Reyes Holdings, LLC

APN: 3090-431-07
Victorville, CA 92395

PRELIMINARY

WATER QUALITY MANAGEMENT PLAN
MOJAVE RIVIER WATERSHED

Prepared For:

Industrial Warehouse Development
Reyes Holdings, LLC
APN 3090-431-07
Victorville, San Bernardino County, California

Duke Engineering
44732 Yucca Avenue
Lancaster, Ca 93534
Phone 661-952-7918

Submittal Date: 04/22/2022
Revision No. and Date: _____
Revision No. and Date: _____
Revision No. and Date: _____
Revision No. and Date: _____

Final Approval Date: _____

Project Owner's Certification

This Mojave River Watershed Water Quality Management Plan (WQMP) has been prepared for Reyes Holdings, LLC by Duke Engineering The WQMP is intended to comply with the requirements of the County of San Bernardino 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):	PLAN22-00004	Grading Permit Number(s):	
Tract/Parcel Map Number(s):		Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 3090-431-07

Owner's Signature			
Owner Name: Reyes Holdings			
Title			
Company			
Address			
Email			
Telephone #			
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	PLAN22-00004	Grading Permit Number(s):	
Tract/Parcel Map Number(s):		Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 3090-431-07

"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: Ryan Duke		PE Stamp Below
Title	Principal Engineer	
Company	Duke Engineering	
Address	44732 Yucca Ave Lancaster CA 93534	
Email	ryan@duke-engineering.com	
Telephone #	661-952-7918	
Signature		
Date	04-22-2022	

Table of Contents

Forms

Section I – Introduction

This WQMP 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	Reyes Industrial Building				
Project Owner Contact Name:	Philip Erdman				
Mailing Address:	6250 North River Road Suite 9000 Rosemont IL 60018	E-mail Address:	PErdman@reyesholdings.com	Telephone:	707-684-9941
Permit/Application Number(s):	PLAN22-00004	Tract/Parcel Map Number(s):			
Additional Information/ Comments:					
Description of Project:	The project site is located withing the city of Victorville, on the South East corner of Ottawa St. and Enterprise Wy. The subject property consists of approximately 10 acres. The new construction will consist of a 18,525 SF metal warehouse building with office spaces, a parking lot, sidewalk, and landscaping per City requirements. The existing site condition is vacant with a drainage channel along the North and West property lines.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	The current project site is approximately 7.5 acres of undeveloped land. There is an existing drainage channel easement on the eastern and northern portions of the site that will remain undisturbed. The proposed site condition will be an industrial development consisting of a 18,525 SF office ware house building, landscaping, parking lot, loading dock, and fencing. The proposed grading consists of a new on-site retention basin located on the South West corner of the project site. A hydrology study has been completed to determine the sizing of the retention basin. The site water will be conveyed to the retention basin through on-site storm drain system, catch basins, and ribbon gutters. All water runoff from the site will be captured and treated by the infiltration / detention basin. There will also be BMP's implemented for the project. There are large landscape areas to accommodate the storm water treatment strategies.				

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 ft^2 or more of impervious surface collectively over entire site	☐ #2 Significant re-development involving the addition or replacement of 5,000 ft^2 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):	184,452	**3** Number of Dwelling Units:	0	**4** SIC Code:	4225

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 listed below will be responsible for long-term maintenance of WQMP storm water facilities. Including but not limited to landscape areas, catch basins, filter inserts, and basin maintenance until the property is sold or transfered.

Reyes Holdings, LLC
6250 North River Road
Suite 9000
Rosemont IL 60018

Refer to Section 5 and Attachment E of the WQMP report for detailed maintenance activities.

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 ☐	Expected per Table 3-3 in the TGD for WQMP. Per section 3.3 of the TGD for WQMP, potential sources include animal waste.
Nutrients - Phosphorous	E ☒	N ☐	Expected per Table 3-3 in the TGD for WQMP. Per section 3.3 of the TGD for WQMP, potential sources include fertilizers and eroded soils.
Nutrients - Nitrogen	E ☒	N ☐	Expected per Table 3-3 in the TGD for WQMP. Per section 3.3 of the TGD for WQMP, potential sources include fertilizers and eroded soils.
Noxious Aquatic Plants	E ☐	N ☒	Expected per Table 3-2 in the TGD for WQMP. Sources from urban runoff include fertilizers and eroded soils
Sediment	E ☒	N ☐	Expected per Table 3-3 in the TGD for WQMP. Per section 3.3 of the TGD for WQMP, potential sources include eroded soils.
Metals	E ☒	N ☐	Expected per Table 3-3 in the TGD for WQMP. Per section 3.3 of the TGD for WQMP, potential sources include brake pad and tire tread wear associated with driving.
Oil and Grease	E ☒	N ☐	Expected per Table 3-3 in the TGD for WQMP. Per section 3.3 of the TGD for WQMP, potential sources include petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids.
Trash/Debris	E ☒	N ☐	Expected per Table 3-3 in the TGD for WQMP. Per section 3.3 of the TGD for WQMP, potential sources include paper, plastic, polystyrene packing foam, and aluminum materials.
Pesticides / Herbicides	E ☒	N ☐	Expected per Table 3-3 in the TGD for WQMP. Per section 3.3 of the TGD for WQMP, potential sources include fertilizers and pest sprays..
Organic Compounds	E ☒	N ☐	Expected per Table 3-3 in the TGD for WQMP. Per section 3.3 of the TGD for WQMP, potential sources include solvents and cleaning compounds.
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 342934.92	Longitude -1171718.88	

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*

See attached hydrology map.

Conveyance	All areas drain to the on-site retention basin.
DA1 DMA C flows to DA1 DMA A	
DA1 to BMP1	
DA2 to BMP2	
DA3 to BMP3	

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1

For Drainage Area 1's sub-watershed, provide the following characteristics	DA 1	DA	DA	DA
1 DMA drainage area (ft^2)	184,452			
2 Existing site impervious area (ft^2)	0			
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	II			
4 Hydrologic soil group *Refer to County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf*	A			
5 Longest flowpath length (ft)	700			
6 Longest flowpath slope (ft/ft)	0.04%			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Natural Cover 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			

Form 3-3 Watershed Description for Drainage Area 1	
Receiving waters Refer to SWRCB site: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	Mojave River
Applicable TMDLs *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	Mojave River - None
303(d) listed impairments *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	Mojave River - None
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	Mojave Ground Squirrel
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	☒	☐	The Property Owner will provide practical information materials to the first residents/occupants/tenants on general housekeeping practices that contribute to the protection of stormwater quality. These materials will be initially included in the approved WQMP. Thereafter such materials will be available through the local jurisdiction's stormwater education program.The current website is www.sbcountystormwater.org
N2	Activity Restrictions	☒	☐	Activity restrictions will be imposed by the owner to limit exposure of stormwater to potential pollutants listed above in table 2.3-1.Restrictions will include fertilizers and pesticides be applied by certified persons.
N3	Landscape Management BMPs	☒	☐	Owner will ensure landscaping and irrigation is properly maintained. Fertilizers and pesticides be applied by certified persons. See CASQA handout in appendix B of WQMP O&M plan, for more detailed information.
N4	BMP Maintenance	☒	☐	The property owner will provide the applicable BMP maintenance information to those who will be maintaining the non-structural and structural BMPs. See forms 4.1-1, 4.1-2 and 5-1 for BMP list as well as the WQMP O&M plan for maintenance activities.
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	No hazardous waste storage is proposed for this project.
N6	Local Water Quality Ordinances	☒	☐	This project will comply with the City of Victorville's Stormwater Ordinance through the implementation of BMP's.
N7	Spill Contingency Plan	☐	☒	Building operators shall prepare specific plans based on materials on-site for the cleanup of spills. Plans shall mandate stock piling of cleanup materials, notification of agencies, disposal, documentation, etc.
N8	Underground Storage Tank Compliance	☐	☒	No underground storage tanks are proposed.
N9	Hazardous Materials Disclosure Compliance	☐	☒	Per San Bernardino County Fire, Hazardous Materials Division, the basic quantities for disclosure are: hazardous materials at or exceeding 55 gallons, 500 pounds, or 200 cubic feet at any time in the course of a year. The proposed use of this site does not meet this threshold.

Form 4.1-1 Non-Structural Source Control BMPs

N10	Uniform Fire Code Implementation	☐	☒	Project plans are reviewed for compliance by local fire protection agency based on determination by planning department. Article 80 of the Uniform Fire Code deals with storage of Hazardous Materials, which are not being stored on this site.
N11	Litter/Debris Control Program	☒	☐	Litter/Debris inspection and clean up will be made part of the regular grounds maintenance and house keeping. At-least once a week. When trash/debris is seen it will be cleaned up as soon as possible.
N12	Employee Training	☒	☐	Employees will be trained on the BMPs listed on form 5-1. The training material will be innitially provided by the property owner per N1 above. See O&M plan in the approved WQMP for BMP handouts, based on the intended use, to be used in initial training.
N13	Housekeeping of Loading Docks	☒	☐	The employees will keep the loading docks clean and free of debris. They will be maintained and kept in operable order.
N14	Catch Basin Inspection Program	☒	☐	For privately maintained drainage systems, the owner is required to have at least 80 percent of drainage facilities inspected, cleaned and maintained on an annual basis with 100 percent of the facilities included in a two-year period. Cleaning should take place in the late summer/early fall prior to the start of the rainy season. See CASQA handout in Appendix B of the O&M plan for more detailed information.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	At a minimum paved parking areas of a business shall be swept, using a vacuum assisted sweeper, in late summer or early fall, prior to the start of the rainy season. See CASQA handout in Appendix B of the O&M plan for more detailed information.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	Project is not a public agency Priority Project and this is not required by the local jurisdiction.
N17	Comply with all other applicable NPDES permits	☒	☐	The proposed site will comply with current NPDES permit requirements through implementation of the site specific Storm Water Pollution Prevension Plan (SWPPP) BMPs. Refer to separate SWPPP document.

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)	☒	☐	NPDES, 40 CFR 122.26 (1999) compliant labeling of all storm drain inlets and catch basins, constructed or modified, within the project area will be added per the approved grading plan. Catch basin labels will be inspected once annually and relabeled as necessary to maintain legibility. See CASQA handout in Appendix B of O&M plan for more detailed information and approved grading plan for example.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No outdoor material storage is proposed.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Trash and waste storage areas will be constructed per approved grading plans and include a impervious paved area for storage of the state compliant receptacles that are provided by the refuse service provider.
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)	☒	☐	Owner will ensure landscaping and irrigation is properly maintained in accordance with The Water Conservation in Landscaping Act of 2006, Assembly Bill 1881 (AB 1881). The landscaping and irrigation will be installed per the approved landscaping plans,which will incorporate rain-triggered shutoff devices and automatic irrigations controllers. See separate landscaping plan and CASQA handout in Appendix B of O&M plan for more detailed information.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Landscape areas are designed with a minimum of 1 inch below adjacent impervious areas.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	There is an existing channel on the site. There is a proposed basin that will have an access driveway for maintenance.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	No dock areas are proposed.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☒	☐	There will be spill plans in place to comply with the BMP handbook
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No vehicle washingis proposed.

S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	No outdoor processing areas are proposed.

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)	☒	☐	Spill containment plans will be kept on site and developed per the BMP handbook.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	No fueling is proposed.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	No hillside landscaping is proposed.
S14	Wash water control for food preparation areas	☐	☒	No food preparation areas proposed.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	No car washing proposed.

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: Impervious area has been minimized as much as possible for the proposed use of this site.
Maximize natural infiltration capacity; Including improvement and maintenance of soil: Yes ☒ No ☐ Explanation: Landscape and BMP areas will be marked, with flagging tape or other method at the contractor's discression, durning construction to minimize compaction and maximize natural infiltration capacity.
Preserve existing drainage patterns and time of concentration: Yes ☐ No ☒ Explanation: Existing time of concentration will change due to the proposed development.
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: Impervious areas have been disconnected as much as possible for this site.
Protect existing vegetation and sensitive areas: Yes ☒ No ☐ Explanation: No sensitive areas exist on site.
Re-vegetate disturbed areas. Including planting and preservation of drought tolerant vegetation. : Yes ☒ No ☐ Explanation: Disturbed areas will be re-vegetated where possible, see site plan for proposed landscaping areas.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: Stormwater BMP areas will be marked, with flagging tape or other method at the contractor's discression, durning construction to minimize compaction and maximize natural infiltration capacity.
Utilize naturalized/rock-lined drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Naturalized drainage swales will not be used on this project due to site constraints.

Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐
Explanation: Landscape areas will be marked, with flagging tape or other method at the contractor's discression, durning construction to minimize compaction and maximize natural infiltration capacity.

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 1 (ft^2): 184,452	**2** Imperviousness after applying preventative site design practices (Imp%): 0.41	**3** Runoff Coefficient (Rc): _0.635 *$R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.455 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 2.28 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (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): 43,037 *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 4.2-2 Summary of Hydromodification Assessment (DA 1)

Is the change in post- and pre- condition flows captured on-site? : Yes ☒ No ☐

If "Yes", then complete Hydromodification assessment of site hydrology for 10yr storm event using Forms 4.2-3 through 4.2-5 and insert results below *(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual- Addendum 1)*

If "No," then proceed to Section 4.3 BMP Selection and Sizing

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	**1** *Form 4.2-3 Item 12*	**2** *Form 4.2-4 Item 13*	**3** *Form 4.2-5 Item 10*
Post-developed	**4** 43,037 *Form 4.2-3 Item 13*	**5** *Form 4.2-4 Item 14*	**6** *Form 4.2-5 Item 14*
Difference	**7** *0* *Item 4 – Item 1*	**8** *0.00* *Item 2 – Item 5*	**9** *0.00* *Item 6 – Item 3*
Difference (as % of pre-developed)	**10** *0%* *Item 7 / Item 1*	**11** *0%* *Item 8 / Item 2*	**12** *%* *Item 9 / Item 3*

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	Barron							
2a Hydrologic Soil Group (HSG)	A							
3a DMA Area, ft^2 *sum of areas of DMA should equal area of DA*	184445							
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)	A							
3b DMA Area, ft^2 *sum of areas of DMA should equal area of DA*	184445							
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)
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)

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)	184445		
3 Ratio of pervious area receiving runoff to impervious area	0.41		
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*	62,663		
5 Sum of retention volume achieved from impervious area dispersion (ft^3): 0 $V_{retention}$ *=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 BMP Type	DA DMA BMP Type	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): 0 $V_{retention}$ *=Sum of Item 12 for all BMPs*			

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

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	33		
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): 0 $V_{retention}$ *= Sum of Item 17 for all BMPs*			
19 Total Retention Volume from Site Design BMPs: 0 *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.

.

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design BMP (ft^3): 12,815 *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 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*			
16 Total Retention Volume from LID Infiltration BMPs: *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 100% *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 (DA 1)

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: 0 *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 : 0 *(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): 188445 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design BMP (ft^3): 62,663 *Copy Item18 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): 62.663 *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): *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. ☐

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 (DA 1)

1 Volume reduction needed for hydromodification performance criteria (ft^3): 0 *(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	Source Control BMP Identifier	Reponsible Party(s)	Inspection Activities Required	Maintenance Activities Required	Minimum Frequency of Activities
Building & Grounds Maintenance	~	Property Owner	Inspect site for trash and debris	Clean up trash and debris	Weekly
			See CASQA handout SC-41 in Appendix B of O&M plan for more detailed information.		
Underground Chambers	~	N/A	Inspect for trash and debris	Clean trash and debris if needed	Monthly
			Inspect for sediment and damage	Clean and repair per manufacturer's recommendations	Annually prior to October 1st and after major storm events
			See manufacturer's handout in Appendix B of O&M plan for more detailed information.		
Education of Property Owners, Tenants & Occupants on Stormwater BMPs	N1	Property Owner	The Property Owner will provide practical information materials to the first residents/occupants/tenants on general housekeeping practices that contribute to the protection of stormwater quality.	These materials will be initially included in the approved WQMP. Thereafter such materials will be available through the local jurisdiction's storm water education program.	At time of hire/occupancy and annualy

			The current website is www.sbcountystormwater.org		
Activity Restrictions	N2	Property Owner	- Vehicles and equipment will not be washed or maintenance in areas exposed to storm water - do not use water to clean impervious areas - Restrictions shall conform to local water quality ordinance.		Revised annually prior to training (N1)
Landscape Management	N3	Property Owner	Application of pesticides or herbicides shall be done by a licensed professional		When Applicable
			Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring.	Adjust timers, sprinkler heads and make repairs as needed	Monthly
			See CASQA Landscape Managment and SC-41 handouts in Appendix B of O&M plan for more detailed information.		
BMP Maintenance	N4	Property Owner	Identify responsibility for implementation of each non-structural BMP and scheduled cleaning and/or maintenance of all structural BMP facilities.	Maintain BMPs per Form 5-1	Per Form 5-1
			See handouts in Appendix B of O&M plan for more detailed information.		
Local Water Quality Ordinances	N6	Property Owner	Local water quality ordinances shall be followed per local agency.	Implement this WQMP and comply with supplemental information provided by local jurisdiction in the future	As needed.
Uniform Fire Code Implementation	N10	Property Owner	An inventory of hazardous materials stored (including cleaning chemicals) on site will be created	Hazardous material inventory will be kept up to date as materials change	Monthly
			Compliance with Article 80 of the Uniform Fire enforced by the fire protection agency.	Comply with requirements provided after fire protection agency inspections	After inspections
Litter/Debris Control Program	N11	Property Owner	Implement trash management and litter control procedures in common areas to reduce pollution of drainage area	Empty trash receptacles	Weekly
Employee Training	N12	Property Owner	Educational materials on general housekeeping practices for the protection of storm water quality shall be provided to employees.	Materials are available through local jurisdiction's storm water education program.	At time of hire

			Employees will be trained by the property owner or tenant on the implementation of this WQMP	Review WQMP material prior to annual training	Annually
			The current website is www.sbcountystormwater.org		
Catch Basin Inserts	N14	Property Owner	Inspect for trash, debris and damage	Clean and repair as needed	Monthly
			See CASQA handout MP-52 in Appendix B of O&M plan for more detailed information.		
Sweeping	N15	Property Owner	Inspect parking lots for debris accumulation	Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the potential discharge of pollutants into the storm water conveyance system	Annually (prior to October 1st)
			See CASQA handout SC-43 in Appendix B of O&M plan for more detailed information.		
NPDES Permits	N17	Property Owner	Approval and implementation of this WQMP	Implement this WQMP	On going
			The owner/tenant shall insure that a industrial SWPPP is created if required based on the use of the site	Implement site specific SWPPP	Per separate SWPPP
Provide storm drain system stenciling and signage	S1	Property Owner	Inspected storm drain system stenciling and signage	relabeled as necessary to maintain legibility	Annually
			See CASQA handout SD-13 in Appendix B of O&M plan for more detailed information.		
Trash Enclosure	S3	Property Owner	Inspect trash enclosure for debris	Clean enclosure area and dry sweep	Monthly
			Inspect receptacle for damage/leaks	Contact contracted refuse company for replacement as needed	Monthly
			See CASQA handout SD-32 in Appendix B of O&M plan for more detailed information.		

