ATTACHMENT A: Project Modification Request (PMR) Form

The purpose of this PMR form is to initiate the Project modification process and provide the District with information necessary to evaluate the Project modification request.

Regional Program	☒Infrastructure Program Project ☐Scientific Studies Program ☐Technical Resources Program
Project/Study Name	Fulton Playfield Multi-Benefit Infiltration Project
Project/Study Lead	City of Redondo Beach
Watershed Area(s)	South Santa Monica Bay
Current Project Phase	Design
Approved Stormwater Investment Plan Fiscal Year	FY22-23
Transfer Agreement ID (e.g., 2020RPULAR52)	2022RPSMB02

Has Transfer Agreement or most recent Addendum been executed (i.e., signed by the project lead and the District)? ☒ Yes ☐ No

What type(s) of modification request?

☐ like-for-like modifications

☒ functionally equivalent BMP modifications

☐ modifications to Project or Study components that were not material to the WASC, ROC, or Board's decision to include the Project or Study in the SIP

☐ change in primary or secondary objective

☐ change in Project benefits

☐ change in methodology (e.g., infiltration instead of diversion to sanitary sewer)

☐ decrease in BMP capacity

☐ change in Project or Study location

☐ change in capture area where benefits claimed are diminished or where there is a change in the municipalities that are receiving benefits
☐ updated engineering analysis resulting in a reduction of benefits
☒ any modification resulting in an increase or decrease of the total amount of Regional Program funding for the Project or Study and/or reallocation of annual funding projections in the SIP
☐ other, please describe:

Impact on scope or benefits?

☐ Improved
☐ Diminished
☒ Neither
☐ Not Sure

Description of the proposed modification(s) and the reason(s) why the modification(s) is/are being proposed. Attach additional pages, as needed.

Proposed project modifications include the installation of a trench drain within the Greenflag Detention Basin to diver stormwater to flow towards the drywells, changes to the drywell system layout, and the inclusion of a nutrient-separating baffle box for pretreatment. These modifications, in addition to inflation and increased construction costs since the original estimate was developed in June 2021, have increased the overall project cost. The updated project design will not reduce the water quality, nature-based solutions, or community benefits claimed in the Feasibility Study. These proposed project modifications were primarily driven by further investigation of existing site conditions and are discussed in further detail in Attachment B.

If applicable, list previously approved funding allocations/disbursements and revised funding request:

Note, if some or all of a previously Funded Activity cannot be completed as a result of the proposed modification, please include a description and indicate the amount of unused funds. Any unused funds should be reallocated and accounted for in your revised funding request. Attach additional pages, as needed.

Fiscal Year	Approved Funding Allocations	Increase/ Decrease Requested	Revised Funding Request	Description/Phase/Status *If applicable, include description of unused funds*
FY22-23	$93,000		$93,000	Planning
FY23-24	$2,073,000		$2,073,000	Design; Construction Year 1
FY24-25	$1,683,000	$1,500,000	$3,183,000	Construction Year 2
FY25-26	$50,500	$910,000	$960,500	Construction Reimbursement
FY26-27	$46,500	$1,600,000	$1,646,500	Construction Reimbursement
Beyond FY26-27	$346,138		$346,138	O&M
TOTAL	$4,292,138	$4,010,000	$8,302,138	

A: SCWP Approved Total Funding Allocations	$4,292,138
B: Revised SCWP Anticipated Total Funding Request	$8,302,138
C: SCWP Expenditures to date	$298,000
D: Difference between B and A	$4,010,000

Would the additional funding request be the only option that would allow the project to be implemented?	☒ YES
Would delaying funding allocations impact the project's ability to be implemented?	☒ YES
Would funding only a portion of the additional funding request impact the project's ability to be implemented?	☐ YES
Has the Recipient considered other funding sources?	☒ YES

If applicable, a description of difference in SCWP Anticipated Total Funding Request and a description of your responses to the questions above. As a reminder, annual funding is at the discretion of the WASC, ROC, and ultimately the Board of Supervisors. Attach additional pages, as needed.

Proposed project modifications include the installation of a trench drain within the Greenflag Detention Basin to force stormwater to flow towards the drywells, changes to the drywell system layout, and the inclusion of a nutrient-separating baffle box for pretreatment. These modifications, along with the inflation and increased construction cost, resulted in an increase in overall project cost. Redondo Beach is requesting an additional $1.5M funding to mitigate the cost escalation. In addition to this request, Redondo Beach is also in the process of applying for additional grant funding from Caltrans to assist in mitigation of the cost increase. See Attachment C for the revised detailed cost estimate.

Brief description of Supporting Documentation provided.

Attachment B - Letter of Supplementary Documentation Attachment C - Updated Detail Project Construction Cost Estimate

I certify the information and supporting documentation provided is accurate and true.	☒ YES
I understand this is a request and it is under the WASC's discretion to consider requested modifications.	☒ YES

Name Ashwini Bhide Organization City of Redondo Beach

Signature AShide Date 10-30-24

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Proposed Modifications to Projects or Studies:

	Status	Date
Scope/benefits of the modified Project or Study is **consistent** with the Project or Study included in the current fiscal year's SIP and proposed modifications were **approved** by the District.	☐ YES	
Scope/benefits of the modified Project or Study is **NOT consistent** with the Project or Study included in the current fiscal year's SIP. **If yes, select all that apply**:	☐ YES	
Budget/schedule modifications would impact future SIP funding allocations. **If yes, select all that apply**:	☐ YES	
PMR was received **after** October 31 of a fiscal year and the PMR will be considered for approval during the preparation of **subsequent** SIP for the fiscal year after the next	☐ YES	-
Project or Study **abandoned** the proposed modifications	☐ YES	
Projector or Study was **withdrawn** from consideration by the WASC and shall issue repayment of unspent funds	☐ YES	
Proposed modifications were **recommended for approval** in the SIP	☐ YES ☐ NO	

Proposed Modifications to Project Concepts:

	Status	Date
Proposed modifications were deemed **consistent** with the Project concept that was approved by the WASC, ROC and Board for inclusion in the SIP and can be addressed within the existing budget. District will proceed to incorporate the proposed modification into the Feasibility Study immediately.	☐ YES	
Proposed modifications were deemed significant enough to result in a **significantly different** Project concept from the one approved by the WASC, ROC and Board for inclusion in the SIP. **If yes, select one:**	☐ YES	
District to **discontinue** work on the Feasibility Study, return unused funds to be programmed in the SIP for the next fiscal year, and advise the proponent to submit the modified Project concept during the Call for Projects for a future fiscal year.	☐ YES	-
District to **abandon** the proposed modifications and proceed with the Project concept included in the SIP.	☐ YES	-

REDONDO BEACH

415 Diamond Street
Redondo Beach CA90277

Tel: 310.697.3417

Ashwini.Bhide@Redondo.org

Subject: Attachment B – Project Modification Supplementary Documentation

Dear South Santa Monica Bay (SSMB) Watershed Area Steering Committee:

On October 31st, 2024, the City of Redondo Beach ("Redondo Beach") submitted a Project Modification Form (PMR) for the Fulton Playfield Multi-Benefit Infiltration Project ("Project"), which was originally approved during Round 3 of the Safe Clean Water Program Stormwater Investment Program (SCWP SIP). This letter provides supplementary documentation to the PMR.

Project Overview

The Project is a high-priority, compliance-driven regional project included in the 2021 Beach Cities Watershed Management Plan. The Project is critical to help the Beach Cities Watershed Management Group to meet their Municipal Separate Storm Sewer System (MS4) permitting requirement and to demonstrate compliance with the Santa Monica Bay Beaches Bacteria Total Maximum Daily Loads (TMDLs). Redondo Beach is implementing this high-priority regional project on behalf of the Beach Cities Watershed Management Group. We submitted a SCWP Feasibility Study Report during Round 3 (FY21/22) Call for Projects. The Project is currently in the detailed design phase. The 75% design package was completed in May 2024.

In the original design submitted as part of the Feasibility Study, the Project proposed to install 13 drywells underneath the eastern portion of the Playfield and connect them to the existing 6.4 acre-feet Greenflag Detention Basin ("Basin"). Proposed modifications to the existing Basin's weir chamber would divert nearly all stormwater runoff to the Basin for infiltration via the drywells. The Project would also include 800 square feet (ft^2) of green elements, including parkway bioretention cells and an ocean-friendly garden.

The updated Project includes the installation of a trench drain within the Basin to direct water to flow toward the drywells. The drywell layout was also split into three separate branches that receive flows from the basin following pretreatment in a hydrodynamic separator. As shown in Table 1, the updated Project design will not reduce the water quality, nature-based solutions, or community benefits claimed in the Feasibility Study.

Table 1. Comparison of Original and Modified Project Design

	2021 Project Concept	Updated 2024 Project Configuration
BMP Description	• 13 drywells • 800 ft^2 landscaping and ocean-friendly garden	• 13 drywells • 800 ft^2 landscaping and ocean-friendly garden • Trench drain within the Basin • Hydro Dynamic Separator • Additional connection pipes between the Basin and the drywells
Drainage Area	463 acres	463 acres
24-hour stormwater capacity	13.1 acre-feet	13.1 acre-feet
Average Bacteria Load Reduction	75.3%	75.3%

	2021 Project Concept	Updated 2024 Project Configuration
Average Trash Reduction	100%	100%

Project Modifications Requested

1. Functionally Equivalent BMP Modifications

While there is no change to the number of drywells, footprint of surface greening elements, or reduction in impervious surface, the Project includes the following modifications that would optimize the design:

1. The drywell locations have been updated to accommodate existing utilities. There is no change in drywell quantity or depth.
2. An additional trench drain will be constructed inside the Basin to efficiently divert stormwater runoff to the drywells.
3. A pretreatment hydrodynamic separator will be constructed to capture sediments upstream of the drywells, therefore elongating the service life of the drywells.
4. The location of the ocean-friendly garden will be moved to the eastern portion of the Project site, which has fewer utility constraints and higher constructability than the original garden location. The footprint of the ocean-friendly garden remains unchanged.

2. Any modification resulting in an increase or decrease of the total amount of Regional Program funding for the Project or Study and/or reallocation of annual funding projections in the SIP

The original cost estimate was developed in June 2021. Since then, the design has been modified to include a hydrodynamic separator for pretreatment and the construction of a trench drain within the Basin to divert flows to the drywell system. Modifications to the drywell layout also led to increased piping installation costs. Finally, construction costs have significantly escalated due to inflation and supply shortages. Table 2 below summarizes the changes in Project cost.

Table 2. Updated Project Cost

Phase	2021 Cost Estimate	Updated Cost 2024
Planning	$90,000	$90,000
Design	$369,000	$369,000
Construction	$3,387,000	$9,895,000*

* Please see Attachment C for Detailed Cost Estimates.

In this PMR, Redondo Beach is requesting an additional $4,010,000 SCWP funding to partially mitigate the escalated Project construction cost. The additional funding request is spread over three fiscal years to potentially fit into the available SSMB SIP Budget. We plan to pursue other grants and seek external partnerships to mitigate the remaining funding deficit.

Closing

On behalf of the Beach Cities Watershed Management Group, Redondo Beach appreciates the SSMB Watershed Area Steering Committee's consideration of this PMR and assistance in mitigating industry-wide cost escalation. We remain committed to partially funding the Project's operation and maintenance and, therefore, maintain the Project's full functionality through its life cycle. We are also actively pursuing other grants, as well as external partnerships to assist in mitigation of the cost increase.

REDONDO BEACH

415 Diamond Street
Redondo Beach CA90277

If you have any questions, or require any additional information, please contact me at 310-697-3417 or ashwini.bhide@redondo.org.

Sincerely,

Ashwini Bhide, PE
Associated Civil Engineer
City of Redondo Beach

Geosyntec consultants

ATTACHMENT C - PROJECT CONSTRUCTION COST ESTIMATE

Project Title: Fulton Playfield Multi-Benefit Infiltration Project

Scope: This estimate was prepared for the purpose of applying for additional Safe Clean Water Program funding. The project involves piped inflow of wet-weather flows from 465-ac area. The design includes alteration of the existing diversion structure and detention basin, and installation of pretreatment device and 13 drywells.

Description	Unit	Quantity	Unit Price	Item Total
General Construction				***$ 124,912***
Traffic Control	LS	1	$ 100,000.00	$ 100,000
Clearing and Grubbing	LS	1	$4,912.00	$ 4,912
Utility Potholing	LS	1	$ 20,000.00	$ 20,000
Detention Basin Retrofit				***$ 5,791,825***
Weir Chamber Modifications	LS	1	$ 140,000.00	$ 140,000
Demo and Construct Trench Drain	LF	115	$ 6,418.00	$ 738,070
Tank Connection to (N) 24" HDPE	EA	1	$ 15,000.00	$ 15,000
Demo AC Pavement	SF	1,710	$ 22.60	$ 38,644
24" DIPS Smooth HDPE Storm Drain Pipe *(see assumptions)*	LF	57	$ 4,564.79	$ 260,193
18" HDPE Storm Drain Pipe *(see assumptions)*	LF	132	$ 4,346.39	$ 573,723
15" HDPE Storm Drain Pipe *(see assumptions)*	LF	135	$ 4,342.58	$ 586,249
12" HDPE Storm Drain Pipe *(see assumptions)*	LF	225	$ 4,478.48	$ 1,007,659
Drywell (50' Overall Depth)	EA	13	$ 122,989.23	$ 1,598,860
First Defense HDS	EA	1	$ 494,650.00	$ 494,650
Isolation Valve with Access Manhole	EA	1	$ 252,900.00	$ 252,900
Playfield Restoration	LS	1	$ 31,157.78	$ 31,158
Restore AC Pavement	SF	1,710	$32.00	$ 54,720
Rindge Lane Parkway Bioretention & Ocean-Friendly Garden				***$ 230,111***
Parkway Bioretention	SF	341	$ 182.21	$ 62,175
Bioretention Catch Basin Inlet	EA	2	$ 18,000.00	$ 36,000
Parkway Landscaping Replacement	SF	62	$ 1,389.07	$ 85,613
Ocean-Friendly Garden	SF	453	$ 72.71	$ 32,902
Ocean-Friendly Garden Reverse Parkway Inlet	EA	1	$ 13,421.25	$ 13,421

Subtotal (1)	**$ 6,146,849**

General Conditions & Requirements - 10% of Subtotal (1)	$ 614,685
Mobilization - 5% of Subtotal (1)	$ 307,342
Permits Allowances - 3% of Subtotal (1)	$ 184,405
Allowance for Unforeseen & Differing Site Conditions - **5%** of Subtotal (2)	$ 307,342
Subtotal (2)	**$ 7,560,624**

Contingency - 10% to 35% of Subtotal (2), used 10%	$ 756,062
Subtotal (3)	**$ 8,974,399**

Escalation (year 2025-2026) - used 5**%**	$ 448,720
Escalation (year 2026-2027) - used 5**%**	$ 471,156
Subtotal (4)	**$ 9,894,275**

Total Estimated Project Construction Cost	**$ 9,895,000**

Fulton Playfield Multi-Benefit Infiltration Project
Project Construction Cost Estimate

PROJECT CONSTRUCTION COST ESTIMATE - ASSUMPTIONS

General Construction
Cost of traffic control assumed to include Traffic Control Work Plan, equipment, and flaggers for work along Earle LN, Hall CT, Rindge LN, and at the construction entrance(s) to the park
Cost of potholing effort assumes (16) potholes by Hydrovac to locate existing utilities
Playfield restoration assumes 12" of topsoil will be imported and placed
Detention Basin Retrofit
Cost of weir chamber modifications includes demolition, removal, disposal of wall opening, and construction of new inlet into basin with screen, new weir wall, concrete beam, and new fin wall per structural details
Cost of basin trench drain modification includes demo, removal, and disposal of existing slab, and construction for new 2.5' wide trench drain, including rebar dowels, formwork, 4,000 psi reinforced concrete, and trench drain frame and grate
Storm drain unit costs include trenching, hauling and disposal of excess soil, shoring, bedding, pipe installation, and slurry backfill
Costs for internal modifications to existing detention basin components (incl. diversion chamber modifications & detention basin modifications) include an assumed modifier of 25-50% to account for reduced productivity rate in confined spaces
Rindge Lane Parkway Bioretention & Ocean-Friendly Garden
Cost for parkway bioretention areas assumes 40% hand excavation, then 60% with hydraulic excavator (1 CY capacity). Includes hauling and disposal of excess soil

Prepared by:	HB	Date:	10/25/2024
Checked by:	LW	Date:	10/25/2024
Approved by:	CF	Date:	10/25/2024
Client Approval:		Date:	

ATTACHMENT A: Project Modification Request (PMR) Form

The purpose of this PMR form is to initiate the Project modification process and provide the District with information necessary to evaluate the Project modification request.

Regional Program	☒ Infrastructure Program Project ☐ Scientific Studies Program ☐ Technical Resources Program
Project/Study Name	Downtown Lomita Multi-Benefit Stormwater Project
Project/Study Lead	City of Lomita, Department of Public Works
Watershed Area(s)	South Santa Monica Bay
Current Project Phase	Design
Approved Stormwater Investment Plan Fiscal Year	FY22-23
Transfer Agreement ID (e.g., 2020RPULAR52)	2022RPSSMB01

Has Transfer Agreement or most recent Addendum been executed (i.e., signed by the project lead and the District)? ☒ Yes ☐ No

What type(s) of modification request?

☒ like-for-like modifications

☒ functionally equivalent BMP modifications

☐ modifications to Project or Study components that were not material to the WASC, ROC, or Board's decision to include the Project or Study in the SIP

☐ change in primary or secondary objective

☐ change in Project benefits

☐ change in methodology (e.g., infiltration instead of diversion to sanitary sewer)

☐ decrease in BMP capacity

☐ change in Project or Study location

☐ change in capture area where benefits claimed are diminished or where there is a change in the municipalities that are receiving benefits
☐ updated engineering analysis resulting in a reduction of benefits
☐ any modification resulting in an increase or decrease of the total amount of Regional Program funding for the Project or Study and/or reallocation of annual funding projections in the SIP
☐ other, please describe:

Impact on scope or benefits?

☐ Improved
☐ Diminished
☒ Neither
☐ Not Sure

Description of the proposed modification(s) and the reason(s) why the modification(s) is/are being proposed. Attach additional pages, as needed.

The Downtown Lomita Multi-Benefit Stormwater Project proposed to design stormwater capture and infiltration facilities near the intersection of Lomita Boulevard and Narbonne Avenue in downtown Lomita. During preliminary phases of design, it was discovered that the infiltration gallery parcel proposed in the feasibility study was previously occupied by a gas station. In the past, cleanup efforts were required for a leaking underground storage tank at the site, and lack of residual contamination of the site could not be confirmed. As a result, the City of Lomita does not wish to introduce infiltration at this location due to the potential to mobilize potential contaminants which could impact the groundwater.

The City performed a preliminary site assessment and determined another City-owned parking lot across the street on Narbonne Avenue (northwest of the original parking lot) could potentially be feasible for an infiltration gallery. The planned geotechnical testing to assess infiltration rates was therefore performed at this location as well as at the drywell alignment originally included in the project, resulting in infiltration rates ranging from approximately 1/2 to 1/4th the rate assumed in the feasibility report. Due to the geotechnical results, the number of drywells that would be required to maintain the original alignment and capture volume that was in the feasibility study and SCWP application was prohibitively high, making it no longer a feasible alignment and necessitating the team to evaluate a location for a larger infiltration gallery to allow for more storage as well as dynamic infiltration.

The investigated Narbonne Avenue parking lot has limited space. Therefore, the City evaluated a different location where all of the design flow could be diverted to consolidate the subsurface infiltration features into one larger infiltration gallery which would be located at Lomita's City Hall. This gallery would have capacity to store flows even if the infiltration rates are similar to the geotechnical report. The proposed project modifications are summarized in detail in the enclosed "Attachment B, Supplemental Information". The original feasibility study (Attachment C) provides details for the hydrology and Water Quality and Water Supply Benefits.

If applicable, list previously approved funding allocations/disbursements and revised funding request:

Note, if some or all of a previously Funded Activity cannot be completed as a result of the proposed modification, please include a description and indicate the amount of unused funds. Any unused funds should be reallocated and accounted for in your revised funding request. Attach additional pages, as needed.

Fiscal Year	Approved Funding Allocations	Increase/ Decrease Requested	Revised Funding Request	Description/Phase/Status *If applicable, include description of unused funds*
FY 22-23	$449,300.00			Funding has been disbursed
TOTAL	$449,300.00			

A: SCWP Approved Total Funding Allocations	$449,300.00
B: Revised SCWP Anticipated Total Funding Request	N/A (note questions below are also N/A)
C: SCWP Expenditures to date	$177,884.44
D: Difference between B and A	N/A

Would the additional funding request be the only option that would allow the project to be implemented?	☐ YES
Would delaying funding allocations impact the project's ability to be implemented?	☐ YES
Would funding only a portion of the additional funding request impact the project's ability to be implemented?	☐ YES
Has the Recipient considered other funding sources?	☐ YES

If applicable, a description of difference in SCWP Anticipated Total Funding Request and a description of your responses to the questions above. As a reminder, annual funding is at the discretion of the WASC, ROC, and ultimately the Board of Supervisors. Attach additional pages, as needed.

N/A

Brief description of Supporting Documentation provided.

Attachment B provides supplemental information on the proposed modifications. Attachment C provides the original concept design, results from the geotechnical investigation, and the proposed alternative project layout.

I certify the information and supporting documentation provided is accurate and true.	☒ YES
I understand this is a request and it is under the WASC's discretion to consider requested modifications.	☒ YES

Name Andrew Vialpando

Organization City of Lomita

Signature 

Date 10/31/24

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Proposed Modifications to Projects or Studies:

	Status	Date
Scope/benefits of the modified Project or Study is **consistent** with the Project or Study included in the current fiscal year's SIP and proposed modifications were **approved** by the District.	☐ YES	
Scope/benefits of the modified Project or Study is **NOT consistent** with the Project or Study included in the current fiscal year's SIP. **If yes, select all that apply**:	☐ YES	
Budget/schedule modifications would impact future SIP funding allocations. **If yes, select all that apply**:	☐ YES	
PMR was received **after** October 31 of a fiscal year and the PMR will be considered for approval during the preparation of **subsequent** SIP for the fiscal year after the next	☐ YES	-
Project or Study **abandoned** the proposed modifications	☐ YES	
Projector or Study was **withdrawn** from consideration by the WASC and shall issue repayment of unspent funds	☐ YES	
Proposed modifications were **recommended for approval** in the SIP	☐ YES ☐ NO	

Proposed Modifications to Project Concepts:

	Status	Date
Proposed modifications were deemed **consistent** with the Project concept that was approved by the WASC, ROC and Board for inclusion in the SIP and can be addressed within the existing budget. District will proceed to incorporate the proposed modification into the Feasibility Study immediately.	☐ YES	
Proposed modifications were deemed significant enough to result in a **significantly different** Project concept from the one approved by the WASC, ROC and Board for inclusion in the SIP. **If yes, select one:**	☐ YES	
District to **discontinue** work on the Feasibility Study, return unused funds to be programmed in the SIP for the next fiscal year, and advise the proponent to submit the modified Project concept during the Call for Projects for a future fiscal year.	☐ YES	-
District to **abandon** the proposed modifications and proceed with the Project concept included in the SIP.	☐ YES	-

Attachment B

Project Modification Request Form, Supplemental Information

This document is provided as a supplemental narrative to Attachment A: Project Modification Request Form. Attachment C: Downtown Lomita Multi-Benefit Stormwater Project Modification Memo provides details regarding the recommended project modification.

The following describes the **types of modification requests** identified in Attachment A.

1. **Like-For-Like Modifications**
    a. Landscaping Areas & Nature-Based Solutions – **SLIGHT CHANGE ANTICIPATED.** Two bioretention areas originally proposed along Lomita boulevard included in the Feasibility Study are no longer feasible, as they are located on private parcels. Instead, additional bioretention is being considered along Narbonne Avenue. In addition, if the City Hall front lawn option is used, drought tolerant landscaping is proposed in front of City Hall. The runoff previously captured by the bioretention areas will still be infiltrated, allowing the total capture volume of the project to remain the same, because it will be captured by the diversion structure and infiltrated at the proposed subsurface infiltration gallery.
2. **Functionally equivalent BMP Modifications**
    a. Drainage Area, Drainage Area Imperviousness, and 85th Percentile Storm Volume – **NO CHANGE ANTICIPATED.** The original project concept included three diversion structures placed on storm drain locations that feed to a Los Angeles County Flood Control District (LACFD) 69-inch reinforced concrete pipe (RCP) storm drain flowing from North to South along Narbonne Avenue. The proposed project modification would instead include a single diversion structure from the LACFD 69-inch RCP storm drain; downstream from all diversion points included in the original design concept. Since all previous flow inputs are accounted for in the single diversion, no change in the drainage area is anticipated for this project.
    b. Method of Capture – **CHANGE ANTICIPATED.** The original project concept methodology was based on infiltration of stormwater through the use of gravity diversions, pretreatment, an infiltration gallery, drywells, and surface BMPs such as bioretention and tree wells. Due to the significantly reduced infiltration rate encountered during geotechnical exploration, the use of drywells is no longer feasible. Instead, the use of a subsurface infiltration gallery is proposed because unlike drywells, a gallery allows for storage during the storm, more effectively accommodating lower infiltration rates. The proposed project modification will consolidate the infiltration benefits into a single infiltration gallery location at Lomita City Hall. This will provide the same project benefit, capture volume, and tributary area included in the original project. The proposed modifications also include just one pumped diversion, instead of three gravity diversions. All other components of the original design (pretreatment, surface BMPs, community benefits along Narbonne Avenue and Lomita Boulevard, trees, bike lane, etc.) remain unchanged.
3. **Change in Project benefits**

a. Water Quality Benefits – **NO CHANGE ANTICIPATED.** The proposed project modification will divert and capture the same volume of water from the same drainage areas as the original concept design and will continue to include pretreatment and infiltration. As such, no change in the water quality benefit is anticipated.
b. Water Supply Benefits - **NO CHANGE ANTICIPATED.** The proposed project modification will divert and capture the same volume of water from the same drainage areas as the original concept design.
c. Community Investment Benefits – **NO CHANGE ANTICIPATED.** The proposed project modification will include the same community investment benefits as the original concept design.
d. Nature-Based Solutions – **NO CHANGE ANTICIPATED** – The proposed project modification includes the planting of 45 tree wells along Narbonne Avenue as was originally proposed in the concept design. The original concept design included bioretention on Lomita Boulevard that is no longer included. However, additional bioretention along Narbonne Avenue and at City Hall will result in no net change in nature-based solutions.
e. Leveraging Funds – **NO CHANGE.**
f. Community Support – **NO CHANGE.**

4. **Change in Project or Study Location**

Project Location – **NO CHANGE.** The project location remains the same. The project remains located in downtown Lomita along Lomita Boulevard and Narbonne Avenue, providing the same community benefits, capturing the same drainage area, and the same capture volume. The relocation of the subsurface features is the only change, but the modified location falls within the original area of the project.

Hazen *Technical Memorandum*

October 31, 2024

To: City of Lomita

From: Hazen and Sawyer

Downtown Lomita Multi-Benefit Stormwater Project Modification Supplemental Information Technical Memorandum

Attachment C

Introduction

The City of Lomita (City) is developing the Downtown Lomita Multi-Benefit Stormwater Project (Project) to provide the community with water quality and flood control benefits, and community beautification and recreation benefits. This technical memorandum (TM) provides a narrative surrounding the evolution of the proposed project from the feasibility report to Project Modification Request (PMR).

This TM provides updated background project information resulting from preliminary investigations following the submittal and approval for funding of the July 2021 Downtown Lomita Multi-Benefit Stormwater Project Application, which included the Feasibility Study Report, by the SCWP. This includes parcel history research and a geotechnical investigation conducted in May 2024. Section 1 of this TM details the original concept design, Section 2 explains geotechnical investigation infiltration findings, and Section 3 details the proposed project modification. Appendices A and B include the original feasibility report and the draft project geotechnical report.

The City is dedicated to providing a multi-benefit project that meets the original project goals of improving water quality, water supply, and local community benefits. Despite additional design constraints, the proposed project modification offers the same benefits as the original project and a potential to pair the benefits of the conceptual design with a community focused landscape design to provide Lomita residents with a multi-benefit project.

Job no

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1. Original Concept Design

A concept design was developed in 2021 to capture, treat, and infiltrate local urban runoff in the downtown area of Lomita in an effort to address the City's responsibility to meet the discharge requirements defined in their National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit and address Total Maximum Daily Loads (TMDLs). The volume of stormwater the City of Lomita is required to capture and manage is established by the reasonable assurance analysis (RAA) in the Dominguez Channel Watershed Management Plan (DCWMP), which is subject to approval by the Los Angeles Regional Water Quality Control Board (LARWQCB). The Downtown Lomita Multi-Benefit Stormwater Project significantly contributes to Lomita's required capture volume and is a critical project for the City to implement, as it captures 110 acres of the 146 acres Lomita is required to capture based on the RAA analysis.

As shown in Figure 1, the original concept design begins on Narbonne Avenue and extends 450-feet south to Lomita Boulevard. It continues along the 1,100-foot length of Lomita Boulevard from Lucille Avenue to Woodward Avenue. The Project was intended to capture and infiltrate stormwater flow by infiltrating stormwater under a City-owned parking lot on Narbonne Avenue and in drywells under Lomita Boulevard. Other key components of the Project include the planting of 45 trees along Narbonne Avenue and Lomita Boulevard, new vegetated areas along the sidewalk and in the medians that will further capture stormwater in a natural way, and bioretention along Narbonne Avenue. Community aspects of the original design included benches, and the addition of a bike lane along Lomita Boulevard from Woodward Avenue to Lucille Avenue. Additional bike locking locations would also be provided in key locations to further encourage this healthy mode of transportation.

In October of 2020, geotechnical investigations were conducted at 2154 245th Street, directly adjacent to the proposed infiltration gallery location at the City-owned parking lot at 24418 Narbonne Avenue. Based on this investigation, an infiltration rate of 16.9 inches per hour (in/hr) was used to provide preliminary sizing for the infiltration best management practices (BMPs). The Project planned to capture and infiltrate 5.6 acre-feet (ac-ft) of stormwater over a 110-acre drainage area. 1.72 ac-ft would be captured by an infiltration gallery, 3.95 ac-ft by dry wells, and 0.03 ac-ft by surface BMPs. For further information regarding the original concept design, refer to the feasibility report included in Appendix A.

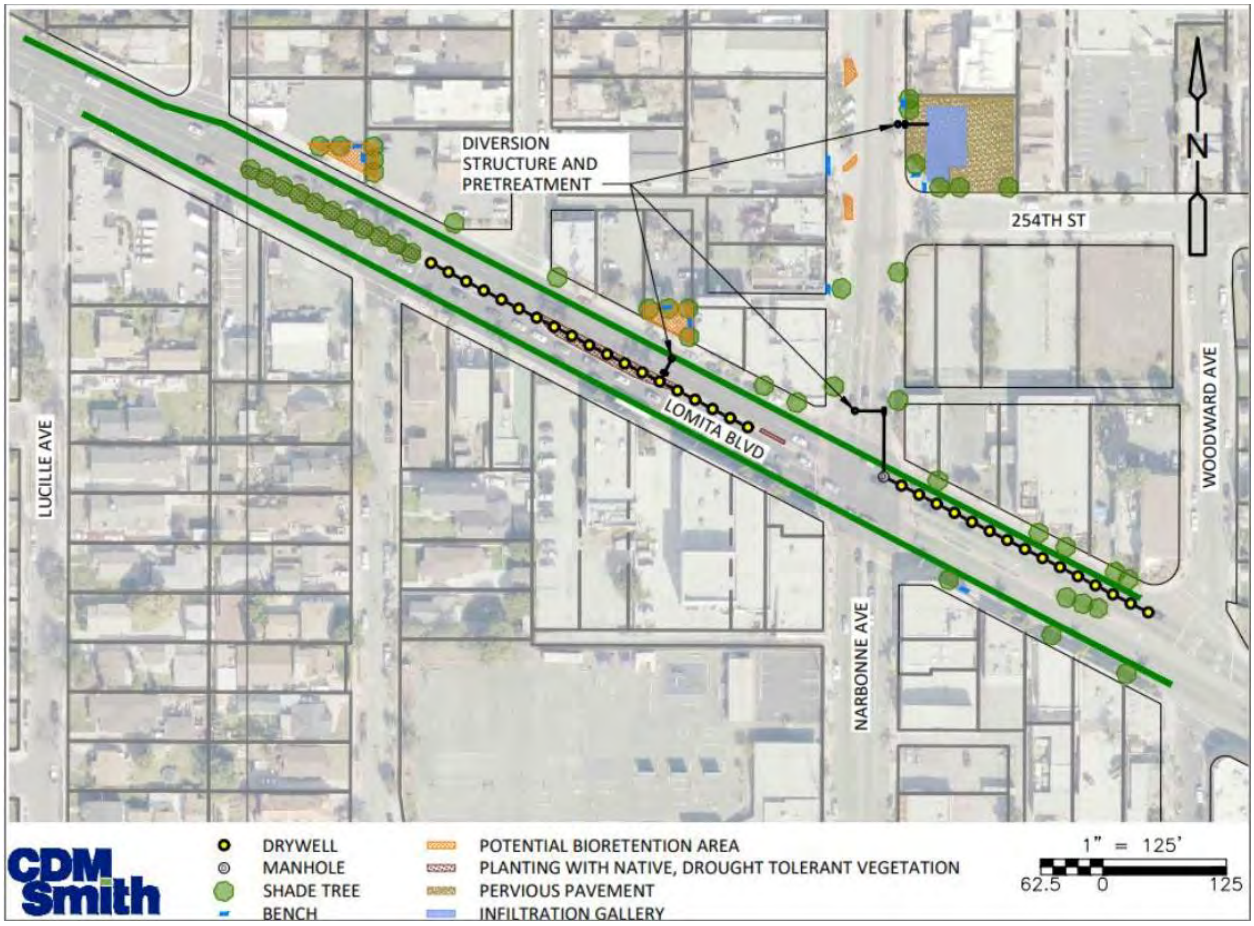

Figure 1 – Original Concept Design Layout

2. Past Use Concerns at Infiltration Gallery Location

During preliminary phases of design, it was discovered that the infiltration gallery parcel proposed in the feasibility study was previously occupied by a gas station. In the past, cleanup efforts were required for a leaking underground storage tank, and lack of residual contamination of the site could not be confirmed. Hydrogeologists were consulted to identify available information and to understand the groundwater movement at the location. Due to past use at the site and the potential to mobilize any possible contaminants that could be currently immobilized at the parking lot site, the City of Lomita does not wish to introduce infiltration at this location due to the potential risks and impacts to the groundwater.

Another City-owned parking lot on Narbonne Avenue just to the northwest of the original parking lot was considered as a potential alternative and was selected as a central location for the Narbonne Avenue geotechnical investigations to be conducted, along with those along Lomita Boulevard, as discussed in Section 3.

3. Geotechnical Investigation

Beginning in May 2024, the City began a geotechnical investigation that included three Cone Penetration Tests (CPT), followed by five hollow stem auger borings and infiltration tests, and two double-ring infiltrometer tests. Figures 2 through 4 show the geotechnical testing locations. The testing was completed near the proposed BMP locations to most accurately determine infiltration rates and soil characteristics that could be used for design.

Figure 2 – Geotechnical Investigation Near Proposed Infiltration Gallery

Figure 3 – Geotechnical Investigation Near Proposed Drywells West of Narbonne Ave

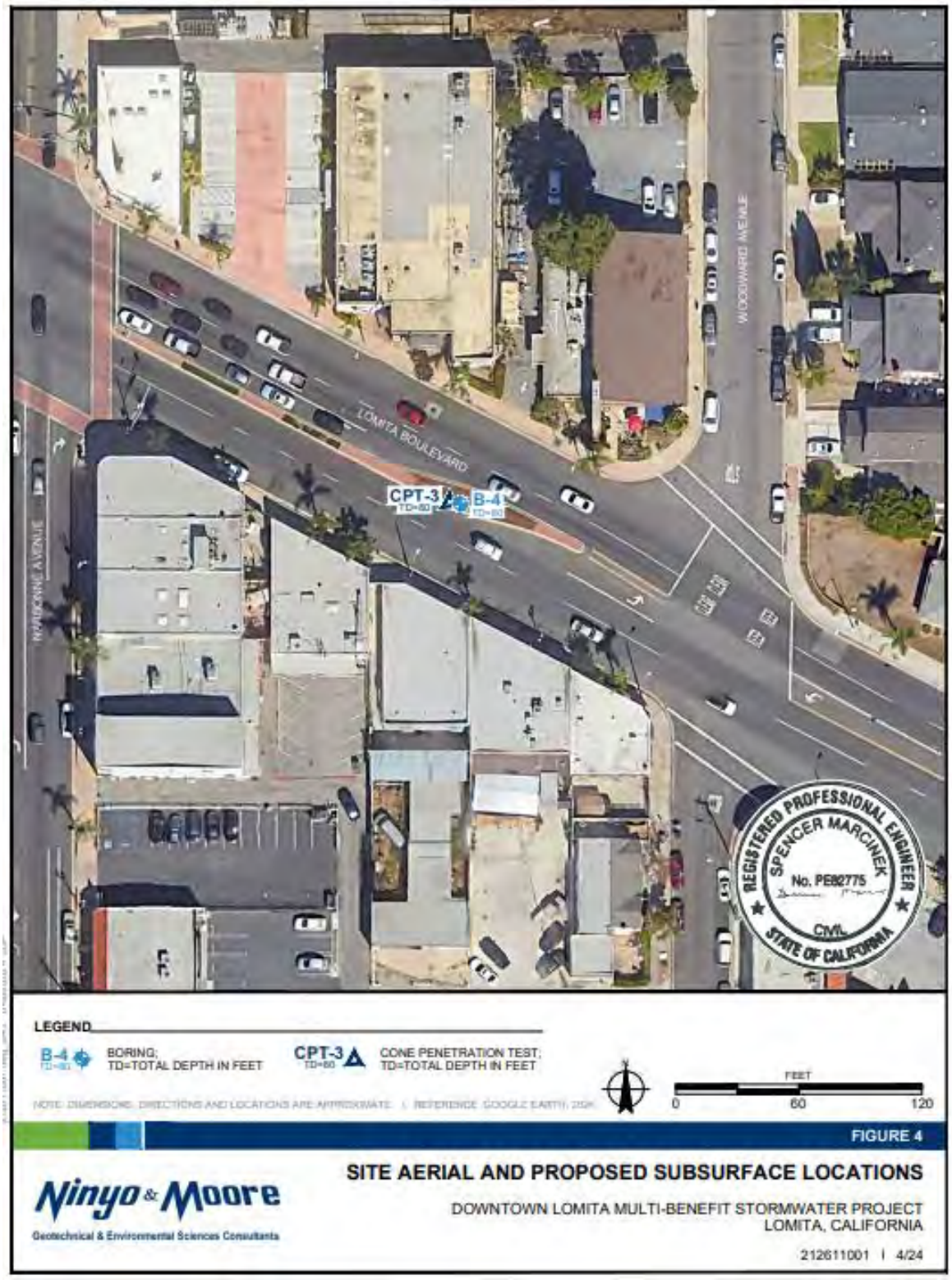

Figure 4 – Geotechnical Investigation Near Proposed Drywells East of Narbonne Ave

Below is a table presenting the preliminary infiltration rates for the project. The infiltration rate measured in boring B-4 (Lomita Blvd median east of Narbonne Ave) was slightly higher than the infiltration rate measured in boring B-3 (Lomita Blvd median west of Narbonne Ave), but overall the values are consistent, with an average infiltration rate of 3.45 in/hr for drywells. Based on these findings, maximum design drywell depth is 65 feet as groundwater was encountered in one of the borings at 76 feet. The feasibility study assumed 60 feet. The draft geotechnical report is included in Appendix B. This average infiltration rate is significantly lower than what was assumed in the feasibility study.

Table 1 – Geotechnical Investigation Infiltration Rate Test Results

Boring	Test Type	Groundwater Depth (feet)	Soil Type	Infiltration Testing Zone (feet)	Preliminary Field Infiltration Rate (inches/hour)	Reduction Factors				Preliminary Adjusted Infiltration Rate (inches/hour)
						Test Type (RFt)	Variability (RFv)	Siltation (RFs)	Total (RF)	
B-1a	Constant Head	Not encountered	Poorly graded sand with silt (SP-SM)	45 - 50	33.0	2	1	1	4	8.3
B-1b	Constant Head	Not encountered	SP-SM	26 - 31	18.3	2	1	1	4	4.6
B-2	Falling Head	Not Encountered	Clayey sand (SC)	5 - 10	0.31	2	1	1	4	0.08
B-3	Constant Head	Not Encountered	Generally SP-SM with interbedded SC layers	21 - 80	11.8	2	1	1	4	3.0
B-4	Constant Head	76	Generally SP-SM with interbedded SC layers	25-65	15.4	2	1	1	4	3.9
DR-1	Double Ring	Not Encountered	Silty sand (SM)	Ground surface	1.6	2	1	1	4	0.39
DR-2	Double Ring	Not Encountered	SM	Ground surface	3.9	2	1	1	4	0.97

4. Proposed Project Modifications

After receiving the geotechnical findings, the City investigated multiple project alternatives prior to arriving at the proposed project modification. The decreased infiltration rate resulted in a need for 87 drywells to capture the 85th percentile flow from drainage areas two through four shown in the feasibility report. This was deemed infeasible when considering available land, utility conflicts, construction cost, construction impacts, maintainability, and other constraints. The second parking lot on Narbonne Avenue did not have sufficient space to accommodate additional volumes.

Instead, the City proposes an alternative design that captures and infiltrates the entire 85th percentile storm event in one infiltration gallery via a single, pumped diversion. The required infiltration gallery footprint was estimated to be approximately 12,500 square feet with an internal gallery depth of 14 feet, including 1 foot of freeboard. The proposed location of the infiltration gallery is at Lomita's City Hall, including both the front lawn and back parking lot. Utilizing Lomita's City Hall, which is a public space, may enhance community benefits.

A conceptual design for the proposed City Hall infiltration gallery was developed, shown in Figure 5, that includes a single diversion to capture the entire Project drainage area, and incorporates a submersible pump station on Lomita Boulevard to convey stormwater flows to an infiltration gallery. Due to the proximity of the proposed infiltration gallery to the previous geotechnical investigation, it is anticipated that infiltration rates will remain similar. However, if a geotechnical investigation reveals lower infiltration rates, there is enough space available for an infiltration gallery that is large enough to provide additional capacity for storage and infiltration.

5. Conclusion

The modifications to the Downtown Lomita Multi-Benefit Stormwater Project maintains the benefits identified in the SCWP application and feasibility study. The project continues to provide the same capture volume, tributary area, project location, and community benefits as the original project.. The modifications to the subsurface features are required to accommodate geotechnical findings, but they do not ultimately change the intention of the project to capture, pretreat, and infiltrate stormwater from the tributary area for the 85th percentile 24-hour storm event, providing identical water quality benefits.

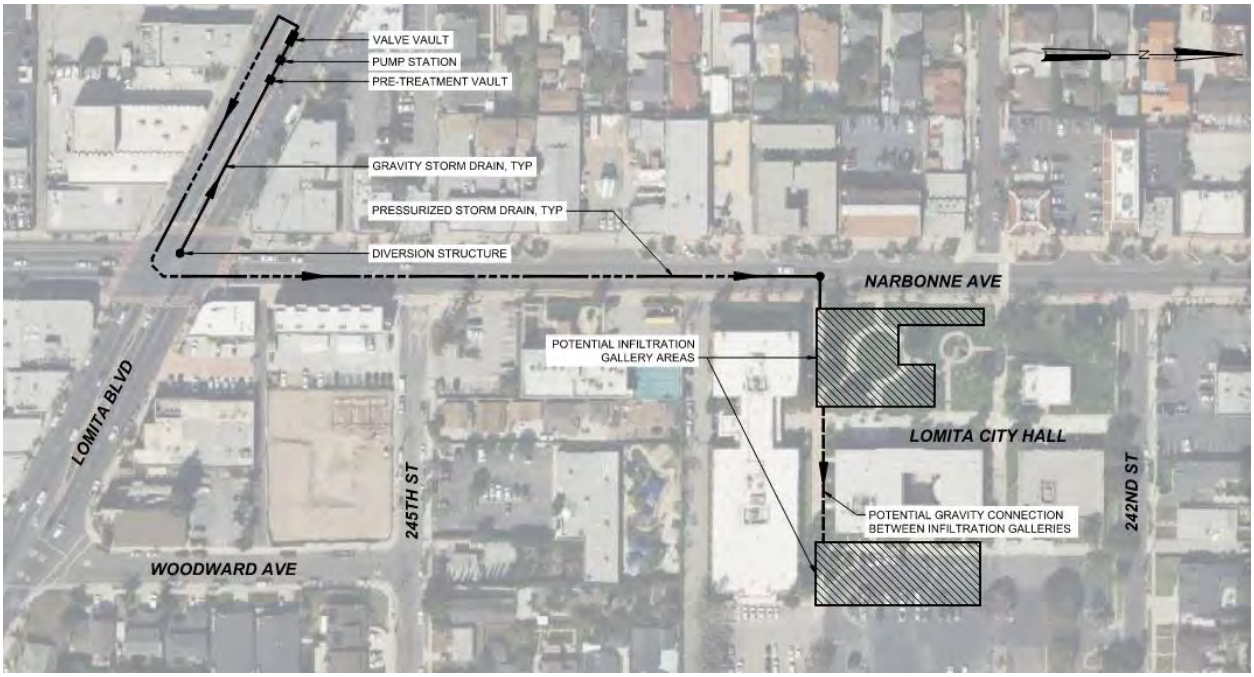

Figure 5 - Proposed Modifications for Downtown Lomita Multi-Benefit Stormwater Project Design

Appendix A: Lomita Feasibility Report

REPORT

Downtown Lomita Multi-Benefit Stormwater Project

Feasibility Study

City of Lomita

July 29, 2021

CDM Smith

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Abbreviations/Acronyms

ac-ft	Acre-foot / Acre-feet
ADA	Americans with Disabilities Act
bgs	Below ground surface
BMP	Best Management Practice
CEQA	California Environmental Quality Act
City	City of Lomita
CNDDB	California Natural Diversity Database
County	County of Los Angeles
CPT	Cone Penetration Test
DAC	Disadvantaged Communities
DC WMG	Dominguez Channel Watershed Management Group
DFW	Department of Fish and Wildlife
DS1	Diversion Structure 1
DS2	Diversion Structure 2
DS3	Diversion Structure 3
DSBB	Debris Separating Baffle Box
EIR	Environmental Impact Report
EWMP	Enhanced Watershed Management Program
IPaC	Information for Planning and Consultation
LACFCD	Los Angeles County Flood Control District
LID	Low Impact Development
MS4	Municipal Separate Storm Sewer System
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetlands Inventory
Nutrients TMDL	Machado Lake Nutrients Total Maximum Daily Load
O&M	Operations and Maintenance
PCB	Polychlorinated biphenyl
Project	Downtown Lomita Multi-Benefit Stormwater Project
Regional Board	Los Angeles Regional Water Quality Control Board
SCW Program	Safe, Clean Water Program
sf	Square foot / Square feet
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WMMS2	Watershed Management Modeling System Version 2.0

Appendices

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Section 1
Overview

The City of Lomita (City) has developed the Downtown Lomita Multi-Benefit Stormwater Project (Project) to provide the community with water quality and flood control benefits, and community beautification and recreation benefits. This feasibility study has been developed to describe the project improvements, quantify potential benefits, and demonstrate technical feasibility. It is intended to be comprehensive of the requirements of the Safe, Clean Water (SCW) Program grant funding opportunity that is available within the County of Los Angeles (County).

Section 1 provides a discussion on the existing conditions at the Project site, a summary of the proposed elements of the Project, and an outline for the remainder of this feasibility study report. Included is a table that identifies which sections of the report address each of the 19 requirements of an SCW Program Feasibility Study.

1.1 Project Vicinity

The City is located in the southwestern portion of the County, east of Interstate 110 near its intersection with Highway 1. The City has a footprint of just under two square miles and has a history predating California's Spanish period. The City boasts a diverse population of 20,000 (Lomita). The City falls within the Machado Lake and Wilmington Drain Watersheds, as illustrated in **Figure 1-1**.

The proposed Project is located in the northern portion of the City, in the Wilmington Drain Watershed, as illustrated in **Figure 1-1**. The Wilmington Drain Watershed, which drains directly to Wilmington Drain, discharges to Machado Lake and further downstream to the Los Angeles and Long Beach Harbor (Harbor). As such, the Project impacts each of these watersheds which face multiple water quality concerns described in the sections below.

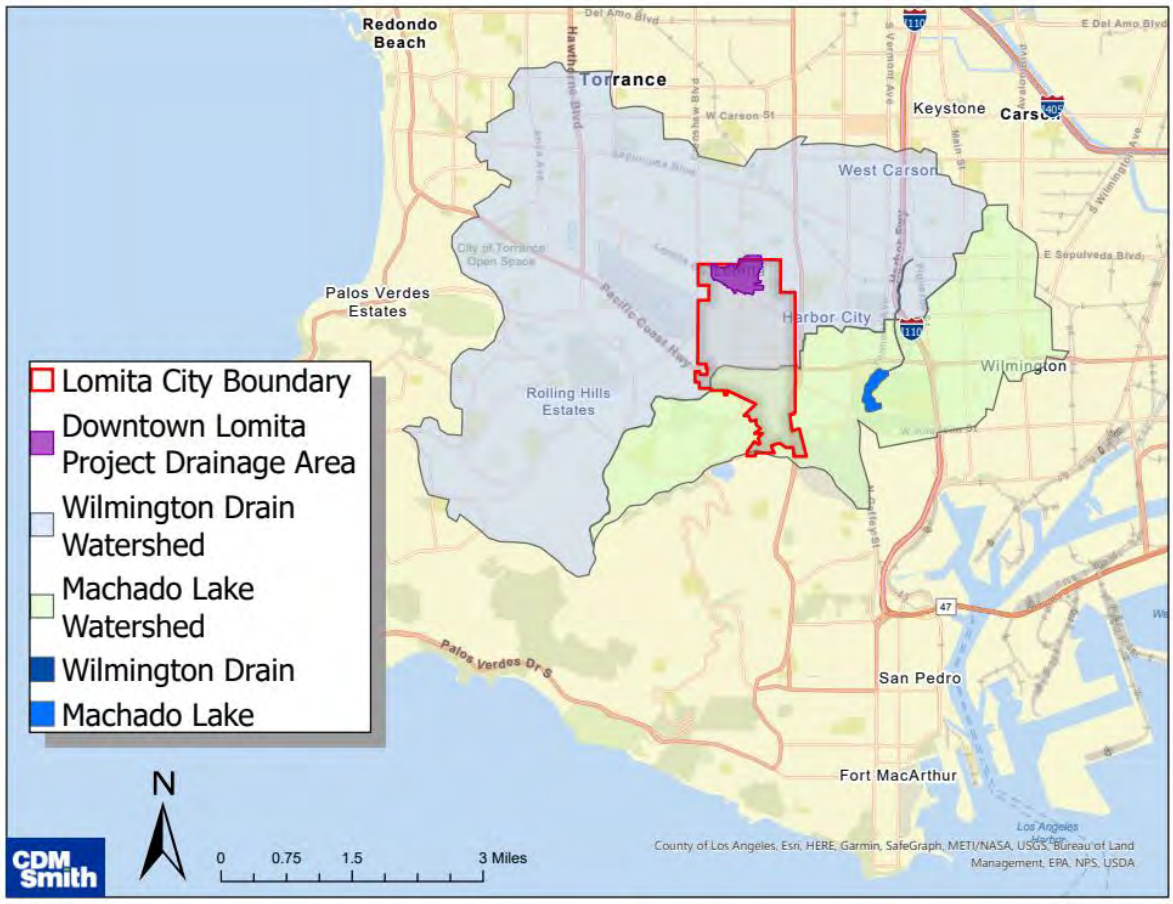

Figure 1-1. Project Vicinity

1.2 Regional Water Quality Context

The City is a part of the Dominguez Channel Watershed Management Group (DC WMG) that consists of the County of Los Angeles, Los Angeles County Flood Control District (LACFCD), and the cities of Lomita, Los Angeles, Carson, El Segundo, Lawndale, Hawthorne, and Inglewood. The City of Lomita represents 2.4 percent of the total land area within the DC WMG. An Enhanced Watershed Management Plan (EWMP) was developed by the DC WMG pursuant to the requirements set forth by Order No. R4-2012- 0175, Los Angeles County Municipal Separate Storm Sewer System (MS4) National Pollutant Discharge Elimination System (NPDES) Permit (MS4 Permit). The EWMP was originally submitted to the Los Angeles Regional Water Quality Control Board (Regional Board) in February of 2016, approved in April of 2016, and was updated in June of 2021. The update is pending approval. This Project is included in the EWMP.

The Wilmington Drain Watershed, which is a tributary to the Machado Lake Watershed and ultimately the Harbor, is one of the subwatersheds delineated in the EWMP (**Figure 1-1**). Wilmington Drain consists of a concrete-lined channel that transitions to an earthen channel just south of the Interstate 110 crossing. This is the receiving waterbody for runoff generated by the Project's 110-acre tributary area, which represents 3.8 percent of the drainage area to Machado Lake.

Flow from Wilmington Drain continues to Machado Lake, which is comprised of an upper and a lower basin separated by an earthen dam. A 40-acre recreational lake is located in the upper basin and is created by the impoundment of stormwater runoff. The lower basin consists of an approximately 63-acre seasonal freshwater marsh.

Beneficial uses for the Wilmington Drain are not explicitly defined in the Basin Plan. Therefore, beneficial uses for the Wilmington Drain, based on the tributary rule (Regional Board, 2014), are assumed to be the same as Machado Lake, which has the following beneficial uses:

- Existing beneficial uses: Warm freshwater habitat (WARM); wildlife habitat (WILD); rare, threatened, or endangered species (RARE); wetland habitat (WET); water contact recreation (REC-1); and non-contact recreation (REC-2); and
- Potential beneficial uses: municipal and domestic supply (MUN).

A Total Maximum Daily Load (TMDL) is a regulatory term used to describe a value of the maximum amount of a pollutant that a water body can receive while still meeting water quality standards. Machado Lake has multiple TMDL provisions included in the MS4 Permit, which are discussed in the EWMP. The City is responsible for addressing the following TMDLs:

- Machado Lake Trash TMDL;
- Machado Lake Nutrients TMDL;
- Machado Lake Pesticides and Polychlorinated Biphenyls (PCBs) TMDL; and
- Dominguez Channel and Greater Los Angeles and Long Beach Harbor Toxic Pollutants TMDL.

The Regional Board adopted the Machado Lake Nutrients Total Maximum Daily Load (Nutrients TMDL) in 2008 and approved the Machado Lake Pesticides and Polychlorinated Biphenyls (PCBs) TMDL in 2010 to address organochlorine pesticides and PCBs. In 2011, the Regional Board adopted the Dominguez Channel and Greater Los Angeles and Long Beach Harbor Toxic Pollutants TMDL which address (among other constituents) cadmium, chromium, copper, mercury, lead, and zinc. The Machado Lake Trash TMDL has been in effect since 2008.

Based on these pollutants of concern, the Project has identified a primary pollutant of concern to be nitrogen, which is included in the Machado Lake Nutrients TMDL. A secondary pollutant of concern is zinc, which is included in the Dominguez Channel and Greater Los Angeles and Long Beach Harbor Toxic Pollutants TMDL.

The proposed Project will assist with managing these priority pollutants by capturing the 85th percentile, 24-hour storm event from the area tributary to the Project (see **Appendix E** for the hydrology calculations). This flow will be managed using proven, effective green infrastructure best management practices (BMPs) to reduce pollutant loading downstream and improve water quality for the region as a whole.

1.3 Proposed Green Infrastructure Best Management Practices

Green infrastructure BMPs provide an effective means of managing stormwater in a way that works with the existing environment in a natural, non-invasive manner. They serve to reduce pollutant loading through passive methods that are intended to capture and treat/infiltrate stormwater in upstream areas to reduce runoff volumes discharged downstream. They have a smaller carbon footprint than traditional end-of-pipe treatment methods.

To manage the pollutants of concern, the Project includes several green infrastructure BMPs and site design measures. These Project elements are further discussed in Sections 3 and 5 and are briefly summarized here:

- Debris Separating Baffle Boxes (DSBB) to pretreat stormwater diverted at three separate locations from LACFCD storm drains via debris removal;
- Infiltration gallery that detains and infiltrates stormwater underneath a City-owned parking lot;
- Parking lot resurfaced with pervious pavement;
- A series of drywells to provide water quality benefits through infiltration;
- Bioretention to treat surface flow in segments along Lomita Boulevard and Narbonne Avenue;
- Surface features such as benches at bus stops at the intersection of Lomita Boulevard and Narbonne Avenue, at strategic locations along Narbonne Avenue, and native tree planting along Narbonne Avenue and Lomita Boulevard to increase shade;
- Enhanced native, drought tolerant vegetation in street medians retrofitted with dry wells and in other locations throughout the Project; and
- Signage to educate the community about the benefits of stormwater management.

1.4 Report Layout

This report is organized to ensure each of the nineteen feasibility study components required by the Safe, Clean Water Program are included. The nineteen components are organized into the following sections:

- Section 2: Project Description and Objectives
- Section 3: Engineering Analysis
- Section 4: Cost Estimate and Schedule
- Section 5: Estimated Benefits and Project Scoring
- Section 6: Additional Information and Data Gaps

- Appendix A: Conceptual Design Drawings
- Appendix B: Photographs of Existing Conditions
- Appendix C: Operations and Maintenance Plan
- Appendix D: Monitoring Plan
- Appendix E: Hydrology and Water Quality Analysis Report
- Appendix F: Geotechnical Percolation Report
- Appendix G: Life-Cycle Cost Estimate
- Appendix H: Design Phase Schedule
- Appendix I: Letters of Support
- Appendix J: Los Angeles County Flood Control District Conceptual Approval

The SCW Program requires that a feasibility study include certain specific components, which are detailed in the Safe, Clean Water Program Feasibility Study Guidelines (SCW Program, 2019). To aid in evaluating this feasibility study for its comprehensiveness, **Table 1-1** identifies each of the required nineteen components and where in this document they can be found.

Table 1-1. Safe, Clean Water Program Feasibility Study Requirements

	Requirement from SCW Program	Applicable Section in Document
1.	Description of Objectives and Schematic	
	A summary of the Project's primary objective(s), secondary objective(s), and any additional objective(s).	Section 2
	A description of the primary mechanisms by which the Project will achieve its objectives (e.g., runoff and/or pollutant reduction through infiltration, treat and release, capture and use, etc.).	Section 2
	A description and schematic of the Project layout including its anticipated footprint and key components.	Section 2 and Appendix A
	An outline of the capture area for the Project on a map and a breakdown of acreage, land uses and percent imperviousness within the capture area.	Section 2 and Section 3
	Land ownership and related rights of way.	Section 6
2.	Description of Estimated Benefits from Project	Section 5
3.	Develop Project Schedule	Section 4 and Appendix H
4.	Review Effectiveness of Completed Similar Projects	Section 3
5.	Develop Monitoring Plan	Section 3 and Appendix D
6.	Prepare Life-Cycle Cost Estimate	Section 4.1 and Appendix G
7.	Prepare Operations and Maintenance Plan	Section 3.7.2 and Appendix C
8.	Conduct Engineering Analysis	Section 3, Appendix E and Appendix F
9.	Assess CEQA requirements	Section 3.6
10.	Non-municipal applicants must obtain support from the local municipality	NA

Requirement from SCW Program	Applicable Section in Document
11. Develop Outreach Plan	Section 6
12. Confirm County-Wide Anti-Displacement Requirements are Met	Section 6
13. Describe Vector Controls and Seek Approval from Local Vector Control Agency (include in O&M Plan)	Section 3 and Appendix C
14. Discuss Nature Based Controls	Section 2 and Section 5
15. Summarize Legal Requirements	Section 6
16. Conceptual approval from LA County Flood Control District	Section 6 and Appendix J
17. Acknowledgment of eligible expenditures being only those incurred on or after November 6, 2018.	Section 4
18. Summary of Other Funding Sources	Section 6
19. Describe Benefits to Disadvantaged Communities	Section 6

Section 2
Project Description and Objectives

The Project will provide water quality benefits to the community by reducing pollutant loading to Wilmington Drain and Machado Lake, reducing risks of flooding downstream and locally, and enhancing the downtown area by providing recreational benefits, increased vegetation, and increased shade.

This section describes the key components of the Project and how they relate to the Project's objectives.

2.1 Project Description

The Project is located in the downtown area of Lomita. It begins south of City Hall on Narbonne Avenue and extends 450-feet south to Lomita Boulevard. It continues along the 1,100-foot length of Lomita Boulevard from Lucille Avenue to Woodward Avenue. The Project will capture and infiltrate stormwater flow that would otherwise carry urban pollutants downstream to Wilmington Drain, Machado Lake, and the Harbor. By infiltrating stormwater under the City-owned parking lot on Narbonne Avenue and in drywells under Lomita Boulevard, the Project will reduce the risk of flooding that could occur downstream of the Project. Bioretention along Narbonne Avenue will mitigate existing localized flooding that frequently occurs in that area.

Other key components of the Project include the planting of 45 trees along Narbonne Avenue and Lomita Boulevard as well as new vegetated areas along the sidewalk and in the medians that will further capture stormwater in a natural way. These features will reduce the heat island effect that can occur in high impervious areas by providing shade and vegetated ground cover that absorbs the heat. With key placement of benches, the downtown area of Lomita Boulevard will be even more inviting to pedestrians who want to enjoy the downtown area. As a recreational feature and as part of the City's plan to increase alternatives to vehicle use, a bike lane will be added along Lomita Boulevard from Woodward Avenue to Lucille Avenue, which is one part of a more expansive bicycle and pedestrian plan for the City (Lomita, 2018). This bike lane will provide a safe location for bicyclists traveling to the downtown area and for those just passing by. Additional bike locking locations will also be provided in key locations to further encourage this healthy mode of transportation that also helps reduce pollution.

See **Appendix C** for an Operations and Maintenance (O&M) Plan for each element of the Project and **Appendix D** for a discussion on the Monitoring Plan. Section 5 provides a discussion on the benefits expected to be seen from these BMPs.

The following series of figures have been developed to illustrate the proposed Project:

- **Figure 2-1** presents a schematic of the Project;
- **Figure 2-2** presents the drainage areas to each of the infiltration BMPs;
- **Appendix A** presents the conceptual drawings for the Project layout; and

- **Appendix B** presents photographs of the existing conditions along the Project alignment.

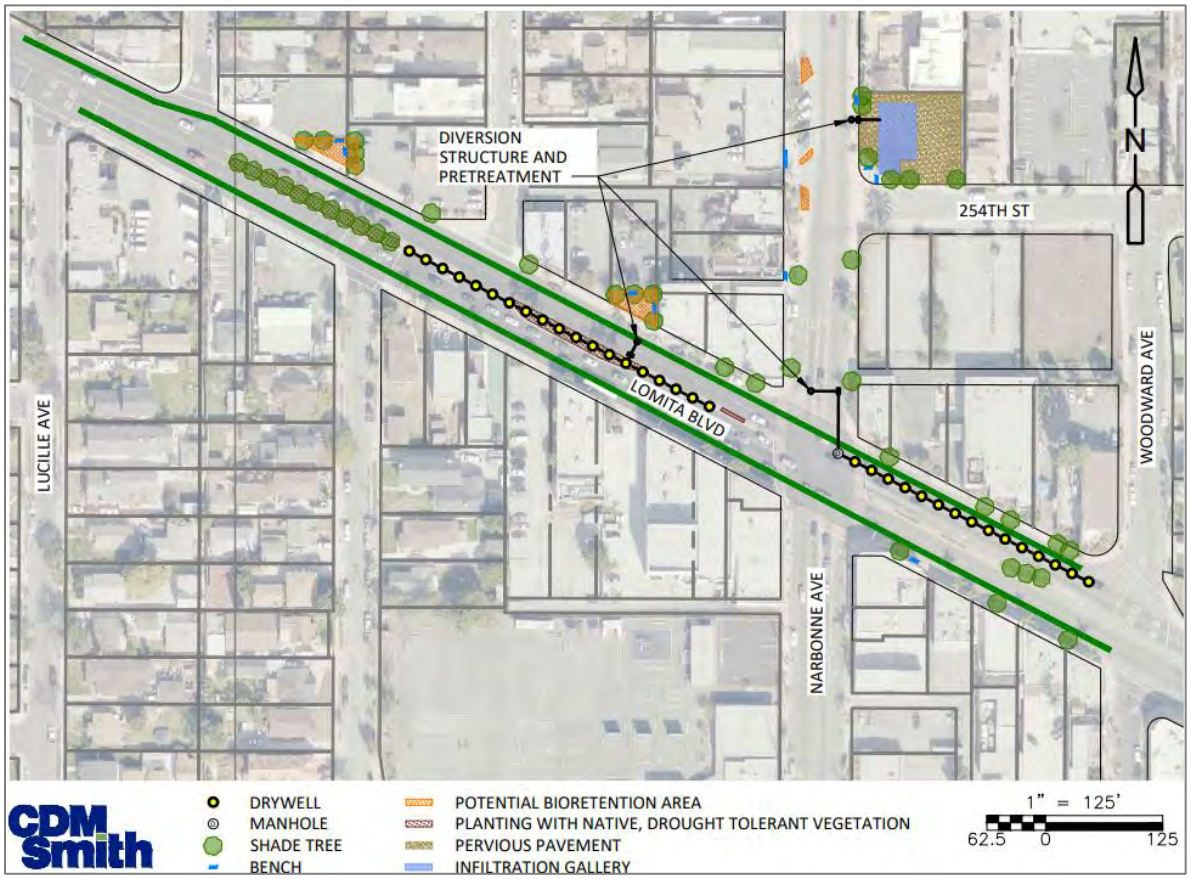

Figure 2-1. Project Schematic

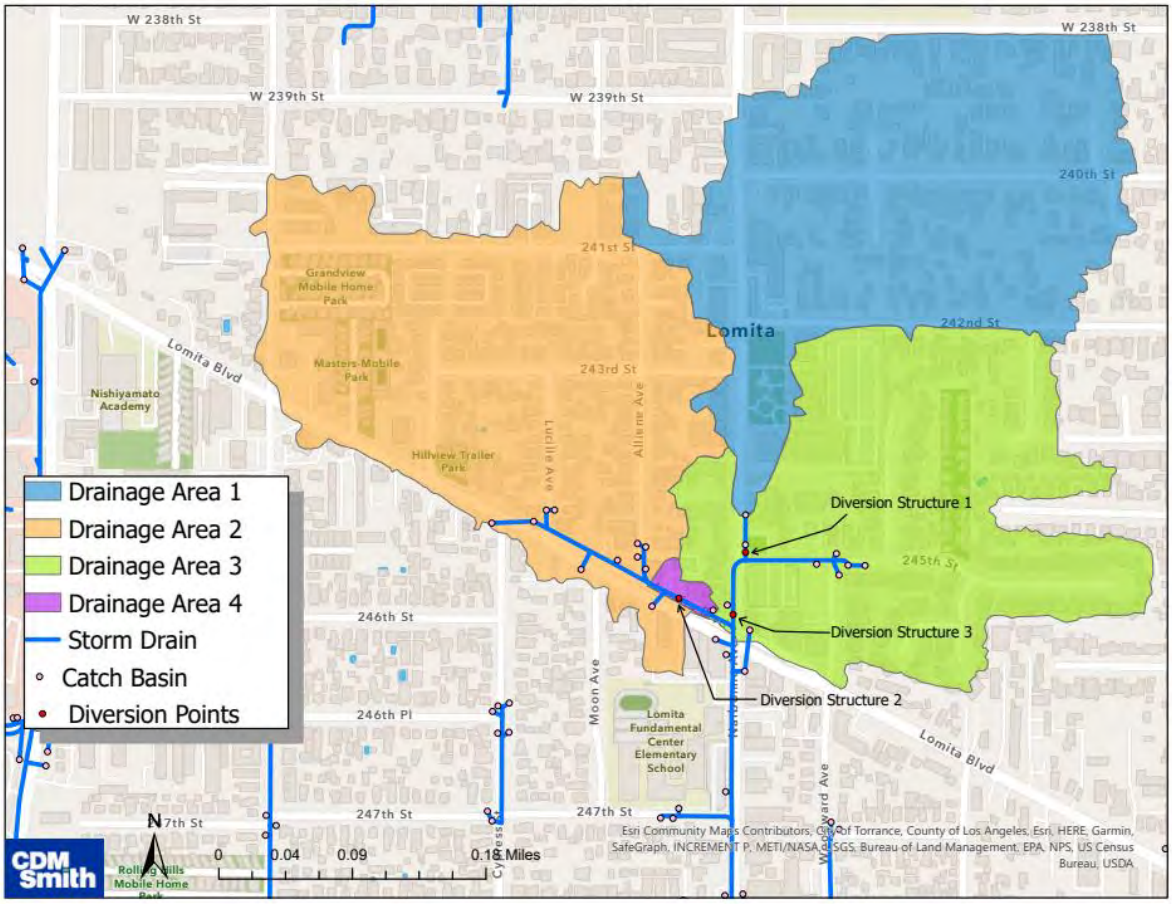

Figure 2-2. Existing LACFCD Storm Drains and Tributary Areas

2.1.1 Infiltration Gallery with Pretreatment

Runoff from the 37-acre drainage area referred to as Drainage Area 1 on **Figure 2-2** will be diverted by a proposed Diversion Structure 1 (DS1) installed along a LACFCD-owned 24-inch storm drain located under Narbonne Avenue. Approximately 1.7 acre-feet (ac-ft) of runoff from the 85th percentile, 24-hour storm will be diverted to a debris separating baffle box (DSBB) pretreatment device followed by a subsurface infiltration gallery located under the City-owned parking lot at 24418 Narbonne Avenue.

