SFCTA Contract Number 06/07-29

Caltrans EA Number 04-163701

SOUTH ACCESS TO THE GOLDEN GATE BRIDGE

DOYLE DRIVE

DOYLE DRIVE REPLACEMENT PROJECT

Draft Stormwater BMP Report

June 2009

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JUNE 2009

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Contents

Figures

1 Introduction

1.1 Purpose

The purpose of this report is to provide background information, discuss options and describe the preferred alternative for the design of stormwater best management practices (BMPs) associated with the Doyle Drive Replacement Project (Project). This includes BMPs for treating runoff from the new road surfaces included in the Project (Roadway Drainage) but does not include BMPs for treatment of runoff from any non-Project runoff which crosses the Doyle Drive alignment (Offsite Drainage). Treatment of Offsite Drainage is not a requirement of the Doyle Drive project.

The Project will be constructed in several contracts, and storm drainage improvements will be part of Contract 3 to Contract 7. Arup PB JV (Design Team) has evaluated the stormwater systems of the entire project at a design development level. The stormwater BMPs will be constructed in Contract 6 for the eastern end of the project and Contract 7 for the BMPs on the western end.

Additional background material can be found in the 35% Stormwater Drainage Report dated February 2009 (35% Report) prepared by Arup PB Joint Venture (Design Team).

1.2 Regulatory Framework and Guidelines

The following discussions describe key aspects of regulatory frameworks and guidelines issued by regulating authorities and agencies pertaining to the design of stormwater BMPs.

1.2.1 Regional Water Quality Control Board

The San Francisco Bay Regional Water Quality Control Board (RWQCB) regulates stormwater quality under authorities of the federal Clean Water Act and California's Porter-Cologne Water Quality Control Act. The RWQCB is the primary regulatory agency that will oversee conformance of the Project's stormwater quality management system with the Clean Water Act. The California Water Code established the Water Boards as the primary State agencies for protecting the quality of waters.

1.2.1.1 Beneficial Uses

The project lies within the Central Bay Basin hydrologic planning area. The San Francisco Bay Regional Water Quality Control Board (RWQCB) lists the Beneficial Uses of the Central Bay Basin to include industrial service supply, industrial process supply, ocean commercial and sports fishing, shellfish harvesting, estuarine habitat, migration of aquatic organisms, preservation of rare and endangered species, fish spawning, wildlife habitat, navigation, water contact recreation, and non-contact water recreation.

1.2.1.2 Total Maximum Daily Load Program

Total Maximum Daily Load (TMDL) programs completed or underway in the Bay include TMDLs for Mercury, PCBs, Copper, Nickel, and exotic species. Mercury, PCBs and exotic species are not prevalent in urban stormwater runoff. However, both copper and nickel are naturally abundant elements that occur in highway runoff and therefore should be addressed by stormwater BMPs. Copper sources include vehicle brake pads, air emission, soil erosion, and vehicle fluid leaks. Nickel occurs in fossil fuels and can be deposited on road surfaces directly or through atmospheric deposition.

1.2.1.3 Federal 401 certification

All parties proposing to discharge waste that could affect waters of the state must file a report of waste discharge with the appropriate regional board. The regional board will then

respond to the report of waste discharge by issuing waste discharge requirements (WDRs), or by waiving WDRs (with or without conditions) for that proposed discharge.

While Section 401 certifications are required when the activity results in discharge directly below the ordinary high water line of waters of the United States, any activity that results or may result in a discharge that directly or indirectly impacts waters of the state or the beneficial uses of those waters are subject to WDRs.

The project has been awarded 401 certification (and the parent 404 permit) based on the strategy outlined in the 35% Report.

1.2.1.4 National Pollution Discharge Elimination System (NPDES) Permit

In 1999, the State Water Board issued Caltrans a statewide permit (Order No. 99-06-DWQ) which authorizes stormwater and authorized non-stormwater discharges from Caltrans properties, facilities, and activities. The permit requires the Project to reduce or prevent pollutants in storm water Roadway Drainage through the development and implementation of BMPs which constitutes compliance with maximum extent practicable (MEP).

According to the NPDES permit, storm water discharges must also be in compliance with water quality standards. If receiving water quality standards are exceeded, Caltrans is required to submit a written report providing additional BMPs or other measures to be taken that will be implemented to achieve water quality standards.

The current Caltrans statewide NPDES permit does not include definitions or methodologies for determining the water quality flow rates or water quality volumes required to design BMPs.

The NPDES permit does not discuss the limits of discharging to ground water through infiltration within storm water BMPs. It does however, within the construction activities section (C-2) note that “Storm water discharges and authorized non-storm water discharges to any surface or ground water shall not adversely impact human health or the environment.”

