

Post-Construction Storm Water Quality Plan

For:
Circle K
City of Roseville, CA
5900 Baseline Road

Prepared for:
Circle K

Land Development Consultants
11811 N. Tatum Blvd., Ste. 1051
Phoenix, AZ 85028
(602)-850-8101

Prepared by:
Blue Peak Engineering
18543 Yorba Linda Boulevard
Yorba Linda, CA 92886
714-749-3077


Preparation Date: January, 2022
Approval Date: _____

Section 1 General Project Information

The undersigned owner of the subject property, is responsible for the implementation of the provisions of this plan, including ongoing operations and maintenance (O&M), consistent with the requirements of the West Placer Storm Water Quality Design Manual and the State of California Phase II Small MS4 General Permit (Order No: 2013-0001-DWQ). If the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement the SWQP.

For all Regulated Projects (As identified in Form 1-2 below), the undersigned owner hereby grants access to all representatives of the Jurisdictional Agency for the sole purpose of performing O&M inspections of the installed treatment system(s) and hydromodification control(s) if any.

A copy of the final signed and fully approved SWQP shall be available on the subject site for the duration of construction and then stored with the project approval documentation and improvement plans in perpetuity.

Form 1-1 Project Identification and Owner's Certification		
Project Site Address:	5900 Baseline Road, Roseville, CA	
Owner Name:	Circle K	
Title	0	
Company	Land Development Consultants	
Address	11811 N. Tatum Blvd., Ste. 1051	
City, State, Zip Code	Phoenix, AZ 85028	
Email	info@ldcaz.com	
Telephone #	(602)-850-8101	
Signature	Date	
Engineer:*	Thomas Hawksworth, PE	<p>PE Stamp*</p> <p>(Required for all Regulated Projects)</p> 
Title	Senior Vice President	
Company	Blue Peak Engineering	
Address	18543 Yorba Linda Boulevard	
City, State, Zip Code	Yorba Linda, CA 92886	
Email	thomash@bluepeakeng.com	
Telephone #	714-749-3077	
Signature		
Brief Description of Project: (Attach additional sheets as necessary)	The proposed Circle K parcel comprises about 2.178 acres of land at the Northeast Corner of Baseline Road and Westbrook Boulevard in Roseville, California. The site is bound to the north by a screen wall and active construction and grading activities beyond; to the east by vacant land; to the south by Baseline Road; and to the west by the newly constructed Westbrook Boulevard.	

* Not required for Small Projects as determined in Form 1-2 below. Project owners are responsible for ensuring that all storm water facilities are designed by an appropriately licensed and qualified professional.

Form 1-2 Project Category

Development Category (Select all that apply)

¹ Small Project – All projects, except LUPs, that create and/or replace between 2,500-5,000 ft ² of impervious surface or detached single family homes that create and/or replace 2,500 ft ² or more of impervious surface and are not part of a larger plan of development.	
² Enter total new and/or replaced impervious surface (ft ²)	
³ Regulated Project – All projects that create and/or replace 5,000 ft ² or more of impervious surface.	X
⁴ Regulated Redevelopment Project with equal to, or greater than 50 percent increase in impervious area	
⁵ Regulated Redevelopment Project with less than 50 percent increase in impervious area	
⁶ Enter total pre-project impervious surface (ft ²)	0
⁷ Enter total new and/or replaced impervious surface (ft ²)	57,835
⁸ Regulated Road or linear underground/overhead project (LUP) creating 5,000 ft ² or more of newly constructed contiguous impervious surface.	
⁹ Enter total new and/or replaced impervious surface (ft ²)	57,835
¹⁰ Regulated Hydromodification Management Project – Regulated projects that create and/or replace 1 acre or more of impervious surface. A project that does not increase impervious surface area over the pre-project condition is not a hydromodification management project.	X
¹¹ Enter total new and/or replaced impervious surface (ft ²)	57,835

Section 2 Small Projects

Form 2-1 Site Assessment and Layout Documentation

	Has this Item been considered in the Site Layout and depicted in the Site Plan?	
	Yes	Not Applicable (Include brief explanation)
Define the development envelope and protected areas, identifying areas that are most suitable for development and areas to be landscaped , or left undisturbed, and used for infiltration.	X	
Minimize overall impervious coverage (paving and roofs) of the site.	X	
Set back development from creeks, wetlands, and riparian habitats in accordance with local ordinances.	X	
Preserve significant trees and native vegetation.	X	
Conform site layout along natural landforms.	X	
Avoid excessive grading and disturbance of vegetation and soils and stabilize disturbed areas.	X	
Replicate the site's natural drainage patterns.	X	

Attach a Site Plan that incorporates the applicable considerations above. Ensure that the following items are included in the Site Plan:

- Site Boundary
- Topographic data with 1 ft. contours (5 ft. contours are acceptable on steeper sites).
- Existing natural hydrologic features (depressions, watercourses, wetlands, riparian corridors)
- Environmentally sensitive areas and areas to be preserved.
- Proposed locations and footprints of improvements creating new, or replaced, impervious surfaces
- Proposed site drainage with flow directions and site run-on and discharge locations
- Proposed Site Design Measures to reduce runoff

Form 2-2 Runoff Reduction Calculator for Site Design Measures on Small Projects				
¹ Project Site Elevation (ft. above seal level)	N/A			
Site Design Measure	Runoff Reduction Parameters			Runoff Reduction (ft³)
² Adjacent/On-Site Stream Setbacks and Buffers	A _{imp} (ft ²)	<i>impervious drainage area</i>		0
	V ₈₅ (in)	<i>runoff volume from 85th percentile, 24-hour storm</i>	1.0	
³ Soil Quality Improvement and Maintenance	A _{pond} (ft ²)	<i>ponding area</i>		0
	D _{pond} (ft)	<i>ponding depth</i>		
	A _{sa} (ft ²)	<i>soil amendment area</i>		
	D _{sa} (ft)	<i>depth of amended soil</i>		
	n	<i>porosity of amended soil</i>		
⁴ Tree Planting and Preservation	n _e	<i>number of new evergreen trees</i>		0
	n _d	<i>number of new deciduous trees</i>		
	A _{tc} (ft ²)	<i>Canopy area of existing trees to remain on the property</i>		
	V ₈₅ (in)	<i>runoff volume from 85th percentile, 24-hour storm</i>	1.0	
⁵ Rooftop and Impervious Area Disconnection	A _{imp} (ft ²)	<i>impervious drainage area</i>		0
	V ₈₅ (in)	<i>runoff volume from 85th percentile, 24-hour storm</i>	1.0	
⁶ Porous Pavement	A _{res} (ft ²)	<i>area of gravel storage layer</i>		0
	D _{res} (ft)	<i>depth of gravel storage layer</i>		
	n _{agg}	<i>porosity of aggregate</i>		
	C	<i>efficiency factor</i>		
⁷ Vegetated Swales	A _{imp} (ft ²)	<i>impervious drainage area</i>		0
	V ₈₅ (in)	<i>runoff volume from 85th percentile, 24-hour storm</i>	1.0	
⁸ Rain Barrels and Cisterns	N	<i>number of rain barrels and/or cisterns</i>		0
	V _a (ft ³)	<i>volume of each rain barrel and/or cistern</i>		
⁹ Total Volume Reduction (ft ³)				0
¹⁰ Effective Treated Impervious Area (ft ²)				0
<u>85th Percentile, 24 Hour Design Storm Depth</u> Elevation <500 feet = 0.9 inch Elevation 500-1,000 feet = 1.0 inch Elevation 1,000-1,500 feet = 1.1 inch				

Section 3 Regulated Projects

Section 3 forms are to be completed for all Regulated Projects.

Form 3-1 Site Location and Hydrologic Features

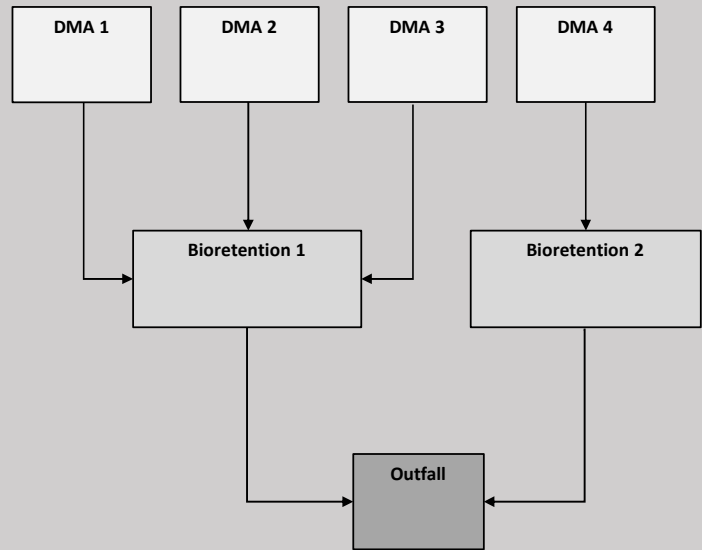
Site coordinates: <i>Take GPS measurement at approximate center of site</i>	¹ Latitude 38°45'08.05"N.	² Longitude 121°22'57.74"W.	³ Elevation (ft. above sea level) 100	⁴ 85th Percentile, 24 Hour Design Storm Depth (in): 0.9
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⁵ Receiving waters <i>Name of stream, lake or other downstream waterbody to which the site runoff eventually drains</i>	Curry Creek
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⁶ 303(d) listed pollutants of concern <i>Refer to State Water Resources Control Board website www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/#impaired</i>	None
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⁷ Is Project going to be phased? <i>If yes, ensure that the SWQP evaluates each phase with distinct DMAs, requiring LID BMPs to address runoff at time of completion</i>	No
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⁸Use this form to show a conceptual schematic depicting DMAs and conveyance features connecting DMAs to the site outlet(s). An example is provided below that can be modified for the proposed project or a drawing clearly showing DMAs and flow routing may be attached.



Form 3-2 Site Assessment and Layout Documentation

	Has this Item been considered in the Site Layout and depicted in the Site Plan?	
	Yes	Not Applicable (Include brief explanation)
Define the development envelope and protected areas, identifying areas that are most suitable for development areas to be left undisturbed.	X	
Concentrate development on portions of the site with less permeable soils and preserve areas that can promote infiltration.	X	
Limit overall impervious coverage of the site with paving and roofs.	X	
Set back development from creeks, wetlands, and riparian habitats.	X	
Preserve significant trees.	X	
Conform site layout along natural landforms.	X	
Avoid excessive grading and disturbance of vegetation and soils.	X	
Replicate the site's natural drainage patterns.	X	
Detain and retain runoff throughout the site.	X	

Attach a Site Plan that incorporates the applicable considerations above. Ensure that the following items are included in the Site Plan:

- Site Boundary
- Soil types and areal extents, test pit and infiltration test locations
- Topographic data with 1 ft. contours
- Existing natural hydrologic features (depressions, watercourses, wetlands, riparian corridors)
- Environmentally sensitive areas and areas to be preserved.
- Proposed locations and footprints of improvements creating new, or replaced, impervious surfaces
- Potential pollutant sources and locations
- Entire site divided into separate DMAs with unique identifiers
- Existing and proposed site drainage network with flow directions and site run-on and discharge locations
- Proposed design features and surface treatments used to minimize imperviousness and reduce runoff
- Proposed locations and footprints of treatment and hydromodification management facilities
- Design features for managing authorized non-stormwater discharges
- Areas of soil and/or groundwater contamination
- Existing utilities and easements
- Maintenance areas

Form 3-3 Source Control Measures			
Potential Pollutant Generating Activity or Source	Check One		Describe the source control measures to be implemented for each potential pollutant generating activity or source present on the project as listed in Appendix C and in the CASQA Fact Sheets. Include any special features, materials, or methods of construction that will be used.
	Present	Not Applicable	
Accidental spills or leaks	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Interior floor drains	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Parking/storage areas and maintenance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Indoor and structural pest control	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Pools, spas, ponds, decorative fountains, and other water features	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Landscape/outdoor pesticide use	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Restaurants, grocery stores, and other food service operations	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Refuse areas	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Industrial Processes	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Outdoor storage of equipment or materials	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Vehicle and equipment cleaning	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Vehicle and equipment repair and maintenance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Fuel dispensing areas	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Loading docks	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Fire sprinkler test water	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Drain or wash water from boiler drain lines, condensate drain lines, rooftop equipment, drainage sumps, and other sources	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Unauthorized non-storm water discharges	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Building and grounds maintenance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

The source control measures identified in this table shall be designed consistent with recommendations from the CASQA Stormwater BMP Handbook for New Development and Redevelopment¹, or from another equivalent manual.

^[1] California Stormwater BMP Handbook New Development and Redevelopment. California Stormwater Quality Association (CASQA). January 2003.

Form 3-4 Runoff Reduction Calculator for Site Design Measures on Regulated P

			¹ DMA ID No.	1	2	
Site Design Measure	Runoff Reduction Parameters			Runoff Reduction (ft ³)	Runoff Reduction (ft ³)	
² Adjacent/On-Site Stream Setbacks and Buffers	A_{imp} (ft ²)	<i>impervious drainage area</i>		0		0
	V_{85} (in)	<i>runoff volume from 85th percentile, 24-hour storm</i>	0.8		0.8	
³ Soil Quality Improvement and Maintenance	A_{pond} (ft ²)	<i>ponding area</i>		0		0
	D_{pond} (ft)	<i>ponding depth</i>				
	A_{sa} (ft ²)	<i>soil amendment area</i>				
	D_{sa} (ft)	<i>depth of amended soil</i>				
	n	<i>porosity of amended soil</i>				
⁴ Tree Planting and Preservation	n_e	<i>number of new evergreen trees</i>		0		0
	n_d	<i>number of new deciduous trees</i>				
	A_{tc} (ft ²)	<i>canopy area of existing trees to remain on the property</i>				
	V_{85} (in)	<i>runoff volume from 85th percentile, 24-hour storm</i>	0.8		0.8	
⁵ Rooftop and Impervious Area Disconnection	A_{imp} (ft ²)	<i>impervious drainage area</i>		0		0
	V_{85} (in)	<i>runoff volume from 85th percentile, 24-hour storm</i>	0.8		0.8	

Form 3-6 Volume-Based Infiltrating Bioretention Measures

¹ DMA ID No. <i>If combining multiple DMAs from Form 3-5, enter a new unique DMA ID No.</i>			
² WQV (ft ³) <i>Item 5 in Form 3-5</i> <i>If combining multiple DMAs from Form 3-5, enter the sum of their respective WQVs.</i>			
³ Surface Loading Rate <i>Maximum 5.0 in/hr</i>			
⁴ BMP Surface Area (ft ²) <i>Top of BMP</i>			
⁵ Infiltration rate of underlying soils (in/hr)			
⁶ Maximum ponding depth (ft) <i>BMP specific, see BMP design details</i>			
⁷ Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 5} * 48 \text{ hrs}) \text{ or Item 6}$	-	-	-
⁸ Infiltrating surface area, SA_{BMP} (ft ²) <i>Bottom of BMP</i>			
⁹ Planting media depth, d_{media} (ft)			
¹⁰ Planting media porosity			
¹¹ Gravel depth, d_{media} (ft) <i>Only included in certain BMP types</i>			
¹² Gravel porosity			
¹³ Retention Volume (ft ³) $V_{retention} = \text{Item 8} * [\text{Item 7} + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (1.5 * (\text{Item 5} / 12))]$	-	-	-
¹⁴ Untreated Volume (ft ³) $V_{untreated} = \text{Item 2} - \text{Item 13}$ <i>If greater than zero, adjust BMP sizing variables and re-compute retention volume</i>	0	0	0
¹⁵ Treated Flow Rate (ft ³ /s) $Q_{treated} = 1/43,200 * (\text{Item 3} * \text{Item 4})$	0.0000	0.0000	0.0000
¹⁶ Total Treated Flow Rate for Project (ft ³ /s) $Q_{total} = \text{Sum of Item 15 for all DMAs}$			
¹⁷ Is WQV for each DMA treated on-site?	Yes		No

Form 3-7 Flow-Through Planters, Tree Box and Media Filters

¹ DMA ID No. <i>If combining multiple DMAs from Form 3-5, enter a new unique DMA ID No.</i>	1	2	3	
² WQF (ft ³ /s) <i>Item 6 in Form 3-5</i> <i>If combining multiple DMAs from Form 3-5, enter the sum of their respective WQFs.</i>	0.2570	0.0180	0.0028	
³ Surface Loading Rate <i>Maximum 5.0 in/hr</i>				
⁴ Maximum Ponding Depth (ft) <i>BMP Specific, see BMP design details</i>				
⁵ Soil/Media Surface Area (ft ²) <i>Top of BMP</i>				
⁶ Soil/Media Depth (ft)				
⁷ Soil/Media porosity				
⁸ Gravel Depth (ft)				
⁹ Gravel porosity				
¹⁰ Detention Volume (ft ³) $V_d = \text{Item } 5 * [\text{Item } 4 + (\text{Item } 6 * \text{Item } 7) + (\text{Item } 8 * \text{Item } 9) + (3 * (\text{Item } 3 / 12))]$	0.00	0.00	0.00	0.00
¹¹ Manufacturers' specified flow rate for proprietary devices (ft ³ /s) <i>(attach a copy of the product specifications)</i>	0.2600			
¹² Treated Flow Rate (ft ³ /s) $Q_{\text{treated}} = 1/43,200 * (\text{Item } 3 * \text{Item } 5) \text{ or Item } 11$	0.2600	0.0000	0.0000	0.0000
¹³ Untreated Flow Rate (ft ³ /s) $Q_{\text{untreated}} = \text{Item } 2 - \text{Item } 12$ <i>If greater than zero, adjust BMP sizing variables and re-compute treated flow</i>	0.0000	0.0180	0.0028	0.0000
¹⁴ Total Treated Flow Rate for Project (ft ³ /s) $Q_{\text{total}} = \text{Sum of Item } 12 \text{ for all DMAs}$	0.26			
¹⁵ Is WQF for each DMA treated on-site?	Yes		No	X

Section 4 Regulated Hydromodification Management Projects

Form 4-1 Peak Runoff Response Time

(Complete Section 4 forms for Regulated Hydromodification Projects only)

Determine total runoff response time for pre- and post-construction conditions at each project outlet.

Variables	Pre-construction DMAs to Project Outlet				Post-construction DMAs to Project Outlet			
	1	2	3	4	1	2	3	4
¹ Length of longest overland flow path <i>Not to exceed 100 ft</i>	100				62	100	100	
² Slope of overland flow path (ft/ft)	0.0064				0.0180	0.0050	0.0050	
³ Manning's roughness coefficient for overland flow surface <i>See Table 5-5 of the Placer County SWMM</i>	0.4000				0.1100	0.1100	0.1100	
⁴ Overland flow response time (min) $(0.355 * (\text{Item 1} * \text{Item 3})^{0.6}) / (\text{Item 2}^{0.3})$	15	-	-	-	4	7	7	-
⁵ Hydrologic Soil Group <i>Refer to Section 3.1.1. or NRCS Web Soil Survey</i>	D				D	D	D	
⁶ Current Land Cover Type(s) <i>Select from categories shown in Table 5-3 of the SWMM</i>	OPEN SPACE				PAVED	PAVED	PAVED	
⁷ Pervious Area Condition: <i>Based on the extent of vegetated cover Good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating</i>	POOR				POOR	POOR	POOR	
⁸ Infiltration Rate (in/hr) <i>Refer to Table 5-3 of the SWMM using Items 3, 4, and 5 above or obtain site specific field measurements (See Section 3.1.1)</i>	0.06				0.03	0.03	0.03	
⁹ Length of collector flow (ft)	174				606	156	168	
¹⁰ Cross-sectional area of collector flow facility (ft ²)	1				20	20	20	
¹¹ Wetted perimeter of collector flow facility (ft)	4				1	1	1	
¹² Manning's roughness of collector flow facility	0.4000				0.0130	0.1100	0.1100	
¹³ Slope of collector flow facility (ft/ft)	0.0064				0.0050	0.0050	0.0050	
¹⁴ Channel flow velocity (ft/sec) $V = (1.49 / \text{Item 12}) * (\text{Item 10} / \text{Item 11})^{0.67} * (\text{Item 13})^{0.5}$	0.1	-	-	-	52.2	7.1	7.1	-
¹⁵ Collector flow facility response time (min) $T_c = \text{Item 9} / (\text{Item 14} * 60)$	38.9	-	-	-	0.2	0.4	0.4	-
¹⁶ Total runoff response time or T _t (min) $T_t = \text{Item 4} + \text{Item 15}$	53.7	-	-	-	3.9	7.7	-	-

Form 4-2 Hydromodification Target for Peak Runoff

Variables	Pre-construction DMAs to Project Outlet				Post-construction DMAs to Project Outlet			
	1	2	3	4	1	2	3	4
¹ Drainage Area (ft ²) <i>Sum of all outlet level DMAs should equal total project area.</i>	101,500				69,469	13,133	11,394	
² Impervious Area (ft ²) <i>Sum of all outlet level DMAs should equal total project impervious area.</i>	0				54,650	1,900	1,285	
³ Rainfall depth for 2yr storm with duration equal to response time (in) <i>See Placer County SWMM Table 5-A-1 for elevation of site and duration equal to response time</i>	0.54				0.13	0.13	0.13	
⁴ Unit peak runoff (cfs/acre) <i>q = 60/Form 4-1 Item 16 * Item 3</i>	0.60	-	-	-	2.04	1.01	-	-
⁵ Infiltration factor (cfs/acre) <i>F_i = Form 4-1 Item 8 * (1 + 1 / (1.3 + 0.0005 * Form 3-1 Item 3))</i>	0.10	-	-	-	0.05	0.05	0.05	-
⁶ Peak runoff from DMAs (cfs) <i>Q_p = Item 1 * Item 4 – Item 5 * (Item 1 - Item 2)</i>	1.17	-	-	-	3.26	0.29	(0.01)	-
⁷ Total Pre-Project Peak Runoff (ft ³ /s) <i>Q_{total} = Sum of Item 6 for all Pre-construction DMAs</i>	1.17							
⁸ Is the total post-project peak runoff equal to or less than the total pre-project peak runoff? <i>Yes, if Item 7 is greater than or equal to the sum of the Total Treated Flow Rates from Form 3-6 Item 16 and 3-7 Item 12.</i>	YES							

Form 4-3 Detention Volumes for Hydromodification Management

	Post-construction DMAs to Project Outlet			
	1	2	3	4
¹ Land cover and hydrologic condition <i>See NRCD TR-55 Manual Table 2-2 for types</i>	COMMERCIAL			
² Hydrologic Soil Group <i>Refer to Section 3.1.1. or NRCS Web Soil Survey</i>	D	D	D	-
³ Drainage Area (A) (ft ²)	69,469	13,133	11,394	-
⁴ Curve Number (CN) <i>Use Items 1 and 2 to select curve number from NRCS TR-55 Manual Table 2-2</i>	95	95	95	
⁵ Post-development soil storage capacity, S (in): $S = (1000 / \text{Item 4}) - 10$	0.5	0.5	0.5	#DIV/0!
⁶ Precipitation for 2-yr, 24-hr storm (in) <i>See Placer County SWMM Table 5-A-1 for elevation of site and 24-hr duration depths</i>	1.90	1.90	1.90	
⁷ Post-developed runoff volume for 2-yr – 24-hour storm, V_{runoff} (ft ³): $V_{\text{runoff}} = \text{Item 3} * (1 / 12) * [(\text{Item 6} - 0.2 * \text{Item 5})^2 / (\text{Item 6} + 0.8 * \text{Item 5})]$	8,034	1,519	1,318	#DIV/0!
⁸ Attenuation Factor, $q_{\text{out/in}}$ (ratio of target outflow rate to peak inflow rate): $q_{\text{out/in}} = \text{Form 4-2 Item 6 Pre-Construction} / \text{Form 4-2 Item 6 Post-Construction}$	0.36	0.00	0.00	#DIV/0!
⁹ Equalization Factor, V_s/V_r (ratio of storage capacity to runoff volume) <i>V_s/V_r obtained using Item 8 and nomograph in Figure 6-1 of NRCS TR-55 Manual for Rainfall Type IA</i>	0.13	0.13	0.13	
¹⁰ Runoff detention capacity to achieve hydromodification management criteria (ft ³) $D_{\text{hydromod}} = \text{Item 7} * \text{Item 9}$	1044	197	171	#DIV/0!
¹¹ Site Design Measure (SDM) Volume (ft ³): <i>Sum of Item 10 in Form 3-4 for all SDMs in this DMA.</i>	0	0	0	
¹² Bioretention Volume (ft ³): <i>Sum of Item 14 in Form 3-6 for all bioretention measures in this DMA.</i>	0	0	0	
¹³ Flow-Through Detention Volume (ft ³): <i>Sum of Item 10 in Form 3-7 for all flow-through facilities in this DMA.</i>	0	0	0	
¹⁴ Supplemental Detention Volume (ft ³):	3392	1129	1005	
¹⁵ Combined Detention Volume in this DMA (ft ³): <i>Sum of Items 11 through 14</i>	3,392	1,129	1,005	-
¹⁶ Is detention capacity to achieve hydromodification management criteria achieved at all project outlets? <i>Yes, if Item 10 is less than or equal to Item 15. If not provide additional storage capacity</i>	Yes		No	

Form 5-1 BMP Inspection and Maintenance

BMP	Inspection Point and Frequency	Maintenance Activity Required
Modular Wetland System	Monthly and after Rain Events	As required by manufacturer. Monthly and after major storm events.

Form 6-1 Post-Construction Stormwater BMPs

Following is a summary of all BMPs included in the Project design. This checklist must be included on the cover sheet of the Improvement Plans for all Regulated Projects.

BMP		Plan Sheet Number(s)
Structural Source Controls (list BMPs)	Intets marked "NO DUMPING"	1
	Landscaping shall be maintained without pesticides.	1
	Trash enclosure marked "NO DUMPING HAZARDOUS MATERIAL"	1
Site Design Measures	Stream Setbacks and Buffers	N/A
	Soil Quality Improvement and Maintenance	N/A
	Tree Planting and Preservation	N/A
	Rooftop and Impervious Area Disconnection	N/A
	Porous Pavement	N/A
	Vegetated Swales	N/A
	Rain Barrels and Cisterns	N/A
Stormwater Treatment and Baseline Hydromodification Measures	Bioretention with Infiltration	N/A
	Flow-Through Planters, Tree Box Filters and Media Filters	N/A
Hydromodification Management Measures	Supplemental Detention	N/A

ATTACHMENTS

Form 3-1 Site Location and Hydrologic Features

Enter the project specific information to document the site location and elevation to calculate the 85th percentile, 24-hour design storm depth. For reference, the table below provides the 85th percentile, 24-hour design storm depths for three elevation increments within the West Placer region.

85 th Percentile, 24-Hour Design Storm Depth
Elevation <500 feet = 0.9 inch
Elevation 500-1,000 feet = 1.0 inch
Elevation 1,000-1,500 feet = 1.1 inch

Identify the ultimate receiving waters and provide a general description of their location and distance in relation to the project site.

If the receiving waters are listed as impaired on the state 303(d) list, identify the pollutant(s) of concern. Refer to SWRCB website for the most current information:

www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/#impaired

For phased projects, the form clarifies requirements for defining DMAs and incorporating storm water control measures as each phase is developed.

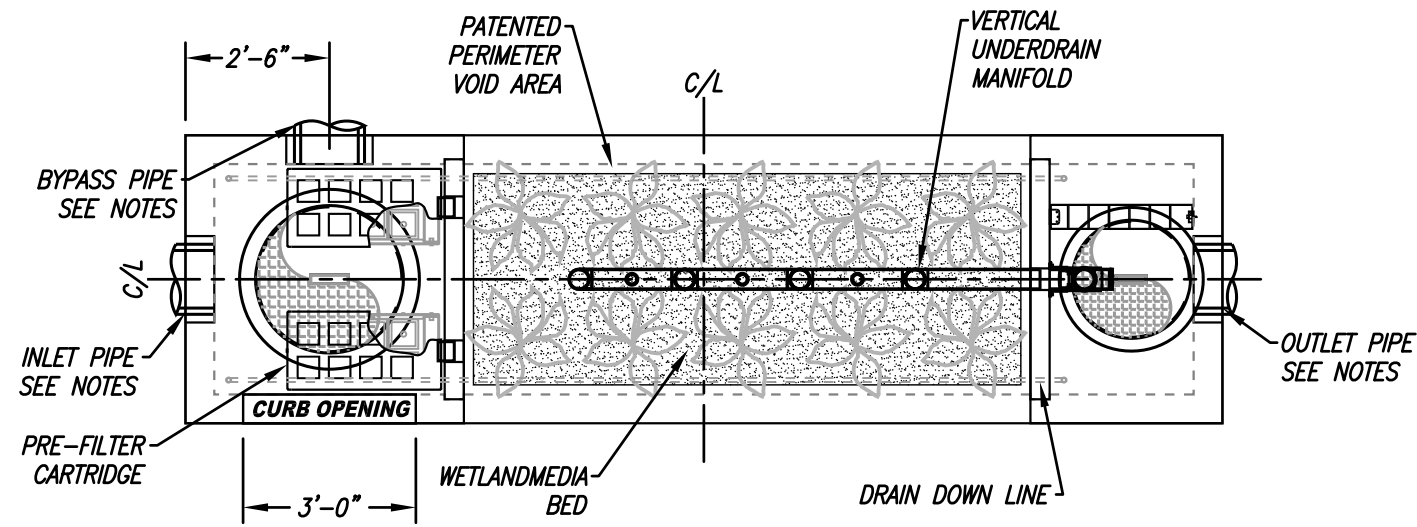
This form is also used to define the project's DMAs, as described in Chapter 4. For projects with more than one DMA, a conceptual level schematic should be developed showing the DMAs that have been defined for the project and their hydrologic connections to the site discharge location(s). The conceptual DMA diagram in this form should be referenced when laying out DMAs and conveyances in the project's site plan as required in Form 3-2.

Form 3-2 LID Site Assessment and Layout Documentation

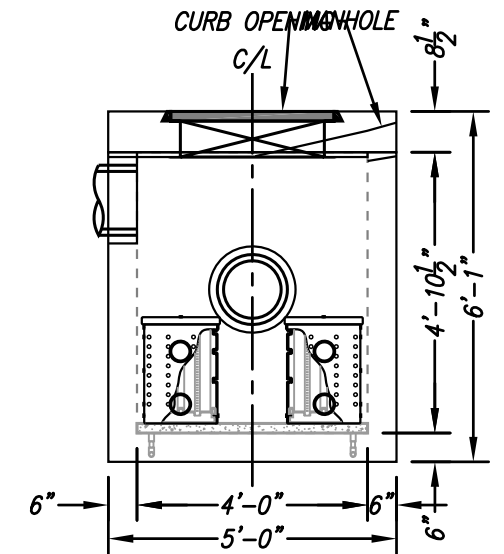
A site assessment must be conducted as early as possible in the project planning process to appropriately plan the site layout for the capture and treatment of storm water runoff. The goal is to develop a site layout that minimizes impacts to site hydrology and other environmental systems, functions, and processes.

