MOJAVE RIVER WATERSHED

Water Quality Management Plan

For:

McDonalds and Starbucks

APN: 0413-101-08-0-000, 0413-101-10-0-000, 0413-101-11-0-000, 0413-101-12-0-000, 0413-101-13-0-000, 0413-101-14-0-000

Prepared for:

Fountainhead Palace, LP

1401 Quail Street, Suite 100

Newport Beach, CA 92660

949-752-2515

Prepared by:

C3 Civil Engineering, LLC

10870 W Fairview Ave, Ste 102-1187

Boise, ID 83713

208-918-0998

Submittal Date: 12/06/2024

Revision No. and Date: Insert No and Current Revision Date

Revision No. and Date: Insert No and Current Revision Date

Revision No. and Date: Insert No and Current Revision Date

Revision No. and Date: Insert No and Current Revision Date

Revision No. and Date: Insert No and Current Revision Date

Final Approval Date:_____

Project Owner's Certification

This Mojave River Watershed Water Quality Management Plan (WQMP) has been prepared for Fountainhead Palace, LP by C3 Civil Engineering, LLC. The WQMP is intended to comply with the requirements of the San Bernardino County and the Phase II Small MS4 General Permit for the Mojave River Watershed. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the Phase II Small MS4 Permit and the intent of San Bernardino County (unincorporated areas of Phelan, Oak Hills, Spring Valley Lake and Victorville) and the incorporated cities of Hesperia and Victorville and the Town of Apple Valley. Once the undersigned transfers its interest in the property, its successors in interest and the city/county/town shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	Block 275, Map No. 1, per map recorded in Book 12	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0413-101-08-0-000, 0413-101-10-0-000, 0413-101-11-0-000, 0413-101-12-0-000, 0413-101-13-0-000, 0413-101-14-0-000

Owner's Signature			
Owner Name: Fountainhead Palace, LP			
Title			
Company			
Address	1401 Quail Street, Suite 100, Newport Beach, CA 92660		
Email	vokuma@fountainheaddev.com		
Telephone #	949-752-2515		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	Block 275, Map No. 1, per map recorded in Book 12	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0413-101-08-0-000, 0413-101-10-0-000, 0413-101-11-0-000, 0413-101-12-0-000, 0413-101-13-0-000, 0413-101-14-0-000

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of the California State Water Resources Control Board Order No. 2013-0001-DWQ.

Engineer: Thomas Hawksworth		PE Stamp Below
Title	Principal	
Company	C3 Civil Engineering	
Address	10870 W Fairview Ave, Ste 102-1187, Boise, ID 83713	
Email	thomas@c3civileng.com	
Telephone #	208-918-0998	
Signature		
Date	12/06/2024	

Table of Contents

Forms

Section I – Introduction

This WQMP template has been prepared specifically for the Phase II Small MS4 General Permit in the Mojave River Watershed. This location is within the jurisdiction of the Lahontan Regional Water Quality Control Board (LRWQCB). This document should not be confused with the WQMP template for the Santa Ana Phase I area of San Bernardino County.

WQMP preparers must refer to the MS4 Permit for the Mojave Watershed WQMP template and Technical Guidance (TGD) document found at: http://cms.sbcounty.gov/dpw/Land/NPDES.aspx to find pertinent arid region and Mojave River Watershed specific references and requirements.

Section 1 Discretionary Permit(s)

Form 1-1 Project Information

Project Name	Fountainhead - Hesperia				
Project Owner Contact Name:	Vasanthi Okuma				
Mailing Address:	1401 Quail Street, Suite 100 Newport Beach, CA 92660	E-mail Address:	vokuma@fountainheaddev.com	Telephone:	949-752-2515
Permit/Application Number(s):	TBD		Tract/Parcel Map Number(s):	1,1A,2,2A,3A,4,4A,5,5A	
Additional Information/ Comments:					
Description of Project:	Proposed improvements begin with demolition of current buildings and paving. The project improvements will include two drive-thru establishments, one coffee and one fast food. A drive aisle will traverse between Main Street and Walnut Street between the two drive-thru establishments and will provide adequate points of access for both. New paving and landscaping will accompany the project to fit zone requirements.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	This report is a conceptual WQMP so no conditions are available at the time of this report.				

Section 2 Project Description

2.1 Project Information

The WQMP shall provide the information listed below. The information provided for Conceptual/ Preliminary WQMP should give sufficient detail to identify the major proposed site design and LID BMPs and other anticipated water quality features that impact site planning. Final Project WQMP must specifically identify all BMP incorporated into the final site design and provide other detailed information as described herein.

The purpose of this information is to help determine the applicable development category, pollutants of concern, watershed description, and long term maintenance responsibilities for the project, and any applicable water quality credits. This information will be used in conjunction with the information in Section 3, Site Description, to establish the performance criteria and to select the LID BMP or other BMP for the project or other alternative programs that the project will participate in, which are described in Section 4.

2.1.1 Project Sizing Categorization

If the Project is greater than 5,000 square feet, and not on the excluded list as found on Section 1.4 of the TGD, the Project is a Regulated Development Project.

If the Project is creating and/or replacing greater than 2,500 square feet but less than 5,000 square feet of impervious surface area, then it is considered a Site Design Only project. This criterion is applicable to all development types including detached single family homes that create and/or replace greater than 2,500 square feet of impervious area and are not part of a larger plan of development.

Form 2.1-1 Description of Proposed Project

1 Regulated Development Project Category (Select all that apply):

☐ #1 New development involving the creation of 5,000 ft² or more of impervious surface collectively over entire site	☒ #2 Significant re-development involving the addition or replacement of 5,000 ft² or more of impervious surface on an already developed site	☐ #3 Road Project – any road, sidewalk, or bicycle lane project that creates greater than 5,000 square feet of contiguous impervious surface	☐ #4 LUPs – linear underground/overhead projects that has a discrete location with 5,000 sq. ft. or more new constructed impervious surface

☐ Site Design Only (Project Total Square Feet > 2,500 but < 5,000 sq.ft.) *Will require source control Site Design Measures. Use the "PCMP" Template. Do not use this WQMP Template.*

2 Project Area (ft2):	69,034	**3** Number of Dwelling Units:	N/A	**4** SIC Code:	5812-Eating Places

5 Is Project going to be phased? Yes ☐ No ☒ *If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.*

2.2 Property Ownership/Management

Describe the ownership/management of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.) after project completion. State if a homeowners or property owners association will be formed and be responsible for the long-term maintenance of project stormwater facilities. Describe any lot-level stormwater features that will be the responsibility of individual property owners.

Form 2.2-1 Property Ownership/Management

Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:

The Owner is responsible for ensuring that BMPs are maintained by the tenant.

Current Owner: Fountainhead Palace, LP

Attn: Vasanthi Okuma

1401 Quail Run Street, SUite 100, Newport Beach, Ca 92660

V okuma@fountainheaddev.com

(949) 752-2515

2.3 Potential Stormwater Pollutants

Best Management Practices (BMP) measures for pollutant generating activities and sources shall be designed consistent with recommendations from the CASQA Stormwater BMP Handbook for New Development and Redevelopment (or an equivalent manual). Pollutant generating activities must be considered when determining the overall pollutants of concern for the Project as presented in Form 2.3-1.

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-2 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern

Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	
Nutrients - Phosphorous	E ☒	N ☐	
Nutrients - Nitrogen	E ☒	N ☐	
Noxious Aquatic Plants	E ☒	N ☐	
Sediment	E ☒	N ☐	
Metals	E ☒	N ☐	
Oil and Grease	E ☒	N ☐	
Trash/Debris	E ☒	N ☐	
Pesticides / Herbicides	E ☒	N ☐	
Organic Compounds	E ☒	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

Section 3 Site and Watershed Description

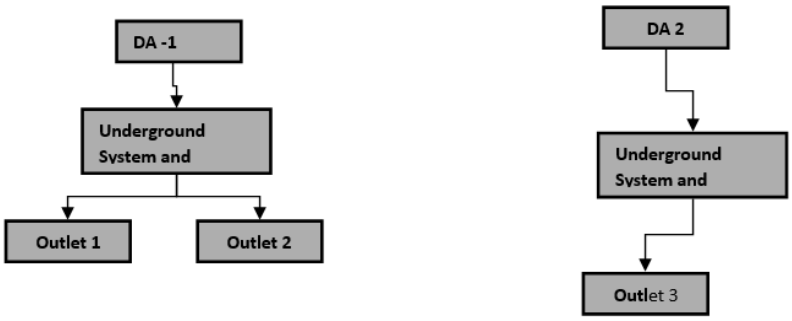
Describe the project site conditions that will facilitate the selection of BMPs through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed Drainage Management Areas (DMAs)) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. The form below is provided as an example. Then complete Forms 3.2 and 3.3 for each DA on the project site. ***If the project has more than one drainage area for stormwater management, then complete additional versions of these forms for each DA / outlet. A map presenting the DMAs must be included as an appendix to the WQMP document.***

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34.423163	Longitude -117.316317	Thomas Bros Map page

1 San Bernardino County climatic region: ☒ Desert

2 Does the site have more than one drainage area (DA): Yes☒ No☐ *If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached*



Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DA1 to Outlet 1	Unfiltered flow from underground system and dry-well will discharge out of storm drain and daylight out of an existing catch basin on Main Street.
DA1 to Outlet 2	Unfiltered flow from underground system and dry-well will discharge out of storm drain and daylight out of an existing catch basin on Main Street.
DA2 to Outlet 3	Unfiltered flow from underground system and dry-well will discharge out of storm drain and daylight out of an existing catch basin on Seventh Avenue.

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
1 DMA drainage area (ft^2)	7229.64	24795	39340	
2 Existing site impervious area (ft^2)	2049	24725	20847	
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	II	II	II	
4 Hydrologic soil group *Refer to County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf*	B	B	B	
5 Longest flowpath length (ft)	152	137	305	
6 Longest flowpath slope (ft/ft)	0.02	0.013	0.017	
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Commercial landscaping	Commercial landscaping	Vacant/Barren	
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50%* ***Attach photos of site to support rating***	Poor	Poor	Poor	

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1 (use only as needed for additional DMA w/in DA 1)				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA E	DMA F	DMA G	DMA H
1 DMA drainage area (ft^2)				
2 Existing site impervious area (ft^2)				
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*				
4 Hydrologic soil group *County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf*				
5 Longest flowpath length (ft)				
6 Longest flowpath slope (ft/ft)				
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*				
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*				

Form 3-3 Watershed Description for Drainage Area

Receiving waters Refer to SWRCB site: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	Mojave River (Mojave Forks Reservoir outlet to Upper Narrows)
Applicable TMDLs *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	None.
303(d) listed impairments *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	Fluoride (76107), Sodium (102499), Sulfates (71643)
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	None.
Hydromodification Assessment	☐ Yes *Complete Hydromodification Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-9 in submittal* ☒ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMPs and Site Design BMP Measures

The information and data in this section are required for both Regulated Development and Site Design Only Projects. Source Control BMPs and Site Design BMP Measures are the basis of site-specific pollution management.

4.1.1 Source Control BMPs

Non-structural and structural source control BMP are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs used in the WQMP or to explain why a certain BMP is not applicable. Table 7-3 of the TGD for WQMP provides a list of applicable source control BMP for projects with specific types of potential pollutant sources or activities. The source control BMP in this table must be implemented for projects with these specific types of potential pollutant sources or activities.

The preparers of this WQMP have reviewed the source control BMP requirements for new development and significant redevelopment projects. The preparers have also reviewed the specific BMP required for project as specified in Forms 4.1-1 and 4.1-2. All applicable non-structural and structural source control BMP shall be implemented in the project.

The identified list of source control BMPs correspond to the CASQA Stormwater BMP Handbook for New Development and Redevelopment.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	Property owner(s) are to familiarize themselves with the BMP's included in this document, and are to notify tenants of their responsibilities and requirements of this document.
N2	Activity Restrictions	☒	☐	Restrictions include: outdoor food preparation, vehicle maintenance, washing, and pesticide application by any other person than an applicator certified by the California Department of Pesticide Regulation.
N3	Landscape Management BMPs	☒	☐	A landscape maintenance company will be retained by the property owner(s) to service all site landscaping and irrigation. Site trees and shrubs are to be trimmed as necessary and all wastes disposed of offsite. Mulch that has been disturbed is to be replaced. Ongoing maintenance shall be consistent with local guidelines, and fertilizer and pesticide usage shall be consistent with the instructions contained on product labels and with the regulations administered by the State Department of Pesticide Regulation. Any breaks or leaks in piping must be repaired within 5 business days of report to the landscaper. Scrap pipe and extra materials shall be recycled if possible. All non-recycleable wastes shall be landfilled. The property owner(s) are responsible for the maintenance of the underground basins.
N4	BMP Maintenance	☒	☐	The isolator row of the underground basin shall be inspected at the beginning of the wet and dry seasons or more frequently as needed and shall be cleaned out when the average depth of sediment exceeds 3" throughout the length of the isolator row using the Jetvac process per manufacturer's recommendations.The drywells shall be inspected at the beginning of the wet and dry seasons or more frequently as needed and shall be cleaned out yearly. If inspection indicates the need for maintenance access is necessary, OSHA rules for contained space entries shall be followed.
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	No hazardous materials onsite.

Form 4.1-1 Non-Structural Source Control BMPs				
N6	Local Water Quality Ordinances	☒	☐	The property owner(s) and tenants are responsible to comply with all City of Hesperia Water Quality Ordinances.
N7	Spill Contingency Plan	☐	☒	No hazardous materials onsite.
N8	Underground Storage Tank Compliance	☐	☒	No underground storage tanks as part of this project.
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous materials onsite.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	☐	☒	No hazardous materials onsite.
N11	Litter/Debris Control Program	☒	☐	A landscape maintenance company will be retained by the property owner(s) to provide litter control services, and will ensure that the site is trash free, including the inside of the trash enclosure. This will occur on a monthly basis or more frequently as directed by volume of trash. They are to report to the owner(s) if lids to the trash bins are broken.
N12	Employee Training	☒	☐	The tenants are to schedule an annual seminar and refresher course to review Source Control BMPs based on this document which can be conducted by a designated representative.
N13	Housekeeping of Loading Docks	☐	☒	No loading docks are included in the project.
N14	Catch Basin Inspection Program	☒	☐	The property owner(s) will ensure that the drop inlets are inspected after the first storm event of the rainy season and two times per month thereafter until the end of the rainy season. They are to be cleaned out as necessary or when filled to 25% capacity
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	The property owner(s) will contract with a sweeping company to to complete this BMP. Sweeping will occur annually, prior to the rainy season.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	This is not a Public Agency Project.
N17	Comply with all other applicable NPDES permits	☒	☐	The property owner(s) shall comply with all other applicable NPDES permits.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	The pavement adjacent to the drop inlets will be painted with a "No Dumping, Drains to River" sign or equivalent.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No outdoor material storage areas are included as part of the project.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	The trash enclosures are per City standards.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	☒	☐	Project plan designs maximize natural water storage and infiltration opportunities, and protect slopes and channels. Plants have been grouped with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Landscaping correlates to the climate, soil, related natural resources and existing vegetation of the site, as well as the type of development proposed. Irrigation methods have been utilized to minimize runoff of excess irrigation water across impervious surfaces and into the underground basin. Mulch has been used to minimize sediment run-off and maintain soil infiltration capacity. A programmable controller will be used that includes a weather sensor and flow sensor to eliminate irrigation during and immediately after rain events and in the event of a broken line. Scrap pipe and extra materials shall be recycled if possible. All non-recyclable wastes shall be landfilled. Hazardous wastes shall be disposed of per County hazardous material disposal regulations.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	The finished grade of landscape areas will be 1-2" below adjacent grades.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☐	☒	No significant slopes or channels are proposed. All areas that are not paved will be planted and irrigated.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	No loading docks are included in the project.

S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	No maintenance bays are included in the project.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No wash areas are proposed.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	No outdoor processing areas are included in the project.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No equipment wash areas are included in the project.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	No fueling areas are included in the project.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	No hillsides are proposed as part of the project.
S14	Wash water control for food preparation areas	☒	☐	There will be a contained area or sink with sanitary sewer connection for disposal of wash waters containing kitchen and food waste. No food preparation will take place outdoors. Adequate signs shall be provided and appropriately placed stating the prohibition of discharging wash water to the storm drain system.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	No community car wash racks are included in the project.

4.1.2 Site Design BMPs

As part of the planning phase of a project, the site design practices associated with new LID requirements in the Phase II Small MS4 Permit must be considered. Site design BMP measures can result in smaller Design Capture Volume (DCV) to be managed by both LID and hydromodification control BMPs by reducing runoff generation.

As is stated in the Permit, it is necessary to evaluate site conditions such as soil type(s), existing vegetation and flow paths will influence the overall site design.

Describe site design and drainage plan including:

- A narrative of site design practices utilized or rationale for not using practices
- A narrative of how site plan incorporates preventive site design practices
- Include an attached Site Plan layout which shows how preventative site design practices are included in WQMP

Refer to Section 5.2 of the TGD for WQMP for more details.

Form 4.1-3 Site Design Practices Checklist

Site Design Practices *If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets*
Minimize impervious areas: Yes ☒ No ☐ Explanation: Only 25% of the site is pervious as the site was designed to minimize impervious area by planning for hardscape for only areas required by city code.
Maximize natural infiltration capacity; Including improvement and maintenance of soil: Yes ☒ No ☐ Explanation: The drywells will promote infiltration of runoff.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: Though time of concentration has been shortened due to the development, existing drainage patterns have been preserved to the maximum extent possible.
Disconnect impervious areas. Including rerouting of rooftop drainage pipes to drain stormwater to storage or infiltration BMPs instead of to storm drain : Yes ☐ No ☒ Explanation: All runoff is directed will sheetflow via curb and gutter, captured by proposed grated inlets.
Use of Porous Pavement.: Yes ☐ No ☒ Explanation: The project site will not be utilizing porous pavement.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: The entire project area will be disturbed and graded to accommodate the development. Protecting vegetation is not feasible.
Re-vegetate disturbed areas. Including planting and preservation of drought tolerant vegetation. : Yes ☒ No ☐ Explanation: Pervious areas will be landcaped.

Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: The underground basins and drywells are proposed under proposed pavement. The contractor shall avoid unecessary compaction of the basin bottom during construction.
Utilize naturalized/rock-lined drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Due to the nature of the site, all runoff is directed to the underground basin as sheet flow via curb and gutter, captured by proposed grated inlets. From the grated inlet, it is then piped via storm drain into the underground basin.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐ Explanation: Unnecessary compaction will be minimized in landscaped areas around the perimeter of the project.
Use of Rain Barrels and Cisterns, Including the use of on-site water collection systems.: Yes ☐ No ☒ Explanation: This project site wil not have on-site water collection systems, such as rain barrels.
Stream Setbacks. Includes a specified distance from an adjacent steam: : Yes ☐ No ☒ Explanation: There are no stream setbacks on this site.

It is noted that, in the Phase II Small MS4 Permit, site design elements for green roofs and vegetative swales are required. Due to the local climatology in the Mojave River Watershed, proactive measures are taken to maximize the amount of drought tolerant vegetation. It is not practical in this region to have green roofs or vegetative swales. As part of site design the project proponent should utilize locally recommended vegetation types for landscaping. Typical landscaping recommendations are found in following local references:

San Bernardino County Special Districts:

Guide to High Desert Landscaping -
http://www.specialdistricts.org/Modules/ShowDocument.aspx?documentid=795

Recommended High-Desert Plants -
http://www.specialdistricts.org/modules/showdocument.aspx?documentid=553

Mojave Water Agency:

Desert Ranch: http://www.mojavewater.org/files/desertranchgardenprototype.pdf

Summertree: http://www.mojavewater.org/files/Summertree-Native-Plant-Brochure.pdf

Thornless Garden: http://www.mojavewater.org/files/thornlessgardenprototype.pdf

Mediterranean Garden: http://www.mojavewater.org/files/mediterraneangardenprototype.pdf

Lush and Efficient Garden: http://www.mojavewater.org/files/lushandefficientgardenprototype.pdf

Alliance for Water Awareness and Conservation (AWAC) outdoor tips – http://hdawac.org/save-outdoors.html

4.2 Treatment BMPs

After implementation and design of both Source Control BMPs and Site Design BMP measures, any remaining runoff from impervious DMAs must be directed to one or more on-site, treatment BMPs (LID or biotreatment) designed to infiltrate, evaportranspire, and/or bioretain the amount of runoff specified in Permit Section E.12.e (ii)(c) Numeric Sizing Criteria for Storm Water Retention and Treatment.

4.2.1 Project Specific Hydrology Characterization

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in Section E.12.e.ii.c and Section E.12.f of the Phase II Small MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection from hydromodification.

If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.

It is noted that in the Phase II Small MS4 Permit jurisdictions, the LID BMP Design Capture Volume criteria is based on the 2-year rain event. The hydromodification performance criterion is based on the 10-year rain event.

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), San Bernardino County requires use of the P_6 method (Form 4.2-1) For pre- and post-development hydrologic calculation, San Bernardino County requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi^2), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for hydromodification performance criteria.

Refer to Section 4 in the TGD for WQMP for detailed guidance and instructions.

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)

1 Project area DA 2 (ft^2):	2 Imperviousness after applying preventative site design practices (Imp%):	3 Runoff Coefficient (Rc):
36,055	79.0%	0.59 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$*

4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.41 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

5 Compute P_6, Mean 6-hr Precipitation (inches): 0.516

*P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*

6 Drawdown Rate

Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.

24-hrs ☐
48-hrs ■

7 Compute design capture volume, DCV (ft^3): 1,788

*DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)*
Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 2)

1 Project area DA 2 (ft^2):	2 Imperviousness after applying preventative site design practices (Imp%):	3 Runoff Coefficient (Rc):
32,978	64.4	0.44 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$*

4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.41 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

5 Compute P_6, Mean 6-hr Precipitation (inches): 0.516

*P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*

6 Drawdown Rate

Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.

24-hrs ☐
48-hrs ■

7 Compute design capture volume, DCV (ft^3): 1,236

*DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)*
Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2

Form 4.2-3 Hydromodification Assessment for Runoff Volume (DA 1)

Weighted Curve Number Determination for: Pre-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4a Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								
Weighted Curve Number Determination for: Post-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								

5 Pre-Developed area-weighted CN:	**7** Pre-developed soil storage capacity, S (in): *S = (1000 / Item 5) - 10*	**9** Initial abstraction, I_a (in): *I_a = 0.2 * Item 7*
6 Post-Developed area-weighted CN:	**8** Post-developed soil storage capacity, S (in): *S = (1000 / Item 6) - 10*	**10** Initial abstraction, I_a (in): *I_a = 0.2 * Item 8*

11 Precipitation for 10 yr, 24 hr storm (in):
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

13 Post-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)*

14 Volume Reduction needed to meet hydromodification requirement, (ft^3):
*Vhydro = (Item 13 * 0.95) – Item 12*

Form 4.2-4 Hydromodification Assessment for Time of Concentration (DA 1)

Compute time of concentration for pre and post developed conditions for each DA *(For projects using the Hydrology Manual complete the form below)*

Variables	Pre-developed DA1 *Use additional forms if there are more than 4 DMA*				Post-developed DA1 *Use additional forms if there are more than 4 DMA*			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) *Use Form 3-2 Item 5 for pre-developed condition*								
2 Change in elevation (ft)								
3 Slope (ft/ft), S_o *= Item 2 / Item 1*								
4 Land cover								
5 Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP*								
6 Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet*								
7 Cross-sectional area of channel (ft^2)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) V_{fps} *= (1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5*								
11 Travel time to outlet (min) T_t *= Item 6 / (Item 10 * 60)*								
12 Total time of concentration (min) T_c *= Item 5 + Item 11*								
13 Pre-developed time of concentration (min): *Minimum of Item 12 pre-developed DMA*								
14 Post-developed time of concentration (min): *Minimum of Item 12 post-developed DMA*								
15 Additional time of concentration needed to meet hydromodification requirement (min): $T_{C\text{-}Hydro}$ *= (Item 13 * 0.95) – Item 14*								

Form 4.2-5 Hydromodification Assessment for Peak Runoff (DA 1)

Compute peak runoff for pre- and post-developed conditions

Variables		Pre-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*			Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*		
		DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration *I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.7 LOG Form 4.2-4 Item 5 /60)*							
2 Drainage Area of each DMA (Acres) *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
3 Ratio of pervious area to total area *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*							
5 Maximum loss rate (in/hr) *F_m = Item 3 * Item 4* *Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*							
7 Time of concentration adjustment factor for other DMA to site discharge point *Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)*	DMA A	*n/a*			*n/a*		
	DMA B		*n/a*			*n/a*	
	DMA C			*n/a*			*n/a*

8 Pre-developed Q_p at T_c for DMA A: *Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*	**9** Pre-developed Q_p at T_c for DMA B: *Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*	**10** Pre-developed Q_p at T_c for DMA C: *Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*
10 Peak runoff from pre-developed condition confluence analysis (cfs):		*Maximum of Item 8, 9, and 10 (including additional forms as needed)*
11 Post-developed Q_p at T_c for DMA A: *Same as Item 8 for post-developed values*	**12** Post-developed Q_p at T_c for DMA B: *Same as Item 9 for post-developed values*	**13** Post-developed Q_p at T_c for DMA C: *Same as Item 10 for post-developed values*
14 Peak runoff from post-developed condition confluence analysis (cfs):		*Maximum of Item 11, 12, and 13 (including additional forms as needed)*
15 Peak runoff reduction needed to meet Hydromodification Requirement (cfs):		*$Q_{p\text{-}hydro}$ = (Item 14 * 0.95) – Item 10*

4.3 BMP Selection and Sizing

Complete the following forms for each project site DA to document that the proposed treatment (LID/Bioretention) BMPs conform to the project DCV developed to meet performance criteria specified in the Phase II Small MS4 Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the Phase II Small MS4 Permit (see Section 5.3 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design Measures (Form 4.3-2)
- Retention and Infiltration BMPs (Form 4.3-3) or
- Biotreatment BMPs (Form 4.3-4).

> Please note that the selected BMPs may also be used as dual purpose for on-site, hydromodification mitigation and management.

At the end of each form, additional fields facilitate the determination of the extent of mitigation provided by the specific BMP category, allowing for use of the next category of BMP in the hierarchy, if necessary.

The first step in the analysis, using Section 5.3.2 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is "Yes," provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Form 4.3-2 to determine the feasibility of applicable Site Design BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

If no site constraints exist that would limit the type of BMP to be implemented in a DA, evaluate the use of combinations of LID BMPs, including all applicable Site Design BMPs to maximize on-site retention of the DCV. If no combination of BMP can mitigate the entire DCV, implement the single BMP type, or combination of BMP types, that maximizes on-site retention of the DCV within the minimum effective area.

If the combination of site design, retention and/or infiltration BMPs is unable to mitigate the entire DCV, then the remainder of the volume-based performance criteria that cannot be achieved with site design, retention and/or infiltration BMPs must be managed through biotreatment BMPs. If biotreatment BMPs are used, then they must be sized to provide equivalent effectiveness based on Template Section 4.3.4.

4.3.1 Exceptions to Requirements for Bioretention Facilities

Contingent on a demonstration that use of bioretention or a facility of equivalent effectiveness is infeasible, other types of biotreatment or media filters (such as tree-box-type biofilters or in-vault media filters) may be used for the following categories of Regulated Projects:

1) Projects creating or replacing an acre or less of impervious area, and located in a designated pedestrian-oriented commercial district (i.e., smart growth projects), and having at least 85% of the entire project site covered by permanent structures;

2) Facilities receiving runoff solely from existing (pre-project) impervious areas; and

3) Historic sites, structures or landscapes that cannot alter their original configuration in order to maintain their historic integrity.

Form 4.3-1 Infiltration BMP Feasibility (DA 1 & DA 2)
Feasibility Criterion – Complete evaluation for each DA on the Project Site
[1] Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒ *Refer to Section 5.3.2.1 of the TGD for WQMP*
If Yes, Provide basis: (attach)
[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒ (Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert): • The location is less than 50 feet away from slopes steeper than 15 percent • The location is less than ten feet from building foundations or an alternative setback. • A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.
If Yes, Provide basis: (attach)
[3] Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[4] Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[5] Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒ *See Section 3.5 of the TGD for WQMP and WAP*
If Yes, Provide basis: (attach)
[7] Any answer from Item 1 through Item 3 is "Yes": Yes ☐ No ☒ *If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Selection and Evaluation of Biotreatment BMP.* *If no, then proceed to Item 8 below.* [8] Any answer from Item 4 through Item 6 is "Yes": Yes ☐ No ☒ *If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Site Design BMP.* *If no, then proceed to Item 9, below.* [9] All answers to Item 1 through Item 6 are "No": *Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP.* *Proceed to Form 4.3-2, Site Design BMPs.*

4.3.2 Site Design BMP

Section E.12.e. of the Small Phase II MS4 Permit emphasizes the use of LID preventative measures; and the use of Site Design Measures reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable Site Design Measures shall be provided except where they are mutually exclusive

with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of Site Design BMPs. If a project cannot feasibly meet BMP sizing requirements or cannot fully address hydromodification, feasibility of all applicable Site Design BMPs must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design BMP. Refer to Section 5.4 in the TGD for more detailed guidance.

Form 4.3-2 Site Design BMPs (DA 1 & DA 2)

1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☒ *If yes, complete Items 2-5; If no, proceed to Item 6*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Total impervious area draining to pervious area (ft^2)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft^3) *V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff*			
5 Sum of retention volume achieved from impervious area dispersion (ft^3): *$V_{retention}$ =Sum of Item 4 for all BMPs*			
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☒ *If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14*	DA DMA A BMP Type Drywell	DA DMA B BMP Type Drywell	DA DMA BMP Type *(Use additional forms for more BMPs)*
7 Ponding surface area (ft^2)			
8 Ponding depth (ft) (min. 0.5 ft.)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (ft) (min. 1 ft.)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft^3) *$V_{retention}$ = (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*			
13 Runoff volume retention from on-lot infiltration (ft^3): *$V_{retention}$ =Sum of Item 12 for all BMPs*			

Form 4.3-2 Site Design BMPs (DA 1 & DA 2)

Form 4.3-2 cont. Site Design BMPs (DA 1 & DA 2)

14 Implementation of Street Trees: Yes ☐ No ☒ *If yes, complete Items 14-18. If no, proceed to Item 19*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
15 Number of Street Trees			
16 Average canopy cover over impervious area (ft^2)			
17 Runoff volume retention from street trees (ft^3) $V_{retention}$ *= Item 15 * Item 16 * (0.05/12) assume runoff retention of 0.05 inches*			
18 Runoff volume retention from street tree BMPs (ft^3):	$V_{retention}$ *= Sum of Item 17 for all BMPs*		
19 Total Retention Volume from Site Design BMPs:	*Sum of Items 5, 13 and 18*		

4.3.3 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix C of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).

4.3.3.1 Allowed Variations for Special Site Conditions

The bioretention system design parameters of this Section may be adjusted for the following special site conditions:

1) Facilities located within 10 feet of structures or other potential geotechnical hazards established by the geotechnical expert for the project may incorporate an impervious cutoff wall between the bioretention facility and the structure or other geotechnical hazard.

2) Facilities with documented high concentrations of pollutants in underlying soil or groundwater, facilities located where infiltration could contribute to a geotechnical hazard, and facilities located on elevated plazas or other structures may incorporate an impervious liner and may locate the underdrain discharge at the bottom of the subsurface drainage/storage layer (this configuration is commonly known as a “flow-through planter”).

3) Facilities located in areas of high groundwater, highly infiltrative soils or where connection of underdrain to a surface drain or to a subsurface storm drain are infeasible, may omit the underdrain.

4) Facilities serving high-risk areas such as fueling stations, truck stops, auto repairs, and heavy industrial sites may be required to provide adequate pretreatment to address pollutants of concern unless these high-risk areas are isolated from storm water runoff or bioretention areas with no chance of spill migration.

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Form 4.3-3 Infiltration LID BMP - including underground BMPs

1 Remaining LID DCV not met by site design BMP (ft^3): 1,788 (DMA A), 1,239 (DMA B) *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item19*			
BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 DMA BMP Type	DA 2 DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods*			
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*			
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*			
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*			
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*			
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*			
8 Infiltrating surface area, *SA_{BMP}* (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*			
9 Amended soil depth, *d_{media}* (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*			
10 Amended soil porosity			
11 Gravel depth, *d_{media}* (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*			
12 Gravel porosity			
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*			
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*			
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	1,657	1,154	
16 Total Retention Volume from LID Infiltration BMPs: 1,819cf (DA 1), 1,278cf (DA 2) *(Sum of Items 14 and 15 for all infiltration BMP*			
17 Fraction of DCV achieved with infiltration BMP: 102% (DA 1); 103% (DA 2) % *Retention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.*			

4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration. A key consideration when using biotreatment BMP is the effectiveness of the proposed BMP in addressing the pollutants of concern for the project (see Table 5-5 of the TGD for WQMP).