The DSBB, which is the type of pretreatment device selected for the Project, captures stormwater pollutants through the use of a non-clogging screening system that stores trash and debris above the water level. This allows for solids to be easily accessed and removed and reduces the risk of nutrient leaching and bacterial growth that would be more likely to occur if the debris were submerged. Additionally, there are three chambers which allow for filtration and sedimentation of fine particles that are carriers of nitrogen (the primary pollutant of concern for the Project), heavy metals (including zinc, the selected secondary pollutant of concern for the Project), and other contaminants. The device includes the following components, as shown in the example, which is not site specific, in **Figure 2-3**:

- Splitter screen: Directs flow to the filtration screens and provides additional screen flow capacity. Non-Clotting for continuous maintenance-free treatment;
- Filtration system: Collects and stores trash, debris, organics, and oxygen demanding substances above standing water in a dry state;
- Turbulence deflectors: Prevent resuspension of captured pollutants;
- Sediment chambers: Maximizes total suspended solids (TSS) removal and eliminates scouring during extreme flow rates; and
- Skimmer and Boom: Collects hydrocarbons and controls flow velocity which improves removal efficiency.

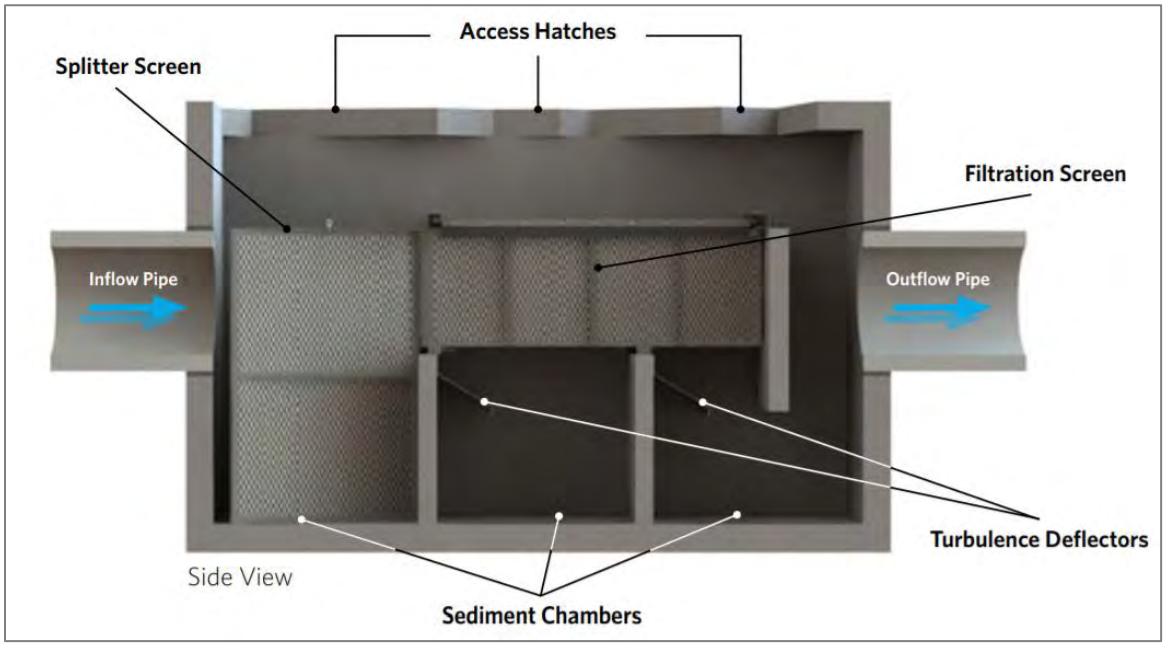

Figure 2-3. Typical Debris Separating Baffle Box (DSBB) Pretreatment Device (Source: Bio Clean)

Following the DSBB, the entire 1.7 ac-ft of flow generated from the design storm will be routed to the infiltration gallery which will have a configuration similar to the example shown in **Figure 2-4**, which is not site specific. This system allows for installation of modular devices that can fit in large or small spaces. Since they can be built below parks, buildings, or parking lots, the City can continue to use the site as a parking lot.

For the conceptual design, the proposed infiltration gallery has been sized based on outputs of PCSWMM, a robust hydrologic and hydraulic modeling software (PCSWMM). The dynamic model, accounting for both storage and infiltration, has been iterated to find the minimum infiltration gallery footprint required to manage the 85th percentile, 24-hour storm. The infiltration gallery has been modeled assuming the following characteristics: 5 ft internal storage depth, 0.9 void ratio, and 6 in of freeboard. The entire footprint of the gallery is assumed to be available for infiltration at a constant rate of 16.9 in/hr. Model results show that the proposed infiltration

gallery should be a minimum 3,100 SF to manage the entire design storm. Final sizing will be refined during the design phase.

Figure 2-4. Typical Infiltration Gallery (Source: StormTrap)

Upon completion of construction of the infiltration gallery, the 10,800-sf parking lot will be repaved with pervious pavement. This will allow additional surface flow to infiltrate into the ground. During design it will be evaluated whether underdrains are required in the areas directly above the infiltration gallery to allow this surface flow to infiltrate adjacent to the device.

2.1.2 Dry Wells with Pretreatment

The Project includes two structures that will divert flow from LACFCD storm drains to a series of infiltration drywells. Runoff from the 40-acre tributary Drainage Area 2 (**Figure 2-2**) will be diverted from a 39-inch LACFCD storm drain via the proposed Diversion Structure 2 (DS2) located in the westbound lanes of Lomita Boulevard, west of Narbonne Avenue. Approximately 2.2 ac-ft of runoff from the 85th percentile, 24-hour storm event will enter a DSBB pretreatment

device (**Figure 2-3**) followed by a series of 19 dry wells located in the median on Lomita Boulevard. The drywells will be configured in series and will be 60 ft deep with an infiltration zone assumed to be 40 ft. The diameter of the drywells will be 2 ft, for a volume of 251 cf.

The third infiltration area involves infiltrating runoff from the 33-acre tributary Drainage Area 3 (**Figure 2-2**). Stormwater runoff will be diverted via Diversion Structure 3 (DS3) from the 54-inch LACFCD storm drain in Narbonne Avenue, just north of the intersection with Lomita Boulevard. Flow will then pass through a DSBB device for pretreatment and continue southeast to a series of 15 drywells to be located on the northern side of Lomita Boulevard, east of Narbonne Avenue. The drywells will be configured in series and will be 60 ft deep with an infiltration zone of 40 ft. The diameter of the drywells will be 2 ft, for a volume of 251 cf.

For the conceptual design, drywell spacing was set at 20 feet from center to center. Final spacing and sizing will be refined during the design phase. A typical drywell layout is presented in **Figure 2-5**.

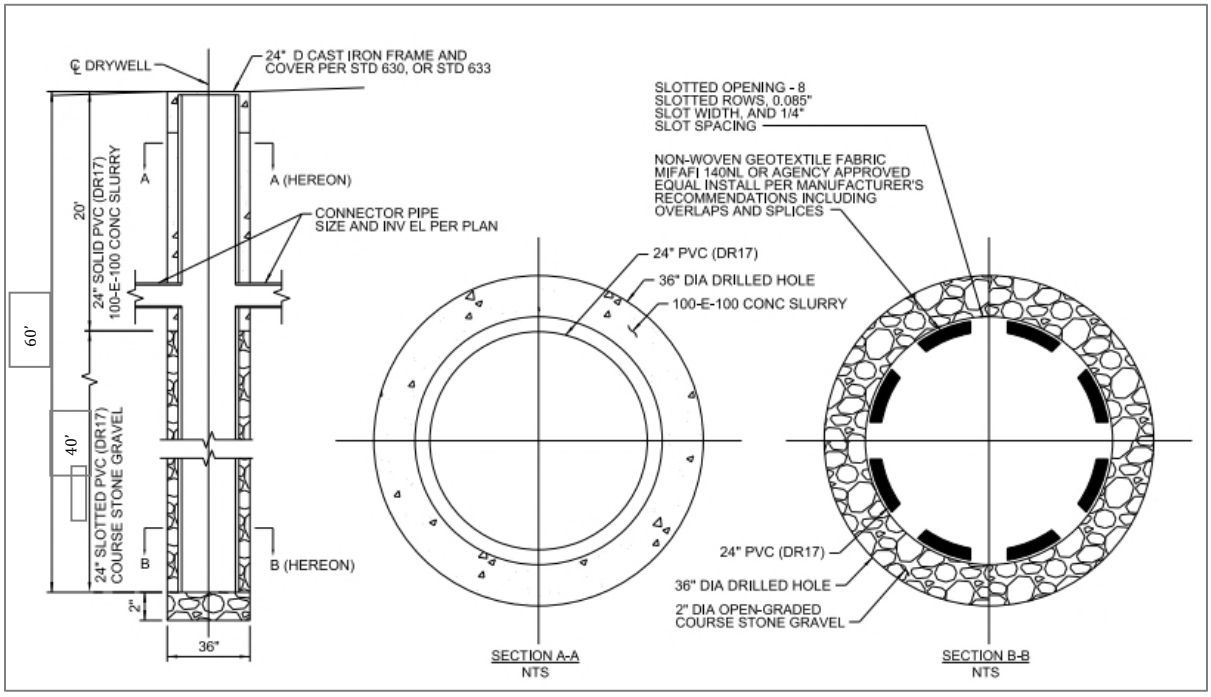

Figure 2-5. Typical Dry Well (see Appendix A)

2.1.3 Surface BMPs

The Project includes the installation of 8,000 sf of bioretention and vegetation areas throughout the Project site. These areas will be retrofitted with curb-cutouts to capture street flow (see **Figure 2-1** and the drawings in **Appendix A** for proposed locations which will be further refined during the design phase). The bioretention area located on Lomita Boulevard, west of Narbonne Avenue, will capture stormwater runoff from the 0.03-acre tributary Drainage Area 4 that would otherwise not flow to the drywells due to the location of the diversion structures. All plantings will include native, drought tolerant vegetation.

Additional surface BMPs include the installation of 45 trees, with tree wells receptive to stormwater infiltration. These trees and the vegetation will provide needed shade in than area largely devoid of shade and vegetation, reducing the heat island effect and increasing pollutant capture. **Figure 2-6** provides typical configurations of bioretention and tree well units (not site specific).

Additional native, drought tolerant vegetation will be installed throughout the Project. Locations of these features are shown on the conceptual drawings in **Appendix A** and in **Figure 2-1**, though specific placement will be determined during the design phase.

Figure 2-6. Typical Bioretention and Tree Well (Source: Philadelphia Green Streets Design Manual)

2.1.4 Additional Features

The Project also includes the installation of a bike lane along Lomita Boulevard from Woodward Avenue to Lucille Avenue. This bike lane will allow safe passage for bicyclists along this stretch of roadway, which the City has plans to expand as part of the City's Bicycle and Pedestrian Master Plan (Lomita, 2018). The Project will include the installation of bicycle locking stations at key locations downtown to further encourage this healthy mode of transportation that also helps reduce pollution. While not currently included in the design drawings or cost estimate, the inclusion of pervious pavement along the proposed bike lanes and/or parking lanes will be considered during the design phase to evaluate the impact and cost effectiveness of those features.

Benches will be installed along Narbonne Avenue and at the bus stops at the intersection of Lomita Boulevard and Narbonne Avenue. This will provide areas for visitors to the downtown area to rest under the shade of the proposed trees. Where trees are not possible due to the placement of underground or overhead utilities, benches with canopies will be used to provide shade.

Locations of these features are shown on the conceptual drawings in **Appendix A** and in **Figure 2-1**, though specific placement will be determined during the design phase.

2.2 Project Objectives

This section discusses each of the Project objectives and how the various project components serve to achieve them. These Project objectives are also discussed in Section 5 in terms of how they relate to the SCW Program scoring criteria.

2.2.1 Water Quality Benefits

A primary objective of the Project is to improve water quality in Wilmington Drain and Machado Lake, and ultimately the downstream receiving water, the Harbor. This will primarily be achieved through the installation of the treatment and infiltration BMPs described in Sections 2.1.1 through 2.1.3, including diversion structures, pretreatment devices, drywells, and an infiltration gallery. The proposed BMPs will capture, and infiltrate 5.6 ac-ft of runoff over the 110-acre tributary area (see **Appendix E** for hydrology calculations).

Implementation of the Project will result in the removal of multiple pollutants present in runoff from the target storm event captured by the proposed BMPs, including the primary pollutant, nitrogen, and secondary pollutant, zinc. Additional surface Low Impact Development (LID) features will be used to capture stormwater in segments of the Project alignment where surface flow does not enter a storm drain upstream of one of the proposed diversion points. LID features will include bioretention, native, drought tolerant vegetation, tree wells, and pervious pavement.

The anticipated reduction in zinc and nitrogen loads through the Project are described in **Appendix E** and Section 3.4.

2.2.2 Water Supply Benefits

The Project involves reducing the City's consumption of potable water by installing native, drought tolerant plants in the medians along Lomita Boulevard, along both sides of Narbonne Avenue, and along Lomita Boulevard. These drought tolerant plants will not require significant watering once they are established, which is typically estimated to be one to two years. While this may reduce the amount of potable water currently used to water existing vegetation in the medians, and this may provide some offset to potable water use, the Project does not quantify water supply benefits from this effort for the purpose of SCW Program scoring.

The Project includes infiltration of 5.6 ac-ft of stormwater (see **Appendix E** for the hydrology calculations). However, this infiltrated stormwater is not considered to be providing a water supply benefit due to the hydrogeologic conditions present at the site. Water at levels above 250 ft in the west coast basin are similar to seawater. Monitoring wells have also encountered oil-field brine in the shallow aquifers. This water is therefore not consumed and therefore no supply credit can be gained from injecting into this layer (Land, et al., 2004). The Project does not include this effort in SCW Program scoring.

2.2.3 Flood Control Benefits

Downtown Lomita, along Narbonne Avenue within the Project alignment, is an area where nuisance flooding has occurred, impacting vehicular traffic and pedestrians. However, this

location does not have a specifically identified flood control objective. Nevertheless, the Project will capture and divert stormwater flow, thereby offering heightened protection against this type of localized flooding.

Components of the Project that will contribute to a reduction in flooding include the underground infiltration gallery and other LID BMPs along Narbonne Avenue and Lomita Boulevard. The underground infiltration gallery at 24418 Narbonne Avenue will divert all of the 1.7 ac-ft of runoff from the entire tributary area. The LID BMPs along Narbonne Avenue and Lomita Boulevard include curb-cutouts to divert flow to bioretention, vegetated areas, and tree wells. These areas will be designed to capture surface flow and the location of these features will be further refined during the design phase to maximize benefits. They will provide some flood mitigation from smaller storm events. However, these proposed project elements will not provide significant reduction in flooding from larger flood events (e.g.,10- or 100-year recurrence interval storms).

2.2.4 Community Enhancement and Education Benefits

The Project proposes multiple community enhancements in the form of nature-based surface LID features, including bioretention facilities, new tree planting and new vegetated areas that provide greenscapes and a heat island reduction. The benefits from these elements are quantified in Section 4. The Project also includes a bike lane on Lomita Boulevard that will allow for those visiting the downtown area, or passing by, to safely use this healthy mode of transportation.

Additionally, the Project offers opportunities for the public to learn about stormwater and nature-based treatment alternatives that help keep our waterways clean in a safe, effective manner that have multiple positive impacts on the environment. Educational signage identifying the project benefits will be located at the entrance to the parking lot that will house the infiltration gallery, along Narbonne Avenue, and at strategic locations where additional bioretention facilities are proposed. This includes the bus stops on the west and east sides of Narbonne Avenue just north of the intersection with Lomita Boulevard and at bike lock stations.

The details of these educational features will be developed during the design phase including placement and design of the signs in a way that will have the most impact at locations where they can be easily noticed and read. Signs will be designed to prevent graffiti and minimize maintenance.

2.2.5 Environmental Benefits

The Project will provide multiple environmental and greenscape benefits through the inclusion of natural features. By planting approximately 45 shade trees and 8,000 sf of bioretention and plant cover, the Project will reduce the heat island effect. Drought tolerant, native plant and tree species will be used to maximize plant survival potential while minimizing irrigation requirements. The Project also includes the removal of approximately 10,800 sf of traditional pavement that will be replaced with pervious pavement. The estimated benefits projected for the Project are described in Section 3.5.

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Section 3
Engineering Analysis

Several engineering analyses were conducted to evaluate Project feasibility. The following sections summarize these efforts, with additional information provided in the appendices, as applicable.

3.1 Site Conditions and Pertinent Historical Data

The Project is located within the urbanized downtown area of Lomita, which has a semi-arid climate. The 85th percentile, 24-hour storm is 1.0 inches for each of the drainage areas (see **Appendix E**). The Project tributary areas (as shown in **Figure 2-2**) have at least two oil and gas wells that are not within the Project boundary (CalGEM GIS, 2021). A desktop evaluation determined the site has not been developed over former buried landfills.

Land use is presented in **Figure 3-1**. **Table 3-1** provides a list of land uses in Drainage Areas 1 through 3, while Drainage Area 4 is comprised of only commercial land uses and a stretch of Lomita Boulevard (see **Figure 3-1**). As indicated, the area has no significant open space or park land and is predominantly residential, with commercial and institutional facilities as well as streets.

Table 3-1. Land Use by Drainage Area

Drainage Area	SCAG Code[1]	Land Use Type	Area (acres)	Percent of Total Area (%)
1	1110	Single Family Residential	24.03	65.03
	1120	Multi-Family Residential	0.62	1.68
	1200	Commercial and Services	2.87	7.75
	1240	Institutional/Public Facilities	1.91	5.18
	1600	Mixed Residential and Commercial	1.22	3.29
	Road	Secondary Roads and Alleys	6.30	17.06
		Total	**37**	**100**
2	1110	Single Family Residential	0.05	0.13
	1120	Multi-Family Residential	21.62	54.55
	1240	Institutional/Public Facilities	0.03	0.08
	1600	Mixed Residential and Commercial	8.98	22.67
	Road	Secondary Roads and Alleys	8.94	22.56
		Total	**40**	**100**

Drainage Area	SCAG Code[1]	Land Use Type	Area (acres)	Percent of Total Area (%)
3	1110	Single Family Residential	18.10	55.89
	1120	Multi-Family Residential	0.11	0.33
	1200	Commercial and Services	0.01	0.05
	1240	Institutional/Public Facilities	3.68	11.37
	1600	Mixed Residential and Commercial	5.11	15.77
	Road	Secondary Roads and Alleys	5.38	16.60
		Total	**33**	**100**

Notes: 1: Source: Southern California Association of Governments (SCAG, ND)

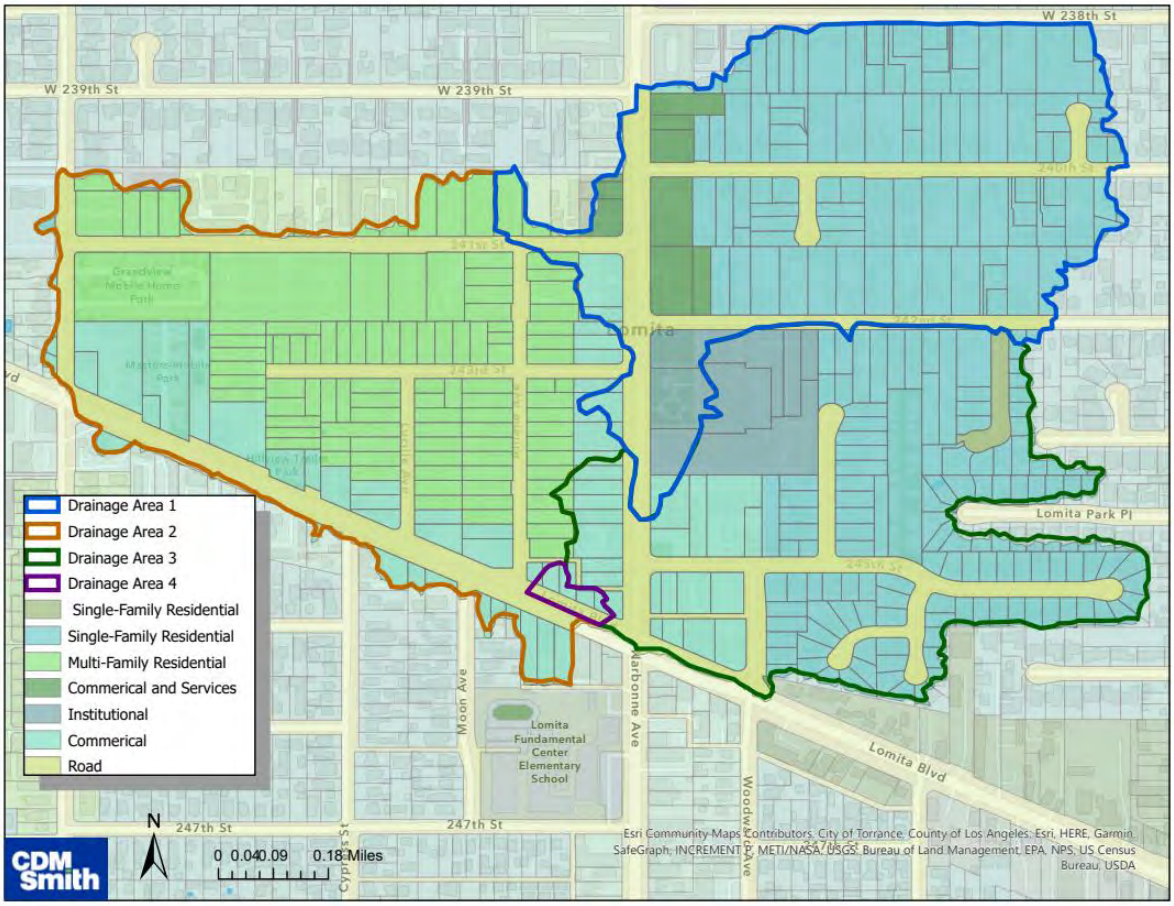

Figure 3-1. Land Use within Project Drainage Areas

Commercial and institutional uses are located generally along Narbonne Avenue and Lomita Boulevard, with single- and multi-family residences located along local and collector streets. In terms of impervious areas, the combined drainage area has the following characteristics:

- Single-family residential: 41.6 acres, 53.8% impervious
- Multi-family residential: 22.3 acres, 66.0% impervious

- Commercial: 18.2 acres, 82.7% impervious
- Institutional: 5.6 acres, 61.7% impervious
- Secondary roads and alleys: 21.2 acres, 73.6% impervious

3.2 Soil Characteristics

In October of 2020, geotechnical investigations were conducted at 2154 245th Street, directly adjacent to the proposed infiltration gallery at 24418 Narbonne Avenue. The certified geotechnical report is included in **Appendix F**.

The geotechnical investigation identified subsurface soil conditions by excavating one eight-inch diameter exploratory boring to approximately 41 ft. This investigation evaluated general soil subsurface conditions and conducted percolation testing (Hamilton & Associates, 2020).

Soils were found to consist of brown, moist to wet, sandy silty clay to approximately 15-feet. Below this layer, the report states that "soils consisted of tan/beige, damp to slightly moist, slightly silty sand to sand with trace silt, light brown/tan in color, and generally slightly moist to moist." Groundwater was not encountered in the approximately 41-ft borings. The highest water surface throughout the Project area (Geotracker, 2017 measurement) is 72.8 feet below ground surface (bgs). Additionally, based on the Los Angeles County Public Works Groundwater Well website, which includes a station in Lomita, groundwater was encountered at greater than 80 feet bgs dating back to 2002 (LACPW-2).

Percolation testing was performed using the boring percolation test procedure. The eight-inch percolation test hole was backfilled to 30-feet. The bottom was sealed with bentonite and the hole was equipped with a 4-inch diameter perforated PVC pipe to prevent caving. During excavation of the test hole, soil types encountered included sandy silty clay, silty sand, and sand with silt. After presoaking, the test hole was filled with water using a garden hose. Using the high flowrate percolation test, since the test hole was found to drain in under ten minutes, a constant head was maintained within the test hole and volume readings were taken every ten minutes for two hours. This resulted in a measured percolation rate of 33.8 inches/hour.

Using these results, an assumed infiltration rate was calculated for the Project by applying a factor of safety based on a set of reduction factors that are applied to the percolation rate. Reduction factors used were within the range of those allowed by the County in their Low Impact Development Stormwater Infiltration manual (LA County, 2017). The calculation is detailed in **Appendix E**, and results in a design infiltration rate of 16.9 in/hr. This infiltration rate is preliminary and used for the conceptual design of the infiltration BMPs included in the Project. The infiltration rate for the final design of the Project will be based on project-specific geotechnical exploration and percolation testing to be performed during final design and could vary from the preliminary value.

3.3 Preliminary Hydrology Analysis

The hydrology report is included in **Appendix E** and summarized herein.

As illustrated in **Figure 2-2**, there are four drainage areas that contribute flow to the various components of the Project. Drainage Area 1 drains to DS1, which diverts flow to the infiltration gallery in the parking lot on Narbonne Avenue (see **Figure 2-1**). Drainage Area 2 drains to DS2, which diverts flow to the drywells west of Narbonne Avenue along the median in Lomita Boulevard. Drainage Area 3 drains to DS3, which diverts flow to the drywells to the east of Narbonne Avenue, along the northern curb of Lomita Boulevard. Runoff from Drainage Area 4 travels via surface flow to the bioretention areas located along Lomita Boulevard, west of Narbonne Avenue. **Table 3-2** provides a summary of the characteristics of each drainage area.

Table 3-2. Drainage Area Characteristics

Characteristic	Drainage Area 1 (Drains to Diversion Structure 1)	Drainage Area 2 (Drains to Diversion Structure 2)	Drainage Area 3 (Drains to Diversion Structure 3)	Drainage Area 4 (Drains to Bioretention)
Drainage Area (acres)	37	40	33	0.5
Flow Path Length (feet)	2,000	2,500	1,500	200
Flow Path Slope (foot/foot)	0.01	0.01	0.01	0.01
Impervious Percent	58%	72%	66%	92%
85th Percentile, 24-hr Storm Depth (in)	1.0	1.0	1.0	1.0
85th Percentile, 24-hr Peak Flow (cfs)	3.4	4.4	3.8	0.16
85th Percentile, 24-hr Volume (ft^3)	75,100	97,400	74,600	1,500
85th Percentile, 24-hr Volume (ac-ft)	1.72	2.24	1.71	0.03

Flow length was calculated by tracing a flow path from the furthest edge of the area to the most downstream catch basin and the slope was approximated by the grade of adjacent streets. The percent impervious values were derived from the 2016 USGS National Land Cover Database, and the soil type was derived from LA County maps (LA County). The percent impervious is based on the land uses identified in **Table 3-1**.

The Los Angeles County HydroCalc calculator (version 1.0.3) was used to estimate the runoff hydrograph from the 85th percentile, 24-hour storm for these drainage areas. HydroCalc requires the 85th percentile design storm depth to compute a hydrograph based on the modified rational method. The 85th percentile, 24-hour rainfall depth was taken from County isohyets. **Table 3-2** lists rainfall depth and runoff properties.

These values were used to size the BMPs in conjunction with the infiltration rate discussed in the previous section.

The runoff volume for each interval of the HydroCalc hydrograph ($Q_{HydroCalc,t}$) was reduced by a volume equal to the design infiltration rate multiplied by the number of drywells ($Q_{infil,t}$) to yield a reduced flow ($Q_{reduced,t}$). The number of drywells (NumberWells) was set, using Excel GoalSeek, to prohibit the maximum non-infiltrated storage at any timestep ($S_{remaining}$) from exceeding the

combined volume of the drywell shafts (cross-sectional area times length times the number of drywells.)

$$Q_{reduced,t} = Q_{HydroCalc,t} - Q_{infil,t}$$

$$Q_{infil,t} = \min\left(Q_{HydroCalc,t}, NumberWells \times Screened\ Area \times Infiltration\ Rate\right)$$

$$S_{remaining,t} = Q_{reduced,t} \times \Delta t + S_{remaining,t-1}$$

$$set\ S_{remaining,t} \leq NumberWells \times Well\ Volume$$

The design infiltration rate of 16.9 in/hr yields 19 drywells for Drainage Area 2 and 15 drywells for Drainage Area 3. See Section 3.2 and **Appendix E** for a discussion on the infiltration rate used.

The same infiltration rate of 16.9 in/hr was used to calculate the size of the infiltration gallery that captured Drainage Area 1. Hydraulic analysis estimated the size to be 15,500 cubic feet with a height 5-ft and a surface area of 3,100 sf.

As discussion in Section 2.1.1, for the conceptual design, the proposed infiltration gallery has been sized based on outputs of PCSWMM, a robust hydrologic and hydraulic modeling software (PCSWMM). The dynamic model, accounting for both storage and infiltration, has been iterated to find the minimum infiltration gallery footprint required to manage the 85th percentile, 24-hour storm. The infiltration gallery has been modeled assuming the following characteristics: 5 ft internal storage depth, 0.9 void ratio, and 6 in of freeboard. The entire footprint of the gallery is assumed to be available for infiltration at a constant rate of 16.9 in/hr. Model results show that the proposed infiltration gallery should be a minimum 3,100 SF to manage the entire design storm. Final sizing will be refined during the design phase.

3.4 Water Quality Analysis

The water quality analysis is detailed in **Appendix E** and is summarized herein.

The anticipated reduction in nitrogen (primary pollutant) and zinc (secondary pollutant) loads through the Project were analyzed using the Watershed Management Modeling System (WMMS2) watershed model. WMMS2 establishes runoff volumes and pollutant loads for watersheds throughout the County through the Loading Simulation Program C++ (LSPC) model.

WMMS2 was run using data from October 1, 2000 to September 30, 2018 at hourly and daily time steps. WMMS2 model output relevant to this analysis included:

- Total rate of outflow (i.e., inflow to Project) from area
- Total nitrogen (dissolved + sediment-associated) concentration in outflow (mg/l)
- Total phosphorus (dissolved + sediment-associated) concentration in outflow (mg/l)
- Total zinc (dissolved + sediment-associated) concentration in outflow (ug/l)
- Nitrogen mass in outflow (lb/day)

- Phosphorus mass in outflow (lb/day)
- Zinc mass in outflow (lb/day)

The Project is predicted to capture between 35 and 53 lbs of nitrogen, and 5 to 11 lbs of zinc for a 24-hour, 85th percentile storm event for the combined Project drainage area of 110 acres. A mass balance was completed considering WMMS flow for each tributary area and the expected rate of diversion over a 20-year period. It was estimated that the following reductions in pollutant loading would occur for the first and second priority pollutants:

- Drainage Area 1: 91% nitrogen reduction, and 86% zinc reduction
- Drainage Area 2: 93% nitrogen reduction, and 90% zinc reduction
- Drainage Area 3: 92% nitrogen reduction, and 89% zinc reduction

These values exceed the target objective of an 80 percent reduction.

3.5 Reduced Heat Island Effect

To counteract the heat island effect of the Project, 45 native shade trees and 8,000 sf of drought tolerant native species vegetation will be installed along the Project alignment.

Shiflett, et al. studied the effect of vegetation on the peak daily land surface temperature and ambient air temperature 2 meters above the ground, which represents the temperature humans interact with) for three areas in southern California. The presence of vegetation was compared to bare soil conditions. Each type of vegetation decreased the temperature of a 1-acre plot of land in Irvine, California, with trees providing the largest decrease in peak temperature and short grasses providing a smaller decrease in peak temperature (Shiflett, et al., 2017).

Based on Shiflett, et al., the presence of trees on a 1-acre plot was found to decrease the peak daily temperature by an average of 4° C, and the presence of short grass was found to decrease the peak daily temperature by 1° C. Using these assumptions and considering the drought tolerant native vegetation to have an effect on temperature similar to grass, the decrease in peak daily temperature due to the presence of 45 trees with an assumed footprint of 65 sf each and 8,000 sf of vegetation, weighted over the 25 acres that comprise the Project boundary, was calculated to be 0.02° C, using the following equation.

$$\frac{acres\ of\ tree\ coverage * 4°\ C + acres\ of\ vegetation * 1°\ C}{acres\ of\ watershed\ area}$$

$$= peak\ daily\ temperature\ decrease$$

$$\frac{0.07\ acres * 4°C + 0.18\ acres * 1°C + 24.8\ acres * 0°C}{25\ acres} = 0.02°\ C$$

3.6 CEQA and NEPA Assessment

This section describes the potential California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) related requirements that are anticipated and that may arise during the design and construction phases of the Project.

3.6.1 CEQA

The Project will require clearance under the CEQA to achieve environmental compliance. The minimum environmental studies needed include those listed below. Additional study may be needed depending on the determinations of the initial environmental studies.

- Geotechnical study to determine potential Project impacts to groundwater, soils, and drainage;
- Desktop analysis to determine impacts to the 100-year floodplain or floodway;
- Desktop analysis to determine impacts to state or federal listed species using the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) system and the California Department of Fish and Wildlife (DFW) California Natural Diversity Database (CNDDB);
- Desktop analysis to determine the presence and potential impacts to wetlands or surface waters utilizing the USFWS National Wetlands Inventory (NWI) database and applicable U.S. Geological Survey (USGS) topographic map;
- Cultural resources study to determine potential impacts to historic, prehistoric and/or tribal resources. This must be prepared by a qualified archeologist and architectural historian, and include research at the California Historic Records Information Center, field survey and tribal consultation;
- Air quality and greenhouse gas emissions analysis for potential impacts; and
- Desktop analysis utilizing the EnviroStor database (CA Department of Toxic Substances Control) and/or Geotracker database (State Water Resources Control Board) to determine the risk of encountering hazards associated with the presence of contaminated soil, groundwater, or other hazardous materials.

Upon completion of the studies, the CEQA Environmental Checklist Form in Appendix G of the CEQA Guidelines (AEP, 2021) and an Initial Study would be completed. The Initial Study will be completed in accordance with CEQA Guidelines Article 5. If it is determined that there would be no impacts from the Project, the CEQA lead agency may determine that a CEQA Categorical Exemption can be obtained; provided the Project qualifies in accordance with CEQA Guidelines Article 19. Categorical Exemptions, Sections 15300 to 15332.

If it is determined that the Project will have potential impacts to the environment after completion of the CEQA Environmental Checklist, but these impacts will be less than significant, the CEQA lead agency may determine that a Negative Declaration or Mitigated Negative Declaration would be prepared in accordance with CEQA Guidelines Article 6.

If it is determined that the Project has the potential for significant impacts and/or impacts cannot be mitigated and a Statement of Overriding Considerations is required, the lead agency may determine that an Environmental Impact Report (EIR) is needed. An EIR would be prepared in accordance with Article 7 of the CEQA Guidelines.

3.6.2 National Environmental Policy Act (NEPA)

NEPA compliance will be required if the Project were to receive funding from a federal agency or the Project would require a permit from a federal agency. If NEPA is required, a stand-alone NEPA document or joint NEPA/CEQA document could be prepared utilizing the NEPA guidelines of the lead federal agency, and in accordance with CEQA Guidelines for the appropriate CEQA document and Article 11, Section 15270 of the CEQA Guidelines.

3.7 Utilities and Traffic Control

A desktop investigation of existing utilities was conducted utilizing City as-built drawings, LACFCD storm drain system maps (LACPW-3), and the County of Los Angeles substructure maps (LACPW-4). These utilities are included on the conceptual drawings in **Appendix A**. The Project layout was configured to avoid conflicts with these utilities.

As presented, several major utilities exist along the project alignment which will require coordination during design and construction. During design, a preliminary search using DigAlert will be conducted to provide the contact information for utility agencies with potential existing facilities within the Project site. The utility agencies will then be contacted individually and provided a map of the Project limits so they can provide up-to-date information on their locations and given utility notices at the 60 percent and 90 percent design phases.

Overhead utilities exist along the western side of Narbonne Avenue. These utilities extend past the intersection with Lomita Boulevard. Overhead utilities also extend down the south side of 245th Street, which is the street adjacent to the proposed infiltration gallery. Construction of the proposed Project is not anticipated to interfere with overhead utilities.

A traffic control plan will be developed as part of the design of the Project to ensure impacts to traffic are minimized when possible.

3.8 Effectiveness and Performance

This section discusses the effectiveness of similar projects implemented in the region and how performance will be monitored and maintained for the life of the Project.

3.8.1 Effectiveness of Similar Projects

The effectiveness of infiltration BMPs has been well established and are recommended as part of numerous BMP handbooks, including the California Stormwater Quality Association's Stormwater Best Management Practice Handbook (CASQA, 2003). Additionally, many similar projects have been implemented throughout the Los Angeles region. This section discusses a few that have similar elements.

A notable stormwater diversion project that involves an underground storage system, similar to the infiltration gallery, is the Penmar Stormwater Capture, Use and Water Quality Project.

Completed in 2013, this project is located under Penmar Golf Course in the Venice area of the City of Los Angeles. The $14 million project was funded by Proposition O and includes an underground 8.4 ac-ft (2.75-million-gallon) storage system that has a 180-foot by 20-foot footprint (Argonaut, 2017). Though this project reuses stormwater onsite rather than infiltrating it, the storage structure is similar to the infiltration gallery proposed on Narbonne Avenue. This project successfully allows for surface usage with an underground storage system of this size buried beneath. In 2017, the City reported the continued success of the project, stating it had captured 184 ac-ft (60 million gallons) that February alone (LASD, 2017).

Another similar project is the Elmer Avenue Neighborhood Retrofit Project by Los Angeles County. This project uses underground infiltration galleries and permeable pavers as well as climate-appropriate landscaping to manage stormwater and reduce potable water demands. This project was completed in 2010 and shows continued success. Annually, it manages 16 ac-ft (5.4 million gallons) of stormwater (LACPW).

The Glenoaks Bioswales and Dry Well Project was also funded by Proposition O with a cost of $500,000. It includes both drywells and bioswales. Annually, the project captures 30 ac-ft (9.7 million gallons) of stormwater (LABT). It represents an example of the successful and cost-effective use of drywells to manage stormwater.

3.8.2 Operation and Maintenance (O&M) Plan

In order to ensure the proper performance of the Project, it is critical that it be operated and maintained as intended, which includes weed and vegetation management. **Appendix C** details the preliminary O&M Plan. This plan will be updated and further refined during the design phase.

Included in **Appendix C** is a discussion on how the Project will incorporate vector controls. During the design phase, when a comprehensive vector control plan is developed, it will be reviewed by the appropriate local vector control district or agency and modified as required to ensure all requirements are met.

3.8.3 Monitoring Plan

To measure the effectiveness and performance of the Project, a monitoring plan will be required. This will be further refined during the design phase, but **Appendix D** provides a discussion on the components anticipated to be included in the plan.

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Section 4
Cost Estimate and Schedule

The SCW Program requires that Projects include a life-cycle cost estimate that contains Project costs including but not limited to costs related to early concept design, pre-Project monitoring, feasibility study development, site investigations, formal Project design, intermediate and Project completion audits, California Environmental Quality Act (CEQA) compliance and other environmental impact studies, land acquisition, permitting, construction, full lifetime operations and maintenance, monitoring, etc. The only costs not to be included in the life-cycle cost estimate are the dismantling and replacement costs at the Project's end of life.

This section includes a cost estimate that is inclusive of these requirements.

4.1 Cost Estimate

The City has prepared a cost estimate that includes design, permitting, construction, and operation and maintenance, and monitoring of the Project. A detailed Opinion of Probable Construction Cost (OPCC) is included in **Appendix G**. All eligible expenditures are only those incurred on or after November 2, 2018.

Table 4-1. Cost Estimate

Category	Cost
Construction Cost Estimate	
Infiltration Gallery	$446,100
Drywells from Diversion Structure 2	$1,503,800
Drywells from Diversion Structure 3	$1,244,200
Improvements along Lomita	$127,100
Improvements along Narbonne	$72,700
Subtotal	**$3,393,900**
General Conditions	$407,300
Permits and Insurance	$207,700
Overhead and Profit	$481,100
Contingency (15%)	$673,500
Escalation to midpoint of construction (based on 4% per year)	$206,500
Interim and Project Completion Audit	$20,000
Total Construction Subtotal	**$5,390,000**

Category	Cost
Design Cost Estimate	
Design (10% of Construction)	$539,000
Pre-design (includes concept development and feasibility study already completed)	$102,000
Environmental Assessment (CEQA) (20% of design cost)[1]	$107,800
Geotechnical Investigations[2]	$150,000
Total Design Subtotal	$898,800
Total Capital Cost	**$6,288,800**
Lifecycle Cost	
Annual O&M	$50,000/yr
50 Year lifecycle cost (@ 3.375% discount on future O&M)	$7,504,000
Annualized Lifecycle Cost	$150,100/yr
Monitoring Cost	$25,000/yr

Notes: 1 – Assumes an initial study/mitigated negative declaration. Additional work may be required based on the findings of the initial study.
2 – Geotechnical investigations to include percolation testing at the location of the infiltration gallery and drywells to confirm design parameters. See Section 6 for additional details. See Appendix G for additional detail.

Based on the O&M Costs of other similar projects, it is anticipated that the Project will have an annual cost of $50,000. This cost considers multiple maintenance crew members that will be available for multiple hours monthly, as well as on-call assistance as needed. Maintenance costs are projected to potentially increase over the life of the Project, depending on market rates for labor and equipment.

The annual cost for ongoing monitoring is expected to be $25,000 per year.

4.2 Funding Breakdown

The SCW Program allocates fifty percent of revenues to fund stormwater projects and programs at the watershed level. Referred to as the Regional Program, these funds are distributed across nine watershed areas. Individual projects are then funded as determined by each Watershed Area Steering Committee (WASC). The proportion of the total funds that each watershed area receives is proportional to the tax revenues collected within their boundaries.

The Project is located in the South Santa Monica Bay Watershed Area, which is expected to receive an annual $18.4 million to fund regional projects and programs. As detailed in Section 6, the Project must receive a qualifying number of points to be eligible to apply for funding through the SCW Program. **Table 4-2** provides a breakdown of the matching funds and SCW Program funding request.

The City will be requesting **$449,400** in matching funds, which is **50 percent** of the total cost of the design phase of the Project. The City intends to request funds for the construction phase of the Project once design is complete, and later to request funding for O&M.

Table 4-2. Funding Source

Phase	Cost	Estimated Matching Funds	SCW Program Funds to be Requested
Pre-Design/Planning	$102,000	$51,000	$51,000
Design	$796,800	$398,500	$398,300
Subtotal	**$898,800**	**$449,500**	**$449,300**

4.3 Schedule

Appendix H presents the Project schedule for the design phase of the Project, which is the phase for which the City is currently seeking SCW Program funding. It is anticipated that design would commence within two months of funds being made available and that the entire design phase would take fourteen months to complete.

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Section 5
Estimated Benefits and Project Scoring

The following sections describe the estimated benefits the Project is expected to achieve from each of the objectives detailed in Section 2. Included is a discussion on how each component relates to the SCW Program scoring criteria. The total number of points a project can achieve is 110 points. As stated in the SCW Program literature, all Regional Program Projects must meet a threshold score of 60 points or more in order to be eligible for consideration.

A summary of the preliminary Project score based on SCW Program scoring criteria is included in Section 5.2.

5.1 Safe, Clean Water Program Benefits

In addition to the nineteen components required of an eligible feasibility study submitted for Infrastructure Program funding through the SCW Program, the SCW Program also includes scoring criteria for key components that the Program prioritizes in their selection process. The following sections discuss each of these categories as they relate to the Project.

5.1.1 Water Quality Benefits and Scoring

The SCW Program includes two water quality sections in its scoring methodology. One section is for projects that treat both wet and dry weather flows, and the second is for projects that only treat dry weather flows. Since this Project will manage both wet and dry weather flows, only the former section will be discussed here.

Points can be earned through two categories. The first category is related to the cost effectiveness of the Project and the second is related to the pollutant load reduction the Project is able to achieve.

5.1.1.1 Cost Effectiveness Scoring

The SCW Program evaluates cost effectiveness based on the benefit-cost ratio calculated as the total ac-ft of stormwater that is treated divided by the total capital cost for the Project (in millions). The scoring is broken down as follows:

- <0.4 (ac-ft capacity/$ Million) = 0 points
- 0.4-0.6 (ac-ft capacity/$ Million) = 7 points
- 0.6-0.8 (ac-ft capacity/$ Million) = 11 points
- 0.8-1.0 (ac-ft capacity/$ Million) = 14 points
- >1.0 (ac-ft capacity/$ Million) = 20 points

The Project will treat 5.6 ac-ft of flow (**Appendix E**) and has a total capital cost of $6.3 Million. This results in a benefit-cost ratio of 0.9. Based on this the Project is eligible for 14 points.

5.1.1.2 Pollutant Load Removal Scoring

The SCW Program includes scoring criteria related to the percent reduction in the primary and secondary pollutants. The scoring criteria literature states that the analysis used to determine the pollutant load reduction should be similar to that used for the E/WMP which uses the District's Watershed Management Modeling System 2 (WMMS2) and should be an average percent reduction comparing influent and effluent for the class of pollutants over a ten-year period showing the impact of the Project. Scoring criteria is detailed as follows:

- Primary class of pollutants
  - >50 percent = 15 points
  - >80 percent = 20 points
- Second or more classes of pollutants
  - >50 percent = 5 points
  - >80 percent = 10 points
  - 10 points maximum

The Project identified the primary pollutant as nitrogen since managing nitrogen in the watershed is critical to Machado Lake meeting its Nutrients TMDL. The secondary pollutant identified for the Project is zinc, a critical pollutant for meeting the Dominguez Channel and Greater Los Angeles and Long Beach Harbor Toxic Pollutants TMDL.

As detailed in Section 3.4 and **Appendix E**, the Project utilizes the District's WMMS2 model to evaluate pollutant load reduction from the various elements of the Project (LA County-2). For both the primary and secondary pollutants, the Project removes over 80 percent of the load over the ten-year period analyzed. This results in a combined eligible score of 30 points for this category.

5.1.2 Water Supply

The SCW Program applies points when the Project exhibits significant water supply benefits. This is in the form of cost-effectiveness and the magnitude of the benefit.

As detailed in Section 2.2.2, the Project does not currently include significant water supply benefits. Benefits associated with incorporating water supply elements will be considered during the design phase.

5.1.3 Community Investment Benefits

The SCW Program identifies multiple areas where categories of community benefits are prioritized by the Program. A Project can receive two points if it includes one community investment benefit, five points for including three distinct community investment benefits, and ten points for including six distinct community investment benefits.

The following are considered community investment benefits for the SCW Program:

- Improved flood management, flood conveyance, or flood risk mitigation;
- Creation, enhancement, or restoration of parks, habitat, or wetlands;
- Improved public access to waterways;
- Enhanced or new recreational opportunities;
- Greening of schools;
- Reducing local heat island effect and increasing shade; and
- Increasing the number of trees and/or other vegetation at the site location that will increase carbon reduction/sequestration and improve air quality.

The Project includes improved flood management and flood risk mitigation benefits. By infiltrating 5.6 ac-ft of stormwater flow, this volume of flow will not reach the downstream receiving waters which will result in less risk of flooding. This can be especially significant as climate change results in more erratic weather events and flash floods. Additionally, the surface BMPs will capture flow from the surface, thereby reducing the risks of localized flooding, which occurs regularly in the downtown area.

New recreational opportunities are included in the Project because it includes the creation of a bike lane along the north and south sides of Lomita Boulevard from Woodward Avenue to Lucille Avenue. This will provide the opportunity for cyclists to safely navigate this stretch of roadway, which will also reduce air pollution by promoting alternatives to vehicles. The City plans to expand the bike lane further as part of a separate effort when funding is available, but this stretch will provide direct benefits to those traveling to the busy downtown area.

The local heat island effect will be reduced by the Project by increasing shade through the planting of 45 trees and by installing 8,000 sf of plant cover with native, drought tolerant vegetation. The potential locations of these features are presented on the drawings in **Appendix A**, based on a landscaping plan the City developed recently. As detailed in Section 3, this can reduce the temperature for the Project area by 0.02° C.

These four areas where the Project provides community investment benefits results in a total eligibility for five points.

5.1.4 Nature Based Solutions

The SCW Program includes points for the implementation of nature-based solutions. There are three categories where points can be earned, as follows:

- Implements natural processes or mimics natural processes to slow, detain, capture, and absorb/infiltrate water in a manner that protects, enhances and/or restores habitat, green space and/or usable open space = 5 points

- Utilizes natural materials such as soils and vegetation with a preference for native vegetation = 5 points
- Removes Impermeable Area from Project (1 point per 20% paved area removed) = 5 points

The Project involves design components that address all three categories. By capturing stormwater in bioretention areas, an underground infiltration gallery, and in drywells, the Project is allowing polluted stormwater to infiltrate into the ground and remove pollutants through natural filtration. The bioretention areas will allow for the creation of additional green space in this urban area. The Project will utilize native, drought tolerant vegetation in the bioretention areas and in the replanted medians along Lomita Boulevard as well as adjacent to the infiltration gallery on Narbonne Avenue, and in other locations that will be identified during the design phase.

The percent of impervious area removed is presented in **Table 5-1**. As shown, the total area of the Project is 18,800 square feet (sf). Based on the components of the Project discussed above, the Project results in conversion of approximately 65 percent of ground cover from impervious to pervious. This results in 3 points.

Table 5-1. Impervious Area Removed

Project Segments	Total Project Footprint (disturbed areas) (sf)	Area Converted from Impervious to Pervious (sf)	Percent of Total (%)
Parking lot at 24418 Narbonne Avenue (Diversion 1)	10,800	10,800	100%
Lomita Blvd Medians (W of Narbonne Ave, Diversion 2)	2,500	0	0%
Lomita Blvd Westbound Near Curb (E of Narbonne, Diversion 3)	2,500	0	0%
Bioretention areas (Lomita Blvd and Narbonne)	2,000	1,000	100%
Tree Wells (Lomita Blvd and Narbonne)	1,000	500	100%
Total	**18,800**	**12,300**	**65%**

[1]Total footprint includes the following: 1) the area of the parking lot at 24418 Narbonne Avenue; 2) six-foot wide strip along the length of the medians west of Narbonne Avenue on Lomita Avenue as well as a six-foot wide path along the northern edge of Lomita Boulevard east of Narbonne for drywells, diversion structure, and associated piping and pretreatment will be installed; 3) segments of the sidewalk that will be removed to install bioretention and tree wells. Some areas have existing vegetation that will be converted or trees that will be replaced.

Since the Project includes all three elements, it is eligible to achieve a score of 13 points for this category.

5.1.5 Leveraging Funds

There are two categories the SCW Program includes in the category of leveraging funds. The first is based on the cost share that the applicant proposes to match. A cost share of greater than 25 percent earns three points, while a cost share of greater than 50 percent results in 6 points. The City will provide a funding match of 50 percent, and therefore be eligible to earn 6 points for this category.

In addition, the SCW Program provides points for projects that demonstrate strong local, community-based support and/or develop a project as part of a partnership with local non-governmental organizations or community-based organizations. The Project has already received support from the local community, as documented in **Appendix I**. In addition, during the design phase the City will conduct stakeholder workshops to engage the local community in the design of the Project. These workshops will not simply be informational sessions, but rather working sessions where the City will engage the community, solicit their input, and modify certain components of the 60 percent and final design where appropriate. It is anticipated that this kind of inclusive and holistic design process will generate additional community support beyond what has been demonstrated already. See Section 6 for additional discussion.

Based on these two components in the leveraging funds category, the Project is eligible to achieve a total of 10 points for this category.

5.2 Scoring Criteria Summary

Table 5-2 presents a summary of the scores the Project receives. The Project achieves a total score of 72, which exceeds the 60-point threshold and would allow the Project to be considered eligible for funding consideration.

Table 5-2. Project Scoring

Scoring Section	Project Score	Maximum Points
Water Quality (Wet+Dry Weather) – Part 1	14	20
Water Quality (Wet+Dry Weather) – Part 2	30	30
Water Supply – Part 1	0	13
Water Supply – Part 2	0	12
Community Investment	5	10
Nature-Based Solutions	13	15
Leveraging Funds – Part 1	6	6
Leveraging Funds – Part 2	4	4
Totals	**72**	**110**

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Section 6
Additional Information and Data Gaps

This section includes additional information on specific components required to be addressed in a feasibility study when applying for SCW Program funding and identifies data gaps that will be addressed during the design phase.

6.1 Anti-Displacement Requirements

The SCW Program requires that a feasibility study include an acknowledgment that the Project will be fully subject to and comply with any County-wide displacement policies as well as with any specific anti-displacement requirements associated with other funding sources. No displacement is anticipated to occur as a result of the Project. In the unlikely event that changes made during the design phase result in any displacement, the City will ensure that all relevant policies are adhered to.

6.2 Coordination with Other Agencies

6.2.1 Los Angeles County Flood Control District Conceptual Approval

The Project involves diversion of runoff from three LACFCD storm drains at the locations shown in **Figure 2-2** and in the drawings included in **Appendix A**. The City submitted a technical memorandum to LACFCD on June 1, 2021 detailing the proposed diversion structures for LACFCD to perform a review to determine if they could provide conceptual approval of the proposed Project. On July 14, 2021, the City received a letter from LACFCD granting conceptual approval of the project. This letter is included in **Appendix J**.

If the Project receives funding and progresses to the design and construction phases, any modifications or refinements will be done in close coordination with LACFCD to ensure all applicable agreements and/or permit provisions are adhered to.

6.2.2 Other Jurisdictions

As shown on **Figure 2-2**, the vast majority of the Project drainage area is fully within the City of Lomita. A small section on the north end is within the City of Torrance. Since this portion is small proportional to the remainder of the project boundary, the City will not be pursuing a partnership with the City of Torrance. However, the City will notify Torrance that this portion within their jurisdictional boundary has been included in the Project.

6.3 Outreach Plan

Support for the Project is documented in letters from community members in **Appendix I**. A comprehensive Outreach Plan will be developed during the design phase and will include stakeholder workshops that will engage the local community in the design of the Project. The intention of these workshops will not simply be informational, but rather for the City to engage the community, solicit input, and modify certain Project design elements as appropriate. It is anticipated that this inclusive and holistic design process will generate additional community

support beyond what has already been demonstrated. The Outreach Plan will address any issues related to displacement and gentrification.

6.4 Legal Requirements

Legal requirements are an important component in any infrastructure project. The following provides a summary of legal concerns that could impact the Project.

- **Easements**: The pretreatment devices, infiltration gallery, drywells, bike lane, and much of the vegetation and trees will be constructed in the City's street right-of-way. As such, it is not anticipated that there will be any legal issues related to land ownership for these elements. However, some trees and other vegetation may need to be installed on private property due to the locations of utilities and to ensure the width of the sidewalks comply with all Americans with Disabilities Act (ADA) accessibility requirements. If it is determined that some aspect of the Project will encroach on private property, the City will determine if an easement is required. If an agreement cannot be reached with a property owner, that feature will be relocated.

- **Diversions**: The Project involves constructing three diversion structures to divert flow from LACFCD storm drains (see Section 6.2). LACFCD requires a Use and Maintenance Agreement which the City will execute in the timeframe determined by LACFCD.

- **Environmental**: Environmental requirements will be strictly adhered to for the Project.

  - **CEQA**: The Project will require clearance under the CEQA and environmental studies to make findings for environmental compliance. The minimum environmental studies needed are described in Section 3.6, and additional study may be needed depending on the determinations of the initial environmental studies. The Project will meet all requirements determined to be necessary through this process that will occur during the design phase.

  - **NEPA**: If the Project were to receive federal funding, it will be required to meet all NEPA requirements, as described in Section 3.6. No federal permits are anticipated at this time.

6.5 Summary of Other Funding Sources

The City intends to provide a 50 percent funding match for the design phase of the project. This will be comprised of funds from the City's Measure W municipal funds, Proposition C (which can be used for the work on the bike lanes), and the City's general funds. Some of these funds will also be used during the construction phase of the Project. The City will also explore using TDA and Proposition A funds as well where the project may involve work in crosswalks and ramps at Lomita Boulevard and Narbonne Avenue.

Additional funding sources for the construction phase of the Project will be explored during the design phase.

6.6 Benefits to Disadvantaged Communities

The SCW Program requires that projects located within Disadvantaged Communities (DAC) summarize how the project will benefit the DAC and disclose any displacement avoidance measures. The SCW Program references the California Department of Water Resources (DWR) California Disadvantaged Communities Mapping Tool (DWR, 2018) and the Environmental Health Hazard Assessment CalEnviroScreen 3.0 tool (CA OEHHA, 2018).

The footprint of the Downtown Lomita Multi-Benefit Project is not located within a DAC, however its eastern boundary is 0.6 miles from a DAC, which is located in the City of Lomita, as shown in **Figure 6-1**. As the Project involves improving the Downtown area, which may in turn attract more local businesses and attract more customers to existing businesses, this Project may provide additional employment opportunities to this adjacent DAC. Additionally, the downstream watershed, including areas surrounding Machado Lake, are designated as DACs. Reducing the loading of pollutants to these areas and reducing the risk of flooding now and into the future (as the impacts of climate change make high rainfall storm events more frequent) are important features the Project provides. Water quality improvements will allow Machado Lake to meet its beneficial uses of water contact and non-contact recreation. It is therefore anticipated that local DACs will benefit overall by the implementation of the Project.

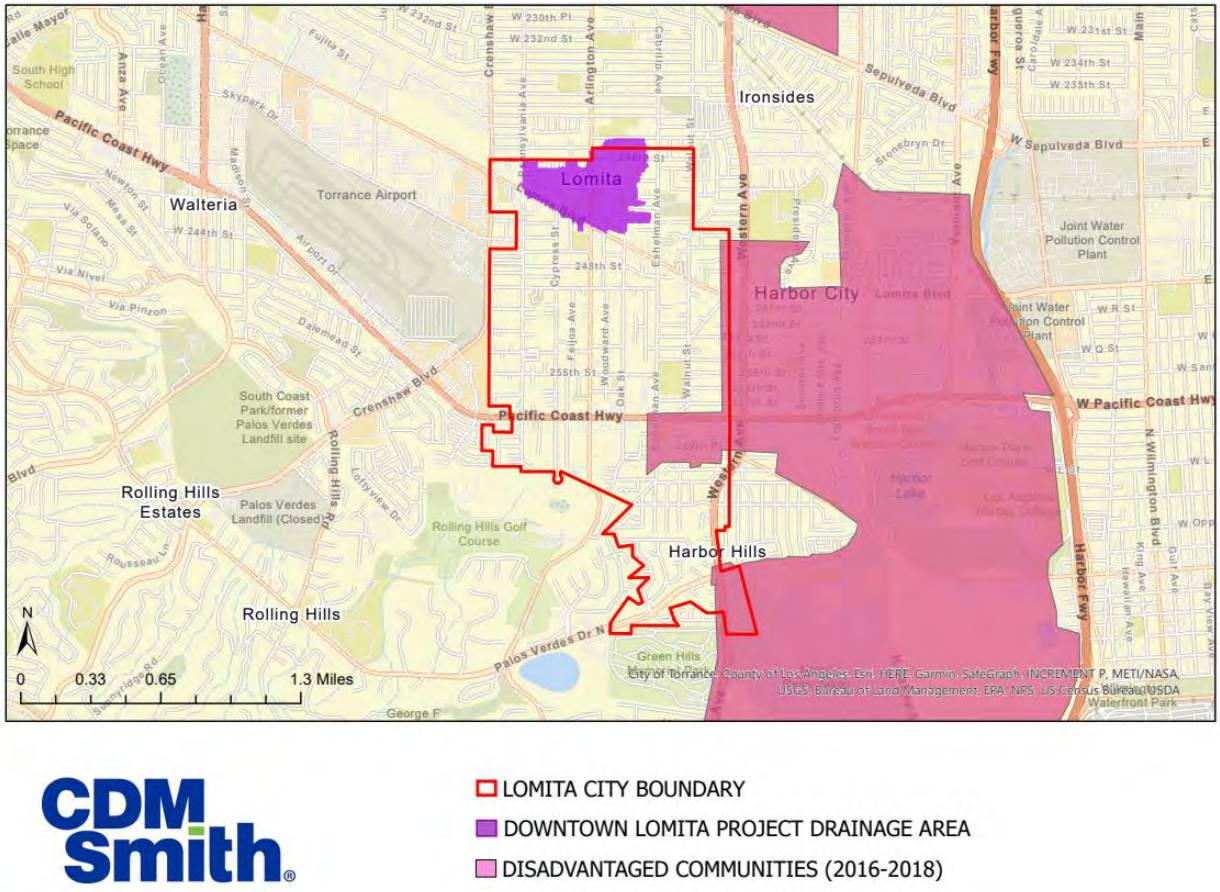


Figure 6-1. Disadvantaged Communities (DAC) within Machado Lake and Wilmington Drain Watersheds

The Environmental Health Hazard Assessment CalEnviroScreen 3.0 tool (CA OEHHA, 2018) identifies the following statistics for the Project site. As shown, the Project has a 41 percent poverty rate and a 35 percent unemployment rate. The population is majority non-white.

- Population: 3,311
- CalEnviroScreen 3.0 Percentile: 50-55%
- Pollution Burden Percentile: 77%
- Population Characteristics Percentile: 32%
- Ozone: 32%
- PM 2.5: 69%
- Diesel: 57%
- Pesticides: 0%
- Toxic Releases: 89%
- Traffic: 74%
- Drinking Water: 39%
- Cleanups: 57%
- Groundwater Threats: 69%
- Hazardous Waste: 90%
- Impaired Water: 0%
- Solid Waste: 52%
- Asthma: 41%
- Low Birth Weight: 49%
- Cardiovascular Rate: 19%
- Education: 52%
- Linguistic Isolation: 66%
- Poverty: 41%
- Unemployment: 35%
- Housing Burden: 5%

- Race and Ethnicity Profiles: 32% Hispanic, 47% white, 15% Asian American, 2% African American, and 4% Other

No displacement is anticipated to occur as a result of the Project. In the unlikely event that changes made during the design phase result in any displacement, the City will ensure that all relevant policies are adhered to.

6.7 Data Gaps

There are several data gaps that will need to be filled during the design phase of the Project which are detailed here.

6.7.1 Geotechnical Investigations

Additional geotechnical work will need to be completed during the design phase, including tests to determine percolation rates that will be used to establish final design infiltration rates, which may impact the sizing and spacing of the drywells and the infiltration gallery. Additional geotechnical tests will be required to properly design the proposed Project elements, which will include but may not be limited to:

- Shallow percolation testing at two areas identified for bioretention to determine if underdrains are required.
- Phase 1: Cone penetration tests (CPTs) (inclusion of this test to be determined during the design phase where the potential to proceed directly to Phase 2 will be evaluated):
  - Infiltration gallery site: Two CPTs with a target depth of 50 ft
  - Dry well alignment: Two CPTs with a target depth of 80 ft
- Phase 2: Hollow-stem auger borings, 8-inch diameter:
  - Infiltration gallery site: Three borings to target depths of 25 ft (two borings) and 50 ft (one boring), all three being used for borehole percolation testing (constant head)
  - Dry well alignment: One boring with a target depth of 80 ft
- Phase 3: Large-diameter (>18 inches) test dry wells:
  - Dry well alignment: Two test dry wells with a target depth of up to 80 ft for percolation testing (actual target depth will be determined based on Phase 1 (if completed) and 2 results).

6.7.2 CEQA/NEPA

The Project will require work to be done under CEQA, as detailed in Section 3.6, but the extent of it will not be determined until the investigation commences. This will occur during the design phase. Similarly, depending on the sources of match funding, the Project may be required adhere to NEPA requirements as well.

6.7.3 Monitoring

It is not anticipated that the project will require pre-construction monitoring. Pollutant loading will be measured through implementation of the monitoring plan by measuring flow and pollutant concentrations in the influent flow to the pretreatment DSBB devices. Further evaluation and development of the monitoring plan will be conducted as part of the design phase.

Section 7
References

Argonaut, The. 2017. Venice: Penmar Park Stormwater Project Complete. https://argonautnews.com/venice-penmar-park-stormwater-project-completed/

Association of Environmental Professionals (AEP). 2021. 2021 CEQA, California Environmental Quality Act, Statute and Guidelines. https://www.califaep.org/statute_and_guidelines.php

BioClean. ND. DSBB Separator. https://biocleanenvironmental.com/wp-content/uploads/2020/03/DSBB-Separator-Brochure_4-8-2021.pdf

CalGEM GIS. Well Finder. Retrieved July 2, 2021. https://maps.conservation.ca.gov/doggr/wellfinder/#openModal/-118.31263/33.80781/16

California Department of Public Health (CDPH). 2010. Checklist for Minimizing Vector Production in Stormwater Management Structures. https://westnile.ca.gov/download.php?download_id=1788

California Reginal Water Quality Control Board (Reginal Board). 2014. Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties. https://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/

California Reginal Water Quality Control Board (Reginal Board). ND. Dry Wells. https://www.waterboards.ca.gov/board_reference/2014fall/docs/dry_wells_fs.pdf

California Stormwater Quality Association's Stormwater (CASQA). 2003. New & Redevelopment Best Management Practice Handbook. https://www.casqa.org/resources/bmp-handbooks/new-development-redevelopment-bmp-handbook

Department of Water Resources (DWR). 2018. California Disadvantaged Communities (DAC) Mapping Tool. https://gis.water.ca.gov/app/dacs/

Geotracker. 2017. https://geotracker.waterboards.ca.gov/

Philadelphia. 2014. City of Philadelphia Green Streets Design Manual. https://www.phila.gov/media/20160504172218/Green-Streets-Design-Manual-2014.pdf

Hamilton & Associates. 2020. Geotechnical Percolation Report Proposed Infiltration System. (Included in **Appendix F** of this report).

Land, M., E.G. Reichard, S.M. Crawford, R.R. Everett, M.W. Newhouse, and C.F. Williams. 2004. Ground-Water Quality of Coastal Aquifer Systems in West Coast Basin, Los Angeles County, California, 1999-2002. https://pubs.usgs.gov/sir/2004/5067/sir2004-5067.pdf

Los Angeles Beautification Team (LABT). ND. Glenoaks Bioswales and Dry Well. https://hbteam.org/featured-projects/trees-as-bio-swales/

Los Angeles County (LA County). ND. Open Data, LA County Soil Types. https://data.lacounty.gov/Shape-Files/LA-County-Soil-Types/sz94-meiu

Los Angeles County (LA County -2). ND. Watershed Management Modeling System 2.0 (WMMS2). County of Los Angeles (LA County). 2017. Administrative Manual, County of Los Angeles, Department of Public Works, Geotechnical and Materials Engineering Division, Guidelines for Geotechnical Investigations and Reporting, Low Impact Development Stormwater Infiltration. June 30, 2017. http://dpw.lacounty.gov/gmed/permits/docs/policies/GS200.1.pdf

Los Angeles County (LA County). 2017. Administrative Manual, County of Los Angeles, Department of Public Works, Geotechnical and Materials Engineering Division, Guidelines for Geotechnical Investigations and Reporting, Low Impact Development Stormwater Infiltration. June 30, 2017. http://dpw.lacounty.gov/gmed/permits/docs/policies/GS200.1.pdf

Los Angeles County (LA County). 2018. Publications; Los Angeles County HydroCalc Calculator (version 1.0.3, released 2/21/2018). http://ladpw.org/wrd/publication/

Los Angeles County Public Works (LACPW). ND. Elmer Avenue Neighborhood Retrofit. https://pw.lacounty.gov/wmd/svw/elmeravenue

Los Angeles County Public Works (LACPW-2). ND. Groundwater Wells. https://dpw.lacounty.gov/general/wells/

Los Angeles County Public Works (LACPW-3). ND. Los Angeles County Storm Drain System. https://dpw.lacounty.gov/fcd/stormdrain/disclaimer.cfm?CFID=7760071&CFTOKEN=5611d19264b4a4e5-53C3EF01-B828-62AA-2960007BB8FD48FF

Los Angeles County Public Works (LACPW-4). ND. Los Angeles County Substructure Maps. https://pw.lacounty.gov/mpm/substructure/

Los Angeles Sanitation District (LASD). 2017. Stormwater Slam Dunk. https://www.lacitysan.org/san/faces/home/service/blogs-landing/blogs-detail;jsessionid=aJegSUt4eJIk1wLADwCGvNwZiRqxwwO3lNhPHACwPFfkUGG8xU-w!-1708335573!1100403579?postName=stormwater-slam-dunk&_afrLoop=15221176250847197&_afrWindowMode=0&_afrWindowId=null&_adf.ctrl-state=aoju7sojc_1#!%40%40%3F_afrWindowId%3Dnull%26_afrLoop%3D15221176250847197%26postName%3Dstormwater-slam-dunk%26_afrWindowMode%3D0%26_adf.ctrl-state%3Daoju7sojc_5

Lomita, City of. ND. City History. http://www.lomita.com/cityhall/about_lomita/index.cfm?p=history/index.cfm&h=

Lomita, City of. 2018. Bicycle & Pedestrian Master Plan. http://lomita.granicus.com/MetaViewer.php?view_id=3&event_id=490&meta_id=26345

Office of Environmental Health Hazard Assessment (CA OEHHA). 2018. CalEnviroScreen 3.0. https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30

PCSWMM. Advanced Modeling Software for Stomwater, Wastewater, and Water Distribution Systems. https://www.pcswmm.com/

Safe, Clean Water Program (SCW Program). 2019. Feasibility Study Guidelines. https://safecleanwaterla.org/wp-content/uploads/2019/08/Feasibility-Study-Guidelines-20190807-FINAL.pdf

Shiflett, S.A. et al. 2017. Variation in the Urban Vegetation, Surface Temperature, Air Temperature Nexus. *Science of the Total Environment*, 579: 495-505. https://doi.org/10.1016/j.scitotenv.2016.11.069

South Bay Cities Council of Governments (SBCOG). 2018. Dominguez Channel Watershed Strategic Green Street Implementation Plan, Planning Framework Report, July 2018.