1.2.2 San Francisco Public Utilities Commission

The San Francisco Public Utilities Commission (SFPUC) and the Port of San Francisco (Port) have established stormwater design guidelines (Guidelines) to fulfill state and federal requirements for runoff control in City areas that have separated, combined or no storm sewer services. Since runoff from the project will discharge directly into San Francisco Bay, and the project is surrounded by areas that must adhere to the SFPUC’s guidelines, the Project should, in addition to meeting other state and national criteria, provide runoff treatment for all project areas to the standards set forth by the Guidelines. The Guidelines provide detailed sizing and selection guidance for water quality devices that meet the National Pollution Discharge Elimination System (NPDES) requirements of MEP.

1.2.3 Caltrans

The Caltrans Storm Water Quality Handbook provides design guidelines for treatment BMPs in areas where Caltrans operates in order to meet the MEP requirement of the statewide NPDES permit. The recommended BMP selection process begins with maximizing the use of biofiltration swales, strips and dry weather diversion. Infiltration basins should be considered next, followed by detention devices. The BMPs described in the Handbook includes:

- Pollution Prevention BMPs,
- Treatment BMPs,

- Construction Site BMPs, and
- Maintenance BMPs

This report focuses on the design of Pollution Prevention and Treatment BMPs. Approved Caltrans BMP options are as follows:

- Biofiltration Systems,
- Infiltration Devices,
- Detention Devices,
- Traction Sand Traps,
- Dry Weather Flow Diversion,
- Gross Solids Removal Devices,
- Media Filters,
- Multi-Chamber Treatment Train, and
- Wet Basins.

From this list, biofiltration systems, detention devices, media filters, and wet basins were previously selected as options for the Doyle Drive treatment BMPs in the 35% Report. The Design Team has selected vegetated swales, a biofiltration system, for the design feature of the BMPs on site.

1.3 Design Criteria

The Design Team has referenced the above frameworks in developing the BMP concepts in this report. The Design Team used the design criteria set forth in the Caltrans Stormwater Quality Handbook for Water Quality Event (WQE) treatment. These criteria include both flow rates for flow-based BMPs and volumes for volume-based BMPs.

WQE runoff is diverted from the storm drains to the appropriate BMPs. Therefore, during storm events that are more intense than the WQE, the BMPs are required to handle only the flows WQE flows not higher flows from the roadway area associated with the increase in rainfall intensity.

The definitions of the WQE volume and flow rates were previously calculated in the Stormwater Drainage Report prepared by Arup PB as follows:

- WQE flow rates were based on a rainfall intensity of 0.2 in/hr for water quality flow in Region 2 (San Francisco) as found in the Caltrans Storm Water Quality Handbook Section 2.4.2.2.
- The water quality treatment unit basin storage volume was found to be 0.7 inches. This was calculated using the unit basin storage volume, taken from the Basin Sizer version 1.46 Program which uses the Caltrans Method, Downtown San Francisco rain gauges with a 48-hour drawdown time.

Both the flow rate and water quality unit basin storage volume described above are consistent with the SFPUC's Stormwater Guideline's.

While no specific flow attenuation requirements govern the site, BMP devices have the potential to provide stormwater detention and retention in addition to improving water quality. This study prioritizes devices that provide how attenuation in addition to treatment.

2 Site Constraints

This section describes several of the key site constraints that affect BMP placement, and design. The location of best management practices is limited to the availability of land adjacent or beneath the Doyle Drive alignment or on Presidio Trust or National Parks Land.

2.1 Outfalls

Design of the drainage system, including all storm drain alignments, pumping stations and BMPs is by necessity constrained by the downstream boundary condition. The locations of the outfalls for the alignment runoff are therefore paramount to the overall drainage design.

In early discussions with representatives from the National Parks Service, the Design Team was advised that it would not be acceptable to discharge Roadway Drainage from the Doyle Drive alignment to Crissy Marsh. This direction is being carried forth as a design constraint despite that it being likely that Roadway runoff reaches the Marsh via overland flow and continuing to drain to Crissy Marsh after the Project would significantly improve the available design options.

This constraint eliminates the use of Outfalls G, F, D, and C. In addition, Outfall B is not serviceable because it is completely blocked. The Project only has the option of being discharged to either Outfalls A, IJKL, M or 15. Runoff from the Drainage Areas A, B, and C will discharge to Outfalls A, IJKL, and M respectively.