The form lists a series of considerations that should be evaluated when developing the site layout. For each item, check the appropriate box to indicate that it has been considered and appropriately incorporated, or that it is not applicable (N/A) and provide a brief explanation (use a separate sheet if necessary). To complete this form, develop and attach a site plan that illustrates the proposed site layout. The site plan may consist of a preliminary or conceptual level design drawing, but it is a key requirement of the Preliminary SWQP described in Section 2.

SITE SPECIFIC DATA			
PROJECT NUMBER	14181		
PROJECT NAME	CIRCLE K		
PROJECT LOCATION	ROSEVILLE, CA		
STRUCTURE ID	MWS UNIT		
TREATMENT REQUIRED			
VOLUME BASED (CF)	FLOW BASED (CFS)		
N/A	0.22		
TREATMENT HGL AVAILABLE (FT)	N/K		
PEAK BYPASS REQUIRED (CFS) - IF APPLICABLE	2.08		
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE	96.25	HDPE	12"
BYPASS PIPE	97.88	HDPE	12"
OUTLET PIPE	94.17	HDPE	12"
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION	99.84	99.84	99.84
SURFACE LOAD	PEDESTRIAN	N/A	PEDESTRIAN
FRAME & COVER	ø30"	OPEN PLANTER	ø24"
WETLAND MEDIA VOLUME (CY)	7.27		
ORIFICE SIZE (DIA. INCHES)	ø2.08"		
NOTES: PRELIMINARY NOT FOR CONSTRUCTION. BYPASS PIPE ELEVATION SLIGHTLY ADJUSTED AND UNIT IS DEEPENED BY AN INCH TO ACCOMMODATE ADDITIONAL LOW FLOWS.			



PLAN VIEW



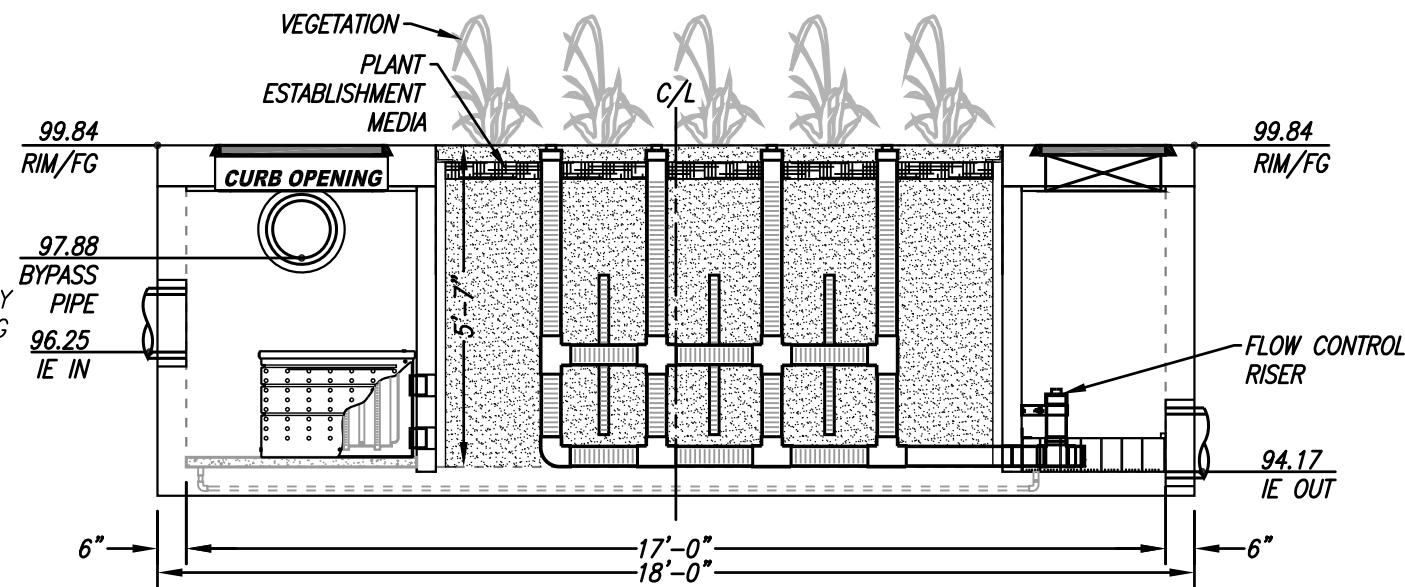
LEFT END VIEW

INSTALLATION NOTES

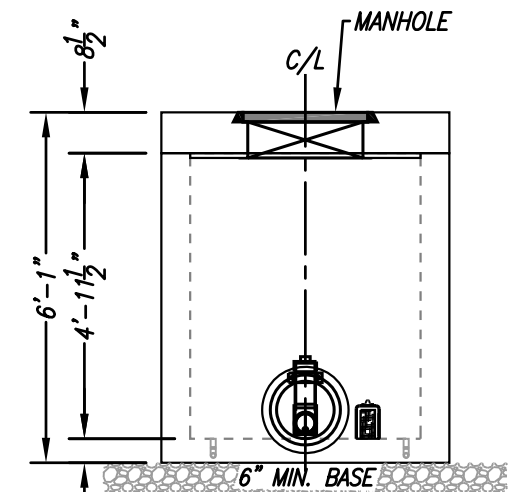
1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS' SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURER'S CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE FOR VERIFYING PROJECT ENGINEER'S RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. 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 PIPES SHALL BE SEALED WATERTIGHT PER MANUFACTURER'S STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL PIPES, RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. VEGETATION SUPPLIED AND INSTALLED BY OTHERS. ALL UNITS WITH VEGETATION MUST HAVE DRIP OR SPRAY IRRIGATION SUPPLIED AND INSTALLED BY OTHERS.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURER'S WARRANTY IS VOID WITHOUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.

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 BIO CLEAN.



ELEVATION VIEW

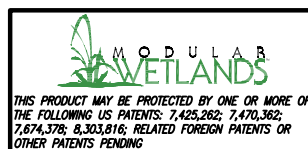


RIGHT END VIEW

INTERNAL BYPASS DISCLOSURE:

THE DESIGN AND CAPACITY OF THE PEAK CONVEYANCE METHOD TO BE REVIEWED AND APPROVED BY THE ENGINEER OF RECORD. HGL(S) AT PEAK FLOW SHALL BE ASSESSED TO ENSURE NO UPSTREAM FLOODING. PEAK HGL AND BYPASS CAPACITY SHOWN ON DRAWING ARE USED FOR GUIDANCE ONLY.

TREATMENT FLOW (CFS)	0.22
OPERATING HEAD (FT)	3.6
PRETREATMENT LOADING RATE (GPM/SF)	1.9
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0



PROPRIETARY AND CONFIDENTIAL:
THE INFORMATION CONTAINED IN THIS DOCUMENT IS THE SOLE PROPERTY OF FORTERRA AND ITS COMPANIES. THIS DOCUMENT, NOR ANY PART THEREOF, MAY BE USED, REPRODUCED OR MODIFIED IN ANY MANNER WITH OUT THE WRITTEN CONSENT OF FORTERRA.



MWS-L-4-17-5'-7"-C-HC
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL



Modular Wetlands[®] Linear

A Stormwater Biofiltration Solution



OVERVIEW

The Modular Wetlands® Linear (MWS Linear*) represents a pioneering breakthrough in stormwater technology as the only biofiltration system to utilize patented horizontal flow, allowing for a smaller footprint, higher treatment capacity, and a wide range of versatility. While most biofilters use little or no pretreatment, the Modular Wetlands Linear incorporates an advanced pretreatment chamber that includes separation and pre-filter boxes. In this chamber, sediment and hydrocarbons are removed from runoff before entering the biofiltration chamber, reducing maintenance costs and improving performance.

Horizontal flow also gives the system the unique ability to adapt to the environment through a variety of configurations, bypass orientations, and diversion applications.

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 cities grow and develop, our environment's natural filtration systems are blanketed with impervious roads, rooftops, and parking lots.

Bio Clean understands this loss and has spent years re-establishing nature's presence in urban areas, and rejuvenating waterways with the Modular Wetlands Linear.

*Also known as: Modular Wetlands®, Modular Wetlands® System Linear, Modwet™, or MWS Linear™.



PERFORMANCE

The Modular Wetlands® Linear continues to outperform other treatment methods with superior pollutant removal for TSS, heavy metals, nutrients, hydrocarbons, and bacteria. Since 2007 the Modular Wetlands Linear has been field tested on numerous sites across the country and is proven to effectively remove pollutants through a combination of physical, chemical, and biological filtration processes. In fact, the Modular Wetlands Linear harnesses some of the same biological processes found in natural wetlands in order to collect, transform, and remove even the most harmful pollutants.

66%
REMOVAL
OF
DISSOLVED
ZINC

69%
REMOVAL
OF TOTAL
ZINC

38%
REMOVAL
OF
DISSOLVED
COPPER

85%
REMOVAL
OF TSS

100%
REMOVAL
OF TRASH

45%
REMOVAL
OF
NITROGEN

50%
REMOVAL
OF TOTAL
COPPER

95%
REMOVAL
OF MOTOR
OIL

67%
REMOVAL
OF ORTHO
PHOSPHORUS

64%
REMOVAL
OF TOTAL
PHOSPHORUS

APPROVALS

The Modular Wetlands® 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.

Here is a list of some of the most high-profile approvals, certifications, and verifications from around the country.



Washington State Department of Ecology TAPE Approved

The Modular Wetlands Linear (MWS-Linear) is approved for General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus treatment at 1 gpm/ft² loading rate. The highest performing BMP on the market for all main pollutant categories.



California Water Resources Control Board, Full Capture Certification

The Modular Wetlands® Linear is the first biofiltration system to receive certification as a full capture trash treatment control device.



Virginia Department of Environmental Quality, Assignment

The Virginia Department of Environmental Quality assigned the Modular Wetlands Linear the highest phosphorus removal rating for manufactured treatment devices to meet the new Virginia Stormwater Management Program (VSMP) regulation technical criteria.



Maryland Department of the Environment, Approved ESD

Granted Environmental Site Design (ESD) status for new construction, redevelopment, and retrofitting when designed in accordance with the design manual.



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 Department of Environmental Management BMP Approval



Texas Commission on Environmental Quality (TCEQ) Approval



Atlanta Regional Commission Certification

ADVANTAGES

- HORIZONTAL FLOW BIOFILTRATION
- GREATER FILTER SURFACE AREA
- PRETREATMENT CHAMBER
- PATENTED PERIMETER VOID AREA
- FLOW CONTROL
- NO DEPRESSED PLANTER AREA
- AUTO DRAINDOWN MEANS NO MOSQUITO VECTOR

OPERATION

The Modular Wetlands® Linear is the most efficient and versatile biofiltration system on the market, and it is the only system with horizontal flow which:

- Improves performance
- Reduces footprint
- Minimizes maintenance

Figure 1 & Figure 2 illustrate the invaluable benefits of horizontal flow and the multiple treatment stages.

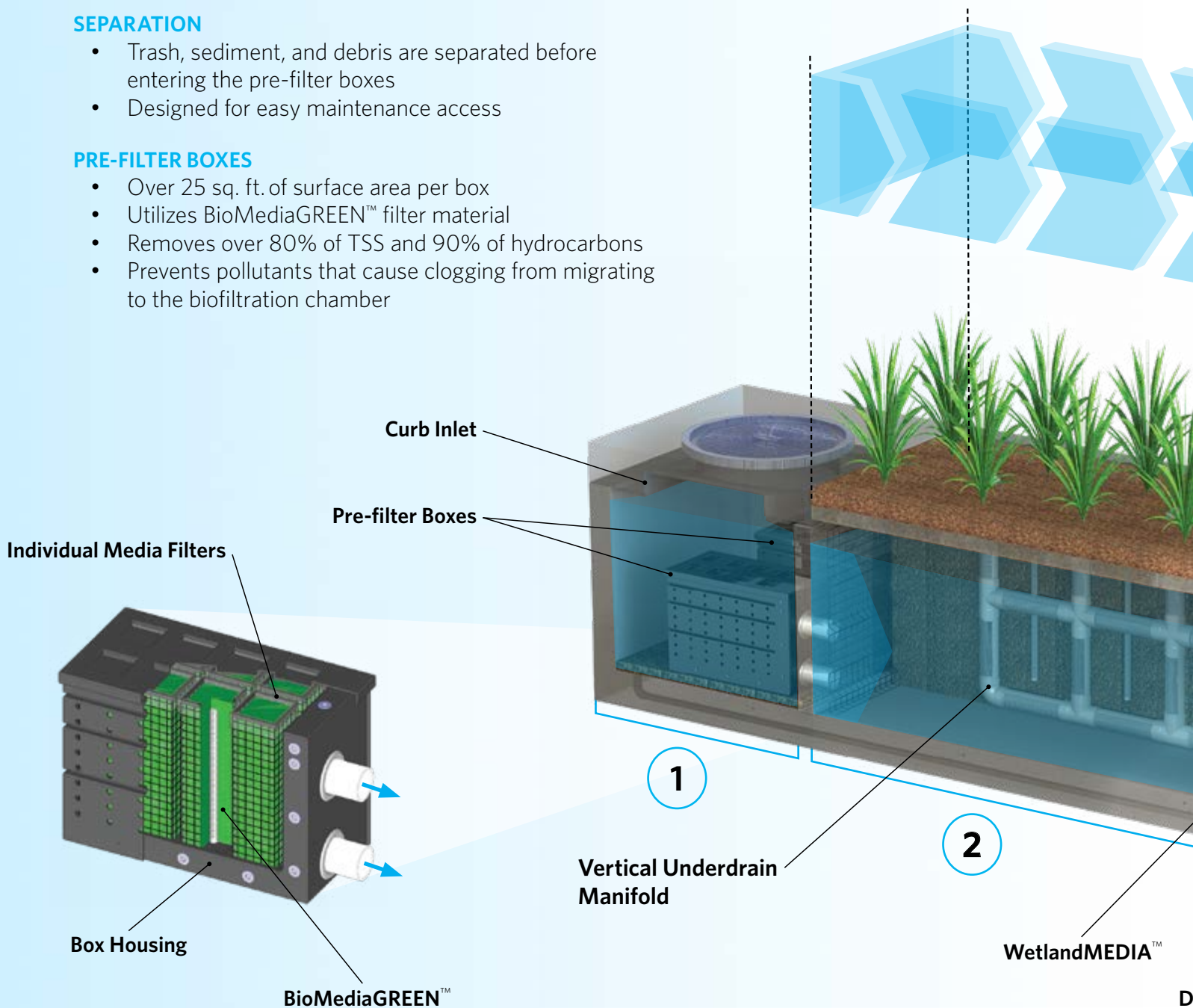
1 PRETREATMENT

SEPARATION

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

PRE-FILTER BOXES

- Over 25 sq. ft. of surface area per box
- Utilizes BioMediaGREEN™ filter material
- Removes over 80% of TSS and 90% of hydrocarbons
- Prevents pollutants that cause clogging from migrating to the biofiltration chamber



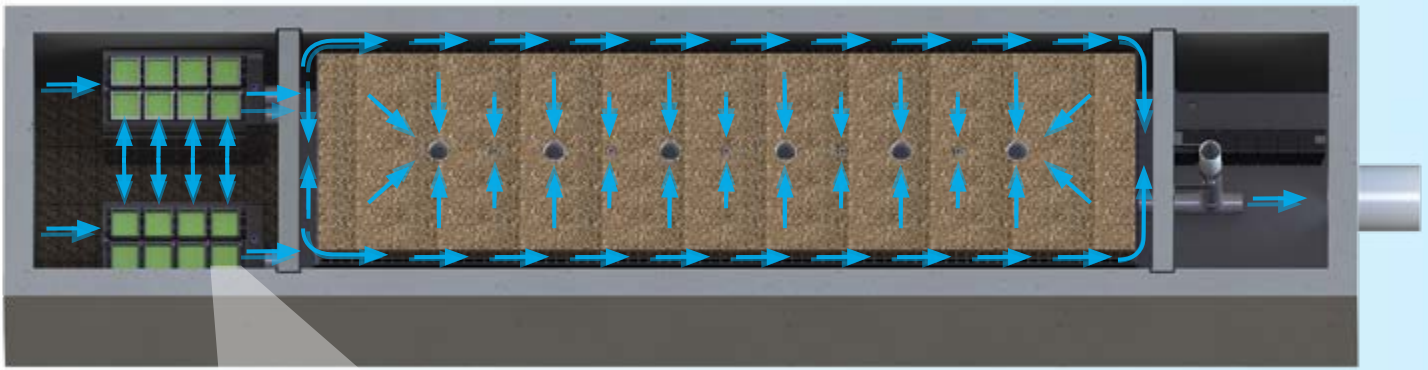


Figure 2,
Top View

2x to 3x more surface area than traditional downward flow bioretention systems.

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 lightweight

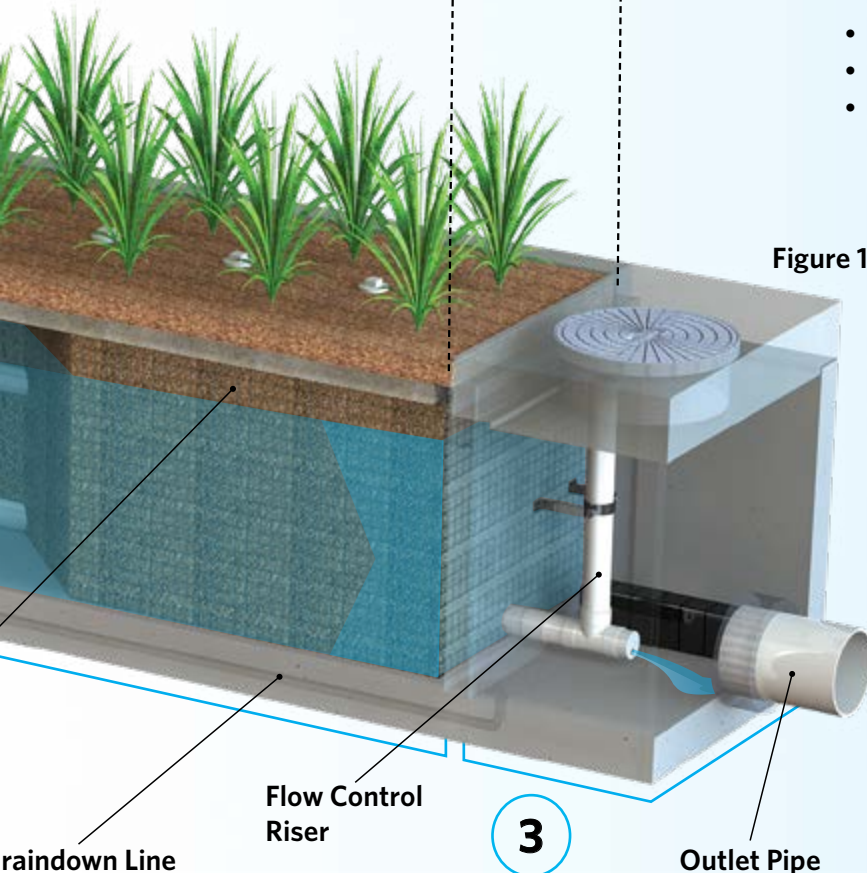
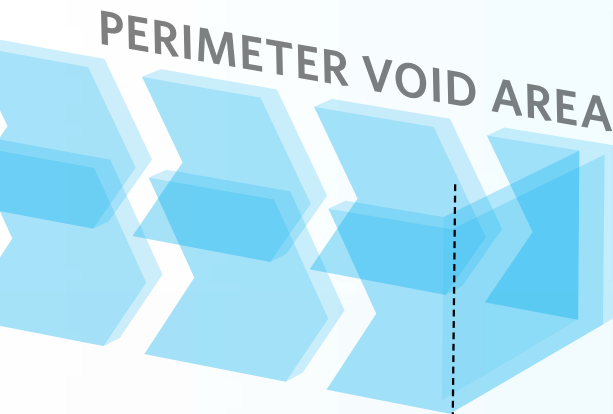


Figure 1

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

DRAINDOWN FILTER

- The draindown is an optional feature that completely drains the pretreatment chamber
- Water that drains from the pretreatment chamber between storm events will be treated



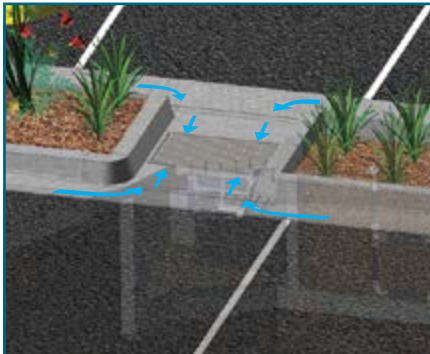
CONFIGURATIONS

The Modular Wetlands® 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 storm drain design.



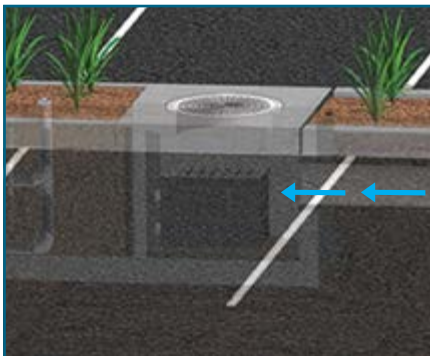
CURB TYPE

The Curb Type configuration accepts sheet flow through a curb opening and is commonly used along roadways 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 pretreatment chamber. It has the added benefit of allowing 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 pretreatment chamber, meaning the Modular Wetlands® 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 rooftop 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.

ORIENTATIONS

SIDE-BY-SIDE

The Side-By-Side orientation places the pretreatment 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 pretreatment 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 that bypass must be external.



BYPASS

INTERNAL BYPASS WEIR (SIDE-BY-SIDE ONLY)

The Side-By-Side orientation places the pretreatment 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 pretreatment chamber directly to the discharge chamber.

EXTERNAL DIVERSION WEIR STRUCTURE

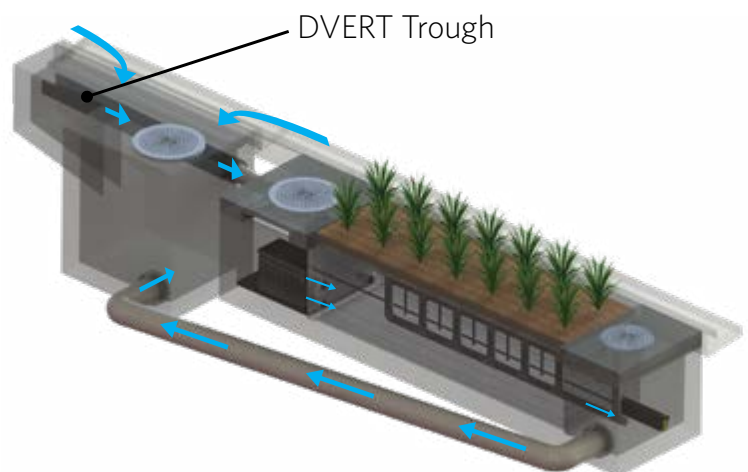
This traditional offline diversion method can be used with the Modular Wetlands® Linear in scenarios where runoff is being piped to the system. These simple and effective structures are generally configured with two outflow pipes. The first is a smaller pipe on the upstream side of the diversion weir - 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 Modular Wetlands® 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 allow the system to be installed anywhere space is available.

SPECIFICATIONS

FLOW-BASED DESIGNS

The Modular Wetlands® System Linear can be used in stand-alone applications to meet treatment flow requirements, and since it 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.

MODEL #	DIMENSIONS	WETLAND MEDIA SURFACE AREA (sq. ft.)	TREATMENT FLOW RATE (cfs)
MWS-L-4-4	4' x 4'	23	0.052
MWS-L-4-6	4' x 6'	32	0.073
MWS-L-4-8	4' x 8'	50	0.115
MWS-L-4-13	4' x 13'	63	0.144
MWS-L-4-15	4' x 15'	76	0.175
MWS-L-4-17	4' x 17'	90	0.206
MWS-L-4-19	4' x 19'	103	0.237
MWS-L-4-21	4' x 21'	117	0.268
MWS-L-6-8	6' x 8'	64	0.147
MWS-L-8-8	8' x 8'	100	0.230
MWS-L-8-12	8' x 12'	151	0.346
MWS-L-8-16	8' x 16'	201	0.462
MWS-L-8-20	8' x 20'	252	0.577
MWS-L-8-24	8' x 24'	302	0.693

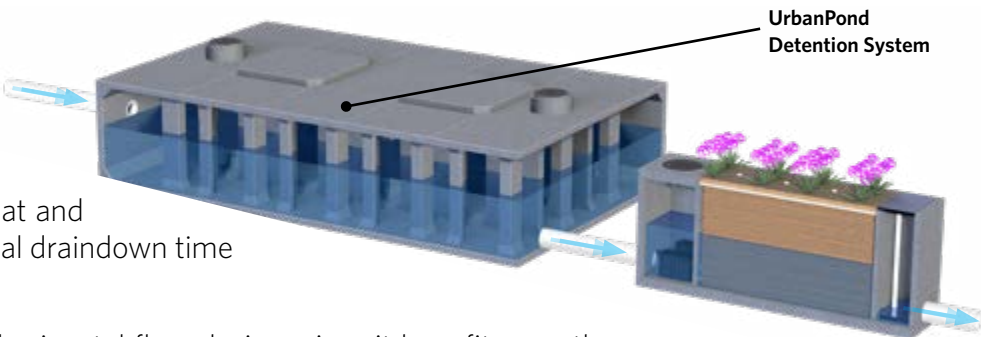
VOLUME-BASED DESIGNS

HORIZONTAL FLOW BIOFILTRATION ADVANTAGE



URBANPOND™ PRESTORAGE

In the example above, the Modular Wetlands Linear is installed downstream of the UrbanPond storage system. The Modular Wetlands Linear is designed for the water quality volume and will treat and discharge the required volume within local draindown time requirements.



The Modular Wetlands Linear's unique horizontal flow design, gives it benefits no other biofilter has - the ability to be placed downstream of detention ponds, extended dry detention basins, underground storage systems and permeable paver reservoirs. The system's horizontal flow configuration and built-in orifice control allows it to be installed with just 6" of fall between inlet and outlet pipe for a simple connection to projects with shallow downstream tie-in points.

DESIGN SUPPORT

Volume control and hydromodification regulations are expanding the need to decrease the cost and size of your biofiltration system. Bio Clean will help you realize these cost savings with the Modular Wetlands Linear. Bio Clean engineers are aware of state and local regulations, and they are trained to provide you with superior support, so they can optimize a system to maximize feasibility.

ADVANTAGES

- LOWER COST THAN FLOW-BASED DESIGN
- BUILT-IN ORIFICE CONTROL STRUCTURE
- MEETS LID REQUIREMENTS
- WORKS WITH DEEP INSTALLATIONS

APPLICATIONS

The Modular Wetlands® System 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 Modular Wetlands® 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 Modular Wetlands®. 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 Modular Wetlands® is very adaptable, and it 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 Modular Wetlands'® 4 ft. standard planter width allows for easy integration into parking lot islands and other landscape medians.



COMMERCIAL

Compared to bioretention systems, the Modular Wetlands® can treat far more area in less space, meeting treatment and volume control requirements.



MIXED USE

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

More applications include:

- Agriculture
- Reuse
- Low Impact Development
- Waste Water

PLANT SELECTION

Abundant plants, trees, and grasses bring value and an aesthetic benefit to any urban setting, but those in the Modular Wetlands® System 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 Modular Wetlands®, giving the plants more contact time so that pollutants are more successfully decomposed, volatilized, and incorporated into the biomass of the Modular Wetlands'® micro/macro flora and fauna.



A wide range of plants are suitable for use in the Modular Wetlands®, but selections vary by location and climate. View suitable plants by visiting biocleanenvironmental.com/plants.

INSTALLATION



The Modular Wetlands® 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 precast 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 is available to supervise installations and provide technical support.

