PRELIMINARY
WATER QUALITY MANAGEMENT PLAN
(WQMP)

For:

901 E. Katella Avenue
Orange, CA 92867

Prepared for:
Intracorp SW, LLC
895 Dove Street, Suite 400
Newport Beach, CA 92660
(949) 955-2370

Prepared by:
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August 2022

_____ _____
Public Works Director **Date**

_____ _____
City Engineer **Date**

OWNER'S CERTIFICATION

WATER QUALITY MANAGEMENT PLAN

FOR

901 E. Katella Avenue

This Water Quality Management Plan (WQMP) for the **901 E. Katella Avenue** project has been prepared for **Intracorp SW, LLC**. This WQMP is intended to comply with the requirements of the City of Orange's **Site Development Permit No. MNSP 1097-22** requiring preparation of a Water Quality Management Plan.

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 City of Orange Local Implementation Plan (LIP), and the intent of NPDES Permit and Waste Discharge Requirements for the City of Orange, County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region.

This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party having responsibility for implementing portions of this WQMP. Maintenance requirements within Section V and Appendix D will be adhered to with particular emphasis on maintaining the BMPs described within Sections IV and V. The Owner's Annual Self Certification Statement along with a BMP maintenance implementation table will be submitted by June 30th every year following project completion. At least one copy of the approved WQMP shall be available on the subject property in perpetuity.

Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. The City of Orange will be notified of the change of ownership and the new owner will submit a new certification.

Signature: _____ Date: _____

Name: _____

Title: _____

Company: _____

Address: _____

Telephone Number: _____

Notice of Transfer of Responsibility

Water Quality Management Plan (WQMP)

WQMP Number – As assigned by the City of Orange:_____

Submission of this Notice of Transfer of Responsibility constitutes notice to the City that responsibility for the Water Quality Management Plan (WQMP) for the subject property identified below, and implementation of that plan, is being transferred from the Previous Owner (and his/her agent) of the site (or portion thereof) to the New Owner, as further described below.

I. Previous Owner/ Responsible Party Information

Company/ Individual:_____ Contact Person:_____

Street Address:_____ Title:_____

City _____State____ Zip_____ Phone:_____

II. Information about Site Relevant to WQMP

Name of Project: _____
Title of WQMP applicable to site: _____
Street Address of the site: _____
Date of Transfer of Responsibility: _____

III. New Owner/ Responsible Party Information

Company/ Individual: Intracorp SW, LLC Contact Person: Emilie Simard

Street Address: 895 Dove Street, Suite 400 Title: Project Manager

City Newport Beach State CA Zip 92660 Phone: 949-955-2370

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I. Discretionary Permit Number(s), Water Quality Condition Number(s) and Conditions of Approval

Tract No **19253** Lot No.**1**

Site Development Permit No. MNSP 1097-22

GPS Coordinates: 33.80953, -117.84392

Water Quality Conditions (WQMP conditions listed below)
A complete copy of the signed Conditions of Approval, Resolution Number _____ dated _____ are included as Appendix A

Conditions of Approval:
Project Conditions of Approval and Water Quality Conditions have not been provided at this time. If and when project conditions are issued, any conditions pertaining to Water Quality will listed verbatim.

II. Project Description

Planning Area: 901 E Katella Ave, Orange, CA 92867

Project Size (ac): 2.71 gross acres; 2.69 net acres

A 3' R/W dedication is required along Cambridge Street to support the development, therefore the post-project calculations will reflect this within the report.

Percent Change in Impermeable Surfaces: The proposed project will increase the total amount of impervious area. The current site has approximately 77% impervious. The proposed project will have approximately 87% impervious.

SIC Code
Not Applicable

Project Description
The property consists of 2.69 acres located at 901 E. Katella Avenue in the City of Orange. The project proposes to construct 52 residential units including 50 duplex residential condominium units and 2 single family detached condominium units. There will be a 3' wide dedication to the city along the entire frontage of the property on Cambridge Street. This accounts for the difference between pre-developed site area and post developed site area. The development proposes open space areas, parking areas, walkways, and driveways. Each residential unit will have a garage parking space and additional uncovered parking. *The site has two entrance/exits, one (1) on Cambridge Street and one (1) on Katella Avenue.*

Potential Storm Water Pollutants

The proposed residential project is expected to produce: Suspended Solids, Nutrients, Pathogens, Pesticides, Oil and Grease, and Trash and Debris.

Hydrologic Conditions of Concern

Per the TGD Figure 3, Susceptibility Analysis of Santa Ana River dated February 2013, the project site drains to engineered facilities, therefore HCOCs do not exist. Refer to Section IV.8 for a the TGD Figure.

Post Development Drainage Characteristics

The proposed development has been designed utilizing two (2) Drainage Management Areas (DMA) based on the Final Grading and Drainage design. Runoff will be collected by v-gutters throughout the site and an onsite area drain system and be routed to the proposed Biofiltration Vault treatment device prior to discharge to the public right-of-way via a stormwater sump pump system. Treated runoff and overflow will be conveyed through a proposed parkway drain to the public right-of-way of Cambridge Street.
.

Commercial Projects

Not Applicable

Residential Projects

The project proposes 52 residential units over approximately 2.69 acres. There are two (2) driveways on Cambridge Street and Katella Avenue that provide access to the site. The site will include 3-story duplexes and 2 & 3 Story Stacked flats. This project includes a pocket park with a tot lot near the primary entrance on Cambridge Avenue. A 6' community wall is proposed along the east property line. Parking will be provided as 104 garage spaces and 13 uncovered spaces. Common open space areas are limited to landscaping and walkways.

Site Ownership and any Easements

Intracorp SW, LLC, (Owner/ Developer) will appoint a Homeowner's Association (HOA) or Property Management Company (PMC) to manage the operation and maintenance of the property.

Intracorp SW, LLC
895 Dove Street, Suite 400
Newport Beach, CA 92660
(949) 955-2370

III. Site Description

Reference Location Map: Refer to Vicinity Map on Site Plan within Appendix C.

Site Address: 901 E. Katella Avenue, Orange, CA 92867

Zoning: Commercial Professional (C-P)

Predominant Soil type: D

Pre-project percent pervious: 23% **Post-project percent pervious:** 13%

Pre-project percent impervious: 77% **Post-project percent impervious:** 87%

Site Characteristics

The existing site at 2.71 acres is currently occupied by an abandoned office building in the southwest quadrant, a parking lot in the remaining three quadrants, and landscape area surrounding the site. There is an existing block wall surrounding the parking lot on all sides, except along the border with the building. The existing site is served by two (2) existing driveway approaches: one (1) on N. Cambridge Street and one (1) on E. Katella Avenue. There is a wrought iron vehicular gate at each driveway entry. There are two (2) concrete walkways that connect the building to the public sidewalk on E. Katella Avenue. The Precipitation Zone for this area equals 0.85" Per Rainfall Zone per Figure XVI-1 per the Orange County Technical Guidance. The site primarily flows in the north and westerly direction toward Cambridge Street. Existing stormwater runoff flows in the westerly direction before entering the public right-of-way of N. Cambridge Street through an existing v-gutter at the driveway, then continues in the northly direction within the gutter of the public street. Per the OCFCD Drainage Maps, surface runoff from the site continues in the northerly direction to N. Cambridge Street then is conveyed in the catch basin directly north of the intersection with Trenton Avenue. Stormwater then enters the existing underground storm drain system and continues to the OCFCD El Modena Storm Channel, converging with the Collins Storm Channel, Santa Ana River, and ultimately discharging to the Pacific Ocean.

Watershed Characteristics

Watershed: Lower Santa Ana River

Downstream Receiving Waters: El Modena Channel, Collins Channel, Santa Ana River, Pacific Ocean

Water Quality Impairments (if applicable): Bacteria

Identify Hydromodification Susceptibility: Project site not susceptible to hydromodication concerns since all downstream waterbodies are stabilized. Refer to the Section IV.8 of this report for a copy of the TGD Appendix XVI, Figure 3 Susceptibility Analysis Map for the Santa Ana River dated February 2013.

Identify Watershed Management Priorities: Not applicable

IV. Best Management Practices

Street/ parking lot surface runoff will be collected and conveyed via a concrete longitudinal v-gutter to a proposed Modular Wetlands System (MWS), Biofiltration vault for water quality treatment. An onsite area drain system will connect directly to the MWS Biofiltration system for treatment of landscaped areas. Treated runoff will discharge through a proposed parkway drain via stormwater sump pump system. Overflow will be conveyed through the Biofiltration system to the proposed parkway drain to the public right-of-way of Cambridge Street.
The Modular Wetland System (MWS) Biofiltration vaults are designed to provide a 3-phase treatment train. Initially, when the stormwater enters the system, a trash rack, filter media and settling chamber will capture large trash/ debris and sediment in the stormwater before entering the planting media. This system is designed to treat stormwater flow horizontally. Before the stormwater enters the planting or "wetland" chamber, the runoff flows through the 2nd phase, a pre-filter cartridge which captures fines TSS, metals, nutrients and bacteria. The pre-filter chamber eliminates additional maintenance of the planting area. The wetland chamber is the 3rd phase of the system which provides final treatment through a combination of physical, chemical and biological processes.

IV.1 Site Design and Drainage Characteristics

Table 1
Site Design BMPs

Technique	Included?		If no, state justification.
	Yes	No	
Minimize Directly Connected Impervious Areas (DCIAs) (C-Factor Reduction)	X		The proposed site has been designed at minimum widths in accordance to fire and planning departments.
Create Reduced or "Zero Discharge" Areas (Runoff Volume Reduction)[1]	X		
Minimize Impervious Area/Maximize Permeability (C-Factor Reduction)[2]	X		The site has been designed to allow for the maximum pervious coverage possible in order to maximize natural permeability.
Conserve Natural Areas (C-Factor Reduction)		X	No existing area to conserve.

1 Detention and retention areas incorporated into landscape design provide areas for retaining and detaining stormwater flows, resulting in lower runoff rates and reductions in volume due to limited infiltration and evaporation. Such Site Design BMPs may reduce the size of Treatment Control BMPs.

2 The "C Factor" is a representation of the ability of a surface to produce runoff. Surfaces that produce higher volumes of runoff are represented by higher C Factors. By incorporating more pervious, lower C Factor surfaces into a development, lower volumes of runoff will be produced. Lower volumes and rates of runoff translate directly to lowering treatment requirements.

The proposed project is designed to capture the required storm water runoff volume utilizing a Modular Wetlands System (MWS), Bioinfiltration vault.

IV.2 Source Control BMPs

IV.2.1 Routine Non-Structural BMPs

Table 2
Routine Non-Structural BMPs

BMP No.	Name	Check One		If not applicable, state brief reason.
		Included	Not Applicable	
N1	Education for Property Owners, Tenants and Occupants	X		
N2	Activity Restriction	X		
N3	Common Area Landscape Management	X		
N4	BMP Maintenance	X		
N5	Title 22 CCR Compliance		X	
N6	Local Water Quality Permit Compliance		X	This BMP is not applicable. The City of Orange does not issue water quality permits.
N7	Spill Contingency Plan	X		
N8	Underground Storage Tank Compliance		X	Not Applicable
N9	Hazardous Materials Disclosure Compliance		X	Not Applicable
N10	Uniform Fire Code Implementation	X		
N11	Common Area Litter Control	X		
N12	Employee Training	X		
N13	Housekeeping of Loading Docks		X	Not Applicable
N14	Common Area Catch Basin Inspection	X		
N15	Street Sweeping Private Streets and Parking Lots	X		

Non-Structural Measures

Non-structural BMPs are generally managerial, educational, inspection and/ or maintenance oriented. These items consist of educating employees and occupants, developing and implementing Owner guidelines, implementing BMPs and enforcing Code requirements. Non-structural BMPs used for this project are summarized below:

N1. Education for Employees and Occupants

Practical informational materials will be provided to owners, occupants and employees on general good housekeeping practices that contribute to protection of storm water quality. Among other things, these materials will describe the use of chemicals (including household type) that should be limited to the property, with no discharge of specified wastes via hosing or other direct discharge to gutters, catch basins and storm drains. The property owner will provide these materials. Thereafter, such materials will

be available through the property owner education program. This program must be maintained, enforced, and updated periodically by the property owner. Educational materials including, but not limited to, the materials included in the Appendix B section of this plan will be made available to the employees and contractors of the property owner.

N2. Activity Restrictions

CC&R's will be recorded for the subject site and will implement all restrictions as conditions. These will also cover any restrictions as denoted in the final set of conditions of approve as provided by the subject site. Restrictions shall include, but not limited to car washing, washing of any hard pavement such as sidewalks, parking lots, streets, mandatory pet waste management, etc.

N3. Common Area Landscape Management

Management programs will be designed and established by the property owner, who will maintain the common areas within the project site. These programs will include how to mitigate the potential dangers of fertilizer and pesticide usage (refer to the Maintenance and Frequency Table – See project Operations and Maintenance Plan).

Ongoing maintenance will be consistent with the City of Orange Model Water-Efficient Landscape Ordinance.

Fertilizer and pesticide usage shall be consistent with City of Orange Guidelines for use of Fertilizers and Pesticides.

N4. BMP Maintenance

The Homeowner Association through use of their management contractors will be responsible for maintenance each of the BMPs detailed in this plan. Maintenance operations should be logged in Appendix D.

N7. Spill Contingency Plan

The HOA shall implement a spill contingency plan and provide this to all employees at the time of hire. This plan shall identify all potential hazardous materials and a plan of action to safety clean and remove as well as protect all stormwater inlets.

N10: Uniform Fire Code Implementation

HOA is responsible for compliance with Article 80 of the Uniform Fire Code enforced by the local fire protection agency.

N11. Common Area Litter Control

The property owners through the HOA and the contracted maintenance company will perform required common area litter control to remove any accumulated trash, debris and other litter.

N12. Employee Training

A training program will be established as it would apply to future employees,

contractors, and leasers of the property owner to inform and train in maintenance activities regarding the impact of dumping oil, paints, solvents, or other potentially harmful chemicals into storm drains; the proper use of fertilizers and pesticides in landscaping maintenance practices; and the impacts of littering and improper water disposal. Training will be done annually and with any new employees.

N14. Catch Basin Inspection

The HOA will maintain the drainage systems, including catch basins and detention systems. The HOA is required to have catch basins inspected and, if necessary, cleaned prior to the storm season, no later than October 1st each year. These duties may be contracted out to the landscape maintenance firm hired by the property owner. Please see Appendix D for maintenance program. Maintenance operations should be logged in Appendix.

N15. Street Sweeping Private Streets and Parking Lots

The HOA shall clean the surface of pavement surfaces by mechanized methods at least one time per week.

IV.2.2 Routine Structural BMPs

Table 3
Routine Structural BMPs

Name	Check One		If not applicable, state brief reason
	Included	Not Applicable	
Provide storm drain system stenciling and signage- "No Dumping – Drains to Ocean"	X		
Design and construct outdoor material storage areas to reduce pollution introduction		X	No outside storage
Design and construct trash and waste storage areas to reduce pollution introduction		X	No trash enclosures proposed
Use efficient irrigation systems & landscape design	X		
Protect slopes and channels and provide energy dissipation		X	No proposed slopes
Incorporate requirements applicable to individual project features			
a. Dock areas		X	No proposed dock areas
b. Maintenance bays		X	No proposed maintenance bays
c. Vehicle or community wash areas		X	No proposed vehicle wash areas
d. Outdoor processing areas		X	No proposed outdoor processing areas
e. Equipment wash areas		X	No proposed equipment wash areas
f. Fueling areas		X	No proposed fuel areas
g. Hillside landscaping		X	Project Site not located within hillside area
h. Wash water control for food preparation areas		X	No proposed food preparation areas

Structural BMPs

Structural BMPs shall be installed by the developer/ owner, through the construction and development of the project, for instance; slope planting and irrigation systems shall be designed by licensed landscape architects and installed by qualified contractors to specifications and standards of the City of Orange. The structural BMPs used for this project are summarized below:

Efficient Irrigation

As part of the design of all common area landscape irrigation shall employ water conservation principals, including, but not limited to, such provisions as water sensors, programmable irrigation times (for short cycles), etc., will be used. Such common areas will be maintained by the HOA.

Runoff-Minimizing Landscape Design

As part of the design of all common area landscape areas, similar planting material with similar water requirements will be used in order to reduce excess irrigation runoff and

promote surface filtration. Such common areas will be maintained by the property owner/HOA.

Catch Basin Stenciling

Phrase "No Dumping – Drains to Ocean" to be stenciled on catch basins to alert the public to the destination of pollutants discharged into storm water. This stenciling will be inspected and re-stenciled on a periodic basis by the HOA. Please see Table (8) for maintenance frequency.

IV.3 Low Impact Development BMP Selection

Refer to Section 2.4.2.3 and 4.1 in the TGD for selecting LID BMPs.

IV.3.1 Hydrologic Source Controls

Select from the following table all hydrologic source control BMPs that are used by the project and identify in Site Plan. See Section 4.2 of Technical Guidance Document for additional information.

Table 4

Hydrologic Source Control BMPs

Name	Check If Used
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☐
Street trees (canopy interception)	☐
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐

** HSC BMPs are not required since the site has been exempted based on HCOC map. Refer to Section IV.8 of this report for additional information.*

IV.3.2 Infiltration BMPs

Table 5

Infiltration BMPs

Name	Check If Used
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Drywells	☐
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐
Other:	☐

Infiltration BMPs will not be utilized and have been determined to be infeasible for this site due to potential geotechnical hazards. Biotreatment BMPs will be utilized to provide the required treatment flow rates.

Refer to Table 2.7 Infiltration BMP Feasibility Worksheet located within Section IV.8 for additional information.

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

Identify any evapotranspiration and/or, rainwater harvesting BMPs used by the project See Section 4.4 and 4.4 of the Technical Guidance Document for additional information.

Table 6

Evapotranspiration, Rainwater Harvesting BMP

Name	Check If Used
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☐
Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐
Other:	☐
Other:	☐

Not Applicable. Biotreatment BMPs will be utilized to provide the required treatment flow rates.

IV.3.4 Biotreatment BMPs

Table 7
Biotreatment BMPs

Bioretention with underdrains	☐
Storm water planter boxes with underdrains	☐
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated swales	☐
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems	☒
Wet extended detention basin	☐
Dry extended detention basins	☐
Other:	☐
Other:	☐

A Modular Wetland System (MWS) Biofiltration vault will be utilized to capture and treat the stormwater runoff before leaving the site. The MWS Biofiltration system utilizes a 3-phase treatment train by collecting the stormwater runoff in a Pre-Treatment Chamber, Planting or "Wetland" Chamber and Discharge Chamber. Treated storm water runoff will be pumped and discharged into a proposed parkway drain on Cambridge Street.

The MWS Biofiltration curb inlet system was sized based on the treatment flow rate method per the Orange County Technical Guidance Document worksheets. Refer to Worksheet D in Section IV.8 for calculations.

DMA	Area (ac)	Required Treatment, Q (cfs)	MWS Model	Treatment Capacity, Q (cfs)
1	1.64	0.343	MWS-L-8-12-V	0.346
2	1.05	0.216	MWS-L-8-8-V	0.231

Treated storm water runoff discharging from the MWS Biofiltration vault will enter a proposed stormwater sump pump system designed to meet the treatment flow rate. Pump sizing and details will be provided prior to final approval.

IV.3.5 Hydromodification Control BMPs

Not Applicable

IV.3.6 Regional/Sub-Regional LID BMPs

Not Applicable

IV.3.7 Treatment Control BMPs

Not Applicable

IV. 4 Water Quality Credits

Not Applicable

IV.5 Alternative Compliance Plan

Not Applicable

IV.6 Vector Control

Not Applicable

IV.7 Drainage Management Area (DMA)

DMA Number	*BMPs*	*Area Treated*
1	*BIO-7: Proprietary Bioinfiltration*	*1.64 acres*
2	*BIO-7: Proprietary Bioinfiltration*	*1.05 acres*
Total Area		*2.69 acres*

Total Project Area= 2.69 acres (117, 220 sf)
(Note if all project design storm volume is captured by these BMPs).

IV.8 Calculations

Provide calculations for all LID, Structural and Treatment BMPs selected. All calculations must be signed by a registered civil engineer. Individual or worksheets provided in Technical Guidance Document (if applicable) may be used.

DMA 1

$d_{remainder}$= 0.85 remainder of the design capture storm depth
A=1.64 acres (area tributary to BMP)
imp=0.87 (project imperviousness)
C=0.806 (runoff coefficient, ((0.75 x imp) + 0.15))
V_{design} = (C x $d_{remainder}$ x A x 43560 x (1/12))
= 0.806 x 0.85 x 1.64 x 43560 x (1/12) = **4,076 *cf***
Q_{design}= (C x idesign x A) = .806 x .26 x 1.64 = ***.343 cfs***

DMA 2

$d_{remainder}$= 0.85 remainder of the design capture storm depth
A=1.05 acres (area tributary to BMP)
imp=0.85 (project imperviousness)
C=0.789 (runoff coefficient, ((0.75 x imp) + 0.15))
V_{design} = (C x $d_{remainder}$ x A x 43560 x (1/12))
= 0.789 x 0.85 x 1.05 x 43560 x (1/12) = **2,561 *cf***
Q_{design}= (C x idesign x A) = .789 x .26 x 1.05 = ***.216 cfs***

Refer to Worksheet B and D in this section.

Table 2.7: Infiltration BMP Feasibility Worksheet

	Infeasibility Criteria	*Yes*	*No*
1	**Would Infiltration BMPs pose significant risk for groundwater related concerns?** Refer to Appendix VII (Worksheet I) for guidance on groundwater-related infiltration feasibility criteria.		X
Provide basis: Refer to Attachment D of this report for a copy of the Geotechnical report. Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
2	Would Infiltration BMPs **pose significant risk of increasing risk of geotechnical hazards that cannot be mitigated to an acceptable level**? (Yes if the answer to any of the following questions is yes, as established by a geotechnical expert): • The BMP can only be located less than 50 feet away from slopes steeper than 15 percent • The BMP can only be located less than eight feet from building foundations or an alternative setback. • A study prepared by a geotechnical professional or an available watershed study substantiates that stormwater infiltration would potentially result in significantly increased risks of geotechnical hazards that cannot be mitigated to an acceptable level.	X	
Provide basis: The project site is considered a Soil Type D per the NCRS Hydraulic Soils Group Figure XVI-2a and the Updated Geotechnical and Infiltration Evaluation by Geotek dated June 3, 2022. Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
3	Would infiltration of the DCV from drainage area **violate downstream water rights**?		X
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

	Partial Infeasibility Criteria	*Yes*	*No*
4	Is proposed infiltration facility **located on HSG D soils** or the site geotechnical investigation identifies presence of soil characteristics which support categorization as D soils?	X	

Provide basis:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.

5	Is **measured infiltration rate below proposed facility less than 0.3 inches per hour**? This calculation shall be based on the methods described in Appendix VII.	X	

Provide basis:
From Updated Geotechnical and Infiltration Evaluation by Geotek dated June 3, 2022:

SUMMARY OF RESULTS		
Boring	Observed Infiltration Rate, $K_{observed}$ (inches per hour)	Measured Infiltration Rate, $K_{measured}$ (inches per hour)
I-1	4.2	2.1
I-2	0.04	0.02

"As shown on the table above, poor to favorable infiltration rates (nil to 2 inches per hour) were encountered at the site. Salem (2019) reported relatively similar findings with variable rates ranging from nil to 0.23 inches per hour."

Boring I-1 is located upstream, therefore, it is not a feasible testing location. Boring I-2 and P-2 (from Salem 2019) resulted in low infiltration rates less than 0.3 inches per hour.

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.

6	Would **reduction of over predeveloped conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?**		X

Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible:

Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

7	Would **an increase in infiltration over predeveloped conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?**		X
Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Infiltration Screening Results (check box corresponding to result):			
8	Is there substantial evidence that infiltration from the project would result in a significant increase in I&I to the sanitary sewer that cannot be sufficiently mitigated? (See Appendix XVII) Provide narrative discussion and supporting evidence: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.	No	
9	If any answer from row 1-3 is yes: infiltration of any volume is **not feasible** within the DMA or equivalent. Provide basis: Summarize findings of infeasibility screening	Yes	
10	If any answer from row 4-7 is yes, infiltration is **permissible but is not presumed to be feasible for the entire DCV.** Criteria for designing biotreatment BMPs to achieve the maximum feasible infiltration and ET shall apply. Provide basis: Summarize findings of infeasibility screening	Yes	
11	If all answers to rows 1 through 11 are no, infiltration of the full DCV is potentially feasible, BMPs must be designed to infiltrate the full DCV to the maximum extent practicable.	Not feasible	

Worksheet B: Simple Design Capture Volume Sizing Method **DMA 1**

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	1.64	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.87	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.806	
4	Calculate runoff volume, V_{design}= *(C x* $d_{remainder}$ *x A x 43560 x (1/12))*	V_{design}=	4,076	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate N/A				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=		In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=		
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=		In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=		Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=		feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=		sq-ft

Worksheet B: Simple Design Capture Volume Sizing Method **DMA 2**

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	1.05	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.789	
4	Calculate runoff volume, V_{design}= *(C x* $d_{remainder}$ *x A x 43560 x (1/12))*	V_{design}=	2,561	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate N/A				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=		In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=		
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=		In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=		Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=		feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=		sq-ft

Worksheet D: Capture Efficiency Method for Flow-Based BMPs **DMA 1**

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1-I_2$	I_{design}=	0.26	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	1.64	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.87	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.806	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.343	cfs

Supporting Calculations

Describe system:
Stormwater runoff will be collected by an area drain system and by two (2) Modular Wetlands System (MWS) Biofiltration vaults for treatment and discharge via a stormwater sump pump system and parkway drain to the public right-of-way of Cambridge Street.

Provide time of concentration assumptions:

The Time of Concentration was assumed to be 5 minutes for conservative purposes.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs **DMA 2**

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1-I_2$	I_{design}=	0.26	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	1.05	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.85	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.789	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.216	cfs

Supporting Calculations

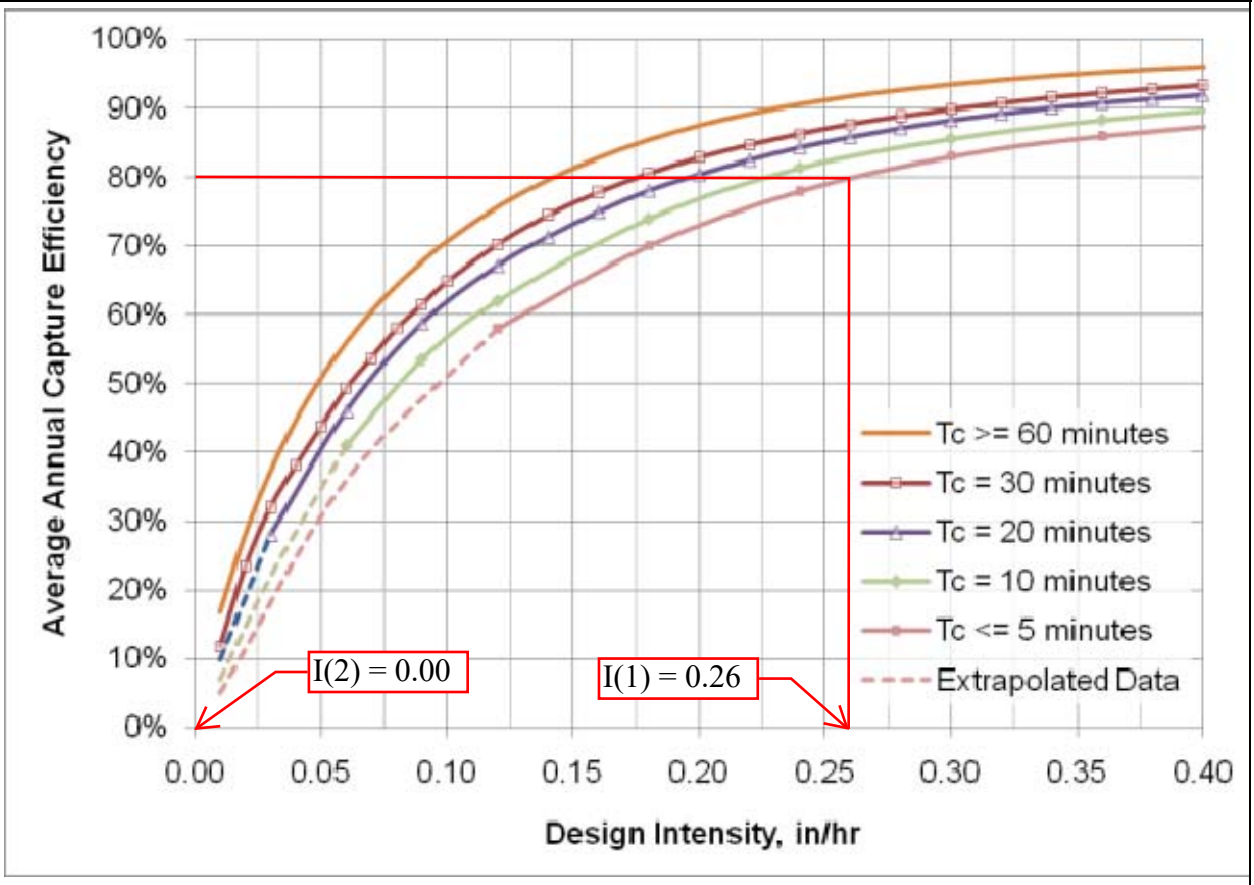
Describe system:
Stormwater runoff will be collected by an area drain system and by two (2) Modular Wetlands System (MWS) Biofiltration vaults for treatment and discharge via a stormwater sump pump system and parkway drain to the public right-of-way of Cambridge Street.

Provide time of concentration assumptions:

The Time of Concentration was assumed to be 5 minutes for conservative purposes.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Provide supporting graphical operations. See Example III.7.

Susceptibility

Potential Areas of Erosion, Habitat, & Physical Structure Susceptibility

Channel Type

Earth (Unstable)
Earth (Stabilized)
Stabilized

Tidel Influence

<= Mean High Water Line (4.28')

Water Body

Basin
Dam
Lake
Reservoir

Forest Areas

Cleveland National Forest

Federal Lands

Amarus Salt Marsh

San Gabriel-Coyote Creek Watershed

San Bernardino County

Riverside County

South Orange County

Newport Bay Watershed

AnaheimBay-HuntingtonHarbor Watershed

Carbon Canyon

Yorba Linda Reservoir

Miller Retarding Basin

Anaheim Lake

Warner Basin

Kraemer Basin

Olive Hills

Fletcher Retarding Basin

Walnut Canyon Reservoir

Villa Park Dam

Peters Canyon Reservoir

Irvine Lake

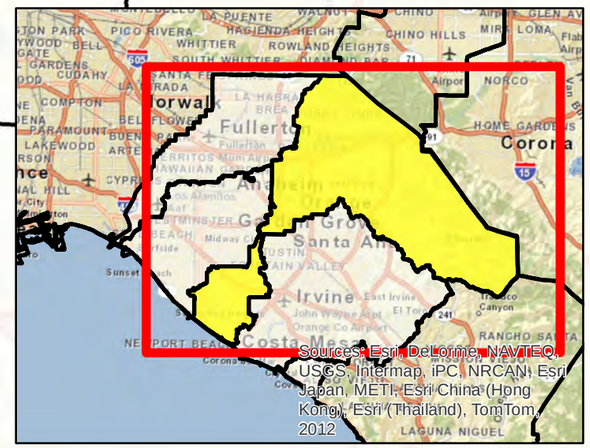
Project Site

Stabilized by Grade Control Structure

SOUTHPARK PUMP STATION

Bartlett Retarding Basin

Cleveland National Forest



0 12,000 24,000 Feet

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

TITLE: SUSCEPTIBILITY ANALYIS SANTA ANA RIVER

JOB: ORANGE COUNTY WATERSHED MASTER PLANNING ORANGE CO. CA

SCALE	1" = 12000'
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/30/10
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE 3

P:\9526E\16-GIS\Mxds\SuceptiabilityMaps_20100505\9526E_SantaAnaRiverSuscepitibility_20100430.mxd

SUBJECT TO FURTHER REVISION

LEGEND

- Orange County Precipitation Stations
- 24 Hour, 85th Percentile Rainfall (Inches)
- 24 Hour, 85th Percentile Rainfall (Inches) - Extrapolated
- City Boundaries

Rainfall Zones

Design Capture Storm Depth (inches)

- 0.65"
- 0.7
- 0.75
- 0.80
- 0.85
- 0.90
- 0.95
- 1.00
- 1.10"

Note: Events defined as 24-hour periods (calendar days) with greater than 0.1 inches of rainfall.
For areas outside of available data coverage, professional judgment shall be applied.

0.65 0.7 0.75 0.8 0.85 0.9 0.95 1 1.05

PROJECT SITE

LOS ANGELES COUNTY
ORANGE COUNTY
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY

0 3 6 12 Kilometers
0 1.8 3.6 7.2 Miles

San Pedro Channel
Pacific Ocean

TITLE: RAINFALL ZONES

JOB: ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT — ORANGE CO. CA

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE XVI-1

P:\9526E\16-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-1_RainfallZones_20110215.mxd

SUBJECT TO FURTHER REVISION

LEGEND

City Boundaries

OCWD Groundwater Basin Protection Boundary

Depth To Groundwater

<= 5'

5-10'

Note: Data are not available for South Orange County at this time.

Source:
Sprotte, Fuller and Greenwood, 1980.
California Division of Mines and Geology;
California Geological Survey

LOS ANGELES COUNTY
ORANGE COUNTY

SAN BERNARDINO COUNTY
ORANGE COUNTY

RIVERSIDE COUNTY
ORANGE COUNTY

Project site

0 2 4 8 Kilometers

0 1.25 2.5 5 Miles

TITLE
NORTH ORANGE COUNTY
MAPPED SHALLOW GROUNDWATER

ORANGE COUNTY
INFILTRATION STUDY

JOB ORANGE CO. CA

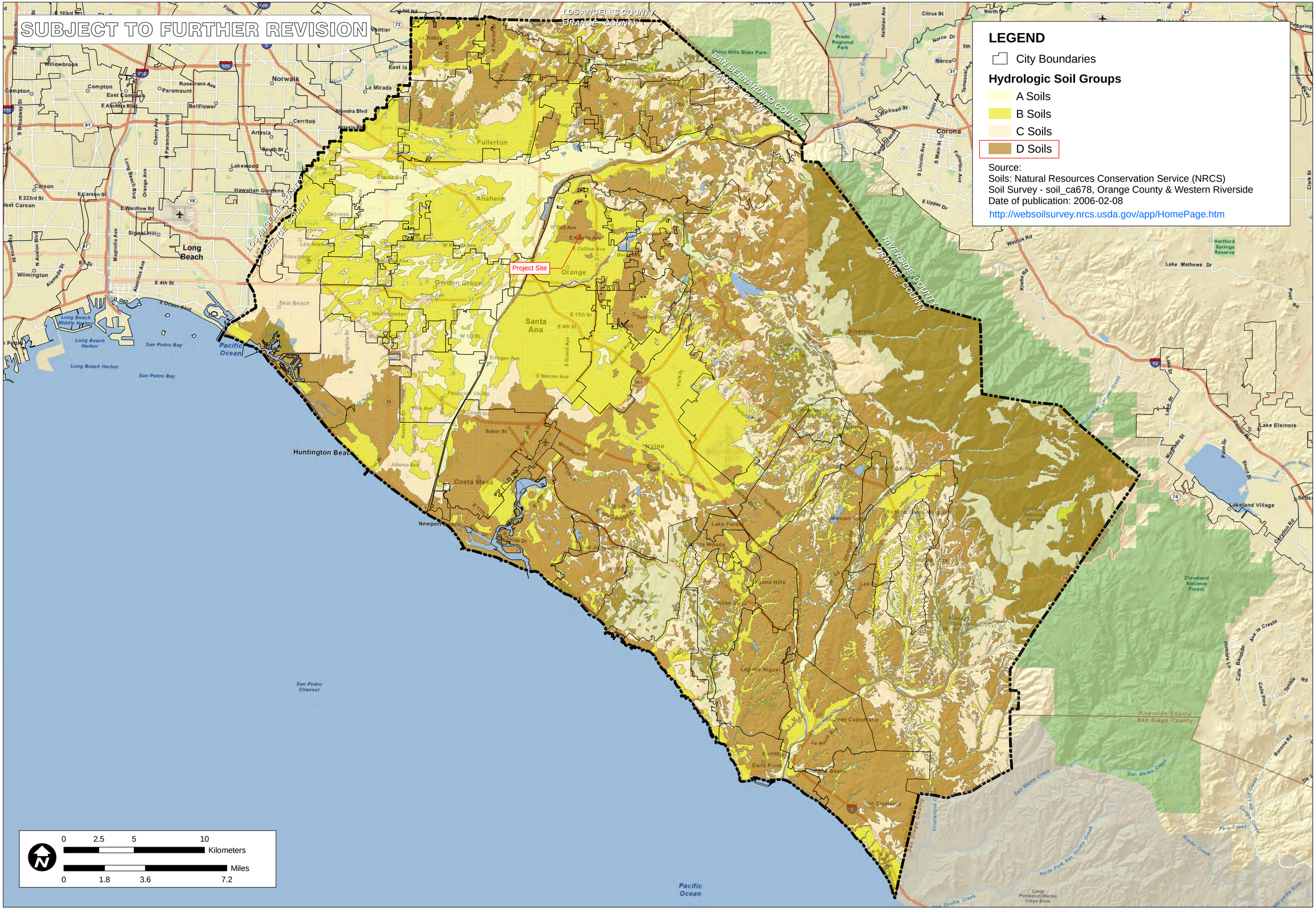
SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2e

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2e_DepthToGroundwater15ft_20110215.mxd

SUBJECT TO FURTHER REVISION



LEGEND

- City Boundaries

Hydrologic Soil Groups

- A Soils
- B Soils
- C Soils
- D Soils

Source:
Soils: Natural Resources Conservation Service (NRCS)
Soil Survey - soil_ca678, Orange County & Western Riverside
Date of publication: 2006-02-08
http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

0 2.5 5 10 Kilometers
0 1.8 3.6 7.2 Miles

TITLE
NRCS HYDROLOGIC SOILS GROUPS

JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2a

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2a_HydroSoils_20110215.mxd

V. Implementation, Maintenance and Inspection Responsibility for BMPs (O&M Plan)

Responsible Party Information (Local Contact Information)

Name: Emilie Simard Title: Project Manager

Company: Intracorp SW, LLC Phone Number: (949) 955-2370

The property is currently owned by Intracorp SW, LLC. The Owner will be responsible for the long term maintenance of the project's storm water facilities and conformance to this WQMP after construction is complete. A Notice of Transfer of Responsibility is located at the beginning of this report and should be executed as part of any ownership transfer after construction is complete. The owner will appoint a Homeowner's Association (HOA) to provide long term BMP maintenance for the proposed development upon completion of construction.

Table 8 - Frequency Inspection Matrix

BMP	***Responsible Party***	****Maintenance Activity***	****Inspection/Maintenance Frequency***
Source Control BMPs (Structural and Non-structural)			
N1. Education for Property Owners, Tenants & Occupants	Owner/ HOA	This will be addressed through educational materials. All included materials provide ways of mitigating stormwater pollution in everyday activities associated with residents as well as employees of the property management company and their sub-contractors. Practical informational materials are provided to residents, occupants, or tenants to increase the public's understanding of stormwater quality, sources of pollutants, and what they can do to reduce pollutants in	The distribution of these materials will be the responsibility of the HOA at the time of the leasing signing or purchase per property owner, tenant or occupant. Annual newsletters shall be provided by HOA to property owners, tenants and occupants.

		stormwater.	
N2. Activity Restriction	Owner/ HOA	Rules or guidelines for developments are established within the appropriate documents which prohibit activities that can result in discharges of pollutants. Car washing or washing of hardscaped surfaced such as sidewalks, streets, parking lots, vehicle maintenance will not be allowed on the subject site.	The distribution of these materials will be the responsibility of the HOA at the time of the leasing signing or purchase per property owner, tenant or occupant.
N3. Common Area Landscaped Management	Owner / HOA	Specific practices are followed and ongoing maintenance is conducted to minimize erosion and over-irrigation, conserve water, and reduce pesticide and fertilizer applications and remove all trash/ debris and litter.	Landscape maintenance should occur at least once per week or to the desire of the HOA. Overall landscape care should be inspected monthly.
N4. BMP Maintenance	Owner / HOA	In order to ensure adequate and comprehensive BMP implementation, all responsible parties are identified for implementing all non-structural and structural BMPs, cleaning, inspection, and other maintenance activities are specified including responsible parties for conducting such activities.	4 Inspections/ Cleanings per year per manufacturer's specifications starting on or near October 1st (before the rainy season)
N7. Spill Contingency Plan	Owner / HOA	HOA to provide and implement spill contingency plan for all	Plan shall be provided to all employees at the time of hire.

		hazardous materials utilized onsite.	
N11. Common Area Litter Control		The landscape contractor through the HOA will remove trash within the open areas.	It will be the responsibility of the HOA to empty and maintain the upkeep of these areas on a weekly basis.
N12. Employee Training	Owner / HOA	HOA to provide proper employee training for all site concerns.	At the time of employment or when there is a policy change
N14. Common Area Catch Basin Inspection	Owner / HOA	Common inspection should occur weekly or prior to any significant storm events by method of clearing any trash/ debris from the catch basin.	On a weekly basis
N15. Street Sweeping Private Street and Parking Lots	Owner / HOA	Regular sweeping is conducted to reduce pollution of drainage water.	On a weekly basis
S1. Storm Drain System Stenciling & Signage	Owner / HOA	Catch Basin Stenciling and Signage will be specified on all on-site catch basins.	Any defacement of the signage should be addressed immediately by the HOA and visually inspected annually.
S2. Use Efficient Irrigation Systems & Landscape Design	Owner / HOA	Irrigation system and landscaped design shall be monitored by HOA selected landscaping company to verify appropriate watering measures and the landscaping/ irrigation systems are maintained.	At minimum one time per month.
Low Impact Development and Treatment BMPs			
BIO-7: Modular Wetlands System (MWS) Biofiltration Vaults	Owner/ HOA	Owner/ HOA will be required to hire a professional maintenance company to provide regular inspections, repairs and cleaning per manufacturer's	Inspections/ Cleanings should occur at least two times per year and before the start of the rainy season (October 1st). Refer to Attachment C for additional information and manufacturer's

		specifications.	specifications.
Storm Water Sump Pump	Owner/ HOA	Owner/ HOA to conduct regular inspections and cleanings of pump station area, report performance deficiencies, and schedule regular inspections by professional technician.	Inspections/ cleanings should occur at least two times per year and before the start of the rainy season (October 1st). Scheduled inspections by technician should occur at least once per year/ per manufacturer's recommendation.

