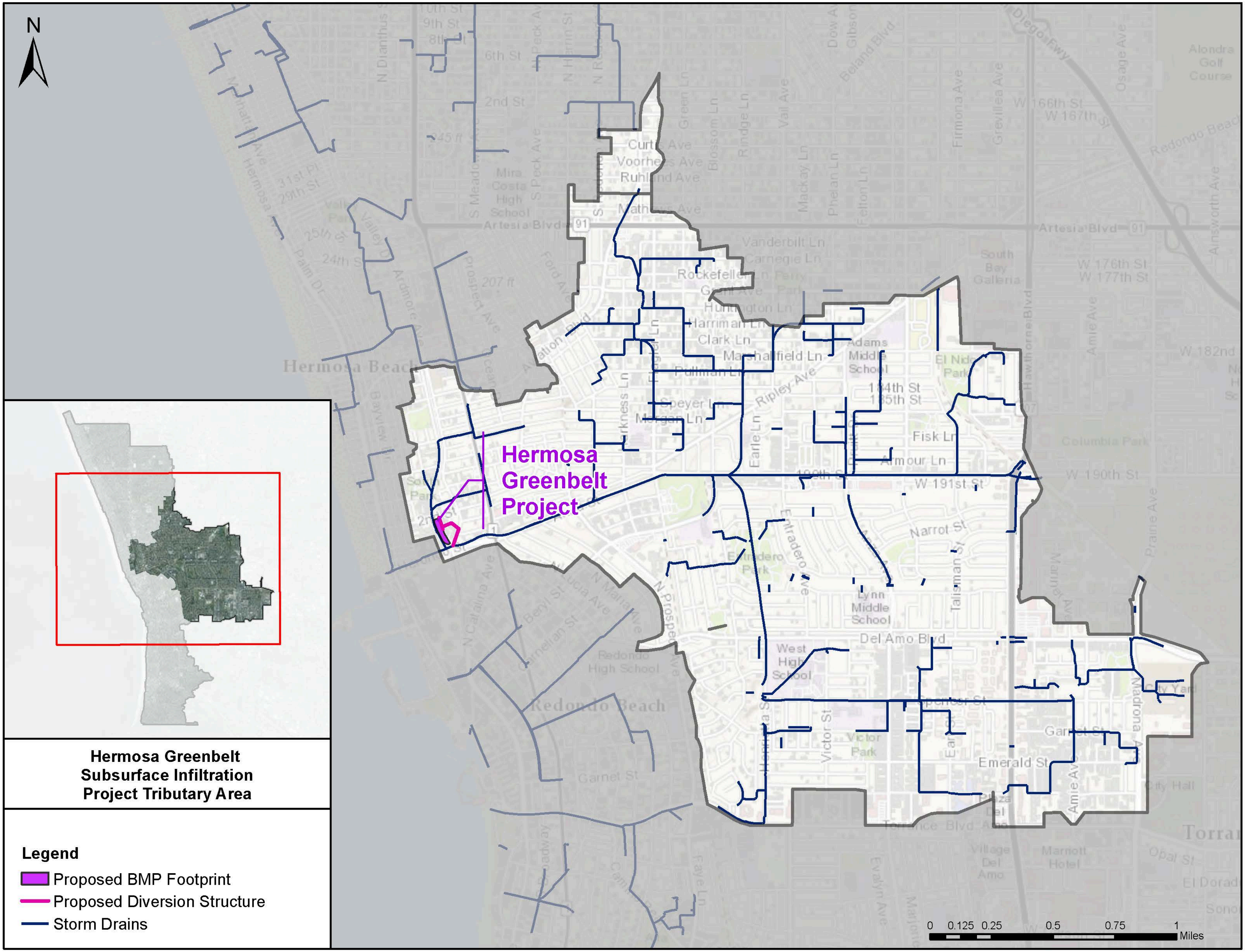
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Hermosa Greenbelt Project
Hermosa Greenbelt
Subsurface Infiltration
Project Tributary Area
Legend
Proposed BMP Footprint
Proposed Diversion Structure
Storm Drains
0 0.125 0.25 0.5 0.75 1
Miles
Hermosa Beach
Redondo Beach
Artesia Blvd
Del Amo Blvd
Torrance Blvd
W 190th St
W 191st St
Adams Middle School
Lynn Middle School
West High School
Redondo High School
South Bay Galleria
Columbia Park
Victor Park
Entradero Park
El Nido Park
City Hall
City Yard
Alondra Golf Course