Use Efficient Irrigation Systems and Landscape Design	S4	Property Owner	Designing irrigation systems to each landscape area's specific water requirements	Adjust irrigation system as needed to prevent overwatering	Monthly
			Irrigation systems shall conform to The Water Conservation in Landscaping Act of 2006, Assembly Bill (AB 1881). See CASQA handout SD-12 in Appendix B of O&M plan for more detailed information.		
Finished Grade of Landscape Areas	S5	Property Owner	Landscape areas are to be constructed with a minimum of 1 inch below adjacent impervious areas.	Adjust landscape areas so they are a minimum of 1 inch below adjacent impervious areas.	After construction

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

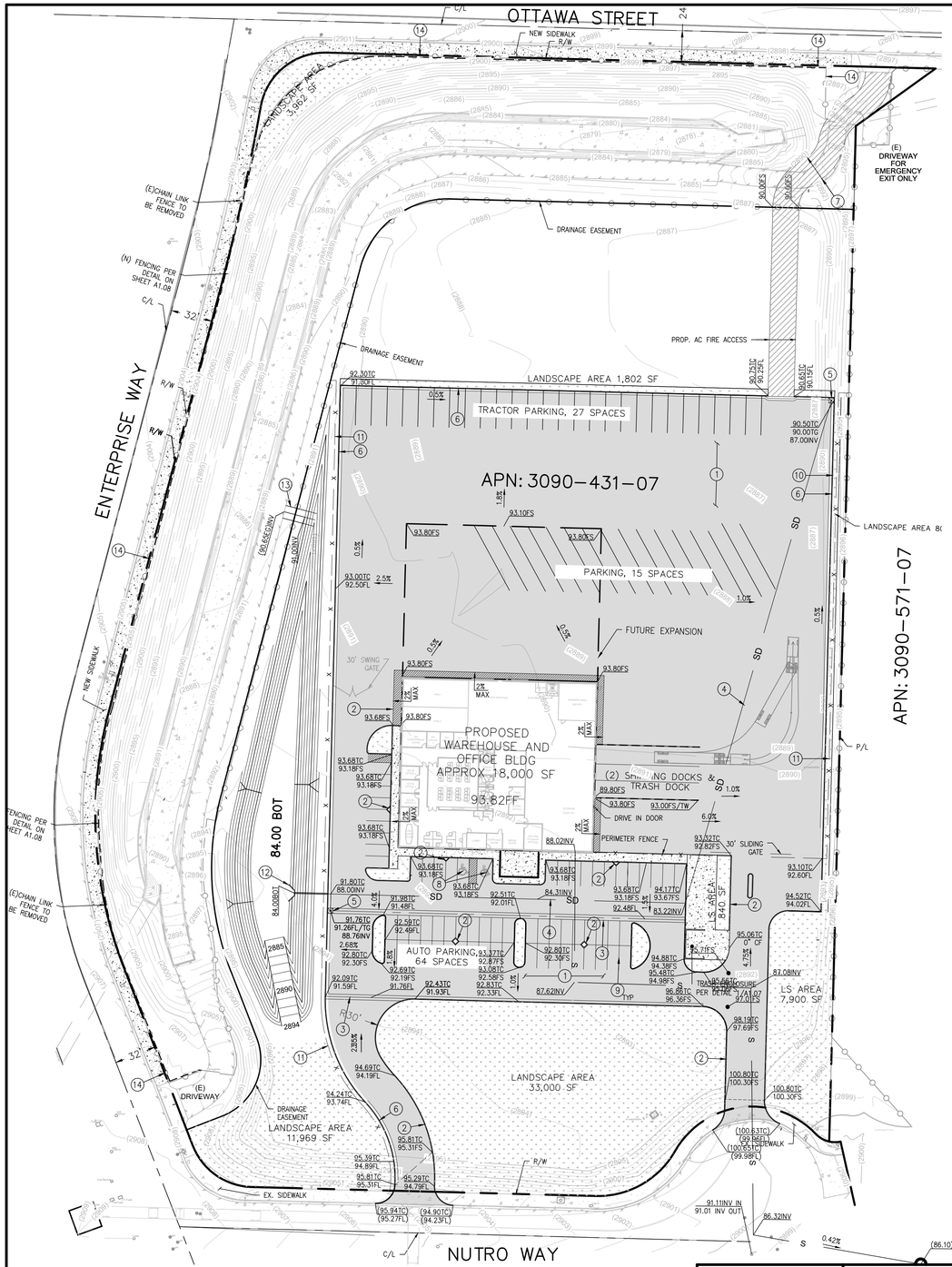
Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

6.4 Other Supporting Documentation

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

Appendix 6.1 – Site Plan and Drainage Plan

CITY OF VICTORVILLE
CONCEPTUAL GRADING



LEGAL DESCRIPTION:

PARCEL 1 OF PARCEL MAP NO. 27170-01, IN THE CITY OF LANCASTER, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA AS PER MAP FILED IN BOOK 322 PAGES 62 THROUGH 65 INCLUSIVE OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAIS COUNTY.

APN: 3090-431-07

SOILS ENGINEER

BRUIN GSI
44732 YUCCA AVE
LANCASTER, CA 93534
(661)273-9078

BENCHMARK

BM NO. TL5646 EL. 2327.370 FT.
DPW BM TAG IN W CB 1FT S/O BCR @ SW COR SIERRA HWY & AVE H-8
65.6FT S/O & 31.2FT W/O C/L INT
LANCASTER QUAD NAVD 88 DATUM 2012 ADJ

BASIS OF BEARING:

THE BEARINGS SHOWN HEREON ARE BASED ON THE BEARING N04°11'33"E OF THE CENTERLINE OF TREVOR AVE AS SHOWN ON PARCEL MAP NO 27170-01 RECORDED IN BOOK 322, PAGES 62 THROUGH 65, INCLUSIVE OF MAPS IN THE CITY OF LANCASTER, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA.

UTILITIES

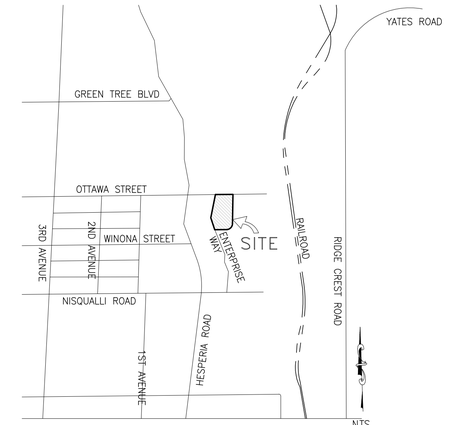
SOUTHERN CALIFORNIA EDISON
PO BOX 4349
42060 10TH STREET WEST
LANCASTER, CA 93534
DENISE HENDERSON
PHONE (661) 945-9327

VICTORVILLE MUNICIPAL UTILITY SERVICES
14343 CIVIC DRIVE
P.O. BOX 5001
VICTORVILLE, CA 92393-5001
PHONE (760) 243-6340
FAX (760) 269-0039

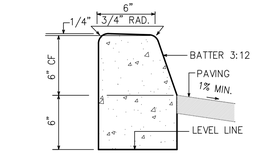
VICTORVILLE WATER DISTRICT
14343 CIVIC DRIVE
P.O. BOX 5001
VICTORVILLE, CA 92393-5001
PHONE (760) 955-5000
FAX (760) 269-0013

VICTORVILLE SEWER DISTRICT
14343 CIVIC DRIVE
P.O. BOX 5001
VICTORVILLE, CA 92393-5001
PHONE (760) 955-5000
FAX (760) 269-0013

VERIZON
12133 HESPERIA ROAD
VICTORVILLE, CA 92395
PHONE (760) 243-3801

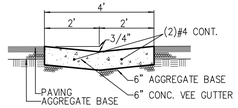


VICINITY MAP



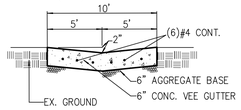
A 6" PCC CURB TYP.

NTS



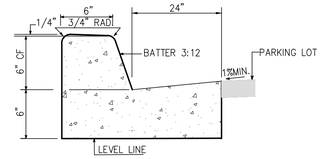
B 4' RIBBON GUTTER TYP.

NTS



D 10' DRAINAGE CHANNEL

NTS



C 6" PCC CURB & GUTTER TYP.

NTS

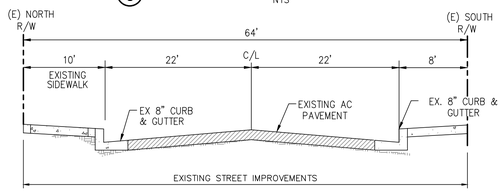
LEGEND/ABBREVIATIONS

- CITY BOUNDARY
- EXISTING P/L
- EXISTING R/W
- EXISTING SEWER
- EXISTING WATER
- PROPOSE SEWER
- PROPOSE WATER
- PROPOSE STORM DRAIN
- PROPOSED CURB
- EXISTING CURB
- BOLLARD
- PROPOSED FENCING

- ADA PARKING SIGN
- WHEEL STOP
- PAINTED ADA SYMBOL
- EXIST STREET LIGHT
- SEWER CLEAN – OUT
- FIRE HYDRANT
- WATER VALVE
- JOSHUA TREE
- EXISTING TREES

TC	TOP OF CURB
FL	FLOWLINE
EG	EDGE OF GUTTER
LS	LANDSCAPING
BW	BACK OF WALK
FF	FINISH FLOOR
FS	FINISH SURFACE
FG	FINISH GRADE
GB	GRADE BREAK
GR	EX. GROUND

- CONCRETE
- FIRE DEPARTMENT TURN-AROUND
- ADA PARKING

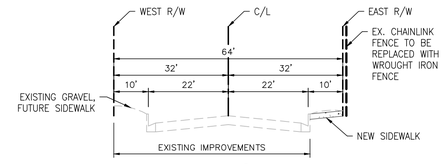


TYPICAL SECTION – NUTRO WAY –PUBLIC

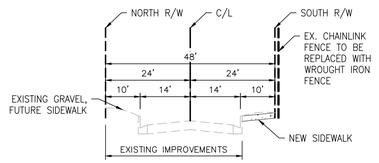
NTS

CONSTRUCTION NOTES:

1. CONSTRUCT 6" THICK PCC PAVEMENT OVER 8" THICK AGGREGATE BASE OVER 95% COMPACTED SUBGRADE.
2. CONSTRUCT 6" PCC CURB PER SPPWC 120-2, A1-6 (150). SEE DETAIL 'A' HEREON.
3. CONSTRUCT 4' WIDE RIBBON GUTTER PER DETAIL 'B' HEREON.
4. INSTALL 12" HDPE STORM DRAIN
5. INSTALL NDS 48" X 48" CATCH BASIN.
6. CONSTRUCT 6" PCC CURB AND GUTTER PER SPPWC 120-2, A2-6 (150). SEE DETAIL 'C' HEREON.
7. FIRE DEPARTMENT ACCESS.
8. INSTALL ADA PARKING SIGNAGE AND STRIPING PER 1-4/A1.08
9. INSTALL WHITE PARKING STRIPING.
10. INSTALL RETAINING WALL PER SEPARATE PERMIT
11. INSTALL NEW WROUGHT IRON PERIMETER FENCE
12. CONSTRUCT D89 CAL TRANS CONCRETE HEADWALL
13. CONSTRUCT 10' WIDE CONCRETE DRAINAGE CHANNEL PER DETAIL 'D' HEREON
14. REMOVE EXISTING CHAINLINK FENCE AND REPLACE WITH WROUGHT IRON FENCE W/ DECORATIVE PILASTERS EVERY 100' TO MATCH ADJACENT DEVELOPEMENT



ENTERPRISE WAY



OTTOWA STREET

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 50 ft.

Underground Service Alert
Call: TOLL FREE 811
TWO WORKING DAYS BEFORE YOU DIG

PREPARED FOR:

LONE OAK LANCASTER LLC.
6250 NORTH RIVER RD
ROSEMONT, IL 60018

Duke Engineering
CIVIL & STRUCTURAL
LANCASTER - CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
RYAN DUKE
No. 73723
Exp. 09-30-22
CIVIL
STATE OF CALIFORNIA

REV #	RECORD RCE APPR.	DATE	REVISION BLOCK: REVISION DESCRIPTION	CITY APPR.	DATE
△					

CITY OF VICTORVILLE

WAREHOUSE EXPANSION INDUSTRIAL BUILDING
VICTORVILLE, CA
APN: 3090-431-07

SCALE: PER PLAN
DESIGNED: GB
DRAWN: GB
CHECKED: RD
DUKE ENG 21094
SHEET NO.
C1.00

Appendix 6.2 – Electronic Data Submittal

Note: This WQMP was submitted digitally, in PDF format, per reviewing agency requirements. There is no CD attachment included.

Appendix 6.3 – Post Construction

Note: As indicated in section 8.2.3 of the "Technical Guidance Document for Water Quality Management Plans", dated June 7, 2013, a maintenance agreement may be required by local jurisdiction for proposed BMPs. A maintenance agreement will be provided in this section if requested by the local jurisdiction.

Appendix 6.4 – Other Supporting Documentation

Reyes Holdings, LLC

APN: 3090-431-07
Victorville, CA 92395

HYDROLOGY STUDY

Prepared For:

Reyes Holdings, LLC
APN 3090-431-07
Victorville, San Bernardino County, California

Duke Engineering
44732 Yucca Avenue
Lancaster, Ca 93534
Phone 661-952-7918

Date: 1/18/2022

Table of Contents

Introduction

The purpose of this report is to address the drainage conditions for the onsite development of a new warehouse and parking lot on the subject property at APN 3090-431-07 in Victorville. The results of this report will quantify the sub area storm runoff, size the above ground detention system, and ribbon gutter to safely convey storm water generated from the project site to above ground detention system. The intention of this hydrology study is to show that the detention system will be able to retain all of the 100-yr 1-hr and 10-yr 24hr storms, and the drainage devices are sized to convey the peak flow from the same storms. The pre-developed flow rates will not be analyzed in this study as all of the post-developed runoff will be retained with the current design.

Project Location

The project site is located on at the corner of Ottowa St and Enterprise Way. The site is 7.5 acres of undeveloped land; there is an existing drainage easement on the eastern and northern portions of the site that will not be considered in the hydrology study.

Rainfall Data

The rainfall data used for sizing the drainage devices is from the San Bernardino County Hydrology Manual. The rainfall data used for the basin sizing calculations is from the NOAA Atlas 14.

Basin Sizing Calculations

The total area of development is 5.2 Acres. The 10-yr, 24-hr storm will produce more runoff than the 100-yr, 1-hr storm. The depth of rainfall for the 10-yr, 24-hr storm is 2.28 inches according to the NOAA Atlas 14 table shown in Figure 1. Based on this data, the maximum runoff produced from the 10-yr storm can be calculated below:

Runoff Volume = (5.2 ac) * (2.28 in) * (43560 ft / 1 ac) * (1 ft / 12 in) = 43,037 Cu. Ft.

This is a conservative approach as no losses are considered for this calculation. As the basin sizing calculations show in Figure 2, the volume of the basin (62,663 Cu. Ft) is significantly larger than the runoff. The top of the basin is considered to be at an elevation of 90.00 as this is the elevation of the lowest catch basin.

Storm Drain Sizing Calculations

The San Bernardino County Rational Method was used to calculate the peak flow rate for the storm drain system. The peak runoff rate for the 100-year, 1-hr storm was used as it produces a much larger flow rate than the 10-yr, 24-hr storm. See Figure 3 for peak flow rate calculations and Figure 5 for storm drain sizing calculations. These calculations show that the 15” storm drain at a minimum slope of 0.4% has capacity (at 12” deep) for the peak flow rate of 5.6 CFS produced by the 100-yr storm.

Conclusion

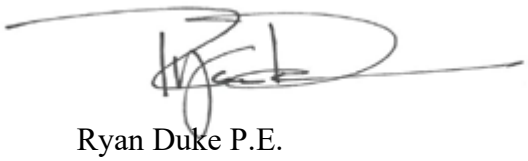
In conclusion, the proposed storm drain, and onsite detention basin have been analyzed to ensure proper capacity for a 10-yr, 24-hr and 100-yr, 1-hr storm event. It is recommended that the site be developed with pre-cautions as described in this report to account for the storm water runoff from the areas within the project site.

The onsite storm water detention facility shall comply with the Victorville requirements for storm water volume storage.

It is of our opinion that this analysis sufficiently quantifies the onsite tributary area and calculates the required storm drain devices on-site to safely collect and convey the storm water runoff.

Please contact our office for any additional questions.