Regulatory Permits

Not Applicable

Funding

Intracorp SW, LLC
895 Dove Street, Suite 400
Newport Beach, CA 92660
(949) 955-2370

Maintenance requirements and responsibilities for the property will be listed in the Maintenance Contract for this project and will be the responsibility of the HOA after final construction at all times. Maintenance Contract to follow during final WQMP approval.

OWNER SELF CERTIFICATION STATEMENT

As the owner representative of the **901 E. Katella Avenue** project for which a Water Quality Management Plan (WQMP) was approved by the City, I hereby certify under penalty of law that all Best Management Practices contained within the approved Project WQMP have been maintained and inspected in accordance with the schedule and frequency outlined in the approved WQMP Maintenance Table.

The maintenance activities and inspections conducted are shown in the attached table and have been performed by qualified and knowledgeable individuals. Structural Treatment BMPs have been inspected and certified by a licensed professional engineer.

To the best of my knowledge, the information submitted is true and accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and citations for violating water quality regulations.

Signed: _____

Name: _____

Title: _____

Company: _____

Address: _____

Telephone Number: _____

Date: _____

BMP Implementation Tracking Table

BMP	***Activity/ Frequency***	***Completion Dates***	***Initial***
Source Control BMPs (Structural and Nonstructural)			
N1. Education for Property Owners, Tenants & Occupants	This will be addressed through educational materials. All included materials provide ways of mitigating stormwater pollution in everyday activities associated with residents as well as employees of the property management company and their sub-contractors. Practical informational materials are provided to residents, occupants, or tenants to increase the public's understanding of stormwater quality, sources of pollutants, and what they can do to reduce pollutants in stormwater. Distribution of these materials is required at the time of purchase or lease signing.		
N2. Activity Restriction	Rules or guidelines for developments are established within the appropriate documents which prohibit activities that can result in discharges of pollutants. Car washing or washing of hardscaped surfaced such as sidewalks, streets, parking lots, vehicle maintenance will not be allowed on the subject site. Distribution of these materials is required at the time of purchase or lease signing. Landscape maintenance shall occur at least once per week.		
N3. Common Area Landscaped Management	Specific practices are followed and ongoing maintenance is conducted to minimize erosion and over-irrigation, conserve water, and reduce pesticide and fertilizer applications and remove all trash/ debris and litter.		
N4. BMP Maintenance	In order to ensure adequate and comprehensive BMP		

	implementation, all responsible parties are identified for implementing all non-structural and structural BMPs, cleaning, inspection, and other maintenance activities are specified including responsible parties for conducting such activities. 4 Inspections per year per manufacturer's specifications.		
N7. Spill Contingency Plan	HOA to provide and implement spill contingency plan for all hazardous materials utilized onsite. Shall be provided to all new employees at the time of hiring.		
N11. Common Area Litter Control	The landscape contractor through the HOA will remove trash within the open areas. Litter control shall be maintained at least once per week.		
N12. Employee Training	HOA to provide proper employee training for all site concerns. Shall be provided to all new employees at the time of hiring.		
N14. Common Area Catch Basin Inspection	Common inspection should occur weekly or prior to any significant storm events by method of clearing any trash/ debris from the catch basin. Shall occur on a weekly basis.		
N15. Street Sweeping Private Street and Parking Lots	Regular sweeping is conducted to reduce pollution of drainage water. Shall occur on a weekly basis.		
S1. Storm Drain System Stenciling & Signage	Catch Basin Stenciling and Signage will be specified on all on-site catch basins. Visually inspected yearly, replace/ repair immediately as needed.		
S2. Use Efficient Irrigation Systems & Landscape Design	Irrigation system and landscaped design shall be monitored by HOA selected landscaping company to verify appropriate watering measures and the landscaping/ irrigation systems are maintained.		

	Shall be inspected at minimum one time per month.		
Low Impact Development and Treatment BMPs			
BIO-7: Modular Wetlands System (MWS) Biofiltration Vaults	Owner/ HOA will be required to hire a professional maintenance company to provide regular inspections, repairs and cleaning per manufacturer's specifications.		
Storm Water Sump Pump	Owner/ HOA to conduct regular inspections and cleanings of pump station area, report performance deficiencies, and schedule regular inspections by professional technician.		

* This sheet is to be submitted annually with the Owner Self Certification Statement.
** Structural Treatment BMPs should be certified by a Licensed Professional Engineer.

VI. Location Map, Site Plan, and BMP Details

Include a location map that identifies project location and proximity to nearby water bodies. In an 11X17 sheet Identify land use, cover, feasibility constraints, structures, buildings, number of units, landscape areas, storm drain inlets, storm drain facilities, drainage flow direction, structural and treatment BMP locations, dumpsters, trash enclosures, wash areas, etc.

Delineate drainage management areas showing limits (acreage) of each drainage area for all structural, treatment and Low Impact Development BMPs used and provide BMP details on plan or in Appendix C.

VII. Educational Materials

Refer to the City's website or the Orange County Stormwater Program (ocwatersheds.com) for a library of materials available. Attach only the educational materials specifically applicable to the project.

Education Materials			
Residential Material (http://www.ocwatersheds.com)	**Check If Applicable**	**Business Material (http://www.ocwatersheds.com)**	**Check If Applicable**
The Ocean Begins at Your Front Door	☒	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☐
Tips for the Home Mechanic	☐	Tips for the Food Service Industry	☐
Homeowners Guide for Sustainable Water Use	☒	Proper Maintenance Practices for Your Business	☐
Household Tips	☒	**Other Material**	**Check If Attached**
Proper Disposal of Household Hazardous Waste	☒		
Recycle at Your Local Used Oil Collection Center (North County)	☒		☐
Recycle at Your Local Used Oil Collection Center (Central County)	☐		☐
Recycle at Your Local Used Oil Collection Center (South County)	☐		☐
Tips for Maintaining a Septic Tank System	☐		☐
Responsible Pest Control	☒		☐
Sewer Spill Response	☒		☐
Tips for the Home Improvement Projects	☒		☐
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☒		☐
Tips for Pet Care	☒		☐
Tips for Pool Maintenance	☐		☐
Tips for Residential Pool, Landscape and Hardscape Drains	☐		☐
Tips for Projects Using Paint	☒		☐

Appendix A:

Conditions of Approval

Resolution No. _____ dated _____

To be provided during final engineering

Appendix B:

Educational Material

The Ocean Begins at Your Front Door



Never allow pollutants to enter the

street, gutter or storm drain!

Follow these simple steps to help reduce water pollution:

Household Activities

- Do not rinse spills with water. Use dry cleanup methods such as applying cat litter or another absorbent material, sweep and dispose of in the trash. Take items such as used or excess batteries, oven cleaners, automotive fluids, painting products and cathode ray tubes, like TVs and computer monitors, to a Household Hazardous Waste Collection Center (HHWCC).
- For a HHWCC near you call (714) 834-6752 or visit www.oclandfills.com.
- Do not hose down your driveway, sidewalk or patio to the street, gutter or storm drain. Sweep up debris and dispose of it in the trash.

Automotive

- Take your vehicle to a commercial car wash whenever possible. If you wash your vehicle at home, choose soaps, cleaners, or detergents labeled non-toxic, phosphate- free or biodegradable. Vegetable and citrus-based products are typically safest for the environment.
- Do not allow washwater from vehicle washing to drain into the street, gutter or storm drain. Excess washwater should be disposed of in the sanitary sewer (through a sink or toilet) or onto an absorbent surface like your lawn.
- Monitor your vehicles for leaks and place a pan under leaks. Keep your vehicles well maintained to stop and prevent leaks.
- Never pour oil or antifreeze in the street, gutter or storm drain. Recycle these substances at a service station, a waste oil collection center or used oil recycling center. For the nearest Used Oil Collection Center call 1-800-CLEANUP or visit www.1800cleanup.org.

Pool Maintenance

- Pool and spa water must be dechlorinated and free of excess acid, alkali or color to be allowed in the street, gutter or storm drain.
- When it is not raining, drain dechlorinated pool and spa water directly into the sanitary sewer.
- Some cities may have ordinances that do not allow pool water to be disposed of in the storm drain. Check with your city.

Landscape and Gardening

- Do not over-water. Water your lawn and garden by hand to control the amount of water you use or set irrigation systems to reflect seasonal water needs. If water flows off your yard onto your driveway or sidewalk, your system is over-watering. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of waste by composting, hauling it to a permitted landfill, or as green waste through your city's recycling program.
- Follow directions on pesticides and fertilizer, (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Take unwanted pesticides to a HHWCC to be recycled. For locations and hours of HHWCC, call (714) 834-6752 or visit www.oclandfills.com.

Trash

- Place trash and litter that cannot be recycled in securely covered trash cans.
- Whenever possible, buy recycled products.
- Remember: Reduce, Reuse, Recycle.

Pet Care

- Always pick up after your pet. Flush waste down the toilet or dispose of it in the trash. Pet waste, if left outdoors, can wash into the street, gutter or storm drain.
- If possible, bathe your pets indoors. If you must bathe your pet outside, wash it on your lawn or another absorbent/permeable surface to keep the washwater from entering the street, gutter or storm drain.
- Follow directions for use of pet care products and dispose of any unused products at a HHWCC.

Common Pollutants

Home Maintenance

- Detergents, cleaners and solvents
- Oil and latex paint
- Swimming pool chemicals
- Outdoor trash and litter

Lawn and Garden

- Pet and animal waste
- Pesticides
- Clippings, leaves and soil
- Fertilizer

Automobile

- Oil and grease
- Radiator fluids and antifreeze
- Cleaning chemicals
- Brake pad dust

Even if you live miles from the Pacific Ocean, you may be unknowingly polluting it.

Dumping one quart of motor oil into a storm drain can contaminate 250,000 gallons of water.

Did You Know?

- Most people believe that the largest source of water pollution in urban areas comes from specific sources such as factories and sewage treatment plants. In fact, the largest source of water pollution comes from city streets, neighborhoods, construction sites and parking lots. This type of pollution is sometimes called “non-point source” pollution.
- There are two types of non-point source pollution: stormwater and urban runoff pollution.
- Stormwater runoff results from rainfall. When rainstorms cause large volumes of water to rinse the urban landscape, picking up pollutants along the way.
- Urban runoff can happen any time of the year when excessive water use from irrigation, vehicle washing and other sources carries trash, lawn clippings and other urban pollutants into storm drains.

Where Does It Go?

- Anything we use outside homes, vehicles and businesses – like motor oil, paint, pesticides, fertilizers and cleaners – can be blown or washed into storm drains.
- A little water from a garden hose or rain can also send materials into storm drains.
- Storm drains are separate from our sanitary sewer systems; unlike water in sanitary sewers (from sinks or toilets), water in storm drains is not treated before entering our waterways.

Sources of Non-Point Source Pollution

- Automotive leaks and spills.
- Improper disposal of used oil and other engine fluids.
- Metals found in vehicle exhaust, weathered paint, rust, metal plating and tires.
- Pesticides and fertilizers from lawns, gardens and farms.
- Improper disposal of cleaners, paint and paint removers.
- Soil erosion and dust debris from landscape and construction activities.
- Litter, lawn clippings, animal waste, and other organic matter.
- Oil stains on parking lots and paved surfaces.



The Effect on the Ocean



Non-point source pollution can have a serious impact on water quality in Orange County. Pollutants from the storm drain system can harm marine life as well as coastal and wetland habitats. They can also degrade recreation areas such as beaches, harbors and bays.

Stormwater quality management programs have been developed throughout Orange County to educate and encourage the public to protect water quality, monitor runoff in the storm drain system, investigate illegal dumping and maintain storm drains.

Support from Orange County residents and businesses is needed to improve water quality and reduce urban runoff pollution. Proper use and disposal of materials will help stop pollution before it reaches the storm drain and the ocean.



For More Information

California Environmental Protection Agency
www.calepa.ca.gov

- **Air Resources Board**
  www.arb.ca.gov
- **Department of Pesticide Regulation**
  www.cdpr.ca.gov
- **Department of Toxic Substances Control**
  www.dtsc.ca.gov
- **Integrated Waste Management Board**
  www.ciwmb.ca.gov
- **Office of Environmental Health Hazard Assessment**
  www.oehha.ca.gov
- **State Water Resources Control Board**
  www.waterboards.ca.gov

Earth 911 - Community-Specific Environmental Information 1-800-cleanup or visit www.1800cleanup.org

Health Care Agency's Ocean and Bay Water Closure and Posting Hotline
(714) 433-6400 or visit www.ocbeachinfo.com

Integrated Waste Management Dept. of Orange County (714) 834-6752 or visit www.oclandfills.com for information on household hazardous waste collection centers, recycling centers and solid waste collection

O.C. Agriculture Commissioner
(714) 447-7100 or visit www.ocagcomm.com

Stormwater Best Management Practice Handbook
Visit www.cabmphandbooks.com

UC Master Gardener Hotline
(714) 708-1646 or visit www.uccemg.com

The Orange County Stormwater Program has created and moderates an electronic mailing list to facilitate communications, take questions and exchange ideas among its users about issues and topics related to stormwater and urban runoff and the implementation of program elements. To join the list, please send an email to ocstormwaterinfo-join@list.ocwatersheds.com

Orange County Stormwater Program

Aliso Viejo	(949)	425-2535
Anaheim Public Works Operations	(714)	765-6860
Brea Engineering	(714)	990-7666
Buena Park Public Works	(714)	562-3655
Costa Mesa Public Services	(714)	754-5323
Cypress Public Works	(714)	229-6740
Dana Point Public Works	(949)	248-3584
Fountain Valley Public Works	(714)	593-4441
Fullerton Engineering Dept.	(714)	738-6853
Garden Grove Public Works	(714)	741-5956
Huntington Beach Public Works	(714)	536-5431
Irvine Public Works	(949)	724-6315
La Habra Public Services	(562)	905-9792
La Palma Public Works	(714)	690-3310
Laguna Beach Water Quality	(949)	497-0378
Laguna Hills Public Services	(949)	707-2650
Laguna Niguel Public Works	(949)	362-4337
Laguna Woods Public Works	(949)	639-0500
Lake Forest Public Works	(949)	461-3480
Los Alamitos Community Dev.	(562)	431-3538
Mission Viejo Public Works	(949)	470-3056
Newport Beach, Code & Water Quality Enforcement	(949)	644-3215
Orange Public Works	(714)	532-6480
Placentia Public Works	(714)	993-8245
Rancho Santa Margarita	(949)	635-1800
San Clemente Environmental Programs	(949)	361-6143
San Juan Capistrano Engineering	(949)	234-4413
Santa Ana Public Works	(714)	647-3380
Seal Beach Engineering	(562)	431-2527 x317
Stanton Public Works	(714)	379-9222 x204
Tustin Public Works/Engineering	(714)	573-3150
Villa Park Engineering	(714)	998-1500
Westminster Public Works/Engineering	(714)	898-3311 x446
Yorba Linda Engineering	(714)	961-7138
Orange County Stormwater Program	(877)	897-7455

Orange County 24-Hour
Water Pollution Problem Reporting Hotline
1-877-89-SPILL (1-877-897-7455)

On-line Water Pollution Problem Reporting Form
www.ocwatersheds.com

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The Ocean Begins at Your Front Door





Preventing water pollution at your commercial/industrial site

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many landscape and building maintenance activities can lead to water pollution if you're not careful. Paint, chemicals, plant clippings and other materials can be blown or washed into storm drains that flow to the ocean. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never pour soap or fertilizers into the ocean, so why would you let them enter the storm drains? Follow these easy tips to help prevent water pollution.

Some types of industrial facilities are required to obtain coverage under the State General Industrial Permit. For more information visit: **www.swrcb.ca.gov/stormwater/industrial.html**

For more information, please call the **Orange County Stormwater Program** at **1-877-89-SPILL** (1-877-897-7455) or visit **www.ocwatersheds.com**

To report a spill, call the **Orange County 24-Hour Water Pollution Problem Reporting Hotline** at **1-877-89-SPILL** (1-877-897-7455).

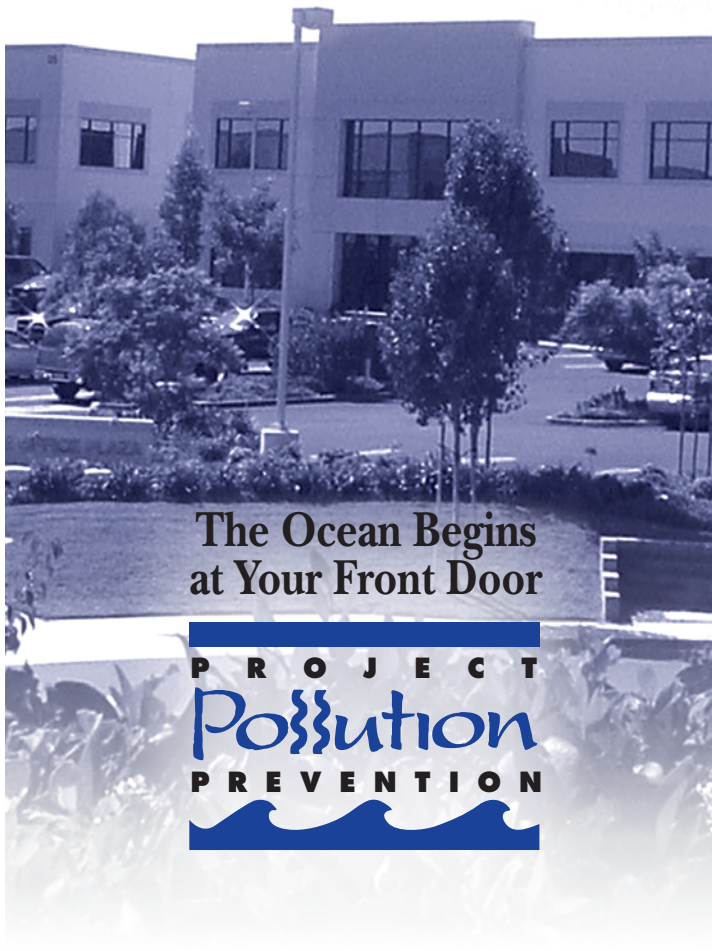
For emergencies, dial 911.

RECYCLE USED OIL

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Help Prevent Ocean Pollution:

Proper Maintenance Practices for Your Business



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Proper Maintenance Practices for your Business

Landscape Maintenance

- Compost grass clippings, leaves, sticks and other vegetation, or dispose of it at a permitted landfill or in green waste containers. Do not dispose of these materials in the street, gutter or storm drain.
- Irrigate slowly and inspect the system for leaks, overspraying and runoff. Adjust automatic timers to avoid overwatering.
- Follow label directions for the use and disposal of fertilizers and pesticides.
- Do not apply pesticides or fertilizers if rain is expected within 48 hours or if wind speeds are above 5 mph.
- Do not spray pesticides within 100 feet of waterways.
- Fertilizers should be worked into the soil rather than dumped onto the surface.
- If fertilizer is spilled on the pavement or sidewalk, sweep it up immediately and place it back in the container.

Building Maintenance

- Never allow washwater, sweepings or sediment to enter the storm drain.
- Sweep up dry spills and use cat litter, towels or similar materials to absorb wet spills. Dispose of it in the trash.
- If you wash your building, sidewalk or parking lot, you **must** contain the water. Use a shop vac to collect the water and contact your city or sanitation agency for proper disposal information. Do not let water enter the street, gutter or storm drain.
- Use drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of materials in the trash.
- Use a ground cloth or oversized tub for mixing paint and cleaning tools.
- Use a damp mop or broom to clean floors.
- Cover dumpsters to keep insects, animals, rainwater and sand from entering. Keep the area around the dumpster clear of trash and debris. Do not overfill the dumpster.
- Call your trash hauler to replace leaking dumpsters.
- Do not dump any toxic substance or liquid waste on the pavement, the ground, or near a storm drain. Even materials that seem harmless such as latex paint or biodegradable cleaners can damage the environment.

Never Dispose of Anything in the Storm Drain.

- Recycle paints, solvents and other materials. For more information about recycling and collection centers, visit **www.oclandfills.com**.
- Store materials indoors or under cover and away from storm drains.
- Use a construction and demolition recycling company to recycle lumber, paper, cardboard, metals, masonry, carpet, plastic, pipes, drywall, rocks, dirt, and green waste. For a listing of construction and demolition recycling locations in your area, visit **www.ciwmb.ca.gov/recycle.**
- Properly label materials. Familiarize employees with Material Safety Data Sheets.

PROJECT Pollution PREVENTION

HOMEOWNER TIPS
PROTECTING WATER

Before Buying Pest Control Products

- Identify the pest.
- Decide if pest control products are the best control measure or if there are alternatives available.
- Are integrated pest management guidelines available for this pest?
- Read the product label:
  - Is the pest listed on the label?
  - Is it the best product for the pest?

Before Mixing Your Sprayer



- Read the label carefully.
- Buy only enough pesticide to treat the area affected by the pest.
- Check the weather and don't apply if it's windy or about to rain
- Measure the area you're treating.
- Calculate how much spray to mix.
- Wear long sleeve shirt, long pants, shoes and any other protective equipment listed on the label and follow all the label precautions.
- Be prepared for spills and know how to clean them up.

When You're Ready To Spray

- Mix and load spray in an area where any spilled pesticide will not be able to drain or be washed away into storm drains, ditches, streams, ponds or other bodies of water.
- Mix sprayer on grass, not the sidewalk or driveway.
- Mix only as much as needed.

When You're Spraying

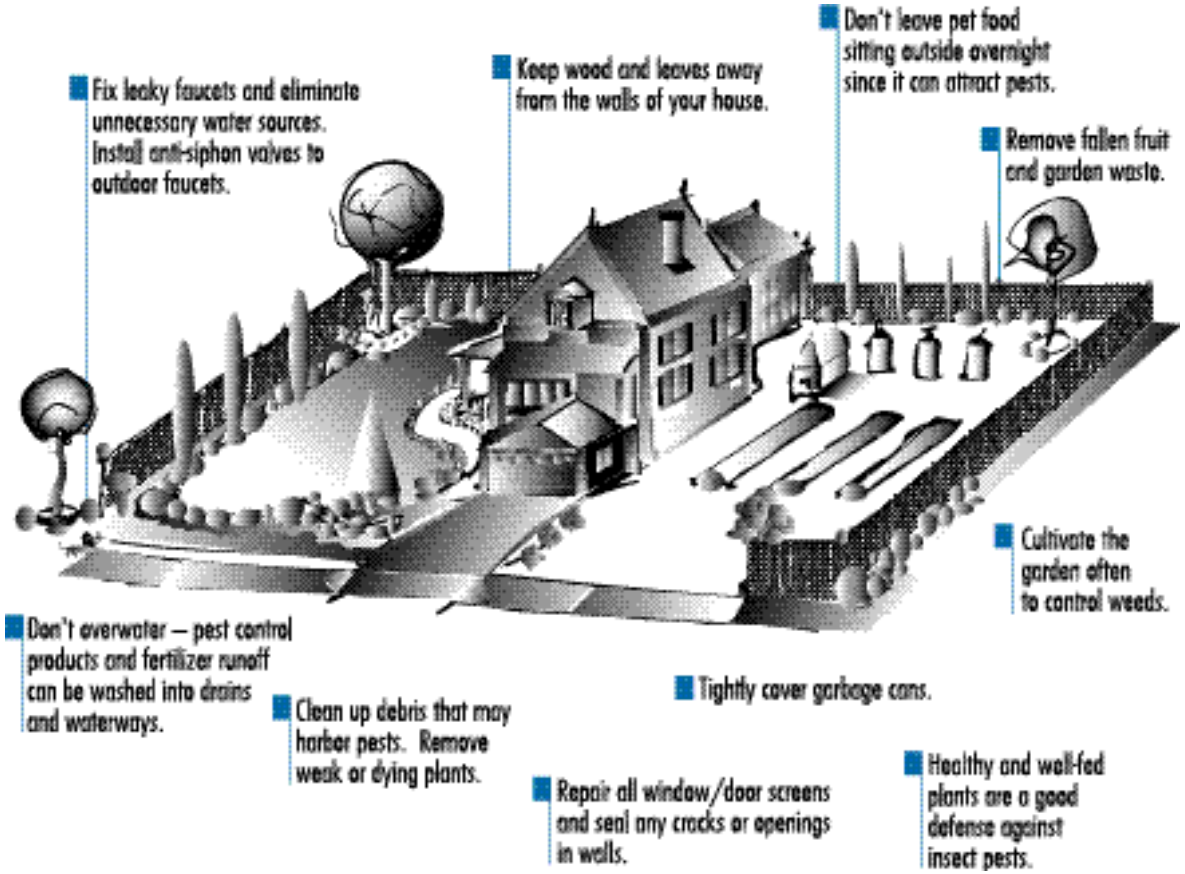
- AVOID spraying in or near storm drains, ditches, streams, and ponds!
- Leave an untreated strip around these areas to protect the water.

When You're done

- Never dump leftovers down any drain; Save for a future application.
- Triple-rinse sprayer and apply rinsewater to treated area.
- Take any old or unwanted pesticides to a Household Hazardous Waste Collection Center (714) 834-6752.

Using Pest Control Products. It's Your Responsibility To Do It Right!





IPM... Outsmarting Pests While Protecting Water

With Integrated Pest Management (IPM), homeowners use common sense and nature to make it difficult for pests to survive. IPM techniques include cultural practices (such as mulching to prevent weeds), encouraging natural enemies (good bugs), and judicious use of pest control products.

- First, identify your pest problem. To find the best solution, you need to pin down the problem. Consult gardening books, your county cooperative extension office or your local nursery.
- Decide how much pest control is necessary. If you can live with some pest damage, you can avoid intensive pest control product treatments.
- Choose an effective option. Try various types of controls first: washing bugs off plants, pruning diseased parts of plants. If you need to use pest control products, choose one that targets the problem and poses the least hazard.
- Finally, it's easier to prevent pests than to control them.

Think ahead.



This brochure is being distributed in order to reduce the impacts of pesticides on water quality. It was produced with support from the Orange County Storm Water Program, the Coalition for Urban/Rural Environmental Stewardship (CURES) and a 319(h) grant from the State Water Resources Control Board.

Orange County Storm Water Program Participants:

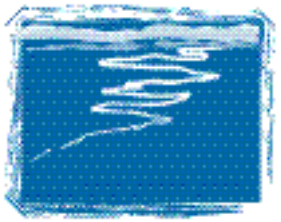
Anaheim Public Works/Engineering	(714) 765-5176
Brea Engineering	(714) 990-7666
Buena Park Public Works	(714) 562-3655
Costa Mesa Public Services	(714) 754-5248
Cypress Engineering	(714) 229-6752
Dana Point Public Works	(949) 248-3562
Fountain Valley Public Works	(714) 593-4400 x347
Fullerton Engineering Dept	(714) 738-6853
Garden Grove Development Services	(714) 741-5554
Huntington Beach Public Works	(714) 536-5432
Irvine Public Works	(949)724-6515
La Habra Public Services	(562) 905-9792
La Palma Public Works	(714) 523-1140 x102
Laguna Beach Municipal Services	(949) 497-0711
Laguna Hills Engineering	(949) 707-2600
Laguna Niguel Public Works	(949) 362-4337
Lake Forest Public Works	(949) 461-3480
Los Alamitos Community Dev	(562) 431-3538 x301
Mission Viejo Public Works	(949) 470-3095
Newport Beach Public works	(949) 644-3311
Orange Public Works	(714) 744-5551
Placentia Engineering	(714) 993-8131
San Clemente Engineering	(949) 361-6100
San Juan Capistrano Engineering	(949) 493-1171
Santa Ana Public Works	(714) 647-3380
Seal Beach Engineering	(562) 431-2527 x318
Stanton Public Works	(714) 379-9222 x204
Tustin Public Works Engineering	(714) 573-3150
Villa Park Engineering	(714) 998-1500
Westminster Public Works Eng.	(714) 898-3311 x215
Yorba Linda Engineering	(714) 961-7170 x174
O.C. Storm Water Program	1-877-89-SPILL (1-877-897-7455)
24 Hour Water Pollution Hotline	(714) 567-6363 or ashbyk@pfrd.co.orange.ca.us
Chemical and Hazardous Material Spill Emergencies	911

Other Important Phone Numbers:

For Additional Brochures	1-877-89-SPILL (1-877-897-7455)
UC Masters & Coop Extension	(714) 708-1646 ucmastergardeners@yahoo.com
O.C. Household Hazardous Waste Information	(714) 834-6752 or www.oc.ca.gov/IWMD
Information on agriculture chemicals, pesticides and possible alternatives, O.C. Agriculture Commissioner	(714) 447-7115

Original graphics developed with support from:
Coalition For Urban/Rural Environmental Stewardship (CURES)
Western Crop Protection Association (WCPA)
Responsible Industry for a Sound Environment (RISE)

Keeping Pest Control Products Out of Creeks, Rivers and The Ocean



HOMEOWNER TIPS

PROTECTING WATER

Sewage Spill Regulatory Requirements

Allowing sewage to discharge to a gutter or storm drain may subject you to penalties and/or out-of-pocket costs to reimburse cities or public agencies for clean-up efforts.

Here are the pertinent codes, fines, and agency contact information that apply.

Orange County Stormwater Program
24 Hour Water Pollution Reporting Hotline
1-877-89-SPILL (1-877-897-7455)

- County and city water quality ordinances prohibit discharges containing pollutants.

Orange County Health Care Agency Environmental Health
(714) 433-6419

California Health and Safety Code, Sections 5410-5416

- No person shall discharge raw or treated sewage or other waste in a manner that results in contamination, pollution or a nuisance.
- Any person who causes or permits a sewage discharge to any state waters:
  - must immediately notify the local health agency of the discharge.
  - shall reimburse the local health agency for services that protect the public's health and safety (water-contact receiving waters).
  - who fails to provide the required notice to the local health agency is guilty of a misdemeanor and shall be punished by a fine (between $500–$1,000) and/or imprisonment for less than one year.

Regional Water Quality Control Board
Santa Ana Region (951) 782-4130
San Diego Region (858) 467-2952

- Requires the prevention, mitigation, response to and reporting of sewage spills.

California Office of Emergency Services
(800) 852-7550

California Water Code, Article 4, Chapter 4, Sections 13268-13271
California Code of Regulations, Title 23, Division 3, Chapter 9.2, Article 2, Sections 2250-2260

- Any person who causes or permits sewage in excess of 1,000 gallons to be discharged to state waters **shall immediately notify the Office of Emergency Services.**
- Any person who fails to provide the notice required by this section is **guilty of a misdemeanor** and shall be punished by a fine (less than $20,000) and/or imprisonment for not more than one year.

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Sewage Spill
Reference Guide

Your Responsibilities as a Private Property Owner

Residences
Businesses
Homeowner/Condominium Associations
Federal and State Complexes
Military Facilities



Orange County Sanitation District

Health Care Agency
Environmental Health

PROJECT Pollution PREVENTION
www.ocwatersheds.com

This brochure was designed courtesy of the Orange County Sanitation District (OCSD). For additional information, call (714) 962-2411, or visit their website at www.ocsd.com

What is a Sewage Spill?

Sewage spills occur when the wastewater being transported via underground pipes overflows through a manhole, cleanout or broken pipe. Sewage spills can cause health hazards, damage to homes and businesses, and threaten the environment, local waterways and beaches.

Common Causes of Sewage Spills

Grease builds up inside and eventually blocks sewer pipes. Grease gets into the sewer from food establishments, household drains, as well as from poorly maintained commercial grease traps and interceptors.

Structure problems caused by tree roots in the lines, broken/cracked pipes, missing or broken cleanout caps or undersized sewers can cause blockages.

Infiltration and inflow (I/I) impacts pipe capacity and is caused when groundwater or rainwater enters the sewer system through pipe defects and illegal connections.

You Are Responsible for a Sewage Spill Caused by a Blockage or Break in Your Sewer Lines!

Time is of the essence in dealing with sewage spills. You are required to **immediately**:

Control and minimize the spill. Keep spills contained on private property and out of gutters, storm drains and public waterways by shutting off or not using the water.

Use sandbags, dirt and/or plastic sheeting to prevent sewage from entering the storm drain system.

Clear the sewer blockage. Always wear gloves and wash your hands. It is recommended that a plumbing professional be called for clearing blockages and making necessary repairs.

Always notify your city sewer/public works department or public sewer district of sewage spills. If the spill enters the storm drains also notify the Health Care Agency. In addition, if it exceeds 1,000 gallons notify the Office of Emergency Services. Refer to the numbers listed in this brochure.



Overflowing cleanout pipe located on private property

You Could Be Liable

Allowing sewage from your home, business or property to discharge to a gutter or storm drain may subject you to penalties and/or out-of-pocket costs to reimburse cities or public agencies for clean-up and enforcement efforts. See Regulatory Codes & Fines section for pertinent codes and fines that apply.

What to Look For

Sewage spills can be a very noticeable gushing of water from a manhole or a slow water leak that may take time to be noticed. Don't dismiss unaccounted-for wet areas.

Look for:

- Drain backups inside the building.
- Wet ground and water leaking around manhole lids onto your street.
- Leaking water from cleanouts or outside drains.
- Unusual odorous wet areas: sidewalks, external walls or ground/landscape around a building.

Caution

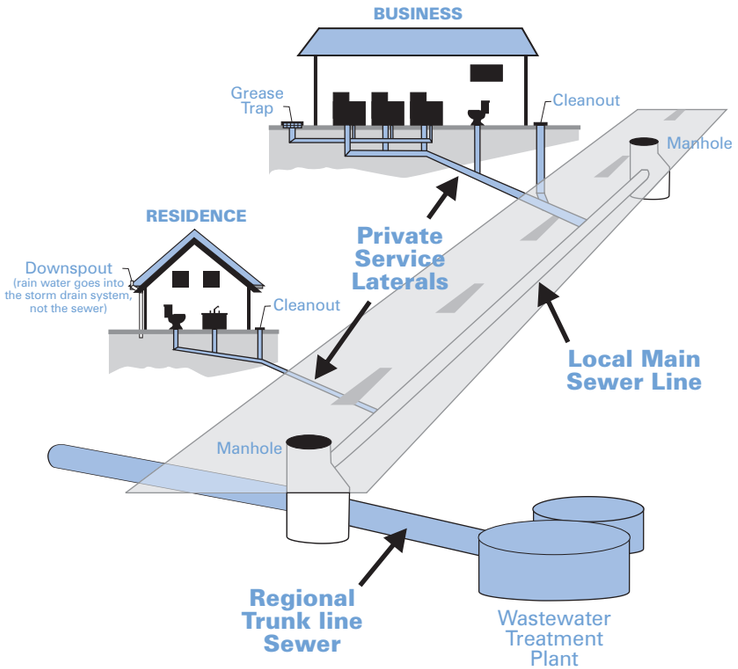
Keep people and pets away from the affected area. Untreated sewage has high levels of disease-causing viruses and bacteria. Call your local health care agency listed on the back for more information.

If You See a Sewage Spill Occurring, Notify Your City Sewer/Public Works Department or Public Sewer District IMMEDIATELY!

How a Sewer System Works

A property owner's sewer pipes are called service laterals and are connected to larger local main and regional trunk lines. Service laterals run from the connection at the home to the connection with the public sewer (including the area under the street). These laterals are the responsibility of the property owner and must be maintained by the property owner. Many city agencies have adopted ordinances requiring maintenance of service laterals. Check with your city sewer/local public works department for more information.

Operation and maintenance of **local and regional sewer lines** are the responsibility of the city sewer/public works departments and public sewer districts.



How You Can Prevent Sewage Spills

1. **Never put grease down garbage disposals, drains or toilets.**
2. **Perform periodic cleaning to eliminate grease, debris and roots in your service laterals.**
3. **Repair any structural problems in your sewer system and eliminate any rainwater infiltration/inflow leaks into your service laterals.**



Preventing Grease Blockages

The drain is not a dump! Recycle or dispose of grease properly and never pour grease down the drain.

Homeowners should mix fats, oils and grease with absorbent waste materials such as paper, coffee grounds, or kitty litter and place it in the trash. Wipe food scraps from plates and pans and dump them in the trash.

Restaurants and commercial food service establishments should always use "Kitchen Best Management Practices." These include:

- Collecting all cooking grease and liquid oil from pots, pans and fryers in covered grease containers for recycling.
- Scraping or dry-wiping excess food and grease from dishes, pots, pans and fryers into the trash.
- Installing drain screens on all kitchen drains.
- Having spill kits readily available for cleaning up spills.
- Properly maintaining grease traps or interceptors by having them serviced regularly. Check your local city codes.

Orange County Agency Responsibilites

- **City Sewer/Public Works Departments—** Responsible for protecting city property and streets, the local storm drain system, sewage collection system and other public areas.
- **Public Sewer/Sanitation District—** Responsible for collecting, treating and disposing of wastewater.
- **County of Orange Health Care Agency—** Responsible for protecting public health by closing ocean/bay waters and may close food-service businesses if a spill poses a threat to public health.
- **Regional Water Quality Control Boards—** Responsible for protecting State waters.
- **Orange County Stormwater Program—** Responsible for preventing harmful pollutants from being discharged or washed by stormwater runoff into the municipal storm drain system, creeks, bays and the ocean.

You Could Be Liable for Not Protecting the Environment

Local and state agencies have legal jurisdiction and enforcement authority to ensure that sewage spills are remedied.

They may respond and assist with containment, relieving pipe blockages, and/or clean-up of the sewage spill, especially if the spill is flowing into storm drains or onto public property.

A property owner may be charged for costs incurred by these agencies responding to spills from private properties.



Report Sewage Spills!

City Sewer/Public Works Departments

Aliso Viejo	(949) 425-2500
Anaheim	(714) 765-6860
Brea	(714) 990-7691
Buena Park	(714) 562-3655
Costa Mesa	(949) 645-8400
Cypress	(714) 229-6760
Dana Point	(949) 248-3562
Fountain Valley	(714) 593-4600
Fullerton	(714) 738-6897
Garden Grove	(714) 741-5375
Huntington Beach	(714) 536-5921
Irvine	(949) 453-5300
Laguna Beach	(949) 497-0765
Laguna Hills	(949) 707-2650
Laguna Niguel	(949) 362-4337
Laguna Woods	(949) 639-0500
La Habra	(562) 905-9792
Lake Forest	(949) 461-3480
La Palma	(714) 690-3310
Los Alamitos	(562) 431-3538
Mission Viejo	(949) 831-2500
Newport Beach	(949) 644-3011
Orange	(714) 532-6480
Orange County	(714) 567-6363
Placentia	(714) 993-8245
Rancho Santa Margarita	(949) 635-1800
San Clemente	(949) 366-1553
San Juan Capistrano	(949) 443-6363
Santa Ana	(714) 647-3380
Seal Beach	(562) 431-2527
Stanton	(714) 379-9222
Tustin	(714) 962-2411
Villa Park	(714) 998-1500
Westminster	(714) 893-3553
Yorba Linda	(714) 961-7170

Public Sewer/Water Districts

Costa Mesa Sanitary District	(714) 393-4433/ (949) 645-8400
El Toro Water District	(949) 837-0660
Emerald Bay Service District	(949) 494-8571
Garden Grove Sanitary District	(714) 741-5375
Irvine Ranch Water District	(949) 453-5300
Los Alamitos/Rossmoor Sewer District	(562) 431-2223
Midway City Sanitary District (Westminster)	(714) 893-3553
Moulton Niguel Water District	(949) 831-2500
Orange County Sanitation District	(714) 962-2411
Santa Margarita Water District	(949) 459-6420
South Coast Water District	(949) 499-4555
South Orange County Wastewater Authority	(949) 234-5400
Sunset Beach Sanitary District	(562) 493-9932
Trabuco Canyon Sanitary District	(949) 858-0277
Yorba Linda Water District	(714) 777-3018

Other Agencies

Orange County Health Care Agency	(714) 433-6419
Office of Emergency Services	(800) 852-7550



Clean beaches and healthy creeks, rivers, bays, and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Washwater, oil and residue from car washing should not flow into the street, gutter or storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump soap, oil or dirty water into the ocean, so don't let it enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL**
(1-877-897-7455)
or visit
www.ocwatersheds.com

To report a spill,
call the
Orange County 24-Hour
Water Pollution Problem
Reporting Hotline
at **1-877-89-SPILL**
(1-877-897-7455)

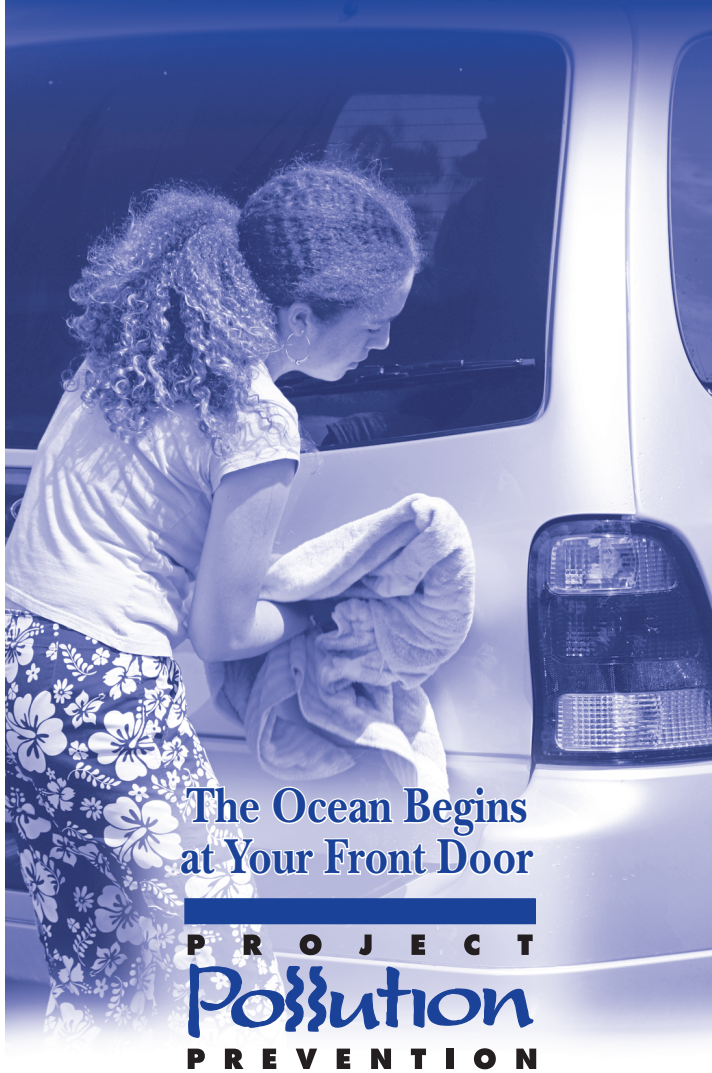
For emergencies, dial 911.