There is the potential for runoff from the western side of the high viaduct to the toll plaza to be routed to the storm drains along Lincoln Avenue which discharge to Outfall 15. However, treating this runoff before it reaches Lincoln Boulevard is difficult to achieve. Open space areas are available between the various connector ramps of the Highway 101 and Veterans Boulevard interchange. However, these areas are not suitable for BMP implementation due to dense existing vegetation, steep slopes, and access issues. High travel speeds around the interchange combined with limited lines of site combine to create a non-optimal condition for access to these open spaces. Therefore, the opportunity of discharging to Outfall 15 is not considered further in this report.

2.2 Quartermasters Site Area

Construction is not allowed within the Quartermaster Site Area due to archaeological constraints. This constraint eliminates the opportunity to create new storm drain alignments that cross this area. This negatively affects the ability to discharge Roadway Drainage to potential BMP locations immediately west of the dump site.

2.3 Groundwater

Discharge of surface runoff, via infiltration, to the shallow Marina groundwater aquifer is being considered as a design option associated with the BMPs. The Design Team's current understanding of the site constraints are that neither the statewide Caltrans NPDES permit, nor the completed EIR for the Doyle Drive project eliminate the possibility of discharging to the Marina aquifer. This aquifer is not currently used, nor are there known plans for future use, as a water supply within the vicinity of the project.

Infiltration at natural rates of treated stormwater to the groundwater aquifer would not cause significant detrimental impacts to either the environment or to human health. Allowing for infiltration in BMPs could provide a significant benefit by maintaining natural infiltration rates. Intentionally accelerated infiltration, such as would occur in a well maintained infiltration basin, could however cause unanticipated changes in groundwater flow and elevations and

is not recommended. The consequential infiltration to groundwater that occurs from implementation of stormwater BMPs is being considered as permissible except where it could potentially have an adverse affect on the groundwater regime.

3 Proposed Drainage System Areas

The Roadway Drainage from the Doyle Drive alignment includes all of the intersections, ramps, feeder roads and associated with the project as well as the high viaduct. The system is divided into three watersheds identified in Figure 1. The Construction Contract 3 and Contract 7 drainage area consists of Watersheds B and C, while Contract 4, 5, 6 consist of Watershed A.

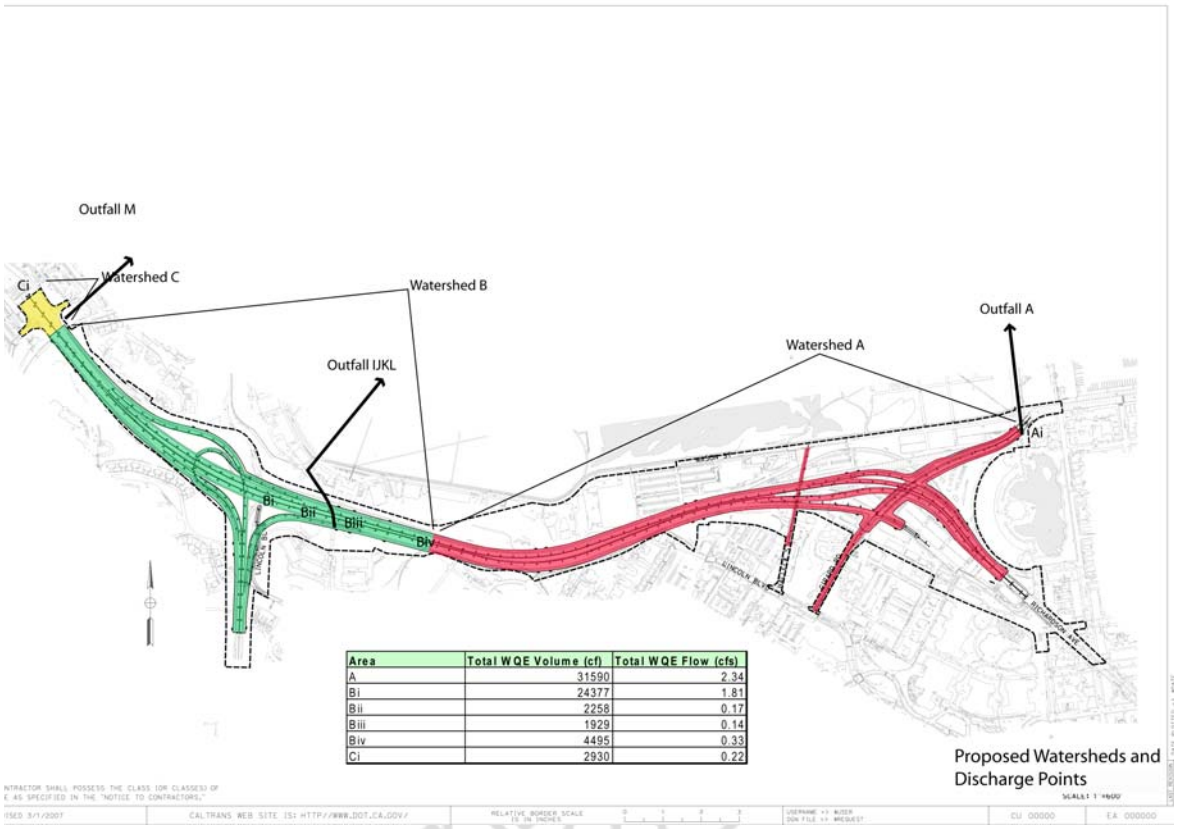
The watershed at the east end of the alignment (Watershed A) is divided into two distinct areas including all project roadways East of the Main Post Tunnel, and project roadways West of the Main Post Tunnel. Both areas of Watershed A discharge to Outfall A located at the extreme West end of the alignment near the Marina Gate of the Presidio.