Use Form 4.3-4 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV. Biotreatment computations are included as follows:

- Use Form 4.3-5 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-6 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-7 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-4 Selection and Evaluation of Biotreatment BMP

1 Remaining LID DCV not met by site design , or infiltration, BMP for potential biotreatment (ft^3): 0 *Form 4.2-1 Item 7 - Form 4.3-2 Item 19 – Form 4.3-3 Item 16*	List pollutants of concern *Copy from Form 2.3-1.*	
2 Biotreatment BMP Selected *(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)*	Volume-based biotreatment *Use Forms 4.3-5 and 4.3-6 to compute treated volume*	Flow-based biotreatment *Use Form 4.3-7 to compute treated flow*
	☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment
3 Volume biotreated in volume based biotreatment BMP (ft^3): *Form 4.3-5 Item 15 + Form 4.3-6 Item 13*	**4** Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft^3): *Item 1 – Item 3*	**5** Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % *Item 4 / Item 1*
6 Flow-based biotreatment BMP capacity provided (cfs): *Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)*		
7 Metrics for MEP determination: • Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: ☐ *If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.*		

Form 4.3-5 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains

Biotreatment BMP Type *(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*			
2 Amended soil infiltration rate *Typical ~ 5.0*			
3 Amended soil infiltration safety factor *Typical ~ 2.0*			
4 Amended soil design percolation rate (in/hr) P_{design} *= Item 2 / Item 3*			
5 Ponded water drawdown time (hr) *Copy Item 6 from Form 4.2-1*			
6 Maximum ponding depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Ponding Depth (ft) d_{BMP} *= Minimum of (1/12 * Item 4 * Item 5) or Item 6*			
8 Amended soil surface area (ft^2)			
9 Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Amended soil porosity, *n*			
11 Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
12 Gravel porosity, *n*			
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*			
14 Biotreated Volume (ft^3) $V_{biotreated}$ *= Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*			
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: *Sum of Item 14 for all volume-based BMPs included in this form*			

Form 4.3-6 Volume Based Biotreatment (DA 1) – Constructed Wetlands and Extended Detention

Biotreatment BMP Type *Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (E.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.*	DA DMA BMP Type		DA DMA BMP Type *(Use additional forms for more BMPs)*	
	Forebay	Basin	Forebay	Basin
1 Pollutants addressed with BMP forebay and basin *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*				
2 Bottom width (ft)				
3 Bottom length (ft)				
4 Bottom area (ft^2) A_{bottom} = *Item 2 * Item 3*				
5 Side slope (ft/ft)				
6 Depth of storage (ft)				
7 Water surface area (ft^2) $A_{surface}$ =*(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))*				
8 Storage volume (ft^3) *For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details* V =*Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]*				
9 Drawdown Time (hrs) *Copy Item 6 from Form 2.1*				
10 Outflow rate (cfs) Q_{BMP} = *(Item* $8_{forebay}$ *+ Item* 8_{basin}*) / (Item 9 * 3600)*				
11 Duration of design storm event (hrs)				
12 Biotreated Volume (ft^3) $V_{biotreated}$ = *(Item* $8_{forebay}$ *+ Item* 8_{basin}*) +(Item 10 * Item 11 * 3600)*				
13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : *(Sum of Item 12 for all BMP included in plan)*				

Form 4.3-7 Flow Based Biotreatment (DA 1)

Biotreatment BMP Type *Vegetated swale, vegetated filter strip, or other comparable proprietary BMP*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5*			
2 Flow depth for water quality treatment (ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
3 Bed slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
4 Manning's roughness coefficient			
5 Bottom width (ft) b_w *= (Form 4.3-5 Item 6 * Item 4) / (1.49 * Item 2^1.67 * Item 3^0.5)*			
6 Side Slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Cross sectional area (ft^2) *A = (Item 5 * Item 2) + (Item 6 * Item 2^2)*			
8 Water quality flow velocity (ft/sec) *V = Form 4.3-5 Item 6 / Item 7*			
9 Hydraulic residence time (min) *Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Length of flow based BMP (ft) *L = Item 8 * Item 9 * 60*			
11 Water surface area at water quality flow depth (ft^2) SA_{top} *= (Item 5 + (2 * Item 2 * Item 6)) * Item 10*			

4.3.5 Conformance Summary

Complete Form 4.3-8 to demonstrate how on-site LID DCV is met with proposed site design, infiltration, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-8 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)

1 Total LID DCV for the Project DA-1 (ft^3): 1,788 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design BMP (ft^3): 0 *Copy Item18 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): *Copy Item 16 in Form 4.3-3*

4 On-site biotreatment with volume based biotreatment BMP (ft^3): 0 *Copy Item 3 in Form 4.3-4*

5 Flow capacity provided by flow based biotreatment BMP (cfs): 0 *Copy Item 6 in Form 4.3-4*

6 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- Full retention of LID DCV with site design or infiltration BMP: Yes ☒ No ☐
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☒
  If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized
- On-site retention and infiltration is determined to be infeasible; therefore biotreatment BMP provides biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☒
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

7 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- Combination of Site Design, retention and infiltration, , and biotreatment BMPs provide less than full LID DCV capture: ☐
  Checked yes if Form 4.3-4 Item 7is checked yes, Form 4.3-4 Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} *= (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%*

- Facilities, or a combination of facilities, of a different design than in Section E.12.e.(ii)(f) may be permitted if all of the following Phase II Small MS4 General Permit 2013-0001-DWQ 55 February 5, 2013 measures of equivalent effectiveness are demonstrated:
  1) Equal or greater amount of runoff infiltrated or evapotranspired; ☐
  2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment; ☐
  3) Equal or greater protection against shock loadings and spills; ☐
  4) Equal or greater accessibility and ease of inspection and maintenance. ☐

Form 4.3-8 Conformance Summary and Alternative Compliance Volume Estimate (DA 2)

1 Total LID DCV for the Project DA 2 (ft^3): 1,239 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design hydrologic source control LID BMP (ft^3): 0 *Copy Item 30 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): *Copy Item 16 in Form 4.3-3*

4 On-site retention with LID harvest and use BMP (ft^3): *Copy Item 9 in Form 4.3-4*

5 On-site biotreatment with volume based biotreatment BMP (ft^3): *Copy Item 3 in Form 4.3-5*

6 Flow capacity provided by flow based biotreatment BMP (cfs): *Copy Item 6 in Form 4.3-5*

7 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes ☒ No ☐
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☒
  If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized
- On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☒
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

8 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: ☐
  *Checked yes for Form 4.3-5 Item 7, Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} = (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%*
- An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility: ☐
  Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed

4.3.6 Hydromodification Control BMP

Use Form 4.3-9 to compute the remaining runoff volume retention, after Site Design BMPs are implemented, needed to address hydromodification, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential hydromodification. Describe the proposed hydromodification treatment control BMP. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-9 Hydromodification Control BMPs

1 Volume reduction needed for hydromodification performance criteria (ft^3): *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	**2** On-site retention with site design and infiltration, BMP (ft^3): *Sum of Form 4.3-8 Items 2, 3, and 4. Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving hydromodification volume reduction*
3 Remaining volume for hydromodification volume capture (ft^3): *Item 1 – Item 2*	**4** Volume capture provided by incorporating additional on-site BMPs (ft^3):

5 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☐

If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site BMP ☐
- Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐

6 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☐

If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site retention BMPs ☐

4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, or biotreat the DCV via on-site LID practices. A project proponent must develop an alternative compliance plan to address the remainder of the LID DCV. Depending on project type some projects may qualify for water quality credits that can be applied to reduce the DCV that must be treated prior to development of an alternative compliance plan (see Form 2.4-1, Water Quality Credits). Form 4.3-9 Item 8 includes instructions on how to apply water quality credits when computing the DCV that must be met through alternative compliance.

Alternative Designs — Facilities, or a combination of facilities, of a different design than in Permit Section E.12.e.(ii)(f) may be permitted if all of the following measures of equivalent effectiveness are demonstrated:

1) Equal or greater amount of runoff infiltrated or evapotranspired;

2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment;

3) Equal or greater protection against shock loadings and spills;

4) Equal or greater accessibility and ease of inspection and maintenance.

The Project Proponent will need to obtain written approval for an alternative design from the Lahontan Regional Water Board Executive Officer (see Section 6 of the TGD for WQMP).

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMPs included as part of the project WQMP are required to be maintained through regular scheduled inspection and maintenance (refer to Section 8, Post Construction BMP Requirements, in the TGD for WQMP). Fully complete Form 5-1 summarizing all BMP included in the WQMP. Attach additional forms as needed. The WQMP shall also include a detailed Operation and Maintenance Plan for all BMP and a Maintenance Agreement. The Maintenance Agreement must also be attached to the WQMP.

Note that at time of Project construction completion, the Maintenance Agreement must be completed, signed, notarized and submitted to the County Stormwater Department

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Education of Property Owners, Tenants and occupants on storm-water BMPs	Property Owner(s) / Tenants	This BMP will begin at building occupancy. Practical informational materials are provided in this document in Section 6. These include BMPs that eliminate or reduce pollution during property improvements. The property owners and tenants are encouraged to implement the use of alternative building materials, drought resistant and native plant species in landscaping and pervious pavement in all additions and modifications to the property. Reference educational material can be found at http://sbcountystormwater.org/government/outreach-materials/	Ongoing
Activity Restrictions	Property Owner(s) / Tenants	Restrictions include vehicle washing and maintenance, outdoor materials storage, outdoor work or processing areas, and pesticide application by any other person than an applicator certified by the California Department of Pesticide Regulation. The Owner is to notify tenants of violation and cite if violation persists (within 1 week of violation).	Ongoing

Sweeping of Parking Lots	Property Owner(s) / Tenants	This BMP will begin within 1 year of project completion and sweeping will occur annually thereafter, prior to the rainy season. The tenant will contract with a sweeping company to complete this BMP. All wastes shall be landfilled. The parking lots shall be swept. There will be no parking lot cleaning with water.	Annually
Infiltration Basin Maintenance	Property Owner(s)	The isolator row of the underground basins shall be inspected at the beginning of the wet and dry seasons or more frequently as needed and shall be cleaned out when the average depth of sediment exceeds 3" throughout the length of the isolator row using the Jetvac process per manufacturer's recommendations. If inspection indicates the need for maintenance access is necessary, OSHA rules for contained space entries shall be followed.	At the Beginning of the Wet and Dry Seasons
Litter Control	Property Owner(s)	This BMP will will occur on a monthly basis (or more frequently if dictated by volume of trash). A landscape maintenance company will be retained to provide litter control services. They are to ensure that overall site is trash free, including catch basin trash guards and the inside of the trash enclosure. Trash in these areas is to be removed and placed inside the trash bins. They are also to report to the Owner if the trash bins or lids have become damaged so that they can be replaced.	Monthly
Landscape Management BMPs	Property Owner(s)	This BMP will begin within 30 days of building occupancy and will occur on a monthly basis (or more frequently if desired). The property owner(s) will retain a landscape maintenance company or will have staff designated to service all site landscaping. Site trees and shrubs are to be trimmed as necessary and all wastes disposed of offsite. Mulch fiber that has been disturbed is to be replaced. They are also to ensure that all areas are trash free. Trash is to be disposed of offsite. Ongoing maintenance shall be consistent with local guidelines, and fertilizer and pesticide usage shall be consistent with the instructions	Monthly

		contained on product labels and with the regulations administered by the State Department of Pesticide Regulation. Clippings and yard waste shall be composted. A landscape maintenance company will be retained to service all site irrigation. Any breaks or leaks in piping must be repaired within 2 business days of report to the landscaper.	
Employee Training	Property Owner(s) / Tenants	This BMP will begin within 30 days of building occupancy and refresher course will occur annually thereafter. The tenants shall insure that all employees are familiar with the contents of this plan and appendix.	Annually
Catch Basin Inspection Program	Property Owner(s)	This BMP will begin within 30 days of project completion. Inspections will be done by a landscape maintenance company or other staff after the first storm of the rainy season and two times per month thereafter for the duration of the rainy season. The inspector is also required to clean the facilities as needed or when filled to 25% capacity. Cleaning can be by pump or shopvac or by hand. Debris and trash shall be landfilled.	After first storm and 2x/month in rainy season

Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural Source Control BMP locations
- Site Design Hydrologic Source Control BMP locations
- LID BMP details
- Drainage delineations and flow information
- Drainage connections

6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

6.3 Post Construction

Final O&M Plan to be completed in final report.

6.4 Other Supporting Documentation

- BMP Educational Materials
- Activity Restriction – C,C&R's & Lease Agreements

Appendix A: Geotechnical Engineering Investigation Report

MOORE TWINING ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING INVESTIGATION

PROPOSED STARBUCKS

SOUTHWEST CORNER OF 7th AVENUE AND MAIN STREET

HESPERIA, CALIFORNIA

Project Number: H33201.01

For:

Fountainhead Development
1401 Quail Street, Suite 100
Newport Beach, CA 92660

November 15, 2024

www.mooretwining.com

PH: 559.268.7021
FX: 559.268.7126
2527 Fresno Street
Fresno, CA 93721

MOORE TWINING ASSOCIATES, INC.

November 15, 2024 H33201.01

Fountainhead Development
1401 Quail Street, Suite 100
Newport Beach, CA 92660

Attention: Ms. Vasanthi Okuma

Subject: **Geotechnical Engineering Investigation**
Proposed Starbucks
SWC 7th Avenue and Main Street
Hesperia, California

Dear Ms. Okuma:

We are pleased to submit this geotechnical engineering investigation report prepared for a proposed Starbucks to be located on the southwest corner of 7th Avenue and Main Street in the City of Hesperia, California.

The contents of this report include the purpose of the investigation, scope of services, background information, investigative procedures, our findings, evaluation, conclusions, and recommendations.

It is recommended that Moore Twining Associates, Inc. (Moore Twining) be retained to review those portions of the plans and specifications that pertain to earthwork, pavements, and foundations to determine if they are consistent with our recommendations. This service is not a part of this current contractual agreement; however, the client should provide these documents for our review prior to their issuance for construction bidding purposes.

In addition, it is recommended that Moore Twining be retained to provide inspection and testing services for the excavation, earthwork, pavement, and foundation phases of construction. These services are necessary to determine if the subsurface conditions are consistent with those used in the analyses and formulation of recommendations for this investigation, and if the construction complies with our recommendations. These services are not, however, part of this current contractual agreement. A representative with our firm will contact you in the near future regarding these services.

PH: 559.268.7021
FX: 559.268.7126
2527 Fresno Street
Fresno, CA 93721

We appreciate the opportunity to be of service to Fountainhead Development. If you have any questions regarding this report, or if we can be of further assistance, please contact us at your convenience.

Sincerely,

MOORE TWINING ASSOCIATES, INC.

Allen H. Harker, CEG
Engineering Geologist
Geotechnical Engineering Division

EXECUTIVE SUMMARY

Moore Twining Associates, Inc. (Moore Twining) prepared this geotechnical engineering investigation report for the proposed Starbucks to be located in Hesperia, California.

The subject site is located on the southwest corner of 7th Avenue and Main Street in Hesperia, California. The area indicated for the proposed Starbucks is a 0.596-acre property which includes an auto sales business and auto repair shop in the north half of the site and pavements from a former auto sales businesses in the south half of the site.

The proposed Starbucks development is planned to include a 1,263 square foot single story building with a drive-thru pickup drive lane. Appurtenant construction is anticipated to include concrete walkways, asphaltic concrete and Portland cement concrete parking and drive areas, underground utilities, and landscape areas.

Moore Twining conducted a previous investigation at the subject site when the Starbucks parcel and adjacent McDonald's parcel (west of the Starbucks parcel) were being considered for development of a Circle K convenience store, car wash and gas station. Near surface infiltrations systems were not deemed to be feasible from Moore Twining's previous February 13, 2019 "Results of Percolation Testing" report. However, deeper poorly graded sand layers were previously encountered at the site and were targeted to conduct deeper percolation tests for consideration of infiltration systems such as dry wells to be used as part of the proposed construction.

On October 23, 2024, five (5) test borings were drilled at the site to depths ranging from 15 to 60 feet below site grades (BSG). The subsurface soils encountered generally consisted of very loose to medium dense silty sands extending to depths of about 1½ to 3½ feet across the site. Below the very loose to loose silty sands, the relative density of the silty sands soils improved to medium dense to dense and extended to depths of about 3½ to 13½ feet BSG. Below the silty sands, medium dense silty, clayey sands; medium dense clayey sands; medium dense to dense poorly graded sands with silt; and medium dense well graded sands with silt were encountered extending to a depth of about 33½ feet BSG which was generally underlain by dense poorly graded sands and dense well graded sands with silt extending to the maximum depth explored of 60 feet BSG.

The surface soils encountered are non-plastic and non-expansive. These soils exhibit low compressibility characteristics, slight collapse potential, and moderate to high shear strength properties. The near surface soils exhibit fair support characteristics for pavements when compacted as engineered fill.

Due to the depth to historical groundwater levels in the vicinity of this site (greater than 450 feet BSG), liquefaction is not considered a concern for the proposed development. However, there is potential for dry seismic settlement to occur during shaking from earthquakes. As part of the analysis, the (N1)60s values of 30 or greater (dense to very dense soils) were not considered to be subject to significant dry seismic settlement in the analyses. Based on the analysis, seismic settlement was estimated to be negligible.

EXECUTIVE SUMMARY

Foundations supported directly on the existing loose native silty sands would be subject to excessive static settlement. In order to reduce the potential for excessive settlement of foundations, over-excavation and compaction of the upper 4 feet of the near surface soils, or to a depth of 12 inches below the bottom of the foundations, or to the depth required to remove existing undocumented fill soils, or to at least 12 inches below subsurface improvements (structures, utilities, etc.) to be removed, whichever is greater, followed by scarification and compaction of an additional 8 inches is recommended in the building pad areas to reduce the total and differential static settlement to 1 inch total and ½ inch differential. An allowable bearing capacity of 2,500 pounds per square foot is recommended for foundation design, for dead-plus-live loads.

The closest active fault is the Ord Mountain Fault zone (part of the North Front Thrust System), which is located about 6½ miles southeast of the site. The project site is not located in an Alquist-Priolo Earthquake Fault Zone. Accordingly, the potential for ground rupture at the site is considered low.

Chemical testing of soil samples indicated the soils exhibit a “corrosive” corrosion potential.

Based on Table 19.3.1.1 - Exposure categories and classes from Chapter 19 of ACI 318, the sulfate concentration from chemical testing of soil samples falls in the S0 classification (less than 0.10 percent by weight) for concrete.

This executive summary should not be used for design or construction and should be reviewed in conjunction with the attached report.

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

Page

GEOTECHNICAL ENGINEERING INVESTIGATION

PROPOSED STARBUCKS

SOUTHWEST CORNER OF 7th AVENUE AND MAIN STREET

HESPERIA, CALIFORNIA

Project Number: H33201.01

1.0 INTRODUCTION

This report presents the results of a geotechnical engineering investigation for a proposed Starbucks to be located on the southwest corner of 7th Avenue and Main Street in Hesperia, California. Moore Twining Associates, Inc. (Moore Twining) was authorized by Fountainhead Development to perform this geotechnical engineering investigation.

The contents of this report include the purpose of the investigation and the scope of services provided. The site history, previous studies, site description, and anticipated construction are discussed. In addition, a description of the investigative procedures used and the subsequent findings obtained are presented. Finally, the report provides an evaluation of the findings, general conclusions, and related recommendations. The report appendices contain the drawings (Appendix A), the logs of borings and (Appendix B), the results of laboratory tests (Appendix C), the results of percolation tests (Appendix D) and the compaction report, test data and test locations for backfill of the area of removed underground storage tanks with engineered fill (Appendix E).

The Geotechnical Engineering Division of Moore Twining, headquartered in Fresno, California, performed the investigation.

2.0 PURPOSE AND SCOPE OF INVESTIGATION

2.1 Purpose: The purpose of the investigation was to conduct a field exploration and a laboratory testing program, evaluate the data collected during the field and laboratory portions of the investigation, and provide the following:

2.1.1 Evaluation of the near surface soils within the zone of influence of the proposed foundations and pavements with regard to the anticipated foundation and vehicle traffic loads;

2.1.2 Recommendations for 2022 California Building Code seismic coefficients and earthquake spectral response acceleration values;

2.1.3 Geotechnical parameters for use in design of foundations and slabs-on-grade, (e.g., soil bearing capacity and settlement);

2.1.4 Recommendations for site preparation including placement, moisture conditioning, and compaction of engineered fill soils;

2.1.5 Recommendations for the design and construction of new asphaltic concrete (AC) and Portland cement concrete (PCC) pavements;

2.1.6 Recommendations regarding infiltration of storm water;

2.1.7 Recommendations for temporary excavations and trench backfill, and

2.1.8 Conclusions regarding soil corrosion potential.

This report is provided specifically for the Starbucks referenced in the Anticipated Construction section of this report. This investigation did not include a geologic/seismic hazards evaluation, flood plain investigation, compaction tests, environmental investigation, or environmental audit.

2.1.9 **Scope:** Our revised proposal (MTP 24-0548R), dated October 2, 2024, outlined the scope of our services. The actions undertaken during the investigation are summarized as follows.

2.1.10 The conceptual site plan SP-8, dated June 12, 2024, prepared by Greenberg Farrow, was reviewed for project information.

2.1.11 A report entitled, "Geotechnical Engineering Investigation, Proposed Circle K Store, Southwest Corner of 7th Avenue and Main Street, Hesperia, California," prepared by Moore Twining, dated January 24, 2019, Moore Twining Project No. G28812.02, was reviewed. This investigation was previously conducted by Moore Twining for a previous Circle K development on the currently planned Starbucks parcel and the adjacent McDonald's parcel on the west side of the Starbucks parcel.

A report entitled, "Supplemental Report of Percolation Testing, Proposed Circle K Store, Southwest Corner of Main Street and 7th Avenue, Hesperia, California," prepared by Moore Twining, dated February 13, 2019, Moore Twining Project Number G28812.02, was reviewed. The percolation testing conducted by Moore Twining in 2019 included shallow percolation testing in the upper 5 feet below site grade on both the currently planned Starbucks and McDonald's parcels.

In addition, a draft report entitled, "Phase I Environmental Site Assessment, Proposed Circle K, 15901 Main Street, Hesperia, California 92345, prepared by Moore Twining's Environmental Division, dated February 13, 2019, Moore Twining Project Number G28812.01, was reviewed.

2.1.12 A visual site reconnaissance and subsurface exploration were conducted.

2.1.13 Satellite images of the site between the years 1994 and 2023 from online sources, were reviewed.

2.1.14 Laboratory tests were conducted to determine selected physical and engineering properties of the subsurface soils.

2.1.15 Ms. Vasanthi Okuma (Fountainhead Development and Mr. Thomas Hawksworth (C3 Civil Engineering) were consulted during the investigation.

2.1.16 The data obtained from the investigation were evaluated to develop an understanding of the subsurface soil conditions and the engineering properties of the subsurface soils.

2.1.17 This report was prepared to present the purpose and scope, background information, field exploration procedures, findings, evaluation, conclusions, and recommendations.

3.0 BACKGROUND INFORMATION

The existing site features, site history, previous studies, and the anticipated construction are summarized in the following subsections.

3.1.1 Site Description: The site is located at the southwest corner of 7th Avenue and Main Street in Hesperia, California. The north portion of the site was occupied by a Best Buy Auto Sales business, which has an address of 15901 Main Street. The area indicated for the proposed Starbucks development is a 0.596-acre property. The conceptual site plan SP-8, dated June 12, 2024, prepared by Greenberg Farrow, shows a proposed McDonald's fast-food restaurant on the west side of the Starbucks parcel; however, this report only includes a geotechnical engineering investigation for the proposed Starbucks. A site location map is presented on Drawing No. 1 in Appendix A. The site is located at 34.423305 degrees latitude and -117.316065 degrees longitude.

The streets that bound the site are not aligned to true north and are skewed slightly. For the purpose of this report, the assumed north direction is towards Main Street. So, the site is bound to the north by Main Street, to the east by 7th Avenue, to the south by Walnut Street and to the west by the proposed McDonald's parcel with retail shops and a parking lot beyond. The McDonald's parcel adjacent to the west side of the site includes an asphalt concrete paved parking lot in the northern half of the site, and an unpaved dirt lot with a concrete slab-on-grade (about 3,250 square feet) from a previous development in the southern half of the site.

The north half of the Starbucks site is occupied by a retail auto sales and repair business. Also, a canopy is present in the north portion of the site which covered former fuel islands. The existing sales/shop building is located within the building footprint for the proposed Starbucks building and occupies about 1,200 square feet. Equipment surrounded by a chain link fence was noted on the south side of the existing building. A trash enclosure was also noted on the south side of the existing building. Most of the remaining portions of the north half of the site were covered with asphalt concrete pavements in poor condition with large longitudinal and traverse cracking, some areas of raveling, and some patches. Also, underground utility scans identified numerous pipelines throughout the site.

The south half of the site did not include any above grade improvements. However, asphalt concrete pavements covered this area and two small concrete slabs-on-grade (about 160-square-feet and 120-square feet) were located in the western portion of the south half of the site. An exposed pipe was noted as extending vertically from the ground surface on the west side of the 120-square-foot slab-on-grade, and the outline of a trench was noted as extending northeast from the east side of the 120-square-foot slab-on-grade. The exposed pipe on the west side of the 120-square-foot slab-on-grade is believed to be a sewer or septic pipe. An apparent sewer cleanout valve also extended above the ground surface adjacent to the sewer pipe. Another pipe with a steel plate at the top of the pipe extended vertically from the ground surface within the 160-square-foot slab-on-grade. The pavements in the southern half of the Starbucks site were in poor condition with extensive weathering, severe block cracking and weeds growing out of the cracks. A chain link fence surrounded the northern, eastern and southern sides of the southern half of the site with an opening in the fence in the southern portion of the site that provides access to the site. A power pole was noted in the southeast portion of the site with an overhead power line extending southeast of the power pole. A tree was noted along the southern property line in the southwest corner of the site.

3.2 <u>Site History and Previous Studies</u>: As a part of this investigation, a Draft Phase I Environmental Site Assessment Report (Phase I ESA) and on-line aerial images were reviewed regarding the history of the site that are pertinent to this investigation.

The review of historical aerial photographs and city directories, conducted as a part of the Phase I ESA, indicated that the site was occupied by open, undeveloped land since before 1938 until the 1950's. In 1959, a building was present on the site in the north portion. During the 1980's, portions of the southern half of the site were paved, and by at least 1983 until 2004, the northeast portion of the site operated as a gas station. From 2005 to the time of our October 2024 field investigation, Best Buy Auto Sales has operated at the site. At the time of this investigation, the Phase I ESA had identified some records that the underground storage tanks associated with the past fuel facilities had been removed. Three (3) underground storage tanks in the western portion of the fuel canopy and southwest of the fuel canopy were reportedly removed in 1998. Moore Twining's Draft Phase I Environmental Site Assessment prepared for the previous Circle K development indicated that

Advanced Environmental Concepts observed and tested the backfill of two areas for the three (3) underground storage tanks that were removed and summarized their results in a December 1, 1998 report. The results of eleven tests presented in the report prepared by Hi Desert Testing & Inspection for Advanced Environmental Concepts show that the compacted fill met the minimum required 90 percent relative compaction. The initial tests in each area tested placement of fill at depths of about 10 and 11 feet below site grade. Thus, the areas of the excavations made to remove the underground storage tanks were at least about 10 to 11 feet in depth below adjacent site grades. The area of the three (3) removed Underground Storage Tanks appears to be northwest of the proposed Starbucks building (see Drawing No. 2 in Appendix A of this report). The compaction test report, test data and test locations for backfill of the area of the removed underground storage tanks with engineered fill is included in Appendix E of this report.

Aerial images of the site were also reviewed between May 1994 and December 2017. The 1994 and 1995 images of the site appear to show a service station in the northern portion of the site, and an open car sales lot in the southern portion of the site. By 2009, the southern portion of the site was vacant (no cars parked for sale). Between June and December 2017, a small building was removed in the southern half of the site, and two slabs-on-grade (about 160-square-feet and 120-square feet) remained. A sewer or septic pipe also remained adjacent to the west of the 120-square-foot slab-on-grade and an outline of a trench was noted as trending in a northeast direction from the east side of the 120-square-foot slab-on-grade. Another pipe with a steel plate at the top of the pipe extended vertically from the ground surface within the 160-square-foot slab-on-grade. The Draft Phase I ESA report indicated, "The pipes observed during the site reconnaissance indicate that a septic tank may have been associated with the site. As a result, the tank, piping and leach field(s) may be encountered and could impact future development. Additionally, it is unknown whether the historical building foundations located on the site maintained septic systems, and if so, whether they were removed. Costs would be incurred to handle the removal of the tank(s), lines and leach field(s) upon discovery. If the septic system(s) (tanks, piping, leach fields, etc.) is (are) discovered during development, especially in the area of any planned construction, the septic system(s) will need to be removed." The site appears to be consistent with the current site uses in images for various years after the 2017 aerial image of the site was taken.

Moore Twining's Geotechnical Engineering Division prepared a report for the site entitled, "Geotechnical Engineering Investigation, Proposed Circle K Store, Southwest Corner of 7th Avenue and Main Street, Hesperia, California," prepared by Moore Twining, dated January 24, 2019, Moore Twining Project No. G28812.02. The investigation was conducted on both the parcels for the proposed Starbucks and McDonald's development that was previously planned for development of a Circle K store, car wash and gas station. The investigation included drilling five (5) test borings at the site to depths ranging from 15 to 27 feet below site grades (BSG) in January 2019. The maximum depth proposed for the investigation of 50 feet BSG could not be achieved due to auger refusal on materials that were possibly cemented or cobbles at depths of 25 and 27 feet BSG in two attempts to reach the target maximum depth. The soils encountered consisted of silty sands extending to depths ranging from about 20 to 25 feet BSG. Below the silty sand, poorly graded

sands with silt soils were encountered to the maximum depth explored 27 feet BSG. Drilling refusal was encountered at depths of 25 and 27 feet BSG at boring locations B-1 and B-2 due to suspected cobbles. Laboratory testing on the near surface soils indicated the materials were non-plastic, non-expansive, and exhibited moderate compressibility, moderate collapse, and moderate to high shear strength properties. Laboratory testing on the near surface silty sand soils also indicated the near surface soils exhibited good support characteristics for pavements when compacted as engineered fill. Due to the soils exhibiting moderate collapse in the upper 5 feet, the report recommended over-excavation for the proposed Circle K store to a depth of 5 feet below preconstruction site grade, to the depth required to provide at least 2 feet of engineered fill below bottom of footings, to the depth required to remove existing undocumented fill soils and to at least 12 inches below subsurface improvements (structures, utilities, etc.) to be removed, whichever provided the deeper excavation. The Circle K store was recommended to be supported on shallow foundations and designed based on an allowable bearing pressure of 2,500 pounds per square foot for dead-plus-live loads which could be increased by one-third for short duration of seismic loads. Perimeter footings were recommended to extend to a depth of 18 inches below lowest adjacent finished exterior grade, and interior footings were recommended to extend to a minimum depth of at least 12 inches below the bottom of the slab-on-grade. The report recommended the following settlements to be anticipated for design: 1) a total static settlement of 1 inch, 2) a differential static settlement of ½-inch in 40 feet, 3) a total seismic settlement of ¼ inch, and 4) a differential seismic settlement of ¼ inch in 40 feet.

Moore Twining also issued a report for the previous Circle K development entitled, "Supplemental Report of Percolation Testing, Proposed Circle K Store, Southwest Corner of Main Street and 7th Avenue, Hesperia, California," dated February 13, 2019, Moore Twining Project Number G28812.02. An additional boring was drilled in the northeast corner of the site to a depth of 16½ feet BSG, and three (3) percolation test borings were drilled to depths of 3 feet, 4 feet and 5 feet BSG. The percolation tests were conducted within near surface silty sand soils, some of which exhibited cementation. The percolation tests indicated a negligible percolation rate in one of the percolation tests and unfactored infiltration rates of 1.7 inches and 3.0 inches per hour in the other two tests. However, Moore Twining concluded, "Since the borings indicate that the dense cemented soils occur below about 4 to 5 feet across the site and these materials did not have any significant measured infiltration during testing, it does not appear that on-site infiltration of significant stormwater in the near surface soils will be feasible."

No other previous geotechnical engineering, geological, compaction reports, or environmental studies conducted for this site were provided for review during this investigation. If available, these reports should be provided for review and consideration for this project.

3.3 Anticipated Construction: The latest conceptual site plan SP-8, dated June 12, 2024, prepared by Greenberg Farrow indicates the Starbucks development will include a 1,263 square foot single story Starbucks building and a drive-thru pick up drive lane. Appurtenant construction is indicated to include concrete walkways, asphaltic concrete and Portland cement concrete parking and drive areas, a trash enclosure, underground utilities, and landscaped areas.

It is anticipated that the proposed Starbucks structure will consist of a one-story building including concrete masonry unit wall or wood-framed construction with concrete slab-on-grade floors. It is anticipated that the proposed building will be supported on shallow spread foundation systems. Basements and loading docks are not anticipated as part of the proposed construction.

Based on our experience with past Starbucks projects, it is assumed the that the proposed Starbucks building will have maximum column loads of about 10 kips and maximum wall loads of about 1.5 kips per linear foot for dead-plus-live loads. In the event that the maximum foundation loads exceed those assumed for design, the recommendations of this report may not be applicable and may need to be revised.

Based on the lack of significant slope or grades differences noted across the site, cuts and fills on the order of 1 to 2 feet are anticipated to achieve level pad grades and provide site drainage.

Near surface infiltrations systems were not deemed to be feasible from Moore Twining's previous February 13, 2019 "Results of Percolation Testing" report. However, deeper poorly graded sand layers were previously encountered at the site and were targeted to conduct deeper percolation tests for consideration of infiltration systems such as dry wells to be used as part of the proposed construction.

4.0 INVESTIGATIVE PROCEDURES

The field exploration and laboratory testing programs conducted for this investigation are summarized in the following subsections.

4.1 Field Exploration: The field exploration consisted of a site reconnaissance, drilling test borings, conducting standard penetration tests, soil sampling and conducting percolation tests.

4.1.1 Site Reconnaissance: The site reconnaissance consisted of walking the site and noting visible surface features. The reconnaissance was conducted by a Moore Twining field engineer on October 23, 2024. The features noted are described in the background information section of this report.

4.1.2 Drilling Test Borings: Prior to drilling, the site was marked for Underground Service Alert for members to mark out the locations of existing public utilities. Also, an underground utility locating service was retained to scan the proposed boring locations to identify potential private on-site underground utilities that could be damaged during drilling. The borings were then offset from marked underground utilities.

The depths and locations of the test borings were selected based on the size of the structures, type of construction, estimated depths of influence of the anticipated foundation loads, and the subsurface soil conditions encountered.

On October 23, 2024, five (5) test borings were drilled at the site to depths ranging from 15 to 60 feet below site grades (BSG). Boring B-1 was intended to be drilled near the southeast corner of the proposed building footprint. However, due to the presence of an existing building and overhead power line trending southeast from the southeast corner of the existing building, boring B-1 had to be drilled on the east side of the existing building. Boring B-1 could not be drilled on the south side of the existing building as this area was occupied by an equipment storage area and surrounded by chain link fencing. Boring B-2 was drilled to 60 feet BSG within the northern portion of the proposed Starbucks building footprint (and north of the existing building) for evaluation of liquefaction. Boring B-3 was drilled to a depth of about 15 feet BSG within the entrance to the proposed drive-thru pickup drive lane area. Two (2) of the borings (P-1 and P-2) were drilled to depths of about 20 feet BSG to install percolation test pipe in the boreholes and conduct percolation tests. At the direction of Mr. Thomas Hawksworth (C3 Civil Engineering), the percolation tests were drilled in the northern portion of the Starbucks parcel and the northern portion of the adjacent McDonald's parcel. The boring locations are shown on Drawing No. 2 in Appendix A of this report. The borings were drilled with a conventional truck-mounted CME-75 drill rig equipped 8-inch outside diameter (O.D.) hollow-stem augers.

The test borings were drilled under the direction of a Moore Twining Geotechnical Engineer. The soils encountered in the test borings were logged during drilling by a representative of our firm. The field soil classification was in accordance with the Unified Soil Classification System and consisted of particle size, color, and other distinguishing features of the soil.

The presence and elevation of free water, if any, in the borings were noted and recorded during drilling and immediately following completion of the borings.

Test boring locations were determined with reference to existing property corners and site features shown on the site plan. The locations of the test borings are described on the boring logs in Appendix B of this report. The test borings were backfilled with material excavated during the drilling operations and patched with asphalt concrete cold patch materials.

4.1.3 Soil Sampling: Standard penetration tests were conducted in the test borings, and both disturbed and relatively undisturbed soil samples were obtained.

The standard penetration resistance, N-value, is defined as the number of blows required to drive a standard split barrel sampler into the soil. The standard split barrel sampler has a 2-inch O.D. and a 1⅜-inch inside diameter (I.D.). The sampler is driven by a 140-pound weight free falling 30 inches. The sampler is lowered to the bottom of the bore hole and set by driving it an initial 6 inches. It is then driven an additional 12 inches and the number of blows required to advance the sampler the additional 12 inches is recorded as the N-value.

Relatively undisturbed soil samples for laboratory tests were obtained by pushing or driving a California modified split barrel ring sampler into the soil. The soil was retained in brass rings, 2.5 inches O.D. and 1-inch in height. The lower 6-inch portion of the samples were placed in close-fitting, plastic, airtight containers which, in turn, were placed in cushioned boxes for transport to the laboratory.

During the drilling of the test borings, bulk samples of soil were also obtained for laboratory testing. Soil samples obtained were taken to Moore Twining's laboratory for classification and testing.