MAINTENANCE



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

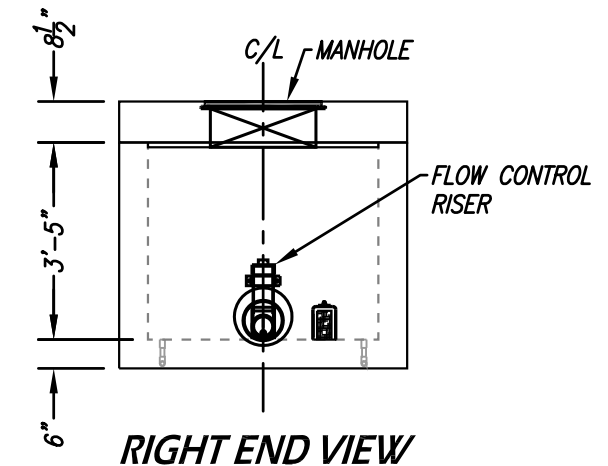
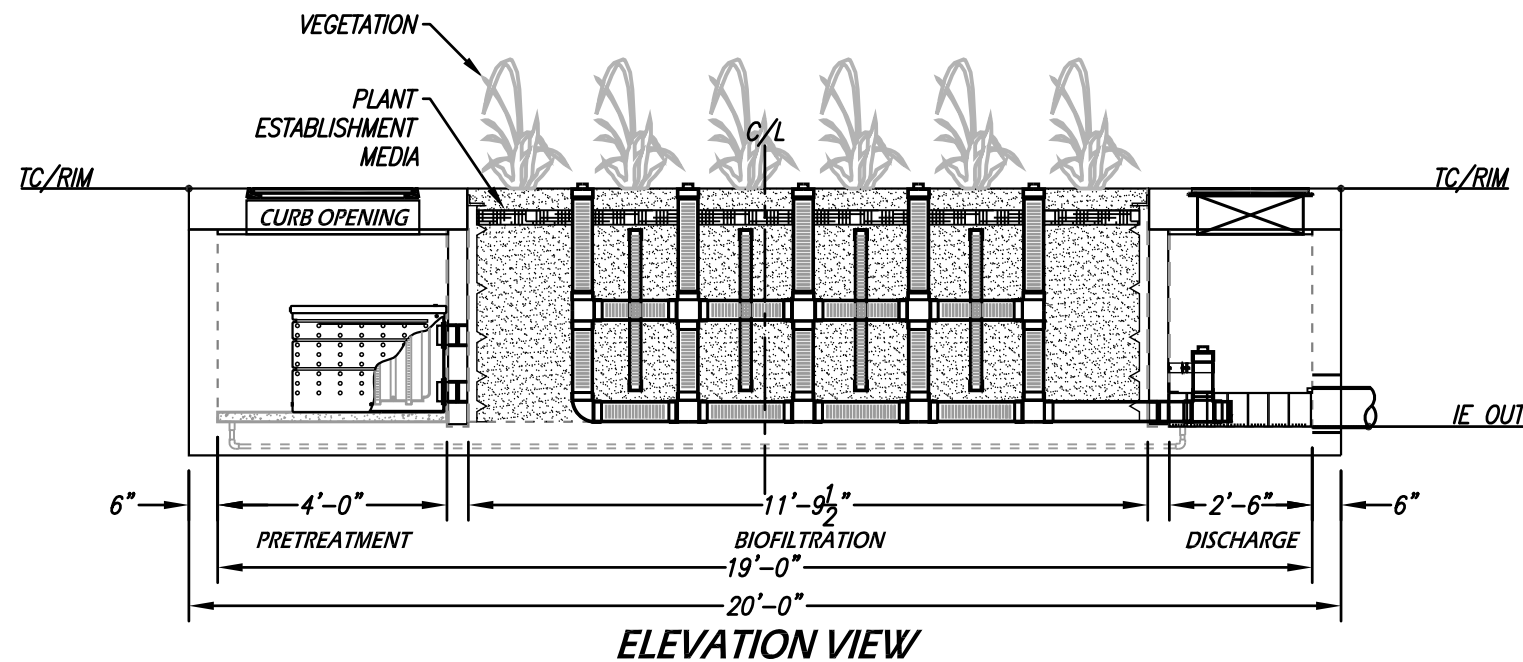
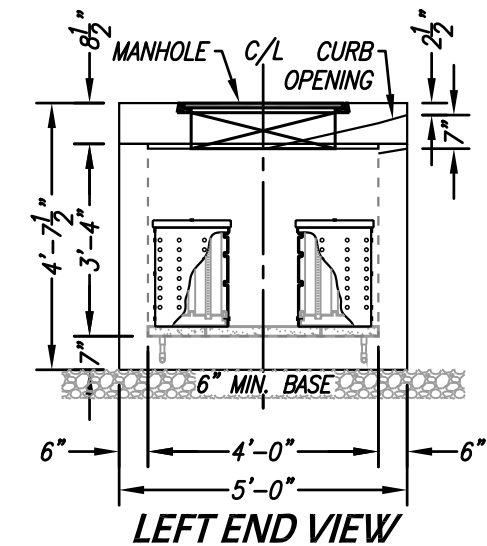
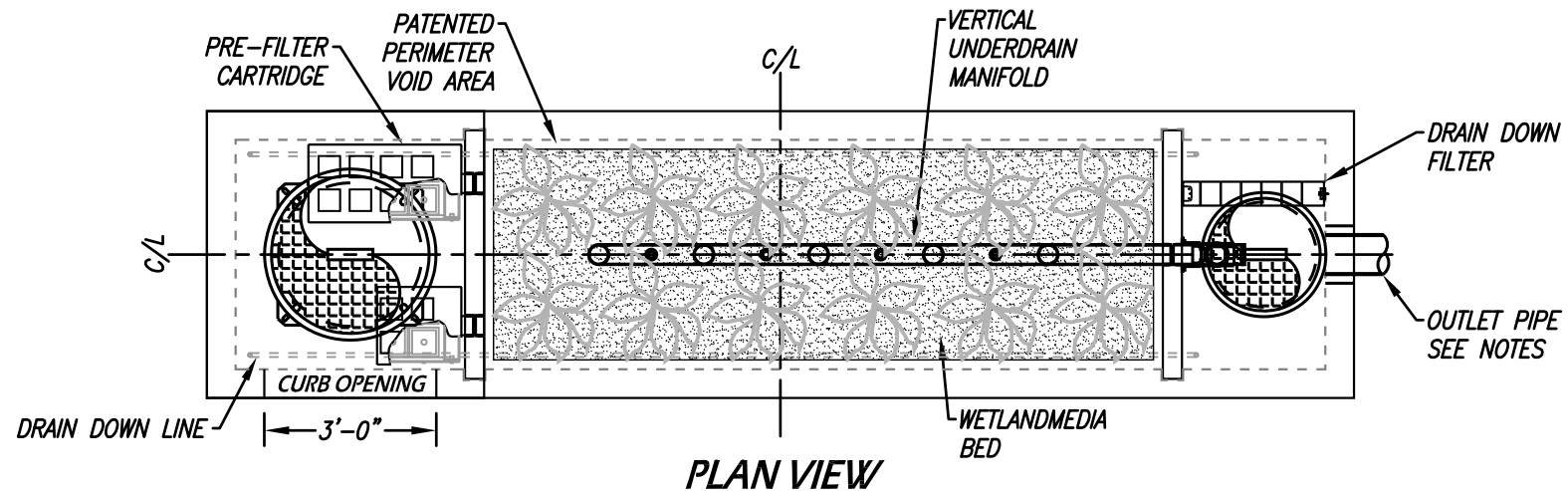
Maintenance requirements for the biofilter itself are almost completely eliminated, as the pretreatment chamber removes and isolates trash, sediments, and hydrocarbons. What's left is the simple maintenance of an easily accessible pretreatment chamber that can be cleaned by hand or with a standard vac 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.



Bio  Clean
A Forterra Company

398 Via El Centro
Oceanside, CA 92058
855.566.3938
stormwater@forterrabp.com
biocleanenvironmental.com

SITE SPECIFIC DATA			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) - IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PARKWAY	OPEN PLANTER	PARKWAY
FRAME & COVER	ø30"	N/A	ø24"
WETLANDMEDIA VOLUME (CY)	6.52		
WETLANDMEDIA DELIVERY METHOD	TBD		
ORIFICE SIZE (DIA. INCHES)	ø2.20"		
MAXIMUM PICK WEIGHT (LBS)	40000		
NOTES:			



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.
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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

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TREATMENT FLOW (CFS)	0.237
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

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MWS-L-4-19-C STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL



July 2017

GENERAL USE LEVEL DESIGNATION FOR BASIC, ENHANCED, AND PHOSPHORUS TREATMENT

For the

MWS-Linear Modular Wetland

Ecology's Decision:

Based on Modular Wetland Systems, Inc. application submissions, including the Technical Evaluation Report, dated April 1, 2014, Ecology hereby issues the following use level designation:

1. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Basic treatment

- Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

2. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Phosphorus treatment

- Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

3. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Enhanced treatment

- Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

4. Ecology approves the MWS - Linear Modular Wetland Stormwater Treatment System units for Basic, Phosphorus, and Enhanced treatment at the hydraulic loading rate listed above. Designers shall calculate the water quality design flow rates using the following procedures:

- □ Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
- □ Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
- □ Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.

5. These use level designations have no expiration date but may be revoked or amended by Ecology, and are subject to the conditions specified below.

Ecology's Conditions of Use:

Applicants shall comply with the following conditions:

1. □ Design, assemble, install, operate, and maintain the MWS – Linear Modular Wetland Stormwater Treatment System units, in accordance with Modular Wetland Systems, Inc. applicable manuals and documents and the Ecology Decision.
2. □ Each site plan must undergo Modular Wetland Systems, Inc. review and approval before site installation. This ensures that site grading and slope are appropriate for use of a MWS – Linear Modular Wetland Stormwater Treatment System unit.
3. □ MWS – Linear Modular Wetland Stormwater Treatment System media shall conform to the specifications submitted to, and approved by, Ecology.
4. □ The applicant tested the MWS – Linear Modular Wetland Stormwater Treatment System with an external bypass weir. This weir limited the depth of water flowing through the media, and therefore the active treatment area, to below the root zone of the plants. This GULD applies to MWS – Linear Modular Wetland Stormwater Treatment Systems whether plants are included in the final product or not.
5. □ Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a “one size fits all” maintenance cycle for a particular model/size of manufactured filter treatment device.

- □ Typically, Modular Wetland Systems, Inc. designs MWS - Linear Modular Wetland systems for a target prefilter media life of 6 to 12 months.
- □ Indications of the need for maintenance include effluent flow decreasing to below the design flow rate or decrease in treatment below required levels.
- □ Owners/operators must inspect MWS - Linear Modular Wetland systems for a minimum of twelve months from the start of post-construction operation to determine site-specific

maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.

- Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.
- When inspections are performed, the following findings typically serve as maintenance triggers:
 - Standing water remains in the vault between rain events, or
 - Bypass occurs during storms smaller than the design storm.
 - If excessive floatables (trash and debris) are present (but no standing water or excessive sedimentation), perform a minor maintenance consisting of gross solids removal, not prefilter media replacement.
 - Additional data collection will be used to create a correlation between pretreatment chamber sediment depth and pre-filter clogging (see *Issues to be Addressed by the Company* section below)

6. Discharges from the MWS - Linear Modular Wetland Stormwater Treatment System units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant: Modular Wetland Systems, Inc.
Applicant's Address: PO. Box 869
Oceanside, CA 92054

Application Documents:

- *Original Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., January 2011
- *Quality Assurance Project Plan: Modular Wetland system – Linear Treatment System performance Monitoring Project*, draft, January 2011.
- *Revised Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., May 2011
- *Memorandum: Modular Wetland System-Linear GULD Application Supplementary Data, April 2014*
- *Technical Evaluation Report: Modular Wetland System Stormwater Treatment System Performance Monitoring, April 2014.*

Applicant's Use Level Request:

General use level designation as a Basic, Enhanced, and Phosphorus treatment device in accordance with Ecology's Guidance for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) January 2011 Revision.

Applicant's Performance Claims:

- The MWS – Linear Modular wetland is capable of removing a minimum of 80-percent of TSS from stormwater with influent concentrations between 100 and 200 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 50-percent of Total Phosphorus from stormwater with influent concentrations between 0.1 and 0.5 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 30-percent of dissolved Copper from stormwater with influent concentrations between 0.005 and 0.020 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 60-percent of dissolved Zinc from stormwater with influent concentrations between 0.02 and 0.30 mg/l.

Ecology Recommendations:

- Modular Wetland Systems, Inc. has shown Ecology, through laboratory and field-testing, that the MWS - Linear Modular Wetland Stormwater Treatment System filter system is capable of attaining Ecology's Basic, Total phosphorus, and Enhanced treatment goals.

Findings of Fact:Laboratory Testing

The MWS-Linear Modular wetland has the:

- Capability to remove 99 percent of total suspended solids (using Sil-Co-Sil 106) in a quarter-scale model with influent concentrations of 270 mg/L.
- Capability to remove 91 percent of total suspended solids (using Sil-Co-Sil 106) in laboratory conditions with influent concentrations of 84.6 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 93 percent of dissolved Copper in a quarter-scale model with influent concentrations of 0.757 mg/L.
- Capability to remove 79 percent of dissolved Copper in laboratory conditions with influent concentrations of 0.567 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 80.5-percent of dissolved Zinc in a quarter-scale model with influent concentrations of 0.95 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 78-percent of dissolved Zinc in laboratory conditions with influent concentrations of 0.75 mg/L at a flow rate of 3.0 gpm per square foot of media.

Field Testing

- Modular Wetland Systems, Inc. conducted monitoring of an MWS-Linear (Model # MWS-L-4-13) from April 2012 through May 2013, at a transportation maintenance facility in Portland, Oregon. The manufacturer collected flow-weighted composite samples of the system's influent and effluent during 28 separate storm events. The system treated approximately 75 percent of the runoff from 53.5 inches of rainfall during the monitoring period. The applicant sized the system at 1 gpm/sq ft. (wetland media) and 3gpm/sq ft. (prefilter).
- Influent TSS concentrations for qualifying sampled storm events ranged from 20 to 339 mg/L. Average TSS removal for influent concentrations greater than 100 mg/L (n=7) averaged 85 percent. For influent concentrations in the range of 20-100 mg/L (n=18), the upper 95 percent confidence interval about the mean effluent concentration was 12.8 mg/L.
- Total phosphorus removal for 17 events with influent TP concentrations in the range of 0.1 to 0.5 mg/L averaged 65 percent. A bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean total phosphorus reduction was 58 percent.
- The lower 95 percent confidence limit of the mean percent removal was 60.5 percent for dissolved zinc for influent concentrations in the range of 0.02 to 0.3 mg/L (n=11). The lower 95 percent confidence limit of the mean percent removal was 32.5 percent for dissolved copper for influent concentrations in the range of 0.005 to 0.02 mg/L (n=14) at flow rates up to 28 gpm (design flow rate 41 gpm). Laboratory test data augmented the data set, showing dissolved copper removal at the design flow rate of 41 gpm (93 percent reduction in influent dissolved copper of 0.757 mg/L).

Issues to be addressed by the Company:

1. Modular Wetland Systems, Inc. should collect maintenance and inspection data for the first year on all installations in the Northwest in order to assess standard maintenance requirements for various land uses in the region. Modular Wetland Systems, Inc. should use these data to establish required maintenance cycles.
2. Modular Wetland Systems, Inc. should collect pre-treatment chamber sediment depth data for the first year of operation for all installations in the Northwest. Modular Wetland Systems, Inc. will use these data to create a correlation between sediment depth and pre-filter clogging.

Technology Description:

Download at <http://www.modularwetlands.com/>

Contact Information:

Applicant: Zach Kent
BioClean A Forterra Company.
398 Vi9a El Centro
Oceanside, CA 92058
zach.kent@forterrabp.com

Applicant website: <http://www.modularwetlands.com/>

Ecology web link: <http://www.ecy.wa.gov/programs/wg/stormwater/newtech/index.html>

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	Revision
June 2011	Original use-level-designation document
September 2012	Revised dates for TER and expiration
January 2013	Modified Design Storm Description, added Revision Table, added maintenance discussion, modified format in accordance with Ecology standard
December 2013	Updated name of Applicant
April 2014	Approved GULD designation for Basic, Phosphorus, and Enhanced treatment
December 2015	Updated GULD to document the acceptance of MWS-Linear Modular Wetland installations with or without the inclusion of plants
July 2017	Revised Manufacturer Contact Information (name, address, and email)



GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED CIRCLE K STORE AND REMAINDER PARCEL
NORTHEAST CORNER OF BASELINE ROAD AND
WESTBROOK BOULEVARD
ROSEVILLE, CALIFORNIA
Project Number: G71523.02

For:

Land Development Consultants
3281 E. Guasti Road, Suite 700
Ontario, CA 91761

March 31, 2021



March 31, 2021

G71523.02

Land Development Consultants
3281 E. Guasti Road, Suite 700
Ontario, CA 91761

Attention: Mr. Brett Smirl

Subject: **Geotechnical Engineering Investigation
Proposed Circle K Store and “Remainder Parcel”
Northeast Corner of Baseline Road and Westbrook Boulevard
Roseville, California**

Dear Mr. Smirl:

We are pleased to submit this geotechnical engineering investigation report prepared for the proposed Circle K to be located at the Northeast Corner of Baseline Road and Westbrook Boulevard in Roseville, California.

In addition, this report includes a summary of a limited investigation conducted within the “remainder parcel” that is not currently planned for any specific development.

The contents of this report include the purpose of the investigation, scope of services, background information, investigative procedures, our findings, evaluation, conclusions, and recommendations. It is recommended that those portions of the plans and specifications that pertain to earthwork, pavements, and foundations be reviewed by Moore Twining Associates, Inc. (Moore Twining) to determine if they are consistent with our recommendations. This service is not a part of this current contractual agreement; however, the client should provide these documents for our review prior to their issuance for construction bidding purposes.

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

**Geotechnical Engineering Investigation
Proposed Circle K Store and Remainder Parcel
Northeast Corner of Baseline Road and Westbrook Boulevard
Roseville, California
March 31, 2021**

G71523.02

Page No. 2

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

Sincerely,

MOORE TWINING ASSOCIATES, INC.



Zubair Anwar, PE
Project Engineer
Geotechnical Engineering Division



EXECUTIVE SUMMARY

Moore Twining Associates, Inc. (Moore Twining) prepared this geotechnical engineering investigation for the proposed Circle K store, on a site comprising about 2.178 acres of land at the Northeast Corner of Baseline Road and Westbrook Boulevard in Roseville, California. In addition, the site plan SP-6.1, revision dated February 18, 2020, prepared by Greenberg Farrow, Inc., shows a “Remainder Parcel” with an area of 6.407 acres that extends east and north of the proposed Circle K development.

Based on the referenced site plan, the Circle K development is planned to include a Circle K store building, a carwash, a fuel canopy, and underground storage tanks. The site plan indicates the proposed Circle K store will be about 5,187 square feet in plan area with a fueling canopy area about 6,429 square feet, a car wash building about 1,262 square feet, and underground storage tanks. Appurtenant construction is anticipated to include concrete walkways, asphaltic concrete and Portland cement concrete parking and drive areas, a trash enclosure, underground utilities, and landscaped areas.

At the time of our field exploration, the site area consisted of vacant field. The proposed Circle K parcel area was generally bare ground surface with scattered areas of weeds and grasses. Areas of scattered gravel, erosion control fabric, and small concrete debris fragments were noted on the ground surface.

On August 4 and 5, 2020, eleven (11) test borings (B-1 through B-11) and two percolation test borings (P-1 and P-2) were drilled at the site to depths ranging from about 5 to 31½ feet below site grades (BSG).

The soils encountered generally consisted of undocumented fill soils extending from the ground surface to depths of about 1 to 13½ feet BSG. The fill soils comprised of clayey sands, silty-clayey sand, silty sands and sandy lean clays. Below the fills soils, interbedded layer of native soils comprising silty sands, clayey sands, lean clays, sandy lean clays, silts, sandy silt, and poorly graded sand with silt were encountered to the maximum depth explored, about 31½ feet BSG. Many of the native soil samples in the upper 2 to 30 feet BSG exhibited varying degrees of cementation.

Undocumented fill soils were encountered in six (6) of the soil borings drilled within the Circle K parcel to depths ranging from about 3½ to 6⅓ feet BSG. In order to reduce the potential for excessive static settlement, as a part of site preparation the undocumented fill soils are recommended to be removed and recompacted. The structure are recommended to be supported on engineered fill.

The near surface soils encountered have very low to low expansion potential and fair support characteristics for pavements when compacted as engineered fill.

The results of soil sample analyses indicate that the near-surface soils exhibit an “extremely corrosive” corrosion potential to buried metal objects. In addition, the results of soil sample analyses indicated the soils exhibit a “negligible” potential for sulfate exposure to concrete.

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

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GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED CIRCLE K STORE AND REMAINDER PARCEL
NORTHEAST CORNER OF BASELINE ROAD AND WESTBROOK BOULEVARD
ROSEVILLE, CALIFORNIA

Project Number: G71523.02

1.0 INTRODUCTION

This report presents the results of a geotechnical engineering investigation for a proposed Circle K store to be located at the northeast corner of Baseline Road and Westbrook Boulevard in Roseville, California. Moore Twining Associates, Inc. (Moore Twining) was authorized by Land Development Consultants to perform this geotechnical engineering investigation.

The contents of this report include the purpose of the investigation and the scope of services provided. The site history, previous studies, site description, and anticipated construction are discussed. In addition, a description of the investigative procedures used and the subsequent findings obtained are presented. Finally, the report provides an evaluation of the findings, general conclusions, and related recommendations. The report appendices contain the drawings (Appendix A), the logs of borings (Appendix B), the results of laboratory tests (Appendix C) and the results of percolation tests (Appendix D).

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

2.0 PURPOSE AND SCOPE OF INVESTIGATION

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

- 2.1.1 Evaluation of the near surface soils within the zone of influence of the proposed foundations and pavements with regard to the anticipated foundation and traffic loads;
- 2.1.2 Recommendations for 2019 California Building Code seismic coefficients and earthquake spectral response acceleration values;
- 2.1.3 Geotechnical parameters for use in design of foundations and slabs-on-grade, (e.g., soil bearing capacity and settlement);
- 2.1.4 Recommendations for site preparation including placement, moisture conditioning, and compaction of engineered fill soils;

- 2.1.5 Recommendations for the design and construction of new asphaltic concrete (AC) and Portland cement concrete (PCC) pavements;
- 2.1.6 Recommendations for temporary excavations and trench backfill.
- 2.1.7 Conclusions regarding soil corrosion potential; and
- 2.1.8 A summary of geotechnical engineering conditions and any identified development constraints within the “remainder parcel” area.

This report is provided specifically for the Circle K store referenced in the Anticipated Construction section of this report. This investigation did not include a geologic/seismic hazards evaluation, flood plain investigation, percolation or infiltration tests, compaction tests, environmental investigation, or environmental audit. Details regarding the development planned in the “Remainder Parcel” were not known at the time of this investigation. This report is not intended to provide design recommendations for development in the areas outside of the Circle K improvements. When future development plans are developed for this area, Moore Twining should be contacted to develop a recommendation for the scope of geotechnical studies for proposed future development of the Remainder Parcel.

2.2 **Scope:** Our proposal, dated July 10, 2020, outlined the scope of our services. The actions undertaken during the investigation are summarized as follows.

- 2.2.1 The site plans SP-6.1 and SP-6.2, revision dated February 18, 2020, prepared by Greenberg Farrow, Inc., were reviewed.
- 2.2.2 The ALTA/NSPS Land Title Survey “Topo Sheet” 2 of 3, revision dated August 5, 2020, prepared by Base Consulting Group, Inc, was reviewed.
- 2.2.3 A report in progress entitled, “Phase I Environmental Site Assessment, Proposed Circle K Store, 5900 Baseline Road, Roseville, California 95747,” prepared by the Environmental Division at Moore Twining Associates, Inc., identified by project number G71523.01, was reviewed. Historical aerial photographs from the in progress report were reviewed for the following years for site history information pertinent to this investigation: 1937, 1947, 1952, 1957, 1966, 1972, 1975 1984, 1993, 1998, 2006, 2009, 2012, 2016 and 2019.
- 2.2.4 Satellite images of the site between the years 1993 and 2019 from online sources, were reviewed.

- 2.2.5 A visual site reconnaissance and subsurface exploration were conducted.
- 2.2.6 Laboratory tests were conducted to determine selected physical and engineering properties of the subsurface soils.
- 2.2.7 Mr. Brett Smirl (Land Development Consultants) was consulted during the investigation.
- 2.2.8 The data obtained from the investigation were evaluated to develop an understanding of the subsurface soil conditions and the engineering properties of the subsurface soils.
- 2.2.9 This report was prepared to present the purpose and scope, background information, field exploration procedures, findings, evaluation, conclusions, and recommendations.

3.0 BACKGROUND INFORMATION

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

3.1 Site History and Previous Studies: For site history information, historical aerial photographs from Moore Twining’s Phase I Environmental Site Assessment (ESA) report were reviewed for the following years: 1937, 1947, 1952, 1957, 1966, 1972, 1975, 1984, 1993, 1998, 2006, 2009, 2012, 2016 and 2019. Online satellite images from 1993 to 2019 were also reviewed.

The site appeared as undeveloped vacant land until about August of 2013 where the land appeared to be tilled and plowed. The image from October 2018 showed grading activity, trucks, construction equipment and a water pond on the west side of Westbrook Boulevard (not within the proposed Circle K Store parcel). The image from September of 2019 showed more grading activity and construction of Westbrook Boulevard.

It should be noted that historical aerial photographs for the years of 1947, 1952, 1957, 1966, 1972, 1975, 1984, 1993, 1998, 2006, 2009 and 2012, appear to show drainage feature traversing the site area.

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

3.2 Site Description: The proposed Circle K parcel comprises about 2.178 acres of land at the Northeast Corner of Baseline Road and Westbrook Boulevard in Roseville, California. In addition, the site plan SP - 6.1 and SP-6.2, revision dated February 18, 2020, prepared by Greenberg Farrow, Inc., shows a “Remainder Parcel” with an area of 6.407 acres that extends north and east of

the proposed Circle K development. A site location map is presented on Drawing No. 1 in Appendix A. The site is bound to the north by a screen wall and active construction and grading activities beyond; to the east by vacant land; to the south by Baseline Road; and to the west by the newly constructed Westbrook Boulevard.

At the time of our field exploration, the site area was vacant. The proposed Circle K parcel area was generally a bare ground surface with scattered areas of weeds and grasses. Areas of scattered gravel, erosion control fabric, and small fragments of concrete were noted on the ground surface. The remainder parcel area was mostly covered with weeds and grasses with areas of bare ground within the northern portion. In addition, the northern portion of the remainder parcel was being used for concrete pipe storage at the time of our site observations. An underground gas pipeline was noted on the south site boundary.

Site area was noted to be about 1 to 3 feet higher in elevation than Baseline Road and Westbrook Boulevard. The site appeared to have been graded previously and was relatively flat.

Areas of disturbed ground from construction activities associated with the adjoining Baseline Road and Westbrook Boulevard were noted within the west portion of the site. A large soil stockpile was noted near the northeast site boundary and a second large soil stockpile was noted near the southeast site boundary.

3.3 Anticipated Construction: Based on the referenced site plan, the Circle K development is planned to include a Circle K store building, carwash, a fuel canopy, and underground storage tanks. The site plan indicates the proposed Circle K store will be about 5,187 square feet in plan area with a fueling canopy area of about 6,429 square feet, a car wash building of about 1,262 square feet, and underground storage tanks. Appurtenant construction is anticipated to include concrete walkways, asphaltic concrete and Portland cement concrete parking and drive areas, a trash enclosure, underground utilities, and landscaped areas.

It is anticipated that the proposed Circle K structure will consist of a one-story building including concrete masonry unit wall construction with concrete slab-on-grade floors. It is anticipated that the proposed building will be supported on shallow foundation systems. The fuel canopy is anticipated to be supported on a cast-in-drilled-hole foundation. Basements and loading docks are not anticipated as part of the proposed construction. In addition, we understand storm water infiltration systems are being considered as part of the proposed construction.

For the purpose of this report, maximum column loads of about 40 kips and maximum perimeter wall loads of 3 kips per linear foot were assumed. The actual design foundation loads should be provided to Moore Twining when available. In the event that the maximum foundation loads exceed those assumed for design, the recommendations of this report may not be applicable and may need to be revised.

Details regarding the development planned in the "Remainder Parcel" were not known at the time of this investigation.

4.0 INVESTIGATIVE PROCEDURES

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

4.1 Field Exploration: The field exploration consisted of a site reconnaissance, drilling test borings, soil sampling and percolation testing. Prior to drilling, a test soil boring permit was obtained from the City of Roseville Environmental Utilities Technical Services department.

4.1.1 Site Reconnaissance: The site reconnaissance consisted of walking the site and noting visible surface features. The reconnaissance was conducted by Mr. Zubair Anwar (Professional Engineer) of Moore Twining on August 4 and 5, 2020. The features noted are described in the background information section of this report.

4.1.2 Drilling Test Borings: Prior to drilling, the site was marked for Underground Service Alert for members to mark out the locations of existing public utilities.

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

On August 4 and 5, 2020, eleven (11) test borings (B-1 through B-11) and two percolation test borings (P-1 and P-2) were drilled at the site to depths ranging from about 5 to 41½ feet below site grades (BSG). The borings were drilled with a conventional truck-mounted CME-75 drill rig equipped with 6⅝-inch and the percolation tests were drilled using a 8-inch outside diameter (O.D.) hollow-stem augers. The test borings and percolation test borings drilled within the proposed Circle K development and within the remainder parcel are shown on Drawing No. 2 in Appendix A of this report.

During the drilling of the test borings, bulk samples of soil were obtained for laboratory testing. The test borings were drilled under the direction of and logged during drilling by a Moore Twining professional engineer. The field soil classification was in accordance with the Unified Soil Classification System and consisted of particle size, color, and other distinguishing features of the soil.

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

Test boring locations were determined with reference to existing site features shown on the site plan. The locations of the test borings are described on the boring logs in Appendix B. The test borings were backfilled with neat cement grout and the excess soil cuttings were spread near the boring locations.

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

The standard penetration resistance, N-value, is defined as the number of blows required to drive a standard split barrel sampler into the soil. The standard split barrel sampler has a 2-inch O.D. and a 1 $\frac{3}{8}$ -inch inside diameter (I.D.). The sampler is driven by a 140-pound weight free falling 30 inches. The sampler is lowered to the bottom of the bore hole and set by driving it an initial 6 inches. It is then driven an additional 12 inches and the number of blows required to advance the sampler the additional 12 inches is recorded as the N-value.

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

4.1.4 Percolation Tests: Percolation tests were conducted on August 5, 2020. Percolation test borings P-1 and P-2 were drilled to a depth of about 5 $\frac{1}{2}$ and 9 feet BSG, respectively, on August 4, 2020. Three (3) of the other borings were drilled at the site to depths of 21 $\frac{1}{2}$ to 31 $\frac{1}{2}$ feet BSG prior to drilling the percolation test holes within the proposed Circle K store site area to determine if there were any potential favorable soil layers to target for the percolation tests. However, no favorable soil layers were encountered.

The percolation tests for P-1 and P-2 were conducted by adding water to the percolation test holes and measuring the decline in the water level in the holes over time. The test holes were cylindrical with a diameter of about 8 inches. Gravel packing was used to protect the sidewalls of the hole from washout during refilling. A 2-inch diameter perforated PVC pipe was placed over a thin layer of gravel in the borehole and used to transmit poured water to the bottom of the hole. On the day prior to the start of the percolation testing, the percolation test hole was presoaked with 26 inches of water in P-1 and about 20 inches of water in P-2. The presaturation water in the both percolation test holes had completely seeped away by the next morning. Water was added to both percolation test holes on the morning of August 5, 2020 prior to beginning the percolation tests. The percolation tests were conducted for about 2 hours by measuring the drop in water level over time. Measurements of water levels and the time of each reading were recorded on the field percolation test logs. The rate of water level decline near the end of the test period (generally stabilized) was used to estimate the average stabilized percolation rate of the soils tested. The head of the water in the test hole during the percolation test was generally about 12 inches when refilling the water level in percolation test P-1, and about 20 inches in percolation test P-2.

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

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

5.0 FINDINGS AND RESULTS

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

5.1 Soil Profile: The soils encountered generally consisted of near surface fill soils extending from the ground surface to depths of about 1 to 13½ feet BSG. The fill soils comprised clayey sands, silty-clayey sand, silty sands and sandy lean clays. Below the fill soils, interbedded layers of native soils comprising silty sands, clayey sands, lean clays, sandy lean clays, silts, sandy silt, and poorly graded sand with silt were encountered to the maximum depth explored, about 31½ feet BSG.

Many of the native soil samples exhibited varying degrees of cementation.