Southern California Association of Governments (SCAG). ND. https://scag.ca.gov/data-tools-geographic-information-systems

StormTrap. ND. Sample Drawing SingleTrap Infiltration. https://stormtrap.com/products/singletrap/#singletrap-Docs

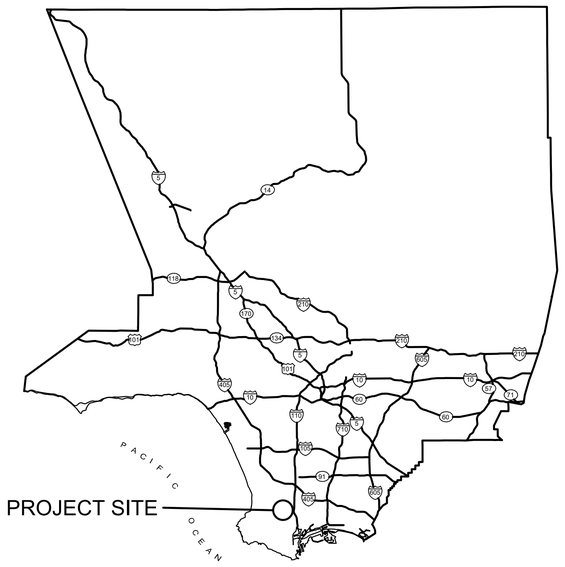
USGS. 2016. National Land Cover Database. https://www.usgs.gov/centers/eros/science/national-land-cover-database?qt-science_center_objects=0#qt-science_center_objects

Appendix A

Conceptual Design Drawings

CITY OF LOMITA

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT



LOCATION MAP
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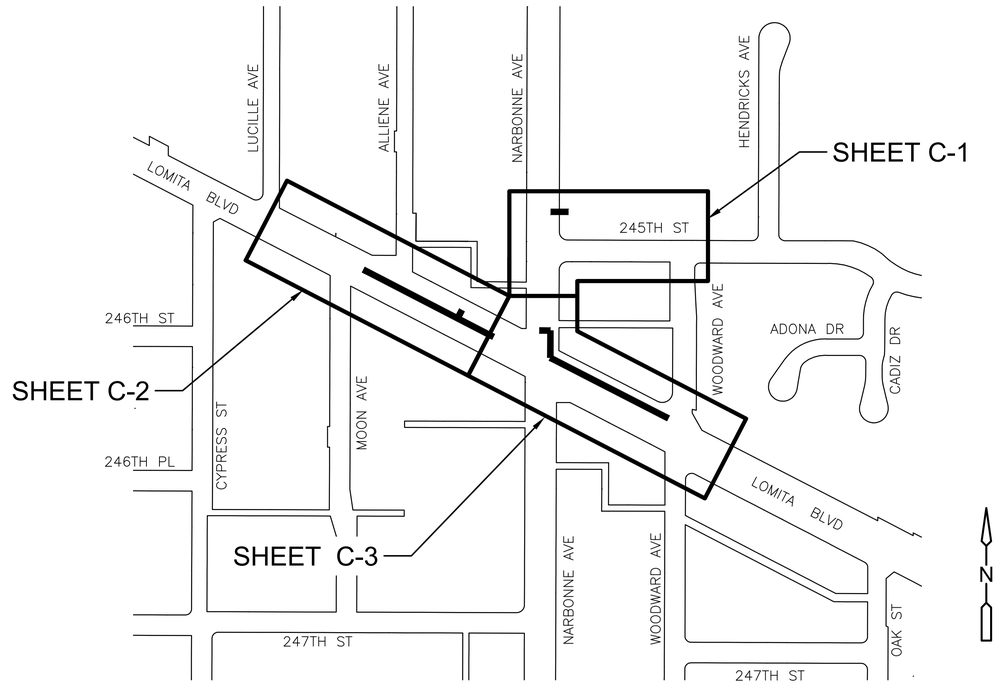

KEY MAP
NOT TO SCALE

INDEX TO PROJECT PLANS

SHEET NUMBER	DESCRIPTION
G-1	TITLE SHEET
C-1	NARBONNE AVE SITE PLAN
C-2	LOMITA BLVD SITE PLAN
C-3	LOMITA BLVD SITE PLAN
C-4	DETAIL SHEET

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: J. Coryell
DRAWN BY: M. Perez
SHEET CHK'D BY: R. Vadenais
CROSS CHK'D BY:
APPROVED BY:
DATE: JULY 2021

CDM Smith
600 Wilshire Boulevard, Suite 750
Los Angeles, CA 90017
Tel: (213) 457-2200

CITY OF LOMITA

DOWNTOWN LOMITA
MULTI-BENEFIT STORMWATER PROJECT

TITLE SHEET

PROJECT NO. 263073-262801
FILE NAME: G-1.DWG
SHEET NO.
G-1

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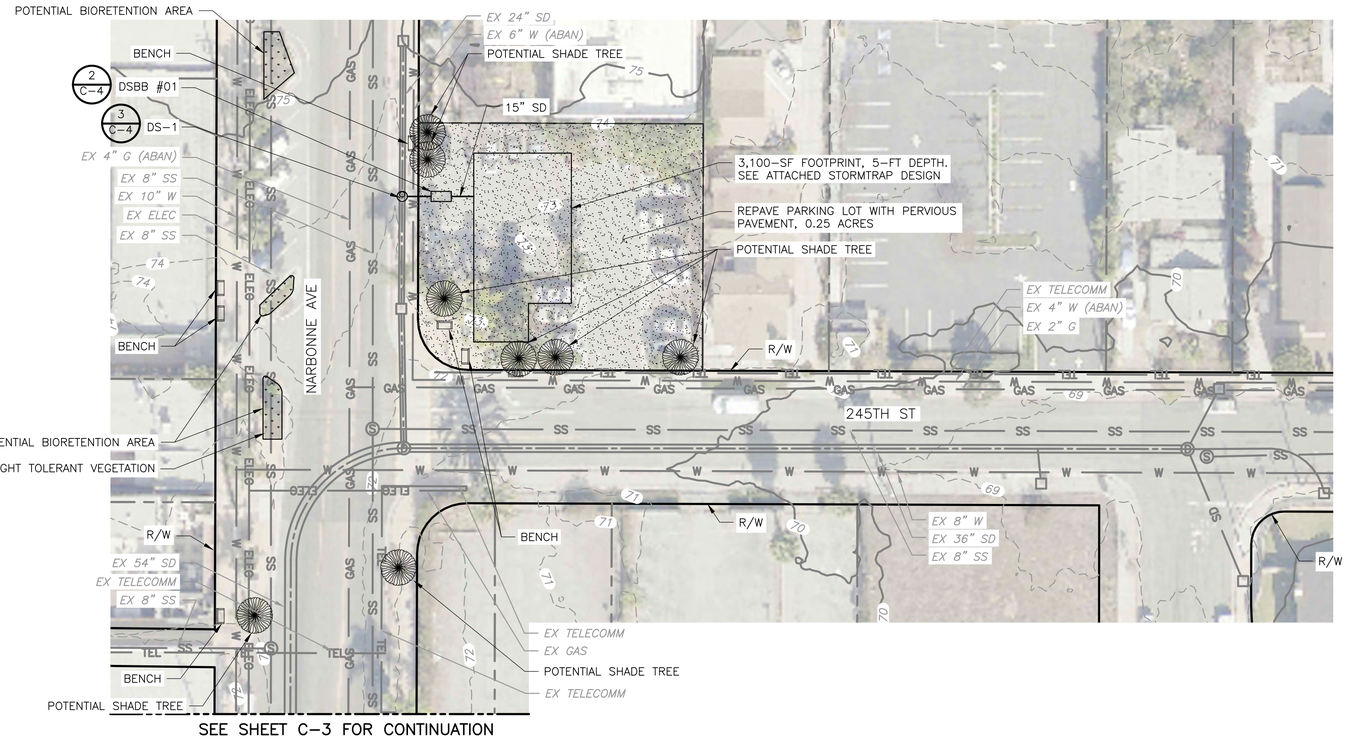

SEE SHEET C-3 FOR CONTINUATION

N

1" = 30'

15 0 30

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: J. Coryell
DRAWN BY: M. Perez
SHEET CHK'D BY: R. Vadenais
CROSS CHK'D BY:
APPROVED BY:
DATE: JULY 2021

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CITY OF LOMITA

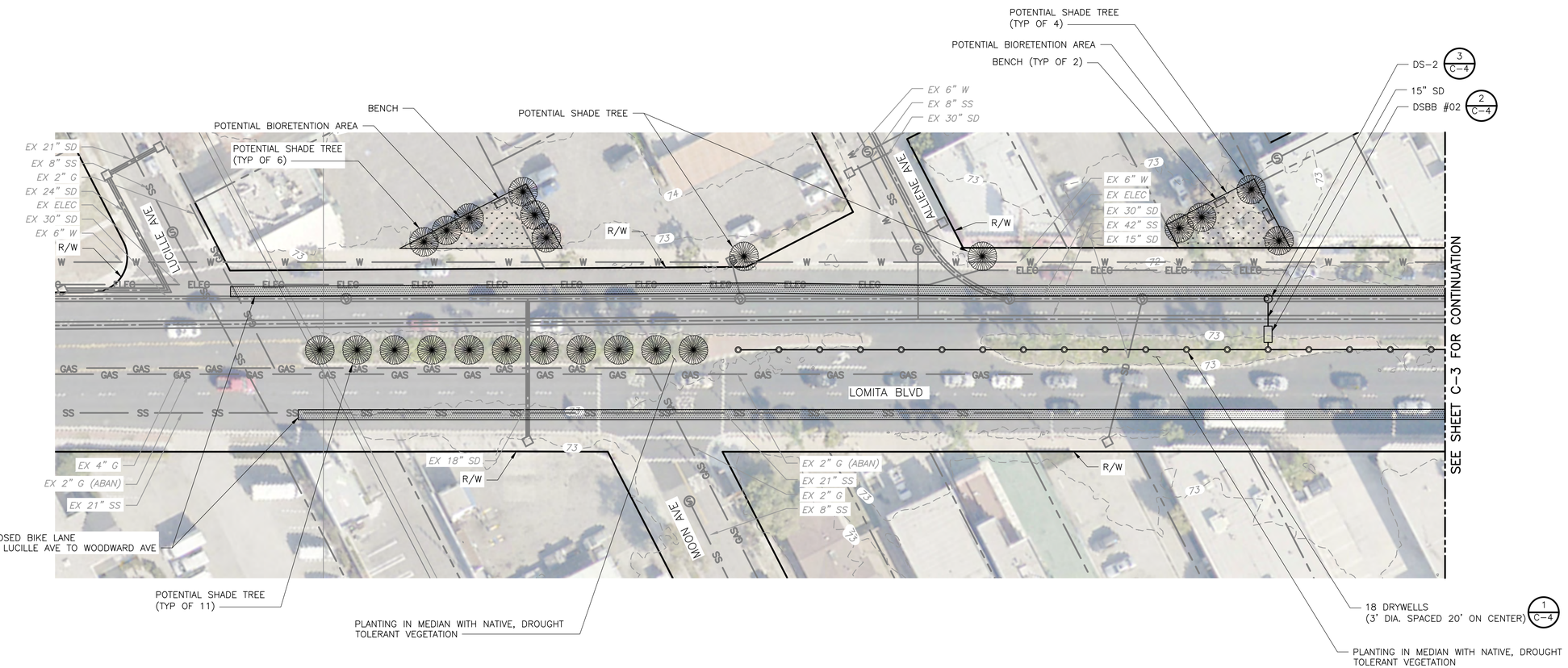
DOWNTOWN LOMITA
MULTI-BENEFIT STORMWATER PROJECT

NARBONNE AVE
SITE PLAN

PROJECT NO. 263073-262801
FILE NAME: C-1.DWG

SHEET NO.
C-1

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION



PLAN
1" = 30'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: J. Coryell
DRAWN BY: M. Perez
SHEET CHK'D BY: R. Vadenais
CROSS CHK'D BY:
APPROVED BY:
DATE: JULY 2021

CDM Smith
600 Wilshire Boulevard, Suite 750
Los Angeles, CA 90017
Tel: (213) 457-2200

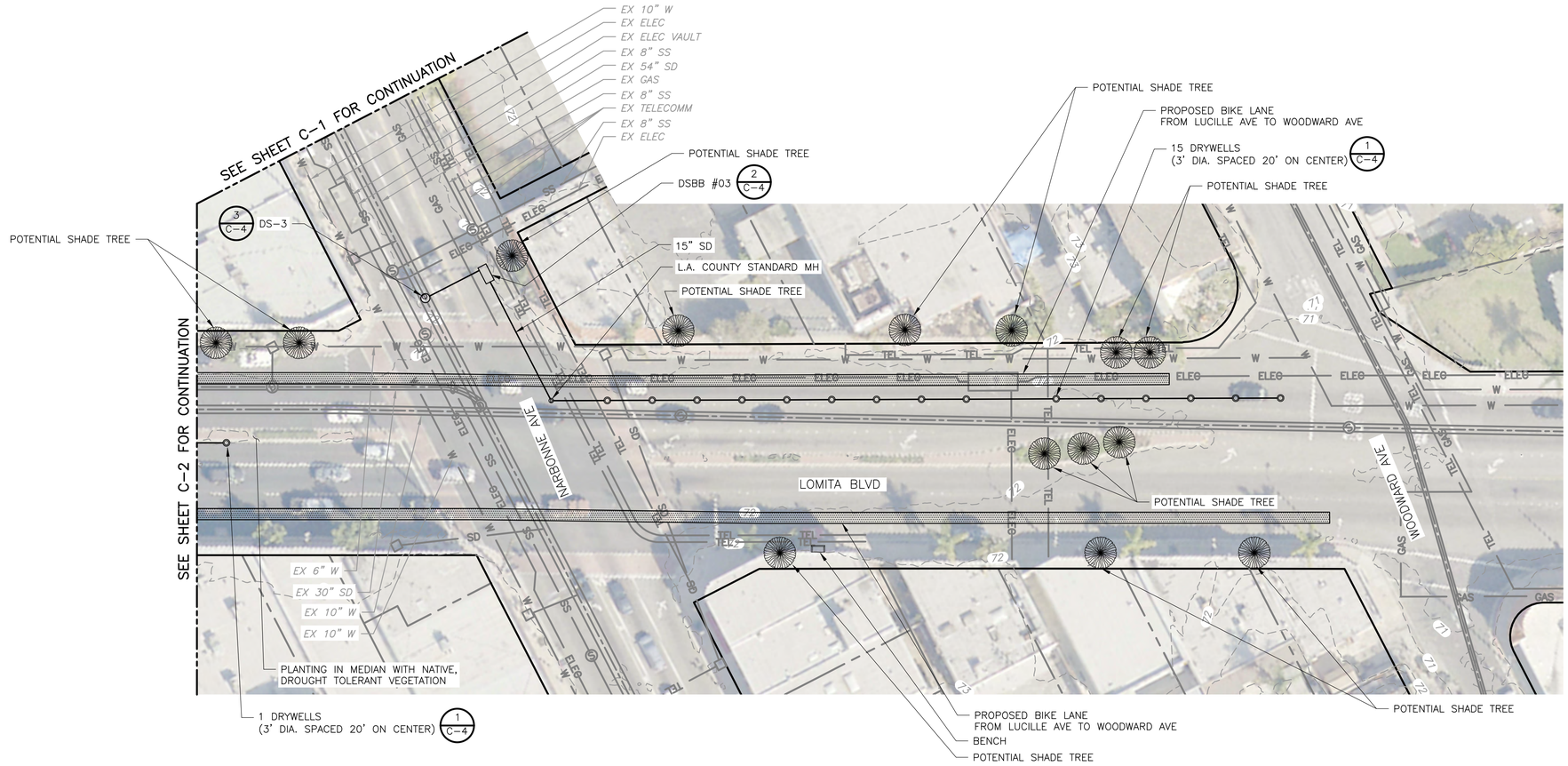
CITY OF LOMITA

DOWNTOWN LOMITA
MULTI-BENEFIT STORMWATER PROJECT

LOMITA BLVD
SITE PLAN

PROJECT NO. 263073-262801
FILE NAME: C-2.DWG
SHEET NO.
C-2

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION



PLAN
1" = 30'

REV. NO.	DATE	DRWN	CHKD	REMARKS

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CITY OF LOMITA

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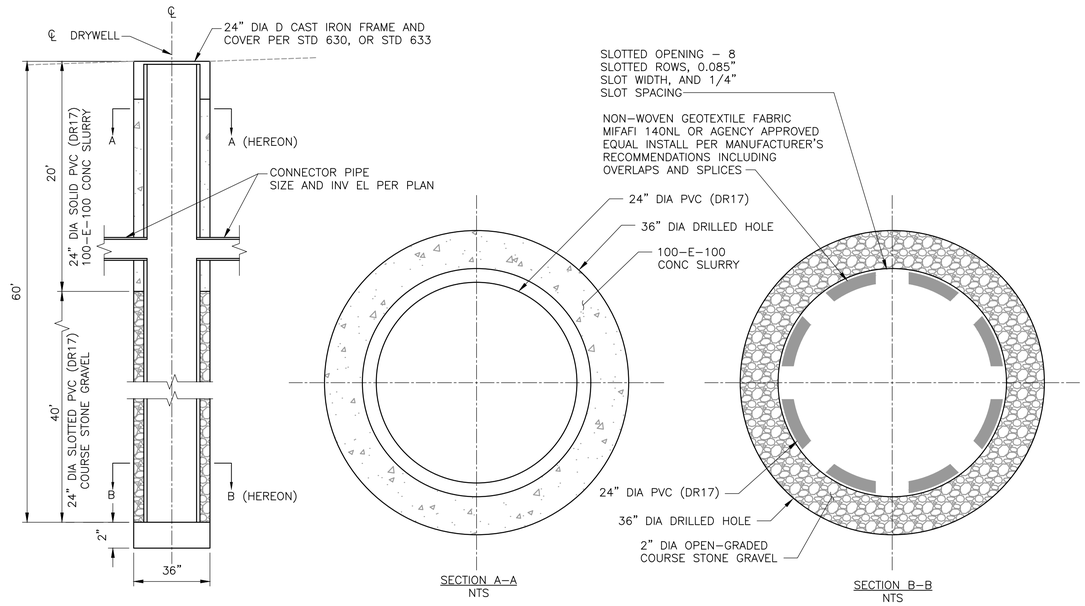
MULTI-BENEFIT STORMWATER PROJECT

LOMITA BLVD
SITE PLAN

PROJECT NO. 263073-262801
FILE NAME: C-3.DWG
SHEET NO.
C-3

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

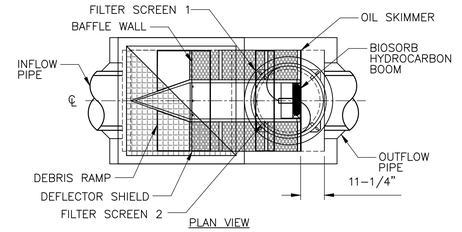


SECTION A–A
NTS

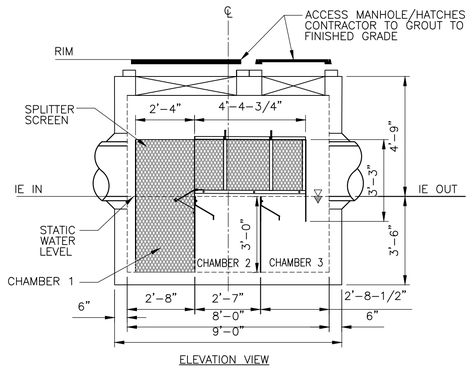
SECTION B–B
NTS

TYPICAL DRYWELL

DETAIL 1
NTS



PLAN VIEW



ELEVATION VIEW

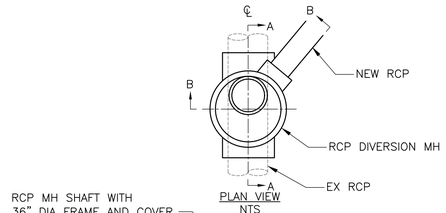
DEBRIS SEPARATING BAFFLE BOX (DSBB)
MODEL 4-8

DETAIL 2
NTS

GENERAL NOTES FOR ALL DSBB UNITS

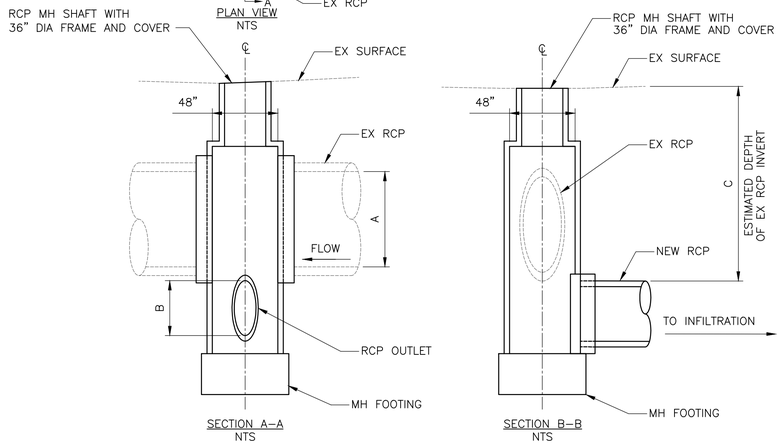
1. BIO CLEAN TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS, AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS, AND ACCESSORIES PLEASE CONTACT BIO CLEAN.

Bio Clean
A Forterra Company



PLAN VIEW
NTS

LOCATION	A	B	C
24418 NARBONNE AVE	24"	15"	10'
LOMITA BLVD WEST OF NARBONNE AVE	39"	15"	10'
LOMITA BLVD EAST OF NARBONNE AVE	54"	15"	12'



SECTION A–A
NTS

SECTION B–B
NTS

DIVERSION STRUCTURE

DETAIL 3
NTS

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APPROVED BY:
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DETAILS

PROJECT NO. 263073-262801
FILE NAME: C-4.DWG

SHEET NO.
C-4

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

Attachment to Drawings

Sample Infiltration Gallery (not site specific)

StormTrap®

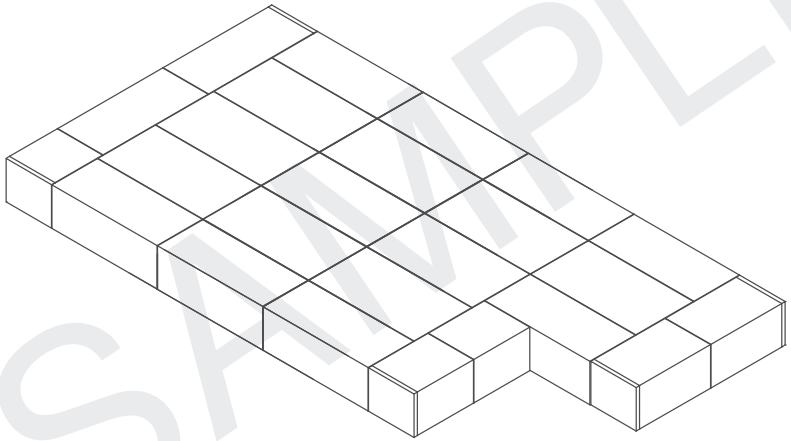
MODULAR CONCRETE
STORMWATER MANAGEMENT

CONTACT STORMTRAP TO REQUEST A DESIGN AND BUDGET FOR YOUR SPECIFIC PROJECT NEEDS.

SHEET INDEX

STORMTRAP CONTACT INFORMATION

STORM TRAP SUPPLIER: STORMTRAP
CONTACT NAME: STORMTRAP
CELL PHONE: STORMTRAP
SALES EMAIL: STORMTRAP



SINGLETRAP© - INFILTRATION
SAMPLE PROJECT

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SHEET TITLE:

COVER SHEET

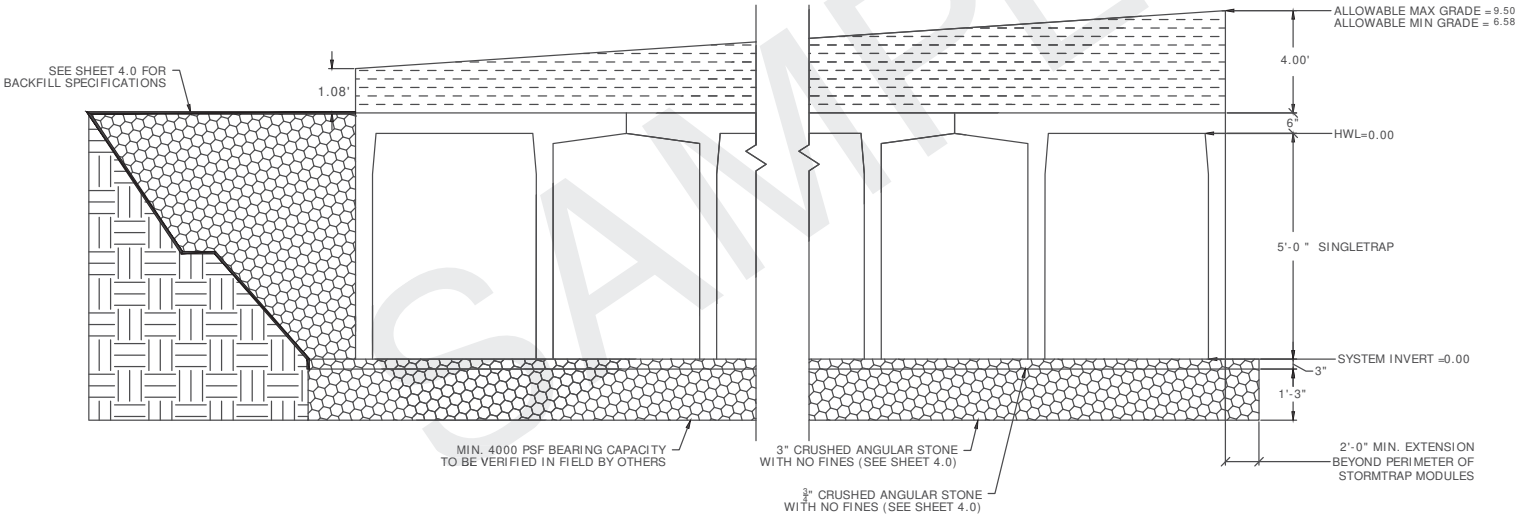
SHEET NUMBER:

0.0

STORMTRAP SYSTEM INFORMATION		
WATER STORAGE REQ'D:	10000	CUBIC FEET
WATER STORAGE PROV:	12559.8	CUBIC FEET
UNIT HEADROOM:	5' 0 "	SINGLETRAP
UNIT QUANTITY:	27	TOTAL PIECES

STORMTRAP STRUCTURAL DESIGN CRITERIA

1. STORMTRAP MODULES SHALL BE MANUFACTURED AND INSTALLED ACCORDING TO SHOP DRAWINGS APPROVED BY THE INSTALLING CONTRACTOR AND ENGINEER OF RECORD. THE SHOP DRAWINGS SHALL INDICATE SIZE AND LOCATION OF ROOF OPENINGS AND INLET/ OUTLET PIPE TYPES, SIZES, INVERT ELEVATIONS AND SIZE OF OPENINGS.
2. COVER RANGE: MIN. 1.08' MAX. 4.00' CONSULT STORMTRAP FOR ADDITIONAL COVER OPTIONS.
3. ALL DIMENSIONS AND SOIL CONDITIONS, INCLUDING BUT NOT LIMITED TO GROUNDWATER AND SOIL BEARING CAPACITY ARE REQUIRED TO BE VERIFIED IN THE FIELD BY OTHERS PRIOR TO STORMTRAP INSTALLATION.



5'-0 " SINGLETRAP

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SINGLETRAP DESIGN CRITERIA

SHEET NUMBER:

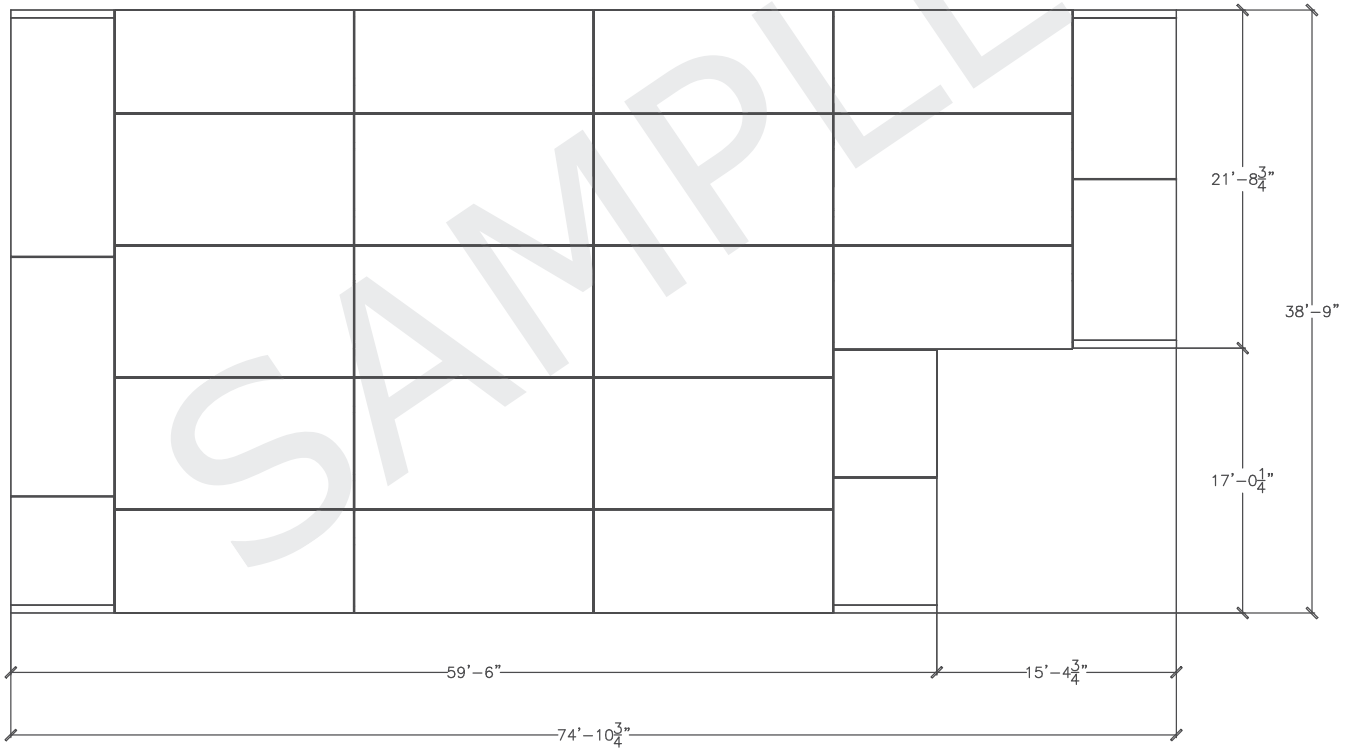
1.0

BILL OF MATERIALS

QTY.	UNIT TYPE	DESCRIPTION	WEIGHT
0	I	5' 0 " SINGLETRAP	
10	II	5' 0 " SINGLETRAP	
0	III	5' 0 " SINGLETRAP	
12	IV	5' 0 " SINGLETRAP	
0	VII	5' 0 " SINGLETRAP	
5	SPIV	5' 0 " SINGLETRAP	
5	PANEL	8" THICK PANELS	
5	JOINTWRAP	150' PER ROLL	
24	JOINTTAPE	14.5' PER ROLL	

DESIGN CRITERIA
ALLOWABLE MAX GRADE= 9.50
ALLOWABLE MIN GRADE = 6.58
INSIDE HEIGHT ELEVATION = 0.00
SYSTEM INVERT = 0.00
STORMTRAP VOLUME = 12559.8 C.F.

NOTES:
1. DIMENSIONING OF STORMTRAP SYSTEM SHOWN BELOW ALLOW FOR A 3/4" GAP BETWEEN EACH MODULE.
2. ALL DIMENSIONS TO BE VERIFIED IN THE FIELD BY OTHERS.
3. SEE SHEET 3.0 FOR INSTALLATION SPECIFICATIONS.
4. SP - INDICATES A MODULE WITH MODIFICATIONS.
5. P - INDICATES A MODULE WITH A PANEL ATTACHMENT.
6. CONTRACTORS RESPONSIBILITY TO ENSURE CONSISTENCY/ACCURACY TO FINAL ENGINEER OF RECORD PLAN SET.



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LAYOUT DETAILS

SHEET NUMBER:
2.0

STORMTRAP INSTALLATION SPECIFICATIONS

1. STORMTRAP SHALL BE INSTALLED IN ACCORDANCE WITH ASTM C891 STANDARD PRACTICE FOR INSTALLATION OF UNDERGROUND PRE-CAST CONCRETE UTILITY STRUCTURES. THE FOLLOWING ADDITIONS AND/OR EXCEPTIONS SHALL APPLY:

2. IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO ENSURE THAT PROPER/ADEQUATE EQUIPMENT IS USED TO SET/INSTALL THE MODULES.

3. THE AGGREGATE FOUNDATION HAS BEEN DESIGNED BASED ON THE FOLLOWING ASSUMPTIONS. THESE ASSUMPTIONS WILL NEED TO BE VERIFIED BY A GEOTECHNICAL ENGINEER WHICH WILL NEED TO BE EMPLOYED BY THE OWNER.

   3.1. A QUALIFIED GEOTECHNICAL ENGINEER WILL BE EMPLOYED, BY OWNER, TO PROVIDE ASSISTANCE IN EVALUATING THE EXISTING SOIL CONDITIONS AT THE ELEVATION THE STONE FOUNDATION IS TO BE PLACED. IF A FOUNDATION IS TO BE USED FOR THIS CONDITION, THE BEARING PRESSURE OF THE SOILS AT THIS LEVEL WILL NEED TO MEET OR EXCEED ALLOWABLE CAPACITY. IF THIS IS NOT POSSIBLE, THE STONE FOUNDATION MAY NOT BE AN OPTION FOR THIS LOCATION.

   3.2. A QUALIFIED GEOTECHNICAL ENGINEER WILL BE EMPLOYED, BY OWNER, TO EVALUATE A SOURCE OF STONE AGGREGATES THAT WILL BE PLACED ON PROPERLY COMPACTED SOILS (SEE SHEET 1.0 FOR SOIL BEARING CAPACITY REQUIREMENTS). THE AGGREGATE BASE COURSE FOR WHICH THE STORMTRAP SYSTEM WILL BEAR DIRECTLY ON SHALL CONSIST OF A 3" THICK BED OF ¾" DIAMETER ANGULAR STONE, WELL COMPACTED AND SEATED, WITH NO FINES. AND A 15" THICK BED OF 3" DIAMETER STONE AGGREGATE (SEE SHEET 4.0 FOR FURTHER DESCRIPTION/EXPLANATION). PLEASE NOTE THAT THESE ARE ONLY MINIMUM RECOMMENDATIONS AND A QUALIFIED GEOTECHNICAL ENGINEER SHALL BE USED TO DETERMINE THE EXACT REQUIREMENTS FOR THE LOCATIONS THAT THE STORMTRAP SYSTEM IS TO BE LOCATED.

   3.3. THE CONTRACTOR SHALL REMOVE ANY AND ALL EXPANDABLE OR COLLAPSIBLE SOILS AT THE DIRECTION OF A QUALIFIED GEOTECHNICAL ENGINEER.

   3.4. THE AGGREGATE FOUNDATION SHALL BE INSTALLED SUCH THAT THE AGGREGATE EXTENDS A MINIMUM OF 2'-0" PAST THE OUTSIDE OF THE SYSTEM (SEE DETAIL 1).

   3.5. THE ¾" AGGREGATE SHALL BE COMPACTED USING A VIBRATING ROLLER WITH ITS' FULL DYNAMIC FORCE APPLIED TO ACHIEVE A FLAT SURFACE.

   3.6. DISK, DRY AND COMPACT THE TOP 8" OF THE SUBGRADE SOILS TO 95% OF THE STANDARD DRY DENSITY AND 110% OPTIMUM MOISTURE CONTENT.

   3.7. AGGREGATE SHALL BE GRADED WITHIN +/- ¼" OF THE GRADE SHOWN ON THE PLANS.

   3.8. MINIMUM SOIL BEARING CAPACITY LISTED ON SHEET 1.0 SHALL BE VERIFIED IN FIELD BY OTHERS.

4. THE STORMTRAP MODULES SHALL BE PLACED SUCH THAT THE MAXIMUM SPACE BETWEEN ADJACENT MODULES DOES NOT EXCEED ¾" (SEE DETAIL 2). IF THE SPACE EXCEEDS ¾", THE MODULES SHALL BE RESET WITH APPROPRIATE ADJUSTMENT MADE TO LINE AND GRADE TO BRING THE SPACE INTO SPECIFICATION.

5. STORMTRAP MODULES ARE NOT WATERTIGHT. IF A WATERTIGHT SOLUTION IS REQUIRED, CONTACT STORMTRAP FOR RECOMMENDATIONS. THE WATERTIGHT APPLICATION IS TO BE PROVIDED AND IMPLEMENTED BY THE CONTRACTOR. THE CONTRACTOR IS RESPONSIBLE TO ENSURE THAT THE SELECTED WATERTIGHT SOLUTION PERFORMS AS SPECIFIED BY THE MANUFACTURER. CONTACT STORMTRAP IF A WATERTIGHT APPLICATION IS REQUIRED.

6. ALL EXTERIOR JOINTS BETWEEN ADJACENT STORMTRAP MODULES SHALL BE SEALED WITH 8" WIDE PRE-FORMED, COLD-APPLIED, SELF-ADHERING ELASTOMERIC RESIN, BONDED TO A WOVEN , HIGHLY PUNCTURE RESISTANT POLYMER WRAP, CONFORMING TO ASTM C891 AND SHALL BE INTEGRATED WITH PRIMER SEALANT AS APPROVED BY STORMTRAP (SEE DETAILS 3 & 4). THE JOINT WRAP DOES NOT PROVIDE A WATERTIGHT SEAL. THE SOLE PURPOSE OF THE JOINT WRAP IS TO PROVIDE A SILT AND SOIL TIGHT SYSTEM. THE ADHESIVE EXTERIOR JOINT WRAP SHALL BE INSTALLED ACCORDING TO THE FOLLOWING INSTALLATION INSTRUCTIONS:

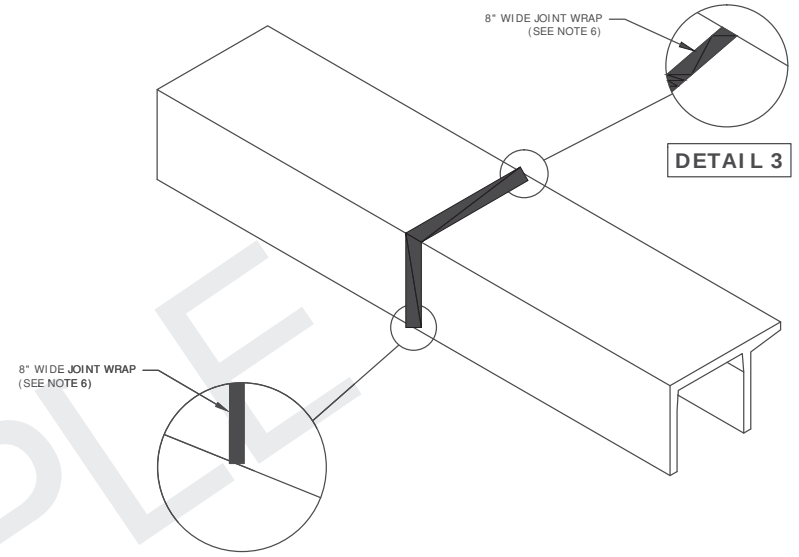
   6.1. USE A BRUSH OR WET CLOTH TO THOROUGHLY CLEAN THE OUTSIDE SURFACE AT THE POINT WHERE THE JOINT WRAP IS TO BE APPLIED.

   6.2. A RELEASE PAPER PROTECTS THE ADHESIVE SIDE OF THE JOINT WRAP. PLACE THE ADHESIVE TAPE (ADHESIVE SIDE DOWN) AROUND THE STRUCTURE, REMOVING THE RELEASE PAPER AS YOU GO. PRESS THE JOINT WRAP FIRMLY AGAINST THE STORMTRAP MODULE SURFACE WHEN APPLYING.

7. IF THE CONTRACTOR NEEDS TO CANCEL ANY SHIPMENTS, THEY MUST DO SO 48 HOURS PRIOR TO THEIR SCHEDULED ARRIVAL AT THE JOB SITE. IF CANCELED AFTER THAT TIME, PLEASE CONTACT THE PROJECT MANAGER.

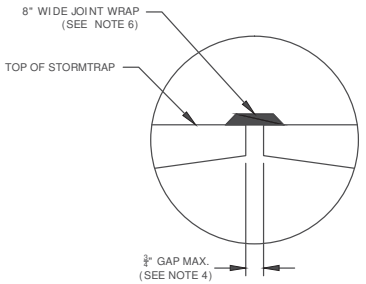
8. IF THE STORMTRAP MODULE(S) IS DAMAGED IN ANY WAY PRIOR, DURING, OR AFTER INSTALL, STORMTRAP, MUST BE CONTACTED IMMEDIATELY TO ASSESS THE DAMAGE AND TO DETERMINE WHETHER OR NOT THE MODULE(S) WILL NEED TO BE REPLACED. IF ANY MODULE ARRIVES AT THE JOBSITE DAMAGED DO NOT UNLOAD IT; CONTACT STORMTRAP, IMMEDIATELY. ANY DAMAGE NOT REPORTED BEFORE THE TRUCK IS UNLOADED WILL BE THE CONTRACTOR'S RESPONSIBILITY.

9. STORMTRAP MODULES CANNOT BE ALTERED IN ANY WAY AFTER MANUFACTURING WITHOUT WRITTEN CONSENT FROM STORMTRAP, .

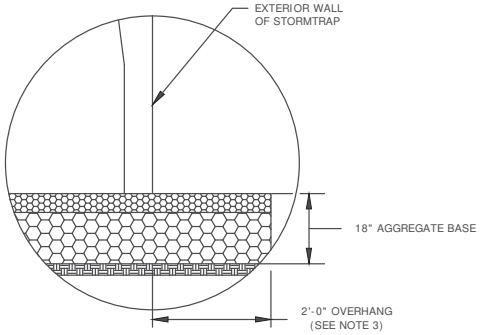


DETAIL 3

DETAIL 4



DETAIL 2



DETAIL 1

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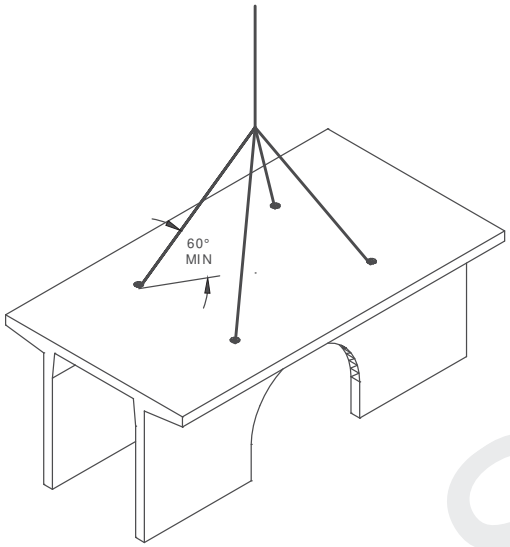
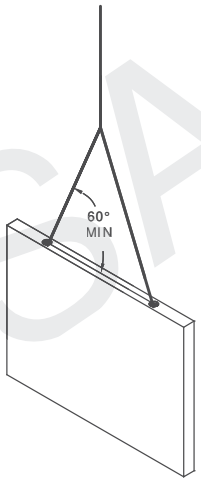
3.0

END PANEL ERECTION/INSTALLATION NOTES

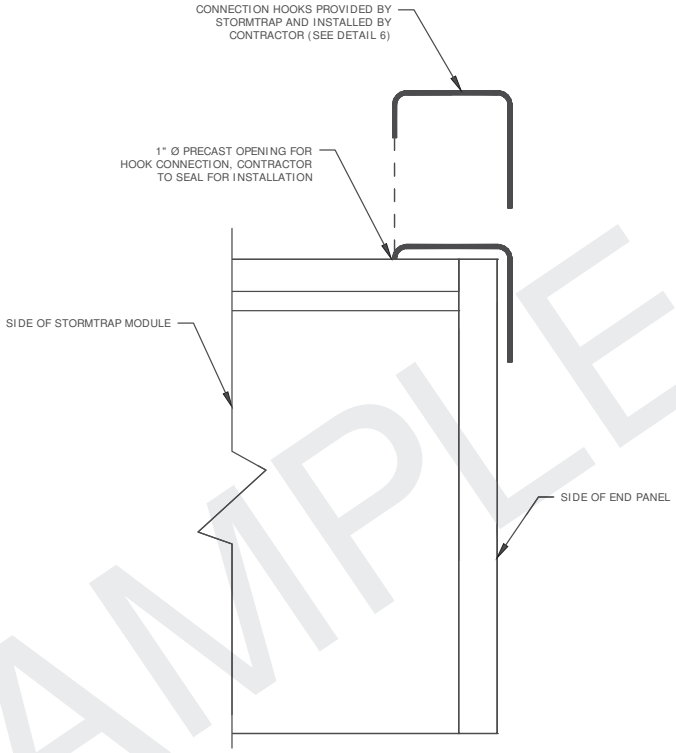
1. END PANELS WILL BE SUPPLIED TO CLOSE OFF OPEN ENDS OF ROWS.
2. PANELS SHALL BE INSTALLED IN A TILT UP FASHION DIRECTLY ADJACENT TO OPEN END OF MODULE (REFER TO SHEET 2.0 FOR END PANEL LOCATIONS).
3. CONNECTION HOOKS WILL BE SUPPLIED WITH END PANELS TO SECURELY CONNECT PANEL TO ADJACENT STORMTRAP MODULE (SEE PANEL CONNECTION ELEVATION VIEW).
4. ONCE CONNECTION HOOK IS ATTACHED, LIFTING CLUTCHES MAY BE REMOVED.
5. JOINT WRAP SHALL BE PLACED AROUND PERIMETER JOINT PANEL (SEE SHEET 3.0).



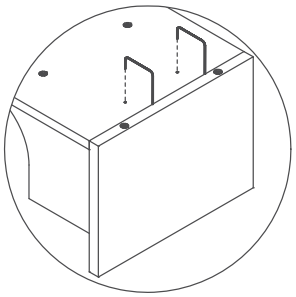
MODULE LIFTING DETAIL



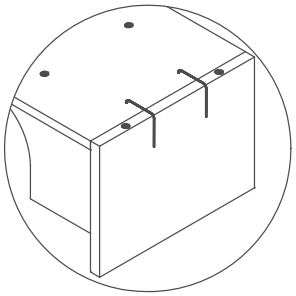
END PANEL LIFTING DETAIL



PANEL CONNECTION ELEVATION VIEW



STEP 1



STEP 2

DETAIL 6

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3.1

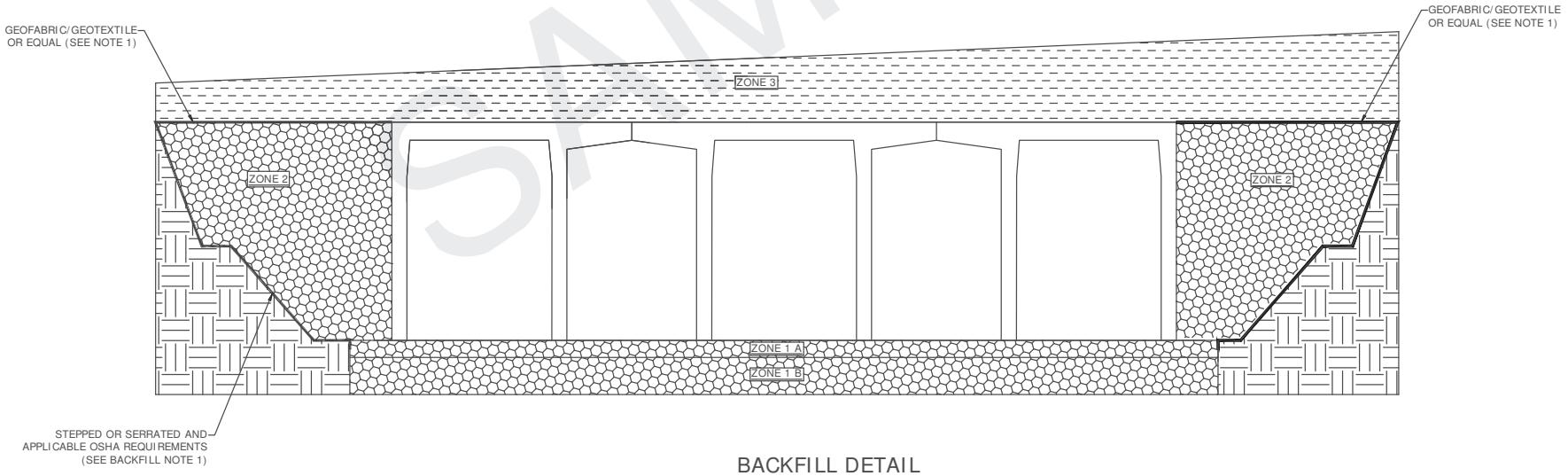
ZONE CHART		
ZONES	ZONE DESCRIPTIONS	REMARKS
ZONE 1 A	FOUNDATION AGGREGATE	
ZONE 1 B	FOUNDATION AGGREGATE	
ZONE 2	BACKFILL	
ZONE 3	FINAL COVER OVERTOP	

STORMTRAP ZONE INSTALLATION SPECIFICATIONS/PROCEDURES

1. THE FILL PLACED AROUND THE STORMTRAP MODULES MUST DEPOSITED ON BOTH SIDES AT THE SAME TIME AND TO APPROXIMATELY THE SAME ELEVATION. AT NO TIME SHALL THE FILL BEHIND ONE SIDE WALL BE MORE THAN 2'-0" HIGHER THAN THE FILL ON THE OPPOSITE SIDE. BACKFILL SHALL EITHER BE COMPACTED AND/OR VIBRATED TO ENSURE THAT BACKFILL AGGREGATE/STONE MATERIAL IS WELL SEATED AND PROPERLY INTER LOCKED. CARE SHALL BE TAKEN TO PREVENT ANY WEDGING ACTION AGAINST THE STRUCTURE, AND ALL SLOPES WITHIN THE AREA TO BE BACKFILLED MUST BE STEPPED OR SERRATED TO PREVENT WEDGING ACTION. CARE SHALL ALSO BE TAKEN AS NOT TO DISRUPT THE JOINT WRAP FROM THE JOINT DURING THE BACKFILL PROCESS. BACKFILL MATERIAL SHALL BE CLEAN, CRUSHED, ANGULAR No. 5 (AASHTO M43) AGGREGATE. IF NATIVE EARTH IS SUSCEPTIBLE TO MIGRATION, CONFIRM WITH GEOTECHNICAL ENGINEER AND PROVIDE PROTECTION AS REQUIRED.

2. DURING PLACEMENT OF MATERIAL OVERTOP THE SYSTEM, AT NO TIME SHALL MACHINERY BE USED OVERTOP THAT EXCEEDS THE DESIGN LIMITATIONS OF THE SYSTEM. WHEN PLACEMENT OF MATERIAL OVERTOP, MATERIAL SHALL BE PLACED SUCH THAT THE DIRECTION OF PLACEMENT IS PARALLEL WITH THE OVERALL LONGITUDINAL DIRECTION OF THE SYSTEM WHENEVER POSSIBLE.

3. THE FILL PLACED OVERTOP THE SYSTEM SHALL BE PLACED AT A MINIMUM OF 6" LIFTS. AT NO TIME SHALL MACHINERY OR VEHICLES GREATER THAN THE DESIGN HS-20 LOADING CRITERIA TRAVEL OVERTOP THE SYSTEM WITHOUT THE MINIMUM DESIGN COVERAGE. IF TRAVEL IS NECESSARY OVERTOP THE SYSTEM PRIOR TO ACHIEVING THE MINIMUM DESIGN COVER, IT MAY BE NECESSARY TO REDUCE THE ULTIMATE LOAD/BURDEN OF THE OPERATING MACHINERY SO AS TO NOT EXCEED THE DESIGN CAPACITY OF THE SYSTEM. IN SOME CASES, IN ORDER TO ACHIEVE REQUIRED COMPACTION, HAND COMPACTION MAY BE NECESSARY IN ORDER NOT TO EXCEED THE ALLOTTED DESIGN LOADING.



BACKFILL DETAIL

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4.0

RECOMMENDED ACCESS OPENING SPECIFICATION

1. A TYPICAL ACCESS OPENING FOR THE STORMTRAP SYSTEM ARE 2'-0" IN DIAMETER. ACCESS OPENINGS LARGER THAN 3'-0" IN DIAMETER NEED TO BE APPROVED BY STORMTRAP. ALL OPENINGS MUST RETAIN AT LEAST 1'-0" OF CLEARANCE FROM THE END OF THE STORMTRAP MODULE UNLESS NOTED OTHERWISE. ALL ACCESS OPENINGS TO BE LOCATED ON INSIDE LEG UNLESS OTHERWISE SPECIFIED.
2. PLASTIC COATED STEEL STEPS PRODUCED BY M.A. INDUSTRIES PART #PS3-PFC OR APPROVED EQUAL (SEE STEP DETAIL) ARE PROVIDED INSIDE ANY MODULE WHERE DEEMED NECESSARY. THE HIGHEST STEP IN THE MODULE IS TO BE PLACED A DISTANCE OF 1'-0" FROM THE INSIDE EDGE OF THE STORMTRAP MODULES. ALL ENSUING STEPS SHALL BE PLACED WITH A MAXIMUM DISTANCE OF 1'-4" BETWEEN THEM. STEPS MAY BE MOVED OR ALTERED TO AVOID OPENINGS OR OTHER IRREGULARITIES IN THE MODULE.
3. STORMTRAP LIFTING INSERTS MAY BE RELOCATED TO AVOID INTERFERENCE WITH ACCESS OPENINGS OR THE CENTER OF GRAVITY OF THE MODULE AS NEEDED.
4. STORMTRAP ACCESS OPENINGS MAY BE RELOCATED TO AVOID INTERFERENCE WITH INLET AND/OR OUTLET PIPE OPENINGS SO PLACEMENT OF STEPS IS ATTAINABLE.
5. ACCESS OPENINGS SHOULD BE LOCATED IN ORDER TO MEET THE APPROPRIATE MUNICIPAL REQUIREMENTS. STORMTRAP RECOMMENDS AT LEAST TWO ACCESS OPENINGS PER SYSTEM FOR ACCESS AND INSPECTION.
6. USE PRECAST ADJUSTING RINGS AS NEEDED TO MEET GRADE. STORMTRAP RECOMMENDS FOR COVER OVER 2' TO USE PRECAST BARREL OR CONE INSPECTIONS. (PROVIDED BY OTHERS)

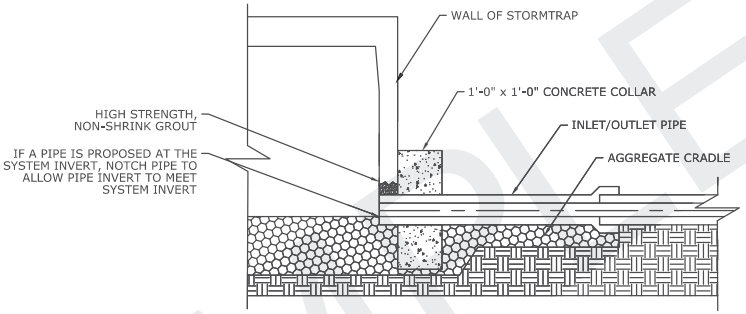
RECOMMENDED PIPE OPENING SPECIFICATION

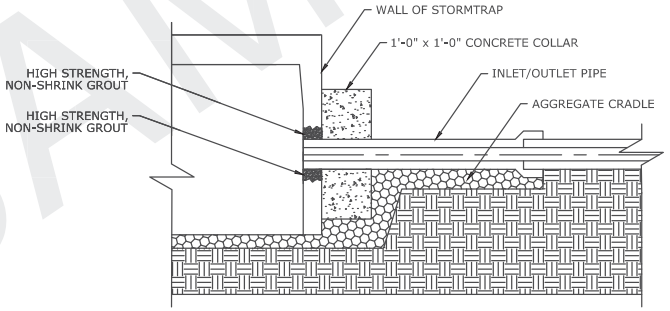
1. MINIMUM EDGE DISTANCE FOR AN OPENING ON THE OUTSIDE WALL SHALL BE NO LESS THAN 1'-0".
2. MAXIMUM OPENING SIZE TO BE DETERMINED BY THE MODULE HEIGHT. PREFERRED OPENING SIZE IS Ø 36" OR LESS. ANY OPENING NEEDED THAT DOES NOT FIT THIS CRITERIA SHALL BE BROUGHT TO THE ATTENTION OF STORMTRAP FOR REVIEW.
3. CONNECTING PIPES SHALL BE INSTALLED WITH A 1'-0" CONCRETE COLLAR, AND AN AGGREGATE CRADLE FOR AT LEAST ONE PIPE LENGTH (SEE PIPE CONNECTION DETAIL). A STRUCTURAL GRADE CONCRETE OR HIGH STRENGTH, NON-SHRINK GROUT WITH A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI SHALL BE USED.
4. THE ANNULAR SPACE BETWEEN THE PIPE AND THE HOLE SHALL BE FILLED WITH HIGH STRENGTH NON-SHRINK GROUT.

RECOMMENDED PIPE INSTALLATION INSTRUCTIONS

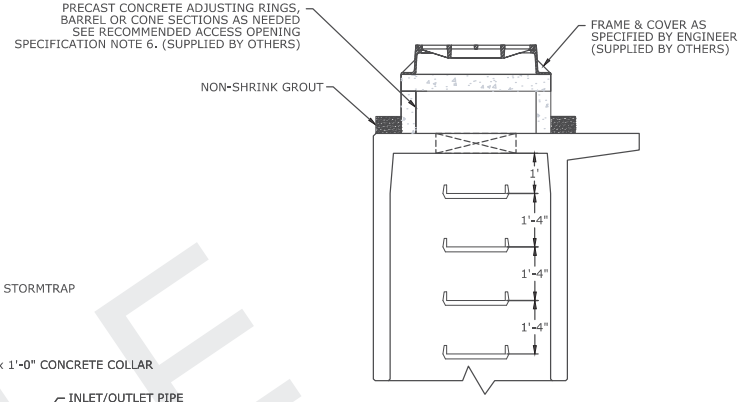
1. CLEAN AND LIGHTLY LUBRICATE ALL OF THE PIPE TO BE INSERTED INTO STORMTRAP.
2. IF PIPE IS CUT, CARE SHOULD BE TAKEN TO ALLOW NO SHARP EDGES. BEVEL AND LUBRICATE LEAD END OF PIPE.
3. ALIGN CENTER OF PIPE TO CORRECT ELEVATION AND INSERT INTO OPENING.

NOTE: ALL ANCILLARY PRODUCTS RECOMMENDED AND SHOWN ON THIS SHEET ARE RECOMMENDATIONS ONLY AND SUBJECT TO CHANGE PER THE INSTALLING CONTRACTOR.

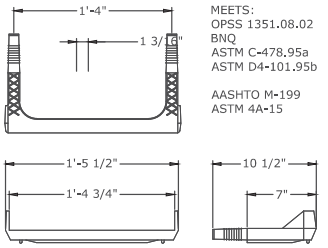




PIPE CONNECTION DETAIL



RISER / STAIR DETAIL



MEETS:
OPSS 1351.08.02
BNQ
ASTM C-478.95a
ASTM D4-101.95b

AASHTO M-199
ASTM 4A-15

STEP DETAIL

StormTrap®
PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]
1-877-867-6872

ENGINEER INFORMATION:

PROJECT INFORMATION:
SINGLETRAP
INFILTRATION

CURRENT ISSUE DATE:

ISSUED FOR:
SAMPLE PROJECT

REV.	DATE:	ISSUED FOR:	DWN BY:

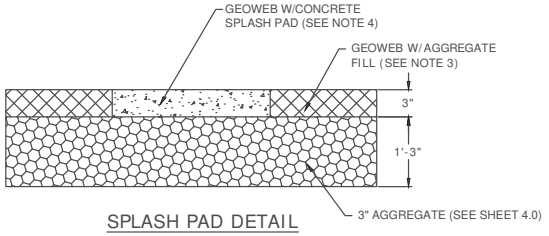
SCALE:
NTS

SHEET TITLE:
RECOMMENDED PIPE / ACCESS OPENING SPECIFICATIONS

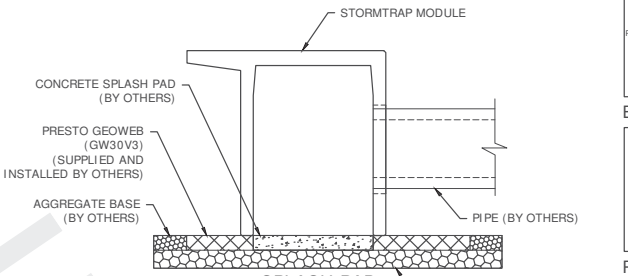
SHEET NUMBER:
5.0

NOTES:

1. THE APPROVED GEOWEB SHALL BE PRESTO GEOWEB (GW30V3). THE GEOWEB NOMINAL DIMENSIONS SHALL BE 9-FT x 25-FT.
2. THE CONCRETE SPLASH PAD AND GEOWEB SHALL BE INSTALLED PRIOR TO INSTALLATION OF THE STORMTRAP MODULES.
3. THE GEOWEB INFILL MATERIAL SHALL BE #5 AGGREGATE.
4. THE CONCRETE SPLASH PAD SHALL BE INSTALLED WITHIN THE GEOWEB AND IS REQUIRED AT ALL PIPE ENTRY LOCATIONS.
5. THE GEOWEB EDGE SHALL BE INSTALLED 1-FT BEYOND THE OUTER PERIMETER OF THE STORMTRAP SYSTEM.
6. THE GEOWEB LONGITUDINAL DIMENSION (25-FT) SHALL BE INSTALLED PARALLEL TO THE STORMTRAP LEGS.
7. THE CONCRETE SPLASH PAD AND GEOWEB SHALL BE CENTERED AT THE PIPE PENETRATION.
8. REFER TO SPLASH PAD LAYOUT FOR CONCRETE SPLASH PAD DIMENSIONS.
9. IF ANY PRODUCT OTHER THAN PRESTO GEOWEB IS TO BE INSTALLED, THE PRODUCT MANUFACTURER IS REQUIRED TO SUBMIT A LETTER STATING THAT THE PRODUCT IS EQUAL OR BETTER THEN PRESTO GEOWEB, BOTH IN PERFORMANCE AND IN STRUCTURAL CAPACITY.

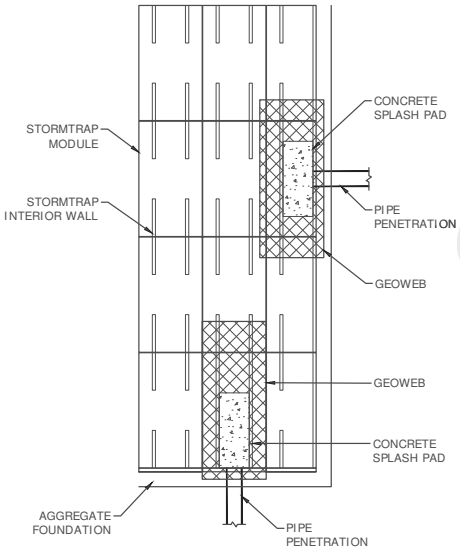


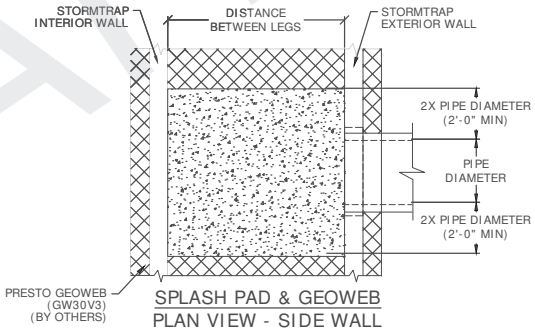
SPLASH PAD DETAIL



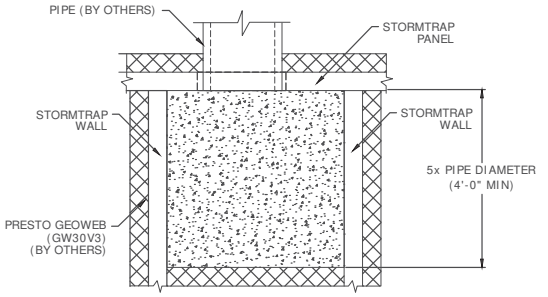
SPLASH PAD ELEVATION

SPLASH PAD CONFIGURATION





SPLASH PAD & GEOWEB
PLAN VIEW - SIDE WALL



SPLASH PAD & GEOWEB
PLAN VIEW - END PANEL

StormTrap

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SCALE:

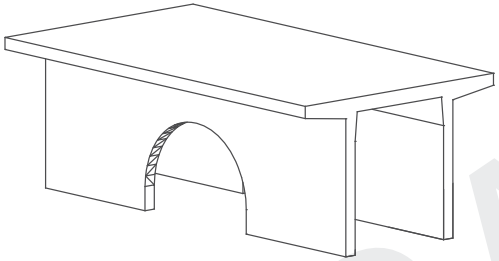
NTS

SHEET TITLE:

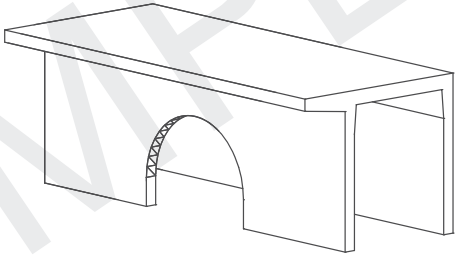
SPLASH PAD & GEOWEB DETAILS

SHEET NUMBER:

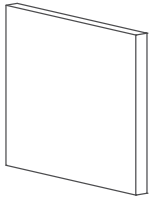
6.0



TYPE I



TYPE II



TYPE IV
END PANEL

NOTES:
1. OPENING LOCATIONS AND SHAPES MAY VARY.
2. SP - INDICATES A MODULE WITH MODIFICATIONS.
3. P - INDICATES A MODULE WITH A PANEL ATTACHMENT.
4. POCKET WINDOW OPENINGS ARE OPTIONAL.