The watershed at the center of the Doyle Drive alignment (Watershed B) consists of a number of parts including all roadways east of the high viaduct, the high viaduct, and the small area of at-grade roadway between the high viaduct and the Battery Tunnel. Watershed B will discharge to Outfall IJKL. Watershed B includes 4 sub-drainage areas that each discharge to a unique location within the Presidio Trust. These are identified below in Figure 2.

The small watershed at the west end of the alignment (Watershed C) receives runoff from approximately 100 ft of roadway and drains to an existing outfall which also receives runoff from the toll plaza area. Drainage from this portion of roadway will be designed to replace-in-kind the existing drains and shall discharge to Outfall M.

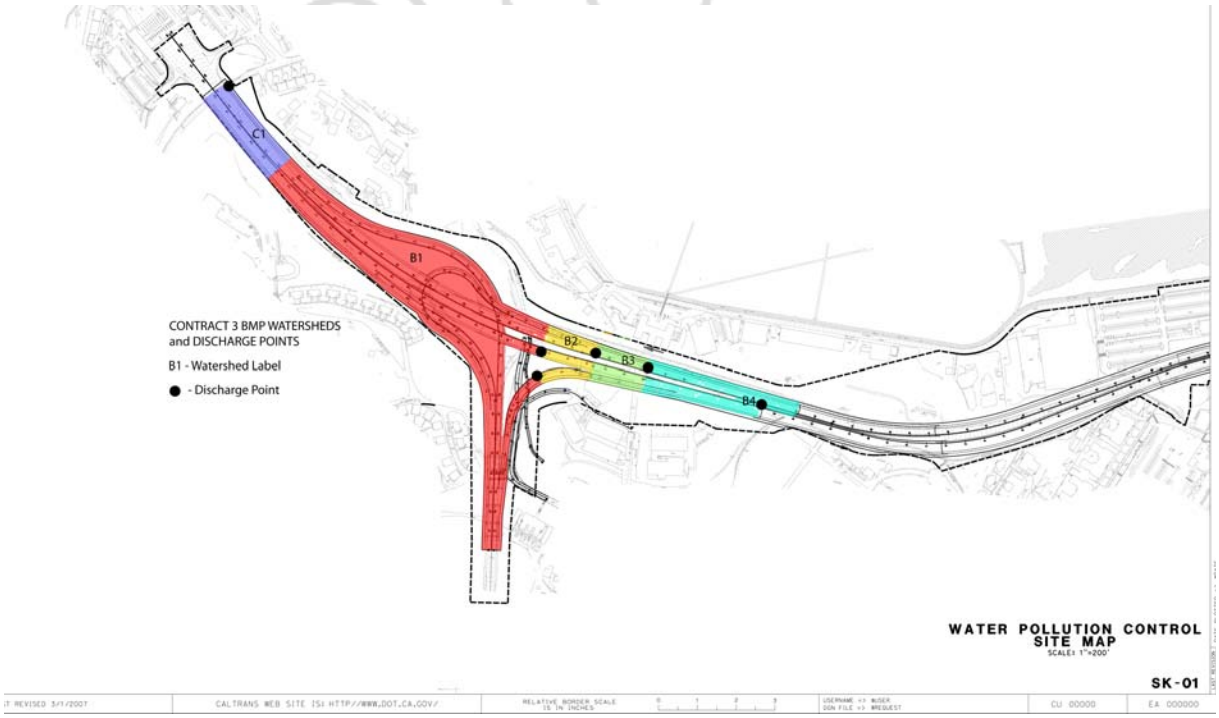
Figure 1 provides the primary points of discharge from the Doyle Drive alignment within the three watersheds as well as the estimated WQE volume and flow rates from each point.