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

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

FILL - Clayey Sand and Silty, Clayey Sand Fill Soils: The clayey sand and silty, clayey sand fill soils encountered were described as medium dense to very dense, as indicated by standard penetration resistance, N-values, ranging from 13 to 55 blows per foot. The moisture content of the samples tested ranged from about 4 to 14 percent. An Atterberg Limits test conducted on a clayey sand sample indicated a liquid limit of 23 and a plasticity index of 5. An Atterberg Limits test conducted on a silty, clayey sand sample indicated a liquid limit of 27 and a plasticity index of 6. A consolidation test conducted on a sample collected from depths of about 5 to 6.3 feet BSG from boring B-3 indicated low compressibility characteristics (about 4.6 percent consolidation under a load of 16 kips per square foot). Upon inundation, the sample exhibited free swell (0.4 percent swell when wetted under a load of 2 kips per square foot).

FILL - Sandy Lean Clay Fill Soils: The sandy lean clay fill soils encountered were described as stiff to very stiff, as indicated by standard penetration resistance, N-values, ranging from 12 to 23 blows per foot.

FILL - Silty Sand Fill Soils: The silty sand fill soils encountered were described as loose to medium dense, as indicated by standard penetration resistance, N-values, ranging from 7 to 21 blows per foot. The moisture content of a samples tested ranged from about 11 to 26 percent. A relatively undisturbed sample revealed a dry density of 101.6 pounds per cubic foot.

NATIVE - Sandy Lean Clay and Lean Clay Soils: The sandy lean clay and lean clay soils encountered were described as very stiff to hard, as indicated by standard penetration resistance, N-values, ranging from 21 to greater than 80 blows per foot. The moisture content of the samples tested ranged from about 7 to 41 percent. Three (3) relatively undisturbed samples revealed dry densities of 87.8, 111.7 and 116.4 pounds per cubic foot. Two (2) Atterberg Limits test indicated liquid limits of 31 and 25 with corresponding plasticity index values of 12 and 9. A consolidation test conducted on a sample collected from depths of about 6 $\frac{1}{3}$ to 6 $\frac{1}{2}$ feet BSG from boring B-1 indicated moderate compressibility characteristics (about 5 percent consolidation under a load of 8 kips per square foot). Upon inundation, the sample exhibited 0.8 percent collapse when wetted under a load of 2 kips per square foot.

NATIVE - Silty Sand Soils: The silty sand soils encountered were described as medium dense to very dense, as indicated by standard penetration resistance, N-values, ranging from 15 to greater than 50 blows per foot. The moisture content of the samples tested ranged from about 12 to 19 percent.

NATIVE - Clayey Sand Soils: The clayey sand soils encountered were described as medium dense to dense as indicated by standard penetration resistance, N-values, ranging from 22 to 55 blows per foot. An Atterberg Limits test indicated a liquid limit of 27 and a plasticity index of 6.

NATIVE - Silt and Sandy Silt Soils: The silt and sandy silt soils encountered were described as stiff to hard, as indicated by standard penetration resistance, N-values, ranging from 26 to greater than 80 blows per foot. The moisture content of the samples tested ranged from about 19 to 25 percent. Two (2) relatively undisturbed samples revealed dry densities of 93.5 and 93.9 pounds per cubic foot. Atterberg Limits testing conducted on a sandy silt sample indicated a liquid limit of 35 and a plasticity index of 5. A consolidation test conducted on a sample collected from depths of about 8 $\frac{1}{2}$ to 10 feet BSG from boring B-5 indicated low compressibility characteristics (about 3.1 percent consolidation under a load of 8 kips per square foot).

NATIVE - Poorly Graded Sand with Silt: The poorly grade sands encountered were described as dense, as indicated by a standard penetration resistance, N-value, of 31 blows per foot.

Expansion Index Tests: Expansion index tests were conducted on samples collected in the upper 3 $\frac{1}{2}$ feet BSG from borings B-1 and boring B-4 indicated expansion index values of 21 and 1, respectively.

Loss-On-Ignition Test: A loss on ignition test performed on a clayey sand fill soil sample from boring Boring B-3 at a depth of from 5 to 6.3 feet BSG indicated an organic content of 2.3 percent. A loss on ignition test performed on a silty sand fill soil sample from boring Boring B-10 at a depth of from 5 to 5 $\frac{1}{2}$ feet BSG indicated an organic content of 1.6 percent.

R-value Test: An R-value test conducted on a near surface sandy lean clay sample collected from depths of about 0 to 3 $\frac{1}{2}$ feet BSG from boring B-6 resulted in an R-value of 31.

Chemical Tests: Chemical tests performed on a near surface soil sample collected from depths of 0 to 3½ feet BSG from boring B-1 resulted in a pH value of 7.1; a minimum resistivity value of 690 ohms-centimeter; 0.00094 percent by weight concentration of sulfate; and less than 0.00060 percent by weight concentration of chloride. Chemical tests performed on a near surface soil sample collected from depths of 0 to 3½ feet BSG from boring B-4 resulted in a pH value of 6.3; a minimum resistivity value of 5,800 ohms-centimeter; less than 0.00060 percent by weight concentration of sulfate; and less than 0.00060 percent by weight concentration of chloride.

5.3 Groundwater Conditions: Groundwater was not encountered in the test borings drilled at the time of our August 4 and 5, 2020 field exploration to the maximum depth explored, about 31½ feet BSG.

Based on our review of the California Department of Water Resources, Water Data Library System, two water level stations northwest and northeast of the subject site indicate that groundwater in the site vicinity has ranged between 131.15 feet and 125.65 feet BSG between October 1, 2011 and April 15, 2020, respectively.

Due to the presence of cemented soils and zones of fill, seasonal perched water conditions can develop.

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

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

Table No. 1
Results of Percolation Testing

Location and Depth	Field (Unfactored) Infiltration Rate (Inches per Hour)¹	Subgrade Soil Type
P-1 at 5½ feet BSG	0.2	Silty Sand and Lean Clay
P-2 at 9 feet BSG	0	Lean Clay

Notes:

BSG - Below site grade

¹ - Includes no factor of safety

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

6.0 EVALUATION

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

6.1 Existing Surface and Subsurface Conditions: At the time of our field investigation, the proposed Circle K parcel area was generally bare ground surface with scattered areas of weeds and grasses. The remainder parcel area was mostly covered with weeds and grasses with areas of bare ground surface within the northern portion. Some construction materials (concrete pipe) and stockpiles of soil were noted at the site.

As part of site grading, existing vegetation will need to be stripped to the depth required to remove root structures. These materials will not be considered suitable for reuse as engineered fill. Trash (if any) and unsuitable debris (if any) should also be removed from the site and not included with soils to be used as engineered fill.

The undocumented fill soils encountered during this investigation are recommended for support of future structures (see section 6.2 for detailed discussion of undocumented fill soils).

Cemented native soils were encountered in many of the borings at various depths. Where encountered, the cemented material will require additional processing to reduce maximum particle size to no greater than 3 inches and mix the hardpan fragments with the soils. The processed material should be well blended with the on-site materials to achieve a well-graded fill material.

6.2 Undocumented Fill Soils: Undocumented fill soils were encountered in six (6) of the soil borings drilled within the Circle K parcel to depths ranging from about 3½ to 6⅓ feet BSG. In addition, the borings drilled within the remainder parcel encountered fill soils to depths of about 1 to 8 feet BSG, with exception that one (1) of the borings encountered fill soils to a depth of about 13½ feet BSG. The approximate depth of fill encountered in the various borings is depicted on Drawing No. 2 in Appendix A of this report.

Based on our review of the pre-grading topographic survey provided by Mr. Brett Smirl (Land Development Consultants) on September 10, 2020, the site elevations within the Circle K Store parcel range from about 95 feet to 99 feet and 94 feet to 105 feet within areas north and east of the proposed Circle K development. Based on our review of the ALTA/NSPS Land Title Survey "Topo Sheet" 2 of 3, revision dated August 5, 2020, prepared by Base Consulting Group, Inc.; the existing site elevations at the time of our investigation ranged from about 100 feet to 102 feet within the Circle K Store parcel and 102 feet to 104 feet within areas north and east of the proposed Circle K development. The fill depths reported in this report are based on review of site elevations from the topographic maps provided and soil encountered in the test borings drilled at the subject site.

Based on the wide range of the N-values determined from standard penetration testing and the presence of some zones of organics (such as Boring B-3 at a depth of about 5 feet), the fill soils encountered are considered to be undocumented and not recommended for support of future structures. Therefore, as a part of site preparation, the undocumented fill soils will require removal and recompaction to support future structures.

The ground surface conditions visually indicate grading has been performed in the site area to create a relatively flat site for development. Historic topographic maps indicate the natural topography is rolling terrain with some low areas within the site.

The fill soils are generally anticipated to be suitable for reuse as engineered fill on the project; however, some organics were noted in several samples, such as Boring B-3 at a depth of about 5 feet BSG (organic odors and grass) and Borings B-9 and B-10 at depths of about 5 feet BSG (rootlets and grass). Where organics are encountered, these materials should be removed from soils to be used as engineered fill.

6.3 Expansive Soils: In evaluation of the potential for expansive soils at the site, expansion index testing was performed on representative samples of the near surface soils which are anticipated to be within the zone of influence of the planned improvements. In evaluation of the potential for expansive soils at the site, expansion index testing was performed on a representative sample of the near surface soils which are anticipated to be within the zone of influence of the planned improvements. The expansion index testing was performed in accordance with ASTM D4829 and the results are included in Appendix C of this report. The result of expansion index testing indicated that the near surface soils have a very low to low expansion potential based on expansion index values of 1 and 21. Thus, expansive soil concerns within the near surface soils are generally not anticipated. However, due to the extent of grading, there is a potential that zones of expansive soils will be encountered such as in deeper excavations or as part of excavation of undocumented fill soils. Where encountered, expansive soils with an expansion index of 30 or more should not be used as fill in building pad areas. These materials should be segregated and used outside of the building pad areas.

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

In order to limit the total and differential static settlement of foundations to 1 inch total and ½ inch differential in 40 feet, this report recommends removal of undocumented fill soils from past grading activities in order to support new foundations on compacted engineered fill soils. Provided the building pad and foundation areas are prepared in accordance with the recommendations included in this report, a net allowable soil bearing pressure of 2,500 pounds per square foot, for dead-plus-live loads, may be used for design.

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

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

6.5 Seismic Ground Rupture and Design Parameters: The project site is not located in an Alquist-Priolo Earthquake Fault Zone. Accordingly, the potential for ground rupture at the site is considered low.

It is our understanding that the 2019 CBC will be used for structural design, and that seismic site coefficients are needed for design.

Based on the 2019 CBC, a Site Class D represents the on-site soil conditions with standard penetration resistance, N-values, averaging between 15 and 50 blows per foot in the upper 100 feet below site grade.

A table providing the recommended seismic coefficients and earthquake spectral response acceleration values for the project site is included in the Foundation Recommendations section of this report. A Maximum Considered Earthquake (geometric mean) peak ground acceleration adjusted for site effects (PGA_M) of 0.279g was determined for the site using the Ground Motion Parameter Calculator provided by the Structural Engineers Association of California website (<https://seismicmaps.org/>).

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

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

Based on the results of the testing included in this report, the procedures of the Caltrans Highway Design Manual, an R-value of 25 was used to provide the pavement section thickness recommendations.

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

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

The pavement sections were prepared based on traffic indexes ranging from 5 to 7. The recommended structural sections were based primarily on the Portland Cement Association "Thickness Design of Highway and Street Pavements." A modulus of subgrade reaction, K-value, for the pavement section, considering a minimum 6-inch layer of aggregate base material (minimum R-value of 78), of 180 psi/in at the top of the aggregate base was used for pavement design.

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

Soils make up a complex environment for potential metallic corrosion. The corrosion potential of a soil depends on numerous factors including soil resistivity, texture, acidity, field moisture and chemical concentrations. In order to evaluate the potential for corrosion of metallic objects in

contact with the onsite soils, chemical testing of soil samples was performed by Moore Twining as part of this report. The test results are included in Appendix C of this report. Conclusions regarding the corrosion potential of the soils tested are included in the Conclusions section of this report based on the National Association of Corrosion Engineers (NACE) corrosion severity ratings listed in the Table No. 2 below.

**Table No. 2
Soil Resistivity and Corrosion Potential Ratings**

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

The results of soil sample analyses indicate that the near-surface soils exhibit “moderately corrosive” to “extremely corrosive” corrosion potential to buried metal objects. Appropriate corrosion protection should be provided for buried improvements based on the “extremely corrosive” corrosion potential. If piping or concrete are placed in contact with imported soils, these soils should be analyzed to evaluate the corrosion potential of these soils.

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

6.9 Sulfate Attack of Concrete: Degradation of concrete in contact with soils due to sulfate attack involves complex physical and chemical processes. When sulfate attack occurs, these processes can reduce the durability of concrete by altering the chemical and microstructural nature of the cement paste. Sulfate attack is dependent on a variety of conditions including concrete quality, exposure to sulfates in soil/groundwater and environmental factors. The standard practice for geotechnical engineers in evaluation of the soils anticipated to be in contact with concrete is to perform testing to determine the sulfates present in the soils. The test results are then compared with the provisions of ACI 318, section 4.3 to provide guidelines for concrete exposed to sulfate-containing solutions. Common methods used to resist the potential for degradation of concrete due to sulfate attack from soils include, but are not limited to the use of sulfate-resisting cements, air-entrainment and reduced water to cement ratios. The test results are included in Appendix C of this report. Conclusions regarding the sulfate test results are included in the Conclusions section of this report.

The soil corrosion data should be provided to the manufacturers or suppliers of materials that will be in contact with soils (pipes or ferrous metal objects, etc.) to provide assistance in selecting the protection and materials for the proposed products or materials. If the manufacturers or suppliers cannot determine if materials are compatible with the soil corrosion conditions, a professional consultant, i.e., a corrosion engineer, with experience in corrosion protection should be consulted to provide design parameters.

7.0 CONCLUSIONS

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

- 7.1 The site is considered suitable for the proposed construction with regard to support of the proposed improvements, provided the recommendations contained in this report are followed. It should be noted that the recommended design consultation and observation of clearing, and earthwork activities by Moore Twining are integral to this conclusion.
- 7.2 The soils encountered generally consisted of undocumented fill soils extending from the ground surface to depths of about 1 to 13½ feet BSG. The fill soils consisted of clayey sands, silty-clayey sand, silty sands and sandy lean clays. Below the fill soils, interbedded layers of native soils comprising silty sands, clayey sands, lean clays, sandy lean clays, silts, sandy silt, and poorly graded sand with silt were encountered to the maximum depth explored, about 31½ feet BSG.
- 7.3 Undocumented fill soils were encountered in six (6) of the soil borings drilled within the Circle K parcel to depths ranging from about 3½ to 6⅓ feet BSG. Undocumented fill soils were encountered to a depth of 3½ feet BSG within the Circle K store building. In addition, the borings drilled within the remainder parcel encountered fill soils to depths of about 1 to 8 feet BSG, with exception that one (1) of the borings encountered fill soils to a depth of about 13½ feet BSG. The approximate depth of fill encountered in the various borings is depicted on Drawing No.2 in Appendix A of this report. Based on the wide range of the N-values determined from standard penetration testing and the presence of some zones of organics (such as Boring B-3 at a depth of about 5 feet), the fill soils encountered are considered to be undocumented and not recommended for support of future structures. Therefore, as a part of site preparation, this report recommends removal and recompaction of the undocumented fill soils in areas where improvements are planned that are sensitive to settlement.
- 7.4 The near surface soil samples tested exhibited a very low to low expansion potential and fair support characteristics for pavements when compacted as engineered fill.

- 7.5 Groundwater was not encountered in the test borings drilled at the time of our August 4 and 5, 2020 field exploration to the maximum depth explored, about 31½ feet BSG.
- 7.6 In order to limit the total and differential static settlement of foundations to 1 inch total and ½ inch differential in 40 feet, this report recommends removal of undocumented fill soils from past grading activities and supporting new foundations on compacted engineered fill soils
- 7.7 The results of the percolation tests conducted at depths of 5 and 9 indicated infiltration rates of 0.2 and 0 inches per hour, respectively. Due to the low permeability and expansive nature of the near surface soils, infiltration of storm water at the site is not recommended.
- 7.8 Chemical testing of soil samples indicated the soils exhibit a “moderately corrosive” to “extremely corrosion” corrosion potential.
- 7.9 Chemical analyses indicated a “negligible” potential for sulfate attack on concrete placed in contact with the near surface soils.
- 7.10 The project site is not located in an Alquist-Priolo Earthquake Fault Zone. Accordingly, the potential for ground rupture at the site is considered low.
- 7.11 The “remainder parcel” area outside of the limits of the proposed Circle K parcel encountered similar soil conditions that were encountered in the Circle parcel. Development constraints include removal and recompaction of existing undocumented fill.

8.0 RECOMMENDATIONS

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

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

8.1 General

- 8.1.1 Moore Twining should be retained to review the final grading plans and foundation plans before the plans are released for bidding purposes so that any relevant recommendations can be presented.
- 8.1.2 When the actual foundation loads are known, this information should be provided to Moore Twining for review to confirm the recommendations for site preparation are appropriate. In the event the foundation loads are different than assumed, the recommendations in this report may need to be revised.
- 8.1.3 A preconstruction meeting including, as a minimum, the owner, general contractor, earthwork contractor, foundation and paving subcontractors, and Moore Twining should be scheduled by the general contractor at least one week prior to the start of clearing and grubbing. The purpose of the meeting should be to discuss critical project requirements and scheduling.
- 8.1.4 The Contractor(s) bidding on this project should determine if the information included in the construction documents are sufficient for accurate bid purposes. If the data are not sufficient, the Contractor should conduct, or retain a qualified geotechnical engineer to conduct, supplemental studies and collect information as required to prepare accurate bids.
- 8.1.5 The fill soils encountered in the borings drilled for this investigation are considered to be undocumented and are not recommended for support of future structures. Therefore, as a part of site preparation, the undocumented fill soils will require removal and recompaction to support future structures. In the event documents such as grading plans showing previous site grading or other documentation such as earthwork inspection reports for the site are available, this information should be provided to Moore Twining for review and consideration. In the event no additional information is available regarding the depth and nature of the fill soils, a supplement backhoe pit investigation could be conducted to further evaluate the depth and character of the undocumented fill soils, including the organic materials noted at some of the sample depths.
- 8.1.6 This report is not intended to provide design recommendations for development of the "Remainder Parcel" outside of the Circle K improvements. When future development plans are developed for this area, Moore Twining should be contacted to develop a recommendation for the scope of geotechnical studies for proposed future development of the Remainder Parcel.

- 8.1.7 If construction occurs during the wet season, the onsite soils could become unstable. Where wet, unstable soil conditions are experienced, methods such as aeration, mixing wet soils with drier soils, chemical (i.e., cement) treatment of the soil, or over-excavation of an additional depth of 12 inches and placement of a bridge lift of aggregate base and a geotextile stabilization fabric such as Mirafi 600X, may be required to achieve a stable soil condition. The actual method employed to stabilize the bottom of the excavation or pavement subgrade should be selected at the time of construction. All stabilization of wet soils should be conducted in accordance with the project specifications.

8.2 Site Grading and Drainage

- 8.2.1 Shallow, hard or very dense cemented soils were encountered in some of the borings at the site which will increase the potential for perched water from surface irrigation and stormwater sources that infiltrate the near surface soils. Due to the low permeability of the cemented materials, water may infiltrate and result in a perched condition, ponding and migrating laterally over the top of the hardpan materials. Perched water will reduce the drainage capacity of the soils, increasing the potential for moisture-related problems. Therefore, providing and maintaining positive drainage systems, limiting irrigation use, etc. will be important aspects of design and site development to reduce the potential for moisture-related problems.
- 8.2.2 It is critical to develop and maintain site grades which will drain surface and roof runoff away from foundations and floor slabs - both during and after construction. Adjacent exterior finished grades should be sloped a minimum of two percent for a distance of at least ten feet away from the structures, or as necessary to preclude ponding of water adjacent to foundations, whichever is more stringent. Adjacent exterior grades which are paved should be sloped at least 1 percent away from the foundations.
- 8.2.3 It is recommended that landscape planted areas, etc. not be placed adjacent to the building foundations and/or interior slabs-on-grade. Trees should be setback from the proposed structures at least 10 feet or a distance equal to the anticipated drip line radius of the mature tree. For example, if a tree has an anticipated drip-line diameter of 30 feet, the tree should be planted at least 15 feet away (radius) from proposed or existing buildings.
- 8.2.4 Landscaping after construction should direct rainfall and irrigation runoff away from the structures and should establish positive drainage of water away from the structures. Care should be taken to maintain a leak-free sprinkler system.

- 8.2.5 Landscape and planter areas should be irrigated using low flow irrigation (such as drip, bubblers or mist type emitters). The use of plants with low water requirements are recommended.
- 8.2.6 Rain gutters and roof drains should be provided, and connected directly to the site storm drain system. As an alternative, the roof drains should extend a minimum of 5 feet away from the structures and the resulting runoff directed away from the structures on paved surfaces at a minimum of 2 percent.
- 8.2.7 Due to the low permeability and expansive nature of the near surface soils, infiltration of storm water at the site is not recommended for this site. In the event subsurface storm water collection systems, bioretention systems or similar designs that allow concentrated runoff to wet the soils are planned, the proposed locations and details of these features should be provided to Moore Twining for review and comment. If these types of features are required, sufficient setbacks to existing improvements should be maintained such as a minimum 20 foot setback to planned foundations, unless the systems are fully lined with a waterproof liner. In addition, specific measures such as deepened curbs, perimeter cutoffs, liners, etc. should be incorporated in the designs to reduce the potential for excessive movement of other adjacent improvements due to moisture, concentrated wetting, and freewater migration from storm water disposal systems.

8.3 Site Preparation

- 8.3.1 Stripping should be conducted in all areas of existing improvements to remove surface vegetation and root systems (if any). The general depth of stripping should be sufficiently deep to remove the root systems and organic topsoils.
- 8.3.2 After stripping, the building pad area for the Circle K store and carwash and over-build zones should be over-excavated to a minimum of 1 foot below the bottom of footings, to at least 3½ feet below preconstruction site grades and to the depth required to remove all undocumented fill soils (encountered to depths of 3½ to 6⅓ feet BSG), whichever is greater. The horizontal limits of over-excavation should include the footprint of the building, all foundations, all concrete walkways adjacent to the building, and a minimum of 5 feet beyond these features, whichever is greater. Upon review of the Contractor's survey data (documenting the vertical and horizontal limits of the over-excavation) and approval of the over-excavation by Moore Twining, the bottom of the excavation should be scarified to a depth of 8 inches, moisture conditioned, and compacted as engineered fill.

- 8.3.3 The horizontal limit of over-excavation for the building pad should be depicted on the project plans.
- 8.3.4 It is recommended that extra care be taken by the contractor to ensure that the horizontal and vertical extent of the over-excavation and compaction conform to the site preparation recommendations presented in this report. Moore Twining is not responsible for measuring and verifying the horizontal and vertical extent of over-excavation and compaction. The contractor should verify in writing to the owner and Moore Twining that the horizontal and vertical over-excavation limits were completed in conformance with the recommendations of this report, the project plans, and the specifications (the most stringent applies). It is recommended that this verification be performed by a licensed surveyor. This verification should be provided prior to requesting pad certification from Moore Twining or excavating for foundations.
- 8.3.5 Following stripping, areas to receive miscellaneous lightly loaded foundations with a line load of less than 1.5 kips per foot, such as site walls and short retaining walls, should be over-excavated to at least 12 inches below the bottom of foundations, to at least 2 feet below preconstruction site grades and to the depth necessary to remove undocumented fill soils (encountered to depths of 3½ to 6⅓ feet BSG) and to at least 12 inches below subsurface improvements (structures, utilities, etc.) to be removed (if any), whichever is greater. The over-excavation for retaining walls/screen walls should extend to at least 3 feet beyond the edges of the foundations. The bottom of the over-excavation should be scarified to a depth of 8 inches, moisture conditioned and compacted as engineered fill.
- 8.3.6 Following stripping, removal of surface and subsurface improvements, areas to receive new pavements, exterior slabs on grade outside the building pad preparation limits and areas to receive fill outside the building pad preparation limits should be over-excavated to remove undocumented fill/disturbed soils from previous grading activities at the site (encountered to depths of 3½ to 6⅓ feet BSG). The bottom of over-excavation should be scarified to a depth of 12 inches below site grades and scarified soils should be moisture conditioned to between one (1) and two (2) percent above optimum moisture content and compacted as engineered fill. The limits of scarification for pavement areas and exterior slabs should extend at least 3 feet beyond the edge of these improvements. The upper 12 inches of the subgrade soils beneath the pavement areas should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Test Method D1557. As an alternative to removing all existing undocumented fills in pavement and site work areas, existing fill soils outside the building pad may remain in-place if an increased risk of damage and higher maintenance and

repair due to settlement of this fill is accepted by Circle K. The magnitude of settlement cannot be estimated since undocumented fills can be highly variable. If this option is selected by Circle K, Contractors should be notified in writing prior to bid.

- 8.3.7 In the event that the “remainder parcel” is required to be rough graded during preparation of the Circle K parcel, the “remainder parcel” should be stripped to remove surface vegetation and organics followed by scarification to a depth of at least 8 inches and compaction of the scarified soils as engineered fill. This is a general recommendation for preparing a rough graded area only and is not intended for support of any specific improvement. In the event settlement sensitive improvements are planned in the remainder parcel, details of the locations and types of proposed improvements should be provided to Moore Twining to develop recommendations. A design level geotechnical engineering investigation would be required to provide specific site preparation recommendations for development on the “remainder parcel”. In general, settlement sensitive improvements should be prepared by removing and recompaction all undocumented fill soils (encountered to depths ranging from 1 to 13½ feet BSG .
- 8.3.8 All fill required to bring the site to final grades should be placed as engineered fill. In addition, all native soils over-excavated should be compacted as engineered fill.
- 8.3.9 The contractor should locate all on-site water wells (if any). All wells scheduled for demolition should be abandoned per state and local requirements. The contractor should obtain an abandonment permit from the local environmental health department, and issue certificates of destruction to the owner and Moore Twining upon completion. At a minimum, wells in building areas (and within 5 feet of building perimeters) should have their casings removed to a depth of at least 8 feet below preconstruction site grades or finished pad grades, whichever is deeper. In parking lot or landscape areas, the casings should be removed to a depth of at least 5 feet below site grades or finished grades. The wells should be capped with concrete and the resulting excavations should be backfilled as engineered fill.
- 8.3.10 The moisture content and density of the compacted soils should be maintained until the placement of concrete. If soft or unstable soils are encountered during excavation or compaction operations, our firm should be notified so the soils conditions can be examined and additional recommendations provided to address the pliant areas.

- 8.3.11 Final grading shall produce a building pad which is smooth, planar, and resistant to rutting. The finished pad subgrade (before aggregate base is placed) shall not depress more than one-half ($\frac{1}{2}$) inch under the wheels of a fully loaded water truck, or equivalent loading. If depressions more than one-half ($\frac{1}{2}$) inch occur, the contractor shall perform remedial grading to achieve this requirement at no cost to the owner.
- 8.3.12 The Contractor should be responsible for the disposal of concrete, asphaltic concrete, soil, spoils, etc. (if any) that must be exported from the site. Individuals, facilities, agencies, etc. may require analytical testing and other assessments of these materials to determine if these materials are acceptable. The Contractor should be responsible to perform the tests, assessments, etc. to determine the appropriate method of disposal.

8.4 Engineered Fill

- 8.4.1 The on-site near surface soils encountered within the Circle K parcel are predominantly sandy lean clays and clayey sands with an expansion index less than 30. The on-site soils with an expansion index of less than 30 will be suitable for use as engineered fill below the recommended aggregate base section, provided they are free of debris, organics (less than 3 percent by weight and no roots larger than $\frac{1}{4}$ inch in diameter), irreducible material greater than 3 inches, and the moisture content of the soil is within one (1) to four (4) percent above optimum moisture content at the time of placement. The on-site soils are not suitable for use as backfill behind retaining walls. Cemented soils should be processed to reduce the maximum particle size to no greater than 3 inches and the excavated materials should be blended with the soils to generate a well-graded material prior to use as engineered fill. This report recommends that interior and exterior slabs-on-grade be underlain by at least 6 inches of aggregate base over engineered fill soils recommended in this report. If soils other than those considered in this report are encountered, Moore Twining should be notified to provide alternate recommendations.

The fill soils are generally anticipated to be suitable for reuse as engineered fill on the project; however, some organics were noted in several samples, such as Boring B-3 at a depth of about 5 feet BSG (organic odors and grass) and Borings B-9 and B-10 at depths of about 5 feet BSG (rootlets and grass). These may occur at the contact between the fill and native soils. Where organics are encountered, these materials should be removed from soils to be used as engineered fill.

- 8.4.2 The compactability of the native soils is dependent upon the moisture contents, subgrade conditions, degree of mixing, type of equipment, as well as other factors. The evaluation of such factors was beyond the scope of this report; therefore, it is recommended that they be evaluated by the contractor during preparation of bids and construction of the project.
- 8.4.3 Import fill soil (if any) should be non-recycled, non-expansive and granular in nature with the following acceptance criteria recommended.

Percent Passing 3-Inch Sieve	100
Percent Passing No. 4 Sieve	85 - 100
Percent Passing No. 200 Sieve	15 - 40
Expansion Index (ASTM D4829)	Less than 20
Organics	Less than 3 percent by weight
R-Value	Minimum 30*
Sulfates	< 0.05 percent by weight
Min. Resistivity	> 3,000 ohm-cm

* for pavement areas only

Prior to being transported to the site, the import material shall be certified by the Contractor and the supplier (to the satisfaction of the Owner) that the soils do not contain any environmental contaminants regulated by local, state or federal agencies having jurisdiction. In addition, Moore Twining should be requested to sample and test the material to determine compliance with the above geotechnical criteria. Contractors should provide a minimum of 7 working days to complete the testing.

- 8.4.4 Native engineered fill soil should be placed in loose lifts approximately 8 inches thick, moisture-conditioned to between one (1) and four (4) percent above optimum moisture content, and compacted to a dry density of at least 90 percent of the maximum dry density as determined by ASTM Test Method D1557. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable. The upper 12 inches of fill and subgrade compacted in pavement areas as well as all fill soils below a depth of 10 feet below finished grade should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM Test Method D1557.
- 8.4.5 Imported, granular, non-expansive engineered fill soil should be placed in loose lifts approximately 8 inches thick, moisture-conditioned to between optimum and three (3) percent above optimum moisture content, and compacted to a dry density of at least 92 percent of the maximum dry density as determined by ASTM Test Method D1557. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil

conditions are not stable. The upper 12 inches of fill and subgrade compacted in pavement areas as well as all fill soils below a depth of 10 feet below finished grade should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM Test Method D1557.