StormTrap®

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1-877-867-6872

ENGINEER INFORMATION:

PROJECT INFORMATION:

SINGLETRAP

INFILTRATION

CURRENT ISSUE DATE:

ISSUED FOR:

SAMPLE PROJECT

REV.	DATE:	ISSUED FOR:	DWN BY:

SCALE:

NTS

SHEET TITLE:

SINGLETRAP
MODULE TYPES

SHEET NUMBER:

7.0

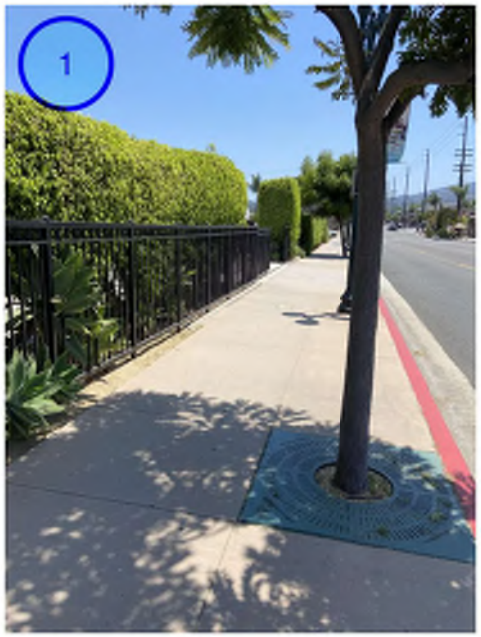
Appendix B

Photographs of Existing Conditions


Section 1
Section 2
Section 3
Section 4
Section 5
Section 6
Lomita Blvd
Narbonne Ave
Lucille Ave
Alilene Ave
Cypress St
Moon Ave
Woodward Ave
Hendricks Ave
245th St
246th St
Adona Dr
Cadiz Dr
Lomita Farmers Market
ICP DAS USA
Beach Front Property Management - Lomita...
LA County DPW Building and Safety...
Social Workplace
Lomita Feed Store
Suki Time Thai Kitchen
Takeout · Delivery
The Learning Tree Preschool
South Bay Eye Care Optometry
Benelli's New York Pizza
Takeout · Delivery
Family ARBOR TIRES AND AUTO SERVICES
Tire shop
Pure Water
The Trim Tart
Takeout · Delivery
Nail Island
Burnin Daylight Brewing Company
Takeout
Gasser's G...
Lomita Lock and Key
Anchor Southbay Church
S.T.I.L. GOT IT
Summer Studios
Bajal Fishing Tackle
Delivery
El Jacalito
Takeout · Delivery
M & A Management
Corridor Flow
Takeout · Delivery
The Blackthorn Pub
Taiwanese Presbyterian Church In South Bay

Section 1


1
2
3
4
5
6
Narbonne Ave
Chabad of South Bay
24418
Narbonne Ave
245th St
245th
Narbonne Ave
Burnin Daylight
Brewing Company
Takeout
South Bay Credit Union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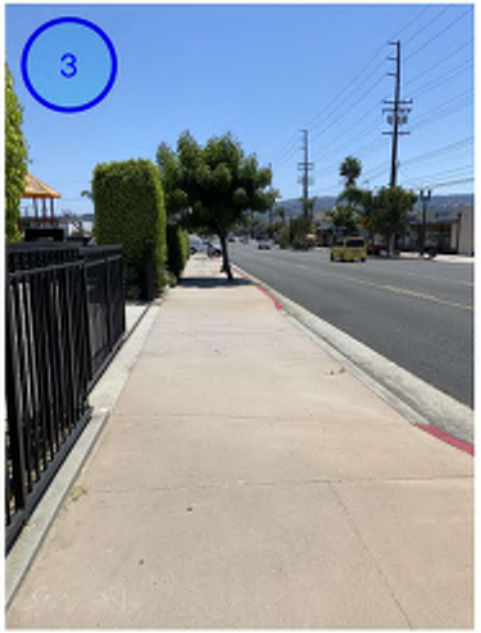
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4


5


6


Narbonne Ave
Chabad of South Bay
Narbonne Ave
24418
245th St
245th
Narbonne Ave
Burnin Daylight
Brewing Company
Takeout
South Bay Credit Union


7


8


9


10


11


12


13


14

Section 2


Narbonne Ave
Narbonne Ave
245th St
245th St
245th St
245th St
1
2
3
4
5


1


2


3


CHABAD of SOUTH BAY
4


5


Narbonne Ave
Narbonne Ave
245th St
245th St
245th St
245th St
6
7
8
9
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6

7

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10


15
14
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13
12


Narbonne Ave
STOP
11


12


STOP
13


14


15


244.8'
16
17
18
19
20
21
22


16


17


18


19


20


21


22

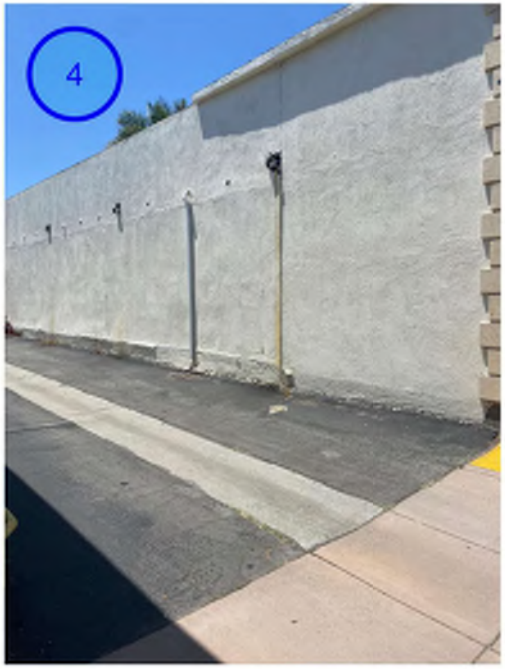
Section 3


Machida Karate Academy
Lomita Feed Store
Delivery
24437
24431
A Notary
Notary public
24425
Narbonne Ave
nello's New York Pizza
Takeout · Delivery
BobbleHead Empire
Outdoor sports store
24403
The Trim Taft
Takeout · Delivery
2315
24510
House Of Brides
uxedo · Wedding
Bridal shop
Nail Island
1
2
3
4
5
6


1


2


3


4


5


6


24329
Machida Karate Academy
Lomita Feed Store
Delivery
24457
24471
12
A Notary
Notary public
Narbonne Ave
11
24423
10
9
hello's New York Pizza
Takeout · Delivery
Bobblehead Empire
8
7
24503
24507
The Trim Tan
Takeout · Delivery
24508
House Of Brides
uxedo - Wedding...
Bridal shop
Nail Island
Narbonne Ave
Narbonne Ave

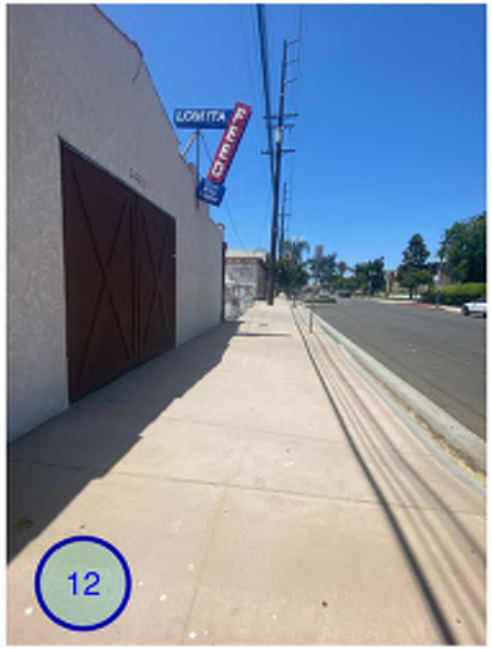

7


PIZZA
8


9


NO PUBLIC PARKING
NHD
SALON
10


11


LOMITA
12


18
17
19
16
A Notary
South Bay
15
13
14
BobbleHead Empire


13


14


15


16


17


18


19


Narbonne Ave
Narbonne Ave
Narbonne
Machida Karate Academy
Lomita Food Store
Delivery
25
24
23
22
21
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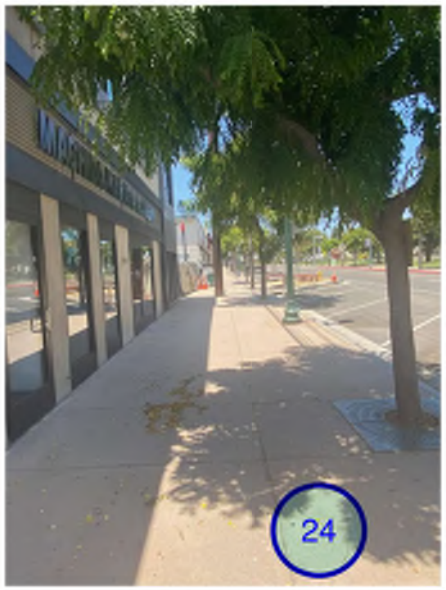
23


24


25


28
27
26
30
29
31
Narbonne Ave
Narbonne Ave
Mashido Karate Academy


26


27


28


29


30


31

Section 4


9
8
7
6
5
4
3
2
1
Lomita Blvd
Lomita Blvd
Nail Island
Narbonne Ave


4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12


Lucille Ave
13


14


15


16
17
18
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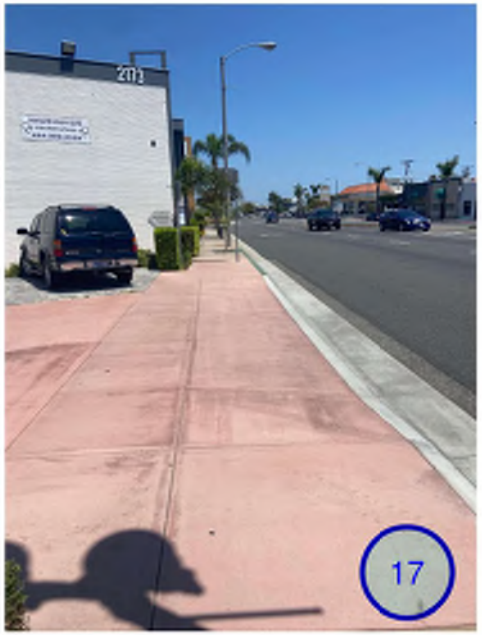
21
Lomita Blvd
Woodward Ave
Narbonne Ave
Summer Studios
Lomita Blvd
Lomita Blvd
Lomita Blvd


16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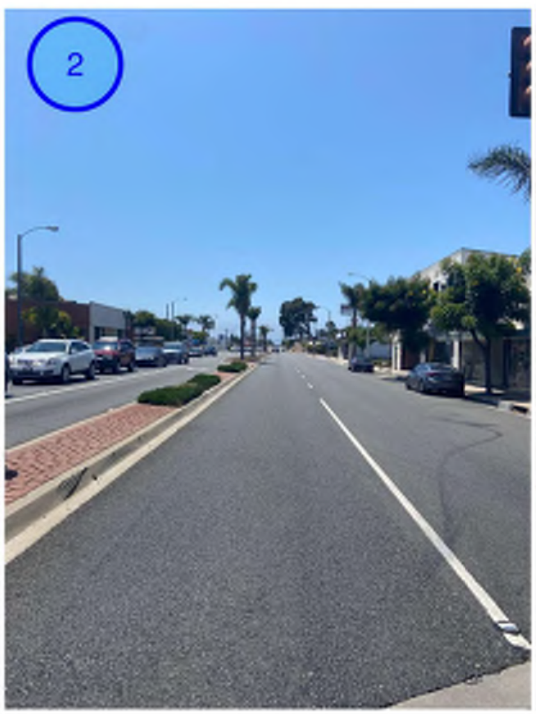
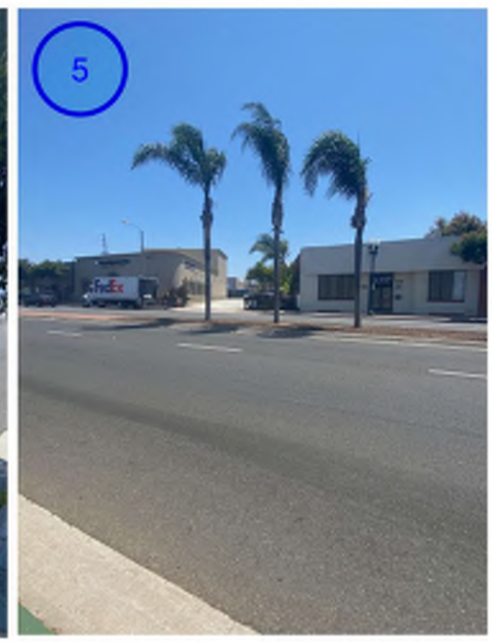
OPEN
21

Section 5



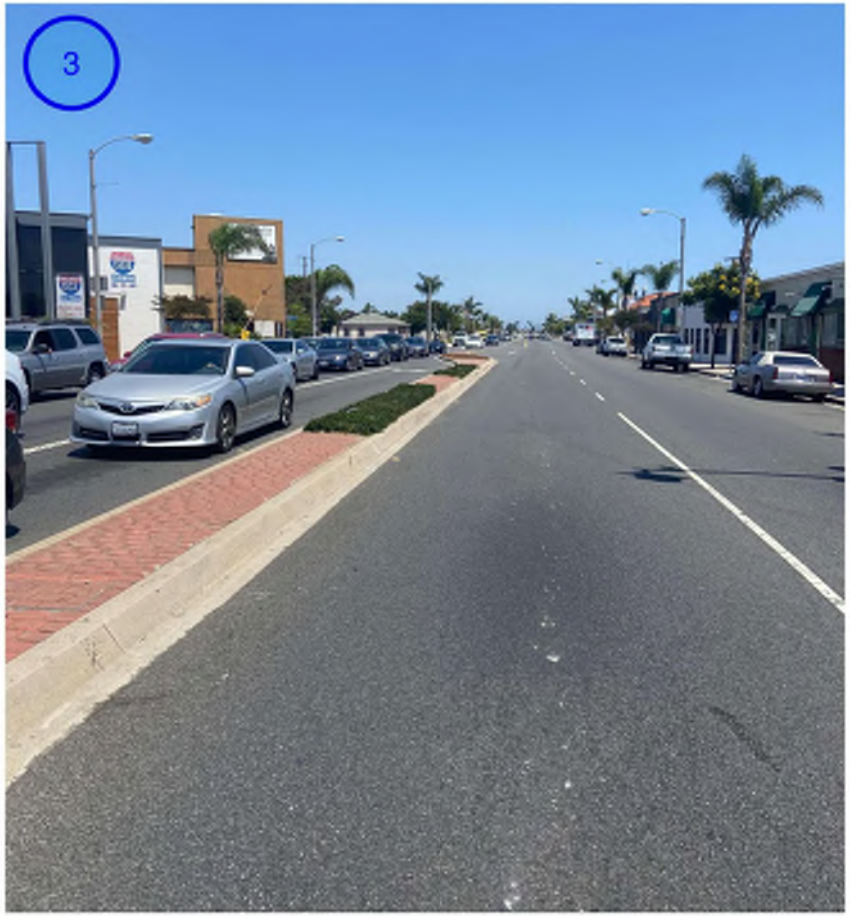


Section 6


1
2
3
4
STILL GOT IT
Summer Studios
Lomita Blvd
Narbonne Ave
Pop Up Pin-Up
Clothing store
Shaolin Temple
Kung Fu School
M & A Management
Horrible Flow
Takeout · Delivery
The Blackthorn Pub


1


2
NO U TURN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4

Appendix C
Operations and Maintenance Plan

The Safe, Clean Water Program requires that the feasibility study include details on how the operations and maintenance (O&M) tasks will be performed, associated costs, and the responsible party.

The following sections document the planned O&M tasks involved in assuring the functionality of the elements of the Downtown Lomita Multi-Benefit Stormwater Project (Project). Further refinement of these tasks will occur during the design phase as specific components are designed, manufacturers are selected, and site-specific constraints are identified. Anticipated costs associated with the preliminary O&M plan are described in Appendix E of this Feasibility Study.

The City of Lomita will be the responsible party for conducting all O&M tasks as identified in the final O&M Plan.

Also included herein is a discussion of vector controls that will be employed by the Project.

Operations and maintenance will utilize monitoring and adaptive management to assess the functionality and effectiveness of each project component and develop repairs and enhancements for those components that are not achieving project objectives.

C.1 Diversion Structures

Diversion structures are proposed to divert flow from Los Angeles County Flood Control District (LACFCD) storm drain facilities to infiltration Best Management Practices (BMPs). The City of Lomita will enter into a Use and Maintenance Agreement with LACFCD stipulating that the City of Lomita will take responsibility for proper maintenance and functionality of the diversion structures and appurtenances.

Tasks anticipated to be included in the O&M Plan include, but are not limited to, the following:

- Inspections will occur frequently for the first year following construction to establish a baseline for determining which events generate large amounts of debris.
- Following the first year, a schedule will be tailored to address findings from the first year of frequent inspections. As a minimum, diversion structures will be inspected twice annually before and after wet season and following large storm events.
- Sediment and debris will be removed based on the schedule developed during the first year of inspections, and tailored to meet changing conditions, but at a minimum three times per year after storm events.
- Equipment will be cleaned and disinfected to avoid algal growth and vector production.

C.2 Debris Separating Baffle Box (DSBB)

Following each diversion structure, a pretreatment device will remove debris and pollutants from the flow so that the downstream BMP devices remain unclogged and free of debris and

sediment that could otherwise reduce their usefulness. The Project proposes to use Debris Separating Baffle Boxes (DSBB) devices to accomplish this task.

While the DSBB may be able to capture and store debris for years without loss of effectiveness, frequent inspection of the device will occur following construction to establish an appropriate inspection and cleanout frequency required for each specific location. Tasks anticipated to be included in the O&M Plan include, but are not limited to, the following:

- The DSBBs should be inspected twice annually to ensure that they are effectively removing litter, debris, sediments, and hydrocarbons. Trash baskets will be cleaned during these inspections. Damage to the device will be noted and repairs made to restore the functionality of the device.
- The filtration screens and sediment chambers will be pressure washed and vacuumed out as needed. Removed material will be disposed of as required per local regulations.
- Vector control activities will be performed as needed.
- Damaged parts will be replaced.

C.4 Drywells

Drywells are included in the Project as one of the primary methods of capturing and treating stormwater and dry weather flow. Drywells are expected to require limited maintenance because adequate pretreatment devices will prevent them from clogging with sediment and debris. Only the first and last drywell will have an access lid so the drywell can be accessed; the other drywells will be buried. As described in the Monitoring Plan (see Appendix D), proper function of the drywells will be monitored through pressure transducers installed in the first and last drywells to monitor water levels and infiltration to ensure any reduction in efficacy is identified. Depending on those results, more frequent or less frequent maintenance may be required. Replacement of individual drywells that are not functioning would need to be evaluated based on the functioning of the system as a whole.

Tasks anticipated to be included in the O&M Plan include, but are not limited to, the following:

- The first and last drywells will be inspected four times per year: at the beginning and end of the wet season, and twice during the wet season.
- Monitoring of performance to determine if infiltration rates have decreased will be performed as described in the Monitoring Plan (see Appendix D).
- First and last drywells will be inspected for standing water. If water is standing in the device for more than 96 hours, excess sediment and the top aggregate layer will be replaced, when possible. If standing water persists after initial maintenance, the wells may need to be replaced and/or additional pretreatment installed.

C.5 Infiltration Gallery

An infiltration gallery is included in the Project as one of the primary methods of detaining and treating stormwater and dry weather flow. The infiltration gallery is expected to require limited maintenance because pretreatment capture devices will prevent it from clogging with sediment and debris. Per the proposed Monitoring Plan (see Appendix D), proper function of the infiltration gallery will be assessed utilizing pressure transducers installed in strategic

locations in the infiltration gallery to ensure any reduction in efficacy is identified. Depending on those results, more frequent or less frequent maintenance may be required.

Tasks anticipated to be included in the O&M Plan include, but are not limited to, the following:

- The infiltration gallery will be inspected four times per year: at the beginning and end of the wet season, and twice during the wet season.
- Monitoring of performance to determine if infiltration rates have decreased will be performed as described in the Monitoring Plan (see Appendix D).
- The infiltration gallery will be inspected for standing water. If water is retained in the device for more than 96 hours, excess sediment and the top aggregate layer will be removed and replaced, when possible. If standing water persists after initial maintenance, further investigation may be necessary and additional pretreatment may need to be installed.

C.6 Porous Pavement

Porous pavement is proposed to be installed in the parking lot where the infiltration gallery is proposed. The infiltration gallery has a footprint that is approximately 30 percent the size of the parking lot. There will be 13 ft of cover over the infiltration gallery and during design, it will be evaluated as to whether underdrains are required to move infiltrated surface water away from the top of the infiltration gallery.

Porous pavement must be inspected and cleaned out to ensure clogging does not occur, which would reduce the efficacy of the BMP.

Tasks anticipated to be a part of the O&M Plan include, but may not be limited to, the following:

- Twice per year the porous pavement will be vacuumed to remove clogs caused by debris.
- The pavement will be inspected regularly and swept as necessary to clean off plant matter and other debris.
- The pavement will be inspected twice or more during the wet season to assess proper infiltration performance. The permeable pavement and aggregate will be disposed of and replaced as necessary.
- Holes in the ground near and in the porous pavement will be refilled with appropriate material.
- Erosion will be controlled at the site. Gravel or another permeable ground cover may be necessary where vehicular or foot traffic causes erosion.
- Repair any areas that become damaged.

C.7 Vegetation Planting

The Project includes planting new vegetation and replacing disturbed vegetation. This includes numerous native species of drought tolerant plants and trees. These components are

critically important to the Project in that they provide much needed shading, reduction in heat island effects, and community greenscape benefits. It is critical that these features be properly maintained, especially as they are being established. The specific selection of plants will occur during the design phase, and the O&M Plan for this vegetation will be tailored to meet the needs of those plants specifically.

In addition, disturbance of areas identified for revegetation often result in the introduction of weedy and invasive species. It is important that newly vegetated areas be inspected regularly for infestations of undesirable species and that these species be removed before they become established.

Tasks anticipated to be included in the O&M Plan include, but are not limited to, the following:

- Vegetated areas will be cleaned of trash, weeds, and plant litter monthly.
- Mowing and/or pruning of vegetation will be done monthly to avoid overgrowth.
- Displaced sediment will be removed after large storms
- Soil, mulch, and/or plant material will be replaced every three years or earlier if erosion occurs.
- Plants will be watered regularly following planting for 2-3 years until they are established and during prolonged dry periods if necessary for specific species. Determination on proper watering frequency to encourage growth of healthy, drought tolerant plants will be determined based on specific plants selected. Vegetation design will include a watering plan.
- Standing water will be eliminated to prevent vector breeding.

C.8 Bioretention

Bioretention areas will be included in the Project alignment to treat surface flow. Proper function of these features requires adequate maintenance. The specific selection of plants will occur during the design phase, and the O&M Plan for this vegetation will be tailored to meet the needs of those plants specifically.

Tasks anticipated to be included in the O&M Plan include, but are not limited to, the following:

- Plants, mulch, and soil will be replaced regularly to ensure proper infiltration and pollutant removal.
- Flow entrances and surface overflow areas will be inspected, and topsoil will be replaced where erosion is occurring. If erosion persists, the flow velocities, gradients, and energy dissipation components will be reassessed.
- In the case of potential areas receiving irrigation, these areas will be kept free of trash, debris, and loose vegetation.
- Weeds will be removed as plants are being established. Less frequent weed removal should be required once plants are established.

- Pruning and removal of dead plant material will occur as needed. Plants will be replaced as necessary.
- Plants will be irrigated during prolonged dry periods while they are being established (first 2-3 years) but may not require long term irrigation. Determination on proper watering frequency to encourage growth of healthy, drought tolerant plants will be determined based on specific plants selected.
- Mulch will be replaced annually if heavy metal deposition is possible. This includes areas near parking lots and roads.
- If standing water is found during inspections, it will be eliminated to prevent vector breeding.

C.9 Vector Production Minimization

Vector minimization will be a key aspect of the design of the Project utilizing, but not necessarily limited to, the following protocols will be considered:

- Guidelines included in the California Department of Public Health's Checklist for Minimizing Vector Production in Stormwater Management Structures (CDPH, 2010);
- All requirements developed by local vector control districts or agencies; project plans and pertinent design documents will be sent to these districts or agencies for review and comment.
- Incorporating best vector control practices into Project designs. Examples of this include specifying manhole security barriers made of stainless steel with watertight seals and plugs intended to prevent unauthorized access and control odors and vectors, with City padlocks used as locking mechanisms.
- Routine inspection for required vector control will be included in the final Project O&M Plan, which will be overseen by the City. The frequency of required inspections for vector control will be developed during final design as well as during the initial operation of the devices. The City will collaborate with local vector control districts or agencies to ensure the best vector control practices are incorporated into project plans and operation and maintenance documents.

During the design phase, when a comprehensive vector control plan is developed, it will be reviewed by the appropriate local vector control district or agency and modified as required to ensure all requirements are met.

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Appendix D
Monitoring Plan

The Safe, Clean Water Program requires that a Feasibility Study include a monitoring plan that will measure the effectiveness of the completed project, including metrics specific to the identified benefits.

The City of Lomita is committed to implementing a comprehensive monitoring plan that will assess the efficacy and performance of the Downtown Lomita Multi-Benefit Stormwater Project (Project). This will include metrics related to improving water quality. These metrics are included in **Table D-1**.

The full scope of the post-construction monitoring plan will be developed during the design phase of the Project when the design of all project components has been finalized. This will include, but may not be limited to, 1) monitoring of runoff volume captured and treated by the various components of the Project, and 2) measuring the water quality of the runoff that is captured and treated by the water quality components of the Project.

The City of Lomita will be responsible for conducting all monitoring as part of this plan.

Table D-1. Performance Goals and Metrics

Category	Goal/Metric		
Goals	Improve Water Quality by reducing pollutant loading to Wilmington Drain and downstream waterbodies		
Desired Outcomes	Capture and infiltrate all dry weather flow	Capture and infiltrate 85th Percentile 24-hour storm	Determine required O&M intervals
Output Indicators	Flow Data	Pollutant concentrations measured at influent of BMPs	Water level data in infiltration BMPs
Outcome Indicators	Flow Volume	Pollutant Load	Infiltration Rate
Measurement Tools and Indicators	Monitoring and Reporting Plan	Flow sensors/auto-samplers	Pressure transducers
Targets	Up to 5.6 acre-feet of wet weather flow captured by Project	Minimum of 80% of phosphorus removed annually by the Project	Minimum of 80% of zinc removed annually by the Project

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Appendix E
Hydrology and Water Quality Analysis Report

A hydrology and water quality analysis for the Downtown Lomita Multi-Benefit Stormwater Project (Project) demonstrates anticipated compliance with the updated Los Angeles Regional Water Quality Control Board (Regional Board) MS4 NPDES Permit (Regional Board, 2020). The draft MS4 permit was introduced in August 2020, and when finalized and adopted, will supersede the current 2012 MS4 Permit. The proposed stormwater solution involves multiple stormwater best management practices (BMPs) working together in a treatment train to manage the 85th percentile, 24-hour storm from a combined tributary area of 110.5 acres.

E.1 Project Definition

The Project consists of four drainage areas within the vicinity of the junction of Narbonne Ave with Lomita Blvd as shown in **Figure E-1**. Three of the drainage areas (Drainage Areas 1 through 3) include diversion structures to divert flow from the storm drains for treatment, while Drainage Area 4 involves surface flow.

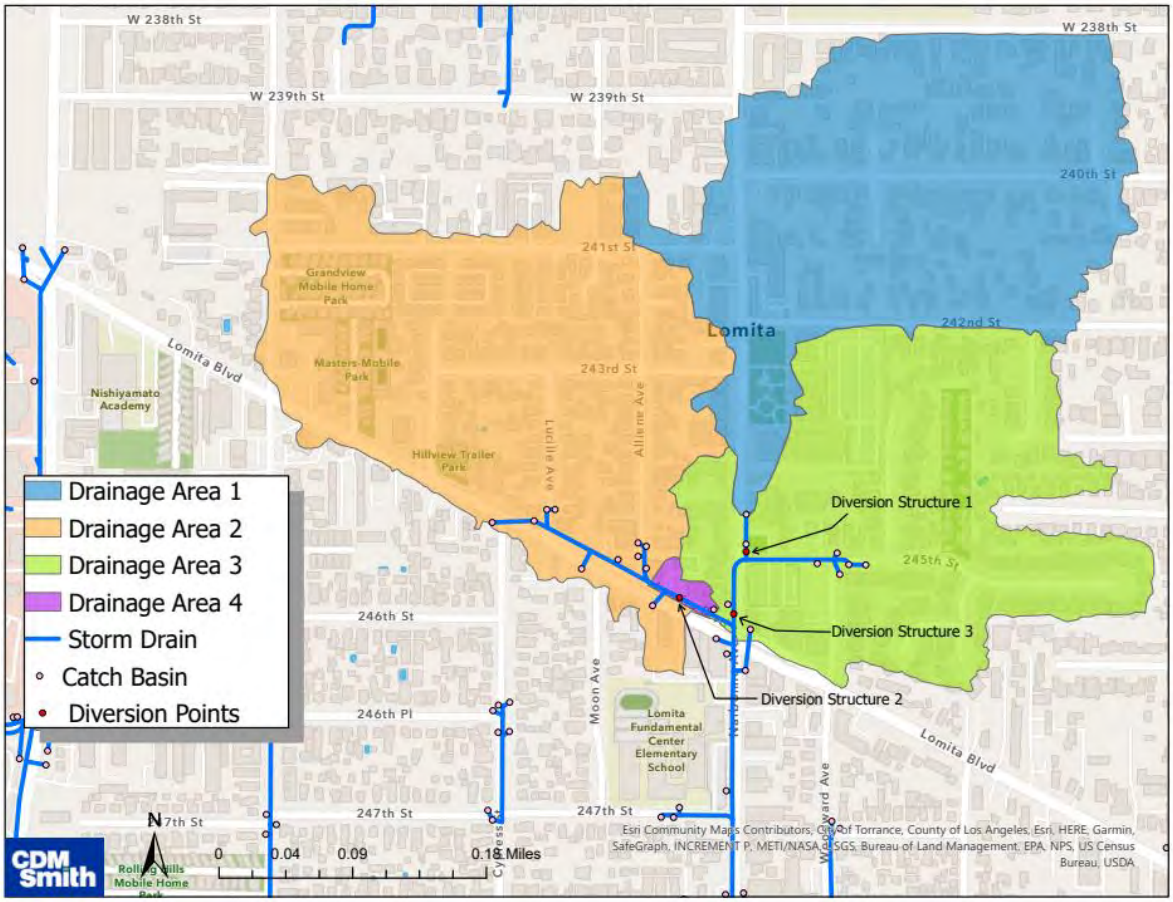

Figure E-1. Drainage Areas and Proposed Diversions

Contributing areas to each Los Angeles County (County) catch basin were mapped as part of the Dominguez Channel Watershed Strategic Green Street Implementation Plan (SBCOG, 2018.) Multiple small catch basin drainage areas were combined into each of the three larger

diversion drainage areas shown in **Figure E-1**. **Table E-1** lists characteristics for each drainage area.

Table E-1. Drainage Area Characteristics

Characteristic	Drainage Area #1	Drainage Area #2	Drainage Area #3	Drainage Area #4
Drainage Area (acres)	37	40	33	0.5
Flow Path Length (feet)	2,000	2,500	1,500	200
Flow Path Slope (foot/foot)	0.01	0.01	0.01	0.01
Impervious Percent	58%	72%	66%	92%

Flow length was calculated by tracing a flow path from the furthest edge of the tributary area to most downstream catch basin and the slope was approximated by the grade of adjacent streets. The percent impervious values were derived from the 2016 USGS National Land Cover Database (USGS, 2016), and the soil type was derived from LA County maps (LA County).

E.2 Hydrology Calculations

The City of Lomita complies with the Los Angeles County MS4 permit through participation in the Dominguez Channel EWMP. Although the 2020 MS4 Permit will remove the term "Enhanced" from Watershed Management Programs, the final compliance coverage for drainage areas that capture the 85th percentile, 24-hour storm event will remain in place.

The Los Angeles County HydroCalc calculator (version 1.0.3) was used to estimate the runoff hydrograph from the water quality storm over the four Project drainage areas (LA County, 2018). In addition to the data listed in **Table E-1**, HydroCalc requires the 85th percentile design storm depth to compute a hydrograph based on the modified rational method. The 85th percentile, 24-hour rainfall depth was taken from County isohyets. **Table E-2** lists rainfall depth and runoff properties.

Table E-2. Runoff Characteristics

Characteristics	Area to Diversion #1	Area to Diversion #2	Area to Diversion #3	Area to Bioretention
85th Percentile, 24-hr Storm Depth (in)	1.0	1.0	1.0	1.0
85th Percentile, 24-hr Peak Flow (cfs)	3.4	4.4	3.8	0.16
85th Percentile, 24-hr Volume (ft^3)	75,100	97,400	74,600	1,500
85th Percentile, 24-hr Volume (AF)	1.72	2.24	1.71	0.03

Infiltration BMPs downstream of each diversion are sized to infiltrate the 24-hour runoff volume. The highest groundwater surface throughout the project area (Geotracker, 2017 measurement) is 72.8 feet below ground surface (bgs). Additionally, based on the Los Angeles County Public Works Groundwater Well website (LACPW-2), which includes a station in Lomita, groundwater was encountered at greater than 80 feet bgs dating back to 2002. Drywells may extend to 10 feet above the water table (CA DWR, 2014) to a maximum depth of 60 feet. Drywell design will prohibit infiltration above 20 feet BGS to avoid to utilities, roadways, and nearby structures.

A design infiltration rate of 16.9 in/hr has been derived from a recent soil analysis in Downtown Lomita (Hamilton, 2020). The design infiltration rate was calculated by observing a percolation rate of 33.8 in/hr in a 30 ft deep drywell.

For the purpose of conceptual design of the proposed Project, this observed percolation rate was divided by the product of three reduction factors:

- Reduction factor for the boring percolation test (RFt, assumed to be 2),
- Reduction factor for site soil variability (RFv, assumed to be 1), and
- Reduction factor for long-term siltation, plugging and maintenance (RFs assumed to be 1).

$$Total\ Reduction\ Factor, RF = RF_t \times RF_v \times RF_s$$

$$RF = 2 \times 1 \times 1 = 2$$

$$Design\ Infiltration\ Rate = \frac{Measured\ Percolation\ Rate}{RF}$$

$$16.9 \frac{in}{hr} = \frac{33.8\ in/hr}{2}$$

These factors are supported by the LA County administrative manual for low impact development stormwater infiltration standards (County, 2017), which allows for a range of factors to be used. This reduction factor is considered preliminary and used for the purpose of preliminary conceptual design. Additional Project-specific soils analyses and percolation testing will be conducted during the design phase to further refine the infiltration rates.

To determine the number of drywells required, the runoff volume for each interval of the HydroCalc hydrograph ($Q_{HydroCalc,t}$) was reduced by a volume equal to the design infiltration rate multiplied by the number of drywells ($Q_{infil,t}$) to yield a reduced flow ($Q_{reduced,t}$). The number of drywells (NumberWells) was set, using Excel GoalSeek, to prohibit the maximum non-infiltrated storage at any timestep ($S_{remaining}$) from exceeding the combined volume of the drywell shafts (cross-sectional area times length times the number of drywells.)

$$Q_{reduced,t} = Q_{HydroCalc,t} - Q_{infil,t}$$

$$Q_{infil,t} = \min\left(Q_{HydroCalc,t}, NumberWells \times\ Screened\ Area\ \times\ Infiltration\ Rate\right)$$

$$S_{remaining,t} = Q_{reduced,t} \times \Delta t + S_{remaining,t-1}$$

$$set\ Sremaining, t \leq NumberWells \times\ Well\ Volume$$

The design infiltration rate of 16.9 in/hr yields 19 drywells for Diversion #2, and 15 drywells for Diversion #3. Runoff from Drainage Area #4 will flow to proposed bioretention areas located along the north side of Lomita Boulevard. **Appendix A** provides potential locations for these bioretention areas, however optimal locations will be selected during the design phase.

For the conceptual design, the proposed infiltration gallery has been sized based on outputs of PCSWMM, a robust hydrologic and hydraulic modeling software (PCSWMM). The dynamic model, accounting for both storage and infiltration, has been iterated to find the minimum infiltration gallery footprint required to manage the 85th percentile, 24-hour storm. The infiltration gallery has been modeled assuming the following characteristics: 5 ft internal

storage depth, 0.9 void ratio, and 6 in of freeboard. The entire footprint of the gallery is assumed to be available for infiltration at a constant rate of 16.9 in/hr. Model results show that the proposed infiltration gallery should be a minimum 3,100 sf to manage the entire design storm. Final sizing will be refined during the design phase.

E.3 Water Quality Calculations

The Project is in the Wilmington Drain tributary to the Machado Lake watershed. The Regional Board adopted the Machado Lake Nutrients Total Maximum Daily Load (Nutrients TMDL) in 2008 and approved the Machado Lake Toxic Pollutants TMDL (Toxics TMDL) in 2010 to address Organochlorine Pesticides and Polychlorinated Biphenyls. In 2011, the Regional Board adopted the Los Angeles and Long Beach Harbors Toxic and Metals TMDLs which address (among other constituents) cadmium, chromium, copper, mercury, lead, and zinc. The water quality analysis for the Project addresses Nitrogen (to examine the effects on the Nutrients TMDL) and Zinc (to analyze impacts on the Toxic and Metals TMDL).

The anticipated reduction in Zinc and Nitrogen loads throughout the Project were analyzed using the Watershed Management Modeling System (WMMS2) watershed model (LA County-2). WMMS2 establishes runoff volumes and pollutant loads for watersheds throughout LA County through the Loading Simulation Program C++ (LSPC) model.

Figure E-3 shows that WMMS2 watershed 2094 covers the combined area of all three diversion areas. Runoff characteristics from watershed 2094 were scaled to infer pollutant loads from the Project drainage area.

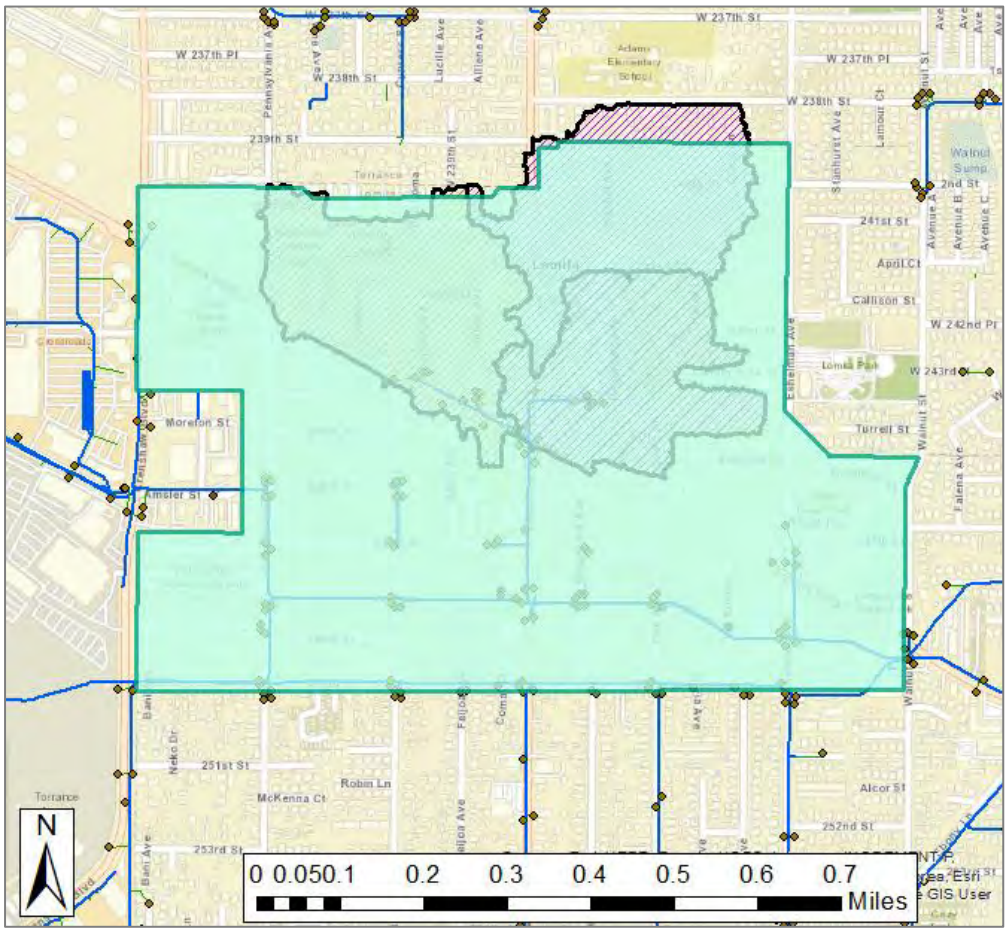

Figure E-3. WMMS2 watershed 2094

WMMS2 shows no boundary inflows into watershed 2094; all flow and pollutant loading is assumed to be generated within the area. The three downtown Lomita watersheds are located at the upstream boundaries of watershed 2094, and pollutant runoff to the project from these drainages was assumed to be proportional by area to the total runoff from watershed 2094.

WMMS2 was run from October 1, 2000 to September 30, 2018 at hourly and daily time steps. WMMS2 model output relevant to this analysis included:

- Total rate of outflow (i.e., inflow to project) from area;
- Total Nitrogen (dissolved + sediment-associated) concentration in outflow (mg/l);
- Total Phosphorus (dissolved + sediment-associated) concentration in outflow (mg/l);
- Total Zinc (dissolved + sediment-associated) concentration in outflow (ug/l);
- Nitrogen mass in outflow (lb/day);
- Phosphorus mass in outflow (lb/day); and
- Zinc mass in outflow (lb/day).

Two 24-hour storm events over the 19-year period were found to have a total rainfall similar to the 85th percentile storm event (**Table E-3**) with over three dry days preceding the storm event.

Table E-3. Storm events close to 85th percentile

24-hour Storm Event	Total Rainfall (inches)
12/19/2002	0.994
12/27/2004	1.003

Table E-4 shows the pollutant mass runoff from the entire watershed 2094 for each storm event.

Table E-4. Storm Event Loads from Watershed 2094

Event	12/19/2002	12/27/2004
Total Nitrogen Mass (lb)	102.85	153.54
Zinc Mass (lb)	14.56	32.22

WMMS2 watershed 2094 has an area of 320 acres. The mass of each constituent in the runoff for each of the downtown Lomita watersheds was determined by scaling the pollutant loading for WMMS2 watershed 2094 by the drainage area to each Lomita diversion. Multipliers were determined as the project drainage area divided by the total watershed 2094 drainage area. **Table E-5** shows the results.

Table E-5. Lomita Drainage Area Mass Captured

Event	DA	#1	#2	#3	Bioretention	Total
	Area (ac)	37	40	33	0.5	**110.5**
	Multiplier	0.12	0.13	0.10	0.0016	
12/19/2002	Nitrogen (lb)	11.89	12.86	10.61	0.16	**35.52**
	Zinc (lb)	1.68	1.82	1.50	0.02	**5.03**
12/27/2004	Nitrogen (lb)	17.75	19.19	15.83	0.24	**53.02**
	Zinc (lb)	3.73	4.03	3.32	0.05	**11.13**

The Project is expected to capture between 35 and 53 lbs of Nitrogen, and 5 to 11 lbs of Zinc for a 24-hour, 85th percentile storm event. The combined Project drainage areas total 110.5 acres, 2.1% of the 5,057-acre drainage area to Wilmington Drain. The 2016 Dominguez Channel EWMP (Appendix I) summarized Nitrogen and Zinc percentile loads for Wilmington Drain Watershed for several storm events; a December 17, 2010 event had a rainfall volume of 0.98 inches and was closest to the 1-inch 85th percentile storm. The EWMP reported a Nitrogen load of 2,026 lb and a Zinc load of 121.2 lb for this event. The maximum WMMS2 simulated Nitrogen load is approximately 2.6% of the December 2010 load, and the minimum simulated Zinc load is 4% of the load observed for the 2010 storm. Due to the variation in loads produced by different rainfall volumes reported in the EWMP (greater loads are produced at lower rainfall in some cases), the numbers computed in WMMS2 to be captured by the Project are considered in the appropriate range.

A mass balance was completed considering WMMS2 flow for each tributary area and the expected rate of diversion over a 20-year period. It was estimated that the following reductions in pollutant loading would occur for the first and second priority projects:

- Drainage Area 1: 91% Nitrogen reduction, and Zinc 86% reduction
- Drainage Area 2: 93% Nitrogen reduction, and Zinc 90% reduction
- Drainage Area 3: Nitrogen 92% reduction, and Zinc 89% reduction

These values exceed the target objective of an 80 percent reduction.

Appendix F

Geotechnical Percolation Report

October 27, 2020

GEOTECHNICAL PERCOLATION REPORT
PROPOSED INFILTRATION SYSTEM

2154 245th Street, Lomita, California

H&A Project No. 15-2036-1

Prepared For

Luigi Schiappa Development, Inc.
2040 Lomita Boulevard, Suite 100
Lomita, California, 90717

Prepared By

Hamilton & Associates, Inc.
1641 Border Avenue
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October 27, 2020
Project No. 15-2036-1

Luigi Schiappa Development, Inc.
2040 Lomita Boulevard, Suite 100
Lomita, CA 90717

Subject: Geotechnical Percolation Report, Proposed Stormwater Infiltration System, 2154 245th Street, Lomita, California.

Reference: 1) Hamilton & Associates, Inc. (2015), Percolation Testing Report, 24516 Narbonne Avenue, Lomita California, Project No. 15-2036, Dated May 20, 2015.

2) T.I.N. Engineering Company (2015), Soil Engineering Investigation and Report, Proposed On-Grade, No Basement, Apartment Building Development on Vacant Lots 35-40, Tract 47, Southeast Corner of Narbonne and 245th Street, Lomita, California, File No. 152100, Dated June 6, 2015.

Dear Mr. Schiappa,

Presented herewith is Hamilton & Associates, Inc. (H&A) geotechnical percolation report for the proposed stormwater infiltration system at 2154 235th Street, Lomita, California. The investigation was completed in accordance with our proposal dated September 28, 2020, and your subsequent authorization on October 1, 2020.

We thank you for the opportunity of working with you on this project. If you have any questions or require additional information, please contact the undersigned.

Respectfully Submitted,
HAMILTON & ASSOCIATES, INC.

Brendan J. Miller
Staff Engineer

Richard A. Martin, MS, PE, GE
Senior Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
RICHARD A. MARTIN
No. 563
Exp. 9-30-21
GEOTECHNICAL
STATE OF CALIFORNIA

BJM/RAM:rsm
Distribution: (4) Addressee

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Figures

Appendices

1.0 INTRODUCTION AND PURPOSE

This report presents the results of geotechnical investigation services to gather subsurface data for planning of a proposed infiltration system at 2145 245th Street in the City of Lomita, California. The approximate location of the site is shown on the Site Location Map (Figure 1).

The purpose of this investigation was to explore the subsurface soil conditions at the location of the proposed stormwater infiltration BMP system. Our scope of work included excavating one (1) 8-inch diameter exploratory borings to evaluate general soil subsurface conditions and conduct percolation testing. The locations of the exploratory borings are shown on the Percolation Test Location Plan, included as Plate A.

2.0 SITE AND SUBSURFACE CONDITIONS

2.1 EXISTING DEVELOPMENT

The site consists of a relatively flat rectangular vacant corner lot.

2.2 SUBSURFACE CONDITIONS

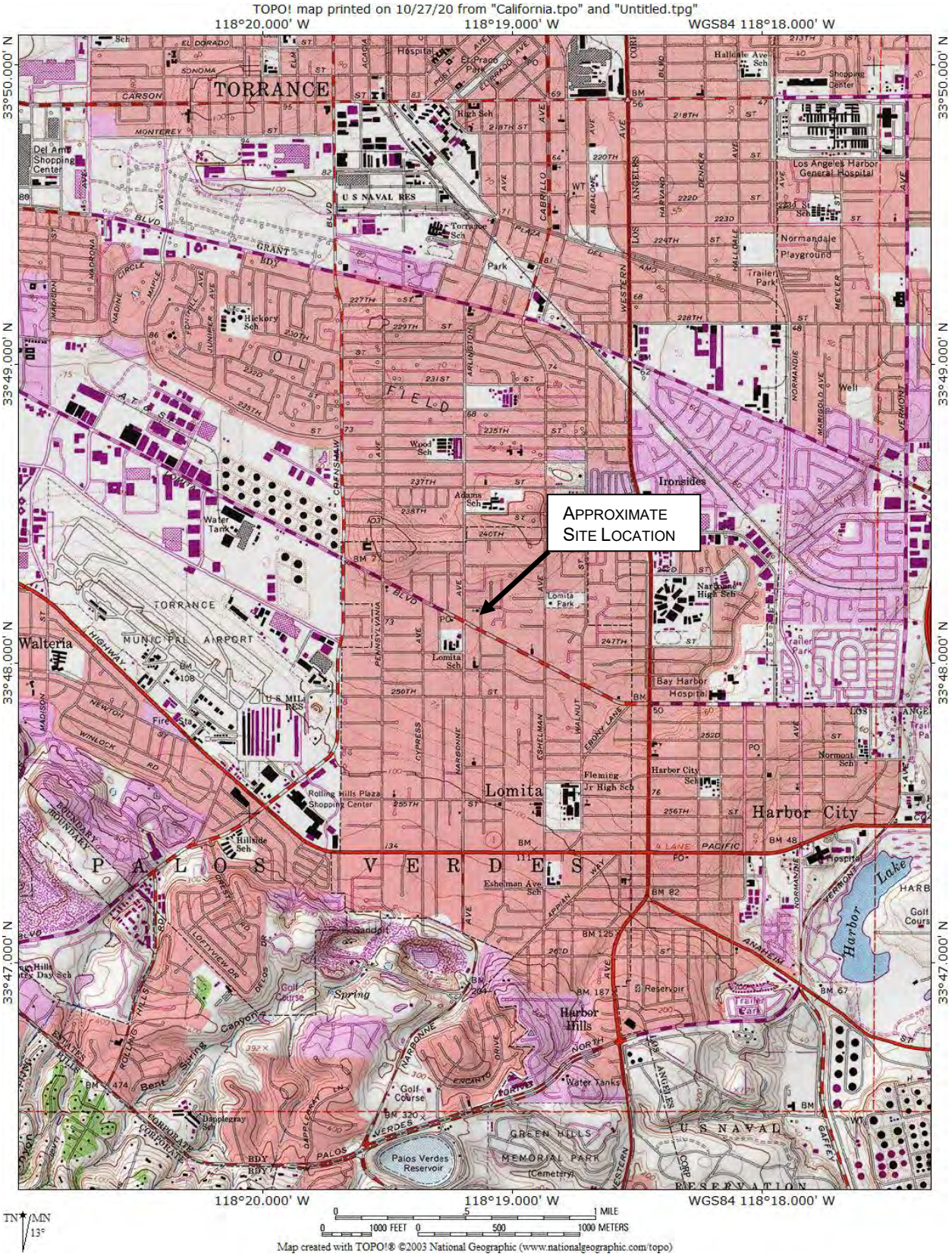
Based on published references, the project site is situated upon alluvium slightly elevated and locally dissected (Qae) as shown on the "*Geologic Map of the Palos Verdes Peninsula and Vicinity, Redondo Beach, Torrance, and San Pedro Quadrangles, Los Angeles County, California," by Thomas W. Dibblee, JR., 1999",* Figure 2.

During our field investigation one (1) boring was excavated to a depth of approximately 41-feet below ground surface at the approximate location shown on Plate A. Soils generally consisted of brown, moist to wet, sandy silty clay to about 15 feet, followed by tan/beige, damp to slightly moist, slightly silty sand to sand with trace silt, light brown/tan in color, and generally slightly moist to moist.

More detailed descriptions of the soils encountered and conditions observed during the subsurface exploration are recorded in the Logs of Borings, included in Appendix A (Plate B-1). Included in the boring logs are the depths of soil samples, barrel sample blow counts, field dry densities and field moisture contents, as well as the relevant laboratory tests performed.

2.3 GROUNDWATER AND CAVING

Ground water was not encountered to a total depth explored of approximately 41 feet below grade. Seasonal and long-term fluctuations in the groundwater



Schiappa Percolation
P.N. 15-2036-1

SITE LOCATION MAP
FIGURE 1

REGIONAL GEOLOGY MAP

LEGEND

af	
Qs	Qa
Qds	Qae

SURFICIAL SEDIMENTS

af *Artificial fill or cut and fill; many areas may not be shown*
Qs *Beach sediments, ranging from sand to cobble-boulder gravel*
Qds *Loose dune and drift sand*
Qa *Alluvium, mostly loamy clay of valley and flood plains; includes fine sand near Palos Verdes Hills*
Qae *Alluvium, similar to Qa but slightly elevated and locally dissected*

Qos	Qoa[1]

OLDER SURFICIAL SEDIMENTS

Qos *Older, stabilized dune and drift sand – mostly unconsolidated fine-grained sand*
Qoa *Older alluvium – nonmarine terrace cover of Woodring et al., 1946; Poland et al., 1959; Cleveland, 1972; sandy loam and loamy clay, includes sand and pebble gravel in Palos Verdes Hills, with pebbles derived mostly from Miocene hard siliceous shale and limestone; includes Palos Verdes Sand of Woodring et al., 1946, not differentiated on this map*
1 *Elevated old marine terrace remnants in Palos Verdes Hills, with little or no alluvial sedimentary cover; compiled in large part from Woodring et al., 1946; Cleveland, 1972*

N

From: "Geologic Map of the Palos Verdes Peninsula and Vicinity, Redondo Beach, Torrance, and San Pedro Quadrangles, Los Angeles County, California," by Thomas W. Dibblee, Jr., 1999

PROJECT: Schiappa Percolation	PROJECT NO: 15-2036-1	DATE: October 2020
Hamilton & Associates		**FIGURE 2**

conditions may occur however as a result of variations in rainfall, irrigation, surface run-off and other factors.

The use of hollow-stem augers precluded observation of potential caving conditions which may have otherwise occurred in an uncased hole, however moderate caving and/or soil sloughing may be likely in site deep excavations.

3.0 PERCOLATION

Hamilton & Associates, Inc. performed percolation testing at the location of the exploratory boring shown on Plate A. Geotechnical considerations and percolation test procedures were based on the County of Los Angeles "Low Impact Development Best Management Practice Guideline for Design, Investigation, and Reporting", dated June 30, 2017. The method employed was the boring percolation test procedure.

On October 9, 2020, one (1) 8-inch diameter percolation test hole was excavated with truck mounted drill rig equipped with hollow-stem auger equipment to a depth of approximately 41 feet bgs. The boring was backfilled to 30-feet and bottom sealed with bentonite prior to percolation testing. The location of percolation test hole P-1 is shown on the attached Percolation Test Location Plan, Plate A. Soil types encountered during excavation of the test hole boring P-1 generally consisted of sandy silty clay, silty sand, and sand with silt.

To protect the test hole from caving, the borehole was equipped with a 4-inch diameter perforated PVC pipes to the 30-foot depth chosen for percolation testing. Water supply for the test hole P-1 was provided via on-site garden hose. The percolation test hole was presoaked prior to testing. The test hole was found to drain in less than 10 minutes therefore the high flowrate percolation test procedure was performed. A constant head was maintained within the test hole with volume reading taken every 10 minutes for 2 hours. The following table summarizes data and percolation rates based on the above described procedure with no factor of safety applied. Percolation Test Data Sheets are attached to this report.

Summary of Test Results

Test Hole	Total Depth (feet bgs)	Starting Water Depth (in bgs)	Total Gallons Added	Elapsed Time (min)	Percolation Rate (in/hr)	Total Reduction Factor (RF)	Infiltration Rate (in/hr)
P-1	30	15	1340	120	33.8	4.5	7.51

The above percolation rate is calculated using the change in the water column height inside an open borehole protected with slotted pipe with no factor of safety applied. The 'Percolation Rate' was converted to an 'Infiltration Rate' using a Los Angeles County recommended reduction factor. Both rates are presented in the above table for your use, as applicable.

$$\text{Total Reduction Factor, } RF = RF_f \times RF_v \times RF_s$$
$$RF_f = 2 \text{ (Boring Percolation)}$$
$$RF_v = 1 \text{ to } 3 \quad RF_s = 1 \text{ to } 3$$

The value RF_t refers to the reduction factor for the type of test, RF_v refers to the reduction factor for site soil variability (assumed as 1.5), and RF_s refers to the reduction factor for long-term siltation, plugging and maintenance (assumed as 1.5). The Project Civil Engineer should review the parameters and correction factors. Final selection of correction factors should be made by the civil engineering consultant based on the site use and the desired level of conservatism.

4.0 DISCUSSION

Infiltration test rates fall below the required minimum County infiltration rate of 0.3 inches per hour. Based on standard-of-practice testing methods used in this study, infiltration of water by dry well at the site is considered feasible. The following sections qualitatively address Collapsible Soil, Expansive Soil, Slopes and Liquefaction.

4.1 COLLAPSIBLE SOIL (HYDRO-CONSOLIDATION)

Site soils in the infiltration zone below 15 feet consist of sand with silt. Consolidation test results (Plates C-1 and C-2) show on select samples soils exhibit approximately 0.2 to 0.4 percent collapse when inundated with water under 0.8 ksf loading. Hydro-consolidation settlement potential is considered to be low to moderate.

4.2 EXPANSIVE SOILS

Soils at the proposed depth of percolation were found to consist of sand with trace silt. The potential for soil expansion is considered to be low at the proposed depths of infiltration.

4.3 SLOPES

Based on relatively level site topographic conditions the potential for adverse impacts of infiltration to slopes is considered very low.

4.4 LIQUEFACTION

The term “liquefaction” describes a phenomenon in which a saturated cohesionless soil loses strength and acquires a degree of mobility as a result of strong ground shaking during an earthquake. The factors known to influence liquefaction potential include soil type and depth, grain size, relative density, groundwater level, degree of saturation, and both the intensity and duration of ground shaking. Published data (“State of California Seismic Hazard Zones Official Map, Torrance Quadrangle”) from the California Division of Mines and Geology, released March 25, 1999 (Figure 3) indicates that the subject site is not within an area identified as having a potential for soil liquefaction. Based on site subsurface conditions and published literature, it is our opinion that the potential for liquefaction is low.

5.0 CLOSURE

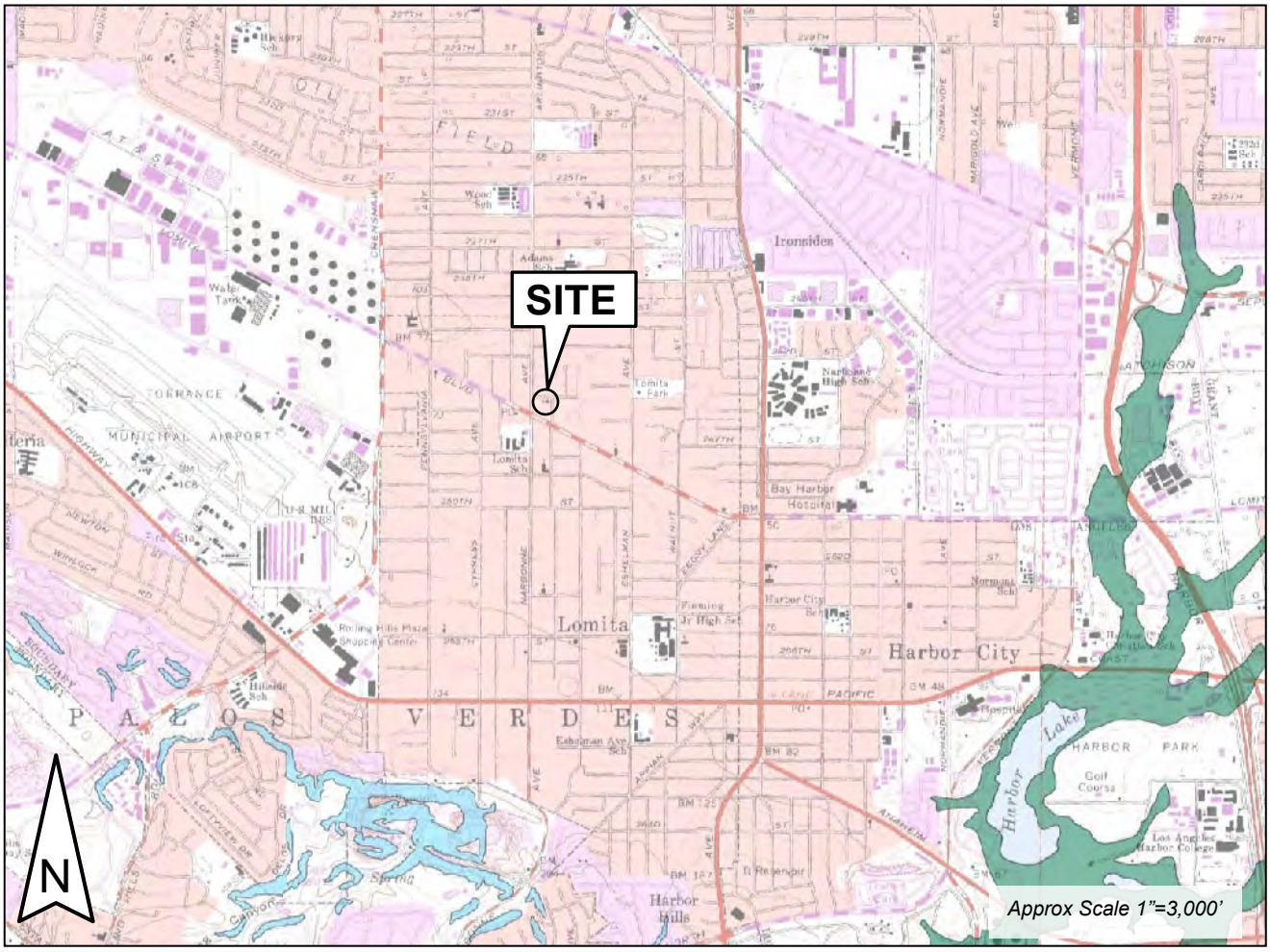
Percolation test rates at 15 feet were found to meet the County’s minimum requirements. Based on standard-of-practice testing methods used in this study, it is feasible to infiltrate water at the site at the depth of below 15 feet. Owing to the unavoidably unknown soil conditions, both between and below the borings, however, uncertainties exist in those methods. Thus, from the forgoing and from case history and geotechnical viewpoints, it is discouraged to infiltrate water into soils near a structure. Water induced soil movement and other problems might occur. Measures, such as setback, increased infiltration depths, and monitoring can be taken to reduce and control the risk of adverse impacts; however, the potential for water induced problems cannot be completely alleviated.

This report has been prepared for the exclusive use of Luigi Schiappa Development, Inc. and there design team for the subject Stormwater Infiltration System. The report has not been prepared for use by other parties, and may not contain sufficient information for purposes of other parties.

The findings contained in this report are based upon our evaluation and interpretation of the information obtained from review of background geologic references and the subsurface exploration described herein. No warranty is expressed or implied as to the conditions at locations or depths other than those excavated. Should any conditions encountered during construction differ from those described herein, this office should be contacted immediately for recommendations prior to continuation of work.

Our findings and recommendations were obtained in accordance with generally accepted current professional principles and local practice in geotechnical and

SEISMIC HAZARD ZONES MAP



MAP EXPLANATION

ALQUIST-PRIOLO EARTHQUAKE FAULT ZONES

Earthquake Fault Zones
Zone boundaries are delineated by straight-line segments; the boundaries define the zone encompassing active faults that constitute a potential hazard to structures from surface faulting or fault creep such that avoidance as described in Public Resources Code Section 2621.5(a) would be required.

Active Fault Traces
Faults considered to have been active during Holocene time and to have potential for surface rupture. Solid Line in Black or Red where Accurately Located; Long Dash in Black or Solid Line in Purple where Approximately Located; Short Dash in Black or Solid Line in Orange where Inferred; Dotted Line in Black or Solid Line in Hose where Concealed. Query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or D for displacement caused by fault creep.

SEISMIC HAZARD ZONES

Liquefaction Zones
Areas where historical occurrence of liquefaction, or local geological, geotechnical and ground water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslide Zones
Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

TORRANCE QUADRANGLE

EARTHQUAKE FAULT ZONES

Delineated in compliance with
Chapter 7.5 Division 2 of the California Public Resources Code
(Alquist-Priolo Earthquake Fault Zoning Act)

OFFICIAL MAP

Released: July 1, 1986

STATE GEOLOGIST

SEISMIC HAZARD ZONES

Delineated in compliance with
Chapter 7.8 Division 2 of the California Public Resources Code
(Seismic Hazards Mapping Act)

OFFICIAL MAP

Released: March 25, 1999

STATE GEOLOGIST

PROJECT: Schiappa Percolation	PROJECT NO: 15-2036-1	DATE: October 2020
Hamilton & Associates		**FIGURE 3**

engineering geological practice and reflect our best professional judgment. We make no other warranty, either express or implied. This concludes our scope of services as described in our proposal dated September 28, 2020. Any further geotechnical services that may be required of our office will be performed on a time and expense basis as per our current fee schedule.

APPENDIX A

The following Appendix contains the substantiating data and laboratory test results to complement this geotechnical data report.

Plate A	Percolation Test Location Plan
Plate B-1	Logs of Boring
Plates C-1 and C-2	Consolidation Test Results
Plate P-1	Percolation Test Data Sheets

SITE EXPLORATION

On October 9, 2020 field exploration was performed by excavating one (1) 8-inch diameter boring at the approximate locations indicated on the attached Percolation Test Location Map, Plate A. The exploratory boring was excavated using a truck mounted drill rig equipped with 8-inch hollow stem augers.

The conditions observed in ring samples were recorded and subsurface soil materials were classified in the field by visual and tactile examination. Descriptions of soil encountered in the exploratory boring is provided on Plate B-1.

LABORATORY TESTING

After samples were visually classified in the field and laboratory, a laboratory testing program was performed to evaluate various geotechnical properties. The results are presented in the following sections.

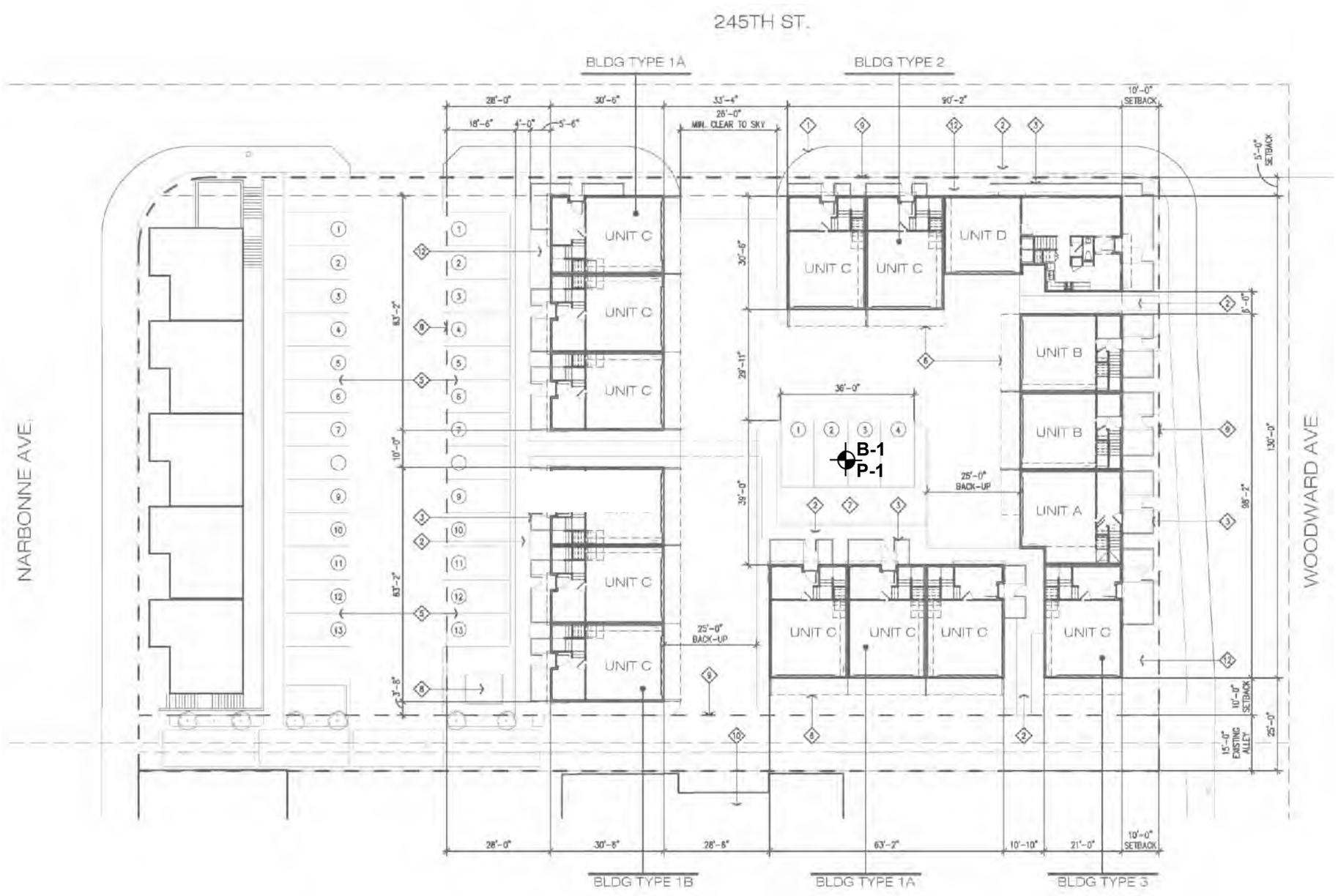
MOISTURE CONTENT AND DENSITY TESTS

The undisturbed soil retained within the sampler rings was tested in the laboratory to determine in-place dry density and moisture content, in accordance with ASTM D2216 and D653, respectively. The results are tabulated on the Logs of Borings, included as Plate B-1.

CONSOLIDATION

Consolidation tests were performed on selected relatively undisturbed samples to determine the settlement characteristics of various soil samples, when in contact with water. The results of these tests are shown graphically on the appended “C” Plates.