4.1.4 Percolation Tests: Two percolation tests was conducted on October 24, 2024. Percolation test borings P-1 and P-2 were drilled to depths of about 20 feet BSG on October 23, 2024. The locations of the percolation tests are shown on Drawing No. 2 in Appendix A of this report.

Percolation tests were conducted at locations P-1 and P-2 and infiltration rates were estimated from the percolation test data.

The percolation testing was conducted in general conformance with San Bernardino County's Section VII.3.8 in Appendix D of their "Technical Guidance Document for Water Quality Management Plans," effective date September 19, 2013, which utilizes the percolation test procedure per Riverside County Department of Environmental Health. The percolation tests included placement of about 2 inches of gravel at the bottom of the hole and installation of percolation test pipe with gravel in the annulus space to keep the pipe stabilized and reduce the potential for washout of the soils on the sides of the holes within the test zone. On the day prior to the testing, about 5 gallons of water was added to each hole. On the day of the percolation tests, per the procedure for deep percolation tests, the percolation tests included presoaking the percolation test holes with at least 40 to 50 gallons of water in P-1 and about 60 gallons of water in P-2 for a period of 2 hours so that the water flow into the hole held constant at a level of at least 5 times the hole's radius above the bottom of the hole. Testing commenced following the presoak. The sandy soil test method was used. This included making two (2) consecutive measurements to show that at least six (6) inches of water seeped away in less than 25 minutes, and the test method indicates to run the test for an additional hour with measurements taken every ten (10) minutes. During the tests, measurements were taken every 10 minutes for an hour at each percolation test location. Measurements were taken with a precision of 0.25 inches or better. The procedure indicates that the drop that occurs during the final reading is to be used to calculate the percolation rate. As required, the field data included the two (2) 25-minute readings and the readings for an additional hour. The head of the water in the test holes was generally about 27 to 28 inches when refilling the water level.

4.2 Laboratory Testing: The laboratory testing was programmed to determine selected physical and engineering properties of the soils sampled during drilling. The tests were conducted on disturbed and relatively undisturbed samples considered representative of the subsurface soils encountered.

The results of laboratory tests are summarized in Appendix C of this report. These data, along with the field observations, were used to prepare the final test boring logs in Appendix B of this report.

5.0 FINDINGS AND RESULTS

The findings and results of the research, field exploration and laboratory testing are summarized in the following subsections.

5.1 Subsurface Profile: The following paragraphs describe the subsurface conditions encountered at the boring locations drilled.

The borings were all drilled in existing asphalt concrete pavement areas. The five (5) borings drilled (borings B-1 through B-3 and P-1 and P-2) encountered approximately 2 to 3 inches of asphalt concrete. No aggregate base was encountered underlying any of the asphalt concrete pavements at the locations cored. The asphalt concrete pavement was underlain by silty sand soils that extended to depths ranging from about 1½ to 13½ feet BSG. The silty sands were underlain by interbedded layers of silty, clayey sands; clayey sands; poorly graded sands with silt and well graded sands with silt that extended to depths of about 8½ to 33½ feet BSG. These layers were generally underlain by poorly graded sands and well graded sands with silt extending to the maximum depth explored, about 60 feet BSG.

The foregoing is a general summary of the soil conditions encountered in the test borings drilled for this investigation. Detailed descriptions of the soils encountered at each test boring location are presented in the logs of borings in Appendix B of this report. The stratification lines in the logs represent the approximate boundary soil types; the actual in-situ transition may be gradual.

5.2 Soil Engineering Properties: The following is a description of the soil engineering properties as determined from our field exploration and laboratory testing.

Silty Sands: The silty sands encountered were described as very loose to dense, as determined by standard penetration resistance, N-values, ranging from 3 to 32 blows per foot. The moisture content of the silty sands ranged from 4 to 12 percent. Two (2) relatively undisturbed samples revealed dry densities of 113.6 and 116.0 pounds per cubic foot.

A consolidation test conducted on a silty sand sample collected at depths of about 1 to 2½ feet BSG from boring B-2 indicated low compressibility characteristics (about 2.4 percent consolidation under a load of 8 kips per square foot). Upon inundation, the sample exhibited slight swell potential (about 0.1 percent collapse) when wetted under a load of 0.25 kips per square foot. Another consolidation test conducted on a silty sand sample collected at depths of about 5 to 6½ feet BSG from boring B-2 indicated low compressibility characteristics (about 4.0 percent consolidation under a load of 8 kips per square foot). Upon inundation, the sample exhibited slight collapse potential (about 0.4 percent collapse) when wetted under a load of 0.5 kips per square foot. Direct shear tests conducted on silty sand samples collected from depths of about 1 to 2½ feet BSG and 5 to 6½ feet BSG from boring B-2 indicated internal angles of friction of 33 and 41 degrees with cohesion values of 130 and 220 pounds per square foot, respectively.

Silty, Clayey Sands: The silty, clayey sands encountered were described as medium dense, as determined by an SPT equivalent N-value (estimated by driving a California Modified split barrel sampler) of 28 blows per foot. The moisture content of a sample tested was 6.2 percent. One (1) relatively undisturbed sample revealed a dry density of 126.5 pounds per cubic foot. An Atterberg Limits conducted on a silty, clayey sand sample collected from depths of about 3½ to 5 feet BSG from boring B-1 indicated a liquid limit of 21 and a plasticity index of 6.

Clayey Sands: The clayey sands encountered were described as medium dense, as indicated by standard penetration resistance, N-values, ranging from 14 to 30 blows per foot. The moisture content of the samples tested ranged from about 6 to 11 percent. An Atterberg Limit test conducted on a clayey sand sample collected from depths of about 28½ to 30 feet BSG from boring B-2 indicated a liquid limit of 25 and a plasticity index of 8.

Poorly Graded Sands, Poorly Graded Sands with Silt and Well Graded Sands with Silt: The poorly graded sands, poorly graded sands with silt and well graded sands with silt encountered were described as loose to dense as determined by standard penetration resistance, N-values, ranging from 10 to 49 blows per foot. The moisture content of the samples tested ranged from about 4 to 8 percent. One (1) relatively undisturbed sample of poorly graded sand with silt revealed a dry density of 119.2 pounds per cubic foot.

Resistance-Value (R-value) Test: An R-value test conducted on a near surface sample containing a mixture of some silty sand and mostly clayey sand and collected from depths of about 1 to 5 feet BSG from boring B-3 indicated an R-value of 37.

Chemical Tests: Chemical tests performed on a near surface soil sample resulted in a pH value of 7.5; a minimum resistivity value of 3,100 ohms-centimeter; 0.0021 percent by weight concentration of chlorides; and 0.0026 percent by weight concentration of sulfates.

5.3 Groundwater Conditions: Groundwater was not encountered in the test borings drilled at the time of our October 2024 field exploration to the maximum depth explored, about 60 feet BSG.

Based on our review of groundwater data published by the Department of Water Resources, a well located about 1½ miles northwest of the site indicates that groundwater has ranged from an elevation of about 2,808 feet in 1981 to an elevation of about 2,767 feet BSG in 2005 for data collected between the years 1981 and 2017. The most recent measurement from this well in 2017 indicated groundwater at an elevation of about 2,778 feet. Considering the subject site has an average elevation of about 3,259 feet above mean sea level (USGS Topographic Data on Google Earth), groundwater at the site is considered to be greater than 450 feet below site grade.

It should be recognized, however, that groundwater elevations fluctuate with time, since they are dependent upon seasonal precipitation, irrigation, land use, and climatic conditions as well as other factors. Therefore, water level observations at the time of the field investigation may vary from those encountered both during the construction phase and the design life of the project. The evaluation of such factors was beyond the scope of this investigation and report.

5.4 Results of Percolation Testing: The infiltration rate estimated from the percolation test data is summarized in Table No. 1 below. The percolation test data is included in Appendix D of this report.

Table No. 1
Results of Percolation Testing

Location and Depth	Field (Unfactored) Infiltration Rate (Inches per Hour)[1]	Subgrade Soil Type
P-1 at 20.25 feet BSG	3.3	Dense Poorly Graded Sand with Silt
P-2 at 20.2 feet BSG	4.3	Medium Dense Well Graded Sand with Silt

Notes:
BSG - Below site grade
[1] - Includes no factor of safety

It should be noted that the field tests do not consider the long-term effects of subgrade saturation, silt accumulation, groundwater influence, nor vegetation. In general, the infiltration rate of the soils will decrease when the soils are saturated and the reduction in the infiltration rate increases the longer the soils are saturated. Published studies indicate field infiltration rates can significantly overestimate the saturated permeability. In addition, soil bed consolidation, sediment, suspended soils, etc. in the discharge water can result in clogging of the pore spaces in the soil. This clogging effect can also reduce the long-term infiltration rate. Numerous other factors, such as variations in soil type and soil density across the entire area of the system can influence the infiltration rate, both short and long term.

6.0 EVALUATION

The data and methodology used to develop conclusions and recommendations for project design and preparation of construction specifications are summarized in the following subsections. The evaluation was based upon the subsurface soil conditions encountered during this investigation and our understanding of the proposed construction. The conclusions obtained from the results of our evaluations are described in the Conclusions section of this report.

6.1 Existing Surface and Subsurface Conditions: At the time of our field exploration, the surface of the site was occupied by various pavements, a building, a canopy, and slabs-on-grade, which are to be demolished. It is possible some of the existing slabs on grade in the southern half of the site include buried foundations where a building was removed in 2017. In addition, the sewer or septic pipe extending vertically out of the ground in the area of the slabs-on-grade in the southern half of the site and an outline of a trench trending northeast away from one of these slabs-on-grade suggest that subsurface septic system(s) (tanks, piping, leach fields, etc.) may be present. A power pole exists in the southeastern portion of the site, and an overhead line was noted as trending to the southeast away from the power pole. Abundant weed growth was noted within the cracked pavements in the southern half of the site and also in some of the cracked pavements in the northern half of the site. A chain link fence surrounded an equipment storage area on the south side of the existing building in the northern half of the site. A chain link fence also surrounded the northern, eastern and southern sides of the southern half of the site. Also, a tree was also noted along the fence and southern boundary of the site in the southwest corner of the site.

It is our understanding that the existing improvements will be demolished and removed as part of the site preparation for the proposed Starbucks development. As a part of demolition, it is recommended to remove all existing surface and subsurface improvements. Further, all utilities not required for the new construction should be entirely removed, and not abandoned in-place. Numerous underground utilities were noted at the site, including site light (electric), water lines, sewer lines, etc, that should be identified and removed during demolition and site preparation. As previously noted, a subsurface septic system(s) (tanks, piping, leach fields, etc.) may be present in the southern portion of the site in the area of the concrete slabs-on-grade left in-place. These surface and subsurface features and undocumented fill soils should be entirely removed to expose native, undisturbed soils; and the resulting excavations backfilled as engineered fill to the finished grades. The power pole in the southeastern portion of the site will also need to be removed from the site.

Deep shaft foundations may support the existing canopy in the northern half of the site. If the existing canopy is supported by deep shaft foundations, the portion of foundations that extend below 5 feet below final grade, and that are not within 5 feet of any utility trench, may remain in place. The portion of the foundations above five feet below grade, or within 5 lateral feet of adjacent excavations, should be cutoff and removed. The resultant excavations should be backfilled as engineered fill to final grades.

6.2 Static Settlement and Bearing Capacity of Shallow Foundations: The potential for excessive total and differential static settlement of foundations and slabs-on-grade is a geotechnical concern that was evaluated for this project. The increases in effective stress to underlying soils which can occur from new foundations and structures, placement of fill, etc. can cause vertical deformation of the soils, which can result in damage to the overlying structures and improvements. The differential component of the settlement is often the most damaging. In addition, the allowable bearing pressures of the soils supporting the foundations were evaluated for shear and punching type failure of the soils resulting from the imposed foundation loads.

The near surface loose soils encountered in the borings drilled for the proposed Starbucks building are not considered suitable for direct support of proposed structure. In order to reduce the potential for excessive static settlement of foundations and to limit the total and differential static settlement of foundations to 1 inch total and ½ inch differential in 40 feet, it is recommended to support new foundations for the Starbucks structure on engineered fill soils that extend to either: 1) a depth of 4 feet below preconstruction site grade; or 2) to the depth required to provide at least 1 foot of engineered fill below proposed foundations, whichever is greater. In addition, the over-excavation recommended for the proposed Starbucks building will also need to be conducted to remove all surface and subsurface structure such as the existing building, foundations, underground utilities, etc. All undocumented fill soils and soils disturbed from removal of subsurface improvements will also need to be removed during site preparation for the proposed Starbucks building. Provided the building pad areas are prepared in accordance with the recommendations included in this report, a net allowable soil bearing pressure of 2,500 pounds per square foot, for dead-plus-live loads, may be used for design.

The net allowable soil bearing pressure is the additional contact pressure at the base of the foundations caused by the structure. The weight of the soil backfill and weight of the footing may be neglected. The net allowable soil bearing pressure presented was selected using the Terzaghi bearing capacity equations for foundations considering a minimum factor of safety of 3.0 and based on the anticipated static settlements noted in this report.

A structural engineer experienced in foundation and slab-on-grade design should determine the thickness, reinforcement, design details and concrete specifications for the proposed building foundations and slabs-on-grade based on the anticipated settlements estimated in this report.

6.3 Seismic Ground Rupture and Design Parameters: The closest active fault is the Ord Mountain Fault zone (part of the North Front Thrust System), which is located about 6½ miles southeast of the site. The project site is not located in an Alquist-Priolo Earthquake Fault Zone. Accordingly, the potential for ground rupture at the site is considered low.

It is our understanding that the 2022 CBC will be used for structural design, and that seismic site coefficients are needed for design.

Based on the 2022 CBC, a Site Class D represents the on-site soil conditions with standard penetration resistance, N-values averaging between 15 and 50 blows per foot in the upper 100 feet below site grade.

A table providing the recommended seismic coefficients and earthquake spectral response acceleration values for the project site is included in the Foundation Recommendations section of this report. A Maximum Considered Earthquake (geometric mean) peak ground acceleration adjusted for site effects (PGA_M) of 0.550g was determined for the site using the Seismic Design Maps tool provided by the Structural Engineers Association of California (https://seismicmaps.org/).

6.4 Liquefaction and Seismic Settlement: Liquefaction and seismic settlement are conditions that can occur under seismic shaking from earthquake events. Liquefaction describes a phenomenon in which a saturated, cohesionless soil loses strength during an earthquake as a result of induced shearing strains. Lateral and vertical movements of the soil mass, combined with loss of bearing usually results. Fine, well sorted, loose sand, shallow groundwater conditions, higher intensity earthquakes, and particularly long duration of ground shaking are the requisite conditions for liquefaction.

Seismic settlement analyses were conducted based on soil properties from the boring with the deepest advance (B-2) using the computer program LiquefyPro, developed by CivilTech Software. Also, the depth of engineered fill recommended for site preparation was considered in the analysis. A Maximum Considered Earthquake (geometric mean) peak ground acceleration adjusted for site effects (PGA_M) of 0.550g was determined for the site using the Ground Motion Parameter Calculator provided by the United States Geological Survey (http://earthquake.usgs.gov/designmaps/us/application.php). A Maximum Considered Earthquake magnitude of 8.2 was applied in the analysis based on the highest earthquake magnitude determined from probabilistic analysis (hazard deaggregation analysis fro the USGS Unified Hazard Tool (https://earthquake.usgs.gov/hazards/interactive/), and deterministic analysis using the Building Seismic Safety Council 2014 (BSSC2014) Scenario Catalog from the USGS website for the Earthquake Hazards Program (https://earthquake.usgs.gov/scenarios/catalog/bssc2014/). Soil parameters, such as wet unit weight, standard penetration test, N-values, and fines content were input from the boring data for the soil layers encountered throughout the depths explored.

Due to the depth to historical groundwater in the vicinity of this site (greater than 450 feet BSG), liquefaction is not considered a concern for the proposed development. However, there is potential for dry seismic settlement to occur during shaking from earthquakes. As part of the analysis, the (N1)60s values of 30 or greater (dense to very dense soils) were not considered to be subject to significant dry seismic settlement in the analyses. Based on the analysis, seismic settlement was estimated to be negligible.

6.5 Asphaltic Concrete (AC) Pavements: Recommendations for asphaltic concrete pavement structural sections are presented in the "Recommendations" section of this report for proposed asphaltic concrete (AC) pavements. The structural sections were designed using the gravel equivalent method in accordance with the California Department of Transportation Highway Design Manual. The analysis was based on traffic index values ranging from 5.0 to 7.0. The appropriate paving section should be determined by the project civil engineer or applicable design professional based on the actual vehicle loading (traffic index) values. If traffic loading is anticipated to be greater than assumed, the pavement sections should be re-evaluated.

It should be noted that if pavements are constructed prior to the construction of the structures, the additional construction truck traffic should be considered in the selection of the traffic index value. If more frequent or heavier traffic is anticipated and higher Traffic Index values are needed, Moore Twining should be contacted to provide additional pavement section designs.

A Resistance-Value (R-value) test was conducted on a near surface sample containing a mixture of some silty sand and mostly clayey sand that was collected from boring B-3 which was drilled in the entrance area for the proposed drive-thru pickup drive lane for the Starbucks. The test indicated an R-value result of 37. R-values of 45 and 51 were determined in the area of the bordering proposed McDonald's parcel during our previous January 2019 investigation at the subject site for the previously planned Circle K development. However, the previous samples tested contained all silty sand material and did not contain any clayey sand material, thus resulting in higher R-values. Based on the result of the current testing, and considering potential variation in the near surface soils, an R-value of 35 was used to provide the pavement section thickness recommendations.

6.6 Portland Cement Concrete (PCC) Pavements: Recommendations for Portland cement concrete (PCC) pavement structural sections are presented in the "Recommendations" section of this report. The PCC pavement sections are based upon the amount and type of traffic loads being considered and the characteristics of the subgrade soils which will support the pavement. The measure of the amount and type of traffic loads are based upon an index of equivalent axle loads (EAL) from the loading of heavy trucks called a traffic index (T.I).

The recommendations provided in this report for PCC pavements are based on a trash truck loading and the design procedures contained in the Portland Cement Association "Thickness Design of Highway and Street Pavements."

The pavement sections were prepared based on traffic indexes ranging from 6.0 to 8.0. The recommended structural sections were based primarily on the Portland Cement Association "Thickness Design of Highway and Street Pavements." A modulus of subgrade reaction, K-value, for the pavement section, considering a minimum 4-inch layer of aggregate base material (minimum R-value of 78), of 190 psi/in at the top of the aggregate base was used for pavement design.

6.7 Soil Corrosion: The risk of corrosion of construction materials relates to the potential for soil-induced chemical reaction. Corrosion is a naturally occurring process whereby the surface of a metallic structure is oxidized or reduced to a corrosion product such as iron oxide (i.e., rust). The metallic surface is attacked through the migration of ions and loses its original strength by the thinning of the member.

Soils make up a complex environment for potential metallic corrosion. The corrosion potential of a soil depends on numerous factors including soil resistivity, texture, acidity, field moisture and chemical concentrations. In order to evaluate the potential for corrosion of metallic objects in contact with the onsite soils, chemical testing of soil samples was performed by Moore Twining as part of this report. The test results are included in Appendix C of this report. Conclusions regarding the corrosion potential of the soils tested are included in the Conclusions section of this report based on the National Association of Corrosion Engineers (NACE) corrosion severity ratings listed in the Table No. 2 below.

Table No. 2
Soil Resistivity and Corrosion Potential Ratings

Soil Resistivity (ohm cm)	Corrosion Potential Rating
>20,000	Essentially non-corrosive
10,000 - 20,000	Mildly corrosive
5,000 - 10,000	Moderately corrosive
3,000 - 5,000	Corrosive
1,000 - 3,000	Highly corrosive
<1,000	Extremely corrosive

The results of soil sample analyses indicate that the near-surface soils exhibit a "corrosive" corrosion potential to buried metal objects. This is consistent with our previous 2019 test results at the site on the proposed McDonald's parcel during Moore Twining's investigation for the previously planned Circle K development. Appropriate corrosion protection should be provided for buried improvements based on the "corrosive" corrosion potential. If piping or concrete are placed in contact with imported soils, these soils should be analyzed to evaluate the corrosion potential of these soils.

If the manufacturers or suppliers cannot determine if materials are compatible with the soil corrosion conditions, a professional consultant, i.e., a corrosion engineer, with experience in corrosion protection should be consulted to provide design parameters. Moore Twining does not provide corrosion engineering services.

6.8 Sulfate Attack of Concrete: Degradation of concrete in contact with soils due to sulfate attack involves complex physical and chemical processes. When sulfate attack occurs, these processes can reduce the durability of concrete by altering the chemical and microstructural nature of the cement paste. Sulfate attack is dependent on a variety of conditions including concrete quality, exposure to sulfates in soil, groundwater and environmental factors. The standard practice for geotechnical engineers in evaluation of the soils anticipated to be in contact with structural concrete is to perform laboratory testing to determine the concentrations of sulfates present in the soils. The test results are then compared with the exposure classes in Table 19.3.1.1 of ACI 318 to provide guidelines for concrete exposed to soils containing sulfates. It should be noted that other exposure conditions such as the presence of: seawater, groundwater with elevated concentrations of dissolved sulfates, or materials other than soils can result in sulfate exposure categories to concrete that are higher than the concentrations of sulfate in soil. The design engineer will need to determine whether other potential sources of sulfate exposure need to be considered other than exposure to sulfates in soil. The sulfate exposure classes for soils from Table 19.3.1.1 are summarized in the below table.

Table No. 3
ACI Exposure Categories for Water Soluble Sulfate in Soils

Sulfate Exposure Class (per ACI 318)	Water Soluble Sulfate in Soil (Percent by Mass)
S0	Less than 0.10 Percent
S1	0.10 to Less than 0.20 Percent
S2	0.20 to Less than or Equal to 2.00 Percent
S3	Greater than 2.00 Percent

Common methods used to resist the potential for degradation of concrete due to sulfate attack from soils include, but are not limited to the use of sulfate-resisting cements, air-entrainment and reduced water to cement ratios. The laboratory test results for sulfates are included in Appendix C of this report. Conclusions regarding the sulfate test results are included in the Conclusions section of this report.

7.0 CONCLUSIONS

Based on the data collected during the field and laboratory investigations, our geotechnical experience in the vicinity of the project site, and our understanding of the anticipated construction, the following general conclusions are presented.

7.1 The site is considered suitable for the proposed construction with regard to support of the proposed improvements, provided the recommendations contained in this report are followed. It should be noted that the recommended design consultation and observation of clearing, and earthwork activities by Moore Twining are integral to this conclusion.

7.2 The subsurface soils encountered generally consisted of very loose to medium dense silty sands extending to depths of about 1½ to 3½ feet across the site. Below the very loose to loose silty sands, the relative density of the silty sands soils improved to medium dense to dense and extended to depths of about 3½ to 13½ feet BSG. Below the silty sands, medium dense silty, clayey sands; medium dense clayey sands; medium dense to dense poorly graded sands with silt; and medium dense well graded sands with silt were encountered extending to a depth of about 33½ feet BSG which were generally underlain by dense poorly graded sands and dense well graded sands with silt extending to the maximum depth explored of 60 feet BSG.

7.3 Laboratory testing on the near surface soils indicate the materials are non-plastic, non-expansive, and exhibit low compressibility characteristics, slight collapse potential, and moderate to high shear strength properties. The near surface soils exhibit fair support characteristics for pavements when compacted as engineered fill.

7.4 Groundwater was not encountered in the test borings drilled at the time of our October 2024 investigation to the maximum depth explored, about 60 feet BSG. Based on groundwater data published by the Department of Water Resources, the depth to groundwater at the site is considered to be greater than 450 feet below site grade.

7.5 Due to the depth to historical groundwater in the vicinity of this site (greater than 450 feet BSG), liquefaction is not considered a concern for the proposed development. However, there is potential for dry seismic settlement to occur during shaking from earthquakes. As part of the analysis, the (N1)60s values of 30 or greater (dense to very dense soils) were not considered to be subject to significant dry seismic settlement in the analyses. Based on the analysis, seismic settlement was estimated to be negligible.

7.6 The result at percolation test P-1 at 20.25 feet BSG indicated an unfactored infiltration rate of 3.3 inches per hour. The result at percolation test P-2 at 20 feet BSG indicated an unfactored infiltration rate of 4.3 inches per hour. The results indicate that storm water infiltration systems at a depth of 20 feet BSG appear feasible for this site. This report recommends that the lower unfactored infiltration rate of 3.3 inches per hour be considered for use in design for infiltration systems at a depth of 20 feet BSG when including an appropriate factor of safety. Appendix D, Section VII (Technical Guidance Document Appendices) of Technical Guidance Document for Water Quality Management Plans, dated June 7, 2013, prepared by CDM Smith Inc. for the County of San Bernardino Areawide Stormwater Program discusses the factor of safety to be used to be used for design of infiltration facilities. Appendix D, Section VII.4 'Considerations for Infiltration Rate Factor of Safety' indicates, "The factor of safety used to compute the *design infiltration rate* shall not be less than 2.0 but may be higher at the discretion of the design engineer and acceptance of the plan reviewer...."

7.7 Chemical testing of soil samples indicated the soils exhibit a "corrosive" corrosion potential.

7.8 Based on Table 19.3.1.1 - Exposure categories and classes from Chapter 19 of ACI 318, the sulfate concentration from chemical testing of soil samples falls in the S0 classification (less than 0.10 percent by weight) for concrete.

7.9 The potential for fault rupture on the site is low.

7.10 It is our understanding that the existing improvements will be demolished as part of the site preparation for the proposed Starbucks development. To provide adequate support for the planned building and pavement improvements, existing surface and subsurface improvements not required for the new construction should be entirely removed, and not abandoned in-place. Numerous underground utilities were noted at the site, including site light (electric), water lines, sewer lines, etc, that should be identified and removed during demolition and site preparation. A subsurface septic system(s) (tanks, piping, leach fields, etc.) may also be present in the southern portion of the site in the area of the concrete slabs-on-grade left in-place. These surface and subsurface features and undocumented fill soils should be entirely removed to expose native, undisturbed soils; and the resulting excavations backfilled as engineered fill to the finished grades.

In order to reduce the potential for excessive static settlement of foundations and to limit the total and differential static settlement of foundations to 1 inch total and ½ inch differential in 40 feet, it is recommended to support new foundations for the Starbucks structure on engineered fill soils that extend to either: 1) a depth of 4 feet below preconstruction site grade; or 2) to the depth required to provide at least 1 foot of engineered fill below proposed foundations, whichever is greater.

7.11 If the existing canopy is supported by deep shaft foundations, the portion of foundations that extend below 5 feet below final grade, and that are not within 5 feet of any utility trench, may remain in place. The portion of the foundations above five feet below grade, or within 5 lateral feet of adjacent excavations, should be cutoff and removed. The resultant excavations should be backfilled as engineered fill to final grades.

8.0 RECOMMENDATIONS

Based on the evaluation of the field and laboratory data and our geotechnical experience in the vicinity of the project, the following recommendations are presented for use in the project design and construction. However, this report should be considered in its entirety. When applying the recommendations for design, the background information, procedures used, findings, evaluation, and conclusions should be considered. The recommended design consultation and construction monitoring by Moore Twining are integral to the proper application of the recommendations. The Contractor is required to comply with the requirements and recommendations presented in this report.

Where the requirements of a governing agency, utility agency or pipe manufacturer differ from the recommendations of this report, the more stringent recommendations should be applied to the project.

8.1 General

8.1.1 Moore Twining should be retained to review the final grading plans and foundation plans before the plans are released for bidding purposes so that any relevant recommendations can be presented.

8.1.2 When the actual foundation loads are known, this information should be provided to Moore Twining for review to confirm the recommendations for site preparation are appropriate. In the event the foundation loads are different than assumed, the recommendations in this report may need to be revised.

8.1.3 A preconstruction meeting including, as a minimum, the owner, general contractor, earthwork contractor, foundation and paving subcontractors, and Moore Twining should be scheduled by the general contractor at least one week prior to the start of clearing and grubbing. The purpose of the meeting should be to discuss critical project requirements and scheduling.

8.1.4 The Contractor(s) bidding on this project should determine if the information included in the construction documents are sufficient for accurate bid purposes. If the data are not sufficient, the Contractor should notify the owner in writing prior to bidding the project that the data provided in this report is not sufficient to bid the project. This notification should be specific and explain in detail as to what data are not sufficient.

8.2 Site Grading and Drainage

8.2.1 It is critical to develop and maintain site grades which will drain surface and roof runoff away from foundations and floor slabs - both during and after construction. Adjacent exterior finished grades should be sloped a minimum of two percent for a distance of at least ten feet away from the structures, or as necessary to preclude ponding of water adjacent to foundations, whichever is more stringent. Adjacent exterior grades which are paved should be sloped at least 1 percent away from the foundations.

8.2.2 It is recommended that landscape planted areas, etc. not be placed adjacent to the building foundations and/or interior slabs-on-grade. Trees should be setback from the proposed structures at least 10 feet or a distance equal to the anticipated drip line radius of the mature tree. For example, if a tree has an anticipated drip-line diameter of 30 feet, the tree should be planted at least 15 feet away (radius) from proposed or existing buildings.

8.2.3 Landscaping after construction should direct rainfall and irrigation runoff away from the structures and should establish positive drainage of water away from the structures. Care should be taken to maintain a leak-free sprinkler system.

8.2.4 Landscape and planter areas should be irrigated using low flow irrigation (such as drip, bubblers or mist type emitters). The use of plants with low water requirements are recommended.

8.2.5 Rain gutters and roof drains should be provided, and connected directly to the site storm drain system. As an alternative, the roof drains should extend a minimum of 5 feet away from the structures and the resulting runoff directed away from the structures at a minimum of 2 percent.

8.2.6 Stormwater systems that allow wetting of the soils should not be placed directly adjacent to structures or foundations. On a preliminary basis, these types of features should be setback at least 20 feet from foundations. The result at percolation test P-1 at 20.25 feet BSG indicated an unfactored infiltration rate of 3.3 inches per hour. The result at percolation test P-2 at 20 feet BSG indicated an unfactored infiltration rate of 4.3 inches per hour. The results indicate that storm water infiltration systems at a depth of 20 feet BSG appear feasible for this site for infiltration systems such as deeper dry wells. This report recommends that the lower unfactored infiltration rate of 3.3 inches per hour be considered for use in design for infiltration systems at a depth of 20 feet BSG when including an appropriate factor of safety. Shallow infiltration systems should not be considered based on the results of previous percolation testing conducted by Moore Twining at the site in 2019 that identified cemented soils and unfavorable infiltration rates in the near surface soils. Appendix D, Section VII (Technical Guidance Document Appendices) of Technical Guidance Document for Water Quality Management Plans, dated June 7, 2013, prepared by CDM Smith Inc. for the County of San Bernardino Areawide Stormwater Program discusses the factor of safety to be used for design of infiltration facilities. Appendix D, Section VII.4 'Considerations for Infiltration Rate Factor of Safety' indicates, "The factor of safety used to compute the *design infiltration rate* shall not be less than 2.0 but may be higher at the discretion of the design engineer and acceptance of the plan reviewer...."

8.3 Site Preparation

8.3.1 Stripping should be conducted in all areas of existing landscaping to remove surface vegetation and root systems (if any). The general depth of stripping should be sufficiently deep to remove the root systems and organic topsoils. A tree occupied the southwest corner of the site. Tree roots that are encountered during site grading should be excavated to remove all roots larger than ¼-inch or accumulation of organics greater than 3 percent by dry weight.

8.3.2 As part of the site preparation, existing surface and subsurface improvements should be completely removed. Existing subsurface improvements and associated backfill soils should be excavated to at least 12 inches below the improvements removed, to the depth required to remove all disturbed soils, and all fill materials, whichever requires the deeper excavation. Underground utilities to be removed should not be capped and abandoned or crushed and buried in-place. Instead, underground utilities not scheduled to remain should be fully removed from the site along with the

associated trench backfill soils that should be assumed to extend at a 1 horizonal to 1 vertical gradient extending from the bottom of the utility to the ground surface. Excavated soils associated with removal of utilities and other subsurface improvements should be moisture conditioned and compacted as engineered fill as recommended in this report.

8.3.3 For the deep shaft foundations that may support the existing canopy, the portion of foundations that extend below 5 feet below final grade, and that are not within 5 feet of any utility trench, may remain in place. The portion of the foundations above five feet below grade, or within 5 lateral feet of adjacent excavations, should be cutoff and removed. The resultant excavations should be backfilled as engineered fill to final grades.

8.3.4 The fill soils used to backfill the USTs (removed in 1998 from the western portion and southwest side of the existing canopy) were documented to be compacted as engineered fill. When the area of this certified fill is exposed, Moore Twining should observe it and probe it to determine if any unsuitable or loose soils are exposed during the over-excavations for the proposed building and other site improvements. If any unsuitable or loose soils are exposed, these soils should be removed, moisture conditioned as necessary and compacted as engineered fill.

8.3.5 After stripping and removal of existing surface and subsurface improvements, the building pad areas for the proposed Starbucks and over-build zone should be over-excavated to the depths required to meet all of the following requirements, whichever requires the deeper excavation:

1) to at least 1 foot below the bottom of footings,
2) to at least 4 feet below preconstruction site grades,
3) to the depth required to remove existing undocumented fill soils, and
4) to at least 12 inches below the subsurface improvements (structures, utilities, etc.) to be removed.

The horizontal limits of over-excavation should include the footprint of the building, all foundations, all concrete walkways adjacent to the structures, and a minimum of 5 feet beyond these features, whichever is greater. Upon review of the Contractor's survey data (regarding the vertical and horizontal limits of the over-excavation) and approval of the over-excavation by Moore Twining, the bottom of the excavation should be scarified to a minimum depth of 8 inches, moisture conditioned, and compacted as engineered fill.

8.3.6 It is recommended that extra care be taken by the contractor to ensure that the horizontal and vertical extent of the over-excavation and compaction conform to the site preparation recommendations presented in this report. The horizontal limit of over-excavation for the building pad for the proposed Starbucks building and attached concrete walkways should be depicted on the project plans. Moore Twining is not responsible for measuring and verifying the horizontal and vertical extent of over-excavation and compaction. The contractor should verify in writing to the owner and Moore Twining that the horizontal and vertical over-excavation limits were completed in conformance with the recommendations of this report, the project plans, and the specifications (the most stringent applies). It is recommended that this verification be performed by a licensed surveyor. This verification should be provided prior to requesting pad certification from Moore Twining or excavating for foundations.

8.3.7 Following stripping and removal of surface and subsurface improvements, areas to receive miscellaneous lightly loaded foundations, such as site walls, retaining walls or screen walls for trash enclosures, should be over-excavated to a minimum of 1 foot below foundations, to a depth of at least 4 feet below preconstruction site grades, to the depth required to remove undocumented fills, or to at least 12 inches below subsurface improvements (utilities, etc.) to be removed, whichever is greater. The over-excavation for retaining walls/screen walls should extend to at least 3 feet beyond the edges of the foundations or up to improvements to remain, whichever occurs first. The bottom of the over-excavation should be scarified to a depth of at least 8 inches, moisture conditioned and compacted as engineered fill.

