APPENDIX 5

Geotechnical Investigation Technical Memorandum

Technical Memorandum
GEOTECHNICAL INVESTIGATION

Prepared for

Mission Springs Water District (MSWD)
West Valley Water Reclamation Facility (WVWRF) Design Project
Desert Hot Springs, CA

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October 24, 2018

October 24, 2018

Danny Friend, Project Manager
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Subject: **Geotechnical Investigation**
Technical Memorandum
Mission Springs Water District
West Valley Water Reclamation Facility (WVWRF) Design Project

Dear Mr. Friend,

AECOM Technical Services, Inc. (AECOM) is pleased to provide you with our Geotechnical Investigation Technical Memorandum in support of the proposed West Valley Water Reclamation Facility (WVWRF) Design project.

The scope of work included a site-specific subsurface exploration, laboratory testing, geotechnical engineering analyses, earthwork and foundation recommendations and preparation of this Geotechnical Investigation memorandum. This memorandum presents the findings from our subsurface exploration, our interpretation of the subsurface conditions encountered, the results from laboratory testing, and conclusions and recommendations pertaining to the geotechnical aspects of the design and construction.

We hope this memorandum meets your current project needs. If you require additional information, please contact the undersigned, Praveen Yerra, at (714) 567-2492 or Praveen.yerra@aecom.com

Sincerely,

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ACRONYMS

AECOM	AECOM Technical Services, Inc. (CONSULTANT)
AB	aggregate base
ASTM	ASTM International
bgs	below ground surface
bpf	blows per foot, i.e., blow count
Cal/OSHA	California Occupational Safety and Health Administration
Caltrans	California Department of Transportation
CBC	California Building Code
CGS	California Geological Survey
CMB	crushed miscellaneous base
deg	degree
ft	feet
GLA	GeoLogic Associates
HMA	Hot mix asphalt
ksf	kips per square foot
LCI	Landmark Consultants, Inc.
MSWD	Mission Springs Water District (CLIENT)
OWC	optimum water content
PCC	portland cement concrete
psi	pounds per square inch
pci	pounds per cubic inch
ppm	parts per million
psf	pounds per square feet
PVC	polyvinyl chloride
RCFCWCD	Riverside County Flood Control and Water Conservation District
WVWRF	West Valley Water Reclamation Facility
SPT	Standard Penetration Test
TI	Traffic Index
TM	Technical Memorandum
USEPA	United States Environmental Protection Agency

Section 1 – Introduction

1.1 General

The site comprises two locations in the vicinity of North Palm Springs, California, as shown on Figure 1. The first location, at approximately 33.906721°N, 116.529044°W, is the planned primary location of the proposed Mission Springs Water District (MSWD) West Valley Water Reclamation Facility (WVWRF), southeast of North Palm Springs. The alternate site location, at approximately 33.943012°N, 116.534067°W, is tentatively chosen as an alternative location for off-site spreading basins for discharge of the treated water if the primary location is deemed unsuitable for treated water discharge. The alternate site is located northeast of North Palm Springs.

1.2 Scope and Purpose

This Technical Memorandum (TM) has been prepared to present the results of our geotechnical investigation and recommendations for the design and construction of the proposed WVWRF for MSWD in North Palm Springs, California. This memorandum provides the findings from geotechnical field exploration and laboratory testing, interpretation of the geologic and geotechnical conditions encountered, and recommendations for the proposed WVWRF including the spreading basins.

Our scope-of-work included:

- Review of available geotechnical information.
- Subsurface exploration including infiltration testing and drilling, sampling and logging of hollow-stem auger borings.
- Laboratory testing on selected soil samples.
- Interpretation of the geologic and geotechnical conditions encountered.
- Conducting engineering evaluations and analyses to develop recommendations for the design and construction of the MSWD WVWRF.
- Preparation of this TM that addresses the geotechnical aspects of the proposed WVWRF design and construction.

Appendix A presents the geotechnical boring logs for the current investigation as well as select boring logs that are relevant to this project from previous exploration programs performed by others. **Appendix B** presents the results from our infiltration testing. **Appendix C** presents the laboratory test results. **Appendix D** presents calculations that support the geotechnical recommendations provided in this report.

1.3 Summary of Findings

As part of the scope of work, AECOM collected available geotechnical data and identified locations where additional information was necessary for preliminary evaluation. Based on the identified data gaps, AECOM completed geotechnical borings at 10 locations with depths ranging between 21 feet and 50.5 feet below ground surface (bgs). Temporary wells were installed at four () of the boring locations for the purpose of infiltration testing to study soil permeability characteristics. From the borings, soil samples were collected and tested and site data were analyzed for development of preliminary geotechnical recommendations for the proposed WVWRF.

Summary of findings from this TM:

- Subsurface soils encountered during the field exploration consist of medium dense to very dense silty sands and poorly graded sands with silt and gravel.
- While no cobbles or boulders were encountered during the geotechnical investigation for this project or in the LCI Report (2008), cobble and boulders were encountered throughout MSWD's solar project site, adjacent to (to the north) this site and are indicated on the boring logs from that project (BSK Associates, 2015). Cobbles and boulders were also encountered during the drilling of Well 33 and indicated in the geotechnical report by GeoLogic Associates (GLA, 2004). Therefore, the possibility of encountering cobbles and boulders and difficult excavation conditions is considered likely and contractors bidding the work should consider this in estimating the construction means, methods, schedule and cost.
- Soil is non-corrosive in accordance with the Caltrans corrosion guidelines (Caltrans, 2015).
- Groundwater was not encountered during this geotechnical investigation or in previous investigations. Groundwater level is expected to be as deep as 230 feet bgs. However, the possibility of seasonal fluctuations in groundwater due to precipitation or perched water cannot be discounted.
- Recent publications do not indicate mapped faults crossing the site (CGS, 2010). The potential fault rupture hazard at the site is considered low to moderate. However, the site is likely to be subject to seismic shaking at some time in the future. The subsurface soils at the site correspond to the International Building Code Site Class Type D.
- Shallow foundations are a proposed option for the project site. It is anticipated that all structures will be founded on mat foundations or slabs-on-grade.
- Due to the presence of loose soils at the anticipated bottom of foundation elevation, it is recommended that soils within 3 feet from the bottom of foundation or slab on grade be removed and replaced with structural fill following recommendations in this TM.
- Unsupported temporary slopes with conditions similar to those encountered during the exploration (Cal/OSHA Type C soils) should be made at an inclination no steeper than 1.5:1 (horizontal to vertical), or flatter if field conditions dictate.
- As soil conditions may vary, the contractor should employ an excavation competent person as defined by Cal/OSHA to determine all aspects of excavation safety.
- Majority of the project site soils are suitable for use as structural fill provided it meets the requirements outlined in **Section 5.2.5** of this TM**.**

Section 2 – Geotechnical Exploration and Laboratory Testing

2.1 Field Work

AECOM conducted a geotechnical field exploration at the project site from September 26th through October 4th, 2017. The exploration program advanced a total of ten (10) hollow-stem auger borings with depths ranging between 20 feet and 50 feet bgs. The borings were drilled across both the primary and alternate site locations for the proposed WVWRF. Of these borings, four (4) were developed into temporary monitoring wells with 2-inch diameter slotted PVC pipe for the purpose of infiltration testing. Approximate locations of the borings are presented in **Figures 2a** and **2b,** and a summary of the exploration program is provided in **Table 1**. Boring and monitoring well logs are provided in **Appendix A**.

An AECOM field representative visually classified the soil cuttings and samples in accordance with the Caltrans Soil and Rock Logging, Classification, and Presentation Manual (Caltrans, 2010), and maintained a detailed record of subsurface materials encountered in the exploratory boring. Driven soil sampling was performed at approximately 5-foot vertical intervals to collect soil samples. Due to the granular nature of the subsurface soils, the majority of samples were collected using standard penetration test (SPT) samplers without liners, in accordance with ASTM International (ASTM) D1586 guidelines. When conditions permitted, California samplers (2.42-inch inside diameter) were advanced to collect relatively intact samples. Both SPT and California samplers were driven 18 inches into the subsurface soils using a 140-pound automatic-trip hammer with successive 30-inch drops. The number of blows required to drive the sampler for the last 12 inches was recorded on the boring records.

Temporary monitoring wells were installed in 20-foot deep boreholes with the bottom ten-foot section consisting of 2-inch inside diameter flush-threaded Schedule 40 polyvinyl chloride (PVC) with a 0.010 inch slot size. The top and bottom of the PVC pipe were fitted with flush threaded plugs (cap). The portion above the slotted PVC pipe was fitted with a solid PVC pipe to allow for infiltration testing only in the bottom 11 to 12 feet of the borehole. It is anticipated that the invert of the proposed spreading basins will be approximately 9 to 10 feet below existing ground surface. The approximate screened interval ranged from 9 to 9.5 feet bgs to a maximum depth of 20.9 to 21.5 feet bgs. The annular space around the PVC pipe within the borehole was filled with sand filter pack from the bottom of the borehole to approximately 3 to 4 feet above the screened interval (5 to 6 feet bgs). The filter pack consisted of rounded to sub-rounded graded #2/12 sand. Above the sand pack, 1 foot of ¼-inch bentonite “time release” pellets were placed. The upper 5 feet of annular space above the bentonite pellets zone was grouted using Portland cement/ bentonite slurry. Following construction of the well, water was continuously added to the borehole for approximately 15 minutes to flush any debris out the threaded screens.

Table 1 – Summary of Geotechnical Field Exploration

Boring Number[1]	Maximum Boring Depth (ft)	Latitude (deg.)[2]	Longitude (deg.)[2]	Approximate Ground Surface Elevation (ft)[2]	Temporary Well Installed?
A-17-001	21.5	33.903680°	-116.528750°	717	Y
A-17-002	21.5	33.903920°	-116.530230°	718	Y
A-17-003	41.5	33.907970°	-116.529581°	745	N
A-17-004	32	33.908510°	-116.528919°	750	N
A-17-005	40.3	33.908070°	-116.530740°	746	N
A-17-006	50.1	33.909800°	-116.530211°	761	N
A-17-007	50.2	33.909720°	-116.530800°	760	N
A-17-008	20.9	33.946298°	-116.535102°	1028	Y
A-17-009	50.3	33.942640°	-116.533889°	996	N
A-17-010	21	33.940944°	-116.533340°	984	Y

[1] A – Hollow-stem auger

[2] Locations based on GPS; elevations based on USGS topographic maps and were converted to North American Vertical Datum of 1988.

2.2 Borehole Abandonment

Boreholes that were not developed into temporary wells were backfilled by pumping a mixture of cement and bentonite grout through a tremie pipe that was lowered to the bottom of the borehole. The upper 6 inches near existing ground at each bored hole was capped with soil cuttings to match existing subsurface conditions. The surrounding ground surface was reinstated to match surroundings following borehole completion. The boring logs are provided in **Appendix A.**

2.3 Infiltration Testing

Infiltration tests were conducted at four boring locations: A-17-001 & A-17-002 (primary WVWRF site) and A-17-008 & A-17-010 (alternate off-site spreading grounds site) to evaluate the in-situ soil permeability characteristics. The boring infiltration testing method followed the procedure outlined in “Riverside County – Low Impact Development BMP Design Handbook” for the Santa Ana River watershed by Riverside County Flood Control and Water Conservation District (RCFCWCD, 2011).

Prior to performing the boring infiltration tests, each test hole was pre-soaked for two hours by continuously filling the borehole with clean water. Following the pre-soaking period, the test boring was refilled with water to at least five times the hole’s radius. General subsurface conditions at the infiltration boring locations indicate dry loose granular soils with high infiltration rates. This was confirmed in the field as the first two consecutive rates of water drop measurements in the borehole indicate six inches of water dissipates into the surrounding soils through the PVC slots in less than 25 minutes. The drop in water level was measured from the top of casing at pre-determined time intervals. In order to capture a reasonable rate that can be measured in the field, the time interval for water level measurements was adjusted for each of the borehole locations. The time interval between water level readings for each well varied between 4 minutes and 10 minutes due to the quick rate of water level drop in the casings. The hole was refilled with clean water after every reading to the fixed reference point at all test locations (A-17-001, A-17-002, A-17-008 and A-17-010). Occasionally to allow for faster and more accurate measurement of water levels or lack of enough water available for refilling the borehole, measurements were taken without filling the borehole to the top of the casing after every reading. The drop in water level measured is the infiltration rate which relates to the speed at which water progresses downward and laterally through the soil. The test was performed for at least one hour, consisting of at least six measurements taken with a precision of 0.25 inches or better.

Based on the BMP Design Handbook, Appendix A, Section 2.3, the tested infiltration rates are derived converted from the measured percolation rates using the "Porchet Method" (RCFC, 2011). Both the measured percolation rates and the tested infiltration rates are presented in **Appendix B**. The procedure calls for using the last reading as the rate of infiltration. Based on the calculations from various borings, the rate of infiltration at the primary site varied between 5 and 9 inches/hour and the rate varied between 5 and 11 inches/hour at the alternate spreading ground site.

2.4 Laboratory Testing

Laboratory testing was performed primarily at AECOM's geotechnical laboratory in Santa Ana. Select samples were tested to confirm or modify (if necessary) the visual classification of the soils from the field identification, and to evaluate their physical and engineering properties. Tests performed include soil classification (ASTM D2487), water content determination (ASTM D2216), in-situ density (ASTM D7263), Atterberg limits (ASTM D4318), wash analysis (ASTM D1140), sieve analysis (ASTM D6913), direct shear (ASTM D3080), and swell or settlement potential (ASTM D4546).

Corrosivity (Caltrans test methods 417, 422 and 643) tests were performed by the HDR laboratory in Claremont, California, and R-value (Caltrans test method 301) tests were performed by AP Engineering and Testing, Inc. in Pomona, California.

A description of the laboratory testing and the test results are presented in **Appendix C**.

Section 3 – Geology and Subsurface Conditions

3.1 Regional Geology

The project area lies within the Colorado Desert geomorphic province of California. A major feature of the Colorado Desert geomorphic province is the Salton Trough, a seismically active extensional basin influenced by the movement along the San Andreas Fault, which separates the Pacific Plate to the west and the North American Plate to the east. The Salton Trough is a large northwest-southeast oriented basin filled with alluvial sediments that have been shed off the surrounding mountains and subsequently carried down the valley towards the Salton Sea via alluvial fan and fluvial processes (e.g., Mission Creek and Whitewater River drainage systems in Coachella Valley). The Coachella Valley forms the northern part of the basin, which opens up to the much broader Imperial Valley to the southeast. The northeastern side of the basin is bound by the Little San Bernardino Mountains and the Chocolate Mountains. The southwestern side of the basin is bound by the San Jacinto Mountains and the Santa Rosa Mountains. The surrounding mountains are typically composed of crystalline basement rock. The material filling the basin is predominantly Quaternary aged alluvial fan, fluvial and lacustrine deposits. Early Quaternary/ late Tertiary sedimentary deposits crop out forming small hills within the valley as geomorphic expressions of the San Andreas Fault (CDMG, 1965). **Figure 3** shows a regional geologic map of the project site. Local fault strands from the San Andreas Fault system are also shown.

The proposed locations of the WVWRF and off-site spreading basins lie within the northwestern end of the Coachella Valley. The site is on a gentle south-sloping alluvial fan surface within the general influence of the Mission Creek Drainage. A primary wash of the Mission Creek drainage system lies approximately 0.15 miles to the east of the WVWRF site. The subsurface deposits at the site are derived from Late Holocene alluvial wash deposits (Qw) and Holocene to Late Pleistocene alluvial valley deposits (Qya) (California Geological Survey [CGS], 2012).

3.2 Project Site Soils

Subsurface conditions were examined based on the recent AECOM subsurface investigation and a review of boring logs from previous investigations performed at MSWD Well 33 (GLA, 2004; LCI, 2008). **Figures 4a and 4b** show the proposed main WVWRF and the alternative off-site spreading basins are underlain by alluvial soils. The alluvial soils are typically medium dense to very dense silty sands and poorly graded sands with silt and gravel.

At the primary WVWRF location, two layers of alluvium can be distinguished based on the subsurface material properties. The upper alluvium layer is composed predominantly of medium dense to dense poorly graded sand with silt and loose to dense well-graded sand with silt. A thin layer of medium dense sandy silt was observed at boring A-17-003. The lower alluvium layer is denser, has slightly lower water content, and increased content of fines. The lower alluvium layer is composed predominantly of medium dense to very dense silty sand, poorly graded sand with silt, and well-graded sand with silt. The uppermost 3 feet of alluvial soils are found to be very loose, and will require removal during excavation. Details on other excavation considerations are located in **Section 5.2.2**.

At the off-site location, highly variable alluvium consisting of medium dense to very dense poorly graded sand with silt and silty sand, and very dense well-graded sand with silt are found to the maximum depths explored (20.9 to 50.5 feet bgs). Generalized subsurface profiles at the proposed primary WVWRF site and the alternative off-site location for the spreading basins are presented in **Table 2** and **Table 3**, respectively.

Table 2 – Generalized Subsurface Material Properties – Primary MSWD WVWRF Site

Geologic Unit	**Soil Description**	**Approximate Depth bgs**	**SPT $N_{60}^{2,3}$ Values (bpf)**	**Index Properties**		
				Water^2 Content (%)	**Dry Unit Weight^2 (pcf)**	**Fines Content^2 (%)**
UPPER ALLUVIUM	Med. dense to dense Poorly-graded Sand with Silt (SP-SM); Loose to dense Well-graded Sand with Silt (SW-SM)	Northern extent: 0-15ft; Center: 0-20ft Southern Extent: 0-14ft.	Granular Soil			
			12 to 51 (28)	<1 to 22 (2)	110-118 (115)	5 to 9 (7.5)
	Med. dense Sandy Silt (ML)	Center: 20-22ft	Fine Grained Soil			
			26 (26)	--	--	--
LOWER ALLUVIUM	Med. dense to v. dense Silty Sand (SM), Med. dense to v. dense Poorly-graded Sand with Silt (SP-SM), Med. dense to v. dense Well-graded Sand with Silt (SW-SM); Dense to v. dense Poorly-graded Sand (SP)	Northern extent: Elev. 15-50ft; Center: 15-40ft Southern Extent: 15-20ft	Granular Soil			
			25 to 100 (55)	<1 to 10 (1)	--	4 to 49 (13)
	V. dense Sand with Silt (SP-SM)	Northern extent: 45-50ft	Clayey Soil			
			65 (65)	<1 (<1)	--	--

Notes:
(1) Subsurface profile based on borings A-17-B1 through A-17-B7.
(2) Test values shown in low-high range with average value in parenthesis.
(3) SPT-N_{60}: SPT blow count adjusted for standard hammer efficiency of 60%.
(4) bpf: blow counts per foot; pcf: pounds per cubic foot; psf: pounds per square foot; ksf: kips per square foot.

Table 3 – Generalized Subsurface Material Properties – Alternative Off-site Spreading Basins

Geologic Unit	Soil Description	Approximate Depth bgs	SPT $N_{60}^{2,3}$ Values (bpf)	Index Properties		
				Water^2 Content (%)	Dry Unit Weight^2 (pcf)	Fines Content^2 (%)
			Granular Soil			
ALLUVIUM	Med. dense to v. dense Poorly graded Sand with Silt (SP-SM), V. dense Well-graded Sand with Silt (SW-SM), Med. dense to v. dense Silty Sand (SM)	0-50ft	17 to 100 (76)	0 to 2 (<1)	98 to 112 (105)	6 to 21 (10)

Notes:
(1) Subsurface profile based on borings A-17-B8 through A-17-B10.
(2) Test values shown in low-high range with average value in parenthesis.
(3) SPT-N_{60}: SPT blow count adjusted for standard hammer efficiency of 60%.
(4) bpf: blows per foot, i.e., blow count; pcf: pounds per cubic foot; psf: pounds per square foot; ksf: kips per square foot.

Two prior subsurface investigations were performed at the project site. The first report was completed by GeoLogic Associates in September, 2004 and is titled “Geotechnical Report, Garnet Well Suction Reservoir, Mission Springs Water District, Desert Hot Springs, Riverside County, California.” One soil boring was performed to 30.5 feet bgs during this investigation. Well-graded sand with gravel with increasing gravel content starting at 19 feet bgs was reported in the boring. Blow counts indicated medium dense materials above approximately 15 feet bgs, and dense materials below. No groundwater was encountered during drilling.

The second subsurface investigation was performed by Landmark Consultants, Inc. in April 2008 titled “Geotechnical Investigation Report, Proposed Future Regional Wastewater Facility, Desert Hot Springs, California.” The investigation included ten soil borings across the site that varied in depth from 38.5 to 51.5 feet bgs. Materials reported on the borings logs were a combination of poorly graded sand, silty sand, gravelly sand and gravelly silty sand. A thin interbed of sandy silt was reported in boring B-2. Apparent densities of the material ranged from medium dense to dense with few very dense layers. The very dense layers typically occurred in gravelly deposits, and the high blow counts are likely more a reflection of the gravel content than of the soil’s relative density. No groundwater was encountered in any of the borings during drilling to the maximum depth explored of 51.5 feet bgs.

Cobble and boulders were encountered throughout MSWD's solar project site, adjacent to (to the north) this site and was indicated on the geotechnical report prepared for that project (BSK Associates, 2015). Majority of the borings for the solar project encountered refusal due to cobbles between 5 feet and 17 feet bgs. Significant amounts of cobbles and boulders were encountered during the installation of short c-channel piles at MSWD's solar project site, adjacent (to the north) to this site. The piles were driven to a maximum depth of 8.5 feet bgs, and cobbles and/or boulders were encountered at approximately 102 of the 620 locations. Based on information available from MSWD representatives who provided construction observation for the construction of the pile foundations, the cobbles and boulders prevented pile driving and had to be removed by excavation. Cobbles and boulders are also evident from the drilling log for well No. 33, where cobbles and boulders were encountered continuously from the ground surface up to a maximum depth of 150 feet bgs. The geotechnical report by Geologic Associates (GLA, 2004) prepared for Well No. 33 indicated cobbles to the maximum depth explored of 30 feet bgs.

3.3 Groundwater

Due to multiple splays of the San Andreas Fault transecting the Coachella Valley, the alluvial groundwater aquifer is split into multiple sub-basins (MWH, 2013). The project site lies within the Garnet Hills Sub-basin. Groundwater data from 2009 suggest groundwater elevations in the project vicinity are between 500 and 600 feet. These elevations correspond to a depth to water between 130 and 230 feet below ground surface. Groundwater level measurements from the production well on the north end of the project site shows levels deeper than 150 feet bgs.

Groundwater was not encountered during the previous field investigations in 2004 (GLA, 2004) and 2008 (LCI, 2008) to the maximum depth explored of about 30.5 feet and 51.5 feet below ground surface (bgs), respectively, corresponding to approximately 725.5 feet and 688.5 feet in elevation (National Geodetic Vertical Datum of 1929). Groundwater was not encountered during the recent borings performed for the subject investigation, to the maximum depth explored of about 50.3 feet bgs, at approximately 709 feet elevation (National Geodetic Vertical Datum of 1929). However, the possibility of seasonal fluctuations in groundwater due to precipitation or perched water cannot be discounted.

3.4 Corrosivity

Corrosivity testing was completed as part of this investigation to assess the corrosion potential of the soils. The corrosion tests were completed in accordance with Caltrans test methods and United States Environmental Protection Agency (USEPA) test methods. The results are summarized in **Table 4.**

Table 4 - Summary of Corrosivity Test Results

Boring	Depth (feet)	Approximate Elevation (feet NAVD88)	pH Threshold ≤ 5.5	Minimum Resistivity (Ohm-cm) Threshold ≤ 1,000	Sulfate Content (ppm) Threshold ≥ 2,000	Chloride Content (ppm) Threshold ≥ 500
A-17-003	10	760	9.8	9,600	17	2.0
A-17-006	10	761	11.4	2,400	139	4.5

Notes:
(1) ppm = parts per million. ND = Non Detectable. ohm-cm = ohm-centimeter.
(2) Resistivity is not a corrosion criterion, but an indicator of soluble salts per Caltrans Corrosion Guidelines (Caltrans, 2015).

Caltrans (Caltrans, 2015) considers a site to be corrosive to foundation elements if one or more of the following conditions exist for the soil samples taken from the site:

- Chloride concentration is greater than or equal to 500 parts per million (ppm),
- Sulfate concentration is greater than or equal to 2,000 ppm,
- PH is 5.5 or less.

The minimum resistivity can be an indicator for the relative quantity of soluble salts present in the soil or water. In general, a minimum resistivity value less than 1,000 ohm-cm indicates high soluble salts and higher propensity for corrosion. However, since sulfate and chloride contents were measured, the minimum resistivity is considered an indicator only.

Based on the results of the corrosivity testing, the site is interpreted to be non-corrosive in accordance with the Caltrans corrosion guidelines (Caltrans, 2015).

Section 4 – Geotechnical Evaluations

4.1 Seismicity and Faulting

A summary of the preliminary geotechnical findings is presented below. The WVWRF site lies approximately 400 feet southwest of an Alquist-Priolo Fault Zone pertaining to the San Bernardino Mountain Section of the South Branch of the San Andreas Fault (CDMG, 1980). The fault is considered active within the Holocene time period (CGS, 2010). The mapped fault trace itself lies as near as approximately 1,000 feet northeast of the site of the proposed WVWRF. The North Branch of the San Andreas Fault lies 3.5 miles to the northeast of the site and is also an Alquist-Priolo Zoned Fault. The Garnet Hill Fault is considered a potentially active strand of the San Andreas Fault and lies approximately 0.65 miles to the southwest of the site. Recent publications do not indicate mapped faults crossing the site (CGS, 2010). The potential for fault rupture at the site is considered low to moderate.

The WVWRF site location with respect to nearby faults, as generated by Caltrans' ARS Online Tool (Caltrans, 2017), is shown on **Figure 5**. The South Branch of the San Andreas Fault (referred to as San Bernardino South) is the closest fault and could generate the highest ground motion. The San Andreas San Bernardino South is a strike-slip fault with a vertical (90 degree) orientation. Caltrans has assigned the fault a maximum earthquake magnitude (M_{max}) of 7.9. A summary of fault parameters and distances to this fault and two others for both the primary WVWRF site and the alternative off-site spreading basins site are presented in **Table 5**.

Table 5 – Seismic Parameters for the Significant Faults in the Site Vicinity

Faults (Caltrans Fault ID)	Maximum Earthquake Moment Magnitude (M_{max}) [1]	Fault-Site Distances to WVWRF[1]	Fault-Site Distances to Alternate spreading basins[1]	Fault Type[1]
San Andreas[2] (San Bernardino South Segment) (325)	7.9	0.80 km (0.5 miles)	2.80 km (1.75 miles)	Strike-Slip
San Andreas[2] (San Gorgonio – Garnet Hill Segment) (358)	6.7	1.5 km (0.95 miles)	4.6 km (2.85 miles)	Strike-Slip
San Andreas[2] (San Bernardino North Segment) (294)	7.4	6.0 km (3.7 miles)	3.5 km (2.2 miles)	Strike-Slip

[1] Obtained from Caltrans ARS Online, v2.3.09 (2017)

[2] This fault is a blind thrust fault that does not rupture the ground surface. The distance noted is the distance to the upper limit of the rupture plane in the subsurface provided by Caltrans ARS Online.

4.2 Seismic Parameters

The site will likely be subject to seismic shaking at some time in the future. Seismic ground motion parameters were developed using the USGS website, U.S. Seismic Design Maps. The site coordinates used in the analysis were 33.90605° north latitude, -116.52902° west longitude, which pertains to the primary WVWRF site where new structures are planned. The subsurface soil at the WVWRF site corresponds to International Building Code Site Class Type D based on the average Vs30 of 270 meters per second obtained for the site (Vs30 is the time-averaged shear-wave velocity (Vs) in the upper 30 meters).

Table 6 - Seismic Design Parameters

Parameter	Factor	Value
Mapped Spectral Response Acceleration (0.2 sec Period)	S_S	3.029g
Mapped Spectral Response Acceleration (1.0 sec Period)	S_1	1.222g
Site Class	Site Class	D
Site Coefficient	F_a	1.0
Site Coefficient	F_v	1.5
Maximum Considered Earthquake Spectral Response Acceleration (0.2 sec Period)	S_{MS}	3.029g
Maximum Considered Earthquake Spectral Response Acceleration (1.0 sec Period)	S_{M1}	1.833g
Design Spectral Response Acceleration (0.2 sec Period)	S_{DS}	2.020g
Design Spectral Response Acceleration (1.0 sec Period)	S_{D1}	1.222g
Seismic Design Category: D		

It should be recognized that much of southern California is subject to some level of damaging ground shaking as a result of rupture along the major active (and potentially active) fault zones that characterize this region. Design utilizing the 2016 California Building Code (CBC, 2016) is not meant to completely protect against damage or loss of function. Therefore, the preceding parameters should be considered as minimum design values.

The alternate site will only have discharge basins constructed very close to the surface and they are not considered to be structures that will require seismic design.

4.3 Slope Stability

The topography at the site is relatively flat with very gentle slopes. Due to the relatively flat-lying topographic character of the site, the potential for slope failure is considered low.

For the planned discharge basins, slopes inclined 2:1 (horizontal: vertical) or flatter are considered grossly stable. At this time, detailed design of the planned basins is not available for slope stability analysis. Once the design is available, specific slope stability analysis can be performed and recommendations can be refined.

4.4 Liquefaction

Liquefaction is a phenomenon in which loose to medium dense, saturated, granular materials undergo matrix rearrangement, develop high pore water pressure, and lose significant shear strength because of cyclic ground vibrations induced by earthquakes. This rearrangement and strength loss is followed by a reduction in bulk volume of the liquefied soils. The effects of liquefaction can include development of sand boils, the loss of bearing capacity below foundations, settlement in level ground, large horizontal deformations of relatively level ground with an unconfined vertical face (referred to as lateral spreading) and instability in areas of sloping ground (also known as flow sliding). Liquefaction is generally considered to occur only within about 50 feet of the ground surface.

Due to the lack of presence of groundwater in the upper 50 feet of subsurface, the potential for liquefaction at the site is considered low.

4.5 Tsunami

Tsunamis are large waves in the ocean typically caused by submarine earth processes such as earthquakes, coastal landslides or volcanic eruptions. Tsunamis can travel thousands of miles across the ocean and present a serious hazard to coastal developments. The degree of this hazard strongly depends on the size and type of the source of the tsunami, the exposure of the project site to the open ocean and the direction from which the tsunami is coming. The site has no coastal exposure and therefore very low potential for tsunami hazard.

4.6 Expansion Potential

The on-site material predominantly consists of granular soils. Expansive soils are typically fine grained. Potential for expansive soils should be considered low.

4.7 Collapse Potential

At their dry, natural state, soils with collapse potential possess stiffness and high apparent shear strength; but upon wetting, they could exhibit a significant decrease in volume (described as collapse, hydro-consolidation, or hydro-compression). Such soils, which exhibit this phenomenon at fairly low stresses, are called collapsible soils. Collapsible soils are generally characterized by their loose structure of bulky shaped grains, often in the silt to fine sand size with a small amount of clay. There may be only slight cementing agents such as calcium carbonate, salts and dried clay, with combinations being common. Geologic materials with collapse potential consist of Aeolian, fine alluvial fan deposits, mud flows, flash flood deposits, loosely place fills, and some types of residual soils. Collapse potential is evaluated in terms of collapse index in the laboratory using ASTM D4546, wherein a soil sample is seated in a consolidation apparatus and loaded dry to a selected pressure, then saturated. The collapse potential is defined as the ratio of change in height of a specimen to the original height of the specimen determined at any stress level after wetting of a soil sample and duplicating the in-situ soil conditions of overburden stress and pore water pressure. Collapse Index is very similar to Collapse potential except it is measured at a vertical stress of 2 tons per square feet (tsf) and is used to describe degree of collapse under specified conditions. Table 7 summarizes Collapse Potential Test (ASTM D4546) results for this project:

Table 7 – Summary of Collapse Potential Test Results

Boring ID	Site Location	Sample Depth (ft)	USCS Soil Type	Final Water Content (%)	Final Dry Unit Weight (pcf)	Collapse Potential (%)
ACM-17-B4	WVWRF	5	SW-SM	14	112	0.3
LCI-08-B1	WVWRF	20	SM/SP	17.5	113	0.1
LCI-08-B2	WVWRF	30	SM/SP	21	106	0.2
LCI-08-B7	WVWRF	22	SM/SP	21	107	0.6

Notes:
LCI – Landmark Consultants, Inc. (2008), ACM – AECOM Technical Services (2017)

Table 8 – Degree of Collapse and Ranges of Collapse Index

Degree of Collapse	Collapse Index (%)
None	0
Slight	0.1 to 2.0
Moderate	2.1 to 6.0
Moderately Severe	6.1 to 10.0
Severe	>10

[1]Collapse classification index in accordance with ASTM D5333-03

Based on laboratory test results from current and previous investigations, the site has slight collapse potential.

4.8 Scour

Scour was not considered a design issue at this site. The foundations are not located in rivers/creeks or drainage channels.

Section 5 – Conclusions and Recommendations

5.1 General

Based on the results of our geotechnical investigation and our understanding of the project requirements, the site can be developed for its intended purpose provided the recommendations in this report are incorporated in the design and implemented during earthwork and construction of the project.

Recommendations for earthwork, foundation design, seismic design, floor slab support, pavement design, and corrosion protection considerations are presented below.

5.2 Earthwork

Earthwork should be performed in accordance with the applicable portion of the grading code of the State of California, the City of Desert Hot Springs as well as the recommendations of this report, under the observation and testing of the Geotechnical Engineer. Temporary cut and fill slopes should not be steeper than 1.5:1 (horizontal to vertical).

5.2.1 Site Clearing, Grubbing and Stripping

Prior to starting earthwork, the areas to be excavated, to receive fill, or to receive stockpile materials should be cleared, grubbed and stripped of all topsoil, organic material, vegetation, rubbish, deleterious material, and debris resulting from site demolition (if any). Cleared and grubbed material, as well as all rubble waste that may be encountered or created, should be disposed of offsite. All active or inactive utilities within the construction limits should be identified, marked and relocated, while abandoned utility lines should be removed or backfilled.

The project geotechnical consultant should be notified at the appropriate times to provide observation and testing services during clearing, grubbing and stripping operations to verify compliance with the above recommendations. In addition, should any buried structures or unusual or adverse soil conditions be encountered during grading that are not described or anticipated herein, these conditions should be brought to the immediate attention of the project geotechnical engineer for corrective recommendations.

5.2.2 Temporary Excavations

Excavations during construction should be performed in accordance with applicable local, state, and federal regulations including the current California Occupational Safety and Health Administration (Cal/OSHA) excavation and trench safety standards. Unsupported temporary slopes with conditions similar to those encountered during the exploration (Cal/OSHA Type C soils) should be made at an inclination no steeper than 1.5:1 (horizontal to vertical), or flatter if field conditions so dictate. Surcharge loads from vehicle and equipment parking and traffic, excavated materials, stockpile materials or other sources should be set back from the top of the temporary excavation a horizontal distance equal to or greater than 1.5 times the depth of the adjacent excavation.

Trench excavations might be required for utility lines. Based on available data, the upper few feet of soil are predominately loose, dry and cohesion less soils of low fines content. Temporary excavation sidewalls and utility trench walls, even if less than 4 feet high, might pose a life-threatening cave-in danger if excavated with vertical walls. The contractor's excavation competent person, as defined by Cal/OSHA, should determine all aspects of any trench excavation safety.

Based on our exploratory borings for this investigation, no groundwater was encountered. Therefore, we do not anticipate the need for construction dewatering. However, the possibility of seasonal fluctuations in groundwater due to precipitation cannot be discounted. If groundwater is encountered, dewatering will be required. Surface drainage should be controlled along the top of temporary excavations to prevent wetting of the soils and erosion of the excavated faces. Even with the implementation of these recommendations, sloughing of the walls and slopes of temporary excavations may still occur, and workers should be adequately protected.

It is anticipated that the on-site soils can provide suitable support for underground utilities and piping that may be installed for this project. Any soft, loose and/or unstable material encountered at the bottom of excavations for such facilities should be removed and replaced with an adequate bedding material. A non-expansive granular material with a sand equivalent greater than 20 should be used for bedding and shading of utilities.

Significant amounts of cobbles and boulders were encountered during the construction of MSWD's solar project site, adjacent (to the north) to this site. It is also evident from the well No. 33 drilling log where cobbles and boulders were encountered. Refer to Section 3.2 for further details.

Based on information available from MSWD representatives who observed the construction of pile foundations to support the solar panels for the MSWD solar project site, it was noted that several of the piles encountered refusal during pile driving and warranted excavation to remove large rocks and boulders.

We anticipate the construction excavation slopes to be temporarily stable, provided the above recommendations are followed. However, modifications to these recommendations may be required based on observations of the actual conditions exposed in the field or the findings of the contractor's competent person. Our temporary excavation recommendations are provided only as general guidelines; as soil conditions may vary, the contractor should employ an excavation competent person as defined by Cal/OSHA to determine all aspects of excavation safety. The design and construction of temporary excavation support systems (e.g., shoring) and temporary slopes, as well as the maintenance and monitoring of these works during construction, are the responsibility of the contractor. All work associated with temporary excavations should meet the minimal requirements as set forth by the California Occupational Safety and Health Administration (Cal/OSHA). Unsupported temporary slopes with conditions similar to those encountered during the exploration should be made at an inclination no steeper than 1.5:1 (horizontal to vertical), or flatter, as field conditions dictate. Trench excavations should be made with nearly vertical sides, using sheeting and shoring whenever required. All excavation should be observed by a geotechnical engineer of record or a representative so that any necessary modifications based on variations in soil conditions encountered can be performed in an efficient manner. Soils encountered during our field investigation are expected to be excavatable using conventional excavation and grading equipment. All applicable safety requirements and regulations, including Cal/OSHA regulations, should be satisfied. Locally, there is a potential for cobbles, boulders, or cemented materials that may require hard excavation. Raveling of gravel and cobbles should be expected in excavations and could pose a potential safety concern to the construction personnel.

For design purposes, an equivalent fluid weight of 37 pcf, based on an active lateral earth pressure condition, may be used to estimate lateral earth pressure above the groundwater. For portions subject to submergence below groundwater (if encountered), use 17 pcf of equivalent fluid pressure along with the hydrostatic pressure. Hydrostatic pressure should be added to the active earth pressure where the shoring will be submerged.

Surcharge pressures (dead or live) should be added to the above lateral earth pressures where surcharge loads may be located adjacent to the shoring. Surcharge pressures should be applied as a uniform (rectangular) pressure distribution by using a lateral earth pressure coefficient of 0.35. The above coefficient assumes a uniform surcharge load.

Surcharge loads from vehicle/equipment parking and traffic or stockpile materials should be set back from the top of the temporary excavation a horizontal distance equal to at least 1.5 times the depth of excavation. Surface drainage should be controlled along the top of temporary excavations to prevent wetting of the soils and erosion of the excavated faces. Even with the implementation of these recommendations, sloughing of the surface of temporary excavations may still occur, and workers should be adequately protected. In any event, excavation and personnel safety during construction is the sole responsibility of the Contractor.

Care should be taken during shoring removal to prevent creation of voids on the face of excavations. If large voids are created during removal, they should be filled with cement slurry or other approved grout mix.

5.2.3 Over excavation

Due to the presence of loose granular soils with high percentage of silt and clay material at the anticipated bottom of footing elevation, it is recommended that soils within 3 feet from the bottom of foundation or slab on grade and soils within 3 feet of the original ground surface be removed and replaced with structural backfill following recommendations in this TM. The compacted fill should extend a minimum of 5 feet beyond the edges of foundation. The proposed structure may be supported on mat foundations bearing on compacted Structural Fill. It is recommended that “Structural Fill” be used within structural zones[1] beneath all foundations and floor slabs.

