GEOTECHNICAL EVALUATION
GUADALUPE ROAD
MERIDIAN ROAD TO DELAWARE DRIVE
APACHE JUNCTION, ARIZONA

PREPARED FOR:
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April 3, 2015
Project No. 604516001

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Mr. Robert Iannarino, PE
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4600 East Washington Street, Suite 300
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Subject: Geotechnical Evaluation
Guadalupe Road
Meridian Road to Delaware Drive
Apache Junction, Arizona

Dear Mr. Iannarino:

In accordance with our proposal dated June 23, 2014, and your authorization, Ninyo & Moore has performed a geotechnical evaluation for the above-referenced project. The attached report describes our methodology, findings, conclusions, and recommendations regarding the geologic and geotechnical conditions along the project alignment.

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

Sincerely,
NINYO & MOORE

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Project Manager

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ARIZONA U.S.A.
EXPIRES 06/30/2015

SNP/HAH/SG/SDN/hmf

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1. INTRODUCTION

In accordance with our proposal dated June 23, 2014, we have performed a geotechnical evaluation for the proposed improvements to Guadalupe Road from Meridian Road to Delaware Drive in Apache Junction, Arizona. The purpose of our study was to evaluate the existing subsurface conditions along the project alignment in order to formulate geotechnical recommendations for the design and construction of the new roadway. This report presents the results of our evaluation and our geotechnical conclusions and recommendations regarding the proposed roadway.

2. SCOPE OF SERVICES

The scope of our services for this phase of the project generally included:

- Reviewing readily available aerial photographs and published geologic literature, including maps and reports pertaining to the project site and vicinity.
- Conducting a field trip to mark out exploration locations.
- Notifying Arizona Blue Stake of the proposed boring locations prior to excavating.
- Manually excavating, logging, and sampling four exploratory borings along the proposed project alignment to depths of up to approximately 5 feet below the ground surface (bgs). The boring logs are presented in Appendix A.
- Laboratory testing on selected soil samples to evaluate in-situ moisture content and dry density, gradation, Atterberg limits, consolidation (response-to-wetting), and corrosion 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 to present our findings, conclusions, and geotechnical recommendations.

Our scope of services did not include the optional tasks as described in our proposal, which included a geologic mapping of possible earth fissure alignments, seismic refraction surveys, and/or the excavation of test pits to evaluate the presence of earth fissures immediately beneath the surface. Our scope of services did not include on-site environmental consulting services, such

as hazardous waste sampling or analytical testing. 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 the border of Section 6 and 7 in Township 1 South, Range 8 East of the Gila-Salt River Baseline and Meridian along Guadalupe Road from Meridian Road to Delaware Drive in Apache Junction, Arizona. The general location of the project is shown on the Site Location Map (Figure 1). At the time of our evaluation, Guadalupe Road consisted of a two-lane, east-west trending, unpaved roadway bordered by commercial/industrial and residential development to the north and west and undeveloped desert land to the east and south. Within the project limits, Desert View Drive, Warner Drive, and Pinal Drive intersect Guadalupe Road from the north. The site is relatively flat with scattered desert vegetation on the undeveloped parcels. The Central Arizona Project (CAP) canal is located approximately 3,000 feet to the east of the project site.

According to the *Desert Well, 7.5-Minute United States Geological Survey* (USGS) *Topographic Quadrangle Map* (USGS, 2011), the elevation of the project site ranges from approximately 1,517 feet relative to mean sea level (MSL) at the western limits of the project site to approximately 1,545 feet relative to MSL at the eastern limits of the project site. Based on information presented on this map, the regional topography generally slopes gently from the northeast down to the southwest.

Several aerial photographs from Google Earth™ and the Flood Control District of Maricopa County (FCDMC) were reviewed for this project. Aerial photographs dated 1937 and 1953 depicted the site as undeveloped desert land that was dissected by many northeast-southwest traversing natural drainages; Guadalupe Road and the surrounding streets were not depicted in these photographs. Earth fissure lineaments were not observed in the 1937 and 1953 photographs, but were observed in the 1992 aerial photograph crossing the alignment of

Guadalupe Road between Meridian Road and South Pinal Drive and between Warner Drive and Desert View Drive. Earth fissures are discussed in more detail in Section 7.1 of this report.

The western portion of Guadalupe Road was depicted as an unpaved, but visibly well-traveled, roadway in the 2002 photograph, with some grading in the surrounding areas. Aerial photographs dated 2004 and later depict increased, scattered development along the northern and western boundaries of the project alignment with graded lots on the north side of Guadalupe Road and undeveloped, desert land on the south side. A 2014 aerial photograph depicted the site as being similar to its current condition as a dirt road and 2-lane asphalt concrete (AC) paved section.

4. PROPOSED CONSTRUCTION

We understand that this project includes improvements to Guadalupe Road from Meridian Road to Delaware Drive, a distance of approximately 3,600 feet. Roadway improvements will consist of the construction of new AC and Portland cement concrete (PCC) pavement sections whose final grades will match existing, with no planned structures and/or underground utilities considered.

5. FIELD EXPLORATION AND LABORATORY TESTING

On August 27, 2014, Ninyo & Moore conducted a subsurface exploration, which consisted of manually excavating, logging, and sampling of four, small-diameter borings along the proposed project alignment. The approximate boring locations are shown on Figure 2, and are enumerated B-1 through B-4. The borings were drilled using hand auger equipment to depths of about 5 feet bgs. Bulk and relatively undisturbed soil samples were collected at selected intervals. Detailed descriptions of the soils encountered at each boring location are presented on the boring logs in Appendix A.

The soil samples collected from our drilling activities were transported to the Ninyo & Moore laboratory in Phoenix, Arizona, for geotechnical laboratory testing. The testing included in-situ moisture content and dry density, gradation, Atterberg limits, consolidation (response-to-

wetting), 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. GEOLOGY AND SUBSURFACE CONDITIONS

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

6.1. Geologic Setting

The project site is located in the Sonoran Desert Section of the Basin and Range Physiographic Province, which is typified by broad alluvial valleys separated by steep, discontinuous, 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 age. 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 deposition from rivers. Coarser-grained alluvial material was deposited at the margins of the basins near the mountains.

The surficial geology of the site is described as being fine-grained Holocene (less than 10,000 years) to Late Pleistocene-age (10,000 to 100,000 years) alluvial deposits with some very young (less than 500 years) channel deposits (Huckleberry, 1994). The United States Department of Agriculture (USDA) Web Soil Survey described the site as generally varying from fine sandy loam to clay loam across the alignment. Loam is an agricultural soil

classification that refers to a soil comprised of a mixture of clay, silt, and sand. A clay loam indicates a higher percentage of clay in the mixture.

6.2. 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. The following sections provide a generalized description of the materials encountered. More detailed descriptions are presented on the boring logs in Appendix A.

6.2.1. Fill

Fill was encountered in borings B-2, B-3, and B-4 and extended to depths ranging from about 2 inches to 2.5 feet bgs. The fill generally consisted of dry, loose, silty sand in borings B-2 and B-3 and medium dense, poorly graded gravel with silt and sand in B-4.

6.2.2. Alluvium

Alluvium was encountered at the ground surface or below the fill soils in our borings. The alluvium extended to the total depths explored. This material generally consisted of dry, loose to medium dense, clayey sand with varying amounts of gravel in our borings.

6.3. Groundwater

Groundwater was not encountered in our borings. Based on well data from the Arizona Department of Water Resources (ADWR), the approximate depth to regional groundwater in the vicinity of the site is approximately 485 feet bgs. Groundwater levels can fluctuate due to seasonal variations, groundwater withdrawal or injection flows within nearby washes or drainages, irrigation, and other factors.

7. GEOLOGIC HAZARDS

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

7.1. 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). Ninyo & Moore reviewed land subsidence maps and available Synthetic Aperture Radar Interferometry (InSAR) imagery from the ADWR website. InSAR is an application used to measure the rate of ground subsidence by measuring subtle changes in the ground surface elevation versus time. To monitor elevation changes, elevation data points are collected at separate passes during satellite orbits and the change in elevation is depicted on an interferogram image.