BORING LOCATION PLAN



Schiappa Percolation
2154 245th Street
Lomita, CA 90717

LEGEND

Approximate Location of Percolation Boring

B-1

Based on Plan by:
Sakurai Architects, Inc.
2040 Lomita Blvd., Suite 104
Lomita, California 90247
Sheet: A1.1
Dated 9/17/2020

PROJECT: Schiappa Percolation

APPROX SCALE: 1" = 30'

PROJECT NO: 15-2036-1

Hamilton & Associates

PLATE A

FIELD LOG OF BORING NO: B-1

Sheet 1 of 1

HAMILTON & Associates

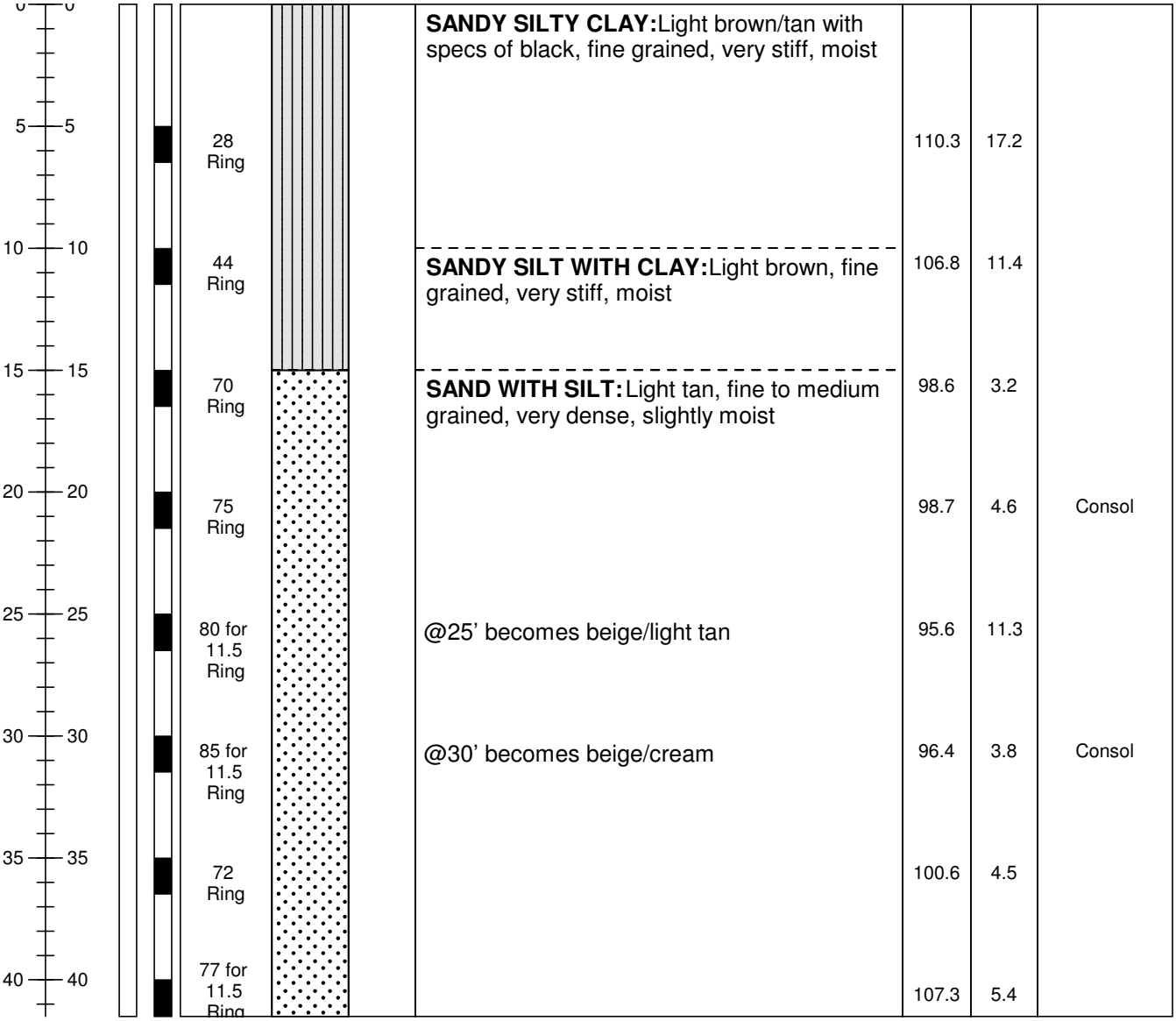
PROJECT: **Schiappa Percolation**

PROJECT NO: **15-2036-1**

LOCATION: **24516 Narbonne Avenue, Lomita**

DATE(S) DRILLED:	**10/9/20**	LOGGED BY:	**RM**
DRILLED BY:	**Hamilton Drilling Corp.**	TOTAL DEPTH:	**41.5'**
RIG MAKE/MODEL:	**CME 45 C**	HAMMER TYPE:	**Auto Hammer**
DRILLING METHOD:	**Hollow Stem Auger**	HAMMER DROP/ WT:	**140 lbs./30"**
HOLE DIAMETER:	**8-Inch**	SURFACE ELEVATION:	**Unknown**

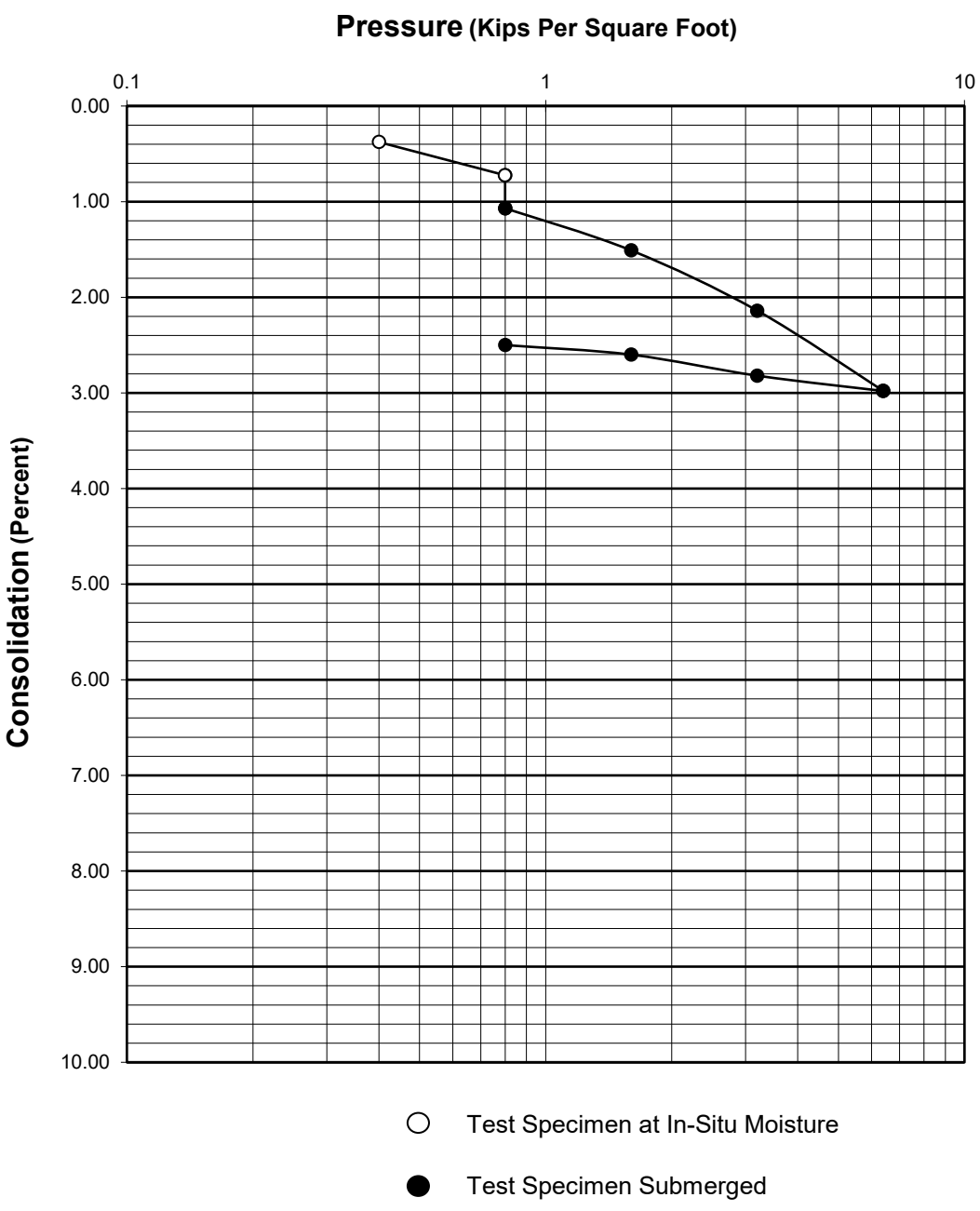
COMMENTS: **No groundwater encountered**



DEPTH (FT)	ELEVATION	SAMPLE INT. BULK	SAMPLE INT. DRIVE	BLOWCOUNT (Blows/Ft)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	OTHER TESTS
0	0									
5	5		■	28 Ring			**SANDY SILTY CLAY:** Light brown/tan with specs of black, fine grained, very stiff, moist	110.3	17.2	
10	10		■	44 Ring			**SANDY SILT WITH CLAY:** Light brown, fine grained, very stiff, moist	106.8	11.4	
15	15		■	70 Ring			**SAND WITH SILT:** Light tan, fine to medium grained, very dense, slightly moist	98.6	3.2	
20	20		■	75 Ring				98.7	4.6	Consol
25	25		■	80 for 11.5 Ring			@25' becomes beige/light tan	95.6	11.3	
30	30		■	85 for 11.5 Ring			@30' becomes beige/cream	96.4	3.8	Consol
35	35		■	72 Ring				100.6	4.5	
40	40		■	77 for 11.5 Ring				107.3	5.4	

CONSOLIDATION TEST RESULTS

B-1 at 20 feet

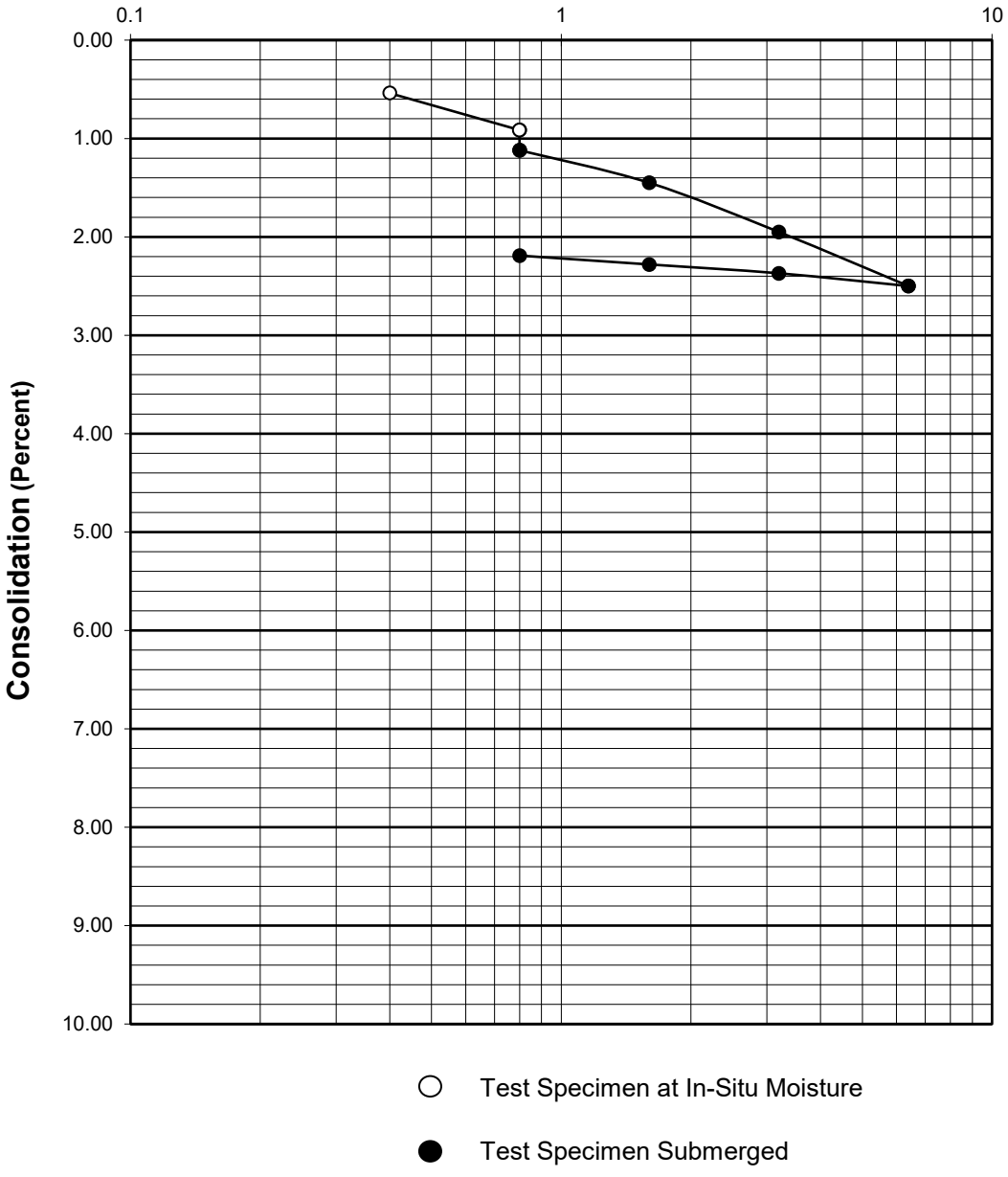


Geotechnical Engineering Investigation 2154 245th Street Lomita, CA	Project No. 15-2036-1 Plate C-1

HAMILTON & ASSOCIATES, INC.

CONSOLIDATION TEST RESULTS

B-1 at 30 feet



Geotechnical Engineering Investigation 2154 245th Street Lomita, CA	Project No. 15-2036-1 Plate C-2

HAMILTON & ASSOCIATES, INC.

Boring/Excavation PercolationTesting Field Log

Date 10/9/2020

Project Location	Schiappa Percolation	**Boring/Test Number**	B-1		
Project Number	15-2036-1	**Diameter of Boring**	8"	**Diameter of Casing**	4"
Earth Description	Sand with Silt	**Depth of Boring**	30 Feet		
Tested by	BM	**Depth to Invert of BMP**			
Water Source	Garden Hose	**Depth to Water Table**			
Measurement Method		**Depth to Initial Water Depth (d_1)**	15 Feet		
Time Interval Standard					
Start Time for Pre-Soak	10:13	**Water Remaining In Boring (Y/N)**	No		
Start Time for Standard	12:03	**Standard Time Interval Between Readings**	10 Minutes		

Reading Number	Time Start/End	Elapsed Time Δtime (mins)	Total Gallons Added	Percolation Rate for Reading (in/hr)	Soil Description/Notes/Comments
1	12:03 12:13	10	120	36.4	
2	12:13 12:23	10	230	34.8	
3	12:23 12:33	10	340	34.3	
4	12:33 12:43	10	460	34.8	
5	12:43 12:53	10	570	34.5	
6	12:53 1:03	10	670	33.8	
7	1:03 1:13	10	790	34.3	
8	1:13 1:23	10	900	34.1	
9	1:23 1:33	10	1010	34.2	
10	1:33 1:43	10	1130	34.2	
11	1:43 1:53	10	1230	33.5	
12	1:53 2:03	10	1340	33.8	

Appendix G

Life-Cycle Cost Estimate

City of Lomita, CA
Proposition W Stormwater Funding
Opinion of Probable Construction Cost, June 2021, 0% Design

Project name	Prop W Stormwater Funding Lomita CA
Estimate Type	OPCC
Design Level	0 %
CDM Smith DB Ver.	V8
Estimators	TS
ENR 20 City CCI:	Jun 2021 12,112.05

Notes

This is an Opinion of Probable Construction Cost only, as defined by the documents provided at the level of design indicated above. CDM Smith has no control over the cost of labor, materials, equipment, or services furnished, over schedules, over contractor's methods of determining prices, competitive bidding (at least 3 each - both prime bidders and major subcontractors), market conditions or negotiating terms. CDM Smith does not guarantee that this opinion will not vary from actual cost, or contractor's bids.

There are not any costs provided for: Change Orders, Design Engineering, Construction Oversight, Client Costs, Finance or Funding Costs, Legal Fees, Land Acquisition or temporary/permanent Easements, Operations, or any other costs associated with this project that are not specifically part of the bidding contractor's proposed scope.

This OPCC shall remain vaild for 120 days. Beyond this date, CDM Constructors should be notified of design changes. The estimate will also be reviewed to reflect current market conditions.

Assumptions:
No rock excavation is required.
Only nominal dewatering is needed.
No consideration for contaminated soils or hazardous materials is included (i.e. asbestos, lead, etc).
Based on a normal 40 hour work week with no overtime.

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
01 Component 1: Underground Infiltration Gallery							
05 Infiltration Gallery							
02180 Facility Remediation							
02180 Subsurface Storage Modules							
12 oz/sq yd (heavy weight) Geotextile Fabric	6,660.00 sf	1,991	1,922	-	639	-	4,551
Double Storage Media Blocks	14,000.00 cf	33,871	126,000	-		-	159,871
02180 Subsurface Storage Modules	**2,800.00 sf**	**35,862**	**127,922**		**639**		**164,422**
02180 Facility Remediation		**35,862**	**127,922**		**639**		**164,422**
02220 Demolition							
02220.0400 Demo Asphalt Pavement							
Saw Cut Asphalt Pavement, 6"thk	100.00 lf	635	45	-	539	-	1,219
Demo Bituminous Pavement	10,890.00 sf	14,626	-	-	8,225	-	22,850
Load Demo to Stockpile Cat 325 Excavator	134.44 cy	135	-	-	221	-	356
Haul Demo/On Site 8cy Rear Dump	134.44 cy	1,272	-	-	823	-	2,095
Load Off-site Haul Cat 325 Excavator	134.44 cy	135	-	-	221	-	356
Haul Demo/Off Site 18cy Rear Dump 1 Load/Hour	14.94 load	1,413	-	-	1,673	-	3,086
Demo - Tipping Fees-	134.44 cy	-	-	10,524	-	-	10,524
02220.0400 Demo Asphalt Pavement	**10,890.00 sf**	**18,215**	**45**	**10,524**	**11,701**		**40,485**
02220 Demolition		**18,215**	**45**	**10,524**	**11,701**		**40,485**
02300 Earthwork							
02300.0400 Ex and Backfill of Infiltration Gallery							
Mob / DeMob Earthwork Equip (8hr each way)	2.00 ea	2,664	-	-	3,844	-	6,508
EXCAVATION (Summary)	***5,462.48 CY***	**-**	**-**	**-**	**-**		
Excav- Excavator C325- 33MT-186HP/1.5cy	5,462.48 cy	3,796	-	-	6,199	-	9,995
BACKFILL from STOCKPILE (Summary)	***4,804.48 CY***	**-**	**-**	**-**	**-**		
Place Backfill from Stockpile- Excavator C325-33MT- 186HP-1.5cy/CP323 Compactor	4,804.48 cy	9,248	-	-	9,270	-	18,518
Place Backfill from Import- Excavator C325-33MT- 186HP/1.5cy/CP323 Compactor	137.82 cy	265	-	-	266	-	531
IMPORT MATERIAL (Summary)	***137.82 CY***	**-**	**-**	**-**	**-**		
Import Stone Fill	137.82 cy	-	3,153	2,007	-	-	5,160
FINE GRADE (Summary)	***3,721.00 sf***	**-**	**-**	**-**	**-**		
Structure Subgrade- Scarify & Recompact/Proof Roll	3,721.00 sf	208	-	-	188	-	395
Fine Grade- Dozer D4	3,721.00 sf	126	-	-	93	-	218
EXCAVATION SPOILS-SOURCES of FILL (Grand Total)	***658.00 CY***	**-**	**-**	**-**	**-**		
Structure Excavation Spoils (Summary)	***658.00 CY***	**-**	**-**	**-**	**-**		
Load Spoils from Stockpile Cat 325 Excavator-32MT- 180hp	658.00 cy	583	-	-	952	-	1,535
Haul Spoils/Off Site 18cy Rear Dump 1 Load/Hour	658.00 cy	3,941	-	-	4,664	-	8,605
02300.0400 Ex and Backfill of Infiltration Gallery	**9,555.00 cy**	**20,831**	**3,153**	**2,007**	**25,475**		**51,466**
02300 Earthwork		**20,831**	**3,153**	**2,007**	**25,475**		**51,466**
02600 Drainage & Containment							
02600.0400 DSBB (Debris Separating Baffle Box)							
Mob / DeMob Earthwork Equip	1.00 ea	1,332	-	-	1,922	-	3,254
Excav- Excavator C325- 30MT-186HP/1.5cy	52.58 cy	37	-	-	60	-	96
Place Backfill from Stockpile- Backhoe Loader C466- 7MT- 95HP/1.5cy/Plate Compactor (2ea)	37.76 cy	1,589	-	-	716	-	2,306
Import Engineered Fill	2.33 cy	-	60	34	-	-	94
Load Spoils from Stockpile Cat 325 Excavator-32MT- 180hp	14.82 cy	13	-	-	21	-	35
Haul Spoils/Off Site 18cy Rear Dump 2 Load/Hour	14.82 cy	45	-	-	53	-	97
Unload Care & Protect Catch Basins	1.00 ea	95	-	-	-	-	95
DSBB 6-112 5' x 10' x 8' Deep	1.00 ea	4,262	58,020	-	1,736	-	64,018
02600.0400 DSBB (Debris Separating Baffle Box)	**1.00 ea**	**7,372**	**58,079**	**34**	**4,509**		**69,994**
02600.0405 Diversion Structure							
Mob / DeMob Earthwork Equip	1.00 ea	1,332	-	-	1,922	-	3,254
Excav- Excavator C325- 30MT-186HP/1.5cy	62.77 cy	44	-	-	71	-	115
Place Backfill from Stockpile- Excavator C320-20MT- 140HP/1.25cy/CP323 Compactor	46.76 cy	35	-	-	42	-	77
Place Backfill from Import- Excavator C320-20MT- 140HP/1.25cy/CP323 Compactor	1.76 cy	1	-	-	2	-	3

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
02600.0405 Diversion Structure							
Import Engineered Fill	1.76 cy	-	45	26	-	-	71
Load Spoils from Stockpile Cat 325 Excavator-32MT- 180hp	16.01 cy	14	-	-	23	-	37
Haul Spoils/Off Site 18cy Rear Dump 1 Load/Hour	16.01 cy	96	-	-	114	-	209
Unload Care & Protect Manhole	1.00 ea	121	-	-	42	-	163
Place & Shape Manhole Base & Inverts- 72"	1.00 ea	331	-	-	-	541	872
Manhole 72" x 10' Deep	1.00 ea	2,134	5,982	-	844	-	8,960
Manhole Boots 15"	1.00 ea	-	229	-	-	-	229
Manhole Boots 39"	2.00 ea	-	1,030	-	-	-	1,030
Cast Iron Frame & Cover 24 in.	1.00 ea		875	-	95	-	970
02600.0405 Diversion Structure	**1.00 ea**	**4,108**	**8,161**	**26**	**3,155**	**541**	**15,990**
02600.0410 15" RCP Pipe from 36" to Gallery							
Layout & Stake Pipe Excavation	30.00 lf	14	3	-	-	-	18
Trenching- Excavator C330- 40MT-240HP/2.25cy- Average Exc.	58.40 cy	103	-	-	205	-	309
Trench Bedding-Excavator C330- 40MT-240HP/2.25cy	1.99 cy	5	-	-	11	-	16
Trench Pipe Zone Backfill- Excavator C330- 40MT-240HP/2.25cy	8.10 cy	34	-	-	70	-	105
Trench Native Backfill- Loader C938 3cy	46.12 cy	303	-	-	111	-	414
3/8 Stone Bedding/Zone/Engineered Fill Material	10.09 cy	-	343	147	-	-	490
Load & Haul Trenching Spoils to Stockpile-C446 Backhoe Loader- 85hp/1.37CY/Dump Truck 8cy (4ea)	12.28 cy	40	-	-	29	-	70
Trench Shield- 8x20	2.00 u/mo	-	-	-	3,837	-	3,837
Pipe Detectable/Non-Detectable Tape	30.00 lf	12	2	-	-	-	14
EXCAVATION SPOILS-SOURCES of FILL (Grand Total)	***12.28 CY***	**-**	**-**	**-**	**-**		
Trenching Spoils (Summary)	***12.28 CY***	**-**	**-**	**-**	**-**		
Load Spoils from Stockpile Cat 325 Excavator-32MT- 180hp	12.28 cy	11	-	-	18	-	29
Haul Spoils/Off Site 18cy Rear Dump 1 Load/Hour	12.28 cy	74	-	-	87	-	161
Unload Care & Protect RCP & Fittings	30.00 lf	1	-	-	0	-	1
Layout Pipe & Fitting	30.00 lf	28	-	-	-	-	28
RCP Equipment- Cat 325 Excavator	1.32 ch	140	-	-	229	-	370
RCP Class V Pipe 15"	30.00 lf	498	502	-	-	-	999
RCP-Encase Closure 15	7.48 cy	2,127	494	-	-	-	2,621
15" x 15" Slide Gate	1.00 ea	852	2,656	-	-	-	3,508
02600.0410 15" RCP Pipe from 36" to Gallery	**30.00 lf**	**4,243**	**4,000**	**147**	**4,598**		**12,988**
02600 Drainage & Containment		**15,723**	**70,240**	**206**	**12,261**	**541**	**98,971**
02750 Concrete Paving							
02751.0400 Pervious Pavement							
Import Aggregate Base Fill	201.67 cy	-	4,614	2,936	-	-	7,550
Pervious Paving Form Oil & Hardware	200.00 sf	-	125	-	-	-	125
Hand Fine Grade Pervious Paving	10,890.00 sf	7,904	-	-	-	-	7,904
Pervious Paving Forms < 6" 3 Form Use	200.00 sf	4,855	151	-	-	-	5,006
Truck Place Pervious Paving	201.67 cy	8,535	-	-	-	-	8,535
Finish @ Pervious Paving	10,890.00 sf	8,192	-	-	-	-	8,192
Water Base Non-Residual Cure	10,890.00 sf	2,115	898	-	-	-	3,013
Redi-Mix Pervious Concrete	201.67 cy	-	50,417	-	-	-	50,417
02751.0400 Pervious Pavement	**10,890.00 sf**	**31,601**	**56,206**	**2,936**			**90,743**
02750 Concrete Paving		**31,601**	**56,206**	**2,936**			**90,743**
05 Infiltration Gallery		**122,231**	**257,565**	**15,673**	**50,076**	**541**	**446,086**
01 Component 1: Underground Infiltration Gallery		**122,231**	**257,565**	**15,673**	**50,076**	**541**	**446,086**
02 Component 2: Dry Wells Along Medians on Lomita Blvd							
10 Dry Wells on Lomita Blvd from Diversion Structure 2							
01590 Safety/Traffic/Pollution Control							
01590.0400 Traffic Control							
Mobilize Traffic Control Sub	1.00 ls	-	-	1,000	-	-	1,000
Traffic Barrel w/Flasher Light (HDPE)	250.00 ea	9,073	-	-	-	28,750	37,823
Flashing Arrow Panel	60.00 day	-	-	9,000	-	-	9,000
Changeable Message Sign	60.00 day	-	-	12,000	-	-	12,000

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
01590.0400 Traffic Control							
Place Concrete Jersey Barriers	500.00 lf	-	-	-	-	3,333	3,333
Rent- 10' Jersey Barriers (1st MO)	500.00 lf	-	-	-	-	2,000	2,000
Rent- 10' Jersey Barriers (2nd MO)	500.00 lf	-	-	-	-	1,500	1,500
Remove Concrete Jersey Barriers	500.00 lf	-	-	-	-	3,333	3,333
01590.0400 Traffic Control	**1.00 ls**	**9,073**		**22,000**		**38,917**	**69,989**
01590 Safety/Traffic/Pollution Control		**9,073**		**22,000**		**38,917**	**69,989**
02220 Demolition							
02220.0400 Demo Asphalt Pavement							
Saw Cut Asphalt Pavement, 6"thk	1,750.00 lf	11,115	788	-	9,436	-	21,338
Demo Bituminous Pavement	10,000.00 sf	13,431	-	-	7,553	-	20,983
Load Demo to Stockpile Cat 325 Excavator	185.19 cy	185	-	-	305	-	490
Haul Demo/On Site 8cy Rear Dump	185.19 cy	1,752	-	-	1,133	-	2,885
Load Off-site Haul Cat 325 Excavator	185.19 cy	185	-	-	305	-	490
Haul Demo/Off Site 18cy Rear Dump 1 Load/Hour	20.58 load	1,947	-	-	2,304	-	4,250
Demo - Tipping Fees-	185.19 cy	-	-	14,495	-	-	14,495
02220.0400 Demo Asphalt Pavement	**10,000.00 sf**	**28,614**	**788**	**14,495**	**21,034**		**64,931**
02220 Demolition		**28,614**	**788**	**14,495**	**21,034**		**64,931**
02520 Wells							
02520.0400 Dry Wells							
Mobilize/Demobilize Drilling Crew	19.00 ea	-	-	11,875	-	-	11,875
Drill/Develop Drywell	19.00 ea	-	-	593,750	-	-	593,750
Pre-treatment Contruction	19.00 ea			237,500	-	-	237,500
Haul-off Spoil to Landfill	19.00 ea	-	-	95,000	-	-	95,000
Sighting and Digaler/no parking signs	19.00 ea	-	-	2,375	-	-	2,375
Geotechnical Observation, percolation testing and screening	19.00 ea	-	-	47,500	-	-	47,500
Traffic Control	19.00 ea	-	-	118,750	-	-	118,750
Permitting	19.00 ea	-	-	2,375	-	-	2,375
CEQA	19.00 ea	-	-	4,750	-	-	4,750
02520.0400 Dry Wells	**19.00 ea**			**1,113,875**			**1,113,875**
02520 Wells				**1,113,875**			**1,113,875**
02600 Drainage & Containment							
02600.0400 DSBB (Debris Separating Baffle Box)							
Mob / DeMob Earthwork Equip	1.00 ea	1,332	-	-	1,922	-	3,254
Excav- Excavator C325- 30MT-186HP/1.5cy	58.42 cy	41	-	-	66	-	107
Place Backfill from Stockpile- Backhoe Loader C466- 7MT- 95HP/1.5cy/Plate Compactor (2ea)	37.09 cy	1,561	-	-	704	-	2,265
Import Engineered Fill	2.59 cy	-	67	38	-	-	104
Load Spoils from Stockpile Cat 325 Excavator-32MT- 180hp	21.33 cy	19	-	-	31	-	50
Haul Spoils/Off Site 18cy Rear Dump 2 Load/Hour	21.33 cy	64	-	-	76	-	140
Unload Care & Protect Catch Basins	1.00 ea	95	-	-	-	-	95
DSBB 6-112 6' x 12' x 8' Deep	1.00 ea	4,262	71,110	-	1,736	-	77,108
02600.0400 DSBB (Debris Separating Baffle Box)	**1.00 ea**	**7,373**	**71,176**	**38**	**4,535**		**83,122**
02600.0405 Diversion Structure							
Mob / DeMob Earthwork Equip	1.00 ea	1,332	-	-	1,922	-	3,254
Excav- Excavator C325- 30MT-186HP/1.5cy	62.77 cy	44	-	-	71	-	115
Place Backfill from Stockpile- Excavator C320-20MT- 140HP/1.25cy/CP323 Compactor	46.76 cy	35	-	-	42	-	77
Place Backfill from Import- Excavator C320-20MT- 140HP/1.25cy/CP323 Compactor	1.76 cy	1	-	-	2	-	3
Import Engineered Fill	1.76 cy	-	45	26	-	-	71
Load Spoils from Stockpile Cat 325 Excavator-32MT- 180hp	16.01 cy	14	-	-	23	-	37
Haul Spoils/Off Site 18cy Rear Dump 1 Load/Hour	16.01 cy	96	-	-	114	-	209
Unload Care & Protect Manhole	1.00 ea	121	-	-	42	-	163
Place & Shape Manhole Base & Inverts- 72"	1.00 ea	331	-	-	-	541	872
Manhole 72" x 10' Deep	1.00 ea	2,134	5,982	-	844	-	8,960
Manhole Boots 15"	1.00 ea	-	229	-	-	-	229
Manhole Boots 39"	2.00 ea	-	1,030	-	-	-	1,030
Cast Iron Frame & Cover 24 in.	1.00 ea		875	-	95	-	970

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
02600.0405 Diversion Structure	**1.00 ea**	**4,108**	**8,161**	**26**	**3,155**	**541**	**15,990**
02600.0411 15" RCP Pipe between Wells							
Layout & Stake Pipe Excavation	545.00 lf	258	60	-	-	-	318
Trenching- Excavator C330- 40MT-240HP/2.25cy- Average Exc.	771.52 cy	1,367	-	-	2,714	-	4,081
Trench Bedding-Excavator C330- 40MT-240HP/2.25cy	36.17 cy	96	-	-	196	-	292
Trench Pipe Zone Backfill- Excavator C330- 40MT-240HP/2.25cy	147.11 cy	626	-	-	1,274	-	1,899
Trench Native Backfill- Loader C938 3cy	548.50 cy	3,607	-	-	1,320	-	4,926
3/8 Stone Bedding/Zone/Engineered Fill Material	183.28 cy	-	6,238	2,668	-	-	8,906
Load & Haul Trenching Spoils to Stockpile-C446 Backhoe Loader- 85hp/1.37CY/Dump Truck 8cy (4ea)	223.02 cy	728	-	-	535	-	1,264
Trench Shield- 8x20	3.00 u/mo	-	-	-	5,755	-	5,755
Pipe Detectable/Non-Detectable Tape	545.00 lf	218	33	-	-	-	251
EXCAVATION SPOILS-SOURCES of FILL (Grand Total)	***223.02 CY***	**-**	**-**	**-**	**-**		
Trenching Spoils (Summary)	***223.02 CY***	**-**	**-**	**-**	**-**		
Load Spoils from Stockpile Cat 325 Excavator-32MT- 180hp	223.02 cy	198	-	-	323	-	520
Haul Spoils/Off Site 18cy Rear Dump 1 Load/Hour	223.02 cy	1,336	-	-	1,581	-	2,917
Unload Care & Protect RCP & Fittings	545.00 lf	15	-	-	5	-	20
Layout Pipe & Fitting	545.00 lf	516	-	-	-	-	516
RCP Equipment- Cat 320 Excavator	23.98 ch	2,550	-	-	3,086	-	5,635
RCP Class V Pipe 15"	545.00 lf	9,038	9,112	-	-	-	18,151
RCP-Encase Closure 15	63.60 cy	18,081	4,198	-	-	-	22,279
15" x 15" Slide Gate	1.00 ea	852	2,656	-	-	-	3,508
02600.0411 15" RCP Pipe between Wells	**545.00 lf**	**39,484**	**22,297**	**2,668**	**16,788**		**81,237**
02600 Drainage & Containment		**50,965**	**101,633**	**2,732**	**24,478**	**541**	**180,349**
02740 Asphalt Paving							
02740.0400 Asphalt Pavement							
--- Total Aggregate Base Area ---	***10,000.00 sf***	**-**	**-**	**-**	**-**		
Scarify & Recompact/Proof Roll	10,000.00 sf	2,665	-	-	2,407	-	5,072
Aggregate Base-Parking Lots	246.91 cy	1,316	-	-	1,107	-	2,423
Aggregate Base	246.91 cy	-	4,938	1,728	-	-	6,667
Mob/Demob Asphalt Paving Equipment	2.00 ea	-	-	6,250	-	-	6,250
Total Asphalt Ton	***437.50 ton***	**-**	**-**	**-**	**-**		
Roadway- Bituminous Surface/Wearing Course 1.0"	1,111.11 sy	678	5,273	1,055	524	-	7,530
Roadway- Bituminous Binder/Intermediate Course 2.0"	1,111.11 sy	1,130	11,719	2,344	874	-	16,066
Roadway- Bituminous Base Course 4"	1,111.11 sy	1,577	22,604	4,521	1,220	-	29,922
Roadway- Tack Coat	1,111.11 sy	-	521	-	222	-	743
02740.0400 Asphalt Pavement	**10,000.00 sf**	**7,367**	**45,055**	**15,898**	**6,354**		**74,674**
02740 Asphalt Paving		**7,367**	**45,055**	**15,898**	**6,354**		**74,674**
10 Dry Wells on Lomita Blvd from Diversion Structure 2		**96,019**	**147,476**	**1,169,000**	**51,866**	**39,458**	**1,503,818**
15 Dry Wells on Lomita Blvd from Diversion Structure 3							
01590 Safety/Traffic/Pollution Control							
01590.0400 Traffic Control							
Mobilize Traffic Control Sub	1.00 ls	-	-	1,000	-	-	1,000
Traffic Barrel w/Flasher Light (HDPE)	250.00 ea	9,073	-	-	-	28,750	37,823
Flashing Arrow Panel	60.00 day	-	-	9,000	-	-	9,000
Changeable Message Sign	60.00 day	-	-	12,000	-	-	12,000
Place Concrete Jersey Barriers	500.00 lf	-	-	-	-	3,333	3,333
Rent- 10' Jersey Barriers (1st MO)	500.00 lf	-	-	-	-	2,000	2,000
Rent- 10' Jersey Barriers (2nd MO)	500.00 lf	-	-	-	-	1,500	1,500
Remove Concrete Jersey Barriers	500.00 lf	-	-	-	-	3,333	3,333
01590.0400 Traffic Control	**1.00 ls**	**9,073**		**22,000**		**38,917**	**69,989**
01590 Safety/Traffic/Pollution Control		**9,073**		**22,000**		**38,917**	**69,989**
02220 Demolition							
02220.0400 Demo Asphalt Pavement							
Saw Cut Asphalt Pavement, 6"thk	2,000.00 lf	12,703	900	-	10,784	-	24,386
Demo Bituminous Pavement	8,550.00 sf	11,483	-	-	6,457	-	17,940

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
02220.0400 Demo Asphalt Pavement							
Load Demo to Stockpile Cat 325 Excavator	158.33 cy	158	-	-	260	-	419
Haul Demo/On Site 8cy Rear Dump	158.33 cy	1,498	-	-	969	-	2,467
Load Off-site Haul Cat 325 Excavator	158.33 cy	158	-	-	260	-	419
Haul Demo/Off Site 18cy Rear Dump 1 Load/Hour	17.59 load	1,664	-	-	1,970	-	3,634
Demo - Tipping Fees-	158.33 cy	-	-	12,394	-	-	12,394
02220.0400 Demo Asphalt Pavement	**8,500.00 sf**	**27,665**	**900**	**12,394**	**20,700**		**61,659**
02220 Demolition		**27,665**	**900**	**12,394**	**20,700**		**61,659**
02520 Wells							
02520.0400 Dry Wells							
Mobilize/Demobilize Drilling Crew	15.00 ea	-	-	9,375	-	-	9,375
Drill/Develop Drywell	15.00 ea	-	-	468,750	-	-	468,750
Pre-treatment Contruction	15.00 ea			187,500	-	-	187,500
Haul-off Spoil to Landfill	15.00 ea	-	-	75,000	-	-	75,000
Sighting and Digaler/no parking signs	15.00 ea	-	-	1,875	-	-	1,875
Geotechnical Observation, percolation testing and screening	15.00 ea	-	-	37,500	-	-	37,500
Traffic Control	15.00 ea	-	-	93,750	-	-	93,750
Permitting	15.00 ea	-	-	1,875	-	-	1,875
CEQA	15.00 ea	-	-	3,750	-	-	3,750
02520.0400 Dry Wells	**15.00 ea**			**879,375**			**879,375**
02520 Wells				**879,375**			**879,375**
02600 Drainage & Containment							
02600.0400 DSBB (Debris Separating Baffle Box)							
Mob / DeMob Earthwork Equip	1.00 ea	1,332	-	-	1,922	-	3,254
Excav- Excavator C325- 30MT-186HP/1.5cy	58.42 cy	41	-	-	66	-	107
Place Backfill from Stockpile- Backhoe Loader C466- 7MT- 95HP/1.5cy/Plate Compactor (2ea)	37.09 cy	1,561	-	-	704	-	2,265
Import Engineered Fill	2.59 cy	-	67	38	-	-	104
Load Spoils from Stockpile Cat 325 Excavator-32MT- 180hp	21.33 cy	19	-	-	31	-	50
Haul Spoils/Off Site 18cy Rear Dump 2 Load/Hour	21.33 cy	64	-	-	76	-	140
Unload Care & Protect Catch Basins	1.00 ea	95	-	-	-	-	95
DSBB 6-112 6' x 12' x 8' Deep	1.00 ea	4,262	71,110	-	1,736	-	77,108
02600.0400 DSBB (Debris Separating Baffle Box)	**1.00 ea**	**7,373**	**71,176**	**38**	**4,535**		**83,122**
02600.0405 Diversion Structure							
Mob / DeMob Earthwork Equip	1.00 ea	1,332	-	-	1,922	-	3,254
Excav- Excavator C325- 30MT-186HP/1.5cy	62.77 cy	44	-	-	71	-	115
Place Backfill from Stockpile- Excavator C320-20MT- 140HP/1.25cy/CP323 Compactor	46.76 cy	35	-	-	42	-	77
Place Backfill from Import- Excavator C320-20MT- 140HP/1.25cy/CP323 Compactor	1.76 cy	1	-	-	2	-	3
Import Engineered Fill	1.76 cy	-	45	26	-	-	71
Load Spoils from Stockpile Cat 325 Excavator-32MT- 180hp	16.01 cy	14	-	-	23	-	37
Haul Spoils/Off Site 18cy Rear Dump 1 Load/Hour	16.01 cy	96	-	-	114	-	209
Unload Care & Protect Manhole	1.00 ea	121	-	-	42	-	163
Place & Shape Manhole Base & Inverts- 72"	1.00 ea	331	-	-	-	541	872
Manhole 72" x 10' Deep	1.00 ea	2,134	5,982	-	844	-	8,960
Manhole Boots 15"	1.00 ea	-	229	-	-	-	229
Manhole Boots 39"	2.00 ea	-	1,030	-	-	-	1,030
Cast Iron Frame & Cover 24 in.	1.00 ea		875	-	95	-	970
02600.0405 Diversion Structure	**1.00 ea**	**4,108**	**8,161**	**26**	**3,155**	**541**	**15,990**
02600.0411 15" RCP Pipe between Wells							
Layout & Stake Pipe Excavation	465.00 lf	220	51	-	-	-	271
Trenching- Excavator C330- 40MT-240HP/2.25cy- Average Exc.	658.27 cy	1,166	-	-	2,316	-	3,482
Trench Bedding-Excavator C330- 40MT-240HP/2.25cy	30.86 cy	82	-	-	167	-	249
Trench Pipe Zone Backfill- Excavator C330- 40MT-240HP/2.25cy	125.52 cy	534	-	-	1,087	-	1,621
Trench Native Backfill- Loader C938 3cy	467.99 cy	3,077	-	-	1,126	-	4,203
3/8 Stone Bedding/Zone/Engineered Fill Material	156.37 cy	-	5,322	2,277	-	-	7,599
Load & Haul Trenching Spoils to Stockpile-C446 Backhoe Loader- 85hp/1.37CY/Dump Truck 8cy (4ea)	190.28 cy	621	-	-	457	-	1,078

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
02600.0411 15" RCP Pipe between Wells							
Trench Shield- 8x20	3.00 u/mo	-	-	-	5,755	-	5,755
Pipe Detectable/Non-Detectable Tape	465.00 lf	186	28	-	-	-	214
EXCAVATION SPOILS-SOURCES of FILL (Grand Total)	***190.28 CY***	**-**	**-**	**-**	**-**		
Trenching Spoils (Summary)	***190.28 CY***	**-**	**-**	**-**	**-**		
Load Spoils from Stockpile Cat 325 Excavator-32MT- 180hp	190.28 cy	169	-	-	275	-	444
Haul Spoils/Off Site 18cy Rear Dump 1 Load/Hour	190.28 cy	1,140	-	-	1,349	-	2,488
Unload Care & Protect RCP & Fittings	465.00 lf	12	-	-	4	-	17
Layout Pipe & Fitting	465.00 lf	441	-	-	-	-	441
RCP Equipment- Cat 320 Excavator	20.46 ch	2,175	-	-	2,633	-	4,808
RCP Class V Pipe 15"	465.00 lf	7,711	7,775	-	-	-	15,486
RCP-Encase Closure 15	50.51 cy	14,358	3,333	-	-	-	17,692
15" x 15" Slide Gate	1.00 ea	852	2,656	-	-	-	3,508
02600.0411 15" RCP Pipe between Wells	**465.00 lf**	**32,745**	**19,165**	**2,277**	**15,168**		**69,355**
02600 Drainage & Containment		**44,226**	**98,502**	**2,340**	**22,858**	**541**	**168,467**
02740 Asphalt Paving							
02740.0400 Asphalt Pavement							
--- Total Aggregate Base Area ---	***8,550.00 sf***	**-**	**-**	**-**	**-**		
Scarify & Recompact/Proof Roll	8,550.00 sf	2,279	-	-	2,058	-	4,337
Aggregate Base-Parking Lots	211.11 cy	1,125	-	-	946	-	2,072
Aggregate Base	211.11 cy	-	4,222	1,478	-	-	5,700
Mob/Demob Asphalt Paving Equipment	2.00 ea	-	-	6,250	-	-	6,250
Total Asphalt Ton	***374.06 ton***	**-**	**-**	**-**	**-**		
Roadway- Bituminous Surface/Wearing Course 1.0"	950.00 sy	580	4,509	902	448	-	6,439
Roadway- Bituminous Binder/Intermediate Course 2.0"	950.00 sy	966	10,020	2,004	747	-	13,737
Roadway- Bituminous Base Course 4"	950.00 sy	1,349	19,327	3,865	1,043	-	25,584
Roadway- Tack Coat	950.00 sy	-	445	-	190	-	635
02740.0400 Asphalt Pavement	**8,550.00 sf**	**6,299**	**38,522**	**14,499**	**5,433**		**64,753**
02740 Asphalt Paving		**6,299**	**38,522**	**14,499**	**5,433**		**64,753**
15 Dry Wells on Lomita Blvd from Diversion Structure 3		**87,262**	**137,925**	**930,607**	**48,991**	**39,458**	**1,244,243**
02 Component 2: Drv Wells Along Medians on Lomita Blvd		**183,280**	**285,401**	**2,099,607**	**100,857**	**78,916**	**2,748,061**
03 Component 3: Improvements Along Lomita Blvd							
20 Lomita Blvd Improvements							
02760 Pavement Specialty & Mark							
02760.0400 Pavement Markings							
Traffic Control	1.00 ls	-	-	4,000	-	-	4,000
Mobilize Pavement Markings Subcontractor	1.00 ls	-	-	1,250	-	-	1,250
Painted Lines - 4" Wide dashed	4,800.00 lf	-	-	7,200	-	-	7,200
Painted Lines - Bike Lane Delineation	2,400.00 lf	-	-	3,000	-	-	3,000
Painted Bike Lane Symbol	8.00 ea	-	-	1,500	-	-	1,500
02760.0400 Pavement Markings	**1.00 ls**			**16,950**			**16,950**
02760 Pavement Specialty & Mark				**16,950**			**16,950**
02930 Trees/Shrubs/Groundcover							
02930.0400 Trees							
Trees -	30.00 ea	-	-	56,250	-	-	56,250
Trees - Guying	30.00 ea	-	-	563	-	-	563
Trees - Maintenance	30.00 ea	-	-	9,375	-	-	9,375
02930.0400 Trees	**30.00 ea**			**66,188**			**66,188**
02930.0401 Median Strip Vegetation or Vegetation along Lomita/Narbonne							
Planting Bed Preparation	74.07 cy	-	-	5,000	-	-	5,000
Weed Barrier - Polyethylene	6,000.00 sf	-	-	1,125	-	-	1,125
Fertilizer	6,000.00 sf	-	-	225	-	-	225
Lime	6,000.00 sf	-	-	113	-	-	113
Groundcover Plants	2,000.00 ea	-	-	37,500	-	-	37,500

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Amount
02930.0401 Median Strip Vegetation or Vegetation along Lomita/Narbonne	**6,000.00 sf**			**43,963**			**43,963**
02930 Trees/Shrubs/Groundcover				110,150			110,150
20 Lomita Blvd Improvements				127,100			127,100
03 Component 3: Improvements Along Lomita Blvd				**127,100**			**127,100**
04 Component 4: Bioretention and Trees along Narbonne Ave							
25 Bioretention and Trees along Narbonne Ave							
02300 Earthwork							
02300.0405 Place Bio Retention Soil							
Purchase and Haul Bioretention Soil	50.00 cy	101	1,359	-	138	-	1,598
Place Bioretention Soil	50.00 cy	483	-	-	789	-	1,273
Geotextile Fabric	100.00 sy	87	91	-	16	-	194
02300.0405 Place Bio Retention Soil	**50.00 cy**	**672**	**1,450**		**943**		**3,065**
02300 Earthwork		672	1,450		943		3,065
02770 Curbs & Gutters							
02770.0400 Bioretention with curb cutouts							
Curbs- Remove & Demo	50.00 lf	2,989	-	-	2,399	-	5,387
Curb 12"	50.00 lf	-	-	1,500	-	-	1,500
02770.0400 Bioretention with curb cutouts	**50.00 lf**	**2,989**		**1,500**	**2,399**		**6,887**
02770 Curbs & Gutters		2,989		1,500	2,399		6,887
02870 Site Furnishings							
02870.0400 Benches							
Benches - Alum	10.00 ea	2,199	12,000	-	760	-	14,958
02870.0400 Benches	**10.00 ea**	**2,199**	**12,000**		**760**		**14,958**
02870 Site Furnishings		2,199	12,000		760		14,958
02930 Trees/Shrubs/Groundcover							
02930.0400 Trees							
Trees -	15.00 ea	-	-	28,125	-	-	28,125
Trees - Guying	15.00 ea	-	-	281	-	-	281
Trees - Maintenance	15.00 ea	-	-	4,688	-	-	4,688
02930.0400 Trees	**15.00 ea**			**33,094**			**33,094**
02930.0402 Vegetation							
Planting Bed Preparation	24.69 cy	-	-	1,667	-	-	1,667
Weed Barrier	2,000.00 sf	-	-	375	-	-	375
Fertilizer	2,000.00 sf	-	-	75	-	-	75
Lime	2,000.00 sf	-	-	38	-	-	38
Groundcover Plants	666.67 ea	-	-	12,500	-	-	12,500
02930.0402 Vegetation	**2,000.00 sf**			**14,654**			**14,654**
02930 Trees/Shrubs/Groundcover				47,748			47,748
25 Bioretention and Trees along Narbonne Ave		5,859	13,450	49,248	4,101		72,658
04 Component 4: Bioretention and Trees along Narbonne Ave		**5,859**	**13,450**	**49,248**	**4,101**		**72,658**

Estimate Totals

Description	Amount	Totals	Hours	Rate
Labor	311,370		3,417 hrs	
Material	556,416			
Subcontract	2,291,628			
Equipment	155,034		1,598 hrs	
Other	79,457			
Subtotal Direct Cost	**3,393,905**	**3,393,905**		
General Conditions				
GC General Conditions	407,269			12.00 %
Subtotal General Conditions	**407,269**	**3,801,174**		
Indirect Costs				
Building Permits(% total cost)	5,370			0.10 %
Sales Tax (MEO)	68,045			9.50 %
Bldr's Risk Ins (% total cost)				
Gen Liab Ins (% total cost)	53,699			1.00 %
GC Bonds (% total cost)	80,549			1.50 %
Subtotal Prior to OH&P	**207,663**	**4,008,837**		
Contractor Total OH&P	481,060			12.00 %
Subtotal with OH&P	**481,060**	**4,489,897**		
Construction Contingency	673,485			15.00 %
Total Cost in Today's Dollars	**673,485**	**5,163,382**		
Escalation to Mid Point Constr	206,535			4.00 %
Based on 4% per year				
	206,535	**5,369,917**		
Total		***5,369,917***		

"This Opinion of Probable Construction Cost is produced in accordance with CDM Smith's Firmwide Quality policies and best practices as described in CDM Smith's Estimating Manual Dated 01/03/12 Section 10 titled Quality Control. I hereby attest that the Cost Estimating policies and procedures were followed in preparation of the Opinion of Probable Cost"

Lead Estimator initials - TJS *Date 7/9/2021*

Appendix H

Design Phase Schedule

Figure H-1 Design Phase Schedule

Appendix I

Letters of Support

STATE CAPITOL
P.O. BOX 942849
SACRAMENTO, CA 94249-0066
(916) 319-2066
FAX (916) 319-2166

E-MAIL
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Assembly
California Legislature

DISTRICT OFFICE
3424 WEST CARSON STREET, SUITE 450
TORRANCE, CA 90503
(310) 375-0691
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AL MURATSUCHI
CHAIR, JOINT LEGISLATIVE COMMITTEE ON CLIMATE CHANGE POLICIES
ASSEMBLYMEMBER, SIXTY-SIXTH DISTRICT

July 26, 2021

Safe Clean Water Program
South Santa Monica Bay WASC
c/o Los Angeles County Public Works
900 South Fremont Avenue
Alhambra, California 91803

Dear Watershed Area Steering Committee:

As the Assemblymember representing California's 66th Assembly District, I am writing to express my support for the City of Lomita's Downtown Lomita Multi-Benefit Stormwater Project application for Safe, Clean Water Program funding. The project will provide the community with water quality benefits, flood control benefits, and community beautification and recreation benefits.

Located in the downtown area of Lomita, the project will capture and infiltrate stormwater flow that would otherwise carry harmful urban pollutants downstream to Wilmington Drain and Machado Lake. By infiltrating stormwater underground, in a City-owned parking lot and in underground wells, the project will reduce the risk of flooding. Other key components of the project include the planting of trees and vegetated areas, installation of benches in the downtown area, and addition of a bike lane bike locking locations.

From a stormwater regulatory standpoint, the City of Lomita is required to comply with the Los Angeles County Municipal Separate Storm Sewer System (MS4) National Pollutant Discharge Elimination System (NPDES) Permit (MS4 Permit). This requires the City to reduce the loading of pollutants, such as nutrients and metals currently carried to Wilmington Drain and Machado Lake by stormwater runoff. This project will capture and infiltrate nearly six acre-feet of stormwater runoff, which will help the City to achieve regulatory compliance. The award would allow the City of Lomita to design and complete this essential project.

I am pleased to offer my support for this application for Safe, Clean Water Program funding and encourage you to favorably consider this project. If you have any questions, please contact my District Director Melissa Ramoso at (310) 375-0691 or Melissa.Ramoso@asm.ca.gov.

Sincerely,

Al Muratsuchi
Assemblymember, 66th District

Lomita CHAMBER OF COMMERCE

July 20, 2021

Safe Clean Water Program
South Santa Monica Bay WASC
c/o Los Angeles County Public Works
900 South Fremont Avenue
Alhambra, California 91803

Dear Watershed Area Steering Committee:

On behalf of the Lomita Chamber of Commerce and its Board of Directors, I am writing to express our support for the City of Lomita's Downtown Lomita Multi-Benefit Stormwater Project.

This project will capture and infiltrate nearly six acre-feet of stormwater runoff, which will reduce pollutant loading to downstream-receiving water bodies including the Wilmington Drain and Machado Lake. Additionally, the project will provide features that directly benefit the community's wellbeing, including a bike lane, new trees which will provide shade, and native, drought tolerant vegetation that will reduce the heat island effect and beautify the downtown area.

If funded, the award would allow the City of Lomita to design the project and be one step closer to seeing this important project built. We are pleased to offer support for this application for Safe, Clean Water Program funding and encourage you to favorably consider this project.

Thank you.

Heidi

Heidi Butzine
President/CEO
Lomita Chamber of Commerce

Safe Clean Water Program
South Santa Monica Bay WASC
c/o Los Angeles County Public Works
900 South Fremont Avenue
Alhambra, California 91803

Dear Watershed Area Steering Committee:

On behalf of over 5,000 members of the South Bay Association of Realtors®, I am pleased to submit this letter of support for the City of Lomita's **Downtown Lomita Multi-Benefit Stormwater Project**.

This project will capture and infiltrate nearly six acre-feet of stormwater runoff, which will reduce pollutant loading to downstream receiving waterbodies including Wilmington Drain and Machado Lake. Additionally, the project will provide features that directly benefit the community's wellbeing, including a bike lane, new trees which will provide shade, and native, drought tolerant vegetation that will reduce the heat island effect and beautify the downtown area. With key placement of benches, the downtown area of Lomita Boulevard will be even more inviting to pedestrians who want to enjoy the downtown area. As our community continues to ease back into the local activities that we know and love, this project will help revitalize sustainable gathering spaces that the city and its residents can be proud of.

If funded, the award would allow the City of Lomita to design the project and be one step closer to seeing this important project built. We are pleased to offer our support for this application for Safe, Clean Water Program funding and encourage you to favorably consider this project.

Sincerely,

Theresa Bruno
2021 Association President
South Bay Association of Realtors®

Coryell, Jennifer L.

From: Travis Graham <travcgraham@gmail.com>
Sent: Friday, July 2, 2021 3:38 PM
To: Coryell, Jennifer L.
Cc: downtownlomitaproject@lomitacity.com
Subject: Re: Project in downtown Lomita

Hello Jenn,

Thanks for the follow up email. I did read it and I believe the project in question would be of great benefit to the City of Lomita. Because we have an arid climate in Lomita, we have very inconsistent rain levels from year to year. For example, last year we saw very little rain, but less than ten years ago while living less than a mile from the area in question, we saw a record breaking amount of rain. A stormwater system would go a long way to prevent flooding when we have wetter winters.

I hope this helps!

Regards,

Travis Graham
Co-Owner, Still Got It Fitness
2173 Lomita Blvd.
Lomita, Ca. 90717

On Tue, Jun 29, 2021 at 7:08 PM Coryell, Jennifer L. <coryelljl@cdmsmith.com> wrote:

> Hello - My colleague spoke with one of your employees last week about a project the City of Lomita is proposing in downtown Lomita that has many community beautification elements. Below is a description of the project in more detail. We are very excited about this project and hope it will be successful in securing funding from the Safe, Clean Water Program (Measure W), which is a county wide, competitive grant program for projects such as this. Currently, we would like to show the selection committee that there is strong community support for this project. Since the project is located within the vicinity of your fitness center, we were hoping you would be able to provide us with a letter/email of support. If the project is selected, during the design phase the team will set up workshops to get the community's input on the design, so there would be more opportunity to give us feedback and let us know what would best serve you and the community.
>
> **Project description:** The Downtown Lomita Multi-Benefit Stormwater Project is a proposed City of Lomita stormwater management project that will provide the community with water quality benefits, flood control benefits, and community beautification and recreation benefits. Located in the downtown area of Lomita, south of City Hall on Narbonne Avenue and extending to a stretch of Lomita Boulevard from Lucille Avenue to Woodward Avenue, the project will capture and infiltrate stormwater flow that would otherwise carry harmful urban pollutants downstream to Wilmington Drain and Machado Lake. By infiltrating stormwater underground in a City-owned parking lot on Narbonne Avenue and in underground wells under Lomita Boulevard, the project will reduce the risk of flooding along Narbonne Avenue. Other key components of the project include the planting of dozens of trees along Narbonne Avenue and Lomita Boulevard as well as new vegetated areas along the sidewalk that will further capture stormwater in a natural way. These features will reduce the heat island effect that can occur in areas where there are large stretches of pavement by providing shade and vegetated ground cover that will absorb the heat. With key placement of benches,

the downtown area of Lomita Boulevard will be even more inviting to pedestrians who want to enjoy the downtown area. As a recreational feature and as part of the City's plan to increase alternatives to vehicle use, a bike lane will be added along Lomita Boulevard from Woodward Avenue to Lucille Avenue, which is one part of a more expansive bicycle and pedestrian plan for the City. This bike lane will provide a safe location for bicyclists traveling to the downtown area and for those just passing by. Additional bike locking locations will also be provided in key locations to further encourage this healthy mode of transportation that also helps reduce pollution.

A letter or even a quick sentence indicating you think the project would benefit the community and that you support it would go a long way. This can be emailed back to me and please also copy the City at DowntownLomitaProject@lomitacity.com (please note that this account is set up just for this purpose and any other communication with the City should follow proper channels).

Please feel free to ask me any questions about the project. Thank you for your support!

Best,

Jenn

Jennifer Coryell, PE*

Water Resources Engineer
CDM Smith
125 S. Wacker Drive, Suite 700, Chicago, IL 60606
(direct) 312.780.7716 (office) 312.346.5000
cdmsmith.com

*Licensed in IL and CA

Appendix J

Los Angeles County Flood Control District Conceptual Approval

COUNTY OF LOS ANGELES

DEPARTMENT OF PUBLIC WORKS

"To Enrich Lives Through Effective and Caring Service"

900 SOUTH FREMONT AVENUE
ALHAMBRA, CALIFORNIA 91803-1331
Telephone: (626) 458-5100
http://dpw.lacounty.gov

MARK PESTRELLA, Director

ADDRESS ALL CORRESPONDENCE TO:
P.O. BOX 1460
ALHAMBRA, CALIFORNIA 91802-1460

IN REPLY PLEASE
REFER TO FILE: SWP-1

July 14, 2021

Ms. Carla Dillon, Director
City of Lomita Public Works
24300 Narbonne Avenue
Lomita, CA 90717

Dear Ms. Dillon:

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LETTER OF CONCEPTUAL APPROVAL FOR SAFE, CLEAN WATER PROGRAM
CONSIDERATION OF INFRASTRUCTURE FUNDING

Los Angeles County Flood Control District has been engaged to review the following multi-benefit project concept and is hereby providing this letter of conceptual approval:

Downtown Lomita Multi-Benefit Stormwater Project
City of Lomita
Dominguez Channel

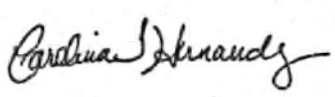
We understand the proposed multi-benefit project concept involves three structures that will divert runoff out of existing storm drains owned by the District. Diversion Structure No. 1 will divert runoff from a 36-inch RCP storm drain in Narbonne Avenue into a separating baffle box (DSBB) for pretreatment followed by discharge to an underground infiltration gallery located at 24418 Narbonne Avenue. Diversion Structure No. 2 will direct runoff from a 39-inch RCP storm drain in Lomita Boulevard, south of Alliene Avenue into a DSBB and a series of approximately 15 dry wells. Diversion Structure No. 3 will reroute runoff from a 54-inch RCP storm drain in Narbonne Avenue, north of the intersection of Lomita Boulevard and Narbonne Avenue, into a DSBB and a series of approximately 12 dry wells located along the curb on the north side of Lomita Boulevard. The Project will also include bioretention systems along Narbonne Ave and Lomita Boulevard, planting of new trees and vegetation, and conversion of a parking lane along Lomita Boulevard (from Woodward Avenue to Lucile Avenue) into a 5-feet wide bike lane constructed of porous pavement.

The Project is not currently inconsistent with any District plans, policies, or goals. Conceptual approval does not indicate the District's consent to support or even permit the Project once developed. If funding is ultimately allocated to the Project, it is required that the project proponent remain closely engaged with District throughout each subsequent project phase and comply with any eventual applicable agreement and/or permit provisions. Please upload a copy of this letter in the Projects Module application when responding to the Regional Program Call for Projects.

Thank you for your interest in the Safe, Clean Water Program. Please be sure to continue to work with your District Watershed Manager from Los Angeles County Public Works, Cung Nguyen. Mr. Nguyen can be reached at (626) 458-4341 or cunguyen@pw.lacounty.gov. Ongoing collaboration is imperative. If the subject project is not funded within 2 years from the date of this letter, a new demonstration of non-objection will be required before the project can be considered.

Very truly yours,

MARK PESTRELLA, PE
Chief Engineer
Los Angeles County Flood Control District



CAROLINA T HERNANDEZ, PE
Assistant Deputy Director
Stormwater Planning Division

RT:yg
P:\swppub\Secretarial\2021\Letters\2021 Conceptual Approval for Downtown Lomita Multi-Benefit Stormwater Project.docx

Appendix B: Draft Geotechnical Report

Geotechnical Evaluation

Downtown Lomita Multi-Benefit Stormwater Project

Lomita, California

Hazen and Sawer

7700 Irvine Center Drive, Suite 200 | Irvine, California 92618

October 25, 2024 | Project No. 212611001

Geotechnical | Environmental | Construction Inspection & Testing | Forensic Engineering & Expert Witness

Geophysics | Engineering Geology | Laboratory Testing | Industrial Hygiene | Occupational Safety | Air Quality | GIS

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

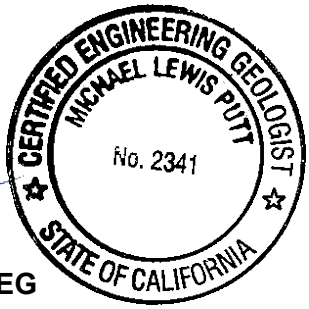
35+ YEARS

Geotechnical Evaluation
Downtown Lomita Multi-Benefit Stormwater Project
Lomita, California

Mr. Christopher Jansen
Hazen and Sawyer
7700 Irvine Center Drive, Suite 200 | Irvine, California 92618

October 25, 2024 | Project No. 212611001

Spencer Marcinek, PE, GE
Senior Engineer



Michael Putt, PG, CEG
Principal Geologist

Soumitra Guha, PhD, PE, GE
Principal Engineer

SXS/SCM/MLP/SG/mlc

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TABLES

FIGURES

APPENDICES

1 INTRODUCTION

In accordance with your request and authorization, we have performed a geotechnical evaluation for the Downtown Lomita Multi-Benefit Stormwater Project in Lomita, California (Figure 1). The purpose of our study was to evaluate the soil and groundwater conditions at the site, develop geotechnical recommendations for construction of the stormwater improvements, and to evaluate the feasibility of infiltrating captured stormwater at the site. Our evaluation was performed in general accordance with our referenced proposal dated January 15, 2024 (Ninyo & Moore, 2024). This report presents our findings, conclusions, and recommendations for the project.

2 SCOPE OF SERVICES

Our scope of services included the following:

- Project coordination, scheduling of field work, and consultation with the project team to provide geotechnical input.
- Permit acquisition from the County of Los Angeles Environmental Health Department for drilling borings deeper than 10 feet below the ground surface.
- Permit acquisition from the City of Lomita for encroachment in the City right-of-way.
- Field reconnaissance to observe and document the site conditions, and to mark the proposed boring, percolation test, and cone penetration test (CPT) sounding locations for underground utility clearance by Underground Service Alert.
- Subsurface exploration consisting of three CPT soundings to depths ranging from approximately 46.1 to 80.3 feet below the ground surface and the drilling, logging, and sampling of five hollow-stem auger exploratory borings to depths ranging from approximately 10 to 80 feet below the ground surface. The borings were logged by a representative from our firm and bulk and relatively undisturbed soil samples were collected at selected depths for laboratory testing.
- Field percolation testing was performed in five of the borings in general accordance with the methods presented in the Los Angeles County Guidelines for Geotechnical Investigation and Reporting Low Impact Development Stormwater Infiltration (County of Los Angeles, 2021). Double ring infiltrometer testing was also performed at the ground surface at two locations near the footprint of the infiltration gallery.
- Geotechnical laboratory testing of selected samples to evaluate in-situ moisture content and dry density, gradation, percentage of particles finer than the No. 200 sieve, Atterberg limits, direct shear strength, R-value, and soil corrosivity.
- Data compilation and engineering analyses of the information obtained from our background review, subsurface evaluation, and laboratory testing.
- Preparation of this report presenting our findings, conclusions, and recommendations pertaining to the geotechnical aspects of the design and construction of the proposed improvements.

3 SITE DESCRIPTION AND PROJECT DESCRIPTION

Based on our review of the Feasibility Study and the Request for Proposal, and our discussions with the project team, we understand that the intent of the project is to capture, treat, and infiltrate stormwater flow that would otherwise carry pollutants of concern downstream to Wilmington Drain, Machado Lake, and Los Angeles Harbor. The project area extends along Narbonne Avenue between City Hall and Lomita Boulevard (approximately 450 feet) and along Lomita Boulevard between Lucille Avenue and Woodward Avenue (approximately 1,100 feet) (Figures 2 through 4). Figure 2 presents the north project area, Figure 3 presents the southwest project area, and Figure 4 presents the southeast project area.

An approximately 3,100 square-foot infiltration gallery with an internal storage depth of 5 feet is proposed within the existing parking lot located at 24329 Narbonne Avenue (Narbonne Plaza) across from City Hall. It is our understanding that Hazen and Sawyer is currently considering alternative locations for the infiltration gallery, including in the parking stalls along Narbonne Avenue and in the grassy area in front of City Hall. The depth of the infiltration gallery is currently unknown, but we anticipate that it may range from approximately 30 to 50 feet below the ground surface. A series of 34 drywells are proposed along Lomita Boulevard close to the centerline. In addition to the infiltration gallery and drywells, new shade trees, benches, permeable pavement, utilities, bioretention areas, vegetation areas, signage, and bike lanes are proposed for the project.

In general, the project area is located within a commercial neighborhood in Lomita. Narbonne Avenue is a two-lane road consisting of asphalt concrete (AC) pavement with a center turn-lane. Lomita Boulevard is a four-lane road consisting of AC pavement with a center median. Parking zones are present at various areas along Narbonne Avenue and Lomita Boulevard. Review of aerial photographs dating back to 1952 indicate that structures and improvements were previously present within the existing footprint of the proposed infiltration gallery at Narbonne Plaza (Historical Aerials, 2024). These improvements were demolished sometime between 1997 and 1998. Topographically, the site is relatively flat and slopes gently downward to the south, with elevations ranging from approximately 72 to 78 feet above the mean sea level (CDM Smith, 2023)

4 SUBSURFACE EVALUATION AND LABORATORY TESTING

Our subsurface evaluation was conducted on May 16, 23, 28 through 31, and June 10, 2024, and consisted of the advancement of three CPT soundings (CPT-1 through CPT-3) and the drilling, logging, and sampling of five hollow-stem auger borings (B-1 [two borings were drilled at B-1] through B-4). The CPT soundings were performed using a 30-ton CPT rig to depths ranging from

approximately 46.1 to 80.3 feet below the ground surface. Continuous soil profiles, including cone tip resistance and sleeve friction, were recorded during the CPT soundings. A representative of Ninyo & Moore was on site to observe the CPT soundings. The CPT soundings were performed for initial screening purposes to evaluate the subsurface alluvial layers that may be suitable for infiltration.