The tips contained in this brochure provide useful information about how you can keep soap, oil and washwater from car wash activities from entering the storm drain system. If you have other suggestions, please contact your city's stormwater representative or call the Orange County Stormwater Program.

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Help Prevent Ocean Pollution:

Tips for Car Wash Fund-Raisers



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Tips for Car Wash Fund-Raisers

Before beginning your car wash fund-raiser

- Partner with a professional car wash and avoid the pollution that parking lot car washes can produce.



- Hold a meeting with all participants to explain the proper procedures that should be followed when washing cars.
- Remove all trash and debris from the car washing area.
- Select only soaps, cleaners or detergents labeled "non-toxic," "phosphate-free," or "biodegradable." The safest products for the environment are vegetable-based or citrus-based soaps. However, even these soaps can be toxic for the environment, so never let any products enter the street, gutter or storm drain.
- Do not use acid based wheel cleaners or engine degreasers.
- Select a site where the washwater can soak into grass, gravel, or be diverted to nearby landscaping. This will allow the washwater to filter through the vegetation and/or soil instead of flowing directly into a storm drain.
- Divert the washwater to an area where the water can pool and evaporate throughout the day, or arrange to dispose of the washwater down a sanitary sewer drain. For details, refer to Factsheet *IC24 Wastewater Disposal Guidelines located* at **www.ocwatersheds.com/StormWater/documents_bmp_existing_development.asp#res**
- If there is a storm drain on-site, block it with sandbags. At the end of the day, dispose of the sandbags by dumping the contents in an authorized landscaped area.



During the fund-raiser

- Never let any trash or washwater enter the street, gutter or storm drain.
- Shake car mats in a trash can or vacuum them. Do not shake dirt from car mats directly onto the ground.
- Use a bucket of soapy water to re-soap rags or sponges throughout the day rather than adding soap directly to them.
- Wring sponges and washrags into buckets, not the ground.
- Conserve water by using a spray nozzle with an automatic shut-off. Turn off the water or kink the hose when not in use.
- Always empty buckets into the sanitary sewer system (e.g. sinks or toilets) or a landscaped area rather than pouring the water on concrete or asphalt.

After the fund-raiser

- Remember to clean up. Have a volunteer walk the perimeter of the site to pick up trash and debris and dispose of it properly.

PROJECT Pollution PREVENTION



Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Fertilizers, pesticides and other chemicals that are left on yards or driveways can be blown or washed into storm drains that flow to the ocean. Overwatering lawns can also send materials into storm drains. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never pour gardening products into the ocean, so don't let them enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

UCCE Master Gardener Hotline:
(714) 708-1646

To report a spill,
call the
Orange County 24-Hour
Water Pollution Problem
Reporting Hotline
1-877-89-SPILL (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while landscaping or gardening. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

Printed on Recycled Paper

Help Prevent Ocean Pollution:

Tips for Landscape & Gardening



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Tips for Landscape & Gardening

Never allow gardening products or polluted water to enter the street, gutter or storm drain.

General Landscaping Tips

- Protect stockpiles and materials from wind and rain by storing them under tarps or secured plastic sheeting.
- Prevent erosion of slopes by planting fast-growing, dense ground covering plants. These will shield and bind the soil.
- Plant native vegetation to reduce the amount of water, fertilizers, and pesticide applied to the landscape.



- Never apply pesticides or fertilizers when rain is predicted within the next 48 hours.

Garden & Lawn Maintenance

- Do not overwater. Use irrigation practices such as drip irrigation, soaker hoses or micro spray systems. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of green waste by composting, hauling it to a permitted landfill, or recycling it through your city's program.



- Use slow-release fertilizers to minimize leaching, and use organic fertilizers.
- Read labels and use only as directed. Do not over-apply pesticides or fertilizers. Apply to spots as needed, rather than blanketing an entire area.
- Store pesticides, fertilizers and other chemicals in a dry covered area to prevent exposure that may result in the deterioration of containers and packaging.



- Rinse empty pesticide containers and re-use rinse water as you would use the product. Do not dump rinse water down storm drains. Dispose of empty containers in the trash.
- When available, use non-toxic alternatives to traditional pesticides, and use pesticides specifically designed to control the pest you are targeting. For more information, visit **www.ipm.ucdavis.edu**.
- If fertilizer is spilled, sweep up the spill before irrigating. If the spill is liquid, apply an absorbent material such as cat litter, and then sweep it up and dispose of it in the trash.
- Take unwanted pesticides to a Household Hazardous Waste Collection Center to be recycled. Locations are provided below.

Household Hazardous Waste Collection Centers

Anaheim:	1071 N. Blue Gum St.
Huntington Beach:	17121 Nichols St.
Irvine:	6411 Oak Canyon
San Juan Capistrano:	32250 La Pata Ave.

For more information, call (714) 834-6752 or visit www.oclandfills.com



Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities such as painting can lead to water pollution if you're not careful. Paint must be used, stored and disposed of properly to ensure that it does not enter the street, gutter or storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump paint into the ocean, so don't let it enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

To report a spill,
call the
Orange County 24-Hour Water Pollution Problem Reporting Hotline
at **1-877-89-SPILL** (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while using, storing and disposing of paint. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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Help Prevent Ocean Pollution:

Tips for Projects Using Paint



Tips for Projects Using Paint

Paint can cause significant damage to our environment. Whether you hire a contractor or do it yourself, it is important to follow these simple tips when purchasing, using, cleaning, storing and disposing of paint.

Purchasing Paint

- Measure the room or object to be painted, then buy only the amount needed.
- Whenever possible, use water-based paint since it usually does not require hazardous solvents such as paint thinner for cleanup.

Painting

- Use only one brush or roller per color of paint to reduce the amount of water needed for cleaning.
- Place open paint containers or trays on a stable surface and in a position that is unlikely to spill.
- Always use a tarp under the area or object being painted to collect paint drips and contain spills.

Cleaning

- Never clean brushes or rinse paint containers in the street, gutter or storm drain.
- For oil-based products, use as much of the paint on the brushes as possible. Clean brushes with thinner. To reuse thinner, pour it through a fine filter (e.g. nylon, metal gauze or filter paper) to remove solids such as leftover traces of paint.
- For water-based products, use as much of the paint on the brushes as possible, then rinse in the sink.
- Collect all paint chips and dust. Chips and dust from marine paints or paints containing lead, mercury or tributyl tin are hazardous waste. Sweep up and dispose of at a Household Hazardous Waste Collection Center (HHWCC).

Storing Paint

- Store paint in a dry location away from the elements.
- Store leftover water-based paint, oil-based paint and solvents separately in original or clearly marked containers.
- Avoid storing paint cans directly on cement floors. The bottom of the can will rust much faster on cement.
- Place the lid on firmly and store the paint can upside-down to prevent air from entering. This will keep the paint usable longer. Oil-based paint is usable for up to 15 years. Water-based paint remains usable for up to 10 years.

Alternatives to Disposal

- Use excess paint to apply another coat, for touch-ups, or to paint a closet, garage, basement or attic.
- Give extra paint to friends or family. Extra paint can also be donated to a local theatre group, low-income housing program or school.
- Take extra paint to an exchange program such as the **"Stop & Swap"** that allows you to drop off or pick up partially used home care products free of charge. **"Stop & Swap"** programs are available at most HHWCCs.
- For HHWCC locations and hours, call **(714) 834-6752** or visit **www.oclandfills.com**.



Disposing of Paint

- Never put wet paint in the trash.

For water-based paint:

- If possible, brush the leftover paint on cardboard or newspaper. Otherwise, allow the paint to dry in the can with the lid off in a well-ventilated area protected from the elements, children and pets. Stirring the paint every few days will speed up the drying.
- Large quantities of extra paint should be taken to a HHWCC.
- Once dried, paint and painted surfaces may be disposed of in the trash. When setting a dried paint can out for trash collection, leave the lid off so the collector will see that the paint has dried.

For oil-based paint:

- Oil-based paint is a household hazardous waste. All leftover paint should be taken to a HHWCC.

Aerosol paint:

- Dispose of aerosol paint cans at a HHWCC.

Spills

- Never hose down pavement or other impermeable surfaces where paint has spilled.
- Clean up spills immediately by using an absorbent material such as cat litter. Cat litter used to clean water-based paint spills can be disposed of in the trash. When cleaning oil-based paint spills with cat litter, it must be taken to a HHWCC.
- Immediately report spills that have entered the street, gutter or storm drain to the County's 24-Hour Water Pollution Problem Reporting Hotline at **(714) 567-6363** or visit **www.ocwatersheds.com** to fill out an incident reporting form.

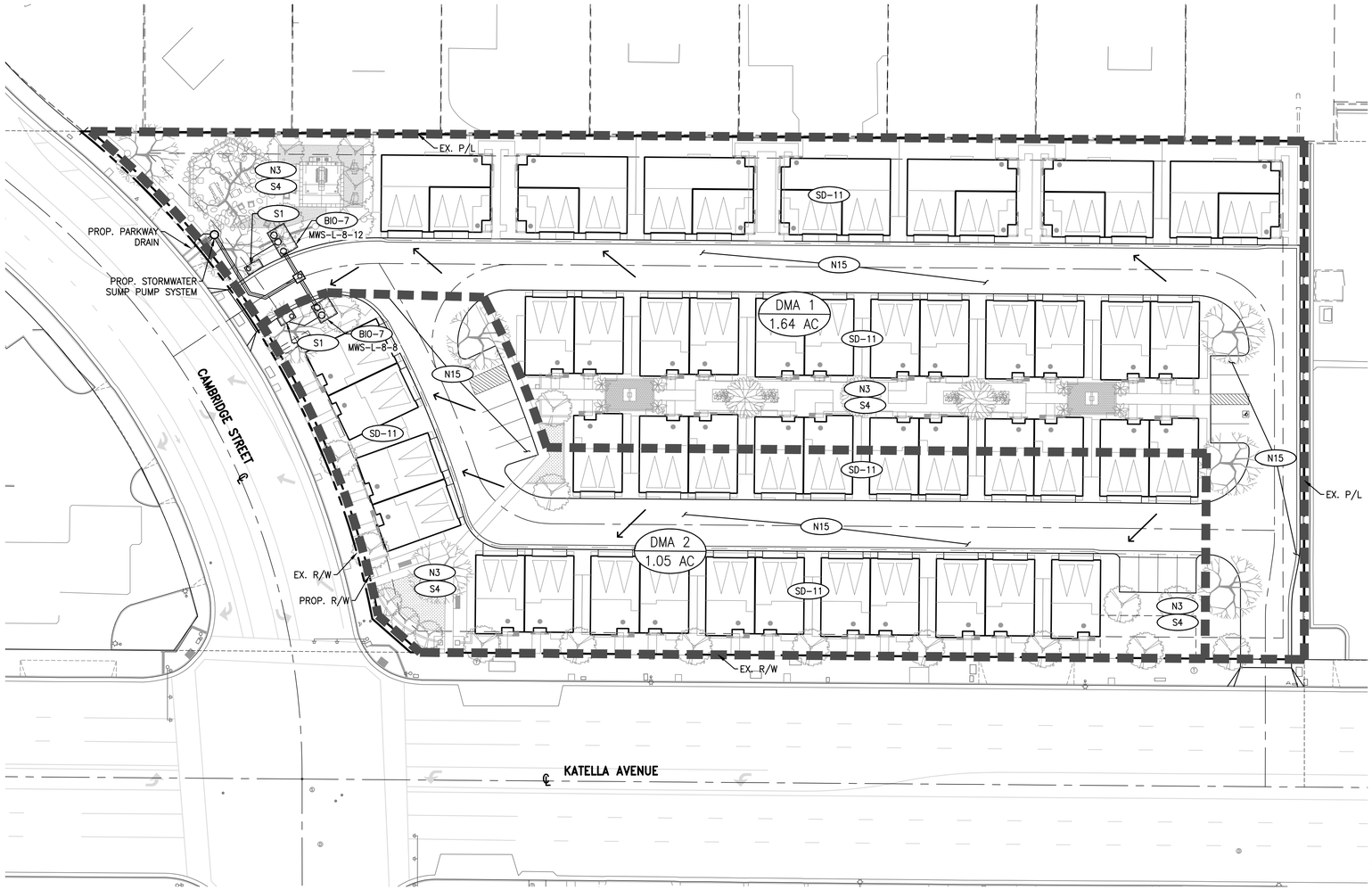
PROJECT Pollution PREVENTION

Appendix C:

Site Plan & BMP Details

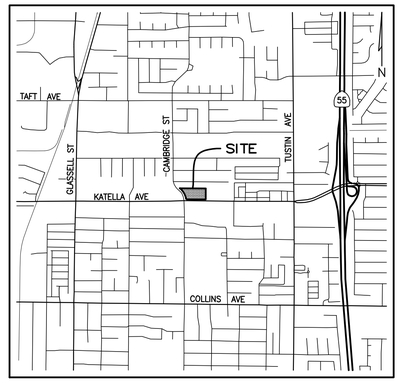
PRELIMINARY WQMP EXHIBIT

901 E. KATELLA AVENUE
CITY OF ORANGE, COUNTY OF ORANGE
STATE OF CALIFORNIA



SCALE: 1" = 30'

0 15 30 60



VICINITY MAP
NOT TO SCALE

LEGEND

- EXISTING RIGHT-OF-WAY/ BOUNDARY
- PROPOSED RIGHT-OF-WAY/ BOUNDARY
- DRAINAGE MANAGEMENT AREA (DMA)
- PROPOSED STORM DRAIN
- SURFACE RUNOFF FLOW ARROWS / STORM DRAIN FLOW ARROWS
- PROPOSED MWS BIOFILTRATION VAULT
- PROPOSED CATCH BASIN
- DMA X / X.XX AC — DRAINAGE MANAGEMENT AREA (DMA) / ACREAGE
- PROPOSED LANDSCAPING
- PROPOSED ASPHALT CONCRETE (AC) PAVEMENT
- PROPOSED ENHANCED PAVEMENT
- PROPOSED PCC PAVEMENT

STRUCTURAL & NON-STRUCTURAL SOURCE CONTROLS:

N3 / S4	SITE DESIGN & LANDSCAPE PLANNING/ EFFICIENT IRRIGATION
SD-11	ROOF RUNOFF CONTROLS
N11 / S3	COMMON AREA LITTER CONTROL/ TRASH ENCLOSURES
N14 / S1	CATCH BASIN INSPECTIONS/ STORM DRAIN SIGNAGE/DRAIN INSERT FILTER
N15	STREET SWEEPING & VACUUMING
BIO-7	PROPRIETARY BIOTREATMENT – MODULAR WETLANDS SYSTEM (MWS), BIOFILTRATION VAULT

NOTES:
1. ASSUME ALL SOIL GROUP D
2. SITE IS LOCATED WITHIN THE LOWER SANTA ANA RIVER WATERSHED
3. GENERAL PLAN LAND USE: MEDIUM DENSITY RESIDENTIAL
4. EXISTING ZONING: COMMERCIAL PROFESSIONAL (C-P)
6. DESIGN CAPTURE STORM DEPTH = 0.85"
7. TOTAL SITE AREA: 117,220 SF (2.69 AC)

REVISIONS

NO	DATE	INITIAL	DESCRIPTION	APP	DATE

DEVELOPER:
INTRACORP HOMES
895 DOVE STREET, SUITE 400
NEWPORT BEACH, CA 92660
PHONE (949) 955-2370

SOILS ENGINEER:
GEOTEK, INC.
1548 N. MAPLE STREET
CORONA, CA 92880
PHONE (951) 710-1160

PREPARED BY :
C&V CONSULTING, INC.
CIVIL ENGINEERING
LAND PLANNING & SURVEYING
9830 IRVINE CENTER DRIVE
IRVINE, CALIFORNIA 92618
(949) 916-3800
INFO@CVC-INC.NET
WWW.CVC-INC.NET

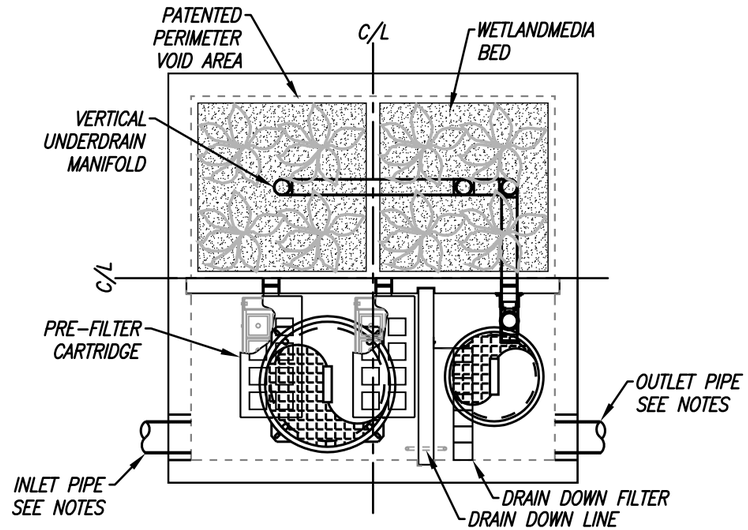
REGISTERED PROFESSIONAL ENGINEER
RYAN J. BITTNER
No. 68167
CIVIL
STATE OF CALIFORNIA

PRELIMINARY WQMP EXHIBIT
901 E. KATELLA AVENUE
SHEET 1 OF 1
SCALE: AS SHOWN | DRAWN BY: MC | CHECKED BY: JH
CITY OF ORANGE

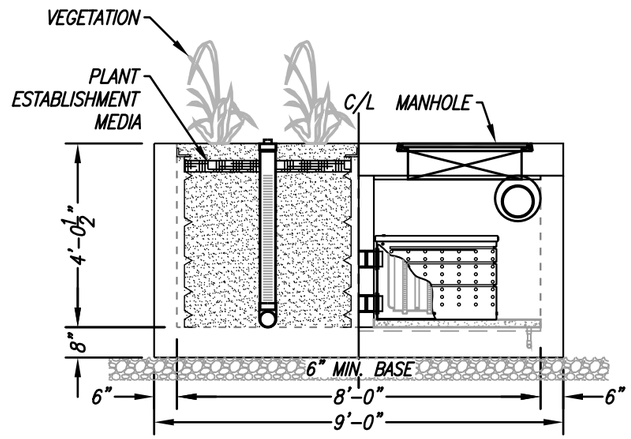
MWS Linear 2.0 HGL Sizing Calculations

MWS MODEL SIZE	WETLAND PERMITER LENGTH	LOADING RATE GPM/SF	HGL HEIGHT																												
			SHALLOW MODELS																			STANDARD HEIGHT MODEL	HIGH CAPACITY MODELS									
			1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.65	3.70	3.75	3.80	3.85	3.90	3.95
MWS-L-4-4	6.70	1.0	0.022	0.023	0.025	0.026	0.028	0.029	0.031	0.032	0.034	0.035	0.037	0.038	0.040	0.042	0.043	0.045	0.046	0.048	0.049	0.051	**0.052**	0.054	0.055	0.056	0.057	0.058	0.058	0.059	0.060	0.061
~~**MWS-L-4-6**~~	~~10.00~~	~~1.0~~	~~0.032~~	~~0.035~~	~~0.037~~	~~0.039~~	~~0.042~~	~~0.044~~	~~0.046~~	~~0.048~~	~~0.051~~	~~0.053~~	~~0.055~~	~~0.058~~	~~0.060~~	~~0.062~~	~~0.065~~	~~0.067~~	~~0.069~~	~~0.072~~	~~0.074~~	~~0.076~~	**0.078**	~~0.081~~	~~0.083~~	~~0.084~~	~~0.085~~	~~0.087~~	~~0.088~~	~~0.089~~	~~0.090~~	~~0.091~~
MWS-L-4-6	9.30	1.0	0.030	0.032	0.034	0.036	0.038	0.041	0.043	0.045	0.047	0.049	0.051	0.053	0.055	0.058	0.060	0.062	0.064	0.066	0.068	0.070	**0.073**	0.075	0.077	0.078	0.079	0.080	0.081	0.082	0.083	0.084
MWS-L-4-8	14.80	1.0	0.048	0.051	0.054	0.058	0.061	0.065	0.068	0.071	0.075	0.078	0.082	0.085	0.088	0.092	0.095	0.099	0.102	0.105	0.109	0.112	**0.115**	0.119	0.122	0.124	0.126	0.127	0.129	0.131	0.132	0.134
MWS-L-4-13	18.40	1.0	0.059	0.063	0.068	0.072	0.076	0.080	0.084	0.089	0.093	0.097	0.101	0.106	0.110	0.114	0.118	0.122	0.127	0.131	0.135	0.139	**0.144**	0.148	0.152	0.154	0.156	0.158	0.160	0.163	0.165	0.167
MWS-L-4-15	22.40	1.0	0.072	0.077	0.082	0.087	0.093	0.098	0.103	0.108	0.113	0.118	0.123	0.129	0.134	0.139	0.144	0.149	0.154	0.159	0.165	0.170	**0.175**	0.180	0.185	0.188	0.190	0.193	0.195	0.198	0.200	0.203
MWS-L-4-17	26.40	1.0	0.085	0.091	0.097	0.103	0.109	0.115	0.121	0.127	0.133	0.139	0.145	0.151	0.158	0.164	0.170	0.176	0.182	0.188	0.194	0.200	**0.206**	0.212	0.218	0.221	0.224	0.227	0.230	0.233	0.236	0.239
MWS-L-4-19	30.40	1.0	0.098	0.105	0.112	0.119	0.126	0.133	0.140	0.147	0.153	0.160	0.167	0.174	0.181	0.188	0.195	0.202	0.209	0.216	0.223	0.230	**0.237**	0.244	0.251	0.255	0.258	0.262	0.265	0.269	0.272	0.276
MWS-L-4-21	34.40	1.0	0.111	0.118	0.126	0.134	0.142	0.150	0.158	0.166	0.174	0.182	0.189	0.197	0.205	0.213	0.221	0.229	0.237	0.245	0.253	0.261	**0.268**	0.276	0.284	0.288	0.292	0.296	0.300	0.304	0.308	0.312
MWS-L-6-8	18.80	1.0	0.060	0.065	0.069	0.073	0.078	0.082	0.086	0.091	0.095	0.099	0.104	0.108	0.112	0.116	0.121	0.125	0.129	0.134	0.138	0.142	**0.147**	0.151	0.155	0.157	0.160	0.162	0.164	0.166	0.168	0.170
MWS-L-8-8	29.60	1.0	0.095	0.102	0.109	0.115	0.122	0.129	0.136	0.143	0.149	0.156	0.163	0.170	0.177	0.183	0.190	0.197	0.204	0.211	0.217	0.224	**0.231**	0.238	0.245	0.248	0.251	0.255	0.258	0.262	0.265	0.268
MWS-L-8-12	44.40	1.0	0.143	0.153	0.163	0.173	0.183	0.194	0.204	0.214	0.224	0.234	0.245	0.255	0.265	0.275	0.285	0.296	0.306	0.316	0.326	0.336	**0.346**	0.357	0.367	0.372	0.377	0.382	0.387	0.392	0.397	0.402
MWS-L-8-16	59.20	1.0	0.190	0.204	0.217	0.231	0.245	0.258	0.272	0.285	0.299	0.312	0.326	0.340	0.353	0.367	0.380	0.394	0.408	0.421	0.435	0.448	**0.462**	0.476	0.489	0.496	0.503	0.509	0.516	0.523	0.530	0.537
MWS-L-8-20	74.00	1.0	0.238	0.255	0.272	0.289	0.306	0.323	0.340	0.357	0.374	0.391	0.408	0.425	0.442	0.459	0.476	0.493	0.509	0.526	0.543	0.560	**0.577**	0.594	0.611	0.620	0.628	0.637	0.645	0.654	0.662	0.671
MWS-L-10-20 or MWS-L-8-24	88.80	1.0	0.285	0.306	0.326	0.346	0.367	0.387	0.408	0.428	0.448	0.469	0.489	0.509	0.530	0.550	0.571	0.591	0.611	0.632	0.652	0.673	**0.693**	0.713	0.734	0.744	0.754	0.764	0.774	0.785	0.795	0.805
4'x'4 media cage	14.80	1.0	0.048	0.051	0.054	0.058	0.061	0.065	0.068	0.071	0.075	0.078	0.082	0.085	0.088	0.092	0.095	0.099	0.102	0.105	0.109	0.112	**0.115**	0.119	0.122	0.124						

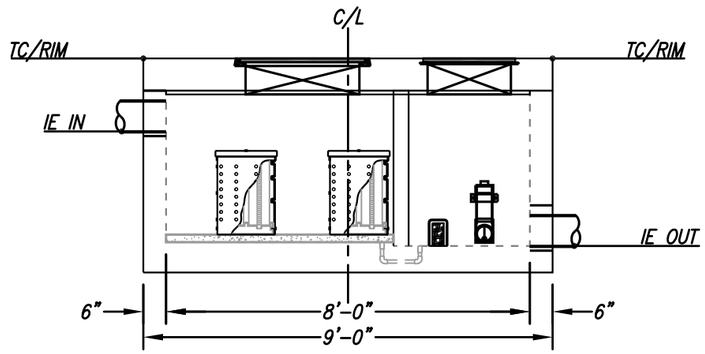
SITE SPECIFIC DATA			
PROJECT NAME		KATELLA AVENUE PROJECT	
PROJECT LOCATION		5701 KATELLA AVENUE, CYPRESS	
STRUCTURE ID		TBD	
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
N/A		0.156	
TREATMENT HGL AVAILABLE (FT)			TBD
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			N/A
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	TBD	TBD	TBD
INLET PIPE 2	TBD	TBD	TBD
OUTLET PIPE	TBD	TBD	TBD
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION	TBD	TBD	TBD
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	ø30"	N/A	ø24"
WETLANDMEDIA VOLUME (CY)			4.84
WETLANDMEDIA DELIVERY METHOD			TBD
ORIFICE SIZE (DIA. INCHES)			ø2.16"
MAXIMUM PICK WEIGHT (LBS)			TBD
NOTES:			



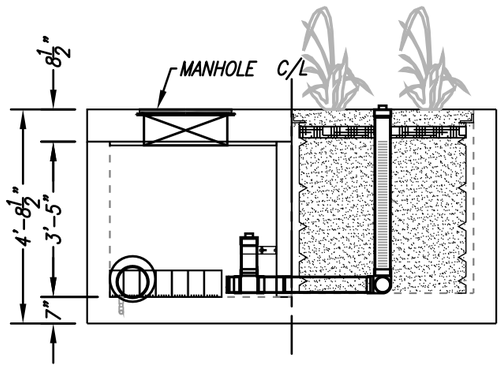
PLAN VIEW



LEFT END VIEW
BIOFILTRATION/PRETREATMENT



ELEVATION VIEW



RIGHT END VIEW
DISCHARGE/BIOFILTRATION

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. DRIP OR SPRAY IRRIGATION REQUIRED ON ALL UNITS WITH VEGETATION.

GENERAL NOTES

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

TREATMENT FLOW (CFS)	0.230
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	TBD
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

THE PRODUCT DESCRIBED MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

PROPRIETARY AND CONFIDENTIAL:

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF MODULAR WETLANDS SYSTEMS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF MODULAR WETLANDS SYSTEMS IS PROHIBITED.

MODULAR WETLANDS
www.ModularWetlands.com | (855) 5MOD-WET

MWS-L-8-8-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

SITE SPECIFIC DATA*	
PROJECT NAME	
PROJECT LOCATION	
STRUCTURE ID	

PERFORMANCE DATA	
TREATMENT VOLUME (CF)	
DRAINDOWN TIME (HR)	
TREATMENT HGL (FT)	
BYPASS FLOW RATE (CFS)	

PROJECT PARAMETERS			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
OUTLET PIPE 1			
RIM ELEVATION			
SURFACE LOADING REQUIREMENT			

FRAME & COVER	PRETREATMENT	BIOFILTRATION	DISCHARGE

WETLANDMEDIA VOLUME (CY)	
MEDIA DELIVERED	
ORIFICE SIZE (DIA)	
MAX PICK WEIGHT (LBS)	

NOTES:

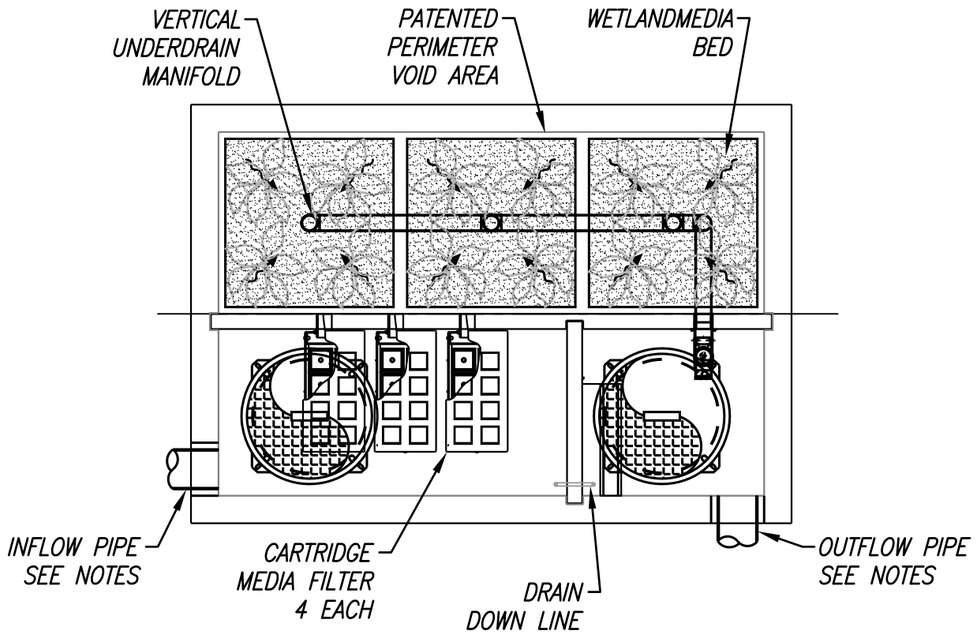
*PER ENGINEER OF RECORD

INSTALLATION NOTES

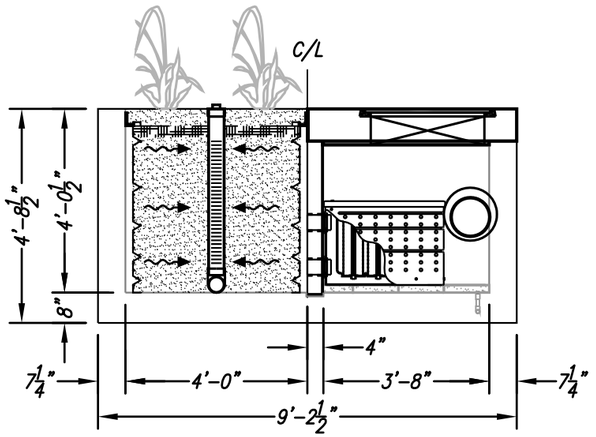
1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. MANUFACTURER RECOMMENDS A MINIMUM 6"LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH).
4. INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR.
5. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
6. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.

GENERAL NOTES

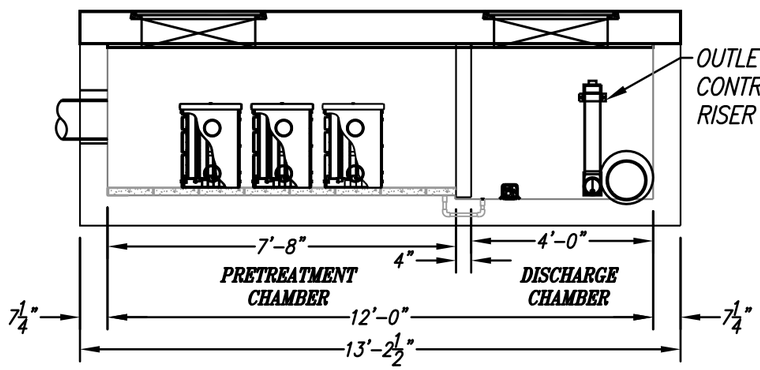
1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT MANUFACTURER.



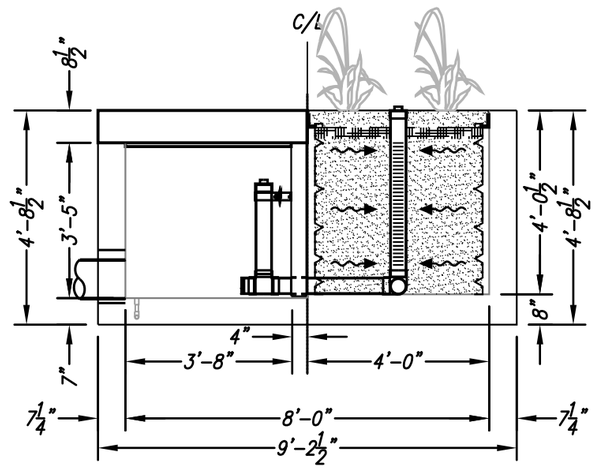
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT END VIEW

MWS UNIT DESIGN DATA	
TREATMENT CAPACITY (CFS)	0.346
OPERATING HEAD (FT)	3.4
PRETREATMENT SURFACE AREA (SF)	105.84
WETLAND LOADING RATE (GPM/MIN)	1.04

THE PRODUCT DESCRIBED MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

PROPRIETARY AND CONFIDENTIAL:

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF MODULAR WETLANDS SYSTEMS. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF MODULAR WETLANDS SYSTEMS IS PROHIBITED.

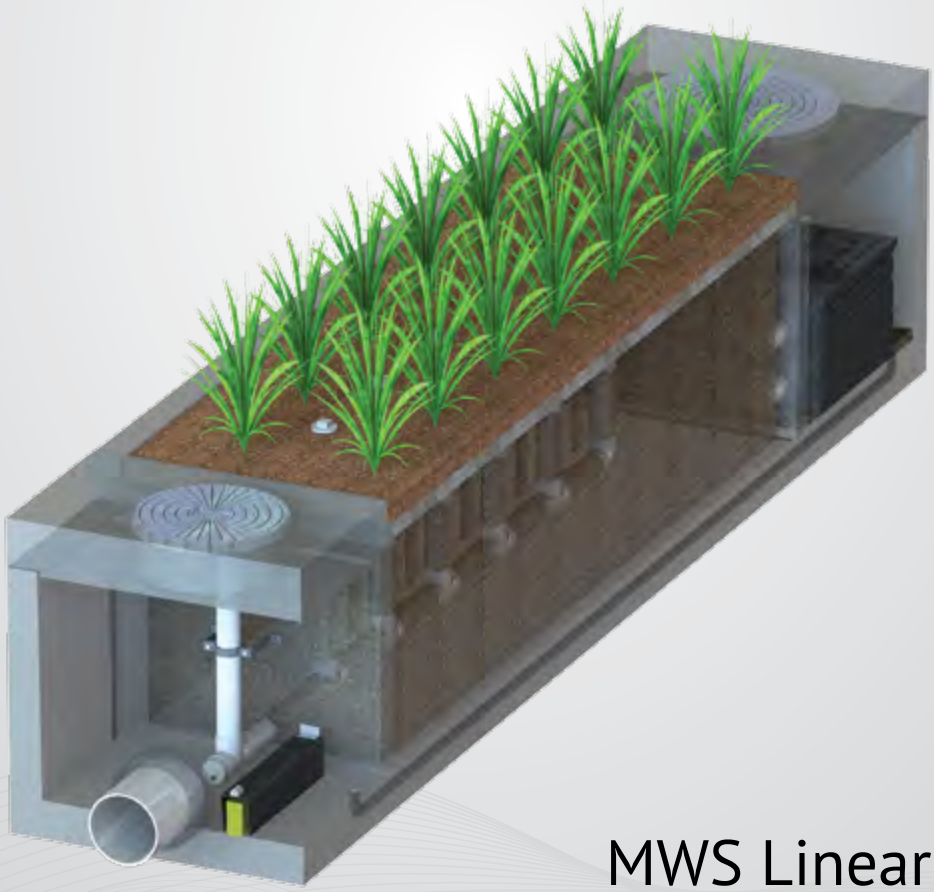
MODULAR WETLANDS

MWS-L-8-12-V

STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL

MODULAR WETLANDS™

*Advanced **Stormwater** Biofiltration*



MWS Linear



Contents

1 Introduction

2 Applications

3 Configurations

4 Advantages

5 Operation

6 Orientations | Bypass

7 Performance | Approvals

8 Sizing

9 Installation | Maintenance | Plants

The Urban Impact

For hundreds of years natural wetlands surrounding our shores have played an integral role as nature's stormwater treatment system. But as our cities grow and develop, these natural wetlands have perished under countless roads, rooftops, and parking lots.



Plant A Wetland

Without natural wetlands our cities are deprived of water purification, flood control, and land stability. Modular Wetlands and the MWS Linear re-establish nature's presence and rejuvenate water ways in urban areas.





MWS Linear

The Modular Wetland System Linear represents a pioneering breakthrough in stormwater technology as the only biofiltration system to utilize patented horizontal flow, allowing for a smaller footprint and higher treatment capacity. While most biofilters use little or no pre-treatment, the MWS Linear incorporates an advanced pre-treatment chamber that includes separation and pre-filter cartridges. In this chamber sediment and hydrocarbons are removed from runoff before it enters the biofiltration chamber, in turn reducing maintenance costs and improving performance.

Applications

The MWS Linear has been successfully used on numerous new construction and retrofit projects. The system's superior versatility makes it beneficial for a wide range of stormwater and waste water applications - treating rooftops, streetscapes, parking lots, and industrial sites.



Industrial

Many states enforce strict regulations for discharges from industrial sites. The MWS Linear has helped various sites meet difficult EPA mandated effluent limits for dissolved metals and other pollutants.



Residential

Low to high density developments can benefit from the versatile design of the MWS Linear. The system can be used in both decentralized LID design and cost-effective end-of-the-line configurations.



Streets

Street applications can be challenging due to limited space. The MWS Linear is very adaptable, and offers the smallest footprint to work around the constraints of existing utilities on retrofit projects.



Parking Lots

Parking lots are designed to maximize space and the MWS Linear's 4 ft. standard planter width allows for easy integration into parking lot islands and other landscape medians.



Commercial

Compared to bioretention systems, the MWS Linear can treat far more area in less space - meeting treatment and volume control requirements.



Mixed Use

The MWS Linear can be installed as a raised planter to treat runoff from rooftops or patios, making it perfect for sustainable "live-work" spaces.

More applications are available on our website: www.ModularWetlands.com/Applications

- Agriculture
- Reuse
- Low Impact Development
- Waste Water





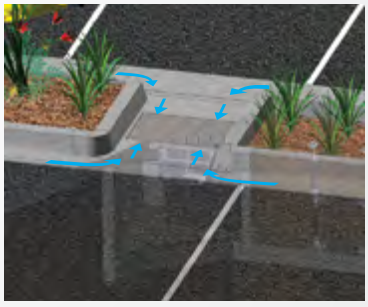
Configurations

The MWS Linear is the preferred biofiltration system of Civil Engineers across the country due to its versatile design. This highly versatile system has available "pipe-in" options on most models, along with built-in curb or grated inlets for simple integration into your stormdrain design.



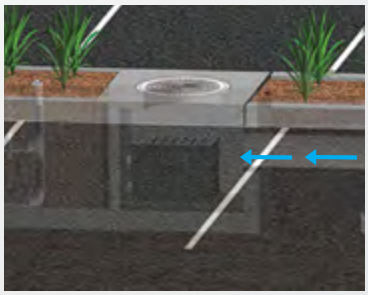
Curb Type

The *Curb Type* configuration accepts sheet flow through a curb opening and is commonly used along road ways and parking lots. It can be used in sump or flow by conditions. Length of curb opening varies based on model and size.



Grate Type

The *Grate Type* configuration offers the same features and benefits as the *Curb Type* but with a grated/drop inlet above the systems pre-treatment chamber. It has the added benefit of allowing for pedestrian access over the inlet. ADA compliant grates are available to assure easy and safe access. The *Grate Type* can also be used in scenarios where runoff needs to be intercepted on both sides of landscape islands.



Vault Type

The system's patented horizontal flow biofilter is able to accept inflow pipes directly into the pre-treatment chamber, meaning the MWS Linear can be used in end-of-the-line installations. This greatly improves feasibility over typical decentralized designs that are required with other biofiltration/bioretention systems. Another benefit of the "pipe in" design is the ability to install the system downstream of underground detention systems to meet water quality volume requirements.



Downspout Type

The *Downspout Type* is a variation of the *Vault Type* and is designed to accept a vertical downspout pipe from roof top and podium areas. Some models have the option of utilizing an internal bypass, simplifying the overall design. The system can be installed as a raised planter and the exterior can be stuccoed or covered with other finishes to match the look of adjacent buildings.

Advantages & Operation

The MWS Linear is the most efficient and versatile biofiltration system on the market, and the only system with horizontal flow which improves performance, reduces footprint, and minimizes maintenance. Figure-1 and Figure-2 illustrate the invaluable benefits of horizontal flow and the multiple treatment stages.