Geosyntec consultants

TECHNICAL MEMORANDUM

Date:	10 April 2017
To:	Kristy Morris, City of Hermosa Beach Kathleen McGowan, McGowan Consulting
From:	Chris Wessel, P.E., Ken Susilo, PE, CPSWQ, D.WRE, Curtis Fang, P.E., and Stacy Luell, P.E., Geosyntec Consultants
Subject:	Hydrology and Hydraulics Modeling Memorandum Hermosa Beach Greenbelt Infiltration Project Beach Cities EWMP Group

1. INTRODUCTION

1.1 Purpose and Scope

The Hermosa Beach Greenbelt Infiltration Project (Project) is a stormwater control measure proposed in the Beach Cities Enhanced Watershed Management Program (EWMP). The Project is proposed within the Herondo Drain watershed in the City of Hermosa Beach, upstream of Santa Monica Bay Beaches Bacteria TMDL Coordinated Shoreline Monitoring Location SMB 6-01.

The Project was identified as part of a rigorous water quality modeling effort within the EWMP known as the Reasonable Assurance Analysis (RAA), which identified control measures for implementation to reasonably assure compliance with applicable water quality objectives. The EWMP presented a conceptual design of the Project based on available desktop data and screening.

Following preliminary geotechnical analyses of the Project site (Geosyntec, 2017), as well as additional data on the performance of the upstream Torrance Basins (Amie, Henrietta, and Entradero basins), the hydrology and hydraulics (H&H) model used to design the original Project concept was updated to reflect these updated data. While model updates included revision of the Project tributary area, effective infiltration rate, and footprint, the modeled Project maintained the volume reduction achieved in the RAA. This technical memorandum was drafted to update the preliminary basis for design of the Project based on updated H&H model results.

1.2 Terms of Reference

This work was conducted by Geosyntec Consultants as a deliverable under the Beach Cities EWMP contract. This work was managed by Ken Susilo, P.E., D.WRE., CPSWQ, and conducted by Chris Wessel, P.E., Curtis Fang, P.E., and Stacy Luell, P.E. of Geosyntec Consultants. Senior review was provided by Ken Susilo in accordance with Geosyntec's quality assurance policies.

2. BACKGROUND AND CONTEXT

2.1 Previous Quantitative Assessment of Proposed BMP Measures in SMB J5/6

In June, 2011, Geosyntec Consultants prepared a Structural BMP Siting and Conceptual Design Study (Design Study) for the Santa Monica Bay Beaches Bacteria (SMBBB) TMDL Jurisdictional Groups 5 and 6 (J5/6). The purpose of the Design Study was to fulfill the structural BMP pilot study component of the J5/6 SMBBB TMDL Implementation Plan (Implementation Plan). Phase 1 of the Implementation Plan consisted of activities intended to pilot site-specific structural BMPs within high priority drainage areas. The Beach Cities WMG identified drainage area SMB 6-01 as one of the high priority areas on which to focus the study, based on the frequency of wet- and dry-weather indicator bacteria exceedances.

Quantitative assessment of the effectiveness of proposed structural BMPs to achieve compliance with the SMBBB TMDL were conducted as part of the Design Study. A site-specific approach was used to develop design criteria for identified structural BMP projects within J5/6 to link design criteria directly to TMDL compliance. The approach involved iterative hydrologic modeling-design analyses which not only assessed compliance following structural BMP implementation, but also iteratively set design criteria for BMPs having design flexibility to improve water quality benefits while reducing costs.