Excavations during construction should be performed in accordance with applicable local, state, and federal regulations such that excessive ground movement and failure will not occur. Where space permits and provided that adjacent structures, utility lines, etc. are adequately supported, open excavations may be considered for construction of the project.

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[1] A structural zone is defined as the space located below a structure or beneath the planes that pass through the bottom of the structure’s perimeter footings / exterior walls and that are inclined at 1 horizontal to 1 vertical (increasing the horizontal distance from the structure with increasing depth).

5.2.4 Subgrade Preparation

After performing planned excavation and any required over-excavation and prior to placing any Structural Fill, the ground surface within the building footprint should be observed by the geotechnical engineer to confirm that satisfactory subgrade soils have been encountered. If unsatisfactory soil is encountered at the bottom of excavation or natural ground surface, additional removals may be required. The bottom of the exposed excavation should be scarified to a depth of at least 6 inches, moisture conditioned (as necessary) to above the optimum water content (OWC), and then compacted in-place to at least 95% relative compaction as determined by ASTM D1557 at 0 to 3 percentage points above OWC prior to placing compacted fills. Relative compaction is a measure of the degree of soil compaction and is defined as the ratio of the in situ dry density (or unit weight) divided by of the material's maximum dry density (or unit weight) measured by a reference test procedure (ASTM D1557 for this project). Following the scarification, moisture conditioning and compaction process, the subgrade should be proof rolled, probed and tested as appropriate. Proof rolling should involve making several passes over a subgrade with heavy roller equipment.

5.2.5 Structural Fill beneath Structures

The site soils excavated from the project site are generally considered suitable for use as Structural Fill provided they do not contain rocks or hard lumps greater than 3 inches in maximum dimension and have at least 80 percent passing the ¾-inch sieve, at least 25 percent passing the No. 4 sieve and less than 10 percent passing the No. 200 sieve. It is recommended that “Structural Fill” be used beneath all foundations and floor slabs. Structural Fill materials shall be free of organic material, debris, or other deleterious materials. Materials greater than 1 inch in size shall be placed such that they are completely surrounded by compacted finer soils. Backfill material such as pea gravel and crushed rock do not meet the requirements for structural fill due to their relatively high permeability and potential to store water.

Structural Fill materials should have a minimum sand equivalent of 20 and an Expansion Index of 20 or less when tested in the laboratory in accordance with ASTM D2419 and D4829, respectively. Based on the results of the field exploration and laboratory testing it is concluded that the some of the onsite soils satisfy the requirements of structural fill.

It is noted that backfill material such as pea gravel and crushed rock do not meet the requirements for Structural Fill. This is because the clean rock materials have relatively high permeability and thereby provide the potential to store water. Permeable material should be reserved for below-grade walls or structures that have an appropriate means of drainage discharge at the base of the zone of permeable material.

5.2.6 Fill Placement and Compaction

The maximum dry unit weight of the fill materials should be measured in accordance with ASTM D1557. The field unit weight of fill should be measured in accordance with the sand cone method (ASTM D1556) or the nuclear method (ASTM D6938). The fill materials should be placed in lifts not exceeding 8 inches in depth. The Structural Fill should be compacted to 95% relative compaction as determined by ASTM D1557 at 1 to 3 percent over OWC.

Structural Fill material should be placed in lifts no greater than 8 inches, loose measurement. The water content of the fill material at the time of compaction should achieve uniform moisture between 1 and 3 percent above its OWC. Particles larger than 1 inch for Structural Fill should be placed so that they are completely surrounded by compacted finer soils.

5.2.7 Trench Wall Stability

Trench wall instability will be dependent on the soil and rock properties in the areas of excavations. Shallow groundwater typically contributes to collapse of fill or alluvial soils due to wetting. Extremely dry cohesionless soil, which lacks the apparent cohesion provided by capillary suction, may run on slopes or collapse with even low excavation faces. Wedge failures can occur in the trench walls under such conditions. Shoring is anticipated to be required where trenches cross existing pavements and/or where adjacent utilities exist that cannot withstand lateral movements of the trench walls.

Trench excavations that are made with nearly vertical sides can typically remain open for minutes to hours until positive sidewall shoring/support can be installed. However, this may not be true in areas that transmit groundwater, where existing loose trench backfills exist, where relatively clean, coarse-grained soils are present (such as poorly-graded sand, well-graded sand, poorly-graded gravel and well-graded gravel soil types). In all cases, the contractor should select an excavation, dewatering, and/or shoring scheme that will protect adjacent improvements, including buried utilities.

5.2.8 Trench Preparation and Backfill

5.2.8.1 General Considerations

We anticipate that shallow trenching can be done by conventional trenching machines or power shovels. This opinion is based solely on our knowledge of general geotechnical conditions and on observations made in the exploratory borings.

Minimum trench dimensions are usually specified to allow proper placement of the pipe and backfill. The trench bottom width should be at least 12 inches greater than the pipe outside diameter; unless the contractor can demonstrate that he is able to otherwise place the pipe and backfill to the Owner's satisfaction.

5.2.8.2 Subgrade Preparation

The bottom surfaces of all excavations to receive bedding/fill should be scarified to a depth of at least 6 inches, moisture conditioned, if necessary, and compacted to at least 90 percent relative compaction (as per ASTM Standard D1557) at 1 to 3 percentage points over OWC prior to placing compacted bedding/fills. Following the scarification process, the subgrade should be observed, probed and tested as appropriate. All identified loose or soft zones should be compacted in-place or excavated and replaced with properly compacted backfill to the satisfaction of the geotechnical engineer-of-record in order to establish a competent subgrade on which to place compacted bedding/fill.

5.2.8.3 Pipe Bedding

Bedding is defined as the supporting material placed below the pipe and should have a minimum thickness of 6 inches. To provide uniform and firm support for the pipe, compacted granular materials, such as clean sand, gravel or ¾-inch crushed aggregate or crushed rock, may be used as pipe bedding material. The type and thickness of the bedding material should be chosen based on the proposed type of pipeline to be installed.

The bedding material above the pipe should consist of sand or other granular material conforming to the requirements of Section 306-1.2.1 of the Greenbook.

5.2.8.4 Compaction of Bedding

The maximum dry unit weight of the bedding material should be measured in accordance with ASTM D1557. The field unit weight of bedding should be measured in accordance with the sand cone method (ASTM D1556) or the nuclear method (ASTM D6938). In a narrow trench, use of conventional compaction equipment may be challenging. Verification of appropriate compaction of the bedding material below the spring line is generally difficult by testing. So care should be taken that appropriate densification of the material is performed by visual observation of the moisture conditioning and compaction operations.

5.2.8.5 Pipe Zone and Final Backfill

The pipe zone is the part of the trench from the bedding to a horizontal level 12 inches above the top of the pipe for the full width of the trench. Materials for pipe zone backfill should consist of imported material or on-site material that meets the following requirements. The material should not contain rocks or hard lumps greater than 1 inch in maximum dimension; at least 80 percent (by weight) of its particles should pass through a ¾-inch sieve; and it should have less than 5 percent passing the No. 200 sieve. Final backfill material with a sand equivalent value of 20 or greater and expansion index less than 20 is recommended. The material used for backfill within the pipe zone should be uniformly graded to avoid migration of soil fines into voids and clogging. Perishable, spongy, hazardous, or other undesirable materials should not be used as fill. Clean sands should be placed to surround the pipe completely and minimize voids. Mechanical compaction equipment may be used where feasible.

Materials for the final backfill zone should consist of imported material or on-site material that meets the following requirements. Final pipe zone material does not contain rocks or hard lumps greater than 6 inches in maximum dimension; has at least 80 percent (by weight) of its particles passing through a ¾-inch sieve; and has less than 30 percent passing the No. 200 sieve. Materials greater than 1 inch in size should be placed so that they are completely surrounded by compacted finer soils. Nesting of rocks will not be permitted. To avoid migration of soil fines from the final backfill zone material to the pipe zone material, filter fabric may be placed at the interface at the discretion of the designer or the owner.

5.2.8.6 Imported Materials

Imported soils may be used for pipe bedding and pipe zone backfill. The imported soil should be uniformly graded and should not contain rocks or hard lumps greater than 6 inches in maximum dimension (3 inches if within the upper 18 inches below planned roadway) if placed in the final backfill zone, or a maximum of 1 inch if placed in the pipe zone or bedding zone. It is recommended that the material have a sand equivalent of 20 or more; a low potential for expansion (expansion index less than 20); and less than 30 percent passing the No. 200 sieve. The materials should be free of organic material, debris, man-made materials, or other deleterious materials.

5.3 Infiltration Basin

5.3.1 Design Recommendations

Based on the results of AECOM's infiltration testing, an average infiltration rate of 5 to 9 inches/hour can be used for sizing of the infiltration basin. Based on this infiltration rate and anticipated capacity demand, calculations should be performed to establish the size (footprint dimension) of the proposed basins. It is suggested that it be assumed that infiltration does not occur through fill areas; i.e., the embankments and the adjacent area of ground preparation discussed in Section 5.3.3. Based on preliminary design, the proposed basins are anticipated to consist of a shallow excavation surrounded by fill embankments up to a maximum height of 5 feet above the existing grade. Anticipated water level within the basin is anticipated to be approximately 1 foot above the bottom of the basin.

It should be anticipated that initially, the rate of infiltration will be somewhat closer to the design rate since the majority of flow will be in the vertical direction. The infiltration rate may reduce as the water encounters fine-grained layers and water is forced to move laterally away from the footprint of the basin. With time the infiltration rate may decease due to sedimentation and other deposits; periodic cleaning and furrowing may help restore infiltration to near initial rates. The infiltration rate and performance of the infiltration basin greatly depends on various other factors such as the frequency at which the water will be discharged into the basin, rate of inflow into the basin, duration of each discharge, and degree of maintenance of the basin bottom. It is anticipated that the water discharge into the basin is generally clean and treated water free of debris.

Further design considerations and recommendations are presented below:

- The bottom of the infiltration basin should be installed entirely in undisturbed natural ground. Therefore, the areas recommended for construction of the subsurface disposal systems should remain in an undisturbed, natural condition.

- Excessive travel over the footprint area at the bottom of the proposed excavation with heavy grading and construction equipment should also be avoided. It is also recommended that the construction of the basin embankments be performed using smaller and lighter equipment such as excavators. Heavier excavation equipment such as dozers, front end loaders or scrapers should be placed in unexcavated areas.

- The subsurface infiltration basin-disposal systems should not be located within 15 feet of any 100-year flood limits or within 15 feet of any principal drainage.

- It is imperative that the infiltration basin pits be observed by the geotechnical consultant during excavation. This is to document the suitability of the exposed soils and to make necessary revisions if widely variable conditions are encountered. Revisions could include adding additional pits or a redesign of the system so that it conforms to the site conditions encountered during grading.

- Materials used in construction and installation of the infiltration systems should conform to the standards and specifications of the County and the State of California.

- The disposal of excessive turbid water or introduction of detergents and chemicals can cause premature system failures, necessitating construction of a system expansion or reconstruction of the primary system.

- Consideration should be given to perform a confirmatory infiltration test, following the construction of the basin. Typically, during a confirmatory infiltration test, the infiltration basin will be filled at an anticipated maximum flow rate for at least 100 minutes. The rate of infiltration of water into the subsurface soil should be recorded and documented. The test should be repeated about three times to establish the time interval required in between two consecutive discharge cycles.

5.3.2 Site Clearing

Any significant vegetation within the areas of proposed grading and construction should be stripped and removed from the site. Any deleterious construction debris (concrete, wood, sand bags, etc.) that is found to be existing on the surface of the site should also be removed.

All active or inactive utilities within the construction limits should be identified for relocation, abandonment, or protection prior to grading. Any pipelines greater than 4 inches in diameter to be abandoned in-place should be filled with a sand /cement slurry after review of their location and approval by the geotechnical engineer.

5.3.3 Ground Preparation – Improvement Areas

Based on field observations and laboratory test results, removal depths on the order of 2 feet below the subgrades of the footprint of the fill areas, access ramps, emergency overflow spillway and earthen swale improvement areas should generally be anticipated. Further, removal depths of 2 feet beneath the basin embankments should generally be anticipated. The removal and compaction of fill should extend at least 2 feet beyond the exterior limits of the improvements, discussed above. The removal and compaction of fill should also extend at least 2 feet beyond the interior limits of the basin embankments. The depth/zone of over-excavation may be larger if unsuitable materials are encountered during grading.

The removal area may then be restored to proposed grade with compacted fill (import or native, as described in Section 5.3.5).

5.3.4 Ground Preparation – Slope Facing

If shotcrete facing is planned for the side slopes of the infiltration basin, it is recommended that the side slopes have a slope ratio no steeper than 3:1 (horizontal to vertical). If shotcrete is used, a toe down with a minimum depth of 1 foot below planned grade should be considered to resist undercutting. Based on site-borings, these cuts would expose loose, low density Silty Sand to Poorly Graded Sand materials and may not provide a competent subgrade for shotcrete concrete. In order to mitigate the detrimental effects of differential settlements of these low-density materials on the shotcrete, we recommend construction of a 5-foot wide Fill Key at the toe of the slope. The Fill Key should be seated a minimum of 24 inches into the competent material and be tilted back into native alluvial soils at a minimum of 2 percent gradient. The back cut of the Fill Key may be benched at an equivalent slope angle of 45 degrees.

5.3.5 Fills/Backfills and Compaction

Onsite materials are generally considered suitable to be used as compacted fill, provided they meet the requirements of Section 5.2.5.

Prior to replacing the over-excavated soils or placing the import soils as properly compacted fill, the exposed bottom surfaces should first be scarified to a depth of 6 inches, watered or dried as necessary to achieve a uniform water content that is equal to or slightly greater than OWC, and then re-compacted in place to a minimum relative compaction of 90 percent. This procedure should be followed in areas of new fill, in areas to remain at existing grade, and in shallow cut areas where the depth of cut is less than 2 feet.

The embankment fills should be moisture conditioned to above OWC and placed in lifts no greater than 8 inches. Relative compaction of 90 percent minimum in accordance with ASTM D1557 is recommended for all fill embankments.

Placement of shotcrete on the slope face should be performed with care so as not to damage the slope face. Due to the desert region with extreme temperatures, placement and curing of concrete for the facing should be performed in such manner that the extreme temperatures and low humidity do not affect the curing process of the facing. Too hot or too cold temperatures will impact the shotcrete placement/curing and generate undesirable cracking of the shotcrete facing.

5.3.6 Imported Soils

Based on our current understanding of the project, excess soil materials will be generated due to the proposed grading operations and therefore soil needs to be exported offsite.

However, if imported soils are required to complete the planned grading, the soils should consist of clean materials devoid of rock exceeding a maximum dimension of 8 inches, as well as organics, trash and similar deleterious materials. Imported soils should also exhibit an expansion index of less than 20. If import soils are required, the project geotechnical consultant should be notified of the location of the proposed borrow site so that samples of the import material may be obtained and tested prior to transport to verify that it meets project geotechnical specifications.

5.3.7 Geotechnical Observations

Observations of the clearing operations, removal of surficial soils and general grading procedures should be performed by a representative of the project geotechnical consultant. It is the grading contractor's responsibility to notify the project geotechnical consultant at least one full workday (24 hours not including weekend days and holidays) prior to requiring observation (including excavation bottom verification). A representative of the project geotechnical consultant should be present on site during major grading operations to document that proper placement and adequate compaction of fills has been achieved, as well as to observe compliance with the other recommendations presented herein.

5.4 Foundation Design

Foundation recommendations provided below should not be modified without the geotechnical engineer’s review. Recommendations for slab-on-grade are included in Section 5.4.5 of this report.

5.4.1 Allowable Bearing Pressures

Lightly loaded facilities or structures can be founded on shallow footings. For design purposes, an allowable bearing pressure of **2,000 pounds per square foot** (psf) may be used for shallow footings (including spread and continuous footings) founded entirely in properly conditioned and compacted Structural Fill. The Structural Fill pad should extend at least 3 feet below the bottom of the footings and 5 feet outside the footings. Shallow footings designed for the bearing value recommended above should have a minimum width of 24 inches. Footings should be embedded at least 24 inches below the lowest adjacent finished grade. As stated before, due to the presence of loose soils at the anticipated bottom of footing elevation, it is recommended that native soils within 3 feet from the bottom of foundation or slab on grade be removed and replaced with structural backfill following recommendations in this technical memorandum. It is expected that over-excavation to a depth of 3 feet will expose firm and unyielding surface below the planned bottom of excavation or base of fill. If firm surface is not encountered at that depth, it is recommended to compact the native material in-place prior to placing compacted fill. The compacted fill should extend a minimum of 5 feet beyond the edges of foundation.

Shallow foundations are proposed for the project site. It is anticipated that all structures will be founded on mat foundations or slab-on-grade. If a mat is being considered for providing foundation support for the proposed facilities, the mat should be founded on a minimum 3-foot thick layer of compacted Structural Fill (over-excavation requirement). A maximum allowable bearing pressure of **2,000 psf** may be used for mat foundations. The bearing capacity of the foundation is limited by settlement. A value of k_s (modulus of subgrade reaction) of **150 pounds per cubic inch** (pci) may be used for design of a rectangular mat foundation with dimensions of 40 x 100 feet, where the k_s value was estimated on the basis of a common correlation between soil type and relative density. It is noted that a k_s value is typically derived from the results of a 1-foot by 1-foot square plate load test. Mat foundations designed for the bearing value recommended above should be embedded at least 24 inches below lowest adjacent finished grade. If the dimensions of the mat foundation are changed, the project geotechnical engineer should be consulted.

No structure foundations should bear partially on cut materials and partially on fill materials. In accordance with the recommendations in Section 5.2.4, Excavation, the upper soils native soils would be removed and replaced with Structural Fill, so all foundations would bear directly on fill mat. It is also possible that all the structure's foundations could bear directly on native soil, provided the all excavations extend below the soil native soils found in the upper 3 feet or so of the site.

If the construction of the footings is not performed immediately after completion of grading, the near surface soils should be re-evaluated and approved by the geotechnical engineer-of-record immediately prior to placement of concrete for the proposed foundation.

5.4.2 Settlement

Based on the allowable bearing pressures and the earthwork recommendations presented in this report, total post-construction settlement of shallow footings or mat foundations is estimated to be less than or equal to about one inch. Differential settlements between similarly loaded footings designed for the bearing values recommended in this report are expected to be less than one-half the total settlement.

5.4.3 Resistance to Lateral Loads

Lateral forces applied to a structure will be resisted by either passive soil resistance against the buried part of the foundation or by sliding friction between the footing and the subgrade. We recommend that if sliding friction and passive soil resistance are combined, passive resistance should be reduced by one-third to account for the difference in the movements required to reach peak resistance.

For design purposes, an ultimate coefficient of friction of 0.4 may be used for footings cast on properly conditioned and compacted subgrade. Ultimate passive pressure available in compacted structural fill may be taken as equivalent to the pressure exerted by a fluid weighing 360 pcf per foot (psf/ft) of depth with a maximum limiting value of 2000 psf (use 180 psf/ft up to a maximum limiting value of 1000 psf if below groundwater). The pressure should be used as a triangular distribution to the maximum allowable limit and then should remain constant at the maximum limiting value. If the ground surface is not covered by permanent concrete slab-on-grade or asphalt pavement, the effective ground surface should be taken as 12 inches lower than the actual post-construction ground surface for the purpose of calculating the passive soil resistance. Appropriate factors of safety should be applied to the above values of ultimate resistances.

5.4.4 Foundation Design Parameters

Bearing Material:	3 feet of structural fill over native soil

Foundation Design Parameters:

Minimum Footing Depth:	24 inches below lowest adjacent final grade
Allowable Bearing Pressure:	2,000 psf
Coefficient of Vertical Subgrade Reaction:	150 pounds per cubic inch (pci)
Coefficient of Sliding:	0.4
Slab Thickness:	Per structural engineer
Slab Subgrade Water Content:	OWC to OWC plus 3%
Cement Type:	I or II
Steel Reinforcement Cover:	Minimum concrete cover of 3 inches
Ultimate Passive Resistance:	360 psf/ft up to a maximum of 2000 psf (No increase for short-term loads; disregard upper 12 inches of ground unless paved; when combined with frictional resistance, passive resistance should be reduced by one-third)
Vapor Retarder:	Stego 15 mil Class A or equivalent No sand required beneath vapor retarder Sand above retarder - per structural engineer

5.4.5 Slab On grade

Conventional concrete slab-on-grade floors may be used for the proposed structures. The slab thickness and reinforcement should be designed by the structural engineer for the anticipated floor loads and other structural considerations. These floors should be supported on a pad of compacted Structural Fill. The Structural Fill pad should extend at least 2 feet below bottom of floor slabs, drainage blanket, or thickened slab edges.

Any materials disturbed during construction should be removed and replaced with Structural Fill properly moisture conditioned and compacted to at least 95 percent relative compaction. The water content of subgrade soil should be maintained at a level slightly over its optimum water content until the slab is poured. At the time of concrete placement, the subgrade soil should be firm and relatively unyielding.
If a moisture-sensitive floor covering (such as tile) is planned in any of the structures, the floor slab should be underlain by an impermeable polyethylene membrane, at least 15-mills thick, covered with a two-inch layer of moistened (not saturated) clean sand (less than 5 percent of particles passing the No. 200 sieve) to both protect the membrane and to promote concrete curing. It may also be prudent to provide a thin layer of clean, coarse sand beneath the membrane to act as a capillary break and to protect the membrane from the underlying subgrade materials.

5.4.6 Pavement Recommendations

Pavement design analyses were based on the California Highway Design Manual (Caltrans, 2016a). In this method, soil and base material strengths are evaluated with respect to an R-value and traffic information is estimated in the form of a traffic index (TI). The exposed subgrade soils should be scarified to a depth of 6 inches; moisture conditioned to not less than the OWC, and compacted to at least 90% relative compaction as determined by ASTM Test Method D1557.

- Either Caltrans Class 2 aggregate base (AB) or an similar material such as Crushed Miscellaneous Base (CMB) should be utilized for the AB section and should be moisture conditioned to at least its OWC and compacted to at least 95% relative compaction.

- The planned hot mix asphalt (HMA) portion of the pavement section should be placed in loose lifts of 4 inches maximum in thickness, compacted and tested per California Test Method 375. The type of AC should consider the hot climate and extreme temperature range and meet the minimum standards set forth by City of Desert Hot Springs or local jurisdiction.

- At this time traffic information is not available. Flexible pavement recommendations for a 20-year design life were calculated using Caltrans' computer program CalFP version 1.5 (Caltrans, 2016b) and are included in Appendix D of this report and a summary of the results is presented in **Table 9** below:

Table 9 – Pavement Design Summary

	Traffic Index	Minimum Thickness HMA (inch)	Minimum Thickness AB (inch)
R-value = 50	**TI=5**	4	4.5
	TI=6	5	4.5
	TI=7	6	4.5

* HMA = Hot mix Asphalt, AB= Aggregate Base

Section 6 – Notes to Designer

6.1 Review of Plans and Specifications

Final project plans and specifications should be reviewed by the geotechnical engineer-of-record prior to construction to confirm that the full intent of the recommendations presented in this report has been applied to the design and that the recommendations presented are applicable to the final scope of the project.

Section 7 – Limitations

This memorandum has been prepared for Mission Springs Water District’s use for the project described herein only, and is not to be distributed to or used by third parties without the written consent of AECOM.

AECOM has observed only a small portion of the pertinent subsurface conditions. The recommendations made in this report are based on the assumption that soil and geologic conditions do not deviate appreciably from those observed in the subsurface explorations. The project quality control should provide observation and testing during foundation excavation, fill placement, and other forms of construction that need geotechnical input to evaluate whether the site conditions are as anticipated, and to provide revised recommendations, if necessary. If variations or undesirable geotechnical conditions are encountered during construction, the geotechnical engineer-of-record should be consulted for further recommendations.

Geotechnical engineering and the geologic sciences are characterized by uncertainty. Professional judgments presented herein are based on the assumption that subsurface conditions do not vary significantly between borings, or vary linearly between borings. The recommendations provided in this report also are based partly on our understanding of the proposed construction, and partly on our general experience. Our engineering work and judgments rendered meet current professional standards; we do not guarantee the performance of the project in any respect.

Section 8 – References

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Caltrans (2010), Soil and Rock Logging Classification Manual, Division of Engineering Geotechnical Services, 2010.

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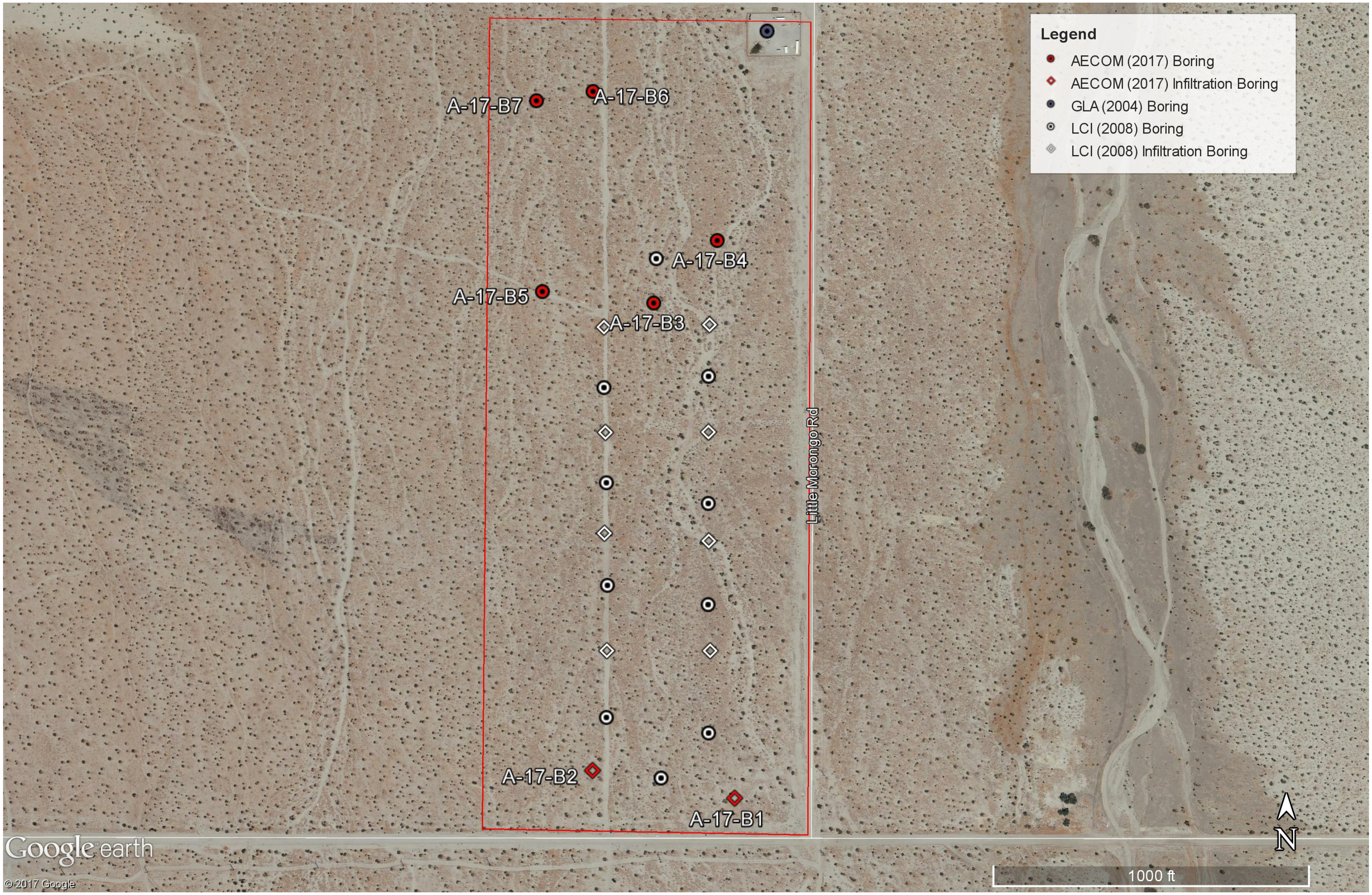
Riverside County Flood Control and Water Conservation District (RCFCWCD, 2011). "Design Handbook for Low Impact Development Best Management Practices for the Santa Ana Watershed." Retrieved from http://www.floodcontrol.co.riverside.ca.us/NPDES/LIDBMP.aspx

Figures

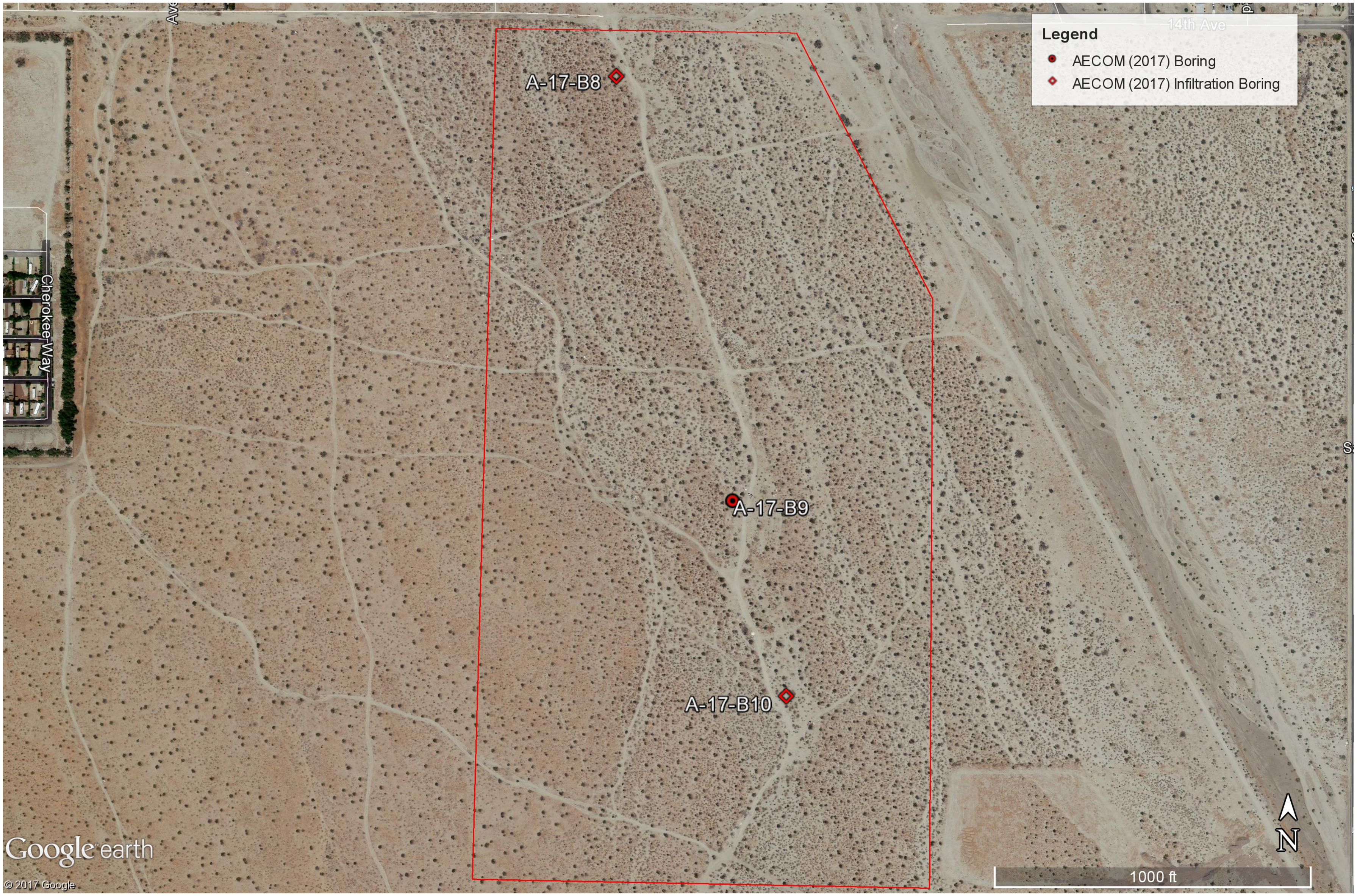
Site Location Map

Project No. 60551186	Date: Oct. 2018	Project: Mission Springs Water District WVWRF	Figure 1	AECOM



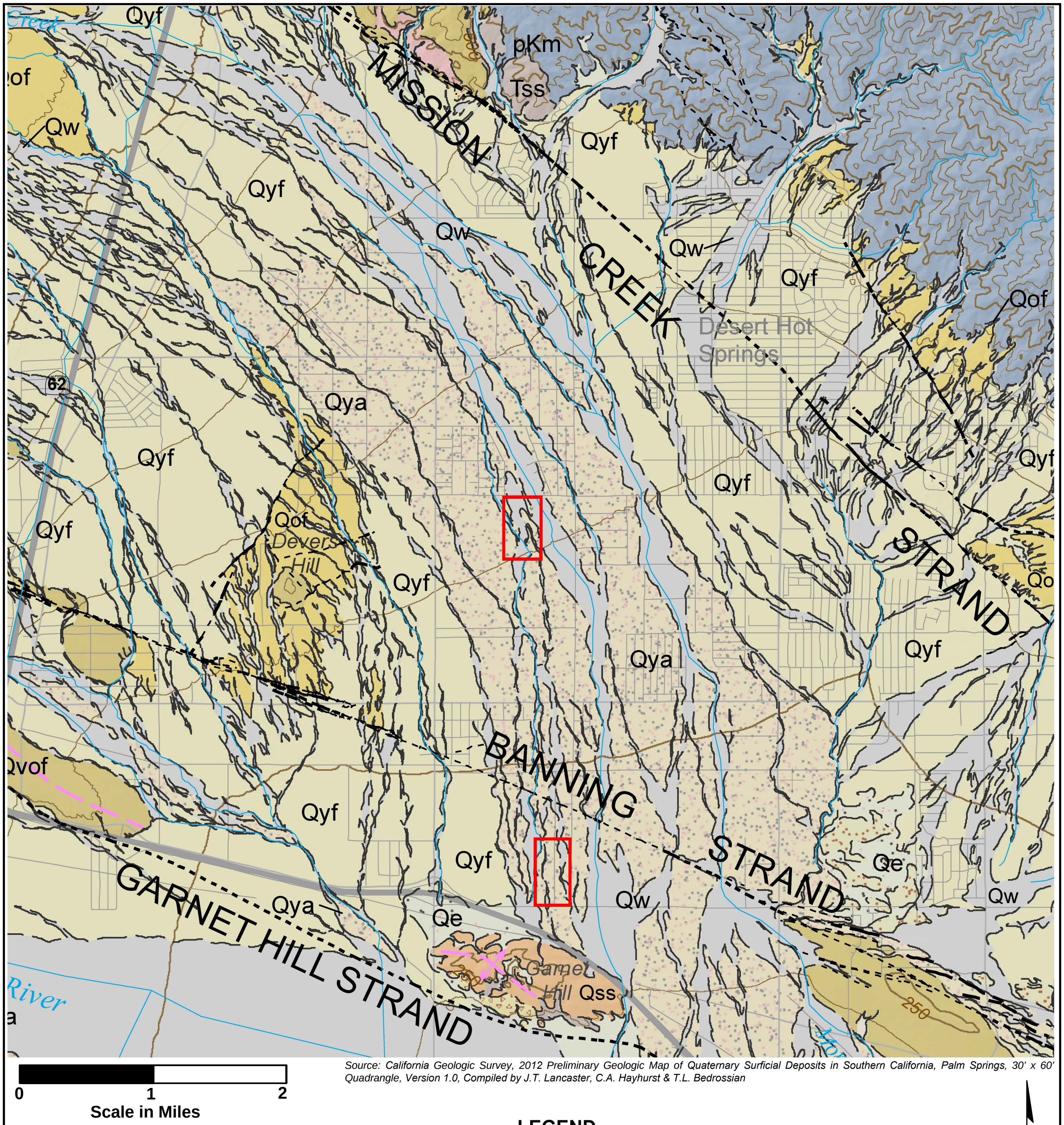
Geotechnical Field Exploration Map - Mission Springs WWTP

Project No. 60551186	Date: Oct. 2018	Project: Mission Springs Water District WVWRF	Figure 2a	AECOM



Geotechnical Field Exploration Map - Off-site Spreading Basin

Project No. 60551186	Date: Oct. 2018	Project: Mission Springs Water District WVWRF	Figure 2b	AECOM



Source: *California Geologic Survey, 2012 Preliminary Geologic Map of Quaternary Surficial Deposits in Southern California, Palm Springs, 30' x 60' Quadrangle, Version 1.0, Compiled by J.T. Lancaster, C.A. Hayhurst & T.L. Bedrossian*

LEGEND

Qw – Alluvial wash deposits (Late Holocene)
Qe – Eolian and dune deposits (Late Holocene)
Qya – Young alluvial valley deposits (Holocene to Late Pleistocene)
Qyf – Young alluvial fan deposits (Holocene to Late Pleistocene)
Qof – Old alluvial fan deposits (Late to Middle Pleistocene)
Qvof – Very old alluvial fan deposits (Middle to Late Pleistocene)
Qss – Coarse-grained sandstone bedrock (Quaternary)
Tss – Sandstone Bedrock (Tertiary)
Pkm – Cretaceous and Pre-Cretaceous Metamorphic (sedimentary and volcanic)

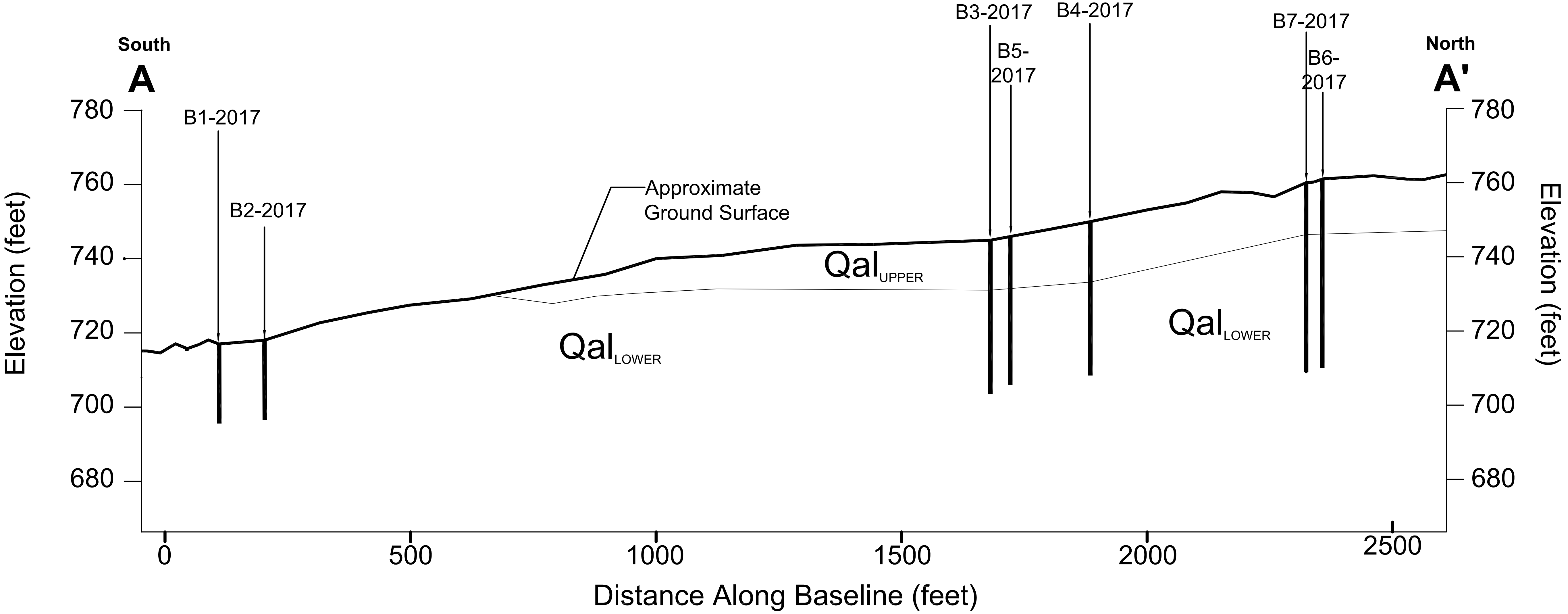
REGIONAL GEOLOGIC MAP

Project No.: 60551186	Date: Oct. 2018	Project: Mission Springs Water District WVWRF	Figure 3