8.3.8 Following stripping and removal of surface and subsurface improvements, areas to receive new pavements, exterior slabs on grade outside the building pad preparation limits and areas to receive fill outside the building pad preparation limits should be over-excavated to a depth of 12 inches below pre-construction pavement grades, to the depth required to remove undocumented fill soils, to a depth of 12 inches below the bottom of the new aggregate base section, to at least 12 inches below subsurface improvements (utilities, etc.) to be removed, and to the depth required to remove all disturbed soils, whichever is greater. The exposed surface after over-excavation should be scarified to a minimum depth of 8 inches, moisture conditioned to between optimum and three (3) percent above optimum moisture content and compacted as engineered fill. The limits of

scarification for pavement areas and exterior slabs should extend at least 3 feet beyond the edge of these improvements or up to improvements to remain, whichever occurs first. The upper 12 inches of the subgrade soils beneath the pavement areas should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Test Method D1557.

8.3.9 All fill required to bring the site to final grades should be placed as engineered fill. In addition, all native soils over-excavated should be compacted as engineered fill. Refer to Section 8.4.5 of this report for the moisture content range and minimum percent relative compaction recommendations for engineered fill.

8.3.10 The contractor should locate all on-site water wells (if any) and monitoring wells. All wells scheduled for demolition should be abandoned per state and local requirements. The contractor should obtain an abandonment permit from the local environmental health department, and issue certificates of destruction to the owner and Moore Twining upon completion. At a minimum, wells in building areas (and within 5 feet of building perimeters) should have their casings removed to a depth of at least 8 feet below preconstruction site grades or finished pad grades, whichever is deeper. In parking lot or landscape areas, the casings should be removed to a depth of at least 5 feet below site grades or finished grades. The wells should be capped with concrete and the resulting excavations should be backfilled as engineered fill.

8.3.11 The moisture content and density of the compacted soils should be maintained until the placement of concrete. If soft or unstable soils are encountered during excavation or compaction operations, our firm should be notified so the soils conditions can be examined and additional recommendations provided to address the pliant areas.

8.3.12 Final grading shall produce building pads ready to receive a slab-on-grade which is smooth, planar, and resistant to rutting. The finished pad (before aggregate base is placed) shall not depress more than one-half (½) inch under the wheels of a fully loaded water truck, or equivalent loading. If depressions more than one-half (½) inch occur, the contractor shall perform remedial grading to achieve this requirement at no cost to the owner.

8.3.13 The Contractor should be responsible for the disposal of concrete, asphaltic concrete, soil, spoils, etc. (if any) that must be exported from the site. Individuals, facilities, agencies, etc. may require analytical testing and other assessments of these materials to determine if these materials are acceptable. The Contractor should be responsible to perform the tests, assessments, etc. to determine the appropriate method of disposal.

8.4 Engineered Fill

8.4.1 The on-site near surface soils encountered are predominantly silty sands; silty, clayey sands; and clayey sands. The on-site soils will be suitable for use as engineered fill below the recommended aggregate base section, provided they are free of organics (less than 3 percent by weight and no roots larger than ¼ inch in diameter), irreducible material greater than 3 inches, have an expansion index of less than 20 and the moisture content of the soil is within optimum to three (3) percent above optimum moisture content at the time of placement. This report recommends that interior and exterior slabs-on-grade be underlain by at least 4 inches of aggregate base. If soils other than those considered in this report are encountered, Moore Twining should be notified to provide alternate recommendations.

8.4.2 If materials larger than 3 inches are encountered in the excavated material, the oversize rock should be removed prior to use as engineered fill (mar require hand picking).

8.4.3 The compactability of the native soils is dependent upon the moisture contents, subgrade conditions, degree of mixing, type of equipment, as well as other factors. The evaluation of such factors was beyond the scope of this report; therefore, it is recommended that they be evaluated by the contractor during preparation of bids and construction of the project.

8.4.4 Import fill soil (if any) should be non-recycled, non-expansive and granular in nature with the following acceptance criteria recommended.

Percent Passing 3-Inch Sieve	100
Percent Passing No. 4 Sieve	85 - 100
Percent Passing No. 200 Sieve	10 - 40
Expansion Index (ASTM D4829)	Less than 15
Organics	Less than 3 percent by weight
R-Value	Minimum 35*
Sulfates	< 0.05 percent by weight
Min. Resistivity	>5,000 ohms-cm

* for pavement areas only

Prior to importing fill, the import material shall be certified by the Contractor and the supplier (to the satisfaction of the Owner) that the soils do not contain any environmental contaminates regulated by local, state or federal agencies having jurisdiction. The Contractor shall pay for the environmental testing required to determine compliance with the requirements of this report. This certification shall consist of, as a minimum, recent analytical data specific to the source of the import material including proper chain-of-custody documentation. In lieu of sampling and testing aggregate base materials (or bedding sand) from virgin sand and gravel sources, a letter stating that the aggregate base (or bedding sand) comprises materials entirely from natural (virgin) sources and that the aggregate base (or bedding sand) is non-contaminated may be provided by the Contractor. Moore Twining will sample and test the material after the environmental certification submittal is approved to verify that the proposed material complies with the geotechnical engineering recommendations of this report. The Contractor shall allow a minimum of seven (7) working days for each import source to be tested for the geotechnical properties.

8.4.5 Native and imported engineered fill soil should be placed in loose lifts approximately 8 inches thick, moisture-conditioned to between optimum moisture content and three (3) percent above optimum moisture content, and compacted to a dry density of at least 92 percent of the maximum dry density as determined by ASTM Test Method D1557, with exception that the upper 12 inches of fill and subgrade compacted in pavement areas should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM Test Method D1557. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable.

8.4.6 In-place density testing should be conducted in accordance with ASTM D 6938 (nuclear methods) at a frequency of at least:

Table No. 4

Area	Minimum Test Frequency
Building Pad	1 test per 5,000 square feet per compacted lift, but not less than two tests per lift
Pavement Subgrade and Mass Grading Outside Building Pads	1 test per 5,000 square feet per compacted lift
Utility Lines	1 test per 150 feet per lift

8.4.7 Open graded gravel and rock material such as ¾-inch crushed rock or ½-inch crushed rock should not be used as backfill, including trench backfill. In the event gravel or rock is required by a regulatory agency for use as backfill (Contractor to obtain a letter from the agency stating the requirement for rock and/or gravel as backfill), all open graded materials shall be fully encased in a geotextile filter fabric, such as Mirafi 140N, to prevent migration of fine grained soils into the porous material. Gravel and rock cannot be used without the written approval of Moore Twining. If the contractor elects to use crushed rock (and if approved by Moore Twining), the contractor will be responsible for slurry cut off walls at the locations directed by Moore Twining. Crushed rock should be placed in thin (less than 8 inch) lifts and densified with a minimum of three (3) passes using a vibratory compactor.

8.4.8 Aggregate base below the interior building slab on grade shall be non-recycled and comply with Class 2 aggregate base (AB) per Caltrans Standard Specifications. Aggregate base used for pavement construction should comply with Class 2 aggregate base in accordance Caltrans Standard Specifications and may include recycled materials. Aggregate base shall be compacted to a minimum relative compaction of 95 percent in accordance with ASTM D1557 standards.

8.5 Shallow Spread Foundations

8.5.1 A structural engineer experienced in foundation design should recommend the thickness, design details and concrete specifications for the foundations based on the estimated settlements. The following static settlements should be anticipated for design: 1) a total static settlement of 1 inch; and 2) a differential static settlement of ½-inch in 40 feet.

8.5.2 Foundations supported on engineered fill prepared as recommended in the Site Preparation section of this report may be designed for a maximum net allowable soil bearing pressure of 2,500 pounds per square foot for dead-plus-live loads. This value may be increased by one-third for short duration wind or seismic loads.

8.5.3 Perimeter foundations should have a minimum depth of 18 inches below the lowest adjacent finished exterior ground surface. Interior footings should have a minimum depth of at least 12 inches below the bottom of the slab-on-grade. All footings should have a minimum width of 15 inches, regardless of load.

8.5.4 The foundations should be continuous around the perimeter of the proposed building to reduce moisture migration beneath the structures. Continuous perimeter foundations should be extended through doorways and/or openings that are not needed for support of loads.

8.5.5 The following seismic factors were developed using online data obtained from the Ground Motion Parameter Calculator provided by the Structural Engineers Association of California website (https://seismicmaps.org/) based upon a latitude of 34.423305 degrees and a longitude of -117.316065 degrees and a Site Class D. The data provided in Table No. 5 are based upon the procedures of the 2022 California Building Code and were not determined based upon a ground motion hazard analysis. The structural engineer should review the values in Table No. 5 and determine whether a ground motion hazard analysis is required for the project considering the seismic design category, structural details, and requirements of ASCE 7-16 (Section 11.4.8 and other applicable sections). If required, Moore Twining should be notified and requested to conduct the additional analysis, develop updated seismic factors for the project, and update the following values.

Table No. 5
Seismic Factors

Seismic Factor	2022 CBC Value*
Site Class	D
Maximum Considered Earthquake (geometric mean) peak ground acceleration adjusted for site effects (PGA_M)	0.550g
Mapped Maximum Considered Earthquake (geometric mean) peak ground acceleration ASCE 7-10 (PGA)	0.500g
Spectral Response At Short Period (0.2 Second), Ss	1.415
Spectral Response At 1-Second Period, S_1	0.547
Site Coefficient (based on Spectral Response At Short Period), Fa	1.0

Seismic Factor	2022 CBC Value*
Site Coefficient (based on spectral response at 1-second period) Fv	See Note
Maximum considered earthquake spectral response acceleration for short period, S_{MS}	1.415
Maximum considered earthquake spectral response acceleration at 1 second, S_{M1}	See Note
Five percent damped design spectral response accelerations for short period, S_{DS}	0.944
Five percent damped design spectral response accelerations at 1-second period, S_{D1}	See Note

Note: Requires ground motion hazard analysis per ASCE Section 21.2 (ASCE 7-16, Section 11.4.8), unless an Exception of Section 11.4.8 of ASCE 7-16 is applicable for the project design.

*The above data is subject to the disclaimers listed in the website https://seismicmaps.org/

8.5.6 All loose soils should be removed from foundation excavations and the excavations should be maintained at near optimum moisture content by periodic wetting. Foundation excavations should be observed by Moore Twining prior to the placement of steel reinforcement and concrete to verify conformance with the intent of the recommendations of this report. The Contractor is responsible for proper notification to Moore Twining and receipt of written confirmation of this observation prior to placement of steel reinforcement.

8.5.7 Structural loads for lightly loaded (less than 1.5 kips per lineal foot) miscellaneous foundations (such as screen walls for the proposed trash enclosures) may be supported engineered fills prepared in accordance with the recommendations included in the Site Preparation section of this report. The lightly loaded foundations should extend to a minimum depth of 12 inches below the lowest adjacent grade and a minimum width of 12 inches, regardless of load. Footings for miscellaneous lightly loaded foundations may be designed for a maximum net allowable soil bearing pressure of 1,500 pounds per square foot for dead-plus-live loads. These values may be increased by one-third for short duration wind or seismic loads.

8.5.8 The bottom surface area of concrete footings or concrete slabs in direct contact with engineered fill can be used to resist lateral loads. An allowable coefficient of friction of 0.40 can be used for design. In areas where slabs are underlain by a synthetic moisture barrier, an allowable coefficient of friction of 0.10 can be used for design.

8.5.9 The allowable passive resistance of the native soils and engineered fill may be assumed to be equal to the pressure developed by a fluid with a density of 350 pounds per cubic foot. The upper 6 inches of subgrade in landscaped areas should be neglected in determining the total passive resistance.

8.6 Interior Slabs-on-Grade

8.6.1 Interior slabs-on-grade should be supported over 4 inches of non-recycled aggregate base over engineered fill extending to the depth recommended below foundations in the Site Preparation section of this report.

8.6.2 The recommendations provided herein are intended only for the design of interior concrete slabs-on-grade and their proposed uses, which do not include construction traffic (i.e., cranes, cement mixers, and rock trucks, etc.). The building contractor should assess the slab section and determine its adequacy to support any proposed construction traffic.

8.6.3 The slabs and underlying subgrade should be constructed in accordance with current American Concrete Institute (ACI) standards.

8.6.4 A vapor retarder should be placed below interior building slabs where moisture could permeate into the interior and create problems. Refer to the American Concrete Institute's Guide to Concrete Floor and Slab Construction (ACI 302.1R) for selection and installation of moisture vapor retarders. It is recommended that a Stegowrap 15 vapor retarder be used where moisture could permeate into the interior and create problems, such as where flooring or floor slab applications will contain moisture sensitive materials (or other slab applications or uses). The vapor retarder should overlay the compacted 4 inch layer of aggregate base. It should be noted that placing the PCC slab directly on the vapor retarder may increase the potential for cracking and curling; however, ACI recommends the placement of the vapor retarding membrane directly below the slab unless a watertight roofing system is in place prior to slab construction to reduce the amount vapor emission through the slab-on-grade. It is recommended that the slab be moist cured for a minimum of 7 days to reduce the potential for excessive cracking.

The underslab membrane should have a high puncture resistance (minimum of approximately 2,400 grams of puncture resistance), high abrasion resistance, rot resistant, and mildew resistant. It is recommended that the membrane be selected in accordance with the current ASTM C 755, Standard Practice For Selection of Vapor Retarder For Thermal Insulation and conform to the current ASTM E 1745 Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs and ASTM E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Waters, or as Ground Cover. It is recommended that the vapor barrier installation conform to the current ACI Manual of Concrete Practice, Guide for Concrete Floor and Slab Construction (302.1R), Addendum, Vapor Retarder Location and current ASTM E 1643, Standard Practice for Installation of Water Vapor Retarders Used In Contact with Earth or Granular Fill Under Concrete Slabs. In addition, it is recommended that the manufacturer of floor covering, floor covering adhesive or other slab material applications be consulted to determine if the manufacturers have additional recommendations regarding the design and construction of the slab-on-grade, testing of the slab-on-grade, slab preparation, application of the adhesive, installation of the floor covering and maintenance requirements. It should be noted that the recommendations presented in this report are not intended to achieve a specific vapor emission rate.

8.6.5 The membrane should be installed so that there are no holes or uncovered areas. All seams should be overlapped and sealed with the manufacturer approved tape continuous at the laps so they are vapor tight. All perimeter edges of the membrane, such as pipe penetrations, interior and exterior footings, joints, etc., should be caulked per manufacturer's recommendations.

8.6.6 Tears or punctures that may occur in the membrane should be repaired prior to placement of concrete per manufacturer's recommendations. Once repaired, the membrane should be inspected by the contractor and the owner to verify adequate compliance with manufacture's recommendations.

8.6.7 The moisture retarding membrane is not required beneath exposed concrete floors, such as warehouses and garages, provided that moisture intrusion into the structures are permissible for the design life of the structures.

8.6.8 Additional measures to reduce moisture migration (for moisture sensitive floors) and out of plane drying shrinkage cracking for all slab areas should be implemented. These include: 1) constructing a less pervious concrete floor slab by maintaining a water-cement ratio of 0.52 or less in the concrete for slabs-on-grade, 2) ensuring that all seams and utility protrusions are

sealed with tape to create a "water tight" moisture barrier, 3) placing concrete walkways or pavements adjacent to the structures, 4) providing adequate drainage away from the structures, 5) moist cure the slabs for at least 7 days, and 6) locating lawns, irrigated landscape areas, and flower beds away from the structures.

8.6.9 The Contractor shall test the moisture vapor transmission through the slab, the pH, internal relative humidity, etc., at a frequency and method as specified by the flooring manufacturer or as required by the plans and specifications, whichever is most stringent. The results of vapor transmission tests, pH tests, internal relative humidity tests, ambient building conditions, etc. should be within floor manufacturer's and adhesive manufacturer's specifications at the time the floor is placed. It is recommended that the floor manufacturer and subcontractor review and approve the test data prior to floor covering installation.

8.6.10 To reduce the potential for damaging slabs during construction the following recommendations are presented: 1) design for a differential slab movement of ½ inch relative to interior columns; and 2) the construction equipment which will operate on slabs or pavements should be evaluated by the contractor prior to loading the slab.

8.6.11 Backfill the zone above the top of footings at interior column locations, building perimeters, and below the bottom of slabs with an approved backfill as recommended herein for the area below interior slabs-on-grade. This procedure should provide more uniform support for the slabs which may reduce the potential for cracking.

8.7 Exterior Slabs-On-Grade

The recommendations for exterior slabs provided below are not intended for use for slabs subjected to vehicular traffic. They are intended for pedestrian traffic areas.

8.7.1 Exterior improvements that subject the subgrade soils to a sustained load greater than 150 pounds per square foot should be prepared in accordance with recommendations presented in this report for interior slabs-on-grade. Moore Twining can provide alternative design recommendations for exterior slabs, if requested.

8.7.2 Exterior slabs within the building pad preparation limits and exterior slabs outside the building pad preparation limits should be supported on 4 inches of aggregate base overlying subgrade soils prepared in accordance with the recommendations provided in the "Site Preparation" section of this report.

8.7.3 The moisture content of the subgrade soils should be verified to be at least optimum moisture content within 48 hours of placement of the slab-on-grade. If necessary to achieve the recommended moisture content, the subgrade could be over-excavated, moisture conditioned as necessary and compacted as engineered fill.

8.7.4 The exterior slabs-on-grade adjacent to landscape areas should be designed with thickened edges which extend to the bottom of the aggregate base. This should reduce the potential for infiltration of water into the aggregate base below exterior slabs.

8.7.5 Since exterior sidewalks, curbs, etc. are typically constructed at the end of the construction process, the moisture conditioning conducted during earthwork can revert to natural dry conditions. Placing concrete walks and finish work over dry or slightly moist subgrade should be avoided. It is recommended that the general contractor notify Moore Twining to conduct in-place moisture and density tests prior to placing concrete flatwork. Written test results indicating passing density and moisture tests should be in the general contractor's possession prior to placing concrete for exterior flatwork.

8.8 Asphaltic Concrete (AC) Pavements

8.8.1 The subgrade soils for asphaltic concrete pavements should be over-excavated and compacted as recommended in the "Site Preparation" section of the recommendations in this report. As part of the final preparation, the upper 12 inches of the subgrade soils should be moisture conditioned and compacted to a minimum of 95 percent of the maximum dry density determined in accordance with ASTM D 1557.

8.8.2 The following pavement sections are based on an R-value of 35 and traffic index values ranging from 5.0 to 7.0. A minimum of 3 inches of asphalt concrete is recommended below for the pavement sections. It should be noted that if pavements are constructed prior to construction of the buildings, the traffic index value should account for construction traffic. The actual traffic index values applicable to the site should be determined by the project civil engineer.

Table No. 6
Two-Layer Asphalt Concrete Pavements

Traffic Index	AC thickness, inches	AB thickness, inches	Compacted Subgrade, inches
5.0	3.0	4.5	12
5.5	3.0	6.0	12
6.0	3.5	6.5	12
6.5	3.5	8.0	12
7.0	4.0	8.5	12
7.5	4.0	9.5	12
8.0	4.5	10.0	12

AC - Asphaltic Concrete compacted as recommended in this report
AB - Class II Aggregate Base with minimum R-value of 78 and compacted to at least 95 percent relative compaction (ASTM D1557)
Subgrade - Subgrade soils compacted to at least 95 percent relative compaction (ASTM D1557)

8.8.3 The curbs where pavements meet irrigated landscape areas or uncovered open areas should extend at least to the bottom of the aggregate base section. This should reduce subgrade moisture from irrigation and runoff from migrating into the base section and reducing the life of the pavements.

8.8.4 If actual pavement subgrade materials are significantly different from those tested for this study due to unanticipated grading or soil importing, the pavement sections should be re-evaluated for the changed subgrade conditions.

8.8.5 If the paved areas are to be used during construction, or if the type and frequency of traffic are greater than assumed in design, the pavement sections should be re-evaluated for the anticipated traffic.

8.8.6 Pavement section design assumes that proper maintenance, such as sealing and repair of localized distress, will be performed on an as needed basis for longevity and safety.

8.8.7 Pavement materials and construction method should conform to the State of California Standard Specifications.

8.8.8 It is recommended that the base 2 inch thick course of asphaltic concrete consist of a ¾ inch maximum medium gradation. The top course or wear course should consist of a ½ inch maximum medium gradation.

8.8.9 The asphaltic concrete, including the joint density, should be compacted to an average relative compaction of 93 percent, with no single test value being below a relative compaction of 91 percent and no single test value being above a relative compaction of 97 percent of the referenced laboratory density according to ASTM D2041.

8.8.10 The asphalt concrete should comply with the requirements for a Type A asphalt concrete in accordance with the current State of California Department of Transportation (Caltrans) Standard Specification, or the requirements of the governing agency, whichever is more stringent.

8.9 Portland Cement Concrete (PCC) Pavements

Recommendations for Portland Cement Concrete pavement structural sections are presented in the following subsections. The PCC pavement design assumes a minimum modulus of rupture of 500 psi. The design professional should specify where Portland cement concrete pavements are used based on the anticipated type and frequency of traffic.

8.9.1 The subgrade soils for Portland cement concrete pavements should be over-excavated and compacted as recommended in the "Site Preparation" section of the recommendations in this report. As part of the final preparation, the upper 12 inches of the subgrade soils should be moisture conditioned and compacted to a minimum of 95 percent of the maximum dry density determined in accordance with ASTM D 1557.

8.9.2 The following preliminary Portland cement concrete pavement sections have been prepared for Traffic Indices Ranging from 6.0 to 8.0. The design pavement sections should be selected by the civil engineer based on the anticipated traffic loading. If the paved areas are to be used during construction, or if the type and frequency of traffic are greater than assumed in design, the pavement section should be re-evaluated for the anticipated traffic.

Table No. 7
Portland Cement Concrete Pavements

Traffic Index	Average Daily Truck Traffic (ADTT)	PCC thickness (inches)	Aggregate Base (inches)	Compacted Subgrade (inches)
6.0	2.0	6.0	4.0	12.0
7.0	7.3	6.0	4.0	12.0
8.0	22.2	6.5	4.0	12.0

ADTT - Average Daily Truck Traffic based on a loaded garbage/dumpster truck
PCC - Portland Cement Concrete (minimum Modulus of Rupture=500 psi)
Subgrade - Subgrade soils compacted to at least 95 percent relative compaction (ASTM D-1557)

8.9.3 The PCC pavement should be constructed in accordance with American Concrete Institute requirements, the requirements of the project plans and specifications, whichever is the most stringent. The pavement design engineer should include appropriate construction details and specifications for construction joints, contraction joints, joint filler, concrete specifications, curing methods, etc.

8.9.4 Concrete used for PCC pavements shall possess a minimum flexural strength (modulus of rupture) of 500 pounds per square inch. A minimum compressive strength of 3,500 pounds per square inch, or greater as required by the pavement designer, is recommended. Specifications for the concrete to reduce the effects of excessive shrinkage, such as maximum water requirements for the concrete mix, allowable shrinkage limits, contraction joint construction requirements, etc. should be provided by the designer of the PCC slabs.

8.9.5 Jointing is one of the most critical aspects of the PCC pavement design and construction. Joint spacing, joint type and load transfer devices have significant impacts on the pavement design and performance. Thus, the detailing of joints needs to be considered carefully and applied with clear details on the project plans by the pavement designer/detailer. Positive load transfer devices such as dowels are commonly used at contraction joints whenever the designer cannot be assured aggregate interlock will be maintained.

8.9.6 Specifications for the concrete mixtures used in the PCC pavement to reduce the effects of excessive shrinkage (such as curling and excessive shrinkage at joints), including maximum water requirements for the concrete mix, allowable shrinkage limits, curing methods, etc. should be provided by the designer/detailer of the PCC slabs. In addition, as noted in Section 8.9.5, contraction joint requirements should be detailed by the designer/detailer of the PCC pavement to maintain stability. The minimum PCC thickness noted in this report assumes aggregate interlock occurs at contraction joints. However, curling and excessive shrinkage can disengage aggregate interlock and allow greater pavement deflection at free edges.

8.9.7 Contraction and construction joints should include a joint filler/sealer to prevent migration of water into the subgrade soils. The type of joint filler should be specified by the pavement designer. The joint sealer and filler material should be maintained throughout the life of the pavement.

8.9.8 Contraction joints should have a depth of at least one-fourth the slab thickness, e.g., 1.5-inch for a 6-inch slab. Specifications for contraction joint spacing, timing and depth of sawcuts should be included in the plans and specifications.

8.9.9 Stresses are anticipated to be greater at the edges and construction joints of the pavement section. A thickened edge is recommended on the outside of slabs subjected to wheel loads.

8.9.10 Joint spacing in feet should not exceed twice the slab thickness in inches, e.g., 12 feet by 12 feet for a 6-inch slab thickness. Regardless of slab thickness, joint spacing should not exceed 15 feet.

8.9.11 Lay out joints to form square panels. When this is not practical, rectangular panels can be used if the long dimension is no more than 1.5 times the short.

8.9.12 Isolation (expansion) joints should extend the full depth and should be used only to isolate fixed objects abutting or within paved areas.

8.9.13 Pavement section design assumes that proper maintenance such as sealing and repair of localized distress will be performed on a periodic basis.

8.10 Slopes, Shoring and Temporary Excavations

8.10.1 It is the responsibility of the contractor to provide safe working conditions with respect to excavation slope stability. The contractor is responsible for site slope safety, classification of materials for excavation purposes, and maintaining slopes in a safe manner during construction. The grades, classification and height recommendations presented for temporary slopes are for consideration in preparing budget estimates and evaluating construction procedures.

8.10.2 Due to the low cohesion of the onsite soils, temporary excavations should be constructed in accordance with CAL OSHA requirements. Temporary cut slopes should not be steeper than 2:1, horizontal to vertical, and flatter if possible. If excavations cannot meet these criteria, the temporary excavations should be shored.

8.10.3 In no case should excavations extend below a 2H to 1V zone below existing roadways, utilities, foundations and/or floor slabs which are to remain after construction. Excavations which are required to be advanced below the 2H to 1V envelope should be shored to support the soils, foundations, and slabs.

8.10.4 All soils disturbed as part of the shoring removal shall be over-excavated and compacted as engineered fill. In addition, all cavities and void space resulting from the shoring removal activity shall be backfilled with a cementitious grout under pressure to backfill the voids created by removal of the shoring. All voids resulting from removal of shoring shall be backfilled.

8.10.5 Excavation stability should be monitored by the contractor. Slope gradient estimates provided in this report do not relieve the contractor of the responsibility for excavation safety. In the event that tension cracks or distress to the structure occurs, during or after excavation, the owner should be notified immediately and the contractor should take appropriate actions to minimize further damage or injury.

8.11 Utility Trenches

8.11.1 The utility trench subgrade should be prepared by excavation of a neat trench without disturbance to the bottom of the trench. If sidewalls are unstable, the Contractor shall either slope the excavation to create a stable sidewall or shore the excavation. All trench subgrade soils disturbed during excavation, such as by accidental over-excavation of the trench bottom, or by excavation equipment with cutting teeth, should be compacted to a minimum of 92 percent relative compaction prior to placement of bedding material. The Contractor is responsible for notifying Moore Twining when these conditions occur and arrange for Moore Twining to observe and test these areas prior to placement of pipe bedding. The Contractor shall use such equipment as necessary to achieve a smooth undisturbed native soil surface at the bottom of the trench with no loose material at the bottom of the trench. The Contractor shall either remove all loose soils or compact the loose soils as engineered fill prior to placement of bedding, pipe and backfill of the trench.

8.11.2 The trench width, type of pipe bedding, the type of initial backfill, and the compaction requirements of bedding and initial backfill material for utility trenches (storm drainage, sewer, water, electrical, gas, cable, phone, irrigation, etc.) should be specified by the project Civil Engineer or applicable design professional in compliance with the manufacturer's requirements, governing agency requirements and this report, whichever is more stringent. The contractor is responsible for contacting the governing agency to determine the requirements for pipe bedding, pipe zone and final backfill. The contractor is responsible for notifying the Owner and Moore Twining if the requirements of the agency and this report conflict, the most stringent applies. For flexible polyvinylchloride (PVC) pipes, these requirements should be in accordance with the manufacturer's requirements or ASTM D-2321, whichever is more stringent, assuming a hydraulic gradient exists (gravel, rock, crushed gravel, etc. cannot be used as backfill on the project). The width of the trench should provide a minimum clearance of 8 inches between the sidewalls of the pipe and the trench, or as necessary to provide a trench width that is 12 inches greater than 1.25 times the outside diameter of the pipe, whichever is greater. As a minimum, the pipe bedding should consist of 4 inches of compacted (92 percent relative compaction) select sand with a minimum sand equivalent of 30 and meeting the following requirements: 100 percent passing the 1/4 inch sieve, a minimum of 90 percent passing the No. 4 sieve and not more than 10

percent passing the No. 200 sieve. The haunches and initial backfill (12 inches above the top of pipe) should consist of a select sand meeting these sand equivalent and gradation requirements that is placed in maximum 6-inch thick lifts and compacted to a minimum relative compaction of 92 percent using hand equipment. The final fill (12 inches above the pipe to the surface) should be on-site or imported, non-expansive materials moisture conditioned to between optimum and three (3) percent above optimum moisture content and compacted to a minimum of 92 percent relative compaction, except the upper 12 inches of trench backfill in pavement areas should be compacted to a minimum of 95 percent relative compaction. The project civil engineer should take measures to control migration of moisture in the trenches such as slurry collars, etc.

8.11.3 If ribbed or corrugated HDPE or metal pipes are used on the project, then the backfill should consist of select sand with a minimum sand equivalent of 30, 100 percent passing the 1/4 inch sieve, a minimum of 90 percent passing the No. 4 sieve and not more than 10 percent passing the No. 200 sieve. The sand shall be placed in maximum 6-inch thick lifts, extending to at least 1 foot above the top of pipe, and compacted to a minimum relative compaction of 92 percent using hand equipment. Prior to placement of the pipe, as a minimum, the pipe bedding should consist of 4 inches of compacted (92 percent relative compaction) sand meeting the above sand equivalent and gradation requirements for select sand bedding. The width of the trench should meet the requirements of ASTM D2321 listed in table below (minimum manufacturer requirements), or to a minimum of 24 inches, whichever is greater. As an alternative to the trench width recommended above and the use of the select sand bedding, a lesser trench width for HDPE pipes may be used if the trench is backfilled with a 2-sack sand-cement slurry from the bottom of the trench to 1 foot above the top of the pipe.

Table No. 8
Minimum Trench Widths for HDPE Pipe with Sand Bedding Initial Backfill

Inside Diameter of HDPE Pipe (inches)	Outside Diameter of HDPE Pipe (inches)	Minimum Trench Width (inches) per ASTM D2321
12	14.2	30
18	21.5	39
24	28.4	48
36	41.4	64
48	55	80

8.11.4 Open graded gravel and rock material such as ¾-inch crushed rock or ½-inch crushed rock should not be used as backfill including trench backfill. In the event gravel or rock is required by a regulatory agency for use as backfill (Contractor to obtain a letter from the agency stating the requirement for rock and/or gravel as backfill), all open graded materials shall be fully encased in a geotextile filter fabric, such as Mirafi 140N, to prevent migration of fine grained soils into the porous material. Gravel and rock cannot be used without the written approval of Moore Twining. If the contractor elects to use crushed rock (and if approved by Moore Twining), the contractor will be responsible for slurry cut off walls at the locations directed by Moore Twining. Crushed rock should be placed in thin (less than 8 inch) lifts and densified with a minimum of three (3) passes using a vibratory compactor.

8.11.5 Utility trench backfill placed in or adjacent to building areas, exterior slabs or pavements should be placed in 8 inch lifts, moisture conditioned to between optimum and three (3) percent above the optimum moisture content and compacted to at least 92 percent of the maximum dry density as determined by ASTM Test Method D1557, except the upper 12 inches of trench backfill in pavement areas should be compacted to a minimum of 95 percent relative compaction. Lift thickness can be increased if the contractor can demonstrate the minimum compaction requirements can be achieved. The contractor should use appropriate equipment and methods to avoid damage to utilities and/or structures during placement and compaction of the backfill materials.

8.11.6 On-site soils and approved imported engineered fill may be used as final backfill (12 inches above the pipe to the ground surface) in trenches.

8.11.7 Jetting of trench backfill is not allowed to compact the backfill soils.

8.11.8 Where utility trenches extend from the exterior to the interior limits of a building, lean concrete should be used as backfill material for a minimum distance of 2 feet laterally on each side of the exterior building line to prevent the trench from acting as a conduit to exterior surface water.

8.11.9 Storm drains and/or utility lines should be designed to be "watertight." If encountered, leaks should be immediately repaired. Leaking storm drain and/or utility lines could result in trench failure, sloughing and/or soil movement causing damage to surface and subsurface structures, pavements, flatwork, etc. In addition, landscaping irrigation systems should be monitored for leaks. The Contractor is required to video inspect or pressure test the wet utilities prior to placement of foundations, slabs-on-grade or pavements to verify that the pipelines are constructed properly and are "watertight." The Contractor shall provide the Owner a copy of the results of the testing. The Contractor is required to repair all noted deficiencies at no cost to the owner.

8.11.10 The plans should note that all utility trenches, including electrical lines, irrigation lines, etc. should be compacted to a minimum relative compaction of 92 percent per ASTM D-1557 except for the upper 12 inches below pavements which should be compacted to at least 95 percent relative compaction.

8.11.11 Utility trenches should not be constructed within a zone defined by a line that extends at an inclination of 2 horizontal to 1 vertical downward from the bottom of building foundations.

8.12 Corrosion Protection

8.12.1 Based on National Association of Corrosion Engineers (NACE) corrosion severity ratings listed in the Table No. 1 and the analytical results of sample analyses indicate the one sample tested had a resistivity value of 3,100 ohms-centimeter. This is consistent with data for two samples that had a resistivity values of 4,269 and 4,402 ohms-centimeter that were previously tested in 2019 on the proposed adjacent McDonald's parcel during Moore Twining's investigation for the previously planned Circle K development. Based on the resistivity values, the soils exhibit a "corrosive" corrosion potential. Therefore, buried metal objects should be protected in accordance with the manufacturer's recommendations based on a "corrosive" corrosion potential. The evaluation was limited to the effects of soils to metal objects; corrosion due to other potential sources, such as stray currents and groundwater, was not evaluated. If piping or concrete are placed in contact with deeper soils or engineered fill, these soils should be analyzed to evaluate the corrosion potential of these soils.

8.12.2 Corrosion of concrete due to sulfate attack is not anticipated based on the concentration of sulfates determined for the near-surface soils of 0.0026 percent by dry weight. According to provisions of ACI 318, section 4.3 , the sulfate concentration falls in the negligible classification (0.00 to 0.10 percent by weight) for concrete. Therefore, no restrictions are required regarding the type, water-to-cement ratio, or strength of the concrete used for foundation and slabs due to the sulfate content. However, a low water to cement ratio of 0.52 or less is recommended for slabs on grade as recommended in the "Interior Slab on Grade" section of this report.

8.12.3 These soil corrosion data should be provided to the manufacturers or suppliers of materials that will be in contact with soils (pipes or ferrous metal objects, etc.) to provide assistance in selecting the protection and materials for the proposed products or materials. If the manufacturers or suppliers cannot determine if materials are compatible with the soil corrosion conditions, a professional consultant, i.e., a corrosion engineer, with experience in corrosion protection should be consulted to design parameters. Moore Twining is not a corrosion engineer; thus, cannot provide recommendations for mitigation of corrosive soil conditions. It is recommended that a corrosion engineer be consulted for the site specific conditions.