Featured Advantages

- Horizontal Flow Biofiltration
- Greater Filter Surface Area
- Pre-Treatment Chamber
- Patented Perimeter Void Area
- Flow Control
- No Depressed Planter Area

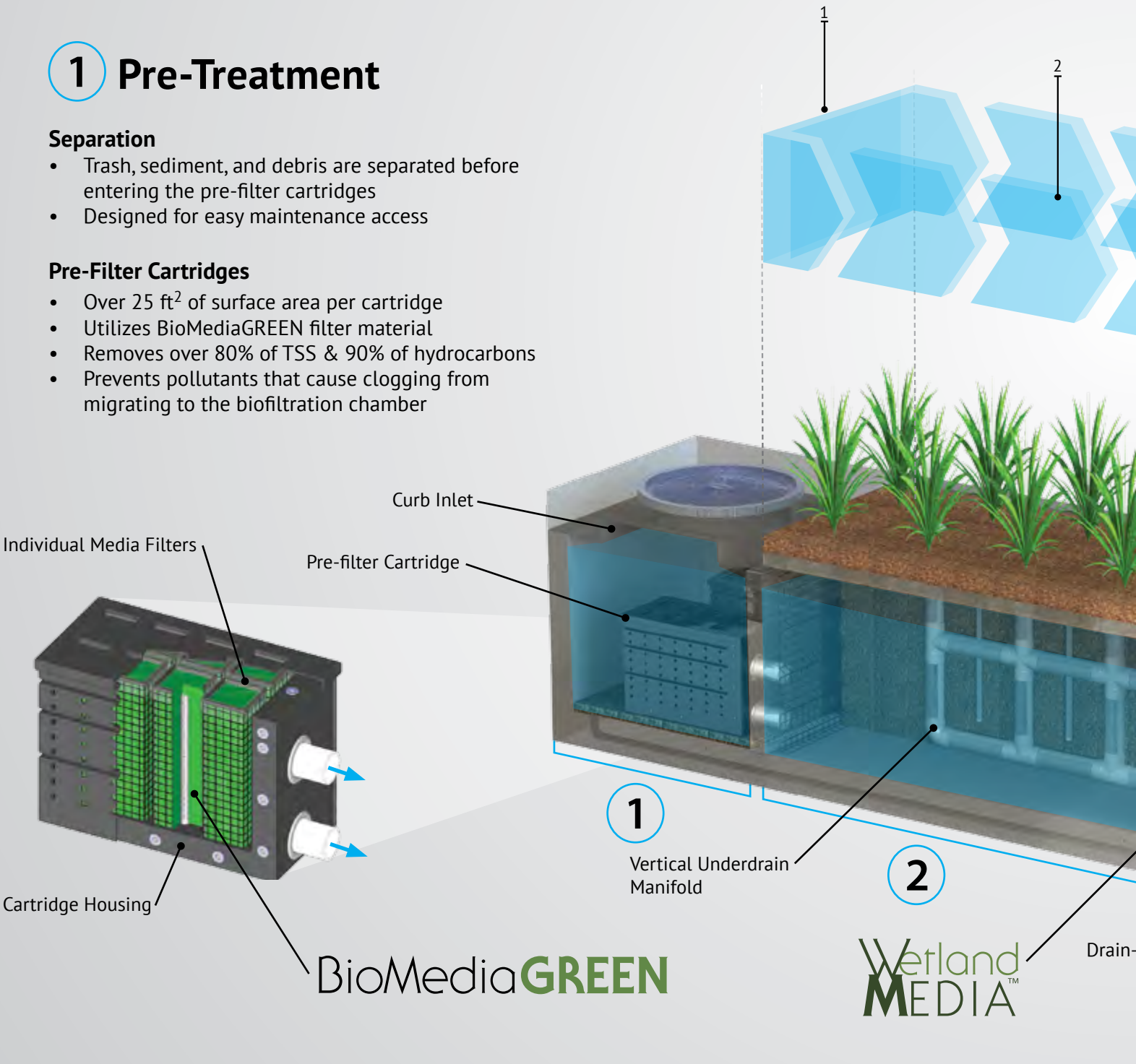
1 Pre-Treatment

Separation

- Trash, sediment, and debris are separated before entering the pre-filter cartridges
- Designed for easy maintenance access

Pre-Filter Cartridges

- Over 25 ft^2 of surface area per cartridge
- Utilizes BioMediaGREEN filter material
- Removes over 80% of TSS & 90% of hydrocarbons
- Prevents pollutants that cause clogging from migrating to the biofiltration chamber



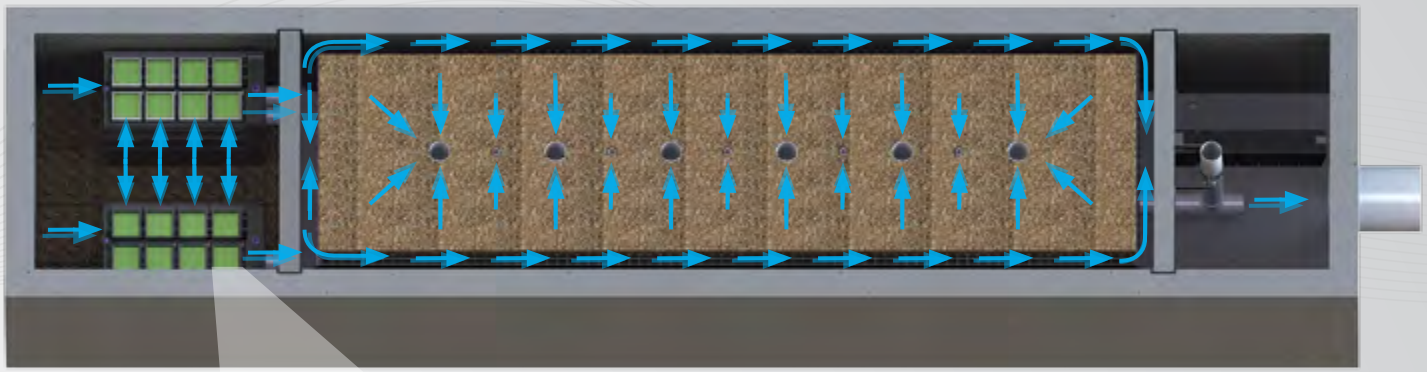


Fig. 2 - Top View

2x to 3x More Surface Area Than Traditional Downward Flow Bioretention Systems.



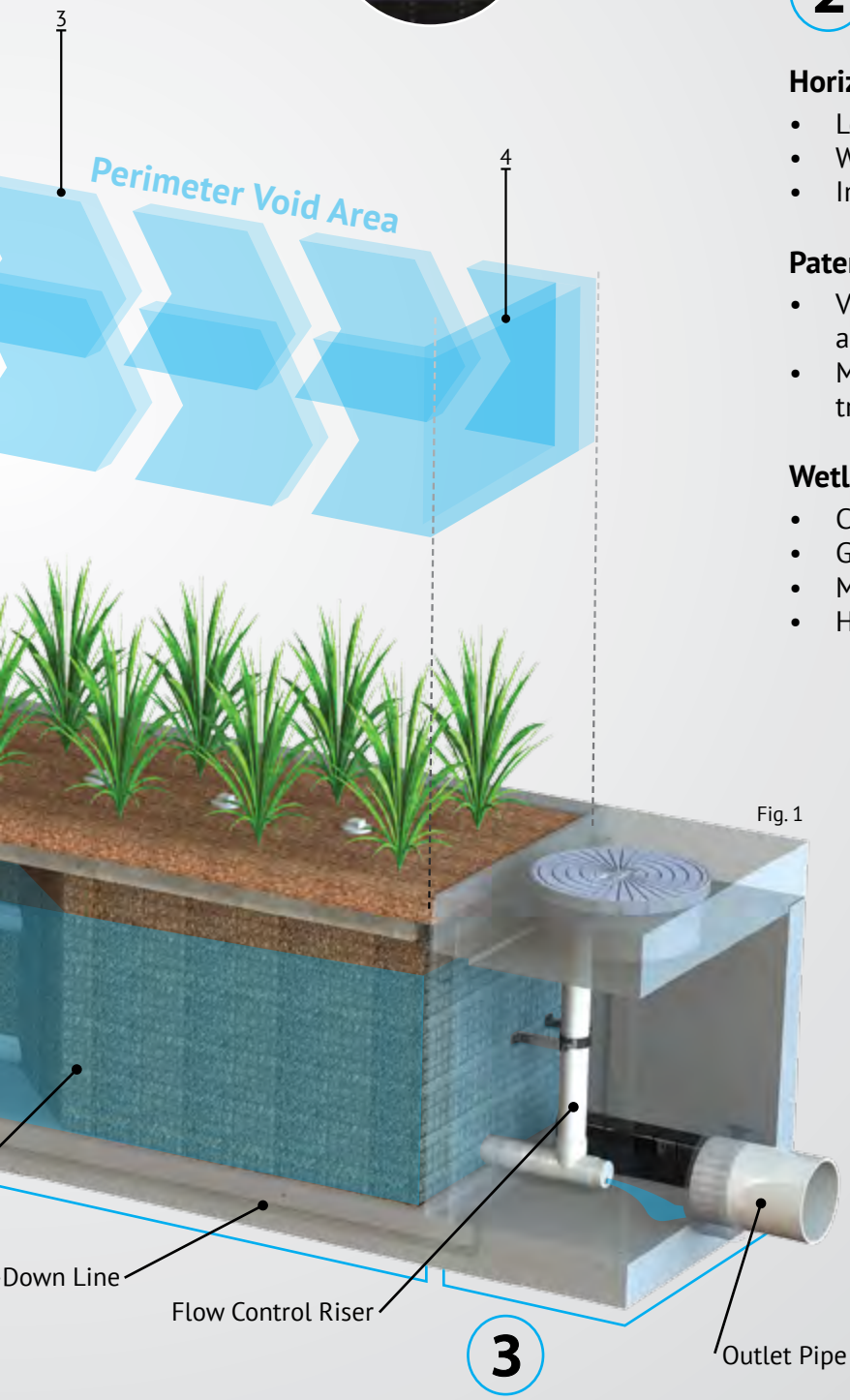


Fig. 1

2 Biofiltration

Horizontal Flow

- Less clogging than downward flow biofilters
- Water flow is subsurface
- Improves biological filtration

Patented Perimeter Void Area

- Vertically extends void area between the walls and the WetlandMEDIA on all four sides.
- Maximizes surface area of the media for higher treatment capacity

WetlandMEDIA

- Contains no organics and removes phosphorus
- Greater surface area and 48% void space
- Maximum evapotranspiration
- High ion exchange capacity and light weight

3 Discharge

Flow Control

- Orifice plate controls flow of water through WetlandMEDIA to a level lower than the media's capacity.
- Extends the life of the media and improves performance

Drain-Down Filter

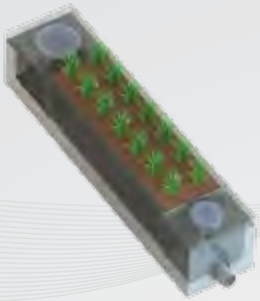
- The Drain-Down is an optional feature that completely drains the pre-treatment chamber
- Water that drains from the pre-treatment chamber between storm events will be treated

Orientations



Side-By-Side

The *Side-By-Side* orientation places the pre-treatment and discharge chamber adjacent to one another with the biofiltration chamber running parallel on either side. This minimizes the system length, providing a highly compact footprint. It has been proven useful in situations such as streets with directly adjacent sidewalks, as half of the system can be placed under that sidewalk. This orientation also offers internal bypass options as discussed below.



End-To-End

The *End-To-End* orientation places the pre-treatment and discharge chambers on opposite ends of the biofiltration chamber therefore minimizing the width of the system to 5 ft (outside dimension). This orientation is perfect for linear projects and street retrofits where existing utilities and sidewalks limit the amount of space available for installation. One limitation of this orientation is bypass must be external.

Bypass

Internal Bypass Weir (Side-by-Side Only)

The *Side-By-Side* orientation places the pre-treatment and discharge chambers adjacent to one another allowing for integration of internal bypass. The wall between these chambers can act as a bypass weir when flows exceed the system's treatment capacity, thus allowing bypass from the pre-treatment chamber directly to the discharge chamber.

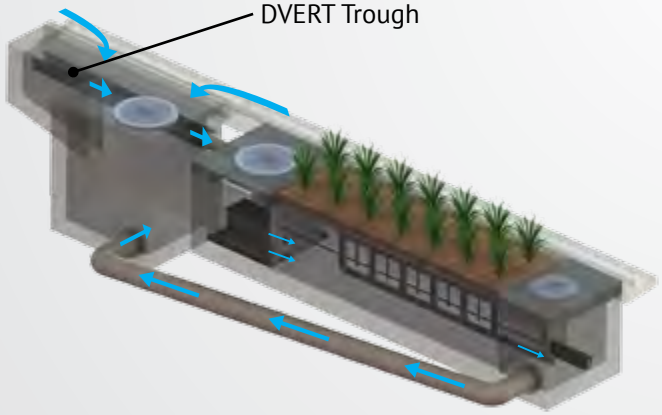
External Diversion Weir Structure

This traditional offline diversion method can be used with the MWS Linear in scenarios where runoff is being piped to the system. These simple and effective structures are generally configured with two outflow pipes. The first is a smaller pipe on the upstream side of the diversion weir - to divert low flows over to the MWS Linear for treatment. The second is the main pipe that receives water once the system has exceeded treatment capacity and water flows over the weir.

Flow By Design

This method is one in which the system is placed just upstream of a standard curb or grate inlet to intercept the first flush. Higher flows simply pass by the MWS Linear and into the standard inlet downstream.

DVERT Low Flow Diversion



This simple yet innovative diversion trough can be installed in existing or new curb and grate inlets to divert the first flush to the MWS Linear via pipe. It works similar to a rain gutter and is installed just below the opening into the inlet. It captures the low flows and channels them over to a connecting pipe exiting out the wall of the inlet and leading to the MWS Linear. The DVERT is perfect for retrofit and green street applications that allows the MWS Linear to be installed anywhere space is available.





Performance

The MWS Linear continues to outperform other treatment methods with superior pollutant removal for TSS, heavy metals, nutrients, hydrocarbons and bacteria. Since 2007 the MWS Linear has been field tested on numerous sites across the country. With it's advanced pre-treatment chamber and innovative horizontal flow biofilter, the system is able to effectively remove pollutants through a combination of physical, chemical, and biological filtration processes. With the same biological processes found in natural wetlands, the MWS Linear harnesses natures ability to process, transform, and remove even the most harmful pollutants.

Approvals

The MWS Linear has successfully met years of challenging technical reviews and testing from some of the most prestigious and demanding agencies in the nation, and perhaps the world.



Washington State DOE Approved

The MWS Linear is approved for General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus treatment at 1 gpm/ft^2 loading rate. The highest performing BMP on the market for all main pollutant categories.

TSS	Total Phosphorus	Ortho Phosphorus	Nitrogen	Dissolved Zinc	Dissolved Copper	Total Zinc	Total Copper	Motor Oil
85%	64%	67%	45%	66%	38%	69%	50%	95%



DEQ Assignment

The Virginia Department of Environmental Quality assigned the MWS Linear, the highest phosphorus removal rating for manufactured treatment devices to meet the new Virginia Stormwater Management Program (VSMP) Technical Criteria.



MASTEP Evaluation

The University of Massachusetts at Amherst – Water Resources Research Center, issued a technical evaluation report noting removal rates up to 84% TSS, 70% Total Phosphorus, 68.5% Total Zinc, and more.



Rhode Island DEM Approved

Approved as an authorized BMP and noted to achieve the following minimum removal efficiencies: 85% TSS, 60% Pathogens, 30% Total Phosphorus for discharges to freshwater systems, and 30% Total Nitrogen for discharges to saltwater or tidal systems.

Flow Based Sizing

The MWS Linear can be used in stand alone applications to meet treatment flow requirements. Since the MWS Linear is the only biofiltration system that can accept inflow pipes several feet below the surface it can be used not only in decentralized design applications but also as a large central end-of-the-line application for maximum feasibility.

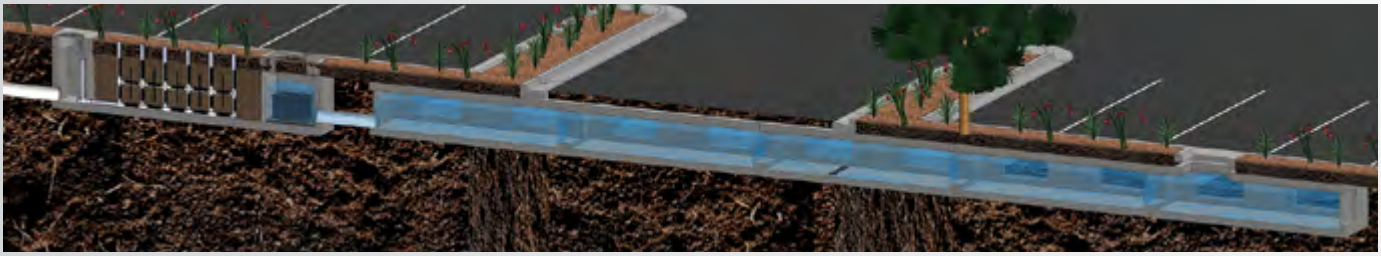


Treatment Flow Sizing Table

Model #	Dimensions	WetlandMedia Surface Area	Treatment Flow Rate (cfs)
MWS-L-4-4	4' x 4'	23 ft^2	0.052
MWS-L-4-6	4' x 6'	32 ft^2	0.073
MWS-L-4-8	4' x 8'	50 ft^2	0.115
MWS-L-4-13	4' x 13'	63 ft^2	0.144
MWS-L-4-15	4' x 15'	76 ft^2	0.175
MWS-L-4-17	4' x 17'	90 ft^2	0.206
MWS-L-4-19	4' x 19'	103 ft^2	0.237
MWS-L-4-21	4' x 21'	117 ft^2	0.268
MWS-L-8-8	8' x 8'	100 ft^2	0.230
MWS-L-8-12	8' x 12'	151 ft^2	0.346
MWS-L-8-16	8' x 16'	201 ft^2	0.462

Volume Based Sizing

Many states require treatment of a water quality volume and do not offer the option of flow based design. The MWS Linear and its unique horizontal flow makes it the only biofilter that can be used in volume based design installed downstream of ponds, detention basins, and underground storage systems.



Treatment Volume Sizing Table

Model #	Treatment Capacity (cu. ft.) @ 24-Hour Drain Down	Treatment Capacity (cu. ft.) @ 48-Hour Drain Down
MWS-L-4-4	1140	2280
MWS-L-4-6	1600	3200
MWS-L-4-8	2518	5036
MWS-L-4-13	3131	6261
MWS-L-4-15	3811	7623
MWS-L-4-17	4492	8984
MWS-L-4-19	5172	10345
MWS-L-4-21	5853	11706
MWS-L-8-8	5036	10072
MWS-L-8-12	7554	15109
MWS-L-8-16	10073	20145

Installation

The MWS Linear is simple, easy to install, and has a space efficient design that offers lower excavation and installation costs compared to traditional tree-box type systems. The structure of the system resembles pre-cast catch basin or utility vaults and is installed in a similar fashion.

The system is delivered fully assembled for quick installation. Generally, the structure can be unloaded and set in place in 15 minutes. Our experienced team of field technicians are available to supervise installations and provide technical support.



Maintenance

Reduce your maintenance costs, man hours, and materials with the MWS Linear. Unlike other biofiltration systems that provide no pre-treatment, the MWS Linear is a self-contained treatment train which incorporates simple and effective pre-treatment.

Maintenance requirements for the biofilter itself are almost completely eliminated, as the pre-treatment chamber removes and isolates trash, sediments, and hydrocarbons. What's left is the simple maintenance of an easily accessible pre-treatment chamber that can be cleaned by hand or with a standard vac truck. Only periodic replacement of low-cost media in the pre-filter cartridges is required for long term operation and there is absolutely no need to replace expensive biofiltration media.



Plant Selection

Abundant plants, trees, and grasses bring value and an aesthetic benefit to any urban setting, but those in the MWS Linear do even more - they increase pollutant removal. What's not seen, but very important, is that below grade the stormwater runoff/flow is being subjected to nature's secret weapon: a dynamic physical, chemical, and biological process working to break down and remove non-point source pollutants. The flow rate is controlled in the MWS Linear, giving the plants more "contact time" so that pollutants are more successfully decomposed, volatilized and incorporated into the biomass of The MWS Linear's micro/macro flora and fauna.

A wide range of plants are suitable for use in the MWS Linear, but selections vary by location and climate. View suitable plants by selecting the list relative to your project location's hardy zone.

Please visit www.ModularWetlands.com/Plants for more information and various plant lists.



SPECIFICATIONS

MWS – Linear

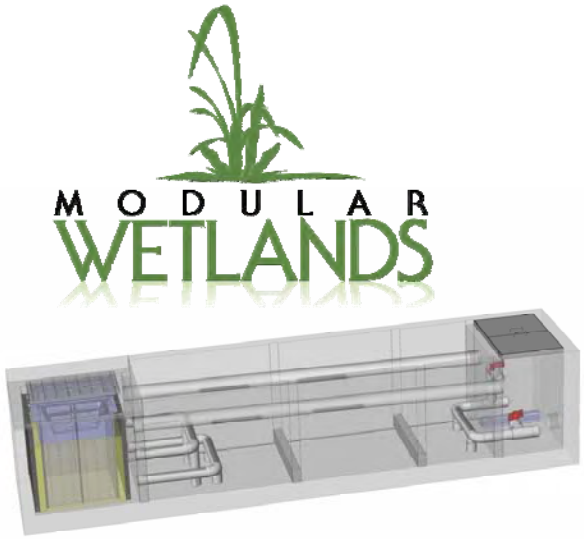
Hybrid Stormwater Filtration System

Modular Wetland Systems, Inc.
P.O. Box 869
Oceanside, CA 92049

www.modularwetlands.com
P 760-433-7640
F 760-433-3179

MWS – Linear

Hybrid Stormwater Filtration System



Save valuable space with small footprint for urban sites.

Improve BMP aesthetics with attractive native and tropical landscape plants.

Reduce lifetime costs with safer and less expensive maintenance

"The MWS – Linear hybrid stormwater treatment system is described as a self contained treatment train. This system utilizes an innovative combination of l treatment processes. Stormwater runoff flows into the system via pipe or curb/grate type catch basin opening. Polluted runoff first encounters a screening device to remove larger pollutants and then enters a hydrodynamic separation chamber which settles out the sediments and larger suspended solids. Next the runoff is treated by a revolutionary filter media, BioMediaGREEN that removes fines and associated pollutants, including bacteria. From there runoff enters of bioretention filter in the form of a subsurface flow vegetated gravel wetland. Within the wetland physical, chemical, and biological mechanisms remove the remaining particulate and dissolved pollutants. The purified runoff leaves the system via the discharge chamber. In the discharge chamber the rate of discharge is controlled by valves set to a desired rate".

Tested Pollutant Removal Efficiencies:

TSS Removal	Dissolved Lead Removal	Dissolved Copper Removal	TPH	E. coli Removal	Turbidity Removal
98%	81%	92%	99%	60.2%	92%

"Nature and Harmony Working Together in Perfect Harmony"

SPECIFICATIONS – MWS- LINEAR

Track Record: The MWS- Linear Hybrid Stormwater Treatment System is manufactured by a company whom is regularly engaged in the engineering design and production of treatment systems for stormwater.

Coverage: The MWS- Linear is designed to treat the water quality volume or water quality flow. For flow based design, high flow bypass is internal, for volume based design, high flow bypass is external and prior to pre-detention system. For offline volume based designs the MWS - Linear has the ability to treat the entire water quality volume when used with pre-storage and properly sized.

Non-Corrosive Materials: The MWS – Linear is designed with non-corrosive materials. All internal piping is SD35 PVC. Catch basin filter components, including mounting hardware, fasteners, support brackets, filtration material, and support frame are constructed of non-corrosive materials (316 stainless steel, and UV protected/marine grade fiberglass). Fasteners are stainless steel. Primary filter mesh is 316 stainless steel welded screens. Filtration basket screens for coarse, medium and fine filtration is ¾" x 1 ¾"expanded, 10 x 10 mesh, and 35 x 35 mesh, respectively. No polypropylene, monofilament netting or fabrics shall be used in this system. Media Protective Panels are constructed of UV protected/marine grade fiberglass. Mounts are constructed of stainless steel. BioMediaGREEN is an inert rock substrate and is non-corrosive. Perimeter filter structure is constructed of lightweight injection molded plastic. Mounting brackets are constructed of SD40 PVC and are mounted with 3/8" diameter stainless steel redheads. Drain down filter cover is constructed of UV protected/marine grade fiberglass and stainless steel hinge and mount.

Weight: Each complete unit weighs approximately 29,000 to 40,000 pounds and requires a boom crane to install. Details of this are provided in the installation section of the MWS-Linear Design Kit.

Transportation: The Modular Wetland System – Linear is designed to be transported on a standard flat bed truck. The unit easily fits on a flat bed truck without the need of special permitting.

Alternative Technology Configurations: The Modular Wetland System – Linear is modular is design. Each module will be up to 22 feet long and 5 feet wide. The system can be made in lengths varying from 13 to 100s of feet long. For lengths longer than 22 feet the system will shipped in modules and assembled on site. The Modular Wetland System – Linear has many alternative configurations. This allows the system to be adapted to many site conditions. Runoff can enter the system through a pipe, and/or a built in curb or grate type opening.

Energy Requirements: The Modular Wetland System – Linear is completely passive and requires no external energy sources.

Buoyancy Issues: Buoyancy is only a an issue when ground water levels rise above the bottom of the Modular Wetland System – Linear's concrete structure. With 8.5 cubic yards of wetland media there is no concern of floatation. As a precaution a footing can also be built into the systems concrete structure.

Durability: The structure of the box will be precast concrete. The concrete will be 28 day compressive strength fc = 5,000 psi. Steel reinforcing will be ASTM A – C857. Structure will support an H20 loading as indicted by AASHTO. The joint between the concrete sections will ship lap and joint sealed with ram-nek. Filter (excluding oil absorbent media) and support structures are of proven durability. The filter and mounting structures are of sufficient strength to support water, sediment, and debris loads when the filter is full, with no slippage, breaking, or tearing. All filters are warranted for a minimum of five (5) years.

Oil Absorbent Media: The MWS – Linear utilizes both physical and biological mechanisms to capture and filter oil and grease. A skimmer and boom system will be positioned on the internal perimeter of the catch basin insert. The primary filtration media, BioMediaGreen, utilized in the perimeter and drain down filters, has excellent hydrocarbon removal abilities. Within the wetland filter biological processes capture and

break down oil and grease. Much of the breakdown and transformation of oil and grease is performed by natural occurring bacteria.

Overflow Protection: The grate and curb type MWS – Linear are designed with an internal bypass consisting of two SD PVC pipes which direct high flows around the perimeter and wetland filter, directly into the discharge chamber. For the volume based vault type configuration, bypass should be located prior to the pre-detention system. For peak flows that exceed internal bypass capacity, external bypass is use.

Filter Bypass: Runoff will bypass filtration (BioMediaGREEN and wetland filter) components of the MWS - Linear. The system will still provide screening and settling during higher flow rates for internally bypassed flows. External bypass will bypass of treatment processes.

Pollutant Removal Efficiency: The MWS - Linear is capable of removing over 90% of the net annual total suspended solids (TSS) load based on a 20-micron particle size. Annual TSS removal efficiency models are based on documented removal efficiency performance from full-scale laboratory tests on BioMediaGreen and quarter-scale laboratory tests on the MWS – Linear flow based system.

POLLUTANT	REMOVAL EFFICIENCY
Trash & Litter	99%
TPH (mg/L)	99%
TSS (mg/L)	98%
E. Coli (MPN/100ml)	60%
Turbidity (NTU)	92%
Dissolved Metals (mg/L)	76%

Sil-Co-Sil 106. Mean particle diameter = 19 microns

Non-Scouring: During heavy storm events the runoff bypasses perimeter and wetland filter components. The system will not re-suspend solids at design flows.

Uniqueness: The Modular Wetland System – Linear is a complete self contained treatment train that incorporates capture, screening, sedimentation, filtration, bioretention, high flow bypass, and flow control into a single modular structure. This system provides four stages of treatment making it the only 4 stage treatment train stormwater filtration system, therefore making it unique to the industry. Other systems do not incorporate all the necessary attributes to make it a complete stormwater management device as with the Modular Wetland System – Linear. Therefore, no equal exists for this system.

Pretreatment & Preconditioning: Since the Modular Wetland System – Linear is a complete capture and treatment train stormwater management system no external pretreatment of preconditioning is necessary.

SPECIFICATIONS – BioMediaGREEN

BioMediaGREEN is a proprietary engineered filter media. Made of a unique combination of the inert naturally occurring material this product is non-combustible and do not pose a fire hazard, stable and non-reactive, and is also biodegradable. It is stable with no known adverse environmental effects.

This product has been tested in long-term carcinogenicity studies [inhalation and intraperitoneal injection (i.p.)] with no significant increase in lung tumors or abdominal tumors. Short-term biopersistent (inhalation and intra-tracheal injection) studies have shown that the products disappear very rapidly from the lung.

In October 2001, IARC classified this product as Group 3, "not classifiable as to its carcinogenicity to humans". The 2001 decision was based on the latest epidemiological studies and animal inhalation studies that show no relation between inhalation exposure and the development of tumors.

The product can typically be disposed of in an ordinary landfill (local regulations may apply). If you are unsure of the regulations, contact your local Public Health Department or the local office of the Environmental Protection Agency (EPA).

Coverage: When properly installed BioMediaGREEN Filter Blocks provide sufficient contact time, at rated flows, of passing contaminate water. The BioMediaGREEN material will capture and retain most pollutants that pass through it. The BioMediaGREEN material is made of a proprietary blend of inert substances. The BioMediaGREEN Filter Blocks can be used in different treatment devices, including but not limited to flume filters, trench drain filters, downspout filters, catch basin inserts, water polishing units, and hydrodynamic separators.

Non-Corrosive Materials: The BioMediaGreen material is made of non-corrosive materials.

Durability: The BioMediaGREEN material has been chosen for its proven durability, with an expected life of 2 plus years. The BioMediaGREEN material is of sufficient strength to support water, sediment, and debris loads when the media is at maximum flow; with no slippage, breaking, or tearing. The BioMediaGREEN material has been tested through rigorous flow and loading conditions.

Oil Absorbent Media: The BioMediaGREEN material has been proven to capture and retain hydrocarbons.

Pollutant Removal Efficiency: The BioMediaGREEN Filter Blocks are designed to capture high levels of Hydrocarbons including but not limited to oils & grease, gasoline, diesel, and PAHs. BioMediaGREEN Filter Blocks have the physical ability to block and filter trash and litter, grass and foliage, sediments, TSS, particulate and dissolved metals, nutrients, and bacteria.

BioMediaGREEN technology is based on a proprietary blend of synthetic inert natural substances aimed at removal of various stormwater pollutants. BioMediaGREEN was created to have a very porous structure capable of selectively removing pollutants while

allowing high flow through rates for water. As pollutants are captured by its structure, BioMediaGREEN captures most pollutants and maintains porosity and filtering capabilities.

Field and laboratory tests have confirmed the BioMediaGREEN capability to capture large percentage of TSS, hydrocarbons, nutrients, and heavy metals. Microbial reduction efficiency will vary depending on colony size, flow rates and site specific conditions.

POLLUTANT	REMOVAL EFFICIENCY
Oil & Grease (mg/L)	90%
TPH (mg/L)	99%
TSS (mg/L)	85%
Turbidity (NTU)	99%
Total Phosphorus (mg/L)	69.6%
Dissolved Metals (mg/L)	75.6%

Sil-Co-Sil 106. Mean particle diameter = 19 microns

Replacement: Removal and replacement of the blocks is simple. Remove blocks from filtration system. Replace with new block of equal size.

BIO-7: Proprietary Biotreatment

Proprietary biotreatment devices are devices that are manufactured to mimic natural systems such as bioretention areas by incorporating plants, soil, and microbes engineered to provide treatment at higher flow rates or volumes and with smaller footprints than their natural counterparts. Incoming flows are typically filtered through a planting media (mulch, compost, soil, plants, microbes, etc.) and either infiltrated or collected by an underdrain and delivered to the storm water conveyance system. Tree box filters are an increasingly common type of proprietary biotreatment device that are installed at curb level and filled with a bioretention type soil. For low to moderate flows they operate similarly to bioretention systems and are bypassed during high flows. Tree box filters are highly adaptable solutions that can be used in all types of development and in all types of soils but are especially applicable to dense urban parking lots, street, and roadways.

Also known as:

- *Catch basin planter box*
- *Bioretention vault*
- *Tree box filter*



Proprietary biotreatment
Source: http://www.americastusa.com /index.php/filterra/

Feasibility Screening Considerations

- Proprietary biotreatment devices that are unlined may cause incidental infiltration. Therefore, an evaluation of site conditions should be conducted to evaluate whether the BMP should include an impermeable liner to avoid infiltration into the subsurface.

Opportunity Criteria

- Drainage areas of 0.25 to 1.0 acres.
- Land use may include commercial, residential, mixed use, institutional, and subdivisions. Proprietary biotreatment facilities may also be applied in parking lot islands, traffic circles, road shoulders, and road medians.
- Must not adversely affect the level of flood protection provided by the drainage system.

OC-Specific Design Criteria and Considerations

☐ Frequent maintenance and the use of screens and grates to keep trash out may decrease the likelihood of clogging and prevent obstruction and bypass of incoming flows.

☐ Consult proprietors for specific criteria concerning the design and performance.

☐ Proprietary biotreatment may include specific media to address pollutants of concern. However, for proprietary device to be considered a biotreatment device the media must be capable of supporting rigorous growth of vegetation.

☐ Proprietary systems must be acceptable to the reviewing agency. Reviewing agencies shall have the discretion to request performance information. Reviewing agencies shall have the discretion to deny the use of a proprietary BMP on the grounds of performance, maintenance considerations, or other relevant factors.

☐ In right of way areas, plant selection should not impair traffic lines of site. Local jurisdictions may also limit plant selection in keeping with landscaping themes.

Computing Sizing Criteria for Proprietary Biotreatment Device

- Proprietary biotreatment devices can be volume based or flow-based BMPs.
- Volume-based proprietary devices should be sized using the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1** or the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs described in **Appendix III.3.2**.
- The required design flowrate for flow-based proprietary devices should be computed using the Capture Efficiency Method for Flow-based BMPs described in **Appendix III.3.3)**.

In South Orange County, the provided ponding plus pore volume must be checked to demonstrate that it is greater than 0.75 of the remaining DCV that this BMP is designed to address. Many propretary biotreatment BMPs will not be able to meet the definition of "biofiltration" that applies in South Orange County. See Section III.7 and Worksheet SOC-1.

Additional References for Design Guidance

- Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: **http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850**
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 9: **http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf**
- Santa Barbara BMP Guidance Manual, Chapter 6: **http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf**

Site Design & Landscape Planning SD-10



Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

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Designing New Installations

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

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

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

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

Conserve Natural Areas during Landscape Planning

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

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

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

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

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

- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

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

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

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

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

Protection of Slopes and Channels during Landscape Design

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

Redeveloping Existing Installations

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

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

Other Resources

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

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

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

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

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

Roof Runoff Controls SD-11



Rain Garden

Design Objectives

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

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

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

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

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barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

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

Supplemental Information

Examples

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

Efficient Irrigation SD-12



Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

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

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

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

Redeveloping Existing Installations

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

Other Resources

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

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

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

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

Storm Drain Signage SD-13



Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

Designing New Installations

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

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

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Placement

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

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

Supplemental Information

Examples

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

Other Resources

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

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

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

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

Street Sweeping and Vacuuming SE-7



Description and Purpose

Street sweeping and vacuuming includes use of self-propelled and walk-behind equipment to remove sediment from streets and roadways, and to clean paved surfaces in preparation for final paving. Sweeping and vacuuming prevents sediment from the project site from entering storm drains or receiving waters.

Suitable Applications

Sweeping and vacuuming are suitable anywhere sediment is tracked from the project site onto public or private paved streets and roads, typically at points of egress. Sweeping and vacuuming are also applicable during preparation of paved surfaces for final paving.

Limitations

Sweeping and vacuuming may not be effective when sediment is wet or when tracked soil is caked (caked soil may need to be scraped loose).

Implementation

- Controlling the number of points where vehicles can leave the site will allow sweeping and vacuuming efforts to be focused, and perhaps save money.
- Inspect potential sediment tracking locations daily.
- Visible sediment tracking should be swept or vacuumed on a daily basis.

Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

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

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Do not use kick brooms or sweeper attachments. These tend to spread the dirt rather than remove it.
- If not mixed with debris or trash, consider incorporating the removed sediment back into the project

Costs

Rental rates for self-propelled sweepers vary depending on hopper size and duration of rental. Expect rental rates from $58/hour (3 yd^3 hopper) to $88/hour (9 yd^3 hopper), plus operator costs. Hourly production rates vary with the amount of area to be swept and amount of sediment. Match the hopper size to the area and expect sediment load to minimize time spent dumping.

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- When actively in use, points of ingress and egress must be inspected daily.
- When tracked or spilled sediment is observed outside the construction limits, it must be removed at least daily. More frequent removal, even continuous removal, may be required in some jurisdictions.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- Adjust brooms frequently; maximize efficiency of sweeping operations.
- After sweeping is finished, properly dispose of sweeper wastes at an approved dumpsite.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Labor Surcharge and Equipment Rental Rates, State of California Department of Transportation (Caltrans), April 1, 2002 – March 31, 2003.

Appendix D:

BMP Maintenance Information

To be provided during final engineering

Appendix E:

Geotechnical Information

UPDATED GEOTECHNICAL AND INFILTRATION EVALUATION
FOR
PROPOSED 54-UNIT RESIDENTIAL DEVELOPMENT
901 E. KATELA AVENUE
CITY OF ORANGE, ORANGE COUNTY, CALIFORNIA

PREPARED FOR

INTRACORP SW, LLC
895 DOVE STREET, SUITE 400
NEWPORT BEACH, CALIFORNIA 926

PREPARED BY

GEOTEK, INC.
1548 NORTH MAPLE STREET
CORONA, CALIFORNIA 92878

PROJECT NO. 3193-CR **JUNE 3, 2022**

GEOTEK

GeoTek, Inc.
1548 North Maple Street, Corona, California 92878
(951) 710-1160 Office (951) 710-1167 Fax www.geotekusa.com

June 3, 2022
Project No. 3193-CR

Intracorp SW, LLC
895 Dove Street, Suite 400
Newport Beach, California 92660

Attention: Ms. Emilie Simard

Subject: Updated Geotechnical and Infiltration Evaluation
Proposed 54-Unit Residential Development
901 E. Katella Avenue
City of Orange, Orange County, California

Dear Ms. Simard:

We are pleased to provide herein the results of our updated geotechnical and infiltration evaluation for the subject property located in the city of Orange, Orange County, California. This report presents a discussion of our evaluation and provides preliminary geotechnical recommendations for earthwork, foundation design, and construction. In our opinion, site development is feasible from a geotechnical viewpoint provided that the recommendations included herein are incorporated into the design and construction phases of site development.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to call our office.

Respectfully submitted,
GeoTek, Inc.

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EDWARD H. LaMONT
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STATE OF CALIFORNIA

LICENSED PROFESSIONAL ENGINEER
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Project Engineer

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Figure 1 – Site Location Map

Figures 2a-b – Exploration Location Maps

Appendix A – Exploratory Boring Logs, Laboratory Test Results, and Infiltration Data by Salem Engineering Group (2019)

Appendix B – Exploratory Boring Logs by GeoTek

Appendix C – Laboratory Test Results by GeoTek

Appendix D – Infiltration Test Data by GeoTek

Appendix E – General Earthwork and Grading Guidelines

1. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to complete an evaluation of the existing geotechnical conditions of the project site with respect to currently anticipated site development. Services provided for this study included the following:

- Research and review of available geologic and general information pertinent to the site,
- Review of the geotechnical report for the property by Salem Engineering Group, Inc. (2019),
- Site reconnaissance,
- Site exploration consisting of the excavation, logging, and sampling of three exploratory hollow-stem auger borings and logging and percolation testing of two hollow-stem auger borings,
- Collection of relatively undisturbed and bulk soil samples of the onsite materials,
- Laboratory testing of the soil samples obtained from the site,
- Review and evaluation of site seismicity,
- Engineering analyses, and
- Compilation of this updated geotechnical and infiltration report which presents our findings, conclusions, and recommendations for site development.

The intent of this report is to aid in the assessment of the site for future proposed development from a geotechnical perspective. The professional opinions and geotechnical information contained in this report may need to be updated based upon our review of the final site development plans. These plans should be provided to GeoTek, Inc. (GeoTek) for review when available.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The subject site is located at 901 East Katella Avenue in the city of Orange, Orange County, California. The site is also identified with Orange County Assessor's Parcel Number (APN) 375-

461-41 and consists of a roughly trapezoidal-shaped 2.71-acre property. The parcel is currently occupied by a 20,000 square foot, single-story office building and associated parking lot and other improvements. At the time of our field exploration, the building was vacant.

The site has a generally flat topography with a elevations ranging from 229 feet above mean sea level (amsl) to 223 feet amsl descending to the west-southwest. Surface drainage is to the west-southwest.

The site is bounded by residential properties on the north, a commercial development on the east, North Cambridge Street on the west, and East Katella Avenue on the south. The general location of the site is shown in Figure 1. The current and proposed improvements on the site are displayed on Figures 2a-b, Exploration Location Maps.

2.2 PROPOSED DEVELOPMENT

According to the Conceptual Site Plan, prepared by Bassenian Lagoni Architecture and dated February 16, 2022, the property will be developed with 54 residences consisting of two (2) detached single-family dwellings and twenty-six (26) sets of paired single-family dwellings, parking and drive areas, parks, underground utilities, and other improvements. The structures are anticipated to be two to three stories, of wood-framed construction, and will utilize concrete slab-on-grade floors and shallow spread foundations. Cuts and fills to reach design grades are estimated to be minimal. Minor slopes and perimeter/retaining walls are also expected. In addition, we anticipate that stormwater at the site be managed via relatively shallow infiltration systems. Specific locations, depths, and characteristics of the BMP systems are currently unknown.