According to the information from ADWR, the project site lies within the Hawk Rock Area of East Mesa and Apache Junction land subsidence feature. The InSAR data that compared satellite passes on May 17, 1992, and April 19, 2000, indicated that about 0 to 5 centimeters of subsidence had occurred at some locations within the project limits within the approximate 8-year timespan. The InSAR data that compared satellite passes on October 20, 2004, and September 29, 2010, indicated that about 0 to 2 centimeters of subsidence had occurred at some locations during the approximate 6-year timespan. The InSAR data on the more recent available imagery was obtained by comparing satellite passes on May 15, 2010, and March 31, 2014. Based on the InSAR data from ADWR, subsidence of about 0 to 1 centimeter has occurred at some locations during the approximate 3-year timespan. Therefore, within the last approximately 20 years, up to about 8 centimeters (or 3.2 inches) of subsidence has been measured in the project area. Historic subsidence may have also occurred prior to ADWR's 1992 measurements.

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, earth fissures are present and underlying the project alignment (Arizona Geologic Survey [AZGS], 2008). Per the AZGS map legend, solid black lines represent the location of earth fissures manifested as open cracks or gullies, solid red lines represent the location of discontinuous earth fissures manifested as elongated to circular depressions or as abbreviated or irregular (frequently representing an incipient surface expression of an earth fissure), and green lines represent the approximate locations of unconfirmed earth fissures, defined as fissures which could not be checked by surface evaluations by AZGS, but have previously been reported by Professional Geologists in published documents or maps. As depicted on Figure 3, there are two earth fissures that bisect and/or are intersected by the Guadalupe Road alignment; the first is observed as being between Meridian Road and Pinal Drive (solid green line on AZGS map) and the second is observed as being between Warner Drive and Desert View Drive (solid black line on AZGS map). Although earth fissure mapping was not included in our scope of services, per Figure 3, open cracks or gullies and unconfirmed earth fissures exist along the alignment of Guadalupe Road between Meridian Road and Delaware Drive. Mitigation techniques discussed in Section 9.3 should be considered for the design and construction of the roadway.

7.2. 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 fault to the site is the Sugarloaf fault zone, located approximately 23 miles to the northeast of the site (Pearthree, 1998). Approximately 2 meters of displacement has occurred along this fault within middle to upper Pleistocene deposits, but the latest Pleistocene and Holocene alluvium are not faulted.

8. CONCLUSIONS

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

- The on-site materials are considered generally excavatable with heavy-duty earthmoving equipment in good operating condition. Gravel deposits were encountered in our borings, which may be more difficult to excavate and may slow the rate of excavation during construction.

- Imported soils and soils generated from on-site excavation activities that exhibit very low to low swell potential and low plasticity indices can generally be used as engineered fill.

- Groundwater was not observed in our borings. The groundwater table in the area is anticipated to be located, based on historic nearby well data, at a depth of approximately 485 feet bgs.

- Documented earth fissures are present within the project limits. In addition, up to about 3 inches of subsidence has occurred in the project area over the past 20 years. Continued groundwater withdrawal in the area may result in further subsidence of the valley and the formation of new fissures or the extension of existing fissures. Future land subsidence in the project area is possible and should be considered in the design of grade-sensitive elements, if any are planned. Earth fissure mitigation recommendations are presented herein, and should be implemented where earth fissures cross the alignment.

- We did not perform earth fissure mapping per our scope of services.

- Corrosivity test results indicate that subgrade materials may be mildly corrosive to ferrous metals and the sulfate content of the soils presents a negligible sulfate exposure to concrete.

9. RECOMMENDATIONS

Based on our understanding of the project, the following sections present our geotechnical recommendations for the proposed design and construction. If the proposed construction is changed from that discussed in this report, Ninyo & Moore should be contacted for additional recommendations.

9.1. General Earthwork

The following sections provide our earthwork recommendations for this project. In general, we understand that Pinal County generally follows the earthwork specifications contained in Maricopa Association of Governments (MAG), *Uniform Standard Specifications and Details for Public Works Construction.* These specifications are expected to apply unless specifically noted.

9.1.1. Excavations

Our evaluation of the excavation characteristics of the site soils 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 site soils can generally be accomplished using heavy-duty excavation equipment in good working condition. However, gravel was encountered in some of our borings. This material might be more difficult to excavate and might slow the excavation rate depending on the actual particle size 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.

We understand that underground utilities may exist within the project area. It may be desirable to recognize utilities, underground structures, or other features that are near the planned construction and to survey or document (e.g., photographs, video, official

documentation, etc.) their pre-construction condition. The findings of the survey could be used to document any damage that might result from this project.

The contractor should provide safely sloped excavations or an adequately constructed braced shoring system, in compliance with Occupational Safety and Health Administration (OSHA) guidelines, for employees working in an excavation that may expose them to the danger of moving ground. If construction or earth material is stored or equipment is operated near an excavation, flatter slope geometry or stronger shoring should be used during construction.

9.1.2. 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 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 tests performed on selected samples from our borings resulted in PI values of 10 and 11. As such, it is our opinion that the on-site soils will probably be suitable for re-use as engineered fill during construction. Because our borings were 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 should be performed 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 30, 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 new pavement and flatwork, we recommend that the existing materials be improved to a depth of 24 inches, or more. This improvement may include scarification or overexcavation and replacement with moisture-conditioned and compacted engineered fill, as noted below. The improvement below these areas should extend laterally to a distance that is equivalent to the depth of improvement.

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 moisture content generally near optimum. An earthwork (shrinkage) factor of 5 to 15 percent for the on-site soils is estimated.

Following the remedial grading as described above, and prior to the placement of new fill or pavement, 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 Ninyo & Moore during the earthwork operations.

9.1.3. 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 2 feet of the roadway subgrade should have an R-value of 30 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.

9.2. Pavement Design Summary

Based on our evaluation, for areas to receive new pavement, we assume that AC and PCCP sections will be used. In summary, the recommended roadway section for this project consists of 6 inches of AC over 7 inches of Aggregate Base (AB), except for the roadway segment crossing the wash where 6 inches of PCCP over 7 inches of AB is recommended. An alternative roadway section consisting of 2 inches of AC over 6 inches of AB section may be used for low traffic volume segments of the project (less than 85 vehicles per day for two-way Average Daily Traffic [ADT] and less than 85,032 Equivalent Single Axle Loads [ESALs]). The pavement sections given are assumed to bear on imported or improved on-site soils as described in Section 9.1.3. with an R-value of 30, or more. The pavement design was performed in general accordance with American Association of State Highway and Transportation (AASHTO) Pavement Design Methods using the parameters summarized below.

9.2.1. Traffic Volumes and Truck Factor Growth Rates

The traffic data used to develop ESALs was taken from a similar project that we provided the geotechnical report for, Guadalupe Road and Delaware Drive

Improvements in Apache Junction, to estimate traffic volumes. Specifically, we used the following information for estimated traffic volumes to develop design ESALs for the pavement design:

- Currently, the Average Daily Traffic (ADT) for Houston Avenue, which is parallel to and north of Guadalupe Road, is approximately 4,400 vehicles per day (one-way);
- The design life for this pavement is 20 years (2015-2035);
- Anticipated traffic growth rate is about 5.5 percent per year; and
- Passenger cars will account for 50 percent and trucks will account for 50 percent of the traffic volume:

Based on these assumptions, and using the AASHTO procedure for pavement design, the one-way flexible pavement ESAL was estimated to be 6,005,806.

For the low traffic volume segments of the project, if needed, we assumed less than 85 vehicles per day for two-way ADT and less than 85,032 ESALs.

9.2.2. Resilient Modulus

A design R-value of 30 was used in our analysis. Based on an R-value of 30 and a seasonal variation factor of 1.2, a resilient modulus of 16,023 pounds per square inch (psi) was calculated.

9.2.3. 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.

9.2.4. 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.

9.2.5. Recommended Pavement Sections

Based on the inputs noted above, the 20-year design ESALs were calculated to be about 6,005,806 resulting in a structural number of 3.58 inches for the roadway under study. Table 1 below presents our recommended pavement sections.