AECOM

GENERALIZED GEOLOGIC PROFILE PRIMARY WVWRF

SITE VIEW WEST



LEGEND

Qal Quaternary Alluvium

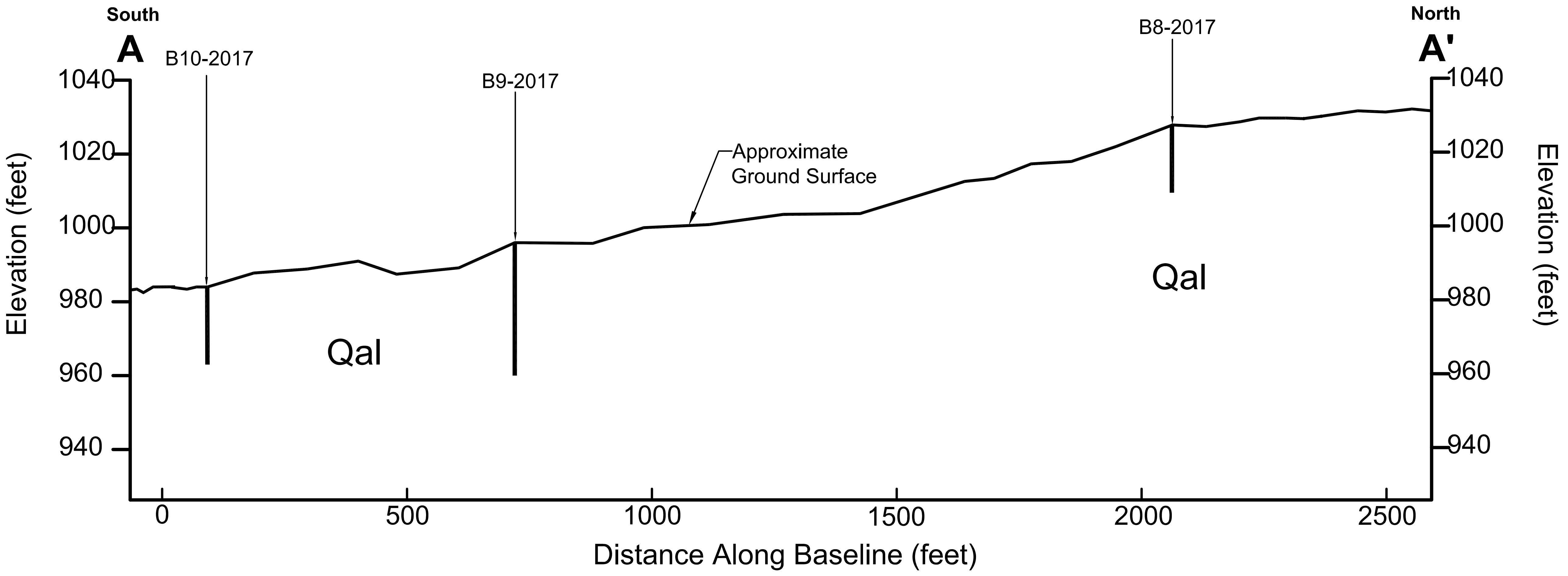
NOT TO SCALE

GENERALIZED GEOLOGIC PROFILE
PRIMARY WVWRF

Proj. No. 60551186	Date: 10–24–2018
Project: Mission Springs Water District WVWRF	Figure 4A

GENERALIZED GEOLOGIC PROFILE ALTERNATIVE OFF-SITE SPREADING BASIN

SITE VIEW WEST



LEGEND

Qal	Quaternary Alluvium

NOT TO SCALE

AECOM

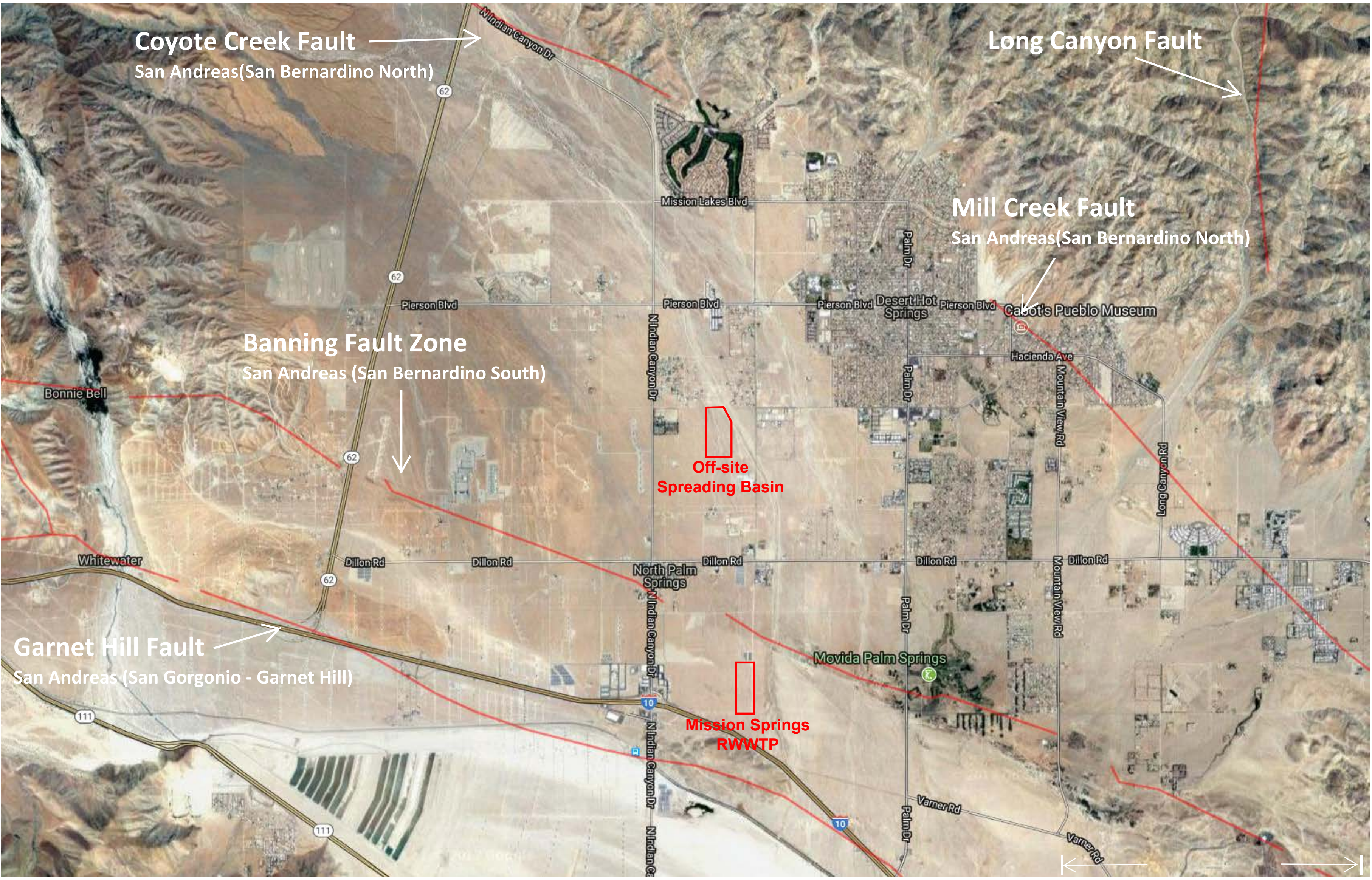
GEOLOGICAL CROSS SECTION
A–A'

Proj. No. 60551186

Date: 11–10–2017

Project: Mission Springs Water District RWWTP

Figure 4B



FAULT MAP

Project No. 60551186	Date: Oct. 2018	Project: Mission Springs Water District WVWRF	Figure 5

Appendix A

Field Boring Logs

APPENDIX A

Field Exploration

A geotechnical field exploration was performed between September 26th and October 4th, 2017 under the supervision of AECOM. A site reconnaissance was performed by an AECOM engineer/geologist prior to the field exploration to identify locations of exploratory borings. The locations were located in the field from the existing site features. AECOM notified Underground Service Alert (USA) so that they could coordinate with various utility companies to locate and clear existing underground lines in the vicinity of the planned exploration.

Subsurface exploration included drilling and sampling 10 hollow stem auger borings in the area of the proposed RWWTP project. The borings were drilled to a maximum depth of approximately 50 feet below ground surface (bgs) using a truck-mounted CME-75 drill rig with an attached CME Auto Hammer. The drill rigs were provided and operated by 2R Drilling of Chino, California. The approximate locations of the borings are shown on Table 1.

An AECOM geotechnical representative was tasked with maintaining field boring logs and visually classified the soils according to the Caltrans Soil and Rock Logging Classification and Presentation Manual (Caltrans, 2010). When subsurface conditions permitted, drive samples were recovered with the California Soil Sampler [(2.42-inch) I.D.] and disturbed samples were obtained using a Standard Penetration Testing (SPT) sampler. The samples were obtained using a 140-pound automatic-trip hammer with a 30-inch drop. The number of blows required to drive the sampler was recorded at 6-inch intervals for each sample taken. SPT was performed in accordance with ASTM D1589 procedures. The total number of blows required to drive the sampler the last 12 inches is recorded on boring records.

Geotechnical samples obtained in the field were carefully sealed and packaged to reduce moisture loss and disturbance and were transported to our laboratory for further testing. After completion of drilling and sampling operations, borings were backfilled with cement/bentonite slurry.

The blow count for the final 12 inches of sampler penetration is commonly referred to as the "N-value". This value generally reflects the resistance to penetration of the soil at the sample depth. The degree of relative density of granular soils and the degree of consistency of cohesive soils are generally described on the boring logs according to the conventional correlations presented below:

Granular Soils			Cohesive Soils	
SPT Blow Count	**Description**		**Pocket Penetrometer Measurement, PP (tsf)**	**Description**
$N_{60} \le 4$	Very Loose		$PP < 0.25$	Very Soft
$5 \le N_{60} \le 10$	Loose		$0.25 \le PP < 0.5$	Soft
$11 \le N_{60} \le 30$	Medium Dense		$0.5 \le PP < 1$	Medium Stiff
$31 \le N_{60} \le 50$	Dense		$1 \le PP < 2$	Stiff
$50 < N_{60}$	Very Dense		$2 \le PP < 4$	Very Stiff
			$4 \le PP$	Hard

The relative density and consistency descriptions on the attached boring logs are based on adjusted blow counts recorded in the field. These numbers are considered useful in providing an estimate of the relative density or consistency of soils. The relative density and consistency descriptions on the log may deviate from the correlation for a number of reasons, including reliance on other test results or the engineer's judgment based on manual manipulation of the sample.

It is widely accepted that the above-listed SPT blow count correlation is overly simplistic. For most applications in non-gravelly soils, the blow count is usually adjusted for the effective vertical pressure at the sampling depth and for other sampling system parameters such as the efficiency of the sampling system and/or sampling techniques used. In gravelly soils, it is recognized that the blow counts are higher than would be expected in non-gravelly soils of similar density or consistency. This occurs because the sampler tends to push larger gravel clasts ahead of it. The area of the gravel clast may be significantly greater than that of the sampler, causing increased resistance and higher blow counts.

The blow count obtained from nonstandard penetration tests using a California Soil Sampler, N, may be converted to standard blow count, N_{60}, by the relationship between SPT values and hammer ratios, Rs = f(inner/outer diameter of sampler, weight of hammer, and height of drop), (Fang, 1991). The conversion factors for California Sampler blow counts used for sandy soil are 0.55 and 0.70 for cohesive soil, respectively. An energy efficiency correction factor of 1.345 (ERi = 80.7%) was applied to correct blow counts for the borings A-17-B1 to A-17-B10.

SPT CAL

SPT HAMMER ENERGY MEASUREMENTS

2R Drilling, Inc.
3968 Chino Ave.
Chino, CA 91710
909-465-1765

Prepared by;

SPT CAL
5512 Belem Dr
Chino Hills, CA 91709

909-730-2161
bc@sptcal.com

Project Title: 2R Drilling Rig 7 2017
Project Description: Ontario

Rig 7

Energy Transfer Ratio = 80.7 @ 54.1 blows per minute

Testing was performed on July 12, 2017 in Ontario, California

Hammer Energy Measurements performed in accordance to ASTM D4633 using an approved and calibrated SPT Analyzer from Pile Dynamics, Inc.

Depth	ETR%	BPM
30	80.0	53.9
35	81.1	54.5
40	81.9	54.0
45	80.2	54.4
50	80.3	53.9
	80.7	54.1

Thank you very much. It was a pleasure to work with you and your drill crews.

Sincerely yours,

Brian Serl
Calibration Engineer
SPTCAL.COM

PRESENTATION OF SPT ANALYZER TEST DATA

1. Introduction

This report presents the results of SPT Hammer Energy Measurements recorded with an SPT Analyzer from Pile Dynamics carried out on July 12, 2017 in Ontario, California

2. Field Equipment and Procedures

The drill used is referred to at 2R Drilling as Rig 7. CME 75 track drill. It has an attached CME Auto Hammer

The CME Auto Hammer uses a 140 lb. weight dropped 30” on to an anvil above the bore hole. AWJ drill rod connects the anvil to a split spoon type soil sampler inside an 8” o.d. hollow stem auger at the designated sample depth. After a seeding blow the sampler is driven 18”. The number of blows required to penetrate the last 12" is referred to as the “N value”, which is related to soil strength.

The first recording was taken at 30' below ground surface and then every 5' to final recording at 50'.

3. Instrumentation

An SPT Analyzer from Pile Dynamics was used to record and the process the data. The raw data was stored directly in the SPT Analyzer computer with subsequent analysis in the office with PDA-W and PDIPlot software. The measurements and analysis were conducted in general accordance with ASTM D4945 and ASTM D6066 test standards.

The SPT Analyzer is fully compliant with the minimum digital sampling frequency requirements of ASTM D4633-05 (50 kHz) and EN ISO 22476-3:2005 (100 kHz), as well as with the low pass filter, (cutoff frequency of 5000 Hz instead of 3000 Hz) requirements of ASTM D4633-05. All equipment and analysis also conform to ASTM D6066.

A 2' instrumented section of AWJ rod, with two sets of accelerometers and strain transducers mounted on opposite sides of the drill rod, was placed below the anvil. It measured strain and acceleration of every hammer blow. The SPT Analyzer then calculates the amount of energy transferred to the rod by force and velocity measurements.

4. Observations

The drill rig motor is diesel fueled. The throttle control is electronically controlled. The per minute average was very consistent for every interval. The drill and sample equipment looked well maintained and operated

5. Results

Results from the SPT Hammer Energy Measurements are summarized below. It shows the Energy Transfer Ratio (ETR) at each sampling depth. ETR is the ratio of the measured maximum transferred energy to rated energy of the hammer which is the product of the weight of the hammer times the height of the fall. 140 lb x 30” = 4200 lb-in = 0.350 kip-ft.

Energy Transfer Ratio = 80.7 @ 54.1 blows per minute

Depth	ETR%	BPM
30	80.0	53.9
35	81.1	54.5
40	81.9	54.0
45	80.2	54.4
50	80.3	53.9
	80.7	54.1

If you have any questions please do not hesitate to call or email.

Thank you,

Brian Serl
Calibration Engineer
SPT CAL
909-730-2161
bc@sptcal.com

Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Key to Logs

Sheet 1 of 1

		SAMPLES								
Elevation, feet	Depth, feet	Type	Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Well constructed	Water Content, %	Dry Density,pcf	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9	10	11

COLUMN DESCRIPTIONS

1 **Elevation:** Elevation in feet referenced to mean sea level (MSL) or site datum.

2 **Depth:** Depth in feet below the ground surface.

3 **Sample Type:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

4 **Sample Number:** Sample identification number.

5 **Blows per foot** Number of blows required to advance driven sampler each 6-inch drive interval, or distance noted, using a 140-lb hammer with a 30-inch drop.

6 **Graphic Log:** Graphic depiction of subsurface material encountered; typical symbols are explained below.

7 **Material Description:** Description of material encountered; may include relative density / consistency, moisture, color, and grain size.

8 **Well constructed:** Graphic depiction of piezometer or well installation; materials are listed in header block; graphic symbols are explained below.

9 **Water Content:** Water content of soil sample measured in laboratory, expressed as percentage of dry weight of specimen.

10 **Dry Unit Weight:** Dry density of soil sample measured in laboratory, in pounds per cubic foot.

11 **Remarks and Other Tests:** Comments and observations regarding drilling or sampling made by driller or field personnel. Other field and laboratory test results, using the following abbreviations:

PA	Sieve Analysis (%<#200 sieve)
WA	Wash Analysis (%<#200 sieve)
LL	Liquid Limit, from Atterberg limits test (%)
PI	Plasticity Index (LL-PL) (%)
DS	Direct Shear test
CU	Consolidated-Undrained Triaxial

TYPICAL SOIL GRAPHIC SYMBOLS

■	Asphalt Concrete	●	Aggregate Base	▥	SILTY SAND (SM)	▥	SILTY SAND with GRAVEL (SM)
▨	CLAYEY SAND (SC)	▨	CLAYEY SAND with GRAVEL (SC)	▨	CLAYEY GRAVEL (GC)	●	Poorly graded GRAVEL with SILT and SAND (GP-GM)

TYPICAL WELL GRAPHIC SYMBOLS

▮	Pipe top cap, inside 12" flush-mount well cover, set in concrete	▯	2" blank PVC (Schedule 40) inside flush-mount well cover, set in concrete
▯	2" blank PVC (Schedule 40) in concrete	▯	2" blank PVC (Schedule 40) in cement/bentonite grout
▯	2" blank PVC (Schedule 40) in bentonite chips	▯	2" blank PVC (Schedule 40) in #2/12 clean graded sand
▤	2" screened PVC (Schedule 40) in #2/12 clean graded sand	▮	Pipe end cap, in #2/12 clean graded sand
▒	Borehole backfill, #2/12 clean graded sand		

TYPICAL SAMPLER GRAPHIC SYMBOLS

▩	Bucket or grab sample	⧗	Modified California sampler
⊠	Standard Penetration sampler		

OTHER GRAPHIC SYMBOLS

▽	First water encountered at time of drilling and sampling
▼	Water level measured at specified time after completion of drilling and sampling
——	Contact between strata
— —	Inferred or gradational contact between strata

GENERAL NOTES

1. Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive; actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of laboratory tests.
2. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.
3. All wells enclosed in 12 inch flush-mount well cover

Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

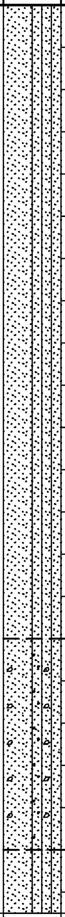
Log of Boring A-17-B1

Sheet 1 of 1

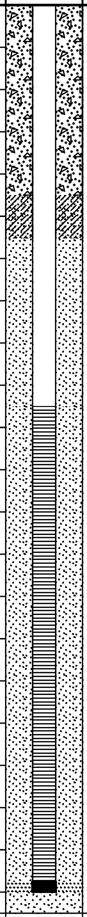
Date(s) Drilled	**09-27-17**	Logged By	**J. Leiva**	Checked By	**L. Vazquez**
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**8" bullet bit**	Total Depth of Borehole	**21.5 feet**
Drill Rig Type	**Limited Acess Rig CME**	Drilling Contractor	**2R Drilling**	Approximate Surface Elevation	**714 feet**
Water Level Depth (Feet)	**Not Encountered**	Sampling Method(s)	**Bulk, SPT (1.4" I.D.)**	Hammer Data	**Automatic Hammer, 140 lbs / 30" drop**
Borehole Backfill	**Temporary well installed for infiltration testing**	Location	**33.903680° N -116.528750° W**	Hammer Efficiency Rating (ERi)	**81** %

Elevation, feet	Depth, feet	SAMPLES Type	Number	Blows per foot	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
715	0	▨	S01		Poorly graded SAND with SILT (SP-SM); yellowish brown; dry; mostly fine SAND; few SILT; trace fine GRAVEL			
710	5	☒	S02	24	medium dense; light brownish gray	0		PA: 9.3%<#200 sieve, only 6" recorvered, rock at the bottom of barrel, moved 5' NW
705	10	☒	S03	30	dense; becomes coarsed grained	1		
700	15	☒	S04	23	Well graded SAND with SILT (SW-SM); medium dense; light brownish gray; dry; mostly fine SAND; few SILT; few fine GRAVEL, fractured rock	1		PA: 7.7%<#200 sieve
695	20	☒	S05	26	Poorly graded SAND with SILT (SP-SM); medium dense; yellowish brown; moist; mostly fine and coarse SAND; few fine GRAVEL	1		
690	25				Total Depth = 21.5 feet Temporary monitoring well installed 9/27/17 Temporary monitoring well over drilled with 8" hollow stem auger on 10/2/17. PVC pipe and screen removed and backfilled with cement-bentonite slurry.			
	30							

Graphic Log



Well constructed



Well Notes:

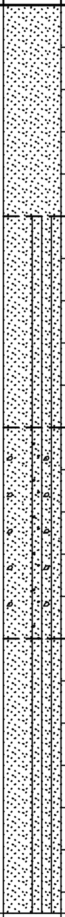
0'-4.5' Backfill: cement-bentonite slurry
4.5'-5.5' Backfill: Pel-Plug Pellets
5.5'-21.5 Backfill: Backfill: #2/12 Clean graded sand
2" I.D Solid PVC pipe 0'-9.5'
2" I.D. Schedule-40 slotted PVC (size 0.010); 9.5'-21'

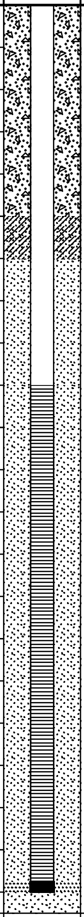
Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Log of Boring A-17-B2

Sheet 1 of 1

Date(s) Drilled	**9-27-17**	Logged By	**J. Leiva**	Checked By	**L. Vazquez**
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**8" bullet bit**	Total Depth of Borehole	**21.5 feet**
Drill Rig Type	**Limited Acess Rig CME**	Drilling Contractor	**2R Drilling**	Approximate Surface Elevation	**715 feet**
Water Level Depth (Feet)	**Not Encountered**	Sampling Method(s)	**Bulk, SPT (1.4" I.D.), Mod CAL**	Hammer Data	**Automatic Hammer, 140 lbs / 30" drop**
Borehole Backfill	**Temporary well installed for infiltration testing**	Location	**33.903920° N -116.530230° W**	Hammer Efficiency Rating (ERi)	**81** %





Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Well constructed	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
	0	▨				Poorly graded SAND (SP); yellowish brown; dry to moist; mostly fine SAND; trace SILT		1		
715			S01							
	5	⧗	S02	31		Poorly graded SAND with SILT (SP-SM); dense; pale yellowish brown; dry; mostly fine and coarse SAND; few SILT; trace fine GRAVEL		1	111	
710										
	10	☒	S03	22		Well graded SAND with SILT (SW-SM); medium dense; light brownish gray; dry; mostly fine and coarse SAND; few SILT; trace coarse GRAVEL		1		PA: 5.7%<#200 sieve.
705										
	15	☒	S04	50		Poorly graded SAND with SILT (SP-SM); very dense; light brownish gray; dry; moslty fine and coarse SAND; little SILT; few fine to coarse GRAVEL		1		WA: 8.6%<#200
700										
	20	☒	S05	43		dense; few fine GRAVEL				fractured rock in barrel
695						Total Depth = 21.5 feet Temporary monitoring well installed 9/27/17 Temporary monitoring well over drilled with 8" hollow stem auger on 10/2/17. PVC pipe and screen removed and backfilled with cement-bentonite slurry.				
	25					Well Notes: 0'-5' Backfill: cement-bentonite slurry 5'-6' Backfill: Pel-Plug Pellets 6'-21.5 Backfill: Backfill: #2/12 Clean graded sand 2" I.D Solid PVC pipe 0'-9' 2" I.D. Schedule-40 slotted PVC (size 0.010); 9'-21'				
690										
	30									

Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Log of Boring A-17-B3

Sheet 1 of 2

Date(s) Drilled	**9-28-17**	Logged By	**J. Leiva**	Checked By	**L. Vazquez**
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**8" bullet bit**	Total Depth of Borehole	**41.5 feet**
Drill Rig Type	**Limited Acess Rig CME**	Drilling Contractor	**2R Drilling**	Surveyed Surface Elevation	**745 feet**
Water Level Depth (Feet)	**Not Encountered**	Sampling Method(s)	**Bulk, SPT (1.4" I.D.), Mod CAL**	Hammer Data	**Automatic Hammer, 140 lbs / 30" drop (Efficiency=81%)**
Borehole Backfill	**cement-bentonite slurry, covered with soil cuttings to match surface**	Location	**33.907970° N -116.529581° W**		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
745	0	▩	S01			Poorly graded SAND with SIILT (SP-SM); brownish gray; dry; mostly fine and little coarse SAND; few SILT; trace GRAVEL	0		
740	5	⧗	S02	33		Well graded SAND (SW); dense; light brownish gray; moslty fine and some coarse SAND; trace SIIT	1	116	PA: 4.6%<#200 sieve, DS
735	10	☒	S03	20					Corr,
						SANDY SILT (ML); medium dense; dry; yellowish brown; some fine SAND			
730	15	⧗	S04	36		Poorly graded SAND (SP); dense; brownish gray; dry; mostly fine and coarse SAND; trace SILT			Dosturbed sample, loose sand, put in baggy, coarse Gravel in shoe
725	20	☒	S05	17		Well graded SAND with SILT (SW-SM); medium dense; light brownish gray; dry; mostly medium and little fine SAND; trace GRAVEL	1		6.1%<#200 sieve.
720	25	⧗	NR	78		very dense			Coarse GRAVEL in shoe, No Recovery
715	30								

Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Log of Boring A-17-B3

Sheet 2 of 2

Elevation, feet	Depth, feet	SAMPLES Type	Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
715	30	☒	S07	41	▨	SILTY SAND (SM); dense; light olive brown; dry; mostly fine SAND; little SILT; trace fine GRAVEL	2		WA: 22.1%<#200, LL= 21 PI=0
710	35	☒	S08	60	▨	very dense; brownish gray; mostly fine and some coarse SAND; little SILT;	1		fractured rock in barrel
705	40	☒	S09	39	▨	dense; becomes fined grained			
						Total Depth = 21.5 feet Backfilled with cement-bentonite slurry			
700	45								
695	50								
690	55								
685	60								
680	65								

Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Log of Boring A-17-B4

Sheet 1 of 2

Date(s) Drilled	**9-28-17**	Logged By	**J. Leiva**	Checked By	**L. Vazquez**
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**8" bullet bit**	Total Depth of Borehole	**32.0 feet**
Drill Rig Type	**Limited Acess Rig CME**	Drilling Contractor	**2R Drilling**	Surveyed Surface Elevation	**750 feet**
Water Level Depth (Feet)	**Not Encountered**	Sampling Method(s)	**Bulk, SPT (1.4" I.D.), Mod CAL**	Hammer Data	**Automatic Hammer, 140 lbs / 30" drop (Efficiency=81%)**
Borehole Backfill	**cement-bentonite slurry, covered with soil cuttings to match surface**	Location	**33.908510° N -116.528919° W**		

Elevation, feet	Depth, feet	SAMPLES Type	 Number	 Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
750	0	▨			▨	Poorly graded SAND with SILT (SP-SM); pale brownish gray; dry; mostly fine and coarse SAND; few SILT			R-Value: 77
		▨	S01		▨				
745	5	⧗	S02	37	▨	Well graded SAND with SIILT (SW-SM); dense; grayish brown; dry mostly fine and coarse SAND; trace fines	1		PA: 7.7%<#200 sieve.
740	10	☒	S03	50/5"	▨	Poorly graded SAND with SILT (SP-SM); very dense; light brownish gray; few SILT; little fine and coarse GRAVEL	1		WA: 9.9%<#200, rock in shoe at 13'. Move 5' N
735	15	☒	NR	43	▨				No recovery, installed sand catcher
730	20	☒	S05	42	▨	Poorly graded SAND (SP); dense; trace SILT	1		GRAVEL in shoe 18" recovered
725	25	☒	S06	37	▨	Poorly graded SAND with SILT (SP-SM); dense; light brownish gray; dry; mostly fine and coarse SAND; few SILT; trace fine GRAVEL	1		PA: 10.2%<#200 sieve.
720	30								

Report: GEO_10_SNA; File: BORINGS_B-1_B-10.GPJ; 11/13/2017 A-17-B4

Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Log of Boring A-17-B4

Sheet 2 of 2

Elevation, feet	Depth, feet	SAMPLES			Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
		Type	Number	Blows per foot					
720	30		S07	50/1"	▨				
						End drilling at 32 feet due to refusal on cobbles			Refusal
						Backfilled with cement-bentonite slurry			
715	35								
710	40								
705	45								
700	50								
695	55								
690	60								
685	65								

Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Log of Boring A-17-B5

Sheet 1 of 2

Date(s) Drilled	**9-28-17**	Logged By	**J. Leiva**	Checked By	**L. Vazquez**
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**8" bullet bit**	Total Depth of Borehole	**40.3 feet**
Drill Rig Type	**Limited Acess Rig CME**	Drilling Contractor	**2R Drilling**	Surveyed Surface Elevation	**746 feet**
Water Level Depth (Feet)	**Not Encountered**	Sampling Method(s)	**Bulk, SPT (1.4" I.D.), Mod CAL**	Hammer Data	**Automatic Hammer, 140 lbs / 30" drop (Efficiency=81%)**
Borehole Backfill	**cement-bentonite slurry, covered with soil cuttings to match surface**	Location	**33.908070° N -116.530740° W**		

Elevation, feet	Depth, feet	SAMPLES Type	Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
745	0	▨	S01			Poorly graded SAND with SILT (SP-SM); light brownish gray; dry; moslty fine, some coarse SAND; few SILT, trace fine GRAVEL	1		
740	5	☒	S02	9		Well graded SAND with SILT (SW-SM); loose; grades coarser	1		PA: 7.8%<#200 sieve, 12" recovered
735	10	■	S03	60		Poorly graded SAND with SILT (SP-SM); very dense; little fine to to coarse 2" GRAVEL	1		2" GRAVEL in shoe, bagged S-3-1
730	15	☒	S04	24		medium dense			15" recovered
725	20	☒	S05	26		light brownish gray	1		PA: 7.1%<#200 sieve, 18" recovered
720	25	☒	S06	22		grayish brown	1		PA: 11.4%<#200 sieve. Non-Plastic, missing bottom 6" of sampler
	30								

Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Log of Boring A-17-B5

Sheet 2 of 2

Elevation, feet	Depth, feet	SAMPLES Type	Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
	30	☒	S07	29		SILTY SAND (SM); medium dense; light olive brown; some fine SAND; some fines	3		PA: 49.3%<#200 sieve.
715						Poorly graded SAND with SILT (SP-SM); medium dense; brownish yellow; dry; mostly fine and coarse SAND; few fines			
	35	☒	S08	26			1		
710									
	40	☒	S09	50/3"		grades fine (few SILT, moslty fine SAND)			
705						Total Depth = 40.25 feet Backfilled with cement-bentonite slurry			
	45								
700									
	50								
695									
	55								
690									
	60								
685									
	65								

Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Log of Boring A-17-B6

Sheet 1 of 2

Date(s) Drilled	**9-29-17**	Logged By	**J. Leiva**	Checked By	**L. Vazquez**
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**8" bullet bit**	Total Depth of Borehole	**50.1 feet**
Drill Rig Type	**Limited Acess Rig CME**	Drilling Contractor	**2R Drilling**	Surveyed Surface Elevation	**761 feet**
Water Level Depth (Feet)	**Not Encountered**	Sampling Method(s)	**Bulk, SPT (1.4" I.D.), Mod CAL**	Hammer Data	**Automatic Hammer, 140 lbs / 30" drop (Efficiency=81%)**
Borehole Backfill	**cement-bentonite slurry, covered with soil cuttings to match surface**	Location	**33.909800° N -116.530211° W**		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
	0					Well graded SAND with SILT (SP-SM); light olive brown; dry; mostly fine, little coarse SAND; few SILT,	1		PA: 9.3%<#200 sieve
760			S01						
755	5		NR	25		Poorly graded SAND with SILT (SP-SM); medium dense			Driller dropped sample
750	10		S03	38		dense; becomes gray; few fine and coarse GRAVEL			fractured rock in barrel
745	15		S04	58		Poorly graded SAND (SP); very dense; light brownish gray; dry; mostly fine to coarse SAND; trace FINES	1		PA: 3.6%<#200 sieve, loose sand in sampler disturbed
740	20		S05	26		Poorly graded SAND with SILT (SP-SM); medium dense; brownish gray; dry; mostly fine to few coarse SAND; few SILT; trace fine GRAVEL			
735	25		S06	27		grayish brown; grades very fine; (mostly fine SAND; trace medium and coarse SAND few fines)	1		PA: 9.6%<#200 sieve
	30								

Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Log of Boring A-17-B6

Sheet 2 of 2

Elevation, feet	Depth, feet	SAMPLES			Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
		Type	Number	Blows per foot					
	30	☒	S07	40		dense; mostly fine and coarse SAND	1		
730									
									2-inches of yellowish brown CLAY in the bottom of sampler and shoe
	35	⧗	S08	50/6"		SILTY SAND (SM); very dense; yellowish brown; dry; mostly fine and medium SAND; some SILT			
725									
	40	☒	S09	44			10		
720						Poorly graded SAND with SILT and CLAY (SP-SM); dense; light olive brown; dry; moslty fine to coarse SAND; few fines	1		PA: 9.9%<#200 sieve
	45	☒	S10	64		very dense; grades coarse; no CLAY; trace fine GRAVEL			
715									
	50	▬	S11	50/1"		few fine to coarse GRAVEL	1		
710						Total Depth = 50.1 feet Backfilled with cement-bentonite slurry			
	55								
705									
	60								
700									
	65								

Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Log of Boring A-17-B7

Sheet 1 of 2

Date(s) Drilled	**9-29-17**	Logged By	**J. Leiva**	Checked By	**L. Vazquez**
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**8" bullet bit**	Total Depth of Borehole	**50.2 feet**
Drill Rig Type	**Limited Acess Rig CME**	Drilling Contractor	**2R Drilling**	Surveyed Surface Elevation	**760 feet**
Water Level Depth (Feet)	**Not Encountered**	Sampling Method(s)	**Bulk, SPT (1.4" I.D.), Mod CAL**	Hammer Data	**Automatic Hammer, 140 lbs / 30" drop (Efficiency=81%)**
Borehole Backfill	**cement-bentonite slurry, covered with soil cuttings to match surface**	Location	**33.909720° N -116.530800° W**		

Elevation, feet	Depth, feet	SAMPLES Type	Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
760	0					Poorly graded SAND with SILT (SP-SM); grayish brown; dry; mostly fine and medium SAND, little coarse SAND; few SILt; trace fine GRAVEL	1		WA: 9.4%<#200
		▨	S01						
755	5	☒	S02	22		medium dense			water leaked in the boring from the drill rig , fractured rock in barrel
750	10	⧗	S03	37		Well graded SAND (SW); light brownish gray; dense; grades coarse; few fine to coarse GRAVEL; trace SILT	1		PA: 4.6%<#200
745	15	☒	S04	30		Poorly graded SAND (SP); little fine and coarse GRAVEL	1		
740	20	☒	S05	21		Well graded SAND with SILT (SW-SM); medium dense; light brownish gray; grades coarse; mostly fine and little coarse SAND, few FINES; trace fine GRAVEL	1		PA: 8.5%<#200
735	25	☒	S06	27		Poorly graded SAND with SILT (SP-SM); medium dense; mostly fine and little coarse SAND; few FINES; trace fine GRAVEL			
730	30								

Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Log of Boring A-17-B7

Sheet 2 of 2

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
730	30	☒	S07	19			1		
						SILTY SAND (SM); Dry; very dense; reddish brown; dry; mostly fine and medium SAND; little SILT; trace fine and coarse GRAVEL			PP = 3.75
725	35	⧗	S08	55		dark yellowish brown	2		PA: 19.8%<#200, LL= 24 PI=1
720	40	☒	S09	25		medium dense			
715	45	☒	S10	49		SILT (ML): reddish brown; dense; dry Poorly graded SAND with SILT (SP-SM); dense; brownish gray; dry; mostly fine and medium SAND, little coarse SAND; few SILT	1		fractured rock in barrel
710	50	☒	S11	50/2"		very dense; damp			
						Total Depth = 50.2 feet Backfilled with cement-bentonite slurry			
705	55								
700	60								
695	65								

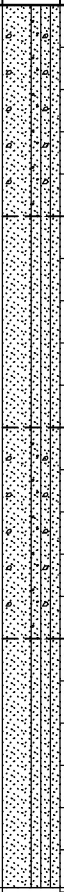
Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

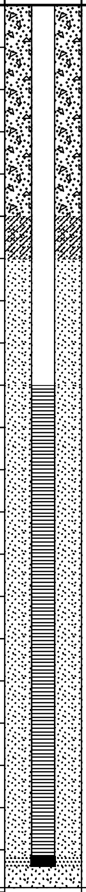
Log of Boring A-17-B8

Sheet 1 of 1

Date(s) Drilled	**9-26-17**	Logged By	**J. Leiva**	Checked By	**L. Vazquez**
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**8" bullet bit**	Total Depth of Borehole	**20.9 feet**
Drill Rig Type	**Limited Acess Rig CME**	Drilling Contractor	**2R Drilling**	Approximate Surface Elevation	**1028 feet**
Water Level Depth (Feet)	**Not Encountered**	Sampling Method(s)	**Bulk, SPT (1.4" I.D.), Mod CAL**	Hammer Data	**Automatic Hammer, 140 lbs / 30" drop**
Borehole Backfill	**Temporary well installed for infiltration testing**	Location	**33.946298° N -116.535102° W**	Hammer Efficiency Rating (ERi)	**81** %

Elevation, feet	Depth, feet	SAMPLES Type	Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Well constructed	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
	0		S01			Well graded SAND with SILT (SW-SM); grayish brown; dry; mostly fine to medium SAND; few FINES; trace fine GRAVEL		1		PA: 9.9%<#200
1025										
	5		S02	46		Poorly graded SAND with SILT (SP-SM); dense; grayish brown; grades coarser SAND		1	112	
1020										
	10		S03	73		Well graded SAND with SILT (SW-SM); very dense; pale light brownish gray; dry; mostly fine to medium SAND; few FINES; trace fine GRAVEL		0		PA: 8.9%<#200, fractured rock
1015										
	15		S04	50/6"		Poorly graded SAND with SILT (SP-SM); grades coarser SAND				
1010										
	20		S05	50/5"						
1005						Total Depth = 20.9 feet Temporary monitoring well installed 9/26/17 Temporary monitoring well over drilled with 8" hollow stem auger on 10/2/17. PVC pipe and screen removed and backfilled with cement-bentonite slurry				
	25					Well Notes: 0'-5' Backfill: cement-bentonite slurry 5'-6' Backfill: Pel-Plug Pellets 6'-20.9' Backfill: Backfill: #2/12 Clean graded sand 2" I.D Solid PVC pipe 0'-9' 2" I.D. Schedule-40 slotted PVC (size 0.010); 9.5'-20.5'				
1000										
	30									





Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Log of Boring A-17-B9

Sheet 1 of 2

Date(s) Drilled	**9-26-17**	Logged By	**J. Leiva**	Checked By	**L. Vazquez**
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**8" bullet bit**	Total Depth of Borehole	**50.5 feet**
Drill Rig Type	**Limited Acess Rig CME**	Drilling Contractor	**2R Drilling**	Surveyed Surface Elevation	**996 feet**
Water Level Depth (Feet)	**Not Encountered**	Sampling Method(s)	**Bulk, SPT (1.4" I.D.), Mod CAL**	Hammer Data	**Automatic Hammer, 140 lbs / 30" drop (Efficiency=81%)**
Borehole Backfill	**cement-bentonite slurry, covered with soil cuttings to match surface**	Location	**33.942640° N -116.533340° W**		

Elevation, feet	Depth, feet	SAMPLES Type	 Number	 Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
	0	▨				Poorly graded SAND with SILT (SP-SM); grayish brown; dry; moslty fine SAND; few FINES; trace fine GRAVEL	1		
995									
			S01						
	5	☒	S02	16		medium dense; brownish gray	0		
990									
	10	☒	S03	50/4"		very dense			
985									Refusal at 11' moved 5 SE for second attempt
	15	☒	S04	28		SILTY SAND (SM); medium dense; grayish brown; mostly fine SAND; little SILT	1		
980									
	20	☒	S05	70		Poorly graded SAND (SP); very dense; pale yellowish brown; mostly fine and coarse SAND; trace FINES; few fine GRAVEL	0		
975									
	25	☒	S06	50/6"		1 1/2" layer of SILTY SAND (SM)			
970									
	30								

Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Log of Boring A-17-B9

Sheet 2 of 2

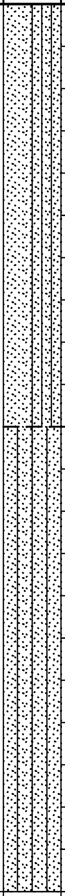
Elevation, feet	Depth, feet	SAMPLES Type	Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
965	30	☒	S07	59		Well graded SAND with SILT (SW-SM); very dense; brownish gray; few SILT	1		
960	35	☒	NR	74					
955	40	☒	S09	49		SILTY SAND (SM); dense; pale yellowish brown; mostly fine SAND; little SILT	1		
950	45	☒	S10	52		Well graded SAND with SILT (SW-SM); very dense; brownish gray; dry; mostly fine and coarse SAND; few fines; trace fine gravel	1		
945	50	☒	NR	50/4"		Total Depth = 50.5 feet Backfilled with cement-bentonite slurry			
940	55								
935	60								
	65								

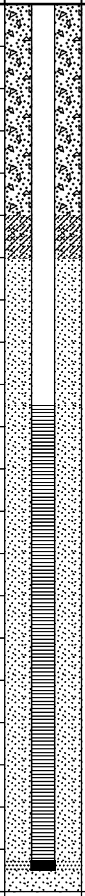
Project: MSWD-Regional WWTP
Project Location: North Palm Springs, CA
Project Number: 60551186 1.13

Log of Boring A-17-B10

Sheet 1 of 1

Date(s) Drilled	**9-26-17**	Logged By	**J. Leiva**	Checked By	**L. Vazquez**
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**8" bullet bit**	Total Depth of Borehole	**21.0 feet**
Drill Rig Type	**Limited Acess Rig CME**	Drilling Contractor	**2R Drilling**	Approximate Surface Elevation	**984 feet**
Water Level Depth (Feet)	**Not Encountered**	Sampling Method(s)	**Bulk, SPT (1.4" I.D.), Mod CAL**	Hammer Data	**Automatic Hammer, 140 lbs / 30" drop**
Borehole Backfill	**Temporary well installed for infiltration testing**	Location	**33.940944° N -116.533340°° W**	Hammer Efficiency Rating (ERi)	**81** %





Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
	0				Poorly graded SAND with SILT (SP-SM); brownish gray; mostly fine to coarse SAND; few fines; trace organic material (roots and grass)	0		
			S01					
980								
	5		S02	23	medium dense; light brownish	1	98	
975								
	10		S03	87/9"	SILTY SAND (SM); very dense; brownish gray; mostly fine SAND; little SILT	0		4" recovered coarse Gravel in barrel
970								
	15		S04	50/4"		0		Rig chatter
965								
	20		S05	50/6"	few fine to coarse GRAVEL			
960								
	25							
955								
	30							

Total Depth = 21 feet

Temporary monitoring well installed 9/26/17
Temporary monitoring well over drilled with 8" hollow stem auger on 10/2/17. PVC pipe and screen removed and backfilled with cement-bentonite slurry.