Figure 1: Proposed longitudinal drainage watersheds and generalized discharge locations



Area	Total WQE Volume (cf)	Total WQE Flow (cfs)
A	31590	2.34
Bi	24377	1.81
Bii	2258	0.17
Biii	1929	0.14
Biv	4495	0.33
Ci	2930	0.22

Figure 2: Roadway alignment discharge points within the Contract 3 and Contract 7 area.



4 Roadway Drainage BMPs Overview

This section provides a summary of the design process for Roadway Drainage BMPs to serve the Doyle Drive alignment. The process is as follows:

1. BMP types were identified that would meet the design criteria and optimize the removal of target constituents.
2. A number of potential locations for BMPs were identified based on the subcatchment drainage areas shown in Figure 2.
3. BMP types were selected and preliminarily designed and developed based on site and sizing constraints.

4.1 BMP Types

A number of Treatment BMPs were considered. A critical factor in selecting the preferred BMPs is the existence of a TMDL program for Copper in the Central San Francisco Bay Basin; copper is a Target Design Constituent (TDC) for the water quality treatment system. The Caltrans Stormwater Quality Handbook clearly identifies three BMPs that are preferential when copper is the TDC. These are infiltration devices, wet basins, and biofiltration strips.

Infiltration devices designed specifically to enhance infiltration rates are not considered feasible at the project site. Wet basins are similarly not feasible at the majority of potential BMP locations due to the lack of a permanent water source and long term maintenance concerns by Caltrans. Finally, biofiltration strips are only feasible in one location along the western edge of the Doyle Drive alignment within a landscaped median area (see BMP 2 in Figure 3).

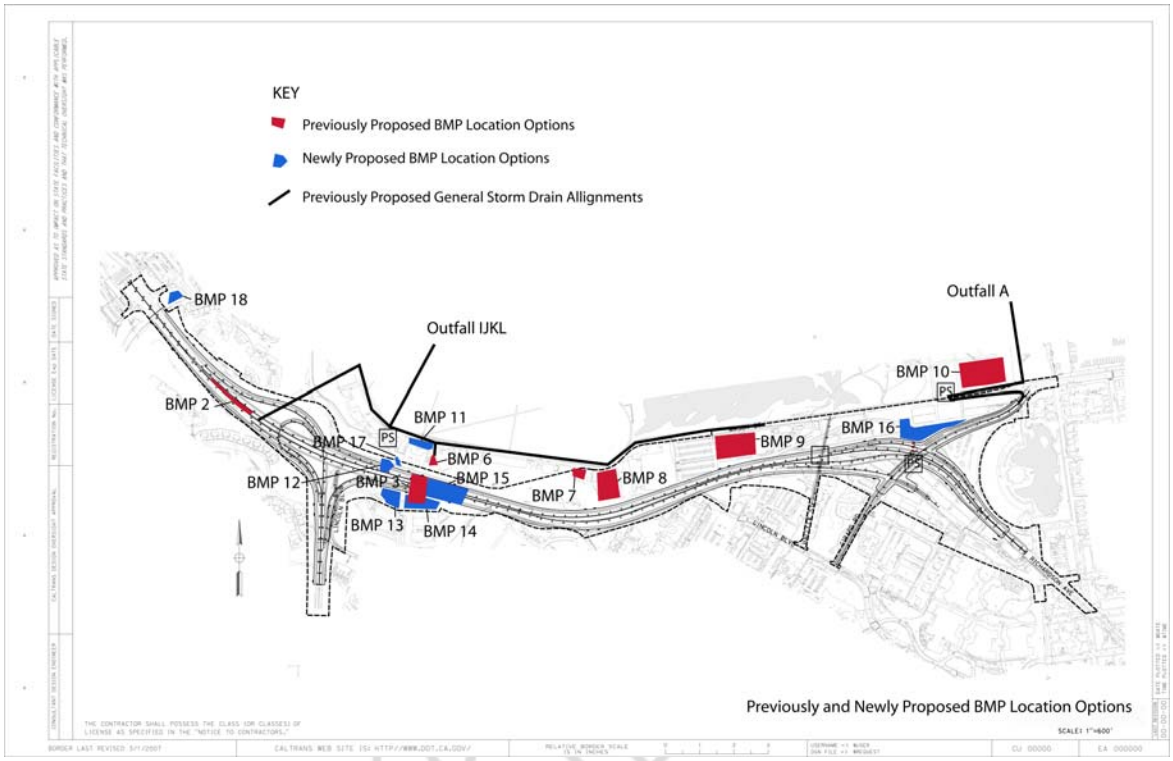
Because none of the suggested BMPs for copper removal were broadly applicable, biofiltration swales were identified as the BMP which most closely mimic the types of removal processes (infiltration and biofiltration) that occur in both infiltration devices and vegetated filter strips.