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

Table No. 3

Area	Minimum Test Frequency
Building Pad	1 test per 5,000 square feet per compacted lift, but not less than two tests per building pad per lift
Pavement Subgrade and Mass Grading Outside Building Pads	1 test per 5,000 square feet per compacted lift
Sidewalks	1 test per 50 lineal feet per lift
Utility Lines	1 test per 150 feet per lift

- 8.4.7 Open graded gravel and rock material such as $\frac{3}{4}$ -inch crushed rock or $\frac{1}{2}$ -inch crushed rock should not be used as backfill including trench backfill. In the event gravel or rock is required by a regulatory agency for use as backfill (Contractor to obtain a letter from the agency stating the requirement for rock and/or gravel as backfill), all open graded materials shall be fully encased in a geotextile filter fabric, such as Mirafi 140N, to prevent migration of fine grained soils into the porous material. Gravel and rock cannot be used without the written approval of Moore Twining. If the contractor elects to use crushed rock (and if approved by Moore Twining), the contractor will be responsible for slurry cut off walls at the locations directed by Moore Twining. Crushed rock should be placed in thin (less than 8 inch) lifts and densified with a minimum of three (3) passes using a vibratory compactor.
- 8.4.8 Aggregate base below the interior building slab on grade shall be non-recycled and comply with Class 2 aggregate base (AB) per Caltrans Standard Specifications. Aggregate base used for pavement construction should comply with Class 2 aggregate base in accordance Caltrans Standard Specifications and may include recycled materials. Aggregate base shall be compacted to a minimum relative compaction of 95 percent in accordance with ASTM D1557 standards.

8.5 Conventional Shallow Spread Foundations

- 8.5.1 A structural engineer experienced in foundation design should recommend the thickness, design details and concrete specifications for the foundations based on the estimated settlements. The following static settlements should be anticipated for design: 1) a total settlement of 1 inch; and 2) a differential settlement of ½-inch in 40 feet.
- 8.5.2 Foundations supported on subgrade soils prepared as recommended in the Site Preparation section of this report may be designed for a maximum net allowable soil bearing pressure of 2,500 pounds per square foot for dead-plus-live loads. This value may be increased by one-third for short duration wind or seismic loads.
- 8.5.3 Perimeter foundations should have a minimum depth of 24 inches below the top of the slab or 24 inches below the lowest adjacent finished exterior ground surface, whichever is greater. Interior footings for the Circle K store should have a minimum depth of at least 24 inches below the bottom of the slab-on-grade. All footings should have a minimum width of 15 inches, regardless of load.
- 8.5.4 The foundations should be continuous around the perimeter of the proposed building to reduce moisture migration beneath the structures. Continuous perimeter foundations should be extended through doorways and/or openings that are not needed for support of loads.
- 8.5.5 The following seismic factors were developed using online data obtained from the Ground Motion Parameter Calculator provided by the Structural Engineers Association of California website (<https://seismicmaps.org/>) based upon a latitude of 38.752286 degrees and a longitude of -121.382895 degrees and a Site Class D - stiff soils. The data provided in Table No. 4 are based upon the procedures of Sections 1613.2.1 through 1613.2.4 of the 2019 California Building Code and were not determined based upon a ground motion hazard analysis. The structural engineer should review the values in Table No. 4 and determine whether a ground motion hazard analysis is required for the project considering the seismic design category, structural details, and requirements of ASCE 7-16 (Section 11.4.8 and other applicable sections). If required, Moore Twining should be notified and requested to conduct the additional analysis, develop updated seismic factors for the project, and update the following values.

Table No. 4

Seismic Factor	2019 CBC Value
Site Class	D
Maximum Considered Earthquake (geometric mean) peak ground acceleration adjusted for site effects (PGA_M)	0.279g
Mapped Maximum Considered Earthquake (geometric mean) peak ground acceleration (PGA)	0.199g
Spectral Response At Short Period (0.2 Second), S_s	0.471
Spectral Response At 1-Second Period, S_1	0.230
Site Coefficient (based on Spectral Response At Short Period), F_a	1.423
Site Coefficient (based on spectral response at 1-second period) F_v	See Note
Maximum considered earthquake spectral response acceleration for short period, S_{MS}	0.67
Maximum considered earthquake spectral response acceleration at 1 second, S_{M1}	See Note
Five percent damped design spectral response accelerations for short period, S_{DS}	0.447
Five percent damped design spectral response accelerations at 1-second period, S_{D1}	See Note

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

- 8.5.6 Foundation excavations should be observed by Moore Twining prior to the placement of steel reinforcement and concrete to verify conformance with the intent of the recommendations of this report. The Contractor is responsible for proper notification to Moore Twining and receipt of written confirmation of this observation prior to placement of steel reinforcement.

- 8.5.7 Structural loads for lightly loaded (less than 1.5 kips per lineal foot) miscellaneous foundations (such as screen walls for the proposed trash enclosures) may be supported on engineered fills prepared in accordance with the recommendations included in the Site Preparation section of this report. The lightly loaded foundations should extend to a minimum depth of 18 inches below the lowest adjacent grade with a minimum width of 15 inches, regardless of load. Footings for miscellaneous lightly loaded foundations may be designed for a maximum net allowable soil bearing pressure of 1,500 pounds per square foot for dead-plus-live loads. These values may be increased by one-third for short duration wind or seismic loads.
- 8.5.8 Sight lighting and pylon signs (if any) may be supported on a drilled-cast-in-hole reinforced concrete foundation (pier). An allowable skin friction of 150 pounds per square foot may be used to resist axial loads. Lateral load resistance may be estimated using the 2019 CBC non-constrained procedure (Section 1807.3.2.1). The allowable passive resistance of the native soils may be assumed to be equal to the pressure developed by a fluid with a density of 250 pounds per cubic foot to a maximum of 2,500 pounds per square foot. The passive pressure may be applied over twice the pier diameter. The upper 12 inches of subgrade soils in landscaped areas should be neglected in determining the total passive resistance.
- 8.5.9 The bottom surface area of concrete footings or concrete slabs in direct contact with engineered fill can be used to resist lateral loads. An allowable coefficient of friction of 0.30 can be used for design. In areas where slabs are underlain by a synthetic moisture barrier, an allowable coefficient of friction of 0.10 can be used for design.
- 8.5.10 The allowable passive resistance of the native soils and engineered fill may be assumed to be equal to the pressure developed by a fluid with a density of 250 pounds per cubic foot. The upper 6 inches of subgrade in landscaped areas should be neglected in determining the total passive resistance.

8.6 Fuel Canopy Foundations Supported on Cast-in-Drilled-Hole (CIDH) Pile Foundations

- 8.6.1 A structural engineer registered in the state of California should prepare structural details for the fuel canopy foundations to resist shear, moment, and axial (tension and compression) loads.
- 8.6.2 Skin friction in the upper portion of the piles within the undocumented fill soils, to a depth of 6½ inches should be neglected for design. The allowable vertical downward load capacity of the CIDH pile foundations below a depth of 6½ feet below site grade may be designed based on an allowable skin friction value of 350 pounds per square foot, which assumes a minimum

embedment depth of 12 feet BSG below finished grade. The above stated values assume that the cast-in-drilled-hole foundations are placed into the existing undisturbed native soils. These values may be increased $\frac{1}{3}$ for short duration loading. The project plans should identify the minimum embedment depth required into native soils below the existing fill.

- 8.6.3 The allowable uplift resistance of the pile foundations may be assumed to be half of the skin friction value used for design.
- 8.6.4 Piles should be placed no closer to each other than three pile diameters, center-to-center. For alternate spacing, the capacity of piles in groups should be reduced using appropriate group reduction formulas.
- 8.6.5 A structural engineer experienced in foundation design should recommend the thickness, design details and concrete specifications for the foundations based on a total static settlement of 1 inch and a differential static settlement of $\frac{1}{2}$ inch between foundations.
- 8.6.6 Passive resistance in the upper portion of the piles, to a depth of 1 foot should be neglected for design. The allowable passive resistance of the soils below a depth of 1 foot below site grade may be assumed to be equal to the pressure developed by a fluid with a density of 250 pounds per cubic foot to a maximum of 2,500 pounds per square foot. These values may be increased by one-third for short duration wind or seismic loads. The passive pressure for drilled pile foundations spaced at three (3) pile diameters may be applied over a width equal to 2 pile diameters.
- 8.6.7 Piles should be placed no closer than three pile diameters, center-to-center. For alternate spacing, the capacity of piles in groups should be reduced using appropriate group reduction formulas.

8.7 Cast-In-Drilled-Hole Pile Construction

- 8.7.1 It is assumed the project structural engineer will prepare a specification for the construction of the deep foundations as part of the construction documents. The specifications should be consistent with the recommendations included in this report.
- 8.7.2 Concrete should be placed in the drilled shaft as soon as possible following drilling.
- 8.7.3 If required, temporary casing should be used for temporary support of the excavations during construction. The casing should be slowly removed from the shaft excavation during placement of concrete to ensure the casing is not raised above the level of the concrete during shaft construction, to prevent sidewall soils from sloughing into the shaft excavation. As an alternative, it

may be possible to utilize a drilling slurry for temporary support of the foundation excavations if unstable sidewalls occur. The Contractor will be required to provide temporary excavation support of the drilled pile excavations as necessary to construct the foundations.

- 8.7.4 Casing (if used) should be able to withstand the external pressures of the caving soils. The outside diameter of the casing should not be less than the diameter of the cast-in-drilled hole concrete pile.
- 8.7.5 The cemented soils encountered in the proposed fuel canopy area at depths between about 5 and 20 feet BSG will increase the resistance to foundation drilling for cast-in-drilled-hole pile foundations. Drilled holes for pile foundations should be drilled within 2 degrees of vertical. The rebar cage should be suspended within 2 degrees of vertical in the center of the excavation. This condition should be verified and documented during construction. Minimum concrete cover, as specified by the project design engineer, should be maintained throughout the length of the excavation.
- 8.7.6 Groundwater is not anticipated to be encountered during pile construction. However, in the event freewater seepage is encountered during excavation, the concrete should be placed from the bottom of the excavation by extending the tremie pipe or pump pipe to the bottom of the excavation and maintaining the outlet of the pipe below the wet concrete to prevent entrapment of freewater or slurry in the concrete. The concrete should be placed in a continuous manner to provide a seamless deep foundation element.
- 8.7.7 Casing should be lifted slowly as the concrete is deposited, while the bottom of the casing is kept at least two feet below the top of the concrete.
- 8.7.8 Moore Twining should inspect the drilling of the shafts to verify that the materials encountered are consistent with those evaluated during our geotechnical engineering investigation. This inspection should be conducted during drilling and prior to placement of reinforcing steel and concrete.
- 8.7.9 Loose soils should be removed from the drilled shaft excavation prior to placement of reinforcing steel and concrete.

8.8 Interior Slabs-on-Grade

- 8.8.1 Interior slabs-on-grade and all concrete walkways attached to the buildings should be constructed over 6 inches of non-recycled aggregate base over engineered fill extending to the depth recommended below foundations in the Site Preparation section of this report.

- 8.8.2 The recommendations provided herein are intended only for the design of interior concrete slabs-on-grade and their proposed uses, which do not include construction traffic (i.e., cranes, cement mixers, and rock trucks, etc.). The building contractor should assess the slab section and determine its adequacy to support any proposed construction traffic.
- 8.8.3 The slabs and underlying subgrade should be constructed in accordance with current American Concrete Institute (ACI) standards.
- 8.8.4 ACI recommends that the interior slab-on-grade should be placed directly on a vapor retarder when the potential exists that the underlying subgrade or sand layer could be wet or saturated prior to placement of the slab-on-grade. It is recommended that Stegowrap 15 should be used where floor coverings, such as carpet and tile, are anticipated or where moisture could permeate into the interior and create problems. The vapor retarder should overlay the compacted 6 inch layer of aggregate base. It should be noted that placing the PCC slab directly on the vapor barrier will increase the potential for cracking and curling; however, ACI recommends the placement of the vapor retarding membrane directly below the slab to reduce the amount vapor emission through the slab-on-grade. Based on discussions with Stego Industries, L.L.C. (telephone 949-493-5460), the Stegowrap can be placed directly on the aggregate base and the concrete can be placed directly on the Stegowrap. It is recommended that the design professional obtain written confirmation from Stego Industries that this product is suitable for the specific project application. It is recommended that the slab be moist cured for a minimum of 7 days to reduce the potential for excessive cracking. The underslab membrane should have a high puncture resistance (minimum of approximately 2,400 grams of puncture resistance), high abrasion resistance, rot resistant, and mildew resistant. It is recommended that the membrane be selected in accordance with the current ASTM C 755, Standard Practice For Selection of Vapor Retarder For Thermal Insulation and conform to the current ASTM E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Waters, or as Ground Cover. It is recommended that the vapor barrier selection and installation conform to the current ACI Manual of Concrete Practice, Guide for Concrete Floor and Slab Construction (302.1R), Addendum, Vapor Retarder Location and current ASTM E 1643, Standard Practice for Installation of Water Vapor Retarders Used In Contact with Earth or Granular Fill Under Concrete Slabs. In addition, it is recommended that the manufacturer of the floor covering and floor covering adhesive be consulted to determine if the manufacturers have additional recommendations regarding the design and construction of the slab-on-grade, testing of the slab-on-grade, slab preparation, application of the adhesive, installation of the floor covering and maintenance requirements.

It should be noted that the recommendations presented in this report are not intended to achieve a specific vapor emission rate.

- 8.8.5 The membrane should be installed so that there are no holes or uncovered areas. All seams should be overlapped and sealed with the manufacturer approved tape continuous at the laps so they are vapor tight. All perimeter edges of the membrane, such as pipe penetrations, interior and exterior footings, joints, etc., should be caulked per manufacturer's recommendations.
- 8.8.6 Tears or punctures that may occur in the membrane should be repaired prior to placement of concrete per manufacturer's recommendations. Once repaired, the membrane should be inspected by the contractor and the owner to verify adequate compliance with manufacture's recommendations.
- 8.8.7 The moisture retarding membrane is not required beneath exposed concrete floors, such as warehouses and garages, provided that moisture intrusion into the structures are permissible for the design life of the structures.
- 8.8.8 Additional measures to reduce moisture migration should be implemented for floors that will receive moisture sensitive coverings. These include: 1) constructing a less pervious concrete floor slab by maintaining a water-cement ratio of 0.52 or less in the concrete for slabs-on-grade, 2) ensuring that all seams and utility protrusions are sealed with tape to create a "water tight" moisture barrier, 3) placing concrete walkways or pavements adjacent to the structures, 4) providing adequate drainage away from the structures, 5) moist cure the slabs for at least 7 days, and 6) locating lawns, irrigated landscape areas, and flower beds away from the structures.
- 8.8.9 The Contractor shall test the moisture vapor transmission through the slab, the pH, internal relative humidity, etc., at a frequency and method as specified by the flooring manufacturer or as required by the plans and specifications, whichever is most stringent. The results of vapor transmission tests, pH tests, internal relative humidity tests, ambient building conditions, etc. should be within floor manufacturer's and adhesive manufacturer's specifications at the time the floor is placed. It is recommended that the floor manufacturer and subcontractor review and approve the test data prior to floor covering installation.
- 8.8.10 To reduce the potential for damaging slabs during construction the following recommendations are presented: 1) design for a differential slab movement of ½ inch relative to interior columns; and 2) the construction equipment which will operate on slabs or pavements should be evaluated by the contractor prior to loading the slab.

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

8.9 Exterior Slabs-On-Grade

The recommendations for exterior slabs provided below are not intended for use for slabs subjected to vehicular traffic, rather lightly loaded sidewalks, curbs, and planters, etc.

- 8.9.1 Exterior improvements that subject the subgrade soils to a sustained load greater than 150 pounds per square foot should be prepared in accordance with recommendations presented in this report for interior slabs-on-grade. Moore Twining can provide alternative design recommendations for exterior slabs, if requested.
- 8.9.2 Exterior concrete slabs-on-grade (such as sidewalks, etc.) should be supported on a minimum of 6 inches of aggregate base over engineered fill prepared as recommended in the Site Preparation section of this report.
- 8.9.3 The moisture content of the subgrade soils should be verified to be slightly above optimum moisture content within 48 hours of placement of the slab-on-grade. If necessary to achieve the recommended moisture content, the subgrade could be over-excavated, moisture conditioned as necessary and compacted as engineered fill.
- 8.9.4 The exterior slabs-on-grade adjacent to landscape areas should be designed with thickened edges which extend to the bottom of the aggregate base. This should reduce the potential for infiltration of water into the aggregate base below exterior slabs.
- 8.9.5 Since exterior sidewalks, curbs, etc. are typically constructed at the end of the construction process, the moisture conditioning conducted during earthwork can revert to natural dry conditions. Placing concrete walks and finish work over dry or slightly moist subgrade should be avoided. It is recommended that the general contractor notify Moore Twining to conduct in-place moisture and density tests prior to placing concrete flatwork. Written test results indicating passing density and moisture tests should be in the general contractor's possession prior to placing concrete for exterior flatwork.

8.10 Asphaltic Concrete (AC) Pavements

- 8.10.1 The subgrade soils for asphaltic concrete pavements should be over-excavated and compacted as recommended in the “Site Preparation” section of the recommendations in this report. As part of the final preparation, the upper 12 inches of the subgrade soils should be moisture conditioned and compacted to a minimum of 95 percent of the maximum dry density determined in accordance with ASTM D 1557.
- 8.10.2 The following pavement sections are based on an R-value of 25, traffic index values ranging from 5.0 to 7.0 and a minimum of 3 inches of asphalt concrete. It should be noted that if pavements are constructed prior to construction of the buildings, the traffic index value should account for construction traffic. The actual traffic index values applicable to the site should be determined by the project civil engineer.

Table No. 5
Two-Layer Asphaltic Concrete Pavements

Traffic Index	AC thickness, inches	AB thickness, inches	Compacted Subgrade, inches
5.0	3.0	6.0	12
5.5	3.0	8.0	12
6.0	3.0	9.5	12
6.5	3.5	10.0	12
7.0	4.0	10.5	12

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

- 8.10.3 The curbs where pavements meet irrigated landscape areas or uncovered open areas should extend at least to the bottom of the aggregate base section. This should reduce subgrade moisture from irrigation and runoff from migrating into the base section and reducing the life of the pavements.
- 8.10.4 If actual pavement subgrade materials are significantly different from those tested for this study due to unanticipated grading or soil importing, the pavement sections should be re-evaluated for the changed subgrade conditions.

- 8.10.5 If the paved areas are to be used during construction, or if the type and frequency of traffic are greater than assumed in design, the pavement sections should be re-evaluated for the anticipated traffic.
- 8.10.6 Pavement section design assumes that proper maintenance, such as sealing and repair of localized distress, will be performed on an as needed basis for longevity and safety.
- 8.10.7 Pavement materials and construction method should conform to the State of California Standard Specifications.
- 8.10.8 It is recommended that the base 2 inch thick course of asphaltic concrete consist of a $\frac{3}{4}$ inch maximum medium gradation. The top course or wear course should consist of a $\frac{1}{2}$ inch maximum medium gradation.
- 8.10.9 The asphaltic concrete, including the joint density, should be compacted to an average relative compaction of 93 percent, with no single test value being below a relative compaction of 91 percent and no single test value being above a relative compaction of 97 percent of the referenced laboratory density according to ASTM D2041.
- 8.10.10 The asphalt concrete should comply with the requirements for a Type A asphalt concrete in accordance with the current State of California Department of Transportation (Caltrans) Standard Specification, or the requirements of the governing agency, whichever is more stringent.

8.11 Portland Cement Concrete (PCC) Pavements

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

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

8.11.2 The following preliminary Portland cement concrete pavement sections have been prepared for Traffic Indices Ranging from 5 to 7. The design pavement sections should be selected by the civil engineer based on the anticipated traffic loading. If the paved areas are to be used during construction, or if the type and frequency of traffic are greater than assumed in design, the pavement section should be re-evaluated for the anticipated traffic. The design thicknesses were prepared based on the procedures outlined in the Portland Cement Association (PCA) document, “Thickness Design for Concrete Highway and Street Pavements,” assuming the following: 1) minimum modulus of rupture of 500 psi for the concrete, 2) a design life of 20 years, 3) load transfer by aggregate interlock or dowels, 4) concrete shoulder, 5) a load safety factor of 1.1, 6) truck loading consisting of 1 single axle load of 18 kips, and 5) a maximum single axle weight of 12,000 pounds, and a maximum tandem axle weight of 36,000 pounds.

Table No. 6
Portland Cement Concrete Pavements

Traffic Index	ADTT	PCC Thickness (inches)	Aggregate Base (inches)	Compacted Subgrade (inches)
5.0	0.42	5.5	6	12
6.0	1.94	6.0	6	12
7.0	7.08	6.0	6	12

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

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

8.11.4 Specifications for the concrete mixtures used in the PCC pavement to reduce the effects of excessive shrinkage (such as curling and excessive shrinkage at joints), including maximum water requirements for the concrete mix, allowable shrinkage limits, curing methods, etc. should be provided by the designer/detailer of the PCC slabs. In addition, as noted in Section 8.11.3,

contraction joint requirements should be detailed by the designer/detailer of the PCC pavement to maintain stability. The minimum PCC thickness noted in this report assumes aggregate interlock occurs at contraction joints. However, curling and excessive shrinkage can disengage aggregate interlock and allow greater pavement deflection at free edges.

- 8.11.5 Concrete used for PCC pavements shall possess a minimum flexural strength (modulus of rupture) of 500 pounds per square inch. A minimum compressive strength of 3,500 pounds per square inch, or greater as required by the pavement designer, is recommended. Specifications for the concrete to reduce the effects of excessive shrinkage, such as maximum water requirements for the concrete mix, allowable shrinkage limits, contraction joint construction requirements, etc. should be provided by the designer of the PCC slabs.
- 8.11.6 The pavement section thickness design provided above assumes the design and construction will include sufficient load transfer at construction joints. Coated dowels or load transfer devices are recommended for construction joints to transfer loads. The joint details should be detailed by the pavement design engineer and provided on the plans.
- 8.11.7 Contraction and construction joints should include a joint filler/sealer to prevent migration of water into the subgrade soils. The type of joint filler should be specified by the pavement designer. The joint sealer and filler material should be maintained throughout the life of the pavement.
- 8.11.8 Contraction joints should have a depth of at least one-fourth the slab thickness, e.g., 1.5-inch for a 6-inch slab. Specifications for contraction joint spacing, timing and depth of sawcuts should be included in the plans and specifications.
- 8.11.9 Stresses are anticipated to be greater at the edges and construction joints of the pavement section. A thickened edge is recommended on the outside of slabs subjected to wheel loads.
- 8.11.10 Joint spacing in feet should not exceed twice the slab thickness in inches, e.g., 12 feet by 12 feet for a 6-inch slab thickness. Regardless of slab thickness, joint spacing should not exceed 15 feet.
- 8.11.11 Lay out joints to form square panels. When this is not practical, rectangular panels can be used if the long dimension is no more than 1.5 times the short.
- 8.11.12 Isolation (expansion) joints should extend the full depth and should be used only to isolate fixed objects abutting or within paved areas.

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

8.12 Underground Fuel Storage Tanks

It is our understanding underground fuel storage tanks are planned as part of a gasoline fueling station.

8.12.1 Excavations resistance may be encountered due to cemented soils.

8.12.2 The excavation limits, type of backfill, and the compaction requirements for the storage tanks should be specified by the applicable design professional and should be in compliance with the manufacturer's requirements and the requirements of the governing agency, whichever is more stringent.

8.12.3 If open graded gravel or rock material such as pea gravel or crushed rock is required by a regulatory agency or designer for use as backfill, the material should be placed in thin lifts and compacted using a vibratory compactor or other appropriate methods to a non-yielding condition as determined by Moore Twining. The backfill should be conducted in accordance with this report and the tank manufacturer's requirements, whichever is the most stringent. Each lift must be approved by Moore Twining prior to placing the next lift. All open graded materials should be fully encased in a geotextile filter fabric to reduce the potential for fines to migrate into the rock section. It should be noted that the use of open graded rock as backfill increases the potential for settlement, migration of water, etc.

8.12.4 Unless open-graded rock is used for backfill, the tank area backfill should be compacted to a minimum of 95 percent of the maximum dry density in accordance with ASTM D1557.

8.13 Slopes, Shoring and Temporary Excavations

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

8.13.2 Temporary excavations should be constructed in accordance with CAL OSHA requirements. Temporary cut slopes should not be steeper than 1.5:1, horizontal to vertical, and flatter if possible. If excavations cannot meet these criteria, the temporary excavations should be shored.

- 8.13.3 In no case should excavations extend below a 2H to 1V zone below existing utilities, foundations and/or floor slabs which are to remain after construction. Excavations which are required to be advanced below the 2H to 1V envelope should be shored to support the soils, foundations, and slabs.
- 8.13.4 All soils disturbed as part of the shoring removal shall be over-excavated and compacted as engineered fill. In addition, all cavities and void space resulting from the shoring removal activity shall be backfilled with engineered fill or a controlled density fill material to backfill the voids created by removal of the shoring. All voids resulting from removal of shoring shall be backfilled and all soils disturbed from the shoring removal shall be over-excavated and compacted as engineered fill.
- 8.13.5 Excavation stability should be monitored by the contractor. Slope gradient estimates provided in this report do not relieve the contractor of the responsibility for excavation safety. In the event that tension cracks or distress to the structure occurs, during or after excavation, the owner should be notified immediately and the contractor should take appropriate actions to minimize further damage or injury.

8.14 Utility Trenches

- 8.14.1 The utility trench subgrade should be prepared by excavation of a neat trench without disturbance to the bottom of the trench. If sidewalls are unstable, the Contractor shall either slope the excavation to create a stable sidewall or shore the excavation. All trench subgrade soils disturbed during excavation, such as by accidental over-excavation of the trench bottom, or by excavation equipment with cutting teeth, should be compacted to a minimum of 92 percent relative compaction prior to placement of bedding material. The Contractor is responsible for notifying Moore Twining when these conditions occur and arrange for Moore Twining to observe and test these areas prior to placement of pipe bedding. The Contractor shall use such equipment as necessary to achieve a smooth undisturbed native soil surface at the bottom of the trench with no loose material at the bottom of the trench. The Contractor shall either remove all loose soils or compact the loose soils as engineered fill prior to placement of bedding, pipe and backfill of the trench.
- 8.14.2 The trench width, type of pipe bedding, the type of initial backfill, and the compaction requirements of bedding and initial backfill material for utility trenches (storm drainage, sewer, water, electrical, gas, cable, phone, irrigation, etc.) should be specified by the project Civil Engineer or applicable design professional in compliance with the manufacturer's requirements, governing agency requirements and this report, whichever is more stringent. The contractor is responsible for contacting the governing agency to

determine the requirements for pipe bedding, pipe zone and final backfill. The contractor is responsible for notifying the Owner and Moore Twining if the requirements of the agency and this report conflict, the most stringent applies. For flexible polyvinylchloride (PVC) pipes, these requirements should be in accordance with the manufacturer's requirements or ASTM D-2321, whichever is more stringent, assuming a hydraulic gradient exists (gravel, rock, crushed gravel, etc. cannot be used as backfill on the project). The width of the trench should provide a minimum clearance of 8 inches between the sidewalls of the pipe and the trench, or as necessary to provide a trench width that is 12 inches greater than 1.25 times the outside diameter of the pipe, whichever is greater. As a minimum, the pipe bedding should consist of 4 inches of compacted (92 percent relative compaction) select sand with a minimum sand equivalent of 30 and meeting the following requirements: 100 percent passing the 1/4 inch sieve, a minimum of 90 percent passing the No. 4 sieve and not more than 10 percent passing the No. 200 sieve. The haunches and initial backfill (12 inches above the top of pipe) should consist of a select sand meeting these sand equivalent and gradation requirements that is placed in maximum 6-inch thick lifts and compacted to a minimum relative compaction of 92 percent using hand equipment. The final fill (12 inches above the pipe to the surface) should be on-site or imported, non-expansive materials moisture conditioned and compacted per sections 8.4.4 and 8.4.5 of this report. The project civil engineer should take measures to control migration of moisture in the trenches such as slurry collars, etc.

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

Table No. 7
Minimum Trench Widths for HDPE Pipe with
Sand Bedding Initial Backfill

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

- 8.14.4 Open graded gravel and rock material such as ¾-inch crushed rock or ½-inch crushed rock should not be used as backfill including trench backfill. In the event gravel or rock is required by a regulatory agency for use as backfill (Contractor to obtain a letter from the agency stating the requirement for rock and/or gravel as backfill), all open graded materials shall be fully encased in a geotextile filter fabric, such as Mirafi 140N, to prevent migration of fine grained soils into the porous material. Gravel and rock cannot be used without the written approval of Moore Twining. If the contractor elects to use crushed rock (and if approved by Moore Twining), the contractor will be responsible for slurry cut off walls at the locations directed by Moore Twining. Crushed rock should be placed in thin (less than 8 inch) lifts and densified with a minimum of three (3) passes using a vibratory compactor.
- 8.14.5 Utility trench backfill placed in or adjacent to building areas, exterior slabs or pavements should be placed in 8 inch lifts, moisture conditioned and compacted per the recommendations of section 8.4.4 and 8.4.5 of this report. Lift thickness can be increased if the contractor can demonstrate the minimum compaction requirements can be achieved. The contractor should use appropriate equipment and methods to avoid damage to utilities and/or structures during placement and compaction of the backfill materials.
- 8.14.6 On-site soils and approved imported engineered fill may be used as final backfill (12 inches above the pipe to the ground surface) in trenches.
- 8.14.7 Jetting of trench backfill is not allowed to compact the backfill soils.

- 8.14.8 Where utility trenches extend from the exterior to the interior limits of a building, lean concrete should be used as backfill material for a minimum distance of 2 feet laterally on each side of the exterior building line to prevent the trench from acting as a conduit to exterior surface water.
- 8.14.9 Storm drains and/or utility lines should be designed to be “watertight.” If encountered, leaks should be immediately repaired. Leaking storm drain and/or utility lines could result in trench failure, sloughing and/or soil movement causing damage to surface and subsurface structures, pavements, flatwork, etc. In addition, landscaping irrigation systems should be monitored for leaks. The Contractor is required to video inspect or pressure test the wet utilities prior to placement of foundations, slabs-on-grade or pavements to verify that the pipelines are constructed properly and are “watertight.” The Contractor shall provide the Owner a copy of the results of the testing. The Contractor is required to repair all noted deficiencies at no cost to the owner.
- 8.14.10 The plans should note that all utility trenches, including electrical lines, irrigation lines, etc. should be compacted per the recommendations of section 8.4.4 and 8.4.5 of this report except for the upper 12 inches below pavements which should be compacted to at least 95 percent relative compaction.
- 8.14.11 Utility trenches should not be constructed within a zone defined by a line that extends at an inclination of 2 horizontal to 1 vertical downward from the bottom of building foundations.