Well Notes:

0'-5' Backfill: Cement Grout
5'-6' Backfill: Pel-Plug Pellets
6'-21' Backfill: Backfill: #2/12 Clean graded sand
2" I.D Solid PVC pipe 0'-9.5'
"2"" I.D. Schedule-40 slotted PVC (size 0.010); 9.5'-20.5'"

GeoLogic Associates
Boring Log

BORING NO.: B–1

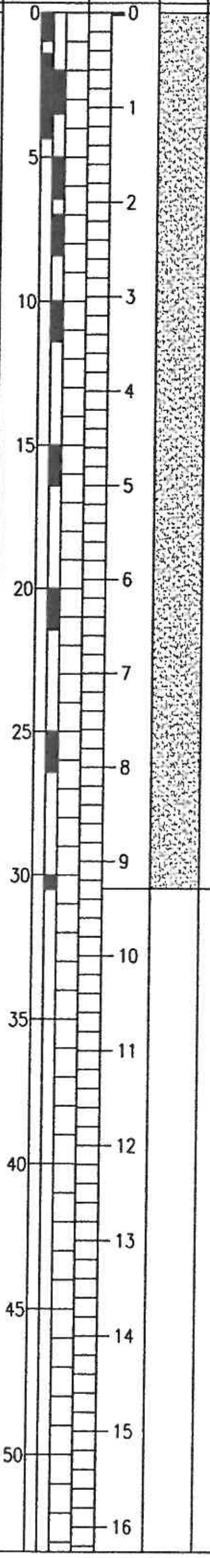
PAGE: 1 OF 1

JOB NO.: 2004-155
SITE LOCATION: GARNET WELL, DESERT HOT SPRINGS, CA
DRILLING METHOD: 8 3/4" ø HOLLOW STEM AUGER
CONTRACTOR: C & K DRILLING
LOGGED BY: T. PRIMAS

DATE STARTED: 8/23/2004
DATE FINISHED: 8/23/2004
ELEVATION: 756 FEET MSL (RW BECK, 2004)

GW DEPTH: NOT ENCOUNTERED
CAVING: NONE OBSERVED
TOTAL DEPTH: 30.5 FEET

PID READING (PPM)	LABORATORY TESTING (SEE KEY)	DRY DENSITY (LBS/CU. FT.)	MOISTURE (%)	BLOWS (COUNT/FT.)	SAMPLE SIZE (INCHES)	SAMPLE NO.	USCS/GEOLOGIC FORMATION	DESCRIPTION
					BULK	1	SW	ALLUVIUM: LIGHT BROWNISH GRAY (5YR 6/1), FINE TO COARSE SAND WITH SCATTERED GRAVEL.
				17	1.4	2		
					BULK	3		
				23	1.4	4		
				11	1.4	5		
				17	1.4	6		
				26	1.4	7		
								....AT 19 FEET: INCREASING SAND SIZE GRAVEL
				23	1.4	8		
				32	1.4	9		
								....AT 29 FEET: INCREASING COBBLES
				100+	1.4	10		



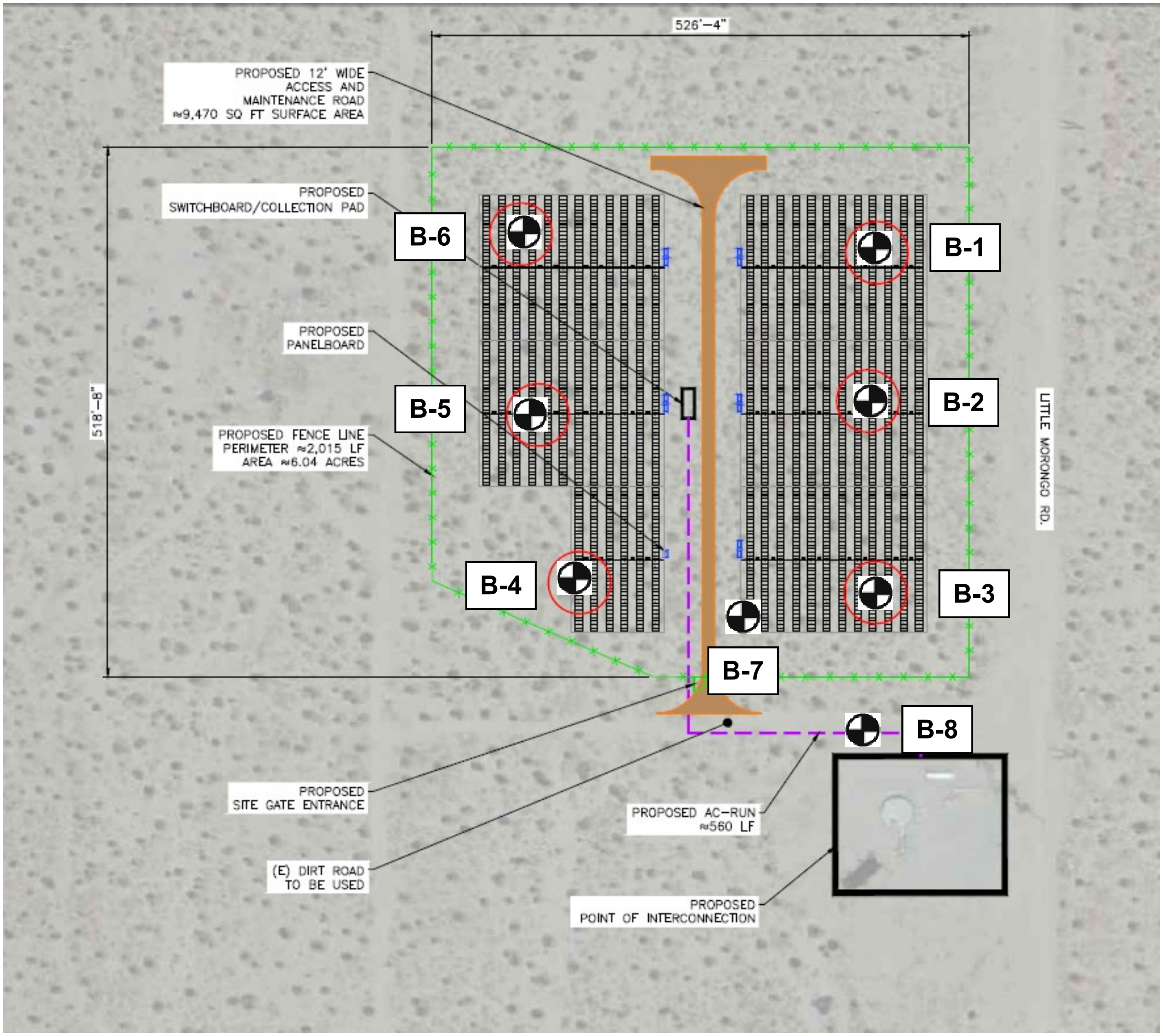
NOTES:

1. TOTAL BORING DEPTH = 30.5 FEET.
2. SAMPLER DRIVEN BY A 140-POUND HAMMER WITH A 30-INCH DROP.
3. NO GROUNDWATER OBSERVED AT TIME OF DRILLING.
4. BORING BACKFILLED WITH CUTTINGS ON 8/23/2004.
5. BORING CAVED UP TO 1 FOOT DEPTH AFTER AUGER WITHDRAWAL.

LEGEND

◐ **B-1** Approximate Boring Location

BSK Job No. G15-068-11B
June 2015
Figure A-2



Map Reference: SunPower - Mission Springs WD Well 33

N

Approximate Scale

0 155 feet

1 inch = 155 feet

BORING LOCATION MAP

GEOTECHNICAL ENGINEERING INVESTIGATION
SUNPOWER MISSION SPRINGS
SOLAR PROJECT
NORTH PALM SPRINGS, CALIFORNIA

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS More than Half >#200	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL- SAND MIXTURES
		GRAVELS WITH OVER 15% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 15% FINES	SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS More than Half <#200 sieve	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS , MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

Note: Dual symbols are used to indicate borderline soil classifications.

⧗	Pushed Shelby Tube	RV	R-Value
☒	Standard Penetration Test	SA	Sieve Analysis
■	Modified California	SW	Swell Test
◧	Auger Cuttings	TC	Cyclic Triaxial
▩	Grab Sample	TX	Unconsolidated Undrained Triaxial
■	Sample Attempt with No Recovery	TV	Torvane Shear
CA	Chemical Analysis	UC	Unconfined Compression
CN	Consolidation	(1.2)	(Shear Strength, ksf)
CP	Compaction	WA	Wash Analysis
DS	Direct Shear	(20)	(with % Passing No. 200 Sieve)
PM	Permeability	▽	Water Level at Time of Drilling
PP	Pocket Penetrometer	▼	Water Level after Drilling (with date measured)

SOIL CLASSIFICATION CHART AND KEY TO TEST DATA
Unified Soil Classification System

BSK Associates
Engineers & Laboratories

PLATE: Figure A-4

BSK Associates
Engineers & Laboratories

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Bakersfield, CA 93301

LOG OF BORING NO. B-1

Project Name:	**Mission Springs Solar Project**
Project Number:	**G15 068 10B**
Project Location:	**North Palm Springs, California**
Logged by:	**C. Rozell**
Checked by:	**A. Terronez**

Surface El.:
Location:

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Sample Number	Penetration Blows / Foot	Pocket Penetro-meter, TSF	% Passing No. 200 Sieve	In-Situ Dry Weight (pcf)	In-Situ Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
		SP: SAND: Light Olive Brown; medium to coarse grained; dry; trace of fine grained sand.	✋									
		... MEDIUM DENSE SAND: Light Olive Gray; medium to coarse grained; dry; trace of fine grained sand.	■		27				0			
5		... trace of gravel.	■		30				0			
10		... VERY DENSE SAND: Light Olive Gray; medium to coarse grained; dry; trace of fine grained sand.	■		50/ 6"				0			
15		... fine to coarse grained; dry; gravel and cobbles encountered.	☒		50/ 6"				0			
		End of boring. Drilling refusal due to cobbles.										
20												

Completion Depth:	15.5	**Drilling Equipment:**	Mobile B-61 Drill Rig
Date Started:	5/15/15	**Drilling Method:**	Hollow Stem Auger w/ Auto Trip Hammer
Date Completed:	5/15/15	**Drive Weight:**	140 pounds
California Sampler:	2.5 inch inner diameter	**Hole Diameter:**	8 inches
SPT Sampler:	1.4 inch inner diameter	**Drop:**	30 inches
		Remarks:	Borings backfilled with soil cuttings. GW not encountered

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LOG OF BORING NO. B-2

Project Name: **Mission Springs Solar Project**
Project Number: **G15 068 10B**
Project Location: **North Palm Springs, California**
Logged by: **C. Rozell**
Checked by: **A. Terronez**

Surface El.:
Location:

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Sample Number	Penetration Blows / Foot	Pocket Penetrometer, TSF	% Passing No. 200 Sieve	In-Situ Dry Weight (pcf)	In-Situ Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
	▨	SP: SAND: Light Olive Brown; medium to coarse grained; dry; trace of fine grained sand.										
	▨	... MEDIUM DENSE SAND: Light Olive Gray; fine to coarse grained; dry; cobbles encountered.	■		17				2			
5	▨	... trace of gravel.	■		27				1			
10	▨	" "	■		17			101	0			
		End of boring. Drilling refusal due to cobbles.										
15												
20												

Completion Depth: 12.0
Date Started: 5/15/15
Date Completed: 5/15/15
California Sampler: 2.5 inch inner diameter
SPT Sampler: 1.4 inch inner diameter

Drilling Equipment: Mobile B-61 Drill Rig
Drilling Method: Hollow Stem Auger w/ Auto Trip Hammer
Drive Weight: 140 pounds
Hole Diameter: 8 inches
Drop: 30 inches
Remarks: Borings backfilled with soil cuttings. GW not encountered

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LOG OF BORING NO. B-3

Project Name: **Mission Springs Solar Project**
Project Number: **G15 068 10B**
Project Location: **North Palm Springs, California**
Logged by: **C. Rozell**
Checked by: **A. Terronez**

Surface El.:
Location:

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Sample Number	Penetration Blows / Foot	Pocket Penetrometer, TSF	% Passing No. 200 Sieve	In-Situ Dry Weight (pcf)	In-Situ Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
	░	SP: SAND: Light Olive Brown; medium to coarse grained; dry; trace of fine grained sand.	✋									
	░	... MEDIUM DENSE SAND: Light Olive Gray; fine to coarse grained; dry; cobbles encountered.	■		33				0			
5	░	... Light Olive Brown; fine to coarse grained; dry; cobbles encountered.	■		39				1			
10	░	... VERY DENSE SAND: Light Olive Gray; fine to coarse grained; dry, cobbles encountered.	■		83				2			
		End of boring. Drilling refusal due to cobbles.										
15												
20												

Completion Depth: 12.0
Date Started: 5/15/15
Date Completed: 5/15/15
California Sampler: 2.5 inch inner diameter
SPT Sampler: 1.4 inch inner diameter

Drilling Equipment: Mobile B-61 Drill Rig
Drilling Method: Hollow Stem Auger w/ Auto Trip Hammer
Drive Weight: 140 pounds
Hole Diameter: 8 inches
Drop: 30 inches
Remarks: Borings backfilled with soil cuttings. GW not encountered

LOG OF BORING NO. B-4

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Bakersfield, CA 93301

Project Name: **Mission Springs Solar Project**
Project Number: **G15 068 10B**
Project Location: **North Palm Springs, California**
Logged by: **C. Rozell**
Checked by: **A. Terronez**

Surface El.:
Location:

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Sample Number	Penetration Blows / Foot	Pocket Penetrometer, TSF	% Passing No. 200 Sieve	In-Situ Dry Weight (pcf)	In-Situ Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
		SP: SAND: Light Olive Brown; medium to coarse grained; dry; trace of fine grained sand.										
		... MEDIUM DENSE SAND: Light Olive Gray; fine to medium grained; dry; trace of coarse grained sand.	■		13				1			
5		... Light Brown; fine to coarse grained; dry; cobbles encountered.	■		30				0			
10		... VERY DENSE SAND: Light Olive Gray; fine to coarse grained; dry; larger cobbles encountered.	■		64				0			
15		SP-SM: MEDIUM DENSE SAND TO SILTY SAND: Light Olive Gray; fine to coarse grained; dry; cobbles.	☒		25				0			
		End of boring.										
20												

Completion Depth: 16.5
Date Started: 5/15/15
Date Completed: 5/15/15
California Sampler: 2.5 inch inner diameter
SPT Sampler: 1.4 inch inner diameter

Drilling Equipment: Mobile B-61 Drill Rig
Drilling Method: Hollow Stem Auger w/ Auto Trip Hammer
Drive Weight: 140 pounds
Hole Diameter: 8 inches
Drop: 30 inches
Remarks: Borings backfilled with soil cuttings. GW not encountered

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Bakersfield, CA 93301

LOG OF BORING NO. B-5

Project Name: **Mission Springs Solar Project**
Project Number: **G15 068 10B**
Project Location: **North Palm Springs, California**
Logged by: **C. Rozell**
Checked by: **A. Terronez**

Surface El.:
Location:

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Sample Number	Penetration Blows / Foot	Pocket Penetro- meter, TSF	% Passing No. 200 Sieve	In-Situ Dry Weight (pcf)	In-Situ Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
		SP: SAND: Light Olive Brown; medium to coarse grained; dry; trace of fine grained sand.	✋									
		... MEDIUM DENSE SAND: Light Brown; medium to coarse grained; dry; trace of fine grained sand, cobbles encountered.	■		36				1			
5		" "	■		39				1			
10		" "	■		43				0			
15		... fine to coarse grained; dry.	☒		21				1			
		End of boring.										
20												

Completion Depth: 16.5
Date Started: 5/15/15
Date Completed: 5/15/15
California Sampler: 2.5 inch inner diameter
SPT Sampler: 1.4 inch inner diameter

Drilling Equipment: Mobile B-61 Drill Rig
Drilling Method: Hollow Stem Auger w/ Auto Trip Hammer
Drive Weight: 140 pounds
Hole Diameter: 8 inches
Drop: 30 inches
Remarks: Borings backfilled with soil cuttings. GW not encountered

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LOG OF BORING NO. B-6

Project Name: **Mission Springs Solar Project**
Project Number: **G15 068 10B**
Project Location: **North Palm Springs, California**
Logged by: **C. Rozell**
Checked by: **A. Terronez**

Surface El.:
Location:

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Sample Number	Penetration Blows / Foot	Pocket Penetrometer, TSF	% Passing No. 200 Sieve	In-Situ Dry Weight (pcf)	In-Situ Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
		SP: SAND: Light Olive Brown; medium to coarse grained; dry; trace of fine grained sand.										
		... LOOSE SAND: Light Olive Gray; fine grained; dry; trace of medium grained sand.	■		14				1			
5		... MEDIUM DENSE SAND: Light Olive Gray; fine grained; dry; trace of medium grained sand, rock in tube.	■		20				0			
10		" "	■		28				0			
15		... Light Olive Brown; fine to coarse grained; dry; gravel and cobbles encountered.	☒		42				0			
		End of boring.										
20												

Completion Depth: 16.5
Date Started: 5/15/15
Date Completed: 5/15/15
California Sampler: 2.5 inch inner diameter
SPT Sampler: 1.4 inch inner diameter

Drilling Equipment: Mobile B-61 Drill Rig
Drilling Method: Hollow Stem Auger w/ Auto Trip Hammer
Drive Weight: 140 pounds
Hole Diameter: 8 inches
Drop: 30 inches
Remarks: Borings backfilled with soil cuttings. GW not encountered

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LOG OF BORING NO. B-7

Project Name: **Mission Springs Solar Project**
Project Number: **G15 068 10B**
Project Location: **North Palm Springs, California**
Logged by: **C. Rozell**
Checked by: **A. Terronez**

Surface El.:
Location:

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Sample Number	Penetration Blows / Foot	Pocket Penetro-meter, TSF	% Passing No. 200 Sieve	In-Situ Dry Weight (pcf)	In-Situ Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
		SP: SAND: Light Olive Brown; medium to coarse grained; dry; trace of fine grained sand.	✋ ■									
5		End of boring.										
10												
15												
20												

Completion Depth: 5.0
Date Started: 5/15/15
Date Completed: 5/15/15
California Sampler: 2.5 inch inner diameter
SPT Sampler: 1.4 inch inner diameter

Drilling Equipment: Mobile B-61 Drill Rig
Drilling Method: Hollow Stem Auger w/ Auto Trip Hammer
Drive Weight: 140 pounds
Hole Diameter: 8 inches
Drop: 30 inches
Remarks: Borings backfilled with soil cuttings. GW not encountered

LOG OF BORING NO. B-8

BSK Associates
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Bakersfield, CA 93301

Project Name: **Mission Springs Solar Project**
Project Number: **G15 068 10B**
Project Location: **North Palm Springs, California**
Logged by: **C. Rozell**
Checked by: **A. Terronez**

Surface El.:
Location:

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Sample Number	Penetration Blows / Foot	Pocket Penetro-meter, TSF	% Passing No. 200 Sieve	In-Situ Dry Weight (pcf)	In-Situ Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
	⁘	SP: SAND: Light Olive Brown; medium to coarse grained; dry; trace of fine grained sand.	✋ ■									
5		End of boring.										
10												
15												
20												

Completion Depth: 4.5
Date Started: 5/15/15
Date Completed: 5/15/15
California Sampler: 2.5 inch inner diameter
SPT Sampler: 1.4 inch inner diameter

Drilling Equipment: Mobile B-61 Drill Rig
Drilling Method: Hollow Stem Auger w/ Auto Trip Hammer
Drive Weight: 140 pounds
Hole Diameter: 8 inches
Drop: 30 inches
Remarks: Borings backfilled with soil cuttings. GW not encountered

Appendix B

Infiltration Test Results

AECOM

Boring/Excavation Percolation Testing Field Log

Date 9/29/2017

Project Location MSWD Mission Springs
Boring/Test Number B-1
Earth Description (SP-SM)
Diameter of Boring (in) 8 **Diameter of Casing (in)** 2
Tested by Luis Vazquez
Depth of Boring (ft) 20.35
Liquid Description Water
Depth to Invert of BMP (in) 120
Measurement Method Water Level Meter
Depth to Initial Water Depth (in) (d_1) 224
Depth to Water Table N/A

Time Interval Standard
Pre-Soak Period 11:55 AM - 1:55 PM
Water Remaining In Boring (Y/N) N
Standard Period 1:55 PM - 3:00 PM
Standard Time Interval Between Readings 10 min

Reading Number	Time Start / End (hh:mm)	Elapsed Time Δtime (mins)	Depth to Water: Initial / Final (in.)	Water Drop During Standard Time Interval Δd (in)	Percolation Rate for Reading (min/in)	Infiltration Rate (in/hr)	Soil Description/Notes/Comments
Trial 1				0.0			Water drained out very quickly
Trial 2				0.0			Water drained out very quickly
1	1:55 PM	10	224.4	19.8	0.51	2.04	The water drained out in less than10 min
	2:05 PM		244.2				
2	2:05 PM	5	235.2	4.0	1.26	0.80	
	2:10 PM		239.2				
3	2:15 PM	5	234.0	4.6	1.10	0.93	
	2:20 PM		238.6				
4	2:25 PM	5	214.2	24.8	0.20	5.49	
	2:30 PM		239.0				
5	2:35 PM	5	237.6	1.2	4.17	0.24	
	2:40 PM		238.8				
6	2:45 PM	5	238.1	0.7	6.94	0.14	
	2:50 PM		238.8				
7	2:55 PM	5	213.8	24.0	0.21	5.34	
	3:00 PM		237.8				
8							
9							
10							
11							
12							
13							

d_1 = Initial water depth (in.)
Δd = Water drop of final period (in.)
DIA = Diameter of boring (in.)
r = Radius of boring (in.)
H_{avg} = Average head height over the time interval (in.)
ΔH = Change in height over the time interval (in.)
Δt = time interval (min.)

$$I_t = \frac{\Delta H \; 60 \; r}{\Delta t \; (r + 2 \; H_{avg})}$$

Tested Infiltration Rate = 5.34 in/hr

AECOM

Boring/Excavation Percolation Testing Field Log

Date 9/29/2017

Project Location	MSWD Mission Springs	**Boring/Test Number**	B-2
Earth Description	(SP-SM)	**Diameter of Boring (in)**	8
		Diameter of Casing (in)	2
Tested by	Luis Vazquez	**Depth of Boring (ft)**	20.35
Liquid Description	Water	**Depth to Invert of BMP (in)**	120
Measurement Method	Water Level Meter	**Depth to Initial Water Depth (in) (d_1)**	195
		Depth to Water Table	N/A

Time Interval Standard

Pre-Soak Period	8:00 AM - 10:00 AM	**Water Remaining In Boring (Y/N)**	N
Standard Period	10:00 AM - 11:40 AM	**Standard Time Interval Between Readings**	10 min

Reading Number	Time Start / End (hh:mm)	Elasped Time Δtime (mins)	Depth to Water: Initial / Final (in.)	Water Drop During Standard Time Interval Δd (in)	Percolation Rate for Reading (min/in)	Infiltration Rate (in/hr)	Soil Description/Notes/Comments
Trial 1	10:00 AM 10:25 AM	25	195.0 244.2	49.2	1.97	2.32	Water drained out very quickly
Trial 2				0.0			Water drained out very quickly
1	10:45 AM 10:50 AM	5	201.6 234.6	33.0	0.15	7.91	
2	10:55 AM 11:00 AM	5	198.6 234.2	35.6	0.14	8.69	
3	11:05 AM 11:10 AM	5	199.4 231.8	32.4	0.15	7.96	
4	11:15 AM 11:20 AM	5	201.4 239.0	37.7	0.13	8.85	
5	11:25 AM 11:30 AM	5	201.1 232.1	31.0	0.16	7.54	
6	11:35 AM 11:40 AM	5	195.8 231.8	36.0	0.14	9.02	
7							
8							
9							
10							
11							
12							
13							

d_1 = Initial water depth (in.)
Δd = Water drop of final period (in.)
DIA = Diameter of boring (in.)
r = Radius of boring (in.)
H_{avg} = Average head height over the time interval (in.)
ΔH = Change in height over the time interval (in.)
Δt = time interval (min.)

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\ (r + 2\ H_{avg})}$$

Tested Infiltration Rate = 9.02 in/hr

Boring/Excavation Percolation Testing Field Log

Date 9/28/2017

Project Location	MSWD Mission Springs	**Boring/Test Number**	B-8		
Earth Description	(SP-SM)	**Diameter of Boring (in)**	10	**Diameter of Casing (in)**	2
Tested by	Luis Vazquez	**Depth of Boring (ft)**	20.33		
Liquid Description	Water	**Depth to Invert of BMP (in)**	120		
Measurement Method	Water Level Meter	**Depth to Initial Water Depth (in) (d_1)**	193.44		
		Depth to Water Table	N/A		

Time Interval Standard

Pre-Soak Period	3:00 PM - 5:00 PM	**Water Remaining In Boring (Y/N)**	N
Standard Period	10:00 AM - 5:48 PM	**Standard Time Interval Between Readings**	4 min

Reading Number	Time Start / End (hh:mm)	Elasped Time Δtime (mins)	Depth to Water: Initial / Final (in.)	Water Drop During Standard Time Interval Δd (in)	Percolation Rate for Reading (min/in)	Infiltration Rate (in/hr)	Soil Description/Notes/Comments
Trial 1							Water drained out very quickly
Trial 2							Water drained out very quickly
1	5:00 PM	10	193.4	37.6	0.27	5.95	Time constrains caused us to take faster readings
	5:10 PM		231.0				
2	5:10 PM	10	231.0	13.0	0.77	1.62	
	5:20 PM		244.0				
3	5:27 PM	4	177.6	33.6	0.12	16.38	
	5:31 PM		211.2				
4	5:31 PM	4	211.2	15.1	0.26	5.60	
	5:35 PM		226.3				

d_1 = Initial water depth (in.)
Δd = Water drop of final period (in.)
DIA = Diameter of boring (in.)
r = Radius of boring (in.)
H_{avg} = Average head height over the time interval (in.)
ΔH = Change in height over the time interval (in.)
Δt = time interval (min.)

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\ (r + 2\ H_{avg})}$$

Tested Infiltration Rate = 5.6 in/hr

AECOM

Boring/Excavation Percolation Testing Field Log

Date 9/29/2017

Project Location	MSWD Mission Springs	**Boring/Test Number**	B-10		
Earth Description	(SP-SM)	**Diameter of Boring (in)**	8	**Diameter of Casing (in)**	2
Tested by	Luis Vazquez	**Depth of Boring (ft)**	20.32		
Liquid Description	Water	**Depth to Invert of BMP (in)**	120		
Measurement Method	Water Level Meter	**Depth to Initial Water Depth (in) (d_1)**	152.8		
		Depth to Water Table	N/A		

Time Interval Standard

Pre-Soak Period	8:30 AM - 10:30 AM	**Water Remaining In Boring (Y/N)**	N
Standard Period	10:30 AM - 1:30 PM	**Standard Time Interval Between Readings**	10 min

Reading Number	Time Start / End (hh:mm)	Elapsed Time Δtime (mins)	Depth to Water: Initial / Final (in.)	Water Drop During Standard Time Interval Δd (in)	Percolation Rate for Reading (min/in)	Infiltration Rate (in/hr)	Soil Description/Notes/Comments
Trial 1	10:30 AM 10:55 AM	25	152.8 233.4	80.6	0.31	5.16	Water drained out very quickly
Trial 2	11:15 AM 11:40 AM	25	151.2 233.0	81.8	0.31	5.30	Water drained out very quickly
1	12:00 PM 12:10 PM	10	147.6 206.5	58.9	0.17	11.97	
2	12:10 PM 12:20 PM	10	206.5 226.8	20.3	0.49	2.47	
3	12:20 PM 12:30 PM	10	226.8 232.8	6.0	1.67	0.64	
4	12:30 PM 12:40 PM	10	232.8 236.6	3.8	2.60	0.39	
5	12:40 PM 12:50 PM	10	236.6 238.9	2.3	4.39	0.23	
6	1:10 PM 1:20 PM	10	159.6 230.4	70.8	0.14	11.03	
7							
8							
9							
10							
11							
12							
13							

d_1 = Initial water depth (in.)
Δd = Water drop of final period (in.)
DIA = Diameter of boring (in.)
r = Radius of boring (in.)
H_{avg} = Average head height over the time interval (in.)
ΔH = Change in height over the time interval (in.)
Δt = time interval (min.)

$$I_t = \frac{\Delta H \; 60 \; r}{\Delta t \; (r + 2 \; H_{avg})}$$

Tested Infiltration Rate = 11.03 in/hr

Appendix C

Geotechnical Laboratory Results

Geotechnical soil samples obtained from the borings were carefully sealed and packaged in the field to reduce moisture loss and disturbance. The samples were subsequently delivered to our laboratory where they were further examined and classified. Selected representative samples were tested to evaluate water content, in-situ dry density, fines content, Atterberg limits, shear strength, corrosivity, swelling potential, and R- value. All tests discussed below were performed in accordance with the latest American Society of Testing and Materials (ASTM), or California Test Method (CTM) standards.

Water Content (ASTM D2216)

Water content tests were performed on selected soil/rock samples in general accordance with ASTM D2216, *Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*. The results of the tests are presented in Table C-1 and also presented on boring logs.

Soil Classification (ASTM D2488)

Soil identification and classification was performed on all soil samples obtained from the borings. The soil identification is based on visual examination and manual tests, in accordance with ASTM D2488, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures).*

Moisture Content and Dry Density (ASTM D7263)

The density tests were performed on selected soil samples obtained from the borings. The dry density tests were performed in accordance with ASTM Test Methods D7263, *Standard Test Methods for Laboratory Determination of Density (Unit Weight) of Soil Specimens*. A summary of the results are presented on the Log of Borings in Appendix A as well as summarized in Table C-1.

Atterberg Limits (ASTM D4318)

Atterberg Limits test was performed to aid in classification and to evaluate the plasticity characteristics of fine-grained materials encountered in the borings. The test was performed in accordance with ASTM Test Method D4318, *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*. The results of this test are presented on the Logs of Borings. Summary plots are plotted as Plasticity Charts (Figures C-1 and C-2).

Wash Analysis (ASTM D1140)

Percent passing no. 200 sieve tests were performed on selected soils samples obtained from the borings. These tests were performed to aid in classification of the soils and to help in evaluating the liquefaction potential of the soils. The tests were performed in accordance with ASTM Test Method D1140, *Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing*. The results of the tests are presented in Table C-1 as well as shown on the Log of Borings in Appendix A.

Sieve Analysis (ASTM D6913)

Tests were performed to determine the particle size distribution of selected soil samples. These tests were performed in accordance with ASTM Test Method D6913, *Standard Test Methods for Particle-Size*

Distribution (Gradation) of Soils Using Sieve Analysis. Test results are appended as Particle Size Distribution Curves and presented within this Appendix C (Figures C-3 through C-23).

Direct Shear Test (ASTM D3080)

Consolidated-drained (saturated) direct shear tests were performed on relative undisturbed samples to evaluate shear strength parameters of the on-site soils. The direct shear tests were performed in accordance with ASTM Test Method D3080, *Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions*. The results of the direct shear tests are presented in Appendix C (Figures C-24 and C-25).

Corrosivity Tests (CTM 417, 422 & 643)

Selected representative samples obtained from the boring were tested for corrosion. Determination of the soluble sulfate and water-soluble chloride content of on-site soils and minimum resistivity and pH testing were conducted in accordance with CTM Test Methods: CTM 417, *Method of Testing Soils and Waters for Sulfate Content*; CTM 422, *Method of Testing Soils and Waters for Chloride Content*; and CTM 643, *Method for Determining Field and Laboratory Resistivity and pH Measurements for Soil and Water.* The results of the corrosion tests are presented in Appendix C (Figure C-26).

One-Dimensional Swell/Collapse Potential (ASTM D4546)

Selected samples were tested to determine the magnitude of swell or settlement of relatively undisturbed or compacted cohesive soil. Test methods were performed in accordance with ASTM D4546, *Standard Test Methods for One-Dimensional Swell or Settlement Potential of Cohesive Soils*. The results are presented in Appendix C (Figure C-27).

R-Value (CTM 301)

Selected representative bulk samples obtained from the boring were tested to measure the response of a compacted sample of soil to a vertically applied pressure under specific conditions. The sand equivalent tests were performed in accordance with CTM 301, *Method for Determining the Resistance "R" Value of Treated and Untreated Bases, Subbases, and Basement Soils by the Stabilometer*. The results of the R-Value tests are presented in Appendix C (Figure C-28).