If site development differs from the assumptions made herein, the recommendations included in this report should be subject to further review and evaluation. Final site development plans should be reviewed by GeoTek when they become available. Additional geotechnical field exploration, analyses and recommendations may be necessary upon review of site development plans.

3. REPORT REVIEW

On May 16, 2019, Salem Geotechnical Engineering Group, Inc. (Salem) issued a geotechnical investigation report for the proposed commercial development of the project site. The investigation eight (8) exploratory borings to depths ranging from 5 to 50 feet and three (3)

borings for percolation testing to depths between 5 and 10 feet. Salem's exploration suggested that the site is mostly underlain by medium dense/stiff to very dense/hard alluvial deposits. However, localized areas with undocumented fill up to 15 feet in thickness were also noted. No groundwater was encountered during the site investigation and the potential for liquefaction at the site was considered nil. Salem concluded that the property has surficial soils with medium expansion potential, negligible sulfate concentrations, and poor infiltration rates.

The logs of the exploratory borings, percolation and infiltration test data, and results of laboratory test results by Salem are included in Appendix A. The approximate locations of Salem's explorations are shown on the Exploration Location Maps, Figures 2a-b.

4. FIELD EXPLORATION, LABORATORY TESTING, AND PERCOLATION TESTING

4.1 FIELD EXPLORATION

GeoTek evaluated the subsurface conditions of the site via three (3) exploratory borings excavated on May 5, 2022 to approximately 19 to 22.5 feet below existing grade. In addition, two (2) percolation test borings approximately five (5) feet deep were advanced within the lower portions of the site (west-southwest side) where stormwater BMP systems may be placed. The borings were drilled with a truck-mounted hollow-stem auger drill rig. The approximate locations of our site explorations and past explorations by Salem are shown on the Exploration Location Maps, Figures 2a-b. Logs of the borings are provided in Appendices A and B.

4.2 LABORATORY TESTING

Laboratory testing was performed on selected relatively undisturbed and bulk soil samples collected during the field exploration. The purpose of the laboratory testing was to confirm the field classification of the soil materials encountered and to evaluate the soils physical properties for use in the engineering design and analysis. Results of the laboratory testing program along with a brief description and relevant information regarding testing procedures are included in Appendix C.

4.3 PERCOLATION TESTING

Percolation testing was performed at boring locations I-1 and I-2 to assess the infiltration rates of the site soils underlying potential stormwater system areas. The borings were excavated to approximately five (5) feet below the existing grade, which was assumed to be the approximate invert depth of the infiltration systems. The boring diameter was approximately eight inches.

Percolation testing was performed within the lower approximately 20 inches in the borings by a representative of our firm, in general conformance with the Boring Percolation Test Procedure outlined in the Technical Guidance Document Appendix VII (Orange County, 2013). As required, the percolation rates were corrected to account for discharge of water from both the sides and bottom of the borings. This correction was done using the Porchet Method, obtaining the infiltration rates tabulated below:

SUMMARY OF RESULTS		
Boring	Observed Infiltration Rate, $K_{observed}$ (inches per hour)	Measured Infiltration Rate, $K_{measured}$ (inches per hour)
I-1	4.2	2.1
I-2	0.04	0.02

As recommended by the referenced Technical Guidance Document (Orange County, 2013), a factor of safety of 2.0 was applied to the observed (field) rates to estimate measured infiltration rates. As shown on the table above, poor to favorable infiltration rates (nil to 2 inches per hour) were encountered at the site. Salem (2019) reported relatively similar findings with variable rates ranging from nil to 0.23 inches per hour. Detailed percolation/infiltration test data is included in Appendix D.

It should be noted that the infiltration rates provided above were performed in relatively undisturbed on-site soils. Infiltration rates will vary and are mostly dependent on the underlying consistency of the site soils and relative density. Infiltration rates may be impacted by weight of equipment travelling over the soils, placement of engineered fill and other various factors. GeoTek assumes no responsibility or liability for the ultimate design or performance of the storm water facility.

5. GEOLOGIC AND SOILS CONDITIONS

5.1 REGIONAL SETTING

The subject property is situated in the Peninsular Ranges geomorphic province. The Peninsular Ranges province is one of the largest geomorphic units in western North America. Basically, it extends roughly 975 miles from the north and extends from the Transverse Ranges geomorphic province to the tip of Baja California, from north to south. This province varies in width from about 30 to 100 miles. It is bounded on the west by the Pacific Ocean, on the south by the Gulf of California and on the east by the Colorado Desert Province.

The Peninsular Ranges are essentially a series of northwest-southeast oriented fault blocks. Several major fault zones are found in this province. The Elsinore Fault zone and the San Jacinto Fault zone trend northwest-southeast and are found in the near the middle of the province. The San Andreas Fault zone borders the northeasterly margin of the province.

More specific to the subject property, Morton, D.M., and Miller, F.K., (2006) map the site to be underlain by old alluvial fan deposits (late to middle Pleistocene age). Additionally, the nearest known active fault to the site is the Elsinore fault- Whittier Section located approximately 7.6 miles to the north.

5.2 GENERAL SOIL/GEOLOGIC CONDITIONS

A brief description of the earth materials encountered in our explorations and explorations by Salem (2019) is presented in the following sections.

5.2.1 Undocumented Fill

Undocumented fill was encountered in the area of GeoTek's boring B-1 and Salem's boring B-5 beneath the existing pavement section to approximately 9 to 15 feet below grade, respectively. The fill is associated to the construction of the existing site improvements and is generally composed of brown to grayish brown, slightly moist clayey sand and poorly graded to well graded sand with silt and some fine gravel. Because of its variable in-place density (ranging from very loose to very dense) and lack of documentation regarding its placement, the fill is considered to be un-engineered, un-compacted material.

5.2.2 Old Alluvial Fan Deposits

Old alluvial fan deposits were encountered in our borings and borings by Salem below the fill or existing pavement section and extended to the maximum depth explored of about 50 feet. The old alluvial fan deposits consist of interbedded units of clayey sand, silty sand, sandy clay, and poorly graded to well graded sand with silt and some fine gravel. The alluvium was reddish brown to grayish brown in color, slightly moist to moist, and in a medium dense/stiff to very dense/hard in-place state to the total depth explored, based on our field observations, blow counts, and in-place density determinations. Tests conducted on the most unfavorable units of the alluvium (selected based on blow counts) indicated a negligible to slight potential for collapse upon application of water. Test results obtained by Salem suggest similar findings.

The near surface site soils were found to have "very low" to "low" expansion potential based on our laboratory test results in accordance with ASTM D 4829. However, Salem also encountered soil units with "medium" expansion potential.

5.3 SURFACE WATER AND GROUNDWATER

5.3.1 Surface Water

If encountered during the earthwork construction, surface water on this site is the result of precipitation or surface run-off from surrounding sites. Overall drainage in the area is variable, and most commonly directed toward the west-southwest. Provisions for surface drainage will need to be accounted for by the project civil engineer.

5.3.2 Groundwater

Groundwater was not encountered in the deepest site boring, Boring B-5, excavated by Salem (2019) to a maximum depth of 50 feet. The GeoTracker database and the California Water Data Library show several groundwater wells located within 1.5 miles from the site, with a depth to groundwater in excess of 100 feet.

Perched groundwater or localized seepage can occur due to variations in rainfall, irrigation practices, and other factors not evident at the time of this investigation.

5.4 FAULTING AND SEISMICITY

The geologic structure of the entire southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is in a seismically active region. No active or potentially active fault is known to exist at this site nor is the site situated within an *"Alquist-Priolo"* Earthquake Fault Zone (Bryant and Hart, 2007; CGS, 1986). The subject property is not located within a State of California Seismic Hazard Zone for earthquake induced liquefaction (CGS, 1997). The subject property is not located within a State of California Seismic Hazard Zone for earthquake induced landsliding. The nearest known active fault to the site is the Elsinore fault- Whittier Section located approximately 7.6 miles to the north.

5.4.1 Seismic Design Parameters

The site is located at approximately 33.8097º Latitude and -117.8437º Longitude. Based on the conditions observed in the site excavations and review of regional geologic maps, a Site Class "D" appears to be the appropriate category for the property. Site spectral accelerations (Sa and S1), for 0.2 and 1.0 second periods for a Class "D" site, were determined from the SEAOC/OSHPD web interface that utilizes the USGS web services and retrieves the seismic design data and presents that information in a report format. As noted using the ASCE 7-16 option on the SEAOC/OSHPD website, the values for SM1 and SD1 are reported as "null-See Section 11.4.8 (of ASCE 7-16)". As noted in ASCE 7-16, Section 11.4.8, a site-specific ground motion procedure is recommended for Site Class D when the value S1 exceeds 0.2. The value S1 for the subject site exceeds 0.2.

For a Site Class "D", an exception to performing a site-specific ground motion analysis is allowed in ASCE 7-16 where S1 exceeds 0.2 provided the value of the seismic response coefficient, Cs, is conservatively calculated by Eq 12.8-2 of ASCE 7-16 for values of T≤1.5Ts and taken as equal to 1.5 times the value computed in accordance with either Eq. 12.8-3 for TL≥T>1.5Ts or Eq. 12.8-4 for T>TL.

Assuming that the Cs value calculated by and used by the structural engineer allows for the exclusion per ASCE 7-16, noted above, then a site-specific ground motion analysis is not required. For this assumption and condition, the following seismic design parameters, based on the 2015 National Earthquake Hazards Reduction Program (NEHRP)/ASCE 7-16, are presented on the following table:

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_S	1.426g
Mapped 1.0 sec Period Spectral Acceleration, S_1	0.507g
Site Coefficient for Site Class "D," F_a	1.0
Site Coefficient for Site Class "D," F_v	1.793
Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, S_{MS}	1.426g
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, S_{M1}	0.908g
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	0.951g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	0.606g
Site Modified Peak Ground Acceleration, PGA_M	0.658g
Seismic Design Category	D

Final selection of the appropriate seismic design coefficients should be made by the project structural engineer based upon the local practices and ordinances, expected building response and desired level of conservatism.

5.5 LIQUEFACTION AND SEISMICALLY INDUCED SETTLEMENT

The project site is not located within an area mapped by the State of California for liquefaction potential. Due to the presence of dense/stiff alluvium and the lack of shallow groundwater, the risk of soil liquefaction at the site is nil.

Loose to medium dense sands tend to densify during strong ground shaking. Based on the blow counts recorded in the deepest site boring (Salem's boring B-5) and utilizing a peak ground acceleration of 0.66g and a modal magnitude weighted (Mw) seismic event of 7.72, we estimate that the seismically induced settlement of the sandy units at the site is less than 0.5 inches total settlement and less than 0.25-inches differential settlement over a 30-foot span.

5.6 OTHER SEISMIC HAZARDS

Evidence of ancient landslides or slope instabilities at this site was not observed during our investigation. Thus, the potential for landslides is considered negligible.

The site is located about two miles west of the Santiago Creek Recharge Basin. However, as the project site is located at a higher elevation than the basin, the potential for a seiche is considered negligible. The potential for a tsunami is also nil due to the great distance between the site and the ocean.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 GENERAL

Development of the site appears feasible from a geotechnical viewpoint. The following recommendations should be incorporated into the design and construction phases of development.

6.2 EARTHWORK CONSIDERATIONS

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the City of Orange, the 2019 California Building Code (CBC), and recommendations contained in this report. Site grading plans should be reviewed by this office when they become available. Additional recommendations will likely be offered subsequent to review of these plans.

6.2.1 Site Clearing and Preparation

Site preparation should start with demolition/razing of existing site improvements and removal of deleterious materials and vegetation. Demolition should include removal of all pavements, floor slabs, foundations, and any other below-grade construction. These materials should be properly disposed of off-site. Voids resulting from site clearing (such as removals of underground utilities, foundations, etc.) should be replaced with engineered fill materials.

6.2.2 Removals

Based on the boring data and the field observations, the upper three (3) to fifteen (15) feet of existing site soils or two (2) feet below footing base, whichever is deeper. should be removed in order to provide a homogeneous, dense fill mat for structural support. Deeper removals may be required in some areas to eliminate all undocumented fill and unsuitable alluvium. The bottom of removals should expose competent native alluvial soils which are defined as relatively homogeneous, no visibly porous materials with an in-place density of at least 85 percent of the soil's maximum dry density as determined per ASTM D 1557. As a minimum, removals should extend down and away from foundation elements at a 1:1 (h:v) projection to the recommended removal depth, or a minimum of five feet laterally.

The upper two feet of soil or one foot below pavement subgrade, whichever is deeper, should be removed below asphaltic concrete pavement and Portland cement concrete hardscape areas. Deeper removals may be required in areas containing loose undocumented fills. The horizontal extent of removals should extend at least two feet beyond the edge of the improvements.

The bottom of all removals should be scarified to a minimum depth of 12 inches, brought to slightly above the optimum moisture content, and then recompacted to at least 90 percent of the soil's maximum dry density (ASTM D 1557). The bottoms of removals should be observed by a GeoTek representative prior to scarification.

6.2.3 Engineered Fill

The onsite soils are considered suitable for reuse as engineered fill provided they are free from vegetation, roots, and rock/concrete or hard lumps greater than six (6) inches in maximum dimension.

Concrete generated from the demolition of existing site improvements may be incorporated into site fills provided the following guidelines are implemented: 1) concrete should be free of rebar or other deleterious materials and should be broken down to a maximum dimension of six (6) inches; 2) concrete should not be placed within three (3) feet of finish grade in the building pad areas or within one (1) foot of subgrade elevations in the street/drive areas; 3) concrete should be distributed in the fill and should not be "nested" or placed in concentrated pockets.

The undercut areas should be brought to final pad elevations with fill materials that are placed and compacted in general accordance with minimum project standards. Fill materials should be placed at or above optimum moisture content and should be compacted to a minimum relative compaction of 90 percent as determined by ASTM Test Method D 1557. Additional recommendations pertaining to fill placement are presented in Appendix E.

6.2.4 Excavation Characteristics

Excavation in the onsite soil materials is expected to be easy using heavy-duty grading equipment in good operating conditions.

All temporary excavations for grading purposes and installation of underground utilities should be constructed in accordance with local and Cal-OSHA guidelines. Temporary excavations within the onsite materials should be stable at 1:1 (h:v) inclinations for cuts less than ten (10) feet in height.

6.2.5 Shrinkage and Subsidence

Several factors will impact earthwork balancing on the site, including shrinkage, subsidence, trench spoil from utilities and footing excavations, as well as the accuracy of topography.

Shrinkage, bulking, and subsidence are primarily dependent upon the degree of compactive effort achieved during construction. For planning purposes, a shrinkage factor of 5 to 10 percent for both the existing fills and upper alluvium may be considered. Site balance areas should be available in order to adjust project grades, depending on actual field conditions at the conclusion of site earthwork construction. Bulking is not considered to be a significant factor with the underlying materials within the vicinity of the anticipated construction. Subsidence on the order of up to 0.1-foot could occur.

6.2.6 Trench Excavations and Backfill

Temporary excavations within the onsite materials should be stable at 1:1 (h:v) inclinations for short durations during construction, and where cuts do not exceed ten (10) feet in height. Temporary cuts to a maximum height of four (4) feet can be excavated vertically, but local sloughing and/or failure could occur due to the granular nature of some of the onsite units. Increased caution should be applied when working near or within any excavations at this site.

Trench excavations should conform to Cal-OSHA regulations. The contractor should have a competent person, per OSHA requirements, on site during construction to observe conditions and to make the appropriate recommendations.

Utility trench backfill should be compacted to at least 90 percent relative compaction (as determined per ASTM D 1557). Under-slab trenches should also be compacted to project specifications. Where applicable, based on jurisdictional requirements, the top 12 inches of backfill below subgrade for road pavements should be compacted to at least 95 percent relative compaction. Much of the onsite materials may not be suitable for use as bedding material but should be suitable as backfill provided particles larger than six (6) ± inches are removed.

Compaction should be achieved with a mechanical compaction device. Ponding or jetting of trench backfill is not recommended. If backfill soils have dried out, they should be thoroughly moisture conditioned prior to placement in trenches.

6.3 DESIGN RECOMMENDATIONS

6.3.1 Foundation Design Criteria

The site soils are anticipated to have a expansion potential ranging from "very low" to "medium" when tested in accordance with ASTM D 4829. Additional testing of the soils should be performed during construction to evaluate the as-graded conditions. Additional recommendations may be necessary based on the as-graded soils conditions.

A summary of GeoTek's preliminary conventional foundation design recommendations is presented in the table below:

MINIMUM DESIGN REQUIREMENTS FOR CONVENTIONAL REINFORCED SHALLOW FOUNDATIONS			
Design Parameter	"Very Low" Expansion Potential (0≤EI≤20)	"Low" Expansion Potential (20≤EI≤50)	"Medium" Expansion Potential (51≤EI≤90)
Foundation Depth or Minimum Perimeter Beam Depth (inches below lowest adjacent grade)	One-Story – 12 Two-Story – 12 Three-Story - 18	One-Story – 12 Two-Story – 12 Three-Story - 18	One-Story – 18 Two-Story – 18 Three-Story - 24
Minimum Foundation Width (Inches)*	One-Story – 12 Two-Story – 12 Three-Story – 15	One-Story – 12 Two-Story – 12 Three-Story – 15	One-Story – 12 Two-Story – 12 Three-Story – 15
Minimum Slab Thickness (actual)	4 inches (actual)	4 inches (actual)	4 inches (actual)
Minimum Slab Reinforcing	6" x 6" – W1.4/W1.4 welded wire fabric placed in middle of slab	6" x 6" – W2.9/W2.9 welded wire fabric or No. 3 reinforcing bars at 24 inches on center each way placed in middle of slab	No. 3 reinforcing bars at 18 inches on center each way placed in middle of slab
Minimum Footing Reinforcement	Two No. 4 Reinforcing Bars, one top and one bottom	Two No. 4 Reinforcing Bars, one top and one bottom	Four No. 4 Reinforcing Bars, Two top and two bottom
Effective Plasticity Index**	NA	15	20
Presaturation of Subgrade Soil (Percent of Optimum/Depth in inches)	Minimum 100% of the optimum moisture content to a depth of at least 12 inches prior to placing concrete	Minimum 110% of the optimum moisture content to a depth of at least 12 inches prior to placing concrete	Minimum 120% of the optimum moisture content to a depth of at least 18 inches prior to placing concrete

*Code minimums per Table 1809.7 of the 2019 CBC should be complied with.
**Effective Plasticity Index should be verified at the completion of the rough grading

It should be noted that the criteria provided are based on soil support characteristics only. The structural engineer should design the slab and beam/footing reinforcement based on actual loading conditions.

An allowable bearing capacity of 2,000 pounds per square foot (psf) may be used for design of continuous and perimeter footings at least 12 inches deep and 12 inches wide, and pad footings 24 inches square and 12 inches deep. This allowable soil bearing capacity may be increased by 400 psf for each additional foot of footing depth and 200 psf for each additional foot of footing width to a maximum value of 3,000 psf. An increase of one-third may be applied when considering short-term live loads (e.g., seismic and wind loads).

Structural foundations should be designed in accordance with the 2019 CBC, and to withstand a total static settlement of one-inch and a differential static settlement of one-half of the total

settlement over a horizontal distance of 30 feet. A total seismically induced settlement of approximately 0.5 inches and a differential seismically induced settlement of about 0.25 inches over a horizontal distance of 30 feet are also anticipated.

The passive earth pressure may be computed as an equivalent fluid having a density of 230 psf per foot of depth, to a maximum earth pressure of 2,000 psf for footings founded on engineered fill. A coefficient of friction between soil and concrete of 0.3 may be used with dead load forces. The passive pressure and frictional resistance can be combined without reduction. The upper one foot of soil should be ignored in the passive pressure calculations unless the surface is covered with concrete or asphalt. The passive pressure and frictional resistance may be combined without reduction.

A grade beam, a minimum of 12 inches wide and 12 inches deep, should be utilized across large entrances. The base of the grade beam should be at the same elevation as the bottom of the adjoining footings.

Alternatively, the buildings may rest on post-tensioned slabs. If this foundation option is selected, GeoTek should be contacted to provide geotechnical design parameters.

A moisture and vapor retarding system should be placed below slabs-on-grade where moisture migration through the slab is undesirable. Guidelines for these systems are provided in the 2019 *California Green Building Standards Code (CALGreen)* Section 4.505.2, the 2019 CBC Section 1907.1, ACI 360R-10, and ACI 302.2R-06.

It should be realized that the effectiveness of the vapor retarding membrane can be adversely impacted as the result of construction related punctures (e.g. stake penetrations, tears, punctures from walking on the aggregate layer, etc.). These occurrences should be limited as much as possible during construction. Thicker membranes are generally more resistant to accidental puncture than thinner ones. Products specifically designed for use as moisture/vapor retarders may also be more puncture resistant. It is GeoTek's opinion that a minimum ten mil thick membrane with joints properly overlapped and sealed should be considered, unless otherwise specified by the slab design professional. Moisture and vapor retarding systems are intended to provide a certain level of resistance to vapor and moisture transmission through the concrete, but do not eliminate it. The acceptable level of moisture transmission through the slab is to a large extent based on the type of flooring used and atmospheric conditions.

Ultimately, the vapor retarding system should be comprised of suitable elements to limit migration of water and reduce transmission of water vapor through the slab to acceptable levels. The selected elements should have suitable properties (i.e. thickness, composition, strength, and

permeance) to achieve the desired performance level. Consideration should be given to consulting with an individual possessing specific expertise in this area for additional evaluation.

6.3.2 Miscellaneous Foundation Recommendations

- To minimize moisture penetration beneath the slab on grade areas, utility trenches should be backfilled with engineered fill, lean concrete, or concrete slurry where they intercept the perimeter footing or thickened slab edge.
- Soils from the footing excavations should not be placed in the slab-on-grade areas unless properly compacted and tested. The excavations should be free of loose/sloughed materials and be neatly trimmed at the time of concrete placement.
- Under-slab utility trenches should be compacted to project specifications. Compaction should be achieved with a mechanical compaction device. If backfill soils have dried out, they should be thoroughly moisture conditioned prior to placement in trenches.

6.3.3 Foundation Set Backs

Foundations should comply with the following setbacks. Improvements not conforming to these setbacks are subject to the increased likelihood of excessive lateral movements and/or differential settlements. If large enough, these movements can compromise the integrity of the improvements. The following recommendations are presented:

- The outside bottom edge of all footings should be set back a minimum of H/2 (where H is the slope height) from the face of any ascending slope. The setback should be at least five (5) feet and need not to exceed fifteen (15) feet. Where a retaining wall is constructed at the toe of the slope, the height of the slope should be measured from top of the wall to the top of the slope.
- The outside bottom edge of all footings should be set back a minimum of H/3 from the face of any descending slope. The setback should be at least seven (7) feet and need not exceed forty (40) feet.
- The bottom of all footings for structures near retaining walls should be deepened so as to extend below a 1:1 (h:v) projection upward from the bottom inside edge of the wall foundation.
- The bottom of any planned foundations for structures should be deepened so as to extend below a 1:1 (h:v) projection upward from the bottom of the nearest excavation.

6.3.4 Retaining Wall Design and Construction

6.3.4.1 General Design Criteria

Recommendations presented in this report apply to typical masonry or concrete walls retaining up to six feet of soils. Additional review and recommendations should be requested for higher walls. These are typical design criteria and are not intended to supersede the design by the structural engineer.

Retaining wall foundations should be embedded a minimum of 12 inches into "very low" and "low" expansive soils and a minimum of 18 inches into "medium" expansive soils. Foundations should be designed in accordance with Section 6.3.1 of this report. Structural needs may govern and should be evaluated by the project structural engineer.

All earth retention structure plans, as applicable, should be reviewed by this office prior to finalization. The seismic design parameters as discussed in this report remain applicable to all proposed earth retention structures at this site and should be properly incorporated into the design and construction of the structures.

Earthwork considerations, site clearing and remedial earthwork for all earth retention structures should meet the requirements of this report, unless specifically provided otherwise, or more stringent requirements or recommendations are made by the designer. The backfill material placement for all earth retention structures should meet the requirement of Section 6.3.4.4 in this report.

In general, cantilever earth retention structures, which are designed to yield at least 0.001H, where H is equal to the height of the earth retention structure to the base of its footing, may be designed using the active condition. Rigid earth retention structures (including but not limited to rigid walls, and walls braced at top, such as typical basement walls) should be designed using the at-rest condition.

In addition to the design lateral forces due to retained earth, surcharges due to improvements, such as an adjacent building or traffic loading, should be considered in the design of the earth retention structures. Loads applied within a 1:1 (h:v) projection from the surcharge on the stem and footing of the earth retention structure should be considered in the design.

Final selection of the appropriate design parameters should be made by the designer of the earth retention structures.

6.3.4.2 Cantilevered Walls

The recommendations presented below are for cantilevered walls retaining up to six feet of soils. Active earth pressure may be used for retaining wall design, provided the top of the wall is not restrained from minor deflections. An equivalent fluid pressure approach may be used to compute the horizontal pressure against the wall. Appropriate fluid unit weights are given below for specific slope gradients of the retained material. These do not include other superimposed loading conditions such as traffic, structures, or adverse geologic conditions.

ACTIVE EARTH PRESSURES		
Surface Slope of Retained Materials (h:v)	Equivalent Fluid Pressure (pcf) Selected Native Backfill*	Equivalent Fluid Pressure (pcf) Import Granular Backfill**
Level	45	36
2:1	81	53

*The design pressures assume the native backfill material has an expansion index less than or equal to 50 and a friction angle of about 28 degrees or better. Backfill zone includes area between the back of the wall and footing to a plane (1:1 h:v) up from the bottom of the wall foundation to the ground surface.
**The design pressures assume that import granular backfill material has an expansion index less than or equal to 20 and a friction angle of at least 34 degrees. Backfill zone includes area between the back of the wall and footing to a plane (1:1 h:v) up from the bottom of the wall foundation to the ground surface.

6.3.4.3 Restrained Retaining Walls

Retaining walls that will be restrained prior to placing and compacting backfill material, or that have reentrant or male corners, should be designed for an at-rest equivalent fluid pressure of 66 pcf, plus any applicable surcharge loading, for native backfill and level back slope condition. For imported granular backfill, an at-rest equivalent fluid pressure of 57 pcf should be utilized. For areas of male or reentrant corners, the restrained wall design should extend a minimum distance of twice the height of the wall laterally from the corner, or a distance otherwise determined by the project structural engineer.

6.3.4.4 Retaining Wall Backfill and Drainage

Retaining wall backfill should be free of deleterious and/or oversized materials and should have properties indicated in Section 6.3.4.2. Retaining walls should be provided with an adequate pipe and gravel back drain system to help prevent buildup of hydrostatic pressures. Backdrains should consist of a four-inch diameter perforated collector pipe (Schedule 40, SDR 35, or approved equivalent) embedded in a minimum of one-cubic foot per linear foot of ¾- to 1-inch clean crushed rock or an approved equivalent, wrapped in filter fabric (Mirafi 140N or an approved

equivalent). The drain system should be connected to a suitable outlet. Waterproofing of site walls should be performed where moisture migration through the wall is undesirable.

Retaining wall backfill should be placed in lifts no greater than eight inches in thickness and compacted to a minimum of 90 percent relative compaction in accordance with ASTM Test Method D 1557. The wall backfill should also include a minimum one-foot wide section of ¾- to 1-inch clean crushed rock (or an approved equivalent). The rock should be placed immediately adjacent to the back of the wall and extend up from a back drain to within approximately 24 inches of the finish grade. The rock should be separated from the earth with filter fabric. The upper 24 inches should consist of compacted on-site soil.

As an alternative to the drain rock and fabric, Miradrain 2000, or approved equivalent, may be used behind the retaining wall. The Miradrain 2000 should extend from the base of the wall to within two feet of the ground surface. The subdrain should be placed at the base of the wall in direct contact with the Miradrain 2000.

The presence of other materials might necessitate revision to the parameters provided and modification of the wall designs. Proper surface drainage needs to be provided and maintained.

6.3.4.5 Other Design Considerations

- Wall design should consider the additional surcharge loads from superjacent slopes and/or footings, where appropriate.
- No backfill should be placed against concrete until minimum design strengths are evident by compression tests of cylinders.
- The retaining wall footing excavations, backcuts, and backfill materials should be approved the project geotechnical engineer or their authorized representative.

6.3.5 Pavement Design Considerations

Pavement design for proposed on-site parking and drive areas was conducted per Caltrans Highway Design Manual guidelines for flexible pavements and the Portland Cement Association for rigid pavements. Based on an assumed design R-value of 20 and for Traffic Indexes (TIs) of 5.0 for car parking areas and 6.0 for drive areas for light traffic with occasional truck traffic, the following preliminary sections were calculated:

PRELIMINARY PAVEMENT SECTIONS		
Traffic Index	Thickness of Flexible Pavement Section	Thickness of Rigid Pavement Section
5.0	3" AC / 7.5" AB	--
6.0	4" AC / 8.5" AB	6.5" PCC/ 4" AB

*AC = Asphalt Concrete, AB = Aggregate Base, PCC = Portland Cement Concrete with a f'c > 3,500 psi.

The TIs used in our pavement design are considered reasonable values for the proposed pavement areas and should provide a pavement life of approximately 20 years with a normal amount of flexible pavement maintenance. Irrigation adjacent to pavements, without a deep curb or other cutoff to separate landscaping from the paving may result in premature pavement failure. Traffic parameters used for design were selected based upon engineering judgment and not upon information furnished to us such as an equivalent wheel load analysis or a traffic study.

No structural reinforcement of the concrete pavements is required. However, temperature and shrinkage control reinforcement should be provided. This reinforcement should consist of No, 4 rebars on 24-inch centers, each way, or equivalent. The reinforcement should be placed at mid-height to the concrete pavement. Also, the concrete pavement should be provided with proper joints to help control cracking. All materials and methods of construction should also conform to the requirements of the City of Orange. These pavement sections should be considered preliminary until reviewed and approved by the City.

The recommended pavement sections provided are intended as a minimum guideline and final selection of pavement cross section parameters should be made by the project civil engineer, based upon the local laws and ordinates, expected subgrade and pavement response, and desired level of conservatism. If thinner or highly variable pavement sections are constructed, increased maintenance and repair could be expected. Final pavement design should be checked by testing of soils exposed at subgrade (the upper one foot) after final grading has been completed.

Asphalt concrete and aggregate base should conform to current Caltrans Standard Specifications Section 39 and 26-1.02, respectively. As an alternative, asphalt concrete can conform to Section 203-6 of the current Standard Specifications for Public Work (Green Book). Crushed aggregate base or crushed miscellaneous base can conform to Section 200-2.2 and 200-2.4 of the Green Book, respectively. Pavement base should be compacted to at least 95 percent of the ASTM D1557 laboratory maximum dry density (modified proctor).

All pavement installation, including preparation and compaction of subgrade, compaction of base material, placement and rolling of asphaltic concrete, should be done in accordance with the City of Orange specifications, and under the observation and testing of GeoTek and a City Inspector

where required. Jurisdictional minimum compaction requirements in excess of the aforementioned minimums may govern.

Deleterious material, excessive wet or dry pockets, oversized rock fragments, and other unsuitable yielding materials encountered during grading should be removed. Once existing compacted fill are brought to the proposed pavement subgrade elevations, the subgrade should be proof-rolled in order to check for a uniform and unyielding surface. The upper 12 inches of pavement subgrade soils should be scarified, moisture conditioned at or near optimum moisture content, and recompacted to at least 95 percent of the laboratory maximum dry density (ASTM D1557). If loose or yielding materials are encountered during construction, additional evaluation of these areas should be carried out by GeoTek. All pavement section changes should be properly transitioned.

6.3.6 Soil Corrosivity

The soil resistivity was tested in the laboratory on two samples collected during our field exploration. The results of the testing (2,750 and 2,814 ohm-cm) indicate that the soil samples are *"highly corrosive"* to buried ferrous metals, based on the guidelines provided in *Corrosion Basics: An Introduction* (Roberge, 2005). Consideration should be given to consulting with a corrosion engineer.

6.3.7 Soil Sulfate Content

The sulfate content was determined in the laboratory for two soil samples obtained during our field exploration. The results (0.0027 and 0.0103 percent) indicate that the water-soluble sulfate range is less than 0.1 percent by weight which is considered "not applicable" (i.e. negligible) as per Table 4.2.1 of ACI 318. Based upon the test results, no special concrete mix design is required by Code for sulfate attack resistance. Additional testing of soils collected near finish grade should be performed subsequent to site grading.

6.3.8 Import Soils

Import soils should have a "very low" expansion potential. GeoTek also recommends that, as a minimum, proposed import soils be tested for soluble sulfate content. GeoTek should be notified a minimum of 72 hours of potential import sources so that appropriate sampling and laboratory testing can be performed.

6.3.9 Concrete Flatwork

6.3.9.1 Exterior Concrete Slabs, Sidewalks, and Driveways

Exterior concrete slabs, sidewalks, and driveways should be designed using a four-inch minimum thickness. No specific reinforcement is required due to the non-structural nature. However, the use of some reinforcement should be considered. Some shrinkage and cracking of the concrete should be anticipated as a result of typical mix designs and curing practices commonly utilized in residential construction.

Sidewalks and driveways may be under the jurisdiction of the governing agency. If so, jurisdictional design and construction criteria would apply, if more restrictive than the recommendations presented herein.

Subgrade soils should be pre-moistened prior to placing concrete. The subgrade with "very low" expansion potential should be pre-saturated to a minimum of 100 percent of optimum moisture content to a depth of at least 12 inches. Soils with "low" and "medium" expansion potentials should be pre-saturated to a minimum of 110 and 120 percent of optimum moisture content, respectively. Presaturation depth should be at least 12 inches.

All concrete installation, including preparation and compaction of subgrade, should be done in accordance with the City of Orange specifications, and under the observation and testing of GeoTek and a City Inspector, if necessary.

6.3.9.2 Concrete Performance

Concrete cracks should be expected. These cracks can vary from sizes that are essentially unnoticeable to more than 1/8 inch in width. Most cracks in concrete, while unsightly, do not significantly impact long-term performance. While it is possible to take measures (proper concrete mix, placement, curing, control joints, etc.) to reduce the extent and size of cracks that occur, some cracking will occur despite the best efforts to minimize it. Concrete can also undergo chemical processes that are dependent on a wide range of variables, which are difficult, at best, to control. Concrete, while seemingly a stable material, is also subject to internal expansion and contraction due to external changes over time.

One of the simplest means to control cracking is to provide weakened control joints for cracking to occur along. These do not prevent cracks from developing; they simply provide a relief point for the stresses that develop. These joints are a widely accepted means to control cracks but are not always effective. Control joints are more effective the more closely spaced they are.

GeoTek suggests that control joints be placed in two directions and located a distance apart roughly equal to 24 to 36 times the slab thickness.

Exterior concrete flatwork (patios, walkways, driveways, etc.) is often some of the most visible aspects of site development. They are typically given the least level of quality control, being considered "non-structural" components. We suggest that the same standards of care be applied to these features as to the structure itself.

6.4 POST CONSTRUCTION CONSIDERATIONS

6.4.1 Landscape Maintenance and Planting

Water has been shown to weaken the inherent strength of soil, and slope stability is significantly reduced by overly wet conditions. Positive surface drainage away from graded slopes should be maintained and only the amount of irrigation necessary to sustain plant life should be provided for planted slopes. Controlling surface drainage and runoff and maintaining a suitable vegetation cover can minimize erosion. Plants selected for landscaping should be lightweight, deep-rooted types that require little water and are capable of surviving the prevailing climate.

Overwatering should be avoided. The soils should be maintained in a solid to semi-solid state as defined by the materials Atterberg Limits. Care should be taken when adding soil amendments to avoid excessive watering. Leaching as a method of soil preparation prior to planting is not recommended. An abatement program to control ground-burrowing rodents should be implemented and maintained. This is critical as burrowing rodents can decreased the long-term performance of slopes.

It is common for planting to be placed adjacent to structures in planter or lawn areas. This will result in the introduction of water into the ground adjacent to the foundation. This type of landscaping should be avoided. If used, then extreme care should be exercised with regard to the irrigation and drainage in these areas.

6.4.2 Drainage

The need to maintain proper surface drainage and subsurface systems cannot be overly emphasized. Positive site drainage should be maintained at all times. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond or seep into the ground. Pad drainage should be directed toward approved area(s) and not be blocked by other improvements.

It is the owner's responsibility to maintain and clean drainage devices on or contiguous to their lot. In order to be effective, maintenance should be conducted on a regular and routine schedule and necessary corrections made prior to each rainy season.

6.5 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

We recommend that site grading plans, pool plans, retaining wall plans, foundation plans, and relevant project specifications be reviewed by this office prior to construction to check for conformance with the recommendations of this report. We also recommend that GeoTek representatives be present during site grading and foundation construction to check for proper implementation of the geotechnical recommendations. The owner/developer should verify that GeoTek representatives perform at least the following duties:

- Observe site clearing and grubbing operations for proper removal of unsuitable materials.
- Observe and test bottom of removals prior to fill placement.
- Evaluate the suitability of onsite and import materials for fill placement and collect soil samples for laboratory testing where necessary.
- Observe the fill for uniformity during placement, including utility trenches.
- Perform field density testing of the fill materials.
- Observe and probe foundation excavations to confirm suitability of bearing materials.

If requested, a construction observation and compaction report can be provided by GeoTek, which can comply with the requirements of the governmental agencies having jurisdiction over the project. We recommend that these agencies be notified prior to commencement of construction so that necessary grading permits can be obtained.

7. INTENT

It is the intent of this report to aid in the design and construction of the proposed development. Implementation of the advice presented in this report is intended to reduce risk associated with construction projects. The professional opinions and geotechnical advice contained in this report are not intended to imply total performance of the project or guarantee that unusual or variable conditions will not be discovered during or after construction.

The scope of our evaluation is limited to the boundaries of the subject site. This review does not and should in no way be construed to encompass any areas beyond the specific area of the proposed construction as indicated to us by the client. Further, no evaluation of any existing site improvements is included. The scope is based on our understanding of the project and the

client's needs, our fee estimate (P-04010622-CR) dated April 20, 2022 and geotechnical engineering standards normally used on similar projects in this region.

8. LIMITATIONS

The materials observed on the project site appear to be representative of the area; however, soil materials vary in character between excavations or conditions exposed during site construction. Site conditions may vary due to seasonal changes or other factors. GeoTek, Inc. assumes no responsibility or liability for work, testing or recommendations performed or provided by others.

Since our recommendations are based on the site conditions observed and encountered, and laboratory testing, our conclusion and recommendations are professional opinions that are limited to the extent of the available data. Observations during construction are important to allow for any change in recommendations found to be warranted. These opinions have been derived in accordance with current standards of practice and no warranty is expressed or implied. Standards of practice are subject to change with time.

9. SELECTED REFERENCES

ASCE, 2017, "Minimum Design Loads for Buildings and Other Structures, ASCE Standard ASCE/SEI 7-16".

ASTM, 2011, "Soil and Rock: American Society for Testing and Materials", vol. 4.08 and 4.09.

Bassenian Lagoni Architecture, 2022, "Conceptual Site Plan, 901 E. Katella Avenue, Orange, California," dated February 16.

Bryant, W.A., and Hart, E.W., 2007, "Fault Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps", California Geological Survey: Special Publication 42.

California Code of Regulations, Title 24, 2019 "California Building Code", 2 volumes.

California Department of Conservation, 1997, "Seismic Hazard Zone Report for the Anaheim and Newport Beach 7.5-Minute Quadrangles, Orange County, California", Seismic Hazard Report 3.

Morton, D.M. and Miller, F.K., 2006, "Geologic Map of the San Bernardino and Santa Ana 30' x 60' Quadrangles, California," US Geological Survey OF 2006-1217, scale 1:100,000.

Orange County, 2013, "Technical Guidance Document Appendix VII".

Roberge, P.R., 2005, "Corrosion Basics: An Introduction", 2nd Edition.

Salem Engineering Group, Inc., 2019, "Geotechnical Engineering Investigation, Proposed Commercial Development, 901 E. Katella Avenue, Orange, California," Project No. 3-219-0272, dated May 16.

Seismic Design Values for Buildings (http://earthquake.usgs.gov/research/hazmaps/design).



