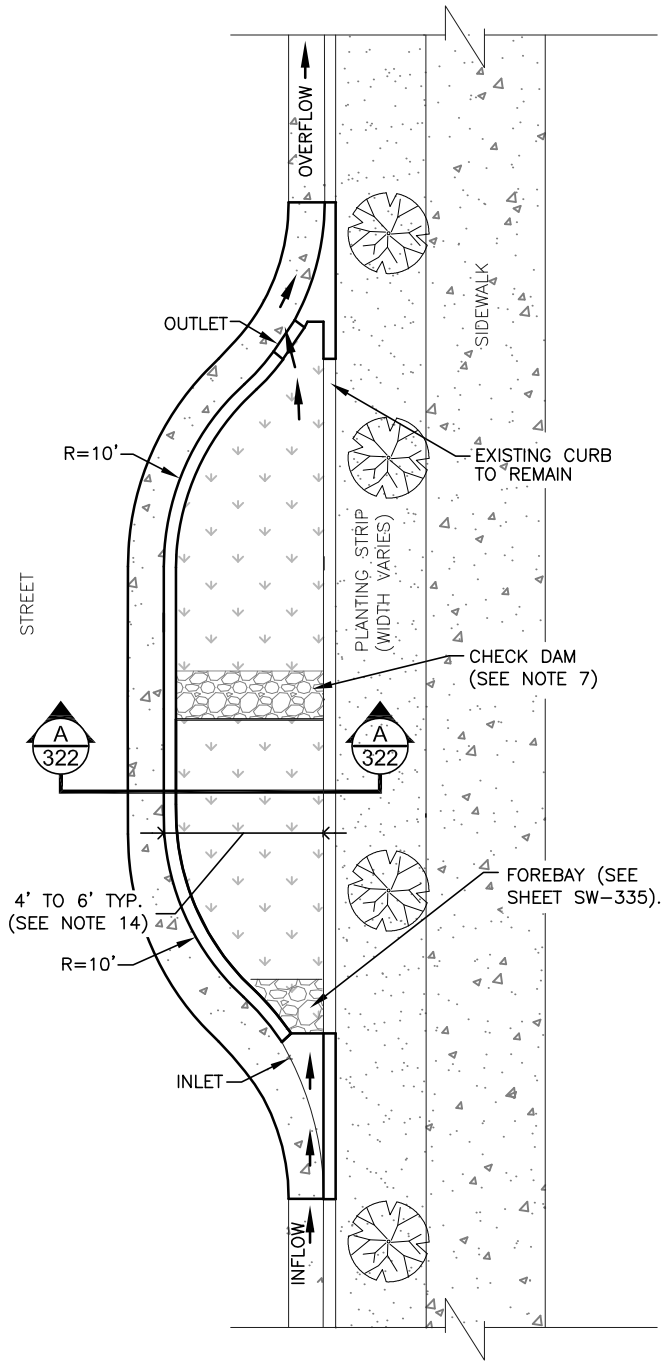
Curb Extensions

Bureau of Environmental Services

NUMBER

SW-320

REVISED: 03/05/10 11:18



PLAN VIEW

NOTES:

1. See City of Portland Standard Construction Specifications Section 00415 - Vegetated Stormwater Facilities.
2. Area and depth of facility are based upon engineering calculations and right-of-way constraints. See Chapter 2 of the City of Portland Stormwater Management Manual (SWMM).
3. Longitudinal slope of planter matches road.
4. Include beginning and ending stations for each facility. Provide stations and elevations at every inlet, outlet, and check dam.
5. Sidewalk elevation must be set above inlet and outlet elevations to allow overflow to drain to street before sidewalk.
6. Inlets and outlets required: See sheet SW-335 for inlet and outlet details.
7. Check dams may be required: See sheets SW-340, SW-341, and SW-342 for details.
8. See Appendix F.3 of the SWMM for stormwater facility topsoil requirements.
9. Special requirements for water lines, meters, and fire hydrants: See sheet SW-324 for details.
10. Utility lines may need to be sleeved or relocated.
11. Curb and Gutter: Standard Drawing P-540. Use 1'-6" wide gutter.
12. Where feasible, width of stormwater facility should extend into existing planting strip (See sheet SW-320).
13. See Landscape Planting Templates on SW-323.

IMPORTANT: Utility conflicts and existing conditions can create major design variables. Locate utilities and survey existing conditions prior to beginning design work.

The Portland Bureau of Transportation (PBOT), Portland Water Bureau (PWB), and Bureau of Environmental Services (BES) are responsible for the review and approval of Stormwater Swales in the public right of way. Stormwater facilities in *Well Field Protection Areas* may require special containment measures.