Table C-1: Santa Ana Geotechnical Laboratory Testing Summary

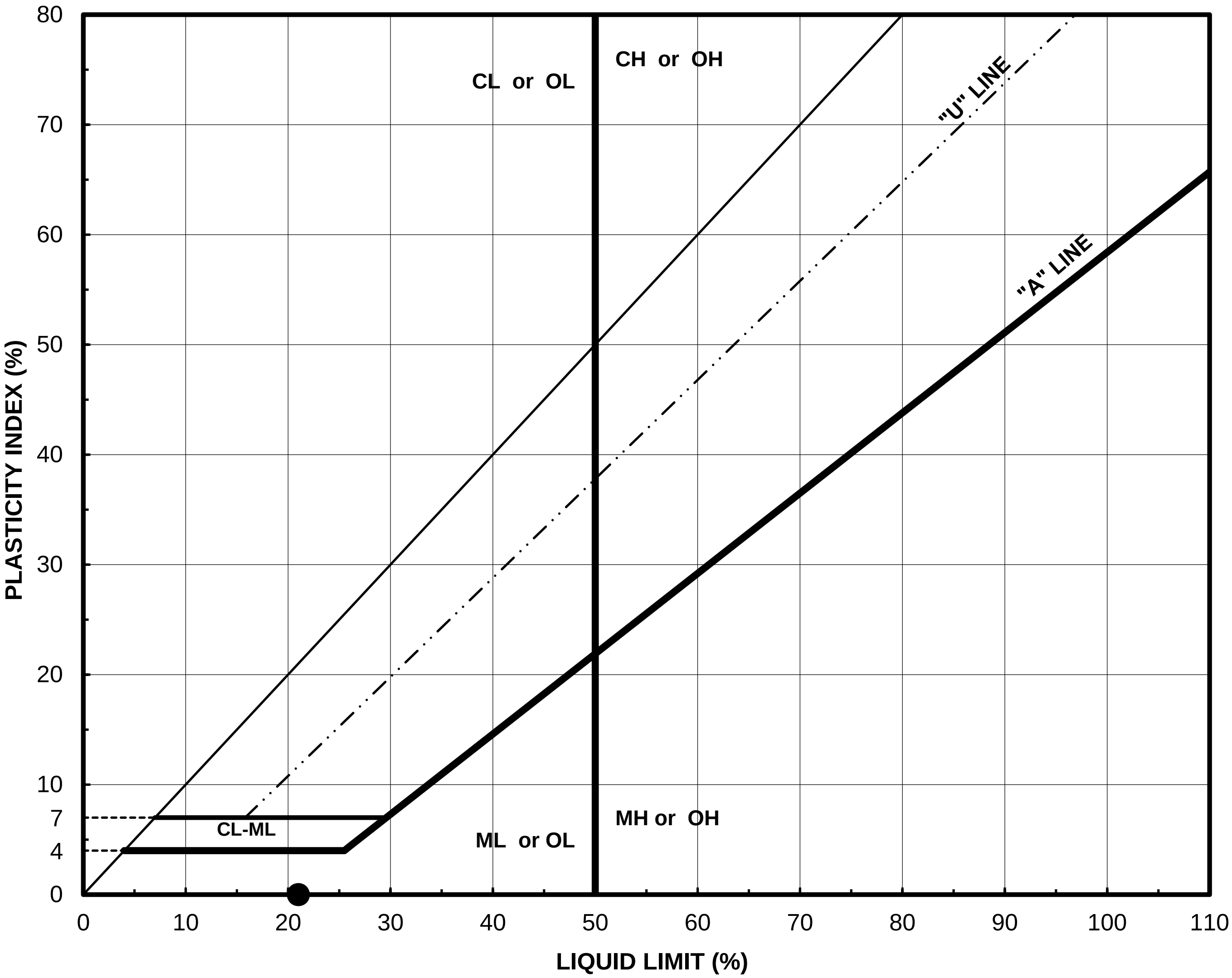
Project Name: MSWD Mission Springs
Project Number: 60551186
Project Engineer: MGS

Location				Initial Condition			Limits			Gradation			Direct Shear			Corrosivity Tests			
Boring Number	Sample Number	Depth (ft)	USCS Symbol	Water Content (%)	Total Unit Weight (pcf)	Dry Unit Weight (pcf)	Liquid Limit	Plasticity Index	Liquidity Index	Gravel (%)	Sand (%)	Fines (%)	Normal Stress Sequence (ksf)	Peak Friction Angle (deg)	Strength Intercept (ksf)	Resistivity, ohm-cm	pH	Sulfate Content, ppm	Chloride Content, ppm
B-1	2	5.0	SP-SM	0.4						31.0	59.7	9.3							
B-1	3	10.0	SP-SM	0.5															
B-1	4	15.0	SW-SM	0.7						6.8	85.5	7.7							
B-1	5	20.0	SP-SM	22.1															
B-2	1	0-5	SP	1.1															
B-2	2	5.0	SP	1.4	112.3	110.7													
B-2	3	10.0	SW-SM	0.9						14.7	79.6	5.7							
B-2	4	15.0	SP-SM	0.8								8.6							
B-3	1	0-5	SP	0.4															
B-3	2	5.0	SP-SM	0.6	117.1	116.4				17.0	78.4	4.6	1,2,4	41	0				
B-3	3	10.0	SP-SM													9,600	9.8	17	2
B-3	5	20.0	SW-SM	0.7						3.2	90.7	6.1							
B-3	6B	30.3	SM	1.6			21	0	N/A			22.1							
B-3	7	35.0	SP	0.6															
B-4	2	5.0	SW-SM	0.8	119.2	118.2				2.0	90.3	7.7							
B-4	3	10.0	SP-SM	0.6								9.9							
B-4	4	20.0	SP	0.6															
B-4	5	25.0	SP-SM	0.7						11.8	78.0	10.2							
B-5	1	0-5	SM	0.5															
B-5	2	5.0	SW-SM	0.5						9.7	92.5	7.8							
B-5	3	10.0	SM/GP	0.5															
B-5	5	20.0	SP-SM	0.7								7.1							
B-5	6	25.0	SP-SM	0.9			Non-Plastic					11.4							
B-5	7B	30.5	SM	2.9								49.3							
B-5	8	35.0	SP-SM	0.7															
B-6	1	0-5	SW-SM	0.8						1.5	89.2	9.3							

Table C-1: Santa Ana Geotechnical Laboratory Testing Summary

Project Name: MSWD Mission Springs
Project Number: 60551186
Project Engineer: MGS

Location				Initial Condition			Limits			Gradation			Direct Shear			Corrosivity Tests			
Boring Number	Sample Number	Depth (ft)	USCS Symbol	Water Content (%)	Total Unit Weight (pcf)	Dry Unit Weight (pcf)	Liquid Limit	Plasticity Index	Liquidity Index	Gravel (%)	Sand (%)	Fines (%)	Normal Stress Sequence (ksf)	Peak Friction Angle (deg)	Strength Intercept (ksf)	Resistivity, ohm-cm	pH	Sulfate Content, ppm	Chloride Content, ppm
B-6	3	15.0	SP	0.7						15.4	81.0	3.6							
B-6	5	25.0	SP-SM	0.7						2.5	87.9	9.6							
B-6	6	30.0	SP-SM	1.0															
B-6	8A	40.0	SM	9.6															
B-6	8B	41.0	SW-SM	0.8						20.8	69.3	9.9							
B-6	10	50.0	SP-SM	0.6												2,400	11.4	139	4.5
B-7	1	0-5	SP-SM	0.5								9.4							
B-7	3	10.0	SW	0.6						8.6	86.8	4.6							
B-7	4	15.0	SP	0.7															
B-7	5	20.0	SW-SM	0.8						7.7	83.8	8.5							
B-7	7A	30.0	SM	1.3															
B-7	8	35.0	SM	2.0			24	1	-21.03			19.8							
B-7	10B	45.5	SP-SM	0.7															
B-8	1	0-5	SW-SM	0.6						3.0	87.1	9.9							
B-8	2	5.0	SP-SM	1.0	113.5	112.4													
B-8	3	10.0	SW-SM	0.3						32.3	58.8	8.9							
B-9	1	0-5	SP-SM	0.6								7.5							
B-9	2	5.0	SP-SM	0.3						20.3	70.3	9.4							
B-9	4	15.0	SM	0.8								21.3							
B-9	5	20.0	SM	0.4															
B-9	7	30.0	SW-SM	0.5						23.2	70.5	6.3							
B-9	8	40.0	SM	0.8															
B-9	9	45.0	SW-SM	0.6						8.1	85.9	6.0							
B-10	1	0-5	SP-SM	0.4						2.8	91.4	5.8							
B-10	2	5.0	SP-SM	1.1	99.4	98.3													
B-10	3	10.0	SM	0.3						19.4	64.2	16.4							
B-10	4	15.0	SM	0.2															



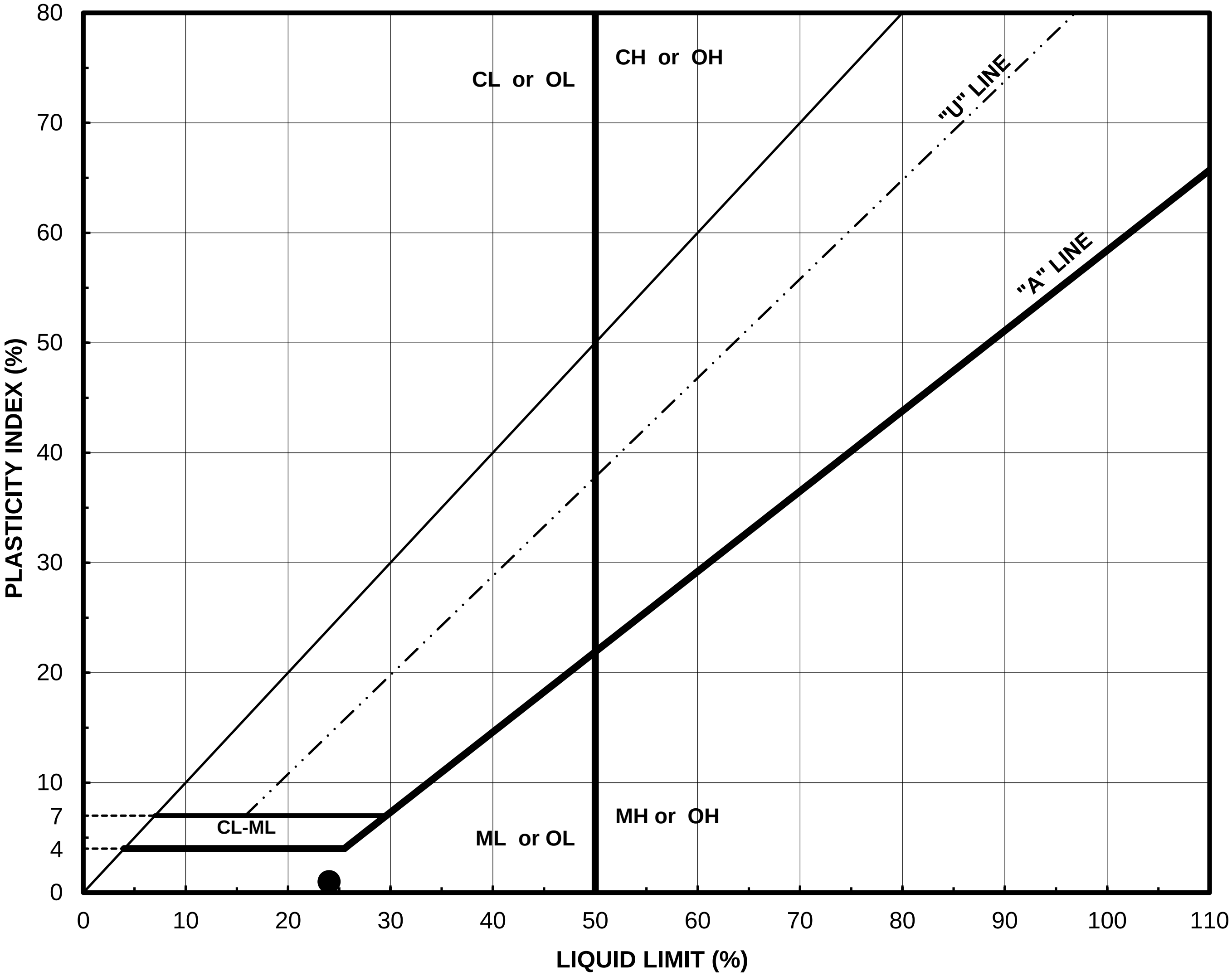
Boring Number	Sample Number	Depth (ft)	Water Content (%)	LL	PI	DESCRIPTION / CLASSIFICATION
B-3	6B	30.3	1.6	21	0	Light olive brown Silty SAND (SM)

Project Name: **MSWD Mission Springs**

Project Number: **60551186**

PLASTICITY CHART

Figure C-1



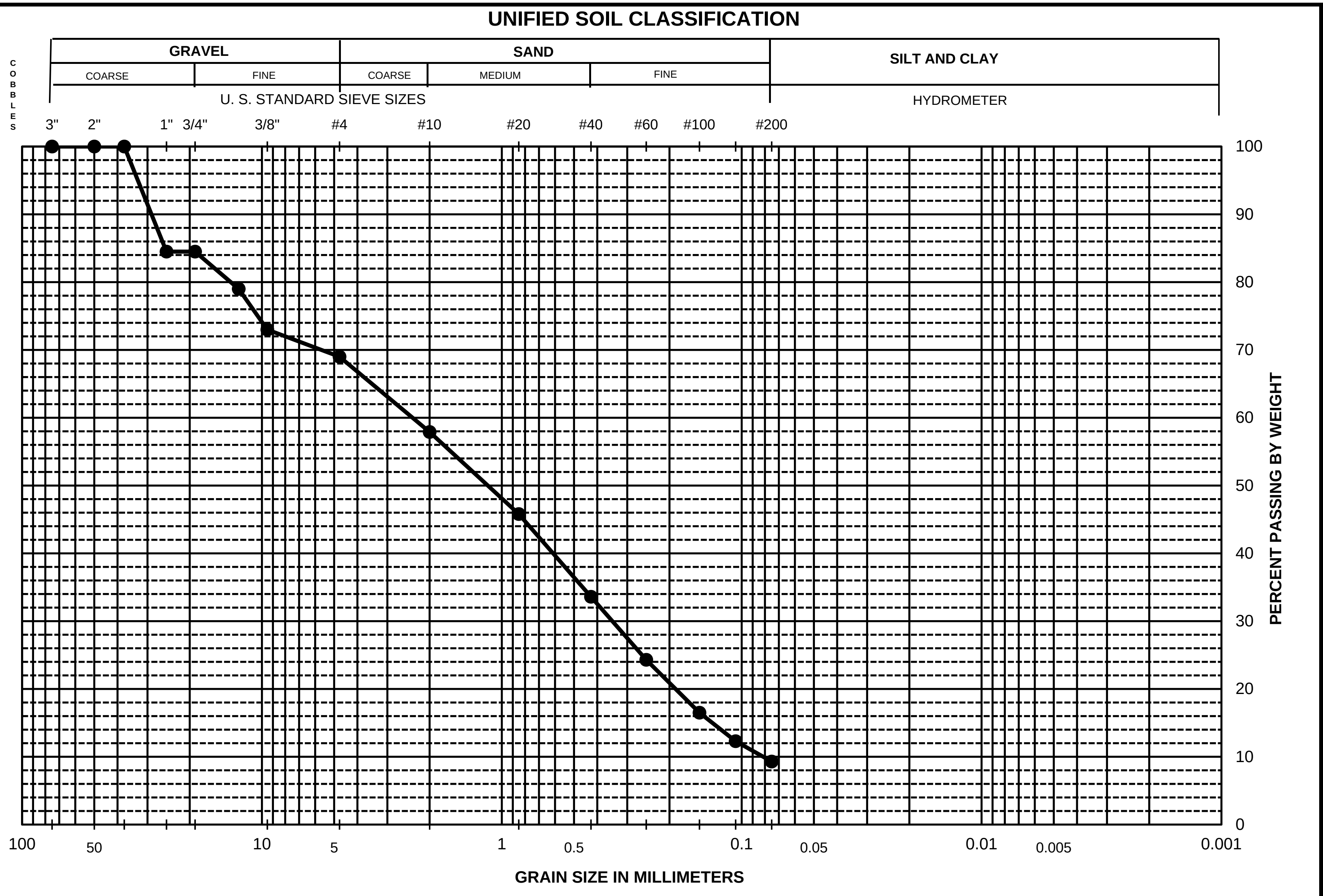
Boring Number	Sample Number	Depth (ft)	Water Content (%)	LL	PI	DESCRIPTION / CLASSIFICATION
B-7	8	35.0	2.0	24	1	Dark yellowish brown Silty SAND (SM)

Project Name: **MSWD Mission Springs**

Project Number: **60551186**

PLASTICITY CHART

Figure C-2



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	84.5
3/4"	19.00	84.5
1/2"	12.50	79.0
3/8"	9.50	73.0
#4	4.75	69.0
#10	2.00	57.9
#20	0.850	45.8
#40	0.425	33.6
#60	0.250	24.3
#100	0.150	16.5
#140	0.106	12.3
#200	0.075	9.3
Hydrometer Analysis		

% Cobbles	---
% Gravel	31.0
% Sand	59.7
% Fines	9.3
D_{85}	25.000
D_{60}	2.356
D_{50}	1.144
D_{30}	0.346
D_{15}	0.133
D_{10}	0.081
C_u	29.0
C_c	0.6

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-1	2	5.0	●	0.4	---	---	---	**Light brownish gray Poorly Graded SAND with Silt and Gravel (SP-SM)**

PROJECT NAME: **MSWD Mission Springs**

PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-3

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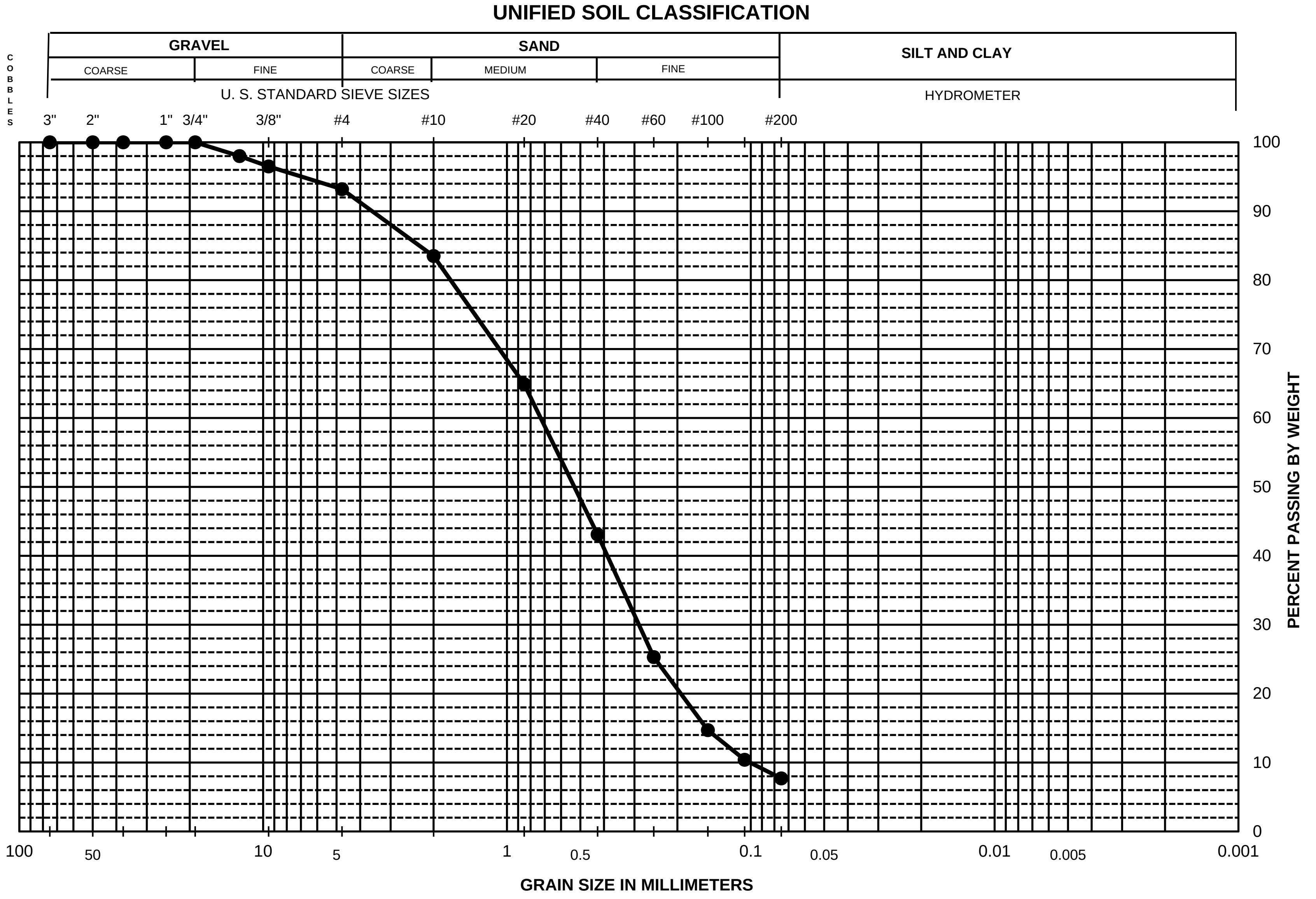

Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	98.0
3/8"	9.50	96.5
#4	4.75	93.2
#10	2.00	83.5
#20	0.850	64.9
#40	0.425	43.1
#60	0.250	25.3
#100	0.150	14.7
#140	0.106	10.4
#200	0.075	7.7
Hydrometer Analysis		

% Cobbles	---
% Gravel	6.8
% Sand	85.5
% Fines	7.7
D_{85}	2.286
D_{60}	0.727
D_{50}	0.529
D_{30}	0.288
D_{15}	0.152
D_{10}	0.101
C_u	7.2
C_c	1.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 µm	Description and Classification
B-1	4	15.0	●	0.7	---	---	---	**Light brownish gray Well Graded SAND with Silt (SW-SM)**

PROJECT NAME: **MSWD Mission Springs**

PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-4

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-1\Sieve MSWD Mission Springs B-1 15 ft.xlsx

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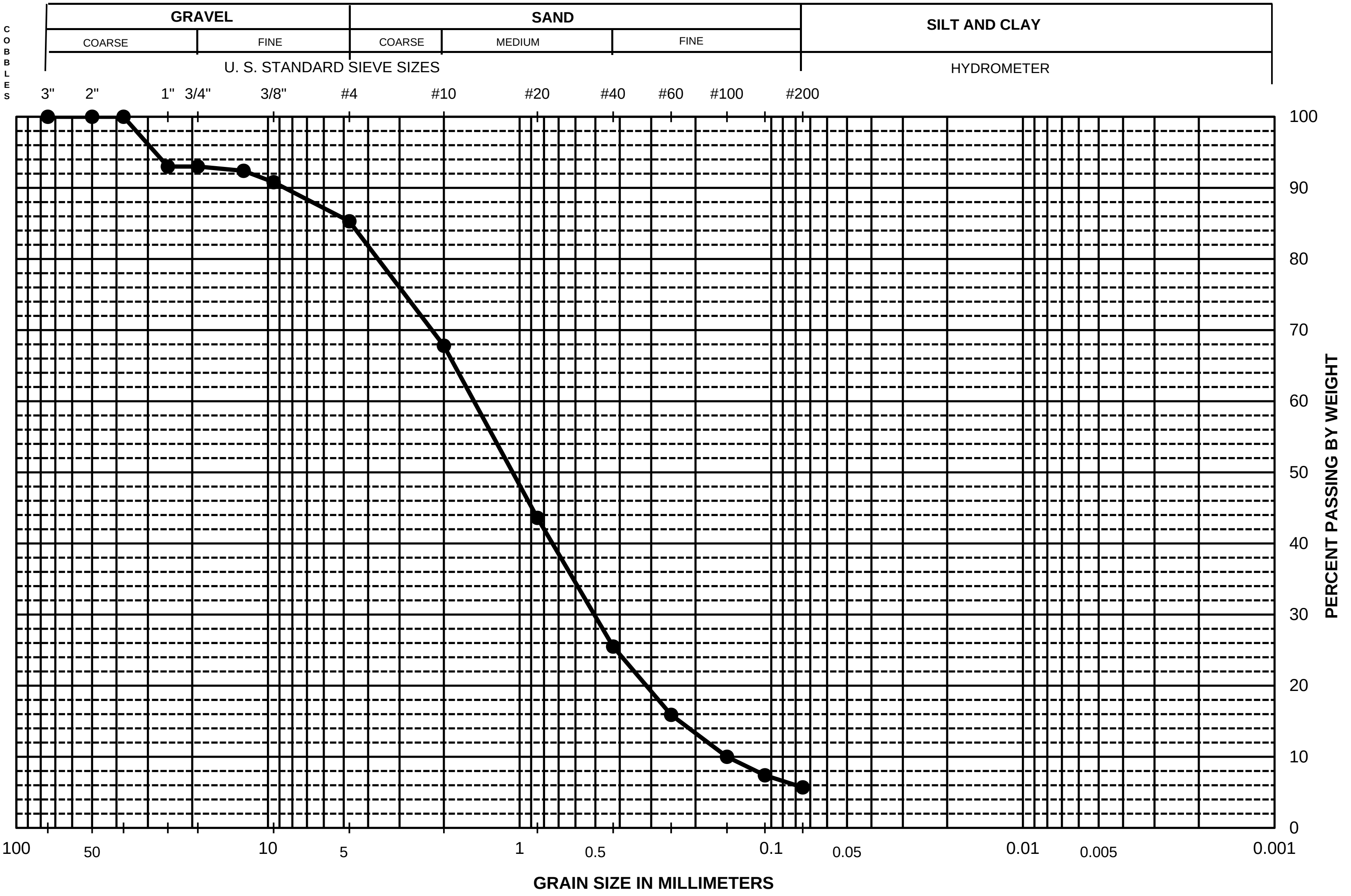
UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	93.0
3/4"	19.00	93.0
1/2"	12.50	92.4
3/8"	9.50	90.8
#4	4.75	85.3
#10	2.00	67.8
#20	0.850	43.6
#40	0.425	25.5
#60	0.250	15.9
#100	0.150	10.0
#140	0.106	7.4
#200	0.075	5.7
Hydrometer Analysis		

% Cobbles	---
% Gravel	14.7
% Sand	79.6
% Fines	5.7
D_{85}	4.680
D_{60}	1.518
D_{50}	1.066
D_{30}	0.505
D_{15}	0.231
D_{10}	0.150
C_u	10.1
C_c	1.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-2	3	10.0	●	0.9	---	---	---	**Light brownish gray Well Graded SAND with Silt (SW-SM)**

PROJECT NAME: **MSWD Mission Springs**

PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-5

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-2\Sieve MSWD Mission Springs B-2 10 ft.xlsx

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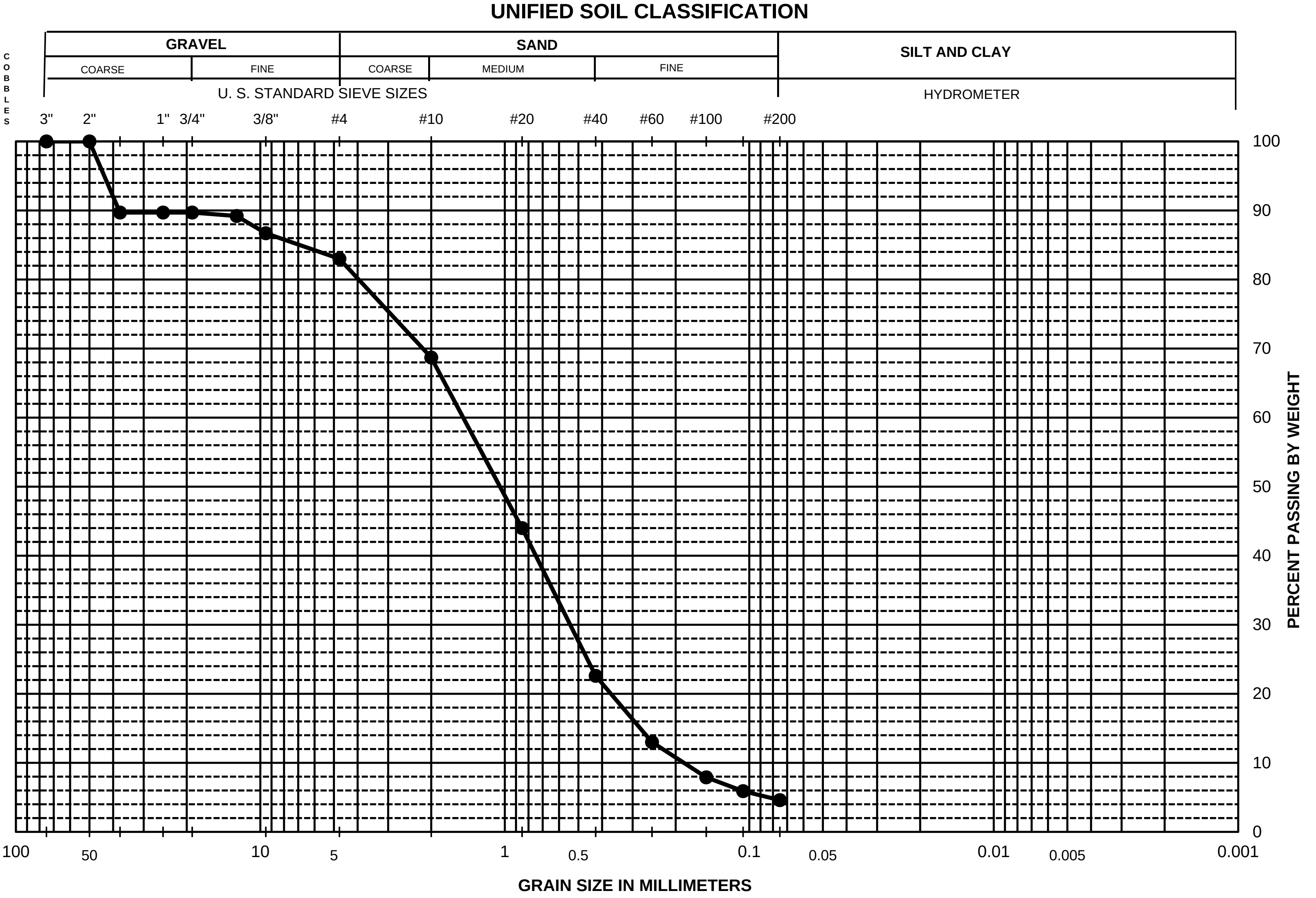

Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	89.7
1"	25.0	89.7
3/4"	19.00	89.7
1/2"	12.50	89.2
3/8"	9.50	86.7
#4	4.75	83.0
#10	2.00	68.7
#20	0.850	44.0
#40	0.425	22.6
#60	0.250	13.0
#100	0.150	7.9
#140	0.106	5.9
#200	0.075	4.6
Hydrometer Analysis		

% Cobbles	---
% Gravel	17.0
% Sand	78.4
% Fines	4.6
D_{85}	6.909
D_{60}	1.480
D_{50}	1.046
D_{30}	0.540
D_{15}	0.279
D_{10}	0.185
C_u	8.0
C_c	1.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-3	2	5.0	●	0.6	---	---	---	**Light brownish gray Well Graded SAND with Gravel (SW)**

PROJECT NAME: **MSWD Mission Springs**

PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-6

AECOM

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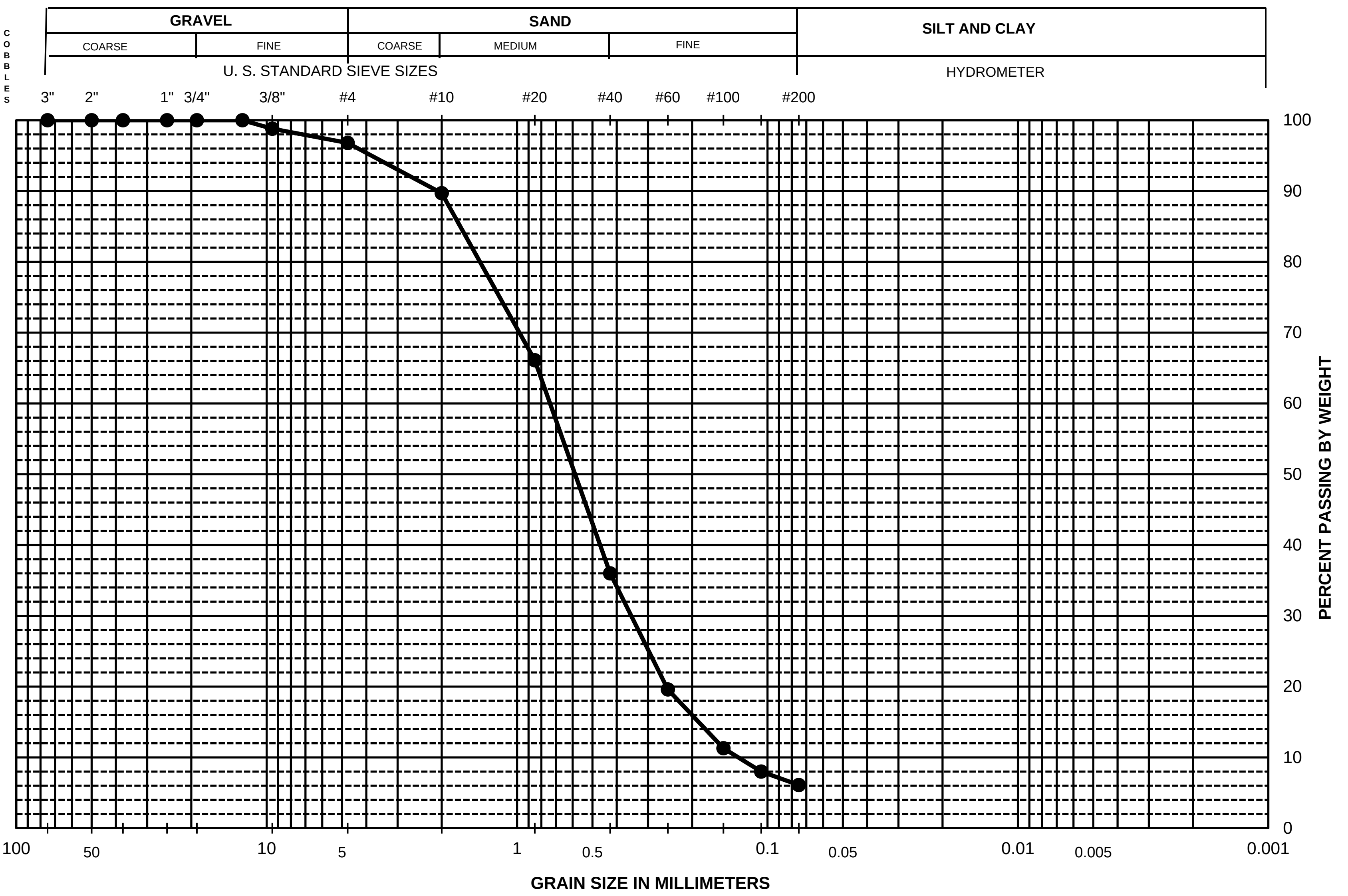
UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	98.8
#4	4.75	96.8
#10	2.00	89.7
#20	0.850	66.1
#40	0.425	36.0
#60	0.250	19.6
#100	0.150	11.3
#140	0.106	8.0
#200	0.075	6.1
Hydrometer Analysis		

% Cobbles	---
% Gravel	3.2
% Sand	90.7
% Fines	6.1
D_{85}	1.687
D_{60}	0.739
D_{50}	0.587
D_{30}	0.350
D_{15}	0.188
D_{10}	0.131
C_u	5.6
C_c	1.3

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-3	5	20.0	●	0.7	---	---	---	**Light brownish gray Well Graded SAND with Silt (SW-SM)**

PROJECT NAME: **MSWD Mission Springs**

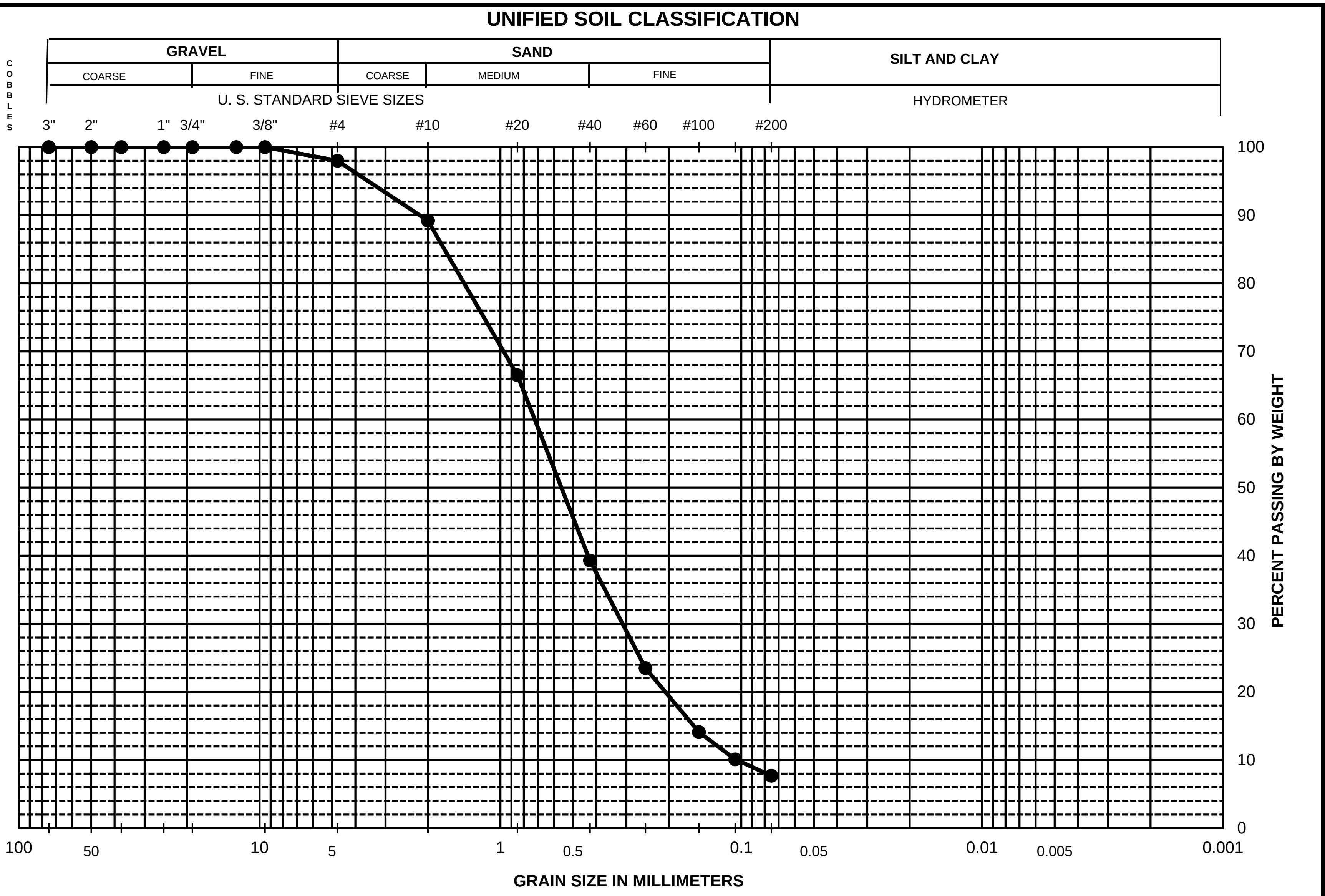
PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-7

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-3\Sieve MSWD Mission Springs B-3 20 ft.xlsx

AECOM



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	98.0
#10	2.00	89.2
#20	0.850	66.5
#40	0.425	39.3
#60	0.250	23.5
#100	0.150	14.1
#140	0.106	10.1
#200	0.075	7.7
Hydrometer Analysis		

% Cobbles	---
% Gravel	2.0
% Sand	90.3
% Fines	7.7
D_{85}	1.707
D_{60}	0.720
D_{50}	0.558
D_{30}	0.311
D_{15}	0.158
D_{10}	0.104
C_u	6.9
C_c	1.3

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-4	2	5.0	●	0.8	---	---	---	**Grayish brown Well Graded SAND with Silt (SW-SM)**

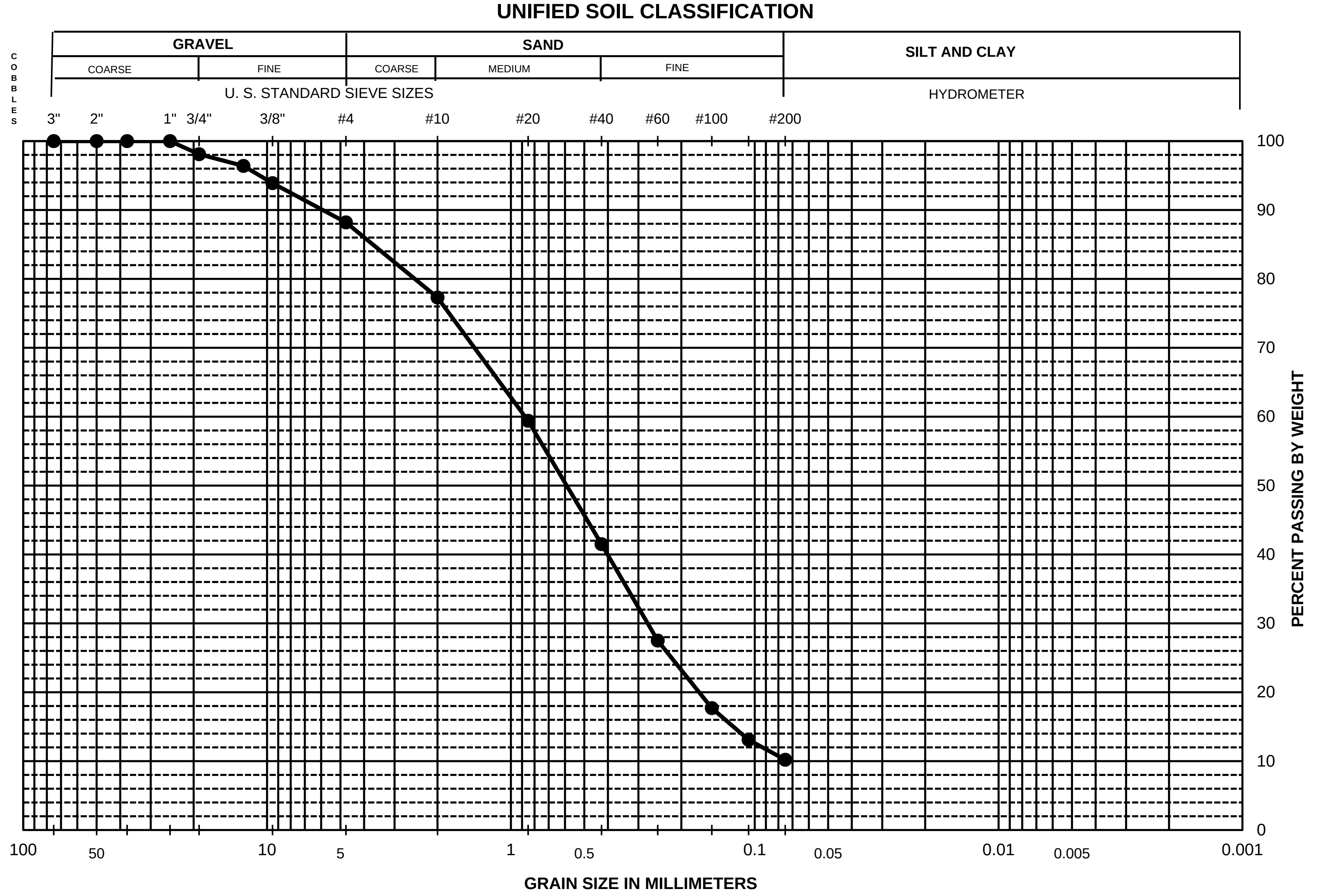
PROJECT NAME: **MSWD Mission Springs**

PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-8

AECOM



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	98.1
1/2"	12.50	96.4
3/8"	9.50	93.9
#4	4.75	88.2
#10	2.00	77.3
#20	0.850	59.4
#40	0.425	41.5
#60	0.250	27.5
#100	0.150	17.7
#140	0.106	13.1
#200	0.075	10.2
Hydrometer Analysis		

% Cobbles	---
% Gravel	11.8
% Sand	78.0
% Fines	10.2
D_{85}	3.685
D_{60}	0.875
D_{50}	0.591
D_{30}	0.275
D_{15}	0.122
D_{10}	----
C_u	----
C_c	-----

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-4	5	25.0	●	0.7	---	---	---	**Light brownish gray Poorly Graded SAND with Silt (SP-SM)**

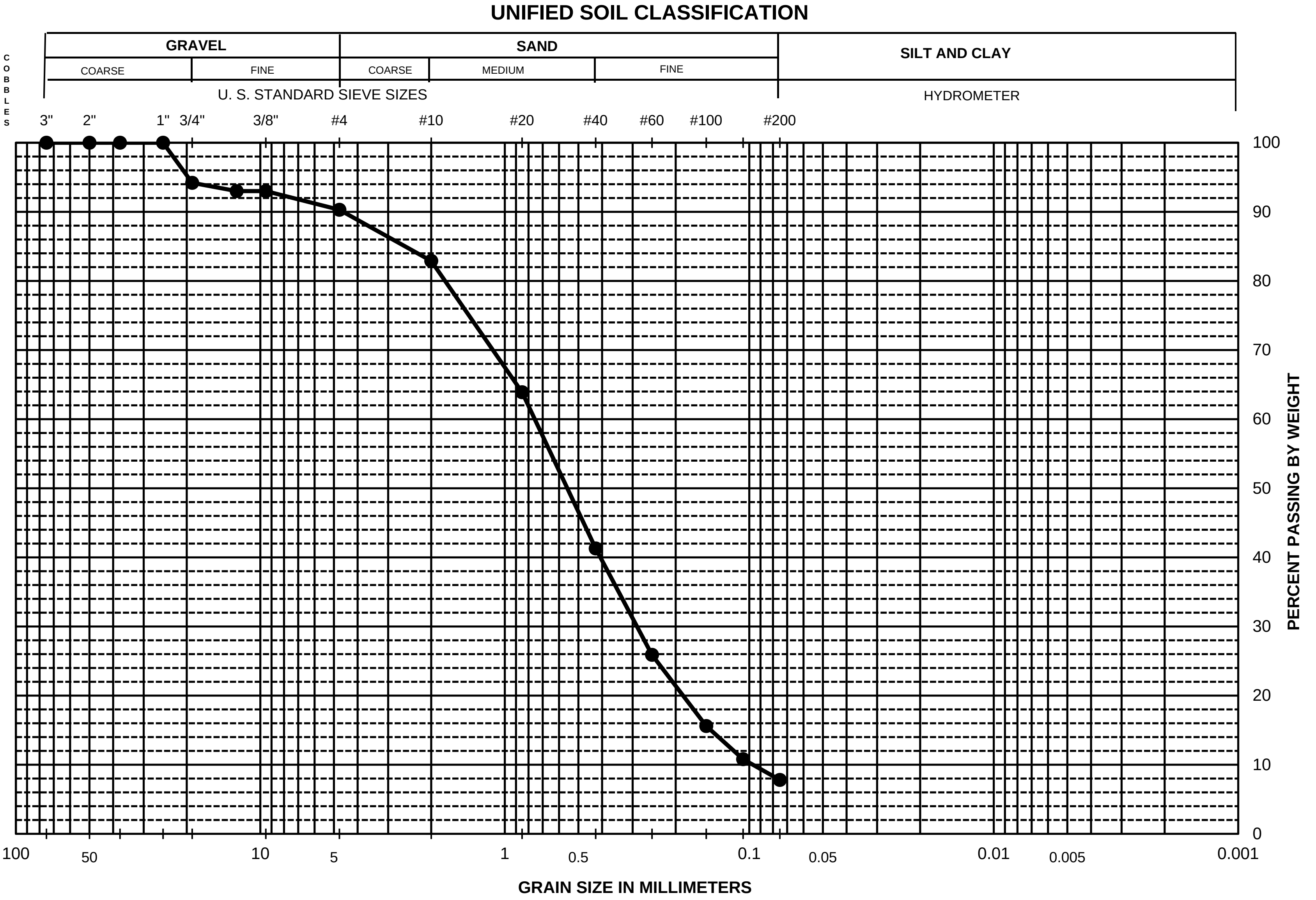
PROJECT NAME: **MSWD Mission Springs**
PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-9

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-4\Sieve MSWD Mission Springs B-4 25 ft.xlsx

AECOM



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	94.2
1/2"	12.50	93.0
3/8"	9.50	93.0
#4	4.75	90.3
#10	2.00	82.9
#20	0.850	63.9
#40	0.425	41.3
#60	0.250	25.9
#100	0.150	15.6
#140	0.106	10.8
#200	0.075	7.8
Hydrometer Analysis		

% Cobbles	---
% Gravel	9.7
% Sand	82.5
% Fines	7.8
D_{85}	2.556
D_{60}	0.754
D_{50}	0.555
D_{30}	0.288
D_{15}	0.144
D_{10}	0.097
C_u	7.8
C_c	1.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-5	2	5.0	●	0.5	---	---	---	**Light brownish gray Well Graded SAND with Silt (SW-SM)**

PROJECT NAME: **MSWD Mission Springs**

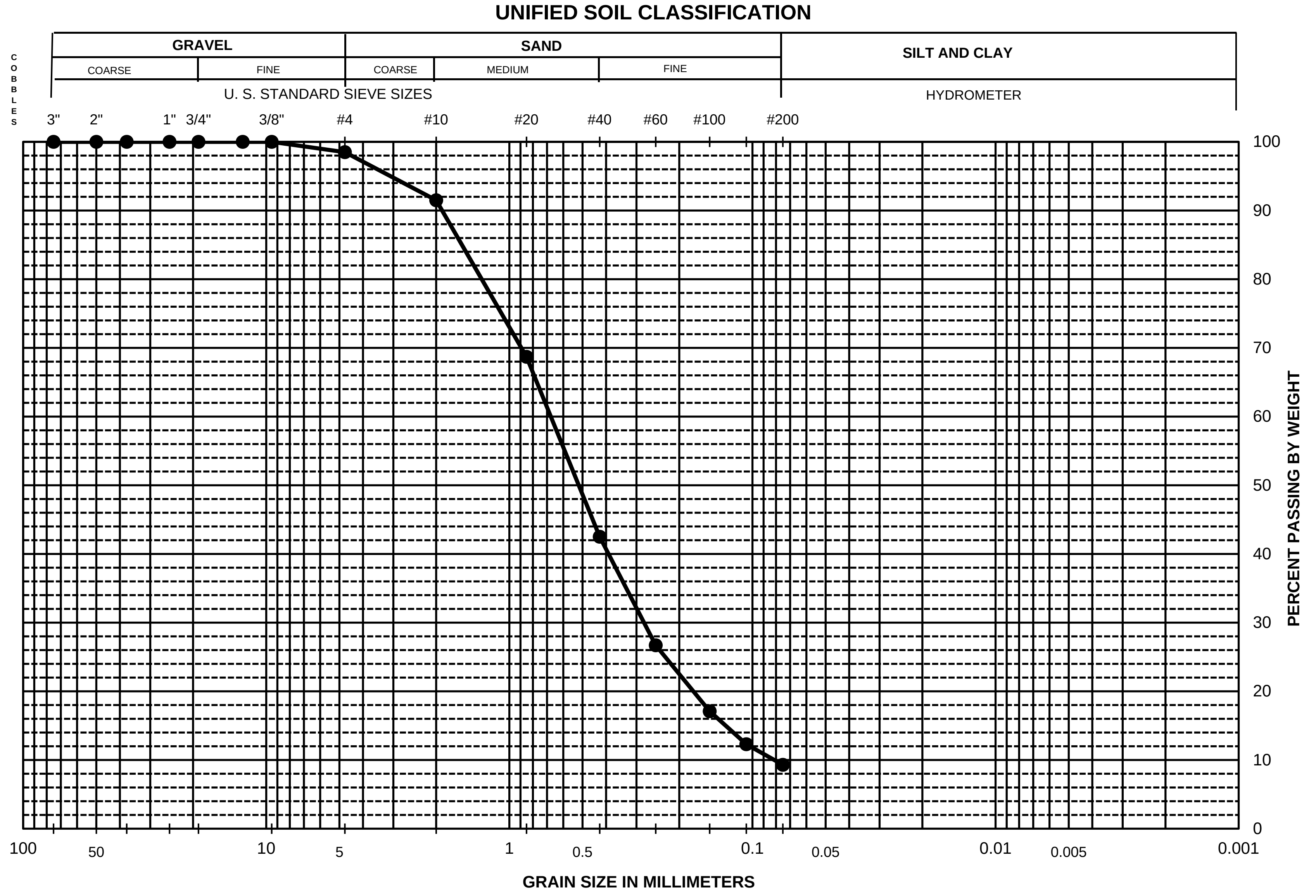
PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-10

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-5\Sieve MSWD Mission Springs B-5 5 ft.xlsx

AECOM



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	98.5
#10	2.00	91.5
#20	0.850	68.7
#40	0.425	42.5
#60	0.250	26.7
#100	0.150	17.1
#140	0.106	12.3
#200	0.075	9.3
Hydrometer Analysis		

% Cobbles	---
% Gravel	1.5
% Sand	89.2
% Fines	9.3

D_{85}	1.567
D_{60}	0.675
D_{50}	0.518
D_{30}	0.279
D_{15}	0.129
D_{10}	0.081
C_u	8.3
C_c	1.4

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-6	1	0~5	●	0.8	---	---	---	**Light olive brown Well Graded SAND with Silt (SW-SM)**

PROJECT NAME: **MSWD Mission Springs**

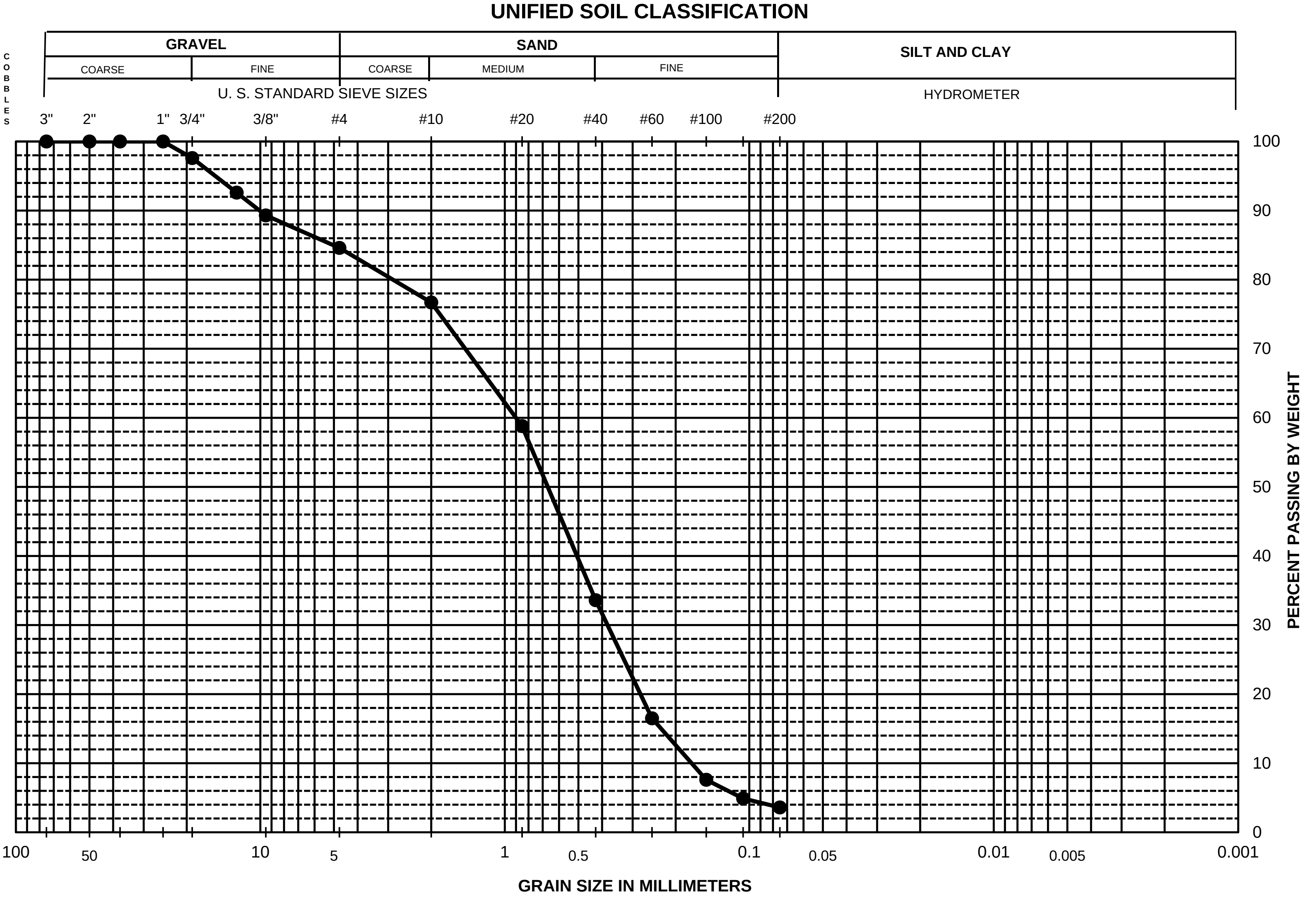
PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-11

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-6\Sieve MSWD Mission Springs B-6 0-5 ft.xlsx

AECOM



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	97.6
1/2"	12.50	92.6
3/8"	9.50	89.3
#4	4.75	84.6
#10	2.00	76.7
#20	0.850	58.8
#40	0.425	33.6
#60	0.250	16.5
#100	0.150	7.6
#140	0.106	4.9
#200	0.075	3.6
Hydrometer Analysis		

% Cobbles	---
% Gravel	15.4
% Sand	81.0
% Fines	3.6

D_{85}	5.039
D_{60}	0.900
D_{50}	0.667
D_{30}	0.380
D_{15}	0.229
D_{10}	0.172
C_u	5.2
C_c	0.9

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-6	3	15.0	●	0.7	---	---	---	**Light brownish gray Poorly Graded SAND with Gravel (SP)**

PROJECT NAME: **MSWD Mission Springs**

PROJECT NUMBER: **60551186**

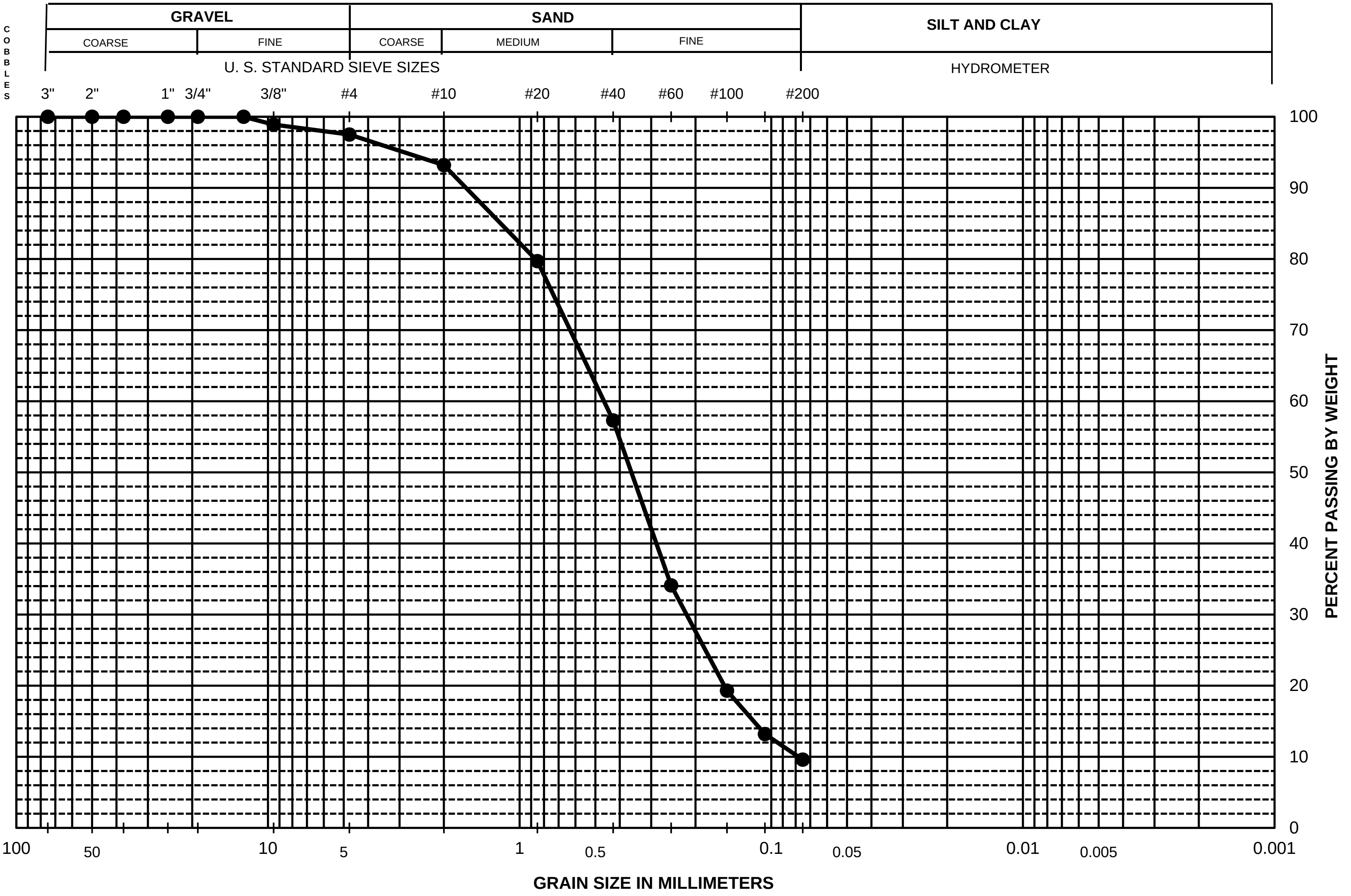
PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-12

AECOM

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-6\Sieve MSWD Mission Springs B-6 15 ft.xlsx

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	98.9
#4	4.75	97.5
#10	2.00	93.2
#20	0.850	79.7
#40	0.425	57.3
#60	0.250	34.1
#100	0.150	19.3
#140	0.106	13.2
#200	0.075	9.6
Hydrometer Analysis		

% Cobbles	---
% Gravel	2.5
% Sand	87.9
% Fines	9.6

D_{85}	1.189
D_{60}	0.462
D_{50}	0.360
D_{30}	0.217
D_{15}	0.117
D_{10}	0.078
C_u	5.9
C_c	1.3

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-6	5	25.0	●	0.7	---	---	---	**Grayish brown Poorly Graded SAND with Silt (SP-SM)**

PROJECT NAME: **MSWD Mission Springs**

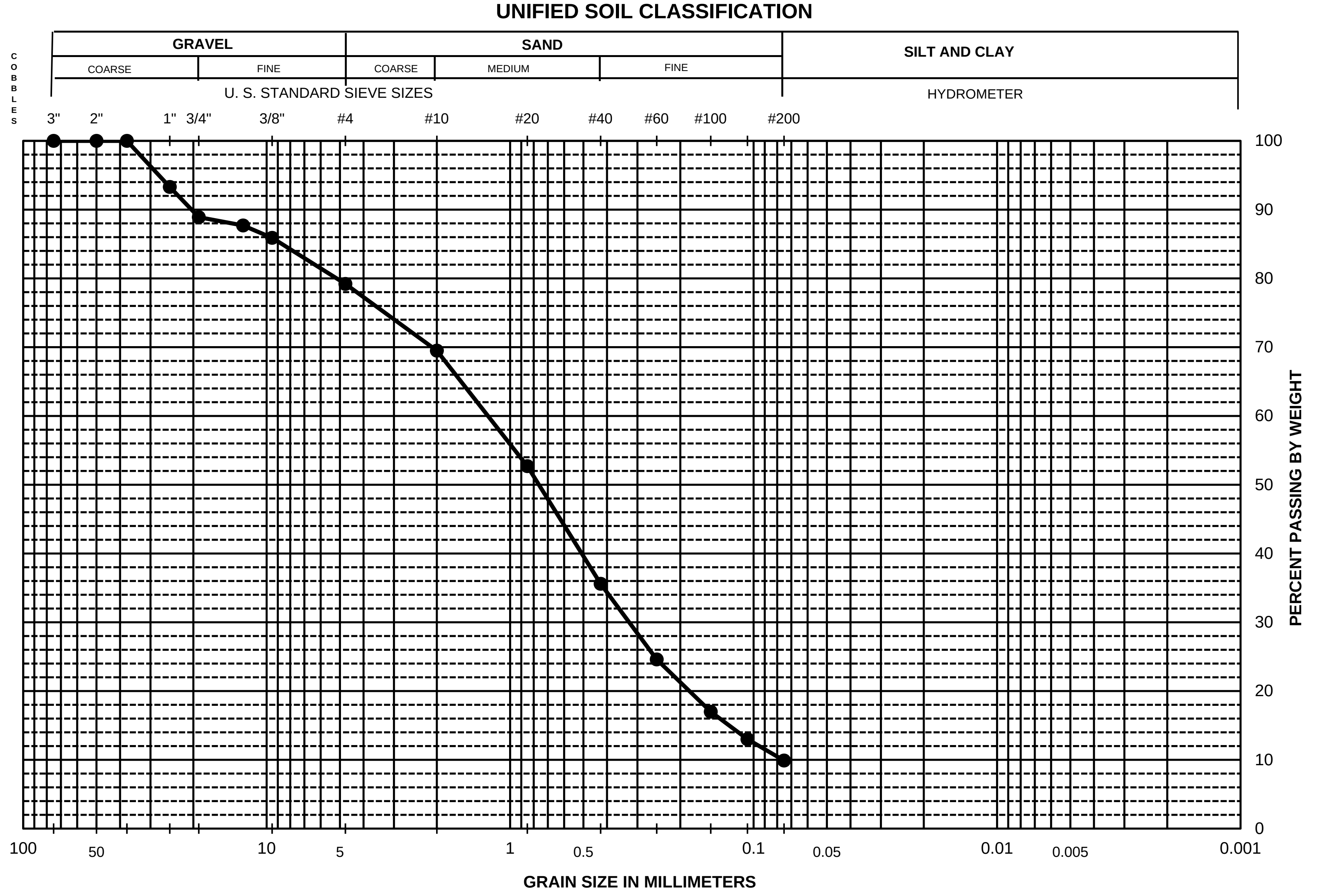
PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-13

AECOM

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-6\Sieve MSWD Mission Springs B-6 25 ft.xlsx



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	93.3
3/4"	19.00	88.9
1/2"	12.50	87.7
3/8"	9.50	85.9
#4	4.75	79.2
#10	2.00	69.5
#20	0.850	52.7
#40	0.425	35.6
#60	0.250	24.6
#100	0.150	17.0
#140	0.106	13.0
#200	0.075	9.9
Hydrometer Analysis		

% Cobbles	---
% Gravel	20.8
% Sand	69.3
% Fines	9.9
D_{85}	8.655
D_{60}	1.233
D_{50}	0.762
D_{30}	0.324
D_{15}	0.126
D_{10}	0.076
C_u	16.3
C_c	1.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-6	8B	41.0	●	0.8	---	---	---	**Light olive brown Well Graded SAND with Silt and Gravel (SW-SM)**

PROJECT NAME: **MSWD Mission Springs**

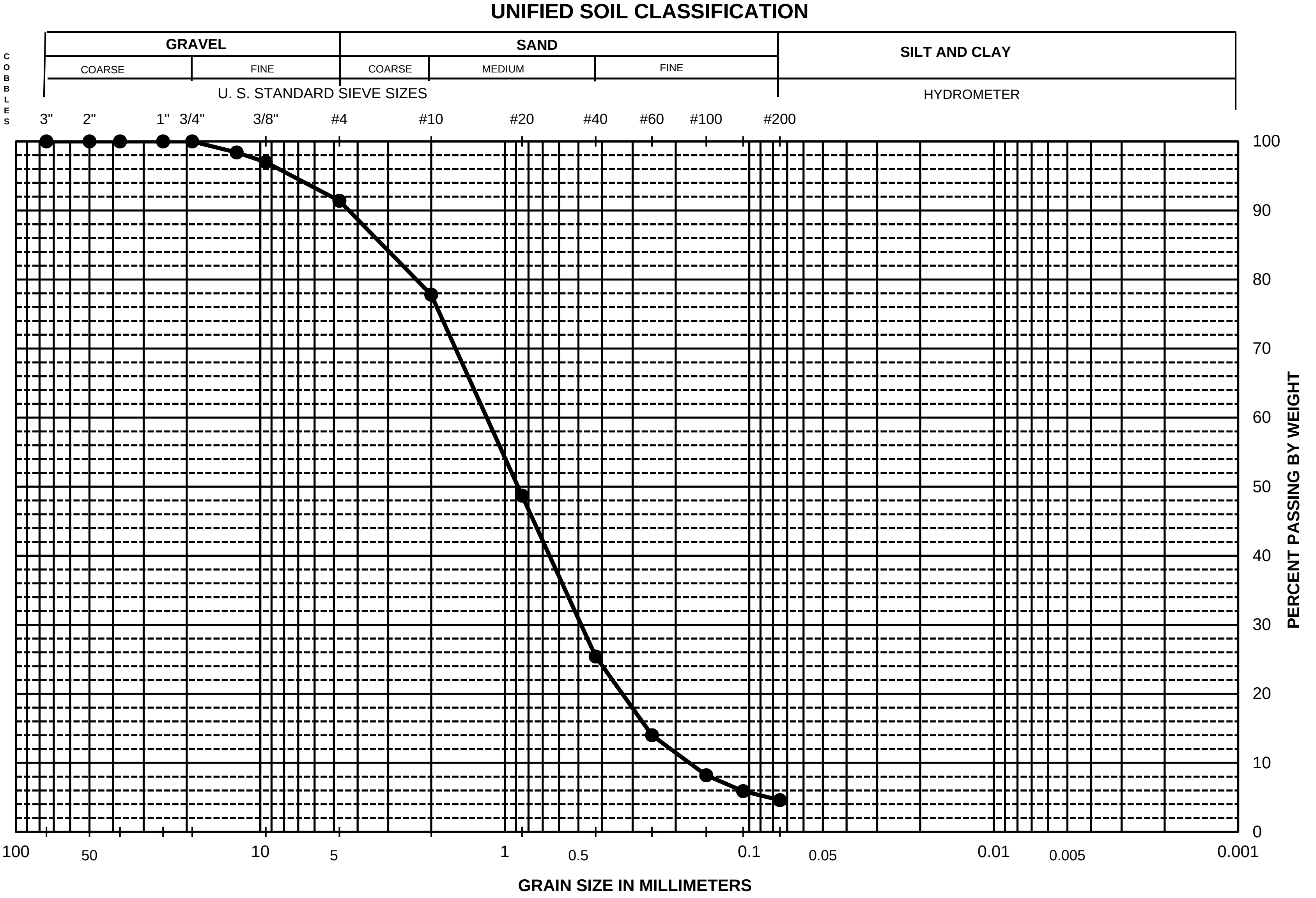
PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-14

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-6\Sieve MSWD Mission Springs B-6 41 ft.xlsx

AECOM



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	98.4
3/8"	9.50	97.0
#4	4.75	91.4
#10	2.00	77.8
#20	0.850	48.7
#40	0.425	25.4
#60	0.250	14.0
#100	0.150	8.2
#140	0.106	5.9
#200	0.075	4.6
Hydrometer Analysis		

% Cobbles	---
% Gravel	8.6
% Sand	86.8
% Fines	4.6
D_{85}	3.162
D_{60}	1.185
D_{50}	0.883
D_{30}	0.487
D_{15}	0.262
D_{10}	0.176
C_u	6.7
C_c	1.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 µm	Description and Classification
B-7	3	10.0	●	0.6	---	---	---	**Light brownish gray Well Graded SAND (SW)**

PROJECT NAME: **MSWD Mission Springs**

PROJECT NUMBER: **60551186**

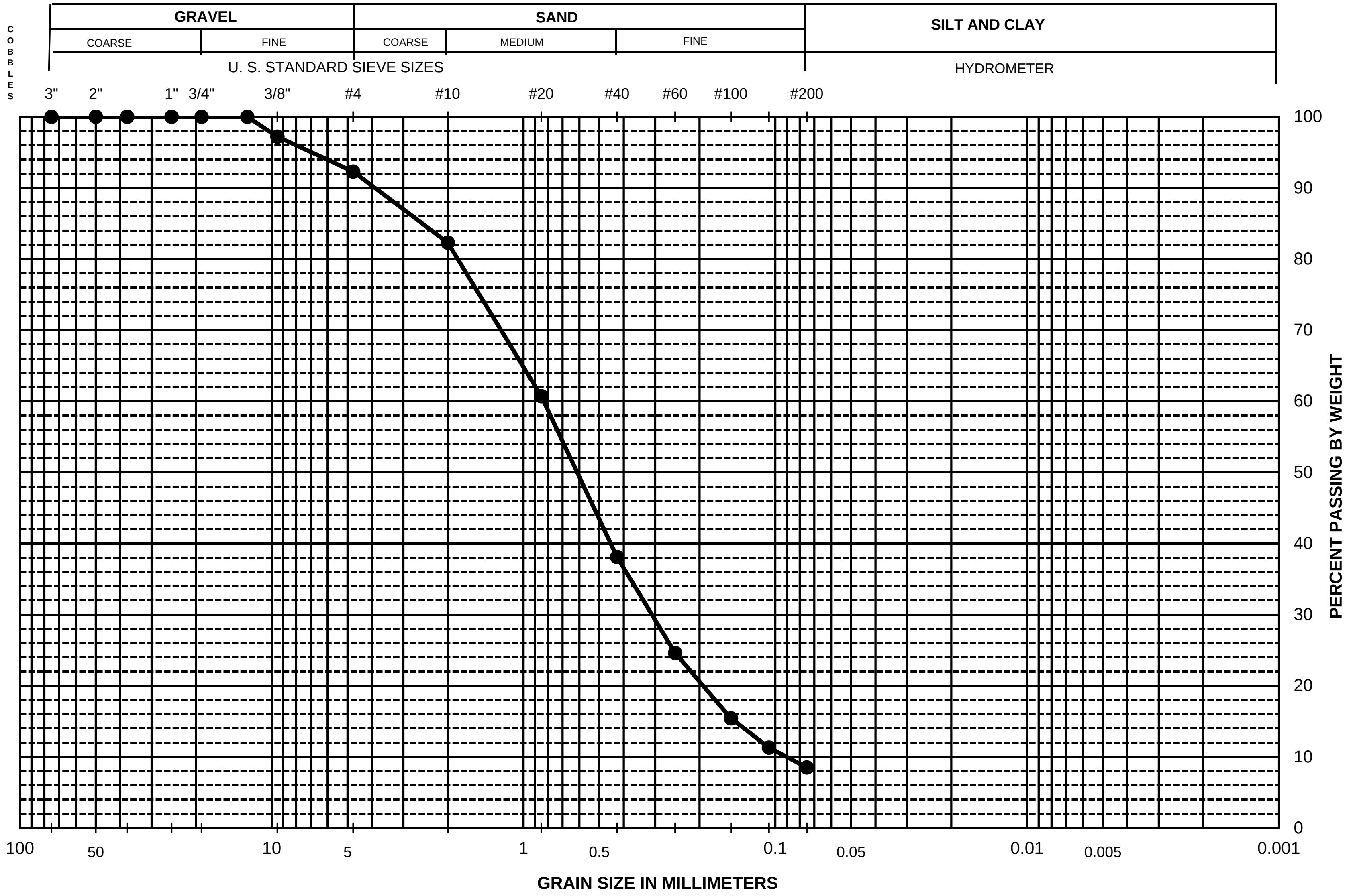
PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-15

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-7\Sieve MSWD Mission Springs B-7 10 ft.xlsx

AECOM

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	97.2
#4	4.75	92.3
#10	2.00	82.3
#20	0.850	60.7
#40	0.425	38.1
#60	0.250	24.6
#100	0.150	15.4
#140	0.106	11.3
#200	0.075	8.5
Hydrometer Analysis		

% Cobbles	---
% Gravel	7.7
% Sand	83.8
% Fines	8.5

D_{85}	2.526
D_{60}	0.832
D_{50}	0.612
D_{30}	0.309
D_{15}	0.145
D_{10}	0.090
C_u	9.2
C_c	1.3

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-7	5	20.0	●	0.8	---	---	---	**Light brownish gray Well Graded SAND with Silt (SW-SM)**

PROJECT NAME: **MSWD Mission Springs**

PROJECT NUMBER: **60551186**

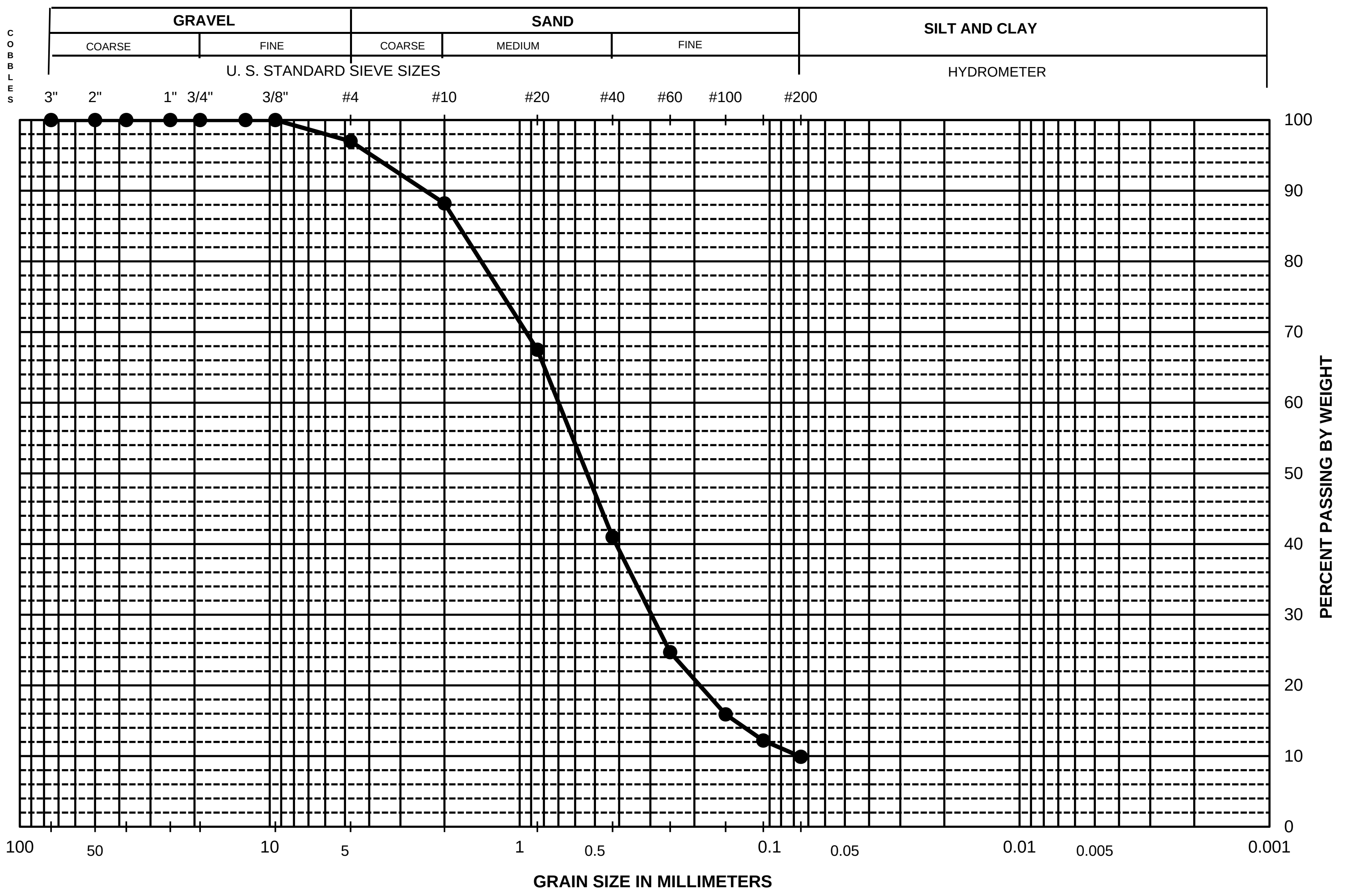
PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-16

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-7\Sieve MSWD Mission Springs B-7 20 ft.xlsx

AECOM

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	97.0
#10	2.00	88.2
#20	0.850	67.5
#40	0.425	41.0
#60	0.250	24.7
#100	0.150	15.9
#140	0.106	12.2
#200	0.075	9.9
Hydrometer Analysis		

% Cobbles	---
% Gravel	3.0
% Sand	87.1
% Fines	9.9
D_{85}	1.752
D_{60}	0.699
D_{50}	0.538
D_{30}	0.297
D_{15}	0.138
D_{10}	0.076
C_u	9.2
C_c	1.7

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-8	1	0~5	●	0.6	---	---	---	**Grayish brown Well Graded SAND with Silt (SW-SM)**

PROJECT NAME: **MSWD Mission Springs**

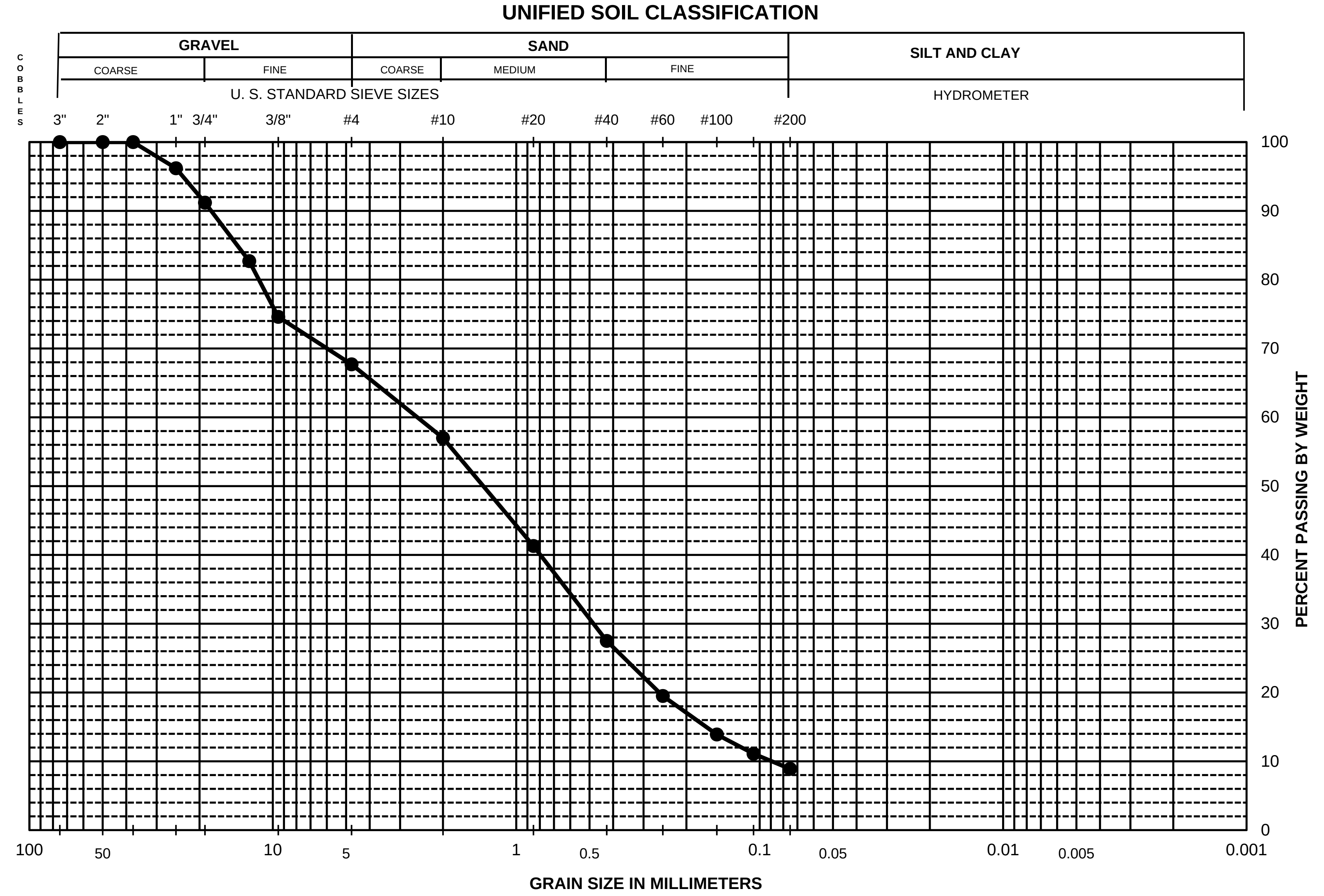
PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-17

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-8\Sieve MSWD Mission Springs B-8 0-5 ft.xlsx

AECOM



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	96.2
3/4"	19.00	91.2
1/2"	12.50	82.7
3/8"	9.50	74.6
#4	4.75	67.7
#10	2.00	57.0
#20	0.850	41.3
#40	0.425	27.5
#60	0.250	19.5
#100	0.150	13.9
#140	0.106	11.1
#200	0.075	8.9
Hydrometer Analysis		

% Cobbles	---
% Gravel	32.3
% Sand	58.8
% Fines	8.9

D_{85}	14.000
D_{60}	2.549
D_{50}	1.366
D_{30}	0.482
D_{15}	0.166
D_{10}	0.089
C_u	28.6
C_c	1.0

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-8	3	10.0	●	0.3	---	---	---	**Grayish brown Well Graded SAND with Silt and Gravel (SW-SM)**

PROJECT NAME: **MSWD Mission Springs**

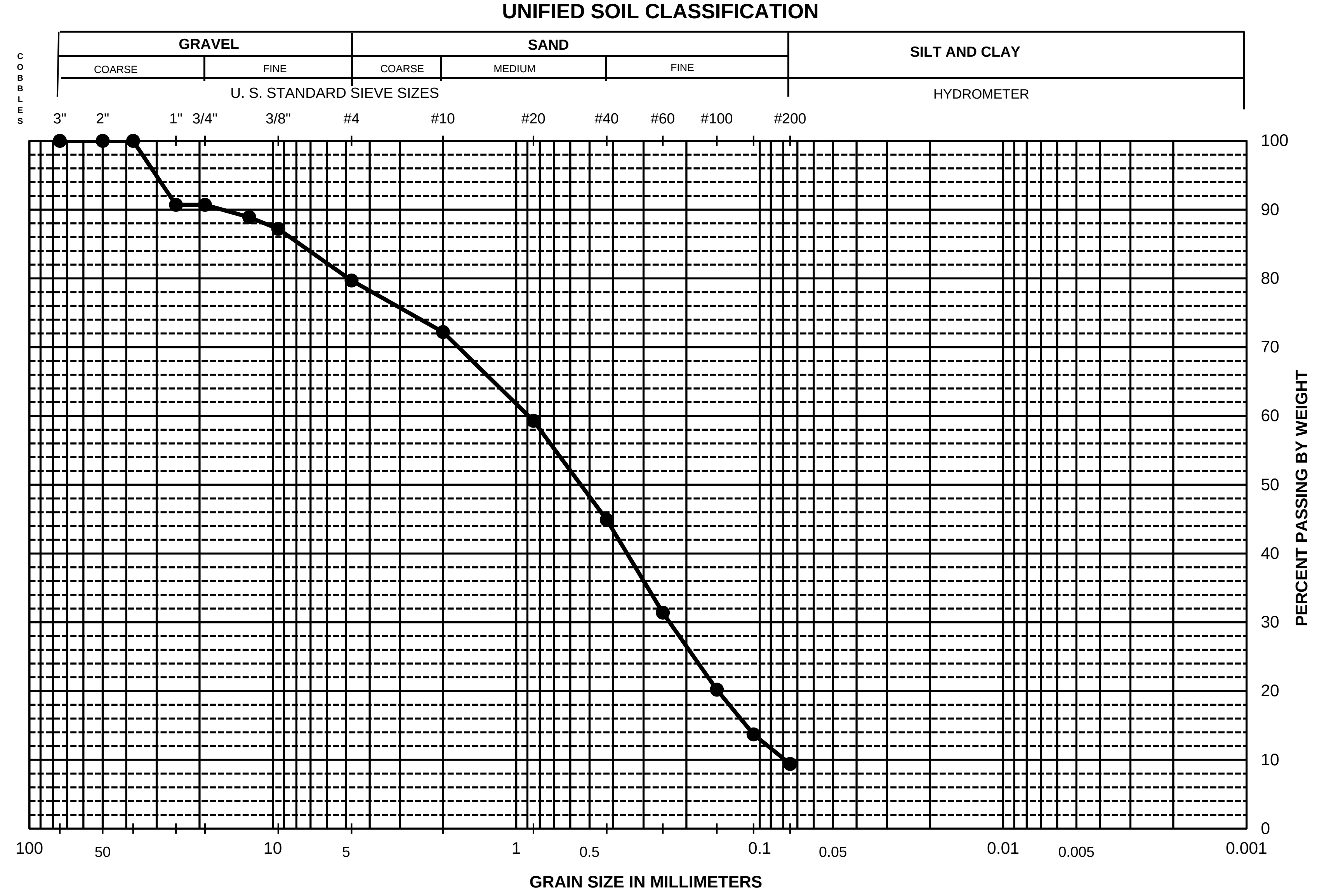
PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-18

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-8\Sieve MSWD Mission Springs B-8 10 ft.xlsx

AECOM



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	90.7
3/4"	19.00	90.7
1/2"	12.50	88.9
3/8"	9.50	87.2
#4	4.75	79.7
#10	2.00	72.2
#20	0.850	59.3
#40	0.425	44.9
#60	0.250	31.4
#100	0.150	20.2
#140	0.106	13.7
#200	0.075	9.4
Hydrometer Analysis		

% Cobbles	---
% Gravel	20.3
% Sand	70.3
% Fines	9.4
D_{85}	7.752
D_{60}	0.890
D_{50}	0.543
D_{30}	0.235
D_{15}	0.114
D_{10}	0.079
C_u	11.3
C_c	0.8

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-9	2	5.0	●	0.2	---	---	---	**Brownish gray Poorly Graded SAND with Silt and Gravel (SP-SM)**

PROJECT NAME: **MSWD Mission Springs**

PROJECT NUMBER: **60551186**

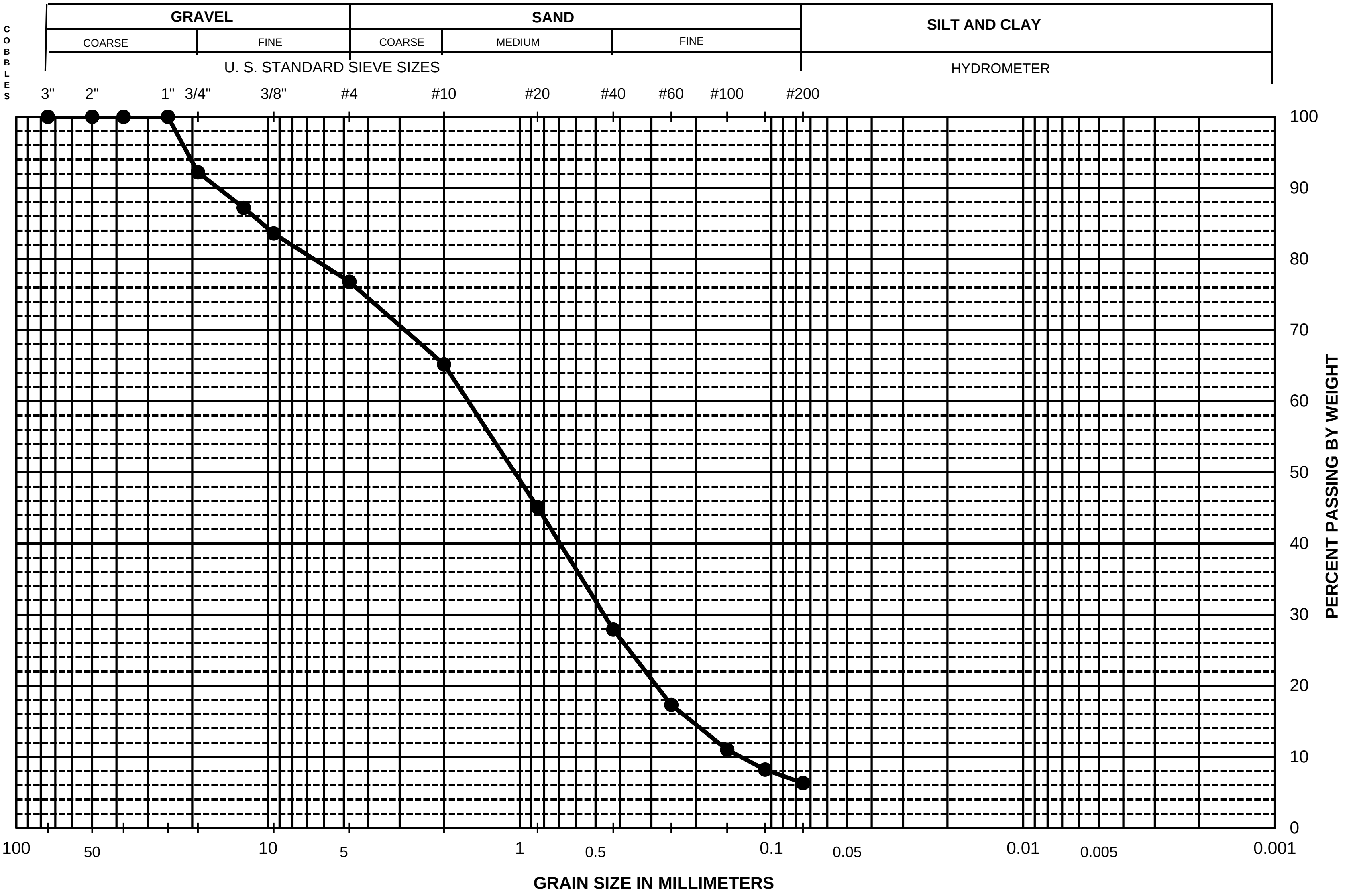
PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-19

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-9\Sieve MSWD Mission Springs B-9 5 ft.xlsx

AECOM

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	92.2
1/2"	12.50	87.2
3/8"	9.50	83.6
#4	4.75	76.8
#10	2.00	65.2
#20	0.850	45.1
#40	0.425	27.9
#60	0.250	17.3
#100	0.150	11.0
#140	0.106	8.2
#200	0.075	6.3
Hydrometer Analysis		

% Cobbles	---
% Gravel	23.2
% Sand	70.5
% Fines	6.3
D_{85}	10.570
D_{60}	1.603
D_{50}	1.047
D_{30}	0.463
D_{15}	0.207
D_{10}	0.133
C_u	12.1
C_c	1.0

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-9	7	30.0	●	0.5	---	---	---	**Brownish gray Well Graded SAND with Silt and Gravel (SW-SM)**

PROJECT NAME: **MSWD Mission Springs**

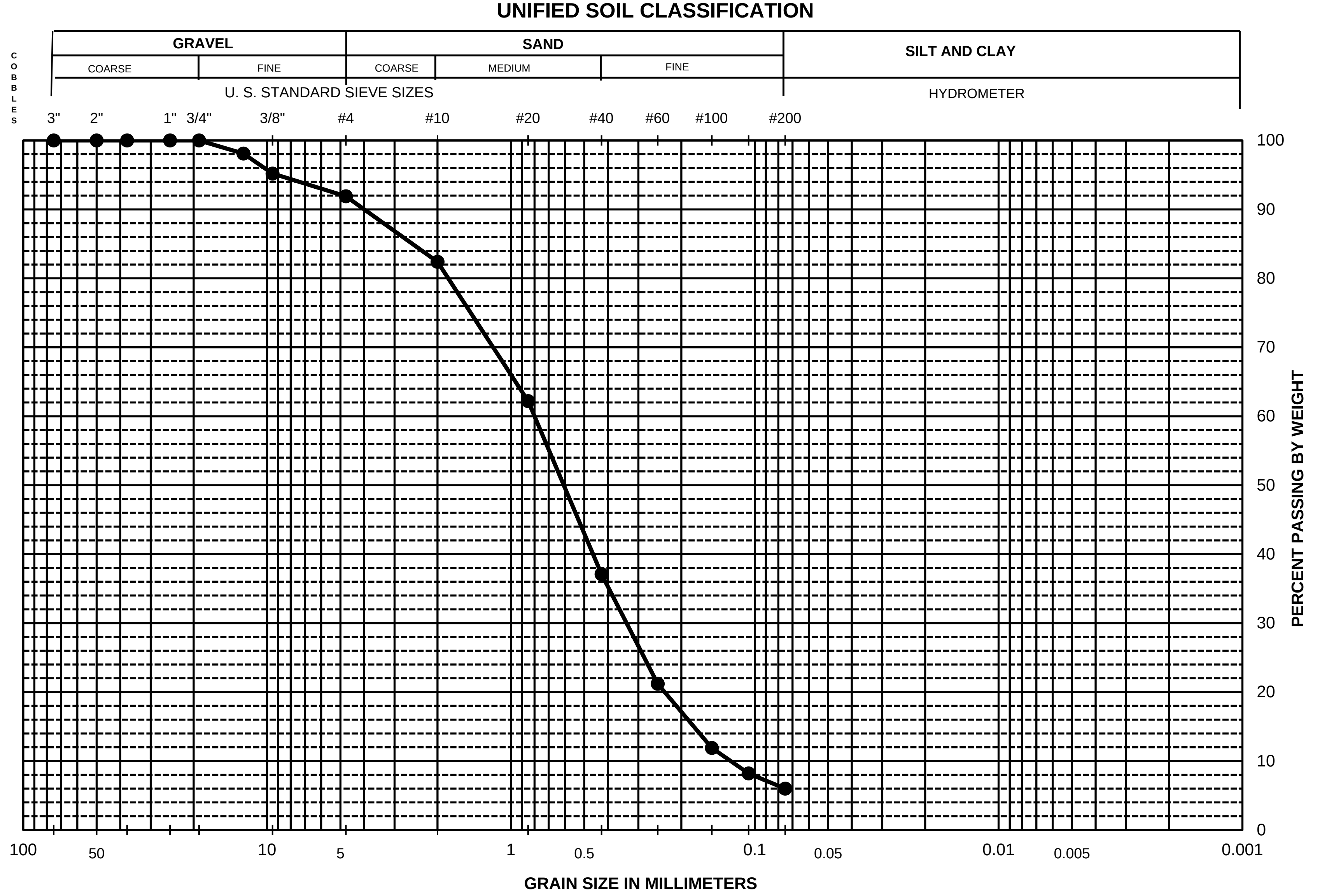
PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-20

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-9\Sieve MSWD Mission Springs B-9 30 ft.xlsx

AECOM



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	98.1
3/8"	9.50	95.2
#4	4.75	91.9
#10	2.00	82.4
#20	0.850	62.2
#40	0.425	37.1
#60	0.250	21.2
#100	0.150	11.9
#140	0.106	8.2
#200	0.075	6.0
Hydrometer Analysis		

% Cobbles	---
% Gravel	8.1
% Sand	85.9
% Fines	6.0
D_{85}	2.534
D_{60}	0.800
D_{50}	0.607
D_{30}	0.335
D_{15}	0.178
D_{10}	0.126
C_u	6.4
C_c	1.1

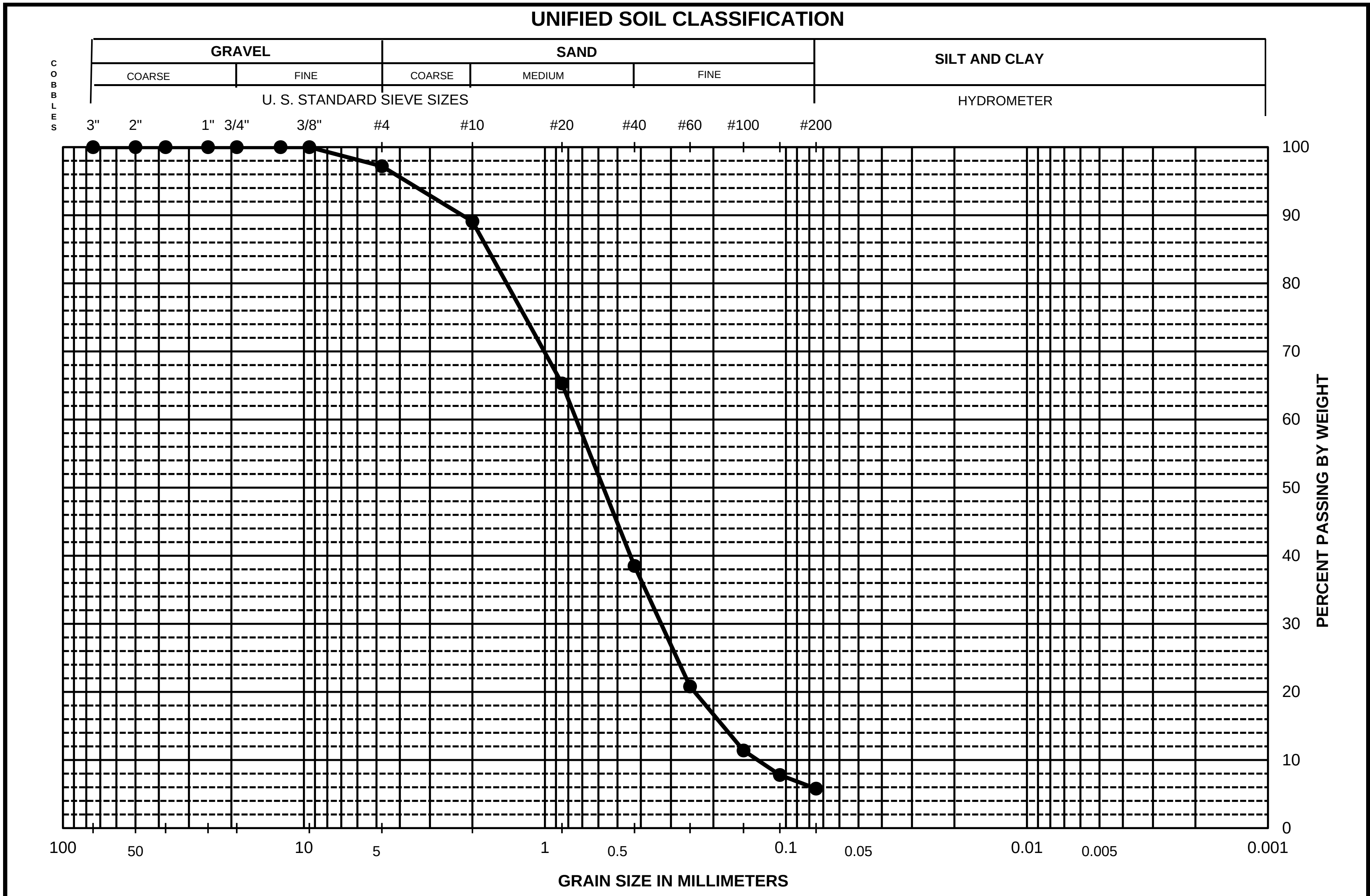
Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-9	9	45.0	●	0.6	---	---	---	**Brownish gray Well Graded SAND with Silt (SW-SM)**

PROJECT NAME: **MSWD Mission Springs**

PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-21



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	97.2
#10	2.00	89.1
#20	0.850	65.3
#40	0.425	38.5
#60	0.250	20.8
#100	0.150	11.4
#140	0.106	7.8
#200	0.075	5.8
Hydrometer Analysis		

% Cobbles	---
% Gravel	2.8
% Sand	91.4
% Fines	5.8
D_{85}	1.726
D_{60}	0.741
D_{50}	0.572
D_{30}	0.329
D_{15}	0.182
D_{10}	0.131
C_u	5.7
C_c	1.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-10	1	0~5	●	0.4	---	---	---	**Brownish gray Poorly Graded SAND with Silt (SP-SM)**

PROJECT NAME: **MSWD Mission Springs**

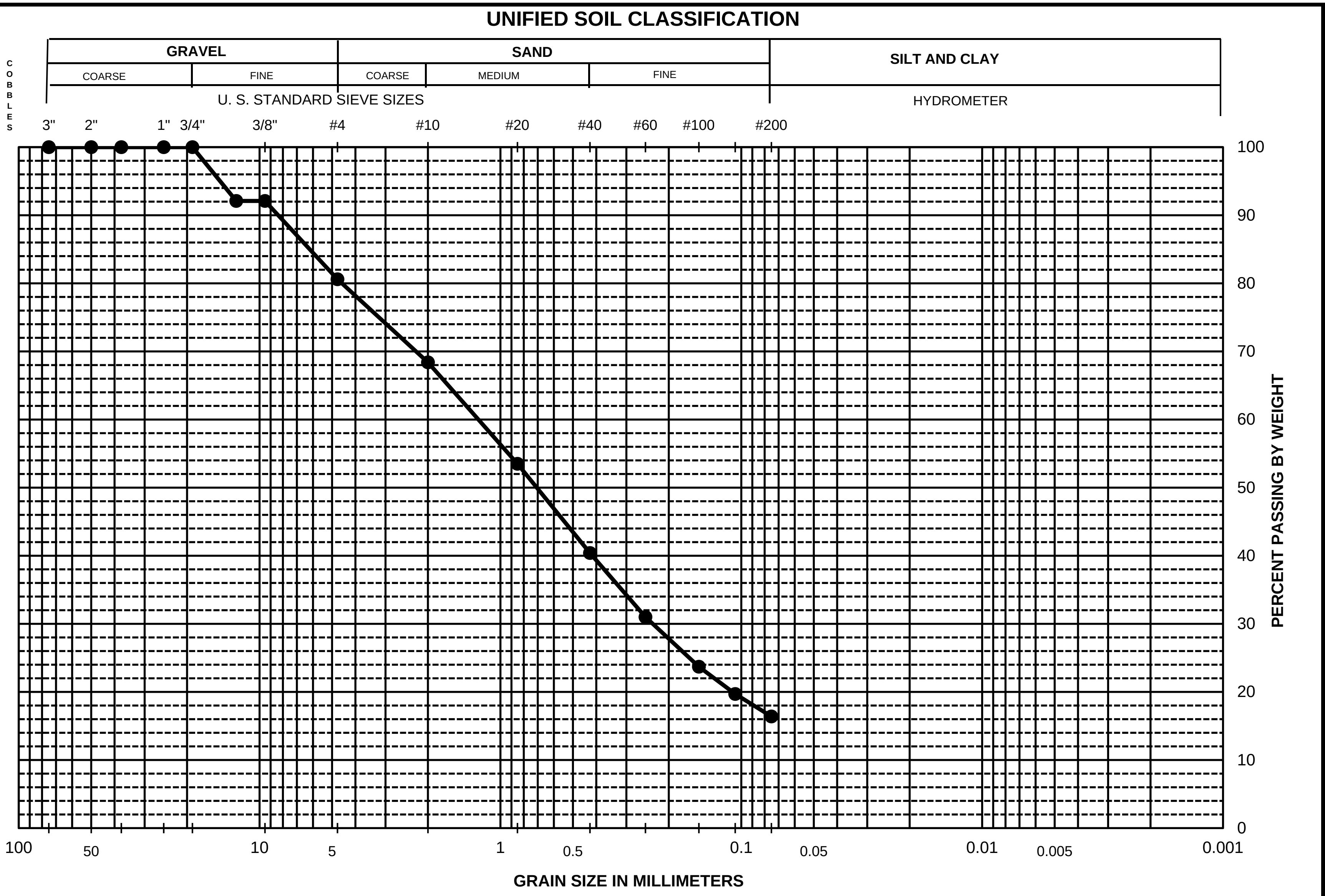
PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-22

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-10\Sieve MSWD Mission Springs B-10 0-5 ft.xlsx

AECOM



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	92.1
3/8"	9.50	92.1
#4	4.75	80.6
#10	2.00	68.4
#20	0.850	53.5
#40	0.425	40.4
#60	0.250	31.0
#100	0.150	23.7
#140	0.106	19.7
#200	0.075	16.4
Hydrometer Analysis		

% Cobbles	---
% Gravel	19.4
% Sand	64.2
% Fines	16.4
D_{85}	6.878
D_{60}	1.235
D_{50}	0.706
D_{30}	0.233
D_{15}	----
D_{10}	-----
C_u	----
C_c	-----

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
B-10	3	10.0	●	0.3	---	---	---	**Brownish gray Silty SAND with Gravel (SM)**

PROJECT NAME: **MSWD Mission Springs**

PROJECT NUMBER: **60551186**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-23

Q:\DCS\Projects\WTR\60551186_MSWD_RWWTP\400-Technical\432_Geotech\Lab Results\B-10\Sieve MSWD Mission Springs B-10 10 ft.xlsx

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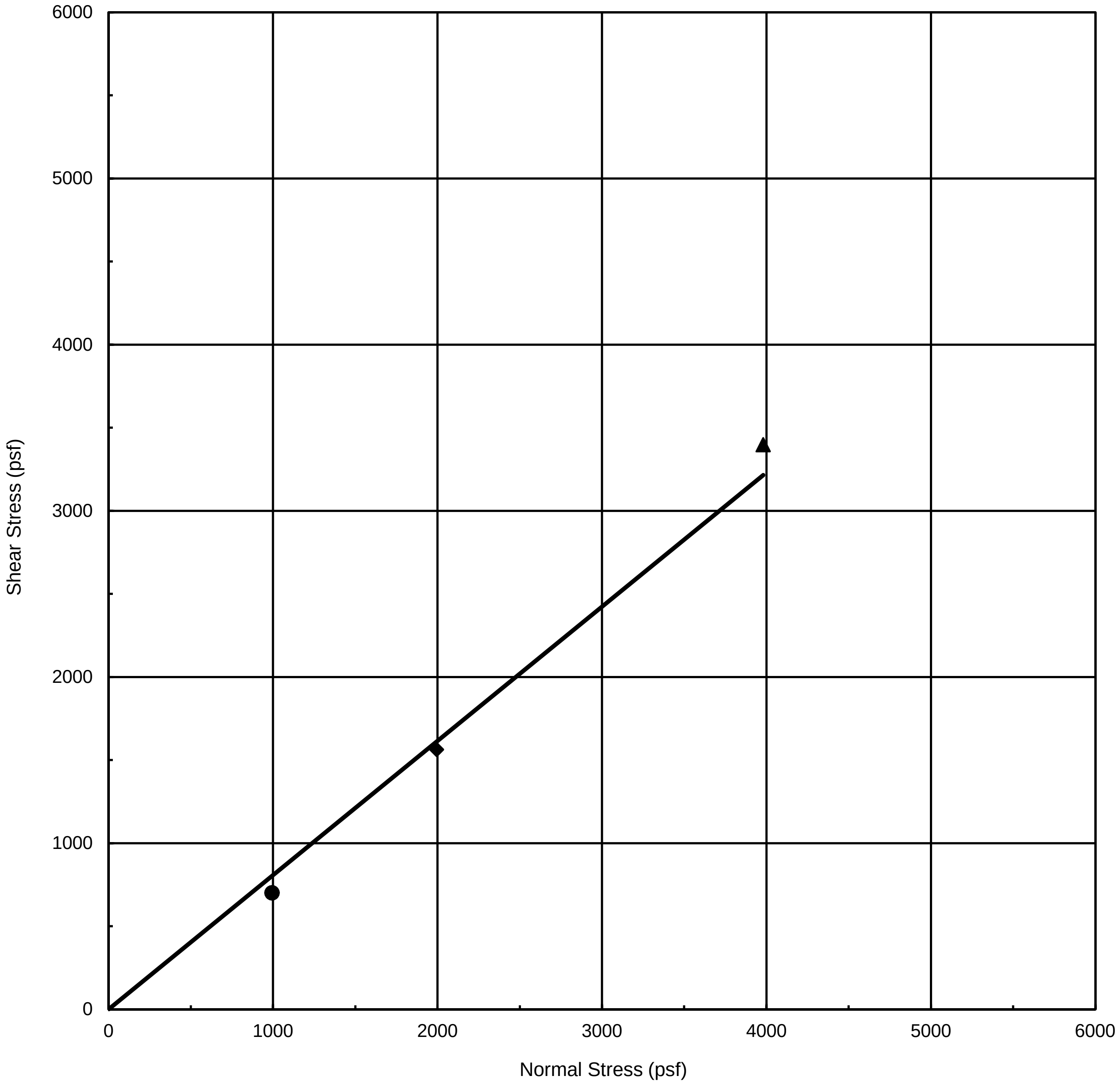


Peak Values are : ● ,solid trend line Ultimate Values are: ❍ ,dashed trend line

Exploration No.:	B-3		Strength Intercept (C) :	0.0	psf	Peak	XXXXX	psf	Ultimate
Sample No.:	2			0.0	kPa		XXXXX	kPa	
Depth (ft | m)	5.0	1.5	Friction Angle (ϕ) :	41	degree		XXXXX	degree	

Description: **Light brownish gray Well Graded SAND with Gravel (SW)** Shear rate : 0.0050 (in/min) , 0.0127 (cm/min)

SYMBOL	% Water Content	Total Unit Weight (pcf)	Total Unit Weight (kN/m^3)	Dry Unit Weight (pcf)	Dry Unit Weight (kN/m^3)	Normal Stress (psf)	Normal Stress (kPa)	Peak Stress (psf)	Peak Stress (kPa)	Ultimate Stress (psf)	Ultimate Stress (kPa)
Initial / Set up	0.6	117.1	18.4	116.4	18.3	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX
pre-shear ● spec. 1	25.0	132.5	20.8	106.0	16.7	994	48	702	34	XXXXX	XXXXX
pre-shear ◆ spec. 2	24.4	133.2	20.9	107.1	16.8	1995	96	1563	75	XXXXX	XXXXX
pre-shear ▲ spec. 3	24.1	133.6	21.0	107.7	16.9	3980	191	3398	163	XXXXX	XXXXX

AECOM

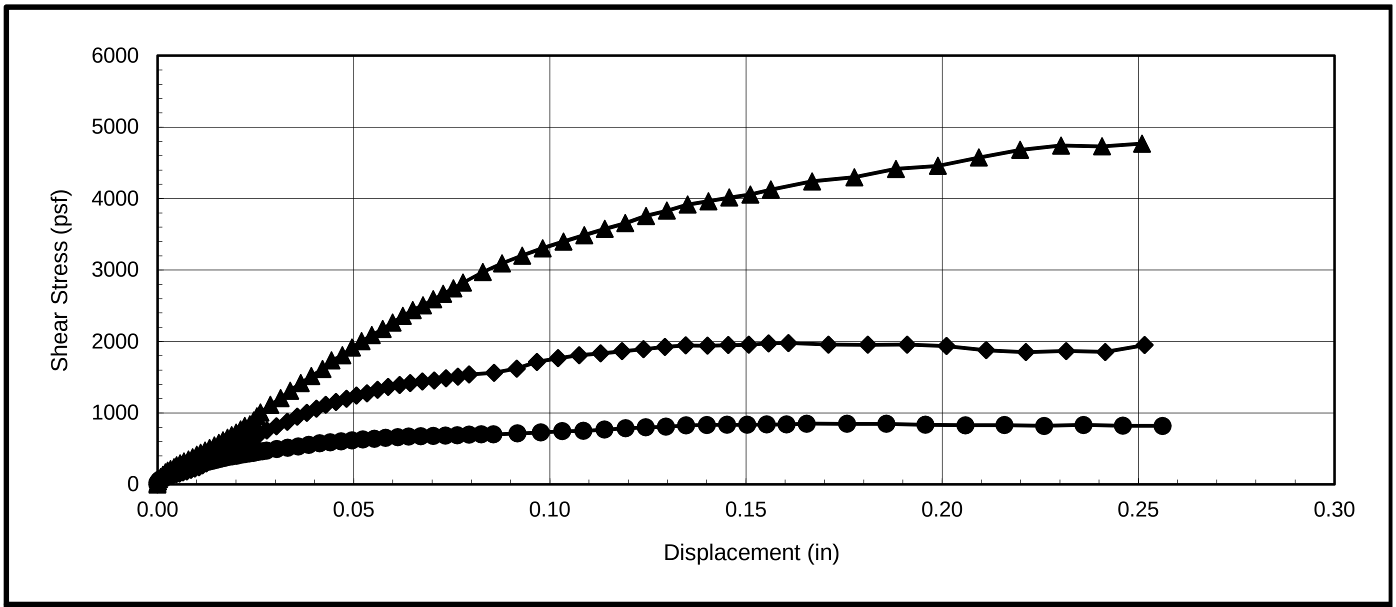
MSWD Mission Springs

Project Number: 60551186
Test Date: 10/13/2017

DIRECT SHEAR TEST
ASTM D 3080

DIRECT SHEAR TEST
ASTM D 3080

Project Name : MSWD Mission Springs
Project Number : 60551186
Boring No.: B-3
Sample No.: 2
Sample Depth (ft.): 5
Specimen Description : Light brownish gray Well Graded SAND with Gravel (SW)
Normal Stress (psf): 994 ●
Apparatus No.: DS3
Normal Stress (psf): 1995 ◆
Shear rate (in/min): 0.005
Normal Stress (psf): 3980 ▲



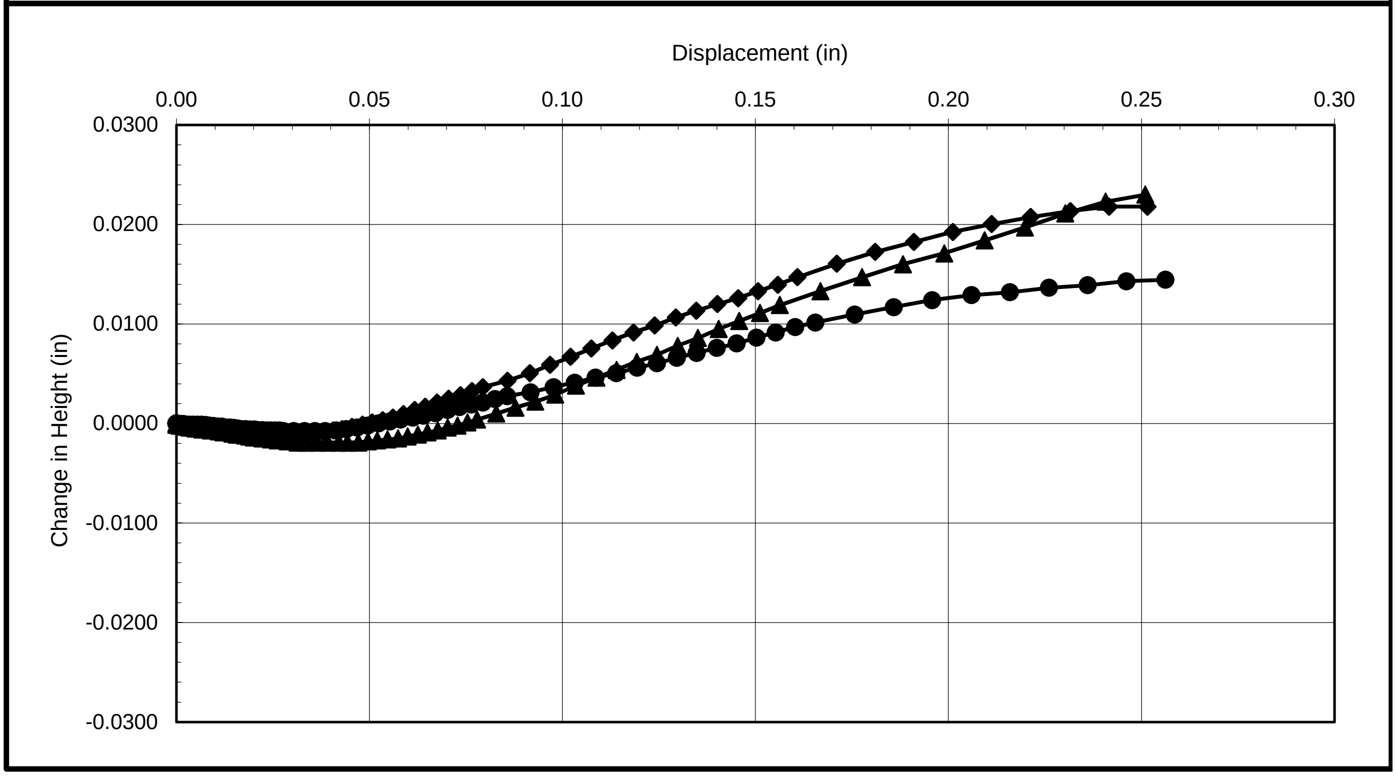


Table 1 - Laboratory Tests on Soil Samples

AECOM
MSWD Mission Springs
HDR Lab #17-0738LAB
2-Nov-17

Sample ID			B-3 Sample	B-6 Sample
			3 @ 10'	2 @ 10'
			SP-SM	GP-GM
Resistivity		**Units**		
as-received		ohm-cm	>4,400,000	>4,400,000
minimum		ohm-cm	9,600	2,400
pH			9.8	11.4
Electrical Conductivity		mS/cm	0.10	0.82
Chemical Analyses				
Cations				
calcium	Ca^{2+}	mg/kg	50	438
magnesium	Mg^{2+}	mg/kg	1.3	ND
sodium	Na^{1+}	mg/kg	29	31
potassium	K^{1+}	mg/kg	34	68
Anions				
hydroxide	OH^{1-}	mg/kg	ND	70
carbonate	CO_3^{2-}	mg/kg	87	34
bicarbonate	HCO_3^{1-}	mg/kg	ND	ND
fluoride	F^{1-}	mg/kg	2.5	5.2
chloride	Cl^{1-}	mg/kg	2.0	4.5
sulfate	SO_4^{2-}	mg/kg	17	139
phosphate	PO_4^{3-}	mg/kg	4.7	ND
Other Tests				
ammonium	NH_4^{1+}	mg/kg	ND	ND
nitrate	NO_3^{1-}	mg/kg	3.2	3.5
sulfide	S^{2-}	qual	na	na
Redox		mV	na	na

Minimum resistivity per CTM 643, Chlorides per CTM 422, Sulfates per CTM 417

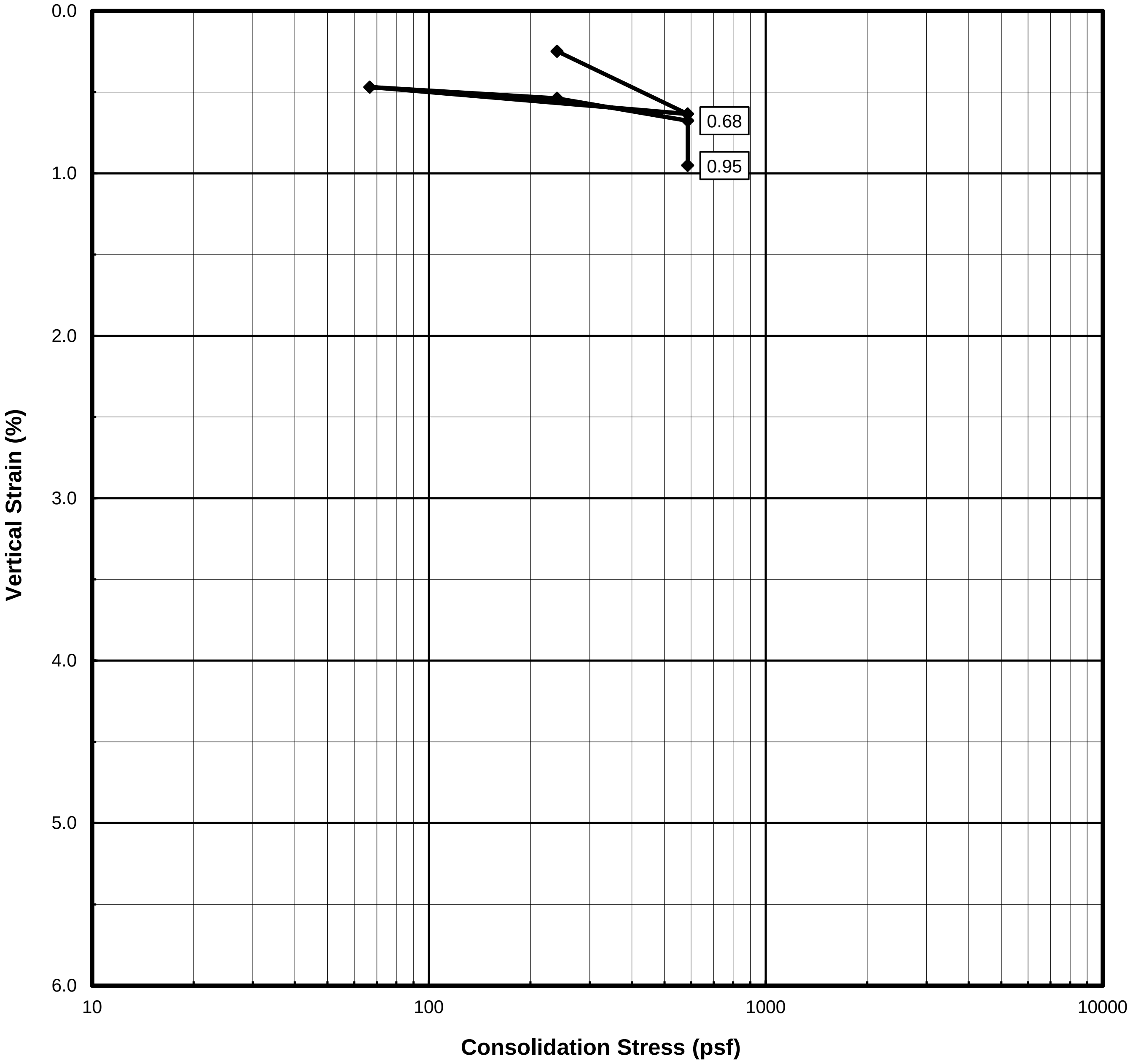
Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.

mg/kg = milligrams per kilogram (parts per million) of dry soil.