8.15 Corrosion Protection

- 8.15.1 Based on the resistivity values and the National Association of Corrosion Engineers (NACE) corrosion severity ratings listed in the Table No. 2 of section 6.8 of this report, the analytical results of sample analyses indicate the samples had resistivity values of 690 and 5,800 ohms-centimeter, with pH values of 6.3 and 7.1. Based on the resistivity values, the soils exhibit an “moderately corrosive” to “extremely corrosive” corrosion potential. Therefore, buried metal objects should be protected in accordance with the manufacturer's recommendations based on an “extremely corrosive” corrosion potential. The evaluation was limited to the effects of soils to metal objects; corrosion due to other potential sources, such as stray currents and groundwater, was not evaluated. If piping or concrete are placed in contact with deeper soils or engineered fill, these soils should be analyzed to evaluate the corrosion potential of these soils.
- 8.15.2 Corrosion of concrete due to sulfate attack is not anticipated based on the concentration of sulfates determined for the near-surface soils (0.00094 and less than 0.00060 percent by dry weight concentrations of sulfate).

According to provisions of ACI 318, section 4.3 , the sulfate concentration falls in the negligible classification (0.00 to 0.10 percent by weight) for concrete. Therefore, no restrictions are required regarding the type, water-to-cement ratio, or strength of the concrete used for foundation and slabs due to the sulfate content. However, a low water to cement ratio is recommended for slabs on grade as recommended in the “Interior Slab on Grade” section of this report.

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

9.0 DESIGN CONSULTATION

- 9.1 Moore Twining should be retained to review those portions of the contract drawings and specifications that pertain to earthwork operations and foundations prior to finalization to determine whether they are consistent with our recommendations. This service is not part of this current contractual agreement.
- 9.2 It is the client's responsibility to provide plans and specification documents for our review prior to their issuance for construction bidding purposes.
- 9.3 If Moore Twining is not retained for review, we assume no liability for the misinterpretation of our conclusions and recommendations. This review is documented by a formal plan/specification review report provided by Moore Twining.

10.0 CONSTRUCTION MONITORING

- 10.1 It is recommended that Moore Twining be retained to observe the excavation, earthwork, and foundation phases of work to determine that the subsurface conditions are compatible with those used in the analysis and design.
- 10.2 Moore Twining can conduct the necessary observation and field testing to provide results so that action necessary to remedy indicated deficiencies can be taken in accordance with the plans and specifications. Upon completion of the work, a

written summary of our observations, field testing and conclusions will be provided regarding the conformance of the completed work to the intent of the plans and specifications. This service is not, however, part of this current contractual agreement.

- 10.3 In the event that the earthwork operations for this project are conducted such that the construction sequence is not continuous, (or if construction operations disturb the surface soils) it is recommended that the exposed subgrade that will receive floor slabs be tested to verify adequate compaction and/or moisture conditioning. If adequate compaction or moisture contents are not verified, the fill soils should be over-excavated, scarified, moisture conditioned and compacted are recommended in the Recommendations of this report.
- 10.4 The construction monitoring is an integral part of this investigation. This phase of the work provides Moore Twining the opportunity to verify the subsurface conditions interpolated from the soil borings and make alternative recommendations if the conditions differ from those anticipated.
- 10.5 If Moore Twining is not afforded the opportunity to provide engineering observation and field-testing services during construction activities related to earthwork, foundations, pavements and trenches; then, Moore Twining will not be responsible for compliance of any aspect of the construction with our recommendations or performance of the structures or improvements if the recommendations of this report are not followed. It is recommended that if a firm other than Moore Twining is selected to conduct these services that they provide evidence of professional liability insurance of at least \$3,000,000 and review this report. After their review, the firm should, in writing, state that they understand the conclusions and recommendations of this report and agree to conduct sufficient observations and testing to ensure the construction complies with this report's recommendations. Moore Twining should be notified, in writing, if another firm is selected to conduct observations and field-testing services prior to construction.
- 10.6 Upon the completion of work, a final report should be prepared by Moore Twining. This report is essential to ensure that the recommendations presented are incorporated into the project construction, and to note any deviations from the project plans and specifications. The client should notify Moore Twining upon the completion of work to prepare a final report summarizing the observations during site preparation activities relative to the recommendations of this report. This service is not, however, part of this current contractual agreement.

11.0 NOTIFICATION AND LIMITATIONS

- 11.1 The conclusions and recommendations presented in this report are based on the information provided regarding the proposed construction, and the results of the field and laboratory investigation, combined with interpolation of the subsurface conditions between boring locations. The nature and extent of subsurface variations between borings may not become evident until construction.
- 11.2 If variations or undesirable conditions are encountered during construction, Moore Twining should be notified promptly so that these conditions can be reviewed and our recommendations reconsidered where necessary. It should be noted that unexpected conditions frequently require additional expenditures for proper construction of the project.
- 11.3 If the proposed construction is relocated or redesigned, or if there is a substantial lapse of time between the submission of our report and the start of work (over 12 months) at the site, or if conditions have changed due to natural cause or construction operations at or adjacent to the site, the conclusions and recommendations contained in this report should be considered invalid unless the changes are reviewed and our conclusions and recommendations modified or approved in writing.
- 11.4 Changed site conditions, or relocation of proposed structures, may require additional field and laboratory investigations to determine if our conclusions and recommendations are applicable considering the changed conditions or time lapse.
- 11.5 The conclusions and recommendations contained in this report are valid only for the project discussed in Section 3.3, Anticipated Construction. The use of the information and recommendations contained in this report for structures on this site not discussed herein or for structures on other sites not discussed in this report is not recommended. The entity or entities that use or cause to use this report or any portion thereof for other structures or site not covered by this report shall hold Moore Twining, its officers and employees harmless from any and all claims and provide Moore Twining's defense in the event of a claim.
- 11.6 This report is issued with the understanding that it is the responsibility of the client to transmit the information and recommendations of this report to developers, owners, buyers, architects, engineers, designers, contractors, subcontractors, and other parties having interest in the project so that the steps necessary to carry out these recommendations in the design, construction and maintenance of the project are taken by the appropriate party.
- 11.7 This report presents the results of a geotechnical engineering investigation only and should not be construed as an environmental audit or study.

- 11.8 Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally-accepted engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied.
- 11.9 Reliance on this report by a third party (i.e., that is not a party to our written agreement) is at the party's sole risk. If the project and/or site are purchased by another party, the purchaser must obtain written authorization and sign an agreement with Moore Twining in order to rely upon the information provided in this report for design or construction of the project.

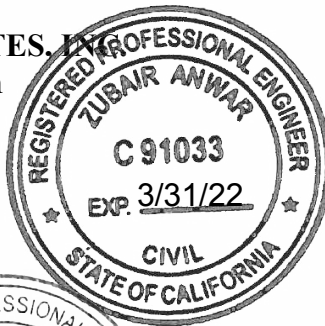
We appreciate the opportunity to be of service to Land Development Consultants. If you have any questions regarding this report, or if we can be of further assistance, please contact us at your convenience.

Sincerely,

MOORE TWINING ASSOCIATES, INC.
Geotechnical Engineering Division



Zubair Anwar, PE
Project Engineer



Read L. Andersen, RGE
Manager

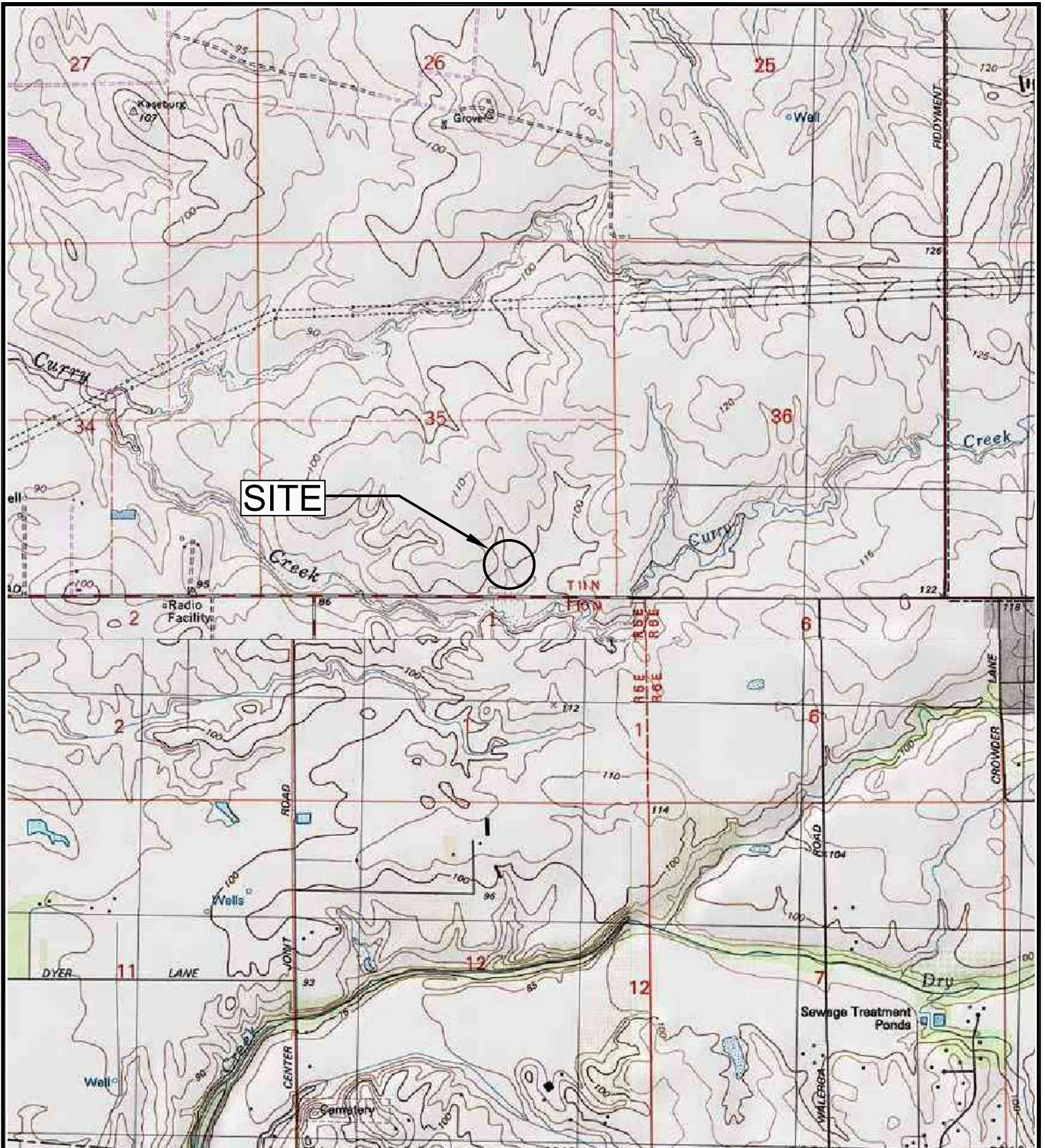


APPENDIX A

DRAWINGS

Drawing No. 1 - Site Location Map

Drawing No. 2 - Test Boring and Percolation Test Location Map



SITE

SOURCE: U.S.G.S. TOPOGRAPHIC MAP, 7 ½ MINUTE SERIES
 PLEASANT GROVE, CALIFORNIA QUADRANGLE 1981



SITE LOCATION MAP
 PROPOSED CIRCLE K STORE AND REMAINDER PARCEL
 NEC BASELINE ROAD AND WESTBROOK BOULEVARD
 ROSEVILLE, CALIFORNIA

FILE NO:
 71523-01-01

DATE:
 08/28/20

DRAWN BY:
 RM

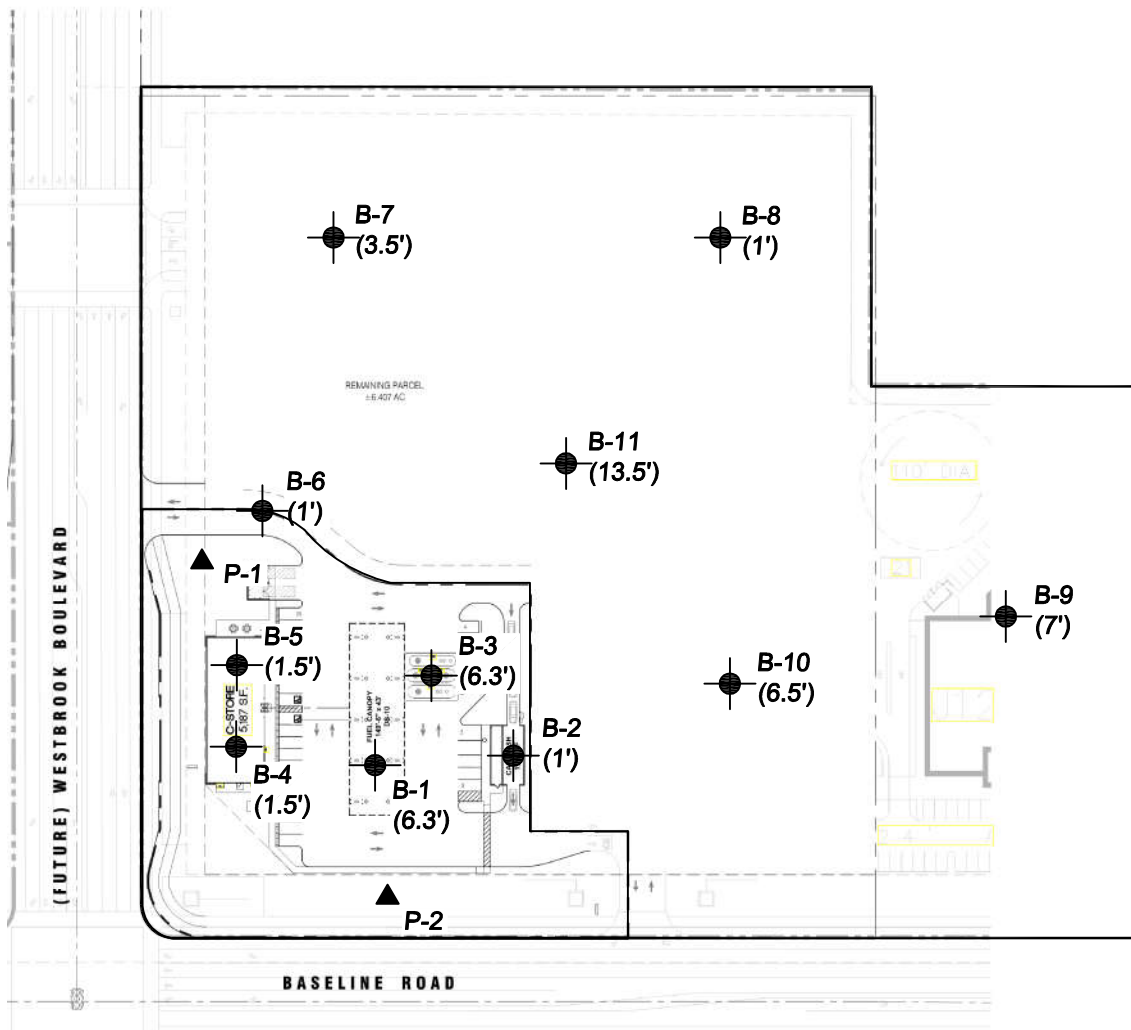
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PROJECT NO.
 G71523.01

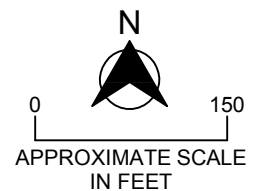
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**MOORE TWINING
 ASSOCIATES, INC.**



- APPROXIMATE TEST BORING LOCATION
- (6.3') APPROXIMATE DEPTH OF UNDOCUMENTED FILLS
- APPROXIMATE PERCOLATION TEST LOCATION



TEST BORING AND PERCOLATION TEST LOCATION MAP
 PROPOSED CIRCLE K STORE AND "REMAINDER PARCEL"
 NEC BASELINE ROAD AND WESTBROOK BOULEVARD
 ROSEVILLE, CALIFORNIA

FILE NO.
71523-02-02

DRAWN BY:
RM

PROJECT NO.
G71523.02

DATE DRAWN:
03/31/20

APPROVED BY:

DRAWING NO.
2



APPENDIX B

LOGS OF BORINGS

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

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

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



MOORE TWINING ASSOCIATES, INC.

Test Boring: B-1

Project: Proposed Circle K Store in Roseville, CA

Project Number: G71523.02

Drilled By: A.B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Z.A.

Date: August 4, 2020

Elevation: N/A

Depth to Groundwater

First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	8/6 6/6 12/6	FILL	FILL - CLAYEY SAND; medium dense, damp, fine to medium grained, light-brown, intermixed clumps of clay Dense	LL=23 PI=5 EI=21	18	
5	11/6 17/6 15/6 8/6 10/6 8/6	CI	Medium dense, light-gray, increase in silt content, strong organic odor LEAN CLAY; stiff, moist, medium plasticity, dark-brown, trace fine gravel SANDY LEAN CLAY; hard, moist, low plasticity, brown to red-brown	Low Recovery DD=111.7 pcf	32 18	14.4 10.3
10	10/6 18/6 23/6				41	29.6
15	7/6 11/6 15/6	ML	SILT; very stiff, moist, non plastic, light-gray, with seams of clay up to to 3 inches thick		26	
20	10/6 8/6 25/6	SM	SILTY SAND; dense, damp, fine to medium grained, gray-brown, increase in sand content with depth		23	
25	8/6 12/6 22/6		With clay, fine to coarse grained		34	

Notes:

Figure Number



MOORE TWINING ASSOCIATES, INC.

Test Boring: B-1

Project: Proposed Circle K Store in Roseville, CA

Project Number: G71523.02

Drilled By: A.B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

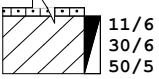
Logged By: Z.A.

Date: August 4, 2020

Elevation: N/A

Depth to Groundwater

First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30		CL	SANDY LEAN CLAY; hard, moist, low plasticity, brown		>80	
31.5			Bottom of boring B-1 at 31.5 feet BSG			
35						
40						
45						
50						
55						

Notes:

Figure Number



MOORE TWINING ASSOCIATES, INC.

Test Boring: B-2

Project: Proposed Circle K Store in Roseville, CA

Project Number: G71523.02

Drilled By: A.B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer







Logged By: Z.A.

Date: August 4, 2020

Elevation: N/A

Depth to Groundwater

First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	 5/6 5/6 8/6	FILL	SANDY LEAN CLAY; stiff, damp, low plasticity, red-brown, weak cementation		13	
5	 12/6 50/6  30/6 50/5	CL	SANDY LEAN CLAY; hard, damp, low plasticity, red-brown, moderate cementation Increase in clay content	DD=116.4 pcf Sand=31.9% #200=68.1% LL=25 PI=9	>50 >50	14.0 7.3
10	 7/6 10/6 10/6	SM	SILTY SAND; medium dense, moist, fine to medium grained, brown		20	
15	 8/6 14/6 14/6		Fine to coarse grained		28	
20	 6/6 16/6 50/5	CL	LEAN CLAY; hard, damp, low plasticity, brown		>65	
21.5			Bottom of boring B-2 at 21.5 feet BSG			

Notes:

Figure Number



MOORE TWINING ASSOCIATES, INC.

Test Boring: B-3

Project: Proposed Circle K Store in Roseville, CA

Project Number: G71523.02

Drilled By: A.B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

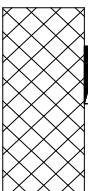




Logged By: Z.A.

Date: August 4, 2020

Elevation: N/A

Depth to Groundwater

First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	 8/6 8/6 13/6	FILL	FILL - CLAYEY SAND; medium dense, damp, fine to medium grained, brown, blended soil matrix		21	12.9
5	 11/6 14/6 27/6	SM	Moist, dark-brown, with trace intermixed, dry grass, strong organic odor SILTY SAND; hard, non-plastic, light-brown, moderate to strong cementation	LOI=2.3% Sand=54.3% #200=45.7%	41	11.8 19.2
10	 10/6 17/6 43/6	CL	LEAN CLAY; hard, damp, low plasticity, light-brown		60	25.3
15	 6/6 10/6 11/6		Very stiff		21	11.6
20	 12/6 13/6 18/6	SM	SILTY SAND; dense, most, fine to medium grained, brown		31	
21.5			Bottom of boring B-3 at 21.5 feet BSG			

Notes:

Figure Number



MOORE TWINING ASSOCIATES, INC.

Test Boring: B-4

Project: Proposed Circle K Store in Roseville, CA

Project Number: G71523.02

Drilled By: A.B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

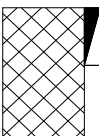
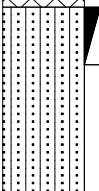
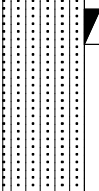
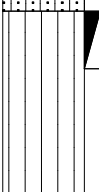

Logged By: Z.A.

Date: August 4, 2020

Elevation: N/A

Depth to Groundwater

First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	 14/6 12/6 10/6	FILL	CLAYEY SAND; medium dense, damp, fine to medium grained, light-brown Brown	EI=1	22	
5	 7/6 11/6 20/6	SM	SILTY SAND; dense, damp, fine to medium grained, brown		31	
10	 16/6 50/5		Very dense, increase in fines content		>50	
15	 9/6 15/6 21/6	ML	SANDY SILT; hard, damp, medium plasticity, light-brown		36	
20	 16/6 30/6 50/5		Increase in sand content		>80	
25			Bottom of boring B-4 at 20 feet BSG			

Notes:

Figure Number



MOORE TWINING ASSOCIATES, INC.

Test Boring: B-5

Project: Proposed Circle K Store in Roseville, CA

Project Number: G71523.02

Drilled By: A.B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Z.A.

Date: August 4, 2020

Elevation: N/A

Depth to Groundwater

First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	17/6 7/6 6/6 10/6 25/6 30/6	FILL	CLAYEY SAND; medium dense, damp, fine to medium grained, light-brown, weak cementation	Sand=55.2% #200=44.8% LL=27 PI=6	13	4.0
		FILL	SILTY, CLAYEY SAND; very dense, damp fine to medium grained, light-brown, weak to moderate cementation		55	12.2
5	10/6 12/6 22/6	SM	SILTY SAND; dense, moist, fine to medium grained, brown		34	14.4
10	44/6 50/3	ML	SANDY SILT; hard, damp, low plasticity, light-brown, weak to moderate cementation	DD=93.5 pcf	>50	18.7
15	20/6 26/6 37/6	CL	LEAN CLAY; hard, moist, low plasticity, light-brown		63	
20	14/6 20/6 50/5		Bottom of boring B-5 at 20 feet BSG		>70	

Notes:

Figure Number



MOORE TWINING ASSOCIATES, INC.

Test Boring: B-6

Project: Proposed Circle K Store in Roseville, CA

Project Number: G71523.02

Drilled By: A.B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

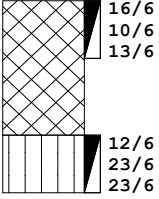
Logged By: Z.A.

Date: August 4, 2020

Elevation: N/A

Depth to Groundwater

First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	 16/6 10/6 13/6 12/6 23/6 23/6	FILL FILL	LEAN CLAY; very stiff, moist, low plasticity, brown SANDY LEAN CLAY; very stiff, moist, low plasticity, brown	LL=31 PI=12	23	
5		ML	SANDY SILT; hard, damp, non-plastic, light-brown		46	
			Bottom of boring B-6 at 5 feet BSG			
10						
15						
20						
25						

Notes:

Figure Number



MOORE TWINING ASSOCIATES, INC.

Test Boring: B-7

Project: Proposed Circle K Store in Roseville, CA

Project Number: G71523.02

Drilled By: A.B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer






Logged By: Z.A.

Date: August 4, 2020

Elevation: N/A

Depth to Groundwater

First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	 9/6 12/6 9/6	FILL	FILL - SILTY SAND; medium dense, fine to medium grained, brown to dark-brown		21	10.6
5	 14/6 50/5	SM	SILTY SAND; very dense, damp, fine to medium grained, olive	DD=93.9 pcf Sand=37.8% #200=62.2%	>50	25.0
10	 17/6 34/6 50/5	ML	SANDY SILT; moist, non-plastic, light-brown	LL=35 PI=5	>84	22.4
15	 6/6 12/6 18/6	CL	LEAN CLAY; very stiff, damp, low plasticity, light-brown		30	41.0
20	 8/6 16/6 50/5		Hard		>66	
			Bottom of boring B-7 at 20 feet BSG			

Notes:

Figure Number



MOORE TWINING ASSOCIATES, INC.

Test Boring: B-8

Project: Proposed Circle K Store in Roseville, CA

Project Number: G71523.02

Drilled By: A.B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Z.A.

Date: August 4, 2020

Elevation: N/A

Depth to Groundwater

First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	24/6 26/6 22/6	FILL	CLAYEY SAND; dense, damp, fine to medium grained, light- brown		48	
	8/6 24/6 50/4	SC	CLAYEY SAND; dense, damp, fine to medium grained, brown			
5	12/6 50/4	CL	LEAN CLAY; hard, dry, low plasticity, brown, weak cementation		>74	33.8
10	12/6 50/4		Moderate cementation	DD=87.8 pcf	>50	30.0
15	12/6 15/6 16/6	SP-SM	POORLY GRADED SAND with SILT; dense, damp, fine to medium grained, gray-brown		31	
20	8/6 10/6 12/6	CL	LEAN CLAY; very stiff, moist, low plasticity, olive-green		22	
			Bottom of boring B-8 at 20 feet BSG			

Notes:

Figure Number



MOORE TWINING ASSOCIATES, INC.

Test Boring: B-9

Project: Proposed Circle K Store in Roseville, CA

Project Number: G71523.02

Drilled By: A.B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Z.A.

Date: August 4, 2020

Elevation: N/A

Depth to Groundwater

First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0		FILL	FILL - CLAYEY SAND; dense, damp, fine to medium grained, red-brown Medium dense	DD=101.6 pcf Gravel=7.8% Sand=58.2% #200=34.0%	43	18.2
5		FILL	SILTY SAND; loose, moist, fine to medium, dark-brown, trace fine rootlets		10	11.7
		FILL	SANDY LEAN CLAY; hard, damp, low plasticity, red-brown	35	12.3	
10		SM	SILTY SAND; dense, damp, fine to medium grained, red-brown			
15		CL	LEAN CLAY; hard, moist, low plasticity, olive	33		
			Bottom of boring B-9 at 15 feet BSG			

Notes:

Figure Number



MOORE TWINING ASSOCIATES, INC.

Test Boring: B-10

Project: Proposed Circle K Store in Roseville, CA

Project Number: G71523.02

Drilled By: A.B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

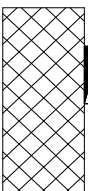
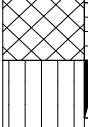
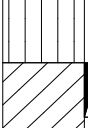
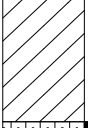
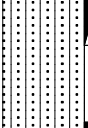
Logged By: Z.A.

Date: August 4, 2020

Elevation: N/A

Depth to Groundwater

First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	 6/6 10/6 14/6	FILL	FILL - CLAYEY SAND; medium dense, damp, fine to medium grained, red-brown		24	
5	 5/6 6/6 7/7 16/6 20/6 20/6	FILL FILL ML	SILTY SAND; loose, fine to medium grained, dark brown, trace fine rootlets and grass LEAN CLAY; stiff, moist, medium plasticity, dark-brown	LOI=1.6%	13 40	10.2 14.6 14.1
10	 10/6 13/6 50/5	CL	SILT; hard, moist, low plasticity, light-brown LEAN CLAY; hard, damp, low plasticity, light red-brown		>63	
15	 6/6 10/6 9/6	SM	SILTY SAND; medium dense, damp, fine to medium grained, light-brown		19	
20	 5/6 7/6 17/6				24	
			Bottom of boring B-10 at 20 feet BSG			

Notes:

Figure Number



MOORE TWINING ASSOCIATES, INC.

Test Boring: B-11

Project: Proposed Circle K Store in Roseville, CA

Project Number: G71523.02

Drilled By: A.B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Z.A.

Date: August 4, 2020

Elevation: N/A

Depth to Groundwater

First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %	
0		FILL	FILL - SILTY SAND; dense, dry, fine to coarse grained, light-brown			10.0	
3			Loose, very moist, brown	Sand=83.1% #200=16.9%	7	20.0	
4					8	19.0	
6			Medium dense (Native?)		26	19.4	
8			Native?		18		
12					28		
14			SM	Silty Sand; medium dense, moist, fine to medium, brown			
16							
18							
20			CL	LEAN CLAY; hard, moist, low plasticity, light-brown		38	
			Bottom of boring B-11 at 20 feet BSG				

Notes:

Figure Number



MOORE TWINING ASSOCIATES, INC.

Test Boring: P-1

Project: Proposed Circle K Store in Roseville, CA

Project Number: G71523.02

Drilled By: A.B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Z.A.

Date: August 4, 2020

Elevation: N/A

Depth to Groundwater

First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0		CL	LEAN CLAY; damp, low plasticity, brown			
5		SM	SILTY SAND; dense, damp, fine to medium grained, olive-brown		33	
		CL	LEAN CLAY; hard, damp, low plasticity, light-brown	Bottom of boring P-1 at 5 feet BSG		
10						
15						
20						
25						

Notes:

Figure Number



MOORE TWINING ASSOCIATES, INC.

Test Boring: P-2

Project: Proposed Circle K Store in Roseville, CA

Project Number: G71523.02

Drilled By: A.B.

Drill Type: CME 75

Auger Type: 6-5/8" Hollow Stem Augers

Hammer Type: 140 LB Auto Trip Hammer

Logged By: Z.A.

Date: August 4, 2020

Elevation: N/A

Depth to Groundwater

First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0		CL	LEAN CLAY; damp, low plasticity, brown			
5			Hard		43	
10			Bottom of boring P-2 at 9.2 feet BSG			
15						
20						
25						

Notes:

Figure Number







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
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
Strata symbols

Misc. Symbols

	Fill
	Lean clay
	Silt
	Silty sand
	Clayey sand
	Poorly graded sand with silt

 Boring continues

Soil Samplers

	Standard penetration test
	California Modified split barrel ring sampler

Notes:

1. Exploratory borings were drilled on 8/4/20 and 8/5/20 using a CME 75 drill rig equipped with 6-5/8" and 8" outside diameter hollow stem augers.
2. Groundwater was not encountered in any of the borings.
3. Boring locations were measured or paced from existing features.
4. These logs are subject to the limitations, conclusions, and recommendations in this report.
5. The "N-value" reported for the California Modified Split Barrel Sampler is the uncorrected field blow count. This value should not be interpreted as an SPT equivalent N-value.
6. Results of tests conducted on samples recovered are reported on the logs.