9.0 DESIGN CONSULTATION

9.1 Moore Twining should be retained to review those portions of the contract drawings and specifications that pertain to earthwork operations, pavements and foundations prior to finalization to determine whether they are consistent with our recommendations. This service is not part of this current contractual agreement..

9.2 It is the client's responsibility to provide plans and specification documents for our review prior to their issuance for construction bidding purposes.

9.3 If Moore Twining is not retained for the plan review, we assume no liability for the misinterpretation of our conclusions and recommendations. This review is documented by a formal plan/specification review report provided by Moore Twining.

10.0 CONSTRUCTION MONITORING

10.1 It is recommended that Moore Twining be retained to observe the excavation, earthwork, and foundation phases of work to determine that the subsurface conditions are compatible with those used in the analysis and design.

10.2 Moore Twining can conduct the necessary observation and field testing to provide results so that action necessary to remedy indicated deficiencies can be taken in accordance with the plans and specifications. Upon completion of the work, a written summary of our observations, field testing and conclusions will be provided regarding the conformance of the completed work to the intent of the plans and specifications. This service is not, however, part of this current contractual agreement.

10.3 In the event that the earthwork operations for this project are conducted such that the construction sequence is not continuous, (or if construction operations disturb the surface soils) it is recommended that the exposed subgrade that will receive floor slabs be tested to verify adequate compaction and/or moisture conditioning. If adequate compaction or moisture contents are not verified, the fill soils should be over-excavated, scarified, moisture conditioned and compacted are recommended in the Recommendations of this report.

10.4 The construction monitoring is an integral part of this investigation. This phase of the work provides Moore Twining the opportunity to verify the subsurface conditions interpolated from the soil borings and make alternative recommendations if the conditions differ from those anticipated.

10.5 If Moore Twining is not afforded the opportunity to provide engineering observation and field-testing services during construction activities related to earthwork, foundations, pavements and trenches; then, Moore Twining will not be responsible for compliance of any aspect of the construction with our recommendations or performance of the structures or improvements if the recommendations of this report are not followed. It is recommended that if a firm other than Moore Twining is selected to conduct these services that they provide evidence of professional liability insurance of at least $3,000,000 and review this report. After their review, the firm should, in writing, state that they understand the conclusions and recommendations of this report and agree to conduct sufficient observations and testing to ensure the construction complies with this report's recommendations. Moore Twining should be notified, in writing, if another firm is selected to conduct observations and field-testing services prior to construction.

10.6 Upon the completion of work, a final report should be prepared by Moore Twining. This report is essential to ensure that the recommendations presented are incorporated into the project construction, and to note any deviations from the project plans and specifications. The client should notify Moore Twining upon the completion of work to prepare a final report summarizing the observations during site preparation activities relative to the recommendations of this report. This service is not, however, part of this current contractual agreement.

11.0 NOTIFICATION AND LIMITATIONS

11.1 The conclusions and recommendations presented in this report are based on the information provided regarding the proposed construction, and the results of the field and laboratory investigation, combined with interpolation of the subsurface conditions between boring locations. The nature and extent of subsurface variations between borings may not become evident until construction.

11.2 If variations or undesirable conditions are encountered during construction, Moore Twining should be notified promptly so that these conditions can be reviewed and our recommendations reconsidered where necessary. It should be noted that unexpected conditions frequently require additional expenditures for proper construction of the project.

11.3 If the proposed construction is relocated or redesigned, or if there is a substantial lapse of time between the submission of our report and the start of work (over 12 months) at the site, or if conditions have changed due to natural cause or construction operations at or adjacent to the site, the conclusions and recommendations contained in this report should be considered invalid unless the changes are reviewed and our conclusions and recommendations modified or approved in writing.

11.4 Changed site conditions, or relocation of proposed structures, may require additional field and laboratory investigations to determine if our conclusions and recommendations are applicable considering the changed conditions or time lapse.

11.5 The conclusions and recommendations contained in this report are valid only for the project discussed in Section 3.3, Anticipated Construction. The use of the information and recommendations contained in this report for structures on this site not discussed herein or for structures on other sites not discussed in this report is not recommended. The entity or entities that use or cause to use this report or any portion thereof for other structures or site not covered by this report shall hold Moore Twining, its officers and employees harmless from any and all claims and provide Moore Twining's defense in the event of a claim.

11.6 This report is issued with the understanding that it is the responsibility of the client to transmit the information and recommendations of this report to developers, owners, buyers, architects, engineers, designers, contractors, subcontractors, and other parties having interest in the project so that the steps necessary to carry out these recommendations in the design, construction and maintenance of the project are taken by the appropriate party.

11.7 This report presents the results of a geotechnical engineering investigation only and should not be construed as an environmental audit or study.

11.8 Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally-accepted engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied.

11.9 Reliance on this report by a third party (i.e., that is not a party to our written agreement) is at the party's sole risk. If the project and/or site are purchased by another party, the purchaser must obtain written authorization and sign an agreement with Moore Twining in order to rely upon the information provided in this report for design or construction of the project.

We appreciate the opportunity to be of service to Fountainhead Development. If you have any questions regarding this report, or if we can be of further assistance, please contact us at your convenience.

Sincerely,
MOORE TWINING ASSOCIATES, INC.
Geotechnical Engineering Division

Allen H. Harker, CEG
Certified Engineering Geologist

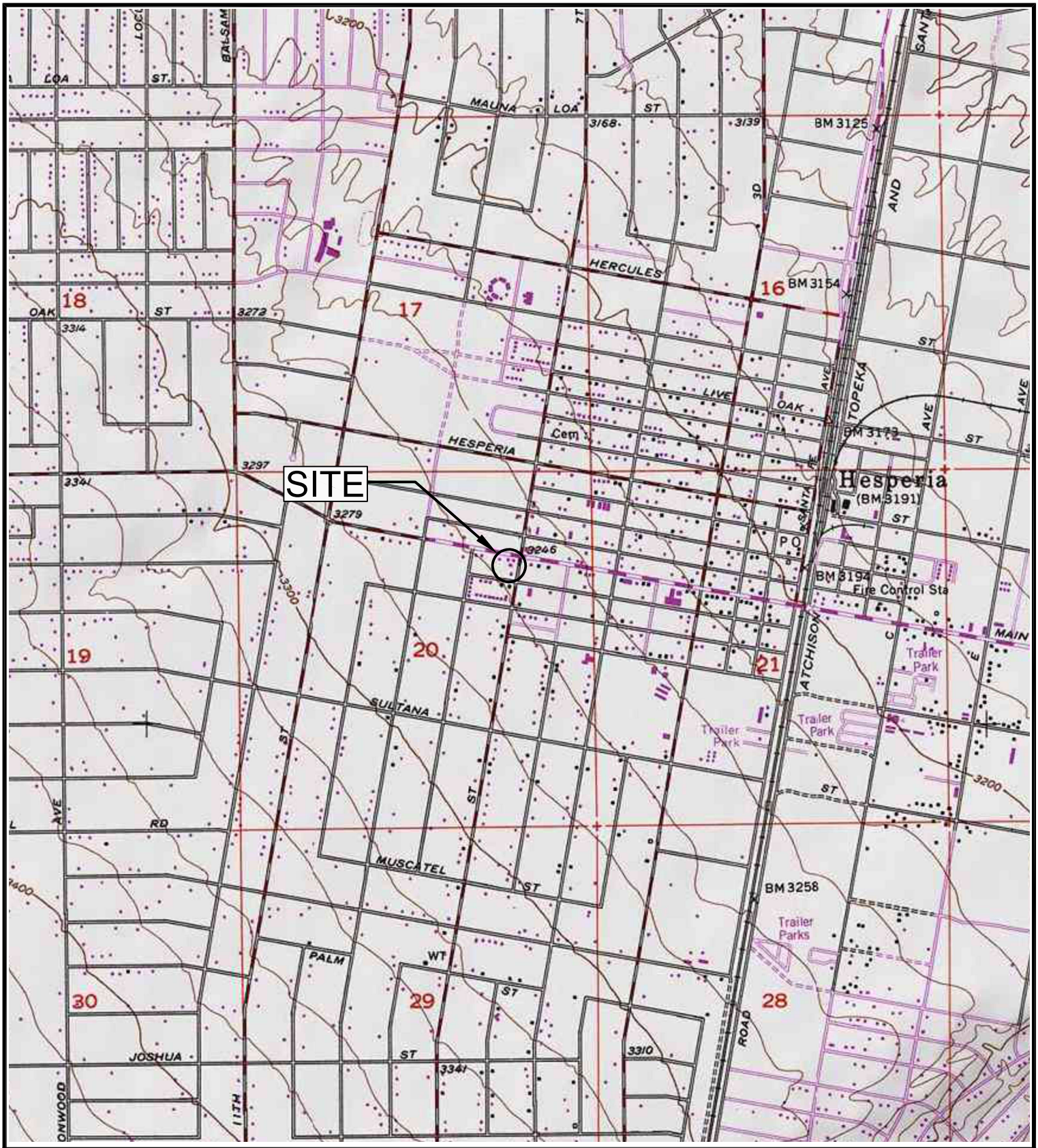
Harry D. Moore, RGE
President

APPENDIX A

DRAWINGS

Drawing No. 1 - Site Location Map

Drawing No. 2 - Test Boring Location Map



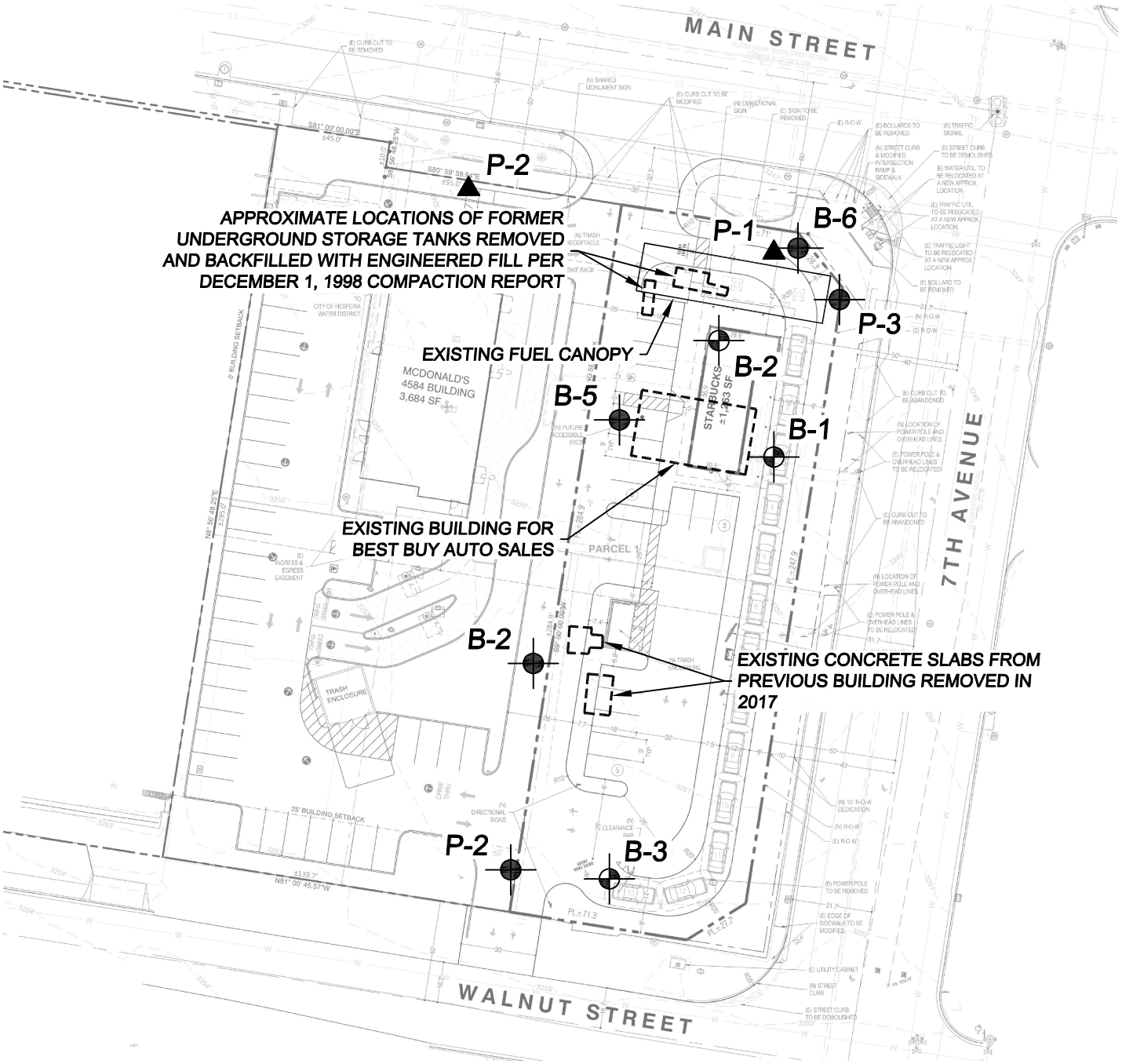
SOURCE: U.S.G.S. TOPOGRAPHIC MAP, 7 ½ MINUTE SERIES
HESPERIA, CALIFORNIA QUADRANGLE 1978, PHOTOREVISED 1980

0 2000
APPROXIMATE SCALE
IN FEET

SITE LOCATION MAP
PROPOSED STARBUCKS
SOUTHWEST CORNER OF MAIN STREET AND 7TH AVENUE
HESPERIA, CALIFORNIA

FILE NO.: 33201-01-01	DATE: 11/08/2024
DRAWN BY: RM	APPROVED BY:
PROJECT NO. H33201.01	DRAWING NO. 1

MOORE TWINING ASSOCIATES, INC.



APPROXIMATE TEST BORING LOCATION

APPROXIMATE PERCOLATION TEST LOCATION

APPROXIMATE LOCATIONS OF PREVIOUS BORINGS DRILLED BY MOORE TWINING IN 2018 WITHIN OR NEAR THE STARBUCKS PARCEL

N

0 60

APPROXIMATE SCALE IN FEET

TEST BORING AND PERCOLATION TEST BORING LOCATION MAP
PROPOSED STARBUCKS
SOUTHWEST CORNER OF MAIN STREET AND 7TH AVENUE
HESPERIA, CALIFORNIA

FILE NO.	DATE DRAWN:
33201-01-02	11/08/2024
DRAWN BY: RM	APPROVED BY:
PROJECT NO. H33201.01	DRAWING NO. 2

MOORE TWINING ASSOCIATES, INC.

APPENDIX B

LOGS OF BORINGS

This appendix contains the final logs of borings. These logs represent our interpretation of the contents of the field logs and the results of the field and laboratory tests.

The logs and related information depict subsurface conditions only at these locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these test boring locations. Also, the passage of time may result in changes in the soil conditions at these test boring locations.

In addition, an explanation of the abbreviations used in the preparation of the logs and a description of the Unified Soil Classification System are provided at the end of Appendix B.

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-1

Project: Proposed Starbucks in Hesperia

Project Number: H33201.01

Drilled By: 2R Drilling

Drill Type: CME 75

Auger Type: 8" O.D. Hollow Stem Augers

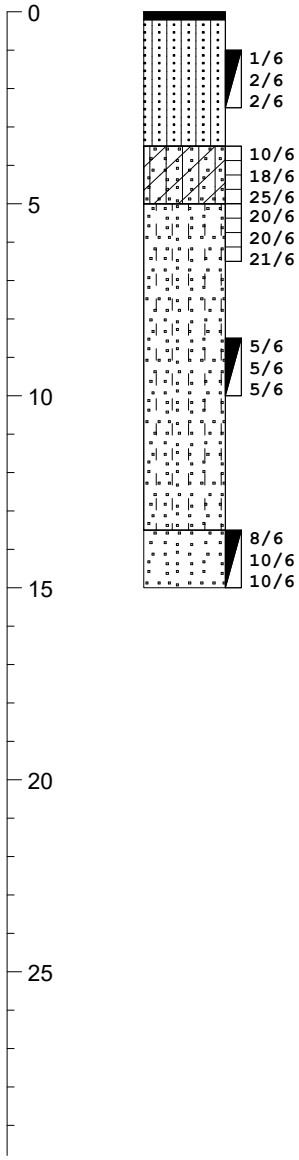
Hammer Type: 140 Pound Auto Trip

Logged By: A.V.

Date: October 23, 2024

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E



ELEVATION/ DEPTH (feet)	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
	AC	Asphalt Concrete = 2.5 inches			
	SM	SILTY SAND; loose, moist, fine to medium grained, brown, trace gravel		4	5.0
	SC-SM	SILTY, CLAYEY SAND; medium dense, moist, fine to coarse grained, brown, with a little fine gravel	From 3.5-5': DD = 126.5 pcf Gravel = 5.2% Sand = 74.4% -200 = 20.4% LL = 21 PI = 6	43	6.2
	SP-SM	POORLY GRADED SAND WITH SILT; medium dense, moist, fine to coarse grained, brown, with a little fine gravel		41	6.0
		At 8.5 feet - Loose, light brown	From 5-6.5': DD = 119.2 pcf	10	
			From 8.5-10': Gravel = 5.4% Sand = 84.1% -200 = 10.5% LL = Non-viscous PI = Non-plastic		
	SP	POORLY GRADED SAND; medium dense, moist, fine to coarse grained, light brown, trace fine gravel		20	
		Bottom of Boring B-1 at 15 feet			

Figure Number 1

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-2

Project: Proposed Starbucks in Hesperia

Project Number: H33201.01

Drilled By: 2R Drilling

Drill Type: CME 75

Auger Type: 8" O.D. Hollow Stem Augers

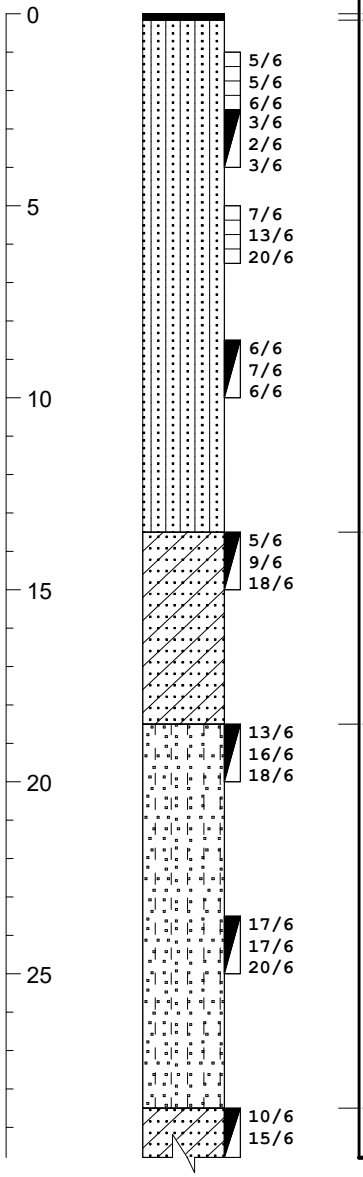
Hammer Type: 140 Pound Auto Trip

Logged By: A.V.

Date: October 23, 2024

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E



ELEVATION/ DEPTH (feet)	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
	AC	Asphalt Concrete = 2 inches			
	SM	SILTY SAND; loose, damp, fine to medium grained, brown, trace subangular gravel	From 0.2-5': pH = 7.5 SR = 3,100 ohm-cm Cl = 0.0021% SS = 0.0026%	11	3.6
				5	
		Medium dense, moist	From 1-2.5': DD = 113.6 pcf ø = 33° c = 130 psf	33	6.0
		Fine to coarse grained, with trace clay			7.1
			From 5-6.5': DD = 116.0 pcf ø = 41° c = 220 psf	13	
	SC	CLAYEY SAND; medium dense, moist, fine to medium grained, brown, trace coarse gravel		27	6.5
	SP-SM	POORLY GRADED SAND WITH SILT; dense, moist, fine to coarse grained, brown		34	
				37	7.8
	SC	CLAYEY SAND; medium dense,	From 28.5-30': Gravel = 5.1%	25	10.9

Figure Number 2

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-2

Project: Proposed Starbucks in Hesperia

Project Number: H33201.01

Drilled By: 2R Drilling

Drill Type: CME 75

Auger Type: 8" O.D. Hollow Stem Augers

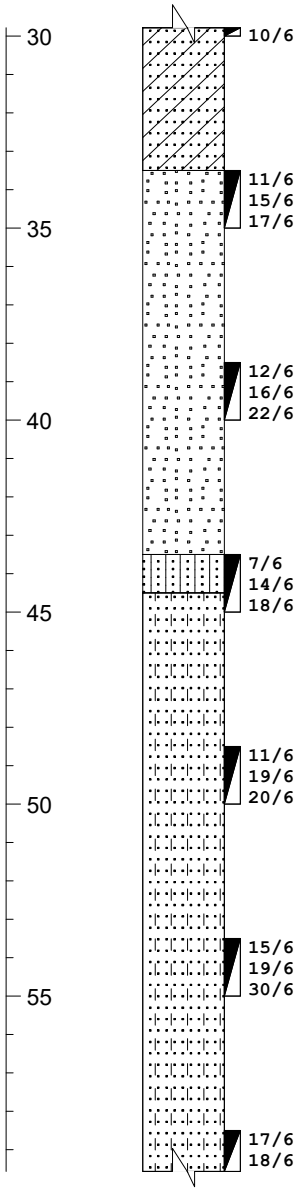
Hammer Type: 140 Pound Auto Trip

Logged By: A.V.

Date: October 23, 2024

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
			moist, fine to coarse grained, brown, with a little fine gravel	Sand = 65.2% -200 = 29.7% LL = 25 PI = 8		
		SP	POORLY GRADED SAND; dense, moist, fine to coarse grained, light brown		32	6.8
					38	
		SM	SILTY SAND; dense, moist, fine grained, brown		32	12.1
		SW-SM	WELL GRADED SAND WITH SILT; dense, damp, fine to coarse grained, brown, with some fine gravel			4.4
				From 48.5-50': Gravel = 11.6% Sand = 79.7% -200 = 8.7%	39	
			Increase in coarse sand content		49	
					43	

Figure Number 2

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-2

Project: Proposed Starbucks in Hesperia

Project Number: H33201.01

Drilled By: 2R Drilling

Drill Type: CME 75

Auger Type: 8" O.D. Hollow Stem Augers

Hammer Type: 140 Pound Auto Trip

Logged By: A.V.

Date: October 23, 2024

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
60	25/6		Bottom of Boring B-2 at 60 feet			
65						
70						
75						
80						
85						

Figure Number 2

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-3

Project: Proposed Starbucks in Hesperia

Project Number: H33201.01

Drilled By: 2R Drilling

Drill Type: CME 75

Auger Type: 8" O.D. Hollow Stem Augers

Hammer Type: 140 Pound Auto Trip

Logged By: A.V.

Date: October 23, 2024

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0		AC	Asphalt Concrete = 3 inches			
	5/6 8/6 8/6	SM SC	SILTY SAND; medium dense, moist, fine to medium grained, brown	From 1-5': R-value = 37	16	7.8
5	13/6 15/6 15/6		At 1.5 feet - CLAYEY SAND; medium dense, moist, fine to coarse grained, brown, trace fine gravel At 3.5 feet - Weakly cemented		30	
10	6/6 9/6 11/6	SP-SM	POORLY GRADED SAND WITH SILT; medium dense, moist, fine to coarse grained, brown, trace fine gravel		20	
15	8/6 12/6 13/6	SP	POORLY GRADED SAND; medium dense, moist, fine to coarse grained, light brown Bottom of Boring B-3 at 15 feet		25	
20						
25						

Figure Number 3

MOORE TWINING ASSOCIATES, INC.

Test Boring: P-1

Project: Proposed Starbucks in Hesperia

Project Number: H33201.01

Drilled By: 2R Drilling

Drill Type: CME 75

Auger Type: 8" O.D. Hollow Stem Augers

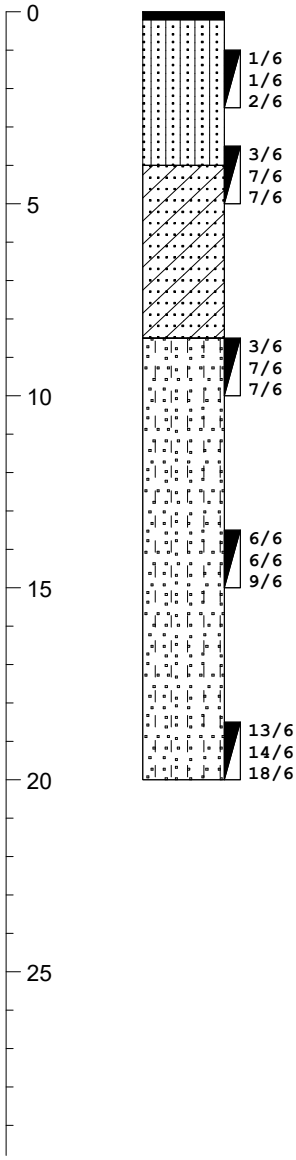
Hammer Type: 140 Pound Auto Trip

Logged By: A.V.

Date: October 23, 2024

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
		AC	Asphalt Concrete = 2.5 inches			
		SM	SILTY SAND; very loose, damp, fine to coarse grained, brown, trace gravel		3	4.2
			Medium dense		14	8.1
		SC	CLAYEY SAND; medium dense, moist, fine to coarse grained, brown, trace gravel			
		SP-SM	POORLY GRADED SAND WITH SILT; medium dense, moist, fine to coarse grained, brown, with trace fine gravel		14	5.5
					15	
			Dense, slight decrease in fines content	From 18.5-20': Gravel = 3.9% Sand = 84.9% -200 = 11.2% LL = Non-viscous PI = Non-plastic	32	5.3
			Bottom of Percolation Test Boring P-1 at 20 feet			

Figure Number 4

MOORE TWINING ASSOCIATES, INC.

Test Boring: P-2

Project: Proposed Starbucks in Hesperia

Project Number: H33201.01

Drilled By: 2R Drilling

Drill Type: CME 75

Auger Type: 8" O.D. Hollow Stem Augers

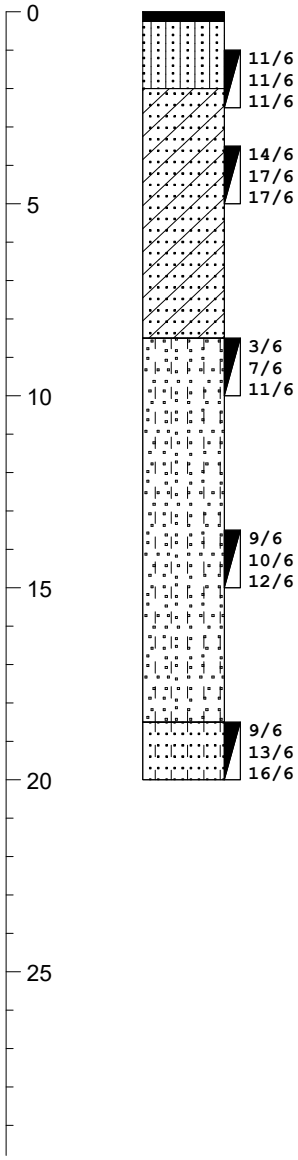
Hammer Type: 140 Pound Auto Trip

Logged By: A.V.

Date: October 23, 2024

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: N/E



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
		AC	Asphalt Concrete = 3 inches			
		SM	SILTY SAND; medium dense, moist, fine to medium grained, brown		22	6.0
		SC	At 2 feet - CLAYEY SAND; medium dense, moist, fine to coarse grained, brown, trace fine gravel At 3.5 feet - Dense, with weak to moderate cementation		34	6.1
		SP-SM	POORLY GRADED SAND WITH SILT; medium dense, damp, fine to coarse grained, brown, trace fine gravel and clay		18	3.5
					22	
		SW-SM	WELL GRADED SAND WITH SILT; medium dense, damp, fine to coarse grained, brown, with fine a little fine gravel	From 18.5-20': Gravel = 8.1% Sand = 82.0% -200 = 9.9%	29	4.1
			Bottom of Percolation Test Boring P-2 at 20 feet			

Figure Number 5

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	Asphalt Concrete
	SM: Silty sand
	SC-SM: Silty, Clayey Sand
	SP-SM: Poorly graded sand with silt
	SP: Poorly graded sand
	SC: Clayey sand
	SW-SM: Well graded sand with silt

Symbol	Description
Misc. Symbols	
	Boring continues
Soil Samplers	
	Standard penetration test
	California Modified split barrel ring sampler

Notes:

1. Exploratory borings were drilled on 10/23/24 using a CME 75 drill rig equpped with 8" outside diameter hollow stem augers.

2. Groundwater was not encountered during drilling of the borings.

3. Boring locations were measured or paced from existing site features.

4. These logs are subject to the limitations, conclusions, and recommendations in this report.

5. The "N-value" reported for the California Modified Split Barrel Sampler is the uncorrected field blow count. This value should not be interpreted as an SPT equivalent N-value.

6. Abbreviations used are:

DD = Natural dry density (pcf)	LL = Liquid Limit (%)
+4 = Percent retained on the No. 4 sieve (%)	PI = Plasticity Index (%)
-200 = Percent passing the No. 200 sieve (%)	EI = Expansion Index
Sand = Percent passing the No. 4 sieve and retained on No. 200 sieve (%)	Gravel = Percent passing 3-inch and retained on No. 4 sieve (%)
SR = Soil resistivity (ohm-cm)	
pH = Soil pH	SS = Soluble sulfates (%)
Cl = Soluble chlorides (%)	O.D. = Outside Diameter
ø = Internal Angle of Friction (degrrees)	c = Cohesion (psf)
pcf = pounds per cubic foot	psf = pounds per square foot
N/A = Not applicable	N/E = Not encountered

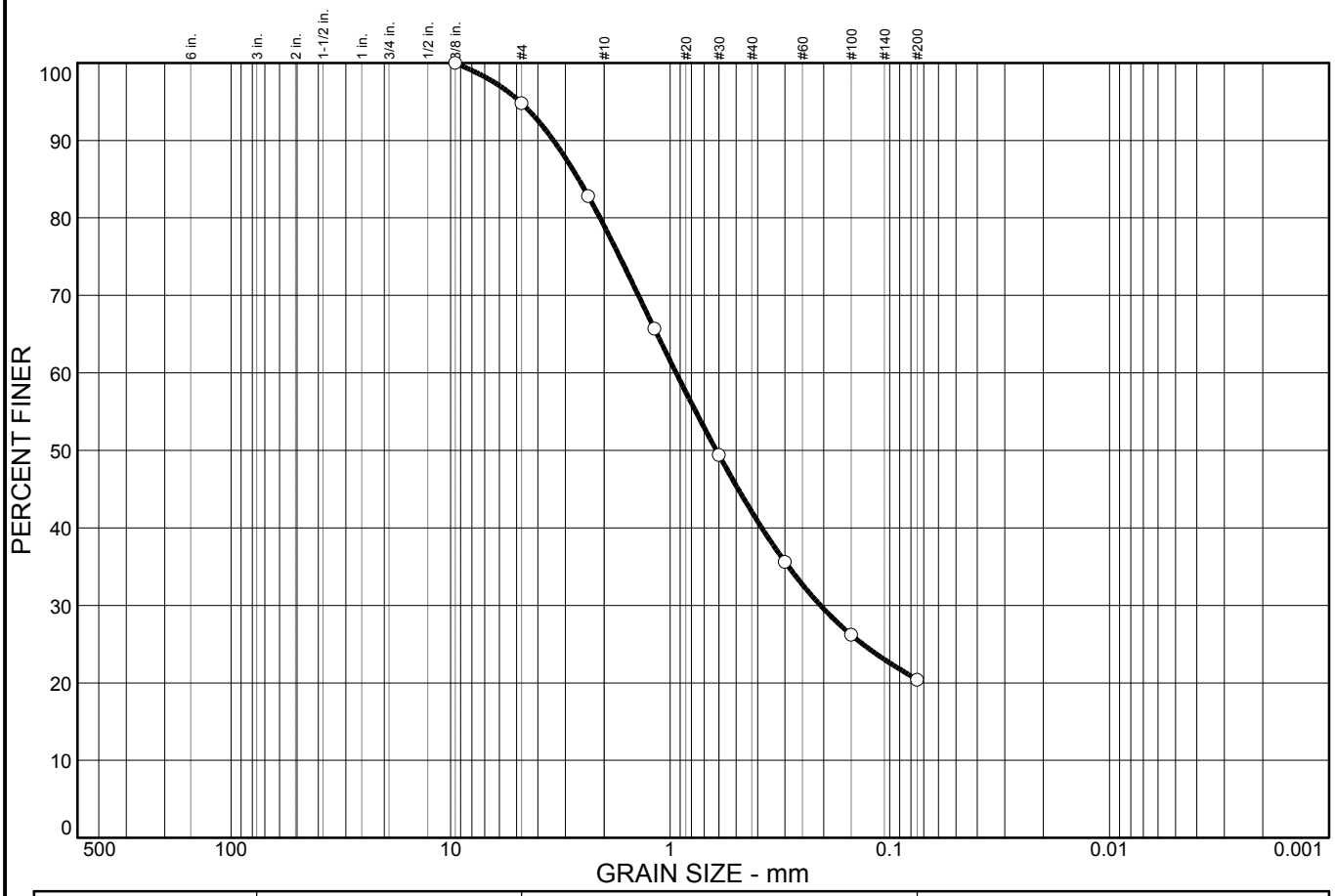
APPENDIX C

RESULTS OF LABORATORY TESTS

This appendix contains the individual results of the following tests. The results of the moisture content and dry density tests are included on the test boring logs in Appendix B. These data, along with the field observations, were used to prepare the final test boring logs in Appendix B.

These Included:	To Determine:
Moisture Content (ASTM D2216)	Moisture contents representative of field conditions at the time the sample was taken.
Dry Density (ASTM D2937)	Dry unit weight of sample representative of in-situ or in-place undisturbed condition.
Grain-Size Distribution (ASTM D422)	Size and distribution of soil particles, i.e., sand, gravel and fines (silt and clay).
Atterberg Limits (ASTM D4318)	Determines the moisture content where the soil behaves as a viscous material (liquid limit) and the moisture content at which the soil reaches a plastic state
Consolidation (ASTM 2435)	The amount and rate at which a soil sample compresses when loaded, and the influence of saturation on its behavior.
Direct Shear (ASTM D3080)	Soil shearing strength under varying loads and/or moisture conditions.
R-Value (ASTM D 2844)	The capacity of a subgrade or subbase to support a pavement section designed to carry a specified traffic load.
Sulfate Content (Cal Test 417)	Percentage of water-soluble sulfate as (SO4) in soil samples. Used as an indication of the relative degree of sulfate attack on concrete and for selecting the cement type.
Chloride Content (Cal Test 422)	Percentage of soluble chloride in soil. Used to evaluate the potential attack on encased reinforcing steel.
Resistivity (ASTM G187)	The potential of the soil to corrode metal.
pH (Cal Test 643)	The acidity or alkalinity of subgrade material.