0 400 ft

Intracorp SW, LLC
901 E Katella Avenue
Orange, Orange County, California

Project No. 3193-CR

NORTH

Figure 1

Site Location Map

GEOTEK



Intracorp SW, LLC
901 E Katella Avenue
Orange, Orange County, California

GeoTek Project No. 3193-CR

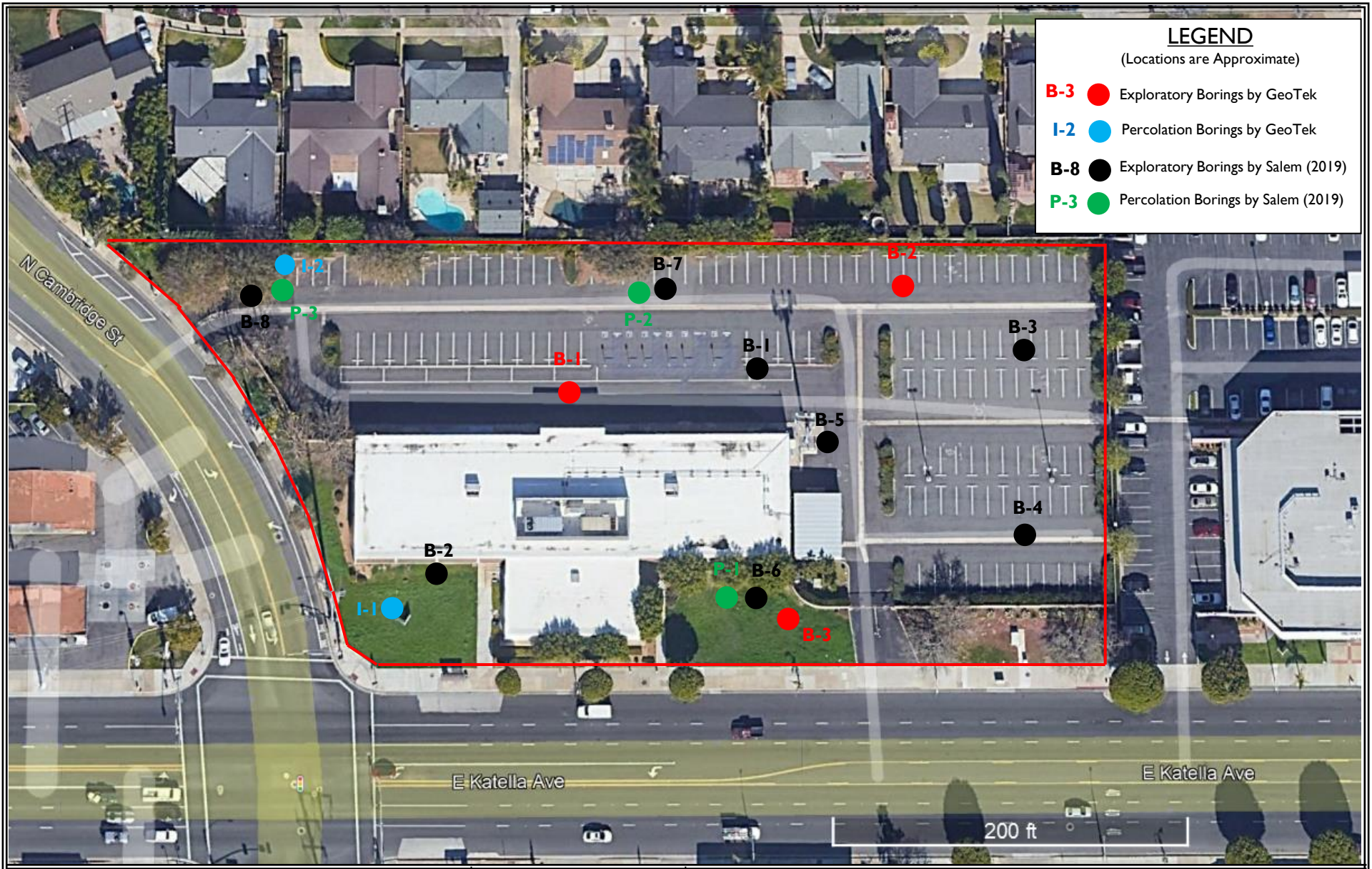
Scale As Shown

NORTH

Figure 2

Boring and Infiltration Test Location Map

GEOTEK



Intracorp SW, LLC
901 E Katella Avenue
Orange, Orange County, California

Project No. 3193-CR

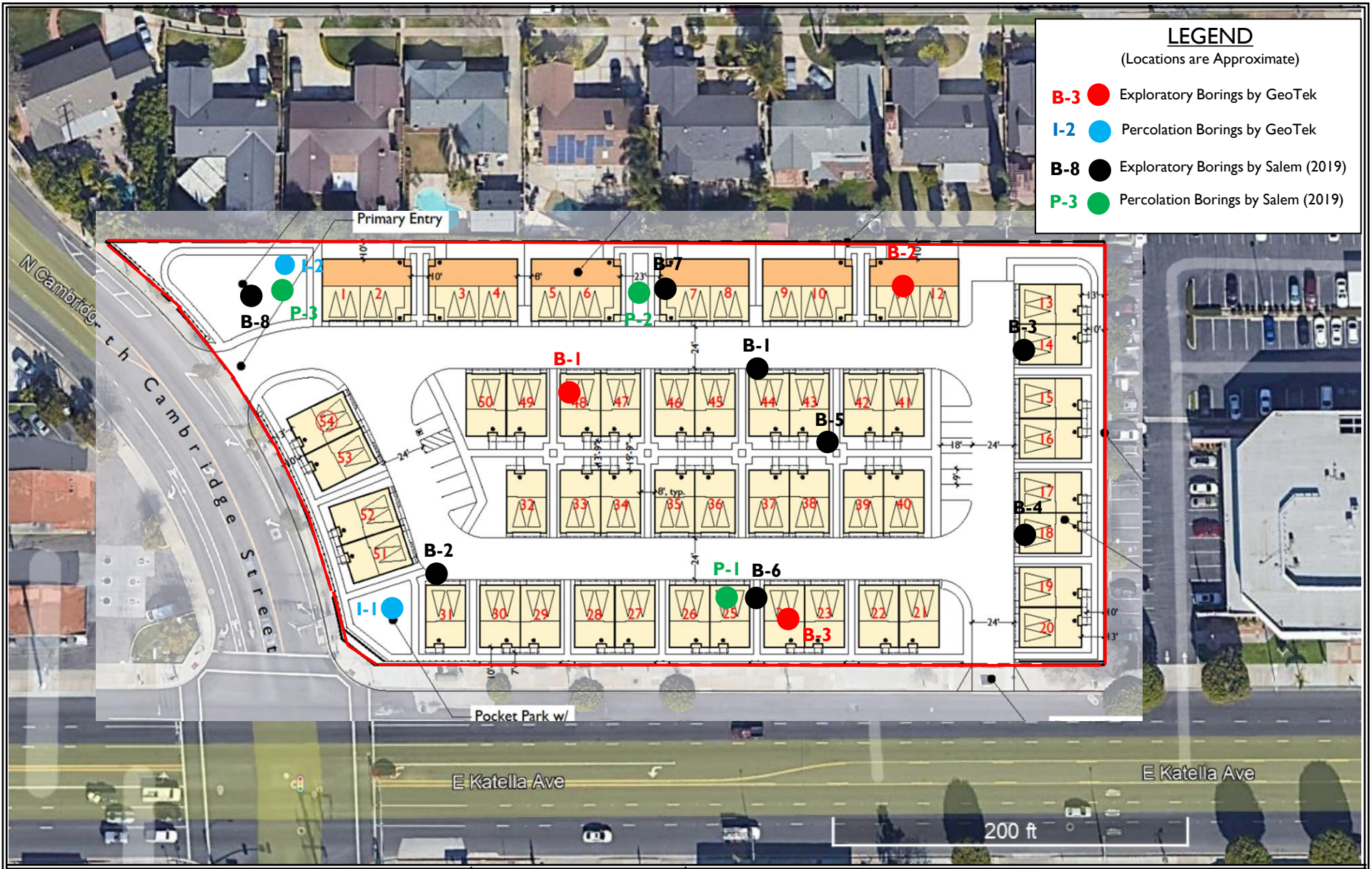
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NORTH

Figure 2a

Exploration Location Map

GEOTEK



Intracorp SW, LLC
901 E Katella Avenue
Orange, Orange County, California

Project No. 3193-CR

Scale As Shown

NORTH

Figure 2b

Exploration Location Map

GEOTEK

APPENDIX A

EXPLORATORY BORING LOGS, LABORATORY TEST RESULTS, AND INFILTRATION DATA BY SALEM ENGINEERING GROUP (2019)

Updated Geotechnical and Infiltration Evaluation
901 E. Katella Avenue, Orange, California
Project No. 3193-CR

GEOTEK

Boring No. B-1

Project: Proposed Commercial Development
Client: The Festival Companies
Location: 901 E. Katella Avenue, Orange, California
Grnd. Surf. Elev. (Ft. MSL) -

Project No: 3-219-0272
Figure No.: A-1
Logged By: JH
Initial: -
Depth to Water>
At Completion: -

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count	Penetration Test (20 40 60 80)	Water Level
0		Ground Surface							
		Asphalt Concrete = 3.5 in							
		Aggregate Base = 6.5 in							
		Sandy CLAY (CL) Very stiff; moist; reddish brown; fine grain sand.	121.3	12.7	MCS		28		
5		**Clayey SAND (SC)** Dense; moist; grayish brown; fine to coarse grain sand; with fine gravel.	125.2	7.9	MCS		49		
10		Grades as above; slightly moist.	115.9	5.0	MCS		53		
15		Grades as above; medium dense.	-	4.4	SPT		27		
		Poorly graded SAND with Silt (SP-SM) Dense; slightly moist; grayish brown; fine to coarse grain sand; with fine gravel.	-	4.3	SPT		31		
		Sandy CLAY (CL) Stiff; moist; reddish brown; fine grain sand.	-	11.9	SPT		9		
25									

Drill Method: Solid Flight
Drill Rig: CME 55
Driller: SALEM
Sheet: 1 of 2

Drill Date: 04/25/19
Borehole Size: 6 in
Hammer Type: Automatic Trip
Weight & Drop: 140 lb/30 in

SALEM

Boring No. B-1

Project: Proposed Commercial Development
Client: The Festival Companies
Location: 901 E. Katella Avenue, Orange, California
Grnd. Surf. Elev. (Ft. MSL) -

Project No: 3-219-0272
Figure No.: A-1
Logged By: JH
Initial: -
Depth to Water>
At Completion: -

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count	Penetration Test (20 40 60 80)	Water Level
30		Grades as above; hard; grayish brown; with fine gravel.	-	6.0	SPT		64		
35		**Well-graded SAND with Silt (SW-SM)** Very dense; slightly moist; grayish brown; fine to coarse grain sand; with fine gravel.	-	5.6	SPT		61		
40		Grades as above.	-	4.2	SPT		54		
45		Grades as above; with fine to coarse gravel; with some cobbles.	-	-	SPT		50		
50		Grades as above.	-	4.7	SPT		50		
		End of Borehole							

Drill Method: Solid Flight
Drill Rig: CME 55
Driller: SALEM
Sheet: 2 of 2

Drill Date: 04/25/19
Borehole Size: 6 in
Hammer Type: Automatic Trip
Weight & Drop: 140 lb/30 in

SALEM

Boring No. B-2

Project: Proposed Commercial Development
Client: The Festival Companies
Location: 901 E. Katella Avenue, Orange, California
Grnd. Surf. Elev. (Ft. MSL) -

Project No: 3-219-0272
Figure No.: A-2
Logged By: JH
Initial: -
Depth to Water>
At Completion: -

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count	Penetration Test (20 40 60 80)	Water Level
0		Ground Surface							
		Sandy CLAY (CL) Stiff; moist; reddish brown; fine grain sand.	113.6	9.4	MCS		19		
5		**Clayey SAND (SC)** Dense; slightly moist; reddish brown; fine to coarse grain sand; with fine gravel.	117.9	4.9	MCS		59		
10		**Silty SAND (SM)** Medium dense; moist; grayish brown; fine to coarse grain sand; trace clay; with fine gravel.	-	6.0	SPT		26		
15		**Clayey SAND (SC)** Dense; moist; reddish brown; fine to coarse grain sand; with fine gravel.	-	7.6	SPT		38		
		End of Borehole							
20									
25									

Drill Method: Solid Flight
Drill Rig: CME 55
Driller: SALEM
Sheet: 1 of 1

Drill Date: 04/25/19
Borehole Size: 6 in
Hammer Type: Automatic Trip
Weight & Drop: 140 lb/30 in

SALEM

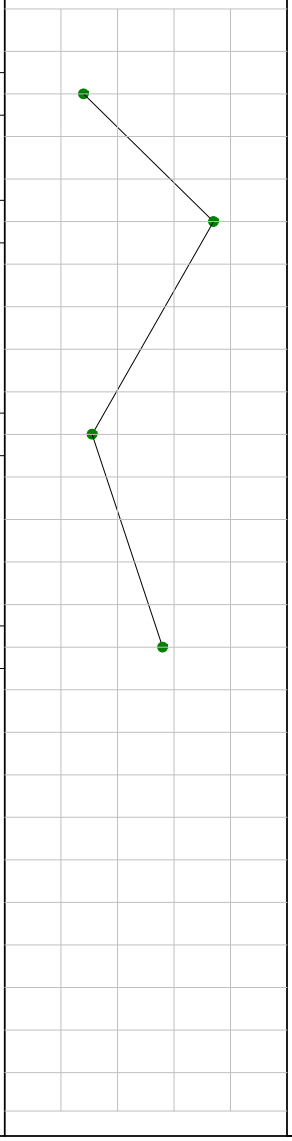
Boring No. B-3

Project: Proposed Commercial Development
Client: The Festival Companies
Location: 901 E. Katella Avenue, Orange, California
Grnd. Surf. Elev. (Ft. MSL) -

Project No: 3-219-0272
Figure No.: A-3
Logged By: JH
Initial: -
Depth to Water>
At Completion: -

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count
		SUBSURFACE PROFILE	**SAMPLE**				
0		Ground Surface					
		Asphalt Concrete = 4 in					
		Sandy CLAY (CL) Very stiff; moist; reddish brown; fine grain sand.	119.4	12.3	MCS		28
5		**Clayey SAND (SC)** Very dense; slightly moist; reddish brown; fine to coarse grain sand; with fine gravel.	106.6	5.1	MCS		74
10		Grades as above; dense; moist.	-	9.5	SPT		31
15		Grades as above; very dense; slightly moist.	-	4.1	SPT		56
		End of Borehole					
20							
25							

Penetration Test



Water Level

Drill Method: Solid Flight
Drill Rig: CME 55
Driller: SALEM
Sheet: 1 of 1

Drill Date: 04/25/19
Borehole Size: 6 in
Hammer Type: Automatic Trip
Weight & Drop: 140 lb/30 in

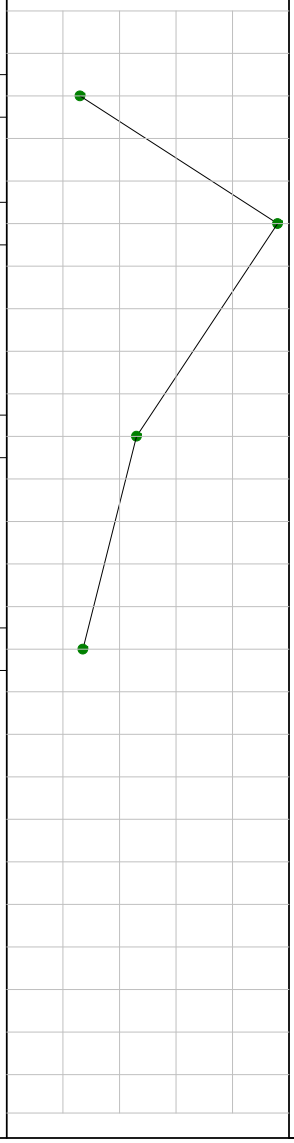
SALEM

Boring No. B-4

Project: Proposed Commercial Development
Client: The Festival Companies
Location: 901 E. Katella Avenue, Orange, California
Grnd. Surf. Elev. (Ft. MSL) -

Project No: 3-219-0272
Figure No.: A-4
Logged By: JH
Initial: -
Depth to Water>
At Completion: -

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count	Penetration Test (20 40 60 80)	Water Level
0		Ground Surface							
		Asphalt Concrete = 2.75 in							
		Aggregate Base = 4 in							
		Sandy CLAY (CL) Very stiff; moist; reddish brown; fine grain sand.	120.5	12.9	MCS		26		
5		**Clayey SAND (SC)** Very dense; slightly moist; reddish brown; fine to coarse grain sand; with fine gravel.	126.3	5.8	MCS		96		
		Silty SAND (SM) Dense; slightly moist; grayish brown; fine to coarse grain sand; with fine gravel.	-	5.1	SPT		46		
15		Grades as above; medium dense; trace clay.	-	5.3	SPT		27		
		End of Borehole							
20									
25									



Drill Method: Solid Flight
Drill Rig: CME 55
Driller: SALEM
Sheet: 1 of 1

Drill Date: 04/25/19
Borehole Size: 6 in
Hammer Type: Automatic Trip
Weight & Drop: 140 lb/30 in

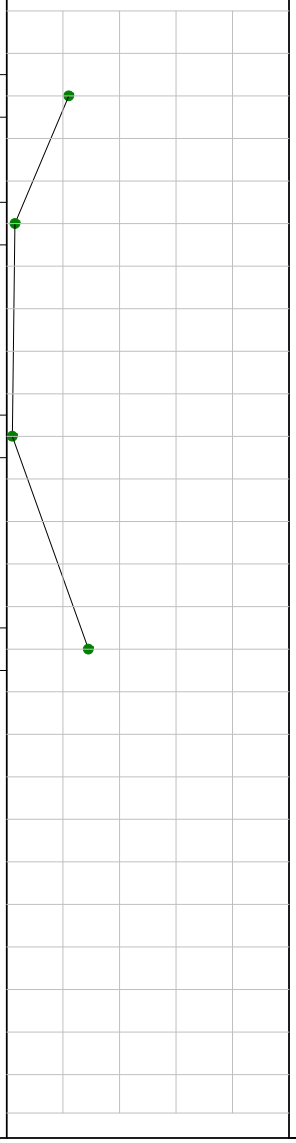
SALEM

Boring No. B-5

Project: Proposed Commercial Development
Client: The Festival Companies
Location: 901 E. Katella Avenue, Orange, California
Grnd. Surf. Elev. (Ft. MSL) -

Project No: 3-219-0272
Figure No.: A-5
Logged By: JH
Initial: -
Depth to Water>
At Completion: -

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count	Penetration Test (20 40 60 80)	Water Level
0		Ground Surface							
		Asphalt Concrete = 3 in							
		Aggregate Base = 4 in							
		Well-graded SAND with Silt (SW-SM) Medium dense; moist; grayish brown; fine to medium grain sand. **Possible FILL.**	108.8	5.6	MCS		22		
5		**Well-graded SAND (SW)** Very loose; slightly moist; grayish brown; fine to coarse grain sand; with fine gravel. **Possible FILL.**	107.0	3.2	MCS		3		
10		**Poorly graded SAND (SP)** Very loose; slightly moist; grayish brown; fine to coarse grain sand; trace clay; with fine to coarse gravel. **Possible FILL.**	-	3.1	SPT		2		
15		Grades as above; medium dense.	-	5.4	SPT		29		
		End of Borehole							
20									
25									



Drill Method: Solid Flight
Drill Rig: CME 55
Driller: SALEM
Sheet: 1 of 1

Drill Date: 04/25/19
Borehole Size: 6 in
Hammer Type: Automatic Trip
Weight & Drop: 140 lb/30 in

SALEM

Boring No. B-6

Project: Proposed Commercial Development
Client: The Festival Companies
Location: 901 E. Katella Avenue, Orange, California
Grnd. Surf. Elev. (Ft. MSL) -

Project No: 3-219-0272
Figure No.: A-6
Logged By: JH
Initial: -
Depth to Water>
At Completion: -

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count	Penetration Test (20 40 60 80)	Water Level
0		Ground Surface							
		Sandy CLAY (CL) Very stiff; moist; reddish brown; fine grain sand.	111.4	8.5	MCS		23		
5		**Clayey SAND (SC)** Dense; moist; reddish brown; fine to coarse grain sand.	-	8.1	SPT		33		
		Grades as above.	-	6.2	SPT		35		
10		End of Borehole							
15									
20									
25									

Drill Method: Solid Flight
Drill Rig: CME 55
Driller: SALEM
Sheet: 1 of 1

Drill Date: 04/25/19
Borehole Size: 6 in
Hammer Type: Automatic Trip
Weight & Drop: 140 lb/30 in

SALEM

Boring No. B-7

Project: Proposed Commercial Development
Client: The Festival Companies
Location: 901 E. Katella Avenue, Orange, California
Grnd. Surf. Elev. (Ft. MSL) -

Project No: 3-219-0272
Figure No.: A-7
Logged By: JH
Initial: -
Depth to Water>
At Completion: -

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count	Penetration Test (20 40 60 80)	Water Level
0		Ground Surface							
		Asphalt Concrete = 6 in							
		Aggregate Base = 12 in							
		Sandy CLAY (CL) Very stiff; moist; reddish brown; fine grain sand.	121.0	12.9	MCS		29		
5		**Clayey SAND (SC)** Dense; moist; grayish brown; fine to coarse grain sand; with fine gravel.	-	5.1	SPT		44		
		Silty SAND (SM) Dense; moist; grayish brown; fine to coarse grain sand; trace clay; with fine gravel.	-	4.7	SPT		32		
10		End of Borehole							
15									
20									
25									

Drill Method: Solid Flight
Drill Rig: CME 55
Driller: SALEM
Sheet: 1 of 1

Drill Date: 04/25/19
Borehole Size: 6 in
Hammer Type: Automatic Trip
Weight & Drop: 140 lb/30 in

SALEM

Boring No. B-8

Project: Proposed Commercial Development
Client: The Festival Companies
Location: 901 E. Katella Avenue, Orange, California
Grnd. Surf. Elev. (Ft. MSL) -

Project No: 3-219-0272
Figure No.: A-8
Logged By: JH
Initial: -
Depth to Water>
At Completion: -

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count	Penetration Test (20 40 60 80)	Water Level
0		Ground Surface							
		Asphalt Concrete = 3 in							
		Aggregate Base = 6 in	125.0	10.7	MCS		46		
		Sandy CLAY (CL) Hard; moist; reddish brown; fine grain sand.							
5		Grades as above; with fine gravel.	-	11.1	SPT		41		
		End of Borehole							
10									
15									
20									
25									



Drill Method: Solid Flight
Drill Rig: CME 55
Driller: SALEM
Sheet: 1 of 1

Drill Date: 04/25/19
Borehole Size: 6 in
Hammer Type: Automatic Trip
Weight & Drop: 140 lb/30 in

SALEM

Percolation Test Worksheet

Project: **Proposed Commercial Development**
901 E. Katella Avenue
Orange, California

Job No.: **3-219-0272**
Date Drilled: **4/25/2019**
Soil Classification: **Clayey SAND (SC)**

Hole Radius: 4 in.
Pipe Dia.: 3 in.
Total Depth of Hole: 120 in.

Test Hole No.: **P-1**
Tested by: **JH**
Drilled Hole Depth: **10** ft.

Presoaking Date: **4/25/2019**
Test Date: **4/26/2019**

Pipe Stick up: 0.2 ft.

Time Start	Time Finish	Depth of Test Hole (ft)#	Refill- Yes or No	Elapsed Time (hrs:min)	Initial Water Level# (ft)	Final Water Level# (ft)	Δ Water Level (in.)	Δ Min.	Meas. Perc Rate (min/in)	Initial Height of Water (in)	Final Height of Water (in)	Average Height of Water (in)	Infiltration Rate, It (in/hr)
8:00	8:30	10.2	Y	0:30	9.12	9.15	0.36	30	83.3	13.0	12.6	12.8	0.10
8:30	9:00	10.2	N	0:30	9.15	9.18	0.36	30	83.3	12.6	12.2	12.4	0.10
9:00	9:30	10.2	N	0:30	9.18	9.21	0.36	30	83.3	12.2	11.9	12.1	0.10
9:30	10:00	10.2	N	0:30	9.21	9.24	0.36	30	83.3	11.9	11.5	11.7	0.11
10:00	10:30	10.2	N	0:30	9.24	9.27	0.36	30	83.3	11.5	11.2	11.3	0.11
10:30	11:00	10.2	N	0:30	9.27	9.29	0.24	30	125.0	11.2	10.9	11.0	0.07
11:00	11:30	10.2	N	0:30	9.29	9.31	0.24	30	125.0	10.9	10.7	10.8	0.08
11:30	12:00	10.2	N	0:30	9.31	9.32	0.12	30	250.0	10.7	10.6	10.6	0.04
12:00	12:30	10.2	N	0:30	9.32	9.33	0.12	30	250.0	10.6	10.4	10.5	0.04
12:30	13:00	10.2	N	0:30	9.33	9.34	0.12	30	250.0	10.4	10.3	10.4	0.04
13:00	13:30	10.2	N	0:30	9.34	9.35	0.12	30	250.0	10.3	10.2	10.3	0.04
13:30	14:00	10.2	N	0:30	9.35	9.36	0.12	30	250.0	10.2	10.1	10.1	0.04
Recommended for Design:										**Infiltration Rate**			**0.04**

SALEM engineering group, inc.

Percolation Test Worksheet

Project: **Proposed Commercial Development**
901 E. Katella Avenue
Orange, California

Job No.: **3-219-0272**
Date Drilled: **4/25/2019**
Soil Classification: **Silty SAND (SM) w/Gravel, trace Clay**

Hole Radius: 4 in.
Pipe Dia.: 3 in.
Total Depth of Hole: 120 in.

Test Hole No.: **P-2**
Tested by: **JH**
Drilled Hole Depth: **10** ft.

Presoaking Date: **4/25/2019**
Test Date: **4/26/2019**

Pipe Stick up: 0.5 ft.

Time Start	Time Finish	Depth of Test Hole (ft)#	Refill- Yes or No	Elapsed Time (hrs:min)	Initial Water Level# (ft)	Final Water Level# (ft)	Δ Water Level (in.)	Δ Min.	Meas. Perc Rate (min/in)	Initial Height of Water (in)	Final Height of Water (in)	Average Height of Water (in)	Infiltration Rate, It (in/hr)
11:00	11:30	10.5	Y	0:30	8.00	8.22	2.64	30	11.4	30.0	27.4	28.7	0.34
11:30	12:00	10.5	N	0:30	8.22	8.39	2.04	30	14.7	27.4	25.3	26.3	0.29
12:00	12:30	10.5	N	0:30	8.39	8.54	1.80	30	16.7	25.3	23.5	24.4	0.27
12:30	13:00	10.5	N	0:30	8.54	8.68	1.68	30	17.9	23.5	21.8	22.7	0.27
13:00	13:30	10.5	N	0:30	8.68	8.81	1.56	30	19.2	21.8	20.3	21.1	0.27
13:30	14:00	10.5	N	0:30	8.81	8.93	1.44	30	20.8	20.3	18.8	19.6	0.27
14:00	14:30	10.5	N	0:30	8.93	9.04	1.32	30	22.7	18.8	17.5	18.2	0.26
14:30	15:00	10.5	N	0:30	9.04	9.14	1.20	30	25.0	17.5	16.3	16.9	0.25
15:00	15:30	10.5	N	0:30	9.14	9.23	1.08	30	27.8	16.3	15.2	15.8	0.24
15:30	16:00	10.5	N	0:30	9.23	9.31	0.96	30	31.3	15.2	14.3	14.8	0.23
16:00	16:30	10.5	N	0:30	9.31	9.39	0.96	30	31.3	14.3	13.3	13.8	0.24
16:30	17:00	10.5	N	0:30	9.39	9.47	0.96	30	31.3	13.3	12.4	12.8	0.26
Recommended for Design:										**Infiltration Rate**			**0.23**

SALEM engineering group, inc.

Percolation Test Worksheet

Project: **Proposed Commercial Development**
901 E. Katella Avenue
Orange, California

Job No.: **3-219-0272**
Date Drilled: **4/25/2019**
Soil Classification: **Sandy CLAY (CL)**

Hole Radius: 4 in.
Pipe Dia.: 3 in.
Total Depth of Hole: 60 in.

Test Hole No.: **P-3**
Tested by: **JH**
Drilled Hole Depth: **5** ft.

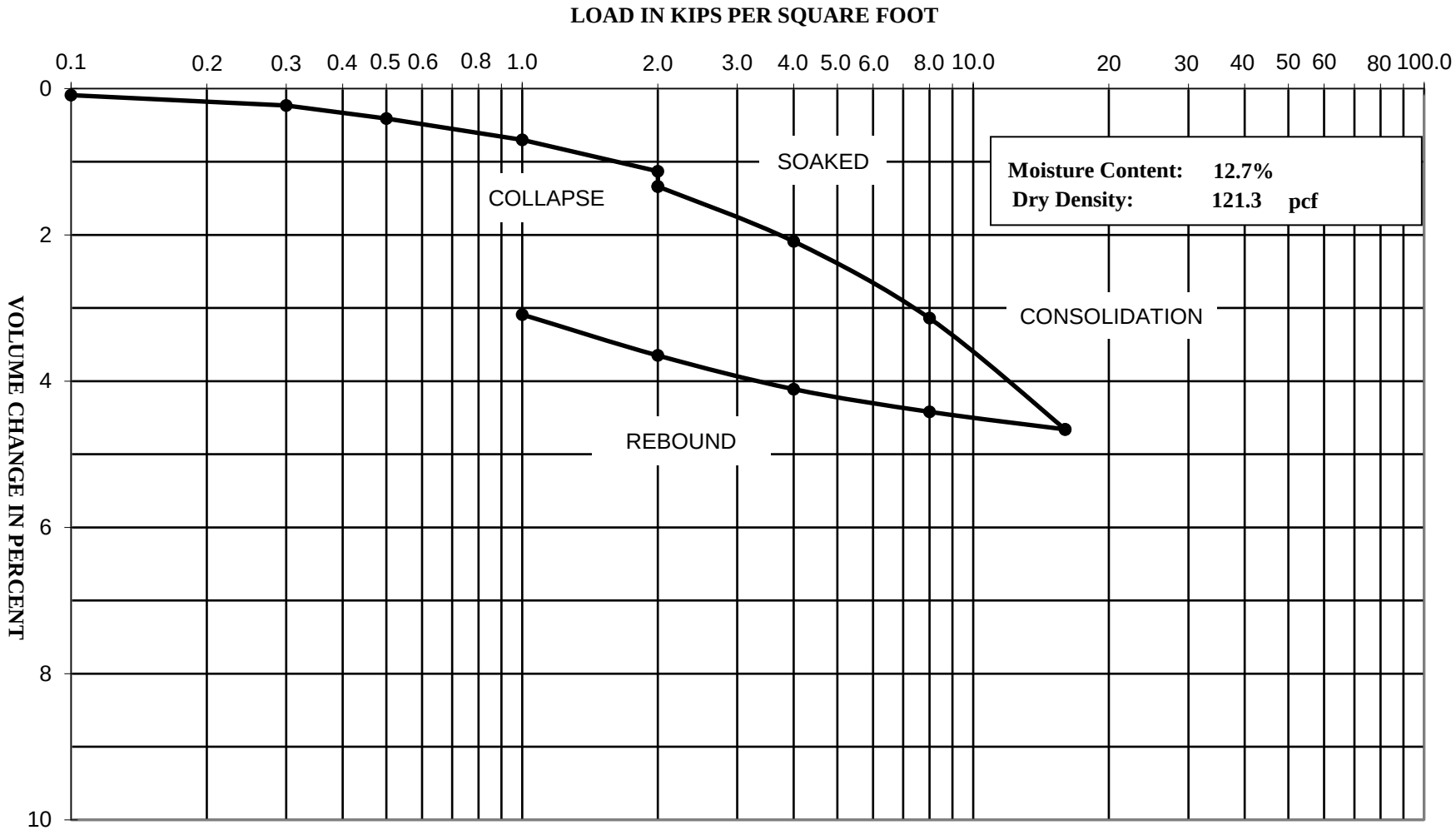
Presoaking Date: **4/25/2019**
Test Date: **4/26/2019**

Pipe Stick up: 1.25 ft.

Time Start	Time Finish	Depth of Test Hole (ft)#	Refill-Yes or No	Elapsed Time (hrs:min)	Initial Water Level# (ft)	Final Water Level# (ft)	Δ Water Level (in.)	Δ Min.	Meas. Perc Rate (min/in)	Initial Height of Water (in)	Final Height of Water (in)	Average Height of Water (in)	Infiltration Rate, It (in/hr)
7:50	8:20	6.3	Y	0:30	4.94	4.95	0.12	30	250.0	15.7	15.6	15.7	0.03
8:20	8:50	6.3	N	0:30	4.95	4.96	0.12	30	250.0	15.6	15.5	15.5	0.03
8:50	9:20	6.3	N	0:30	4.96	4.97	0.12	30	250.0	15.5	15.4	15.4	0.03
9:20	9:50	6.3	N	0:30	4.97	4.98	0.12	30	250.0	15.4	15.2	15.3	0.03
9:50	10:20	6.3	N	0:30	4.98	4.99	0.12	30	250.0	15.2	15.1	15.2	0.03
10:20	10:50	6.3	N	0:30	4.99	5.00	0.12	30	250.0	15.1	15.0	15.1	0.03
10:50	11:20	6.3	N	0:30	5.00	5.01	0.12	30	250.0	15.0	14.9	14.9	0.03
11:20	11:50	6.3	N	0:30	5.01	5.02	0.12	30	250.0	14.9	14.8	14.8	0.03
11:50	12:20	6.3	N	0:30	5.02	5.03	0.12	30	250.0	14.8	14.6	14.7	0.03
12:20	12:50	6.3	N	0:30	5.03	5.04	0.12	30	250.0	14.6	14.5	14.6	0.03
12:50	13:20	6.3	N	0:30	5.04	5.05	0.12	30	250.0	14.5	14.4	14.5	0.03
13:20	13:50	6.3	N	0:30	5.05	5.06	0.12	30	250.0	14.4	14.3	14.3	0.03
Recommended for Design:										**Infiltration Rate**			**0.03**

SALEM engineering group, inc.

CONSOLIDATION - PRESSURE TEST DATA
ASTM D2435



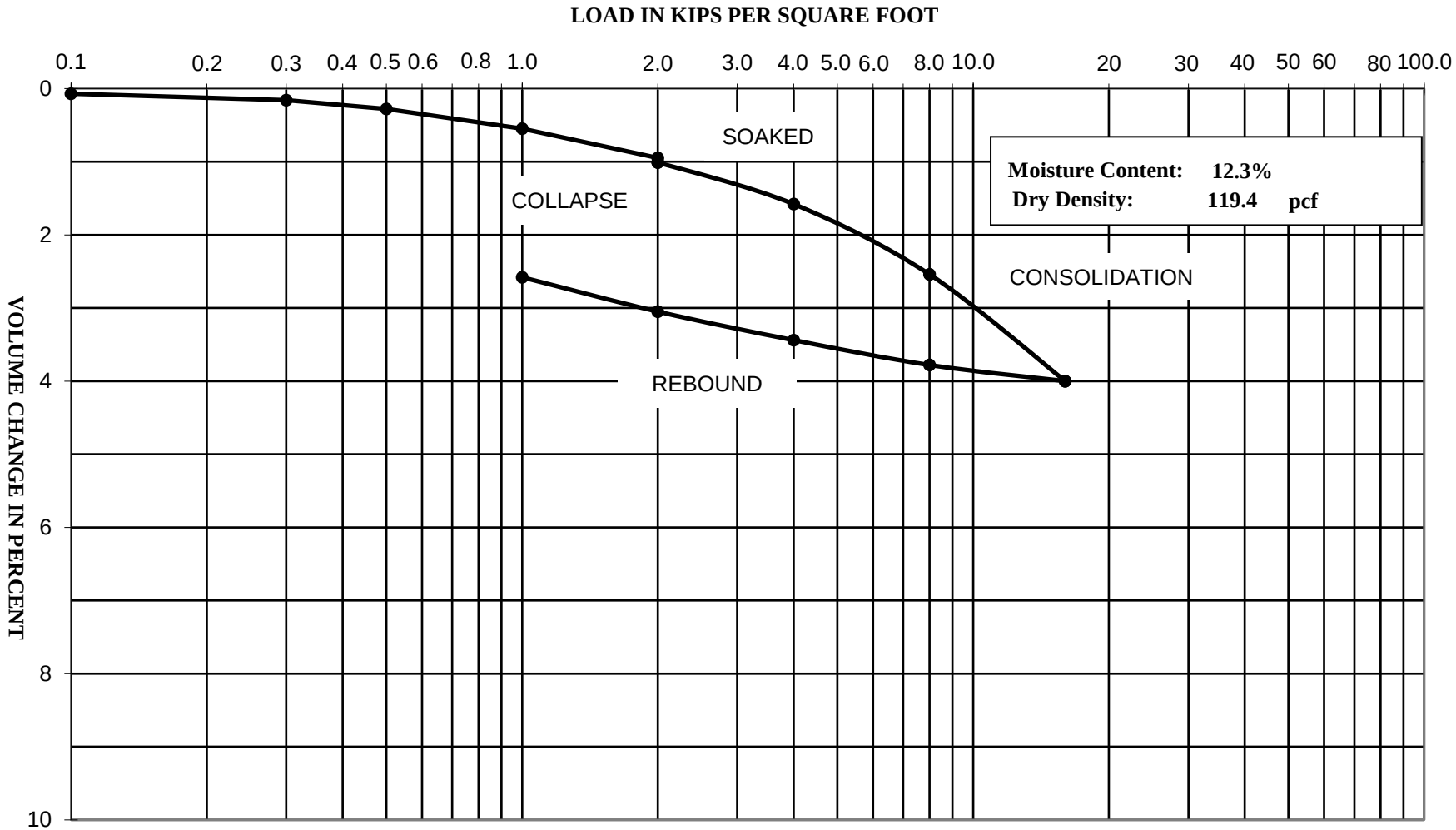
Project Name: Proposed Commercial - Orange, Ca

Project Number: 3-219-0272

Boring: B-1 @ 2'

SALEM engineering group, inc.

CONSOLIDATION - PRESSURE TEST DATA
ASTM D2435



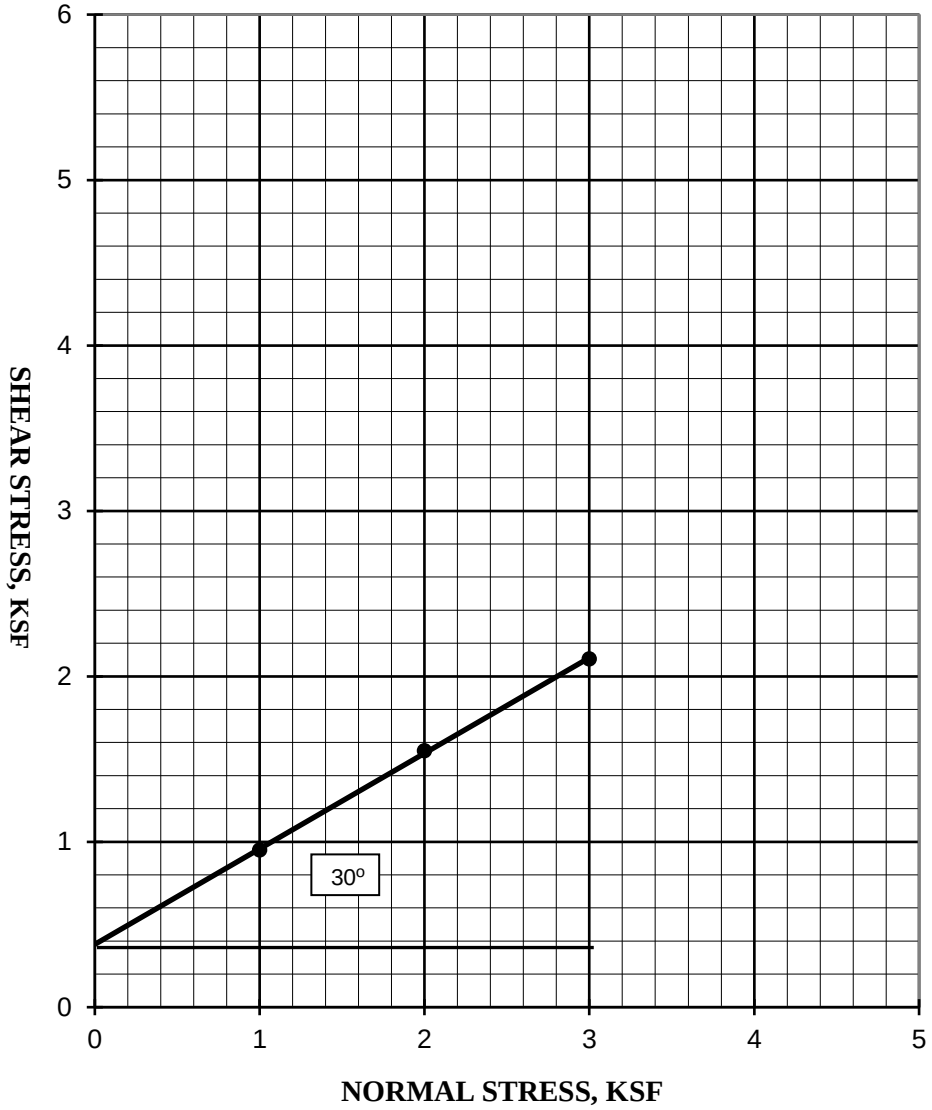
Project Name: Proposed Commercial - Orange, Ca

Project Number: 3-219-0272

Boring: B-3 @ 2'

SALEM engineering group, inc.

SHEAR STRENGTH DIAGRAM
(DIRECT SHEAR)
ASTM D - 3080



Project Name: Proposed Commercial - Orange, Ca

Project Number: 3-219-0272

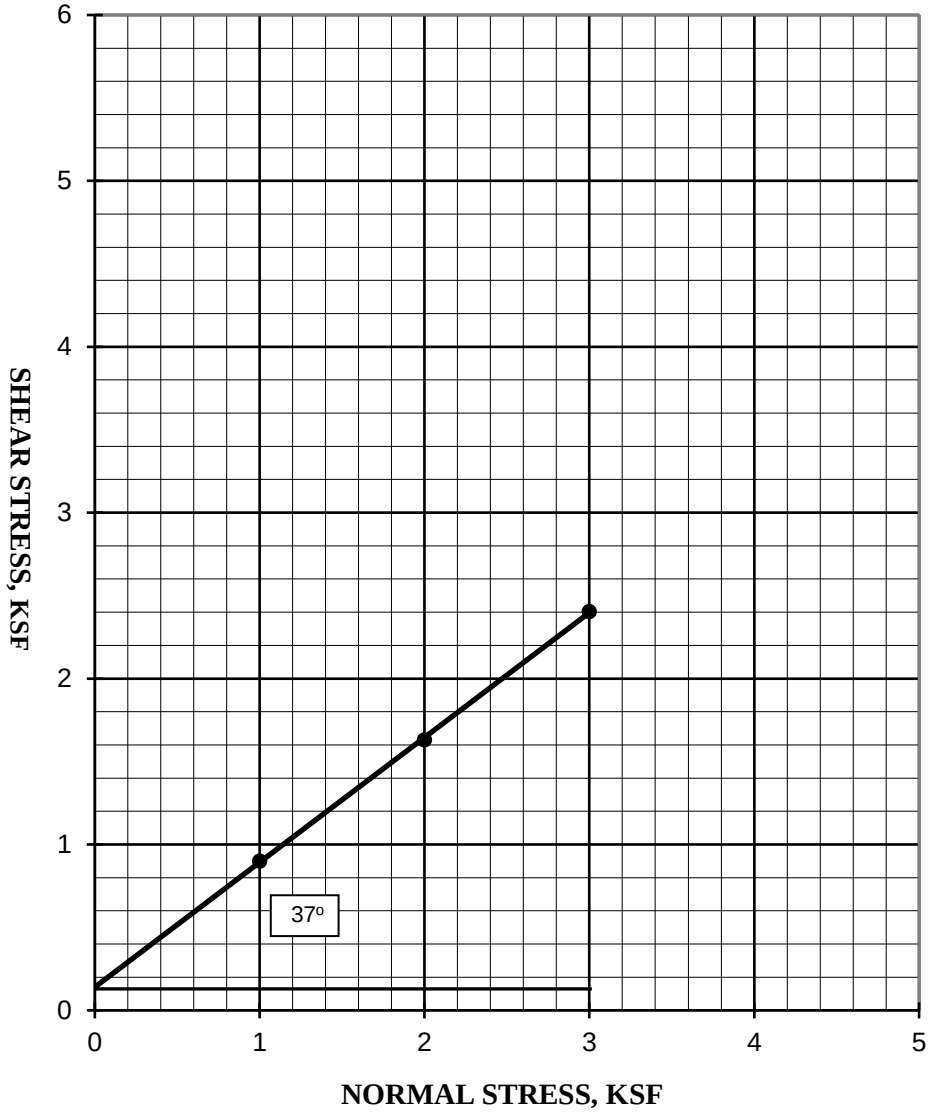
Boring: B-1 @ 2'
Soil Type: Sandy CLAY (CL)

Friction Angle:	**30.0**	**degrees**
Cohesion:	**380**	**psf**

Moisture Content	**12.7%**
Dry Density	**121.3 pcf**

SALEM engineering group, inc.

