GEOTECHNICAL EVALUATION
HUNT HIGHWAY
GARY ROAD TO BELLA VISTA ROAD
PINAL COUNTY, ARIZONA
PINAL COUNTY PROJECT NO. 6621173

PREPARED FOR:
T.Y. Lin International
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January 30, 2014
Project No. 601868003

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Mr. James Barr, PE
T.Y. Lin International
60 East Rio Salado Parkway, Suite 501
Tempe, Arizona 85281

Subject: Geotechnical Evaluation
Hunt Highway; Gary Road to Bella Vista Road
Pinal County, Arizona
Pinal County Project No. 6621173

Dear Mr. Barr:

In accordance with our proposal dated March 6, 2013, and your authorization, Ninyo & Moore has performed a geotechnical evaluation for the above-referenced project. The attached report presents our methodologies, findings, conclusions, and recommendations regarding the geotechnical conditions at the project site.

We appreciate the opportunity to be of service to you during this phase of the project.

Sincerely,
NINYO & MOORE

Kevin L. Porter, PE
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1. INTRODUCTION

In accordance with our revised proposal dated March 6, 2013, and your authorization, we have performed a geotechnical evaluation for the proposed Hunt Highway Widening project in Pinal County, Arizona. The project consists of the design and construction of the widening of Hunt Highway between Gary Road and Bella Vista Road. The purpose of our evaluation was to assess the subsurface conditions along the project alignment in order to formulate geotechnical recommendations for design and construction. This report presents the results of our evaluation and our geotechnical conclusions and recommendations regarding the proposed improvements.

2. SCOPE OF SERVICES

The scope of our services for the project generally included:

- Reviewing available geologic literature, geologic maps, and aerial photographs pertinent to the project site.
- Obtaining a Right-of-Way permit from Pinal County to conduct the fieldwork within County Right-of-Way.
- Conducting a visual geologic reconnaissance and limited fissure evaluation of the project area.
- Conducting a site visit to mark out the boring locations and notifying Arizona Blue Stake of the locations prior to excavating.
- Drilling, logging, and sampling 13 small-diameter exploratory borings to depths of approximately 5 feet below ground surface (bgs). The boring logs are presented in Appendix A.
- Conducting pavement coring at selected locations to document the existing pavement structure.
- Performing laboratory tests on selected samples obtained from the borings to evaluate in-situ moisture content and dry density, gradation, Atterberg limits, consolidation (response-to-wetting), Proctor density, R-values, and corrosivity characteristics (including pH, minimum electrical resistivity, and soluble sulfate and chloride contents). The results of the laboratory testing are presented on the boring logs in Appendix A and/or in Appendix B.

- Preparing this report presenting our findings, conclusions, and recommendations regarding the design and construction of the proposed improvements.

Our scope of services did not include environmental consulting services such as hazardous waste sampling or analytical testing at the site. A detailed scope of services and estimated fee for such services can be provided upon request.

3. SITE DESCRIPTION

The project alignment is situated along Hunt Highway between Gary Road and Bella Vista Road within Sections 12, 18, and 19 in Township 3 South, Range 8 East relative to the Salt River Baseline and Meridian in Pinal County, Arizona, as shown on Figure 1. At the time of our evaluation, Hunt Highway was a two-lane (one lane each direction), northwest-southeast traversing, asphalt concrete (AC) paved roadway. The roadway was generally flanked by residential developments within the project limits, with undeveloped desert land and agricultural land near the northern limits, and scattered commercial developments. The San Tan Mountains were situated to the west of the alignment.

Based on the *Sacaton-NE, Arizona 7.5-Minute United States Geological Survey (USGS) Topographic Quadrangle Map (2011)*, the elevation of the project site ranged from approximately 1,515 feet relative to mean sea level (MSL) at the northern limits to approximately 1,535 feet MSL near the southern limits. The topography of the site vicinity generally slopes from the southwest down to the northeast.

Several aerial photographs were reviewed for this project. A 1937 Flood Control District of Maricopa County (FCDMC) photograph depicted Hunt Highway as an unpaved roadway surrounded by undeveloped desert land that was dissected by many northeast-southwest traversing natural drainages. A 1992 Google Earth™ aerial photograph depicted undeveloped desert land along the project alignment. Aerial photographs from 2004, 2005, and 2007 depicted an increase in residential developments flanking both sides of the project alignment and the 2007 photograph depicted the residential developments as being similar to its current condition. The

2004 image also depicted commercial developments near the southern limits. A 2010 Google Earth™ photograph depicted commercial developments near the northwest limit as being similar to its current condition. The 2010, 2011, 2012, and 2013 Google Earth™ images depicted ongoing commercial developments near the northeast limit of the project.

4. PROJECT DESCRIPTION

The project consists of the design and construction of roadway improvements to Hunt Highway, roughly from about 2,000 feet east of Gary Road to Bella Vista Road. Based on the 30 percent plans we received from T.Y. Lin International, we understand that the project will consist of widening of the existing roadway and construction of a new pavement section. Some portions of the project will also include curb and gutter. We understand that rehabilitation is being considered for portions of the existing pavement that will remain in place.

We understand that the new roadway section will consist of an AC section and the roadway will be designed using the American Association of State Highway and Transportation (AASHTO) pavement design method.

5. FIELD EXPLORATION AND LABORATORY TESTING

On December 3, 2013, Ninyo & Moore conducted a subsurface exploration at the project site in order to evaluate the existing subsurface conditions and to collect soil samples for laboratory testing. The field exploration consisted of drilling, logging, and sampling 13 small-diameter exploratory borings (denoted as B-1 through B-13) to a depth of about 5 feet bgs using a CME-55 truck-mounted drill rig equipped with solid-stem augers. Figure 2 presents the approximate locations of the soil borings. Bulk and relatively undisturbed soil samples were collected at selected depth intervals from the exploratory borings. Detailed descriptions of the soils encountered in the borings are presented on the boring logs in Appendix A.

The borings were advanced through the existing pavement except at boring B-2, which was drilled on the roadway shoulder. The thicknesses of the existing pavement and aggregate base are presented in Section 8.2.1. and on the boring logs presented in Appendix A.

The soil samples collected from our field exploration were transported to the Ninyo & Moore laboratory in Phoenix, Arizona for geotechnical laboratory testing. The analysis included in-situ moisture content and dry density, gradation analysis, Atterberg limits, consolidation (response-to-wetting), Proctor density, R-value, and corrosivity characteristics (including pH, minimum electrical resistivity, and soluble sulfate and chloride contents). The results of the in-situ moisture content and dry density testing are presented on the boring logs in Appendix A. A description of each laboratory test method, and the remainder of the test results are presented in Appendix B.

6. LIMITED PAVEMENT EVALUATION

Ninyo & Moore performed a limited pavement evaluation for the project area on January 16, 2014. Our evaluation consisted of the observation of the pavement surface to evaluate the general pavement distress conditions within the project limits. A detailed pavement evaluation, noting specific distress types, locations, and estimated quantities, was not included as part of our scope. However, the following paragraphs describe the generalized pavement distresses observed during our evaluation.

Based on our field observations, the pavement within the project limits has been sealed with asphaltic sealant. The roadway exhibited low to high severity transverse cracking, longitudinal cracking, and fatigue cracking, and low to moderate raveling, block cracking, asphalt patching, and rutting. In general, the pavement exhibited frequent low to moderate severity distresses, with scattered high severity distresses.

We also observed low to high severity transverse cracking, longitudinal cracking, and fatigue cracking and low to moderate raveling, block cracking, and rutting near the intersection with Gary Road, west of the project limits. The current plans do not show new pavement construction

for this intersection; however, based on the distresses observed near this location, reconstruction should be considered. Pavement recommendations are provided in Section 11.2.

7. GEOLOGIC RECONNAISSANCE AND LIMITED FISSURE EVALUATION

We performed a limited fissure evaluation of the project area. This limited evaluation included a desktop review of available geologic materials and review of historic aerial photographs to observe the possible presence of earth fissures within the project limits. In addition, on November 19, 2013, Ninyo & Moore conducted a geological reconnaissance to evaluate the possible presence of earth fissures along the project alignment. Based on our review of reference material and our geologic reconnaissance, earth fissures were not observed within the project limits. Additional details and findings of the geological reconnaissance are presented in Section 9.

8. GEOLOGY AND SUBSURFACE CONDITIONS

The geology and subsurface conditions at the site are described in the following sections.

8.1. Geologic Setting

The project site is situated in the Sonoran Section of the Basin and Range physiographic province. The Basin and Range physiographic province is typified by broad alluvial valleys separated by steep, discontinuous, and subparallel mountain ranges. The mountain ranges generally trend north-south and northwest-southeast. The basin floors consist of alluvium with thickness extending to several thousands of feet.

The basins and surrounding mountains were formed approximately 10 to 18 million years ago during the Mid- to Late-Tertiary. Extensional tectonics resulted in the formation of horsts (mountains) and grabens (basins) with vertical displacement along high-angle normal faults. Intermittent volcanic activity also occurred during this time. The surrounding basins filled with alluvium from the erosion of the surrounding mountains as well as from river

deposition. Coarser-grained alluvial material was deposited at the margins of the basins near the mountains.

The surficial geology of the site generally consists of two units described as Holocene (<10,000 years) alluvial deposits. One unit which underlies much of the site, generally consists of low terrace alluvial deposits of silt, sand, gravel, cobbles, and boulders with very little calcic cementation. These deposits are generally near active ephemeral streams. The other geologic unit is described as young (<5,000 years) ephemeral stream deposits that generally consist of poorly sorted deposits of silt, sand, gravel, cobbles, and boulders (Pearthree and Huckleberry, 1994).

8.2. Subsurface Conditions

Our knowledge of the subsurface conditions at the project site is based on our field exploration and laboratory testing, and our understanding of the general geology of the area. Detailed descriptions of the subsurface conditions encountered in our borings are presented in Appendix A.

8.2.1. Asphalt Concrete and Aggregate Base

Asphalt concrete was encountered at the surface of borings B-1 through B-13, with the exception of B-2, and ranged in thickness between approximately 3 to 6 inches in our borings. Aggregate base (AB) was encountered underlying the AC and ranged in thickness between approximately 6 and 9 inches in our borings.

8.2.2. Fill

Fill was encountered at the surface of boring B-2 and underlying the pavement section in borings B-1, B-3, B-9, and B-12. The fill underlying the pavement section ranged in thickness between approximately 2.5 to 5 feet and generally consisted of medium dense to very dense silty sand with varying gravel content in our borings.

8.2.3. Alluvium

Alluvium was encountered underlying the pavement section or fill in borings B-3 through B-11 and B-13, and extended to the total explored depths. The alluvium generally consisted of medium dense to very dense clayey sand and silty sand and hard sandy lean clay in our borings. Varying amounts of gravel and scattered caliche nodules were observed in this material.

8.3. Groundwater

Groundwater was not encountered in our borings. Based on well data provided by the Arizona Department of Water Resources (ADWR), the regional groundwater table has historically been measured at approximately 340 feet bgs in nearby wells. Groundwater levels can fluctuate due to seasonal variations in precipitation, irrigation, groundwater withdrawal or injection, and in areas where the alignment crosses ephemeral washes. In general, groundwater is not anticipated to be a constraint to the design and construction of the project.

9. GEOLOGIC HAZARDS

The following sections describe potential geologic hazards at the site, including land subsidence and earth fissures and faulting.

9.1. Land Subsidence and Earth Fissures

Groundwater depletion, due to groundwater pumping, has caused land subsidence and earth fissures in numerous alluvial basins in Arizona. It has been estimated that subsidence has affected more than 3,000 square miles and has caused damage to a variety of engineered structures and agricultural land (Schumann and Genualdi, 1986). From 1948 to 1983, excessive groundwater withdrawal has been documented in several alluvial valleys where groundwater levels have been reportedly lowered by up to 500 feet. With such large

depletions of groundwater, the alluvium has undergone consolidation resulting in large areas of land subsidence.

In Arizona, earth fissures are generally associated with land subsidence, and pose an on-going geologic hazard. Earth fissures generally form near the margins of geomorphic basins where significant amounts of groundwater depletion have occurred. Reportedly, earth fissures have also formed due to tensional stress caused by differential subsidence of the unconsolidated alluvial materials over buried bedrock ridges and irregular bedrock surfaces (Schumann and Genualdi, 1986).

Based on our field reconnaissance and review of the referenced material there are no documented or observed earth fissures within the project limits. The nearest documented earth fissure is located approximately 1.5 miles northwest of the project, near the Thompson Road and Hunt Highway intersection (Arizona Geological Survey, 2008). Because of the unpredictable nature of earth fissures, as well as the difficulty of observing fissures that are not yet projected to the surface, earth fissures may be a constraint to the design and construction of the project. If an earth fissure or soil cracking is encountered during construction, specifically during the earthwork operations, Ninyo & Moore should be notified immediately for further recommendations.

9.2. Faulting

The site lies within the Sonoran zone, which is a relatively stable tectonic region located in southwestern Arizona, southeastern California, southern Nevada, and northern Mexico (Euge et al., 1992). This zone is characterized by sparse seismicity and few Quaternary faults. Based on our field observations, review of pertinent geologic data, and analysis of aerial photographs, faults are not located on or adjacent to the property. The closest Quaternary fault to the project site is the Sugarloaf Fault Zone, situated approximately 37 miles to the north of the site. The Sugarloaf Fault Zone is situated along the western margin of a small sedimentary basin near the base of the Mazatzal Mountains. This fault zone is a series of northwest striking normal faults that generally dip to the northeast. Recent

movement along this fault was approximately 130,000 years ago during the Middle to Late Pleistocene epoch. The slip-rate category of this fault is less than 0.2 millimeters per year (Pearthree, 1998).

10. CONCLUSIONS

Based on the results of our subsurface evaluation, laboratory testing, and data analysis, it is our opinion that the proposed construction for the new roadway improvements is feasible from a geotechnical standpoint, provided that the recommendations of this report are incorporated into the design and construction of the proposed project, as appropriate. Geotechnical considerations include the following:

- The near-surface on-site soils should be excavatable using heavy-duty excavation equipment in good working condition.
- Imported soils and soils generated from on-site excavation activities that exhibit relatively low plasticity indices can generally be used as engineered fill soil.
- Based on the results of our field and laboratory evaluations, it is our opinion that new pavements should be founded on a zone of moisture-conditioned and compacted engineered fill. We estimate an earthwork (shrinkage) factor of approximately 5 to 15 percent for the on-site soils.
- Corrosivity test results indicate that the subgrade materials are generally corrosive to ferrous materials and the sulfate content of the soils presents a negligible sulfate exposure for concrete.
- Groundwater levels, based on historic nearby well data, indicate that regional groundwater depths are approximately 340 feet bgs.
- No known or documented geologic hazards are present underlying the site; however, earth fissures have been documented northwest of the project alignment.

11. RECOMMENDATIONS

Based on our understanding of the project, the following recommendations are provided for the design and construction of the proposed roadway improvements. If the proposed construction is

changed from that discussed in this report, Ninyo & Moore should be contacted for additional recommendations.

11.1. Earthwork

The following sections provide our earthwork recommendations for this project. In general, the earthwork specifications contained in Maricopa Association of Governments (MAG), *Uniform Standard Specifications and Details for Public Works Construction*, are expected to apply, except as noted.

11.1.1. Excavations

Our evaluation of the excavation characteristics of the on-site materials is based on the results of our exploratory borings, site observations, and our experience with similar materials. Based on our evaluation, excavation of the near-surface on-site surface soils can generally be accomplished using heavy-duty excavation equipment in good working condition. However, caliche nodules were encountered in some of our borings. This material might be more difficult to excavate and might slow the excavation rate depending on the actual degree of cementation encountered during construction. Based on aerial photography review, several natural drainages crossed the project alignment. This may result in changes in soil conditions along the alignment that may not have been observed in our widely spaced borings.

For planning purposes, when considering temporary excavations, we recommend that the Occupational Safety and Health Administration (OSHA) soil *"Type C"* be used for the fill and alluvial soils, and a temporary side slope of 1.5:1 (horizontal to vertical), or flatter, be used for sloped excavations that are less than 20 feet deep.

11.1.2. Grading, Fill Placement, and Compaction

Vegetation and debris from the clearing operation, as well as demolition debris (if any), should be removed from the site and disposed of at a legal dumpsite. Obstructions that

extend below finish grade, if present, should be removed and the resulting holes filled with compacted soil.

The geotechnical consultant should carefully evaluate any areas of soft, loose, or wet soils prior to placement of grade-raise fill or other construction. Drying or overexcavation of some materials may be appropriate.

On-site and imported soils that exhibit relatively low plasticity indices are generally suitable for re-use as engineered fill. Relatively low plasticity indices are defined as a Plasticity Index (PI) value of 15 or less, as defined by the American Society for Testing and Materials (ASTM) Test Method D 4318. The Atterberg limits test performed on selected samples from our borings resulted in PI values ranging from 0 (non-plastic) to 26. As such, it is our opinion that some of the on-site soils are not suitable for re-use as engineered fill during construction. Because our borings are spaced widely apart along the project alignment, not every soil condition could be observed in the field during our field exploration. As such, there may be areas of unacceptable soils encountered during construction. Additional field sampling and laboratory testing may be needed during construction to evaluate the suitability of the site soils.

In addition to the above recommendations, suitable fill below new pavement should not have an R-value less than 20, or include organic material, construction debris, or other non-soil fill materials. Rock particles and clay lumps should not be larger than 4 inches in dimension. Unsuitable fill material should be disposed of off-site or in non-structural areas.

Based on relative densities observed in our borings, below grade-raise fill or new pavement, we recommend that the existing materials be improved to a depth of 12 inches, or more. This improvement may include scarification or overexcavation and replacement with moisture-conditioned and compacted engineered fill, as noted below.

Engineered fill material should be compacted by appropriate mechanical methods to 95 percent relative compaction, as evaluated by ASTM D 698 at a moisture content generally near optimum. The improvement below these areas should extend laterally to a distance that is equivalent to the depth of improvement beyond the embankment fill or pavement footprint.

As stated previously, the borings disclosed fill and alluvial deposits, consisting primarily of silty sand, clayey sand, and sandy clay. The laboratory testing indicates that some of the existing subgrade soils may have low R-values and/or a high percentage of material passing the No. 200 sieve and/or a high plasticity. Therefore, we recommend that the roadway subgrade areas that exhibit R-values less than 20 during construction be improved by overexcavation and replacement with suitable material. The depth of overexcavation should be as needed to provide 2 or more feet of suitable material beneath the pavement section. This improvement should extend laterally to a distance that is equivalent to the depth of improvement beyond the edge of the pavement. For areas to receive 2 or more feet of engineered fill, subgrade improvement is not needed, except as noted in preparation for fill placement, provided the upper 2 feet has an R-value of 20 or more. As an alternative, a geogrid may be placed beneath the AB layer on the exposed subgrade.

Engineered fill should be placed in horizontal lifts no more than approximately 8 inches in loose thickness and compacted by appropriate mechanical methods to a relative compaction of 95 percent as evaluated by ASTM D 698 and at a moisture content generally near optimum. An earthwork (shrinkage) factor of 5 to 15 percent for the on-site soils is estimated.

Following the overexcavation as described above, and prior to the placement of new fill, the resulting exposed surface should be carefully evaluated by Ninyo & Moore for the presence of soft, loose, or wet soils. Proof-rolling of the exposed surface should be observed by Ninyo & Moore. Based on this evaluation, additional remediation may be

needed. This could include scarification of the exposed surface. This additional remediation, if needed, should be addressed by the geotechnical consultant during the earthwork operations.

11.1.3. Imported Fill Material

Imported fill, if utilized, should consist of granular material meeting the specifications outlined in MAG Section 210. In addition, material needed within 3 feet of the roadway subgrade should have an R-value of 20 or more. Import material in contact with ferrous materials should preferably have low corrosion potential [minimum resistivity more than 2,000 ohm-cm, chloride content less than 25 parts per million (ppm)]. In lieu of this, corrosion protection techniques (e.g., cathodic protection, pipe wrapping, etc.) can be implemented. A corrosion specialist should be consulted for recommendations. Imported material in contact with concrete should have a soluble sulfate content of less than 0.1 percent. The geotechnical consultant should evaluate such materials and details of their placement prior to importation.

11.2. Pavement Design Summary

For the new pavements, we assume that an asphaltic concrete section will be used. The pavement section given below is assumed to bear on imported or improved on-site soils with an R-value of 20, or more. The pavement design was performed in general accordance with AASHTO Pavement Design Methods.

11.2.1. Traffic Volumes and Truck Factor Growth Rates

The traffic loading information used for the roadway design was obtained from T.Y. Lin International. For Hunt Highway, a two-way average daily traffic (ADT) value of 17,300 vehicles per day was used for this project along with 6 percent heavy trucks. An annual growth rate of 2 percent was used for the design of the roadway.

11.2.2. Resilient Modulus

As discussed above, a design R-value of 20 was used in our analysis. Based on an R-value of 20 and a seasonal variation factor of 1.3, a resilient modulus of 10,359 pounds per square inch (psi) was calculated.

11.2.3. Serviceability

An initial serviceability of 4.1 and a terminal serviceability of 2.6 were used for the design of flexible pavements. The resulting serviceability index loss is 1.5.

11.2.4. Standard Deviation and Level of Reliability

A standard deviation of 0.45 was used for the design of the roadway pavement. A level of reliability of 90 percent was used for the design. A standard normal deviation (Z_R) value of -1.282 was used for 90 percent reliability.

11.2.5. Pavement Design Recommendations

Based on the inputs noted above, the 20-year design Equivalent Single Axle Loads (ESALs) were calculated to be about 4,331,175, resulting in a structural number of 4.02 inches. Table 1 below presents our recommended pavement section for Hunt Highway between Gary Road and Bella Vista Road.

Table 1 – Recommended Pavement Section

Pavement Section	AC (in)	AB (in)	Pavement Section Thickness (in)
Hunt Highway; Gary Road to Bella Vista Road	7.0	10.0	17.0

The AC and AB gradation mentioned above should meet MAG or any Pinal County specifications.

As an alternative, if the subgrade is mechanically stabilized with a layer of geogrid reinforcement beneath the AB layer, the pavement section can be reduced to 6 inches of AC over 8 inches of AB over a triaxial TX-5 geogrid conforming to MAG Section 306, or better. If other geogrid types are considered, calculations should be submitted and approved by Pinal County demonstrating that they meet the design ESALs and structural number noted above.

11.2.6. Mill and Overlay

Based on our field observations and pavement core thicknesses, performing a mill and overlay is feasible for portions of this project, as noted previously. If this rehabilitation technique is adopted, we recommend that the existing pavement within the project limits be milled to a depth of 1.5 inches and overlain with 1.5 inches of rubberized AC or conventional hot-mix asphalt (HMA). Rubberized AC, however, tends to be more flexible and can retard reflection cracking better than HMA. It also has a tendency to reduce traffic-related noise.

If cracks larger than 1/4-inch wide are observed at the surface of the AC after the milling operation is finished, we recommend that a paving fabric or geotextile be incorporated into the pavement section. The paving fabric or geotextile should generally be centered on the crack, and should extend 6 or more inches laterally beyond the crack. For this application, we recommend that a 1/2-inch layer of gap-graded AC be placed on the milled surface and the paving fabric or geotextile be placed over this thin lift of AC. This thin lift of AC is recommended because the paving fabric or geotextile may have difficulty adhering to the milled surface due to the dust and surface roughness. After the pavement fabric or geotextile is applied, the remainder of the pavement overlay can be constructed.

For areas where high severity pavement distresses are apparent at the exposed roadway surface after the milling, and also in areas where the underlying soils or AB are exposed during milling operations, we recommend that the pavement section be removed and

replaced with a new pavement section. Prior to the placement of the new asphalt, the exposed subgrade and/or base should be evaluated for excessively loose or wet material. If encountered, the unacceptable material should either be removed and replaced or recompacted in place. Subgrade preparation guidelines as outlined in Section 11.1.2. should be followed. The expected design life of this option is estimated to be on the order of 5 years, provided that regular maintenance techniques are followed.

11.3. Corrosion

The corrosion potential was evaluated using the results of our laboratory testing on a soil sample obtained from one of our borings that was considered representative of the subsurface soils at the project site.

Laboratory testing consisted of pH, minimum electrical resistivity, and chloride and soluble sulfate contents. The pH and minimum electrical resistivity tests were performed in general accordance with Arizona Test 236b, while sulfate and chloride tests were performed in accordance with Arizona Tests 733 and 736, respectively. The results of the corrosivity tests are presented in Appendix B.

The pH of the selected soil sample was 7.8, which is considered to be alkaline. The minimum electrical resistivity of the sample tested was 1,370 ohm-cm, which is considered to be corrosive to ferrous materials. The chloride content of the sample tested was 25 ppm, which is also considered corrosive to ferrous materials. The soluble sulfate content of the samples tested was 0.013 percent by weight, which represents a negligible sulfate exposure to concrete.

The results of the chloride content and minimum electrical resistivity tests on the sample tested indicate that the materials are generally corrosive to ferrous materials. Based on our experience with other nearby projects, we recommend that special consideration be given to the use of heavy-gauge, corrosion-protected, underground steel pipe. As an alternative,

plastic pipe could be considered. A corrosion specialist should be consulted for further recommendations.

11.4. Concrete

Laboratory chemical tests performed on select soil samples from borings indicated a sulfate content of as much as 0.013 percent by weight. Based on the following tabulated American Concrete Institute (ACI) guidelines, the on-site soils should be considered to have a negligible sulfate exposure for concrete.

Table 2 – ACI Requirements for Concrete Exposed to Sulfate-Containing Soil

Sulfate Exposure	Water-Soluble Sulfate (SO_4) in Soil, Percentage by Weight	Cement Type	Water-Cementitious Materials Ratio, by Weight, Normal-Weight Aggregate Concrete[1]	f'_c, Normal-Weight and Lightweight Aggregate Concrete, psi x 0.00689 for MPa
Negligible	0.00 - 0.10	--	--	--
Moderate[2]	0.10 - 0.20	II, IP(MS), IS (MS)	0.50 or less	4,000 or more
Severe	0.20 - 2.00	V	0.45 or less	4,500 or more
Very severe	Over 2.00	V plus pozzolan[3]	0.45 or less	4,500 or more

Notes:
[1] A lower water-cementitious materials ratio or higher strength may be needed for low permeability or for protection against corrosion of embedded items or freezing and thawing (Table 19-A-2).
[2] Seawater.
[3] Pozzolan that has been evaluated by test or service record to improve sulfate resistance when used in concrete containing Type V cement.

Notwithstanding the sulfate test results and due to the limited number of chemical tests performed, as well as our experience with similar soil conditions and regional practice, we recommend that "Type II" cement be used for the construction of concrete structures at this site. Due to potential uncertainties as to the use of reclaimed irrigation water, or topsoil that

may contain higher sulfate contents, pozzolan, or admixtures designed to increase sulfate resistance may be considered.

The concrete should have a water-cementitious materials ratio no more than 0.50 by weight for normal weight aggregate concrete. The structural engineer should select the concrete design strength based on the project specific loading conditions. However, higher strength concrete may be selected for increased durability, resistance to slab curling and shrinkage cracking.

11.5. Site Drainage

Surface drainage should be provided to divert water away from the paved surfaces. Surface water should not be permitted to pond on or adjacent to pavement areas. To deter accumulation of water below the new pavement sections, the subgrade soils below the new pavement sections should be sloped away from the center toward the edges of the roadway.

Furthermore, given the close proximity of a documented earth fissure to the site, it is important that uncontrolled surface runoff not occur. The Civil Engineer should provide recommendations to address these concerns.

11.6. Pre-Construction Conference

We recommend that a pre-construction conference be held. Representatives of the owner, the civil engineer, the geotechnical consultant, and the contractor should be in attendance to discuss the project plans and schedule. Our office should be notified if the project description included herein is incorrect, or if the project characteristics are significantly changed.

11.7. Construction Observation and Testing

During construction operations, we recommend that Ninyo & Moore perform observation and testing services for the project. These services should be performed to evaluate exposed

subgrade conditions, including the extent and depth of overexcavation, to evaluate the suitability of proposed borrow materials for use as fill, and to observe placement and test compaction of fill soils. If another geotechnical consultant is selected to perform observation and testing services for the project, we request that the selected consultant provide a letter to the owner, with a copy to Ninyo & Moore, indicating that they fully understand our recommendations and that they are in full agreement with the recommendations contained in this report. Qualified subcontractors utilizing appropriate techniques and construction materials should perform construction of the proposed improvements.

12. LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant

perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

13. REFERENCES

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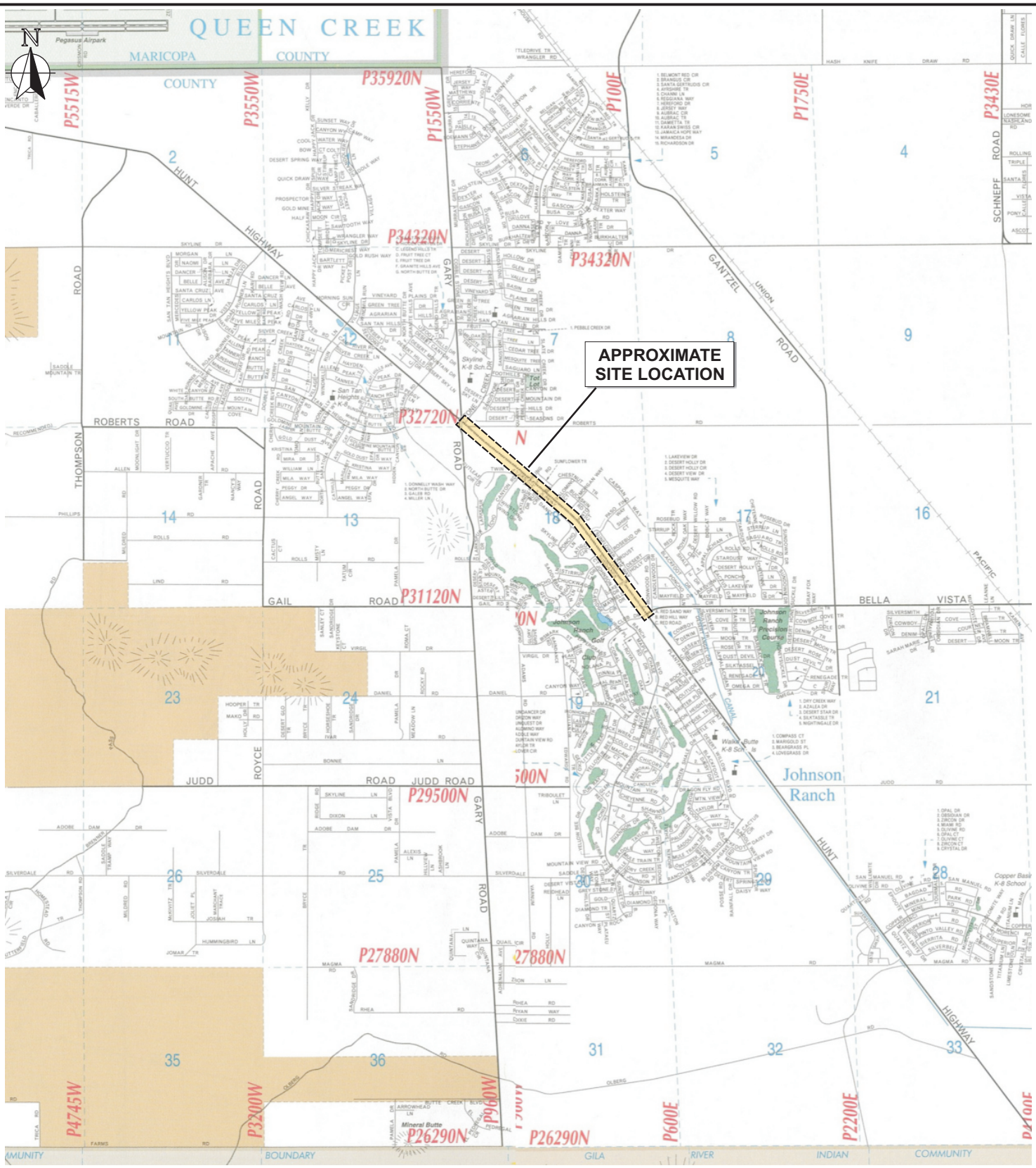
Referenced Aerial Photographs

Source	Photo Dates
Flood Control District of Maricopa County	1937, 2000, 2002
Google Earth™	1992, 2004, 2005, 2006, 2007, 2010, 2011, 2012, 2013

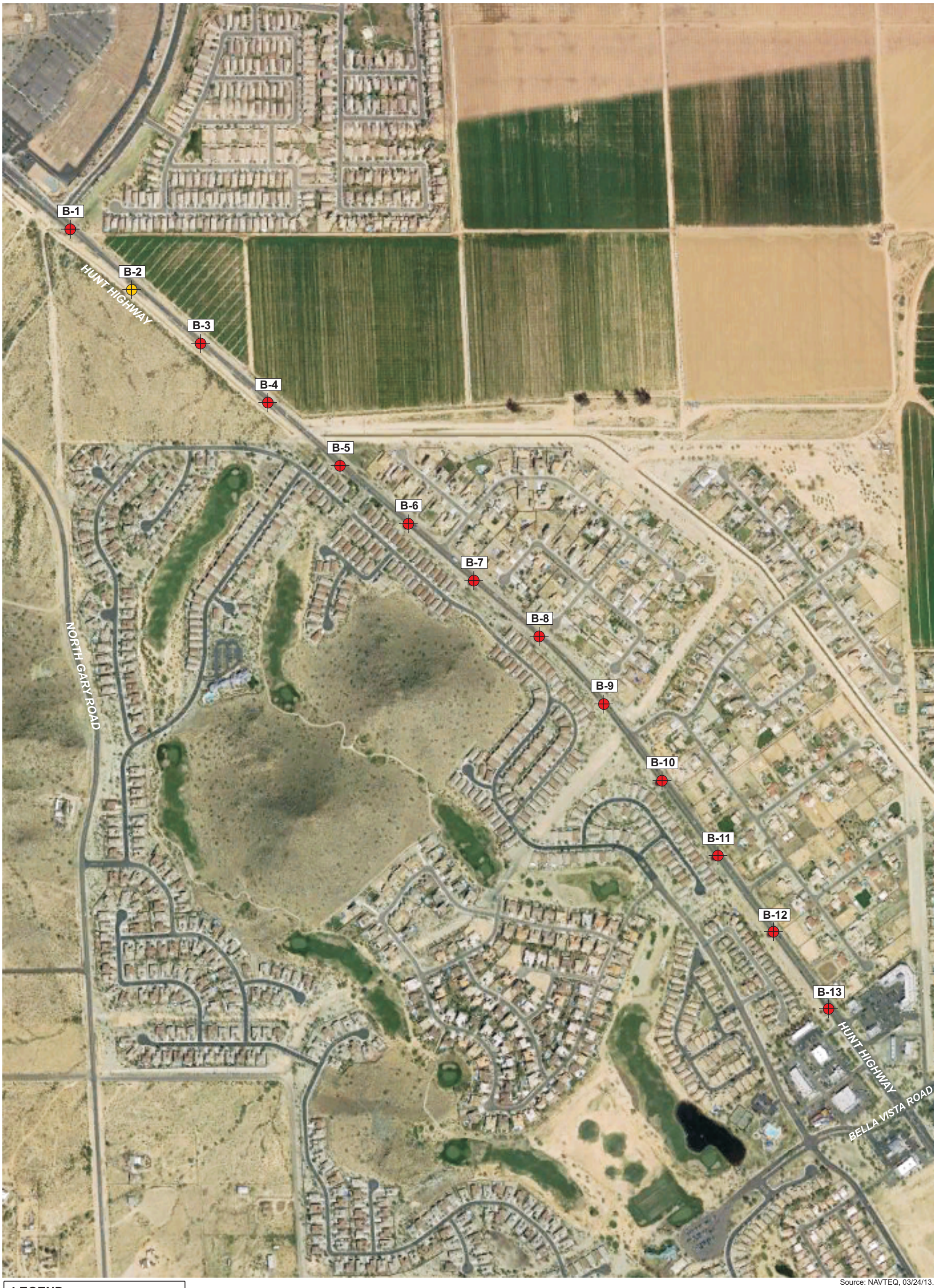


Source: Phoenix Mapping Service, Pinal County Edition, 2009.

Note: Dimensions, directions, and locations are approximate.

Ninyo & Moore		SITE LOCATION	FIGURE 1
PROJECT NO: 601868003	DATE: 1/14	HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD PINAL COUNTY, ARIZONA	

file no: 1868vmap0114



Source: NAVTEQ, 03/24/13.

LEGEND

B-13 Roadway Boring Location

B-2 Shoulder Boring Location

N

0 4000

Approximate Scale:
1 inch = 4000 feet

Note: Dimensions, directions, and locations are approximate.

file no: 1868blm0114a

Ninyo & Moore	BORING LOCATIONS	FIGURE
PROJECT NO: 601868003 / DATE: 1/14	HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD PINAL COUNTY, ARIZONA	2

APPENDIX A

BORING LOGS

Field Procedure for the Collection of Disturbed Samples

Disturbed soil samples were obtained in the field using the following methods.

Bulk Samples

Bulk samples of representative earth materials were obtained from the exploratory borings. The samples were bagged and transported to the laboratory for testing.

The Standard Penetration Test (SPT) Sampler

Disturbed drive samples of earth materials were obtained by means of a Standard Penetration Test sampler. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of 1-3/8 inches. The sampler was driven into the ground 12 to 18 inches with a 140-pound hammer falling freely from a height of 30 inches in general accordance with ASTM D 1586. The blow counts were recorded for every 6 inches of penetration; the blow counts reported on the logs are those for the last 12 inches of penetration. Soil samples were observed and removed from the sampler, bagged, sealed and transported to the laboratory for testing.

Field Procedure for the Collection of Relatively Undisturbed Samples

Relatively undisturbed soil samples were obtained in the field using the following methods.

The Modified Split-Barrel Drive Sampler

The sampler, with an external diameter of 3.0 inches, was lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sample barrel was driven into the ground with the weight of a 140-pound hammer in general accordance with ASTM D 3550. The driving weight was permitted to fall freely. The approximate length of the fall, the weight of the hammer, and the number of blows per foot of driving are presented on the boring logs as an index to the relative resistance of the materials sampled. The samples were removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

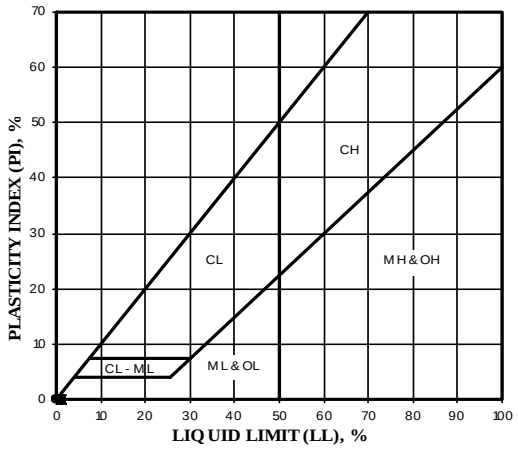
U.S.C.S. METHOD OF SOIL CLASSIFICATION

MAJOR DIVISIONS		SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (More than 1/2 of soil > No. 200 Sieve Size)	GRAVELS (More than 1/2 of coarse fraction > No. 4 sieve size	GW	Well graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 1/2 of coarse fraction < No. 4 sieve size	SW	Well graded sands or gravelly sands, little or no fines
		SP	Poorly graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (More than 1/2 of soil < No. 200 sieve size)	SILTS & CLAYS Liquid Limit <50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS Liquid Limit >50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils

GRAIN SIZE CHART

CLASSIFICATION	RANGE OF GRAIN	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	306 to 76.2
GRAVEL	3" to No. 4	76.2 to 4.76
Coarse	3" to 3/4"	76.2 to 19.1
Fine	3/4" to No. 4	19.1 to 4.76
SAND	No. 4 to No. 200	4.76 to 0.075
Coarse	No. 4 to No. 10	4.76 to 2.00
Medium	No. 10 to No. 40	2.00 to 0.420
Fine	No. 40 to No. 200	0.420 to 0.075
SILT & CLAY	Below No. 200	Below 0.075

PLASTICITY CHART



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U.S.C.S. METHOD OF SOIL CLASSIFICATION

Updated Nov. 2011

BORING LOG EXPLANATION SHEET

DEPTH (feet)	SAMPLES: Bulk	SAMPLES: Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	
0	■							Bulk sample.
		■						Modified split-barrel drive sampler.
		⊠						No recovery with modified split-barrel drive sampler.
		▮						Sample retained by others.
		◤						Standard Penetration Test (SPT).
5		◺						No recovery with a SPT.
		▯	XX/XX					Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.
		◺						No recovery with Shelby tube sampler.
		▯						Continuous Push Sample.
				⚲				Seepage.
10				▽				Groundwater encountered during drilling.
				▼				Groundwater measured after drilling.
						▨	SM	MAJOR MATERIAL TYPE (SOIL): Solid line denotes unit change.
						▨	CL	Dashed line denotes material change.
						▨		Attitudes: Strike/Dip b: Bedding c: Contact j: Joint f: Fracture F: Fault cs: Clay Seam s: Shear bss: Basal Slide Surface sf: Shear Fracture sz: Shear Zone sbs: Shear Bedding Surface
15						▨		
								The total depth line is a solid line that is drawn at the bottom of the boring.
20								

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BORING LOG

Explanation of Boring Log Symbols

PROJECT NO.	DATE	FIGURE

DATE DRILLED 12/03/13 BORING NO. B-1

GROUND ELEVATION 1,514' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 4.5" Diameter Solid Stem Auger (D&S Drilling)

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 4 inches thick.
							AGGREGATE BASE: Approximately 8 inches thick.
		51				SM	FILL: Brown, damp, medium dense, silty SAND; few gravel; scattered caliche filaments.
		26					
5							Total Depth = 5 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 12/03/13 shortly after completion of drilling.
							Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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Ninyo & Moore

BORING LOG

HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD
PINAL COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601868003	1/14	A-1

DATE DRILLED 12/03/13 BORING NO. B-2

GROUND ELEVATION 1,515' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 4.5" Diameter Solid Stem Auger (D&S Drilling)

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0		12				SM	FILL: Brown, damp, medium dense, silty SAND; trace gravel.
		50/5"					Very dense.
5							Total Depth = 4.4 feet. Groundwater not encountered during drilling. Backfilled on 12/03/13 shortly after completion of drilling. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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Ninyo & Moore

BORING LOG

HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD
PINAL COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601868003	1/14	A-2

DATE DRILLED 12/03/13 BORING NO. B-3

GROUND ELEVATION 1,517' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 4.5" Diameter Solid Stem Auger (D&S Drilling)

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 3 inches thick.
							AGGREGATE BASE: Approximately 6 inches thick.
		24	4.3	115.2		SM	FILL: Brown, damp, medium dense, silty SAND; scattered reworked caliche filaments.
5		57				SM	ALLUVIUM: Brown, damp, very dense, silty SAND; few gravel; scattered caliche nodules.
							Total Depth = 5 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 12/03/13 shortly after completion of drilling. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD
PINAL COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601868003	1/14	A-3

DATE DRILLED 12/03/13 BORING NO. B-4

GROUND ELEVATION 1,518' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 4.5" Diameter Solid Stem Auger (D&S Drilling)

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 3.5 inches thick.
							AGGREGATE BASE: Approximately 6 inches thick.
		20				SM	ALLUVIUM: Brown, damp, loose, silty SAND with gravel; scattered caliche filaments.
		50/4"					Very dense.
5							Total Depth = 4.3 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 12/03/13 shortly after completion of drilling. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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Ninyo & Moore

BORING LOG

HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD
PINAL COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601868003	1/14	A-4

DATE DRILLED 12/03/13 BORING NO. B-5

GROUND ELEVATION 1,520' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 4.5" Diameter Solid Stem Auger (D&S Drilling)

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 5 inches thick.
							AGGREGATE BASE: Approximately 7 inches thick.
		64	7.4	117.9		SC	ALLUVIUM: Brown, damp, dense, clayey SAND; few gravel.
		45					
5							Total Depth = 5 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 12/03/13 shortly after completion of drilling. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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Ninyo & Moore

BORING LOG

HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD
PINAL COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601868003	1/14	A-5

DATE DRILLED 12/03/13 BORING NO. B-6

GROUND ELEVATION 1,523' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 4.5" Diameter Solid Stem Auger (D&S Drilling)

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 5.5 inches thick.
							AGGREGATE BASE: Approximately 8 inches thick.
		36				SC	ALLUVIUM: Brown, damp, dense, clayey SAND.
		50/4"					Very dense; trace gravel.
5							Total Depth = 4.3 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 12/03/13 shortly after completion of drilling. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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Ninyo & Moore

BORING LOG

HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD
PINAL COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601868003	1/14	A-6

DATE DRILLED 12/03/13 BORING NO. B-7

GROUND ELEVATION 1,524' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 4.5" Diameter Solid Stem Auger (D&S Drilling)

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 5.5 inches thick.
							AGGREGATE BASE: Approximately 8 inches thick.
		50/5"				SM	ALLUVIUM: Brown, damp, very dense, silty SAND; few gravel.
		50/5"					
5							Total Depth = 3.9 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 12/03/13 shortly after completion of drilling. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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Ninyo & Moore

BORING LOG

HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD
PINAL COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601868003	1/14	A-7

DATE DRILLED 12/03/13 BORING NO. B-8

GROUND ELEVATION 1,527' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 4.5" Diameter Solid Stem Auger (D&S Drilling)

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 5 inches thick.
							AGGREGATE BASE: Approximately 6 inches thick.
		39				SC	ALLUVIUM: Brown, damp, dense, clayey SAND; scattered caliche nodules.
5		46	6.3	112.9			Medium dense. Total Depth = 5 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 12/03/13 shortly after completion of drilling. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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Ninyo & Moore

BORING LOG

HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD
PINAL COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601868003	1/14	A-8

DATE DRILLED 12/03/13 BORING NO. B-9

GROUND ELEVATION 1,532' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 4.5" Diameter Solid Stem Auger (D&S Drilling)

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 5 inches thick.
							AGGREGATE BASE: Approximately 7 inches thick.
		50/5"				SM	FILL: Brown, damp, very dense, silty SAND; few gravel.
		70				SC	ALLUVIUM: Brown, damp, very dense, clayey SAND; trace gravel.
5							Total Depth = 5 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 12/03/13 shortly after completion of drilling. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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Ninyo & Moore

BORING LOG

HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD
PINAL COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601868003	1/14	A-9

DATE DRILLED 12/03/13 BORING NO. B-10

GROUND ELEVATION 1,531' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 4.5" Diameter Solid Stem Auger (D&S Drilling)

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 5.5 inches thick.
							AGGREGATE BASE: Approximately 9 inches thick.
		17				SM	ALLUVIUM: Brown, damp, medium dense, silty SAND; few gravel.
		75/11"					Dense.
5							Total Depth = 4.9 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 12/03/13 shortly after completion of drilling. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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Ninyo & Moore

BORING LOG

HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD
PINAL COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601868003	1/14	A-10

DATE DRILLED 12/03/13 BORING NO. B-11

GROUND ELEVATION 1,532' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 4.5" Diameter Solid Stem Auger (D&S Drilling)

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 5 inches thick.
							AGGREGATE BASE: Approximately 7 inches thick.
		78				SM	ALLUVIUM: Brown, damp, dense, silty SAND; trace gravel.
		72				SC	Brown, damp, very dense, clayey SAND; scattered caliche nodules.
5							Total Depth = 5 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 12/03/13 shortly after completion of drilling. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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Ninyo & Moore

BORING LOG

HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD
PINAL COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601868003	1/14	A-11

DATE DRILLED 12/03/13 BORING NO. B-12

GROUND ELEVATION 1,532' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 4.5" Diameter Solid Stem Auger (D&S Drilling)

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 4 inches thick.
							AGGREGATE BASE: Approximately 9 inches thick.
		23				SM	FILL: Brown, damp, medium dense, silty SAND; trace to few gravel.
		43					
5							Total Depth = 5 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 12/03/13 shortly after completion of drilling.
							Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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Ninyo & Moore

BORING LOG

HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD
PINAL COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601868003	1/14	A-12

DATE DRILLED 12/03/13 BORING NO. B-13

GROUND ELEVATION 1,530' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 4.5" Diameter Solid Stem Auger (D&S Drilling)

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 6 inches thick.
							AGGREGATE BASE: Approximately 8 inches thick.
		42	20.1	103.4		CL	ALLUVIUM: Brown, damp, hard, sandy lean CLAY; few gravel; scattered caliche nodules.
		41					
5							Total Depth = 5 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 12/03/13 shortly after completion of drilling. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
10							
15							
20							

Ninyo & Moore

BORING LOG

HUNT HIGHWAY; GARY ROAD TO BELLA VISTA ROAD
PINAL COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
601868003	1/14	A-13

APPENDIX B

LABORATORY TESTING

Classification

Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the logs of the exploratory borings in Appendix A.

In-Place Moisture and Density Tests

The moisture content and dry density of relatively undisturbed samples obtained from the exploratory borings were evaluated in general accordance with ASTM D 2937. The test results are presented on the logs of the exploratory borings in Appendix A.

Gradation Analysis

Gradation analysis tests were performed on selected representative soil samples in general accordance with ASTM D 422. The grain-size distribution curves are shown on Figures B-1 through B-5. These test results were utilized in evaluating the soil classifications in accordance with the USCS.

Atterberg Limits

Tests were performed on selected representative fine-grained soil samples to evaluate the liquid limit, plastic limit, and plasticity index in general accordance with ASTM D 4318. These test results were utilized to evaluate the soil classification in accordance with the USCS. The test results and classifications are shown on Figure B-6.

Consolidation Tests

Consolidation tests were performed on selected relatively undisturbed soil samples in general accordance with ASTM D 2435. The samples were inundated during testing to represent adverse field conditions. The percent of consolidation for each load cycle was recorded as a ratio of the amount of vertical compression to the original height of the sample. The results of the tests are summarized on Figures B-7 and B-8.

Maximum Dry Density and Optimum Moisture Content Tests

The maximum dry density and optimum moisture content of a selected representative soil sample was evaluated in general accordance with ASTM D 698. The result of this test is summarized on Figure B-9.

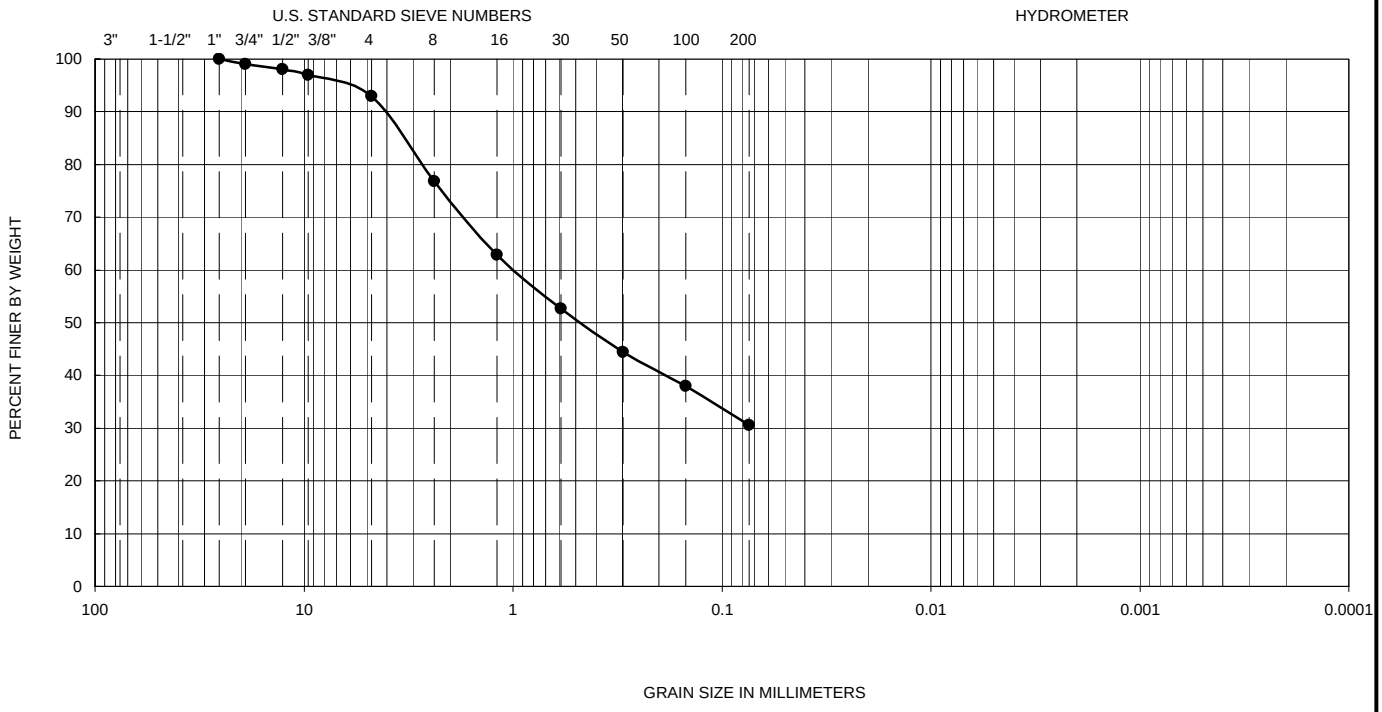
Soil Corrosivity Tests

Soil pH and resistivity tests were performed on a representative sample in general accordance with Arizona Test Method 236b. The soluble sulfate and chloride contents of a selected sample was evaluated in general accordance with Arizona Test Method 733 and Arizona Test Method 736, respectively. The test results are presented on Figure B-10.

R-Value

The resistance value, or R-value, for site soils was evaluated in general accordance with ASTM D 2844. Samples were prepared and evaluated for exudation pressure and expansion pressure. The equilibrium R-value is reported as the lesser or more conservative of the two calculated results. The test results are shown on Figure B-11.

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



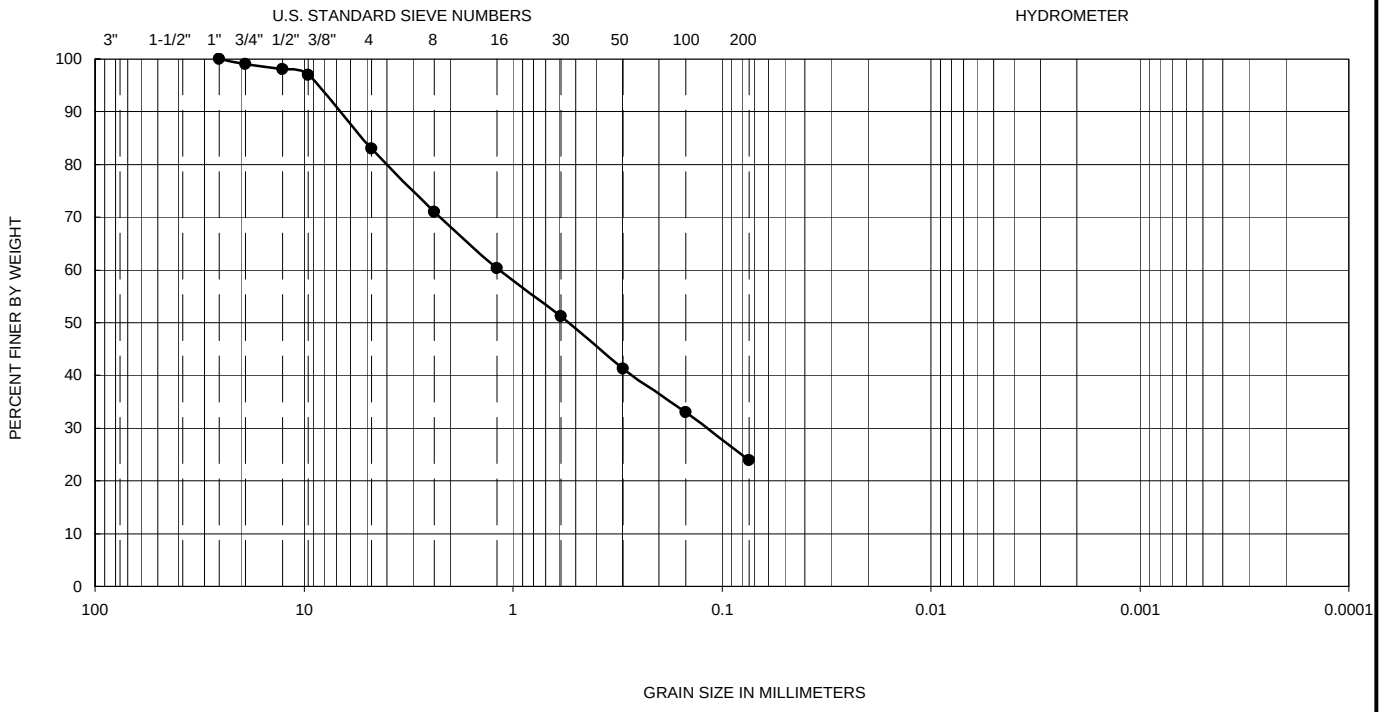
Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-1	1.0-5.0	--	--	NP	--	--	--	--	--	31	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

NP - INDICATES NON-PLASTIC

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	HUNT HIGHWAY GARY ROAD TO BELLA VISTA ROAD PINAL COUNTY, ARIZONA	B-1
601868003 / 1/14		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



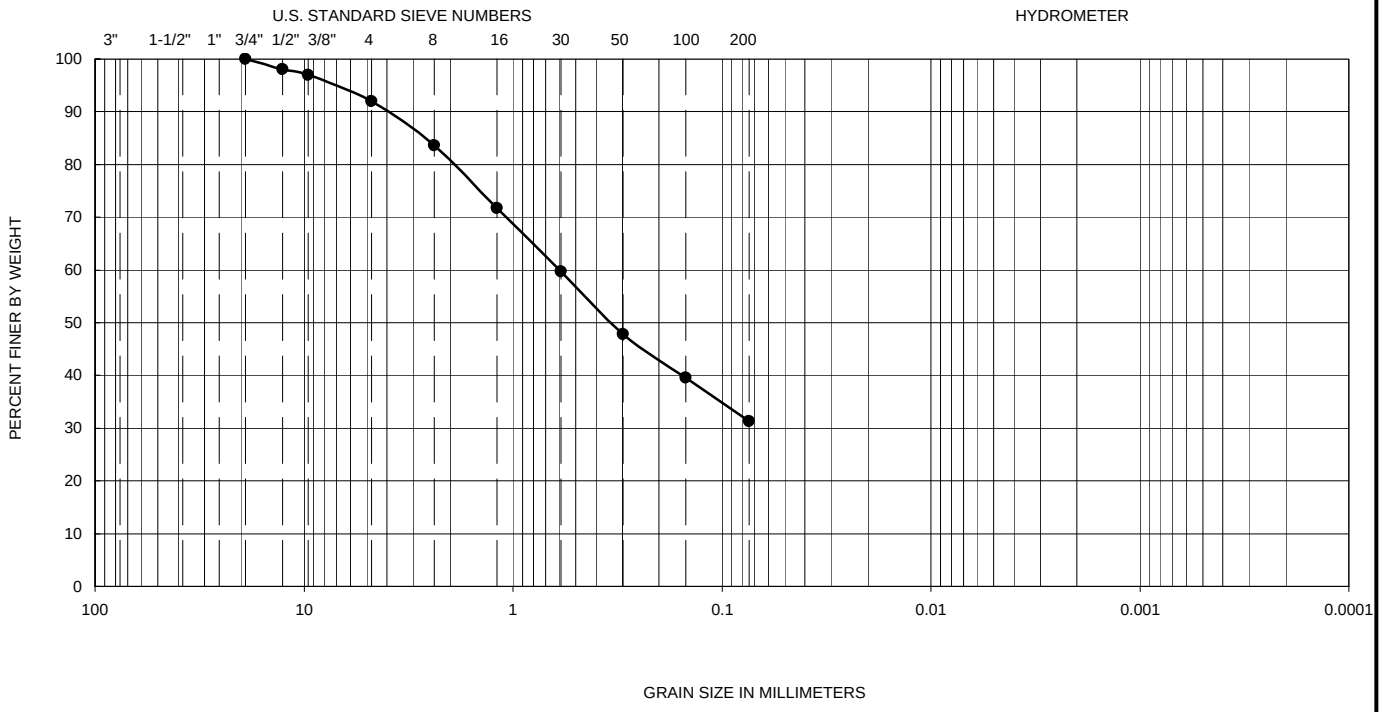
Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-4	1.0-4.3	--	--	NP	--	--	--	--	--	24	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

NP - INDICATES NON-PLASTIC

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	HUNT HIGHWAY GARY ROAD TO BELLA VISTA ROAD PINAL COUNTY, ARIZONA	B-2
601868003 / 1/14		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



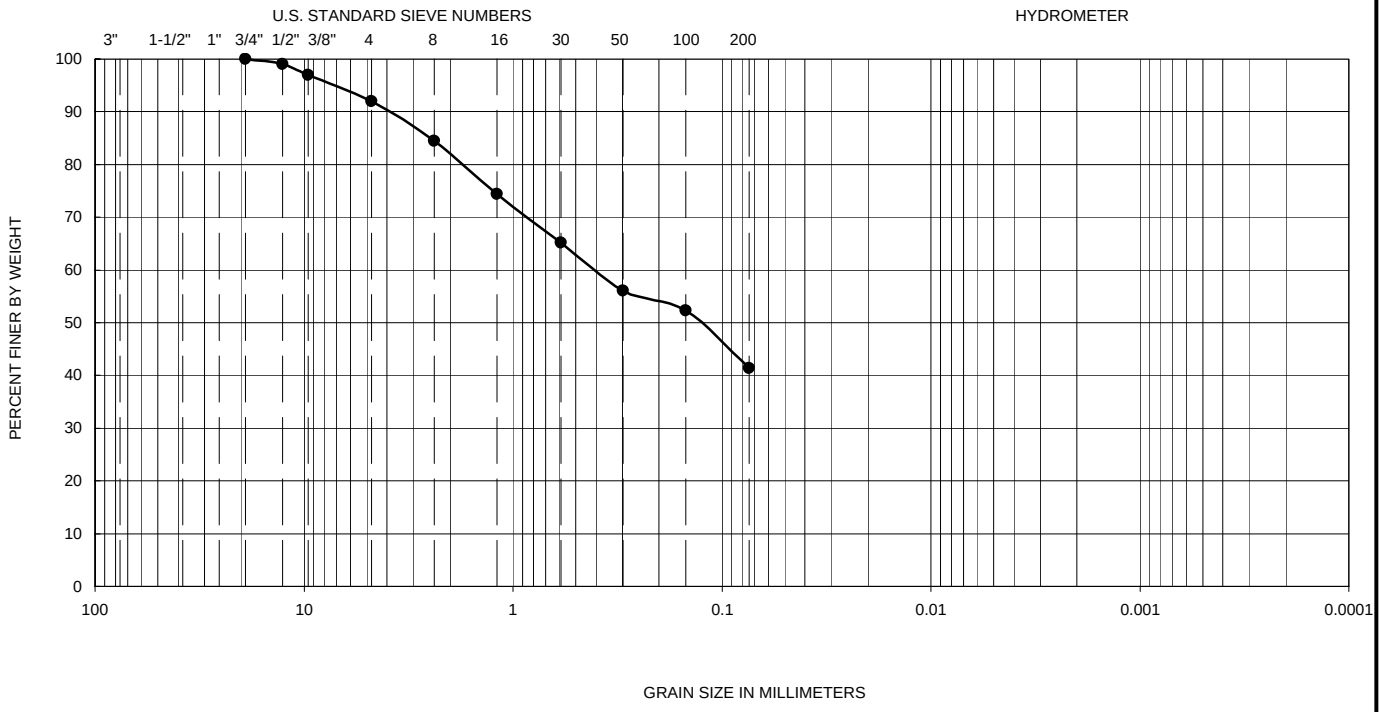
Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-7	1.0-3.9	--	--	NP	--	--	--	--	--	31	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

NP - INDICATES NON-PLASTIC

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	HUNT HIGHWAY GARY ROAD TO BELLA VISTA ROAD PINAL COUNTY, ARIZONA	B-3
601868003 / 1/14		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



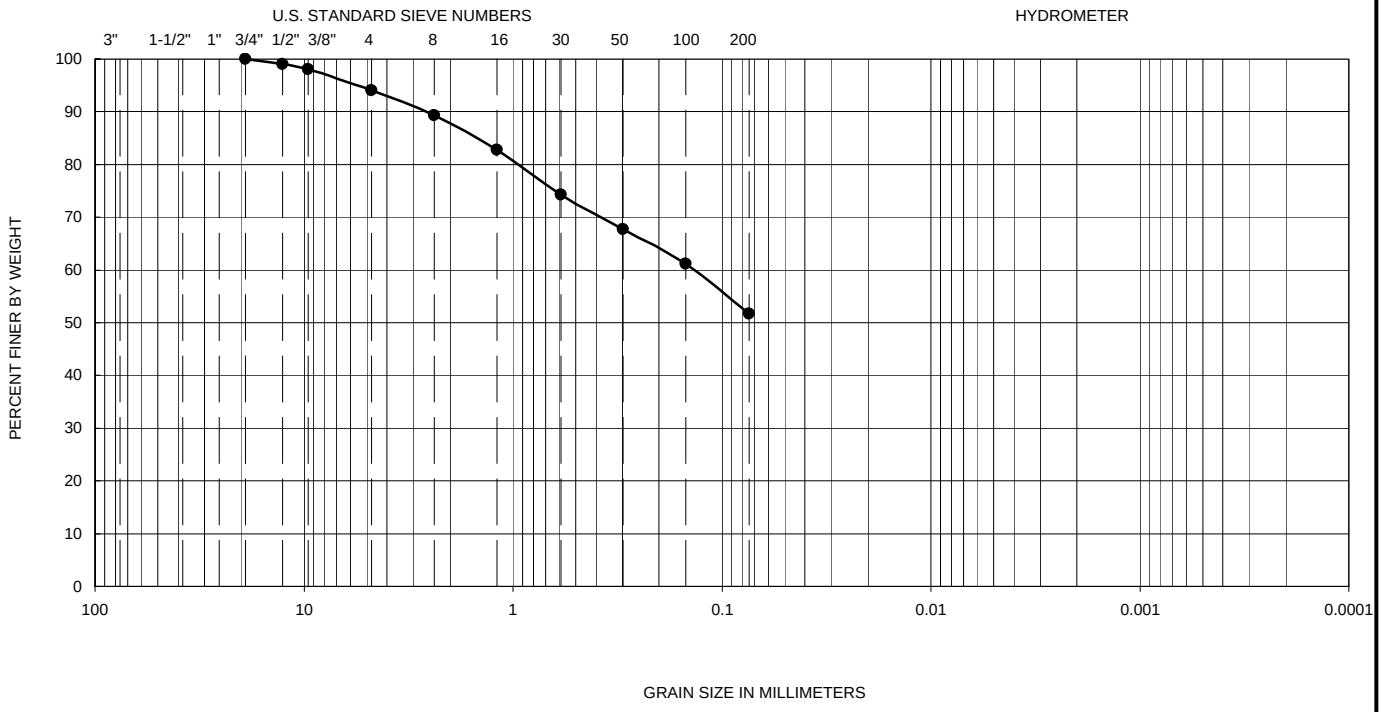
Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-10	1.0-4.9	--	--	NP	--	--	--	--	--	41	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

NP - INDICATES NON-PLASTIC

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	HUNT HIGHWAY GARY ROAD TO BELLA VISTA ROAD PINAL COUNTY, ARIZONA	B-4
601868003 / 1/14		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



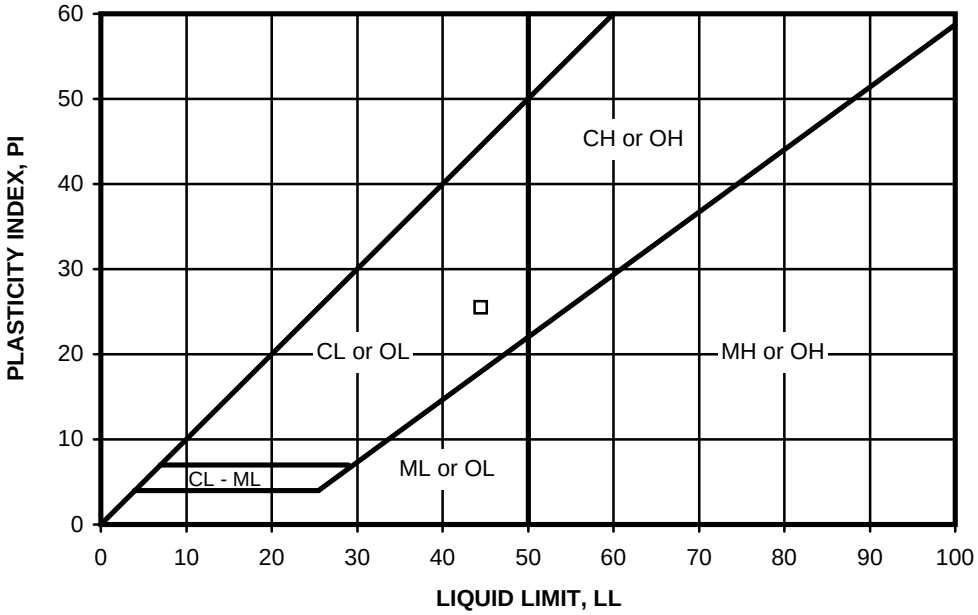
Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-13	1.0-5.0	45	19	26	--	--	--	--	--	52	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	HUNT HIGHWAY GARY ROAD TO BELLA VISTA ROAD PINAL COUNTY, ARIZONA	B-5
601868003 / 1/14		

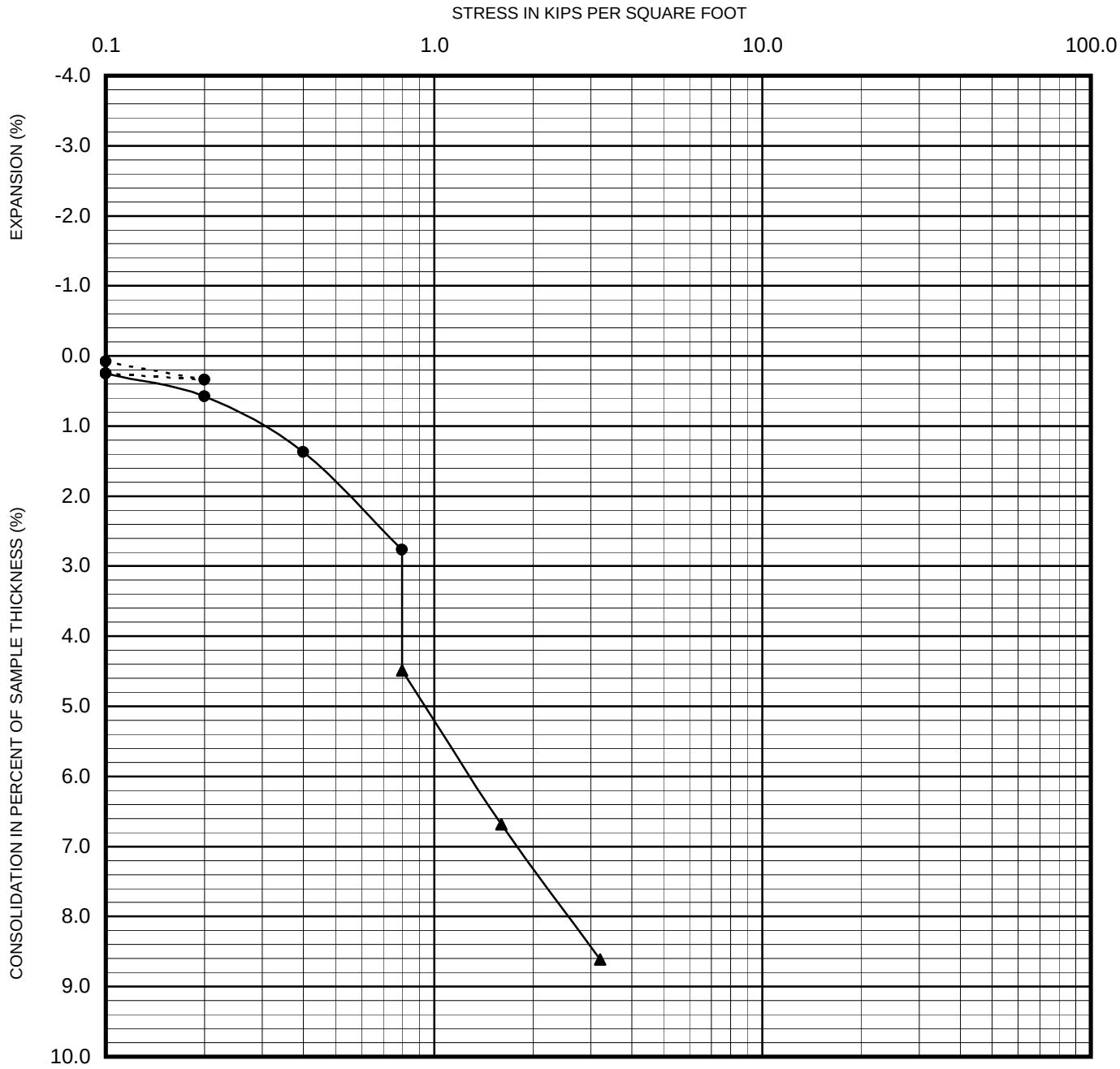
SYMBOL	LOCATION	DEPTH (FT)	LIQUID LIMIT, LL	PLASTIC LIMIT, PL	PLASTICITY INDEX, PI	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS (Entire Sample)
●	B-1	1.0-5.0	--	--	NP	ML	SM
■	B-4	1.0-4.3	--	--	NP	ML	SM
◆	B-7	1.0-3.9	--	--	NP	ML	SM
○	B-10	1.0-4.9	--	--	NP	ML	SM
□	B-13	1.0-5.0	45	19	26	CL	CL

NP - INDICATES NON-PLASTIC



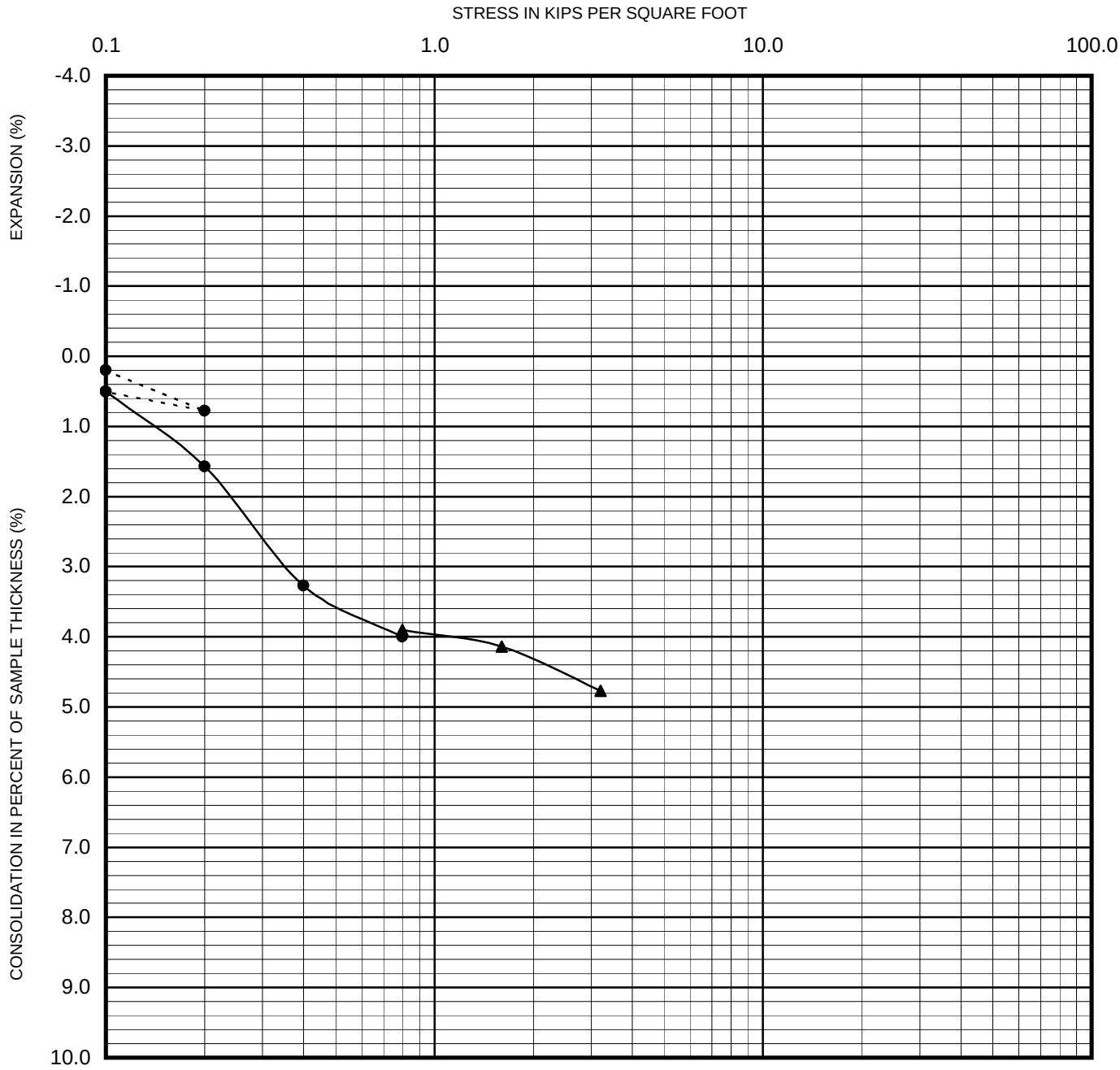
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

Ninyo & Moore	ATTERBERG LIMITS TEST RESULTS	FIGURE
PROJECT NO. 601868003 / DATE 1/14	HUNT HIGHWAY GARY ROAD TO BELLA VISTA ROAD PINAL COUNTY, ARIZONA	B-6



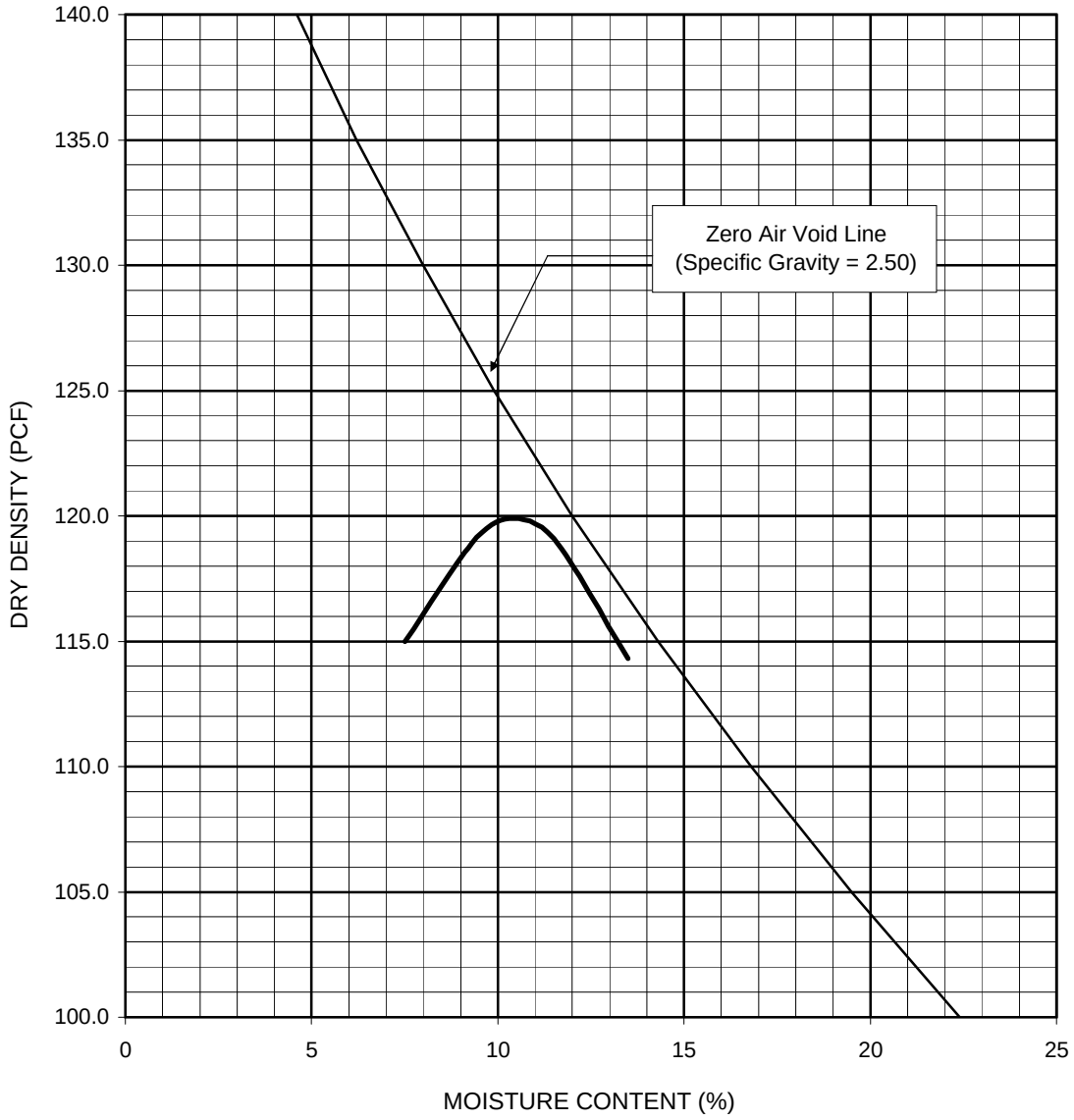
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

Ninyo & Moore	CONSOLIDATION TEST RESULTS	FIGURE
PROJECT NO. 601868003 / DATE 1/14	HUNT HIGHWAY GARY ROAD TO BELLA VISTA ROAD PINAL COUNTY, ARIZONA	B-7



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

Ninyo & Moore	CONSOLIDATION TEST RESULTS	FIGURE
PROJECT NO. 601868003 / DATE 1/14	HUNT HIGHWAY GARY ROAD TO BELLA VISTA ROAD PINAL COUNTY, ARIZONA	B-8



Sample Location	Depth (ft)	Soil Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
B-5	1.0-5.0	CLAYEY SAND	119.9	10.3
Dry Density and Moisture Content Values Corrected for Oversize (ASTM D 4718-87)			123.0	9.0

PERFORMED IN GENERAL ACCORDANCE WITH ☐ ASTM D 1557 ☑ ASTM D 698 METHOD ☑ A ☐ B ☐ C

Ninyo & Moore		PROCTOR DENSITY TEST RESULTS	FIGURE
PROJECT NO.	DATE	HUNT HIGHWAY GARY ROAD TO BELLA VISTA ROAD PINAL COUNTY, ARIZONA	B-9
601868003	1/14		

SAMPLE LOCATION	SAMPLE DEPTH (FT)	pH [1]	RESISTIVITY [1] (Ohm-cm)	SULFATE CONTENT [2]		CHLORIDE CONTENT [3] (ppm)
				(ppm)	(%)	
B-8	1.0-5.0	7.8	1,370	125	0.013	25

[1] PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD 236b

[2] PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD 733

[3] PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD 736

Ninyo & Moore	CORROSIVITY TEST RESULTS	FIGURE
PROJECT NO. 601868003 / DATE 1/14	HUNT HIGHWAY GARY ROAD TO BELLA VISTA ROAD PINAL COUNTY, ARIZONA	B-10

SAMPLE LOCATION	SAMPLE DEPTH (FT)	SOIL TYPE	R-VALUE
B-4	1.0-4.3	SM	26
B-10	1.0-4.9	SM	38

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844

Ninyo & Moore		R-VALUE TEST RESULTS	FIGURE
PROJECT NO.	DATE	HUNT HIGHWAY GARY ROAD TO BELLA VISTA ROAD PINAL COUNTY, ARIZONA	B-11
601868003	1/14		