Table 1 – Recommended Pavement Sections

Pavement Sections	AC (in)	PCCP (in)	AB (in)	Pavement Section Thickness (in)
Guadalupe Road: Meridian Road to Delaware Drive	6.0	-	7.0	13.0
Guadalupe Road: Meridian Road to Delaware Drive (Low Traffic Volumes*)	2	-	6	8.0
Guadalupe Road: Meridian Road to Delaware Drive (Over Wash)	-	6.0	7.0	13.0
*Less than 85 vehicles per day				

We recommend that AC and PCCP used for this project be constructed in accordance with Sections 710 and 725 of the MAG specifications and designated as "arterial." The recommended pavement thickness assumes that the above pavement section is founded on improved soil as outlined in Section 9.1.2.

9.3. Earth Fissure Mitigation Considerations

As mentioned earlier, earth fissures have been documented along the project alignment as depicted on the Approximate Earth Fissure Locations Map (see Figure 3). The scope of services provided for this project did not include earth fissure mapping and therefore, we recommend that Ninyo & Moore be retained to observe the exposed subgrade at the time of

grading to assess the presence of fissure activity and to evaluate if additional remediation is needed.

While not making any evaluations of the locations of the earth fissures on-site and/or in the area vicinity, it is recommended that for any fissure locations encountered during construction, interceptor trenches are used on both sides of the roadway along the fissure/crack alignment, as well as a fissure mitigation trench beneath the roadway as shown on the Typical Plan View of Fissure Mitigation Technique illustration (Figure 4). The interceptor trenches should be excavated to depths of about 10 feet bgs as shown on the Typical Interceptor Trench Guidelines illustration (Figure 5). The fissure mitigation trench should be excavated to a depth of about 5 feet bgs as shown on the Typical Earth Fissure Mitigation Guidelines illustration (Figure 6). Following the excavation, the interceptor trenches should be lined with a 40-mil high-density polyethylene (HDPE) membrane and backfilled with low-strength cement slurry. The top of the interceptor trench and HDPE membrane should be placed 12 inches, or more below grade (Figure 5). The fissure mitigation trench should be lined with a separation geotextile fabric and backfilled with select material. The separation geotextile fabric should be placed over the trench, enclosing the select material (see Figure 6). The select material for the fissure mitigation trench should consist of a washed, narrowly graded mixture of stone or gravel. We recommend that ASTM D 448 (coarse-aggregate grading Size 57), with 100 percent passing a 1-1/2- inch sieve and 0 to 5 percent passing a No. 8 sieve be used for the specification of this material. Also, it is suggested that this material consist mainly of rounded to sub-rounded particles.

Due to the unpredictable nature of earth fissures, the apparent proximity of fissures near the roadway, and the susceptibility of potential new fissures to form along the alignment, it is recommended that geogrid underlain by a separation geotextile fabric be used along the new roadway within the limits of such “fissure zone” areas. The fabric should be placed between the improved subsurface and the AB layer to reduce the potential for infiltration of fill material into the earth fissure voids and to mitigate crack propagation to the surface, and provide strength to the pavement section should underlying cracking occur. We recommend

that Ninyo & Moore be retained for earth fissure mapping if such lineaments are requested for earth fissure locations.

Maintenance of grades and drainage slopes will be important to the long term performance of the roadway. If subsidence activity or fissuring is noticed within the roadway, early detection may allow for actions that slow or stop progressive damage. After construction, we recommend that monitoring points be established and surveyed on a regular basis to estimate ground subsidence and subsequent earth fissure development. In addition, county maintenance personnel should be trained to visually monitor the existing earth fissures in the area and watch for the development of new fissures.

9.4. Concrete Flatwork

To reduce the potential manifestation of distress to exterior concrete flatwork (such as curbs and sidewalks) due to possible movement of the underlying soil, we recommend that such flatwork (if utilized for this project) be installed with crack-control joints at appropriate spacing as designed by the structural engineer. Additionally, we recommend that concrete flatwork be supported on 24 or more inches of adequately moisture-conditioned and compacted fill as described in Section 9.1.2. Positive drainage should be established and maintained adjacent to flatwork.

9.5. Corrosion

The corrosion potential was evaluated using the results of our laboratory testing on a representative soil sample obtained from boring B-2.

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 236c, 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 value of the selected soil sample was 8.2, which is considered to be alkaline. The minimum electrical resistivity value of the sample tested was about 1,805 ohm-cm, which represents a mildly corrosive environment to ferrous materials. The chloride content of the sample tested was 29 ppm, which is also potentially mildly corrosive to ferrous materials. The soluble sulfate content of the sample tested was 0.002 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 indicated that the materials are generally non-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.

9.6. Concrete

Laboratory chemical tests performed on selected samples of on-site soils indicated a sulfate content of 0.002 percent by weight. Based on American Concrete Institute (ACI), the on-site soils should be considered to have a negligible sulfate exposure to concrete.

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 the use of Type II cement for 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.

9.7. Site Drainage

Surface drainage should be provided to divert water off of paved surfaces. Surface water should also not be permitted to pond on or below pavement areas. Positive drainage is defined as a slope of 2 percent, or more, for a distance of 5 feet, or more, away from the pavements. To deter accumulation of water below the new pavement sections, the bottom of the overexcavated zone below the new pavement should be sloped toward the edges of the roadway.

9.8. Pre-Construction Conference

We recommend that a pre-construction conference be held. Representatives of the owner, the civil engineer, Ninyo & Moore, 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.

9.9. 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 (if needed), 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 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.

10. 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.

11. REFERENCES

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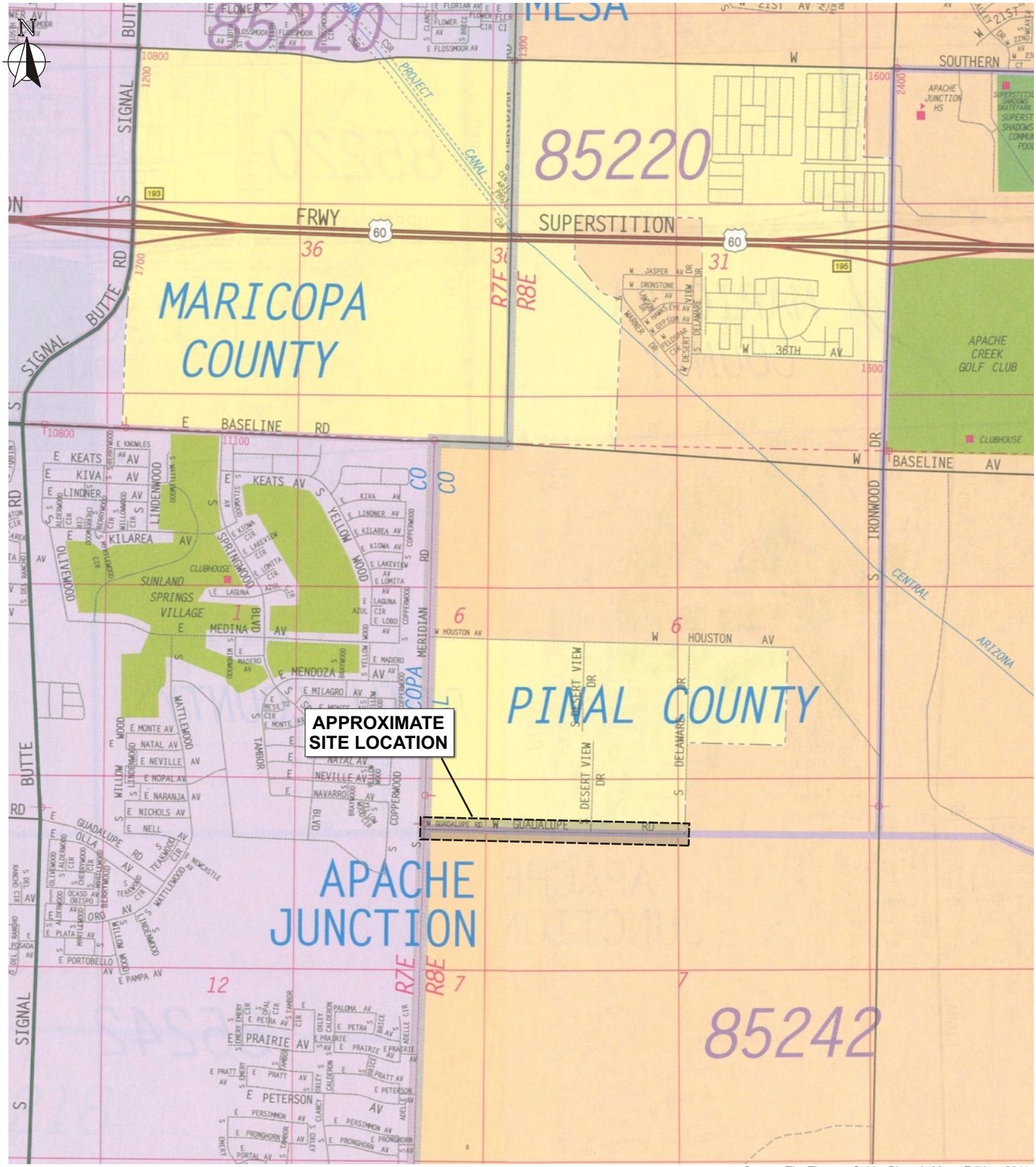
Aerial Photographs