DD = Natural dry density (pcf)	LL = Liquid Limit (%)
+4 = Percent retained on the No. 4 sieve (%)	PI = Plasticity Index (%)
-200 = Percent passing the No. 200 sieve (%)	EI = Expansion Index
Sand = Percent passing the No. 4 sieve and retained on No. 200 sieve (%)	Gravel = Percent passing 3-inch & retained on No. 4 sieves (%)
pH = Soil pH	SR = Soil resistivity (ohms-cm)
SS = Soluble sulfates (%)	Cl = Soluble chlorides (%)
φ = Internal Angle of Friction (degrees)	c = Cohesion (psf)
pcf = Pounds per cubic foot	psf = Pounds per square foot
O.D. = Outside diameter	AMSL = Above mean sea level
N/A = Not applicable	N/E = Not encountered

APPENDIX C**RESULTS OF LABORATORY TESTS**

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

These Included:

Moisture Content
(ASTM D2216)

Dry Density
(ASTM D2937)

Grain-Size Distribution
(ASTM D422)

Atterberg Limits
(ASTM D4318)

Consolidation
(ASTM 2435)

Expansion Index
(ASTM D4829)

R-Value
(ASTM 2844)

Sulfate Content
(ASTM D4327)

Chloride Content
(ASTM D4327)

Resistivity
(ASTM G187)

pH (ASTM D4972)

To Determine:

Moisture contents representative of field conditions at the time the sample was taken.

Dry unit weight of sample representative of in-situ or in-place undisturbed condition.

Size and distribution of soil particles, i.e., sand, gravel and fines (silt and clay).

Determines the moisture content where the soil behaves as a viscous material (liquid limit) and the moisture content at which the soil reaches a plastic state

The amount and rate at which a soil sample compresses when loaded, and the influence of saturation on its behavior.

Swell potential of soil with increases in moisture content.

The capacity of a subgrade or subbase to support a pavement section designed to carry a specified traffic load.

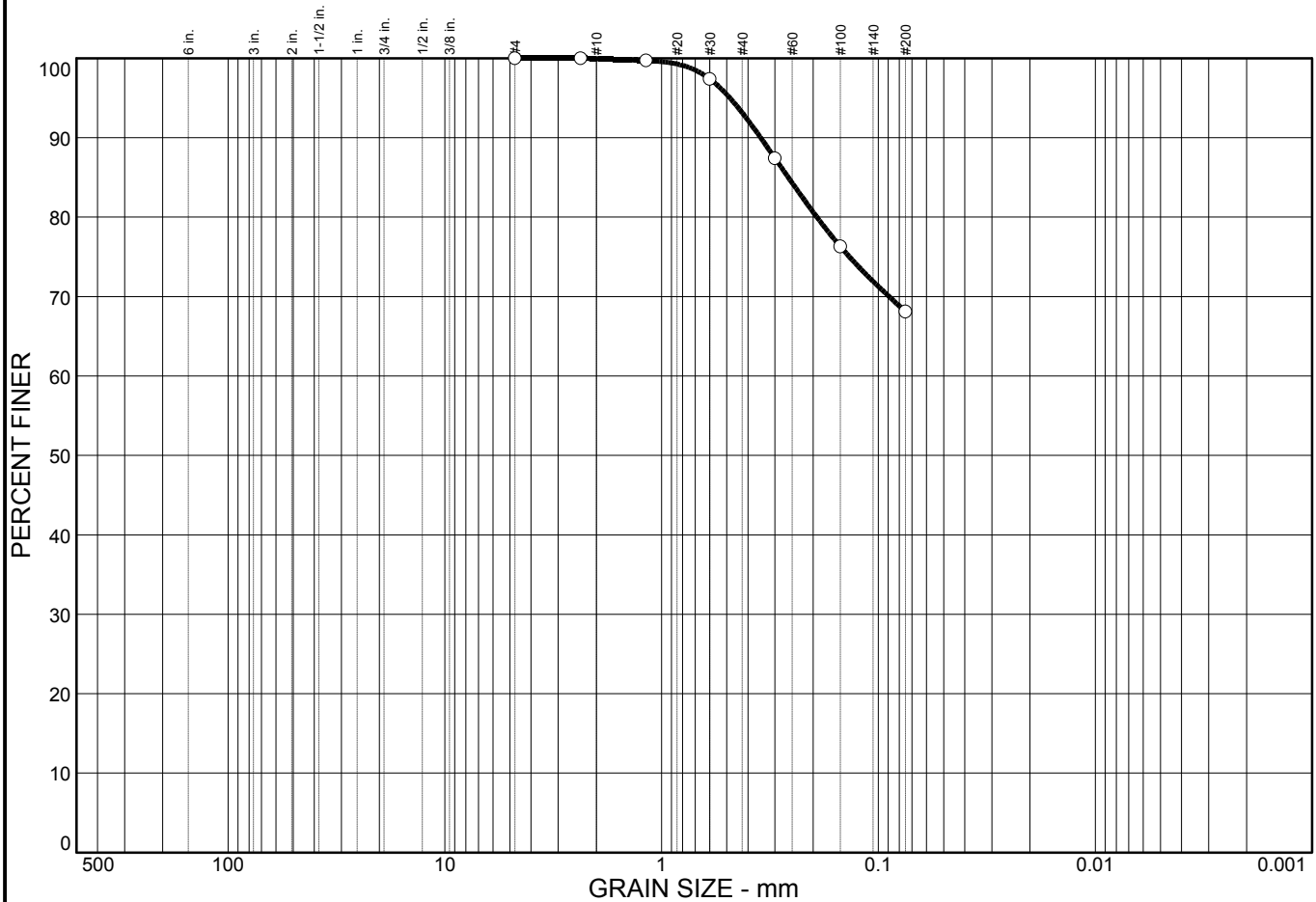
Percentage of water-soluble sulfate as (SO₄) in soil samples. Used as an indication of the relative degree of sulfate attack on concrete and for selecting the cement type.

Percentage of soluble chloride in soil. Used to evaluate the potential attack on encased reinforcing steel.

The potential of the soil to corrode metal.

The acidity or alkalinity of subgrade material.

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	31.9	68.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	99.7		
#30	97.4		
#50	87.4		
#100	76.3		
#200	68.1		

Material Description

Sandy lean clay

Atterberg Limits

PL= 16 LL= 25 PI= 9

Coefficients

D₈₅= 0.261 D₆₀= D₅₀=
D₃₀= D₁₅= D₁₀=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

* (no specification provided)

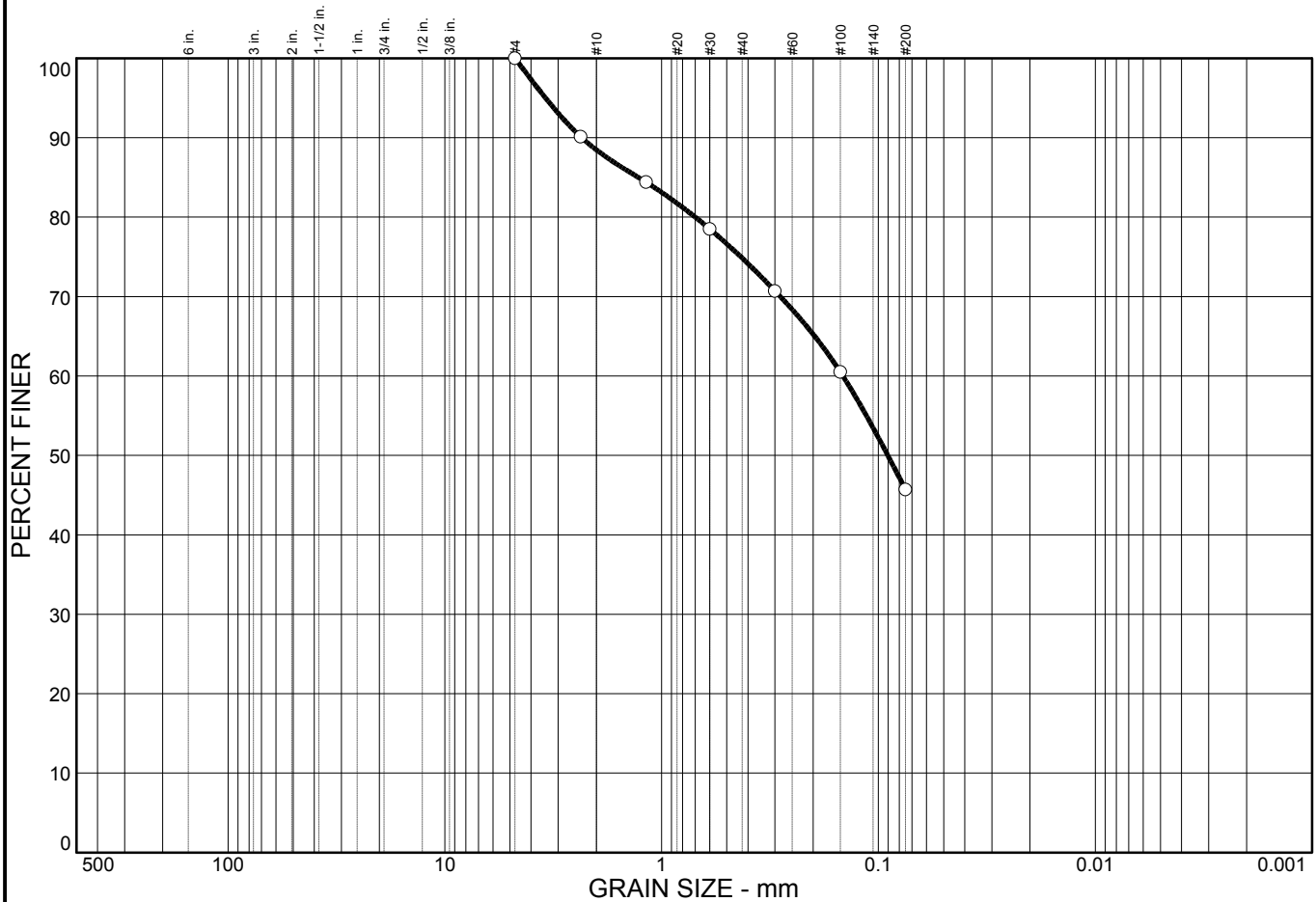
Sample No.: B-2
Location:

Source of Sample:

Date: 8/4/20
Elev./Depth: 5-6.5'

Moore Twining Associates, Inc. Fresno, CA	Client: Project: Proposed Circle K Project No: G71523.02
Figure	

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	54.3	45.7	45.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	90.1		
#16	84.4		
#30	78.5		
#50	70.7		
#100	60.5		
#200	45.7		

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D₈₅= 1.28 D₆₀= 0.146 D₅₀= 0.0906
D₃₀= D₁₅= D₁₀=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

* (no specification provided)

Sample No.: B-3
Location:

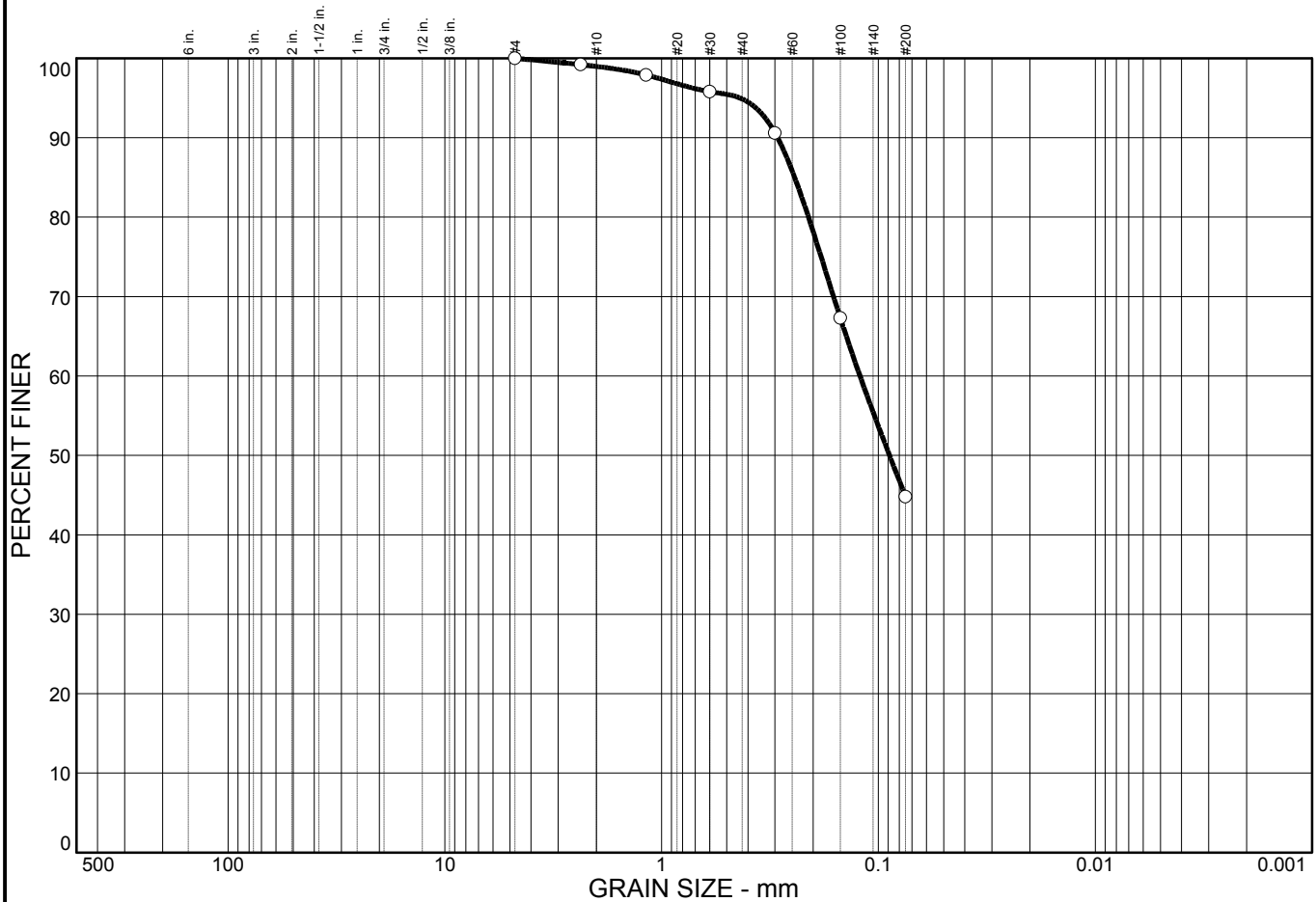
Source of Sample:

Date: 8/4/20
Elev./Depth: 6.25-6.50'

Moore Twining Associates, Inc. Fresno, CA	Client: Project: Proposed Circle K Project No: G71523.02
--	---

Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	55.2	44.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.2		
#16	97.9		
#30	95.8		
#50	90.6		
#100	67.3		
#200	44.8		

Material Description

Silty, clayey sand

Atterberg Limits

PL= 21 LL= 27 PI= 6

Coefficients

D₈₅= 0.244 D₆₀= 0.122 D₅₀= 0.0890
D₃₀= D₁₅= D₁₀=
C_u= C_c=

Classification

USCS= SC-SM AASHTO=

Remarks

* (no specification provided)

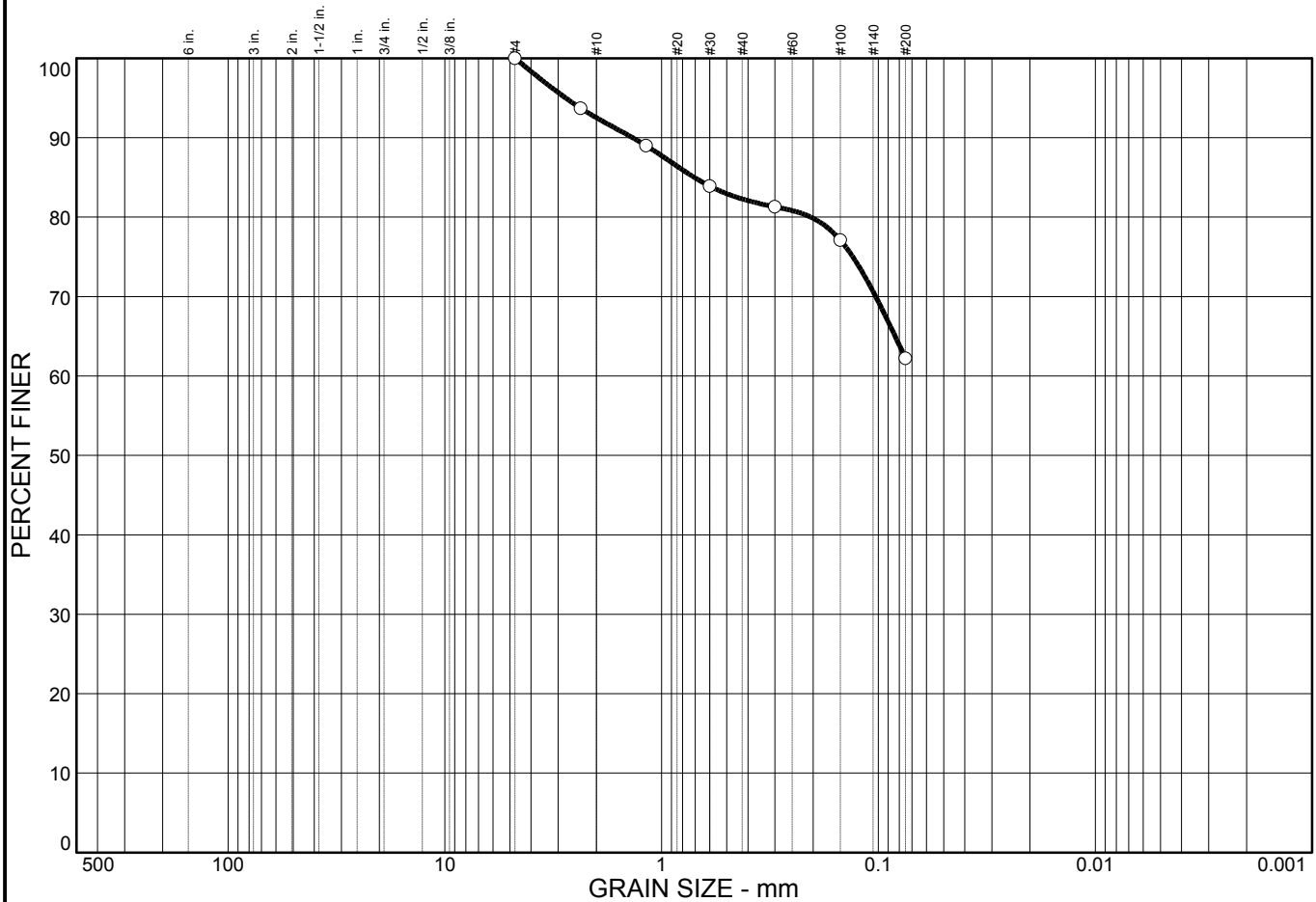
Sample No.: B-5
Location:

Source of Sample:

Date: 8/4/20
Elev./Depth: 1.5-3'

Moore Twining Associates, Inc. Fresno, CA	Client: Project: Proposed Circle K Project No: G71523.02
Figure	

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	37.8	62.2	62.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	93.7		
#16	89.0		
#30	83.9		
#50	81.3		
#100	77.1		
#200	62.2		

Material Description

Sandy silt

Atterberg Limits

PL= LL= PI=

Coefficients

D₈₅= 0.707 D₆₀= D₅₀=
D₃₀= D₁₅= D₁₀=
C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

* (no specification provided)

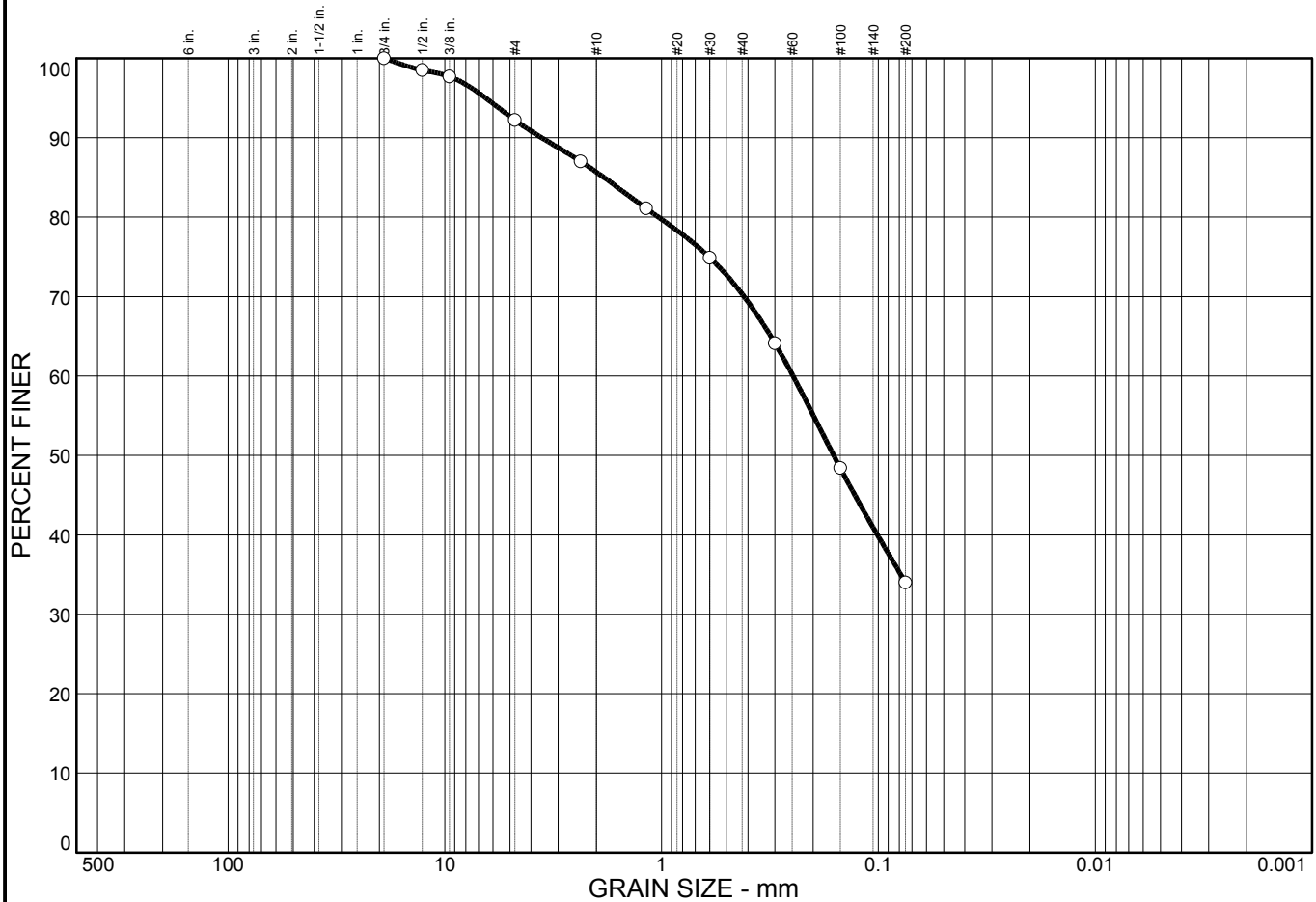
Sample No.: B-7
Location:

Source of Sample:

Date: 8/4/20
Elev./Depth: 3.5-5'

Moore Twining Associates, Inc. Fresno, CA	Client: Project: Proposed Circle K Project No: G71523.02
Figure	

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	7.8	58.2	34.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
1/2 in.	98.5		
3/8 in.	97.7		
#4	92.2		
#8	87.0		
#16	81.1		
#30	74.9		
#50	64.1		
#100	48.4		
#200	34.0		

Material Description

Silty sand

Atterberg Limits
 PL= LL= PI=

Coefficients
 D₈₅= 1.85 D₆₀= 0.248 D₅₀= 0.161
 D₃₀= D₁₅= D₁₀=
 C_u= C_c=

Classification
 USCS= SM AASHTO=

Remarks

* (no specification provided)

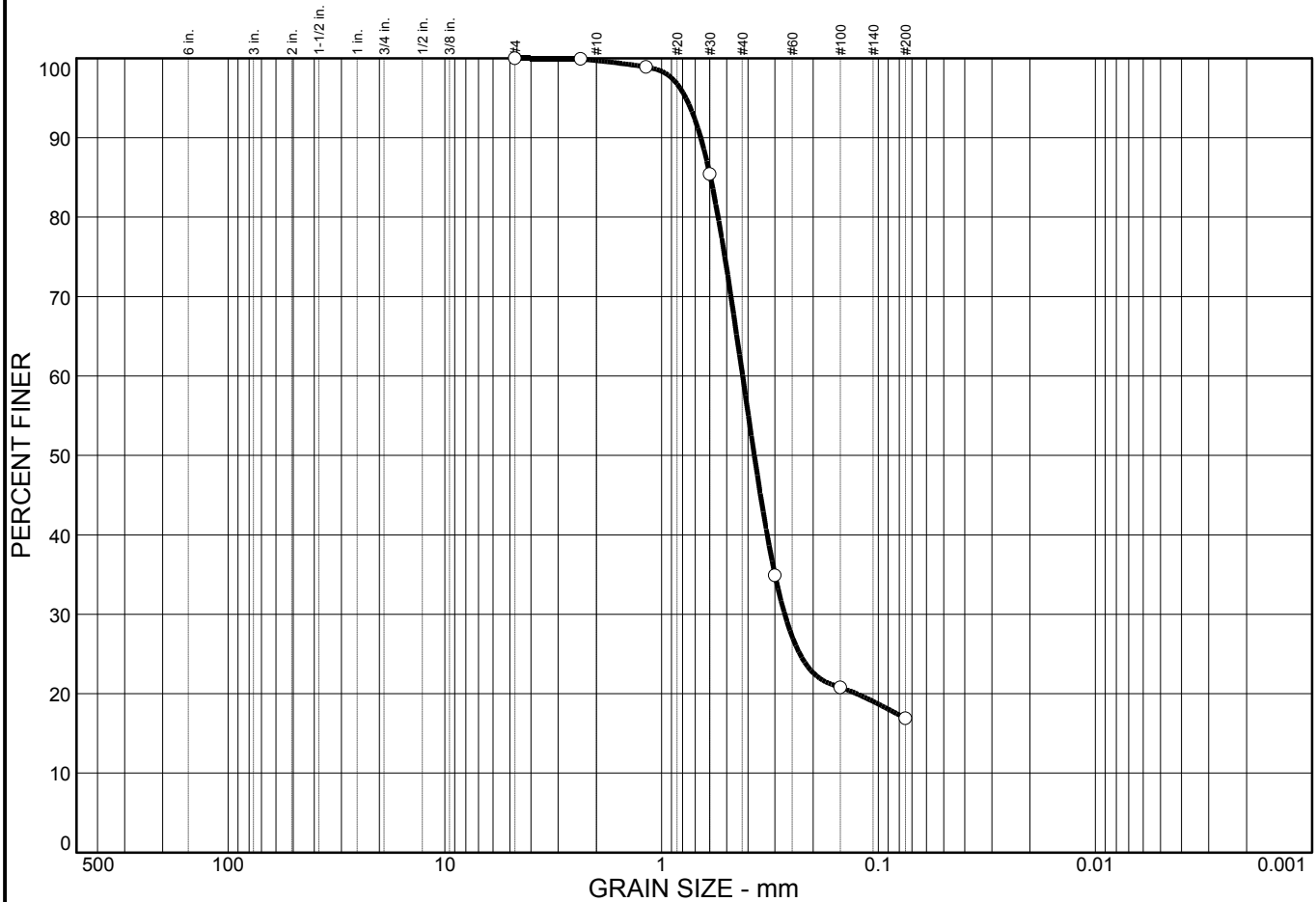
Sample No.: B-9
Location:

Source of Sample:

Date: 8/4/20
Elev./Depth: 2-3.5'

Moore Twining Associates, Inc. Fresno, CA	Client: Project: Proposed Circle K Project No: G71523.02
Figure	

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	83.1	16.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	98.9		
#30	85.4		
#50	34.9		
#100	20.8		
#200	16.9		

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D₈₅= 0.596 D₆₀= 0.423 D₅₀= 0.374

D₃₀= 0.271 D₁₅= D₁₀=

C_u=

Classification

USCS= SM AASHTO=

Remarks

* (no specification provided)

Sample No.: B-11
Location:

Source of Sample:

Date: 8/4/20
Elev./Depth: 3.5-5'

Moore Twining Associates, Inc. Fresno, CA	Client: Project: Proposed Circle K Project No: G71523.02
Figure	



MOORE TWINING ASSOCIATES, INC.