The BMP design approach was based on the assumption that runoff in any quantity at the outfalls would result in an exceedance of the SMBBB TMDL standards.[1] This assumption was intended to simplify the analysis without over-predicting system performance. Compliance with the exceedance frequency standards could then be evaluated on an annual basis (the TMDL compliance period is the “Storm Year”, defined

[1] This assumption is believed to be conservative, since historical monitoring data at SMB 6-01 demonstrates that not all discharge days result in a measured exceedance day.

as November 1 through October 31) by tabulating the number of discharge days at the outfall. Continuous simulations were carried out for storm years 1990 through 1999.

Hydrologic models of the watershed tributary to SMB 6-01 were developed using the Environmental Protection Agency's (EPA) Stormwater Management Model (SWMM) Version 5.0 to refine design criteria for three proposed BMP projects located within the SMB 6-01 watershed. Precipitation records from LAX (National Climatic Data Center Station COOP ID 045114) for a ten-year period were used as input to the model of the watershed to simulate proposed structural BMP implementation conditions for various combinations of design criteria. Hypothetical exceedance days were tallied for each TMDL compliance year for each combination of design criteria based on the assumption that any runoff at the outfall would result in an exceedance of TMDL compliance limits for bacteria. Baseline watershed representations were developed based on a review of existing drainage delineations, land uses, soil types, imperviousness, and slopes. These data were either extracted from previous drainage studies or through GIS analysis of publicly available spatial data. Feasibility-level designs were then updated to reflect refined design criteria resulting from hydrologic modeling of the SMB 6-01 tributary watershed. The details of this modeling effort are described in the Design Study (Geosyntec, 2011).

2.2 Proposed BMP Measures in the Beach Cities EWMP RAA

Following completion of the 2011 Design Study and release of the 2012 Los Angeles MS4 Permit, the RAA was conducted as part of the Beach Cities EWMP to demonstrate reasonable assurance of compliance with the TMDL RWLs and water quality based effluent limits (WQBELs) applicable to each Beach Cities Permittee (BC WMG, 2016). In the SMB Watershed, the modeled pollutant of concern with a Permit-established limit for the receiving water (Santa Monica Bay) was fecal coliform bacteria, modeled as a surrogate for the fecal indicator bacteria identified in the SMBBB TMDL.

The RAA approach leveraged the strengths of the Structural BMP Prioritization and Analysis Tool (SBPAT), which is a publicly available, MS4 Permit-approved, Geographical Information System (GIS)-based model that had already been developed for the region and previously utilized in J5/6. The SBPAT model utilized Los Angeles region land use event mean concentrations (EMCs), USEPA SWMM, USEPA/American Society of Civil Engineers/Water Environment Research Foundation (USEPA/ASCE/ WERF) International BMP Database (IBD) BMP effluent concentrations, watershed/GIS data, and a Monte Carlo approach (relying on repeated random sampling) to quantify water quality benefits and uncertainties and analyze the performance of proposed structural and non-structural BMPS to meet the target load reductions for each drainage

area analyzed. Details of this modeling, including SBPAT input parameter information and results, are included in the Beach Cities EWMP (BC WMG, 2016).

The regional BMPs that were proposed within the SMB 6-01 tributary area in the Beach Cities EWMP differed from those proposed in the 2011 Design Study, due in large part to identification of new opportunities and changes in client interest. The RAA showed that the target load reduction within analysis region SMB 6-01 would be met with reasonable assurance through the implementation of a series of regional-scale BMPs and distributed green street BMPs. One of the identified regional BMPs was the Hermosa Beach Greenbelt Infiltration BMP (Beach Cities WMG, 2016), which was not analyzed as a potential BMP in the 2011 Design Study.

The Hermosa Beach Greenbelt Infiltration BMP was modeled in the RAA as a sub-surface infiltration trench with a potential surface area of 1.5 acres (ac), an average storage depth of 5 feet (ft), a diversion flowrate of 48 cubic feet per second (cfs), and an assumed infiltration rate of 12 inch/hour (in/hr). Since the BMP was modeled as an infiltration BMP, it was assumed to remove pollutant loads via volume loss.