4.2 BMP Location Alternatives

The 35% Report indicated a number of locations where BMPs would be feasible. The Design Team has recently revised assessment of these locations per conversations with the Presidio to include several additional locations while eliminating other options which in light of the site constraints and current drainage design are no longer practicable from either feasibility or economic perspectives. The original BMP opportunities as well as subsequently identified options are illustrated in Figure 3.

BMP 2 is the only pollution prevention BMP identified in the study. This BMP is unique in that it lies adjacent to the roadway, within the landscaped median. In all other areas of the alignment there exist no other opportunities for creating a pollution prevention BMP.

Figure 3: BMP opportunity areas previously identified in the 35% Report and proposed locations



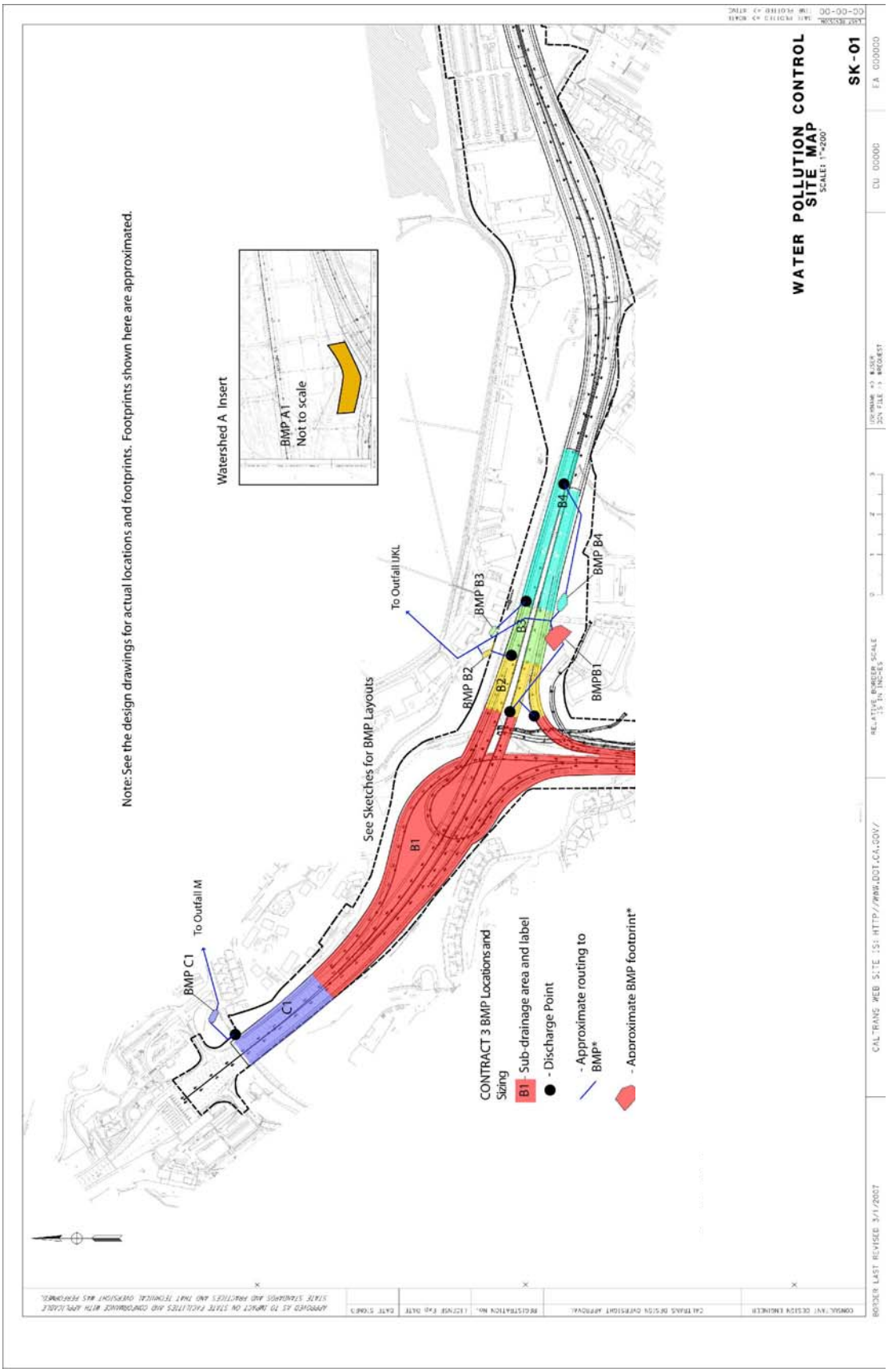
Based on a process of elimination, BMPs 2, 12, 13, 14, 16, 17 and 18 were selected as the preferred BMP locations.