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PWB (503) 823-7368	Urban Forestry (503) 823-4489

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

- 2010 Green Streets -

In-Street Plan View

Curb Extensions

Bureau of Environmental Services

NUMBER

SW-321

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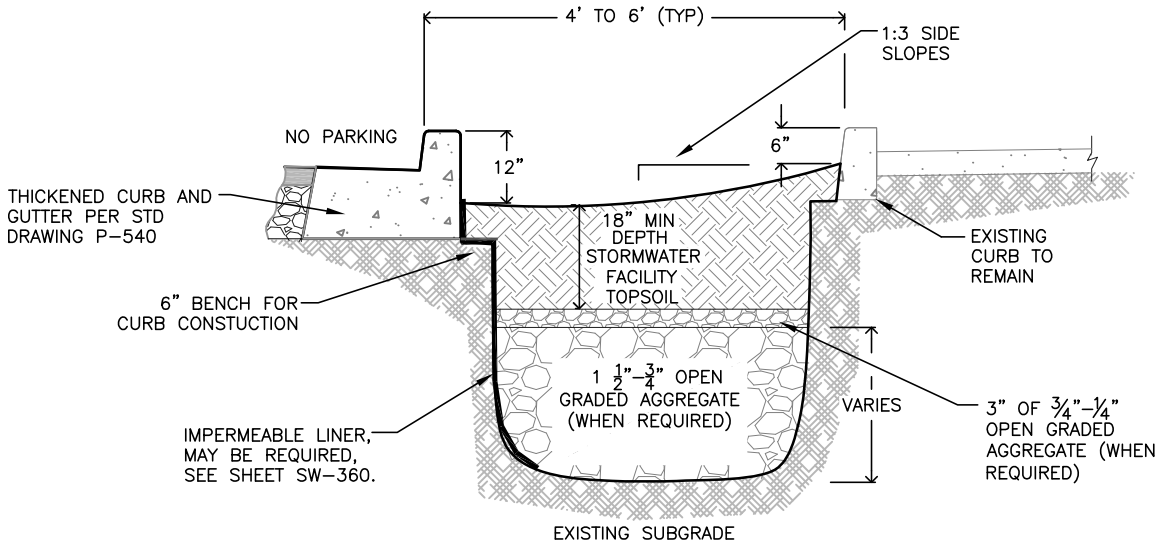
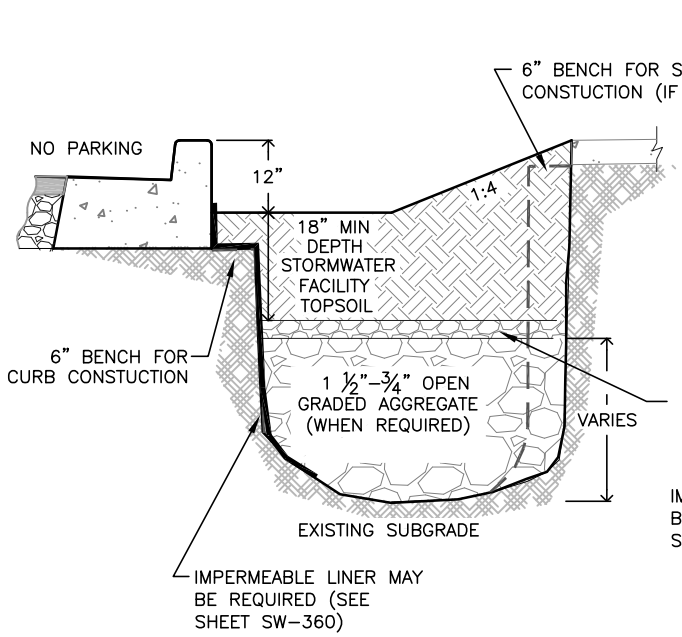
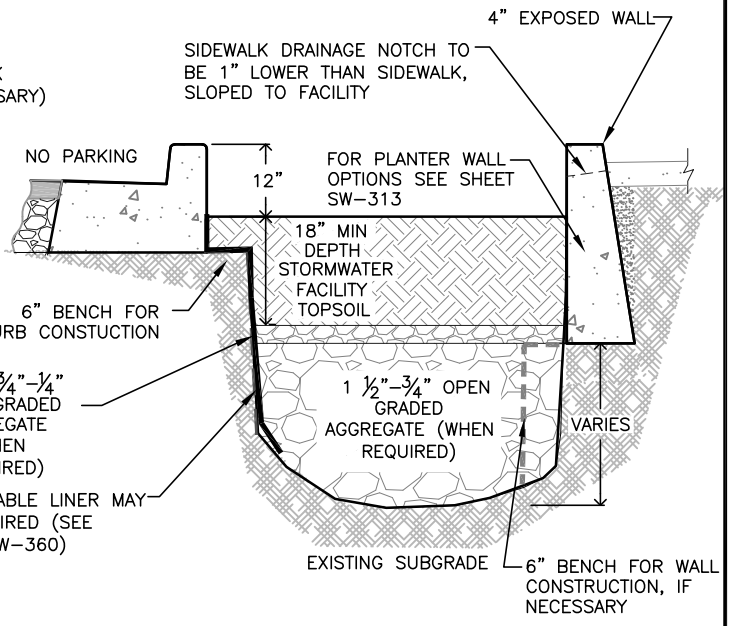