The proposed BMP site is situated between Valley Dr and Ardmore Ave and has an approximate tributary area of 2,914 acres[2]. According to the RAA analysis, the Greenbelt Infiltration BMP is required to capture and infiltrate 543.7 ac-ft of stormwater during the 90th percentile year (storm year 1995) in order to achieve desired load reductions.

3. UPDATED MODELING

3.1 Modeling Methodology

The objective of updating the SWMM model for the Greenbelt Infiltration BMP is to update and refine the preliminary Greenbelt Infiltration BMP design as presented in the Beach Cities EWMP RAA, in light of the results of the geotechnical investigation completed in April 2017. Specifically, the study described herein intends to reduce the Project footprint while verifying the desired volumetric capture requirement through a detailed H&H model.

The previously developed watershed-scale SWMM model for subwatershed SMB 6-01 was adopted and updated based on the Beach Cities EWMP RAA results. Catchment characteristics and hydrologic parameters were inherited from the previous SWMM model developed by Geosyntec Consultants for subwatershed SMB 6-01 (Geosyntec,

[2] Including tributary areas of the three upstream Torrance basins.

2011). Existing BMPs (Amie Basin, Entradero Basin, Henrietta Basin enhancements) were retained in the model. The Greenbelt Infiltration BMP was added immediately north of the intersection between storm drain BI1105 and BI0623. To avoid intervention among multiple projects, no other planned BMPs from previous studies were included in the model. Figure 1 illustrates the SWMM model setup. Figure 2 presents the schematic setup of the Greenbelt Infiltration BMP. Parameters shown in Figure 2 reflect the conceptual design from the Beach Cities EWMP.