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	5.2	15.8	36.9	21.7	20.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	94.8		
#8	82.8		
#16	65.7		
#30	49.4		
#50	35.6		
#100	26.2		
#200	20.4		

* (no specification provided)

Material Description

Silty, clayey sand

Atterberg Limits

PL= 15 LL= 21 PI= 6

Coefficients

D_{85}= 2.61 D_{60}= 0.940 D_{50}= 0.616
D_{30}= 0.207 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC-SM AASHTO=

Remarks

Sample No.: B-1 **Source of Sample:** **Date:** 10/23/24
Location: **Elev./Depth:** 3.5-5'

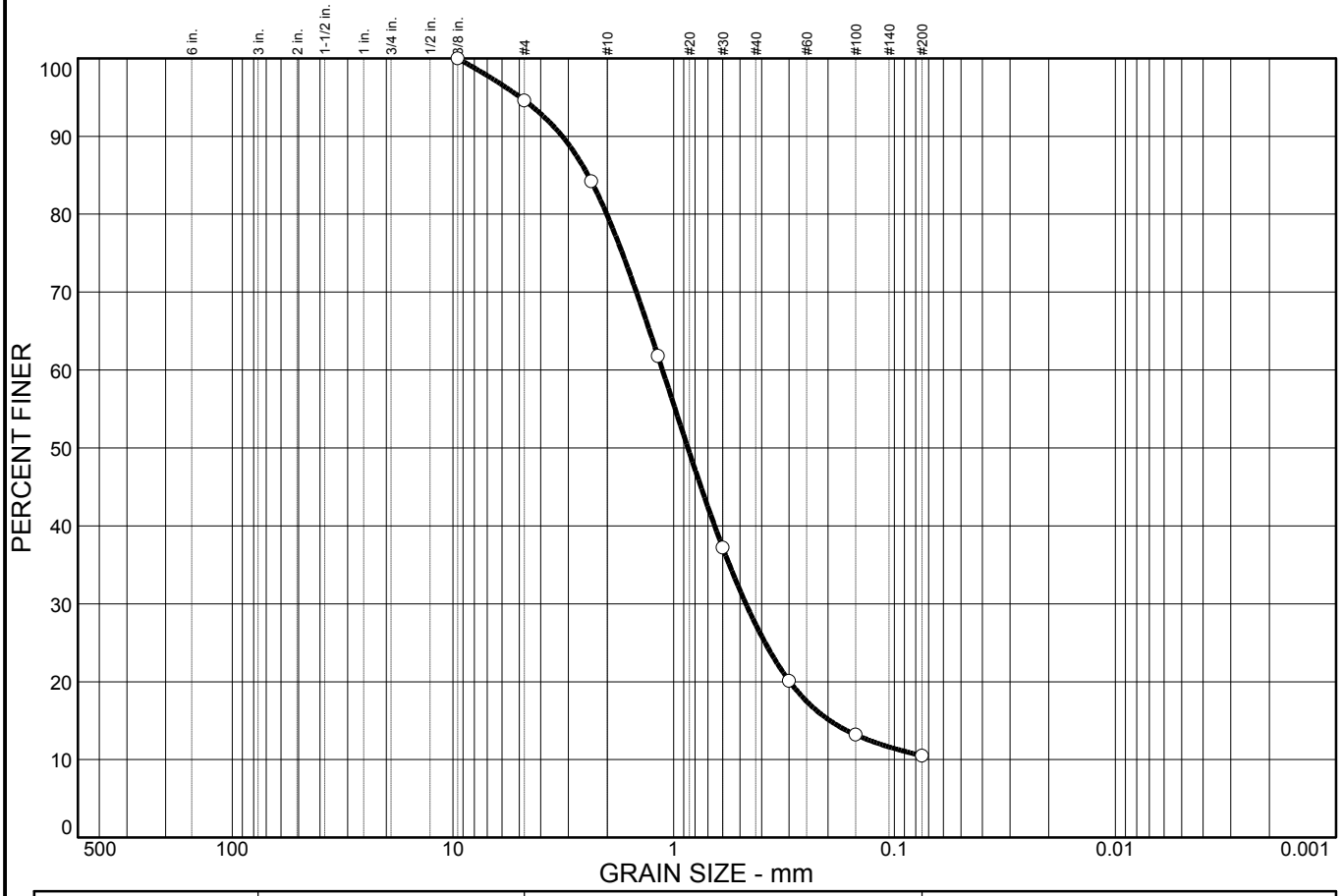
Moore Twining Associates, Inc.

Fresno, CA

Client: Fountainhead Development
Project: Proposed Starbucks

Project No: H33201.01 **Figure** 1

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	5.4	14.8	52.5	16.8	10.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	94.6		
#8	84.2		
#16	61.8		
#30	37.2		
#50	20.1		
#100	13.2		
#200	10.5		

* (no specification provided)

Material Description

Poorly graded sand with silt

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 2.44 D_{60}= 1.12 D_{50}= 0.863
D_{30}= 0.471 D_{15}= 0.196 D_{10}=
C_u= C_c=

Classification

USCS= SP-SM AASHTO=

Remarks

Sample No.: B-1 **Source of Sample:** **Date:** 10/23/24
Location: **Elev./Depth:** 8.5-10'

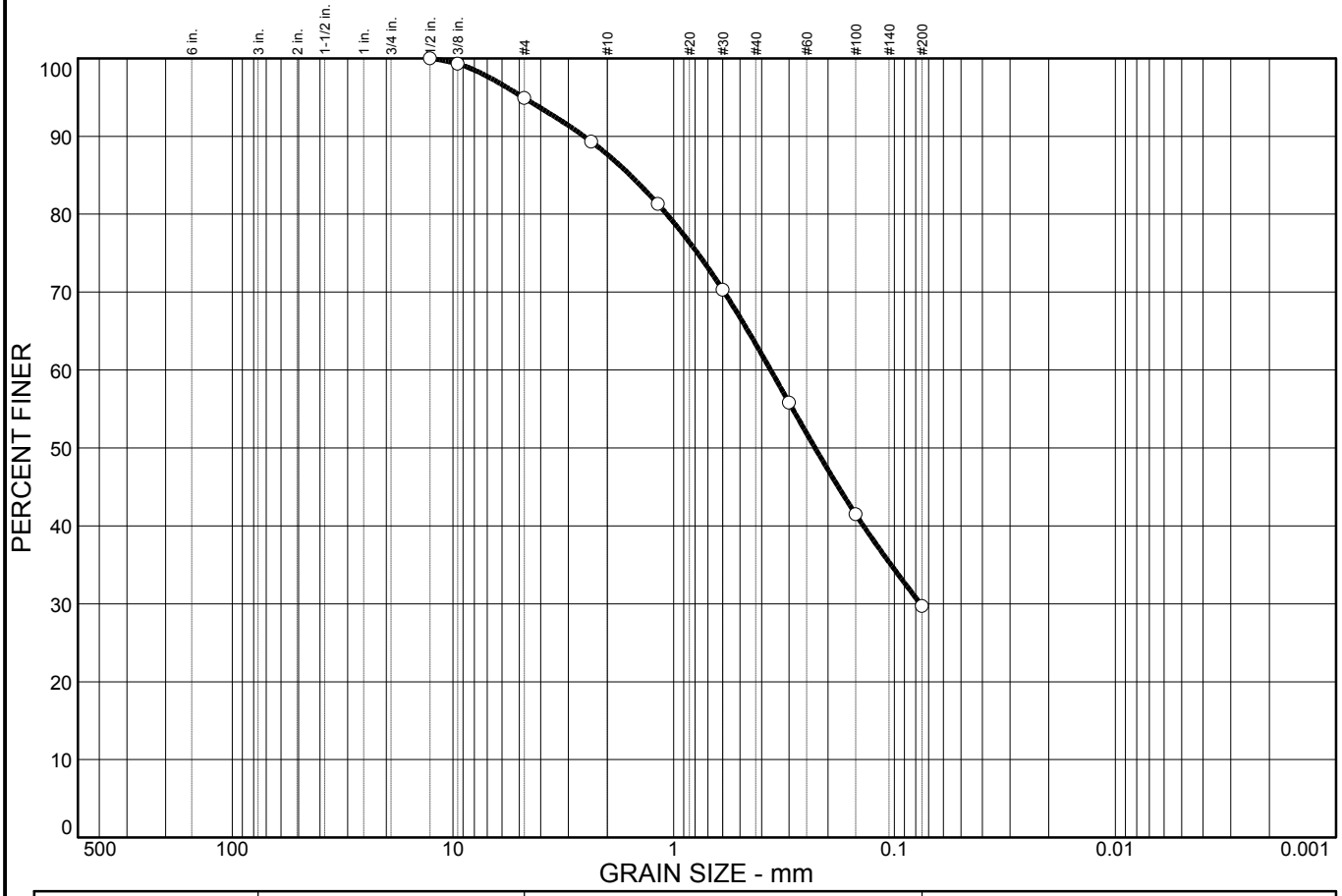
Moore Twining Associates, Inc.

Fresno, CA

Client: Fountainhead Development
Project: Proposed Starbucks

Project No: H33201.01 **Figure** 2

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	5.1	7.2	24.3	33.7	29.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	99.3		
#4	94.9		
#8	89.3		
#16	81.3		
#30	70.3		
#50	55.8		
#100	41.5		
#200	29.7		

* (no specification provided)

Material Description

Clayey sand

Atterberg Limits

PL= 17 LL= 25 PI= 8

Coefficients

D_{85}= 1.57 D_{60}= 0.364 D_{50}= 0.229
D_{30}= 0.0764 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO=

Remarks

Sample No.: B-2 **Source of Sample:** **Date:** 10/23/24
Location: **Elev./Depth:** 28.5-30'

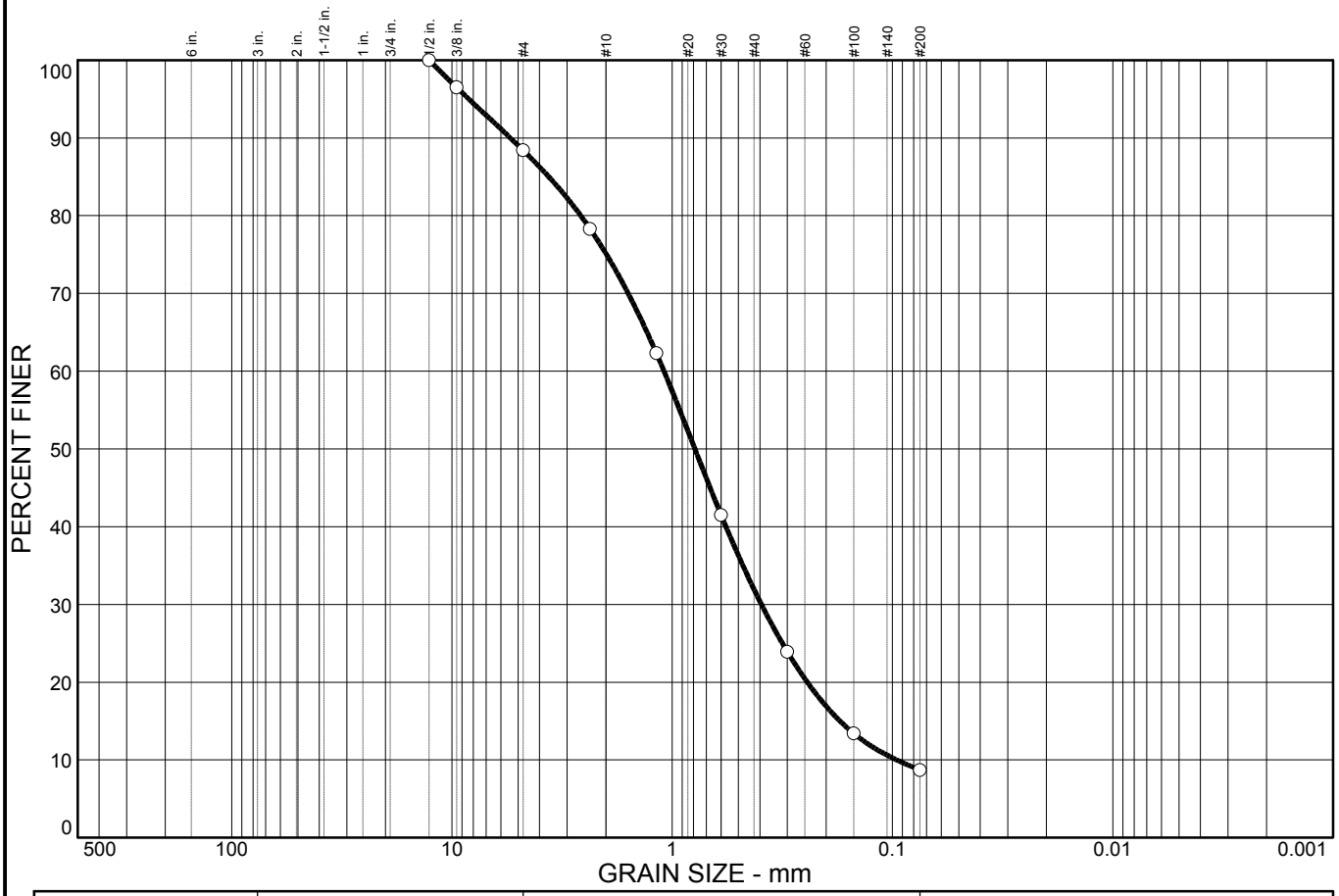
Moore Twining Associates, Inc.

Fresno, CA

Client: Fountainhead Development
Project: Proposed Starbucks

Project No: H33201.01 **Figure** 3

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	11.6	13.3	43.2	23.2	8.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	96.5		
#4	88.4		
#8	78.3		
#16	62.3		
#30	41.5		
#50	23.9		
#100	13.4		
#200	8.7		

* (no specification provided)

Material Description

Well-graded sand with silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 3.63 D_{60}= 1.09 D_{50}= 0.789
D_{30}= 0.394 D_{15}= 0.173 D_{10}= 0.0957
C_u= 11.40 C_c= 1.49

Classification

USCS= SW-SM AASHTO=

Remarks

Sample No.: B-2 **Source of Sample:** **Date:** 10/23/24
Location: **Elev./Depth:** 48.5-50'

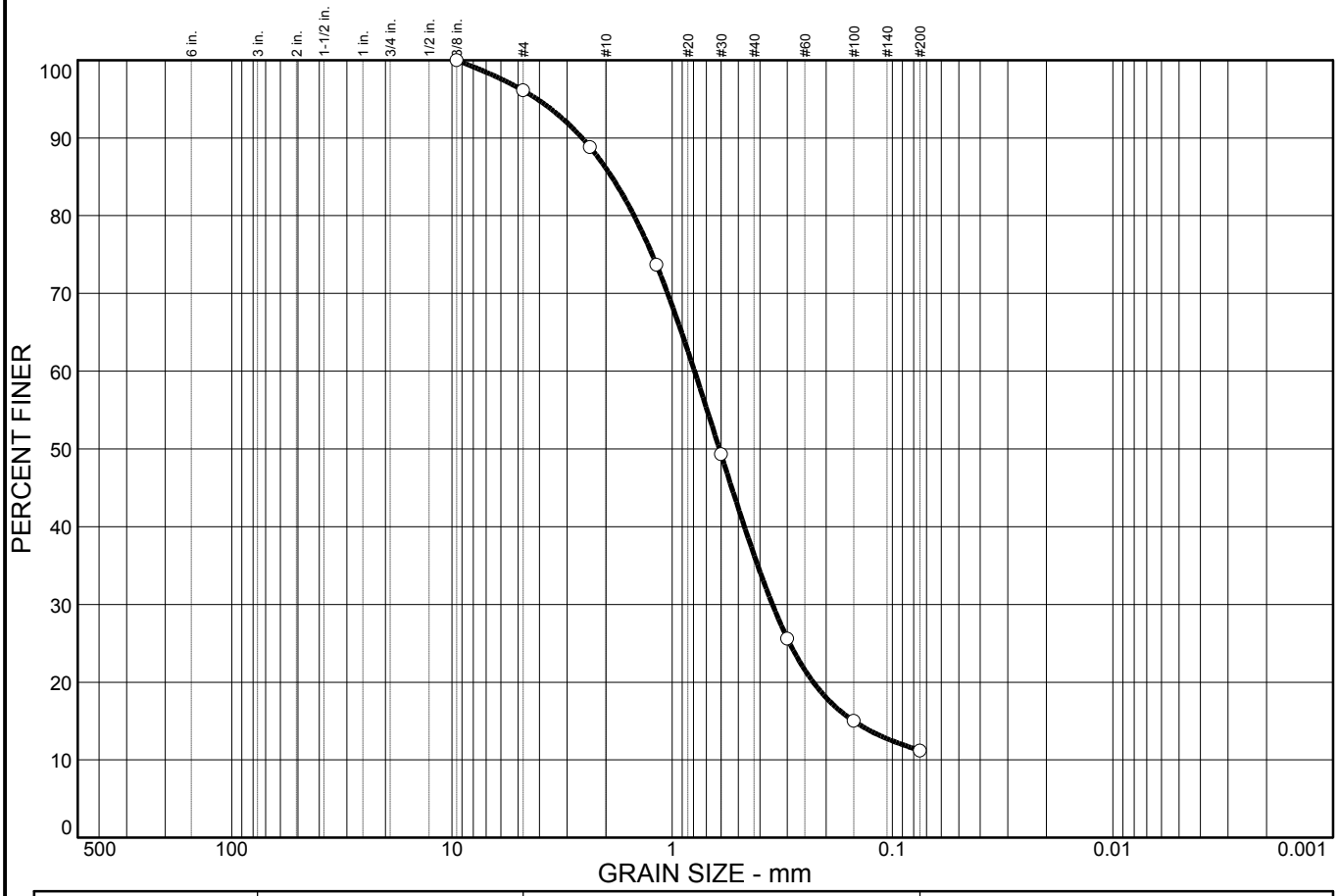
Moore Twining Associates, Inc.

Fresno, CA

Client: Fountainhead Development
Project: Proposed Starbucks

Project No: H33201.01 **Figure** 4

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	3.9	10.0	49.8	25.1	11.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	96.1		
#8	88.8		
#16	73.7		
#30	49.3		
#50	25.6		
#100	15.0		
#200	11.2		

* (no specification provided)

Material Description

Poorly graded sand with silt

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 1.88 D_{60}= 0.792 D_{50}= 0.611
D_{30}= 0.351 D_{15}= 0.150 D_{10}=
C_u= C_c=

Classification

USCS= SP-SM AASHTO=

Remarks

Sample No.: P-1 **Source of Sample:** **Date:** 10/23/24
Location: **Elev./Depth:** 18.5-20'

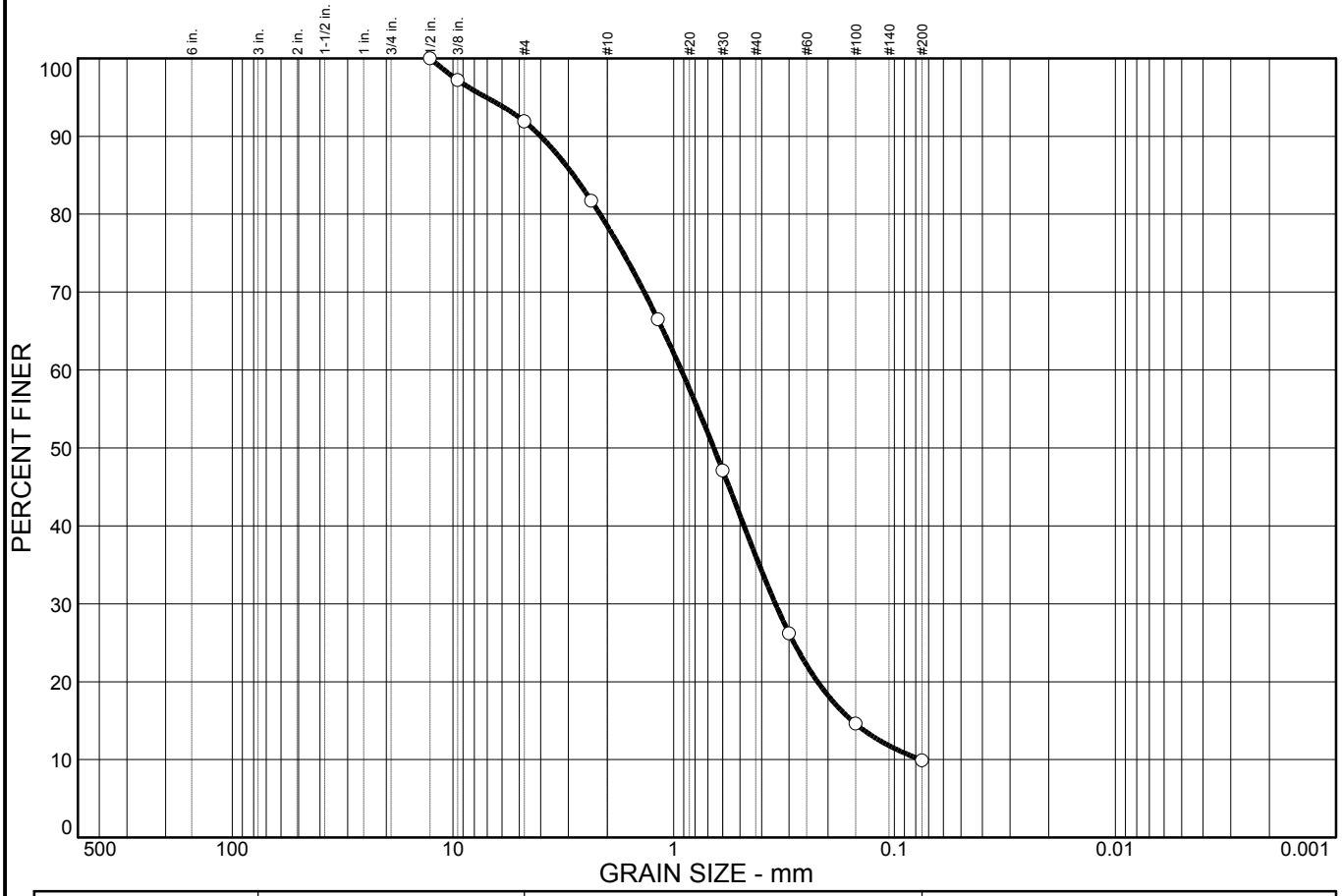
Moore Twining Associates, Inc.

Fresno, CA

Client: Fountainhead Development
Project: Proposed Starbucks

Project No: H33201.01 **Figure** 5

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	8.1	13.4	42.4	26.2	9.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	97.2		
#4	91.9		
#8	81.7		
#16	66.5		
#30	47.1		
#50	26.2		
#100	14.6		
#200	9.9		

* (no specification provided)

Material Description

Well-graded sand with silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 2.85 D_{60}= 0.925 D_{50}= 0.658
D_{30}= 0.346 D_{15}= 0.156 D_{10}= 0.0765
C_u= 12.09 C_c= 1.69

Classification

USCS= SW-SM AASHTO=

Remarks

Sample No.: P-2 **Source of Sample:** **Date:** 10/23/24
Location: **Elev./Depth:** 18.5-20'

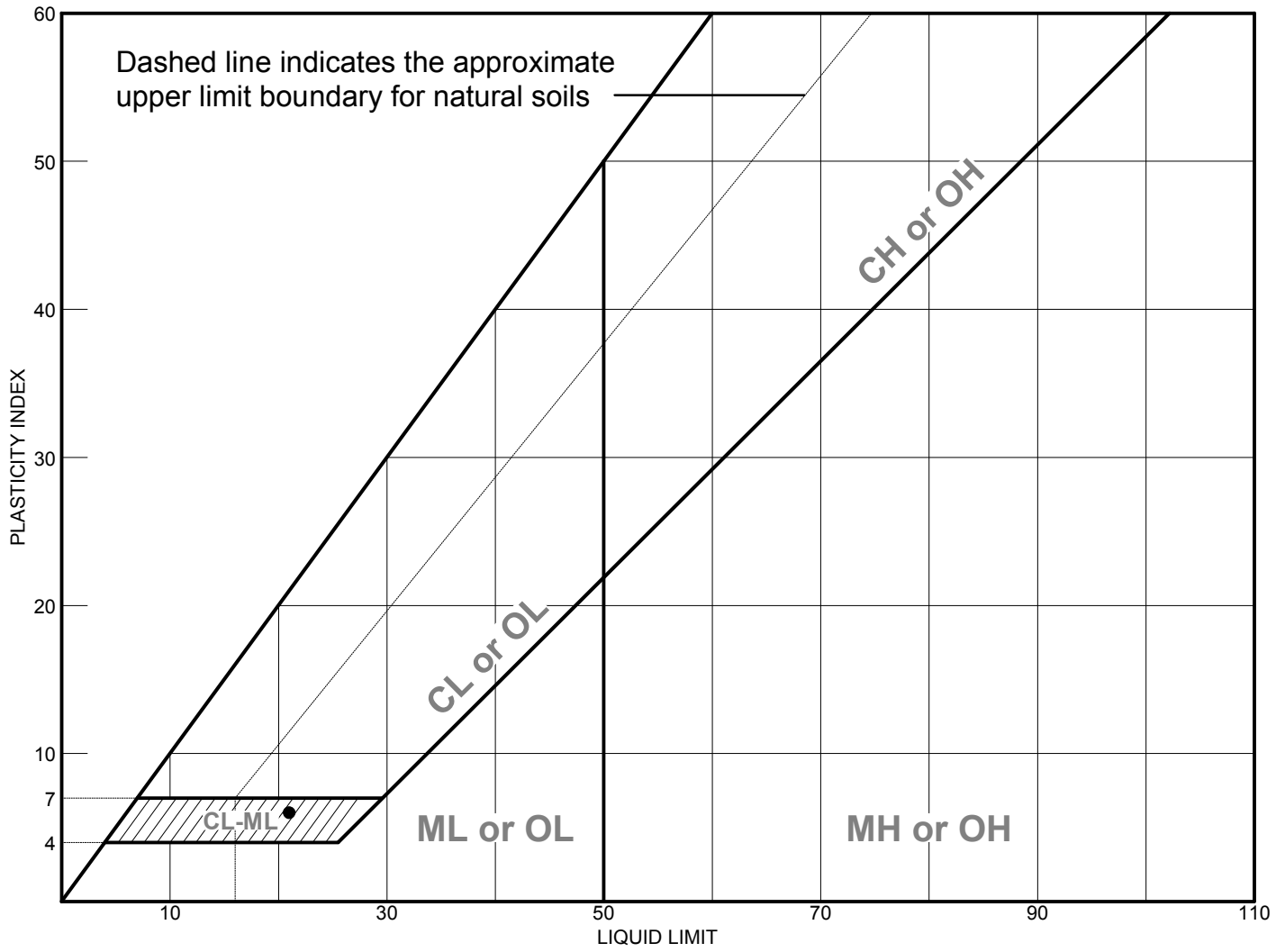
Moore Twining Associates, Inc.

Fresno, CA

Client: Fountainhead Development
Project: Proposed Starbucks

Project No: H33201.01 **Figure** 6

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty, clayey sand	21	15	6	42.1	20.4	SC-SM

Project No. H33201.01 **Client:** Fountainhead Development

Project: Proposed Starbucks

● **Source:** **Sample No.:** B-1 **Elev./Depth:** 3.5-5'

Remarks:

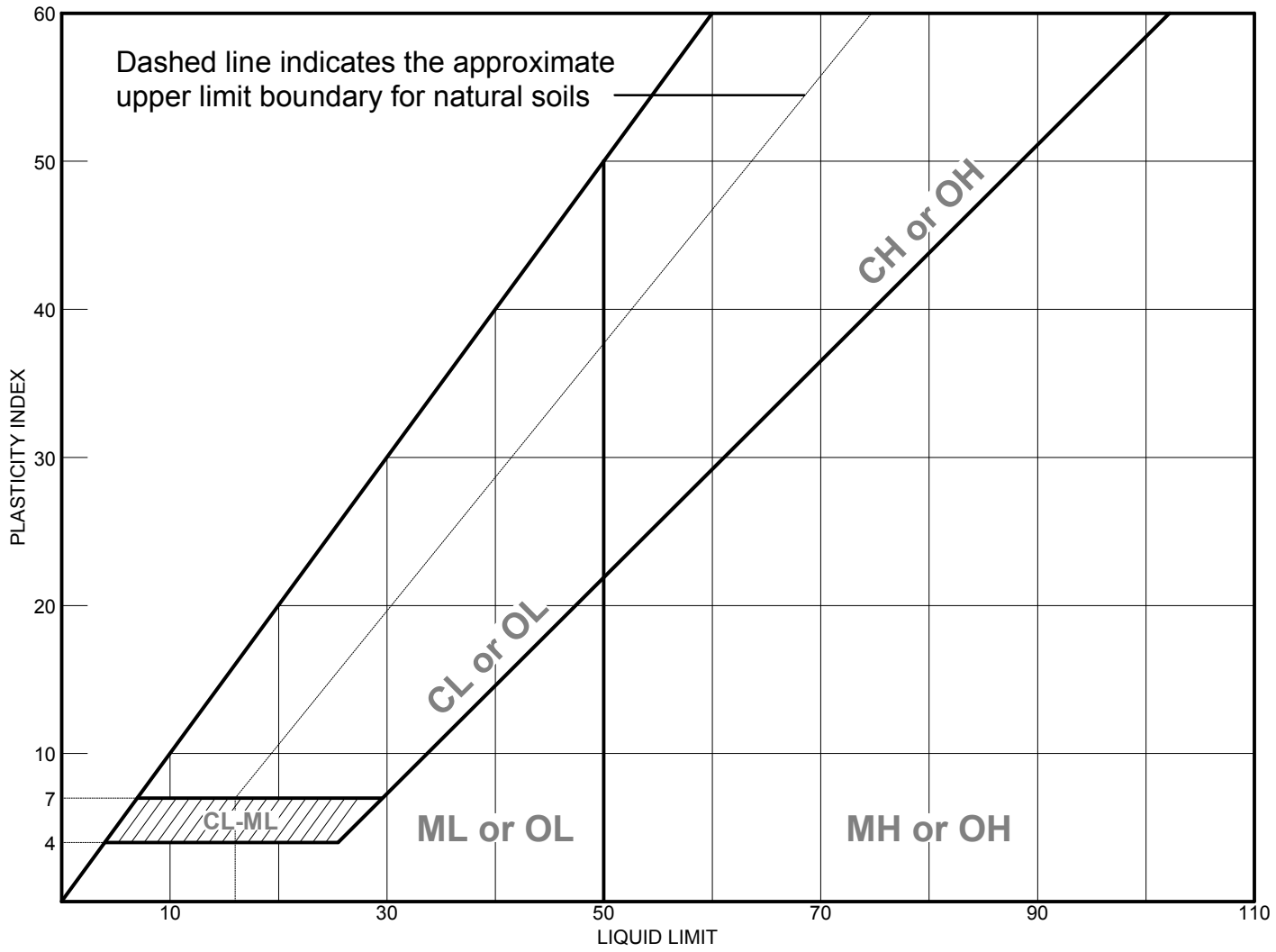
●

Moore Twining Associates, Inc.

Fresno, CA

Figure 7

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Poorly graded sand with silt	NV	NP	NP	27.3	10.5	SP-SM

Project No. H33201.01 **Client:** Fountainhead Development

Project: Proposed Starbucks

● **Source:** **Sample No.:** B-1 **Elev./Depth:** 8.5-10'

Remarks:

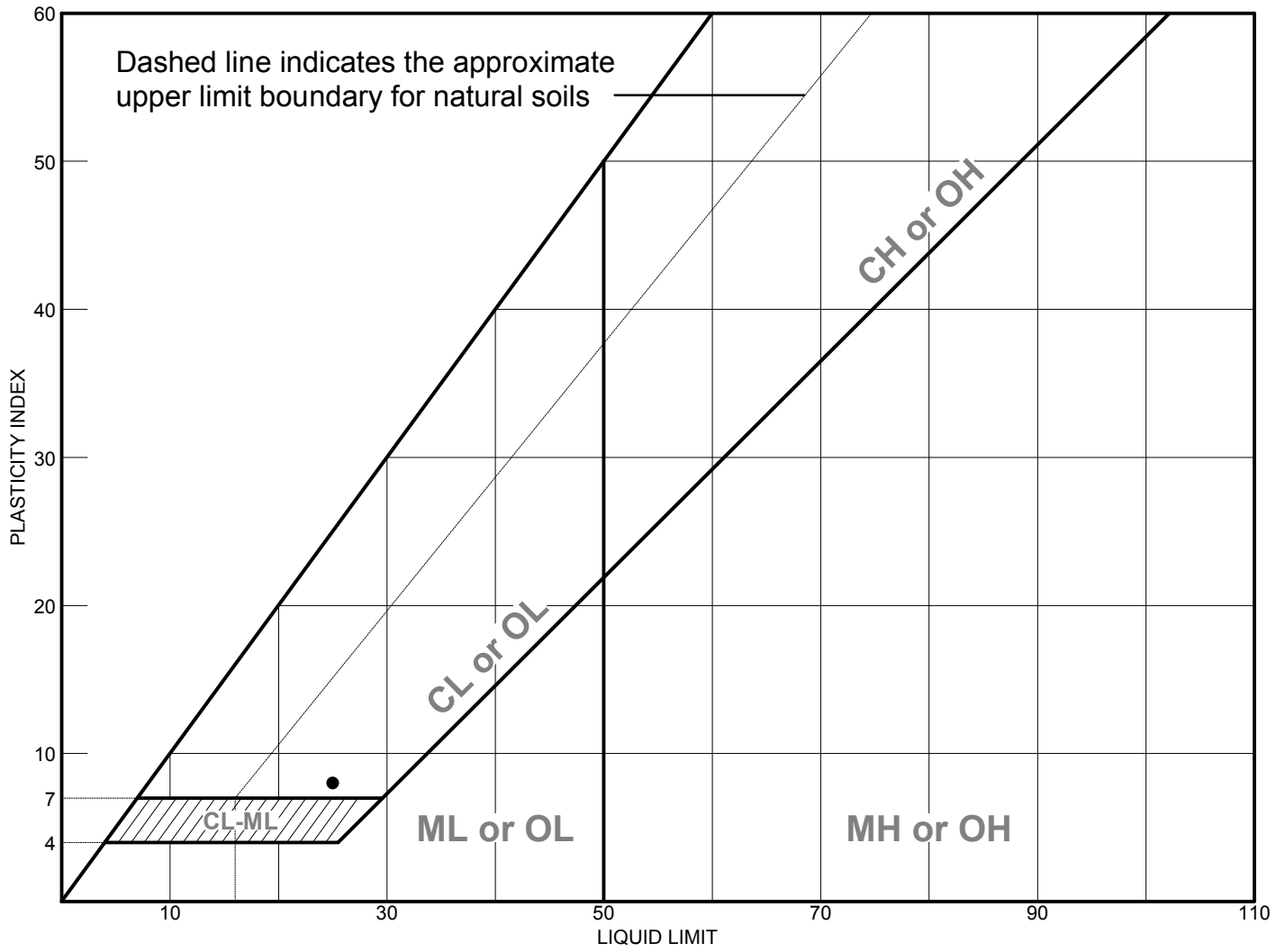
●

Moore Twining Associates, Inc.