SECTION A-A
CURB EXTENSION SECTION

FOR PLAN VIEW REFER TO SW-321



SECTION B-B
CURB EXTENSION SWALE



SECTION B-B
CURB EXTENSION PLANTER

FOR PLAN VIEW REFER TO SW-320

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

- 2010 Green Streets -

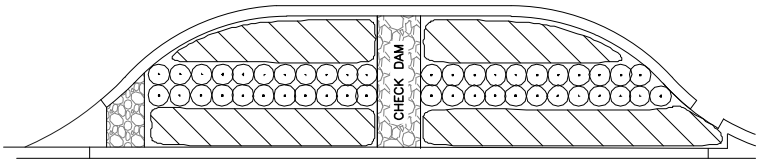
Section Views
Curb Extensions

Bureau of Environmental Services

NUMBER

SW-322

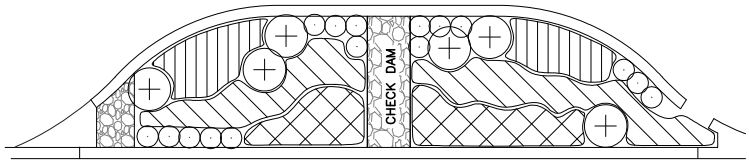
REVISED: 03/05/10 11:18



TEMPLATE 1

PLANT LEGEND 1

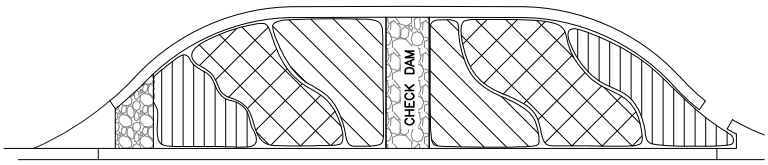
Symbol	Botanical Name / Common Name	
	Carex testacea Orange sedge	*w/ OPTIONAL CAMAS BULBS*
	Deschampsia cespitosa Tufted hair grass	



TEMPLATE 2

PLANT LEGEND 2

Symbol	Botanical Name / Common Name
	Camassia quamash Common camas
	Carex densa Dense sedge
	Cornus sericea 'kelseyii' Kelsey dogwood
	Deschampsia cespitosa Tufted hair grass
	Juncus patens Spreading rush



TEMPLATE 3

PLANT LEGEND 3

Symbol	Botanical Name / Common Name
	Carex obnupta Slough sedge
	Carex testacea Orange sedge
	Juncus patens Spreading rush

NOTES:

1. These are examples of approved planting templates. Other planting plans may be approved.
2. See Section 2.3.3 and Appendix F.4 of the SWMM for planting requirements.