Borings B-1 and B-2 were drilled using a truck-mounted drill rig equipped with 8-inch diameter augers and borings B-3 and B-4 were drilled with 18-inch diameter augers. Boring B-1 was initially drilled to a depth of approximately 50 feet below the ground surface. A second boring adjacent to boring B-1 was drilled to a depth of approximately 31 feet below the ground surface in order to perform a second percolation test at boring B-1 to determine if more favorable layers for infiltration are present at a shallower depth. Boring B-2 was drilled to a depth of approximately 10 feet below the ground surface and borings B-3 and B-4 were drilled to a depth of approximately 80 feet below the ground surface. The borings were logged in the field by a representative of Ninyo & Moore and representative bulk and relatively undisturbed soil samples were collected from the borings at selected depths for laboratory testing.

Percolation testing was performed in borings B-1 through B-4 and is discussed in further detail in Section 8 of this report. Borings B-1 and B-2 and the CPT soundings were backfilled with cement-bentonite grout upon completion. It is our understanding that the percolation test wells at borings B-3 and B-4 will be abandoned by the contractor during construction. Logs of the exploratory borings and CPT soundings are provided in Appendices A and B, respectively. The approximate locations of the borings and CPT soundings are presented on Figures 2 through 4.

As a part of this study, we also reviewed existing data from subsurface exploration performed by Geocon West, Inc. (Geocon), for Narbonne Plaza located at 24384 Narbonne Avenue (2019). Four hand auger borings (B-1 through B-4) were drilled by Geocon to depths ranging from approximately 5.5 to 15.5 feet below the ground surface. Percolation testing was performed in boring B-4 and is discussed in further detail in Section 7 of this report. The approximate locations of the previous exploratory borings by Geocon are depicted on Figure 2. The Geocon boring logs are included in Appendix C.

Geotechnical laboratory testing of representative soil samples included tests to evaluate in-situ moisture content and dry density, gradation, percentage of particles finer than the No. 200 sieve Atterberg limits, direct shear strength, R-value, and soil corrosivity. Moisture and density test results are presented on the boring logs in Appendix A. The remaining test results are presented in Appendix D. Laboratory data from the previous geotechnical evaluation by Geocon for Narbonne Plaza are included in Appendix E.

5 GEOLOGIC AND SUBSURFACE CONDITIONS

5.1 Regional Geology

The subject site is located within the southwestern block of the Los Angeles Basin within the Transverse Ranges geomorphic province of Southern California (Norris and Webb, 1990). Geologically, the Los Angeles Basin and vicinity is a region divided into four blocks that include uplifted portions and synclinal depressions. The southwestern block is the seaward section of the basin and is bounded on the east side by the Newport-Inglewood fault zone (Norris and Webb, 1990).

Review of regional geologic maps indicates that the site is underlain by Holocene-age alluvium (Dibblee, 1999). The alluvium is described as slightly elevated and locally dissected, mostly loamy clay of valley and flood plains, and includes fine sand near Palos Verdes Hills. It should be noted that the northern portion of the alignment is mapped at the geologic boundary of Pleistocene-age dune sand consisting of mostly unconsolidated fine-grained sand. A map of the regional geology is presented on Figure 5.

5.2 Site Geology

Materials encountered during our subsurface exploration generally consisted of undocumented fill underlain by alluvium. Undocumented fill was encountered in each of the borings to depths ranging from approximately 2 to 5 feet below the ground surface. Similarly, undocumented fill was encountered to depths ranging from approximately 1.5 to 2 feet below the ground surface in the previous borings at Narbonne Plaza by Geocon. The undocumented fill generally consisted of moist, loose silty sand and poorly graded sand with silt. Variable amounts of gravel and debris (asphalt, concrete, and trash) were encountered in the undocumented fill. Alluvium was encountered beneath the undocumented fill to the explored depths of up to approximately 80 feet. The alluvium generally consisted of moist to wet, loose to very dense silty sand, clayey sand, poorly graded sand with silt, and poorly graded sand, and very stiff to hard sandy lean clay. Variable amounts of gravel were encountered in the alluvium. More detailed descriptions of the subsurface materials are presented on the boring logs in Appendix A.

6 GROUNDWATER

Groundwater was observed at the time of drilling in exploratory boring B-4 at a depth of approximately 77 feet below the ground surface. The groundwater depth observed at the time of drilling is not considered a stabilized groundwater condition and may vary from the recorded level. Regional maps indicate that the historic high depth to groundwater at the project site is

approximately 10 feet below the ground surface (California Department of Conservation, Division of Mines and Geology [CDMG], 1998). Groundwater levels are subject to variation due to seasonal rainfall, irrigation, groundwater pumping, subsurface stratigraphy, topography, and other factors which may not have been evident at the time of our evaluation.

7 FIELD PERCOLATION TESTING

Percolation testing was performed in borings B-1 through B-4 in general accordance with the County of Los Angeles Guidelines for Geotechnical Investigation and Reporting Low Impact Development Stormwater Infiltration (County of Los Angeles, 2021). The testing was performed to evaluate the infiltration rate of the on-site soils for use in design of the Best Management Practices (BMPs) for stormwater infiltration. The approximate locations of the percolation test borings are shown on Figures 2 through 4.

Boring B-1 was initially drilled to a depth of approximately 50 feet below the ground surface. A second boring adjacent to the boring B-1 location was drilled to a depth of approximately 31 feet below the ground surface in order to perform percolation testing at a different depth interval for the proposed infiltration gallery. Boring B-2 was drilled to a depth of approximately 10 feet below the ground surface within the parking area along Narbonne Avenue south of Narbonne Plaza to evaluate alternative infiltration BMPs, such as bioswales. Borings B-3 and B-4 were drilled to a depth of approximately 80 feet below the ground surface for the proposed drywells. Since groundwater was encountered at a depth of approximately 77 feet in boring B-4, the percolation test well was constructed to a depth of approximately 65 feet, since the invert of stormwater infiltration needs to be at least 10 feet above the design groundwater elevation in accordance with the County of Los Angeles guidelines.

Preparation of each boring for percolation testing included the installation of a 2-inch-diameter slotted polyvinyl chloride (PVC) pipe in the boring and backfilling the annular space between the borehole wall and pipe with clean gravel. An additional dual-nested 4-inch PVC pipe was installed in the 18-inch-diameter borings (B-3 and B-4). The infiltration zones were pre-soaked with water for at least one hour prior to performing percolation testing. After the borings were pre-soaked, constant-head percolation testing was performed in borings B-1, B-3, and B-4, and falling-head percolation testing was performed in boring B-2.

The constant-head test method involved placing and maintaining a constant head of clean water into the PVC pipe and measuring the flow rate in gallons per minute required to keep the water level constant inside the borehole. A flow meter was used to record the volumetric flow rate of water entering the test boring. Once a stabilized head was established in the boring, the constant-

head test was initiated and the flow was maintained for a period of approximately three hours. The field percolation rate was calculated by dividing the average stabilized volumetric rate by the total surface area of infiltration within the boring. The measured field percolation rates are presented in Table 1.

The falling-head test method involved placing clean water into the PVC pipe to establish a head of water and measuring the rate at which the water level dropped in the pipe at consecutive time intervals (approximately 30 minutes). The test readings were repeated for three hours and until a stabilized rate was obtained. The field percolation rate was calculated by measuring the total volume of water infiltrated during the time intervals and dividing by the surface area of the tested zone of the boring based on the average of the last three consecutive readings. The measured field percolation rates are presented in Table 1.

Additionally, double-ring infiltrometer percolation testing was performed at two locations for pervious pavement design near the proposed infiltration gallery in accordance with ASTM International (ASTM) test method D 3385 (DR-1 and DR-2). The approximate locations of the double-ring infiltrometer tests are shown on Figures 2 and 3. The testing was performed at a depth interval from approximately 0 to 6 inches. A 24-inch-diameter stainless steel outer ring and a 12-inch-diameter stainless steel inner ring were driven with minimal disturbance into the ground to a depth of approximately 6 inches. The purpose of having an outer and inner ring was to measure the infiltration rate of the inner ring in a one-dimensional vertical steady state flow condition. Percolation testing was performed under a constant head condition where the water level in the outer and inner rings was maintained at constant level by filling up the rings with water through separate reservoirs. Testing was repeated until the rate of infiltration reached an equilibrium value. The measured field percolation rates are presented in Table 1.

The County of Los Angeles guidelines indicate that the measured field percolation rates should be reduced to account for the long-term performance of the proposed improvements by dividing the rates by the “Total Reduction Factor (RF).” They define the RF as the sum of the "test-specific" reduction factor (RF_t), the "site variability" reduction factor (RF_v), and the "long-term siltation, plugging, and maintenance" reduction factor (RF_s) (i.e., $RF = RF_t + RF_v + RF_s$). The guidelines indicate that the RF_t should be applied to account for variations in the direction of flow during the test and the reliability of the different test methods. The guidelines provide RF_t values to be used in the equation that vary based on the test method performed. A value of 2 was used for the constant-head, falling-head, and double-ring percolation tests and was applied to the RF equation accordingly. The RF_v value is applied to account for site variability, number of tests, and thoroughness of the subsurface investigation and ranges from 1 to 3. For the purposes of this

evaluation, we have assumed an RF_v value of 1. The long-term siltation, plugging, and maintenance value (RF_s) also ranges from 1 to 3 and will generally vary on the level of pre-treatment performed prior to infiltration and the level of future maintenance of the system. For the purposes of this evaluation, we have assumed an RF_s value of 1; however, the RF_s value should be provided by the BMP designer. The RF_t, RF_v, RF_s, and resulting RF values used in our analysis are presented in Table 1. The adjusted preliminary percolation rates based on these values are also presented in Table 1. It should be noted that Geocon used an RF value of 2 in their percolation testing calculations.

Table 1 – Percolation Test Results

Test Boring	Test Type	Approximate Depth of Tested Zone (feet)	Field Percolation Rate (inches/hour)	Reduction Factor				Adjusted Percolation Rate (inches/hour)
				RF_t	RF_v	RF_s	RF	
B-1	Constant Head	45.0 – 50.0	33.0	2	1	1	4	8.3
		26.0 – 31.0	18.3	2	1	1	4	4.6
B-2	Falling Head	5.0 – 10.0	0.31	2	1	1	4	0.08
B-3	Constant Head	21.0 – 80.0	11.8	2	1	1	4	3.0
B-4	Constant Head	25.0 – 65.0	15.4	2	1	1	4	3.9
B-4*	Falling Head	2.0 – 5.5	3.9	-	-	-	2	2.0
DR-1	Double Ring	Ground Surface	1.6	2	1	1	4	0.39
DR-2	Double Ring	Ground Surface	3.9	2	1	1	4	0.97

Notes:
* Boring performed by Geocon (2019)
RF_t – Test Specific Reduction Factor
RF_v – Site Variability Reduction Factor
RF_s – Long-Term Siltation, Plugging, and Maintenance Reduction Factor (To be adjusted by the BMP designer as needed)
RF – Total Reduction Factor

8 FLOOD HAZARDS

Based on our review of flood insurance rate maps for the project area (Federal Emergency Management Agency [FEMA], 2008), the project site is not located in the 100-year Flood Hazard Zone, A99. Zone A99 includes areas to be protected from a 100-year flood by the Federal Flood Protection System under construction at the time of publication of the FEMA map; no base flood elevations are given. The site is located within Other Areas of Flood Hazard – Zone X (areas of minimal flood hazard).

9 FAULTING AND SEISMICITY

The site is in a seismically active area, as is the majority of southern California, and the potential for strong ground motion in the project area is considered significant during the design life of the

project. Figure 6 shows the approximate site location relative to the major faults in the region. The site is not located within a State of California Earthquake Fault Zone, formerly known as the Alquist-Priolo Special Studies Zone (California Geological Survey [CGS], 2018). The nearest mapped active fault to the approximate footprint of the infiltration gallery is the Palos Verdes fault located approximately 1.3 miles south of the site (United States Geological Survey, 2008).

The principal seismic hazards evaluated at the subject site are surface fault rupture, ground motion, and liquefaction. These potential hazards are discussed in the following sections.

9.1 Surface Fault Rupture

Based on our review of the referenced literature and our site reconnaissance, no active faults are known to cross the project site. Therefore, the probability of damage from surface fault rupture is considered to be low. However, lurching or cracking of the ground surface as a result of nearby seismic events is possible.

9.2 Ground Motion

Considering the proximity of the site to active faults capable of producing a maximum moment magnitude of 6.0 or more, the project area has a high potential for experiencing strong ground motion. The 2022 California Building Code (CBC) specifies that the risk-targeted maximum considered earthquake (MCE_R) ground motion response accelerations be used to evaluate seismic loads for design of buildings and other structures. Based on our review of CGS's shear wave velocity map, the average shear wave velocity in the upper 30 meters (100 feet) of the subsurface profile (V_{S30}) at the site is estimated to be approximately 387 meters per second (1,268 feet per second) (CGS, 2015). In accordance with Chapter 20 of the American Society of Civil Engineers (ASCE) Publication 7-16 (2016) for the Minimum Design Loads and Associated Criteria for Building and Other Structures, the site classification is Site Class C (very dense soil and soft rock).

In accordance with ASCE 7-16, the mapped MCE_R ground motion response accelerations were determined using the 2024 Applied Technology Council (ATC) seismic design tool (web-based). The MCE_R ground motion response accelerations are based on the spectral response accelerations for 5 percent damping in the direction of maximum horizontal response and incorporate a target risk for structural collapse equivalent to 1 percent in 50 years with deterministic limits. Spectral response acceleration parameters, consistent with the 2022 CBC, are provided in Section 11.2 for the evaluation of seismic loads on buildings and other structures.

9.3 Liquefaction

Liquefaction is the phenomenon in which loosely deposited granular soils with silt and clay contents of less than approximately 35 percent and non-plastic silts located below the water table undergo rapid loss of shear strength when subjected to strong earthquake-induced ground shaking. Ground shaking of sufficient duration results in the loss of grain-to-grain contact due to a rapid rise in pore water pressure, and causes the soil to behave as a fluid for a short period of time. Liquefaction is known generally to occur in saturated or near-saturated cohesionless soils at depths shallower than 50 feet below the ground surface. Factors known to influence liquefaction potential include composition and thickness of soil layers, grain size, relative density, groundwater level, degree of saturation, and both intensity and duration of ground shaking.

Based on our review of the State of California Seismic Hazard Zones Map (CDMG, 1999), the project site is not located within an area considered to be susceptible to seismically induced liquefaction (Figure 7). Due to the relatively dense soils (i.e., high sampler blow counts recorded below 20 feet) and since groundwater was encountered at a depth of approximately 77 feet in one of our borings, it is our opinion that liquefaction and liquefaction-related seismic hazards (e.g., dynamic settlement, ground subsidence, and/or lateral spreading) are not design considerations for the project.

10 CONCLUSIONS

Based on the results of our evaluation and infiltration testing, the infiltration rates at the site are highly variable. The results from our seven percolation tests indicate that the adjusted infiltration rates of the on-site soils range from approximately 0.08 to 8.3 inches per hour. In general, the soils in the upper 10 feet within the project area have lower infiltration rates than the soils below a depth of approximately 20 feet within the project area. The infiltration rate of 0.08 inches per hour measured at boring B-2 will not meet the County of Los Angeles minimum rate for infiltration (0.3 inches per hour).

It is our understanding that the infiltration rates measured at the site are lower than anticipated, and that Hazen and Sawyer is currently considering alternative options for stormwater infiltration, including relocating the footprint of the infiltration gallery. Scattered clayey soils were encountered in the upper 20 feet at the site. Additionally, dense soils were encountered below a depth of approximately 20 feet, which may have resulted in lower than anticipated infiltration rates.

Performing additional infiltration testing at different locations and depths at the subject site in a future design phase will be appropriate to evaluate the overall infiltration rate of the on-site soils and the feasibility of infiltration, or if smaller-scale infiltration in selected areas is feasible.

Performing additional subsurface exploration in selected project areas prior to mobilization for constructing the percolation test holes may also be considered to evaluate for the presence of more coarse-grained soils so that the percolation test holes can target those layers for testing.

In general, it is our opinion that the proposed BMPs at the site are feasible from a geotechnical standpoint; however, the lower than anticipated infiltration rates may make certain aspects of the project more difficult to achieve. If large-scale infiltration at the site is generally not considered to be feasible by the designer, it is our opinion that construction of the underground storage structure to store stormwater runoff for the project is a feasible alternative from a geotechnical standpoint, provided that the recommendations presented in this report are incorporated into the design and construction of the project. Since the proposed depth of the infiltration gallery will be on the order of 30 to 50 feet, additional geotechnical considerations for the project include shoring and large lateral earth pressures. In general, the following conclusions were made:

- The subject site is underlain by undocumented fill overlying alluvial materials. The thickness of the undocumented fill encountered in our borings ranged from approximately 2 to 5 feet below the ground surface. The undocumented fill generally consisted of moist, loose silty sand and poorly graded sand with silt. Variable amounts of gravel and debris (asphalt, concrete, and trash) were encountered in the undocumented fill. The alluvium generally consisted of moist to wet, loose to very dense silty sand, clayey sand, poorly graded sand with silt, and poorly graded sand, and very stiff to hard sandy lean clay. Variable amounts of gravel were encountered in the alluvium.

- Our five percolation tests performed in borings B-1 through B-4 and the two double ring infiltrometer tests (DR-1 and DR-2) indicate that the on-site soils tested from the ground surface to a depth of approximately 80 feet below the ground surface have adjusted infiltration rates ranging from approximately 0.08 to 8.3 inches per hour. An infiltration rate of 0.08 inches per hour measured at boring B-2 will not meet the County of Los Angeles minimum rate for infiltration.

- In general, excavations in the existing fill soil and alluvium should be feasible with earthmoving equipment in good working condition. Some of the granular soils that will be encountered near the subgrade elevation of the infiltration gallery are very dense and may involve additional excavation effort. Oversized materials and deleterious materials in the undocumented fill should be anticipated by the contractor.

- We anticipate that the on-site excavated materials should be suitable for re-use as engineered fill and trench backfill provided that they are free of trash, debris, roots, contamination, deleterious materials, and cobbles or hard lumps of material in excess of 4 inches in diameter. Processing of the materials to bring them near the laboratory optimum moisture content (i.e., drying and/or wetting) prior to use as fill should be planned by the contractor.

- On-site soils should be considered as Type C soils in accordance with the Occupational Safety and Health Administration (OSHA) soil classifications. The on-site soils will be subject to caving. Where excavations cannot be laid back, temporary shoring is anticipated. Shoring should be designed by the contractor to support the excavation sidewalls and to reduce the potential for settlement of adjacent structures, roadways, and other site improvements. Shoring should be designed in accordance with OSHA regulations.

- Groundwater was encountered in boring B-4 at a depth of approximately 77 feet below the ground surface. The historic high depth to groundwater is mapped as being approximately 10 feet below the ground surface at the site (CDMG, 1998). Fluctuations in the level of groundwater will occur due to variations in ground surface topography, subsurface stratification, rainfall, irrigation practices, groundwater pumping, and other factors that were not evident at the time of our field evaluation.

- The site is not located within an Earthquake Fault Zone associated with active faulting as defined by the Alquist-Priolo Earthquake Fault Zoning Act. Accordingly, the potential for fault rupture across the site is considered to be low.

- The site is not located within a mapped Seismic Hazards Zone considered susceptible to liquefaction (CDMG, 1999). It is our opinion that liquefaction is not a design consideration for the project.

- The site is not located within a designated flood inundation zone from failure of a dam or the 100-year and 500-year flood events (FEMA, 2008).

- Based on our laboratory test results, the near-surface site soils can be classified as non-corrosive based on California Department of Transportation (Caltrans, 2021) corrosion guidelines.

11 RECOMMENDATIONS

The following sections present our geotechnical recommendations for the project based on our field exploration, laboratory test results, and engineering analyses. The proposed construction should be performed in accordance with the requirements of the applicable governing agencies. Our percolation tests indicate highly variable conditions and that large-scale infiltration may not be feasible at the site. We recommend performing additional infiltration tests at different locations and depths within the project area during a subsequent design phase to better characterize the infiltration rates of the on-site soils if stormwater infiltration will be incorporated into the project. Our recommendations are presented below with the understanding that some infiltration at the site will be performed as part of this project.

11.1 Earthwork

We anticipate that earthwork at the site will generally consist of borehole drilling to install the proposed drywell BMP improvements and open-cut excavations to install the infiltration gallery, underground structures, pipelines, and manholes, and the backfilling of those structures and pipeline trenches. Earthwork may also include preparation of subgrade and installation of new pavement, placement of bioswales, and finish grading for establishment of site drainage. Earthwork operations should be performed in accordance with the requirements of applicable governing agencies and the recommendations presented in the following sections.

11.1.1 Pre-Construction Conference

We recommend that grading and foundation plans be submitted to Ninyo & Moore for review to check for conformance to the recommendations provided in this report. We further recommend that a pre-construction conference be held to discuss the grading recommendations presented in this report. The owner and/or their representative, the governing agencies' representatives, the civil engineer, Ninyo & Moore, and the contractor should be in attendance to discuss the work plan, project schedule, and earthwork requirements.

11.1.2 Clearing and Site Preparation

Prior to excavating or other earthwork, the proposed area of improvements should be cleared of surface obstructions, debris, pavement, abandoned utilities, and other deleterious materials. Obstructions that extend below finish grade, if any, should be removed and the resulting holes filled with compacted soils. Existing utilities should be re-routed or protected from damage by equipment. Materials generated from the clearing operations should be removed from the project site and disposed at a legal dump site.

11.1.3 Excavation Characteristics

We anticipate that excavations in the undocumented fill and alluvium should be feasible with earthmoving equipment in good working order. Some of the granular soils that will be encountered near the subgrade elevation of the infiltration gallery are very dense and may involve additional excavation effort. The fill and alluvial materials generally consisted of moist to wet, loose to very dense silty sand, clayey sand, poorly graded sand with silt, and poorly graded sand, and very stiff to hard sandy lean clay. Variable amounts of gravel and debris (asphalt, concrete, and trash) were encountered in the undocumented fill and should be anticipated in the excavations. Variable amounts of gravel were also encountered in the alluvium.

11.1.4 Subgrade Preparation for the Infiltration Gallery

Based on our exploratory borings and CPT soundings, alluvium is anticipated at the bottom of the planned infiltration gallery that should be suitable for support of the gallery and overlying compacted fill. The excavation bottom should be evaluated by our representative during the excavation work. In the event that unsuitable material is encountered along the bottom of the excavation, including undocumented fill and/or waste, the unsuitable material encountered at the bottom of the gallery excavation should be removed and replaced with loosely-packed clean sand or gravel, such as additional drainage rock. The actual

recommendations for removal and replacement should be based on our field observations. We recommend that minimal compaction be performed on the exposed subgrade, materials used to replace unsuitable materials (if needed), and and/or rock blanket placed beneath the gallery. We recommend that the rock blanket consist of open-graded gravel of 0.75-inch to 1.5-inch diameter rock underlain by filter fabric consisting of Mirafi 140N or equivalent. Compaction of the subgrade could potentially reduce the infiltration rate of the gallery. If the subgrade of the infiltration gallery is compacted, we recommend that additional percolation testing be performed.

If foundations are to be installed along the bottom of the gallery, such as strip footings, the upper approximately 8 inches of the subgrade beneath the footings should be scarified, moisture-conditioned to near the optimum moisture content, and recompacted to a relative compaction of 90 percent as evaluated by ASTM D 1557. If unsuitable materials, including undocumented fill, waste, loose/soft, and/or wet materials are encountered along the excavation bottom that extend beneath the proposed footings, specific recommendations for removal and replacement of these materials, if warranted, will be provided by our firm based on field observations. If loose, soft, and/or wet materials are encountered beneath the footings, removal and recompaction of the materials may be warranted. The excavation bottoms should be evaluated by our representative during the excavation work.

11.1.5 Subgrade Preparation for the Other Buried Structures

In order to provide suitable support for proposed buried structures, including catch basins, manholes, etc., we recommend that the existing undocumented fill and upper loose alluvial deposits be removed from beneath the structures. In addition, the structure foundations should be founded on 2 feet or more of newly compacted fill material. The excavation should remove undocumented fill and expose relatively dense alluvial deposits. Additional excavation of loose, soft, and/or wet areas may be appropriate. The excavation bottom should be evaluated by our representative during the excavation work and additional recommendations, if needed, will be based on field observations. The limits of removal should extend approximately 2 feet beyond the footprint of the foundations. If drainage rock is placed beneath the foundations, this can be considered as part of the 2-foot-thick layer of compacted fill beneath the foundations. Prior to placing compacted fill and/or drainage rock, the upper approximately 8 inches of the exposed bottom should be scarified, moisture-conditioned to near the optimum moisture content, and recompacted to a relative compaction of 90 percent as evaluated by ASTM D 1557.

11.1.6 Temporary Excavations and Shoring

We recommend that excavations be designed and constructed in accordance with the OSHA regulations. These regulations provide shoring design parameters for excavations and trenches up to 20 feet deep based on the soil types encountered. Trenches over 20 feet deep should be designed by the contractor's engineer based on site-specific geotechnical analyses. For planning purposes, we recommend that fill and alluvium be considered as OSHA Type C soil. For trench or other excavations, OSHA requirements regarding personnel safety should be met by using appropriate shoring or by laying back the slopes no steeper than 1.5:1 (horizontal to vertical) in the site fill and alluvium. Temporary excavations that encounter seepage may need shoring or may be mitigated by placing sandbags or gravel along the base of the seepage zone. Excavations encountering seepage should be evaluated on a case-by-case basis.

Based on our review of the project drawings, we anticipate that shoring will be used to construct the infiltration gallery at Narbonne Plaza (CDM Smith, 2023). If shoring systems are used for site excavations, they should be designed for the anticipated soil conditions using the lateral earth pressure values presented on Figures 8 and 9 for braced and cantilevered excavations, respectively. We have also included typical construction-induced traffic surcharge loads on Figures 8 and 9. The contractor should include the effect of site-specific surcharge loads, such as soil stockpiles and construction materials, on lateral earth pressures acting on the shoring system. If applicable, loading from the existing buildings along Narbonne Plaza should also be considered during design of the shoring as shown on Figures 8 and 9.

We anticipate that settlement of the ground surface will occur behind the shored excavations. The amount of settlement depends heavily on the type of shoring system, the contractor's workmanship, and soil conditions. To reduce the potential for distress to adjacent improvements, we recommend that the shoring system be designed to limit the ground settlement behind the shoring system to 0.5 inch or less. Possible causes of settlement that should be addressed include settlement during installation of the shoring elements, excavation for structure construction, construction vibrations, and removal of the support system. We recommend that shoring installation be evaluated carefully by the contractor prior to construction and that ground vibration and settlement monitoring be performed during construction.

The contractor should retain a qualified and experienced engineer to design the shoring system. The shoring parameters presented in this report are minimum requirements, and the

contractor should evaluate the adequacy of these parameters and make the appropriate modifications for their design. We recommend that the contractor take appropriate measures to protect workers. OSHA requirements pertaining to worker safety should be observed.

11.1.7 Fill Material

In general, the on-site soils should be suitable for reuse as fill materials, provided they are free of trash, debris, oversize material, or other deleterious materials. Fill should generally be free of rocks or lumps of material in excess of 4 inches in diameter. Rocks or hard lumps larger than approximately 4 inches in diameter should be broken into smaller pieces or should be removed from the site.

Imported fill material, if used, should also consist of clean, granular material with a very low expansion potential, corresponding to an expansion index (EI) of 20 or less. The soil should also be tested for corrosive properties prior to importing. We recommend that the imported materials satisfy the Caltrans (2021) criteria for non-corrosive soils (i.e., soils having a chloride concentration of less than 500 parts per million [ppm], a soluble sulfate content of less than 0.15 percent [1,500 ppm], a pH value of more than 5.5, or an electrical resistivity of more than 1,500 ohm-centimeters [ohm-cm]). Materials for use as fill should be evaluated by Ninyo & Moore prior to importing. The contractor should be responsible for the uniformity of imported materials brought to the site.

11.1.8 Fill Placement and Compaction

In general, fill material, including wall backfill, trench backfill, fill placed beneath gallery footings, etc., should be moisture-conditioned and compacted in horizontal lifts to a relative compaction of 90 percent or more as evaluated by ASTM D 1557. The rock blanket and granular materials placed as fill along the bottom of the gallery excavation, with the exception of fill placed beneath footings, should generally not be compacted. Fill material should be moisture-conditioned to slightly above the laboratory optimum moisture content. The lift thickness for fill soils will depend on the type of compaction equipment used but generally should not exceed 8 inches in loose thickness. Special care should be exercised to avoid damaging pipes during compaction of trench backfill. Placement and compaction of the fill soils should be in general accordance with local grading ordinances and good construction practice.

11.1.9 Pipe Bedding

We recommend that pipes be supported on 6 inches or more of granular bedding material, such as sand, with a sand equivalent (SE) value of 30 or more. Bedding material should be placed around the pipe and 12 inches or more above the top of the pipe in accordance with the current Greenbook, Standard Specifications for Public Works (Public Works Standard, Inc., 2024). We do not recommend the use of crushed rock as bedding material. It has been our experience that the voids within crushed rock are sufficiently large to allow fines to migrate into the voids, thereby creating the potential for sinkholes and depressions to develop at the surfaces.

Special care should be taken not to allow voids beneath the pipe. Compaction of the bedding material and backfill should proceed along both sides of the pipe concurrently. Trench backfill, including bedding material, should be placed and compacted with mechanical equipment in accordance with the recommendations presented in the Earthwork section of this report.

11.1.10 Modulus of Soil Reaction for Pipe Design

The modulus of soil reaction is used to characterize the stiffness of soil backfill placed along the sides of buried flexible pipelines for the purpose of evaluating deflection caused by the weight of the backfill above the pipe. We recommend that a modulus of soil reaction of 1,000 pounds per square inch (psi) be used for design, provided that granular bedding material is placed adjacent to the pipe, as recommended in the previous section.

11.2 Seismic Design Considerations

Design of the proposed improvements should be performed in accordance with the requirements of the governing jurisdictions and applicable building codes. Table 2 presents the mapped seismic design parameters for the site in accordance with the 2022 CBC guidelines.

Table 2 – 2022 California Building Code Seismic Design Criteria

Mapped Spectral Response Acceleration Parameters	Values
Site Classification	C
Site Coefficient, Fa	1.2
Site Coefficient, Fv	1.4
Mapped MCE_R Spectral Response Acceleration at Short Periods, S_s	1.805g
Mapped MCE_R Spectral Response Acceleration at 1.0-Second Period, S_1	0.659g
MCE_R Spectral Response Acceleration at Short Periods Adjusted for Site Class, S_{MS}	2.166g
MCE_R Spectral Response Acceleration at 1.0-Second Period Adjusted for Site Class, S_{M1}	0.922g
Design Spectral Response Acceleration at Short Periods, S_{DS}	1.444g
Design Spectral Response Acceleration at 1.0-Second Period, S_{D1}	0.615g
Maximum Considered Earthquake Geometric Mean (MCE_G) Peak Ground Acceleration, PGA_M	0.962g

11.3 Foundations

It is our opinion that the proposed infiltration gallery may be supported on strip footings and that other underground structures (i.e., catch basins, etc.) may be supported by mat foundations. Spread footings may also be used to support other at-grade structures, if planned.

11.3.1 Spread Footings for Infiltration Gallery and At-Grade Structures

Spread footings for the infiltration gallery (i.e., strip footings) should be placed directly on alluvial materials and/or compacted fill in accordance with the recommendations presented in the Earthwork section of this report. Spread footings for at-grade structures may be supported on compacted fill in accordance with the recommendations presented in the Earthwork section of this report. Spread footings should extend 18 inches or more below the lowest adjacent finished grade. Continuous and isolated footings should have a width of 24 inches or more. Spread footings should be reinforced and detailed in accordance with the recommendations of the structural engineer.

Footings, as described above and bearing on alluvial materials and compacted fill, may be designed using a net allowable bearing capacity of 3,000 pounds per square foot (psf). Total and differential settlements for footings designed in accordance with the above recommendations are estimated to be less than approximately 1 inch and 0.5 inch over a horizontal span of 40 feet, respectively.

Footings bearing on alluvial materials and compacted fill may be designed using a coefficient of friction of 0.35, where the total frictional resistance equals the coefficient of friction times the dead load. Footings may be designed using a passive resistance value of 350 psf per foot of depth, with a maximum value of 3,500 psf. The allowable lateral resistance can be taken as the sum of the frictional resistance and passive resistance, provided the passive resistance does not exceed one-half of the total allowable resistance. The passive resistance (including the maximum value) may be increased by one-third when considering loads of short duration such as wind or seismic forces.

11.3.2 Mat Foundations

Mat foundations for other underground structures (i.e., catch basins, etc.) may be supported on alluvial materials and/or compacted fill in accordance with the recommendations presented in the Earthwork section of this report. Foundations should be designed in accordance with structural considerations and the following recommendations. In addition, requirements of the appropriate governing jurisdictions and applicable building codes should be considered in the design of the structures.

The mat foundations may be designed using a net allowable bearing capacity of 2,000 psf. The total and differential settlement corresponding to this allowable bearing load are estimated to be less than approximately 1 inch and 0.5 inch over a horizontal span of 40 feet, respectively.

Mat foundations typically experience some deflection due to loads placed on the mat and the reaction of the soils directly underlying the mat. A design modulus of subgrade reaction (K) of 50 tons per cubic foot may be used for the subgrade soils in evaluating such deflections.

11.4 Lateral Earth Pressures for Thrust Blocks

Thrust restraint for buried pipelines may be achieved by transferring the thrust force to the soil outside the pipe through a thrust block. Thrust blocks may be designed using the passive lateral earth pressure values presented on Figure 10. Excavations for construction of thrust blocks should be backfilled with granular backfill material and compacted following the recommendations presented in this report.

11.5 Lateral Earth Pressures for Below-Grade Structures

Walls for below-grade structures when constructed as recommended above may be designed for lateral earth pressures presented on Figure 11. To reduce the potential for pipe-to-wall differential settlement, which could cause pipe shearing, we recommend that a flexible pipe joint be located close to the exterior of the wall. The type of joint should be such that minor relative movement can be accommodated without distress. The pipe connections should be sufficiently flexible to withstand differential settlement of approximately 1 inch.

11.6 Exterior Flatwork

We recommend that new exterior concrete sidewalks and flatwork (hardscape) have a thickness of 4 inches and be appropriately reinforced. The hardscape should be underlain by 4 inches of clean sand and installed with crack-control joints at an appropriate spacing as designed by the structural engineer to reduce the potential for shrinkage cracking. Positive drainage should be established and maintained adjacent to flatwork. To reduce the potential for differential offset, joints between the new hardscape and adjacent curbs, existing hardscape, building walls, and/or other structures, and between sections of new hardscape, should be doweled.

11.7 Preliminary Pavement Design

We understand that street improvements may be performed along Lomita Boulevard and Narbonne Avenue that may include the installation of new pavement. We considered full-depth

AC, AC over aggregate base, and Portland Cement Concrete (PCC) structural pavement sections. We also understand that permeable pavement is being considered as one of the alternatives for the project. Details regarding the traffic conditions along Lomita Boulevard and Narbonne Avenue were not provided to us at the time of our evaluation; therefore, we evaluated the structural pavement sections assuming traffic index (TI) values ranging from 5 to 10 for planning purposes. A TI of 5 is generally associated with light-duty pavements and a TI of 10 is generally associated with heavy-duty pavements.

We performed preliminary pavement design based on our evaluation of the subgrade soil conditions and our laboratory testing. Laboratory testing was performed on representative subgrade soil samples and indicated R-values ranging from approximately 61 to 67. Due to the variability of the on-site soils, an R-value of 60 was used for the pavement design. Our pavement analysis was performed using the methodology outlined by the Highway Design Manual (Caltrans, 2023c) and the Navy Pavement Design Manual (Naval Facilities Engineering Command, 1979). The analysis assumes an approximately 20-year design life for new pavement. For the design of PCC pavement, we assumed a 28-day concrete compressive strength of 2,500 psi. Based on the R-value and TIs, recommendations for new pavement sections are provided in Table 3.

Table 3 – Preliminary Structural Pavement Sections

Traffic Index	AC over CAB or AC over CMB (inches)	Full-Depth AC (inches)	PCC (inches)
≤ 5.0	3.0 over 4.5	4.0	5.5
6.0	3.5 over 4.5	5.0	6.0
7.0	4.5 over 4.5	6.0	7.0
8.0	5.0 over 4.5	7.0	8.0
9.0	5.5 over 4.5	8.0	9.5
10.0	6.0 over 4.5	8.5	10.5

Notes:
AC – Asphalt Concrete
CAB – Crushed Aggregate Base
CMB – Crushed Miscellaneous Base
PCC – Portland Cement Concrete with a 28-day compressive strength of 2,500 psi

For the design of pervious pavements (pervious concrete and permeable interlocking concrete pavement), we used the methodology presented in the Pervious Pavement Design Guidance (Caltrans, 2023b). We evaluated the structural pavement sections based on three categories of traffic conditions representing low to moderate vehicular loading. The thickness of the reservoir layer is based on the higher value of the thickness required to handle the 85th percentile 24-hour storm event and the minimum thickness recommended in the pavement design structural requirements section. Our preliminary permeable pavement sections presented in Table 4 below are based on the minimum pavement structures to provide structural adequacy and constructability for the various loading. Thicker class 4 aggregate base may be appropriate in areas that require a high hydraulic storage requirement.

Table 4 – Preliminary Permeable Pavement Sections

Category	PCP over AB (inches)	PICP over PM over AB (inches)
A (Pedestrian and bike pathways, landscaped areas, sidewalks) – No vehicular loads	4.5 over 3.5	$2^{3}/_{8}$ over 4.5 over 3.5
B (Parking lots, park and ride areas, maintenance access roads) – Few heavy loads at low speed	5.5 over 6.0	$3^{1}/_{8}$ over 4.5 over 8.5
C (Parking lots, rest areas, maintenance stations) – Moderate heavy loads at low speed	8.5 over 8.5	$3^{1}/_{8}$ over 4.5 over 24.0

Notes:
PCP – Pervious Concrete Pavement
PICP – Permeable Interlocking Concrete Pavement
AB – Caltrans Class 4 Aggregate Base
PM – Caltrans Class 3 Permeable Material

Prior to placement of new pavement materials, we recommend that the top 12 inches of subgrade soils be removed and recompacted to a relative compaction of 95 percent in accordance with ASTM D 1557. Aggregate base material should conform to the latest specifications in Section 200-2.2 for crushed aggregate base or Section 200-2.4 for crushed miscellaneous base of the Greenbook and should be compacted to a relative compaction of 95 percent in accordance with ASTM D 1557. AC should conform to Section 203-6 of the Greenbook and should be compacted to a relative compaction of 95 percent in accordance with ASTM D 1560 or California Test (CT) method 366. We recommend that 2 inches of aggregate base be placed underneath the PCC. Permeable material should conform to Section 68-2.02 (F) of the Caltrans Standard Specifications (2023a). It is also recommended that a 2-inch-thick bedding sand layer be placed between the Class 3 permeable material and permeable interlocking concrete pavement.

Pavement sections should be selected based on actual anticipated traffic loading conditions and evaluation of the subgrade materials, including R-value testing, at the time of construction. We recommend that the paving operations be observed and tested by Ninyo & Moore. We further recommend that the mix design for the various pavements be made by an engineering company specialized in this type of work.

11.8 Corrosivity

Laboratory testing was performed on representative samples of near-surface soils to evaluate soil pH, electrical resistivity, water-soluble chloride content, and water-soluble sulfate content. The soil pH and electrical resistivity tests were performed in general accordance with CT 643. Chloride content testing was performed in general accordance with CT 422. Sulfate content testing was performed in general accordance with CT 417. The laboratory test results are presented in Appendix D.

The soil pH of the samples tested ranged from approximately 6.5 to 6.7 and the electrical resistivity ranged from approximately 6,783 to 21,340 ohm-cm. The chloride content of the

samples ranged from approximately 40 to 45 ppm. The sulfate content of the samples ranged from approximately 0.001 to 0.002 percent by weight (i.e., 10 to 20 ppm). Based on the laboratory test results and Caltrans (2021) criteria, the project site can be classified as a non-corrosive site. A non-corrosive site is defined as having earth materials with less than 500 ppm chlorides, less than 0.15 percent sulfates (i.e., 1,500 ppm), a pH of 5.5 or more, or an electrical resistivity of more than 1,500 ohm-cm. If corrosion susceptible improvements are planned on site, we recommend that a corrosion engineer be consulted for further evaluation and recommendations.

11.9 Concrete

Concrete in contact with soil or water that contains high concentrations of water-soluble sulfates can be subject to premature chemical and/or physical deterioration. Based on the American Concrete Institute (2022) criteria, the potential for sulfate attack is negligible for water-soluble sulfate contents in soil ranging from 0.00 to 0.10 percent by weight and moderate for water-soluble sulfate contents ranging from 0.10 to 0.20 percent by weight. The potential for sulfate attack is severe for water-soluble sulfate contents ranging from 0.20 to 2.00 percent by weight and very severe for water-soluble sulfate contents over 2.00 percent by weight. The soil samples tested for this evaluation, using CT 417, indicate a water-soluble sulfate content ranging from approximately 0.001 to 0.002 percent by weight (i.e., 10 to 20 ppm). Accordingly, the on-site soils are considered to have a negligible potential for sulfate attack. However, due to the potential variability of the on-site soils, consideration should be given to using Type II/V cement for the project.

In order to reduce the potential for shrinkage cracks in the concrete during curing, we recommend that the concrete for the proposed improvements be placed with a slump of 4 inches based on ASTM C 143. The slump should be checked periodically at the site prior to concrete placement. We further recommend that concrete cover over reinforcing steel for foundations be provided in accordance with CBC (2022). The structural engineer should be consulted for additional concrete specifications.

11.10 Drainage

Positive surface drainage is imperative for satisfactory site performance. Positive drainage should be provided and maintained to direct surface water away from foundations and off-site. Positive drainage is defined as a slope of 2 percent or more for a distance of 5 feet or more away from foundations and tops of slopes. Runoff should then be directed by the use of swales or pipes into a collective drainage system. Surface water should not be allowed to pond adjacent to foundations or pavement. Area drains for landscaped and paved areas are recommended.

11.11 Landscaping

Project landscaping should consist of drought tolerant plants. Landscape irrigation should be kept to a level just sufficient to maintain plant vigor. Overwatering should not be permitted.

12 CONSTRUCTION MONITORING PROGRAM

To reduce the potential for construction related claims, construction monitoring programs should be implemented to monitor ground vibrations, ground surface settlement, and lateral movement of shoring support systems. These monitoring programs should be in-place and conducted prior to the start of construction to reduce the potential for damage claims and to facilitate settlement of legitimate damage claims. The resulting data should be reviewed and evaluated during construction and distributed to appropriate parties during the course of construction.

12.1 Documentation of Existing Conditions

We recommend that pre-construction condition surveys be performed on structures within approximately 50 feet of the proposed excavations prior to construction. This distance should be extended to 100 feet adjacent to proposed excavations if driven and/or vibratory sheet or soldier piles are installed. This survey should include locating existing cracks and measuring widths of cracks, in combination with video documentation of existing conditions. In addition, interviews should be conducted with utility owners so that existing knowledge about the age, type, and maintenance history of affected utilities is available prior to construction.

12.2 Construction Vibrations

People can perceive vibrations from construction activities at significantly lower levels than might cause cosmetic damage to structures. The Transportation and Construction Vibration Guidance Manual (Caltrans, 2020) indicates that transient vibrations, such as from pile installation or construction activities, may be noticeable at peak particle velocities as low as 0.035 inches per second (ips). The vibrations from the construction activities may be disturbing and result in complaints and/or damage claims at peak particle velocities as low as 0.2 to 0.4 ips. However, these vibration levels are well below the level considered to cause cosmetic damage to residential construction.

There is also the possibility of settlement of the soil during construction activities due to vibrations. This settlement may result in damage to structures and improvements. If the construction vibrations can be maintained below a peak particle velocity of 0.2 ips, the settlement can likely be limited to acceptable levels based on past projects in similar conditions.

For the above stated reasons, we recommend that seismographs be used in the early stages of construction to monitor the vibrations. Seismographs should be located near structures and improvements next to the construction activities. Additional seismographs should be located at various structures and improvements farther from the construction activities to monitor vibrations as a function of distance from the sites. Periodic vibration monitoring is recommended during other construction activities. After review of the data obtained, the number of seismographs may be reduced at the discretion of the client and the geotechnical consultant.

12.3 Ground Surface Settlement

We recommend that arrays of ground surface settlement points be installed around the proposed excavations. The contractor should submit a monitoring plan showing the proposed locations of settlement points for review and approval by the project engineer. We recommend that the contractor be responsible for maintaining total settlement at any survey point to less than 0.5 inch. If the settlement reaches this limit, we recommend that a further review of construction methodologies be performed and appropriate changes be made.

12.4 Lateral Movement for Shoring Support System

It may be appropriate to install inclinometers or establish survey points behind excavations at the due to the proximity of the existing structures. The inclinometers or survey points should be monitored and evaluated daily during excavation activities to provide an advanced warning system of potential problems. As discussed previously, we recommend that the shoring system be designed to limit the ground settlement behind the shoring system to 0.5 inch or less to reduce the potential for distress to adjacent structures/improvements. If settlements reach 0.25 inches, we recommend that a review of the contractor's methods be performed and appropriate changes be made, if needed.

13 CONSTRUCTION OBSERVATION

The recommendations provided in this report are based on our understanding of the proposed project and our evaluation of the data collected based on subsurface conditions observed in our exploratory borings and CPT soundings. It is imperative that the interpolated subsurface conditions be checked by our representative during construction. Observation and testing of compacted fill and backfill should also be performed by our representative during construction. We further recommend that the project plans and specifications be reviewed by Ninyo & Moore prior to construction. It should be noted that, upon review of these documents, some recommendations presented in this report might be revised or modified.

During construction, we recommend that the duties of Ninyo & Moore include, but not be limited to:

- Observing clearing, grubbing, and removals.
- Observing excavation, placement, and compaction of fill.
- Evaluating existing excavated materials and/or imported materials prior to their use as fill.
- Performing field tests to evaluate fill compaction.
- Observing drywell shaft excavations to confirm suitable soils for infiltration.
- Observing infiltration gallery bottom for suitable soils for infiltration.
- Observing foundation excavations for bearing materials and cleaning prior to placement of reinforcing steel or concrete.
- Performing material testing services including concrete compressive strength and steel tensile strength tests and inspections.

The recommendations provided in this report assume that Ninyo & Moore will be the geotechnical consultant during the construction phase of this project. In the event the services of Ninyo & Moore are not utilized during construction, we request that the selected consultant provide the owner with a letter (with a copy to Ninyo & Moore) indicating that they fully understand Ninyo & Moore's recommendations, and that they are in full agreement with the design parameters and recommendations contained in this report.

14 LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore

should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified, and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject sites or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

15 REFERENCES

American Concrete Institute, 2022a, ACI Collection of Concrete Codes, Specifications, and Practices.

American Concrete Institute, 2022b, Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19).

American Society of Civil Engineers, 2016, Minimum Design Loads and Associated Criteria for Building and Other Structures, ASCE Standard 7-16.

Applied Technology Council, 2024, Hazards by Location, https://hazards.atcouncil.org/.

ASTM International, 2022, Annual Book of ASTM Standards, West Conshohocken, Pennsylvania.

Building Seismic Safety Council, 2015, National Earthquake Hazards Reduction Program (NEHRP) Recommended Seismic Provisions for New Buildings and Other Structures (FEMA P-1051), dated July.

Bowles, J.E., 1996, Foundation Analysis and Design, Fifth Edition, The McGraw-Hill Companies, Inc.

Building Seismic Safety Council, 2015, National Earthquake Hazards Reduction Program (NEHRP) Recommended Seismic Provisions for New Buildings and Other Structures (FEMA P-1051), dated July.

California Building Standards Commission, 2022, California Building Code: California Code of Regulations, Title 24, Part 2, Volumes 1 and 2, based on the 2021 International Building Code.

California Department of Conservation, 2024, Los Angeles County Tsunami Hazard Areas, https://www.conservation.ca.gov/cgs/tsunami/maps/los-angeles.

California Department of Conservation, Division of Mines and Geology, State of California, 1998, Seismic Hazard Zone Report for the San Pedro 7.5-Minute Quadrangle, Los Angeles County, California: Seismic Hazard Zone Report 033.

California Department of Conservation, Division of Mines and Geology, State of California, 1999, Seismic Hazard Zones Official Map, San Pedro Quadrangle, dated March 25.

California Department of Transportation, Division of Environmental Analysis, Environmental Engineering, Hazardous Waste, Air, Noise, Paleontology Office, 2020, Transportation and Construction Vibration Guidance Manual, dated April.

California Department of Transportation, 2021, Corrosion Guidelines, Version 3.2, Division of Engineering Services, Materials Engineering and Testing Services, Corrosion Technology Branch, dated May.

California Department of Transportation, 2023a, Standard Specifications.

California Department of Transportation, 2023b, Pervious Pavement Design Guidance, HQ Division of Design, dated July.

California Department of Transportation, 2023c, Highway Design Manual, Seventh Edition, dated September 29.

California Department of Transportation, 2024, CalME Online Software Program (V3.DD002.0), http://www.ucprc.ucdavis.edu/calme/.

California Geological Survey, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California, Special Publication 117A, dated September 11.

California Geological Survey, 2010, Fault Activity Map of California, http://maps.conservation.ca.gov/cgs/fam/.

California Geological Survey, 2015, CGS Map Sheet 48: Shear-wave Velocity in Upper 30m of Surficial Geology (Vs30); https://maps.conservation.ca.gov/cgs/DataViewer/, dated May 24.

California Geological Survey, 2018, Earthquake Fault Zones, A Guide for Government Agencies, Property Owners/Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California Special Publication 42.

California Geological Survey, 2024, Earthquake Zones of Required Investigation, https://maps.conservation.ca.gov/cgs/EQZApp/app/.

CDM Smith, 2021, Feasibility Study, Downtown Lomita Multi-Benefit Stormwater Project, City of Lomita, dated July 29.

CDM Smith, 2023, Request for Proposal, Engineering Design Services for Downtown Lomita Multi-Benefit Stormwater Project, dated October.

City of Lomita, 2023, Project Drawings, City of Lomita, Downtown Lomita Multi-Benefit Stormwater Project, dated October.

County of Los Angeles, Department of Public Works, Geotechnical and Materials Engineering Division, 2021, Guidelines for Geotechnical Investigation and Reporting, Low Impact Stormwater Infiltration, dated June 30.

Dibblee, T.W., 1999, Geologic Map of the Palos Verdes and Vicinity: Redondo Beach, Torrance and San Pedro Quadrangles, Los Angeles County, California, Dibblee Foundation, DF-70, Scale 1:24,000.

Federal Emergency Management Agency, 2008, Flood Insurance Rate Map, City of Los Angeles, California, Map Number 06037C1940F, dated September 26.

Geocon West, Inc., 2019, Limited Geotechnical Investigation, Proposed Village Plaza, 24384 Narbonne Avenue, Lomita, California, dated August 7.

Google, 2024, Website for Aerial Photographs; website: http://maps.google.com/.

Historical Aerials, 2024, Website for Viewing Aerial Photographs, www.historicaerials.com.

Jennings, C.W. and Bryant, W.A., 2010, Fault Activity Map of California and Adjacent Areas: California Division of Mines and Geology, California Geologic Data Map Series, Map No. 6, Scale 1:750,000.

Naval Facilities Engineering Command, 1979, Pavement Design Manual, D.M. 5.4, dated October.

Naval Facilities Engineering Command, 1982, Foundations and Earth Structures Design Manuals, dated May

Ninyo & Moore, 2024, Revised Proposal for Geotechnical Consulting Services, Downtown Lomita Multi-Benefit Stormwater Project, Lomita, California, Proposal No. 04-04320, dated January 15.

Norris, R.M. and Webb, R.W., 1990, Geology of California: John Wiley & Sons.

Public Works Standard, Inc., 2024, The “Greenbook”: Standard Specifications for Public Works Construction, BNI Building News, Vista, California.

Robertson, 2010, Soil Behavior Type from the CPT: An Update, 2nd International Symposium on Cone Penetration Testing, CPT’ 10, Huntington Beach, California, USA, www.cpt10.com.

Saucedo, G.J., Greene, H.G., Kennedy, M.P., Bezore, S.P., 2016, Geologic Map of the Long Beach 30’x60’ Quadrangle, California, Version 2.0, Scale 1:10,000.

State of California, Department of Water Resources, 2024, Water Data Library Station Map, https://wdl.water.ca.gov/waterdatalibrary/.

State of California, State Water Resources Control Board, 2024, GeoTracker Database System, http://geotracker.swrcb.ca.gov/.

Studio One Eleven, 2020, Project Drawings, Narbonne Vacant Lot Activation, 24329 Narbonne Avenue, Lomita, Califonria, dated March 16.

United States Department of Agriculture, 1952, Aerial Photographs, Flight No. AXJ-7K, Photograph Nos. 154 and 155, Scale 1:20,000, dated December 4.

United States Geological Survey, 2008, National Seismic Hazard Maps - Fault Parameters, https://earthquake.usgs.gov/cfusion/hazfaults_2008_search/query_main.cfm

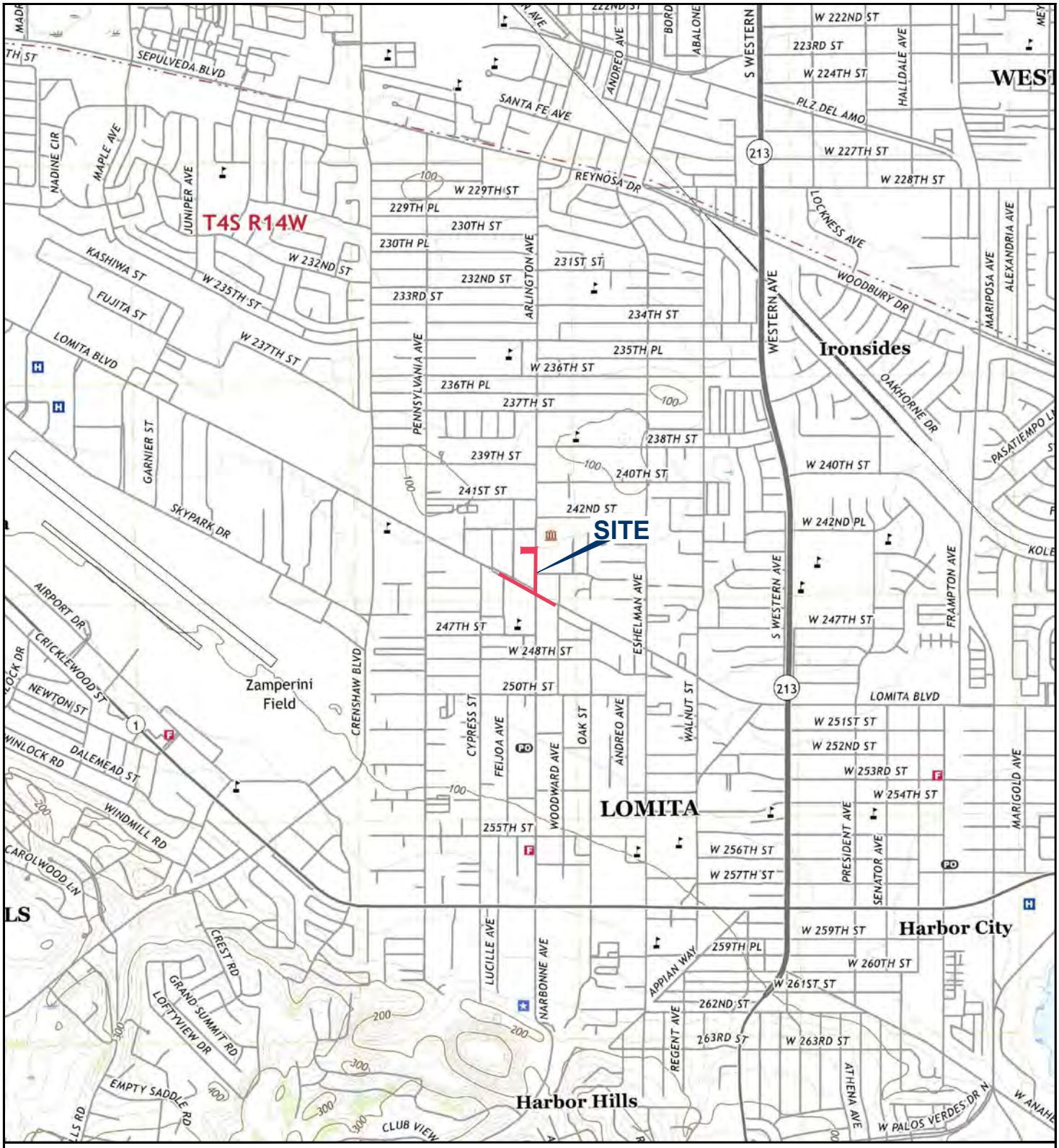
United States Geological Survey, 2021, Torrance, California, Quadrangle Map, 7.5 Minute Series: Scale 1:24,000.

United States Geological Survey, 2024a, Quaternary Fault and Fold Database of the United States, https://www.usgs.gov/natural-hazards/earthquakehazards/hazards.

United States Geological Survey, 2024b, Unified Hazard Tool; https://earthquake.usgs.gov/hazards/interactive/.

United States Geological Survey and Southern California Earthquake Center, 2021, Open Seismic Hazard Analysis, Version 1.5.2, released June 3, http://www.opensha.org/.

FIGURES



NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: USGS, 2021.

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FIGURE 1

SITE LOCATION

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

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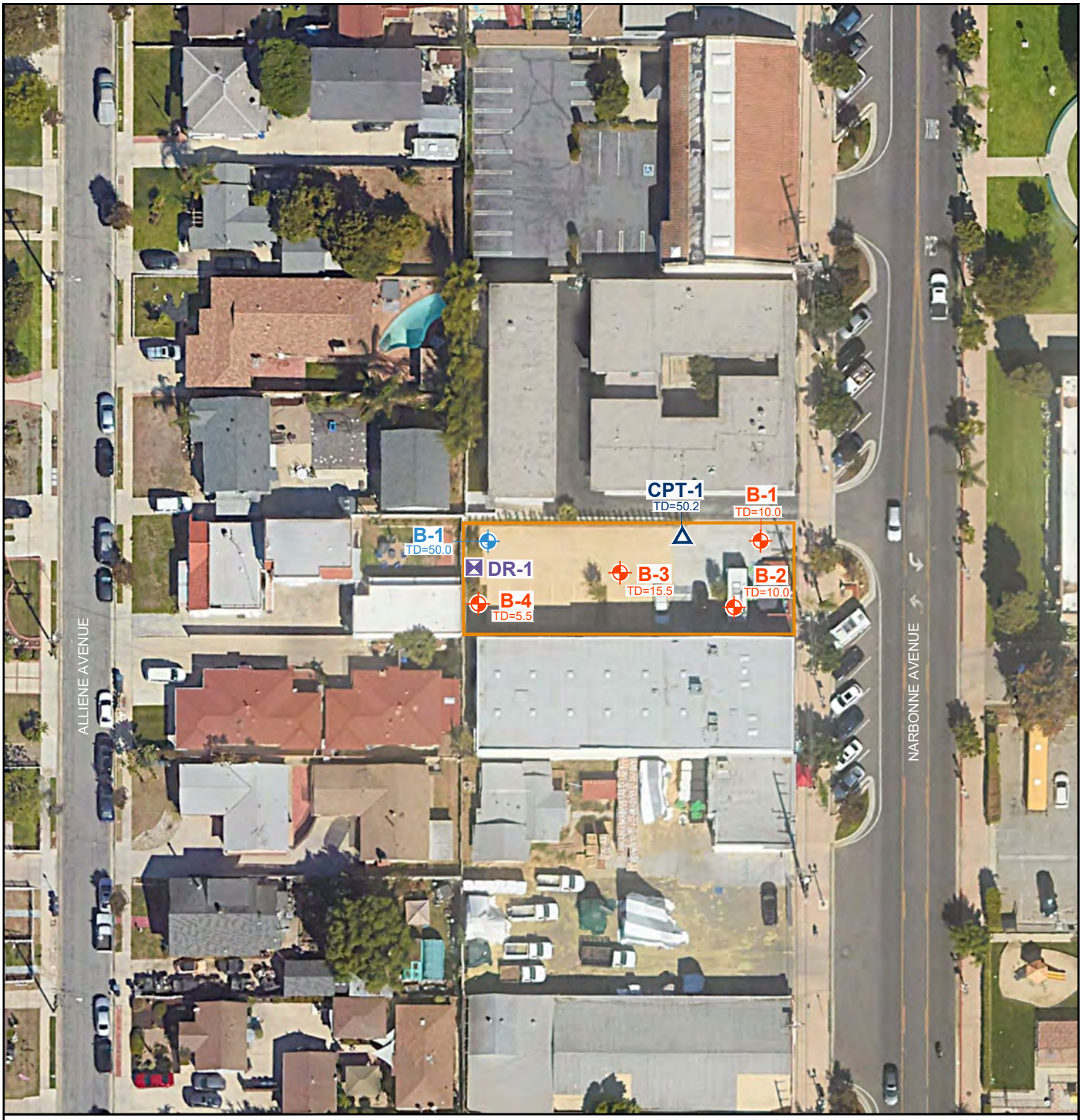
Ninyo & Moore
Geotechnical & Environmental Sciences Consultants



LEGEND

- **B-1** TD=50.0 — BORING; TD=TOTAL DEPTH IN FEET
- **DR-1** — DOUBLE RING INFILTROMETER TEST
- **CPT-1** TD=50.2 — CONE PENETRATION TEST; TD=TOTAL DEPTH IN FEET
- **B-4** TD=5.5 — BORING; (GEOCON, 2019) TD=TOTAL DEPTH IN FEET
- APPROXIMATE FOOTPRINT OF INFILTRATION GALLERY

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: GOOGLE EARTH, 2024.

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FEET

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FIGURE 2

SITE AERIAL AND SUBSURFACE EXPLORATION LOCATIONS (NORTH PROJECT AREA)

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

212611001 I 10/24

LEGEND

B-3 TD=80.0 — BORING; TD=TOTAL DEPTH IN FEET

CPT-2 TD=80.3 — CONE PENETRATION TEST; TD=TOTAL DEPTH IN FEET

DR-2 — DOUBLE RING INFILTROMETER TEST

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: GOOGLE EARTH, 2024.

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FIGURE 3

SITE AERIAL AND SUBSURFACE EXPLORATION LOCATIONS (SOUTHWEST PROJECT AREA)

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

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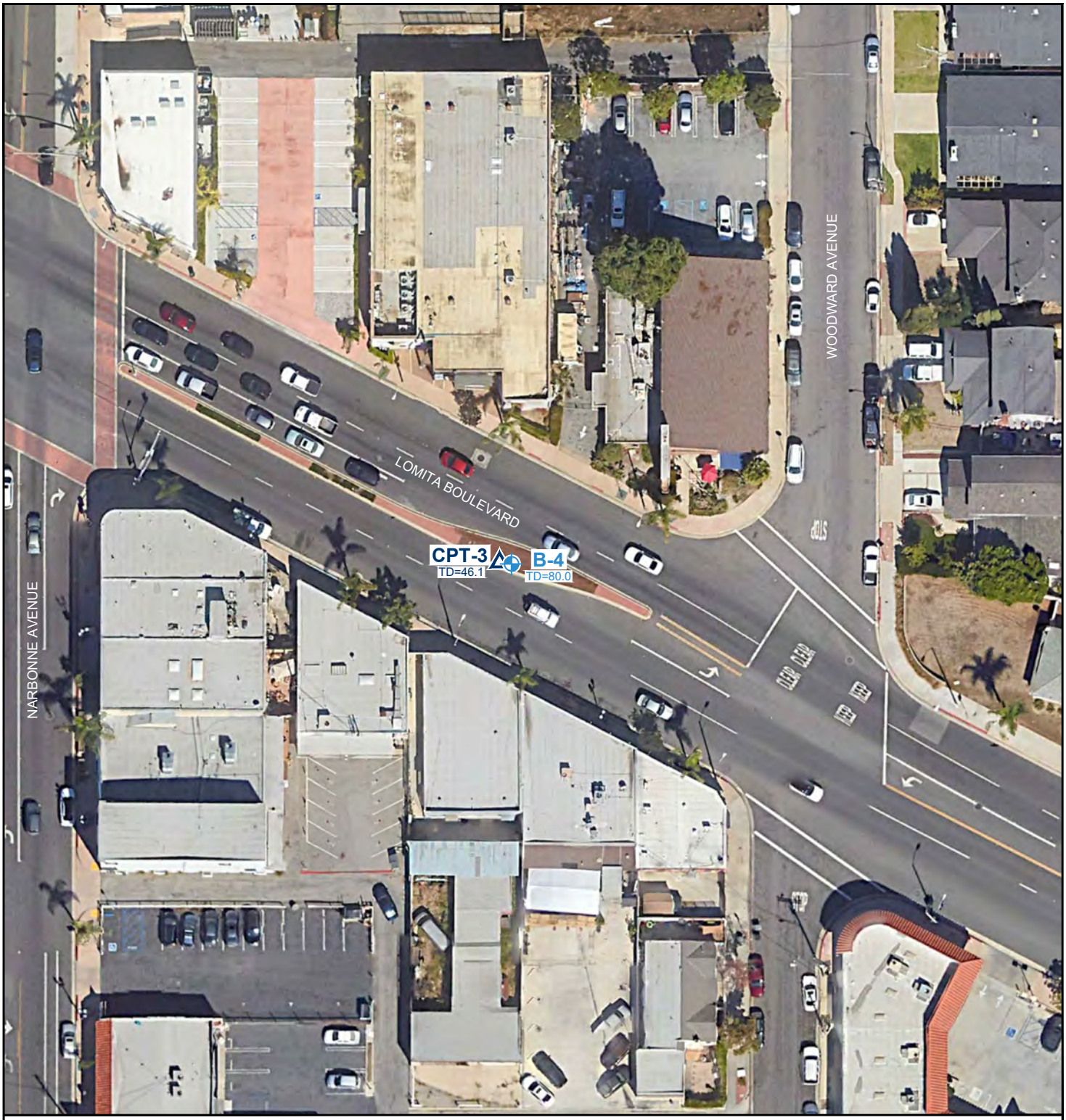

LEGEND

B-4 TD=80.0 — BORING; TD=TOTAL DEPTH IN FEET

CPT-3 TD=46.1 — CONE PENETRATION TEST; TD=TOTAL DEPTH IN FEET

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: GOOGLE EARTH, 2024.