SHEAR STRENGTH DIAGRAM
(DIRECT SHEAR)
ASTM D - 3080



Project Name: Proposed Commercial - Orange, Ca

Project Number: 3-219-0272

Boring: B-5 @ 2'
Soil Type: Well-graded SAND with Silt (SW-SM)

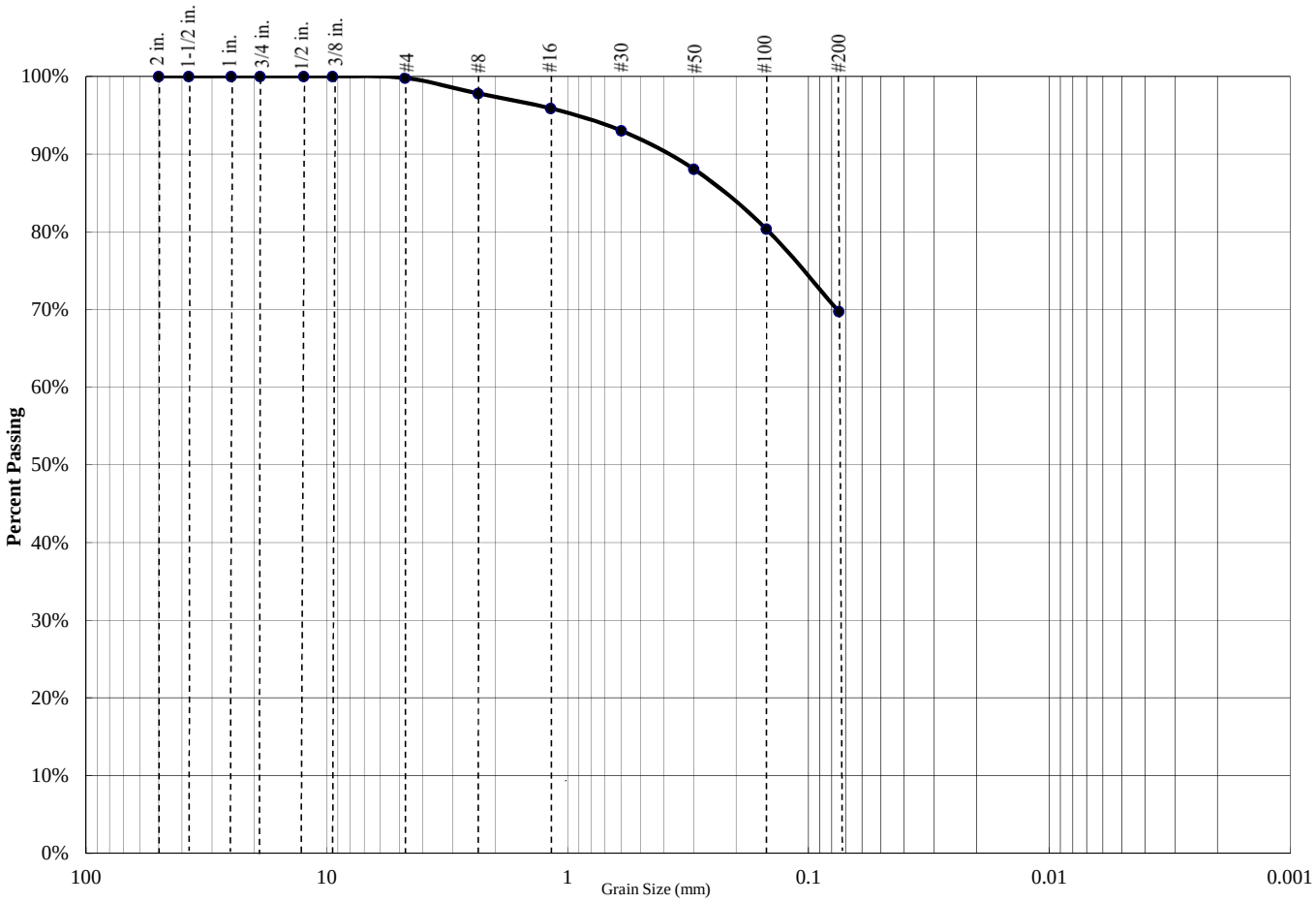
Friction Angle:	**37.0**	**degrees**
Cohesion:	**140**	**psf**

Moisture Content	**5.6%**
Dry Density	**108.8 pcf**

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
0%	30%	70%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	99.8%
#8	97.8%
#16	95.9%
#30	93.0%
#50	88.1%
#100	80.4%
#200	69.7%

Atterberg Limits		
PL=	**LL=**	**PI=**

Coefficients					
D_{85}=		**D_{60}=**		**D_{50}=**	
D_{30}=		**D_{15}=**		**D_{10}=**	
C_u=	N/A	**C_c=**	N/A		

USCS CLASSIFICATION
Sandy CLAY (CL)

Project Name: Proposed Commercial - Orange, Ca

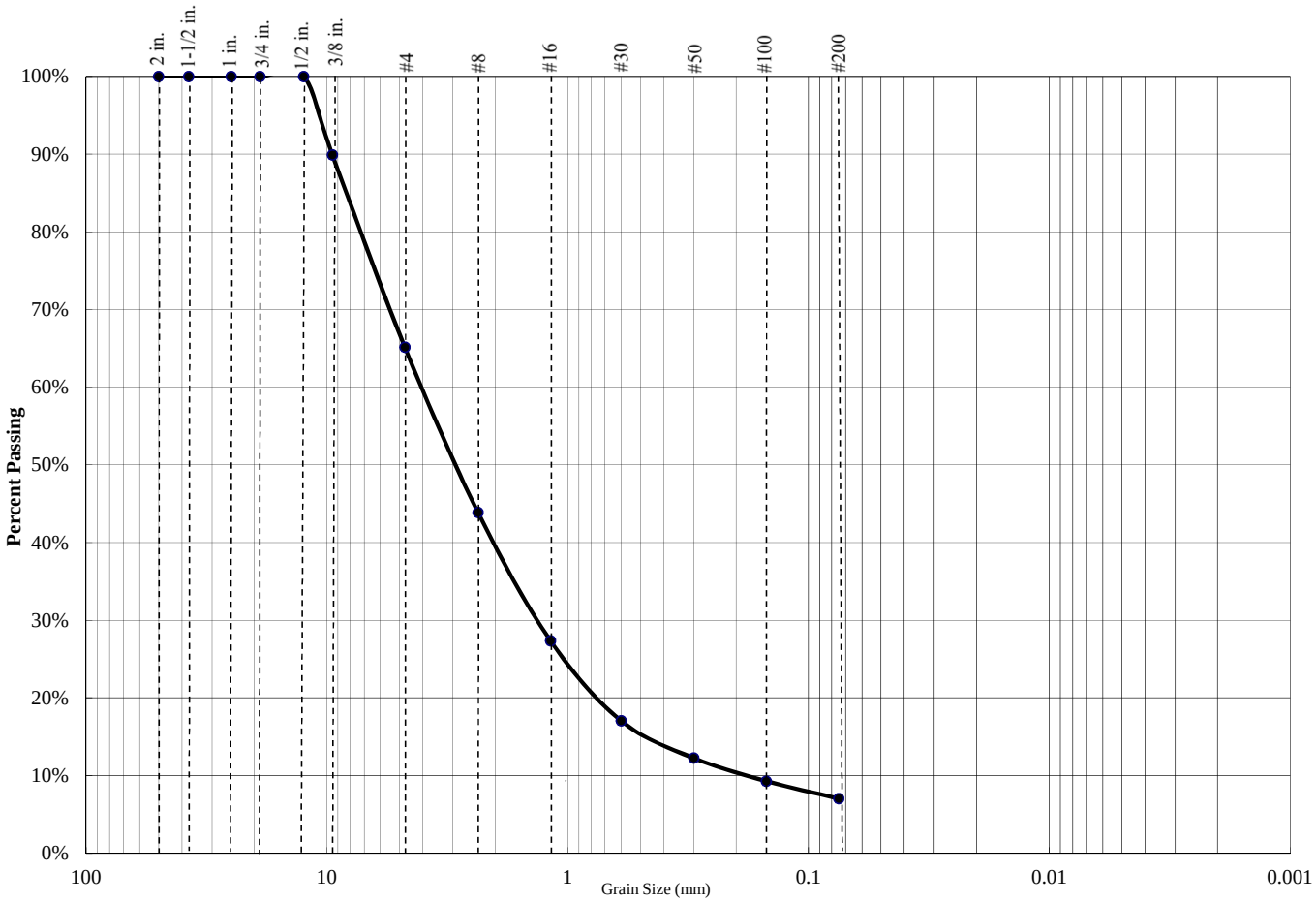
Project Number: 3-219-0272

Boring: B-1 @ 2'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
35%	58%	7%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	89.9%
#4	65.1%
#8	43.9%
#16	27.4%
#30	17.1%
#50	12.3%
#100	9.3%
#200	7.0%

Atterberg Limits		
PL=	LL=	PI=

Coefficients					
D_{85}=		D_{60}=	4	D_{50}=	
D_{30}=	1.5	D_{15}=		D_{10}=	0.2
C_u=	20.00	C_c=	2.81		

USCS CLASSIFICATION
Poorly graded SAND with Silt (SP-SM)

Project Name: Proposed Commercial - Orange, Ca

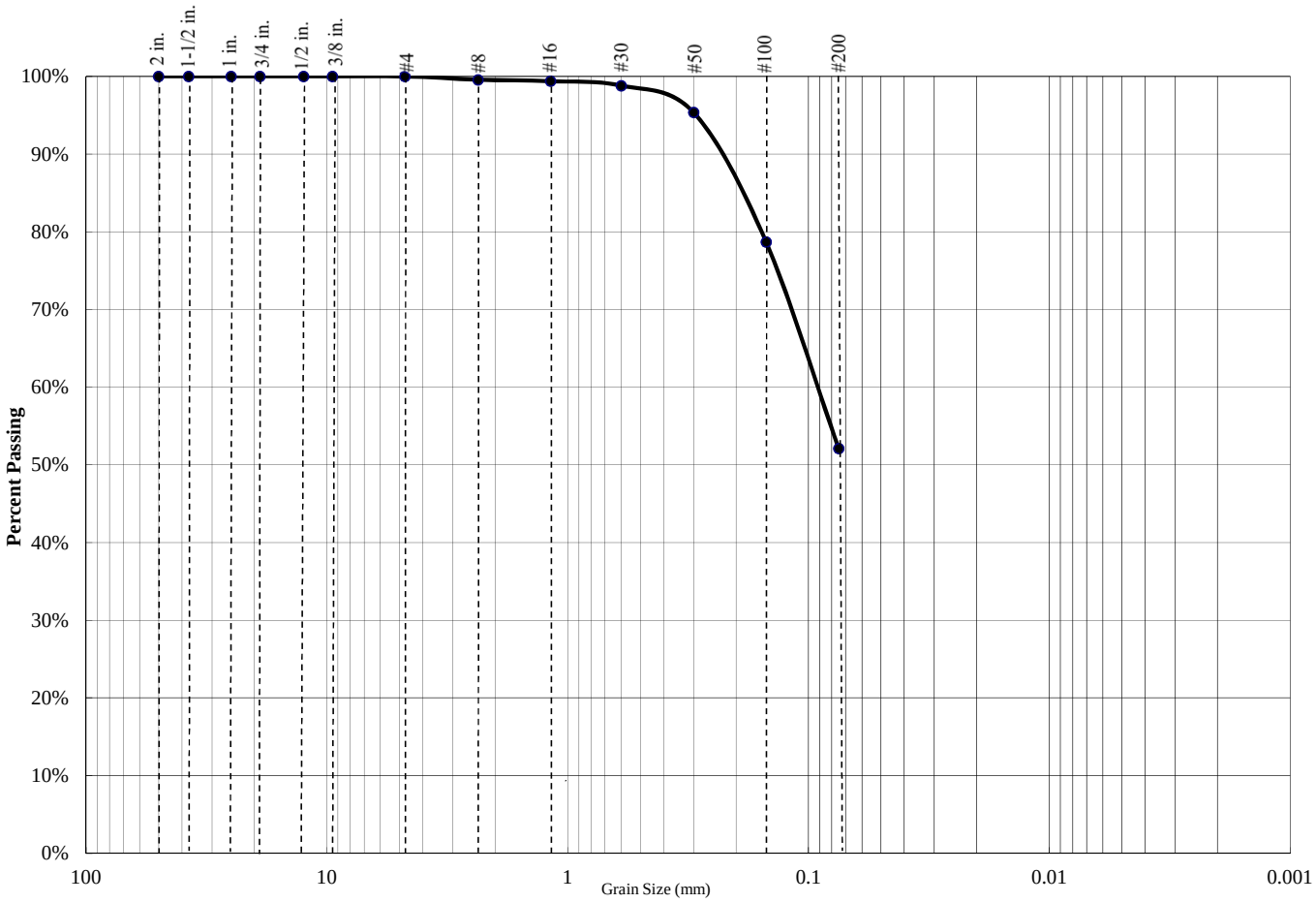
Project Number: 3-219-0272

Boring: B-1 @ 20'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
0%	48%	52%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	100.0%
#8	99.6%
#16	99.4%
#30	98.8%
#50	95.3%
#100	78.7%
#200	52.1%

Atterberg Limits		
PL=	LL=	PI=

Coefficients					
D_{85}=		D_{60}=		D_{50}=	
D_{30}=		D_{15}=		D_{10}=	
C_u=	N/A	C_c=	N/A		

USCS CLASSIFICATION
Sandy CLAY (CL)

Project Name: Proposed Commercial - Orange, Ca

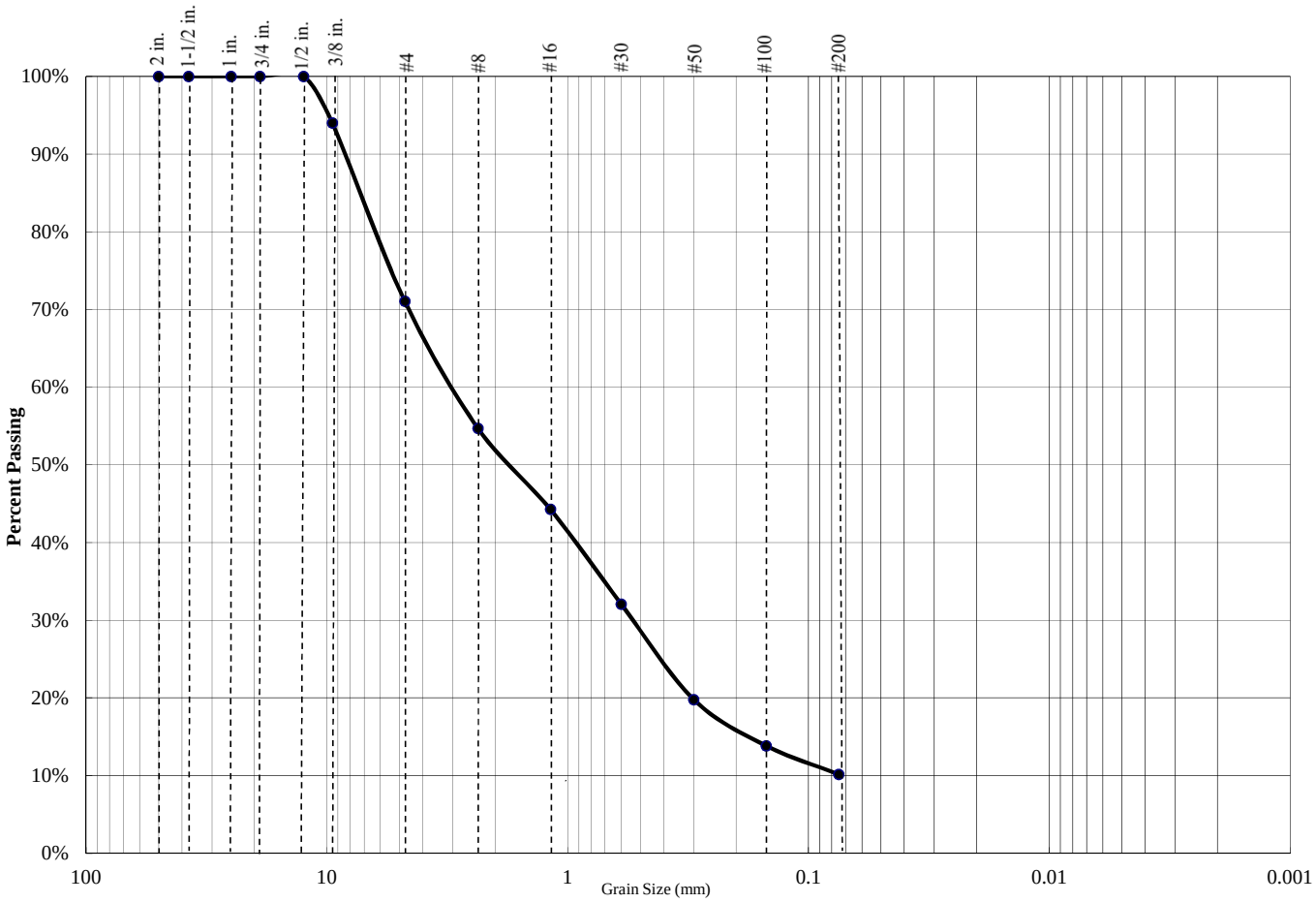
Project Number: 3-219-0272

Boring: B-1 @ 25'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
29%	61%	10%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	94.0%
#4	71.1%
#8	54.7%
#16	44.3%
#30	32.1%
#50	19.8%
#100	13.8%
#200	10.2%

Atterberg Limits		
PL=	LL=	PI=

Coefficients					
D_{85}=		D_{60}=	3	D_{50}=	
D_{30}=	0.55	D_{15}=		D_{10}=	0.075
C_u=	40.00	C_c=	1.34		

USCS CLASSIFICATION
Well-graded SAND with Silt (SW-SM)

Project Name: Proposed Commercial - Orange, Ca

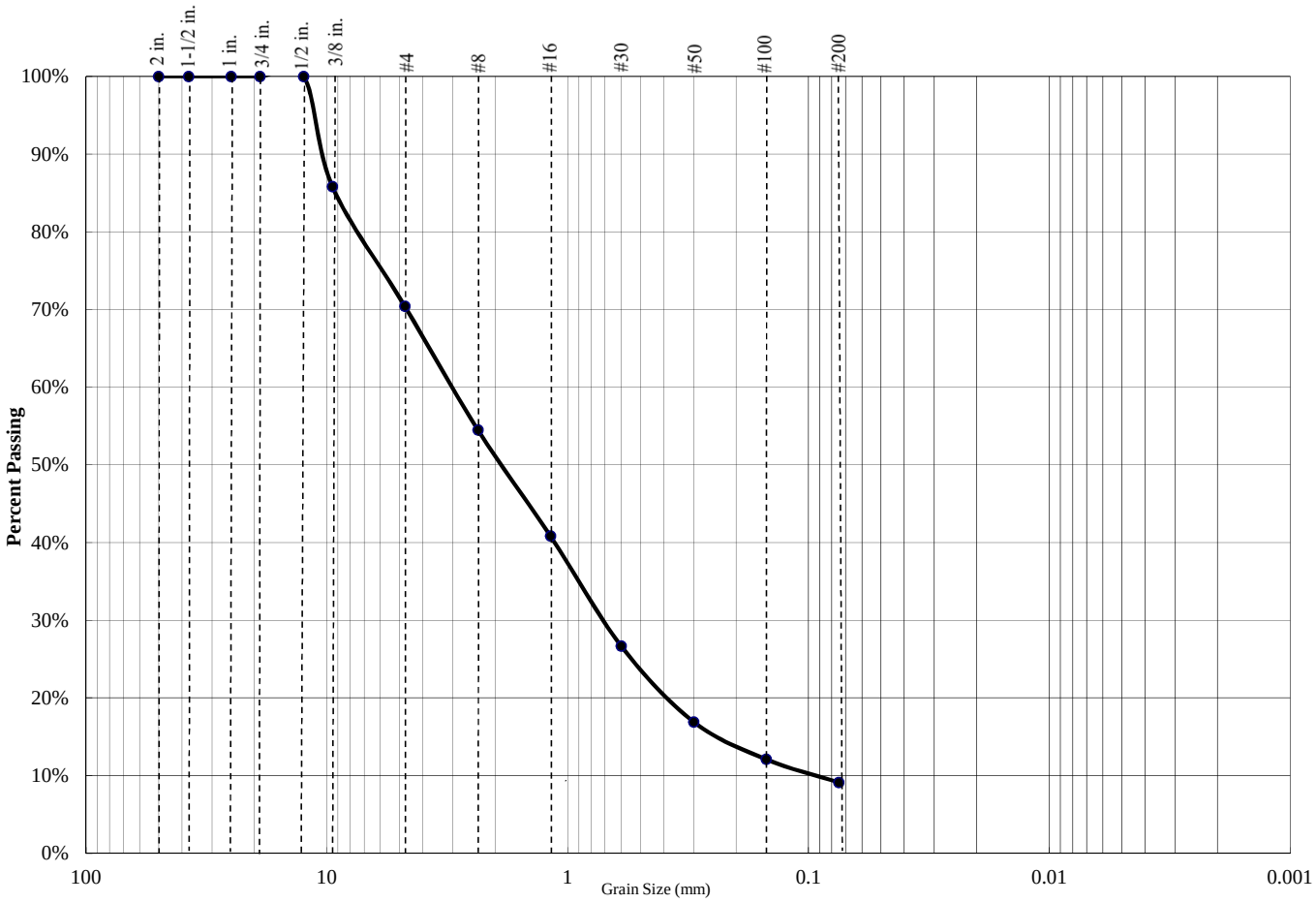
Project Number: 3-219-0272

Boring: B-1 @ 35'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
30%	61%	9%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	85.8%
#4	70.4%
#8	54.5%
#16	40.8%
#30	26.7%
#50	16.9%
#100	12.1%
#200	9.1%

Atterberg Limits		
PL=	LL=	PI=

Coefficients					
D_{85}=		D_{60}=	3	D_{50}=	
D_{30}=	0.7	D_{15}=		D_{10}=	0.09
C_u=	33.33	C_c=	1.81		

USCS CLASSIFICATION
Well-graded SAND with Silt (SW-SM)

Project Name: Proposed Commercial - Orange, Ca

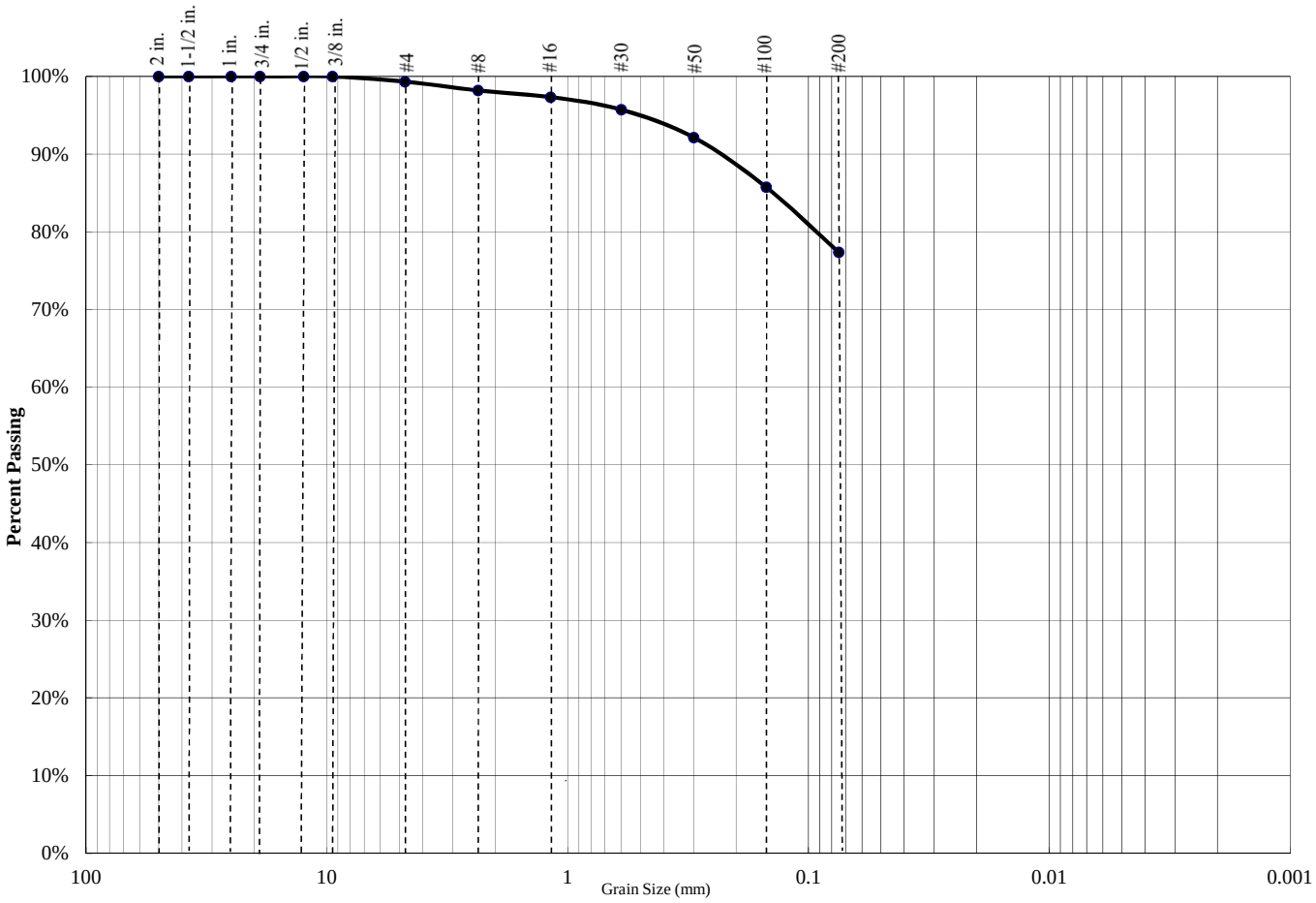
Project Number: 3-219-0272

Boring: B-1 @ 48.5

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
1%	22%	77%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	99.3%
#8	98.2%
#16	97.3%
#30	95.7%
#50	92.1%
#100	85.7%
#200	77.4%

Atterberg Limits		
PL=	**LL=**	**PI=**

Coefficients					
D_{85}=		**D_{60}=**		**D_{50}=**	
D_{30}=		**D_{15}=**		**D_{10}=**	
C_u=	N/A	**C_c=**	N/A		

USCS CLASSIFICATION
CLAY with Sand (CL)

Project Name: Proposed Commercial - Orange, Ca

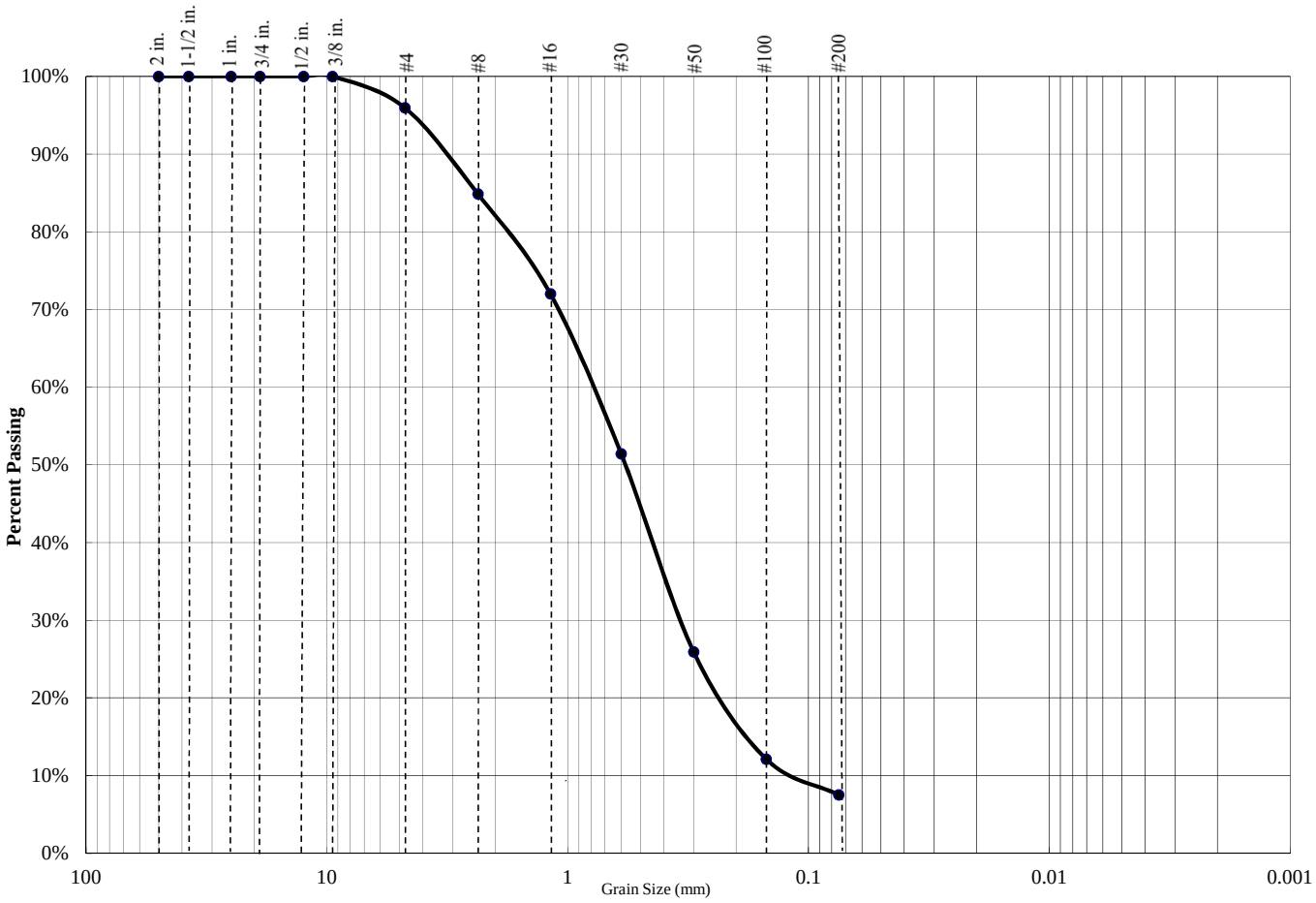
Project Number: 3-219-0272

Boring: B-3 @ 2'

SALEM engineering group, inc.

PARTICLE SIZE DISTRIBUTION DIAGRAM

GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
4%	88%	8%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	96.0%
#8	84.9%
#16	72.0%
#30	51.4%
#50	25.9%
#100	12.1%
#200	7.5%

Atterberg Limits		
PL=	LL=	PI=

Coefficients					
D_{85}=		D_{60}=	0.8	D_{50}=	
D_{30}=	0.35	D_{15}=		D_{10}=	0.125
C_u=	6.40	C_c=	1.23		

USCS CLASSIFICATION
Well-graded SAND with Silt (SW-SM)

Project Name: Proposed Commercial - Orange, Ca

Project Number: 3-219-0272

Boring: B-5 @ 2'

SALEM engineering group, inc.

EXPANSION INDEX TEST
ASTM D4829

Project Name: Proposed Commercial - Orange, Ca
Project Number: 3-219-0272
Date Sampled: 4/25/19 Date Tested: 5/3/19
Sampled By: SEG Tested By: NL
Sample Location: B-1 @ 0 - 3'
Soil Description: Reddish Brown Sandy CLAY (CL)

Trial #	1	2	3
Weight of Soil & Mold, g.	586.3		
Weight of Mold, g.	188.2		
Weight of Soil, g.	398.1		
Wet Density, pcf	120.1		
Weight of Moisture Sample (Wet), g.	851.0		
Weight of Moisture Sample (Dry), g.	772.9		
Moisture Content, %	10.1		
Dry Density, pcf	109.0		
Specific Gravity of Soil	2.7		
Degree of Saturation, %	50.1		

Time	Inital	30 min	1 hr	6 hrs	12 hrs	24 hrs
Dial Reading	0	0.0345	0.0442	--	--	0.054

Expansion Index $_{measured}$ = 54
Expansion Index $_{50}$ = 54.0

Expansion Index = 54

Expansion Potential Table	
Exp. Index	Potential Exp.
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

SALEM engineering group, inc.

CHEMICAL ANALYSIS

SO_4 - Modified CTM 417 & Cl - Modified CTM 417/422

Project Name: Proposed Commercial - Orange, Ca
Project Number: 3-219-0272
Date Sampled: 4/25/19 Date Tested: 5/2/19
Sampled By: SEG Tested By: DZ
Soil Description: Reddish Brown Sandy CLAY (CL)

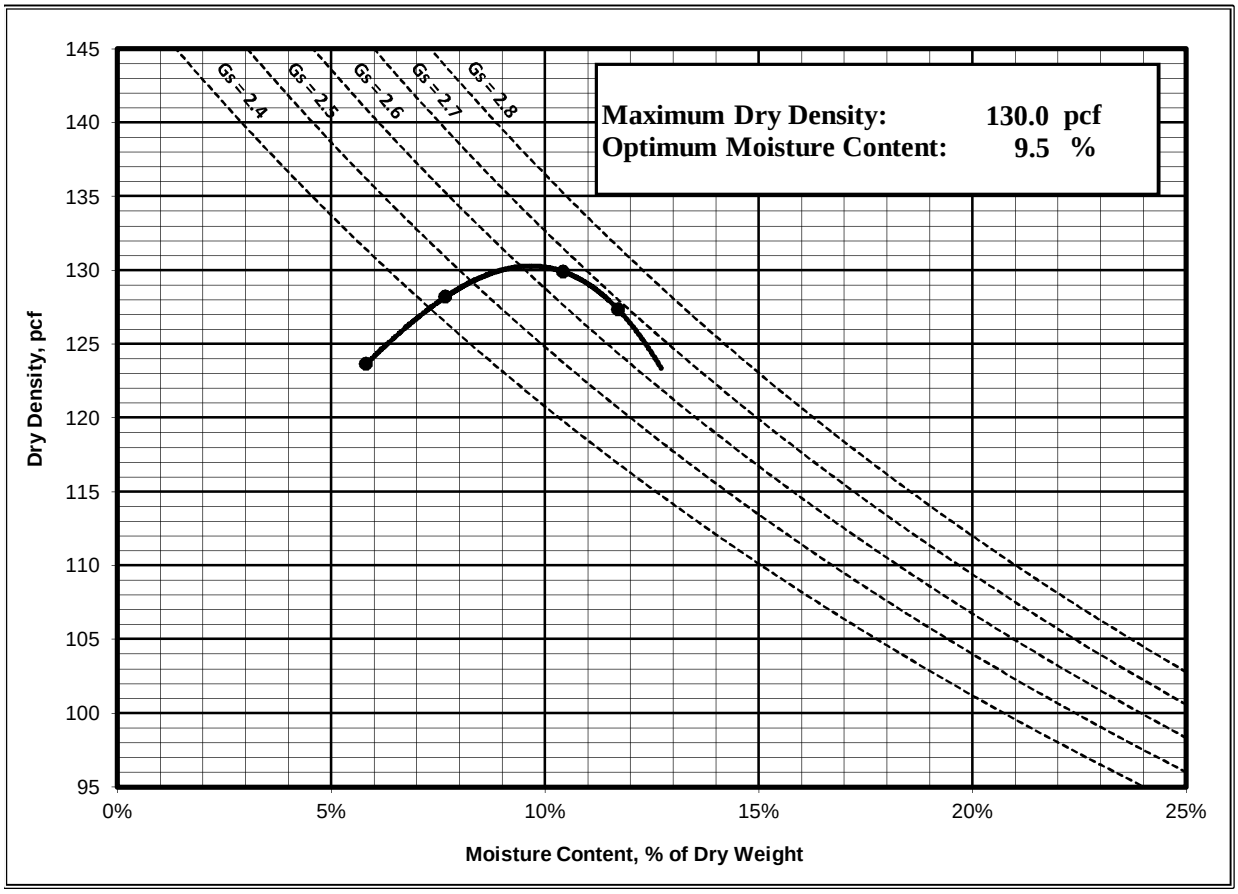
Sample Number	Sample Location	Soluble Sulfate SO_4-S	Soluble Chloride Cl	pH
1a.	B-1 @ 0 - 3'	530 mg/kg	68 mg/kg	7.7
1b.	B-1 @ 0 - 3'	530 mg/kg	67 mg/kg	7.7
1c.	B-1 @ 0 - 3'	530 mg/kg	65 mg/kg	7.7
Average:		**530 mg/kg**	**67 mg/kg**	**7.7**

SALEM engineering group, inc.

Laboratory Compaction Curve
ASTM D1557

Project Name: Proposed Commercial - Orange, Ca
Project Number: 3-219-0272
Date Sampled: 4/25/19 Date Tested: 5/2/19
Sampled By: SEG Tested By: MZ
Sample Location: B-1 @ 0 - 3'
Soil Description: Reddish Brown Sandy CLAY (CL)
Test Method: Method A

	1	2	3	4
Weight of Moist Specimen & Mold, (g)	3955.3	4064.2	4145.8	4127.7
Weight of Compaction Mold, (g)	1977.1	1977.1	1977.1	1977.1
Weight of Moist Specimen, (g)	1978.2	2087.1	2168.7	2150.6
Volume of Mold, (ft^3)	0.0333	0.0333	0.0333	0.0333
Wet Density, (pcf)	130.8	138.0	143.4	142.2
Weight of Wet (Moisture) Sample, (g)	336.5	336.5	336.5	336.5
Weight of Dry (Moisture) Sample, (g)	318.0	312.5	304.7	301.2
Moisture Content, (%)	5.8%	7.7%	10.4%	11.7%
Dry Density, (pcf)	123.6	128.2	129.9	127.3



SALEM engineering group, inc.

APPENDIX B

EXPLORATORY BORING LOGS BY GEOTEK

Updated Geotechnical and Infiltration Evaluation
901 E. Katella Avenue, Orange, California
Project No. 3193-CR

GEOTEK

A - FIELD TESTING AND SAMPLING PROCEDURES

The Modified Split-Barrel Sampler (Ring)

The ring sampler is driven into the ground in accordance with ASTM Test Method D 3550. The sampler, with an external diameter of 3.0 inches, is lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sampler is typically driven into the ground 12 or 18 inches with a 140-pound hammer free falling from a height of 30 inches. Blow counts are recorded for every 6 inches of penetration as indicated on the logs of borings. The samples are removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

Bulk Samples (Large)

These samples are normally large bags of earth materials over 20 pounds in weight collected from the field by means of hand digging or exploratory cuttings.

Bulk Samples (Small)

These are plastic bag samples which are normally airtight and contain less than five pounds in weight of earth materials collected from the field by means of hand digging or exploratory cuttings. These samples are primarily used for determining natural moisture content and classification indices.