Sincerely,



Ryan Duke P.E.
RCE 79729
Principle Engineer

FIGURE 1:
NOAA Atlas 14

NOAA Atlas 14, Volume 6, Version 2
Location name: Victorville, California, USA*
Latitude: 34.4915°, Longitude: -117.2884°
Elevation: 2914.08 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.092 (0.076-0.113)	0.128 (0.106-0.157)	0.178 (0.146-0.219)	0.221 (0.180-0.273)	0.282 (0.223-0.361)	0.332 (0.257-0.434)	0.386 (0.291-0.517)	0.444 (0.326-0.611)	0.527 (0.371-0.756)	0.595 (0.405-0.884)
10-min	0.132 (0.109-0.161)	0.184 (0.151-0.225)	0.255 (0.210-0.313)	0.316 (0.258-0.392)	0.405 (0.319-0.518)	0.477 (0.369-0.623)	0.553 (0.418-0.741)	0.636 (0.467-0.876)	0.756 (0.532-1.08)	0.853 (0.581-1.27)
15-min	0.160 (0.132-0.195)	0.222 (0.183-0.272)	0.309 (0.254-0.379)	0.383 (0.312-0.474)	0.489 (0.386-0.626)	0.576 (0.446-0.753)	0.669 (0.505-0.896)	0.770 (0.565-1.06)	0.914 (0.643-1.31)	1.03 (0.702-1.53)
30-min	0.217 (0.179-0.266)	0.302 (0.249-0.370)	0.420 (0.345-0.515)	0.520 (0.425-0.644)	0.666 (0.525-0.852)	0.784 (0.606-1.02)	0.910 (0.687-1.22)	1.05 (0.768-1.44)	1.24 (0.875-1.78)	1.40 (0.955-2.08)
60-min	0.262 (0.217-0.321)	0.365 (0.301-0.447)	0.507 (0.417-0.622)	0.629 (0.513-0.778)	0.804 (0.635-1.03)	0.947 (0.732-1.24)	1.10 (0.830-1.47)	1.26 (0.928-1.74)	1.50 (1.06-2.15)	1.70 (1.15-2.52)
2-hr	0.370 (0.305-0.452)	0.497 (0.410-0.609)	0.673 (0.554-0.826)	0.823 (0.672-1.02)	1.04 (0.820-1.33)	1.21 (0.938-1.58)	1.40 (1.05-1.87)	1.60 (1.17-2.19)	1.88 (1.32-2.69)	2.11 (1.43-3.13)
3-hr	0.446 (0.368-0.545)	0.594 (0.490-0.727)	0.796 (0.655-0.978)	0.969 (0.791-1.20)	1.22 (0.959-1.55)	1.41 (1.09-1.85)	1.62 (1.22-2.17)	1.85 (1.36-2.54)	2.16 (1.52-3.10)	2.42 (1.65-3.59)
6-hr	0.607 (0.501-0.742)	0.803 (0.662-0.983)	1.07 (0.879-1.31)	1.29 (1.06-1.60)	1.61 (1.27-2.06)	1.87 (1.44-2.44)	2.13 (1.61-2.85)	2.42 (1.77-3.32)	2.81 (1.98-4.04)	3.13 (2.13-4.65)
12-hr	0.778 (0.643-0.952)	1.04 (0.859-1.27)	1.40 (1.15-1.71)	1.69 (1.38-2.09)	2.10 (1.66-2.69)	2.43 (1.88-3.17)	2.77 (2.09-3.70)	3.12 (2.29-4.30)	3.62 (2.55-5.19)	4.01 (2.73-5.96)
24-hr	1.02 (0.902-1.17)	1.39 (1.23-1.60)	1.88 (1.66-2.17)	2.28 (2.00-2.66)	2.85 (2.41-3.43)	3.29 (2.73-4.04)	3.74 (3.03-4.71)	4.22 (3.32-5.46)	4.87 (3.68-6.58)	5.39 (3.94-7.53)
2-day	1.17 (1.03-1.34)	1.61 (1.43-1.86)	2.21 (1.95-2.55)	2.70 (2.37-3.15)	3.38 (2.87-4.07)	3.92 (3.25-4.82)	4.47 (3.62-5.63)	5.05 (3.98-6.54)	5.86 (4.43-7.91)	6.50 (4.75-9.07)
3-day	1.27 (1.12-1.46)	1.76 (1.56-2.03)	2.43 (2.15-2.81)	2.98 (2.61-3.47)	3.74 (3.17-4.51)	4.34 (3.60-5.34)	4.96 (4.02-6.25)	5.62 (4.42-7.27)	6.52 (4.93-8.81)	7.25 (5.29-10.1)
4-day	1.35 (1.20-1.55)	1.88 (1.67-2.17)	2.59 (2.29-3.00)	3.18 (2.79-3.71)	4.00 (3.39-4.81)	4.64 (3.85-5.70)	5.30 (4.29-6.67)	5.99 (4.72-7.76)	6.96 (5.26-9.39)	7.72 (5.64-10.8)
7-day	1.46 (1.30-1.69)	2.02 (1.79-2.33)	2.77 (2.45-3.20)	3.39 (2.97-3.95)	4.25 (3.60-5.11)	4.91 (4.08-6.04)	5.60 (4.54-7.05)	6.32 (4.98-8.18)	7.31 (5.53-9.87)	8.10 (5.92-11.3)
10-day	1.55 (1.37-1.78)	2.13 (1.89-2.46)	2.91 (2.57-3.36)	3.56 (3.12-4.14)	4.45 (3.77-5.35)	5.14 (4.26-6.32)	5.85 (4.74-7.37)	6.60 (5.20-8.55)	7.63 (5.77-10.3)	8.44 (6.16-11.8)
20-day	1.78 (1.58-2.05)	2.47 (2.19-2.85)	3.39 (3.00-3.92)	4.16 (3.64-4.84)	5.23 (4.43-6.29)	6.06 (5.03-7.45)	6.93 (5.61-8.73)	7.83 (6.17-10.1)	9.08 (6.87-12.3)	10.1 (7.35-14.1)
30-day	2.02 (1.80-2.33)	2.82 (2.49-3.25)	3.90 (3.44-4.50)	4.80 (4.21-5.60)	6.08 (5.15-7.32)	7.09 (5.89-8.72)	8.14 (6.60-10.3)	9.25 (7.29-12.0)	10.8 (8.16-14.6)	12.0 (8.78-16.8)
45-day	2.37 (2.10-2.72)	3.31 (2.93-3.81)	4.61 (4.07-5.32)	5.72 (5.01-6.66)	7.31 (6.20-8.81)	8.60 (7.14-10.6)	9.95 (8.06-12.5)	11.4 (8.98-14.8)	13.4 (10.2-18.1)	15.1 (11.0-21.0)
60-day	2.59 (2.30-2.98)	3.61 (3.20-4.16)	5.06 (4.47-5.85)	6.31 (5.53-7.36)	8.14 (6.90-9.80)	9.64 (8.00-11.8)	11.2 (9.10-14.2)	13.0 (10.2-16.8)	15.4 (11.7-20.8)	17.5 (12.8-24.4)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

FIGURE 2:
Basin Volume Calculation

Victorville Reyes Main Basin

ONSITE RETENTION BASIN SIZING CALCULATION

Basin Sizing

Basin A		
Depth 0'	4,964	Volume
Depth 1'	6,204	5,584
Depth 2'	7,562	6,883
Depth 3'	9,052	8,307
Depth 4'	10,669	9,861
Depth 5'	12,412	11,541
Depth 6'	14,282	13,347
Depth 7'		7,141
Depth 8'		0
Depth 9'		
Depth 10'		

Depth 6' Free Board

Total Volume CF	62,663	
Total Volume AC-FT	1.44	468,719.24

Peak Flow Mitigation Req'd

FIGURE 3:
Rational Method Calculations

The following calculation in the rational equation given in the San Bernardino County Hydrology Manual to calculate the peak flow rate for a given storm.

$$I = 1.2\frac{in}{hr} = rainfall\ intensity\ (obtained\ from\ Figure\ 4, 100yr, 1hr\ isohyet)$$

$$C = \text{runoff coefficient} = 0.9\left[a_i + \frac{(I - F_p)a_p}{I}\right] = 0.9$$

$$for: a_i = 0.9 = \text{impervious fraction}$$

$$a_p = 0.1 = \text{pervious fraction}$$

$$F_p = 0 = \text{infiltration rate for pervious area}$$

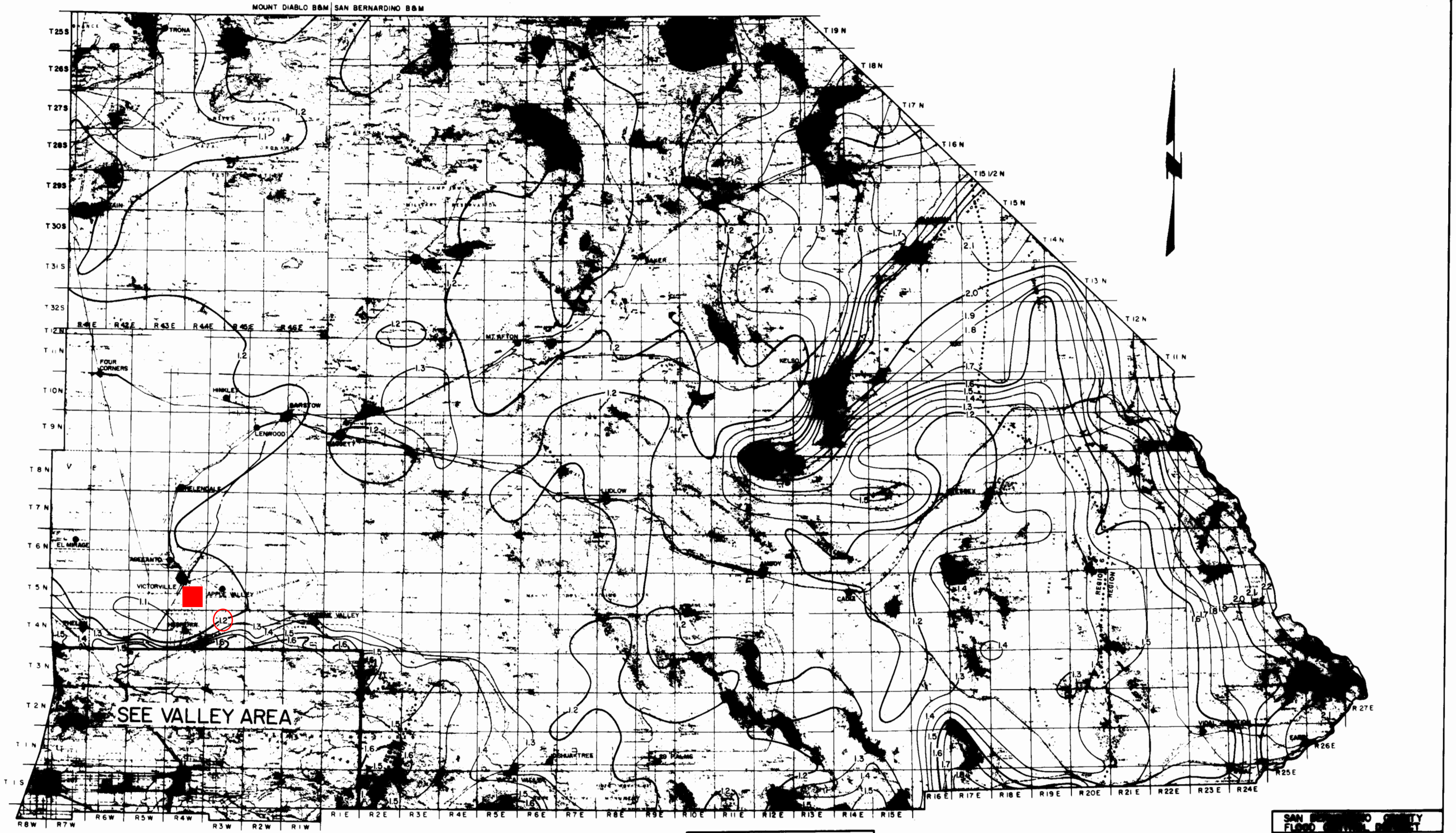
$$a_p = 0.1 = \text{pervious fraction}$$

$$A = 5.19\ \text{acres} = \text{area of project}$$

Then

$$Q = \text{peak runoff rate} = CIA = 5.605\ \text{cfs}$$

FIGURE 4:
100-yr, 1-hr Isohyet



REDUCED DRAWING

0 1 2 3

3 INCHES ON ORIGINAL

LEGEND:

1.2 ISOLINES PRECIPITATION (INCHES)

SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT

DESERT AREA

ISOHYETALS

Y_{100} - 100 YEAR 1 HOUR

BASED ON U.S.D.C., N.O.A.A. ATLAS 2, 1973

APPROVED BY [redacted]

DATE 1982

SCALE [redacted]

SAN BERNARDINO COUNTY

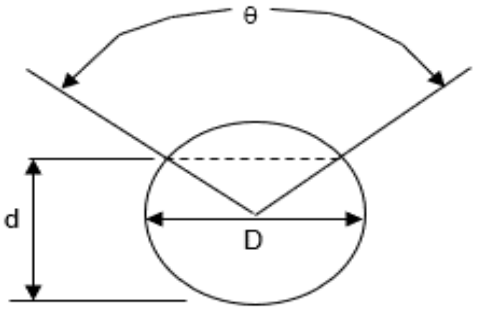
HYDROLOGY MANUAL

FIGURE B-10

FIGURE 5:
Storm Drain Sizing Calculation

Duke Engineering
CIVIL & STRUCTURAL
LANCASTER - CALIFORNIA

15" HDPE Minimum 0.4% Slope



R = A/P

A = Cross Section Area

P = Wetted Perimeter

S = Slope of Channel

n = Manning's Roughness Coefficient

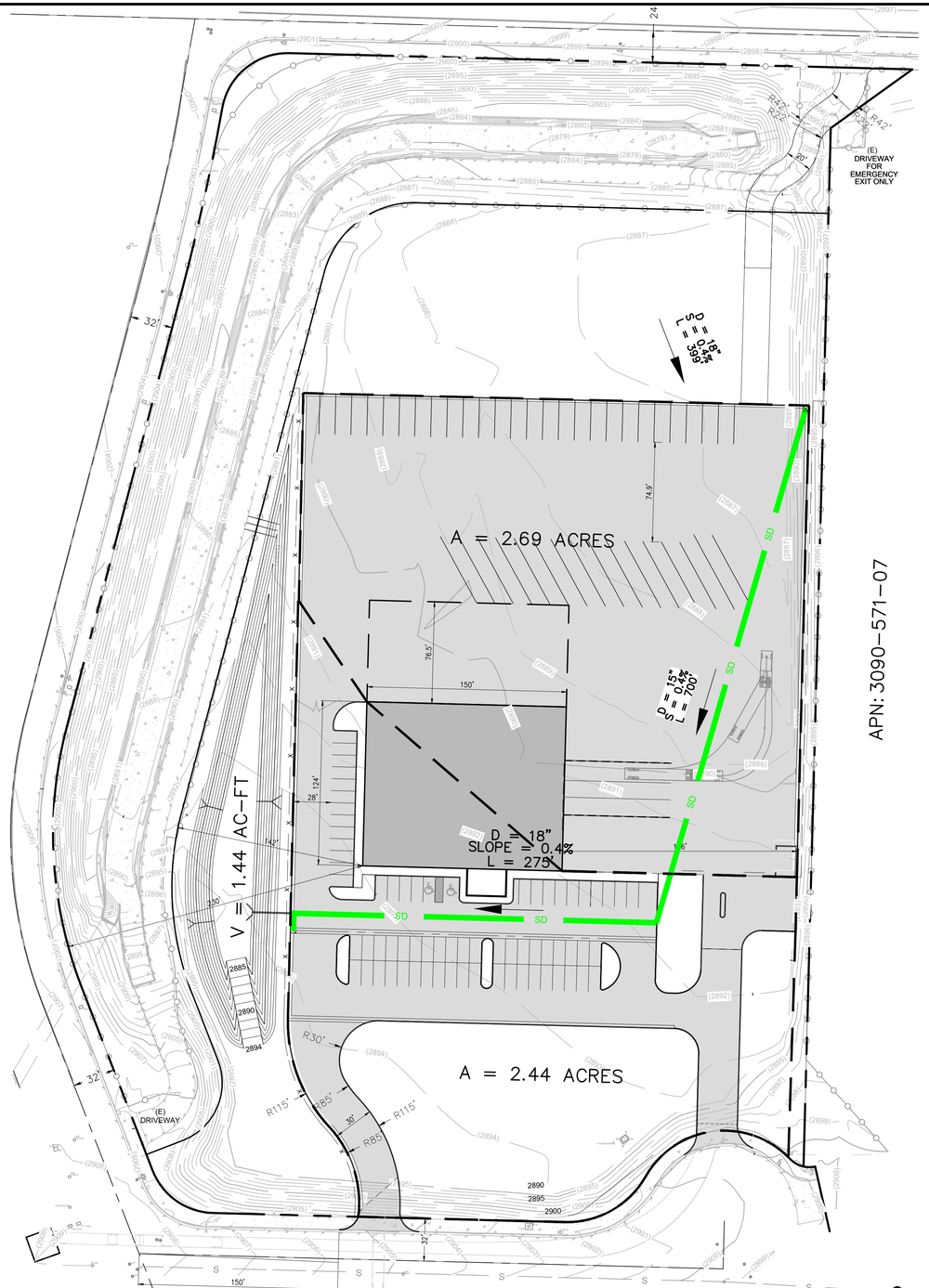
D =	15	in
d =	11.7	in
n =	0.009	
Angle =	111.8884	θ
S =	0.004	ft/ft

Mannings Formula = $Q = (1.486/n)\ A\ R_h^{2/3}\ S^{1/2}$

Area, ft^2	Wetted Perimeter	Hydraulic Radius	Velocity (ft/s)	Flow Rate (cfs)
1.027	2.706	0.379	5.473	5.621
Flow Depth = 11.7 INCHES. 78% FULL				

FIGURE 6:
Site Map

CITY OF VICTORVILLE
CONCEPTUAL GRADING

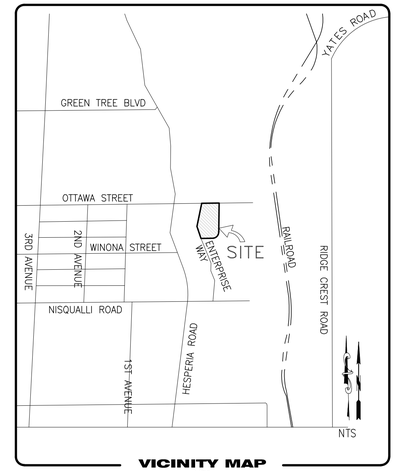


APN: 3090-571-07

SITE AREA
= 5.2 ACRES

RUNOFF VOLUME
= 43,037 CU FT

PEAK FLOW RATE
= 5.605 CFS



VICINITY MAP
NTS

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 50 ft.

Underground Service Alert
Call: TOLL FREE
811
TWO WORKING DAYS BEFORE YOU DIG

PREPARED FOR:

REYES HOLDINGS, LLC
6250 NORTH RIVER RD
ROSEMONT, IL 60018

Duke Engineering
CIVIL & STRUCTURAL
LANCASTER - CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
RYAN DUKE
No. 78129
Exp. 12-31-22
CIVIL
STATE OF CALIFORNIA

	RECORD RCE		REVISION BLOCK	CITY	
REV #	APPR.	DATE	REVISION DESCRIPTION	APPR.	DATE
△					

CITY OF VICTORVILLE

WAREHOUSE EXPANSION
INDUSTRIAL BUILDING
VICTORVILLE, CA
APN: 3090-431-07

SCALE: PER PLAN
DESIGNED: GB
DRAWN: GB
CHECKED: RD
DUKE ENG 21094
SHEET NO.
C1.00

GEOTECHNICAL ENGINEERING REPORT

Prepared For
Duke Engineering & Associates, Inc.