Other BMP options were eliminated for the following reasons:

- BMP locations 3 and 15 were considered infeasible for vegetated BMPs due to their location within shady areas beneath the high viaduct.
- BMP location 6 is in a narrow open space area between two buildings which is also currently utilized by numerous other utilities including gas, electric, water and storm drain.
- BMP locations 7, 8, and 9 are considered impracticable due to the need for an additional pump to route water to Outfall IJKL.
- BMP 10 is considered impracticable due to its location within the Golden Gate National Recreation Area as well as that it is a highly landscaped component of the existing Crissy Field waterfront park.

A generalized layout of the selected water quality BMPs is provided in Figure 4. Actual footprints, design and routing are per Figure 4.

Figure 4: Final BMP locations, sizing and layout



5 BMP Sizing and layout

Vegetated swales were sized based on the design criteria presented in the Caltrans Stormwater Quality Handbook. Critical sizing criteria included:

- Flow depth – no greater than 5 inches
- Residence time – minimum of 10 minutes
- Longitudinal slope – no greater than 5% with 2% being optimal
- Bottom width – no greater than 8 feet
- Side slopes – maximum of 3:1, 4:1 being optimal

5.1 BMP A1

BMP A1 will treat the runoff from eastern portion of the project and will be constructed as part of Contract 6. The drainage area for this BMP is very large so it required multiple vegetated swales in parallel to treat all of the runoff. The swales have been grouped in a configuration of 4, 5, and 4 to allow for access by maintenance staff.

The design parameters for A1 area as follows:

Impermeable Roadway Area Draining to BMP (C=0.9)	551,400 sf
Permeable Open Space Area Draining to BMP (C=0.25)	44,155 sf
Total Watershed Area	595,600 sf
Weighted Runoff Coefficient	0.85
Total Design Flow	2.4 cfs
Number of Swales	13
Design Flow per Swale	0.18 cfs
Swale Width	8 ft
Swale Length	35 ft
Side Slopes	4:1
Flow Depth	5”
Freeboard	3”
Linear Slope	2%
Infiltration Flow	0.01 cfs
Design Flow	0.17 cfs
Flow Capacity per Manning’s Equation	0.18 cfs
Flow Residence Time	13 min

Sketches for BMP A1 can be found in the Appendix on BMP-03 and BMP-07.

5.2 BMP B1

BMP B1 will treat the runoff from western portion of the project and will be constructed as part of Contract 7. The drainage area for this BMP is very large so it required multiple vegetated swales in parallel to treat all of the runoff. The swales have been grouped in a configuration of 5 and 5 to allow for access by maintenance staff.

The design parameters for B1 area as follows:

Impermeable Roadway Area Draining to BMP (C=0.9)	401,100 sf
Permeable Open Space Area Draining to BMP (C=0.25)	116,300 sf
Total Watershed Area	517,400 sf
Weighted Runoff Coefficient	0.75
Total Design Flow	1.8 cfs
Number of Swales	10
Design Flow per Swale	0.18 cfs
Swale Width	8 ft
Swale Length	37 ft
Side Slopes	4:1
Flow Depth	5”
Freeboard	3”
Linear Slope	2%
Infiltration Flow	0.01 cfs
Design Flow	0.17 cfs
Flow Capacity per Manning’s Equation	0.18 cfs
Flow Residence Time	14 min

Sketches for BMP B1 can be found in the Appendix on BMP-04 and BMP-08.

5.3 BMP B2

BMP B2 will treat the runoff from western portion of the project and will be constructed as part of Contract 7. The drainage area for this BMP is relatively small and will require 1 swale. The space necessary for this BMP is larger because the slope in this area is significantly steep and grading work will be required to ensure that the swales function properly.