EXPANSION INDEX TEST, ASTM D4829

MTA PROJECT NAME: Proposed Circle K REPORT DATE: 8/26/2020
 TEST DATE: 8/20/2020
 MTA PROJECT NO.: G71523.02
 SAMPLE I.D.: B-1 @ 0-3.5'
 SAMPLED BY: ZA
 SAMPLE DATE: 8/4/2020 TESTED BY: MA

MATERIALS DESCRIPTION: Clayey sand

% PASSING # 4 SIEVE 100

<u>Initial Moisture Determination:</u>		<u>Final Moisture Determination:</u>	
Pan + Wet Soil Wt., gm	<u>250.0</u>	Wet Soil Wt., lbs	<u>0.9304</u>
Pan + Dry Soil Wt., gm	<u>225.0</u>	Dry Soil Wt., lbs	<u>0.7633</u>
Pan Wt., gm	<u>0.0</u>		
Initial % Moisture Content	<u>11.1</u>	Final % Moisture Content	<u>21.9</u>

<u>Initial Expansion Data:</u>		<u>Final Expansion Data:</u>	
Ring + Sample Wt., lbs	<u>0.8481</u>	Ring + Sample Wt., lbs	<u>0.9304</u>
Ring Wt., lbs	<u>0.0000</u>	Ring Wt., lbs	<u>0.0000</u>
Remolded Wt., lbs	<u>0.8481</u>	Remolded Wt., lbs	<u>0.9304</u>
Remolded Wet Density, pcf	<u>116.6</u>	Remolded Wet Density, pcf	<u>125.3</u>
Remolded Dry Density, pcf	<u>105.0</u>	Remolded Dry Density, pcf	<u>102.8</u>

<u>Expansion Data:</u>	<u>Initial Volume</u>	<u>Final Volume</u>
	<u>0.00727222</u>	<u>0.007426</u>
Initial Gage Reading, in:	<u>0.0500</u>	
Final Gage Reading, in:	<u>0.0712</u>	
Expansion, in:	<u>0.0212</u>	
Expansion Index	<u>21</u>	Comments: <u>Low Expansion Potential</u>

Classification of Expansive Soils. (Table No.1 From ASTM D4829)

<u>Expansion Index</u>	<u>Potential Expansion</u>
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
>130	Very High



EXPANSION INDEX TEST, ASTM D4829

MTA PROJECT NAME: Proposed Circle K REPORT DATE: 8/26/2020
 TEST DATE: 8/20/2020
 MTA PROJECT NO.: G71523.02
 SAMPLE I.D.: B-4 @ 0-3.5'
 SAMPLED BY: ZA
 SAMPLE DATE: 8/4/2020 TESTED BY: MA

MATERIALS DESCRIPTION: Clayey sand

% PASSING # 4 SIEVE 100

<u>Initial Moisture Determination:</u>		<u>Final Moisture Determination:</u>	
Pan + Wet Soil Wt., gm	<u>250.0</u>	Wet Soil Wt., lbs	<u>0.9950</u>
Pan + Dry Soil Wt., gm	<u>231.4</u>	Dry Soil Wt., lbs	<u>0.8662</u>
Pan Wt., gm	<u>0.0</u>		
Initial % Moisture Content	<u>8.0</u>	Final % Moisture Content	<u>14.9</u>

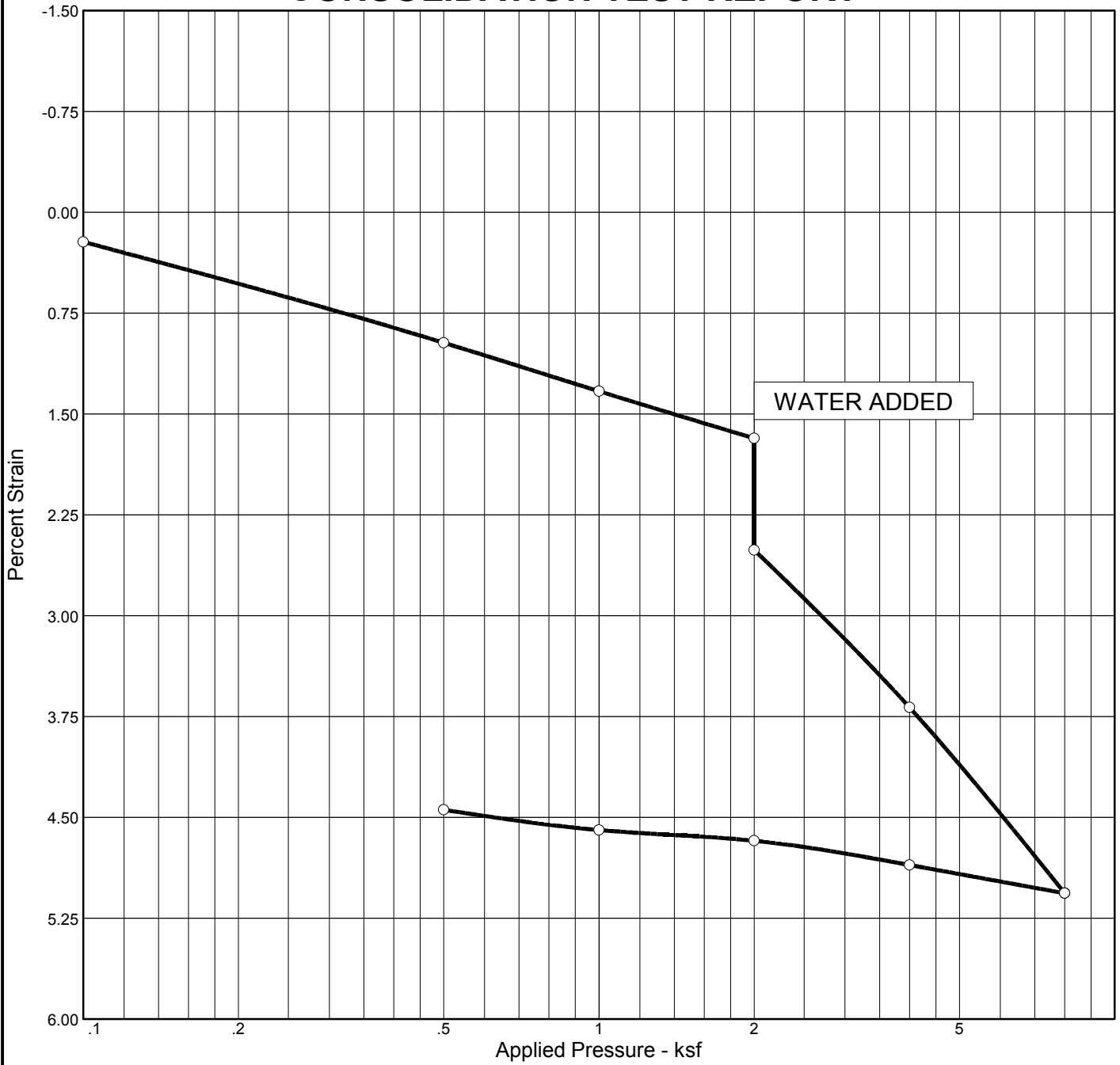
<u>Initial Expansion Data:</u>		<u>Final Expansion Data:</u>	
Ring + Sample Wt., lbs	<u>0.9358</u>	Ring + Sample Wt., lbs	<u>0.9950</u>
Ring Wt., lbs	<u>0.0000</u>	Ring Wt., lbs	<u>0.0000</u>
Remolded Wt., lbs	<u>0.9358</u>	Remolded Wt., lbs	<u>0.9950</u>
Remolded Wet Density, pcf	<u>128.7</u>	Remolded Wet Density, pcf	<u>136.7</u>
Remolded Dry Density, pcf	<u>119.1</u>	Remolded Dry Density, pcf	<u>119.0</u>

<u>Expansion Data:</u>	<u>Initial Volume</u>	<u>Final Volume</u>
	<u>0.00727222</u>	<u>0.007279</u>
Initial Gage Reading, in:	<u>0.0500</u>	
Final Gage Reading, in:	<u>0.0510</u>	
Expansion, in:	<u>0.0010</u>	
Expansion Index	<u>1</u>	Comments: <u>Very Low Expansion Potential</u>

Classification of Expansive Soils. (Table No.1 From ASTM D4829)

<u>Expansion Index</u>	<u>Potential Expansion</u>
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
>130	Very High

CONSOLIDATION TEST REPORT

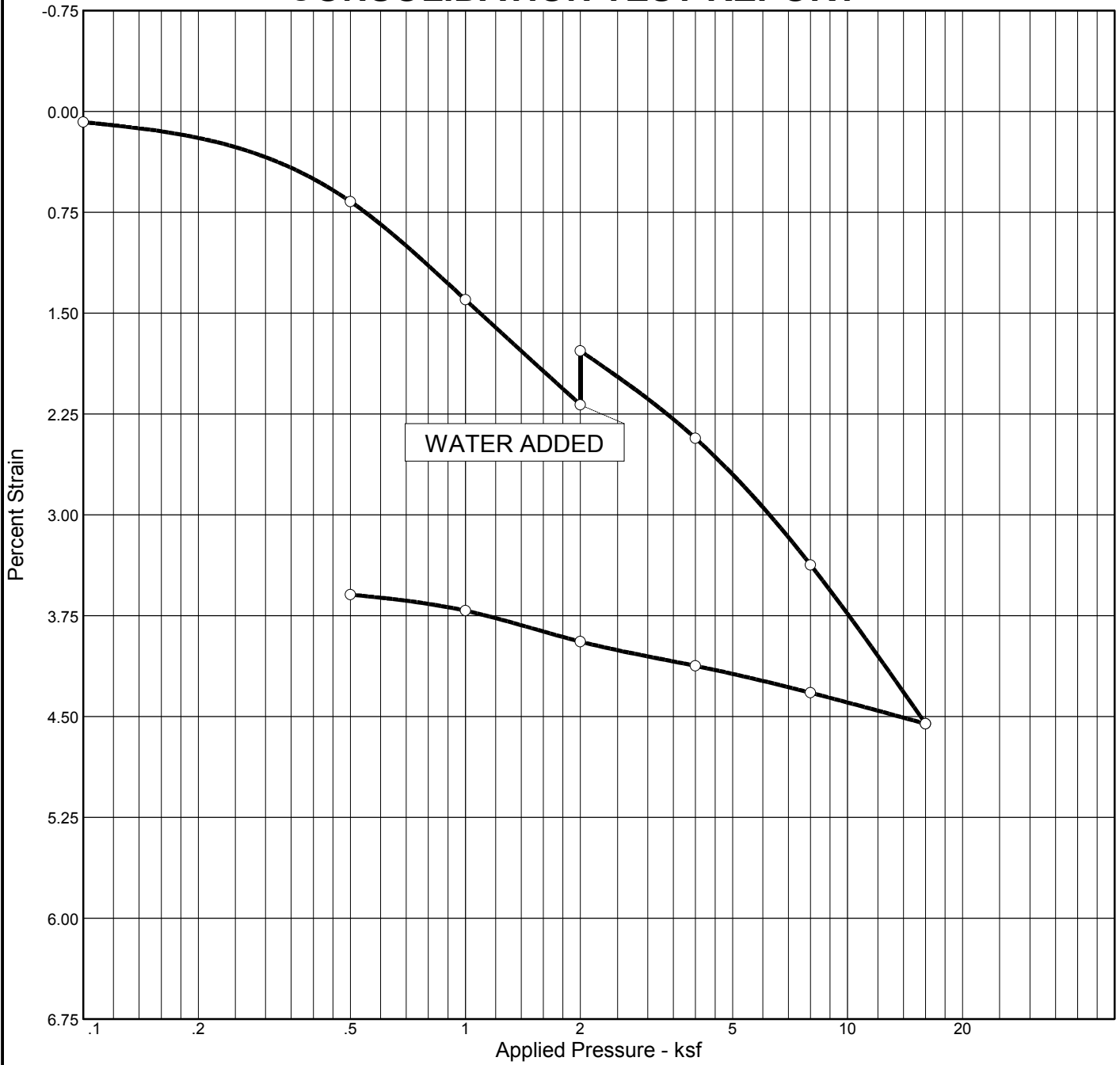


Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P _c (ksf)	C _c	C _s	Swell Press. (ksf)	Clpse. %	e ₀
Sat.	Moist.											
70.9 %	11.3 %	116.3			2.65		4.10	0.07	0.01		0.8	0.423

MATERIAL DESCRIPTION	USCS	AASHTO
Lean clay	CL	

Project No. G71523.02 Client: Project: Proposed Circle K Source: Sample No.: B-1 Elev./Depth: 6.3-6.5' <div style="text-align: center; border: 1px solid black; padding: 5px;"> Moore Twining Associates, Inc. Fresno, CA </div>	Remarks: <div style="text-align: right; margin-top: 20px;">Figure</div>
--	--

CONSOLIDATION TEST REPORT



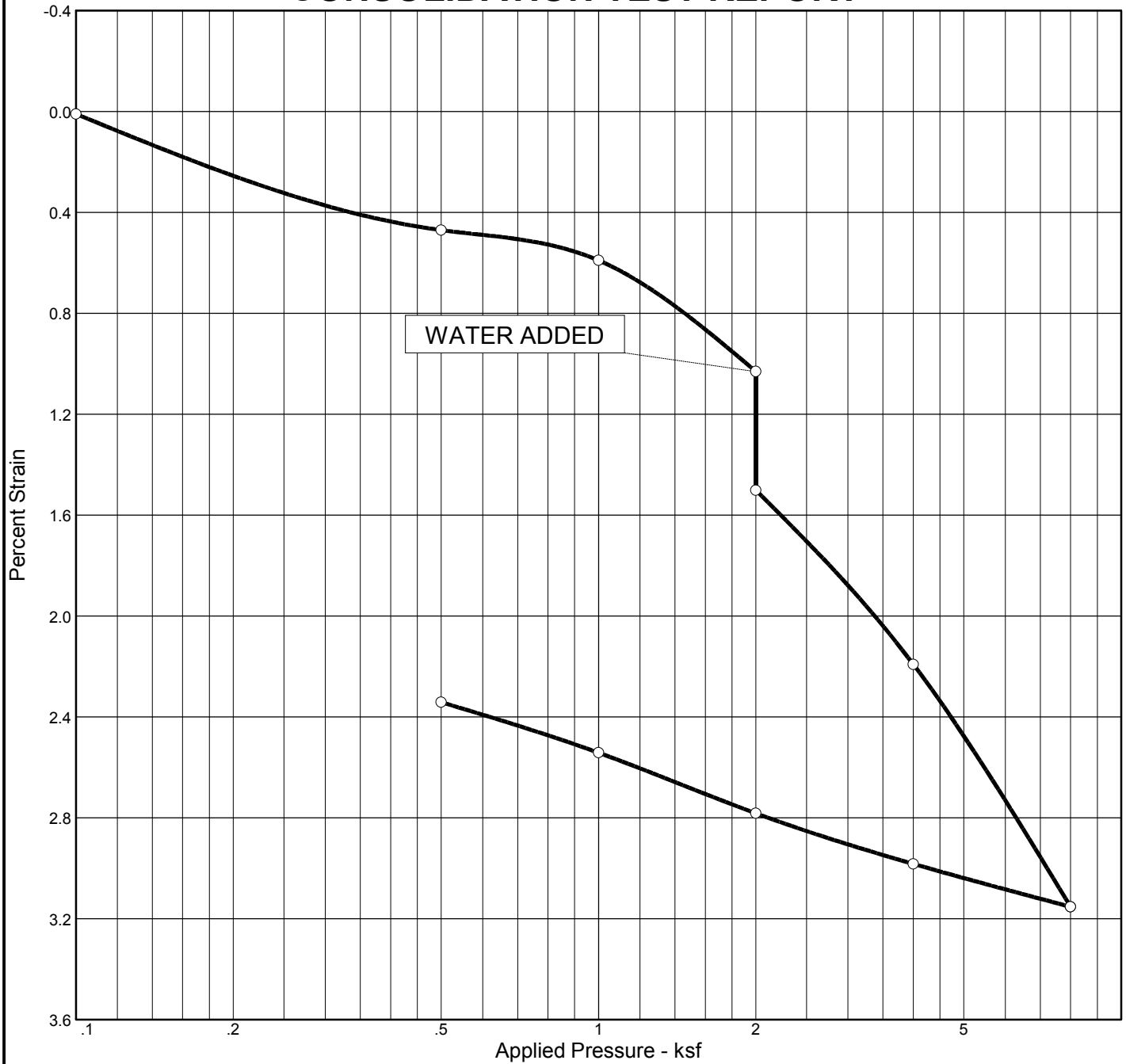
Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P _c (ksf)	C _c	C _s	Swell Press. (ksf)	Swell %	e ₀
Sat.	Moist.											
17.8 %	2.3 %	123.4			2.65		2.51	0.05	0.01	3.14	0.4	0.341

MATERIAL DESCRIPTION	USCS	AASHTO
Clayey sand	SC	

Project No. G71523.02 Client: Project: Proposed Circle K Source: Sample No.: B-3 Elev./Depth: 5-6.3'	Remarks:
Moore Twining Associates, Inc. Fresno, CA	

Figure

CONSOLIDATION TEST REPORT

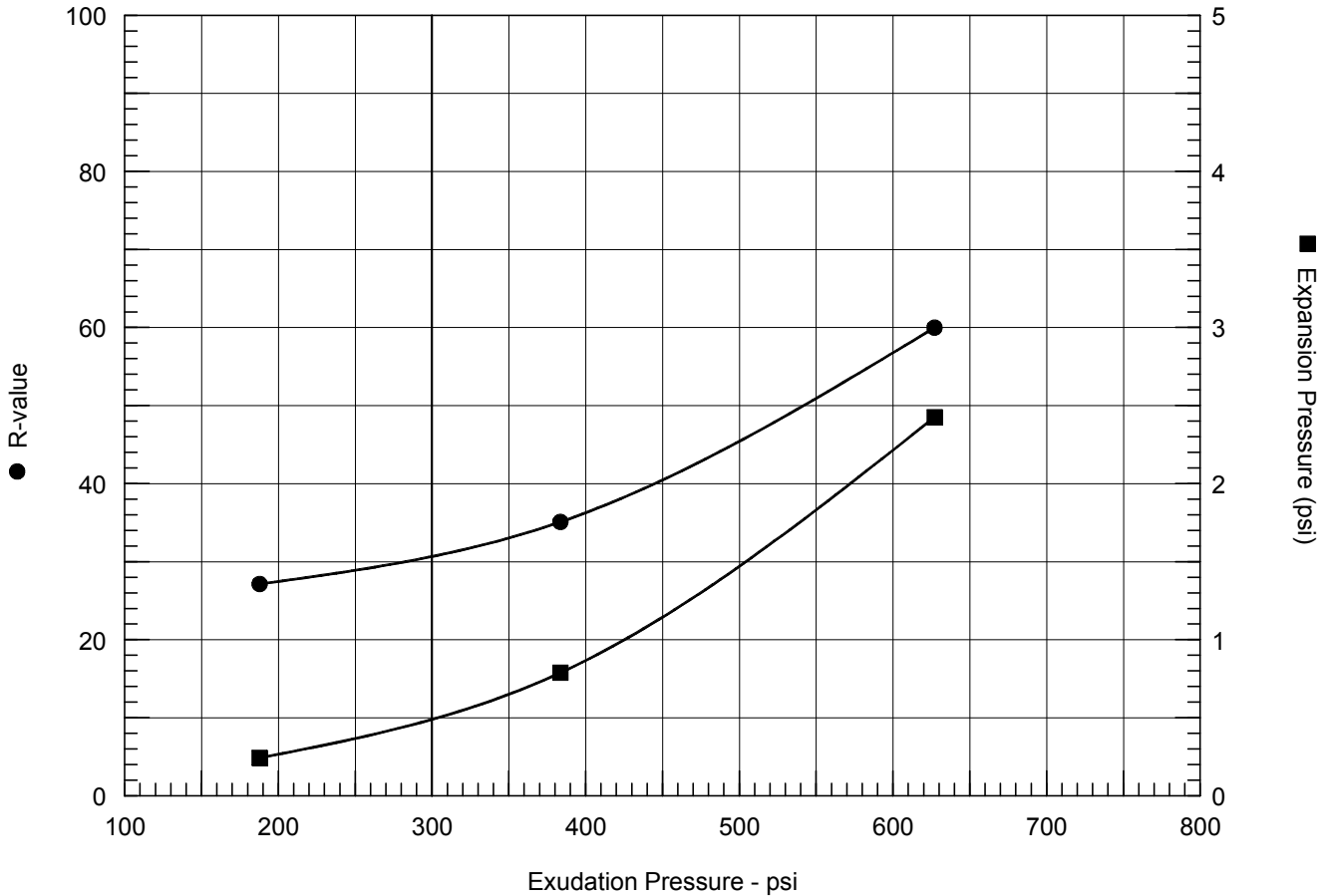


Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P _c (ksf)	C _c	C _s	Swell Press. (ksf)	Clpse. %	e ₀
Sat.	Moist.											
51.3 %	16.7 %	88.9			2.65		1.38	0.06	0.01		0.5	0.860

MATERIAL DESCRIPTION	USCS	AASHTO
Sandy silt	ML	

Project No. G71523.02 Client: Project: Proposed Circle K Source: Sample No.: B-5 Elev./Depth: 8.5-10' <div style="text-align: center; border: 1px solid black; padding: 5px;"> Moore Twining Associates, Inc. Fresno, CA </div>	Remarks: <div style="text-align: right; padding-top: 20px;">Figure</div>
---	---

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - ASTM D 2844

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	350	107.4	20.2	2.43	58	2.60	627	57	60
2	250	104.5	21.5	0.79	86	2.55	384	35	35
3	150	102.0	23.2	0.24	102	2.64	188	25	27

Test Results	Material Description
<p>R-value at 300 psi exudation pressure = 31</p> <p>Exp. pressure at 300 psi exudation pressure = 0.49 psi</p>	Sandy lean clay
<p>Project No.: G71523.02</p> <p>Project: Proposed Circle K</p> <p>Sample Number: B-6 Depth: 0-3.5'</p> <p>Date: 9/4/2020</p>	<p>Tested by: GC</p> <p>Checked by: MS</p> <p>Remarks:</p>
<p>R-VALUE TEST REPORT</p> <p>Moore Twining Associates, Inc.</p>	



Project No: Proposed Circle K
Project: G71523.02

Report Date: 8/26/2020

Materials Testing Report ASTM D2974

Sample Location:	B-3 @ 5-6.25'	Tested By:	MA
Sampled By:	ZA	Date Tested:	8/20/2020
Sample Date:	8/4/2020		
Material Description:	Clayey sand		

Start Weight, gm:	199.7
Final Weight, gm:	196.60
Tare Weight, gm	62.2
Percent of Organic, %:	2.3



Project No: Proposed Circle K
Project: G71523.02

Report Date: 8/26/2020

Materials Testing Report ASTM D2974

Sample Location:	B-10 @ 5-5.5	Tested By:	MA
Sampled By:	ZA	Date Tested:	8/20/2020
Sample Date:	8/4/2020		
Material Description:	Silty sand		

Start Weight, gm:	<u>152.0</u>
Final Weight, gm:	<u>150.60</u>
Tare Weight, gm	<u>62.0</u>
Percent of Organic, %:	<u>1.6</u>

August 26, 2020

Work Order #: **GH11007**

Zubair Anwar
MTA Geotechnical Division
2527 Fresno Street
Fresno, CA 93721

RE: Proposed Circle K

Enclosed are the analytical results for samples received by our laboratory on **08/11/20** . For your reference, these analyses have been assigned laboratory work order number **GH11007**.

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

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

Sincerely,

Moore Twining Associates, Inc.



Susan Federico
Client Services Representative

MTA Geotechnical Division
2527 Fresno Street
Fresno CA, 93721

Project: Proposed Circle K
Project Number: G71523.02
Project Manager: Zubair Anwar

Reported:
08/26/2020

Analytical Report for the Following Samples

Sample ID	Notes	Laboratory ID	Matrix	Date Sampled	Date Received
B1 @ 0 -3.5		GH11007-01	Soil	08/05/20 00:00	08/11/20 11:15
B4 @ 0 -3.5		GH11007-02	Soil	08/05/20 00:00	08/11/20 11:15

MTA Geotechnical Division
2527 Fresno Street
Fresno CA, 93721

Project: Proposed Circle K
Project Number: G71523.02
Project Manager: Zubair Anwar

Reported:
08/26/2020

B1 @ 0 -3.5

GH11007-01 (Soil)

Sampled: 08/05/20 00:00

Analyte	Flag	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method
Inorganics									
Chloride		ND	6.0	mg/kg	3	B0H2408	08/24/20	08/24/20	ASTM D4327
Chloride		ND	0.00060	% by Weight	3	[CALC]	08/24/20	08/24/20	ASTM D4327
Sulfate as SO4		0.00094	0.00060	% by Weight	3	[CALC]	08/24/20	08/24/20	ASTM D4327
pH		7.1	0.10	pH Units	1	B0H2408	08/24/20	08/24/20	ASTM D4972 Mod
Sulfate as SO4		9.4	6.0	mg/kg	3	B0H2408	08/24/20	08/24/20	ASTM D4327

B4 @ 0 -3.5

GH11007-02 (Soil)

Sampled: 08/05/20 00:00

Analyte	Flag	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method
Inorganics									
Chloride		ND	6.0	mg/kg	3	B0H2408	08/24/20	08/24/20	ASTM D4327
Chloride		ND	0.00060	% by Weight	3	[CALC]	08/24/20	08/24/20	ASTM D4327
Sulfate as SO4		ND	0.00060	% by Weight	3	[CALC]	08/24/20	08/24/20	ASTM D4327
pH		6.3	0.10	pH Units	1	B0H2408	08/24/20	08/24/20	ASTM D4972 Mod
Sulfate as SO4		ND	6.0	mg/kg	3	B0H2408	08/24/20	08/24/20	ASTM D4327

Notes and Definitions

- µg/L micrograms per liter (parts per billion concentration units)
- mg/L milligrams per liter (parts per million concentration units)
- mg/kg milligrams per kilogram (parts per million concentration units)
- ND Analyte NOT DETECTED at or above the reporting limit
- RPD Relative Percent Difference

Analysis of pH, filtration, and residual chlorine is to take place immediately after sampling in the field.
If the test was performed in the laboratory, the hold time was exceeded. (for aqueous matrices only)



MOORE TWINING

CHAIN OF CUSTODY / ANALYSIS REQUEST

2527 FRESNO STREET • FRESNO, CA 93721 • PHONE (559) 268-7021 • FAX: (559) 268-0740

ANALYTICAL CHEMISTRY DIVISION
CALIFORNIA ELAP CERTIFICATION # 1371

WORK ORDER #: 2GH11007
PAGE 1 OF 2

REPORT TO: ATTENTION: Zubair Ansvar
INVOICE TO:
REPORT COPY TO:
REPORTING: STANDARD FORMAT, EDT (SWRCB), GEOTRACKER/COELT (LUFT), COUNTY ENVIRONMENTAL HEALTH, STATE WATER RESOURCES CONTROL BOARD, OTHER

SAMPLE INFORMATION: SAMPLED BY, SIGNATURE, PUBLIC SYSTEM, PRIVATE WELL, OTHER, ROUTINE, REPEAT, REPLACEMENT, TURN AROUND TIME
SAMPLE TYPES: SOLID (BS, CR, SL), LIQUID (DW, GW, OL, SF, ST, WW)
PROJECT INFORMATION: CONTRACT / P.O. NO., PROJECT: Proposed Circle k, PROJECT NUMBER: G71523.02, PROJECT MANAGER: Zubair Ansvar

Table with columns: LAB USE, CLIENT SAMPLE ID, DATE, TIME, TYPE, ANALYSIS REQUESTED, STATION CODE. Includes handwritten entries for samples B1e0-35 and B4e0-35 with date 8/4-5/20 and type SL.

COMMENTS / ADDITIONAL INSTRUCTIONS:

Table with columns: RELINQUISHED BY, COMPANY, DATE, TIME, RECEIVED BY, COMPANY. Includes handwritten signatures and dates.

Payment for services rendered as noted herein are due in full within 30 days from the date invoiced. If not so paid, account balances are deemed delinquent. Delinquent balances are subject to monthly service charges and interest specified in MTA's current Standard Terms and Conditions for Laboratory Services.

COC Info	Was temperature within range? Chemistry $\leq 6^{\circ}\text{C}$ Micro $< 10^{\circ}\text{C}$ Temp <u> </u> $^{\circ}\text{C}$ if samples were taken today, is there evidence that chilling has begun? Recvd <u> </u> $^{\circ}\text{C}$	Yes		No		Did all bottle labels agree with COC? Was a sufficient amount of sample received? Were correct containers and preservatives received for the tests requested?	Yes		No		Were there bubbles in VOA vials? (Volatiles Only) Was PM notified of discrepancies? PM: By/Time:	Yes		No	
		Yes	No	Yes	No		Yes	No	Yes	No					
Do samples have a hold time < 72 hours? 125ml (A) 250ml (B) 1Liter (C) 40ml VOA (V)		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Bacti Na ₂ S ₂ O ₃															
None (P)															
Cr6 Buffer (P) Borate Carbonate Buffer															
HNO ₃ (P)															
H ₂ SO ₄ (P)															
NaOH (P)															
NaOH+ZnAc (P)															
Dissolved Oxygen 300ml (P)															
None (AG)															
None (CG) 500ml															
Na ₂ S ₂ O ₃ 250ml (Brown P) 549															
Na ₂ S ₂ O ₃ (AG)															
Na ₂ S ₂ O ₃ (AG)															
Thio/K Citrate															
NH ₄ Cl (AG) 552															
HCl (AG)															
None (CG) 500ml															
H ₃ PO ₄ (AG)															
Other:															
Plastic Bag															
Low Level Hg/Metals Double Bag															
Client Own															
Glass Jar: 125/ 250/ 500															
Soil Tube: Brass/ Steel/ Plastic															
5 g Encore															
Ascorbic Acid (AG) Voa															
1gallon Cubitainer															

Labeled by: @
 Labels checked by: @ 1150
 Filter or Split
 S P F
 S P F
 S P F
 S P F
 S P F
 Container
 Preservative
 Date/Time/Initials



Project Name: Proposed Circle K
Project Number: G71523.02
Subject: Minimum Resistivity, ASTM G187
Material Description: Clayey sand
Location: B-1 @ 0-3.5'

Report Date: 8/26/2020
Sample Date: 8/4/2020
Sampled By: ZA
Tested By: MA
Test Date: 8/20/2020

Laboratory Test Results, Minimum Resistivity - ASTM G187

<u>Total Water Added, mls</u>	<u>Resistivity, Ohm-cm</u>
<u>75 mls</u>	<u>9,300</u>
<u>100 mls</u>	<u>7,100</u>
<u>125 mls</u>	<u>3,700</u>
<u>150 mls</u>	<u>930</u>
<u>175 mls</u>	<u>720</u>
<u>200 mls</u>	<u>690</u>
<u>225 mls</u>	<u>2,200</u>

Remarks: Min. Resistivity is 690 Ohm-cm



Project Name: Proposed Circle K
Project Number: G71523.02
Subject: Minimum Resistivity, ASTM G187
Material Description: Clayey sand
Location: B-4 @ 0-3.5'

Report Date: 8/26/2020
Sample Date: 8/4/2020
Sampled By: ZA
Tested By: MA
Test Date: 8/20/2020

Laboratory Test Results, Minimum Resistivity - ASTM G187

<u>Total Water Added, mls</u>	<u>Resistivity, Ohm-cm</u>
<u>75 mls</u>	<u>19,000</u>
<u>100 mls</u>	<u>11,000</u>
<u>125 mls</u>	<u>6,400</u>
<u>150 mls</u>	<u>6,000</u>
<u>175 mls</u>	<u>5,800</u>
<u>200 mls</u>	<u>6,300</u>

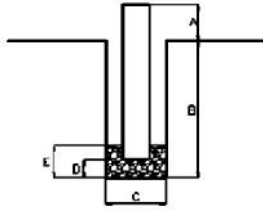
Remarks: Min. Resistivity is 5,800 Ohm-cm

APPENDIX D
RESULTS OF PERCOLATION TESTS

**PERCOLATION TEST FOR INFILTRATION ESTIMATE
P-2**

**Project: Proposed Circle K Store
Location: Roseville, CA**

**Project No. G71523.02
Test Date: 8/5/2020**



21
 2
 33
 2
 2

21
 2
 33
 2
 2

2
 11
 2

2

Test No.	Time (min)	Water Level (in)	Water Level (in)	Water Level (in)	Water Level (in)	Water Level (in)	Water Level (in)
1	0:02:20	32	32	3	1	33	
	0:02:20	33	32	3	1	33	
2	0:02:20	32	32	3		1	
	0:02:20	33	33	3		1	
3	0:02:20	33	33	3			
	0:02:20	33	33	3	1.2		
4	0:02:20	33	33	3			
	0:02:20	33	33	3	1		