Proposed
Industrial Development
Southeast Corner of Ottawa Street & Enterprise Way
Victorville, San Bernardino, California
APN 3090-431-07

Job No: 21-493
July 20, 2021

BRUIN GEOTECHNICAL SERVICES, INC.
44732 Yucca Avenue
Lancaster, California 93534
www.bruingsi.net

BRUIN
GEOTECHNICAL
SERVICES INC.
est. 2004

SOIL AND MATERIAL
TESTING AND INSPECTIONS

July 20, 2021 J.N. 21-493

Mr. Ryan D. Duke, P.E.
Duke Engineering and Associates, Inc.
44732 Yucca Avenue
Lancaster, CA 93534

Subject: **Geotechnical Engineering Report for Proposed Industrial Development Located at the Southeast Corner of Ottawa Street and Enterprise Way, Victorville, San Bernardino County, California**
APN 3090-431-07

Dear Mr. Duke:

Presented herewith is the report of our Geotechnical Engineering Report for the subject project. Our work was performed in accordance with the scope of work outlined in our original proposal dated June 21, 2021.

This report presents the results of our field investigation, laboratory testing and our engineering judgment, opinions, conclusions and recommendations pertaining to the proposed development.

It has been a pleasure to be of service to you on this project. Should you have any questions regarding the contents of this report, or should you require additional information, please contact the undersigned at (661) 273-9078.

Respectfully submitted,

BRUIN GEOTECHNICAL SERVICES, INC.

Ryan D. Duke, P.E.
RDD/mes

REGISTERED PROFESSIONAL ENGINEER
RYAN DUKE
C070729
Exp. 9-30-22
CIVIL
STATE OF CALIFORNIA

BRUIN
GEOTECHNICAL
SERVICES INC.
est. 2004

SOIL AND MATERIAL
TESTING AND INSPECTIONS

July 20, 2021 J.N. 21-493

Project: Proposed Industrial Development Located at the Southeast Corner of Ottawa Street and Enterprise Way, Victorville, San Bernardino County, California
APN 3090-431-07

Executive Summary

Based on our geotechnical investigation of the subject site, our review of available reports and literature and our experience, it is our opinion that the proposed development is feasible from a geotechnical standpoint. There appear to be no significant geotechnical constraints on-site that cannot be mitigated by our recommendations, the proposed planning, design, and utilization of sound construction practices. The engineering properties of the soil and native materials offer favorable conditions for site development.

The following key elements are conclusions confirmed from this investigation:

- The subject site is located within the seismically active Southern California area. As such, the proposed development shall be designed in accordance with seismic considerations specified in the 2019 California Building Code (CBC) and the County requirements.

SUMMARY OF RECOMMENDATIONS

Design Item	Recommendations
Structure Over-Excavation/ Scarification	48”/12” compacted at 90%, 5’ beyond foundation perimeter
Traffic Pavement Concrete	12” compacted to 95%
Non-Traffic Exterior Concrete	12” compacted to 90%
Native Soil Shrinkage	10-15%
Soil Expansion	Very Low (EI=0)
Soil Resistivity	2,400 ohm-cm (moderately corrosive)
Soil Sulfate Content	0.0144% (Negligible)
Footing Bearing Pressure	
Continuous	1,800 psf. – Net Allowable
Isolated	2,000 psf. - Net Allowable
Lateral Earth Pressure	
Active	48 psf.
At Rest	60 psf.
Passive Lateral Resistance	350 psf. per foot
Coefficient of Friction	0.3
Perimeter Continuous Footing	
Embedment	Min. 18” below lowest adjacent grade (single-story)
Width	24”
Reinforcement	No. 4 bars, one top and one bottom
Isolated (Column) Footing	
Embedment	Min. 24” below lowest adjacent grade (single-story)
Width	24” square
Reinforcement	No. 4 mat, one top and one bottom
Interior Concrete Slab-On-Grade	Min. 4” thick
Reinforcement	No. 3 bars at 18” O.C. each way
Vapor Barrier	Min. 15 mil.

GEOTECHNICAL ENGINEERING REPORT

TABLE OF CONTENTS

FIGURES	
Figure 1	**Vicinity Map**
Figure 2	**Boring Location Map**

APPENDIXES	
Appendix A	**Boring Logs and Classification Key**
Appendix B	**Laboratory Test Data**
Appendix C	**Seismic Design Summary Report**
Appendix D	**General Earthwork and Grading Guidelines**

GEOTECHNICAL ENGINEERING REPORT
PROPOSED INDUSTRIAL DEVELOPMENT
SE CORNER OF OTTAWA STREET AND ENTERPRISE WAY
VICTORVILLE, SAN BERNARDINO COUNTY, CALIFORNIA
APN 3090-431-07

1.0 INTRODUCTION

This report presents the results of our geotechnical investigation performed by Bruin Geotechnical Services, Inc. for the proposed industrial development at the subject site based on discussions and preliminary site plans provided by the client. This report is specific to the proposed development.

The purpose of this investigation was to evaluate the on-site subsurface soil conditions relative to geotechnical engineering characteristics and to provide geotechnical recommendations relative to proposed development.

The scope of the authorized geotechnical investigation included the following tasks:

- Performing a site reconnaissance
- Conducting field subsurface exploration through soil borings and sampling
- Laboratory testing program of selected soil samples
- Performing engineering analyses of the data
- Preparing this Geotechnical Engineering Report

This study also includes a review of published and unpublished literature and geotechnical maps with respect to active and potentially active faults located in proximity to the site which may have impact on the seismic design of the proposed structure.

2.0 SITE LOCATION AND DESCRIPTION

The subject site, identified as APN 3090-431-07, is located on the southeast corner of Enterprise Way and Ottawa Street, in the city of Victorville, San Bernardino County, California. The irregular-shaped parcel consists of approximately 10.29 acres. At the time of our investigation, the site was vacant, undeveloped land. The site contained moderate vegetation with scattered weeds and shrubs. The aforementioned site description is intended to be illustrative and is specifically not intended for use as a legal description of the Site.

The Site is located in semi-developed area of Victoville, bounded by industrial parcels to the east and south, and vacant land to the west and north.

Access to the Site is from Enterprise Way, which is a paved road.

Topographically, the Site is relatively flat and level with a gentle slope down to the northeast corner. Drainage occurs by sheet flow across the site at an approximate 1-2% gradient toward the northeast. The elevation of the Site is approximately 2,500 feet above mean sea level near the center.

The general location of the subject site is shown on Figure 1.

3.0 PROPOSED GRADING AND CONSTRUCTION

Based on our review of the preliminary site plans and discussions, Bruin GSI understands that there will be one structure, approximately 15,000 square feet, a parking lot, and trash enclosure. We anticipate concrete-masonry construction with conventional concrete continuous and isolated foundations and slab-on-grade floors. No basements are planned. We anticipate maximum structural loads of 1,800 pounds per lineal foot and 50-60 kips for isolated foundations.

Exterior improvements are anticipated to include concrete flatwork, asphalt-concrete parking lot, and off-site roadway construction. It is anticipated that the drainage will consist of sloped surfaces to drainage swales to an approved area. The proposed structures will be connected to a public sewer system and existing utilities lines from the street.

Due to the relatively flat topography, it appears the proposed earthwork will consist of conventional cut and fill methods to grade the Site, with anticipated maximum slope heights of approximately one to two (1-2) feet to achieve design grades.

4.0 GEOTECHNICAL INVESTIGATION

The geotechnical investigation included a field subsurface exploration program and a laboratory testing program on soil samples collected. These programs were performed in accordance with our proposal for Geotechnical Engineering Report dated June 21, 2021. The scope of work did not include environmental assessment or investigation for the presence or absence of hazardous substances or toxic materials in structures, soil, surface water, groundwater, or air, below or around the site. The field subsurface exploration and laboratory testing programs are described below.

4.1 Field Exploration Program

A site reconnaissance was made by our representative prior to instigating the field exploration program. The Site was observed, and boundaries roughly located for purposes of underground utility locating. As required by law, Bruin GSI contacted Underground Service Alert (one-call notification service) to attain underground utility marking and clearance, a minimum of 72 hours prior to performing the field subsurface investigation.

The field exploration program was initiated on June 28, 2021, under the technical supervision of our engineer. A total of five (5) exploratory borings were drilled using a CME 75 drill rig with eight (8) inch hallow stem auger in accordance with generally accepted geotechnical exploration procedures (ASTM D 1452). The borings were advanced to maximum depths of fifty (50) feet below ground surface (bgs). The approximate locations of the borings within the area of the proposed construction were determined by sighting and pacing from existing site improvements, such as streets, and should be only considered accurate to the degree implied by the method used. The borings locations are shown on Figure 2.

Soil samples were obtained at various depth intervals, consisting of relatively undisturbed brass ring samples (Modified California split-spoon sampler) and Standard Penetration Test (SPT) samples driven by a 140-pound hammer falling thirty (30) inches. After seating of the sampler, the number of blows required to drive the sampler one foot was recorded in six (6) inch increments, in general accordance with procedures presented in ASTM D 1586.

Bulk samples were also collected at various depths from auger cuttings during drilling and represent a mixture of soils within the noted depths. The soil samples were returned to the laboratory for analysis and testing.

Final boring logs presented in Appendix A are Bruin GSI's interpretation of the field logs prepared by our representative during drilling, as well as laboratory test results. The stratification lines represent approximate boundaries between soil types. The actual soil transitions may be gradual.

4.2 Laboratory Testing

The field boring logs and soil samples were reviewed to assess which samples would be analyzed further. The selected soil samples collected during drilling activities at the Site were then tested in the laboratory to assist in evaluating engineering properties of subsurface materials deemed within structural influence.

The soil samples were classified in accordance with the Unified Soils Classification System and a testing program was established. The samples were tested to determine the following:

- In-situ moisture and dry unit weight determinations were determined in accordance with ASTM D 2937.

- Relative strength characteristics were estimated from results of direct shear tests (ASTM D 3080) performed on in-situ soil samples from the ring sampler and also bulk soil samples remolded to approximately 90 percent of the maximum dry density as determined by ASTM D 1557 test method.

- Consolidation potential was determined on select soil samples in accordance with ASTM D 2435. The samples were saturated at 1.6 KSF to check hydro-consolidation potential. The maximum load applied was 6.8 KSF. The soil samples were unloaded to 0.4 KSF to check rebound.

- Soil chemical analysis on a soil sample from the site was performed by Anaheim Test Lab, which included pH, resistivity, soluble sulfates and soluble chlorides as well as other chemical contents.

The following additional tests were performed:

• Identification of soils	ASTM D 2488
• Expansion Index	ASTM D 4829
• Maximum density -Optimum moisture	ASTM D 1557
• Material Finer than the No. 200 Sieve	ASTM D 1140
• Sand Equivalent Value	ASTM D 2419

Pertinent tabular and graphic test results are presented in Appendix B.

5.0 CONCLUSIONS

The following conclusions for the site are based on the results of the field exploration and laboratory testing programs and represent professional opinions.

5.1 Site and Subsurface Conditions

Native alluvial materials were encountered within all of our exploratory borings. The soil strata encountered consisted mainly of silty sand (SM), poorly graded sand (SP), and occasional clayey silts (ML). The native materials were noted to be slightly moist to very moist, and loose to dense or moderately firm. The upper three to four (3-4) feet of native soils were found to be relatively dense, low relative compaction and non-uniform. For more detailed descriptions of the subsurface materials refer to the boring logs in Appendix A.

5.2 Groundwater Conditions

Groundwater was not encountered in any of our exploratory borings, at least to the maximum depth explored (50 feet bgs). Bruin GSI reviewed available reports and electronic data bases to assess historic water level conditions in the vicinity of the Site. Sources reviewed included the historically highest groundwater contours prepared by State of California Department of Water Resources SGMA electronic database, historically highest groundwater levels in the immediate site vicinity indicate that groundwater level at the site are over 90 feet bgs. Based on this information, groundwater is not a design factor for this project.

5.3 Soil Engineering Properties

Physical tests were performed on the bulk and relatively undisturbed samples to characterize the engineering properties of the native soils.

Moisture content and dry unit weight determinations were performed on samples to evaluate the in-situ unit weights of the different materials. Of the samples analyzed, moisture contents ranged from two to sixteen (2-16) percent. In-place dry densities ranged from 94 pounds per cubic foot (pcf) to 115 pcf. Moisture content and dry unit weight results are shown on the boring logs in Appendix A.

The expansion index tests (ASTM D 4829) indicate that the surficial soils are within the “very low” expansion category.

Consolidation test (ASTM D 2435) results reveal that the upper three to four (3-4) feet of soil tested have a moderate potential to hydro-consolidate.

6.0 REGIONAL GEOLOGY AND SEISMIC HAZARDS

The project site is located in a seismically active area typical of Southern California and likely to be subjected to a strong ground shaking due to earthquakes on nearby faults.

The San Andreas Fault zone is the largest active fault rift zone, which is several miles wide, and passes through the Antelope Valley south of the subject site, extending from the Gulf of Mexico through the western portion of the State of California to a point at Cape Mendocino in northern California. The San Andreas Fault is predicted to have an event every 100-200 years based on geologic records. The San Andreas Fault has had two major eruptions in the last 150 years: 1) in the Southern California area in 1857, and 2) in San Francisco in 1906. In each event, approximately 320 kilometers of surface rupture has taken place, as well as a horizontal displacement of approximately 9 meters. Additional faulting has occurred adjacent to the San Andreas Fault causing numerous events of various magnitudes throughout the length of the San Andreas Fault.

The project site is located north of an area in which active seismic occurrences are recorded on a yearly basis. Seismic studies conducted show a major break along the San Andreas Fault could be responsible for an event of approximately 8.4 on the Richter scale. A seismic event of this magnitude could cause bedrock accelerations as large as 0.5g. Events of this magnitude are anticipated to occur approximately every 150 years. The last occurrence of this magnitude was in 1857.

No known active faults have been mapped across the subject site. The potential hazards due to active fault ground rupture are considered minimal. According to current publications by the State of California, the project site is not located within the Alquist-Priolo special studies zone.

6.1 IBC Design Parameters

The following coefficients have been estimated in accordance with the requirements of the 2019 CBC, utilizing the Structural Engineers Association of California and California's Office of Statewide Health Planning and Development Seismic Design Maps Application:

https://seismicmaps.org/

The following seismic parameters are provided, based on the approximate latitude and longitude at the southwest corner of the subject site:

Latitude	34.49159108 °
Longitude	-117.28847159°

Spectral Response Acceleration, Short Period) - S_s	1.193g	0.2(sec)
Spectral Response Acceleration at 1 sec. - S_1	0.46g	1.0(sec)
Mapped Spectral Response, Short period - S_{DS}	0.814g	0.2(sec)
Mapped Spectral Response at 1 sec. - S_{D1}	*	1.0(sec)
Site Coefficient – F_A	1.023	
Site Coefficient – F_V	*	
Site Modified Spectral Response Acceleration, Short period -S_{MS}	1.22	
Site Modified Spectral Response Acceleration, Short period -S_{M1}	*	

Site Classification (2019 CBC, further defined in ASCE7-16 Chapter 20) = D
* The actual method of seismic design should be determined by the Structural Engineer in accordance with Section 11.4.8 Site-Specific Ground Motion Procedures of the ASCE 7-16. Refer to Appendix C for the Design Maps Summary Report provided by the Structural

Engineers Association of California and California's Office of Statewide Health Planning and Development website.

The actual method of seismic design should be determined by the Structural Engineer.

6.2 Liquefaction Potential

Liquefaction is a seismic phenomenon in which loose, saturated, granular (non-cohesive) soils react as a fluid when subject to high-intensity ground shaking. Research and historical data indicate loose granular soils with a specific range of grain size distribution, saturated by a relatively shallow groundwater table are most susceptible to liquefaction.

The effects of liquefaction on level ground include settlement, sand boils and bearing capacity failures below structures.

In view of the relatively dense silty sand and poorly graded sand encountered in the borings, relative densities, and depth to static groundwater (over 400 feet), it is Bruin GSI's opinion that the potential for on-site liquefaction or seismically induced dynamic settlement should be negligible. Based on our review of the Seismic Hazards Map, Lancaster West Quadrangle, the Site is not located in an area requiring a liquefaction analysis.

6.2.1 Other Liquefaction Associated Hazards

Potential hazards associated with liquefaction include lateral spreading and slow slides, foundation bearing failure, and ground surface settlement. Considering the upper 50 feet of the native soils are not likely to liquefy, these hazards are not considered to be design factors for this project.

6.3 Other Secondary Seismic Hazards

Seismic hazards relative to earthquakes include landslides, ground lurching, tsunamis, seiches and seismic-induced settlement. As site topography is relatively flat, hazards from landslides are considered negligible. Ground lurching is generally associated with fault rupture and liquefaction. As these hazards are considered unlikely, it is Bruin GSI's opinion that the potential for ground lurching is low. Tsunami hazards are considered nonexistent due to the site location.

6.4 Soil Settlement

Differential soil settlement occurs when supporting soils are not uniform in density or classification and seismic shaking causes one type of soil to settle more than the

other. When unaccounted for in design, such settlement can result in damage to structures, pavement and subsurface utilities. Soils with potential for hydro-consolidation can also cause differential settlement under loading conditions and the induction of moisture.

Re-compaction of the upper site soils is intended to remedy most potentials of settlement due to structures supported on native soils with non-uniform densities, soil classifications and hydro-consolidation.

Settlement of structures founded on compacted fill will be relatively small, less than one (1) inch. Differential settlement is anticipated to be on the order of 50% of the total settlement in a thirty-foot span. Most settlement should take place during construction.

7.0 111 STATEMENT

Subsequent to compliance with the recommendations provided in this report and based on the site reconnaissance, subsurface exploration, and laboratory analysis, it is our opinion the proposed structure will be safe from hazards associated with faulting, landslides, slippage, and settlement. The proposed development will not adversely impact the existing geologic stability of adjacent sites.

8.0 EFFECT OF PROPOSED GRADING ON ADJACENT PROPERTIES

It is our opinion that the proposed grading and construction will not adversely affect the stability of adjoining properties provided that grading and construction are performed in compliance with the recommendations presented herein.

9.0 OPINIONS AND CONCLUSIONS

Based upon the results of our investigation, the proposed development is considered feasible from a geotechnical standpoint provided the recommendations presented herein are incorporated into the design and construction. If changes in the design of the structure are made or variations of changed conditions are encountered during construction, Bruin GSI should be contacted to evaluate their effects on these recommendations.

As mentioned in Section 5.1, the upper three to four (3-4) feet of native soils were found to be non-uniform. Based on the laboratory testing and subsurface data obtained, it is Bruin GSI's opinion that the upper site soils will not provide a uniform soil support system without remediation through re-compaction. In order to provide a more uniform soil support system

and minimize the potential for differential settlement, the proposed retaining wall should be supported by a re-compacted fill.

Provide the recommendations in this report are incorporated into the design and construction, it is Bruin GSI's opinion that conventional shallow (continuous and isolated) foundations may be designed to support the proposed structures. Refer to Section 11.2 for details and soil values regarding foundation design.

10.0 GEOTECHNICAL RECOMMENDATIONS

The following geotechnical engineering recommendations for the proposed development are based on observations from the field investigation program and the laboratory test results and our experience with sites of similar conditions.