Source	Aerial Photograph Date(s)
FCDMC	1937, 1953, 1997, 2000, 2002, 2003, 2004, 2006, 2007, 2013
Google Earth™	1992, 2003, 2004, 2005, 2007, 2010, 2011, 2012, 2014



Source: The Thomas Guide, Phoenix Metro Edition, 2011.

0 1900

Approximate Scale:
1 inch = 1900 feet

Note: Dimensions, directions and locations are approximate.

Ninyo & Moore	SITE LOCATION	FIGURE
PROJECT NO: 604516001 / DATE: 4/15	GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE APACHE JUNCTION, ARIZONA	1

file no: 4516vmap0914

Source: NAVTEQ, 01/07/14.

N

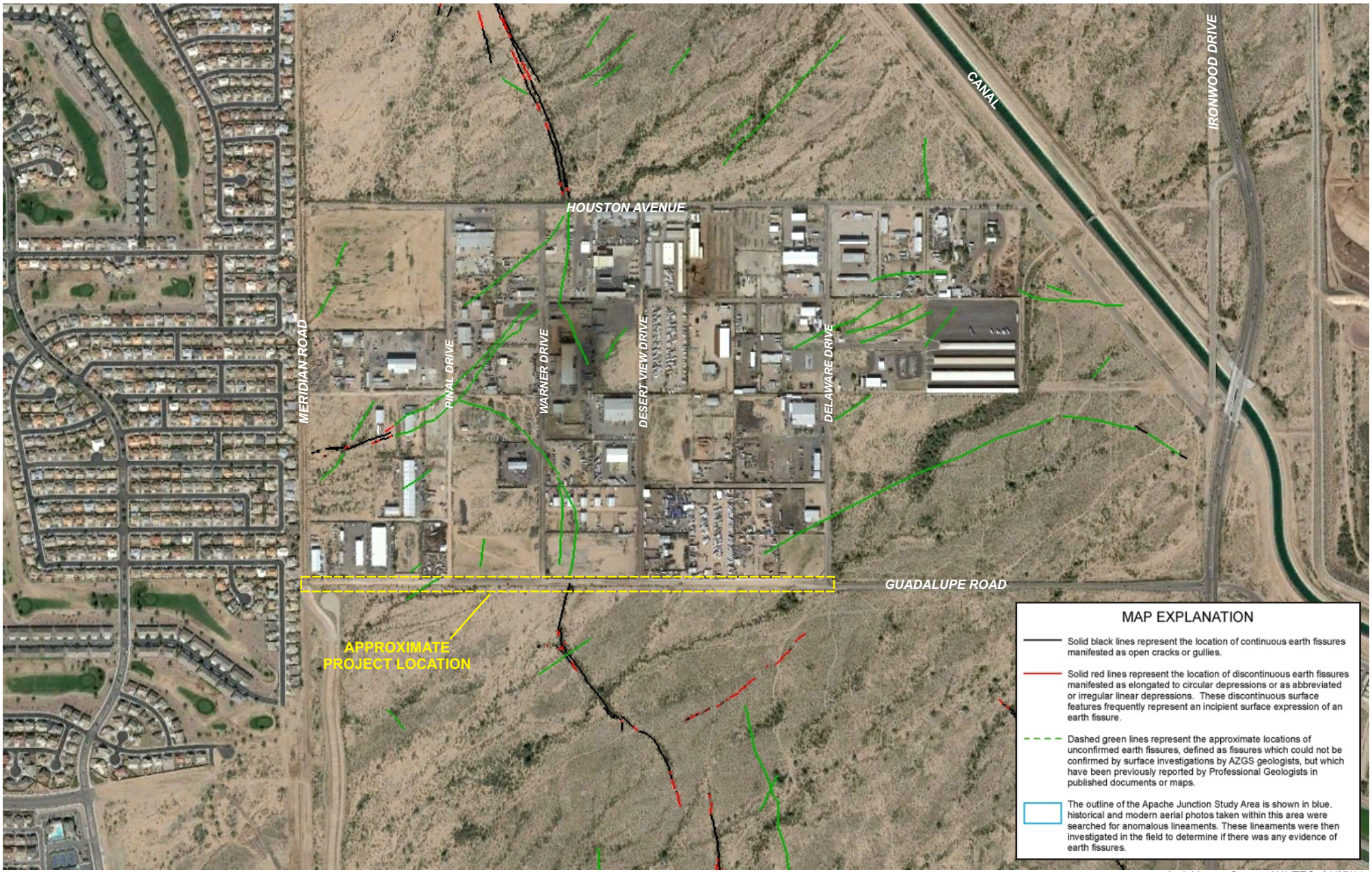
0 600

Approximate Scale:
1 inch = 600 feet

Note: Dimensions, directions, and locations are approximate.

file no: 4516blm0914

Ninyo & Moore	BORING LOCATIONS	FIGURE
PROJECT NO: 604516001 / DATE: 4/15	GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE APACHE JUNCTION, ARIZONA	2



Aerial Image Source: NAVTEQ, 01/07/14.

N

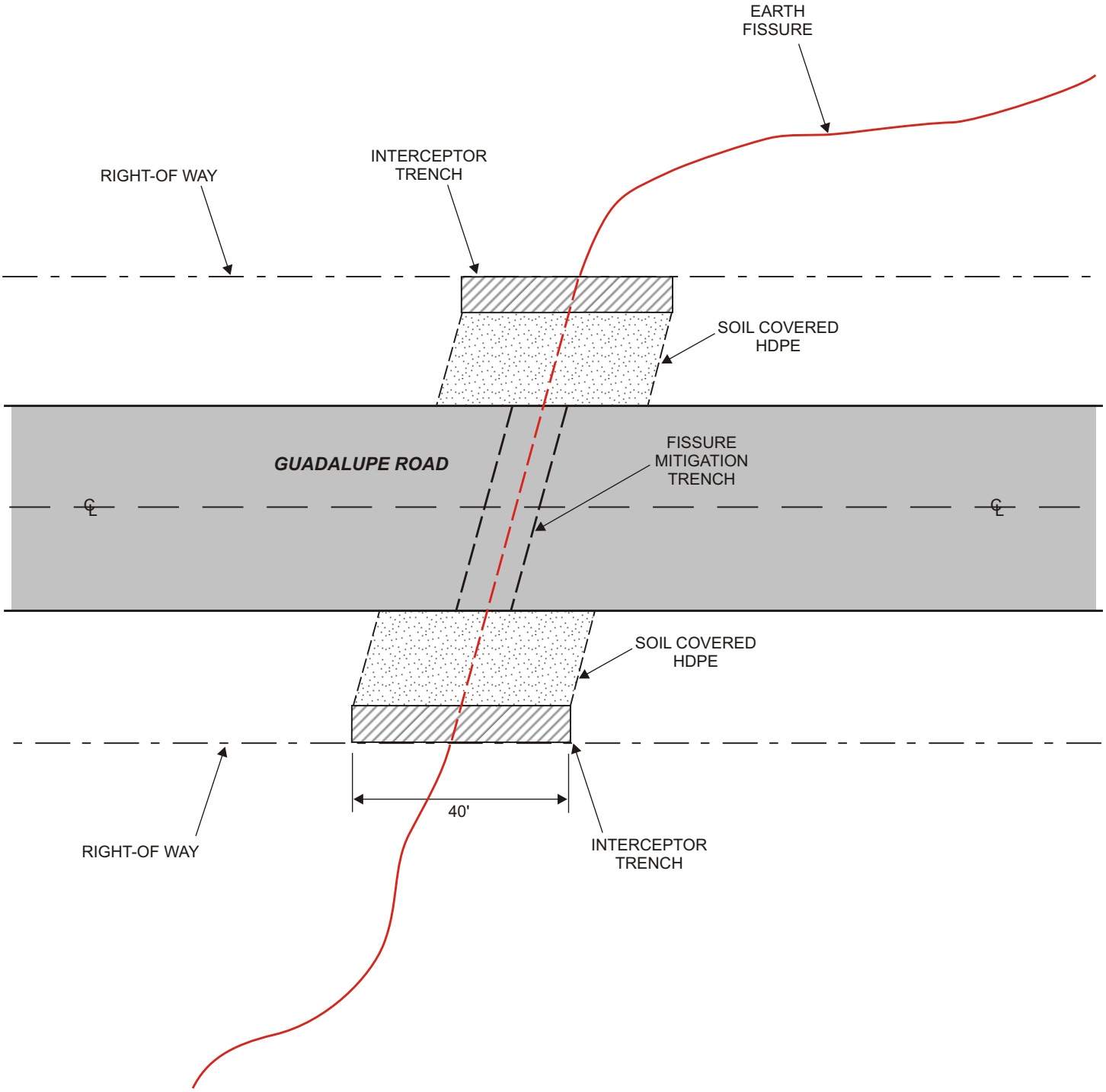
0 900

Approximate Scale:
1 inch = 900 feet

Source: Arizona GIS Map #2, Earth Fissure Map of the Apache Junction Study Area, 2008.
Note: Dimensions, directions, and locations are approximate.

file no: 4516fis0914

Ninyo & Moore	APPROXIMATE EARTH FISSURE LOCATIONS	FIGURE
PROJECT NO: 604516001 / DATE: 4/15	GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE APACHE JUNCTION, ARIZONA	3

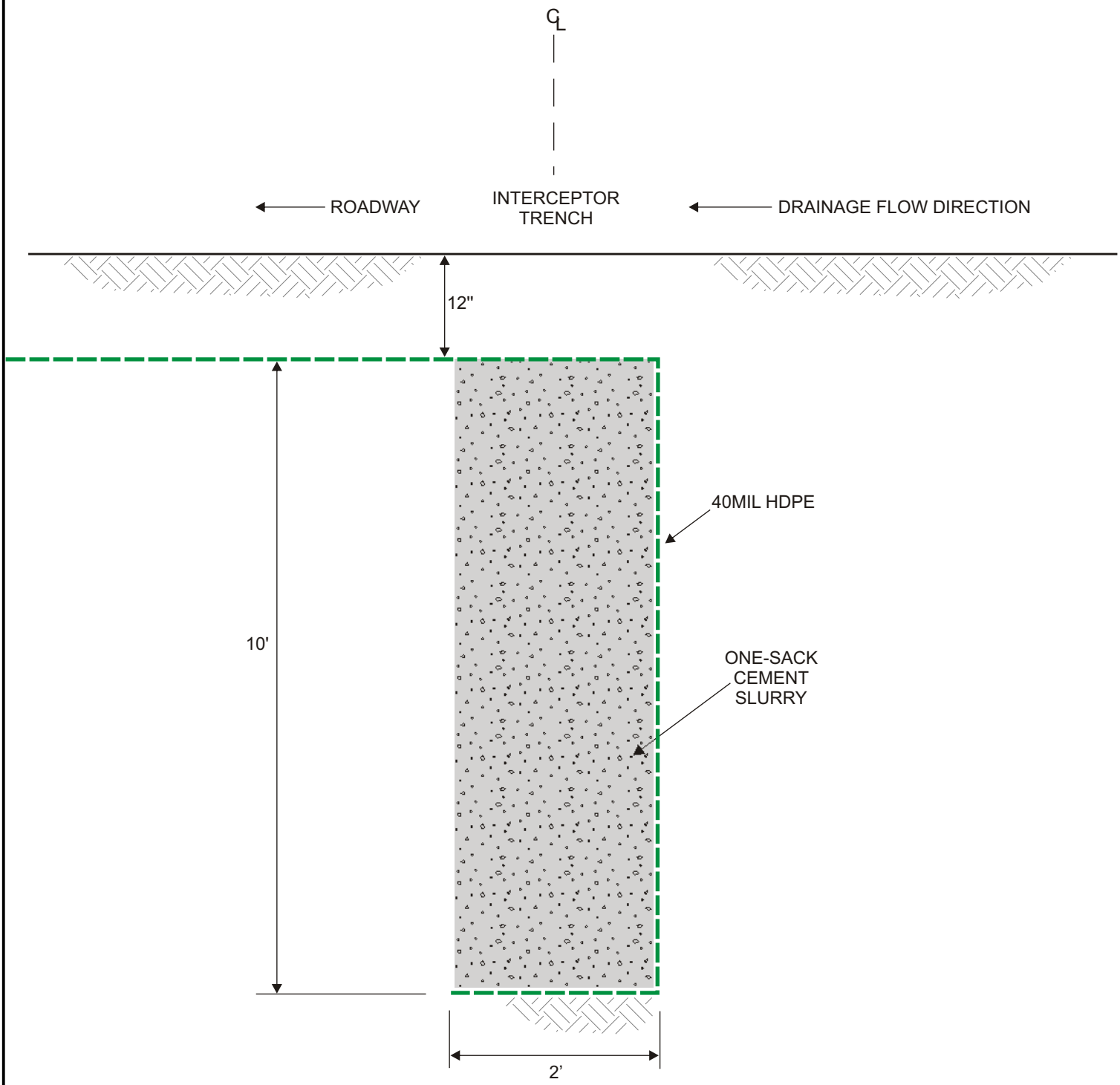


NOT TO SCALE

Note: Dimensions, directions and locations are approximate.

Ninyo & Moore	TYPICAL PLAN VIEW OF FISSURE MITIGATION TECHNIQUE	FIGURE
PROJECT NO: 604516001 / DATE: 4/15	GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE APACHE JUNCTION, ARIZONA	4

4516sch0914c

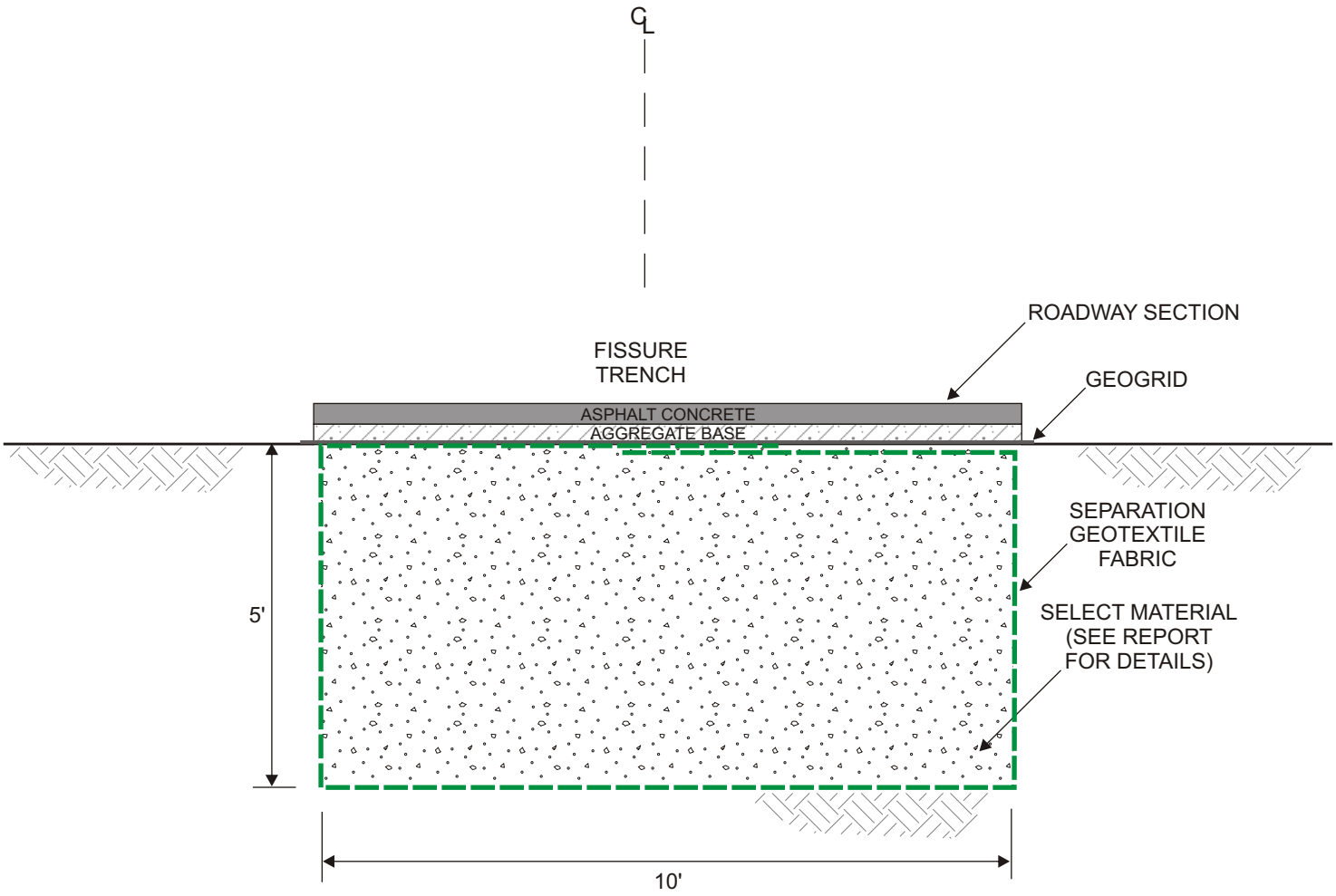


NOT TO SCALE

Note: Dimensions, directions and locations are approximate.

Ninyo & Moore	TYPICAL INTERCEPTOR TRENCH GUIDELINES	FIGURE
PROJECT NO: 604516001 / DATE: 4/15	GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE APACHE JUNCTION, ARIZONA	5

4516sch0914a



NOT TO SCALE

Note: Dimensions, directions and locations are approximate.

Ninyo & Moore	TYPICAL EARTH FISSURE MITIGATION GUIDELINES	FIGURE
PROJECT NO: 604516001 / DATE: 4/15	GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE APACHE JUNCTION, ARIZONA	6

4516sch0914b

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.

Field Procedure for the Collection of Relatively Undisturbed Samples

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

The Split-Barrel Knocker Bar Sampler

The sampler, with an external diameter of 3.0 inches, was lined with 1-inch long, thin brass rings with an inside diameter of approximately 2.4 inches. The sampler was manually driven into the ground with a hammer weighing approximately 35 pounds. The samples were removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

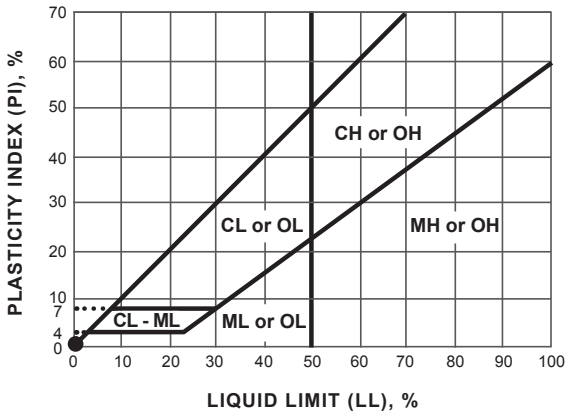
SOIL CLASSIFICATION CHART PER ASTM D 2488

PRIMARY DIVISIONS			SECONDARY DIVISIONS	
			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOILS more than 50% retained on No. 200 sieve	**GRAVEL** more than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVEL less than 5% fines	GW	well-graded GRAVEL
			GP	poorly graded GRAVEL
		GRAVEL with DUAL CLASSIFICATIONS 5% to 12% fines	GW-GM	well-graded GRAVEL with silt
			GP-GM	poorly graded GRAVEL with silt
			GW-GC	well-graded GRAVEL with clay
			GP-GC	poorly graded GRAVEL with clay
		GRAVEL with FINES more than 12% fines	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND 50% or more of coarse fraction passes No. 4 sieve	CLEAN SAND less than 5% fines	SW	well-graded SAND
			SP	poorly graded SAND
		SAND with DUAL CLASSIFICATIONS 5% to 12% fines	SW-SM	well-graded SAND with silt
			SP-SM	poorly graded SAND with silt
			SW-SC	well-graded SAND with clay
			SP-SC	poorly graded SAND with clay
		SAND with FINES more than 12% fines	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS 50% or more passes No. 200 sieve	**SILT and CLAY** liquid limit less than 50%	INORGANIC	CL	lean CLAY
			ML	SILT
			CL-ML	silty CLAY
		ORGANIC	OL (PI > 4)	organic CLAY
			OL (PI < 4)	organic SILT
	SILT and CLAY liquid limit 50% or more	INORGANIC	CH	fat CLAY
			MH	elastic SILT
		ORGANIC	OH (plots on or above "A"-line)	organic CLAY
			OH (plots below "A"-line)	organic SILT
	Highly Organic Soils		PT	Peat

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		> 12"	> 12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	Coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	Fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	Coarse	#10 - #4	0.079 - 0.19"	Rock-salt-sized to pea-sized
	Medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock-salt-sized
	Fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized
Fines		Passing #200	< 0.0029"	Flour-sized and smaller

PLASTICITY CHART



APPARENT DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPOOLING CABLE OR CATHEAD		AUTOMATIC TRIP HAMMER	
	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)
Very Loose	≤ 4	≤ 8	≤ 3	≤ 5
Loose	5 - 10	9 - 21	4 - 7	6 - 14
Medium Dense	11 - 30	22 - 63	8 - 20	15 - 42
Dense	31 - 50	64 - 105	21 - 33	43 - 70
Very Dense	> 50	> 105	> 33	> 70

CONSISTENCY - FINE-GRAINED SOIL

CONSIS-TENCY	SPOOLING CABLE OR CATHEAD		AUTOMATIC TRIP HAMMER	
	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)
Very Soft	< 2	< 3	< 1	< 2
Soft	2 - 4	3 - 5	1 - 3	2 - 3
Firm	5 - 8	6 - 10	4 - 5	4 - 6
Stiff	9 - 15	11 - 20	6 - 10	7 - 13
Very Stiff	16 - 30	21 - 39	11 - 20	14 - 26
Hard	> 30	> 39	> 20	> 26

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USCS METHOD OF SOIL CLASSIFICATION

Explanation of USCS Method of Soil Classification

PROJECT NO.	DATE	FIGURE

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.
15								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
20								The total depth line is a solid line that is drawn at the bottom of the boring.

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BORING LOG

Explanation of Boring Log Symbols

PROJECT NO.	DATE	FIGURE

Updated Nov. 2011

DATE DRILLED 8/27/14 BORING NO. B-1

GROUND ELEVATION 1,533' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING Manual

DRIVE WEIGHT 35 lbs. (Manual) DROP Variable

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	■						SC	ALLUVIUM: Brown, dry, loose, clayey SAND; trace gravel.
		■	15					
	■							
		■	20	8.9	102.5			Loose to medium dense.
	■							
5								Total Depth = 5 feet. Groundwater not encountered during drilling. Backfilled on 8/27/14 shortly after completion of drilling.
								Notes: 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.
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
10								Bulk sample comprised of composite samples.
								Manual blow counts recorded are not equivalent to SPT N-values.
15								
20								

Ninyo & Moore

BORING LOG

GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE
APACHE JUNCTION, ARIZONA

PROJECT NO.	DATE	FIGURE
604516001	4/15	A-1

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	FILL: Approximately 4 inches thick.
							SC	Brown, dry, loose, silty SAND; few gravel.
								ALLUVIUM: Brown, dry, loose, clayey SAND; trace gravel.
			19	5.1	102.4			
			29					Medium dense.
5								Total Depth = 5 feet. Groundwater not encountered during drilling. Backfilled on 8/27/14 shortly after completion of drilling.
10								
15								
20								

DATE DRILLED 8/27/14 BORING NO. B-2

GROUND ELEVATION 1,533' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING Manual

DRIVE WEIGHT 35 lbs. (Manual) DROP Variable

SAMPLED BY DM LOGGED BY DM REVIEWED BY HAH

Notes:

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.

The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.

Bulk sample comprised of composite samples.

Manual blow counts recorded are not equivalent to SPT N-values.

Ninyo & Moore

BORING LOG

GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE
APACHE JUNCTION, ARIZONA

PROJECT NO.	DATE	FIGURE
604516001	4/15	A-2

DATE DRILLED	8/27/14	BORING NO.	B-3
GROUND ELEVATION	1,533' ± (MSL)	SHEET 1	OF 1
METHOD OF DRILLING	Manual		
DRIVE WEIGHT	35 lbs. (Manual)	DROP	Variable
SAMPLED BY	DM	LOGGED BY DM	REVIEWED BY HAH

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	FILL: Approximately 2 inches thick.
							SC	Black brown, dry, loose, silty SAND.
								ALLUVIUM:
			12	8.2	91.5			Brown, dry, loose, clayey SAND with gravel.
			16					
5								Total Depth = 5 feet.
								Groundwater not encountered during drilling.
								Backfilled on 8/27/14 shortly after completion of drilling.
								Notes:
								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.
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
10								Bulk sample comprised of composite samples.
								Manual blow counts recorded are not equivalent to SPT N-values.
15								
20								

Ninyo & Moore

BORING LOG

GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE
APACHE JUNCTION, ARIZONA

PROJECT NO.	DATE	FIGURE
604516001	4/15	A-3

DATE DRILLED	8/27/14	BORING NO.	B-4
GROUND ELEVATION	1,533' ± (MSL)	SHEET 1	OF 1
METHOD OF DRILLING	Manual		
DRIVE WEIGHT	35 lbs. (Manual)	DROP	Variable
SAMPLED BY	DM	LOGGED BY DM	REVIEWED BY HAH

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	■						GP-GM	FILL: Brown, dry, medium dense, poorly graded GRAVEL with silt and sand.
		X	50/6"					Coarse gravel; possible cobbles.
	■						SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND.
		■	29					
	■							
5								Total Depth = 5 feet. Groundwater not encountered during drilling. Backfilled on 8/27/14 shortly after completion of drilling.
								Notes: 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.
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
10								Bulk sample comprised of composite samples.
								Manual blow counts recorded are not equivalent to SPT N-values.
15								
20								

Ninyo & Moore

BORING LOG

GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE
APACHE JUNCTION, ARIZONA

PROJECT NO.	DATE	FIGURE
604516001	4/15	A-4

APPENDIX B

LABORATORY TEST RESULTS

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 and B-2. 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-3.

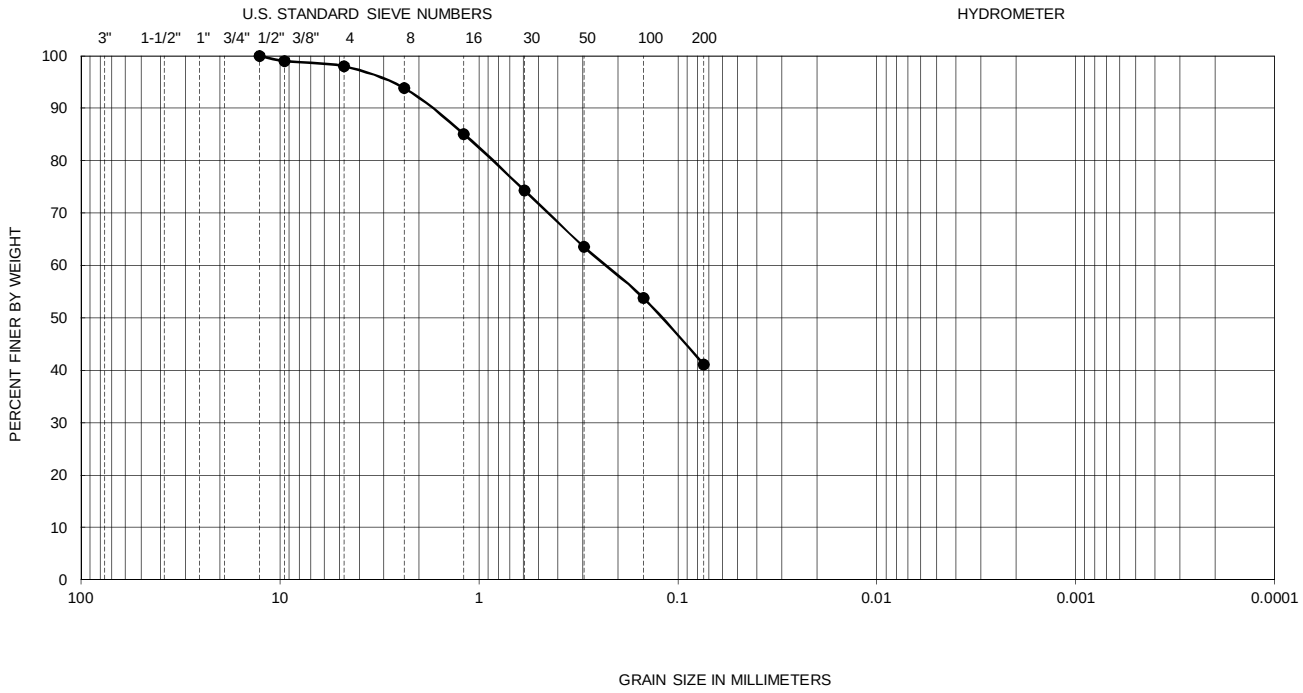
Consolidation Test

A consolidation test was performed on a selected relatively undisturbed soil sample in general accordance with ASTM D 2435. The sample was 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 test are summarized on Figure B-4.

Soil Corrosivity Tests

Soil pH and minimum resistivity tests were performed on a representative soil sample in general accordance with Arizona Test 236c. The sulfate content was evaluated in general accordance with Arizona Test 733. The chloride content was evaluated in general accordance with Arizona Test 736. The test results are presented on Figure B-5.

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

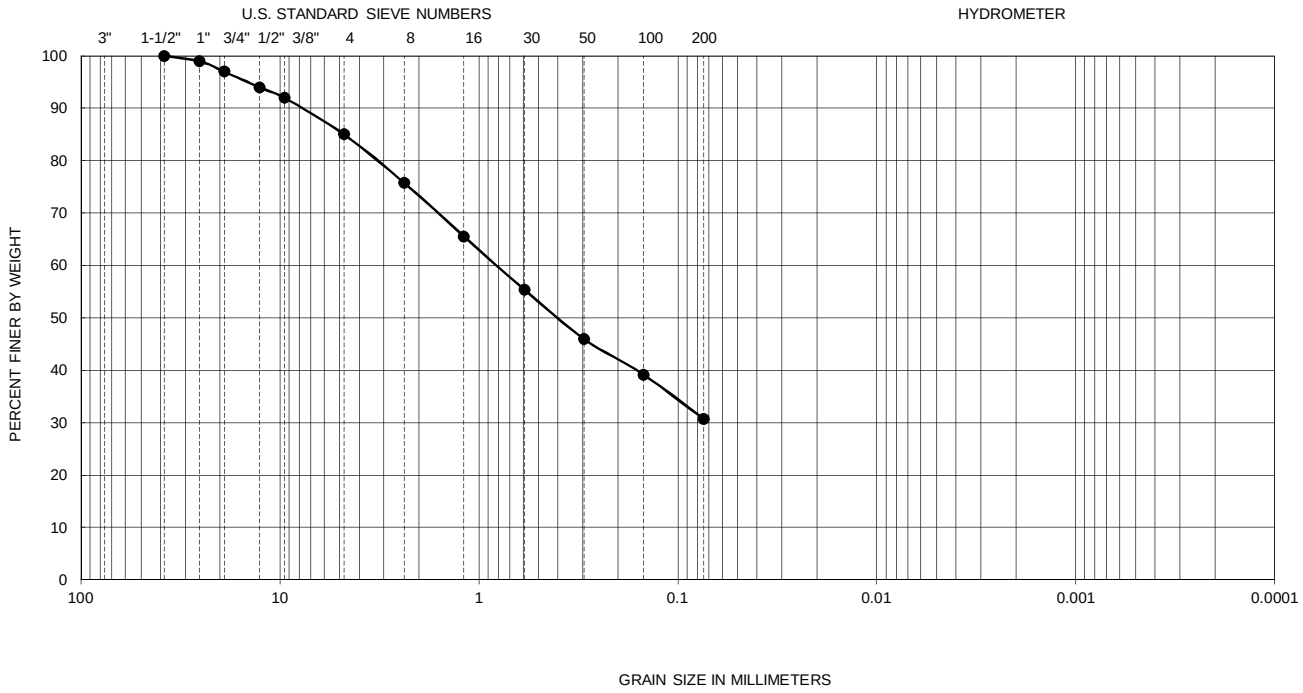


Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-1	0.0-5.0 (Composite)	26	16	10	--	--	--	--	--	41	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE APACHE JUNCTION, ARIZONA	B-1
604516001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

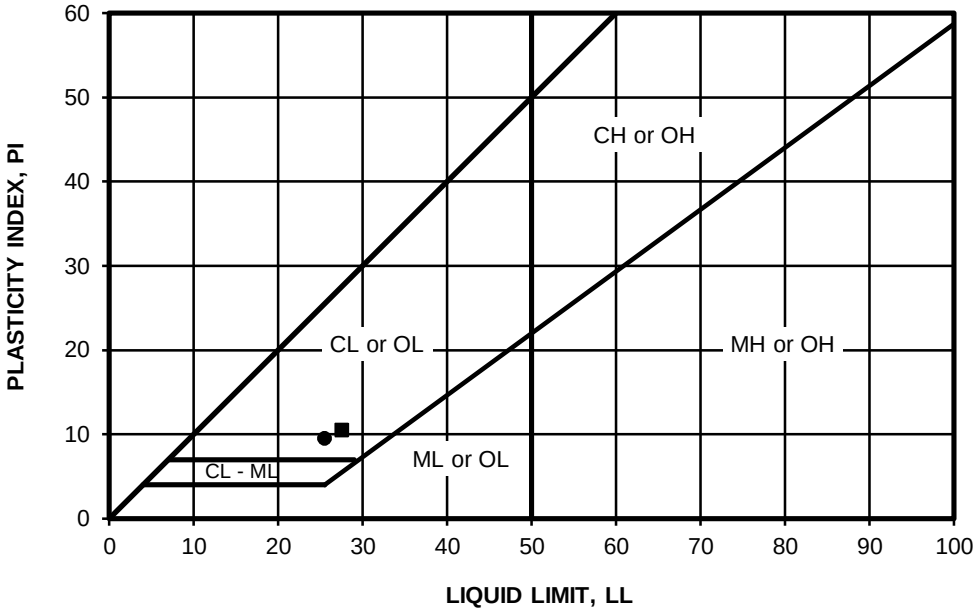


Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-3	0.2-5.0 (Composite)	28	17	11	--	--	--	--	--	31	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

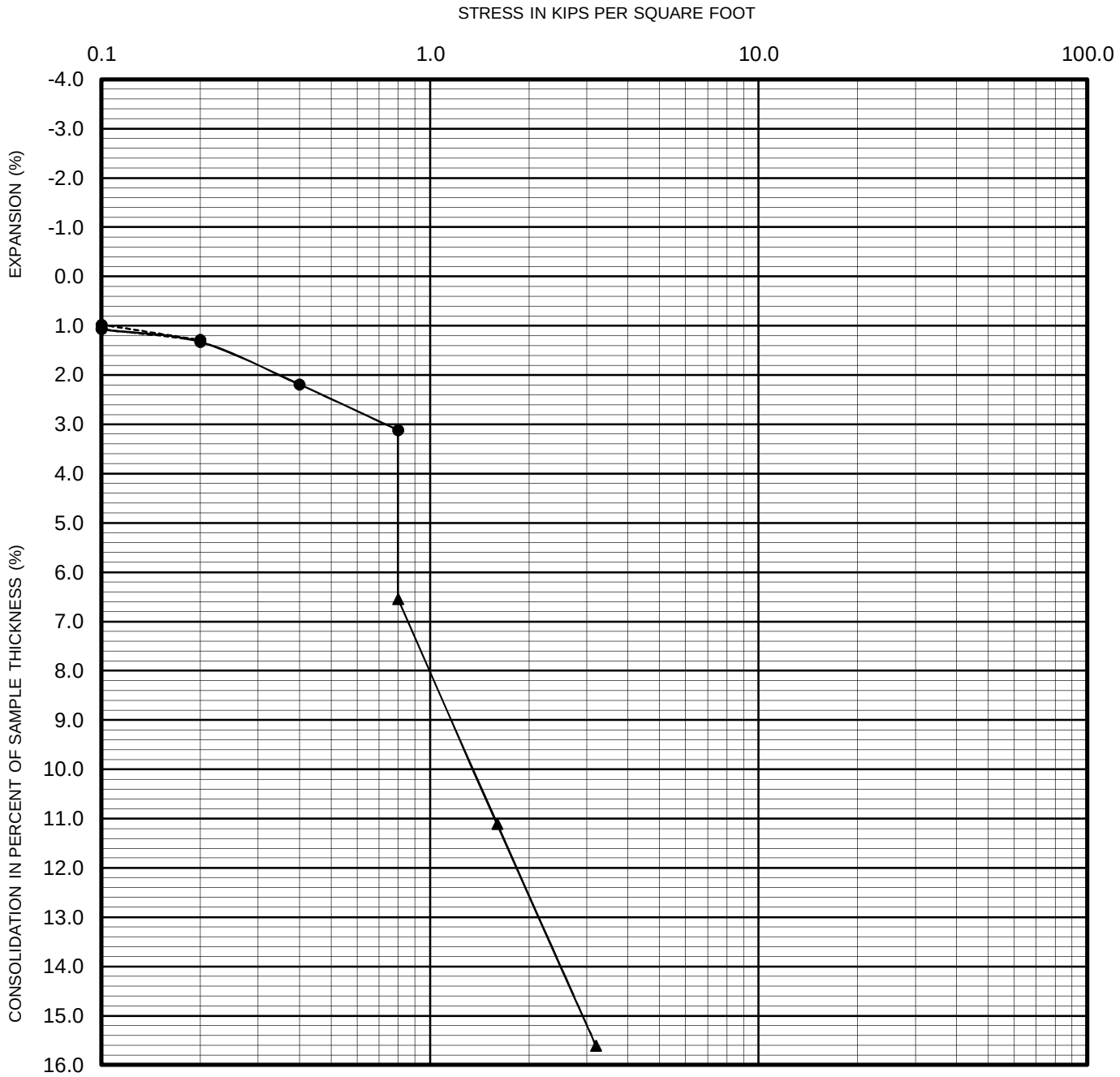
Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE APACHE JUNCTION, ARIZONA	B-2
604516001 / 4/15		

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	0.0-5.0	26	16	10	CL	SC
■	B-3	0.2-5.0	28	17	11	CL	SC



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

Ninyo & Moore	ATTERBERG LIMITS TEST RESULTS	FIGURE
PROJECT NO. 604516001 / DATE 4/15	GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE APACHE JUNCTION, ARIZONA	B-3



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

Ninyo & Moore	CONSOLIDATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE APACHE JUNCTION, ARIZONA	B-4
604516001 / 4/15		

SAMPLE LOCATION	SAMPLE DEPTH (FT)	pH [1]	RESISTIVITY [1] (Ohm-cm)	SULFATE CONTENT [2]		CHLORIDE CONTENT [3] (ppm)
				(ppm)	(%)	
B-2	0.4-5.0	8.2	1,805	24	0.002	29

[1] PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD 236c
[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.	DATE	GUADALUPE ROAD - MERIDIAN ROAD TO DELAWARE DRIVE APACHE JUNCTION, ARIZONA	B-5
604516001	4/15		