The design parameters for B2 area as follows:

Impermeable Roadway Area Draining to BMP (C=0.9)	40,100 sf
Permeable Open Space Area Draining to BMP (C=0.25)	0 sf
Total Watershed Area	40,100 sf
Weighted Runoff Coefficient	0.90
Total Design Flow	0.17 cfs
Number of Swales	1
Design Flow per Swale	0.17 cfs
Swale Width	8 ft
Swale Length	30 ft
Side Slopes	4:1
Flow Depth	5”
Freeboard	3”
Linear Slope	2%
Infiltration Flow	0.01 cfs
Design Flow	0.16 cfs
Flow Capacity per Manning’s Equation	0.18 cfs
Flow Residence Time	11 min

Sketches for BMP B2 can be found in the Appendix on BMP-04 and BMP-10.

5.4 BMP B3

BMP B3 will treat the runoff from western portion of the project and will be constructed as part of Contract 7. The drainage area for this BMP is relatively small and will require 1 swale. The space necessary for this BMP is larger because the slope in this area is significant and grading work will be required to ensure that the swales function properly.

The design parameters for B3 area as follows:

Impermeable Roadway Area Draining to BMP (C=0.9)	34,300 sf
Permeable Open Space Area Draining to BMP (C=0.25)	0 sf
Total Watershed Area	34,300 sf
Weighted Runoff Coefficient	0.90
Total Design Flow	0.14 cfs
Number of Swales	1
Design Flow per Swale	0.14 cfs
Swale Width	7 ft
Swale Length	30 ft
Side Slopes	4:1
Flow Depth	5”
Freeboard	3”
Linear Slope	2%
Infiltration Flow	0.01 cfs
Design Flow	0.13 cfs
Flow Capacity per Manning’s Equation	0.15 cfs
Flow Residence Time	12 min

Sketches for BMP B3 can be found in the Appendix on BMP-04 and BMP-10.

5.5 BMP B4

BMP B4 will treat the runoff from western portion of the project and will be constructed as part of Contract 7. The drainage area for this BMP is relatively small and will require 2 swales. The space necessary for this BMP is larger because the slope in this area is significant and grading work will be required to ensure that the swales function properly.

The design parameters for B4 area as follows:

Impermeable Roadway Area Draining to BMP (C=0.9)	79,000 sf
Permeable Open Space Area Draining to BMP (C=0.25)	3,400 sf
Total Watershed Area	83,400 sf
Weighted Runoff Coefficient	0.90
Total Design Flow	0.33 cfs
Number of Swales	2
Design Flow per Swale	0.17 cfs
Swale Width	8 ft
Swale Length	33 ft
Side Slopes	4:1
Flow Depth	5”
Freeboard	3”
Linear Slope	2.2%
Infiltration Flow	0.01 cfs
Design Flow	0.16 cfs
Flow Capacity per Manning’s Equation	0.18 cfs
Flow Residence Time	12 min

Sketches for BMP B4 can be found in the Appendix on BMP-04 and BMP-09.

5.6 BMP B5

BMP B5 is not designed as a treatment BMP but as a best practice. The landscaped median between the northbound and southbound travel ways will receive runoff from the adjacent roadways. The stormwater runoff will then be conveyed to BMP B1 for treatment.

Sketches for BMP B5 can be found in the Appendix on BMP-05 and BMP-11.

5.7 BMP C1

BMP C1 will treat the runoff from very most western portion of the project and will be constructed as part of Contract 7. The drainage area for this BMP is relatively small and will require 2 swales. The space necessary for this BMP is larger because the slope in this area is significant and grading work will be required to ensure that the swales function properly.

The design parameters for C1 area as follows:

Impermeable Roadway Area Draining to BMP (C=0.9)	52,000 sf
Permeable Open Space Area Draining to BMP (C=0.25)	0 sf
Total Watershed Area	52,000 sf
Weighted Runoff Coefficient	0.90
Total Design Flow	0.22 cfs
Number of Swales	2
Design Flow per Swale	0.11 cfs
Swale Width	5 ft
Swale Length	30 ft
Side Slopes	4:1
Flow Depth	5”
Freeboard	3”
Linear Slope	2%
Infiltration Flow	0.005 cfs
Design Flow	0.11 cfs
Flow Capacity per Manning’s Equation	0.11 cfs
Flow Residence Time	13 min

Sketches for BMP C1 can be found in the Appendix on BMP-06 and BMP-12.

6 Conclusion

The BMP design represents the work to date by the Design Team conceptualizing the BMP treatment facilities. The approach represents compliance to the standards set forth by Caltrans and designing BMP features that are natural and will blend into the background of the Presidio. The detailed design and construction details of the BMPs will be submitted during Contract 6 and Contract 7.

References

Arup PB Joint Venture, 2009. Stormwater Drainage Report, Doyle Drive Replacement Project. February 2009.

Caltrans. 2003. Caltrans Storm Water Quality Practice Guidelines. May 2003.

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