The local Department of Building and Safety should be contacted prior to start of construction to assure the project is properly permitted and inspected during construction. Any grading performed at the site shall be incompliance with the recommendations provided in this report, the local building code and the Earthwork and Grading Specifications for Rough Grading presented in Appendix D.

Field observations and testing during rough-grading operations should be provided by Bruin GSI so a decision can be formed regarding the adequacy of the site preparation, the acceptability of fill materials, and the extent to which the earthwork construction and the degree of compaction comply with the project geotechnical specifications. **Any work related to grading performed without the full knowledge of, and under the supervision of the Geotechnical Consultant, may render the recommendations of this report invalid.**

10.1 Earthwork

Prior to any grading, the site should be cleared and grubbed of all vegetation. All artificial fill, pavements concrete slab and foundations, vegetation, trash, debris and abandoned underground utilities shall be removed from the area to be graded and should not be incorporated into engineered fill.

Any depressions resulting from removals during grubbing process (trees etc.) shall be observed by the Geotechnical Consultant. Depressions requiring backfill within structural areas will require placement of engineered fill, observed, and tested by the Geotechnical Consultant.

It is our professional opinion that the grading of the site can be performed with conventional earth-moving equipment.

10.2 Remedial Grading for Building Pads

To provide a more uniform bearing for the proposed structure foundations, slab-on-grade, and structural retaining walls and, subsequent to clearing and grubbing of the area to graded, the existing native soils shall be excavated to a depth of forty-eight (48) inches below existing grade or finish grade with a minimum of twenty-four (24) inches of compacted fill required beneath the proposed foundations, whichever is deepest. The excavation shall extend a minimum of five (5) feet beyond the limits of the proposed foundations, where obtainable. The bottom of the excavation shall be a level elevation.

The Geotechnical Consultant shall inspect the resulting surfaces prior to scarification and fill placement.

Subsequent to approval of the resulting surface by the Geotechnical Consultant, the resulting soil surface shall be scarified (ripped) an additional twelve (12) inches, properly moisture conditioned or aerated to near optimum moisture content, and mechanically compacted with heavy compaction equipment to 90% relative compaction as determined by ASTM D 1557 test method. **Compaction shall be verified by testing.**

10.3 Remedial Grading for Flexible (Asphalt-Concrete) and Rigid (PCC) Pavement

Subsequent to clearing and grubbing the area to be graded, the existing native soils shall be scarified (ripped) twelve (12) inches below existing grade or finish grade, whichever is lower. The scarification shall extend a minimum of three (3) feet beyond the limits of the proposed pavement, where obtainable. The Geotechnical Consultant shall inspect the resulting surfaces prior to fill placement.

Subsequent to approval of the resulting surface by the Geotechnical Consultant, the resulting soil surface shall be properly moisture conditioned or aerated to near optimum moisture content, and mechanically compacted with heavy compaction equipment to 90% relative compaction (95% relative compaction beneath proposed PCC pavement in the upper twelve inches) as determined by ASTM D 1557 test method. **Compaction shall be verified by testing**.

10.4 Remedial Grading and Exterior Non-Traffic Bearing Concrete Flatwork (Sidewalks, Patios, Walkways, etc.)

Subsequent to clearing and grubbing the area to be graded, the existing native soils shall be scarified (ripped) an additional twelve (12) inches. The excavation shall extend a minimum of two (2) feet beyond the limits of the proposed flatwork, were obtainable. The Geotechnical Consultant shall inspect the resulting surfaces prior to fill placement.

Subsequent to approval of the resulting surface by the Geotechnical Consultant, the resulting soil surface shall be properly moisture conditioned or aerated to near optimum moisture content, and mechanically compacted with mechanical compaction equipment to 90% relative compaction as determined by ASTM D 1557 test method. **Compaction shall be verified by testing**.

10.5 Fill Placement and Compaction Requirements

The excavated native soils may be used as engineered fill to backfill the excavation. Materials for engineered fill should be free of organic material, debris, and other deleterious substances, and should not contain rocks greater than six (6) inches in maximum dimension.

All native soil shall be moisture conditioned or air dried as necessary to achieve near optimum moisture condition, placed in lifts (eight to ten inches, measured loose) and then compacted in place by mechanical compaction equipment to a minimum relative compaction of 90 percent (95% beneath PCC pavement) as determined in accordance with Test Method ASTM D 1557.

All import soil fill (meeting the requirements of Section 10.8) should be placed in 8-inch-thick maximum lifts measured loose, moisture conditioned or air dried as necessary to near optimum moisture condition, and then compacted in place to a minimum relative compaction of 90% (95% beneath PCC pavement) as determined in accordance with Test Method ASTM D 1557.

A representative of the project consultant should be present on-site during grading operations to verify proper placement and compaction of all fill, as well as to verify compliance with the other geotechnical recommendations presented herein.

10.6 Native Soil Shrinkage

A shrinkage factor of the upper site soils is estimated four to nine (4-9) percent. This estimate is based on the limited data collected from the subsurface exploration and laboratory test data with an average degree of compaction of 92 percent and may vary depending on contractor methods.

During compaction, an additional one-quarter of an inch (1/4”) subsidence of the underlying soil is estimated. Losses from site clearing and grubbing operations mat effect quantity calculations and should be taken into account. Actual shrinkage of the soil may vary.

We recommend monitoring the rough grading excavations by survey with comparison to grading contractor earthwork yardage estimates to determine a closer

estimate of actual shrinkage so adjustments (if necessary) may be made during grading.

10.7 Fill Slope Construction and Stability

Provided all material is properly compacted as recommended, fill slopes may be constructed at a 2:1 (horizontal to vertical) gradient or flatter. Permanent cut slopes may be constructed at 2:1 or flatter. Fill slopes constructed as recommended at a slope ratio not exceeding 2:1 (horizontal: vertical), are expected to be both grossly and surficially stable and are expected to remain so under normal conditions.

Proper drainage should be planned so water is not allowed to flow over the tops of slopes. The slopes should be planted as soon as possible to minimize erosion and maintenance.

If slopes are planned steeper than 2:1, the Geotechnical Consultant shall be notified for slope stability determinations.

10.8 Imported Soils

If imported soils are required to complete the planned grading, these soils shall be free of organic matter and deleterious substances, meeting the following criteria:

- 100% passing a 2-inch sieve
- 60% to 100% passing the #4 sieve
- no more than 20% passing a #200 sieve
- expansion index less than 20
- liquid limit less than 35
- plasticity index less than 12
- R-value greater than 40
- Low corrosion potential
    - Soluble Sulfates less than 1,500 ppm
    - Soluble Chlorides less than 150 ppm
    - Minimum Resistivity greater than 8,000 ohm-cm

Prospective import soils should be observed, tested and pre-approved by this firm prior to importing the soils to the site. Final approval of the import soil will be given once the material is on site either in place or adequate quantities to finish the grading.

10.9 Grading Observations and Testing

The grading of the site shall be observed and tested by the Geotechnical Consultant to verify compliance with the recommendations. Any grading performed without full

knowledge of the Geotechnical Consultant may render the recommendations of this report invalid.

11.0 POST-GRADING AND DESIGN CONSIDERATIONS

11.1 Pad Drainage

A surface drainage system consisting of a combination of sloped concrete flatwork, swales and sheet flow gradients in landscape areas, and roof gutters and downspouts should be designed for the site. The roof gutters and downspouts should also be tied directly into the proposed area drain system. Drainage from structures should be designed at minimum 5% gradient to approved areas. The purpose of this drainage system will be to reduce water infiltration into the subgrade soils and to direct surface waters away from building foundations, walls and slope areas.

Concrete flatwork surfaces and paved sloped surfaces should be inclined at a minimum gradient of 2% away from the building foundations and similar structures. A minimum twelve (12)-inch-high berm should be maintained along the top of the descending slope to prevent any water from flowing over the slope.

The owner is advised that all irrigation and drainage devices should be properly maintained throughout the lifetime of the development.

11.2 Foundation Design Recommendations

The proposed structure shall be constructed on a conventional concrete foundation system. Provided the recommendations in this report are incorporated into site development, foundation for load bearing walls and interior columns constructed on compacted certified fill may be designed as follows:

11.2.1 Allowable Bearing Capacity

Continuous Foundations Design Values: An allowable “net” bearing capacity of 1,800 psf. can be utilized for dead and sustained live loads. This value includes a minimum safety factor of three, and may be increased by 1/3 for total loads, including seismic forces.

Continuous foundations should be embedded a minimum of eighteen (18) inches below lowest adjacent soil elevation and a minimum of fifteen (15) inches in width. Reinforcement shall consist of a minimum of four #4 bars, two top and two bottom. Actual depth, width, and reinforcement requirements for continuous foundations will be dependent on the Expansion

Index of the bearing soils, applicable sections of the governing building code and requirements of the structural engineer.

The allowable bearing capacity for continuous foundations may be increased by 150 psf. for each additional six (6) inches of foundation depth and 150 psf. for each additional one foot of foundation width. The allowable bearing capacity should not exceed 2,200 psf. for continuous foundations to keep estimated settlements within allowable limits.

Isolated Pad (Column or Pier) Foundations Design Values: An allowable "net" bearing capacity of 2,000 psf. can be utilized for dead and sustained live loads. This value includes a minimum safety factor of three, and may be increased by 1/3 for total loads, including seismic forces.

Isolated foundations should be a minimum of twenty-four (24) inches square and embedded a minimum of twenty-four (24) inches below lowest adjacent soil elevation. Actual depth, width, and reinforcement requirements for continuous foundations will be dependent on the Expansion Index of the bearing soil, applicable sections of the governing building code and requirements of the structural engineer.

The allowable bearing capacity for isolated foundations may be increased by 200 psf. for each additional six inches of foundation depth and 200 psf. for each additional one foot of foundation width. The allowable bearing capacity should not exceed 2,600 psf. for isolated foundations to keep estimated settlements within allowable limits.

11.2.2 Lateral Load Resistance

Lateral load resistance for the spread footings will be developed by passive soil pressure against sides of footings below grade and by friction acting at the base of the concrete footings bearing on compacted fill. An allowable passive pressure of 300 Z PSF, where Z = Depth (in feet) below finish grade. In passive pressure calculations, the upper one foot of soil should be subtracted from the depth, Z, unless confined by pavement or slab. An appropriate safety factor should be used for design calculations.

Friction along the foundation base may provide resistance to lateral loading. The coefficient of friction was estimated to be 0.25 for site soils compacted to 90% of the maximum dry density as determined by ASTM D 1557 test method, and may be used for dead load forces and includes a reduction factor of 1/3.

For design of building foundations, passive resistance may be combined with frictional resistance provided that a one-third reduction in the coefficient of friction is used.

11.2.3 Footing Reinforcement

Reinforcement for footings should be designed by the structural engineer based on the anticipated loading conditions and expansion index of the supporting soil. Preliminary expansion index for the native soil is categorized as "very low" as determined by ASTM D 4829. Footings should be reinforced with a minimum of two No. 4 bars, one top and one bottom.

11.2.4 Footing Observations

All footing trenches should be observed by a representative of the project geotechnical consultant to verify that they have been excavated into competent soils prior to placement of forms, reinforcement or concrete. The excavations should be trimmed neat, level and square. All loose, sloughed or moisture-softened soils and/or any construction debris should be removed prior to placing of concrete. **Excavated soils derived from footing and/or utility trenches should not be placed in building slab-on-grade areas or exterior concrete flatwork areas unless the soils are compacted to at least 90 percent of maximum dry density.**

11.2.5 Foundation Setbacks

Footings of structures (including retaining walls) located above a slope having a total height of ten (10) feet or less should have a minimum setback of 5 feet, measured from the outside edge of the footing bottom along a horizontal line to the face of the slope. For footings above slopes having a total height greater than ten (10) feet, the setback should be, at minimum, equal to one third of the total height of the slope but need not exceed 40 feet. Refer to the IBC Table 1805.3.1.

11.3 RETAINING WALLS

The project may include shallow retaining walls or walls below grade (i.e. loading docks, light standards, flagpoles or similar structures supporting soil materials. These walls are anticipated to be shallow (i.e., approximately ten (10) feet or less in height). Design lateral earth pressures, backfill criteria, and drainage recommendations for walls below grade are presented.

11.3.1 Lateral Earth Pressures

	Driving Earth Pressure*	Resisting Earth Pressure*
Well-drained soil	45	300***
Well-drained soil (2:1 backfill)	60	
At-rest (restrained wall)	60**	

*Equivalent fluid pressure (PSF) per foot of soil height

**For design purposes, a wall is considered restrained if it prevented from movement greater than 0.002H (H= height of wall in feet) at the top of the wall.

***The upper one foot of soil should be subtracted from the depth, Z, unless confined by pavement or slab. This is an ultimate value.

Note: The pressures recommended above are based on the assumption that the backfill will be compacted to 90% of the maximum dry density. The use of select may lower the recommended driving earth pressure. The revisiting pressure provided is an ultimate value. An appropriate factor of safety is recommended.

Friction acting along the base of the foundation may provide resistance to lateral loading. The coefficient of friction is estimated to be 0.25 for native soils compacted to 90% of the maximum dry density and may be used with dead loads. This value may be increase by 1/3 for total loads, including seismic forces. Frictional and passive resistance may be combined without reduction.

The above values are for retaining walls that have been supplied with a proper sub-drain system. All walls should be designed to support any adjacent structural surcharge loads imposed by other nearby walls, footings, or vehicular traffic within a distance approximately equal to the height of the wall.

Retaining walls over six feet in height may need to be designed for a seismic load force that is applied to the static forces when the seismic shaking occurs. The geotechnical consultant should be contacted for retaining walls over six feet in height.

11.3.2 Wall Backfill

Backfill behind shallow retaining walls or walls below grade should consist of non-expansive granular materials. Wall backfill should not contain organic material, rubble, debris, and rocks or cemented fragments larger than three (3) inches in greatest dimension. In the case where no shoring was used, the granular backfill should extend outward from the base of the wall to ground surface at a 1:1 (horizontal: vertical) slope. The geotechnical consultant should be allowed the opportunity to sample and test and comment about the adequacy of the proposed imported backfill material once adequate quantities to complete the project are on site.

Backfill should be placed in lifts not exceeding eight to ten (8-10) inches in thickness measured loose, moisture conditioned to above optimum moisture content and mechanically compacted with hand-operated equipment to minimum 90% of the maximum dry density as determined by ASTM D 1557. Walls below grade that are not free to deflect should be properly braced prior to placement and compaction of backfill. **Compaction should be verified by testing.**

11.3.3 Drainage and Waterproofing

It is recommended that waterproofing be provided behind the retaining walls to help reduce efflorescent formation.

Walls designed for drained earth pressures shall have adequate drainage provided behind the walls. Sub-drains or weep holes at the base of the walls shall be incorporated into design. Wall back-drains shall be designed by a registered Civil Engineer.

12.0 CORROSION AND CHEMICAL ATTACK

Soluble sulfate, pH, resistivity and chloride concentration test results are presented in Appendix B. The Resistivity (CTM 643) test results on a bulk soil sample from the site indicated that on-site soils are **corrosive** when in contact with ferrous material (1,700 ohm-cm).

Corrosion test results also indicate that the surficial soils at the site have negligible sulfate attack potential (0.00741%) on concrete, according to the ACI 318 Table 4.3.1. Type II cement should be used in all concrete that may be in contact with the on-site soils.

Based on the preliminary chemical analysis performed on a sample of the native soil, foundation concrete shall consist of type II cement with a minimum compressive strength of

2,500 psi as indicated in the ACI 318 Table 4.3.1. A higher compressive strength may be required by the structural engineer. Additional soil chemical analysis during grading is recommended. The minimum concrete compressive strength should be determined by the structural engineer.

The chemical test results should be distributed to the project design team for their interpretations pertaining to the corrosivity or reactivity of the construction materials (ferrous metals, and piping). Chemical test results performed on a bulk soil sample obtained during the field investigation are presented in Appendix C.

13.0 EXCAVATIONS

It is Bruin GSI's opinion that standard construction techniques should be sufficient for site excavations. All excavations should be made in accordance with applicable regulations, including CAL/OSHA for and OSHA type "C" soil. Project safety is the contractor's responsibility and the owner. Bruin GSI will not be responsible for project safety.

The attention of contractors, particularly the underground contractors, should be drawn to the State of California Construction Safety Orders for "Excavations, Trenches, and Earthwork." Trenches or excavations greater than five (5) feet in depth should be shored or sloped back in accordance with OSHA Regulations prior to entry.

Open excavations, un-shored or un-surcharged (above the groundwater level) may be cut vertically to a maximum depth of no more than five feet. Excavations higher than five feet should be sloped back at a minimum 1.5:1 (horizontal to vertical) slope or flatter or shored. Sloughing will occur if the soil is dry or dries our while open. No excavation should be made within a 1:1 line projected outward from the toe of any existing foundation or structure.

No heavy equipment or other surcharge loads (i.e. excavation spoils) should be allowed within the top of slope a distance equal to the depth of the excavation, both measured from the top of the excavation.

Soil backfill around foundations or behind walls below grade should be placed in lifts not exceeding eight to ten inches, measured loose, moisture conditioned to near optimum moisture content and uniformly mechanically compacted to minimum 90% relative compaction as determined by ASTM D 1557 test method. Flooding or jetting is not recommended.

14.0 UTILITY TRENCHES AND BACKFILL

Standard construction techniques should be sufficient for site utility trench excavations. Utility trenches often settle even when backfill is placed under optimum conditions.

Trench backfill shall be moisture conditioned to near optimum moisture content, placed in lifts not exceeding eight to ten inches, measured loose, and uniformly compacted to minimum 90% of the maximum dry density with mechanical compaction equipment. **No flooding or jetting is recommended.**

Backfill of public utilities within road right-of-ways or on the subject site should be placed in strict conformance with the requirements of the governing agency. As a minimum it is recommended that utility trench backfill should be moisture conditioned to near optimum moisture content, placed in lifts not exceeding eight to ten inches, measured loose, (depending on means of compaction) and uniformly compacted to minimum 90% of the maximum dry density with mechanical compaction equipment. If aggregate base is used for backfill material, it should be moisture conditioned to near optimum moisture content, placed in eight to ten inch lifts, measured loose, and uniformly compacted to minimum 95% of the maximum dry density using mechanical compaction equipment. **Compaction should be verified by testing.**

For purposes of this section of the report, "bedding" is defined as material placed in a trench up to one (1) foot above a utility pipe, and "backfill" is all material placed in the trench above the bedding. Unless concrete bedding is required around utility pipes, free-draining sand should be used as bedding. Sand proposed for use as bedding should be tested in our laboratory to verify its suitability and measure its compaction characteristics. **Sand bedding should be compacted by mechanical means to achieve at least 90% relative compaction based on ASTM D 1557.**

Backfill operations should be observed and tested by the Geotechnical Consultant to monitor compliance with these recommendations.

Where utility trenches enter the footprint of the building, trenches should be backfilled through their entire depths with on-site fill materials, sand-cement slurry, or concrete rather than with any sand or gravel shading. This "Plug" of less- or non-permeable materials will mitigate the potential for water to migrate though the backfilled trenches from outside of the building to the areas beneath the foundations and floor slabs.

The backfill soil should be moisture conditioned to near optimum moisture content, placed in lifts not exceeding eight to ten inches, measured loose, (depending on means of compaction) and uniformly compacted to minimum 90% of the maximum dry density with mechanical compaction equipment.

15.0 INTERIOR CONCRETE SLAB-ON-GRADE

It should be understood that as a manufactured product, concrete will crack even under ideal conditions. It is our experience that shrinkage is more pronounced in the Antelope Valley

due to environmental conditions (high winds, daily extreme temperature differences and low humidity. Appropriate mix designs, placement procedures and concrete curing methods should be planned and implemented during construction in order to reduce the occurrence and magnitude of concrete shrinkage cracking.

Interior and exterior slab-on-grade construction should be supported by a minimum of five feet of compacted soil, prepared as recommended in Section 10.2 of this report.

15.1 Vapor Barrier and Water Proofing

It is recommended that a vapor retardant/waterproofing be placed below the concrete slab on grade. Vapor/moisture transmission through slabs does occur and can impact various components of the structure.

Vapor retardant/waterproofing designing and inspection of installation is not the responsibility of the geotechnical engineer (most often the responsibility of the architect). Bruin Geotechnical Services, Inc. does not practice in the field of water and moisture vapor transmission evaluation/mitigation. Therefore, we recommend that a qualified person/firm be engaged/consulted to evaluate the general and specific water and moisture vapor transmission paths and any impact on the proposed development. This person/firm should provide recommendations for mitigation of potential adverse impact of water and moisture vapor transmission on various components of the structure ad deemed necessary. The actual waterproofing design shall be provided by the architect, structural engineer or contractor with experience in waterproofing.

In order to promote good building practices and alert the rest of the design/construction team of the appropriate standards and expect recommendations pertaining to vapor barriers/retardants, engineers (especially those aware of the issues surrounding below-slab moisture protection and its effect on the success of their projects) should consider recommending and citing specific performance characteristics. The following paragraph includes criteria from the latest standards and expert recommendations and should be considered for use in your firm's own recommendations:

Vapor barrier shall consist of a minimum 15 mil extruded polyolefin plastic (no recycled content of woven materials permitted). Permeance as tested before and after mandatory conditions (ASTM E 17455 Section 7.1 and Sub-Paragraph 7.1.1-7.1.5): less than 0.01 perms [grains/(ft²-hr-inHg)] and comply with the ASTM E1745 Class A requirements. Install vapor barrier according to ASTM E1643, including proper perimeter seal. Basis of design: Stego Wrap Vapor Barrier 15 mil and Stego Crete Claw Tape (perimeter seal tape). Approved Alternatives: Vaporguard by Reef Industries, Sundance 15 mil Vapor Barrier by Sundance Inc.

15.2 Thickness and Joint Spacing

Concrete slab-on-grade should be at least five (5) inches thick and provided with construction joints or expansion joints every ten (10) feet or less. The slab-on-grade should have a minimum compressive strength of 2,500 psi at 28 days. More stringent requirements may be required by the structural engineer.

15.3 Reinforcement

Reinforcement of the slab-on-grade is contingent on the structural engineer's recommendations and the Expansion Index of the supporting soil. As a minimum, reinforcement should consist of No. 4 bars spaced sixteen (16) inches on center, both ways. The reinforcement should be positioned near the middle of the slabs by means of concrete chairs or brick. Additional reinforcement may be required by the structural engineer.

15.4 Subgrade Preparation

As further measure to minimize cracking of concrete flatwork, the subgrade soils and all utility line trenches below concrete slab-on-grade areas should first be compacted to a minimum relative compaction of **90 percent** and then thoroughly moistened to achieve a moisture content that is near optimum moisture content. **A representative of the project geotechnical consultant should observe and verify the density and moisture content of the soils, and the depth or moisture penetration prior to pouring concrete.**

16.0 EXTERIOR CONCRETE FLATWORK (PATIOS, WALKWAYS, SIDEWALKS, etc.)

It should be understood that as a manufactured product, concrete will crack even under ideal conditions. It is our experience that shrinkage is more pronounced in the Antelope valley due to environmental conditions (high winds, daily extreme temperature differences and low humidity. Appropriate mix designs, placement procedures and concrete curing methods should be planned and implemented during construction in order to reduce the occurrence and magnitude of concrete shrinkage cracking.

Exterior slab-on-grade construction should be supported by at least twelve (12) inches of compacted soil, prepared as recommended in Section 10.4 of this report. At locations where slabs cross trenches, observation and testing of trench backfill should be performed to confirm uniformity of conditions.

16.1 Thickness and Joint Spacing

To reduce the potential of unsightly cracking, concrete sidewalks, patio-type slabs should be at least four (4) inches thick and provided with frequent construction joints

or expansion joints, especially at area of re-entrant corners, to help control cracking. Exterior perimeter slabs should be designed relatively independent of the foundation stems (free-floating) to help cracking due to settlement and /or expansion.

16.2 Reinforcement

Reinforcement of the exterior slab-on-grade is contingent on the structural engineer's recommendations and the Expansion Index of the supporting soil. As a minimum, reinforcement should consist of No. 3 bars spaced twenty-four (24) inches on center, both ways. The reinforcement should be positioned near the middle of the slabs by means of concrete chairs or brick. Additional reinforcement may be required by the structural engineer.

16.3 Subgrade Preparation

As further measure to minimize cracking of concrete flatwork, the subgrade soils below concrete flatwork areas should first be compacted to a minimum relative compaction of 90 percent and then thoroughly moistened to achieve a moisture content that is near optimum moisture content. Pre-wetting of the soils to a depth of six inches a maximum of 24 hours prior to concrete placement will promote uniform curing of the concrete and minimize the development of shrinkage cracks. **A representative of the project geotechnical consultant should observe and verify the density and moisture content of the soils, and the depth or moisture penetration a maximum of 24 hours prior to pouring concrete.**

17.0 RIGID (PCC) PAVEMENT

It should be understood that as a manufactured product, concrete will crack even under ideal conditions. It is our experience that shrinkage is more pronounced in the Antelope Valley due to environmental conditions (high winds, daily extreme temperature differences and low humidity. Appropriate mix designs, placement procedures and concrete curing methods should be planned and implemented during construction in order to reduce the occurrence and magnitude of concrete shrinkage cracking.

Exterior slab-on-grade construction should be supported by at least twelve (12) inches of compacted soil, prepared as recommended in Section 10.3 of this report. At locations where slabs cross trenches, observation and testing of trench backfill should be performed to confirm uniformity of conditions.

17.1 Thickness and Joint Spacing

To reduce the potential of unsightly cracking, rigid concrete pavement should be at least five (5) inches thick (six inches thick in heavy truck areas) and provided with

frequent construction joints or expansion joints, especially at area of re-entrant corners, to help control cracking. Perimeter pavement should be designed relatively independent of the foundation stems (free-floating) to help cracking due to settlement and /or expansion.

17.2 Reinforcement

Reinforcement of the exterior pavement is contingent on the structural engineer's recommendations and the Expansion Index of the supporting soil. As a minimum, reinforcement should consist of No. 3 bars spaced twenty-four (24) inches on center, both ways. The reinforcement should be positioned near the middle of the slabs by means of concrete chairs or brick. Additional reinforcement may be required by the structural engineer.

17.3 Subgrade Preparation

As further measure to minimize cracking of concrete flatwork, the upper twelve inches of subgrade soils below concrete flatwork areas should first be compacted to a minimum relative compaction of 95% and then thoroughly moistened to achieve a moisture content that is near optimum moisture content. Pre-wetting of the soils to a depth of six inches a maximum of 24 hours prior to concrete placement will promote uniform curing of the concrete and minimize the development of shrinkage cracks. **A representative of the project geotechnical consultant should observe and verify the density and moisture content of the soils, and the depth or moisture penetration a maximum of 24 hours prior to pouring concrete.**

18.0 CONSTRUCTION CONSIDERATIONS

Based on our field exploration program, earthwork can be performed with conventional construction equipment.

18.1 Temporary Dewatering

Groundwater was not encountered in any of our borings to the maximum depth of our explorations. Based on the anticipated excavation depths, the need for temporary dewatering is considered low.

18.2 Construction Slopes

Excavations during construction should be conducted so that slope failure and excessive ground movement will not occur. The short-term stability of excavation depends on many factors, including slope angle, engineering characteristics of the

subsoils, height of the excavation and length of time the excavation remains unsupported and exposed to equipment vibrations, rainfall and desiccation.

Where spacing permits, and providing that adjacent facilities are adequately supported, open excavations may be considered. In general, unsupported slopes for temporary construction excavations should not be expected to stand at an inclination steeper than 1:1 (horizontal: vertical). The temporary excavation side walls may be cut vertically to a height of 3 feet and then laid back at a 1:1 slope ratio above a height of 3 feet.

Surcharge loads (equipment, spoil piles, etc.) should be kept away from the top of temporary excavations a horizontal distance equal to the depth of excavation. Surface drainage should be controlled along the top of temporary excavations to preclude wetting of the soils and erosion of the excavation faces. Even with the implementation of the above recommendations, sloughing of the surface of the temporary excavations may still occur, and workmen should be adequately protected from such sloughing.

18.3 Temporary Shoring

If shoring is considered, Bruin GSI should be notified in order to provide appropriate design parameters.

19.0 ADDITIONAL SERVICES

Final project plans and specifications should be reviewed prior to construction to confirm that the full intent of the recommendations presented herein have been applied to design and construction. This report is based on the assumption that an adequate testing and inspection program along with client consultation will be performed during final design and construction phases to verify compliance with the recommendations of this report.

Retaining Bruin GSI as the geotechnical consultant to provide additional services from preliminary design through project completion will assure continuity of services.

Additional services include:

- Consultation during design stages of the project.
- Review, stamp and signature of the grading and building plans.
- Observation and testing during rough grading, fine grading and trench backfill as well as placement of engineered fill.
- Consultation as required during construction.

Cost estimates can be prepared if requested. Please contact our office.

20.0 PRELIMINARY FLEXIBLE PAVEMENT DESIGN

Asphalt-concrete pavements shall be designed per the Caltrans Highway Design Manual based on R-Value and Traffic Index. An assumed R-value of the native soil of 55 was used for the preliminary structural pavement section. During grading as soils are mixed, soil samples should be obtained and tested for R-Value determination.

For pavement design, the preliminary flexible pavement layer thickness is as follows:

RECOMMENDED ASPHALT PAVEMENT SECTION LAYER THICKNESS

Pavement Material	**Recommended Thickness (TI = 5.0) On-Site Parking**
Asphalt Concrete	3½"
Class II Aggregate Base	5"
Compacted Subgrade	24

*ASPHALT PAVEMENT CALCULATIONS -CalTrans Highway Design Manual 603-1 July 1, 2020

Pavement Material	**Recommended Thickness (TI = 6.0)** Drive Areas
Asphalt Concrete	3½"
Class II Aggregate Base	7"
Compacted Subgrade	24

*ASPHALT PAVEMENT CALCULATIONS -CalTrans Highway Design Manual 603-1 July 1, 2020

Asphalt concrete should conform to Sections 203 and 302 of the latest edition of the Standard Specifications for Public Works Construction ("Greenbook").

Class II aggregate base should conform to Section 26 of the Caltrans Standard Specifications, latest edition. The aggregate base material should be compacted to at least 95% of the maximum dry density as determined by ASTM Method D 1557.

21.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

This report is based on the development plans provided to our office. If structure design changes or structure locations changes occur, the conclusion and recommendations in this report may not be considered valid unless the changes are reviewed and the conclusions of this report are modified or approved by the Geotechnical Consultant.

The subsurface conditions and characteristics described herein have been projected from individual borings or test pits placed across the subject property. Actual variations in the subsurface conditions and characteristics may occur.

If conditions encountered during construction differ from those described in this report, this office should be notified so as to consider the necessity for modifications. No responsibility for construction compliance with the design concepts, specifications, or recommendations is assumed unless on-site construction review is performed during the course of construction, which pertains to the specific recommendations contained herein.
It is recommended that Bruin GSI be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design specifications. If Bruin GSI is not accorded the privilege of making this recommended review, Bruin GSI can assume no responsibility for misinterpretation of the recommendations contained in this report.

This report has been prepared in accordance with generally accepted practice and standards in this community at this time. No warranties, either expressed or implied, are made as to the professional advice provided under the terms of the agreement and included in this report. This report has been prepared for the exclusive use of Mr. Ryan Duke, and his authorized agents. Unauthorized reproduction of any portion of this report without expressed written permission is prohibited.

If parties other than Bruin GSI are engaged to provide construction geotechnical services, they must be notified that they will be required to assume complete responsibility for the geotechnical phase of the project by concurring with the findings and recommendations in this report or providing alternate recommendations.

22.0 CLOSURE

The conclusions, recommendations, and opinions presented herein are: (1) based upon our evaluation and interpretations of the limited data obtained from our field and laboratory programs; (2) based upon an interpolation of soil conditions between and beyond the borings; (3) are subject to confirmation of the actual conditions encountered during construction; and, (4) are based upon the assumption that sufficient observation and testing will be provided during the grading, infrastructure installation and building phases of site development.

APPENDIX A

Boring Logs and Classification Key

BRUIN GEOTECHNICAL SERVICES INC. est. 2004 TM

Date(s) drilled	6/28/2021	**LOG OF BORING 1**	
Drilling Contractor	GP Drilling	**Page 1 of 2**	
Drilling Method	Hollow Stem Auger		
Drill Rig Type	CME 75	Logged By:	DM
Drill Bit Size/Type	8"	Checked By:	MS
Sampling Method(s)	CSS	Total Depth of Borehole	50' bgs
Client: Duke	Groundwater	None Encountered	Boring Location: See Figure 2
Project Number: 21-493	Borehole Backfill	Native/ Cuttings	Notes:
Project Location: Victorville	Hammer Data	140#, 30" drop	

Depth	Sample	USCS	Graphic Log	Material Description	Penetration Resistance (Blows/6")	Dry Unit Weight pcf	Water Content %
		ML		Yellowish-brown fine sandy silt w/ medium sand Moderate firm, moist	12-16	99.9	9.5
5'		SM		Tannish-brown slightly silty fine to medium sand w/ coarse sand Dense, moist	10-16	107.0	7.1
		SP		Light brown fine to medium sand w/ coarse sand & occ 3/8" gravel Dense, moist	24-28	110.3	2.0
10'		SP		Light brown fine to medium sand w/ coarse sand & occ 3/8" gravel	17-24	108.4	1.6
15'		SP		Olive brown fine to coarse sand w/ occ 3/8" gravel Loose, moist	15-25	93.7	3.1
20'		SP		Olive brown fine to coarse sand w/ occ 3/8" gravel	17-23	107.7	2.5
25'		SP		Olive brown fine to coarse sand w/ occ 3/8" gravel	20-28	101.4	4.2
30'		SM		Olive brown silty fine sand w/ occ medium sand; medium dense, moist	16-24	105.4	10.1

BRUIN GEOTECHNICAL SERVICES INC. est. 2004 TM

Date(s) drilled	6/28/2021	**LOG OF BORING 1**	
Drilling Contractor	GP Drilling	**Page 2 of 2**	
Drilling Method	Hollow Stem Auger		
Drill Rig Type	CME 75	Logged By:	DM
Drill Bit Size/Type	8"	Checked By:	MS
Sampling Method(s)	CSS	Total Depth of Borehole	
Client: Duke	Groundwater	None Encountered	Boring Location: See Figure 2
Project Number: 21-493	Borehole Backfill	Native/ Cuttings	Notes:
Project Location: Victorville	Hammer Data	140#, 30" drop	

Depth	Sample	USCS	Graphic Log	Material Description	Penetration Resistance (Blows/6")	Dry Unit Weight pcf	Water Content %
35'							
40'		SM		Brown silty fine sand w/ medium sand Medium dense, moist	15-28	105.5	10.4
45'							
50'		SM		Brown very silty fine sand w/ medium sand & clay binder Medium dense, very moist	17-37	98.0	12.7
				Boring terminated @ 50' bgs No groundwater No caving			

BRUIN GEOTECHNICAL SERVICES INC. est. 2004 ™

Date(s) drilled	6/28/2021	**LOG OF BORING 2**	
Drilling Contractor	GP Drilling	**Page 1 of 1**	
Drilling Method	Hollow Stem Auger		
Drill Rig Type	CME 75	Logged By:	DM
Drill Bit Size/Type	8"	Checked By:	MS
Sampling Method(s)	SPT	Total Depth of Borehole	15' bgs
Client: Duke	Groundwater	None Encountered	Boring Location: See Figure 2
Project Number: 21-493	Borehole Backfill	Native/ Cuttings	Notes:
Project Location: Victorville	Hammer Data	140#, 30" drop	

Depth	Sample	USCS	Graphic Log	Material Description	Penetration Resistance (Blows/6")	Dry Unit Weight pcf	Water Content %
		SM/SP		Moderate brown slightly silty fine to medium sand w/ coarse sand & occ #4 grvl Medium dense, slightly moist	6-7-9		2.2
5'		SM		Moderate brown fine to coarse sand w/ 1/2" gravel, clay binder Dense, moist	9-13-16		2.8
		SM		Moderate brown fine to coarse sand w/ 1/2" gravel, clay binder	7-14-18		6.5
10'		SM		Moderate brown slightly silty fine to medium sand w/ occ coarse sand Medium dense, moist	9-13-19		7.1
15'		SM		Moderate brown slightly silty fine to medium sand w/ occ coarse sand Dense	16-24-19		5.1
20'				Boring terminated @ 15' bgs No groundwater No caving			
25'							
30'							

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Date(s) drilled	6/28/2021	**LOG OF BORING 3**	
Drilling Contractor	GP Drilling	**Page 1 of 1**	
Drilling Method	Hollow Stem Auger		
Drill Rig Type	CME 75	Logged By:	DM
Drill Bit Size/Type	8"	Checked By:	MS
Sampling Method(s)	CSS	Total Depth of Borehole	20' bgs
Client: Duke	Groundwater	None Encountered	Boring Location: See Figure 2
Project Number: 21-493	Borehole Backfill	Native/ Cuttings	Notes:
Project Location: Victorville	Hammer Data	140#, 30" drop	