Fresno, CA

Figure 8

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clayey sand	25	17	8	63.3	29.7	SC

Project No. H33201.01 **Client:** Fountainhead Development

Project: Proposed Starbucks

● **Source:** **Sample No.:** B-2 **Elev./Depth:** 28.5-30'

Remarks:

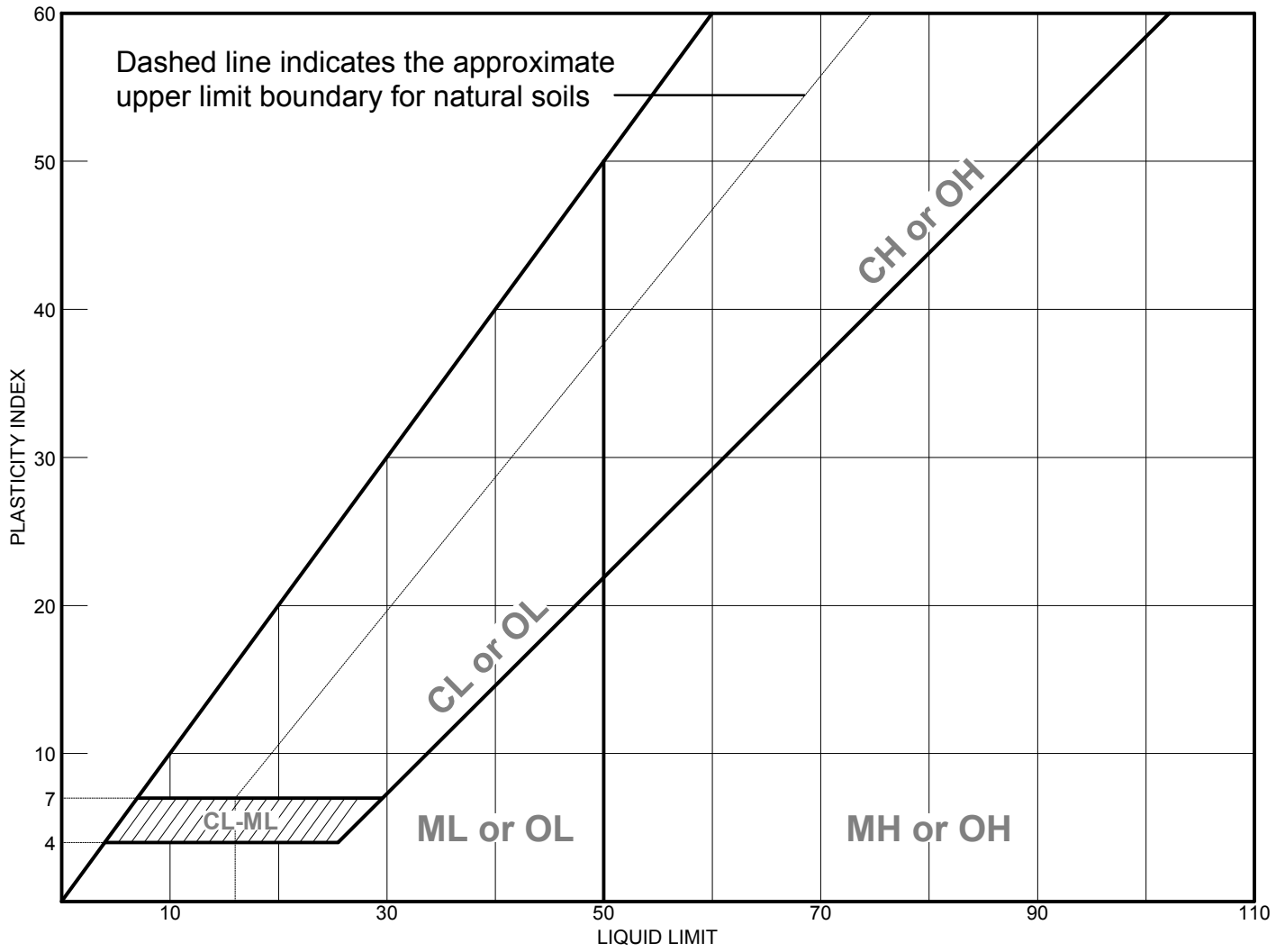
●

Moore Twining Associates, Inc.

Fresno, CA

Figure 9

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Poorly graded sand with silt	NV	NP	NP	36.3	11.2	SP-SM

Project No. H33201.01 **Client:** Fountainhead Development

Project: Proposed Starbucks

● **Source:** **Sample No.:** P-1 **Elev./Depth:** 18.5-20'

Remarks:

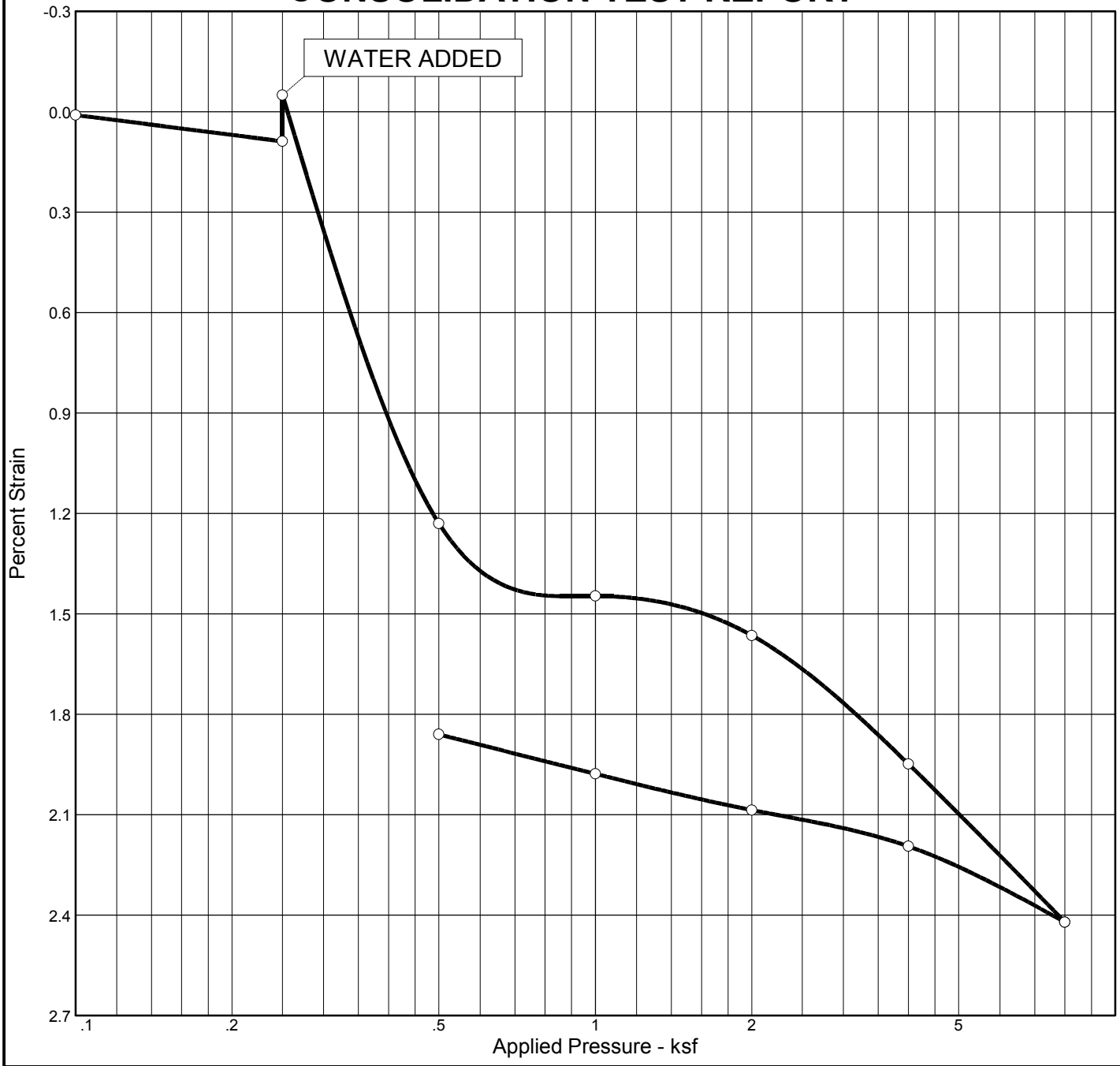
●

Moore Twining Associates, Inc.

Fresno, CA

Figure 10

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_s	Swell Press. (ksf)	Swell %	e_o
Sat.	Moist.											
31.0 %	5.3 %	113.8			2.65		3.05	0.02	0.01	0.27	0.1	0.454

MATERIAL DESCRIPTION	USCS	AASHTO
Silty sand		

Project No. H33201.01 **Client:** Fountainhead Development

Project: Proposed Starbucks

Source: **Sample No.:** B-2 **Elev./Depth:** 1-2.5'

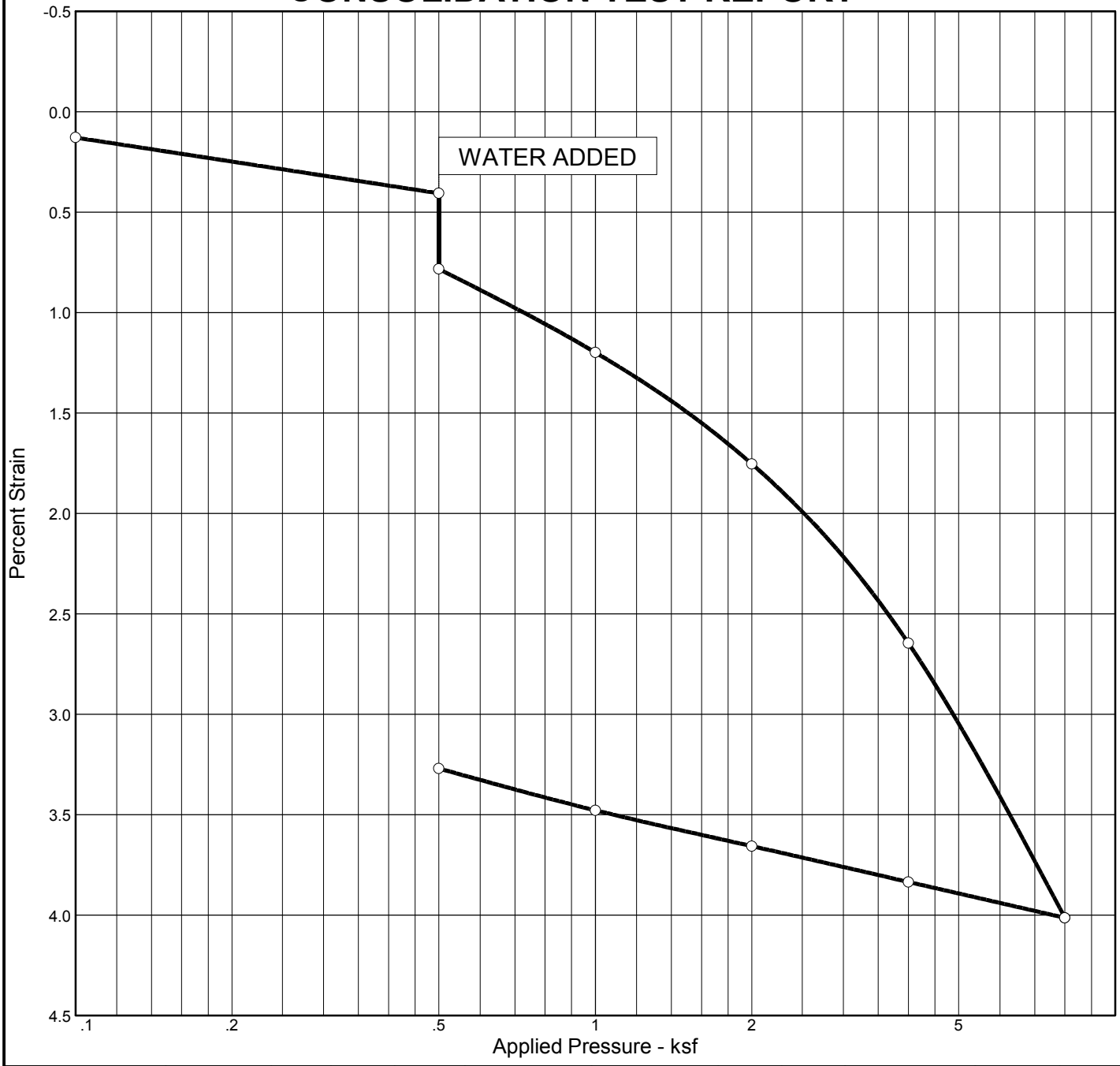
Remarks:

Moore Twining Associates, Inc.

Fresno, CA

Figure 11

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_s	Swell Press. (ksf)	Clpse. %	e_o
Sat.	Moist.											
66.2 %	8.6 %	122.9			2.65		3.54	0.06	0.01		0.4	0.346

MATERIAL DESCRIPTION	USCS	AASHTO
Silty sand		

Project No. H33201.01 **Client:** Fountainhead Development

Project: Proposed Starbucks

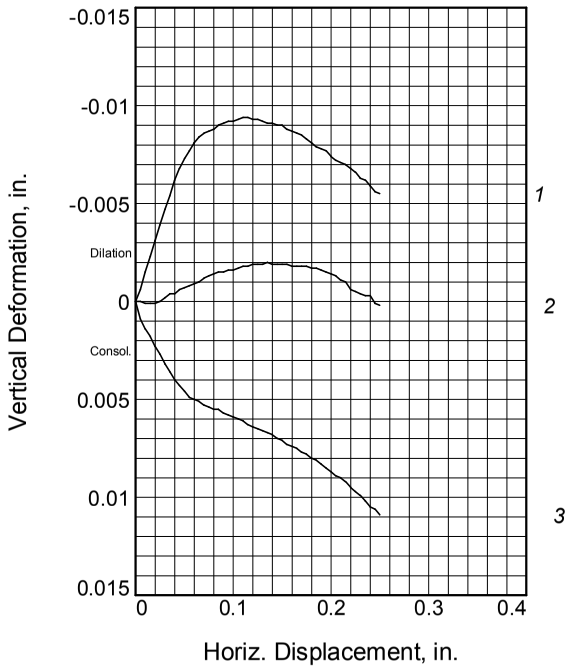
Source: **Sample No.:** B-2 **Elev./Depth:** 5-6.5'

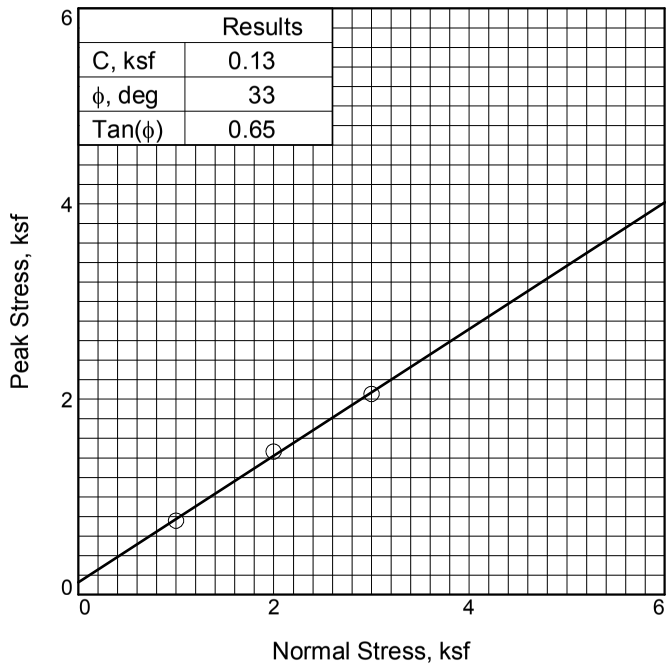
Remarks:

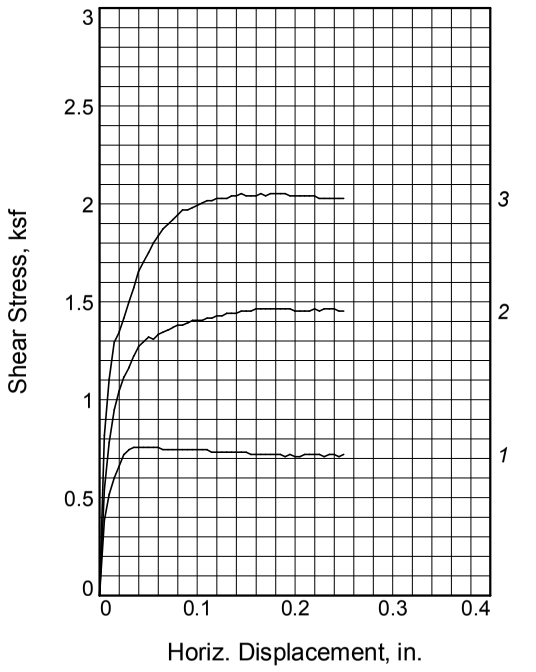
Moore Twining Associates, Inc.

Fresno, CA

Figure 12







Sample No.		1	2	3
Initial	Water Content, %	7.9	5.2	6.4
	Dry Density, pcf	115.4	117.6	115.8
	Saturation, %	48.4	33.7	39.5
	Void Ratio	0.4333	0.4072	0.4292
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	15.6	14.7	15.4
	Dry Density, pcf	115.6	117.9	116.1
	Saturation, %	96.0	96.5	96.2
	Void Ratio	0.4311	0.4033	0.4250
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
Normal Stress, ksf		1.00	2.00	3.00
Peak Stress, ksf		0.76	1.46	2.05
Displacement, in.		0.04	0.16	0.14
Ultimate Stress, ksf				
Displacement, in.				
Strain at peak, %		1.4	6.6	6.0

Sample Type:
Description: Silty sand

Specific Gravity= 2.65
Remarks:

Figure 13

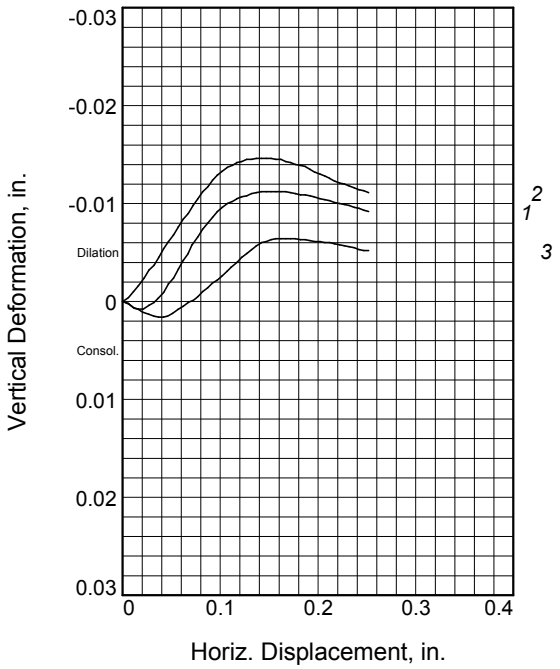
Client: Fountainhead Development

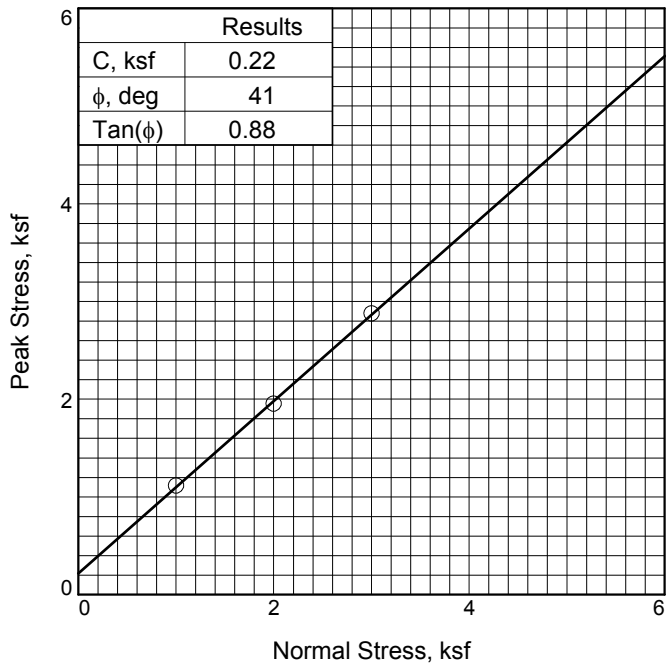
Project: Proposed Starbucks

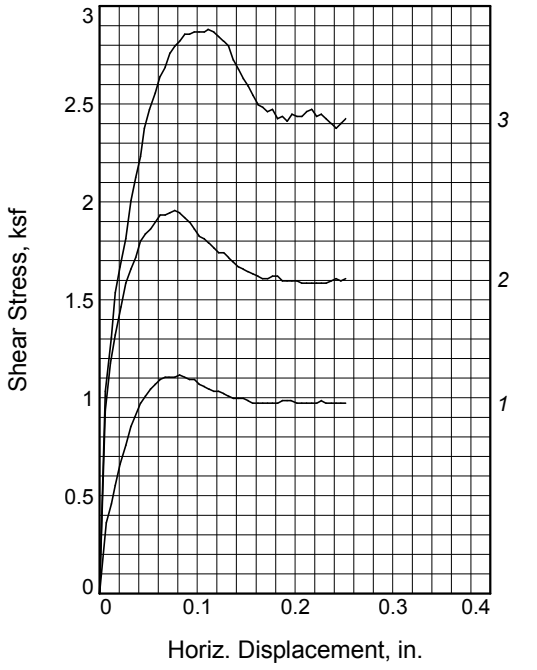
Sample Number: B-2 **Depth:** 1-2.5'

Proj. No.: H33201.01 **Date Sampled:** 10/23/24

DIRECT SHEAR TEST REPORT
Moore Twining Associates, Inc.
Fresno, CA







Sample No.		1	2	3
Initial	Water Content, %	10.3	9.3	8.3
	Dry Density, pcf	110.9	117.6	114.4
	Saturation, %	55.7	60.3	49.2
	Void Ratio	0.4924	0.4069	0.4458
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	18.1	14.8	15.9
	Dry Density, pcf	111.0	117.8	114.7
	Saturation, %	98.0	96.9	95.4
	Void Ratio	0.4907	0.4038	0.4417
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
Normal Stress, ksf		1.00	2.00	3.00
Peak Stress, ksf		1.12	1.96	2.88
Displacement, in.		0.08	0.08	0.11
Ultimate Stress, ksf				
Displacement, in.				
Strain at peak, %		3.4	3.2	4.6

Sample Type:
Description: Silty sand

Specific Gravity= 2.65
Remarks:

Figure 14

Client: Fountainhead Development

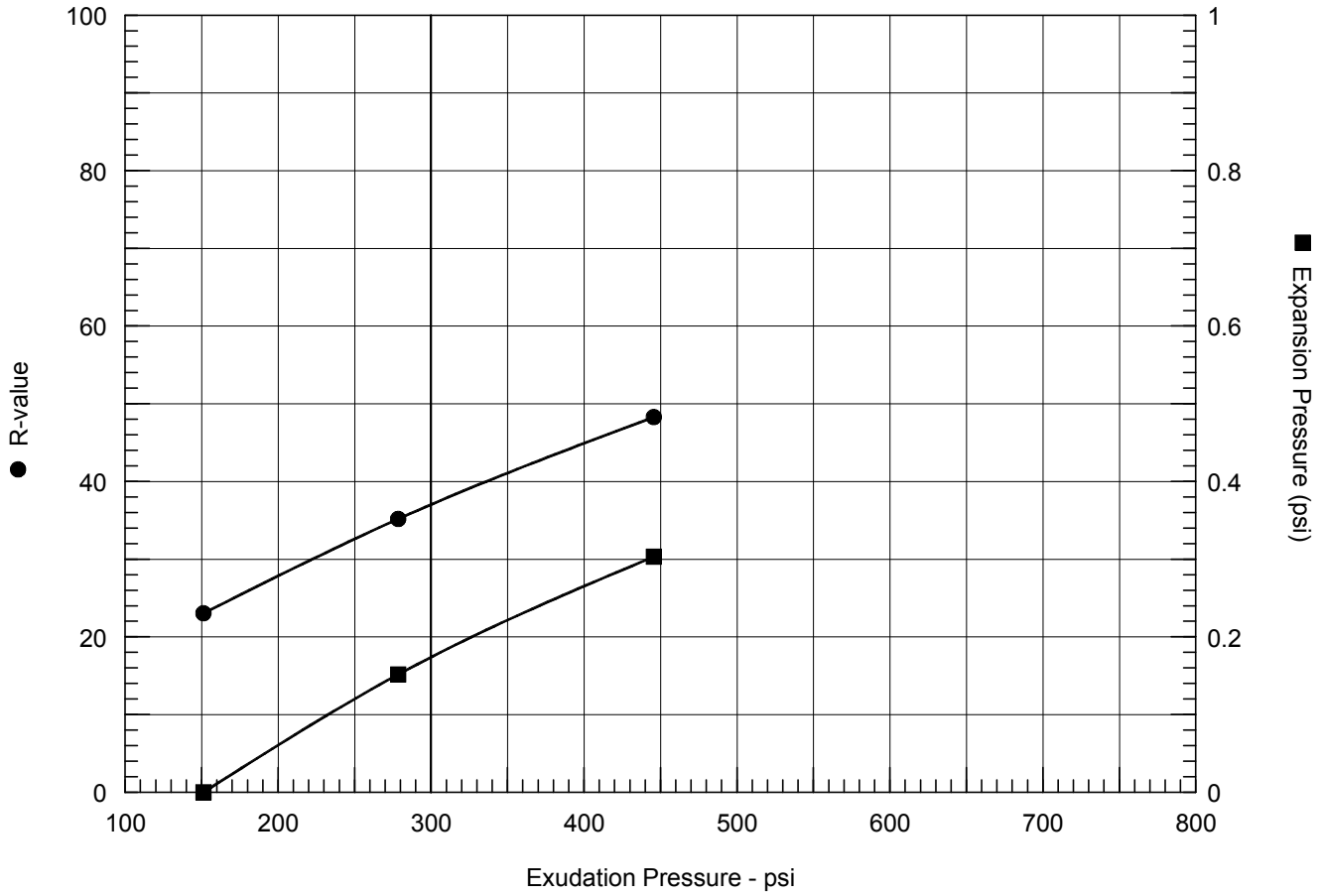
Project: Proposed Starbucks

Sample Number: B-2 **Depth:** 5-6.5'

Proj. No.: H33201.01 **Date Sampled:** 10/23/24

DIRECT SHEAR TEST REPORT
Moore Twining Associates, Inc.
Fresno, CA

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - ASTM D 2844

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	350	127.7	11.6	0.30	71	2.44	446	50	48
2	200	125.3	12.5	0.15	93	2.51	279	35	35
3	100	122.0	13.5	0.00	115	2.58	151	22	23

Test Results	Material Description
R-value at 300 psi exudation pressure = 37 **Exp. pressure at 300 psi exudation pressure =** 0.17 psi	Mix of silty sand and clayey sand

Project No.: H33201.01
Project: Proposed Starbucks
Sample Number: B-3 **Depth:** 1-5'
Date: 11/8/2024

Tested by: CG
Checked by: MS
Remarks:

R-VALUE TEST REPORT

Moore Twining Associates, Inc.

Figure 15

MOORE TWINING ASSOCIATES, INC.
California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

November 07, 2024

Work Order #: **KJ29014**

Allen Harker
MTA Geotechnical Division
2527 Fresno Street
Fresno, CA 93721

RE: Proposed Starbucks

Enclosed are the analytical results for samples received by our laboratory on **10/29/24** . For your reference, these analyses have been assigned laboratory work order number **KJ29014**.

All analyses have been performed according to our laboratory's quality assurance program. All results are intended to be considered in their entirety, Moore Twining Associates, Inc. (MTA) is not responsible for use of less than complete reports. Results apply only to samples analyzed.

If you have any questions, please feel free to contact us at the number listed above.

Sincerely,

Moore Twining Associates, Inc.

Lauren Cox
Client Services Representative

Figure 16

MOORE TWINING ASSOCIATES, INC.
California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

MTA Geotechnical Division	**Project:** Proposed Starbucks	**Reported:**
2527 Fresno Street	**Project Number:** H33201.01	11/07/2024
Fresno CA, 93721	**Project Manager:** Allen Harker	

Analytical Report for the Following Samples

Sample ID	Notes	Laboratory ID	Matrix	Date Sampled	Date Received
B-2 @ 0.2-5		KJ29014-01	Soil	10/23/24 00:00	10/29/24 11:00

MOORE TWINING ASSOCIATES, INC.
California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

MTA Geotechnical Division	**Project:** Proposed Starbucks	**Reported:**
2527 Fresno Street	**Project Number:** H33201.01	11/07/2024
Fresno CA, 93721	**Project Manager:** Allen Harker	

B-2 @ 0.2-5

KJ29014-01 (Soil)

Analyte	Result	Reporting Limit	Units	Batch	Prepared	Analyzed	Method	Flag
Inorganics								
Chloride	**0.0021**	0.00060	% by Weight	[CALC]	11/02/24	11/02/24	[CALC]	
Chloride	**21**	6.0	mg/kg	B4J3113	10/31/24	11/02/24	Cal Test 422	
pH	**7.5**	0.10	pH Units	B4J3113	10/31/24	11/04/24	Cal Test 643 M	
Sulfate as SO4	**0.0026**	0.00060	% by Weight	[CALC]	11/02/24	11/02/24	[CALC]	
Sulfate as SO4	**26**	6.0	mg/kg	B4J3113	10/31/24	11/02/24	Cal Test 417	

Notes and Definitions

DUP1	A high RPD was observed between a sample and this sample's duplicate.
PREP	Modified preparation by pulverizing sample to pass #40 sieve and soaked for a minimum of 12 hours using a minimum dilution ratio of 1:10
ND	Analyte NOT DETECTED at or above the reporting limit
mg/kg	milligrams per kilogram (parts per million concentration units)

MOORE TWINING ASSOCIATES, INC.

Project Name:	Proposed Starbucks	Report Date:	11/7/2024
		Sample Date:	10/23/2024
Project Number:	H33201.01		
		Sampled By:	AV
Subject:	Minimum Resistivity, ASTM G187	Tested By:	RS
Material Description:	Silty sand	Test Date:	11/4/2024
Location:	B-2 @ 0.2-5'		

Laboratory Test Results, Minimum Resistivity - ASTM G187

Total Water Added, mls	Resistivity, Ohm-cm
25 mls	9,000
50 mls	6,000
75 mls	4,400
100 mls	3,400
125 mls	3,100
150 mls	3,200

Remarks: Min. Resistivity is 3,100 Ohm-cm

Figure 17

PH: 559.268.7021
FX: 559.268.7126
2527 Fresno Street
Fresno, CA 93721

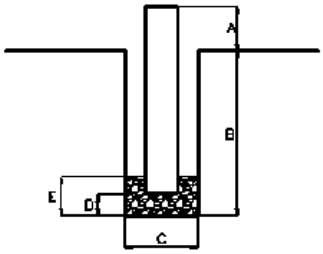
APPENDIX D

RESULTS OF PERCOLATION TESTS

PERCOLATION TEST
No. P-1

Project: Proposed Starbucks
Location: SWC of Main Street and 7th Avenue, Hesperia, CA
Coordinates:

Project No. H33201.01
Test Date: 10/24/2024



A. Top of Pipe Above Ground	0	Inches
B. Depth of Hole	243	Inches
C. Diameter of Hole	8	Inches
D. Depth of Gravel Below Pipe	5	Inches
E. Total Gravel Layer Thickness	60	Inches
F. Pipe Length	238	Inches
G. Pipe Diameter	2	Inches

Pre-saturated: 40-50 gallons of water for required 2-hour presoak
Water was constantly filled up to about 2.45 feet from bottom of hole on 10/24/24

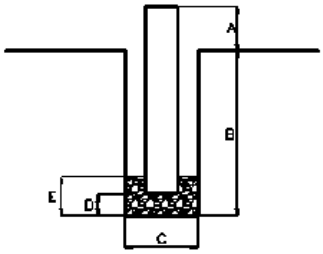
Gravel Correction Factor: 2.6

Trial	Date	Time	Depth To Water* (feet)	Time Interval (min)	Water Drop (inches)	Unfactored Percolation Rate, (minutes per inch)	Unfactored Infiltration Rate, (Inches per hour)
1	10/24/2024	8:40:00	17.9				
	10/24/2024	8:41:25	18.4	1.42	6	0.6	7.2
2	10/24/2024	8:41:25	18.4				
	10/24/2024	8:43:50	18.9	2.42	6	1.0	5.4
Refill 3	10/24/2024	8:45:30	17.9				
Begin Test	10/24/2024	8:55:30	19.28	10.00	16.56	1.5	3.5
Refill 4	10/24/2024	8:57:30	17.9				
	10/24/2024	9:07:30	19.27	10.00	16.44	1.6	3.5
Refill 5	10/24/2024	9:09:25	17.9				
	10/24/2024	9:19:25	19.27	10.00	16.44	1.6	3.5
Refill 6	10/24/2024	9:21:25	17.9				
	10/24/2024	9:31:25	19.25	10.00	16.2	1.6	3.4
Refill 7	10/24/2024	9:32:55	17.9				
	10/24/2024	9:42:55	19.23	10.00	15.96	1.6	3.3
Refill 8	10/24/2024	9:44:20	17.9				
	10/24/2024	9:54:20	19.22	10.00	15.84	1.6	3.3
Refill 9	10/24/2024	9:56:30	17.9				
	10/24/2024	10:06:30	19.22	10.00	15.84	1.6	3.3

* Depth to water measured from top of pipe

PERCOLATION TEST
No. P-2

Project:	Proposed Starbucks	**Project No.**	H33201.01
Location:	SWC of Main Street and 7th Avenue, Hesperia, CA	**Test Date:**	10/24/2024
Coordinates:			



A. Top of Pipe Above Ground	1 Inches
B. Depth of Hole	242 Inches
C. Diameter of Hole	8 Inches
D. Depth of Gravel Below Pipe	5 Inches
E. Total Gravel Layer Thickness	60 Inches
F. Pipe Length	238 Inches
G. Pipe Diameter	2 Inches

Pre-saturated: 60 gallons of water for required 2-hour presoak
Checked Water was constantly filled up to about 2.4 feet from bottom of hole on 10/24/24
Gravel Correction Factor: 2.6

Trial	Date	Time	Depth To Water* (feet)	Time Interval (min)	Water Drop (inches)	Unfactored Percolation Rate, (minutes per inch)	Unfactored Infiltration Rate, (Inches per hour)
1	10/24/2024	11:40:00	17.85				
	10/24/2024	11:41:45	18.35	1.75	6	0.7	5.7
2	10/24/2024	11:41:45	18.35				
	10/24/2024	11:44:05	18.85	2.33	6	1.0	5.4
Refill 3	10/24/2024	11:45:50	17.9				
Begin Test	10/24/2024	11:55:50	19.5	10.00	19.2	1.3	4.3
Refill 4	10/24/2024	11:57:30	17.8				
	10/24/2024	12:07:30	19.41	10.00	19.32	1.3	4.1
Refill 5	10/24/2024	12:09:30	17.9				
	10/24/2024	12:19:30	19.5	10.00	19.2	1.3	4.3
Refill 6	10/24/2024	12:21:15	17.9				
	10/24/2024	12:31:15	19.51	10.00	19.32	1.3	4.3
Refill 7	10/24/2024	12:33:00	17.9				
	10/24/2024	12:43:00	19.5	10.00	19.2	1.3	4.3
Refill 8	10/24/2024	12:44:30	17.9				
	10/24/2024	12:54:30	19.5	10.00	19.2	1.3	4.3

* Depth to water measured from top of pipe

APPENDIX E

COMPACTION TEST REPORT, TEST DATA AND TEST LOCATIONS FOR BACKFILL OF THE AREA OF REMOVED UNDERGROUND STORAGE TANKS WITH ENGINEERED FILL

This appendix contains the compaction test report, test data and test locations, prepared by Hi Desert Testing & Inspection, dated December 1, 1998, for backfill of the removed underground storage tanks with engineered fill in the vicinity of the former fuel canopy. The area of the removed Underground Storage Tanks are also shown on Drawing No. 2 in Appendix A of this report.