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FIGURE 4

SITE AERIAL AND SUBSURFACE EXPLORATION LOCATIONS (SOUTHEAST PROJECT AREA)

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

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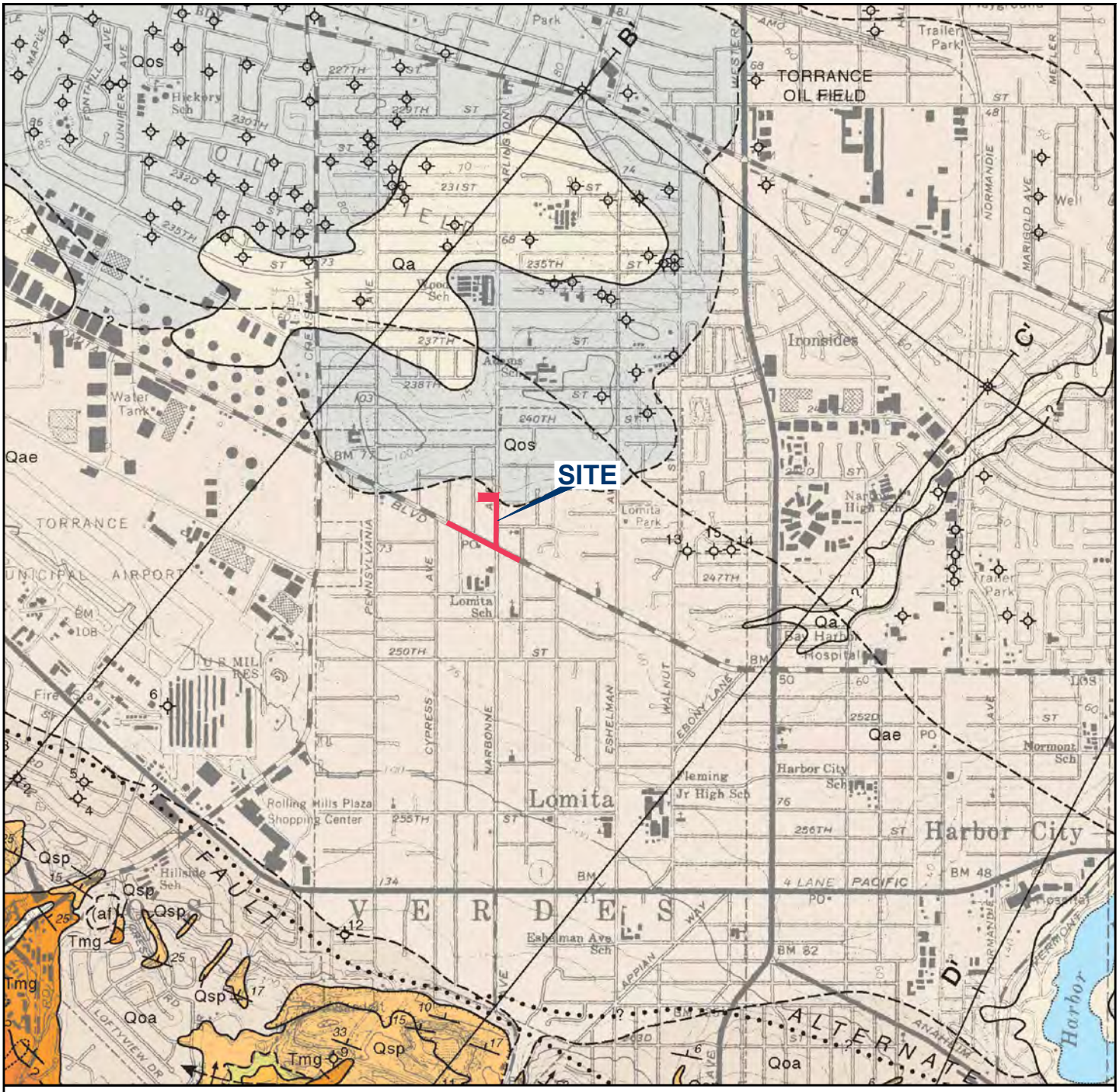

LEGEND

Qa	ALLUVIUM	Qos	OLDER DUNE SAND
Qae	ALLUVIUM (ELEVATED)	Qsp	SAN PEDRO SAND
			GEOLOGIC CONTACT

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NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: DIBBLEE, 1999.

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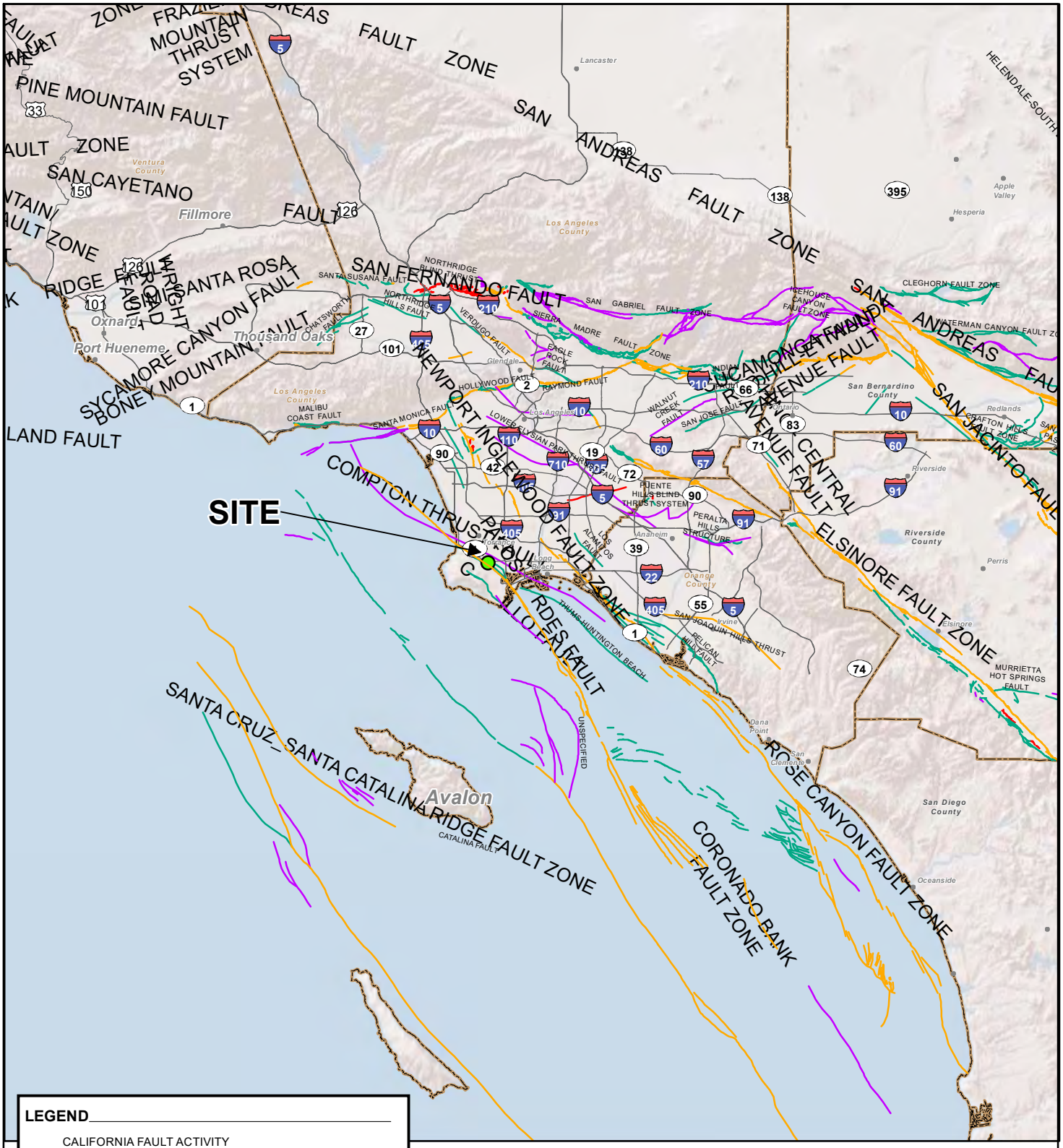
FIGURE 5

REGIONAL GEOLOGY

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

212611001 I 10/24

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants



LEGEND

CALIFORNIA FAULT ACTIVITY

- HISTORICALLY ACTIVE
- HOLOCENE ACTIVE
- LATE QUATERNARY (POTENTIALLY ACTIVE)
- QUATERNARY (POTENTIALLY ACTIVE)
- STATE/COUNTY BOUNDARY

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

SOURCES: QUATERNARY FAULTS DATABASE - U.S. GEOLOGICAL SURVEY AND CALIFORNIA GEOLOGICAL SURVEY, QUATERNARY FAULT AND FOLD DATABASE FOR THE UNITED STATES, ACCESSED OCTOBER 17, 2024, AT: https://www.usgs.gov/programs/earthquake-hazards/faults, ESRI, 2023.

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FIGURE 6

FAULT LOCATIONS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

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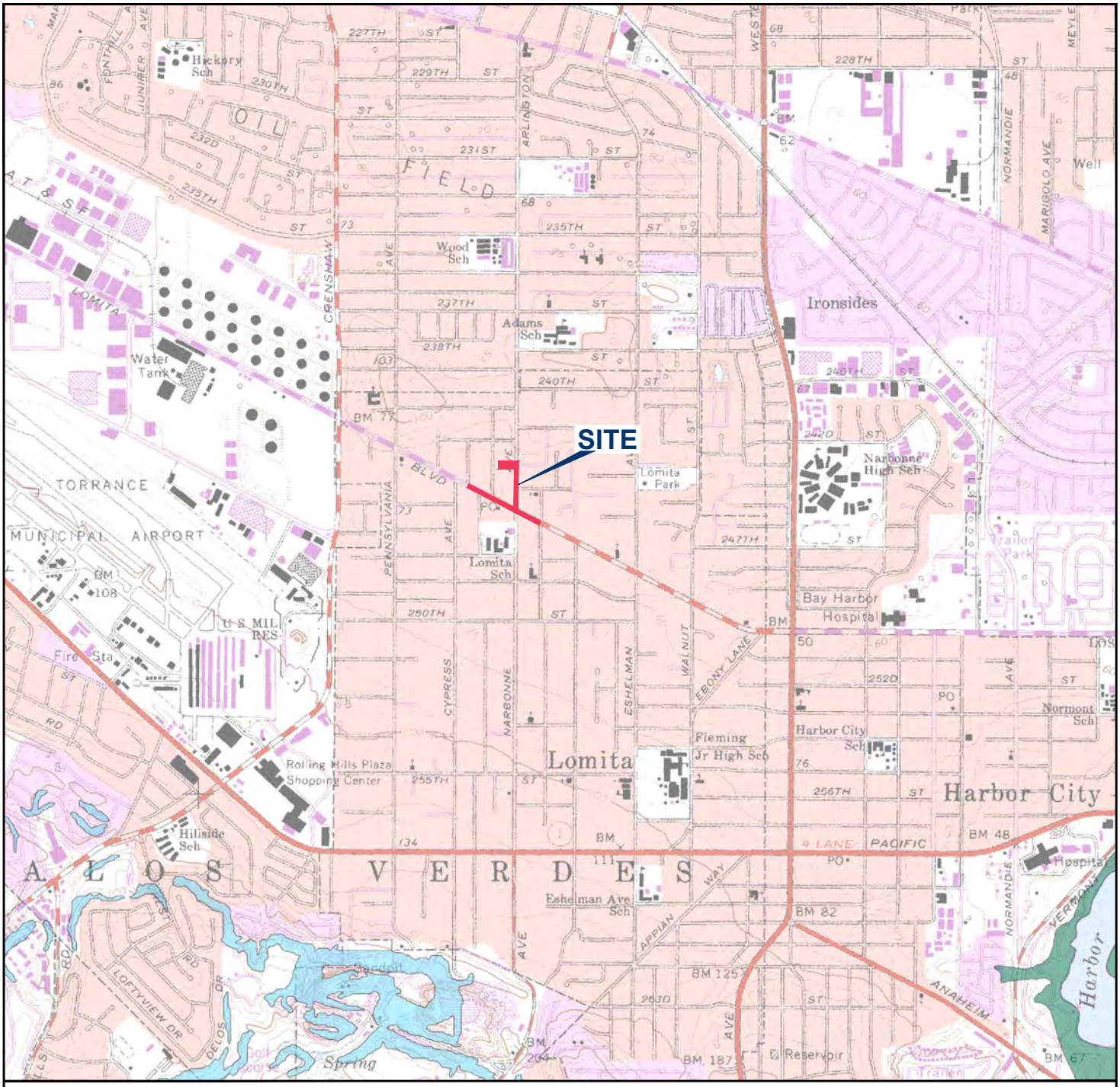
Ninyo & Moore
Geotechnical & Environmental Sciences Consultants



LEGEND

EARTHQUAKE-INDUCED LANDSLIDES

Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

LIQUEFACTION

Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: CDMG, 1999.

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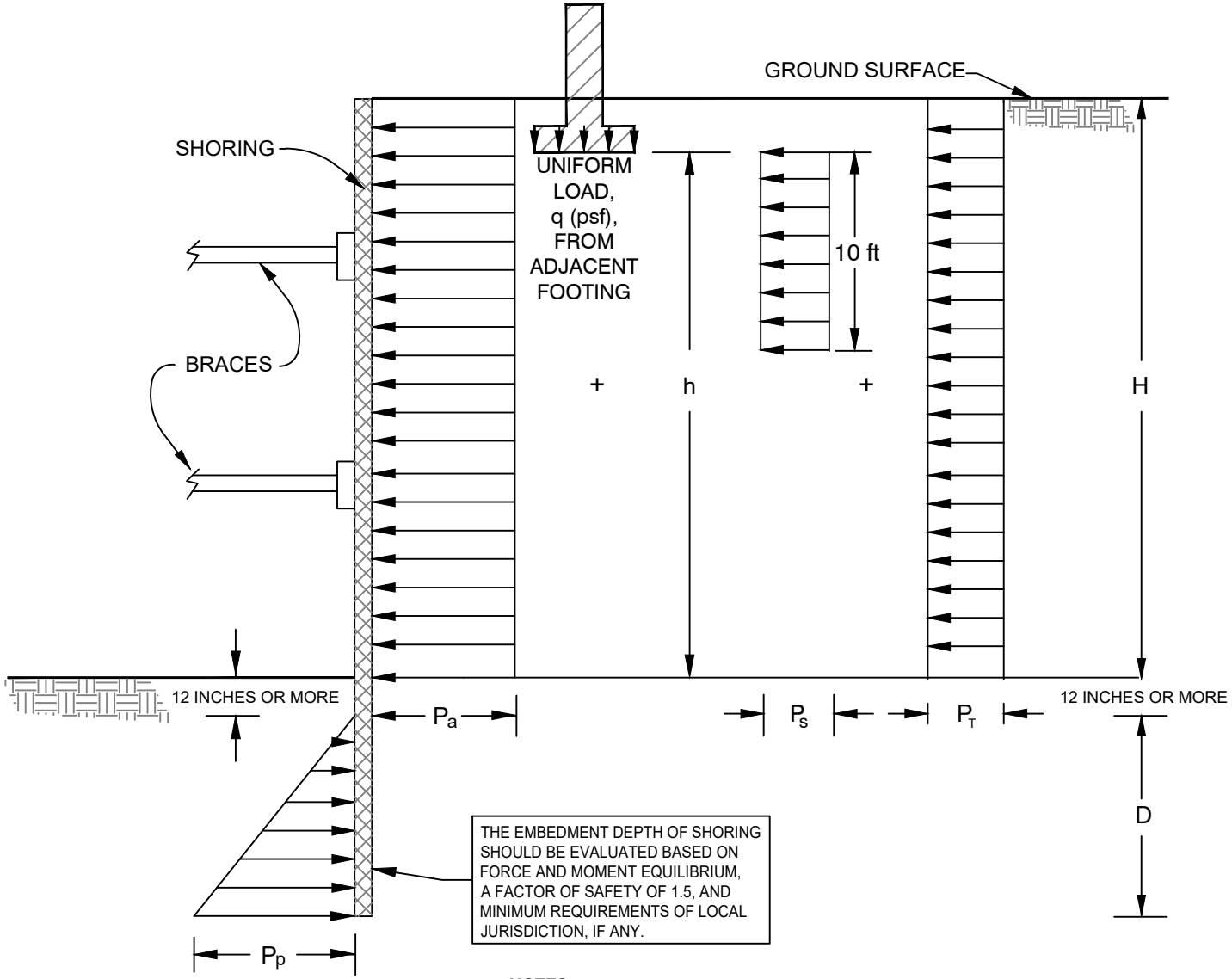
FIGURE 7

SEISMIC HAZARD ZONES

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

212611001 I 10/24

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants



NOTES:

1. APPARENT LATERAL EARTH PRESSURE, P_a
   P_a = 25H psf
2. CONSTRUCTION TRAFFIC INDUCED SURCHARGE PRESSURE, P_T
   P_T = 120 psf
3. PASSIVE LATERAL EARTH PRESSURE, P_p
   P_p = 350D psf
4. ASSUMES GROUNDWATER IS NOT PRESENT
5. SURCHARGES FROM EXCAVATED SOIL OR CONSTRUCTION MATERIALS ARE NOT INCLUDED
6. H AND D ARE IN FEET
7. SURCHARGE PRESSURE, P_S
   $P_S = 0.5_q$ psf
   SURCHARGE PRESSURES, P_S, CAUSED BY NEARBY UNIFORM LOADS DO NOT NEED TO BE INCLUDED IF THE UNIFORM LOADS ARE LOCATED BEYOND A DISTANCE OF H FEET FROM WALL

NOT TO SCALE

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FIGURE 8

LATERAL EARTH PRESSURES FOR BRACED EXCAVATION

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

212611001 I 10/24

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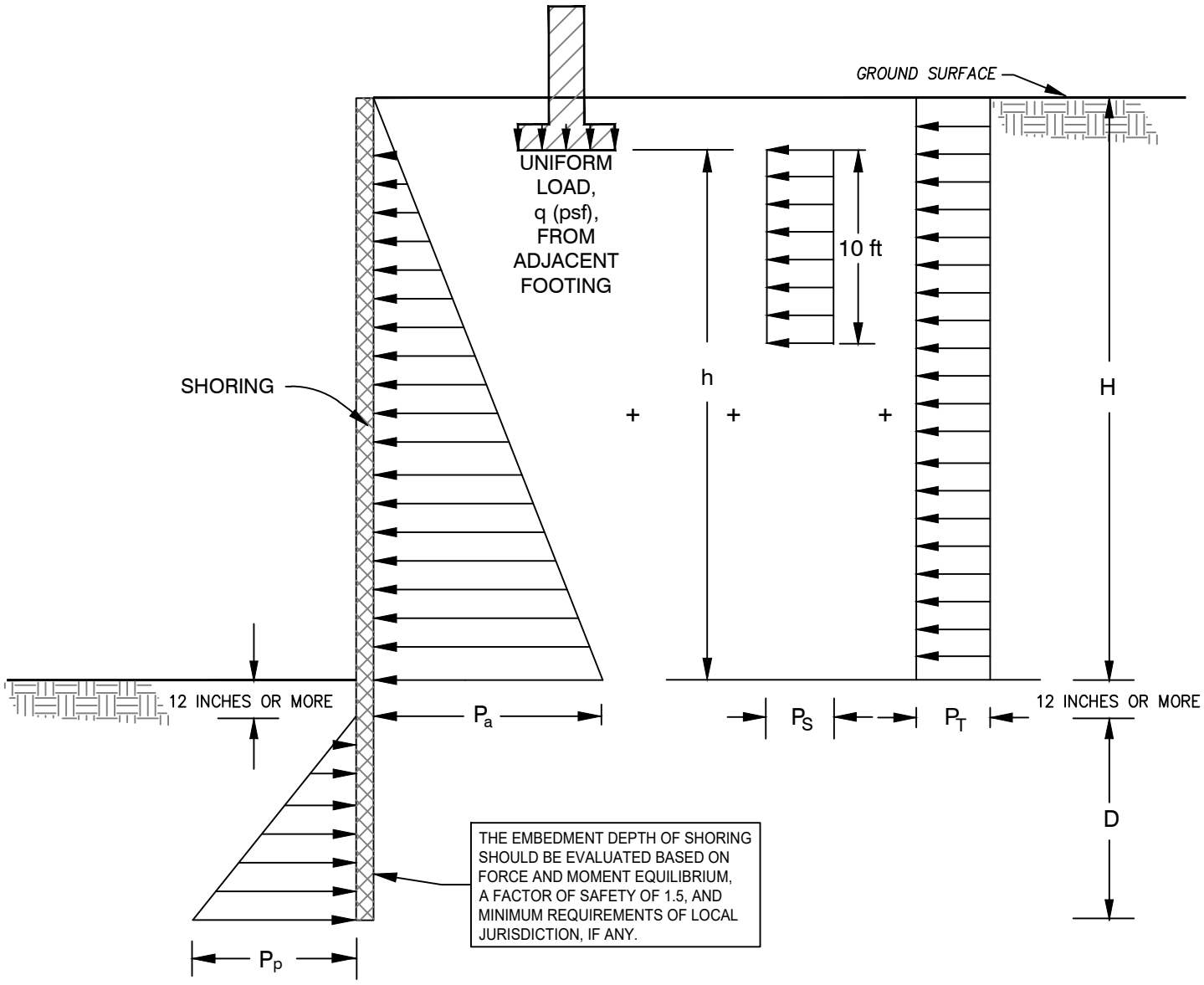
Geotechnical & Environmental Sciences Consultants



NOTES:

1. ACTIVE LATERAL EARTH PRESSURE, P_a
   $P_a = 39H$ psf
2. CONSTRUCTION TRAFFIC INDUCED SURCHARGE PRESSURE, P_T
   $P_T = 120$ psf
3. PASSIVE LATERAL EARTH PRESSURE, P_p
   $P_p = 350D$ psf
4. ASSUMES GROUNDWATER IS NOT PRESENT
5. SURCHARGES FROM EXCAVATED SOIL OR CONSTRUCTION MATERIALS ARE NOT INCLUDED
6. H AND D ARE IN FEET
7. SURCHARGE PRESSURE, P_S
   $P_S = 0.3q$ psf

   SURCHARGE PRESSURES, P_S, CAUSED BY NEARBY UNIFORM LOADS DO NOT NEED TO BE INCLUDED IF THE UNIFORM LOADS ARE LOCATED BEYOND A DISTANCE OF H FEET FROM WALL

NOT TO SCALE

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FIGURE 9

LATERAL EARTH PRESSURES FOR TEMPORARY CANTILEVERED SHORING

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

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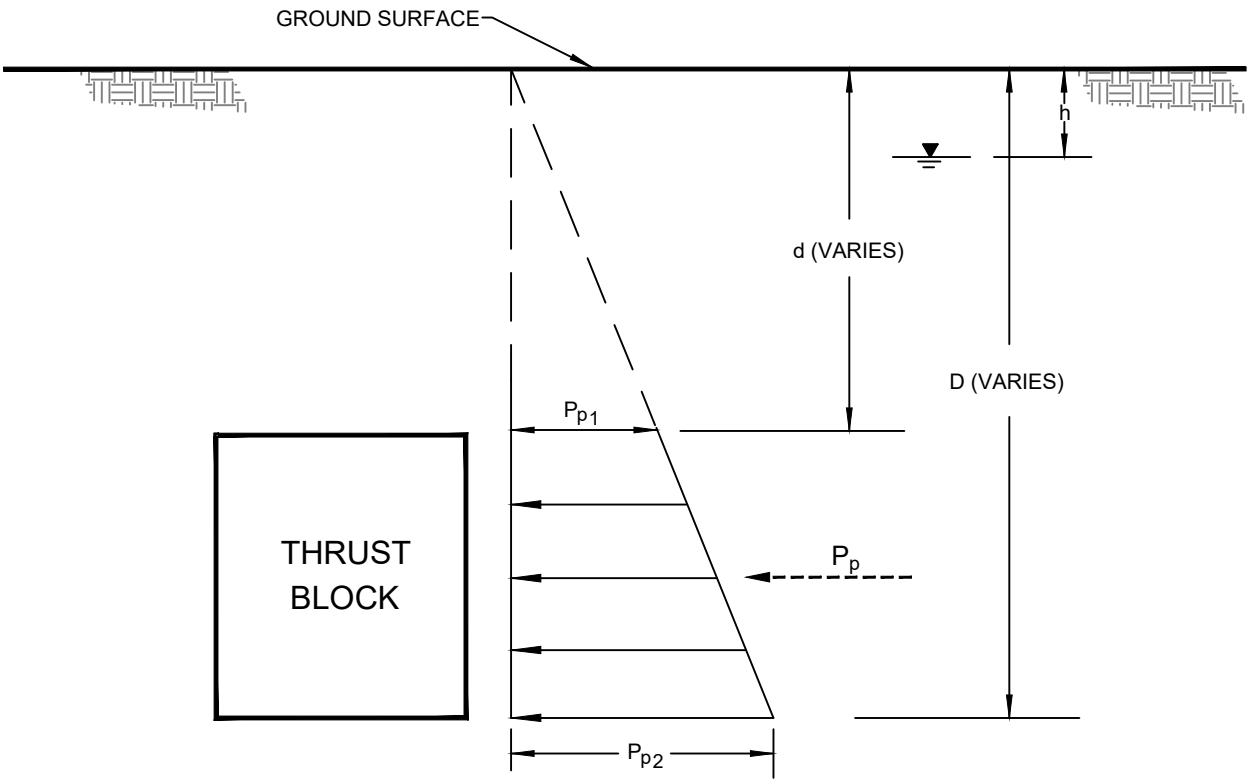

NOTES:

1. GROUNDWATER BELOW BLOCK
   $P_p = 175(D^2-d^2)$ lb/ft
2. GROUNDWATER ABOVE BLOCK
   $P_p = 1.5(D - d)[124.8h + 57.6(D+d)]$ lb/ft
3. ASSUMES BACKFILL IS GRANULAR MATERIAL
4. ASSUMES THRUST BLOCK IS ADJACENT TO COMPETENT MATERIAL
5. D, d AND h ARE IN FEET
6. GROUNDWATER TABLE

NOT TO SCALE

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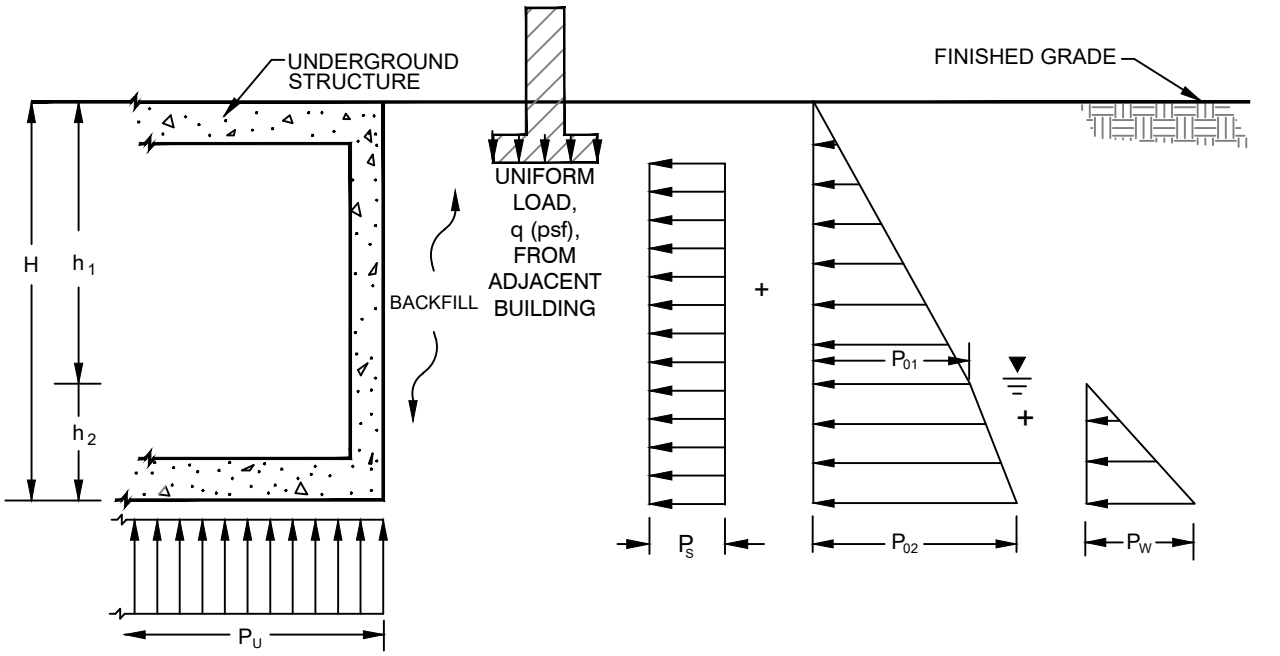
FIGURE 10

THRUST BLOCK LATERAL EARTH PRESSURE DIAGRAM

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

212611001 I 10/24



NOTES:

1. APPARENT LATERAL EARTH PRESSURES, P_{01} AND P_{02}
   LEVEL CONDITION
   $P_{01} = 57h_1$ psf
   $P_{02} = 57h_1 + 28h_2$ psf
2. HYDROSTATIC PRESSURE, P_w
   $P_w = 62.4h_2$ psf
3. UPLIFT PRESSURE, P_u
   $P_u = 62.4h_2$ psf
4. H, h, h_1, AND h_2 ARE IN FEET
5. ▼ GROUNDWATER TABLE
6. SURCHARGE PRESSURE, P_S
   $P_S = 0.5q$ psf

   SURCHARGE PRESSURES, P_S, CAUSED BY NEARBY UNIFORM LOADS DO NOT NEED TO BE INCLUDED IF THE UNIFORM LOADS ARE LOCATED BEYOND A DISTANCE OF H FEET FROM WALL

NOT TO SCALE

FIGURE 11

LATERAL EARTH PRESSURES FOR UNDERGROUND STRUCTURES

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

APPENDIX A

Boring Logs

APPENDIX A

BORING LOGS

Field Procedure for the Collection of Disturbed Samples
Disturbed soil samples were obtained in the field using the following method.

Bulk Samples
Bulk samples of representative earth materials were obtained from the exploratory borings. The samples were bagged and transported to the laboratory for testing.

The Standard Penetration Test (SPT) Sampler
Disturbed drive samples of earth materials were obtained by means of a Standard Penetration Test sampler. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of approximately 1.4 inches. The sampler was driven into the ground 12 to 18 inches with a 140-pound hammer falling freely from a height of 30 inches in general accordance with ASTM D 1586. The blow counts were recorded for every 6 inches of penetration; the blow counts reported on the logs are those for the last 12 inches of penetration. Soil samples were observed and removed from the sampler, bagged, sealed and transported to the laboratory for testing.

Field Procedure for the Collection of Relatively Undisturbed Samples
Relatively undisturbed soil samples were obtained in the field using the following method.

The Modified Split-Barrel Drive Sampler
The sampler, with an external diameter of 3 inches, was lined with 1-inch-long, thin brass rings with inside diameters of approximately 2.4 inches. The sampler barrel was driven into the ground with the weight of a hammer in general accordance with ASTM D 3550. The driving weight was permitted to fall freely. The approximate length of the fall, the weight of the hammer, and the number of blows per foot of driving are presented on the boring logs as an index to the relative resistance of the materials sampled. The samples were removed from the sampler barrel in the brass rings, sealed, and transported to the laboratory for testing.

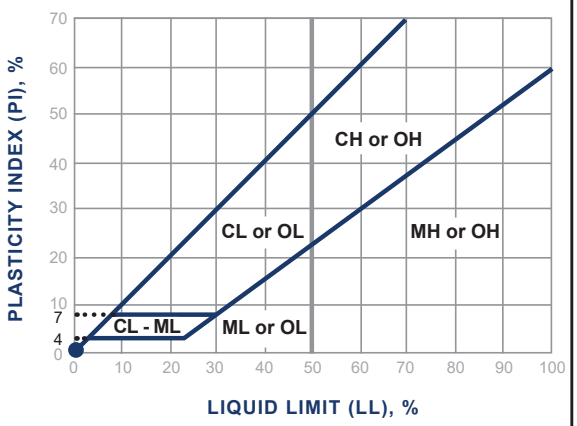
Soil Classification Chart Per ASTM D 2488

Primary Divisions			Secondary Divisions	
			Group Symbol	Group Name
COARSE-GRAINED SOILS more than 50% retained on No. 200 sieve	**GRAVEL** more than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVEL less than 5% fines	GW	well-graded GRAVEL
			GP	poorly graded GRAVEL
		GRAVEL with DUAL CLASSIFICATIONS 5% to 12% fines	GW-GM	well-graded GRAVEL with silt
			GP-GM	poorly graded GRAVEL with silt
			GW-GC	well-graded GRAVEL with clay
			GP-GC	poorly graded GRAVEL with clay
		GRAVEL with FINES more than 12% fines	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND 50% or more of coarse fraction passes No. 4 sieve	CLEAN SAND less than 5% fines	SW	well-graded SAND
			SP	poorly graded SAND
		SAND with DUAL CLASSIFICATIONS 5% to 12% fines	SW-SM	well-graded SAND with silt
			SP-SM	poorly graded SAND with silt
			SW-SC	well-graded SAND with clay
			SP-SC	poorly graded SAND with clay
		SAND with FINES more than 12% fines	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS 50% or more passes No. 200 sieve	**SILT and CLAY** liquid limit less than 50%	INORGANIC	CL	lean CLAY
			ML	SILT
			CL-ML	silty CLAY
		ORGANIC	OL (PI > 4)	organic CLAY
			OL (PI < 4)	organic SILT
	SILT and CLAY liquid limit 50% or more	INORGANIC	CH	fat CLAY
			MH	elastic SILT
		ORGANIC	OH (plots on or above "A"-line)	organic CLAY
			OH (plots below "A"-line)	organic SILT
	Highly Organic Soils		PT	Peat

Grain Size

Description		Sieve Size	Grain Size	Approximate Size
Boulders		> 12"	> 12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	Coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	Fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	Coarse	#10 - #4	0.079 - 0.19"	Rock-salt-sized to pea-sized
	Medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock-salt-sized
	Fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized
Fines		Passing #200	< 0.0029"	Flour-sized and smaller

Plasticity Chart



Apparent Density - Coarse-Grained Soil

Apparent Density	Spooling Cable or Cathead		Automatic Trip Hammer	
	SPT (blows/foot)	Modified Split Barrel (blows/foot)	SPT (blows/foot)	Modified Split Barrel (blows/foot)
Very Loose	≤ 4	≤ 8	≤ 3	≤ 5
Loose	5 - 10	9 - 21	4 - 7	6 - 14
Medium Dense	11 - 30	22 - 63	8 - 20	15 - 42
Dense	31 - 50	64 - 105	21 - 33	43 - 70
Very Dense	> 50	> 105	> 33	> 70

Consistency - Fine-Grained Soil

Consis-tency	Spooling Cable or Cathead		Automatic Trip Hammer	
	SPT (blows/foot)	Modified Split Barrel (blows/foot)	SPT (blows/foot)	Modified Split Barrel (blows/foot)
Very Soft	< 2	< 3	< 1	< 2
Soft	2 - 4	3 - 5	1 - 3	2 - 3
Firm	5 - 8	6 - 10	4 - 5	4 - 6
Stiff	9 - 15	11 - 20	6 - 10	7 - 13
Very Stiff	16 - 30	21 - 39	11 - 20	14 - 26
Hard	> 30	> 39	> 20	> 26

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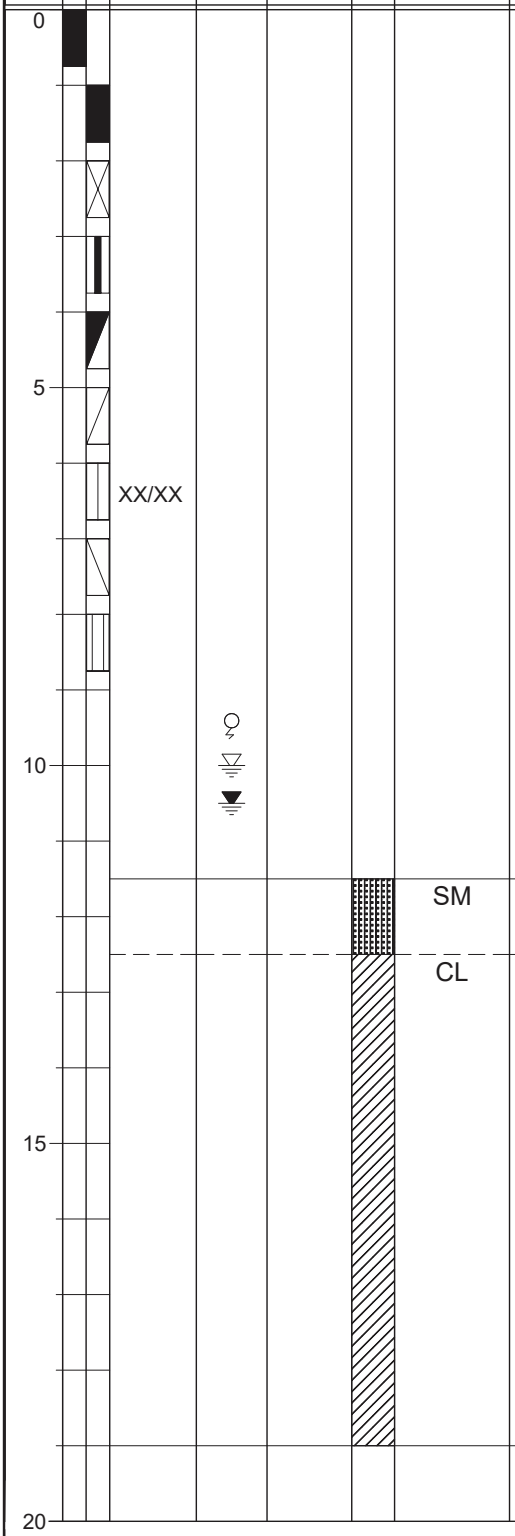
USCS METHOD OF SOIL CLASSIFICATION

BORING LOG EXPLANATION SHEET



Bulk sample.

Modified split-barrel drive sampler.

No recovery with modified split-barrel drive sampler.

Sample retained by others.

Standard Penetration Test (SPT).

No recovery with a SPT.

Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.

No recovery with Shelby tube sampler.

Continuous Push Sample.

Seepage.

Groundwater encountered during drilling.

Groundwater measured after drilling.

SM

MAJOR MATERIAL TYPE (SOIL):

Solid line denotes unit change.

CL

Dashed line denotes material change.

Attitudes: Strike/Dip
b: Bedding
c: Contact
j: Joint
f: Fracture
F: Fault
cs: Clay Seam
s: Shear
bss: Basal Slide Surface
sf: Shear Fracture
sz: Shear Zone
sbs: Shear Bedding Surface

The total depth line is a solid line that is drawn at the bottom of the boring.

DATE DRILLED 5/23/24 BORING NO. B-1

GROUND ELEVATION 78' ± (MSL) SHEET 1 OF 2

METHOD OF DRILLING 8" Hollow-Stem Auger (Baja Exploration)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY SXS LOGGED BY SXS REVIEWED BY SCM/MLP

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SP-SM	FILL: Light brown, moist, loose, poorly graded SAND with silt and gravel; few asphalt and trash debris.
						SM	ALLUVIUM: Brown, moist, loose, silty SAND.
		14	8.6	94.4			
10		13					Medium dense.
						SC-SM	Brown, moist, medium dense, silty, clayey SAND.
		42	18.8	109.4			
						CL	Brown, moist, hard, sandy lean CLAY.
20		22					
						SC	Light brown, moist, medium dense, clayey SAND; oxidation staining.
		33	19.6	88.7			
						SP-SM	Light brown, moist, medium dense, poorly graded SAND with silt.
30		42					Very dense.
		20				CL	Brown, moist, very stiff, sandy lean CLAY; oxidation staining.
						SP-SM	Light brown, moist, very dense, poorly graded SAND with silt.
40							

FIGURE A- 1

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DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

DATE DRILLED 5/23/24 BORING NO. B-1

GROUND ELEVATION 78' ± (MSL) SHEET 2 OF 2

METHOD OF DRILLING 8" Hollow-Stem Auger (Baja Exploration)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY SXS LOGGED BY SXS REVIEWED BY SCM/MLP

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40		34				SP-SM	ALLUVIUM: (Continued) Light brown, moist, very dense, poorly graded SAND with silt.
						CL	Brown, moist, hard, sandy lean CLAY; oxidation staining.
						SC	Light brown, moist, very dense, clayey SAND.
		50/5"	8.6	93.6		SP-SM	Light brown, moist, very dense, poorly graded SAND with silt; pinhole porosity.
50		85/9"					Total Depth = 50.0 feet. Groundwater not encountered during drilling. In-situ percolation test performed 6/4/24. Backfilled with cement-bentonite grout on 6/13/24. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
60							
70							
80							

FIGURE A- 2

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DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

DATE DRILLED 5/23/24 BORING NO. B-2

GROUND ELEVATION 73' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Hollow-Stem Auger (Baja Exploration)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY SXS LOGGED BY SXS REVIEWED BY SCM/MLP

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SM	FILL: Brown, moist, loose, silty SAND; few concrete and asphalt debris; few organics.
						SM	ALLUVIUM: Brown, moist, loose, silty SAND.
		24	13.4	114.6			Medium dense; trace gravel.
						SC	Brown, moist, medium dense, clayey SAND; oxidation staining.
		16					
10							Total Depth = 10.0 feet. Groundwater not encountered during drilling. In-situ percolation test performed 5/24/24. Backfilled with cement-bentonite grout on 6/13/24. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
20							
30							
40							

FIGURE A- 5

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DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

DATE DRILLED 5/28/24 through 5/30/24 BORING NO. B-3

GROUND ELEVATION 73' ± (MSL) SHEET 1 OF 3

METHOD OF DRILLING 18" Hollow-Stem Auger (2R Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY SXS LOGGED BY SXS REVIEWED BY SCM/MLP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	FILL: Brown, moist, loose, silty SAND; few concrete debris; few organics.
			23	18.0	110.6		SM	ALLUVIUM: Brown, moist, medium dense, silty SAND; interbedded sandy silt layers; oxidation staining.
							SC	Reddish brown, moist, medium dense, clayey SAND.
10			16					
			30	10.9	106.2			
							CL	Grayish brown, moist, hard, sandy lean CLAY; oxidation staining.
20			26				SC	Brown, moist, dense, clayey SAND.
			70	6.2	97.7		SP-SM	Light brown, moist, dense, poorly graded SAND with silt; oxidation staining; pinhole porosity.
							SC	Light brown, moist, very dense, clayey SAND.
30			60					
			67	5.6	95.9		SP-SM	Light brown, moist, dense, poorly graded SAND with silt.
							SC	Light brown, moist, very dense, clayey SAND.
40								

DATE DRILLED 5/28/24 through 5/30/24 BORING NO. B-3

GROUND ELEVATION 73' ± (MSL) SHEET 2 OF 3

METHOD OF DRILLING 18" Hollow-Stem Auger (2R Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY SXS LOGGED BY SXS REVIEWED BY SCM/MLP

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40	Driven	39				SC	ALLUVIUM: (Continued) Light brown, moist, very dense, clayey SAND.
						SP	Light brown, moist, very dense, poorly graded SAND; oxidation staining.
	Driven	70/11"	12.9	96.4			
50	Driven	81/11"					Trace gravel.
	Driven	61	15.2	98.7			Dense.
60	Driven	66					Very dense.
	Driven	80/9"	5.0	97.0			
70	Driven	64					
						SP-SM	Light brown, moist, very dense, poorly graded SAND with silt.
	Driven	80	8.0	92.9			
	Driven	60					
80							

FIGURE A- 7

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

212611001 | 10/24

DATE DRILLED 5/28/24 through 5/30/24 BORING NO. B-3

GROUND ELEVATION 73' ± (MSL) SHEET 3 OF 3

METHOD OF DRILLING 18" Hollow-Stem Auger (2R Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY SXS LOGGED BY SXS REVIEWED BY SCM/MLP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
80								Total Depth = 80.0 feet. Groundwater not encountered during drilling. In-situ percolation test performed 6/3/24. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
90								
100								
110								
120								

DATE DRILLED 5/31/24 and 6/10/24 BORING NO. B-4

GROUND ELEVATION 72' ± (MSL) SHEET 1 OF 3

METHOD OF DRILLING 18" Hollow-Stem Auger (2R Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY SXS LOGGED BY SXS REVIEWED BY SCM/MLP

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SM	FILL: Brown, moist, loose, silty SAND; few gravel; few asphalt debris; few organics.
		35				CL	ALLUVIUM: Brown, moist, hard, sandy lean CLAY.
						SC	Brown, moist, dense, clayey SAND; oxidation staining.
10		22					
		55	14.2	103.4		SP-SM	Light brown, moist, dense, poorly graded SAND with silt.
						SC	Brown, moist, medium dense, clayey SAND.
20		12					
		77	5.2	93.6		SP-SM	Light brown, moist, very dense, poorly graded SAND with silt; oxidation staining.
						SC	Light brown, moist, very dense, clayey SAND; oxidation staining.
30		53				SP	Light brown, moist, very dense, poorly graded SAND.
		69	4.5	102.7			Dense.
						SC	Light brown, moist, dense, clayey SAND.
40							

FIGURE A- 9

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DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA
212611001 | 10/24

DATE DRILLED 5/31/24 and 6/10/24 BORING NO. B-4

GROUND ELEVATION 72' ± (MSL) SHEET 2 OF 3

METHOD OF DRILLING 18" Hollow-Stem Auger (2R Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY SXS LOGGED BY SXS REVIEWED BY SCM/MLP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40			50/6"				SP-SM	ALLUVIUM: (Continued) Light brown, moist, very dense, poorly graded SAND with silt; trace gravel; pinhole porosity.
			50/5"	3.6	103.5			
50			78					
			50/6"	9.2	87.6			Oxidation staining.
60			90					
			50/6"	16.5	94.2			
70			60					
			50/6"					
				▽				@ 77': Groundwater encountered during drilling; wet.
			50/6"					
80								

FIGURE A- 10

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

212611001 | 10/24

DATE DRILLED 5/31/24 and 6/10/24 BORING NO. B-4

GROUND ELEVATION 72' ± (MSL) SHEET 3 OF 3

METHOD OF DRILLING 18" Hollow-Stem Auger (2R Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY SXS LOGGED BY SXS REVIEWED BY SCM/MLP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
80								Total Depth = 80.0 feet. Groundwater encountered at a depth of approximately 77 feet during drilling. In-situ percolation test performed on 6/4/24. Notes: Groundwater may rise to a level higher than that measured in borehole due to seasonal variations in precipitation and several other factors as discussed in the report. Groundwater, though The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
90								
100								
110								
120								

APPENDIX B

CPT Soundings

APPENDIX B

CPT SOUNDINGS

Field Procedure for Cone Penetration Testing

The CPT soundings described in this report were conducted by Kehoe Testing & Engineering in general accordance with ASTM D 5778. The cone penetrometer assembly used for this project consisted of a conical tip and a cylindrical friction sleeve. The conical tip had an apex angle of 60 degrees and a cross-section area of approximately 15 square centimeters. The interior of the CPT probe was instrumented with strain gauges that allowed simultaneous measurement of cone tip and friction sleeve resistance during penetration. The cone hydraulically pushed into the soil using the reaction mass of a specially designed 30-ton truck at a constant rate while the cone tip resistance and sleeve friction were recorded at an approximately 1-inch interval and stored in digital form. The computer generated logs presented on the following pages include cone resistance, friction resistance, friction ratio, and interpreted soil types. The soil type interpretations were based on the method proposed by Robertson (2010).

SUMMARY

OF

CONE PENETRATION TEST DATA

Project:

Downtown Lomita Stormwater
24329 Narbonne Avenue
Lomita, CA
May 16, 2024

Prepared for:

Mr. Roy Flores
Ninyo & Moore
475 Goddard, Ste 200
Irvine, CA 92618-4605
Office (949) 753-7070 / Fax (949) 753-7071

Prepared by:

KEHOE TESTING & ENGINEERING
5415 Industrial Drive
Huntington Beach, CA 92649-1518
Office (714) 901-7270 / Fax (714) 901-7289
www.kehoetesting.com

TABLE OF CONTENTS

SUMMARY
OF
CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the Downtown Lomita Stormwater project located at 24329 Narbonne Avenue in Lomita, California. The work was performed by Kehoe Testing & Engineering (KTE) on May 16, 2024. The scope of work was performed as directed by Ninyo & Moore personnel.

2. SUMMARY OF FIELD WORK

The fieldwork consisted of performing CPT soundings at three locations to determine the soil lithology. A summary is provided in **TABLE 2.1**.

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-1	50	
CPT-2	80	
CPT-3	46	Refusal

TABLE 2.1 - Summary of CPT Soundings

3. FIELD EQUIPMENT & PROCEDURES

The CPT soundings were carried out by **KTE** using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig. The cone used during the program was a 15 cm^2 cone with a cone net area ratio of 0.83. The following parameters were recorded at approximately 2.5 cm depth intervals:

- Cone Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (u)
- Inclination
- Penetration Speed

The above parameters were recorded and viewed in real time using a laptop computer. Data is stored at the KTE office for up to 2 years for future analysis and reference. A complete set of baseline readings was taken prior to each sounding to determine temperature shifts and any zero load offsets. Monitoring base line readings ensures that the cone electronics are operating properly.

4. CONE PENETRATION TEST DATA & INTERPRETATION

The Cone Penetration Test data is presented in graphical form in the attached Appendix. These plots were generated using the CPeT-IT program. Penetration depths are referenced to ground surface. The soil behavior type on the CPT plots is derived from the attached CPT SBT plot (Robertson, "Interpretation of Cone Penetration Test…", 2009) and presents major soil lithologic changes. The stratigraphic interpretation is based on relationships between cone resistance (qc), sleeve friction (fs), and penetration pore pressure (u). The friction ratio (Rf), which is sleeve friction divided by cone resistance, is a calculated parameter that is used along with cone resistance to infer soil behavior type. Generally, cohesive soils (clays) have high friction ratios, low cone resistance and generate excess pore water pressures. Cohesionless soils (sands) have lower friction ratios, high cone bearing and generate little (or negative) excess pore water pressures.

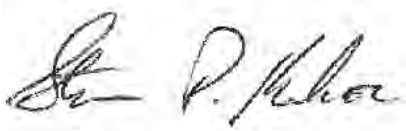
The CPT data files have also been provided. These files can be imported in CPeT-IT (software by GeoLogismiki) and other programs to calculate various geotechnical parameters.

It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and u. In these situations, experience, judgement and an assessment of the pore pressure data should be used to infer the soil behavior type.

If you have any questions regarding this information, please do not hesitate to call our office at (714) 901-7270.

Sincerely,

KEHOE TESTING & ENGINEERING



Steven P. Kehoe
President

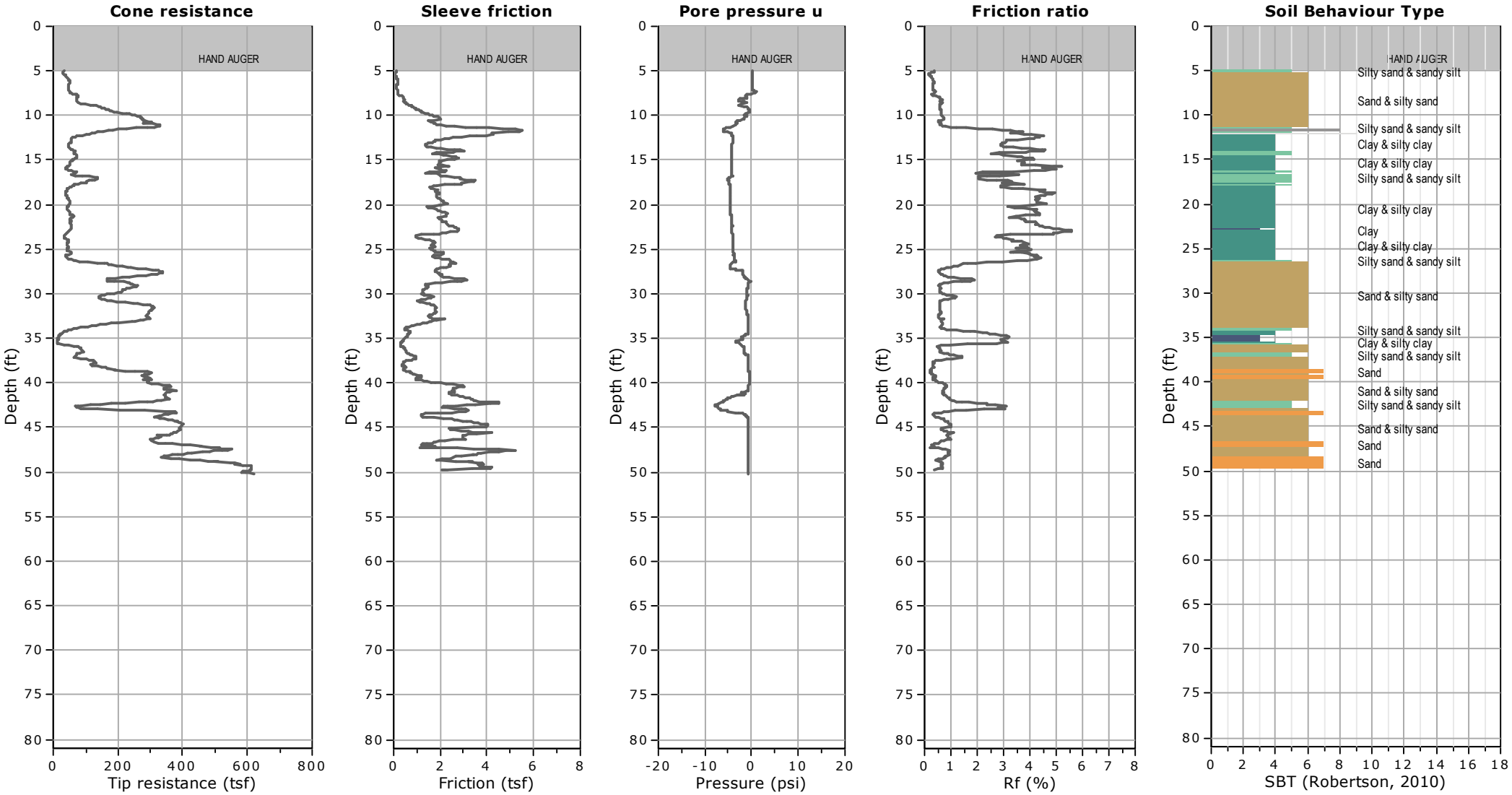
05/17/24-eb-6499

APPENDIX

Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **Ninyo & Moore / Downtown Lomita Stormwater**
Location: **24329 Narbonne Ave, Lomita, CA**

CPT-1
Total depth: 50.20 ft, Date: 5/16/2024



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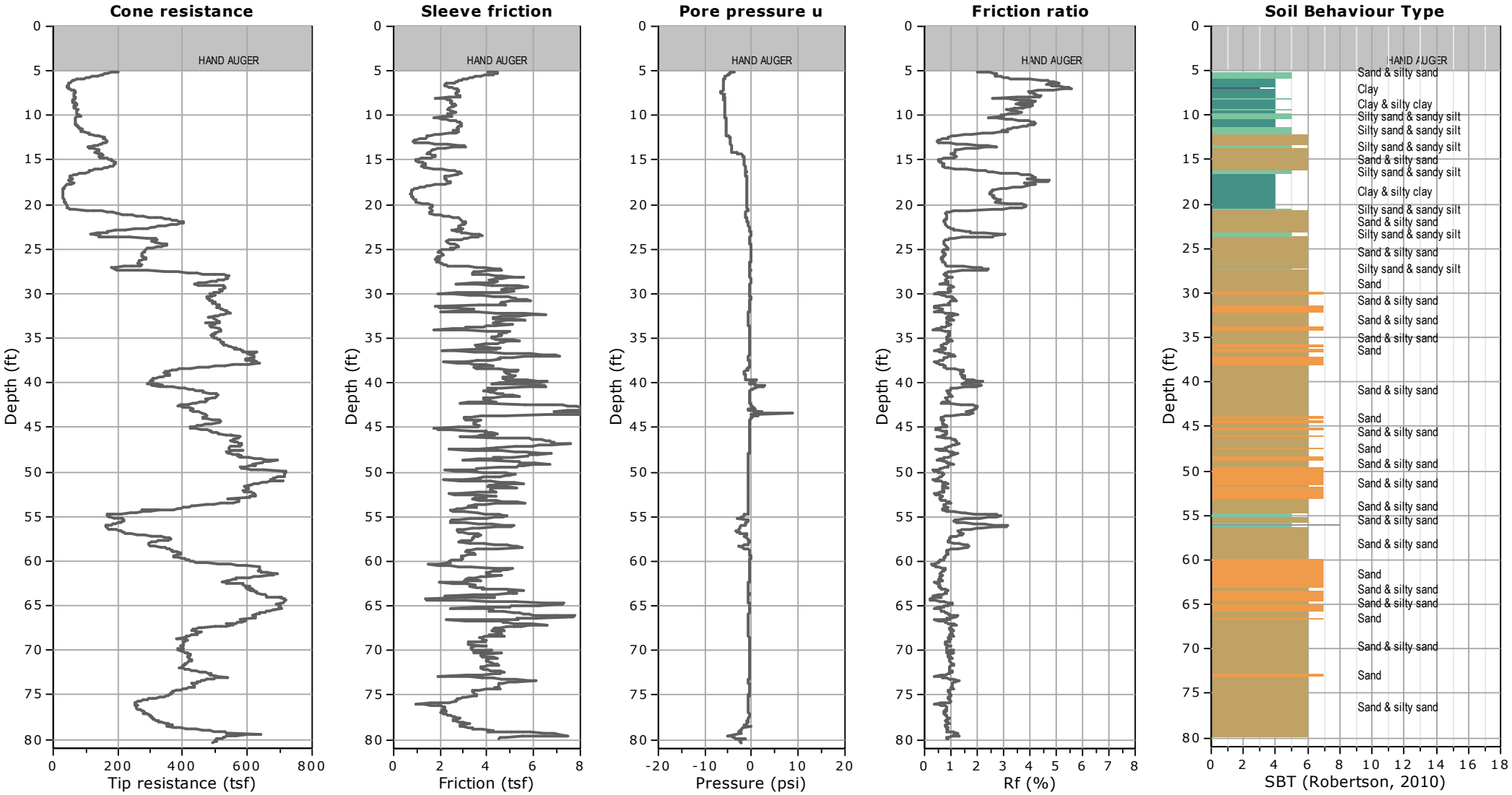
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **Ninyo & Moore / Downtown Lomita Stormwater**
Location: **24329 Narbonne Ave, Lomita, CA**

CPT-2
Total depth: 80.32 ft, Date: 5/16/2024



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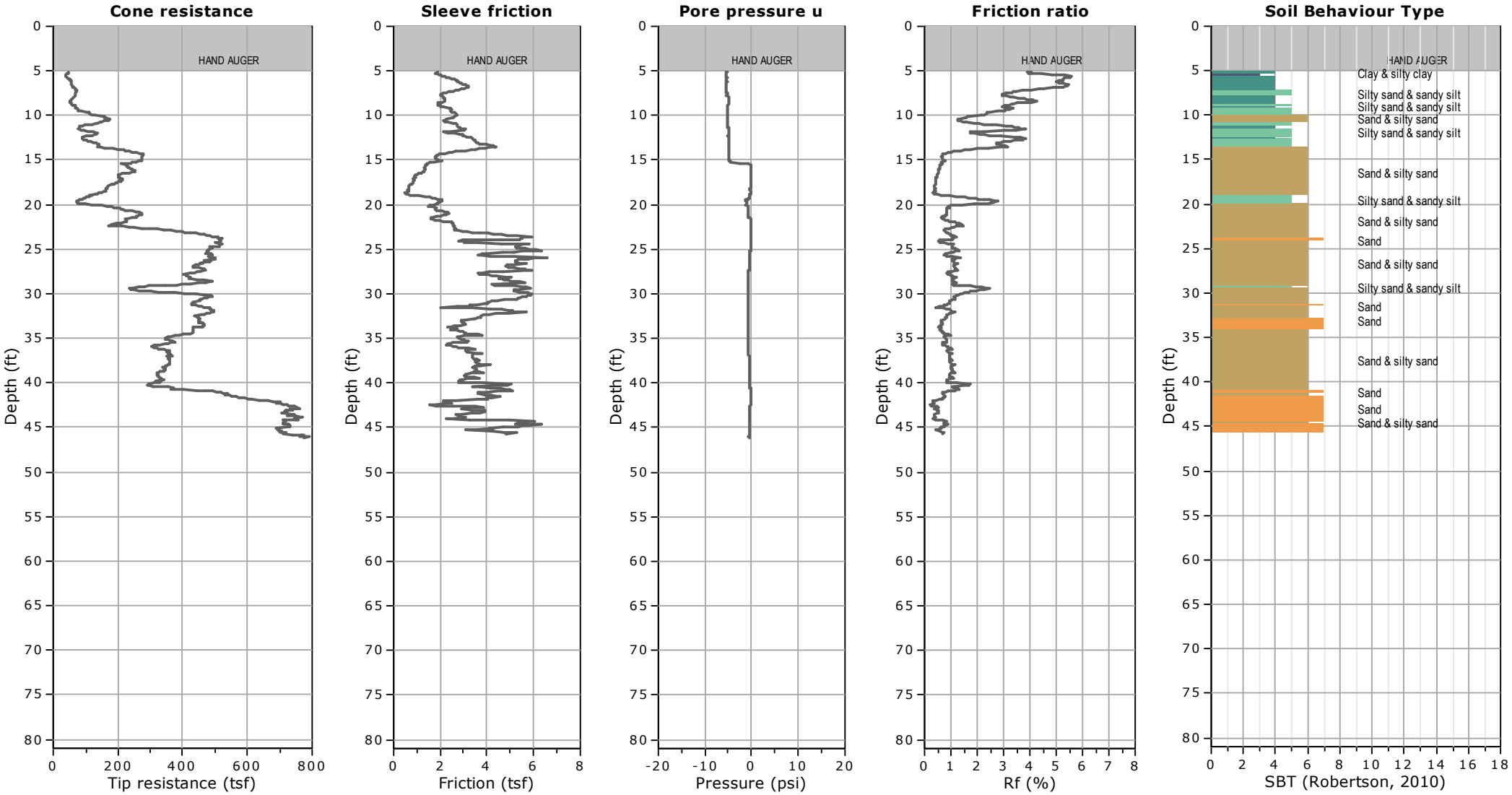
steve@kehoetesting.com
www.kehoetesting.com

Project: **Ninyo & Moore / Downtown Lomita Stormwater**
Location: **24329 Narbonne Ave, Lomita, CA**

CPT-3
Total depth: 46.13 ft, Date: 5/16/2024



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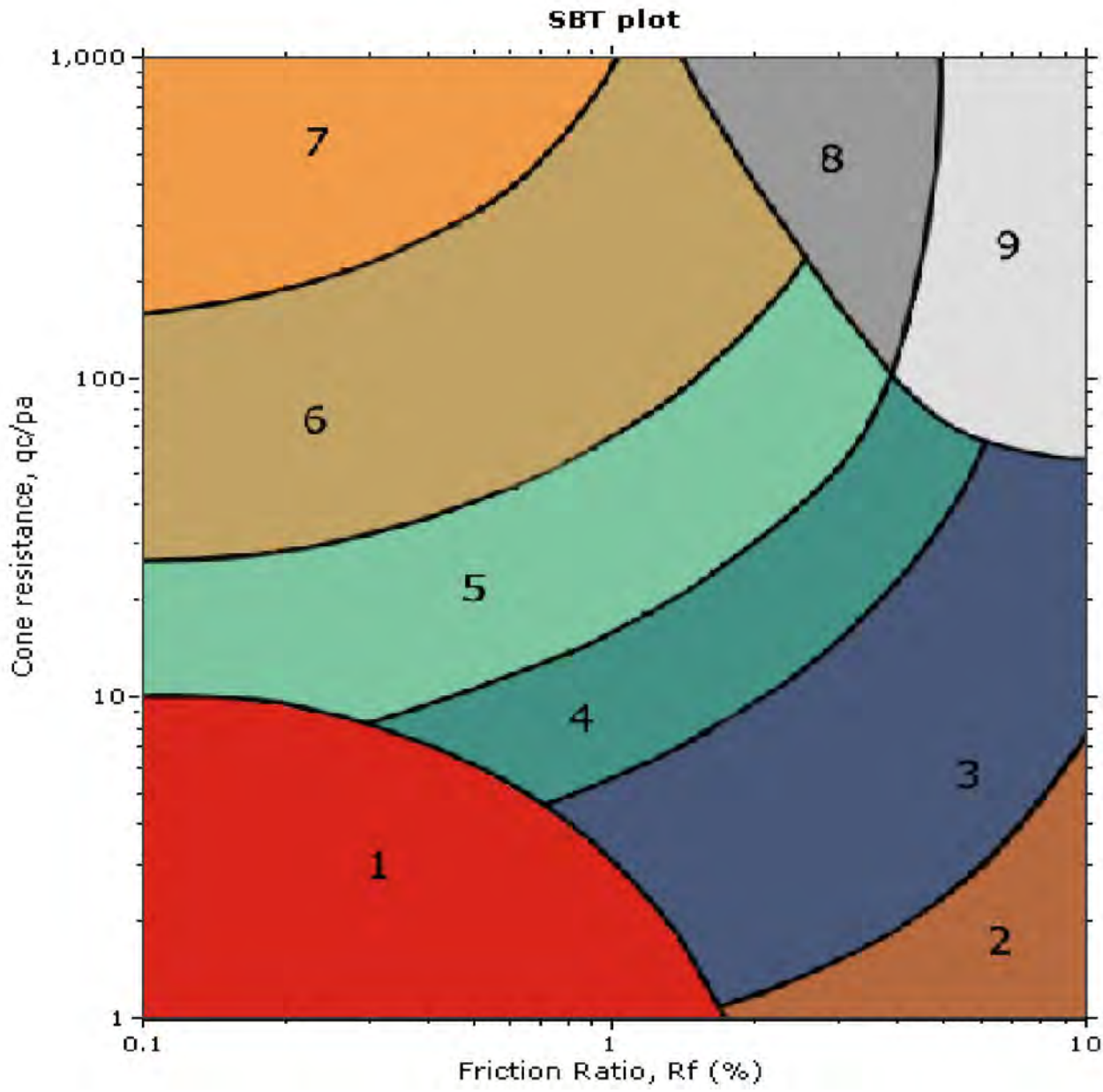
www.kehoetesting.com



SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

APPENDIX C

Previous Boring Logs
(Geocon West, Inc., 2019)

PROJECT NO. W1020-06-01

BORING 1

ELEV. (MSL.) -- DATE COMPLETED **7/2/19**

EQUIPMENT **HAND AUGER** BY: **RP**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-3'				**ARTIFICIAL FILL** Silty Sand, medium dense, slightly moist, brown, fine-grained, some fine gravel.			
2					**ALLUVIUM** Silty Sand, medium dense, slightly moist, reddish brown, fine-grained.			
4	B1@3'						95.8	9.7
6	B1@6'			SM	- olive brown with reddish brown mottles		105.6	14.9
8								
10	B1@9.5'				- trace carbon deposits		113.0	11.8
					Total depth of boring: 10 feet Fill to 2 feet. No groundwater encountered Backfilled with soil cuttings and tamped.			

W1020-06-01 BORING LOGS.GPJ

Figure A1,
Log of Boring 1, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1020-06-01

BORING 2

ELEV. (MSL.) -- DATE COMPLETED **7/2/19**

EQUIPMENT **HAND AUGER** BY: **RP**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-3'				**ARTIFICIAL FILL** Silty Sand, medium dense, slightly moist, brown, fine-grained, some fine gravel.			
2	B2@2.5'				**ALLUVIUM** Silty Sand, medium dense, slightly moist, reddish brown fine-grained.		99.8	6.0
4	B2@5'			SM	- no recovery			
6	B2@6.5'				- moist		112.4	19.3
8								
10	B2@9.5'				- no recovery			
					Total depth of boring: 10 feet Fill to 2 feet. No groundwater encountered. Backfilled with soil cuttings and tamped.			

W1020-06-01 BORING LOGS.GPJ

Figure A2,
Log of Boring 2, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1020-06-01

BORING 3

ELEV. (MSL.) -- DATE COMPLETED **7/2/19**

EQUIPMENT **HAND AUGER** BY: **RP**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ARTIFICIAL FILL** Silty Sand, dry to slightly moist, brown, fine-grained, trace fine gravel.			
2					**ALLUVIUM** Silty Sand, slightly moist, reddish brown, fine-grained.			
4	B3@3'						101.0	6.3
6	B3@6'			SM			110.2	18.3
8					- moist			
10	B3@9'				- slight increase in moisture			
12	B3@12'			SC	Clayey Sand, medium dense, slightly moist, olive brown with reddish brown mottles, fine-grained. - no recovery		117.1	15.3
14	B3@15'				- slight decrease in clay		114.9	17.7
					Total depth of boring: 15.5 feet Fill to 1.5 feet. No groundwater encountered. Backfilled with soil cuttings and tamped.			

W1020-06-01 BORING LOGS.GPJ

Figure A3,
Log of Boring 3, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1020-06-01

BORING 4

ELEV. (MSL.) -- DATE COMPLETED **7/2/19**

EQUIPMENT **HAND AUGER** BY: **RP**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ARTIFICIAL FILL** Silty Sand, loose, dry, brown, fine-grained, some fine gravel, trace brick and glass.			
2	B4@2.5'			SM	**ALLUVIUM** Silty Sand, medium dense, reddish brown, fine-grained.		101.9	5.8
4	B4@5'				- slight increase in moisture, trace coarse-grained		100.8	14.6
					Total depth of boring: 5.5 feet Fill to 1.5 feet. No groundwater encountered. Percolation testing performed on 7/3/19.			

W1020-06-01 BORING LOGS.GPJ

Figure A4,
Log of Boring 4, Page 1 of 1

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL ◧ ... STANDARD PENETRATION TEST ■ ... DRIVE SAMPLE (UNDISTURBED)

⊠ ... DISTURBED OR BAG SAMPLE ◪ ... CHUNK SAMPLE ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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APPENDIX D

Laboratory Testing

APPENDIX D

LABORATORY TESTING

Classification
Soils were visually and texturally classified in adherence to the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the logs of the exploratory borings in Appendix A.

In-Place Moisture and Density Tests
The moisture content and dry density of relatively undisturbed samples obtained from the exploratory borings were evaluated in general accordance with ASTM D 2937. The test results are presented on the logs of the exploratory borings in Appendix A.

Gradation Analysis
Gradation analysis tests were performed on selected representative soil samples in general accordance with ASTM D 422. The grain-size distribution curves are presented on Figures D-1 through D-8. These test results were utilized in evaluating the soil classifications in accordance with the USCS.

200 Wash
An evaluation of the percentage of particles finer than the No. 200 sieve in selected soil samples was performed in general accordance with ASTM D 1140. The results of the tests are summarized on Figure D-9.