Depth	Sample	USCS	Graphic Log	Material Description	Penetration Resistance (Blows/6")	Dry Unit Weight pcf	Water Content %
		SM/SP		Light brown slightly silty fine to medium sand w/ coarse sand & occ #4 gravel Dense, moist	15-23	104.2	2.1
5'		SM/SP		Light brown slightly silty fine to medium sand w/ coarse sand & occ #4 gravel	16-24	109.9	3.1
		SM		Brown silty fine to medium sand w/ occ coarse sand, slightly cemented Dense, moist	11-24	109.2	3.1
10'		SP		Reddish brown fine to coarse sand w/ occ 1/2" gravel Dense, moist	15-34		2.0
15'		SP		Olive brown fine to medium sand w/ coarse sand & occ 3/8" gravel Dense, moist	18-25	95.4	8.2
20'		SM/ML		Moderate brown very silty fine to medium sand Dense, very moist	10-13	102.0	15.6
25'				Boring terminated @ 20' bgs No groundwater No caving			
30'							

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Date(s) drilled	6/28/2021	**LOG OF BORING 4**	
Drilling Contractor	GP Drilling	**Page 1 of 1**	
Drilling Method	Hollow Stem Auger		
Drill Rig Type	CME 75	Logged By:	DM
Drill Bit Size/Type	8"	Checked By:	MS
Sampling Method(s)	SPT	Total Depth of Borehole	10' bgs
Client: Duke	Groundwater	None Encountered	Boring Location: See Figure 2
Project Number: 21-493	Borehole Backfill	Native/ Cuttings	Notes:
Project Location: Victorville	Hammer Data	140#, 30" drop	

Depth	Sample	USCS	Graphic Log	Material Description	Penetration Resistance (Blows/6")	Dry Unit Weight pcf	Water Content %
		ML		Yellowish-brown fine to medium sandy silt w/ coarse sand & occ #4 gravel Dense, moist	11-14-19		2.5
		SM		Yellowish-brown slightly silty fine to medium sand w/ coarse sand & occ #4 grvl Medium dense, moist	9-10-10		8.7
5'							
		SM		Moderate brown silty fine sand w/ occ medium sand Medium dense, moist	11-15-16		4.4
10'		SM/ML		Moderate brown very silty fine sand w/ medium to coarse sand, clay binder Medium dense, slightly moist	7-9-11		8.1
15'				Boring terminated @ 10' bgs No groundwater No caving			
20'							
25'							
30'							

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Date(s) drilled	6/28/2021	**LOG OF BORING 5**	
Drilling Contractor	GP Drilling	**Page 1 of 1**	
Drilling Method	Hollow Stem Auger		
Drill Rig Type	CME 75	Logged By:	DM
Drill Bit Size/Type	8"	Checked By:	MS
Sampling Method(s)	CSS	Total Depth of Borehole	15' bgs
Client: Duke	Groundwater	None Encountered	Boring Location: See Figure 2
Project Number: 21-493	Borehole Backfill	Native/ Cuttings	Notes:
Project Location: Victorville	Hammer Data	140#, 30" drop	

Depth	Sample	USCS	Graphic Log	Material Description	Penetration Resistance (Blows/6")	Dry Unit Weight pcf	Water Content %
5'		SM		Reddish brown silty fine to coarse sand w/ occ #4 gravel Dense, slightly moist	11-14	114.7	4.5
		SM		Reddish brown slightly silty fine to coarse sand w/ occ 1/2" gravel Medium dense, moist	14-18	100.4	8.6
10'		SM		Light brown silty fine sand w/ medium sand Medium dense, moist	13-19	109.2	7.1
15'		SP/SM		Orange brown slightly silty fine to coarse sand w/ occ #4-3/8" gravel Medium dense, moist	16-25	104.6	4.1
20'							
25'				Boring terminated @ 15' bgs No groundwater No caving			
30'							

BRUIN GEOTECHNICAL SERVICES, INC.

GEOTECHNICAL REPORTS | MATERIAL TESTING | CONSTRUCTION INSPECTION

SOIL CLASSIFICATION KEY

MAJOR DIVISIONS			SYMBOL		TYPICAL NAMES
Coarse Grained Soils 50% or more larger than #200 sieve	**Gravels** More than half coarse-fraction is larger than No. 4 sieve size	Clean gravels with little or no fines	GW		Well graded gravels, gravel-sand mixtures
			GP		Poorly graded gravels, gravel-sand mixtures
		Gravel with over 12% fines	GM		Silty gravels, poorly graded gravel-sand-silt mixtures
			GC		Clayey gravels, poorly graded gravel-sand-clay mixtures
	Sands More than half coarse-fraction is smaller than No. 4 sieve size	Clean sands with little or no fines	SW		Well graded sands, gravelly sands
			SP		Poorly graded sands, gravelly sands
		Sands with over 12% fines	SM		Silty sands, poorly graded sand-silt mixtures
			SC		Clayey sands, poorly graded sand-clay mixtures
Fine Grained Soils 50% or more smaller than #200 sieve	**Silts and Clays** Liquid limit less than 50		ML		Inorganic silts, rock flour, clayey silts
			CL		Inorganic clays of low to medium plasticity, sandy clays, silty clays
			OL		Organic clays and organic silty clays of low plasticity
	Silts and Clays Liquid limit greater than 50		MH		Inorganic silts, micaceous or diatomaceous fine sandy/silty soils, elastic silts
			CH		Inorganic clays with high plasticity, fat clays
			OH		Organic clays of medium to high plasticity, organic silts
Highly Organic Soils			Pt		Peat and other highly organic soils

CLASSIFICATION SYSTEM BASED ON THE UNIFIED SOIL CLASSIFICATION SYSTEM

44732 Yucca Avenue
Tel (661) 273-9078

Lancaster, California 93534
www.bruingsi.net

Boring Log Key

Depth	Sample	USCS	Graphic Log	Material Description	Penetration Resistance (Blows/6")	Dry Unit Weight pcf	Water Content %
1	2	3	4	5	6	7	8

COLUMN DESCRIPTIONS

1	Depth in feet below the ground surface
2	Sampling Method see "symbols" below
3	USCS symbol
4	Graphic depiction of the subsurface material
5	Description of the material encountered. May include consistency, moisture, color, and other descriptors
6	Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval
7	Dry weight per unit volume of soil sample measured in laboratory units in pounds per cubic foot
8	Water content of the sample expressed as a percentage of the dry weight of the sample

ABBREVIATIONS

DIST = Disturbed Sample
N/R = No Recovery
CHEM = Chemical Test
N/A = Not Analyzed

SAMPLING METHOD SYMBOLS


California Split Spoon (CSS)


Standard Penetration Test (SPT)


Bulk Sample


Grab Sample

GENERAL NOTES

1. Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.

2. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

APPENDIX B

Laboratory Test Data

SUMMARY OF LABORATORY TEST RESULTS

SIEVE ANALYSIS

Percent passing individual sieves

Sample I.D.	1/2"	3/8"	#4	#10	#40	#100	#200
B1@2’	100	100	100	100	99	84	60
B1@20’	100	99	94	83	36	5	3
B1@30’	100	100	100	99	92	50	25
B1@750’	100	100	100	99	91	62	43
B2@9’	98	98	98	85	51	36	29
B2@15’	96	93	87	72	37	24	18
B3@10’	96	92	82	63	21	7	5
B4@2’	100	99	99	92	67	57	55
B4@4’	100	100	99	98	69	33	21
B4@10’	96	96	95	93	82	63	50
B5@2’	98	97	95	86	52	28	18
B5@15’	100	100	99	90	43	13	8

SAND EQUIVALENT

Sample I.D.	Sand Equivalent
B1@10’	75
B1@15’	61
B1@40’	13
B2@12’	15
B3@2’	52
B3@20’	5
B4@7’	21

EXPANSION INDEX

Sample	Expansion Index	Classification
E1@0-5’	0	Non-Expansive

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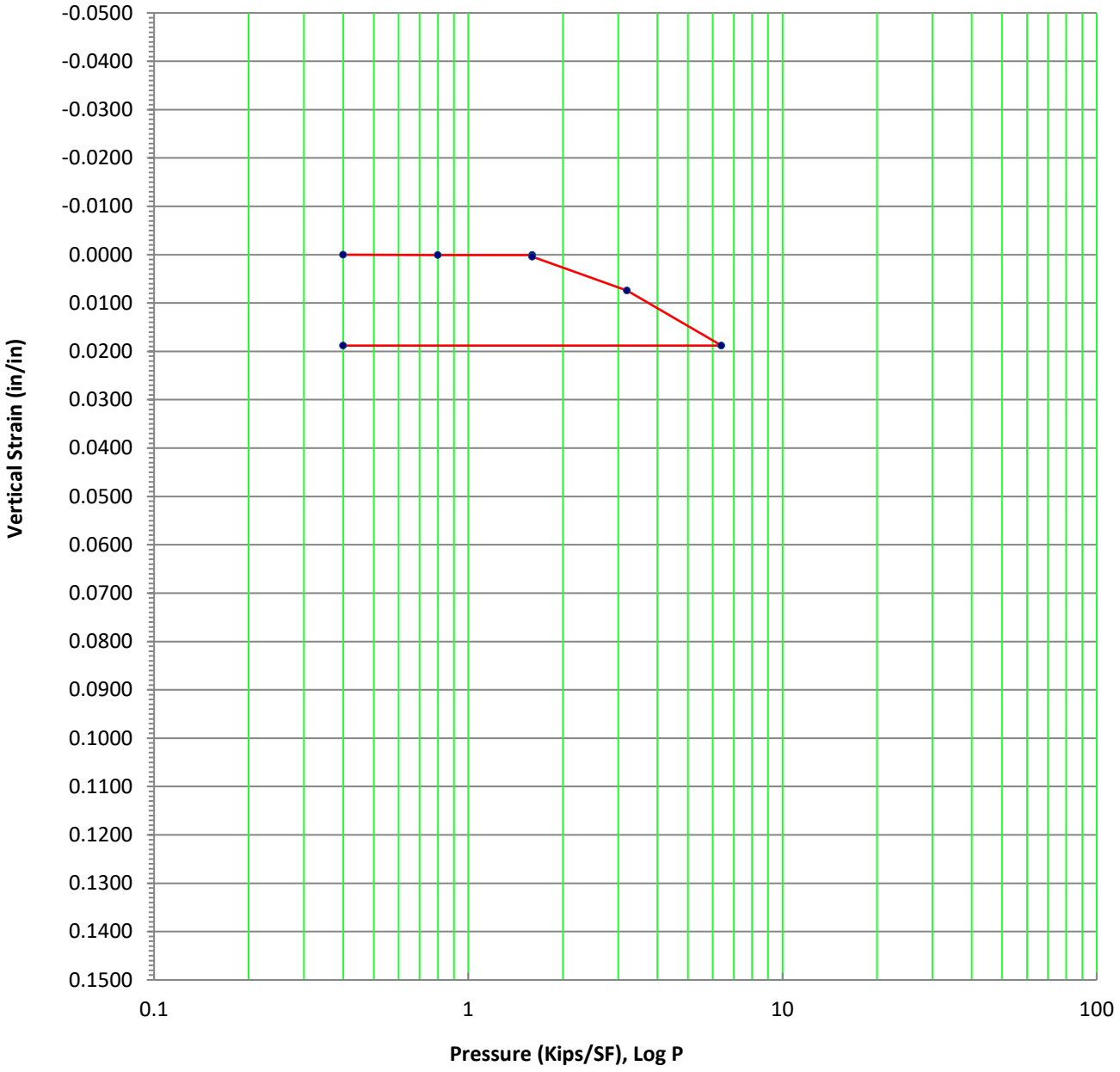
Lancaster, CA 93534
661-273-9078

Maximum Density/Optimum Moisture Proctor ASTM D698/D1557

Project Number:	21-493	July 16, 2021
Project Name:	Duke Engineering	ASTM D-1557 C
Lab ID Number:	B1 Bulk	Rammer Type: 10#
Sample Location:	B1 0'-5'	
Description:	Yellowish brown silty sand fine to coarse and w/occ # 10 - # 4 gravel	

		Sieve Size	% Retained
Maximum Density:	**126.5 pcf**	3/4"	
Optimum Moisture:	**10.5%**	3/8"	
		#4	



Sample location:	B1@4'	
Material:	SM	
Initial Dry Density:	107.1	PCF
Moisture Content:	7.2	%
% Hydroconsolidation:	0.0	%

* Test Method: ASTM D-2435

Consolidation Test

Duke

Victorville, CA

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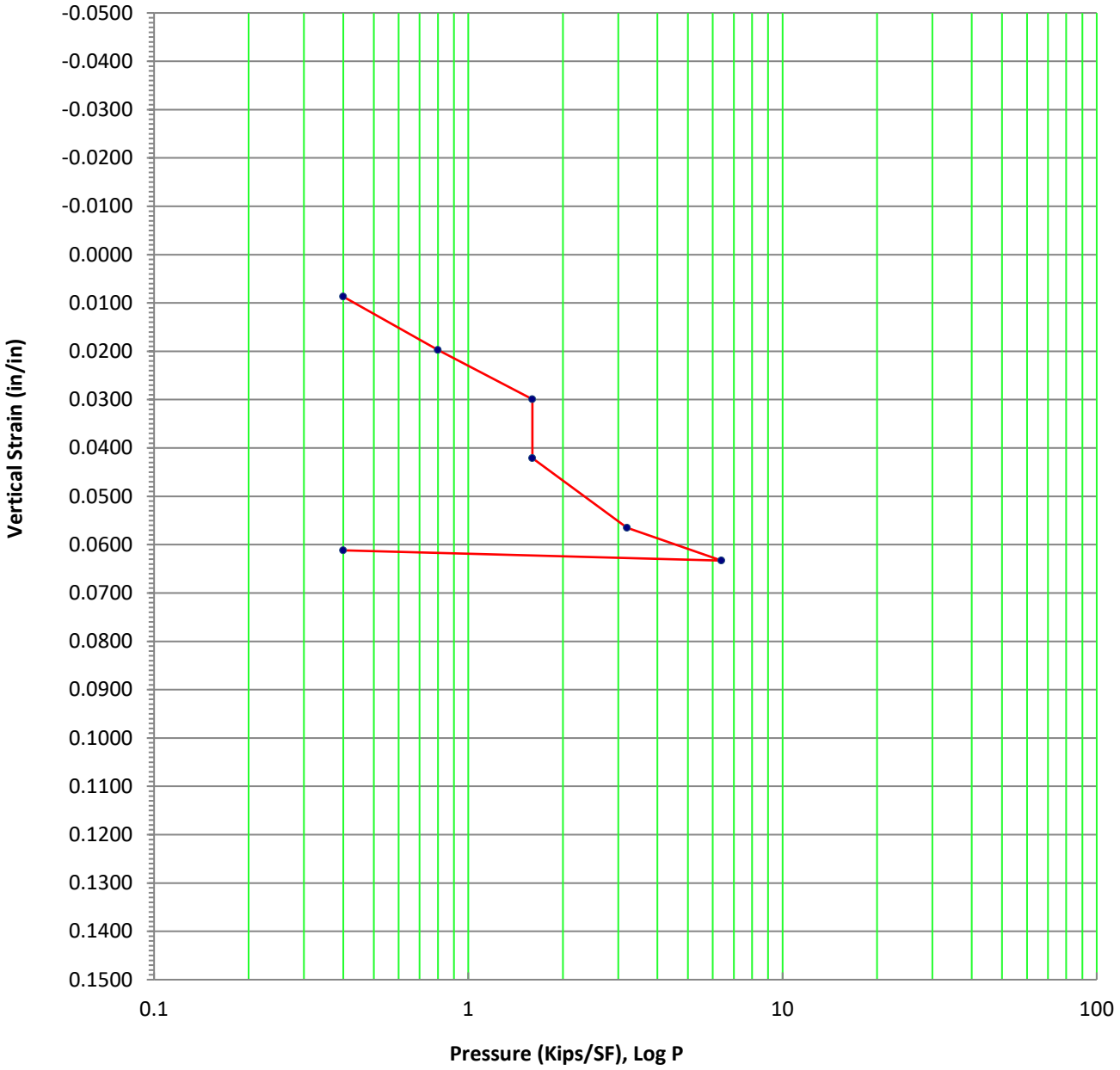
est. 2004

7/16/2021	21-493



Sample location:	B1@7'	
Material:	SP	
Initial Dry Density:	110.3	PCF
Moisture Content:	2.0	%
% Hydroconsolidation:	1.2	%

* Test Method: ASTM D-2435

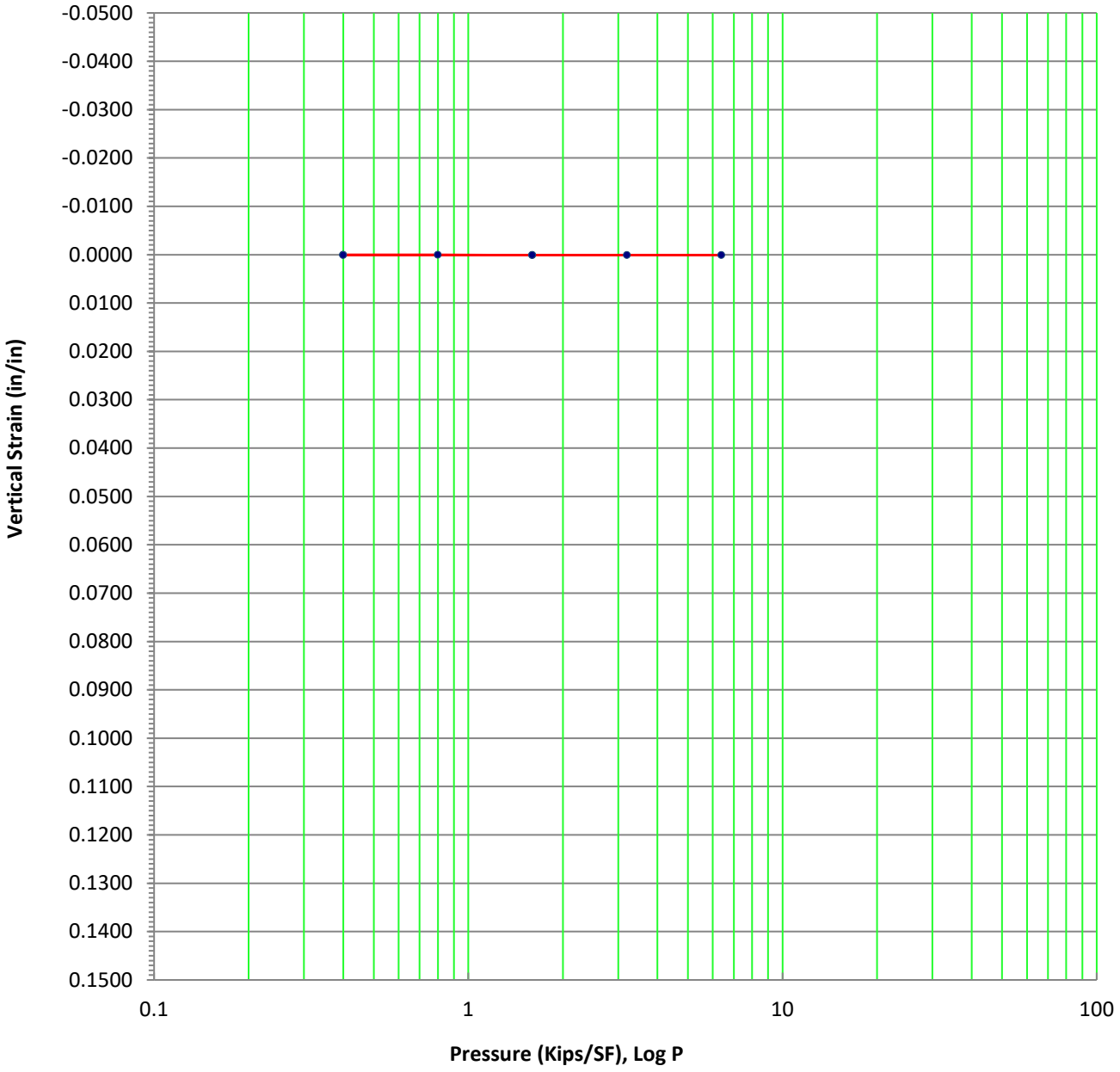
Consolidation Test

Duke

Victorville, CA

BRUIN
GEOTECHNICAL SERVICES INC.
est. 2004

7/16/2021	21-493



Sample location:	B3@5'	
Material:	SM/SP	
Initial Dry Density:	110.0	PCF
Moisture Content:	3.1	%
% Hydroconsolidation:	0.0	%