- DRAWING NOT TO SCALE -

STORMWATER MANAGEMENT MANUAL TYPICAL DETAILS

- 2010 Green Streets -

Landscape Planting Templates

Curb Extensions

Bureau of Environmental Services

NUMBER

SW-323

REVISED: 03/05/10 11:18

APPENDIX D

Project Cost Estimates

Table D-1: Ettie Street Pump Station Retrofit Project Cost Estimate

Project Phase	Item	Unit	Unit Price	Quantity	Amount	Source
Con-struction	Fiberglass tanks	cu-ft	$5,000	2	$10,000	Tank dimensions: (13ft x 4 ft x 5 ft); Vendor: http://dtfiberglass.com/
	Pump	each	$2,000	1	$2,000	Assumes 1 gpm pump (0.5 Hp); http://www.mcmaster.com
	Flow control valves	each	$300	4	$1,200	http://www.mcmaster.com
	Flow meter	each	$1,000	1	$1,000	http://www.mcmaster.com
	Weir	each	$500	2	$1,000	Assumes local fabrication at metal workshop of 2 weirs
	Media	cu-yd	$250	1000	$1,000	Assumes media blended and placed; Vendor: http://www.stcloudmining.com/
	Filter fabric	sq-yd	$2.31	8	$18	RS Means category 33 46 26 ($2.31/SY)
	Waterproofing membrane	sq-yd	$1.32	8	$11	R.S. Means category 33 47 13 ($1.32/SF); 60 mil
	Pea gravel	cu-yd	$35	2	$70	R.S. Means category 31 23 23.17 ($35/CY); assuming by hand installation
	Underdrain	feet	$1.42	20	$28	Assumes 2 inch Schedule 40 perforated PVC pipe R.S. Means category 33 11 13.25 ($1.42/LF)
	Piping for inlet/outlet	feet	$4.5	40	$180	Assumes 40 ft of 3 inch Schedule 40 PVC pipe R.S. Means category 33 11 13.25 ($$4.50/LF)
	Total Cost – Materials				*$16,500*	
	Staff Rate (with overhead)	$/ man-hr		77		Light Equipment Operator RS Means Heavy Construction Cost Data 2011 (with 20% increase for Bay Area)
	Labor for Fabrication	hour		80	$6,200	Assume 80 hours for fabrication,
	Labor for Installation	hour		120	$9,200	Assume 120 hours for installation.
	Total Cost – Labor				*$15,400*	
Total Construction Cost		$			$32,000	Includes construction and labor for fabrication and installation of filter system.
Design	Assume 40% of Construction				$13,000	
Main-tenance	Staff Rate (with overhead)	$/ man-hr		77		Light Equipment Operator RS Means Heavy Construction Cost Data 2011 (with 20% increase for Bay Area)
	Sediment removal and equipment maintenance	man-hrs/yr		36	$2,400	Assume one person working quarterly, total of 36 hrs annually
	Replacing spent media	cu-yd		250	$250	Assumes annual replacement of 250 cu-yds of media
	Total Maintenance Labor	$/yr			$3,000	

Table D-2: Nevin Avenue Improvement Project Cost Estimate

Attach Nevin detailed cost estimate from BKF here.

Table D-3: PG&E Substation Retrofit Project Cost Estimate

Project Phase	Item	Unit	Amount	Source
Construction	Total Length of Bioretention Facilities	feet	810	PG&E Concept Plan, 25 July 2011 (Geosyntec)
	Average Width	feet	9	PG&E Concept Plan, 25 July 2011 (Geosyntec)
	Total Landscaped Area	sq-ft	7,300	Includes 2 bioretention facilities
	Cost/Area (Portland)	$/sq-ft	60	T. Kurtz (Portland, Oregon Bureau of Environmental Services) based on 2010 bids for 67 facilities most of which were curb extensions
	Cost/Area (San Francisco Bay Area)	$/sq-ft	72	RS Means Location Factors for installation (Bay Area has installation factor 20% higher than Portland)
	Total Cost – Curb Extensions, no Underdrain		*$526,000*	
	Underdrains	feet	810	Assumes one underdrain pipe in each bioretention facility
	Cost of underdrain	$/feet	20	Estimation based on preliminary analysis using BMP and LID Whole Life Cost Models (WERF, 2009) and RSMeans CostWorks, 2011
	Total Cost – Underdrains		*$16,000*	
	Linear feet of connection to storm drain	feet	60	Assumes connections for 2 bioretention facilities, approximately 30 feet per connection.
	Cost of connection to storm drain	$/ feet	130	Includes estimates for demolition, excavation/trenching, installation, connection pipe to storm drain; Estimation based on preliminary analysis using BMP and LID Whole Life Cost Models (WERF, 2009) and RSMeans CostWorks, 2011
	Total Cost – Connections to Storm Drain		*$7,800*	
	Total Construction Cost	$	$535,000	Includes construction, plant installation and 2 years of plant establishment
Design	Assume 20% of Construction		$107,000	
Maintenance	Weeding, Leaf and Sediment Removal	hrs/yr	32	Activity and frequency from 2008 Stormwater Management Facility Monitoring Report for NE Siskiyou Green Street (Portland Environmental Services Dept.) Geosyntec assumes a crew of 2 working one full day, 2xs per year - once during the fall/winter and once during the spring/summer.
	Staff Rate (with overhead)	$/hr	77	Light Equipment Operator RS Means Heavy Construction Cost Data 2011 (with 20% increase for Bay Area)
	Total Maintenance Cost	$/yr	2,500	