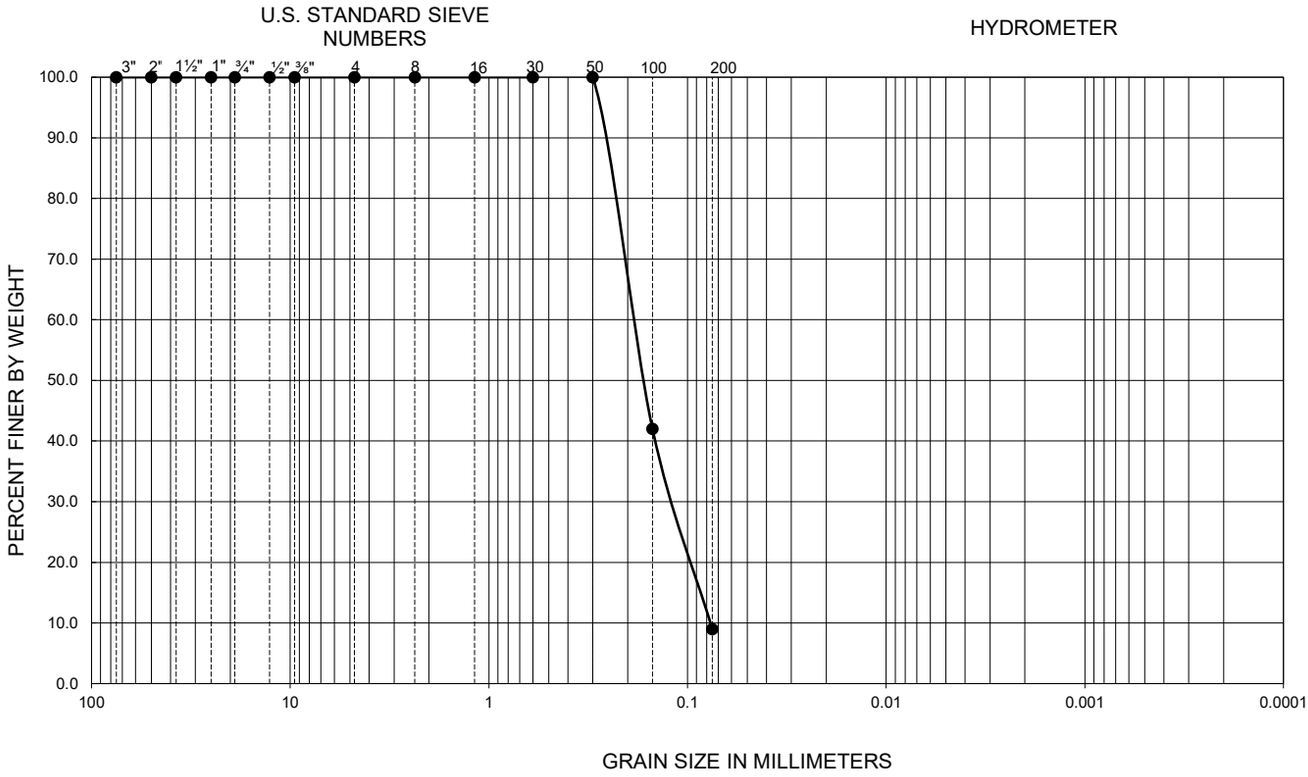
Atterberg Limits
Tests were performed on selected representative fine-grained soil samples to evaluate the liquid limit, plastic limit, and plasticity index in general accordance with ASTM D 4318. These test results were utilized to evaluate the soil classifications in accordance with the USCS. The test results and classifications are summarized on Figure D-10.

Direct Shear Tests
Direct shear tests were performed on relatively undisturbed samples in general accordance with ASTM D 3080 to evaluate the shear strength characteristics of the selected materials. The samples were inundated during shearing to represent adverse field conditions. The results are presented on Figures D-11 and D-12.

R-Value
The resistance value, or R-value, for site soils was evaluated in general accordance with CT 301. Samples were prepared and evaluated for exudation pressure and expansion pressure. The equilibrium R-value is reported as the lesser or more conservative of the two calculated results. The test results are summarized on Figure D-13.

Soil Corrosivity Tests
Soil pH and resistivity tests were performed on representative samples in general accordance with CT 643. The soluble sulfate content and chloride content of the selected samples were evaluated in general accordance with CT 417 and CT 422, respectively. The test results are summarized on Figure D-14.

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-1	30.0-31.5	--	--	--	0.08	0.12	0.18	2.4	1.1	9	SP-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

FIGURE D-1

GRADATION TEST RESULTS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

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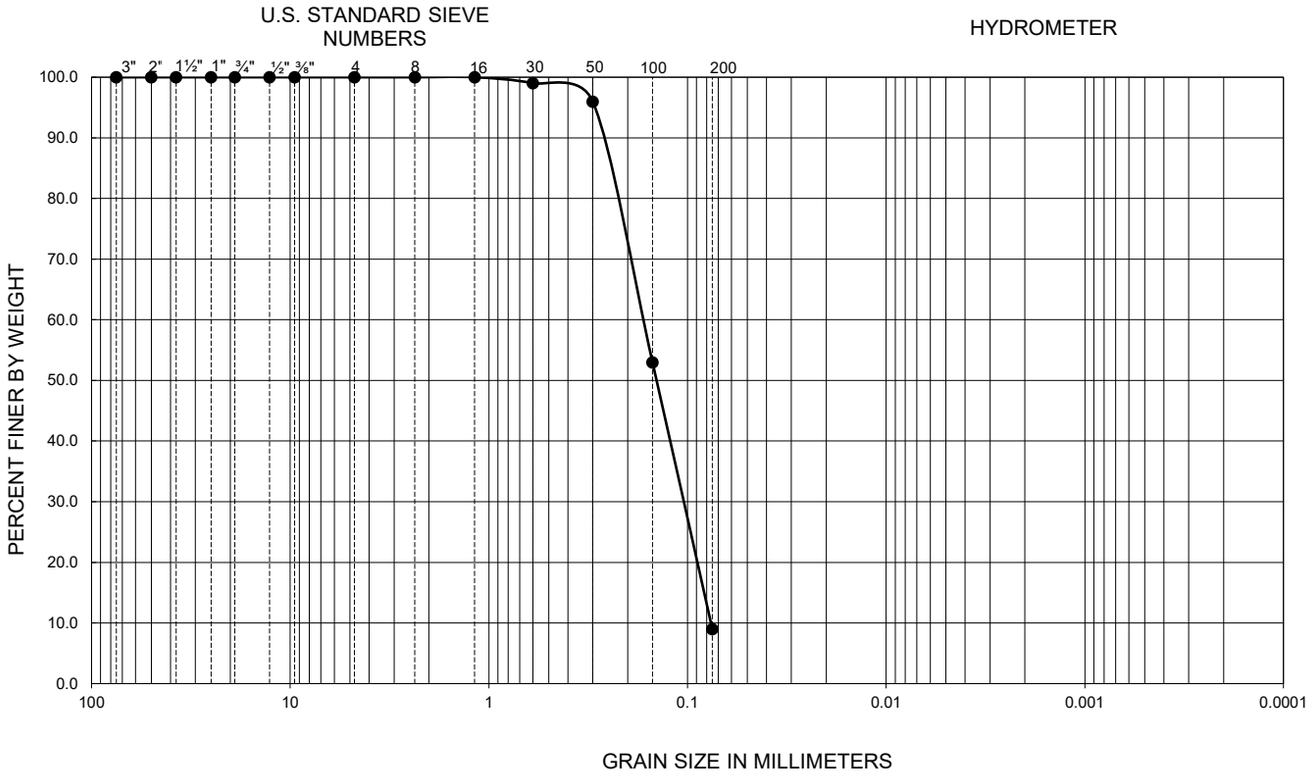
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-1	45.0-46.0	--	--	--	0.08	0.10	0.17	2.2	0.8	9	SP-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

FIGURE D-2

GRADATION TEST RESULTS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

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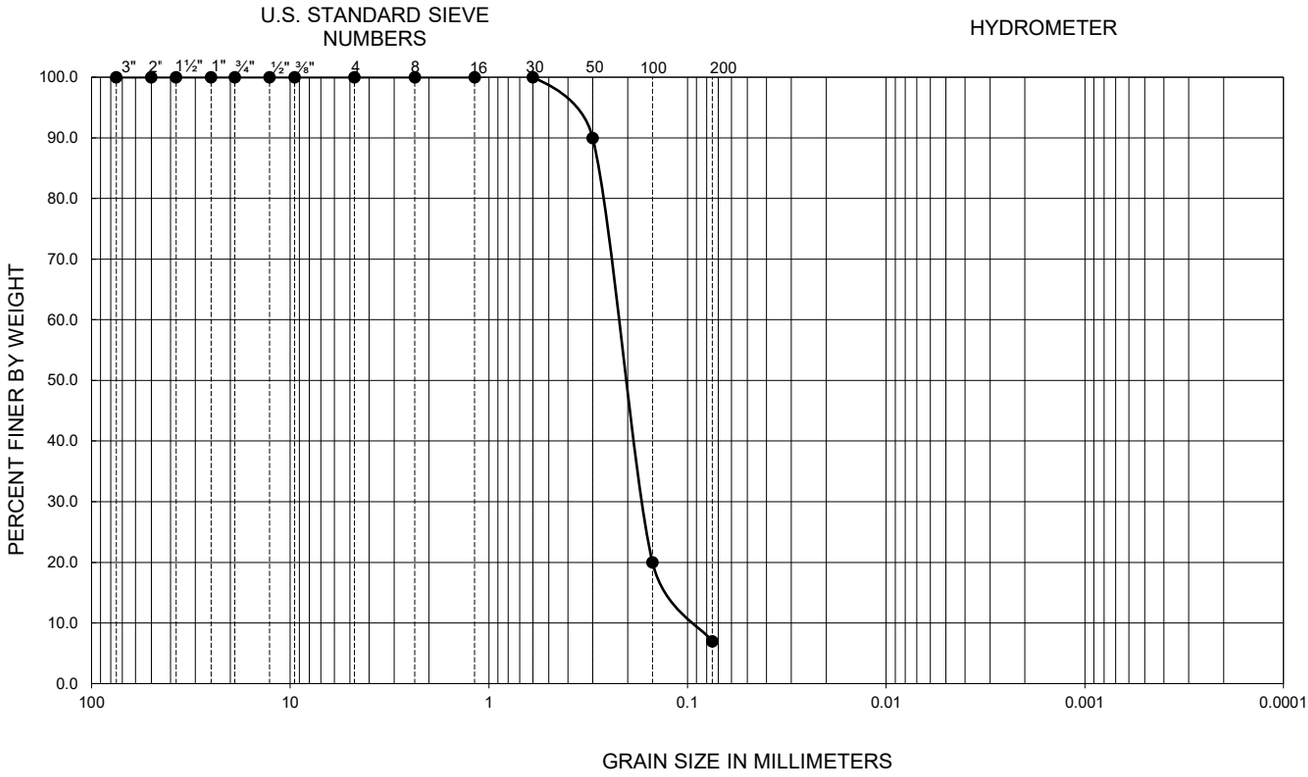
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-3	25.0-26.5	--	--	--	0.09	0.17	0.21	2.2	1.5	7	SP-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

FIGURE D-3

GRADATION TEST RESULTS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

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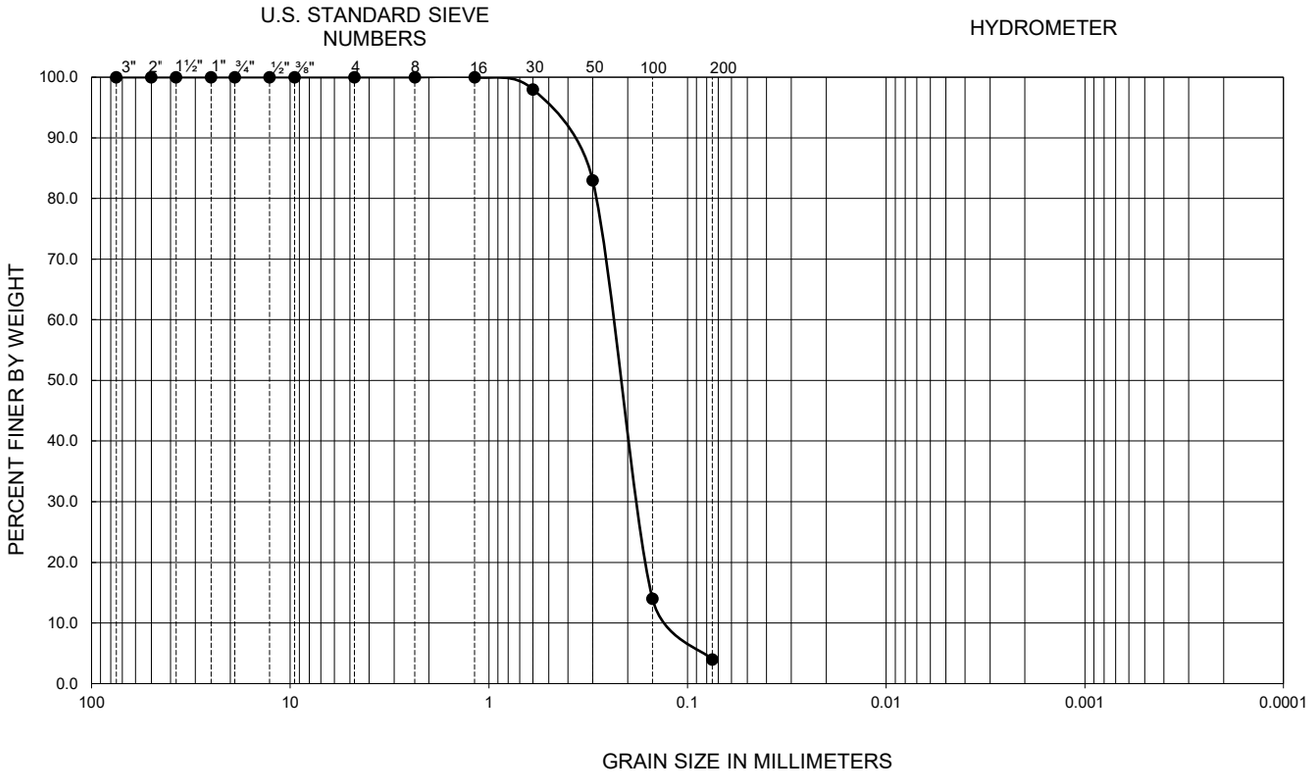
Geotechnical & Environmental Sciences Consultants

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-3	65.0-66.5	--	--	--	0.13	0.18	0.24	1.8	1.0	4	SP

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

FIGURE D-4

GRADATION TEST RESULTS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

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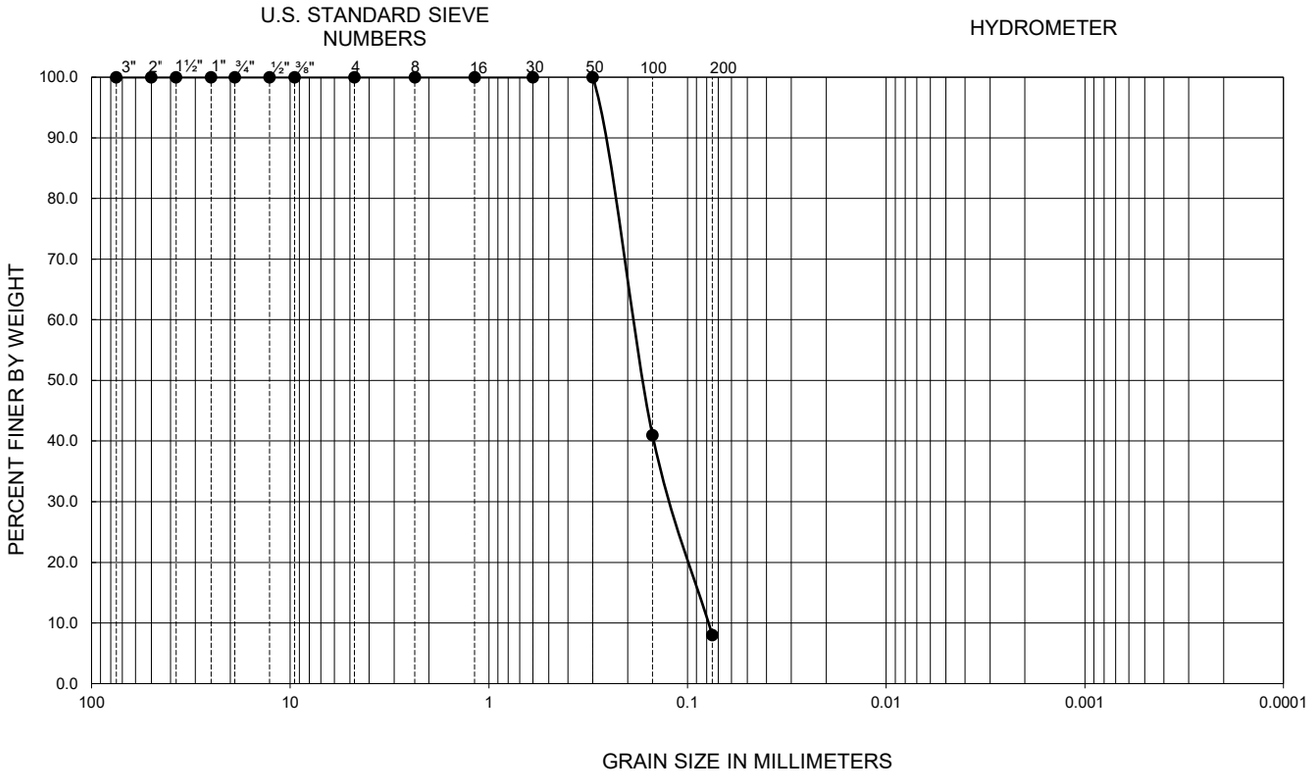
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-3	75.0-76.5	--	--	--	0.08	0.13	0.19	2.4	1.1	8	SP-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

FIGURE D-5

GRADATION TEST RESULTS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

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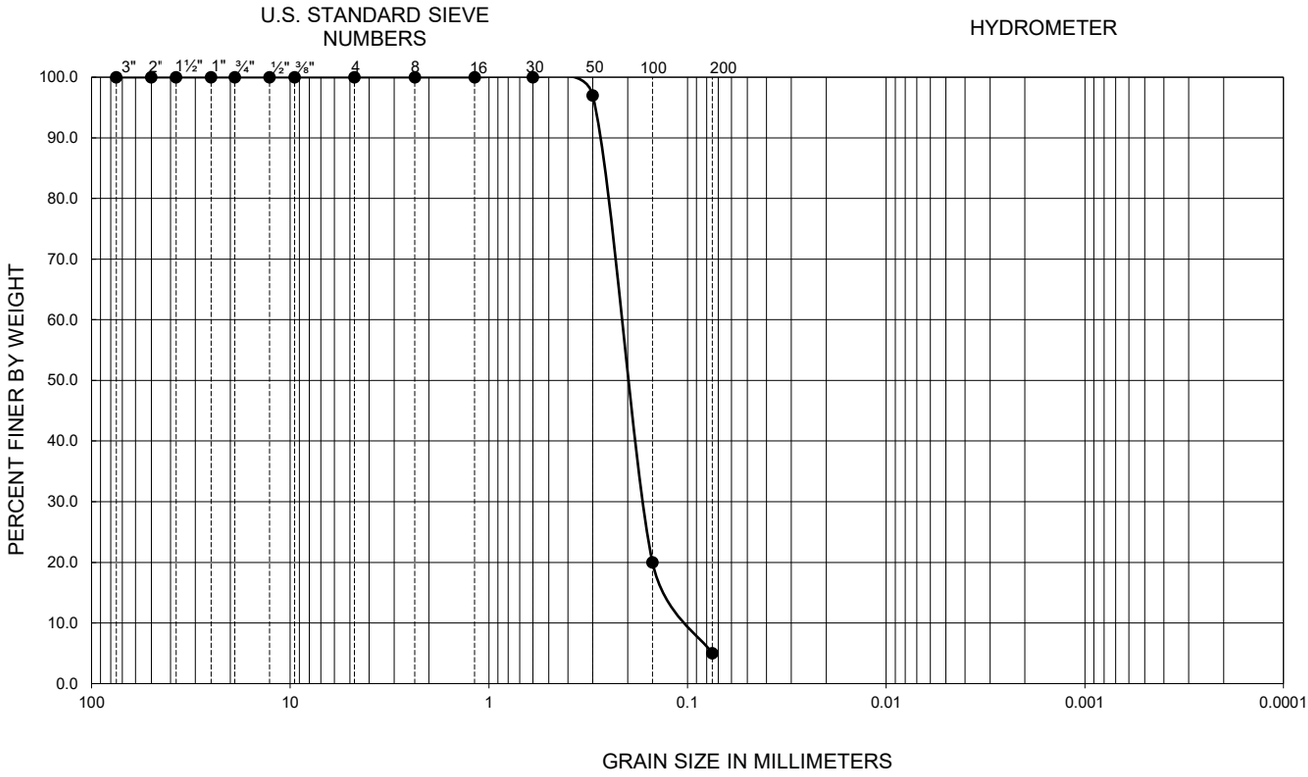
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-4	25.0-26.5	--	--	--	0.10	0.17	0.21	2.0	1.4	5	SP-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

FIGURE D-6

GRADATION TEST RESULTS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

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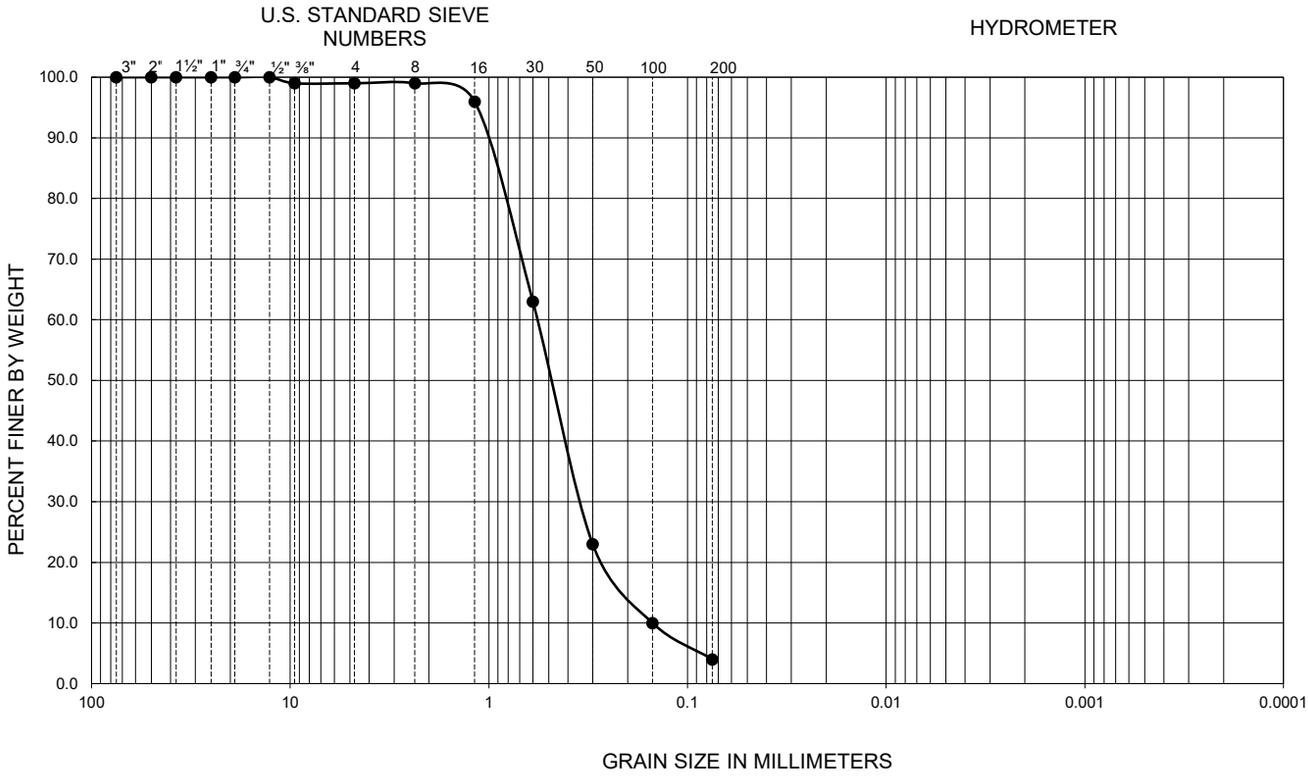
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-4	45.0-46.0	--	--	--	0.15	0.34	0.57	3.8	1.4	4	SP-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

FIGURE D-7

GRADATION TEST RESULTS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

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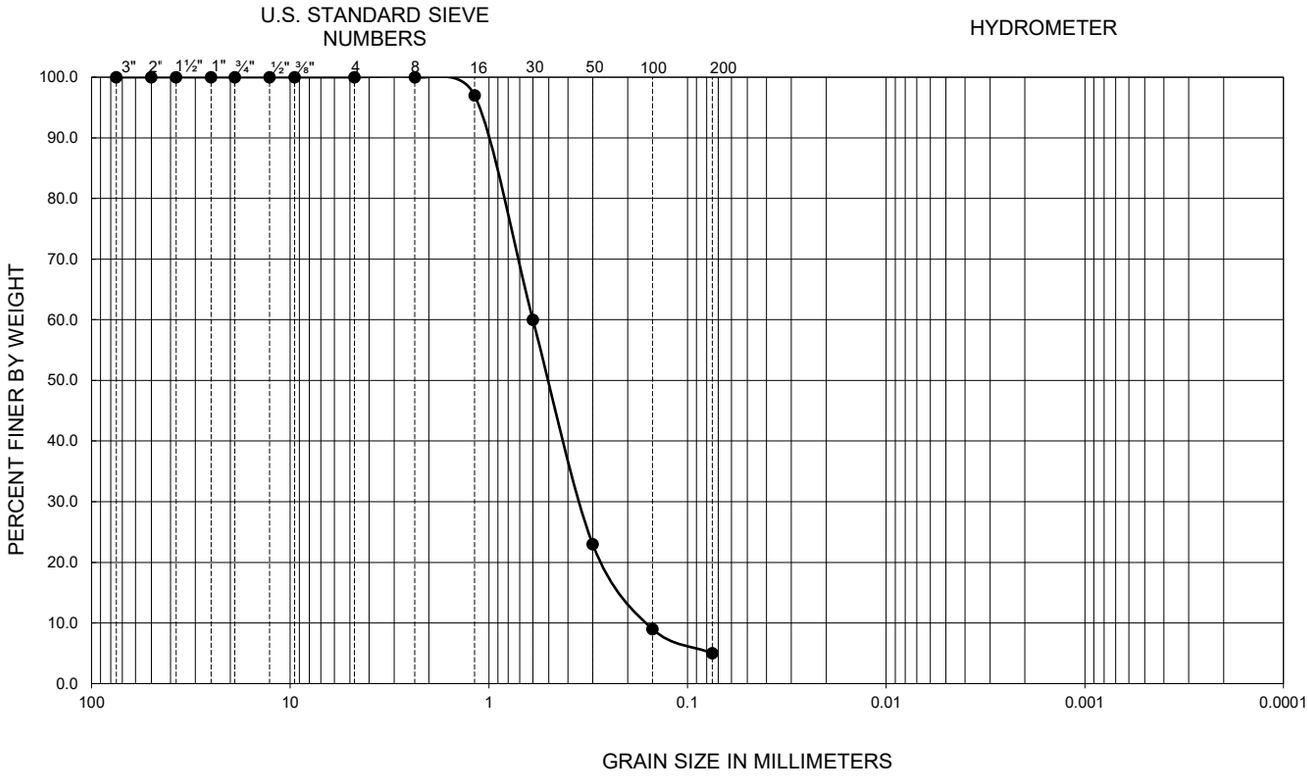
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-4	60.0-61.5	--	--	--	0.16	0.35	0.60	3.8	1.3	5	SP-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

FIGURE D-8

GRADATION TEST RESULTS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

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SAMPLE LOCATION	SAMPLE DEPTH (ft)	DESCRIPTION	PERCENT PASSING NO. 4	PERCENT PASSING NO. 200	USCS (TOTAL SAMPLE)
B-1	5.0-6.5	SILTY SAND	100	16	SM
B-1	15.0-16.5	SILTY, CLAYEY SAND	100	35	SC-SM
B-2	5.0-6.5	SILTY SAND	99	38	SC
B-2	8.5-10.0	CLAYEY SAND	100	35	SC
B-3	40.0-41.5	CLAYEY SAND	100	32	SC
B-3	50.0-51.5	POORLY GRADED SAND	99	4	SP
B-4	0.0-5.0	SILTY SAND	95	38	SM
B-4	15.0-16.5	POORLY GRADED SAND WITH SILT	100	10	SP-SM
B-4	35.0-36.0	POORLY GRADED SAND	100	4	SP

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 1140

FIGURE D-9

NO. 200 SIEVE ANALYSIS TEST RESULTS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

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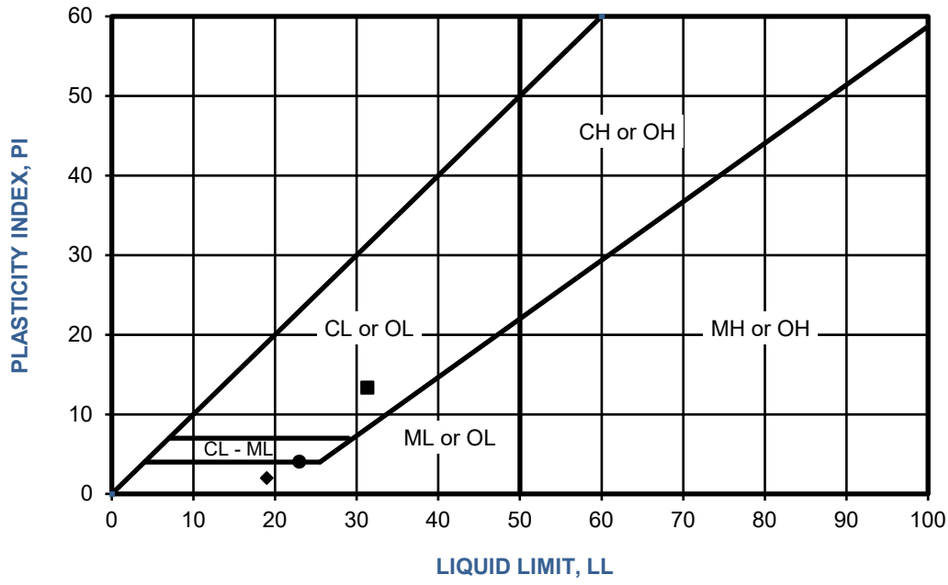
SYMBOL	LOCATION	DEPTH (ft)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS
●	B-1	15.0-16.5	23	19	4	CL-ML	SC-SM
■	B-2	8.5-10.0	31	18	13	CL	SC
◆	B-3	5.0-6.5	19	17	2	ML	SM



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

FIGURE D-10

ATTERBERG LIMITS TEST RESULTS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
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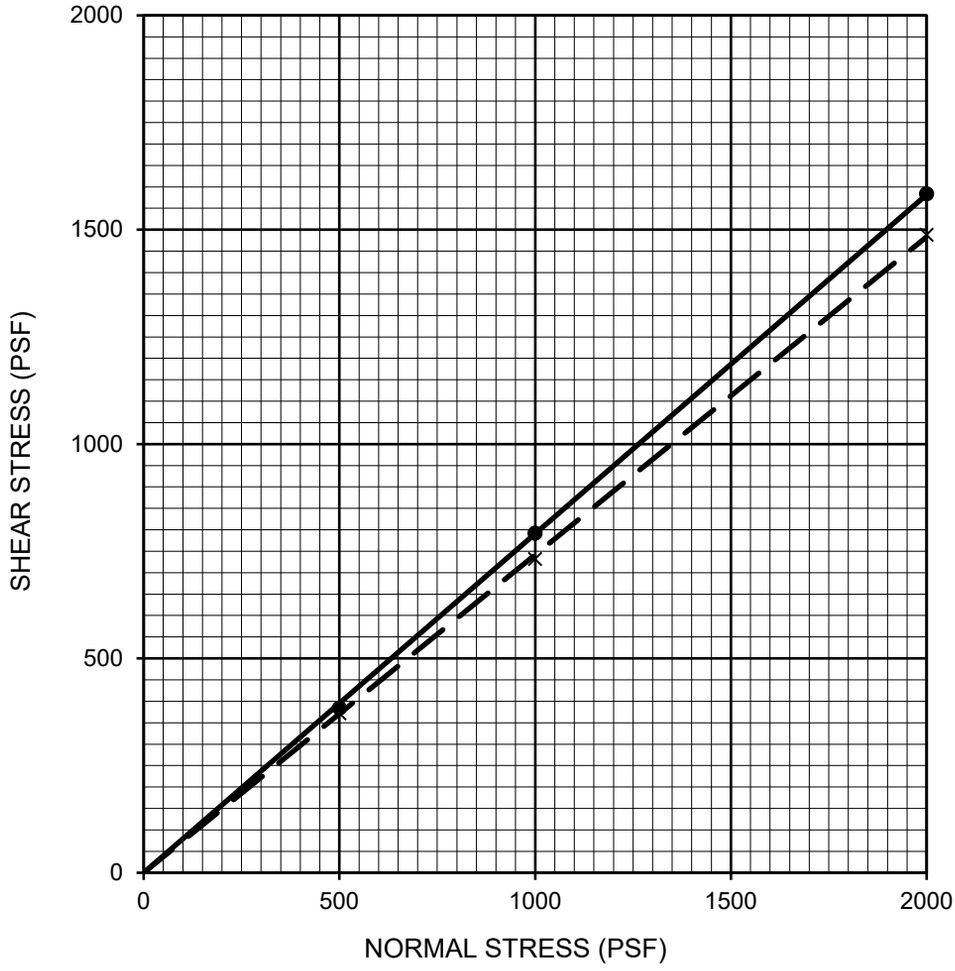

Description	Symbol	Sample Location	Depth (ft)	Shear Strength	Cohesion (psf)	Friction Angle (degrees)	Soil Type
SILTY SAND	●——	B-1	5.0-6.5	Peak	0	39	SM
SILTY SAND	– – X – –	B-1	5.0-6.5	Ultimate	0	37	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 3080

FIGURE D-11

DIRECT SHEAR TEST RESULTS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
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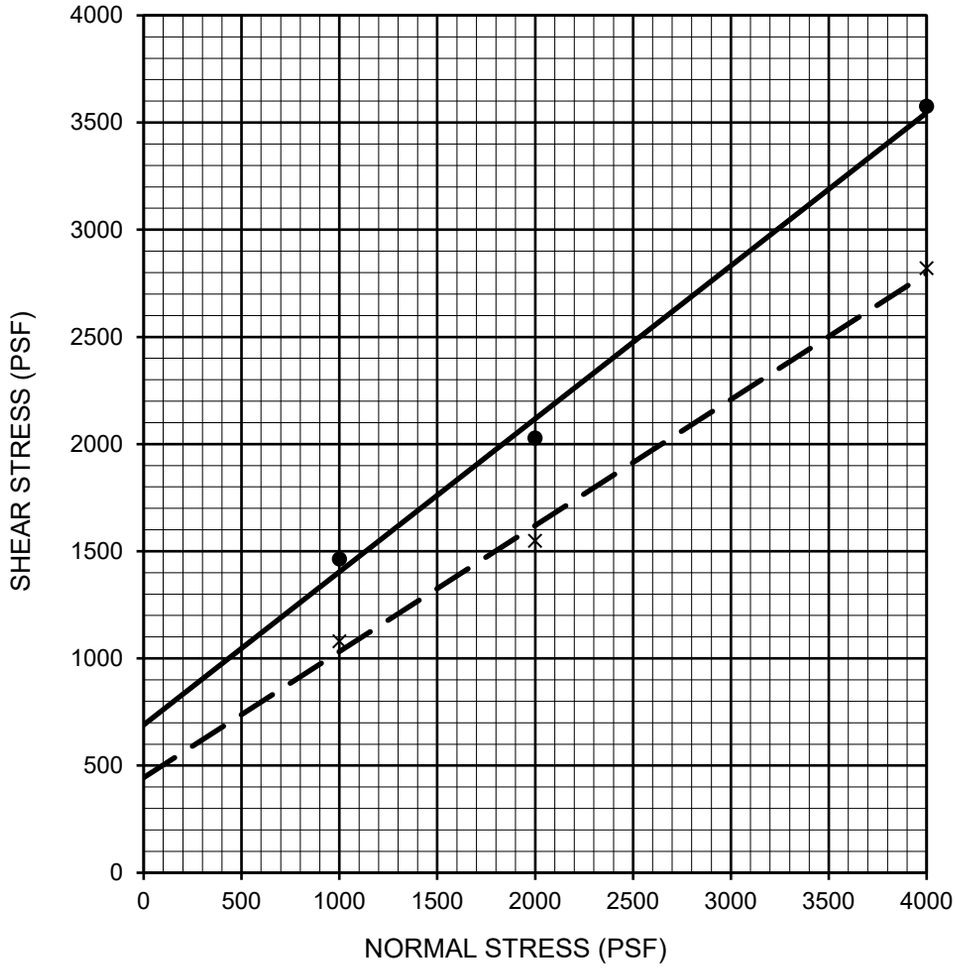

Description	Symbol	Sample Location	Depth (ft)	Shear Strength	Cohesion (psf)	Friction Angle (degrees)	Soil Type
SILTY, CLAYEY SAND	●——	B-1	15.0-16.5	Peak	690	36	SC-SM
SILTY, CLAYEY SAND	– – X – –	B-1	15.0-16.5	Ultimate	444	30	SC-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 3080

FIGURE D-12

DIRECT SHEAR TEST RESULTS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

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SAMPLE LOCATION	SAMPLE DEPTH (ft)	SOIL TYPE	R-VALUE
B-2	0.0-5.0	SM	61
B-4	0.0-5.0	SM	67

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

FIGURE D-13

R-VALUE TEST RESULTS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

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SAMPLE LOCATION	SAMPLE DEPTH (ft)	pH [1]	RESISTIVITY [1] (ohm-cm)	SULFATE CONTENT [2]		CHLORIDE CONTENT [3] (ppm)
				(ppm)	(%)	
B-1	30.0-31.5	6.5	10,013	20	0.002	45
B-2	0.0-5.0	6.7	21,340	10	0.001	40
B-4	0.0-5.0	6.5	6,783	10	0.001	40

[1] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 643
[2] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 417
[3] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 422

FIGURE D-14

CORROSIVITY TEST RESULTS

DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT
LOMITA, CALIFORNIA

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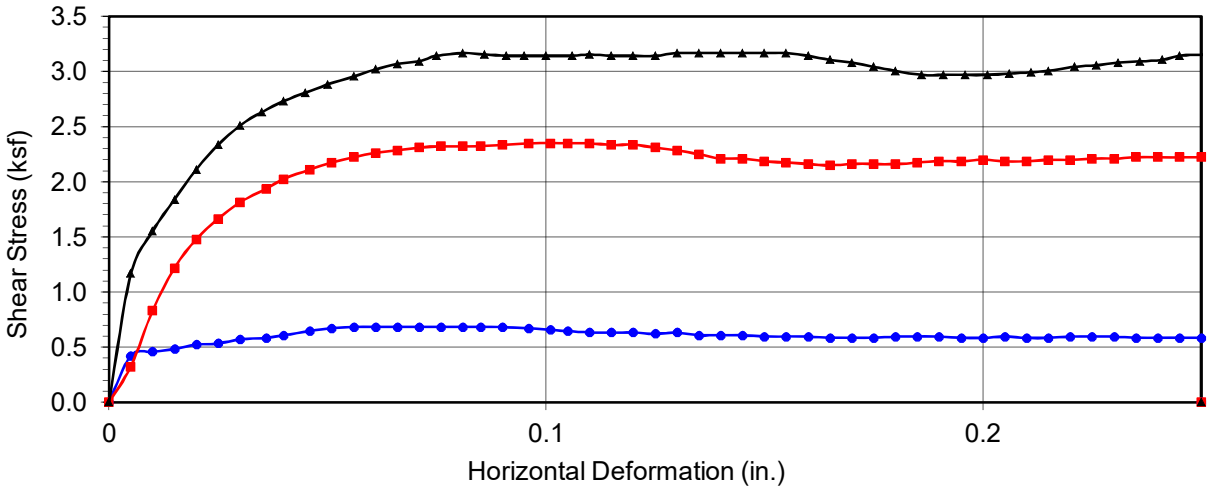
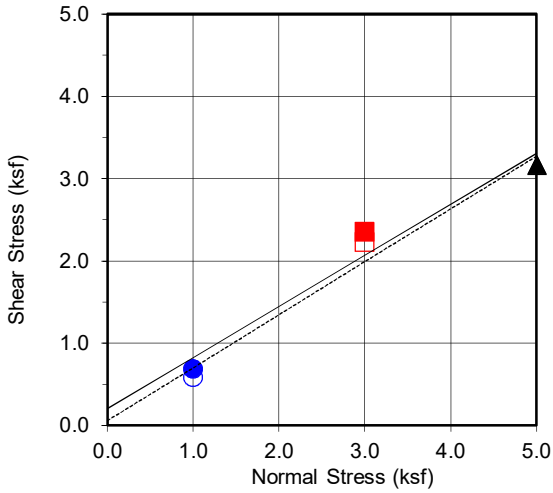
APPENDIX E

Previous Laboratory Testing (Geocon West, Inc., 2019)





Boring No.	**B1**
Sample No.	**@3**
Depth (ft)	**3**
Sample Type:	Ring

Soil Identification:		
Bronw Silty Sand (SM)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	203	31.8
Ultimate	59	32.7

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.68	■ 2.35	▲ 3.17
Shear Stress @ End of Test (ksf)	○ 0.58	□ 2.22	△ 3.15
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	10.1	13.9	13.8
Initial Dry Density (pcf)	94.2	92.3	93.6
Initial Degree of Saturation (%)	34.5	45.3	46.4
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	20.8	20.3	22.8

GEOCON

DIRECT SHEAR TEST RESULTS

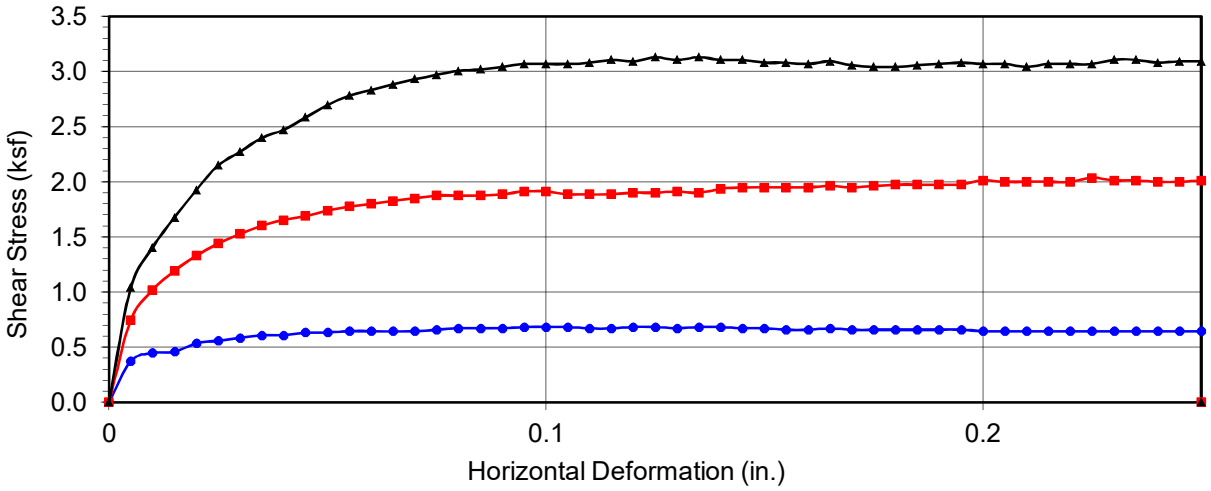
Consolidated Drained ASTM D-3080

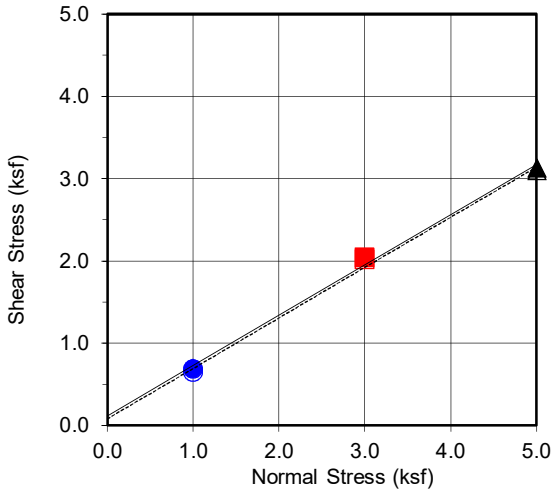
Checked by: JJK

Project No.: W1020-06-01

24384 Narbonne Avenue
Lomita, California

Aug 19 Figure B1





Boring No.	**B1**
Sample No.	**B1 @ 0-5**
Depth (ft)	**0-5**
Sample Type:	Ring

Soil Identification:		
Brown Silty Sand (SM)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	115	31.4
Ultimate	82	31.4

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.68	■ 2.04	▲ 3.13
Shear Stress @ End of Test (ksf)	○ 0.65	□ 2.01	△ 3.09
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	16.9	15.1	14.8
Initial Dry Density (pcf)	95.7	97.2	97.5
Initial Degree of Saturation (%)	59.9	55.3	54.9
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	21.5	22.1	20.5

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DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

Checked by: JJK

Project No.: W1020-06-01

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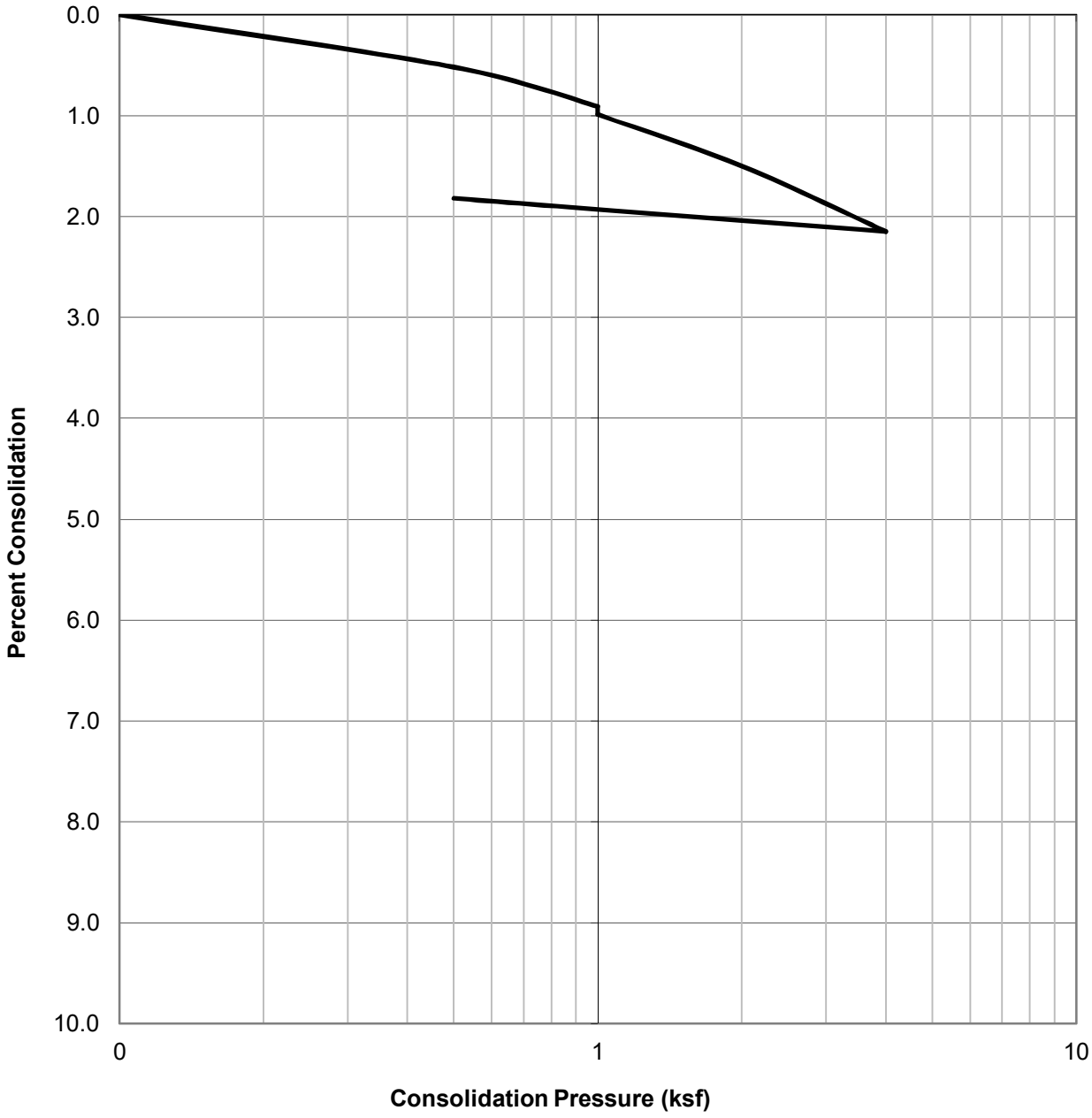
Aug 19 Figure B2

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@3	Brown Silty Sand (SM)	95.8	9.7	22.0

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

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Project No.: W1020-06-01

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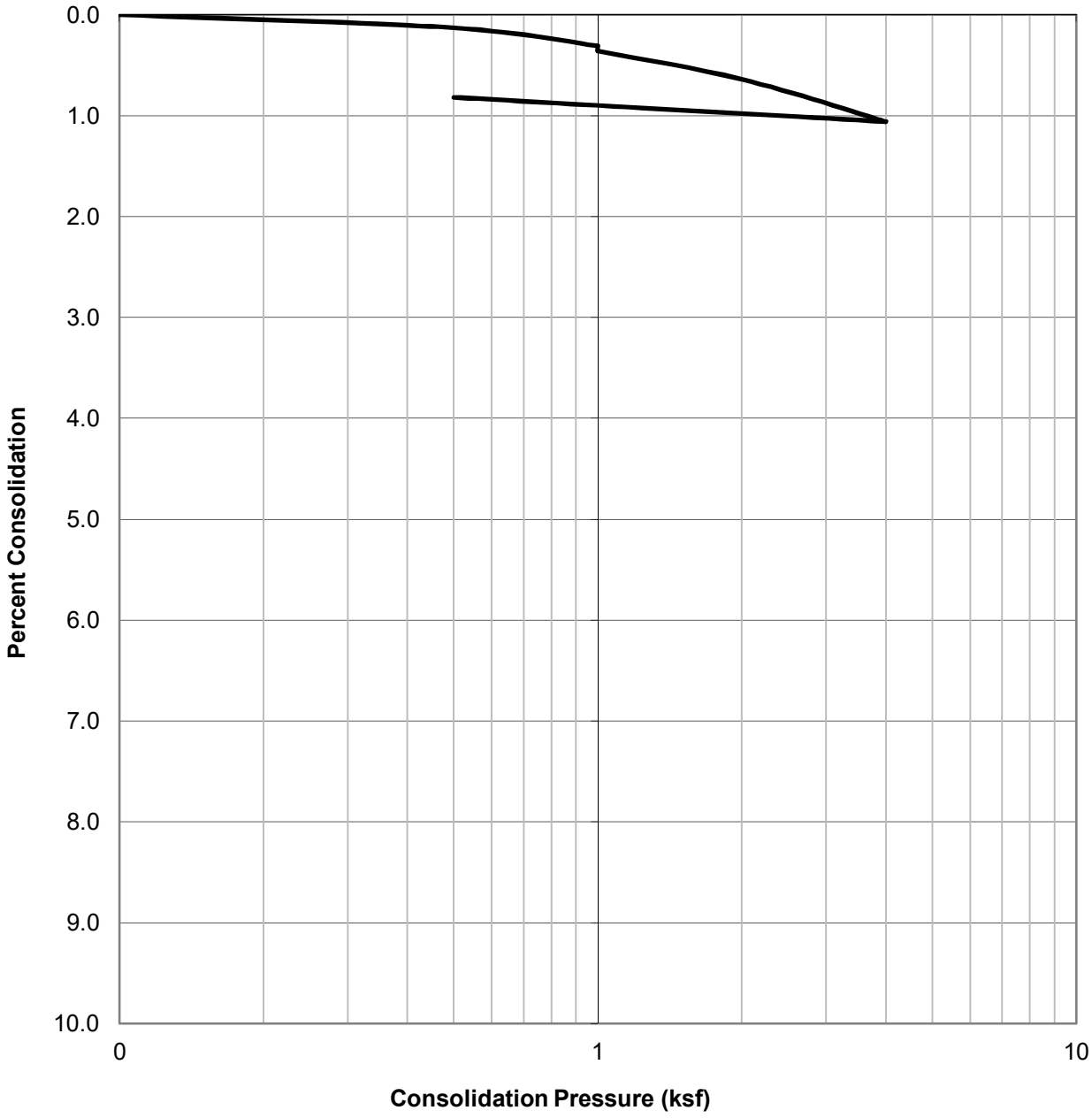
Aug 19 Figure B3

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@6	Brown Silty Sand (SM)	105.0	17.6	17.5

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

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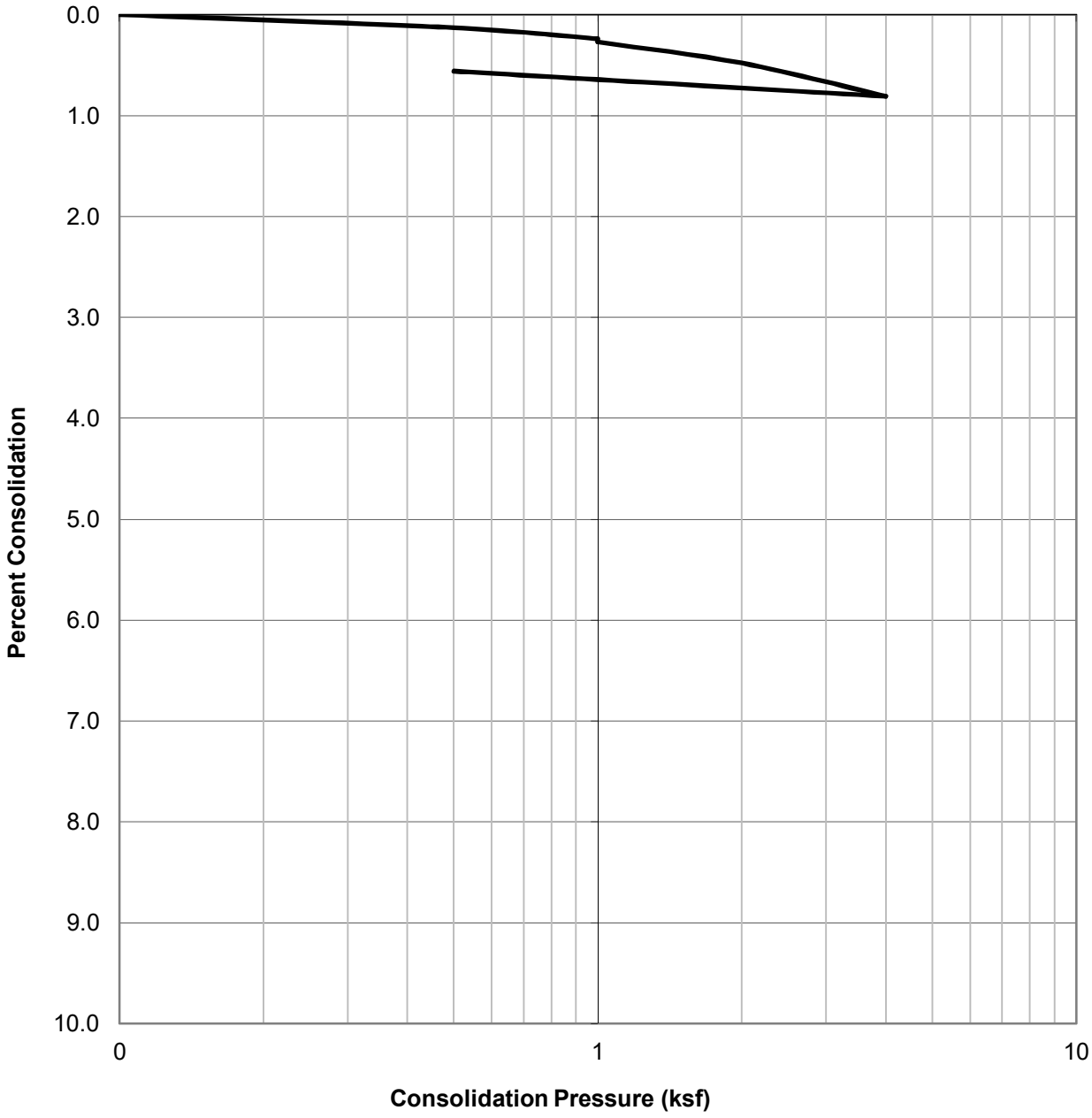
Aug 19 Figure B

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@9	Brown Silty Sand (SM)	112.5	13.2	15.9

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CONSOLIDATION TEST RESULTS

ASTM D-2435

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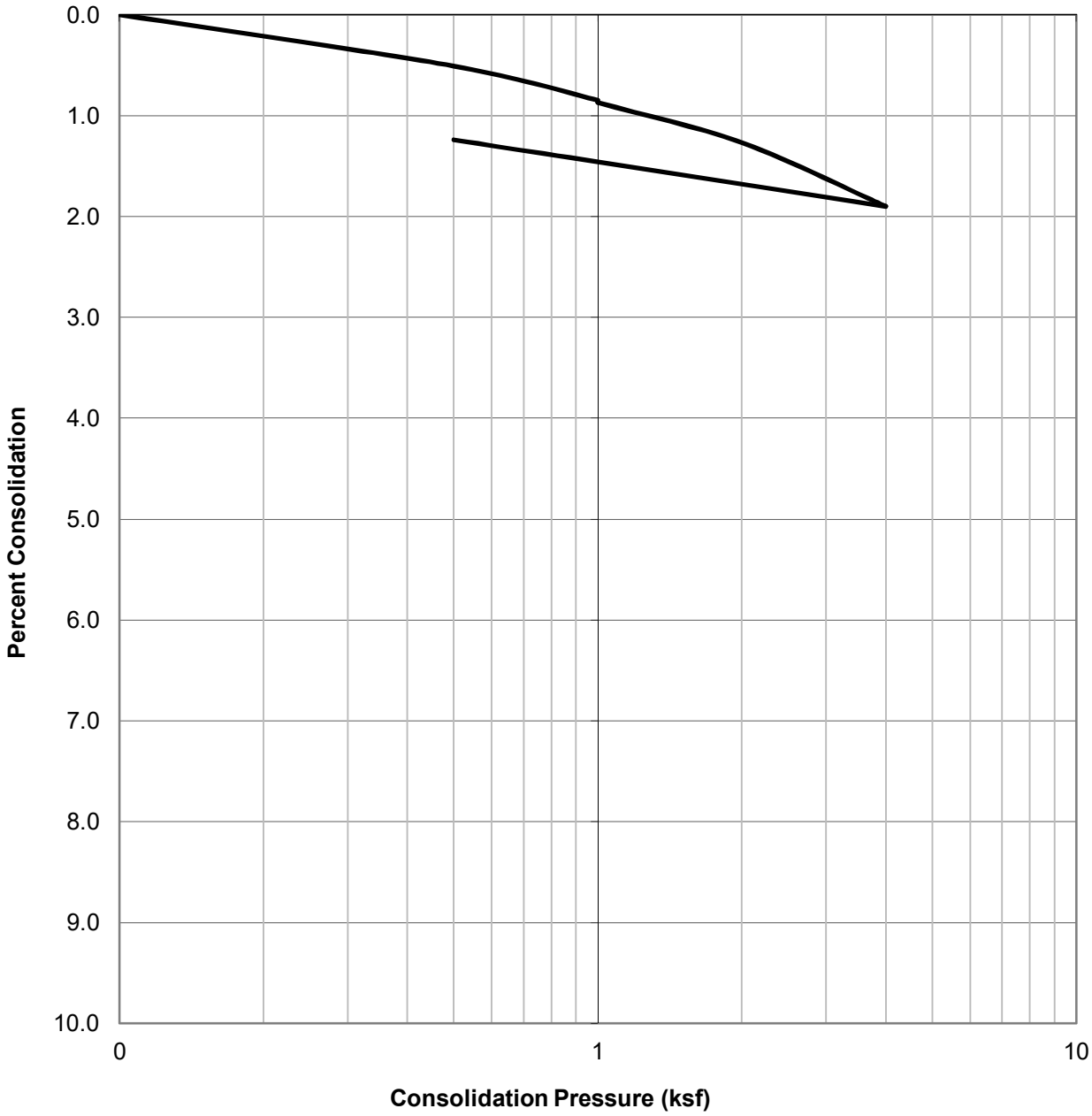
Aug 19 Figure B5

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B3@12	Brown Clayey Sand (SC)	112.1	17.6	18.3

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CONSOLIDATION TEST RESULTS

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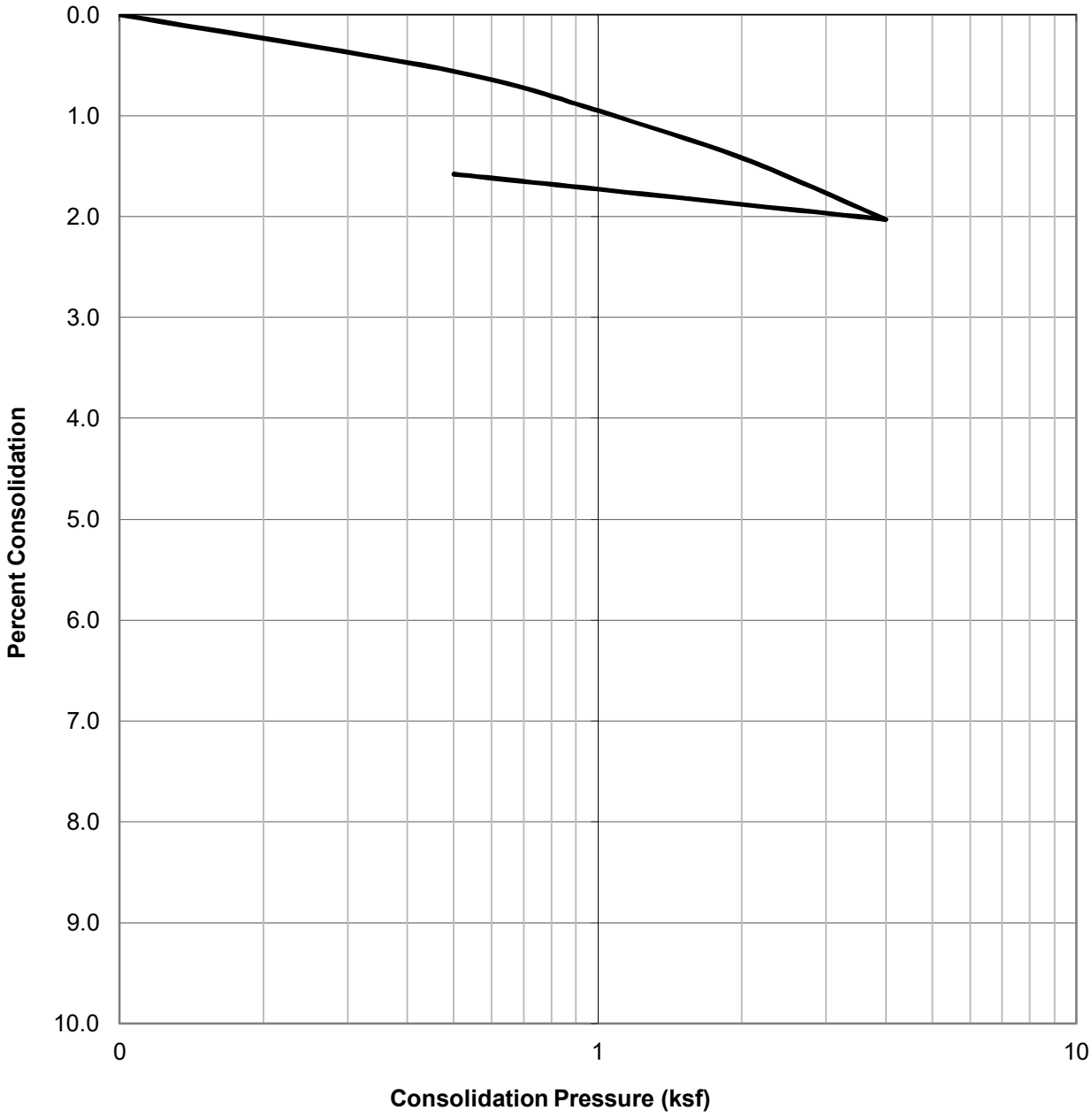
Aug 19 Figure B6

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B3@15	Brown Clayey Sand (SC)	108.4	19.1	19.3

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CONSOLIDATION TEST RESULTS

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Aug 19 Figure B7

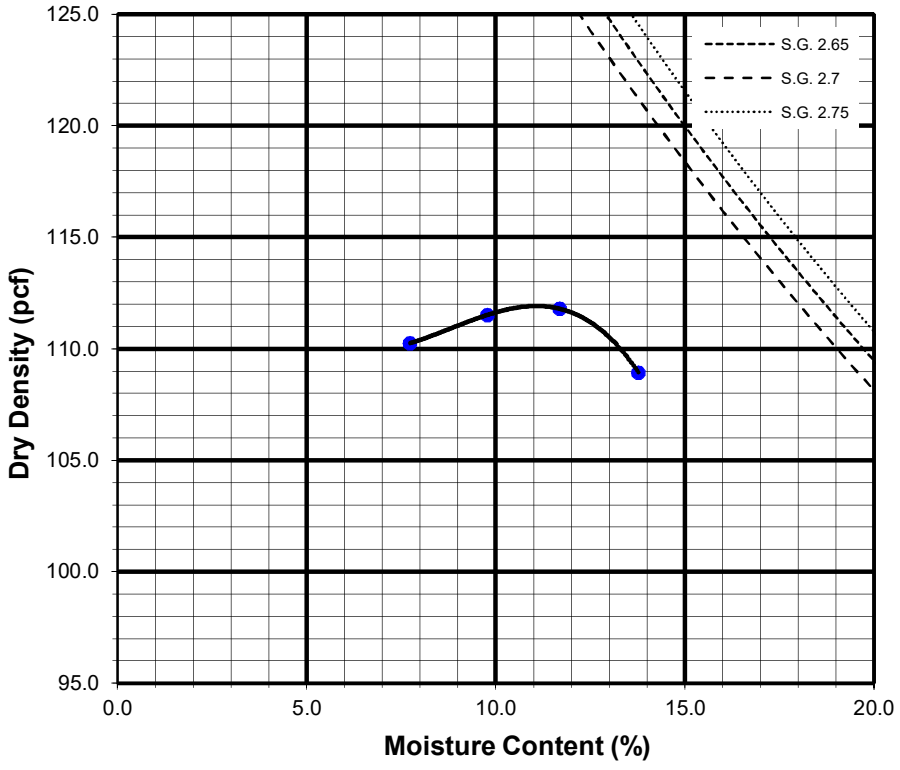
Sample No:

B1&B2 @ 0-3	Brown Silty Sand (SM)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6046	5968	6023	6060		
Weight of Mold	(g)	4174	4174	4174	4174		
Net Weight of Soil	(g)	1872	1794	1849	1886		
Wet Weight of Soil + Cont.	(g)	537.5	598.6	572.9	575.2		
Dry Weight of Soil + Cont.	(g)	490.3	566.2	533.0	530.2		
Weight of Container	(g)	147.6	147.1	124.7	145.2		
Moisture Content	(%)	13.8	7.7	9.8	11.7		
Wet Density	(pcf)	123.9	118.8	122.4	124.9		
Dry Density	(pcf)	108.9	110.2	111.5	111.8		

Maximum Dry Density (pcf)	**112.0**

Optimum Moisture Content (%)	**11.0**



Preparation Method: A

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MODIFIED COMPACTION TEST OF SOILS

ASTM D-1557

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Aug 19 Figure B8

SUMMARY OF LABORATORY POTENTIAL
OF HYDROGEN (pH) AND RESISTIVITY TEST RESULTS
CALIFORNIA TEST NO. 643

Sample No.	pH	Resistivity (ohm centimeters)
B1 @ 0-5	7.7	2400 (Moderately Corrosive)

SUMMARY OF LABORATORY CHLORIDE CONTENT TEST RESULTS
EPA NO. 325.3

Sample No.	Chloride Ion Content (%)
B1 @ 0-5	0.018

SUMMARY OF LABORATORY WATER SOLUBLE SULFATE TEST RESULTS
CALIFORNIA TEST NO. 417

Sample No.	Water Soluble Sulfate (% SO_4)	Sulfate Exposure*
B1 @ 0-5	0.028	S0

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CORROSIVITY TEST RESULTS

Checked by: JJK

Project No.: W1020-06-01

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Aug 19 Figure B9

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Appendix C: Proposed Alternative Conceptual Design Drawings

Hazen

1" = 100'

100 50 0 100'

CITY OF LOMITA
DOWNTOWN LOMITA MULTI-BENEFIT STORMWATER PROJECT

ALTERNATIVE INFILTRATION GALLERY LOCATIONS

File = O:\20007-000\20007-011\CAD_BIM\FIGURES\Alt Infiltration Gallery Saved by CJansen Save date = 10/29/2024 3:29 PM