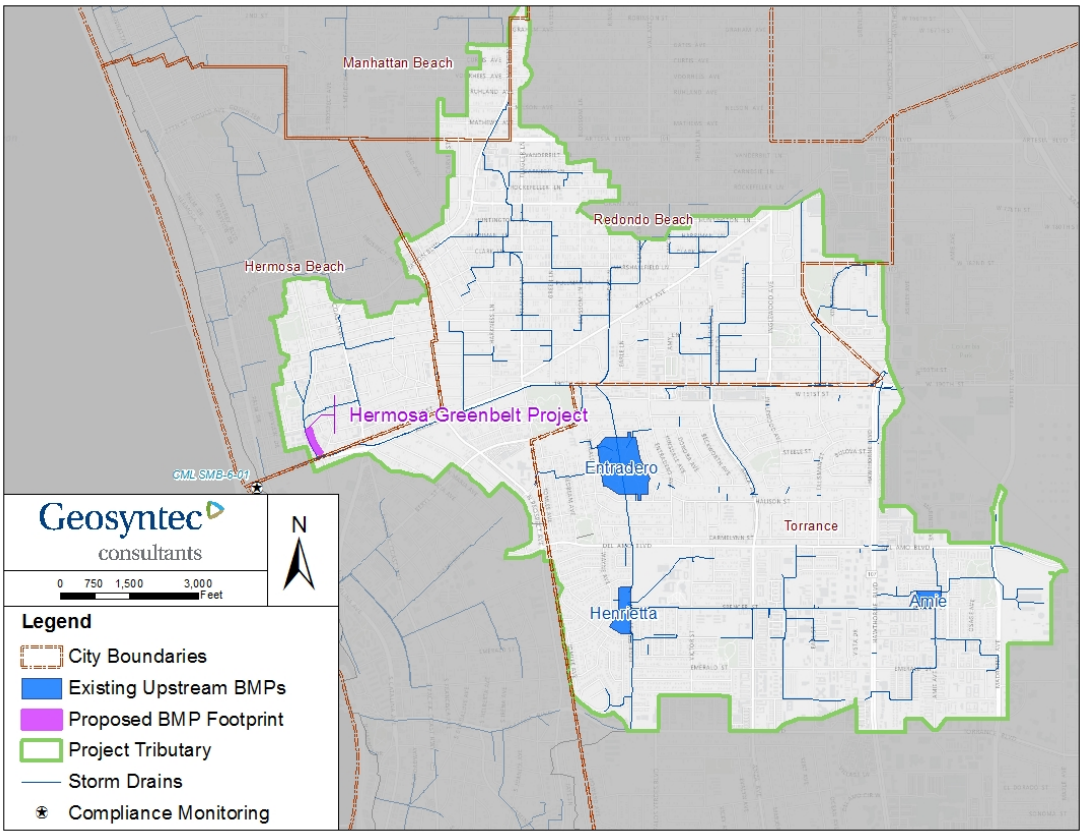


Figure 1. Model Setup Overview

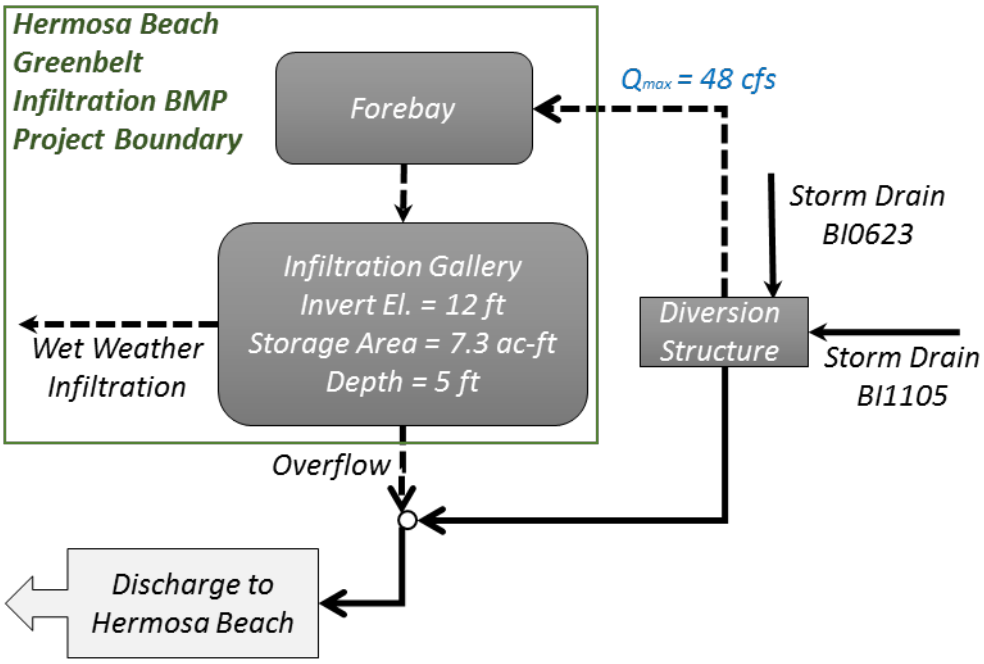


Figure 2. Hermosa Beach Greenbelt Infiltration BMP Schematic

To initiate the analysis, the Hermosa Greenbelt BMP was configured in the SWMM model in accordance with its preliminary design from the Beach Cities EWMP. Runoff from storm drains BI1105 and BI0623 were diverted to the Greenbelt Infiltration BMP at a maximum flowrate of 48 cfs. The infiltration gallery provided 63,800 ft^2 of effective infiltration area and 7.3 ac-ft of retention capacity. Assuming a cubic shape configuration, the effective depth of the infiltration gallery was calculated as 5 feet. Consistent with the Beach Cities EWMP RAA, the limited retention and infiltration capacity of the forebay was not modeled.

3.2 Model Updates Based on Geotechnical Information

According to the recently completed geotechnical investigation, the design infiltration rate of the Project was determined to be 4.4 in/hr, which differed from the 12 in/hr that was initially assumed in the Beach Cities EWMP RAA. For modeling purposes, the infiltration loss rate from the infiltration gallery was calculated by multiplying the design infiltration rate by the effective infiltration area.

The recently completed geotechnical investigation also found that the groundwater table was found to be approximately 25 to 30 feet below the groundwater surface of the Project site. Hence, the acceptable range of depth of the infiltration gallery was evaluated from 5 feet to 15 feet below ground surface, which would allow for 10 feet of separation from the infiltrating surface to the groundwater surface.