* Test Method: ASTM D-2435

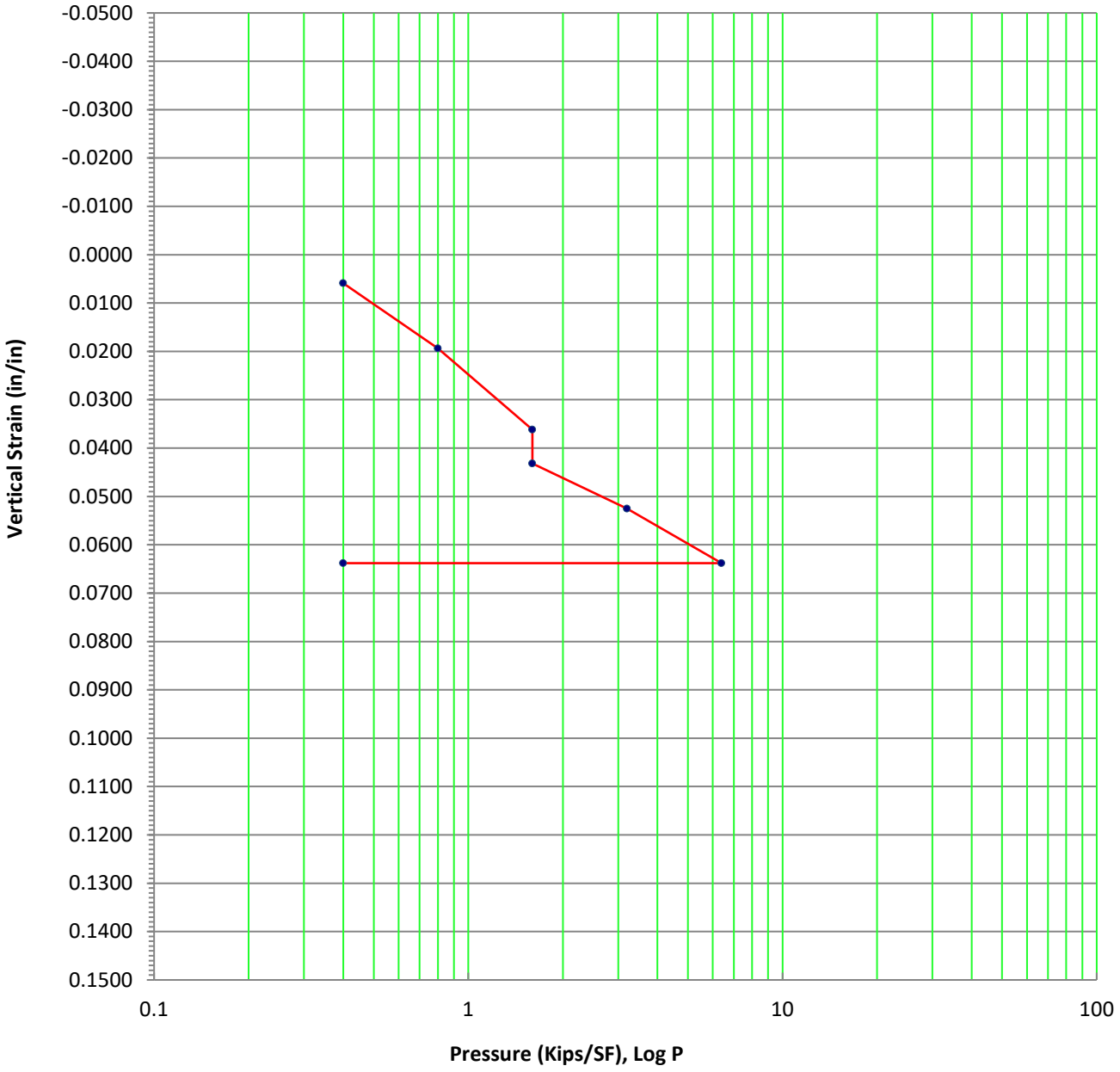
Consolidation Test

Duke

Victorville, CA

BRUIN
GEOTECHNICAL SERVICES INC.
est. 2004

7/16/2021	21-493



Sample location:	B3@8'	
Material:	SM	
Initial Dry Density:	109.2	PCF
Moisture Content:	3.1	%
% Hydroconsolidation:	0.7	%

* Test Method: ASTM D-2435

Consolidation Test

Duke

Victorville, CA

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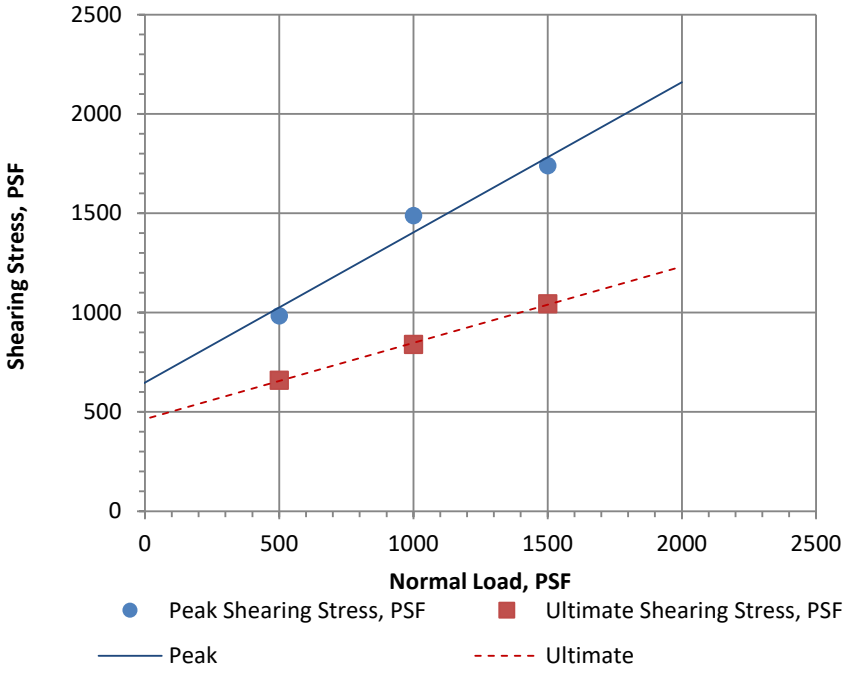
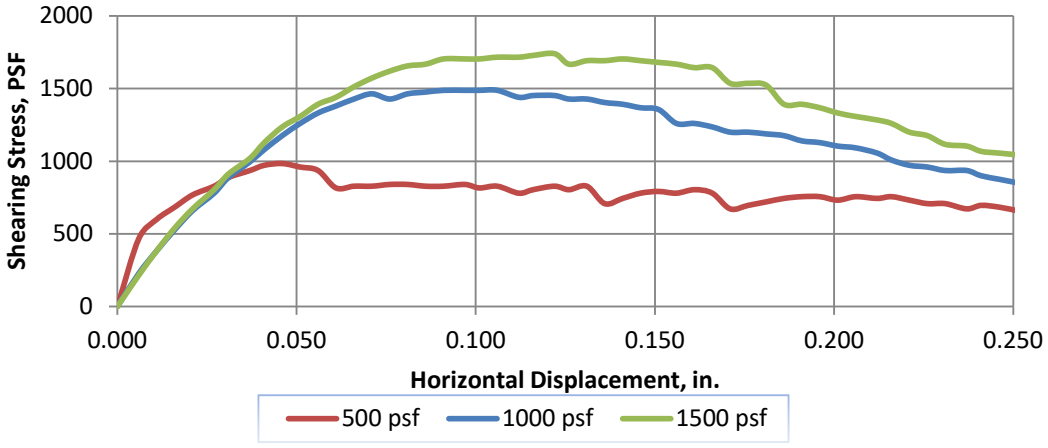
est. 2004

7/16/2021	21-493





Soil Classifcation: ML

Soil Description: Yellowish brown silty very fine to medium sand occ coarse sand to # 4 gravel

SHEAR DATA

Sample ID	Symbol	Depth, feet	Dry Density, PCF *	Average deg. of saturation %
B5 Bulk	●	0-5'	114	94

* Sample remolded to 90% relative compaction as determined by ASTM D-1557 Test Method

	Peak	Ultimate
Angle of friction, (degrees)	37	21
Cohesive Strength (PSF)	648	464

Direct Shear Test

Duke Engineering

Victorville, CA

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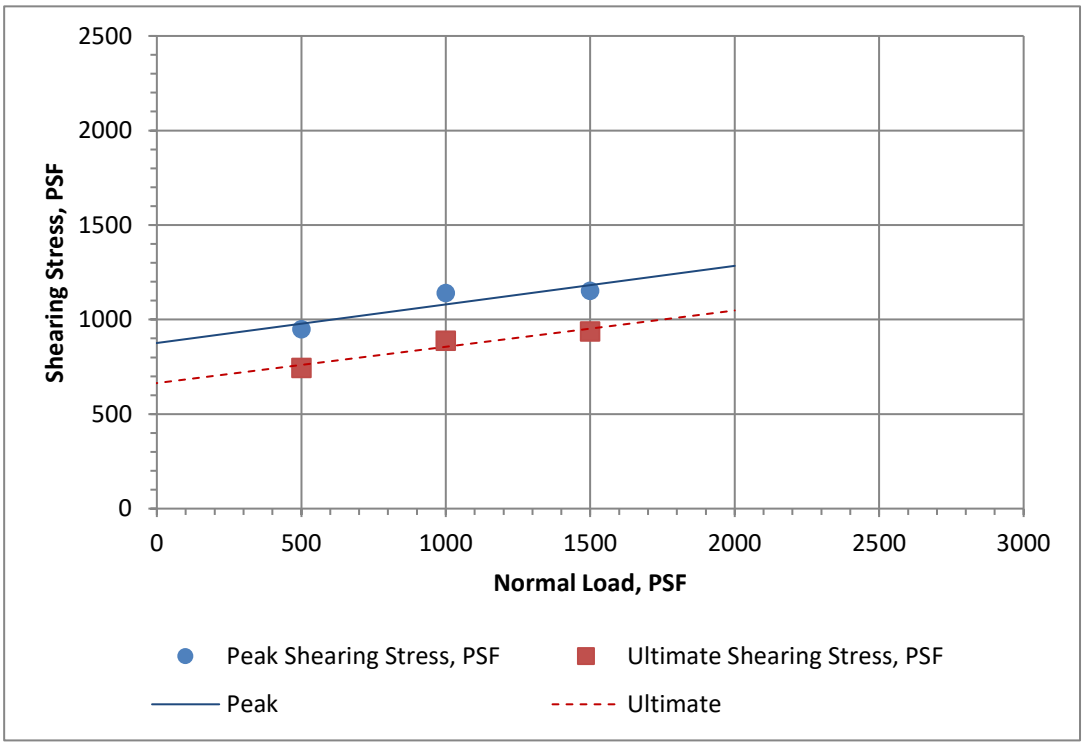
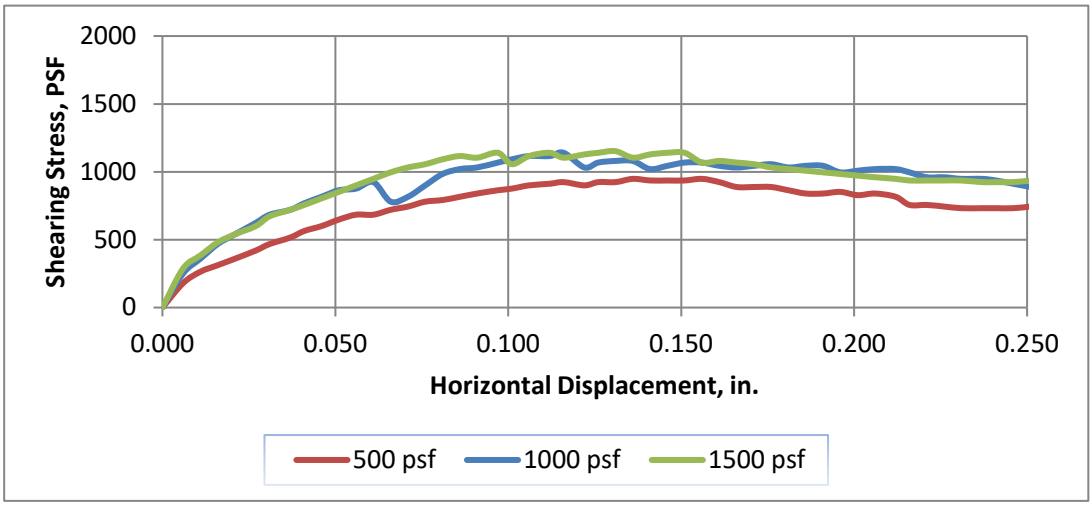
7/16/2021 | **21-493**





Sample Description: Yellowish brown silty very fine to medium sand occ coarse sand - # 4 gravel

DIRECT SHEAR DATA (Per ASTM D-3080)

Sample ID	Symbol	Depth, feet	Dry Density, PCF	Average deg. of saturation
B5 Bulk	●	6'	103	87

	Peak	Ultimate
Angle of friction, (degrees)	12	11
Cohesive Strength (PSF)	876	664

Direct Shear Test

Duke Engineering

Victorville, CA

BRUIN GEOTECHNICAL SERVICES INC. est. 2004

7/18/2021	21-493

ANAHEIM TEST LAB, INC

196 Technology Drive, Unit D
Irvine, CA 92618
Phone (949)336-6544

Bruin Geotechnical Services, Inc.
44732 Yucca Avenue
Lancaster, CA 93534

DATE: 07/16/2021

P.O. NO.: TRANSMITTAL

LAB NO.: C-5022

SPECIFICATION: CTM-643/417/422

MATERIAL: Soil

Project No: 21-493
Job Name: Duke Engineering
Site Address: APN 3090-431-07
Site City & State: Victorville, CA
Boring ID: B1Bulk @ 0-5'

ANALYTICAL REPORT

CORROSION SERIES
SUMMARY OF DATA

pH	MIN. RESISTIVITY per CT. 643 ohm-cm	SOLUBLE SULFATES per CT. 417 (% by weight)	SOLUBLE CHLORIDES per CT. 422 ppm
7.4	1,700	0.0741%	90

RESPECTFULLY SUBMITTED

WES BRIDGER, LAB MANAGER

APPENDIX C

Seismic Design Summary Report

21-493

Ottawa St & Enterprise Way, Victorville, CA 92395, USA

Latitude, Longitude: 34.4927977, -117.2891636

Date	7/21/2021, 11:16:28 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.193	MCE_R ground motion. (for 0.2 second period)
S_1	0.46	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.22	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	0.814	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1.023	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.5	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.55	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
SsRT	1.193	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.275	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.46	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.5	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.936	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.919	Mapped value of the risk coefficient at a period of 1 s

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APPENDIX D

General Earthwork and Grading Guidelines

Earthwork and Grading Specifications for Rough Grading

1.0 General

1.1 **Intent:** These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 **The Geotechnical Consultant of Record:** Prior to commencement of work, the owner shall employ a qualified Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observations, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to confirm that the attained level of compaction is being accomplished as specified. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 **The Earthwork Contractor:** The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the project plans and specifications. The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "equipment" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of

grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate personnel will be available for observation and testing. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultants, unsatisfactory conditions, such as unsuitable soil, improper moisture-condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in the specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified. It is the contractor's sole responsibility to provide proper fill compaction.

2.0 Preparation of Areas to be Filled

2.1 **Clearing and Grubbing:** Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 10 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminant dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed. The contractor is responsible for all hazardous waste relating to his work. The Geotechnical Consultant does not have expertise in this area. If hazardous waste is a concern, then the Client should acquire the services of a qualified environmental assessor.

2.2 **Processing:** Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free from oversize material and the working surface is reasonably uniform, flat, and free from uneven features that would inhibit uniform compaction.

2.3 **Overexcavation:** In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading pan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 **Benching:** Where fills are to be places on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter that 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 **Evaluation/Acceptance of Fill Areas:** All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observes, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 **General:** Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 **Oversize:** Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 **Import:** If importing of fill material is required for grading, proposed import material shall meet the requirements of the geotechnical report(s). The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so the suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 **Fill Layers:** Approved fill material shall be placed in areas prepared to receive fill in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates that grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 **Fill Moisture Conditioning:** Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain relatively uniform moisture content within 2% of optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557-91).

4.3 **Compaction of Fill:** After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557-91). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 **Compaction of Fill Slopes:** In addition to normal compaction procedures specified above, compaction of slopes, shall be accomplished by backrolling of slopes with sheepfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557-91.

4.5 **Compaction Testing:** Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 **Frequency of Compaction Testing:** Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 **Compaction Test Locations:** The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less then 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical repot(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land survey/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well we over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 The Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

7.2 All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding Material shall have a Sand Equivalent greater then 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of maximum from 1 foot above the top of the conduit to the surface.

7.3 The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

7.4 The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

7.5 Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.