B – BORING LOG LEGEND

The following abbreviations and symbols often appear in the classification and description of soil and rock on the logs of borings:

SOILS

USCS	Unified Soil Classification System
f-c	Fine to coarse
f-m	Fine to medium

GEOLOGIC

B: Attitudes	Bedding: strike/dip
J: Attitudes	Joint: strike/dip
C: Contact line	
……..	Dashed line denotes USCS material change
———	Solid Line denotes unit / formational change
———	Thick solid line denotes end of boring

(Additional denotations and symbols are provided on the logs of borings)

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Intracorp SW, LLC	**DRILLER:**	2R Drilling	**LOGGED BY:**	C. Diaz
PROJECT NAME:	901 E Katella Ave	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Jeff
PROJECT NO.:	3193-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Orange, CA			**DATE:**	5/12/2022

Boring No.: B-1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					4" Asphalt, 7" Base **Fill:**			EI, MD, SR
5		30 35 44	R1	SC	Clayey f-c SAND, brown, slightly moist, very dense, few f gravel	6.4	130.8	
		50/5	R2		No Recovery			
10		50/6	R3	SM	**Alluvium:** Silty f-c SAND, brown, slightly moist, very dense, little f gravel	4.6	130.4	
15		50/5	R4		Silty f-c SAND, brown, slightly moist to moist, very dense, little f gravel, disturbed sample			
20		14 16 23	R5		Silty f-m SAND, brown, slightly moist to moist, medium dense	8.1	98.4	HC
		9 15 24	R6		Silty f-m SAND, brown, moist, medium dense	15.1	116.9	
25					**BORING TERMINATED AT 22.5 FEET** No groundwater encountered Boring backfilled with soil cuttings			
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Intracorp SW, LLC	**DRILLER:**	2R Drilling	**LOGGED BY:**	C. Diaz
PROJECT NAME:	901 E Katella Ave	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Jeff
PROJECT NO.:	3193-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Orange, CA			**DATE:**	5/12/2022

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	**Boring No.: B-2** / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					4" Asphalt, 5" Base			
					Alluvium:			
	■	11 13 42	R1	CL	Sandy CLAY, reddish brown, slightly moist to moist, hard, trace f gravel	8.0	118.5	
5	■	10 27 47	R2	SM/SC	Silty f-c SAND, reddish brown, slightly moist, very dense, few f gravel and clay	6.4	126.4	
	■	22 35 25	R3	SM	Silty f-c SAND, reddish brown, slightly moist, dense, little f gravel	6.0	134.6	
10	■	30 30 25	R4		No recovery			
15	■	30 50/5	R5		No recovery			
20	■	50/2	R6		No recovery			
					BORING TERMINATED AT 20.5 FEET			
					No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ■ ---Ring ■ ---SPT ▨ ---Small Bulk ▩ ---Large Bulk □ ---No Recovery ▽ ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Intracorp SW, LLC	**DRILLER:**	2R Drilling	**LOGGED BY:**	C. Diaz
PROJECT NAME:	901 E Katella Ave	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Jeff
PROJECT NO.:	3193-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Orange, CA			**DATE:**	5/12/2022

Boring No.: B-3

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Alluvium:			MD, EI, SR
		15 50/6	R1	SC	Clayey SAND, reddish brown, slightly moist to moist, very dense, trace organic	7.6	107.5	
5		50/6	R2		No Recovery			
		38 50/6	R3		Clayey f-c SAND, reddish brown, slightly moist, very dense, few f gravel	4.6	126.4	
10		50/3	R4		No Recovery			
15		50/3	R5		No Recovery			
		38 50/6	S1		No Recovery			
20					**BORING TERMINATED AT 19 FEET**			
					No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Intracorp SW, LLC	**DRILLER:**	2R Drilling	**LOGGED BY:**	C. Diaz
PROJECT NAME:	901 E Katella Ave	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Jeff
PROJECT NO.:	3193-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Orange, CA			**DATE:**	5/12/2022

Boring No.: I-1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Alluvium:			
				SM	Silty f-m SAND, light brown, slightly moist			
5					**BORING TERMINATED AT 5 FEET**			
					No groundwater encountered Boring set with pipe, sock, and gravel			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Intracorp SW, LLC	**DRILLER:**	2R Drilling	**LOGGED BY:**	C. Diaz
PROJECT NAME:	901 E Katella Ave	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Jeff
PROJECT NO.:	3193-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Orange, CA			**DATE:**	5/12/2022

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	**Boring No.: I-2** / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					4" Asphalt, 6" Base			
					Alluvium:			
				CL	Sandy CLAY, reddish brown, slightly moist			
5					**BORING TERMINATED AT 5 FEET**			
					No groundwater encountered Boring set with pipe, sock, and gravel			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

APPENDIX C

LABORATORY TEST RESULTS

Updated Geotechnical and Infiltration Evaluation
901 E. Katella Avenue, Orange, California
Project No. 3193-CR

GEOTEK

SUMMARY OF LABORATORY TESTING

Classification

Soils were classified visually in general accordance with the Unified Soil Classification System (ASTM Test Method D 2487). The soil classifications are shown on the logs of exploratory borings in Appendix B.

Collapse

Collapse tests were conducted in accordance with ASTM D4546. The results of these tests are presented herewith.

Expansion Index

The expansion potential of the soils was determined by performing expansion index tests on two representative soil samples from the site in general accordance with ASTM D 4829. The results of these tests are presented herewith.

In Situ Moisture Content and Unit Weight

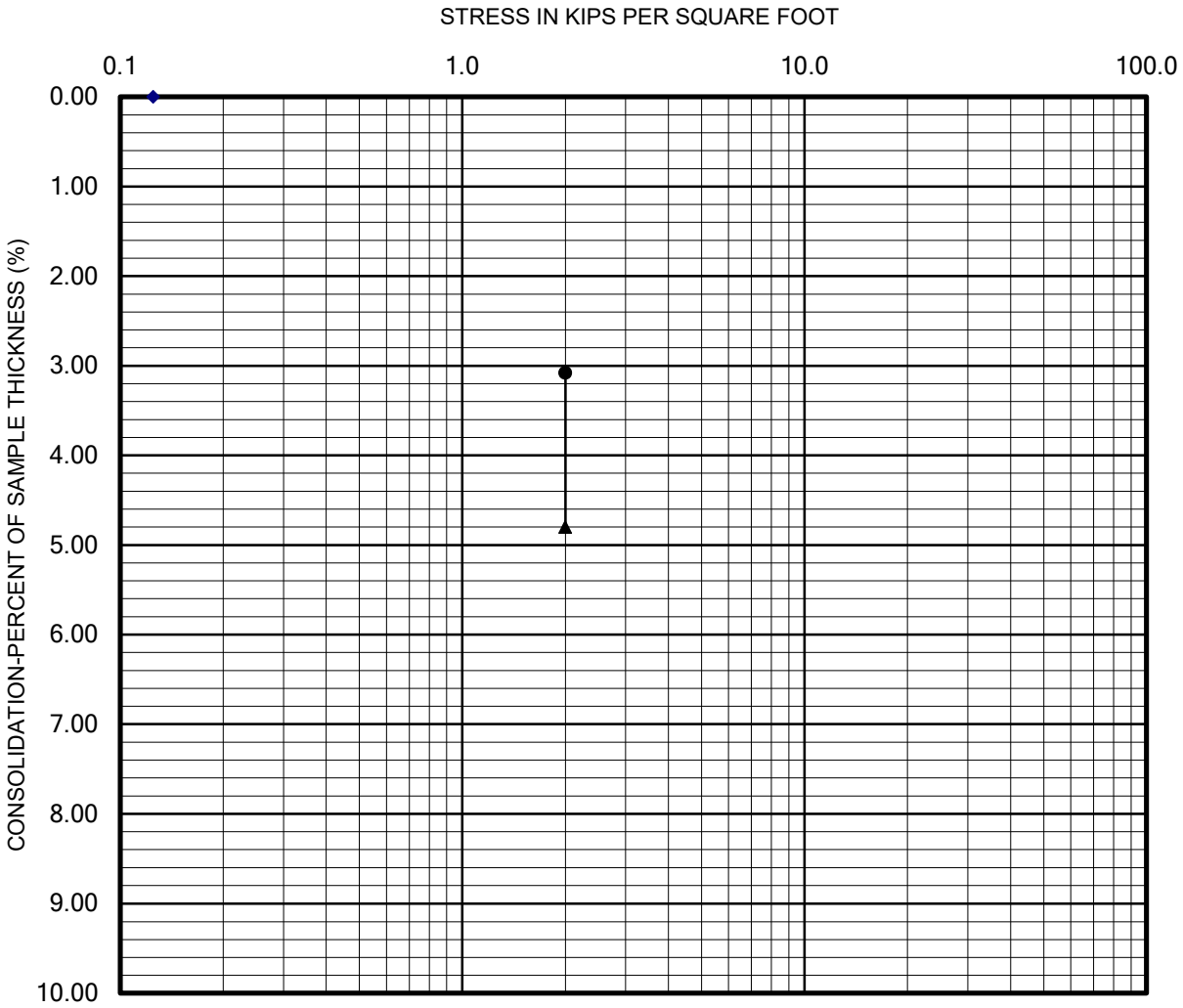
The field moisture content was measured in the laboratory on selected samples collected during the field investigation. The field moisture content is determined as a percentage of the dry unit weight. The dry density was measured in the laboratory on selected ring samples. The results are shown on the logs of exploratory borings in Appendix B.

Moisture-Density Relationship

Laboratory testing was performed on two representative soil samples collected during the subsurface exploration. The laboratory maximum dry density and optimum moisture content for the soil type was determined in general accordance with test method ASTM Test Procedure D 1557. The results are presented herewith.

Sulfate Content, Resistivity and Chloride Content

Testing to determine the water-soluble sulfate content, minimum resistivity, and chloride concentration in selected soil samples was performed by others. The results are included herewith.



Seating Cycle
Loading Prior to Inundation
Loading After Inundation
Rebound Cycle

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4546

GEOTEK

COLLAPSE REPORT

CHECKED BY: DA	Lab: Corona
3193-CR	5/17/2022

Sample: B-1 @ 18 feet

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Client:	Intracorp SW LLC	***Tested/ Checked By:***	RL Lab No Corona
Project Number:	3193-CR	***Date Tested:***	5/17/2022
Project Location:	901 E Katella Avenue, Orange	***Sample Source:***	B-1 @ 0-5 feet
		Sample Description:	

Ring #: _____ Ring Dia. : 4.01" Ring Ht. 1"

DENSITY DETERMINATION

Weight of compacted sample & ring (gm)	786.5
Weight of ring (gm)	362.6
Net weight of sample (gm)	**423.9**
Wet Density, lb / ft3 (C*0.3016)	**127.8**
Dry Density, lb / ft3 (D/1.F)	**118.4**

SATURATION DETERMINATION

Moisture Content, %	8.0
Specific Gravity, assumed	**2.70**
Unit Wt. of Water @ 20 °C, (pcf)	**62.4**
% Saturation	**51.0**

READINGS

DATE	TIME	READING	
5/17/2022		0.7450	Initial
5/17/2022		0.7430	10 min/Dry
5/18/2022		0.7430	Final

FINAL MOISTURE

Final Weight of wet sample & tare	% Moisture
789.2	**8.6**

EXPANSION INDEX = 0

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Client:	Intracorp SW LLC	***Tested/ Checked By:***	RL Lab No Corona
Project Number:	3193-CR	***Date Tested:***	5/17/2022
Project Location:	901 E Katella Avenue, Orange	***Sample Source:***	B-3 @ 0-5 feet
		Sample Description:	

Ring #: _____ Ring Dia. : 4.01" Ring Ht. 1"

DENSITY DETERMINATION

Weight of compacted sample & ring (gm)	778.3
Weight of ring (gm)	370.3
Net weight of sample (gm)	**408.0**
Wet Density, lb / ft3 (C*0.3016)	**123.1**
Dry Density, lb / ft3 (D/1.F)	**112.4**

SATURATION DETERMINATION

Moisture Content, %	9.5
Specific Gravity, assumed	**2.70**
Unit Wt. of Water @ 20 °C, (pcf)	**62.4**
% Saturation	**51.4**

READINGS

DATE	TIME	READING	
5/17/2022		0.1300	Initial
5/17/2022		0.1290	10 min/Dry
5/18/2022		0.1580	Final

FINAL MOISTURE

Final Weight of wet sample & tare	% Moisture
806.7	**16.5**

EXPANSION INDEX = 29

GEOTEK

MOISTURE/DENSITY RELATIONSHIP

Client: Intracorp SW LLC
Project: 901 E Katella Avenue
Location: Orange
Material Type: Yellow brown medium to coarse sand
Material Supplier: -
Material Source: -
Sample Location: B-1 @ 0-5 feet
-

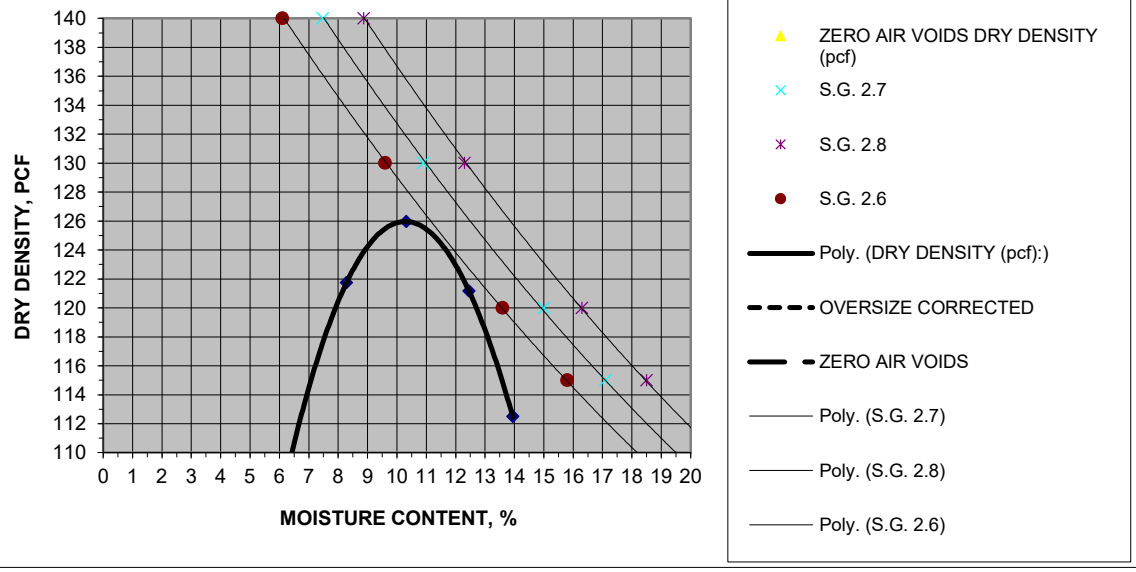
Job No.: 3193-CR
Lab No.: Corona

Sampled By: CD
Received By: MP
Tested By: MP
Reviewed By: DA

Date Sampled: -
Date Received: 5/16/2022
Date Tested: 5/18/2022
Date Reviewed: 5/26/2022

Test Procedure: ASTM D1557 **Method:** A
Oversized Material (%): 11.2 **Correction Required:** ■ yes ☐ no

MOISTURE/DENSITY RELATIONSHIP CURVE



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	126.0	**@ Optimum Moisture, %**	10.5
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

Classification:

Unified Soils Classification:
AASHTO Soils Classification:

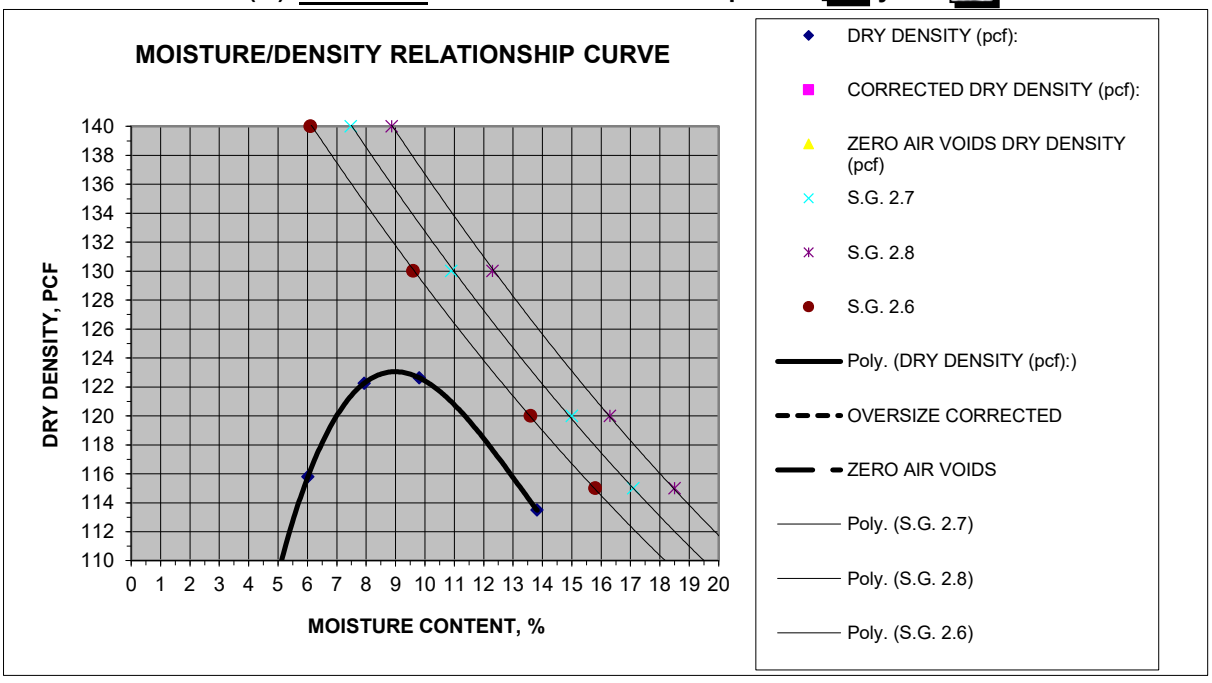
GEOTEK

MOISTURE/DENSITY RELATIONSHIP

Client:	Intracorp SW LLC	**Job No.:**	3193-CR
Project:	901 E Katella Avenue	**Lab No.:**	Corona
Location:	Orange		
Material Type:	Yellow brown medium to coarse sand		
Material Supplier:	-		
Material Source:	-		
Sample Location:	B-3 @ 0-5 feet		
	-		
Sampled By:	CD	**Date Sampled:**	-
Received By:	MP	**Date Received:**	5/16/2022
Tested By:	MP	**Date Tested:**	5/23/2022
Reviewed By:	DA	**Date Reviewed:**	5/26/2022

Test Procedure: ASTM D1557 **Method:** A

Oversized Material (%): 3.4 **Correction Required:** ☐ yes ☒ no



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	123.0	**@ Optimum Moisture, %**	9.0
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

Classification:

Unified Soils Classification:

AASHTO Soils Classification:

Soil Analysis Lab Results

Client: GeoTek, Inc.
Job Name: 901 E. Katella Avenue Orange, CA
Client Job Number: 3193-CR Intracropsin, LLC
Project X Job Number: S220518B
May 19, 2022

	Method	ASTM D4327		ASTM D4327		ASTM G187		ASTM G51	ASTM G200	SM 4500-D	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D4327	ASTM D4327
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-		**Resistivity** As Rec'd | Minimum		**pH**	**Redox**	**Sulfide** S^{2-}	**Nitrate** NO_3^-	**Ammonium** NH_4^+	**Lithium** Li^+	**Sodium** Na^+	**Potassium** K^+	**Magnesium** Mg^{2+}	**Calcium** Ca^{2+}	**Fluoride** F_2^{--}	**Phosphate** PO_4^{3-}
	(ft)	(mg/kg)	(wt%)	(mg/kg)	(wt%)	(Ohm-cm)	(Ohm-cm)		(mV)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
B1	0-5	26.5	0.0027	12.0	0.0012	3,417	2,747	8.7	132	12.70	1.0	46.0	ND	9.9	4.4	2.8	7.0	0.8	11.6
B3	0-5	103.2	0.0103	24.3	0.0024	26,130	2,814	7.9	144	3.50	42.5	13.7	ND	57.0	2.3	14.1	18.4	0.7	7.5

Cations and Anions, except Sulfide and Bicarbonate, tested with Ion Chromatography
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
ND = 0 = Not Detected | NT = Not Tested | Unk = Unknown
Chemical Analysis performed on 1:3 Soil-To-Water extract
PPM = mg/kg (soil) = mg/L (Liquid)

APPENDIX D

INFILTRATION TEST DATA BY GEOTEK

Updated Geotechnical and Infiltration Evaluation
901 E. Katella Avenue, Orange, California
Project No. 3193-CR

GEOTEK

Client:	**Intracorp SW, LLC**
Project:	**901 E. Katella, Orange**
Project No:	**3193-CR**
Date:	**5/13/2002**

Boring No. **I-1**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	10	min
Final Depth to Water, D_F =	43.75	in
Test Hole Radius, r =	4	in
Initial Depth to Water, D_O =	36	in
Total Test Hole Depth, D_T =	60	in

Equation - $I_t = \dfrac{\Delta H\,(60r)}{\Delta t\,(r+2H_{avg})}$

$H_O = D_T - D_O$ =	24	in
$H_F = D_T - D_F$ =	16.25	in
$\Delta H = \Delta D = H_O - H_F$ =	7.75	in
$Havg = (H_O+H_F)/2$ =	20.125	in

I_t = 4.20 **Inches per Hour**

GEOTEK

Client:	**Intracorp SW, LLC**
Project:	**901 E. Katella, Orange**
Project No:	**3193-CR**
Date:	**5/13/2002**

Boring No. **I-2**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	30	min
Final Depth to Water, D_F =	39.5	in
Test Hole Radius, r =	4	in
Initial Depth to Water, D_O =	39.25	in
Total Test Hole Depth, D_T =	60	in

Equation - $I_t = \dfrac{\Delta H\,(60r)}{\Delta t\,(r+2H_{avg})}$

$H_O = D_T - D_O$ =	20.75	in
$H_F = D_T - D_F$ =	20.5	in
$\Delta H = \Delta D = H_O - H_F$ =	0.25	in
$H_{avg} = (H_O+H_F)/2$ =	20.625	in

I_t = 0.04 **Inches per Hour**

GEOTEK

PERCOLATION DATA SHEET

Project: Intracorp SW, LLC 901 E Katella Ave. Orange **Job No.:** 3193-CR

Test Hole No.: I-I **Tested By:** _____ **Date:** 5/12/2022

Depth of Hole As Drilled: 60 **Before Test:** 60 **After Test:** 60

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final water Level (Inches)	Δ in Water Level (Inches)	Rate (minutes per Inch)	Comments
								Pre Soak 5 Gal
	11:27 / 11:57	30	60	24	4 3/4	19 1/4		1st 30 min
	11:59 / 12:29	30	60	24	5 1/2	18 1/2		2nd 30 min
	12:31 / 12:41	10	60	24	15	9		1st 10 min
	12:43 / 12:53	10	60	24	16 1/4	7 3/4		2nd 10 min
	12:55 / 1:05	10	60	24	16	8		3rd 10 min
	1:07 / 1:17	10	60	24	16	8		4th 10 min
	1:19 / 1:29	10	60	24	16 1/4	7 3/4		5th 10 min
	1:31 / 1:41	10	60	24	16 1/4	7 3/4		6th 10 min

PERCOLATION DATA SHEET

Project: Intra corp SW, LLC 901 E. Katella Ave Orange **Job No.:** 3193-CR

Test Hole No.: I-2 **Tested By:** C. Diaz **Date:** 3/13/2022

Depth of Hole As Drilled: 60 **Before Test:** 60 **After Test:** 60

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final water Level (Inches)	Δ in Water Level (Inches)	Rate (minutes per Inch)	Comments
								Pre Soak 5 Gal.
	5:48 / 6:18	30	60	24	23 3/4	1/4		1st 30 min
	6:18 / 6:48	30	60	23 3/4	23 1/2	1/4		2nd 30 min
	6:48 / 7:18	30	60	23 1/2	23 1/4	1/4		1st 30 min
	7:18 / 7:48	30	60	23 1/4	23	1/4		2nd 30 min
	7:48 / 8:18	30	60	23	22 3/4	1/4		3rd 30 min
	8:18 / 8:48	30	60	22 3/4	22 1/2	1/4		4th 30 min
	8:48 / 9:18	30	60	22 1/2	22 1/4	1/4		5th 30 min
	9:18 / 9:48	30	60	22 1/4	22	1/4		6th 30 min
	9:48 / 10:18	30	60	22	21 3/4	1/4		7th 30 min

PERCOLATION DATA SHEET

Project: Intra Corp. SW, LLC 901 E. Katella Ave Orange **Job No.:** 3193-CR

Test Hole No.: I-2 **Tested By:** C. Diaz **Date:** 5/13/2022

Depth of Hole As Drilled: 60 **Before Test:** 60 **After Test:** 60

Reading No.	Time	Time Interval (Min)	Totall Depth of Hole (Inches)	Initial Water Level (Inches)	Final water Level (Inches)	in Water Lebel (Inches)	Rate (minutes per Inch)	Comments
	10:18 10:48	30	60	21 3/4	21 1/2	1/4		8th 30 min
	10:48 11:18	30	60	21 1/2	21 1/4	1/4		9th 30 min
	11:18 11:48	30	60	21 1/4	21	1/4		10th 30 min
	11:48 12:18	30	60	21	20 3/4	1/4		11th 30 min
	12:18 12:48	30	60	20 3/4	20 1/2	1/4		12th 30 min

APPENDIX E

GENERAL EARTHWORK AND GRADING GUIDELINES

Updated Geotechnical and Infiltration Evaluation
901 E. Katella Avenue, Orange, California
Project No. 3193-CR

GEOTEK

GENERAL GRADING GUIDELINES

Guidelines presented herein are intended to address general construction procedures for earthwork construction. Specific situations and conditions often arise which cannot reasonably be discussed in general guidelines, when anticipated these are discussed in the text of the report. Often unanticipated conditions are encountered which may necessitate modification or changes to these guidelines. It is our hope that these will assist the contractor to more efficiently complete the project by providing a reasonable understanding of the procedures that would be expected during earthwork and the testing and observation used to evaluate those procedures.

General

Grading should be performed to at least the minimum requirements of governing agencies, Chapters 18 and 33 of the California Building Code, CBC (2019) and the guidelines presented below.

Preconstruction Meeting

A preconstruction meeting should be held prior to site earthwork. Any questions the contractor has regarding our recommendations, general site conditions, apparent discrepancies between reported and actual conditions and/or differences in procedures the contractor intends to use should be brought up at that meeting. The contractor (including the main onsite representative) should review our report and these guidelines in advance of the meeting. Any comments the contractor may have regarding these guidelines should be brought up at that meeting.

Grading Observation and Testing

1. Observation of the fill placement should be provided by our representative during grading. Verbal communication during the course of each day will be used to inform the contractor of test results. The contractor should receive a copy of the "Daily Field Report" indicating results of field density tests that day. If our representative does not provide the contractor with these reports, our office should be notified.
2. Testing and observation procedures are, by their nature, specific to the work or area observed and location of the tests taken, variability may occur in other locations. The contractor is responsible for the uniformity of the grading operations; our observations and test results are intended to evaluate the contractor's overall level of efforts during grading. The contractor's personnel are the only individuals participating in all aspect of site work. Compaction testing and observation should not be considered as relieving the contractor's responsibility to properly compact the fill.
3. Cleanouts, processed ground to receive fill, key excavations, and subdrains should be observed by our representative prior to placing any fill. It will be the contractor's responsibility to notify our representative or office when such areas are ready for observation.
4. Density tests may be made on the surface material to receive fill, as considered warranted by this firm.
5. In general, density tests would be made at maximum intervals of two feet of fill height or every 1,000 cubic yards of fill placed. Criteria will vary depending on soil conditions and size of the fill. More frequent testing may be performed. In any case, an adequate number of field density tests should be made to evaluate the required compaction and moisture content is generally being obtained.

6. Laboratory testing to support field test procedures will be performed, as considered warranted, based on conditions encountered (e.g. change of material sources, types, etc.) Every effort will be made to process samples in the laboratory as quickly as possible and in progress construction projects are our first priority. However, laboratory workloads may cause in delays and some soils may require a **minimum of 48 to 72 hours to complete test procedures**. Whenever possible, our representative(s) should be informed in advance of operational changes that might result in different source areas for materials.
7. Procedures for testing of fill slopes are as follows:
   a) Density tests should be taken periodically during grading on the flat surface of the fill, three to five feet horizontally from the face of the slope.
   b) If a method other than over building and cutting back to the compacted core is to be employed, slope compaction testing during construction should include testing the outer six inches to three feet in the slope face to determine if the required compaction is being achieved.
8. Finish grade testing of slopes and pad surfaces should be performed after construction is complete.

Site Clearing

1. All vegetation, and other deleterious materials, should be removed from the site. If material is not immediately removed from the site it should be stockpiled in a designated area(s) well outside of all current work areas and delineated with flagging or other means. Site clearing should be performed in advance of any grading in a specific area.
2. Efforts should be made by the contractor to remove all organic or other deleterious material from the fill, as even the most diligent efforts may result in the incorporation of some materials. This is especially important when grading is occurring near the natural grade. All equipment operators should be aware of these efforts. Laborers may be required as root pickers.
3. Nonorganic debris or concrete may be placed in deeper fill areas provided the procedures used are observed and found acceptable by our representative.

Treatment of Existing Ground

1. Following site clearing, all surficial deposits of alluvium and colluvium as well as weathered or creep effected bedrock, should be removed unless otherwise specifically indicated in the text of this report.
2. In some cases, removal may be recommended to a specified depth (e.g. flat sites where partial alluvial removals may be sufficient). The contractor should not exceed these depths unless directed otherwise by our representative.
3. Groundwater existing in alluvial areas may make excavation difficult. Deeper removals than indicated in the text of the report may be necessary due to saturation during winter months.
4. Subsequent to removals, the natural ground should be processed to a depth of six inches, moistened to near optimum moisture conditions and compacted to fill standards.
5. Exploratory back hoe or dozer trenches still remaining after site removal should be excavated and filled with compacted fill if they can be located.

Fill Placement

1. Unless otherwise indicated, all site soil and bedrock may be reused for compacted fill; however, some special processing or handling may be required (see text of report).

2. Material used in the compacting process should be evenly spread, moisture conditioned, processed, and compacted in thin lifts six (6) to eight (8) inches in compacted thickness to obtain a uniformly dense layer. The fill should be placed and compacted on a nearly horizontal plane, unless otherwise found acceptable by our representative.
3. If the moisture content or relative density varies from that recommended by this firm, the contractor should rework the fill until it is in accordance with the following:
   a) Moisture content of the fill should be at or above optimum moisture. Moisture should be evenly distributed without wet and dry pockets. Pre-watering of cut or removal areas should be considered in addition to watering during fill placement, particularly in clay or dry surficial soils. The ability of the contractor to obtain the proper moisture content will control production rates.
   b) Each six-inch layer should be compacted to at least 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency. In most cases, the testing method is ASTM Test Designation D 1557.
4. Rock fragments less than eight inches in diameter may be utilized in the fill, provided:
   a) They are not placed in concentrated pockets;
   b) There is a sufficient percentage of fine-grained material to surround the rocks;
   c) The distribution of the rocks is observed by, and acceptable to, our representative.
5. Rocks exceeding eight (8) inches in diameter should be taken off site, broken into smaller fragments, or placed in accordance with recommendations of this firm in areas designated suitable for rock disposal. On projects where significant large quantities of oversized materials are anticipated, alternate guidelines for placement may be included. If significant oversize materials are encountered during construction, these guidelines should be requested.
6. In clay soil, dry or large chunks or blocks are common. If in excess of eight (8) inches minimum dimension, then they are considered as oversized. Sheepsfoot compactors or other suitable methods should be used to break up blocks. When dry, they should be moisture conditioned to provide a uniform condition with the surrounding fill.

Slope Construction

1. The contractor should obtain a minimum relative compaction of 90 percent out to the finished slope face of fill slopes. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment.
2. Slopes trimmed to the compacted core should be overbuilt by at least three (3) feet with compaction efforts out to the edge of the false slope. Failure to properly compact the outer edge results in trimming not exposing the compacted core and additional compaction after trimming may be necessary.
3. If fill slopes are built "at grade" using direct compaction methods, then the slope construction should be performed so that a constant gradient is maintained throughout construction. Soil should not be "spilled" over the slope face nor should slopes be "pushed out" to obtain grades. Compaction equipment should compact each lift along the immediate top of slope. Slopes should be back rolled or otherwise compacted at approximately every 4 feet vertically as the slope is built.
4. Corners and bends in slopes should have special attention during construction as these are the most difficult areas to obtain proper compaction.
5. Cut slopes should be cut to the finished surface. Excessive undercutting and smoothing of the face with fill may necessitate stabilization.

UTILITY TRENCH CONSTRUCTION AND BACKFILL

Utility trench excavation and backfill is the contractors responsibility. The geotechnical consultant typically provides periodic observation and testing of these operations. While efforts are made to make sufficient observations and tests to verify that the contractors' methods and procedures are adequate to achieve proper compaction, it is typically impractical to observe all backfill procedures. As such, it is critical that the contractor use consistent backfill procedures.

Compaction methods vary for trench compaction and experience indicates many methods can be successful. However, procedures that "worked" on previous projects may or may not prove effective on a given site. The contractor(s) should outline the procedures proposed, so that we may discuss them **prior** to construction. We will offer comments based on our knowledge of site conditions and experience.

1. Utility trench backfill in slopes, structural areas, in streets and beneath flat work or hardscape should be brought to at least optimum moisture and compacted to at least 90 percent of the laboratory standard. Soil should be moisture conditioned prior to placing in the trench.
2. Flooding and jetting are not typically recommended or acceptable for native soils. Flooding or jetting may be used with select sand having a Sand Equivalent (SE) of 30 or higher. This is typically limited to the following uses:
   a) shallow (12 + inches) under slab interior trenches and,
   b) as bedding in pipe zone.

   The water should be allowed to dissipate prior to pouring slabs or completing trench compaction.
3. Care should be taken not to place soils at high moisture content within the upper three feet of the trench backfill in street areas, as overly wet soils may impact subgrade preparation. Moisture may be reduced to 2% below optimum moisture in areas to be paved within the upper three feet below sub grade.
4. Sand backfill should not be allowed in exterior trenches adjacent to and within an area extending below a 1:1 projection from the outside bottom edge of a footing, unless it is similar to the surrounding soil.
5. Trench compaction testing is generally at the discretion of the geotechnical consultant. Testing frequency will be based on trench depth and the contractors procedures. A probing rod would be used to assess the consistency of compaction between tested areas and untested areas. If zones are found that are considered less compact than other areas, this would be brought to the contractors attention.

JOB SAFETY

General

Personnel safety is a primary concern on all job sites. The following summaries are safety considerations for use by all our employees on multi-employer construction sites. On ground personnel are at highest risk of injury and possible fatality on grading construction projects. The company recognizes that construction activities will vary on each site and that job site safety is the contractor's responsibility. However, it is, imperative that all personnel be safety conscious to avoid accidents and potential injury.

In an effort to minimize risks associated with geotechnical testing and observation, the following precautions are to be implemented for the safety of our field personnel on grading and construction projects.

1. Safety Meetings: Our field personnel are directed to attend the contractor's regularly scheduled safety meetings.
2. Safety Vests: Safety vests are provided for and are to be worn by our personnel while on the job site.
3. Safety Flags: Safety flags are provided to our field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

In the event that the contractor's representative observes any of our personnel not following the above, we request that it be brought to the attention of our office.

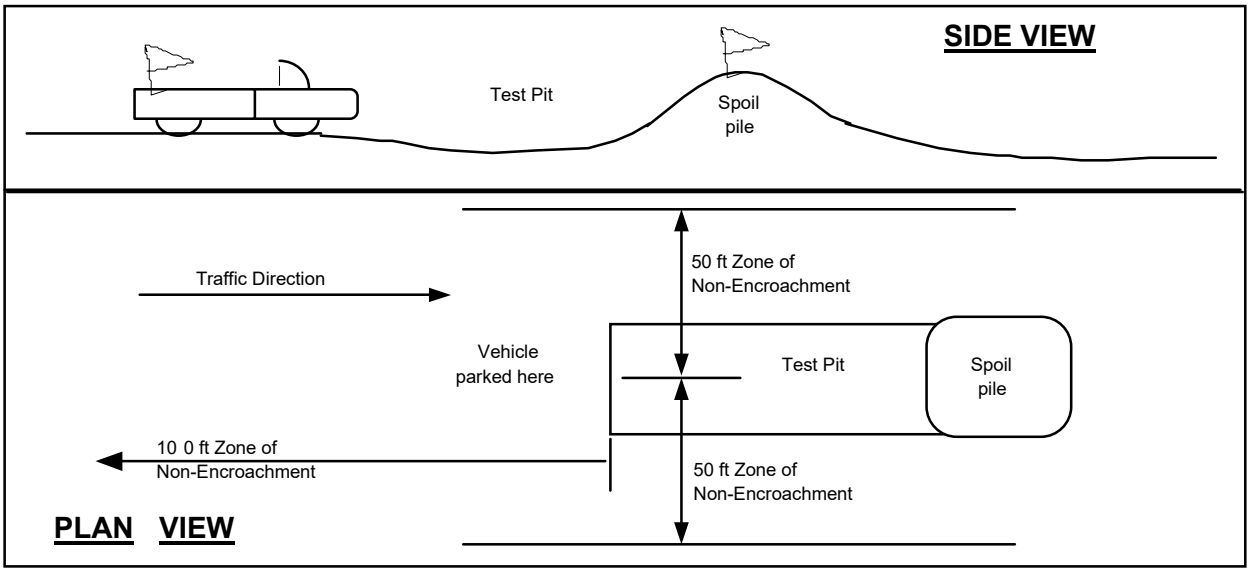
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The technician is responsible for selecting test pit locations. The primary concern is the technician's safety. However, it is necessary to take sufficient tests at various locations to obtain a representative sampling of the fill. As such, efforts will be made to coordinate locations with the grading contractors authorized representatives (e.g. dump man, operator, supervisor, grade checker, etc.), and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractors authorized representative should direct excavation of the pit and safety during the test period. Again, safety is the paramount concern.

Test pits should be excavated so that the spoil pile is placed away from oncoming traffic. The technician's vehicle is to be placed next to the test pit, opposite the spoil pile. This necessitates that the fill be maintained in a drivable condition. Alternatively, the contractor may opt to park a piece of equipment in front of test pits, particularly in small fill areas or those with limited access.

A zone of non-encroachment should be established for all test pits (see diagram below). No grading equipment should enter this zone during the test procedure. The zone should extend outward to the sides approximately 50 feet from the center of the test pit and 100 feet in the direction of traffic flow. This zone is established both for safety and to avoid excessive ground vibration, which typically decreases test results.

TEST PIT SAFETY PLAN



Slope Tests

When taking slope tests, the technician should park their vehicle directly above or below the test location on the slope. The contractor's representative should effectively keep all equipment at a safe operation distance (e.g. 50 feet) away from the slope during testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location.

Trench Safety

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Trenches for all utilities should be excavated in accordance with CAL-OSHA and any other applicable safety standards. Safe conditions will be required to enable compaction testing of the trench backfill.

All utility trench excavations in excess of 5 feet deep, which a person enters, are to be shored or laid back. Trench access should be provided in accordance with OSHA standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

Our personnel are directed not to enter any excavation which;

1. is 5 feet or deeper unless shored or laid back,
2. exit points or ladders are not provided,
3. displays any evidence of instability, has any loose rock or other debris which could fall into the trench, or
4. displays any other evidence of any unsafe conditions regardless of depth.

If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraws and notifies their supervisor. The contractors representative will then be contacted in an effort to effect a solution. All backfill not tested due to safety concerns or other reasons is subject to reprocessing and/or removal.

Procedures

In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is directed to inform both the developer's and contractor's representatives. If the condition is not rectified, the technician is required, by company policy, to immediately withdraw and notify their supervisor. The contractor's representative will then be contacted in an effort to effect a solution. No further testing will be performed until the situation is rectified. Any fill placed in the interim can be considered unacceptable and subject to reprocessing, recompaction or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to technicians attention and notify our project manager or office. Effective communication and coordination between the contractors' representative and the field technician(s) is strongly encouraged in order to implement the above safety program and safety in general.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

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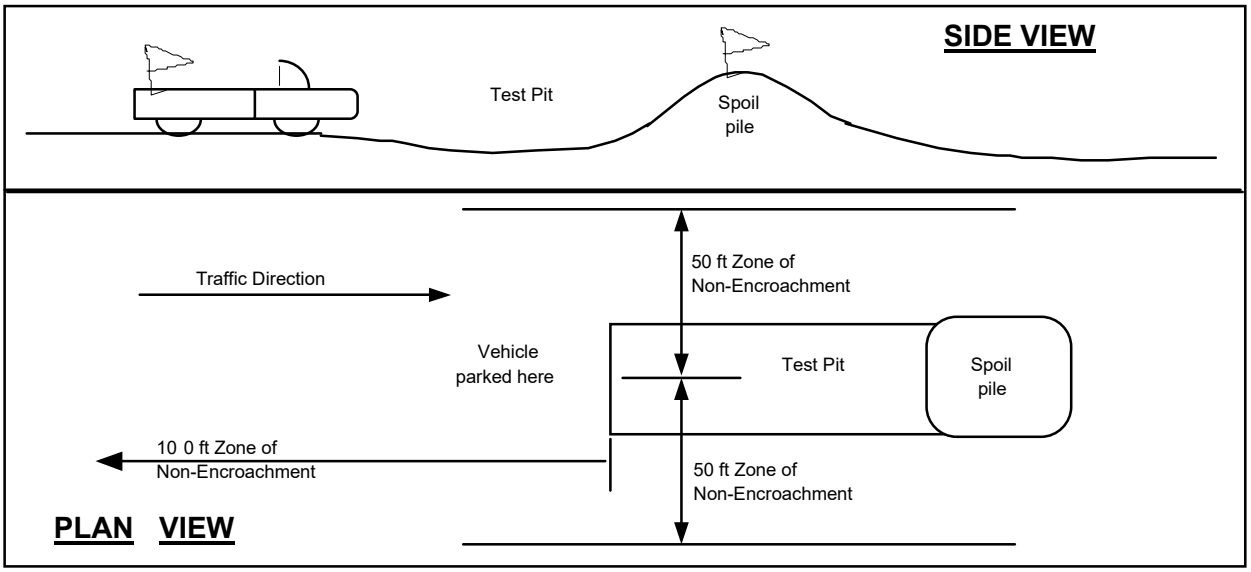
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TEST PIT SAFETY PLAN



Slope Tests

When taking slope tests, the technician should park their vehicle directly above or below the test location on the slope. The contractor's representative should effectively keep all equipment at a safe operation distance (e.g. 50 feet) away from the slope during testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location.

Trench Safety

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Trenches for all utilities should be excavated in accordance with CAL-OSHA and any other applicable safety standards. Safe conditions will be required to enable compaction testing of the trench backfill.

All utility trench excavations in excess of 5 feet deep, which a person enters, are to be shored or laid back. Trench access should be provided in accordance with OSHA standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

Our personnel are directed not to enter any excavation which;

1. is 5 feet or deeper unless shored or laid back,
2. exit points or ladders are not provided,
3. displays any evidence of instability, has any loose rock or other debris which could fall into the trench, or
4. displays any other evidence of any unsafe conditions regardless of depth.

If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraws and notifies their supervisor. The contractors representative will then be contacted in an effort to effect a solution. All backfill not tested due to safety concerns or other reasons is subject to reprocessing and/or removal.

Procedures

In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is directed to inform both the developer's and contractor's representatives. If the condition is not rectified, the technician is required, by company policy, to immediately withdraw and notify their supervisor. The contractor's representative will then be contacted in an effort to effect a solution. No further testing will be performed until the situation is rectified. Any fill placed in the interim can be considered unacceptable and subject to reprocessing, recompaction or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to technicians attention and notify our project manager or office. Effective communication and coordination between the contractors' representative and the field technician(s) is strongly encouraged in order to implement the above safety program and safety in general.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

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