3.3 Result Discussion

A continuous simulation was conducted for each design alternative for the 90th percentile year, defined from November 1, 1994 to October 31, 1995. For the Beach Cities EWMP conceptual design configuration, the Greenbelt Infiltration BMP captured and infiltrated 546.2 ac-ft, which was slightly above the required infiltration volume of 543.7 ac-ft. Model iterations were performed to attempt to reduce infiltration area footprint while maintaining the desired annual capture volume presented in the Beach Cities EWMP.

Following the methodology described above, a correlation curve was developed to present the updated depth-area configuration that could capture and infiltrate 543.7 ac-ft of runoff at various depths. The effective infiltration area was evaluated at 500 ft^2 increments and the smallest effective infiltration area was found at each foot of depth that would allow for infiltration of the required volume during the 90th percentile year. The correlation curve is presented in Figure 3. Table 1 compares the original preliminary design with the updated preliminary design at minimum and maximum depths.

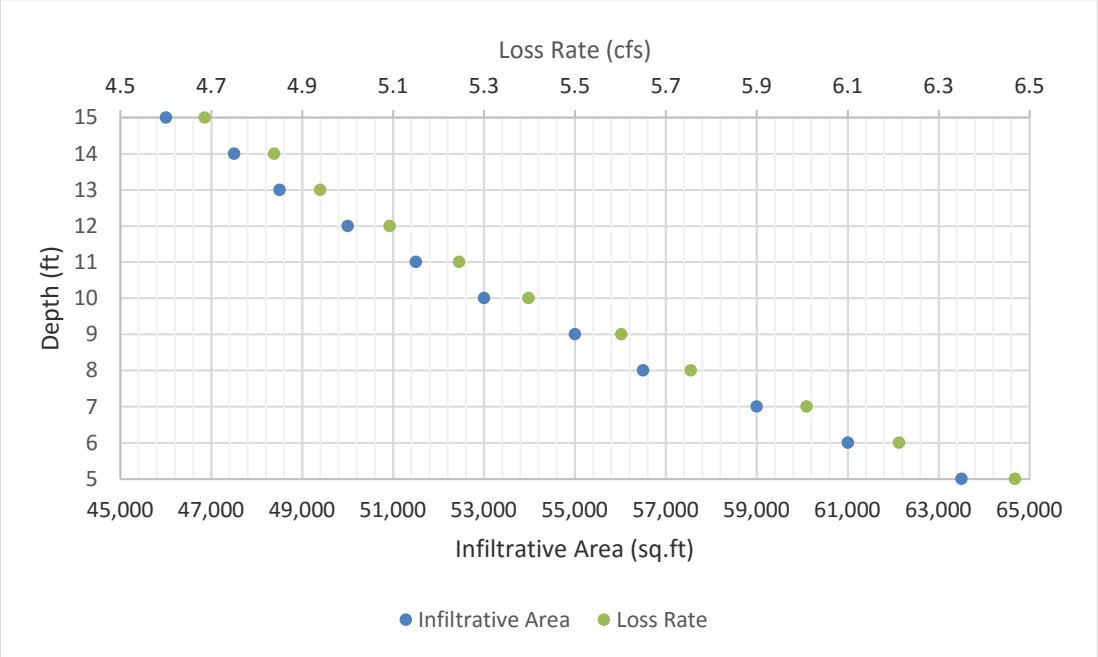


Figure 3. Depth-Area Correlation Curve of Updated Design

Table 1. Comparison of Preliminary Design Parameters Required to Meet EWMP Volume Reduction

	Original Preliminary Design[1]	Updated Preliminary Design at Minimum Depth	Updated Preliminary Design at Maximum Depth
Maximum Diversion Flow Rate (cfs)	47	50	104
Retention Capacity (acre-foot)	7.32	7.29	15.84
Infiltration Footprint (ft^2)	63,800	63,500	46,000
Cumulative Loss Rate (cfs)	6.50	6.47	4.69
Gallery Footprint	63,800	63,500	46,000
Gallery Ponding Depth (ft)	5	5	15

[1]Presented in BC EWMP

Appendix A provides a figure of the updated conceptual design based on the new geotechnical data and updated H&H modeling.

4. CONCLUSIONS

The conceptual design of the Greenbelt Infiltration BMP presented in the Beach Cities EWMP was updated to reflect recently-received geotechnical information from the Project site. Updated infiltrative areas were found for the range of feasible BMP depths, based on results from the recently completed geotechnical investigation. Figure 3 and Table 1 summarize these results.

Although the analyzed BMP scenarios provide possible configurations to achieve compliance with the Beach Cities EWMP, alternative approaches to compliance may exist if higher effective infiltration rates can be achieved (e.g., through the use of dry wells). Such an approach would be in-line with the intent of the RAA.

5. LIMITATIONS

Usage of the technical memorandum is limited to address the purpose and scope described above. Geosyntec shall not be held responsible for any unauthorized application of this memorandum and the contents herein. The opinions represented in this memorandum

have been derived in accordance with current standards of civil engineering practice. No other warranty is expressed or implied.

6. REFERENCES

Beach Cities Watershed Management Group (BC WMG), 2016. Enhanced Watershed Management Program (EWMP) for the Beach Cities Watershed Management Area (Santa Monica Bay and Dominguez Channel Watersheds). February.

Geosyntec Consultants, 2011. Structural BMP Siting and Conceptual Design Study, Santa Monica Bay Beaches Bacteria TMDL Implementation. Produced for SMBBB TMDL Jurisdictional Groups 5 & 6. June.

Geosyntec Consultants, 2017. Infiltration Testing and Preliminary Geotechnical Investigation, Hermosa Greenbelt Project, Hermosa Beach, CA. April 7.

Appendix A

Revised Hermosa Beach Greenbelt Infiltration BMP Concept

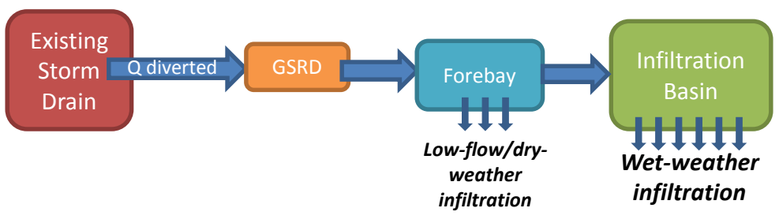
Hermosa Greenbelt Infiltration Facility Overview

A volume reduction BMP is planned for the Hermosa Greenbelt site. Infiltration galleries function similarly to subsurface storm water detention systems but are constructed with a permeable base and sides designed to infiltrate stormwater runoff. It is usually not practical to infiltrate runoff at the same rate that it is generated; therefore, these facilities generally include both storage and drainage components. Infiltration basins remove pollutants from stormwater network by infiltrating stormwater into highly permeable engineered soil beneath the system.

Existing Site Conditions

The site is part of the 3.5-mile long Hermosa Valley Green Belt Trail in the City of Hermosa Beach.

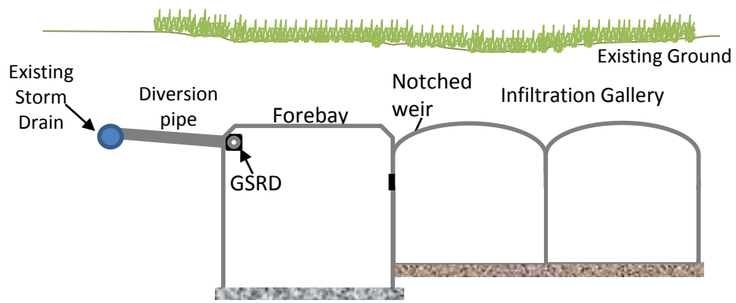
Treatment Process



The BMP will consist of a diversion structure, conveyance pipes, a gross solids removal device (GSRD), a forebay, and an infiltration gallery. Dry- and wet-weather flows will be diverted from the existing storm and flow into the forebay through the conveyance pipe and GSRD and begin to infiltrate into native soil. Flows exceeding infiltration rate at the forebay will fill the forebay and ultimately overflow via a notched weir into the infiltration gallery, where additional infiltration will occur. The system will fill until inflows no longer exceed loss rates, at which time the basin will drawdown. When persistent flows fill the system to storage capacity, runoff in the storm drain will bypass the diversion until capacity is regained by ways of infiltration losses.