Dan Goodwin,
Hi Desert
Testing & Inspection

December 1, 1998
HDT&I P.N. 81041
Report No. 1

ADVANCED ENVIRONMENTAL CONCEPTS, INC.
4400 Ashe Road #206
Bakersfield, CA 93313
(805)831-1646

Attention: Mr. Jonathan L. Buck
Reference: 15901 Main Street, Hesperia, California.

Gentlemen:

In accordance with your request, a representative of this office observed backfilling of two gas tank excavations at the referrenced site, and performed random representative testing of compacted backfill. Samples of the soils were delivered to our laboratory where maximum density and optimum moisture were determined.

Results of our inspections and testing indicates backfill compaction complies with minimum requirements. Results are shown on the attached sheet.

Respectively submitted,
HI DESERT TESTING & INSPECTION

REGISTERED PROFESSIONAL ENGINEER
JERRY L. MILES
No. 42593
Exp 3/31/2000
CIVIL
STATE OF CALIFORNIA

Dan D. Goodwin

Jerry L. Miles, P.E.
RCE 42593

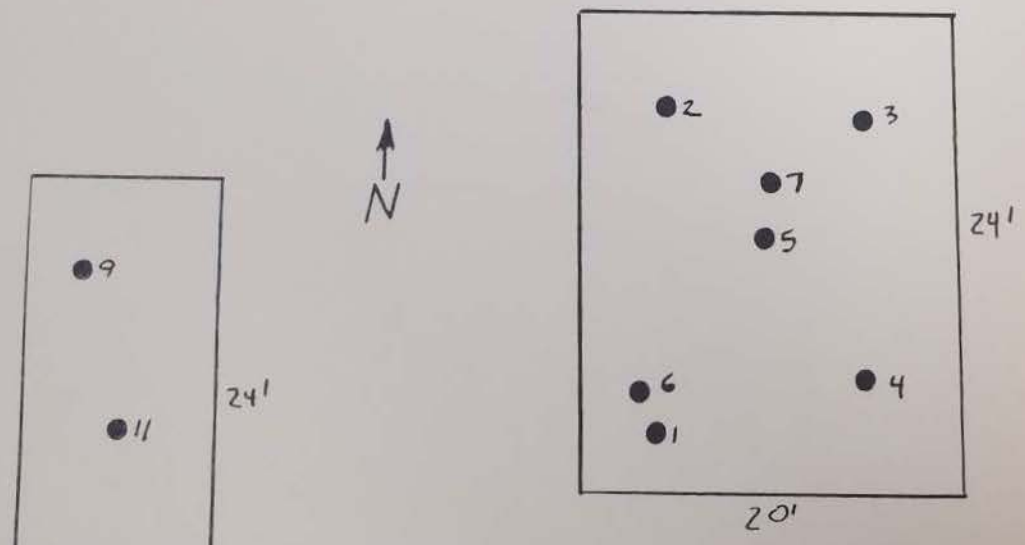
TEST RESULTS

ASTM D 1557-91 TEST METHODS FOR LABORATORY COMPACTION CHARACTERISTICS OF SOIL USING MODIFIED EFFORT

SAMPLE NO.	MAXIMUM DENSITY, P.C.F.	OPTIMUM MOISTURE CONTENT, %
1	126.5	11.0
2	124.0	9.5

ASTM D 2922-91 TEST METHOD FOR DENSITY AND UNIT WEIGHT OF SOIL IN PLACE BY NUCLEAR METHOD.

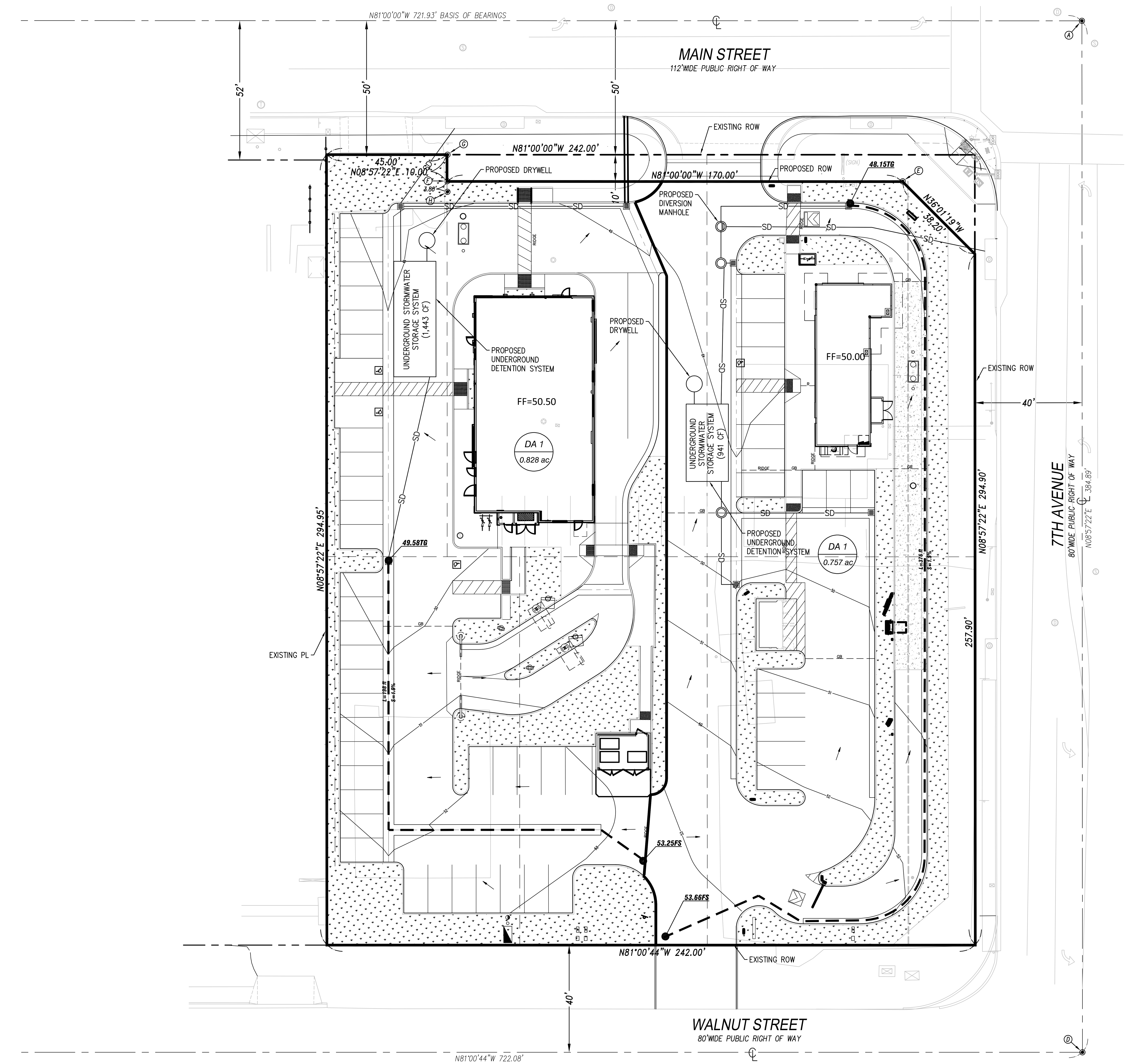
Test No.	Depth From Finished Grade Ft.	Dry Density, P.C.F.	Maximum Density, P.C.F.	Relative Density, %	Required R.D., %
1	11.0	119.6	126.5	94.5	90
2	9.0	119.8	126.5	94.7	90
3	7.0	125.4	126.5	99.1	90
4	6.0	120.4	126.5	95.2	90
5	4.0	112.8	124.0	91.0	90
6	2.0	121.0	124.0	97.6	90
7	0.5	122.7	124.0	99.0	90
8	10.0	119.9	124.0	96.7	90
9	8.0	121.4	124.0	97.9	90
10	6.0	120.7	124.0	97.3	90
11	0.5	117.1	124.0	94.4	90



APPROXIMATE TEST LOCATIONS (NO SCALE)

DG/cg

Appendix B: Site Plan



WQMP CALCULATIONS

AREA #	IMPERVIOUS AREA (sf)	PERVIOUS AREA (sf)	TOTAL AREA (ac)	IMPERVIOUS AREA (%)	LID DCV REQ'D (cf)	BMP VOLUME PROVIDED (cf)
DA 1	25,400	7,572	0.828	70	1,788	1,819
DA 2	21,240	8,417	0.757	64	1,239	1,278

LEGEND:

- DRAINAGE AREA
- FLOW LINE PATH
- AREA / ACRE — DRAINAGE CALLOUT
- EXISTING CONTOUR

0 20 40
SCALE: 1:20

REVISION RECORD

#	DATE	DESCRIPTION

STARBUCKS AND MCDONALDS
SWC MAIN STREET & 7TH AVEUE
HESPERIA, CA

10870 W. FAIRVIEW DR
STE 102-1187
BOISE, ID 83713
(208) 918-0928
thomas@c3civileng.com
www.c3civileng.com
C3 CIVIL ENGINEERING

PROFESSIONAL SEAL

DATE: 12/06/2024
C3 JOB NO: 24-041
DRAWN BY: NM
CHECKED BY: TH

SHEET TITLE

WQMP PLAN

SHEET NUMBER

1 of 1

Appendix C: Calculations and Design

User Inputs

Chamber Model:	DC-780
Outlet Control Structure:	No
Project Name:	Mcdonalds
Engineer:	Nadia Manzur n/a
Project Location:	California
Measurement Type:	Imperial
Required Storage Volume:	1413 cubic ft.
Stone Porosity:	40%
Stone Foundation Depth:	9 in.
Stone Above Chambers:	6 in.
Design Constraint Dimensions:	(20 ft. x 45 ft.)

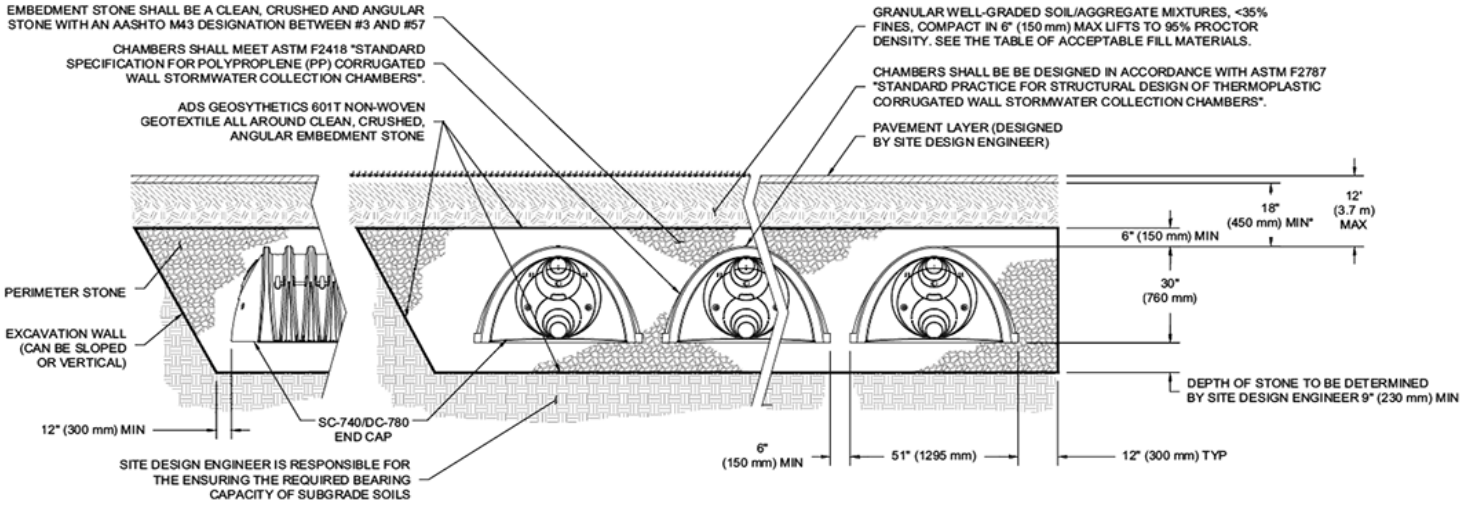
Results

System Volume and Bed Size

Installed Storage Volume:	1443.74 cubic ft.
Storage Volume Per Chamber:	46.20 cubic ft.
Number Of Chambers Required:	15
Number Of End Caps Required:	6
Chamber Rows:	3
Maximum Length:	43.11 ft.
Maximum Width:	15.75 ft.
Approx. Bed Size Required:	679.05 square ft.
Average Cover Over Chambers:	N/A .

System Components

Amount Of Stone Required:	69 cubic yards
Volume Of Excavation (Not Including Fill):	95 cubic yards
Total Non-woven Geotextile Required:	240 square yards
Woven Geotextile Required (excluding Isolator Row):	21 square yards
Woven Geotextile Required (Isolator Row):	25 square yards
Total Woven Geotextile Required:	46 square yards
Impervious Liner Required:	0 square yards



*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 24" (600 mm).

User Inputs

Chamber Model:	DC-780
Outlet Control Structure:	No
Project Name:	Starbucks
Engineer:	Nadia Manzur n/a
Project Location:	California
Measurement Type:	Imperial
Required Storage Volume:	915 cubic ft.
Stone Porosity:	40%
Stone Foundation Depth:	9 in.
Stone Above Chambers:	6 in.
Design Constraint Dimensions:	(20 ft. x 30 ft.)

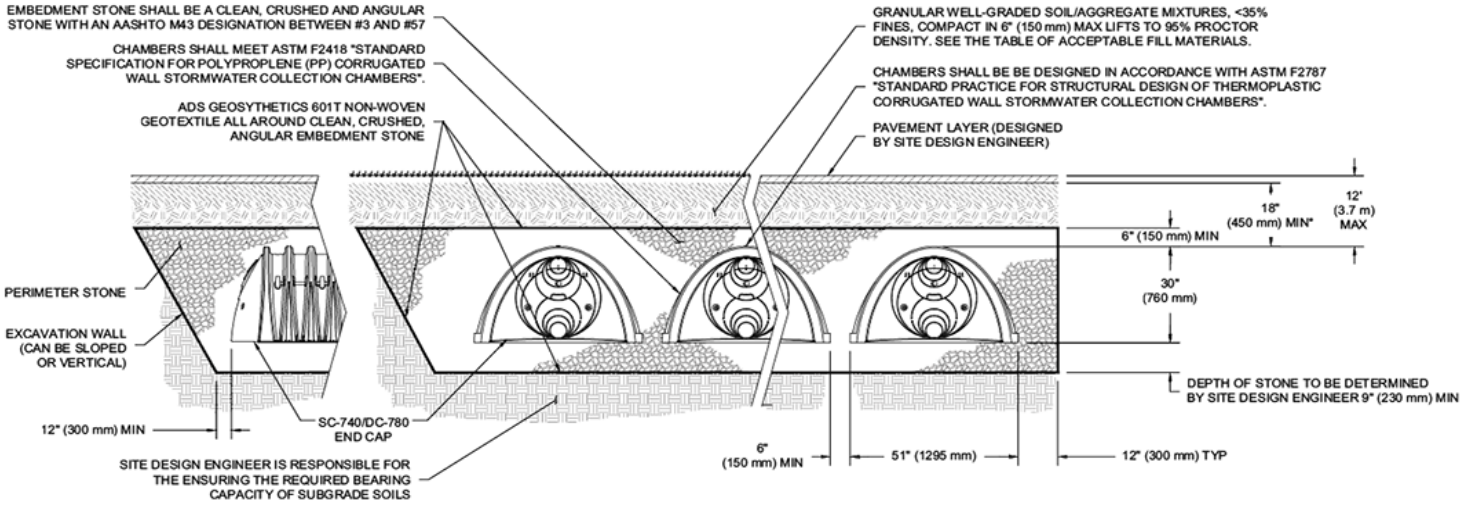
Results

System Volume and Bed Size

Installed Storage Volume:	941.16 cubic ft.
Storage Volume Per Chamber:	46.20 cubic ft.
Number Of Chambers Required:	9
Number Of End Caps Required:	6
Chamber Rows:	3
Maximum Length:	28.88 ft.
Maximum Width:	15.75 ft.
Approx. Bed Size Required:	454.88 square ft.
Average Cover Over Chambers:	N/A .

System Components

Amount Of Stone Required:	48 cubic yards
Volume Of Excavation (Not Including Fill):	64 cubic yards
Total Non-woven Geotextile Required:	166 square yards
Woven Geotextile Required (excluding Isolator Row):	21 square yards
Woven Geotextile Required (Isolator Row):	16 square yards
Total Woven Geotextile Required:	37 square yards
Impervious Liner Required:	0 square yards

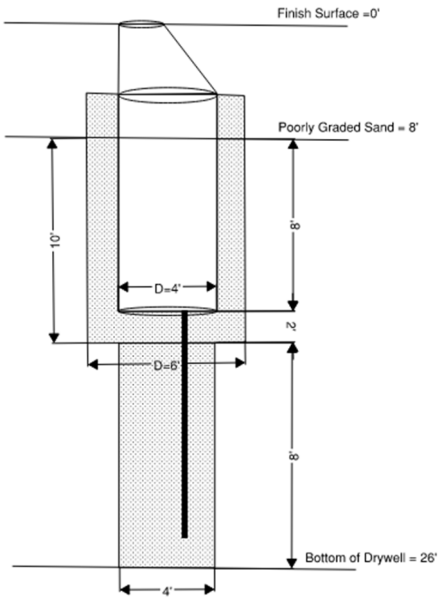


*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 24" (600 mm).

Infiltration LID BMP – Dry wells

[1] $V_{ret} = (P_{design}/12*SA_{inf}*T_{fill}) + (SA_{reservoir}*d_{resevior}*n_{aggregate}) = X_1 + X_2$

BMP Type	DMA A	DMA B
[2] Design capture Volume, DCV (ft^3) See Form 4.21 Item 7	1,788	1,239
[3] Infiltration Rate of underlying soils (in/hr)	4.3	3.3
[4]Infiltration Safety Factor See TGD section 5.4.2 and Appendix D	2	2
[5] Design percolation rate (in/hr) P_{Design} = Item 2/ intem 3	2.15	1.65
[6]$SA_{inf, res}$= surface area (ft^2) for drywell	301.6	301.6
[7]Duration of storm when infiltration is occurring as basin is filling (hrs) ; T_{fill} (default is 3 hours)	3	3
[8]Drawdown time for stored runoff(hrs); $T_{drawdown}$ (default is 48 hours)	48	48
[9] X_1= total infiltrating volume after 3 hrs (cf)	162.10	124.40
[10] Depth (ft) of Drywell	16	16
[11] Porosity of Aggregate, if none then 1.0	0.4	0.4
[12]X_2 = Maximum volume of drywell (cf)	213	213
[13]Total Volume of Drywell, V_{ret} (cf) = item 9 + item 12	375	337.4
[14]Minimum Retention Volume = Item 2 – item 9	1,626	1,114
[15]Additional storage volume required= Item 14- item 12	1,413	902
[16] Underground Retention Volume (ft^3), ADS Stormtech System	1,444	941
[16] Design Drawdown Time for stored runoff (hrs), T_{design}= (Item 14)/ (Item 6 * (Item 5)/12)	30	27



Appendix D: Educational Materials

Building & Grounds Maintenance SC-41

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	
Organics	

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

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- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.
- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

Training

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

Other Considerations

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

Maintenance

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Parking/Storage Area Maintenance SC-43

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

The goal of this program is to ensure stormwater pollution prevention practices are considered when conducting activities on or around parking areas and storage areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)
- Keep accurate maintenance logs to evaluate BMP implementation.

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SC-43 Parking/Storage Area Maintenance

Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Discharge soapy water remaining in mop or wash buckets to the sanitary sewer through a sink, toilet, clean-out, or wash area with drain.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel, and dispose of litter in the trash.

Surface Cleaning

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Follow the procedures below if water is used to clean surfaces:
  - Block the storm drain or contain runoff.
  - Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below when cleaning heavy oily deposits:
  - Clean oily spots with absorbent materials.
  - Use a screen or filter fabric over inlet, then wash surfaces.

- Do not allow discharges to the storm drain.
- Vacuum/pump discharges to a tank or discharge to sanitary sewer.
- Appropriately dispose of spilled materials and absorbents.

Surface Repair

- Preheat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

Other Considerations

Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

SC-43 Parking/Storage Area Maintenance

Requirements

Costs

Cleaning/sweeping costs can be quite large. Construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot regularly to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities regularly to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Only use only as much water as is necessary for dust control to avoid runoff.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Drainage System Maintenance SC-44

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	✓
Oil and Grease	
Organics	

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
  - Is there evidence of spills such as paints, discoloring, etc?

- Are there any odors associated with the drainage system?
- Record locations of apparent illegal discharges/illicit connections?
- Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).

- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Other Considerations (Limitations and Regulations)

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:

  - Purchase and installation of signs.

  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.

  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.

  - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:
http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Site Design & Landscape Planning SD-10

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

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Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.

- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.

- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.

- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.

- Promote natural vegetation by using parking lot islands and other landscaped areas.

- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.

- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Efficient Irrigation SD-12

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING

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– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Alternative Building Materials SD-21

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Source Control
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutant
- Collect and Convey

Description

Alternative building materials are selected instead of conventional materials for new construction and renovation. These materials reduce potential sources of pollutants in stormwater runoff by eliminating compounds that can leach into runoff, reducing the need for pesticide application, reducing the need for painting and other maintenance, or by reducing the volume of runoff.

Approach

Alternative building materials are available for use as lumber for decking, roofing materials, home siding, and paving for driveways, decks, and sidewalks.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Decking

One of the most common materials for construction of decks and other outdoor construction has traditionally been pressure treated wood, which is now being phased out. The standard treatment is called CCA, for chromated copper arsenate. The key ingredients are arsenic (which kills termites, carpenter ants and other insects), copper (which kills the fungi that cause wood to rot) and chromium (which reacts with the other ingredients to bind them to the wood). The amount of arsenic is far from trivial. A deck just 8 feet x 10 feet contains more than 1 1/3 pounds of this highly potent poison. Replacement materials include a new type of pressure treated wood, plastic and composite lumber.

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There are currently over 20 products in the market consisting of plastic or plastic-wood composites. Plastic lumber is made from 100% recycled plastic, # 2 HDPE and polyethylene plastic milk jugs and soap bottles. Plastic-wood composites are a combination of plastic and wood fibers or sawdust. These materials are a long lasting exterior weather, insect, and chemical resistant wood lumber replacement for non structural applications. Use it for decks, docks, raised garden beds and planter boxes, pallets, hand railings, outdoor furniture, animal pens, boat decks, etc.

New pressure treated wood uses a much safer recipe, ACQ, which stands for ammoniacal copper quartenary. It contains no arsenic and no chromium. Yet the American Wood Preservers Association has found it to be just as effective as the standard formula. ACQ is common in Japan and Europe.

Roofing

Several studies have indicated that metal used as roofing material, flashing, or gutters can leach metals into the environment. The leaching occurs because rainfall is slightly acidic and slowly dissolved the exposed metals. Common traditional applications include copper sheathing and galvanized (zinc) gutters.

Coated metal products are available for both roofing and gutter applications. These products eliminate contact of bare metal with rainfall, eliminating one source of metals in runoff. There are also roofing materials made of recycled rubber and plastic that resemble traditional materials.

A less traditional approach is the use of green roofs. These roofs are not just green, they're alive. Planted with grasses and succulents, low- profile green roofs reduce the urban heat island effect, stormwater runoff, and cooling costs, while providing wildlife habitat and a connection to nature for building occupants. These roofs are widely used on industrial facilities in Europe and have been established as experimental installations in several locations in the US, including Portland, Oregon. Their feasibility is questionable in areas of California with prolonged, dry, hot weather.

Paved Areas

Traditionally, concrete is used for construction of patios, sidewalks, and driveways. Although it is non-toxic, these paved areas reduce stormwater infiltration and increase the volume and rate of runoff. This increase in the amount of runoff is the leading cause of stream channel degradation in urban areas.

There are a number of alternative materials that can be used in these applications, including porous concrete and asphalt, modular blocks, and crushed granite. These materials, especially modular paving blocks, are widely available and a well established method to reduce stormwater runoff.

Building Siding

Wood siding is commonly used on the exterior of residential construction. This material weathers fairly rapidly and requires repeated painting to prevent rotting. Alternative “new” products for this application include cement-fiber and vinyl. Cement-fiber siding is a masonry product made from Portland cement, sand, and cellulose and will not burn, cup, swell, or shrink.

Pesticide Reduction
A common use of powerful pesticides is for the control of termites. Chlordane was used for many years for this purpose and is now found in urban streams and lakes nationwide. There are a number of physical barriers that can be installed during construction to help reduce the use of pesticides.

Sand barriers for subterranean termites are a physical deterrent because the termites cannot tunnel through it. Sand barriers can be applied in crawl spaces under pier and beam foundations, under slab foundations, and between the foundation and concrete porches, terraces, patios and steps. Other possible locations include under fence posts, underground electrical cables, water and gas lines, telephone and electrical poles, inside hollow tile cells and against retaining walls.

Metal termite shields are physical barriers to termites which prevent them from building invisible tunnels. In reality, metal shields function as a helpful termite detection device, forcing them to build tunnels on the outside of the shields which are easily seen. Metal termite shields also help prevent dampness from wicking to adjoining wood members which can result in rot, thus making the material more attractive to termites and other pests. Metal flashing and metal plates can also be used as a barrier between piers and beams of structures such as decks, which are particularly vulnerable to termite attack.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of "redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

There are no good, independent, comprehensive sources of information on alternative building materials for use in minimizing the impacts of stormwater runoff. Most websites or other references to "green" or "alternative" building materials focus on indoor applications, such as formaldehyde free plywood and low VOC paints, carpets, and pads. Some supplemental information on alternative materials is available from the manufacturers.

Fires are a source of concern in many areas of California. Information on the flammability of alternative decking materials is available from the University of California Forest Product Laboratory (UCFPL) website at: http://www.ucfpl.ucop.edu/WDDeckIntro.htm

Trash Storage Areas SD-32

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

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- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

SAN BERNARDINO COUNTY
STORMWATER POLLUTION PREVENTION

Commercial landscape maintenance:

Yard waste, sediments and toxic lawn and garden chemicals used in commercial landscape maintenance often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates local waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution, protect public health and avoid fines or legal action.

- **Recycle Yard Waste:** Recycle leaves, grass clippings and other yard waste. Do not blow, sweep, rake or hose yard waste into the street. Let your customers know about grass cycling --the natural recycling of grass by leaving clippings on the lawn when mowing instead of using a grass catcher. Grass clippings will quickly decompose, returning valuable nutrients to the soil. You can get more information at www.ciwmb.ca.gov/Organics.
- **Use Fertilizers, Herbicides & Pesticides Safely:** Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural, non-toxic alternatives to traditional garden chemicals. If you must use chemical fertilizers, herbicides, or pesticides spot apply rather than blanketing entire areas, avoid applying near curbs and driveways and never apply before a rain.
- **Recycle Hazardous Waste:** Pesticides, fertilizers, herbicides and motor oil contaminate landfills and should be disposed of through a Hazardous Waste Facility. For information on proper disposal, call (909) 386-8401.
- **Use Water Wisely:** Conserve water and prevent runoff by controlling the amount of water and direction of sprinklers. Sprinklers should be on long enough to allow water to soak into the ground but not so long as to cause runoff. Periodically inspect, fix leaks and realign sprinkler heads.
- **Planting:** Plant native vegetation to reduce the need of water, fertilizers, herbicides and pesticides.

- **Prevent Erosion:** Erosion washes sediments, debris and toxic runoff into the storm drain system, polluting waterways. Prevent erosion and sediment runoff by using ground cover, berms and vegetation down-slope to capture runoff. Avoid excavation or grading during wet weather.
- **Store Materials Safely:** Keep landscaping materials and debris away from the street, gutter and storm drains. On-site stockpiles of materials should be covered with plastic sheeting to protect from rain, wind and runoff.

For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org

SAN BERNARDINO COUNTY
STORMWATER POLLUTION PREVENTION

Food & Restaurants:

Food waste, grease, cleaning fluids, mop water and trash from restaurant operations often make their way into the San Bernardino County storm drain system, and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution, protect public health and avoid fines or legal action.

- **Cleaning & Maintenance:** Clean equipment, floor mats, filters and garbage cans in a mop sink, wash rack or floor drain connected to the sewer through a grease trap. Don't wash them or pour wash water in a parking lot, alley, sidewalk or street. Sweep outside areas and put the debris in the garbage, instead of sweeping or hosing it into the parking lot or street.
- **Recycle oil & grease:** Oil and grease wastes can be recycled. Look in the yellow pages for rendering companies, or call (909) 386-8401 for disposal information. Don't pour oil or grease into sinks, floor drains or onto a parking lot or street. Keep grease bins covered and contained.
- **Dumpster areas:** Keep dumpster lids closed and the areas around them clean. Do not fill with liquid waste or hose them out. Call your trash hauler to replace any dumpsters that are damaged or leak. Do not wash down or steam clean trash enclosure area or trash bin unless you collect the water and dispose of it into the sanitary sewer. Hire a mobile pressure wash business that is familiar with the storm water regulations to clean these areas and make sure they provide you with a record of proper wastewater disposal.

- **Managing spills:** Use dry methods for spill cleanup, sweeping and using cat litter instead of hosing. Have spill containment and cleanup kits available for possible spills on your property. To report serious toxic spills, call (800) 33-TOXIC.
- **Handling toxic chemicals:** Dispose of all unwanted toxics materials like cleaners, solvents and detergents through a hazardous waste hauler. These items are not trash. Use non-toxic cleaning products whenever possible. For information on hazardous waste pickup, call (909) 386-8401.

For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org

LANDSCAPE MAINTENANCE

DISCHARGE TO THE STORM DRAIN, **ACCIDENTAL OR NOT**, COULD LEAD TO ENFORCEMENT ACTIONS, WHICH COULD INCLUDE FINES.

Follow the best practices below to **prevent water pollution from landscaping activities.**

RECYCLE YARD WASTE

- Recycle leaves, grass clippings and other yard waste.
- Do not blow, sweep, rake or hose yard waste into the street or catch basin.
- **Try grasscycling:** the natural recycling of grass by leaving clippings on the lawn when mowing.

  For more information, please visit: **www.calrecycle.ca.gov/organics/grasscycling**

USE FERTILIZERS, HERBICIDES AND PESTICIDES SAFELY

- Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural and non-toxic alternatives as often as possible.
- If you must use chemical fertilizers, herbicides or pesticides:
  - Spot apply, rather than blanketing entire areas.
  - Avoid applying near curbs and driveways, and **never** before a rain.
  - Apply fertilizers as needed: when plants could best use it and when the potential runoff would be low.
  - Follow the manufacturer's instructions carefully—this will not only give the best results, but will save money.

USE WATER WISELY

- Control the amount of water and direction of sprinklers. Sprinklers should only be on long enough to allow water to soak into the ground, but not so long as to cause runoff.
- Periodically inspect, fix leaks and realign sprinkler heads.
- Plant native vegetation to reduce the need of water, fertilizers, herbicides and pesticides.

HOMEOWNERS

KEEP THESE TIPS IN MIND WHEN HIRING PROFESSIONAL LANDSCAPERS AND REMIND AS NECESSARY.

Leftover pesticides, fertilizers, and herbicides contaminate landfills and should be disposed of through a Hazardous Waste Facility.

For more information on proper disposal call,

(909) 382-5401 or 1-800-OILY CAT.

*FREE for San Bernardino County residents only. Businesses can call for cost inquiries and to schedule an appointment.

To report illegal dumping, call (877) WASTE18 or visit sbcountystormwater.org
To report toxic spills, call 1(800) 33 TOXIC
To dispose of hazardous waste, call 1(800) OILY CAT

sbcountystormwater.org

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COMMERCIAL TRASH ENCLOSURES

FOLLOW THESE **REQUIREMENTS** TO **KEEP OUR WATERWAYS CLEAN**

Trash enclosures, such as those found in commercial and apartment complexes, typically contain materials that are intended to find their way to a landfill or a recycling facility. **These materials are NOT meant to go into our local lakes and rivers.**

PROTECT WATER QUALITY BY FOLLOWING THESE SIMPLE STEPS

PUT TRASH INSIDE

Place trash inside the bin (preferably in sealed bags)

CLOSE THE LID

Prevent rain from entering the bin in order to avoid leakage of polluted water runoff

KEEP TOXICS OUT

- Paint
- Grease, fats and used oils
- Batteries, electronics and fluorescent lights

SOME ADDITIONAL GUIDELINES, INCLUDE

✓ **SWEEP FREQUENTLY**

Sweep trash enclosure areas frequently, instead of hosing them down, to prevent polluted water from flowing into the streets and storm drains.

✓ **FIX LEAKS**

Address trash bin leaks immediately by using dry clean up methods and report to your waste hauler to receive a replacement.

✓ **CONSTRUCT ROOF**

Construct a solid cover roof over the existing trash enclosure structure to prevent rainwater from coming into contact with trash and garbage. Check with your local City/County for Building Codes.

In San Bernardino County, stormwater pollution is caused by food waste, landscape waste, chemicals and other debris that are washed into storm drains and end up in our waterways - untreated! You can be part of the solution by maintaining a water-friendly trash enclosure.

THANK YOU FOR HELPING TO KEEP SAN BERNARDINO COUNTY CLEAN AND HEALTHY!

To report illegal dumping **(877-WASTE18)** or
to find a household hazardous waste facility (800-OILY CAT): **sbcountystormwater.org**
To dispose of hazardous waste call the San Bernardino County Fire Dept. - CUPA Program **(909) 386-8401**

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STORMWATER Pollution Prevention

FOOD AND RESTAURANT

Food waste, grease, cleaning fluids, mop water and trash from restaurant operations often make their way into the San Bernardino County storm drain system, and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

Recycle Oil & Grease

Oil and grease wastes can be recycled. Look in the yellow pages for rendering companies, or call (909) 386-8401 for disposal information. Don't pour oil or grease into sinks, floor drains or onto a parking lot or street. Keep grease bins covered and contained. Keep your grease interceptor maintained to prevent sewer overflows or backups and keep records of grease waste hauling.

Dumpster Areas

Keep dumpster lids closed and the areas around them clean. Do not fill with liquid waste or hose them out. Call your trash hauler to replace any dumpsters that are damaged or leak.

Managing Spills

Clean food spills in loading and trash areas by using absorbent materials and sweeping then mopping, and discharge mop water into the sewer through a grease interceptor. Have spill containment and cleanup kits available. To report serious toxic spills, call 911.

Cleaning & Maintenance

Clean equipment, floor mats, filters and garbage cans in a mop sink, wash rack or floor drain connected to the sewer through a grease trap. Don't wash them or pour wash water in a parking lot, alley, sidewalk or street. Sweep outside areas and put the debris in the garbage, instead of sweeping or hosing it into the parking lot or street.

Handling Toxic Chemicals

Dispose of all unwanted toxics materials like cleaners, solvents and detergents through a hazardous waste hauler. These items are not trash. For information on hazardous waste pickup, call (909) 386-8401. Use non-toxic cleaning products whenever possible.

To report illegal dumping call

(877) WASTE18

sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM