GEOTECHNICAL ENGINEERING REPORT

LAKE WILDWOOD BACKBONE EXTENSION

Rough and Ready Road
Nevada County, California

October 5, 2019

Prepared For:

Nevada Irrigation District
Tonia Herrera
1036 W Main Street
Grass Valley, California 95959

NV5

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Nevada City, CA 95959

PROJECT NO. 5353.00

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October 5, 2019

Nevada Irrigation District
Tonia Herrera
1036 W Main Street
Grass Valley, California 95959

Reference: Lake Wildwood Backbone Extension Project
Rough and Ready Road
Nevada County, California

Subject: Geotechnical Engineering Report

Dear Mrs. Herrera:

This report presents the results of our geotechnical engineering investigation for the Lake Wildwood Backbone Extension Project located along Rough and Ready Highway, Rough and Ready Road, Empty Diggins Lane, and Bosa Drive in Nevada County, California. As proposed, the project is to include development of approximately 4.75 miles of new waterline and 5 pressure reducing valves (PRVs).

The findings presented in this report are based on our subsurface investigation, laboratory test results, and our experience with subsurface conditions in the area. Our opinion is that the project can be completed as proposed, provided the recommendations presented in this report are implemented. Our primary concerns, from a geotechnical engineering standpoint is the presence of shallow resistant bedrock and oversized boulders. Recommendations for mitigating these concerns are presented in the report.

Please contact us if you have any questions regarding our observations or the recommendations presented in this report.

Sincerely,
NV5

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1.0 INTRODUCTION

At the request of M. Tabucchi of Nevada Irrigation District, NV5 performed a geotechnical investigation of the approximately 4.75-mile new waterline located along Rough and Ready Highway, Rough and Ready Road, Empty Diggins Lane, and Bosa Drive in Nevada County, California. The geotechnical investigation was performed in general accordance with our proposal (PN19076) dated May 24, 2018, a copy of which is included as Appendix A of this report. For your review, Appendix B contains a document prepared by Geoprofessional Business Association (GBA) entitled Important Information about Your Geotechnical Engineering Report, which summarizes the general limitations, responsibilities, and use of geotechnical reports.

1.1 SITE DESCRIPTION

The location of the proposed pipeline runs along Rough and Ready Highway, Rough and Ready Road, Empty Diggins Lane, and Bosa Drive. The pipeline is proposed to run in the center of the northern traffic (west bound) lane. The above listed roadways are generally bordered by rural residential properties and passes through the historic town of Rough and Ready.

We understand the proposed pipeline will run along Rough and Ready Highway and Rough and Ready Road. At the time of our field investigation Rough and Ready Highway and Rough and Ready Road were paved with asphaltic concrete. The proposed pipeline will then continue for a short distance west along Riffle Box Road, which is covered with gravel, before crossing undeveloped private property. The proposed pipeline rejoins Rough and Ready Road for a short distance before turning south onto the gravel covered Empty Diggins Lane. The remainder of the proposed pipeline travels along undeveloped dirt roads crossing private property.

1.2 PROPOSED IMPROVEMENTS

Based on our understanding of the project, the proposed improvements will include approximately 4.75 miles of new waterline with five pressure reducing valves. The waterline will likely be 12 to 18-inch diameter ductile iron pipe buried at least 30 inches below existing site grades. We anticipate that excavations for the project will include cuts of up to 6 feet in depth to install the waterline.

1.3 PURPOSE

We performed a surface reconnaissance and subsurface geotechnical investigation at the site, collected soil samples for laboratory testing, and performed engineering calculations to provide grading and drainage recommendations and foundation and pavement design criteria for the proposed improvements.

1.4 SCOPE OF SERVICES

To prepare this report, we performed the following scope of services:

- We performed a site investigation, including a literature review and a limited subsurface investigation.
- We collected relatively undisturbed soil samples and bulk soil samples from selected exploratory trenches.

- We performed 9 seismic refraction surveys in selected areas where there was limited access for trenching resistant bedrock, as shown on Figure 2.
- We performed laboratory tests on select soil samples obtained during our subsurface investigation to determine their engineering material properties.
- Based on observations made during our subsurface investigation and the results of laboratory testing, we performed engineering calculations to provide geotechnical engineering recommendations for earthwork and structural improvements.

Our scope of services did not include a groundwater flow analysis nor an evaluation of the site for the presence of hazardous materials, historic mining features, asbestiform minerals, or mold.

2.0 SITE INVESTIGATION

We performed a site investigation to characterize the existing surface conditions and shallow subsurface soil/rock conditions. Our site investigation included a literature review and field investigation as described below.

2.1 LITERATURE REVIEW

We performed a limited review of geologic literature pertaining to the project site. The following sections summarize our findings.

2.1.1 Soil Survey

As part of our study, we reviewed the U.C. Davis Soil Resource Laboratory Online WebSoil Survey (https://casoilresource.lawr.ucdavis.edu/gmap/). The soil survey indicated that the site is located in an area containing eleven classifications of seven soil families. The Aiken family is found along the eastern portion of the site on broad gently sloping tabular ridges and moderately steep to steep sideslopes. The Iron Mountain family is found surrounded by the Aiken Family in the eastern portion of the site on steep side slopes and narrow ridge tops. The Secca family extends from Randolph Lane to Bonanza Way on gently sloping to steep mountainous terrain. The Boomer Family extends from Randolph Lane to Stagecoach Way on level to very steep slopes. The Trabuco family extends from Stagecoach Way west to the end of the site on gentle to very steep slopes.

Table 2.1.1.1 – Soil Families

Soil Family Name	Depth	Drainage	Runoff	Permeability	Parent Material
Aiken	Very Deep	Well Drained	Medium	Moderately Slow	Andesitic Lahar Deposit
Boomer	Deep to Very Deep	Well Drained	High	Slow	Colluvium and/or Residuum from Igneous or Metamorphic Rock
Iron Mountain	Shallow	Well to Excessively Drained	Medium	Moderately Rapid	Residuum from Conglomerate
Secca	Moderately Deep	Moderately Well Drained	Very High	Slow	Colluvium or Residuum from Igneous and/or Metamorphic Rock
Trabuco	Moderately Deep	Well Drained	High	Slow	Residuum from Igneous Rock

2.1.2 Geologic Setting

According to the Geologic Map of the Chico Quadrangle (California Division of Mines and Geology, 1981), the area containing the project site is generally underlain by Miocene to Pliocene-age volcanic rock and Triassic-age massive diabase and gabbroic rocks. The Miocene to Pliocene era spans the period of time between 2.58 and 20.44 million years before present and the Triassic period spans from 50.6 to 251.9 million years before the present.

We reviewed California Geological Survey Open File Report 96-08, Probabilistic Seismic Hazard Assessment for the State of California, and the 2002 update entitled California Fault Parameters. The documents indicate the property is located within the Foothills Fault System. The Foothills Fault System is designated as a Type C fault zone, with low seismicity and a low rate of recurrence. The 1997 edition of California Geological Survey Special Publication 42, Fault Rupture Hazard Zones in California, describes active faults and fault zones (activity within 11,000 years), as part of the Alquist-Priolo Earthquake Fault Zoning Act. The map and document indicate the site is not located within an Alquist-Priolo active fault zone.

2.2 FIELD INVESTIGATION

We performed our field investigations on September 6, September 24, and September 25. During our field investigations, we observed the local topography and surface conditions and performed a limited subsurface investigation. The following sections summarize surface and subsurface conditions observed during our field investigation.

Our subsurface investigation included the excavation of 25 exploratory trenches across the project site. We excavated to depths ranging between 2 and 7 feet below the ground surface (bgs) using a Case 580 backhoe equipped with a 24-inch bucket. We obtained samples using a hand-actuated slide sampler and shovel. A staff engineer from our firm logged the soil conditions revealed in the exploratory trenches and collected relatively undisturbed and bulk soil samples for laboratory testing. Figure 1 shows the approximate exploratory trench locations.

2.2.1 Surface Conditions

At the time of our investigation, the site was a fully developed roadway that traveled through a generally residential area. The site runs through the community of Rough and Ready, which includes a few stores, community center, and fire station. Towards the western portion of the site the area is generally less developed with fewer residences on larger parcels of land. The site crosses some private land on the western portion of the site and eventually travels along a gravel road and a portion of unmaintained gravel/dirt road.

The roadway is generally gently sloping to moderately sloping across the site. The sideslopes of the roadway vary from level to steeply sloping. Some portions of the cut made for roadway construction are near vertical to vertical with exposed rock.

Vegetation on the site was typical of the Sierra Nevada Foothills, with areas of dense oak and pine trees, manzanita and poison oak, and open fields of grasses and forbs. Natural drainage consisted of sheet flow over the slopes that concentrate in man-made surface drainage elements (such as roadside ditches, canals and gutters, and natural drainage elements such as swales, ravines, and creeks that generally trend toward the central valley from the surrounding slopes). Going from east to west, drainages in the area are the Lower Rough and Ready Ditch, Squirrel Creek, Riffle Box Ditch and Deer Creek.

2.2.2 Subsurface Soil Conditions

The soil conditions described in the following paragraphs are generalized, based on our observations of soil revealed in our 25 exploratory trenches. More detailed information can be found in the trench logs in Appendix C.

Trenches T-2, T-4, T-6 to T-8, T-10 to T-21, and T-23 to T-26 were excavated from the ground surface to depths of approximately 2.5 to 7 feet bgs without encountering difficult digging or boulders. Trenches T-1, T-3, T-9, and T-22 encountered practical refusal at depths ranging from 2.5 to 4 feet bgs. All trenches encountered a surficial layer of topsoil and or gravel prior to encountering various soils before the trenches were terminated or encountered practical refusal.

2.2.3 Groundwater Conditions

During our site investigation, we did not encounter groundwater seepage in our exploratory trenches. We did observe a spring/surface water flow at the corner of Rough and Ready Road and Stagecoach Way as well as drainage channels and swales across the site that indicate seasonal flow of surface water.

Our observations of groundwater conditions were made in September 2019 following a period of dry weather. Although we did not observe groundwater in our exploratory trenches, our experience has shown that seepage may be encountered in excavations which reveal the soil/weathered rock transition, particularly during or after the rainy season.

2.2.4 Seismic Refraction Microtremor Survey

As a part of our field investigation, we performed nine seismic refraction microtremor (ReMi) surveys across the site. The seismic surveys were performed to determine seismic velocities of the underlying bedrock. Refraction survey locations are depicted on Figure 1 and 2.

The surveys were performed using a multichannel, SeisOpt® seismograph and a single seismic line utilizing 12 geophones. The seismic source consisted of impacting a steel plate with a 7-pound trip hammer.

Following the survey, the collected seismic data was provided to Optim, Inc. in Reno, Nevada for processing and analysis. From the seismic refraction survey, P-wave velocities were correlated to rippability as referenced in the Caterpillar (Cat) Handbook of Ripping (12th Edition, February 2000). In general, velocities above 5,000 feet per second are difficult to rip with a Cat D8 single-tooth ripper. The resulting subsurface soil/rock velocities are shown in Figures 3-1 through 3-9. Contractors bidding for the project should refer to the Caterpillar (Cat) Handbook of Ripping (12th Edition, February 2000) to correlate the maximum recorded velocity with rippability, and to determine the necessary required grading equipment.

2.2.5 Test Trench Excavations

To determine the excavatability of the proposed utility trenches, we timed the excavation rate of several trenches during our exploration. To determine the excavation rate the backhoe continuously tried to scrape/excavate a four foot long section that was two feet wide for a determined period of time. The average depth the backhoe was able to progress across the specified area was recorded.

In trench T-1 from a depth of approximately 4 feet, 3 inches of progression was made in a 1-minute time period. In trench T-3 from a depth of approximately 2 feet, 6 inches of progression was made in a 1-minute time period. In trench T-9 from a depth of approximately 2.5 feet, 5 inches of progression was made in a 1-minute time period. In trench T-22 refusal was encountered and no progress could be made with the backhoe.

3.0 LABORATORY TESTING

We performed laboratory tests on selected soil samples collected from our subsurface exploratory trenches to determine their engineering material properties. These engineering material properties were used to develop geotechnical engineering design recommendations for earthwork and structural improvements. We performed the following laboratory tests:

- Atterberg Limits (ASTM D4318)
- Particle Size (ASTM D422)

Several samples were submitted to a California state-certified analytical laboratory, Sunland Analytical Lab (Rancho Cordova, California), for corrosion evaluation testing. The testing performed included determination of pH (CA DOT 643), chloride content (CA DOT 422), sulfate content (CA DOT 417), and minimum electrical resistivity (CA DOT 643). Results of the corrosion evaluation testing are summarized in the following table.

Table 3.1.1 – Corrosion Testing Results

Sample Number	Depth (feet)	Chloride Content (ppm)	Sulfate Content (ppm)	pH	Minimum Resistivity (ohm-cm) x1000
T2-B1	1.5	6.7	17.5	5.67	4.29
T7-B1	3.0	18.4	66.9	5.01	0.72
T18-B1	5.0	3.2	28.1	5.17	2.95
T24-B1	2.5	1.8	9.8	6.41	2.06

According to the Caltrans Corrosion Guidelines (Caltrans, 2003), soil with resistivity greater than 1,000 ohms/cm is considered to have low corrosion potential based on sensitivity to sulfate and chloride intrusion. Soil with sulfate concentration less than 2,000 ppm and chloride concentration less than 500 ppm are also considered non-corrosive. However, soil with a pH of 5.5 or less is considered corrosive. According to these guidelines, samples collected at T7-B1 and T18-B1 should be considered to have a medium risk of corrosion potential.

Soil or water with a pH of 5.5 or less can react with the lime in concrete to form soluble reaction products that can readily leach out of the concrete. The result is a weaker and more porous concrete.

To reduce the likelihood of corrosion problems, materials used for underground utilities, permanent subsurface drainage improvements, and foundation systems should be selected based on local experience and practice. If alternative or new construction methods or materials are being proposed, it may be appropriate to have the selected materials evaluated by a corrosion engineer for compatibility with the onsite soil and groundwater conditions.

We performed particle size determination and Atterberg limits tests of several samples collected from our exploratory trenches across the site. The results are presented in the table below.

Table 3.1.2 – Particle Size and Atterberg Testing Results

Sample Number	Depth (feet)	Percent Sand	Percent Fines	Moisture Content (percent)	Liquid Limit	Plastic Limit	Plastic Index
T4-B1	5.5	70	30	10.7	48	29	19
T6-B1	5.0	8	92	9.9	65	28	37
T8-B1	2.5	34	66	10.3	62	27	35
T12-B1	4.0	57	43	7.3	-	-	-
T19-B1	3.0	81	19	2.4	-	-	-
T23-B1	3.5	88	12	1.0	-	-	-

4.0 CONCLUSIONS

The following conclusions are based on our field observations, laboratory test results, and our experience in the area.

1. Our opinion is that the site is suitable for the proposed improvements, provided that the geotechnical engineering recommendations and design criteria presented in this report are incorporated into the project plans.
2. Our primary concern is the presence of resistant rock at shallow depths and large boulders, which may affect excavatability.
3. Two of the samples tested had a plastic index greater than 35 which indicate potentially expansive soils. These soils should be mixed with granular material to limit their potential for volume change. Mixture ratio can be determined on a case by case basis in the field.
4. Trenches should be wide enough to ensure compaction equipment can operate between the trench sidewall and the waterline.
5. Based on our site observations, the geology of the region, and our experience in the area, our opinion is that the risk of seismically induced hazards such as slope instability, liquefaction, and surface rupture are remote at the project site.

6. Based on the site geology and our observation of the surface conditions, we anticipate that grading and excavation onsite will reveal variably weathered, fractured, metamorphic and volcanic rock. Areas of resistant rock may be encountered which may require splitting, hammering, or blasting to increase the rate of excavation. In addition, spoil resulting from excavations in rocky areas onsite will likely consist of predominantly angular, gravel to boulder-sized rock fragments. This material may be suitable for use as fill, depending on the nominal size of the rock fragments, but will likely require specific recommendations for fill placement and observation to confirm compaction. Preliminary recommendations addressing rock fill placement are included in this report.
7. During our site investigation, we did not encounter ultramafic rock, serpentinite, or naturally occurring asbestos (NOA) minerals. However, the referenced geologic map indicates that the project site is located near areas of amphibolite, an ultramafic rock often associated with NOA. If ultramafic rock, serpentinite or NOA-containing minerals are encountered at the site, site grading would be regulated under Cal/EPA Air Resources Board Regulation 93105, Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations (ATCM) and Nevada County Rule 228, Fugitive Dust. We anticipate that, as a minimum, dust mitigation measures such as limiting site access, restricting onsite construction vehicle speeds, covering stockpiled soil, and liberal use of water during grading will be required during grading to prevent the generation of dust from the site. We can prepare an asbestos dust mitigation plan (ADMP), if required, for project planning and approval purposes. The ADMP will be submitted to the Northern Sierra Air Quality Management District for approval.
8. During our site investigation, we did not observe groundwater or seepage within our exploratory trenches. However, we did observe evidence that surface water is seasonally transported through the drainage channels and swales on the property. We anticipate that moist to saturated soil conditions and groundwater may be encountered during grading, particularly during the rainy season and/or in excavations that reveal the soil/rock transition. Recommendations addressing moisture conditioning, drainage, and fill placement are presented in the following sections of this report.
9. Prior to grading and construction, we should be retained to review the proposed grading plan and structural improvements to confirm our recommendations.

5.0 RECOMMENDATIONS

The following geotechnical engineering recommendations are based on our understanding of the project as currently proposed, our field observations, the results of our laboratory testing program, engineering analysis, and our experience in the area.

5.1 GRADING

The following sections present our grading recommendations. The grading recommendations address clearing and grubbing, soil preparation, cut slope grading, fill placement, fill slope grading, erosion control, subsurface drainage, surface water drainage, construction dewatering, underground utility trenches, soil corrosion potential, plan review, and construction monitoring.

5.1.1 Clearing and Grubbing

The areas to be graded for structures should be cleared and grubbed to remove vegetation and other deleterious materials as described below.

1. In areas outside of roadways, strip and remove debris from clearing operations and the top 2 to 12 inches of soil containing shallow vegetation, roots and other deleterious materials. The organic topsoil can be stockpiled onsite and used in landscape areas but is not suitable for use as fill. The project engineer should approve any proposed use of the spoil generated from stripping prior to placement.
2. Overexcavate any relatively loose debris and soil that is encountered in our exploratory trenches or any other onsite excavations to underlying, competent material. Possible excavations include exploratory trenches excavated by others, mantles or soil test pits, holes resulting from tree stump or boulder removal, and mining relics.
3. Although not observed during our investigation, if loose, untested fill is encountered during site development, overexcavate to competent native soil or weathered rock a minimum of 5 feet beyond the areas of proposed improvements.
4. Overexcavate any encountered leach lines, abandoned sewer, water, and fuel lines, and loose soil in abandoned subsurface utility line trenches within the proposed improvement areas to underlying competent soil, as determined by a representative of NV5.
5. Fine grained, potentially expansive soil, as determined by NV5, that is encountered during grading should be mixed with granular soil, or overexcavated and stockpiled for removal from the project site or for later use in landscape areas. A typical mixing ratio for granular to expansive soil is 4 to 1. The actual mixing ratio should be determined by NV5.
6. Vegetation, deleterious materials, structural debris, and oversized rocks not used in landscape areas, drainage channels, or other non-structural uses should be removed from the site.

5.1.2 Excavation of Resistant Rock

Seismic refraction surveys were performed to measure the velocity of compression waves in shallow subsurface materials and to estimate the approximate depths to the underlying strata. Compression wave velocities are typically used as a general indication of the rippability of subsurface soil and rock.

The seismic refraction technique has several limitations. The technique is based on the assumption that less dense or softer, lower velocity materials overlie denser, higher velocity materials, which may not always be the case. Thin strata are not reliably detected by the method. Average velocities and depth measurements are obtained in areas of heterogeneous subsurface conditions such as boulders, irregular bedrock surfaces, and variably weathered rock. Thus, the heterogeneity and variability of subsurface conditions may not be detected. The results of the seismic refraction survey should be considered an indication of average or typical values, rather than as a direct measurement or observation of subsurface conditions.

In general, velocities over 4,000 feet per second indicate that the subsurface material will require ripping with large excavation equipment, jackhammering or blasting to excavate. The results of the seismic refraction survey are included in Figures 3-1 through 3-9. It is recommended that the contractor consult these values along with published manufacturer's rippability tables to determine appropriate

equipment for this project. The contractor may wish to consult with a licensed engineering geologist to aid in determining rippability.

5.1.3 Soil Preparation for Fill Placement

Where fill placement is proposed, the surface soil exposed by site clearing and grubbing should be prepared as described below.

1. The surface soil should be scarified to a minimum depth of 12 inches below the existing ground surface, or to resistant rock, whichever is shallower. Following scarification, the soil should be uniformly moisture conditioned to within approximately 3 percentage points of the ASTM D1557 optimum moisture content.
2. The scarified and moisture conditioned soil should then be compacted to achieve a minimum relative compaction of 90 percent based on ASTM D1557 maximum dry density. The moisture content, density, and relative percent compaction should be verified by a representative of NV5. The earthwork contractor should assist our representative by excavating test pads with onsite earth moving equipment.
3. Where fill placement is proposed on native slopes steeper than approximately 5:1, H:V, a base key and routine benches must be provided. Unless otherwise recommended by the project geotechnical engineer, the base key should be excavated at the toe of the fill a minimum of 2 feet into competent stratum, as determined by a representative of NV5 during construction observation. The bottom of the base key should be sloped slightly into the hillside at an approximate gradient of 5 percent or greater.
4. The fill must be benched into existing side slopes as fill placement progresses. Benching must extend through loose surface soil into firm material, and at intervals such that no loose surface soil is beneath the fill. As a minimum, a horizontal bench should be excavated every 5 vertical feet or as determined by a representative of NV5.

5.1.4 Fill Placement

Soil fill placement proposed for the project should incorporate the following recommendations:

1. Soil used for fill should be imported, free of rocks larger than 3 inches, uncontaminated, predominantly granular, non-expansive and free of deleterious material. Import material that is proposed for use onsite should be submitted to NV5 for approval and possible laboratory testing at least 72 hours prior to transport to the site. Rocks larger than 3 inches are considered oversized material and should be stockpiled for offhaul or later use in landscape areas and drainage channels.
2. Cohesive, predominantly fine grained, or potentially expansive soil encountered during grading should be stockpiled for removal, mixed as directed by NV5, or used in landscape areas.

   As an option, cohesive fine grained, or potentially expansive soil can often be placed in the deeper portions of proposed fill (e.g., depths greater than 3 feet below subgrade in building footprints). However, this option would have to be evaluated on a case-by-case basis with consideration of the fill depth and proposed loading.
3. Soil used to construct fill should be uniformly moisture conditioned to within approximately 3 percentage points of the ASTM D1557 optimum moisture content. Wet soil may need to be air

dried or mixed with drier material to facilitate placement and compaction, particularly during or following the wet season.

4. Fill should be constructed by placing uniformly moisture conditioned soil in maximum 8-inch-thick loose, horizontal lifts (layers) prior to compacting.
5. Trenches should be sized so that compaction equipment is able to operate between the trench sidewalls and the waterline.
6. All fill should be compacted to a minimum relative compaction of 90 percent of the ASTM D1557 maximum dry density. The upper 12 inches of fill in paved areas, beneath proposed slabs-on-grade, and within the proposed building footprint should be compacted to a minimum of 95 percent relative compaction.

The moisture content, density and relative percent compaction of fill should be confirmed by a representative of NV5 during construction.

5.1.5 Erosion Controls

Graded portions of the site should be seeded as soon as possible to allow vegetation to become established prior to and during the rainy season. In addition, grading that results in greater than one acre of soil disturbance or in sensitive areas may require the preparation of a site-specific storm water pollution prevention plan. As a minimum, the following controls should be installed prior to and during grading to reduce erosion.

1. Prior to commencement of site work, fiber rolls should be installed down slope of the proposed area of disturbance to reduce migration of sediment from the site. Fiber rolls on slopes are intended to reduce sediment discharge from disturbed areas, reduce the velocity of water flow, and aid in the overall revegetation of slopes. The fiber rolls should remain in place until construction activity is complete and vegetation becomes established.
2. All soil exposed in permanent slope faces should be hydroseeded or hand seeded/strawed with an appropriate seed mixture compatible with the soil and climate conditions of the site as recommended by the local Resource Conservation District.
3. Following seeding, jute netting or erosion control blankets should be placed and secured over the slopes steeper than 2:1, H.V.
4. Surface water drainage ditches should be established as necessary to intercept and redirect concentrated surface water away from cut and fill slope faces. Under no circumstances should concentrated surface water be directed over slope faces. The intercepted water should be discharged into natural drainage courses or into other collection and disposal structures.

5.1.6 Underground Utility Trenches

Underground utility trenches should be excavated and backfilled as described below.

1. Based on subsurface conditions observed in our exploratory trenches, we anticipate that resistant rock and boulders at shallow depths will limit utility trench excavations. Pre-ripping of the trench alignment, blasting, or splitting may be required.

2. Asphalt that is saw cut for excavation may need to be expanded to allow excavation and removal of rocks that are larger than the trench width. An excavator with a thumb should increase excavation rates.
3. The California Occupational Safety and Health Administration (OSHA) requires all utility trenches deeper than 4 feet bgs be shored with bracing equipment prior to being entered by any individuals, whether or not they are associated with the project.
4. We anticipate that shallow subsurface seepage may be encountered, particularly if utility trenches are excavated during the winter, spring, or early summer. The earthwork contractor may need to employ dewatering methods as discussed in the Construction Dewatering section on page 15 to excavate, place and compact the trench backfill materials.
5. Trench backfill used within the bedding and shading zones should consist of ¾-inch minus crushed rock, granular material with a sand equivalent greater than 30, or similar material approved by the project engineer.
6. Where designated on plans, soil used as trench backfill should consist of non-expansive soil with a plasticity index (PI) less than or equal to 15 and should not contain rocks greater than 3 inches in greatest dimension unless otherwise approved by the geotechnical engineer.
7. In roadways, the Class 2 aggregate base rock should be compacted to 95% of the ASTM D1557 maximum dry density. The pavement section should match existing asphalt sections.
8. Where utility trenches will intersect perimeter footings or pass within the proposed building footprint, we recommend that a low permeability backfill plug be placed to reduce water migration and infiltration. In general, a low permeability, predominantly fine-grained soil backfill, sand-cement slurry, or other approved material should be placed within five feet of the building exterior.
9. Trench backfill should be constructed by placing uniformly moisture conditioned soil in maximum 12-inch-thick loose lifts prior to compacting.
10. Trench backfill should be compacted to a minimum relative compaction of 90 percent of the ASTM D1557 maximum dry density. In areas of proposed pavement or concrete flatwork, the upper 12 inches of backfill should be compacted to a minimum relative compaction of 95 percent of the ASTM D1557 maximum dry density. Jetting is not an acceptable method of compacting trench backfill or bedding sand.
11. The loose lift thickness, moisture, density and relative compaction of the trench backfill soil should be observed by a representative of NV5 during placement.
12. Construction quality assurance tests should be performed at a frequency determined by the project geotechnical engineer. Where trench backfill is placed at depths greater than approximately 4 feet, or where potentially unstable sidewall conditions exist, shoring may need to be provided by the contractor to facilitate compaction testing. If shoring is not provided or unsafe conditions are encountered, full time observation will likely be required to confirm compactive effort.

5.1.7 Construction Dewatering

Seepage may be encountered during grading, particularly in deeper excavations made during site preparation. The earthwork contractor should be prepared to dewater excavations if seepage is encountered during grading. Seepage may be encountered if grading is performed during or

immediately after the rainy season. In addition, perched groundwater may be encountered on low permeability soil or weathered rock layers even during the summer months.

If subsurface seepage or groundwater conditions are encountered which prevent or restrict fill placement or construction of the proposed improvements, subdrains may be necessary. If groundwater or saturated soil conditions are encountered during grading, we should be retained to observe the conditions and provide site specific subsurface drainage recommendations. The following typical measures can be employed to mitigate the presence of seepage in excavations.

1. We anticipate that dewatering of utility trenches can be performed by constructing sumps to depths below the trench bottom and removing the water with sump pumps.
2. Additional sump excavations and pumps should be added as necessary to keep the excavation bottom free of standing water and relatively dry when placing and compacting the trench backfill material.
3. If groundwater enters the trench faster than it can be removed by the dewatering system, the underlying compacted soil may become unstable while compacting successive soil lifts. If this occurs, the unstable soil may need to be removed and replaced with free draining open graded drain rock. If drain rock is used, it should meet or exceed the following gradation specifications: 100 percent passing the ¾-inch sieve, 95 to 100 percent passing the ½-inch sieve, 70 to 100 percent passing the ⅜-inch sieve, 0 to 55 percent passing the No. 4 sieve, 0 to 10 percent passing the No. 8 sieve, and 0 to 3 percent passing the No. 200 sieve. Other approved backfill materials can again be used after placing the drain rock to an elevation that is higher than the groundwater.
4. We recommend that the utility trench excavations be performed as late in the summer months as possible to allow the groundwater table to reach its lowest seasonal elevation.

5.1.8 Soil Corrosion Potential

Index testing of the soil was performed as a part of our soil evaluation in an effort to evaluate corrosion potential. Based on Caltrans Corrosion Guidelines, two of the samples, T7-B1 and T18-B1 have a high acidity, pH less than 5.5, and are considered corrosive. Soil or water with a pH of 5.5 or less can react with lime in concrete to form soluble reaction products that can easily leach out of the concrete. The result is a more porous, weaker concrete. While the corrosion rate of ferrous materials does increase with a decreasing pH, only at a pH of less than 4 is there a significant increase in the corrosion rate. All of the chloride, sulfate, and resistivity values were below the threshold for corrosive soils.

To reduce the likelihood of corrosion problems, materials used for underground utilities should be selected based on local experience and practice. If alternative or new construction methods or materials are being proposed, it may be appropriate to have the selected materials evaluated by a corrosion engineer for compatibility with the onsite soil and groundwater conditions.

5.1.9 Surface Water Drainage

Proper surface water drainage is important to the successful development of the project. We recommend the following measures to help mitigate surface water drainage problems:

1. Slope final grades in structural areas so that surface water drains away from building pad finish subgrade at a minimum 2 percent slope for a minimum distance of 10 feet. For structures utilizing slab-on-grade interior floor systems we recommend increasing the slope to 4 percent.
2. To reduce surface water infiltration, compact and slope all soil placed adjacent to building foundations such that water is not allowed to pond. Backfill should be free of deleterious materials.
3. Direct downspouts to positive drainage or a closed collector pipe that discharges flow to positive drainage.
4. Construct V-ditches at the top of cut and fill slopes where necessary to reduce concentrated surface water flow over slope faces. Typically, V-ditches should be 3 feet wide and at least 6 inches deep. Surface water collected in V-ditches should be directed away and downslope from proposed building pads and driveways into a drainage channel.

5.2 STRUCTURAL IMPROVEMENT DESIGN CRITERIA

The following sections present our structural improvement design criteria and recommendations. The recommendations address foundations, seismic parameters, and pavement design.

5.2.1 Seismic Design Criteria

Our classification of on-site soil conditions is based on field observations and laboratory tests. The on-site soil primarily consists of sand, with seams of soft, fine-grained silt or clay underlain by resistant rock at relatively shallow depths.

Table 5.2.1.1 below summarizes seismic design criteria based on, ASCE 7-10, the 2016 California Building Code and the United States Geological Survey (USGS) U.S. Seismic Design Maps tool (available online at https://seismicmaps.org/).

Table 5.2.1.1 - Seismic Design Parameters

Description	Value	Reference	Description	Value	Reference
Latitude Longitude	39.2297 -121.1377	1	Site Class	C	2
Site Coefficient, F_A	1.172	5	Site Coefficient, F_V	1.556	6
Short (0.2 sec) Spectral Response, S_S	0.57 g	3	Long (1.0 sec) Spectral Response, S_1	0.24 g	4
S_S modified for Site Class Effects, S_{MS}	0.668 g	7	S_1 modified for Site Class Effects, S_{M1}	0.38 g	8
Design Spectral Response Acceleration, Short Periods, S_{DS}	0.445 g	9	Design Spectral Response Acceleration, Long Periods, S_{D1}	0.254 g	10

References:

1) USGS 7.5 min
2) ASCE 7-10 Table 20.3-1
3) ASCE 7-10 Figure 22-1
4) ASCE 7-10 Figure 22-2
5) ASCE 7-10 Table 11.4-1
6) ASCE 7-10 Table 11.4-2
7) ASCE 7-10 Equation 11.4-1
8) ASCE 7-10 Equation 11.4-2
9) ASCE 7-10 Equation 11.4-3
10) ASCE 7-10 Equation 11.4-4

5.2.2 Foundations

The following are our recommendations for foundations constructed on compacted and tested fill or competent native soil. These recommendations assume the grading for the project is performed in accordance with the recommendations presented in this report:

1. Footings for lightly loaded structures should be a minimum of 12 inches wide and trenched through any loose surface material, potentially expansive soil, or untested fill, and a minimum of 12 inches into competent native soil, weathered rock or compacted fill. If clay is encountered at the base of footing excavations, the footing should be deepened through the clay into underlying granular material or weathered rock, as determined in the field by NV5.
2. The base of the footing excavation should be approximately level. On sloping sites, it will be necessary to step the base of the footing excavation as necessary to maintain a slope of less than 10 percent at the base of the footing.
3. Footing trenches should be cleaned of all loose soil and construction debris prior to placing concrete. A representative from NV5 should observe the footing excavations prior to concrete placement.
4. As a minimum, the footings should be designed with two No. 4 rebar reinforcement, one near the top of the footing and one near the bottom. A minimum of 3 inches of concrete coverage should surround the bars.
5. In general, structures constructed adjacent to descending slopes should employ a minimum setback of either 1/3 the height of the slope, or 40 feet, whichever is less. The setback for ascending slopes is either 1/2 the slope height or 15 feet, whichever is less. Where footings are proposed within these code-based setbacks, the project geotechnical engineer should review the proposed slope configuration and provide revised setback recommendations, if appropriate.

6. Footing excavations should be saturated prior to placing concrete to reduce the risk of problems caused by wicking of moisture from curing concrete. However, concrete should not be placed through standing water in the footing excavations.
7. In an effort to reduce the likelihood of settlement-induced distress to the proposed structures, we recommend that strip and isolated footings with a minimum embedment depth of 12 inches in competent soil be sized for an allowable bearing capacity of 3,000 psf for dead plus live loads. This value can be increased by 500 psf for each additional foot of embedment up to a limiting value of 4,000 psf. Allowable bearing may be increased by 33 percent for additional transient loading, such as wind or seismic loads.
8. A triangularly-distributed lateral resistance (passive soil resistance) of 350d psf, where d is footing depth, may be used for footings. This value may be increased by 33 percent for wind and seismic. As an alternate to the passive soil resistance described above, a coefficient of friction for resistance to sliding of 0.33 may be used. The higher of the two values should be reduced by 50 percent if both resisting values are to be used.

6.0 LIMITATIONS

The following limitations apply to the findings, conclusions and recommendations presented in this report:

1. Our professional services were performed consistent with the generally accepted geotechnical engineering principles and practices employed in northern California. No warranty is expressed or implied.
2. These services were performed consistent with our agreement with our client. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of our services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report. This report is solely for the use of our client unless noted otherwise. Any reliance on this report by a third party is at the party's sole risk.
3. If changes are made to the nature or design of the project as described in this report, then the conclusions and recommendations presented in this report should be considered invalid. Only our firm can determine the validity of the conclusions and recommendations presented in this report. Therefore, we should be retained to review all project changes and prepare written responses with regards to their impacts on our conclusions and recommendations. However, we may require additional fieldwork and laboratory testing to develop any modifications to our recommendations. Costs to review project changes and perform additional fieldwork and laboratory testing necessary to modify our recommendations are beyond the scope of services presented in this report. Any additional work will be performed only after receipt of an approved scope of services, budget, and written authorization to proceed.
4. The analyses, conclusions and recommendations presented in this report are based on site conditions as they existed at the time we performed our surface and subsurface field investigations. We have assumed that the subsurface soil and groundwater conditions encountered at the location of our exploratory trenches are generally representative of the subsurface conditions throughout the entire project site. However, the actual subsurface conditions at locations between and beyond our exploratory trenches and seismic testing locations may differ. Therefore, if the subsurface conditions encountered during construction

are different than those described in this report, then we should be notified immediately so that we can review these differences and, if necessary, modify our recommendations.

5. The elevation or depth to groundwater underlying the project site may differ with time and location.
6. The project site map shows approximate exploratory trench locations as determined by pacing distances from identifiable site features. Therefore, the trench locations should not be relied upon as being exact nor located with surveying methods.
7. Our geotechnical investigation scope of services did not include evaluating the project site for the presence of historic mining operations or hazardous materials. Although we did not observe evidence of historic mining activity or hazardous materials within the proposed building area at the time of our field investigation, all project personnel should be careful and take the necessary precautions should hazardous materials be encountered during construction. Possible historic mining excavation not detected during our investigation may impact the proposed improvements.
8. The findings of this report are valid as of the present date. However, changes in the conditions of the property can occur with the passage of time. The changes may be due to natural processes or to the works of man, on the project site or adjacent properties. In addition, changes in applicable or appropriate standards can occur, whether they result from legislation or the broadening of knowledge. Therefore, the recommendations presented in this report should not be relied upon after a period of two years from the issue date without our review.

FIGURES

PROPOSED PIPELINE

REFRACTION SURVEY

EXPLORATORY TRENCH

N

0 1,000 2,000 4,000 Feet

1"=2000'

NV5

OVERALL AERIAL MAP

NID - LAKE WILDWOOD BACKBONE

NEVADA COUNTY, CALIFORNIA

DRAWN BY:	JMC
CHECKED BY:	CRK
NV5 PROJECT:	5353.00
DATE:	SEPTEMBER 2019

FIGURE

1-1

PROPOSED PIPELINE
REFRACTION SURVEY
EXPLORATORY TRENCH

N
0 1,000 2,000 4,000 Feet
1"=2,000'

OVERALL STREET MAP

NID - LAKE WILDWOOD BACKBONE
NEVADA COUNTY, CALIFORNIA

DRAWN BY:	JMC
CHECKED BY:	CRK
NV5 PROJECT:	5353.00
DATE:	SEPTEMBER 2019

FIGURE
1-2

N|V|5

EXPLORATION MAP

NID - LAKE WILDWOOD BACKBONE

NEVADA COUNTY, CALIFORNIA

DRAWN BY:	JMC
CHECKED BY:	CRK
NV5 PROJECT:	5353.00
DATE:	SEPTEMBER 2019

FIGURE 2-1

N|V|5

EXPLORATION MAP

NID - LAKE WILDWOOD BACKBONE

NEVADA COUNTY, CALIFORNIA

DRAWN BY:	JMC
CHECKED BY:	CRK
NV5 PROJECT:	5353.00
DATE:	SEPTEMBER 2019

FIGURE 2-2

NV5

EXPLORATION MAP

NID - LAKE WILDWOOD BACKBONE

NEVADA COUNTY, CALIFORNIA

DRAWN BY:	JMC
CHECKED BY:	CRK
NV5 PROJECT:	5353.00
DATE:	SEPTEMBER 2019

FIGURE 2-3

N|V|5

EXPLORATION MAP

NID - LAKE WILDWOOD BACKBONE

NEVADA COUNTY, CALIFORNIA

DRAWN BY:	JMC
CHECKED BY:	CRK
NV5 PROJECT:	5353.00
DATE:	SEPTEMBER 2019

FIGURE 2-4

N|V|5

EXPLORATION MAP

NID - LAKE WILDWOOD BACKBONE

NEVADA COUNTY, CALIFORNIA

DRAWN BY:	JMC
CHECKED BY:	CRK
NV5 PROJECT:	5353.00
DATE:	SEPTEMBER 2019

FIGURE 2-5

NV5

EXPLORATION MAP

NID - LAKE WILDWOOD BACKBONE

NEVADA COUNTY, CALIFORNIA

DRAWN BY:	JMC
CHECKED BY:	CRK
NV5 PROJECT:	5353.00
DATE:	SEPTEMBER 2019

FIGURE 2-6

N|V|5

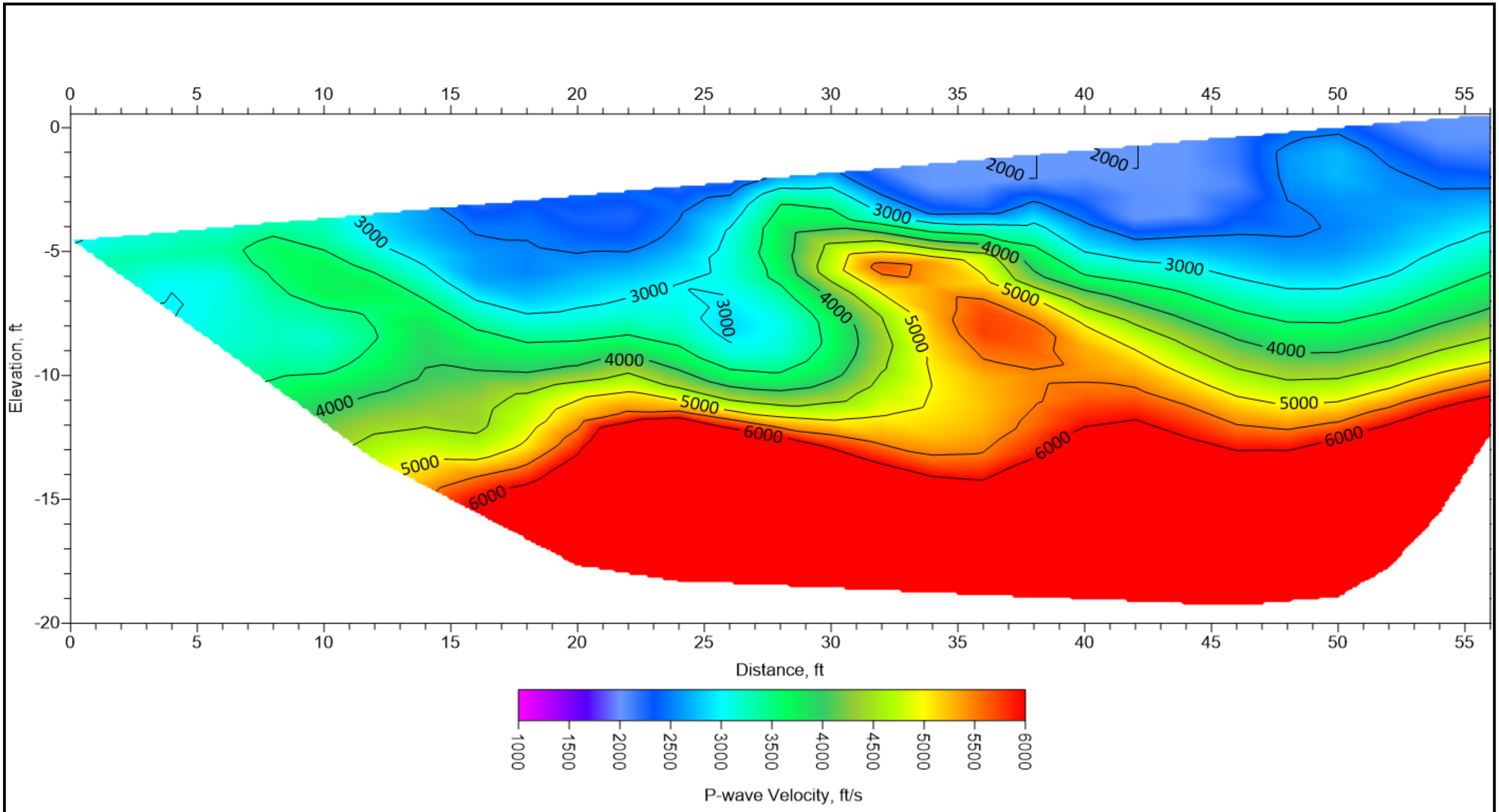
EXPLORATION MAP

NID - LAKE WILDWOOD BACKBONE

NEVADA COUNTY, CALIFORNIA

DRAWN BY:	JMC
CHECKED BY:	CRK
NV5 PROJECT:	5353.00
DATE:	SEPTEMBER 2019

FIGURE 2-7



N|V|5

R-1 STA 120+90

P-Wave Velocity Profile

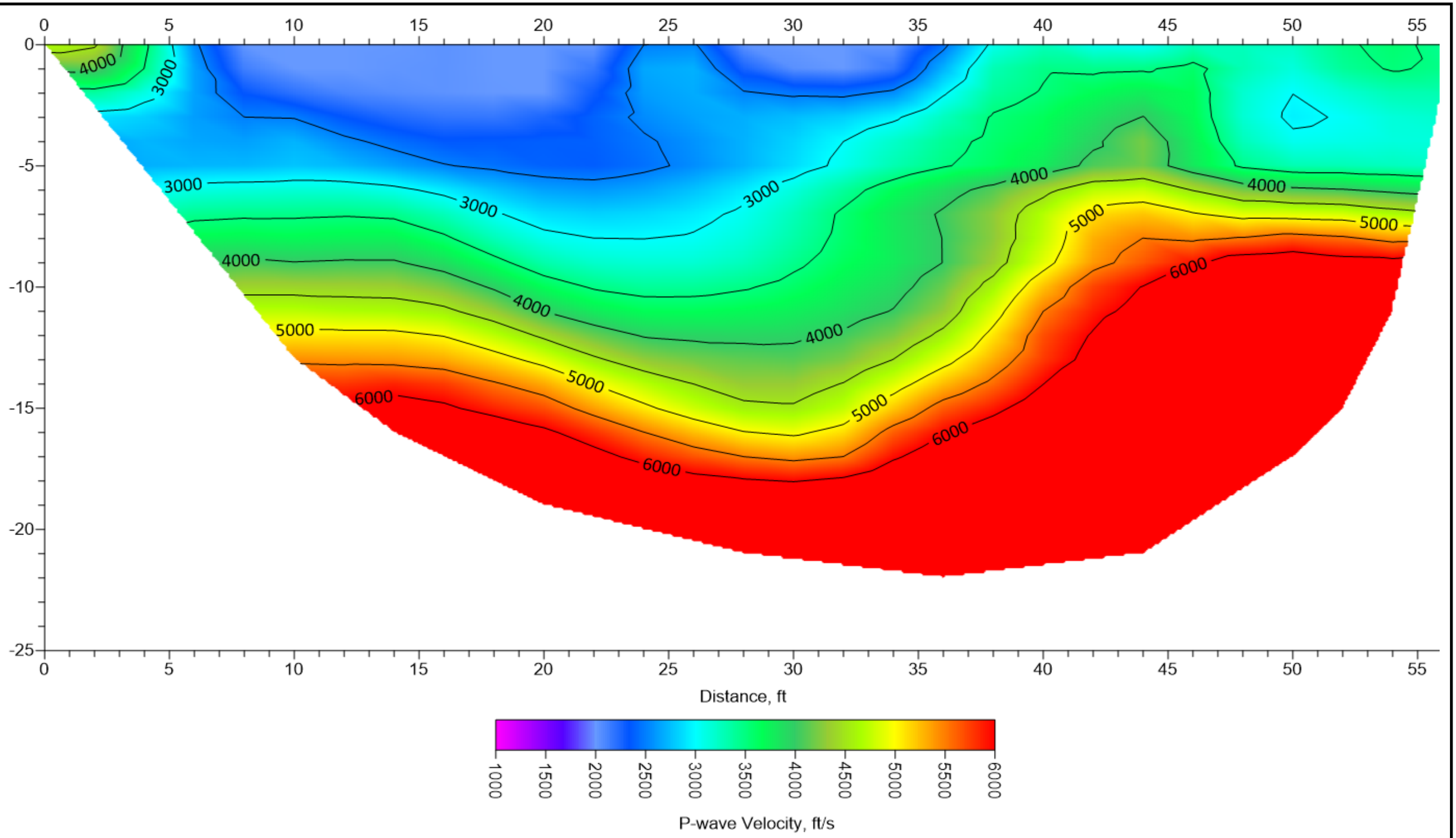
NID - Lake Wildwood Backbone

Nevade County, California

Project No. 5353.00

September 2019

Figure 3-1



N|V|5

R-3 STA 137+90

P-Wave Velocity Profile

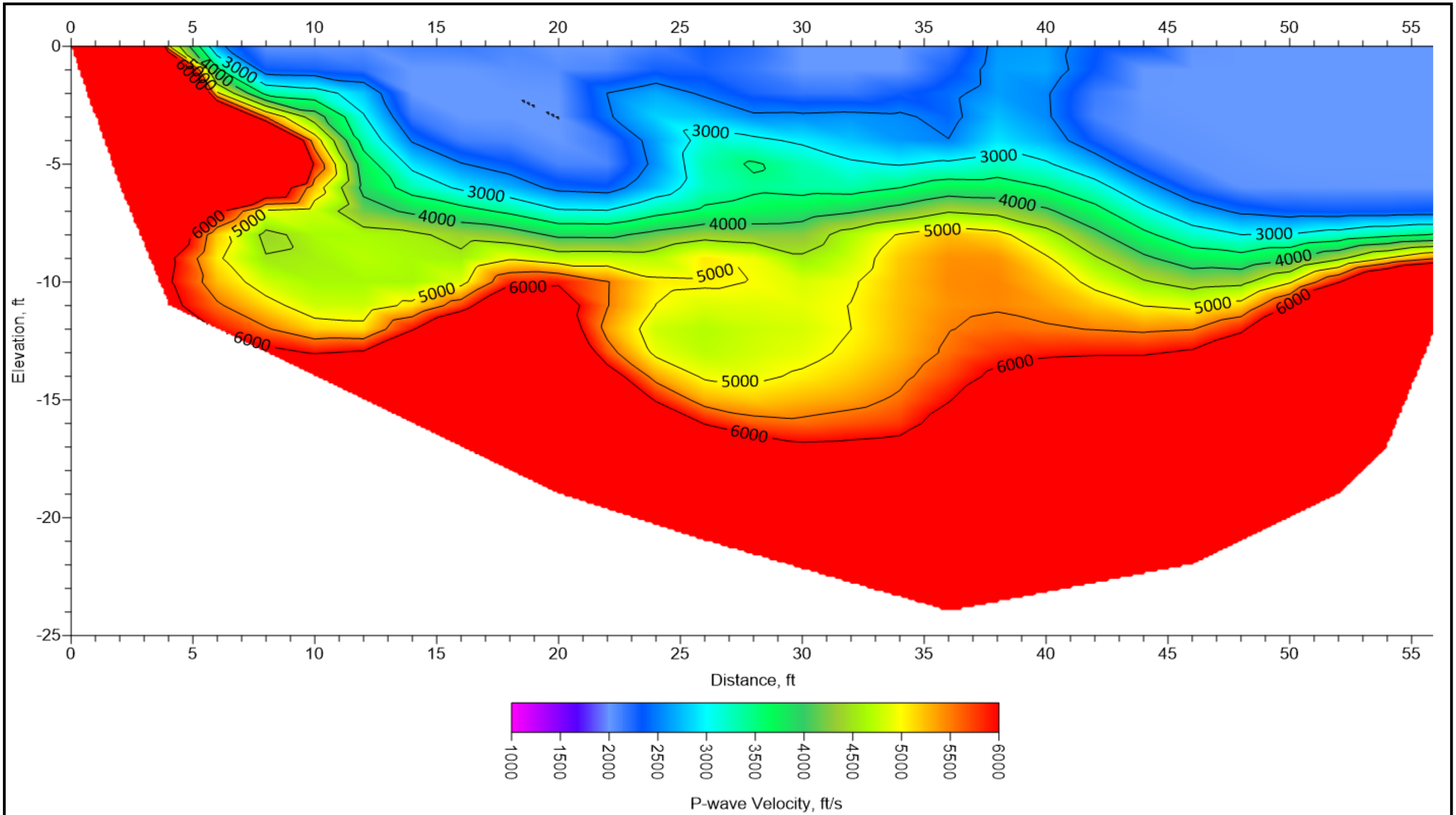
NID - Lake Wildwood Backbone

Nevade County, California

Project No. 5353.00

September 2019

Figure 3-2



N|V|5

R-4 STA 161+00

P-Wave Velocity Profile

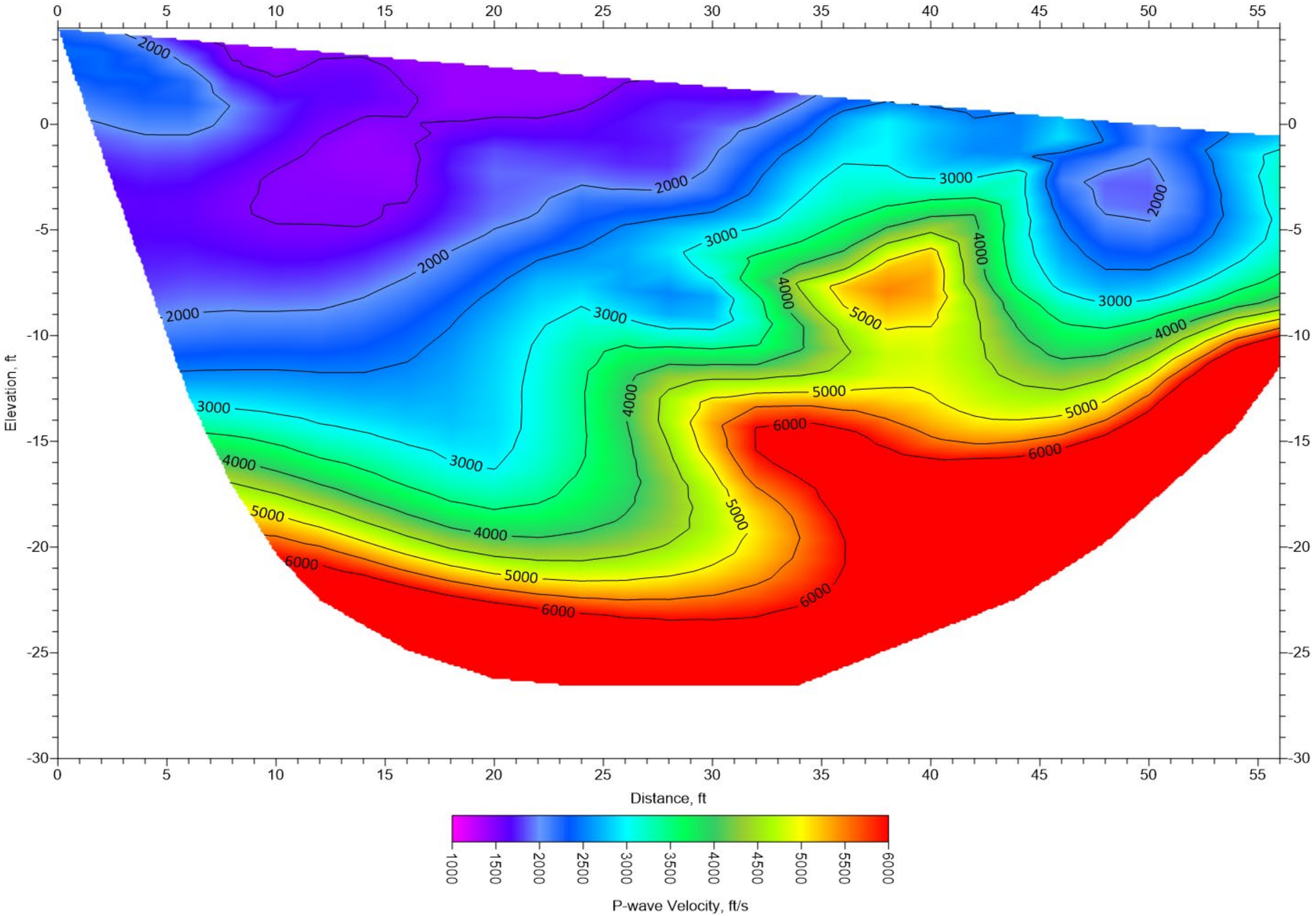
NID - Lake Wildwood Backbone

Nevade County, California

Project No. 5353.00

September 2019

Figure 3-3



R-5

P-Wave Velocity Profile

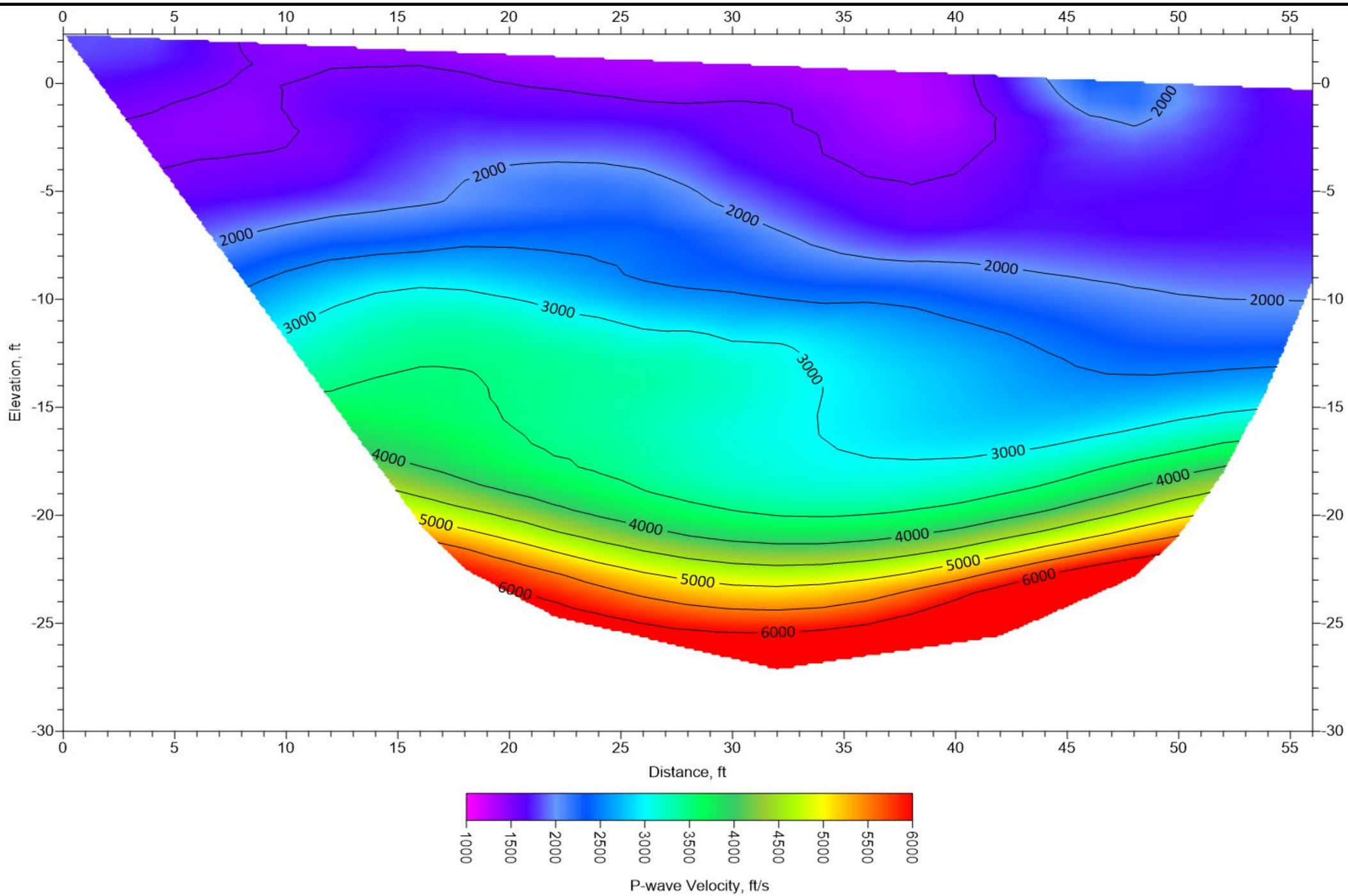
NID - Lake Wildwood Backbone

Nevade County, California

Project No. 5353.00

September 2019

Figure 3-4



N|V|5

R-6

P-Wave Velocity Profile

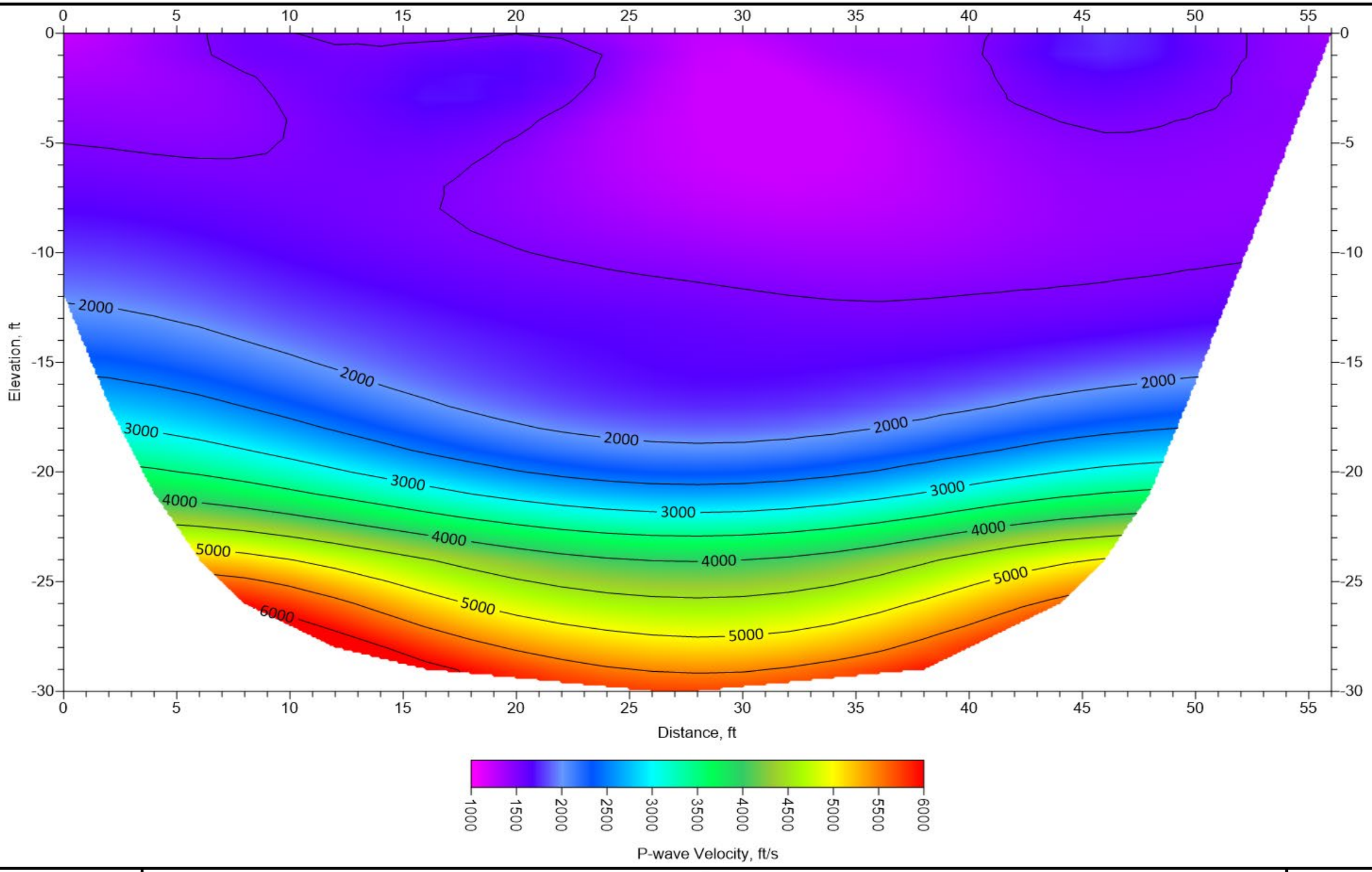
NID - Lake Wildwood Backbone

Nevade County, California

Project No. 5353.00

September 2019

Figure 3-5



N|V|5

R-7

P-Wave Velocity Profile

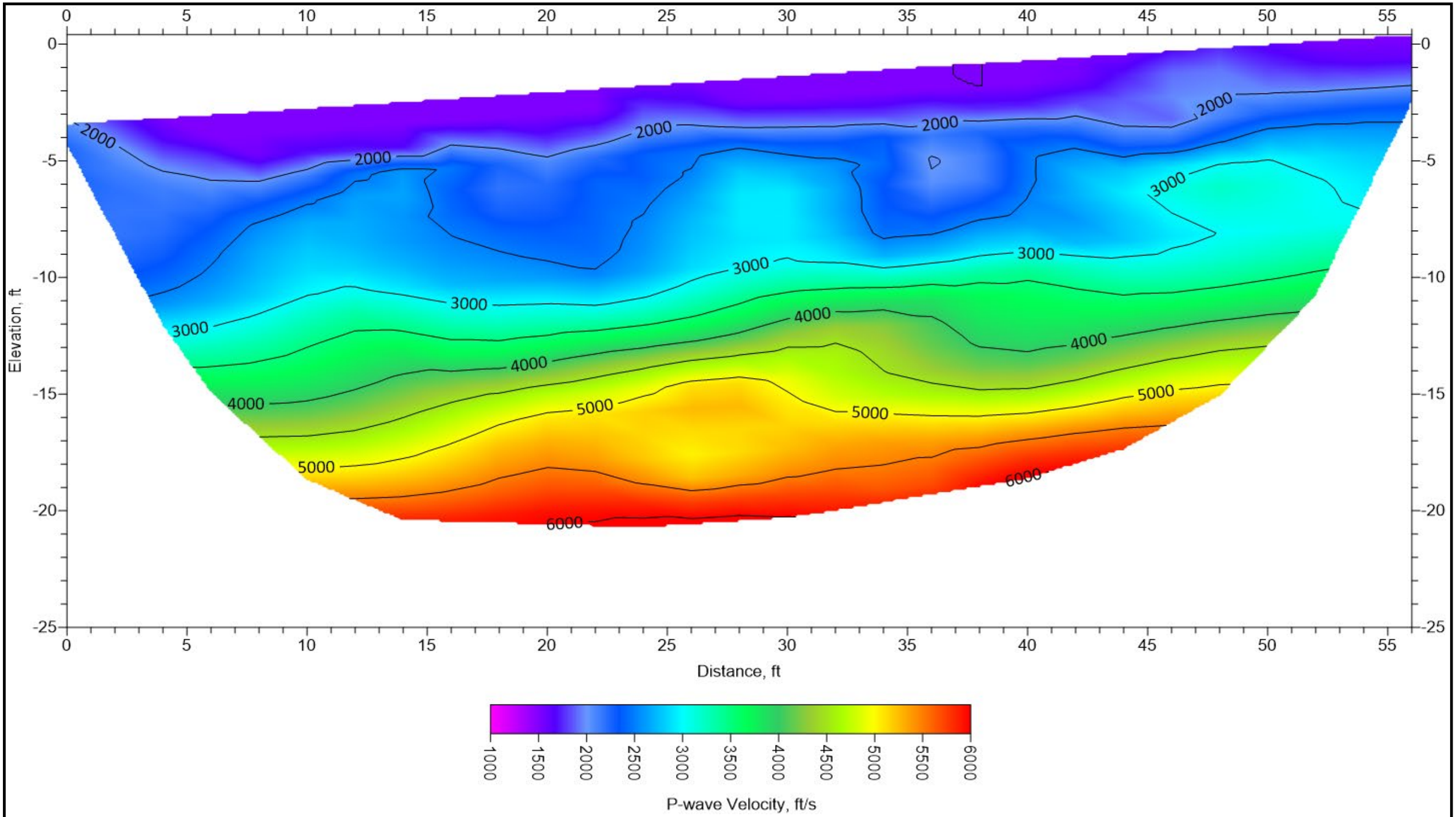
NID - Lake Wildwood Backbone

Nevade County, California

Project No. 5353.00

September 2019

Figure 3-6



N|V|5

R-8

P-Wave Velocity Profile

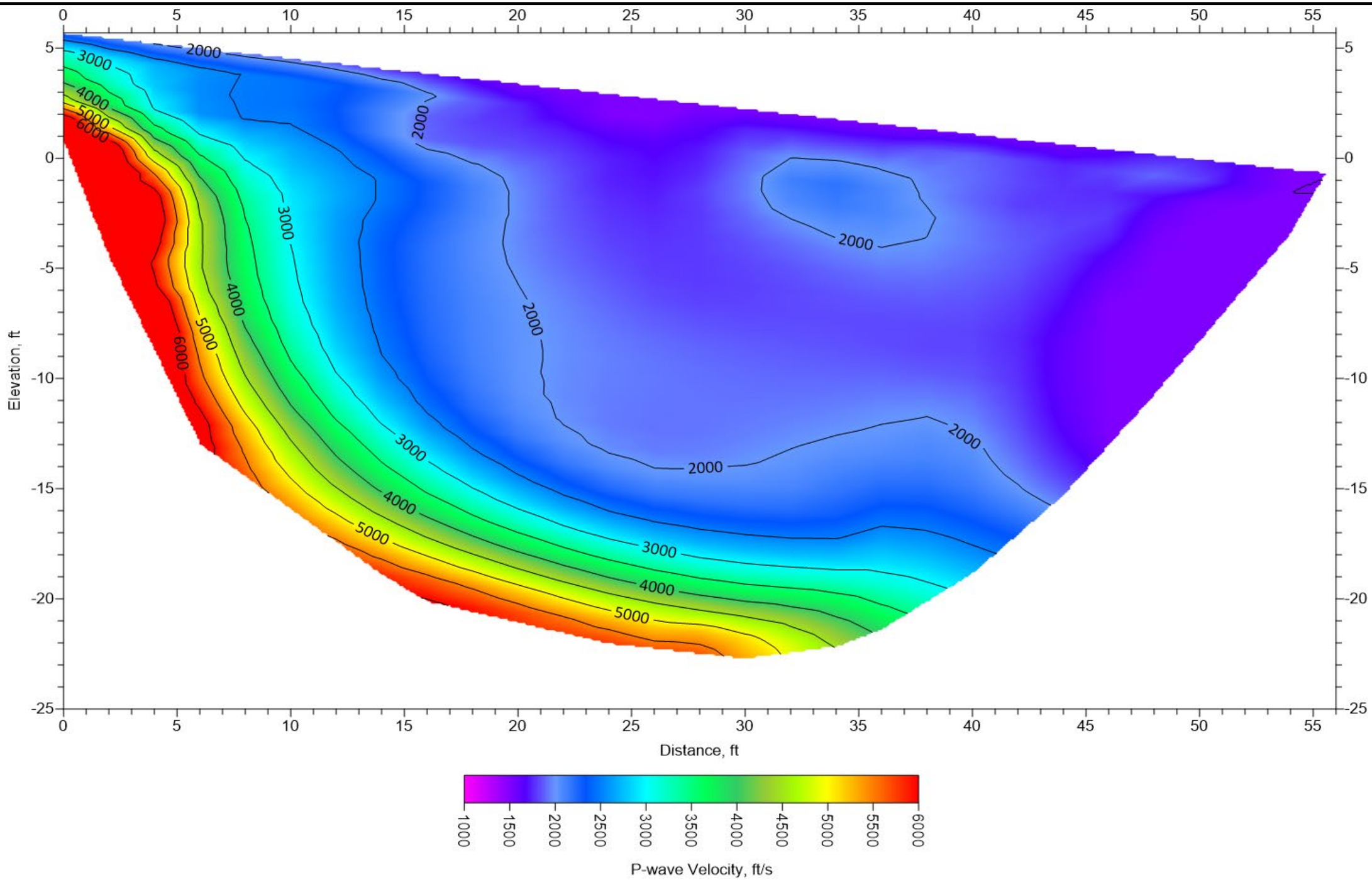
NID - Lake Wildwood Backbone

Nevade County, California

Project No. 5353.00

September 2019

Figure 3-7



N|V|5

R-9

P-Wave Velocity Profile

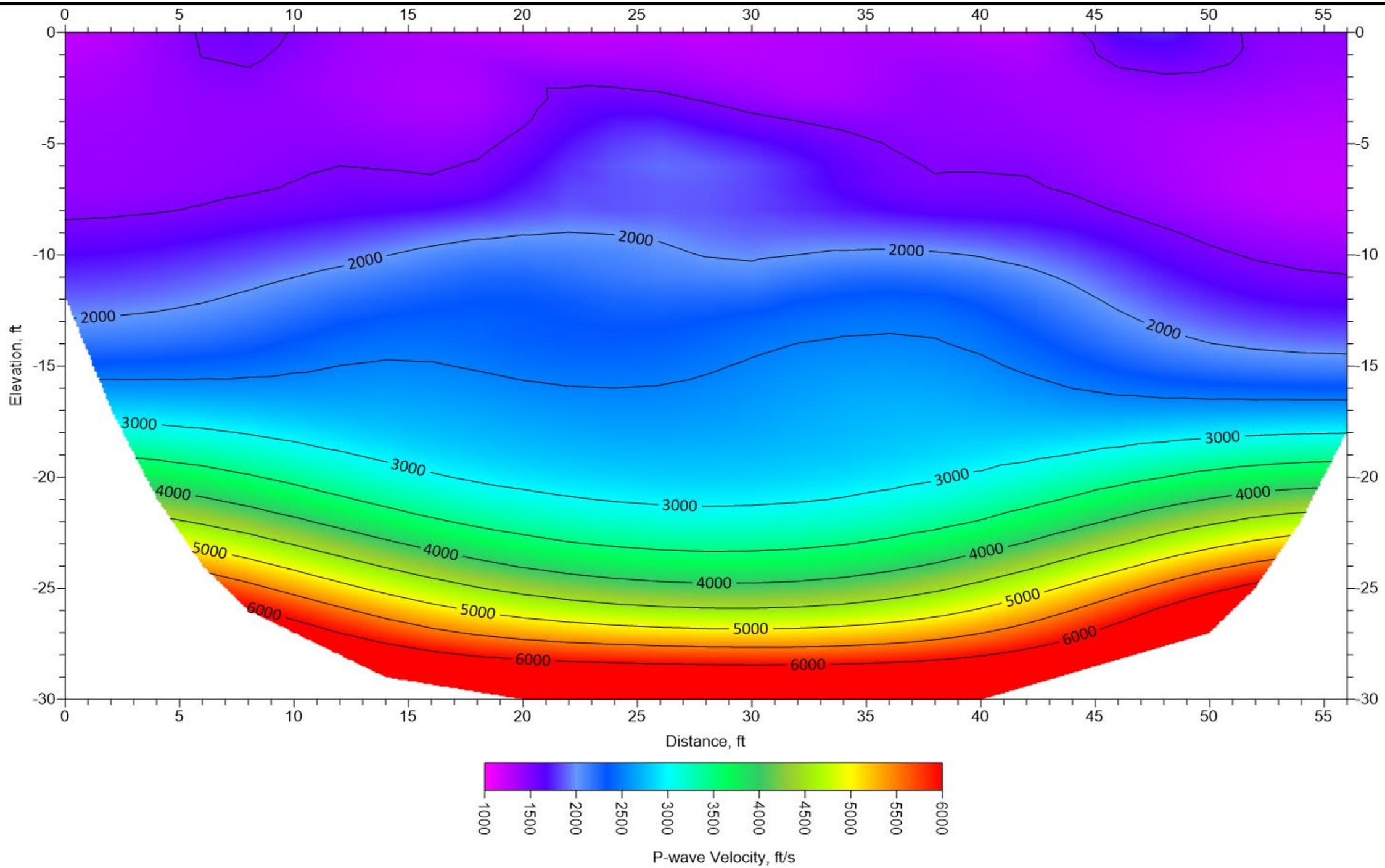
NID - Lake Wildwood Backbone

Nevada County, California

Project No. 5353.00

September 2019

Figure 3-8



N|V|5

R-10

P-Wave Velocity Profile

NID - Lake Wildwood Backbone

Nevade County, California

Project No. 5353.00

September 2019

Figure 3-9

APPENDIX A

Proposal

Proposal No. PN19076
May 24, 2018 (Revised June 5, 2019)

Nevada Irrigation District
1036 W Main St
Grass Valley, CA 95959

Attention: Tonia Herrera

Reference: **Lake Wildwood Backbone Extension Project**
Rough and Ready Road
Nevada County

Subject: **Proposal for Geotechnical Engineering Services**

Dear Ms. Herrera:

Holdrege & Kull, An NV5 Company (NV5) is providing this proposal to perform geotechnical engineering services for the Lake Wildwood Backbone Extension Project located in Nevada County, California. We understand that the proposed infrastructure improvement involves installing approximately 4.75 miles of new waterline and 5 pressure reducing valves (PRVs) along Rough and Ready Road, Empty Diggins Lane, and Bosa Drive. To prepare this proposal we spoke with you and reviewed a site map of the proposed waterline alignment prepared by Nevada Irrigation District (NID) dated February 6, 2019. Based on our understanding of the project, we propose to provide the following scope of services.

SCOPE OF SERVICES

As currently proposed, NV5 will perform a geotechnical investigation in general accordance with the 2016 California Building Code (CBC). The investigation will focus on the currently proposed improvement.

TASK 1 - PRELIMINARY ANALYSIS

Task 1.1 - Literature and Aerial Photograph Review

NV5 will perform a map and literature review of published documents pertinent to the project site, including geologic maps, soil surveys, and any relevant documents provided by NID.

Aerial photographs will provide a helpful resource in ascertaining the site geology and consistency of underlying rock along the alignment. Our experience has shown that vegetation in the foothills is often governed by the underlying geology. Typically, areas that are underlain by near-surface rock and poorly drained soils host broad leaf varieties (oak, manzanita, other chaparral vegetation). Conifers (pine, cedar and fir trees) are generally underlain by deep, well-drained soil.

Information from our literature and aerial photograph review will be used to focus our field investigation in critical areas uncovered during this initial phase of work.

Task 1.2 - Surface Reconnaissance

NV5 will perform a surface reconnaissance of the project site to identify surface conditions that may impact the proposed site development plans. In general, NV5's field geologist will observe and describe surface exposures of the following existing site conditions:

- Site and surrounding land uses
- Surface soil conditions
- Existing site improvements, including road surface, cut and fill slope geometries, and pertinent structures
- Site topography and drainage
- Slumps, landslides, hummocky topography, and wedge failures, if observed
- Suspect or identified relic mining features, if observed
- Vegetation
- Geologic units exposed at the surface

TASK 2 - GEOTECHNICAL INVESTIGATION

Task 2.1 - Subsurface Investigation

We will perform a subsurface investigation to assess soil and rock conditions underlying the project site (to the maximum depth excavated). We propose to excavate up to 25 exploratory trenches to a maximum depth of 6 feet utilizing a track mounted excavator or backhoe.

Twenty seismic refraction lines will be performed within existing roadways along the proposed alignment. The estimated depth of recorded velocities would be 10 to 15 feet. Locations of trenches and seismic lines will be presented on AutoCAD drawings. GPS coordinates will be plotted on maps from Google Earth and drawings provided by NID.

A field engineer/geologist from our firm will collect relatively undisturbed and bulk soil samples from each exploratory site. Relatively undisturbed soil samples will be collected from the exploratory trenches with a 2.0-inch diameter barrel sampler equipped with brass liner tubes. The soil samples will be labeled, sealed, and transported to our laboratory where selected samples will be tested to determine their engineering material properties. If groundwater is encountered, the depth to groundwater below the existing ground surface will be measured. Bulk soil samples will be collected for their corrosion potential and grain size.

Prior to our subsurface investigation, we will obtain underground service alert (USA) clearance for portions of the site that we plan to investigate. USA coverage may not include all existing utilities. If requested, we can revise the proposal to retain a private utility locating service to supplement the USA clearance to reduce the risk of damage to underground utilities. NV5 will not be responsible for damage to subsurface utilities that were not marked or were improperly marked prior to our investigation.

Task 2.2 - Traffic Control

NV5 will provide traffic control during trenching operations, pursuant to Caltrans *Temporary Traffic Control for Lane Closure on a Two-Lane Road Using Flaggers*.

Task 2.3 - Laboratory Testing

NV5 will perform laboratory tests on selected soil samples to determine their engineering material properties. The majority of the tests will be performed at our in-house soil laboratory. The following laboratory tests will be performed using ASTM International (ASTM) and Caltrans methods as guidelines.

- D1140, Sieve Analysis with 200 Wash (grain size analysis)
- D2216, Moisture Content
- D2487, Unified Soil Classification System
- D2488, Soil Description Visual Manual Method
- D2937, Density
- D4318, Atterberg Plasticity Indices (if necessary)
- D4829, Expansion Index (if necessary)
- Caltrans Method 417 and 422, Sulfate and Chloride
- Caltrans Method 643, Resistivity

TASK 3 - GEOTECHNICAL DESIGN

We will use geotechnical engineering methods to evaluate the on-site soil/rock properties along the waterline alignment. Using field and laboratory data, NV5 will develop geotechnical engineering recommendations for the proposed earthwork. The geotechnical engineering analyses will address the following:

- Soil and rock stratigraphy
- Cut and fill slope stability analyses
- Soil plasticity indices (if necessary)
- Soil expansion and swell potential (if necessary)
- Groundwater seepage and drainage controls
- Potential presence of chemically active or corrosive materials

TASK 4 - GEOTECHNICAL BASELINE REPORT

We will prepare a geotechnical baseline report that will present our findings and conclusions for design and construction of the waterline alignment. The report will include a summary of the site and subsurface conditions encountered during field investigation and our laboratory test results. It will also provide general geotechnical engineering recommendations for the earthwork, including:

- Site clearing and soil subgrade preparation
- Cut slope and fill slope geometries

- Soil/Rock rippability for conventional grading equipment and/or blasting potential based on the geophysical survey and exploratory trenches
- Temporary cut slope recommendations
- Exclusion of oversized fill soil materials
- Fill moisture conditioning and compaction requirements including weather-related grading
- Fill soil loose lift (layer) thickness requirements
- Utility trench backfill material processing, placement and compaction requirements
- Soil/steel and concrete corrosion potential
- Surface water and subsurface water control and drainage
- Expansive soil mitigation (if present)
- Temporary construction dewatering methods (if required)
- Subdrain systems (if necessary)

The report will also include a site plan showing the approximate locations of the exploratory trenches and seismic refraction, and a map depicting locations of possible difficult trenching. Report appendices will present the exploratory trench logs and laboratory test data.

ASSUMPTIONS AND CLIENT RESPONSIBILITIES

This proposal is based on the following assumptions:

- The client will provide NV5 with authorization to access the site. We understand that the client will contact property owners for access in privately owned sections of the site.
- The client will provide information regarding the location of existing onsite utilities. Although reasonable care will be used during our investigation, the client understands that unmarked underground utilities may be damaged. NV5 will not be responsible for repair of utilities that were not marked or were improperly marked prior to the investigation.
- Upon completion, a PDF digital copy of the report will be provided to the client and/or the client's engineers and architects.
- Client meetings, report revisions and consultation services following report submittal are not included in the fee estimate but can be provided on a time and materials basis at the client's request.
- This proposal and our associated fee are based on the use of the attached terms and conditions.

FEES

Our fee to perform the geotechnical engineering investigation will be $35,000, including the cost to provide an excavator and operator for the subsurface investigation. Our fee includes 4 days of field work (2 days for trenching and 2 days for seismic surveys). Traffic control would be $1,900/day, totaling $7,600 for 4 days. Progress billing will be monthly on a percent complete basis.

If this proposal is acceptable, please contact our office to provide authorization to proceed. We understand that our services would be completed under NID's professional services agreement.

SCHEDULE

We can schedule our subsurface investigation within three weeks of receiving authorization to proceed. Inclement weather, saturated site conditions, or contractor scheduling could delay the investigation. We can typically provide verbal preliminary conclusions on trench excavation within two weeks of our field investigation. We anticipate the geotechnical report would be issued within six weeks of the field investigation.

If we encounter field conditions that may require additional investigation or otherwise impact our proposed schedule, we will contact you promptly to discuss.

Thank you for the opportunity to provide this proposal. If you have any questions, please contact our office.

Sincerely,

NV5

Chuck Kull G.E. 2359
Principal Engineer

F:\2 Proposals\PN19076 Lake Wildwood Backbone Extension\Proposal\PN19076 Lake Wildwood Backbone Extension_NV5 Proposal (revised).docx

APPENDIX B

Important information about your Geotechnical engineering report

(Included with Permission of GBA, copyright 2016)

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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e-mail: info@geoprofessional.org www.geoprofessional.org

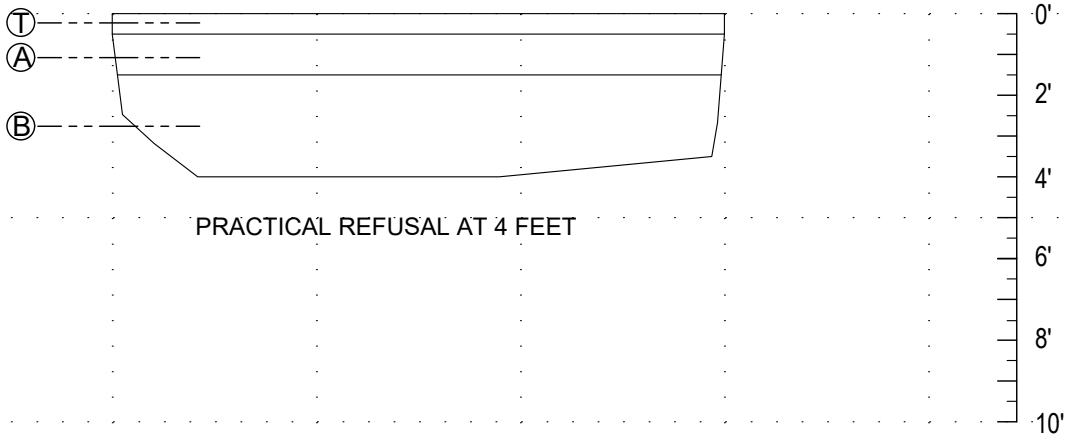
APPENDIX C

Exploratory Trench Logs

Exploratory Trench Log

Trench No. T-1

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	05+77
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



LEGEND: ☒ BULK BAG SAMPLE
NFWE: NO FREE WATER ENCOUNTERED

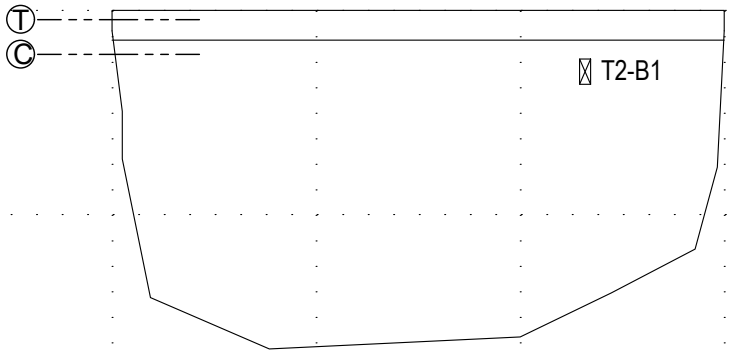
NOTE: 1 MINUTE OF SCRAPING FOR 3 INCHES OF PROGRESSION

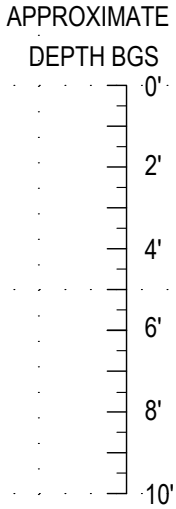
Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 3"		TOPSOIL
A	3" - 3'		(SM) SILTY SAND WITH SOME CLAY; FIELD EST: 60% SAND, 40% FINES; DARK REDDISH BROWN (2.5YR 3/4); MEDIUM DENSE TO DENSE; DAMP.
B	3' - 4'		(SM) SILTY SAND WITH BOULDERS TO 18 INCHES; FIELD EST: 50% SAND, 30% BOULDERS, 20% FINES; REDDISH GRAY(2.5YR 6/1); DENSE TO VERY DENSE; DAMP.

Exploratory Trench Log

Trench No. T-2

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	19+00
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET





LEGEND: ☒ BULK BAG SAMPLE

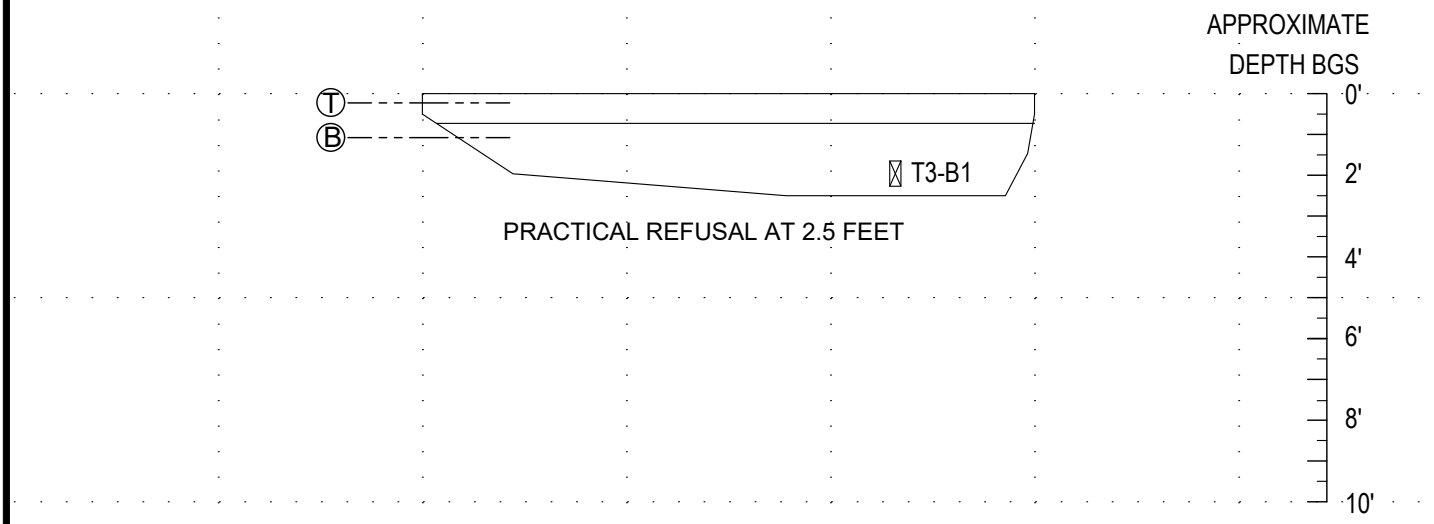
NFWE: NO FREE WATER ENCOUNTERED

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 8"		TOPSOIL
C	8" - 6'	T2-B1 AT 1'	(SM) SILTY SAND; FIELD EST: 60% SAND, 40% FINES; REDDISH BROWN (2.5YR 3/4); MEDIUM DENSE; DAMP.

Exploratory Trench Log

Trench No. T-3

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	29+90
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



LEGEND: ☒ BULK BAG SAMPLE
NFWE: NO FREE WATER ENCOUNTERED

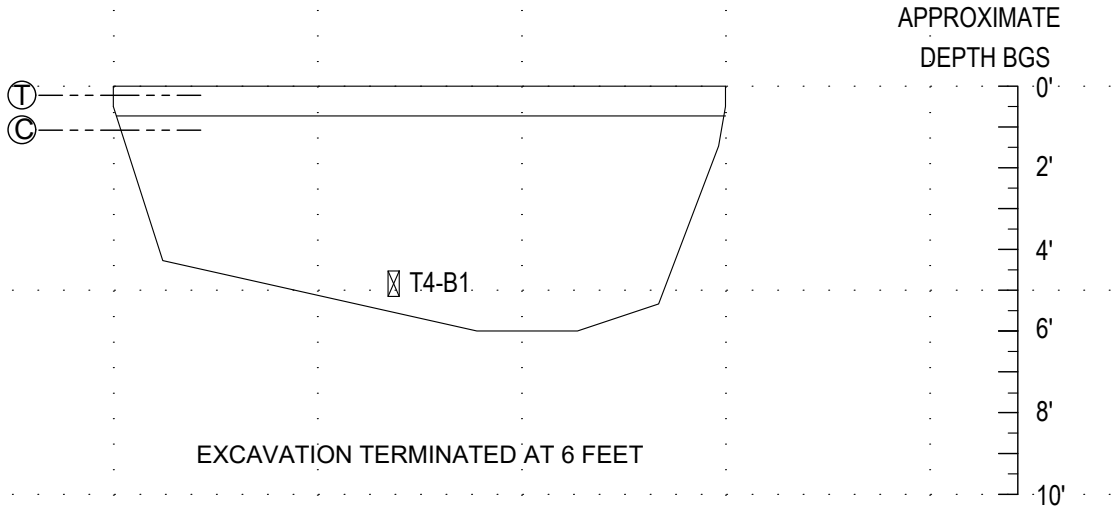
NOTE: 1 MINUTE OF SCRAPING FOR 6 INCHES OF PROGRESSION AT 2 FEET

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 2"		TOPSOIL
B	8" - 2 1/2'	T3-B1 AT 2'	(SM) SILTY SAND WITH BOULDERS TO 18 INCHES; FIELD EST: 50% SAND, 30% BOULDERS, 20% FINES; REDDISH GRAY(2.5YR 6/1); DENSE TO VERY DENSE; DAMP.

Exploratory Trench Log

Trench No. T-4

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Trench Bearing:	38+00
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



EXCAVATION TERMINATED AT 6 FEET

LEGEND: ☒ BULK BAG SAMPLE
NFWE: NO FREE WATER ENCOUNTERED

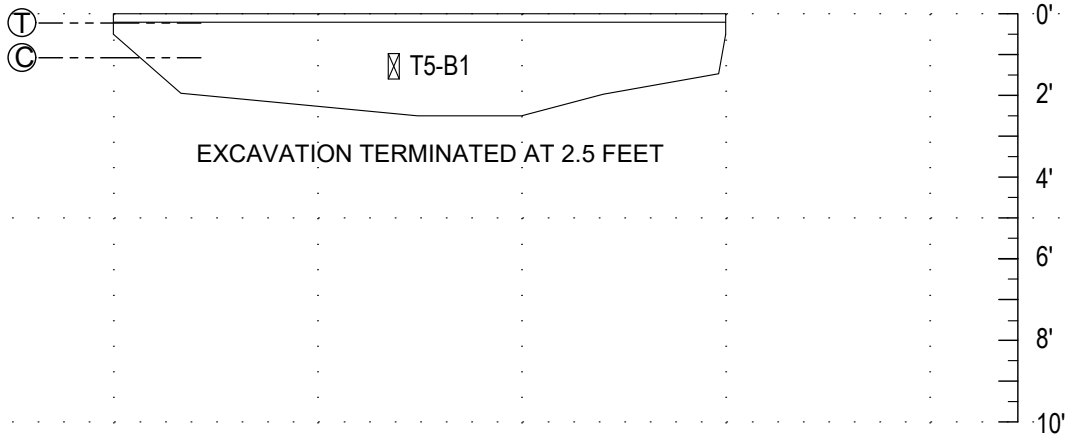
NOTE: BOULDERS TO 18 INCHES AT 5 FEET

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 5"		TOPSOIL
C	5" - 6'	T4-B1 AT 5.5'	(ML) SANDY SILT; FIELD EST: 70% FINES, 30% FINES; DARK REDDISH BROWN (2.5YR 3/4); MEDIUM DENSE TO DENSE; DAMP.

Exploratory Trench Log

Trench No. T-5

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	51+50
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



LEGEND: ☒ BULK BAG SAMPLE
NFWE: NO FREE WATER ENCOUNTERED

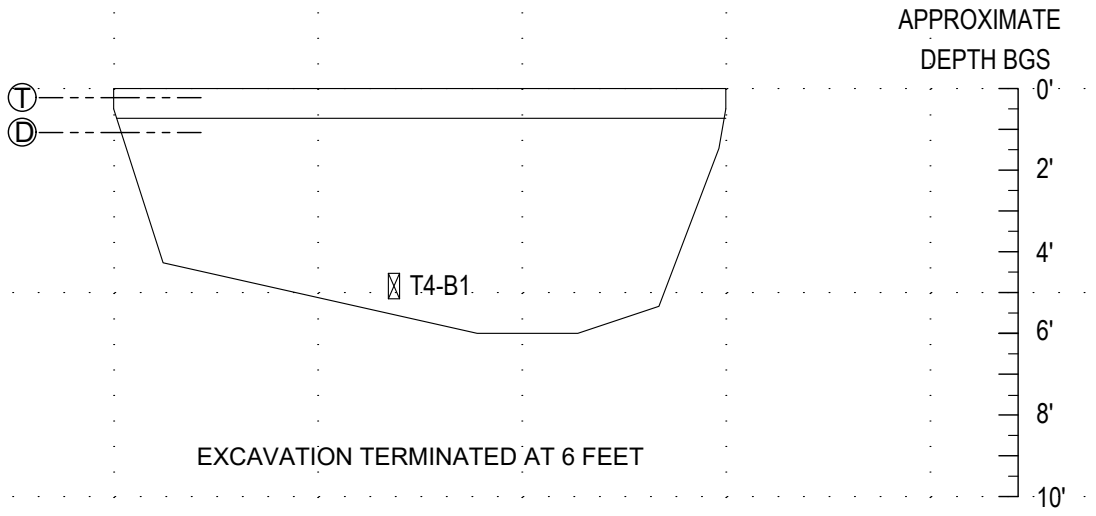
NOTE: ENCOUNTERED UNMARKED PIPE AT 2.5 FEET

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 3"		TOPSOIL
C	3" - 2.5'	T5-B1 AT 1'	(SM) SILTY SAND; FIELD EST: 60% SAND, 40% FINES; DARK REDDISH BROWN (2.5YR 3/4); MEDIUM DENSE TO DENSE; DAMP.

Exploratory Trench Log

Trench No. T-6

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	60+47
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



EXCAVATION TERMINATED AT 6 FEET

LEGEND: ☒ BULK BAG SAMPLE
NFWE: NO FREE WATER ENCOUNTERED

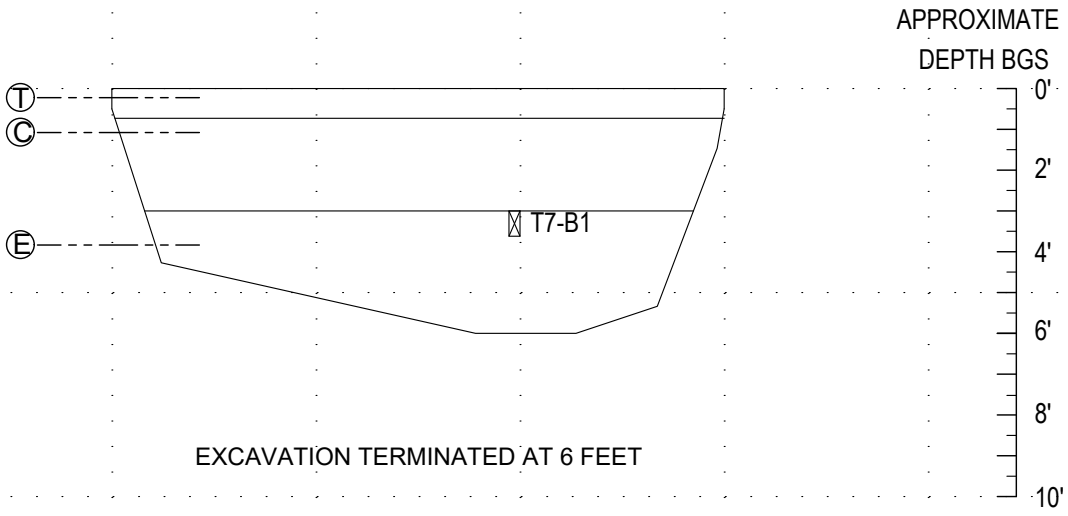
NOTE: BOULDERS TO 18 INCHES AT 5 FEET

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 6"		GRAVEL
D	6" - 6'	T6-B1 AT 5'	(CH) CLAY; FIELD EST: 80% FINES, 20% SAND; DARK REDDISH BROWN (2.5YR 3/4); FIRM; DAMP.

Exploratory Trench Log

Trench No. T-7

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	74+00
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



EXCAVATION TERMINATED AT 6 FEET

LEGEND: ☒ BULK BAG SAMPLE

NFWE: NO FREE WATER ENCOUNTERED

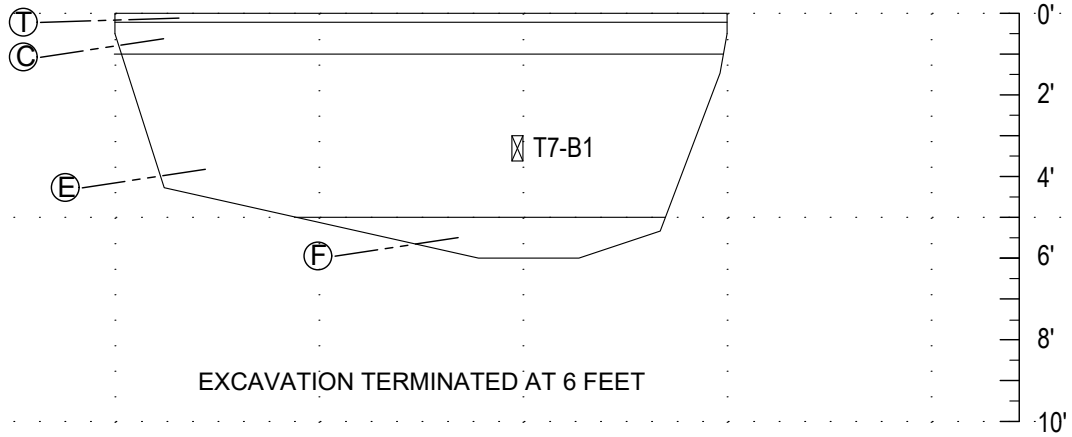
Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 4"		GRAVEL AND TOPSOIL
C	4" - 3'		(SM) SILTY SAND; FIELD EST: 60% SAND, 40% FINES; DARK REDDISH BROWN (2.5YR 3/4); MEDIUM DENSE TO DENSE; DAMP. [FILL]
E	3' - 6'	T7-B1 AT 3'	(CL) SANDY CLAY; FIELD EST: 80% FINES, 20% SAND; LIGHT OLIVE BROWN (2.5Y 5/4); FIRM; WET.

Exploratory Trench Log

Trench No. T-8

Project Name:	NID - LAKE WILDWOOD BACKBONE
Project No.:	5353.00
Task No.:	
Location:	ROUGH AND READY HIGHWAY
Logged By:	JMC
Date Logged:	9/24/19
Excavator Company:	CME
Excavator Type:	CASE 580 WITH 24 INCH BUCKET
Backfill Description:	BUCKET COMPACTED

Ground Water Information		
Date:	NFWE	
Time:	-	
Depth bgs (ft):	-	
Trench Elev.:	-	Ft. AMSL
Approx. Station:	89+56	
Scale:	1 In. = 5	FEET



EXCAVATION TERMINATED AT 6 FEET

LEGEND: ⊠ BULK BAG SAMPLE

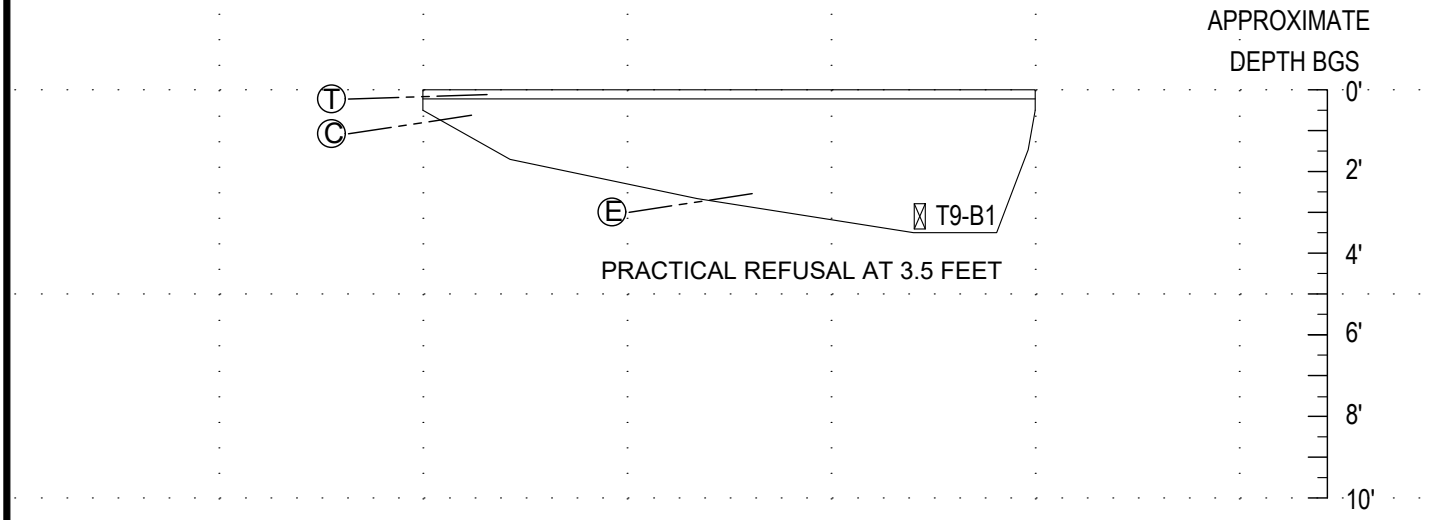
NFWE: NO FREE WATER ENCOUNTERED

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 4"		GRAVEL
C	4' - 1'		(SM) SILTY SAND; FIELD EST: 60% SAND, 40% FINES; DARK REDDISH BROWN (2.5YR 3/4); MEDIUM DENSE TO DENSE; DAMP.
E	1' - 5'	T8-B1 AT 2.5'	(CH) SANDY CLAY; FIELD EST: 80% FINES, 20% SAND; LIGHT OLIVE BROWN (2.5Y 5/4); FIRM; WET.
F	5' - 6'		(SC) CLAYEY SAND; FIELD EST: 70% SAND, 30% FINES; LIGHT YELLOWISH BROWN AND GRAY(2.5Y 6/4 & 2.5Y6/1); MEDIUM DENSE; WET.

Exploratory Trench Log

Trench No. T-9

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	94+08
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



LEGEND: ☒ BULK BAG SAMPLE
NFWE: NO FREE WATER ENCOUNTERED

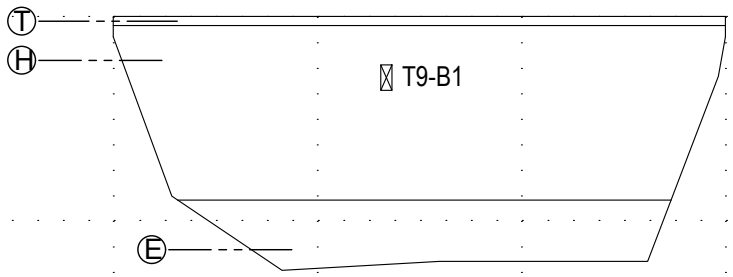
NOTE: 2 MINUTE OF SCRAPING FOR 5 INCHES OF PROGRESSION AT 2.5 FEET

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 8"		GRAVEL
G	8" - 1.5'		(GW) SANDY GRAVEL; FIELD EST: 90% GRAVEL, 10% SAND; REDDISH BROWN (2.5YR 4/4); MEDIUM DENSE TO DENSE; DRY.
I	1.5' - 3.5'	T8-B1 AT 2.5'	(Rx) ROCK; REDDISH BROWN AND GRAY (2.5YR 4/4 & 2.5Y 6/1); SLIGHTLY WEATHERED; VERY ANGULAR; DRY. EXCAVATED AS PIECES UP TO 20"

Exploratory Trench Log

Trench No. T-10

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	103+68
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



APPROXIMATE DEPTH BGS

0'
2'
4'
6'
8'
10'

EXCAVATION TERMINATED AT 6 FEET

LEGEND: ⊠ BULK BAG SAMPLE

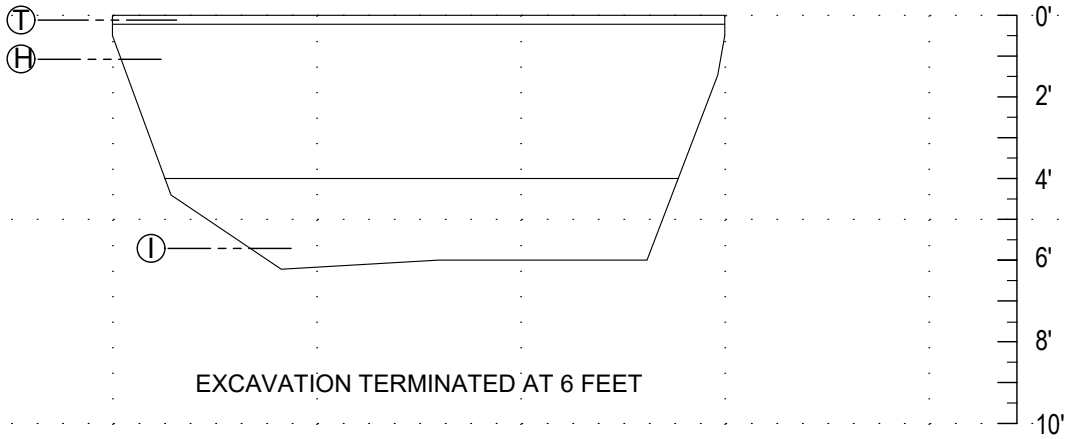
NFWE: NO FREE WATER ENCOUNTERED

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 6"		GRAVEL
H	6" - 4.5'	T10-B1 AT 1.5'	(SM) SILTY SAND WITH GRAVEL; FIELD EST: 60% SAND, 20% GRAVEL, 20% FINES; LIGHT REDDISH BROWN (5Y 6/4); MEDIUM DENSE; DAMP.
E	4.5' - 6'		(CL) SANDY CLAY; FIELD EST: 80% FINES, 20% SAND; LIGHT OLIVE BROWN (2.5Y 5/4); FIRM; WET.

Exploratory Trench Log

Trench No. T-11

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	109+17
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



EXCAVATION TERMINATED AT 6 FEET

LEGEND: ☒ BULK BAG SAMPLE
NFWE: NO FREE WATER ENCOUNTERED

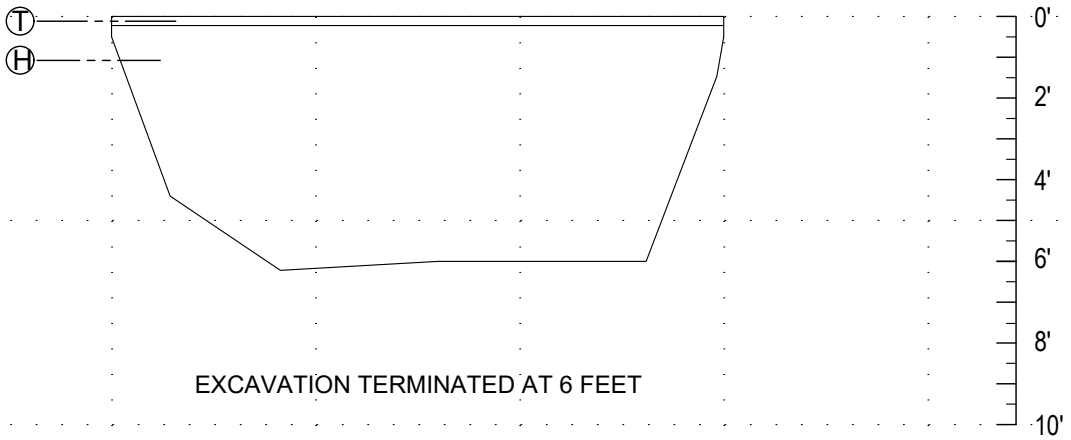
NOTE: DIFFICULT DIGGING AND BOULDERS TO 18 INCHES STARTING AT 4 FEET

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 3"		GRAVEL
H	3" - 4'		(SM) SILTY SAND WITH GRAVEL; FIELD EST: 60% SAND, 20% GRAVEL, 20% FINES; LIGHT REDDISH BROWN (5Y 6/4); MEDIUM DENSE; DAMP.
I	4' - 6'		(Rx) ROCK; REDDISH BROWN AND GRAY (2.5YR 4/4 & 2.5Y 6/1); SLIGHTLY WEATHERED; VERY ANGULAR; DRY. EXCAVATED AS PIECES UP TO 20"

Exploratory Trench Log

Trench No. T-12

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	126+90
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



LEGEND: ☒ BULK BAG SAMPLE
NFWE: NO FREE WATER ENCOUNTERED

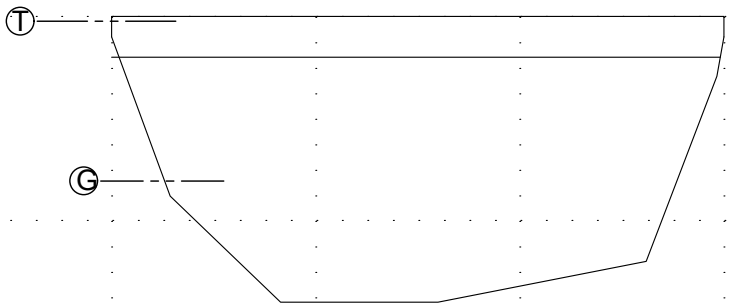
NOTE: GRAVEL UP TO 12 INCHES

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 1'		GRAVEL
J	1' - 6'	T12-B1 AT 4'	(SM) SANDY SILT WITH SOME GRAVEL; FIELD EST: 60% FINE, 40% SAND; LIGHT OLIVE BROWN AND GRAY (2.5Y 5/4 & 2.5Y 5/1); STIFF TO HARD; DAMP.

Exploratory Trench Log

Trench No. T-13

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	138+00
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



APPROXIMATE DEPTH BGS

0'
2'
4'
6'
8'
10'

EXCAVATION TERMINATED AT 7 FEET

LEGEND: ☒ BULK BAG SAMPLE
NFWE: NO FREE WATER ENCOUNTERED

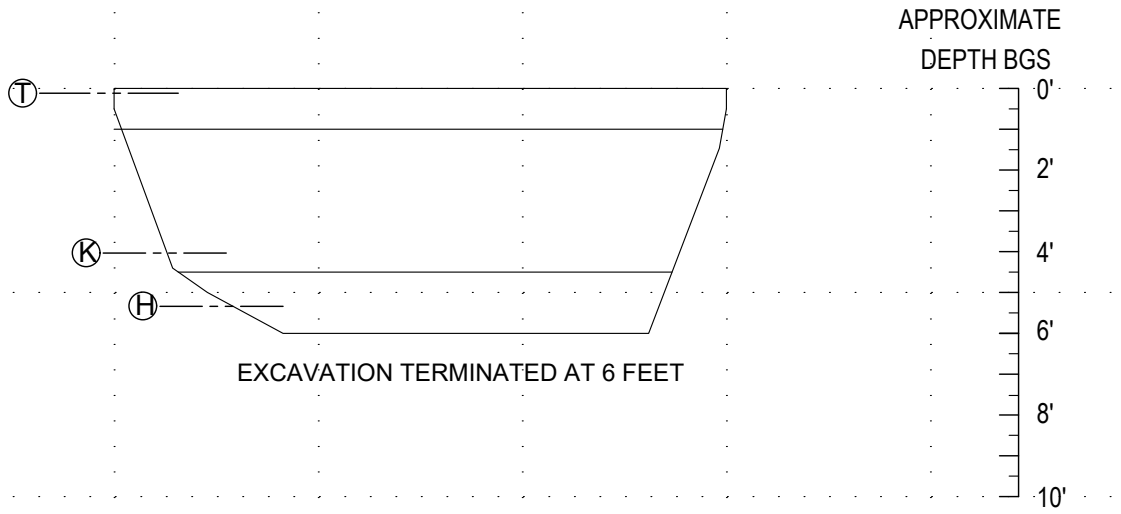
NOTE: NORTH SIDEWALL OF EXCAVATION APPEARED TO BE MASSIVE ROCK ALONG WITH NEARBY CUT SLOPES

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 1'		TOPSOIL AND GRAVEL
G	1' - 6'		(GP) SANDY GRAVEL; FIELD EST: 80% GRAVEL, 20% SAND; REDDISH BROWN (2.5YR 4/4); MEDIUM DENSE TO DENSE; DRY; [FILL].

Exploratory Trench Log

Trench No. T-14

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	150+05
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



LEGEND: ☒ BULK BAG SAMPLE

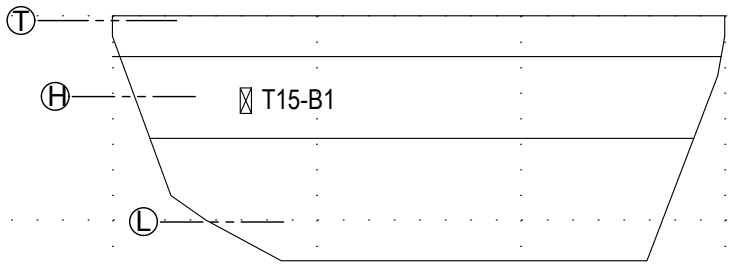
NFWE: NO FREE WATER ENCOUNTERED

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 8"		TOPSOIL
K	8" - 4.5'		(SC) CLAYEY SAND; FIELD EST: 70% SAND, 30% FINES; REDDISH BROWN (2.5YR 4/4); MEDIUM DENSE TO DENSE; DRY; [FILL].
H	4.5' - 6'		(SM) SILTY SAND WITH GRAVEL; FIELD EST: 60% SAND, 20% GRAVEL, 20% FINES; LIGHT REDDISH BROWN (5Y 6/4); MEDIUM DENSE; DAMP.

Exploratory Trench Log

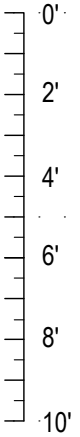
Trench No. T-15

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	160+90
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



EXCAVATION TERMINATED AT 6 FEET

APPROXIMATE DEPTH BGS



LEGEND: ☒ BULK BAG SAMPLE

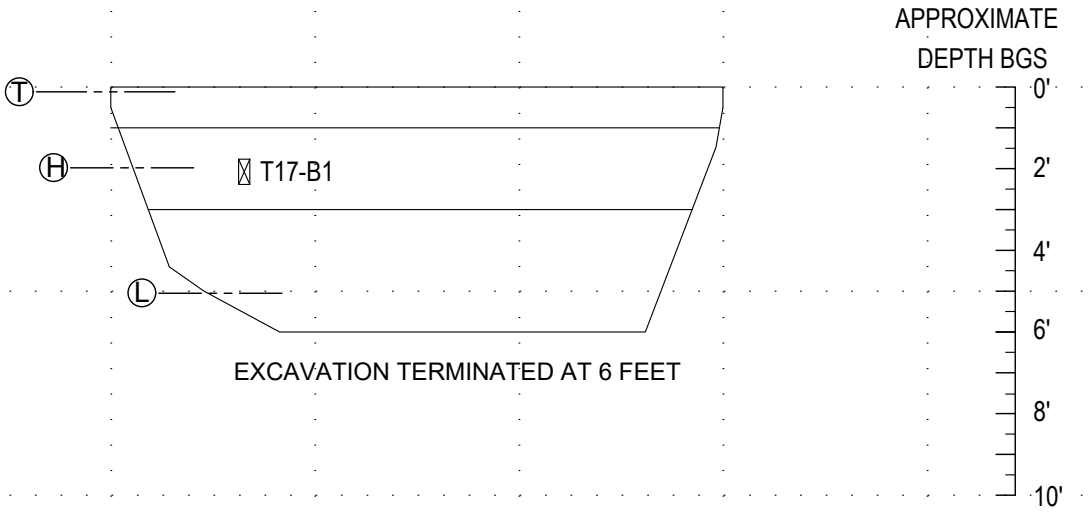
NFWE: NO FREE WATER ENCOUNTERED

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 1'		TOPSOIL AND GRAVEL
H	1' - 3'	T15-B1 AT 1.5'	(SM) SILTY SAND WITH GRAVEL; FIELD EST: 60% SAND, 20% GRAVEL, 20% FINES; LIGHT REDDISH BROWN (5Y 6/4); MEDIUM DENSE; DAMP.
L	3' - 6'		(SC) CLAYEY SAND; FIELD EST: 60% SAND, 20% GRAVEL, 20% FINES; LIGHT OLIVE BROWN (2.5Y 5/4); MEDIUM DENSE; DAMP.

Exploratory Trench Log

Trench No. T-17

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	--
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



LEGEND: ☒ BULK BAG SAMPLE

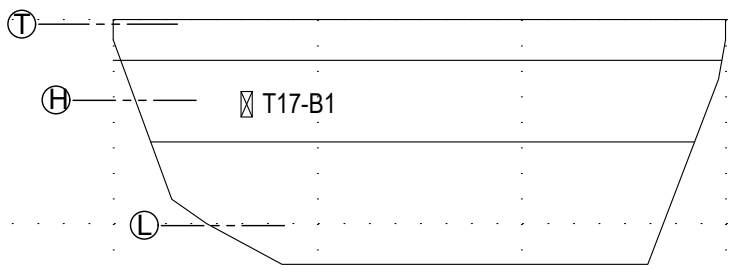
NFWE: NO FREE WATER ENCOUNTERED

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 6"		TOPSOIL
D	6" - 2.5'		(CL) SANDY CLAY; FIELD EST: 80% FINES, 20% SAND; DARK REDDISH BROWN (2.5YR 3/4); FIRM; DAMP. [FILL]
L	2.5' - 6'	T17-B1 AT 4.5'	(SC) CLAYEY SAND; FIELD EST: 60% SAND, 20% GRAVEL, 20% FINES; LIGHT OLIVE BROWN (2.5Y 5/4); MEDIUM DENSE; DAMP.

Exploratory Trench Log

Trench No. T-18

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	--
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



APPROXIMATE DEPTH BGS

0'
2'
4'
6'
8'
10'

EXCAVATION TERMINATED AT 6 FEET

LEGEND: ☒ BULK BAG SAMPLE
NFWE: NO FREE WATER ENCOUNTERED

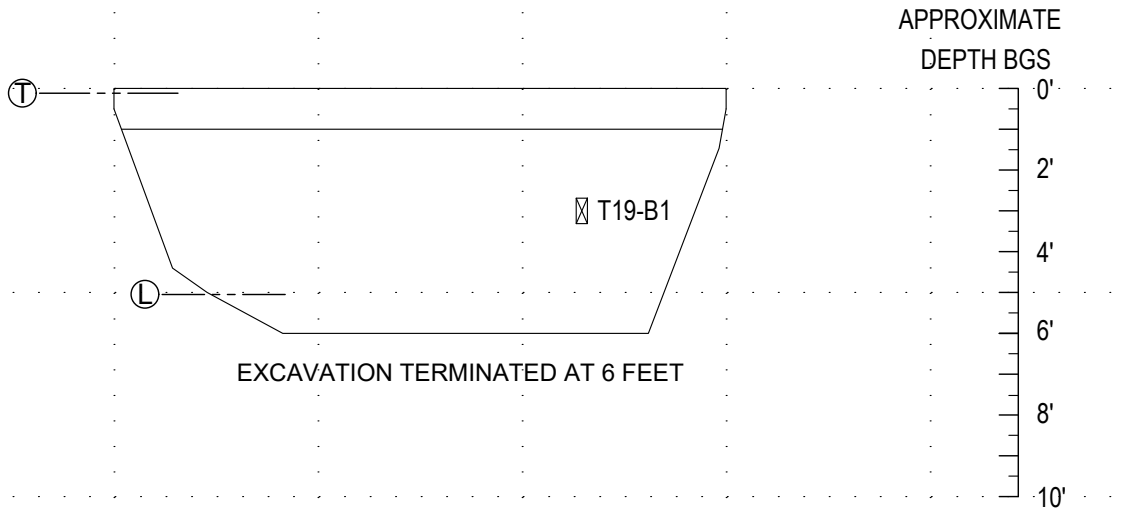
NOTE: LAYER OF 6-8 INCH GRAVEL FROM 3 TO 4 FEET IN DEPTH

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 5"		GRAVEL
L	5" - 4'		(SC) CLAYEY SAND; FIELD EST: 60% SAND, 20% GRAVEL, 20% FINES; LIGHT OLIVE BROWN (2.5Y 5/4); MEDIUM DENSE; DAMP.
M	4 - 6'	T18-B1 AT 5'	(CH) CLAY; FIELD EST: 100% FINES; BLACK AND GRAY (2.5Y 2.5/1 & 2.5Y5/1); SOFT; MOIST.

Exploratory Trench Log

Trench No. T-19

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	--
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



LEGEND: ☒ BULK BAG SAMPLE

NFWE: NO FREE WATER ENCOUNTERED

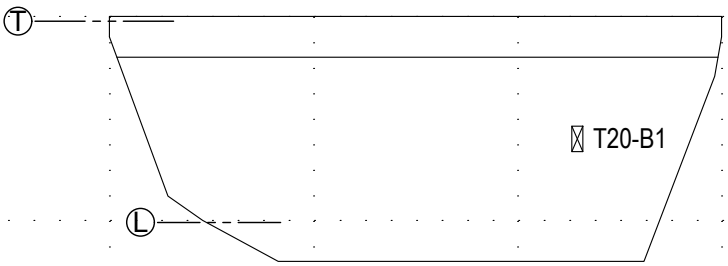
Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 6"		TOPSOIL AND GRAVEL
L	6" - 6'	T19-B1 AT 3'	(SM) SILTY SAND; FIELD EST: 60% SAND, 20% GRAVEL, 20% FINES; LIGHT OLIVE BROWN (2.5Y 5/4); MEDIUM DENSE; DAMP.

Exploratory Trench Log

Trench No. T-20

Project Name:	NID - LAKE WILDWOOD BACKBONE		
Project No.:	5353.00	Task No.:	
Location:	ROUGH AND READY HIGHWAY		
Logged By:	JMC	Date Logged:	9/24/19
Excavator Company:	CME		
Excavator Type:	CASE 580 WITH 24 INCH BUCKET		
Backfill Description:	BUCKET COMPACTED		

Ground Water Information		
Date:	NFWE	
Time:	-	
Depth bgs (ft):	-	
Trench Elev.:	-	Ft. AMSL
Approx. Station:	--	
Scale:	1 In. = 5	FEET



APPROXIMATE DEPTH BGS

0'
2'
4'
6'
8'
10'

EXCAVATION TERMINATED AT 6 FEET

LEGEND: ☒ BULK BAG SAMPLE

NFWE: NO FREE WATER ENCOUNTERED

NOTE: AT 5 FEET, MATERIAL EXCAVATES IN PIECES TO 3 INCHES

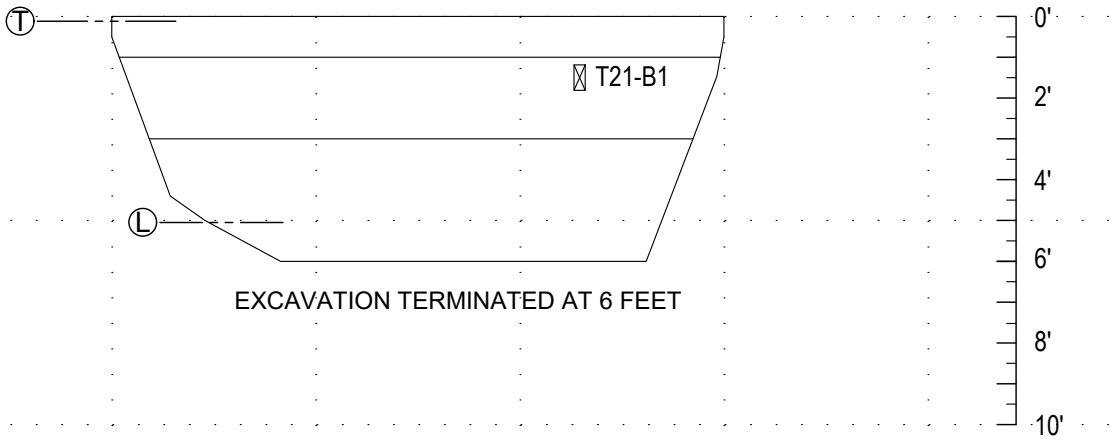
Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 8"		TOPSOIL
C	8" - 6'	T20-B1 AT 3'	(SM) SILTY SAND; FIELD EST: 60% SAND, 40% FINES; DARK REDDISH BROWN (2.5YR 3/4); MEDIUM DENSE TO DENSE; DAMP.

Exploratory Trench Log

Trench No. T-21

Project Name:	NID - LAKE WILDWOOD BACKBONE
Project No.:	5353.00 Task No.:
Location:	ROUGH AND READY HIGHWAY
Logged By:	JMC Date Logged: 9/24/19
Excavator Company:	CME
Excavator Type:	CASE 580 WITH 24 INCH BUCKET
Backfill Description:	BUCKET COMPACTED

Ground Water Information		
Date:	NFWE	
Time:	-	
Depth bgs (ft):	-	
Trench Elev.:	-	Ft. AMSL
Approx. Station:	--	
Scale:	1 In. = 5	FEET



LEGEND: ☒ BULK BAG SAMPLE
NFWE: NO FREE WATER ENCOUNTERED

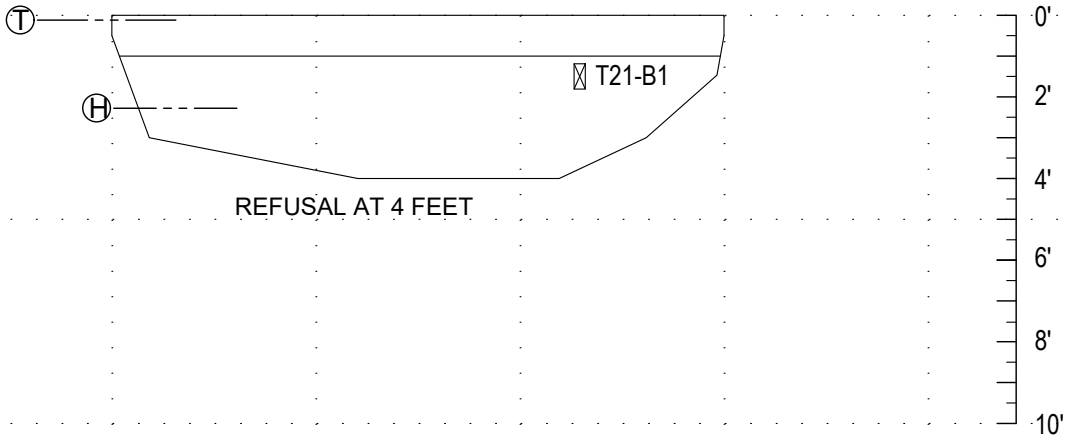
NOTE: LAYER OF 6-8 INCH GRAVEL FROM 3 TO 4 FEET IN DEPTH

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 2"		TOPSOIL
A	2" - 3'	T21-B1 AT 3'	(SM) SILTY SAND WITH SOME CLAY; FIELD EST: 60% SAND, 40% FINES; DARK REDDISH BROWN (2.5YR 3/4); MEDIUM DENSE TO DENSE; DAMP.
H	3' - 6'		(SM) SILTY SAND; FIELD EST: 60% SAND, 40% FINES; LIGHT REDDISH BROWN (5Y 6/4); MEDIUM DENSE; DAMP.

Exploratory Trench Log

Trench No. **T-22**

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	--
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



LEGEND: ☒ BULK BAG SAMPLE
NFWE: NO FREE WATER ENCOUNTERED

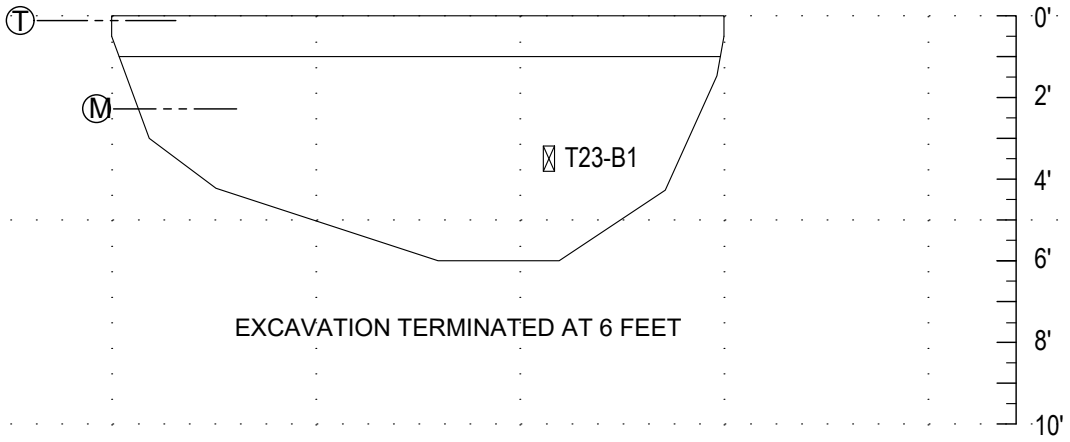
NOTE: GRANITE BOULDERS TO 18 INCHES EXCAVATED PRIOR TO REFUSAL ON GRANITE BOULDERS.

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 6"		TOPSOIL
H	6" - 4'	T22-B1 AT 1.5'	(SM) SILTY SAND; FIELD EST: 60% SAND, 40% FINES; LIGHT REDDISH BROWN (5Y 6/4); MEDIUM DENSE; DAMP.

Exploratory Trench Log

Trench No. T-23

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	--
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



EXCAVATION TERMINATED AT 6 FEET

LEGEND: ⊠ BULK BAG SAMPLE

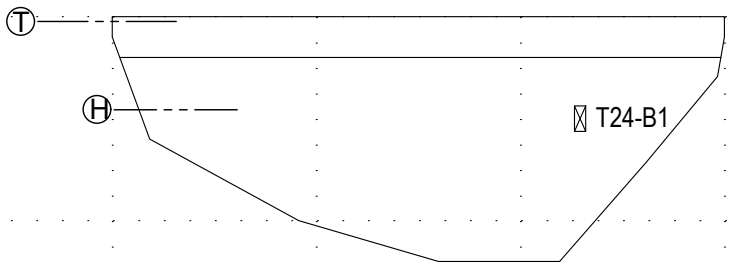
NFWE: NO FREE WATER ENCOUNTERED

Unit No.	Unit Depth	Sample No.		Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 3"			TOPSOIL AND GRAVEL
M	3" - 6'	T23-B1 AT 3.5'	(Rx)	HIGHLY WEATHERED GRANITE: EXCAVATES AS SILTY SAND; FIELD EST: 80% SAND, 20% FINES; GRAY (2.5Y 5/1); DENSE TO VERY DENSE; DAMP.

Exploratory Trench Log

Trench No. T-24

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	--
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



APPROXIMATE DEPTH BGS

0'
2'
4'
6'
8'
10'

EXCAVATION TERMINATED AT 6 FEET

LEGEND: ☒ BULK BAG SAMPLE

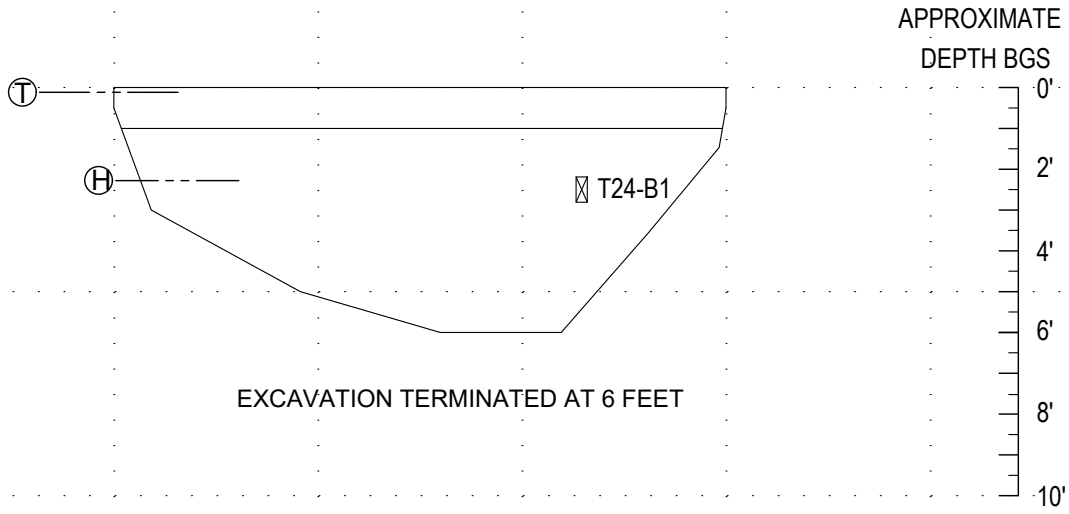
NFWE: NO FREE WATER ENCOUNTERED

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 2"		TOPSOIL AND GRAVEL
N	2" - 6'	T24-B1 AT 2.5'	(SM) SILTY SAND; FIELD EST: 80% SAND, 20% FINES; LIGHT OLIVE BROWN (2.5Y 5/4); DENSE TO VERY DENSE; DAMP.

Exploratory Trench Log

Trench No. T-25

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	-- -
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



EXCAVATION TERMINATED AT 6 FEET

LEGEND: ☒ BULK BAG SAMPLE
NFWE: NO FREE WATER ENCOUNTERED

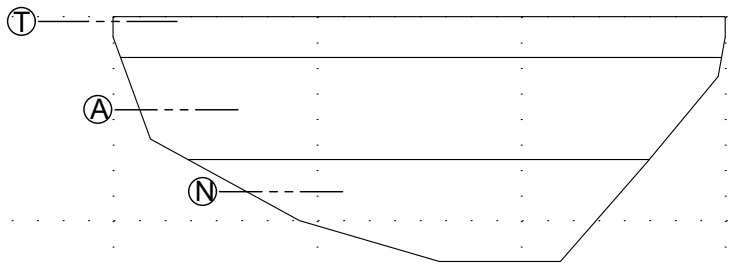
NOTE: HARD DIGGING AT 4 FEET

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 4"		TOPSOIL
N	4" - 6'	T25-B1 AT 3'	(SM) SILTY SAND; FIELD EST: 80% SAND, 20% FINES; LIGHT OLIVE BROWN (2.5Y 5/4); DENSE TO VERY DENSE; DAMP.

Exploratory Trench Log

Trench No. T-26

Project Name:	NID - LAKE WILDWOOD BACKBONE	Ground Water Information	
Project No.:	5353.00 Task No.:	Date:	NFWE
Location:	ROUGH AND READY HIGHWAY	Time:	-
Logged By:	JMC Date Logged: 9/24/19	Depth bgs (ft):	-
Excavator Company:	CME	Trench Elev.:	- Ft. AMSL
Excavator Type:	CASE 580 WITH 24 INCH BUCKET	Approx. Station:	--
Backfill Description:	BUCKET COMPACTED	Scale:	1 In. = 5 FEET



APPROXIMATE DEPTH BGS

0'
2'
4'
6'
8'
10'

EXCAVATION TERMINATED AT 6 FEET

LEGEND: ☒ BULK BAG SAMPLE

NFWE: NO FREE WATER ENCOUNTERED

NOTE: MATERIAL EXCAVATES AS IN PIECES TO 8 INCHES

Unit No.	Unit Depth	Sample No.	Soil And/Or Rock Material Descriptions (USCS Symbol; Particle Sizes Est. %; Munsel Color; Moisture; Etc.)
T	0 - 3"		TOPSOIL
A	3" - 3.5'		(SM) SILTY SAND WITH SOME CLAY; FIELD EST: 60% SAND, 40% FINES; DARK REDDISH BROWN (2.5YR 3/4); MEDIUM DENSE TO DENSE; DAMP.
N	3" - 3.5'		(SM) SILTY SAND WITH SOME GRAVEL; FIELD EST: 80% SAND, 10% GRAVEL, 10% FINES; LIGHT OLIVE BROWN (2.5Y 5/4); DENSE TO VERY DENSE; DAMP.

APPENDIX D

Laboratory Test Data

PARTICLE SIZE DISTRIBUTION

ASTM D1140

DSA File #:
DSA Appl #:

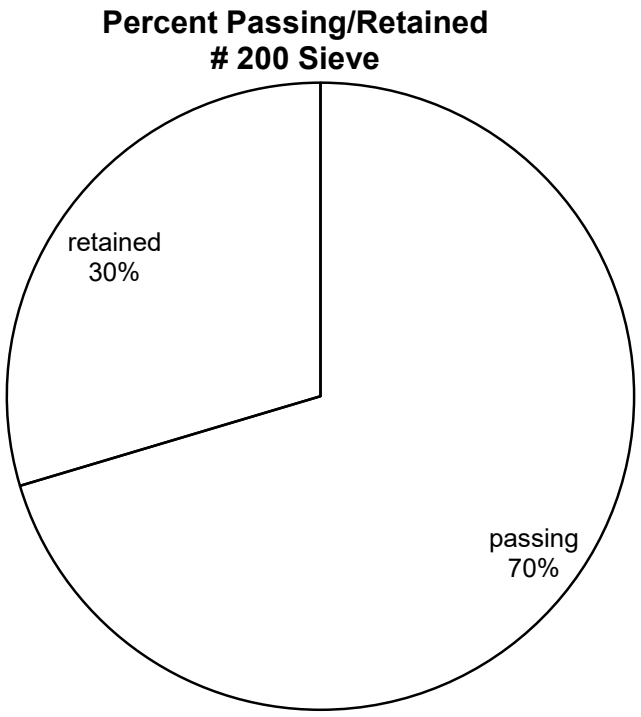
Project No.:	**5353.00**	Project Name:	**Lake Wildwood Backbone**			Date:	**9/30/2019**
Sample No.:	**B1**	Boring/Trench:	**T4**	Depth, (ft.):	**-**	Tested By:	**MLH**
Description:	**Reddish Brown (5YR 4/4) Sandy Silt**					Checked By:	**MLH**
Sample Location:						Lab. No.:	**15-19-447**

Moisture Content Data:

Pan ID	ST	
Pan Weight	50.58	(gm)
Wet Soil + Pan	143.09	(gm)
Dry Soil + Pan	134.13	(gm)
Water Weight	8.96	(gm)
Dry Soil Weight	83.55	(gm)
Moisture Content	10.7	(%)

Total Material Sample Data:

Pan ID	DE	
Pan Weight	258.50	(gm)
Wet Soil + Pan Wt.	385.07	(gm)
Wet Weight	126.57	(gm)
Dry Weight	114.31	(gm)
Dry Wt.> #200 Sieve & Pan	292.35	(gm)
Dry Wt.> #200 Sieve	33.85	
Total Percent <#200 Sieve	70.39	(%)



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CQA – INFRASTRUCTURE – ENERGY – PROGRAM MANAGEMENT – ENVIRONMENTAL

ATTERBERG INDICES

ASTM D4318

DSA File #:

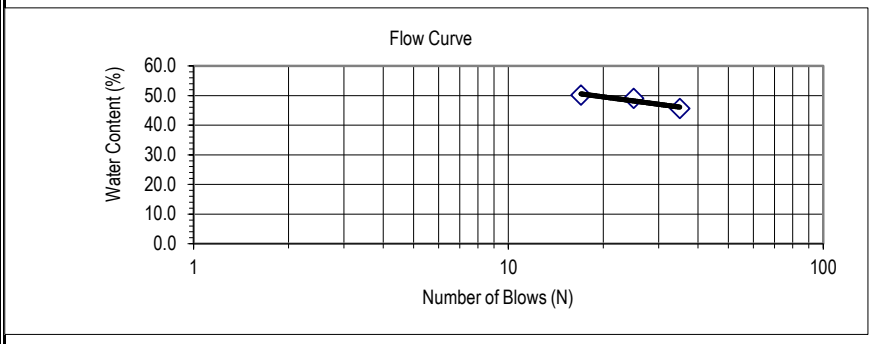
DSA Appl #:

Project No.:	**5353.00**	Project Name:	**Lake Wildwood Backbone**	Date:	**9/30/2019**
Sample No.:	**B1**	Boring/Trench:	**T4**	Depth, (ft.): **-**	Tested By: **SLN**
Description:	**Reddish Brown (5YR 4/4) Sandy Silt**			Checked By:	**MLH**
Sample Location:				Lab. No.:	**15-19-447**

Estimated % of Sample Retained on No. 40 Sieve: 15 Sample Air Dried: yes

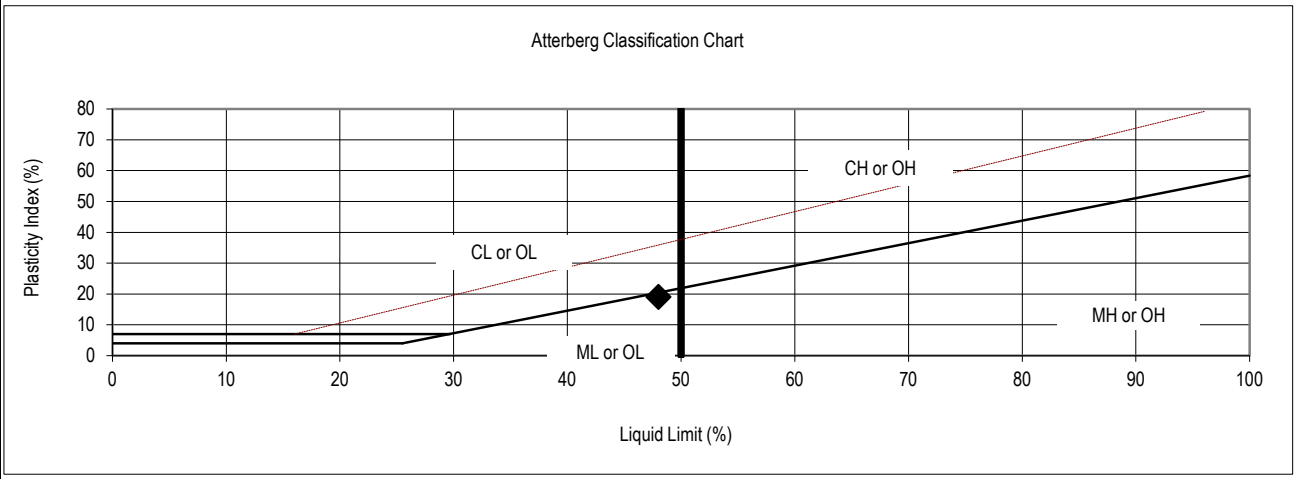
Test Method A or B: A

	LIQUID LIMIT:					PLASTIC LIMIT:		
Sample No.:	1	2	3	4	5	1	2	3
Pan ID:	LD	34	47			Lf	la	
Wt. Pan (gr)	15.23	22.47	21.44			11.01	11.03	
Wt. Wet Soil + Pan (gr)	23.91	31.68	31.14			17.07	17.68	
Wt. Dry Soil + Pan (gr)	21.19	28.65	27.90			15.71	16.21	
Wt. Water (gr)	2.72	3.03	3.24			1.36	1.47	
Wt. Dry Soil (gr)	5.96	6.18	6.46			4.70	5.18	
Water Content (%)	45.6	49.0	50.2			28.9	28.4	
Number of Blows, N	35	25	17					
				LIQUID LIMIT =	48		PLASTIC LIMIT =	29



Plasticity Index = 19

Group Symbol = ML



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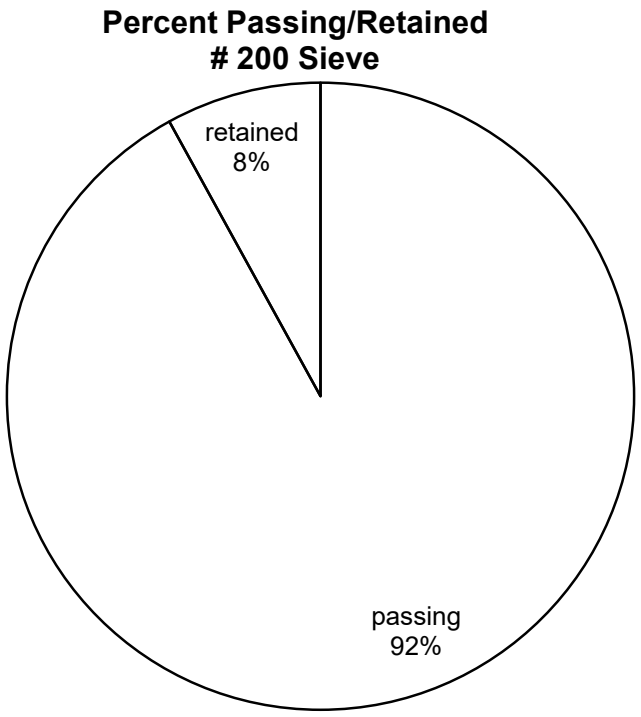
PARTICLE SIZE DISTRIBUTION

ASTM D1140

DSA File #:
DSA Appl #:

Project No.:	**5353.00**	Project Name:	**Lake Wildwood Backbone**			Date:	**9/30/2019**
Sample No.:	**B1**	Boring/Trench:	**T6**	Depth, (ft.):	**-**	Tested By:	**MLH**
Description:	**Dark Red (2.5YR 3/6) Fat Clay**					Checked By:	**MLH**
Sample Location:						Lab. No.:	**15-19-447**

Moisture Content Data:			Total Material Sample Data:		
Pan ID	PD		Pan ID	MH	
Pan Weight	50.64	(gm)	Pan Weight	140.09	(gm)
Wet Soil + Pan	154.84	(gm)	Wet Soil + Pan Wt.	247.85	(gm)
Dry Soil + Pan	145.45	(gm)	Wet Weight	107.76	(gm)
Water Weight	9.39	(gm)	Dry Weight	98.05	(gm)
Dry Soil Weight	94.81	(gm)	Dry Wt.> #200 Sieve & Pan	147.94	(gm)
Moisture Content	9.9	(%)	Dry Wt.> #200 Sieve	7.85	
			Total Percent <#200 Sieve	91.99	(%)



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ATTERBERG INDICES

ASTM D4318

DSA File #:

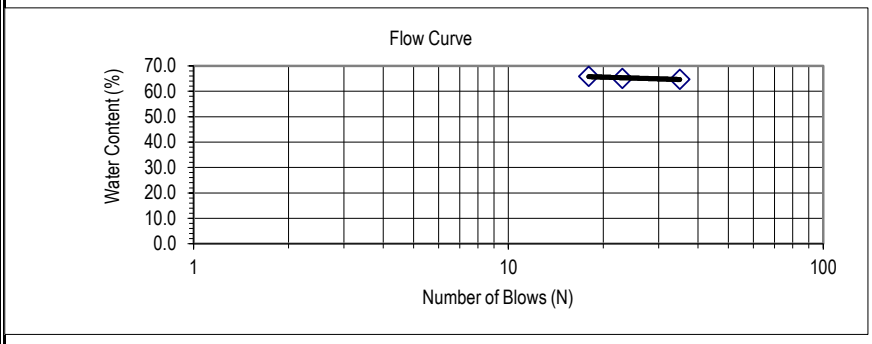
DSA Appl #:

Project No.:	**5353.00**	Project Name:	**Lake Wildwood Backbone**	Date:	**9/30/2019**
Sample No.:	**B1**	Boring/Trench:	**T6**	Depth, (ft.): **-**	Tested By: **SLN**
Description:	**Dark Red (2.5YR 3/6) Fat Clay**			Checked By:	**MLH**
Sample Location:				Lab. No.:	**15-19-447**

Estimated % of Sample Retained on No. 40 Sieve: 5% Sample Air Dried: yes

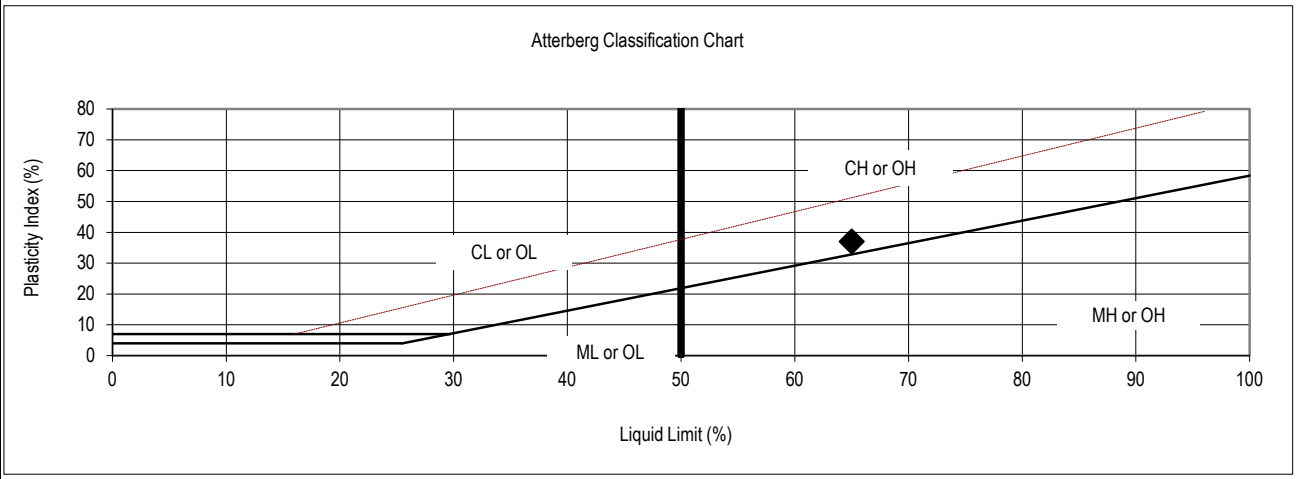
Test Method A or B: A

	LIQUID LIMIT:					PLASTIC LIMIT:		
Sample No.:	1	2	3	4	5	1	2	3
Pan ID:	32	38	45			1	14	
Wt. Pan (gr)	21.71	21.27	21.16			21.82	22.29	
Wt. Wet Soil + Pan (gr)	31.15	30.58	28.03			27.92	28.62	
Wt. Dry Soil + Pan (gr)	27.44	26.91	25.30			26.60	27.24	
Wt. Water (gr)	3.71	3.67	2.73			1.32	1.38	
Wt. Dry Soil (gr)	5.73	5.64	4.14			4.78	4.95	
Water Content (%)	64.7	65.1	65.9			27.6	27.9	
Number of Blows, N	35	23	18					
				LIQUID LIMIT =	65	PLASTIC LIMIT =		28



Plasticity Index = 37

Group Symbol = CH



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PARTICLE SIZE DISTRIBUTION

ASTM D1140

DSA File #:
DSA Appl #:

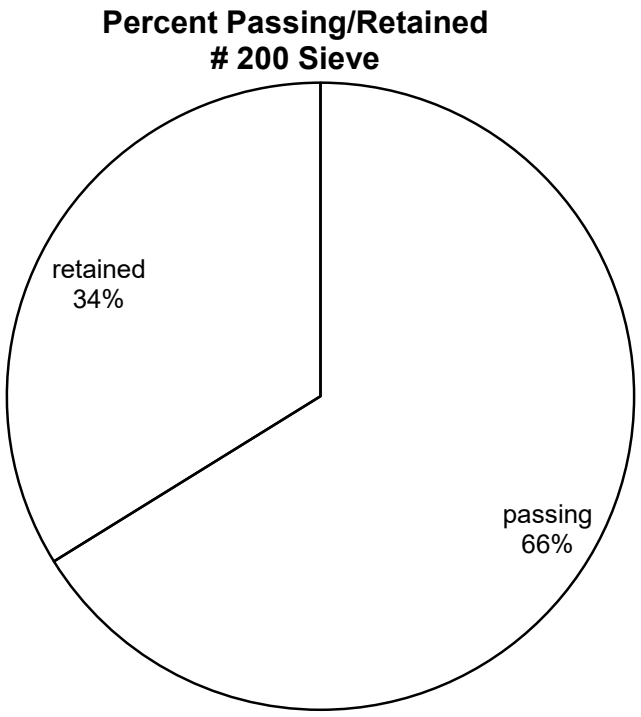
Project No.:	**5353.00**	Project Name:	**Lake Wildwood Backbone**			Date:	**9/30/2019**
Sample No.:	**B1**	Boring/Trench:	**T8**	Depth, (ft.):	**-**	Tested By:	**MLH**
Description:	**Olive Yellow (2.5Y 6/6) Sandy Fat Clay**					Checked By:	**MLH**
Sample Location:						Lab. No.:	**15-19-447**

Moisture Content Data:

Pan ID	TB	
Pan Weight	50.32	(gm)
Wet Soil + Pan	174.37	(gm)
Dry Soil + Pan	162.75	(gm)
Water Weight	11.62	(gm)
Dry Soil Weight	112.43	(gm)
Moisture Content	10.3	(%)

Total Material Sample Data:

Pan ID	A6	
Pan Weight	153.87	(gm)
Wet Soil + Pan Wt.	305.73	(gm)
Wet Weight	151.86	(gm)
Dry Weight	137.63	(gm)
Dry Wt.> #200 Sieve & Pan	200.43	(gm)
Dry Wt.> #200 Sieve	46.56	
Total Percent <#200 Sieve	66.17	(%)



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ATTERBERG INDICES

ASTM D4318

DSA File #:

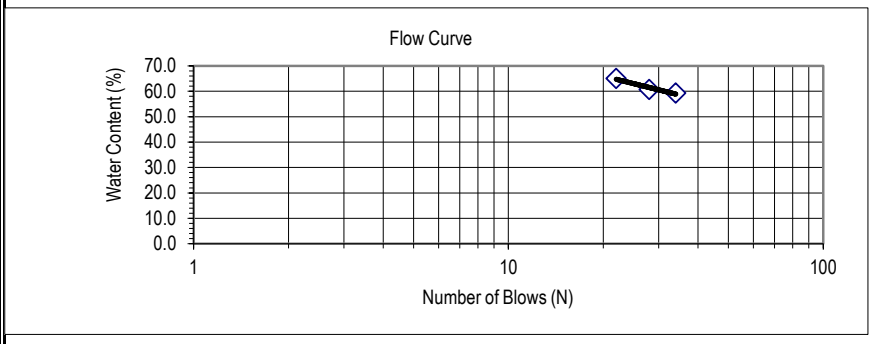
DSA Appl #:

Project No.:	**5353.00**	Project Name:	**Lake Wildwood Backbone**	Date:	**9/30/2019**
Sample No.:	**B1**	Boring/Trench:	**T8**	Depth, (ft.): **-**	Tested By: **SLN**
Description:	**Olive Yellow (2.5Y 6/6) Sandy Fat Clay**			Checked By:	**MLH**
Sample Location:				Lab. No.:	**15-19-447**

Estimated % of Sample Retained on No. 40 Sieve: 15 Sample Air Dried: yes

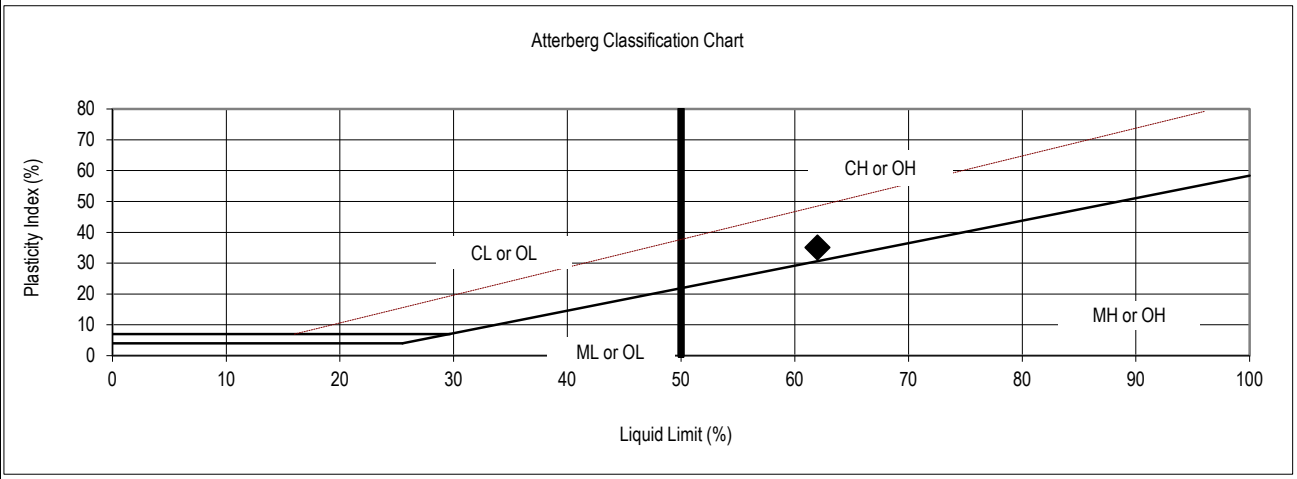
Test Method A or B: A

	LIQUID LIMIT:					PLASTIC LIMIT:		
Sample No.:	1	2	3	4	5	1	2	3
Pan ID:	11	31	27			NF	NE	
Wt. Pan (gr)	30.00	21.10	21.67			11.32	11.08	
Wt. Wet Soil + Pan (gr)	40.29	27.50	31.21			17.61	17.35	
Wt. Dry Soil + Pan (gr)	36.46	25.08	27.45			16.27	16.05	
Wt. Water (gr)	3.83	2.42	3.76			1.34	1.30	
Wt. Dry Soil (gr)	6.46	3.98	5.78			4.95	4.97	
Water Content (%)	59.3	60.8	65.1			27.1	26.2	
Number of Blows, N	34	28	22					
				LIQUID LIMIT =	62	PLASTIC LIMIT =		27



Plasticity Index = 35

Group Symbol = CH



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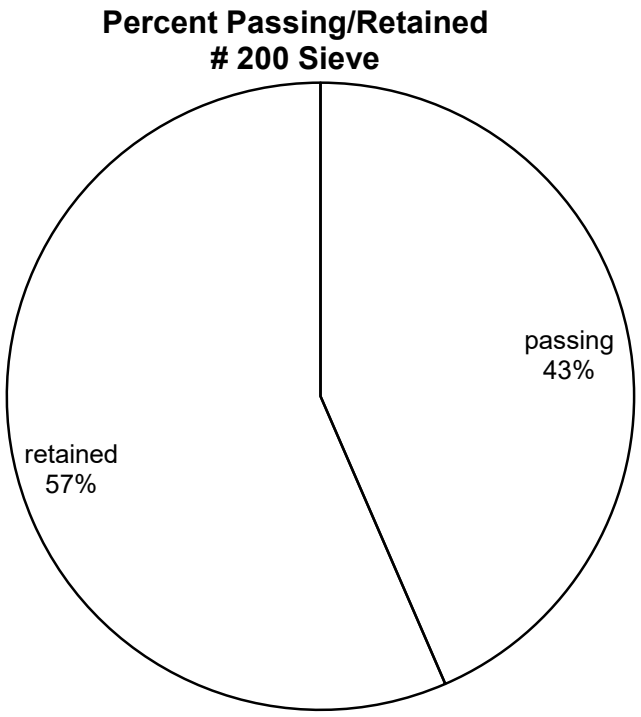
DSA File #:
DSA Appl #:

Project No.:	**5353.00**	Project Name:	**Lake Wildwood Backbone**			Date:	**9/30/2019**
Sample No.:	**B1**	Boring/Trench:	**T12**	Depth, (ft.):	**-**	Tested By:	**MLH**
Description:	**Olive (5Y 5/4) Silty Sand**					Checked By:	**MLH**
Sample Location:						Lab. No.:	**15-19-447**

Moisture Content Data:		
Pan ID	LG	
Pan Weight	50.95	(gm)
Wet Soil + Pan	312.62	(gm)
Dry Soil + Pan	294.78	(gm)
Water Weight	17.84	(gm)
Dry Soil Weight	243.83	(gm)
Moisture Content	7.3	(%)

Total Material Sample Data:		
Pan ID	JT	
Pan Weight	219.10	(gm)
Wet Soil + Pan Wt.	483.40	(gm)
Wet Weight	264.30	(gm)
Dry Weight	246.28	(gm)
Dry Wt.> #200 Sieve & Pan	358.28	(gm)
Dry Wt.> #200 Sieve	139.18	
Total Percent <#200 Sieve	43.49	(%)



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PARTICLE SIZE DISTRIBUTION

ASTM D1140

DSA File #:
DSA Appl #:

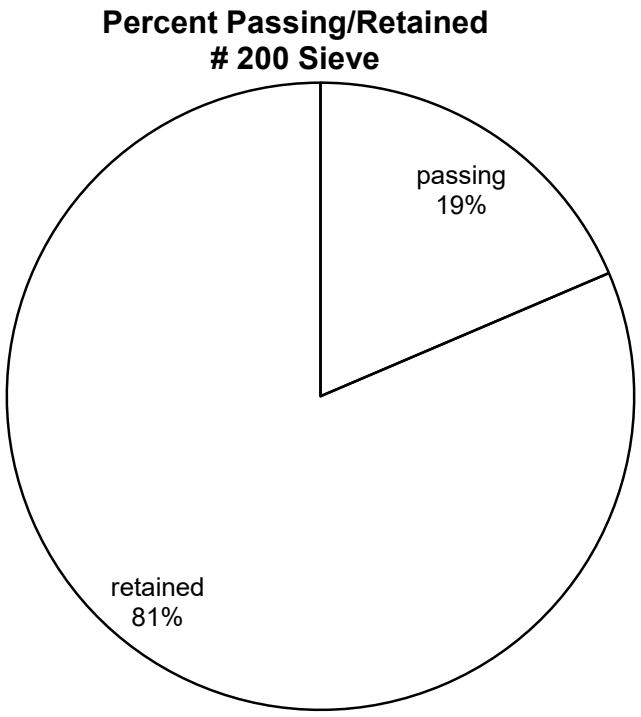
Project No.:	**5353.00**	Project Name:	**Lake Wildwood Backbone**			Date:	**9/30/2019**
Sample No.:	**B1**	Boring/Trench:	**T19**	Depth, (ft.):	**-**	Tested By:	**MLH**
Description:	**Yellowish Brown (10YR 5/4) Silty Sand**					Checked By:	**MLH**
Sample Location:						Lab. No.:	**15-19-447**

Moisture Content Data:

Pan ID	B	
Pan Weight	320.02	(gm)
Wet Soil + Pan	590.06	(gm)
Dry Soil + Pan	583.68	(gm)
Water Weight	6.38	(gm)
Dry Soil Weight	263.66	(gm)
Moisture Content	2.4	(%)

Total Material Sample Data:

Pan ID	C4	
Pan Weight	272.75	(gm)
Wet Soil + Pan Wt.	563.24	(gm)
Wet Weight	290.49	(gm)
Dry Weight	283.63	(gm)
Dry Wt.> #200 Sieve & Pan	503.69	(gm)
Dry Wt.> #200 Sieve	230.94	
Total Percent <#200 Sieve	18.58	(%)



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PARTICLE SIZE DISTRIBUTION

ASTM D1140

DSA File #:
DSA Appl #:

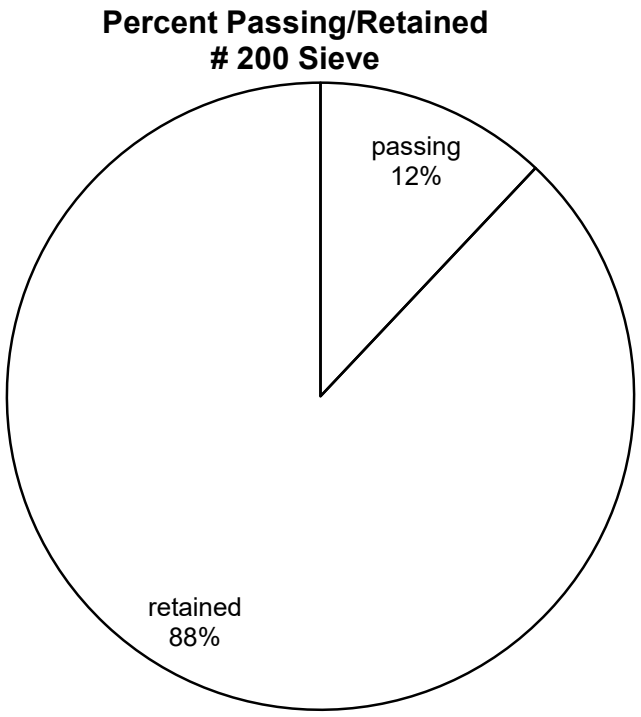
Project No.:	**5353.00**	Project Name:	**Lake Wildwood Backbone**			Date:	**9/30/2019**
Sample No.:	**B1**	Boring/Trench:	**T23**	Depth, (ft.):	**-**	Tested By:	**MLH**
Description:	**Yellowish Brown (10YR 5/4) Silty Sand**					Checked By:	**MLH**
Sample Location:						Lab. No.:	**15-19-447**

Moisture Content Data:

Pan ID	TJ	
Pan Weight	50.24	(gm)
Wet Soil + Pan	477.14	(gm)
Dry Soil + Pan	473.16	(gm)
Water Weight	3.98	(gm)
Dry Soil Weight	422.92	(gm)
Moisture Content	0.9	(%)

Total Material Sample Data:

Pan ID	77	
Pan Weight	207.33	(gm)
Wet Soil + Pan Wt.	608.19	(gm)
Wet Weight	400.86	(gm)
Dry Weight	397.12	(gm)
Dry Wt.> #200 Sieve & Pan	556.70	(gm)
Dry Wt.> #200 Sieve	349.37	
Total Percent <#200 Sieve	12.02	(%)



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CQA – INFRASTRUCTURE – ENERGY – PROGRAM MANAGEMENT – ENVIRONMENTAL

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 10/09/2019
Date Submitted 10/02/2019

To: Michelle Holub
Holdrege & Kull
792 Searls Ave.
Nevada City, CA 95959

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 5353.000 Site ID : T2 B-1.
Thank you for your business.

* For future reference to this analysis please use SUN # 80697-168619.

EVALUATION FOR SOIL CORROSION

Soil pH	5.67	
Minimum Resistivity	4.29 ohm-cm (x1000)	
Chloride	6.7 ppm	00.00067 %
Sulfate	17.5 ppm	00.00175 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 10/09/2019
Date Submitted 10/02/2019

To: Michelle Holub
Holdrege & Kull
792 Searls Ave.
Nevada City, CA 95959

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 5353.000 Site ID : T7 B-1.
Thank you for your business.

* For future reference to this analysis please use SUN # 80697-168620.

EVALUATION FOR SOIL CORROSION

Soil pH	5.01	
Minimum Resistivity	0.72 ohm-cm (x1000)	
Chloride	18.4 ppm	00.00184 %
Sulfate	66.9 ppm	00.00669 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 10/09/2019
Date Submitted 10/02/2019

To: Michelle Holub
Holdrege & Kull
792 Searls Ave.
Nevada City, CA 95959

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 5353.000 Site ID : T18 B-1.
Thank you for your business.

* For future reference to this analysis please use SUN # 80697-168621.

EVALUATION FOR SOIL CORROSION

Soil pH	5.17	
Minimum Resistivity	2.95 ohm-cm (x1000)	
Chloride	3.2 ppm	00.00032 %
Sulfate	28.1 ppm	00.00281 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 10/09/2019
Date Submitted 10/02/2019

To: Michelle Holub
Holdrege & Kull
792 Searls Ave.
Nevada City, CA 95959

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 5353.000 Site ID : T24 B-1.
Thank you for your business.

* For future reference to this analysis please use SUN # 80697-168622.

EVALUATION FOR SOIL CORROSION

Soil pH	6.41	
Minimum Resistivity	2.06 ohm-cm (x1000)	
Chloride	1.8 ppm	00.00018 %
Sulfate	9.8 ppm	00.00098 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m