Redox = oxidation-reduction potential in millivolts

ND = not detected

na = not analyzed



Description:	**Grayish brown Well Graded SAND with Silt (SW-SM)**										
Boring No.:	B-4		Liquid Limit	---	%			Specific Gravity	2.70	assumed	
Sample No.:	2		Plasticity Index	---	%			Strain for Saturation	28.1	%	
Depth (ft | m)	5.0	1.52	Fines Content	7.7	%			Water added at	586	psf	
								swell strain, ε_s =	-0.3	%	

	Water Content (%)	Total Unit Weight		Dry Unit Weight		Saturation (%)	Void Ratio	Height		Diameter	
		(pcf)	(kN/m^3)	(pcf)	(kN/m^3)			(inches)	(cm)	(inches)	(cm)
Initial	2.6	115.8	18.19	112.9	17.74	14.2	0.49	0.725	1.84	2.415	6.134
Final	14.1	127.7	20.06	111.9	17.58	75.6	0.50	0.732	1.86		

URS

MSWD Mission Springs

SWELL / COLLAPSE TEST

ASTM D 4546, Method B

Project Number: 60551186 Date: 10/12/2017 Figure No.:

AP Engineering and Testing, Inc.
DBE|MBE|SBE
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

R-VALUE TEST DATA

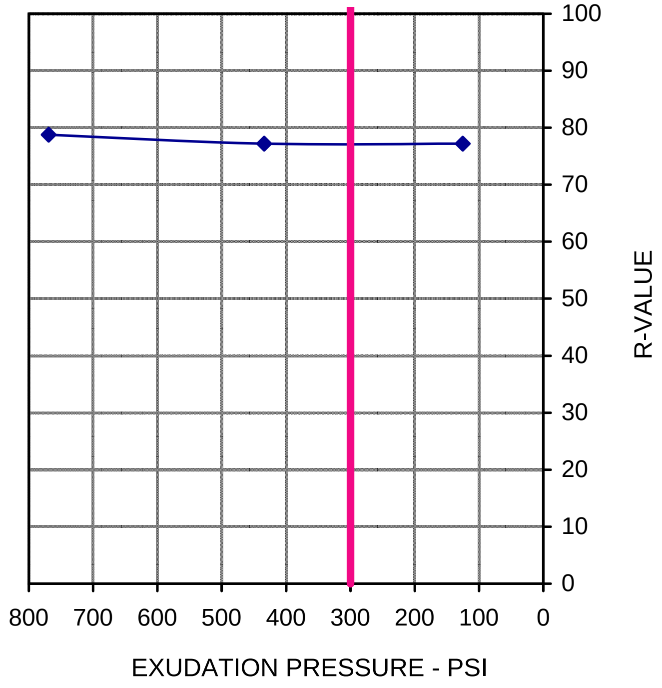
ASTM D2844

Project Name: MSWD Mission Springs
Project Number: 60413030.29865969.00000
Boring No.: B-4
Sample No.: -
Depth (ft.): 0-5
Location: N/A
Soil Description: Sand w/silt, fine-coarse grained

Tested By: ST Date: 10/09/17
Computed By: KM Date: 10/11/17
Checked By: AP Date: 10/12/17

Mold Number	D	E	F	
Water Added, g	71	86	101	
Compact Moisture(%)	7.0	8.4	9.8	
Compaction Gage Pressure, psi	350	250	250	
Exudation Pressure, psi	769	434	125	
Sample Height, Inches	2.7	2.7	2.7	
Gross Weight Mold, g	3131	3127	3045	
Tare Weight Mold, g	1968	1955	1869	
Net Sample Weight, g	1162	1172	1176	
Expansion, inchesx10^{-4}	0	0	0	
Stability 2,000 (160 psi)	11/19	12/20	12/20	
Turns Displacement	5.90	6.05	6.13	
R-Value Uncorrected	76	74	74	
R-Value Corrected	79	77	77	
Dry Density, pcf	121.9	121.3	120.2	
Traffic Index	8.0	8.0	8.0	
G.E. by Stability	0.41	0.44	0.44	
G.E. by Expansion	0.00	0.00	0.00	

R-VALUE	By Exudation:	77
	By Expansion:	*N/A
	At Equilibrium: (by Exudation)	77
Remarks	Gf = 1.34, and 0.0 % Retained on the ¾" *Not Applicable	



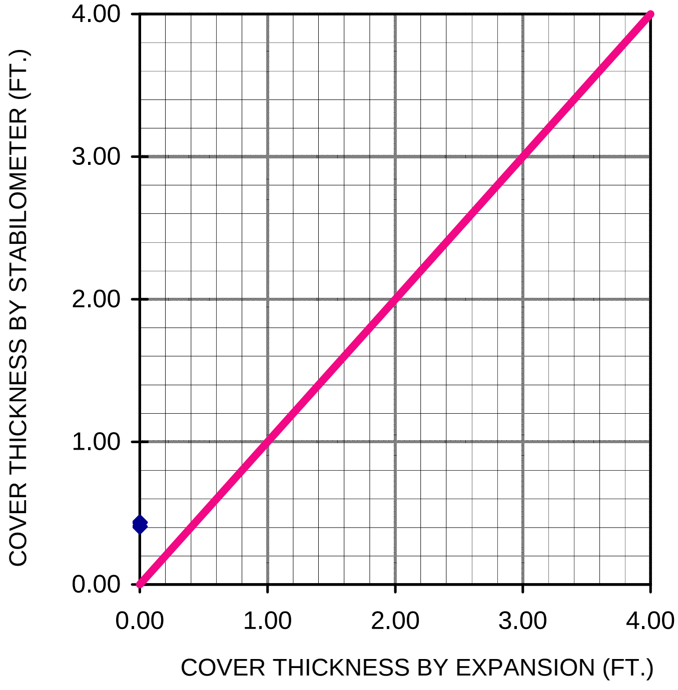


Figure C-28

Appendix D

Geotechnical Calculations

Design Maps Summary Report

User–Specified Input

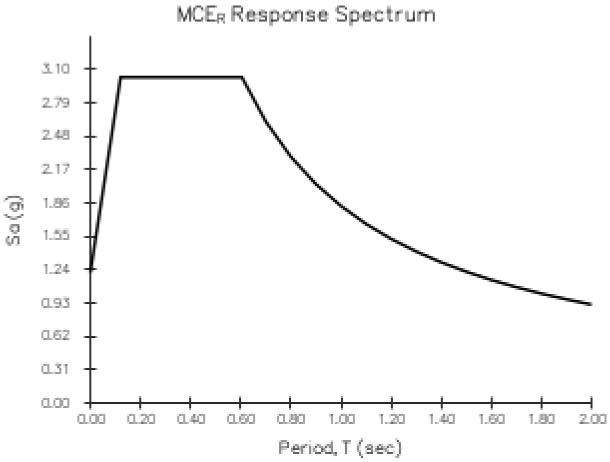
Report Title	Mission Springs Water Treatment Plant Fri October 27, 2017 16:47:22 UTC
Building Code Reference Document	2012/2015 International Building Code (which utilizes USGS hazard data available in 2008)
Site Coordinates	33.90685°N, 116.52902°W
Site Soil Classification	Site Class D – “Stiff Soil”
Risk Category	IV (e.g. essential facilities)

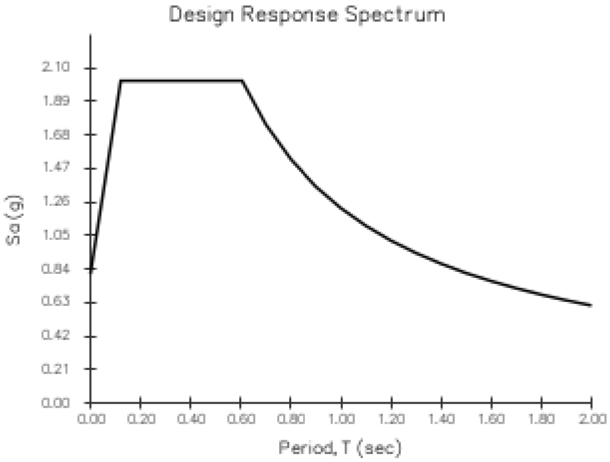
USGS–Provided Output

S_S = 3.029 g **S_{MS} =** 3.029 g **S_{DS} =** 2.020 g

S_1 = 1.222 g **S_{M1} =** 1.833 g **S_{D1} =** 1.222 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the “2009 NEHRP” building code reference document.





USGS Design Maps Detailed Report

2012/2015 International Building Code (33.90685°N, 116.52902°W)

Site Class D – “Stiff Soil”, Risk Category IV (e.g. essential facilities)

Section 1613.3.1 — Mapped acceleration parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2012/2015 International Building Code are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 1613.3.3.

From Figure 1613.3.1(1) [1] $S_S = 3.029$ g

From Figure 1613.3.1(2) [2] $S_1 = 1.222$ g

Section 1613.3.2 — Site class definitions

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Section 1613.

2010 ASCE-7 Standard – Table 20.3-1
SITE CLASS DEFINITIONS

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index $PI > 20$, • Moisture content $w \geq 40\%$, and • Undrained shear strength $\bar{s}_u < 500$ psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 1613.3.3 — Site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters

TABLE 1613.3.3(1)
VALUES OF SITE COEFFICIENT F_a

Site Class	Mapped Spectral Response Acceleration at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = D and S_S = 3.029 g, F_a = 1.000

TABLE 1613.3.3(2)
VALUES OF SITE COEFFICIENT F_v

Site Class	Mapped Spectral Response Acceleration at 1–s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 1.222 g, F_v = 1.500

Equation (16-37): $S_{MS} = F_aS_S = 1.000 \times 3.029 = 3.029$ g

Equation (16-38): $S_{M1} = F_vS_1 = 1.500 \times 1.222 = 1.833$ g

Section 1613.3.4 — Design spectral response acceleration parameters

Equation (16-39): $S_{DS} = ⅔\ S_{MS} = ⅔ \times 3.029 = 2.020$ g

Equation (16-40): $S_{D1} = ⅔\ S_{M1} = ⅔ \times 1.833 = 1.222$ g

Section 1613.3.5 — Determination of seismic design category

TABLE 1613.3.5(1)
SEISMIC DESIGN CATEGORY BASED ON SHORT-PERIOD (0.2 second) RESPONSE ACCELERATION

VALUE OF S_{DS}	**RISK CATEGORY**		
	I or II	**III**	**IV**
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = IV and S_{DS} = 2.020 g, Seismic Design Category = D

TABLE 1613.3.5(2)
SEISMIC DESIGN CATEGORY BASED ON 1-SECOND PERIOD RESPONSE ACCELERATION

VALUE OF S_{D1}	**RISK CATEGORY**		
	I or II	**III**	**IV**
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = IV and S_{D1} = 1.222 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 1613.3.5(1) or 1613.3.5(2)" = F

Note: See Section 1613.3.5.1 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 1613.3.1(1)*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/IBC-2012-Fig1613p3p1(1).pdf
2. *Figure 1613.3.1(2)*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/IBC-2012-Fig1613p3p1(2).pdf

Calculation of Subgrade Modulus

Job Name: Mission Springs Water Treatment Plant
Job No. 60551186
Location: Desert Hot Springs
Subject: Subgrade Modulus
Calculation by: SD Checked by: PY
Date: 10/27/2017

For Foundations on Sands

B = 40 ft

L = 100 ft

For Dense soils

K(bxb) 180 tcf 208.3 pci From Figure 6 Navfac manual 7.01

K(LxB) 166.7 pci

$$k\,(LxB) = \frac{k\,(bxb) * (1+0.5*\,(B/L))}{1.5}$$

Immediate Settlement

$$\Delta hi = \frac{4*q*B\hat{}2}{Kv1\ (B+1)\ \hat{}2}$$

From Principles of Foundation Engineering Third Edition
Braja M. Das Eq 4.47 pg 264

q = 1 tsf

AECOM

DATE 10/27/2017
Calculated By: SD
Checked By:

PROJECT: Mission Springs Water Treatment Plant
SUBJECT: Static Settlement Calculations with Consolidation

Data Input:

1. Location	A-17-006					
2. Depth of GWT	100.0					
3. GWT Elevation	200.0					
4. Ground Surface Elevation	300.0	6. Applied Pressure		2.00	ksf	
5. Bottom of Footing Elevation	298.0	7. Pressure Distribution	Boussinesq	NA	:1 to 3B	NA

Total Settlement (inch) **0.6**

Top Layer Elevation (feet)	Top layer depth w.r.t. ground surface (feet)	Bottom layer depth w.r.t. ground surface (feet)	Soil Layer Type	$(N_1)_{60}$	Total unit weight (pcf)	Su (ksf)	Es (ksf)	C'	Cec	Cer	Average layer depth below excavation (feet)	Layer Thickness (feet)	σ_{vo}' (psf)	σ_p' (psf)	$\Delta\sigma_v'$ (psf)	ΔHc_i (inches)
300	0	1	SP	27	115			94		-	0.5	1	58			NA
299	1	2	SP	27	115			94		-	1.5	1	173			NA
298	2	3	SP	27	120			94		-	2.5	1	293		1988	0.114
297	3	4	SP	27	120			94		-	3.5	1	413		1792	0.093
296	4	5	SP	27	120			94		-	4.5	1	533		1481	0.074
295	5	6	SP	27	120			94		-	5.5	1	653		1211	0.058
294	6	7	SP	27	120			94		-	6.5	1	773		1006	0.046
293	7	8	SP	27	120			94		-	7.5	1	893		854	0.037
292	8	9	SP	27	120			94		-	8.5	1	1013		739	0.030
291	9	10	SP	27	120			94		-	9.5	1	1133		649	0.025
290	10	11	SP	50	120			164		-	10.5	1	1253		579	0.012
289	11	12	SP	50	120			164		-	11.5	1	1373		521	0.010
288	12	13	SP	50	120			164		-	12.5	1	1493		474	0.009
287	13	14	SP	50	120			164		-	13.5	1	1613		434	0.008
286	14	15	SP	50	120			164		-	14.5	1	1733		400	0.007
285	15	16	SP	41	120			133		-	15.5	1	1853		371	0.007
284	16	17	SP	41	120			133		-	16.5	1	1973		346	0.006
283	17	18	SP	41	120			133		-	17.5	1	2093		324	0.006
282	18	19	SP	41	120			133		-	18.5	1	2213		304	0.005
281	19	20	SP	41	120			133		-	19.5	1	2333		287	0.005
280	20	21	SP	29	120			99		-	20.5	1	2453		272	0.006
279	21	22	SP	29	120			99		-	21.5	1	2573		258	0.005
278	22	23	SP	29	120			99		-	22.5	1	2693		245	0.005
277	23	24	SP	29	120			99		-	23.5	1	2813		233	0.004
276	24	25	SP	29	120			99		-	24.5	1	2933		223	0.004
275	25	26	SP	27	120			83		-	25.5	1	3053		213	0.004
274	26	27	SP	27	120			83		-	26.5	1	3173		204	0.004
273	27	28	SP	27	120			83		-	27.5	1	3293		196	0.004
272	28	29	SP	27	120			83		-	28.5	1	3413		188	0.003
271	29	30	SP	27	120			83		-	29.5	1	3533		181	0.003
270	30	31	SP	36	120			102		-	30.5	1	3653		174	0.002
269	31	32	SP	36	120			102		-	31.5	1	3773		168	0.002
268	32	33	SP	36	120			102		-	32.5	1	3893		162	0.002
267	33	34	SP	36	120			102		-	33.5	1	4013		156	0.002
266	34	35	SP	36	120			102		-	34.5	1	4133		151	0.002
265	35	36	SP	46	120			125		-	35.5	1	4253		146	0.001
264	36	37	SP	46	120			125		-	36.5	1	4373		141	0.001
263	37	38	SP	46	120			125		-	37.5	1	4493		136	0.001
262	38	39	SP	46	120			125		-	38.5	1	4613		132	0.001
261	39	40	SP	46	120			125		-	39.5	1	4733		128	0.001
260	40	41	SP	35	120			100		-	40.5	1	4853		124	0.001
259	41	42	SP	35	120			100		-	41.5	1	4973		120	0.001
258	42	43	SP	35	120			100		-	42.5	1	5093		117	0.001
257	43	44	SP	35	120			100		-	43.5	1	5213		113	0.001
256	44	45	SP	35	120			100		-	44.5	1	5333		110	0.001
255	45	46	SP	47	120			128		-	45.5	1	5453		107	0.001
254	46	47	SP	47	120			128		-	46.5	1	5573		104	0.001
253	47	48	SP	47	120			128		-	47.5	1	5693		101	0.001
252	48	49	SP	47	120			128		-	48.5	1	5813		99	0.001
251	49	50	SP	47	120			128		-	49.5	1	5933		96	0.001
250	50	51	SP	27	120			83		-	50.5	1	6053		94	0.001
249	51	52	SP	27	120			83		-	51.5	1	6173		91	0.001
248	52	53	SP	27	120			83		-	52.5	1	6293		89	0.001
247	53	54	SP	27	120			83		-	53.5	1	6413		86	0.001
246	54	55	SP	27	120			83		-	54.5	1	6533		85	0.001
245	55	56	SP	27	120			83		-	55.5	1	6653		82	0.001
244	56	57	SP	27	120			83		-	56.5	1	6773		80	0.001
243	57	58	SP	27	120			83		-	57.5	1	6893		79	0.001
242	58	59	SP	27	120			83		-	58.5	1	7013		76	0.001
241	59	60	SP	27	120			83		-	59.5	1	7133		75	0.001
240	60	61	SP	27	120			83		-	60.5	1	7253		73	0.001
239	61	62	SP	27	120			83		-	61.5	1	7373		71	0.001
238	62	63	SP	27	120			83		-	62.5	1	7493		70	0.001
237	63	64	SP	27	120			83		-	63.5	1	7613		68	0.001
236	64	65	SP	27	120			83		-	64.5	1	7733		67	0.001
235	65	66	SP	27	120			83		-	65.5	1	7853		65	0.001
234	66	67	SP	27	120			83		-	66.5	1	7973		63	0.000
233	67	68	SP	27	120			83		-	67.5	1	8093		62	0.000
232	68	69	SP	27	120			83		-	68.5	1	8213		60	0.000
231	69	70	SP	27	120			83		-	69.5	1	8333		60	0.000
230	70	71	SP	27	120			83		-	70.5	1	8453		58	0.000
229	71	72	SP	27	120			83		-	71.5	1	8573		57	0.000
228	72	73	SP	27	120			83		-	72.5	1	8693		56	0.000
227	73	74	SP	27	120			83		-	73.5	1	8813		54	0.000
226	74	75	SP	27	120			83		-	74.5	1	8933		54	0.000
225	75	76	SP	27	120			83		-	75.5	1	9053		52	0.000
224	76	77	SP	27	120			83		-	76.5	1	9173		52	0.000
223	77	78	SP	27	120			83		-	77.5	1	9293		50	0.000
222	78	79	SP	27	120			83		-	78.5	1	9413		49	0.000
221	79	80	SP	27	120			83		-	79.5	1	9533		48	0.000
220	80	81	SP	27	120			83		-	80.5	1	9653		47	0.000
219	81	82	SP	27	120			83		-	81.5	1	9773		47	0.000
218	82	83	SP	27	120			83		-	82.5	1	9893		45	0.000
217	83	84	SP	27	120			83		-	83.5	1	10013		44	0.000
216	84	85	SP	27	120			83		-	84.5	1	10133		44	0.000
215	85	86	SP	27	120			83		-	85.5	1	10253		43	0.000
214	86	87	SP	27	120			83		-	86.5	1	10373		42	0.000
213	87	88	SP	27	120			83		-	87.5	1	10493		41	0.000
212	88	89	SP	27	120			83		-	88.5	1	10613		40	0.000
211	89	90	SP	27	120			83		-	89.5	1	10733		40	0.000
210	90	91	SP	27	120			83		-	90.5	1	10853		39	0.000
209	91	92	SP	27	120			83		-	91.5	1	10973		39	0.000
208	92	93	SP	27	120			83		-	92.5	1	11093		38	0.000
207	93	94	SP	27	120			83		-	93.5	1	11213		37	0.000
206	94	95	SP	27	120			83		-	94.5	1	11333		36	0.000
205	95	96	SP	27	120			83		-	95.5	1	11453		35	0.000
204	96	97	SP	27	120			83		-	96.5	1	11573		35	0.000
203	97	98	SP	27	120			83		-	97.5	1	11693		34	0.000
202	98	99	SP	27	120			83		-	98.5	1	11813		34	0.000
201	99	100	SP	27	120			83		-	99.5	1	11933		33	0.000
200	100	101	SP	27	120			83		-	100.5	1	11990		32	0.000

Total Static Settlement (in) **0.6**

BEARING CAPACITY OF SHALLOW FOUNDATIONS
Terzaghi and Vesic Methods

Date November 6, 2017
Identification Spread Footing

Input

Units of Measurement
E SI or E

Foundation Information
Shape SQ SQ, CI, CO, or RE
B = 2 ft
L = ft
D = 1.5 ft

Soil Information
c = 0 lb/ft^2
phi = 32 deg
gamma = 120 lb/ft^3
Dw = 200 ft

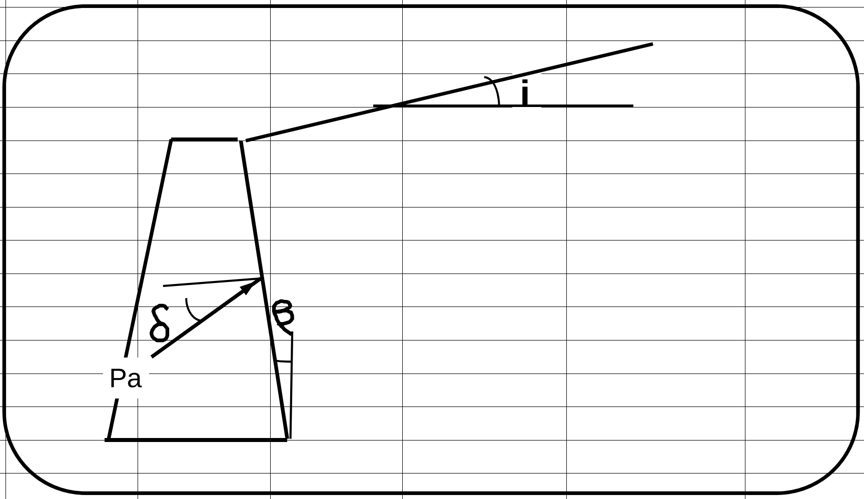
Factor of Safety
F = 3

Results

	Terzaghi		Vesic	
Bearing Capacity				
q ult =	7,826	lb/ft^2	10,358	lb/ft^2
q a =	2,609	lb/ft^2	3,453	lb/ft^2
Allowable Column Load				
P =	10	k	14	k

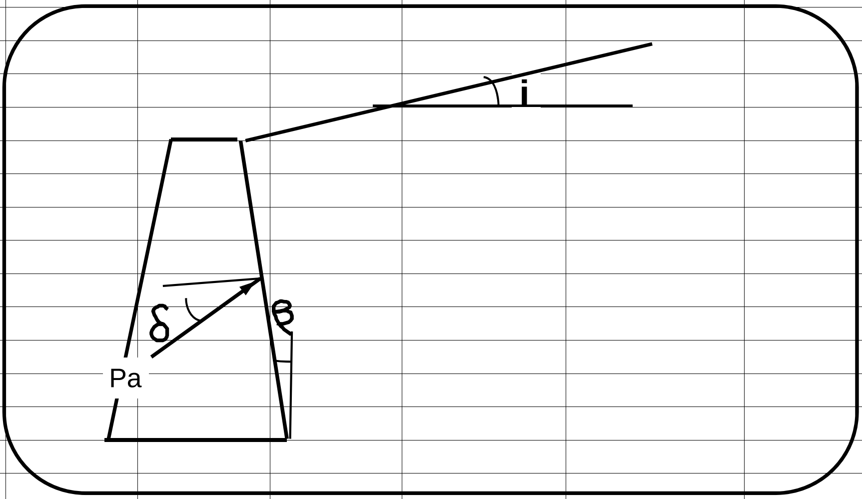
Active Earth Pressures

Coulomb's Theory



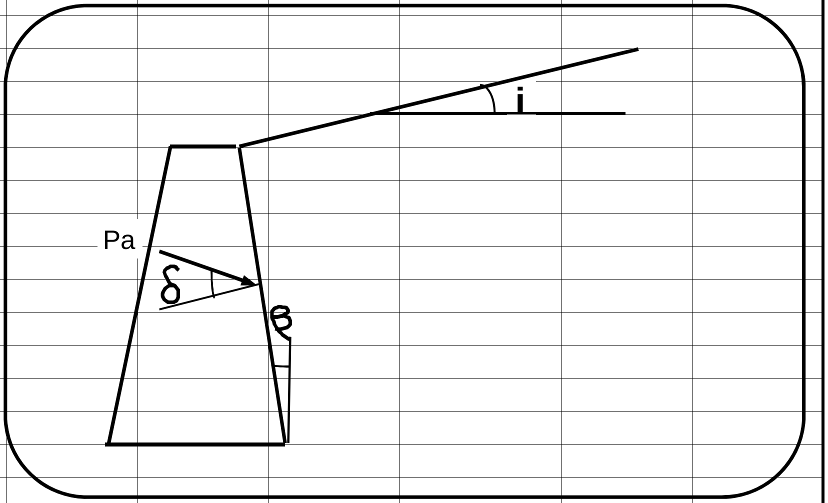
		Degrees	Radians		
β	wall inclination - degrees	0	0.0000000		
δ	wall friction - degrees	0	0.0000000		
i	slope inclination - degrees	0	0.0000000		
ø	soil friction angle - degrees	31	0.5410361		
Ka	Active Earth Pressure Coefficient		0.32		
Kah	Horizontal Component		0.32		
γ_s	Unit Weight of Soil		115		
γ_{ef}	Equivalent Fluid Unit Weight		36.81	Recommend:	37

Active Earth Pressures
Coulomb's Theory



		Degrees	Radians		
β	wall inclination - degrees	0	0.0000000		
δ	wall friction - degrees	0	0.0000000		
i	slope inclination - degrees	0	0.0000000		
ø	soil friction angle - degrees	31	0.5410361		
Ka	Active Earth Pressure Coefficient		0.32		
Kah	Horizontal Component		0.32		
γ **s**	Unit Weight of Soil		52.6		
γ **ef**	Equivalent Fluid Unit Weight		16.84	Recommend:	17

Passive Earth Pressures
Coulomb's Theory



		Degrees	Radians	
β	wall inclination - degrees	0	0.0000000	
δ	wall friction - degrees	0	0.0000000	
i	slope inclination - degrees	0	0.0000000	
Ø	soil friction angle - degrees	31	0.5410361	
Kp	Passive Earth Pressure Coefficient		3.12	
Kah	Horizontal Component		3.12	
γ_s	Unit Weight of Soil		115	
γ_{ef}	Equivalent Fluid Unit Weight		359	ultimate value

a)	Sand				a)	Sand	
Brace Loads for Internally Braced Flexible Walls					Tie-back excavation		
Total Density		115			Total Density		115
Friction Angle		31			Friction Angle		31
Ka		0.32			Ko		0.48
Uniform xH		24			Uniform xH		25

```
      CALFP Version 1.5


      Unit System = E

      Title:  MSWD RWWTP TI 5 R 50
      Traffic Index (TI)  =  05.0
      R.Value of Subgrade (Native Soil)  =  50
      Required GE  = 0000.80 ft

      Base Type   = AB-Class 2

     Base Gravel Factor     = 0001.10
     Base R.Value           = 0078.00
     0.0032*TI*(100-R.VALUE) = 0000.35 ft
     Base MAX. depth        = 0002.00 ft
     Base MIN. depth        = 0000.35 ft


     Depth     GF       GE                    Depth      GF        GE
         (ft)                   (ft)                          (ft)
(ft)

------------------------------------------------------------------------------------
-------
     00.10    02.54    00.25                 00.15    02.54    00.38
     00.20    02.54    00.51                 00.25    02.54    00.64
     00.30    02.54    00.76                 00.35    02.54    00.89
     00.40    02.54    01.02                 00.45    02.54    01.14
     00.50    02.54    01.27                 00.55    02.56    01.41
     00.60    02.64    01.58                 00.65    02.71    01.76

  HMA Safety Factor (GE)          = 0000.20 ft
  HMA Ultimate Depth              = 0000.65 ft
  (HMA MAX. Depth shown in Table)

  HMA MIN. Depth (from Base)   = 0000.20 ft

  HMA MIN. Depth (selected)    = 0000.20 ft



     Note:  Positive Residual GE indicates over-design.
     Note:  Negative Safety Factor in Base

------------------------------------------------------------------------------------
-----------------------

    HMA     TPB    T-Base  B-Base  Subbase  Res-GE  Cost     HMA-GF
       ft            ft            ft            ft            ft            ft
$/y^2

------------------------------------------------------------------------------------
-----------------------
    00.20    00.00    00.35    00.00    00.00     00.09    0000.00    02.54
    00.25    00.00    00.35    00.00    00.00     00.22    0000.00    02.54
    00.30    00.00    00.35    00.00    00.00     00.35    0000.00    02.54
    00.35    00.00    00.35    00.00    00.00     00.47    0000.00    02.54
    00.40    00.00    00.35    00.00    00.00     00.60    0000.00    02.54

 ***** FINISH *****
```

```
       CALFP Version 1.5

       Unit System = E

       Title:  MSWD RWWTP TI 6 R 50
       Traffic Index (TI)  =  06.0
       R.Value of Subgrade (Native Soil)  =  50
       Required GE  = 0000.96 ft

       Base Type   = AB-Class 2

      Base Gravel Factor     = 0001.10
      Base R.Value           = 0078.00
      0.0032*TI*(100-R.VALUE) = 0000.42 ft
      Base MAX. depth        = 0002.00 ft
      Base MIN. depth        = 0000.35 ft


      Depth     GF       GE                    Depth      GF        GE
          (ft)                   (ft)                           (ft)
(ft)

------------------------------------------------------------------------------------
-------
      00.10    02.31    00.23                 00.15    02.31    00.35
      00.20    02.31    00.46                 00.25    02.31    00.58
      00.30    02.31    00.69                 00.35    02.31    00.81
      00.40    02.31    00.92                 00.45    02.31    01.04
      00.50    02.31    01.16                 00.55    02.34    01.29
      00.60    02.41    01.45                 00.65    02.48    01.61
      00.70    02.54    01.78                 00.75    02.60    01.95
      00.80    02.65    02.12                 00.85    02.71    02.30

  HMA Safety Factor (GE)          = 0000.20 ft
  HMA Ultimate Depth              = 0000.80 ft
  (HMA MAX. Depth shown in Table)

  HMA MIN. Depth (from Base)   = 0000.20 ft

  HMA MIN. Depth (selected)    = 0000.20 ft



     Note:  Positive Residual GE indicates over-design.
     Note:  Negative Safety Factor in Base

------------------------------------------------------------------------------------
-----------------------

    HMA     TPB    T-Base  B-Base  Subbase  Res-GE  Cost     HMA-GF
       ft            ft            ft            ft            ft             ft
$/y^2

------------------------------------------------------------------------------------
-----------------------
    00.25    00.00    00.35    00.00    00.00     00.00    0000.00    02.31
    00.30    00.00    00.35    00.00    00.00     00.12    0000.00    02.31
    00.35    00.00    00.35    00.00    00.00     00.23    0000.00    02.31
    00.40    00.00    00.35    00.00    00.00     00.35    0000.00    02.31
    00.45    00.00    00.35    00.00    00.00     00.46    0000.00    02.31
    00.50    00.00    00.35    00.00    00.00     00.58    0000.00    02.31

 ***** FINISH *****
```

```
  CALFP Version 1.5

       Unit System = E

       Title:  MSWD RWWTP TI 7 R 50
       Traffic Index (TI)  =  07.0
       R.Value of Subgrade (Native Soil)  =  50
       Required GE  = 0001.12 ft

       Base Type   = AB-Class 2

      Base Gravel Factor     = 0001.10
      Base R.Value           = 0078.00
      0.0032*TI*(100-R.VALUE) = 0000.49 ft
      Base MAX. depth        = 0002.00 ft
      Base MIN. depth        = 0000.35 ft


      Depth     GF       GE                    Depth      GF        GE
          (ft)                   (ft)                           (ft)
(ft)

------------------------------------------------------------------------------------
-------
      00.10    02.14    00.21                 00.15    02.14    00.32
      00.20    02.14    00.43                 00.25    02.14    00.54
      00.30    02.14    00.64                 00.35    02.14    00.75
      00.40    02.14    00.86                 00.45    02.14    00.96
      00.50    02.14    01.07                 00.55    02.17    01.19
      00.60    02.23    01.34                 00.65    02.29    01.49
      00.70    02.35    01.65                 00.75    02.40    01.80
      00.80    02.46    01.97                 00.85    02.51    02.13
      00.90    02.55    02.30                 00.95    02.60    02.47

  HMA Safety Factor (GE)          = 0000.20 ft
  HMA Ultimate Depth              = 0000.95 ft
  (HMA MAX. Depth shown in Table)

  HMA MIN. Depth (from Base)   = 0000.20 ft

  HMA MIN. Depth (selected)    = 0000.20 ft


     Note:  Positive Residual GE indicates over-design.
     Note:  Negative Safety Factor in Base

------------------------------------------------------------------------------------
-----------------------

    HMA     TPB    T-Base  B-Base  Subbase  Res-GE  Cost     HMA-GF
       ft           ft           ft           ft           ft            ft
$/y^2

------------------------------------------------------------------------------------
-----------------------
    00.35    00.00    00.35    00.00    00.00     00.01    0000.00    02.14
    00.40    00.00    00.35    00.00    00.00     00.12    0000.00    02.14
    00.45    00.00    00.35    00.00    00.00     00.23    0000.00    02.14
    00.50    00.00    00.35    00.00    00.00     00.34    0000.00    02.14
    00.55    00.00    00.35    00.00    00.00     00.46    0000.00    02.17
    00.60    00.00    00.35    00.00    00.00     00.60    0000.00    02.23

 ***** FINISH *****
```