Table D-4: Bransten Road Green Streets Project Cost Estimate

Project Phase	Item	Unit	Amount	Source
Construction	Total Length of Curb Extensions	feet	1,270	Branston Road Rough Concept Plan 18 Jan. 2011 (K.R. Perry, Portland Oregon)
	Average Width	feet	6	Concept Plan (K.R. Perry)
	Total Landscaped Area	sq-ft	7,600	Includes flow-through and filtration curb extensions
	Cost/Area (Portland)	$/sq-ft	60	T. Kurtz (Portland, Oregon Bureau of Environmental Services) based on 2010 bids for 67 facilities most of which were curb extensions
	Cost/Area (San Francisco Bay Area)	$/sq-ft	72	RS Means Location Factors for installation (Bay Area has installation factor 20% higher than Portland)
	Total Cost – Curb Extensions, no Underdrain		*$547,000*	
	Underdrains	feet	500	Assumes one underdrain pipe in each filtration curb extension
	Cost of underdrain	$/feet	20	Estimation based on preliminary analysis using BMP and LID Whole Life Cost Models (WERF, 2009) and RSMeans CostWorks, 2011
	Total Cost – Underdrains		*$10,000*	
	Linear feet of connection to storm drain	feet	330	Assumes connections for all filtration facilities, approximately 30 feet per connection.
	Cost of connection to storm drain	$/ feet	130	Includes estimates for demolition, excavation/trenching, installation, connection pipe to storm drain; Estimation based on preliminary analysis using BMP and LID Whole Life Cost Models (WERF, 2009) and RSMeans CostWorks, 2011
	Total Cost – Connections to Storm Drain		*$43,000*	
Total Construction Cost		$	$600,000	Includes construction, plant installation and 2 years of plant establishment
Design	Assume 20% of Construction		$120,000	
Maintenance	Vegetation Management, Trash and Sediment Removal	man-hrs/yr	64	Activity and frequency from 2008 Stormwater Management Facility Monitoring Report for NE Siskiyou Green Street (Portland Environmental Services Dept.) Assumes a crew of 4 working one full day, twice per year - once during the fall/winter and once during the spring/summer.
	Staff Rate (with overhead)	$ / man-hr	77	Light Equipment Operator RS Means Heavy Construction Cost Data 2011 (with 20% increase for Bay Area)
	Total Maintenance Labor	$/yr	$5,000	

Table D-5: Broadway and Redwood Project

Project Phase	Item	Unit	Unit Price	Quantity	Amount	Notes
Con-struction	Removal of asphalt pathway	SY	$8.60	400	$3,440	RS Means Category 02 41 13.17
	Swale	Acres (drainage area)	$15,000	3	$45,000	WERF Life Cycle Cost Template "very high estimate" (includes grading, soil improvements, and landscaping)
	Irrigation system	SF	$1.25	6000	$7,500	RS Means Category 32 84 23
Total Construction Cost					***$55,940***	Includes construction and labor for fabrication and installation of filter system.
Design	Assume 40% of Construction				**$22,000**	
Main-tenance	Staff Rate (with overhead)	$/ man-hr		77		Light Equipment Operator RS Means Heavy Construction Cost Data 2011 (with 20% increase for Bay Area)
	Sediment removal and Vegetation Management	man-hrs/yr		64	$5,000	Assume two staff quarterly for 8 hours
	Total Maintenance Labor	**$/yr**			**$5,000**	

Table D-6: West Oakland Industrial Area Project Cost Estimate

Project Phase	Item	Unit	Option 1	Option 2	Option 3	Source
Construction	Total Length of Bioretention Facilities	feet	350	700	250	West Oakland Concept Plan,11 August 2011 (Geosyntec)
	Average Width	feet	6-15	6	6-15	West Oakland Concept Plan,11 August 2011 (Geosyntec)
	Total Landscaped Area	sq-ft	3,200	4,200	2,800	Includes facilities proposed for each option
	Cost/Area (San Francisco Bay Area)	$/sq-ft	72	72	72	RS Means Location Factors for installation (Bay Area costing)
	Total Cost – Bioretention, no Underdrain		*$230,000*	*$300,000*	*$200,000*	Includes construction, plant installation and 2 years of plant establishment
	Underdrains	feet	350	700	250	Assumes one underdrain pipe in each bioretention facility
	Cost of underdrain	$/feet	20	20	20	Estimation based on preliminary analysis using BMP and LID Whole Life Cost Models (WERF, 2009) and RSMeans CostWorks, 2011
	Total Cost – Underdrains		*$7,000*	*$14,000*	*$5,000*	
	Total Cost of Construction	$	$237,000	$314,000	$205,000	
Design	Assume 20% of Construction	$	$47,000	$63,000	$41,000	

Maintenance would be conducted by the Urban Releaf project. Costs would be estimated with the organization.