Site Configuration

Plan View (Preliminary Footprint – Subject to Change)

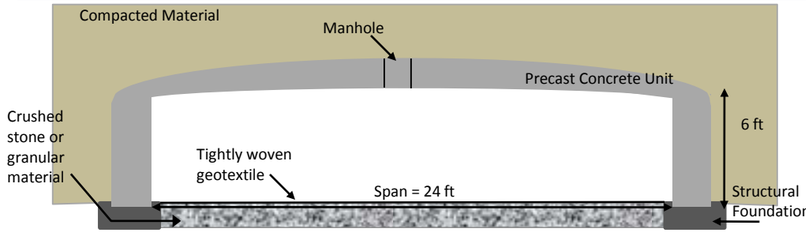


Profile (not to scale)

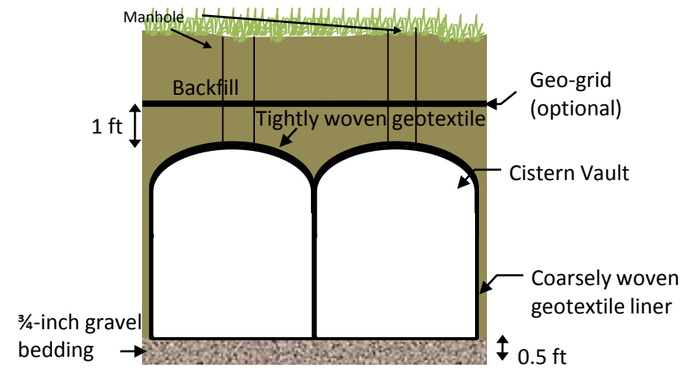
Design Parameters

General			
Tributary Area (ac)	2914	Drawdown Time (hrs)	72
Storm Drain Diverted	21" RCP	Sat. Hyd. Cond. (in/hr)	4.4
Design Criteria			
Max. Diversion Flow Rate (Q_{dmax}) (cfs)	48	Cumulative Loss Rate (cfs)	6.47
Design Storage Volume (AF)	7.3	Infiltration Footprint (ft²)	63,500
Design Parameters			
Pretreatment		***Infiltration Gallery***	
GSRD Length (24" diam.) (ft)	15	Gallery Footprint (ft²)	63,500
Forebay Footprint (ft²)	4185	Gallery Length (ft)	420
Forebay Length (ft)	30	Gallery Width (ft)	150
Forebay Width (ft)	150	Gallery Ponding Depth (ft)	5
Forebay Ponding Depth (ft)	6		

Typical Details



Forebay – Cross-section (not to scale)



Infiltration Gallery – Cross-section (not to scale)

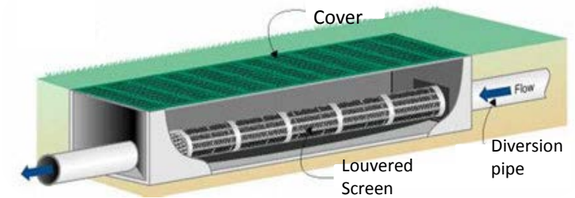


Photo credit: Roscoe Moss Company
Product shown: StormFlo™*

GSRD – Isometric view (not to scale)

Stormwater Chambers

DRAFT	**Hermosa Greenbelt Subsurface Infiltration Facility Conceptual Design (10% Design): Hermosa Beach**	
April 2017	LA0298	Geosyntec consultants

*Products shown above were used as examples for sizing and cost analyses; other equivalent products may be used.